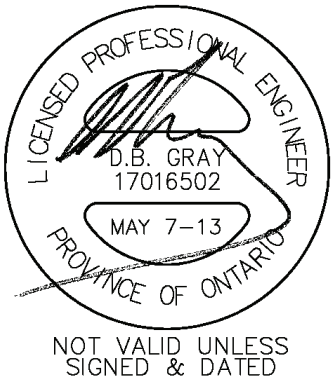
STORMWATER MANAGEMENT REPORT

1003 Prince of Wales Drive
Ottawa, Ontario

Report No. 12069-SWM

May 7, 2013



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STORMWATER MANAGEMENT REPORT

1003 Prince of Wales Drive
Ottawa, Ontario

This report addresses the stormwater management requirements of a proposed seven lot residential development consisting of detached houses. It will be a freehold development with common elements located on 2178 sq.m. of land at 1003 Prince of Wales Drive in Ottawa. The subject property is adjacent to an existing residential development to the south. A small area of these lands currently drain onto the subject property and will be allowed to continue to do so. There is an open field to the north and to the east is approximately 55 m of wooded and grassed lands between the subject property and the Rideau Canal. The total drainage area is 2404 sq.m. The runoff from the approximately 15% of the drainage area currently drains to the roadside ditch which conveys the stormwater to the open field to the north. Approximately 30% of the property drains directly to the open field and the remainder drains to the wooded area to the east. All runoff from the subject property ultimately drains to the canal.

This report forms part of the stormwater management design for the proposed development. Also refer to drawing SG-1, SG-2, SS-1 and SS-2, prepared by D. B. Gray Engineering Inc.

WATER QUALITY:

Rainfall runoff from approximately 76% of the drainage area (Drainage Area III) will be controlled by an inlet control device and a weir to 18.5 l/s during the 1:100 year event. This controlled flow will drain to a swale behind a 24 m wide grassed level spreader which will evenly distribute the flow across the 55 m of wooded and grassed lands between the subject property and the Rideau Canal. When flow across a vegetative filter strip is restricted to 1 litre per second per metre width, a filter strip 5 m long is 60% (fine particles) to greater than 95% (coarse particles) effective in the removal of sediment (Effectiveness of Vegetative Filter Strips in Removal of Sediments from Overland Flow, Ghawabaghi & Rudra/University of Guelph and Goel/MOE). It is estimated that a vegetated filter strip designed to the above criteria has an overall 80% effectiveness in the removal of TSS. The proposed level spreader, evenly distributing the flow across the 55 m of wooded and grassed lands, is expected to have greater than 80% effectiveness.

The remaining areas will drain across the open field to the north. The flow will travel at least 55 m before reaching the canal. As such, the effectiveness in the removal of TSS is expected to be greater than 80%.

During construction, an erosion and sediment control plan has been developed (see notes 2.1 to 2.4 on drawing SG-1). In summary: to filter out construction sediment a silt fence barrier will be installed along the property line (except where the adjacent lands are at a

higher elevation); and a 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 the pre-development conditions.

As recommended in City of Ottawa Technical Bulletin ISDTB-2012-1, the drainage system has been "stress tested" using design storms calculated on the basis of a 20% increase of the City's 1:100 year IDF curve rainfall values. The purpose of the stress test is to identify potential flooding of properties and, if necessary, to modify the proposed drainage system to prevent the flooding.

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

During the 1:5 year event an inlet control device (ICD) located at the outlet pipe of manhole MH-6 will control the release of stormwater off the site. During the 1:100 year event, in addition to the ICD, a weir (a retaining wall) will also control the flow. The ICD will restrict the flow and force the stormwater to back up into the stormwater detention areas and upstream sewer pipes, catch basin and manholes. 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 13.98 l/s at 0.30 m head.

It is calculated that an orifice area of 9496 sq.mm. ($\pm$110 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 13.98 l/s at a head of 0.30 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 9.14 l/s at 0.13 m.

Stress Test:
The maximum ponding elevation in the detention area is reached during the 1:100-year event. Above this elevation, stormwater flows over the weir (retaining wall). The maximum flowrate off the site will increase by about 47% from 26.43 to 38.78 l/s but it will be less than the pre-development flow of 39.67 l/s. There are no potential flooding issues and therefore the proposed drainage system does not need to be modified.

Since the proposed services are located on more than one property it is expected that a Ministry of Environment Environmental Compliance Approval (ECA) will be required.

CONCLUSIONS:

WATER QUALITY:

The proposed grassed level spreader will evenly distribute the flow across the 55 m of wooded and grassed lands between the subject property and the Rideau Canal. It is estimated that this vegetated filter strip has at least an overall 80% effectiveness in the removal of TSS.

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 33.05 l/s. The post-development release rate for the 100-year storm event is calculated to be 26.43 l/s. Therefore the maximum post development release rate for the 100-year storm event is only 80% of the maximum allowable release rate. A maximum stored volume of 35.13 cu.m. is required to achieve the post development release rate.

Five Year Storm Event:
The maximum allowable release rate for the five year storm event for the site is 16.56 l/s. The post-development release rate for the 5-year storm event is calculated to be 13.12 l/s. Therefore the maximum post development release rate for the 5-year storm event is only 79%of the maximum allowable release rate. A maximum stored volume of 18.92 cu.m. is required to achieve the post development release rate.

Stress Test:
Increasing the 1:100 year IDF rainfall values by 20% does not identify any potential flooding issues and therefore the proposed drainage system does not need to be modified.

Summary Table

ONE HUNDRED YEAR EVENT				
Drainage Area	Pre-development Flow l/s	Post-development Flow l/s	Volumes Required cu.m.	Achieved Volumes cu.m.
AREA A (Flow to Roadside Ditch)	7.65	-	-	-
AREA I (Uncontrolled Flow to Roadside Ditch)	-	1.03	-	-
AREA B (Flow to Undeveloped Lands to the North & East)	25.40	-	-	-
AREA II (Uncontrolled Flow to Undeveloped Lands to the North & East)	-	6.93	-	-
AREA III (Controlled Flow to Undeveloped Lands to the North & East)	-	18.47	35.13	35.13
TOTAL (Undeveloped Lands to the North & East)	25.40	25.40	35.13	35.13
TOTAL (Site)	33.05	26.43	35.13	35.13

Summary Table

FIVE YEAR EVENT				
Drainage Area	Pre-development Flow l/s	Post-development Flow l/s	Volumes Required cu.m.	Achieved Volumes cu.m.
AREA A (Flow to Roadside Ditch)	3.92	-	-	-
AREA I (Uncontrolled Flow to Roadside Ditch)	-	0.48	-	-
AREA B (Flow to Undeveloped Lands to the North & East)	12.64	-	-	-
AREA II (Uncontrolled Flow to Undeveloped Lands to the North & East)	-	3.49	-	-
AREA III (Controlled Flow to Undeveloped Lands to the North & East)	-	9.14	18.92	18.92
TOTAL (Undeveloped Lands to the North & East)	12.64	12.64	18.92	18.92
TOTAL (Site)	16.56	13.12	18.92	18.92

Summary Table

STRESS TEST - 20% INCREASE TO ONE HUNDRED YEAR EVENT RAINFALL				
Drainage Area	Pre-development Flow l/s	Post-development Flow l/s	Volumes Required cu.m.	Achieved Volumes cu.m.
AREA A (Flow to Roadside Ditch)	9.18	-	-	-
AREA I (Uncontrolled Flow to Roadside Ditch)	-	1.24	-	-
AREA B (Flow to Undeveloped Lands to the North & East)	30.48	-	-	-
AREA II (Uncontrolled Flow to Undeveloped Lands to the North & East)	-	8.31	-	-
AREA III (Controlled Flow to Undeveloped Lands to the North & East)	-	29.22	35.13	35.13
TOTAL (Undeveloped Lands to the North & East)	30.48	37.54	35.13	35.13
TOTAL (Site)	39.67	38.78	35.13	35.13

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 for the stormwater detention area are based on the following formula for volume of a prismodal shape (the formula is accurate if both length and width are changing proportionally):

$$V = (A_{top} + A_{bottom} + (A_{top} \times A_{bottom})^{0.5}) / 3 \times d$$

where:

V = volume in cu.m.
A_{top} = area of pond in sq.m.
A_{bottom} = area of bottom of depressed area
d = ponding depth 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

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STORM WATER MANAGEMENT CALCULATIONS
Quantity Control

Rational Method

ONE HUNDRED YEAR EVENT

PRE-DEVELOPMENT FLOW TO ROADSIDE DITCH (DRAINAGE AREA A)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	173	sq.m.	1.00
Landscaped Area:	226	sq.m.	0.25
Total Catchment Area	399	sq.m.	0.58
Area (A):	399	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	120	mm/hr (Ottawa IDF Curves - 100 Year Event)	
Runoff Coeficient (C):	0.58		
Flow Rate (2.78AiC):	7.65	l/s	

POST-DEVELOPMENT FLOW TO ROADSIDE DITCH (DRAINAGE AREA I)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	0	sq.m.	1.00
Landscaped Area:	124	sq.m.	0.25
Total Catchment Area	124	sq.m.	0.25
Area (A):	124	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	120	mm/hr (Ottawa IDF Curves - 100 Year Event)	
Runoff Coeficient (C):	0.25		
Flow Rate (2.78AiC):	1.03	l/s	

ONE HUNDRED YEAR EVENT

PRE-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST
(DRAINAGE AREA B)

			C
Roof Area:	197	sq.m.	1.00
Asphalt/Concrete Area:	181	sq.m.	1.00
Landscaped Area:	1535	sq.m.	0.25
Total Catchment Area	1913	sq.m.	0.40
Area (A):	1913	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	120	mm/hr (Ottawa IDF Curves - 100 Year Event)	
Runoff Coeficient (C):	0.40		
Flow Rate (2.78AiC):	25.40	l/s	

POST-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST

DRAINAGE AREA II:
(Uncontrolled Flow):

			C
Roof Area:	126	sq.m.	1.00
Asphalt/Concrete Area:	0	sq.m.	1.00
Landscaped Area:	327	sq.m.	0.25
Total Catchment Area	453	sq.m.	0.46
Area (A):	453	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	120	mm/hr (Ottawa IDF Curves - 100 Year Event)	
Runoff Coeficient (C):	0.46		
Flow Rate (2.78AiC):	6.93	l/s	

POST-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST

DRAINAGE AREA III
(ONE HUNDRED-YEAR EVENT)

			C
Roof Area:	471	sq.m.	1.00
Asphalt/Concrete Area:	829	sq.m.	1.00
Landscaped Area:	527	sq.m.	0.25
Total Catchment Area	1827	sq.m.	0.78

Water Elevation: 72.65 m

Top of Level Spreader 72.35 m

ICD Elevation: 72.05 m
(Outlet Pipe of MH-6)

Head: 0.30 m
(water elevation - top of level spreader elevation)

Orifice Diameter 110 mm

Orifice Area: 9496 sq.mm.

Coefficient of Discharge: 0.610

Storage in MH's & CB's

	Invert m	Depth m		
MH-6	72.05	0.60	0.67	cu.m.
CB/MH-4	72.19	0.46	0.66	cu.m.
MH-5	72.27	0.38	0.54	cu.m.
CB/MH-3	72.29	0.36	0.51	cu.m.
CB/MH-2	72.40	0.25	0.36	cu.m.

Storage in Sewer Pipes

Diam. mm	Length m		
300	21.2	1.46	cu.m.
300	4.9	0.26	cu.m.
300	13.0	0.83	cu.m.
300	13.9	0.85	cu.m.

Surface Storage Detention Area

Bottom Area sq.m.	Top Area sq.m.	Ave. Depth m		
45	99	0.41	28.98	cu.m.

Max. ICD Release Rate: 13.98 l/s
Max. Weir Release Rate: 4.49 l/s

Max. Release Rate: 18.47 l/s

Achieved Vol: 35.13 cu.m.

Max. Vol. Required: 35.13 cu.m.

DRAINAGE AREA III (continued)

(ONE HUNDRED-YEAR EVENT)

Time	i	2.78AiC	ICD Release Rate	Weir 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	243	96.60	13.98	0.00	13.98	82.62	24.79
10	179	71.07	13.98	0.00	13.98	57.09	34.26
15	143	56.88	13.98	3.87	17.85	39.03	35.13
20	120	47.74	13.98	4.49	18.47	29.27	35.13
25	104	41.33	13.98	3.94	17.92	23.42	35.13
30	92	36.57	13.98	3.07	17.05	19.51	35.13
35	83	32.87	13.98	2.16	16.14	16.73	35.13
40	75	29.91	13.98	1.29	15.27	14.64	35.13
45	69	27.48	13.98	0.49	14.47	13.01	35.13
50	64	25.46	13.98	0.00	13.98	11.48	34.43
55	60	23.73	13.98	0.00	13.98	9.75	32.18
60	56	22.25	13.98	0.00	13.98	8.27	29.76
65	53	20.95	13.98	0.00	13.98	6.98	27.20
70	50	19.82	13.98	0.00	13.98	5.84	24.52
75	47	18.81	13.98	0.00	13.98	4.83	21.73
80	45	17.91	13.98	0.00	13.98	3.93	18.85
85	43	17.10	13.98	0.00	13.98	3.12	15.90
90	41	16.36	13.98	0.00	13.98	2.38	12.87
95	39	15.70	13.98	0.00	13.98	1.72	9.78
100	38	15.09	13.98	0.00	13.98	1.11	6.64
105	36	14.53	13.98	0.00	13.98	0.55	3.45
110	35	14.01	13.98	0.00	13.98	0.03	0.21
115	34	13.54	13.54	0.00	13.54	0.00	0.00
120	33	13.09	13.09	0.00	13.09	0.00	0.00
125	32	12.68	12.68	0.00	12.68	0.00	0.00
130	31	12.30	12.30	0.00	12.30	0.00	0.00
135	30	11.94	11.94	0.00	11.94	0.00	0.00
140	29	11.60	11.60	0.00	11.60	0.00	0.00
145	28	11.29	11.29	0.00	11.29	0.00	0.00
150	28	10.99	10.99	0.00	10.99	0.00	0.00
180	24	9.51	9.51	0.00	9.51	0.00	0.00
210	21	8.42	8.42	0.00	8.42	0.00	0.00
240	19	7.56	7.56	0.00	7.56	0.00	0.00
270	17	6.88	6.88	0.00	6.88	0.00	0.00
300	16	6.33	6.33	0.00	6.33	0.00	0.00

FIVE YEAR EVENT

PRE-DEVELOPMENT FLOW TO ROADSIDE DITCH (DRAINAGE AREA A)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	173	sq.m.	0.90
Landscaped Area:	226	sq.m.	0.20
Total Catchment Area	399	sq.m.	0.50
Area (A):	399	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	70	mm/hr (Ottawa IDF Curves - 5 Year Event)	
Runoff Coeficient (C):	0.50		
Flow Rate (2.78AiC):	3.92	l/s	

POST-DEVELOPMENT FLOW TO ROADSIDE DITCH (DRAINAGE AREA I)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Landscaped Area:	124	sq.m.	0.20
Total Catchment Area	124	sq.m.	0.20
Area (A):	124	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	70	mm/hr (Ottawa IDF Curves - 5 Year Event)	
Runoff Coeficient (C):	0.20		
Flow Rate (2.78AiC):	0.48	l/s	

FIVE YEAR EVENT

PRE-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST
(DRAINAGE AREA B)

			C
Roof Area:	197	sq.m.	0.90
Asphalt/Concrete Area:	181	sq.m.	0.90
Landscaped Area:	1535	sq.m.	0.20
Total Catchment Area	1913	sq.m.	0.34
Area (A):	1913	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	70	mm/hr (Ottawa IDF Curves - 5 Year Event)	
Runoff Coeficient (C):	0.34		
Flow Rate (2.78AiC):	12.64	l/s	

POST-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST

DRAINAGE AREA II:
(Uncontrolled Flow):

			C
Roof Area:	126	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Landscaped Area:	327	sq.m.	0.20
Total Catchment Area	453	sq.m.	0.39
Area (A):	453	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	70	mm/hr (Ottawa IDF Curves - 5 Year Event)	
Runoff Coeficient (C):	0.39		
Flow Rate (2.78AiC):	3.49	l/s	

POST-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST

DRAINAGE AREA III
(FIVE-YEAR EVENT)

			C
Roof Area:	471	sq.m.	0.90
Asphalt/Concrete Area:	829	sq.m.	0.90
Landscaped Area:	527	sq.m.	0.20
Total Catchment Area	1827	sq.m.	0.70

Water Elevation:	72.48	m
Top of Level Spreader	72.35	m
ICD Elevation: (Outlet Pipe of MH-6)	72.05	m
Head: (water elevation - top of level spreader elevation)	0.13	m
Orifice Diameter	110	mm
Orifice Area:	9496	sq.mm.
Coefficient of Discharge:	0.610	
Max. ICD Release Rate:	9.14	l/s

Storage in MH's & CB's

	Invert m	Depth m		
MH-6	72.05	0.43	0.48	cu.m.
CB/MH-4	72.19	0.29	0.41	cu.m.
MH-5	72.27	0.21	0.30	cu.m.
CB/MH-3	72.29	0.19	0.27	cu.m.
CB/MH-2	72.40	0.08	0.11	cu.m.

Storage in Sewer Pipes

Diam. mm	Length m		
300	21.2	1.46	cu.m.
300	4.9	0.20	cu.m.
300	13.0	0.63	cu.m.
300	13.9	0.27	cu.m.

Surface Storage Detention Area

Bottom Area sq.m.	Top Area sq.m.	Ave. Depth m		
45	78	0.24	14.79	cu.m.

Achieved Vol: 18.92 cu.m.

Max. Vol. Required: 18.92 cu.m.

DRAINAGE AREA III (continued)

(FIVE-YEAR EVENT)

Time min.	i mm/hr	2.78AiC l/s	ICD Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	50.06	9.14	40.91	12.27
10	104	36.94	9.14	27.80	16.68
15	84	29.63	9.14	20.48	18.43
20	70	24.91	9.14	15.76	18.92
25	61	21.59	9.14	12.45	18.67
30	54	19.12	9.14	9.98	17.96
35	49	17.20	9.14	8.06	16.92
40	44	15.67	9.14	6.52	15.65
45	41	14.41	9.14	5.26	14.21
50	38	13.35	9.14	4.21	12.62
55	35	12.45	9.14	3.31	10.92
60	33	11.68	9.14	2.54	9.13
65	31	11.01	9.14	1.86	7.27
70	29	10.41	9.14	1.27	5.34
75	28	9.89	9.14	0.74	3.35
80	27	9.42	9.14	0.27	1.32
85	25	8.99	8.99	0.00	0.00
90	24	8.61	8.61	0.00	0.00
95	23	8.26	8.26	0.00	0.00
100	22	7.94	7.94	0.00	0.00
105	22	7.65	7.65	0.00	0.00
110	21	7.38	7.38	0.00	0.00
115	20	7.13	7.13	0.00	0.00
120	19	6.90	6.90	0.00	0.00
125	19	6.69	6.69	0.00	0.00
130	18	6.49	6.49	0.00	0.00
135	18	6.30	6.30	0.00	0.00
140	17	6.12	6.12	0.00	0.00
145	17	5.96	5.96	0.00	0.00
150	16	5.80	5.80	0.00	0.00
180	14	5.03	5.03	0.00	0.00
210	13	4.45	4.45	0.00	0.00
240	11	4.00	4.00	0.00	0.00
270	10	3.65	3.65	0.00	0.00
300	9	3.35	3.35	0.00	0.00

STRESS TEST - 20% INCREASE TO ONE HUNDRED YEAR EVENT RAINFALL

PRE-DEVELOPMENT FLOW TO ROADSIDE DITCH (DRAINAGE AREA A)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	173	sq.m.	1.00
Landscaped Area:	226	sq.m.	0.25
Total Catchment Area	399	sq.m.	0.58
Area (A):	399	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	144	mm/hr (Ottawa IDF Curves - 120% of 100 Year Event)	
Runoff Coeficient (C):	0.58		
Flow Rate (2.78AiC):	9.18	l/s	

POST-DEVELOPMENT FLOW TO ROADSIDE DITCH (DRAINAGE AREA I)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	0	sq.m.	1.00
Landscaped Area:	124	sq.m.	0.25
Total Catchment Area	124	sq.m.	0.25
Area (A):	124	sq.m.	
Time of Concentration:	20	min.	
Rainfall Intensity (i):	144	mm/hr (Ottawa IDF Curves - 120% of 100 Year Event)	
Runoff Coeficient (C):	0.25		
Flow Rate (2.78AiC):	1.24	l/s	

STRESS TEST - 20% INCREASE TO ONE HUNDRED YEAR EVENT RAINFALL

PRE-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST
(DRAINAGE AREA B)

			C
Roof Area:	197	sq.m.	1.00
Asphalt/Concrete Area:	181	sq.m.	1.00
Landscaped Area:	1535	sq.m.	0.25
Total Catchment Area	1913	sq.m.	0.40

Area (A):	1913	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	144	mm/hr (Ottawa IDF Curves - 120% of 100 Year Event)
Runoff Coeficient (C):	0.40	
Flow Rate (2.78AiC):	30.48	l/s

POST-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST

DRAINAGE AREA II:
(Uncontrolled Flow):

			C
Roof Area:	126	sq.m.	1.00
Asphalt/Concrete Area:	0	sq.m.	1.00
Landscaped Area:	327	sq.m.	0.25
Total Catchment Area	453	sq.m.	0.46

Area (A):	453	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	144	mm/hr (Ottawa IDF Curves - 120% of 100 Year Event)
Runoff Coeficient (C):	0.46	
Flow Rate (2.78AiC):	8.31	l/s

POST-DEVELOPMENT FLOW
TO UNDEVELOPED LANDS TO THE NORTH & EAST

DRAINAGE AREA III
(STRESS TEST)

			C
Roof Area:	471	sq.m.	1.00
Asphalt/Concrete Area:	829	sq.m.	1.00
Landscaped Area:	527	sq.m.	0.25
Total Catchment Area	1827	sq.m.	0.78

Water Elevation:	72.65	m
Top of Level Spreader	72.35	m
ICD Elevation: (Outlet Pipe of MH-6)	72.05	m
Head: (water elevation - top of level spreader elevation)	0.30	m
Orifice Diameter	110	mm
Orifice Area:	9496	sq.mm.
Coefficient of Discharge:	0.610	

Storage in MH's & CB's

	Invert m	Depth m		
MH-6	72.05	0.60	0.67	cu.m.
CB/MH-4	72.19	0.46	0.66	cu.m.
MH-5	72.27	0.38	0.54	cu.m.
CB/MH-3	72.29	0.36	0.51	cu.m.
CB/MH-2	72.40	0.25	0.36	cu.m.

Storage in Sewer Pipes

Diam. mm	Length m		
300	21.2	1.46	cu.m.
300	4.9	0.26	cu.m.
300	13.0	0.83	cu.m.
300	13.9	0.85	cu.m.

Surface Storage Detention Area

Bottom Area sq.m.	Top Area sq.m.	Ave. Depth m		
45	99	0.41	28.98	cu.m.

Max. ICD Release Rate:	13.98	l/s	Achieved Vol:	35.13	cu.m.
Max. Weir Release Rate:	15.24	l/s			
Max. Release Rate:	29.22	l/s	Max. Vol. Required:	35.13	cu.m.

DRAINAGE AREA III (continued)

(STRESS TEST)

Time min.	i mm/hr	2.78AiC l/s	ICD Release Rate l/s	Weir Release Rate l/s	TOTAL Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	291	115.92	13.98	0.00	13.98	101.94	30.58
10	214	85.29	13.98	12.76	26.74	58.54	35.13
15	171	68.25	13.98	15.24	29.22	39.03	35.13
20	144	57.29	13.98	14.04	28.02	29.27	35.13
25	125	49.60	13.98	12.20	26.18	23.42	35.13
30	110	43.88	13.98	10.39	24.36	19.51	35.13
35	99	39.44	13.98	8.74	22.72	16.73	35.13
40	90	35.89	13.98	7.28	21.26	14.64	35.13
45	83	32.98	13.98	5.99	19.97	13.01	35.13
50	77	30.55	13.98	4.86	18.84	11.71	35.13
55	72	28.48	13.98	3.85	17.83	10.64	35.13
60	67	26.70	13.98	2.96	16.94	9.76	35.13
65	63	25.15	13.98	2.16	16.14	9.01	35.13
70	60	23.78	13.98	1.44	15.42	8.36	35.13
75	57	22.57	13.98	0.79	14.76	7.81	35.13
80	54	21.49	13.98	0.19	14.17	7.32	35.13
85	52	20.52	13.98	0.00	13.98	6.54	33.34
90	49	19.64	13.98	0.00	13.98	5.66	30.54
95	47	18.84	13.98	0.00	13.98	4.86	27.68
100	45	18.10	13.98	0.00	13.98	4.12	24.74
105	44	17.43	13.98	0.00	13.98	3.45	21.75
110	42	16.81	13.98	0.00	13.98	2.83	18.71
115	41	16.24	13.98	0.00	13.98	2.26	15.61
120	39	15.71	13.98	0.00	13.98	1.73	12.47
125	38	15.22	13.98	0.00	13.98	1.24	9.29
130	37	14.76	13.98	0.00	13.98	0.78	6.07
135	36	14.33	13.98	0.00	13.98	0.35	2.82
140	35	13.92	13.92	0.00	13.92	0.00	0.00
145	34	13.54	13.54	0.00	13.54	0.00	0.00
150	33	13.19	13.19	0.00	13.19	0.00	0.00
180	29	11.42	11.42	0.00	11.42	0.00	0.00
210	25	10.10	10.10	0.00	10.10	0.00	0.00
240	23	9.08	9.08	0.00	9.08	0.00	0.00
270	21	8.26	8.26	0.00	8.26	0.00	0.00
300	19	7.59	7.59	0.00	7.59	0.00	0.00

7-May-13

1003 Prince of Wales Drive
Ottawa, Ontario

BROAD CRESTED WEIR CALCULATIONS

1:100 YEAR EVENT

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

if Q=	4.49	l/s (maximum flow)	
=	0.00449	cu.m./s	assumes Cd= 0.57735
& H=	0.003	m (max. depth of water above top of weir)	
then L=	20.0	m (length of weir) L = (Q / ((1.705 x H^(3/2))	(assumes P/H is large)

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

if P=	0.36	m (depth of pond)
& Lp=	23.7	m (width of pond: perpendicular to direction of flow)
then Vp=	0.0005	m/s (velocity in pond: Vp = Q / (P+H) / Lp)
& E=	0.002590	m (energy: E = H + 2V^2/2g)
& Cd=	0.577	(Cd = 0.577 x (E/H)^(3/2))

if Q=	4.49	l/s (maximum permited flow)
=	0.00449	cu.m./s
& H=	0.003	m (depth of water above top of weir)
then L=	20.0	m (length of weir) L = (Q / ((Cd^(2/3) x (2x9.81)^(1/2) x H^(3/2))

STRESS TEST

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

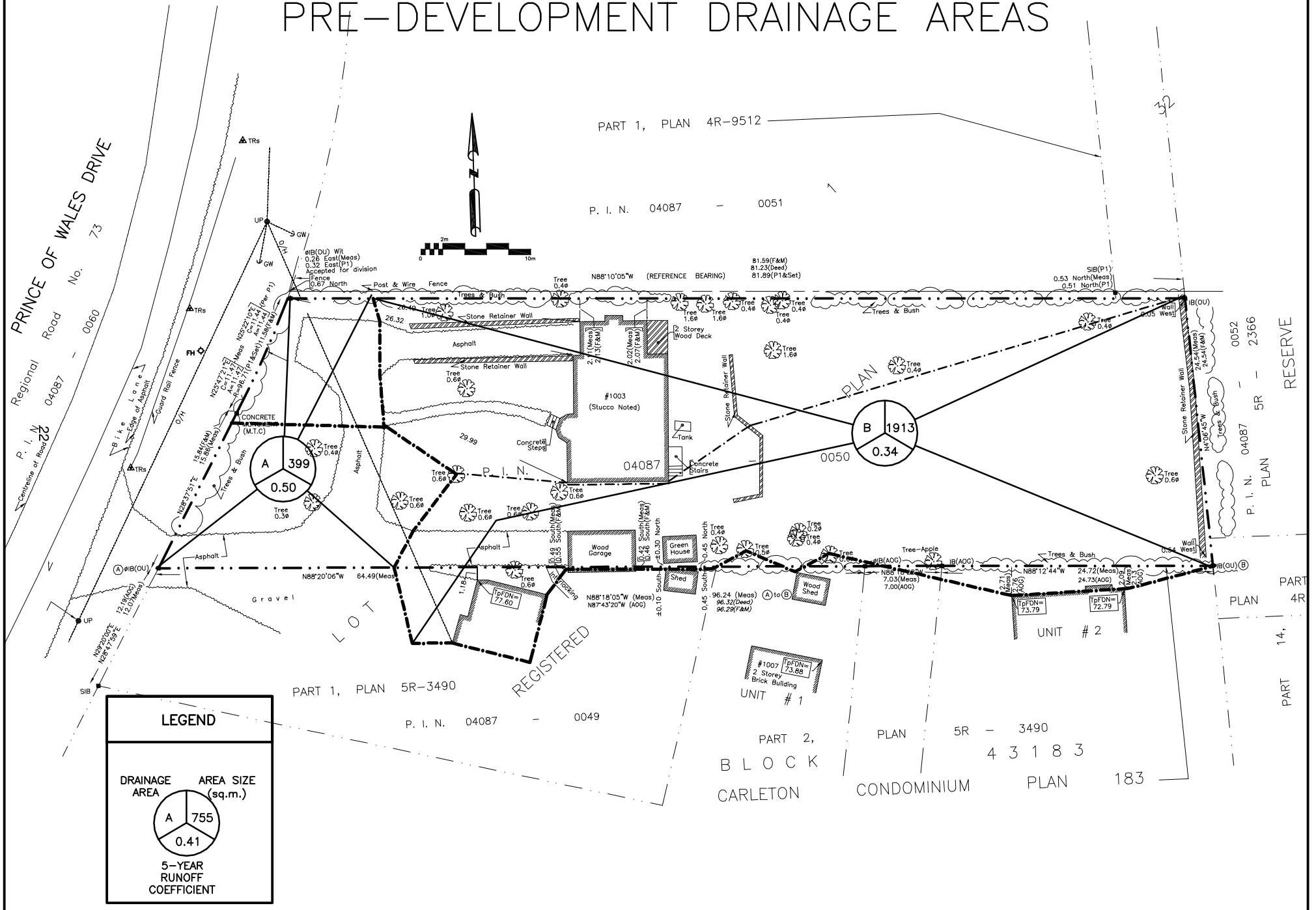
if Q=	15.24	l/s (maximum flow)	
=	0.01524	cu.m./s	assumes Cd= 0.57735
& H=	0.006	m (max. depth of water above top of weir)	
then L=	20.0	m (length of weir) L = (Q / ((1.705 x H^(3/2))	(assumes P/H is large)

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

if P=	0.36	m (depth of pond)
& Lp=	23.7	m (width of pond: perpendicular to direction of flow)
then Vp=	0.0018	m/s (velocity in pond: Vp = Q / (P+H) / Lp)
& E=	0.005850	m (energy: E = H + 2V^2/2g)
& Cd=	0.577	(Cd = 0.577 x (E/H)^(3/2))

if Q=	15.24	l/s (maximum permited flow)
=	0.01524	cu.m./s
& H=	0.006	m (depth of water above top of weir)
then L=	20.0	m (length of weir) L = (Q / ((Cd^(2/3) x (2x9.81)^(1/2) x H^(3/2))

PRE-DEVELOPMENT DRAINAGE AREAS



POST DEVELOPMENT DRAINAGE AREAS