2606657 Ontario Inc.

(Revised) Stormwater Management and Functional Servicing Report for 1871 & 1879 Gordon Street

GMBP File: 118170

March 9, 2021

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
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(REVISED) STORMWATER MANAGEMENT AND FUNCTIONAL SERVICING REPORT

1871 & 1879 GORDON STREET, GUELPH

MARCH 9, 2021

GMBP FILE NO: 118170

1. INTRODUCTION

In support of the Zoning By-law Amendment Application, this revised report documents the proposed stormwater management design and servicing for the proposed multi-storey high density residential development at 1871 and 1879 Gordon Street in the City of Guelph (City), as well as addresses the first submission comments received from the City of Guelph in February 2020.

The Owner is required to have a Professional Engineer design a stormwater management system and have the said Engineer supervise and certify that the stormwater management system is installed in accordance with the approvals given under Section 41 of the Planning Act.

This report and stormwater management design is based on the following information:

- Van Harten Surveying Inc. completed a topographic survey of the site dated January 2, 2019
- The Site Plan was provided by Grinham Architects on February 5, 2021
- The existing and proposed site details are shown on the GM BluePlan Engineering Plans.

2. SITE INFORMATION

The 0.329-hectare subject property is located at 1871 and 1879 Gordon Street in the City of Guelph. The subject property is generally rectangular, with approximately 73m of frontage along Gordon Street and approximately 45m deep. For the purposes of this review, the adjacent Gordon Street is considered east of the subject site and to have a north-south orientation. The site is further bordered by 1861 Gordon Street to the north, Bird Landing Subdivision townhouses to the west, and 332 Gosling Gardens development to the south.

The arterial east-west roadways surrounding the site are Clair Road West to the north and Maltby Road to the south of the site. Local collector roads near the site are Poppy Drive West to the north and Gosling Gardens to the south. Please refer to Figure No. 1.

The 1871 and 1879 Gordon Street properties currently contain detached single-family dwellings, asphalt driveways and garages. The overall site topography slopes from the southeast to northwest with an 4% average grade along the east property line and a 7% average grade along the west property line. Existing runoff sheet flows uncontrolled to the adjacent northerly and westerly properties.

3. SOILS

The predominant surface soil type on the site and the surrounding area is Dumfries Loam (Wellington County Soils Map). The hydrologic soil classification for this soil type is Type A. This soil type generally has good drainage characteristics.

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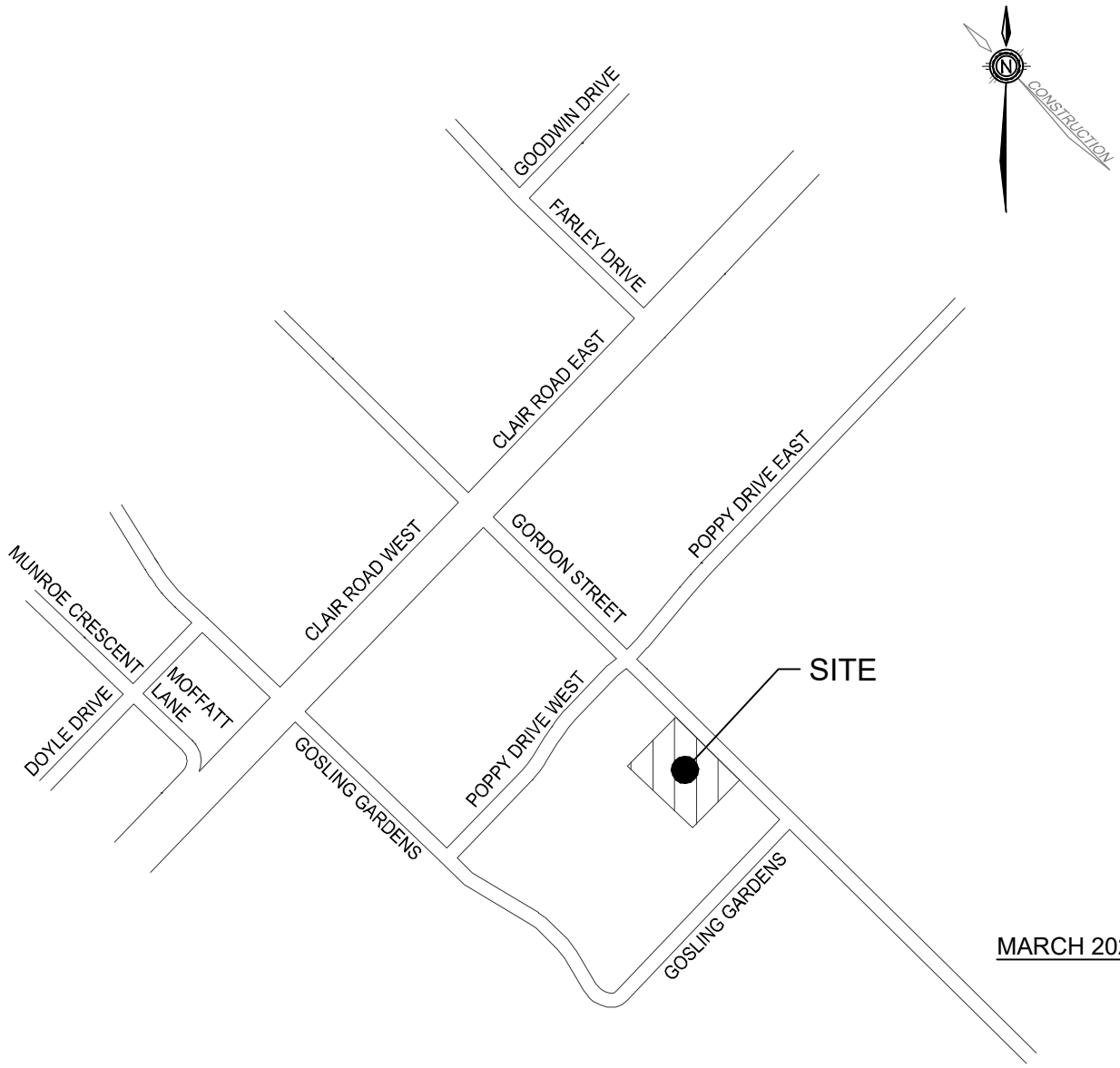
1871 & 1879 GORDON STREET
CITY OF GUELPH



MARCH 2021

SITE
LOCATION
MAP
Figure No. 1

BluePlan
ENGINEERING

4. PROPOSED DEVELOPMENT

The proposed development includes one building which includes residential floors, and two below grade parking levels, with associated exterior parking and driving areas.

4.1 Storm Sewers

The City of Guelph provided the following drawings for information:

- Dwg No. 2D-118 – Gordon Street Reconstruction – Gordon Street Proposed Works – Station 11+950 to Clair Road, As Recorded, by AECOM, dated January 2010.
- Dwg No. 2D-119 – Gordon Street Reconstruction – Gordon Street Proposed Works – Station 11+810 to Station 11+950, As Recorded, by AECOM, dated January 2010.
- Dwg No. 2D-119A – Gordon Street Reconstruction – Future Poppy Drive - Proposed Works – Station 0+940 to Station 1+040, As Recorded, by AECOM, dated January 2010.
- Dwg No. 2D-120 – Gordon Street Reconstruction – Gordon Street Proposed Works – Station 11+670 to Station 11+810, As Recorded, by AECOM, dated January 2010.
- Dwg No. 2D-121 – Gordon Street Reconstruction – Gordon Street Proposed Works – Station 11+530 to Station 10+670, As Recorded, by AECOM, dated January 2010.

Based on record drawings 2D-120 from November 2008, there is a 300mm diameter storm sewer along the west curb line of Gordon Street, starting to the south of the site and flows to the north.

Given the available information, the current design does not utilize this existing storm system along Gordon Street.

We propose all runoff from roof surfaces, grassed areas, sidewalks, and paved surfaces will be conveyed through the proposed on-site storm sewer system to the proposed infiltration gallery at the northwest end of the site. Major storms will be routed overland to the municipal right-of-way by way of the pedestrian pathway located to the north of the building. A small portion of the stormwater runoff generated from the edges of the property will discharge to the adjacent property to the north or the municipal right-of-way.

4.2 Sanitary Sewers

Based on the December 17, 2018 City comments the subject property does not have frontage to an active municipal sanitary sewer. The subject lands were accounted to flow south towards the incomplete future Clair/Maltby secondary plan area sewershed. Unless a suitable alternative is created, any rezoning application for this subject property would have a holding zone until there is a sanitary sewer outlet. The timing of the installation of a sanitary outlet to the Clair/Maltby secondary plan area is unknown.

GMBP has explored other alternatives to service the subject property.

Existing Conditions

Existing sanitary stubs located near the subject property are as follows:

- MH. S at the west side of the Poppy Dr. W. and Gordon Intersection, 40m north of the subject property at an invert elevation of approximately 341.78m and a top of grate elevation of 344.8m (Bird Landing Subdivision, 1897 Gordon Street, As Record Drawings, dated June 20, 2017, by Gamsby and Mannerow Engineers).
- MH. N at the west side of the Gosling Gardens and Gordon Intersection, 80m south of the subject property at an invert elevation of approximately 346.7m and a top of grate elevation of 349.3m
- Stub to Block 24 of Bird Landing Subdivision (0.75 ha block at northwest corner of Gordon and Gosling) located 50.5m west of manhole at Gordon and Gosling with an invert of 346.35m.

Above noted sanitary stubs taken from Bird Landing Subdivision, 1897 Gordon Street, As Record Drawings, dated June 20, 2017, by Gamsby and Mannerow Engineers.

Previous Design Conditions

Based on our review of the Bird Land Subdivision sewer design for Poppy Drive West, specifically Manholes S to R (intersection at Gordon to 69.0m west of Gordon) , 1861, 1871 and 1979 Gordon Street were accounted for at 6 L/s/ha in accordance with 150 units per hectare for High Density Residential Official Plan land use designation and the current City of Guelph Development Engineering Manual V2.0 January 2019.

Proposed Conditions

The current development concept is for High Density Residential on the 0.329-hectare subject site. The Bird Landing Subdivision design of the Poppy Drive West sanitary sewer accounted for the subject property as High Density Residential.

Therefore, it is proposed to extend a temporary sanitary service from sanitary manhole S, along Gordon Street, to service the subject property. The temporary sanitary service will be 200mm diameter in size to service the proposed development. Once the sanitary sewer on Gordon Street is operational as part of the Clair/Maltby secondary plan, the temporary sanitary service will be abandoned, and the property will connect to the sanitary sewer on Gordon Street.

4.3 Watermain

Based on record drawings noted in Section 4.1, there is a 400mm diameter PVC DR-25 watermain beneath the southbound traffic lanes of Gordon Street.

The site is to be serviced by a 150mm diameter watermain connected to the existing 400mm diameter watermain on Gordon Street. The proposed watermain will enter the mechanical room at the northeast corner of the building where it will connect to a water meter prior to connecting to the internal water system.

5. STORMWATER MANAGEMENT

5.1 Criteria

The stormwater management criteria established by the City of Guelph are as follows:

1. Control Post Development discharge from site to Pre-development rates for the 2 to 100-year Guelph Design Storms.
2. Sites that do not have a positive outlet must be designed to provide storage on site for twice the 5-year design storm runoff volume.
3. For commercial, institutional and high-density residential developments, excess runoff for the 2-year design storm is to be stored underground or on roof tops.
4. Major storm flows are to be routed overland to the municipal stormwater drainage system.

5. Excess runoff from the 5-year design storm may pond in parking areas of least anticipated use to a maximum depth of 0.3 metres.
6. Clean runoff (roof water) should be directed to pervious areas for infiltration to encourage ground water recharge.
7. Quality control facilities are required to remove suspended solids (oil and grit) from areas draining driveways and parking lots.
8. The minimum acceptable water quality level for discharge to the municipal collection system is 70% TSS removal or an enhanced level 80% TSS removal – depending on the receiving water course.

5.2 Modelling Parameters

The City of Guelph mass rainfall data was used to model the full range of design storm events. The Chicago storm parameters and the total depth of rainfall for each storm are shown below in Table No. 1.

Table 1: Chicago Storm Parameters

	2 Year	5 Year	25 Year	100 Year
a =	743	1,593	3,158	4,688
b =	6	11	15	17
c =	0.799	0.879	0.936	0.962
R =	0.4	0.4	0.4	0.4
td =	170	170	210	210
Rainfall depth (mm)	33.816	46.775	69.476	88.830

The Horton infiltration method was used in the MIDUSS model. The following parameters summarized in Table No. 2 were used according to the City of Guelph Standards:

Table 2: MIDUSS Horton Parameters

	Impervious Areas	Pervious Areas
Manning's 'n'	0.013	0.300
Maximum Infiltration (mm/hr)	0.0	75.0
Minimum Infiltration (mm/hr)	0.0	12.5
Lag Constant (hr)	0.00	0.25
Depression Storage (mm)	1.5	5.0

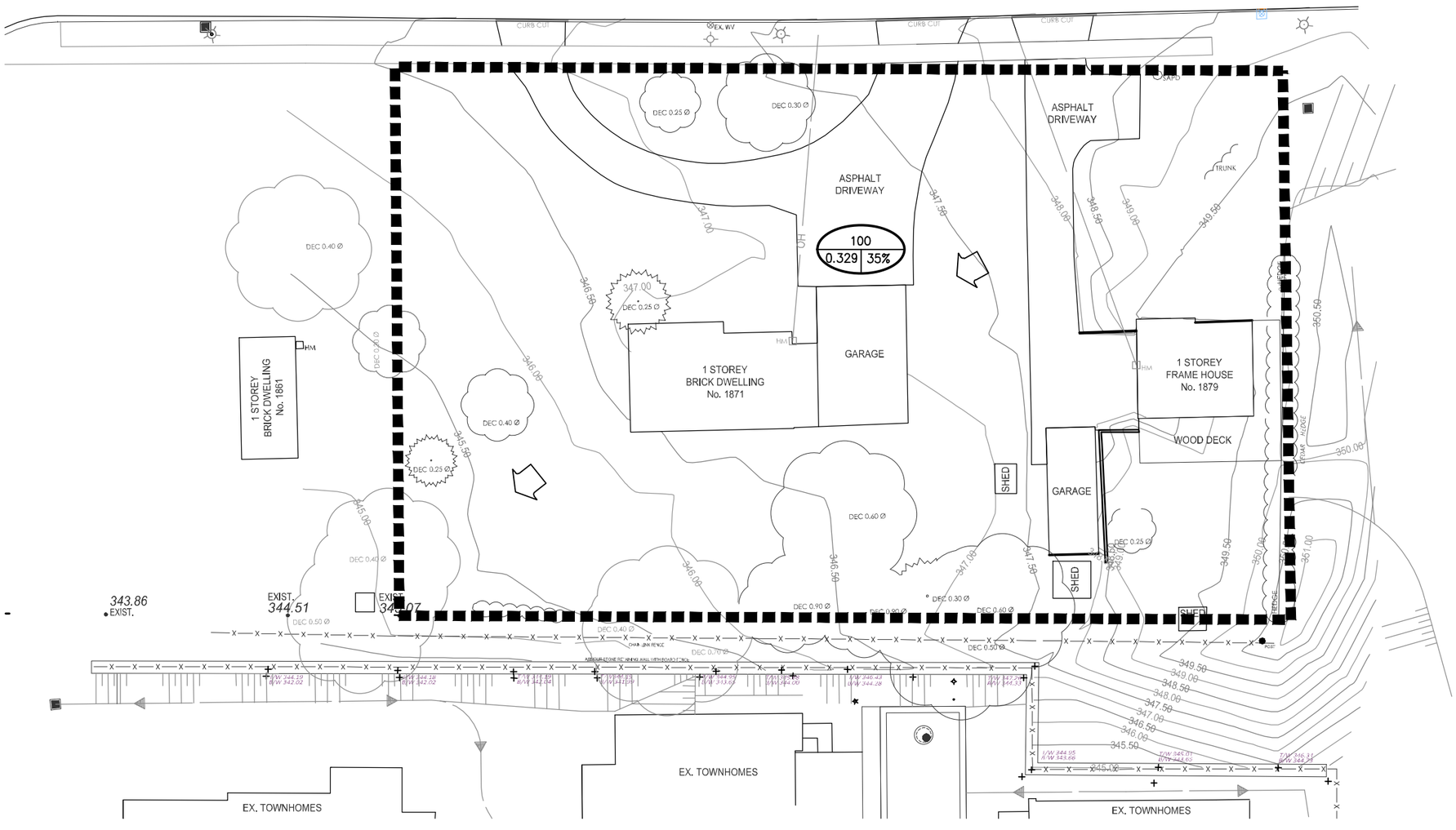
5.3 Pre-Development Conditions

For pre-development analysis purposes, the 0.329 hectare site was modelled as single drainage catchment due to the single outlet at the northwest corner of the site. The pre-development drainage catchment is shown on Figure No. 2 and described below. The pre-development MIDUSS computer modeling is attached in Appendix 'B'.

Catchment 100 (0.329 hectares, 35% impervious) represents the entire site including two single family dwellings, garages, sheds and asphalt driveways. Runoff from Catchment 100 flows overland to the northwest corner of the site to adjacent properties.

118170
1871 & 1879 GORDON STREET
SWM FIGURE
CITY OF GUELPH

GORDON STREET



CONSTRUCTION

LEGEND

100 — CATCHMENT NUMBER
1.2486 | 0 — % IMPERVIOUS
CATCHMENT AREA IN HECTARES

CATCHMENT BOUNDARY

MINOR FLOW DIRECTION

5 0 5 10 20
1:500 (m)

SCALE = 1:400
JULY 2019

PRE-DEVELOPEMENT DRAINAGE AREAS

Figure No. 2

BluePlan ENGINEERING

FILE:W:\Guelph\118-2018\118170 Gordon St. ZCA\5 Work In Progress\Drafting\118170-DESIGN.dwg LAYOUT:FIG. 2
LAST SAVED BY:Sgasior, 3/9/2021 2:09:26 PM PLOTTED BY:Steve Gasior - GM BluePlan 3/9/2021 2:11:45 PM

A summary of the pre-development peak flow from the site for various design storm events are provided in Table No. 3 below.

Table 3: Pre-development Conditions: Flow Rates and Runoff Volumes

	Total Discharge to Adjacent Properties (Catchment 100)	Total
2 Year		
Flow Rate (m^3/s)	0.028	0.028
Runoff Volume (m^3)	41.09	41.09
5 Year		
Flow Rate (m^3/s)	0.039	0.039
Runoff Volume (m^3)	74.28	74.28
25 Year		
Flow Rate (m^3/s)	0.082	0.082
Runoff Volume (m^3)	137.39	137.39
100 Year		
Flow Rate (m^3/s)	0.125	0.125
Runoff Volume (m^3)	194.85	194.85

5.4 Post-Development Conditions

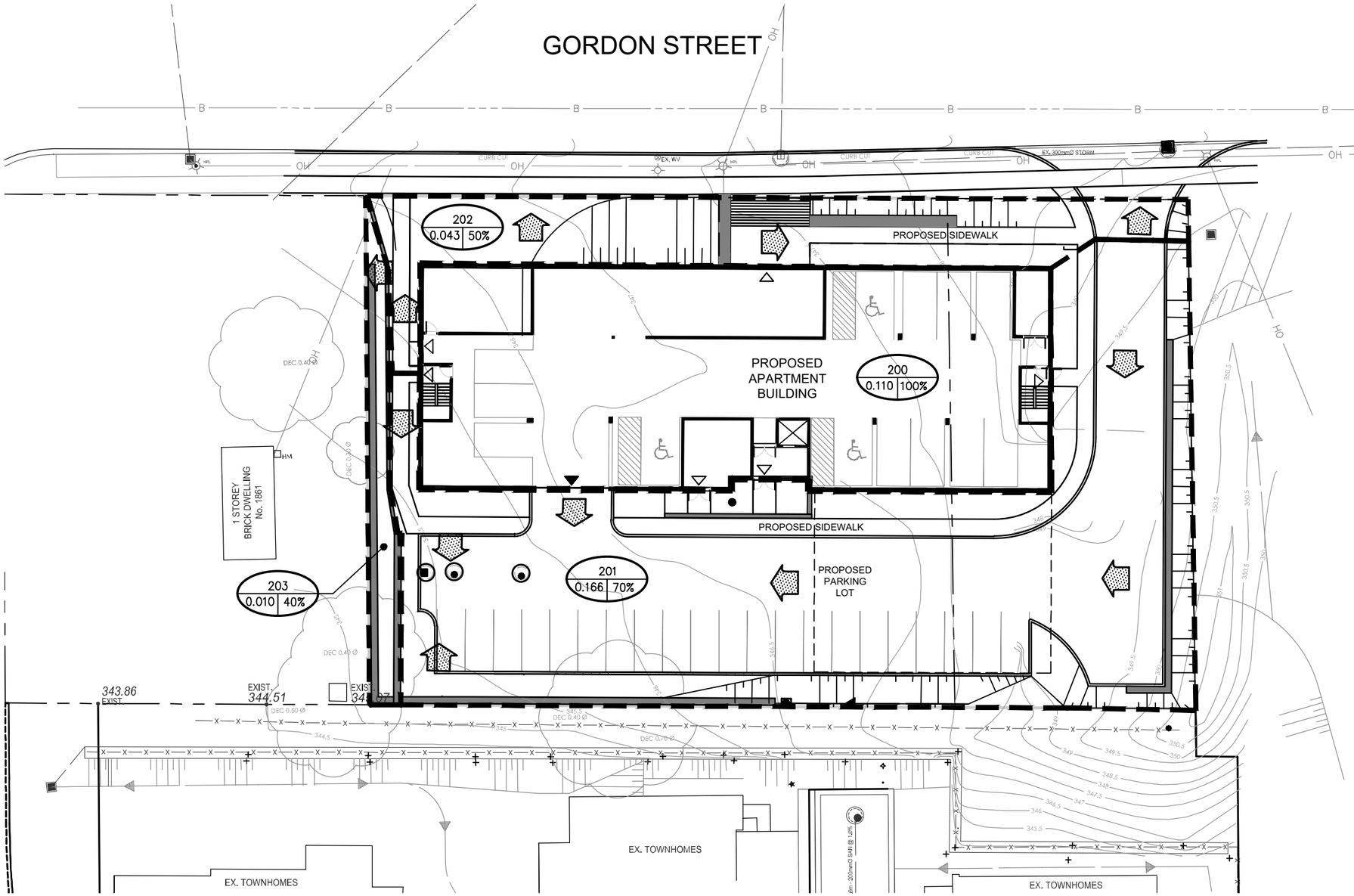
For post-development analysis purposes, the 0.329 hectare site was modelled as four (4) drainage catchments. The post-development drainage catchments are shown on Figure No. 3 and described below. The post-development MIDUSS computer modeling is attached in Appendix 'B'.

Catchment 200 (0.110 hectares, 100% impervious) represents the residential building's rooftop. Stormwater runoff from Catchment 200 is proposed to be attenuated at a controlled rate by roof drains. Catchment 200 is modeled with three roof drains, complete with six weirs in each drain. The roof drains are proposed to discharge directly to the storm sewer system, which discharges into the infiltration gallery. Catchment 200 stage-storage-discharge calculation table is presented in Appendix B.

Catchment 201 (0.166 hectares, 70% impervious) represents the proposed parking lot, driving isles, side walks and vegetated surfaces adjacent to the building and south retaining wall. Runoff from this catchment will be directed to the catch basin at the northwest end of the subject site and treated by an oil/grit separator structure prior to the Debris Row in the Brentwood system. The combined oil/grit separator and Debris Row filters runoff and connects with a feeder manhole that collects a combination of rooftop runoff and treated oil/grit separator runoff. The manhole discharges to the infiltration gallery.

Catchment 202 (0.043 hectares, 50% impervious) represents the east side of the site in the front of the building which includes grassed areas, sidewalks, and a portion of the site entrance. Under post-development conditions, this area will sheetflow overland towards the Gordon Street municipal right-of-way.

118170
1871 & 1879 GORDON STREET
SWM FIGURE
CITY OF GUELPH



LEGEND

100
1.2472 87%

- CATCHMENT NUMBER
- % IMPERVIOUS
- CATCHMENT AREA IN HECTARES

CATCHMENT BOUNDARY

MINOR FLOW DIRECTION

NOTE: REFER TO SITE GRADING PLAN FOR THE MAJOR OVERLAND FLOW DIRECTION

5 0 5 10 20
1:500 (m)

SCALE = 1:1000
MARCH 2021

POST-DEVELOPMENT DRAINAGE AREAS

Figure No. 3

BluePlan ENGINEERING

Catchment 203 (0.010 hectares, 40% impervious) represents the retaining walls and grassed area along the north edge of the subject property. Runoff from Catchment 203 will sheetflow overland towards the neighbouring properties to the north.

5.5 Infiltration

In Table No. 4 below is a summary of information from the below noted report that can be found in Appendix A:

- Guelph Permeameter Testing, Proposed Apartment Development 1871 & 1879 Gordon Street, Guelph, Ontario, completed by V.A. Wood (Guelph) Incorporated, dated April 2019, Amended June 5, 2019, Ref. No. G4091-19-7.

Table 4: Summary of Guelph Permeameter Testing Report

Date	Test Location	Test Depth Below Ex. Grade (m+/-)	Hydraulic Conductivity (cm/sec)[*1]	Test Log GW Encountered (m)
June 18, 2019	TP 1	0.9	$7.10x10^{-5}$	-
June 18, 2019	TP 1	1.6	$1.69x10^{-2}$	-
June 18, 2019	TP 1	2.4	$7.34x10^{-4}$	-

[*1] Calculations completed by Guelph Permeameter Soil Moisture Program by V.A. Wood (Guelph) Ltd.

V.A. Wood (Guelph) noted that deeper permeameter tests could not be completed due to unsafe excavation conditions in conjunction with the close proximity of the inground tile bed which was exposed in the test pit.

Table No. 5 below describes the calculation summary used to determine the design infiltration rates.

Table 5: Infiltration Gallery Information and Design Parameters

Location	Existing Grade (m)	Test Depth Below Ex. Grade (m+/-)	Elevation (m)	Test Hydraulic Conductivity (cm/s)*1	Assumed Hydraulic Conductivity (cm/s)*1	Ratio of Mean Measured Infiltration Rates	Safety Correction Factor*2	Hydraulic Conductivity (cm/s)	Design Infiltration Rate (mm/hr) *3	Design Hydraulic Conductivity (cm/s)
TP1	345.64	0.9	344.74	$7.10x10^{-5}$	--	1.0	2.5	$2.9 x10^{-4}$	61.5	$1.71 x10^{-3}$
TP1	345.64	1.6	344.04	$1.69x10^{-2}$	--					
Bot. of Proposed Infiltration Gallery	345.64	--	343.70	--	$7.34x10^{-4}$					
TP1	345.64	2.4	343.24	$7.34x10^{-4}$	--					
1.5 m below Bot. of Proposed Infiltration Gallery	345.64	--	342.2	--	$7.34x10^{-4}$					

*1 Calculations completed by Guelph Permeameter Soil Moisture Program by V.A. Wood (Guelph) Ltd.

*2 Credit Valley Conservation Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0 2011, Appendix C Table C2 Safety correction factors for calculating design infiltration rates.

*3 Credit Valley Conservation Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0 2011, Appendix C Figure C1: Approximate relationship between infiltration rate and hydraulic conductivity.

As noted above, permeameter testing could not be completed deeper than 2.4m below existing ground surface. Therefore, we have estimated the hydraulic conductivity at the bottom of the structure and 1.5 m below the infiltration gallery.

The infiltration gallery is proposed to be 18.5 m long, 6.5 m wide, and have a depth of 1.8m consisting of double stacked Brentwood Stormtank Module 25 totalling 1.8m in depth. The proposed infiltration gallery will provide a base area of 120m^2 and approximately 208 m^3 of storm water storage. From the Geotechnical Investigation completed for the site prepared by V.A. Wood (Guelph) Incorporated, the native soils in the area of the infiltration gallery were found to be silty sand, silty sand and gravel/or sand and gravel. Based on the Design Infiltration Rate of 61.5 mm/hr in Table 5 above, it is estimated that the draw down time for the infiltration gallery is approximately 30 hours for the 5-year design storm (106.4 m^3 of runoff) and 60 hours for the 100-year design storm event (216.9 m^3 of runoff).

5.6 Routing

The hydrologic model MIDUSS was used to create the design storm runoff hydrographs and to route the hydrographs. The routing results for the proposed infiltration gallery is summarized in Table No. 6 below.

Table 6: Infiltration Gallery - Stage-Storage-Discharge Capacity

	Available Capacity			Actual Capacity Used		
	Peak Flow m^3/s	Storage Volume m^3	Storage Elevation m	Peak Flow m^3/s	Storage Volume m^3	Storage Elevation m
Bottom of Gallery	0.002	0.00	343.70	---	---	---
5-Year Design Storm	---	---	---	0.002	83.1	344.43
Top of Gallery	0.0019	207.8	345.53	---	---	---
100-Year Design Storm	---	---	---	0.002	188.0	345.36
Top of DICB Grate	0.0019	209.3	346.33	---	---	---
Start of Overflow to Gordon Street	0.0019	242.7	346.60	---	---	---

Peak flows in the above table for the design storm events are equivalent to the infiltration rate of the native soils.

A summary of the post-development peak flows from the site for the 2-year to 100-year design storm events are provided in Table No. 7 below.

Table 7: Proposed Peak Flow Rate from Site (m3/s)

Catchment	2-Year	5-year	25-Year	100-Year
Catchment 200 – Roof top to Infiltration Gallery	0.007 m^3/s	0.010 m^3/s	0.015 m^3/s	0.019 m^3/s
Catchment 201 – Asphalt to Infiltration Gallery	0.027 m^3/s	0.036 m^3/s	0.054 m^3/s	0.072 m^3/s
Total Flow Infiltrated in Infiltration Gallery	**0.002 m^3/s**	**0.002 m^3/s**	**0.002 m^3/s**	**0.002 m^3/s**
Total Overflow to Gordon Street R.O.W. from Infiltration Gallery	0.0 m^3/s	0.0 m^3/s	0.0 m^3/s	0.0 m^3/s
Catchment 202 – To Gordon Street R.O.W.	0.005 m^3/s	0.007 m^3/s	0.012 m^3/s	0.018 m^3/s
Total Flow to Gordon Street R.O.W.	**0.005 m^3/s**	**0.007 m^3/s**	**0.012 m^3/s**	**0.018 m^3/s**
Catchment 203 – To Adjacent Properties	0.001 m^3/s	0.001 m^3/s	0.003 m^3/s	0.004 m^3/s
Total Flow to Adjacent Properties	**0.001 m^3/s**	**0.001 m^3/s**	**0.003 m^3/s**	**0.004 m^3/s**
Total Flow from Site	**0.006 m^3/s**	**0.008 m^3/s**	**0.015 m^3/s**	**0.022 m^3/s**

A summary of the pre- and post-development peak flow rates from the site for the 2-year to 100-year design storm events are provided in Table No. 8 below.

Table 8: Pre- and Post-Development Conditions: Flow Rates and Runoff Volumes – All Storms

	Peak Flow to Adjacent Properties / Gordon Street R.O.W. (m^3/s)
2 Year	
Pre-Development	0.028
Post-Development	0.006
5 Year	
Pre-Development	0.039
Post-Development	0.008
25 Year	
Pre-Development	0.082
Post-Development	0.015
100 Year	
Pre-Development	0.125
Post-Development	0.022

From Table No. 8 above, it can be observed that the proposed peak flow rate from the site, under the full range of design storm events, is estimated to be lower than the pre-development peak flow rate from site.

Upon completion of the development, all design storm flows will be directed to the low impact development (LID) infiltration gallery and flows from storm events greater than the 100-year will be directed to the Gordon Street right-of-way prior to overflowing to adjacent properties.

5.7 Water Quality

Enhanced water quality treatment (80% TSS removal) for runoff generated from the asphalt area (Catchment 201) will be achieved by routing the runoff through an oil/grit separator, Stormceptor Model EFO4 oil/grit separator prior to discharge to the infiltration gallery. The infiltration gallery is a Brentwood Stormtank system with a Debris Row to provide additional water quality prior to infiltration. Details of the oil/grit separator and Brentwood Stormtank have been included in Appendix “B”.

6. WATER BUDGET

The average annual precipitation for the area in which the study site is located is estimated to be about 916.3mm. This amount is based on precipitation data recorded at the Waterloo Wellington Airport meteorological station for the period from 1981 to 2010. The water balance has been calculated on a monthly basis based on the strategy provided in “Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance” by Thornthwaite and Mather (dated 1957).

The 0.329-ha development site is understood to have underlying gravel and sand soils, with an estimated infiltration rate of 61.5mm/hr, based on the Guelph Permeameter Test completed by VA Wood and converted to

an infiltration rate using the Credit Valley Conservation Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0 2011 (see Section 5.5).

The existing pre-development site discharges to the north of the adjacent property via overland sheet flow. The 0.329-ha site is 35% impervious, given building and driveway characteristics, which produces approximately 788 m^3 of runoff annually.

Under pre-development conditions, the site currently produces approximately 854 m^3 of recharge volume annually.

The post-development site is approximately 77% impervious. The increase in impervious area results in additional precipitation being available for recharge and runoff, as evapotranspiration is reduced. The total annual runoff volume towards the infiltration gallery is 2,132 m^3. Under post-development conditions the total annual natural recharge volume (through pervious surfaces) is 105.7 m^3.

An infiltration gallery has been designed to facilitate recharge and satisfy the water balance requirements for the overall site. The infiltration gallery has been designed with 1 metre clearance from the seasonally high groundwater table and 1.2 m of frost protection, where feasible. The post development potential annual enhanced recharge volume available is 1,557 m^3, for a total potential annual recharge volume of 1,663m^3. The design of the infiltration gallery provides a sufficient volume to satisfy the recharge and infiltration requirements.

Overall, the site development provides an increase of approximately 95% (854 m^3) of recharge volume from existing to proposed conditions.

The results of the site water budget analysis, including the additional recharge provided by the infiltration gallery has been included in Appendix C.

7. MAINTENANCE PLAN

To ensure that the stormwater management system continues to function as designed and constructed, we recommend that the following inspections and maintenance activities be completed on an annual basis:

1. Infiltration galleries will be kept “off-line” until construction is complete. They will not serve as a sediment control device during site construction. Sediment will be prevented from entering the infiltration facility using super silt fence, diversion berms or other means.
2. We have specified clean outs at either end of the infiltration gallery to provide a means of inspecting and flushing them out as part of routine maintenance.
3. Maintenance typically consists of cleaning out leaves, debris and accumulated sediment caught in sumps in catchbasins and manholes and inspection and cleanout of inlets and outlets annually or as needed.
4. Inspection via observation in cleanouts will be performed to ensure the facility drains within the maximum acceptable length of time at least annually and following every major storm event (>25 mm). If the time required to fully drain exceeds 48 to 72 hours, they will be drained via pumping and clean out of the perforated distribution pipe. If slow drainage persists, the system may need removal and replacement of granular material and/or geotextile fabric.
5. Regular inspections and cleanings of the Stormceptor Model EFO4 oil/grit separator and Brentwood Stormtank complete with Debris Row will be required as a part of the standard maintenance procedures carried out annually by the Owner.

8. SEDIMENT AND EROSION CONTROL PLAN

Silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. The silt fence will serve to minimize the opportunity for water borne sediments to be washed on to the adjacent properties.

Upon completion of the grading, any area not subject to active construction within 30 days will be topsoiled and hydroseeded as per OPSS 572.

Inspection and maintenance of all silt fencing will start after installation is complete. The silt fence will be inspected on a weekly basis during active construction or after a rainfall event of 13mm or greater. Maintenance will be carried out, within 48 hours, on any part of the silt fence found to need repair.

Once construction and landscaping has been substantially completed, the silt fence will be removed, any accumulated sediment will be removed, and the landscaping will be completed.

Details of the proposed sediment and erosion control measures will be detailed on a drawing at the Site Plan Application stage of the project.

9. CONCLUSIONS

The 1871 and 1879 Gordon Street Stormwater Management and Functional Servicing report developed and clearly illustrated the following:

1. The post-development release rate from the site to adjacent properties and the Gordon Street right-of-way is 0.022 m3/s during the 100-year design storm event and is lower than pre-development release rate of 0.125 m3/s. Additionally, the post-development release rates for the 2-, 5-, and 25-year design storms are below the pre-development release rate and are summarized in Table 8.
2. Quality control for the stormwater collected from the paved surfaces will be provided by routing overland flows through an oil/grit separator prior to discharge into the infiltration gallery. The infiltration gallery will consist of a Brentwood Stormtank complete with Debris Row to provide additional water quality treatment prior to infiltration. The proposed water quality control measures will achieve above 70% TSS removal.
3. The site will provide infiltration through the onsite infiltration gallery consisting of Brentwood Stormtank Module 25 or approved equivalent. The post-development annual recharge volume is above the pre-development recharge volume by approximately 95%.
4. Prior to construction, a silt fence will be installed along the property boundary in all locations where runoff will discharge from the site to adjacent lands. This will minimize the transport of sediment off-site during the construction period.

All of which is respectfully submitted.

Yours truly,
GM BLUEPLAN ENGINEERING LIMITED
Per:

Jack Turner, P.Eng.

W:\Guelph\118-2018\118170 Gordon St. ZCA\5 Work In Progress\Reports, Manuals, Contracts\SWM Report\2021-03-05 Submission\118170 SWM And FSR Report_2021-03-08.Docx

Appendix A
Geotechnical Investigation

V.A. WOOD (GUELPH) INCORPORATED
CONSULTING GEOTECHNICAL ENGINEERS

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TELEPHONE: 519-763-3101

PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED APARTMENT BUILDING
1871 & 1879 GORDON STREET
GUELPH, ONTARIO

Ref. No. G4091-19-4
April, 2019

Amended
June 5, 2019

Prepared for:

Mar-Cot Developments Inc.
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Guelph, Ontario
N1G 3W6

Attention: Mr. Mario Cotroneo

Distribution:

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APPENDIX

ENCLOSURES

1.0 INTRODUCTION:

V.A. Wood (Guelph) Inc. was retained by Mar-Cot Developments Inc. to carry out a preliminary geotechnical investigation for the proposed apartment building to be constructed at 1871 and 1879 in Guelph, Ontario.

Detailed plans for the proposed development were not available at the time of this report but it is understood that the preliminary plans are for a four-storey apartment building with two levels of underground parking as well as surface parking.

It is noted that the subject properties are currently occupied with two detached residential dwellings.

The purpose of the investigation was to reveal the subsurface conditions and to determine the relevant soil properties for preliminary recommendations for the design and construction of building foundations, retaining walls, storm water management and pavement designs.

2.0 FIELD WORK:

The fieldwork was carried out over the period of March 12 to 14, 2019 and consisted of seven (7) boreholes at the locations shown on Enclosure 1. The boreholes were advanced to the sampling depths by means of a track-mounted, power auger machine, equipped for soil sampling. Standard Penetration tests were carried out at frequent intervals of depth and the results are shown on the Logs as N-values. The subsurface soils were visually inspected, logged and sampled at the borehole locations.

Engineering staff from our office supervised the fieldwork with personnel from GM BluePlan Engineering Ltd. and the ground elevation at each borehole was supplied by GM BluePlan Engineering Ltd.

3.0 SUBSURFACE CONDITIONS:

Full details of the soils encountered in each borehole/monitoring well are given on the Borehole/Monitoring Well Logs, Enclosures 2 to 9, inclusive and the following notes are intended to summarize this data.

*Monitoring Wells 1 and 2 and Boreholes 4 to 7, inclusive encountered a surficial deposit of **topsoil** ranging between 150 and 325mm thick. The natural moisture content was found to range from 39 to 44%.*

*Monitoring Well 3 encountered an existing paved driveway consisting of 25mm of **asphalt** on 100mm thick granular base.*

*The topsoil at Monitoring Wells 1 and 2 and Boreholes 4, 5 and 7, and the pavement at Monitoring Well 3 were underlain by deposits of **fill** to depths ranging between 0.3 and 3.0 metres below grade. The fill generally consisted of brown silty sand, silty sand and gravel and/or sand and gravel. Standard Penetration tests in the fill gave N-values ranging between 4 and 47 blows/300mm and the natural moisture content was found to range from 3 to 35%.*

Based on the test results, the deposits of fill are considered to be in a generally very loose to dense condition, although it is noted that the presence of gravel and cobbles in the deposits may have resulted in high N-values and these may not accurately represent the relative density of the soils.

*The fill at the monitoring wells and boreholes was underlain by a deposit of brown **gravel and sand** to the full depth of the investigation (i.e. 3.5 to 18.7 metres below grade). Thin layers of brown sand and/or silty sand were encountered within the gravel and sand at Monitoring Well 1. Standard Penetration tests in this deposit gave N-values ranging between 16 and greater than 100 blows/300mm and the natural moisture content was found to range from 3 to 10%. A typical grain size distribution curve for this material can be found on Enclosure 9.*

Based on the test results, the deposit of gravel and sand is considered to have a generally compact to very dense relative density, although it is noted that the presence of gravel and cobbles in the deposit may have resulted in high N-values and these may not accurately represent the relative density of the soil.

The gravel and sand at Monitoring Well 1 was underlain by a deposit of grey ***sand and silt till*** *to the full depth of the investigation (i.e.18.7 metres below grade). Standard Penetration tests in this deposit gave an N-value of 0 blows/300mm and the natural moisture content was found to be about 9%. A typical grain size distribution curve can be found on Enclosure 10.*

Based on the test results, the deposit of sand and silt till is considered to have a very loose relative density.

4.0 GROUNDWATER CONDITIONS:

Boreholes 4 to 7, inclusive were dry and open to the full depth of the investigation on completion of the fieldwork program.

Monitoring Wells 1 and 3 had a free water surface at elevations of 331.0m± and 341.7m± (i.e. 15.0 and 6.1 metres below grade), respectively while Monitoring Well 2 was dry on April 2, 2019.

An examination of the soil samples indicated that they were generally moist to wet.

It is noted that no sub-artesian water pressures were encountered in any of the boreholes/monitoring wells.

Based on the foregoing, the groundwater table is considered to be located at elevations ranging between 331.0m± and 341.7m±.

5.0 DISCUSSION AND RECOMMENDATIONS:

5.1 General:

The boreholes encountered a surfical deposit of topsoil and/or pavement underlain by loose to dense fill on a deposit of compact to very dense gravel and sand on a very loose sand and silt till.

The groundwater table is considered to be located at elevations ranging between 331.0m± and 341.7m±.

Final details concerning the proposed development were not available at the time of this report but it is understood that the preliminary plans are for a four-storey apartment building with two levels of underground parking as well as surface parking. Therefore the following discussion is considered preliminary and it should be reviewed when more details are available.

5.2 Sewers:

It is anticipated that the sewer inverts will be located at depths ranging between 3 and 4 metres below existing grade.

Reference to the Borehole Logs indicates that the subgrade will generally consist of competent gravel and sand. These deposits will generally provide adequate support for the pipes and allow the use of normal Class 'B' bedding using Granular 'A' material. Clear crushed stone should not be used as bedding unless it is wrapped with geotextile to prevent undesirable settlements caused from fines migrating into the voids of the stone. Where the exposed subgrade is less competent, the bedding thickness may have to be increased and it may be necessary to protect the excavation with a skim coat of concrete immediately after it has been exposed.

Where sewer trench grades are below the groundwater table, provisions may be required to lower the groundwater table through pumping from local sumps as and where required or through the use of well points. The sides of the excavation to a depth of more than 1.2 metres (and above the water table) should either be cut back at a side slope of 1 to 1 or supported using adequately braced closed sheeting.

The excavated materials will be generally suitable for use as trench backfill provided that they are free of topsoil and boulders. If the on-site materials are or become wet, they should be air dried prior to re-use as trench backfill. The trench backfill should be placed in 150 to 200mm thick layers and uniformly compacted to at least 95% of its Standard Proctor maximum dry density. The backfill around manholes should consist of well-graded and well-compacted granular material.

To minimize potential problems and wetting of the subgrade material, backfilling operations should follow closely after excavations, so that only a minimal length of trench is exposed at a time. Should construction be carried out in the winter season, particular attention should be given to make sure no frozen material is used for backfill.

5.3 Foundations

The pavement, topsoil, and fill are not considered to be suitable bearing strata. Therefore, the foundations for the proposed structures should extend into the competent native gravel and sand designed to 300 kPa S.L.S/450 kPa U.L.S at the elevations indicated in the following chart:

Location	Borehole Ground Elevation (m±)	Suitable Bearing Stratum Elevation (m±)	Bearing Stratum	Depth to Suitable Bearing Stratum Below Existing Grade (m±)
MW 1	346.0	343.4	Gravel and Sand	2.6
MW 2	346.9	344.6	Gravel and Sand	2.3
MW 3	347.8	345.2	Gravel and Sand	2.6
BH 4	349.9	348.2	Gravel and Sand	1.7
BH 5	349.5	348.9	Gravel and Sand	0.6
BH 6	346.2	345.7	Gravel and Sand	0.5
BH 7	345.2	341.9	Gravel and Sand	3.3

All exterior footings or footings in unheated areas should be located at least 1.2 metres below finished grade for adequate frost protection.

Elevation differences between adjacent footings should not be more than a half of the horizontal distance between them.

It is estimated that the total and differential settlements of footings designed to these bearing pressures will be less than 25 and 20mm respectively, which are normally considered acceptable for the proposed residential structures.

The minimum footing sizes should not be less than those specified in the National Building Code of Canada.

It is recommended that all foundation excavations be inspected by geotechnical personnel from V.A. Wood (Guelph) Inc. to ensure the founding soils are similar to those identified in the Test Pit Logs and that they are capable of supporting the design loads.

Based on the 2012 Building Code Compendium, the classification of soils for seismic design should be based on the average properties of the top 30 metres of the soil profile. The deepest boreholes were only 18 metres deep and were terminated in very dense gravel and sand. Assuming the very dense deposits extend to depth, the site soils may be classified as Site Class 'C' under the site classification for seismic site response of 2012 Building Code Compendium.

For the design of members resisting lateral loads, the recommended soil parameters are as follows:

Soil Parameters	Loose to Dense Fill	Very Dense Gravel and Sand
Unit Weight	20 kN/m^3	21 kN/m^3
Friction Angle	30°	34°
Cohesion	0	0
Coefficient of Earth Pressure at Rest	0.47	0.44
Coefficient of Active Pressure	0.31	0.28
Coefficient of Passive Pressure	3.2	3.6
Coefficient of Friction	0.35	0.45
Modulus of Subgrade Reaction	25	50 kPa

5.4 Basement/Underground Parking/Retaining Walls:

The basement walls should be designed to resist lateral earth pressures, the magnitude of which can be determined from:

$$p = K(\gamma d + q)$$

where;

p	=	*earth pressure, kN/m²*
K	=	*earth pressure co-efficient = 0.33, if retaining structure is permitted to move, otherwise K = 0.5*
γ	=	*unit weight of backfill, 20 kN/m² for sand*
d	=	*depth below finished grade, metres*
q	=	*all adjacent surcharge kN/m²*

Water will tend to collect around the walls and under the slab which, therefore, should be designed to resist hydrostatic pressures unless a perimeter drainage system is installed. Water collected in this system should be connected to the local storm drainage system either by gravity or by a permanent sump pump. Surface drainage around the building should be directed away from the building.

If basement grades are within 0.5m of the measured high groundwater table we recommend that a sub-floor drainage system connected to the local storm drainage system either by gravity or by a permanent sump pump be installed. As well, waterproofing the basement walls would be recommended.

5.5 Excavation, Shoring and Groundwater Control:

No major construction problems due to water are anticipated with excavations above El. 341.7m±. Provision should, however, be made for control of any surface water run-off by pumping from local sumps as and where required.

Excavations to a depth of more than 1.2 metres below grade should be cut back to a side slope of 1 to 1 or, supported using adequately braced sheeting.

5.6 Floor Slabs:

The subgrade for the underground parking floor slabs will generally consist of compact to very dense gravel and sand. This material will generally provide adequate support for the proposed slabs. The proposed subgrade should be re-compacted from the surface to at least 98% of its Standard Proctor maximum dry density. Any loose/wet material encountered should be sub-excavated and replaced with approved fill.

The fill may consist of approved on-site materials free of cobbles/boulders or approved imported fill. All fill should be placed in 150 to 200mm thick lifts and compacted to at least 98% Standard Proctor maximum dry density. It is recommended the underfloor fill be placed at least one month prior to floor construction in order to minimize settlement.

A layer of well-graded, free-draining material, at least 150mm thick and compacted to 100% Standard Proctor maximum density, should be placed under the floor slabs to provide a uniform bearing surface and act as a vapour barrier.

Frequent inspections by geotechnical personnel from V.A. Wood (Guelph) Inc. should be carried out during construction to verify compaction of the subgrade and base courses by in-situ density testing using nuclear gauges.

5.7 Surface Pavement Designs:

All topsoil and any deleterious fill materials encountered should be stripped from the paved area. The underlying subgrade should then be re-compacted from the surface to at least 98% of its Standard Proctor maximum dry density prior to construction of the pavement. Any loose areas which are detected should be sub-excavated and backfilled with suitable on-site material or approved imported granular fill. All fill should be placed in 150 to 200mm thick lifts and compacted to at least 98% Standard Proctor maximum dry density.

Considering the probable traffic requirements and subsoil conditions, the following pavement designs are recommended:

	Passenger Car Parking (Light Duty) (mm)	*Access Road (Medium Duty) (mm)*
Asphaltic Concrete	*50*	*90*
Granular 'A' Base Course	*150*	*150*
Granular 'B' Sub-base Course	*200*	*300*

The base and sub-base granular materials should be compacted to at least 100% Standard Proctor maximum dry density. The asphalt should be compacted to OPS Specifications.

Frequent inspections by geotechnical personnel from V.A. Wood (Guelph) Inc. should be carried out during construction to verify the compaction of the subgrade, base courses and asphaltic concrete by in-situ density testing using nuclear gauges.

5.6 Storm Water Management:

As per the City of Guelph requirements, Guelph Permeameter testing in the proposed storm water management infiltration galleries will be carried out in the future to determine the hydraulic conductively of the subsoils for the storm water management design.

5.7 Chemical Analysis Results:

Representative samples of the subsoils from the boreholes were submitted to the Environmental Division of ALS Laboratory Group for chemical analyses. The analyses included:

- *i) O.Reg. 153/04 as amended by O.Reg. 511 (April 15, 2011) [metals and inorganics].*
- *ii) BTEX*
- *iii) F1-F4*
- *iv) PAH*

The soil samples obtained from the boreholes were submitted as follows.

Chemical Analysis (Subsoils)							
Sample Description	**Submission Date**	**Material Type**	**Depth (m±)**	**Eagle Detector Readings (TOV) (ppm)**	**Staining (Y/N)**	**Odour (Y/N)**	**Chemical Testing**
ALS #L2244494-1 MW 1, Sam 3	14-Mar-19	Silty Clay Fill	1.5 – 2.0	0	N	N	Metals and Inorganics,BTEX, F1-F4,PAH
ALS #L224494-2 MW 2, Sam 5	14-Mar-19	Gravel and Sand	3.0 – 3.5	0	N	N	Metals and Inorganics, BTEX, F1-F4, PAH
ALS #L224494-3 MW 3, Sam 9	14-Mar-19	Gravel and Sand	9.1 –9.6	0	N	N	Metals and Inorganics, BTEX, F1-F4, PAH
ALS #L2246201-1 MW 3, Sam 3	19-Mar-19	Sand and Gravel Fill	1.5 – 2.0	0	N	N	Metals and Inorganics
ALS #L2246201-2 BH 4, Sam 1	19-Mar-19	Topsoil	0.0 – 0.6	0	N	N	Metals and Inorganics

The analytical results are shown in Appendix 'B'. They indicate:

- *topsoil, fill and gravel and sand yielded concentrations below the applicable below the applicable MOE Tables 1 and 2 Site Condition Standards as outlined in Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, March 9, 2004, O.Reg. 153/04 as amended by O.Reg. 511 (April 2011) for all parameters analyzed for residential, parkland, institutional, industrial, commercial, community, agricultural or other property uses **except** for lead in the gravel and sand and topsoil at Boreholes 2 and 4, respectively and mercury in the topsoil at Borehole 4..*

6.0 STATEMENT OF LIMITATION:

The Statement of Limitation presented on Appendix 'A' is an integral part of this report.

V.A. WOOD (GUELPH) INC.

J. Broad, B.A.
President & General Manager

V. Wood, M.Eng., P.Eng.
Chief Engineer

REGISTERED PROFESSIONAL ENGINEER
V. WOOD
PROVINCE OF ONTARIO

JB:sm

Encls.

APPENDIX 'A'

STATEMENT OF LIMITATIONS:

The conclusions and recommendations in this report are based on information determined at the borehole locations and on geological data of a general nature, which may be available, for the area investigated. Soil and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations and conditions may become apparent during construction, which would not be detected or anticipated at the time of the soil investigation.

We recommend that we be retained to ensure that all necessary stripping, subgrade preparation and compaction requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in the boreholes. ***In cases where this recommendation is not followed, the company's responsibility is limited to interpreting accurately the information encountered at the boreholes.***

This report is applicable only to the project described in the introduction, constructed substantially in accordance with details of alignment and elevations quoted in the text.

V.A. Wood (Guelph) Inc. prepared this report for Mar-Cot Developments Inc. The material in it reflects V.A. Wood (Guelph) Inc. judgement in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such Third Parties. V.A. Wood (Guelph) Inc. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

APPENDIX 'B'

V.A. WOOD (GUELPH)
ATTN: JOHN BROAD
405 YORK ROAD
GUELPH ON N1E 3H3

Date Received: 14-MAR-19
Report Date: 22-APR-19 14:37 (MT)
Version: FINAL REV. 2

Client Phone: 519-763-3101

Certificate of Analysis

Lab Work Order #: L2244494
Project P.O. #: NOT SUBMITTED
Job Reference: G4091-19-3
C of C Numbers: 17-641549
Legal Site Desc:

Emily Hansen
Account Manager

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	#4
L2244494-1 G4091-19-3 MW1 SAM 3 Sampled By: CLIENT on 14-MAR-19 @ 10:30 Matrix: SOIL									
Physical Tests									
% Moisture	16.7		0.10	%	17-MAR-19				
Metals									
Antimony (Sb)	<1.0		1.0	ug/g	20-MAR-19	1	1.3	7.5	40
Arsenic (As)	7.5		1.0	ug/g	20-MAR-19	11	18	18	18
Barium (Ba)	73.2		1.0	ug/g	20-MAR-19	210	220	390	670
Beryllium (Be)	0.66		0.50	ug/g	20-MAR-19	2.5	2.5	4	8
Boron (B)	<5.0		5.0	ug/g	20-MAR-19	36	36	120	120
Cadmium (Cd)	<0.50		0.50	ug/g	20-MAR-19	1	1.2	1.2	1.9
Chromium (Cr)	21.2		1.0	ug/g	20-MAR-19	67	70	160	160
Cobalt (Co)	7.8		1.0	ug/g	20-MAR-19	19	21	22	80
Copper (Cu)	19.1		1.0	ug/g	20-MAR-19	62	92	140	230
Lead (Pb)	30.8		1.0	ug/g	20-MAR-19	45	120	120	120
Molybdenum (Mo)	<1.0		1.0	ug/g	20-MAR-19	2	2	6.9	40
Nickel (Ni)	15.2		1.0	ug/g	20-MAR-19	37	82	100	270
Selenium (Se)	<1.0		1.0	ug/g	20-MAR-19	1.2	1.5	2.4	5.5
Silver (Ag)	<0.20		0.20	ug/g	20-MAR-19	0.5	0.5	20	40
Thallium (Tl)	<0.50		0.50	ug/g	20-MAR-19	1	1	1	3.3
Uranium (U)	<1.0		1.0	ug/g	20-MAR-19	1.9	2.5	23	33
Vanadium (V)	39.2		1.0	ug/g	20-MAR-19	86	86	86	86
Zinc (Zn)	141		5.0	ug/g	20-MAR-19	290	290	340	340
Volatile Organic Compounds									
Benzene	<0.0068		0.0068	ug/g	20-MAR-19	0.02	0.02	0.21	0.32
Ethylbenzene	<0.018		0.018	ug/g	20-MAR-19	0.05	0.05	1.1	1.1
Toluene	<0.080		0.080	ug/g	20-MAR-19	0.2	0.2	2.3	6.4
o-Xylene	<0.020		0.020	ug/g	20-MAR-19				
m+p-Xylenes	<0.030		0.030	ug/g	20-MAR-19				
Xylenes (Total)	<0.050		0.050	ug/g	20-MAR-19	0.05	0.05	3.1	26
Surrogate: 4-Bromofluorobenzene	86.2		50-140	%	20-MAR-19				
Surrogate: 1,4-Difluorobenzene	92.3		50-140	%	20-MAR-19				
Hydrocarbons									
F1 (C6-C10)	<5.0		5.0	ug/g	20-MAR-19	17	25	55	55
F1-BTEX	<5.0		5.0	ug/g	21-MAR-19	17	25	55	55
F2 (C10-C16)	<10		10	ug/g	20-MAR-19	10	10	98	230
F2-Naphth	<10		10	ug/g	21-MAR-19				
F3 (C16-C34)	<50		50	ug/g	20-MAR-19	240	240	300	1700
F3-PAH	<50		50	ug/g	21-MAR-19				
F4 (C34-C50)	<50		50	ug/g	20-MAR-19	120	120	2800	3300
Total Hydrocarbons (C6-C50)	<72		72	ug/g	21-MAR-19				
Chrom. to baseline at nC50	YES			No Unit	20-MAR-19				
Surrogate: 2-Bromobenzotrifluoride	94.2		60-140	%	20-MAR-19				
Surrogate: 3,4-Dichlorotoluene	96.6		60-140	%	20-MAR-19				
Polycyclic Aromatic Hydrocarbons									
Acenaphthene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.072	7.9	21
Acenaphthylene	<0.050		0.050	ug/g	21-MAR-19	0.093	0.093	0.15	0.15
Anthracene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.16	0.67	0.67
Benzo(a)anthracene	<0.050		0.050	ug/g	21-MAR-19	0.095	0.36	0.5	0.96

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-RPIICC-C

#1: T1-Soil-Agricultural or Other Property Use

#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#3: T2-Soil-Res/Park/Inst. Property Use (Coarse)

#4: T2-Soil-Ind/Com/Commu Property Use (Coarse)

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	#4
L2244494-1 G4091-19-3 MW1 SAM 3 Sampled By: CLIENT on 14-MAR-19 @ 10:30 Matrix: SOIL									
Polycyclic Aromatic Hydrocarbons									
Benzo(a)pyrene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.3	0.3	0.3
Benzo(b)fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.3	0.47	0.78	0.96
Benzo(g,h,i)perylene	<0.050		0.050	ug/g	21-MAR-19	0.2	0.68	6.6	9.6
Benzo(k)fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.48	0.78	0.96
Chrysene	<0.050		0.050	ug/g	21-MAR-19	0.18	2.8	7	9.6
Dibenzo(ah)anthracene	<0.050		0.050	ug/g	21-MAR-19	0.1	0.1	0.1	0.1
Fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.24	0.56	0.69	9.6
Fluorene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.12	62	62
Indeno(1,2,3-cd)pyrene	<0.050		0.050	ug/g	21-MAR-19	0.11	0.23	0.38	0.76
1+2-Methylnaphthalenes	<0.042		0.042	ug/g	21-MAR-19	0.05	0.59	0.99	30
1-Methylnaphthalene	<0.030		0.030	ug/g	21-MAR-19	0.05	0.59	0.99	30
2-Methylnaphthalene	<0.030		0.030	ug/g	21-MAR-19	0.05	0.59	0.99	30
Naphthalene	<0.013		0.013	ug/g	21-MAR-19	0.05	0.09	0.6	9.6
Phenanthrene	<0.046		0.046	ug/g	21-MAR-19	0.19	0.69	6.2	12
Pyrene	<0.050		0.050	ug/g	21-MAR-19	0.19	1	78	96
Surrogate: 2-Fluorobiphenyl	109.5		50-140	%	21-MAR-19				
Surrogate: p-Terphenyl d14	104.4		50-140	%	21-MAR-19				
L2244494-2 G4091-19-3 MW2 SAM 5 Sampled By: CLIENT on 14-MAR-19 @ 10:30 Matrix: SOIL						#1	#2	#3	#4
Physical Tests									
% Moisture	4.30		0.10	%	17-MAR-19				
Metals									
Antimony (Sb)	<1.0		1.0	ug/g	20-MAR-19	1	1.3	7.5	40
Arsenic (As)	4.5		1.0	ug/g	20-MAR-19	11	18	18	18
Barium (Ba)	13.1		1.0	ug/g	20-MAR-19	210	220	390	670
Beryllium (Be)	<0.50		0.50	ug/g	20-MAR-19	2.5	2.5	4	8
Boron (B)	7.1		5.0	ug/g	20-MAR-19	36	36	120	120
Cadmium (Cd)	0.52		0.50	ug/g	20-MAR-19	1	1.2	1.2	1.9
Chromium (Cr)	7.1		1.0	ug/g	20-MAR-19	67	70	160	160
Cobalt (Co)	3.0		1.0	ug/g	20-MAR-19	19	21	22	80
Copper (Cu)	12.5		1.0	ug/g	20-MAR-19	62	92	140	230
Lead (Pb)	125		1.0	ug/g	20-MAR-19	*45	*120	*120	*120
Molybdenum (Mo)	<1.0		1.0	ug/g	20-MAR-19	2	2	6.9	40
Nickel (Ni)	5.8		1.0	ug/g	20-MAR-19	37	82	100	270
Selenium (Se)	<1.0		1.0	ug/g	20-MAR-19	1.2	1.5	2.4	5.5
Silver (Ag)	<0.20		0.20	ug/g	20-MAR-19	0.5	0.5	20	40
Thallium (Tl)	<0.50		0.50	ug/g	20-MAR-19	1	1	1	3.3
Uranium (U)	<1.0		1.0	ug/g	20-MAR-19	1.9	2.5	23	33
Vanadium (V)	11.2		1.0	ug/g	20-MAR-19	86	86	86	86
Zinc (Zn)	243		5.0	ug/g	20-MAR-19	290	290	340	340
Volatile Organic Compounds									
Benzene	<0.0068		0.0068	ug/g	20-MAR-19	0.02	0.02	0.21	0.32
Ethylbenzene	<0.018		0.018	ug/g	20-MAR-19	0.05	0.05	1.1	1.1

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-RPIICC-C

#1: T1-Soil-Agricultural or Other Property Use

#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#3: T2-Soil-Res/Park/Inst. Property Use (Coarse)

#4: T2-Soil-Ind/Com/Commu Property Use (Coarse)

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	#4
L2244494-2 G4091-19-3 MW2 SAM 5 Sampled By: CLIENT on 14-MAR-19 @ 10:30 Matrix: SOIL									
Volatile Organic Compounds									
Toluene	<0.080		0.080	ug/g	20-MAR-19	0.2	0.2	2.3	6.4
o-Xylene	<0.020		0.020	ug/g	20-MAR-19				
m+p-Xylenes	<0.030		0.030	ug/g	20-MAR-19				
Xylenes (Total)	<0.050		0.050	ug/g	20-MAR-19	0.05	0.05	3.1	26
Surrogate: 4-Bromofluorobenzene	95.6		50-140	%	20-MAR-19				
Surrogate: 1,4-Difluorobenzene	102.6		50-140	%	20-MAR-19				
Hydrocarbons									
F1 (C6-C10)	<5.0		5.0	ug/g	20-MAR-19	17	25	55	55
F1-BTEX	<5.0		5.0	ug/g	21-MAR-19	17	25	55	55
F2 (C10-C16)	<10		10	ug/g	19-MAR-19	10	10	98	230
F2-Naphth	<10		10	ug/g	21-MAR-19				
F3 (C16-C34)	<50		50	ug/g	19-MAR-19	240	240	300	1700
F3-PAH	<50		50	ug/g	21-MAR-19				
F4 (C34-C50)	<50		50	ug/g	19-MAR-19	120	120	2800	3300
Total Hydrocarbons (C6-C50)	<72		72	ug/g	21-MAR-19				
Chrom. to baseline at nC50	YES			No Unit	19-MAR-19				
Surrogate: 2-Bromobenzotrifluoride	100.3		60-140	%	19-MAR-19				
Surrogate: 3,4-Dichlorotoluene	100.1		60-140	%	20-MAR-19				
Polycyclic Aromatic Hydrocarbons									
Acenaphthene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.072	7.9	21
Acenaphthylene	<0.050		0.050	ug/g	21-MAR-19	0.093	0.093	0.15	0.15
Anthracene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.16	0.67	0.67
Benzo(a)anthracene	<0.050		0.050	ug/g	21-MAR-19	0.095	0.36	0.5	0.96
Benzo(a)pyrene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.3	0.3	0.3
Benzo(b)fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.3	0.47	0.78	0.96
Benzo(g,h,i)perylene	<0.050		0.050	ug/g	21-MAR-19	0.2	0.68	6.6	9.6
Benzo(k)fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.48	0.78	0.96
Chrysene	<0.050		0.050	ug/g	21-MAR-19	0.18	2.8	7	9.6
Dibenzo(ah)anthracene	<0.050		0.050	ug/g	21-MAR-19	0.1	0.1	0.1	0.1
Fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.24	0.56	0.69	9.6
Fluorene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.12	62	62
Indeno(1,2,3-cd)pyrene	<0.050		0.050	ug/g	21-MAR-19	0.11	0.23	0.38	0.76
1+2-Methylnaphthalenes	<0.042		0.042	ug/g	21-MAR-19	0.05	0.59	0.99	30
1-Methylnaphthalene	<0.030		0.030	ug/g	21-MAR-19	0.05	0.59	0.99	30
2-Methylnaphthalene	<0.030		0.030	ug/g	21-MAR-19	0.05	0.59	0.99	30
Naphthalene	<0.013		0.013	ug/g	21-MAR-19	0.05	0.09	0.6	9.6
Phenanthrene	<0.046		0.046	ug/g	21-MAR-19	0.19	0.69	6.2	12
Pyrene	<0.050		0.050	ug/g	21-MAR-19	0.19	1	78	96
Surrogate: 2-Fluorobiphenyl	110.5		50-140	%	21-MAR-19				
Surrogate: p-Terphenyl d14	108.9		50-140	%	21-MAR-19				
L2244494-3 G4091-19-3 MW3 SAM 9 Sampled By: CLIENT on 14-MAR-19 @ 10:30 Matrix: SOIL						#1	#2	#3	#4
Physical Tests									
% Moisture	4.66		0.10	%	17-MAR-19				

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Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-RPIICC-C

#1: T1-Soil-Agricultural or Other Property Use

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#3: T2-Soil-Res/Park/Inst. Property Use (Coarse)

#4: T2-Soil-Ind/Com/Commu Property Use (Coarse)

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	#4
L2244494-3 G4091-19-3 MW3 SAM 9 Sampled By: CLIENT on 14-MAR-19 @ 10:30 Matrix: SOIL									
Metals									
Antimony (Sb)	<1.0		1.0	ug/g	20-MAR-19	1	1.3	7.5	40
Arsenic (As)	2.9		1.0	ug/g	20-MAR-19	11	18	18	18
Barium (Ba)	13.3		1.0	ug/g	20-MAR-19	210	220	390	670
Beryllium (Be)	<0.50		0.50	ug/g	20-MAR-19	2.5	2.5	4	8
Boron (B)	<5.0		5.0	ug/g	20-MAR-19	36	36	120	120
Cadmium (Cd)	<0.50		0.50	ug/g	20-MAR-19	1	1.2	1.2	1.9
Chromium (Cr)	6.4		1.0	ug/g	20-MAR-19	67	70	160	160
Cobalt (Co)	2.8		1.0	ug/g	20-MAR-19	19	21	22	80
Copper (Cu)	17.0		1.0	ug/g	20-MAR-19	62	92	140	230
Lead (Pb)	28.3		1.0	ug/g	20-MAR-19	45	120	120	120
Molybdenum (Mo)	<1.0		1.0	ug/g	20-MAR-19	2	2	6.9	40
Nickel (Ni)	5.7		1.0	ug/g	20-MAR-19	37	82	100	270
Selenium (Se)	<1.0		1.0	ug/g	20-MAR-19	1.2	1.5	2.4	5.5
Silver (Ag)	<0.20		0.20	ug/g	20-MAR-19	0.5	0.5	20	40
Thallium (Tl)	<0.50		0.50	ug/g	20-MAR-19	1	1	1	3.3
Uranium (U)	<1.0		1.0	ug/g	20-MAR-19	1.9	2.5	23	33
Vanadium (V)	17.9		1.0	ug/g	20-MAR-19	86	86	86	86
Zinc (Zn)	183		5.0	ug/g	20-MAR-19	290	290	340	340
Volatile Organic Compounds									
Benzene	<0.0068		0.0068	ug/g	20-MAR-19	0.02	0.02	0.21	0.32
Ethylbenzene	<0.018		0.018	ug/g	20-MAR-19	0.05	0.05	1.1	1.1
Toluene	<0.080		0.080	ug/g	20-MAR-19	0.2	0.2	2.3	6.4
o-Xylene	<0.020		0.020	ug/g	20-MAR-19				
m+p-Xylenes	<0.030		0.030	ug/g	20-MAR-19				
Xylenes (Total)	<0.050		0.050	ug/g	20-MAR-19	0.05	0.05	3.1	26
Surrogate: 4-Bromofluorobenzene	87.1		50-140	%	20-MAR-19				
Surrogate: 1,4-Difluorobenzene	94.7		50-140	%	20-MAR-19				
Hydrocarbons									
F1 (C6-C10)	<5.0		5.0	ug/g	20-MAR-19	17	25	55	55
F1-BTEX	<5.0		5.0	ug/g	21-MAR-19	17	25	55	55
F2 (C10-C16)	<10		10	ug/g	19-MAR-19	10	10	98	230
F2-Naphth	<10		10	ug/g	21-MAR-19				
F3 (C16-C34)	<50		50	ug/g	19-MAR-19	240	240	300	1700
F3-PAH	<50		50	ug/g	21-MAR-19				
F4 (C34-C50)	<50		50	ug/g	19-MAR-19	120	120	2800	3300
Total Hydrocarbons (C6-C50)	<72		72	ug/g	21-MAR-19				
Chrom. to baseline at nC50	YES			No Unit	19-MAR-19				
Surrogate: 2-Bromobenzotrifluoride	95.5		60-140	%	19-MAR-19				
Surrogate: 3,4-Dichlorotoluene	99.1		60-140	%	20-MAR-19				
Polycyclic Aromatic Hydrocarbons									
Acenaphthene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.072	7.9	21
Acenaphthylene	<0.050		0.050	ug/g	21-MAR-19	0.093	0.093	0.15	0.15
Anthracene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.16	0.67	0.67
Benzo(a)anthracene	<0.050		0.050	ug/g	21-MAR-19	0.095	0.36	0.5	0.96
Benzo(a)pyrene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.3	0.3	0.3
Benzo(b)fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.3	0.47	0.78	0.96

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#4: T2-Soil-Ind/Com/Commu Property Use (Coarse)

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	#4
L2244494-3 G4091-19-3 MW3 SAM 9 Sampled By: CLIENT on 14-MAR-19 @ 10:30 Matrix: SOIL									
Polycyclic Aromatic Hydrocarbons									
Benzo(g,h,i)perylene	<0.050		0.050	ug/g	21-MAR-19	0.2	0.68	6.6	9.6
Benzo(k)fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.48	0.78	0.96
Chrysene	<0.050		0.050	ug/g	21-MAR-19	0.18	2.8	7	9.6
Dibenzo(ah)anthracene	<0.050		0.050	ug/g	21-MAR-19	0.1	0.1	0.1	0.1
Fluoranthene	<0.050		0.050	ug/g	21-MAR-19	0.24	0.56	0.69	9.6
Fluorene	<0.050		0.050	ug/g	21-MAR-19	0.05	0.12	62	62
Indeno(1,2,3-cd)pyrene	<0.050		0.050	ug/g	21-MAR-19	0.11	0.23	0.38	0.76
1+2-Methylnaphthalenes	<0.042		0.042	ug/g	21-MAR-19	0.05	0.59	0.99	30
1-Methylnaphthalene	<0.030		0.030	ug/g	21-MAR-19	0.05	0.59	0.99	30
2-Methylnaphthalene	<0.030		0.030	ug/g	21-MAR-19	0.05	0.59	0.99	30
Naphthalene	<0.013		0.013	ug/g	21-MAR-19	0.05	0.09	0.6	9.6
Phenanthrene	<0.046		0.046	ug/g	21-MAR-19	0.19	0.69	6.2	12
Pyrene	<0.050		0.050	ug/g	21-MAR-19	0.19	1	78	96
Surrogate: 2-Fluorobiphenyl	64.1		50-140	%	21-MAR-19				
Surrogate: p-Terphenyl d14	87.0		50-140	%	21-MAR-19				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
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#4: T2-Soil-Ind/Com/Commu Property Use (Coarse)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
BTX-511-HS-WT	Soil	BTEX-O.Reg 153/04 (July 2011)	SW846 8260

BTX is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-HS-511-WT	Soil	F1-O.Reg 153/04 (July 2011)	E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F2-F4-511-WT	Soil	F2-F4-O.Reg 153/04 (July 2011)	CCME Tier 1

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MET-200.2-CCMS-WT	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). For tests intended to support Ontario regulations, the <2mm fraction is ground to pass through a 0.355 mm sieve. Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

Reference Information

METHYLNAPS-CALC-WT	Soil	ABN-Calculated Parameters	SW846 8270
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PAH-511-WT	Soil	PAH-O.Reg 153/04 (July 2011)	SW846 3510/8270

A representative sub-sample of soil is fortified with deuterium-labelled surrogates and a mechanical shaking techniqueis used to extract the sample with a mixture of methanol and toluene. The extracts are concentrated and analyzed by GC/MS. Results for benzo(b) fluoranthene may include contributions from benzo(j)fluoranthene, if also present in the sample.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

XYLENES-SUM-CALC-WT	Soil	Sum of Xylene Isomer Concentrations	CALCULATION

Total xylenes represents the sum of o-xylene and m&p-xylene.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

17-641549

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2244494 Report Date: 22-APR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BTX-511-HS-WT	Soil							
Batch R4573668								
WG3008713-4 DUP		**WG3008713-3**						
Benzene		<0.0068	<0.0068	RPD-NA	ug/g	N/A	40	20-MAR-19
Ethylbenzene		<0.018	<0.018	RPD-NA	ug/g	N/A	40	20-MAR-19
m+p-Xylenes		<0.030	<0.030	RPD-NA	ug/g	N/A	40	20-MAR-19
o-Xylene		<0.020	<0.020	RPD-NA	ug/g	N/A	40	20-MAR-19
Toluene		<0.080	<0.080	RPD-NA	ug/g	N/A	40	20-MAR-19
WG3008713-2 LCS								
Benzene			92.6		%		70-130	20-MAR-19
Ethylbenzene			89.3		%		70-130	20-MAR-19
m+p-Xylenes			89.1		%		70-130	20-MAR-19
o-Xylene			88.3		%		70-130	20-MAR-19
Toluene			91.3		%		70-130	20-MAR-19
WG3008713-1 MB								
Benzene			<0.0068		ug/g		0.0068	20-MAR-19
Ethylbenzene			<0.018		ug/g		0.018	20-MAR-19
m+p-Xylenes			<0.030		ug/g		0.03	20-MAR-19
o-Xylene			<0.020		ug/g		0.02	20-MAR-19
Toluene			<0.080		ug/g		0.08	20-MAR-19
Surrogate: 1,4-Difluorobenzene			101.5		%		50-140	20-MAR-19
Surrogate: 4-Bromofluorobenzene			96.2		%		50-140	20-MAR-19
WG3008713-5 MS		**L2244298-3**						
Benzene			96.7		%		60-140	20-MAR-19
Ethylbenzene			92.4		%		60-140	20-MAR-19
m+p-Xylenes			91.0		%		60-140	20-MAR-19
o-Xylene			90.4		%		60-140	20-MAR-19
Toluene			94.0		%		60-140	20-MAR-19
F1-HS-511-WT	Soil							
Batch R4573668								
WG3008713-4 DUP		**WG3008713-3**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	30	20-MAR-19
WG3008713-2 LCS								
F1 (C6-C10)			101.0		%		80-120	20-MAR-19
WG3008713-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	20-MAR-19
Surrogate: 3,4-Dichlorotoluene			111.6		%		60-140	20-MAR-19
WG3008713-6 MS		**L2244298-2**						

ALS Environmental

Quality Control Report

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F1-HS-511-WT	Soil							
Batch R4573668								
WG3008713-6 MS		L2244298-2						
F1 (C6-C10)			99.8		%		60-140	20-MAR-19
F2-F4-511-WT	Soil							
Batch R4571550								
WG3008331-3 DUP		WG3008331-5						
F2 (C10-C16)		<10	<10	RPD-NA	ug/g	N/A	30	19-MAR-19
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	30	19-MAR-19
F4 (C34-C50)		<50	<50	RPD-NA	ug/g	N/A	30	19-MAR-19
WG3008331-2 LCS								
F2 (C10-C16)			98.6		%		80-120	19-MAR-19
F3 (C16-C34)			102.5		%		80-120	19-MAR-19
F4 (C34-C50)			107.6		%		80-120	19-MAR-19
WG3008331-1 MB								
F2 (C10-C16)			<10		ug/g		10	19-MAR-19
F3 (C16-C34)			<50		ug/g		50	19-MAR-19
F4 (C34-C50)			<50		ug/g		50	19-MAR-19
Surrogate: 2-Bromobenzotrifluoride			94.2		%		60-140	19-MAR-19
WG3008331-4 MS		WG3008331-5						
F2 (C10-C16)			105.3		%		60-140	19-MAR-19
F3 (C16-C34)			110.8		%		60-140	19-MAR-19
F4 (C34-C50)			117.4		%		60-140	19-MAR-19
Batch R4573488								
WG3009783-3 DUP		WG3009783-5						
F2 (C10-C16)		<10	<10	RPD-NA	ug/g	N/A	30	20-MAR-19
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	30	20-MAR-19
F4 (C34-C50)		<50	<50	RPD-NA	ug/g	N/A	30	20-MAR-19
WG3009783-2 LCS								
F2 (C10-C16)			93.6		%		80-120	20-MAR-19
F3 (C16-C34)			96.8		%		80-120	20-MAR-19
F4 (C34-C50)			101.9		%		80-120	20-MAR-19
WG3009783-1 MB								
F2 (C10-C16)			<10		ug/g		10	20-MAR-19
F3 (C16-C34)			<50		ug/g		50	20-MAR-19
F4 (C34-C50)			<50		ug/g		50	20-MAR-19
Surrogate: 2-Bromobenzotrifluoride			89.5		%		60-140	20-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F2-F4-511-WT	Soil							
Batch R4573488								
WG3009783-4 MS		**WG3009783-5**						
F2 (C10-C16)			97.5		%		60-140	20-MAR-19
F3 (C16-C34)			100.6		%		60-140	20-MAR-19
F4 (C34-C50)			105.0		%		60-140	20-MAR-19
MET-200.2-CCMS-WT	Soil							
Batch R4573663								
WG3009844-2 CRM		**WT-CANMET-TILL1**						
Antimony (Sb)			112.3		%		70-130	20-MAR-19
Arsenic (As)			111.6		%		70-130	20-MAR-19
Barium (Ba)			113.7		%		70-130	20-MAR-19
Beryllium (Be)			105.3		%		70-130	20-MAR-19
Boron (B)			2.8		mg/kg		0-8.2	20-MAR-19
Cadmium (Cd)			112.9		%		70-130	20-MAR-19
Chromium (Cr)			108.6		%		70-130	20-MAR-19
Cobalt (Co)			107.8		%		70-130	20-MAR-19
Copper (Cu)			109.8		%		70-130	20-MAR-19
Lead (Pb)			112.6		%		70-130	20-MAR-19
Molybdenum (Mo)			110.6		%		70-130	20-MAR-19
Nickel (Ni)			107.8		%		70-130	20-MAR-19
Selenium (Se)			0.34		mg/kg		0.11-0.51	20-MAR-19
Silver (Ag)			0.25		mg/kg		0.13-0.33	20-MAR-19
Thallium (Tl)			0.132		mg/kg		0.077-0.18	20-MAR-19
Uranium (U)			107.2		%		70-130	20-MAR-19
Vanadium (V)			108.4		%		70-130	20-MAR-19
Zinc (Zn)			104.5		%		70-130	20-MAR-19
WG3009844-6 DUP		**WG3009844-5**						
Antimony (Sb)		0.21	0.20		ug/g	2.1	30	20-MAR-19
Arsenic (As)		4.10	3.82		ug/g	7.3	30	20-MAR-19
Barium (Ba)		153	116		ug/g	28	40	20-MAR-19
Beryllium (Be)		0.59	0.60		ug/g	1.0	30	20-MAR-19
Boron (B)		5.3	5.2		ug/g	1.3	30	20-MAR-19
Cadmium (Cd)		0.211	0.227		ug/g	7.6	30	20-MAR-19
Chromium (Cr)		21.7	21.2		ug/g	2.1	30	20-MAR-19
Cobalt (Co)		8.81	8.46		ug/g	4.0	30	20-MAR-19
Copper (Cu)		15.8	15.3		ug/g			20-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3

Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	Soil							
Batch R4573663								
WG3009844-6 DUP		**WG3009844-5**						
Copper (Cu)		15.8	15.3		ug/g	3.1	30	20-MAR-19
Lead (Pb)		25.7	25.7		ug/g	0.1	40	20-MAR-19
Molybdenum (Mo)		0.47	0.46		ug/g	2.9	40	20-MAR-19
Nickel (Ni)		17.1	16.8		ug/g	1.6	30	20-MAR-19
Selenium (Se)		0.27	0.28		ug/g	4.5	30	20-MAR-19
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	20-MAR-19
Thallium (Tl)		0.136	0.140		ug/g	2.5	30	20-MAR-19
Uranium (U)		0.505	0.502		ug/g	0.5	30	20-MAR-19
Vanadium (V)		34.2	33.7		ug/g	1.5	30	20-MAR-19
Zinc (Zn)		95.5	87.3		ug/g	9.0	30	20-MAR-19
WG3009844-4 LCS								
Antimony (Sb)			107.0		%		80-120	20-MAR-19
Arsenic (As)			98.4		%		80-120	20-MAR-19
Barium (Ba)			101.6		%		80-120	20-MAR-19
Beryllium (Be)			97.2		%		80-120	20-MAR-19
Boron (B)			93.2		%		80-120	20-MAR-19
Cadmium (Cd)			96.6		%		80-120	20-MAR-19
Chromium (Cr)			98.4		%		80-120	20-MAR-19
Cobalt (Co)			96.3		%		80-120	20-MAR-19
Copper (Cu)			95.6		%		80-120	20-MAR-19
Lead (Pb)			98.0		%		80-120	20-MAR-19
Molybdenum (Mo)			102.6		%		80-120	20-MAR-19
Nickel (Ni)			96.0		%		80-120	20-MAR-19
Selenium (Se)			99.3		%		80-120	20-MAR-19
Silver (Ag)			102.0		%		80-120	20-MAR-19
Thallium (Tl)			97.7		%		80-120	20-MAR-19
Uranium (U)			99.0		%		80-120	20-MAR-19
Vanadium (V)			101.2		%		80-120	20-MAR-19
Zinc (Zn)			97.1		%		80-120	20-MAR-19
WG3009844-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	20-MAR-19
Arsenic (As)			<0.10		mg/kg		0.1	20-MAR-19
Barium (Ba)			<0.50		mg/kg		0.5	20-MAR-19
Beryllium (Be)			<0.10		mg/kg		0.1	20-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	Soil							
Batch R4573663								
WG3009844-1 MB								
Boron (B)			<5.0		mg/kg		5	20-MAR-19
Cadmium (Cd)			<0.020		mg/kg		0.02	20-MAR-19
Chromium (Cr)			<0.50		mg/kg		0.5	20-MAR-19
Cobalt (Co)			<0.10		mg/kg		0.1	20-MAR-19
Copper (Cu)			<0.50		mg/kg		0.5	20-MAR-19
Lead (Pb)			<0.50		mg/kg		0.5	20-MAR-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	20-MAR-19
Nickel (Ni)			<0.50		mg/kg		0.5	20-MAR-19
Selenium (Se)			<0.20		mg/kg		0.2	20-MAR-19
Silver (Ag)			<0.10		mg/kg		0.1	20-MAR-19
Thallium (Tl)			<0.050		mg/kg		0.05	20-MAR-19
Uranium (U)			<0.050		mg/kg		0.05	20-MAR-19
Vanadium (V)			<0.20		mg/kg		0.2	20-MAR-19
Zinc (Zn)			<2.0		mg/kg		2	20-MAR-19
MOISTURE-WT	Soil							
Batch R4568352								
WG3007826-8 DUP		**L2244137-1**						
% Moisture		89.0	89.4		%	0.4	20	17-MAR-19
WG3007826-7 LCS								
% Moisture			100.2		%		90-110	17-MAR-19
WG3007826-6 MB								
% Moisture			<0.10		%		0.1	17-MAR-19
PAH-511-WT	Soil							
Batch R4572647								
WG3007282-3 DUP		**WG3007282-5**						
1-Methylnaphthalene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	20-MAR-19
2-Methylnaphthalene		<0.030	<0.030	RPD-NA	ug/g	N/A	40	20-MAR-19
Acenaphthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Acenaphthylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Benzo(a)anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Benzo(a)pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Benzo(b)fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Benzo(g,h,i)perylene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	Soil							
Batch R4572647								
WG3007282-3 DUP		**WG3007282-5**						
Benzo(k)fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Chrysene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Dibenzo(ah)anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Fluorene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Indeno(1,2,3-cd)pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
Naphthalene		<0.013	<0.013	RPD-NA	ug/g	N/A	40	20-MAR-19
Phenanthrene		<0.046	<0.046	RPD-NA	ug/g	N/A	40	20-MAR-19
Pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	20-MAR-19
WG3007282-2 LCS								
1-Methylnaphthalene			99.5		%		50-140	20-MAR-19
2-Methylnaphthalene			95.9		%		50-140	20-MAR-19
Acenaphthene			103.3		%		50-140	20-MAR-19
Acenaphthylene			94.2		%		50-140	20-MAR-19
Anthracene			97.1		%		50-140	20-MAR-19
Benzo(a)anthracene			98.2		%		50-140	20-MAR-19
Benzo(a)pyrene			98.5		%		50-140	20-MAR-19
Benzo(b)fluoranthene			90.0		%		50-140	20-MAR-19
Benzo(g,h,i)perylene			93.3		%		50-140	20-MAR-19
Benzo(k)fluoranthene			107.6		%		50-140	20-MAR-19
Chrysene			97.7		%		50-140	20-MAR-19
Dibenzo(ah)anthracene			81.1		%		50-140	20-MAR-19
Fluoranthene			93.9		%		50-140	20-MAR-19
Fluorene			96.2		%		50-140	20-MAR-19
Indeno(1,2,3-cd)pyrene			76.1		%		50-140	20-MAR-19
Naphthalene			96.1		%		50-140	20-MAR-19
Phenanthrene			100.1		%		50-140	20-MAR-19
Pyrene			93.8		%		50-140	20-MAR-19
WG3007282-1 MB								
1-Methylnaphthalene			<0.030		ug/g		0.03	20-MAR-19
2-Methylnaphthalene			<0.030		ug/g		0.03	20-MAR-19
Acenaphthene			<0.050		ug/g		0.05	20-MAR-19
Acenaphthylene			<0.050		ug/g		0.05	20-MAR-19
Anthracene			<0.050		ug/g		0.05	20-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3

Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	Soil							
Batch R4572647								
WG3007282-1 MB								
Benzo(a)anthracene			<0.050		ug/g		0.05	20-MAR-19
Benzo(a)pyrene			<0.050		ug/g		0.05	20-MAR-19
Benzo(b)fluoranthene			<0.050		ug/g		0.05	20-MAR-19
Benzo(g,h,i)perylene			<0.050		ug/g		0.05	20-MAR-19
Benzo(k)fluoranthene			<0.050		ug/g		0.05	20-MAR-19
Chrysene			<0.050		ug/g		0.05	20-MAR-19
Dibenzo(ah)anthracene			<0.050		ug/g		0.05	20-MAR-19
Fluoranthene			<0.050		ug/g		0.05	20-MAR-19
Fluorene			<0.050		ug/g		0.05	20-MAR-19
Indeno(1,2,3-cd)pyrene			<0.050		ug/g		0.05	20-MAR-19
Naphthalene			<0.013		ug/g		0.013	20-MAR-19
Phenanthrene			<0.046		ug/g		0.046	20-MAR-19
Pyrene			<0.050		ug/g		0.05	20-MAR-19
Surrogate: 2-Fluorobiphenyl			112.1		%		50-140	20-MAR-19
Surrogate: p-Terphenyl d14			105.4		%		50-140	20-MAR-19
WG3007282-4 MS		**WG3007282-5**						
1-Methylnaphthalene			97.8		%		50-140	20-MAR-19
2-Methylnaphthalene			96.3		%		50-140	20-MAR-19
Acenaphthene			104.2		%		50-140	20-MAR-19
Acenaphthylene			95.6		%		50-140	20-MAR-19
Anthracene			99.0		%		50-140	20-MAR-19
Benzo(a)anthracene			105.1		%		50-140	20-MAR-19
Benzo(a)pyrene			99.9		%		50-140	20-MAR-19
Benzo(b)fluoranthene			108.1		%		50-140	20-MAR-19
Benzo(g,h,i)perylene			97.9		%		50-140	20-MAR-19
Benzo(k)fluoranthene			98.8		%		50-140	20-MAR-19
Chrysene			101.3		%		50-140	20-MAR-19
Dibenzo(ah)anthracene			86.1		%		50-140	20-MAR-19
Fluoranthene			103.8		%		50-140	20-MAR-19
Fluorene			99.0		%		50-140	20-MAR-19
Indeno(1,2,3-cd)pyrene			90.9		%		50-140	20-MAR-19
Naphthalene			95.1		%		50-140	20-MAR-19
Phenanthrene			100.4		%		50-140	20-MAR-19
Pyrene			103.4		%		50-140	20-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	Soil							
Batch R4575591								
WG3007741-3 DUP		**WG3007741-5**						
1-Methylnaphthalene		41.9	39.8		ug/g	5.2	40	21-MAR-19
2-Methylnaphthalene		55.4	52.7		ug/g	5.0	40	21-MAR-19
Acenaphthene		1.53	1.46		ug/g	4.6	40	21-MAR-19
Acenaphthylene		0.320	0.299		ug/g	6.8	40	21-MAR-19
Anthracene		0.638	0.437		ug/g	37	40	21-MAR-19
Benzo(a)anthracene		0.214	0.176		ug/g	19	40	21-MAR-19
Benzo(a)pyrene		0.075	0.077		ug/g	3.3	40	21-MAR-19
Benzo(b)fluoranthene		0.071	0.059		ug/g	18	40	21-MAR-19
Benzo(g,h,i)perylene		0.054	<0.050	RPD-NA	ug/g	N/A	40	21-MAR-19
Benzo(k)fluoranthene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	21-MAR-19
Chrysene		0.383	0.346		ug/g	10	40	21-MAR-19
Dibenzo(ah)anthracene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	21-MAR-19
Fluoranthene		0.321	0.302		ug/g	6.1	40	21-MAR-19
Fluorene		1.52	1.47		ug/g	3.5	40	21-MAR-19
Indeno(1,2,3-cd)pyrene		<0.050	<0.050	RPD-NA	ug/g	N/A	40	21-MAR-19
Naphthalene		32.6	30.8		ug/g	5.7	40	21-MAR-19
Phenanthrene		3.67	3.42		ug/g	7.1	40	21-MAR-19
Pyrene		0.980	0.837		ug/g	16	40	21-MAR-19
WG3007741-2 LCS								
1-Methylnaphthalene			95.4		%		50-140	21-MAR-19
2-Methylnaphthalene			90.1		%		50-140	21-MAR-19
Acenaphthene			99.4		%		50-140	21-MAR-19
Acenaphthylene			91.9		%		50-140	21-MAR-19
Anthracene			96.5		%		50-140	21-MAR-19
Benzo(a)anthracene			97.1		%		50-140	21-MAR-19
Benzo(a)pyrene			104.2		%		50-140	21-MAR-19
Benzo(b)fluoranthene			104.2		%		50-140	21-MAR-19
Benzo(g,h,i)perylene			109.0		%		50-140	21-MAR-19
Benzo(k)fluoranthene			121.8		%		50-140	21-MAR-19
Chrysene			104.0		%		50-140	21-MAR-19
Dibenzo(ah)anthracene			104.8		%		50-140	21-MAR-19
Fluoranthene			103.0		%		50-140	21-MAR-19
Fluorene			93.1		%		50-140	21-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	Soil							
Batch R4575591								
WG3007741-2 LCS								
Indeno(1,2,3-cd)pyrene			90.8		%		50-140	21-MAR-19
Naphthalene			99.5		%		50-140	21-MAR-19
Phenanthrene			101.7		%		50-140	21-MAR-19
Pyrene			98.8		%		50-140	21-MAR-19
WG3007741-1 MB								
1-Methylnaphthalene			<0.030		ug/g		0.03	21-MAR-19
2-Methylnaphthalene			<0.030		ug/g		0.03	21-MAR-19
Acenaphthene			<0.050		ug/g		0.05	21-MAR-19
Acenaphthylene			<0.050		ug/g		0.05	21-MAR-19
Anthracene			<0.050		ug/g		0.05	21-MAR-19
Benzo(a)anthracene			<0.050		ug/g		0.05	21-MAR-19
Benzo(a)pyrene			<0.050		ug/g		0.05	21-MAR-19
Benzo(b)fluoranthene			<0.050		ug/g		0.05	21-MAR-19
Benzo(g,h,i)perylene			<0.050		ug/g		0.05	21-MAR-19
Benzo(k)fluoranthene			<0.050		ug/g		0.05	21-MAR-19
Chrysene			<0.050		ug/g		0.05	21-MAR-19
Dibenzo(ah)anthracene			<0.050		ug/g		0.05	21-MAR-19
Fluoranthene			<0.050		ug/g		0.05	21-MAR-19
Fluorene			<0.050		ug/g		0.05	21-MAR-19
Indeno(1,2,3-cd)pyrene			<0.050		ug/g		0.05	21-MAR-19
Naphthalene			<0.013		ug/g		0.013	21-MAR-19
Phenanthrene			<0.046		ug/g		0.046	21-MAR-19
Pyrene			<0.050		ug/g		0.05	21-MAR-19
Surrogate: 2-Fluorobiphenyl			71.2		%		50-140	21-MAR-19
Surrogate: p-Terphenyl d14			102.2		%		50-140	21-MAR-19
WG3007741-4 MS		**WG3007741-5**						
1-Methylnaphthalene			N/A	MS-B	%		-	21-MAR-19
2-Methylnaphthalene			N/A	MS-B	%		-	21-MAR-19
Acenaphthene			N/A	MS-B	%		-	21-MAR-19
Acenaphthylene			80.8		%		50-140	21-MAR-19
Anthracene			106.3		%		50-140	21-MAR-19
Benzo(a)anthracene			105.1		%		50-140	21-MAR-19
Benzo(a)pyrene			106.7		%		50-140	21-MAR-19
Benzo(b)fluoranthene			95.6		%		50-140	21-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3

Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-511-WT	Soil							
Batch R4575591								
WG3007741-4 MS		**WG3007741-5**						
Benzo(g,h,i)perylene			98.8		%		50-140	21-MAR-19
Benzo(k)fluoranthene			100.8		%		50-140	21-MAR-19
Chrysene			88.3		%		50-140	21-MAR-19
Dibenzo(ah)anthracene			93.5		%		50-140	21-MAR-19
Fluoranthene			112.7		%		50-140	21-MAR-19
Fluorene			N/A	MS-B	%		-	21-MAR-19
Indeno(1,2,3-cd)pyrene			110.0		%		50-140	21-MAR-19
Naphthalene			N/A	MS-B	%		-	21-MAR-19
Phenanthrene			N/A	MS-B	%		-	21-MAR-19
Pyrene			N/A	MS-B	%		-	21-MAR-19

Quality Control Report

Workorder: L2244494 Report Date: 22-APR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

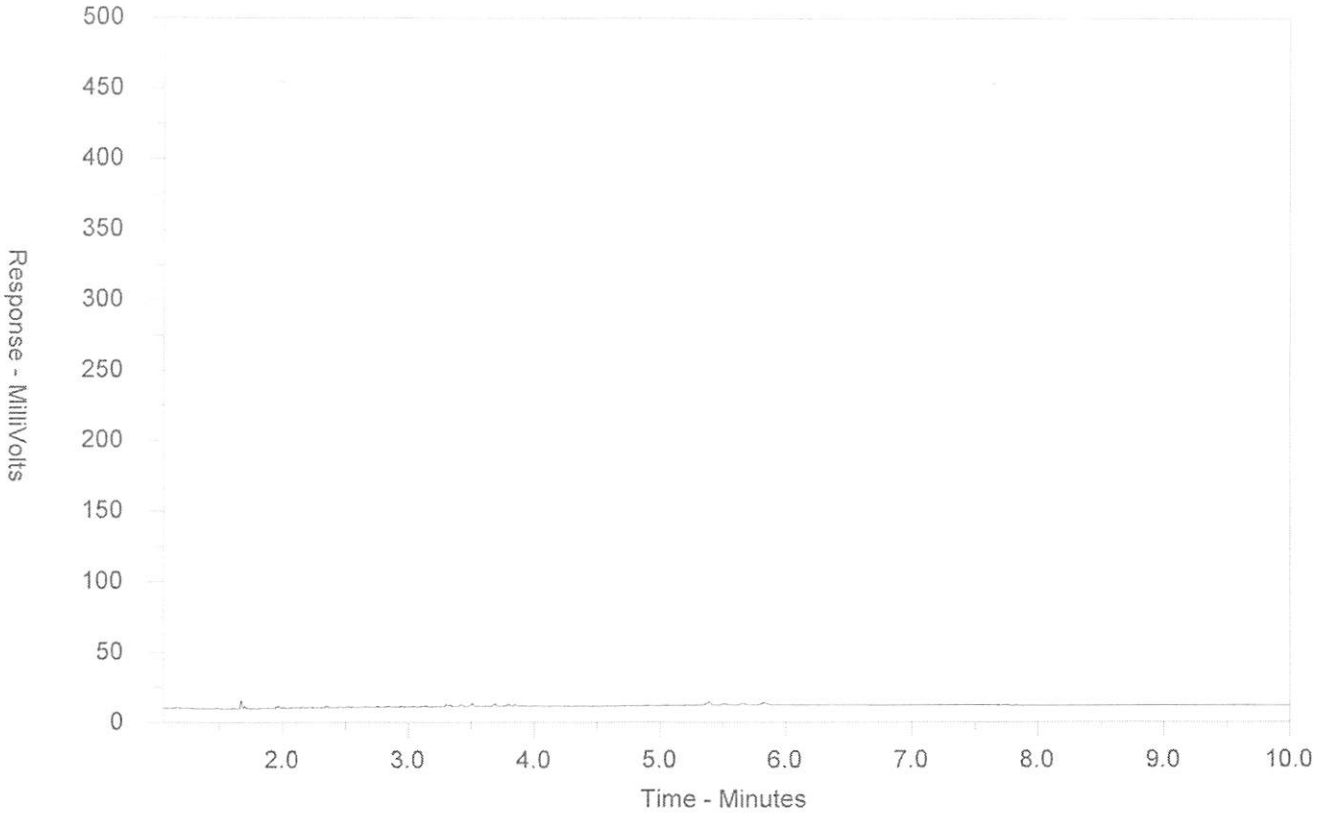
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2244494-1
Client Sample ID: G4091-19-3 MW1 SAM3



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

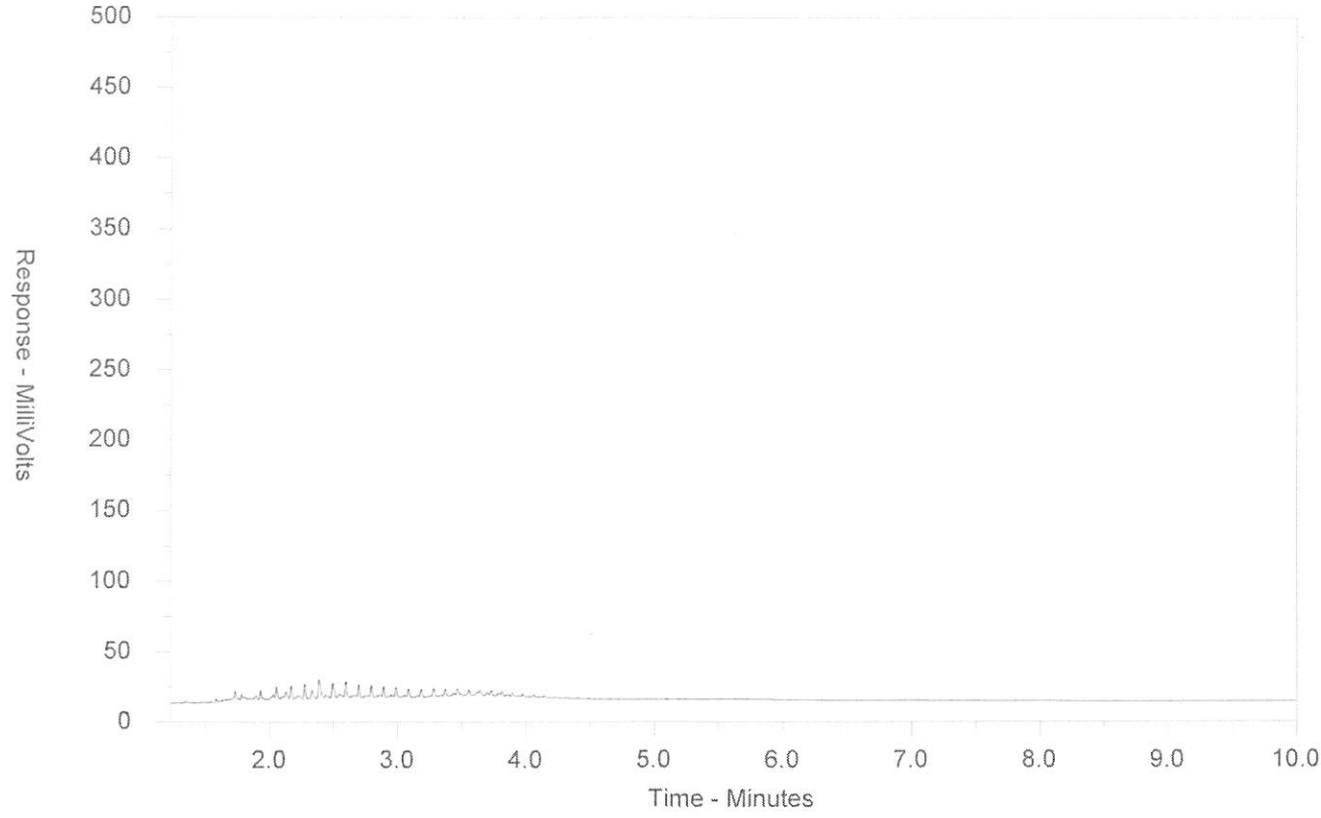
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2244494-2
Client Sample ID: G4091-19-3 MW2 SAM 5



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

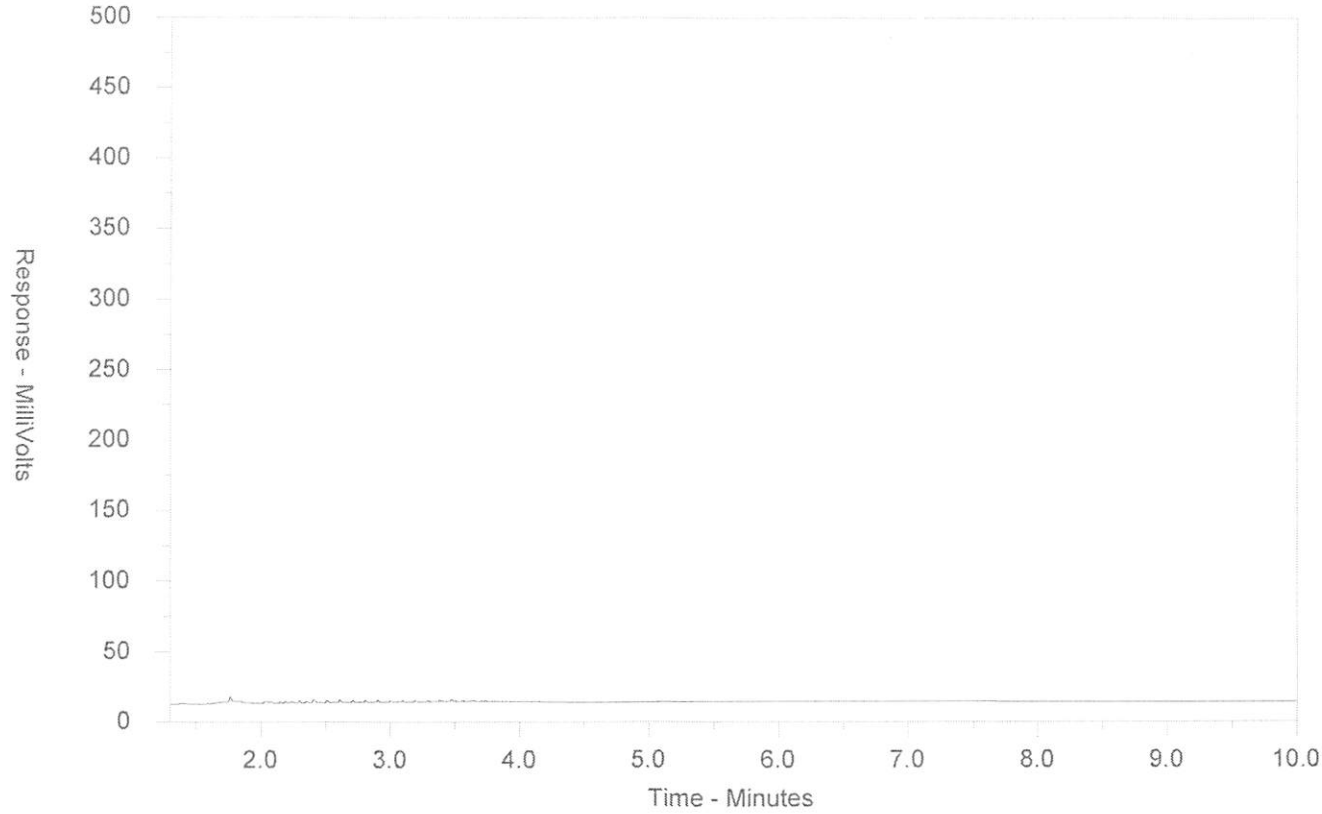
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2244494-3
Client Sample ID: G4091-19-3 MW3 SAM 9



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2244494-COFC

COC Number: 17 - 641549

Page of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	V.A. Wood (Guelph) Inc.	Select Report Format: ☒ PDF ☐ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	John Broad	Quality Control (QC) Report with Report ☐ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:	519-763-3101	☒ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E-100%] ☐ / Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	
Street:	405 York Rd.	Email 1 or Fax: johnb@vawoodguelph.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Guelph / ON	Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	N1E 3M3	Email 3	
Invoice To	Same as Report To ☒ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☒ YES ☐ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax: office@vawoodguelph.com	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#:
Job #:	G4091-19-3	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2244494	ALS Contact:	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	metals	BTEX	F1	F2-F4	PAHs	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
1	G4091-19-3 MW1 SAM 3	14 03 19	10:30	SOIL	X	X	X	X	X			3
2	G4091-19-3 MW2 SAM 5	14 03 19	10:30	SOIL	X	X	X	X	X			3
3	G4091-19-3 MW3 SAM 9	14 03 19	10:30	SOIL	X	X	X	X	X			3

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	Table 1 and Table 2
Are samples for human consumption/ use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C					FINAL COOLER TEMPERATURES °C				
					11.2				

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date: mar 14/2019	Time: 436

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

V.A. WOOD (GUELPH)
ATTN: JOHN BROAD
405 YORK ROAD
GUELPH ON N1E 3H3

Date Received: 19-MAR-19
Report Date: 22-APR-19 14:35 (MT)
Version: FINAL REV. 3

Client Phone: 519-763-3101

Certificate of Analysis

Lab Work Order #: L2246201

Project P.O. #:	NOT SUBMITTED
Job Reference:	G4091-19-3
C of C Numbers:	17-641551
Legal Site Desc:	

Emily Hansen
Account Manager

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	#4
L2246201-1 G4091-19-3 MW3, SAM 3 Sampled By: CLIENT on 13-MAR-19 @ 15:00 Matrix: SOIL									
Physical Tests									
Conductivity	0.240		0.0040	mS/cm	25-MAR-19	0.47	0.57	0.7	1.4
% Moisture	3.58		0.10	%	22-MAR-19				
pH	8.13		0.10	pH units	24-MAR-19				
Cyanides									
Cyanide, Weak Acid Diss	<0.050		0.050	ug/g	22-MAR-19	0.051	0.051	0.051	0.051
Saturated Paste Extractables									
SAR	0.92		0.10	SAR	25-MAR-19	1	2.4	5	12
Calcium (Ca)	18.4		0.50	mg/L	25-MAR-19				
Magnesium (Mg)	8.12		0.50	mg/L	25-MAR-19				
Sodium (Na)	18.8		0.50	mg/L	25-MAR-19				
Metals									
Antimony (Sb)	<1.0		1.0	ug/g	25-MAR-19	1	1.3	7.5	40
Arsenic (As)	2.7		1.0	ug/g	25-MAR-19	11	18	18	18
Barium (Ba)	13.4		1.0	ug/g	25-MAR-19	210	220	390	670
Beryllium (Be)	<0.50		0.50	ug/g	25-MAR-19	2.5	2.5	4	8
Boron (B)	5.2		5.0	ug/g	25-MAR-19	36	36	120	120
Boron (B), Hot Water Ext.	<0.10		0.10	ug/g	25-MAR-19	36	36	1.5	2
Cadmium (Cd)	<0.50		0.50	ug/g	25-MAR-19	1	1.2	1.2	1.9
Chromium (Cr)	7.2		1.0	ug/g	25-MAR-19	67	70	160	160
Cobalt (Co)	2.3		1.0	ug/g	25-MAR-19	19	21	22	80
Copper (Cu)	14.8		1.0	ug/g	25-MAR-19	62	92	140	230
Lead (Pb)	14.5		1.0	ug/g	25-MAR-19	45	120	120	120
Mercury (Hg)	<0.0050		0.0050	ug/g	25-MAR-19	0.16	0.27	0.27	3.9
Molybdenum (Mo)	<1.0		1.0	ug/g	25-MAR-19	2	2	6.9	40
Nickel (Ni)	4.9		1.0	ug/g	25-MAR-19	37	82	100	270
Selenium (Se)	<1.0		1.0	ug/g	25-MAR-19	1.2	1.5	2.4	5.5
Silver (Ag)	<0.20		0.20	ug/g	25-MAR-19	0.5	0.5	20	40
Thallium (Tl)	<0.50		0.50	ug/g	25-MAR-19	1	1	1	3.3
Uranium (U)	<1.0		1.0	ug/g	25-MAR-19	1.9	2.5	23	33
Vanadium (V)	15.3		1.0	ug/g	25-MAR-19	86	86	86	86
Zinc (Zn)	252		5.0	ug/g	25-MAR-19	290	290	340	340
Speciated Metals									
Chromium, Hexavalent	<0.20		0.20	ug/g	22-MAR-19	0.66	0.66	8	8
L2246201-2 G4091-19-3 BH4, SAM 1 Sampled By: CLIENT on 12-MAR-19 @ 16:15 Matrix: SOIL						#1	#2	#3	#4
Physical Tests									
Conductivity	0.222		0.0040	mS/cm	25-MAR-19	0.47	0.57	0.7	1.4
% Moisture	21.5		0.10	%	22-MAR-19				
pH	7.30		0.10	pH units	24-MAR-19				
Cyanides									
Cyanide, Weak Acid Diss	<0.050		0.050	ug/g	22-MAR-19	0.051	0.051	0.051	0.051
Saturated Paste Extractables									
SAR	0.29		0.10	SAR	25-MAR-19	1	2.4	5	12

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-RPIICC-C

#1: T1-Soil-Agricultural or Other Property Use

#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#3: T2-Soil-Res/Park/Inst. Property Use (Coarse)

#4: T2-Soil-Ind/Com/Commu Property Use (Coarse)

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2	#3	#4
L2246201-2 G4091-19-3 BH4, SAM 1 Sampled By: CLIENT on 12-MAR-19 @ 16:15 Matrix: SOIL									
Saturated Paste Extractables									
Calcium (Ca)	33.8		0.50	mg/L	25-MAR-19				
Magnesium (Mg)	5.50		0.50	mg/L	25-MAR-19				
Sodium (Na)	6.95		0.50	mg/L	25-MAR-19				
Metals									
Antimony (Sb)	<1.0		1.0	ug/g	25-MAR-19	1	1.3	7.5	40
Arsenic (As)	8.7		1.0	ug/g	25-MAR-19	11	18	18	18
Barium (Ba)	70.5		1.0	ug/g	25-MAR-19	210	220	390	670
Beryllium (Be)	<0.50		0.50	ug/g	25-MAR-19	2.5	2.5	4	8
Boron (B)	5.8		5.0	ug/g	25-MAR-19	36	36	120	120
Boron (B), Hot Water Ext.	0.55		0.10	ug/g	25-MAR-19	36	36	1.5	2
Cadmium (Cd)	0.62		0.50	ug/g	25-MAR-19	1	1.2	1.2	1.9
Chromium (Cr)	15.5		1.0	ug/g	25-MAR-19	67	70	160	160
Cobalt (Co)	5.5		1.0	ug/g	25-MAR-19	19	21	22	80
Copper (Cu)	24.6		1.0	ug/g	25-MAR-19	62	92	140	230
Lead (Pb)	80.4		1.0	ug/g	25-MAR-19	*45	120	120	120
Mercury (Hg)	0.686		0.0050	ug/g	25-MAR-19	*0.16	*0.27	*0.27	3.9
Molybdenum (Mo)	<1.0		1.0	ug/g	25-MAR-19	2	2	6.9	40
Nickel (Ni)	10.5		1.0	ug/g	25-MAR-19	37	82	100	270
Selenium (Se)	<1.0		1.0	ug/g	25-MAR-19	1.2	1.5	2.4	5.5
Silver (Ag)	<0.20		0.20	ug/g	25-MAR-19	0.5	0.5	20	40
Thallium (Tl)	<0.50		0.50	ug/g	25-MAR-19	1	1	1	3.3
Uranium (U)	<1.0		1.0	ug/g	25-MAR-19	1.9	2.5	23	33
Vanadium (V)	30.3		1.0	ug/g	25-MAR-19	86	86	86	86
Zinc (Zn)	183		5.0	ug/g	25-MAR-19	290	290	340	340
Speciated Metals									
Chromium, Hexavalent	<0.20		0.20	ug/g	22-MAR-19	0.66	0.66	8	8

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-RPIICC-C

#1: T1-Soil-Agricultural or Other Property Use

#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

#3: T2-Soil-Res/Park/Inst. Property Use (Coarse)

#4: T2-Soil-Ind/Com/Commu Property Use (Coarse)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
B-HWS-R511-WT	Soil	Boron-HWE-O.Reg 153/04 (July 2011)	HW EXTR, EPA 6010B

A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CN-WAD-R511-WT	Soil	Cyanide (WAD)-O.Reg 153/04 (July 2011)	MOE 3015/APHA 4500CN I-WAD

The sample is extracted with a strong base for 16 hours, and then filtered. The filtrate is then distilled where the cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CR-CR6-IC-WT	Soil	Hexavalent Chromium in Soil	SW846 3060A/7199

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 7199, published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

HG-200.2-CVAA-WT	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MET-200.2-CCMS-WT	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). For tests intended to support Ontario regulations, the <2mm fraction is ground to pass through a 0.355 mm sieve. Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

SAR-R511-WT	Soil	SAR-O.Reg 153/04 (July 2011)	SW846 6010C

A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

Reference Information

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

17-641551

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

ALS Environmental

Quality Control Report

Workorder: L2246201 Report Date: 22-APR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3

Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-HWS-R511-WT	Soil							
Batch R4581096								
WG3013226-4 DUP		**L2246269-1**						
Boron (B), Hot Water Ext.		0.24	0.22		ug/g	9.0	30	25-MAR-19
WG3013226-2 IRM		**HOTB-SAL_SOIL5**						
Boron (B), Hot Water Ext.			94.8		%		70-130	25-MAR-19
WG3013226-3 LCS								
Boron (B), Hot Water Ext.			100.2		%		70-130	25-MAR-19
WG3013226-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	25-MAR-19
CN-WAD-R511-WT	Soil							
Batch R4580571								
WG3011187-3 DUP		**L2245548-2**						
Cyanide, Weak Acid Diss		N/A	<0.050	RPD-NA	ug/g	N/A	35	22-MAR-19
WG3011187-2 LCS								
Cyanide, Weak Acid Diss			98.3		%		80-120	22-MAR-19
WG3011187-1 MB								
Cyanide, Weak Acid Diss			<0.050		ug/g		0.05	22-MAR-19
WG3011187-4 MS		**L2245548-2**						
Cyanide, Weak Acid Diss			98.0		%		70-130	22-MAR-19
CR-CR6-IC-WT	Soil							
Batch R4580508								
WG3011371-4 CRM		**WT-SQC012**						
Chromium, Hexavalent			90.5		%		70-130	22-MAR-19
WG3011371-3 DUP		**L2246362-2**						
Chromium, Hexavalent		<0.20	<0.20	RPD-NA	ug/g	N/A	35	22-MAR-19
WG3011371-2 LCS								
Chromium, Hexavalent			97.2		%		80-120	22-MAR-19
WG3011371-1 MB								
Chromium, Hexavalent			<0.20		ug/g		0.2	22-MAR-19
EC-WT	Soil							
Batch R4581535								
WG3013231-9 DUP		**WG3013231-8**						
Conductivity		0.435	0.426		mS/cm	2.1	20	25-MAR-19
WG3013231-7 IRM		**WT SAR2**						
Conductivity			103.9		%		70-130	25-MAR-19
WG3013364-1 LCS								
Conductivity			102.3		%		90-110	25-MAR-19
WG3013231-6 MB								

Client: V.A. WOOD (GUELPH)
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GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-WT	Soil							
Batch R4581535								
WG3013231-6 MB								
Conductivity			<0.0040		mS/cm		0.004	25-MAR-19
HG-200.2-CVAA-WT	Soil							
Batch R4581415								
WG3013223-2 CRM		**WT-CANMET-TILL1**						
Mercury (Hg)			101.1		%		70-130	25-MAR-19
WG3013223-6 DUP		**WG3013223-5**						
Mercury (Hg)		0.0153	0.0161		ug/g	4.8	40	25-MAR-19
WG3013223-3 LCS								
Mercury (Hg)			101.0		%		80-120	25-MAR-19
WG3013223-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	25-MAR-19
MET-200.2-CCMS-WT	Soil							
Batch R4581588								
WG3013223-2 CRM		**WT-CANMET-TILL1**						
Antimony (Sb)			113.3		%		70-130	25-MAR-19
Arsenic (As)			116.5		%		70-130	25-MAR-19
Barium (Ba)			120.2		%		70-130	25-MAR-19
Beryllium (Be)			110.8		%		70-130	25-MAR-19
Boron (B)			2.9		mg/kg		0-8.2	25-MAR-19
Cadmium (Cd)			111.4		%		70-130	25-MAR-19
Chromium (Cr)			115.0		%		70-130	25-MAR-19
Cobalt (Co)			115.1		%		70-130	25-MAR-19
Copper (Cu)			116.8		%		70-130	25-MAR-19
Lead (Pb)			113.4		%		70-130	25-MAR-19
Molybdenum (Mo)			116.4		%		70-130	25-MAR-19
Nickel (Ni)			115.3		%		70-130	25-MAR-19
Selenium (Se)			0.37		mg/kg		0.11-0.51	25-MAR-19
Silver (Ag)			0.26		mg/kg		0.13-0.33	25-MAR-19
Thallium (Tl)			0.136		mg/kg		0.077-0.18	25-MAR-19
Uranium (U)			108.0		%		70-130	25-MAR-19
Vanadium (V)			116.4		%		70-130	25-MAR-19
Zinc (Zn)			109.3		%		70-130	25-MAR-19
WG3013223-6 DUP		**WG3013223-5**						
Antimony (Sb)		0.23	0.23		ug/g	0.1	30	25-MAR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	Soil							
Batch R4581588								
WG3013223-6 DUP		**WG3013223-5**						
Arsenic (As)		9.16	9.68		ug/g	5.5	30	25-MAR-19
Barium (Ba)		114	123		ug/g	7.7	40	25-MAR-19
Beryllium (Be)		0.63	0.66		ug/g	4.1	30	25-MAR-19
Boron (B)		8.8	9.8		ug/g	10	30	25-MAR-19
Cadmium (Cd)		0.081	0.078		ug/g	3.4	30	25-MAR-19
Chromium (Cr)		19.9	21.1		ug/g	6.0	30	25-MAR-19
Cobalt (Co)		13.9	14.5		ug/g	4.4	30	25-MAR-19
Copper (Cu)		59.0	61.3		ug/g	3.8	30	25-MAR-19
Lead (Pb)		13.3	13.4		ug/g	0.7	40	25-MAR-19
Molybdenum (Mo)		0.47	0.51		ug/g	7.2	40	25-MAR-19
Nickel (Ni)		26.2	27.6		ug/g	5.2	30	25-MAR-19
Selenium (Se)		<0.20	<0.20	RPD-NA	ug/g	N/A	30	25-MAR-19
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	25-MAR-19
Thallium (Tl)		0.116	0.121		ug/g	3.7	30	25-MAR-19
Uranium (U)		0.518	0.530		ug/g	2.3	30	25-MAR-19
Vanadium (V)		28.1	30.0		ug/g	6.4	30	25-MAR-19
Zinc (Zn)		66.2	69.7		ug/g	5.2	30	25-MAR-19
WG3013223-4 LCS								
Antimony (Sb)			104.1		%		80-120	25-MAR-19
Arsenic (As)			98.1		%		80-120	25-MAR-19
Barium (Ba)			101.0		%		80-120	25-MAR-19
Beryllium (Be)			91.8		%		80-120	25-MAR-19
Boron (B)			84.9		%		80-120	25-MAR-19
Cadmium (Cd)			96.5		%		80-120	25-MAR-19
Chromium (Cr)			94.6		%		80-120	25-MAR-19
Cobalt (Co)			95.9		%		80-120	25-MAR-19
Copper (Cu)			93.7		%		80-120	25-MAR-19
Lead (Pb)			97.9		%		80-120	25-MAR-19
Molybdenum (Mo)			100.6		%		80-120	25-MAR-19
Nickel (Ni)			94.3		%		80-120	25-MAR-19
Selenium (Se)			96.7		%		80-120	25-MAR-19
Silver (Ag)			98.8		%		80-120	25-MAR-19
Thallium (Tl)			97.7		%		80-120	25-MAR-19

ALS Environmental

Quality Control Report

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	Soil							
Batch R4581588								
WG3013223-4 LCS								
Uranium (U)			92.4		%		80-120	25-MAR-19
Vanadium (V)			99.7		%		80-120	25-MAR-19
Zinc (Zn)			90.9		%		80-120	25-MAR-19
WG3013223-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	25-MAR-19
Arsenic (As)			<0.10		mg/kg		0.1	25-MAR-19
Barium (Ba)			<0.50		mg/kg		0.5	25-MAR-19
Beryllium (Be)			<0.10		mg/kg		0.1	25-MAR-19
Boron (B)			<5.0		mg/kg		5	25-MAR-19
Cadmium (Cd)			<0.020		mg/kg		0.02	25-MAR-19
Chromium (Cr)			<0.50		mg/kg		0.5	25-MAR-19
Cobalt (Co)			<0.10		mg/kg		0.1	25-MAR-19
Copper (Cu)			<0.50		mg/kg		0.5	25-MAR-19
Lead (Pb)			<0.50		mg/kg		0.5	25-MAR-19
Molybdenum (Mo)			<0.10		mg/kg		0.1	25-MAR-19
Nickel (Ni)			<0.50		mg/kg		0.5	25-MAR-19
Selenium (Se)			<0.20		mg/kg		0.2	25-MAR-19
Silver (Ag)			<0.10		mg/kg		0.1	25-MAR-19
Thallium (Tl)			<0.050		mg/kg		0.05	25-MAR-19
Uranium (U)			<0.050		mg/kg		0.05	25-MAR-19
Vanadium (V)			<0.20		mg/kg		0.2	25-MAR-19
Zinc (Zn)			<2.0		mg/kg		2	25-MAR-19
MOISTURE-WT	Soil							
Batch R4577930								
WG3011223-3 DUP		**L2246205-2**						
% Moisture		34.6	34.0		%	1.8	20	22-MAR-19
WG3011223-2 LCS								
% Moisture			100.3		%		90-110	22-MAR-19
WG3011223-1 MB								
% Moisture			<0.10		%		0.1	22-MAR-19
PH-WT	Soil							
Batch R4580399								
WG3011289-1 DUP		**L2246195-1**						
pH		7.77	7.82	J	pH units	0.05	0.3	24-MAR-19
WG3012846-1 LCS								

ALS Environmental

Quality Control Report

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-WT	Soil							
Batch R4580399								
WG3012846-1 LCS								
pH			6.98		pH units		6.9-7.1	24-MAR-19
SAR-R511-WT	Soil							
Batch R4581423								
WG3013231-9 DUP		**WG3013231-8**						
Calcium (Ca)		25.9	25.4		mg/L	1.9	30	25-MAR-19
Sodium (Na)		17.0	17.3		mg/L	1.7	30	25-MAR-19
Magnesium (Mg)		10.5	10.3		mg/L	1.9	30	25-MAR-19
WG3013231-7 IRM		**WT SAR2**						
Calcium (Ca)			109.5		%		70-130	25-MAR-19
Sodium (Na)			95.5		%		70-130	25-MAR-19
Magnesium (Mg)			107.9		%		70-130	25-MAR-19
WG3013231-10 LCS								
Calcium (Ca)			109.0		%		70-130	25-MAR-19
Sodium (Na)			103.6		%		70-130	25-MAR-19
Magnesium (Mg)			104.8		%		70-130	25-MAR-19
WG3013231-6 MB								
Calcium (Ca)			<0.50		mg/L		0.5	25-MAR-19
Sodium (Na)			<0.50		mg/L		0.5	25-MAR-19
Magnesium (Mg)			<0.50		mg/L		0.5	25-MAR-19

Quality Control Report

Workorder: L2246201 Report Date: 22-APR-19

Client: V.A. WOOD (GUELPH)
405 YORK ROAD
GUELPH ON N1E 3H3
Contact: JOHN BROAD

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2246201-COFC

COC Number: 17 - 641551

Page of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	VA Wood (Guelph) Inc	Select Report Format: ☒ PDF ☐ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	John Broad	Quality Control (QC) Report with Report ☐ YES ☐ NO	Priority (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:	519-763-3101	☒ Compare Results to Criteria on Report - provide details below if box checked	Emergency: 1 Business day [E-100%] ☐ / Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	
Street:		Email 1 or Fax johnb@vawoodguelph.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:		Email 2	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:		Email 3	
Invoice To	Same as Report To ☐ YES ☐ NO	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☐ YES ☐ NO	Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax office@vawoodguelph.com	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	G4091-19-3	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	L2246201	ALS Contact:	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	metals + inorganics	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	G4091-19-3 MW 3, SAM 3	13-Mar-19	15:00	SOIL	X			1
	G4091-19-3 BH 4, SAM 1	12-Mar-19	16:15	SOIL	X			1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	Table 1 and Table 2
Are samples for human consumption/ use? | | YES | | NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				4.9			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: DH	Date: Mar 19, 2019	Time:	Received by: PK	Date: 3-19-19	Time: 10:15	Received by:	Date: Mar 19/19	Time: 14:55

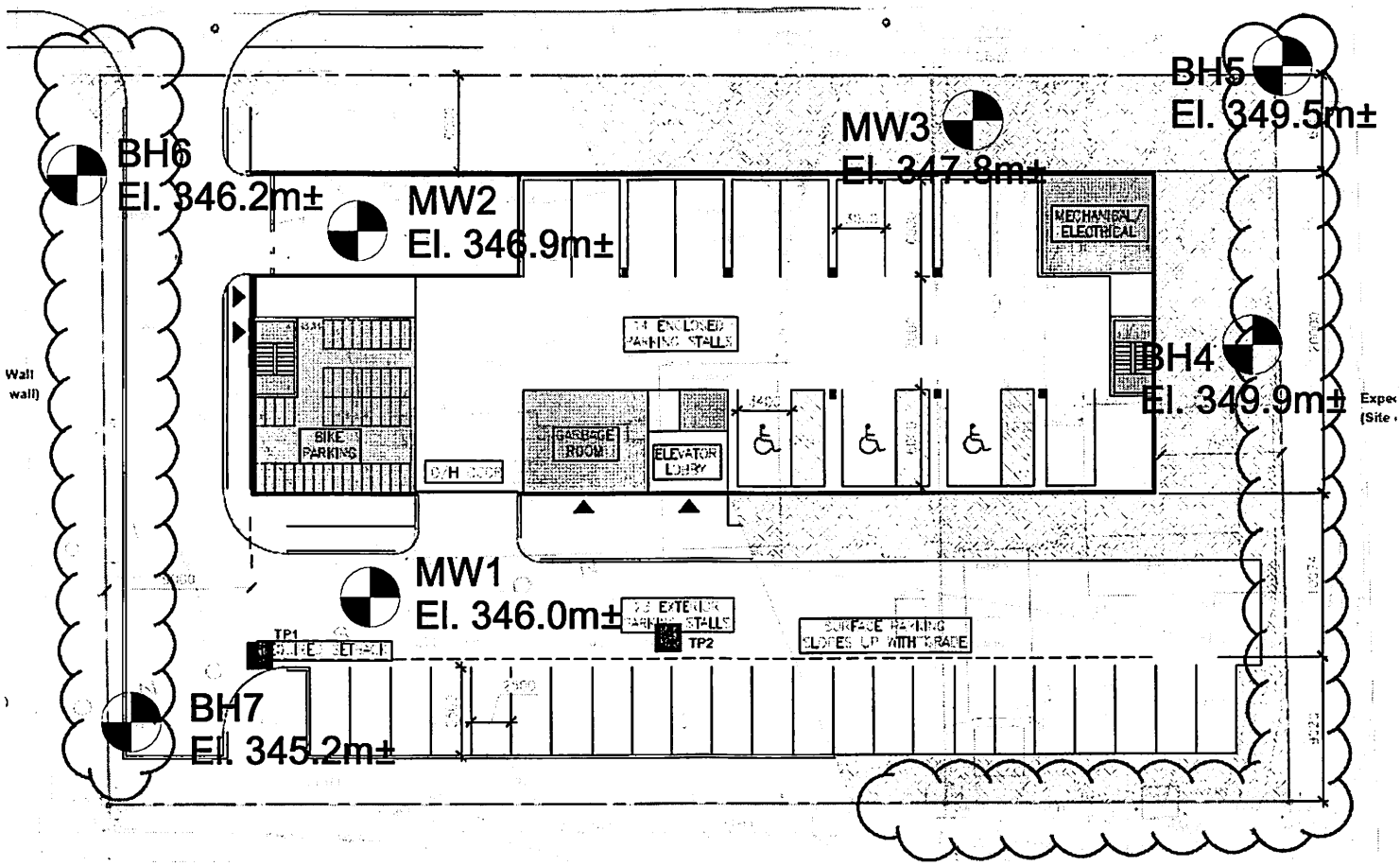
REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ENCLOSURES



Benchmark:MW1 - MW3 Elevations supplied by GMBP, BH4 - BH7 Ground elevation @ MW2 El. 346.9m

V.A. WOOD (GUELPH) INC.
Consulting Geotechnical Engineers
405 York Road, Guelph, Ontario N1E 3H3
Ph. (519) 763-3101 Fax. (519) 763-5912

Borehole Location Plan
1871 & 1879 Gordon Street
City of Guelph, Ontario

Scale: NTS	Ref. No. G4091-19-6
Date: June 5, 2019	Enclosure 1

REFERENCE No: G4091-19-3

MONITORING WELL No: 1

CLIENT: Mar-Cot Investments

PROJECT: Geotechnical Investigation

ENCLOSURE No: 2

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

SUPERVISOR: B.A.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE					
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING WELL	NUMBER	TYPE	N-VALUE	PENETRATION RESISTANCE 20 40 60 80	WATER CONTENT % 5 10 15 20 25	EAGLE TOV (ppm)
0.0	Ground Surface	346.0								
0.3	275mm Topsoil	345.7			1	SS	9			0
	dark brown, compact Sand and Gravel FILL trace organics, moist				1	SS	10			0
					2	SS	19			0
1.7		344.3								
	dark brown, very stiff Silty Clay FILL moist				3	SS	16			0
2.3		343.7								
	brown, compact to very dense GRAVEL AND SAND trace silt, moist				4	SS	50	250m		0
					5	SS	50	175mm		0
					6	SS	38			0
					7	SS	30			0
					8	SS	45			0
					9	SS	38			0

Protective Cover
Bentonite Holeplug
Riser

DRILLED BY: London Soil Tests Ltd.

HOLE DIAMETER: 150mm

DRILL METHOD: Hollow Stem Augers

DATUM: Geodetic

DRILL DATE: March 14, 2019

SHEET: 1 of 2

REFERENCE No: G4091-19-3

MONITORING WELL No: 1

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

CLIENT: Mar-Cot Investments

PROJECT: Geotechnical Investigation

ENCLOSURE No: 2

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

SUPERVISOR: B.A.

SUBSURFACE PROFILE					SAMPLE					
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING WELL	NUMBER	TYPE	N-VALUE	PENETRATION RESISTANCE 20 40 60 80	WATER CONTENT % 5 10 15 20 25	EAGLE TOV (ppm)
					10	SS	22			0
12.2		333.8								
12.5	brown, compact SAND moist	333.5			11	SS	26			0
	brown, compact SILTY SAND moist									
	brown, dense to very dense GRAVEL AND SAND trace silt, moist to wet			W.L @ El. 331.0m (2-Apr-19)	12	SS	50	150mm		0
				Sand / Screen	13	SS	41			0
					14	SS	32			0
18.3		327.7								
18.7	grey, very loose SAND AND SILT TILL some clay, trace gravel, saturated	327.3			15	SS	HW			0
	End of Borehole									

DRILLED BY: London Soil Tests Ltd.

DRILL METHOD: Hollow Stem Augers

DRILL DATE: March 14, 2019

HOLE DIAMETER: 150mm

DATUM: Geodetic

SHEET: 2 of 2

REFERENCE No: G4091-19-3

MONITORING WELL No: 2

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

CLIENT: Mar-Cot Investments

PROJECT: Geotechnical Investigation

ENCLOSURE No: 3

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

SUPERVISOR: B.A.

SUBSURFACE PROFILE					SAMPLE					
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING WELL	NUMBER	TYPE	N-VALUE	PENETRATION RESISTANCE 20 40 60 80	WATER CONTENT % 5 10 15 20 25	EAGLE TOV (ppm)
0.0	Ground Surface	346.9		Protective Cover						
0.3	250mm Topsoil	346.6			1	SS	9			0
	dark brown, very loose Silty Sand and Gravel FILL moist				1	SS	15			0
					2	SS	4			0
1.5		345.4		Bentonite Holeplug						
	brown, compact to very dense GRAVEL AND SAND trace silt, moist			DRY (2-Apr-19)	3	SS	16			0
				Riser	4	SS	23			0
					5	SS	50			0
				Sand	6	SS	41			0
				Screen	7	SS	38			0
	SAND seam @ 6.1m									
				Bentonite Holeplug	8	SS	50	100mm		0
9.6		337.3			9	SS	50	225mm		0
	End of Borehole									

DRILLED BY: London Soil Tests Ltd.

HOLE DIAMETER: 150mm

DRILL METHOD: Hollow Stem Augers

DATUM: Geodetic

DRILL DATE: March 13, 2019

SHEET: 1 of 1

REFERENCE No: G4091-19-3

MONITORING WELL No: 3

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

CLIENT: Mar-Cot Developments Inc.

PROJECT: Geotechnical Investigation

ENCLOSURE No: 4

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

SUPERVISOR: B.A.

SUBSURFACE PROFILE					SAMPLE					
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	MONITORING WELL	NUMBER	TYPE	N-VALUE	PENETRATION RESISTANCE 20 40 60 80	WATER CONTENT % 5 10 15 20 25	EAGLE TOV (ppm)
0.0	Ground Surface	347.8								
	25mm Asphalt 100mm Granular Base brown, compact to dense Sand and Gravel FILL moist			Flushmount Cover	1	AS	-		•	0
					2	SS	20	○		0
					3	SS	43	○	•	0
2.3		345.5		Bentonite Holeplug						
	brown, compact to very dense GRAVEL AND SAND trace silt, moist			Riser	4	SS	26	○		0
				W.L. @ El. 341.7m (2-Apr-19)	5	SS	26	○	•	0
				Sand	6	SS	38	○		0
					7	SS	50	○ 250mm	•	0
				Screen	8	SS	50	○ 225mm		0
				Bentonite Holeplug						
9.6		338.2			9	SS	50	○ 175m	•	0
	End of Borehole									

DRILLED BY: London Soil Tests Ltd.

HOLE DIAMETER: 150mm

DRILL METHOD: Hollow Stem Augers

DATUM: Geodetic

DRILL DATE: March 13, 2019

SHEET: 1 of 1

REFERENCE No: G4091-19-3

CLIENT: Mar-Cot Developments Inc.

PROJECT: Geottechnical Investigation

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

BOREHOLE No: 4

ENCLOSURE No: 5

SUPERVISOR: B.A.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE BLOWS/0.3m	WATER CONTENT %	UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m	20 40 60 80	5 10 15 20 25	
0.0	Ground Surface	349.9		DRY (12-Mar-19)						
0.3	250mm Topsoil	349.6			1	SS	12			
	brown, compact to dense Silty Sand and Gravel FILL moist				1	SS	20			
					2	SS	42			
1.5		348.4								
	brown, dense to very dense GRAVEL AND SAND trace silt, moist				3	SS	50	175mm		
					4	SS	50	225mm		
					5	SS	49			
3.5		346.4								
	End of Borehole									

DRILLED BY: London Soil Tests Ltd.

DRILL METHOD: Solid Stem Augers

DRILL DATE: March 12, 2019

HOLE DIAMETER: 110mm

DATUM: Geodetic

SHEET: 1 of 1

REFERENCE No: G4091-19-3

BOREHOLE No: 5

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

CLIENT: Mar-Cot Developments Inc.

PROJECT: Geotechnical Investigation

ENCLOSURE No: 6

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

SUPERVISOR: B.A.

SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE BLOWS/0.3m	WATER CONTENT %	UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m	20 40 60 80	5 10 15 20 25	
0.0	Ground Surface	349.5		DRY (12-Mar-19)						
0.1	150mm Topsoil	349.3			1	SS	21	○	•	
0.3	brown, dense Sand and Gravel FILL frozen	349.2			1	SS	37	○	•	
	brown, compact to very dense GRAVEL AND SAND trace silt, moist				2	SS	25	○		
					3	SS	50	○ 200mm	•	
					4	SS	50	○ 100mm		
					5	SS	50	○ 175mm	•	
3.5		346.0								
	End of Borehole									

DRILLED BY: London Soil Tests Ltd.

HOLE DIAMETER: 110mm

DRILL METHOD: Solid Stem Augers

DATUM: Geodetic

DRILL DATE: March 12, 2019

SHEET: 1 of 1

REFERENCE No: G4091-19-3

CLIENT: Mar-Cot Developments Inc.

PROJECT: Geotechnical Investigation

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

BOREHOLE No: 6

ENCLOSURE No: 7

SUPERVISOR: B.A.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE BLOWS/0.3m	WATER CONTENT %	UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m	20 40 60 80	5 10 15 20 25	
0.0	Ground Surface	346.2		DRY (12-Mar-19)						
0.2	225mm Topsoil	346.0			1	SS	21			
	brown, compact to dense GRAVEL AND SAND trace silt moist				1	SS	24			
					2	SS	47			
					3	SS	31			
					4	SS	45			
					5	SS	40			
3.5	End of Borehole	342.7								

DRILLED BY: London Soil Tests Ltd.

DRILL METHOD: Solid Stem Augers

DRILL DATE: March 12, 2019

HOLE DIAMETER: 110mm

DATUM: Geodetic

SHEET: 1 of 1

REFERENCE No: G4091-19-3

CLIENT: Mar-Cot Developments Inc.

PROJECT: Geotechnical Investigation

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

BOREHOLE No: 7

ENCLOSURE No: 8

SUPERVISOR: B.A.

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

SUBSURFACE PROFILE					SAMPLE			PENETRATION RESISTANCE BLOWS/0.3m	WATER CONTENT %	UNIT WEIGHT
DEPTH (m)	DESCRIPTION	ELEVATION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' BLOWS/0.3m	20 40 60 80	5 10 15 20 25	
0.0	Ground Surface	345.2		DRY (12-Mar-19)						
	325mm Topsoil				1	SS	18			
0.3		344.8								
	dark brown, compact to dense Silty Sand FILL moist				1	SS	18			
					2	SS	47			
					3	SS	12			
					4	SS	23			
3.0		342.1								
	brown, dense GRAVEL AND SAND trace silt, moist				5	SS	42			
3.5		341.7								
	End of Borehole									

DRILLED BY: London Soil Tests Ltd.

DRILL METHOD: Solid Stem Augers

DRILL DATE: March 12, 2019

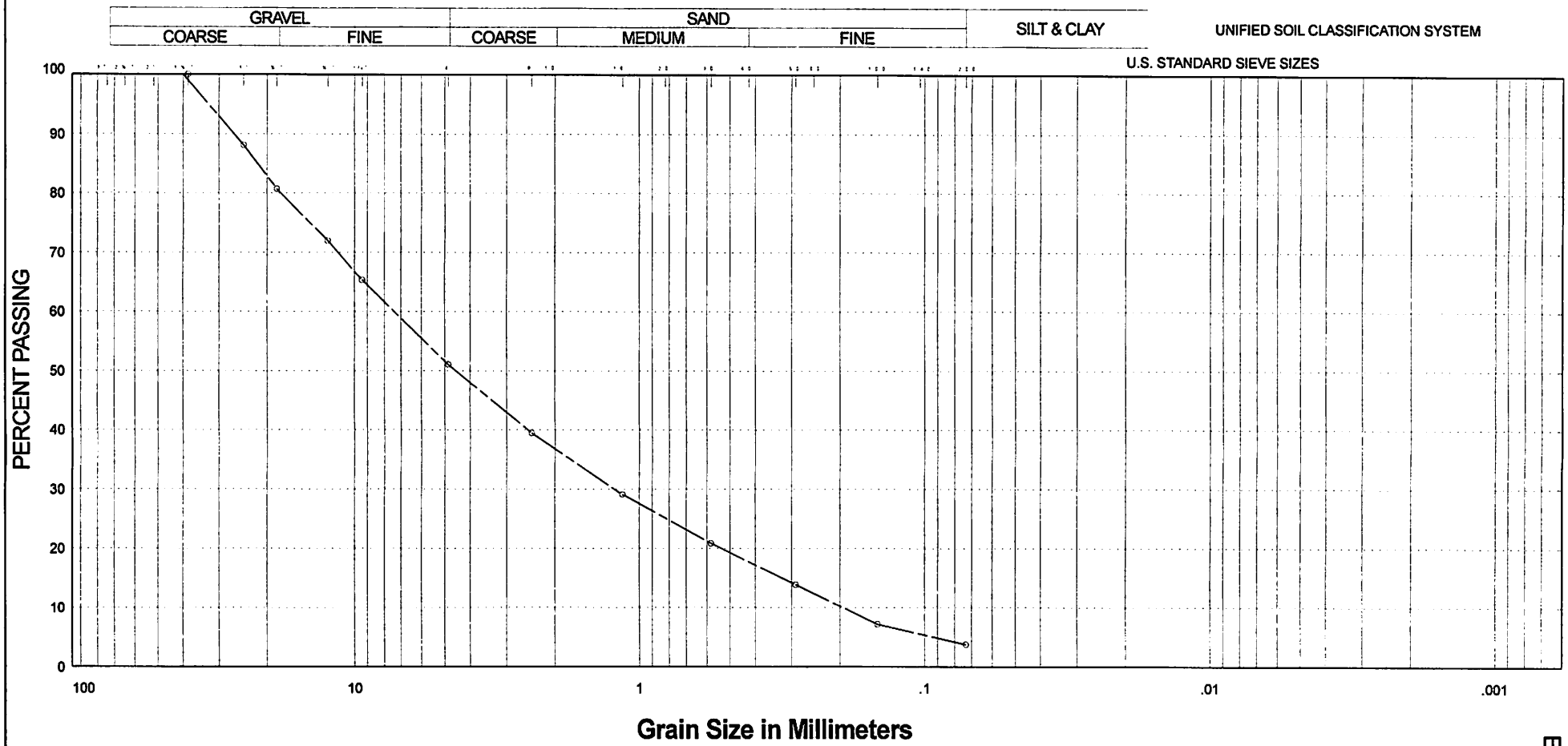
HOLE DIAMETER: 110mm

DATUM: Geodetic

SHEET: 1 of 1

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4091-19-3



PROJECT: Proposed Residential Development

LOCATION: 1871 & 1879 Gordon St., Guelph, ON

BOREHOLE N°: 3

SAMPLE N°: 3

DEPTH: 1.5 - 1.9m±

ELEVATION: 344.7 - 344.2m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

GRAVEL AND SAND, trace silt

PLASTIC PROPERTIES

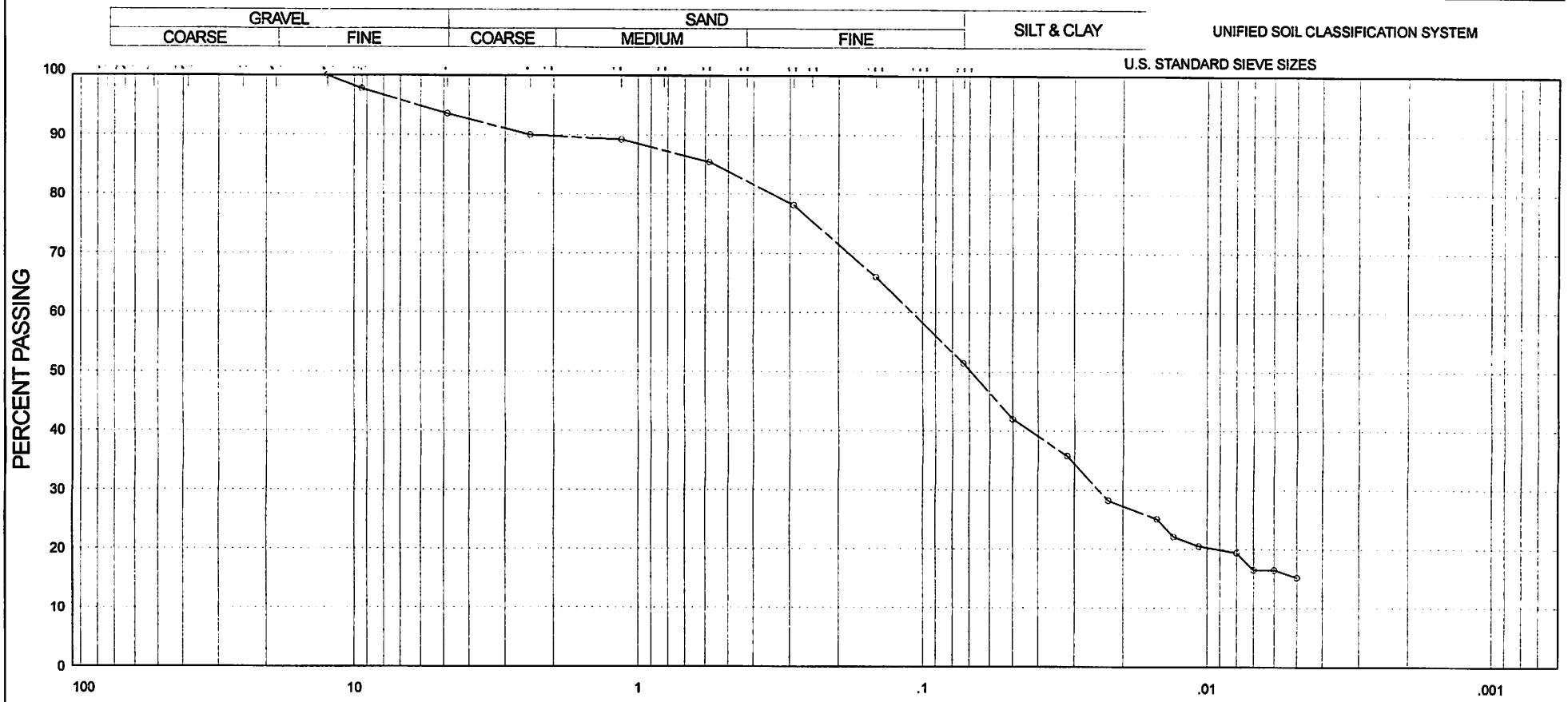
LIQUID LIMIT	% = -
PLASTIC LIMIT	% = -
PLASTICITY INDEX	% = -
MOISTURE CONTENT	% = 3.7

ENCLOSURE N° 9

V. A. WOOD (GUELPH) INCORPORATED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4091-19-3



PROJECT: Proposed residential Development

LOCATION: 1871 & 1879 Gordon St, Guelph, ON

MONITORING WELL N°: 1

SAMPLE N°: 15

DEPTH: 18.3 - 18.7m±

ELEVATION: 81.7 - 81.3m±

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SAND AND SILT TILL. some clay, trace gravel

PLASTIC PROPERTIES

LIQUID LIMIT	% = 0
PLASTIC LIMIT	% = 0
PLASTICITY INDEX	% = 0
MOISTURE CONTENT	% = 10.5

ENCLOSURE N° 10

V. A. WOOD (GUELPH) INCORPORATED

V.A. WOOD (GUELPH) INCORPORATED
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
TELEPHONE: 519-763-3101

July 3, 2019

Reference No. G4091-19-7

Mar-Cot Developments Inc.
375 Southgate Drive
Guelph, Ontario
N1G 3W6

Attention: Mr. Mario Cotroneo, President

RE: Guelph Permeameter Testing
Proposed Residential Development
1871 & 1879 Gordon Street
City of Guelph, Ontario

Dear Sir,

V.A. Wood (Guelph) Inc. was retained by Mar-Cot Developments Inc. to carry out Guelph Permeameter testing for the proposed residential development at 1871 & 1879 Gordon Street in the City of Guelph, Ontario.

The purpose of the testing was to determine the hydraulic conductivity of the subsoils within the proposed development area for the storm water management design.

The Guelph Permeameter testing took place on June 18 and the Test Pit location and ground elevation is given on Guelph Permeameter Test Location Plan, Enclosure 1.

The permeameter testing consisted of three (3) permeameter tests at depths ranging between 0.9± and 2.4± metres below existing grade, at the locations and depths selected by GM BluePlan Engineering Ltd. Full details of the soils encountered in the test pit is given on the Test Pit Log, Enclosure 2. We note that further permeameter testing at deeper depths could not be completed on June 18, 2019 due to unsafe excavation conditions in conjunction with the close proximity of the inground tile bed which was exposed in the test pit.

The results of the Guelph Permeameter testing is noted in following chart:

Date	Test Location	Test Depth Below Ex. Grade (m±)	Field Description of Soils	Hydraulic Conductivity[1]	
				(cm^2/min)	(cm/sec)
June 18, 2019	TP 1	0.9	brown, compact Sand and Gravel FILL, trace to some silt, trace organics, moist	5.91×10^{-4}	7.10×10^{-5}
June 18, 2019	TP 1	1.6	brown, compact Sand and Gravel FILL, trace to some silt, trace organics, moist	1.41×10^{-1}	1.69×10^{-2}
June 18, 2019	TP 1	2.4	brown, compact SAND AND SILT, some clay, moist	6.12×10^{-3}	7.34×10^{-4}

[1]*Calculations completed by Guelph Permeameter Soil Moisture Program*

We trust this report has been completed within our terms of reference; however, should you have any questions, please do not hesitate to contact this office.

Yours very truly,
V.A. WOOD (GUELPH) INC.

J. Broad, B.A.
President & General Manager

JB:sm

Encls.

Cc: GM BluePlan Engineering Ltd.

APPENDIX

STATEMENT OF LIMITATIONS:

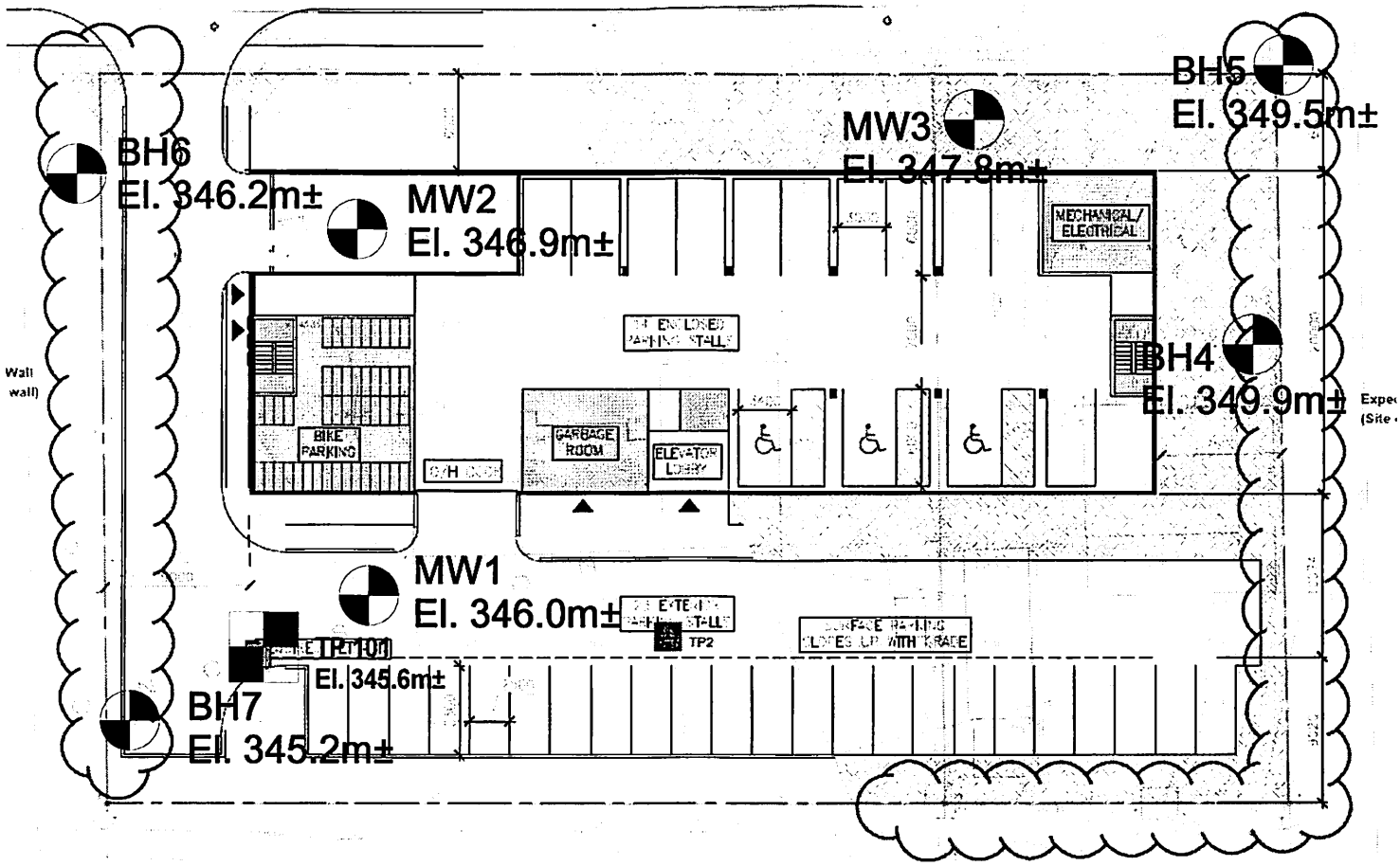
The conclusions and recommendations in this report are based on information determined at the test pit locations and on geological data of a general nature, which may be available, for the area investigated. Soil and groundwater conditions between and beyond the test pits may differ from those encountered at the test pit locations and conditions may become apparent during construction, which would not be detected or anticipated at the time of the soil investigation.

We recommend that we be retained to ensure that all necessary stripping, subgrade preparation and compaction requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in the test pits. ***In cases where this recommendation is not followed the company's responsibility is limited to interpreting accurately the information encountered at the test pits.***

This report is applicable only to the project described in the introduction, constructed substantially in accordance with details of alignment and elevations quoted in the text.

V.A. Wood (Guelph) Inc. prepared this report for Mar-Cot Developments Inc. and GM BluePlan Engineering Ltd. The material in it reflects V.A. Wood (Guelph) Inc. judgement in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. V.A. Wood (Guelph) Inc. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

ENCLOSURES



Benchmark:Ground Elevations supplied by GMBP

V.A. WOOD (GUELPH) INC.
Consulting Geotechnical Engineers
405 York Road, Guelph, Ontario N1E 3H3
Ph. (519) 763-3101 Fax. (519) 763-5912

Guelph Permeamater Test Location Plan
1871 & 1879 Gordon Street
City of Guelph, Ontario

Scale: NTS	Ref. No. G4091-19-6
Date: June 21, 2019	Enclosure 1

REFERENCE No: G4091-19-7 **TEST PIT No: 101**

CLIENT: Mar-Cot Developments Inc.

PROJECT: Proposed Residential Development **ENCLOSURE No:** 2

LOCATION: 1871 & 1879 Gordon St, Gue., ON **SUPERVISOR:** JB/BRF

V.A. WOOD (GUELPH) INC.
CONSULTING GEOTECHNICAL ENGINEERS

405 YORK ROAD, GUELPH, ONTARIO N1E 3H3
PH. (519) 763-3101 FAX (519) 763-5912

DEPTH (m)	SOIL DESCRIPTION	ELEVATION (m)	SYMBOL	GROUND WATER	SAMPLES
0.0	**GROUND SURFACE**	345.6			
	250mm Topsoil				
	brown, compact Sand and Gravel FILL trace to some silt, trace organics, moist				
2.3		343.3			
2.7	brown, compact SAND AND SILT, some clay moist	342.9			1
3.0	brown, compact to dense GRAVEL AND SAND trace silt, moist	342.6			
	END OF TEST PIT				

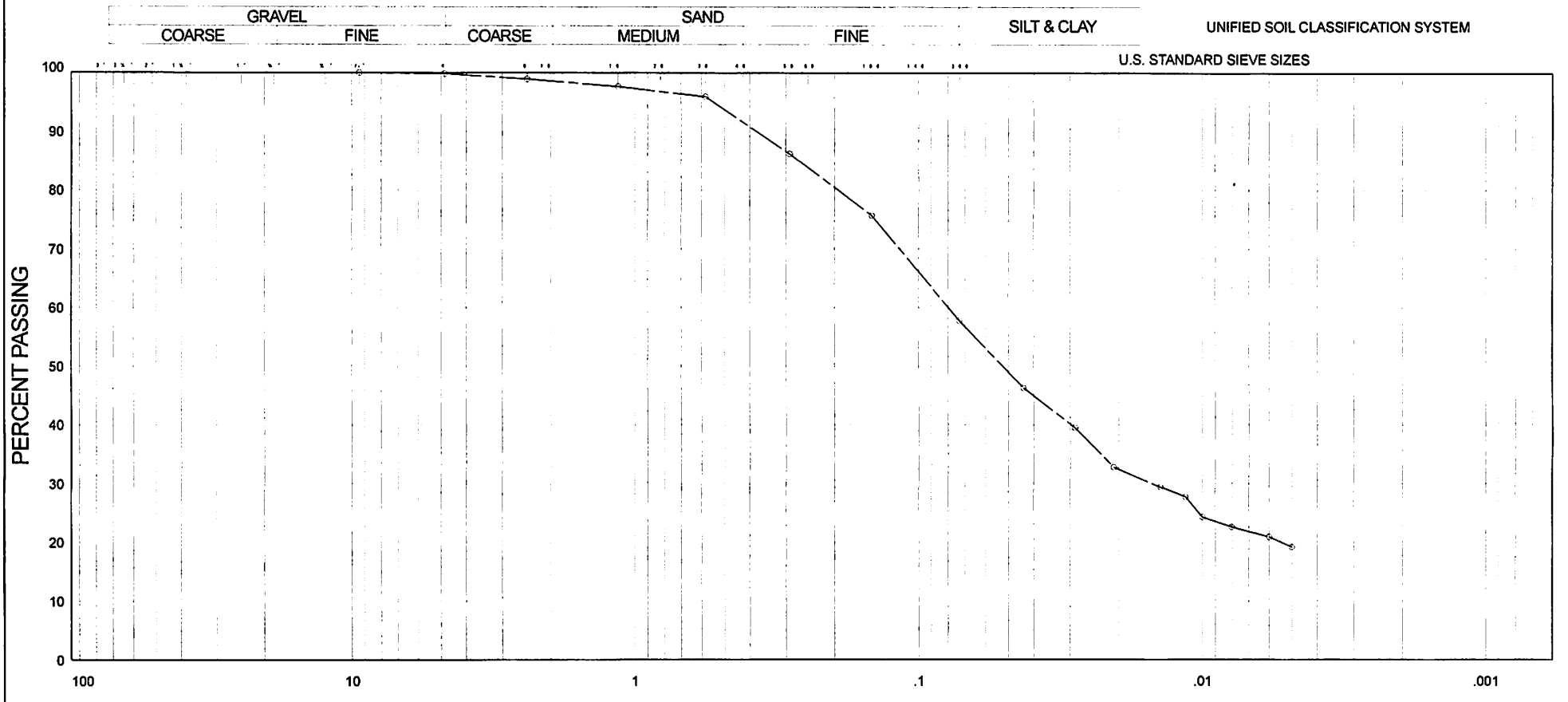
EXCAVATED BY: Mar-Cot Developments Inc. **EST PIT DIMENSIONS:** 3.0 x 3.0m

METHOD: Excavator **DATUM ELEVATION:** Geodetic

DATE: June 18, 2019 **SHEET:** 1 of 1

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N° G4091-19-7



PROJECT: Prop. Residential Development
LOCATION: 1871 Gordon St, Guelph, ON
TEST PIT N°: 1
SAMPLE N°: 1
DEPTH: 2.4m±
ELEVATION: 343.2m±

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SAND AND SILT, some clay

PLASTIC PROPERTIES

LIQUID LIMIT	% = 19.2
PLASTIC LIMIT	% = 18.0
PLASTICITY INDEX	% = 1.1
MOISTURE CONTENT	% = 15.6

ENCLOSURE N° 3

V. A. WOOD (GUELPH) INCORPORATED

Appendix B

Pre- and Post-Development MIDUSS Model Output
and Stage-Storage-Discharge Calculation Tables
and Oil/Grit Separator and Brentwood Stormtank Details

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                         Sunday, February 07, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:          \\gamsby.local\GMProjects\Guelph\118-2018\"
"                118170 Gordon St. ZCA\5 Work in Progress\Design Calcs\2019-07-22
Middus"
"                Output filename:                          118170 2-year pre.out"
"                Licensee name:                                              gmbp"
"                Company                                                        "
"                Date & Time last used:                 7/23/2019 at 11:26:32 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      170.000   Max. Storm length"
"     2880.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      743.000   Coefficient A"
"        6.000   Constant B"
"        0.799   Exponent C"
"        0.400   Fraction R"
"      170.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           105.606    mm/hr"
"             Total depth                  33.816    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catch 100 Existing Property"
"       35.000   % Impervious"
"        0.329   Total Area"
"       25.000   Flow length"
"        4.000   Overland Slope"
"        0.214   Pervious Area"
"       25.000   Pervious length"
"        4.000   Pervious slope"
"        0.115   Impervious Area"
"       25.000   Impervious length"
"        4.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.028     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.214      0.115      0.329      hectare"
"             Time of concentration  18.023     1.450      3.271      minutes"
"             Time to Centroid       89.989     83.076     83.835     minutes"
"             Rainfall depth         33.816     33.816     33.816     mm"
"             Rainfall volume        72.32      38.94      111.25     c.m"
"             Rainfall losses        31.705     2.050      21.326     mm"
"             Runoff depth           2.111      31.766     12.490     mm"
"             Runoff volume          4.51       36.58      41.09      c.m"
"             Runoff coefficient     0.062      0.939      0.369      "
"             Maximum flow           0.004      0.028      0.028      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.028     0.028     0.000     0.000"
" 38          START/RE-START TOTALS 100"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.329    hectare"
"             Total Impervious area                     0.115    hectare"
"             Total % impervious                       35.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                         Sunday, February 07, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:          \\gamsby.local\GMProjects\Guelph\118-2018\"
"                118170 Gordon St. ZCA\5 Work in Progress\Design Calcs\2019-07-22
Middus"
"                Output filename:                          118170 5-year pre.out"
"                Licensee name:                                              gmbp"
"                Company                                                        "
"                Date & Time last used:                 7/23/2019 at 11:30:50 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      170.000   Max. Storm length"
"     2880.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1593.000   Coefficient A"
"       11.000   Constant B"
"        0.879   Exponent C"
"        0.400   Fraction R"
"      170.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           134.894    mm/hr"
"             Total depth                  46.775    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catch 100 Existing Property"
"       35.000   % Impervious"
"        0.329   Total Area"
"       25.000   Flow length"
"        4.000   Overland Slope"
"        0.214   Pervious Area"
"       25.000   Pervious length"
"        4.000   Pervious slope"
"        0.115   Impervious Area"
"       25.000   Impervious length"
"        4.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.039     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.214      0.115      0.329      hectare"
"             Time of concentration  12.476     1.315      4.789      minutes"
"             Time to Centroid       86.079     81.462     82.899     minutes"
"             Rainfall depth         46.775     46.775     46.775     mm"
"             Rainfall volume        100.03     53.86      153.89     c.m"
"             Rainfall losses        35.965     2.347      24.198     mm"
"             Runoff depth           10.810     44.428     22.577     mm"
"             Runoff volume          23.12      51.16      74.28      c.m"
"             Runoff coefficient     0.231      0.950      0.483      "
"             Maximum flow           0.019      0.037      0.039      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.039     0.039     0.000     0.000"
" 38          START/RE-START TOTALS 100"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.329    hectare"
"             Total Impervious area                     0.115    hectare"
"             Total % impervious                       35.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                      Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:         \\gamsby.local\GMProjects\Guelph\118-2018\"
"                118170 Gordon St. ZCA\5 Work in Progress\Design Calcs\2019-07-22
Middus"
"                Output filename:                      118170 25-year pre.out"
"                Licensee name:                                           gmbp"
"                Company                                                     "
"                Date & Time last used:              7/23/2019 at 11:33:18 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      210.000   Max. Storm length"
"     2880.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3158.000   Coefficient A"
"       15.000   Constant B"
"        0.936   Exponent C"
"        0.400   Fraction R"
"      210.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          169.546    mm/hr"
"             Total depth                 69.476    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catch 100 Existing Property"
"       35.000   % Impervious"
"        0.329   Total Area"
"       25.000   Flow length"
"        4.000   Overland Slope"
"        0.214   Pervious Area"
"       25.000   Pervious length"
"        4.000   Pervious slope"
"        0.115   Impervious Area"
"       25.000   Impervious length"
"        4.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.082     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.214      0.115      0.329      hectare"
"             Time of concentration  9.152      1.200      4.727      minutes"
"             Time to Centroid       100.709    97.488     98.917     minutes"
"             Rainfall depth         69.476     69.476     69.476     mm"
"             Rainfall volume        148.58     80.00      228.58     c.m"
"             Rainfall losses        40.980     3.086      27.717     mm"
"             Runoff depth           28.497     66.390     41.760     mm"
"             Runoff volume          60.94      76.45      137.39     c.m"
"             Runoff coefficient     0.410      0.956      0.601      "
"             Maximum flow           0.052      0.047      0.082      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.082     0.082     0.000     0.000"
" 38          START/RE-START TOTALS 100"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.329    hectare"
"             Total Impervious area                     0.115    hectare"
"             Total % impervious                       35.000"
" 19          EXIT"
```

```
"                MIDUSS Output ----------------------------------------------->"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                         Sunday, February 07, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:          \\gamsby.local\GMProjects\Guelph\118-2018\"
"                118170 Gordon St. ZCA\5 Work in Progress\Design Calcs\2019-07-22
Middus"
"                Output filename:                       118170 100-year pre.out"
"                Licensee name:                                             gmbp"
"                Company                                                       "
"                Date & Time last used:                7/23/2019 at 11:54:37 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      210.000   Max. Storm length"
"     2880.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4688.000   Coefficient A"
"       17.000   Constant B"
"        0.962   Exponent C"
"        0.400   Fraction R"
"      210.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           213.574    mm/hr"
"             Total depth                  88.830    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          100   Catch 100 Existing Property"
"       35.000   % Impervious"
"        0.329   Total Area"
"       25.000   Flow length"
"        4.000   Overland Slope"
"        0.214   Pervious Area"
"       25.000   Pervious length"
"        4.000   Pervious slope"
"        0.115   Impervious Area"
"       25.000   Impervious length"
"        4.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
```

```
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.125     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           0.214      0.115      0.329      hectare"
"             Time of concentration  7.559      1.094      4.318      minutes"
"             Time to Centroid       100.595    96.787     98.686     minutes"
"             Rainfall depth         88.830     88.830     88.830     mm"
"             Rainfall volume        189.96     102.29     292.25     c.m"
"             Rainfall losses        43.392     4.001      29.605     mm"
"             Runoff depth           45.438     84.829     59.225     mm"
"             Runoff volume          97.17      97.68      194.85     c.m"
"             Runoff coefficient     0.512      0.955      0.667      "
"             Maximum flow           0.086      0.059      0.125      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.125     0.125     0.000     0.000"
" 38          START/RE-START TOTALS 100"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.329    hectare"
"             Total Impervious area                     0.115    hectare"
"             Total % impervious                       35.000"
" 19          EXIT"
```

1871 Gordon Street
Our File: 118170
July 25, 2019

Catchment 200: Proposed Rooftop Storage (Residential Building)

Design Discharge Rate =	1.50	l/min/mm/weir	2.50E-05	m^3/s/mm/weir
Max. Average Storage Depth =	100	mm		
Design Discharge =	150.0	l/min/weir	0.0015	m^3/s/weir
No. of Drains =	3			
No. Weirs/Drain =	6			
Allowable Release Rate =	2700.0	l/min	0.027	m^3/s
Rooftop Area =	1,120	m^2	(flat rooftop area that is available for storage)	

Therefore: 464.5 sq m/Roof Drain or 5000 sq ft/Roof Drain as per OBC

STAGE-STORAGE-DISCHARGE TABLE

Stage (m)	Storage (m^3)	Discharge (m^3/s)
0.000	0.0	0.000
0.025	28.0	0.011
0.050	56.0	0.023
0.075	84.0	0.034
0.100	112.0	0.045

1871 & 1879 Gordon Street
MAR-COT
CITY OF GUELPH
OUR FILE: 118170
5-Mar-21

CATCHMENT 200 AND 201 - INFILITRATION GALLERY

STAGE STORAGE VOLUME CALCULATIONS

ELEV (m)	DEPTH (m)	SURFACE AREA (sq m)	INCR. VOLUME (cu m)	ACCUM. STORAGE VOLUME (cu m)	
343.70	0.000	117.1	0.0	0.0	Bottom of Gallery
343.71	0.010	117.1	1.1	1.1	
344.10	0.400	117.1	44.3	45.4	
344.50	0.800	117.1	45.4	90.8	
345.00	1.300	117.1	56.8	147.6	
345.25	1.550	117.1	28.4	176.0	
345.53	1.830	117.1	31.8	207.8	Top of Gallery (1.2m below Pr. Grade)
345.54	1.840	1.2	0.6	208.4	
345.75	2.050	1.2	0.2	208.6	
346.00	2.300	1.2	0.3	208.9	
346.20	2.500	1.2	0.2	209.2	
346.35	2.650	1.2	0.2	209.3	T/CB Lid
346.50	2.800	150.0	15.0	224.3	
346.60	2.900	200.0	18.3	242.7	Overflow @ Gordon Street
346.65	2.950	250.0	11.7	254.3	
346.70	3.000	1.0	1.0	255.3	T/Curb on Site

BOTTOM INFILTRATION ONLY

L(dw) =	18.29	m
W(dw) =	6.40	m
Perimeter=	49.38	m
D(dw) =	1.83	m
A(c) =	117.1	sq m
VOL(dw)=	214.2	cu m
VOL(st)=	207.8	cu m
K =	1.71E-05	m/s

STAGE/STORAGE/DISCHARGE TABLE

ELEV. (m)	STAGE (m)	STORAGE VOLUME (m^3)	SOIL DISCHARGE (m^3/s)	WEIR DISCHARGE (m^3/s)	TOTAL DISCHARGE (m^3/s)	
343.70	0.000	0.0	0.0000000	0.00000	0.000000	Bottom of Gallery
343.71	0.010	1.1	0.0020017	0.00000	0.002002	
344.10	0.400	45.4	0.0020117	0.00000	0.002012	
344.50	0.800	90.8	0.0020217	0.00000	0.002022	
345.00	1.300	147.6	0.0020317	0.00000	0.002032	
345.25	1.550	176.0	0.0020417	0.00000	0.002042	
345.53	1.830	207.8	0.0020517	0.00000	0.002052	Top of Gallery (1.2m below Pr. Grade)
345.54	1.840	208.4	0.0020617	0.00000	0.002062	
345.75	2.050	208.6	0.0020717	0.00000	0.002072	
346.00	2.300	208.9	0.0020817	0.00000	0.002082	
346.20	2.500	209.2	0.0020917	0.00000	0.002092	
346.35	2.650	209.3	0.0021017	0.00000	0.002102	T/CB Lid
346.50	2.800	224.3	0.0021117	0.00000	0.002112	
346.60	2.900	242.7	0.0021217	0.00000	0.002122	Overflow @ Gordon Street
346.65	2.950	254.3	0.0021317	0.00000	0.002132	
346.70	3.000	255.3	0.0021417	0.00000	0.002142	T/Curb on Site

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"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
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"                        5 Work in Progress\Design Calcs\2021-01-27 Middus\post"
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" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      170.000   Max. Storm length"
"     2880.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      743.000   Coefficient A"
"        6.000   Constant B"
"        0.799   Exponent C"
"        0.400   Fraction R"
"      170.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          105.606    mm/hr"
"             Total depth                 33.816    mm"
"            6   002hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catch 200 Roof Top"
"      100.000   % Impervious"
"        0.110   Total Area"
"       25.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        1.000   Pervious slope"
"        0.110   Impervious Area"
"       25.000   Impervious length"
"        1.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.025     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.110      0.110      hectare"
"             Time of concentration  27.317     2.198      2.198      minutes"
"             Time to Centroid       97.835     84.196     84.196     minutes"
"             Rainfall depth         33.816     33.816     33.816     mm"
"             Rainfall volume        0.00       37.20      37.20      c.m"
"             Rainfall losses        31.705     1.990      1.990      mm"
"             Runoff depth           2.111      31.826     31.826     mm"
"             Runoff volume          0.00       35.01      35.01      c.m"
"             Runoff coefficient     0.000      0.941      0.941      "
"             Maximum flow           0.000      0.025      0.025      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.025     0.025     0.000     0.000"
" 54          POND DESIGN"
"         0.025   Current peak flow    c.m/sec"
"         0.001   Target outflow    c.m/sec"
"          35.0   Hydrograph volume    c.m"
"            5.   Number of stages"
"         0.000   Minimum water level    metre"
"         0.100   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000     0.000"
"                  0.02500   0.01100    28.000"
"                  0.05000   0.02300    56.000"
"                  0.07500   0.03400    84.000"
"                   0.1000   0.04500   112.000"
"             Peak outflow                  0.007    c.m/sec"
"             Maximum level                 0.016    metre"
"             Maximum storage              17.539    c.m"
"             Centroidal lag                2.110   hours"
"                  0.025     0.025     0.007     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.025     0.007     0.007     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Catchment 201"
"        70.000   % Impervious"
"         0.166   Total Area"
"        30.000   Flow length"
"         3.000   Overland Slope"
"         0.050   Pervious Area"
"        30.000   Pervious length"
"         3.000   Pervious slope"
```

```
"        0.116   Impervious Area"
"       30.000   Impervious length"
"        3.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.027     0.007     0.007     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.050      0.116      0.166      hectare"
"             Time of concentration  21.919     1.764      2.319      minutes"
"             Time to Centroid       93.239     83.461     83.730     minutes"
"             Rainfall depth         33.816     33.816     33.816     mm"
"             Rainfall volume        16.84      39.29      56.13      c.m"
"             Rainfall losses        31.710     1.965      10.889     mm"
"             Runoff depth           2.106      31.851     22.927     mm"
"             Runoff volume          1.05       37.01      38.06      c.m"
"             Runoff coefficient     0.062      0.942      0.678      "
"             Maximum flow           0.001      0.027      0.027      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.027     0.030     0.007     0.000"
" 54          POND DESIGN"
"        0.030   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"         73.1   Hydrograph volume    c.m"
"          16.   Number of stages"
"      343.700   Minimum water level    metre"
"      346.700   Maximum water level    metre"
"      343.700   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"               343.700     0.000     0.000"
"               343.710   0.00200     1.100"
"               344.100   0.00201    45.400"
"               344.500   0.00202    90.800"
"               345.000   0.00203   147.600"
"               345.250   0.00204   176.000"
"               345.530   0.00205   207.800"
"               345.540   0.00206   208.400"
"               345.750   0.00207   208.600"
"               346.000   0.00208   208.900"
"               346.200   0.00209   209.200"
"               346.350   0.00210   209.300"
```

```
"               346.500   0.00211   224.300"
"               346.600   0.00212   242.700"
"               346.650   0.00213   254.300"
"               346.700   0.00214   255.300"
"             Peak outflow                  0.002    c.m/sec"
"             Maximum level               344.154    metre"
"             Maximum storage              51.521    c.m"
"             Centroidal lag                5.755   hours"
"                  0.027     0.030     0.002     0.000 c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.027     0.000     0.002     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Catch 202 Front of Site"
"       50.000   % Impervious"
"        0.043   Total Area"
"       10.000   Flow length"
"        3.000   Overland Slope"
"        0.022   Pervious Area"
"       10.000   Pervious length"
"        3.000   Pervious slope"
"        0.022   Impervious Area"
"       10.000   Impervious length"
"        3.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.005     0.000     0.002     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.022      0.022      0.043      hectare"
"             Time of concentration  11.338     0.912      1.576      minutes"
"             Time to Centroid       84.340     82.188     82.325     minutes"
"             Rainfall depth         33.816     33.816     33.816     mm"
"             Rainfall volume        7.27       7.27       14.54      c.m"
"             Rainfall losses        31.706     2.778      17.242     mm"
"             Runoff depth           2.110      31.038     16.574     mm"
"             Runoff volume          0.45       6.67       7.13       c.m"
"             Runoff coefficient     0.062      0.918      0.490      "
"             Maximum flow           0.000      0.005      0.005      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
```

```
"            4   Add Runoff "
"                     0.005     0.005     0.002     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.005     0.000     0.002     0.000"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Catch 203 Flow off North of Site"
"       40.000   % Impervious"
"        0.010   Total Area"
"       10.000   Flow length"
"        5.000   Overland Slope"
"        0.006   Pervious Area"
"       10.000   Pervious length"
"        5.000   Pervious slope"
"        0.004   Impervious Area"
"       10.000   Impervious length"
"        5.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.001     0.000     0.002     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.006      0.004      0.010      hectare"
"             Time of concentration  9.727      0.783      1.608      minutes"
"             Time to Centroid       82.804     82.220     82.274     minutes"
"             Rainfall depth         33.816     33.816     33.816     mm"
"             Rainfall volume        2.03       1.35       3.38       c.m"
"             Rainfall losses        31.735     3.093      20.279     mm"
"             Runoff depth           2.081      30.723     13.537     mm"
"             Runoff volume          0.12       1.23       1.35       c.m"
"             Runoff coefficient     0.062      0.909      0.400      "
"             Maximum flow           0.000      0.001      0.001      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.001     0.001     0.002     0.000"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.329    hectare"
"             Total Impervious area                     0.252    hectare"
"             Total % impervious                       76.505"
```

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"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:          W:\Guelph\118-2018\118170 Gordon St. ZCA\"
"                        5 Work in Progress\Design Calcs\2021-01-27 Middus\post"
"                Output filename:                                   Default.Out"
"                Licensee name:                                            gmbp"
"                Company                                                      "
"                Date & Time last used:                  2/5/2021 at 3:31:48 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      170.000   Max. Storm length"
"     2880.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1593.000   Coefficient A"
"       11.000   Constant B"
"        0.879   Exponent C"
"        0.400   Fraction R"
"      170.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          134.894    mm/hr"
"             Total depth                 46.775    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catch 200 Roof Top"
"      100.000   % Impervious"
"        0.110   Total Area"
"       25.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        1.000   Pervious slope"
"        0.110   Impervious Area"
"       25.000   Impervious length"
"        1.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.033     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.110      0.110      hectare"
"             Time of concentration  18.910     1.993      1.993      minutes"
"             Time to Centroid       91.758     82.400     82.400     minutes"
"             Rainfall depth         46.775     46.775     46.775     mm"
"             Rainfall volume        0.00       51.45      51.45      c.m"
"             Rainfall losses        35.917     2.122      2.122      mm"
"             Runoff depth           10.858     44.653     44.653     mm"
"             Runoff volume          0.00       49.12      49.12      c.m"
"             Runoff coefficient     0.000      0.955      0.955      "
"             Maximum flow           0.000      0.033      0.033      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.033     0.033     0.000     0.000"
" 54          POND DESIGN"
"         0.033   Current peak flow    c.m/sec"
"         0.001   Target outflow    c.m/sec"
"          49.1   Hydrograph volume    c.m"
"            5.   Number of stages"
"         0.000   Minimum water level    metre"
"         0.100   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000     0.000"
"                 0.02500   0.01100    28.000"
"                 0.05000   0.02300    56.000"
"                 0.07500   0.03400    84.000"
"                  0.1000   0.04500   112.000"
"             Peak outflow                  0.010    c.m/sec"
"             Maximum level                 0.022    metre"
"             Maximum storage              25.193    c.m"
"             Centroidal lag                2.080   hours"
"                  0.033     0.033     0.010     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.033     0.010     0.010     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"           201   Catchment 201"
"        70.000   % Impervious"
"         0.166   Total Area"
"        30.000   Flow length"
"         3.000   Overland Slope"
"         0.050   Pervious Area"
"        30.000   Pervious length"
"         3.000   Pervious slope"
```

```
"        0.116   Impervious Area"
"       30.000   Impervious length"
"        3.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.036     0.010     0.010     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.050      0.116      0.166      hectare"
"             Time of concentration  15.173     1.599      2.881      minutes"
"             Time to Centroid       88.550     81.788     82.427     minutes"
"             Rainfall depth         46.775     46.775     46.775     mm"
"             Rainfall volume        23.29      54.35      77.65      c.m"
"             Rainfall losses        35.918     2.140      12.273     mm"
"             Runoff depth           10.857     44.636     34.502     mm"
"             Runoff volume          5.41       51.87      57.27      c.m"
"             Runoff coefficient     0.232      0.954      0.738      "
"             Maximum flow           0.004      0.036      0.036      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.036     0.041     0.010     0.000"
" 54          POND DESIGN"
"        0.041   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"        106.4   Hydrograph volume    c.m"
"          16.   Number of stages"
"      343.700   Minimum water level    metre"
"      346.700   Maximum water level    metre"
"      343.700   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                343.700     0.000     0.000"
"                343.710   0.00200     1.100"
"                344.100   0.00201    45.400"
"                344.500   0.00202    90.800"
"                345.000   0.00203   147.600"
"                345.250   0.00204   176.000"
"                345.530   0.00205   207.800"
"                345.540   0.00206   208.400"
"                345.750   0.00207   208.600"
"                346.000   0.00208   208.900"
"                346.200   0.00209   209.200"
"                346.350   0.00210   209.300"
```

```
"               346.500   0.00211   224.300"
"               346.600   0.00212   242.700"
"               346.650   0.00213   254.300"
"               346.700   0.00214   255.300"
"             Peak outflow                  0.002    c.m/sec"
"             Maximum level               344.432    metre"
"             Maximum storage              83.065    c.m"
"             Centroidal lag                7.980   hours"
"                  0.036     0.041     0.002     0.000 c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.036     0.000     0.002     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Catch 202 Front of Site"
"       50.000   % Impervious"
"        0.043   Total Area"
"       10.000   Flow length"
"        3.000   Overland Slope"
"        0.022   Pervious Area"
"       10.000   Pervious length"
"        3.000   Pervious slope"
"        0.022   Impervious Area"
"       10.000   Impervious length"
"        3.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.007     0.000     0.002     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.022      0.022      0.043      hectare"
"             Time of concentration  7.849      0.827      2.242      minutes"
"             Time to Centroid       82.333     80.769     81.084     minutes"
"             Rainfall depth         46.775     46.775     46.775     mm"
"             Rainfall volume        10.06      10.06      20.11      c.m"
"             Rainfall losses        35.894     3.664      19.779     mm"
"             Runoff depth           10.881     43.111     26.996     mm"
"             Runoff volume          2.34       9.27       11.61      c.m"
"             Runoff coefficient     0.233      0.922      0.577      "
"             Maximum flow           0.003      0.007      0.007      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
```

```
"            4   Add Runoff "
"                     0.007     0.007     0.002     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.007     0.000     0.002     0.000"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Catch 203 Flow off North of Site"
"       40.000   % Impervious"
"        0.010   Total Area"
"       10.000   Flow length"
"        5.000   Overland Slope"
"        0.006   Pervious Area"
"       10.000   Pervious length"
"        5.000   Pervious slope"
"        0.004   Impervious Area"
"       10.000   Impervious length"
"        5.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.001     0.000     0.002     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.006      0.004      0.010      hectare"
"             Time of concentration  6.734      0.710      2.355      minutes"
"             Time to Centroid       81.098     80.784     80.869     minutes"
"             Rainfall depth         46.775     46.775     46.775     mm"
"             Rainfall volume        2.81       1.87       4.68       c.m"
"             Rainfall losses        36.131     4.287      23.393     mm"
"             Runoff depth           10.644     42.488     23.382     mm"
"             Runoff volume          0.64       1.70       2.34       c.m"
"             Runoff coefficient     0.228      0.908      0.500      "
"             Maximum flow           0.001      0.001      0.001      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.001     0.001     0.002     0.000"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.329    hectare"
"             Total Impervious area                     0.252    hectare"
"             Total % impervious                       76.505"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                         Sunday, February 07, 2010"
"           10   Units used:                                            ie METRIC"
"                Job folder:          W:\Guelph\118-2018\118170 Gordon St. ZCA\"
"                        5 Work in Progress\Design Calcs\2021-01-27 Middus\post"
"                Output filename:                                    Default.Out"
"                Licensee name:                                             gmbp"
"                Company                                                       "
"                Date & Time last used:                  2/5/2021 at 3:39:06 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      170.000   Max. Storm length"
"     2880.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     3158.000   Coefficient A"
"       15.000   Constant B"
"        0.936   Exponent C"
"        0.400   Fraction R"
"      170.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          185.783    mm/hr"
"             Total depth                 67.552    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catch 200 Roof Top"
"      100.000   % Impervious"
"        0.110   Total Area"
"       25.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        1.000   Pervious slope"
"        0.110   Impervious Area"
"       25.000   Impervious length"
"        1.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.047     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.110      0.110      hectare"
"             Time of concentration  12.857     1.754      1.754      minutes"
"             Time to Centroid       89.137     81.044     81.044     minutes"
"             Rainfall depth         67.552     67.552     67.552     mm"
"             Rainfall volume        0.00       74.31      74.31      c.m"
"             Rainfall losses        39.582     2.356      2.356      mm"
"             Runoff depth           27.970     65.196     65.196     mm"
"             Runoff volume          0.00       71.72      71.72      c.m"
"             Runoff coefficient     0.000      0.965      0.965      "
"             Maximum flow           0.000      0.047      0.047      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.047     0.047     0.000     0.000"
" 54          POND DESIGN"
"         0.047   Current peak flow    c.m/sec"
"         0.001   Target outflow    c.m/sec"
"          71.7   Hydrograph volume    c.m"
"            5.   Number of stages"
"         0.000   Minimum water level    metre"
"         0.100   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000     0.000"
"                 0.02500   0.01100    28.000"
"                 0.05000   0.02300    56.000"
"                 0.07500   0.03400    84.000"
"                  0.1000   0.04500   112.000"
"             Peak outflow                 0.015    c.m/sec"
"             Maximum level                0.033    metre"
"             Maximum storage             36.942    c.m"
"             Centroidal lag               2.054   hours"
"                  0.047     0.047     0.015     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.047     0.015     0.015     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Catchment 201"
"        70.000   % Impervious"
"         0.166   Total Area"
"        30.000   Flow length"
"         3.000   Overland Slope"
"         0.050   Pervious Area"
"        30.000   Pervious length"
"         3.000   Pervious slope"
```

```
"        0.116   Impervious Area"
"       30.000   Impervious length"
"        3.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.054     0.015     0.015     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.050      0.116      0.166      hectare"
"             Time of concentration  10.316     1.407      2.794      minutes"
"             Time to Centroid       86.583     80.567     81.504     minutes"
"             Rainfall depth         67.552     67.552     67.552     mm"
"             Rainfall volume        33.64      78.50      112.14     c.m"
"             Rainfall losses        39.601     2.569      13.678     mm"
"             Runoff depth           27.951     64.983     53.874     mm"
"             Runoff volume          13.92      75.51      89.43      c.m"
"             Runoff coefficient     0.414      0.962      0.798      "
"             Maximum flow           0.011      0.051      0.054      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.054     0.062     0.015     0.000"
" 54          POND DESIGN"
"        0.062   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"        161.1   Hydrograph volume    c.m"
"          16.   Number of stages"
"      343.700   Minimum water level    metre"
"      346.700   Maximum water level    metre"
"      343.700   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                343.700     0.000     0.000"
"                343.710   0.00200     1.100"
"                344.100   0.00201    45.400"
"                344.500   0.00202    90.800"
"                345.000   0.00203   147.600"
"                345.250   0.00204   176.000"
"                345.530   0.00205   207.800"
"                345.540   0.00206   208.400"
"                345.750   0.00207   208.600"
"                346.000   0.00208   208.900"
"                346.200   0.00209   209.200"
"                346.350   0.00210   209.300"
```

```
"               346.500   0.00211   224.300"
"               346.600   0.00212   242.700"
"               346.650   0.00213   254.300"
"               346.700   0.00214   255.300"
"             Peak outflow                 0.002    c.m/sec"
"             Maximum level              344.894    metre"
"             Maximum storage            135.510    c.m"
"             Centroidal lag              11.632   hours"
"                  0.054     0.062     0.002     0.000 c.m/sec"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.054     0.000     0.002     0.000"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          202   Catch 202 Front of Site"
"       50.000   % Impervious"
"        0.043   Total Area"
"       10.000   Flow length"
"        3.000   Overland Slope"
"        0.022   Pervious Area"
"       10.000   Pervious length"
"        3.000   Pervious slope"
"        0.022   Impervious Area"
"       10.000   Impervious length"
"        3.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.012     0.000     0.002     0.000 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.022      0.022      0.043      hectare"
"             Time of concentration  5.336      0.728      2.161      minutes"
"             Time to Centroid       81.715     79.769     80.374     minutes"
"             Rainfall depth         67.552     67.552     67.552     mm"
"             Rainfall volume        14.52      14.52      29.05      c.m"
"             Rainfall losses        39.573     5.566      22.570     mm"
"             Runoff depth           27.978     61.985     44.982     mm"
"             Runoff volume          6.02       13.33      19.34      c.m"
"             Runoff coefficient     0.414      0.918      0.666      "
"             Maximum flow           0.006      0.010      0.012      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
```

```
"            4   Add Runoff "
"                     0.012     0.012     0.002     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.012     0.000     0.002     0.000"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Catch 203 Flow off North of Site"
"       40.000   % Impervious"
"        0.010   Total Area"
"       10.000   Flow length"
"        5.000   Overland Slope"
"        0.006   Pervious Area"
"       10.000   Pervious length"
"        5.000   Pervious slope"
"        0.004   Impervious Area"
"       10.000   Impervious length"
"        5.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.003     0.000     0.002     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.006      0.004      0.010      hectare"
"             Time of concentration  4.578      0.624      2.237      minutes"
"             Time to Centroid       80.921     79.743     80.224     minutes"
"             Rainfall depth         67.552     67.552     67.552     mm"
"             Rainfall volume        4.05       2.70       6.76       c.m"
"             Rainfall losses        39.616     6.699      26.449     mm"
"             Runoff depth           27.936     60.853     41.103     mm"
"             Runoff volume          1.68       2.43       4.11       c.m"
"             Runoff coefficient     0.414      0.901      0.608      "
"             Maximum flow           0.002      0.002      0.003      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.003     0.003     0.002     0.000"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.329    hectare"
"             Total Impervious area                     0.252    hectare"
"             Total % impervious                       76.505"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                         Sunday, February 07, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:          W:\Guelph\118-2018\118170 Gordon St. ZCA\"
"                        5 Work in Progress\Design Calcs\2021-01-27 Middus\post"
"                Output filename:                                      Default.Out"
"                Licensee name:                                               gmbp"
"                Company                                                         "
"                Date & Time last used:                   2/5/2021 at 3:50:58 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      210.000   Max. Storm length"
"     2880.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     4688.000   Coefficient A"
"       17.000   Constant B"
"        0.962   Exponent C"
"        0.400   Fraction R"
"      210.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           213.574    mm/hr"
"             Total depth                  88.830    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          200   Catch 200 Roof Top"
"      100.000   % Impervious"
"        0.110   Total Area"
"       25.000   Flow length"
"        1.000   Overland Slope"
"        0.000   Pervious Area"
"       25.000   Pervious length"
"        1.000   Pervious slope"
"        0.110   Impervious Area"
"       25.000   Impervious length"
"        1.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
```

```
"                    0.057     0.000     0.000     0.000 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.110      0.110      hectare"
"             Time of concentration  11.457     1.659      1.659      minutes"
"             Time to Centroid       104.423    97.486     97.486     minutes"
"             Rainfall depth         88.830     88.830     88.830     mm"
"             Rainfall volume        0.00       97.71      97.71      c.m"
"             Rainfall losses        43.310     2.646      2.646      mm"
"             Runoff depth           45.520     86.184     86.184     mm"
"             Runoff volume          0.00       94.80      94.80      c.m"
"             Runoff coefficient     0.000      0.970      0.970      "
"             Maximum flow           0.000      0.057      0.057      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.057     0.057     0.000     0.000"
" 54          POND DESIGN"
"         0.057   Current peak flow    c.m/sec"
"         0.001   Target outflow    c.m/sec"
"          94.8   Hydrograph volume    c.m"
"            5.   Number of stages"
"         0.000   Minimum water level    metre"
"         0.100   Maximum water level    metre"
"         0.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                   0.000     0.000     0.000"
"                  0.02500   0.01100    28.000"
"                  0.05000   0.02300    56.000"
"                  0.07500   0.03400    84.000"
"                   0.1000   0.04500   112.000"
"             Peak outflow                  0.019    c.m/sec"
"             Maximum level                 0.043    metre"
"             Maximum storage              47.660    c.m"
"             Centroidal lag                2.322   hours"
"                  0.057     0.057     0.019     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    0.057     0.019     0.019     0.000"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          201   Catch 201"
"        70.000   % Impervious"
"         0.166   Total Area"
"        30.000   Flow length"
"         3.000   Overland Slope"
"         0.050   Pervious Area"
"        30.000   Pervious length"
"         3.000   Pervious slope"
```

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"        0.116   Impervious Area"
"       30.000   Impervious length"
"        3.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.072     0.019     0.019     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.050      0.116      0.166      hectare"
"             Time of concentration  9.192      1.331      2.779      minutes"
"             Time to Centroid       102.017    97.031     97.949     minutes"
"             Rainfall depth         88.830     88.830     88.830     mm"
"             Rainfall volume        44.24      103.22     147.46     c.m"
"             Rainfall losses        43.671     3.096      15.269     mm"
"             Runoff depth           45.159     85.733     73.561     mm"
"             Runoff volume          22.49      99.62      122.11     c.m"
"             Runoff coefficient     0.508      0.965      0.828      "
"             Maximum flow           0.018      0.059      0.072      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.072     0.086     0.019     0.000"
" 54          POND DESIGN"
"        0.086   Current peak flow    c.m/sec"
"        0.001   Target outflow    c.m/sec"
"        216.9   Hydrograph volume    c.m"
"          16.   Number of stages"
"      343.700   Minimum water level    metre"
"      346.700   Maximum water level    metre"
"      343.700   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                343.700     0.000     0.000"
"                343.710   0.00200     1.100"
"                344.100   0.00201    45.400"
"                344.500   0.00202    90.800"
"                345.000   0.00203   147.600"
"                345.250   0.00204   176.000"
"                345.530   0.00205   207.800"
"                345.540   0.00206   208.400"
"                345.750   0.00207   208.600"
"                346.000   0.00208   208.900"
"                346.200   0.00209   209.200"
"                346.350   0.00210   209.300"
```

```
"               346.500   0.00211   224.300"
"               346.600   0.00212   242.700"
"               346.650   0.00213   254.300"
"               346.700   0.00214   255.300"
"            Peak outflow                 0.002    c.m/sec"
"            Maximum level              345.355    metre"
"            Maximum storage            187.982    c.m"
"            Centroidal lag              15.499   hours"
"                 0.072     0.086     0.002     0.000 c.m/sec"
" 40         HYDROGRAPH Start - New Tributary"
"           2   Start - New Tributary"
"                    0.072     0.000     0.002     0.000"
" 33         CATCHMENT 202"
"           1   Triangular SCS"
"           1   Equal length"
"           2   Horton equation"
"         202   Catch 202 Front of Site"
"      50.000   % Impervious"
"       0.043   Total Area"
"      10.000   Flow length"
"       3.000   Overland Slope"
"       0.022   Pervious Area"
"      10.000   Pervious length"
"       3.000   Pervious slope"
"       0.022   Impervious Area"
"      10.000   Impervious length"
"       3.000   Impervious slope"
"       0.300   Pervious Manning 'n'"
"      75.000   Pervious Max.infiltration"
"      12.500   Pervious Min.infiltration"
"       0.250   Pervious Lag constant (hours)"
"       5.000   Pervious Depression storage"
"       0.013   Impervious Manning 'n'"
"       0.000   Impervious Max.infiltration"
"       0.000   Impervious Min.infiltration"
"       0.001   Impervious Lag constant (hours)"
"       1.500   Impervious Depression storage"
"                    0.018     0.000     0.002     0.000 c.m/sec"
"            Catchment 202          Pervious   Impervious Total Area "
"            Surface Area           0.022      0.022      0.043      hectare"
"            Time of concentration  4.755      0.688      2.146      minutes"
"            Time to Centroid       97.550     96.291     96.743     minutes"
"            Rainfall depth         88.830     88.830     88.830     mm"
"            Rainfall volume        19.10      19.10      38.20      c.m"
"            Rainfall losses        43.505     7.737      25.621     mm"
"            Runoff depth           45.325     81.093     63.209     mm"
"            Runoff volume          9.74       17.43      27.18      c.m"
"            Runoff coefficient     0.510      0.913      0.712      "
"            Maximum flow           0.009      0.011      0.018      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
```

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"            4   Add Runoff "
"                     0.018     0.018     0.002     0.000"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.018     0.000     0.002     0.000"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            1   Equal length"
"            2   Horton equation"
"          203   Catch 203 Flow from North of Site"
"       40.000   % Impervious"
"        0.010   Total Area"
"       10.000   Flow length"
"        5.000   Overland Slope"
"        0.006   Pervious Area"
"       10.000   Pervious length"
"        5.000   Pervious slope"
"        0.004   Impervious Area"
"       10.000   Impervious length"
"        5.000   Impervious slope"
"        0.300   Pervious Manning 'n'"
"       75.000   Pervious Max.infiltration"
"       12.500   Pervious Min.infiltration"
"        0.250   Pervious Lag constant (hours)"
"        5.000   Pervious Depression storage"
"        0.013   Impervious Manning 'n'"
"        0.000   Impervious Max.infiltration"
"        0.000   Impervious Min.infiltration"
"        0.001   Impervious Lag constant (hours)"
"        1.500   Impervious Depression storage"
"                     0.004     0.000     0.002     0.000 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           0.006      0.004      0.010      hectare"
"             Time of concentration  4.079      0.591      2.189      minutes"
"             Time to Centroid       96.861     96.274     96.543     minutes"
"             Rainfall depth         88.830     88.830     88.830     mm"
"             Rainfall volume        5.33       3.55       8.88       c.m"
"             Rainfall losses        43.992     9.314      30.121     mm"
"             Runoff depth           44.838     79.516     58.709     mm"
"             Runoff volume          2.69       3.18       5.87       c.m"
"             Runoff coefficient     0.505      0.895      0.661      "
"             Maximum flow           0.003      0.002      0.004      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.004     0.004     0.002     0.000"
" 38          START/RE-START TOTALS 203"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      0.329    hectare"
"             Total Impervious area                     0.252    hectare"
"             Total % impervious                       76.505"
```

Stormceptor®

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

03/09/2021

Province:	Ontario
City:	Guelph
Nearest Rainfall Station:	WATERLOO WELLINGTON AP
NCDC Rainfall Station Id:	9387
Years of Rainfall Data:	34

Site Name:	

Drainage Area (ha):	0.14
% Imperviousness:	95.00

Runoff Coefficient 'c': 0.87

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	4.77
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	1871 & 1879 Gordon
Project Number:	118170
Designer Name:	Madeline Carter
Designer Company:	GMBluePlan
Designer Email:	madeline.carter@gmblueplan.ca
Designer Phone:	519-831-7814
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	87
EFO6	91
EFO8	92
EFO10	92
EFO12	92

Recommended Stormceptor EFO Model: EFO4

Estimated Net Annual Sediment (TSS) Load Reduction (%): 87

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

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

PERFORMANCE

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

PARTICLE SIZE DISTRIBUTION (PSD)

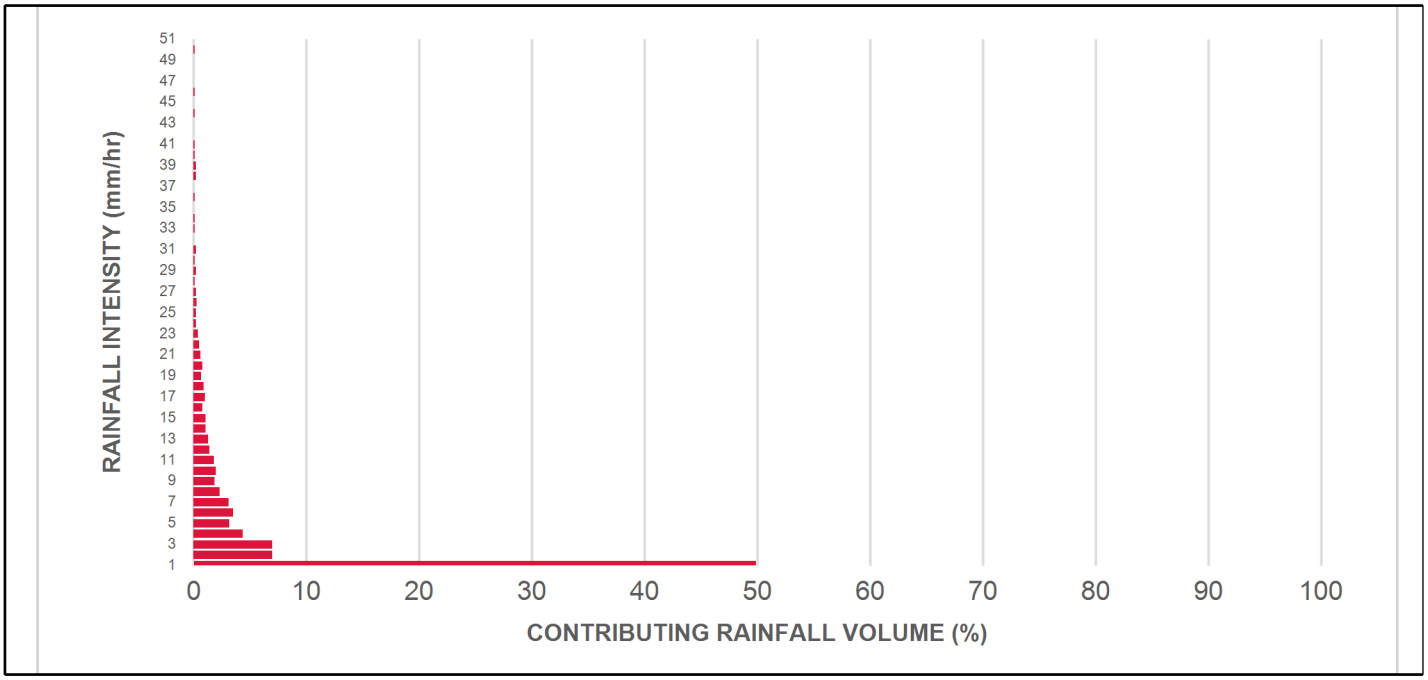
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a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

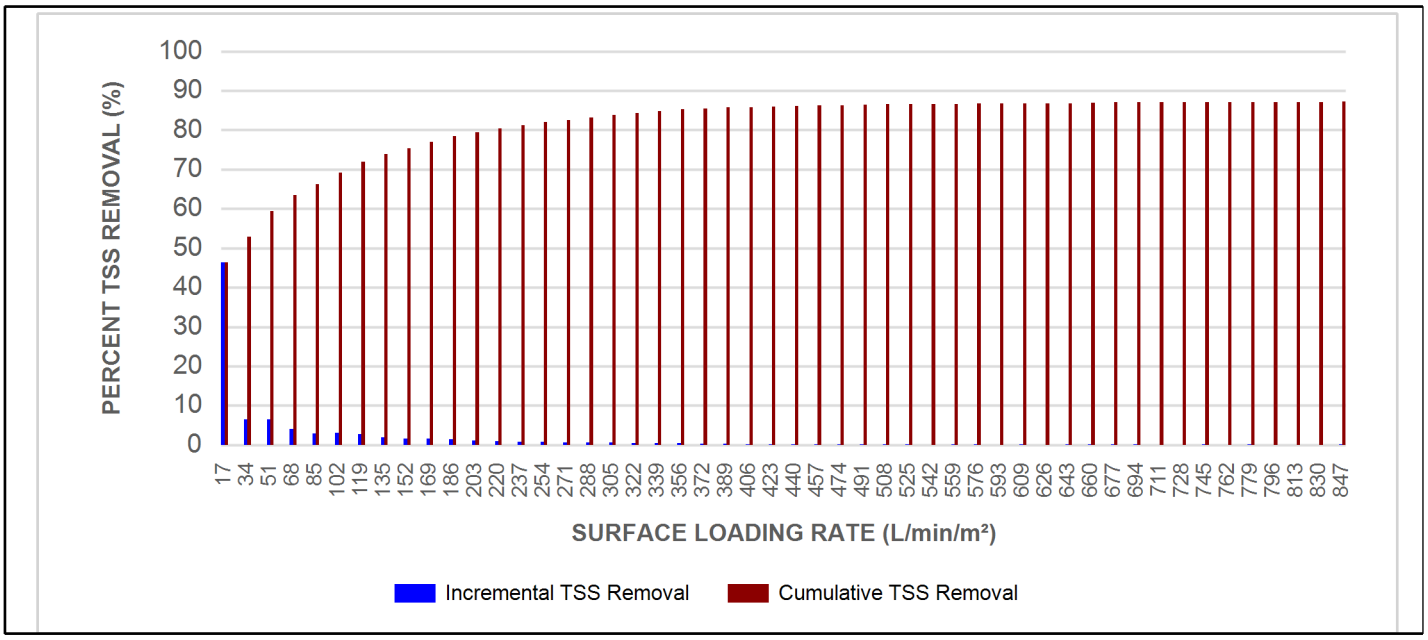
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	49.9	49.9	0.34	20.0	17.0	93	46.4	46.4
2	7.0	56.9	0.68	41.0	34.0	93	6.5	52.9
3	7.0	63.9	1.02	61.0	51.0	92	6.4	59.4
4	4.4	68.3	1.35	81.0	68.0	91	4.0	63.4
5	3.2	71.5	1.69	102.0	85.0	89	2.8	66.2
6	3.5	75.0	2.03	122.0	102.0	87	3.0	69.2
7	3.1	78.1	2.37	142.0	119.0	86	2.7	71.9
8	2.3	80.4	2.71	163.0	135.0	84	1.9	73.8
9	1.9	82.3	3.05	183.0	152.0	81	1.5	75.4
10	2.0	84.3	3.39	203.0	169.0	79	1.6	77.0
11	1.8	86.1	3.72	223.0	186.0	78	1.4	78.4
12	1.4	87.5	4.06	244.0	203.0	76	1.1	79.4
13	1.3	88.8	4.40	264.0	220.0	74	1.0	80.4
14	1.1	89.9	4.74	284.0	237.0	73	0.8	81.2
15	1.1	91.0	5.08	305.0	254.0	72	0.8	82.0
16	0.8	91.8	5.42	325.0	271.0	70	0.6	82.5
17	1.0	92.8	5.76	345.0	288.0	69	0.7	83.2
18	0.9	93.7	6.09	366.0	305.0	67	0.6	83.8
19	0.7	94.4	6.43	386.0	322.0	65	0.5	84.3
20	0.8	95.2	6.77	406.0	339.0	64	0.5	84.8
21	0.6	95.8	7.11	427.0	356.0	63	0.4	85.2
22	0.5	96.3	7.45	447.0	372.0	61	0.3	85.5
23	0.4	96.7	7.79	467.0	389.0	59	0.2	85.7
24	0.2	96.9	8.13	488.0	406.0	58	0.1	85.8
25	0.2	97.1	8.47	508.0	423.0	57	0.1	86.0

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 (%)
26	0.3	97.4	8.80	528.0	440.0	57	0.2	86.1
27	0.2	97.6	9.14	549.0	457.0	57	0.1	86.2
28	0.1	97.7	9.48	569.0	474.0	56	0.1	86.3
29	0.2	97.9	9.82	589.0	491.0	55	0.1	86.4
30	0.1	98.0	10.16	609.0	508.0	55	0.1	86.5
31	0.2	98.2	10.50	630.0	525.0	54	0.1	86.6
32	0.0	98.2	10.84	650.0	542.0	54	0.0	86.6
33	0.1	98.3	11.17	670.0	559.0	54	0.1	86.6
34	0.1	98.4	11.51	691.0	576.0	53	0.1	86.7
35	0.0	98.4	11.85	711.0	593.0	52	0.0	86.7
36	0.1	98.5	12.19	731.0	609.0	52	0.1	86.7
37	0.0	98.5	12.53	752.0	626.0	52	0.0	86.7
38	0.2	98.7	12.87	772.0	643.0	52	0.1	86.8
39	0.2	98.9	13.21	792.0	660.0	52	0.1	86.9
40	0.1	99.0	13.54	813.0	677.0	52	0.1	87.0
41	0.1	99.1	13.88	833.0	694.0	52	0.1	87.0
42	0.0	99.1	14.22	853.0	711.0	51	0.0	87.0
43	0.0	99.1	14.56	874.0	728.0	51	0.0	87.0
44	0.1	99.2	14.90	894.0	745.0	51	0.1	87.1
45	0.0	99.2	15.24	914.0	762.0	51	0.0	87.1
46	0.1	99.3	15.58	935.0	779.0	51	0.1	87.1
47	0.0	99.3	15.91	955.0	796.0	51	0.0	87.1
48	0.0	99.3	16.25	975.0	813.0	51	0.0	87.1
49	0.0	99.3	16.59	995.0	830.0	51	0.0	87.1
50	0.1	99.4	16.93	1016.0	847.0	51	0.1	87.2
						Estimated Net Annual Sediment (TSS) Load Reduction =		**87 %**

RAINFALL DATA FROM WATERLOO WELLINGTON 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

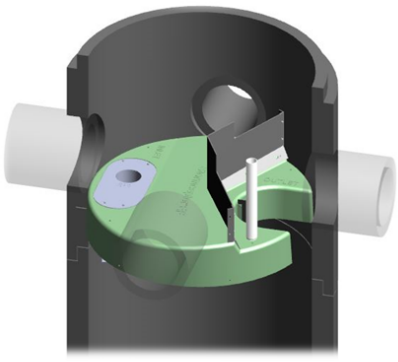
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test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

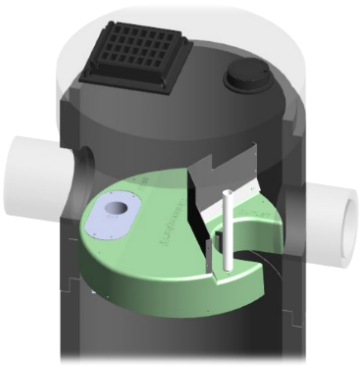
DESIGN FLEXIBILITY

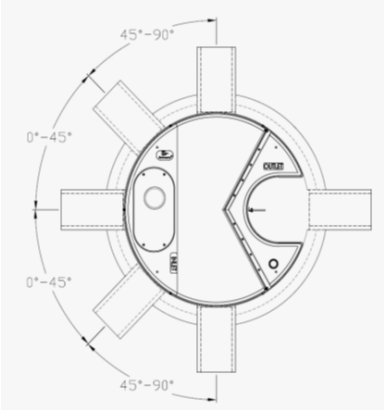
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend 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)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

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

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

STANDARD STORMCEPTOR EF/EFO DRAWINGS

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

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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

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 shall be determined using historical rainfall data and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. 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

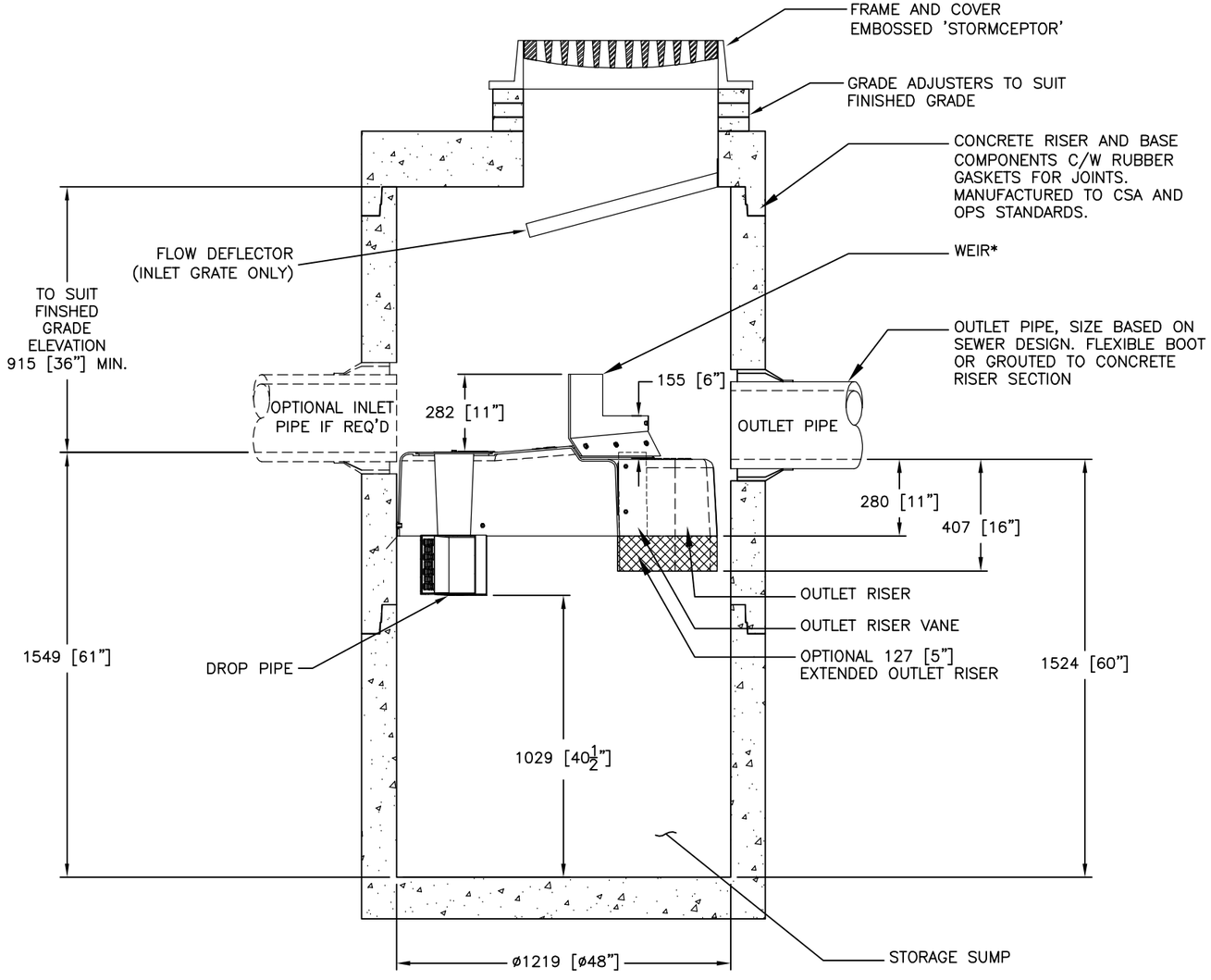
The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

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.

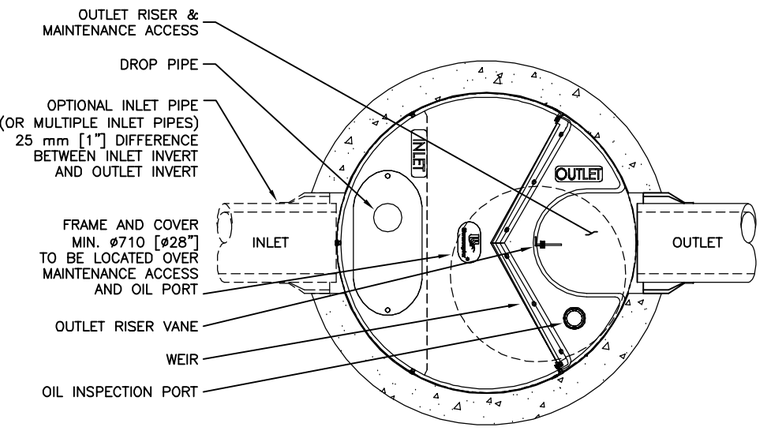
3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

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.

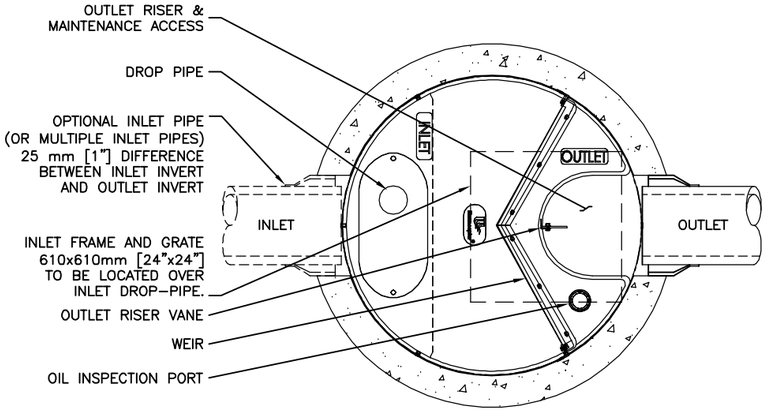
3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m2 to 2600 L/min/m2) 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.



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF4 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO4 (OIL CAPTURE CONFIGURATION). WEIR HEIGHT IS 150 mm (6 INCH) FOR EF04.

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO4
STRUCTURE ID	*
HYDROCARBON STORAGE REQ'D (L)	*
WATER QUALITY FLOW RATE (L/s)	*
PEAK FLOW RATE (L/s)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
DRAINAGE AREA (HA)	*
DRAINAGE AREA IMPERVIOUSNESS (%)	*

PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
1	6/8/18	UPDATES	JSK
0	5/26/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium®
407 FAIRVIEW DRIVE, WHITBY, ON, L1N 9A9
TF 800-565-4501 CA 416-800-9000 INTL +1-416-800-9000

DATE: 10/13/2017

DESIGNED:	DRAWN:
JSK	JSK
CHECKED:	APPROVED:
BSF	SP
PROJECT No.:	SEQUENCE No.:
EFO4	*

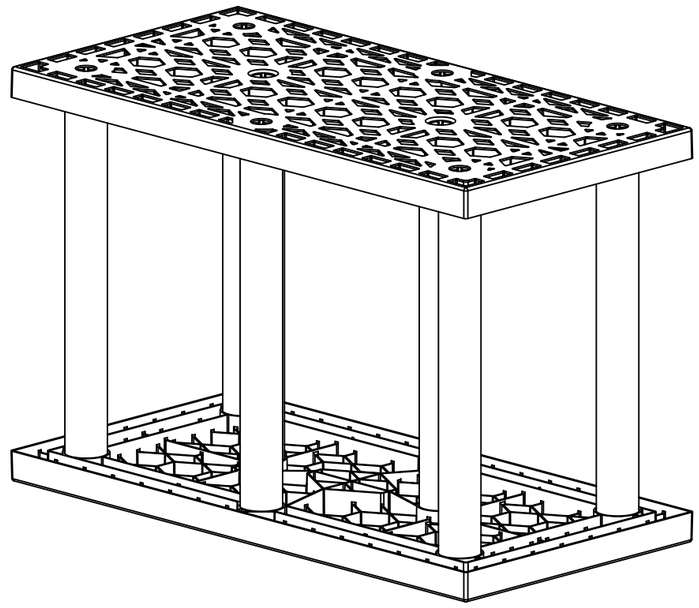
SHEET: 1 OF 1

LAYFIELD

BRENTWOOD STORMTANK
MODULE SHOP DRAWINGS

1871 & 1879 GORDON STREET

Guelph, ON



Pages:

LAYFIELD

117 Basaltic Rd,
Concord, ON L4K 1G4 Canada
Ph: (905) 761-9123
www.layfieldgroup.com

DOUBLE STACK MODULE SYSTEM

Total Storage Volume	199.87 m³
Module Storage Volume	169.36 m³
Stone Storage Volume	30.51 m³
System Footprint	109.63 m²
Estimated Geotextile Fabric	730m²
Estimated Stone Volume	76.29m³
Excavation Required	284.02 m³
Excavation Depth	2.59m
Stone Type	19mm clear
Stone Void Space	40%
Module Type (Bottom)	25 Series ST-36
Module Type (Top)	25 Series ST-36

1871 & 1879 GORDON STREET

Guelph, ON

REV.	Record of Changes	Date	By
△	Preliminary Drawing	02MAR21	AC

Page Name: Cover Page

Drawn by: AC | Checked By: AW

Scale: NTS | Date: 02MAR21

Sheet: **01 OF 07**

ANSI B Size Page (Horizontal)

Material Quantity (ST-36)

ST-36	456
Platens	912
36" Columns	3648
36" Side Panels	214
10" Observation Port	3
6" Saddle Port	1

Elevations

Leveling Stone Bottom	343.6976
Module Invert	343.8500
Top of Module	345.6788
Top of Stone Backfill	345.9836
Minimum Finished Grade	346.2884
Maximum Finished Grade	347.2000

Contractor to confirm that quantities shipped to site match those listed above. Please report any discrepancy or damage to Layfield immediately.

a. All dimensions are measured in meters unless noted otherwise.

b. Reference Brentwood Industries standard drawings and notes for detailed information.

c. Reference current Brentwoood Module installation instructions for proper installation practices.
[http://www.brentwoodindustries.com/products/stormwater-management/stormtank/module.php#feature5]

d. Engineer of record to confirm conformance to manufacturer's allowable proximity to other structures and slopes.

e. All inlet and pipe locations and designs by others.

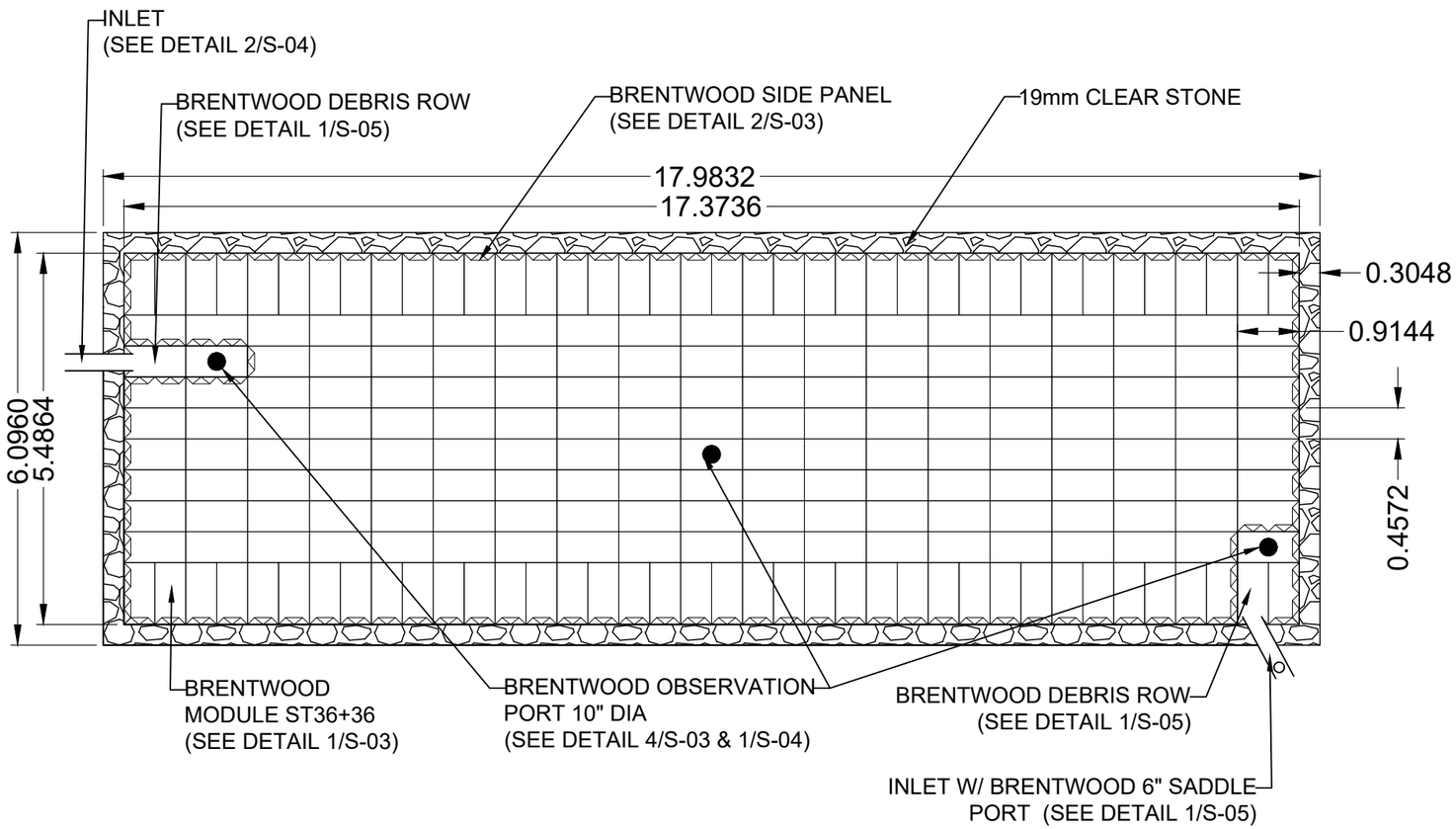
f. The sub-grade and side backfill needs to be compacted to 95%, unless noted otherwise.

g. During and after installation, the Brentwood Module area should be clearly marked and roped off to prevent unauthorized construction and equipment trafficking over the modules.

h. Top of Ground water is to be maintained 610 mm (2 ft) below the module to prevent buoyancy, unless otherwise noted by engineer.

i. The quantities related to stone and geosynthetics are estimated values as the roll size, overlaps, waste, ect. may vary.

1 S-02 **NOTES**



2 S-02 **MODULE LAYOUT**
SCALE: NTS

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1871 & 1879 GORDON STREET

Guelph, ON

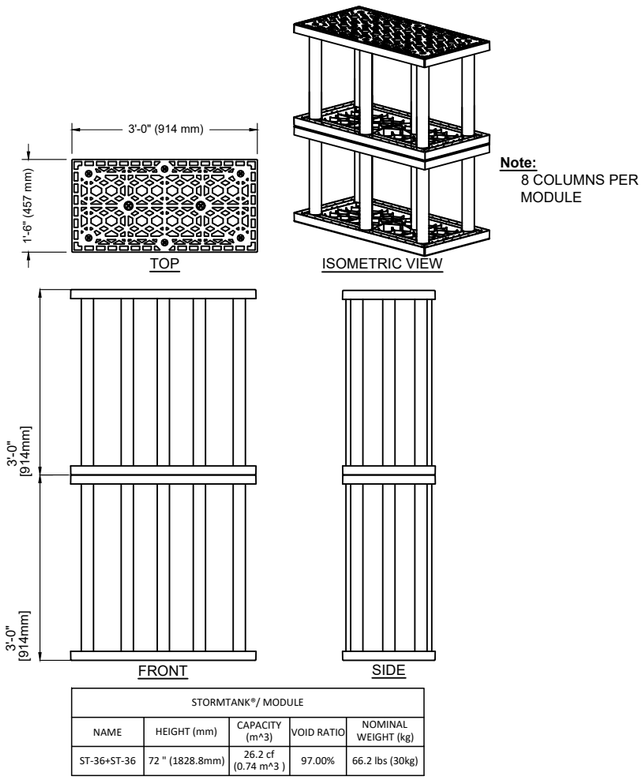
REV.	Record of Changes	Date	By
△	Preliminary Drawing	02MAR21	AC

Page Name: Module Layout

Drawn by:	Checked By:
AC	AW
Scale: NTS	Date: 02MAR21

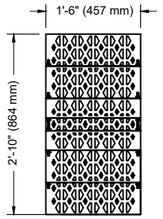
Sheet:

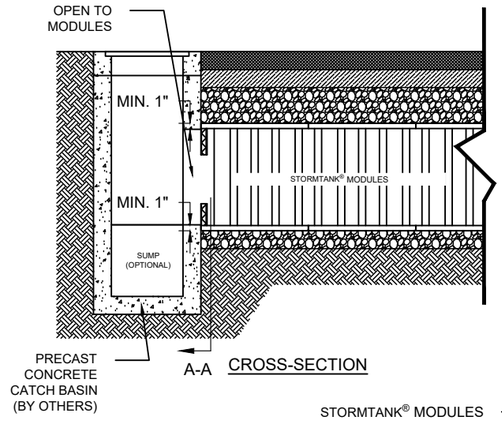
02 OF 07



Note:
8 COLUMNS PER MODULE

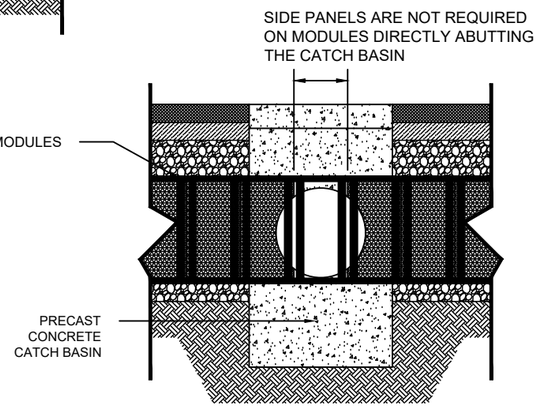
STORMTANK®/ MODULE				
NAME	HEIGHT (mm)	CAPACITY (m^3)	VOID RATIO	NOMINAL WEIGHT (kg)
ST-36+ST-36	72 " (1828.8mm)	26.2 cf (0.74 m^3)	97.00%	66.2 lbs (30kg)





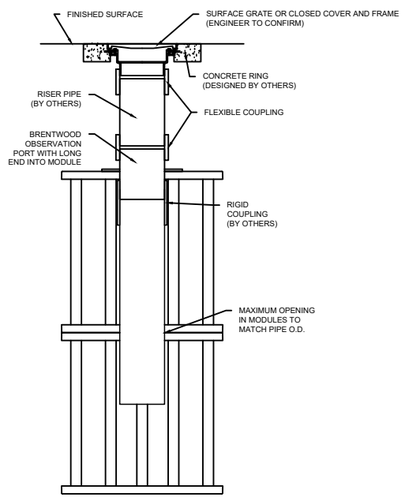
ORIFICE CONFIGURATIONS (BY OTHERS)

MAXIMUM PIPE DIAMETERS	
MODULE	NOMINAL PIPE DIAMETER (mm)
ST-18	14" (356)
ST-24	20" (508)
ST-30	26" (660)
ST-33	29" (737)
ST-36	32" (813)



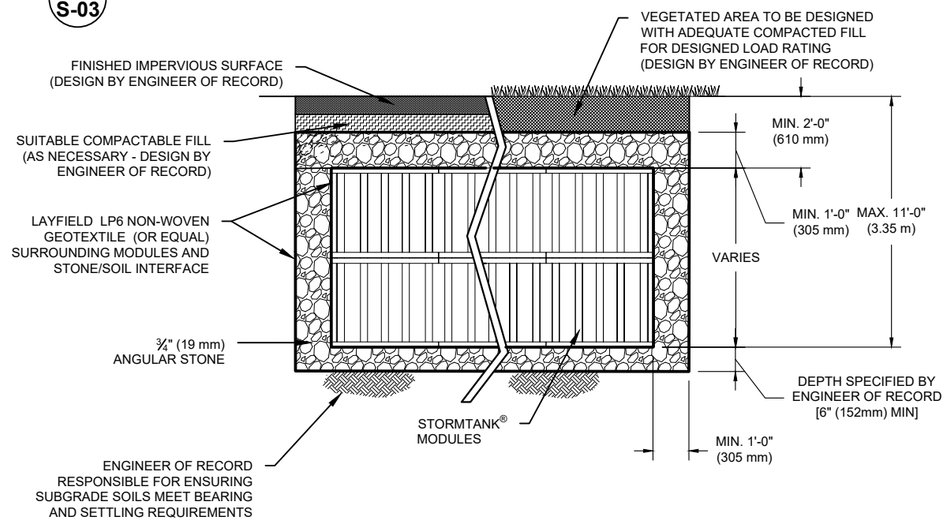
1 S-03 36"(914mm) &36"(914mm) DOUBLE STACKED MODULE DETAIL

2 S-03 36"(914mm) &36"(914mm) SIDE PANEL DETAIL



4 S-03 DOUBLE STACK OBSERVATION PORT DETAIL

3 S-03 TYP. CATCH BASIN ABUTMENT DETAIL



5 S-03 TYPICAL DOUBLE STACKED SYSTEM BASIC CROSS-SECTION

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www.layfieldgroup.com

DOUBLE STACK MODULE SYSTEM

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1871 & 1879 GORDON STREET

Guelph, ON

REV.	Record of Changes	Date	By
△	Preliminary Drawing	02MAR21	AC

Page Name: TYP. Construction Details

Drawn by:	Checked By:
AC	AW
Scale: NTS	Date: 02MAR21

Sheet: **03 OF 07**

STEP 1:

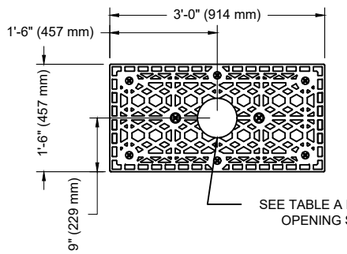
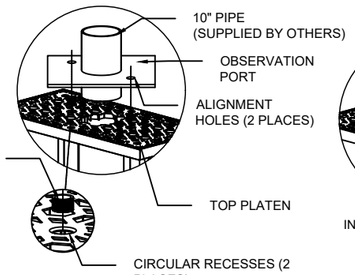


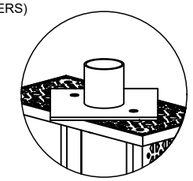
TABLE A: OBSERVATION PORT DIMENSION		
PORT SIZE	OPEN SIZE	RISER PIPE DIA.
6" (152 mm)	7" (178 mm)	6" (152 mm)
8" (203 mm)	9" (229 mm)	8" (203 mm)
10" (254 mm)	11" (279 mm)	10" (254 mm)

LAYOUT & CUT OPENING INTO THE CENTER OF THE TOP PLATEN FOR BRENTWOOD OBSERVATION PORT.

STEP 2:

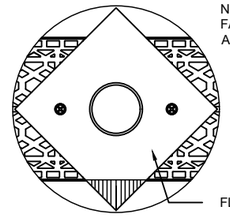


STEP 3:



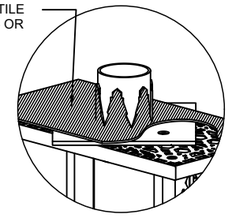
INSTALL OBSERVATION PORT

STEP 4:



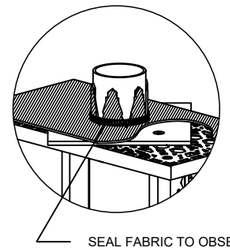
MARK & CUT FLANGE PLATE FLUSH WITH MODULE SIDE "WHEN MODULE IS ON THE PERIMETER OF THE SYSTEM."

STEP 5:



INSTALL GEOTEXTILE:
WRAP SPECIFIED GEOTEXTILE FABRIC AROUND ENTIRE INSTALLATION OF STORMTANK MODULES. CUT "X" PATTERN INTO GEOTEXTILE FABRIC AT OBSERVATION PORT AND PEEL EDGES OUT.

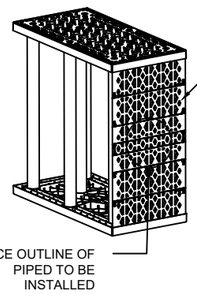
STEP 6:



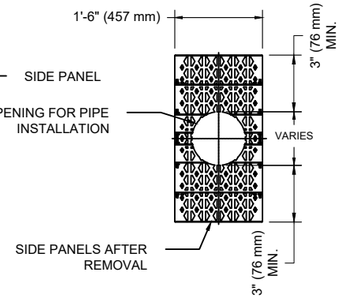
SEAL FABRIC TO OBSERVATION PORT WITH SS BANDING, WATER RESISTANT TAPE OR NYLON ZIP-TIE

1 S-04 TYP. OBSERVATION PORT INSTALLATION DETAIL

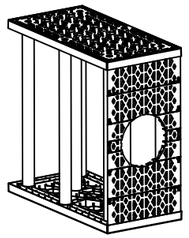
STEP 1:
LOCATE AND MARK OPENING



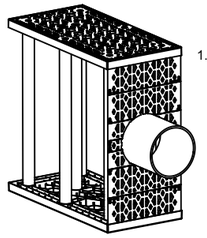
STEP 2:
REMOVE SIDE PANELS FROM MODULES AND CUT OPENING

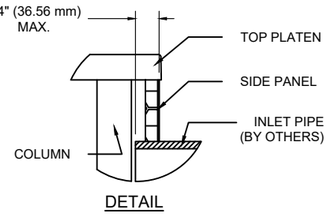


STEP 3:
REINSTALL SIDE PANELS



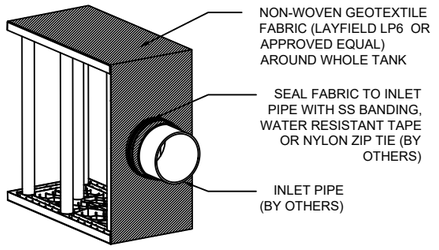
STEP 4:
INSTALL PIPE (SLIP FIT)





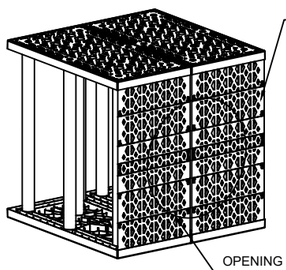
DETAIL

STEP 5:
WRAP AND SECURE GEOTEXTILE

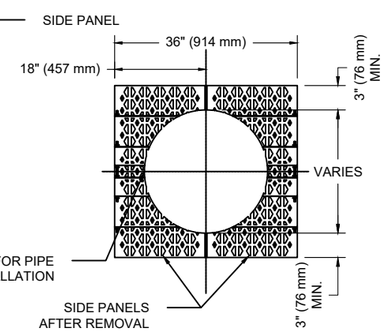


2 S-04 SMALL DIAMETER (14" [356 mm] AND SMALLER) PIPE CONNECTION DETAIL

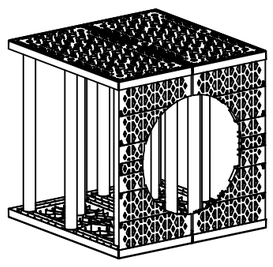
STEP 1:
LOCATE AND MARK OPENING



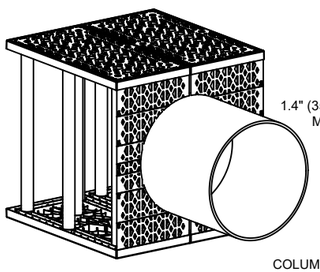
STEP 2:
REMOVE SIDE PANELS FROM MODULES AND CUT OPENING

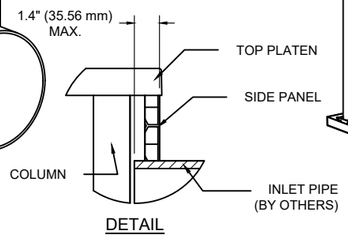


STEP 3:
REINSTALL SIDE PANELS



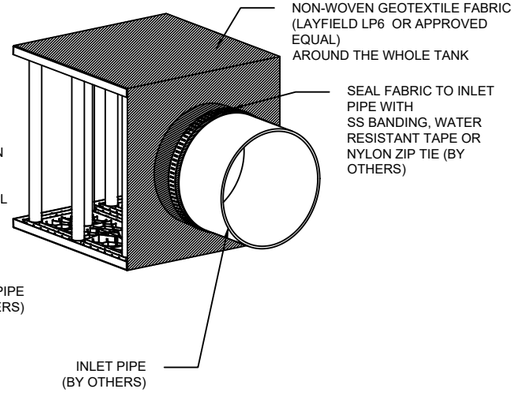
STEP 4:
INSTALL PIPE (SLIP FIT)





DETAIL

STEP 5:
WRAP AND SECURE GEOTEXTILE



3 S-04 LARGE DIAMETER (15" [381 mm] AND GREATER) PIPE CONNECTION DETAIL

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DOUBLE STACK MODULE SYSTEM

Total Storage Volume	199.87 m³
Module Storage Volume	169.36 m³
Stone Storage Volume	30.51 m³
System Footprint	109.63 m²
Estimated Geotextile Fabric	730 m²
Estimated Stone Volume	76.29 m³
Excavation Required	284.02 m³
Excavation Depth	2.59m
Stone Type	19mm clear
Stone Void Space	40%
Module Type (Bottom)	25 Series ST-36
Module Type (Top)	25 Series ST-36

1871 & 1879 GORDON STREET

Guelph, ON

REV.	Record of Changes	Date	By
△	Preliminary Drawing	02MAR21	AC

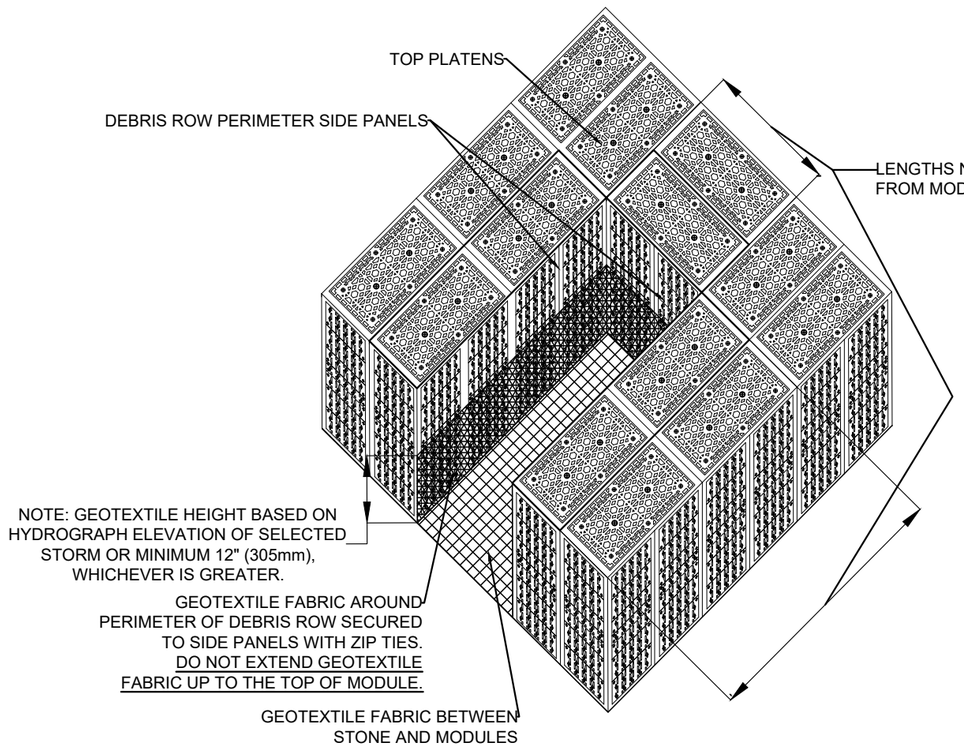
Page Name: TYP. Pipe Penetration Details

Drawn by:	Checked By:
AC	AW
Scale: NTS	Date: 02MAR21

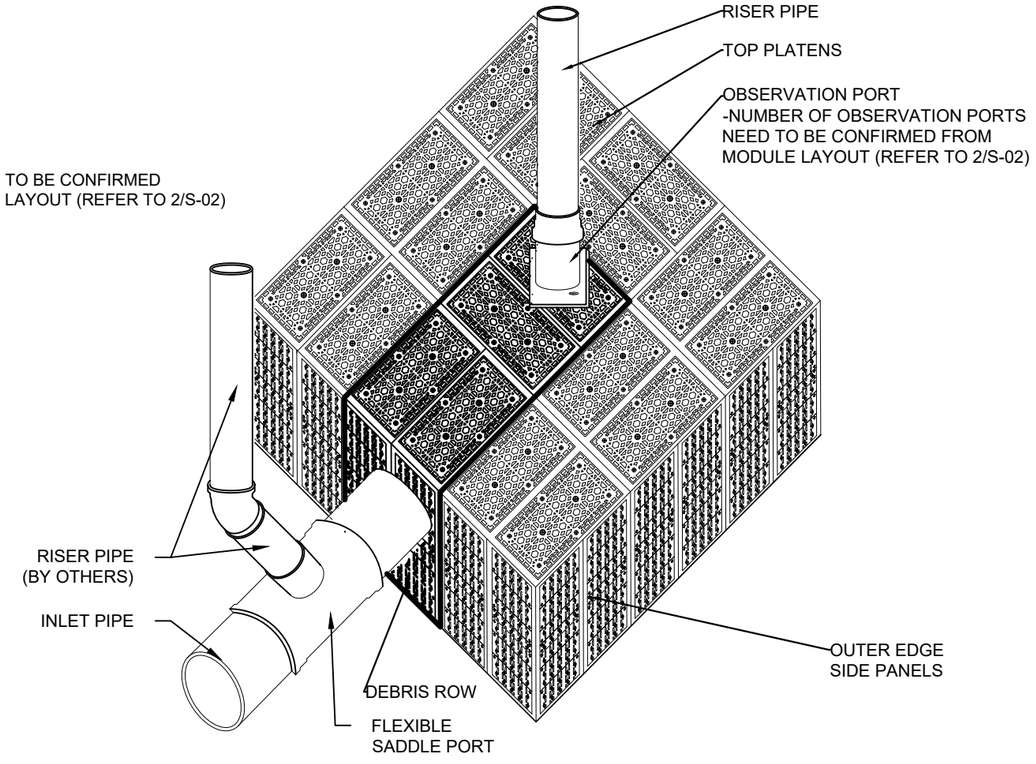
Sheet:

04 OF 07

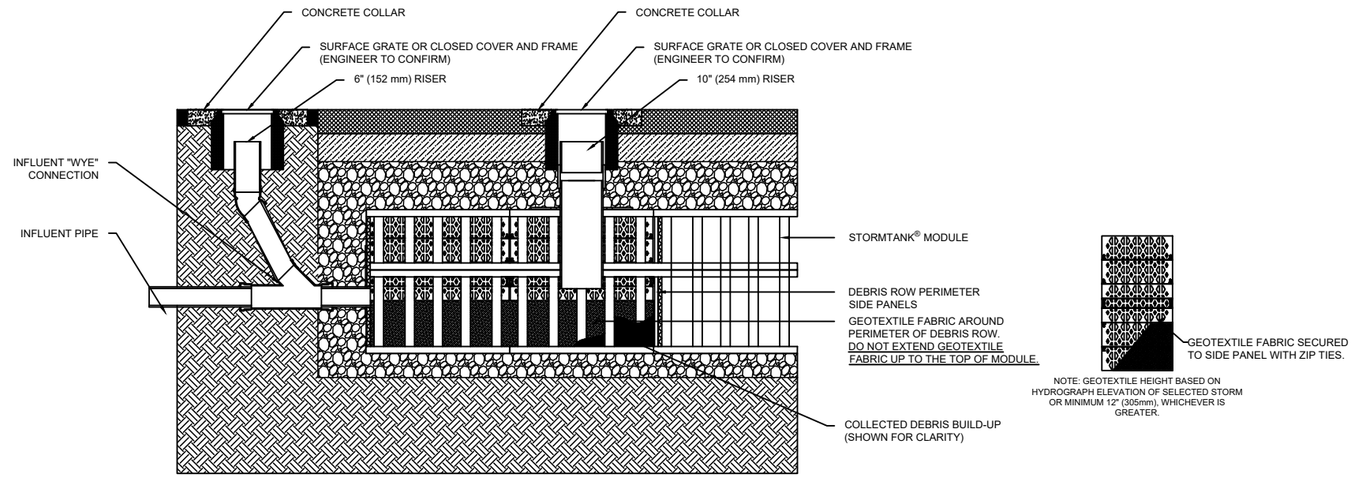
ANSI B Size Page (Horizontal)



SIDE PANELS AND GEOTEXTILE FABRIC ALONG THE PERIMETER OF DEBRIS ROW



FINISHED DEBRIS ROW WITH INLET AND OBSERVATION PORT



TYP. DEBRIS ROW CROSS SECTION

1 / S-05 TYP. DEBRIS ROW DETAIL DOUBLE STACK

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1871 & 1879 GORDON STREET

Guelph, ON

REV.	Record of Changes	Date	By
△	Preliminary Drawing	02MAR21	AC

Page Name: TYP. Debris Row Details

Drawn by:	Checked By:
AC	AW
Scale: NTS	Date: 02MAR21

Sheet: **05 OF 07**

ANSI B Size Page (Horizontal)

General Conditions

- Review installation procedures and coordinate the installation with other construction activities, such as grading, excavation, utilities, construction access, erosion control, etc.
- Engineered Drawings supersede all provided documentation, as the information furnished in this document is based on a typical installation.
- When installed based on Brentwood's Site Preparation and Installation Instructions or similar, a StormTank® system can support an HS-25 load.
- Coordinate the installation with manufacturer's representative/distributor to be on-site to review start up procedures and installation instructions.
- Components shall be unloaded, handled and stored in an area protected from traffic and in a manner to prevent damage.
- Assembled modules may be walked on, but vehicular traffic is prohibited until backfilled per Manufacturer's requirements. Protect the installation against damage with highly visible construction tape, fencing, or other means until construction is complete.

Ensure all construction occurs in accordance with Federal, Provincial and Local Laws, Ordinances, Regulations and Safety Requirements.

- Extra care and caution should be taken when temperatures are at or below 40° F (4.4° C).

1.0 StormTank® Assembly

StormTank® Modules:

StormTank® modules are delivered to the site as palletized components requiring simple assembly. No special equipment, tools or bonding agents are required; only a rubber mallet. A single worker can typically assemble a module in two minutes.

ASSEMBLY INSTRUCTIONS:

1. Place a platen on a firm level surface and insert the eight (8) columns into the platen receiver cups. Firmly tap each column with a rubber mallet to ensure the column is seated.
2. Place a second platen on a firm level surface. Flip the previously assembled components upside down onto the second platen, aligning the columns into the platen receiver cups.
3. Once aligned, seat the top assembly by alternating taps, with a rubber mallet at each structural column until all columns are firmly seated.

SIDE PANEL

4. If side panels are required, firmly tap the top platen upward to raise the top platen. Insert the side panel into the bottom platen.
5. Align the top of the side panel with the top platen and firmly seat the top platen utilizing a rubber mallet.

GENERAL NOTES:

- Remove packaging material and check for any damage. Report any damaged components to a StormTank® Distributor or Brentwood personnel.
- StormTank® components are backed by a one year warranty, when installed per manufacturer's recommendations.

2.0 Basin Excavation

1. Stake out and excavate to elevations per approved plans.Excavation Requirements:
   a. Sub-grade excavation must be a minimum of 6" (152 mm) below designed StormTank® Module invert.
   b. The excavation should extend a minimum of 12" (305 mm) beyond the StormTank® dimensions in each length and width (an additional 24" [610 mm] in total length and total width) to allow for adequate placement of side backfill material.
   c. Remove objectionable material encountered within the excavation, including protruding material from the walls.
   d. Furnish, install, monitor and maintain excavation support (e.g., shoring, bracing, trench boxes, etc.) as required by Federal, Provincial and Local Laws, Ordinances, Regulations and Safety Requirements.

3.0 Sub-Grade Requirements

1. Sub-grade shall be unfrozen, level (plus or minus 1%), and free of lumps or debris with no standing water, mud or muck. Do not use materials nor mix with materials that are frozen and/or coated with ice or frost.

2. Unstable, unsuitable and/or compromised areas should be brought to the Engineer's attention and mitigating efforts determined prior to compacting the sub-grade.

3. Sub-grade must be compacted to 95% Standard Proctor Density or as approved by the Engineer of Record. If code requirements restrict subgrade compaction, it is the requirement of the geotechnical Engineer to verify that the bearing capacity and settlement criteria for support of the system are met. *

* The Engineer of Record shall reference Brentwood document Appendix A for minimum soil bearing capacity required based on Load Rating and top cover depth. Minimum soil bearing capacity is required so that settlements are less than 1" through the entire sub-grade and do not exceed long-term 1/2" differential settlement between any two adjacent units within the system. Sub-grade must be designed to ensure soil bearing capacity is maintained throughout all soil saturation levels.

4.0 Leveling Bed Installation

1. Install geotextile fabric and/or liner material, as specified.
   a. Geotextile fabric shall be placed per manufacturer's recommendations.
   b. Additional material to be utilized for wrapping above the system must be protected from damage until use.

2. After the geotextile is secured, place a minimum 6" (152 mm) Leveling Bed.
   a. Material should be a 3/4" (19 mm) angular stone meeting Appendix B – Acceptable Fill Material.
   b. Material should be raked free of voids, lumps, debris, sharp objects and plate vibrated to a level with a maximum 1% slope.

3. Correct any unsatisfactory conditions.

5.0 StormTank® Module Placement

1. 1. Install geotextile fabric and/or liner material, as specified.
   a. Geotextile fabric shall be placed per manufacturer's recommendations.
   b. Additional material to be utilized for wrapping above the system must be protected from damage until use.

2. Mark the footprint of the modules for placement.
   a. Ensure module perimeter outline is square or similar prior to Module placement.
   b. Care should be taken to note any connections, ports or other irregular units to be placed.

3. Install the individual modules by hand, as detailed below.
   a. The modules should be installed as shown in the StormTank® submittal drawings with the short side of perimeter modules facing outward, except as otherwise required.
   b. Make sure the top/bottom platens are in alignment in all directions to within a maximum 1/4" (6.4 mm).
   c. For double stack configurations:
      i. Install the bottom module first. **DO NOT INTERMIX VARIOUS MODULE HEIGHTS ACROSS LAYERS.** Backfilling prior to proceeding to second layer is optional.
      ii. Insert stacking pins (2 per module) into the top platen of the bottom module.
      iii. Place the upper module directly on top of the bottom module in the same direction, making sure to engage the pins.

4. Install the modules to completion, taking care to avoid damage to the geotextile and/or liner material.

5. Locate any ports or other penetration of the StormTank®.
   a. Install ports/penetrations in accordance with the approved submittals, contract documents and manufacturer's recommendations.

6. Upon completion of module installation, wrap the modules in geotextile fabric and/or liner.
   a. Geotextile fabric shall be wrapped and secured per manufacturer's recommendations.
   b. Seal any ports/penetrations per Manufacturer's requirements

Notes:

- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations.

6.0 Side Backfill

1. Inspect all geotextile, ensuring that no voids or damage exists; which will allow sediment into the StormTank® system.

2. Adjust the stone/soil interface geotextile along the side of the native soil to ensure the geotextile is taught to the native soil.

3. Once the geotextile is secured, begin to place the Side Backfill.
   a. a. Material should be a 3/4" (19 mm) angular stone meeting Appendix B – Acceptable Fill Material.
   b. b. Backfill sides "evenly" around the perimeter without exceeding single 12" (305 mm) lifts.
   c. Place material utilizing an excavator, dozer or conveyor boom.
   d. Utilize a plate vibrator to settle the stone and provide a uniform distribution.

Notes:

- Do not apply vehicular load to the modules during placement of side backfill. All material placement should occur with equipment located on the native soil surrounding the system.
- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations.
-

7.0 Top Backfill (Stone)

1. Begin to place the Top Backfill.
   a. Material should be a 3/4" (19 mm) angular stone meeting Appendix B – Acceptable Fill Material.
   b. Place material utilizing an excavator, dozer or conveyor boom (Appendix C – Material Placement) and use a walk-behind plate vibrator to settle the stone and provide an even distribution.

DO NOT DRIVE ON THE MODULES WITHOUT A MINIMUM 12" (305 mm) COVER.

2. Upon completion of Top Backfilling, wrap the system in geotextile fabric and/or liner per manufacturer's recommendations.

3. Install metallic tape around the perimeter of the system to mark the area for future utility detection.

Notes:

- If damage occurs to the geotextile fabric or impermeable liner, repair the material in accordance with the geotextile/liner Manufacturer's recommendations.

8.0 Suitable Compactable Fill

Following Top Backfill placement and geotextile fabric wrapping; complete the installation as noted below.

Vegetated Area

1. Place fill onto the geotextile.
   a. Maximum 12" (305 mm) lifts, compacted with a vibratory plate or walk behind roller to a minimum of 90% Standard Proctor Density.
   b. The minimum top cover to finished grade should not be less than 24" (610 mm) and the maximum depth from final grade to the bottom of the lowest module should not exceed 11' (3.35 m).

2. Finish to the surface and complete with vegetative cover.

Impervious Area

1. Place fill onto the geotextile.
   a. Maximum 12" (305 mm) lifts, compacted with a vibratory plate or walk behind roller to a minimum of 90% Standard Proctor Density.
   b. The minimum top cover to finished grade should not be less than 24" (610 mm) and the maximum depth from final grade to the bottom of the lowest module should not exceed 11' (3.35 m).

2. Finish to the surface and complete with asphalt, concrete, etc.

Notes:

- A vibratory roller may only be utilized after a minimum 24" (610 mm) of compacted material has been installed or for the installation of the asphalt wearing course.
- If damage occurs to the geotextile fabric, repair the material in accordance with the geotextile Manufacturer's recommendations.
- For most recent installation guidelines visit: http://www.brentwoodindustries.com/products/stormwater-management/stormtank/module.php#feature5

9.0 Inspection and Maintenance

If the following inspections and maintenance procedures are not followed as specified below then the end-user is responsible for the performance of the modules. These Maintenance procedure must be performed after a heavy rainfall, flooding or any incident that will vary the flow of water drastically.

Inspection

1. Inspect all observation ports, inflow and outflow connection and the discharge area
2. Identify and log any sediment and debris accumulation, system backup, or discharge rate changes.
3. If there is a sufficient need for a cleanout, contact a local cleaning company for assistance.

Cleaning:

1. If a pretreatment device is installed, follow manufacturer recommendations.
2. Using vacuum pump truck, evacuate debris from the inflow and outflow points.
3. Flush the system with clean water, forcing debris from the system.
4. Repeat steps 2 and 3 until no debris is evident.

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1871 & 1879 GORDON STREET

Guelph, ON

REV.	Record of Changes	Date	By
△	Preliminary Drawing	02MAR21	AC

Page Name: Supplementary Notes

Drawn by:	Checked By:
AC	AW
Scale: NTS	Date: 02MAR21

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Appendix A - Bearing Capacity Tables

Cover		HS-25 (Unfactored)		HS-25 (Factored)	
English (in.)	Metric (mm)	English (ksf)	Metric (kPa)	English (ksf)	Metric (kPa)
24	610	1.89	90.45	4.75	227.43
25	635	1.82	86.96	4.53	216.9
26	660	1.75	83.78	4.34	207.8
27	686	1.69	80.88	4.16	199.18
28	711	1.63	78.24	3.99	191.04
29	737	1.58	75.82	3.84	183.86
30	762	1.54	73.62	3.7	177.16
31	787	1.5	71.6	3.57	170.93
32	813	1.46	69.75	3.45	165.19
33	838	1.42	68.06	3.34	159.92
34	864	1.39	66.51	3.24	155.13
35	889	1.36	65.1	3.14	150.34
36	914	1.33	63.8	3.05	146.03
37	940	1.31	62.62	2.97	142.2
38	965	1.29	61.54	2.9	138.85
39	991	1.26	60.55	2.83	135.5
40	1,016	1.25	59.65	2.76	132.15
41	1,041	1.23	58.84	2.7	129.28
42	1,067	1.21	58.09	2.67	127.84
43	1,092	1.2	57.42	2.6	124.49
44	1,118	1.19	56.81	2.55	122.09
45	1,143	1.18	56.26	2.5	119.7
46	1,168	1.16	55.77	2.46	117.79
47	1,194	1.16	55.33	2.42	115.87
48	1,219	1.15	54.94	2.39	114.43
49	1,245	1.14	54.59	2.36	113
50	1,270	1.13	54.29	2.33	111.56
51	1,295	1.13	54.03	2.3	110.12
52	1,321	1.12	53.8	2.27	108.69
53	1,346	1.12	53.62	2.25	107.73
54	1,372	1.12	53.46	2.23	106.77
55	1,397	1.11	53.34	2.21	105.82
56	1,422	1.11	53.24	2.19	104.86
57	1,448	1.11	53.18	2.17	103.9
58	1,473	1.11	53.14	2.16	103.42
59	1,499	1.11	53.12	2.14	102.46
60	1,524	1.11	53.13	2.13	101.98
61	1,549	1.11	53.16	2.12	101.51
62	1,575	1.11	53.21	2.11	101.03
63	1,600	1.11	53.28	2.1	100.55
64	1,626	1.11	53.37	2.09	100.07
65	1,651	1.12	53.48	2.08	99.59
66	1,676	1.12	53.61	2.08	99.59
67	1,702	1.12	53.75	2.07	99.11
68	1,727	1.13	53.91	2.07	99.11
69	1,753	1.13	54.08	2.06	98.63
70	1,778	1.13	54.26	2.06	98.63
71	1,803	1.14	54.46	2.06	98.63

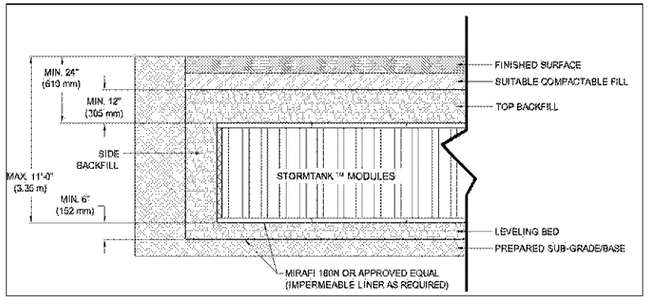
Cover		HS-25 (Unfactored)		HS-25 (Factored)	
English (in.)	Metric (mm)	English (ksf)	Metric (kPa)	English (ksf)	Metric (kPa)
67	1,702	1.12	53.75	2.07	99.11
68	1,727	1.13	53.91	2.07	99.11
69	1,753	1.13	54.08	2.06	98.63
70	1,778	1.13	54.26	2.06	98.63
71	1,803	1.14	54.46	2.06	98.63
72	1,829	1.14	54.67	2.06	98.63
73	1,854	1.15	54.9	2.06	98.63
74	1,880	1.15	55.13	2.06	98.63
75	1,905	1.16	55.38	2.06	98.63
76	1,930	1.16	55.64	2.06	98.63
77	1,956	1.17	55.9	2.06	98.63
78	1,981	1.17	56.18	2.06	98.63
79	2,007	1.18	56.46	2.07	99.11
80	2,032	1.19	56.76	2.07	99.11
81	2,057	1.19	57.06	2.07	99.11
82	2,083	1.2	57.37	2.08	99.59
83	2,108	1.2	57.69	2.08	99.59
84	2,134	1.21	58.02	2.09	100.07
85	2,159	1.22	58.35	2.09	100.07
86	2,184	1.23	58.69	2.1	100.55
87	2,210	1.23	59.04	2.11	101.03
88	2,235	1.24	59.39	2.11	101.03
89	2,261	1.25	59.75	2.12	101.51
90	2,286	1.26	60.11	2.13	101.98
91	2,311	1.26	60.48	2.13	101.98
92	2,337	1.27	60.86	2.14	102.46
93	2,362	1.28	61.24	2.15	102.94
94	2,388	1.29	61.62	2.16	103.42
95	2,413	1.3	62.01	2.17	103.9
96	2,438	1.3	62.41	2.18	104.38
97	2,464	1.31	62.81	2.19	104.86
98	2,489	1.32	63.21	2.2	105.34
99	2,515	1.33	63.62	2.21	105.82
100	2,540	1.34	64.03	2.22	106.29
101	2,565	1.35	64.45	2.23	106.77
102	2,591	1.35	64.87	2.24	107.25
103	2,616	1.36	65.29	2.25	107.73
104	2,642	1.37	65.72	2.27	108.69
105	2,667	1.38	66.15	2.28	109.17
106	2,692	1.39	66.58	2.29	109.65
107	2,718	1.4	67.02	2.3	110.12
108	2,743	1.41	67.45	2.31	110.6
109	2,769	1.42	67.9	2.33	111.56
110	2,794	1.43	68.34	2.34	112.04
111	2,819	1.44	68.79	2.35	112.52
112	2,845	1.45	69.24	2.36	113
113	2,870	1.46	69.69	2.38	113.96
114	2,896	1.47	70.15	2.39	114.43

Notes: 1. Additional load ratings and associated bearing capacities may be applicable on a case by case basis. Please contact your local Brentwood Representative.

Appendix B - ACCEPTABLE FILL MATERIALS

Material Location	Description	AASHTO M43 Designation	ASTM D2321 Class	Compaction/Density
Finished Surface	Topsoil, hardscape, stone, concrete or asphalt per engineer of record.	N/A	N/A	Prepare per engineered plans.
Suitable Compaction Fill	Granular well graded soil/aggregate, typically road base or earthen fill, maximum 4" particle size.	56, 57, 6, 67, 68 Earth	I & II III (Earth Only)	Place in max. 12" lifts to a min. 90% standard proctor density.
Top Backfill	Crushed angular stone placed between modules and road base or earthen fill.	56, 57, 6, 67, 68	I & II	Plate compacted to provide evenly distributed layers.
Side Backfill	Crushed angular stone placed between earthen walls amd modules.	56, 57, 6, 67, 68	I & II	Place in uniform 12" lifts around the system.
Leveling Bed	Crushed angular stone placed to provide level surface for installation of modules.	56, 57, 6, 67, 68	I & II	Plate vibrated to achieve level surface.

* See Appendix C - Material Placement for limitations



Notes:
2. All stone must be angular stone meeting ASTM D2321. Recycled concrete may be utilized when meeting acceptable gradation and ASTM standards.
3. The sub-grade is to be prepared to meet bearing and compaction requirements. Please see engineer of record's design.
4. Storage of materials such as construction materials, equipment, soils, etc. over the StormTank® system is strictly prohibit
5. Please contact a Geotechnical Engineer and the Brentwood representative prior to utilization of any material not listed abo

Appendix C - MATERIAL PLACEMENT GUIDELINES

Material Location	Placement Methods	Tired Equipment Limitations	Tracked Equipment Limitations	Roller Limitations
Finished Surface	Numerous methods may be utilized. Material dumping on to system be limited unless otherwise noted.	Asphalt can be dumped into pavers.		Vibratory rollers may only be utilized if compacted cover exceeds 24" (610 mm) or for pavement installation.
Suitable Compactable Fill	Utilize an excavator, skid loader or dozer to place material. (Max. gross operating load of 6000 lbs. [2,721 kg] or less).	No DUMPING by dump trucks. No wheel loads unitl ill approved by Engineer of Record.	SMALL DOZERS ONLY (Max. gross operating load of 6,000 lbs. [2,721 kg] or less).	Static rollers ONLY are permitted until compacted cover exceeds 24" (610 mm).
Top Backfill	Utilize an excavator bucket or stone conveyor, positioned off of system, to uniformly backfill on the top of modules. No DUMPING directly onto modules by dump trucks.	No DUMPING by dump trucks. No wheel loads unitill approved by Engineer of Record.	Utilize an excavator or skid loader (Max. gross operating load of 6,000 lbs. [2,721 kg] once a min. 12" (305 mm) has been placed and compacted.	No rollers allowed at this time.
Side Backfill	Utilize an excavator bucket or stone conveyor, positioned off of system, to uniformly backfill on the top of modules. Stone to be placed in max. 12" (305mm) lifts until stone reaches the top of modules.	No equipment is permitted on the modules during the side backfilling progress.		
Levelling Bed	No limitations			

Notes:
1. Storage of materials such as construction materials, equipment, soils, etc. over the StormTank® system is strictly ***prohibited.***
2. Please contact a Brentwood representative/distributor prior to utilization of any equipment not listed above.
3. During paving operations, it may be necessary to utilize dump operations for paving equipment. Additional precautions should be utilized to limit heh dump distance and prevent rutting of road base.
4. It is recommended that all backfilling operations be completed with low ground pressure vehicles such as mini excavators, skid steers, etc. ***All*** *equipment is to access system by a level approach to the system.*

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Excavation Required	284.02 m³
Excavation Depth	2.59m
Stone Type	19mm clear
Stone Void Space	40%
Module Type (Bottom)	25 Series ST-36
Module Type (Top)	25 Series ST-36

1871 & 1879 GORDON STREET

Guelph, ON

REV.	Record of Changes	Date	By
1	Preliminary Drawing	02MAR21	AC

Page Name: Supplementary Notes

Drawn by:	Checked By:
AC	AW
Scale: NTS	Date: 02MAR21

Sheet:

07 OF 07

Appendix C
Water Budget Analysis

1871 and 1879 Gordon Street
City of Guelph
Table 1 : Monthly Water Balance - Infiltration Gallery
GMBP Prj #: 118070

EXISTING CONDITION

Contributing Catchments: 100
Contributing Area = 0.329 ha
Percent Impervious = 35%
Soil Type: Fine Sand
Vegetation: Shallow-rooted crops
Root Zone Depth = 0.5m
Soil Moisture Retention Capacity = 50mm
Runoff Factor = 0.48

Month	Daily Average Temperature (°C)	Monthly Heat Index	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factors	Adjusted Potential Evapotranspiration (mm)	Average Precipitation (mm)	P-PE (mm)	Accum. Pot. Water Loss (mm)	Storage (mm)	ΔS (mm)	Actual Evapotrans-piration (mm)	Moisture Surplus (mm)	Water Runoff (mm)	Snow Melt Runoff (mm)	Total Recharge & Runoff (mm)	Actual Runoff (mm)	Runoff Volume (m^3)	Recharge Volume (m^3)
Jan	-6.5	0.00	0.0	24.3	0.0	65.2	65.2		186.4	0.0	0.0	0.0	11.8	0.0	11.8	5.6	19	20
Feb	-5.5	0.00	0.0	24.6	0.0	54.9	54.9		241.3	0.0	0.0	0.0	5.9	0.0	5.9	2.8	9	10
Mar	-1.0	0.00	0.0	30.6	0.0	61.0	61.0		302.3	0.0	0.0	0.0	2.9	0.0	2.9	1.4	5	5
Apr	6.2	1.39	1.0	33.6	33.6	74.5	40.9		50.0	0.0	25.8	48.7	24.3	25.2	49.6	23.8	78	85
May	12.5	4.00	2.0	37.8	75.6	82.3	6.7		50.0	0.0	58.1	24.2	24.3	113.5	137.8	66.1	218	236
Jun	17.6	6.72	2.9	38.4	111.4	82.4	-29.0	-29.0	27.0	-23.0	81.0	24.4	24.3	56.8	81.1	38.9	128	139
Jul	20.0	8.16	3.4	38.7	131.6	98.6	-33.0	-61.9	14.9	-12.1	85.1	25.6	24.9	28.4	53.3	25.6	84	91
Aug	18.9	7.49	3.2	36.0	115.2	83.9	-31.3	-93.2	7.0	-7.9	70.6	21.2	23.1	14.2	37.3	17.9	59	64
Sep	14.5	5.01	2.4	31.2	74.9	87.8	12.9		19.9	12.9	57.6	17.3	20.2	7.3	27.5	13.2	43	47
Oct	8.2	2.12	1.3	28.5	37.1	67.4	30.4		50.0	30.1	28.5	8.8	14.5	3.9	18.4	8.8	29	32
Nov	2.5	0.35	0.4	24.3	9.7	87.1	77.4		50.0	0.0	7.5	79.6	47.1	2.0	49.1	23.6	77	84
Dec	-3.3	0.00	0.0	23.1	0.0	71.2	71.2		121.2	0.0	0.0	0.0	23.5	1.0	24.5	11.8	39	42
Total		**35.2**				**916.3**	**327.3**				**414.2**	**249.8**	**246.8**	**252.3**	**499.1**	**239.6**	**788**	**854**

POST-DEVELOPMENT CONDITION

Contributing Catchments: 200, 201, 202, 203
Contributing Area = 0.329 ha
Percent Impervious = 77%
Soil Type: Fine Sand
Vegetation: Shallow-rooted crops
Root Zone Depth = 0.5m
Soil Moisture Retention Capacity (mm)= 50mm
Runoff Factor = 0.82
Evapotranspiration Factor for Impervious Surfaces = 0.34

Month	Daily Average Temperature (°C)	Monthly Heat Index	Unadjusted Daily Potential Evapotranspiration (mm)	Correction Factors	Adjusted Potential Evapotranspiration (mm)	Average Precipitation (mm)	P-PE (mm)	Accum. Pot. Water Loss (mm)	Storage (mm)	ΔS (mm)	Actual Evapotrans-piration (mm)	Moisture Surplus (mm)	Water Runoff (mm)	Snow Melt Runoff (mm)	Total Recharge & Runoff (mm)	Total Recharge & Runoff (m^3)	Enhanced Recharge (m^3)	Runoff Volume (m^3)	Recharge Through Pervious Surfaces (m^3)	Total Recharge Volume (m^3)
Jan	-6.5	0.00	0.0	24.3	0.0	65.2	65.2		186.4	0.0	0.0	0.0	14.2	0.0	14.2	46.7	34	10	2	36
Feb	-5.5	0.00	0.0	24.6	0.0	54.9	54.9		241.3	0.0	0.0	0.0	7.1	0.0	7.1	23.4	17.1	5.1	1.2	18.2
Mar	-1	0.00	0.0	30.6	0.0	61.0	61.0		302.3	0.0	0.0	0.0	3.5	0.0	3.5	11.7	8.5	2.6	0.6	9.1
Apr	6.2	1.39	1.0	33.6	33.6	74.5	40.9		50.0	0.0	16.5	58.0	29.0	25.2	54.2	178.4	130.3	39.2	8.8	139.2
May	12.5	4.00	2.0	37.8	75.6	82.3	6.7		50.0	0.0	37.2	45.1	37.1	113.5	150.6	495.5	362.0	108.9	24.6	386.5
Jun	17.6	6.72	2.9	38.4	111.4	82.4	-29.0	-29.0	27.0	-23.0	51.8	53.6	45.3	56.8	102.1	335.9	245.4	73.9	16.7	262.0
Jul	20	8.16	3.4	38.7	131.6	98.6	-33.0	-61.9	14.9	-12.1	54.4	56.3	50.8	28.4	79.2	260.5	190.3	57.3	12.9	203.3
Aug	18.9	7.49	3.2	36.0	115.2	83.9	-31.3	-93.2	7.0	-7.9	45.1	46.7	48.7	14.2	62.9	207.0	151.3	45.5	10.3	161.5
Sep	14.5	5.01	2.4	31.2	74.9	87.8	12.9		19.9	12.9	36.8	38.1	43.4	7.3	50.7	166.8	121.9	36.7	8.3	130.1
Oct	8.2	2.12	1.3	28.5	37.1	67.4	30.4		50.0	30.1	18.2	19.1	31.3	3.9	35.2	115.7	84.5	25.4	5.7	90.2
Nov	2.5	0.35	0.4	24.3	9.7	87.1	77.4		50.0	0.0	4.8	82.3	56.8	2.0	58.8	193.4	141.3	42.5	9.6	150.9
Dec	-3.3	0.00	0.0	23.1	0.0	71.2	71.2		121.2	0.0	0.0	0.0	28.4	1.0	29.4	96.7	70.7	21.3	4.8	75.4
Total		**35.2**				**916.3**	**327.3**				**264.8**	**399.2**	**395.6**	**252.3**	**647.9**	**2,131.7**	**1,557.3**	**468.7**	**105.7**	**1,663.0**

Notes: Precipitation and Temperature data from Environment Canada Climate Normals 1981-2010 for Waterloo Wellington A
Monthly water balance strategy as outlined in the document *Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance (Thornthwaite and Mather, 1957)*

1871 and 1879 Gordon Street
City of Guelph
Table 2 : Monthly Enhanced Recharge
GMBP Prj #: 118170

Infiltration Gallery #1

Site Infiltration Gallery

Structure Length =	18.29	m
Structure Width =	6.40	m
Structure Depth =	1.80	m

Contact Area of Gallery = 205.94 sq m

Volume of Gallery = 207.65 cu m

Storage Volume of Gallery = 207.65 cu m

A = contact area of structure =	205.94	sq m	Note: Drawdown is based on flow from sides and bottom of gallery
V = runoff volume to be infiltrated =	207.65	cu m	
P = percolation rate of native soils =	61.5	mm/hr	
n = porosity of storage media (weighted) =	0.49		
T = retention time =	Solve for T		

T = (1000 x V) / (P x n x A) = 33.46 hours or 1.4 day draindown period

Contributing Area	0.253	ha	(Area to Infiltration Gallery)	
Recharge Time	33.46	hours	/ 1.39	days
Recharge Volume Potential	207.65	m^3		

Month	Total Recharge & Runoff (mm)	No. of days	Max Potential Recharge (m^3)	Available Recharge (m^3)	Enhanced Recharge (m^3)
Jan	14.2	31	4,617	36	34
Feb	7.1	28	4,170	18	17
Mar	3.5	31	4,617	9	9
Apr	54.2	30	4,468	137	130
May	150.6	31	4,617	381	362
Jun	102.1	30	4,468	258	245
Jul	79.2	31	4,617	200	190
Aug	62.9	31	4,617	159	151
Sep	50.7	30	4,468	128	122
Oct	35.2	31	4,617	89	85
Nov	58.8	30	4,468	149	141
Dec	29.4	31	4,617	74	71
Total	**647.9**	**365.0**	**54,364.6**	**1,639.3**	**1,557.3**

1871 and 1879 Gordon Street
City of Guelph
Table 3 : Monthly Water Balance Summary
GMBP Prj #: 118170

Month	Site		
	Existing **Recharge** Volume (m^3)	Proposed **Recharge** Volume (m^3)	Percent Change (%)
Jan	20	36	81.0%
Feb	10	18	81.0%
Mar	5	9	81.0%
Apr	85	139	64.1%
May	236	387	64.0%
Jun	139	262	88.9%
Jul	91	203	122.8%
Aug	64	162	153.3%
Sep	47	130	176.7%
Oct	32	90	186.5%
Nov	84	151	79.7%
Dec	42	75	79.7%
Total	**854**	**1,663**	**94.8%**

Month	Site		
	Existing **Runoff** Volume (m^3)	Proposed **Runoff** Volume (m^3)	Percent Change (%)
Jan	19	10	-44.7%
Feb	9	5	-44.7%
Mar	5	3	-44.7%
Apr	78	39	-49.9%
May	218	109	-49.9%
Jun	128	74	-42.3%
Jul	84	57	-32.0%
Aug	59	46	-22.7%
Sep	43	37	-15.5%
Oct	29	25	-12.5%
Nov	77	43	-45.1%
Dec	39	21	-45.1%
Total	**788**	**469**	**-40.5%**