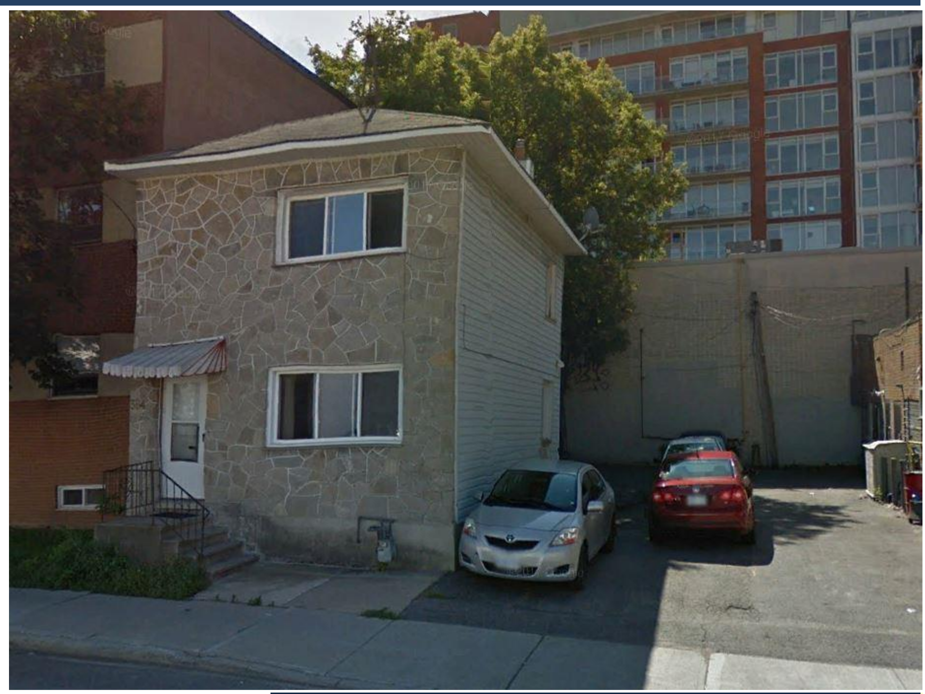
384 Frank Street Ottawa
Assessment of Adequacy of Public Services



Project # CW-03-17

Prepared for:

384 frank street inc

By:

Arch-Nova Design Inc.

February 2018

(Updated June 2019)

Table of Contents

1. Introduction

The subject property is located at 384 Frank Street, Ottawa. The proposed work comprises of a 3-storey+basement apartment building. For the purpose of this report the site is considered to run north-south. Frank Street is extending west-east between Bank Street and O'Connor Street.

Currently the property is used as a residential lot with a single house which will be demolished. The rest of the lot is a parking (asphalt surface) with a grown tree on the south east corner of the property. Adjacent property on east side is also residential. Two properties, on south an west side are commercial buildings.

The area is serviced by municipal water (203 mm) and combined sewer pipe line (375 mm). Gas line (35 mm) is located along the north side of the street. A hydro duct is located under the sidewalk in front of the property and at elevation between 69.0-70.0 m a.s.l.

384 Frank Street, Ottawa: Location

2. Public Services Capacity

This section of the report will analyze existing municipal services and the potential impact of the proposed building at 384 Frank Street on the existing service capacity.

2.1 Water Supply

Existing building is supplied from 203 mm pipe and calculate consumption is 0.2 l/sec for the peak period.

Fire hydrant is located across the street at distance of 22.65 m, which is sufficient for use of this hydrant by fire department and its vehicles and provide fire protection of the site.

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Residential Average Daily Demand	280 L/d/P
Residential Maximum Daily Demand	9.5 x Average Daily *
Residential Maximum Hourly	1.5 x Maximum Daily *
Commercial Demand	2.5 L / m2 /d
Commercial Maximum Daily Demand	1.5 x Average Daily
Commercial Maximum Hourly	1.8 x Maximum Daily
Minimum Watermain Size	150mm diameter
Minimum Depth of Cover	2.4m from top of watermain to finished grade
During Peak Hourly Demand operating pressure must remain within	275kPa and 552kPa
During fire flow operating pressure must not drop below	140kPa
* Residential Max. Daily and Max. Hourly peaking factors per MOE Guidelines for Drinking-Water Systems Table 3-3 for 0 to 500 persons.	

Table 1: Water Supply Design Criteria

[1]The following are boundary conditions, HGL, for hydraulic analysis at 384 Frank (zone 1W) assumed to be connected to the 203 mm on Frank St (see attached PDF for location).

Minimum HGL = 106.9 m

[1] City of Ottawa boundary condition information is based on current operation of the city water distribution system (also see Appendix A for complete correspondence information)

Maximum HGL = 115.7 m

Max Day (0.35 L/s) + Fire Flow (30.86 L/s) = 103.3 m, the estimated ground elevation is 70.8 m.

The consumption is expected to be **32.39 l/min (0.54 L/sec)** for peak period. The fire flow for residential spaces was estimated to be 8000 l/min (133 l/sec)[2]. The City staff confirmed the required flow availability. With fire hydrant at distance of 22.65 m and available fire flow, the proposed building will be sufficiently protected from fire.

Table 1 presents the City of Ottawa design criteria based on MOE Guidelines.

2.2 Sanitary Sewer

Sanitary sewer outflow for the current building is 0.06 l/sec. the lateral is connected to combined sewer 375 mm.

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Average Daily Demand	280 L/cap/day
Peaking Factor	Harmon's Peaking Factor. Max 4.0, Min 2.0
Correction Factor (City of Ottawa Tech.Bulletin ISTB-2018-01)	0.8
Commercial Space	28,000 L/ha/day
Infiltration and Inflow Allowance	0.33L/s/ha
Sanitary sewers are to be sized employing the Manning's Equation	Q =(1/n)AR2/3S1/2
Minimum Sewer Size	200mm diameter
Minimum Manning's 'n'	0.013
Minimum Depth of Cover	2.5m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6m/s
Maximum Full Flowing Velocity	3.0m/s
Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, November 2012 & Infrastructure Technical Bulletins 2018	

Table 2: Wastewater Design Criteria

[2] OBC SectionA.3.2.5.7, Table 2.

The estimated outflow for the new building is **0.15 l/sec** (peak flow + wet weather).

Existing municipal sewer 375 mm has a capacity of 12.29 l/sec for 0.546% slope and 20% full. For increase of 0.09 l/sec the increase will be only 0..75%. The capacity at 80% full is 137 l/sec.

Detailed calculation of pre and post development flow is presented in Appendix A.

2.3 Site Stormwater Services

Current building and the rest of surface of the lot at 384 Frank Street are impervious and all stormwater runoff is under uncontrolled condition. For the purpose of protecting the combined sewer system the City of Ottawa requires that the predevelopment 5-year runoff coefficient should be in range of C=0.4 so the newly developed site must store certain amount of water.

At the time of preparation of this report the City officers were not able to confirm if there is any residual capacity on the minor system (375 and 450 mm) so, for the calculation purposes only theoretical capacity was considered as a reference.

The proposed new building and area of the lot are proposed to be impervious however, in order to accommodate the City's requirement to reduce the runoff from the site and in accordance with MOE F-5-5 regulations for combined systems the predevelopment runoff coefficient was reduced to C=0.6 from actual C=1.0. This resulted in provision of a storage on the roof of the proposed building. The outflow control devices will be two weir orifices installed on entrances to scuppers. Detailed calculation is provided in Appendix A as well on the Servicing & Grading Plan No.W-01 drawing. In order to determine the runoff factor the storage time was a reference: maximum retention time was 1 hour. As a result of calculation factor of C=0.6 was used for the predevelopment calculation. Total amount of water for the 100 year storm is 5.61 m^3 and it will be released within two hours. For a climate of Ottawa region this will prevent freezing of significant amount of water on the roof and the ice build-up.

The foundation drain (weeping tiles) will be connected by a lateral directly to the 375 mm combined minor system. If the construction manager finds that there is no sufficient elevation, the drainage system should also be equipped with a sump pump system.

3. Conclusion and Recommendation

3.1 Water Supply

The water supply demand calculation is based on the fire flow requirement for residential buildings; it is 8,000 l/min (133 l/sec). The City provided information that required flow is available at 103.3 m of HGL. The building roof is at elevation of 83 m which leaves 28.45 psi of residual pressure at maximum HGL of pressure.

3.2 Sanitary Sewer

The existing sanitary sewer 375 mm under 0.546% and 20% full is expected to provide a flow of 12.29 l/sec. Flow from the new building in rate of 0.15 l/sec for the peak wet weather flow will increase the pipe fulness for only 0.075%. The connection from the site will be by gravity (as presented on the plan).

3.3 Stormwater

Currently all runoff is directed toward the street and catch basins. The proposed grading plan also directs all runoff toward the street. The proposed new building and area of the lot are proposed to be impervious however, in order to accommodate the City's requirement to reduce the runoff from the site and in accordance with MOE F-5-5 regulations for combined systems the predevelopment runoff coefficient was reduced to C=0.6 from actual C=1.0.

Based on the information provided by the City of Ottawa, the existing municipal services are adequate. Furthermore it will be protected from overloading (combine sewer system) with proposed stormwater storage after the construction of the buildings at 384 Frank Street.

Prepared by:

Zoran Mrdja, P.Eng.

Professional Engineers
Ontario

Authorized by Professional Engineers of Ontario to provide professional services to public

May, 2019

Appendix A: Calculations

Water Supply Design Criteria

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Residential Average Daily Demand	350 L/d/P
Residential Maximum Daily Demand	9.5 x Average Daily *
Residential Maximum Hourly	1.5 x Maximum Daily *
Commercial Demand	2.5 L / m2 /d
Commercial Maximum Daily Demand	1.5 x Average Daily
Commercial Maximum Hourly	1.8 x Maximum Daily
Minimum Watermain Size	150mm diameter
Minimum Depth of Cover	2.4m from top of watermain to finished grade
must remain within	275kPa and 552kPa (40-80 psi; 28-56m)
During fire flow operating pressure must not drop below	140kPa (20 psi; 14 m)
* Residential Max. Daily and Max. Hourly peaking factors per MOE Guidelines for Drinking-Water Systems Table 3-3 for 0 to 500 persons.	

Wastewater Design Criteria

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Average Daily Demand	350 L/d/per
Peaking Factor	Harmon’s Peaking Factor. Max 4.0, Min 2.0
Commercial Space	5L/m2/day
Infiltration and Inflow Allowance	0.28L/s/ha
Sanitary sewers are to be sized employing the Manning’s Equation	$Q = (1/n)AR^{2/3}S^{1/2}$
Minimum Sewer Size	200mm diameter
Minimum Manning’s ‘n’	0.013
Minimum Depth of Cover	2.5m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6m/s
Maximum Full Flowing Velocity	3.0m/s
Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, November 2004.	

Domestic Demand

Type of Housing	Per / Unit	Units	Pop
Single Family	3.4	1	3
Semi-detached	2.7		0
Townhouse	2.7		0
Apartment			0
Bachelor	1.4		0
1 Bedroom	1.4	0	0
2 Bedroom	2.1	0	0
3 Bedroom	3.1	0	0
4 Bedroom	4.2	0	0

	Pop	Avg. Daily		Max Day		Peak Hour	
		m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Total Domestic Demand	3	1.19	0.83	11.31	7.85	16.96	11.78

Institutional / Commercial / Industrial Demand

				Avg. Daily		Max Day		Peak Hour	
Property Type	**Unit Rate**		**Units**	m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Commercial floor space	2.5	$L/m^2/d$	0	0.00	0.00	0.00	0.00	0.00	0.00
Office	75.0	$L/9.3m^2/d$	0	0.00	0.00	0.00	0.00	0.00	0.00
Restaurant*	125.0	L/seat/d							
Industrial -Light	35,000.0	L/gross ha/d							
Industrial -Heavy	55,000.0	L/gross ha/d							
Total I/C/I Demand				0.00	0.00	0.00	0.00	0.00	0.00

Total Demand	1.19	0.83	11.31	7.85	16.96	11.78

* Estimated number of seats at 1seat per $9.3m^2$

384 Frank Street, Ottawa
Current

Sanitary Sewer Post Development Outflow

Site Area	**0.02**	**ha**
Extraneous Flow Allowances		
Infiltration / Inflow	**0.0056**	**L/s**

Domestic Contributions

Unit Type	Unit Rate	Units	**Pop**
Single Family	3.4	1	3.4
Semi-detached and duplex	2.7		0
Duplex	2.3		0
Townhouse	2.7		0
Apartment			
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1	0	0
3 Bedroom	3.1	0	0
4 Bedroom	4.2	0	0
		Total Population	**3.4**
		Average Domestic Flow	**0.01 L/s**
		Peaking Factor	**4.00**
		Peak Domestic Flow	**0.06 L/s**

Institutional / Commercial / Industrial Contributions

Property Type	**Unit Rate**	**No. of Units**	**Avg Wastewater (L/s)**
Commercial floor space	5 L/m2/d	0	0
Hospitals	900 L/bed/d		
School	70 L/student/d		
Industrial - Light	35,000 L/gross ha/d		
Industrial - Heavy	55,000 L/gross ha/d		
		Average I/C/I Flow	**0**
		Peak Institutional / Commercial Flow	
		Peak Industrial Flow**	
		Peak I/C/I Flow	

Total Estimated Average Dry Weather Flow Rate	**0.01**
Total Estimated Peak Dry Weather Flow Rate	**0.06**
Total Estimated Peak Wet Weather Flow Rate	**0.06**

Domestic Demand

Type of Housing	Per / Unit	Units	Pop
Single Family	3.4		0
Semi-detached	2.7		0
Townhouse	2.7		0
Apartment			0
Bachelor	1.4		0
1 Bedroom	1.4	0	0
2 Bedroom	2.1	17	36
3 Bedroom	3.1	0	0
4 Bedroom	4.2	0	0

	Pop	Avg. Daily		Max Day		Peak Hour	
		m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Total Domestic Demand	36	12.50	8.68	118.70	82.43	178.05	123.65

Institutional / Commercial / Industrial Demand

				Avg. Daily		Max Day		Peak Hour	
Property Type	**Unit Rate**		**Units**	m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Commercial floor space	2.5	$L/m^2/d$	0	0.00	0.00	0.00	0.00	0.00	0.00
Office	75.0	$L/9.3m^2/d$	90	0.73	0.50	1.09	0.76	1.96	1.36
Restaurant*	125.0	L/seat/d							
Industrial -Light	35,000.0	L/gross ha/d							
Industrial -Heavy	55,000.0	L/gross ha/d							
			Total I/C/I Demand	0.73	0.50	1.09	0.76	1.96	1.36

Total Demand	13.22	9.18	119.79	83.19	180.01	125.01

* Estimated number of seats at 1seat per $9.3m^2$

Water Demand and Boundary Conditions
Proposed Conditions

Design Parameter	Anticipated Demand[1] (L/min)	Boundary Condition[2] (kPa)
Average Daily Demand	9.18	115.7
Max Day + Fire Flow	14,083.19	103.3
Peak Hour	125.01	106.9

[1)] Water demand calculation per Water Supply Guidelines. See Appendix B for detailed calculations.

[2)] Boundary conditions supplied by the City of Ottawa. See Appendix B for correspondence with the City.

384 Frank Street, Ottawa
New Development

Sanitary Sewer Post Development Outflow

Site Area	**0.02**	**ha**
Extraneous Flow Allowances		
Infiltration / Inflow	**0.0056**	**L/s**

Domestic Contributions

Unit Type	Unit Rate	Units	**Pop**
Single Family	3.4		0
Semi-detached and duplex	2.7		0
Duplex	2.3		0
Townhouse	2.7		0
Apartment			
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1	17	35.7
3 Bedroom	3.1	0	0
4 Bedroom	4.2	0	0
		Total Population	**35.7**
		Average Domestic Flow	**0.14 L/s**
		Peaking Factor	**4.00**
		Peak Domestic Flow	**0.58 L/s**

Institutional / Commercial / Industrial Contributions

Property Type	**Unit Rate**	**No. of Units**	**Avg Wastewater (L/s)**
Commercial floor space	5 L/m2/d	90	0.0052
Hospitals	900 L/bed/d		
School	70 L/student/d		
Industrial - Light	35,000 L/gross ha/d		
Industrial - Heavy	55,000 L/gross ha/d		
		Average I/C/I Flow	**0.0052**
		Peak Institutional / Commercial Flow	
		Peak Industrial Flow**	
		Peak I/C/I Flow	**0.0052**

Total Estimated Average Dry Weather Flow Rate	**0.15**
Total Estimated Peak Dry Weather Flow Rate	**0.58**
Total Estimated Peak Wet Weather Flow Rate	**0.59**

Free Online Manning Pipe Flow Calculator

>> Nationalism not welcome here. <<

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Check out our newest spreadsheet update: Download Spreadsheet (spreadsheet/Manning-Pipe-Flow.xlsx) Open Google Sheets version (spreadsheet/Manning-Pipe-Flow.php) View All Spreadsheets (http://www.hawsedc.com/engcalcs/SpreadsheetLibrary.php)

--CAUTION: If you have downloaded the spreadsheet prior to September 24, you may have received incorrect results!--

384 Frank Street Ottawa

375 mm Combined Sewer - current

Set units: m mm ft in

Pipe diameter, d_0	375	mm
Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)	.012	
Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), S_0	0.546	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	20	%

Results

Flow, Q	12.2907	l/s
Velocity, v	0.7816	m/s
Velocity head, h_v	0.0311	m
Flow area	0.0157	m^2
Wetted perimeter	0.3477	m
Hydraulic radius	0.0452	m
Top width, T	0.3000	m
Froude number, F	1.09	
Shear stress (tractive force), tau	4.0156	N/m^2

Free Online Manning Pipe Flow Calculator

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Manning Formula Uniform Pipe Flow at Given Slope and Depth

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384 Frank Street Ottawa

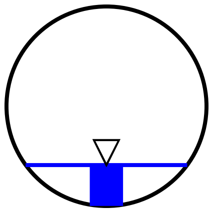
375 mm Combined Sewer - proposed

Set units: m mm ft in

Pipe diameter, d_0	375	mm
Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)	.012	
Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), S_0	0.546	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	20.5	%

Results

Flow, Q	12.9203	l/s
Velocity, v	0.7931	m/s
Velocity head, h_v	0.0321	m
Flow area	0.0163	m^2
Wetted perimeter	0.3524	m
Hydraulic radius	0.0462	m
Top width, T	0.3028	m
Froude number, F	1.09	
Shear stress (tractive force), tau	4.1159	N/m^2



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Pressure Drop Online-Calculator

Calculation output

Flow medium:	Water 10 °C / liquid
Volume flow::	2.08 l/s
Weight density:	998.206 kg/m³
Dynamic Viscosity:	1001.61 10-6 kg/ms
Element of pipe:	circular
Dimensions of element:	Diameter of pipe D: 50 mm Length of pipe L: 40 m
Velocity of flow:	1.06 m/s
Reynolds number:	52787
Velocity of flow 2:	-
Reynolds number 2:	-
Flow:	turbulent
Absolute roughness:	0.0016 mm
Pipe friction number:	0.02
Resistance coefficient:	16.61
Resist.coeff.branching pipe:	-
Press.drop branch.pipe:	-
Pressure drop:	93.02 mbar 0.09 bar

PRE-DEVELOPMENT

The pre-development time of concentration is 10 minutes

where:

$I_5 = 998.071 / (Tc + 6.053)^{0.814}$ $I_{100} = 1735.688 / (Tc + 6.014)^{0.820}$

$I_5 =$ **104.2 mm/hr** $I_{100} =$ **178.6 mm/hr**

Surface Type	ID	Area (ha)	Percent of total Area	C	A X C (ha)
Site	A1	0.02063	100.0%	0.95	0.020
TOTAL		0.0206	100.0%		0.020
Weighted C =					0.60

C=0.6 used for predevelopment calculation (City of Ottawa requirement)

Q_{5pre} = (2.78)*(C)*(I_5)*(A)

Q_{5pre} = 2.78 x 0.60 x 104.2 x 0.0206

Q_{5pre} = 3.59 L/s

Q_{100pre} = (2.78)*(C)*(I_{100})*(A)

Q_{100pre} = 2.78 x 0.75 x 178.6 x 0.0206

Q_{100pre} = 7.68 L/s

POST-DEVELOPMENT (UNCONTROLLED RUNOFF)

The post-development time of concentration is 10 minutes

where:

$I_5 = 998.071 / (Tc + 6.053)^{0.814}$ $I_{100} = 1735.688 / (Tc + 6.014)^{0.820}$

$I_5 =$ **104.2 mm/hr** $I_{100} =$ **178.6 mm/hr**

Surface Type	ID	Area (ha)	Percent of total Area	C	A X C (ha)
Area	A1	0.0031	100.0%	0.95	0.003
Building	A2	0.0000	0.0%	0.00	0.000
TOTAL		0.0031	100.0%		0.003
Weighted C =					1.00

Q_{5post} = (2.78)*(C)*(I_5)*(A)

Q_{5post} = 2.78 x 1.00 x 104.2 x 0.0031

Q_{5post} = 0.91 L/s

$Q_{100post}$ = (2.78)*(C)*(I_{100})*(A)

$Q_{100post}$ = 2.78 x 1.00 x 178.6 x 0.0031

$Q_{100post}$ = 1.56 L/s

Project Number: CW-03-17 384 Frank Street., Ottawa

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Architecture
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Consulting

PRE-DEVELOPMENT

The pre-development time of concentration is 10 minutes

where:

$I_5 = 998.071 / (Tc + 6.053)^{0.814}$ $I_{100} = 1735.688 / (Tc + 6.014)^{0.820}$

$\mathbf{I_5 =}$ **104.2 mm/hr** $I_{100} =$ **178.6 mm/hr**

Surface Type	ID	Area (ha)	Percent of total Area	C	A X C (ha)
Bus Stop	A1	0.00000	0.0%	0.95	0.000
Parking	A2	0.00000	0.0%	0.95	0.000
Green area	A3	0.00000	0.0%	0.70	0.000
TOTAL		0.0000	0.0%		0.000
Weighted C =					0.60

C=0.6 used for predevelopment calculation (City of Ottawa requirement)

$Q_{5pre} = (2.78)*(C)*(I_5)*(A)$

$Q_{5pre} =$ 2.78 x 0.60 x 104.2 x 0.0000

$Q_{5pre} =$ 0.00 L/s

$Q_{100pre} = (2.78)*(C)*(I_{100})*(A)$

$Q_{100pre} =$ 2.78 x 0.60 x 178.6 x 0.0000

$Q_{100pre} =$ 0.00 L/s

POST-DEVELOPMENT (CONTROLLED RUNOFF)

The post-development time of concentration is 10 minutes

where:

$I_5 = 998.071 / (Tc + 6.053)^{0.814}$ $I_{100} = 1735.688 / (Tc + 6.014)^{0.820}$

$\mathbf{I_5 =}$ **104.2 mm/hr** $I_{100} =$ **178.6 mm/hr**

Surface Type	ID	Area (ha)	Percent of total Area	C	A X C (ha)
Landscape	A1	0.0000	0.0%	0.95	0.000
Building	A4	0.01746	100.0%	0.95	0.017
TOTAL		0.01746	0.0%		0.017
Weighted C =					1.00

$Q_{5post} = (2.78)*(C)*(I_5)*(A)$

$Q_{5post} =$ 2.78 x 1.00 x 104.2 x 0.0175

$Q_{5post} =$ 5.06 L/s

$Q_{100post} = (2.78)*(C)*(I_{100})*(A)$

$Q_{100post} =$ 2.78 x 1.00 x 178.6 x 0.0175

$Q_{100post} =$ 8.67 L/s

ALLOWABLE RUNOFF

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Predevelopment Runoff:		
Uncontrolled Runoff		
5-year	3.59	l/sec
100-year	7.68	l/sec
Controlled Runoff:		
5-year	0.00	l/sec
100-year	0.00	l/sec

Postdevelopment Runoff:		
Uncontrolled Runoff		
5-year	0.91	l/sec
100-year	1.56	l/sec
Controlled Runoff:		
5-year	5.06	l/sec
100-year	8.67	l/sec

Controlled allowable runoff		
Controlled Runoff:		
5-year	2.03	l/sec
100-year	6.12	l/sec

Comment:

Storage Volumes (5-Year Storm)

Project: 384 Frank St.

Tc = 10 (mins)
C_{AVG} = 1.00 (dimmensionless)
Area = 0.0200 (hectares)
Storm = 5 (year)
Release Rate = 2.03 (L/sec)
Time Interval = 5 (mins)

Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
1	204	1.1	2.03		
6	132	4.4	2.03	2.36	0.85
11	99	5.5	2.03	3.49	2.30
16	80	4.5	2.03	2.45	2.35
21	68	3.8	2.03	1.76	2.22
26	59	3.3	2.03	1.27	1.98
31	53	2.9	2.03	0.91	1.68
36	48	2.6	2.03	0.62	1.33
41	43	2.4	2.03	0.39	0.95
46	40	2.2	2.03	0.20	0.54
51	37	2.1	2.03	0.04	0.11
56	35	1.9	2.03	-0.10	-0.34
61	33	1.8	2.03	-0.22	-0.80
66	31	1.7	2.03	-0.32	-1.27
71	29	1.6	2.03	-0.41	-1.75
76	28	1.5	2.03	-0.49	-2.24
81	26	1.5	2.03	-0.56	-2.74
86	25	1.4	2.03	-0.63	-3.25
91	24	1.3	2.03	-0.69	-3.76
96	23	1.3	2.03	-0.74	-4.27
101	22	1.2	2.03	-0.79	-4.79
106	21	1.2	2.03	-0.84	-5.32
111	21	1.1	2.03	-0.88	-5.84
116	20	1.1	2.03	-0.92	-6.38
121	19	1.1	2.03	-0.95	-6.91
126	19	1.0	2.03	-0.99	-7.45
131	18	1.0	2.03	-1.02	-7.99
136	18	1.0	2.03	-1.05	-8.53

Notes

1) For a storm duration that is less than the time of concentration the peak flow is equal to the product of 2.78CIA and the ratio of the storm duration to the time of concentration.

2) Rainfall Intensity, I = 998.071 / (Tc + 6.053)^0.814 (5 year, City of Ottawa)
3) Peak Flow = Duration/Tc x 2.78 x C x I x A (Duration < Tc)
4) Peak Flow = 2.78 x C x I x A (Duration > Tc)
5) Storage = Duration x Storage Rate

Storage Volumes (100-Year Storm)

Tc = 10 (mins)
C_{AVG} = 1.00 (dimmensionless)
Area = 0.0200 (hectares)
Storm = 100 (year)
Release Rate = 2.03 (L/sec)
Time Interval = 5 (mins)

Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
1	351	2.0	2.03		
6	226	7.5	2.03	5.51	1.98
11	170	9.4	2.03	7.42	4.90
16	138	7.6	2.03	5.62	5.40
21	116	6.5	2.03	4.44	5.59
26	101	5.6	2.03	3.60	5.61
31	90	5.0	2.03	2.97	5.52
36	81	4.5	2.03	2.47	5.34
41	74	4.1	2.03	2.08	5.11
46	68	3.8	2.03	1.75	4.83
51	63	3.5	2.03	1.48	4.52
56	59	3.3	2.03	1.24	4.18
61	55	3.1	2.03	1.04	3.82
66	52	2.9	2.03	0.87	3.43
71	49	2.7	2.03	0.71	3.03
76	47	2.6	2.03	0.57	2.62
81	45	2.5	2.03	0.45	2.19
86	43	2.4	2.03	0.34	1.75
91	41	2.3	2.03	0.24	1.31
96	39	2.2	2.03	0.15	0.85
101	38	2.1	2.03	0.06	0.39
106	36	2.0	2.03	-0.01	-0.08
111	35	1.9	2.03	-0.08	-0.56
116	34	1.9	2.03	-0.15	-1.04
121	33	1.8	2.03	-0.21	-1.53
126	32	1.8	2.03	-0.27	-2.02
131	31	1.7	2.03	-0.32	-2.51
136	30	1.7	2.03	-0.37	-3.01

Notes

1) For a storm duration that is less than the time of concentration the peak flow is equal to the product of 2.78CIA and the ratio of the storm duration to the time of concentration.

2) Rainfall Intensity, I = 1735.688 / (Tc + 6.014)^0.820 (100 year, City of Ottawa)
3) Peak Flow = Duration/Tc x 2.78 x C x I x A (Duration < Tc)
4) Peak Flow = 2.78 x C x I x A (Duration > Tc)
5) Storage = Duration x Storage Rate

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Storage Requirements

5-year	**2.35**	**m^3**
100-year	**5.61**	**m^3**

Surface Type	ID	Area (ha)	Percent of total Area	Required Storage 5 year	Required Storage 100 year	Max Allowed Drain Outflow l/s	Max Allowed Drain Outflow GPM
Roof	A1	0.0087	50.0%	1.17	2.81	1.01	8.03
Roof	A2	0.0087	50.0%	1.17	2.81	1.01	8.03
TOTAL		0.0175	100.0%	2.35	5.61	2.03	16.07

Stage-Storage

Roof A1 (Scupper 1)			**Roof A2 (Scupper 2)**		
Depth m	**Area** m^2	**Volume** m^3	**Depth** m	**Area** m^2	**Volume** m^3
0.020	9.10	0.09	0.020	9.10	0.09
0.040	20.10	0.40	0.040	20.10	0.40
0.054	**35.00**	**0.95**	**0.054**	**35.00**	**0.95**
0.075	**65.5**	**2.46**	**0.075**	**65.5**	**2.46**

Legend:	
data for 5-year event	
data for 100-year event	

.

Notes:

Roof drains with controlled flow to be specified by manufacturer using the allowable flow rates presented in this chart

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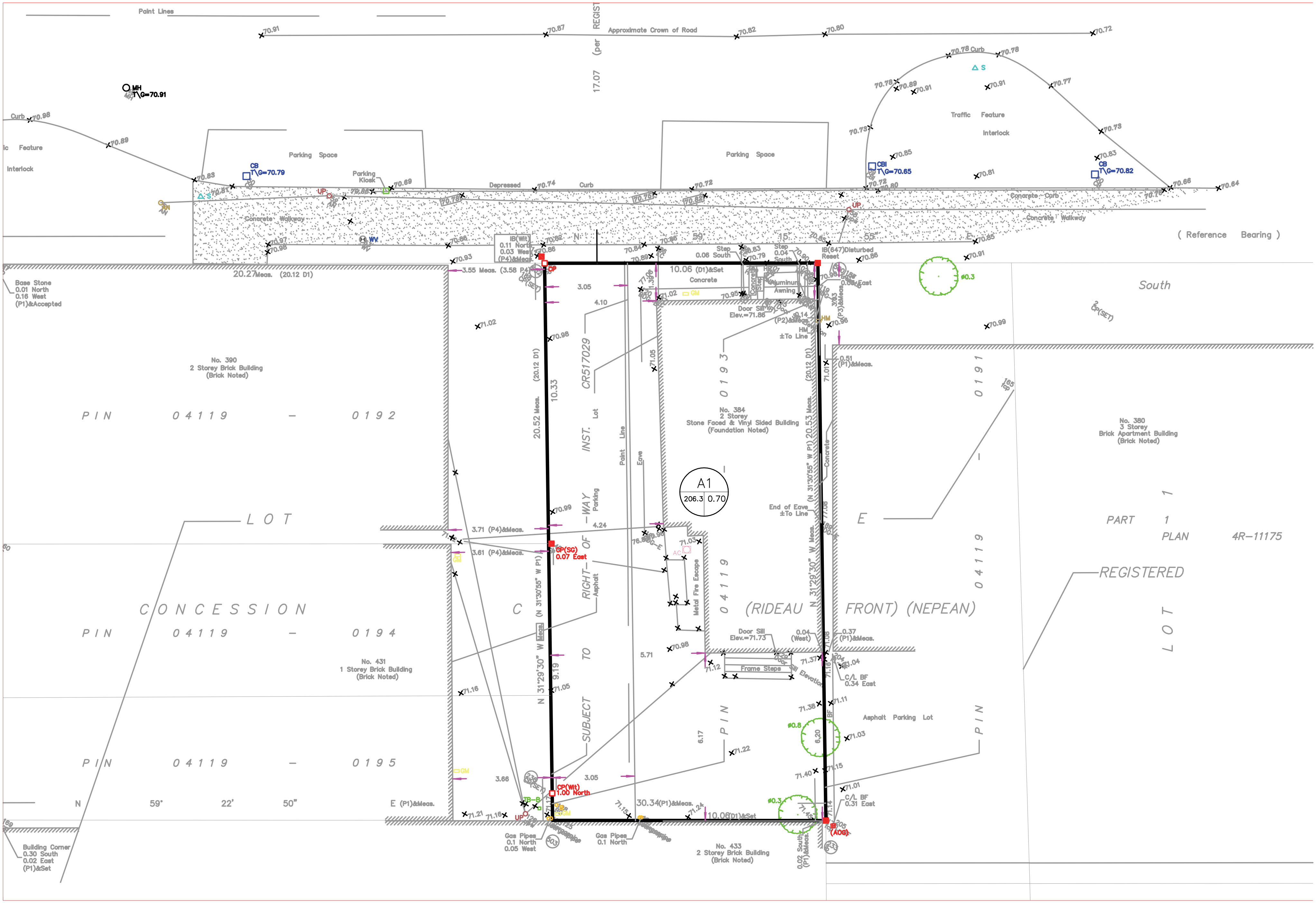
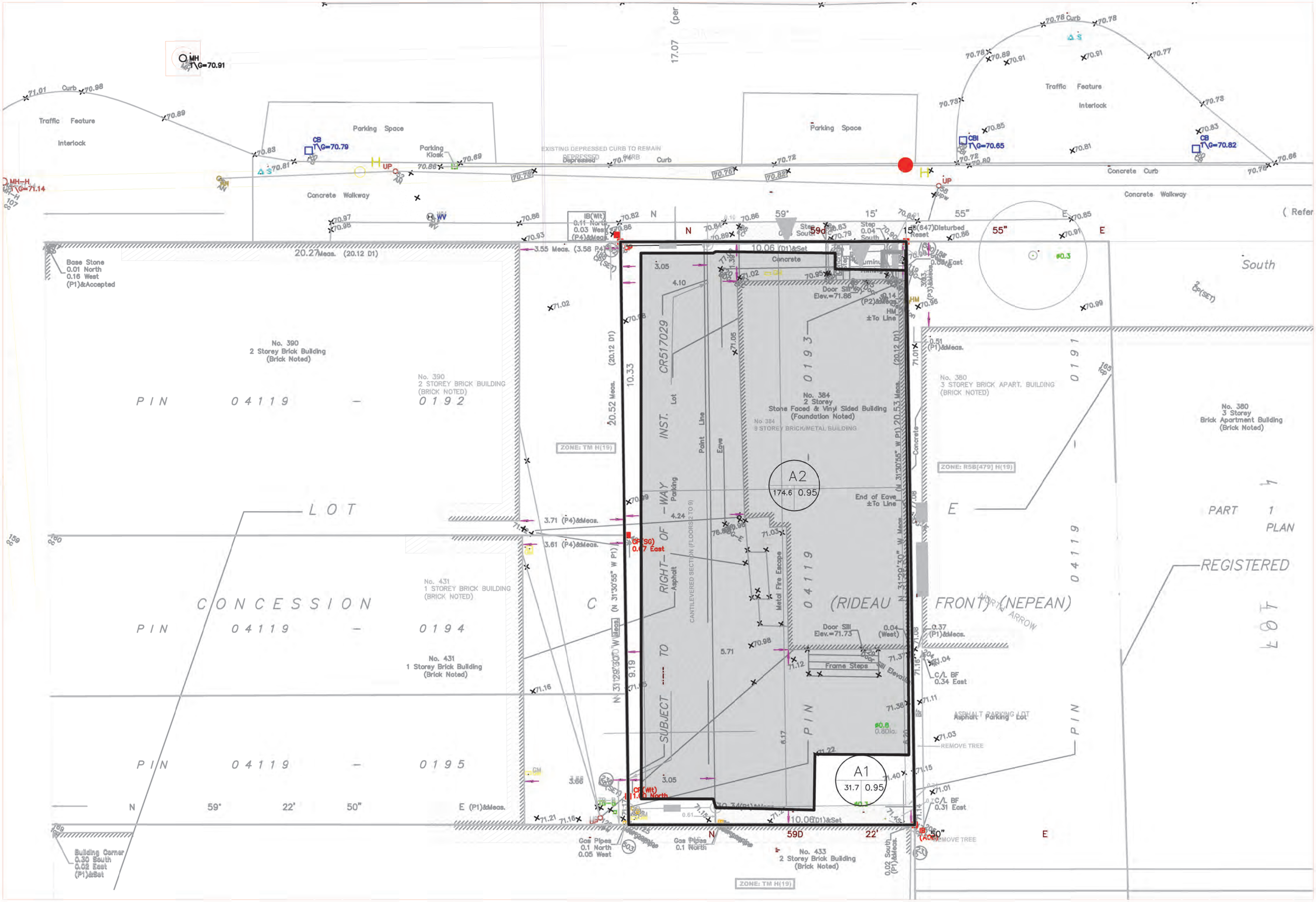


384 FRANK STREET, OTTAWA
SWM PREDEVELOPMENT

ARCH-NOVA Design Inc.
45 Banner Road NEPEAN ON K2H 8X5
613-829-5722 contact@archnova.ca



384 FRANK STREET, OTTAWA
SWM POSTEVELOPMENT

ARCH-NOVA Design Inc.
45 Banner Road NEPEAN ON K2H 8X5
613-829-5722 contact@archnova.ca

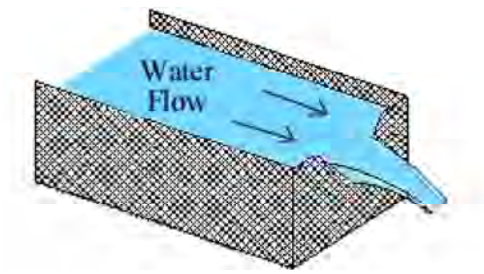
V-Notch (Triangular) Weir Calculator

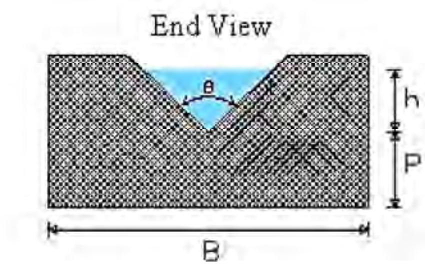
Discharge and Head Calculations, Equations, and Guidelines for water flow measurement in streams and channels.

Solve for: Discharge

Click to Calculate | Initial Values

Discharge, Q:	0.001139654	m3/s
Head, h:	7.5	cm
Notch Angle, θ:	55	degrees
Discharge Coefficient, C:	0.57753377	
Head Correction Factor, k:	0.12266938	cm





Units in V-notch weir calculation: ft^3=cubic foot, gal=US gallons, m^3=cubic meter, mm=millimeter, s=second

Topics for V-notch weir: Introduction Equations Installation Guidelines and Equation Applicability Error Messages References

Introduction

Weirs are typically installed in open channels such as streams to determine discharge (flowrate). The basic principle is that discharge is directly related to the water depth above the crotch (bottom) of the V; this distance is called head (h). The V-notch design causes small changes in discharge to have a large change in depth allowing more accurate head measurement than with a rectangular weir.

Triangular Weir (V-Notch Weir) Equations

V-notch weir equations have become somewhat standardized. ISO (1980), ASTM (1993), and USBR (1997) all suggest using the Kindsvater-Shen equation, which is presented below from USBR (1997) for Q in cfs and heights in ft units. All of the references show similar curves for C and k vs. angle, but none of them provide equations for the curves. To produce automated calculations, LMNO Engineering used a curve fitting program to obtain the equations which best fit the C and k curves. Our equations are shown below. The graph shown is from our fits. If you compare it to the graphs shown in the references, it looks nearly identical which implies that our fits are very good.

To:
LMNO Engineering home page (more calculations)

Related calculations:

Weirs:
Rectangular
Cipoletti

End Depth Method:
Circular
Rectangular
Triangular

Flumes:
Parshall (submerged)

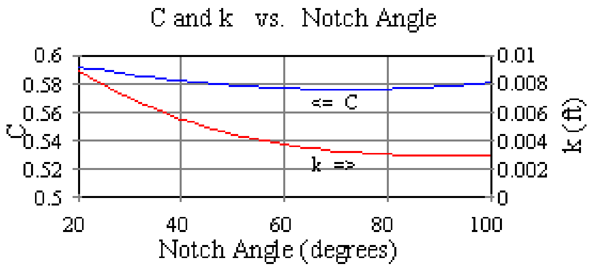
Parshall, Trapezoidal, Rectangular, and U shape

Unit Conversions

Register

$$Q = 4.28\, C \tan\left(\frac{\theta}{2}\right) (h+k)^{5/2}$$

where Q = Discharge (cfs)
C = Discharge Coefficient
θ = Notch Angle
h = Head (ft)
k=Head Correction Factor (ft)



C = 0.607165052 - 0.000874466963 θ + 6.10393334x10^{-6} θ^2
k (ft.) = 0.0144902648 - 0.00033955535 θ + 3.29819003x10^{-6} θ^2 - 1.06215442x10^{-8} θ^3
where θ is the notch angle in degrees

Installation Guidelines and Equation Applicability

Top of Page

USBR (1997) suggests using the V-notch weir equations for the following conditions:

Head (h) should be measured at a distance of at least 4h upstream of the weir.

It doesn't matter how thick the weir is except where water flows over the weir through the "V." The weir should be between 0.03 and 0.08 inches (0.8 to 2 mm) thick in the V. If the bulk of the weir is thicker than 0.08 inch, the downstream edge of the V can be chamfered at an angle greater than 45^o (60^o is recommended) to achieve the desired thickness of the edges. You want to avoid having water cling to the downstream face of the weir.

Water surface downstream of the weir should be at least 0.2 ft. (6 cm) below the bottom of the V to allow a free flowing waterfall.

Measured head (h) should be greater than 0.2 ft. (6 cm) due to potential measurement error at such small heads and the fact that the nappe (waterfall) may cling to the weir.

The equations have been developed for h<1.25 ft. (38 cm) and h/P<2.4.

The equations have been developed for fully contracted V-notch weirs which means h/B should be $\le$ 0.2.

The average width of the approach channel (B) should be > 3 ft. (91 cm).

The bottom of the "V" should be at least 1.5 ft. (45 cm) above the bottom of the upstream channel.

If your weir does not achieve some of the above criteria, you may have a "partially contracted V-notch weir" where h/B needs only to be $\le$ 0.4, the bottom of the "V" only needs to be 4 inch (10 cm) above the bottom of the upstream channel, the approach channel only needs to be 2 ft. (61 cm) wide, and h can be up to 2 ft. (61 cm) instead of 1.25 ft. (38 cm). Partially contracted weirs use a different graph for C which is a function of h/P and P/B and is only valid for a notch angle of 90^o. In the graph (not shown - see USBR, 1997), C varies from 0.576 to 0.6; whereas, for a fully contracted 90^o notch, C is 0.578 from our graph shown above. Our calculation does not account for partially contracted weirs, but for most practical purposes the difference in C is inconsequential.

Error Messages given by V-notch weir calculation

Top of Page

"All inputs must be positive". This is an initial check of user input.

"Angle out of range". The notch angle must be between 20° and 100° (0.35 and 1.75 radians) for the equations to be valid.
"Infeasible input". Input results in a negative head due to the compiler's machine precision. Occurs if head is being computed and a very low Q is entered (e.g. 1.0e-20).

References

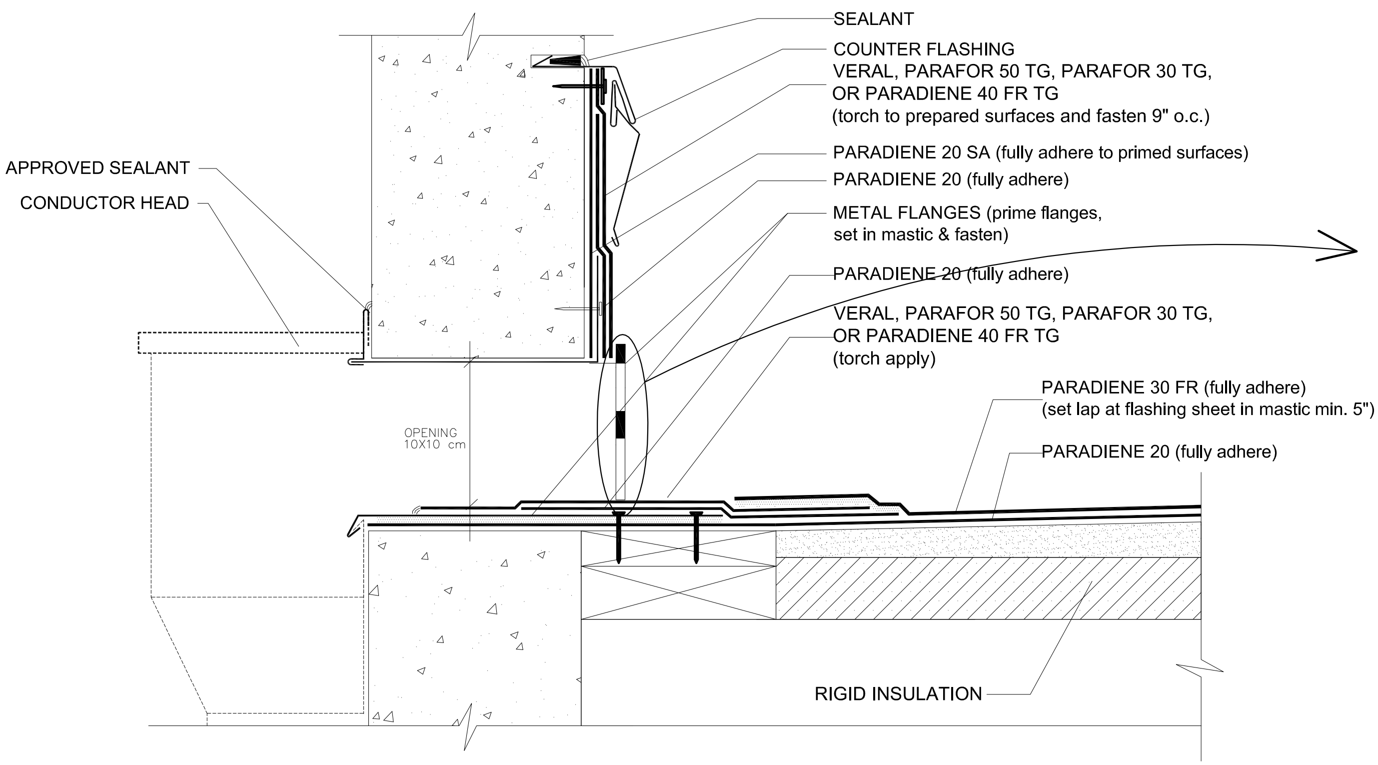
ASTM. (1993). American Society for Testing and Materials. ASTM D5242. Standard method for open-channel flow measurement of water with thin-plate weirs. 1993. Available from Global Engineering Documents at http://global.ihs.com

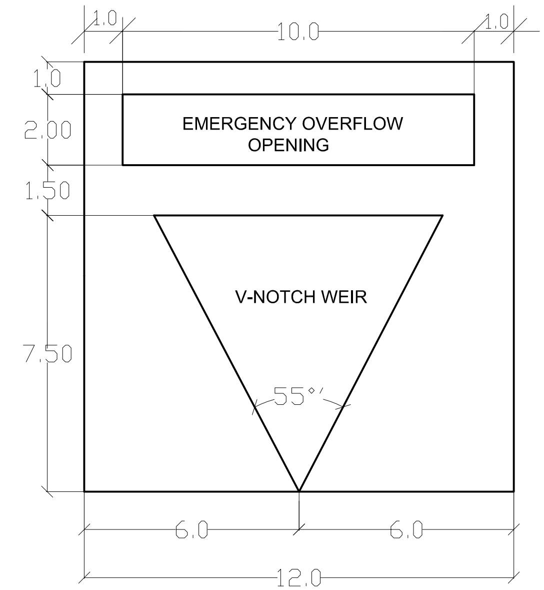
ISO. (1980). International Organization of Standards. ISO 1438/1-1980(E). Water flow measurement in open channels using weirs and venturi flumes - Part 1: Thin plate weirs. 1980. Available from Global Engineering Documents at http://global.ihs.com

USBR. (1997). U.S. Department of the Interior, Bureau of Reclamation. Water Measurement Manual. 3ed. Available from http://www.usbr.gov/tsc/techreferences/mands/wmm/index.htm .

Please contact us for consulting or other questions.

LMNO Engineering, Research, and Software, Ltd.
7860 Angel Ridge Rd. Athens, Ohio 45701 USA Phone: (740) 592-1890
LMNO@LMNOeng.com http://www.LMNOeng.com





ICD TO INSTALL IN FRAME
DIMENSIONS IN CM

DETAIL 1: ROOF INLET CONTROL DEVICE (SCUPPER)

Appendix B: Correspondence

zoran@archnova

From: Wu, John <John.Wu@ottawa.ca>
Sent: December 8, 2017 9:20 AM
To: zoran@archnova
Subject: RE: 384 Frank Street, Ottawa: boundary conditions
Attachments: 384 Frank December 2017.pdf

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 384 Frank (zone 1W) assumed to be connected to the 203 mm on Frank St (see attached PDF for location).

Minimum HGL = 106.9 m

Maximum HGL = 115.7 m

Max Day (2.08 L/s) + Fire Flow (217 L/s) = 103.3 m

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.

Thanks.

John

From: zoran@archnova [mailto:zoran@archnova.ca]
Sent: Tuesday, December 05, 2017 8:07 PM
To: Wu, John <John.Wu@ottawa.ca>
Subject: RE: 384 Frank Street, Ottawa: boundary conditions

Hello John,

It is from City of Ottawa Guideline, which refers to MOE guideline and Table 3.3 for services for less than 500 persons. The table I sent to you is that one (Please see notes in tables). The only thing is that I used the factor of 9.5 for up to 30 persons and in reality we have 36 persons. This means that factor of 4.9 should be used however, 36 is closer to 30 person cut than to 100 and more possible that the factor is higher than 4.9.
If you still prefer 4.9 I will prepare it that way,

Cheers,

ZM

From: Wu, John [mailto:John.Wu@ottawa.ca]
Sent: December 5, 2017 9:28 AM
To: zoran@archnova <zoran@archnova.ca>
Subject: RE: 384 Frank Street, Ottawa: boundary conditions

Hi, Zoran:

In the Ottawa water design guidelines 2010, page49.
4.2.8
State it clearly.
I do not know where your reference is from. You have to use Ottawa's water design guideline.

John

From: zoran@archnova [mailto:zoran@archnova.ca]
Sent: Monday, December 04, 2017 6:13 PM
To: Wu, John <John.Wu@ottawa.ca>
Subject: RE: 384 Frank Street, Ottawa: boundary conditions

Hello John,

I have used the following table:

Table 3-3: Peaking Factors for Drinking-Water Systems Serving Fewer than 500 People

DWELLING UNITS	EQUIVALENT	NIGHT MINIMUM	MAXIMUM DAY	PEAK HOUR
10	30	0.1	9.5	14.3
50	150	0.1	4.9	7.4
100	300	0.2	3.6	5.4
150	450	0.3	3.0	4.5
167	500	0.4	2.9	4.3

The occupancy of proposed building is between 30 and 50 persons so I used factors for 30 persons. If you have different factors used for this particular area, please advise and I will adjust my calculation. For now we are on the safe side.

Regards,

Zoran

From: Wu, John [mailto:John.Wu@ottawa.ca]
Sent: December 4, 2017 10:03 AM
To: zoran@archnova <zoran@archnova.ca>
Subject: RE: 384 Frank Street, Ottawa: boundary conditions

Hi, Zoran:

I already send the request.
Please check where you got the maxday factor 9.5 for water Ottawa design guideline is not that high. Please read that section.

Thanks.

John

From: zoran@archnova [mailto:zoran@archnova.ca]
Sent: Saturday, December 02, 2017 7:33 PM
To: Wu, John <John.Wu@ottawa.ca>
Subject: 384 Frank Street, Ottawa: boundary conditions

Hello John,

Please could you provide the boundary conditions for the location of 384 Frank Street, Ottawa. The owner is planning to construct a new apartment building at this location. Attached are the water and sewer calculations, FUS and OBC fire flow calculation and the site plan for proposed development.

Type of development: apartment building (basement + 9 stories)

Average daily demand: 0.15 l/s

Maximum daily demand: 1.39 l/s.

Maximum hourly daily demand: 2.08 l/s.
Fire flow: 217 l/sec

Regards,

Zoran Mrdja, P.Eng., FEC
Arch-Nova Design Inc.
613-818-3884

'

'
'

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.

'

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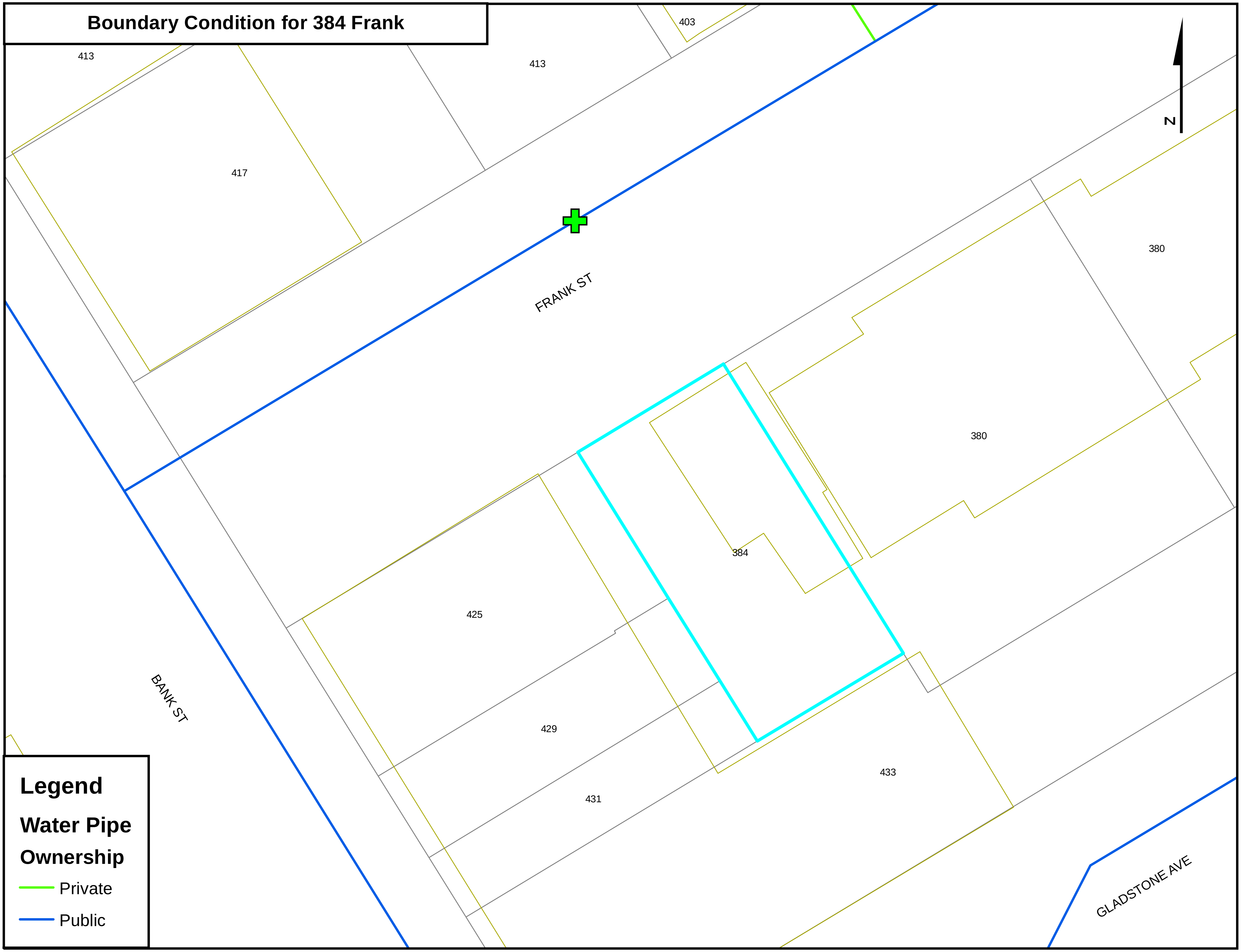
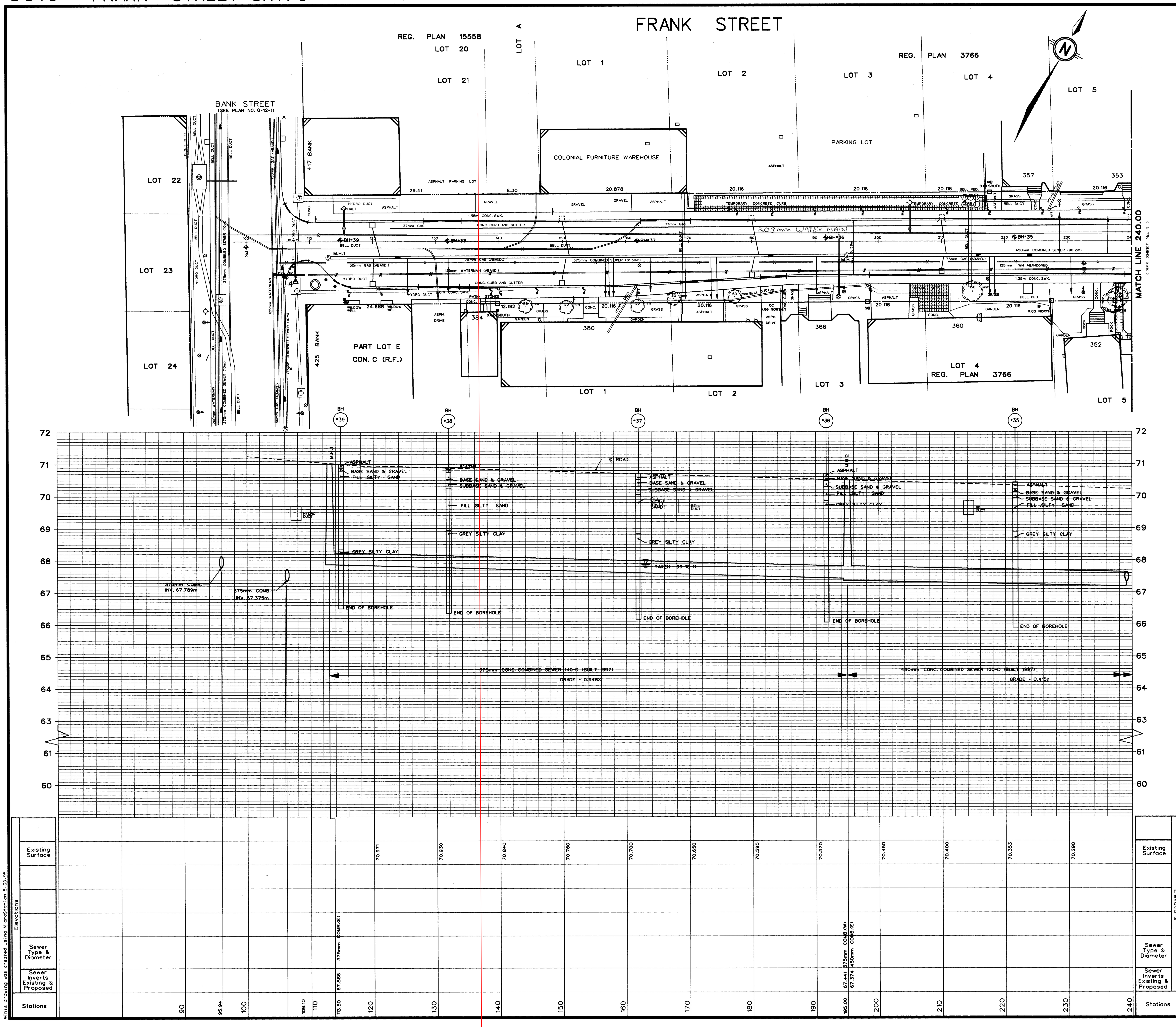
'


Boundary Condition for 384 Frank
413
413
403
417
FRANK ST
380
380
384
425
429
431
433
BANK ST
GLADSTONE AVE
N
Legend
Water Pipe
Ownership
Private
Public

3015 FRANK STREET SHT. 3



Revisions:				
No.	Date	Description	Drawn By	Approved By

Design:

Designed By MR. Z. RANA	Date MARCH/97	Checked By	Date
Survey Detail By MR.K. ROGERS, MR.R. LESTER	Date JULY/96	Field Checked By	Date
Drafting By MR. G.J. SWITZER	Date APR./97	Checked By	Date

Chief Design & Const. Eng.
H. V. Pascoe, P.Eng.

Final Measurements:

Construction Type SEWER,ROAD WATER,SWK	Inspector G.SWITZER D. BROWN
Work Commenced JULY 97	Project Manager Z. RANA
Work Completed JULY 97	Field Book * NONE
Contractor TAGGART	Date JAN. /98
Drafting Revisions G.J. SWITZER Date JAN./98	Checked By Z. RANA

Notes:

- While illustrations and utilities shown are taken from the best available information, they cannot be guaranteed.
- The contractor is requested to check with all utility companies before digging.
- Soil information shown is not guaranteed and contractors are advised to collect additional soils information as deemed necessary
- The actual rock line was recorded during construction of the existing sewer.
- Soil information taken from : JACQUES WHITFORD DEC./96
- Reference bench mark : MON. No.3618 ELEV. 70.385m INDEX No. 204
- Date of television inspection : TAMARACK 2-90-137, SANITEC 2-94-148,
- This plan supercedes (in whole or in part) plan *D-21

As Built Notes:

- Boreholes prior to construction.
- See typical cross sections for road structure material depths

City of / Ville d' **Ottawa**

Department Of Engineering And Works
Engineering Branch
Design And Construction Division
111 SUSSEX DRIVE, SUSSEX PAVILION, 7TH FLOOR, OTTAWA, ONTARIO. K1N 5A1

E.M. Robinson Commissioner	**W.R. Cole, P.Eng.** Branch Director

FRANK STREET

Contract No:	Survey Books:	Scales: (See note)	Plan No:
~~97C~~3015	3015	HOR. 1:250 VERT. 1:50	3015 Sheet 3 of 12

Filename: 3015s1.dgn
Reference: 3015b.dgn
3015w.dgn

This drawing was created using MicroStation 5.00.95