SERVICING BRIEF &
STORMWATER MANAGEMENT REPORT

1164-1166 Highcroft Drive
Ottawa, Ontario

Report No. 18035

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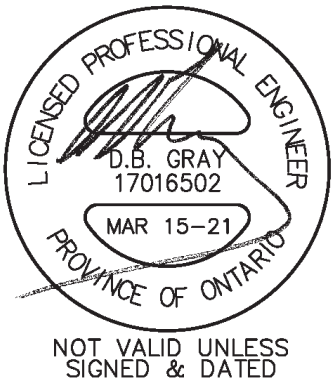

D. B. GRAY ENGINEERING INC.

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

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SERVICING BRIEF &
STORMWATER MANAGEMENT REPORT

1164-1166 Highcroft Drive
Ottawa, Ontario

This report describes the services and addresses the stormwater management requirements of a 3542 sq.m. property at 1164-1166 Highcroft Drive, Manotick in Ottawa. The property currently has two single-family dwellings that will be demolished. Ten single-family dwellings are proposed. Four dwellings will front on Highcroft Drive and six will front onto a proposed private road. There is a significant grade difference across the property such that there is an approximate 7.7 m elevation difference between the floor level of the lowest and highest proposed dwelling. The slope of Highcroft Drive is also significant, varying from approximately 8 to 14% in front of the subject property.

This report forms part of the stormwater management design for the proposed development. Refer to drawing C-1 to C-14 also prepared by D. B. Gray Engineering Inc.

WATER SUPPLY FOR FIREFIGHTING:

Currently there is no watermain in Highcroft Drive but a municipal watermain is proposed that will connect to an existing 400 mm watermain in Manotick Main Street at the intersection with Highcroft Drive. A private watermain is proposed to be located in the private road. A new municipal fire hydrant will be located at the end of the municipal watermain and a new private hydrant will be located at the end of the 200mm private watermain. There is also an existing municipal fire hydrant on Manotick Main Street near the intersection with Highcroft Drive. It is 147m from the furthest building in the proposed development.

A fire flow of 183.3 L/s (11,000 L/min) is required, as calculated as per the Fire Underwriter Survey "Water Supply For Fire Protection".

The City provided two sets of boundary conditions both based on a 168.2 l/s flowrate (Max day (1.5 L/s) + Fire Flow (166.7 L/s). The pre-configuration boundary conditions reflect the current conditions and the post configuration boundary conditions reflect the future conditions due to a new pump station and changes to the boundaries of a pressure zone. Since the “pre” and “post” fire flow HGLs are approximately the same (being 123.9 m and 123.6 m respectively), only the lower “post” boundary condition was used for the fire flow hydraulic analysis.

A model was created using EPANET software to analyze the hydraulics of the proposed 200mm municipal and private watermain serving the proposed municipal and private on-site fire hydrant. Using the 123.6 m HGL boundary condition and using a 95 L/s flowrate at the on-site fire hydrant and 62 L/s at the proposed municipal fire hydrant, the pressure at the on-site hydrant was determined to be 181 kPa (26.3 psi) and 139 kPa (20.1 psi) at the new municipal hydrant. Since the pressures are above 138 kPa (20 psi) or above, the watermain is adequately sized.

As per City of Ottawa Tech Bulletin ISTB-2018-02, the aggregate fire flow of all contributing fire hydrants within 150 m of the building can used to supply the required fire flow. The private on-site hydrant will be a Class AA contributing 5,700 L/min (95 L/s) (as per Table 1 of ISTB-2018-02). The new municipal hydrant is also Class AA but can only contribute 3,720 L/min (62 L/s) during fire flow conditions (62 L/s is the maximum flow available at 20 psi at this hydrant). The existing municipal fire hydrant in Manotick Main Street is a Class AA hydrant, and since it is greater than 75 m and less than 150 m of the building, it can contribute up to 3800 L/min (63.3 L/s) (as per Table 1). Therefore, the aggregate flow from all three hydrants is 13,220 L/min (220.3 L/s); greater than the required fire flow of 11,000 L/min 183.3 L/s).

WATER SERVICE:

As previously mentioned, there is currently no watermain in Highcroft Drive but a municipal watermain is proposed that will connect to an existing 400 mm watermain in Manotick Main Street.

Based on the City of Ottawa Water Distribution Design Guidelines for residential properties (10 single-family dwellings / 3.4 person per dwelling – 350 L/person/day) and Ministry of the Environment Design Guidelines for peaking factors the daily average flow is 0.1 L/s with a maximum daily and maximum hourly demand of 1.3 and 1.9 L/s respectively.

To determine water pressure under these demands, boundary conditions, based on the City of Ottawa computer simulation of the water distribution system, at the subject location, are required. The boundary conditions for the subject area based on the following:

Average Daily Demand: 0.2 L/s.
Maximum Daily Demand: 1.3 L/s.
Maximum Hourly Demand: 2.1 L/s

As previously mentioned, the City provided two sets of boundary conditions, pre-configuration boundary conditions, reflecting the current conditions, and the post configuration boundary conditions, reflecting the future conditions.

Based on the “pre” boundary conditions, the minimum HGL (hydraulic grade line) is 141.6 m and the maximum is 158.8 m. With these HGLs, the water pressure at the

water meter of the lowest dwelling is calculated to vary from 515 kPa to 684 kPa (75 to 99 psi) and 442 kPa to 610 kPa (64 to 89 psi) at the highest dwelling.

Based on the “post” boundary conditions, the minimum HGL is 144.6 m and the maximum is 147.7 m. With these HGLs, the water pressure at the water meter of the lowest dwelling is calculated to vary from 545 kPa to 575 kPa (79 to 83 psi) and 471 kPa to 502 kPa (68 to 73 psi) at the highest dwelling.

These are acceptable pressures for the proposed development, however, since it is calculated that the water pressure can be above 80 psi at times an on-site pressure check is recommended to determine if a pressure reducing valve (PRV) is required.

As request from the City, a hydraulic analysis for the 50mm watermain is required. The analysis includes Peak Hour Flows and assumes that lawn sprinklers are operating at all proposed dwellings (at 5 USgpm / 0.33 L/s each). A model was created using EPANET software. To simplify the analysis (and to be very conservative) the entire demand is assumed to be required at the end of the watermain. The result is a 57 kPa (8 psi) pressure drop in the 50mm watermain. Since the actual demand would be distributed along the length of the watermain, the actual pressure drop would be significantly less, which means that the under above conditions the pressure at the water meter at the Lot 10 dwelling (the highest of the dwellings) would be greater than the 442 kPa (64 psi) calculated. This is obviously an acceptable pressure under any condition.

SANITARY SERVICE:

Currently there are no sanitary sewers in Highcroft Drive, but a 200 mm municipal sanitary sewer is proposed that will connect to an existing 600 mm sanitary sewer in Manotick Main Street at the intersection with Highcroft Drive. A private 200 mm sanitary sewer is proposed to be located in the private road.

Based on the City of Ottawa Sewer Design Guidelines for residential properties (10 single-family dwellings / 3.4 person per dwelling – 280 L/person/day – 3.2 peaking factor); and based on a 0.33 l/s/ha infiltration flow; the post development flow is calculated to be 0.53 L/s (this flow includes a future connection to the house across the street – 1167 Highcroft Drive).

This flow will be adequately handled by the proposed sanitary sewers (200 mm at 0.32% to 0.65% - 19.36 to 27.59 L/s capacity) since, at the design flows, these sewers will be at 3% of capacity or less.

The 0.61 L/s increase in sanitary flows contributing to the existing 600 mm municipal sanitary sewer (at $\pm$0.2%) is expected to have a negligible impact given its capacity of 248.1 L/s.

The 600 mm sanitary sewer drains to the Manotick Main Pump Station. As per a conversation John Bougadis (City of Ottawa, Senior Project Manager, Infrastructure Planning) the peak flow at the pump station is currently 5 to 10 L/s during dry conditions and 45 to 50 L/s during wet; the capacity of the pump station is 60 L/s; and renovation in 2020 will increase the capacity to 120 L/s. John Bougadis advised that the proposed development (with a 0.53 L/s increase in sanitary flows) will have a negligible impact on the pump station.

STORMWATER MANAGEMENT:

Water Quality:
The Rideau Valley Conservation Authority (RVCA) has advised that 80% total suspended solids (TSS) removal is required.

To achieve 80% TSS removal manhole MH-9 will be an oil/grit separator (OGS) manhole (Soleno AquaShield Aqua-Swirl Concentrator model AS-2). The Aqua-Swirl model AS-2 has a sediment capacity of 0.28 cubic metres and an oil/debris capacity of 140 litres.

Based on software supplied by the manufacturer, the OGS will remove approximately 91% of TSS from the runoff. Output from the manufacturer's software is attached to the report.

An erosion and sediment control plan has been developed to be implemented during construction, (see drawing C-6 and notes 2.1 to 2.7 on drawing C-7). In summary: to filter out construction sediment a silt fence barrier will be installed adjacent to the south and east property line; sediment capture filter sock inserts will be installed in all new catch basins as they are installed; and geotextile fabric mud mats will be install at all points of egress to public roads.

Water Quantity:

Currently there is no storm sewer in Highcroft Drive but 300 and 375 mm municipal storm sewers are proposed connecting to an existing 375 mm storm sewer in Manotick Main Street at the intersection with Highcroft Drive. Private 250 to 375 mm storm sewers are proposed to be located in the private road.

The stormwater management criteria for quantity control are to control the post development peak flows to the pre-development peak flow using a pre-development runoff coefficient and a calculated time of concentration (but not less than 10 minutes). It is calculated that the pre-development conditions reflect a 5-year runoff coefficient of 0.33 and a 4.0 minute time of concentration (using the Bransby Williams Formula). The 100-year runoff coefficient is 0.39 and time of concentration is 4.0 minutes. Using the Rational Method, the maximum allowable release rate is 33.82 L/s for the 5-year event and 68.38 L/s for the 100-year.

Storage calculations are based on the Modified Rational Method. The runoff coefficients for the 100-year event are increased by 25% to maximum 1.00.

To the west of the subject property 1,230 sq.m. of lands drain onto the property. This off-site drainage area is not required to be controlled but is included in the stormwater management calculations and the storm sewer design form.

Stormwater will be stored within the development in underground in cisterns. To calculate the required storage volume in an underground cistern an average release rate is assumed to be equal to 50% of the maximum release rate.

Drainage Area I
(Uncontrolled Flow Off Site – 345 sq.m.):
The runoff from front yards of the dwellings fronting on Highcroft Drive will be allowed to flow uncontrolled off the site. The flow from is calculated at 10 minutes concentration.

	100-year	5-year
Maximum flow rate:	14.93 L/s	7.80 L/s

Drainage Area II (1,227 sq.m.):
An inlet control device (ICD) located at the outlet pipe of catch basin / manhole CB/MH-4 will control the release of stormwater from this drainage area. The ICD will restrict the flow and force the stormwater to back up into an underground cistern (Cistern 1). The ICD was sized for the 5-year event. During the one hundred-year event, 18.08 L/s is released through the ICD and 2.62 L/s flows out an overflow pipe at CB/MH-4. The 2.62 L/s is included in the total release rate (20.69 L/s) from this drainage area. The cistern was sized by ignoring the off-site drainage. The off-site drainage area was then included in the calculations, but the since the size of the cistern was not increased the excess water will flow out the overflow pipe located at CB/MH-4 (27.92 L/s during the 100-year event). The ICD shall be a plug style with a round orifice design manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 18.08 L/s at 2.54 m head. It is calculated that an orifice area of 4,195 sq.mm. (±73 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 18.08 L/s at a head of 2.54 m. Based on this orifice the maximum outflow rate for the 1:5-year storm event is calculated to be 14.72 L/s at 1.69 m (ignoring the off-site drainage).

	100-year	5-year
Maximum ICD release rate:	18.08 L/s	14.72 L/s
Maximum overflow release rate:	2.62 L/s	0.00 L/s
Maximum total release rate:	20.69 L/s	14.72 L/s
Maximum water elevation:	89.41 m	88.55 m
Maximum stored volume:	18.55 cu.m.	8.37 cu.m.

Including Off Site Drainage:

	100-year	5-year
Maximum ICD release rate:	18.08 L/s	17.72 L/s

Maximum overflow release rate:	27.92 L/s	0.00 L/s
Maximum total release rate:	45.99 L/s	17.72 L/s
Maximum water elevation:	89.41 m	89.31 m
Maximum stored volume:	18.55 cu.m.	17.36 cu.m.

Drainage Area III (1,970 sq.m.):
An inlet control device (ICD) located at the outlet pipe of catch basin / manhole CB/MH-10 will control the release of stormwater from this drainage area. The ICD will restrict the flow and force the stormwater to back up into two underground cisterns (Cisterns 2 and 3). The ICD was sized for the 5-year event. During the one hundred-year event, 13.47 L/s is released through the ICD and 6.50 L/s flows out an overflow pipe at CB/MH-10. The 6.50 L/s is included in the total release rate from this drainage area. The ICD shall be a plug style with a round orifice design manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 13.47 L/s at 1.41 m head. It is calculated that an orifice area of 4,195 sq.mm. (±73 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 13.47 L/s at a head of 1.41 m. Based on this orifice the maximum outflow rate for the 1:5-year storm event is calculated to be 11.30 L/s at 0.99 m.

	100-year	5-year
Maximum ICD release rate:	13.47 L/s	11.30 L/s
Maximum overflow release rate:	6.50 L/s	0.00 L/s
Maximum total release rate:	19.97 L/s	11.30 L/s
Maximum water elevation:	87.67 m	87.25 m
Maximum stored volume:	30.87 cu.m.	17.55 cu.m.

The Entire Site:

	100-year	5-year
Maximum permitted release rate:	68.38 L/s	33.82 L/s
Maximum release rate:	55.59 L/s	33.82 L/s
Maximum stored volume:	49.42 cu.m.	25.92 cu.m.

Therefore, the maximum post-development release rate for the 100-year storm event is calculated to be 19% less that the maximum allowable and the maximum post-development release rate for the 5-year storm event is calculated to be equal to the maximum allowable.

At 73 mm diameter the ICDs are slightly less than the minimum 75 mm required by the City guidelines. However, since vortex style ICDs are much more prone to blockages plug style ICDs are recommended. To reduce the risk of blockages the ICDs will be manufactured a trash basket.

The unrestricted flowrate in resulting from one in five-year storm event will produce a peak flow of 61.44 L/s in the proposed private storm sewer system. The proposed storm sewer system is adequate with no pipe segment no more than 68% of its capacity. (This flow includes the 1230 sq.m. off-site area to the west that drains to catch basin CB-3.)

The unrestricted flowrate in resulting from one in five-year storm event will produce a peak flow of 108.24 L/s in the proposed municipal storm sewer system. The proposed storm sewer system is adequate with no pipe segment no more than 79% of its capacity. (This flow includes the 3843 sq.m. area to the west that is draining to the existing driveway culvert for 1172 Highcroft Drive.)

The stormwater flowrate contributing to the existing municipal storm sewer in Manotick Main Street is expected to have an acceptable impact on the existing stormwater infrastructure given that the post release rate is less than or equal to the pre-development flows.

UTILITIES:

An existing utility pole located in the Highcroft Drive ROW in front of Lot 3 conflicts with a proposed driveway will be removed. Prior to removal, a new pole will be installed approximately 1 m to the west. The pole will have a street light; and other necessary equipment; and the work will coordinated with the utility companies to minimize disruption to services.

CONCLUSIONS:

1. There is an adequate water supply for firefighting.

2. The water pressure in the municipal and private watermain will be acceptable for the proposed development, however, since it is calculated that the water pressure can be above 80 psi at times an on-site pressure check is recommended to determine if a pressure reducing valve (PRV) is required.

3. The sanitary flow generated by the proposed development will be adequately handled by the proposed sanitary sewers.

4. The 0.61 L/s increase in sanitary flows contributing to the existing 600 mm municipal sanitary sewer is expected to have a negligible impact.

5. The proposed development will have a negligible impact Manotick Main Pump Station.

6. To achieve 80% TSS removal manhole MH-9 will be an oil/grit separator (OGS) manhole.

7. An erosion and sediment control plan has been developed to be implemented during construction.

8. The stormwater management criteria for quantity control are to control the post development peak flows for the 5-year and 100-year storm events to peak flows during the 5-year and 100-year storm event respectively. To achieve quantity control, stormwater will be stored within the development in an underground cistern.

9. The flowrate produced by a one in five-year storm event will be adequately handled by the proposed private and municipal storm sewers.

10. The restricted stormwater flow contributing to the existing municipal storm sewer is expected to have an acceptable impact.

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08-Aug-19
REVISED 12-Nov-20
REVISED 24-Dec-20

1164-1166 Highcroft Dr
Residential Dwellings on Highcroft Dr - Two Houses (on Lots 1 & 2)
Ottawa, Ontario

Fire Flow Requirements

Fire flow requirement as calculated as per Fire Undewriter Survey "Water Supply For Fire Protection".

$F = 220\ C\ A^{0.5}$ = the required fire flow in litres per minute

C = coefficient related to the type of construction
= 1.5 Wood Frame Construction

A = total floor area (all storeys excluding basements at least 50% below grade)

Proposed House Lot 1 (Dwelling Type 1)	2nd Floor	102	sq.m.
	Ground Floor	100	sq.m.
	Walkout Basment	95	sq.m.
	TOTAL AREA:	297	sq.m.
Proposed House Lot 2 (Dwelling Type 1)	2nd Floor	102	sq.m.
	Ground Floor	100	sq.m.
	Walkout Basment	95	sq.m.
	TOTAL AREA:	297	sq.m.
	TOTAL FIRE AREA:	594	sq.m.

F = 8,043 L/min
= 8,000 L/min (rounded off to the nearest 1,000 L/min)

-15% Charge for Limited-combustible Occupancy

= 6,800 L/min

0% Reduction to above for no sprinkler protection

= 6,800 L/min

Increase for Separation Exposed Buildings

				Adjacent Building			Length-Height
				Constuction	Length m	Storeys	Factor
18%	East	3.1 to 10m		W-F	16	3	48
17%	South	3.1 to 10m		W-F	8	3	24
17%	West	3.1 to 10m		W-F	13	2	26
5%	North	30.1 to 45m					0

57% Total Increase for Exposure (maximum 75%)
= 3,876 L/min Increase

= 10,676 L/min
F = 11,000 L/min (rounded off to the nearest 1,000 L/min)
= 183.3 l/s

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1164-1166 Highcroft Dr
Residential Dwelling on the Private Rd - Two Houses (Lots 5 & 6)
Ottawa, Ontario

Fire Flow Requirements

Fire flow requirement as calculated as per Fire Undewriter Survey "Water Supply For Fire Protection".

F = 220 C $A^{0.5}$ = the required fire flow in litres per minute

C = coefficient related to the type of construction
= 1.5 Wood Frame Construction

A = total floor area (all storeys excluding basements at least 50% below grade)

Proposed House Lot 5 (Dwelling Type 3)	2nd Floor	91	sq.m.
	Ground Floor	90	sq.m.
	Walkout Basment	68	sq.m.
	TOTAL AREA:	249	sq.m.
Proposed House Lot 6 (Dwelling Type 3)	2nd Floor	91	sq.m.
	Ground Floor	90	sq.m.
	Walkout Basment	68	sq.m.
	TOTAL AREA:	249	sq.m.
	TOTAL FIRE AREA:	498	sq.m.

F = 7,364 L/min
= 7,000 L/min (rounded off to the nearest 1,000 L/min)

-15% Charge for Limited-combustible Occupancy

= 5,950 L/min

0% Reduction to above for no sprinkler protection

= 5,950 L/min

Increase for Separation Exposed Buildings

			Adjacent Building			Length-Height
			Constuction	Length m	Storeys	Factor
12%	East	10.1 to 20m	W-F	3	1	3
18%	South	3.1 to 10m	W-F	15	3	45
13%	West	10.1 to 20m	W-F	8	4	32
0%	North	>45m				0

43% Total Increase for Exposure (maximum 75%)
= 2,559 L/min Increase

= 8,509 L/min
F = 9,000 L/min (rounded off to the nearest 1,000 L/min)
= 150.0 l/s

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1164-1166 Highcroft Dr
Residential Dwelling on Private Rd - Lot 9
Ottawa, Ontario

Fire Flow Requirements

Fire flow requirement as calculated as per Fire Undewriter Survey "Water Supply For Fire Protection".

F = 220 C $A^{0.5}$ = the required fire flow in litres per minute

C = coefficient related to the type of construction
= 1.5 Wood Frame Construction

A = total floor area (all storeys excluding basements at least 50% below grade)

3rd Floor	74	sq.m.
2nd Floor	114	sq.m.
Ground Floor	114	sq.m.
Basement	106	sq.m.
TOTAL AREA:	408	sq.m.

F = 6,666 L/min
= 7,000 L/min (rounded off to the nearest 1,000 L/min)

-15% Charge for Limited-combustible Occupancy

= 5,950 L/min

0% Reduction to above for no sprinkler protection

= 5,950 L/min

Increase for Separation Exposed Buildings

			Adjacent Building			Length-Height
			Constuction	Length m	Storeys	Factor
12%	East	10.1 to 20m	W-F	6	2	12
18%	South	3.1 to 10m	W-F	15	4	60
0%	West	>45m				0
18%	North	3.1 to 10m	W-F	15	4	60
48%	Total Increase for Exposure (maximum 75%)					

= 2,856 L/min Increase

= 8,806 L/min
F = 9,000 L/min (rounded off to the nearest 1,000 L/min)
= 150.0 l/s

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08-Aug-19
REVISED 17-Jun-20

1164 & 1166 Highcroft Dr
Ottawa, Ontario

Water Demand

	Number of Units	Persons Per Unit	Population
Single-Family Dwelling:	10	3.4	34
		TOTAL:	34

DAILY AVERAGE 350 litres / person / day
8.3 l/min 0.1 l/s 2 USgpm

MAXIMUM DAILY DEMAND 9.3 (Peaking Factor for a population of 34: Table 3-3 MOE Design Guidelines for Drinking-Water Systems)
77.2 l/min 1.3 l/s 20 USgpm

MAXIMUM HOURLY DEMAND 14.1 (Peaking Factor for a population of 36: Table 3-3 MOE Design Guidelines for Drinking-Water Systems)
116.3 l/min 1.9 l/s 31 USgpm

PRE-CONFIGURATION

DWELLING AT THE HIGHEST ELEVATION
Elevation of Water Meter: 96.54 m ASL
Finish Floor Elevation: 95.64 m ASL

			Static Pressure at Water Meter			
MINIMUM HGL:	141.6	m ASL	64	psi	442	kPa
MAXIMUM HGL:	158.8	m ASL	89	psi	610	kPa

DWELLING AT THE LOWEST ELEVATION
Elevation of Water Meter: 89.04 m ASL
Finish Floor Elevation: 88.14 m ASL

			Static Pressure at Water Meter			
MINIMUM HGL:	141.6	m ASL	75	psi	515	kPa
MAXIMUM HGL:	158.8	m ASL	99	psi	684	kPa

POST CONFIGURATION

DWELLING AT THE HIGHEST ELEVATION
Elevation of Water Meter: 96.54 m ASL
Finish Floor Elevation: 95.64 m ASL

			Static Pressure at Water Meter			
MINIMUM HGL:	144.6	m ASL	68	psi	471	kPa
MAXIMUM HGL:	147.7	m ASL	73	psi	502	kPa

DWELLING AT THE LOWEST ELEVATION
Elevation of Water Meter: 89.04 m ASL
Finish Floor Elevation: 88.14 m ASL

			Static Pressure at Water Meter			
MINIMUM HGL:	144.6	m ASL	79	psi	545	kPa
MAXIMUM HGL:	147.7	m ASL	83	psi	575	kPa

BOUNDARY CONDITIONS

Boundary Conditions For: 1164/1166 Highcroft Dr.

Date of Boundary Conditions: 2019-Jan-31

Provided Information:

Scenario	Demand	
	L/min	L/s
Average Daily Demand	6.0	0.1
Maximum Daily Demand	72.0	1.2
Peak Hour	114.0	1.9
Fire Flow #1 Demand	10,000	166.7

Number Of Connections: 1

Location:

BOUNDARY CONDITIONS

Results:

Pre

Connection #: 1

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	158.8	100.6
Peak Hour	141.6	76.4
Max Day Plus Fire (10,000) L/min	123.9	51.2

[1]Elevation: **87.870 m**

Post

Connection #: 1

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.7	85.4
Peak Hour	144.6	80.8
Max Day Plus Fire (10,000) L/min	123.6	51.0

[1]Elevation: **87.870 m**

Notes:

1) As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:

a) If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.
b) Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.

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. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

Gmail by Google

Douglas Gray <d.gray@dbgrayengineering.com>

1164 Highcroft Dr. Boundary Conditions Revision.

1 message

Alvey, Harry <Harry.Alvey@ottawa.ca> Tue, Jan 29, 2019 at 1:47 PM
To: Douglas Gray <d.gray@dbgrayengineering.com>
Cc: "Whittaker, Damien" <Damien.Whittaker@ottawa.ca>, "McCormick, Sarah" <sarah.mccormick@ottawa.ca>

Good Afternoon Doug,

Enclosed is the revised Boundary Conditions based on your latest information. In addition, I received a correction as to what our Asset Management Group meant by "Pre" and "Post". The following is their explanation of the use of these terms and how it applies to this project:

The "pre" Boundary condition provided reflects the current water pressure zone HGLs and pressures for BARR (which is where the current development is located). The "post" zone reflects the future pressure zone configuration, which will be "3SW" and the pressure and HGL, will improve significantly due to a new pump station that will be installed, and changes to the boundaries of the pressure zone "BARR". Currently, we have both scenarios modelled and, for future developments requesting boundary conditions, we give HGLs and Pressures for both scenarios, because we still do not know when the configuration will take place.

The consultant is generally asked to design to the "pre" configured pressure zone HGLs and pressures for conservative design.

There are several administrative steps that are being negotiated with stakeholders in that area that is delaying the installation of the new pump station and the reconfiguration of the pressure zone.

Harry

Harry R. Alvey, P.E., P.Eng.

Project Manager

Planning, Infrastructure and Economic Development Department

Development Review Rural Branch

Services de la planification, de l'infrastructure et du développement économique

City of Ottawa | Ville d'Ottawa

613.580.2424 ext./poste 28103

ottawa.ca/planning / ottawa.ca/urbanisme

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1164, 1166 Highcroft Dr_Rev1.docx
198K

8-Aug-19
REVISED 17-Jun-20
REVISED 12-Nov-20
REVISED 12-Mar-21

1164-1166 Higcroft Drive
Ottawa, Ontario

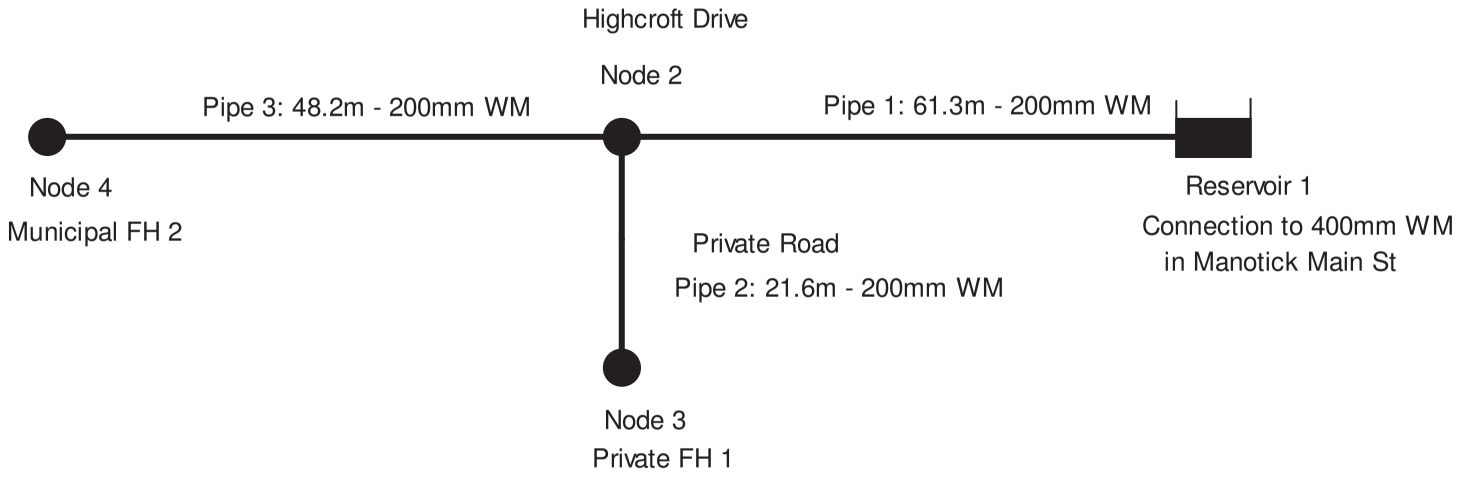
EPANET HYDRAULIC MODELLING RESULTS

MAX DAY + FIRE FLOW: 158.3 L/s - HGL: 123.6

200mm WM in Highcroft Dr & Private Rd
(95 L/s Fire Flow at New Private Hydrant + 62.0 L/s Flow at new Municipal FH)

Node ID	Demand	Head	Elevation	Pressure		
	l/s	m	m	m	psi	kPa
1 Reservoir 1 (Connection to 400 WM)	-158.3	123.60	87.81	35.79	50.9	351
2	0.0	111.44	90.73	20.71	29.4	203
3 Fire Hydrant 1 (inc. 0.8 L/s Domestic)	95.8	109.23	90.72	18.51	26.3	181
4 Fire Hydrant 2 (inc. 0.5 L/s Domestic)	62.5	110.04	95.87	14.17	20.1	139

Link ID	Diameter	Length	Roughness	Loss Coeff.	Flow	Velocity
	mm	m			l/s	m/s
Pipe 1	200	61.3	110	2.40	158.30	5.04
Pipe 2	200	21.6	110	2.00	95.80	3.05
Pipe 3	200	48.2	110	0.60	62.50	1.99


Highcroft Drive
Node 2
Pipe 3: 48.2m - 200mm WM
Pipe 1: 61.3m - 200mm WM
Node 4
Municipal FH 2
Reservoir 1
Connection to 400mm WM
in Manotick Main St
Private Road
Pipe 2: 21.6m - 200mm WM
Node 3
Private FH 1

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 2	90.73	0	0.00	111.44	20.71
Junc 3	90.72	95.8	95.80	109.23	18.51
Junc 4	95.87	62.5	62.50	110.04	14.17
Resvr 1	123.6	#N/A	-158.30	123.60	0.00

Network Table - Links

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s
Pipe 1	61.3	200	110	158.30	5.04
Pipe 2	21.6	200	110	95.80	3.05
Pipe 3	48.2	200	110	62.50	1.99

12-Mar-21

1164-1166 Higcroft Drive
Ottawa, Ontario

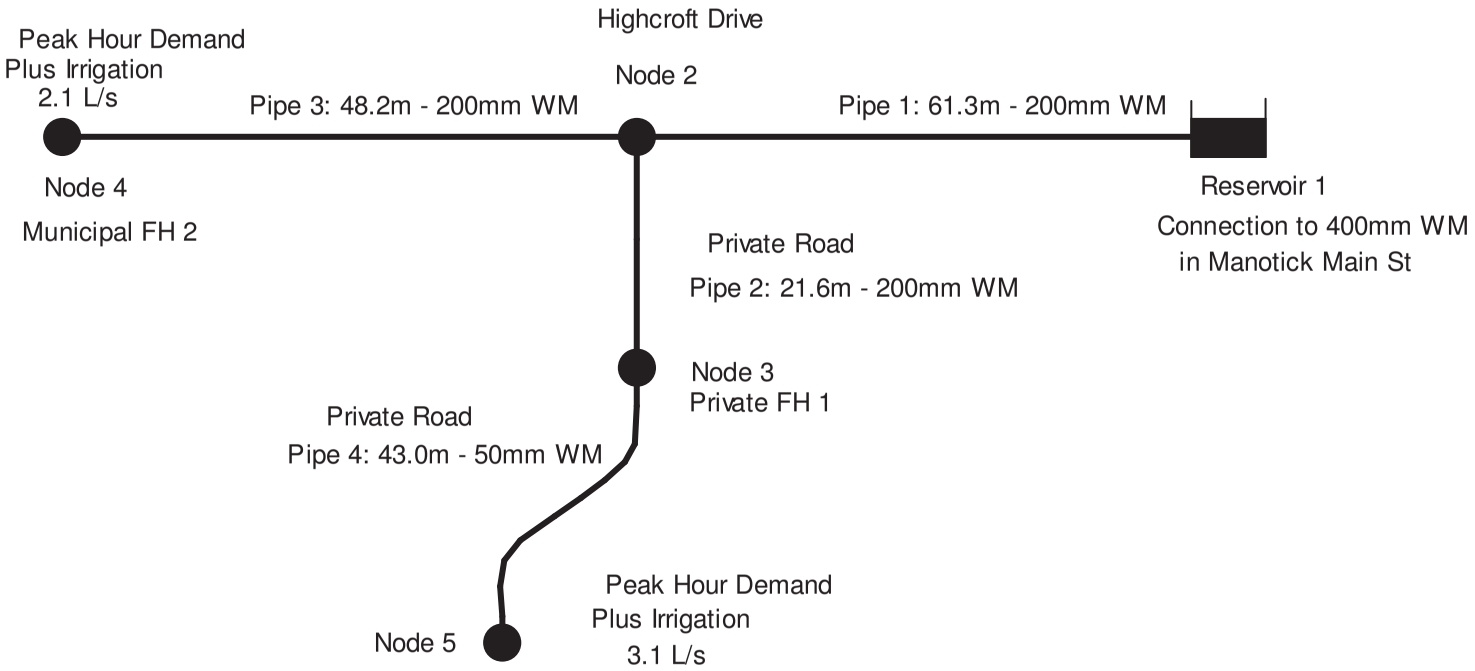
EPANET HYDRAULIC MODELLING RESULTS

Peak Dometsic Demand Including Irrigation

50mm WM in Private Rd

Node ID	Demand	Head	Elevation	Pressure		
	l/s	m	m	m	psi	kPa
1 Reservoir 1 (Connection to 400 WM)	-5.2	141.60	87.81	53.79	76.5	527
2	0.0	141.58	90.73	50.85	72.3	499
3 (FH 1)	0.0	141.58	90.72	50.86	72.3	499
4 (FH 2) Peak Domestic Demand)	2.1	141.58	95.63	45.95	65.3	451
5 Peak Domestic Demand	3.1	136.87	91.80	45.07	64.1	442

Link ID	Diameter	Length	Roughness	Loss Coeff.	Flow	Velocity
	mm	m			l/s	m/s
Pipe 1	200	61.3	110	2.40	5.2	0.17
Pipe 2	200	21.6	110	2.00	3.1	0.10
Pipe 3	200	48.2	110	0.60	2.1	0.07
Pipe 4	50	43.0	100	2.00	3.1	1.58


Highcroft Drive
Peak Hour Demand
Plus Irrigation
2.1 L/s
Node 2
Pipe 3: 48.2m - 200mm WM
Pipe 1: 61.3m - 200mm WM
Node 4
Municipal FH 2
Reservoir 1
Connection to 400mm WM
in Manotick Main St
Private Road
Pipe 2: 21.6m - 200mm WM
Node 3
Private FH 1
Private Road
Pipe 4: 43.0m - 50mm WM
Peak Hour Demand
Plus Irrigation
3.1 L/s
Node 5

Network Table - Nodes

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc 2	90.73	0.00	141.58	50.85
Junc 3	90.72	0.00	141.58	50.86
Junc 4	95.87	2.10	141.58	45.71
Junc 5	91.80	3.10	136.87	45.07
Resvr 1	141.6	-5.20	141.60	0.00

Network Table - Links

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s
Pipe 1	61.3	200	110	5.20	0.17
Pipe 2	21.6	200	110	3.10	0.10
Pipe 3	48.2	200	110	2.10	0.07
Pipe 4	43.0	50	100	3.10	1.58

D.B. GRAY ENGINEERING INC.

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

700 Long Point Circle
Ottawa, Ontario K1T 4E9
613-425-8044
d.gray@dbgrayengineering.com

SANITARY SEWER DESIGN FORM

Average Daily Flows:
Residential: 280 l / capita / day
Commercial: 28,000 l / ha / day
Instituational: 28,000 l / ha / day
Light Industrial: 35,000 l / ha / day
Heavy Industrial: 55,000 l / ha / day

Infiltration Allowance: 0.33 l / s / ha

Peaking Factor:
Residential (Harmon Equation): $P.F. = 1 + \frac{14}{4 + P^{0.5}}$
P = Population / 1000
Harmon Correction Factor 0.8
Commercial & Institutional: 1.5 If contrinbution > 20%
Commercial & Institutional: 1.0 If contrinbution < 20%
Industrial: As per Ottawa Guidelines Appendix 4-B

PROJECT: 1164-1166 Highcroft

Designed By: DBG

12-Mar-21

		Section								Cumulative		Section				Cumulative				SEWER DATA								COMMENTS
		Single Family	Semi/Townhouse	Duplex / Triplex	Apartment (average)	Apartment (1 Bed.)	Apartment (2 Bed.)	Apartment (3 Bed.)	Resid-ential Area	Residential		Non-Residential				Area	Sewage Flow	Infil-tration Flow	Total Flow	n = 0.013								
FROM	TO	ppu = 3.4	ppu = 2.7	ppu = 2.3	ppu = 1.8	ppu = 1.4	ppu = 2.1	ppu = 3.1		Pop.	Peaking Factor	Area	Flow	Peaking Factor	Flow					Type of Pipe	Dia. Actual (mm)	Dia. Nom. (mm)	Slope (%)	Length (m)	Capacity (l/s)	Velocity (m/s)	Ratio Q/Qfull	
		No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	ha			ha	l/ha/day		l/s	ha	l/s	l/s	l/s								
MH.-SA.2	MH-SA.3	5							0.151	17	3.2					0.151	0.18	0.05	0.23	PVC	203.2	200	0.65	21.3	27.6	0.85	0.01	
MH-SA.3	MH-SA.4	1							0.070	20	3.2					0.220	0.21	0.07	0.28	PVC	203.2	200	0.32	23.6	19.4	0.60	0.01	
MH-SA.4	MH.-SA.5								0.017	20	3.2					0.238	0.21	0.08	0.29	PVC	203.2	200	0.32	14.1	19.4	0.60	0.01	
MH-SA.5	MH.-SA.6								0.013	20	3.2					0.251	0.21	0.08	0.29	PVC	203.2	200	0.32	14.5	19.4	0.60	0.02	
MH-SA.1	MH.-SA.6	5							0.338	17	3.2					0.338	0.18	0.11	0.29	PVC	203.2	200	8.00	45.7	96.8	2.98	0.00	
MH.-SA.6	MH-SA.7								0.097	37	3.2					0.685	0.39	0.23	0.61	PVC	203.2	200	4.24	48.3	70.5	2.17	0.01	
MH-SA.7	EXISTING STUB								0	37	3.2					0.6852	0.39	0.23	0.61	PVC	203.2	200	0.32	18.4	19.4	0.60	0.03	
																				MUNICIPAL SANITARY SEWER IN MANOTICK MAIN ST								
																					609.6	600	0.15		248.1	0.85		

Gmail by Google

Douglas Gray <d.gray@dbgrayengineering.com>

RE: 1164/1166 Highcroft Dr

1 message

Eric Lalande <eric.lalande@rvca.ca> Thu, Sep 19, 2019 at 3:35 PM
To: Douglas Gray <d.gray@dbgrayengineering.com>
Cc: Ryan Faith <r.faith@dbgrayengineering.com>

Hi Doug,

It would appear that the site drains through overland flow (ditches) to the city's storm sewer on Manotick Main,

We are looking for 80% TSS removal, and defer quantity requirements to the City.

Let me know if you require anything else.

Thank you,

Eric Lalande, MCIP, RPP

Planner, Rideau Valley Conservation Authority

613-692-3571 x1137

From: Douglas Gray <d.gray@dbgrayengineering.com>
Sent: Thursday, September 19, 2019 8:31 AM
To: Eric Lalande <eric.lalande@rvca.ca>
Cc: Ryan Faith <r.faith@dbgrayengineering.com>
Subject: 1164/1166 Highcroft Dr

Hi Eric

We are working on a proposed residential development on a 3542 sq.m. property at 1164/1166 Highcroft Dr in Manotick Dr. It will consist of eleven single-family dwellings. The property currently has two single-family dwellings that will be demolished.

Attached is a site plan.

Please comment concerning the stormwater management for this site.

Regards, Doug

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

700 Long Point Circle Tel: 613-425-8044

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

AquaShield™ STORMWATER TREATMENT SOLUTIONS

Sizing Report

2733 Kanasita Drive • Suite 111 • Chattanooga, TN 37343 • Phone: (423) 870-8888 • Fax: (423) 826-2112 • www.aquashieldinc.com

Site Information

Project Name: **1164-1166 Highcroft Drive**

Site Area (hectacres): **0.3352**

Unit Label: **OGS 1**

Runoff Coeff. : **.55**

Unit Location: **Ottawa, ON**

Target Removal Efficiency(%): **80% based on NJDEP**

Product Recommendation

Aqua-Swirl™ Model	Net Annual TSS Removal Efficiency	Chamber Diameter	Maximum Inside Diameter (mm)		Oil/Debris Storage Capacity	Sediment Storage Capacity
			Offline	BYP[5]		
AS-2	**90.81 %**	763 mm.	205 mm.	381 mm.	140 L	0.28 m^3

Rainfall Information

NCDC Station[1]: **OTTAWA MACDONALD-CARTIER INT'L A**

Data Range[4]: **261,759 readings taken hourly between 1967 to 2007 (~40 years)**

Rainfall Event Range (mm/hre)	Rainfall Interval Point (mm/hre)	Operating Rate (Lps/m^2)	Total Rainfall (%)	Removal Efficiency (%)[2]	Relative Efficiency(%)
02.00 - 03.00	02.50	02.81	44.18	95.28	42.10
03.00 - 04.00	03.50	03.93	21.52	93.76	20.18
04.00 - 05.00	04.50	05.06	11.68	92.01	10.75
05.00 - 06.00	05.50	06.18	06.68	90.06	06.02
06.00 - 07.00	06.50	07.30	04.03	87.89	03.54
07.00 - 08.00	07.50	08.43	01.99	85.50	01.70
08.00 - 09.00	08.50	09.55	01.84	82.91	01.53
09.00 - 10.00	09.50	10.67	01.81	80.09	01.45
10.00 - 15.00	12.50	14.04	04.12	70.38	02.90
15.00 - 20.00	17.50	19.66	01.02	49.90	00.51
20.00 - 25.00	22.50	25.28	00.54	24.09	00.13
		Total Cumulative Rainfall %:	**99.41[3]**	**Net Annual %:**	**90.81**

Sales Agent Information

Agent Name: **Dave Kanters**

Phone: **416-347-2799**

Company Name: **Soleno**

Fax:

Address: **347, 15-75 Bayly St. W.**

E-mail: **dkanters@soleno.com**

City, State Zip: **Ajax, ON L1S7K7**

Footnotes

1. Recorded as hourly precipitation rainfall data (inches), National Climatic Data Center (NCDC)
2. Based on Tennessee Tech University laboratory testing of the AquaSwirl™ Model AS-3 for OK-110 silica particles 50-125 microns(Neary, 2002)
3. 90% Rainfall Event, calculated as a cumulative percentile of individual events, www.stormwatercenter.net, sizing criteria (Center for Watershed Protection)
4. NCDC data may not be consecutive, skipping days, months and/or years in the range of dates.
5. The Aqua-Swirl™ Internal Bypass (BYP) provides full treatment of the "first flush," while the peak design storm is diverted and channeled through the main conveyance pipe. Please refer to your local representative for more information.
6. When applicable, the performance curve was adjusted via Peclet Scaling to provide estimated sizing per NJDEP PSD (d50 = 67 microns).

CERTIFICATE

OF TECHNOLOGY ASSESSMENT

AQUA-SWIRL® Stormwater Treatment System
(in collaboration between AquaShield ™, Inc.
and Soleno, Inc.)

Based on a review of the data and the information submitted in support of the technology, the ministry concludes that the Aqua-Swirl® stormwater treatment system, by AquaShield™-, Inc., may be applied to the treatment of stormwater to remove debris, settleable solids and their associated pollutants, oil, and floatables.

The Aqua-Swirl® stormwater treatment system may be applicable to spill control, pre-treatment, or end-of-pipe control for the management of stormwater at smaller sites (as part of a multi-component approach) where stormwater management options are limited. Such applications would include urban and highway sites with high imperviousness and where pollutant loads in stormwater are expected to be high.

The NETE evaluation is not considered an approval or implied approval of the technology and it in no way removes or limits the obligation to obtain the necessary environmental approvals under the Ontario Water Resources Act or the Environmental Protection Act for an application of the technology. The ministry approval process ensures the applicability of the technology against site-specific performance and environmental requirements.

S. Klose

Steve Klose, Director
Standards Development Branch
Ontario Ministry of the Environment
(July 2014)

New Environmental Technology Evaluation Program
Promoting the development and application of new environmental technologies

Ontario

Aqua-Swirl® Stormwater Treatment System

Notable aspects of the technology include:

/ The Aqua-Swirl® Stormwater Treatment System is a custom-designed, patented treatment system designed to remove sediment, floating debris and free-floating oil using swirl technology, or hydrodynamic vortex-enhanced sedimentation separation. The system is a high flow rate device that has no moving parts and operates on gravity flow or movement of the stormwater runoff entering the structure.

/ Typically, the device operates in an off-line configuration (see details below) that requires the use of a separate diversion structure, or weir device located upstream of the device. The device may also be used in an in-line configuration.

/ If the device is used in an off-line configuration, the diversion structure should be constructed such that the first flush of the peak design storm receives treatment. In this configuration, the remaining portions of flows from less frequent large storms are routed around the treatment chamber. Dry weather flows and flows from smaller storms would be directed through the unit.

/ The diameter of the swirl chamber varies from 2.5 to 12 feet (0.7 to 3.6 meters) according to the calculated peak storm event and the intended flow rate for an individual site. The unit may be used in parallel to accommodate higher flow rates. The height of a standard unit varies from 8.67 to 9.5 feet (2.64 to 2.9 meters) not including the length of the access riser.

/ Units have been designed to provide water quality treatment at operating rates ranging from 0.031 to 0.714 m^3/s (1.1 to 25.2 cfs).

/ The primary contaminants treated by the units include sediment (including contaminants bound to sediment and other particulate matter), floating debris, and floating oil.

/ Laboratory tests were conducted by Tennessee Tech University (TTU) on the Model AS-3 Aqua-Swirl® on very fine rounded sand (50 to 125 microns) which does not represent the size spectrum expected in the field. The removal efficiency of suspended sediment concentration (SSC), in lieu of the total suspended solid (TSS) concentration was measured in laboratory tests. Annual removal efficiency was calculated for 5-year hydrologic data from Portland, Maine area, using relative removal efficiency calculation and percent runoff. Although the annual SSC removal efficiency was calculated at 91%, the results could not be extrapolated for TSS removal measured in the field.

/ The Ontario Stormwater Management Planning and Design Manual (Ministry of the Environment, March 2003) has three levels of protection for existing aquatic habitat. For ecosystems where the Basic (60% removal of SS), Normal (70% removal of SS), or Enhanced (80%

removal of SS) level of protection is required, the technology may be applied as part of a stormwater treatment system.

/ Periodic maintenance of the units is required. Captured sediments and floatables must be removed. Site-specific conditions determine the frequency of maintenance. Depending on the nature of influent, the accumulated material may require special handling and disposal procedures.

/ AquaShield™ monitored a model AS-5 installed in a parking lot of a shopping centre in Silver Spring, Maryland, USA between March 2009 and June 2011. A mixture of parking lot runoff, roof runoff, and groundwater seepage was treated by the unit. Total suspended solids in influent averaged 131.7 mg/L for the select storms monitored. The monitored storms produced peak loading rates between 1.9 gpm/ft^2 and 35.4 gpm/ft^2. For storms that produced peak loading rates less than approximately 17 gpm/ft^2 (21 L/s) total suspended solids were reduced by approximately 80%.

APPENDIX

Documents reviewed:

NETE Application dated April 10, 2007 to Ontario Ministry of the Environment from Mr. Eric B. Rominger, General Manager, and Mark B. Miller, P.G., AquaShield™, Inc.

Laboratory Evaluation of TSS Removal Efficiency for Aqua-Swirl® Concentrator Stormwater Treatment System, Tennessee Tech University, Department of Civil and Environmental Engineering, Cookeville, TN.

Supplement to NETE Application dated May 9, 2009 to Ontario Ministry of the Environment from AquaShield™, Inc.

Second supplement to NETE Application dated September 25, 2009 to Ontario Ministry of the Environment from AquaShield™, Inc.

NJCAT Technology Verification, Aqua-Swirl® Model AS-5 Stormwater Treatment System, AquaShield™, Inc., November 2012.

Application for Revised Certificate of Technology Assessment dated January 31, 2013 to Ontario Ministry of the Environment from AquaShield™, Inc.

Correspondence from Richard S. Magee, New Jersey Corporation for Advanced Technology to Mark Miller, February 15, 2013.

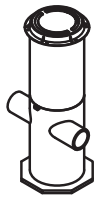
Correspondence from AquaShield™, Inc.:
April 30, 2013
July 12, 2013
February 27, 2014
April 3, 2014
May 19, 2014

To receive pricing and/or technical support on the Aqua-Swirl, please contact Soleno. (www.Soleno.com)

Paul Antoine
Sales Representative
Tel: 613-292-4094
Email: pantoine@soleno.com

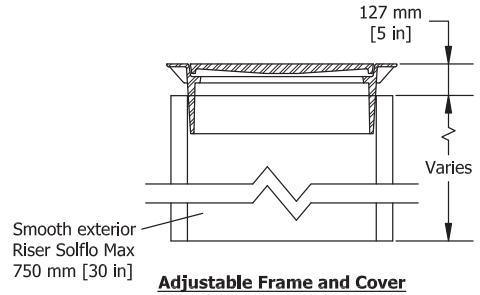
David Kanters
Engineer, Technical Service
Tel: 416-347-2799
Email: dkanters@soleno.com

Aqua-Swirl High Density Polyethylene (HDPE) Stormwater Treatment System



Projected View
SCALE 1:80

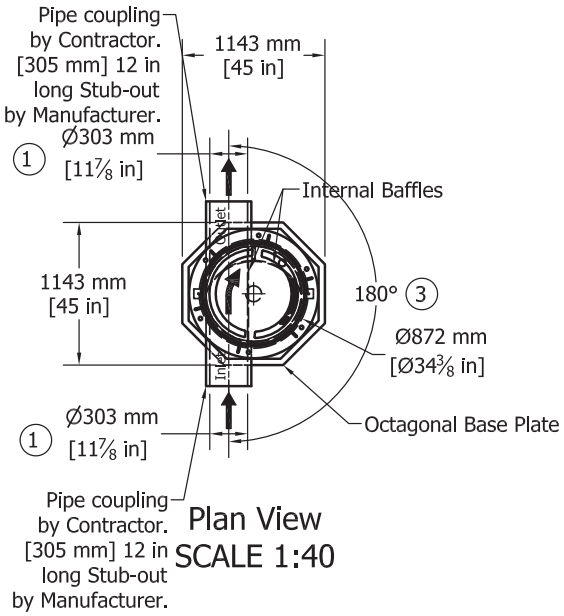
Please see accompanied Aqua-Swirl specification notes. See Site Plan for actual system orientation.
Approximate dry (pick) weight: 400 kg [800 lbs].



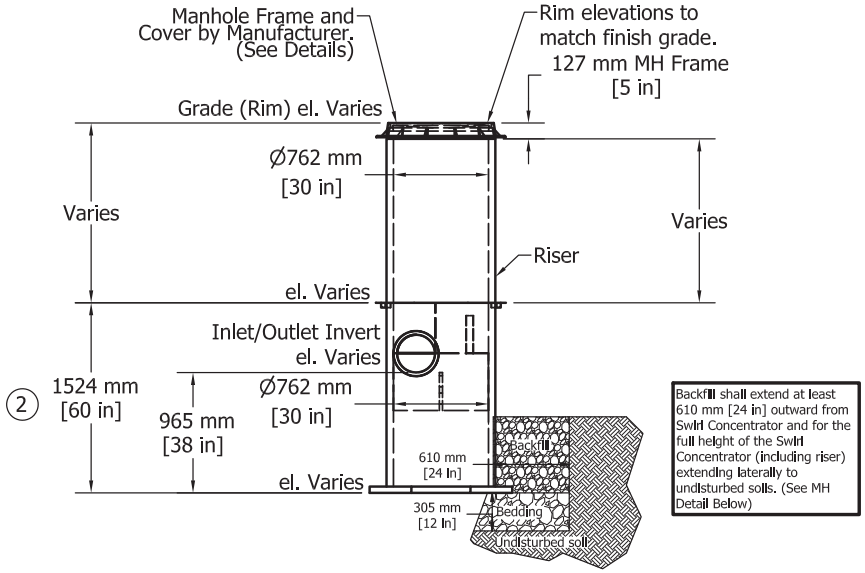
Adjustable Frame and Cover

System shall be designed for the following capacities:
Swirl Treatment Flow: 31 L/s [1.1 cfs]
Swirl Sediment Storage: 0.28 m³ [10 ft³]
Swirl Oil/Debris Storage: 140 L [37 gal]

1. AS-2 BYP inlet/outlet pipe size ranges from 203 mm [8 in] to 381 mm [15 in].
2. AS-2 chamber height may vary from 1321 mm [52 in] to 1524 mm [60 in], depending on inlet/outlet pipe size.
3. Orientation may vary from a minimum of 90° to a maximum of 180°.



Plan View
SCALE 1:40



Elevation View
SCALE 1:40

AquaShield
WATER TREATMENT SOLUTIONS
2733 Kanasita Drive, Suite 111, Chattanooga, TN 37343
Phone (888) 344-9044 Fax (423) 826-2112
www.aquashieldinc.com

Aqua-Swirl Concentrator
AS-2 BYP CW STD

Standard Detail

Structure #:	AS-2 STD	Rvwed	Rvw. Date
Drawn By:	OFlores		
Scale:	As Shown		
Date:	3/7/2018		

STORMWATER MANAGEMENT CALCULATIONS

The orifice calculations are based on the following formula:

$$Q = C_d \times A_o \sqrt{2gh} \times 1000$$

where:

Q = flowrate in litres per second
C_d = coefficient of discharge
A_o = orifice area in sq.m.
g = 9.81 m/s2
h = head above orifice in meters

Summary Tables

ONE HUNDRED YEAR EVENT

Drainage Area	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)	-	14.93	-	-
AREA II	-	20.69	18.55	18.55
AREA III	-	19.97	30.87	30.87
TOTAL	68.38	55.59	49.42	49.42

FIVE YEAR EVENT

Drainage Area	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)	-	7.80	-	-
AREA II	-	14.72	8.37	8.37
AREA III	-	11.30	17.55	17.55
TOTAL	33.82	33.82	25.92	25.92

ICD TABLE

Location	Type	Orifice Size (mm)	Head (m)	FIlow Rate (L/s)
Outlet Pipe of CB/MH-4	plug style with trash basket and orifice located at bottom of plug	73.08	2.54	18.08
Outlet Pipe of CB/MH-10	plug style with trash basket and orifice located at bottom of plug	73.08	1.41	13.47

July 26, 2019
REVISED September 27, 2019
REVISED May 4, 2020
REVISED February 26, 2021

1164-1166 Highcroft Drive

Manotick, Ontario

STORM WATER MANAGEMENT CALCULATIONS

Rational Method

ONE HUNDRED YEAR EVENT

(Calculations Assuming No Off Site Drainage)

Pre-Development Conditions

			C
Roof Area:	264	sq.m	1.00
Asphalt/Concrete Area:	392	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	2886	sq.m	0.25
Total Catchment Area:	3542	sq.m	0.39

Bransby William Formula

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

Sheet Flow Distance (L):	98	m	
Slope of Land (Sw):	9	%	
Area (A):	0.354	ha	
Time of Concentration (Sheet Flow):	4.0	min	
Area (A):	3542	sq.m	
Time of Concentration:	10.0	min	
Rainfall Intensity (i):	179	mm/hr	(100 year event)
Runoff Coeficient (C):	0.39		
Maximum Allowable 100 Year Release Rate (2.78AiC):	68.38	L/s	

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	201	sq.m	1.00
Asphalt/Concrete Area:	85	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	59	sq.m	0.25
Total Catchment Area:	345	sq.m	0.87
Area (A):	345	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr	
Runoff Coeficient (C):	0.87		
Release Rate (2.78AiC):	14.93	L/s	

DRAINAGE AREA II

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	300	sq.m	1.00
Asphalt/Concrete Area:	374	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	553	sq.m	0.25
Total Catchment Area:	1227	sq.m	0.66

Water Elevation:	89.41	m
Invert of Outlet Pipe:	86.83	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-4)	86.87	m
Head:	2.54	m
Orifice Diameter:	73	mm
Orifice Area:	4195	sq.mm
Coefficient of Discharge:	0.61	
Maximum ICD Release Rate:	18.08	L/s
Maximum Overflow Pipe Release Rate:	2.62	L/s
Total Maximum Release Rate:	20.69	L/s

Cistern 1

Length (m)	Width (m)	Depth (m)	Volume	
4.975	2.39	1.56	18.55	cu.m

Achieved Volume: 18.55 cu.m

Maximum Volume Required: 18.55 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% ICD Release Rate (L/s)	Overflow Pipe Release Rate (L/s)	Total Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	54.80	9.04	0.00	9.04	45.77	13.73
10	179	40.32	9.04	0.37	9.40	30.91	18.55
15	143	32.27	9.04	2.62	11.66	20.61	18.55
20	120	27.09	9.04	2.59	11.63	15.46	18.55
25	104	23.45	9.04	2.05	11.08	12.37	18.55
30	92	20.74	9.04	1.40	10.44	10.30	18.55
35	83	18.65	9.04	0.78	9.81	8.83	18.55
40	75	16.97	9.04	0.20	9.24	7.73	18.55
45	69	15.59	9.04	0.00	9.04	6.55	17.70
50	64	14.44	9.04	0.00	9.04	5.40	16.21
55	60	13.46	9.04	0.00	9.04	4.43	14.61
60	56	12.62	9.04	0.00	9.04	3.58	12.90
65	53	11.89	9.04	0.00	9.04	2.85	11.12
70	50	11.24	9.04	0.00	9.04	2.21	9.26
75	47	10.67	9.04	0.00	9.04	1.63	7.35
80	45	10.16	9.04	0.00	9.04	1.12	5.38
85	43	9.70	9.04	0.00	9.04	0.66	3.37
90	41	9.28	9.04	0.00	9.04	0.25	1.33
95	39	8.90	8.90	0.00	8.90	0.00	0.00
100	38	8.56	8.56	0.00	8.56	0.00	0.00
105	36	8.24	8.24	0.00	8.24	0.00	0.00
110	35	7.95	7.95	0.00	7.95	0.00	0.00
115	34	7.68	7.68	0.00	7.68	0.00	0.00
120	33	7.43	7.43	0.00	7.43	0.00	0.00
125	32	7.19	7.19	0.00	7.19	0.00	0.00
130	31	6.98	6.98	0.00	6.98	0.00	0.00
135	30	6.77	6.77	0.00	6.77	0.00	0.00
140	29	6.58	6.58	0.00	6.58	0.00	0.00
145	28	6.40	6.40	0.00	6.40	0.00	0.00
150	28	6.23	6.23	0.00	6.23	0.00	0.00
180	24	5.40	5.40	0.00	5.40	0.00	0.00
210	21	4.77	4.77	0.00	4.77	0.00	0.00
240	19	4.29	4.29	0.00	4.29	0.00	0.00
270	17	3.91	3.91	0.00	3.91	0.00	0.00
300	16	3.59	3.59	0.00	3.59	0.00	0.00
330	15	3.32	3.32	0.00	3.32	0.00	0.00
360	14	3.10	3.10	0.00	3.10	0.00	0.00

DRAINAGE AREA III

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	615	sq.m	1.00
Asphalt/Concrete Area:	286	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	1069	sq.m	0.25
Total Catchment Area:	1970	sq.m	0.59

Water Elevation: 87.67 m

Invert of Outlet Pipe: 86.22 m

Centroid of ICD Orifice: 86.26 m
(ICD in Outlet Pipe of CB/MH-10)

Head: 1.41 m

Orifice Diameter: 73 mm

Orifice Area: 4195 sq.mm

Coefficient of Discharge: 0.61

Maximum ICD Release Rate: 13.47 L/s

Maximum Overflow Pipe Release Rate: 6.50 L/s

Total Maximum Release Rate: 19.97 L/s

Cistern 2

Length (m)	Width (m)	Depth (m)	Volume	
5.795	2.75	0.96	15.27	cu.m

Cistern 3

Length (m)	Width (m)	Depth (m)	Volume	
5.795	2.75	0.98	15.59	cu.m

Achieved Volume: 30.87 cu.m

Maximum Volume Required: 30.87 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% ICD Release Rate (L/s)	Overflow Pipe Release Rate (L/s)	Total Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	78.82	6.73	0.00	6.73	72.09	21.63
10	179	57.99	6.73	0.00	6.73	51.26	30.75
15	143	46.41	6.73	5.38	12.11	34.30	30.87
20	120	38.96	6.73	6.50	13.23	25.72	30.87
25	104	33.73	6.73	6.41	13.15	20.58	30.87
30	92	29.84	6.73	5.95	12.69	17.15	30.87
35	83	26.82	6.73	5.39	12.12	14.70	30.87
40	75	24.41	6.73	4.81	11.54	12.86	30.87
45	69	22.43	6.73	4.26	10.99	11.43	30.87
50	64	20.77	6.73	3.75	10.48	10.29	30.87
55	60	19.36	6.73	3.28	10.01	9.35	30.87
60	56	18.15	6.73	2.85	9.58	8.57	30.87
65	53	17.10	6.73	2.45	9.18	7.91	30.87
70	50	16.17	6.73	2.09	8.82	7.35	30.87
75	47	15.35	6.73	1.75	8.49	6.86	30.87
80	45	14.61	6.73	1.45	8.18	6.43	30.87
85	43	13.95	6.73	1.16	7.90	6.05	30.87
90	41	13.35	6.73	0.90	7.64	5.72	30.87
95	39	12.81	6.73	0.66	7.39	5.42	30.87
100	38	12.31	6.73	0.43	7.17	5.14	30.87
105	36	11.85	6.73	0.22	6.95	4.90	30.87
110	35	11.43	6.73	0.02	6.76	4.68	30.87
115	34	11.04	6.73	0.00	6.73	4.31	29.74
120	33	10.68	6.73	0.00	6.73	3.95	28.44
125	32	10.35	6.73	0.00	6.73	3.61	27.11
130	31	10.03	6.73	0.00	6.73	3.30	25.75
135	30	9.74	6.73	0.00	6.73	3.01	24.37
140	29	9.47	6.73	0.00	6.73	2.73	22.97
145	28	9.21	6.73	0.00	6.73	2.48	21.55
150	28	8.97	6.73	0.00	6.73	2.23	20.10
180	24	7.76	6.73	0.00	6.73	1.03	11.12
210	21	6.87	6.73	0.00	6.73	0.13	1.68
240	19	6.17	6.17	0.00	6.17	0.00	0.00
270	17	5.62	5.62	0.00	5.62	0.00	0.00
300	16	5.16	5.16	0.00	5.16	0.00	0.00
330	15	4.78	4.78	0.00	4.78	0.00	0.00
360	14	4.46	4.46	0.00	4.46	0.00	0.00

DRAINAGE AREA II

(ONE HUNDRED YEAR EVENT- Calculations Including Off Site Drainage)

			C
Roof Area:	495	sq.m	1.00
Asphalt/Concrete Area:	509	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	1453	sq.m	0.25
Total Catchment Area:	2457	sq.m	0.56

Water Elevation:	89.41	m
Invert of Outlet Pipe:	86.83	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-4)	86.87	m
Head:	2.54	m
Orifice Diameter:	73	mm
Orifice Area:	4195	sq.mm
Coefficient of Discharge:	0.61	
Maximum ICD Release Rate:	18.08	L/s
Maximum Overflow Pipe Release Rate:	27.92	L/s
Total Maximum Release Rate:	45.99	L/s

Cistern 1

Length (m)	Width (m)	Depth (m)	Volume	
4.975	2.39	1.56	18.55	cu.m
		Achieved Volume:	18.55	cu.m
		Maximum Volume Required:	18.55	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	50% ICD Release Rate (L/s)	Overflow Pipe Release Rate (L/s)	Total Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	92.25	9.04	21.38	30.42	61.83	18.55
10	179	67.87	9.04	27.92	36.95	30.91	18.55
15	143	54.31	9.04	24.67	33.70	20.61	18.55
20	120	45.59	9.04	21.10	30.14	15.46	18.55
25	104	39.47	9.04	18.07	27.11	12.37	18.55
30	92	34.92	9.04	15.58	24.61	10.30	18.55
35	83	31.39	9.04	13.52	22.55	8.83	18.55
40	75	28.56	9.04	11.80	20.83	7.73	18.55
45	69	26.25	9.04	10.34	19.38	6.87	18.55
50	64	24.31	9.04	9.09	18.13	6.18	18.55
55	60	22.66	9.04	8.00	17.04	5.62	18.55
60	56	21.25	9.04	7.06	16.09	5.15	18.55
65	53	20.01	9.04	6.22	15.25	4.76	18.55
70	50	18.92	9.04	5.47	14.51	4.42	18.55
75	47	17.96	9.04	4.80	13.84	4.12	18.55
80	45	17.10	9.04	4.20	13.24	3.86	18.55
85	43	16.33	9.04	3.65	12.69	3.64	18.55
90	41	15.63	9.04	3.15	12.19	3.43	18.55
95	39	14.99	9.04	2.70	11.73	3.25	18.55
100	38	14.41	9.04	2.28	11.32	3.09	18.55
105	36	13.87	9.04	1.89	10.93	2.94	18.55
110	35	13.38	9.04	1.53	10.57	2.81	18.55
115	34	12.93	9.04	1.20	10.24	2.69	18.55
120	33	12.50	9.04	0.89	9.93	2.58	18.55
125	32	12.11	9.04	0.60	9.64	2.47	18.55
130	31	11.74	9.04	0.33	9.37	2.38	18.55
135	30	11.40	9.04	0.07	9.11	2.29	18.55
140	29	11.08	9.04	0.00	9.04	2.04	17.16
145	28	10.78	9.04	0.00	9.04	1.74	15.15
150	28	10.49	9.04	0.00	9.04	1.46	13.11
180	24	9.09	9.04	0.00	9.04	0.05	0.52
210	21	8.04	8.04	0.00	8.04	0.00	0.00
240	19	7.22	7.22	0.00	7.22	0.00	0.00
270	17	6.57	6.57	0.00	6.57	0.00	0.00
300	16	6.04	6.04	0.00	6.04	0.00	0.00
330	15	5.59	5.59	0.00	5.59	0.00	0.00
360	14	5.22	5.22	0.00	5.22	0.00	0.00

FIVE YEAR EVENT

(Calculations Assuming No Off Site Drainage)

Pre-development Conditions

			C
Roof Area:	264	sq.m	0.90
Asphalt/Concrete Area:	392	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	2886	sq.m	0.20
Total Catchment Area:	3542	sq.m	0.33

Bransby William Formula (Used if C > 0.40)

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

Sheet Flow Distance (L):	98	m
Slope of Land (Sw):	9	%
Area (A):	0.354	ha
Time of Concentration (Sheet Flow):	4.0	min
Area (A):	3542	sq.m
Time of Concentration:	10.0	min
Rainfall Intensity (i):	104	mm/hr (5 year event)
Runoff Coeficient (C):	0.33	
Maximum Allowable 5 Year Release Rate (2.78AiC):	33.82	L/s

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(FIVE YEAR EVENT)

			C
Roof Area:	201	sq.m	0.90
Asphalt/Concrete Area:	85	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	59	sq.m	0.20
Total Catchment Area:	345	sq.m	0.78
Area (A):	345	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.78		
Release Rate (2.78AiC):	7.80	L/s	

DRAINAGE AREA II

(FIVE YEAR EVENT)

			C
Roof Area:	300	sq.m	0.90
Asphalt/Concrete Area:	374	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	553	sq.m	0.20
Total Catchment Area:	1227	sq.m	0.58

Water Elevation:	88.55	m
Invert of Outlet Pipe:	86.83	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-4)	86.87	m
Head:	1.69	m
Orifice Diameter:	73	mm
Orifice Area:	4195	sq.mm
Coefficient of Discharge:	0.61	
Maximum ICD Release Rate:	14.72	L/s
Maximum Overflow Pipe Release Rate:	0.00	L/s
Total Maximum Release Rate:	14.72	L/s

Cistern 1

Length (m)	Width (m)	Depth (m)	Volume	
4.975	2.39	0.70	8.37	cu.m

Achieved Volume: 8.37 cu.m

Maximum Volume Required: 8.37 cu.m

Time min	i mm/hr	2.78AiC L/s	50% ICD Release Rate L/s	Overflow Pipe Release Rate (L/s)	Total Release Rate (L/s)	Stored Rate L/s	Stored Volume cu.m
5	141	28.15	7.36	0.00	7.36	20.79	6.24
10	104	20.77	7.36	0.00	7.36	13.41	8.05
15	84	16.66	7.36	0.00	7.36	9.30	8.37
20	70	14.01	7.36	0.00	7.36	6.65	7.98
25	61	12.14	7.36	0.00	7.36	4.78	7.17
30	54	10.75	7.36	0.00	7.36	3.39	6.10
35	49	9.67	7.36	0.00	7.36	2.31	4.86
40	44	8.81	7.36	0.00	7.36	1.45	3.48
45	41	8.10	7.36	0.00	7.36	0.74	2.00
50	38	7.51	7.36	0.00	7.36	0.15	0.44
55	35	7.00	7.00	0.00	7.00	0.00	0.00
60	33	6.57	6.57	0.00	6.57	0.00	0.00
65	31	6.19	6.19	0.00	6.19	0.00	0.00
70	29	5.86	5.86	0.00	5.86	0.00	0.00
75	28	5.56	5.56	0.00	5.56	0.00	0.00
80	27	5.30	5.30	0.00	5.30	0.00	0.00
85	25	5.06	5.06	0.00	5.06	0.00	0.00
90	24	4.84	4.84	0.00	4.84	0.00	0.00
95	23	4.65	4.65	0.00	4.65	0.00	0.00
100	22	4.47	4.47	0.00	4.47	0.00	0.00
105	22	4.30	4.30	0.00	4.30	0.00	0.00
110	21	4.15	4.15	0.00	4.15	0.00	0.00
115	20	4.01	4.01	0.00	4.01	0.00	0.00
120	19	3.88	3.88	0.00	3.88	0.00	0.00
125	19	3.76	3.76	0.00	3.76	0.00	0.00
130	18	3.65	3.65	0.00	3.65	0.00	0.00
135	18	3.54	3.54	0.00	3.54	0.00	0.00
140	17	3.44	3.44	0.00	3.44	0.00	0.00
145	17	3.35	3.35	0.00	3.35	0.00	0.00
150	16	3.26	3.26	0.00	3.26	0.00	0.00
180	14	2.83	2.83	0.00	2.83	0.00	0.00
210	13	2.50	2.50	0.00	2.50	0.00	0.00
240	11	2.25	2.25	0.00	2.25	0.00	0.00
270	10	2.05	2.05	0.00	2.05	0.00	0.00
300	9	1.89	1.89	0.00	1.89	0.00	0.00
330	9	1.75	1.75	0.00	1.75	0.00	0.00
360	8	1.63	1.63	0.00	1.63	0.00	0.00

DRAINAGE AREA III

(FIVE YEAR EVENT)

			C
Roof Area:	615	sq.m	0.90
Asphalt/Concrete Area:	286	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	1069	sq.m	0.20
Total Catchment Area:	1970	sq.m	0.52

Water Elevation: 87.25 m

Invert of Outlet Pipe: 86.22 m

Centroid of ICD Orifice: 86.26 m
(ICD in Outlet Pipe of CB/MH-10)

Head: 0.99 m

Orifice Diameter: 73 mm

Orifice Area: 4195 sq.mm

Coefficient of Discharge: 0.61

Maximum ICD Release Rate: 11.30 L/s

Maximum Overflow Pipe Release Rate: 0.00 L/s

Total Maximum Release Rate: 11.30 L/s

Cistern 2	Length (m)	Width (m)	Depth (m)	Volume	
	5.795	2.75	0.54	8.61	cu.m

Cistern 3	Length (m)	Width (m)	Depth (m)	Volume	
	5.795	2.75	0.56	8.93	cu.m

Achieved Volume: 17.55 cu.m

Maximum Volume Required: 17.55 cu.m

Time	i	2.78AiC	50% ICD Release Rate	Overflow Pipe Release Rate	Total Release Rate	Stored Rate	Stored Volume
min	mm/hr	L/s	L/s	(L/s)	(L/s)	L/s	cu.m
5	141	40.22	5.65	0.00	5.65	34.57	10.37
10	104	29.68	5.65	0.00	5.65	24.03	14.42
15	84	23.80	5.65	0.00	5.65	18.15	16.34
20	70	20.01	5.65	0.00	5.65	14.36	17.24
25	61	17.35	5.65	0.00	5.65	11.70	17.55
30	54	15.36	5.65	0.00	5.65	9.71	17.48
35	49	13.82	5.65	0.00	5.65	8.17	17.16
40	44	12.59	5.65	0.00	5.65	6.94	16.65
45	41	11.57	5.65	0.00	5.65	5.92	15.99
50	38	10.73	5.65	0.00	5.65	5.08	15.23
55	35	10.01	5.65	0.00	5.65	4.36	14.37
60	33	9.38	5.65	0.00	5.65	3.73	13.45
65	31	8.84	5.65	0.00	5.65	3.19	12.46
70	29	8.37	5.65	0.00	5.65	2.72	11.41
75	28	7.94	5.65	0.00	5.65	2.29	10.33
80	27	7.57	5.65	0.00	5.65	1.92	9.20
85	25	7.23	5.65	0.00	5.65	1.58	8.04
90	24	6.92	5.65	0.00	5.65	1.27	6.85
95	23	6.64	5.65	0.00	5.65	0.99	5.64
100	22	6.38	5.65	0.00	5.65	0.73	4.40
105	22	6.15	5.65	0.00	5.65	0.50	3.14
110	21	5.93	5.65	0.00	5.65	0.28	1.86
115	20	5.73	5.65	0.00	5.65	0.08	0.56
120	19	5.55	5.55	0.00	5.55	0.00	0.00
125	19	5.37	5.37	0.00	5.37	0.00	0.00
130	18	5.21	5.21	0.00	5.21	0.00	0.00
135	18	5.06	5.06	0.00	5.06	0.00	0.00
140	17	4.92	4.92	0.00	4.92	0.00	0.00
145	17	4.79	4.79	0.00	4.79	0.00	0.00
150	16	4.66	4.66	0.00	4.66	0.00	0.00
180	14	4.04	4.04	0.00	4.04	0.00	0.00
210	13	3.58	3.58	0.00	3.58	0.00	0.00
240	11	3.22	3.22	0.00	3.22	0.00	0.00
270	10	2.93	2.93	0.00	2.93	0.00	0.00
300	9	2.69	2.69	0.00	2.69	0.00	0.00
330	9	2.50	2.50	0.00	2.50	0.00	0.00
360	8	2.33	2.33	0.00	2.33	0.00	0.00

DRAINAGE AREA II

(FIVE YEAR EVENT - Calculations Including Off Site Drainage)

			C
Roof Area:	495	sq.m	0.90
Asphalt/Concrete Area:	509	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	1453	sq.m	0.20
Total Catchment Area:	2457	sq.m	0.49

Water Elevation:	89.31	m
Invert of Outlet Pipe:	86.83	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-4)	86.87	m
Head:	2.44	m
Orifice Diameter:	73	mm
Orifice Area:	4195	sq.mm
Coefficient of Discharge:	0.61	
Maximum ICD Release Rate:	17.72	L/s
Maximum Overflow Pipe Release Rate:	0.00	L/s
Total Maximum Release Rate:	17.72	L/s

Cistern 1

Length (m)	Width (m)	Depth (m)	Volume	
4.975	2.39	1.46	17.36	cu.m

Achieved Volume: 17.36 cu.m

Maximum Volume Required: 17.36 cu.m

Time min	i mm/hr	2.78AiC L/s	50% ICD Release Rate L/s	Overflow Pipe Release Rate (L/s)	Total Release Rate (L/s)	Stored Rate L/s	Stored Volume cu.m
5	141	46.87	8.86	0.00	8.86	38.01	11.40
10	104	34.59	8.86	0.00	8.86	25.73	15.44
15	84	27.74	8.86	0.00	8.86	18.88	16.99
20	70	23.32	8.86	0.00	8.86	14.46	17.36
25	61	20.22	8.86	0.00	8.86	11.36	17.04
30	54	17.90	8.86	0.00	8.86	9.05	16.28
35	49	16.11	8.86	0.00	8.86	7.25	15.22
40	44	14.67	8.86	0.00	8.86	5.81	13.95
45	41	13.49	8.86	0.00	8.86	4.63	12.50
50	38	12.50	8.86	0.00	8.86	3.64	10.93
55	35	11.66	8.86	0.00	8.86	2.80	9.25
60	33	10.94	8.86	0.00	8.86	2.08	7.48
65	31	10.31	8.86	0.00	8.86	1.45	5.65
70	29	9.75	8.86	0.00	8.86	0.89	3.75
75	28	9.26	8.86	0.00	8.86	0.40	1.80
80	27	8.82	8.82	0.00	8.82	0.00	0.00
85	25	8.42	8.42	0.00	8.42	0.00	0.00
90	24	8.06	8.06	0.00	8.06	0.00	0.00
95	23	7.74	7.74	0.00	7.74	0.00	0.00
100	22	7.44	7.44	0.00	7.44	0.00	0.00
105	22	7.17	7.17	0.00	7.17	0.00	0.00
110	21	6.91	6.91	0.00	6.91	0.00	0.00
115	20	6.68	6.68	0.00	6.68	0.00	0.00
120	19	6.46	6.46	0.00	6.46	0.00	0.00
125	19	6.26	6.26	0.00	6.26	0.00	0.00
130	18	6.07	6.07	0.00	6.07	0.00	0.00
135	18	5.90	5.90	0.00	5.90	0.00	0.00
140	17	5.73	5.73	0.00	5.73	0.00	0.00
145	17	5.58	5.58	0.00	5.58	0.00	0.00
150	16	5.43	5.43	0.00	5.43	0.00	0.00
180	14	4.71	4.71	0.00	4.71	0.00	0.00
210	13	4.17	4.17	0.00	4.17	0.00	0.00
240	11	3.75	3.75	0.00	3.75	0.00	0.00
270	10	3.41	3.41	0.00	3.41	0.00	0.00
300	9	3.14	3.14	0.00	3.14	0.00	0.00
330	9	2.91	2.91	0.00	2.91	0.00	0.00
360	8	2.71	2.71	0.00	2.71	0.00	0.00

CISTERN STORAGE

Cistern 1 MacGregor 18,600 Litre Tank			
Length (m)	Width (m)	Water Depth (m)	Volume Stored (cu.m.)
4.975	2.39	1.80	21.40
4.975	2.39	1.70	20.21
4.975	2.39	1.60	19.02
4.975	2.39	1.50	17.84
4.975	2.39	1.40	16.65
4.975	2.39	1.30	15.46
4.975	2.39	1.20	14.27
4.975	2.39	1.10	13.08
4.975	2.39	1.00	11.89
4.975	2.39	0.90	10.70
4.975	2.39	0.80	9.51
4.975	2.39	0.70	8.32
4.975	2.39	0.60	7.13
4.975	2.39	0.50	5.95
4.975	2.39	0.40	4.76
4.975	2.39	0.30	3.57
4.975	2.39	0.20	2.38
4.975	2.39	0.10	1.19
4.975	2.39	0.00	0.00

Cisterns 2 & 3 MacGregor 41,300 Litre Tanks			
Length (m)	Width (m)	Depth (m)	Volume (cu.m.)
5.795	2.75	2.80	44.62
5.795	2.75	2.70	43.03
5.795	2.75	2.60	41.43
5.795	2.75	2.50	39.84
5.795	2.75	2.40	38.25
5.795	2.75	2.30	36.65
5.795	2.75	2.20	35.06
5.795	2.75	2.10	33.47
5.795	2.75	2.00	31.87
5.795	2.75	1.90	30.28
5.795	2.75	1.80	28.69
5.795	2.75	1.70	27.09
5.795	2.75	1.60	25.50
5.795	2.75	1.50	23.90
5.795	2.75	1.40	22.31
5.795	2.75	1.30	20.72
5.795	2.75	1.20	19.12
5.795	2.75	1.10	17.53
5.795	2.75	1.00	15.94
5.795	2.75	0.90	14.34
5.795	2.75	0.80	12.75
5.795	2.75	0.70	11.16
5.795	2.75	0.60	9.56
5.795	2.75	0.50	7.97
5.795	2.75	0.40	6.37
5.795	2.75	0.30	4.78
5.795	2.75	0.20	3.19
5.795	2.75	0.10	1.59
5.795	2.75	0.00	0.00

STORM SEWER COMPUTATION FORM

Rational Method

FIVE YEAR EVENT

Q = 2.78 A i C

March 12, 2021

n = 0.013

Location		Areas (ha)									Pipe Data									Notes
		Hard	Gravel	Landscape	Roof	Individual	Accum.	Time of Conc.	Rainfall Intensity i	Peak Flow Q		Actual Diameter	Nominal Diameter	Slope	Length	Capacity	Velocity	Time of Flow	Ratio	
From	To	C = 0.9	C = 0.7	C = 0.2	C = 0.9	2.78AC	2.78AC	(min)	(mm/hr)	(L/s)	Material	(mm)	(mm)	(%)	(m)	(L/s)	(m/s)	(min)	Q/Qfull	
																				Includes 1,575 sq.m
CB-3	CB/MH-4	0.0153		0.1553	0.0249	0.1869	0.1869	10.00	104	19.48	PVC	254.0	250	3.00	28.4	107.5	2.12	0.22	0.18	offsite drainage
CB/MH-4	MH-5	0.0336		0.026	0.0251	0.1613	0.3483	10.22	103	35.99	PVC	304.8	300	0.34	20.7	58.8	0.81	0.43	0.61	Q inc. 0.45 L/s/ha for
																				foundation drains
										16.80	PVC	304.8	300	0.34	20.7	58.8	0.81	0.43	0.29	Flow through ICD
																				Q inc. 0.45 L/s/ha for
MH-5	MH-11						0.3483	10.65	101	35.24	PVC	304.8	300	0.34	24.3	58.8	0.81	0.50	0.60	foundation drains
										16.80	PVC	304.8	300	0.34	24.3	58.8	0.81	0.50	0.29	Restricted flow
CB-6	CB/MH-7	0.0033		0.0323	0.0240	0.0863	0.0863	10.00	104	8.99	PVC	304.8	300	0.34	26.1	58.8	0.81	0.54	0.15	
CB/MH-7	CB/MH-8			0.002	0.0043	0.0119	0.0981	10.54	101	9.95	PVC	304.8	300	0.34	3.8	58.8	0.81	0.08	0.17	
CB/MH-8	CB/MH-10			0.0325		0.0181	0.1162	10.62	101	11.74	PVC	304.8	300	0.34	9.8	58.8	0.81	0.20	0.20	
CB-9	CB/MH-10	0.0253		0.0401	0.0332	0.1687	0.1687	10.00	104	17.57	PVC	254.0	250	0.43	10.0	40.7	0.80	0.21	0.43	
CB/MH-10	MH-11					0.0000	0.2849	10.82	100	28.50	PVC	304.8	300	0.34	2.0	58.8	0.81	0.04	0.48	
										9.93	PVC	304.8	300	0.34	2.0	58.8	0.81	0.04	0.17	Flow through ICD
																				Q inc. 0.45 L/s/ha for
MH-11	MH-12					0.0000	0.6331	11.15	98	62.45	PVC	381.0	375	0.25	16.8	91.5	0.80	0.35	0.68	foundation drains
										26.73	PVC	381.0	375	0.25	16.8	91.5	0.80	0.35	0.29	Restricted flow
																				Q inc. 0.45 L/s/ha for
MH-12	MH-13					0.0000	0.6331	11.50	97	61.44	PVC	381.0	375	0.25	14.5	91.5	0.80	0.30	0.67	foundation drains
										26.73	PVC	381.0	375	0.25	14.5	91.5	0.80	0.30	0.29	Restricted flow
EXIST.				C = 0.35																
450 CULV.	CB/MH-15			0.3843		0.3739	0.3739	10.00	104	38.96		457.2	450	7.00	12.0	786.9	4.79	0.04	0.05	
CB/MH-15	MH-1	0.0055		0.0013		0.0145	0.3884	10.04	104	40.38	PVC	304.8	300	4.69	9.5	218.5	2.99	0.05	0.18	
CB-16	MH-1	0.0064		0.0052		0.0189	0.0189	10.00	104	1.97	PVC	254.0	250	1.00	5.8	62.0	1.22	0.08	0.03	
MH-1	MH-2					0.0000	0.4073	10.09	104	42.24	PVC	304.8	300	4.69	25.1	218.5	2.99	0.14	0.19	
CB-17	MH-2	0.0229		0.0132	0.0106	0.0912	0.0912	10.00	104	9.50	PVC	254.0	250	1.00	5.7	62.0	1.22	0.08	0.15	
MH-2	MH-13					0.0000	0.4985	10.23	103	51.33	PVC	304.8	300	4.69	29.3	218.5	2.99	0.16	0.23	
																				Q inc. 0.45 L/s/ha for
MH-13	MH-14					0.0000	1.1316	11.80	96	108.24	CONC	457.2	450	0.21	60.7	136.3	0.83	1.22	0.79	foundation drains
										78.06	CONC	457.2	450	0.21	60.7	136.3	0.83	1.22	0.57	Restricted flow
											CAPACITY OFEXISTING STORM SEWER IN MANOTICK MAIN ST									
												381.0	375	0.64		146.3	1.28			

City of Ottawa Servicing Study Checklist

General Content

Executive Summary (for large reports only): not applicable

Date and revision number of the report: see page 1 of Servicing Brief and Stormwater Management Report

Location map and plan showing municipal address, boundary, and layout of proposed development: see drawings C-1 to C-8

Plan showing the site and location of all existing services: see drawings C-1 to C-8

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 1 of Servicing Brief and Stormwater Management Report

Identification of existing and proposed infrastructure available in the immediate area: see drawings C-1 to C-8

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-8

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 1.5 on drawing C-1

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 of Servicing Brief

Identification of system constraints: see page 2 of Servicing Brief

Confirmation of adequate domestic supply and pressure: see page 2 of Servicing Brief

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 of Servicing Brief

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 Brief

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 Brief

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 Brief

(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 Brief

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 page 15 of Servicing Brief

Description of proposed sewer network including sewers, pumping stations, and forcemains: see page 3 of Servicing Brief

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 4 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-4

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 Stormwater Management Report 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: 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-8 and 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-8 and 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 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: 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 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 notes 2.1 to 2.7 on drawing C-3

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: see page 19 of Servicing Brief and Stormwater Management Report

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 7 of Servicing Brief

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