



Cambridge Mill Hotel- Condo

Functional Servicing and Stormwater Management Report

Project Location:

130 Water Street North, Cambridge, ON

Prepared for:

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October 15, 2020

MTE File No.: 35571-200



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Existing Conditions Plan MTE Drawing No. C1.1	Appended Separately.
Conceptual Site Grading Plan MTE Drawing No. F1.1	Appended Separately.
Conceptual Site Servicing Plan MTE Drawing No. F1.2	Appended Separately.

1.0 Introduction

MTE Consultants Inc. was retained to complete a Functional Servicing and Stormwater Management Report (FSSWMR) for a new residential/commercial development to be constructed at 130 Water Street North (herein referred to as 'the Site') in the City of Cambridge. This report is required to support the Official Plan Amendment and Zoning By-Law Amendment Applications. The property is currently designated "Urban Growth Centre" within the Region of Waterloo Official Plan and is designated 'Community Core Area (Galt City Centre)' within the City of Cambridge Official Plan. The current zoning of the site is Commercial Residential, (H)(F)C1RM1. The development proposes to increase the permitted building height and density within the current zoning.

The property is bounded to the north by existing residential condominiums (Waterscape), to the east by Water Street North, to the south by the Cambridge Mill, and to the west by the east bank levee or the Grand River. For the exact location of the Site, refer to Figure 1.0.

The proposed development for the Site is the construction of a 37 storey, 253 residential unit condominium building and a 28 storey, 146 unit hotel building connected by a two storey base podium complete with one and a half levels of above/ at grade parking and one level under building parking and associated drive aisles. It is noted that 26 of the 146 hotel suites will be treated as long-term stay hotel units and have been considered the same use as a condominium unit for the purposes of the servicing calculation.

The purpose of this study is to support the Official Plan Amendment and Zoning By-Law Amendment Applications by reviewing the opportunities and constraints for the subject property with respect to servicing, grading, and stormwater management; reviewing the requirements of the reviewing agencies; and demonstrating the functional serviceability of the property. Pending approval of the Amendment applications, detailed engineering design of the Site will commence and be submitted to the City in support of a Site Plan application.

2.0 Existing Conditions

2.1 Existing Topography

The Site encompasses an area of 0.626 ha and is comprised of existing asphalt parking areas and open landscaped space. In the existing condition, surface runoff from the Site drains to an existing private storm sewer system which connects to a municipal storm sewer that outlets directly to the Grand River. The Site is approximately 80% impervious in the existing condition. There is an elevation difference of approximately 1.5 metres between the north and south property line and approximately 1.0 metres between the east property line and the base of the levee. Adjacent to the north property line there is an existing retaining wall on the Waterscape property. The Site is regulated by the Grand River Conservation Authority and is within the floodplain of the Grand River. This property falls within the Galt City Centre Floodplain Special Policy Area (SPA).



FIGURE 1.0 Date: OCT. 05/2020
 Scale: N.T.S.

SITE LOCATION PLAN



Engineers, Scientists, Surveyors

2.2 Existing Servicing

2.2.1 Water

There is an existing 300mm diameter municipal watermain along the east side of Water Street North. The closest municipal fire hydrant is located approximately 30 metres south of the existing north driveway entrance to the Site, on the east side of Water Street North. The Site is currently not serviced with water.

The Site is located in Cambridge Zone 1 pressure zone (CAM1), with an existing Hydraulic Grade Line (HGL) of 332mASL. It should be noted that CAM1 will be undergoing adjustments to the HGL by the end of 2023. The future expected HGL is 323.5mASL.

2.2.2 Sanitary

There is an existing 900mm diameter municipal trunk sanitary sewer along the west side of Water Street North fronting the proposed development which drains south to an existing 675mm diameter municipal sanitary sewer within the Water Street North right of way. The closest manhole is located in front of the Site, approximately 37 metres north of the south driveway entrance off of Water Street North and is approximately three metres deep. There is an existing 675mm diameter trunk sanitary sewer located through the subject Site. It is unclear if this sewer has already been removed. The Site is currently not serviced with sanitary.

2.2.3 Storm

There is an existing 600mm diameter private storm sewer located within the Site, parallel with the east property line fronting Water Street North which drains south to an existing oil-grit-separator (OGS) located within the existing southerly Site entrance. This existing storm sewer conveys runoff from the existing residential development to the north of the Site (Waterscape), and also accepts some runoff from the Site through various storm structures. There is an existing easement over this storm sewer in favour of the Waterscape property.

Beyond the OGS, the 600mm diameter storm sewer outlets into an existing 900mm diameter municipal trunk storm sewer which outlets into the Grand River. The closest existing manhole along the trunk storm sewer is located within the south driveway entrance off of Water Street North and is approximately two metres deep. There is an existing easement over the municipal trunk storm sewer in favour of the City of Cambridge. There is also an existing 300mm diameter municipal storm sewer along the east side of Water Street North which drains south on Water Street North.

Surface runoff from the majority of the Site is conveyed overland to existing catchbasins within the parking lot, which outlet to the existing OGS and onto the 900mm diameter municipal trunk storm sewer that outlets to the Grand River.

2.3 Existing Soils Information

A geotechnical investigation for the Site was completed by Peto MacCallum Ltd. (PML) December 7 to 10, 2015. The investigation determined the depth to bedrock, and provided geotechnical design and construction recommendations to assist in the preliminary planning and design of the Site. In addition, a chemical screening investigation was conducted concurrently by MTE Consultants Inc. as the site was previously occupied by an industrial facility which was demolished.

In PML's investigation two boreholes were advanced to depths between 7.5 and 28.4 metres below the existing grade in order to determine the underlying soil conditions on the Site. PML had carried out previous geotechnical investigations at the Site in 1984 and 1986 and the pertinent borehole logs from that investigation were also used in order to determine the underlying soil conditions. In general, the subsurface stratigraphy encountered in the boreholes comprised surficial fill, and buried alluvium deposits, which were underlain by localized layers of sand and silt deposits and an extensive sand and gravel deposit which is underlain by probable bedrock. The surficial fill generally comprised sand and gravel near the ground surface and contained more numerous layers of black sandy silt with depth. The fill also contained concrete pieces, bricks, black tar and ash layers, and occasional organic/topsoil materials. The alluvium deposits were comprised of organic sand silty sand, silt, and clayey silt. Underlying the fill, native deposits of sand, sand and gravel, silt, sandy silt and silty sand deposits were contacted. These deposits also contained numerous cobbles and boulders.

The wet and saturated conditions in the boreholes reflect the ground water level at the Site. Water levels were measured to be approximately 4.44 and 4.85 metres below grade, relating to an elevation of 264.61 and 264.20 respectively. The ground water levels generally match the water levels of the adjacent Grand River. The ground water levels at the Site are expected to fluctuate respective of seasonal and weather events, along with the water level in the adjacent Grand River.

In addition to the water level measurements recorded as part of the geotechnical investigation, twenty-one monitoring wells were installed by MTE in addition to the five existing wells, for continuous groundwater monitoring to determine the existing high groundwater level across the Site. A Hydrogeological Characterization was completed by MTE for the Site, and the investigation and monitoring revealed that the high groundwater table is at an **elevation of 265.73**.

For more information, refer to the Geotechnical Investigation Revised Draft Report by Peto MacCallum Ltd. dated August 21, 2018, appended separately. A final Geotechnical Report should be issued for the Site prior to final design.

2.4 Reviewing Agencies

2.4.1 City of Cambridge

Conceptual grading, servicing and stormwater management designs as well as this Functional Servicing and Stormwater Management Report will be required for submission to the City of Cambridge in support of the Official Plan Amendment, the Zoning By-Law Amendment and the Site Plan applications. The City will also be responsible for the review and approval of site plans, detailed site grading, servicing, stormwater management, lighting and landscape designs and ultimately issuing building permits.

2.4.2 Grand River Conservation Authority (GRCA)

The Site falls within the floodplain of the Grand River and as such is regulated by the GRCA. The Site is designated in the City's Official Plan (OP) as part of the Galt City Centre Floodplain Special Policy Area. As such, a "fill permit" will need to be obtained from the GRCA prior to Site Plan Approval. In support of the fill permit application, this Functional Servicing and Stormwater Management Report and the site engineering design will be submitted to the GRCA for their review and approval.

2.4.3 Region of Waterloo

Water Street North is a Regional Road. As such, the Region of Waterloo will be circulated on the Official Plan Amendment, Zoning By-Law Amendment and the Site Plan Applications and will need to approve the site grading, servicing and stormwater management designs.

The Site is located within a Source Water Protection Area, WHSA 5, and will require a Notice of Source Water Protection Plan Compliance from the Region of Waterloo.

3.0 Proposed Grading and Servicing Strategy

Conceptual grading and servicing strategies for the proposed development were developed based on the topographic survey, plan and profile information, and the Conceptual Site Plan prepared by Martin Simmons, dated September 11, 2020.

3.1 Proposed Grading

The proposed development includes a 37 storey condominium building and a 28 storey hotel building connected by a two storey base podium, complete with one and a half levels of above/ at grade parking and one level of underbuilding parking and associated at grade drive aisles. The proposed grading strategy will respect the existing grades along Water Street North and match into the existing driveway entrances. An internal private drive aisle is proposed to connect the north and south driveway entrances to the Site, fronting the west face of the proposed building. The area between the west edge of the new drive aisle and the east edge of the existing asphalt trail along the Grand River will be re-graded slightly to accommodate the proposed development. New pedestrian walkway connections are proposed from the Site to the existing asphalt trail, and connecting to the neighbouring Cambridge Mill Restaurant.

Refer to Drawing C2.1 for an illustration of the conceptual grading design.

3.2 Proposed Servicing

Refer to Drawing C2.2 for an illustration of the conceptual servicing design described in the sections below.

3.2.1 Water

A new connection to the 300mm diameter municipal watermain along Water Street North will be required in order to service the proposed development. The required private water service size will be determined during detailed design, but will likely be 200mm diameter. The water service will enter the Site adjacent to the existing south driveway entrance and will continue west into the Site to connect to the west face of the proposed building/parking garage. For firefighting purposes, a new on-site hydrant is proposed fronting the west face of the proposed building. The proposed fire department connection will be located at the main entrance to the building, at a maximum of 45 metres from the proposed private hydrant. A fire flow analysis will be completed at the detailed design stage to ensure that adequate flow and pressure will be available at the proposed hydrant.

Based on the current Hydraulic Grade Line for Cambridge Zone 1 of 332mASL, any development with a finished road elevation below 276.1mASL will require individual pressure

reducing devices on each water service. The existing road elevation of Water Street North fronting of the development is between 268.5 and 267.5, therefore pressure reducing devices are required. However, if building occupancy occurs after the HGL modification expected to be completed in 2023, pressure reducing valves will no longer be required.

It should be noted that an internal booster pump will likely be required to achieve appropriate flow and pressure on the upper floors given the proposed height of the towers.

3.2.2 Sanitary

A sanitary flow design sheet has been prepared to determine the flows anticipated to be generated by the proposed development. Under the existing zoning of (H)(F)C1RM1 and permitted density of 250 units/ha, the maximum anticipated peak sanitary flow generation rate is 3.85L/s. With the proposed building having 146 hotel rooms (26 being long term stay hotel units) and 153 condo units, a commercial space of 0.42ha, and with an overall site area of 0.626ha, the resulting sanitary flow from the Site is expected to be 9.25 L/s. For the purpose of the sanitary flow calculation, the 26 units that will be treated as long-term stay hotel units have been considered the same use as a condominium unit to be conservative.

It is proposed that the Site will serviced by a new 250mm diameter sanitary service connection to the existing sanitary manhole and trunk sewer fronting the Site on Water Street North. The 250mm diameter sanitary sewer will enter the building approximately 40 metres north of the south driveway entrance from Water Street North. The private sanitary service will be installed at a slope that provides depth for the servicing of the building while maintaining adequate capacity. The sewer size, slope and inverts will be confirmed at detailed design.

A sanitary sewer capacity assessment was undertaken by the City which confirmed that there is sufficient downstream reserve capacity to service the proposed development.

3.2.3 Storm

In order to facilitate the construction of the proposed building, the existing 600mm diameter storm sewer running through the Site adjacent to the east property line is proposed to be relocated within the Water Street North right of way along the west curb line. A new catchbasin manhole is proposed within the right of way, just south of the existing shared driveway entrance to the north, which will accept some runoff from the Water Street North right of way. There is an existing catchbasin located just north of the south driveway entrance to the Site that is proposed to be shifted slightly south to accommodate the re-aligned storm sewer. The realigned storm sewer enters the Site at the south driveway entrance, upstream of the existing OGS.

It is anticipated that the existing 675mm diameter municipal trunk sanitary sewer that crosses Water Street North will be upsized to a 900mm diameter sewer in the future. The re-aligned storm sewer is proposed as a 675mm diameter sewer at a slope of 0.25% in order to provide proper clearance from the future 900mm diameter municipal truck sanitary sewer crossing and provide equal capacity to the existing storm sewer being removed through the Site. The re-aligned storm sewer will not only provide service to the Waterscape property, but will also improve the drainage along this section of Water Street North.

A private storm sewer system will be installed within the Site to collect runoff generated within the private drive aisle fronting the west side of the proposed building. The runoff collected in the storm sewers will be directed to an OGS unit located at the top of the ramp from the south driveway entrance on to the municipal trunk storm sewer that outlets to the Grand River. A new storm sewer connection to the building is also proposed to connect to the municipal trunk storm sewer on the Site.

Runoff from the drive aisle ramps off of the north and south driveway entrances will flow into catchbasins located at the base of the driveway entrances, and then onto the municipal trunk storm sewer. The sewer sizes, slopes and inverts will be confirmed at detailed design. Any uncollected runoff from the property will flow towards the Water Street North right-of-way, and will ultimately end up in the trunk storm sewer.

4.0 Preliminary Storm Water Management Design

4.1 SWM Criteria

The stormwater management design criteria for the subject site, as established by the City of Cambridge and the GRCA, are as follows:

- i) Attenuation of the post-development peak flows for the 5 and 100 year storm event to the pre-development (existing) peak flow;
- ii) Implementation of Enhanced (Level 1) water quality controls as per MOE (2003) guidelines;
- iii) Design the site, including flood-proofing the buildings, to meet the policies of the SPA in accordance with O. Reg. 150/06; and,
- iv) Implementation of Erosion and Sediment Control measures.

4.2 Water Quantity Control

In order to successfully complete the preliminary stormwater management design for the site, the following specific tasks were undertaken:

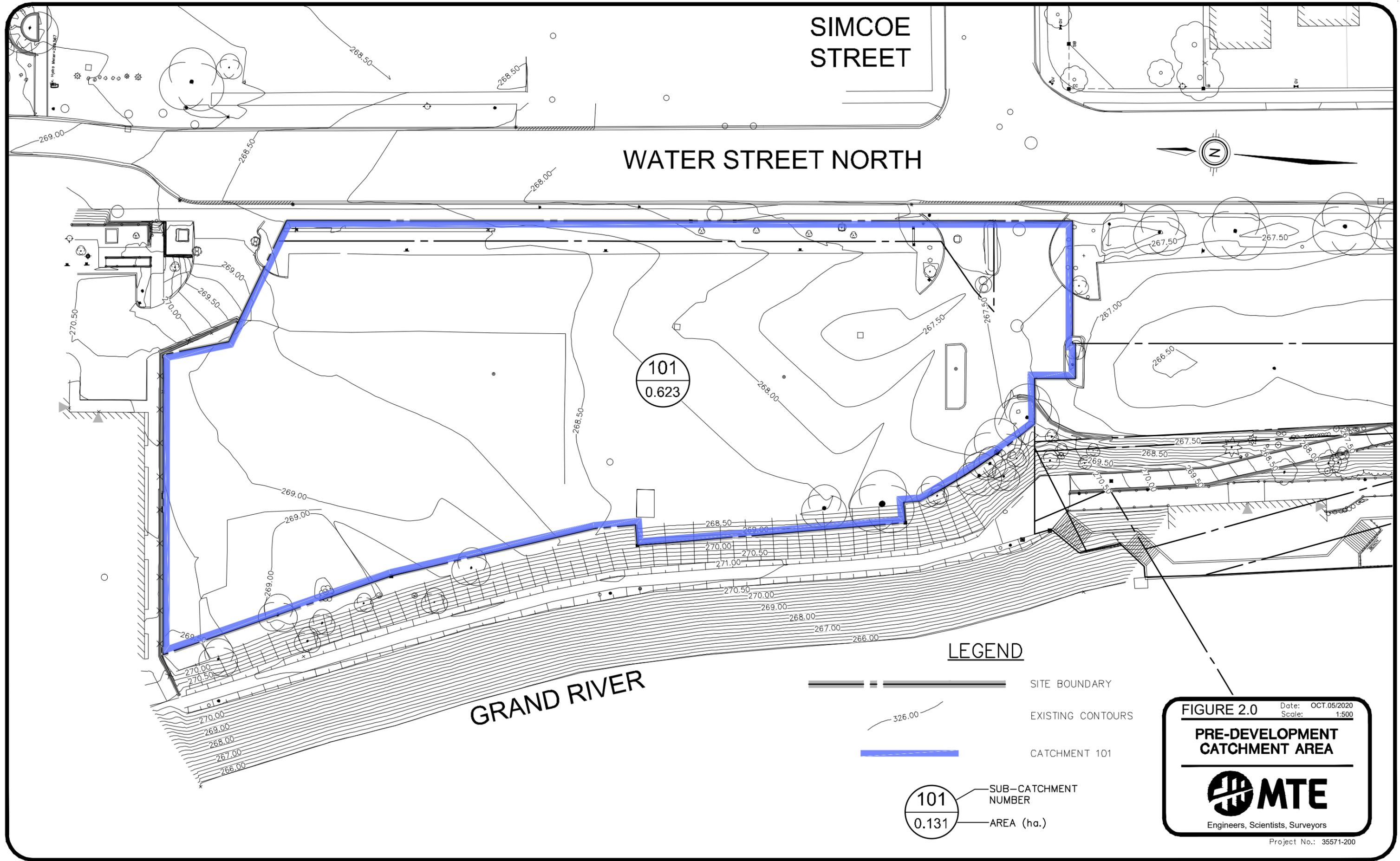
- i) Calculate the allowable runoff rates using MIDUSS NET;
- ii) Determine the percent impervious of the site and catchment parameters for inclusion in MIDUSS modeling; and,
- iii) Calculate post-development runoff hydrographs using MIDUSS NET.

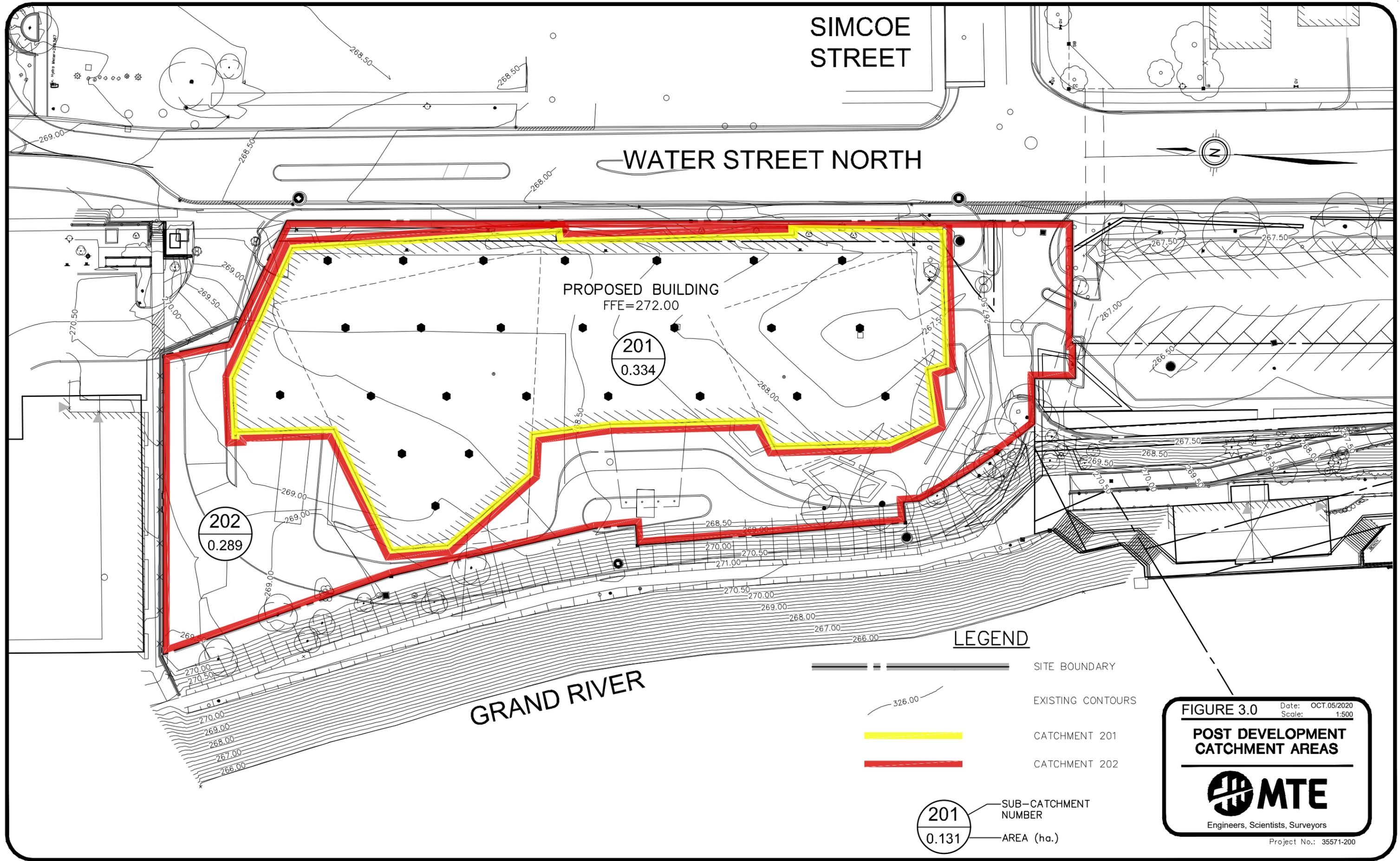
The following table summarizes the catchments used in modeling the Site. The post development condition was separated into two catchment areas: the building roof and the uncontrolled area. Figure 2.0 illustrates the limits of the pre-development catchment area. Figure 3.0 illustrates the limits of the post-development catchment areas.

Table 4.1 – Catchment Parameters

#	Catchment	Area (ha)	% Impervious	Pervious CN	Impervious CN	Slope (%)	Flow Length (m)
Pre-Development Catchment Area							
101	Total Site	0.623	80	75	98	3.0	60.0
Post Development Catchment Areas							
201	Building Roof	0.334	100	75	98	1.5	10.0
202	Uncontrolled Area	0.289	77	75	98	5.0	20.0

As described in section 2.3, a geotechnical investigation was undertaken by Peto MacCallum Ltd. The investigation revealed the Site comprised surficial fill, and buried alluvium deposits, which were underlain by sand and gravel deposits which is underlain by probable bedrock. Therefore, a pervious CN of 75 for grass areas is appropriate.





SIMCOE STREET

WATER STREET NORTH

PROPOSED BUILDING
FFE=272.00

201
0.334

202
0.289

GRAND RIVER

LEGEND

-  SITE BOUNDARY
-  EXISTING CONTOURS
-  CATCHMENT 201
-  CATCHMENT 202

201
0.131

SUB-CATCHMENT NUMBER
AREA (ha.)

FIGURE 3.0 Date: OCT.05/2020
Scale: 1:500

**POST DEVELOPMENT
CATCHMENT AREAS**



Engineers, Scientists, Surveyors

Project No.: 35571-200

The Site's impervious percentage under the existing condition is approximately 80% and will increase to approximately 89% under proposed development conditions. Runoff from the increased impervious area will need to be attenuated to reduce post development peak flows to pre-development (existing) rates. The water quantity control requirements for the Site can be achieved by utilizing flow control roof drains on the building roof. A maximum of 0.15 metres of ponding is permitted on the rooftop. The following table summarizes the expected flows that will be generated by the whole Site. Refer to Appendix B for the MIDUSS Output. Please note that these flows are subject to change at the detailed design stage.

Table 4.2 - Summary of Flows

Modeling Condition	5 year Storm Event (m³/s)	100 year Storm Event (m³/s)
Pre-development	0.133	0.208
Post Development	0.087	0.129

4.3 Water Quality Control

There is an existing Stormceptor Model STC750 installed on the Site, located within the existing storm easement for the Waterscape property, within the south driveway entrance to the Site. This existing OGS is proposed to remain to continue to provide water quality treatment for the storm runoff conveyed by the proposed 675mm diameter storm sewer. The Stormceptor was originally sized for both 130 and 170 Water Street North, however as part of the redevelopment of the Site, the existing parking lot at 130 Water Street North will be removed and this runoff will no longer be directed to the existing OGS. With the addition of the catchbasin manhole within Water Street North along the proposed re-aligned 675mm diameter storm sewer, additional runoff will be collected from the right-of-way. The drainage area within the right-of-way is less than that of the existing parking lot to be removed on the Site, and therefore the existing Stormceptor unit will continue to function as designed.

A new Stormceptor Model EFO4 will be installed on the private storm sewer system to provide water quality control for the runoff collected on the private drive aisle west of the proposed building. The chosen unit has been sized using the ETV particle size distribution and is expected to provide 66% TSS removal. (Refer to Appendix A for the sizing output from the Stormceptor Expert program.) The Stormceptor will require regular annual maintenance to ensure it is operating properly. The owner may be required to enter into a maintenance agreement with a suitable contractor to complete this work. In addition, all new storm structures will have a 600mm sump.

4.4 Erosion & Sediment Control

Precautions will need to be taken during construction to limit erosion and sedimentation tracking including the installation of sediment control fence, silt sacs and regular cleaning of the roadway. Typically, the following measures are recommended during construction for erosion and sedimentation control:

- i) Erosion and sedimentation facilities are to be installed prior to any area grading operations;
- ii) All erosion control measures are to be inspected and monitored by the contractor and repairs are to be completed as required; and,

- iv) All materials and equipment used for the purpose of site preparation and project completion should be operated and stored in a manner that prevents any deleterious substance from leaving the site.

5.0 Conclusions

Based on the foregoing analysis, it is concluded that:

- The proposed grading strategy will respect the existing grades along Water Street North and match into the existing driveway entrances off of the right of way, at the north and south end of the Site;
- Existing municipal infrastructure for water and sanitary is available for the development along Water Street North;
- Existing municipal infrastructure for storm is available within the Site;
- A fire flow analysis will be completed at the detailed design stage to ensure that adequate flow and pressure will be available at the proposed private hydrant; and,
- The SWM criteria can be satisfied with the implementation of onsite controls for water quantity and water quality.

Detailed grading and servicing designs and a detailed stormwater management design and report will be provided during detailed design in support of Site Plan Approval and Building Permits.

All of which is respectfully submitted,

MTE CONSULTANTS INC.

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Appendix A

Calculations

Cambridge Mill Hotel-Condo CITY OF CAMBRIDGE				SANITARY SEWER DESIGN SHEET ENGINEERING AND PUBLIC WORKS					Design Parameters																				
Project Number: 35571-200 Date: September 28, 2020 Design By: CAH Checked By: File: Q:\35571\200\Sanitary Sewer Design Sheet_2020-09-28.xls				Drainage Area Plan No:					Average Daily Flow		Resid. Density (ppu)			Mannings "n" 0.013															
LOCATION				RESIDENTIAL AREAS and POPULATION					SCHOOL, INSTITUTIONAL			COMMERCIAL			INDUSTRIAL			INFILTRATION			DESIGN								
STREET	AREA NO.	MANHOLE LOCATION		AREA	PROP. DENSITY		CUMMULATIVE	PEAK FACTOR "F"	PEAK RES. FLOW	HECTARES AND FLOW OF EACH ZONING									TOTALS- C-1 FLOW	AREA	CUMUL AREA	INFIL FLOW	TOTAL VOLUME FLOW	LENGTH	SLOPE	PIPE SIZE	CAPACITY	FULL FLOW VELOCITY	ACTUAL VELOCITY
		FROM MH	TO MH		ZONE	UNITS				POPUL.	AREA	POPUL.	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW											
				ha	p/unit	p/unit	1000s	ha	1000s	L/sec	ha	ha	L/sec	ha	ha	L/sec	L/sec	ha	ha	L/sec	L/sec	m	%	mm	L/sec	m/s	m/s		
(H)(F)C1RM1				0.62	156.00	0.285	0.285	4.0876	3.8508																				
Hotel Units* using DJW's #s						120.00	0.144	4.1967	1.9943																				
Condo Units					280.00	0.512	0.512	3.9687	6.4726																				
Commerical Space									8.4669			0.42	0.42	0.6300			0.6300	0.63	0.63	0.1565	9.2534		2.00	250	84.0571	1.713	1.126		

Stormceptor® EF Sizing Report

STORMCEPTOR®

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

09/24/2020

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

Project Name:	Cambridge Mill
Project Number:	33258
Designer Name:	Chelsea Hiebert
Designer Company:	MTE Consultants Inc.
Designer Email:	chiebert@mte85.com
Designer Phone:	519-743-6500
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Site Name:	Cambridge Mill
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Drainage Area (ha):	0.13
% Imperviousness:	100.00

Runoff Coefficient 'c': 0.90

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

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	4.58
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Net Annual Sediment (TSS) Load Reduction Sizing Summary	
Stormceptor Model	TSS Removal Provided (%)
EFO4	66
EFO6	68
EFO8	69
EFO10	70
EFO12	70

Recommended Stormceptor EFO Model: **EFO4**
 Estimated Net Annual Sediment (TSS) Load Reduction (%): **66**
 Water Quality Runoff Volume Capture (%): **> 90**



Stormceptor® EF Sizing Report

THIRD-PARTY TESTING AND VERIFICATION

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

PERFORMANCE

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

PARTICLE SIZE DISTRIBUTION (PSD)

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

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

Stormceptor®EF Sizing Report

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	49.9	49.9	0.33	20.0	16.0	70	35.1	35.1
2	7.0	56.9	0.65	39.0	33.0	70	4.9	40.1
3	7.0	63.9	0.98	59.0	49.0	70	4.9	45.0
4	4.4	68.3	1.30	78.0	65.0	67	3.0	47.9
5	3.2	71.5	1.63	98.0	81.0	64	2.0	50.0
6	3.5	75.0	1.95	117.0	98.0	63	2.2	52.2
7	3.1	78.1	2.28	137.0	114.0	62	1.9	54.1
8	2.3	80.4	2.60	156.0	130.0	60	1.4	55.5
9	1.9	82.3	2.93	176.0	146.0	59	1.1	56.6
10	2.0	84.3	3.25	195.0	163.0	57	1.1	57.8
11	1.8	86.1	3.58	215.0	179.0	57	1.0	58.8
12	1.4	87.5	3.90	234.0	195.0	55	0.8	59.5
13	1.3	88.8	4.23	254.0	211.0	54	0.7	60.2
14	1.1	89.9	4.55	273.0	228.0	53	0.6	60.8
15	1.1	91.0	4.88	293.0	244.0	53	0.6	61.4
16	0.8	91.8	5.20	312.0	260.0	52	0.4	61.8
17	1.0	92.8	5.53	332.0	276.0	52	0.5	62.3
18	0.9	93.7	5.85	351.0	293.0	51	0.5	62.8
19	0.7	94.4	6.18	371.0	309.0	51	0.4	63.2
20	0.8	95.2	6.51	390.0	325.0	50	0.4	63.6
21	0.6	95.8	6.83	410.0	342.0	50	0.3	63.9
22	0.5	96.3	7.16	429.0	358.0	50	0.2	64.1
23	0.4	96.7	7.48	449.0	374.0	49	0.2	64.3
24	0.2	96.9	7.81	468.0	390.0	48	0.1	64.4
25	0.2	97.1	8.13	488.0	407.0	48	0.1	64.5



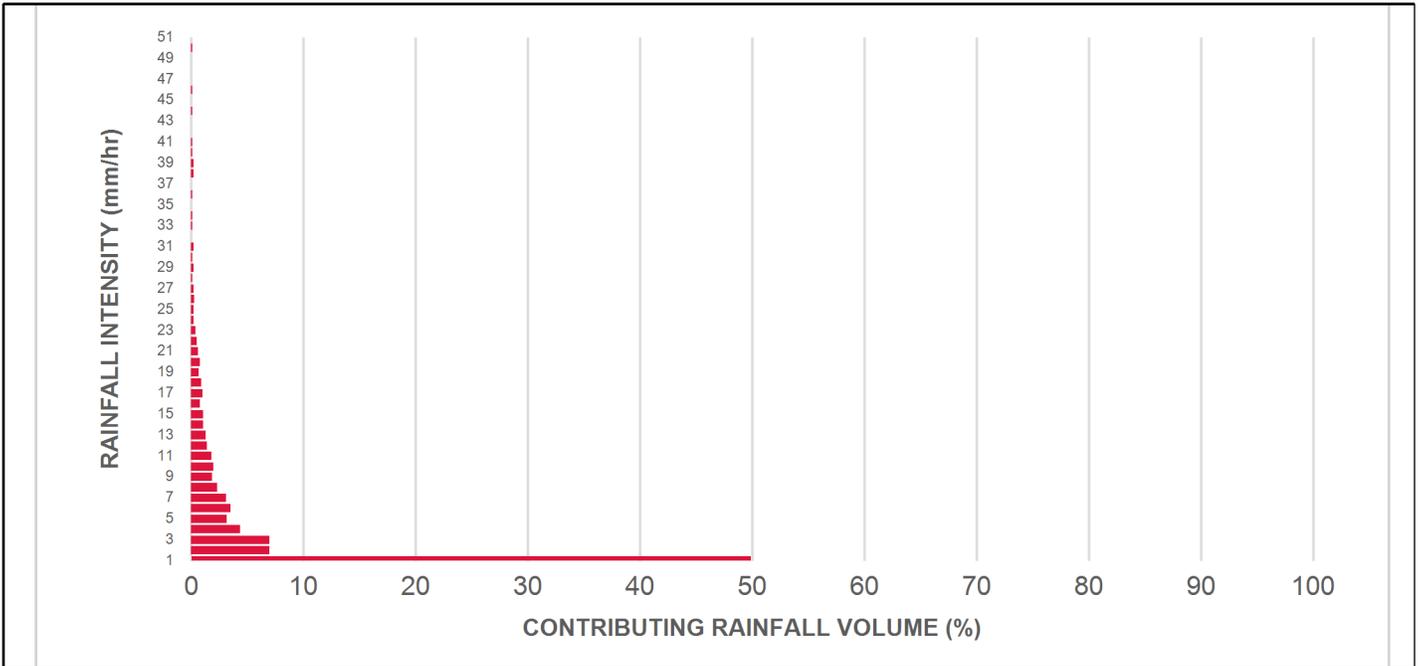
Stormceptor® EF Sizing Report

Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m ²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
26	0.3	97.4	8.46	507.0	423.0	47	0.1	64.6
27	0.2	97.6	8.78	527.0	439.0	47	0.1	64.7
28	0.1	97.7	9.11	546.0	455.0	47	0.0	64.8
29	0.2	97.9	9.43	566.0	472.0	46	0.1	64.9
30	0.1	98.0	9.76	585.0	488.0	46	0.0	64.9
31	0.2	98.2	10.08	605.0	504.0	45	0.1	65.0
32	0.0	98.2	10.41	624.0	520.0	44	0.0	65.0
33	0.1	98.3	10.73	644.0	537.0	44	0.0	65.0
34	0.1	98.4	11.06	664.0	553.0	44	0.0	65.1
35	0.0	98.4	11.38	683.0	569.0	43	0.0	65.1
36	0.1	98.5	11.71	703.0	585.0	43	0.0	65.1
37	0.0	98.5	12.03	722.0	602.0	42	0.0	65.1
38	0.2	98.7	12.36	742.0	618.0	42	0.1	65.2
39	0.2	98.9	12.69	761.0	634.0	42	0.1	65.3
40	0.1	99.0	13.01	781.0	651.0	42	0.0	65.3
41	0.1	99.1	13.34	800.0	667.0	42	0.0	65.4
42	0.0	99.1	13.66	820.0	683.0	42	0.0	65.4
43	0.0	99.1	13.99	839.0	699.0	42	0.0	65.4
44	0.1	99.2	14.31	859.0	716.0	41	0.0	65.4
45	0.0	99.2	14.64	878.0	732.0	41	0.0	65.4
46	0.1	99.3	14.96	898.0	748.0	41	0.0	65.5
47	0.0	99.3	15.29	917.0	764.0	41	0.0	65.5
48	0.0	99.3	15.61	937.0	781.0	41	0.0	65.5
49	0.0	99.3	15.94	956.0	797.0	41	0.0	65.5
50	0.1	99.4	16.26	976.0	813.0	41	0.0	65.5
Estimated Net Annual Sediment (TSS) Load Reduction =								66 %

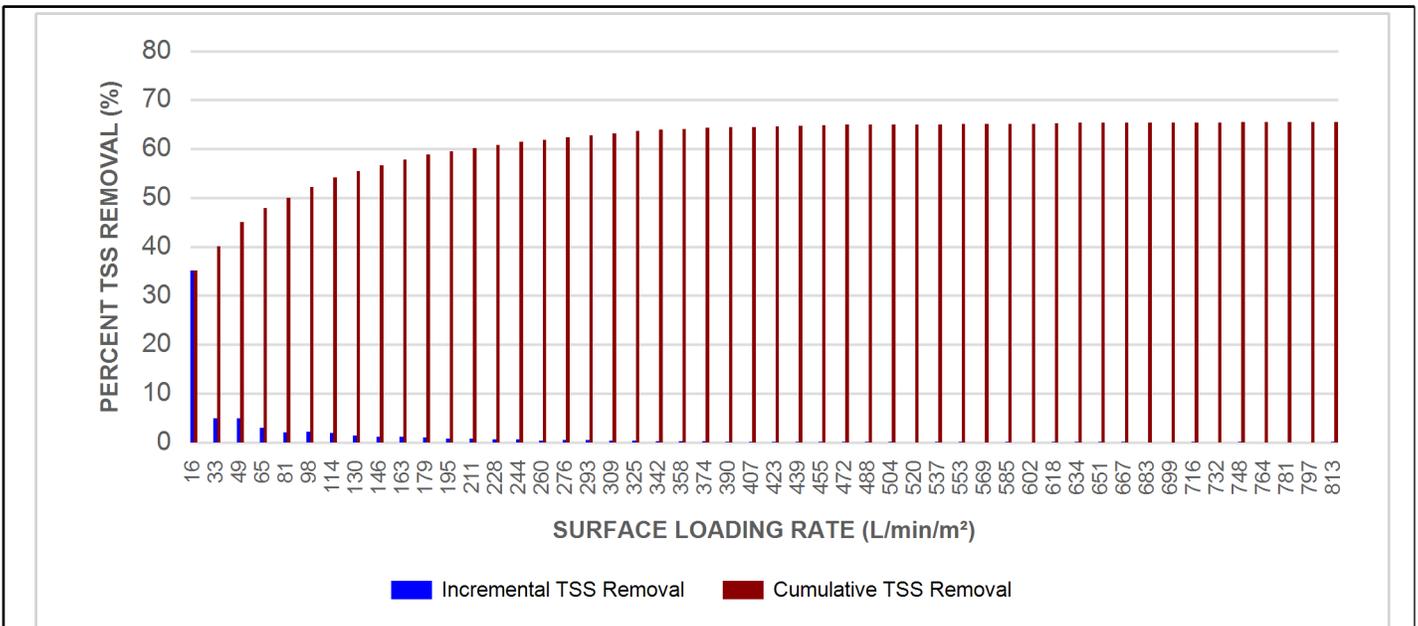


Stormceptor® **EF** Sizing Report

RAINFALL DATA FROM WATERLOO WELLINGTON AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Stormceptor® **EF** Sizing Report

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

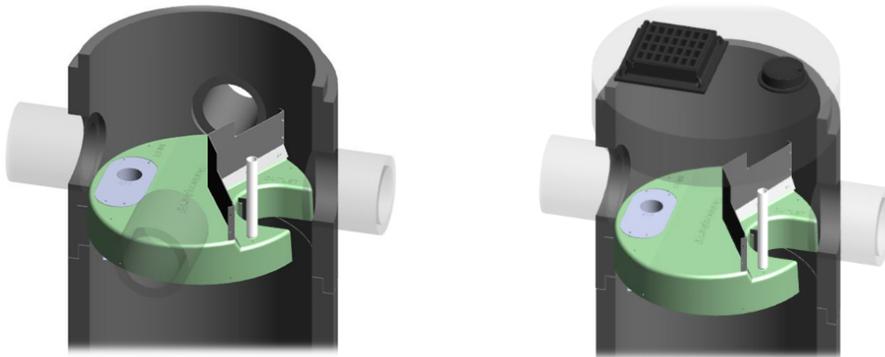
► Stormceptor® EF and EFO feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance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

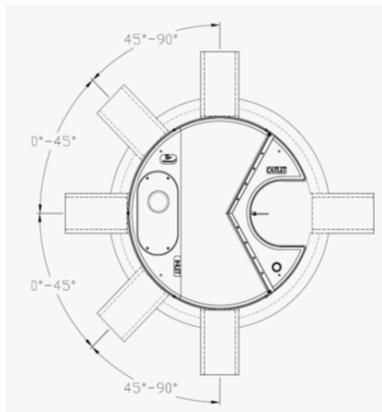
► Stormceptor® EF and EFO offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle,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



Stormceptor® EF Sizing Report



INLET-TO-OUTLET DROP

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

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

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

HEAD LOSS

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

For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

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

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

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

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

STANDARD STORMCEPTOR EF/EFO DRAWINGS

[For standard details, please visit http://www.imbrium.com/stormwater-treatment-solutions/stormceptor-ef](http://www.imbrium.com/stormwater-treatment-solutions/stormceptor-ef)

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

[For specifications, please visit http://www.imbrium.com/stormwater-treatment-solutions/stormceptor-ef](http://www.imbrium.com/stormwater-treatment-solutions/stormceptor-ef)

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

SLR (L/min/m²)	TSS % REMOVAL						
1	70	660	46	1320	48	1980	35
30	70	690	46	1350	48	2010	34



Stormceptor® EF Sizing Report

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



Stormceptor® **EF** Sizing Report

**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



Stormceptor® EF Sizing Report

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/m².

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.

Appendix B

MIDUSS Output

Pre-Development



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1 "          MIDUSS Output ----->"
2 "          MIDUSS version                Version 2.25  rev. 473"
3 "          MIDUSS created                 Sunday, February 7, 2010"
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8 "          Company                       "
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11 "          5.000 Time Step"
12 "          180.000 Max. Storm length"
13 "          1500.000 Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "          1 Chicago storm"
16 "          1219.800 Coefficient A"
17 "          10.500 Constant B"
18 "          0.823 Exponent C"
19 "          0.400 Fraction R"
20 "          180.000 Duration"
21 "          1.000 Time step multiplier"
22 "          Maximum intensity              127.834 mm/hr"
23 "          Total depth                    48.647 mm"
24 "          6 005hyd Hydrograph extension used in this file"
25 " 33          CATCHMENT 101"
26 "          1 Triangular SCS"
27 "          1 Equal length"
28 "          1 SCS method"
29 "          101 Total Site"
30 "          80.000 % Impervious"
31 "          0.623 Total Area"
32 "          60.000 Flow length"
33 "          3.000 Overland Slope"
34 "          0.125 Pervious Area"
35 "          60.000 Pervious length"
36 "          3.000 Pervious slope"
37 "          0.498 Impervious Area"
38 "          60.000 Impervious length"
39 "          3.000 Impervious slope"
40 "          0.250 Pervious Manning 'n'"
41 "          75.000 Pervious SCS Curve No."
42 "          0.266 Pervious Runoff coefficient"
43 "          0.100 Pervious Ia/S coefficient"
44 "          8.467 Pervious Initial abstraction"
45 "          0.015 Impervious Manning 'n'"
46 "          98.000 Impervious SCS Curve No."
47 "          0.875 Impervious Runoff coefficient"
48 "          0.100 Impervious Ia/S coefficient"
49 "          0.518 Impervious Initial abstraction"
50 "          0.133 0.000 0.000 0.000 c.m/sec"
51 "          Catchment 101 Pervious Impervious Total Area "
52 "          Surface Area 0.125 0.498 0.623 hectare"
53 "          Time of concentration 26.212 2.748 4.403 minutes"
54 "          Time to Centroid 132.978 91.261 94.203 minutes"
55 "          Rainfall depth 48.647 48.647 48.647 mm"
56 "          Rainfall volume 60.61 242.46 303.07 c.m"
57 "          Rainfall losses 35.727 6.078 12.007 mm"
58 "          Runoff depth 12.920 42.569 36.640 mm"
59 "          Runoff volume 16.10 212.17 228.26 c.m"
60 "          Runoff coefficient 0.266 0.875 0.753 "
61 "          Maximum flow 0.004 0.132 0.133 c.m/sec"
62 " 40          HYDROGRAPH Add Runoff "
63 "          4 Add Runoff "
64 "          0.133 0.133 0.000 0.000"
65 " 38          START/RE-START TOTALS 101"
66 "          3 Runoff Totals on EXIT"
67 "          Total Catchment area 0.623 hectare"
68 "          Total Impervious area 0.498 hectare"
69 "          Total % impervious 80.000"
70 " 19          EXIT"
    
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8 "          Company                        "
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11 "          5.000 Time Step"
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13 "          1500.000 Max. Hydrograph"
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15 "          1 Chicago storm"
16 "          3015.100 Coefficient A"
17 "          21.000 Constant B"
18 "          0.870 Exponent C"
19 "          0.400 Fraction R"
20 "          180.000 Duration"
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26 "          1 Triangular SCS"
27 "          1 Equal length"
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29 "          101 Total Site"
30 "          80.000 % Impervious"
31 "          0.623 Total Area"
32 "          60.000 Flow length"
33 "          3.000 Overland Slope"
34 "          0.125 Pervious Area"
35 "          60.000 Pervious length"
36 "          3.000 Pervious slope"
37 "          0.498 Impervious Area"
38 "          60.000 Impervious length"
39 "          3.000 Impervious slope"
40 "          0.250 Pervious Manning 'n'"
41 "          75.000 Pervious SCS Curve No."
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48 "          0.100 Impervious Ia/S coefficient"
49 "          0.518 Impervious Initial abstraction"
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53 "          Time of concentration 17.767 2.384 4.032 minutes"
54 "          Time to Centroid 119.430 89.658 92.848 minutes"
55 "          Rainfall depth 89.669 89.669 89.669 mm"
56 "          Rainfall volume 111.73 446.91 558.64 c.m"
57 "          Rainfall losses 49.986 6.991 15.590 mm"
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66 "          3 Runoff Totals on EXIT"
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Post-Development

```

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8 "          Company                       "
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11 "          5.000 Time Step"
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14 " 32          STORM Chicago storm"
15 "          1 Chicago storm"
16 "          1219.800 Coefficient A"
17 "          10.500 Constant B"
18 "          0.823 Exponent C"
19 "          0.400 Fraction R"
20 "          180.000 Duration"
21 "          1.000 Time step multiplier"
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23 "          Total depth                    48.647 mm"
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26 "          1 Triangular SCS"
27 "          1 Equal length"
28 "          1 SCS method"
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33 "          1.500 Overland Slope"
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35 "          10.000 Pervious length"
36 "          1.500 Pervious slope"
37 "          0.334 Impervious Area"
38 "          10.000 Impervious length"
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42 "          0.000 Pervious Runoff coefficient"
43 "          0.100 Pervious Ia/S coefficient"
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62 " 40          HYDROGRAPH Add Runoff "
63 "          4 Add Runoff "
64 "          0.099 0.099 0.000 0.000"
65 " 54          POND DESIGN"
66 "          0.099 Current peak flow c.m/sec"
67 "          0.049 Target outflow c.m/sec"
68 "          141.6 Hydrograph volume c.m"
69 "          11. Number of stages"
70 "          0.000 Minimum water level metre"
71 "          0.150 Maximum water level metre"
    
```

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72 "      0.000 Starting water level  metre"
73 "      0 Keep Design Data: 1 = True; 0 = False"
74 "      Level Discharge  Volume"
75 "      0.000      0.000      0.000"
76 "      0.01500    0.00750    1.188"
77 "      0.03000    0.01500    9.500"
78 "      0.04500    0.02250   32.064"
79 "      0.06000    0.03000   75.150"
80 "      0.07500    0.03750  125.250"
81 "      0.09000    0.04500  175.350"
82 "      0.1050     0.05250  225.450"
83 "      0.1200     0.06000  275.550"
84 "      0.1350     0.06750  325.650"
85 "      0.1500     0.07500  375.750"
86 "      1. ROOFTOP"
87 "      Roof area  Store area  Area/drain  Drain flow  Roof slope"
88 "      hectare    hectare    sq.metre    L/min/25mm  g H:1V"
89 "      0.334      0.250     100.000     22.500     66.667"
90 "      Using 25 roofdrains on roofstorage area of 2505. square metre"
91 "      Peak outflow                0.026    c.m/sec"
92 "      Maximum level                0.053    metre"
93 "      Maximum storage                54.354    c.m"
94 "      Centroidal lag                1.838    hours"
95 "      0.099      0.099      0.026      0.000 c.m/sec"
96 " 40 HYDROGRAPH  Combine  1"
97 " 6  Combine "
98 " 1  Node #"
99 " Total Site"
100 "      Maximum flow                0.026    c.m/sec"
101 "      Hydrograph volume            141.615    c.m"
102 "      0.099      0.099      0.026      0.026"
103 " 40 HYDROGRAPH Start - New Tributary"
104 " 2  Start - New Tributary"
105 "      0.099      0.000      0.026      0.026"
106 " 33 CATCHMENT 202"
107 " 1  Triangular SCS"
108 " 1  Equal length"
109 " 1  SCS method"
110 " 202 Uncontrolled Area"
111 " 77.000 % Impervious"
112 " 0.289 Total Area"
113 " 20.000 Flow length"
114 " 5.000 Overland Slope"
115 " 0.066 Pervious Area"
116 " 20.000 Pervious length"
117 " 5.000 Pervious slope"
118 " 0.223 Impervious Area"
119 " 20.000 Impervious length"
120 " 5.000 Impervious slope"
121 " 0.250 Pervious Manning 'n'"
122 " 75.000 Pervious SCS Curve No."
123 " 0.265 Pervious Runoff coefficient"
124 " 0.100 Pervious Ia/S coefficient"
125 " 8.467 Pervious Initial abstraction"
126 " 0.015 Impervious Manning 'n'"
127 " 98.000 Impervious SCS Curve No."
128 " 0.874 Impervious Runoff coefficient"
129 " 0.100 Impervious Ia/S coefficient"
130 " 0.518 Impervious Initial abstraction"
131 "      0.066      0.000      0.026      0.026 c.m/sec"
132 "      Catchment 202      Pervious  Impervious  Total Area  "
133 "      Surface Area      0.066      0.223      0.289      hectare"
134 "      Time of concentration  11.632      1.220      2.085      minutes"
135 "      Time to Centroid    115.189     88.914     91.097     minutes"
136 "      Rainfall depth     48.647     48.647     48.647     mm"
137 "      Rainfall volume     32.34      108.25     140.59     c.m"
138 "      Rainfall losses     35.749     6.138      12.948     mm"
139 "      Runoff depth        12.898     42.509     35.699     mm"
140 "      Runoff volume       8.57       94.60      103.17     c.m"
141 "      Runoff coefficient  0.265     0.874     0.734      "
142 "      Maximum flow        0.003     0.066     0.066     c.m/sec"
    
```

143	"	40	HYDROGRAPH Add Runoff "				
144	"		4 Add Runoff "				
145	"		0.066 0.066	0.026	0.026"		
146	"	40	HYDROGRAPH Copy to Outflow"				
147	"		8 Copy to Outflow"				
148	"		0.066 0.066	0.066	0.026"		
149	"	40	HYDROGRAPH Combine 1"				
150	"		6 Combine "				
151	"		1 Node #"				
152	"		Total Site"				
153	"		Maximum flow	0.087	c.m/sec"		
154	"		Hydrograph volume	244.785	c.m"		
155	"		0.066 0.066	0.066	0.087"		
156	"	40	HYDROGRAPH Confluence 1"				
157	"		7 Confluence "				
158	"		1 Node #"				
159	"		Total Site"				
160	"		Maximum flow	0.087	c.m/sec"		
161	"		Hydrograph volume	244.785	c.m"		
162	"		0.066 0.087	0.066	0.000"		
163	"	38	START/RE-START TOTALS 1"				
164	"		3 Runoff Totals on EXIT"				
165	"		Total Catchment area		0.623	hectare"	
166	"		Total Impervious area		0.557	hectare"	
167	"		Total % impervious		89.331"		
168	"	19	EXIT"				

```

1 "          MIDUSS Output ----->"
2 "          MIDUSS version              Version 2.25 rev. 473"
3 "          MIDUSS created              Sunday, February 7, 2010"
4 "          10 Units used:              ie METRIC"
5 "          Job folder:                 Q:\35571\200"
6 "          Output filename:            100 yr post.out"
7 "          Licensee name:              A"
8 "          Company                     "
9 "          Date & Time last used:      9/22/2020 at 1:22:30 PM"
10 " 31          TIME PARAMETERS"
11 "          5.000 Time Step"
12 "          180.000 Max. Storm length"
13 "          1500.000 Max. Hydrograph"
14 " 32          STORM Chicago storm"
15 "          1 Chicago storm"
16 "          3015.100 Coefficient A"
17 "          21.000 Constant B"
18 "          0.870 Exponent C"
19 "          0.400 Fraction R"
20 "          180.000 Duration"
21 "          1.000 Time step multiplier"
22 "          Maximum intensity            177.123 mm/hr"
23 "          Total depth                  89.669 mm"
24 "          6 100hyd Hydrograph extension used in this file"
25 " 33          CATCHMENT 201"
26 "          1 Triangular SCS"
27 "          1 Equal length"
28 "          1 SCS method"
29 "          201 Building Rooftop"
30 "          100.000 % Impervious"
31 "          0.334 Total Area"
32 "          10.000 Flow length"
33 "          1.500 Overland Slope"
34 "          0.000 Pervious Area"
35 "          10.000 Pervious length"
36 "          1.500 Pervious slope"
37 "          0.334 Impervious Area"
38 "          10.000 Impervious length"
39 "          1.500 Impervious slope"
40 "          0.250 Pervious Manning 'n'"
41 "          75.000 Pervious SCS Curve No."
42 "          0.000 Pervious Runoff coefficient"
43 "          0.100 Pervious Ia/S coefficient"
44 "          8.467 Pervious Initial abstraction"
45 "          0.015 Impervious Manning 'n'"
46 "          98.000 Impervious SCS Curve No."
47 "          0.911 Impervious Runoff coefficient"
48 "          0.100 Impervious Ia/S coefficient"
49 "          0.518 Impervious Initial abstraction"
50 "          0.145 0.000 0.000 0.000 c.m/sec"
51 "          Catchment 201 Pervious Impervious Total Area "
52 "          Surface Area 0.000 0.334 0.334 hectare"
53 "          Time of concentration 7.465 1.002 1.002 minutes"
54 "          Time to Centroid 107.208 87.763 87.763 minutes"
55 "          Rainfall depth 89.669 89.669 89.669 mm"
56 "          Rainfall volume 0.00 299.49 299.49 c.m"
57 "          Rainfall losses 50.109 7.975 7.975 mm"
58 "          Runoff depth 39.560 81.694 81.694 mm"
59 "          Runoff volume 0.00 272.86 272.86 c.m"
60 "          Runoff coefficient 0.000 0.911 0.911 "
61 "          Maximum flow 0.000 0.145 0.145 c.m/sec"
62 " 40          HYDROGRAPH Add Runoff "
63 "          4 Add Runoff "
64 "          0.145 0.145 0.000 0.000"
65 " 54          POND DESIGN"
66 "          0.145 Current peak flow c.m/sec"
67 "          0.049 Target outflow c.m/sec"
68 "          272.9 Hydrograph volume c.m"
69 "          11. Number of stages"
70 "          0.000 Minimum water level metre"
71 "          0.150 Maximum water level metre"
    
```

```

72 "      0.000 Starting water level  metre"
73 "      0 Keep Design Data: 1 = True; 0 = False"
74 "      Level Discharge  Volume"
75 "      0.000 0.000 0.000"
76 "      0.01500 0.00563 0.5000"
77 "      0.03000 0.01125 4.000"
78 "      0.04500 0.01688 13.500"
79 "      0.06000 0.02250 32.000"
80 "      0.07500 0.02812 62.500"
81 "      0.09000 0.03375 100.000"
82 "      0.1050 0.03937 137.500"
83 "      0.1200 0.04500 175.000"
84 "      0.1350 0.05063 212.500"
85 "      0.1500 0.05625 250.000"
86 "      1. ROOFTOP"
87 "      Roof area Store area Area/drain Drain flow Roof slope"
88 "      hectare hectare sq.metre L/min/25mm g H:1V"
89 "      0.334 0.250 100.000 22.500 66.667"
90 "      Using 25 roofdrains on roofstorage area of 2500. square metre"
91 "      Peak outflow 0.036 c.m/sec"
92 "      Maximum level 0.097 metre"
93 "      Maximum storage 116.902 c.m"
94 "      Centroidal lag 2.073 hours"
95 "      0.145 0.145 0.036 0.000 c.m/sec"
96 " 40 HYDROGRAPH Combine 1"
97 " 6 Combine "
98 " 1 Node #"
99 " Total Site"
100 " Maximum flow 0.036 c.m/sec"
101 " Hydrograph volume 272.788 c.m"
102 " 0.145 0.145 0.036 0.036"
103 " 40 HYDROGRAPH Start - New Tributary"
104 " 2 Start - New Tributary"
105 " 0.145 0.000 0.036 0.036"
106 " 33 CATCHMENT 202"
107 " 1 Triangular SCS"
108 " 1 Equal length"
109 " 1 SCS method"
110 " 202 Uncontrolled Area"
111 " 77.000 % Impervious"
112 " 0.289 Total Area"
113 " 20.000 Flow length"
114 " 5.000 Overland Slope"
115 " 0.066 Pervious Area"
116 " 20.000 Pervious length"
117 " 5.000 Pervious slope"
118 " 0.223 Impervious Area"
119 " 20.000 Impervious length"
120 " 5.000 Impervious slope"
121 " 0.250 Pervious Manning 'n'"
122 " 75.000 Pervious SCS Curve No."
123 " 0.442 Pervious Runoff coefficient"
124 " 0.100 Pervious Ia/S coefficient"
125 " 8.467 Pervious Initial abstraction"
126 " 0.015 Impervious Manning 'n'"
127 " 98.000 Impervious SCS Curve No."
128 " 0.914 Impervious Runoff coefficient"
129 " 0.100 Impervious Ia/S coefficient"
130 " 0.518 Impervious Initial abstraction"
131 " 0.101 0.000 0.036 0.036 c.m/sec"
132 " Catchment 202 Pervious Impervious Total Area "
133 " Surface Area 0.066 0.223 0.289 hectare"
134 " Time of concentration 7.885 1.058 1.919 minutes"
135 " Time to Centroid 107.660 87.772 90.281 minutes"
136 " Rainfall depth 89.669 89.669 89.669 mm"
137 " Rainfall volume 59.60 199.54 259.14 c.m"
138 " Rainfall losses 50.066 7.726 17.464 mm"
139 " Runoff depth 39.603 81.944 72.205 mm"
140 " Runoff volume 26.32 182.35 208.67 c.m"
141 " Runoff coefficient 0.442 0.914 0.805 "
142 " Maximum flow 0.012 0.097 0.101 c.m/sec"
    
```

143	"	40	HYDROGRAPH Add Runoff "				
144	"		4 Add Runoff "				
145	"		0.101 0.101	0.036	0.036"		
146	"	40	HYDROGRAPH Copy to Outflow"				
147	"		8 Copy to Outflow"				
148	"		0.101 0.101	0.101	0.036"		
149	"	40	HYDROGRAPH Combine 1"				
150	"		6 Combine "				
151	"		1 Node #"				
152	"		Total Site"				
153	"		Maximum flow	0.129	c.m/sec"		
154	"		Hydrograph volume	481.461	c.m"		
155	"		0.101 0.101	0.101	0.129"		
156	"	40	HYDROGRAPH Confluence 1"				
157	"		7 Confluence "				
158	"		1 Node #"				
159	"		Total Site"				
160	"		Maximum flow	0.129	c.m/sec"		
161	"		Hydrograph volume	481.461	c.m"		
162	"		0.101 0.129	0.101	0.000"		
163	"	38	START/RE-START TOTALS 1"				
164	"		3 Runoff Totals on EXIT"				
165	"		Total Catchment area		0.623	hectare"	
166	"		Total Impervious area		0.557	hectare"	
167	"		Total % impervious		89.331"		
168	"	19	EXIT"				