D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle
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SITE SERVICING STUDY & STORMWATER MANAGEMENT REPORT

1328 MICHAEL STREET
OTTAWA, ONTARIO

REPORT NO. 21014

JANUARY 12, 2022
REVISED JULY 21, 2022
REVISED JANUARY 16, 2023

CONTENTS

LIST OF APPENDICES

1.0 INTRODUCTION

This report describes the servicing and stormwater management requirements for a proposed 2-storey Volvo dealership located on a 1,809 sq.m. property at 1328 Michael Street at the corner of Parisien Street in Ottawa, Ontario. The property is currently occupied by an existing single family dwelling to be demolished.

This report forms part of the servicing and stormwater management design for the proposed development. Also refer to drawings C-1 to C-6, prepared by D.B. Gray Engineering Inc.

2.0 WATER SERVICING

2.1 WATER SUPPLY FOR FIREFIGHTING

The proposed building will have a sprinkler system with the fire department connection (FDC) located at the southeast corner of the building facing Michael Street. There is an existing municipal Class AA fire hydrant located at the intersection of Michael Street and Parisien Street. It is about 37 m unobstructed distance to the proposed FDC, and since it is less than 45 m a private fire hydrant is not required.

As per City of Ottawa Technical Bulletin ISTB-2021-03, when calculating the required fire flow where pipe sizing is not affected, the Ontario Building Code (OBC) method is to be used. Using the OBC method the required fire flow was calculated to be 5,400 L/min (90 L/s) at a minimum required pressure of 140 kPa (20 psi). Refer to Appendix A.

The boundary conditions in the 300 mm Parisien Street watermain provided by the City of Ottawa for a 38 L/s fire flow (+ Max day) at the subject property indicates a hydraulic grade line (HGL) of 112.7 m. For a 90 L/s fire flow (+ Max day) the HGL is calculated to be 106.7 m. This HGL calculates to 367 kPa (53 psi). Refer to Appendix A. Since the pressure is above the required minimum pressure of 140 kPa (20 psi), there is an adequate water supply for firefighting from the existing municipal water distribution system.

As per City of Ottawa Technical Bulletin ISTB-2018-02, the aggregate flow of all contributing fire hydrants within 150 m of the building shall not be less than the required fire flow. The existing municipal Class AA fire hydrant can contribute 95 L/s (as per Table 1 of ISTB-2018-02), which is greater than the required fire flow of 90 L/s.

2.2 DOMESTIC WATER SUPPLY

As discussed above, the proposed building will have a sprinkler system. A 150 mm water service connecting to the 150 mm Parisien Street watermain is proposed to service the sprinkler system. The same 150 mm water service will be adequate for the domestic water demand.

As per the City of Ottawa Water Design Guidelines and the City of Ottawa Technical Bulletin ISTB-2021-03, the average daily demand was calculated to be 0.2 L/s, the maximum daily demand was calculated to be 0.4 L/s and the maximum hourly demand was calculated to be 0.6 L/s. Refer to Appendix A.

The boundary conditions in the 150 mm Michael Street watermain provided by the City of Ottawa at the subject property indicate a minimum HGL of 110.2 m and a maximum HGL of 118.2 m. With these boundary conditions, the pressure at the water meter is calculated to vary between 387 kPa (56 psi) and 466 kPa (68 psi). This is an acceptable range for the proposed development.

3.0 SANITARY SERVICING

As per the City of Ottawa Sewer Design Guidelines and City of Ottawa Technical Bulletin ISTB 2018-01, the post development sanitary flow rate was calculated to be 0.32 L/s. A 150 mm sanitary service at 2% slope (22.47 L/s capacity) is proposed to service the development. At the design flow rate the sanitary service will only be at 1% of its capacity. The proposed 150 mm sanitary service will connect to the existing 300 mm municipal sanitary sewer in Parisien Street, which at 1.21% slope has a capacity of 110.97 L/s. The pre development sanitary flow rate was calculated to be 0.09 L/s. The 0.23 L/s increase in flow is expected to have an acceptable impact on the 300 mm Parisien Street sanitary sewer. Refer to Appendix B.

4.0 STORMWATER MANAGEMENT

4.1 QUALITY CONTROL

The Rideau Valley Conservation Authority (RVCA) has stated: *"Based on this information, onsite water quality treatment would be required as the downstream outlet is less than 1 km away. The water quality target is 'enhanced' (80% TSS removal)."* To meet the water quality target of 80% total suspended solids (TSS) removal an oil grit separator (OGS) is proposed to be located downstream of the inlet control device (ICD). A CDS Model PMSU2015-4 was selected by the manufacturer based on the manufacturer's software. The CDS PMSU2015-4 is calculated to remove approximately 91% of the TSS. Refer to Appendix C. The OGS has an oil capacity of 232 L and a sediment capacity of 0.7 cu.m.

An Erosion & Sediment Control Plan has been developed to be implemented during construction. Refer to drawing C-3 and notes 2.1 to 2.5 on drawing C-4. In summary: To filter out construction sediment; sediment capture filter sock inserts will be installed in all existing catch-basins adjacent to the site and in all new catch basins as they are installed; and any material deposited on a public road will be removed as required.

4.2 QUANTITY CONTROL

The stormwater quantity control criterion is to control the post development 100-year peak flow rate to the pre development 5-year peak flow rate using a calculated pre development runoff coefficient not less than 0.50 and a calculated time of concentration not less than 10 minutes. It was calculated that the pre development conditions reflect a 5-year runoff coefficient of 0.71 and a time of concentration of 3 minutes. Using the Rational Method with a time of concentration of 10 minutes, the pre-development flow rates were calculated to be 70.81 L/s during the 100-year event and 36.82 L/s during the 5-year event. Using the Rational Method with a time of concentration of 10 minutes and a runoff coefficient of 0.50, the maximum allowable release rate was calculated to be 26.20 L/s.

The Modified Rational Method is used to calculate the required storage volume. The runoff coefficients for the 100-year event are increased by 25% to maximum 1.00. Stormwater will be stored on the roof; and underground in catch basins, manholes, and sewer pipes. Since the required storage incudes underground storage, to calculate the required storage volume, an average release rate, assumed to be equal to 50% of the maximum release rate, is used. Refer to Appendix C.

Drainage Area I (Uncontrolled Flow Off Site – 160 sq.m):
The area to the east of the proposed building and an area in the southwest corner of the property will drain uncontrolled off the site. The flow rates are calculated at a time of concentration of 10 minutes.

	100-Year Event	5-Year Event
Maximum Flow Rate	3.07 L/s	1.48 L/s

Drainage Area II (RD-1 – 90 sq.m):
Roof drain RD-1 will be a flow control type roof drain which will restrict the flow of stormwater and cause the stormwater to pond on the roof. The roof drain will be installed with a weir with one parabolic shaped slot designed to release 0.0124 L/s/mm (5 USgpm/in) and with an opening at the top of the weir a minimum 50 mm in diameter: Watts roof drain with a Watts Accutrol Weir RD-100-A1 or approved equal.

	100-Year Event	5-Year Event
Maximum Release Rate	1.44 L/s	1.06 L/s
Maximum Ponding Depth	116 mm	86 mm
Maximum Volume Stored	1.92 cu.m	0.77 cu.m

Drainage Area III (RD-2, 3, 4 & 5 – 810 sq.m):
Roof drains RD-2, 3, 4 & 5 will be flow control type roof drains which will restrict the flow of stormwater and cause the stormwater to pond on the roof. Each roof drain will be installed with a weir with one parabolic shaped slot designed to release 0.0124 L/s/mm (5 USgpm/in) and with an opening at the top of the weir a minimum 50 mm in diameter: Watts roof drain with a Watts Accutrol Weir RD-100-A1 or approved equal.

	100-Year Event	5-Year Event
Maximum Release Rate	5.68 L/s	4.01 L/s
Maximum Ponding Depth	114 mm	81 mm
Maximum Volume Stored	27.13 cu.m	12.50 cu.m

Drainage Area IV (RD-6 & 7 – 108 sq.m):
Roof drains RD-6 & 7 will be flow control type roof drains which will restrict the flow of stormwater and cause the stormwater to pond on the roof. Each roof drain will be installed with a weir with one parabolic shaped slot designed to release 0.0124 L/s/mm (5 USgpm/in) and with an opening at the top of the weir a minimum 50 mm in diameter: Watts roof drain with a Watts Accutrol Weir RD-100-A1 or approved equal.

	100-Year Event	5-Year Event
Maximum Release Rate	2.22 L/s	1.50 L/s
Maximum Ponding Depth	89 mm	61 mm
Maximum Volume Stored	1.89 cu.m	0.79 cu.m

Roof Scuppers
The upper roof (RD-1, 2, 3, 4 & 5) requires a minimum of 9 scuppers. The lower roof (RD-6 & 7) requires a minimum of two scuppers. All scuppers will be a minimum 300 mm wide installed 150 mm above the roof drains. Refer to architectural for exact locations and details. The roof will be designed to carry the load of water having a 50 mm depth at the scuppers and 200 mm depth at the roof drains. Refer to structural.

Drainage Area V (641 sq.m + 843 sq.m. drainage from Adjacent Lands)
An inlet control device (ICD) located in the outlet pipe of catch-basin / manhole CB/MH-3 will restrict the flow of stormwater and cause it to backup into the upstream pipes, manholes and catch basins. Since the restricted stormwater is proposed to be stored using underground infrastructure, an average release rate equal to 50% of the maximum release rate was used to calculate the required storage volumes. The storage requirements were calculated by ignoring the adjacent lands that are draining onto the subject property. The drainage area from the adjacent lands was then included in the calculations, but the since

the size of the storage was not increased the excess water will flow out the Parisien Street entrance onto the ROW. The ICD will be a plug style with a round orifice (located at the bottom of the plug) with a trash basket manufactured by Pedro Plastics (or approved equal) and sized by the manufacturer for a release rate of 13.79 L/s at 1.60 m. It was calculated that an orifice area of 4,033 sq.mm (72 mm dia.) with a discharge coefficient of 0.61 will achieve a release rate of 13.79 L/s at 1.60 m. Based on this orifice the maximum outflow rate for the 5-year storm event is calculated to be 6.39 L/s at 0.34 m (ignoring the drainage from the adjacent lands).

Ignoring Drainage from Adjacent Lands:

	100-Year Event	5-Year Event
Maximum ICD Release Rate	13.79 L/s	6.39 L/s
Maximum Ponding Elevation	69.04	67.78
Maximum Volume Stored	15.33 cu.m	8.61 cu.m

Including Drainage from Adjacent Lands:

	100-Year Event	5-Year Event	2-Year Event
Maximum ICD Release Rate	14.02 L/s	14.02 L/s	11.87 L/s
Maximum Overflow Release Rate	37.76 L/s	5.31 L/s	0.00 L/s
Maximum Total Release Rate	51.78 L/s	19.33 L/s	11.87 L/s
Maximum Ponding Elevation	69.09	69.09	68.66 (No Ponding)
Maximum Volume Stored	15.81 cu.m	15.81 cu.m	15.33 cu.m

Including off-site drainage during the 100 and 5-year events the maximum ponding elevation of 69.09 is reached and excess drainage overflows to the Parisien Street ROW. As required by the City there is no ponding during the 2-year event.

Entire Site (Ignoring Drainage from Adjacent Lands):

	100-Year Event	5-Year Event
Pre Development Flow Rate	70.81 L/s	36.82 L/s
Maximum Allowable Release Rate	26.20 L/s	26.20 L/s
Maximum Release Rate	26.20 L/s	14.44 L/s
Maximum Volume Stored	46.26 cu.m	22.67 cu.m

The maximum post development release rate during the 100-year event was calculated to be 26.20 L/s, which is 63% less than the pre development flow rate and equal to the maximum allowable release rate. To achieve the maximum allowable release rate, a maximum storage volume of 44.26 cu.m is required and provided. The maximum post development release rate during the 5-year event was calculated to be 14.44 L/s, which is 61% less than the pre development flow rate and 45% less than the maximum allowable release rate. The reduction in flow is expected to have a positive impact on the 525 mm Parisien Street storm sewer.

4.3 STORM SERVICING

A private storm sewer system is proposed to service the development. The unrestricted flow rate in the last pipe segment during the 5-year event was calculated to be 59.60 L/s. The last pipe segment will be a 375 mm storm sewer at 0.25% slope (91.46 L/s capacity) which will make the connection to the existing

525 mm municipal storm sewer in Parisien Street (which at 0.59% slope has a capacity of 344.62 L/s). The unrestricted 5-year flow rate in each pipe segment of the private storm sewer system varies from 8% to 77% capacity, with the last pipe segment at 65%. The restricted flow rate (due to flow control roof drains and the ICD) in the last pipe segment during the 5-year event was calculated to be 20.59 L/s. At the restricted 5-year flow rate in the last pipe segment is only at 23% capacity.

The unrestricted roof flow rate during the 5-year event was calculated to be 26.28 L/s. A 200 mm storm service at 1% (34.22 L/s capacity) is proposed to service the building. At the unrestricted 5-year flow rate the 200 mm storm service would be at 77% of its capacity. The restricted flow rate during the 5-year event was calculated to be 6.57 L/s. At the restricted 5-year flow rate the storm service will only be at 19% of its capacity. The proposed 200 mm building storm sewer will connect to the proposed private storm sewer system downstream of the ICD.

5.0 CONCLUSIONS

1. A private fire hydrant is not required.

2. There is an adequate water supply for firefighting from the existing municipal water distribution system.

3. The existing municipal fire hydrant can contribute 95 L/s, which is greater than the required fire flow of 90 L/s.

4. The proposed water service will be adequate for the domestic water demand.

5. There is an acceptable range of water pressures in the existing water distribution system.

6. The post development sanitary flow rate will be adequately handled by the proposed sanitary service.

7. The post development increase in sanitary flow is expected to have an acceptable impact on the existing municipal sanitary sewer.

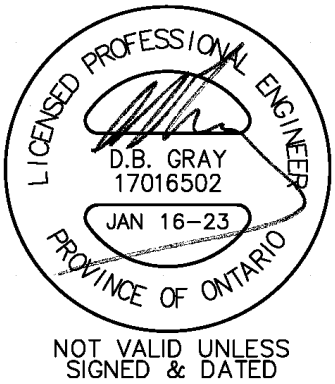
8. To meet the RVCA's water quality target of 80% TSS removal an oil grit separator (OGS) is proposed

9. An Erosion & Sediment Control Plan has been developed to be implemented during construction.

10. The maximum post development release rate during the 100-year event is 63% less than the pre development flow rate and equal to the maximum allowable release rate. The maximum post development release rate during the 5-year event is 61% less than the pre development flow rate and 45% less than the maximum allowable release rate.

11. The post development reduction in stormwater flow is expected to have a positive impact on the existing municipal storm sewer.

12. The unrestricted flow rates during the 5-year event will be adequately handled by the proposed storm sewer system and building storm sewer.


LICENSED PROFESSIONAL ENGINEER
D.B. GRAY
17016502
JAN 16-23
PROVINCE OF ONTARIO
NOT VALID UNLESS
SIGNED & DATED

APPENDIX A

WATER SERVICING

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

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January 10, 2022

1328 Michael Street
2-Storey Volvo Dealership
Ottawa, Ontario

FIRE FLOW CALCULATIONS
OBC Method

Q = Required water supply in litres
= KVS_{Total}

S_{Total} = Total of spatial coefficients from exposure distances
= $1.0 + S_{Side\ 1} + S_{Side\ 2} + S_{Side\ 3} + S_{Side\ 4}$

	Spatial Coefficient	Exposure Distance (m)	
$S_{Side\ 1}$	0.5	4	(to north property line)
$S_{Side\ 2}$	0	12	(to centerline of Michael Street)
$S_{Side\ 3}$	0	10	(to centerline of Parisien Street)
$S_{Side\ 4}$	0	17	(to west property line)
S_{Total}	1.5		

Group D (Showroom & Offices) Occupancy

K_1 = Water supply coefficient, as per OBC A-3.2.5.7. Table 1
= 16 Building is of noncombustible construction with fire separations without fire resistance ratings.

V_1 = Building volume in cubic meters

Floor Area (sq.m)	Height (m)	Volume (cu.m)
430	7.2	3,096

Q_1 = 74,304 L

Group F, Division 3 (Auto Repair Shop) Occupancy

K_2 = Water supply coefficient, as per OBC A-3.2.5.7. Table 1
= 19 Building is of noncombustible construction with fire separations without fire resistance ratings.

V_2 = Building volume in cubic meters

Floor Area (sq.m)	Height (m)	Volume (cu.m)
503	7.2	3,622
75	3.6	270

Q_2 = 103,216 L

Q_{Total} = $Q_1 + Q_2$
= 177,520 L
= 5,400 L/min as per OBC A-3.2.5.7. Table 2
= 90.0 L/s

HGL (Max Day + 90.0 L/s Fire Flow) =	106.70	m ASL (calculated)				
Elevation at Fire Hydrant =	69.28	m ASL				
Static Pressure at Fire Hydrant =	37.42	m	367	kPa	53	psi

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07-Jan-22

1328 Michael Street
Proposed 2-Storey Automobile Dealership Building
Ottawa, Ontario

Water Demand

COMMERCIAL:

DAILY AVERAGE:	28,000	L /gross ha / day (as per Ottawa Design Guidelines)				
	0.24	ha (land area)				
	6731	L/day				
	8	hour day				
	14.0	L/min	0.2	L/s	3.7	USgpm
MAXIMUM DAILY DEMAND:	1.5	(Peaking Factor as per Ottawa Design Guidelines)				
	21.0	L/min	0.4	L/s	5.6	USgpm
MAXIMUM HOURLY DEMAND:	1.8	(Peaking Factor as per Ottawa Design Guidelines)				
	37.9	L/min	0.6	L/s	10.0	USgpm

Elevation of Water Meter:	70.71	m ASL				
Finish Floor Elevation:	69.81	m ASL				
			Static Pressure at Water Meter			
MINIMUM HGL:	110.2	m ASL	56	psi	387	kPa
MAXIMUM HGL:	118.2	m ASL	68	psi	466	kPa

D.B. Gray Engineering Inc.

Ryan Faith <r.faith@dbgrayengineering.com>

RE: Volvo Dealership - 1300 Michael St - Boundary Condition Request

1 message

Mashaie, Sara <sara.mashaie@ottawa.ca> Thu, Oct 7, 2021 at 2:57 PM
To: Ryan Faith <r.faith@dbgrayengineering.com>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>

Hi Ryan,

Please find the boundary conditions, as requested.

The following are boundary conditions, HGL, for hydraulic analysis at 1300 Michael Street (zone 1E) assumed to be connected to the new 152 mm watermain on Michael Street (see attached PDF for location).

Minimum HGL: 110.2 m

Maximum HGL: 118.2 m

Max Day + FF (38 L/s): 112.7 m

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

Regards,

Sara Mashaie, P.Eng., ing.

Project Manager | Gestionnaire de Projet

Development Review, East Branch | Examen des projets d'aménagement, Secteur est

Planning, Infrastructure and Economic Development Department | Services de la planification, de l'infrastructure et du développement économique

City of Ottawa | Ville d'Ottawa

110 Laurier Avenue West. Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1

613.580.2424 ext./poste 27885, sara.mashaie@ottawa.ca

From: Ryan Faith <r.faith@dbgrayengineering.com>
Sent: September 28, 2021 3:52 PM
To: Mashaie, Sara <sara.mashaie@ottawa.ca>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>
Subject: Re: Volvo Dealership - 1300 Michael St - Boundary Condition Request

Hi Sara,

The property has less than 30m of frontage on Michael. Can you just provide the boundary conditions at the midpoint of the property line fronting Michael?

Thanks,

Ryan Faith

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle 613-425-8044
Ottawa, Ontario r.faith@dbgrayengineering.com

On Wed, Sep 22, 2021 at 10:06 AM Mashaie, Sara <sara.mashaie@ottawa.ca> wrote:

> Hi Doug,
>
> Could you please provide a map showing the location of connection?
>
> Thank you in advance.

Regards,

Sara Mashaie, P.Eng., ing.

Project Manager | Gestionnaire de Projet

Development Review, East Branch | Examen des projets d'aménagement, Secteur est

Planning, Infrastructure and Economic Development Department | Services de la planification, de l'infrastructure et du développement économique

City of Ottawa | Ville d'Ottawa

110 Laurier Avenue West. Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1

613.580.2424 ext./poste 27885, sara.mashaie@ottawa.ca

From: Douglas Gray <d.gray@dbgrayengineering.com>
Sent: September 22, 2021 7:54 AM
To: Mashaie, Sara <sara.mashaie@ottawa.ca>
Cc: Ryan Faith <r.faith@dbgrayengineering.com>
Subject: Volvo Dealership - 1300 Michael St - Boundary Condition Request

Hi Sara

Please provide the boundary conditions for the 150mm Michael St watermain at 1300 Michael St. We have calculated the following expected demands:

Average daily demand: 0.2 L/s.

Maximum daily demand: 0.4 L/s.

Maximum hourly daily demand: 0.6 L/s

Water demand calculations are attached.

Fire Flow demand: 38 L/s (based on OBC / NFPA 13)

Fire Flow + Max Day: 38.4 L/s

As per the Ontario Building Code (OBC) the flow required for firefighting is required to be calculated using NFPA-13 since the building will have a sprinkler system. The sprinkler system is not yet designed but it is expected that the

required fire flow will be no more than 38 L/s (600 USgpm) including the flow required for hose stream allowances.

Thanks, Doug

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle Tel: 613-425-8044

Ottawa, Ontario K1T 4E9 d.gray@dbgrayengineering.com

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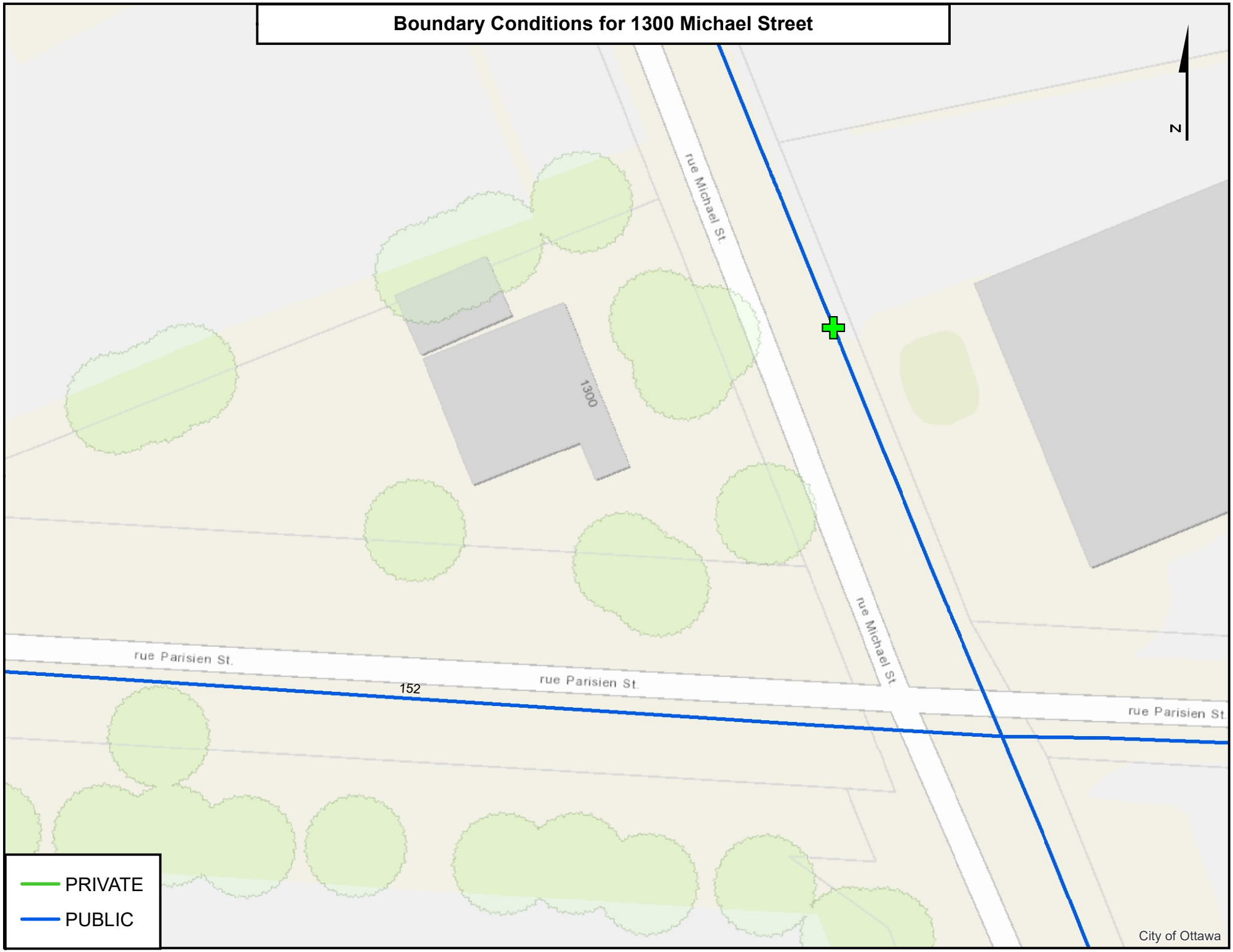
1300 Michael Street October 2021.pdf
985K

Boundary Conditions for 1300 Michael Street



10-Jan-22

Calculated Boundary Condtions for 90.0 L/s + 0.4 L/s MaxDay

(Based on provided Boundary Condtions for 38 L/s Fire Flow)

1328 Michael St

Grade Elevation:	69.28	m ASL				
MINIMUM HGL:	110.2	m ASL	58	psi	401	kPa
MAXIMUM HGL:	118.2	m ASL	70	psi	480	kPa
MXDY + Fireflow	112.7	m ASL	61.7	psi	426	kPa

Average Static (MIN + MAX HGL)/2	64	psi
Residual (MXDY+ Fireflow)	61.7	psi
Available Fire Flow:	602	USgpm
	2279	L/min
	38.0	L/s
Calculated Flowrate at:	367	kPa
	53.2	psi
	1433	USgpm Hazen-Williams
	5425	L/min
	90.4	L/s (FF + MAXDAY)

CALCULATED BOUNDARY CONDITION (MXDY + Fire flow)	106.7	m ASL	53	psi	367	kPa

APPENDIX B

SANITARY SERVICING

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle
Ottawa, Ontario

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SANITARY SEWER DESIGN FORM

Average Daily Flows

Residential:	280	L / capita / day
Commercial:	28000	L / ha / day
Instituational:	28000	L / ha / day
Light Industrial:	35000	L / ha / day
Heavy Industrial:	55000	L / ha / day

Infiltration Allowance: 0.33 l / s / ha

Peaking Factor:

Residential (Harmon Equation): $1 + \frac{14}{4 + P^{0.5}}$

P = Population / 1000

Harmon Correction Factor: 0.8

Commercial & Institutional: 1.5 If contrinbution > 20%

Commercial & Institutional: 1 If contrinbution < 20%

Industrial: As per Ottawa Guidelines Appendix 4-B

Project: 1328 Michael Street

Designed By: D.B.G

November 2, 2021

Page: 1 of 1

n = 0.013

Location		Section								Cumulative Residential		Section Non-Residential			Cumulative					Sewer Data								Comments
		Single Family ppu = 3.4	Semi / Townhouse ppu = 2.7	Duplex / Triplex ppu = 2.3	Apartment (average) ppu = 1.8	Apartment (1 Bed) ppu = 1.4	Apartment (2 Bed) ppu = 2.1	Apartment (3 Bed) ppu = 3.1	Area			Area	Flow		Flow	Area	Sewage Flow	Infiltration Flow	Total Flow		Actual Diameter	Nominal Diameter	Slope	Length	Capacity	Velocity	Ratio	
From	To	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	(ha)	Pop.	Peaking Factor	(ha)	(L/ha/day)	Peaking Factor	(L/s)	(ha)	(L/s)	(L/s)	(L/s)	Material	(mm)	(mm)	(%)	(m)	(L/s)	(m/s)	Q/Qfull	
		Existing Single																										
Existing Single	Existing 300 SAN	1							0.1799	3.4	3.20					0.1799	0.04	0.06	0.09									
		Proposed Building																										
Proposed Building	Existing 300 SAN											0.1799	28000	4.5	0.26	0.1799	0.26	0.06	0.32	PVC	152.4	150	2.00	4.8	22.47	1.23	0.01	
													4.5 = 1.5 x 24hrs / 8hrs															
																					Existing 300 SAN in Parisien Street							
																					304.8	300	1.21		110.97	1.52		

APPENDIX C

STORMWATER MANAGEMENT

D.B. Gray Engineering Inc.

Ryan Faith <r.faith@dbgrayengineering.com>

RE: RVCA Stormwater Management Comments - 1328 Michael Street

1 message

Jamie Batchelor <jamie.batchelor@rvca.ca> Mon, Nov 1, 2021 at 2:27 PM
To: Ryan Faith <r.faith@dbgrayengineering.com>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>

Thanks Ryan,

Based on this information, onsite water quality treatment would be required as the downstream outlet is less than 1 km away. The water quality target is 'enhanced' (80% TSS removal).

Jamie Batchelor, MCIP, RPP

Planner, ext. 1191

Jamie.batchelor@rvca.ca

Rideau Valley Conservation Authority

3889 Rideau Valley Drive
PO Box 599, Manotick ON K4M 1A5
T 613-692-3571 | 1-800-267-3504 F 613-692-0831 | www.rvca.ca

From: Ryan Faith <r.faith@dbgrayengineering.com>
Sent: Monday, November 1, 2021 2:22 PM
To: Jamie Batchelor <jamie.batchelor@rvca.ca>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>
Subject: Re: RVCA Stormwater Management Comments - 1328 Michael Street

Hi Jamie,

We intend on outleting to the existing storm sewer on the south side of the property in Parisien Street.

Regards,

Ryan Faith

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle 613-425-8044
Ottawa, Ontario r.faith@dbgrayengineering.com

On Mon, Nov 1, 2021 at 2:15 PM Jamie Batchelor <jamie.batchelor@rvca.ca> wrote:

> Good Afternoon Ryan,
>
> Based on our GIS layers, it does not appear a storm sewer is available fronting this site. Where do you intend on directing stormwater?
>
> Jamie Batchelor, MCIP, RPP
>
> Planner, ext. 1191
>
> Jamie.batchelor@rvca.ca
>
> Rideau Valley Conservation Authority
> 3889 Rideau Valley Drive
> PO Box 599, Manotick ON K4M 1A5
> T 613-692-3571 | 1-800-267-3504 F 613-692-0831 | www.rvca.ca
>
>
>
> **From:** Ryan Faith <r.faith@dbgrayengineering.com>
> **Sent:** Wednesday, October 27, 2021 10:19 AM
> **To:** Jamie Batchelor <jamie.batchelor@rvca.ca>
> **Cc:** Douglas Gray <d.gray@dbgrayengineering.com>
> **Subject:** RVCA Stormwater Management Comments - 1328 Michael Street
>
> Hi Jamie,
>
> We are working on a proposed 2 storey Volvo dealership at 1328 Michael Street in Ottawa.
>
> Please comment on the stormwater management for the site.
>
> I have attached a site plan for your reference.
>
> Thanks,
>
> Ryan Faith
>
> D.B. Gray Engineering Inc.
>
> *Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains*
>
> 700 Long Point Circle 613-425-8044
> Ottawa, Ontario r.faith@dbgrayengineering.com

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

Project Name:	1328 Michael Street	**Engineer:**	**D.B. Gray Engineering Inc.**
Location:	Ottawa, ON	**Contact:**	R. Faith
OGS #:	1	**Report Date:**	13-Dec-21

Area	0.0631	ha	**Rainfall Station #**	215	
Weighted C	0.77		**Particle Size Distribution**	FINE	
CDS Model	2015-4		**CDS Treatment Capacity**	20	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	9.2%	9.2%	0.1	0.1	0.3	98.8	9.1
1.0	10.6%	19.8%	0.1	0.1	0.7	98.7	10.5
1.5	9.9%	29.7%	0.2	0.2	1.0	98.6	9.8
2.0	8.4%	38.1%	0.3	0.3	1.4	98.5	8.3
2.5	7.7%	45.8%	0.3	0.3	1.7	98.4	7.6
3.0	5.9%	51.7%	0.4	0.4	2.0	98.3	5.8
3.5	4.4%	56.1%	0.5	0.5	2.4	98.2	4.3
4.0	4.7%	60.7%	0.5	0.5	2.7	98.1	4.6
4.5	3.3%	64.0%	0.6	0.6	3.1	98.0	3.3
5.0	3.0%	67.1%	0.7	0.7	3.4	97.9	3.0
6.0	5.4%	72.4%	0.8	0.8	4.1	97.7	5.3
7.0	4.4%	76.8%	0.9	0.9	4.8	97.5	4.2
8.0	3.5%	80.3%	1.1	1.1	5.5	97.3	3.4
9.0	2.8%	83.2%	1.2	1.2	6.1	97.1	2.7
10.0	2.2%	85.3%	1.4	1.4	6.8	96.9	2.1
15.0	7.0%	92.3%	2.0	2.0	10.2	95.9	6.7
20.0	4.5%	96.9%	2.7	2.7	13.6	95.0	4.3
25.0	1.4%	98.3%	3.4	3.4	17.0	94.0	1.4
30.0	0.7%	99.0%	4.1	4.1	20.4	93.0	0.6
35.0	0.5%	99.5%	4.7	4.7	23.8	92.0	0.4
40.0	0.5%	100.0%	5.4	5.4	27.3	91.0	0.5
45.0	0.0%	100.0%	6.1	6.1	30.7	90.1	0.0
50.0	0.0%	100.0%	6.8	6.8	34.1	89.1	0.0
							97.7

Removal Efficiency Adjustment[2] = 6.5%

Predicted Net Annual Load Removal Efficiency = 91.2%

Predicted % Annual Rainfall Treated = 100.0%

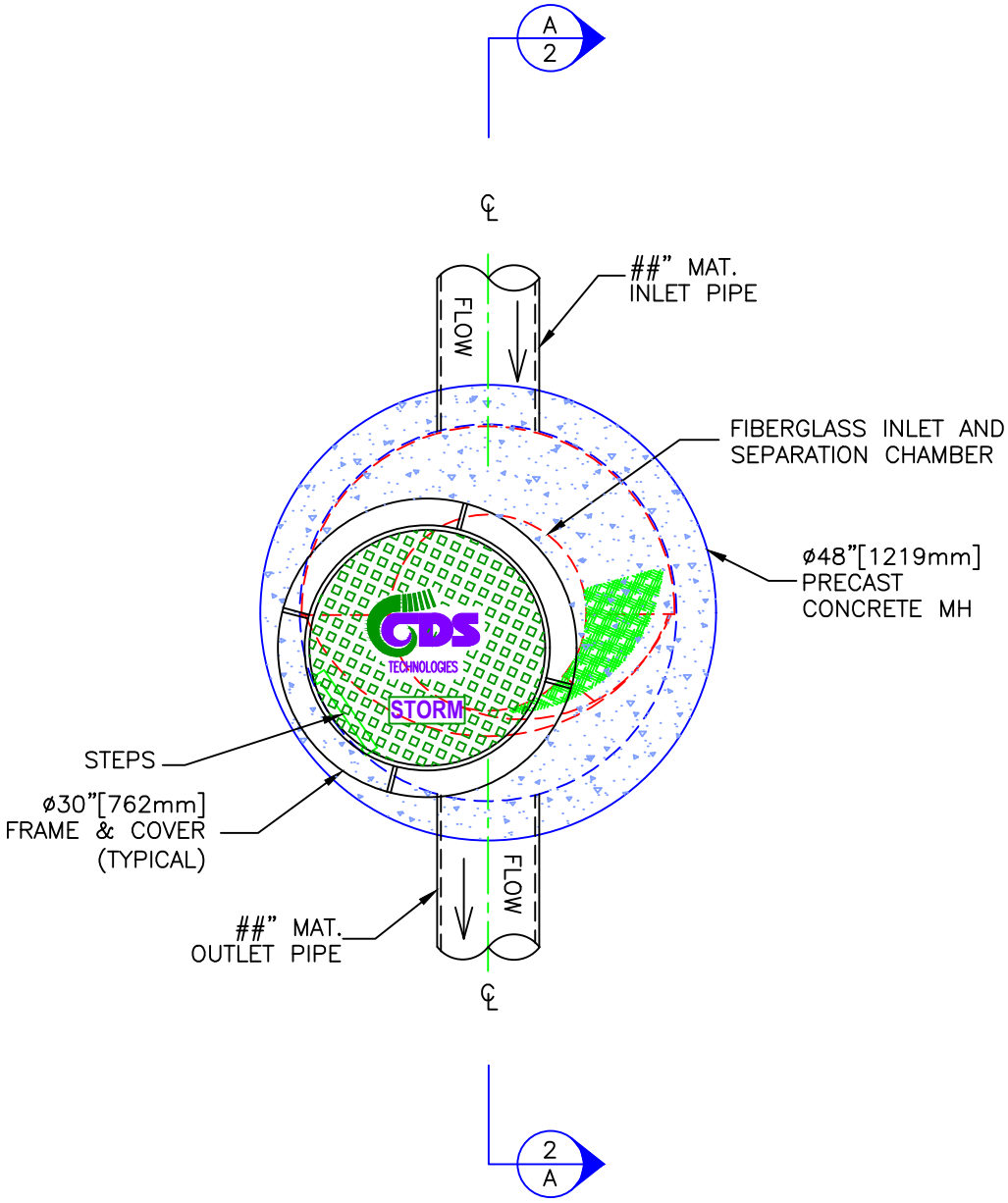
1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

3 - CDS Efficiency based on testing conducted at the University of Central Florida

4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

PLAN VIEW

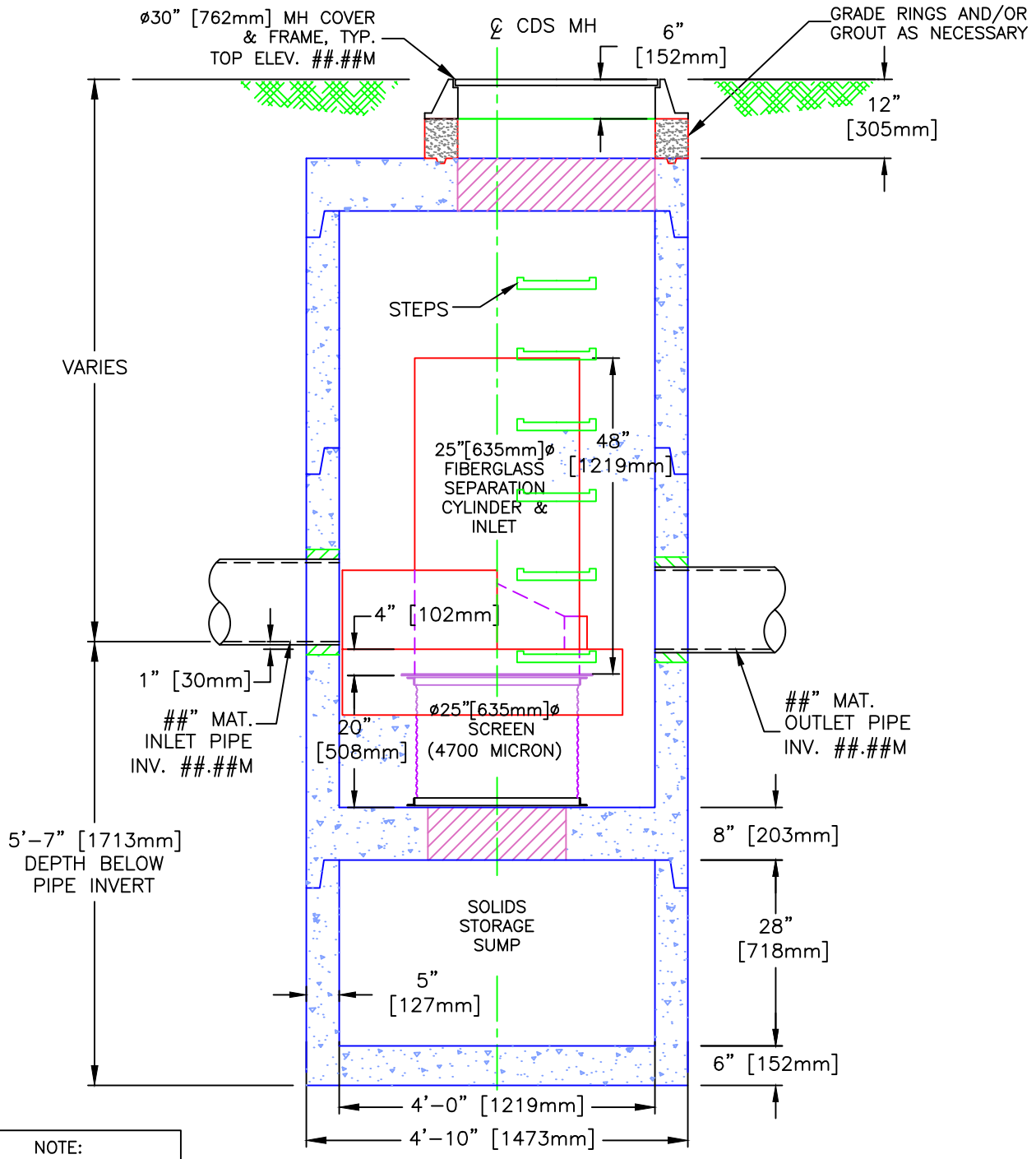


CDS MODEL PMSU20_15_4m
STORMWATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, PROVINCE	JOB# XX-##-###	SCALE 1" = 2'
		DATE ##/##/##	SHEET 1
		DRAWN INITIALS	
		APPROV.	

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

SECTION A–A
ELEVATION VIEW



NOTE:
CONTRACTOR TO FIELD VERIFY DIMENSIONS OF OR CONCRETE SECTIONS

CDS MODEL PMSU20_15_4m
STORMWATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS

PROJECT NAME
CITY, PROVINCE

JOB#	XX–##–###	SCALE 1" = 2'
DATE	##/##/##	SHEET 2
DRAWN	INITIALS	
APPROV.		

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

CDS Hydrodynamic Separator®

Developed by CONTECH Engineered Solutions LLC
Scarborough, Maine, USA

Registration: GPS-ETV_VR2020-03-31_CDS

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 31, 2020
Vancouver, BC, Canada

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

Technology description and application

The CDS® is a Stormwater treatment device designed to remove pollutants, including sediment, trash and hydrocarbons from Stormwater runoff. The CDS is typically comprised of a manhole that houses flow and screening controls that use a combination of swirl concentration and continuous deflective separation.

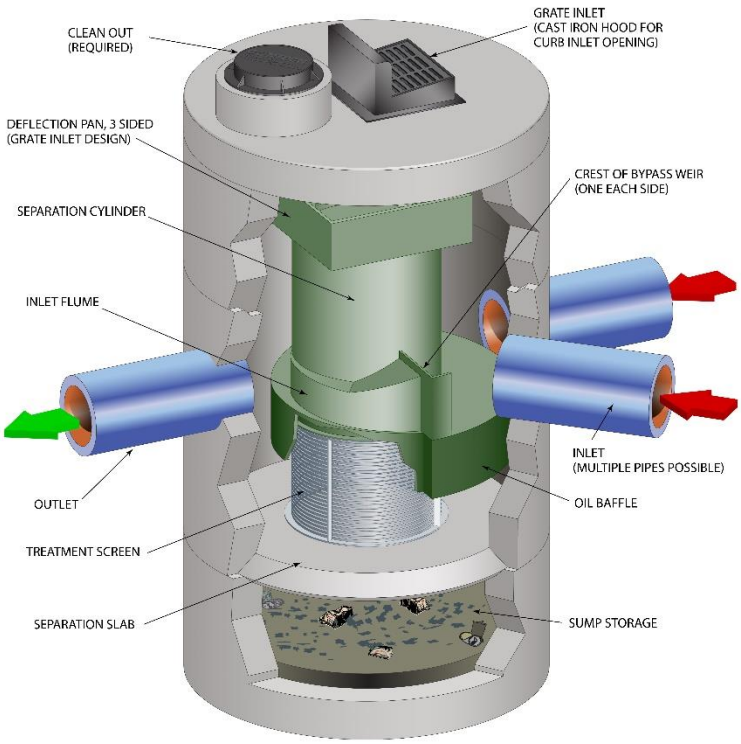


Figure 1. Graphic of typical inline CDS unit and core components.

When stormwater runoff enters the CDS unit's diversion chamber, the diversion pan guides the flow into the unit's separation chamber. The water and associated gross pollutants contained within the separation cylinder are kept in continuous circular motion by the energy generated from the incoming flow. This has the effect of a continuous deflective separation of the pollutants and their eventual deposition into the sump storage below. A perforated screen plate allows the filtered water to pass through to a volute return system and thence to the outlet pipe. The oil and other light liquids are retained within the oil baffle. Figure 1 shows a schematic representation of a typical CDS unit including critical components

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Contech CDS-4 OGS device, in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014). The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for Environment Canada's Environmental Technology Verification (ETV) Program requirements. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test[1]:

During the sediment capture test, the Contech CDS OGS device with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removed 74, 70, 63, 53, 45, 42, 32 and 23 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, 1400 and 1893 L/min/m^2, respectively.

Scour test[a]:

During the scour test, the Contech CDS OGS device with preloaded test sediment reaching 50% of the manufacturer's recommended maximum sediment storage depth, generated corrected effluent concentrations of 1.8, 6.5, 8.2, 11.2, and 309.3 mg/L during a test run[2] with approximately 5 minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test[a]:

During the light liquid re-entrainment test, the Contech CDS OGS device with surrogate low-density polyethylene beads preloaded within the oil collection skirt area, representing floating liquid to a volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.9, 98.6, 99.5, and 99.7 percent of loaded beads by volume during a test run[2] with 5 minutes duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Performance results

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

[1] The claim can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)
[2] See variance #1 in "Variances from testing procedure" section below.

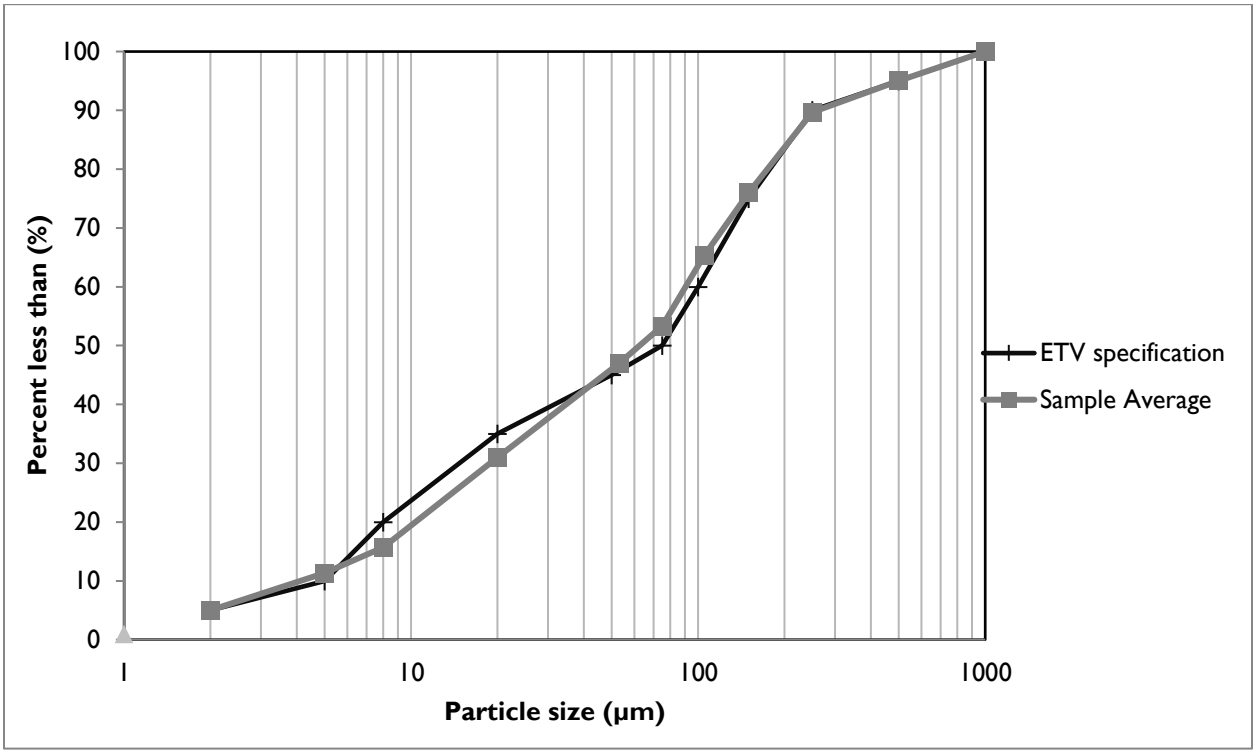


Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

The capacity of the device to retain sediment was determined at eight surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1).

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

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

Particle size fraction (µm)	Surface loading rate (L/min/m²)							
	40	80	200	400	600	1000	1400	1893
>500	100	100*	66	79	97	100*	84	77
250 - 500	100*	100*	85	95	100*	91	100*	75
150 - 250	99	100*	100*	97	100	75	68	37
105 - 150	100	100*	100*	74	47	45	30	27
75 - 105	90	91	100*	61	33	36	26	18
53 - 75	71	27	54	100	42	44	15	16
20 - 53	65	51	20	8	10	8	5	4
8 - 20	28	22	9	7	1	1	2	1
5 – 8	30	9	0	8	2	0	1	0
<5	11	8	16	2	6	5	2	2
All particle sizes by mass balance	**73.5**	**70.3**	**63.4**	**52.6**	**45.1**	**41.5**	**32.4**	**23.0**

* Removal efficiencies were calculated to be above 100%. Calculated values typically ranged between 101 and 175% (average 126%). Higher values were observed for the >500 µm and 150-250 µm size fractions during the 80 L/min/m² test run. See text and Bulletin # CETV 2016-11-0001 for more information.

Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the retained sediment at each of the tested surface loading rates. As expected, the capture efficiency for fine particles was generally found to decrease as surface loading rates increased.

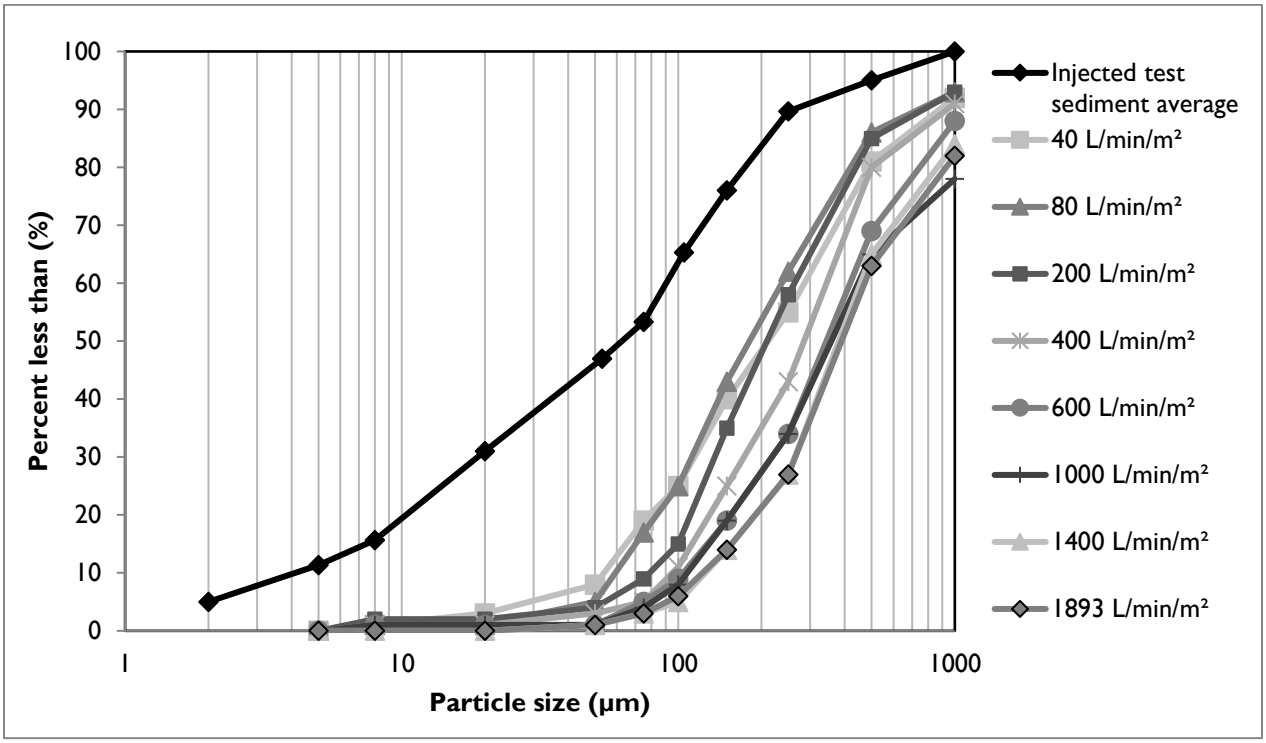


Figure 3. Particle size distribution of retained sediment in relation to the injected test sediment average.

Table 2 shows the results of the sediment scour and re-suspension test. This test involved preloading 10.2 cm of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Sediment was also pre-loaded to the same depth on the separation slab (see Figure 1) since sediment was observed to have been deposited in this area during the sediment capture test. Clean water was run through the device at five surface loading rates over a 36 minute period. The test was stopped and started after the second flow rate in order to change flow meters. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water and the smallest 5% of particles captured during the 40 L/min/m^2 sediment capture test, as per the method described in Bulletin # CETV 2016-09-0001.

Table 2. Scour test adjusted effluent sediment concentration.

Run	Surface loading rate (L/min/m^2)	Run time (min)	Background sample concentration (mg/L)	Adjusted effluent suspended sediment concentration (mg/L)[†]	Average (mg/L)
1	200	1.03	0.5	1.0	1.8
		2.03		1.6	
		3.03		1.8	
		4.03		1.8	
		5.03		2.6	
2	800	6.23	2.0	5.0	6.5
		7.23		6.7	
		8.23		9.4	
		9.23		5.4	
		10.23		5.9	
3	1400	11.43[‡]	2.0	3.1	8.2
		12.43		11.0	
		13.43		14.6	
		14.43		7.1	
		15.43		5.2	
4	2000	17.20	3.2	7.3	11.2
		18.20		22.8	
		19.20		6.9	
		20.20		6.8	
		21.20		12.1	
5	2600	22.40	8.5	248.5	309.3
		23.40		83.0	
		24.40		438.9	
		25.40		338.7	
		26.40		437.5	

[†] The adjusted effluent suspended sediment concentration represents the actual measured effluent concentration minus the smallest 5% of sediment particles (i.e. d5) removed during the 40 L/min/m^2 capture test, minus the background concentration. For more information see Bulletin # CETV 2016-09-0001.

[‡] See variance #1 in "Variances from testing procedure" section below.

The results of the light liquid re-entrainment test used to evaluate the unit's capacity to prevent re-entrainment of light liquids are reported in Table 3. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m^2) of surrogate low-density polyethylene beads within the oil collection skirt and running clean water through the device at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m^2) over a 38 minute period. As with the sediment scour test, flow was stopped and started after the second flow rate to change flow meters. Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates. The effluent flow was screened to capture all re-entrained pellets throughout the test.

Table 3. Light liquid re-entrainment test results.

Target Flow (L/min/m^2)	Time Stamp	Collected Volume (L)	Collected Mass (g)	Percent re-entrained by volume	Percent retained by volume
200	10:48:42	27 pellets	0.8	0.01	99.99
800	10:55:09	0.07	41	0.12	99.88
1400	11:06:59	0.8	439	1.37	98.63
2000	11:13:00	0.31	177	0.53	99.47
2600	11:19:00	0.18	98	0.31	99.69
Interim Collection Net		0.025	14.2	0.04	99.96
Total Loaded		58.3	33398	--	--
Total Re-entrained		1.385	770	--	--
Percent Re-entrained and retained		--	--	2.38	97.62

Variances from testing Procedure

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

1. It was necessary to change flow meters during the scour and light liquid re-entrainment test, as the required flows exceeded the minimum and/or maximum range of any single meter. After the loading rate of 800 L/min/m^2, the flow was gradually shut down and re-initiated through the larger meter immediately after closing the valve controlling flows to the small meter. The transition time of 1-minute for each target flow was followed, resulting in an elapsed time of 3 minutes to reach the next target flow of 1400 L/min/m^2. This procedure was approved by CETV prior to testing, in recognition that most particles susceptible to scour at low flows would not be in the sump at higher flows. Similarly, re-entrainment of the oil beads was not expected to be significantly affected by the flow meter change.

2. As part of the capture test, evaluation of the 40 L/min/m^2 surface loading rate was split into 3 parts due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit. At the end of the first and second parts of the test, the flow rates were gradually shutdown to prevent capture of particles that would have been washed out under normal circumstances. The amended procedure was reviewed and approved by the verifier prior to testing.

3. Inflow concentrations during the 40 L/min/m^2 surface loading rate varied from 162 mg/L to 246 mg/L, which is wider than specified ±25 mg/L range in the Procedure.

Verification

This verification was first completed in March 2017 and is considered valid for subsequent renewal periods every three (3) years thereafter, subject to review and confirmation of the original performance and performance claims. The original verification was completed by the Toronto and Region Conservation Authority of Mississauga, Ontario, Canada using the Canadian ETV Program's General Verification Protocol (June 2012) and taking into account ISO 14034:2016. This ETV renewal is considered to meet the equivalency of an ETV verification completed using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***.

Data and information provided by Contech Engineered Solutions to support the performance claim included the following: Performance test report prepared by Alden Research Laboratory, Inc of Holden, Massachusetts, USA and dated February 2015; the report is based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

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

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

For more information on the CDS Stormwater Treatment System please contact:

CONTECH Engineered Solutions LLC
71 US Route 1, Suite F
Scarborough, ME
04074 USA
Tel: 207-885-9830
info@conteches.com
www.conteches.com

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

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

Summary Tables

ONE HUNDRED-YEAR EVENT

Drainage Area	Pre Development Flow Rate (L/s)	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	-	3.07	-	-
AREA II (RD-1)	-	-	1.44	1.92	1.92
AREA III (RD-2,3,4,5)	-	-	5.68	27.13	27.13
AREA IV (RD-6,7)	-	-	2.22	1.89	1.89
AREA V	-	-	13.79	15.33	15.33
TOTAL	70.81	26.20	26.20	46.26	46.26

FIVE-YEAR EVENT

Drainage Area	Pre Development Flow Rate (L/s)	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	-	1.48	-	-
AREA II (RD-1)	-	-	1.06	0.77	0.77
AREA III (RD-2,3,4,5)	-	-	4.01	12.50	12.50
AREA IV (RD-6,7)	-	-	1.50	0.79	0.79
AREA V	-	-	6.39	8.61	8.61
TOTAL	36.82	26.20	14.44	22.67	22.67

December 13, 2021
REVISED July 22, 2022
REVISED January 16, 2023

1328 Michael Street

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS
Rational Method

PRE-DEVELOPMENT CONDITIONS

(Calculations Assuming No Off Site Drainage)

100-Year Flow Rate

			C
Roof Area:	115	sq.m	1.00
Asphalt/Concrete Area:	1184	sq.m	1.00
Landscaped Area:	510	sq.m	0.25
Total Catchment Area:	1809	sq.m	0.79

Bransby William Formula

$$Tc = \frac{0.057 \cdot L}{Sw^{0.2} \cdot A^{0.1}} \text{ min}$$

Sheet Flow Distance (L):	50	m
Slope of Land (Sw):	1.0	%
Area (A):	0.1809	ha
Time of Concentration (Sheet Flow):	3	min
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
100-Year Pre-Development Release Rate (2.78AiC):	70.81	L/s

5-Year Flow Rate

			C
Roof Area:	115	sq.m	0.90
Asphalt/Concrete Area:	1184	sq.m	0.90
Landscaped Area:	510	sq.m	0.20
Total Catchment Area:	1809	sq.m	0.70
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
5-Year Pre-Development Release Rate (2.78AiC):	36.82	L/s	

Maximum Allowable Release Rate

			C
Roof Area:	115	sq.m	0.90
Asphalt/Concrete Area:	1184	sq.m	0.90
Landscaped Area:	510	sq.m	0.20
Total Catchment Area:	1809	sq.m	0.70
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	(5 year event)
Runoff Coeficient (C):	0.50		
Maximum Allowable Release Rate (2.78AiC):	26.20	L/s	

ONE HUNDRED-YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(ONE HUNDRED-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	15	sq.m	1.00
Permeable Pavers Area:	85	sq.m	0.375
Landscaped Area:	60	sq.m	0.25
Total Catchment Area:	160	sq.m	0.39
Area (A):	160	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr	
Runoff Coeficient (C):	0.39		
Release Rate (2.78AiC):	3.07	L/s	

DRAINAGE AREA II (RD-1)

(ONE-HUNDRED-YEAR EVENT)

			C
Total Catchment Area:	90	sq.m	1.00

No. of Roof Drains:	1	
Slots per Wier:	1	0.0124 L/s/mm/slot (5 USGPM/in/slot)
Depth at Roof Drain:	116	mm
Maximum Release Rate:	1.44	L/s

Pond Area:	49	sq.m
Achieved Volume:	1.92	cu.m
Maximum Volume Required:	1.92	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	6.07	1.44	4.63	1.39
10	179	4.47	1.44	3.02	1.81
15	143	3.58	1.44	2.13	1.92
20	120	3.00	1.44	1.56	1.87
25	104	2.60	1.44	1.15	1.73
30	92	2.30	1.44	0.85	1.54
35	83	2.07	1.44	0.62	1.31
40	75	1.88	1.44	0.44	1.05
45	69	1.73	1.44	0.28	0.77
50	64	1.60	1.44	0.16	0.47
55	60	1.49	1.44	0.05	0.16
60	56	1.40	1.40	0.00	0.00
65	53	1.32	1.32	0.00	0.00
70	50	1.25	1.25	0.00	0.00
75	47	1.18	1.18	0.00	0.00
80	45	1.13	1.13	0.00	0.00
85	43	1.07	1.07	0.00	0.00
90	41	1.03	1.03	0.00	0.00
95	39	0.99	0.99	0.00	0.00
100	38	0.95	0.95	0.00	0.00
105	36	0.91	0.91	0.00	0.00
110	35	0.88	0.88	0.00	0.00
115	34	0.85	0.85	0.00	0.00
120	33	0.82	0.82	0.00	0.00

DRAINAGE AREA III (RD-2,3,4 & 5)

(ONE-HUNDRED-YEAR EVENT)

			C
Total Catchment Area:	810	sq.m	1.00

No. of Roof Drains:	4	
Slots per Wier:	1	0.0124 L/s/mm/slot (5 USGPM/in/slot)
Depth at Roof Drain:	114	mm
Maximum Release Rate:	5.68	L/s

Pond Area:	535	sq.m
Achieved Volume:	27.13	cu.m
Maximum Volume Required:	27.13	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	54.65	5.68	48.98	14.69
10	179	40.21	5.68	34.53	20.72
15	143	32.18	5.68	26.50	23.85
20	120	27.01	5.68	21.33	25.60
25	104	23.38	5.68	17.71	26.56
30	92	20.69	5.68	15.01	27.02
35	83	18.60	5.68	12.92	27.13
40	75	16.92	5.68	11.25	26.99
45	69	15.55	5.68	9.87	26.66
50	64	14.40	5.68	8.73	26.18
55	60	13.43	5.68	7.75	25.58
60	56	12.59	5.68	6.91	24.88
65	53	11.85	5.68	6.18	24.10
70	50	11.21	5.68	5.54	23.25
75	47	10.64	5.68	4.97	22.34
80	45	10.13	5.68	4.46	21.39
85	43	9.67	5.68	4.00	20.38
90	41	9.26	5.68	3.58	19.34
95	39	8.88	5.68	3.20	18.26
100	38	8.54	5.68	2.86	17.16
105	36	8.22	5.68	2.54	16.02
110	35	7.93	5.68	2.25	14.86
115	34	7.66	5.68	1.98	13.67
120	33	7.41	5.68	1.73	12.47

DRAINAGE AREA IV (RD-6 & 7)

(ONE-HUNDRED-YEAR EVENT)

			C
Total Catchment Area:	108	sq.m	1.00

No. of Roof Drains:	2	
Slots per Wier:	1	0.0124 L/s/mm/slot (5 USGPM/in/slot)
Depth at Roof Drain:	89	mm
Maximum Release Rate:	2.22	L/s

Pond Area:	48	sq.m
Achieved Volume:	1.89	cu.m
Maximum Volume Required:	1.89	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	7.29	2.22	5.07	1.52
10	179	5.36	2.22	3.14	1.89
15	143	4.29	2.22	2.07	1.86
20	120	3.60	2.22	1.38	1.66
25	104	3.12	2.22	0.90	1.35
30	92	2.76	2.22	0.54	0.97
35	83	2.48	2.22	0.26	0.55
40	75	2.26	2.22	0.04	0.09
45	69	2.07	2.07	0.00	0.00
50	64	1.92	1.92	0.00	0.00
55	60	1.79	1.79	0.00	0.00
60	56	1.68	1.68	0.00	0.00
65	53	1.58	1.58	0.00	0.00
70	50	1.49	1.49	0.00	0.00
75	47	1.42	1.42	0.00	0.00
80	45	1.35	1.35	0.00	0.00
85	43	1.29	1.29	0.00	0.00
90	41	1.23	1.23	0.00	0.00
95	39	1.18	1.18	0.00	0.00
100	38	1.14	1.14	0.00	0.00
105	36	1.10	1.10	0.00	0.00
110	35	1.06	1.06	0.00	0.00
115	34	1.02	1.02	0.00	0.00
120	33	0.99	0.99	0.00	0.00

DRAINAGE AREA V

(ONE-HUNDRED-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	561	sq.m	1.00
Permeable Pavers Area:	70	sq.m	0.375
Landscaped Area:	10	sq.m	0.25
Total Catchment Area:	641	sq.m	0.92

Water Elevation:	69.04	m
Invert of Outlet Pipe - CB/MH-3:	67.40	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-3)	67.44	m
Head:	1.60	m
Orifice Diameter:	72	mm
Orifice Area:	4,033	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	13.79	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume
CB/MH-3	0	0.00	0.00

CB/MH Storage			
CB/MH	Invert	Size	Volume
CB/MH-1	67.52	1.219	1.77
CB/MH-2	67.42	1.219	1.89
CB/MH-3	67.40	1.219	1.91

Pipe Storage						
From	Invert	To	Invert	Length	Dia.	Volume
CB/MH-1	67.52	CB/MH-2	67.42	50.3	0.457	8.05
CB/MH-2	67.42	CB/MH-3	67.40	11.6	0.457	1.71

Achieved Volume: 15.33 cu.m

Maximum Volume Required: 15.33 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% of Max. Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	39.79	6.89	32.90	9.87
10	179	29.27	6.89	22.38	13.43
15	143	23.43	6.89	16.53	14.88
20	120	19.67	6.89	12.77	15.33
25	104	17.03	6.89	10.13	15.20
30	92	15.06	6.89	8.17	14.70
35	83	13.54	6.89	6.65	13.96
40	75	12.32	6.89	5.43	13.02
45	69	11.32	6.89	4.43	11.95
50	64	10.49	6.89	3.59	10.78
55	60	9.78	6.89	2.88	9.51
60	56	9.16	6.89	2.27	8.17
65	53	8.63	6.89	1.74	6.78
70	50	8.16	6.89	1.27	5.33
75	47	7.75	6.89	0.85	3.84
80	45	7.38	6.89	0.48	2.32
85	43	7.04	6.89	0.15	0.76
90	41	6.74	6.74	0.00	0.00
95	39	6.47	6.47	0.00	0.00
100	38	6.21	6.21	0.00	0.00
105	36	5.98	5.98	0.00	0.00
110	35	5.77	5.77	0.00	0.00
115	34	5.58	5.58	0.00	0.00
120	33	5.39	5.39	0.00	0.00

DRAINAGE AREA V

(ONE-HUNDRED-YEAR EVENT- **Including Drainage from Adjacent Lands**)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	561	sq.m	1.00
Adjacent Lands:	**843**	**sq.m**	**1.00**
Permeable Pavers Area:	70	sq.m	0.375
Landscaped Area:	10	sq.m	0.25
Total Catchment Area:	1484	sq.m	0.97

Water Elevation:	69.09	m
Invert of Outlet Pipe - CB/MH-3:	67.40	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-3)	67.44	m
Head:	1.65	m
Orifice Diameter:	72	mm
Orifice Area:	4,033	sq.mm
Discharge Coefficient:	0.61	
Maximum ICD Release Rate:	14.02	L/s
Maximum Overflow Release Rate:	37.76	L/s
Maximum Total Release Rate:	51.78	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume
CB/MH-3	29	0.05	0.48

CB/MH Storage			
CB/MH	Invert	Size	Volume
CB/MH-1	67.52	1.219	1.77
CB/MH-2	67.42	1.219	1.89
CB/MH-3	67.40	1.219	1.91

Pipe Storage						
From	Invert	To	Invert	Length	Dia.	Volume
CB/MH-1	67.52	CB/MH-2	67.42	50.3	0.457	8.05
CB/MH-2	67.42	CB/MH-3	67.40	11.6	0.457	1.71

Achieved Volume: 15.81 cu.m

Maximum Volume Required: 15.81 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% of Max. Release Rate (L/s)	Overflow Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	96.67	7.01	36.96	52.70	15.81
10	179	71.12	7.01	37.76	26.35	15.81
15	143	56.92	7.01	32.34	17.57	15.81
20	120	47.78	7.01	27.59	13.18	15.81
25	104	41.36	7.01	23.81	10.54	15.81
30	92	36.59	7.01	20.80	8.78	15.81
35	83	32.89	7.01	18.35	7.53	15.81
40	75	29.93	7.01	16.34	6.59	15.81
45	69	27.50	7.01	14.64	5.86	15.81
50	64	25.47	7.01	13.20	5.27	15.81
55	60	23.75	7.01	11.95	4.79	15.81
60	56	22.26	7.01	10.86	4.39	15.81
65	53	20.97	7.01	9.91	4.05	15.81
70	50	19.83	7.01	9.06	3.76	15.81
75	47	18.82	7.01	8.30	3.51	15.81
80	45	17.92	7.01	7.62	3.29	15.81
85	43	17.11	7.01	7.00	3.10	15.81
90	41	16.37	7.01	6.44	2.93	15.81
95	39	15.71	7.01	5.93	2.77	15.81
100	38	15.10	7.01	5.45	2.64	15.81
105	36	14.54	7.01	5.02	2.51	15.81
110	35	14.02	7.01	4.62	2.40	15.81
115	34	13.54	7.01	4.25	2.29	15.81
120	33	13.10	7.01	3.90	2.20	15.81
150	28	11.00	7.01	2.23	1.76	15.81
180	24	9.52	7.01	1.05	1.46	15.81
210	21	8.42	7.01	0.16	1.25	15.81
240	19	7.57	7.01	0.00	0.56	8.10
270	17	6.89	6.89	0.00	0.00	0.00
300	16	6.33	6.33	0.00	0.00	0.00

FIVE-YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(FIVE-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	15	sq.m	0.90
Permeable Pavers Area:	85	sq.m	0.30
Landscaped Area:	60	sq.m	0.20
Total Catchment Area:	160	sq.m	0.32
Area (A):	160	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.32		
Release Rate (2.78AiC):	1.48	L/s	

DRAINAGE AREA II (RD-1)

(FIVE-YEAR EVENT)

			C
Total Catchment Area:	90	sq.m	0.90

No. of Roof Drains:	1	
Slots per Wier:	1	0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain:	86	mm			
Maximum Release Rate:	1.06	L/s	Pond Area:	27	sq.m
			Achieved Volume:	0.77	cu.m
			Maximum Volume Required:	0.77	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	3.18	1.06	2.11	0.63
10	104	2.35	1.06	1.28	0.77
15	84	1.88	1.06	0.82	0.74
20	70	1.58	1.06	0.52	0.62
25	61	1.37	1.06	0.31	0.46
30	54	1.21	1.06	0.15	0.27
35	49	1.09	1.06	0.03	0.06
40	44	0.99	0.99	0.00	0.00
45	41	0.91	0.91	0.00	0.00
50	38	0.85	0.85	0.00	0.00
55	35	0.79	0.79	0.00	0.00
60	33	0.74	0.74	0.00	0.00
65	31	0.70	0.70	0.00	0.00
70	29	0.66	0.66	0.00	0.00
75	28	0.63	0.63	0.00	0.00
80	27	0.60	0.60	0.00	0.00
85	25	0.57	0.57	0.00	0.00
90	24	0.55	0.55	0.00	0.00
95	23	0.52	0.52	0.00	0.00
100	22	0.50	0.50	0.00	0.00
105	22	0.49	0.49	0.00	0.00
110	21	0.47	0.47	0.00	0.00
115	20	0.45	0.45	0.00	0.00
120	19	0.44	0.44	0.00	0.00

DRAINAGE AREA III (RD-2,3,4 & 5)

(FIVE-YEAR EVENT)

			C
Total Catchment Area:	810	sq.m	0.90

No. of Roof Drains:	4	
Slots per Wier:	1	0.0124 L/s/mm/slot (5 USGPM/in/slot)
Depth at Roof Drain:	81	mm
Maximum Release Rate:	4.01	L/s

Pond Area: 340 sq.m

Achieved Volume: 12.50 cu.m

Maximum Volume Required: 12.50 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	28.61	4.01	24.61	7.38
10	104	21.12	4.01	17.11	10.27
15	84	16.93	4.01	12.93	11.63
20	70	14.24	4.01	10.23	12.28
25	61	12.34	4.01	8.34	12.50
30	54	10.93	4.01	6.92	12.46
35	49	9.83	4.01	5.83	12.24
40	44	8.95	4.01	4.95	11.88
45	41	8.23	4.01	4.23	11.41
50	38	7.63	4.01	3.62	10.87
55	35	7.12	4.01	3.11	10.27
60	33	6.68	4.01	2.67	9.61
65	31	6.29	4.01	2.29	8.91
70	29	5.95	4.01	1.95	8.17
75	28	5.65	4.01	1.65	7.41
80	27	5.38	4.01	1.38	6.61
85	25	5.14	4.01	1.13	5.79
90	24	4.92	4.01	0.92	4.95
95	23	4.72	4.01	0.72	4.09
100	22	4.54	4.01	0.53	3.21
105	22	4.37	4.01	0.37	2.32
110	21	4.22	4.01	0.21	1.41
115	20	4.08	4.01	0.07	0.49
120	19	3.95	3.95	0.00	0.00

DRAINAGE AREA IV (RD-6 & 7)

(FIVE-YEAR EVENT)

			C
Total Catchment Area:	108	sq.m	0.90

No. of Roof Drains:	2	
Slots per Wier:	1	0.0124 L/s/mm/slot (5 USGPM/in/slot)
Depth at Roof Drain:	61	mm
Maximum Release Rate:	1.50	L/s

Pond Area:	29	sq.m
Achieved Volume:	0.79	cu.m
Maximum Volume Required:	0.79	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	3.81	1.50	2.31	0.69
10	104	2.82	1.50	1.31	0.79
15	84	2.26	1.50	0.75	0.68
20	70	1.90	1.50	0.39	0.47
25	61	1.65	1.50	0.14	0.21
30	54	1.46	1.46	0.00	0.00
35	49	1.31	1.31	0.00	0.00
40	44	1.19	1.19	0.00	0.00
45	41	1.10	1.10	0.00	0.00
50	38	1.02	1.02	0.00	0.00
55	35	0.95	0.95	0.00	0.00
60	33	0.89	0.89	0.00	0.00
65	31	0.84	0.84	0.00	0.00
70	29	0.79	0.79	0.00	0.00
75	28	0.75	0.75	0.00	0.00
80	27	0.72	0.72	0.00	0.00
85	25	0.69	0.69	0.00	0.00
90	24	0.66	0.66	0.00	0.00
95	23	0.63	0.63	0.00	0.00
100	22	0.61	0.61	0.00	0.00
105	22	0.58	0.58	0.00	0.00
110	21	0.56	0.56	0.00	0.00
115	20	0.54	0.54	0.00	0.00
120	19	0.53	0.53	0.00	0.00

DRAINAGE AREA V

(FIVE-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	561	sq.m	0.90
Permeable Pavers Area:	70	sq.m	0.30
Landscaped Area:	10	sq.m	0.20
Total Catchment Area:	641	sq.m	0.82

Water Elevation:	67.78	m
Invert of Outlet Pipe - CB/MH-3:	67.40	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-3)	67.44	m
Head:	0.34	m
Orifice Diameter:	72	mm
Orifice Area:	4,033	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	6.39	L/s

CB/MH Storage			
CB/MH	Invert	Size	Volume
CB/MH-1	67.52	1.219	0.30
CB/MH-2	67.42	1.219	0.42
CB/MH-3	67.40	1.219	0.44

Pipe Storage						
From	Invert	To	Invert	Length	Dia.	Volume
CB/MH-1	67.52	CB/MH-2	67.42	50.3	0.457	5.82
CB/MH-2	67.42	CB/MH-3	67.40	11.6	0.457	1.62

Achieved Volume:	8.61	cu.m
Maximum Volume Required:	8.61	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% of Max. Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	20.72	3.19	17.52	5.26
10	104	15.29	3.19	12.10	7.26
15	84	12.26	3.19	9.07	8.16
20	70	10.31	3.19	7.12	8.54
25	61	8.94	3.19	5.74	8.61
30	54	7.91	3.19	4.72	8.50
35	49	7.12	3.19	3.93	8.24
40	44	6.48	3.19	3.29	7.90
45	41	5.96	3.19	2.77	7.47
50	38	5.53	3.19	2.33	6.99
55	35	5.15	3.19	1.96	6.47
60	33	4.83	3.19	1.64	5.90
65	31	4.56	3.19	1.36	5.31
70	29	4.31	3.19	1.12	4.69
75	28	4.09	3.19	0.90	4.04
80	27	3.90	3.19	0.70	3.38
85	25	3.72	3.19	0.53	2.70
90	24	3.56	3.19	0.37	2.00
95	23	3.42	3.19	0.23	1.29
100	22	3.29	3.19	0.09	0.56
105	22	3.17	3.17	0.00	0.00
110	21	3.06	3.06	0.00	0.00
115	20	2.95	2.95	0.00	0.00
120	19	2.86	2.86	0.00	0.00

DRAINAGE AREA V

(FIVE-YEAR EVENT- **Including Drainage from Adjacent Lands**)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	561	sq.m	0.90
Adjacent Lands:	**843**	**sq.m**	**0.90**
Permeable Pavers Area:	70	sq.m	0.30
Landscaped Area:	10	sq.m	0.20
Total Catchment Area:	1484	sq.m	0.87

Water Elevation:	69.09	m
Invert of Outlet Pipe - CB/MH-3:	67.40	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-3)	67.44	m
Head:	1.65	m
Orifice Diameter:	72	mm
Orifice Area:	4,033	sq.mm
Discharge Coefficient:	0.61	
Maximum ICD Release Rate:	14.02	L/s
Maximum Overflow Release Rate:	5.31	L/s
Maximum Total Release Rate:	19.33	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume
CB/MH-3	29	0.05	0.48

CB/MH Storage			
CB/MH	Invert	Size	Volume
CB/MH-1	67.52	1.219	1.77
CB/MH-2	67.42	1.219	1.89
CB/MH-3	67.40	1.219	1.91

Pipe Storage						
From	Invert	To	Invert	Length	Dia.	Volume
CB/MH-1	67.52	CB/MH-2	67.42	50.3	0.457	8.05
CB/MH-2	67.42	CB/MH-3	67.40	11.6	0.457	1.71

Achieved Volume: 15.81 cu.m

Maximum Overflow Rate: Maximum Volume Required: 15.81 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% of Max. Release Rate (L/s)	Overflow Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	50.50	7.01	0.00	43.49	13.05
10	104	37.27	7.01	3.91	26.35	15.81
15	84	29.89	7.01	5.31	17.57	15.81
20	70	25.13	7.01	4.94	13.18	15.81
25	61	21.78	7.01	4.23	10.54	15.81
30	54	19.29	7.01	3.50	8.78	15.81
35	49	17.35	7.01	2.82	7.53	15.81
40	44	15.80	7.01	2.21	6.59	15.81
45	41	14.53	7.01	1.67	5.86	15.81
50	38	13.47	7.01	1.19	5.27	15.81
55	35	12.56	7.01	0.76	4.79	15.81
60	33	11.78	7.01	0.38	4.39	15.81
65	31	11.10	7.01	0.04	4.05	15.81
70	29	10.51	7.01	0.00	3.50	14.69
75	28	9.97	7.01	0.00	2.97	13.35
80	27	9.50	7.01	0.00	2.49	11.97
85	25	9.07	7.01	0.00	2.07	10.54
90	24	8.69	7.01	0.00	1.68	9.07
95	23	8.34	7.01	0.00	1.33	7.57
100	22	8.01	7.01	0.00	1.01	6.04
105	22	7.72	7.01	0.00	0.71	4.48
110	21	7.45	7.01	0.00	0.44	2.90
115	20	7.20	7.01	0.00	0.19	1.30
120	19	6.96	6.96	0.00	0.00	0.00
150	16	5.85	5.85	0.00	0.00	0.00
180	14	5.07	5.07	0.00	0.00	0.00
210	13	4.49	4.49	0.00	0.00	0.00
240	11	4.04	4.04	0.00	0.00	0.00
270	10	3.68	3.68	0.00	0.00	0.00
300	9	3.38	3.38	0.00	0.00	0.00

TWO-YEAR EVENT

DRAINAGE AREA V

(TWO-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	561	sq.m	0.90
Permeable Pavers Area:	70	sq.m	0.30
Landscaped Area:	10	sq.m	0.20
Total Catchment Area:	641	sq.m	0.82

Water Elevation:	67.68	m
Invert of Outlet Pipe - CB/MH-3:	67.40	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-3)	67.44	m
Head:	0.25	m
Orifice Diameter:	72	mm
Orifice Area:	4,033	sq.mm
Discharge Coefficient:	0.61	
Maximum Release Rate:	5.42	L/s

CB/MH Storage

CB/MH	Invert	Size	Volume
CB/MH-1	67.52	1.219	0.30
CB/MH-2	67.42	1.219	0.42
CB/MH-3	67.40	1.219	0.44

Pipe Storage

From	Invert	To	Invert	Length	Dia.	Volume
CB/MH-1	67.52	CB/MH-2	67.42	50.3	0.457	3.60
CB/MH-2	67.42	CB/MH-3	67.40	11.6	0.457	1.15

Achieved Volume: 5.91 cu.m

Maximum Volume Required: 5.91 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% of Max. Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	104	15.20	2.71	12.49	3.75
10	77	11.27	2.71	8.56	5.14
15	62	9.06	2.71	6.35	5.72
20	52	7.64	2.71	4.93	5.91
25	45	6.63	2.71	3.92	5.88
30	40	5.88	2.71	3.17	5.70
35	36	5.29	2.71	2.58	5.42
40	33	4.82	2.71	2.11	5.07
45	30	4.44	2.71	1.73	4.67
50	28	4.12	2.71	1.41	4.22
55	26	3.84	2.71	1.13	3.73
60	25	3.60	2.71	0.89	3.22
65	23	3.40	2.71	0.69	2.68
70	22	3.22	2.71	0.51	2.12
75	21	3.05	2.71	0.34	1.55
80	20	2.91	2.71	0.20	0.96
85	19	2.78	2.71	0.07	0.36
90	18	2.66	2.66	0.00	0.00
95	17	2.56	2.56	0.00	0.00
100	17	2.46	2.46	0.00	0.00
105	16	2.37	2.37	0.00	0.00
110	16	2.28	2.28	0.00	0.00
115	15	2.21	2.21	0.00	0.00
120	15	2.14	2.14	0.00	0.00

DRAINAGE AREA V

(TWO-YEAR EVENT- **Including Drainage from Adjacent Lands**)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	561	sq.m	0.90
Adjacent Lands:	**843**	**sq.m**	**0.90**
Permeable Pavers Area:	70	sq.m	0.30
Landscaped Area:	10	sq.m	0.20
Total Catchment Area:	1484	sq.m	0.87

Water Elevation:	68.66	m
Invert of Outlet Pipe - CB/MH-3:	67.40	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-3)	67.44	m
Head:	1.23	m
Orifice Diameter:	71	mm
Orifice Area:	3,968	sq.mm
Discharge Coefficient:	0.61	
Maximum ICD Release Rate:	11.87	L/s
Maximum Overflow Release Rate:	0.00	L/s
Maximum Total Release Rate:	11.87	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume
CB/MH-3	0	0.00	0.00

CB/MH Storage			
CB/MH	Invert	Size	Volume
CB/MH-1	67.52	1.219	1.77
CB/MH-2	67.42	1.219	1.89
CB/MH-3	67.40	1.219	1.91

Pipe Storage						
From	Invert	To	Invert	Length	Dia.	Volume
CB/MH-1	67.52	CB/MH-2	67.42	50.3	0.457	8.05
CB/MH-2	67.42	CB/MH-3	67.40	11.6	0.457	1.71

Achieved Volume: 15.33 cu.m

Maximum Volume Required: 15.33 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% of Max. Release Rate (L/s)	Overflow Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	104	37.04	5.94	0.00	31.11	9.33
10	77	27.47	5.94	0.00	21.53	12.92
15	62	22.09	5.94	0.00	16.16	14.54
20	52	18.61	5.94	0.00	12.67	15.21
25	45	16.16	5.94	0.00	10.22	15.33
30	40	14.32	5.94	0.00	8.39	15.09
35	36	12.90	5.94	0.00	6.96	14.62
40	33	11.75	5.94	0.00	5.82	13.96
45	30	10.82	5.94	0.00	4.88	13.17
50	28	10.03	5.94	0.00	4.09	12.28
55	26	9.36	5.94	0.00	3.42	11.30
60	25	8.78	5.94	0.00	2.85	10.25
65	23	8.28	5.94	0.00	2.34	9.14
70	22	7.84	5.94	0.00	1.90	7.98
75	21	7.44	5.94	0.00	1.51	6.78
80	20	7.09	5.94	0.00	1.16	5.55
85	19	6.78	5.94	0.00	0.84	4.28
90	18	6.49	5.94	0.00	0.55	2.98
95	17	6.23	5.94	0.00	0.29	1.66
100	17	5.99	5.94	0.00	0.05	0.32
105	16	5.77	5.77	0.00	0.00	0.00
110	16	5.57	5.57	0.00	0.00	0.00
115	15	5.38	5.38	0.00	0.00	0.00
120	15	5.21	5.21	0.00	0.00	0.00
150	12	4.38	4.38	0.00	0.00	0.00
180	11	3.80	3.80	0.00	0.00	0.00
210	9	3.37	3.37	0.00	0.00	0.00
240	8	3.03	3.03	0.00	0.00	0.00
270	8	2.76	2.76	0.00	0.00	0.00
300	7	2.54	2.54	0.00	0.00	0.00

22-Jul-22

1328 Michael Street
Ottawa, Ontario

BROAD CRESTED WEIR CALCULATIONS

Length of Weir based on an assumed coefficient of discharge (Cd):

if Q=	37.75	l/s (maximum permited flow)	assumes Cd= 0.577
=	0.03775	cu.m./s	
& H=	0.02	m (max. depth of water above top of weir)	(assumes P/H is large)
then L=	7.0	m (length of weir) L = (Q / ((1.705 x H^(3/2))	

Length of Weir based on a calculate coefficient of discharge (Cd):

if P=	0.05	m (depth of pond)
& Lp=	7.0	m (width of pond: perpendicular to direction of flow)
then Vp=	0.0755	m/s (velocity in pond: Vp = Q / (P+H) / Lp)
& E=	0.021740	m (energy: E = H + 2V^2/2g)
& Cd=	0.589	(Cd = 0.577 x (E/H)^(3/2))

if Q=	37.75	l/s (maximum permited flow)
=	0.03775	cu.m./s
& H=	0.02	m (depth of water above top of weir)
then L=	6.9	m (length of weir) L = (Q / ((Cd^(2/3) x (2x9.81)^(1/2) x H^(3/2))

STORM SEWER DESIGN FORM
Rational Method

FIVE YEAR EVENT
Q = 2.78 A i C

July 22, 2022

n = 0.013

Location		Areas (ha)									Pipe Data									Notes
		Roof	Hard	Pavers	Landscape	Individual	Accum.	Time of	Rainfall Intensity	Peak Flow		Actual	Nominal					Time of		
From	To	C = 0.9	C = 0.9	C = 0.3	C = 0.2	2.78AC	2.78AC	Conc. (min)	i (mm/hr)	Q (L/s)	Material	Diameter (mm)	Diameter (mm)	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Flow (min)	Ratio Q/Qfull	
CB/MH-1	CB/MH-2		0.0383			0.0958	0.0958	10.00	104	9.98	PVC	457.2	450	0.20	50.3	133.02	0.81	1.03	0.08	
CB/MH-2	CB/MH-3		0.0859			0.2149	0.3107	11.03	99	30.77	PVC	457.2	450	0.20	11.6	133.02	0.81	0.24	0.23	
CB/MH-3	MH-4		0.0162	0.0070	0.0010	0.0469	0.3577	11.27	98	35.02	PVC	381.0	375	0.25	2.0	91.46	0.80	0.04	0.38	
										14.02	PVC	381.0	375	0.25	2.0	91.46	0.80	0.04	0.15	Flow through ICD
Roof	MH-4	0.1008				0.2522	0.2522	10.00	104	26.28	PVC	203.2	200	1.00	18.3	34.22	1.06	0.29	0.77	
										6.57	PVC	203.2	200	1.00	18.3	34.22	1.06	0.29	0.19	Thru flow control RDs
MH-4	MH-5						0.6099	11.31	98	59.60	PVC	381.0	375	0.25	6.9	91.46	0.80	0.14	0.65	
										20.59	PVC	381.0	375	0.25	6.9	91.46	0.80	0.14	0.23	Restricted flow
												Existing 525 ST in Parisien Street								
												533.4	525	0.59		344.62	1.54			

APPENDIX D

CITY OF OTTAWA SERVICING STUDY CHECKLIST

City of Ottawa Servicing Study Checklist

General Content

Executive Summary (for large reports only): not applicable

Date and revision number of the report: see cover page of Servicing Study and Stormwater Management Report

Location map and plan showing municipal address, boundary, and layout of proposed development: see drawings C-1 to C-6

Plan showing the site and location of all existing services: see drawings C-1 to C-6

Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere: not applicable

Summary of Pre-consultation Meetings with City and other approval agencies: not available

Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria: not applicable

Statement of objectives and servicing criteria: see page 2 of Servicing Sudy and Stormwater Management Report

Identification of existing and proposed infrastructure available in the immediate area: see drawings C-1 to C-6

Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available). see drawings C-1 to C-6

Concept level master grading plan to confirm existing and proposed grades in the development and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths: not applicable

Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts: not applicable

Proposed phasing of the development, if applicable: not applicable

Reference to geotechnical studies and recommendations concerning servicing: see note 1.6 on drawing C-4

All preliminary and formal site plan submissions should have the following information:

- **Metric scale:** included
- **North arrow:** included
    - **(including construction North):** not included
- **Key Plan:** included

- **Name and contact information of applicant and property owner:** not available
- **Property limits**: included
    - **including bearings and dimensions:** not included
- **Existing and proposed structures and parking areas:** included
- **Easements, road widening and rights-of-way:** included
- **Adjacent street names:** included

Development Servicing Report: Water

Confirm consistency with Master Servicing Study, if available: not applicable

Availability of public infrastructure to service proposed development: see page 2 Servicing Study and Stormwater Management Report

Identification of system constraints: see page 2 of Servicing Study and Stormwater Management Report

Confirmation of adequate domestic supply and pressure: see page 2 of Servicing Study and Stormwater Management Report

Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow locations throughout the development: see page 2 Servicing Study and Stormwater Management Report and Appendix A

Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves: see page 2 of Servicing Study and Stormwater Management Report

Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design: not applicable

Address reliability requirements such as appropriate location of shut-off valves: not applicable

Check on the necessity of a pressure zone boundary modification:. not applicable

Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range: not applicable

Description of the proposed water distribution network, including locations of proposed connections to the existing systems, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions: not applicable

Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation: not applicable

Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines: see page 2 of Servicing Study and Stormwater Management Report

Provision of a model schematic showing the boundary conditions locations, streets , parcels, and building locations for reference: not applicable

Development Servicing Report: Wastewater

Summary of proposed design criteria: see page 3 of Servicing Study and Stormwater Management Report

(Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure): not applicable

Confirm consistency with Master Servicing Study and /or justification for deviations: not applicable

Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and conditions of sewers: not applicable

Descriptions of existing sanitary sewer available for discharge of wastewater from proposed development: see page 3 of Servicing Study and Stormwater Management Report

Verify available capacity in downstream sanitary sewer and / or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable): not applicable

Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix C) format. see Appendix B

Description of proposed sewer network including sewers, pumping stations, and forcemains: see page 3 of Servicing Study and Stormwater Management Report

Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality): not applicable

Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development: not applicable

Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity: not applicable

Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding: not applicable

Special considerations such as contamination, corrosive environment etc: not applicable

Development Servicing Report: Stormwater Checklist

Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property): see page 3 to 5 of Servicing Brief and Stormwater Management Report

Analysis of available capacity in existing public infrastructure. not applicable

A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern: see drawing C-1 & C-3

Water quality control objective (e/g/ controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects: see page 3 to 5 of Servicing Brief and Stormwater Management Report

Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements: see page 3 to 5 of Servicing Brief and Stormwater Management Report

Descriptions of the references and supporting information.

Set-back from private sewage disposal systems. not applicable

Watercourse and hazard lands setbacks: not applicable

Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed: the pre-application consultation record is not yet been issued

Confirm consistency with sub-waterched and Master Servicing Study, if applicable study exists: not applicable

Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period). see drawings C-1 to C-6 and see page 3 to 5 of Servicing Brief and Stormwater Management Report

Identification of watercourses within the proposed development and how watercourses will be protected, or , if necessary, altered by the proposed development with applicable approvals. see drawings C-1 to C- and see page 3 to 5 of Servicing Brief and Stormwater Management Report

Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions: see page 3 to 5 of Servicing Brief and Stormwater Management Report

Any proposed diversion of drainage catchment areas from one outlet to another. : not applicable

Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities. : not applicable

If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event: not applicable

Identification of potential impacts to receiving watercourses: see page 3 to 5 of Servicing Brief and Stormwater Management Report

Identification of municipal drains and related approval requirements. : not applicable

Descriptions of how the conveyance and storage capacity will be achieved for the development: see page 3 to 5 of Servicing Brief and Stormwater Management Report

100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading:

Inclusion of hydraulic analysis including hydraulic grade line elevations. : not applicable

Description of approach to erosion and sediment control during construction for the protection of receiving watercourses of drainage corridors: see drawing C-3 and notes 2.1 to 2.5 on drawing C-4

Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplains elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current: not applicable

Identification of fill constraints related to floodplain and geotechnical investigation. : not applicable

Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act: not applicable

Application for Certificate of Approval (CofA) under the Ontario Water Resources Act:

Changes to Municipal Drains. : not applicable

Other permits (National Capital commission, Parks Canada, public Works and Government Services Canada, Ministry of transportation etc.) : not applicable

Conclusion Checklist

Clearly stated conclusions and recommendations: see page 5 & 6 of Servicing Brief and Stormwater Management Report

Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.

All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario: included