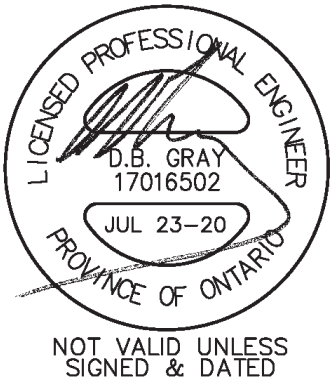
STORMWATER MANAGEMENT REPORT

1479 Youville Drive
Ottawa, Ontario

Report No. 18090

July 23, 2020



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STORMWATER MANAGEMENT REPORT

1479 Youville Drive
Ottawa, Ontario

This report addresses the stormwater management requirements of a property 5609 sq.m. in area located 1479 Youville Drive in Ottawa. The property was formerly the site of a Canada Post building. The building and site has been repurposed to an automobile car dealership.

This report forms part of the stormwater management design for the proposed development. Refer to drawings C-1 to C-7 also prepared by D. B. Gray Engineering Inc.

The stormwater management criteria for quantity control are to control the post development peak flows to peak flows generated during pre-development conditions. It is assumed that pre-development conditions are the conditions that existed for at least 25 years when it was a Canada Post facility (prior to 2015) with about 56% of the area being soft landscaping. It is calculated that the pre-development conditions reflect a 5-year runoff coefficient of 0.51, therefore, using a 10 minute time of concentration, and the Rational Method; the maximum allowable release rate is 83.00 L/s for the 5-year storm event. The runoff coefficients for the 100-year event are increased by 25% to maximum 1.00. Therefore, using runoff coefficient of 0.58, a 10 minute time of concentration, and the Rational Method; the maximum allowable release rate is 162.35 L/s for the 100-year storm event.

Stormwater will be stored within the development on the parking area above four catch basins.

Drainage Area I (Uncontrolled Flow Off Site – 979 sq.m.):
The runoff from front of the site 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:	46.96 L/s	24.63 L/s

Drainage Area II (2,490 sq.m.):
An inlet control device (ICD) located at the outlet pipe of catch basin/manhole CB/MH-2 will control the release of stormwater from Drainage Area II. The ICD will restrict the flow and force the stormwater to back up onto surface above CB/MH-2 and catch basin CB-1. The ICD shall be a plug style with a round orifice design (with the orifice located at the bottom of the plug) manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 16.06 L/s at 1.68 m head. It is calculated that an orifice area of 4,592 sq.mm. ($\pm$76 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 16.06 L/s at a head of 1.68 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 15.83 l/s at 1.63 m. During the one hundred-year event, when the maximum ponding elevation is reached water will flow overland and into Drainage Area IV. These flows are added to Drainage Area IV.

	100-year	5-year
Maximum release rate:	16.06 L/s	15.83 L/s
Maximum water elevation:	58.20 m	58.16 m
Maximum stored volume:	70.54 cu.m.	31.52 cu.m.

Drainage Area III (663 sq.m.):
An inlet control device (ICD) located at the outlet pipe of catch basin CB-3 will control the release of stormwater from Drainage Area III. The ICD will restrict the flow and force the stormwater to back up onto surface above CB-3. The ICD shall be a plug style with a round orifice design (with the orifice located at the bottom of the plug) manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 15.79 L/s at 1.32 m head. It is calculated that an orifice area of 5,088 sq.mm. (±80 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 15.79 L/s at a head of 1.32 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 15.59 l/s at 1.29 m. During the one hundred-year event, when the maximum ponding elevation is reached water will flow overland and off the site. The maximum overland release rate of 11.05 L/s is added to the maximum ICD release rate to obtain the total maximum release rate of 26.84 L/s.

	100-year	5-year
Maximum ICD release rate:	15.79 L/s	15.59 L/s
Maximum overflow release rate:	11.05 L/s	0.00 L/s
Total maximum release rate:	26.84 L/s	15.59 L/s
Maximum water elevation:	57.85 m	57.82 m
Maximum stored volume:	5.37 cu.m.	2.35 cu.m.

Drainage Area IV (1,477 sq.m.):
An inlet control device (ICD) located at the outlet pipe of catch basin CB-4 will control the release of stormwater from Drainage Area IV. The ICD will restrict the flow and force the stormwater to back up onto surface above CB-4. The ICD shall be a plug style with a round orifice design (with the orifice located at the bottom of the plug) manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 27.52 L/s at 1.30 m head. It is calculated that an orifice area of 8,944 sq.mm. (±107 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 27.52 L/s at a head of 1.30 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 16.94 l/s at 1.24 m. During the one hundred-year event, when the maximum ponding elevation is reached water will flow overland and off the site. The maximum overland release rate of 13.69 L/s is added to the maximum ICD release rate to obtain the total maximum release rate of 41.21 L/s.

	100-year	5-year
Maximum ICD release rate:	27.52 L/s	26.94 L/s
Maximum overflow release rate:	13.69 L/s	0.00 L/s
Total maximum release rate:	41.21 L/s	26.94 L/s
Maximum water elevation:	57.76 m	57.71 m
Maximum stored volume:	19.27 cu.m.	7.57 cu.m.

The Entire Site:

	100-year	5-year
Maximum permitted release rate:	162.35 L/s	83.00 L/s
Maximum release rate:	131.07 L/s	83.00 L/s
Maximum stored volume:	95.17 cu.m.	41.44 cu.m.

Therefore, the maximum post-development release rate for the 100-year storm event is calculated to be131.07 L/s, 19% less than the maximum allowable of 162.35 L/s and to achieve this release rate the total maximum required capacity is 95.17 cu.m. For the 5-year event the maximum post-development release is calculated to be equal to maximum

allowable at 83.00 L/s and to achieve this release rate the total maximum required capacity is 41.44cu.m.

The unrestricted flowrate in the site storm sewer system, resulting from one in five-year storm event, will produce a peak flow of 113.1 L/s which will be adequately served by the proposed site storm sewer system with the last pipe segment (375 mm at 0.65% - 147.5 L/s capacity) being at 77% of its capacity. (With the restricted flow (i.e. through the ICDs) last pipe segment will be only 40% full.)

The stormwater flows contributing to the municipal storm sewer system is expected to have a positive impact given the post-development flows from the site are being reduced by 19% (from 162.35 to 131.07 L/s) during the 100-year event and given there is no increase (at 83.00 L/s) during the 5-year event.

CONCLUSIONS:

1. The stormwater management criteria for quantity control are to control the post development peak flows to peak flows generated during pre-development conditions. It is assumed that pre-development conditions are the conditions that existed for at least 25 years when it was a Canada Post facility (prior to 2015) with about 56% of the area being soft landscaping.

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

3. The unrestricted flowrate in the site storm sewer system, resulting from one in five-year storm event will be adequately served by the proposed site storm sewer system.

4. The stormwater flows contributing to the municipal storm sewer system is expected to have a positive impact given the post-development flows from the site are being reduced by 19% during the 100-year event and given there is no increase during the 5-year event.

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

Storage calculations above the catch basins are based on the following formula for volume of a cone:

$$V = (A \times d)/3$$

where:

V = volume in cu.m.
A = ponding area in sq.m.
d = ponding depth 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)	-	46.96	-	-
AREA II	-	16.06	70.54	70.54
AREA III	-	26.84	5.37	5.37
AREA IV	-	41.21	19.27	19.27
TOTAL	162.35	131.07	95.17	95.17

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)	-	24.63	-	-
AREA II	-	15.83	31.52	31.52
AREA III	-	15.59	2.35	2.35
AREA IV	-	26.94	7.57	7.57
TOTAL	83.00	83.00	41.44	41.44

1479 Youville Drive

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS
Rational Method

ONE HUNDRED YEAR EVENT

Pre-Development Conditions
(Circa 2014)

			C
Roof Area:	671	sq.m	1.00
Asphalt/Concrete Area:	1820	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	3118	sq.m	0.25
Total Catchment Area:	5609	sq.m	0.58

Bransby William Formula (Used when C > 0.40)

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

Sheet Flow Distance (L):	26	m
Slope of Land (Sw):	1.3	%
Area (A):	0.56	ha
Time of Concentration (Sheet Flow):	1.5	min
Area (A):	5609	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.58	
100 Year Pre-Development Release Rate (2.78AiC): (Maximum Allowable Release Rate)	162.35	L/s

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	671	sq.m	1.00
Asphalt/Concrete Area:	264	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	44	sq.m	0.25
Total Catchment Area:	979	sq.m	0.97

Area (A):	979	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.97	
Release Rate (2.78AiC):	46.96	L/s

DRAINAGE AREA II

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	2368	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	122	sq.m	0.25
Total Catchment Area:	2490	sq.m	0.96

Water Elevation:	58.20	m
Invert of Outlet Pipe - CB/MH-2:	56.49	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-2)	56.53	m
Head:	1.68	m
Orifice Diameter:	76	mm
Orifice Area:	4592	sq.mm
Coefficient of Discharge:	0.61	
Maximum ICD Release Rate:	16.06	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB-1	284	0.20	19.43	cu.m
CB/MH-2	748	0.20	51.11	cu.m
		Achieved Volume:	70.54	cu.m
		Maximum Volume Required:	70.54	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Overflow to Area IV (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	161.83	16.06	0.00	145.77	43.73
10	179	119.06	16.06	0.00	103.00	61.80
15	143	95.28	16.06	0.84	78.38	70.54
20	120	79.98	16.06	5.13	58.78	70.54
25	104	69.24	16.06	6.15	47.03	70.54
30	92	61.26	16.06	6.00	39.19	70.54
35	83	55.06	16.06	5.41	33.59	70.54
40	75	50.11	16.06	4.65	29.39	70.54
45	69	46.04	16.06	3.85	26.13	70.54
50	64	42.64	16.06	3.07	23.51	70.54
55	60	39.76	16.06	2.32	21.38	70.54
60	56	37.27	16.06	1.61	19.59	70.54
65	53	35.10	16.06	0.95	18.09	70.54
70	50	33.20	16.06	0.34	16.80	70.54
75	47	31.51	16.06	0.00	15.44	69.50
80	45	30.00	16.06	0.00	13.93	66.89
85	43	28.64	16.06	0.00	12.58	64.14
90	41	27.41	16.06	0.00	11.35	61.28
95	39	26.29	16.06	0.00	10.23	58.31
100	38	25.27	16.06	0.00	9.21	55.25
105	36	24.34	16.06	0.00	8.27	52.11
110	35	23.47	16.06	0.00	7.41	48.89
115	34	22.67	16.06	0.00	6.61	45.61
120	33	21.93	16.06	0.00	5.87	42.26
125	32	21.24	16.06	0.00	5.18	38.85
130	31	20.60	16.06	0.00	4.54	35.40
135	30	20.00	16.06	0.00	3.94	31.89
140	29	19.44	16.06	0.00	3.37	28.34
145	28	18.91	16.06	0.00	2.84	24.75
150	28	18.41	16.06	0.00	2.35	21.11
180	24	15.94	15.94	0.00	0.00	0.00
210	21	14.10	14.10	0.00	0.00	0.00
240	19	12.67	12.67	0.00	0.00	0.00
270	17	11.53	11.53	0.00	0.00	0.00
300	16	10.60	10.60	0.00	0.00	0.00

DRAINAGE AREA III

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	663	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	0	sq.m	0.25
Total Catchment Area:	663	sq.m	1.00

Water Elevation:	57.85	m
Invert of Outlet Pipe - CB-3:	56.49	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB-3)	56.53	m
Head:	1.32	m
Orifice Diameter:	80	mm
Orifice Area:	5088	sq.mm
Coefficient of Discharge:	0.61	
Maximum ICD Release Rate:	15.79	L/s
Maximum Overflow Release Rate:	11.05	L/s
Total Maximum Release Rate:	26.84	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB-3	115	0.14	5.37	cu.m

Achieved Volume:	5.37	cu.m
Maximum Volume Required:	5.37	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Overflow Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	44.73	15.79	11.05	17.89	5.37
10	179	32.91	15.79	8.17	8.94	5.37
15	143	26.34	15.79	4.58	5.96	5.37
20	120	22.11	15.79	1.84	4.47	5.37
25	104	19.14	15.79	0.00	3.35	5.02
30	92	16.93	15.79	0.00	1.14	2.05
35	83	15.22	15.22	0.00	0.00	0.00
40	75	13.85	13.85	0.00	0.00	0.00
45	69	12.73	12.73	0.00	0.00	0.00
50	64	11.79	11.79	0.00	0.00	0.00
55	60	10.99	10.99	0.00	0.00	0.00
60	56	10.30	10.30	0.00	0.00	0.00
65	53	9.70	9.70	0.00	0.00	0.00
70	50	9.18	9.18	0.00	0.00	0.00
75	47	8.71	8.71	0.00	0.00	0.00
80	45	8.29	8.29	0.00	0.00	0.00
85	43	7.92	7.92	0.00	0.00	0.00
90	41	7.58	7.58	0.00	0.00	0.00
95	39	7.27	7.27	0.00	0.00	0.00
100	38	6.99	6.99	0.00	0.00	0.00
105	36	6.73	6.73	0.00	0.00	0.00
110	35	6.49	6.49	0.00	0.00	0.00
115	34	6.27	6.27	0.00	0.00	0.00
120	33	6.06	6.06	0.00	0.00	0.00
125	32	5.87	5.87	0.00	0.00	0.00
130	31	5.69	5.69	0.00	0.00	0.00
135	30	5.53	5.53	0.00	0.00	0.00
140	29	5.37	5.37	0.00	0.00	0.00
145	28	5.23	5.23	0.00	0.00	0.00
150	28	5.09	5.09	0.00	0.00	0.00
180	24	4.41	4.41	0.00	0.00	0.00
210	21	3.90	3.90	0.00	0.00	0.00
240	19	3.50	3.50	0.00	0.00	0.00
270	17	3.19	3.19	0.00	0.00	0.00
300	16	2.93	2.93	0.00	0.00	0.00

DRAINAGE AREA IV

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	1477	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	0	sq.m	0.25
Total Catchment Area:	1477	sq.m	1.00

Water Elevation:	57.76	m
Invert of Outlet Pipe - CB-4:	56.41	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB-4)	56.46	m
Head:	1.30	m
Orifice Diameter:	107	mm
Orifice Area:	8944	sq.mm
Coefficient of Discharge:	0.61	

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB-4	289	0.20	19.27	cu.m

Maximum ICD Release Rate:	27.52	L/s	Achieved Volume:	19.27 cu.m
Maximum Overflow Release Rate:	13.69	L/s		
Total Maximum Release Rate:	41.21	L/s	Maximum Volume Required:	19.27 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Overflow from Area IV (L/s)	Total Inflow (L/s)	ICD Release Rate (L/s)	Overflow Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	243	99.66	0.00	99.66	27.52	7.91	64.22	19.27
10	179	73.32	0.00	73.32	27.52	13.69	32.11	19.27
15	143	58.67	0.84	59.51	27.52	10.58	21.41	19.27
20	120	49.25	5.13	54.39	27.52	10.81	16.06	19.27
25	104	42.64	6.15	48.79	27.52	8.43	12.84	19.27
30	92	37.72	6.00	43.72	27.52	5.50	10.70	19.27
35	83	33.91	5.41	39.31	27.52	2.62	9.17	19.27
40	75	30.86	4.65	35.50	27.52	0.00	7.99	19.17
45	69	28.35	3.85	32.20	27.52	0.00	4.68	12.65
50	64	26.26	3.07	29.33	27.52	0.00	1.81	5.42
55	60	24.48	2.32	26.80	26.80	0.00	0.00	0.00
60	56	22.95	1.61	24.56	24.56	0.00	0.00	0.00
65	53	21.62	0.95	22.57	22.57	0.00	0.00	0.00
70	50	20.44	0.34	20.78	20.78	0.00	0.00	0.00
75	47	19.40	0.00	19.40	19.40	0.00	0.00	0.00
80	45	18.47	0.00	18.47	18.47	0.00	0.00	0.00
85	43	17.64	0.00	17.64	17.64	0.00	0.00	0.00
90	41	16.88	0.00	16.88	16.88	0.00	0.00	0.00
95	39	16.19	0.00	16.19	16.19	0.00	0.00	0.00
100	38	15.56	0.00	15.56	15.56	0.00	0.00	0.00
105	36	14.99	0.00	14.99	14.99	0.00	0.00	0.00
110	35	14.45	0.00	14.45	14.45	0.00	0.00	0.00
115	34	13.96	0.00	13.96	13.96	0.00	0.00	0.00
120	33	13.51	0.00	13.51	13.51	0.00	0.00	0.00
125	32	13.08	0.00	13.08	13.08	0.00	0.00	0.00
130	31	12.69	0.00	12.69	12.69	0.00	0.00	0.00
135	30	12.32	0.00	12.32	12.32	0.00	0.00	0.00
140	29	11.97	0.00	11.97	11.97	0.00	0.00	0.00
145	28	11.64	0.00	11.64	11.64	0.00	0.00	0.00
150	28	11.34	0.00	11.34	11.34	0.00	0.00	0.00
180	24	9.81	0.00	9.81	9.81	0.00	0.00	0.00
210	21	8.68	0.00	8.68	8.68	0.00	0.00	0.00
240	19	7.80	0.00	7.80	7.80	0.00	0.00	0.00
270	17	7.10	0.00	7.10	7.10	0.00	0.00	0.00
300	16	6.53	0.00	6.53	6.53	0.00	0.00	0.00

FIVE YEAR EVENT

Pre-Development Conditions

(Circa 2014)

			C
Roof Area:	671	sq.m	0.90
Asphalt/Concrete Area:	1820	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	3118	sq.m	0.20
Total Catchment Area:	5609	sq.m	0.51

Bransby William Formula (Used when C > 0.40)

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

Sheet Flow Distance (L):	26	m
Slope of Land (Sw):	1.3	%
Area (A):	0.56	ha
Time of Concentration (Sheet Flow):	1.5	min
Area (A):	5609	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	104	mm/hr
Runoff Coeficient (C):	0.51	
5 Year Pre-Development Release Rate (2.78AiC): (Maximum Allowable Release Rate)	83.00	L/s

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(FIVE YEAR EVENT)

			C
Roof Area:	671	sq.m	0.90
Asphalt/Concrete Area:	264	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	44	sq.m	0.20
Total Catchment Area:	979	sq.m	0.87

Area (A):	979	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	104	mm/hr
Runoff Coeficient (C):	0.87	
Release Rate (2.78AiC):	24.63	L/s

DRAINAGE AREA II

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	2368	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	122	sq.m	0.20
Total Catchment Area:	2490	sq.m	0.87

Water Elevation:	58.16	m
Invert of Outlet Pipe - CB/MH-2:	56.49	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-2)	56.53	m
Head:	1.63	m
Orifice Diameter:	76	mm
Orifice Area:	4592	sq.mm
Coefficient of Discharge:	0.61	
Maximum Release Rate:	15.83	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB-1	166	0.16	8.68	cu.m
CB/MH-2	437	0.16	22.84	cu.m
		Achieved Volume:	31.52	cu.m
		Maximum Volume Required:	31.52	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Overflow to Area IV (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	84.60	15.83	0.00	68.77	20.63
10	104	62.44	15.83	0.00	46.61	27.96
15	84	50.07	15.83	0.00	34.24	30.82
20	70	42.10	15.83	0.00	26.27	31.52
25	61	36.49	15.83	0.00	20.66	30.99
30	54	32.32	15.83	0.00	16.49	29.67
35	49	29.07	15.83	0.00	13.24	27.81
40	44	26.48	15.83	0.00	10.65	25.55
45	41	24.35	15.83	0.00	8.52	22.99
50	38	22.56	15.83	0.00	6.73	20.20
55	35	21.05	15.83	0.00	5.22	17.21
60	33	19.74	15.83	0.00	3.91	14.08
65	31	18.60	15.83	0.00	2.77	10.81
70	29	17.60	15.83	0.00	1.77	7.43
75	28	16.71	15.83	0.00	0.88	3.96
80	27	15.92	15.83	0.00	0.09	0.41
85	25	15.20	15.20	0.00	0.00	0.00
90	24	14.55	14.55	0.00	0.00	0.00
95	23	13.97	13.97	0.00	0.00	0.00
100	22	13.43	13.43	0.00	0.00	0.00
105	22	12.93	12.93	0.00	0.00	0.00
110	21	12.48	12.48	0.00	0.00	0.00
115	20	12.06	12.06	0.00	0.00	0.00
120	19	11.67	11.67	0.00	0.00	0.00
125	19	11.30	11.30	0.00	0.00	0.00
130	18	10.96	10.96	0.00	0.00	0.00
135	18	10.65	10.65	0.00	0.00	0.00
140	17	10.35	10.35	0.00	0.00	0.00
145	17	10.07	10.07	0.00	0.00	0.00
150	16	9.81	9.81	0.00	0.00	0.00
180	14	8.50	8.50	0.00	0.00	0.00
210	13	7.52	7.52	0.00	0.00	0.00
240	11	6.77	6.77	0.00	0.00	0.00
270	10	6.16	6.16	0.00	0.00	0.00
300	9	5.67	5.67	0.00	0.00	0.00

DRAINAGE AREA III

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	663	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	0	sq.m	0.20
Total Catchment Area:	663	sq.m	0.90

Water Elevation:	57.82	m
Invert of Outlet Pipe - CB/MH-2:	56.49	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-2)	56.53	m
Head:	1.29	m
Orifice Diameter:	80	mm
Orifice Area:	5088	sq.mm
Coefficient of Discharge:	0.61	

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB-3	66	0.11	2.35	cu.m

Maximum ICD Release Rate:	15.59	L/s
Maximum Overflow Release Rate:	0.00	L/s
Total Maximum Release Rate:	15.59	L/s

Achieved Volume:	2.35	cu.m
Maximum Volume Required:	2.35	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Overflow Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	23.42	15.59	0.00	7.83	2.35
10	104	17.28	15.59	0.00	1.69	1.02
15	84	13.86	13.86	0.00	0.00	0.00
20	70	11.65	11.65	0.00	0.00	0.00
25	61	10.10	10.10	0.00	0.00	0.00
30	54	8.95	8.95	0.00	0.00	0.00
35	49	8.05	8.05	0.00	0.00	0.00
40	44	7.33	7.33	0.00	0.00	0.00
45	41	6.74	6.74	0.00	0.00	0.00
50	38	6.25	6.25	0.00	0.00	0.00
55	35	5.83	5.83	0.00	0.00	0.00
60	33	5.46	5.46	0.00	0.00	0.00
65	31	5.15	5.15	0.00	0.00	0.00
70	29	4.87	4.87	0.00	0.00	0.00
75	28	4.63	4.63	0.00	0.00	0.00
80	27	4.41	4.41	0.00	0.00	0.00
85	25	4.21	4.21	0.00	0.00	0.00
90	24	4.03	4.03	0.00	0.00	0.00
95	23	3.87	3.87	0.00	0.00	0.00
100	22	3.72	3.72	0.00	0.00	0.00
105	22	3.58	3.58	0.00	0.00	0.00
110	21	3.45	3.45	0.00	0.00	0.00
115	20	3.34	3.34	0.00	0.00	0.00
120	19	3.23	3.23	0.00	0.00	0.00
125	19	3.13	3.13	0.00	0.00	0.00
130	18	3.03	3.03	0.00	0.00	0.00
135	18	2.95	2.95	0.00	0.00	0.00
140	17	2.86	2.86	0.00	0.00	0.00
145	17	2.79	2.79	0.00	0.00	0.00
150	16	2.71	2.71	0.00	0.00	0.00
180	14	2.35	2.35	0.00	0.00	0.00
210	13	2.08	2.08	0.00	0.00	0.00
240	11	1.87	1.87	0.00	0.00	0.00
270	10	1.71	1.71	0.00	0.00	0.00
300	9	1.57	1.57	0.00	0.00	0.00

DRAINAGE AREA IV

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	1477	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	0	sq.m	0.20
Total Catchment Area:	1477	sq.m	0.90

Water Elevation:	57.71	m
Invert of Outlet Pipe - CB-3:	56.41	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB-3)	56.46	m
Head:	1.24	m
Orifice Diameter:	107	mm
Orifice Area:	8944	sq.mm
Coefficient of Discharge:	0.61	
Maximum ICD Release Rate:	26.94	L/s
Maximum Overflow Release Rate:	0.00	L/s
Total Maximum Release Rate:	26.94	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB-4	155	0.15	7.57	cu.m

Achieved Volume:	7.57	cu.m
Maximum Volume Required:	7.57	cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Overflow from Area IV (L/s)	Total Inflow Inflow (L/s)	ICD Release Rate (L/s)	Overflow Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
5	141	52.17	0.00	52.17	26.94	0.00	25.23	7.57
10	104	38.50	0.00	38.50	26.94	0.00	11.56	6.94
15	84	30.88	0.00	30.88	26.94	0.00	3.93	3.54
20	70	25.96	0.00	25.96	25.96	0.00	0.00	0.00
25	61	22.50	0.00	22.50	22.50	0.00	0.00	0.00
30	54	19.93	0.00	19.93	19.93	0.00	0.00	0.00
35	49	17.93	0.00	17.93	17.93	0.00	0.00	0.00
40	44	16.33	0.00	16.33	16.33	0.00	0.00	0.00
45	41	15.01	0.00	15.01	15.01	0.00	0.00	0.00
50	38	13.91	0.00	13.91	13.91	0.00	0.00	0.00
55	35	12.98	0.00	12.98	12.98	0.00	0.00	0.00
60	33	12.17	0.00	12.17	12.17	0.00	0.00	0.00
65	31	11.47	0.00	11.47	11.47	0.00	0.00	0.00
70	29	10.85	0.00	10.85	10.85	0.00	0.00	0.00
75	28	10.31	0.00	10.31	10.31	0.00	0.00	0.00
80	27	9.82	0.00	9.82	9.82	0.00	0.00	0.00
85	25	9.37	0.00	9.37	9.37	0.00	0.00	0.00
90	24	8.98	0.00	8.98	8.98	0.00	0.00	0.00
95	23	8.61	0.00	8.61	8.61	0.00	0.00	0.00
100	22	8.28	0.00	8.28	8.28	0.00	0.00	0.00
105	22	7.98	0.00	7.98	7.98	0.00	0.00	0.00
110	21	7.69	0.00	7.69	7.69	0.00	0.00	0.00
115	20	7.44	0.00	7.44	7.44	0.00	0.00	0.00
120	19	7.19	0.00	7.19	7.19	0.00	0.00	0.00
125	19	6.97	0.00	6.97	6.97	0.00	0.00	0.00
130	18	6.76	0.00	6.76	6.76	0.00	0.00	0.00
135	18	6.56	0.00	6.56	6.56	0.00	0.00	0.00
140	17	6.38	0.00	6.38	6.38	0.00	0.00	0.00
145	17	6.21	0.00	6.21	6.21	0.00	0.00	0.00
150	16	6.05	0.00	6.05	6.05	0.00	0.00	0.00
180	14	5.24	0.00	5.24	5.24	0.00	0.00	0.00
210	13	4.64	0.00	4.64	4.64	0.00	0.00	0.00
240	11	4.17	0.00	4.17	4.17	0.00	0.00	0.00
270	10	3.80	0.00	3.80	3.80	0.00	0.00	0.00
300	9	3.49	0.00	3.49	3.49	0.00	0.00	0.00

D. B. GRAY ENGINEERING INC.

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

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Ottawa, Ontario K1T 4E9

613-425-8044
dbgray@rogers.com

STORM SEWER COMPUTATION FORM

PROJECT: 1479 Youville Drive

RATIONAL METHOD Q = 2.78 A I R FIVE YEAR EVENT

Designed By: DBG

n = 0.013

Date: 23-Jul-20

Page: 1 of 1

LOCATION			AREA (ha) Hard Surface	Gravel	Grass / Lands.	Roof	Individ. 2.78 A R	Accum. 2.78 A R	Time of Conc.	Rainfall Intensity I	Peak Flow Q	SEWER DATA									COMMENTS
STREET	FROM	TO	R = 0.90	R = 0.70	R = 0.20	R = 0.90			(min)	(mm/hr)	(l/s)	Type of Pipe	Dia. Actual (mm)	Dia. Nom. (mm)	Slope (%)	Length (m)	Capacity (l/s)	Velocity (m/s)	Time of Flow (min)	Ratio Q/Qfull	
	CB-1	CB/MH-2	0.0947		0.0049		0.240	0.240	10.00	104.2	25.0	PVC	254.0	250	0.43	43.7	40.7	0.80	0.91	0.61	
	CB-3	CB/MH-2	0.0663				0.166	0.166	10.00	104.2	17.3	PVC	254.0	250	0.43	16.3	40.7	0.80	0.34	0.42	
											15.6	PVC	254.0	250	0.43	16.3	40.7	0.80	0.34	0.38	FLOW THRU ICD
	CB-4	CB/MH-2	0.1477				0.370	0.370	10.00	104.2	38.5	PVC	304.8	300	0.44	20.6	66.9	0.92	0.37	0.58	
											26.9	PVC	304.8	300	0.44	20.6	66.9	0.92	0.37	0.40	FLOW THRU ICD
	CB/MH-2	1050 ST	0.1421		0.0073		0.360	1.135	10.91	99.6	113.1	PVC	381.0	375	0.65	18.0	147.5	1.29	0.23	0.77	
											58.4	PVC	381.0	375	0.65	18.0	147.5	1.29	0.23	0.40	FLOW THRU ICDs
												EXISTING MUNICPAL STORM SEWER IN YOUVILLE DRIVE									
													1066.8	1050	0.10		900.9	1.01			