PROPOSED THREE AND ONE-HALF STOREY

RESIDENTIAL APARTMENT BUILDING SITE

PART OF LOT 25

CONCESSION 1 (OTTAWA FRONT)

GEOGRAPHIC TOWNSHIP OF GLOUCESTER

603 CUMMINGS AVENUE

CITY OF OTTAWA

STORM DRAINAGE REPORT

REPORT R-817-37

T.L. MAK ENGINEERING CONSULTANTS LTD.

DECEMBER 2017

REFERENCE FILE NUMBER 817-37

Introduction

The proposed 3½-storey apartment building site is located on the east side of Cummings Avenue, and situated north of Wilson Street and south of Montreal Road. Its legal property description is part of Lot 25 Concession 1 (Ottawa Front), Geographic Township of Gloucester, City of Ottawa. At this time, the residential lot under consideration is a vacant lot. The municipal address of the property is 603 Cummings Avenue.

The lot area under consideration is approximately 701.6 square metres. This property is proposed for the development of a three and one-half (3½) storey residential apartment building where the basement is approximately 50% below grade and three(3) storeys are above the basement level. The total building gross floor area of the proposed building [all four(4) floor levels] is 7835.2 square feet (727.92 square metres).

The building will house a total of eight(8) units consisting of eight two(2)-bedroom apartments. The storm-water outlet for this site is the existing 900mm diameter storm sewer located within the Cummings Avenue 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 calculated "C" existing value or C=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=0.77, which exceeds the calculated pre-development allowable C=0.5 criteria for the Cummings Avenue 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.

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, Servicing, and Storm-water Management Plan (Dwg. 817-37 G-1), the storm water of this lot will be mostly controlled on site.

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. Development Property Area

Post-Development Site Area Characteristics

Development Lot Area	=701.6m^2
Roof Surface Area	=247.6m^2
Asphalt Area	=209.3m^2
Interlock Paver/Concrete Area	=132.2m^2

Grass Area =112.5m^2

$$C = \frac{(247.6 \times 0.9) + (209.3 \times 0.9) + (132.2 \times 0.8) + (112.5 \times 0.2)}{701.6}$$

$$C = \frac{539.47}{701.6}$$

$$C = 0.769$$

Say "C"=0.77

Therefore, the average post-development "C" for this site is 0.77.

2. Controlled Area Data

Roof Surface Area =247.6m^2
Asphalt Area =173.6m^2
Interlock Paver/Concrete Area =91.88m^2
Grass Area =39.9m^2
Total Storm-water Controlled Area =552.98m^2

$$C = \frac{(247.6 \times 0.9) + (39.9 \times 0.2) + (173.6 \times 0.9) + (91.88 \times 0.8)}{552.98}$$

$$C = \frac{460.564}{552.98}$$

$$C = 0.833$$

Say "C"=0.84

Therefore, the post-development "C" for the controlled storm-water drainage area is 0.84.

3. Uncontrolled Area Data

Asphalt Area =35.7m^2
Grass Area =72.6m^2
Interlock Paver/Concrete Area =40.32m^2
Total Storm-water Uncontrolled Area =148.62m^2

$$C = \frac{(40.32 \times 0.8) + (72.6 \times 0.2) + (35.7 \times 0.9)}{148.62}$$

$$C = \frac{78.906}{148.62}$$

$$C = 0.531$$

Say "C"=0.54

Therefore, the post-development "C" for the uncontrolled storm-water drainage area of the site is 0.54.

The tributary area consisting of approximately 148.62 square metres will be out-letting off site uncontrolled from the residential apartment building site.

The SWM area to be controlled is 552.98m^2. Refer to the attached "Drainage Area Plan" in Figure 1 for details.

The site SWM storage area excluding the rooftop area that is to be controlled by the ICD in STMH1 is 552.98m^2 – 247.6m^2 = 305.38m^2 or 0.03054ha.

Pre-Development Flow Estimation

Maximum allowable off-site flow: five(5)-year storm

Pre-Development Site Area Characteristics

Development Lot Area	=701.6m^2
Asphalt Area	=674.91m^2
Concrete Area	=26.7m^2

$$C = \frac{(674.91 \times 0.9) + (26.7 \times 0.8)}{701.6}$$

$$C = \frac{628.779}{701.6}$$

$$C = 0.896$$

Use C_{pre}=0.5 maximum allowable for redevelopment

T_c=D/V where D=46.0m, ΔH=1.26m, S=2.7%, and V=3.4feet/second=1.04m/s
Therefore,

$$T_c = \frac{46.0m}{1.04m/s}$$

T_c=0.74 minutes
Use T_c=10 minutes
I_5=104.4mm/hr [City of Ottawa, five(5)-year storm]

Using the Rational Method

Q=2.78 (0.5) (104.4) (0.0702)

Q=10.19L/s

Because 148.62 square metres are drained uncontrolled off site, the **net** allowable discharge for this site into the existing Cummings Avenue storm sewer system is Q={2.78 (0.5) (104.4) (0.0702)−[2.78 (0.54) (178.6) (0.0149)]}=10.19L/s−4.0L/s=6.19L/s.

Storm-Water Management Analysis

The calculated net allowable flow rate of 6.19L/s for on-site storm-water management detention volume storage will be used for this SWM analysis. Because a total of three(3) controlled roof drains are proposed to restrict flow from the building at a rate of 1.89L/s into the Cummings Avenue storm sewer, therefore, the remainder of the site allowable release rate from the ICD in STMH1 is 6.19L/s−1.89L/s=4.30L/s.

Therefore, the total allowable five(5)-year release rate of 10.19L/s will be entering into the existing 300mm diameter Cummings Avenue storm sewer. The runoff that is greater than the net allowable release rate will be stored on site in the proposed storm-water management oversized underground storm pipes, underground drainage structures, and the three(3) flat rooftops of the proposed apartment building, all of which will be used for storm-water detention purposes.

The post-development inflow rate during the five(5)-year and 100-year storms for the parking lot drainage system and rooftop areas can be calculated as follows.

Design Discharge Computation

Underground Pipes and Drainage System

The Rational Method was used to estimate peak flows.

Q=2.78 CIA

Inflow rate Q_{ACTUAL} for the site is:

Five(5)-year event

C_5=AVG "C" value of controlled area excluding roof area, where

$$C = \frac{(173.6 \times 0.9) + (39.9 \times 0.2) + (91.88 \times 0.8)}{305.38}$$

$$C = \frac{237.724}{305.38}$$

$$C = 0.779$$

C_5=0.78
A=0.03054ha.

Inflow rate Q_{A5}= 2.78 CIA=2.78 (0.78) (0.03054ha.) I
Q_{A1}= 0.0663 I
I=mm/hr

The inflow rate for the controlled site tributary area can be calculated as follows:
Q_5= 0.0663 I

100-year event
C_{100}=AVG "C" value of controlled area excluding roof area

$$C = \frac{(173.6 \times 1.0) + (39.9 \times 0.2 \times 1.25) + (91.88 \times 0.8 \times 1.25)}{305.38}$$

$$C = \frac{275.455}{305.38}$$

$$C = 0.902$$

C_{100}=0.90

Inflow rate $(Q_A)_{100}$= 2.78 CIA=2.78 (0.90) (0.03054ha.) I
$(Q_A)_{100}$= 0.0765 I
I=mm/hr

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=2.78 CIA

Q_{STORED} is calculated as $Q_S=Q_A - Q_{ALLOW}$

To Calculate Roof Storage Requirements
The proposed flat roof the apartment building on the property will incorporate three(3) roof drains to control flow off site. The smallest standard roof drain flow rate is each at 0.63L/s (10USgal./min.). Therefore, the minimum storm-water flow that can be controlled from this rooftop and outletted off site is 0.63L/s× 3=1.89L/s.

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
Five(5)-Year Event
C_5=0.90
A=83.3m^2
I=mm/hr

Q_{A1}=2.78 (0.90)(0.0084ha.)I=0.021I

100-Year Event
C_{100}=1.0
A=83.3m^2
I=mm/hr

Q_{A1}=2.78 (1.0)(0.0084ha.)I=0.0234I

For Roof Area 2, Q_{A2}=2.78 CIA
Five(5)-Year Event
C_5=0.90
A=81.0m^2
I=mm/hr

Q_{A2}=2.78 (0.90)(0.0081ha.)I=0.0203I

100-Year Event
C_{100}=1.0
A=81.0m^2
I=mm/hr

Q_{A2}=2.78 (1.0)(0.0081ha.)I=0.0225I

For Roof Area 3, Q_{A3}=2.78 CIA
Five(5)-Year Event
C_5=0.90
A=83.3m^2
I=mm/hr

Q_{A3}=2.78 (0.90)(0.0084ha.)I=0.021I

100-Year Event
C_{100}=1.0
A=83.3m^2
I=mm/hr

Q_{A3}=2.78 (1.0)(0.0084ha.)I=0.0234I

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 8 inclusive.

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 silt fence barrier (as per OPSD 219.110 and associated specifications) along Cummings Avenue and all other areas that sheet drain off site. Maintenance hole sediment barriers to be AMOCO 4555 non-woven geotextile or approved equivalent.

Conclusion

For development of this residential site (±0.0702ha.) and in controlling the five(5)-year storm-water release rate off site to an allowable rate of 10.19L/s, a site storage volume of approximately 6.06m^3 minimum is required during the five(5)-year event. We estimate that approximately 3.01m^3 minimum of rooftop storage and 3.05m^3 minimum from the proposed underground storm-water drainage pipes and drainage structures are necessary to attenuate the five(5)-year storm event.

During the five-year storm event for the flat rooftop storage, the ponding depth on this rooftop is estimated at 110mm at the drain and 0mm at the roof perimeter, assuming a 2% minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is 1.58m^3; the rooftop storage available at Roof Area 2 is 1.52m^3; and the rooftop storage available at Roof Area 3 is 1.58m^3, for a total of 4.68m^3, which is greater than the required storage volume of 3.01m^3.

As for the remaining storage volume of 3.05m^3 minimum required from the site development area, for the five(5)-year storm event, the estimated HWL of 78.00m will provide a total available storage volume of 3.12m^3 consisting of the proposed underground drainage structures in the access road of the site. In total, the five(5)-year available site storage volume is approximately 7.80m^3, which is greater than the required site storage volume of 6.06m^3. See Appendix B for details.

To control the 100-year storm-water release rate off site to an allowable rate of 10.19L/s, a site storage volume of approximately 16.85m^3 minimum is required during the 100-year event. We estimate that approximately 8.07m^3 minimum of rooftop storage and 8.78m^3 minimum from the proposed underground drainage pipes and structures are necessary to attenuate the 100-year storm event.

During the 100-year storm event for the flat rooftop storage, the ponding depth on this rooftop is estimated at 150mm at the drain and 0mm at the roof perimeter, assuming a 2% minimum roof pitch to the drain. The rooftop storage available at Roof Area 1 is 4.13m^3; the rooftop storage available at Roof Area 2 is 3.98m^3; and the rooftop storage available at Roof Area 3 is 4.13m^3, for a total of 12.24m^3, which is greater than the required storage volume of 8.07m^3.

As for the remaining storage volume of 8.78m^3 minimum required from the site development area, for the 100-year storm event, the estimated HWL of 79.90m will provide a total available storage volume of 9.54m^3 consisting of the proposed underground storm pipes and drainage structures. In total, the 100-year available site storage volume is 21.78m^3, which is greater than the required site storage volume of 16.85m^3. See Appendix B for details.

Therefore, by means of flat building rooftop storage, grading the site to the proposed grades and constructing the proposed underground storm piping and drainage structures as shown on the Proposed

Site Grading and Storm-water Management Plan Dwg. 817-37 G-1, the desirable five(5)-year storm and 100-year storm event detention volume of $7.80m^3$ and $21.78m^3$ respectively will be available on site.

An inlet control device (ICD) will be installed at the outlet of STMH1 in the 300mm diameter storm pipe (outlet pipe) with Q=4.3L/s under a head of 2.45m. A rooftop drain with a release rate of 0.63L/s will be installed at Roof Drain 1, Roof Drain 2, and Roof Drain 3 of the proposed residential building rooftop as depicted on Dwg. 817-37 G-1. The five(5)-year and 100-year flow off site is restricted to 10.19L/s.

The ICD type recommended is a Hydrovex Regulator (50 VHV-1) or equivalent. See Appendix C for details.

The building weeping tile drainage will be outletted via a proposed 125mm PVC storm lateral, which is connected to the City of Ottawa's existing 900mm diameter storm sewer. The building roof drains will be outletted via a separately proposed 150mmØ PVC storm lateral, which is connected downstream of STMH1 into the proposed 300mmØ PVC storm sewer for storm-water outlet.

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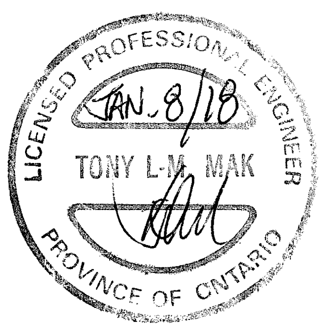


PROPOSED 603 CUMMINGS AVENUE RESIDENTIAL DEVELOPMENT SITE

TABLE 1

FIVE(5)-YEAR EVENT

FOR SITE UNDERGROUND PIPE AND DRAINAGE STRUCTURE

REQUIRED 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	141.20	9.36	2.15	7.21	2.16
10	104.20	6.91	2.15	4.76	2.86
15	83.50	5.54	2.15	3.39	3.05
20	70.30	4.66	2.15	2.51	3.01
25	60.90	4.04	2.15	1.89	2.84

Therefore, the required underground pipe and drainage structure storage volume is 3.05m^3.

*Note: Q Allow=½ of 4.30L/s

PROPOSED 603 CUMMINGS AVENUE RESIDENTIAL DEVELOPMENT SITE

TABLE 2

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)
10	104.20	2.19	0.63	1.56	0.94
15	83.50	1.76	0.63	1.13	1.017
20	70.30	1.48	0.63	0.85	1.02
25	60.90	1.28	0.63	0.65	0.98
30	53.93	1.14	0.63	0.51	0.92

Therefore, the required rooftop storage volume is 1.02m^3.

TABLE 3

FIVE(5)-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)
10	104.20	2.12	0.63	1.49	0.90
15	83.50	1.70	0.63	1.07	0.97
20	70.30	1.43	0.63	1.80	0.96
25	60.90	1.24	0.63	0.61	0.92
30	53.93	1.09	0.63	0.46	0.83

Therefore, the required rooftop storage volume is 0.97m^3.

TABLE 4

FIVE(5)-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)
10	104.20	2.19	0.63	1.56	0.94
15	83.50	1.76	0.63	1.13	1.017
20	70.30	1.48	0.63	0.85	1.02
25	60.90	1.28	0.63	0.65	0.98
30	53.93	1.14	0.63	0.51	0.92

Therefore, the required rooftop storage volume is 1.02m^3.

TABLE 5

100-YEAR EVENT

SITE REQUIRED STORAGE

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	242.8	18.57	2.15	16.42	4.93
10	178.6	13.66	2.15	11.51	6.91
15	142.9	10.93	2.15	8.78	7.90
20	120.0	9.18	2.15	7.03	8.44
25	103.9	7.95	2.15	5.8	8.70
30	91.9	7.03	2.15	4.88	8.78
35	82.6	6.32	2.15	4.17	8.76
40	75.1	5.75	2.15	3.60	8.64

Therefore, the required storage volume is 8.78m^3.

*Note: Q Allow=½ of 4.3L/s

TABLE 6

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	4.18	0.63	3.55	2.13
15	142.9	3.34	0.63	2.71	2.44
20	120.0	2.81	0.63	2.18	2.62
25	103.9	2.43	0.63	1.80	2.70
30	91.9	2.15	0.63	1.52	2.74
35	82.6	1.93	0.63	1.30	2.73
40	75.1	1.76	0.63	1.13	2.71
45	69.1	1.62	0.63	0.99	2.67

Therefore, the required rooftop storage volume is 2.74m^3.

TABLE 7

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	4.02	0.63	3.39	2.03
15	142.9	3.22	0.63	2.59	2.33
20	120.0	2.70	0.63	2.07	2.48
25	103.9	2.34	0.63	1.71	2.57
30	91.9	2.07	0.63	1.44	2.59
35	82.6	1.86	0.63	1.23	2.58
40	75.1	1.69	0.63	1.06	2.54
45	69.1	1.56	0.63	0.93	2.51

Therefore, the required rooftop storage volume is 2.59m^3.

TABLE 8

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	4.18	0.63	3.55	2.13
15	142.9	3.34	0.63	2.71	2.44
20	120.0	2.81	0.63	2.18	2.62
25	103.9	2.43	0.63	1.80	2.70
30	91.9	2.15	0.63	1.52	2.74
35	82.6	1.93	0.63	1.30	2.73
40	75.1	1.76	0.63	1.13	2.71
45	69.1	1.62	0.63	0.99	2.67

Therefore, the required rooftop storage volume is 2.74m^3.

PROPOSED THREE(3) AND ONE-HALF STOREY RESIDENTIAL APARTMENT BUILDING SITE

PART OF LOT 25

CONCESSION 1 (OTTAWA FRONT)

GEOGRAPHIC TOWNSHIP OF GLOUCESTER

603 CUMMINGS AVENUE

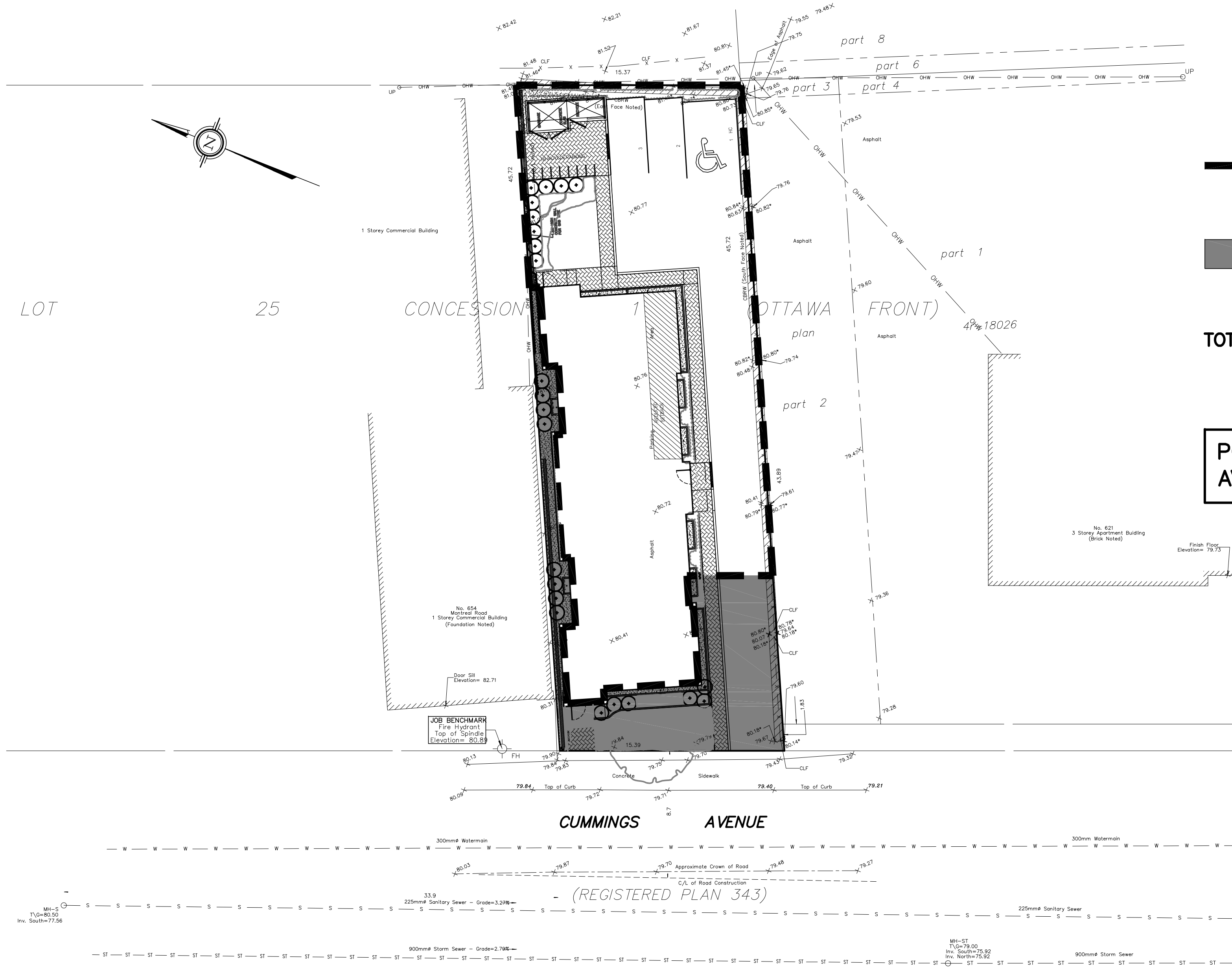
CITY OF OTTAWA

APPENDIX A

STORM DRAINAGE AREA PLAN

FIGURE 1

PROPOSED 603 CUMMINNGS AVENUE
SITE DEVELOPMENT
DRAINAGE AREA PLAN
NOT TO SCALE



LEGEND

- LIMIT OF CONTROLLED STORM DRAINAGE AREA =552.98 SQ. M
- UNCONTROLLED STORM DRAINAGE AREA =148.62 SQ. M

TOTAL AREA = 701.6 SQ. M

POST-DEVELOPMENT SITE AVERAGE "C" = 0.77

FIGURE 1

PROPOSED THREE(3) AND ONE-HALF STOREY RESIDENTIAL APARTMENT BUILDING SITE

PART OF LOT 25

CONCESSION 1 (OTTAWA FRONT)

GEOGRAPHIC TOWNSHIP OF GLOUCESTER

603 CUMMINGS AVENUE

CITY OF OTTAWA

APPENDIX B

DETAILED CALCULATIONS

FOR FIVE(5)-YEAR AND 100-YEAR

AVAILABLE STORAGE VOLUME

AVAILABLE STORAGE VOLUME CALCULATIONS

Five(5)-Year Event

Underground Storm Pipe and Drainage Structure Storage Volume
Assume five(5)-year HWL=78.00m (see attached Dwg. 817-37 G-1)

Drainage Structure Storage
STMH1 Oversized manhole
$V=L\times W\times H$
$V=2.438\times 1.829\times 0.70m^3$
$V=3.07m^3$

Total drainage structure storage volume $=3.12m^3$.

Total underground drainage structure volume $=3.12m^3$.
Therefore, the total underground drainage structure storage volume available at HWL=78.00m is estimated at $3.12m^3$ >required five(5)-year underground pipe and drainage structure storage volume of $3.05m^3$ from Table 1.

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 10U.S.gal./min. or 0.63L/s.

Roof Storage Area 1
Available flat roof area for storage $=83.3m^2$ @roof slope of 2.0% minimum or 110mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V=\frac{(0.11\text{m})[43.2+4(10.80)+0]}{6}$$
$$V=\frac{(0.11)(86.4)}{6}$$
$$V=1.58\text{m}^3$$

The available Roof Area 1 storage volume of $1.58m^3$ >required five(5)-year storage volume of $1.02m^3$ from Table 2.

Roof Storage Area 2
Available flat roof area for storage $=81.0m^2$ @roof slope of 2.0% minimum or 110mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V=\frac{(0.11\text{m})[40.75+4(10.51)+0]}{6}$$
$$V=\frac{(0.11)(82.79)}{6}$$

$V = 1.52m^3$

The available Roof Area 2 storage volume of $1.52m^3$ >required five(5)-year storage volume of $0.97m^3$ from Table 3.

Roof Storage Area 3

Available flat roof area for storage =$83.3m^2$ @roof slope of 2.0% minimum or 110mm of water height above the roof drain. Therefore, the available roof area will store a volume as shown below using the reservoir volume equation.

$$V = \frac{(0.11m)[43.2 + 4(10.80) + 0]}{6}$$

$$V = \frac{(0.11)(86.4)}{6}$$

$$V = 1.58m^3$$

The available Roof Area 3 storage volume of $1.58m^3$ >required five(5)-year storage volume of $1.02m^3$ from Table 4.

Therefore, the ponding depth at the proposed three(3) drain locations is approximately 0.11m (110mm), 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 is adequate to store the minimum required five(5)-year storm event volume of $3.01m^3$ given it can store up to $4.68m^3$. The total available underground drainage structure storage volume is $3.12m^3$, which is greater than the required $3.05m^3$ calculated volume at the estimated HWL=78.00m. The total storage available is $7.8m^3$, which is greater than the minimum required volume of $6.06m^3$.

AVAILABLE STORAGE VOLUME CALCULATIONS

100-Year Event

Assume 100-year HWL=79.90m (see attached Dwg. 817-37 G-1 with the flood limit shown)

Drainage Structures Storage

STMH1 oversized manhole

V=L×W×H

V=2.438×1.829×1.607m^3

V=7.16m^3

CB 2

V=$(0.6)^2$ (1.65)

=0.59m^3

CB 3

V=$(0.6)^2$ (1.65)

=0.59m^3

CB 4
$V=(0.6)^2\ (1.49)$
$=0.54m^3$

Total drainage structure storage volume=$8.88m^3$.

Underground Pipe Storage
Storm Pipe Storage
28m of 300mm diameter PVC pipe
$V=\pi\ (0.15)^2\ (28.0)$
$V=0.63m^3$

3.0m of 200mm diameter PVC pipe
$V=\pi\ (0.10)^2\ (3.0)$
$V=0.03m^3$

Total pipe storage volume =$0.66m^3$.

Total effective underground storm pipe and drainage structure volume =$9.54m^3$.

Therefore, the total underground storm pipe and drainage structure storage volume available at HWL=79.90m is estimated at $9.54m^3$ >required 100-year storage volume of $8.78m^3$ from Table 5.

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 10U.S.gal./min. or 0.63L/s.

Roof Storage Area 1
Available flat roof area for storage =$83.3m^2$ @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.

$$\mathrm{V} = \frac{(0.15\mathrm{m})[83.3 + 4(20.45) + 0]}{6}$$

$$\mathrm{V} = \frac{(0.15)(165.1)}{6}$$

$$\mathrm{V} = 4.13\mathrm{m}^3$$

The available Roof Area 1 storage volume of $4.13m^3$ >required 100-year storage volume of $2.74m^3$ from Table 6.

Roof Storage Area 2

Available flat roof area for storage =81.0m^2 @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.

$$V = \frac{(0.15\text{m})[81.0 + 4(19.58) + 0]}{6}$$

$$V = \frac{(0.15)(159.32)}{6}$$

$$V = 3.98\text{m}^3$$

The available Roof Area 2 storage volume of 3.98m^3 >required 100-year storage volume of 2.59m^3 from Table 7.

Roof Storage Area 3

Available flat roof area for storage =83.3m^2 @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.

$$V = \frac{(0.15\text{m})[83.3 + 4(20.45) + 0]}{6}$$

$$V = \frac{(0.15)(165.1)}{6}$$

$$V = 4.13\text{m}^3$$

The available Roof Area 3 storage volume of 4.13m^3 >required 100-year storage volume of 2.74m^3 from Table 8.

Therefore, the ponding depth at the proposed three(3) drain 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 six(6) roof scuppers as shown on Dwg. 817-37 G-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 buildup at the roof drain.

Hence, Roof Area 1, Roof Area 2, and Roof Area 3 of the proposed residential building flat rooftop storage is adequate to store the minimum required 100-year storm event volume of 8.07m^3 given it can store up to 12.24m^3. The total available underground storm pipe and drainage structure storage volume is 9.54m^3, which is greater than the required 8.78m^3 calculated volume at the estimated HWL=79.90m. The total site storage available is 21.78m^3, which is greater than the minimum site required volume of 16.85m^3.

PROPOSED THREE(3) AND ONE-HALF STOREY RESIDENTIAL APARTMENT BUILDING SITE

PART OF LOT 25

CONCESSION 1 (OTTAWA FRONT)

GEOGRAPHIC TOWNSHIP OF GLOUCESTER

603 CUMMINGS AVENUE

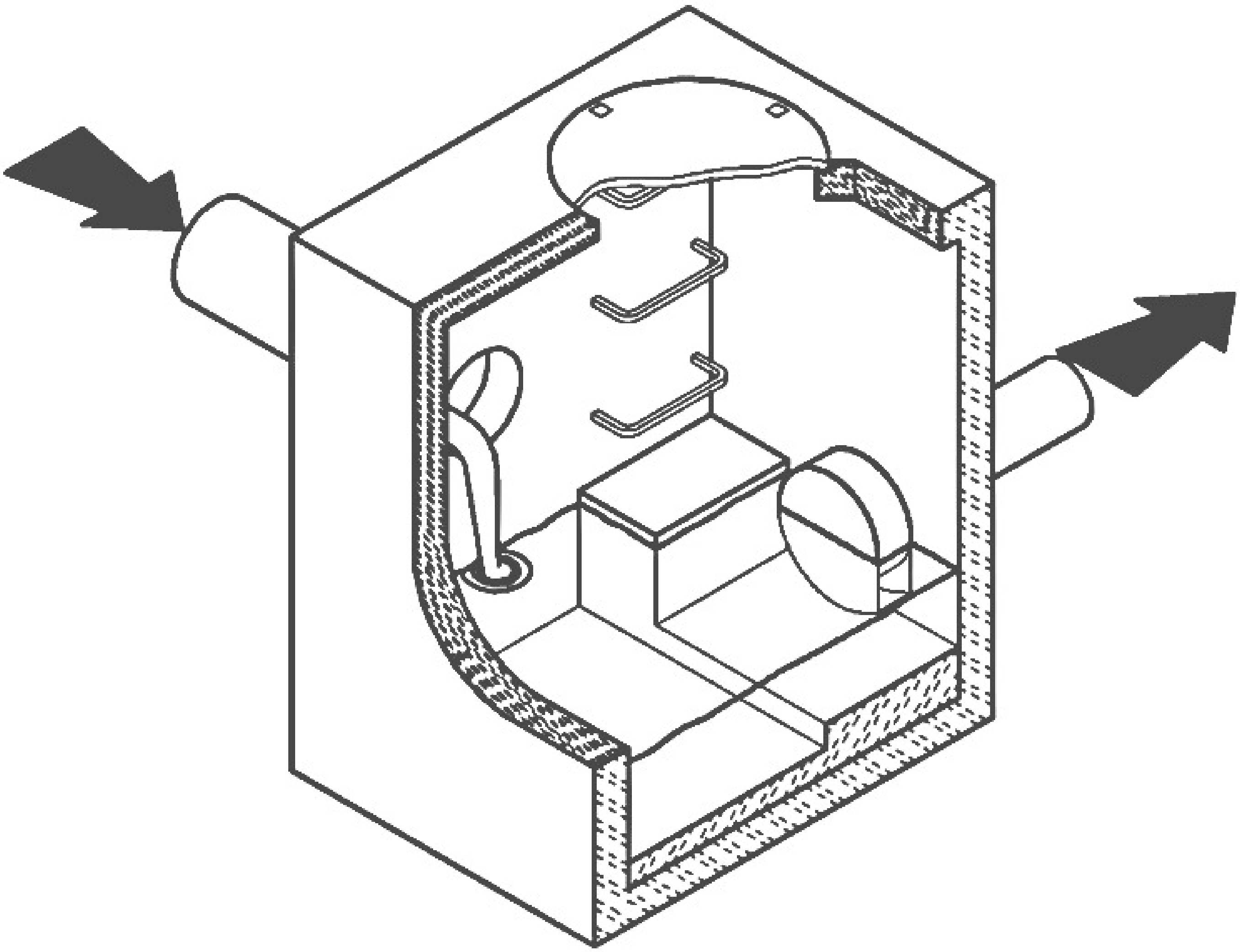
CITY OF OTTAWA

APPENDIX C

INLET CONTROL DEVICE (ICD) DETAILS

HYDROVEX MODEL 50 VHV-1

® HYDROVEX® VHV / SVHV
Vertical Vortex Flow Regulator



JOHN MEUNIER

APPLICATIONS

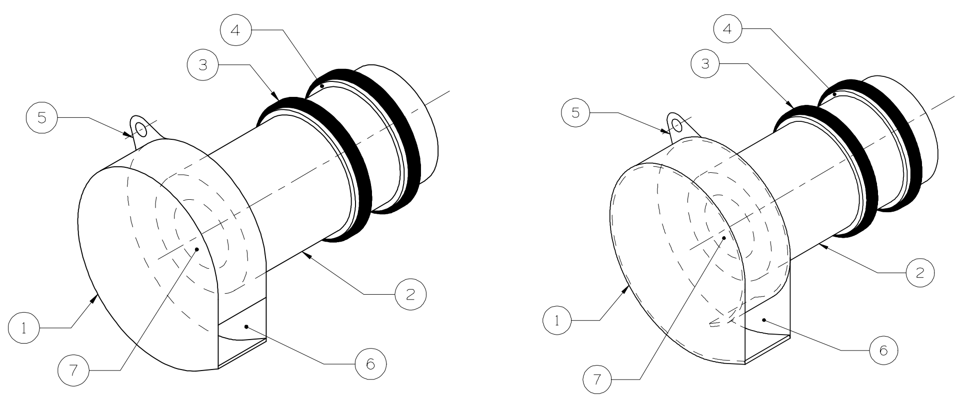
One of the major problems of urban wet weather flow management is the runoff generated after a heavy rainfall. During a storm event, uncontrolled flows may overload the drainage system and cause flooding. Sewer pipe wear and network deterioration are increased dramatically as a result of increased flow velocities. In a combined sewer system, the wastewater treatment plant will experience a significant increase in flows during storms, thereby losing its treatment efficiency.

A simple means of managing excessive water runoff is to control excessive flows at their point of origin, the manhole. **John Meunier Inc.** manufactures the **HYDROVEX® VHV / SVHV** line of vortex flow regulators for point source control of stormwater flows in sewer networks, as well as manholes, catch basins and other retention structures.

The **HYDROVEX® VHV / SVHV** design is based on the fluid mechanics principle of the forced vortex. The discharge is controlled by an air-filled vortex which reduces the effective water passage area without physically reducing orifice size. This effect grants precise flow regulation without the use of moving parts or electricity, thus minimizing maintenance. Although the concept is quite simple, over 12 years of research and testing have been invested in our vortex technology design in order to optimize its performance.

The **HYDROVEX® VHV / SVHV** Vertical Vortex Flow Regulators **(refer to Figure 1)** are manufactured entirely of stainless steel, and consist of a hollow body (**1**) (in which flow control takes place) and an outlet orifice (**7**). Two rubber "O" rings (**3**) seal and retain the unit inside the outlet pipe. Two stainless steel retaining rings (**4**) are welded on the outlet sleeve to ensure that there is no shifting of the "O" rings during installation and operation.

1. BODY
2. SLEEVE
3. O-RING
4. RETAINING RINGS (SQUARE BAR)
5. ANCHOR PLATE
6. INLET
7. OUTLET ORIFICE



VHV ***SVHV***

FIGURE 1: HYDROVEX® VHV-SVHV VERTICAL VORTREX FLOW REGULATORS

ADVANTAGES

- As a result of the air-filled vortex, a **HYDROVEX® VHV / SVHV** flow regulator will typically have an opening 4 to 6 times larger than an orifice plate. Larger opening sizes decrease the chance of blockage caused by sediments and debris found in stormwater flows. **Figure 2** shows the discharge curve of a vortex regulator compared to an equally sized orifice plate. One can see that for the same height of water and same opening size, the vortex regulator controls a flow approximately four times smaller than the orifice plate.

- Having no moving parts, they require minimal maintenance.

- Submerged inlet for floatables control.

- The **HYDROVEX® VHV / SVHV** line of flow regulators are manufactured entirely of stainless steel, making them durable and corrosion resistant.

- Installation of the **HYDROVEX® VHV / SVHV** flow regulators is quick and straightforward and is performed after all civil works are completed.

- Installation requires no assembly, special tools or equipment and may be carried out by any contractor.

®HYDROVEX®

VHV/SVHV Vortex Flow Regulator

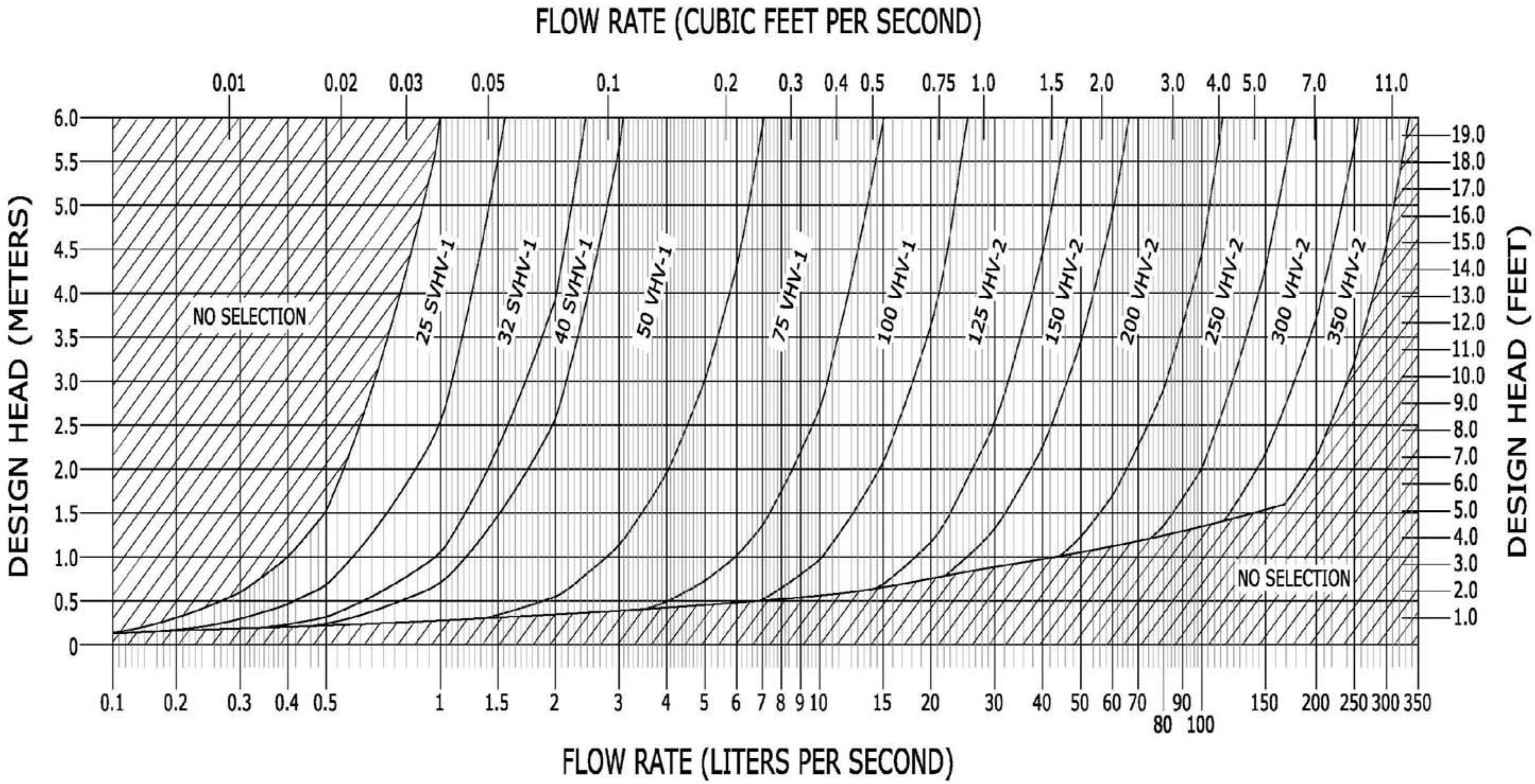


FIGURE 3

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