Block 47
Antigonish Avenue
Ottawa, Ontario

Servicing Brief and

Stormwater Management Report

BLOCK 47 – ANTIGONISH AVENUE
OTTAWA, ONTARIO

SERVICING BRIEF
AND STORMWATER MANAGEMENT REPORT

Prepared by:

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March 2012

Novatech File: 111156-0
Reference: R-2011-185

NOVATECH
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CONSULTANTS LTD.

March 12, 2012

City of Ottawa
Planning and Growth Management Department
Development Review (Urban) Branch
Infrastructure Approvals Division
110 Laurier Avenue West, 4th Floor
Ottawa, Ontario
K1P 1J1

Attention: **Mr. Jeff Shillington, P.Eng.**

Dear Sir:

Reference: **Block 47 – Antigonish Avenue**
Servicing Design Brief
Our File No.: 111156

Enclosed herein is the Servicing Brief and Stormwater Management Report for the proposed development located at Block 47 – Antigonish Avenue. This report is submitted in support of the site plan application. It outlines how the site will be serviced with sanitary sewer, storm sewer and watermain.

Trusting this report is adequate for your purposes. Should you have any questions, or require addition information, please contact me.

Yours truly,

NOVATECH ENGINEERING CONSULTANTS LTD.

Greg MacDonald, P. Eng.
Senior Project Manager

GM/sb

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1.0 INTRODUCTION

The purpose of this report is to provide a servicing and stormwater management solution for the storm runoff of the subject site. The proposed development is located at the north-east corner of Antigonish Avenue and future Trim Road, as shown in Figure 1. The site is part of the Royal Ridge Subdivision which is currently under construction. The proposed development of 0.53 hectares will consist of three new buildings with fourteen condominium units each and on-site parking.

2.0 REFERENCES AND SUPPORTING DOCUMENTS

A supplementary geotechnical study has been prepared for the site by Golder Associates in February 2010. The report number is 0911210163-3000, and has been part of the site plan circulation process. It is not anticipated that there will be any geotechnical concerns with respect to site servicing. The site currently contains 0.5-1.0m of silty clay that had been placed during the overall grading of the Royal Ridge subdivision works.

With regards to servicing, the other supporting documents used for the report include the following:

- *City of Ottawa Sewer Design Guideline*, City of Ottawa – November 2004
- *Stormwater Management Report - Royal Ridge Subdivision (Formerly Russell Findlay Lands),* Novatech Engineering Consultants Ltd. (R-2009-001-2) - December 17, 2009
- *Hydraulic Network Watermain Analysis - Royal Ridge Subdivision (Formerly Russell Findlay Lands),* Novatech Engineering Consultants Ltd. (R-2009-092) - March 22, 2010

3.0 STORMWATER MANAGEMENT CALCULATIONS

3.1 Criteria

Through correspondence with the City of Ottawa and Novatech Engineering's knowledge of development requirements in the area, the following criteria have been adopted:

- Control post-development flows up to and including the 5-year and 100-year events, 24 L/s and 45 L/s respectively. The MOE Certificate of Approval of the approved subdivision assigned a release rate of 34 L/s and 64 L/s for the 5-year and 100-year events, respectively, based on an area of 0.93ha, an imperviousness of 68% and onsite storage of 230 m^3 (ref: *Stormwater Management Report - Royal Ridge Subdivision (Formerly Russell Findlay Lands, Novatech, Dec. 17, 2009*). Since the 9 single lots have been added, it has reduced the site's allowable release rate to 24 L/s and 45 L/s for the 5-year and 100-year events, respectively, based on an area of 0.61ha an imperviousness of 68% and onsite storage of 160 m^3.
- Ponding for the 5-year storm and the 100-year storm will be allowable to 0.15m and 0.30m respectively.
- Determine size and location of drainage system components.
- Provide source controls, which are in conformity with City of Ottawa requirements.

- Provide guidelines to ensure that site preparation and construction is in accordance with the current Best Management Practices for Erosion and Sediment Control.

3.2 Design Steps

The Modified Rational Method was used to determine the storage volume required to control the post-development runoff flows to the allowable runoff release rate and to determine the size of the control device for both the 5-year and the 100-year storm events. The following is a summary of the steps taken in the calculations:

1. Control post-development flows up to and including the 5-year and 100-year events, 24 L/s and 45 L/s respectively.
2. Determine the drainage areas and associated runoff coefficients for the proposed development.
3. Using the Rational Method, calculate the flow per drainage area.
4. Calculate the stage-storage curve per parking lot structure, based on the proposed grading. In addition, pipe storage may be used in the storm sewer.
5. Analyze and compare the available storage to uncontrolled flow. Then select the drainage areas to optimize surface ponding by adding an Inlet Control Device (ICD).
6. Vary the allowable flow through the ICD until the 5-year and 100-year ponding depths meet the requirements set out in Section 2.0.
7. Determine the type and calculate the size of the ICD.
8. Analyze and compare the available parking lot surface storage to the controlled flow. If there still is excess flow, determine the amount of storage that is required in the superpipe. Determine the type and calculate the size of the ICD at the downstream storm maintenance hole within the site to control the superpipe release rate.
9. Confirm that the 5-year and 100-year site flows are less than or equal to the allowable release rates.

3.3 Post-Development Conditions

Stormwater calculations for post-development conditions for both the 5-year and 100-year storm are presented in Table 3.1. The drainage areas are highlighted in the Storm Drainage Area Plan (107049-STM) located at the back of this report.

Table 3.1: Drainage Area Conditions

Drainage Area	Area (ha)	C (5 year)	C (100 year)	Type of Flow
A-1	0.0200	0.38	0.48	Uncontrolled
A-2	0.0138	0.20	0.25	Uncontrolled
A-3	0.0420	0.45	0.56	Controlled
A-4	0.0300	0.80	1.00	Controlled
A-5	0.1230	0.70	0.88	Controlled
A-6	0.0370	0.90	1.00	Controlled
A-7	0.0580	0.78	0.98	Controlled
A-8	0.1760	0.70	0.88	Controlled
A-9	0.0300	0.50	0.63	Controlled

3.4 Allowable Release Rate

From the above noted criteria:

Q_{A5}= 24 L/s
Q_{A100} = 45 L/s

3.5 Post-Development Calculations

The proposed site will be divided into two district categories: Uncontrolled and Controlled.

3.5.1 Uncontrolled Post-Development Flows

Drainage areas and 1 & 2 are uncontrolled off-site flow as shown by the grading on the Storm Drainage Area Plan (111156-STM) in the back of this report. Area 1 will flow into the Antigonish Avenue, while Area 2 will drain into the existing landscape yard catchbasin at the rear of Lot 36. The total uncontrolled flow off-site for the 5-year and 100-year storm event is 3.00 L/s and 6.48 L/s respectively. Table 3.2 below gives a breakdown of the uncontrolled flow per drainage area.

Table 3.2: Uncontrolled Post Development Flows

Design Event	Allowable Release Rate (L/s)	Uncontrolled Drainage Area Flows (L/s)			
		1	2	Total	Remaining
5-year	24	2.20	0.80	**3.00**	**21.00**
100-year	45	4.77	1.71	**6.48**	**38.52**

Therefore, the 5-year and 100-year available release rate for the remainder of the site are 21.00s and 38.52 respectively.

3.5.2 Controlled Surface Flows

Using the Rational Method, the total post-development flow generated by the rest of the site for the 5-year and 100-year design event is 158.7 L/s and 272.0 L/s, as shown in Table 3.3.

Table 3.3: Rational Method Flows (Areas 3, 4, 5, 6, 7, 8, and 9)

Design Event	Remaining Release Rate (L/s)	Drainage Area Flows (L/s)							
		3	4	5	6	7	8	9	Total
5-year	21.00	5.47	6.95	24.94	9.65	13.10	35.69	4.34	**100.14**
100-year	38.52	9.38	14.89	53.42	18.37	28.07	76.44	9.31	**209.88**

Due to the increase in hard surface and low remaining release rate, the remainder of the site will need to utilize available ponding in the parking lot structures. This will be achieved by round plastic or Hydrovex inlet control devices which will control stormwater flows as shown in Table 3.4.

Table 3.4: Controlled Flow Summary

Drainage Area	Storm Structure	5-Year Release Rate (L/s)	100-Year Release Rate (L/s)	Available Storage (m^3)	5-Year Storage (m^3)	100-Year Storage (m^3)	ICD
A-3	CBMH 7	2.83	6.03	5.83	1.59	3.42	LEAD
A-4	CB 2	5.00	5.00	6.75	1.33	6.23	75-SVHV
A-5	CB 5	20.15	20.70	22.50	4.06	17.05	83mm ICD
A-6	CB 3	5.00	5.00	21.67	2.79	8.81	75-SVHV
A-7	CB 4	5.00	5.00	26.67	4.98	17.00	75-SVHV
A-8	CB 6	38.00	39.12	22.92	3.11	22.39	114mm ICD
A-9	LYCB 3	2.54	5.41	2.50	1.08	2.34	LEAD
A3-A9	**Total**				**18.94**	**80.03**	

The following table outlines the proposed release rate for each area for the 5-year and 100-year storm event.

Table 3.5: Rational Proposed Release Rate Summary

Drainage Area	Type of Flow	5-year Release Rate (L/s)	5-year Storage Depth (m)	100-year Release Rate (L/s)	100-year Storage Depth (m)
A-3	Controlled	2.83	0.162	6.03	0.209
A-4	Controlled	5.00	0.087	5.00	0.146
A-5	Controlled	20.15	0.142	20.70	0.240
A-6	Controlled	5.00	0.126	5.00	0.185
A-7	Controlled	5.00	0.143	5.00	0.215
A-8	Controlled	38.00	0.128	39.12	0.248
A-9	Controlled	2.54	0.189	5.41	0.244
A3-A9	**Total**	**78.52**	**0.139**	**86.26**	**0.212**

The average storage depth within the site is 0.139m and 0.212m for the 5-year and 100-year storm respectively. However, the stormwater discharge from the site for the 5-year and 100-year storm events is still greater than the respective allowable stormwater release rates. Therefore, any additional flow to the storm sewer shall be restricted and further pipe storage will be achieved. Refer to the next section for further details.

3.5.3 Controlled Flows – Superpipe

Using the Rational Method, the total post-development flow generated by the rest of the site for the 5-year and 100-year design event is 78.52 L/s and 86.26 L/s as shown in Table 3.5. The flow from all areas will be directed to a 900 mm diameter superpipe to be controlled via an orifice of 130 mm diameter to 20.95 L/s and 31.91 L/s for the 5-year and 100-year events respectively.

Table 3.6 Orifice Inlet Control Flow Summary (Superpipe)

Area No.	Orifice Specification	Structure No.	INLET CONTROL PARAMETERS					
			5-Year Event			100-Year Event		
			Depth (m)	Storage (m^3)	Total Flow (L/s)	Depth (m)	Storage (m^3)	Total Flow (L/s)
A3-A9	130 mm	STMMH 1	0.406	44.25	20.95	0.857	100.36	31.91

3.5.4 Controlled Post-Development Flows

The final proposed flows are as follows:

Table 3.7 Post-Development Flow Summary (Direct Runoff and Superpipe)

			INLET CONTROL PARAMETERS					
			5-Year Event			100-Year Event		
Area No.	Type of Flow	Structure No.	Depth (m)	Storage (m^3)	Total Flow (L/s)	Depth (m)	Storage (m^3)	Total Flow (L/s)
A1-2	Uncontrolled	DR	-		3.00	-		6.48
A3-A9	Controlled	Surface Storage/ 900mm dia. Super Pipe	0.139 / 0.341	18.94 / 44.25	20.95	0.212/ 0.857	80.03/ 100.36	31.91
A1 – A9			Total =	63.19	23.95	Total =	180.39	39.39

Therefore, the stormwater discharge from the site for the 5-year and 100-year storm events is less than the respective allowable stormwater release rates.

3.6 Major Overland Drainage

Major overland flows in excess of the 100-year event will flow overland with a maximum depth of 0.30m. An overland drainage flow route for major system runoff will be provided by grading the site such that excess stormwater runoff will flow overland towards Antigonish Avenue and ultimately to the southern outlet of the Royal Ridge Subdivision which ultimately ends at the unnamed tributary of Cardinal Creek.

3.7 Quality Control

In order to meet the requirement of 80% TSS removal for runoff entering Cardinal Creek, a Vortechs Hydrodynamic Separator unit has been installed upstream of the southern outlet of the Royal Ridge Subdivision. At the outlet to the unnamed tributary, runoff up to the 25mm storm event will be treated with a Vortechs 5000 in-line model. The stormwater management of the entire subdivision has been approved by the Ministry of the Environment, RVCA and the City of Ottawa, prior to its installation. Refer to Appendix C. This unit has since been installed and is fully operational.

3.8 Erosion and Sediment Control Requirements

To prevent surface erosion from entering the storm system during construction, filter cloth will be placed under the grates of all area drains and remain in place until vegetation has been established and construction is completed. Street sweeping and cleaning will be performed on all roads adjacent to active construction on a regular basis.

4.0 SANITARY SERVICING

The development will be serviced by a proposed 200mm diameter sanitary service that will outlet to an existing 250mm diameter sanitary sewer on Antigonish Avenue. The existing sanitary sewer services the properties on Antigonish Avenue in the Royal Ridge Subdivision. The proposed development has been accounted for during the design of the subdivision and outlets the sanitary flows towards the 450mm diameter collector on Trim Road. Refer to

Appendix B for the sanitary design sheets and Appendix C for the MOE Certificate of Approval for existing subdivision sewers.

Calculated Sanitary Flows

The proposed development will have 36 condominium units. The City of Ottawa Sewer Design Guideline (Nov. 2004) stipulates in section 4.3 that the number of persons per unit is 2.1.

Residential: Q_{SAN} = (36 units x 2.1 persons per unit) x 350 L/cap/day
= 26,460L/day =0.306 L/sec

Peak Factor = 4.0

Total Peak Design Flow = 4.0 x 0.306 L/sec = 1.224 L/sec

Extraneous Flows: Q_{EXT} = 0.28 L/sec/ per ha x 0.53 ha
= 0.148 L/sec

Total Proposed Sanitary Flow = Q_{SAN} + Q_{EXT} = 1.224 L/sec + 0.148 L/sec
= 1.372 L/s

Therefore, the existing sewer on Antigonish Avenue has adequate capacity to facilitate the proposed development. Refer to Appendix B for detailed sewer design sheet of the subdivision up to the existing sanitary collector Trim Road.

5.0 WATER SUPPLY

5.1 Domestic Demand

The proposed development will be serviced with a 150mm diameter PVC service that will connect to the existing 250mm diameter watermain on Antigonish Avenue. A shutoff valve will be provided at the property line of the site as per City of Ottawa Specifications. The water meters will be located in the basement level mechanical rooms of each building as indicated in the servicing drawing 111156-GP. Similarly, a remote receptacle will be located at the surface near the entrance to each mechanical room from the exterior.

Estimated domestic water demands for the development are roughly the same as the proposed development sanitary flows listed above in Section 4.0.

Q_{WATER} = 26,460 L/day
= 0.306 L/sec

Using a peak factor of 2.5, the required maximum daily demand yields:

$Q_{Max\ Daily}$ = 66,150 L/day
=0.766 L/sec

Using a peak factor of 2.2, the required maximum hourly demand yields:

$Q_{Max\ Hour}$ = 145,530 L/day
= 1.684 L/sec

The daily water demand for the above site has been accounted for in the Hydraulic Network Analysis that had been completed for the Royal Ridge Subdivision.

5.2 Fire Demand

The building will not be equipped with a sprinkler system. Water supply for the fire fighting is calculated in accordance with article 3.2.5.7 of the Ontario Building Code (OBC). A hydrant is required within 90 meters of the building perimeter per sentence 3.2.5.7(2).

The minimum required water supply is derived from Table 2 of A-3.2.5.7 (Appendix A of the OBC). The building area exceeds 600 m²; therefore the supply is calculated as follows:

$Q_{WATER} = K\ V\ S_{TOT}$

where,

Q = Volume in Liters
K = 23 (for Group C classification from OBC A3.2.5.7 - Table 1)
V= Total Building Volume in m³
S_{TOT} = Spatial Coefficient (minimum distance to next building or Property line)

Based on the above, the fire demands for the buildings range from 1,175 to 1370 igpm. Detailed calculations are included in Appendix D.

The fire protection for the above site has been accounted for in the Hydraulic Network Analysis that had been completed for the Royal Ridge Subdivision. The supply of water for fire availability has been respected with regards to the 90m distance from the proposed private hydrant to the building entrances.

6.0 CONCLUSIONS

Based on the foregoing, adequate sanitary, storm and water services are available to support this development. Additional details are provided in the servicing and grading drawings.

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Project Engineer

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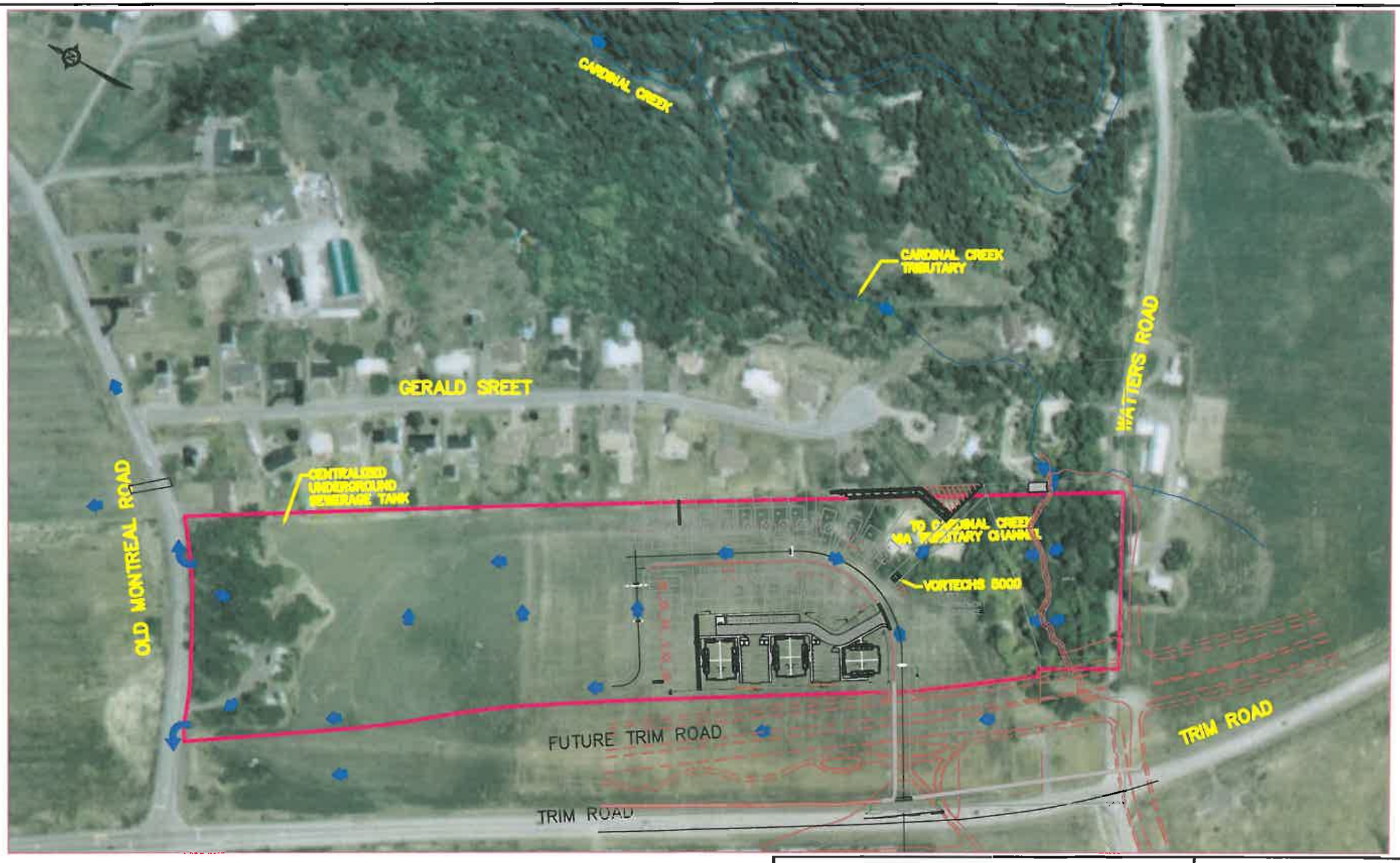
ROYAL RIDGE SUBDIVISION - BLOCK 47

KEY PLAN

MAR. 2012 111156 FIG 1

M:\2011\111156\CAD\Design\Figures\111156-FIG1.dwg, FIG1, Mar 07, 2012 - 4:10pm, alambros

SHT8X11.DWG - 216mmX278mm



LEGEND

- SITE BOUNDARY
- DIRECTION OF FLOW
- DRAINAGE OUTLET
- CULVERT

Scale- 1:2500

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ROYAL RIDGE SUBDIVISION - BLOCK 47

EXISTING SITE CONDITIONS

MAR. 2012 111156 FIG 2

M:\2011\111156\CAD\Design\Figures\111156-FIG2.dwg, FIG. 2, Jan 18, 2012 - 5:17pm, alambros

SHT11X17.DWG - 279mmX432mm

APPENDIX A

STORMWATER CALCULATIONS AND SAMPLE CALCULATIONS

RATIONAL METHOD

The Rational Method was used to determine both the allowable runoff as well as the post-development runoff for the proposed site. The equation is as follows:

$Q=2.78\ CIA$

Where:
Q is the runoff in L/s
C is the weighted runoff coefficient*
I is the rainfall intensity in mm/hr**
A is the area in hectares

*The weighted runoff coefficient is determined for each of the catchment areas as follows:

$$C = \frac{(A_{perv} \times C_{perv}) + (A_{imp} \times C_{imp})}{A_{tot}}$$

Where:
A_{perv} is the pervious area in hectares
C_{perv} is the pervious area runoff coefficient (C_{perv}=0.20)
A_{imp} is the impervious area in hectares
C_{imp} is the impervious area runoff coefficient (C_{imp}=0.90)
A_{tot} is the catchment area ($A_{perv} + A_{imp}$) in hectares

** The rainfall intensity is taken from the City of Ottawa IDF Curves with a time of concentration of 20 min (refer to attached IDF Curves) as specified by the City of Ottawa.

POST-DEVELOPMENT FLOW

The post-development flow is comprised of controlled flow from the building roof, landscaped areas, and asphalt areas.

SAMPLE CALCULATION:

AREA A-2

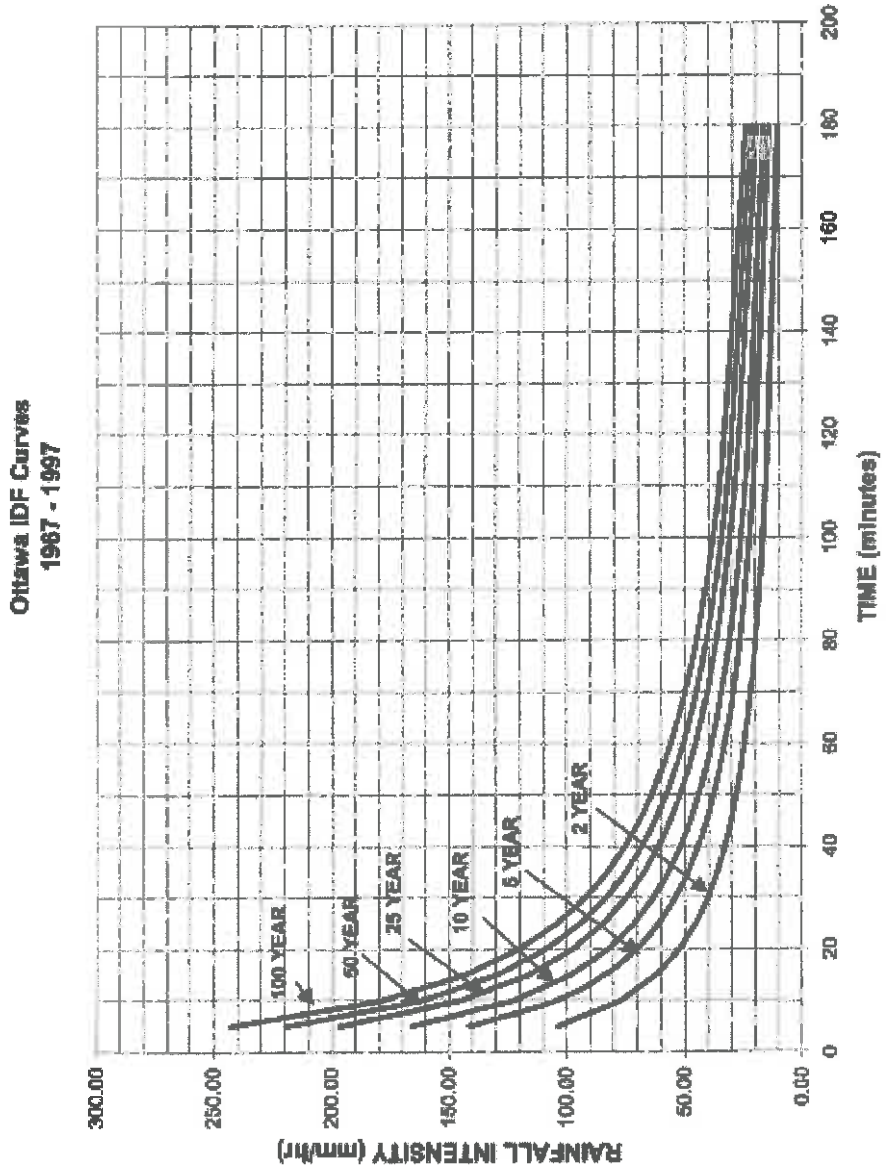
Drainage Area (A) = 0.0138 ha
Impervious Area = 0.0138 ha
Pervious Area = 0.0000 ha
Runoff Coefficient (C) = 0.20 for 5 year STM and
0.25 for 100 year STM
(e.g. 10 year Runoff Coefficient increased by 25%, up to a maximum of 1.0)

Tc = 10 minutes
Intensity (I_{10}) = 104.19 mm/hr
Intensity (I_{100}) = 178.56 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.20 x 104.19 mm/hr x 0.0138 ha
Q_5= 0.80 L/s

Q_{100}= 2.78 CIA
Q_{100}= 2.78 x 0.25 x 178.56 mm/hr x 0.0138 ha
Q_{100}= 1.71 L/s

APPENDIX 5-A OTTAWA INTENSITY DURATION FREQUENCY (IDF) CURVE



CATCHBASIN FLOWS

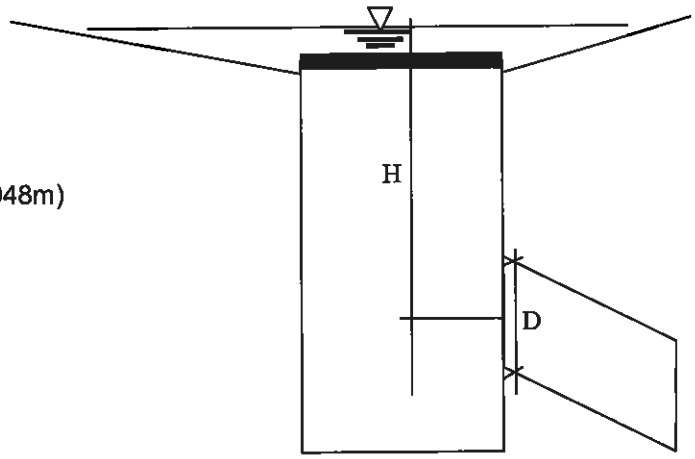
Flows controlled via orifice inlet control devices:

SAMPLE CALCULATION:

AREA A-8

Coefficient (C_d) = 0.62
Orifice Diameter (D) = 114 mm
Area of Orifice = $\pi D^2 / 4 = \pi (0.114m)^2 / 4 = 0.0102 m^2$
Acceleration of gravity (g) = $9.81 m/s^2$
Head (H) = 0.128m (Storage) +1.700m (T/G to center of outlet pipe) =1.828m 5 Yr event
Head (H) = 0.248m (Storage) + 1.700m (T/G to center of outlet pipe) =1.948m 100 Yr event

$Q_{5\ all} = C_d \times A \times \text{sqrt}(2 \times g \times H)$
$Q_{5\ all} = 0.62 \times 0.010207\ m^2 \times \text{sqrt}(2 \times 9.81 m/s^2 \times 1.828m)$
$Q_{5\ all} = 37.90$ L/s



$Q_{100\ all} = C \times A \times \text{sqrt}(2 \times g \times H)$
$Q_{100\ all} = 0.62 \times 0.010207\ m^2 \times \text{sqrt}(2 \times 9.81 m/s^2 \times 1.948m)$
$Q_{100\ all} = 39.12$L/s *

CATCHBASIN FLOWS

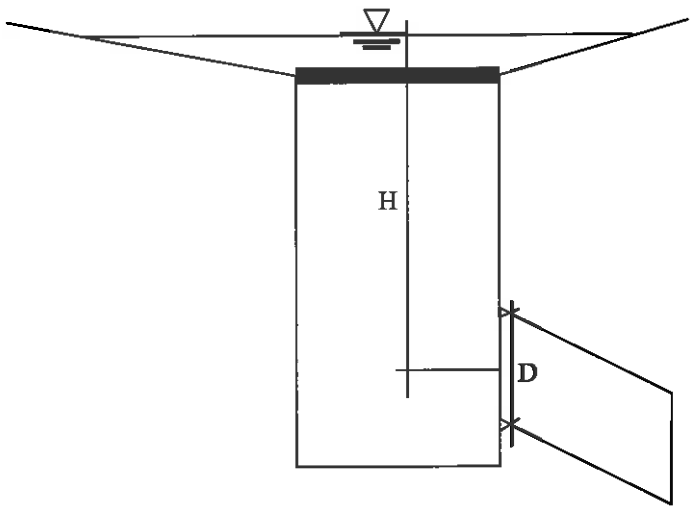
Flows controlled via Hydrovex inlet control devices:

SAMPLE CALCULATION:

AREA A-6

Assume Hydrovex Type – assume 75 SVHV
Head (H) = 0.126m (Storage) +1.70m (T/G to center of outlet pipe) = 1.826m 5 Yr event
Head (H) = 0.185m (Storage) +1.70m (T/G to center of outlet pipe) = 1.885m 100 Yr event

Corresponding flow ($Q_{5\ all}$) = 5.00 L/s for the 5 Yr event
Corresponding flow ($Q_{100\ all}$) = 5.00 L/s for the 100 Yr event



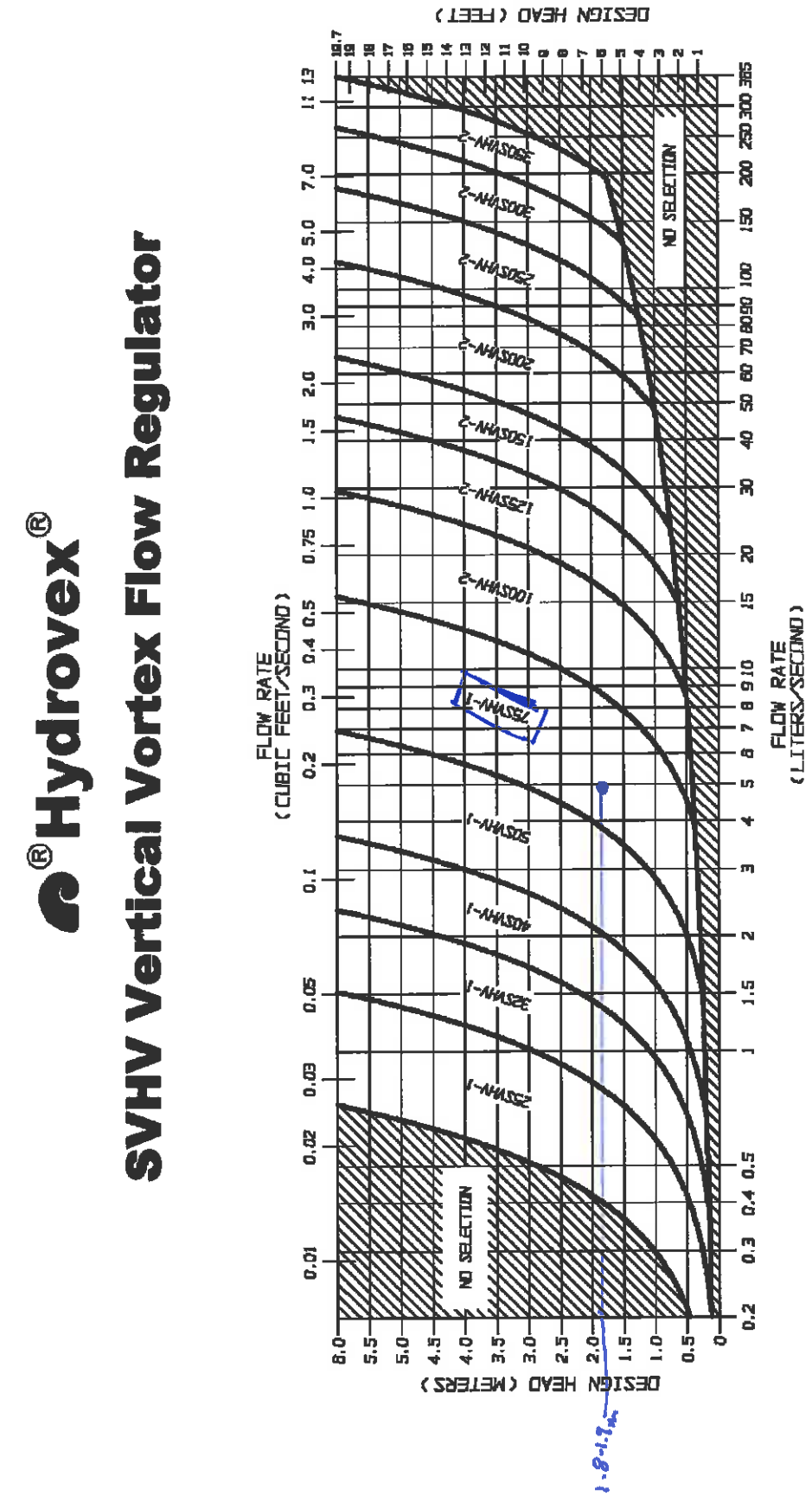


FIGURE 2 - SVHV

John Meunier

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA A-3

OTTAWA IDF CURVE			Qallow (L/s)=	2.83
Area =	0.042	ha	Vol(max m³) =	1.59
Area =	70	m²	T/G-INV C (m)=	1.3
C =	0.45		Flow Control Device	250

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)	
5	141.18	7.42	4.59	1.38	2.83
10	104.19	5.47	2.64	1.59	2.83
15	83.56	4.39	1.56	1.40	2.83
20	70.25	3.69	0.86	1.03	2.83
25	60.90	3.20	0.37	0.55	2.83
30	53.93	2.83	0.00	0.01	2.83
35	48.52	2.55	-0.28	-0.59	2.55
40	44.18	2.32	-0.51	-1.22	2.32
45	40.63	2.13	-0.70	-1.88	2.13
50	37.65	1.98	-0.85	-2.55	1.98
55	35.12	1.85	-0.98	-3.25	1.85
60	32.94	1.73	-1.10	-3.96	1.73
65	31.04	1.63	-1.20	-4.68	1.63
70	29.37	1.54	-1.29	-5.40	1.54
75	27.89	1.47	-1.36	-6.14	1.47
80	26.56	1.40	-1.43	-6.89	1.40
85	25.37	1.33	-1.50	-7.64	1.33
90	24.29	1.28	-1.55	-8.39	1.28
95	23.31	1.22	-1.61	-9.15	1.22
100	22.41	1.18	-1.65	-9.92	1.18
105	21.58	1.13	-1.70	-10.68	1.13
110	20.82	1.09	-1.74	-11.46	1.09
115	20.12	1.06	-1.77	-12.23	1.06
120	19.47	1.02	-1.81	-13.01	1.02

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m²	V (factor)	V m³	H m
25	3.000	1.26	0.15
29	3.000	1.53	0.16
32	3.000	1.83	0.17
36	3.000	2.18	0.18
40	3.000	2.56	0.19
45	3.000	2.99	0.2
49	3.000	3.46	0.21
54	3.000	3.98	0.22
59	3.000	4.54	0.23
65	3.000	5.16	0.24
70	3.000	5.83	0.25

Linear interpolation

0.17	0.16	0.17	H (m)=	0.162
1.83	1.53	1.83	1.59	

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA A-3

OTTAWA IDF CURVE			Qallow (L/s)=	6.03
Area =	0.042	ha	Vol(max m³) =	3.42
Area of storage=	70	m²	T/G-INV C(m)=	1.3
C =	0.56		Flow Control Device	250

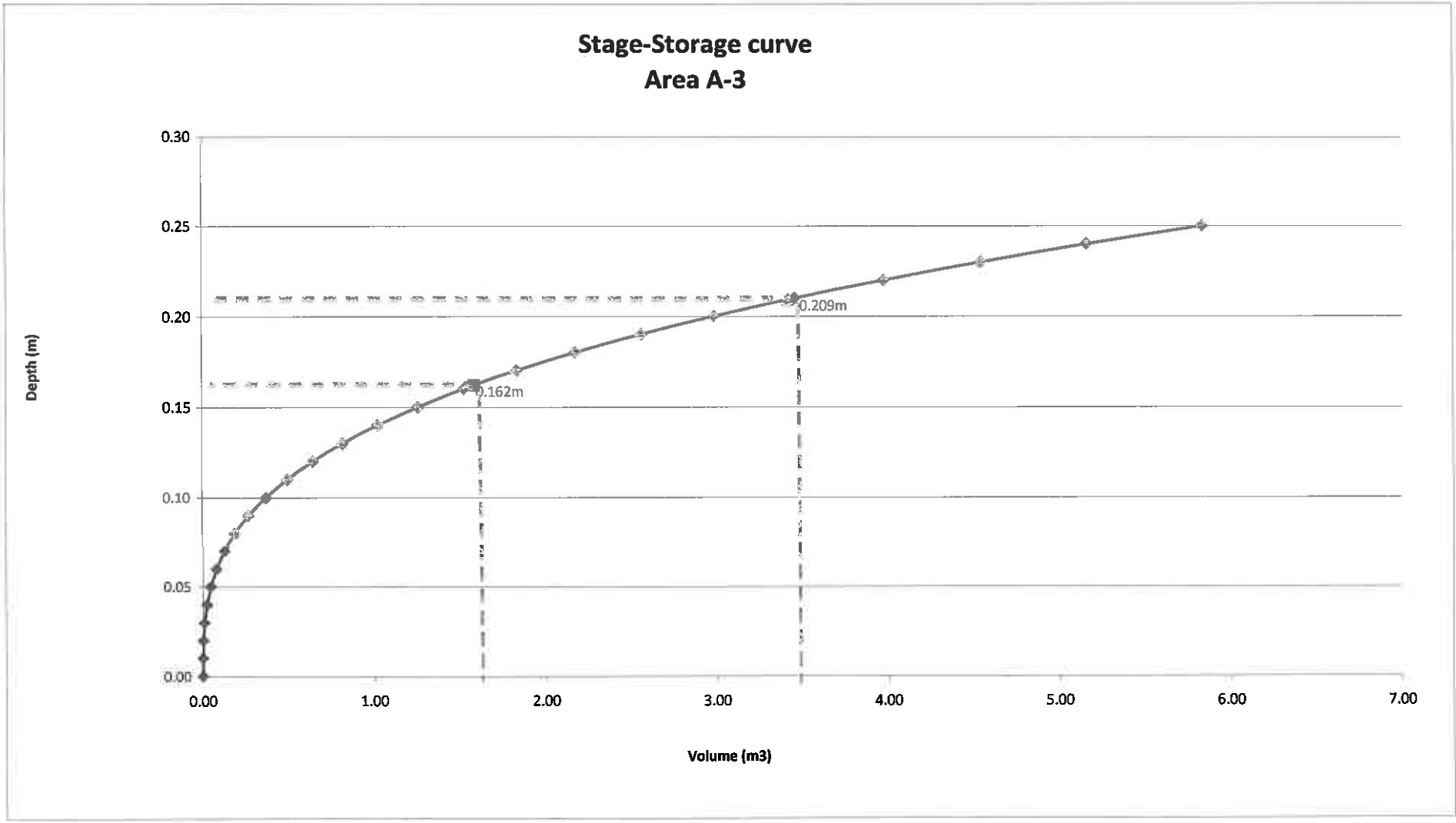
Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m³)	
5	242.70	15.94	9.91	2.97	6.03
10	178.56	11.73	5.70	3.42	6.03
15	142.89	9.38	3.35	3.02	6.03
20	119.95	7.88	1.85	2.22	6.03
25	103.85	6.82	0.79	1.19	6.03
30	91.87	6.03	0.00	0.01	6.03
35	82.58	5.42	-0.61	-1.27	5.42
40	75.15	4.94	-1.09	-2.63	4.94
45	69.05	4.54	-1.49	-4.04	4.54
50	63.95	4.20	-1.83	-5.49	4.20
55	59.62	3.92	-2.11	-6.98	3.92
60	55.89	3.67	-2.36	-8.49	3.67
65	52.65	3.46	-2.57	-10.03	3.46
70	49.79	3.27	-2.76	-11.59	3.27
75	47.26	3.10	-2.93	-13.17	3.10
80	44.99	2.95	-3.08	-14.76	2.95
85	42.95	2.82	-3.21	-16.37	2.82
90	41.11	2.70	-3.33	-17.98	2.70
95	39.43	2.59	-3.44	-19.61	2.59
100	37.90	2.49	-3.54	-21.24	2.49
105	36.50	2.40	-3.63	-22.89	2.40
110	35.20	2.31	-3.72	-24.54	2.31
115	34.01	2.23	-3.80	-26.20	2.23
120	32.89	2.16	-3.87	-27.86	2.16

Ponding depth (1:100yr storm)

B m²	V (factor)	V m³	H m
25	3.000	1.26	0.15
29	3.000	1.53	0.16
32	3.000	1.83	0.17
36	3.000	2.18	0.18
40	3.000	2.56	0.19
45	3.000	2.99	0.2
49	3.000	3.46	0.21
54	3.000	3.98	0.22
59	3.000	4.54	0.23
65	3.000	5.16	0.24
70	3.000	5.83	0.25

Linear interpolation

0.21	0.2	0.21	H (m)=	0.209
3.46	2.99	3.46	3.42	


Stage-Storage curve
Area A-3
Depth (m)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.209m
0.162m
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Volume (m3)

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA A-4

OTTAWA IDF CURVE			Qallow (L/s)=	5.00
Area =	0.030	ha	Vol(max m³) =	1.33
Area =	135	m²	T/G-INV C (m)=	1.7
C =	0.80		Flow Control Device	75 SVHV

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)	
5	141.18	9.42	4.42	1.33	5.00
10	104.19	6.95	1.95	1.17	5.00
15	83.56	5.57	0.57	0.52	5.00
20	70.25	4.69	-0.31	-0.38	4.69
25	60.90	4.06	-0.94	-1.41	4.06
30	53.93	3.60	-1.40	-2.52	3.60
35	48.52	3.24	-1.76	-3.70	3.24
40	44.18	2.95	-2.05	-4.92	2.95
45	40.63	2.71	-2.29	-6.18	2.71
50	37.65	2.51	-2.49	-7.46	2.51
55	35.12	2.34	-2.66	-8.77	2.34
60	32.94	2.20	-2.80	-10.09	2.20
65	31.04	2.07	-2.93	-11.42	2.07
70	29.37	1.96	-3.04	-12.77	1.96
75	27.89	1.86	-3.14	-14.13	1.86
80	26.56	1.77	-3.23	-15.49	1.77
85	25.37	1.69	-3.31	-16.87	1.69
90	24.29	1.62	-3.38	-18.25	1.62
95	23.31	1.55	-3.45	-19.64	1.55
100	22.41	1.50	-3.50	-21.03	1.50
105	21.58	1.44	-3.56	-22.43	1.44
110	20.82	1.39	-3.61	-23.83	1.39
115	20.12	1.34	-3.66	-25.24	1.34
120	19.47	1.30	-3.70	-26.65	1.30

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m²	V (factor)	V m³	H m
15	3.000	0.25	0.05
22	3.000	0.43	0.06
29	3.000	0.69	0.07
38	3.000	1.02	0.08
49	3.000	1.46	0.09
60	3.000	2.00	0.1
73	3.000	2.66	0.11
86	3.000	3.46	0.12
101	3.000	4.39	0.13
118	3.000	5.49	0.14
135	3.000	6.75	0.15

Linear interpolation

0.09	0.08	0.09	H (m)=	0.087
1.46	1.02	1.46	1.33	

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA A-4

OTTAWA IDF CURVE			Qallow (L/s)=	5.00
Area =	0.030	ha	Vol(max m³) =	6.23
Area of storage=	135	m²	T/G-INV C(m)=	1.7
C =	1.00		Flow Control Device	75 SVHV

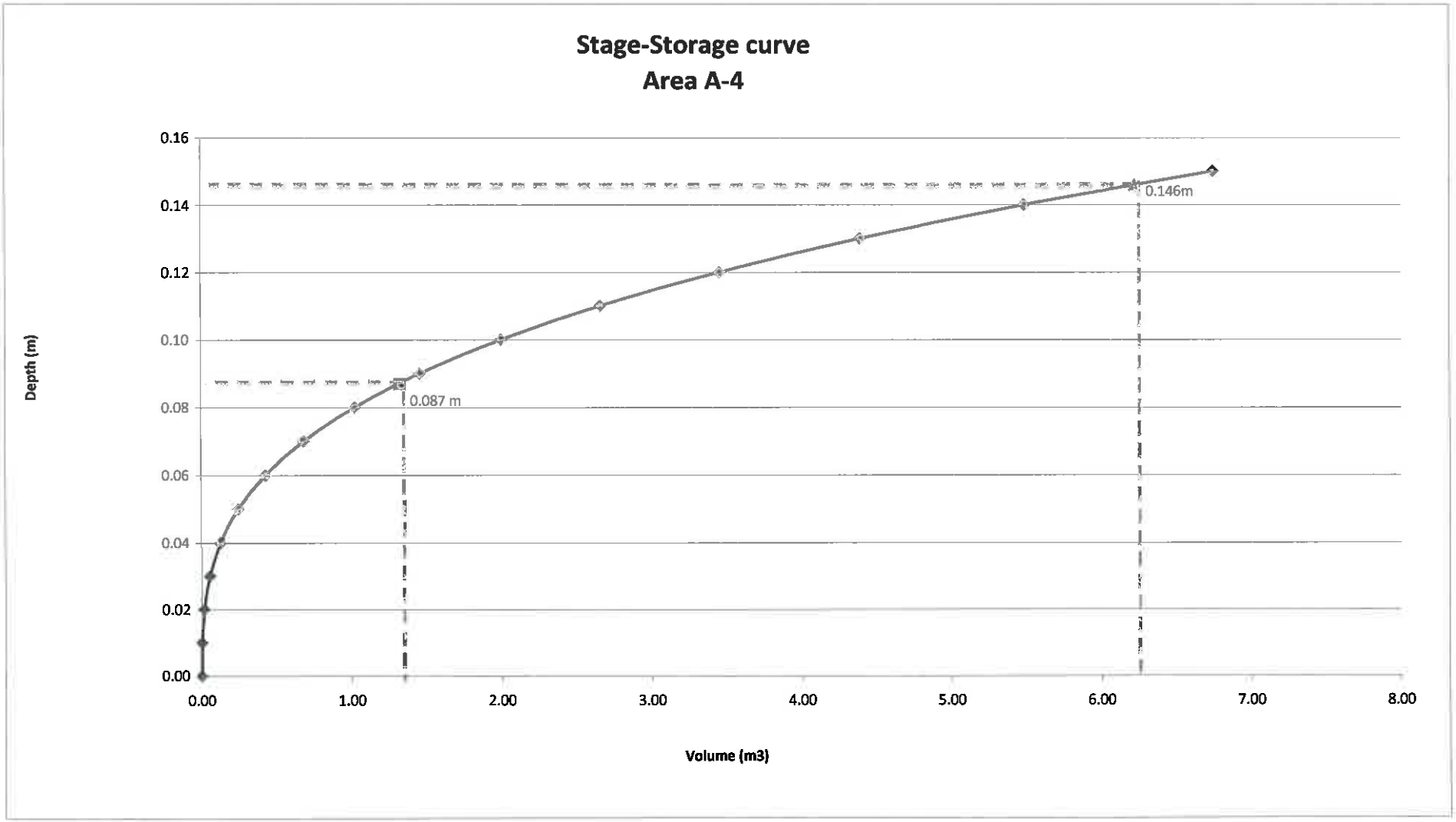
Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m³)	
5	242.70	20.24	15.24	4.57	5.00
10	178.56	14.89	9.89	5.94	5.00
15	142.89	11.92	6.92	6.23	5.00
20	119.95	10.00	5.00	6.00	5.00
25	103.85	8.66	3.66	5.49	5.00
30	91.87	7.66	2.66	4.79	5.00
35	82.58	6.89	1.89	3.96	5.00
40	75.15	6.27	1.27	3.04	5.00
45	69.05	5.76	0.76	2.05	5.00
50	63.95	5.33	0.33	1.00	5.00
55	59.62	4.97	-0.03	-0.09	4.97
60	55.89	4.66	-0.34	-1.22	4.66
65	52.65	4.39	-0.61	-2.38	4.39
70	49.79	4.15	-0.85	-3.56	4.15
75	47.26	3.94	-1.06	-4.77	3.94
80	44.99	3.75	-1.25	-5.99	3.75
85	42.95	3.58	-1.42	-7.23	3.58
90	41.11	3.43	-1.57	-8.49	3.43
95	39.43	3.29	-1.71	-9.75	3.29
100	37.90	3.16	-1.84	-11.03	3.16
105	36.50	3.04	-1.96	-12.32	3.04
110	35.20	2.94	-2.06	-13.62	2.94
115	34.01	2.84	-2.16	-14.93	2.84
120	32.89	2.74	-2.26	-16.25	2.74

Ponding depth (1:100yr storm)

B m²	V (factor)	V m³	H m
15	3.000	0.25	0.05
22	3.000	0.43	0.06
29	3.000	0.69	0.07
38	3.000	1.02	0.08
49	3.000	1.46	0.09
60	3.000	2.00	0.1
73	3.000	2.66	0.11
86	3.000	3.46	0.12
101	3.000	4.39	0.13
118	3.000	5.49	0.14
135	3.000	6.75	0.15

Linear interpolation

0.15	0.14	0.15	H (m)=	0.146
6.75	5.49	6.75	6.23	


Stage-Storage curve
Area A-4
Depth (m)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.087 m
0.146m
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Volume (m3)

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA A-5

OTTAWA IDF CURVE			Qallow (L/s)=	20.15
Area =	0.123	ha	Vol(max m³) =	4.09
Area =	279	m²	T/G-INV C (m)=	1.7
C =	0.70		Flow Control Device	83

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)	
5	141.18	33.79	13.64	4.09	20.15
10	104.19	24.94	4.79	2.87	20.15
15	83.56	20.00	-0.15	-0.13	20.00
20	70.25	16.82	-3.33	-4.00	16.82
25	60.90	14.58	-5.57	-8.36	14.58
30	53.93	12.91	-7.24	-13.04	12.91
35	48.52	11.61	-8.54	-17.93	11.61
40	44.18	10.58	-9.57	-22.98	10.58
45	40.63	9.72	-10.43	-28.15	9.72
50	37.65	9.01	-11.14	-33.41	9.01
55	35.12	8.41	-11.74	-38.75	8.41
60	32.94	7.89	-12.26	-44.15	7.89
65	31.04	7.43	-12.72	-49.61	7.43
70	29.37	7.03	-13.12	-55.10	7.03
75	27.89	6.68	-13.47	-60.64	6.68
80	26.56	6.36	-13.79	-66.20	6.36
85	25.37	6.07	-14.08	-71.80	6.07
90	24.29	5.81	-14.34	-77.42	5.81
95	23.31	5.58	-14.57	-83.06	5.58
100	22.41	5.36	-14.79	-88.72	5.36
105	21.58	5.17	-14.98	-94.40	5.17
110	20.82	4.98	-15.17	-100.10	4.98
115	20.12	4.82	-15.33	-105.81	4.82
120	19.47	4.66	-15.49	-111.53	4.66

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m²	V (factor)	V m³	H m
97	3.000	4.86	0.15
111	3.000	5.90	0.16
125	3.000	7.07	0.17
140	3.000	8.40	0.18
156	3.000	9.88	0.19
173	3.000	11.52	0.2
191	3.000	13.34	0.21
209	3.000	15.33	0.22
229	3.000	17.52	0.23
249	3.000	19.91	0.24
270	3.000	22.50	0.25

Linear interpolation

0.15	0.14	0.15	H (m)=	0.142
4.86	3.95	4.86	4.09	

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA A-5

OTTAWA IDF CURVE			Qallow (L/s)=	20.70
Area =	0.123	ha	Vol(max m³) =	19.66
Area of storage=	270	m²	T/G-INV C(m)=	1.7
C =	0.88		Flow Control Device	83

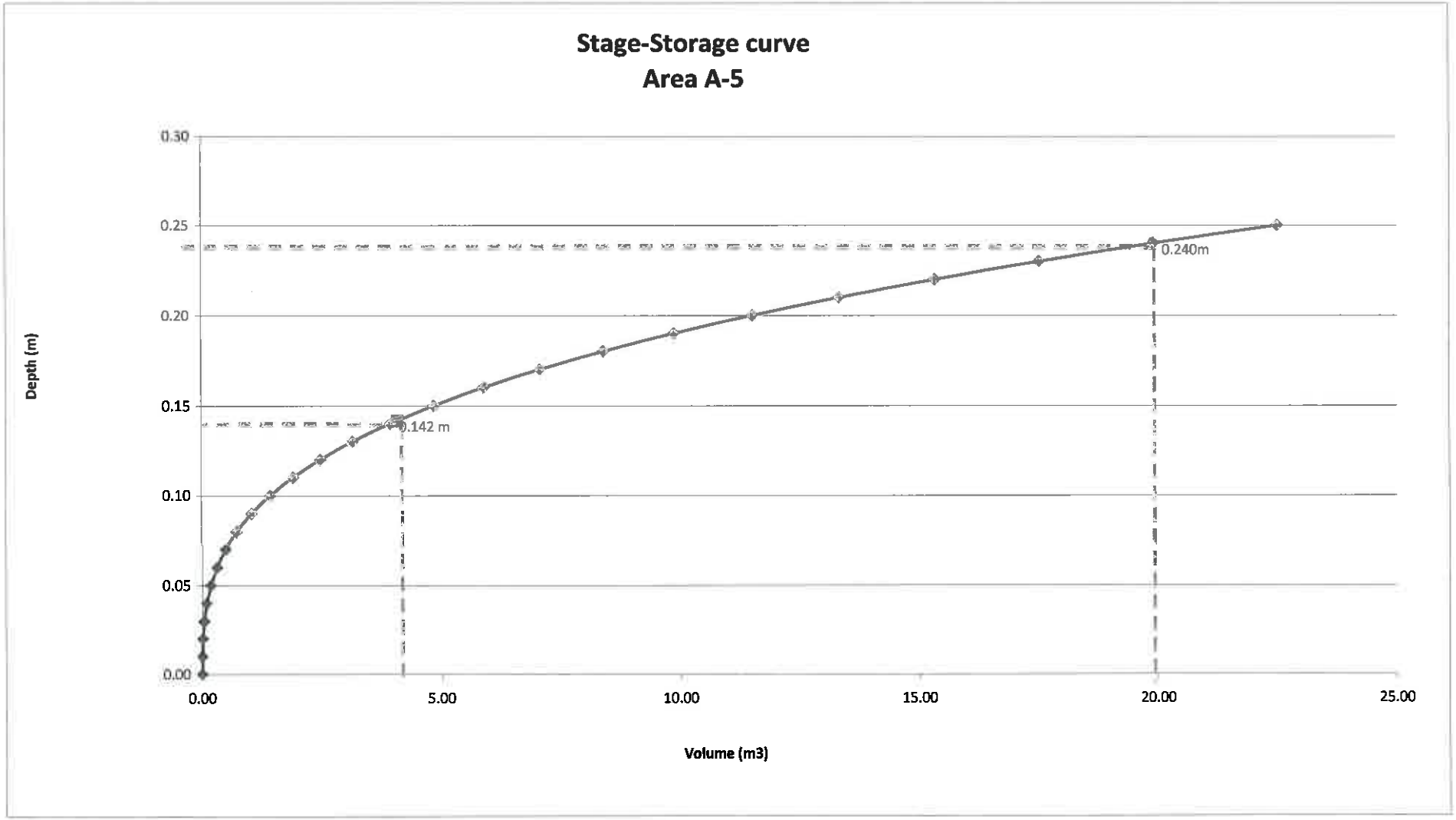
Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m³)	
5	242.70	72.62	51.92	15.57	20.70
10	178.56	53.42	32.72	19.63	20.70
15	142.89	42.75	22.05	19.85	20.70
20	119.95	35.89	15.19	18.23	20.70
25	103.85	31.07	10.37	15.56	20.70
30	91.87	27.49	6.79	12.22	20.70
35	82.58	24.71	4.01	8.42	20.70
40	75.15	22.48	1.78	4.28	20.70
45	69.05	20.66	-0.04	-0.11	20.66
50	63.95	19.13	-1.57	-4.70	19.13
55	59.62	17.84	-2.86	-9.44	17.84
60	55.89	16.72	-3.98	-14.32	16.72
65	52.65	15.75	-4.95	-19.30	15.75
70	49.79	14.90	-5.80	-24.37	14.90
75	47.26	14.14	-6.56	-29.53	14.14
80	44.99	13.46	-7.24	-34.75	13.46
85	42.95	12.85	-7.85	-40.03	12.85
90	41.11	12.30	-8.40	-45.36	12.30
95	39.43	11.80	-8.90	-50.74	11.80
100	37.90	11.34	-9.36	-56.16	11.34
105	36.50	10.92	-9.78	-61.61	10.92
110	35.20	10.53	-10.17	-67.11	10.53
115	34.01	10.17	-10.53	-72.63	10.17
120	32.89	9.84	-10.86	-78.18	9.84

Ponding depth (1:100yr storm)

B m²	V (factor)	V m³	H m
97	3.000	4.86	0.15
111	3.000	5.90	0.16
125	3.000	7.07	0.17
140	3.000	8.40	0.18
156	3.000	9.88	0.19
173	3.000	11.52	0.2
191	3.000	13.34	0.21
209	3.000	15.33	0.22
229	3.000	17.52	0.23
249	3.000	19.91	0.24
270	3.000	22.50	0.25

Linear interpolation

0.24	0.23	0.24	H (m)=	0.240
19.91	17.52	19.91	19.85	


Stage-Storage curve
Area A-5
Depth (m)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.142 m
0.240m
0.00
5.00
10.00
15.00
20.00
25.00
Volume (m3)

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA A-6

OTTAWA IDF CURVE			Qallow (L/s)=	5.00
Area =	0.037	ha	Vol(max m³) =	2.79
Area =	210	m²	T/G-INV C (m)=	1.7
C =	0.90		Flow Control Device	75 SVHV

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)	
5	141.18	13.07	8.07	2.42	5.00
10	104.19	9.65	4.65	2.79	5.00
15	83.56	7.74	2.74	2.46	5.00
20	70.25	6.50	1.50	1.80	5.00
25	60.90	5.64	0.64	0.96	5.00
30	53.93	4.99	-0.01	-0.01	4.99
35	48.52	4.49	-0.51	-1.07	4.49
40	44.18	4.09	-0.91	-2.18	4.09
45	40.63	3.76	-1.24	-3.34	3.76
50	37.65	3.49	-1.51	-4.54	3.49
55	35.12	3.25	-1.75	-5.77	3.25
60	32.94	3.05	-1.95	-7.02	3.05
65	31.04	2.87	-2.13	-8.29	2.87
70	29.37	2.72	-2.28	-9.58	2.72
75	27.89	2.58	-2.42	-10.88	2.58
80	26.56	2.46	-2.54	-12.20	2.46
85	25.37	2.35	-2.65	-13.52	2.35
90	24.29	2.25	-2.75	-14.86	2.25
95	23.31	2.16	-2.84	-16.20	2.16
100	22.41	2.07	-2.93	-17.55	2.07
105	21.58	2.00	-3.00	-18.91	2.00
110	20.82	1.93	-3.07	-20.28	1.93
115	20.12	1.86	-3.14	-21.65	1.86
120	19.47	1.80	-3.20	-23.02	1.80

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m²	V (factor)	V m³	H m
94	3.000	4.68	0.15
106	3.000	5.68	0.16
120	3.000	6.81	0.17
135	3.000	8.09	0.18
150	3.000	9.51	0.19
166	3.000	11.09	0.2
183	3.000	12.84	0.21
201	3.000	14.77	0.22
220	3.000	16.87	0.23
240	3.000	19.17	0.24
260	3.000	21.67	0.25

Linear interpolation

0.13	0.12	0.13	H (m)=	0.126
3.05	2.40	3.05	2.79	

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA A-6

OTTAWA IDF CURVE			Qallow (L/s)=	5.00
Area =	0.037	ha	Vol(max m³) =	8.61
Area of storage=	260	m²	T/G-INV C(m)=	1.7
C =	1.00		Flow Control Device	75 SVHV

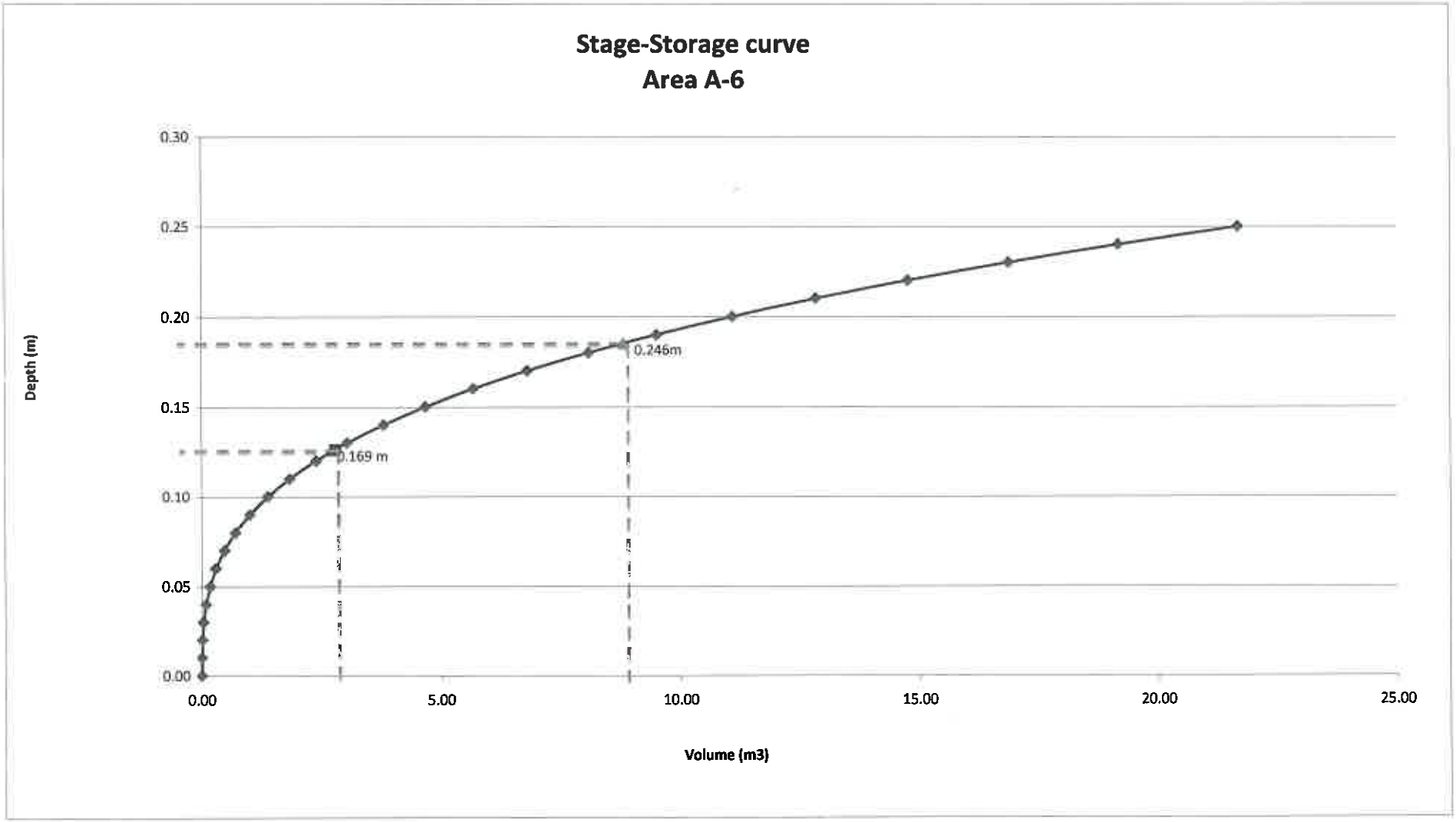
Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m³)	
5	242.70	24.96	19.96	5.99	5.00
10	178.56	18.37	13.37	8.02	5.00
15	142.89	14.70	9.70	8.73	5.00
20	119.95	12.34	7.34	8.81	5.00
25	103.85	10.68	5.68	8.52	5.00
30	91.87	9.45	4.45	8.01	5.00
35	82.58	8.49	3.49	7.34	5.00
40	75.15	7.73	2.73	6.55	5.00
45	69.05	7.10	2.10	5.68	5.00
50	63.95	6.58	1.58	4.73	5.00
55	59.62	6.13	1.13	3.74	5.00
60	55.89	5.75	0.75	2.70	5.00
65	52.65	5.42	0.42	1.62	5.00
70	49.79	5.12	0.12	0.51	5.00
75	47.26	4.86	-0.14	-0.63	4.86
80	44.99	4.63	-0.37	-1.79	4.63
85	42.95	4.42	-0.58	-2.97	4.42
90	41.11	4.23	-0.77	-4.17	4.23
95	39.43	4.06	-0.94	-5.38	4.06
100	37.90	3.90	-1.10	-6.61	3.90
105	36.50	3.75	-1.25	-7.85	3.75
110	35.20	3.62	-1.38	-9.10	3.62
115	34.01	3.50	-1.50	-10.37	3.50
120	32.89	3.38	-1.62	-11.64	3.38

Ponding depth (1:100yr storm)

B m²	V (factor)	V m³	H m
94	3.000	4.68	0.15
106	3.000	5.68	0.16
120	3.000	6.81	0.17
135	3.000	8.09	0.18
150	3.000	9.51	0.19
166	3.000	11.09	0.2
183	3.000	12.84	0.21
201	3.000	14.77	0.22
220	3.000	16.87	0.23
240	3.000	19.17	0.24
260	3.000	21.67	0.25

Linear interpolation

0.19	0.18	0.19	H (m)=	0.185
9.51	8.09	9.51	8.81	


Stage-Storage curve
Area A-6
Depth (m)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.246m
0.169 m
0.00
5.00
10.00
15.00
20.00
25.00
Volume (m3)

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA A-7

OTTAWA IDF CURVE			Qallow (L/s)=	5 00
Area =	0 058	ha	Vol(max m³) =	4 96
Area =	329	m²	T/G-INV C (m)=	1 7
C =	0 78		Flow Control Device	75 SVHV

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)	
5	141.18	17.76	12.76	3.83	5.00
10	104.19	13.10	8.10	4.86	5.00
15	83.56	10.51	5.51	4.96	5.00
20	70.25	8.84	3.84	4.60	5.00
25	60.90	7.66	2.66	3.99	5.00
30	53.93	6.78	1.78	3.21	5.00
35	48.52	6.10	1.10	2.31	5.00
40	44.18	5.56	0.56	1.34	5.00
45	40.63	5.11	0.11	0.30	5.00
50	37.65	4.74	-0.26	-0.79	4.74
55	35.12	4.42	-0.58	-1.92	4.42
60	32.94	4.14	-0.86	-3.08	4.14
65	31.04	3.90	-1.10	-4.27	3.90
70	29.37	3.69	-1.31	-5.49	3.69
75	27.89	3.51	-1.49	-6.72	3.51
80	26.56	3.34	-1.66	-7.96	3.34
85	25.37	3.19	-1.81	-9.23	3.19
90	24.29	3.05	-1.95	-10.50	3.05
95	23.31	2.93	-2.07	-11.79	2.93
100	22.41	2.82	-2.18	-13.09	2.82
105	21.58	2.71	-2.29	-14.40	2.71
110	20.82	2.62	-2.38	-15.72	2.62
115	20.12	2.53	-2.47	-17.04	2.53
120	19.47	2.45	-2.55	-18.37	2.45

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m²	V (factor)	V m³	H m
115	3.000	5.76	0.15
131	3.000	6.99	0.16
148	3.000	8.38	0.17
166	3.000	9.95	0.18
185	3.000	11.71	0.19
205	3.000	13.65	0.2
226	3.000	15.81	0.21
248	3.000	18.17	0.22
271	3.000	20.77	0.23
295	3.000	23.59	0.24
320	3.000	26.67	0 25

Linear interpolation

0.15	0.14	0.15	H (m)=	0.143
5.76	4.68	5.76	4.96	

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA A-7

OTTAWA IDF CURVE			Qallow (L/s)=	5 00
Area =	0 058	ha	Vol(max m³) =	17 66
Area of storage=	320	m²	T/G-INV C(m)=	1 7
C =	0 98		Flow Control Device	75 SVHV

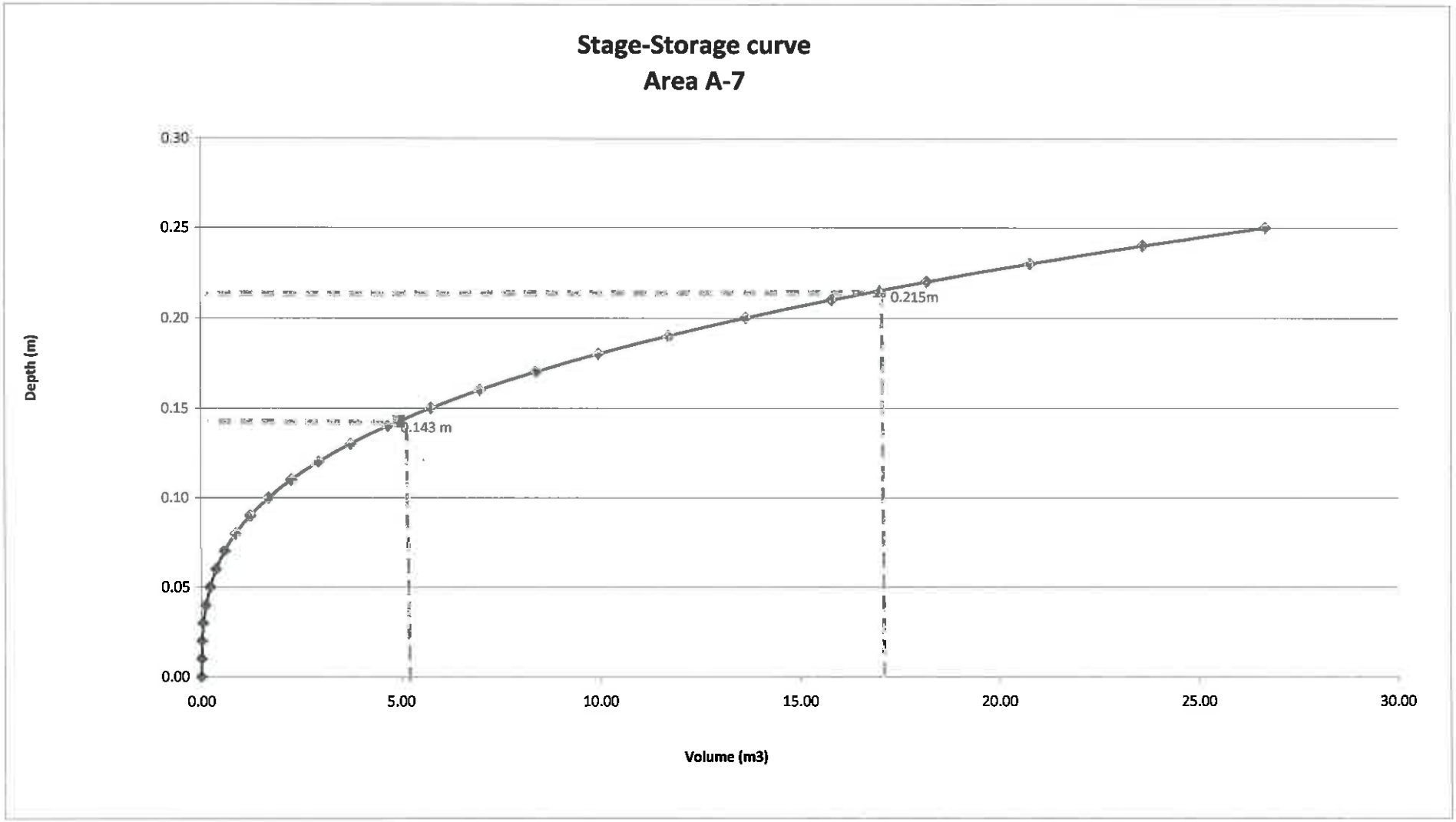
Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m³)	
5	242.70	38.16	33.16	9.95	5.00
10	178.56	28.07	23.07	13.84	5.00
15	142.89	22.46	17.46	15.72	5.00
20	119.95	18.86	13.86	16.63	5.00
25	103.85	16.33	11.33	16.99	5.00
30	91.87	14.44	9.44	17.00	5.00
35	82.58	12.98	7.98	16.76	5.00
40	75.15	11.81	6.81	16.35	5.00
45	69.05	10.86	5.86	15.81	5.00
50	63.95	10.05	5.05	15.16	5.00
55	59.62	9.37	4.37	14.43	5.00
60	55.89	8.79	3.79	13.63	5.00
65	52.65	8.28	3.28	12.78	5.00
70	49.79	7.83	2.83	11.87	5.00
75	47.26	7.43	2.43	10.93	5.00
80	44.99	7.07	2.07	9.95	5.00
85	42.95	6.75	1.75	8.94	5.00
90	41.11	6.46	1.46	7.90	5.00
95	39.43	6.20	1.20	6.84	5.00
100	37.90	5.96	0.96	5.75	5.00
105	36.50	5.74	0.74	4.65	5.00
110	35.20	5.53	0.53	3.53	5.00
115	34.01	5.35	0.35	2.39	5.00
120	32.89	5.17	0.17	1.23	5.00

Ponding depth (1:100yr storm)

B m²	V (factor)	V m³	H m
115	3.000	5.76	0.15
131	3.000	6.99	0.16
148	3.000	8.38	0.17
166	3.000	9.95	0.18
185	3.000	11.71	0.19
205	3.000	13.65	0.2
226	3.000	15.81	0.21
248	3.000	18.17	0.22
271	3.000	20.77	0.23
295	3.000	23.59	0.24
320	3.000	26.67	0 25

Linear interpolation

0.22	0.21	0.22	H (m)=	0.215
18.17	15.81	18.17	17.00	


Stage-Storage curve
Area A-7
Depth (m)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.215m
0.143 m
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Volume (m3)

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA A-8

OTTAWA IDF CURVE			Qallow (L/s)=	38.00
Area =	0.176	ha	Vol(max m³) =	3.11
Area =	270	m²	T/G-INV C (m)=	1.7
C =	0.70		Flow Control Device	114

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)	
5	141.18	48.35	10.35	3.11	38.00
10	104.19	35.69	-2.31	-1.39	35.69
15	83.56	28.62	-9.38	-8.44	28.62
20	70.25	24.06	-13.94	-16.73	24.06
25	60.90	20.86	-17.14	-25.72	20.86
30	53.93	18.47	-19.53	-35.15	18.47
35	48.52	16.62	-21.38	-44.90	16.62
40	44.18	15.13	-22.87	-54.88	15.13
45	40.63	13.92	-24.08	-65.03	13.92
50	37.65	12.90	-25.10	-75.31	12.90
55	35.12	12.03	-25.97	-85.70	12.03
60	32.94	11.28	-26.72	-96.18	11.28
65	31.04	10.63	-27.37	-106.73	10.63
70	29.37	10.06	-27.94	-117.35	10.06
75	27.89	9.55	-28.45	-128.02	9.55
80	26.56	9.10	-28.90	-138.73	9.10
85	25.37	8.69	-29.31	-149.49	8.69
90	24.29	8.32	-29.68	-160.28	8.32
95	23.31	7.98	-30.02	-171.10	7.98
100	22.41	7.67	-30.33	-181.95	7.67
105	21.58	7.39	-30.61	-192.83	7.39
110	20.82	7.13	-30.87	-203.73	7.13
115	20.12	6.89	-31.11	-214.65	6.89
120	19.47	6.67	-31.33	-225.59	6.67

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m²	V (factor)	V m³	H m
99	3.000	4.95	0.15
113	3.000	6.01	0.16
127	3.000	7.21	0.17
143	3.000	8.55	0.18
159	3.000	10.06	0.19
176	3.000	11.73	0.2
194	3.000	13.58	0.21
213	3.000	15.62	0.22
233	3.000	17.84	0.23
253	3.000	20.28	0.24
275	3.000	22.92	0.25

Linear interpolation

0.13	0.12	0.13	H (m)=	0.128
3.22	2.53	3.22	3.11	

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA A-8

OTTAWA IDF CURVE			Qallow (L/s)=	39.12
Area =	0.176	ha	Vol(max m³) =	22.39
Area of storage=	275	m²	T/G-INV C(m)=	1.7
C =	0.88		Flow Control Device	114

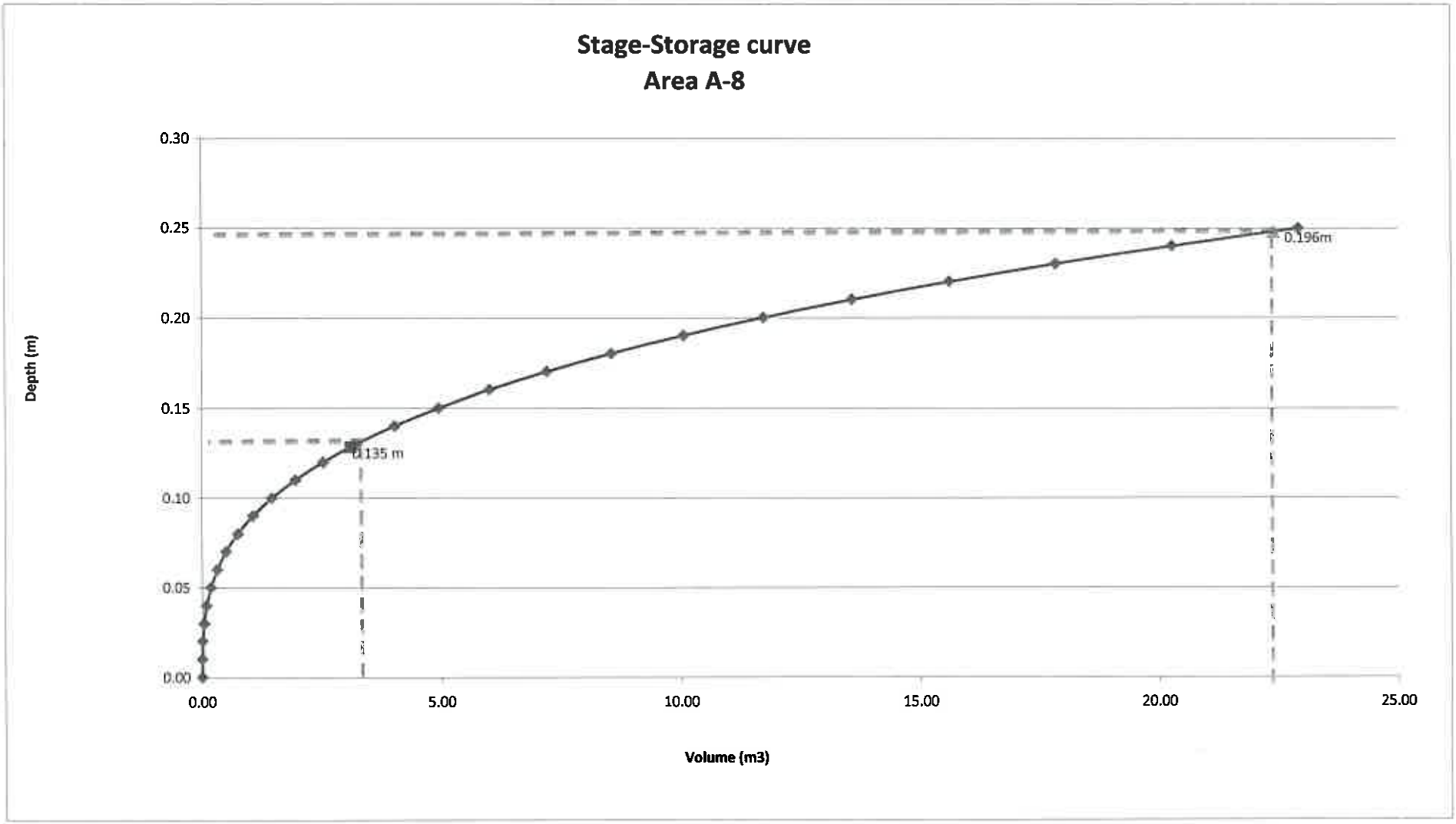
Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m³)	
5	242.70	103.91	64.79	19.44	39.12
10	178.56	76.44	37.32	22.39	39.12
15	142.89	61.18	22.06	19.85	39.12
20	119.95	51.35	12.23	14.68	39.12
25	103.85	44.46	5.34	8.01	39.12
30	91.87	39.33	0.21	0.38	39.12
35	82.58	35.35	-3.77	-7.91	35.35
40	75.15	32.17	-6.95	-16.68	32.17
45	69.05	29.56	-9.56	-25.81	29.56
50	63.95	27.38	-11.74	-35.22	27.38
55	59.62	25.53	-13.59	-44.86	25.53
60	55.89	23.93	-15.19	-54.69	23.93
65	52.65	22.54	-16.58	-64.67	22.54
70	49.79	21.32	-17.80	-74.78	21.32
75	47.26	20.23	-18.89	-85.00	20.23
80	44.99	19.26	-19.86	-95.32	19.26
85	42.95	18.39	-20.73	-105.73	18.39
90	41.11	17.60	-21.52	-116.21	17.60
95	39.43	16.88	-22.24	-126.75	16.88
100	37.90	16.23	-22.89	-137.36	16.23
105	36.50	15.63	-23.49	-148.02	15.63
110	35.20	15.07	-24.05	-158.72	15.07
115	34.01	14.56	-24.56	-169.48	14.56
120	32.89	14.08	-25.04	-180.27	14.08

Ponding depth (1:100yr storm)

B m²	V (factor)	V m³	H m
99	3.000	4.95	0.15
113	3.000	6.01	0.16
127	3.000	7.21	0.17
143	3.000	8.55	0.18
159	3.000	10.06	0.19
176	3.000	11.73	0.2
194	3.000	13.58	0.21
213	3.000	15.62	0.22
233	3.000	17.84	0.23
253	3.000	20.28	0.24
275	3.000	22.92	0.25

Linear interpolation

0.25	0.24	0.25	H (m)=	0.248
22.92	20.28	22.92	22.39	


Stage-Storage curve
Area A-8
Depth (m)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.135 m
0.196m
0.00
5.00
10.00
15.00
20.00
25.00
Volume (m3)

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA A-9

OTTAWA IDF CURVE			Qallow (L/s)=	2.54
Area =	0.030	ha	Vol(max m³) =	1.08
Area =	30	m²	T/G-INV C (m)=	1.7
C =	0.50		Flow Control Device	250

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)	
5	141.18	5.89	3.35	1.00	2.54
10	104.19	4.34	1.80	1.08	2.54
15	83.56	3.48	0.94	0.85	2.54
20	70.25	2.93	0.39	0.47	2.54
25	60.90	2.54	0.00	0.00	2.54
30	53.93	2.25	-0.29	-0.52	2.25
35	48.52	2.02	-0.52	-1.09	2.02
40	44.18	1.84	-0.70	-1.67	1.84
45	40.63	1.69	-0.85	-2.28	1.69
50	37.65	1.57	-0.97	-2.91	1.57
55	35.12	1.46	-1.08	-3.55	1.46
60	32.94	1.37	-1.17	-4.20	1.37
65	31.04	1.29	-1.25	-4.86	1.29
70	29.37	1.22	-1.32	-5.52	1.22
75	27.89	1.16	-1.38	-6.20	1.16
80	26.56	1.11	-1.43	-6.88	1.11
85	25.37	1.06	-1.48	-7.56	1.06
90	24.29	1.01	-1.53	-8.25	1.01
95	23.31	0.97	-1.57	-8.94	0.97
100	22.41	0.93	-1.61	-9.63	0.93
105	21.58	0.90	-1.64	-10.33	0.90
110	20.82	0.87	-1.67	-11.03	0.87
115	20.12	0.84	-1.70	-11.74	0.84
120	19.47	0.81	-1.73	-12.44	0.81

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m²	V (factor)	V m³	H m
11	3.000	0.54	0.15
12	3.000	0.66	0.16
14	3.000	0.79	0.17
16	3.000	0.93	0.18
17	3.000	1.10	0.19
19	3.000	1.28	0.2
21	3.000	1.48	0.21
23	3.000	1.70	0.22
25	3.000	1.95	0.23
28	3.000	2.21	0.24
30	3.000	2.50	0.25

Linear interpolation

0.19	0.18	0.19	H (m)=	0.189
1.10	0.93	1.10	1.08	

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA A-9

OTTAWA IDF CURVE			Qallow (L/s)=	5.41
Area =	0.030	ha	Vol(max m³) =	2.34
Area of storage=	30	m²	T/G-INV C(m)=	1.7
C =	0.63		Flow Control Device	250

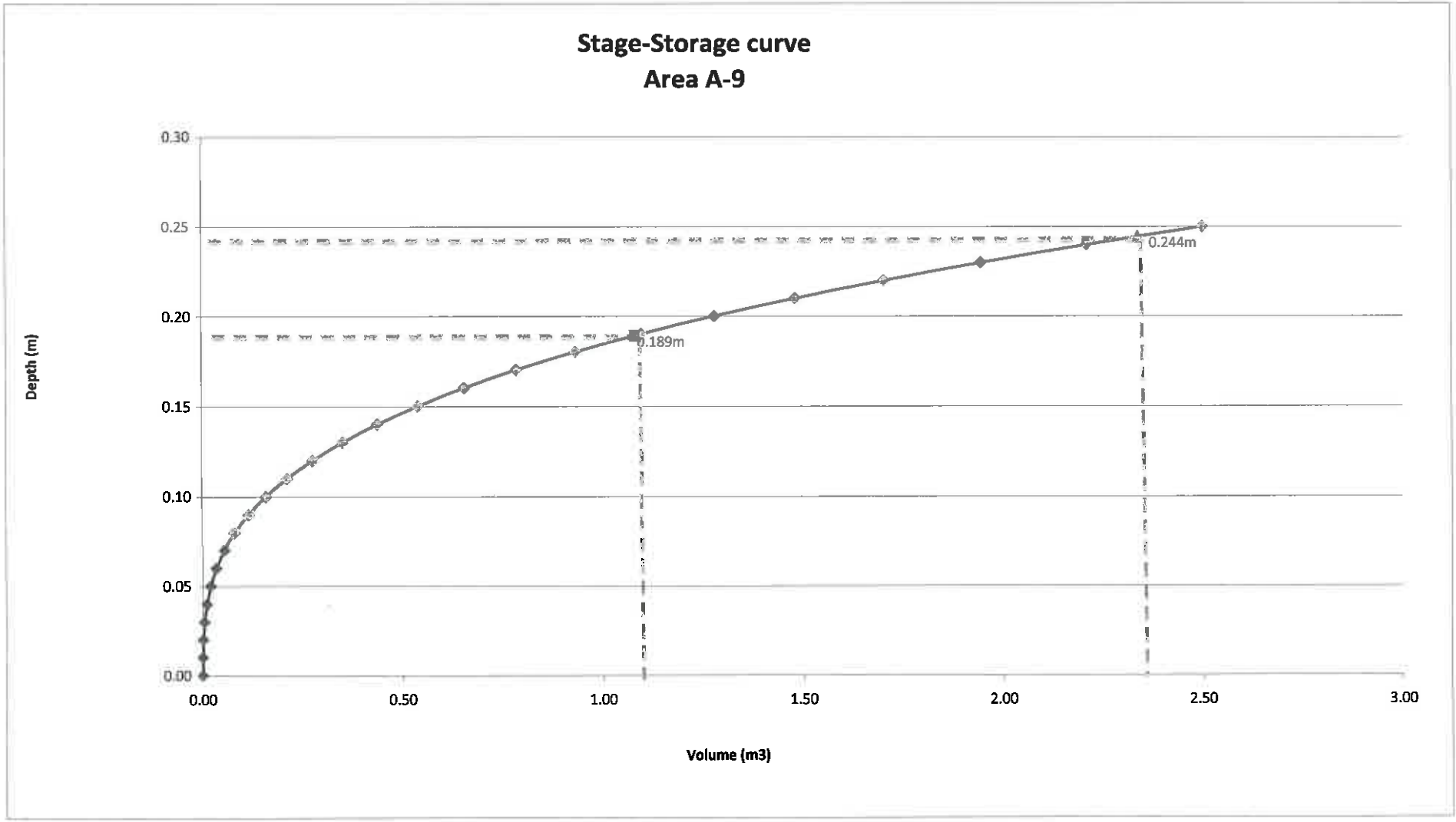
Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m³)	
5	242.70	12.65	7.24	2.17	5.41
10	178.56	9.31	3.90	2.34	5.41
15	142.89	7.45	2.04	1.83	5.41
20	119.95	6.25	0.84	1.01	5.41
25	103.85	5.41	0.00	0.00	5.41
30	91.87	4.79	-0.62	-1.12	4.79
35	82.58	4.30	-1.11	-2.32	4.30
40	75.15	3.92	-1.49	-3.58	3.92
45	69.05	3.60	-1.81	-4.89	3.60
50	63.95	3.33	-2.08	-6.23	3.33
55	59.62	3.11	-2.30	-7.60	3.11
60	55.89	2.91	-2.50	-8.99	2.91
65	52.65	2.74	-2.67	-10.40	2.74
70	49.79	2.60	-2.81	-11.82	2.60
75	47.26	2.46	-2.95	-13.26	2.46
80	44.99	2.35	-3.06	-14.71	2.35
85	42.95	2.24	-3.17	-16.17	2.24
90	41.11	2.14	-3.27	-17.64	2.14
95	39.43	2.06	-3.35	-19.12	2.06
100	37.90	1.98	-3.43	-20.61	1.98
105	36.50	1.90	-3.51	-22.10	1.90
110	35.20	1.83	-3.58	-23.60	1.83
115	34.01	1.77	-3.64	-25.10	1.77
120	32.89	1.71	-3.70	-26.61	1.71

Ponding depth (1:100yr storm)

B m²	V (factor)	V m³	H m
11	3.000	0.54	0.15
12	3.000	0.66	0.16
14	3.000	0.79	0.17
16	3.000	0.93	0.18
17	3.000	1.10	0.19
19	3.000	1.28	0.2
21	3.000	1.48	0.21
23	3.000	1.70	0.22
25	3.000	1.95	0.23
28	3.000	2.21	0.24
30	3.000	2.50	0.25

Linear interpolation

0.25	0.24	0.25	H (m)=	0.244
2.50	2.21	2.50	2.34	


Stage-Storage curve
Area A-9
Depth (m)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.244m
0.189m
0.00
0.50
1.00
1.50
2.00
2.50
3.00
Volume (m3)

Block 47

Project:111156
3/7/2012

REQUIRED STORAGE - 5-YEAR EVENT
SUPERPIPE

OTTAWA IDF CURVE

Area = 0.0000 ha
C = 0.00
Qallow = 20.95
Vol(max) = 44.25

Time (min)	Intensity (mm/hr)	$Q_{Uncontrolled}$ (L/s)	$Q_{Controlled}$ (L/s)	Qnet (L/s)	Vol (m^3)
5	141.18	0.00	76.21	55.26	16.58
10	104.19	0.00	68.99	48.04	28.82
15	83.56	0.00	60.93	39.98	35.98
20	70.25	0.00	54.86	33.91	40.70
25	60.90	0.00	50.05	29.10	43.65
30	53.93	0.00	45.53	24.58	44.25
35	48.52	0.00	41.91	20.96	44.02
40	44.18	0.00	38.94	17.99	43.18
45	40.63	0.00	36.19	15.24	41.15
50	37.65	0.00	33.76	12.81	38.43
55	35.12	0.00	31.66	10.71	35.36
60	32.94	0.00	29.84	8.89	32.00
65	31.04	0.00	28.23	7.28	28.40
70	29.37	0.00	26.81	5.86	24.59
75	27.89	0.00	25.53	4.58	20.61
80	26.56	0.00	24.38	3.43	16.48
85	25.37	0.00	23.34	2.39	12.21
90	24.29	0.00	22.40	1.45	7.83
95	23.31	0.00	21.54	0.59	3.34
100	22.41	0.00	20.74	-0.21	-1.24

REQUIRED STORAGE - 100-YEAR EVENT
SUPERPIPE

OTTAWA IDF CURVE

Area = 0.0000 ha
C = 0.00
Qallow = 31.91
Vol(max) = 100.36

Time (min)	Intensity (mm/hr)	$Q_{Uncontrolled}$ (L/s)	$Q_{Controlled}$ (L/s)	Qnet (L/s)	Vol (m^3)
5	242.70	0.00	86.26	54.35	16.31
10	178.56	0.00	86.26	54.35	32.61
15	142.89	0.00	86.26	54.35	48.92
20	119.95	0.00	86.26	54.35	65.22
25	103.85	0.00	85.64	53.73	80.59
30	91.87	0.00	80.78	48.87	87.97
35	82.58	0.00	76.72	44.81	94.11
40	75.15	0.00	73.36	41.45	99.47
45	69.05	0.00	69.05	37.14	100.28
50	63.95	0.00	65.36	33.45	100.36
55	59.62	0.00	61.90	29.99	98.96
60	55.89	0.00	58.88	26.97	97.10
65	52.65	0.00	56.23	24.32	94.85
70	49.79	0.00	53.74	21.83	91.68
75	47.26	0.00	51.40	19.49	87.72
80	44.99	0.00	49.30	17.39	83.48
85	42.95	0.00	47.40	15.49	79.00
90	41.11	0.00	45.67	13.76	74.32
95	39.43	0.00	44.09	12.18	69.44
100	37.90	0.00	42.64	10.73	64.40

Superpie

Pipe Dia	900	mm
Diameter	0.9144	m
Radius	0.4572	m
Area	0.657	m^2
Length	157	m
Slope	0.17%	

Flow / Storage Summary

Flow Req.		Volume Req.	
Qact. = 5yr	20.95 L/s	5yr	44.25 m^3
Qact. = 100yr	31.91 L/s	100yr	100.36 m^3
Flow Allowable		Flow Check	
5yr	21.00 L/s	GOOD	
100yr	38.52 L/s	GOOD	

Outlet control

Orifice = 130 mm
A= 0.0133 m^2
h = Depth - (Diameter/2)
C = 0.61
$Q = C \times A \times (2*g*H)^{1/2}$

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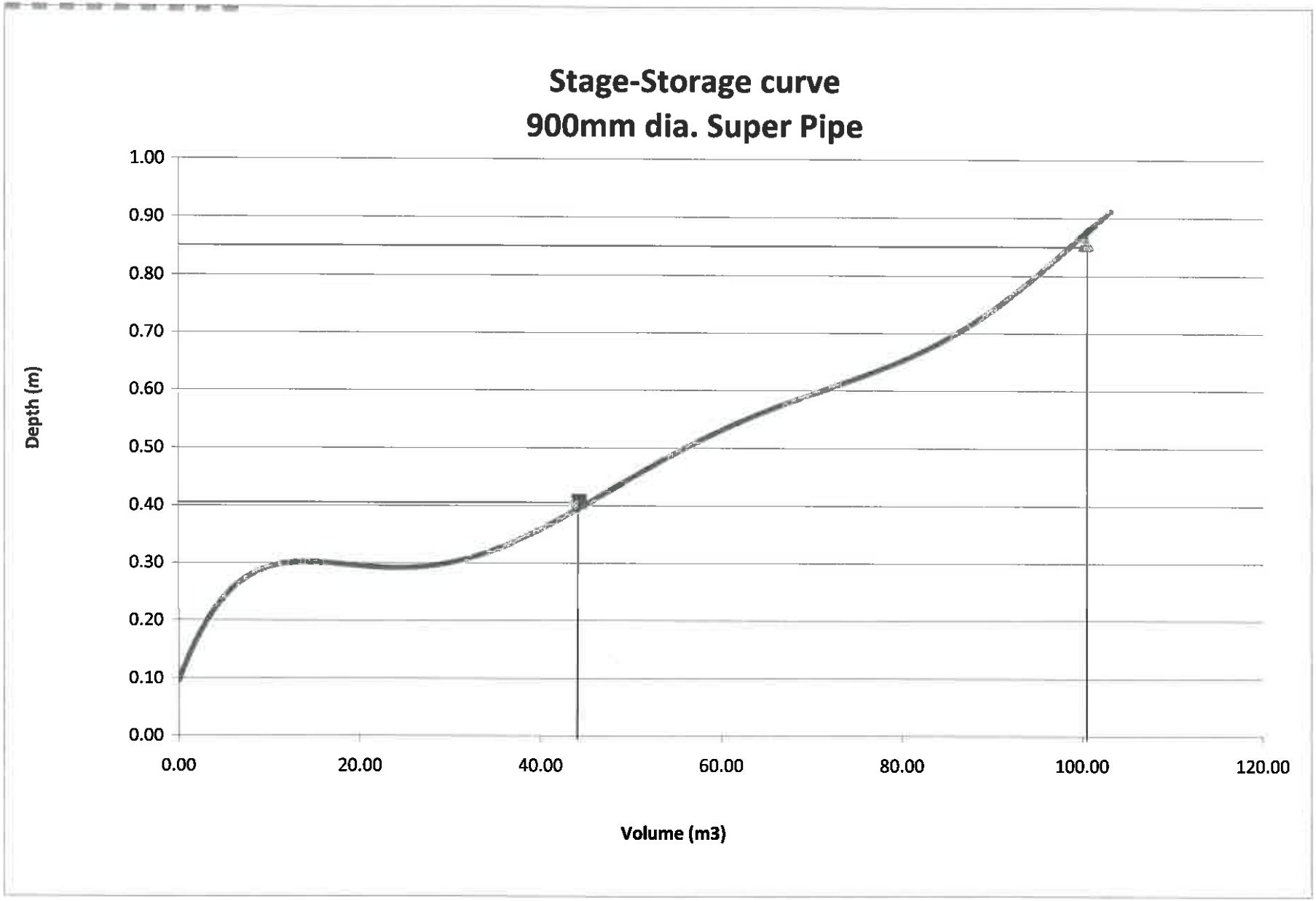
Block 47

Project:111156
3/7/2012

Actual Flow - 5 Year				
0.4149	0.4049	0.4149	Height(m)=	0.406
45.49	44.06	45.49	44.25	
			H (m)=	0.341
			Q=	20.95

Actual Flow - 100 year				
0.8649	0.8549	0.8649	Height(m)=	0.857
100.92	100.25	100.92	100.36	
			H (m)=	0.792
			Q=	31.91


Stage-Storage curve
900mm dia. Super Pipe
Depth (m)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
Volume (m3)

APPENDIX B

SITE PLAN - SANITARY AND STORM SEWER DESIGN SHEETS

BLOCK 47 - ANTIGONISH AVE.
STORM SEWER DESIGN SHEET (5-YEAR EVENT)

JOB# 111156

NOVATECH ENGINEERING CONSULTANTS LTD.

LOCATION				AREA (ha)						FLOW							SEWER DATA								
Street	Area ID	From Node	To Node	R= 0.45	R= 0.50	R= 0.70	R= 0.78	R= 0.80	R= 0.90	Indiv 2.78 AC	Accum 5 2.78 AC	Time of Conc	Design Storm	Rainfall Intensity	Peak Flow (L/sec) Q.5	Qtotal	Dia (m) Actual	Dia (mm)	Type	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Flow Time (min)	Ratio Q/Q full
I. Parking Lot Outlet																									
	A7,A9	STMMH 6	STMMH 5		0.030		0.058			0.17	0.17	10.00	5	104.19	17.4	17.4	0.914	900	CONC	0.10	26.7	596.9	0.91	0.49	3%
												10.49													
	A8	STM MH 8	STMMH 5			0.176				0.34	0.34	10.00	5	104.19	35.7	35.7	0.914	900	CONC	0.10	18.6	596.9	0.91	0.34	6%
												10.34													
	A-6	STMMH 5	STMMH 4						0.037	0.09	0.60	10.49	5	101.68	61.3	61.3	0.914	900	CONC	0.10	37.3	596.9	0.91	0.68	10%
		STMMH 4	STMMH 3							0.00	0.60	11.17	5	98.38	59.3	59.3	0.914	900	CONC	0.10	10.7	596.9	0.91	0.20	10%
												11.37													
	A5	STMMH 7	STMMH 3			0.123				0.24	0.24	10.00	5	104.19	24.9	24.9	0.914	900	CONC	0.10	18.0	596.9	0.91	0.33	4%
												10.33													
		STMMH 3	STMMH 2							0.00	0.84	11.37	5	97.48	82.1	82.1	0.914	899	CONC	0.10	13.5	596.9	0.91	0.25	14%
	A4	STMMH 2	STMMH 1					0.030		0.07	0.91	11.37	5	97.48	88.6	88.6	0.914	900	CONC	0.10	25.5	596.9	0.91	0.47	15%
	A3	STMMH 1	Existing MH (Antigonish)	0.042						0.05	0.96	11.84	5	95.40	91.7	91.7	0.381	375	PVC	0.35	13.4	108.1	0.95	0.24	85%
												12.07													

DESIGN PARAMETERS

Definitions:

Q = 2.78 AIR, where

Q= Peak Flow in Litres per Second (l/s)

A= Area in hectares (ha)

I= Rainfall Intensity (mm/hr)

R= Runoff Coefficient

PROJECT INFORMATION		
Project : Block 47 - Antigonish Ave.		
Consultant: Novatech Engineering Consultants Ltd.		
Date:		December 21, 2011
Design By:	David Smith, Bassam Bahia	
Client:	**Dwg. Reference:**	**Checked and Stamped:**
Clairdge Homes	111156-STM	G.J. MacDONALD

BLOCK 47 - ANTIGONISH AVE.
STORM SEWER: HYDRAULIC GRADE LINE ANALYSIS (100-YEAR EVENT)

This spreadsheet uses the Darcy-Weisbach equation to calculate hydraulic losses through a pipe network with a specified flow rate. Minor losses are accounted for including both pipe bend losses and structure losses.
The spreadsheet returns the upstream hydraulic grade line if surcharged, or the pipe obvert if free flow conditions exist. The HGL slope is calculated and the minimum USF is established +0.30m above the HGL.
The peak flows used in the HGL analysis are based on the capture rate of the CBs for the 100-year event.

LOCATION	MANHOLE		INVERT ELEVATION		GROUND ELEVATION	COVER	PIPE PARAMETERS			TOTAL FLOW	Q_{cap}	Q_{in}/Q_{cap}	COMPUTATIONAL COLUMNS					HEAD LOSS	SURCHARGE	HGL			MIN USF	PIPE
	U/S	D/S	U/S (m)	D/S (m)	U/S (m)	U/S (m)	Dia (mm)	Length (m)	'n'	(m^3/s)	(m^3/s)		Pipe Area (m^2)	L/D	Friction Factor (f)	Velocity V (m/s)	$V^2/2g$	HL (m)	U/S (m)	U/S (m)	D/S (m)	Slope (%)	(m)	Slope (%)
																				81.66	<- MH204 (100yr level)			
	1	EX 204	81.350	81.303	84.43	2.705	375	13.4	0.013	0.0319	0.108	0.29	0.114	36	0.02920	0.28	0.0040	0.0122	0.00	81.73	81.66	0.49	82.03	0.35
	2	1	81.380	81.354	85.03	2.750	900	25.5	0.013	0.0802	0.603	0.13	0.657	28	0.02181	0.12	0.0008	0.0008	0.00	82.28	81.73	2.18	82.58	0.10
	3	2	81.424	81.410	85.04	2.716	900	13.5	0.013	0.0752	0.608	0.12	0.657	15	0.02181	0.11	0.0007	0.0005	0.00	82.32	82.28	0.33	82.62	0.10
	4	3	81.499	81.490	85.08	2.681	900	10.7	0.013	0.0545	0.548	0.10	0.657	12	0.02181	0.08	0.0004	0.0003	0.00	82.40	82.32	0.70	82.70	0.08
	5	4	81.570	81.530	85.10	2.630	900	37.3	0.013	0.0545	0.618	0.09	0.657	41	0.02181	0.08	0.0004	0.0004	0.00	82.47	82.40	0.19	82.77	0.11
	6	5	81.600	81.572	85.15	2.650	900	26.7	0.013	0.0104	0.612	0.02	0.657	30	0.02181	0.02	0.0000	0.0000	0.00	82.50	82.47	0.11	82.80	0.10
	8	5	81.650	81.634	84.80	2.250	900	18.6	0.013	0.0391	0.554	0.07	0.657	21	0.02181	0.06	0.0002	0.0003	0.00	82.55	82.47	0.43	82.85	0.09
	7	3	81.500	81.485	84.83	2.430	900	18.5	0.013	0.0207	0.538	0.04	0.657	21	0.02181	0.03	0.0001	0.0001	0.00	82.40	82.28	0.65	82.70	0.08

DESIGN PARAMETERS

DOWNSTREAM WATER LEVEL: WATER LEVEL OF EXISTING SEWER AT MH 202 = 81.73m
RETURN FREQUENCY = 100 YEARS
MINIMUM VELOCITY= 0.80 m/s
MANNING'S n= 0.013
MIN. HGL CLEARANCE to USF= 0.30m

HGL=Major + Minor Losses
Major Loss= Pipe Friction (Darcy-Weisbach)
Minor Loss= Head loss correction for flow through MH, changes in pipe size, and pipe bends
Friction Factor= 8g/c^2, where c=(1/n)*(D/4)^1/6

Designed: BHB	Project: Antigonish Road Stacked Townhouses
Checked: GJM	Client:
Dwg. Reference: 111156-STM	Date: December 23, 2012

SANITARY DESIGN SHEET
Block 47 - Antigonish Ave.
Proposed Site to Existing Sanitary Sewer
JOB #111156

NOVATECH ENGINEERING CONSULTANTS LTD.

LOCATION			INDIVIDUAL AREA AND POPULATION			CUMULATIVE AREA & POPULATION		FLOWS INCLUDING OFFICE AREA					PROPOSED SEWER						
Street	From MH	To MH	Area (ha)	Occupancy Area: Residential Units	Occupancy Area: Population	Area (ha)	Pop.	Peak Factor (Res)	Peak Factor (Com)	Pop. Flow (L/s)	Infiltration Flow (L/s)	Total Flow (L/s)	Length (m)	Dia Act (mm)	Dia Nom (mm)	Slope (%)	Velocity (Full) (m/s)	Capacity (Full) (L/s)	Ratio Q/Qfull (%)
Block 47	5	4	0.344	24.00	50.4	0.344	50.4	4.00	1.50	0.82	0.10	0.91	66.4	203.2	200	0.35	0.62	20.2	5%
Block 47	4	3	0.017	0.00	0.0	0.361	50.4	4.00	1.50	0.82	0.10	0.92	11.2	203.2	200	0.35	0.62	20.2	5%
Block 47	6	3	0.106	12.00	25.2	0.106	25.2	4.00	1.50	0.41	0.03	0.44	19.0	203.2	200	0.35	0.62	20.2	2%
Block 47	3	2	0.010	0.00	0.0	0.477	75.6	4.00	1.50	1.23	0.13	1.36	11.7	203.2	200	0.35	0.62	20.2	7%
Block 47	2	1	0.074	0.00	0.0	0.551	75.6	4.00	1.50	1.23	0.15	1.38	26.0	203.2	200	0.35	0.62	20.2	7%
Block 47	1	Ex	0.000	0.00	0.0	0.551	75.6	4.00	1.50	1.23	0.15	1.38	10.8	203.2	200	0.35	0.62	20.2	7%

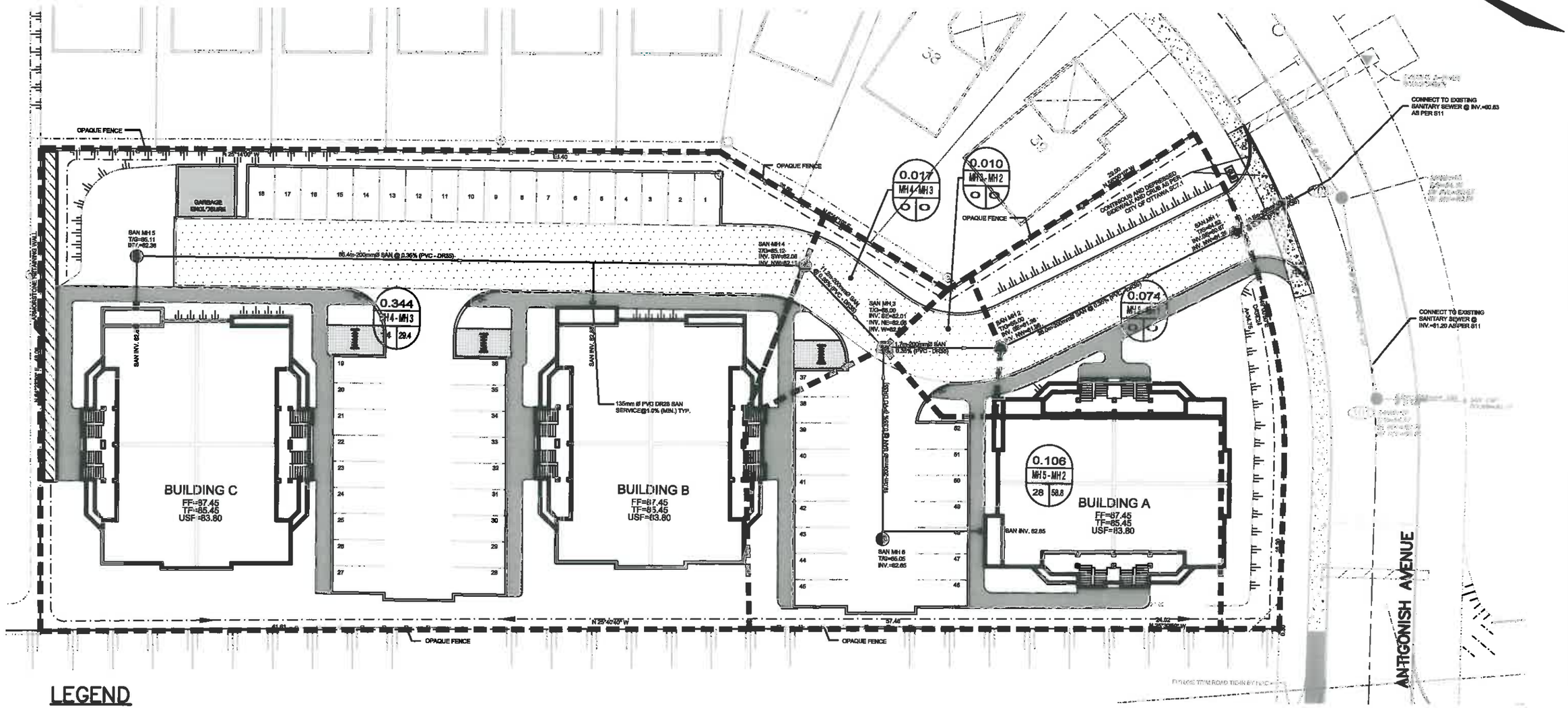
DESIGN PARAMETERS

Appartment Population Density = 2.1 person/unit
Residential Average Flow = 350 L/person/day
Infiltration Flow = 0.28 L/s/ha
Manning's n= 0.013
Peak factor based on Harmon Equation = 1+(14/4+Pop/1000)^1/2)*1 - (Maximum of 4.0)

Notes:

Project: Royal Ridge Subdivision - Block 47
Client: Claridge Homes
Date: March 12, 2012
All flows taken from the Ottawa Sewer Design Guide Figure 4

Designed: BHB
Checked: BHB
Dwg. Reference: Figure 3



LEGEND

- 0.288 / MH4 - MH3 / 14 | 28.4 — AREA IN HECTARES; MANHOLE TO MANHOLE; POPULATION EQUIVALENT; NUMBER OF UNITS
- SANITARY DRAINAGE AREA BOUNDARY
- DIRECTION OF FLOW
- PROPOSED SANITARY SEWER AND MANHOLE
- *EXISTING SANITARY SEWER AND MANHOLE*

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Facsimile (613) 254-5867
Email: novainfo@novatech-eng.com

ROYAL RIDGE SUBDIVISION - BLOCK 47

PROPOSED SANITARY DRAINAGE PLAN

NOV. 2011 | 111156 | FIG 3

M:\2011\111156\CAD\Design\Figures\111156-FIG3.DWG, FIG4, Mar 15, 2012 - 4:26pm, alambros

SHT11X17.DWG - 279mm X 432mm

SANITARY SEWER DESIGN SHEET

PROJECT #: 111156

DESIGNED BY :BHB
CHECKED BY : GM

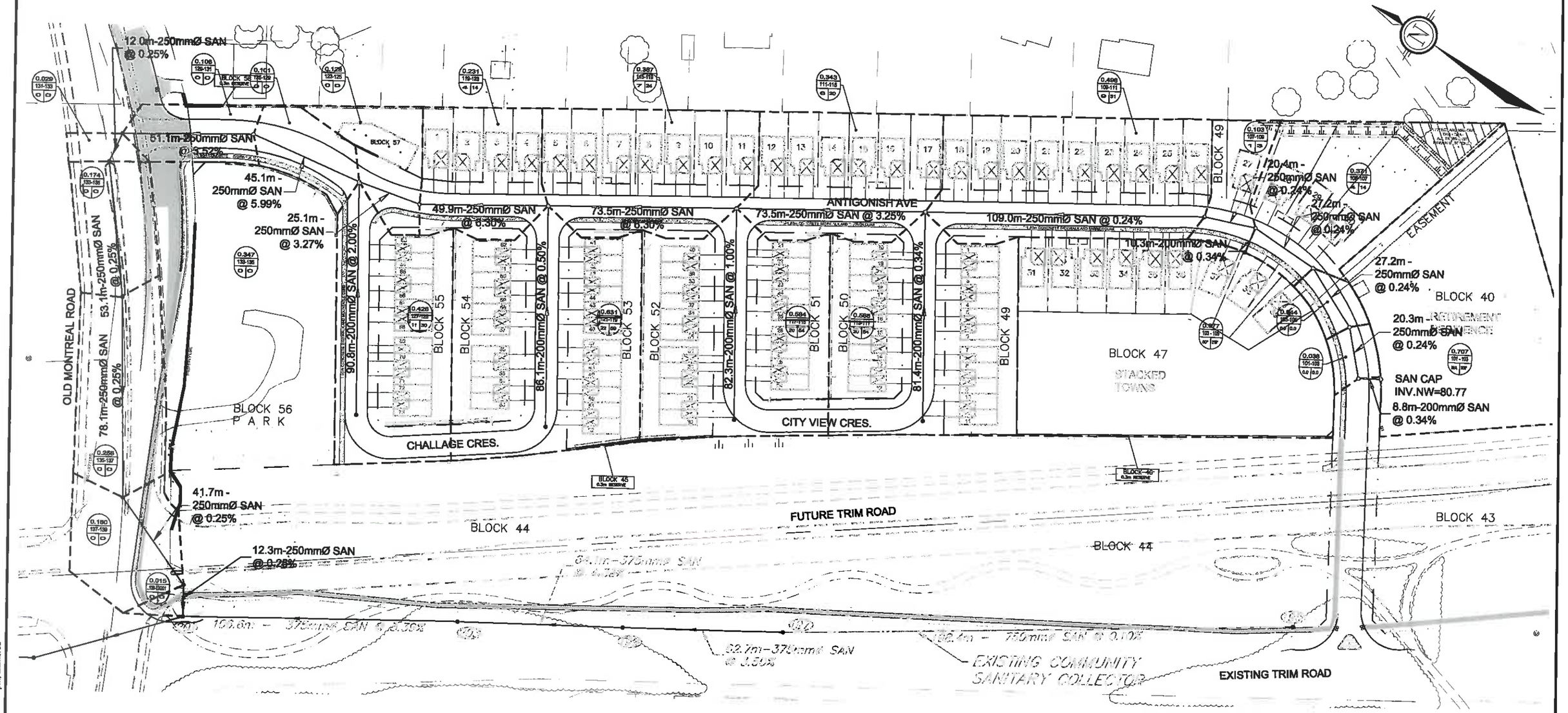
PROJECT: Royal Ridge Subdivision
DEVELOPER: Claridge Homes

DATE: January 16, 2012

LOCATION			INVERTS		UNITS			INDIVIDUAL		CUMULATIVE		PEAK	POPULATION FLOW	PEAK EXTRAN.	PEAK DESIGN	PROPOSED SEWER						
STREET	FROM MH	TO MH	UPS	DWS	Apt. / Stacked Towns	Town	Single	Population (in 1000's)	AREA (ha.)	Population (in 1000's)	AREA (ha.)	FACTOR (M)	Q(p) L/s	FLOW Q(e) (L/s)	FLOW Q(d) (L/s)	LENGTH (m)	PIPE SIZE (mm)	TYPE OF PIPE	GRADE %	CAPACITY (L/s)	Ratio Q/Qfull (%)	FULL FLOW VELOCITY (m/s)
CITYVIEW CRESCENT	*113*	*111*	*80.58*	*80.30*		*20*		*0.054*	*0.57*	*0.054*	*0.57*	*4.0*	*0.88*	*0.16*	*1.03*	*81.4*	*200*	*PVC*	*0.34*	*19.95*	*5.18*	*0.62*
CITYVIEW CRESCENT	*117*	*115*	*78.57*	*77.75*		*20*		*0.054*	*0.58*	*0.054*	*0.58*	*4.0*	*0.88*	*0.16*	*1.04*	*82.3*	*200*	*PVC*	*1.00*	*34.22*	*3.04*	*1.06*
CHALLENGE CRESCENT	*121*	*119*	*73.01*	*72.58*		*22*		*0.059*	*0.63*	*0.059*	*0.63*	*4.0*	*0.96*	*0.18*	*1.14*	*86.1*	*200*	*PVC*	*0.50*	*24.19*	*4.71*	*0.75*
CHALLENGE CRESCENT	*127*	*125*	*70.31*	*68.50*		*11*		*0.030*	*0.43*	*0.030*	*0.43*	*4.0*	*0.48*	*0.12*	*0.60*	*90.8*	*200*	*PVC*	*2.00*	*48.39*	*1.24*	*1.49*
ANTIGONISH AVENUE	**101**	**103**	**80.68**	**80.63**	**95.00**	**FUTURE**		**0.200**	**0.75**	**0.200**	**0.75**	**4.0**	**3.23**	**0.21**	**3.44**	**20.3**	**250**	**PVC**	**0.24**	**30.39**	**11.32**	**0.60**
ANTIGONISH AVENUE (incl Block 47)	**103**	**105**	**80.59**	**80.53**	**35.00**		*2*	**0.082**	**0.64**	**0.282**	**1.39**	**4.0**	**4.57**	**0.39**	**4.96**	**27.2**	**250**	**PVC**	**0.24**	**30.39**	**16.31**	**0.60**
ANTIGONISH AVENUE	*105*	*107*	*80.49*	*80.42*			*3*	*0.010*	*0.41*	*0.292*	*1.80*	*4.0*	*4.73*	*0.50*	*5.24*	*27.2*	*250*	*PVC*	*0.24*	*30.39*	*17.23*	*0.60*
ANTIGONISH AVENUE	*107*	*109*	*80.38*	*80.33*			*2*	*0.007*	*0.14*	*0.299*	*1.94*	*4.0*	*4.84*	*0.54*	*5.39*	*20.4*	*250*	*PVC*	*0.24*	*30.39*	*17.72*	*0.60*
ANTIGONISH AVENUE	*109*	*111*	*80.29*	*80.03*			*15*	*0.051*	*0.75*	*0.350*	*2.69*	*4.0*	*5.67*	*0.75*	*6.42*	*109.0*	*250*	*PVC*	*0.24*	*30.39*	*21.13*	*0.60*
ANTIGONISH AVENUE	*111*	*115*	*79.99*	*77.60*			*6*	*0.020*	*0.34*	*0.424*	*3.60*	*4.0*	*6.89*	*1.01*	*7.90*	*73.5*	*250*	*PVC*	*3.25*	*111.84*	*7.06*	*2.21*
ANTIGONISH AVENUE	*115*	*119*	*77.56*	*72.93*			*7*	*0.024*	*0.39*	*0.502*	*4.57*	*4.0*	*8.08*	*1.28*	*9.36*	*73.5*	*250*	*PVC*	*6.30*	*155.72*	*6.01*	*3.07*
ANTIGONISH AVENUE	*119*	*123*	*72.54*	*69.39*			*4*	*0.014*	*0.23*	*0.575*	*5.43*	*3.9*	*9.18*	*1.52*	*10.71*	*49.9*	*250*	*PVC*	*6.30*	*155.72*	*6.87*	*3.07*
ANTIGONISH AVENUE	*123*	*125*	*69.35*	*68.53*				*0.000*	*0.13*	*0.575*	*5.56*	*3.9*	*9.18*	*1.56*	*10.74*	*25.1*	*250*	*PVC*	*3.27*	*112.19*	*9.57*	*2.21*
ANTIGONISH AVENUE	*125*	*129*	*68.38*	*65.68*				*0.000*	*0.10*	*0.605*	*6.09*	*3.9*	*9.63*	*1.70*	*11.33*	*45.1*	*250*	*PVC*	*5.99*	*151.84*	*7.46*	*3.00*
ANTIGONISH AVENUE	*129*	*131*	*65.64*	*63.84*				*0.000*	*0.11*	*0.605*	*6.20*	*3.9*	*9.63*	*1.73*	*11.36*	*51.1*	*250*	*PVC*	*3.52*	*116.40*	*9.76*	*2.30*
								0.000														
OLD MONTREAL ROAD	*131*	*133*	*63.81*	*63.78*				*0.000*	*0.03*	*0.605*	*6.22*	*3.9*	*9.63*	*1.74*	*11.37*	*12.0*	*250*	*PVC*	*0.25*	*31.02*	*36.66*	*0.61*
OLD MONTREAL ROAD	*133*	*135*	*63.77*	*63.66*				*0.000*	*0.17*	*0.605*	*6.40*	*3.9*	*9.63*	*1.79*	*11.42*	*53.1*	*250*	*PVC*	*0.25*	*31.02*	*36.82*	*0.61*
OLD MONTREAL ROAD	*135*	*137*	*63.60*	*63.40*				*0.000*	*0.26*	*0.605*	*6.66*	*3.9*	*9.63*	*1.86*	*11.49*	*78.1*	*250*	*PVC*	*0.25*	*31.02*	*37.05*	*0.61*
OLD MONTREAL ROAD	*137*	*139*	*63.37*	*63.27*				*0.000*	*0.18*	*0.605*	*6.84*	*3.9*	*9.63*	*1.91*	*11.54*	*41.7*	*250*	*PVC*	*0.25*	*31.02*	*37.21*	*0.61*
OLD MONTREAL ROAD	*139*	*EX 201*	*63.26*	*63.23*				*0.000*	*0.02*	*0.605*	*6.85*	*3.9*	*9.63*	*1.92*	*11.55*	*12.3*	*250*	*PVC*	*0.25*	*31.02*	*37.23*	*0.61*
TOTAL					**131**	**73**	**39**			**0.605**	**6.851**											

1. Q(e) = 0.28 L/sec/ha
2. Q(p) = (PxqxM/86,400)
3. Q(d) = Q(p) + Q(e)

where P = Population (2.1 people/per Apartment or Stacked Townhouse, 2.7 people/per Townhouse, 3.4 people/per Single)
q = Average per capita flow = 350 L/person/day
M = Residential Peaking Factor (Harmon Formula from section 4.4.1 of the City Sewer Design Guidelines) - max 4.0
N = Industrial Peaking Factor (Appendix 4-B "Peaking Factor for Industrial Areas" from City Design Guidelines
Q(d) = Design Flow (L/sec)
Q(p) = Population Flow (L/sec)
Q(e) = Extraneous Flow (L/sec)



LEGEND

- 0.103 / 107 - 109 / 1 | 3 — AREA IN HECTARES; MANHOLE TO MANHOLE; POPULATION EQUIVALENT; NUMBER OF UNITS
- SANITARY DRAINAGE AREA BOUNDARY
- DIRECTION OF FLOW
- 101 — PROPOSED SANITARY SEWER AND MANHOLE
- 101 — EXISTING SANITARY SEWER AND MANHOLE

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ROYAL RIDGE SUBDIVISION - BLOCK 47

SUBDIVISION SANITARY DRAINAGE PLAN

NOV. 2011 | 111156 | FIG 4

APPENDIX C

ROYAL RIDGE SUBDIVISION MOE CERTIFICATE OF APPROVALs

SAN & STM

Ontario

Ministry of the Environment
Ministère de l'Environnement

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 7972-7ZQPXH
Issue Date: January 18, 2010

Claridge Homes (Trim Rd) Inc.
210 Gladstone Avenue, Suite 2001
Ottawa, Ontario
K2P 0Y6

Site Location: 940 Old Montreal Road
Part 1, RP 4R-22747,
Lot 30, Concession 1, Ward 1
City of Ottawa, Ontario

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

sanitary and storm sewers to be constructed in the City of Ottawa, on Old Montreal Road, Antigonish Avenue, Challenge Crescent and Cityview Crescent;

all in accordance with the application from Claridge Homes (Trim Rd) Inc., dated December 17, 2009, including final plans and specifications prepared by Novatech Engineering Consultants Limited.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto, Ontario
M5G 1E5

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the**

SAN D5TM

Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 18th day of January, 2010

Zafar Bhatti, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

DF/
c: District Manager, MOE Ottawa District Office
Rick G. O'Connor, Solicitor/Clerk, City of Ottawa
Karin Smadella, Program Manager, Development Review, City of Ottawa
Linda Carkner, Program Manager, Infrastructure Management Division, City of Ottawa
Greg Macdonald, P.Eng., Novatech Engineering Consultants Limited

Swm

Ontario

Ministry of the Environment
Ministère de l'Environnement

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 5372-835QP7
Issue Date: April 15, 2010

Claridge Homes (Trim Road) Inc.
210 Gladstone Ave, No. Suite 2001
Ottawa, Ontario
K2P 0Y6

Site Location: Royal Ridge Subdivision
940 Old Montreal Road
Part 1, RP 4R-22747, Lot 30, Concession 1
City of Ottawa

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

- ***storm*** and ***sanitary sewers*** to be constructed in the proposed Royal Ridge Subdivision;

- ***stormwater management works including stormwater management facility*** to be constructed at Royal Ridge Subdivision, in the City of Ottawa, comprising the following:

4.19 ha Drainage Area discharging to Unnamed Tributary

Quantity Control

- storage in road sags of approximately 77 cubic metres under 100 year storm event;
- four (4) inlet control devices installed within catch basins, releasing a combined flow of 115 L/s;
- one (1) orifice installed in the catch basin DICB 601, releasing a flow of 6 L/s under a head of 1.5 m with 260 cubic metres of storage provided at 1.0m depth ***(Interim Works)***;

Quality Control

- Vortechs 2 Unit, Model 5000 Inline installed downstream of MH 210, providing treatment to an impervious drainage area of 3.13 ha, having a sediment storage capacity of 2.45 cubic metres, oil capacity of 1383 litres and a total holding capacity of 7731 litres, peak treatment capacity of 240.7 L/s, providing enhanced level treatment (80% TSS removal), outletting to the unnamed tributary;

5.43 ha Drainage Area discharging to Cardinal Creek via Old Montreal Road

Quantity Control

- run off storage in the storage tank of approximately 699.2 cubic metres installed with four outlet orifices to control the flow from 25mm to 100 year storm event;
- twenty nine (29) inlet control devices installed within catch basins controlling the combined post development flow rate to 1259 L/s;

Quality Control

SWM

• Vortechs 1 Unit, Model 7000 offline installed downstream of MH 122, providing treatment to an impervious drainage area of 4.93 ha, having a sediment storage capacity of 3.065 cubic metres, oil capacity of 1687 litres and a total holding capacity of 9515 litres, peak treatment capacity of 311.5 L/s, providing enhanced level treatment (80% TSS removal), outletting to an existing Old Montreal Road Culvert;

3.22 ha Drainage Area discharging to Trim Road Ditch ***(Interim Works)***

Quantity Control

• storage within the ditches of approximately 260 cubic metres under 100 year storm event;
• flow control orifice, 180mm diameter controlling the flow to 105 L/s under a head of 2.26m with 260 cubic metres of storage provided at 1.5 metres depth;

all in accordance with the application dated December 17, 2009 and received on January 13, 2010, and all supporting documentation and information associated with the application including final plans and specifications prepared by Novatech Engineering Consultants Limited.

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

(1) "*Certificate*" means this entire Certificate of Approval document, issued in accordance with Section 53 of the *Ontario Water Resources Act*, and includes any schedules;

(2) "*Owner*" means Claridge Homes (Trim Road) Inc. and includes its successors and assignees; and

(3) "*Works*" means the sewage works described in the *Owner*'s application, this *Certificate* and in the supporting documentation referred to herein, to the extent approved by this *Certificate*.

(4) *"Interim Works"* means the works to be used for short-term purposes only and will be for no more than five (5) years from the date of issuance of this *Certificate,* until otherwise approval for an extension of this period has been granted.

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITIONS

1.1 The *Owner* shall ensure that any person authorized to carry out work on or operate any aspect of the *Works* is notified of this *Certificate* and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

1.2 Except as otherwise provided by these Conditions, the *Owner* shall design, build, install, operate and maintain the *Works* in accordance with the description given in this *Certificate*, the application for approval of the works and the submitted supporting documents and plans and specifications as listed in this *Certificate*.

1.3 Where there is a conflict between a provision of any submitted document referred to in this *Certificate* and the Conditions of this *Certificate*, the Conditions in this *Certificate* shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

1.4 Where there is a conflict between the listed submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

1.5 The requirements of this *Certificate* are severable. If any requirement of this *Certificate*, or the application of any requirement of this *Certificate* to any circumstance, is held invalid or unenforceable, the application of such requirement to other circumstances and the remainder of this *Certificate* shall not be affected thereby.

SW/M

2. EXPIRY OF APPROVAL

2.1 The approval issued by this *Certificate* will cease to apply to those parts of the *Works* which have not been constructed within five (5) years of the date of this *Certificate*.

2.2 This Certificate of Approval will cease to apply to the *Interim* Works as of June 30, 2015 until otherwise approval for an extension of this date has been granted. If an approval of such an extension has not been granted, then in such a case the *Owner* shall submit a written report to the *District Manager* by December 31, 2014 outlining the procedures or plans on how the *Interim Works* will be decommissioned by the expiry date.

3. OPERATION AND MAINTENANCE

3.1 The *Owner* shall carry out and maintain an annual inspection and maintenance program on the operation of the *Works*.

3.2 After a two (2) year period, the District Manager of the MOE District Office may alter the frequency of inspection of the *Works* if he/she is requested to do so by the *Owner* and considers it acceptable upon review of information submitted in support of the request.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition No.1 is imposed to ensure that the *Works* are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the *Certificate* and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review. The condition also advises the Owners their responsibility to notify any person they authorized to carry out work pursuant to this *Certificate* the existence of this *Certificate*.

2. Condition No.2 is included to ensure that, when the *Works* are constructed, the *Works* will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment. Condition 2.2 is included to ensure that interim works will not become a permanent part of the existing Works unless so approved by the Director,.as per the original plans of the Owner.

3. Condition No.3 is imposed to ensure that the *Works* are operated and maintained without any adverse impact on the environment.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

SWM

The Secretary*
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto, Ontario
M5G 1E5

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 15th day of April, 2010

Zafar Bhatti, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

KH/
c: District Manager, MOE Ottawa District.
Greg Macdonald, P.Eng., Novatech Engineering Consultants Limited.

APPENDIX D

ONTARIO BUILDING CODE & FIRE UNDERWRITERS SURVEY EXCERPTS and CALCULATIONS SHEETS

Fire Water Supply Requirements Based on OBC 2006 (A3.2.5.7)

Project: Block 47-Antigonish Av.
Proj. No.: 111156
Design: BHB
Checked:

Reference: Ontario Fire Marshal - OBC Fire Fighting Water Supply
Ontario Building Code 2006

Q : Fire Water Supply Volume Required (L)

K : Water Supply Coefficent

V : Building Volume (m^3)

S_{Tot} : Spatial Coefficent

Part 1 **Building A**

Description: Building is classified as Residential of combustible construction (Class C)

Building Classification	C		OBC 3.1.2.1	
Water Supply Coefficent K:	23		A3.2.5.7 Table 1	
	W (ft) x	m	m	A = 526 m^2
Original Prop. Add.				
	L (ft) x	m	m	V = 5576 m^3
	H (ft) 10.6	m	m	use average interior height

Exterior Wall Exposure = Distance between:
(Limiting Distance) Exterior face and Property Line
OBC 3.2.3.1.(3) or Exterior face and Centreline of Street
or Exterior face and line at mid-distance to another building on same lot

North	11.25 m	$S_{side\ 1}$ =	0.00
East	13.72 m	$S_{side\ 2}$ =	0.00
South	14.26 m	$S_{side\ 3}$ =	0.00
West	4.05 m	$S_{side\ 4}$ =	0.50

A3.2.5.7 Figure 1

$S_{Tot} = 1.0 + (S_{side\ 1} + S_{side\ 2} + S_{side\ 3} + S_{side\ 4})$ 1.50

$Q_{REQ} = K\ V\ S_{Tot}$

Q_{REQ} = 192358 L Flow $_{REQ}$ = 1369.6 igpm/min

Table 2 Flow min = 6300 L/min

Remarks:

NOVATECH ENGINEERING CONSULTANTS LTD.

Fire Water Supply Requirements Based on OBC 2006 (A3.2.5.7)

Project: Block 47-Antigonish Av.
Proj. No.: 111156
Design: BHB
Checked:

Reference: Ontario Fire Marshal - OBC Fire Fighting Water Supply
Ontario Building Code 2006

Q : Fire Water Supply Volume Required (L)

K : Water Supply Coefficent

V : Building Volume (m^3)

S_{Tot} : Spatial Coefficent

Part 1 **Building B**

Description: Building is classified as Residential of combustible construction (Class C)

Building Classification	C		OBC 3.1.2.1	
Water Supply Coefficent K:	23		A3.2.5.7 Table 1	
	W (ft) x	m	m	A = 526 m^2
Original Prop. Add.				
	L (ft) x	m	m	V = 5576 m^3
	H (ft) 10.6	m	m	use average interior height

Exterior Wall Exposure = Distance between:
(Limiting Distance) Exterior face and Property Line
OBC 3.2.3.1.(3) or Exterior face and Centreline of Street
or Exterior face and line at mid-distance to another building on same lot

North	11.01 m	$S_{side\ 1}$ =	0.00
East	14.65 m	$S_{side\ 2}$ =	0.00
South	11.25 m	$S_{side\ 3}$ =	0.00
West	6.02 m	$S_{side\ 4}$ =	0.40

A3.2.5.7 Figure 1

$S_{Tot} = 1.0 + (S_{side\ 1} + S_{side\ 2} + S_{side\ 3} + S_{side\ 4})$ 1.40

$Q_{REQ} = K\ V\ S_{Tot}$

Q_{REQ} = 179278 L Flow $_{REQ}$ = 1173.9 igpm/min

Table 2 Flow min = 5400 L/min

Remarks:

Fire Water Supply Requirements Based on OBC 2006 (A3.2.5.7)

Project: Block 47-Antigonish Av.
Proj. No.: 111156
Design: BHB
Checked:

Reference: Ontario Fire Marshal - OBC Fire Fighting Water Supply
Ontario Building Code 2006

Q : Fire Water Supply Volume Required (L)

K : Water Supply Coefficent

V : Building Volume (m^3)

S_{Tot} : Spatial Coefficent

Part 1 **Building C**

Description: Building is classified as Residential of combustible construction (Class C)

Building Classification	C		OBC 3.1.2.1	
Water Supply Coefficent K:	23		A3.2.5.7 Table 1	
	W (ft) x	m	m	A = 526 m^2
Original Prop. Add.				
	L (ft) x	m	m	V = 5576 m^3
	H (ft) 10.6	m	m	use average interior height

Exterior Wall Exposure = Distance between:
(Limiting Distance) Exterior face and Property Line
OBC 3.2.3.1.(3) or Exterior face and Centreline of Street
or Exterior face and line at mid-distance to another building on same lot

North	3.95 m	$S_{side\ 1}$ =	0.50
East	15.84 m	$S_{side\ 2}$ =	0.00
South	11.01 m	$S_{side\ 3}$ =	0.00
West	6.02 m	$S_{side\ 4}$ =	0.40

A3.2.5.7 Figure 1

$S_{Tot} = 1.0 + (S_{side\ 1} + S_{side\ 2} + S_{side\ 3} + S_{side\ 4})$ 1.90

$Q_{REQ} = K\ V\ S_{Tot}$

Q_{REQ} = 243397 L Flow $_{REQ}$ = 1369.6 igpm/min

Table 2 Flow min = 6300 L/min

Remarks:

A3.2.5.7 - Table 1 - Water Supply Coefficient K

	Classification by Group or Division in Accordance with Table 3.1.2.1 of the Ontario Building Code				
Type of Construction	A-2 B-1 B-2 B-3 C D	A-4 F-3	A-1 A-3	E F-2	F-1
Building is of noncombustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2. of the OBC, including loadbearing walls, columns, and arches.	10	12	14	17	23
Building is of noncombustible construction or of heavy timber construction conforming to Article 3.1.4.6. of the OBC. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns and arches do not have a fire-resistance	16	19	22	27	37
Building is of combustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2. of the OBC, including loadbearing walls, columns and arches. Noncombustible construction may be used in lieu of fire-resistance rating where permitted in Subsection 3.2.2. of the OBC.	18	22	25	31	41
Building is of combustible construction. Floor assemblies are fire separations but with no fire-resistance rating. Roof assemblies, mezzanines, loadbearing walls, columns, and arches do not have a fire-resistance rating.	23	28	32	39	53
Column 1	**2**	**3**	**4**	**5**	**6**

M E M O R A N D U M

DATE: **MARCH 15, 2012**

TO: **SAM BAHIA**

FROM: **MARK BOWEN**

RE: **ROYAL RIDGE BLOCK 47 (JOB. NO. 111158)**

CC:

Hydraulic analysis completed on the future Royal Ridge Block 47 development confirms the proposed watermain can adequately service the site. Analysis included the performance of the watermain during the Interim condition, prior to the extension of the existing watermain on Trim Rd, and during the Ultimate condition, after the extension of the existing watermain on Trim Rd. Figure 1 highlights the watermain during the Interim condition. Figure 2 highlights the watermain during the Ultimate condition. Analysis of the Ultimate condition includes the Royal Ridge Subdivision because the watermain servicing Block 47 loops through the site; however, the summary of results at this memo only includes the performance of the watermain within Block 47 because watermain analysis of the Royal Ridge subdivision was completed and approved during the detailed design of the Royal Ridge Subdivision.

The water demand and fire flow demands are as indicated in the Block 47 Serviceability Brief and Stormwater Management Report and are listed in Table 1 below.

Table 1. Water Demand and Fire Flow Demand

Condition	Water Demand For The Site	Water Demand per Building
High Pressure	0.306 L/s	1.02 L/s
Maximum Daily	0.766 L/s	0.256 L/s
Peak Hour	1.684 L/s	0.561 L/s
Fire Flow	1370 igpm 104 L/s	N/A

Table 2 below summaries the performance of the watermain during the Interim condition.

Table 2. Performance of the watermain during the Interim Condition

Condition	Peak Operating Pressures	
	Proposed	Allowable
High Pressure	488.8kpa (max) 70.9psi (max)	551.6kpa (max) 80psi (max)
Max Daily and Fire Flow	227.5kpa (min) 33.0psi (min)	137.9kpa (min) 20psi (min)
Peak Hour	371.6kpa (min) 53.9psi (min)	275.8kpa (min) 40psi (min)

Table 3 below summaries the performance of the watermain during the Ultimate condition.

Table 3. Performance of the watermain during the Ultimate Condition

Condition	Peak Operating Pressures	
	Proposed	Allowable
High Pressure	510.2kpa (max) 74.0psi (max)	551.6kpa (max) 80psi (max)
Max Daily and Fire Flow	324.1kpa (min) 47.0psi (min)	137.9kpa (min) 20psi (min)
Peak Hour	435.1kpa (min) 63.1psi (min)	275.8kpa (min) 40psi (min)

A complete listing of all watermain operating pressures is included at the end of this memo.

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ENGINEERS & PLANNERS

ROYAL RIDGE BLOCK 47
111156

Created: March 15, 2012

Table 1
High Pressure Check
Interim Watermain System

Node	Elevation (m)	Demand (LPS)	Head (m)	Pressure (m)	Pressure (PSI)	Age (hrs)
1*	N/A	N/A	131.0	N/A	N/A	N/A
2	85.0	0.00	131.0	46.0	65.2	9.8
3	81.0	0.00	131.0	50.0	70.9	12.2
5	82.8	0.00	131.0	48.2	68.3	15.2
23a	84.2	0.00	131.0	46.8	66.4	6.2
23	82.5	0.00	131.0	48.5	68.7	16.4
24	82.6	0.00	131.0	48.5	68.7	17.1
25	82.7	0.00	131.0	48.4	68.6	17.9
26	82.6	0.00	131.0	48.4	68.6	18.0
27	83.1	0.10	131.0	47.9	68.0	18.1
28	82.8	0.00	131.0	48.3	68.4	72.0
29	82.9	0.10	131.0	48.1	68.2	17.2
30	83.0	0.10	131.0	48.1	68.1	16.5

*** Boundry Condition**

Table 2
Max Daily Demand & Fire Flow At Node 28
Interim Watermain System

Node	Elevation (m)	Demand (LPS)	Head (m)	Pressure (m)	Pressure (PSI)
1*	N/A	N/A	120.0	N/A	N/A
2	85.0	0.00	118.0	33.0	46.8
3	81.0	0.00	116.8	35.7	50.7
5	82.8	0.00	115.2	32.4	45.9
23a	84.2	0.00	119.9	35.7	50.6
23	82.5	0.00	111.8	29.3	41.5
24	82.6	0.00	109.8	27.3	38.7
25	82.7	0.00	108.7	26.0	36.9
26	82.6	0.00	108.7	26.1	36.9
27	83.1	0.25	108.6	25.6	36.3
28	82.8	104.00	106.0	23.3	33.0
29	82.9	0.25	109.8	26.9	38.2
30	83.0	0.25	111.8	28.9	40.9

*** Boundry Condition**

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ENGINEERS & PLANNERS

ROYAL RIDGE BLOCK 47
111156

Created: March 15, 2012

Table 3
Peak Hour Demand
Interim Watermain System

Node	Elevation (m)	Demand (LPS)	Head (m)	Pressure (m)	Pressure (PSI)
1*	N/A	N/A	123.0	N/A	N/A
2	85.0	0.00	123.0	38.0	53.9
3	81.0	0.00	123.0	42.0	59.5
5	82.8	0.00	123.0	40.2	57.0
23a	84.2	0.00	123.0	38.8	55.0
23	82.5	0.00	123.0	40.5	57.4
24	82.6	0.00	123.0	40.5	57.4
25	82.7	0.00	123.0	40.4	57.2
26	82.6	0.00	122.9	40.3	57.1
27	83.1	0.56	122.8	39.8	56.4
28	82.8	0.00	123.0	40.3	57.1
29	82.9	0.56	123.0	40.1	56.8
30	83.0	0.56	122.9	40.0	56.6

*** Boundry Condition**

Table 4
Pipe Data
Interim Watermain System

Pipe	Length (m)	Diameter (mm)	Roughness Coefficient
1	54.0	400	120
2	81.0	250	110
3	54.0	250	110
4	68.0	250	110
19	41.0	200	110
26	29.0	200	110
27	17.0	200	110
28	28.0	50	100
29	8.0	50	100
30	8.0	150	100
31	8.0	50	100
32	22.0	50	100

Table 5
High Pressure Check
Ultimate Watermain System

Node	Elevation (m)	Demand (LPS)	Head (m)	Pressure (m)	Pressure (PSI)	Age (hrs)
1*	N/A	N/A	131.0	N/A	N/A	N/A
2*	N/A	N/A	139.2	N/A	N/A	N/A
3	81.0	0.0	133.2	52.2	74.0	0.22
5	82.8	0.61	133.5	50.7	71.8	1.1
23	82.5	0.00	133.5	50.9	72.2	2.3
24	82.6	0.00	133.5	50.9	72.2	3.5
25	82.7	0.00	133.5	50.8	72.0	5.0
26	82.6	0.00	133.5	50.9	72.1	5.1
27	83.1	0.10	133.5	50.4	71.5	5.2
28	82.8	0.00	133.5	50.7	71.9	72.0
29	82.9	0.10	133.5	50.6	71.7	3.6
30	83.0	0.10	133.5	50.5	71.6	2.4

*** Boundary Condition**

Table 6
Max Daily Demand & Fire Flow At Node 28
Ultimate Watermain System

Node	Elevation (m)	Demand (LPS)	Head (m)	Pressure (m)	Pressure (PSI)
1*	N/A	N/A	120.0	N/A	N/A
2*	N/A	N/A	139.2	N/A	N/A
3	81.0	0.00	124.6	43.6	61.8
5	82.8	1.23	124.5	41.7	59.1
23	82.5	0.00	121.7	39.2	55.5
24	82.6	0.00	119.7	37.1	52.7
25	82.7	0.00	118.5	35.9	50.9
26	82.6	0.00	118.5	35.9	50.9
27	83.1	0.25	118.5	35.5	50.3
28	82.8	104.00	115.9	33.2	47.0
29	82.9	0.25	119.7	36.8	52.2
30	83.0	0.25	121.7	38.7	54.9

*** Boundary Condition**

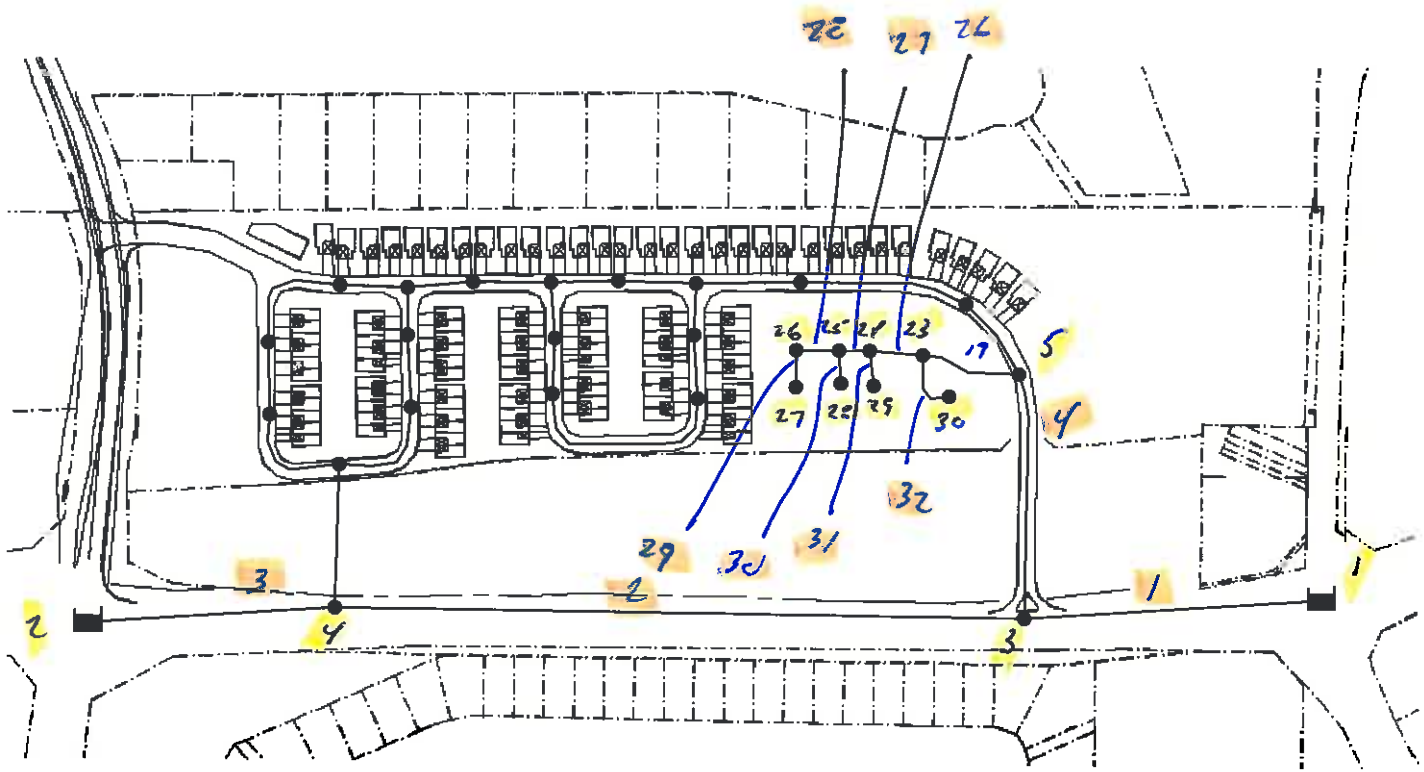
Table 7
Peak Hour Demand
Ultimate Watermain System

Node	Elevation (m)	Demand (LPS)	Head (m)	Pressure (m)	Pressure (PSI)
1*	N/A	N/A	123.0	N/A	N/A
2*	N/A	N/A	139.2	N/A	N/A
3	81.0	0.00	127.3	46.3	65.7
5	82.8	2.20	127.7	44.9	63.7
23	82.5	0.00	127.7	45.2	64.1
24	82.6	0.00	127.7	45.2	64.1
25	82.7	0.00	127.7	45.1	63.9
26	82.6	0.00	127.6	45.0	63.8
27	83.1	0.56	127.6	44.5	63.1
28	82.8	0.00	127.7	45.0	63.8
29	82.9	0.56	127.7	44.8	63.5
30	83.0	0.56	127.6	44.7	63.4

* Boundry Condition

Table 8
Pipe Data
Ultimate Watermain System

Pipe	Length (m)	Diameter (mm)	Roughness Coefficient
1	165.0	600	120
2	350.0	600	120
3	130.0	600	120
4	55.0	250	110
19	41.0	200	110
26	29.0	200	110
27	17.0	200	110
28	28.0	50	100
29	8.0	50	100
30	8.0	150	100
31	8.0	50	100
32	22.0	50	100



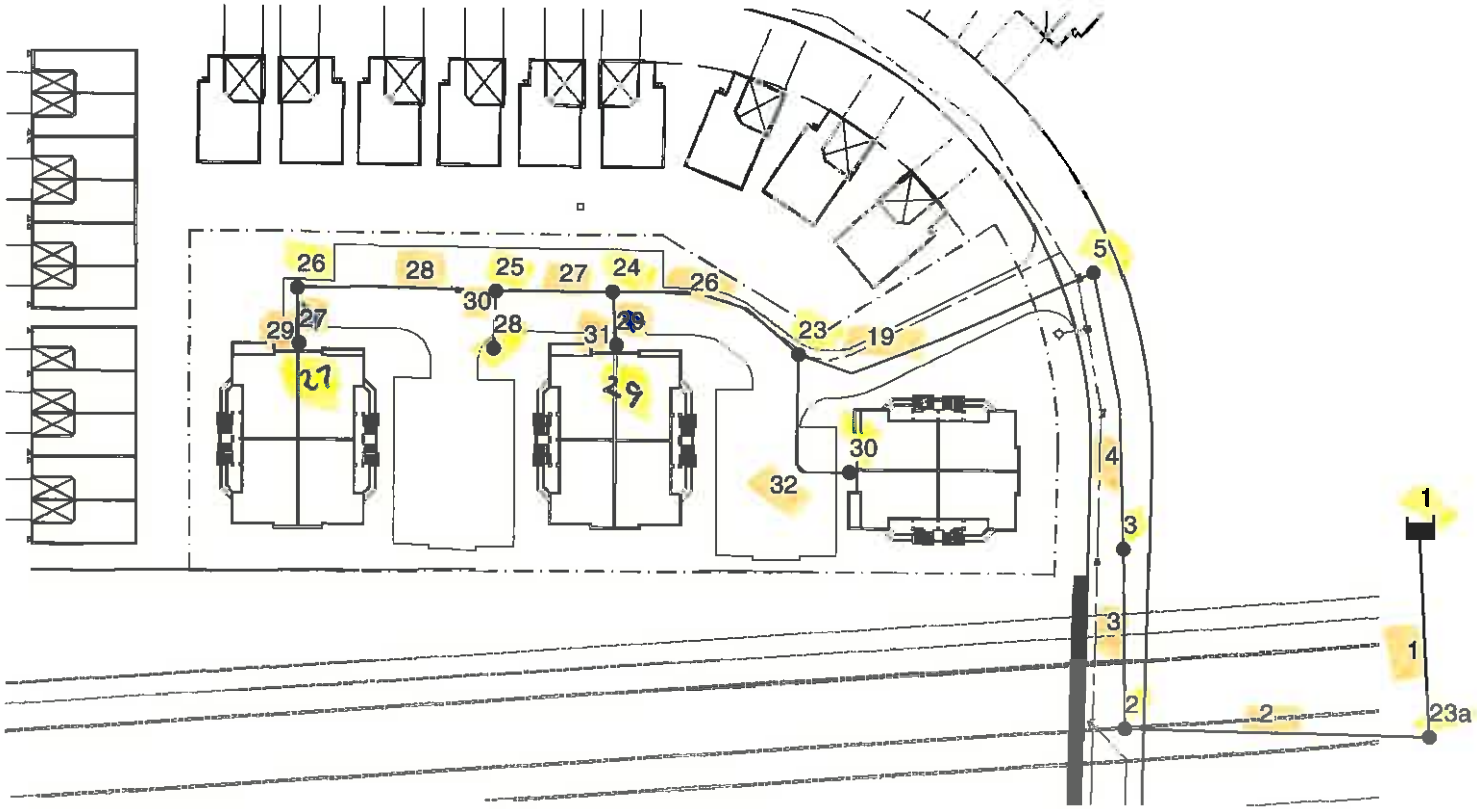
NODE NO.

PIPE NO.

ROYAL RIDGE BLOCK 47

ULTIMATE WATERMAIN NETWORK

MARCH 2012 | 111156 | FIG 1



NODE NO.

PIPE NO.

ROYAL RIDGE BLOCK 47

INTERIM WATERMAIN NETWORK

MARCH 2012 | 111156 | FIG 2

APPENDIX E

SERVICING STUDY GUIDELINES CHECKLIST

NOVATECH ENGINEERING CONSULTANTS LTD.

Project Name: Block 47 - Antigonish Ave.
Project Number:111145
Date: Oct.29th 2011

Development Servicing Study Checklist

4.1 General Content	Addressed (Y/N/NA)	Section	Comments
Executive Summary (for larger reports only).	NA		
Date and revision number of the report.	Y	Cover	
Location map and plan showing municipal address, boundary, and layout of proposed development.	Y	Fig 1	
Plan showing the site and location of all existing services.	Y	Fig 2 / GP	
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.	NA		
Summary of Pre-consultation Meetings with City and other approval agencies.	NA		
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.	NA		
Statement of objectives and servicing criteria.	Y	1	
Identification of existing and proposed infrastructure available in the immediate area.	Y	3,4,5	
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).	NA		
Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighboring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	Y	GR	

Development Servicing Study Checklist

4.1 General Content	Addressed (Y/N/NA)	Section	Comments
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.	NA		
Proposed phasing of the development, if applicable.	NA		
Reference to geotechnical studies and recommendations concerning servicing.	Y	2	
All preliminary and formal site plan submissions should have the following information:			
Metric scale	Y		
North arrow (including construction North)	Y		
Key plan	Y		
Name and contact information of applicant and property owner	Y		
Property limits including bearings and	Y		
Existing and proposed structures and parking	Y		
Easements, road widening and rights-of-way	Y		
Adjacent street names	Y		

Development Servicing Study Checklist

4.2 Water	Addressed (Y/N/NA)	Section	Comments
Confirm consistency with Master Servicing Study, if available.	NA		
Availability of public infrastructure to service proposed development.	Y	5	
Identification of system constraints.			
Identify boundary conditions.			
Confirmation of adequate domestic supply and pressure.			
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 at locations throughout the development.	Y	5 /Appendix C	
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.			
Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design.	NA		
Address reliability requirements such as appropriate location of shut-off valves.	Y	GP	
Check on the necessity of a pressure zone boundary modification.	NA		
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.	Y	5	
Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.	Y	5/GP	
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.	N		
Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Y	5	
Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.			

Development Servicing Study Checklist

4.3 Wastewater	Addressed (Y/N/NA)	Section	Comments
Summary of proposed design criteria (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).	Y	4	
Confirm consistency with Master Servicing Study and/or justifications for deviations.	N		
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 condition of sewers.	N		
Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Y	4	
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)	Y	4, Appendix B	
Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix 'C') format.	N		
Description of proposed sewer network including sewers, pumping stations, and forcemains.	Y	4	
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).	NA		
Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	NA		
Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N		
Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	NA		
Special considerations such as contamination, corrosive environment etc.	NA		

Development Servicing Study Checklist

4.4 Stormwater	Addressed (Y/N/NA)	Section	Comments
Description of drainage outlets and downstream constraints including legality of outlet (i.e. municipal drain, right-of-way, watercourse, or private property).	Y	3	
Analysis of the available capacity in existing public infrastructure.			
A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns and proposed drainage patterns.	Y	Fig. 3 / GR	
Water quantity 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.	N		
Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	Y	3	
Description of stormwater management concept with facility locations and descriptions with references and supporting information.	Y	3	
Set-back from private sewage disposal systems.	NA		
Watercourse and hazard lands setbacks.	NA		
Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	NA		
Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	NA		
Storage requirements (complete with calcs) and conveyance capacity for 5 yr and 100 yr events.	Y	3 / Appendix A	
Identification of watercourse within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	NA		
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.	Y	3	
Any proposed diversion of drainage catchment areas from one outlet to another.	NA		
Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and SWM facilities.	Y	3	
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.	NA		

Development Servicing Study Checklist

4.4 Stormwater	Addressed (Y/N/NA)	Section	Comments
Identification of municipal drains and related approval requirements.	Y	GP	
Description of how the conveyance and storage capacity will be achieved for the development.	Y	3	
100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	y	GR	
Inclusion of hydraulic analysis including HGL elevations.	NA		
Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Y	3 , 4	
Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.	NA		
Identification of fill constrains related to floodplain and geotechnical investigation.	NA		

Development Servicing Study Checklist

4.5 Approval and Permit Requirements	Addressed (Y/N/NA)	Section	Comments
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 the 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.	NA		
Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.	NA		
Changes to Municipal Drains.	NA		
Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	NA		

4.6 Conclusion	Addressed (Y/N/NA)	Section	Comments
Clearly stated conclusions and recommendations.	Y	6	
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.	NA		
All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario.	Y	6	

LIST OF PLANS