Site Servicing and Stormwater Management Report 2140 Baseline Road

Type of Document
Site Plan Submission

Project Name
Ottawa Student Residence
2140 Baseline Road

Project Number
OTT-00245012-A0

Prepared By: J. Fitzpatrick, P.Eng.
Reviewed By: B. Thomas, P.Eng.

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Date Submitted
May 25, 2018

Baseline Constellation Partnership Inc.

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Prepared By:
exp
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada
T: 613 688-1899
F: 613 225-7337
www.exp.com

LICENSED PROFESSIONAL ENGINEER
J.L. FITZPATRICK
2018-05-24
PROVINCE OF ONTARIO

Jason Fitzpatrick, P.Eng.
Project Engineer
Infrastructure Services

Bruce Thomas, P.Eng.
Senior Project Manager
Infrastructure Services

Date Submitted:
May 25, 2018

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1 Introduction

Baseline Constellation Partnership Inc. retained exp Services Inc. (EXP) to prepare a site servicing and stormwater management report for a proposed 11-storey student residence.

The 0.305-hectare development site is situated at 2140 Baseline Road, at the corner of Baseline and Constellation Crescent in the City of Ottawa, Ontario as shown on Figure 1 in Appendix A.

The development is comprised of 144 suites, that contain 1 to 4 bedrooms. This report will discuss the adequacy of the adjacent municipal storm sewers, sanitary sewers and watermains to convey the storm runoff, sewage flows and provide the water demands that will result from the proposed development.

There are municipal sanitary sewers, storm sewers and watermains within Gemini Way that will be utilized to service the development. This report will identify the sanitary, storm or watermain servicing requirements, and provide a design brief for submission, along with the engineering drawings, for City of Ottawa approval.

2 Reference Guidelines

Various documents were referred to in preparing the current report including:

- Sewer Design Guidelines, Second Edition, Document SDG002, October 2012, City of Ottawa (Guidelines) including:
- Technical Bulletin ISDTB-2012-4 (20 June 2012)
- Technical Bulletin ISDTB-2014-01 (05 February 2014)
- Technical Bulletin PIEDTB-2016-01 (September 6, 2016)
- Technical Bulletin ISDTB-2018-01 (21 March 2018)
- Ottawa Design Guidelines – Water Distribution, July 2010 (WDG001).
- Stormwater Management Guidelines for the Pinecrest Creek / Westboro Area, JFSA, June 2012
- Stormwater Management Planning and Design Manual, Ontario Ministry of the Environment and Climate Change, March 2003 (SMPDM)
- Design Guidelines for Drinking-Water Systems, Ontario Ministry of the Environment and Climate Change, 2008 (GDWS)
- Fire Underwriters Survey, Water Supply for Public Fire Protection (FUS), 1999
- Ontario Building Code 2012, Ministry of Municipal Affairs and Housing.

3 Sanitary Sewer Design

The sanitary sewer system is designed based on a population flow, an allowance for amenity areas within the buildings and an area based infiltration allowance. The flows were calculated using City of Ottawa sewer design guidelines (SDG002) as follows:

Area

Gross site area	=	0.305 ha

Number of Units

1-bedroom units	=	9
2-bedroom units	=	27
3-bedroom units	=	9
4-bedroom units	=	99

Population

9, 1-bedroom units (@ 1.4 persons per unit)	=	12.6
27, 2-bedroom units (@ 2.1 persons per unit)	=	56.7
9, 3-bedroom units (@ 3.1 persons per unit)	=	27.9
99, 4-bedroom units (@ 3.8 persons per unit)	=	376.2
Total	=	473.4

Residential Peaking Factor

Peak Factor = $1 + 14 / (4 + (P/1000)^{0.5})* K$, where K = 0.8

Peak Factor = $1 + 14 / (4 + (473.4/1000)^{0.5}) \times 0.8$	=	3.39

Domestic Sewage Flow

Average Domestic Flow (473.4 x 280 L/cap/day x (1/86,400 sec/day)	=	1.53 L/sec
Peak Domestic Flow (3.39 x 1.55)	=	5.20 L/sec

Commercial/Amenity Space Sewage (1st floor plus penthouse)

Ground Floor commercial	=	1,346 m^2
11th Floor amenity area	=	1,346 m^2
Commercial / Amenity Peak Factor	=	1.0 (since < 20%)
Commercial / Amenity Average Sewage Flow Allowance	=	28,000 L/gross ha/d
Commercial / Amenity Average Sewage Flow Allowance (0.305 ha x 28,000 L/gross ha/day x 1.0 x (1/86,400 sec/day)	=	0.10 L/sec

Infiltration

Infiltration Allowance	=	0.28 L/ha/sec
Infiltration Flow (0.305 ha x 0.28 L/ha/sec)	=	0.09 L/sec

Total Peak Sewage Flow

Peak Sanitary Flow = 5.20 + 0.10+ 0.09	**=**	**5.39 L/sec**

The estimated peak sanitary flow rate from the proposed property at 2140 Baseline Road is **5.39 L/sec** based on City of Ottawa Design Guidelines.

The proposed building will have an independent sanitary sewer connection to the existing 300mm sanitary sewer on Gemini Way, with the connection approximately 30 metres west of Constellation Crescent. The proposed 250mm sanitary sewer is proposed with a 2% slope, having a capacity of 85.4 L/sec based on Manning's Equation under full flow conditions. Based on the OBC, the maximum permitted hydraulic load for a 250mm at 2% is 4,500 fixture units.

As the building foundation is tight against the property line, an internal sanitary monitoring port located in the underground parking structure is proposed at the entry point.

4 Watermain Servicing

4.1 Water Demands

We estimated the domestic water demands as shown below, using parameters from the City of Ottawa Water Distribution Design Guidelines.

Number of Units

1-bedroom units	=	9
2-bedroom units	=	27
3-bedroom units	=	9
4-bedroom units	=	99

Population

9, 1-bedroom units (@ 1.4 persons per unit)	=	12.6
27, 2-bedroom units (@ 2.1 persons per unit)	=	56.7
9, 3-bedroom units (@ 3.1 persons per unit)	=	27.9
99, 4-bedroom units (@ 3.8 persons per unit)	=	376.2
Total =	=	473.4

Demand Rates

Average Residential Demands (L/person/day)	=	350
Average Commercial Demands (L/1000m^2/d)	=	2,500

Peaking Factors

Max Day Residential Peaking Factor	=	2.5 x avg. day
Max Day Commercial Peaking Factor	=	1.5 x avg. day
Peak Hour Residential Peaking Factor	=	2.2 x max. day
Peak Hour Commercial Peaking Factor	=	1.8 x max. day

Water Demands

Average Residential Demands (473.4 persons x 350 L/person/day x (1/86,400 sec/day)	=	1.92 L/sec
Average Commercial Demands (1346 x 2 floors x 2,500 L/1000m2 x (1/86,400 sec/day)	=	0.08 L/sec
Total Average Day Demands (1.92 L/sec + 0.08 L/sec)	=	2.0 L/sec
Total Maximum Day Demands (1.92 L/sec x 2.5 + 0.08 L/sec x 1.5)	=	4.91 L/sec
Total Peak Hour Demands (1.92 L/sec x 2.5 x 2.2 + 0.08 L/sec x 1.5 x 1.8)	=	10.77 L/sec

The average day, maximum day, and peak hourly demands for the proposed building at 2140 Baseline Road are 2.0 L/sec, 4.9 L/sec, 10.8 L/sec respectively.

Hydraulic Grade Line (HGL) boundary conditions were obtained from the City of Ottawa for design purposes. A copy of the correspondence received from the City is provided in Appendix F.

The following hydraulic grade line (HGL) boundary conditions were provided:

- Minimum HGL = 127.5 m
- Max Day + Fire Flow = 112.0 m (Assuming 150 L/sec fire flow)
- Maximum HGL = 134.6 m

Based on a ground elevation of approximately 85.75m at the boundary condition location this results in a system water pressure of 41.75 m or 59.4 psi during peak hour conditions.

Since the average day demands of 165.7 m^3 per day exceed 50 m^3 per day, two watermain feeds to the building will be necessary as per Section 4.31 of the WDG001.

A review of the estimated watermain pressures at the building connection, based on the boundary conditions provided and the use of two watermains was completed.

Table C2 in Appendix C provides a comparison of anticipate pressures at the building connecting based on using a single watermain or two watermains. A single watermain analysis was completed to determined if the water pressure still met the City requirement during either the maximum day plus fire flow or peak hour condition.

Based on results, the use of two 150mm watermains would result in a pressure of 27 psi at the building, while the use of two 200mm watermains would improve the pressure to more than 35 psi under maximum day plus fire flow conditions. Therefore, two 200mm watermains with a shut-off valve between them is proposed.

4.2 Fire Flow Requirement

The required fire flows for the proposed site are based on the Ontario Building Code for a building requiring on-site water supply. We used the following equation from the Ontario Building Code (2012) to calculate the on-site supply rates required to be supplied by the hydrants.

$Q = k\ V\ S_{TOT}$ (OBC Section A-3.2.5.7)

Where:

Q	=	minimum supply of water in litres
K	=	water supply coefficient
V	=	total building volume
S_{TOT}	=	total of special coefficients

Table 1 - Summary of Onsite Water Supply for Fire Protection

Item	Design Value
Floors Above Grade	11 floors
Building Classification	Group C / D
Fire Protection Type	Sprinkler System
Building Height (m)	34.2
Building Area (sq.m)	1346
Total Building Volume, V (c.m)	46,033
Water Supply Coefficient, k	10
Total Spatial Coefficient, S_{TOT}	1+(0+0+0+0) = 1.0
$Q = kV\ S_{TOT}$	460,330
Required Fire Supply Rate, L/min	9,000 (150 L/sec)

The fire flow requirement for proposed building is **150 L/sec.**

We estimated the anticipated water pressure at the building using the boundary conditions provided by the City of Ottawa. We calculated the pressure drop between the watermain on Gemini Way and the proposed building based on the Hazen Williams Formula using a maximum day plus fire flow withdrawal of 154.9 L/sec. The estimated pressure from drop from the main connection to building is 37.3 psi to 35.4 psi with one watermain, or 37.3 psi to 37.1 psi using two watermains. Based on this information two (2) 200mm watermains will be used to service the proposed building.

5 Stormwater Management

5.1 Design Criteria

We designed the storm sewer system in conformance with the latest version of the City of Ottawa Design Guidelines (October 2012). Section 5 "Storm and Combined Sewer Design" and Section 8 "Stormwater Management" from the design manual were referenced.

The allowable release rate for the site is limited to a 5-year storm event using a time of concentration of 10 minutes and a runoff coefficient of 0.50. Flows in excess of the 5-year pre-development runoff rate are detained onsite using onsite storage for up to the 100-year storm event.

Minor System Design Criteria

- The proposed storm service was sized based on the rational formula and Manning's Equation under free flow conditions for the 5-year storm using a 10-minute inlet time.
- Inflow rates into the minor system are limited to an allowable release rate as noted above.

Major System Design Criteria

- The major system has been designed to accommodate on-site detention with sufficient capacity to attenuate the 100-year design storm. Excess runoff above the 100-year event will flow overland offsite.
- On site storage is provided and calculated for up to the 100-year design storm with maximum ponding of 150mm depth on the roofs, and 350mm on the ground surface. See Appendix D for the calculations of the required on-site storage volumes.
- We calculated the required storage volumes based on the Modified Rational Method as identified in Section 8.3.10.3 of the City's Sewer Guidelines. The depth and extent of surface storage is illustrated on the grading plan.
- The 100-year discharge rate from the site to be limited to 33.5 L/ha/sec as per the Pinecrest Creek / Westboro Area SWM Guidelines (Table 3.1).

5.2 Runoff Coefficients

Runoff coefficients used for post-development conditions were based on actual areas measured in CAD. Runoff coefficients for impervious surfaces (roofs, asphalt, and concrete) were taken as 0.90, whereas those for pervious surfaces (grass/landscaping) were taken as 0.20.

The average runoff coefficients for the overall site area under post-development conditions was calculated as 0.73, whereas the pre-development average runoff coefficient was closer to 0.20. It should be noted that prior to 2008, the site contained an asphalt roadway, and it was after 2008 that Constellation Crescent and Gemini Way were re-configured into their current location.

5.3 Pre-Development Conditions

The 0.30-hectare site is currently vacant, however prior to 2008 it was used as a connection roadway between Constellation Crescent and Baseline Road. From the existing ground elevations shown on the grading plan, storm runoff flows are in a northerly direction to catch basins on Constellation Crescent and Baseline Road. The pre-development runoff coefficient for the site was determined as 0.20.

Using a time of concentration (T_C) of 10 minutes, the pre-development release rates from the site are determined for the 5-year and 100-year storms using the Rational Method as follows:

Q_{PRE} = 2.78 C I A

where:

Q_{PRE}	=	Peak Discharge (L/sec)
C	=	Runoff Coefficient (C=0.20)
I	=	Average Rainfall Intensity for return period (mm/hr)
	=	998.071/ (T_C+6.053)^0.814 (5-year)
	=	1735.688/ (T_C+6.014)^0.820 (100-year)
Tc	=	Time of concentration (mins)
A	=	Drainage Area (hectares)

therefore:

I_5	=	$998.071/ (10 + 6.053)^{0.814}$ = 104.19 mm/hr
Q_{5PRE}	=	2.78 (0.20) (104.19 mm/hr) (0.3049 ha) = 17.7 L/sec
I_{100}	=	$1735.688/ (10+6.014)^{0.820}$ = 178.56 mm/hr
Q_{100PRE}	=	2.78 (0.25) (178.56 mm/hr) (0.3049 ha) = 37.8 L/sec

5.4 Calculation of Allowable Release Rate

With the proposed changes in land use, the overall imperviousness of the site will change. To control runoff from the site it will be necessary to limit post-development flows to allowable capture rate for all storm return periods up to the 100-year event. The allowable release rate from the site is based on the requirements of Section 8.3.7 of the City of Ottawa Sewer Guidelines.

The allowable release rate from the site will be based on a 5-year storm, runoff coefficient of 0.50, and a time of concentration of 10 minutes. The following parameters will be used to determine the allowable release rates from the proposed site to the existing storm sewer on Gemini Way, using the Rational Formula:

Q_{5ALLOW} = 2.78 C_{AVG} I_T A

where:

$Q5_{ALLOW}$	=	5-year Peak Allowable Discharge (L/sec)
C_{AVG}	=	Allowable Runoff Coefficient (dimensionless)
I_T	=	Average Rainfall Intensity (mm/hr)
A	=	Drainage Area (hectares)

Using a time of concentration (T_C) of 10 minutes and a runoff coefficient of 0.50, the allowable release rate (Q_{5ALLOW}) from the site is determined for the 5-year storm (City of Ottawa Guidelines), I_5, using the IDF Curve as follows:

I_5	=	$998.071/ (10+6.053)^{0.814} = 104.29$ mm/hr
Q_{5ALLOW}	=	2.78 (0.50) (104.29 mm/hr) (0.3049) = 44.2 L/sec

The allowable release rate will be limited to 44.2 L/sec and based on the 5-year storm. To control runoff from the site it will be necessary to limit post-development flows for all storm return periods up to the 100-year event using onsite inlet controls, as noted in the proceeding sections.

5.5 Offsite Overland Flow Areas

We accounted for the 100-year uncontrolled areas of the site drainage, including an increase in the average runoff coefficient by 25% for the 100-year storm, to a maximum of C = 1.0. The peak flows for drainage areas 8 and 9 were estimated below to account for overland flow that will discharge offsite without being captured. For additional calculations of storm drainage areas please refer to Table D4 in Appendix D.

Using a post-development time of concentration (T_C) of 10 minutes and a runoff coefficient of 0.20 the 100-year uncontrolled flow rate, Q_{100UNC}, was determined using the Rational Method as follows:

$Q_{100UNC} = 2.78\ C\ I_{100}\ A$

where:

Q_{100UNC}	=	Peak Discharge (L/s)
C	=	Runoff Coefficient
I_{100}	=	Rainfall Intensity (mm/h) for 100-year storm
A	=	Drainage Area (ha)
I_{100}	=	$1735.688/ (10 + 6.014)^{0.820} = 178.56$ mm/hr
$Q_{100UNC-8}$	=	2.78 x 0.49 x 125% x 178.56 x (0.0091) = 2.8 L/sec
$Q_{100UNC-9}$	=	2.78 x 0.48 x 125% x 178.56 x (0.0216) = 6.5 L/sec

The allowable release rate to the storm sewers (minor system) on Gemini Way is determined by subtracting the uncontrolled 100-year runoff from the allowable release rate as follows:

$Q_{REL} = Q_{ALLOW} - Q_{100UNC}$

The allowable capture rate to the Gemini Way storm sewer and the rates that will be used to determine storage requirements are:

Q_{REL}	=	$Q_{ALLOW} - Q_{100UNC}$
	=	$Q_{ALLOW} - Q_{100UNC-8} - Q_{100UNC-9}$
	=	44.2 – 2.8 – 6.5
	=	35.0 L/sec

Therefore, the allowable discharge into the existing storm sewer (directly connected) from the site is **35.0 L/sec.**

5.6 Calculation of Post-Development Runoff

Stormwater runoff from the proposed site will drain from a combination of controlled and uncontrolled areas. As a result of the changes onsite the overall post development runoff coefficient will change. The increase or decrease in runoff will be the result of changes due to site development (i.e. additional hard surfaces, roof areas and hard landscaping). The following summarizes the increase or decrease in the calculated runoff coefficient for the site, with detailed calculations of the post development runoff coefficients included in Table D3 of Appendix D.

Using a time of concentration (TC) of 10 minutes and an average runoff coefficient of 0.20 for grassed areas and 0.90 for hard surfaces, the post-development runoff rates from the site were determined for the 2-year, 5-year and 100-year storm using the Rational Method as noted below. Note that average runoff coefficients for all catchments were based on actual areas.

I_{2}	=	$732.951 / (Tc + 6.199)^{0.810}$	= 76.81 mm/hr
I_{5}	=	$998.071 / (Tc + 6.053)^{0.814}$	= 104.19 mm/hr
I_{100}	=	$1735.688 / (Tc + 6.014)^{0.820}$	= 178.56 mm/hr

Q_{2POST}	=	2.78 x C_{AVG} x 76.81 mm/hr x Area
Q_{5POST}	=	2.78 x C_{AVG} x 104.19 mm/hr x Area
$Q_{100\ POST}$	=	2.78 x $C_{AVG\ *}$ 25% x 178.56 mm/hr x Area

Based on the storm drainage areas the 2-year, 5-year and 100-year post-development runoff rates are calculated and summarized in Table 2 below with detailed calculations provided in Table D4 of Appendix D.

Table 2 : Summary of Post Development Flows

Area No.	Area (ha)	Runoff Coefficient			Release Rate (L/s)		
		2-yr	5-yr	100-yr	2-yr	5-yr	100-yr
1	0.1397	0.900	0.90	1.00	(3.7)	(5.0)	(9.5)
2	0.0109	0.900	0.90	1.00	(0.9)	(1.2)	(2.2)
3	0.0096	0.900	0.90	1.00	(0.7)	(1.0)	(1.9)
4	0.0162	0.900	0.90	1.00	3.1	4.2	8.0
5	0.0076	0.900	0.90	1.00	1.5	2.0	3.8
6	0.0238	0.738	0.74	0.92	(1.4)	(1.9)	(4.0)
7	0.0637	0.673	0.67	0.84	(1.4)	(1.9)	(4.0)
8	0.0091	0.492	0.49	0.62	1.0	1.3	2.8
9	0.0216	0.482	0.48	0.60	2.2	3.0	6.5
10	0.0027	0.900	0.90	1.00	0.5	0.7	1.3
Total	0.30				16.3	22.1	44.0
Note: Flows denoted in brackets (0.00) are controlled flows.							

In summary (and as noted in Table D5), the 2-year 5-year and 100-year post-development flows (unrestricted) are 52 L/sec, 71 L/sec and 139 L/sec respectively. Inlet controls will be used to restrict these runoff rates from the site to a maximum of **44.0 L/sec** for the 100-year storm.

The inlet controls were necessary to meet the allowable release rate for runoff conditions up to the 100-year storm event. Further details regarding the on-site detention and storage methods are provided in the next section.

Runoff from the roofs of the proposed building will be controlled using flow controlled roof drains. Three flat roof areas will require flow controlled roof drains, whereas one slopped roof area located over the underground parking ramp will flow uncontrolled to internal plumbing, and discharge to the storm sewer on Gemini Way. For the surface areas that are located above the underground parking structure flow controlled area drains will be used.

5.7 Storage Requirements

Runoff from the site and building roof will be restricted via inlet restrictors placed in area drains or rooftop drains.

Table 3 below summarizes the controlled release rates for each area and the corresponding storage requirements. Calculation of the on-site storage has been supported by calculations developed by the design engineer and are provided in Appendix D.

Table 3 - Summary of Storage Requirements

Area No.	Release Rate (L/s)			Storage Required (m^3)			Storage Provided (m3)	Control Location	Control Type
	2-yr	5-yr	100-yr	2-yr	5-yr	100-yr			
1	3.68	4.99	9.50	0.6	25.1	47.4	56.0	roof	Roof Drains
2	0.85	1.16	2.20		1.0	2.0	5.5	roof	Roof Drains
3	0.74	1.00	1.90		0.9	1.7	4.8	roof	Roof Drains
4	3.11	4.22	8.04					none	
5	1.46	1.98	3.77					none	
6	1.38	1.87	4.00		2.0	4.3	5.0	surface	Area Drains
7	1.38	1.87	4.00	0.0	8.2	17.4	21.0	surface	Area Drains
8	0.96	1.30	2.78					none	
9	2.22	3.02	6.46					none	
10	0.52	0.70	1.34					none	
Total	**16.3**	**22.1**	**44.0**	**0.6**	**37.3**	**72.8**	**92.3**		

For the building roofs flow controlled drains are necessary. An estimate of the controlled release rate and associated 100-yerar storage requirements was completed for the three (3) flat roof areas. Tables D11 through D13 provide the estimated release rate based on an assumed number of drains per area. The corresponding 100-year storage volume was estimated using the Modified Rational Method. The storage provided on the roof and ground surfaces were estimated using the prism formula as follows:

V = 1/3 x A x d

where:

V	=	storage volume (cu.m.)
A	=	storage area (sq.m.)
d	=	maximum storage depth (m)

The depth is the difference in elevation between the low point elevation and the maximum water level.

5.8 Inlet Control Divide (ICD) Requirements

Inlet control devices will be used to restrict runoff from entering the stormwater system. Inlet control devices for the roofs and surface areas will consist of flow controlled area and/or roof drains. Table 4 below summarizes the type, release rate and head requirements for each inlet control location.

Table 4 - Summary of Inlet Controls

Area No.	Control Location	Max Flow (L/sec)	Max Head (m)	Type	Model	Estimated No Drains Req'd	Weir Position
1	roof	9.50	0.15	Flow Controlled Roof Drain	ACCUTROL	8	75% Position
2	roof	2.20	0.15	Flow Controlled Roof Drain	ACCUTROL	3	50% Position
3	roof	1.90	0.15	Flow Controlled Roof Drain	ACCUTROL	2	50% Position
4	none	8.04	n/a				
5	none	3.77	n/a				
6	surface	4.00	0.15	Flow Controlled Area Drains	ACCUTROL	1	Open
7	surface	4.00	0.25	Flow Controlled Area Drains	ACCUTROL	1	Open
8	none	2.78	n/a				
9	none	6.46	n/a				
10	none	1.34	n/a				

5.9 Storm Sewer Design

The storm drainage areas are illustrated in Figure A2 in Appendix A. Drainage areas are shown on this drawing with average runoff coefficients calculated for each inlet. The maximum 100-year discharge rate to the storm sewer is 34.8 L/sec, with an additional 9.3 L/sec of overland flow from the site. A single 250mm storm sewer service (installed at minimum 2%) will be used. A 250mm sewer at 2% has a capacity of 88 L/sec, which exceeds the controlled minor system rate of 34.8 L/sec and the 5-year uncontrolled rate of 70.5 L/sec.

5.10 Quality Control Measures

Onsite water quality controls are proposed within the building's underground parking structure. An oil/grit separator will be necessary for quality treatment of catchments tributary to surface area. This would include roof and surface areas.

As this area discharges directly to the Pinecrest Creek, a total suspended solids (TSS) removal efficiency of 80% is required.

6 Erosion and Sediment Control

During all construction activities, erosion and sedimentation shall be controlled by the following techniques:

- Filter cloth shall be installed between the frame and cover of all adjacent catch basins and catch basin manhole structures.
- Light duty silt fencing will be used to control runoff around the construction area. Silt fencing locations are identified on the site grading and erosion control plan.
- Visual inspection shall be completed daily on sediment control barriers and any damage repaired immediately. Care will be taken to prevent damage during construction operations.
- In some cases barriers may be removed temporarily to accommodate the construction operations. The affected barriers will be reinstated at night when construction is completed.
- Sediment control devices will be cleaned of accumulated silt as required. The deposits will be disposed of as per the requirements of the contract.
- During the course of construction, if the engineer believes that additional prevention methods are required to control erosion and sedimentation, the contractor will install additional silt fences or other methods as required to the satisfaction of the engineer.
- Construction and maintenance requirements for erosion and sediment controls are to comply with Ontario Provincial Standard Specification (OPSS) OPSS 805 and City of Ottawa specifications.

7 Conclusions

This report addresses site servicing and stormwater runoff from the proposed development located at the 2140 Baseline Road in the City of Ottawa. The proposed 0.305-hectare development by Baseline Constellation Partnership Inc. consists of a proposed 11-storey student residence, which is comprised of 144 suites, ground floor commercial and 11th floor amenity areas.

The following summarizes the servicing requirements for the site:

- The allowable capture rate from the proposed site was calculated based on a runoff coefficient of 0.50 and a time of concentration of 10 minutes for a 5-year storm event. The allowable release rate was calculated to be 44.2 L/sec. Runoff in excess of this will be detained onsite for up to the 100-year storm.

- Flow from the building rooftops (3 areas) will be restricted to a total maximum flow rate of 13.6 L/sec using flow controlled roof drains. Total required storage on these rooftop is estimated at 51.1 cubic metres for the 100-year storm. Roof storage provided will be coordinated with the architect and mechanical consultants. A preliminary estimate of storage available on the three roof areas is 66.3 m^3.

- Storm runoff to the two (2) proposes areas drains will be controlled using area drains equipped with flow controlled weirs. Each of the two (2) areas drains to have maximum capture rate of 4 L/sec.

- An estimated peak sewage flow of 5.39 L/sec based on City of Ottawa Guidelines. A 250mm sewer lateral will be installed with a slope of 2.00% having a full flow capacity of 68 L/sec.

- The building will be serviced by two 200mm diameter PVC watermain's, with an isolation valve between the two watermain laterals. The two watermains will be connected directly from the building to the existing watermain on Gemini Way. The use of two parallel watermains is required as the water demand is greater than 50 m^3/day as noted in Section 4.3.1 of the City of Ottawa's Water Distribution Guidelines.

- Under maximum day plus fire flow conditions, the calculated pressure drop from the municipal watermain to the proposed building is from 37.3 psi to 37.1 psi at the building based on two (2) 200mm water services. In the event one (1) of the 200mm water services is under service or shut off, the estimated pressure drop through a single watermain would be from 37.3 psi to 35.4 psi. Under either of these scenarios, adequate flow and pressure is provided to the building. This meet the City of Ottawa's minimum pressure guideline of 20 psi. Therefore, the existing municipal watermain along Gemini Way has adequate capacity to service the proposed building for both domestic and fire protection.

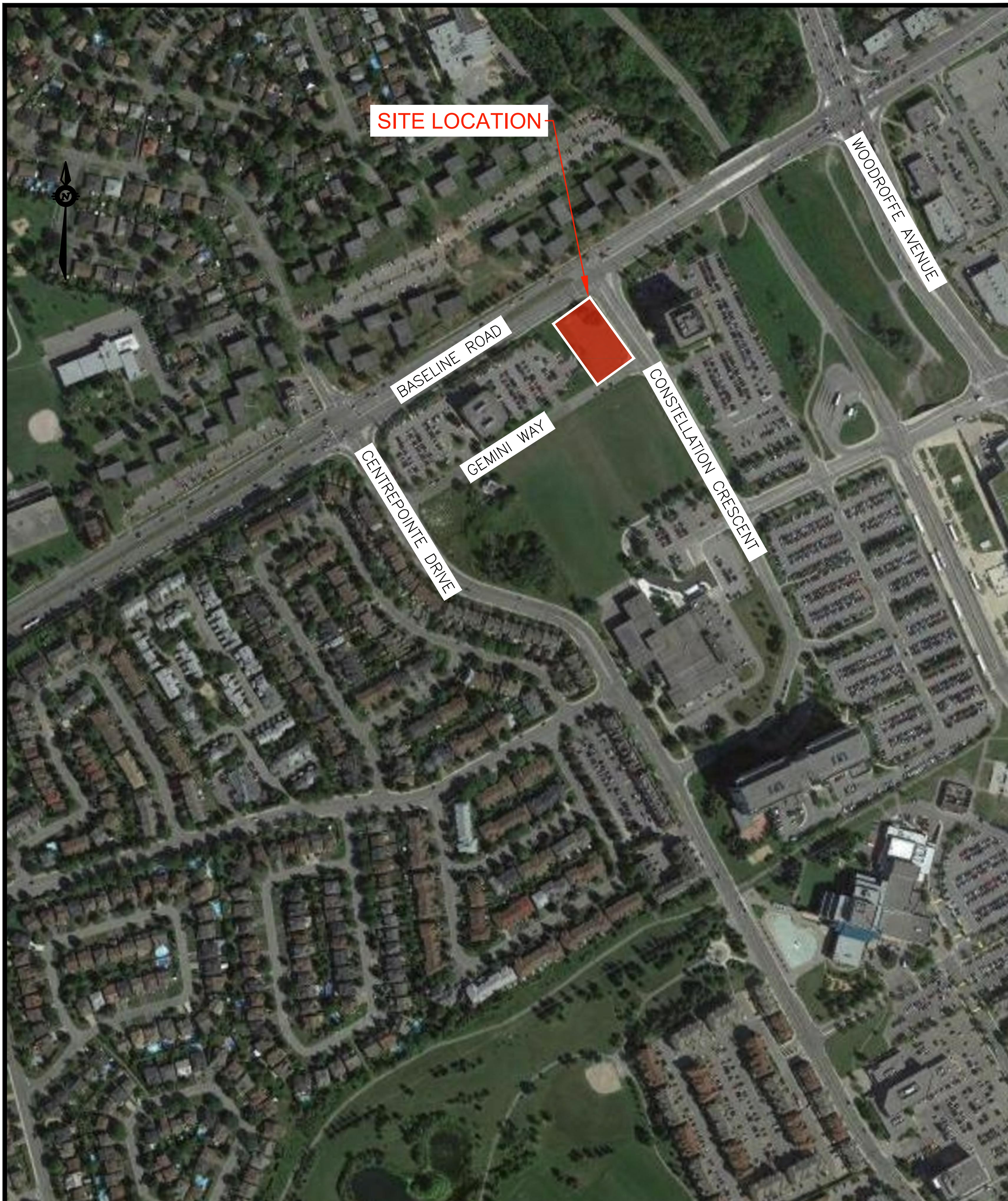
- During all construction activities, erosion and sedimentation will be controlled.

Appendix A – Figures

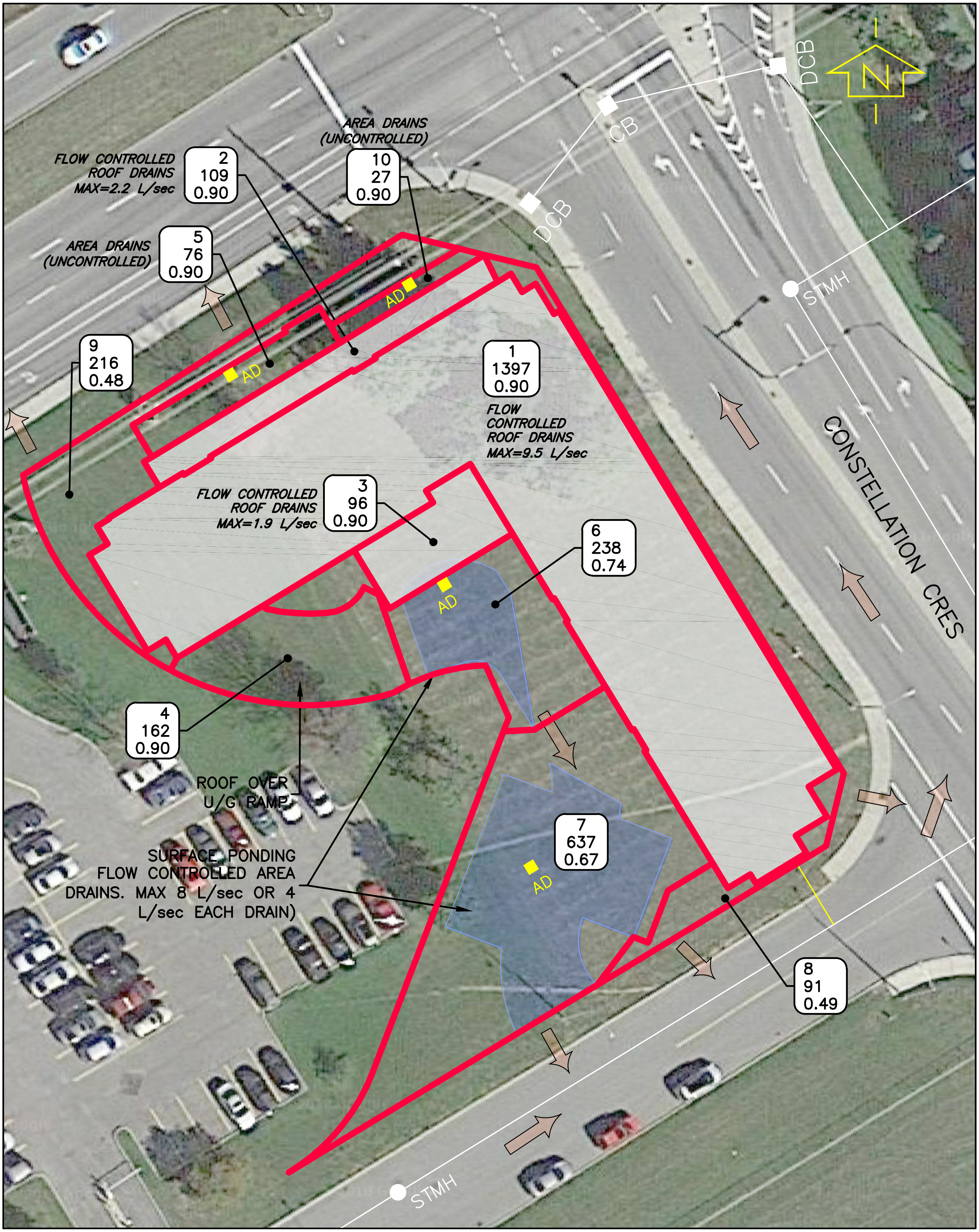
Figure A1: Site Location Plan

Figure A2: Storm Drainage Plan

Figure A3: Site Plan



exp Services Inc. 100-2650 Queensview Drive Ottawa, ON K2B 8H6 www.exp.com	DESIGN JLF DRAWN MZG DATE 23/05/18 FILE NO OTT-00245012-A0	**STUDENT HOUSING** **2140 BASELINE ROAD** **OTTAWA, ONTARIO.** SITE LOCATION PLAN	SCALE 1:5000 SKETCH NO FIG A1



exp Services Inc. 100-2650 Queensview Drive Ottawa, ON K2B 8H6 **www.exp.com**	DESIGN JLF DRAWN SAB	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE 1: 750
	DATE MAY 2018 FILE NO 245012	POST–DEVELOPMENT CATCHMENTS	SKETCH NO FIG A2

Appendix B – Sanitary Sewer Design Tables

Table B1: Sanitary Sewer Calculation Sheet

TABLE B1 - SANITARY SEWER CALCULATION SHEET

LOCATION			POPULATION									COMMERCIAL			AMENITY SPACE			INFILTRATION				SEWER DATA					
Street	From	To	Area (ha)	Studio Apt. Unit	2 Bedroom Apt. Unit	3 Bedroom Apt. Unit	4 Bedroom Apt. Unit	Individual Population	Cumulative Population	Peak Factor	Peak Flow (L/sec)	AREA (Ha)	ACCU AREA (Ha)	Peak Flow (L/sec)	Area (ha)	ACCU Area (ha)	Peak Flow (L/sec)	AREA (ha)	ACCU AREA (Ha)	INFILT FLOW (L/s)	TOTAL FLOW (L/s)	Dia. (mm)	Dia. actual	Slope (%)	Length (m)	Capacity (L/s)	Full Velocity (m/s)
Gemini Way	Building	300 SAN	0.305	9	27	9	99	473.4	473.4	3.39	5.20	0.1525	0.1525	0.05	0.1525	0.1525	0.05	0.305	0.305	0.09	5.39	250	251.46	2.00	7.4	85.42	1.72
			0.305	9			99	473							0.153			0.305		0.085	5.39						

Average Daily Flow (L/p/day) = 280	Pop. Density Persons/Unit	Q(p) = Peak Pop. Flow = PqM/86.4 + Iac	Designed: J. Fitzpatrick, P.Eng.	Project: 2140 Baseline Rd
Amenity Space (L/gros ha/day) = 28,000		Q(i) = Peak Extraneous Flow = I * Ac		
or L/gross ha/sec = 0.324	Single Apt. Unit 1.4	A_i = Individual; Area (hectares)	Checked: B. Thomas, P.Eng.	Location: Ottawa, Ontario
Light Industrial Flow (L/s/ha) = 35,000	2-bed Apt. Unit 2.1	A_c = Cumulative Area (hectares)		
or L/gross ha/sec = 0.405	3-bed Apt. Unit 3.1	M = Peaking Factor = 1 + (14/(4+P^0.5))	Dwg Reference:	File Ref: 245012- Sanitary Design Sheet, Apr 18, 2018
Max Res Peak Factor = 4.0	4-bed Apt. Unit 3.8	P = Population (thousands)		Sheet No: 1 of 1
Commercial / Inst Peak Factor = 1.5		Qcap, (Manning) = $1/n\ S^{1/2} R^{2/3} A_c$		
or 1.0 if Commerical < 20% = 1.0	Correction Factor, K = 0.80	Manning N =		
		I = Peak extraneous flow (L/s/ha) =		

Appendix C – Water Servicing Design Tables

Table C1: Water Consumption/Demand Allocation Table

Table C2: Estimated Water Pressure at Building (through single watermain connection)

TABLE C1: WATER DEMAND TABLE

Location: 2140 Baseline Rd
Project No: OTT-00245012
Designed by: M. Ghadban
Checked By: J.Fitzpatrick
Date Revised: May 25, 2018

Type	Population Density (ppu)
Single =	3.4
Semi Detached =	2.7
Townhome =	2.7
Bachelor =	1.4
1 Bed Apart =	1.4
2 Bed Apart =	2.1
3 Bed Apart =	3.1
4 Bed Apart =	3.8
Avg Apart =	1.8

Water Consumption

Residential = 350 L/cap/day

Commercial = 2,500 L/1000m^2/day

Desc	No of Residental Units													Commercial				Demands in (L/sec)		
	Single / Semi/Townhomes			Apartments						Total Persons	Average Demand (L/day)	Maximum Demand (L/day)	Peak Hourly Demand (L/day)	Area (m^2)	Average Demand (L/day)	Maximum Demand (L/day)	Peak Hourly Demand (L/day)	Avg Day (L/s)	Max Day (L/s)	Max Hour (L/s)
	Single	Semi	Town	Bach	1-Bed	2-Bed	3-Bed	4-Bed Apt	Avg Apt			2.5 x Avg Day	2.2 x Max Day			1.5 x Avg Day	1.8 x Max Day			
Student Residence					9	27	9	99		473	165,690	414,225	911,295					1.92	4.79	10.55
Commercial / Ammenity														2,692	6,730	10,095	18,171	0.08	0.12	0.21
Totals =					9	27	9			473	165,690	414,225	911,295	2,692		10,095	18,171	2.00	4.91	10.76

TABLE C2: ESTIMATED WATER PRESSURE AT PROPOSED BUILDING

Description	From	To	Demand (L/sec)	Pipe Length (m)	Pipe Dia (mm)	Dia (m)	Slope of HGL (m/m)	Head Loss (m)	Elev From (m)	Elev To (m)	*Elev Diff (m)	Pressure From kPa	(psi)	Pressure To kPa	(psi)	Pressure Drop (psi)
Peak Hour Conditons																
Single 200mm watermain	Main	Basement	10.760	13 m	204	0.204	0.00092	0.012	83.4	83.50	-0.1	409.6	(59.4)	408.5	(59.2)	0.2
Double 200mm watermain	Main	Basement	5.380	13 m	204	0.204	0.00026	0.0033	83.4	83.50	-0.1	409.6	(59.4)	408.6	(59.3)	0.1
Max Day Plus Fireflow Conditons																
Single 200mm watermain	Main	Basement	154.9	13 m	204	0.204	0.12868	1.6728	83.4	83.50	-0.1	257.5	(37.3)	240.1	(34.8)	2.5
Double 200mm watermain	Main	Basement	77.455	13 m	204	0.204	0.03564	0.4634	83.4	83.50	-0.1	257.5	(37.3)	252.0	(36.5)	0.8
Max Day Plus Fireflow Conditons (Review of 150mm diameter)																
Single 150mm watermain	Main	Basement	154.9	13 m	150	0.150	0.57523	7.4779	83.4	83.50	-0.1	257.5	(37.3)	183.2	(26.6)	10.8
Double 150mm watermain	Main	Basement	77.455	13 m	150	0.150	0.15934	2.0714	83.4	83.50	-0.1	257.5	(37.3)	236.2	(34.3)	3.1

Water Demand Info

Average Demand =	2	L/sec
Max Day Demand =	4.91	L/sec
Peak Hr Deamand =	10.76	L/sec
Fireflow Requriement =	150	L/sec
Max Day Plus FF Demand =	154.9	L/sec

Pipe Lengths

From watermain to building = 13 m

Hazen Williams C Factor for Friction Loss in Pipe, C= 110

Boundary Conditon

	Peak Hour	Max Day Plus Fireflow	
HGL (m)	127.5	112.0	(From City of Ottawa)
Approx Ground Elev (m) =	85.75	85.75	
Pressure (m) =	41.75	26.25	
Pressure (Pa) =	409,568	257,513	
Pressure (psi) =	59.4	37.3	

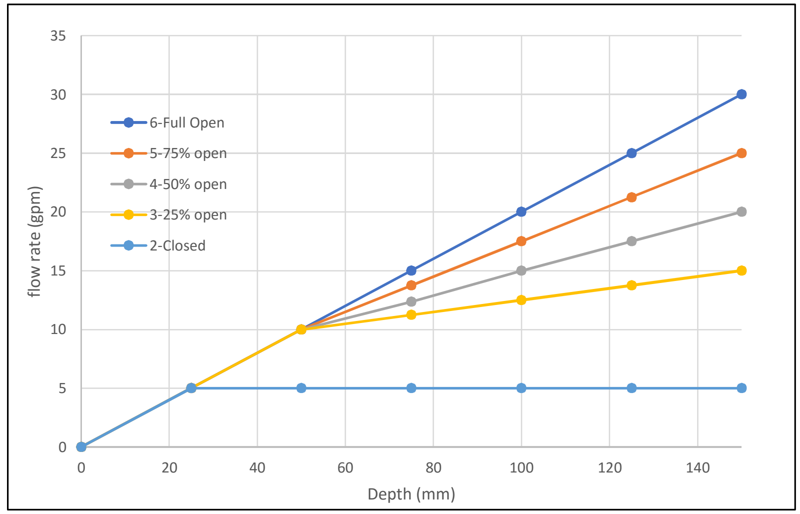
Appendix D – Stormwater Design Tables

Table D11-Main Roof

WATTS ADJ ACCUTROL WEIR FLOW RATES (Flow Rates at Various Depths)

Depth	Weir Position					
	1-None	2-Closed	3-25% open	4-50% open	5-75% open	6-Full Open
	Max Flow Rate per wier @150mm in gpm					
0	0	0	0	0	0	0
0.025	0	5	5	5	5	5
0.05	0	5	10	10	10	10
0.075	0	5	11.25	12.35	13.75	15
0.1	0	5	12.5	15	17.5	20
0.125	0	5	13.75	17.5	21.25	25
0.15	0	5	15	20	25	30

GRAPH OF FLOW RATE VERSUS DEPTH FOR VARIOUS WEIR POSITIONS



WATTS ADJ ACCUTROL WEIR FLOW RATES (Data From Manufacturer's Catalog)

Weir Position	Flow (gpm) per depth							Max Flow Rate per Weir @150mm
	0	25	50	75	100	125	150	
	0	0.025	0.05	0.075	0.1	0.125	0.15	
1-None	0	0	0	0	0	0	0	0
2-Closed	0	5	5	5	5	5	5	0.315
3-25% open	0	5	10	11.25	12.5	13.75	15	0.946
4-50% open	0	5	10	12.35	15	17.5	20	1.262
5-75% open	0	5	10	13.75	17.5	21.25	25	1.577
6-Full Open	0	5	10	15	20	25	30	1.893

BUILDING ROOF INFORMATION

Buidling Number	**Bldg 1 - Upper**	
Total Roof Area (m2)	**1397**	
Minimum Number of Drains Required	1.6	*Minimium of 1 drain every 900 sqaure metres (OBC 7.4.10.4)*
15-min Rainfall Factor for Ottawa (mm)	**23**	*(OBC Supp SB-1)*
Max Permitted Load from All Drains (Litres)	32,131	
Max Permitted Load from All Drains (L/sec)	35.7	*Hydraulic Load expressed in L/sec (OBC Section 7.4.10.3)*
Estimated area per drain (m2)	256	
Estimated Distance from roof edge to drains (m)	**8**	*Not more than 15m from Edge of Roof and 30m to Adjacent Dains (OBC Section 7.4.10.3)*
Estimated No. of Drains Requried	6	*Based on Total Roof Area / Area per Drain*
Actual No. of Drains Used	6	*Use if known*
Effecive Roof Percentage (%)	80%	*Allowance for Mechanical units on roof*
Effecive Total Roof Area (m2)	1118	
Area per Drain (m2)	186	*Based on Effectiive Roof Area / Actual Number of Drains Used*
Max Depth of Ponding at Drains (mm)	**150**	
Estimated Total Volume for Ponding on Roof (m3)	69.9	*Prisim formula, V = 1/3*A*d*
Maximium release rate per drain at 150mm (usgpm)	**25**	*Based on 1 Wier Per Drain and Fully Open Position*
Max Release Rate from Roof (L/sec)	9.5	*Based on Maximum Depth of Ponding of 150mm*
Equiv Runoff C for 100-yr Storm	0.14	*Based on 100-yr storm Intensity of 178.6 mm/hr, where I =1735.688 / (Tc + 6.014)^0.820, with Tc=10min)*

RATING CURVE FOR ROOF

DISCHARGE VERSUS DEPTH				AREA VERSUS DEPTH			Total Ponding Volume - All Drains (m3)
Ponding Depth (m)	Discharge Rate Per Drain (gpm)	Discharge Rate Per Drain (m3/sec)	Total Discharge All Drains (m3/sec)	Ponding Depth (m)	Ponding Area (m2)	Ponding Volume Per Drain (m3)	
0	0	0.00	0.00000	0	0.0	0.0	0.0
0.025	5	0.32	0.00189	0.025	5.2	0.0	0.3
0.05	10	0.63	0.00379	0.05	20.7	0.3	2.1
0.075	13.75	0.87	0.00520	0.075	46.6	1.2	7.0
0.1	17.5	1.10	0.00662	0.1	82.8	2.8	16.6
0.125	21.25	1.34	0.00804	0.125	129.4	5.4	32.3
0.15	25	1.58	0.00946	0.15	186.3	9.3	55.9
Weir Position =	**5-75% open**						

RATING CURVE FOR MODELLING OUTLET

Head or Ponding Depth (m)	Outflow (L/sec)
0	0.0000
0.025	1.8927
0.05	3.7854
0.075	5.2049
0.1	6.6245
0.125	8.0440
0.15	9.4635

RATING CURVE FOR MODELLING ROOF STORAGE

Head or Ponding Depth (m)	Ponding Area (m2)
0	0.0
0.025	5.2
0.05	20.7
0.075	46.6
0.1	82.8
0.125	129.4
0.15	186.3

Table D12-North Lower Roof

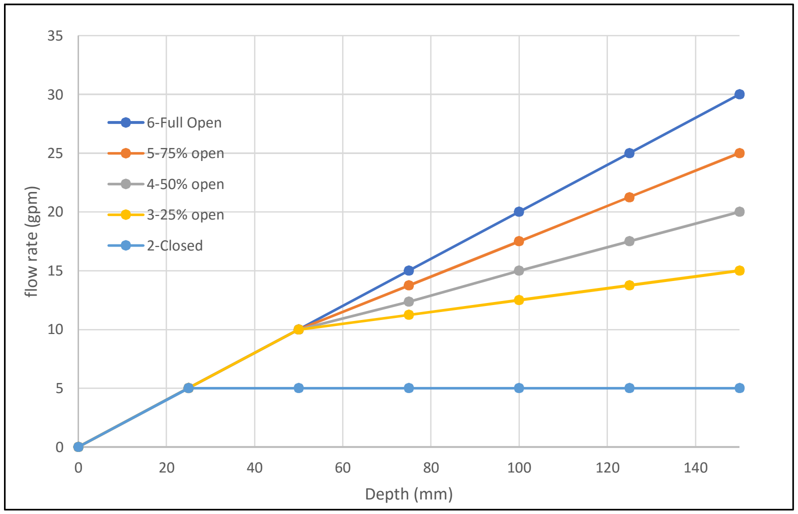
WATTS ADJ ACCUTROL WEIR FLOW RATES (Flow Rates at Various Depths)

Depth	Weir Position					
	1-None	2-Closed	3-25% open	4-50% open	5-75% open	6-Full Open
	Max Flow Rate per wier @150mm in gpm					
0	0	0	0	0	0	0
0.025	0	5	5	5	5	5
0.05	0	5	10	10	10	10
0.075	0	5	11.25	12.35	13.75	15
0.1	0	5	12.5	15	17.5	20
0.125	0	5	13.75	17.5	21.25	25
0.15	0	5	15	20	25	30

WATTS ADJ ACCUTROL WEIR FLOW RATES (Data From Manufacturer's Catalog)

Weir Position	Flow (gpm) per depth							Max Flow Rate per Weir @150mm
	0	25	50	75	100	125	150	
	0	0.025	0.05	0.075	0.1	0.125	0.15	
1-None	0	0	0	0	0	0	0	0
2-Closed	0	5	5	5	5	5	5	0.315
3-25% open	0	5	10	11.25	12.5	13.75	15	0.946
4-50% open	0	5	10	12.35	15	17.5	20	1.262
5-75% open	0	5	10	13.75	17.5	21.25	25	1.577
6-Full Open	0	5	10	15	20	25	30	1.893

GRAPH OF FLOW RATE VERSUS DEPTH FOR VARIOUS WEIR POSITIONS



BUILDING ROOF INFORMATION

Buidling Number	**North side**	
Total Roof Area (m2)	**109**	
Minimum Number of Drains Required	0.1	*Minimium of 1 drain every 900 sqaure metres (OBC 7.4.10.4)*
15-min Rainfall Factor for Ottawa (mm)	**23**	*(OBC Supp SB-1)*
Max Permitted Load from All Drains (Litres)	2,507	
Max Permitted Load from All Drains (L/sec)	2.8	*Hydraulic Load expressed in L/sec (OBC Section 7.4.10.3)*
Estimated area per drain (m2)	64	
Estimated Distance from roof edge to drains (m)	**4**	*Not more than 15m from Edge of Roof and 30m to Adjacent Dains (OBC Section 7.4.10.3)*
Estimated No. of Drains Requried	2	*Based on Total Roof Area / Area per Drain*
Actual No. of Drains Used	2	*Use if known*
Effeceive Roof Percentage (%)	100%	*Allowance for Mechanical units on roof*
Effecive Total Roof Area (m2)	109	
Area per Drain (m2)	55	*Based on Effectiive Roof Area / Actual Number of Drains Used*
Max Depth of Ponding at Drains (mm)	**150**	
Estimated Total Volume for Ponding on Roof (m3)	5.5	*Prisim formula, V = 1/3*A*d*
Maximium release rate per drain at 150mm (usgpm)	**20**	*Based on 1 Wier Per Drain and Fully Open Position*
Max Release Rate from Roof (L/sec)	2.5	*Based on Maximum Depth of Ponding of 150mm*
Equiv Runoff C for 100-yr Storm	0.47	*Based on 100-yr storm Intensity of 178.6 mm/hr, where I =1735.688 / (Tc + 6.014)^0.820, with Tc=10min)*

RATING CURVE FOR ROOF

DISCHARGE VERSUS DEPTH				AREA VERSUS DEPTH			Total Ponding Volume - All Drains (m3)
Ponding Depth (m)	Discharge Rate Per Drain (gpm)	Discharge Rate Per Drain (m3/sec)	Total Discharge All Drains (m3/sec)	Ponding Depth (m)	Ponding Area (m2)	Ponding Volume Per Drain (m3)	
0	0	0.00	0.00000	0	0.0	0.0	0.0
0.025	5	0.32	0.00063	0.025	1.5	0.0	0.0
0.05	10	0.63	0.00126	0.05	6.1	0.1	0.2
0.075	12.35	0.78	0.00156	0.075	13.6	0.3	0.7
0.1	15	0.95	0.00189	0.1	24.2	0.8	1.6
0.125	17.5	1.10	0.00221	0.125	37.8	1.6	3.2
0.15	20	1.26	0.00252	0.15	54.5	2.7	5.5
Weir Position =	**4-50% open**						

RATING CURVE FOR MODELLING OUTLET

Head or Ponding Depth (m)	Outflow (L/sec)
0	0.0000
0.025	0.6309
0.05	1.2618
0.075	1.5583
0.1	1.8927
0.125	2.2082
0.15	2.5236

RATING CURVE FOR MODELLING ROOF STORAGE

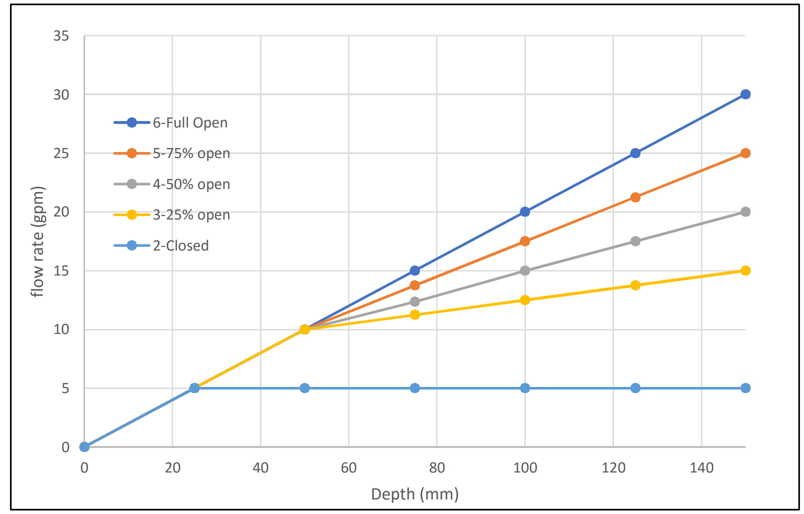
Head or Ponding Depth (m)	Ponding Area (m2)
0	0.0
0.025	1.5
0.05	6.1
0.075	13.6
0.1	24.2
0.125	37.8
0.15	54.5

Table D13-South Canopy Roof

WATTS ADJ ACCUTROL WEIR FLOW RATES (Flow Rates at Various Depths)

Depth	Weir Position					
	1-None	2-Closed	3-25% open	4-50% open	5-75% open	6-Full Open
	Max Flow Rate per wier @150mm in gpm					
0	0	0	0	0	0	0
0.025	0	5	5	5	5	5
0.05	0	5	10	10	10	10
0.075	0	5	11.25	12.35	13.75	15
0.1	0	5	12.5	15	17.5	20
0.125	0	5	13.75	17.5	21.25	25
0.15	0	5	15	20	25	30

GRAPH OF FLOW RATE VERSUS DEPTH FOR VARIOUS WEIR POSITIONS



WATTS ADJ ACCUTROL WEIR FLOW RATES (Data From Manufacturer's Catalog)

Weir Position	Flow (gpm) per depth							Max Flow Rate per Weir @150mm
	0	25	50	75	100	125	150	
	0	0.025	0.05	0.075	0.1	0.125	0.15	
1-None	0	0	0	0	0	0	0	0
2-Closed	0	5	5	5	5	5	5	0.315
3-25% open	0	5	10	11.25	12.5	13.75	15	0.946
4-50% open	0	5	10	12.35	15	17.5	20	1.262
5-75% open	0	5	10	13.75	17.5	21.25	25	1.577
6-Full Open	0	5	10	15	20	25	30	1.893

BUILDING ROOF INFORMATION

Buidling Number	**Canopy**	
Total Roof Area (m2)	**96**	
Minimum Number of Drains Required	0.1	*Minimium of 1 drain every 900 sqaure metres (OBC 7.4.10.4)*
15-min Rainfall Factor for Ottawa (mm)	**23**	*(OBC Supp SB-1)*
Max Permitted Load from All Drains (Litres)	2,208	
Max Permitted Load from All Drains (L/sec)	2.5	*Hydraulic Load expressed in L/sec (OBC Section 7.4.10.3)*
Estimated area per drain (m2)	16	
Estimated Distance from roof edge to drains (m)	**2**	*Not more than 15m from Edge of Roof and 30m to Adjacent Dains (OBC Section 7.4.10.3)*
Estimated No. of Drains Requried	6	*Based on Total Roof Area / Area per Drain*
Actual No. of Drains Used	2	*Use if known*
Effecive Roof Percentage (%)	100%	*Allowance for Mechanical units on roof*
Effecive Total Roof Area (m2)	96	
Area per Drain (m2)	48	*Based on Effectiive Roof Area / Actual Number of Drains Used*
Max Depth of Ponding at Drains (mm)	**150**	
Estimated Total Volume for Ponding on Roof (m3)	4.8	*Prisim formula, V = 1/3*A*d*
Maximium release rate per drain at 150mm (usgpm)	**20**	*Based on 1 Wier Per Drain and Fully Open Position*
Max Release Rate from Roof (L/sec)	2.5	*Based on Maximum Depth of Ponding of 150mm*
Equiv Runoff C for 100-yr Storm	0.53	*Based on 100-yr storm Intensity of 178.6 mm/hr, where I =1735.688 / (Tc + 6.014)^0.820, with Tc=10min)*

RATING CURVE FOR ROOF

DISCHARGE VERSUS DEPTH				AREA VERSUS DEPTH			Total Ponding Volume - All Drains (m3)
Ponding Depth (m)	Discharge Rate Per Drain (gpm)	Discharge Rate Per Drain (m3/sec)	Total Discharge All Drains (m3/sec)	Ponding Depth (m)	Ponding Area (m2)	Ponding Volume Per Drain (m3)	
0	0	0.00	0.00000	0	0.0	0.0	0.0
0.025	5	0.32	0.00063	0.025	1.3	0.0	0.0
0.05	10	0.63	0.00126	0.05	5.3	0.1	0.2
0.075	12.35	0.78	0.00156	0.075	12.0	0.3	0.6
0.1	15	0.95	0.00189	0.1	21.3	0.7	1.4
0.125	17.5	1.10	0.00221	0.125	33.3	1.4	2.8
0.15	20	1.26	0.00252	0.15	48.0	2.4	4.8
Weir Position =	**4-50% open**						

RATING CURVE FOR MODELLING OUTLET

Head or Ponding Depth (m)	Outflow (L/sec)
0	0.0000
0.025	0.6309
0.05	1.2618
0.075	1.5583
0.1	1.8927
0.125	2.2082
0.15	2.5236

RATING CURVE FOR MODELLING ROOF STORAGE

Head or Ponding Depth (m)	Ponding Area (m2)
0	0.0
0.025	1.3
0.05	5.3
0.075	12.0
0.1	21.3
0.125	33.3
0.15	48.0

TABLE D1: PRE-DEVELOPMENT RUNOFF CALCULATIONS

Area Description	Area (ha)	Time of Conc, Tc (min)	Storm = 5 yr			Storm = 100 yr		
			I_5 (mm/hr)	Cavg	Q_{5PRE} (L/sec)	I_{100} (mm/hr)	Cavg	Q_{100PRE} (L/sec)
Total Site	0.3049	10	104.19	0.20	17.7	178.56	0.25	37.8

Notes

1) Intensity, I = 998.071/(Tc+6.035) $^{0.814}$ (5-year, City of 0ttawa)

2) Intensity, I = 1735.688/(Tc+6.014) $^{0.820}$ (100-year, City of Ottawa)

3) Cavg for 100-year is increased by 25% to a maximum of 1.0

TABLE D2: ALLOWABLE RUNOFF CALCULATIONS

Area Description	Area (ha)	Time of Conc, Tc (min)	Storm = 5 yr		
			I_5 (mm/hr)	Cavg	Q_{ALLOW} (L/sec)
Total Site	0.3049	10	104.29	0.50	44.2
	0.3049				44.2

Notes

1) Allowable Capture Rate is based on 5-year storm at Tc=10 minutes.

2) Intensity, I_5 *= 998.071/(Tc+6.035)^0.814 (5-year, City of 0ttawa)*

TABLE D3: AVERAGE RUNOFF COEFFICIENTS (Post Development)

Runoff Coeffients $C_{ASPH/CONC}$ = 0.90 C_{ROOF} = 0.90 C_{GRASS} = 0.20

Area No.	Asphalt /Conc Areas (m^2)	A * C_{ASPH}	Roof Areas (m^2)	A * C_{ROOF}	Grassed Areas (m^2)	A * C_{GRASS}	Sum AC	Total Area (m^2)	C_{AVG}
1			1397.0	1257.3			1257.3	1397.0	0.90
2			109.0	98.1			98.1	109.0	0.90
3			96.0	86.4			86.4	96.0	0.90
4			162.0	145.8			145.8	162.0	0.90
5	76	68.4					68.4	76.0	0.90
6	183	164.7			55	11.0	175.7	238.0	0.74
7	430	387.0			207	41.4	428.4	637.0	0.67
8	38	34.2			53	10.6	44.8	91.0	0.49
9	87	78.3			129	25.8	104.1	216.0	0.48
10	27	24.3					24.3	27.0	0.90
Total	841.0	756.9	1,764.0	1,587.6	444.0	88.8	2,433.3	3,049.0	0.80

ite % IMP = 85% **Average Runoff Coeff (All Areas) =** $\mathbf{C_{AVG}} = \frac{2,433}{3,049}$ **= 0.80**

TABLE D4: SUMMARY OF POST DEVELOPMENT RUNOFF (Uncontrolled and Controlled)

Area No	Area (ha)	Time of Conc, Tc (min)	Storm = 2 yr				Storm = 5 yr				Storm = 100 yr				Comments
			C_{AVG}	I_2 (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	I_5 (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	
1	0.1397	10	0.90	76.81	26.8	**(3.7)**	0.90	104.19	36.4	**(5.0)**	1.00	178.56	69.3	**(9.5)**	Roof Drains
2	0.0109	10	0.90	76.81	2.1	**(0.9)**	0.90	104.19	2.8	**(1.2)**	1.00	178.56	5.4	**(2.2)**	Roof Drains
3	0.0096	10	0.90	76.81	1.8	**(0.7)**	0.90	104.19	2.5	**(1.0)**	1.00	178.56	4.8	**(1.9)**	Roof Drains
4	0.0162	10	0.90	76.81	3.1	**(3.1)**	0.90	104.19	4.2	**(4.2)**	1.00	178.56	8.0	**(8.0)**	uncontrolled
5	0.0076	10	0.90	76.81	1.5	**1.5**	0.90	104.19	2.0	**2.0**	1.00	178.56	3.8	**3.8**	Area Drain uncontrolled
6	0.0238	10	0.74	76.81	3.8	**(1.4)**	0.74	104.19	5.1	**(1.9)**	0.92	178.56	10.9	**(4.0)**	Area drain controlled
7	0.0637	10	0.67	76.81	9.1	**(1.4)**	0.67	104.19	12.4	**(1.9)**	0.84	178.56	26.6	**(4.0)**	Area drain controlled
8	0.0091	10	0.49	76.81	1.0	**1.0**	0.49	104.19	1.3	**1.3**	0.62	178.56	2.8	**2.8**	overland uncontrolled
9	0.0216	10	0.48	76.81	2.2	**2.2**	0.48	104.19	3.0	**3.0**	0.60	178.56	6.5	**6.5**	overland uncontrolled
10	0.0027	10	0.90	76.81	0.5	**0.5**	0.90	104.19	0.7	**0.7**	1.00	178.56	1.3	**1.3**	Area Drain uncontrolled
Totals	0.3049				52.0	**16.3**			70.5	**21.4**			139.4	**44.0**	

ddedit

2-yr Storm Intensity, I = 732.951/(Tc+6.199)^0.810 (City of Ottawa)

5-yr Storm Intensity, I = 998.071/(Tc+6.035)^0.814 (City of Ottawa)

100-yr Storm Intensity, I = 1735.688/(Tc+6.014)&^0.820 (City of Ottawa)

Time of Concentration (min), Tc = ***10***

For Flows under column Qcap which are shown in brackets ***(0.0)*** *, denotes flows that are controlled*

TABLE D5: SUMMARY OF TOTAL STORAGE REQUIRED & PROVIDED

Area No.	Area (ha)	Release Rate (L/s)			Storage Required (m^3)			Storage Provided (m^3)					Control Method
		2-yr	5-yr	100-yr	2-yr	5-yr	100-yr	Roof	Surface Ponding	UG Chambers	UG CB/MHs	Total	
1	0.1397	3.68	5.0	9.5	0.6	25.1	47.4	56.0				56.0	Flow Controlled RD's
2	0.0109	0.85	1.2	2.2		1.0	2.0	5.5				5.5	Flow Controlled RD's
3	0.0096	0.74	1.0	1.9		0.9	1.7	4.8				4.8	Flow Controlled RD's
4	0.0162	3.11	4.2	8.0									none
5	0.0076	1.46	2.0	3.8									none
6	0.0238	1.38	1.9	4.0		2.0	4.3		5.0			5.0	Flow Controlled AD's
7	0.0637	1.38	1.9	4.0	0.0	8.2	17.4		21.0			21.0	Flow Controlled AD's
8	0.0091	0.96	1.3	2.8									none
9	0.0216	2.22	3.0	6.5									none
10	0.0027	0.52	0.7	1.3									none
Totals =	**0.302**	**16.3**	**22.1**	**44.0**	**0.6**	**37.3**	**72.8**	**66.3**	**26.0**			**92.3**	

Table D6 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 1**

C_{AVG} = 0.14 (2-yr)

C_{AVG} = 0.90 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.1397 (hectares)

Duration (min)	Release Rate = 3.7 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951, B = 0.810 (I = A/(T_c+C), C = 6.199					Release Rate = 5.0 (L/sec) Return Period = 5 (years) IDF Parameters, A = 998.071 0.814 (I = A/(T_c+C), C = 6.053					Release Rate = 9.5 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688 0.820 (I = A/(T_c+C), C = 6.014				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	9.1	3.68	5.4	0.00	230.5	80.6	4.989	75.6	0.00	398.6	154.8	9.500	145.3	0.00
2	133.3	7.2	3.68	3.6	0.43	182.7	63.9	4.989	58.9	7.06	315.0	122.3	9.500	112.8	13.54
4	111.7	6.1	3.68	2.4	0.57	152.5	53.3	4.989	48.3	11.60	262.4	101.9	9.500	92.4	22.18
6	96.6	5.2	3.68	1.6	0.56	131.6	46.0	4.989	41.0	14.76	226.0	87.8	9.500	78.3	28.18
8	85.5	4.6	3.68	1.0	0.46	116.1	40.6	4.989	35.6	17.09	199.2	77.4	9.500	67.9	32.57
10	76.8	4.2	3.68	0.5	0.29	104.2	36.4	4.989	31.4	18.86	178.6	69.3	9.500	59.8	35.91
12	69.9	3.8	3.68	0.1	0.08	94.7	33.1	4.989	28.1	20.24	162.1	63.0	9.500	53.5	38.50
14	64.2	3.5	3.68	-0.2	-0.16	86.9	30.4	4.989	25.4	21.33	148.7	57.8	9.500	48.3	40.54
16	59.5	3.2	3.68	-0.4	-0.43	80.5	28.1	4.989	23.1	22.21	137.5	53.4	9.500	43.9	42.16
18	55.5	3.0	3.68	-0.7	-0.72	75.0	26.2	4.989	21.2	22.91	128.1	49.7	9.500	40.2	43.46
20	52.0	2.8	3.68	-0.9	-1.03	70.3	24.6	4.989	19.6	23.48	120.0	46.6	9.500	37.1	44.50
22	49.0	2.7	3.68	-1.0	-1.34	66.1	23.1	4.989	18.1	23.93	112.9	43.8	9.500	34.3	45.33
24	46.4	2.5	3.68	-1.2	-1.67	62.5	21.9	4.989	16.9	24.29	106.7	41.4	9.500	31.9	45.98
26	44.0	2.4	3.68	-1.3	-2.01	59.3	20.7	4.989	15.8	24.58	101.2	39.3	9.500	29.8	46.48
28	41.9	2.3	3.68	-1.4	-2.36	56.5	19.7	4.989	14.8	24.79	96.3	37.4	9.500	27.9	46.85
30	40.0	2.2	3.68	-1.5	-2.71	53.9	18.8	4.989	13.9	24.95	91.9	35.7	9.500	26.2	47.12
32	38.3	2.1	3.68	-1.6	-3.07	51.6	18.0	4.989	13.0	25.06	87.9	34.1	9.500	24.6	47.29
34	36.8	2.0	3.68	-1.7	-3.43	49.5	17.3	4.989	12.3	25.12	84.3	32.7	9.500	23.2	47.38
36	35.4	1.9	3.68	-1.8	-3.80	47.6	16.6	4.989	11.6	25.14	81.0	31.4	9.500	21.9	47.40
38	34.1	1.8	3.68	-1.8	-4.17	45.8	16.0	4.989	11.0	25.13	77.9	30.3	9.500	20.8	47.35
40	32.9	1.8	3.68	-1.9	-4.55	44.2	15.4	4.989	10.5	25.09	75.1	29.2	9.500	19.7	47.24
42	31.8	1.7	3.68	-2.0	-4.93	42.7	14.9	4.989	9.9	25.02	72.6	28.2	9.500	18.7	47.08
Max =					**0.57**					**25.14**					**47.40**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, I = $A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

Table D7 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 2**

C_{AVG} = 0.01 (2-yr)

C_{AVG} = 0.90 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0109 (hectares)

Duration (min)	Release Rate = 0.9 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951, B = 0.810 ($I = A/(T_c+C)$, C = 6.199					Release Rate = 1.2 (L/sec) Return Period = 5 (years) IDF Parameters, A = 998.071, 0.814 ($I = A/(T_c+C)$, C = 6.053					Release Rate = 2.2 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688, 0.820 ($I = A/(T_c+C)$, C = 6.014				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	0.1	0.85	-0.8	0.00	230.5	6.3	1.155	5.1	0.00	398.6	12.1	2.200	9.9	0.00
2	133.3	0.0	0.85	-0.8	-0.10	182.7	5.0	1.155	3.8	0.46	315.0	9.5	2.200	7.3	0.88
4	111.7	0.0	0.85	-0.8	-0.20	152.5	4.2	1.155	3.0	0.72	262.4	8.0	2.200	5.8	1.38
6	96.6	0.0	0.85	-0.8	-0.30	131.6	3.6	1.155	2.4	0.88	226.0	6.8	2.200	4.6	1.67
8	85.5	0.0	0.85	-0.8	-0.40	116.1	3.2	1.155	2.0	0.97	199.2	6.0	2.200	3.8	1.84
10	76.8	0.0	0.85	-0.8	-0.50	104.2	2.8	1.155	1.7	1.01	178.6	5.4	2.200	3.2	1.93
12	69.9	0.0	0.85	-0.8	-0.60	94.7	2.6	1.155	1.4	1.03	162.1	4.9	2.200	2.7	1.95
14	64.2	0.0	0.85	-0.8	-0.70	86.9	2.4	1.155	1.2	1.02	148.7	4.5	2.200	2.3	1.94
16	59.5	0.0	0.85	-0.8	-0.80	80.5	2.2	1.155	1.0	1.00	137.5	4.2	2.200	2.0	1.89
18	55.5	0.0	0.85	-0.8	-0.90	75.0	2.0	1.155	0.9	0.96	128.1	3.9	2.200	1.7	1.82
20	52.0	0.0	0.85	-0.8	-1.00	70.3	1.9	1.155	0.8	0.91	120.0	3.6	2.200	1.4	1.72
22	49.0	0.0	0.85	-0.8	-1.10	66.1	1.8	1.155	0.6	0.86	112.9	3.4	2.200	1.2	1.61
24	46.4	0.0	0.85	-0.8	-1.20	62.5	1.7	1.155	0.6	0.79	106.7	3.2	2.200	1.0	1.49
26	44.0	0.0	0.85	-0.8	-1.31	59.3	1.6	1.155	0.5	0.72	101.2	3.1	2.200	0.9	1.35
28	41.9	0.0	0.85	-0.8	-1.41	56.5	1.5	1.155	0.4	0.65	96.3	2.9	2.200	0.7	1.21
30	40.0	0.0	0.85	-0.8	-1.51	53.9	1.5	1.155	0.3	0.57	91.9	2.8	2.200	0.6	1.05
32	38.3	0.0	0.85	-0.8	-1.61	51.6	1.4	1.155	0.3	0.48	87.9	2.7	2.200	0.5	0.89
34	36.8	0.0	0.85	-0.8	-1.71	49.5	1.3	1.155	0.2	0.40	84.3	2.6	2.200	0.4	0.72
36	35.4	0.0	0.85	-0.8	-1.81	47.6	1.3	1.155	0.1	0.31	81.0	2.5	2.200	0.3	0.55
38	34.1	0.0	0.85	-0.8	-1.92	45.8	1.2	1.155	0.1	0.21	77.9	2.4	2.200	0.2	0.37
40	32.9	0.0	0.85	-0.8	-2.02	44.2	1.2	1.155	0.0	0.12	75.1	2.3	2.200	0.1	0.18
42	31.8	0.0	0.85	-0.8	-2.12	42.7	1.2	1.155	0.0	0.02	72.6	2.2	2.200	0.0	0.00
Max =					**0.00**					**1.03**					**1.95**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

Table D8 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 3**

C_{AVG} = 0.01 (2-yr)

C_{AVG} = 0.90 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0096 (hectares)

Duration (min)	Release Rate = 0.7 (L/sec)					Release Rate = 1.0 (L/sec)					Release Rate = 1.9 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951			, B =	0.810	IDF Parameters, A = 998.071				0.814	IDF Parameters, A = 1735.688				0.820
	(I = A/(T_c+C)			, C =	6.199	(I = A/(T_c+C)			, C =	6.053	(I = A/(T_c+C)			, C =	6.014
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	0.0	0.74	-0.7	0.00	230.5	5.5	0.998	4.5	0.00	398.6	10.6	1.900	8.7	0.00
2	133.3	0.0	0.74	-0.7	-0.08	182.7	4.4	0.998	3.4	0.41	315.0	8.4	1.900	6.5	0.78
4	111.7	0.0	0.74	-0.7	-0.17	152.5	3.7	0.998	2.7	0.64	262.4	7.0	1.900	5.1	1.22
6	96.6	0.0	0.74	-0.7	-0.26	131.6	3.2	0.998	2.2	0.78	226.0	6.0	1.900	4.1	1.49
8	85.5	0.0	0.74	-0.7	-0.34	116.1	2.8	0.998	1.8	0.86	199.2	5.3	1.900	3.4	1.64
10	76.8	0.0	0.74	-0.7	-0.43	104.2	2.5	0.998	1.5	0.90	178.6	4.8	1.900	2.9	1.72
12	69.9	0.0	0.74	-0.7	-0.52	94.7	2.3	0.998	1.3	0.92	162.1	4.3	1.900	2.4	1.75
14	64.2	0.0	0.74	-0.7	-0.60	86.9	2.1	0.998	1.1	0.92	148.7	4.0	1.900	2.1	1.74
16	59.5	0.0	0.74	-0.7	-0.69	80.5	1.9	0.998	0.9	0.90	137.5	3.7	1.900	1.8	1.70
18	55.5	0.0	0.74	-0.7	-0.78	75.0	1.8	0.998	0.8	0.87	128.1	3.4	1.900	1.5	1.64
20	52.0	0.0	0.74	-0.7	-0.87	70.3	1.7	0.998	0.7	0.83	120.0	3.2	1.900	1.3	1.56
22	49.0	0.0	0.74	-0.7	-0.95	66.1	1.6	0.998	0.6	0.78	112.9	3.0	1.900	1.1	1.47
24	46.4	0.0	0.74	-0.7	-1.04	62.5	1.5	0.998	0.5	0.73	106.7	2.8	1.900	0.9	1.36
26	44.0	0.0	0.74	-0.7	-1.13	59.3	1.4	0.998	0.4	0.67	101.2	2.7	1.900	0.8	1.25
28	41.9	0.0	0.74	-0.7	-1.22	56.5	1.4	0.998	0.4	0.60	96.3	2.6	1.900	0.7	1.12
30	40.0	0.0	0.74	-0.7	-1.31	53.9	1.3	0.998	0.3	0.54	91.9	2.5	1.900	0.6	0.99
32	38.3	0.0	0.74	-0.7	-1.39	51.6	1.2	0.998	0.2	0.46	87.9	2.3	1.900	0.4	0.86
34	36.8	0.0	0.74	-0.7	-1.48	49.5	1.2	0.998	0.2	0.39	84.3	2.2	1.900	0.3	0.71
36	35.4	0.0	0.74	-0.7	-1.57	47.6	1.1	0.998	0.1	0.31	81.0	2.2	1.900	0.3	0.56
38	34.1	0.0	0.74	-0.7	-1.66	45.8	1.1	0.998	0.1	0.23	77.9	2.1	1.900	0.2	0.41
40	32.9	0.0	0.74	-0.7	-1.75	44.2	1.1	0.998	0.1	0.15	75.1	2.0	1.900	0.1	0.25
42	31.8	0.0	0.74	-0.7	-1.83	42.7	1.0	0.998	0.0	0.07	72.6	1.9	1.900	0.0	0.09
Max =					**0.00**					**0.92**					**1.75**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, I = $A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

Table D9 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 6**

C_{AVG} = 0.02 (2-yr)

C_{AVG} = 0.74 (5-yr)

C_{AVG} = 0.92 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0238 (hectares)

Duration (min)	Release Rate = 1.4 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951 , B = 0.810 (I = A/(T_c+C) , C = 6.199					Release Rate = 1.9 (L/sec) Return Period = 5 (years) IDF Parameters, A = 998.071 0.814 (I = A/(T_c+C) , C = 6.053					Release Rate = 4.0 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688 0.820 (I = A/(T_c+C) , C = 6.014				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	0.3	1.38	-1.1	0.00	230.5	11.3	1.867	9.4	0.00	398.6	24.3	4.000	20.3	0.00
2	133.3	0.2	1.38	-1.2	-0.14	182.7	8.9	1.867	7.1	0.85	315.0	19.2	4.000	15.2	1.83
4	111.7	0.2	1.38	-1.2	-0.29	152.5	7.4	1.867	5.6	1.34	262.4	16.0	4.000	12.0	2.89
6	96.6	0.2	1.38	-1.2	-0.44	131.6	6.4	1.867	4.6	1.64	226.0	13.8	4.000	9.8	3.53
8	85.5	0.1	1.38	-1.2	-0.60	116.1	5.7	1.867	3.8	1.83	199.2	12.2	4.000	8.2	3.92
10	76.8	0.1	1.38	-1.3	-0.75	104.2	5.1	1.867	3.2	1.93	178.6	10.9	4.000	6.9	4.14
12	69.9	0.1	1.38	-1.3	-0.91	94.7	4.6	1.867	2.8	1.99	162.1	9.9	4.000	5.9	4.25
14	64.2	0.1	1.38	-1.3	-1.07	86.9	4.2	1.867	2.4	2.00	148.7	9.1	4.000	5.1	4.27
16	59.5	0.1	1.38	-1.3	-1.23	80.5	3.9	1.867	2.1	1.98	137.5	8.4	4.000	4.4	4.22
18	55.5	0.1	1.38	-1.3	-1.39	75.0	3.7	1.867	1.8	1.94	128.1	7.8	4.000	3.8	4.13
20	52.0	0.1	1.38	-1.3	-1.55	70.3	3.4	1.867	1.6	1.88	120.0	7.3	4.000	3.3	3.99
22	49.0	0.1	1.38	-1.3	-1.72	66.1	3.2	1.867	1.4	1.80	112.9	6.9	4.000	2.9	3.82
24	46.4	0.1	1.38	-1.3	-1.88	62.5	3.1	1.867	1.2	1.71	106.7	6.5	4.000	2.5	3.62
26	44.0	0.1	1.38	-1.3	-2.04	59.3	2.9	1.867	1.0	1.61	101.2	6.2	4.000	2.2	3.40
28	41.9	0.1	1.38	-1.3	-2.20	56.5	2.8	1.867	0.9	1.50	96.3	5.9	4.000	1.9	3.16
30	40.0	0.1	1.38	-1.3	-2.36	53.9	2.6	1.867	0.8	1.38	91.9	5.6	4.000	1.6	2.90
32	38.3	0.1	1.38	-1.3	-2.53	51.6	2.5	1.867	0.7	1.25	87.9	5.4	4.000	1.4	2.62
34	36.8	0.1	1.38	-1.3	-2.69	49.5	2.4	1.867	0.6	1.12	84.3	5.1	4.000	1.1	2.34
36	35.4	0.1	1.38	-1.3	-2.85	47.6	2.3	1.867	0.5	0.99	81.0	4.9	4.000	0.9	2.04
38	34.1	0.1	1.38	-1.3	-3.02	45.8	2.2	1.867	0.4	0.84	77.9	4.8	4.000	0.8	1.73
40	32.9	0.1	1.38	-1.3	-3.18	44.2	2.2	1.867	0.3	0.70	75.1	4.6	4.000	0.6	1.41
42	31.8	0.1	1.38	-1.3	-3.34	42.7	2.1	1.867	0.2	0.55	72.6	4.4	4.000	0.4	1.09
Max =					**0.00**					**2.00**					**4.27**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

Table D10 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 7**

C_{AVG} = 0.06 (2-yr)

C_{AVG} = 0.67 (5-yr)

C_{AVG} = 0.84 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0637 (hectares)

Duration (min)	Release Rate = 1.4 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951, B = 0.810 (I = A/(T_c+C), C = 6.199					Release Rate = 1.9 (L/sec) Return Period = 5 (years) IDF Parameters, A = 998.071, 0.814 (I = A/(T_c+C), C = 6.053					Release Rate = 4.0 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688, 0.820 (I = A/(T_c+C), C = 6.014				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	1.9	1.38	0.5	0.00	230.5	27.4	1.867	25.6	0.00	398.6	59.3	4.000	55.3	0.00
2	133.3	1.5	1.38	0.1	0.02	182.7	21.8	1.867	19.9	2.39	315.0	46.9	4.000	42.9	5.15
4	111.7	1.3	1.38	-0.1	-0.03	152.5	18.2	1.867	16.3	3.91	262.4	39.1	4.000	35.1	8.42
6	96.6	1.1	1.38	-0.3	-0.10	131.6	15.7	1.867	13.8	4.97	226.0	33.6	4.000	29.6	10.67
8	85.5	1.0	1.38	-0.4	-0.20	116.1	13.8	1.867	12.0	5.74	199.2	29.7	4.000	25.7	12.31
10	76.8	0.9	1.38	-0.5	-0.31	104.2	12.4	1.867	10.5	6.32	178.6	26.6	4.000	22.6	13.55
12	69.9	0.8	1.38	-0.6	-0.42	94.7	11.3	1.867	9.4	6.78	162.1	24.1	4.000	20.1	14.50
14	64.2	0.7	1.38	-0.7	-0.55	86.9	10.4	1.867	8.5	7.13	148.7	22.1	4.000	18.1	15.24
16	59.5	0.7	1.38	-0.7	-0.68	80.5	9.6	1.867	7.7	7.41	137.5	20.5	4.000	16.5	15.82
18	55.5	0.6	1.38	-0.8	-0.81	75.0	8.9	1.867	7.1	7.63	128.1	19.1	4.000	15.1	16.27
20	52.0	0.6	1.38	-0.8	-0.95	70.3	8.4	1.867	6.5	7.80	120.0	17.9	4.000	13.9	16.63
22	49.0	0.6	1.38	-0.8	-1.09	66.1	7.9	1.867	6.0	7.93	112.9	16.8	4.000	12.8	16.90
24	46.4	0.5	1.38	-0.9	-1.23	62.5	7.4	1.867	5.6	8.04	106.7	15.9	4.000	11.9	17.11
26	44.0	0.5	1.38	-0.9	-1.37	59.3	7.1	1.867	5.2	8.11	101.2	15.1	4.000	11.1	17.26
28	41.9	0.5	1.38	-0.9	-1.52	56.5	6.7	1.867	4.9	8.17	96.3	14.3	4.000	10.3	17.36
30	40.0	0.5	1.38	-0.9	-1.66	53.9	6.4	1.867	4.6	8.20	91.9	13.7	4.000	9.7	17.42
32	38.3	0.4	1.38	-0.9	-1.81	51.6	6.1	1.867	4.3	8.22	87.9	13.1	4.000	9.1	17.44
34	36.8	0.4	1.38	-1.0	-1.96	49.5	5.9	1.867	4.0	8.22	84.3	12.5	4.000	8.5	17.43
36	35.4	0.4	1.38	-1.0	-2.11	47.6	5.7	1.867	3.8	8.21	81.0	12.1	4.000	8.1	17.39
38	34.1	0.4	1.38	-1.0	-2.26	45.8	5.5	1.867	3.6	8.18	77.9	11.6	4.000	7.6	17.33
40	32.9	0.4	1.38	-1.0	-2.41	44.2	5.3	1.867	3.4	8.15	75.1	11.2	4.000	7.2	17.25
42	31.8	0.4	1.38	-1.0	-2.57	42.7	5.1	1.867	3.2	8.10	72.6	10.8	4.000	6.8	17.14
Max =					**0.02**					**8.22**					**17.44**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, I = $A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

Appendix E – Manufacturer Information

WATTS ACCUTROL Specification Sheet

WATTS®	Adjustable Accutrol Weir Tag: ________	Adjustable Flow Control for Roof Drains

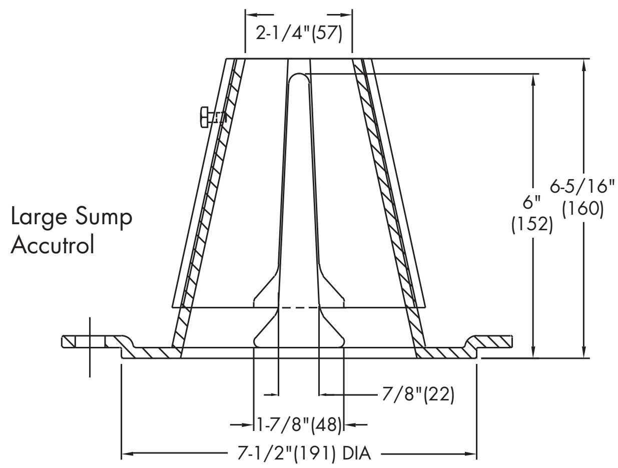
ADJUSTABLE ACCUTROL (for Large Sump Roof Drains only)

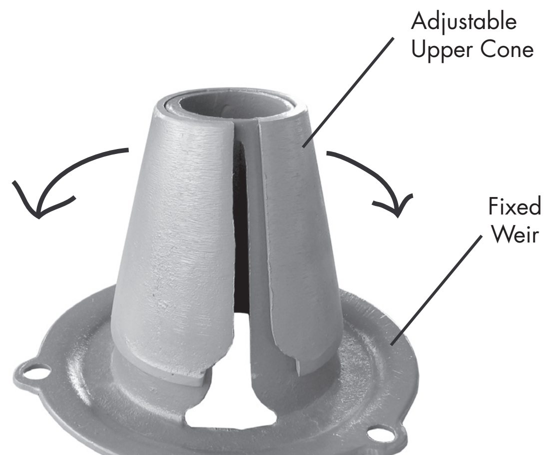
For more flexibility in controlling flow with heads deeper than 2", Watts Drainage offers the Adjustable Accutrol. The Adjustable Accutrol Weir is designed with a single parabolic opening that can be covered to restrict flow above 2" of head to less than 5 gpm per inch, up to 6" of head. To adjust the flow rate for depths over 2" of head, set the slot in the adjustable upper cone according to the flow rate required. Refer to Table 1 below.
Note: Flow rates are directly proportional to the amount of weir opening that is exposed.

EXAMPLE:

For example, if the adjustable upper cone is set to cover 1/2 of the weir opening, flow rates above 2"of head will be restricted to 2-1/2 gpm per inch of head.

Therefore, at 3"of head, the flow rate through the Accutrol Weir that has 1/2 the slot exposed will be:
[5 gpm (per inch of head) x 2 inches of head] + 2-1/2 gpm (for the third inch of head) = 12-1/2 gpm.





1/2 Weir Opening Exposed Shown Above

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Job Name ____________________ Contractor ____________________

Job Location ____________________ Contractor's P.O. No. ____________________

Engineer ____________________ Representative ____________________

WATTS®
A Watts Water Technologies Company

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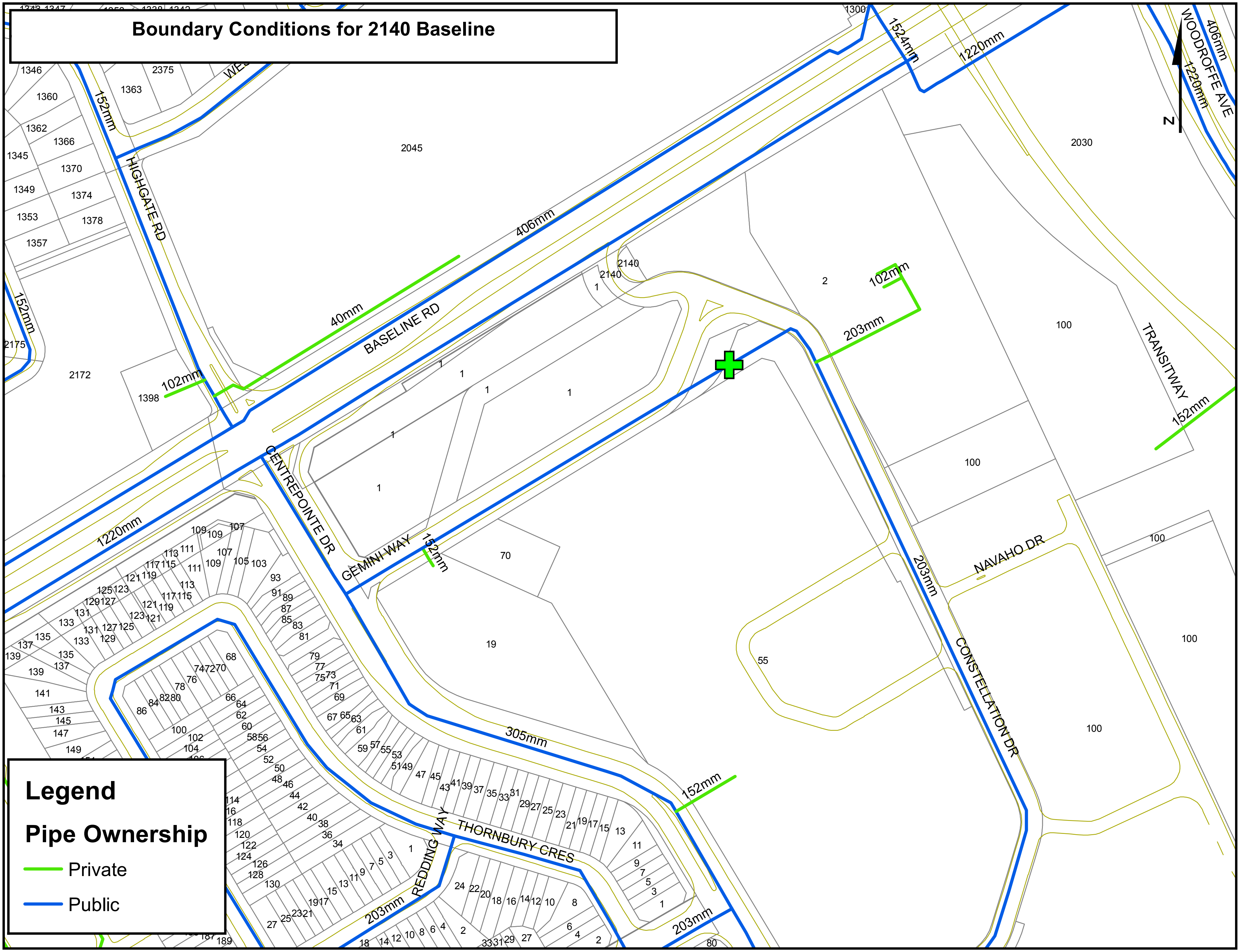
Appendix F – Correspondence

Correspondence from City of Ottawa

Boundary Conditions for 2140 Baseline



Jason Fitzpatrick

From: Armstrong, Justin <justin.armstrong@ottawa.ca>
Sent: Friday, April 27, 2018 9:17 AM
To: Jason Fitzpatrick
Cc: Bruce Thomas; Dickinson, Mary
Subject: RE: Request for Boundary Conditions for Watermain Sizing at 2140 Baseline Road.
Attachments: 2140 Baseline April 2018.pdf

Categories: RECEIVED - TO FILE

Hi Jason,

Here are the boundary conditions. I am assuming a valve will be installed between the two service connections?

The following are boundary conditions, HGL, for hydraulic analysis at 2140 Baseline (zone 2W) assumed to be connected to the 203mm on Constellation (see attached PDF for location).

Minimum HGL = 127.5m

Maximum HGL = 134.6m

MaxDay + FireFlow (150 L/s) = 112.0m

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

Justin Armstrong, E.I.T.
Engineering Intern
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - West Branch
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2400 ext./poste 21746, justin.armstrong@ottawa.ca

From: Jason Fitzpatrick <jason.fitzpatrick@exp.com>
Sent: Thursday, April 26, 2018 12:20 PM
To: Armstrong, Justin <justin.armstrong@ottawa.ca>

Cc: Bruce Thomas <bruce.thomas@exp.com>
Subject: RE: Request for Boundary Conditions for Watermain Sizing at 2140 Baseline Road.

Hi Justin,

I've marked up your sketch (attached). We will be proposing two 200mm water connections to the main on Gemini Way.

The services are approx. 26.6m west of the first 45 degree bend on Constellation. Also they are approx. 3m west of the hydrant tee.

Thanks

Jason Fitzpatrick, P.Eng.
EXP | Project Engineer
t : +1.613.688.1899 | m : +1.613.302.7441 | e : jason.fitzpatrick@exp.com

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From: Armstrong, Justin [mailto:justin.armstrong@ottawa.ca]
Sent: Thursday, April 26, 2018 11:36 AM
To: Jason Fitzpatrick <jason.fitzpatrick@exp.com>
Cc: Dickinson, Mary <mary.dickinson@ottawa.ca>
Subject: RE: Request for Boundary Conditions for Watermain Sizing at 2140 Baseline Road.

Hi Jason,

Would you be able to provide a sketch of the proposed water service connection location on the photo attached?

Regards,

Justin Armstrong, E.I.T.
Engineering Intern
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - West Branch
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2400 ext./poste 21746, justin.armstrong@ottawa.ca

From: Dickinson, Mary
Sent: Monday, April 23, 2018 11:45 AM
To: Jason Fitzpatrick <jason.fitzpatrick@exp.com>
Cc: Armstrong, Justin <justin.armstrong@ottawa.ca>
Subject: RE: Request for Boundary Conditions for Watermain Sizing at 2140 Baseline Road.

Jason
My apologies that this has taken so long, in all honesty it fell off my radar. Justin Armstrong is now working on getting that information for you.
Thank you,
Mary

From: Jason Fitzpatrick <jason.fitzpatrick@exp.com>
Sent: Monday, April 23, 2018 10:47 AM
To: Dickinson, Mary <mary.dickinson@ottawa.ca>
Subject: RE: Request for Boundary Conditions for Watermain Sizing at 2140 Baseline Road.

Hi Mary,

I'm just following up on my request below, as I've not received anything yet.

Can you look into my request as soon as possible?

Much appreciated.

Jason Fitzpatrick, P.Eng.
EXP | Project Engineer
t : +1.613.688.1899 | m : +1.613.302.7441 | e : jason.fitzpatrick@exp.com

From: Jason Fitzpatrick
Sent: Wednesday, March 21, 2018 9:49 AM
To: Dickinson, Mary <mary.dickinson@ottawa.ca>
Cc: Bruce Thomas <bruce.thomas@exp.com>
Subject: Request for Boundary Conditions for Watermain Sizing at 2140 Baseline Road.

Hi Mary,

We are working with Theberge Homes on a site plan application for 2140 Baseline Road, and would appreciate if you could arrange for IAD to provide hydraulic boundary condition that we will need for the watermain design.

I have attached a sketch of the site location and the approximate boundary condition location.

The following is a summary of the demands and fire flow requirements we have estimated for the site based on the proposal for 150 two-bedroom apartment units, and 112 one-bedroom senior apartment units.

Avg. Day Demand =1.95 L/sec
Max. Day Demand = 4.8 L/sec
Peak Hour Demand = 10.6 L/sec
Fire Flow Requirement = 150 L/sec
Max Day + FFs = 154.8 L/sec

We would appreciate the boundary conditions based on our estimates at your earliest convenience.

Regards,

Jason Fitzpatrick, P.Eng.
EXP | Project Engineer
t : +1.613.688.1899 | m : +1.613.302.7441 | e : jason.fitzpatrick@exp.com
2650 Queensview Drive
Suite 100
Ottawa, ON K2B 8H6
CANADA

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