STORMWATER MANAGEMENT REPORT

Cummings Avenue & Ogilvie Road
Townhouses
Ottawa, Ontario

Report No. 11041-SWM

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NOT VALID UNLESS
SIGNED & DATED

D. B. G R A Y E N G I N E E R I N G I N C.

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STORMWATER MANAGEMENT REPORT

Cummings Avenue & Ogilvie Road
Townhouses
Ottawa, Ontario

This report addresses the stormwater management requirements of an 83 unit townhouse development located on 13,250 sq.m. of land located at the south-west corner of the Cummings Avenue / Ogilvie Road intersection in Ottawa. The buildings in the proposed development are slab-on-grade construction.

This report forms part of the stormwater management design for the proposed development. Also refer to drawing SG-1 to SG-3 and SS-1 to SS-6 (Revision 1: Apr 12-12), prepared by D. B. Gray Engineering Inc.

WATER QUALITY:

During construction, an erosion and sediment control plan has been developed (see notes 2.1 to 2.5 on drawing SG-3). In summary: to filter out construction sediment a silt fence barrier will be installed along the south and east property line; and geotextile fabric will be placed between the grate and frame of all existing catch basins adjacent to the site and all new catch basins as they are installed.

WATER QUANTITY:

The stormwater quantity control measures detailed in this report are based on the criteria that the release rate for post-development storm events is equal to or less than the flow produced by a five year storm using a runoff coefficient of 0.50 and a 20 minute time of concentration.

Calculations are based on the Rational Method. The runoff coefficients for the 100 year event were increased by 25% to maximum 1.00.

Stormwater will be stored within the development in catchbasins, manholes, and sewer pipes and 38 pre-cast concrete box culvert sections (1.8 x 0.9 m (inside dimensions) x 2.5 m).

The runoff from the perimeter of the site (Drainage Area I – 2873 sq.m.) will be allowed to flow uncontrolled off the site. The flow from these areas is calculated at 20 minutes concentration.

An inlet control device (ICD) located at the outlet pipe of catch basin/manhole CB/MH-12 will control the release of stormwater off the site. The ICD will restrict the flow and force the stormwater to back up into the upstream sewer pipes, catch basin, manholes and box culvert sections. The ICD shall be a plug style with a round orifice design manufactured by Pedro Plastics (or approved equal manufactured by IPEX) and shall be sized by the manufacturer for a discharge rate of 67.66 l/s at 1.63 m head.

It is calculated that an orifice area of 19,634 sq.mm. ($\pm$158 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 67.66 l/s at a head of 1.63 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 54.02 l/s at 1.04 m.

Since the stormwater management facility is located on more than one property it is expected that a Ministry of Environment Certificate of Approval will be required.

MAXIMUM PERMITTED FLOW:

The maximum permitted flow for the subject site is calculated as follows:

Area (A):	13,2501 sq.m.
Time of Concentration (T):	20 minutes
Rainfall Intensity (Five Year Event) (i):	70 mm/hr
Runoff Coefficient (C):	0.50

Maximum Allowable Release Rate: 129.38 l/s

CONCLUSIONS:

WATER QUALITY:

An erosion and sediment control plan as been developed to be implemented during construction

WATER QUANTITY:

One Hundred Year Storm Event:
The maximum allowable release rate for the one hundred year storm event for the site is 129.38 l/s. The post-development release rate for the 100-year storm event is calculated to be 129.38 l/s. Therefore the maximum post development release rate for the 100-year storm event is equal to the maximum permitted release rate. A maximum stored volume of 277.66 cu.m. is required to achieve the post development release rate.

Five Year Storm Event:
The net maximum allowable release rate for the five year storm event for the site is 129.38 l/s. The post-development release rate for the 5-year storm event is calculated to be 85.89 l/s. Therefore the maximum post development release rate for the 5-year storm event is less than the maximum permitted release rate. A maximum stored volume of 117.11 cu.m. is required to achieve the post development release rate.

Summary Tables

ONE HUNDRED YEAR EVENT				
Drainage Area	Maximum Release Rate l/s	Maximum Allowable Release Rate l/s	Maximum Volume Stored cu.m.	Maximum Volume Required cu.m.
AREA I (Uncontrolled flow off site)	61.72	-	-	-
AREA II	67.66	-	277.66	277.66
TOTAL	129.38	129.38	277.66	277.66

FIVE YEAR EVENT				
Drainage Area	Maximum Release Rate l/s	Maximum Allowable Release Rate l/s	Maximum Volume Stored cu.m.	Maximum Volume Required cu.m.
AREA I (Uncontrolled flow off site)	31.86	-	-	-
AREA II	54.02	-	117.11	117.11
TOTAL	85.89	129.38	117.11	117.11

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 ltires 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

Calculations for sub-surface storage (manholes and sewer pipes) are based on the following formula for volume of a cylinder:

$$V = L \times Pi \times (d/2)^2$$

where:

V = volume in cu.m.
L = depth of water in manhole or length of pipe in meters
d = diameter of manhole (1.22 m) or pipe in meters

Cummings Ave & Ogilvie Rd.
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STORM WATER MANAGEMENT CALCULATIONS
Rational Method

ONE HUNDRED YEAR EVENT

Maximum Allowable Release Rate

Area (A):	13250	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	70	mm/hr (5 year event)
Runoff Coefficient (C):	0.50	
Maximum Allowable Release Rate:	129.38	l/s

DRAINAGE AREA I (Uncontrolled Flow Off Site):

			C
Roof Area:	1300	sq.m.	1.00
Asphalt/Concrete Area:	210	sq.m.	1.00
Landscaped:	1363	sq.m.	0.25
Total Catchment Area	2873	sq.m.	0.64

Area (A):	2873	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	120	mm/hr (100 year event)
Runoff Coeficient (C):	0.64	
Flow Rate (2.78AiC):	61.72	l/s

DRAINAGE AREA II

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	3610	sq.m.	1.00
Asphalt/Concrete Area:	4508	sq.m.	1.00
Landscaped:	2285	sq.m.	0.25
Total Catchment Area	10403	sq.m.	0.84

Water Elevation: 69.05 m

ICD Invert: 67.42 m
(Outlet Pipe of CB/MH-12)

Head: 1.63 m

Orifice Diameter 158 mm

Orifice Area: 19634 sq.mm.

Coefficient of Discharge: 0.610

Max. Release Rate: 67.66 l/s

Storage in MH's & CB's

	Invert m	Depth m		
CB/MH-12	67.42	1.63	1.84	cu.m.
CB/MH-13	68.03	1.02	1.15	cu.m.
CB/MH-14	68.18	0.87	0.98	cu.m.
CB-15	68.26	0.79	0.28	cu.m.
CB/MH-19	68.01	1.04	1.17	cu.m.
CB/MH-21	68.07	0.98	1.10	cu.m.
CB/MH-23	68.19	0.86	0.97	cu.m.
CB/MH-29	68.05	1.00	1.13	cu.m.
CB/MH-30	68.32	0.73	0.82	cu.m.
CB/MH-31	68.37	0.68	0.77	cu.m.
CB/MH-32	68.37	0.68	0.77	cu.m.
CB/MH-33	68.51	0.54	0.61	cu.m.
CB/MH-34	68.60	0.45	0.51	cu.m.
CB-36	68.65	0.40	0.14	cu.m.
CB/MH-37	68.62	0.43	0.48	cu.m.
CB-37A	68.66	0.39	0.14	cu.m.
CB-39	68.83	0.22	0.08	cu.m.
CB-41	68.32	0.73	0.26	cu.m.

Storage in Box Culverts (0.9 x 1.8 x 2.5m)

Number	Length m	Average Depth m		
14	35	0.90	56.7	cu.m.
8	20	0.90	32.4	cu.m.
8	20	0.90	32.4	cu.m.
8	20	0.90	32.4	cu.m.

Storage in Sewer Pipes

	Diam. mm	Length m		
	250	20.3	1.00	cu.m.
	450	90.2	14.35	cu.m.
	600	336.8	95.23	cu.m.

Achieved Vol: 277.66 cu.m.

Max. Vol. Required: 277.66 cu.m.

DRAINAGE AREA II (continued)

(ONE HUNDRED YEAR EVENT)

Time	i	2.78AiC	Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	cu.m.
5	243	586.28	67.66	518.62	155.59
10	179	431.33	67.66	363.67	218.20
15	143	345.18	67.66	277.52	249.76
20	120	289.75	67.66	222.09	266.51
25	104	250.85	67.66	183.19	274.79
30	92	221.92	67.66	154.26	277.66
35	83	199.48	67.66	131.82	276.82
40	75	181.52	67.66	113.86	273.27
45	69	166.80	67.66	99.14	267.67
50	64	154.49	67.66	86.83	260.48
55	60	144.03	67.66	76.37	252.01
60	56	135.02	67.66	67.36	242.49
65	53	127.17	67.66	59.51	232.10
70	50	120.27	67.66	52.61	220.97
75	47	114.15	67.66	46.49	209.21
80	45	108.68	67.66	41.02	196.90
85	43	103.76	67.66	36.10	184.11
90	41	99.31	67.66	31.65	170.90
95	39	95.26	67.66	27.60	157.31
100	38	91.56	67.66	23.90	143.39
105	36	88.16	67.66	20.50	129.17
110	35	85.04	67.66	17.38	114.68
115	34	82.14	67.66	14.48	99.93
120	33	79.46	67.66	11.80	84.97
125	32	76.97	67.66	9.31	69.79
130	31	74.64	67.66	6.98	54.43
135	30	72.46	67.66	4.80	38.88
140	29	70.42	67.66	2.76	23.18
145	28	68.50	67.66	0.84	7.32
150	28	66.70	66.70	0.00	0.00
180	24	57.74	57.74	0.00	0.00
210	21	51.08	51.08	0.00	0.00
240	19	45.91	45.91	0.00	0.00
270	17	41.78	41.78	0.00	0.00
300	16	38.39	38.39	0.00	0.00

FIVE YEAR EVENT

Maximum Allowable Release Rate

Area (A):	13250	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	70	mm/hr (5 year event)
Runoff Coefficient (C):	0.50	
Maximum Allowable Release Rate:	129.38	l/s

DRAINAGE AREA I (Uncontrolled Flow Off Site):

			C
Roof Area:	1300	sq.m.	0.90
Asphalt/Concrete Area:	210	sq.m.	0.90
Landscaped:	1363	sq.m.	0.20
Total Catchment Area	2873	sq.m.	0.57

Area (A):	2873	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	70	mm/hr (5 year event)
Runoff Coeficient (C):	0.57	
Flow Rate (2.78AiC):	31.86	l/s

DRAINAGE AREA II

(FIVE YEAR EVENT)

			C
Roof Area:	3610	sq.m.	0.90
Asphalt/Concrete Area:	4508	sq.m.	0.90
Landscaped:	2285	sq.m.	0.20
Total Catchment Area	10403	sq.m.	0.75

Water Elevation: 68.46 m

ICD Invert: 67.42 m
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Head: 1.04 m

Orifice Diameter 158 mm

Orifice Area: 19634 sq.mm.

Coefficient of Discharge: 0.610

Max. Release Rate: 54.02 l/s

Storage in MH's & CB's

	Invert m	Depth m		
CB/MH-12	67.42	1.04	1.17	cu.m.
CB/MH-13	68.03	0.43	0.48	cu.m.
CB/MH-14	68.18	0.28	0.31	cu.m.
CB-15	68.26	0.20	0.07	cu.m.
CB/MH-19	68.01	0.45	0.51	cu.m.
CB/MH-21	68.07	0.39	0.44	cu.m.
CB/MH-23	68.19	0.27	0.30	cu.m.
CB/MH-29	68.05	0.41	0.46	cu.m.
CB/MH-30	68.32	0.14	0.15	cu.m.
CB/MH-31	68.37	0.09	0.10	cu.m.
CB/MH-32	68.37	0.09	0.10	cu.m.
CB/MH-33	68.51	0.00	0.00	cu.m.
CB/MH-34	68.60	0.00	0.00	cu.m.
CB-36	68.65	0.00	0.00	cu.m.
CB/MH-37	68.62	0.00	0.00	cu.m.
CB-37A	68.66	0.00	0.00	cu.m.
CB-39	68.83	0.00	0.00	cu.m.
CB-41	68.32	0.14	0.05	cu.m.

Storage in Box Culverts (0.9 x 1.8 x 2.5m)

Number	Length m	Average Depth m		
14	35	0.34	21.23	cu.m.
8	20	0.35	12.67	cu.m.
8	20	0.34	12.31	cu.m.
8	20	0.33	11.95	cu.m.

Storage in Sewer Pipes

Diam. mm	Length m		
250	20.3	0.00	cu.m.
450	90.2	7.17	cu.m.
600	336.8	47.61	cu.m.

Achieved Vol: 117.11 cu.m.

Max. Vol. Required: 117.11 cu.m.

DRAINAGE AREA II (continued)

(FIVE YEAR EVENT)

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	304.69	54.02	250.66	75.20
10	104	224.87	54.02	170.84	102.51
15	84	180.33	54.02	126.31	113.68
20	70	151.61	54.02	97.59	117.11
25	61	131.42	54.02	77.40	116.10
30	54	116.38	54.02	62.36	112.25
35	49	104.71	54.02	50.68	106.44
40	44	95.36	54.02	41.33	99.20
45	41	87.68	54.02	33.66	90.88
50	38	81.26	54.02	27.24	81.71
55	35	75.80	54.02	21.78	71.87
60	33	71.10	54.02	17.07	61.46
65	31	67.00	54.02	12.97	50.60
70	29	63.39	54.02	9.37	39.34
75	28	60.19	54.02	6.16	27.74
80	27	57.33	54.02	3.30	15.85
85	25	54.75	54.02	0.73	3.70
90	24	52.42	52.42	0.00	0.00
95	23	50.30	50.30	0.00	0.00
100	22	48.36	48.36	0.00	0.00
105	22	46.58	46.58	0.00	0.00
110	21	44.94	44.94	0.00	0.00
115	20	43.42	43.42	0.00	0.00
120	19	42.01	42.01	0.00	0.00
125	19	40.70	40.70	0.00	0.00
130	18	39.48	39.48	0.00	0.00
135	18	38.34	38.34	0.00	0.00
140	17	37.27	37.27	0.00	0.00
145	17	36.26	36.26	0.00	0.00
150	16	35.31	35.31	0.00	0.00
180	14	30.60	30.60	0.00	0.00
210	13	27.10	27.10	0.00	0.00
240	11	24.38	24.38	0.00	0.00
270	10	22.20	22.20	0.00	0.00
300	9	20.41	20.41	0.00	0.00