PROPOSED

THREE-STOREY RESIDENTIAL BUILDING SITE

LOT 3 (NORTH HARVEY STREET)

R-PLAN 48

77-81 HARVEY STREET

CITY OF OTTAWA

STORM DRAINAGE REPORT

REPORT R-819-74

T.L. MAK ENGINEERING CONSULTANTS LTD.

JANUARY 2020

REFERENCE FILE NUMBER 819-74

Introduction

The proposed three (3)-storey residential building site is located on the north side of Harvey Street, and situated east of Main Street and west of Concord North Street. Its legal property description is Lot 3 (North Harvey Street) Registered Plan 48 City of Ottawa. At this time, the residential site under consideration houses a 2 ½ - storey brick and vinyl sided dwelling and a 2 ½ - storey stone and vinyl sided dwelling. The municipal address of the properties are 77-81 Harvey Street.

The lot area under consideration is approximately 614.03 square metres. This property is proposed for the development of a three (3)-storey residential apartment building plus a basement. The total gross floor area of the proposed building is approximately 12,924.0 square feet (1,200.00 square metres) including basement level.

The building will house a total of eight (8) units of four (4)-bedroom apartments. The storm-water outlet for this site is the existing 450mm diameter storm sewer located within the Harvey Street 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 five (5)-year pre-development conditions. The allowable pre-development runoff coefficient is the lesser of the calculated "C" existing value = 0.69 or C_{allow}=0.4 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=0.72, which exceeds the calculated pre-development allowable C=0.4 criteria for the Harvey Street storm 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. 819-74 D-1 for details.

This report will address and detail the grading, drainage, and storm-water management control measures required to develop this property. Based on the Proposed Site Grading and Servicing Plan (Dwg. No. 819-74 G-1), and on the Proposed Rooftop Storm-water Management Plan (Dwg. No. 819-74 SWM-1), the storm water of this lot will be controlled on site only by the building'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 sewershed as identified by the City of Ottawa, therefore, the approval exemption under Ontario Regulations 525/98 would not apply since storm water discharges from this site will outlet flow into a downstream combined collector sewer and not a storm sewer. Thus, an Environmental Compliance Application (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	=	614.03m^2
Roof Surface Area	=	311.22m^2
Concrete Area	=	25.10m^2
Interlock Paver and Clearstone Area	=	115.01m^2
Grass Area	=	162.70m^2

$$C = \frac{(311.22 \times 0.9) + (115.01 \times 0.9) + (25.10 \times 0.9) + (162.70 \times 0.2)}{614.03}$$

$$C = \frac{438.74}{614.03}$$

$$C = 0.715$$

Say "C" $= 0.72$

Therefore, the average post-development "C" for this site is 0.72.

2. Controlled Area Data

Roof Surface Area	=	311.22m^2
Total Storm-water Controlled Area	=	311.22m^2

$$C = \frac{(311.22 \times 0.9)}{311.22}$$

$$C = \frac{280.098}{311.22}$$

$$C = 0.9$$

Say "C" $= 0.9$

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

3. Uncontrolled Area Data

i. PROPOSED SITE

Concrete Area	=	$25.1m^2$
Grass Area	=	$162.70m^2$
Interlock Paver and Clearstone Area	=	$115.01m^2$
Total Storm-water Uncontrolled Area	=	$302.81m^2$

$$C = \frac{(115.01 \times 0.9) + (162.70 \times 0.2) + (25.10 \times 0.9)}{302.81}$$

$$C = \frac{158.639}{302.81}$$

$$C = 0.524$$

Say "C" $= 0.52$

Therefore, the average post-development "C" for the uncontrolled storm-water drainage area of $302.81m^2$ from this site is 0.52.

The total tributary area consisting of approximately 302.81 square metres will be out-letting off site uncontrolled from the residential apartment building site.

ii. SURFACE AREA DRAINING TO FRONT OF LOT (NODE #3)

Grass Area	=	$48.56m^2$
Interlock Paver and Clearstone Area	=	$34.99m^2$
Total Area	=	$83.55m^2$

$$C_5 = \frac{(48.56 \times 0.2) + (34.99 \times 0.9)}{83.55}$$

$$C_5 = \frac{41.203}{83.55}$$

$$C_5 = 0.493$$

Say "C_5" $= 0.49$ (Node #3)

$$C_{100} = \frac{(48.56 \times 0.2 \times 1.25) + (34.99 \times 1.0)}{83.55}$$

$$= \frac{47.13}{83.55}$$
$$= 0.564$$

Therefore, $C_{100} = 0.56$ for (Node #3)

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

Concrete Area	=	25.10m^2
Grass Area	=	114.14m^2
Interlock Paver and Clearstone Area	=	80.02m^2
Total Area	=	219.26m^2

$$C_5 = \frac{(114.14 \times 0.2) + (25.10 \times 0.9) + (80.02 \times 0.9)}{219.26}$$

$$C_5 = \frac{117.436}{219.26}$$

$$C_5 = 0.536$$

Say "C_5" $= 0.54$ (Node #4)

$$C_{100} = \frac{(114.14 \times 0.2 \times 1.25) + (25.10 \times 1.0) + (80.02 \times 1.0)}{219.26}$$

$$= \frac{133.655}{219.26}$$

$$= 0.6095$$

Therefore, $C_{100} = 0.61$ for (Node #4)

The uncontrolled drainage area draining to the rear of the lot is 219.26m^2 and the uncontrolled drainage area draining to the front of the lot is 83.55m^2 which totals to 302.81m^2.

The SWM area to be controlled is 311.22m^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: five (5)-year storm

Pre-Development Site Area Characteristics		
Development Lot Area	=	614.03m^2
Asphalt Area	=	163.70m^2
Concrete and Interlock Area	=	61.05m^2
Roof Area	=	198.65m^2
Grass Area	=	190.63m^2

$$C = \frac{(198.65 \times 0.9) + (61.05 \times 0.9) + (163.70 \times 0.9) + (190.63 \times 0.2)}{614.03}$$

$$C = \frac{419.186}{614.03}$$

$$C = 0.683$$

Say $C = 0.69$

Use C_{pre} = 0.4 maximum allowable for redevelopment

T_c = D/V where D = 34.0m, ΔH = 0.46m, S = 1.35%, and V = 2.7 feet/second = 0.82 m/s
Therefore,

$T_c = \frac{34.0m}{0.82m/s}$

T_c = 0.70 minutes
Use T_c = 10 minutes
I_5 = 104.2 mm/hr [City of Ottawa, five (5)-year storm]

Using the Rational Method

Q = 2.78 (0.4) (104.2) (0.0614)

Q = 7.12 L/s

Therefore, the total allowable flow off-site is 7.12 L/s.

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

Where, Tc = 10 min.

Node #101

Pre-Development Area Draining to the **front**

Roof Area	=	143.19m^2
Concrete Area	=	25.94m^2
Interlock Area	=	1.87m^2
Asphalt Area	=	74.95m^2
Grass Area	=	26.28m^2

A_{Total} = 272.23m^2

$$C_{5pre} = \frac{(143.19 \times 0.9) + (25.94 \times 0.9) + (1.87 \times 0.9) + (74.95 \times 0.9) + (26.28 \times 0.2)}{272.23}$$

$C_{5pre} = \frac{226.611}{272.23}$

$C_{5pre} = 0.832$

Say, $C_{5pre} = 0.83$ draining to the front of lot

$Q_{5pre} = 2.78\ (0.83)\ (104.2)\ (0.0272)$

$= 6.54\ L/s$

$$C_{100pre} = \frac{(143.19 \times 1.0)+(25.94 \times 1.0)+(1.87 \times 1.0)+(74.95 \times 1.0)+(26.28 \times 0.2 \times 1.25)}{272.23}$$

$C_{100pre} = \frac{252.52}{272.23}$

$C_{100pre} = 0.927$

Say, $C_{100pre} = 0.93$ draining to the front of lot

$Q_{100pre} = 2.78\ (0.93)\ (178.6)\ (0.0272)$

$= 12.56\ L/s$

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

Where, Tc = 10 min.

Node #102

Pre-Development Area Draining to the **rear**

Roof Area	=	$55.3m^2$
Concrete Area	=	$14.32m^2$
Interlock Area	=	$9.48m^2$
Asphalt Area	=	$90.5m^2$
Grass Area	=	$172.2m^2$

$A_{Total} = 341.80m^2$

$$C_{5pre} = \frac{(55.3 \times 0.9) + (14.32 \times 0.9) + (9.48 \times 0.9) + (90.50 \times 0.9) + (172.2 \times 0.2)}{341.80}$$

$$C_{5pre} = \frac{187.08}{341.80}$$

$C_{5pre} = 0.547$

Say, $C_{5pre} = 0.55$ draining to the rear of lot

$Q_{5pre} = 2.78\ (0.55)\ (104.2)\ (0.0342)$

$= 5.45\ L/s$

$$C_{100pre} = \frac{(55.3 \times 1.0)+(14.32 \times 1.0)+(9.48 \times 1.0)+(90.5 \times 1.0)+(172.2 \times 0.2 \times 1.25)}{272.23}$$

$$C_{100pre} = \frac{212.65}{272.23}$$

$C_{100pre} = 0.622$

Say, $C_{100pre} = 0.62$ draining to the front of lot

$Q_{100pre} = 2.78\ (0.62)\ (178.6)\ (0.0342)$

$= 10.53\ L/s$

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 five (5)-year and 100-year storm event draining to the **front** of the lot is as follows:

Where, Tc = 10 min.

Node #3

Post Development Area Draining to the **front**

Interlock Area	=	$34.99m^2$
Grass Area	=	$48.56m^2$

$A_{Total} = 83.55\ m^2$

$$C_{5post} = \frac{(34.99 \times 0.9) + (48.56 \times 0.2)}{83.55}$$

$$C_{5post} = \frac{41.203}{83.55}$$

$C_{5post} = 0.493$

Say, $C_{5post} = 0.49$ draining to the front of lot

$Q_{5post} = 2.78\ (0.49)\ (104.2)\ (0.0084)$

$= 1.19\ L/s$

$$C_{100post} = \frac{(34.99 \times 1.0) + (48.56 \times 0.2 \times 1.25)}{83.55}$$

$$C_{100post} = \frac{47.13}{83.55}$$

$C_{100post} = 0.564$

Say, $C_{100post} = 0.57$ draining to the front of lot

$Q_{100post} = 2.78\ (0.57)\ (178.6)\ (0.0084)$

$= 2.38\ L/s$

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

Where, Tc = 10 min.

Node #4

Post-Development Area Draining to the **rear**

Concrete Area	=	$25.10m^2$
Interlock Area	=	$80.02m^2$
Grass Area	=	$114.14m^2$

$A_{Total} = 219.26m^2$

$$C_{5post} = \frac{(80.02 \times 0.9) + (25.10 \times 0.9) + (114.14 \times 0.2)}{219.26}$$

$$C_{5post} = \frac{117.436}{219.26}$$

$C_{5post} = 0.536$

Say, C_{5post}= 0.54 draining to the rear of lot

Q_{5post}= 2.78 (0.53) (104.2) (0.0219)

= 3.36 L/s

$$C_{100post} = \frac{(80.02 \times 1.0) + (25.10 \times 1.0) + (114.14 \times 0.2 \times 1.25)}{219.26}$$

$$C_{100post} = \frac{133.655}{219.26}$$

$C_{100post}$= 0.6096

Say, $C_{100post}$= 0.61 draining to the rear of lot

$Q_{100post}$= 2.78 (0.61) (178.6) (0.0219)

= 6.63 L/s

For this site, because 302.81 square meters of the site area are drained uncontrolled off site, the net allowable discharge for this site into the existing sewer system using the five (5)-year storm event criteria at C = 0.4 (max) is calculated as follow: Q={2.78 (0.4) (104.2) (0.0614)-[2.78 (0.52) (178.6) (0.0303)]} = 7.11 L/s – 7.82 L/s = -0.71 L/s. Therefore, according to this approach, the maximum allowable flow rate off site is 7.11L/s and the new allowable controlled flow rate off-site is -0.71 L/s. Discussions held with City, it was agreed that controlling flow to a net rate of -0.71 L/s is not practical.

Storm-Water Management Analysis

Based on the above calculations and information presented, a practical SWM approach is proposed for this site in order to regulate and control storm water off-site. The total maximum allowable flow off-site is 7.11 L/s. The uncontrollable 100-year post-development flow draining to the front of lot is 2.38 L/s. The net allowable flow will be calculated based on total allowable flow subtracting the uncontrolled 100-year post development flow draining to the front. From our analysis, post-development flow to rear of lot is improved by the proposed site development as $Q_{100post}$=6.63 L/s is less than Q_{100pre}= 10.53 L/s. Therefore, accounting for the 100-year uncontrolled post-development flow draining to the front rather the entire site is proposed to the city.

Thus, the net allowable discharge for this site into the existing 450mm dia. storm sewer is calculated as: Q=2.78(0.4) (104.2) (0.0614) - 2.78(0.57) (178.6) (0.0084) = 7.11 L/s – 2.38 L/s = 4.73 L/s.

Therefore, the maximum allowable flow rate off-site is 7.11 L/s and the net allowable controlled flow rate off-site is 4.73 L/s.

At this site, a controlled flow rate of 1.89 L/s for on-site storm water management detention volume storage calculation will be used for this SWM analysis. This is accomplished by proposing two (2) controlled roof drains to restrict flow from the building at a rate of 2 x 0.946 L/s = 1.89 L/s into the Harvey Street storm sewer which does not exceed the calculated new allowable flow of 4.73 L/s. Controlled roof drain details are found on Dwg. No. 819-74 SWM-1 entitled Proposed Rooftop Stormwater Management Plan.

For this proposed site, the total maximum allowable five (5)-year release rate of 7.11 L/s will not be exceeded since the control flow of 4.27 L/s (1.89 L/s + 2.38 L/s) is expected to enter into the existing 450mm dia. Harvey Street storm sewer for storm events up to and including 100-year. In order to control runoff that is greater than the allowable release rate, stormwater will therefore be stored on site at the flat rooftop of the proposed apartment building which will be used for stormwater detention purposes.

The post-development inflow rate during the five(5)-year and 100-year storms for the (2) two 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 two (2) roof drains to control flow off-site for this development property. The roof drain flow rate proposed is each at 0.946 L/s (15.0 US gal./min.). The specified roof drain is the Watts "Adjustable Accutrol Weir" (Model # RD-100-A-ADJ) with weir opening in the ¼ exposed position which will allow a flow of 0.946 L/s under a head of 150mm 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 0.946 L/s x 2 = 1.89 L/s < 4.73 L/s, which is the net allowable. Refer to the Proposed Rooftop Stormwater Management Plan Dwg. 819-74 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

<u>For Roof Area 1, Q_{A1}=2.78 CIA</u>

Five(5)-Year Event
C_5 = 0.90
A = 155.61m^2
I = mm/hr

Q_1 = 2.78 (0.90) (0.0156 ha.) I = 0.039 I

100-Year Event
$C_{100} = 1.0$
$A = 155.61\ m^2$
I = mm/hr

$Q_1 = 2.78\ (1.0)(0.0156\ ha.)\ I = 0.0434\ I$

For Roof Area 2, Q=2.78 CIA

Five (5)-Year Event
$C_5 = 0.90$
$A = 155.61\ m^2$
I = mm/hr

$Q_2 = 2.78\ (0.90)(0.0156\ ha.)\ I = 0.039\ I$

100-Year Event
$C_{100} = 1.0$
$A = 97.69 m^2$
I = mm/hr

$Q_2 = 2.78\ (1.0)(0.0156\ ha.)\ I = 0.0434\ I$

The summary results of the calculated inflow and the storage volume of the site and building's flat rooftop to store the five (5)-year and 100-year storm events are shown in **Tables 1 to 4** inclusive.

Table 5 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 five (5)-year, and 100-year design events.

Table 5: 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)
			5 YR	100 YR	5 YR	100 YR	5 YR	100 YR	
RD-1 (0.0156 ha)	1	RD-100-A-ADJ (1/4 OPENING EXPOSED)	0.79	0.946	0.102	0.15	2.39	5.56	7.80
RD-2 (0.0156 ha)	1	RD-100-A-ADJ (1/4 OPENING EXPOSED)	0.79	0.946	0.102	0.15	2.39	5.56	7.80
Total Roof (0.0312 ha)	2	-	**1.58**	**1.89**	-	-	**4.78**	**11.12**	**15.60**

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 Harvey 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. #819-74 ESC-1 for details.

Conclusion

For development of this residential site (±0.0614 ha.) and in controlling the five (5)-year storm water release rate to a flow rate of 1.89 L/s, a site storage volume of approximately 4.78m^3 minimum is required during the five (5)-year event. For this site, two(2) flat rooftop storage areas will be used for stormwater management attenuation.

During the five (5)-year storm event for the flat rooftop storage, the ponding depth of rooftop area 1 and 2 is estimated at 102mm at the drain and 0mm at the roof perimeter, assuming a 1.6% minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is 2.39m^3 and the rooftop storage available at Roof Area 2 is 2.39m^3, for a total of 4.78m^3, which is equal to the required volume of 4.78m^3.

To control the 100-year storm-water release rate off site to a flow rate of 1.89 L/s, a site storage volume of approximately 11.12m^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 and 2 is estimated at 150mm at the drain and 0mm at the roof perimeter, assuming a 1.6% minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is 7.80m^3 and the rooftop storage available at Roof Area 2 is 7.80m^3, for a total of 15.60m^3, which is greater than the required volume of 11.12m^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. 81-74 G-1 and 819-74 SWM-1 respectively, the desirable five(5)-year storm and 100-year storm event detention volume of 4.78m^3 and 15.60m^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 125mm PVC storm lateral, where upon both laterals are connected directly to the existing Harvey Street 450mm diameter storm sewer. Refer to the proposed grading and servicing plan Dwg. 819-74 G-1 for details.

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PROPOSED 77-81 HARVEY STREET RESIDENTIAL DEVELOPMENT SITE

TABLE 1

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	5.51	0.79	4.72	1.42
10	104.20	4.06	0.79	3.27	1.96
15	83.50	3.26	0.79	2.47	2.22
20	70.30	2.74	0.79	1.95	2.34
25	60.90	2.38	0.79	1.59	2.385
30	53.93	2.10	0.79	1.31	2.358
35	48.50	1.89	0.79	1.10	2.31
40	44.20	1.72	0.79	0.93	2.23

Therefore, the required rooftop storage volume is 2.39m^3.

TABLE 2

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	5.51	0.79	4.72	1.42
10	104.20	4.06	0.79	3.27	1.96
15	83.50	3.26	0.79	2.47	2.22
20	70.30	2.74	0.79	1.95	2.34
25	60.90	2.38	0.79	1.59	2.385
30	53.93	2.10	0.79	1.31	2.358
35	48.50	1.89	0.79	1.10	2.31
40	44.20	1.72	0.79	0.93	2.23

Therefore, the required storage volume is 2.39m^3.

TABLE 3

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	7.75	0.946	6.80	4.08
15	142.9	6.20	0.946	5.25	4.73
20	120.0	5.21	0.946	4.26	5.11
25	103.9	4.51	0.946	3.56	5.34
30	91.9	3.99	0.946	3.04	5.48
35	82.6	3.59	0.946	2.64	5.55
40	75.1	3.26	0.946	2.314	5.56
45	69.1	3.00	0.946	2.054	5.55
50	63.9	2.77	0.946	1.83	5.49
55	59.6	2.59	0.946	1.644	5.43

Therefore, the required storage volume is 5.56m^3.

TABLE 4

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	7.75	0.946	6.80	4.08
15	142.9	6.20	0.946	5.25	4.73
20	120.0	5.21	0.946	4.26	5.11
25	103.9	4.51	0.946	3.56	5.34
30	91.9	3.99	0.946	3.04	5.48
35	82.6	3.59	0.946	2.64	5.55
40	75.1	3.26	0.946	2.314	5.56
45	69.1	3.00	0.946	2.054	5.55
50	63.9	2.77	0.946	1.83	5.49
55	59.6	2.59	0.946	1.644	5.43

Therefore, the required rooftop storage volume is 5.56m^3.

PROPOSED THREE (3)-STOREY RESIDENTIAL BUILDING SITE

LOT 3 (NORTH HARVEY STREET)

R-PLAN 48

77-81 HARVEY STREET

CITY OF OTTAWA

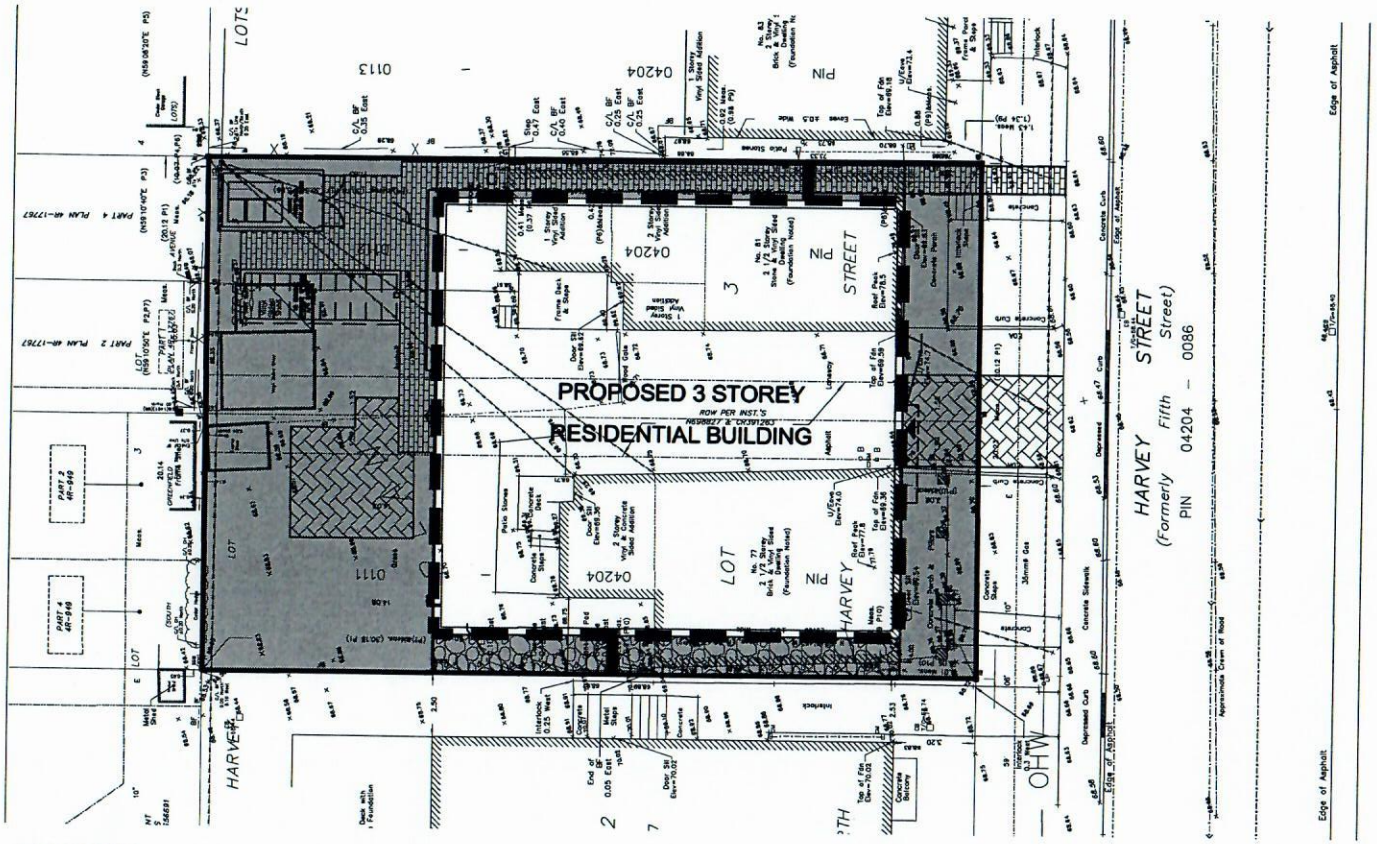
APPENDIX A

STORM DRAINAGE AREA PLAN

FIGURE 1

PROPOSED 77-81 HARVEY STREET
SITE DEVELOPMENT
DRAINAGE AREA PLAN

N.T.S.



LEGEND

- LIMIT OF CONTROLLED STORM DRAINAGE AREA = 311.22 SQ. M
- UNCONTROLLED STORM DRAINAGE AREA = 302.81 SQ. M

TOTAL AREA = 614.03 SQ. M

POST-DEVELOPMENT SITE AVERAGE "C" = 0.72

T.L. MAK ENGINEERING CONSULTANTS LTD.
CONSULTING ENGINEERS

PROJECT No.	DATE	DRAWING No.
819-74	OCTOBER 2019	FIGURE 1

PROPOSED THREE (3)-STOREY RESIDENTIAL BUILDING SITE

LOT 3 (NORTH HARVEY STREET)

R-PLAN 48

77-81 HARVEY STREET

CITY OF OTTAWA

APPENDIX B

SITE PRE-DEVELOPMENT CONDITION

GOOGLE IMAGE

AND

AERIAL PHOTOGRAPHY 2017 (GEOOTTAWA)


38
(E)
32
34
166
168
170
172
176
97
95
87
93
85
83
81
77
73
65
61
43


PROPOSED SITE
32
34
166
168
170
172
176
97
87
95
93
85
83
81
77
73
65
61
rue Harvey St
rue Harvey St
aut/Hwy. 417

PROPOSED THREE (3)-STOREY RESIDENTIAL BUILDING SITE

LOT 3 (NORTH HARVEY STREET)

R-PLAN 48

77-81 HARVEY STREET

CITY OF OTTAWA

APPENDIX C

PROPOSED ROOF DRAIN

DETAILS

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

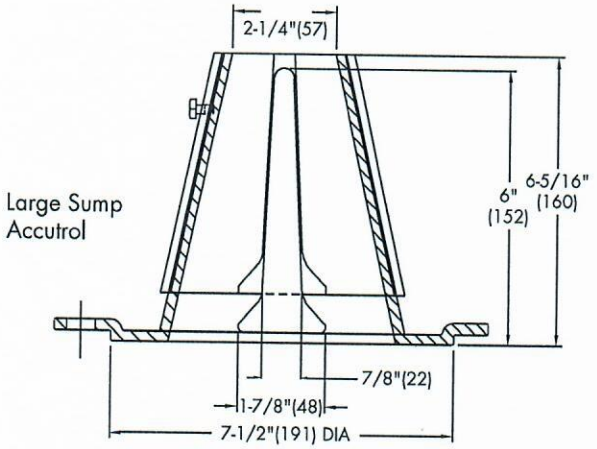
ADJUSTABLE ACCUTROL (for Large Sump Roof Drains only)

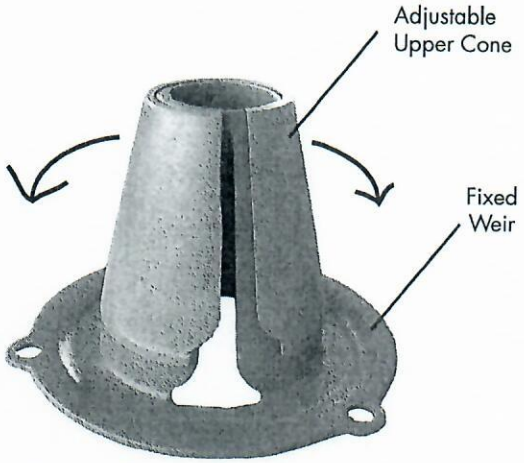
For more flexibility in controlling flow with heads deeper than 2", Watts Drainage offers the Adjustable Accutrol. The Adjustable Accutrol Weir is designed with a single parabolic opening that can be covered to restrict flow above 2" of head to less than 5 gpm per inch, up to 6" of head. To adjust the 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

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A Watts Water Technologies Company

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PROPOSED THREE (3)-STOREY RESIDENTIAL BUILDING SITE

LOT 3 (NORTH HARVEY STREET)

R-PLAN 48

77-81 HARVEY STREET

CITY OF OTTAWA

APPENDIX D

DETAILED CALCULATIONS

FOR FIVE (5)-YEAR AND 100-YEAR

AVAILABLE STORAGE VOLUME

AVAILABLE STORAGE VOLUME CALCULATIONS

Five (5)-Year Event

Roof Storage at Flat Roof Building

The flat Roof Area 1 and Roof Area 2 will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 15.0 U.S. gal./min. or 0.946L/s. Refer to Dwg. 819-74 SWM-1 for roof drain details.

Roof Storage Area 1 (NODE No. 1)

Available flat roof area for storage = 155.61m^2, C = 0.9, @roof slope of 1.6% minimum or 102mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.102\text{m})[69.58 + 4(17.69) + 0]}{6}$$

$$V = \frac{(0.102)(140.34)}{6}$$

$$V = 2.39\text{m}^3$$

The available Roof Area 1 storage volume of 2.39m^3 = required five (5)-year storage volume of 2.39m^3 from Table 1.

Roof Storage Area 2 (NODE No.2)

Available flat roof area for storage = 155.61m^2, C = 0.9, @roof slope of 1.6% minimum or 102mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.102\text{m})[69.58 + 4(17.69) + 0]}{6}$$

$$V = \frac{(0.102)(140.34)}{6}$$

$$V = 2.39\text{m}^3$$

The available Roof Area 2 storage volume of 2.39 m^3 = required five (5)-year storage volume of 2.39m^3 from Table 2.

Therefore, the ponding depth at the Roof Drain 1 and 2 locations is approximately 0.102m (102mm), and the five (5)-year level is estimated not to reach the roof perimeter of the building.

Hence, Roof Area 1 and Roof Area 2 of the proposed residential building flat rooftop storage are adequate to store the minimum required five (5)-year storm event volume of 4.78m^3 given it can store up to 4.78m^3.

AVAILABLE STORAGE VOLUME CALCULATIONS

100-Year Event

Roof Storage at Flat Roof Building

The flat Roof Area 1 to Roof Area 2 will be used for storm-water detention. Each roof area will be drained by a controlled drain designed for a release rate of 15.0 U.S. gal./min. or 0.946L/s. refer to Dwg. 819-74 SWM-1 for roof drain details.

Roof Storage Area 1 (NODE No. 1)

Available flat roof area for storage =155.61m^2, C = 1.0, @roof slope of 1.6% 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.

$$V = \frac{(0.15\text{m})[155.61 + 4(39.13) + 0]}{6}$$

$$V = \frac{(0.15)(312.13)}{6}$$

$$V = 7.80\text{m}^3$$

The available Roof Area 1 storage volume of 7.80m^3 > required 100-year storage volume of 5.56m^3 from Table 3.

Roof Storage Area 2 (NODE No. 2)

Available flat roof area for storage = 155.61m^2, C = 1.0, @roof slope of 1.6% 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.

$$V = \frac{(0.15\text{m})[155.61 + 4(39.13) + 0]}{6}$$

$$V = \frac{(0.15)(312.13)}{6}$$

$$V = 7.80\text{m}^3$$

The available Roof Area 2 storage volume of 7.80m^3 > required 100-year storage volume of 5.56m^3 from Table 4.

Therefore, the ponding depth at the Roof Drain 1 and 2 locations 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 four (4) roof scuppers as shown on Dwg. 819-74 G-1 and 819-74 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 and Roof Area 2 of the proposed residential building flat rooftop storage are adequate to store the minimum required 100-year storm event volume of 11.12m^3 given it can store up to 15.60m^3.