Site Servicing and Stormwater Management Report
994 Bronson Avenue
Ottawa, Ontario

Type of Document:
Site Plan Submission

Client:
Takyan Developments
100 Argyle Avenue, Suite 300
Ottawa, ON K2P 1B6

Project Number:
OTT-00238170-A0

Prepared By: Jason Fitzpatrick, P.Eng.

Reviewed By: Bruce Thomas, P.Eng.

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

Date Submitted:
November 2019

Site Servicing and Stormwater Management Report
994 Bronson Avenue, Ottawa, Ontario

Type of Document:
Site Plan Submission

Client:
Takyan Developments
100 Argyle Avenue, Suite 300
Ottawa, ON K2P 1B6

Project Number:
OTT-00238170-A0

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

Jason Fitzpatrick, P.Eng.
Project Engineer
Infrastructure Services

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

Date Submitted:
November 2019

Legal Notification

This report was prepared by EXP Services Inc. for the account of **Takyan Developments.**

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

Table of Contents

List of Figures

List of Tables

List of Appendices

1 Introduction

Takyan Developments retained EXP Services Inc. (EXP) to prepare a site servicing and stormwater management report in support of a site plan application for a proposed 3-storey building comprised of thirteen (13) multi-tenant residential units located at 994 Bronson Avenue in the City of Ottawa. This report will discuss the adequacy of the existing municipal combined sewer, and watermains, to convey the storm runoff, sewage flows and water demands that will result from the proposed development located at 994 Bronson Avenue. The property is situated on the west side of Bronson Avenue between Findlay Avenue and Holmwood Avenue in the City of Ottawa, Ontario as shown on Figure 1 in Appendix A.

The 0.0656-hectare development being proposed by Takyan Developments will consist of a 3-storey building with thirteen (13) multi-tenant residential units with 3 rear yard surface parking spaces. The site is currently occupied by a 2-storey dwelling that will be demolished.

An existing 600mm combined sewer, 600mm and 125mm watermains are present on Bronson Avenue along the frontage of the property.

This report will identify any sanitary, storm or watermain servicing concerns, and provide a design brief for submission, along with the engineering drawings, for City of Ottawa site plan approval.

2 Referenced Guidelines

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

- Sewer Design Guidelines, Second Edition, Document SDG002, October 2012, City of Ottawa 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)
  - Technical Bulletin ISDTB-2018-04 (27 June 2018)
- Ottawa Design Guidelines – Water Distribution, July 2010 (WDG001), including:
  - Technical Bulletin ISDTB-2014-02 (May 27, 2014)
  - Technical Bulletin ISTB-2018-02 (21 March 2018)
- 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 (OBC), Ministry of Municipal Affairs and Housing.
- Ontario Ministry of Transportation (MTO) Drainage Manual, 1995-1997.

3 Watermain Servicing

3.1 Water Demands

The domestic water demands are estimated below, utilizing parameters from the WDG001 and the GDWS. The following summarizes the parameters used.

- Population:
  3-bachelor apartment x 1.4 person/unit = 4.2
  1-2 Bedroom apartment x 2.1 person/unit = 2.1
  9-4 Bedroom apartment x 4.1 person/unit = 36.9
  = 43.2 Persons

- Average daily water consumption = 350 L/person/day
- Number of residents = 43.2
- Maximum Day Factor = 9.0 x Avg. Day (from GDWS, Table 3-3)
- Maximum Hour Factor = 13.5 x Avg. Day (from GDWS, Table 3-3)

The average, maximum day and peak hour domestic (residential) demands for the building are as follows:

- Average Day = 350 x 43.2 / 86,400 sec/day = 0.175 L/sec
- Maximum Day = 9.0 x 0.175 = 1.57 L/sec
- Peak Hour = 13.5 x 0.175 = 2.37 L/sec

Detailed calculations of the domestic water demands are provided in Table B1 of Appendix B.

3.2 Fire Flow Requirements

Water for fire protection will be available utilizing existing fire hydrants located north and south of the property on the west side of Bronson Ave.

The required fire flows for the proposed site was estimated based on the Fire Underwriters Survey. The following equation from the latest version of the Fire Underwriters Survey (1999) was used for calculation of the supply rates required to be supplied by the hydrant.

$$F = 220 * C\sqrt{A}$$

Where:

F = the required fire flow in litres per minute

C = coefficient related to the type of construction

A = the total floor area in square metres

Table 3-1: Summary of Required Fire Flow Protection

Item	Design Value
Floors Above Grade	3 floors
Construction Coefficient	= 1.0
Fire Protection Type	= none
Building Area (sq.m)	= 1067.4
F=220C$\sqrt{A}$ (L/sec)	= 7,000
Reduction due to low Occupancy	-15%
Increase due to separation	55%
Fire Flow Requirement	= 9,000 L/min or 150 L/sec

The fire flow requirement for the proposed building is **150 L/sec** based on the FUS. There are two fire hydrants located on the west side of Bronson Ave that are accessible for the fire fighting. These hydrants are 33m south and 68m north from the subject building. Additional information on the available fire flows is provided in section 3.4. Please refer to Table B2 in Appendix B for detailed calculations using the FUS method.

3.3 Water Service Requirements

The water pressure anticipated on the top floor of the building was estimated using the boundary conditions provided by the City of Ottawa which can be found in Appendix E of this report. The pressure drop between the existing 125mm watermain on Bronson Avenue and the proposed building was estimated based on the Hazen Williams Formula using the peak hour HGL. The estimated pressure drop between the main connection (65.6 psi) to the top floor of the building (48.3 psi) is 17.3 psi based on the peak demands of 2.37 L/sec. Please refer to Table B3 in Appendix B for detailed calculations.

Based on this information a 50mm service connection has adequate capacity to service the proposed building for domestic water consumption.

3.4 Review of Hydrant Spacing

A review of the hydrant spacing was completed to ensure compliance with Appendix I of Technical Bulletin ISTB-2018-02. As per Section 3 of Appendix I all hydrants within 150 metres were reviewed to assess the total possible contribution of flow from these contributing hydrants. For each hydrant the distance to the proposed building was determined to arrive at the contribution of fire flow from each. All hydrants are EXPected to be of Class AA as per Section 5.1 of Appendix I.

Table B4 in Appendix B summarizes all fire hydrants within a 150m distance from the proposed building. For each hydrant the straight-line distance, distance measured along a fire route or roadway, whether its location is accessible, and its contribution to the required fire flow. Figure 4 in Appendix A illustrates the hydrant locations in proximity to the site.

The total available contribution of flow from the two accessible hydrants were estimated as 11,400 L/min, which exceeds the required fire flow of 9,000 L/min. It should be noted that two other hydrants located on the east side of Bronson were not considered, as they may not be available to the fire department due to the center median in Bronson in front of the site and due to the high traffic volume that would hinder fire

department access to these other hydrants. However if the fire hydrants are used then additional fire flow contribution would be available to should the fire department decide to use them.

4 Sanitary Sewer Design

The sanitary sewer system is designed based on a population flow, and an area based infiltration allowance. The flows were calculated using City of Ottawa design guidelines as follows:

Population:

3-bachelor apartment x 1.4 person/unit	= 4.2
1-2 Bedroom apartment x 2.1 person/unit	= 2.1
9-4 Bedroom apartment x 4.1 person/unit	= 36.9
	= 43.2 Persons

Sanitary Flow

Average Domestic Flow	= 280 L/person/day
Domestic Flow = 43.2 x 280 L/person/day x (1/86,400 sec/day)	= 0.0175 L/sec
Peak Factor = $1 + 14 / (4 + (43.2/1000)^{0.5})$ x K (K=0.8)	= 3.66
Q Peak Domestic = 0.14 L/sec x 3.66	= 0.51 L/sec

Infiltration:

Q Infiltration = 0.28 L/ha/sec x 0.0656 ha	= 0.018 L/sec

Total Peak Sewage Flow:

Total Sanitary Flow = 0.51 + 0.018	**= 0.53 L/sec**

Alternatively, the sanitary flows were estimated using the Ontario Building Code (OBC). As per OBC Table 7.4.9.3. the total fixture count would be 175 based on the number of fixtures shown on the architectural plans. Using this total fixture count, Table 7.4.10.5. provides a Maximum Potable Drainage Rate of 67.3 gal/min or **4.25 L/sec**.

A 150mm dia. sanitary sewer lateral is proposed with a minimum slope of 1.4% having a Manning's full flow capacity of 18.1 L/sec. Therefore, the 150mm diameter lateral has adequate capacity to convey the estimated peak sewage flow to the municipal sewer.

It should be noted that the sanitary lateral will wye into the proposed storm lateral at the property line. Only one lateral will be installed from the property line to the combined sewer on Bronson Avenue. It is recommended that a backflow preventer be installed on the sanitary lateral within the basement as per City of Ottawa standards S14.1.

5 Stormwater Management

5.1 Design Criteria

The storm sewer system was designed 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 2-year storm event using a time of concentration of 10 minutes and a runoff coefficient of 0.40 as per Section 5.1.5.1 and 8.3.7.3 of the SDG002. Flows in excess of the 2-year and up to the 100-year storm event will be detained onsite.

Minor System Design Criteria

- The storm sewers and service laterals have been designed and sized based on the Rational Method and the 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 the 2-year allowable release rate as noted above.

Major System Design Criteria

- The major system has been designed to accommodate onsite detention with sufficient capacity to attenuate the 100-year design storm. Excess runoff above the 100-year event will flow overland offsite.
- Onsite storage is provided for up to the 100-year design storm with maximum allowable ponding depth of 300mm on the ground surface or 150mm on the rooftop. Calculation of the required onsite storage volumes have been supported by calculations provided in Appendix D.
- Calculation of the required storage volumes has been prepared 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 & Erosion Control plan.

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 pervious surfaces (grass/landscaping) were taken as 0.20.

The average runoff coefficient for the overall site area under post-development conditions was calculated as 0.87, whereas the pre-development average runoff coefficient was 0.47.

5.3 Calculation of Allowable Release Rate

To control runoff from the site it will be necessary to limit post-development flows to the allowable capture based on a 2-year storm, with detention of runoff for up to the 100-year event. The allowable release rate from the site is based on 2-year level of service with a runoff coefficient of 0.40 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 combined sewer on Bronson Ave, using the Rational Formula.

Q_{ALL} = 2.78 C I A

Where:

Q_{ALL}	=	Peak Discharge (L/sec)
C	=	Runoff Coefficient (C=0.40)
I	=	Average Rainfall Intensity for return period (mm/hr)
	=	$732.951/(Tc+6.199)^{0.810}$ (2-year)
Tc	=	Time of concentration (mins)
A	=	Drainage Area (hectares)

The allowable discharge rate, based on the 2-year storm, was estimated at 5.6 L/sec. 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 flow control and detention of runoff, as noted in the following sections.

5.4 Pre-Development Conditions

Pre-development peak flows were estimated for comparison. The pre-development runoff coefficient for the site was determined to be 0.47.

Using a time of concentration (T_C) of 10 minutes and an average runoff coefficient of 0.47, the pre-development release rates from the site were estimated at 5.6 L/sec, 7.6 L/sec and 13.0 L/sec for the 2-year, 5-year and 100-year storms respectively.

5.5 Calculation of Post-Development Runoff

As a result of the changes onsite the overall post development runoff coefficient will increase over existing conditions. The increase in runoff will be the result of changes due to site development (i.e. additional hard surfaces, roof areas and hard landscaping).

The post-development average runoff coefficient for the site was calculated as 0.87, based on an average runoff coefficient of 0.20 for grassed areas and 0.90 for hard surfaces.

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

Table 5-5: Summary of Post-Development Flows

Area No	Area (ha)	Time of Conc. T_c (min)	Storm = 2-year			Storm = 5-year			Storm = 100-year		
			C_{AVG}	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	Q (L/sec)	Q_{CAP} (L/sec)
Post-1	0.023	10	0.48	2.4	**0.3**	0.48	3.2	**0.4**	0.60	6.8	**0.8**
Post-2											
Post-3	0.034	10	0.90	6.5	**1.0**	0.90	8.8	**1.4**	0.95	15.9	**2.6**
Post-4	0.003	10	0.90	0.6	0.6	0.90	0.8	0.8	0.95	1.4	1.4
Post-5	0.006	10	0.67	0.9	**0.3**	0.67	1.2	**0.4**	0.84	2.5	**0.8**
Total	0.066			10.3	**2.2**		13.9	**3.0**		26.6	**5.6**

Flows in **bold** under Q_{CAP} denotes flows that are controlled.

In summary, the 2-year, 5-year and 100-year post-development flows are 10.3 L/sec, 13.9 L/sec and 26.0 L/sec respectively. Flow control devices will be used to restrict these runoff rates from the site to **2.2** L/sec, **3.0** L/sec and **5.6** L/sec for the 2-year, 5-year and 100-year storms respectively. Further details regarding the onsite detention and storage methods are provided in the proceeding section.

5.6 Flow Control Method

It will be necessary to control runoff to the allowable rate; therefore, runoff will be detained using inlet control devices (ICDs) within the storm system. This will ensure that sufficient stormwater detention is provided and that the peak flows entering the combined sewer on Bronson Avenue will be equal to or less than the allowable rate. The following Table 5-6 summarizes the ICDs that are proposed.

Table 5-6: Summary of ICDs

Area No	ICD Location	Controlled Rate (L/sec)	Min Elev. (m)	Max Elev. (m)	Head (m)	ICD Type / Model
Post-2	STM MH1 (Parking Lot)	0.8	69.00	70.90	1.90	Hydrovex 32SVHV-1
Post-5	CB2 (Front Yard)	0.8	69.20	70.90	1.70	Hydrovex 32SVHV-1
Post-3	Roof Drains (8 total)	2.6	N/A	N/A	0.15	By Mechanical

The discharge rate for the two ICDs was calculated based on the Orifice Equation, assuming it was fully submerged, as follows:

$Q_{ORF} = C * A * \sqrt{(2gH)}$

where:

Q_{ORF} = Flow through orifice, m^3/sec
C = Discharge Coefficient [0.61]
A = Area of orifice (m^2)

g = Acceleration due to gravity, m/sec^2 [9.81]
H = Head above centreline of orifice, m

5.7 Storage Requirements

Stormwater storage requirements and associated controlled release rates within the site are summarized below in Table 5-7. Detailed calculations using the Modified Rational Method of the onsite storage requirements are provided in Appendix D.

Table 5-7: Summary of Storage Requirements and Release Rates

Area No	Location	Max Release Rate (L/sec)	Storage Requirement (m^3)	Roof Storage (m^3)	Structure/Pipe Storage Provided (m^3)	Surface Storage Provided (m^3)	Total Storage Provided (m^3)
Post-1 & 2	Driveway/Rear Yard	0.8	5.0		3.6	1.4	5.0
Post-3	Roof	2.6	10.8	15.2			15.2
Post-5	Front Yard	0.8	1.1		1.4		1.4
Total		4.2	16.4	15.2	5.0	1.4	21.6

The storage provided on the surface areas 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 Storm Sewer Design

Average runoff coefficients were calculated for all drainage areas for sizing of the storm sewers. Post-development drainage areas are illustated on Figure 3 in Appendix A. Average runoff coefficients were calculated for each catchment and an inlet times of 10 minutes were used as per City of Ottawa Guidelines. A minimum 200mm diameter storm sewer is proposed, and the building foundation will include a backflow preventer and will be connected to the 200mm diameter storm sewer with a wye connection.

All new storm sewers were sized for the 5-year peak flow with no overcapacity. Design sheets for the 5-year sizing of the storm sewer system are included in Appendix C.

6 Combined Sewage Flow

The combined peak sewage and stormwater rate that will be conveyed to the existing 600mm diameter combined sewer on Bronson Avenue is **6.13**L/sec, with the domestic sewage and stormwater allocated as follows.

Peak sanitary flow:	= 0.53 L/sec
Peak 2-year storm flow:	= 5.6 L/sec
Total Combined Flow	= **6.13 L/sec**

7 Erosion and Sediment Control

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

- extent of EXPosed soils shall be limited at any given time,
- EXPosed areas shall be re-vegetated as soon as possible,
- filter cloth shall be installed between frame and cover of all new catch basins and catch basin manholes,
- filter cloth shall be installed between frame and cover of the existing catch basins and catch basin manholes as identified on the site grading and erosion control plan,
- 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, and
- 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.

8 Conclusions

This report addresses stormwater runoff from the proposed development located at 994 Bronson Avenue in the City of Ottawa. The proposed 0.0656-hectare development by Takyan Developments is a three (3) storey building with thirteen (13) multi-tenant residential units. 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 0.40 and a time of concentration of 10 minutes for a 2-year storm event. The allowable release rate was calculated to be 5.6 L/sec. Runoff in excess of this will be detained onsite for up to the 100-year storm.
- Inlet control devices (ICDs) will be installed at two locations onsite to control runoff to the allowable discharge rate. Flow controlled roof drains will also be used to control the post-development peak runoff. The estimated storage required to control peak flows to the allowable release rate was 16.9 m^3 based on the Modified Rational Method. A total of 21.6 m^3 of total storage is provided.
- Inlet control devices installed in storm manhole 1 (STMH1) and CB 2, as shown on the Site Servicing plan, will control peak flows to 0.8 L/sec at 1.9m and 1.70m head for each ICD. Hydrovex inlet control devices (ICD's) model 32SVHV-1 are proposed.
- The proposed development has an estimated peak sewage flow of 0.53 L/sec based on City of Ottawa Guidelines or 4.25 L/sec based on Ontario Building Code. A new 150mm sewer lateral will be installed with a minimum slope of 1.4% having a full flow capacity of 18.1 L/sec. The sanitary sewer will be connected into the storm sewer with a wye at the property line. A single combined lateral will connect into the existing 600mm diameter combined sewer on Bronson Avenue.
- The existing municipal watermain along Bronson Avenue has adequate capacity to service the proposed development for domestic demands. It is proposed to install one 50mm service to the building. The calculated pressure at the top floor of the building is 48.3 psi (333 kPa).
- Fire flow protection is to be provided by the existing fire hydrant located directly across Bronson Avenue. Correspondence from City of Ottawa officials have been attach to verify that this protection will be sufficient. The estimated fire flow requirement based on the FUS is 150 L/sec. The estimated fire flow available is 190L/sec based on hydrant spacing.
- During all construction activities, erosion and sedimentation will be controlled on site.

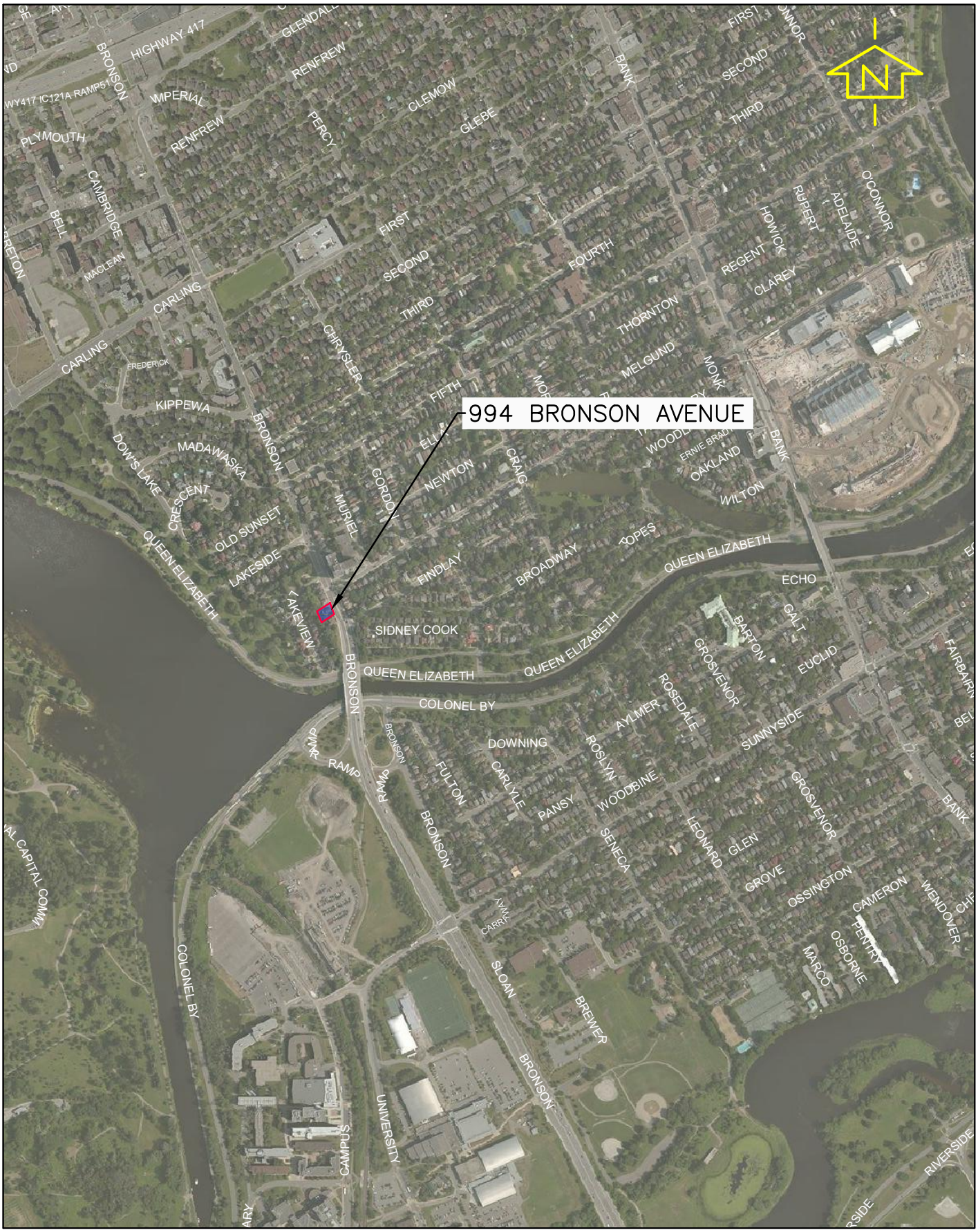
Appendix A – Figures

Figure 1: Site Location Plan

Figure 2: Pre-Development Catchment Areas

Figure 3: Post-Development Catchment Areas

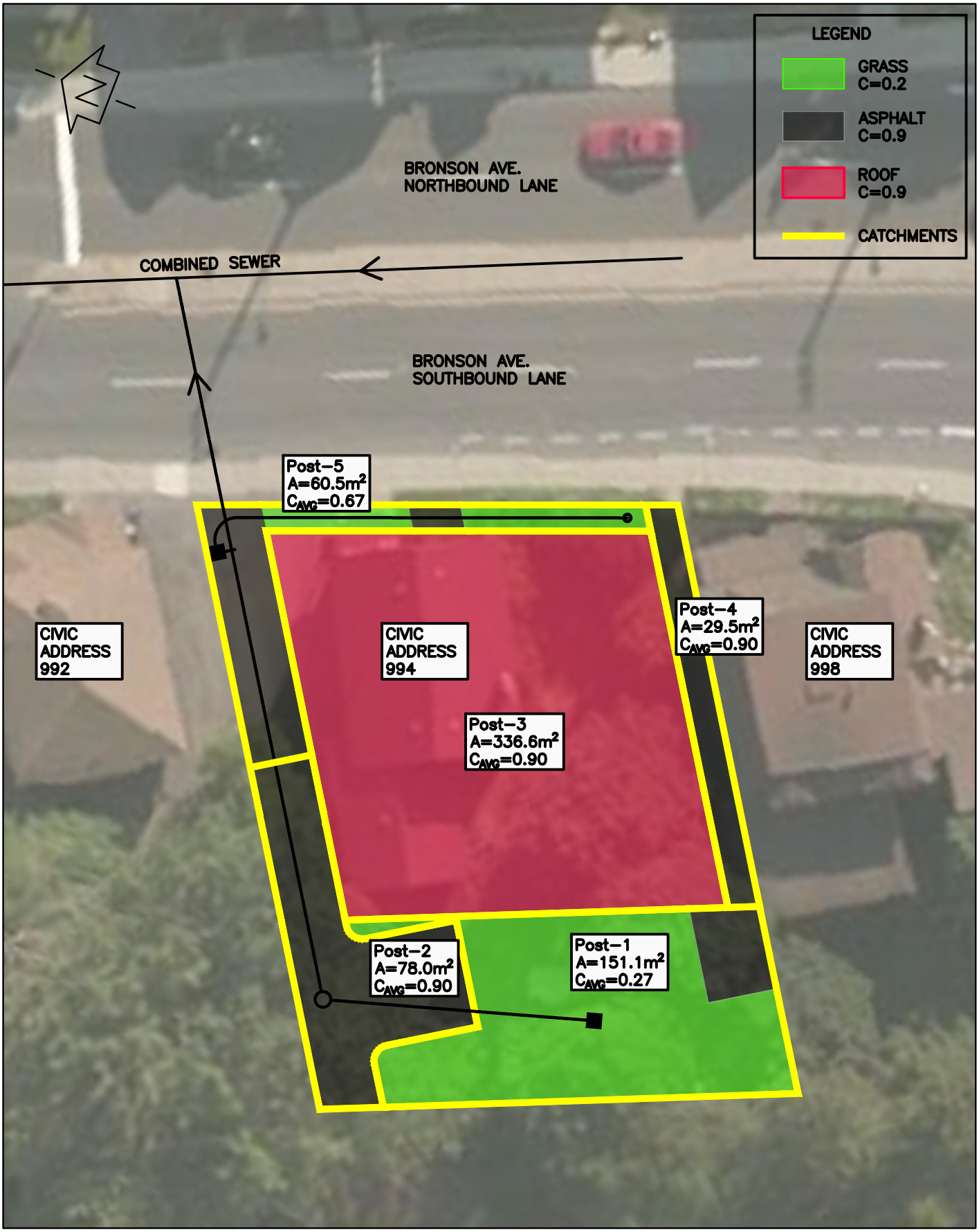
Figure 4: Hydrant Location Plan



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

DESIGN JLF	994 BRONSON AVENUE TAKYAN DEVELOPMENTS	SCALE 1:10,000
DRAWN SAB		SKETCH NO
DATE FEB 2017	SITE LOCATION PLAN	FIG 1
FILE NO 237170		

exp Services Inc. 100-2650 Queensview Drive Ottawa, ON K2B 8H6 www.exp.com	DESIGN ARO DRAWN ARO DATE NOV 2019 FILE NO 237170	994 BRONSON AVENUE TAKYAN DEVELOPMENTS CATCHMENT AREA PRE-DEVELOPMENT	SCALE 1:250 SKETCH NO FIG 2



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

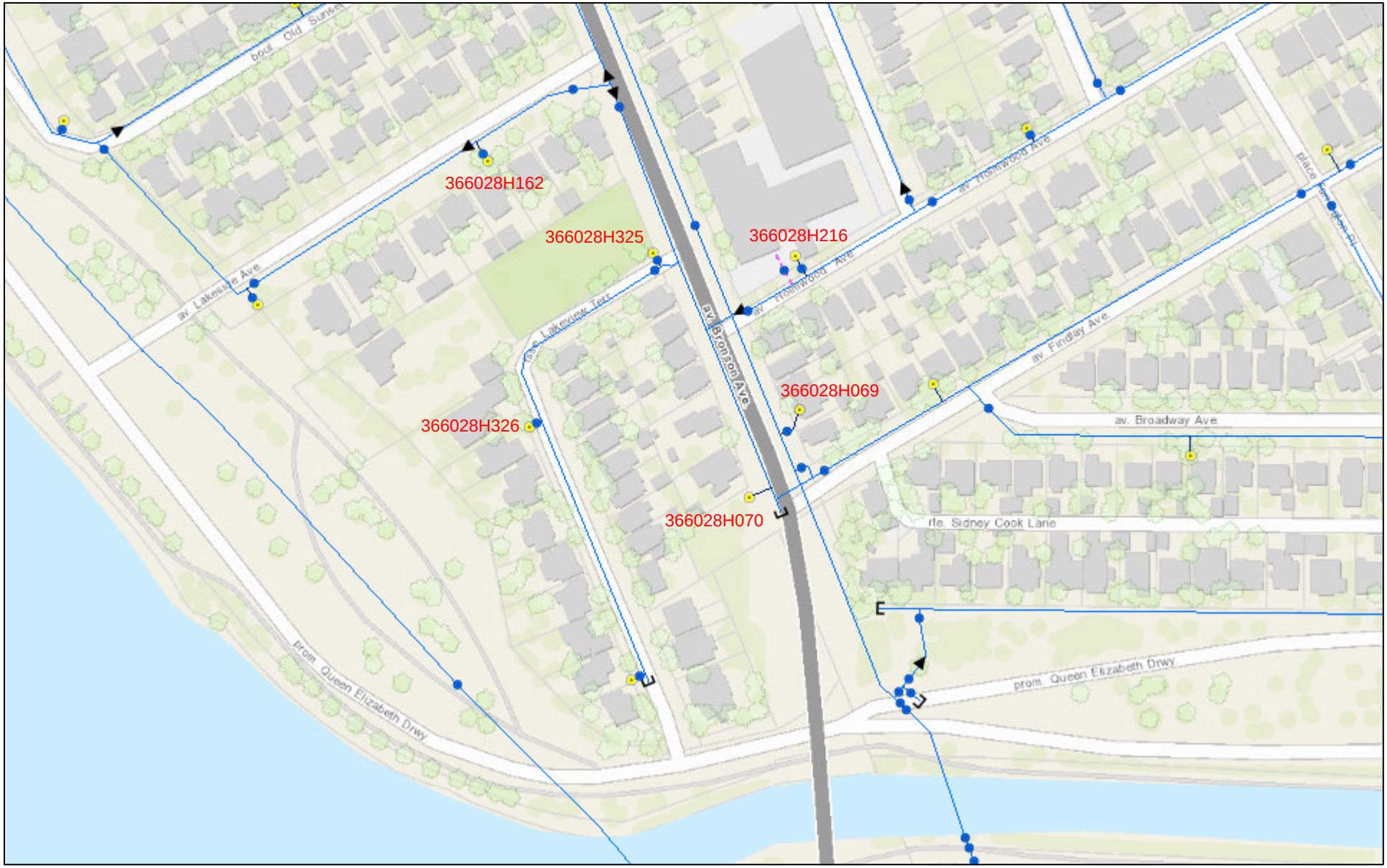
DESIGN	JLF
DRAWN	MZG
DATE	NOV 2019
FILE NO	237170

994 BRONSON AVENUE
TAKYAN DEVELOPMENTS

CATCHMENT AREA
POST-DEVELOPMENT

SCALE	1:250
SKETCH NO	FIG 3

Figure 4 Hydrant Location Plan



November 8, 2019

1:3,000

0 0.025 0.05 0.1 mi

0 0.04 0.08 0.16 km

City of Ottawa

Valves / Vannes

- Valve / Vanne
- TVS, A, D

Water Fittings / Raccords de conduite d'eau

- Cap / bouchon
- Reducer / réducteur
- Hydrants / Bornes-fontaines

- Hydrant Laterals / Branchements de borne-fontaine

Water Mains / Conduites d'eau principales

- Private / Branchement privé
- Public / Branchement public

Appendix B – Water Servicing

Table B1: Water Demand Chart

Table B2: Calculation of Fire Flow Requirements

Table B3: Estimated Water Pressure at Building

Table B4: Fire Flow Contributions Based on Hydrant Spacing

TABLE B1: Water Demand Chart

Location: 994 Bronson Ave.
Project No: 238170
Designed by: M. Ghadban
Checked By: J.Fitzpatrick
Date Revised: November 2019

Water Consumption
Residential = 350 L/cap/day

Population Densities

Bachelor	1.4	person/unit
2 Bedroom	2.1	person/unit
4 Bedroom	4.1	person/unit

Proposed Buildings	Residential			Population	Demands in (L/sec)					
	No. of Units			Total Persons	Average Demand	Maximum Demand	Peak Hourly Demand	Avg Day (L/s)	Max Day (L/s)	Max Hour (L/s)
	Bachelor	2 Bedroom	4 Bedroom			9.0 x Avg Day	13.5 x Avg Day			
994 Bronson Ave.	3	1	9	43	15,120	135,989	204,740	0.18	1.57	2.37
Totals =	3	1	9	43	15,120	135,989	204,740	0.18	1.57	2.37

TABLE B2: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: **994 Bronson Ave**

An estimate of the Fire Flow required for a given fire area may be estimated by:

F = 220 * C * SQRT(A)

where: F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction

Task	Options	Multiplier	Input				Value Used	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Ordinary Construction				1	
	Ordinary Construction	1						
	Non-combustible Construction	0.8						
	Fire Resistive Construction	0.6						
			Area	% Used	Area Used		1,067	
Input Building Floor Areas (A)	Floor 3		365.3	100%	365			
	Floor 2		365.3	100%	365			
	Floor 1 (Ground Floor Commercial)		336.8	100%	337			
	Basement (At least 50% below grade, not included)		336.8	0%	0			
Fire Flow (F) Total	F = 220 * C * SQRT(A)							7,188
Fire Flow (F) Total	Rounded to nearest 1,000							7,000

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents for Floors 2-14	Non-combustible	-25%	Limited Combustible	-15%	-1050	5950
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	No Sprinkler	0%	0	5,950
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	5,950
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	5,950
	Not Fully Supervised or N/A	0%				

Choose Structure Exposure Distance	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposed Wall type	Exposed Wall Length: Length (m)	No of Storeys	Lenth-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
	Side 1 (west)	17	3	10.1 to 20	Type B	18	2	36	3B	11%	55%	3,273	9,223
	Side 2 (east)	24	4	20.1 to 30	Type B	18	2	36	4B	7%			
	Front (north)	5	2	3.1 to 10	Type B	18	2	36	2B	16%			
	Back (south)	2	1	0 to 3	Type B	18	2	30	1A	21%			

Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**9,000**
	Total Required Fire Flow, L/s =	**150**

Note: "Occupancies classified as C-3 (Combustible) in the occupancy classification list may be eligible for C-2 (Limited Combustible) classification, provided that the total square foot area containing combustible material does not exceed 10% of the total square foot area of the occupancy." (ISO, "Guide For Determination Of Needed Fire Flow," 2008)

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Type A	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

Table B3: Estimated Water Pressure at Building (through single water service connection)

Description	From	To	Pipe Length (m)	Pipe Dia (mm)	Dia (m)	Q (L/sec)	Area (m2)	C	Vel (m/s)	Slope of HGL (m/m)	Head Loss (m)	Elev From (m)	Elev To (m)	*Elev Diff (m)	Pressure From kPa	Pressure From (psi)	Pressure To kPa	Pressure To (psi)	Pressure Drop (psi)
50mm Service	Main	Bldg connection	34.0	50	0.050	2.37	0.001963	100	1207	0.063	2.1	70.9	80.9	-10.0	452.2	(65.6)	333.2	(48.3)	17.3

HGL Data (from City of Ottawa

Peak Hour HGL =	117	m
Approx Ground Elev =	70.90	m
Pressure =	46.10	m
	or 452241	Pa
	or 65.6	psi

Donmestic Demands

Peak Hr Deamand =	2.37	l/s

Pipe Lengths

Distance from Main to Unit =	24.0 m
Distance from Bot. to Top Unit =	10.0 m
	34.0 m

TABLE B4: FIRE FLOW CONTRIBUTIONS BASED ON HYDRANT SPACING

Hydrant #	994 Bronson	
	[1]Dist (m)	[2]Fire Flow Contr. (L/min)
366028H325	68	5,700
366028H162	289	0
366028H326	189	0
366028H070	33	5,700
366028H216	NA	0
366028H069	NA	0
Total FirEflow Avail in L/min (L/sec)		11,400 (190)
FUS RFF in L/min (L/sec)		9,000 (150)
Meets Requreiment (Yes/No)		Yes

Notes:

[1]Distance is measured along a road or fire route.

[2]Fire Flow Contribution for Class AA Hydrant from Table 1 of Appendix I, ISTB-2018-02

Appendix C – Storm Sewer Design Sheets

Table C1: 5-year Storm Sewer Calculation Sheet

TABLE C-1: 5-YEAR STORM SEWER CALCULATION SHEET (STORM SEWER SIZING)

Return Period Storm = **5** (5-years, 100-years)
Default Inlet Time= 10 (minutes)
Manning Coefficient = 0.013 (dimensionless)

LOCATION			AREA (hectares)				FLOW (UNRESTRICTED)							SEWER DATA										
Location	From Node	To Node	Area No.	Area (ha)	∑ Area (ha)	Average R	Indiv. 2.78*A*R	Accum. 2.78*A*R	Tc (mins)	I (mm/h)	Indiv. Flow (L/sec)	Return Period	Q (L/sec)	Dia (mm) Actual	Dia (mm) Nominal	Type	Slope (%)	Length (m)	Capacity (L/sec)	Velocity (m/s)		Time in Pipe, Tt (min)	Hydraulic Ratios	
																				Vf	Va		Qa/Qf	Va/Vf
994 Bronson Ave.	CB1	STM MH1	Post-1	0.0151	0.015	0.27	0.01	0.01	10.00	104.19	1.18	5.00	1.2	299.36	300	PVC	1.50	13.00	117.8	1.68	0.52	0.42	0.01	0.31
	STM MH1	Main	Post-2, 3 & 5	0.0480	0.063	0.87	0.12	0.13	10.42	102.04	11.85	5.00	13.0	201.16	200	PVC	4.30	35.20	69.1	2.16	1.39	0.42	0.19	0.64
TOTALS =				**0.063**			**0.13**											**48.20**						

Definitions:
Q = 2.78*AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Watershed Area (hectares)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficients (dimensionless)

Notes:

Ottawa Rainfall Intensity Values:		5yr	100yr
From Sewer Desing Guidelines, 2004	a =	998.071	1735.688
	b=	0.814	0.820
	c =	6.053	6.014

Designed: **Jason Fitzpatrick, P.Eng.**
Checked: **J. Fitzpatrick, P.Eng.**
Dwg Reference: **Figure 3**

Project: **994 Bronson Avenue**
Location: **Ottawa, Ontario**
File Ref: **238170 5-Year Storm Design Sheets**
Sheet No: **1 of 1**

Appendix D – SWM Design Sheets

Table D1
CALCULATION OF AVERAGE RUNOFF COEFFICIENTS (PRE-DEVELOPMENT)

Area No.	Outlet Location	Asphalt Areas		Roof Areas		Gravel Areas		Grassed Areas		Sum AC	Total Area (m^2)	C_{AVG}
		Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C			
		C=0.90		C=0.90		C=0.90		C=0.20				
Pre-1	Outlet	143	128.7	112	100.8			401	80.20	309.7	656	0.47
								Average Runoff Coeff =		C_{AVG} =	$\frac{310}{656}$	= 0.47

Table D2
CALCULATION OF PEAK RUNOFF (PRE-DEVELOPMENT)

Area Description	Outlet Location	Area (ha)	Time of Conc, Tc (min)	Storm = 2-year			Storm = 5-year			Storm = 100-year		
				I_2 (mm/hr)	C_{AVG}	Q_{2PRE} (L/sec)	I_5 (mm/hr)	C_{AVG}	Q_{5PRE} (L/sec)	I_{100} (mm/hr)	C_{AVG}	Q_{100PRE} (L/sec)
Pre-1	Outlet	0.066	10.00	76.81	0.40	5.6	104.19	0.40	7.6	178.56	0.40	13.0
Total =		0.066				5.6			7.6			13.0

Notes
1) Intensity, I = 732.951/(Tc+6.199)$^{0.810}$ (2-year, City of Ottawa)
2) Intensity, I = 998.071/(Tc+6.035)$^{0.814}$ (5-year, City of Ottawa)
3) Intensity, I = 1735.688/(Tc+6.014)$^{0.820}$ (100-year, City of Ottawa)
4) Time of Concentration taken as T_c=10min
5) Cavg for 5-year storm = 0.40 (8.3.7.3, City of Ottawa)
6) Cavg for 100-year is increased by 25%

Table D3
CALCULATION OF AVERAGE RUNOFF COEFFICIENTS (POST-DEVELOPMENT)

Area No.	Area	Asphalt Areas		Roof Areas		Gravel Areas		Grassed Areas		Sum AC	Total Area (m^2)	C_{AVG}
		Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C	Area (m^2)	A * C			
		C=0.90		C=0.90		C=0.90		C=0.20				
Post-1	Grass	14.3	12.9					136.8	27.4	40.2	151	0.27
Post-2	Driveway	77.8	70.0							70.0	78	0.90
Post-3	Roof			336.6	302.9					302.9	337	0.90
Post-4	N-E	29.5	26.6							26.6	30	0.90
Post-5	Front Yard	40.8	36.7					19.8	4.0	40.7	61	0.67
								Average Runoff Coeff =		C_{AVG} =	$\frac{414}{475}$	= 0.87

Table D4
SUMMARY OF POST DEVELOPMENT RUNOFF (UNCONTROLLED AND CONTROLLED)

Area No	Outlet Location	Area (ha)	Time of Conc. T_c (min)	Storm = 2-year				Storm = 5-year				Storm = 100-year			
				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)
Post-1	Grass	0.023	10	0.48	76.81	2.4	**0.3**	0.48	104.19	3.2	**0.4**	0.60	178.56	6.8	**0.8**
Post-2	Driveway														
Post-3	Roof	0.034	10	0.90	76.81	6.5	**1.0**	0.90	104.19	8.8	**1.4**	0.95	178.56	15.9	**2.6**
Post-4	N-E	0.003	10	0.90	76.81	0.6	0.6	0.90	104.19	0.8	0.8	0.95	178.56	1.4	1.4
Post-5	Front Yard	0.006	10	0.67	76.81	0.9	**0.3**	0.67	104.19	1.2	**0.4**	0.84	178.56	2.5	**0.8**
Total		0.066				10.3	**2.2**			13.9	**3.0**			26.6	**5.6**

Pre-Flows

Notes
1) Intensity, I_2 = 732.951/(Tc+6.199)$^{0.810}$ (2-year, City of Ottawa)
2) Intensity, I_5 = 998.071/(Tc+6.035)$^{0.814}$ (5-year, City of Ottawa)
3) Intensity, I_{100} = 1735.688/(Tc+6.014)$^{0.820}$ (100-year, City of Ottawa)
4) Time of Concentration: T_c=10min (5.4.5.2, City of Ottawa)
4) Flows under column Q_{CAP} which are **bold**, denotes flows that are controlled.

Table D5
SUMMARY OF POST DEVELOPMENT STORAGE

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 Pipes	UG CB/MHs	Total	
Post-1	0.0229	0.3	0.4	0.8	1.7	2.2	5.0		1.4	0.9	2.7	5.0	Hydrovex 32SVHV-1
Post-2													
Post-3	0.0337	1.0	1.4	2.6	4.3	5.7	10.8	15.2				15.2	Flow Control Roof Drains (8@5GPM)
Post-4	0.0030	0.6	0.8	1.4									N/A
Post-5	0.0061	0.3	0.4	0.8	0.4	0.5	1.1			1.01	0.4	1.4	Hydrovex 32SVHV-1
Total	0.0656	2.2	3.0	5.6	6.30	8.45	16.88	15.20	1.39	1.93	3.09	21.6	

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

Area No: **Post-1&2**

C_{AVG} = 0.48 (2-yr)

C_{AVG} = 0.48 (5-yr)

C_{AVG} = 0.60 (100-yr, Max 1.0)

Time Interval = 5 (mins)

Drainage Area = 0.0229 (hectares)

Duration (min)	Release Rate = 0.3 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 (I = A/(T_c+C)					Release Rate = 0.4 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 (I = A/(T_c+C)					Release Rate = 0.8 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 (I = A/(T_c+C)				
	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	5.1	0.31	4.8	0.00	230.5	7.1	0.418	6.6	0.00	398.6	15.3	0.800	14.5	0.00
5	103.6	3.2	0.31	2.9	0.86	141.2	4.3	0.418	3.9	1.17	242.7	9.3	0.800	8.5	2.55
10	76.8	2.4	0.31	2.0	1.23	104.2	3.2	0.418	2.8	1.67	178.6	6.8	0.800	6.0	3.62
15	61.8	1.9	0.31	1.6	1.43	83.6	2.6	0.418	2.1	1.93	142.9	5.5	0.800	4.7	4.21
20	52.0	1.6	0.31	1.3	1.54	70.3	2.2	0.418	1.7	2.08	120.0	4.6	0.800	3.8	4.55
25	45.2	1.4	0.31	1.1	1.61	60.9	1.9	0.418	1.4	2.17	103.8	4.0	0.800	3.2	4.77
30	40.0	1.2	0.31	0.9	1.65	53.9	1.7	0.418	1.2	2.22	91.9	3.5	0.800	2.7	4.90
35	36.1	1.1	0.31	0.8	1.67	48.5	1.5	0.418	1.1	2.24	82.6	3.2	0.800	2.4	4.96
40	32.9	1.0	0.31	0.7	1.68	44.2	1.4	0.418	0.9	2.25	75.1	2.9	0.800	2.1	4.99
45	30.2	0.9	0.31	0.6	1.67	40.6	1.2	0.418	0.8	2.23	69.1	2.6	0.800	1.8	4.98
50	28.0	0.9	0.31	0.6	1.65	37.7	1.2	0.418	0.7	2.21	64.0	2.5	0.800	1.7	4.95
55	26.2	0.8	0.31	0.5	1.63	35.1	1.1	0.418	0.7	2.17	59.6	2.3	0.800	1.5	4.90
60	24.6	0.8	0.31	0.4	1.60	32.9	1.0	0.418	0.6	2.13	55.9	2.1	0.800	1.3	4.83
65	23.2	0.7	0.31	0.4	1.57	31.0	1.0	0.418	0.5	2.08	52.6	2.0	0.800	1.2	4.75
70	21.9	0.7	0.31	0.4	1.53	29.4	0.9	0.418	0.5	2.03	49.8	1.9	0.800	1.1	4.65
75	20.8	0.6	0.31	0.3	1.48	27.9	0.9	0.418	0.4	1.97	47.3	1.8	0.800	1.0	4.55
80	19.8	0.6	0.31	0.3	1.44	26.6	0.8	0.418	0.4	1.90	45.0	1.7	0.800	0.9	4.43
85	18.9	0.6	0.31	0.3	1.39	25.4	0.8	0.418	0.4	1.83	43.0	1.6	0.800	0.8	4.31
90	18.1	0.6	0.31	0.2	1.34	24.3	0.7	0.418	0.3	1.76	41.1	1.6	0.800	0.8	4.19
95	17.4	0.5	0.31	0.2	1.29	23.3	0.7	0.418	0.3	1.69	39.4	1.5	0.800	0.7	4.05
100	16.7	0.5	0.31	0.2	1.23	22.4	0.7	0.418	0.3	1.61	37.9	1.5	0.800	0.7	3.91
Max =					**1.68**					**2.25**					**4.99**

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: **Post-3**

C_{AVG} = 0.90 (2-yr)

C_{AVG} = 0.90 (5-yr)

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

Time Interval = 5 (mins)

Drainage Area = 0.0337 (hectares)

Duration (min)	Release Rate = 1.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 (I = A/(T_c+C)					Release Rate = 1.4 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 (I = A/(T_c+C)					Release Rate = 2.6 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 (I = A/(T_c+C)				
	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	14.1	1.00	13.1	0.00	230.5	19.4	1.359	18.1	0.00	398.6	37.3	2.600	34.7	0.00
5	103.6	8.7	1.00	7.7	2.32	141.2	11.9	1.359	10.5	3.16	242.7	22.7	2.600	20.1	6.03
10	76.8	6.5	1.00	5.5	3.28	104.2	8.8	1.359	7.4	4.45	178.6	16.7	2.600	14.1	8.47
15	61.8	5.2	1.00	4.2	3.78	83.6	7.0	1.359	5.7	5.11	142.9	13.4	2.600	10.8	9.69
20	52.0	4.4	1.00	3.4	4.06	70.3	5.9	1.359	4.6	5.47	120.0	11.2	2.600	8.6	10.35
25	45.2	3.8	1.00	2.8	4.20	60.9	5.1	1.359	3.8	5.65	103.8	9.7	2.600	7.1	10.68
30	40.0	3.4	1.00	2.4	4.27	53.9	4.5	1.359	3.2	5.73	91.9	8.6	2.600	6.0	10.79
35	36.1	3.0	1.00	2.0	4.27	48.5	4.1	1.359	2.7	5.73	82.6	7.7	2.600	5.1	10.77
40	32.9	2.8	1.00	1.8	4.24	44.2	3.7	1.359	2.4	5.67	75.1	7.0	2.600	4.4	10.64
45	30.2	2.5	1.00	1.5	4.17	40.6	3.4	1.359	2.1	5.57	69.1	6.5	2.600	3.9	10.43
50	28.0	2.4	1.00	1.4	4.08	37.7	3.2	1.359	1.8	5.44	64.0	6.0	2.600	3.4	10.15
55	26.2	2.2	1.00	1.2	3.97	35.1	3.0	1.359	1.6	5.28	59.6	5.6	2.600	3.0	9.83
60	24.6	2.1	1.00	1.1	3.84	32.9	2.8	1.359	1.4	5.10	55.9	5.2	2.600	2.6	9.47
65	23.2	1.9	1.00	0.9	3.70	31.0	2.6	1.359	1.3	4.90	52.6	4.9	2.600	2.3	9.07
70	21.9	1.8	1.00	0.8	3.54	29.4	2.5	1.359	1.1	4.68	49.8	4.7	2.600	2.1	8.65
75	20.8	1.8	1.00	0.8	3.38	27.9	2.3	1.359	1.0	4.46	47.3	4.4	2.600	1.8	8.20
80	19.8	1.7	1.00	0.7	3.21	26.6	2.2	1.359	0.9	4.22	45.0	4.2	2.600	1.6	7.73
85	18.9	1.6	1.00	0.6	3.03	25.4	2.1	1.359	0.8	3.97	43.0	4.0	2.600	1.4	7.24
90	18.1	1.5	1.00	0.5	2.84	24.3	2.0	1.359	0.7	3.71	41.1	3.8	2.600	1.2	6.73
95	17.4	1.5	1.00	0.5	2.65	23.3	2.0	1.359	0.6	3.44	39.4	3.7	2.600	1.1	6.21
100	16.7	1.4	1.00	0.4	2.45	22.4	1.9	1.359	0.5	3.17	37.9	3.5	2.600	0.9	5.68
Max =					**4.27**					**5.73**					**10.79**

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: **Post-5**

C_{AVG} = 0.67 (2-yr)

C_{AVG} = 0.67 (5-yr)

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

Time Interval = 2 (mins)

Drainage Area = 0.0061 (hectares)

Duration (min)	Release Rate = 0.3 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 (I = A/(T_c+C)					Release Rate = 0.4 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 (I = A/(T_c+C)					Release Rate = 0.8 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 0.820, C = 6.014 (I = A/(T_c+C)				
	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	0.31	1.6	0.00	230.5	2.6	0.418	2.2	0.00	398.6	5.6	0.800	4.8	0.00
2	133.3	1.5	0.31	1.2	0.14	182.7	2.1	0.418	1.6	0.20	315.0	4.5	0.800	3.7	0.44
4	111.7	1.3	0.31	1.0	0.23	152.5	1.7	0.418	1.3	0.31	262.4	3.7	0.800	2.9	0.70
6	96.6	1.1	0.31	0.8	0.28	131.6	1.5	0.418	1.1	0.39	226.0	3.2	0.800	2.4	0.86
8	85.5	1.0	0.31	0.7	0.32	116.1	1.3	0.418	0.9	0.43	199.2	2.8	0.800	2.0	0.97
10	76.8	0.9	0.31	0.6	0.34	104.2	1.2	0.418	0.8	0.46	178.6	2.5	0.800	1.7	1.03
12	69.9	0.8	0.31	0.5	0.35	94.7	1.1	0.418	0.7	0.47	162.1	2.3	0.800	1.5	1.07
14	64.2	0.7	0.31	0.4	0.35	86.9	1.0	0.418	0.6	0.47	148.7	2.1	0.800	1.3	1.09
16	59.5	0.7	0.31	0.4	0.35	80.5	0.9	0.418	0.5	0.47	137.5	1.9	0.800	1.1	1.10
18	55.5	0.6	0.31	0.3	0.34	75.0	0.8	0.418	0.4	0.46	128.1	1.8	0.800	1.0	1.09
20	52.0	0.6	0.31	0.3	0.34	70.3	0.8	0.418	0.4	0.45	120.0	1.7	0.800	0.9	1.07
22	49.0	0.6	0.31	0.2	0.33	66.1	0.7	0.418	0.3	0.44	112.9	1.6	0.800	0.8	1.05
24	46.4	0.5	0.31	0.2	0.31	62.5	0.7	0.418	0.3	0.42	106.7	1.5	0.800	0.7	1.02
26	44.0	0.5	0.31	0.2	0.30	59.3	0.7	0.418	0.3	0.39	101.2	1.4	0.800	0.6	0.98
28	41.9	0.5	0.31	0.2	0.28	56.5	0.6	0.418	0.2	0.37	96.3	1.4	0.800	0.6	0.94
30	40.0	0.5	0.31	0.1	0.26	53.9	0.6	0.418	0.2	0.35	91.9	1.3	0.800	0.5	0.90
32	38.3	0.4	0.31	0.1	0.24	51.6	0.6	0.418	0.2	0.32	87.9	1.2	0.800	0.4	0.85
34	36.8	0.4	0.31	0.1	0.22	49.5	0.6	0.418	0.1	0.29	84.3	1.2	0.800	0.4	0.80
36	35.4	0.4	0.31	0.1	0.20	47.6	0.5	0.418	0.1	0.26	81.0	1.1	0.800	0.3	0.74
38	34.1	0.4	0.31	0.1	0.18	45.8	0.5	0.418	0.1	0.23	77.9	1.1	0.800	0.3	0.69
40	32.9	0.4	0.31	0.1	0.15	44.2	0.5	0.418	0.1	0.20	75.1	1.1	0.800	0.3	0.63
Max =					**0.35**					**0.47**					**1.10**

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 – Correspondence

Jason Fitzpatrick

Subject: RE: 994 Bronson Avenue

From: Wu, John [mailto:John.Wu@ottawa.ca]
Sent: Thursday, February 23, 2017 10:28 AM
To: Jason Fitzpatrick <jason.fitzpatrick@exp.com>
Subject: RE: 994 Bronson Avenue

Available flow in the 610mm is 2700 L/s

John

From: Jason Fitzpatrick [mailto:jason.fitzpatrick@exp.com]
Sent: Wednesday, February 22, 2017 12:14 PM
To: Wu, John
Cc: Bruce Thomas
Subject: RE: 994 Bronson Avenue

Thanks John,

I noticed that the boundary condition provided was for a connection to the existing 125mm watermain on Bronson Ave. We will use the provided HGL when sizing our water service to the building under peak hourly conditions, however under max day plus fire flow we expect that fire stream coverage can be provided to our proposed building from existing hydrants.

In this case, the hydrant on the other opposite side of Bronson Ave is connected off the 600mm watermain. Can we therefore get the HGL available in the 600 mm waterman opposite our property, and if not the latest fire flow test result for this hydrant.

Either that or perhaps you can request from Water resources, fire flows available at the closest hydrants based on their current water model under max day plus fire flow conditions.

Jason Fitzpatrick, P.Eng.
Project Engineer
exp Services Inc.
t: +1.613.688.1891 x3258 | m: +1.613.302.7441 | e:jason.fitzpatrick@**exp**.com
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
CANADA

From: Wu, John [mailto:John.Wu@ottawa.ca]
Sent: Wednesday, February 22, 2017 11:26 AM
To: Jason Fitzpatrick <jason.fitzpatrick@exp.com>
Subject: RE: 994 Bronson Avenue

Here is the result:

******The following information may be passed on to the consultant, but do NOT forward this e-mail directly.******

The following are boundary conditions, HGL, for hydraulic analysis at 994 Bronson (zone 1W) assumed to be connected to the 125mm on Bronson (see attached PDF for location).

Minimum HGL = 104.8m

Maximum HGL = 117.0m

Available Flow = 70 L/s assuming a residual of 20 psi and a ground elevation of 70.9m

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.

John

From: Jason Fitzpatrick [mailto:jason.fitzpatrick@exp.com]
Sent: Tuesday, February 14, 2017 12:54 PM
To: Wu, John
Cc: Bruce Thomas
Subject: 994 Bronson Avenue

Hi John,

We'd appreciate boundary conditions on the existing water system for a site plan application for the above-noted project.

We would appreciate boundary conditions based on the following information:

Address	**994 Bronson Avenue**
Development Type	Proposed Residential (student residence). 4-storey, 13 Units
Fire Flow Requirements	166.7 L/sec (FUS)
Avg. Day Demand	0.18 L/sec
Max Day Demand	0.44 L/sec
Peak Hr. Demand	0.96 L/sec
Max Day + FF	167.7 L/sec

We would also appreciate hydrant pressure/flow data (fire flow tests) for the closest hydrants (H069, H070 , H216, H066) on Bronson, Lakeview, and Holmwood.

Please also confirm the City's requirement to connect to the existing 125mm watermain on Bronson, rather than the 600mm watermain on Bronson which both front the property.

Regards

Jason Fitzpatrick, P.Eng.
Project Engineer
exp Services Inc.
t: +1.613.688.1891 x3258 | m: +1.613.302.7441 | e:jason.fitzpatrick@**exp**.com
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
CANADA

exp.com | *legal disclaimer*

keep it green, read from the screen

This e-mail originates from the City of Ottawa e-mail system. Any distribution, use or copying of this e-mail or the information it contains by other than the intended recipient(s) is unauthorized. Thank you.

Le présent courriel a été expédié par le système de courriels de la Ville d'Ottawa. Toute distribution, utilisation ou reproduction du courriel ou des renseignements qui s'y trouvent par une personne autre que son destinataire prévu est interdite. Je vous remercie de votre collaboration.

This e-mail originates from the City of Ottawa e-mail system. Any distribution, use or copying of this e-mail or the information it contains by other than the intended recipient(s) is unauthorized. Thank you.

Le présent courriel a été expédié par le système de courriels de la Ville d'Ottawa. Toute distribution, utilisation ou reproduction du courriel ou des renseignements qui s'y trouvent par une personne autre que son destinataire prévu est interdite. Je vous remercie de votre collaboration.

EXP Services Inc.

Takyan Developments
994 Bronson Ave
OTT-00238170-A0
November 2019

Appendix F – ICD Sizing

HYDROVEX®

SVHV Vertical Vortex Flow Regulator

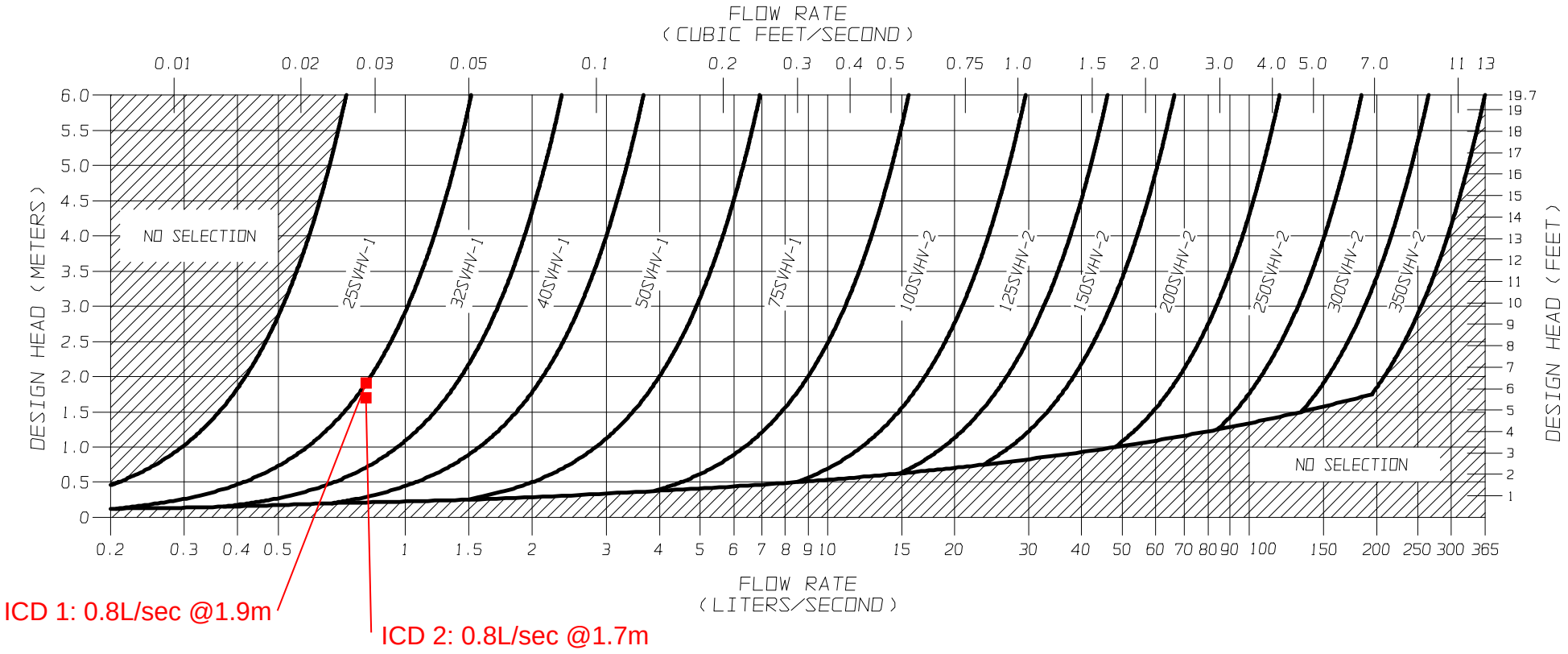


FIGURE 2 - SVHV

JOHN MEUNIER

Appendix G – Drawings

(Included Separately)