109-115 Dalhousie Street, Ottawa
Assessment of Adequacy of Public Services

Project # CW-04-20

Prepared for:

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By:

Arch-Nova Design Inc.

February 2022

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1. Introduction

The subject property is located at 109-115 Dalhousie Street, Ottawa. The proposed work comprises of a 4-storey+basement apartment building and two refurbished single houses at the front to the street. For the purpose of this report the site is considered to run north-south.

Currently the property comprises of two single houses and backyard with paved area as well as a shed. Adjacent properties are residential.

The area is serviced by municipal water, sanitary and storm water systems.

109-115 Dalhousie 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 109-115 Dalhousie Street on the existing service capacity.

2.1 Water Supply

[1]The following are boundary conditions, HGL, for hydraulic analysis at 109-115 Dalhousie Street (zone 1W) assumed to be connected to the 305 mm watermain on Dalhousie Street (see Appendix B).

[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)

Minimum HGL: 106.2 m

Maximum HGL: 115.4 m

Max Day + Fire Flow (117.78 L/s): 108.3 m

Max Day + Fire Flow (200 L/s): 106.9 m

Estimated ground elevation is 57.11 m, the maximum pressure is estimated to be more than 80 psi.

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

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Residential Average Daily Demand	280 L/d/P
[2]Residential Maximum Daily Demand	2.5 x Average Daily
Residential Maximum Hourly	2.2 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 (40-80 psi; 28-56m)
During fire flow operating pressure must not drop below	140kPa (20 psi; 14 m)

Table 1: Water Supply Design Criteria

The consumption is expected to be **120.49 l/min (2.01 L/sec)** for peak period. The fire flow for residential spaces was estimated to be 12,000 l/min (200.0 l/sec)[3] . The City staff confirmed that pressure and flow at the location are available from the network.

The table below summarizes the pressure for the designed parameters:

[2] Residential Max. Daily and Max. Hourly peaking factors per MOE Guidelines for Drinking-Water Systems Table 3-3 for 0 to 500 persons.

[3] FUS calculation (Appendix A)

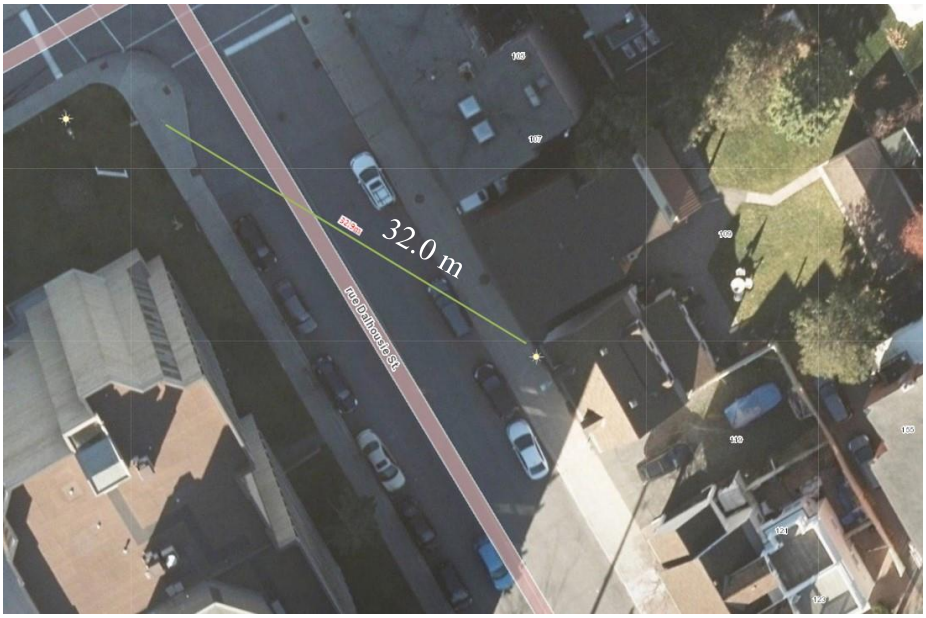
Design Parameter	Anticipated Demand[1] (L/min)	Boundary Condition[2] (m)
Average Daily Demand	8.53	115.4
Max Day + Fire Flow	12,080.30	106.9
Peak Hour	120.49	106.2

Table 2: Water Demand and Boundary Conditions

2.2 Water Supply for Proposed Development

The new building will comprise of 27 apartments with central mechanical room. Peak flow requirement is calculated to be **120,49 l/min (2.01 L/sec)**. A 50 mm water lateral is proposed and it will serve for only domestic use.

Fire protection would be provided from the municipal system. The nearest hydrant is at the 32.0 m distance. The fire department will confirm if the hydrant can provide required flow or additional hydrants in vicinity should be used to compensate for.



109-115 Dalhousie Street, Ottawa: Fire hydrant distance

Pressure loss at the entrance to the building was calculated to be only 0.039 Bar. The building top floor elevation will be at 69.23 m so the loss in water lateral can be neglected. Complete calculation is provided in Appendix A.

2.3 Sanitary Sewer

The estimated outflow for the new building is **0.58l/sec** (peak flow+wet weather).

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Average Daily Demand	280 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

Table 3: Wastewater Design Criteria

Existing municipal sewer 250 mm has a capacity of 0.58 l/sec for 1.12% slope and only 6.0% full and velocity of 0.48 m/sec which is considered sufficient for self-cleaning.

Detailed calculation of flow is presented in Appendix A.

2.4 Sanitary Sewer for Proposed Development

The new building will comprise of 27 apartments with central mechanical room. Peak flow plus wet weather outflow is calculated to be **0.57 l/sec.**

Proposed 135 mm sanitary lateral will provide sufficient outflow capacity for the peak flow at just 12.2% full and 1.5% slope. The self-cleaning velocity under this condition will be 0.58 m/sec and it is considered as sufficient. Complete calculation is provided in Appendix A.

3. Stormwater

3.1 Existing Site Stormwater Services

Currently the property is draining toward south and to the street as the overland runoff. No other storm water services (i.e. storage, ponds, minor system) are on the property.

Surface Type	ID	Area (ha)	Percent of total Area	C	A X C (ha)
Grass	**A1**	0.02450	39.9%	0.25	0.006
Shed	**A2**	0.00382	6.2%	0.90	0.003
asphalt	**A3**	0.01355	22.0%	0.70	0.009
Building	**A4**	0.0108	17.5%	0.90	0.010
Building	**A5**	0.0088	14.4%	0.90	0.008
TOTAL		0.0615	100.0%		0.037
Weighted C =					0.60

Table 4: Current Drainage Areas

Entire site drains uncontrolled over surface to Dalhousie Street Predevelopment C=0.6 is used for the calculation for the post development calculation.

A municipal stormwater service 300 mm is provided on Dalhousie Street and has capacity of 135.72 l/sec for slope of 1.22% and 80% full and 27.19 l/sec for 30% full.

3.2 Stormwater for Proposed Development

The proposed 4-storey building will cover the main part of the property and the flat roof storage is expected to compensate for the pervious areas so the balance between pre and post development run-off is not changed. Also, the main drainage routes, such as the roof drains to the front (Dalhousie Street) will remain unchanged.

For the purpose of managing the 5 year predevelopment runoff, the uncontrolled postdevelopment runoff 100-year was deducted from the 5-year predevelopment uncontrolled runoff and the remaining was used as the allowable controlled runoff (see Table 5. Below).

ALLOWABLE RUNOFF

Predevelopment Runoff:		
Uncontrolled Runoff		
5-year	10.68	l/sec
100-year	22.89	l/sec
Controlled Runoff:		
5-year	0.00	l/sec
100-year	0.00	l/sec

Postdevelopment Runoff:		
Uncontrolled Runoff		
5-year	5.06	l/sec
100-year	8.66	l/sec
Controlled Runoff:		
5-year	8.56	l/sec
100-year	14.67	l/sec

Controlled allowable runoff		
Controlled Runoff:		
5-year	**2.02**	**l/sec**

Table 5: Uncontrolled and Controlled Runoff Summary

The calculation was based on 10 minutes concentration times. The complete calculation is provided in Appendix A.

The drainage system comprises of weeping tiles around the building and connected to a sump in the lower basement-mechanical room and discharged to the surface, a 130 mm lateral connected to a catch basin at rear, the roof storage with four ICDs equipped flat roof drainages which will be connected to the lateral in two manholes and further to the 300 mm street pipe. Details are presented in the Grading and Site Services Plan.

3.3 Proposed Grading

The green space at the back will be graded to route stormwater toward the catch basin. The passage along the east property line is sloped toward the street and serves as an emergency overflow for the backyard.

Along the north and west property line grading is planned toward the catch basin as well. A small narrow area along the west line is in depression so a French drain is proposed to allow water to drain toward the catch basin

as well. To prevent overrun to adjacent properties a landscape features such as shallow french drain are proposed and they will be part of landscape design.

4. Conclusion and Recommendation

4.1 Water Supply

The water supply demand calculation is based on the fire flow requirement for residential buildings; it is 12,000 l/min (200 l/sec). The City personnel provided information that required flow is available a pressure of 106.9 m.

Domestic supply will be by 50 mm lateral with only 0.039 bar of linear loss at the connection to the building.

4.2 Sanitary Sewer

Proposed 135 mm sanitary lateral will provide sufficient outflow capacity for the peak flow at just 12.2% full and 1.5% slope. The self-cleaning velocity under this condition will be 0.58 m/sec and it is considered as sufficient.

4.3 Stormwater

For the purpose of managing the 5 year predevelopment runoff, the uncontrolled postdevelopment runoff 100-year was deducted from the 5-year predevelopment uncontrolled runoff and the remaining was used as the allowable controlled runoff.

The drainage system comprises of weeping tiles around the building and connected to a sump in the lower basement-mechanical room and discharged to the surface, a 130 mm lateral connected to a catch basin at rear, the roof storage with four ICDs equipped flat roof drainages which will be connected to the lateral in two manholes and further to the 300 mm street pipe. Details are presented in the Grading and Site Services Plan.

There will be an increased volume of 9.97 m^3 which is a result of increased imperviousness. This amount of water will be stored on the roof and released under the predevelopment 5-year conditions.

4.4 Grading

Entire rear yard area is graded toward the catch basin. The passage along the east property line is graded toward the street. Depression at the west narrow area will be drained over a French drain.

Based on the information provided by the City of Ottawa, the existing municipal services are adequate and will not be overloaded after the construction of the buildings at 109-115 Dalhousie.

Prepared by:

_____

Zoran Mrdja, P.Eng.

February 2022

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

Appendix A: Calculations

Water Supply Design Criteria

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Residential Average Daily Demand	280 L/d/P
Residential Maximum Daily Demand	2.5 x Average Daily *
Residential Maximum Hourly	2.2 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
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.	

109-115 Dalhousie Street, Ottawa
New

Domestic Demand

Type of Housing	Per / Unit	Units	Pop
Single Family	3.4	0	0
Semi-detached	2.7		0
Townhouse	2.7		0
Apartment			0
Bachelor	1.4	10	14
1 Bedroom	1.4	9	13
2 Bedroom	2.1	8	17
3 Bedroom	3.1		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	43	12.15	8.44	115.44	80.17	173.17	120.25

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
Common Area	2.5	$L/m^2/d$	50.00	0.13	0.09	0.19	0.13	0.34	0.23
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				0.13	0.09	0.19	0.13	0.34	0.23

Total Demand	12.28	8.53	115.63	80.30	173.50	120.49

* 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	8.53	
Max Day + Fire Flow	12,080.17	
Peak Hour	120.49	

[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.

Wastewater Design Criteria

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-2018-0	0.8
Commercial Space	28,000 L/ha/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 2012.	

109-115 Dalhousie Street, Ottawa
New

Sanitary Sewer Post Development Outflow

Site Area	**0.060 ha**
Extraneous Flow Allowances	
Infiltration / Inflow	**0.0198 L/s**

Domestic Contributions

Unit Type	Unit Rate	Units	**Pop**
Single Family	3.4	0	0
Semi-detached and duplex	2.7		0
Duplex	2.3		0
Townhouse	2.7		0
Apartment			
Bachelor	1.4	10	14
1 Bedroom	1.4	9	12.6
2 Bedroom	2.1	8	16.8
3 Bedroom	3.1	0	0
4 Bedroom	4.2	0	0
Total Population			**43.4**
Average Domestic Flow			**0.14 L/s**
Peaking Factor			**4.0**
Peak Domestic Flow			**0.56 L/s**

Institutional / Commercial / Industrial Contributions

Property Type	**Unit Rate**	**No. of Units**	**Avg Wastewater (L/s)**
Commercial	28,000 L/gross ha/d	0	0.0000
Institutional	28,000 L/gross ha/d	0	0.00
Industrial - Light	35,000 L/gross ha/d	0	0.00
Industrial - Heavy	55,000 L/gross ha/d	0	0.00
Average I/C/I Flow			**0.0000**
Peak Institutional / Commercial Flow*			**0.0000**
Peak Industrial Flow**			**0.0000**
Peak I/C/I Flow			**0.0000**

Total Estimated Average Dry Weather Flow Rate	**0.1406**
Total Estimated Peak Dry Weather Flow Rate	**0.5579**
Total Estimated Peak Wet Weather Flow Rate	**0.5777**

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**Use Apendix 4B diagram

109-115 Dalhousie Street, Ottawa
New

Fire Flow Calculation Ontario Building Code 2006 (Appendix A)

Project: 109-115 Dalhousie Street, Ottawa

Date: **February 7, 2022**
Data input by: Zoran Mrdja, P.Eng.

Type of Construction	Building Clasification	Water Supply Coefficient (K)
Non-combustable construction, or a heavy timber conforming to article 3.1.4.6	A-2; B1-; B-2; B-3 C; D	16

		Total Building Volume (V)(m3)
Building Height (incl.Basement)	17.10	7,162.85
Building Width	17.60	
Building Length	23.80	

Side	Exposure Distance (m)	Spatial Coefficient	Total Spatial Coefficient S_{tot}*
North	3.00	0.5	1.85
East	24.00	0	
South	7.00	0.35	
West	23.00	0	
Total Volume of Water Required Q**		**212,020.30**	
Minimum Required Fire Flow (L/min) ***		**7,067.34**	

Note:
* S_{tot}= 1+(S_{side1}+S_{side2}+S_{side3}+S_{side4})
** V=KVS_{tot}
*** Flow=Q/30 (min) for min. duration of 30 min

Notes: 1. nearest hydrant distance 32.9 m

109-115 Dalhousie Street, Ottawa
New

FUS Fire Flow Calculations

Project: 109-115 Dalhousie, Ottawa

Calculations Based on 1999 Publication "Water Supply for Public

Fire Protection " by Fire Underwriters' Survey (FUS)

Project Name: 109-115 Dalhousie Street, Ottawa Fire Flow Calculation #: 1

Date: February 7, 2022

Data input by: Zoran Mrdja, P.Eng.

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
1	Choose Frame Used for Construction of Unit	Framing Material						
		Coefficient related to type of construction (C)	Wood Frame	1.50	Ordinary Construction	1.00		
			Ordinary construction	1.00				
			Non-combustible construction	0.80				
			Fire resistive construction (< 2 hrs)	0.70				
			Fire resistive construction (> 2 hrs)	0.60				
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Floor Space Area						
		Type of Housing	Single Family	1	Other (Comm, ind)	1	Units	
			Townhouse - indicate # of units	1				
			Other (Comm, Ind, etc.)	1				
2.2	# of Storeys	Number of Floors/ Storeys in the Unit (do not include basement):			4	4	Storeys	
3	Enter Ground Floor Area of One Unit	Enter Ground Floor Area (A) of One Unit Only :			173	1284	Area in Square Meters (m^2)	
		Measurement Units	Square Feet (ft^2)	0.093	Square Metres (m2)			
			Square Metres (m^2)	321				
			Hectares (ha)	10000				
4	Obtain Required Fire Flow without Reductions	Required Fire Flow(without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						7,884
5	Apply Factors Affecting Burning	Reductions/Increases Due to Factors Affecting Burning						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	-1,183
			Limited combustible	-0.15				
			Combustible	0.00				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Complete Automatic Sprinkler Protection	-0.3	None	0.00	N/A	0
			None	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	0-3 m	0.25	0.65	m	5,124
			East Side	20.1-30 m	0.10			
			South Side	3.1-10 m	0.20			
			West Side	20.1-30 m	0.10			
6	Obtain Required Fire Flow, Duration & Volume	Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:						12,000
		Total Required Fire Flow (above) in L/s:						200
		Required Duration of Fire Flow (hrs)						2.00
		Required Volume of Fire Flow (m^3)						1440

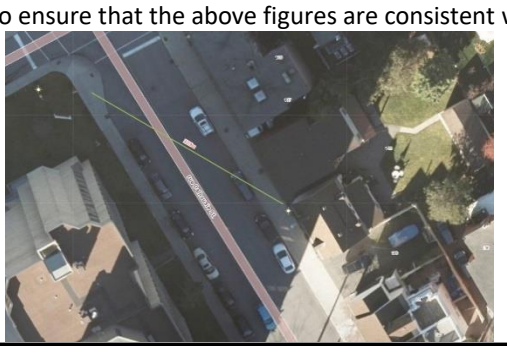
Note: The most current FUS document should be referenced before design to ensure that the above figures are consistent with the intent of the Guideline

Legend	
	Drop down menu - choose option, or enter value.
	No Information, No input required.

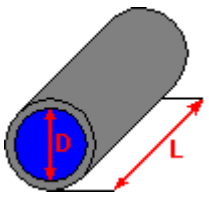
Note:

The most current FUS document should be referenced before design to ensure that the above figures are consistent with the intent of the Guideline.

1. nearest hydrant distance 32.9 m



Element of pipe



Straight pipes

circular

Pipe identification: Water lateral

Number of elements: 1 piece(s)

Diameter of pipe D: 50 mm

Length of pipe L: 14 m

Pipe roughness 0.1 mm

Flow medium

flow medium: Water 20 °C

volume flow: 2.01 l/s

Density: 998.206 kg/m3

Dynamic Viscosity: 1001.61 10-6kg/ms

Condition: liquid

Captcha: 28565 Please input captcha: 28565

Calculation

+ Settings/functions of table:

projects Dalhousie St.

			1	2
1	**1. Flow medium**			
2	Flow medium		Water 20°C	
3	condition		liquid	
4	Volume flow	m3/hr	7,236	
5	mass flow	kg/hr	7223.019	
6	Volume flow branch.pipe	m3/hr	---	
7	density	kg/m3	998,206	
8th	Dynamic Viscosity	10-6kg/m	1001.610	
9	children viscosity	10-6 m2/	1,003	
-	**2. Additional data for gases**			
11	Pressure	bar	---	
12	Temperature (inlet)	°C	---	
13	Temperature (outlet)	°C	---	
14	Norm volume flow	Nm3/hr	---	
15	**3. Element of pipe**			
16	pipe identification		Water lateral	
17	Element of pipe		circular	
18	Number of elements		1	
19	Dimensions of element	S.I	Diameter of pipe D: 50.00 mm	
20			Length of pipe L: 14.00 m	
21			---	
22			---	
23			---	
24			---	
25	**4. Result of calculation**			
26	velocity of flow	m/s	1,024	
27	Reynolds number		51010.279	
28	Velocity of flow 2	m/s	---	
29	Reynolds number 2		---	
30	Flow		turbulent	
31	Absolute roughness	mm	0.100	
32	Pipe friction number		0.026	
33	Resistance coefficient		7.401	
34	Res. coeff. branching pipe		---	
35	Press.drop branching pipe	bar	---	
36	Pressure drop	bar	0.039	
37	**Pressure drop**	bar	0.039	
38	**Total pressure drop**	bar	0.039	
39	remarks			

Manning Formula Uniform Pipe Flow at Given Slope and Depth

109-115 Dalhousie Street Ottawa: Sanitary sewer lateral capacity

Inputs:

Pipe Diameter, d_o	135.0000	mm
Manning Roughness, n	0.0100	
Pressure slope (possibly equal to pipe slope), S_o	1.5000	% slope
Percent of (or ratio to) full depth (100% or 1 if flowing full)	12.2000	%

Results:

Flow, Q	0.5796	l/s
Velocity, v	0.5815	m/s
Velocity head, hv	0.0172	m
Flow Area, A	0.0010	m^2
Wetted Perimeter, P	0.0963	m
Hydraulic Radius	0.0103	m
Top Width, T	0.0884	m
Froude Number, F	1.75	
Shear Stress (tractive force), τ	2.4226	N/m^2

Manning Formula Uniform Pipe Flow at Given Slope and Depth

109-115 Dalhousie Street Ottawa: Sanitary sewer main capacity

Inputs:

Pipe Diameter, d_o	250.0000	mm
Manning Roughness, n	0.0100	
Pressure slope (possibly equal to pipe slope), S_o	1.1200	% slope
Percent of (or ratio to) full depth (100% or 1 if flowing full)	6.0000	%

Results:

Flow, Q	0.5795	l/s
Velocity, v	0.4819	m/s
Velocity head, hv	0.0118	m
Flow Area, A	0.0012	m^2
Wetted Perimeter, P	0.1237	m
Hydraulic Radius	0.0097	m
Top Width, T	0.1187	m
Froude Number, F	1.53	
Shear Stress (tractive force), τ	1.6474	N/m^2

Manning Formula Uniform Pipe Flow at Given Slope and Depth

109-115 Dalhousie Street Ottawa: Storm sewer lateral capacity

Inputs:

Pipe Diameter, d_o	130.0000	mm
Manning Roughness, n	0.0100	
Pressure slope (possibly equal to pipe slope), S_o	1.5000	% slope
Percent of (or ratio to) full depth (100% or 1 if flowing full)	55.0000	%

Results:

Flow, Q	9.6968	l/s
Velocity, v	1.2963	m/s
Velocity head, hv	0.0857	m
Flow Area, A	0.0075	m^2
Wetted Perimeter, P	0.2172	m
Hydraulic Radius	0.0344	m
Top Width, T	0.1293	m
Froude Number, F	1.72	
Shear Stress (tractive force), τ	10.5169	N/m^2

Manning Formula Uniform Pipe Flow at Given Slope and Depth

109-115 Dalhousie Street Ottawa: Storm sewer main capacity

Inputs:

Pipe Diameter, d_o	300.0000	mm
Manning Roughness, n	0.0100	
Pressure slope (possibly equal to pipe slope), S_o	1.2200	% slope
Percent of (or ratio to) full depth (100% or 1 if flowing full)	30.0000	%

Results:

Flow, Q	27.1916	l/s
Velocity, v	1.5246	m/s
Velocity head, hv	0.1185	m
Flow Area, A	0.0178	m^2
Wetted Perimeter, P	0.3478	m
Hydraulic Radius	0.0513	m
Top Width, T	0.2750	m
Froude Number, F	1.91	
Shear Stress (tractive force), τ	10.7670	N/m^2

Project Number: CW-04-20 109-115 Dalhousie Street, Ottawa

ARCH-NOVA DESIGN INC.
Architecture
Engineering
Consulting

PRE-DEVELOPMENT

The pre-development time of concentration is 10 minutes

where:

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

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)
Grass	A1	0.02450	39.9%	0.25	0.006
Shed	A2	0.00382	6.2%	0.90	0.003
asphalt	A3	0.01355	22.0%	0.70	0.009
Building	A4	0.0108	17.5%	0.90	0.010
Building	A5	0.0088	14.4%	0.90	0.008
TOTAL		0.0615	100.0%		0.037
Weighted C =					0.60

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

Q_{5pre} = 2.78 x 0.60 x 104.2 x 0.0615

Q_{5pre} = 10.68 L/s

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

Q_{100pre} = 2.78 x 0.75 x 178.6 x 0.0615

Q_{100pre} = 22.89 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)
Building	A3	0.0040	14.1%	0.90	0.004
Building	A3	0.00396	13.8%	0.90	0.004
backyard	A1	0.02062	72.1%	0.50	0.010
TOTAL		0.0286	100.0%		0.017
Weighted C =					0.61

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

Q_{5post} = 2.78 x 0.61 x 104.2 x 0.0286

Q_{5post} = 5.06 L/s

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

$Q_{100post}$ = 2.78 x 0.61 x 178.6 x 0.0286

$Q_{100post}$ = 8.66 L/s

Project Number: CW-04-20 109-115 Dalhousie Street, Ottawa

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PRE-DEVELOPMENT

The pre-development time of concentration is 10 minutes

where:

$I_5 = 998.071 / (Tc + 6.053)^{0.814}$

I_5 = 104.2 mm/hr

$I_{100} = 1735.688 / (Tc + 6.014)^{0.820}$

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 =					0.70

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

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

Q_{5pre} = 2.78 x 0.70 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 0.70 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_5 = 104.2 mm/hr

$I_{100} = 1735.688 / (Tc + 6.014)^{0.820}$

I_{100} = 178.6 **mm/hr**

Surface Type	ID	Area (ha)	Percent of total Area	C	A X C (ha)
Landscape	A1	0.0328	100.0%	0.90	0.030
TOTAL		0.03284	0.0%		0.030
Weighted C =					0.90

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

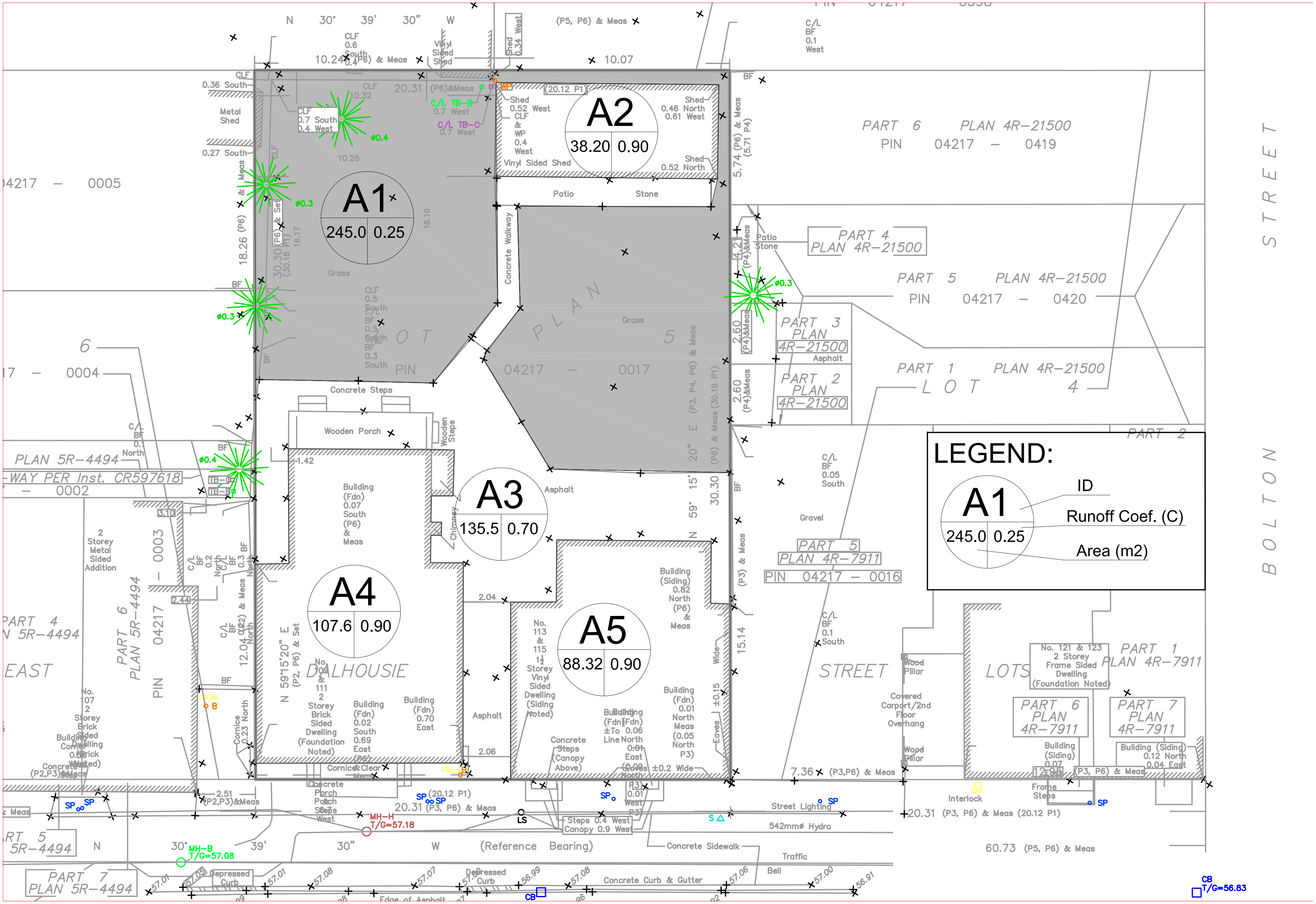
Q_{5post} = 2.78 x 0.90 x 104.2 x 0.0328

Q_{5post} = 8.56 L/s

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

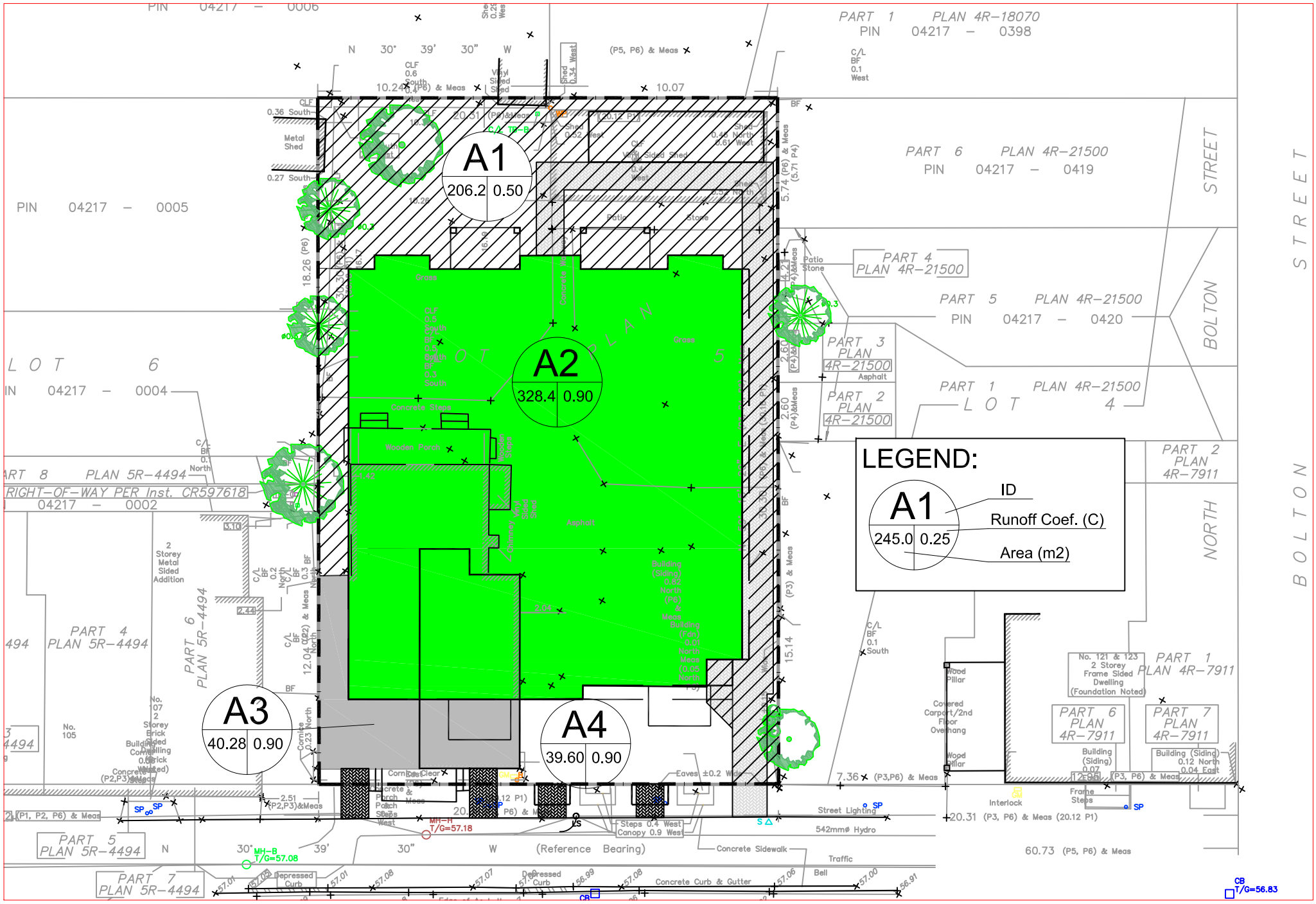
$Q_{100post}$ = 2.78 x 0.90 x 178.6 x 0.0328

$Q_{100post}$ = 14.67 L/s



109-115 DALHOUSIE STREET: SWM PREDEVELOPMENT

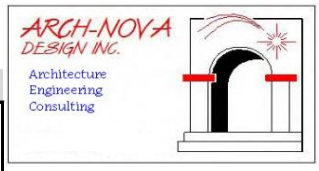
ARCH-NOVA Design Inc.
45 Banner Road NEPEAN ON K2H 8X5
613-702-3403 contact@archnova.ca



109-115 DALHOUSIE STREET: SWM POSTDEVELOPMENT

ARCH-NOVA Design Inc.
45 Banner Road NEPEAN ON K2H 8X5
613-702-3403 contact@archnova.ca

ALLOWABLE RUNOFF



Predevelopment Runoff:		
Uncontrolled Runoff		
5-year	10.68	l/sec
100-year	22.89	l/sec
Controlled Runoff:		
5-year	0.00	l/sec
100-year	0.00	l/sec

Postdevelopment Runoff:		
Uncontrolled Runoff		
5-year	5.06	l/sec
100-year	8.66	l/sec
Controlled Runoff:		
5-year	8.56	l/sec
100-year	14.67	l/sec

Controlled allowable runoff		
Controlled Runoff:		
5-year	**2.02**	**l/sec**
100-year	14.22	l/sec

Comment:

Storage Volumes (5-Year Storm)

Project: 109-115 Dalhousie Street, Ottawa

Tc = 10 (mins)
C_{AVG} = 0.90 (dimmensionless)
Area = 0.0328 (hectares)
Storm = 5 (year)
Release Rate = 2.02 (L/sec)
Time Interval = 10 (mins)

Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
1	204	1.7	2.02		
11	99	8.2	2.02	6.13	4.05
21	68	5.6	2.02	3.58	4.51
31	53	4.3	2.02	2.32	4.31
41	43	3.6	2.02	1.55	3.81
51	37	3.0	2.02	1.03	3.16
61	33	2.7	2.02	0.66	2.40
71	29	2.4	2.02	0.37	1.58
81	26	2.2	2.02	0.14	0.70
91	24	2.0	2.02	-0.04	-0.21
101	22	1.8	2.02	-0.19	-1.16
111	21	1.7	2.02	-0.32	-2.12
121	19	1.6	2.02	-0.43	-3.11
131	18	1.5	2.02	-0.52	-4.12
141	17	1.4	2.02	-0.61	-5.13
151	16	1.3	2.02	-0.68	-6.17
161	15	1.3	2.02	-0.75	-7.21
171	15	1.2	2.02	-0.80	-8.26
181	14	1.2	2.02	-0.86	-9.32
191	14	1.1	2.02	-0.91	-10.38
201	13	1.1	2.02	-0.95	-11.46
211	13	1.0	2.02	-0.99	-12.54
221	12	1.0	2.02	-1.03	-13.62
231	12	1.0	2.02	-1.06	-14.71
241	11	0.9	2.02	-1.09	-15.80
251	11	0.9	2.02	-1.12	-16.90
261	11	0.9	2.02	-1.15	-18.01
271	10	0.8	2.02	-1.18	-19.11

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} = 0.90 (dimmensionless)
Area = 0.0328 (hectares)
Storm = 100 (year)
Release Rate = 2.02 (L/sec)
Time Interval = 10 (mins)

Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
1	351	2.9	2.02		
11	170	14.0	2.02	11.94	7.88
21	116	9.6	2.02	7.54	9.50
31	90	7.4	2.02	5.36	9.97
41	74	6.1	2.02	4.05	9.96
51	63	5.2	2.02	3.16	9.67
61	55	4.5	2.02	2.52	9.22
71	49	4.0	2.02	2.03	8.65
81	45	3.7	2.02	1.64	7.99
91	41	3.3	2.02	1.33	7.27
101	38	3.1	2.02	1.07	6.50
111	35	2.9	2.02	0.85	5.69
121	33	2.7	2.02	0.67	4.85
131	31	2.5	2.02	0.51	3.97
141	29	2.4	2.02	0.36	3.08
151	27	2.3	2.02	0.24	2.16
161	26	2.1	2.02	0.13	1.23
171	25	2.0	2.02	0.03	0.28
181	24	2.0	2.02	-0.06	-0.68
191	23	1.9	2.02	-0.14	-1.65
201	22	1.8	2.02	-0.22	-2.64
211	21	1.7	2.02	-0.29	-3.64
221	20	1.7	2.02	-0.35	-4.64
231	20	1.6	2.02	-0.41	-5.65
241	19	1.6	2.02	-0.46	-6.67
251	18	1.5	2.02	-0.51	-7.70
261	18	1.5	2.02	-0.56	-8.73
271	17	1.4	2.02	-0.60	-9.77

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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ect : 109-115 Dalhousie Street, Ottawa

Storage Requirements

5-year **4.51 m^3**

100-year **9.97 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	0.0084	25.6%	1.16	2.56	0.52	8.20
Roof	A2	0.0077	23.5%	1.06	2.35	0.48	7.53
Roof	A3	0.0091	27.6%	1.25	2.76	0.56	8.84
Roof	A4	0.0076	23.2%	1.05	2.31	0.47	7.42
TOTAL		0.0328	100.0%	4.51	9.97	2.02	31.99

Stage-Storage

Roof A1 (Drain D1)			Roof A2 (Drain D2)			Roof A3 (Drain D3)			Roof A4 (Drain D4)		
Depth m	Area m^2	Volume m^3	Depth m	Area m^2	Volume m^3	Depth m	Area m^2	Volume m^3	Depth m	Area m^2	Volume m^3
0.020	9.10	0.06	0.020	9.10	0.06	0.020	9.10	0.06	0.020	9.10	0.06
0.040	25.00	0.33	0.040	23.00	0.31	0.040	30.00	0.40	0.040	22.00	0.29
0.073	**48.00**	**1.17**	**0.074**	**43.00**	**1.06**	**0.068**	**55.00**	**1.25**	**0.075**	**42.00**	**1.05**
0.092	**84.00**	**2.58**	**0.092**	**77.00**	**2.36**	**0.092**	**91.00**	**2.79**	**0.092**	**76.00**	**2.33**

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

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

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Appendix B: Correspondence

zoran@archnova.ca

From: Fawzi, Mohammed <mohammed.fawzi@ottawa.ca>
Sent: December 23, 2021 10:46 AM
To: zoran@archnova.ca
Cc: Bakhit, Reza
Subject: RE: 109-115 Dalhousie: boundary conditions
Attachments: 109-115 Dalhousie Street December 2021.pdf

Hi Zoran,

The following are boundary conditions, HGL, for hydraulic analysis at 109-115 Dalhousie Street (zone 1W) assumed to be connected to the 305 mm watermain on Dalhousie Street (see attached PDF for location).

Minimum HGL: 106.2 m

Maximum HGL: 115.4 m

Max Day + Fire Flow (117.78 L/s): 108.3 m

Max Day + Fire Flow (200 L/s): 106.9 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.

Best Regards,

Mohammed Fawzi, E.I.T.
Project Manager
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - Central Branch
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2424 ext./poste 20120, Mohammed.Fawzi@ottawa.ca

Please note that due to the current situation, I am working remotely. Email is currently the best way to contact me

From: Fawzi, Mohammed
Sent: December 22, 2021 9:40 AM

To: zoran@archnova.ca
Cc: Bakhit, Reza <reza.bakhit@ottawa.ca>
Subject: RE: 109-115 Dalhousie: boundary conditions

Hi Zoran,

Thank you for your email. This is to confirm your request has been processed.

Best Regards,

Mohammed Fawzi, E.I.T.
Project Manager
Planning, Infrastructure and Economic Development Department - Services de la planification, de l'infrastructure et du développement économique
Development Review - Central Branch
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2424 ext./poste 20120, Mohammed.Fawzi@ottawa.ca

Please note that due to the current situation, I am working remotely. Email is currently the best way to contact me

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From: zoran@archnova.ca <zoran@archnova.ca>
Sent: December 21, 2021 6:31 PM
To: Bakhit, Reza <reza.bakhit@ottawa.ca>; Fawzi, Mohammed <mohammed.fawzi@ottawa.ca>
Subject: RE: 109-115 Dalhousie: boundary conditions

Hello Reza, Mohammed,

Please disregard the previous email and use this calculation for the location of 109-115 Dalhousie Street, Ottawa? Following are the initial information:

1. Type of development: 4storey, 27units building.
2. Fire flow required: 200 l/sec (FUS); 117.78 l/sec (OBC); nearest hydrant distance 32.9 m
3. Average Daily Demand: 0.14 l/sec
4. Maximum Hourly Demand: 2.01 l/sec
5. Maximum Daily Demand: 1.34 l/sec

Best regards,

Zoran Mrdja, P.Eng., FEC
DufkQryd Ghvljq Inf1

613-818-3884

From: zoran@archnova.ca <zoran@archnova.ca>
Sent: December 21, 2021 6:08 PM
To: 'Bakhit, Reza' <reza.bakhit@ottawa.ca>; 'Fawzi, Mohammed' <mohammed.fawzi@ottawa.ca>
Subject: 109-115 Dalhousie: boundary conditions

Hello Reza, Mohammed,

Could you please provide the boundary conditions for the location of 109-115 Dalhousie Street, Ottawa?
Following are the initial information:

1. Type of development: 4storey, 24 units building.
2. Fire flow required: 200 l/sec (FUS); 117.78 l/sec (OBC); nearest hydrant distance 32.9 m
3. Average Daily Demand: 0.12 l/sec
4. Maximum Hourly Demand: 2.04 l/sec
5. Maximum Daily Demand: 1.36 l/sec

Best regards,

Zoran Mrdja, P.Eng., FEC
DufkQryd Ghvljq Inf1
613-818-3884

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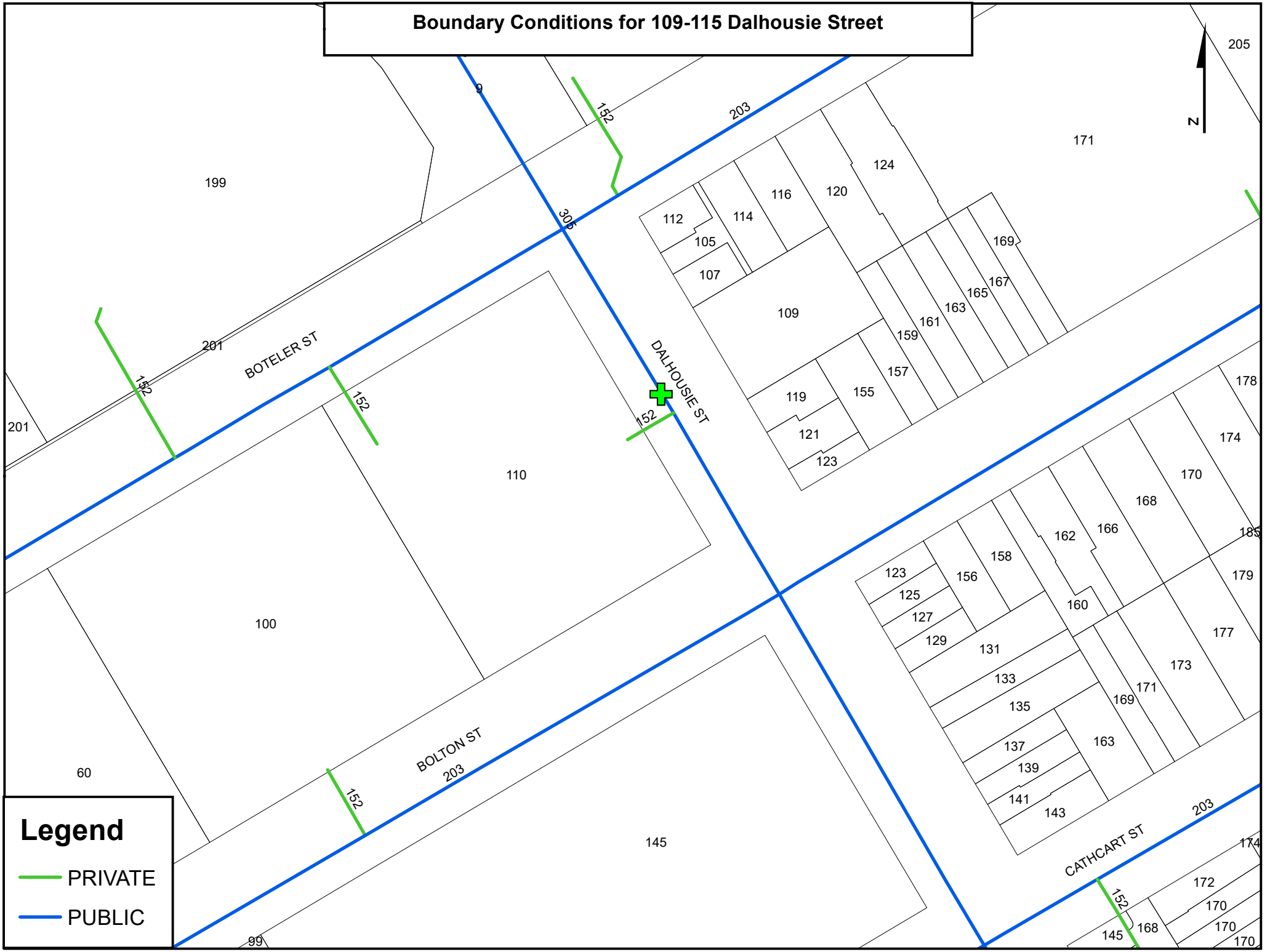
Boundary Conditions for 109-115 Dalhousie Street
N
205
199
171
124
120
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161
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157
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123
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133
135
137
139
141
143
160
179
177
173
171
169
163
185
201
BOTELER ST
DALHOUSIE ST
BOLTON ST
CATHCART ST
110
100
145
60
99
203
305
152
Legend
PRIVATE
PUBLIC