PROPOSED

THREE-STOREY APARTMENT BUILDING ADDITION

LOT RE-DEVELOPEMENT SITE

PART OF LOT "D"

R-PLAN 82717

314 BELL STREET SOUTH

CITY OF OTTAWA

STORM DRAINAGE REPORT

REPORT R-821-102

T.L. MAK ENGINEERING CONSULTANTS LTD.

FEBRUARY 2022

REFERENCE FILE NUMBER 821-102

Introduction

The proposed residential re-development site for a three-storey apartment building addition is located on the west side of Bell Street South, and situated north of Henry Street and south of Champlain Street. Its legal property description is Part of Lot "D" Registered Plan 82717 (Ward 17 - Capital) City of Ottawa. At this time, the residential lot under consideration houses an existing 3-storey brick and vinyl sided apartment building which currently occupies approximately the south half of the lot. The municipal address of the property is referenced as 314 Bell Street South.

The lot at this site is 497.0 square meters in size and presently there exists a three storey pitched roof (4) – unit apartment building on this property.

This current lot re-development proposal is for constructing and adding a (3) – storey four unit flat roof apartment building which will abut the south wall of the existing apartment building with a firewall.

The proposed building addition will be a 3 – storey residential apartment building with a basement. The building contains four – 2 bedroom units. Each floor covers an area of approximately 1,375.0 square feet (127.7 m^2) for a gross floor area of 5,500 ft^2 (511.0 m^2). Storm water outlet for this site is the existing 600mm dia. combined sewer located within the Bell Street South road right of way.

From storm-drainage criteria set by the staff at the City of Ottawa's Engineering Department, the allowable post-development runoff release rates shall not exceed the two (2)-year pre-development conditions. The allowable pre-development runoff coefficient is the calculated "C" existing value = 0.89 or C_{allow} = 0.5 maximum. If the uncontrolled storm-water runoff exceeds the specified requirements, then on-site storm-water management (SWM) control measures are necessary. The post-development runoff coefficient for this site is estimated at C=0.66, which exceeds the calculated pre-development allowable C=0.5 criteria for the Bell Street combined sewer without on-site SWM control. Therefore, SWM measures are required. Refer to the attached Drainage Area Plan (Figure 1) as detailed in Appendix A. For Pre and Post site development characteristics, refer to Dwg. No. 821-102 D-1 for details.

In consultation with the City regarding on-site Storm Water Management (SWM) requirement at this site, it was indicated to consultants that controlling the flat rooftop water from the building addition is required. As to the rest of the site, storm water can be remained uncontrolled as long as there are no major changes to the current grading and drainage pattern.

This report will address and detail the grading, drainage, and storm-water management control measures required to develop this property for a building addition. Based on the Proposed Site Grading and Servicing Plan (Dwg. No. 821-102 G-1), and on the Proposed Rooftop Storm-water Management Plan (Dwg. No. 821-102 SWM-1), the storm water of this lot will be controlled on site only by the building addition's flat rooftop.

The storm water management calculations that follow will detail the extent of on-site SWM control to be implemented and the storage volume required on site to attain the appropriate runoff release that will conform to the City's established drainage criteria and requirements.

Because the site is located within a combined sewer shed, therefore, the approval exemption under Ontario Regulation 525/98 would not apply since storm water discharges from this site will outlet flow into a combined sewer and not a storm sewer. Thus, an Environmental Compliance Approval (ECA) application will be required to be submitted to the Ministry.

Site Data

1. Development Property Area

Post-Development Site Area Characteristics

Development Lot Area	= 497.0 m^2
Roof Surface Area	= 245.94m^2
Concrete Area	= 45.20 m^2
Interlock paver Area	= 40.97 m^2
Grass Area	= 164.89 m^2

$$C = \frac{(245.94 \times 0.9) + (45.20 \times 0.9) + (40.97 \times 0.8) + (164.89 \times 0.2)}{497.0}$$

$$C = \frac{327.78}{497.0}$$

$$C = 0.65952$$

Say "C" $= 0.66$

Therefore, the average post-development "C" for this site is 0.66.

2. Controlled Area Data (NODE #1, #2, and #3)

Roof Surface Area	= 140.85 m^2
Total Storm-water Controlled Area	= 140.85 m^2

$$C = \frac{(140.85 \times 0.9)}{140.85}$$

$$C = \frac{126.765}{140.85}$$

$$C = 0.9$$

Say "C" $= 0.9$

Therefore, the post-development "C" for the controlled storm-water drainage area (rooftop) is 0.90.

3. Uncontrolled Area Data

i. PROPOSED SITE (Current Drainage Pattern) (NODE #4)

Roof Area	= 105.09 m^2
Grass Area	= 164.89 m^2
Interlock Paver Area	= 40.97 m^2
Concrete Area	= 45.20 m^2
Total Storm-water Uncontrolled Area	= 356.15 m^2

$$C = \frac{(105.09 \times 0.9) + (164.89 \times 0.2) + (40.97 \times 0.8) + (45.20 \times 0.9)}{356.15}$$

$$C = \frac{201.015}{356.15}$$

$$C = 0.5644$$

Say "C" $= 0.57$

Therefore, the average post-development "C" for the uncontrolled storm-water drainage area of 356.15 m^2 from this site is 0.57.

The total tributary area consisting of approximately 356.15 square metres will be out-letting off site uncontrolled from the residential apartment building site.

ii. SURFACE AREA DRAINING TO FRONT OF LOT

Total Area	= 0 m^2

iii. SURFACE AREA DRAINING TO REAR OF LOT (Same As NODE #4)

Roof Area	= 105.09 m^2
Concrete Area	= 45.20 m^2
Grass Area	= 164.89 m^2
Interlock paver Area	= 40.97 m^2
Total Area	= 356.15 m^2

$$C_5 = \frac{(164.89 \times 0.2) + (105.09 \times 0.9) + (45.20 \times 0.9) + (40.97 \times 0.8)}{356.15}$$

$$C_5 = \frac{201.015}{356.15}$$

$$C_5 = 0.5644$$

Say "C_5"=0.57

$$C_{100} = \frac{(164.89 \times 0.2 \times 1.25) + (105.09 \times 1.0) + (45.20 \times 1.0) + (40.97 \times 1.0)}{356.15}$$

$$= \frac{232.4825}{356.15}$$

$$= 0.653$$

Therefore, C_{100}= 0.66

The uncontrolled drainage area draining to the rear of the lot is 356.15 m^2 and currently there are no drainage areas or uncontrolled drainage draining to the front of the lot.

The SWM area to be controlled is 140.85 m^2. Refer to the attached "Drainage Area Plan" in Figure 1 of Appendix A for further details.

Pre-Development Flow Estimation

Maximum allowable off-site flow: two (2)-year storm

Pre-Development Site Area Characteristics	
Development Lot Area	= 497.0 m^2
Asphalt Area	= 385.7 m^2
Grass Area	= 3.20 m^2
Interlock Area	= 13.56 m^2
Roof Area	= 94.54 m^2

$$C = \frac{(385.7 \times 0.9) + (94.54 \times 0.9) + (13.56 \times 0.8) + (3.20 \times 0.2)}{497.0}$$

$$C = \frac{443.704}{497.0}$$

$$C = 0.893$$

Say C = 0.89

Use C_{pre} = 0.5 maximum allowable for redevelopment

T_c = D/V where D = 41.0 m, ΔH = 2.07 m, S = 5.05%, and V = 4.9 feet/second = 1.49 m/s
Therefore,

$$T_c = \frac{41.0m}{1.49m/s}$$

T_c = 0.46 minutes
Use T_c = 10 minutes
I_2 = 76.8mm/hr [City of Ottawa, two (2)-year storm]

Using the Rational Method

Q = 2.78 (0.5) (76.8) (0.0497)

Q = 5.31 L/s

Therefore, the total allowable flow off-site is 5.31 L/s.

The pre-development flow of the two (2)-year, five (5)-year and 100-year storm event draining to the **front** of the lot is as follows:

Where, Tc = 10 min.

$A = 0$ hectares

Node #101

$Q_{2pre} = 0$ L/s

$Q_{5pre} = 0$ L/s

$Q_{100pre} = 0$ L/s

Therefore, currently all existing storm water flow of this lot does **not** contribute flow to the front of this property at the Bell Street South road right of way.

The pre-development flow of the two (2)-year, five (5)-year and 100-year storm event draining to the **rear** of the lot is as follows:

Where, Tc = 10 min.

Node #101

$Q_{2pre} = 2.78\ (0.89)\ (76.8)\ (0.0497)$

$= 9.44$ L/s

$Q_{5pre} = 2.78\ (0.89)\ (104.2)\ (0.0497)$

$= 12.81$ L/s

$$Q_{100pre} = 2.78\ (1.0)\ (178.6)\ (0.0497)$$

$$= 24.68\ L/s$$

A coloured Google image and aerial photography of these current pre-development conditions of the site is provided in Appendix B of this report for reference.

Post-Development Flow Estimation

Uncontrolled Drainage Areas

The post-development flow of the two (2)-year, five (5)-year and 100-year storm event draining to the **front** of the lot is as follows:

Where, Tc = 10 min.

$A = 0$ hectares

Node #4

$Q_{2post} = 0\ L/s$

$Q_{5post} = 0\ L/s$

$Q_{100post} = 0\ L/s$

Therefore, Q_2, Q_5 and Q_{100} post-development flow to the front of lot are $0\ L/s$.

The post-development flow of the two (2)-year, five (5)-year and 100-year storm event draining to the **rear** of the lot is as follows:

Where, Tc = 10 min.

Node #4

$$Q_{2post} = 2.78\ (0.57)\ (76.8)\ (0.03562)$$

$$= 4.34\ L/s$$

$$Q_{5post} = 2.78\ (0.57)\ (104.2)\ (0.03562)$$

$$= 5.88\ L/s$$

$$Q_{100post} = 2.78\ (0.66)\ (178.6)\ (0.03562)$$

$$= 11.67\ L/s$$

For this site, because 356.15 square meters of the site area are drained uncontrolled off site and the peak sanitary flow of 0.24 L/s is estimated to discharge into the combined sewer (see Serviceability Report), the net allowable discharge for this site into the existing sewer system using the two (2)-year

storm event criteria at C = 0.5 (max) is calculated as follow: Q = {2.78 (0.5) (76.8) (0.0497) – [2.78 (0.66) (178.6) (0.03562)] – [0.24 L/s]} = 5.31 L/s – 11.67 L/s – 0.13 L/s – 0.11 L/s = -6.60 L/s. Therefore, according to this approach, the maximum allowable flow rate off site is 5.31 L/s and the net allowable controlled flow rate off-site is -6.60 L/s. Therefore, controlling flow to a net rate of -6.60 L/s is not practical.

Storm-Water Management Analysis

Based on the above calculations and information presented, a practical SWM approach is applied used in order to regulate and control storm water for the proposed building addition for the City's consideration. The total maximum allowable flow off-site and into the combined sewer is calculated at 5.31 L/s. Since the uncontrollable 100-year post-development flow draining to the front of lot is 0 L/s and the peak sanitary flow estimated for this proposed development site is 0.24 L/s. Therefore, the net allowable flow into the combined sewer will be calculated based on total allowable flow subtracting the uncontrolled 100-year post development flow draining to the **front** of the lot and the peak sanitary flow. From our analysis, post-development flow to **rear** of lot is improved by the proposed site development as Q_{2post} = 5.54 L/s (4.34 L/s + 0.96 L/s + 0.24 L/s) is less than Q_{2pre} = 9.44 L/s and $Q_{100post}$ = 12.87 L/s (11.67 L/s + 0.96 L/s + 0.24 L/s) is less than Q_{100pre} = 24.68 L/s. Therefore, accounting for the 100-year uncontrolled post-development flow draining to the **front** rather than from the entire site is our design approach for this proposed building addition on-site.

Thus, the net allowable discharge for this site into the existing 600 mm dia. combined sewer is calculated as: Q = 2.78 (0.5) (76.8) (0.0497) - 2.78 (0) (178.6) (0) - 0.24 L/s = 5.07 L/s.

Therefore, the maximum allowable flow rate off-site is 5.31 L/s and the net allowable flow rate off-site is 5.07 L/s.

At this site, a controlled flow rate of 0.96 L/s for on-site storm water management detention volume storage calculation will be used for this SWM analysis. This is accomplished by proposing three (3) controlled roof drains to restrict flow from the building at a rate of 3 x 0.32 L/s = 0.96 L/s into the Bell Street South combined sewer which does not exceed the calculated new allowable flow of 5.07 L/s. Controlled roof drain details are found on Dwg. No. 821-102 SWM-1 entitled Proposed Rooftop Stormwater Management Plan.

For this proposed site, the total maximum allowable two(2)-year release rate of 5.31 L/s will not be exceeded since the off-site flow of 1.20 L/s (0.96 L/s + 0.24 L/s) is expected to enter into the existing 600mm dia. Bell Street South combined sewer for storm events up to and including 100-year. In order to control runoff to less than the allowable release rate, stormwater control is therefore proposed to be stored on-site at the flat rooftop of the proposed apartment building addition which will be used for stormwater detention purposes.

The post-development inflow rate during the two (2)-year, five (5)-year and 100-year storms for the (3) three rooftop areas can be calculated as follows.

Design Discharge Computation

Flat Rooftop Areas

To Calculate Roof Storage Requirements

The proposed flat roof of the apartment building on the property will incorporate three (3) roof drains to control flow off site. The specified standard roof drain flow rate is each at 0.32 L/s (5.0 US gal./min.). The specified roof drain is the Watts "Adjustable Accutrol Weir" (Model # RD-100-A-ADJ) with weir opening in the closed position which will allow a flow of 0.32 L/s under a 150mm regardless of the head of water above the drain. See Appendix C for Roof Drain details. Therefore, the storm-water flow that can be controlled from this rooftop and outletted off site is 0.32 L/s x 3 = 0.96 L/s < 5.07 L/s, which is the net allowable. Refer to the Proposed Rooftop Stormwater Management Plan Dwg. 821-102 SWM-1 for roof drain details.

C = 0.9 will be used for sizing roof storage volume in this case.

Inflow rate (Q_A) = 2.78 CIA, where C = 0.9, A = surface area of roof, I = mm/hr

For Roof Area 1, Q_{A1} = 2.78 CIA (NODE #1)

Two (2)-Year Event
$C_2 = 0.90$
$A = 42.50\ m^2$
I = mm/hr
$Q_2 = 2.78\ (0.90)\ (0.0043\ ha.)\ I = 0.0108I$

Five (5)-Year Event
$C_5 = 0.90$
$A = 42.50\ m^2$
I = mm/hr
$Q_5 = 2.78\ (0.90)\ (0.0043\ ha.)\ I = 0.0108I$

100-Year Event
$C_{100} = 1.0$
$A = 42.50\ m^2$
I = mm/hr
$Q_{100} = 2.78\ (1.0)\ (0.0043\ ha.)\ I = 0.012I$

For Roof Area 2, Q_{A2} = 2.78 CIA (NODE #2)

Two (2)-Year Event
$C_2 = 0.90$

A = 60.57 m^2
I = mm/hr
Q_2 = 2.78 (0.90) (0.0061 ha.) I = 0.0153I

Five (5)-Year Event
C_5 = 0.90
A = 60.57 m^2
I = mm/hr
Q_5 = 2.78 (0.90) (0.0061 ha.) I = 0.0153I

100-Year Event
C_{100} = 1.0
A = 60.57 m^2
I = mm/hr
Q_{100} = 2.78 (1.0) (0.0061 ha.) I = 0.017I

For Roof Area 3, Q_{A3} = 2.78 CIA (NODE #3)

Two (2)-Year Event
C_2 = 0.90
A = 37.78 m^2
I = mm/hr
Q_2 = 2.78 (0.90) (0.0038 ha.) I = 0.0095I

Five (5)-Year Event
C_5 = 0.90
A = 37.78 m^2
I = mm/hr
Q_5 = 2.78 (0.90) (0.0038 ha.) I = 0.0095I

100-Year Event
C_{100} = 1.0
A = 37.78 m^2
I = mm/hr
Q_{100} = 2.78 (1.0) (0.0038 ha.) I = 0.0106I

The summary results of the calculated inflow and the storage volume of the site and building's flat rooftop to store the two (2)-year, five (5)-year and 100-year storm events are shown in **Tables 1 to 9** inclusive.

Table 10 summarizes the post-development design flows from the building roof top area as well as the type of roof drains, the maximum anticipated ponding depths, storage volumes required, and storage volumes provided for the two (2)-year, five (5)-year, and 100-year design events.

Table 10: Design Flow and Roof Drain Table

Roof Drain ID & Drainage Area (ha)	Number of Roof Drains	Watts Roof Drain Model ID (Weir Opening)	Controlled Flow per Drain (L/s)			Approximate Ponding Depth Above Drains (m)			Storage Volume Required (m^3)			Max. Storage Available (m^3)
			2 YR	5 YR	100 YR	2 YR	5 YR	100 YR	2 YR	5 YR	100 YR	
RD-1 (0.0042 ha)	1	RD-100-A-ADJ (Closed)	0.32	0.32	0.32	0.1	0.12	0.15	0.32	0.53	1.41	2.09
RD-2 (0.0061 ha)	1	RD-100-A-ADJ (Closed)	0.32	0.32	0.32	0.1	0.12	0.15	0.59	0.92	2.31	2.37
RD-3 (0.0038 ha)	1	RD-100-A-ADJ (Closed)	0.32	0.32	0.32	0.1	0.12	0.15	0.26	0.52	1.18	1.90
Total Roof (0.0141 ha)	**3**	-	**0.96**	**0.96**	**0.96**	-	-	-	**1.17**	**1.97**	**4.90**	**6.36**

Erosion and Sediment Control

The contractor shall implement Best Management Practices to provide for protection of the receiving storm sewer during construction activities. These practices are required to ensure no sediment and/or associated pollutants are released to the receiving watercourse. These practices include installation of a "siltsack" catch basin sediment control device or equal in catch basins as recommended by manufacturer on-site and off-site within the Bell Street road right of way adjacent to this property. Siltsack shall be inspected every 2 to 3 weeks and after every major storm. The deposits will be disposed of as per the requirements of the contract. See Dwg. #821-102 ESC-1 for details.

Conclusion

In assessing the 2-Year up to the 100-Year storm events under pre-development conditions to that of the same storm events under post-development conditions with implementation of the proposed on-site SWM measures (flat rooftop storage with (3) specified controlled drains) it was determined that post development release rates has been improved for the site compared with the current existing flow rates.

The pre-development flow at the 2-Year storm event is estimated at 9.44 L/s and 24.68 L/s for the 100-Year event. By incorporating the proposed SWM attenuation measures, the post development 2-Year flow off-site is estimated at 5.54 L/s (4.34 L/s + 0.96 L/s + 0.24 L/s) and the 100-Year flow is estimated at 12.87 L/s (11.67 L/s + 0.96 L/s + 0.24 L/s).

Therefore for this proposed development site, the two (2)-Year post development release rate of 5.54 L/s is less than the 2-Year pre-development flow rate of 9.44 L/s. For storm events up to and including the 100-Year event, the total 100-Year post-development release rate of 12.87 L/s is less than the 100-Year pre-development flow of 24.68 L/s.

For development of this residential site (± 0.0497 ha.) with implementation of SWM measures and in controlling the two (2)-year storm water release rate to a flow rate of 0.96 L/s, a site storage volume of

approximately 1.17 m^3 minimum is required during the two (2)-year event. For this site, three (3) flat rooftop storage areas will be used for stormwater management attenuation.

During the two (2)-year storm event for the flat rooftop storage, the ponding depth of rooftop area 1, 2, and 3 is estimated at 100mm at the drain and 0mm at the roof perimeter, assuming a 2.0% minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is 0.63 m^3, rooftop storage available at Roof Area 2 is 0.71 m^3 and the rooftop storage available at Roof Area 3 is 0.60 m^3, for a total of 1.94 m^3, which is greater than the required volume of 1.17 m^3.

To control the five (5)-year storm water release rate off site to a flow rate of 0.96 L/s, a site storage volume of approximately 1.97 m^3 minimum is required during the five (5)-year event.

During the five-year storm event for the flat rooftop storage, the ponding depth of Roof Area 1, 2, and 3 is estimated at 120mm at the drain and 0mm at the roof perimeter, assuming a 2.0% minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is 1.01 m^3, rooftop storage available at Roof Area 2 is 1.23 m^3 and the rooftop storage available at Roof Area 3 is 0.95 m^3, for a total of 3.19 m^3, which is greater than the required volume of 1.97 m^3.

To control the 100-year storm-water release rate off site to a flow rate of 0.96 L/s, a site storage volume of approximately 4.90 m^3 minimum is required during the 100-year event.

During the 100-year storm event for the flat rooftop storage, the ponding depth of Roof Area 1, 2, and 3 is estimated at 150mm at the drain and 0mm at the roof perimeter, assuming a 2.0% minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is 2.09 m^3, rooftop storage at Roof Area 2 is 2.37 m^3 and the rooftop storage available at Roof Area 3 is 1.90 m^3, for a total of 6.36 m^3, which is greater than the required volume of 4.90 m^3.

Therefore, by means of flat building rooftop storage and grading the site to the proposed grades as shown on the Proposed Grading and Servicing Plan and Proposed Rooftop Stormwater Management Plan Dwg. 821-102 G-1 and 821-102 SWM-1 respectively, the desirable two (2)-year storm, five (5)-year storm and 100-year storm event detention volume of 1.94 m^3, 3.19 m^3 and 6.36 m^3 respectively will be available on site. Refer to Appendix D for detailed calculations of available storage volumes.

The building weeping tile drainage will outlet via its separate 150mm diameter PVC storm lateral. The roof drains will be outletted via a proposed 150mm PVC storm lateral, where upon both laterals are connected directly to the existing Bell Street South 600mm diameter combined sewer. Refer to the proposed grading and servicing plan Dwg. 821-102 G-1 for details.

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PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 1

TWO (2)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 1 STORAGE VOLUME

t_c **TIME** (minutes)	I **FIVE(5)-YEAR** (mm/hr)	Q **ACTUAL** (L/s)	Q **ALLOW** (L/s)	Q **STORED** (L/s)	**VOLUME STORED** (m^3)
5	102.80	1.11	0.32	0.79	0.24
10	77.10	0.83	0.32	0.51	0.31
15	63.30	0.68	0.32	0.36	0.32
20	52.03	0.56	0.32	0.24	0.29
25	45.17	0.49	0.32	0.17	0.26

Therefore, the required storage volume is 0.32 m^3.

PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 2

TWO (2)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 2 STORAGE VOLUME

t_c **TIME** (minutes)	I **5-YEAR** (mm/hr)	Q **ACTUAL** (L/s)	Q **ALLOW** (L/s)	Q **STORED** (L/s)	**VOLUME STORED** (m^3)
5	102.80	1.57	0.32	1.25	0.38
10	77.10	1.18	0.32	0.86	0.52
15	63.30	0.97	0.32	0.65	0.59
20	52.03	0.80	0.32	0.48	0.576
25	45.17	0.69	0.32	0.37	0.56

Therefore, the required rooftop storage volume is 0.59 m^3.

PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 3

TWO (2)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 3 STORAGE VOLUME

t_c **TIME** (minutes)	I **5-YEAR** (mm/hr)	Q **ACTUAL** (L/s)	Q **ALLOW** (L/s)	Q **STORED** (L/s)	**VOLUME STORED** (m^3)
5	102.80	0.98	0.32	0.66	0.20
10	77.10	0.73	0.32	0.41	0.25
15	63.30	0.60	0.32	0.28	0.26
20	52.03	0.49	0.32	0.17	0.20

Therefore, the required rooftop storage volume is 0.26 m^3.

PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 4

FIVE (5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 1 STORAGE VOLUME

t_c **TIME** (minutes)	I **5-YEAR** (mm/hr)	Q **ACTUAL** (L/s)	Q **ALLOW** (L/s)	Q **STORED** (L/s)	**VOLUME STORED** (m^3)
5	141.20	1.53	0.32	1.21	0.36
10	104.20	1.13	0.32	0.81	0.49
15	83.50	0.90	0.32	0.58	0.52
20	70.30	0.76	0.32	0.44	0.53
25	60.90	0.66	0.32	0.34	0.51
30	53.93	0.58	0.32	0.26	0.47

Therefore, the required rooftop storage volume is 0.53 m^3.

PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 5

FIVE (5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 2 STORAGE VOLUME

t_c **TIME** (minutes)	**I 100-YEAR** (mm/hr)	**Q ACTUAL** (L/s)	**Q ALLOW** (L/s)	**Q STORED** (L/s)	**VOLUME STORED** (m^3)
5	141.20	2.16	0.32	1.84	0.55
10	104.20	1.59	0.32	1.27	0.76
15	83.50	1.28	0.32	0.96	0.86
20	70.30	1.08	0.32	0.76	0.91
25	60.90	0.93	0.32	0.61	0.92
30	53.93	0.825	0.32	0.51	0.91
35	48.50	0.74	0.32	0.42	0.88

Therefore, the required storage volume is 0.92 m^3.

PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 6

FIVE (5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 3 STORAGE VOLUME

t_c **TIME** (minutes)	I **100-YEAR** (mm/hr)	Q **ACTUAL** (L/s)	Q **ALLOW** (L/s)	Q **STORED** (L/s)	**VOLUME STORED** (m^3)
5	141.20	1.50	0.32	1.18	0.35
10	104.20	1.11	0.32	0.79	0.47
15	83.50	0.89	0.32	0.57	0.51
20	70.30	0.75	0.32	0.43	0.52
25	60.90	0.65	0.32	0.33	0.50
30	53.93	0.57	0.32	0.25	0.45

Therefore, the required storage volume is 0.52 m^3.

PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 7

100-YEAR EVENT

REQUIRED BUILDING ROOF AREA 1 STORAGE VOLUME

t_c **TIME** (minutes)	I **100-YEAR** (mm/hr)	Q **ACTUAL** (L/s)	Q **ALLOW** (L/s)	Q **STORED** (L/s)	**VOLUME STORED** (m^3)
10	178.6	2.14	0.32	1.82	1.09
15	142.9	1.72	0.32	1.40	1.26
20	120.0	1.44	0.32	1.12	1.34
25	103.9	1.25	0.32	0.93	1.40
30	91.9	1.10	0.32	0.78	1.403
35	82.6	0.99	0.32	0.67	1.41
40	75.1	0.90	0.32	0.58	1.39
45	69.1	0.83	0.32	0.51	1.38

Therefore, the required storage volume is 1.41 m^3.

PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 8

100-YEAR EVENT

REQUIRED BUILDING ROOF AREA 2 STORAGE VOLUME

t_c **TIME** (minutes)	I **100-YEAR** (mm/hr)	Q **ACTUAL** (L/s)	Q **ALLOW** (L/s)	Q **STORED** (L/s)	**VOLUME STORED** (m^3)
10	178.6	3.04	0.32	2.72	1.63
15	142.9	2.43	0.32	2.11	1.90
20	120.0	2.04	0.32	1.72	2.06
25	103.9	1.77	0.32	1.45	2.18
30	91.9	1.56	0.32	1.24	2.23
35	82.6	1.40	0.32	1.08	2.27
40	75.1	1.28	0.32	0.96	2.304
45	69.1	1.175	0.32	0.85	2.309
50	63.9	1.09	0.32	0.77	2.31
55	59.6	1.01	0.32	0.69	2.28

Therefore, the required rooftop storage volume is 2.31 m^3.

PROPOSED 314 BELL STREET SOUTH RESIDENTIAL APARTMENT ADDITION
LOT DEVELOPMENT SITE

TABLE 9

100-YEAR EVENT

REQUIRED BUILDING ROOF AREA 3 STORAGE VOLUME

t_c **TIME** (minutes)	I **100-YEAR** (mm/hr)	Q **ACTUAL** (L/s)	Q **ALLOW** (L/s)	Q **STORED** (L/s)	**VOLUME STORED** (m^3)
10	178.6	1.89	0.32	1.57	0.94
15	142.9	1.52	0.32	1.20	1.08
20	120.0	1.27	0.32	0.95	1.14
25	103.9	1.10	0.32	0.78	1.17
30	91.9	0.97	0.32	0.65	1.17
35	82.6	0.88	0.32	0.56	1.18
40	75.1	0.80	0.32	0.48	1.15
45	69.1	0.73	0.32	0.41	1.11

Therefore, the required rooftop storage volume is 1.18 m^3.

PROPOSED

THREE-STOREY APARTMENT BUILDING ADDITION

LOT RE-DEVELOPEMENT SITE

PART OF LOT "D"

R-PLAN 82717

314 BELL STREET SOUTH

CITY OF OTTAWA

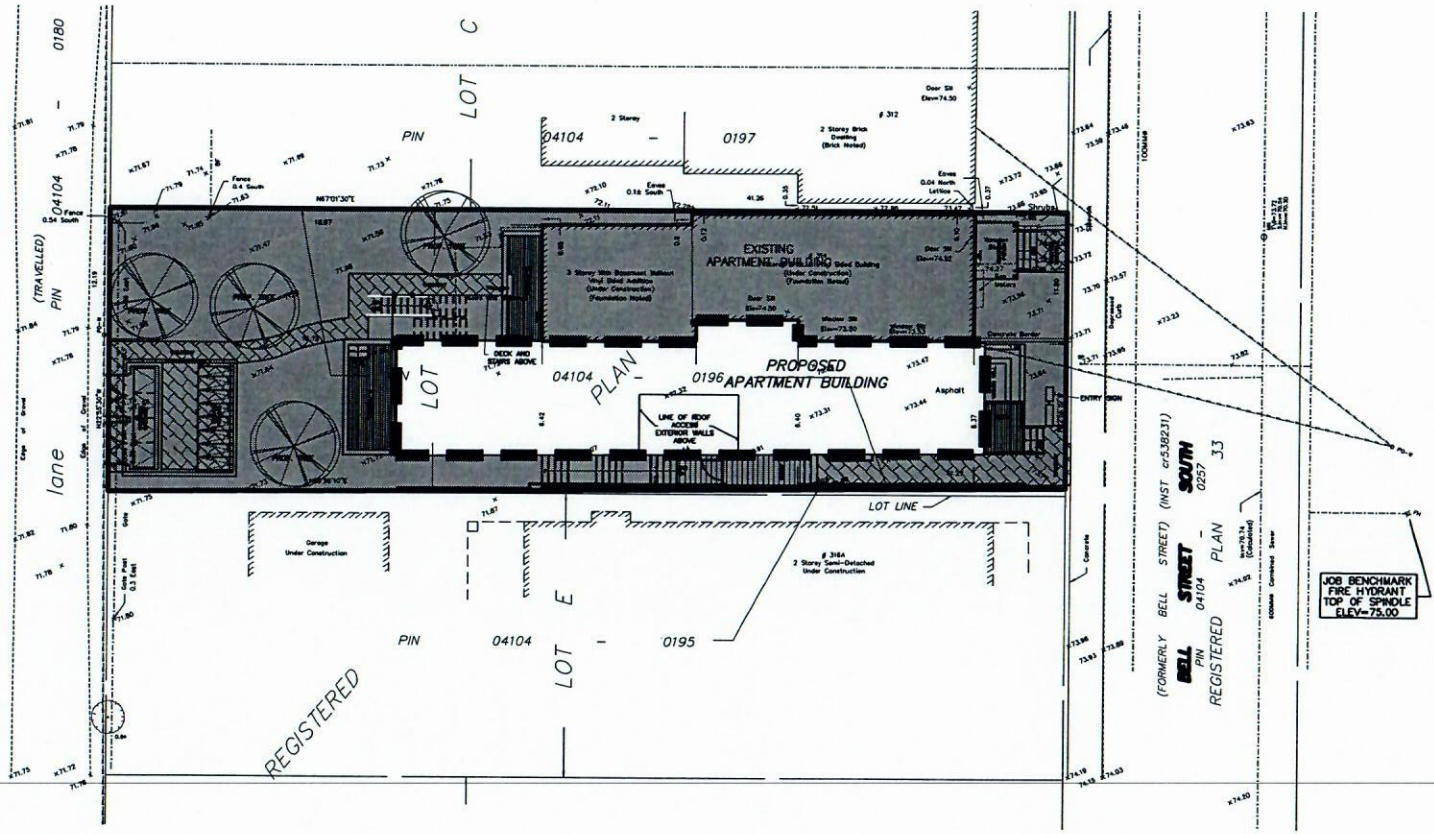
APPENDIX A

STORM DRAINAGE AREA PLAN

FIGURE 1

PROPOSED 314 BELL STREET
SITE DEVELOPMENT
DRAINAGE AREA PLAN

N.T.S.



LEGEND

LIMIT OF CONTROLLED STORM
DRAINAGE AREA = 140.85 SQ. M

UNCONTROLLED STORM
DRAINAGE AREA = 356.15 SQ. M

TOTAL AREA = 497.0 SQ. M

POST-DEVELOPMENT SITE
AVERAGE "C" = 0.66

T.L. MAK ENGINEERING CONSULTANTS LTD.
CONSULTING ENGINEERS

PROJECT No.	DATE	DRAWING No.
821-102	JANUARY 2022	FIGURE 1

PROPOSED

THREE-STOREY APARTMENT BUILDING ADDITION

LOT RE-DEVELOPEMENT SITE

PART OF LOT "D"

R-PLAN 82717

314 BELL STREET SOUTH

CITY OF OTTAWA

APPENDIX B

SITE PRE-DEVELOPMENT CONDITION

GOOGLE IMAGE (2020)

AND

AERIAL PHOTOGRAPHY 2019 (GEOOTTAWA)


294
296
306
310
312
314
PROPOSED
DEVELOPMENT SITE
316
(A)
316
(B)
311
313
317
318
332
334
327
rue Bell St S
rue Bell St. S

2019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(A)
316
(B)
318
332
334
rue Bell St. S.
PROPOSED
DEVELOPMENT SITE

2019

2020

PROPOSED

THREE-STOREY APARTMENT BUILDING ADDITION

LOT RE-DEVELOPEMENT SITE

PART OF LOT "D"

R-PLAN 82717

314 BELL STREET SOUTH

CITY OF OTTAWA

APPENDIX C

PROPOSED ROOF DRAIN DETAILS

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

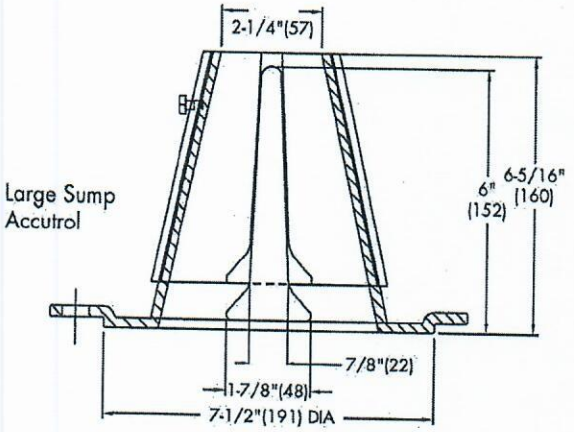
ADJUSTABLE ACCUTROL (for Large Sump Roof Drains only)

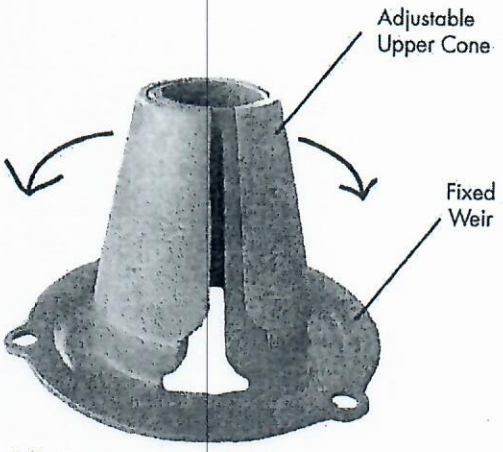
For more flexibility in controlling flow with heads deeper than 2", Watts Drainage offers the Adjustable Accutrol. The Adjustable Accutrol Weir is designed with a single parabolic opening that can be covered to restrict flow above 2" of head to less than 5 gpm per inch, up to 6" of head. To adjust the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

EXAMPLE:

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

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





1/2 Weir Opening Exposed Shown Above

TABLE 1. Adjustable Accutrol Flow Rate Settings

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

Job Name _____ Contractor _____

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

Engineer _____ Representative _____

USA: Tel: (800) 338-2581 • Fax: (828) 248-3929 • Watts.com
Canada: Tel: (905) 332-4090 • Fax: (905) 332-7068 • Watts.ca
Latin America: Tel: (52) 81-1001-8600 • Fax: (52) 81-8000-7091 • Watts.com

WATTS®
A Watts Water Technologies Company

ES-WD-RD-ACCUTROLADJ-CAN 1615

PROPOSED

THREE-STOREY APARTMENT BUILDING ADDITION

LOT RE-DEVELOPEMENT SITE

PART OF LOT "D"

R-PLAN 82717

314 BELL STREET SOUTH

CITY OF OTTAWA

APPENDIX D

DETAILED CALCULATIONS

FOR TWO (2)-YEAR, FIVE (5)-YEAR AND 100-YEAR

AVAILABLE STORAGE VOLUME

AVAILABLE STORAGE VOLUME CALCULATIONS

Two (2)-Year Event

Roof Storage at Flat Roof Building

The flat Roof Area 1, Roof Area 2, and Roof Area 3 will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 5.0 U.S. gal./min. or 0.32 L/s. Refer to Dwg. 821-102 SWM-1 for roof drain details.

Roof Storage Area 1 (NODE No. 1)

Available flat roof area for storage = 42.50 m^2, C = 0.9, @ roof slope of 3.0% minimum or 100mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.10\text{m})[18.52 + 4(4.80) + 0]}{6}$$

$$V = \frac{(0.10)(37.72)}{6}$$

$$V = 0.63\ m^3$$

The available Roof Area 1 storage volume of 0.63 m^3 > required two (2)-year storage volume of 0.32 m^3 from Table 1.

Roof Storage Area 2 (NODE No. 2)

Available flat roof area for storage = 49.63 m^2, C = 0.9, @ roof slope of 2.0% minimum or 100mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.10\text{m})[17.93 + 4(6.21) + 0]}{6}$$

$$V = \frac{(0.10)(42.77)}{6}$$

$$V = 0.71\ m^3$$

The available Roof Area 2 storage volume of 0.71 m^3 > required two (2)-year storage volume of 0.59 m^3 from Table 2.

Roof Storage Area 3 (NODE No. 3)

Available flat roof area for storage = 37.78 m^2, C = 0.9, @ roof slope of 3.5% minimum or 100mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.10\text{m})[17.27 + 4(4.60) + 0]}{6}$$

$$V = \frac{(0.10)(35.67)}{6}$$

$$V = 0.60\ m^3$$

The available Roof Area 3 storage volume of 0.60 m^3 > required two (2)-year storage volume of 0.26 m^3 from Table 3.

Therefore, the ponding depth at the Roof Drain 1, 2, and 3 locations is approximately 0.10m (100mm) and the two (2)-year level is estimated not to reach the roof perimeter of the building.

Hence, Roof Area 1, Roof Area 2 and Roof Area 3 of the proposed residential building flat rooftop storage are adequate to store the minimum required two (2)-year storm event volume of 1.17 m^3 given it can store up to 1.94 m^3.

AVAILABLE STORAGE VOLUME CALCULATIONS

Five (5)-Year Event

Roof Storage at Flat Roof Building

The flat Roof Area 1, Roof Area 2, and Roof Area 3 will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 5.0 U.S. gal./min. or 0.32 L/s. Refer to Dwg. 821-102 SWM-1 for roof drain details.

Roof Storage Area 1 (NODE No. 1)

Available flat roof area for storage = 42.50 m^2, C = 0.9, @ roof slope of 3.0% minimum or 120mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.12\text{m})[26.10 + 4(6.15) + 0]}{6}$$

$$V = \frac{(0.12)(50.70)}{6}$$

$$V = 1.01\ m^3$$

The available Roof Area 1 storage volume of 1.01 m^3 > required five (5)-year storage volume of 0.53 m^3 from Table 4.

Roof Storage Area 2 (NODE No.2)

Available flat roof area for storage = 49.63 m^2, C = 0.9, @ roof slope of 2.0% minimum or 120mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.12\text{m})[29.38 + 4(8.03) + 0]}{6}$$

$$V = \frac{(0.12)(61.5)}{6}$$

$$V = 1.23\ m^3$$

The available Roof Area 2 storage volume of 1.23 m^3 > required five (5)-year storage volume of 0.92 m^3 from Table 5.

Roof Storage Area 3 (NODE No.3)

Available flat roof area for storage = 37.78 m^2, C = 0.9, @ roof slope of 3.5% minimum or 120mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.12\text{m})[23.47 + 4(5.98) + 0]}{6}$$

$$V = \frac{(0.12)(47.39)}{6}$$

$$V = 0.95\ m^3$$

The available Roof Area 2 storage volume of 0.95 m^3 > required five (5)-year storage volume of 0.52 m^3 from Table 6.

Therefore, the ponding depth at the Roof Drain 1, 2, and 3 locations is approximately 0.12m (120mm), and the five (5)-year level is estimated not to reach the roof perimeter of the building.

Hence, Roof Area 1, Roof Area 2 and Roof Area 3 of the proposed residential building flat rooftop storage are adequate to store the minimum required five (5)-year storm event volume of 1.97 m^3 given it can store up to 3.19 m^3.

AVAILABLE STORAGE VOLUME CALCULATIONS

100-Year Event

Roof Storage at Flat Roof Building

The flat Roof Area 1, Roof Area 2, and Roof Area 3 will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 5.0 U.S. gal./min. or 0.32 L/s. Refer to Dwg. 821-102 SWM-1 for roof drain details.

Roof Storage Area 1 (NODE No. 1)

Available flat roof area for storage = 42.50 m^2, C = 1.0, @ roof slope of 3.0% minimum or 150mm of fall from roof perimeter to roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.15\text{m})[42.50 + 4(10.23) + 0]}{6}$$

$$V = \frac{(0.15)(83.42)}{6}$$

$$V = 2.09\ m^3$$

The available Roof Area 1 storage volume of 2.09 m^3 > required 100-year storage volume of 1.41 m^3 from Table 7.

Roof Storage Area 2 (NODE No. 2)

Available flat roof area for storage = 49.63 m^2, C = 1.0, @ roof slope of 2.0% minimum or 150mm of fall from roof perimeter to roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.15\text{m})[49.63 + 4(11.29) + 0]}{6}$$

$$V = \frac{(0.15)(94.79)}{6}$$

$$V = 2.37\ m^3$$

The available Roof Area 2 storage volume of 2.37 m^3 > required 100-year storage volume of 2.31 m^3 from Table 8.

Roof Storage Area 3 (NODE No. 3)

Available flat roof area for storage = 37.78 m^2, C = 1.0, @ roof slope of 3.5% minimum or 150mm of fall from roof perimeter to roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.15\text{m})[37.78 + 4(9.55) + 0]}{6}$$

$$V = \frac{(0.15)(75.98)}{6}$$

$$V = 1.90\ m^3$$

The available Roof Area 2 storage volume of 1.90 m^3 > required 100-year storage volume of 1.18 m^3 from Table 8.

Therefore, the ponding depth at the Roof Drain 1, 2, and 3 location is approximately 0.15m (150mm), and at the perimeter of the flat roof area is 0mm above the roof perimeter surface. Accordingly, it is recommended that six (6) roof scuppers as shown on Dwg. 821-102 G-1 and 821-102 SWM-1 and the architect's roof plan be installed at the perimeter height of the rooftop for emergency overflow purposes in case of blockage from debris build up at the roof drain.

Hence, Roof Area 1, Roof Area 2 and Roof Area 3 of the proposed residential building flat rooftop storage are adequate to store the minimum required 100-year storm event volume of 4.90 m^3 given it can store up to 6.36 m^3.