PROPOSED FIVE-STOREY MIXED-USE BUILDING

DEVELOPMENT SITE

LOT 2

R-PLAN M-62

667 BANK STREET

CITY OF OTTAWA

STORM DRAINAGE REPORT

REPORT R-816-41 (REV. 1)

AUGUST 2016

T.L. MAK ENGINEERING CONSULTANTS LTD.

JULY 2016

REFERENCE FILE NUMBER 816-41

Introduction

The proposed residential/commercial development site is located on the east side of Bank Street at the northeast corner of Bank Street and Clemow Avenue. Its legal property description is Lot 2 (R-Plan M-62). The municipal address of the site is 667 Bank Street.

At this time, the land is vacant. The site is entirely gravel-surfaced and used as a vehicle parking lot. Access to the lot occurs from Clemow Avenue at the southeast corner of the lot. The developer is proposing to re-develop this ±450.21m^2 parcel of land into a five-storey mixed-use building site with a one-level P1 underground parking garage.

The ground floor will be dedicated to commercial use (2386m^2), and floors 2, 3, 4, and 5 will be residential units (12 apartments and two bachelors totalling approximately 8865m^2).

The storm-water outlets available for this re-development property under consideration are a 225mm diameter combined sewer along Clemow Avenue and an 825mm x 1200mm combined sewer along Bank Street.

For this building, only the roof drains are proposed to outlet into the existing Clemow Avenue 225mm diameter combined sewer. The building weeping-tile drainage is proposed to outlet into the Bank Street 825mm x 1200mm combined sewer because a monitoring manhole is required to be located on private property and the existing sewer depth is sufficient to allow gravity flow of the weeping tile water from the building without sump pits and pumps.

According to the City of Ottawa's Engineering Department, the allowable runoff into the combined sewers for this site shall be based on the estimated pre-development value, which is C=0.4 (max.) for this site, where presently it is all gravel-surfaced. T_c=10 minutes for a two(2)-year storm event. If the post-development storm-water runoff exceeds the specified pre-development requirements, then on-site storm-water management (SWM) control measures are necessary. The post-development runoff coefficient for this site is estimated at C=0.87, which exceeds the City's criteria of C=0.4 for a combined sewer system. Storm-water runoff if uncontrolled will exceed the calculated pre-development flow based on a higher post-development "C" value. Therefore, SWM measures are required for this redevelopment property.

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.

Site Data

1. <u>Development Property Area</u>

   Area Characteristics of development lot

Roof Area	=374.56m^2
Concrete/Paver Area	=64.10m^2

Grass Area =$11.55m^2$
Total Area =$450.21m^2$

$$C = \frac{(374.56 \times 0.9) + (64.1 \times 0.8) + (11.55 \times 0.2)}{450.21}$$

$$C = \frac{390.69}{450.21}$$

$$C = 0.868$$

Therefore, the average post-development "C" for this site is 0.87.

The tributary area consisting of approximately $89.81m^2$ is directed off-site uncontrolled.

Controlled site tributary area $= 450.21 - 89.81$= $360.4m^2$

Therefore, the controlled site tributary area is $360.4m^2$.

2. Controlled Area Data

Roof Surface Area =$360.4m^2$
Total Storm-Water Controlled Area =$360.4m^2$

$$C = \frac{(360.4 \times 0.9)}{360.4}$$

$$C = \frac{324.36}{360.4}$$

$$C = 0.9$$

Therefore, the post-development "C" for the controlled storm-water drainage area is 0.9.

3. Uncontrolled Area Data

Grass Area =$11.55m^2$
Concrete/Paver Area =$64.10m^2$
Roof Area =$14.16m^2$

Total Storm-water Uncontrolled Area =$89.81m^2$

$$C = \frac{(64.10 \times 0.8) + (11.55 \times 0.2) + (14.16 \times 0.9)}{89.81}$$

$$C = \frac{66.33}{89.81}$$

$$C = 0.739$$

Say “C”=0.74

Therefore, post-development “C” for the uncontrolled storm-water drainage area is 0.74.

The SWM area to be controlled is 360.4m^2. Refer to the attached “Drainage Area Plan” Figure 1 in Appendix A for details.

Allowable Flow

The maximum allowable off-site flow (pre-development condition) is estimated as follows:

C=0.4
T_c=10 minutes
I_2=77.10mm/hr [City of Ottawa, two(2)-year storm]

Using the Rational Method

Q=2.78 (0.4) (77.1) (0.045)

Q=3.86L/s

Therefore, the allowable flow off site is estimated at 3.86L/s.

Storm-Water Management Analysis

The established flow rate of 3.86L/s from this site is proposed to be directed into the existing 225mm diameter combined sewer located on Clemow Avenue and into the 825mm x 1200mm combined sewer located on Bank Street. Storm-water management attenuation for this site will incorporate flat rooftop storage only.

It is proposed that the flat rooftop areas of the residential building, Roof Areas 1, 2, 3, 4, and 5, will each incorporate a controlled roof drain to provide on-site storm-water detention.

The flat rooftop for SWM detention of the building is at various levels except the fourth storey. The flat rooftop of the first storey, second storey, third storey, and fifth storey of the building will be used for SWM attenuation.

For SWM attenuation, each designated flat rooftop area will incorporate one(1) controlled drain to control flow off site. The smallest standard roof drain flow rate of 0.63L/s (10 U.S.gal./min.) will be specified to release as low a flow as possible from the rooftops.

Therefore, from this building, five(5) individual available flat roof areas each with a controlled drain are proposed, and the minimum storm-water flow that can be controlled from the building and outletted off site is (0.63L/s x 5) or 3.15L/s.

Roof Area 1=122.0m^2
Roof Area 2=128.0 m^2
Roof Area 3=59.4 m^2
Roof Area 4=31.5 m^2
Roof Area 5=19.5 m^2

For the uncontrolled site area of 89.81 m^2, the 100-year uncontrolled flow rate is estimated using the Rational Method.

Q=2.78 CIA

C=0.74
I=120mm/hr, T_c=20 minutes (City of Ottawa IDF data)
A=0.009

Q=2.78 (0.74) (120) (0.009)

Q=2.2L/s

During the 100-year storm event, the flow directly entering the combined sewers is the total of the flow from the controlled area of the rooftop drains and the flow from the uncontrolled drainage area (3.15L/s + 2.2L/s), which total to 5.35L/s. The total of the site controlled and uncontrolled area flows equals 5.35L/s, which exceeds the allowable flow of 3.86L/s by a margin of 1.49L/s.

Design Discharge Computation

The Rational Method was used to estimate peak flows.

Q=2.78 CIA

To calculate roof storage:

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

The inflow rate (Q_{ACTUAL}) during the five(5)-year and 100-year storms for each of the five sub-tributary/flat rooftop building areas of this site can be calculated as follows.

Five(5)-year event

For tributary area 1 (Roof Area 1)
Q_{A1}= 2.78 CIA_1
C=0.90
A=122.0m^2
I=(mm/hr)
Q_{A1}= 2.78 (0.9) (0.0122ha.) I
Q_{A1}= 0.0305 I

For tributary area 2 (Roof Area 2)
Q_{A2}= 2.78 CIA_2
C=0.90
A=128.0m^2
I=(mm/hr)
Q_{A2}= 2.78 (0.9) (0.0128ha.) I
Q_{A2}= 0.032 I

For tributary area 3 (Roof Area 3)
Q_{A3}= 2.78 CIA_3
C=0.90
A=59.4m^2
I=(mm/hr)
Q_{A3}= 2.78 (0.9) (0.0059ha.) I
Q_{A3}= 0.0149 I

For tributary area 4 (Roof Area 4)
Q_{A4}= 2.78 CIA_4
C=0.90
A=31.5m^2
I=(mm/hr)
Q_{A4}= 2.78 (0.9) (0.0032ha.) I
Q_{A4}= 0.008 I

For tributary area 5 (Roof Area 5)
Q_{A5}= 2.78 CIA_5
C=0.90
A=19.5m^2
I=(mm/hr)
Q_{A5}= 2.78 (0.9) (0.002ha.) I
Q_{A5}= 0.005 I

100-year event
For tributary area 1 (Roof Area 1)
Q_{A1}= 2.78 CIA_1

C=1.0
$A=122.0m^2$
I=(mm/hr)
Q_{A1}= 2.78 (1.0) (0.0122ha.) I
Q_{A1}= 0.0339 I

For tributary area 2 (Roof Area 2)
Q_{A2}= 2.78 CIA_2
C=1.0
$A=128.0m^2$
I=(mm/hr)
Q_{A2}= 2.78 (1.0) (0.0128ha.) I
Q_{A2}= 0.0356 I

For tributary area 3 (Roof Area 3)
Q_{A3}= 2.78 CIA_3
C=1.0
$A=59.4m^2$
I=(mm/hr)
Q_{A3}= 2.78 (1.0) (0.0059ha.) I
Q_{A3}= 0.0164 I

For tributary area 4 (Roof Area 4)
Q_{A4}= 2.78 CIA_4
C=1.0
$A=31.5m^2$
I=(mm/hr)
Q_{A4}= 2.78 (1.0) (0.0032ha.) I
Q_{A4}= 0.0089 I

For tributary area 5 (Roof Area 5)
Q_{A5}= 2.78 CIA_5
C=1.0
$A=19.5m^2$
I=(mm/hr)
Q_{A5}= 2.78 (1.0) (0.002ha.) I
Q_{A5}= 0.0056 I

The allowable discharge for Roof Area 1 is:
one(1) roof drain @release rate of 10.0 U.S.gal/min or 0.63L/s

The allowable discharge for Roof Area 2 is:
one(1) roof drain @release rate of 10.0 U.S.gal/min or 0.63L/s

The allowable discharge for Roof Area 3 is:
one(1) roof drain @release rate of 10.0 U.S.gal/min or 0.63L/s

The allowable discharge for Roof Area 4 is:
one(1) roof drain @release rate of 10.0 U.S.gal/min or 0.63L/s

The allowable discharge for Roof Area 5 is:
one(1) roof drain @release rate of 10.0 U.S.gal/min or 0.63L/s

Refer to Appendix B for typical standard roof drain details or equivalent to be used on this site. Please note that the specified 10 U.S.gal./min or 0.63 L/s roof drain for each of the five(5) building roof areas will be custom made by the manufacturer to allow for a maximum release of 0.63L/s under the specified head indicated in this report.

This can be used to determine the storage volume for the site using the Modified Rational Method.

Actual flow Q_{ACTUAL} is calculated as $Q_{A(i)}$=2.78 $CIA_{(i)}$

Q_{STORED} is calculated as $Q_{S(i)}=Q_{A(i)} - Q_{ALLOW}$

The summary results of the calculated inflow and the required storage volume of these five(5) roof areas on this site to store the five(5)-year and 100-year storm events are shown in Tables 1 to 10 inclusive.

Conclusion

The proposed development site consists of a five-storey flat-roof building complete with a common one-level underground parking garage. The flat roofs of the five(5)-storey building will be used for SWM detention. The flat rooftop of building levels 1, 2, 3, and 5 will be used for storm-water attenuation. For storm-water attenuation, one(1) controlled roof drain is proposed at the five(5) available flat-roof areas. Corresponding roof scuppers are proposed at the flat-roof levels per the architectural plan details.

To control the five(5)-year event and up to the 100-year event storm-water release rate off site to an established allowable flow rate of 3.86L/s, it is proposed that at each of the five(5) flat roof areas, a drain be installed and sized for a release rate of 0.63L/s. Therefore, the controlled release rate off site is 3.15L/s from the building's rooftops.

Refer to the Proposed Grading, Servicing, and Storm-water Management Plan Dwg. 816-41 G-1 for details.

During the five-year storm event for Roof Area 1, the ponding depth on the flat-roof area is estimated at 110mm at the drain and 0mm at the roof perimeter surface, assuming a 1.5% (minimum) roof pitch to the drain. The rooftop storage available is $1.86m^3$. Therefore, the available storage from Roof Area 1 is $1.86m^3$, which is greater than the required volume of $1.85m^3$.

During the five-year storm event for Roof Area 2, the ponding depth on the flat-roof area is estimated at 110mm at the drain and 0mm at the roof perimeter surface, assuming a 1.5% (minimum) roof pitch to the drain. The rooftop storage available is 2.01m^3. Therefore, the available storage from Roof Area 2 is 2.01m^3, which is greater than the required volume of 1.98m^3.

During the five-year storm event for Roof Area 3, the ponding depth on the flat-roof area is estimated at 100mm at the drain and 0mm at the roof perimeter surface, assuming a 2% (minimum) roof pitch to the drain. The rooftop storage available is 0.84m^3. Therefore, the available storage from Roof Area 3 is 0.84m^3, which is greater than the required volume of 0.56m^3.

During the five-year storm event for Roof Area 4, the ponding depth on the flat-roof area is estimated at 70mm at the drain and 0mm at the roof perimeter surface, assuming a 2% (minimum) roof pitch to the drain. The rooftop storage available is 0.31m^3. Therefore, the available storage from Roof Area 4 is 0.31m^3, which is greater than the required volume of 0.15m^3.

During the five-year storm event for Roof Area 5, the ponding depth on the flat-roof area is estimated at 70mm at the drain and 0mm at the roof perimeter surface, assuming a 2% (minimum) roof pitch to the drain. The rooftop storage available is 0.26m^3. Therefore, the available storage from Roof Area 5 is 0.26m^3, which is greater than the required volume of 0.02m^3.

Therefore, during the five(5)-year event, the total required rooftop storage volume is 4.56m^3, and the total available storage volume is 5.28m^3 at a ponding depth of 0.11m at Roof Drains 1 and 2. The ponding depth at Roof Drain 3 is 0.1m, and the ponding depth at Roof Drains 4 and 5 is 0.07m. At the perimeter of the five(5) roof areas, the ponding depth is 0mm.

Refer to Appendix C for the available five(5)-year event storage volume calculations.

During the 100-year storm event for Roof Area 1, the ponding depth on the flat-roof area is estimated at 150mm at the drain and 0mm at the roof perimeter surface, assuming a 1.5% (minimum) roof pitch to the drain. The rooftop storage available is 5.78m^3. Therefore, the available storage from Roof Area 1 is 5.78m^3, which is greater than the required volume of 4.62m^3.

During the 100-year storm event for Roof Area 2, the ponding depth on the flat-roof area is estimated at 150mm at the drain and 0mm at the roof perimeter surface, assuming a 1.5% (minimum) roof pitch to the drain. The rooftop storage available is 6.32m^3. Therefore, the available storage from Roof Area 2 is 6.32m^3, which is greater than the required volume of 4.95m^3.

During the 100-year storm event for Roof Area 3, the ponding depth on the flat-roof area is estimated at 150mm at the drain and 0mm at the roof perimeter surface, assuming a 2% (minimum) roof pitch to the drain. The rooftop storage available is 2.87m^3. Therefore, the available storage from Roof Area 3 is 2.87m^3, which is greater than the required volume of 1.61m^3.

During the 100-year storm event for Roof Area 4, the ponding depth on the flat-roof area is estimated at 100mm at the drain and 0mm at the roof perimeter surface, assuming a 2% (minimum) roof pitch to the drain. The rooftop storage available is 1.03m^3. Therefore, the available storage from Roof Area 4 is 1.03m^3, which is greater than the required volume of 0.58m^3.

During the 100-year storm event for Roof Area 5, the ponding depth on the flat-roof area is estimated at 100mm at the drain and 0mm at the roof perimeter surface, assuming a 2% (minimum) roof pitch to the drain. The rooftop storage available is $0.65m^3$. Therefore, the available storage from Roof Area 5 is $0.65m^3$, which is greater than the required volume of $0.23m^3$.

Therefore, during the 100-year event, the total required rooftop storage volume is $11.99m^3$, and the total available storage volume is $16.65m^3$ at a ponding depth of 0.15m at Roof Drains 1, 2, and 3. The ponding depth at Roof Drains 4 and 5 is 0.1m. At the perimeter of the five(5) roof areas, the ponding depth is 0mm.

Refer to Appendix C for the available 100-year event storage volume calculations. At the roof perimeter of the five(5) flat-roof areas, at least one(1) emergency overflow scupper is proposed at the roof perimeter surface to be installed at the perimeter height of the rooftop.

For controlling the five(5)-year storm event up the 100-year event, a controlled roof drain shall be installed at each of the five(5) designated flat rooftop areas having a release rate of 0.63L/s at the locations depicted on Dwg. 816-41 G-1 to provide a controlled flow rate of 3.15L/s off site. The 100-year flow from the uncontrolled drainage area is estimated at 2.2L/s. In total, the estimated 100-year flow into the 225mm diameter combined sewer is estimated at 5.35L/s, which is greater than the estimated allowable flow rate of 3.86L/s by approximately 1.49L/s for this development site.

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PROPOSED 667 BANK STREET DEVELOPMENT SITE

TABLE 1

FIVE(5)-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)
10	104.20	3.18	0.63	2.55	1.53
15	83.50	2.55	0.63	1.92	1.73
20	70.30	2.14	0.63	1.51	1.81
25	60.90	1.86	0.63	1.23	1.85
30	53.93	1.65	0.63	1.02	1.84
35	48.50	1.48	0.63	0.85	1.79

Therefore, the required rooftop storage volume is $1.85m^3$.

PROPOSED 667 BANK STREET DEVELOPMENT SITE

TABLE 2

FIVE(5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 2

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)
10	104.20	3.33	0.63	2.70	1.62
15	83.50	2.67	0.63	2.04	1.84
20	70.30	2.25	0.63	1.62	1.94
25	60.90	1.95	0.63	1.32	1.98
30	53.93	1.73	0.63	1.10	1.97
35	48.50	1.55	0.63	0.92	1.93

Therefore, the required rooftop storage volume is $1.98m^3$.

TABLE 3

FIVE(5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 3

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	140.2	2.09	0.63	1.46	0.44
10	104.20	1.55	0.63	0.92	0.55
15	83.50	1.25	0.63	0.62	0.56
20	70.30	1.05	0.63	0.42	0.50
25	60.90	0.91	0.63	0.28	0.42

Therefore, the required rooftop storage volume is 0.56m^3.

TABLE 4

FIVE(5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 4

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	140.2	1.12	0.63	0.49	0.15
10	104.20	0.84	0.63	0.21	0.13
15	83.50	0.67	0.63	0.04	0.04

Therefore, the required rooftop storage volume is $0.15m^3$.

TABLE 5

FIVE(5)-YEAR EVENT

REQUIRED BUILDING ROOF AREA 5

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	140.2	0.70	0.63	0.07	0.02
10	104.20	0.52	0.63	0.00	0.00

Therefore, the required rooftop storage volume is 0.02m^3.

TABLE 6

100-YEAR EVENT

REQUIRED STORAGE VOLUME

AT ROOF AREA 1

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	6.05	0.63	5.43	3.26
15	142.9	4.84	0.63	4.21	3.79
20	120.0	4.07	0.63	3.44	4.13
25	103.8	3.52	0.63	2.89	4.34
30	91.9	3.12	0.63	2.49	4.48
40	75.1	2.55	0.63	1.92	4.61
50	63.9	2.17	0.63	1.54	4.62
60	55.9	1.90	0.63	1.27	4.57
70	49.8	1.69	0.63	1.06	4.45

Therefore, the required rooftop storage volume is $4.62m^3$.

TABLE 7

100-YEAR EVENT

REQUIRED STORAGE VOLUME

AT ROOF AREA 2

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	6.36	0.63	5.73	3.44
15	142.9	5.09	0.63	4.46	4.01
20	120.0	4.27	0.63	3.64	4.37
25	103.8	3.70	0.63	3.07	4.61
30	91.9	3.27	0.63	2.64	4.75
35	82.6	2.94	0.63	2.31	4.85
40	75.1	2.67	0.63	2.04	4.90
50	63.9	2.28	0.63	1.65	4.95
60	55.9	1.99	0.63	1.36	4.90
70	49.8	1.77	0.63	1.14	4.79

Therefore, the required rooftop storage volume is 4.95m^3.

TABLE 8

100-YEAR EVENT

REQUIRED STORAGE VOLUME

AT ROOF AREA 3

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	242.7	3.98	0.63	3.35	1.00
10	178.6	2.93	0.63	2.30	1.38
15	142.9	2.34	0.63	1.71	1.54
20	120.0	1.97	0.63	1.34	1.61
25	103.8	1.70	0.63	1.07	1.605
30	91.9	1.51	0.63	0.88	1.58

Therefore, the required rooftop storage volume is 1.61m^3.

TABLE 9

100-YEAR EVENT

REQUIRED STORAGE VOLUME

AT ROOF AREA 4

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	242.7	2.16	0.63	1.53	0.46
10	178.6	1.59	0.63	0.96	0.58
15	142.9	1.27	0.63	0.64	0.576
20	120.0	1.07	0.63	0.44	0.53

Therefore, the required rooftop storage volume is $0.58m^3$.

PROPOSED 667 BANK STREET DEVELOPMENT SITE

TABLE 10

100-YEAR EVENT

REQUIRED STORAGE VOLUME

AT ROOF AREA 5

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	242.7	1.36	0.63	0.73	0.22
10	178.6	1.00	0.63	0.37	0.23
15	142.9	0.80	0.63	0.17	0.15

Therefore, the required rooftop storage volume is $0.23m^3$.

PROPOSED FIVE(5)-STOREY MIXED-USE BUILDING

DEVELOPMENT SITE

LOT 2

R-PLAN M-62

662 BANK STREET

CITY OF OTTAWA

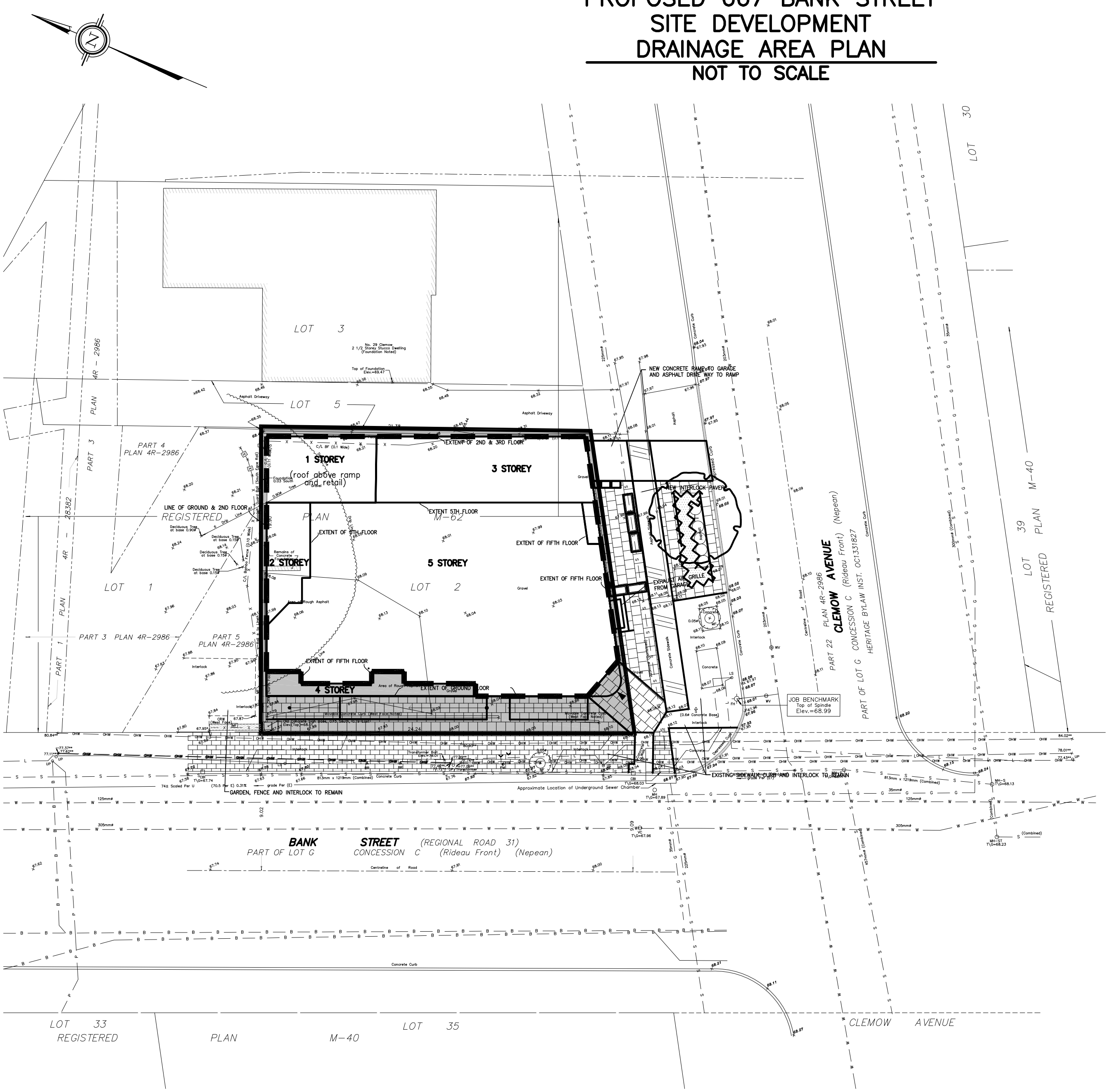
APPENDIX A

STORM DRAINAGE AREA PLAN

FIGURE 1

PROPOSED 667 BANK STREET
SITE DEVELOPMENT
DRAINAGE AREA PLAN

NOT TO SCALE



LEGEND

CONTROLLED STORM DRAINAGE AREA (360.4 SQ. M)

UNCONTROLLED STORM DRAINAGE AREA (89.81 SQ. M)

TOTAL AREA = 450.21 SQ. M

POST-DEVELOPMENT AVERAGE "C" = 0.87

FIGURE 1

PROPOSED FIVE(5)-STOREY MIXED-USE BUILDING

DEVELOPMENT SITE

LOT 2

R-PLAN M-62

662 BANK STREET

CITY OF OTTAWA

APPENDIX B

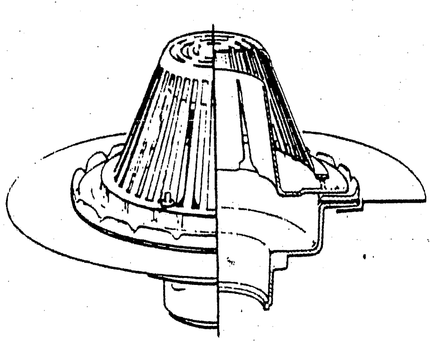
TYPICAL STANDARD ROOF DRAIN DETAILS

enpoco **SPEC**

Flow Control Roof Drain

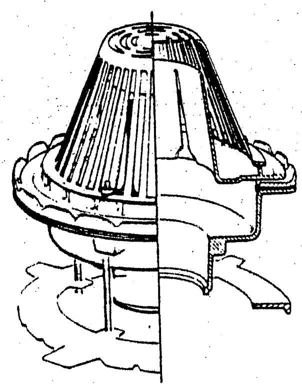
E2000X

Optional Variations



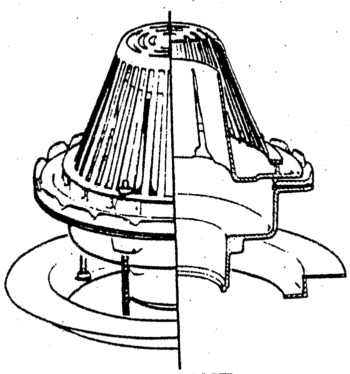
E2000XP

BEARING PAN - Permits roof drain to be installed level with top of deck, eliminating pressure point on membrane around roof drain flange.



E2000XD

UNDERDECK CLAMP - Fastens roof drain securely to deck.



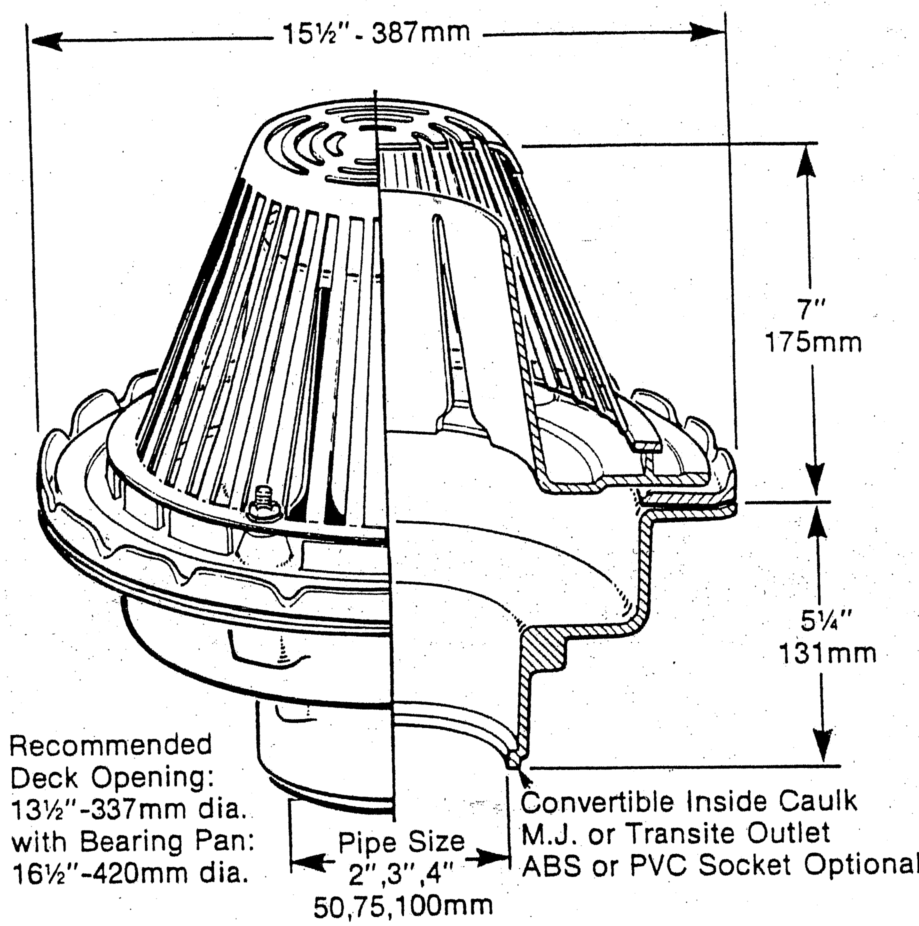
E2000XE

EXTENSION - Securely supports body off the roof deck and adjustable to suit 1"-25mm to 6"-150mm insulation thickness.

E2000XW

(Not Illustrated)

WATERPROOFING FLANGE - Permits expansion and contraction of insulation, eliminating undue stress on roofing membrane.



FLOW CONTROL ROOF DRAIN

FUNCTION: Recommended for installation in flat or sloped roof areas of steel, wood, precast concrete or gypsum decks where a controlled drain down time is required.

SPECIFICATION: ENPOCO Series E2000X Roof Drain with oven cured epoxy coated aluminum alloy body, non-puncturing flashing clamp, flow control and secured H.D. poly dome.

Optional Variations: Add suffix letter to product no. as required.

Suffix

- ☐ **D** - Deck Clamp
- ☐ **E** - Extension
- ☐ **M** - Aluminum Dome
- ☐ **P** - Bearing Pan
- ☐ **SO** - Side Outlet
- ☐ **W** - Waterproofing Flange
- ☐ **XJ** - Expansion Joint

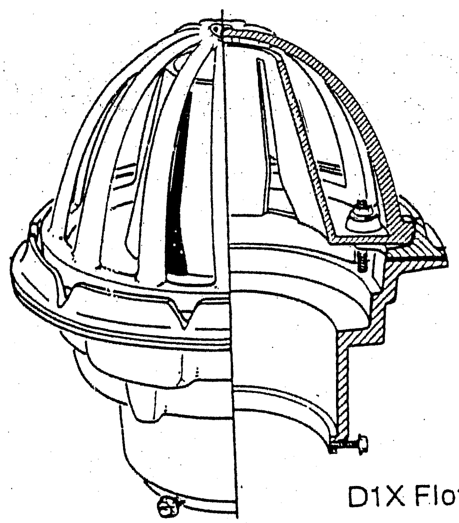
202-115

Selector Guide for Enpoco 'Flotrol' Roof Drains

A Compute area of roof to be drained.
B Determine area factor for location as shown in Schedule No. 1.
C Calculate total flow rate by dividing roof area (Step A) by area factor times ten (10).

If total flow rate is not evenly divisible by 10, increase total flow to next higher figure by 10.
D Compute the number of roof drains recommended as listed below.
(a) Maximum spacing between drains — 100 ft.
(b) Maximum distance from edge of roof to drains — 50 feet.

*See Note



D1X Flotrol

E Determine quantity of 10 GPM weirs required by dividing 10 into total flow rate, (Step C), if quantity of weirs is greater than drains (Step D), begin with corner drains and insert additional weirs among single weir drains.
F Size vertical leaders using Schedule No. 2.
G Size horizontal sewers using Schedule No. 3.

SCHEDULE NO. 2

Vertical Leader Sizing
30 GPM - 2 IPS
90 GPM - 3 IPS
190 GPM - 4 IPS

SCHEDULE NO. 3

Horizontal Storn Sewer Sizing Sizing
Gallons per Minute

Slope Inches per Foot								
	⅛	36	78	231	498	902	1467	2666
	¼	51	111	327	705	1275	2076	3774
	½	72	157	462	996	1804	2934	5332
Inch Pipe Size		3	4	6	8	10	12	15

*Calculations made using Manning's formula for uniform flow in sloping drains, using a valve of 9.9145 for "N".

1 Positioning of drains and extra weir as recommended will ensure maximum efficiency with a minimum of overall flow change during adverse wind conditions, ice, snow, and debris on roof in addition to normal roof settling.
2 Normal roof loading of 40lb. per sq. ft. will safely carry the added water load of 15lbs. per sq. ft. created by 3" water level design factor.
3 Building should have parapets 6" above roof level to minimize spillage caused by high wind conditions. In building with parapets over 6" high, installation of parapet drains 5" above the roof level is recommended as a safety precaution.
4 Roof construction should be of top quality material and workmanship and all flashing should extend 6" above roof level.
5 The installation of flow control devices in roofs other than level roof construction, create major design problems. For instance and advice contact your local ENPOCO representative.
6 Due to possible rapid changes in climatic conditions drain down time should not exceed 30 hours.

Note: Although pipe size calculations should be based on accumulated flow rate, local by-laws should be referred to for minimum pipe size requirements and roof drain spacing.

PROPOSED FIVE(5)-STOREY MIXED-USE BUILDING

DEVELOPMENT SITE

LOT 2

R-PLAN M-62

662 BANK STREET

CITY OF OTTAWA

APPENDIX C

DETAILED CALCULATIONS FOR

FIVE(5)- AND 100-YEAR

AVAILABLE STORAGE VOLUME

ROOFTOP STORAGE

Roof areas 1 to 5 inclusive will be used for storm-water detention. Each area will be drained by a controlled drain designed for a release rate of 10.0 U.S.gal/min. or 0.63L/s. The building flat-roof area consists of levels 1, 2, 3, 4, and 5. The flat-roof area at levels 1, 2, 3, and 5 will be used for storm-water management attenuation. Only level 4 will not be used for attenuation because of its size and geometric configuration.

Five(5)-Year Event

Roof Storage Area 1

The available flat-roof area for storage=122.0m^2 @roof slope of 1.5% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.11\text{m}\ [49.69 + 4(12.88) + 0]}{6}$$

$$V = \frac{(0.11)(101.21)}{6}$$

$$V = 1.86\text{m}^3$$

The available storage volume of Roof Area 1 is 1.86m^3 >the required five(5)-year storage volume of 1.85m^3 from Table 1.

The ponding depth at the proposed Roof Drain 1 location is approximately 0.11m (or 110mm), and at the perimeter of this roof area, there is 0mm ponding depth.

Roof Storage Area 2

The available flat-roof area for storage=128.0m^2 @roof slope of 1.5% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.11\text{m}\ [56.51 + 4(13.33) + 0]}{6}$$

$$V = \frac{(0.11)(109.83)}{6}$$

$$V = 2.01\text{m}^3$$

The available storage volume of Roof Area 2 is 2.01m^3 >the required five(5)-year storage volume of 1.98m^3 from Table 2.

The ponding depth at the proposed Roof Drain 2 location is approximately 0.11m (or 110mm), and at the perimeter of this roof area, there is 0mm ponding depth.

Roof Storage Area 3

The available flat-roof area for storage=59.4m^2 @roof slope of 2% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.1\text{m}\ [25.44 + 4(6.3) + 0]}{6}$$

$$V = \frac{(0.1)(50.64)}{6}$$

$$V = 0.84\text{m}^3$$

The available storage volume of Roof Area 3 is 0.84m^3 >the required five(5)-year storage volume of 0.56m^3 from Table 3.

The ponding depth at the proposed Roof Drain 3 location is approximately 0.1m (or 100mm), and at the perimeter of this roof area, there is 0mm ponding depth.

Roof Storage Area 4

The available flat roof area for storage=31.5m^2 @roof slope of 2% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.07\text{m}\ [13.3 + 4(3.29) + 0]}{6}$$

$$V = \frac{(0.07)(26.46)}{6}$$

$$V = 0.31\text{m}^3$$

The available Roof Area 4 storage volume of 0.31m^3 >the required five(5)-year storage volume of 0.15m^3 from Table 4.

The ponding depth at the proposed Roof Drain 4 location is approximately 0.07m (or 70mm), and at the perimeter of this roof area, there is 0mm ponding depth.

Roof Storage Area 5

The available flat roof area for storage=19.5m^2 @roof slope of 2% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.07\text{m}\ [10.61 + 4(2.88) + 0]}{6}$$

$$V = \frac{(0.07)(22.13)}{6}$$

$V = 0.26m^3$

The available storage volume of Roof Area 5 is $0.26m^3$ >the required five(5)-year storage volume of $0.02m^3$ from Table 5.
The ponding depth at the proposed Roof Drain 5 location is approximately 0.07m (or 70mm), and at the perimeter of this roof area, there is 0mm ponding depth.

During the five(5)-year event, the total required rooftop storage volume is 4.56 m^3, and the total available storage volume is 5.28 m^3 at a ponding depth of 0.11m at Roof Drains 1 and 2, at a ponding depth at Roof Drain 3 of 0.1m, and at a ponding depth at Roof Drains 4 and 5 of 0.07m. At the perimeter of the five(5) roof areas, the ponding depth is 0mm.

AVAILABLE STORAGE VOLUME CALCULATIONS

100-Year Event

Roof Storage Area 1
The available flat-roof area for storage=$122.0m^2$ @roof slope of 1.5% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.15\text{m}\ [122.0 + 4(27.27) + 0]}{6}$$

$$V = \frac{(0.15)(231.08)}{6}$$

$$V = 5.78\text{m}^3$$

The available storage volume of Roof Area 1 is $5.78m^3$ >the required 100-year storage volume of $4.62m^3$ from Table 6.
The ponding depth at the proposed Roof Drain 1 location is approximately 0.15m (or 150mm), and at the perimeter of this roof area, there is 0mm ponding depth. Therefore, it is recommended that roof scuppers 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.

Roof Storage Area 2
The available flat-roof area for storage=$128.0m^2$ @roof slope of 1.5% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.15\text{m}\ [128.0 + 4(31.21) + 0]}{6}$$

$$V = \frac{(0.15)(252.84)}{6}$$

$$V = 6.32m^3$$

The available storage volume of Roof Area 2 is $6.32m^3$ >the required 100-year storage volume of $4.95m^3$ from Table 7.
The ponding depth at the proposed Roof Drain 2 location is approximately 0.15m (or 150mm), and at the perimeter of this roof area, there is 0mm ponding depth. Therefore, it is recommended that roof scuppers 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.

Roof Storage Area 3
The available flat roof area for storage=$59.4m^2$ @roof slope of 2% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.15m\ [59.4 + 4(13.8) + 0]}{6}$$

$$V = \frac{(0.15)(114.6)}{6}$$

$$V = 2.87m^3$$

The available storage volume of Roof Area 3 is $2.87m^3$ >the required 100-year storage volume of $1.61m^3$ from Table 8.
The ponding depth at the proposed Roof Drain 3 location is approximately 0.15m (or 150mm), and at the perimeter of this roof area, there is 0mm ponding depth. Therefore, it is recommended that roof scuppers 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.

Roof Storage Area 4
The available flat roof area for storage=$31.5m^2$ @roof slope of 2% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.10m\ [31.5 + 4(7.56) + 0]}{6}$$

$$V = \frac{(0.10)(61.74)}{6}$$

$$V = 1.03m^3$$

The available storage volume of Roof Area 4 is $1.03m^3$ >the required 100-year storage volume of $0.58m^3$ from Table 9.

The ponding depth at the proposed Roof Drain 4 location is approximately 0.10m (or 100mm), and at the perimeter of this roof area, there is 0mm ponding depth. Therefore, it is recommended that roof scuppers 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.

Roof Storage Area 5

The available flat roof area for storage=19.5m^2 @roof slope of 2% (minimum). Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{0.1\text{m}\,[19.5 + 4(4.85) + 0]}{6}$$

$$V = \frac{(0.1)(38.9)}{6}$$

$$V = 0.65\text{m}^3$$

The available storage volume of Roof Area 5 is 0.65m^3 >the required 100-year storage volume of 0.23m^3 from Table 10.

The ponding depth at the proposed Roof Drain 4 location is approximately 0.1m (or 100mm), and at the perimeter of this roof area, there is 0mm ponding depth. Therefore, it is recommended that roof scuppers 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.

During the 100-year event, the total required rooftop storage volume is 11.99m^3, and the total available storage volume is 16.65m^3 at a ponding depth of 0.15m at Roof Drains 1, 2, and 3, and at a ponding depth at Roof Drains 4 and 5 of 0.1m. At the perimeter of the five(5) roof areas, the ponding depth is 0mm.