BANK AND SLATER TOWER III
215 SLATER STREET
STORMWATER MANAGEMENT REPORT

Prepared for:

B+H ARCHITECTS

Prepared by:

NOVATECH ENGINEERING CONSULTANTS LTD.
Suite 200, 240 Michael Cowpland Drive
Kanata, Ontario
K2M 1P6

November 3, 2009

Ref: R-2009-133
Novatech File No. 109026

November 3, 2009

B+H Architects
481 University Avenue, Suite 300.
Toronto, Ontario, Canada
M5G 2H4

Attention: Mr. Alex Stanichevsky

Dear Sir:

Re: Bank and Slater Tower III
Stormwater Management Report
Our File No.: 109026

Please find enclosed a copy of the Stormwater Management (SWM) Report for the above noted project. This study addresses the mitigation of stormwater related impacts due to the development of the proposed building. This report is hereby submitted for your review and approval. If you require any additional information, please do not hesitate to contact the undersigned.

Yours truly,

NOVATECH ENGINEERING CONSULTANTS LTD.

Miroslav Savic, P. Eng.
Project manager
MS/ms

cc: Bruce Coombe (City of Ottawa) – 9 copies
Douglas Smith (Smith and Andersen) – 1 copy

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ATTACHED PLANS:

1.0 INTRODUCTION

Novatech Engineering Consultants Ltd. was attained to prepare the stormwater management report for the Bank and Slater Tower III project. The project includes a multi-storey building that occupies the majority of the site. The building will incorporate the existing façades of the buildings currently fronting Bank Street. There will be three levels of underground parking that will connect to the adjacent site's existing underground parking garage.

The site is bounded by Slater Street to the north, Laurier Avenue West to the south, and Bank Street to the east. Refer to the Key Plan shown on the attached drawings.

The existing buildings currently occupying the site will be demolished and the proposed building will be built to front both Bank and Slater Street. It will be serviced by connecting to the existing watermain, sanitary and storm sewers in Slater Street.

In order to compare the post-development flow to the allowable flow, the assessment was limited only to the 0.432-hectare area to be redeveloped.

2.0 STUDY OBJECTIVES

The approach for the stormwater management design is not to exceed the allowable flow for the site, calculated using a runoff coefficient of 0.70, as specified by the City of Ottawa. All post-development runoff in excess of the allowable will be stored and controlled on site prior to being released into the existing storm sewer in Slater Street.

3.0 PRE-DEVELOPMENT CONDITIONS

3.1 THE SITE

The site area to be redeveloped is currently occupied by two 3 storey retail buildings that face Bank Street with a parking lot located within the middle of the site that has access from both Slater and Laurier Ave. W. Refer to Figure 1: Existing Conditions Plan for details. The existing parking lot currently sheet drains to various on-site catchbasins that connect to the storm sewer in Bank Street. The parking lot adjacent to Laurier Avenues sheet drains to the street catchbasin along Laurier Avenue.

3.3 ALLOWABLE RELEASE RATE

As mentioned previously, the approach is to undertake a stormwater management design which will not exceed the allowable release rate as specified by the City of Ottawa. The allowable release rate was calculated using the Rational Method, with a runoff coefficient of 0.70 and a time of concentration of 20 minutes.

The allowable release rate for the redeveloped 0.432 ha site was calculated to be 59.1 L/s for the1:5 year design event (refer to Appendix A for detailed calculations). The 1:100 year post-development runoff will be controlled to the 1:5 year pre-development runoff.

4.0 POST-DEVELOPMENT CONDITIONS

4.1 DEVELOPMENT PROPOSAL

Due to the extent of hard surfaced areas and limited allowable release rate from the site, any runoff in excess of the allowable quantity will be stored on site, up to and including the 1:100 year design event. Water quantity control will be achieved by the combination of an inlet control device (ICD) and the use of an internal storage tank.

4.2 POST-DEVELOPMENT FLOW

The post-development flow from the site consists of uncontrolled direct runoff from a small portion of the paved and landscaped areas and controlled flow. The uncontrolled runoff includes direct runoff from Area A-1. The controlled flow from the site includes flow from the proposed building roof top and the runoff captured from the access lane (Area A-2 and A-3).

The runoff from Area A-2 will be capture by the on-site catchbasin and controlled prior to being released to the existing storm sewer in Laurier Ave. Stormwater runoff from Area A-3 will be captured by the proposed building roof drains and will be collected by internal storm plumbing and directed to the stomwater storage tank and controlled before being released into the existing storm sewer in Slater Street.

Groundwater collected by the weeping tile will be pumped directly from a sump to the storm service, by-passing the stormwater storage tank.

4.2.1 AREA A-1: UNCONTROLLED RUNOFF

The post-development runoff from Area A-1 (uncontrolled runoff) was calculated using the Rational Method to be 13.7 L/s for the 1:5 year design event and 26.0 L/s for the 1:100 year design event (refer to Appendix A for detailed calculations).

The uncontrolled runoff captured by the four area drains and the two trench drains will be collected by internal plumbing that will bypass the stormwater management tank and connect to the storm service connecting to the existing storm sewer within Slater Street.

4.2.2 AREA A-2: PAVED AREA DRAINING TO CB1

The post-development runoff from Area A-2 was calculated using the Rational Method to be 8.4 L/s for the 1:5 year design event and 16.0 L/s for the 1:100 year design event

(refer to Appendix A for detailed calculations). To achieve the allowable release rate from the site the runoff from this area will be controlled.

In order to reduce the flow from this catchment area, an inlet control device (ICD) will be located within the outlet pipe of CB 1. A Hydrovex 75 VHV-1 will be installed to control the 1:100 year design event to a maximum rate of 7.8 L/s with a design head of 1.88m. The same Hydrovex will control the 1:5 year design event to 7.5 L/s with a design head of 1.81m. Stormwater runoff from the 1:5 year and 1:100 year design events will be stored within the underground structure as well as on the surface up to a maximum ponding depth of 0.18m.

The Modified Rational Method was used to determine the storage volume required for this catchment area. Based on a release rate of 7.8 L/s, the required storage volume for the 1:100 year design event was calculated to be approximately 8.7m^3. Similarly, based on the release rate of 7.5 L/s, the required storage volume for the 1:5 year design event was calculated to be approximately 3.0m^3. The structure and paved parking surface provide a maximum storage volume of approximately 12.1m^3 up to an elevation of 72.85m. Refer to Appendix B for detailed calculations.

Required storage volumes, maximum storage provided, water elevations, ponding depths, and controlled design flows are summarized in the following table.

Design Event	Storage Volume (m^3)		Water Elevation (m)	Ponding Elevation (m)	Controlled Design Flow (L/s)
	Required (m^3)	Max Provided (m^3)			
1:5 yr	3.0	12.1	72.76	0.11	7.5
1:100 yr	10.1	12.1	72.83	0.18	7.8

4.2.3 AREA A-3: FLOW TO STORAGE TANK (ROOFTOP, AND AREA DRAINS)

The post-development flow from Area A-3 was calculated using the Rational Method to be 53.8 L/s for the 1:5 year design event and 102.0 L/s for the 1:100 year design event. Both events exceed the remaining allowable flow for the area (refer to Appendix A for detailed calculations).

The Modified Rational Method was used to determine the storage volume required for the area. The storage tank is sized to provide stormwater storage for the 1:100 year design event using an allowable flow of 25.3 L/s. The outlet pipe from the tank will be at an elevation of 69.23m to provide a gravity outlet to the Slate Street sewer.

The required storage volume for the 1:100 year design event, 95.1m^3, will be stored entirely within the tank up to an elevation of approximately 71.58m. The storage elevation required to store the 1:5 year design event, 44.3m^3, is approximately 70.32m. Refer to Appendix B for detailed calculations. The stormwater storage tank will be

designed to provide 0.30m freeboard between the 1:100 year water level and the access opening in the tank, providing a factor of safety for less frequent events.

An 88mm diameter orifice will be installed at the outlet pipe to control the release rate to 25.3 L/s for the 1:100 year design event, with a design head of 2.31m. The same orifice will also control the 1:5 year flow, releasing it at 17.1 L/s with a design head of 1.05m (refer to Appendix A for orifice control calculations).

4.2.4 POST-DEVELOPMENT FLOW SUMMARY

A summary of the post-development flows from the site for both the 1:5 year and 1:100 year design events and allowable release rate is shown in the following table.

Design Event	Allowable Release Rate (L/s)	Post-Development Flow (L/s)			
		Area A-1	Area A-2	Area A-3	Total
1:5 yr	59.1	13.7	7.5	17.1	38.3
1:100 yr	59.1	26.0	7.8	25.3	59.1

Consequently, post-development flows from the site will not exceed the allowable release rate. The 1:100 year design event will essentially be controlled to 1:5 year pre-development conditions

5.0 EROSION AND SEDIMENT CONTROL MEASURES

Temporary erosion and sediment control measures will be implemented during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites", (Government of Ontario, May 1987). These measures include:

- Placement of filter fabric under all catchbasins and maintenance hatches
- Silt fences around the area under construction placed as per OPSS 577 and OPSD 219.110

The proposed erosion and sediment control measures will be implemented prior to construction and will remain in place during all phases of construction. Regular inspection and maintenance of the erosion control measures will be under taken.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions are as follows:

- The post-development flows from the site will not exceed the allowable release rate for the site, calculated using the Rational Method with a runoff coefficient of 0.70 and a time of concentration of 20 minutes.
- Water quantity control will be achieved by a combination of surface and structure storage as well as the use of a stormwater storage tank.
- Stormwater from the rooftop (Area A-3) will be directed to the stormwater storage tank. Flow from the tank will be controlled to 25.3L/s for a 1:100 year event and 17.1L/s for the 1:5 year design event by the use of an 88mm dia. ICD.
- Stormwater collected by CB1 (Area A-2) will be controlled to 7.5L/s and 7.8L/s for the 1:5yr and 1:100 year design events respectively. The runoff will be controlled by a Hydrovex 75VHV ICD installed in the outlet pipe of CB1.
- The total post-development flow entering the Slater Street storm sewer for the 1:5 year and 1:100 year design events are 30.8L/s and 51.3 L/s.
- The total post-development flow entering the Laurier Avenue West storm sewer for the 1:5 year and 1:100 year design events are 7.5 L/s and 7.8 L/s.
- Flow from the weeping tile will be pumped directly from a sump to the storm service, by-passing the internal stormwater storage tank.

It is recommended that the proposed stormwater management system be approved for implementation.

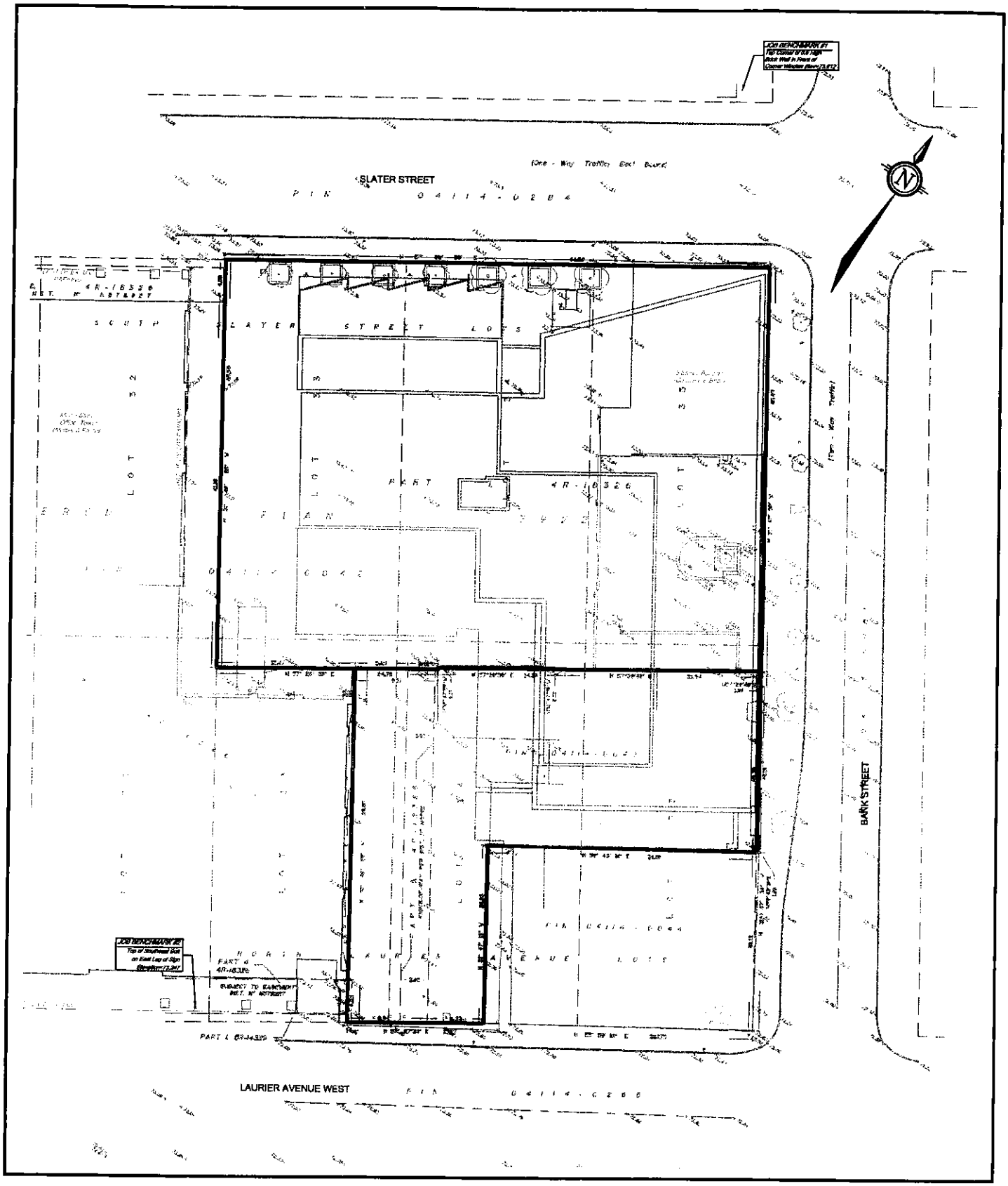
NOVATECH ENGINEERING CONSULTANTS LTD.

Prepared by:

Cody Oram, B.A.Sc.
EIT

Reviewed by:

M. Savic, P. Eng.
Project Manager



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BANK AND SLATER
TOWER III
EXISTING CONDITIONS

109026 NOV 2009 FIGURE 1

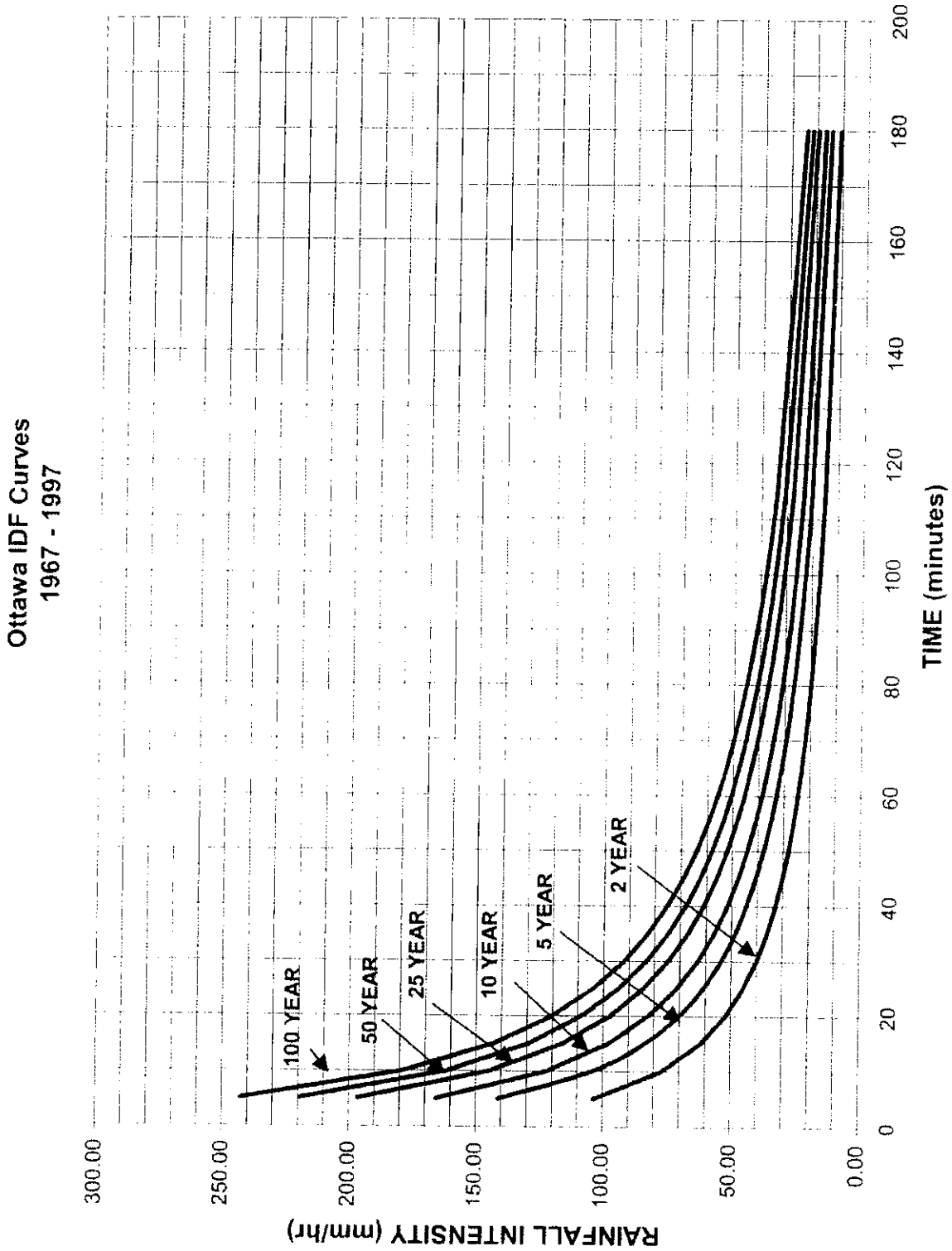
SHT8X11.DWG - 216mmX278mm

Drawing:M:\2009\109026\CAD\figure\109026-FIG1.dwg Layout:Sheet 8xII portrait Updated OCT 29, 2009 at 3:52pm by coram

APPENDIX A

IDF CURVES, RUNOFF CALCULATIONS

APPENDIX 5-A OTTAWA INTENSITY DURATION FREQUENCY (IDF) CURVE



RATIONAL METHOD

The Rational Method was used to determine both the allowable runoff as well as the post-development runoff for the proposed site. The equation is as follows:

Q=2.78 CIA

Where:
Q is the runoff in L/s
C is the weighted runoff coefficient*
I is the rainfall intensity in mm/hr**
A is the area in hectares

*The weighted runoff coefficient is determined for each of the catchment areas as follows:

$$C = \frac{(A_{perv} \times C_{perv}) + (A_{imp} \times C_{imp})}{A_{tot}}$$

Where:
A_{perv} is the pervious area in hectares
C_{perv} is the pervious area runoff coefficient (C_{perv}=0.20)
A_{imp} is the impervious area in hectares
C_{imp} is the impervious area runoff coefficient (C_{imp}=0.90)
A_{tot} is the catchment area (A_{perv} + A_{imp}) in hectares

** The rainfall intensity is taken from the City of Ottawa IDF Curves

ALLOWABLE RELEASE RATE

The allowable release rate was calculated for the 0.432-hectare redeveloped site, using a runoff coefficient of 0.70 and a time of concentration of 20 minutes, as specified by the City of Ottawa.

Drainage Area (A) = 0.432 ha
Runoff Coefficient (C) = 0.70
Intensity (I_5) = 70.3 mm/hr

Q= 2.78 CIA
Q_5= 2.78 x 0.70 x 70.3 x 0.426
Q_5= 59.1 L/s

POST-DEVELOPMENT RUNOFF

The post development runoff from the site is calculated using a time of concentration of 20min, as specified by the City of Ottawa.

AREA A-1: DIRECT RUNOFF

Drainage Area (A) = 0.078 ha
Impervious Area = 0.078 ha
Pervious Area = 0.0 ha
Runoff Coefficient (C_5) = 0.9
Runoff Coefficient (C_{100}) = 1.0
Intensity (I_5) = 70.3 mm/hr
Intensity (I_{100}) = 119.95 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.9 x 70.3 x 0.078
Q_5= 13.7 L/s

Q_{100}= 2.78 CIA
Q_{100}= 2.78 x 1.0 x 119.95 x 0.078
Q_{100}= 26.0 L/s

AREA A-2: PAVED AREA DRAINING TO CB1

Drainage Area (A) = 0.048 ha
Impervious Area = 0.048 ha
Pervious Area = 0.000 ha
Runoff Coefficient (C_5) = 0.9
Runoff Coefficient (C_{100}) = 1.0
Intensity (I_5) = 70.3 mm/hr
Intensity (I_{100}) = 119.95 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.90 x 70.3 x 0.048
Q_5= 8.4 L/s

Q_{100}= 2.78 CIA
Q_{100}= 2.78 x 1.0 x 119.95 x 0.042
Q_{100}= 16.0 L/s

AREA A-3: FLOW TO STORAGE TANK (ROOFTOP DRAINS)

Drainage Area (A) = 0.306 ha
Impervious Area = 0.306 ha
Pervious Area = 0.0 ha
Runoff Coefficient (C_5) = 0.9
Runoff Coefficient (C_{100}) = 1.0
Intensity (I_5) = 70.3 mm/hr
Intensity (I_{100}) = 119.95 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.90 x 70.3 x 0.306
Q_5= 53.8 L/s

Q_{100}= 2.78 CIA
Q_{100}= 2.78 x 1.0 x 119.95 x 0.306
Q_{100}= 102.0 L/s

ORIFICE CONTROLS: Area A-3 Storage Tank

The following equation is used to size the orifice, given a specified release rate and design head.

$Q = 0.62 \times A \times (2gh)^{1/2}$

Where:
Q is the release rate in m^3/s
A is the orifice area in m^2
g is the acceleration due to gravity, 9.81 m/s^2
h is the head of water in m
d is the diameter of the orifice in m

An 88mm diameter orifice will be installed in the outlet pipe of the storage tank to control the release rate to 25.3 L/s for the 1:100 year design event. The calculated design head is 2.31m

$Q = 0.62 \times A \times (2gh)^{1/2}$
$0.0253 = 0.62 \times A \times (2 \times 9.81 \times 2.31)^{1/2}$
$A = 0.00606$
$A = 3.14 \times d^2/4$
d = 0.08785 m, therefore use a 88mm orifice

Iterative calculations were done to determine the release rate for the 1:5 year design events. The same 88mm diameter orifice will release the 1:5 year design event at the rate of 17.1 L/s with a design head of 1.05m

APPENDIX B

SWM CALCULATIONS

BANK AND SLATER
PROJECT No. 109026
REQUIRED STORAGE - 1:5 YEAR EVENT
AREA A-2

OTTAWA IDF CURVE

Area =	0.048	ha	Qallow =	7.50	L/s
C =	0.90		Vol(max) =	3.0	m3

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	16.95	9.45	2.84
10	104.19	12.51	5.01	3.01
15	83.56	10.03	2.53	2.28
20	70.25	8.44	0.94	1.12
25	60.90	7.31	-0.19	-0.28
30	53.93	6.48	-1.02	-1.84
35	48.52	5.83	-1.67	-3.51
40	44.18	5.31	-2.19	-5.26
45	40.63	4.88	-2.62	-7.08
50	37.65	4.52	-2.98	-8.93
55	35.12	4.22	-3.28	-10.83
60	32.94	3.96	-3.54	-12.76
65	31.04	3.73	-3.77	-14.71
70	29.37	3.53	-3.97	-16.68
75	27.89	3.35	-4.15	-18.68
80	26.56	3.19	-4.31	-20.69
85	25.37	3.05	-4.45	-22.71
90	24.29	2.92	-4.58	-24.75

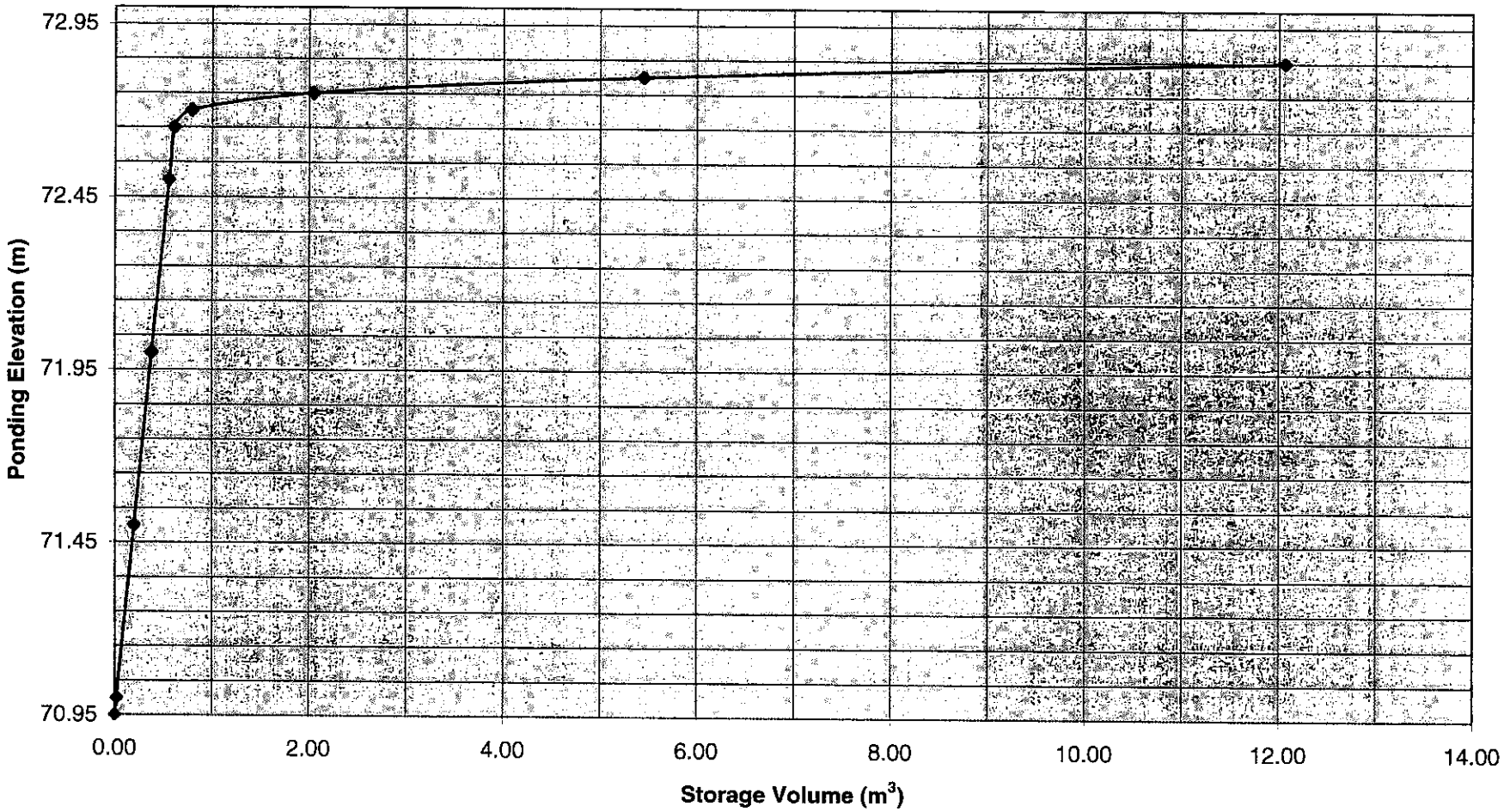
BANK AND SLATER
PROJECT No. 109026
REQUIRED STORAGE - 1:100 YEAR EVENT
AREA A-2

OTTAWA IDF CURVE

Area =	0.048	ha	Qallow =	7.80	L/s
C =	1.00		Vol(max) =	10.1	m3

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	32.39	24.59	7.38
10	178.56	23.83	16.03	9.62
15	142.89	19.07	11.27	10.14
20	119.95	16.01	8.21	9.85
25	103.85	13.86	6.06	9.09
30	91.87	12.26	4.46	8.03
35	82.58	11.02	3.22	6.76
40	75.15	10.03	2.23	5.35
45	69.05	9.21	1.41	3.82
50	63.95	8.53	0.73	2.20
55	59.62	7.96	0.16	0.52
60	55.89	7.46	-0.34	-1.23
65	52.65	7.03	-0.77	-3.02
70	49.79	6.64	-1.16	-4.86
75	47.26	6.31	-1.49	-6.72
80	44.99	6.00	-1.80	-8.62
85	42.95	5.73	-2.07	-10.55
90	41.11	5.49	-2.31	-12.50

BANK AND SLATER TOWER III
Stage Storage Curve: Area A-2
CB1 Surface Storage



BANK AND SLATER
PROJECT No. 109026
REQUIRED STORAGE - 1:5 YEAR EVENT
AREA A-3

OTTAWA IDF CURVE

Area =	0.306	ha	Qallow =	17.10	L/s
C =	0.90		Vol(max) =	44.28	m3

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	108.09	90.99	27.30
10	104.19	79.77	62.67	37.60
15	83.56	63.97	46.87	42.19
20	70.25	53.79	36.69	44.02
25	60.90	46.62	29.52	44.28
30	53.93	41.29	24.19	43.54
35	48.52	37.15	20.05	42.10
40	44.18	33.83	16.73	40.15
45	40.63	31.11	14.01	37.82
50	37.65	28.83	11.73	35.18
55	35.12	26.89	9.79	32.31
60	32.94	25.22	8.12	29.24
65	31.04	23.77	6.67	26.00
70	29.37	22.49	5.39	22.63
75	27.89	21.35	4.25	19.13
80	26.56	20.34	3.24	15.53
85	25.37	19.42	2.32	11.84
90	24.29	18.60	1.50	8.08

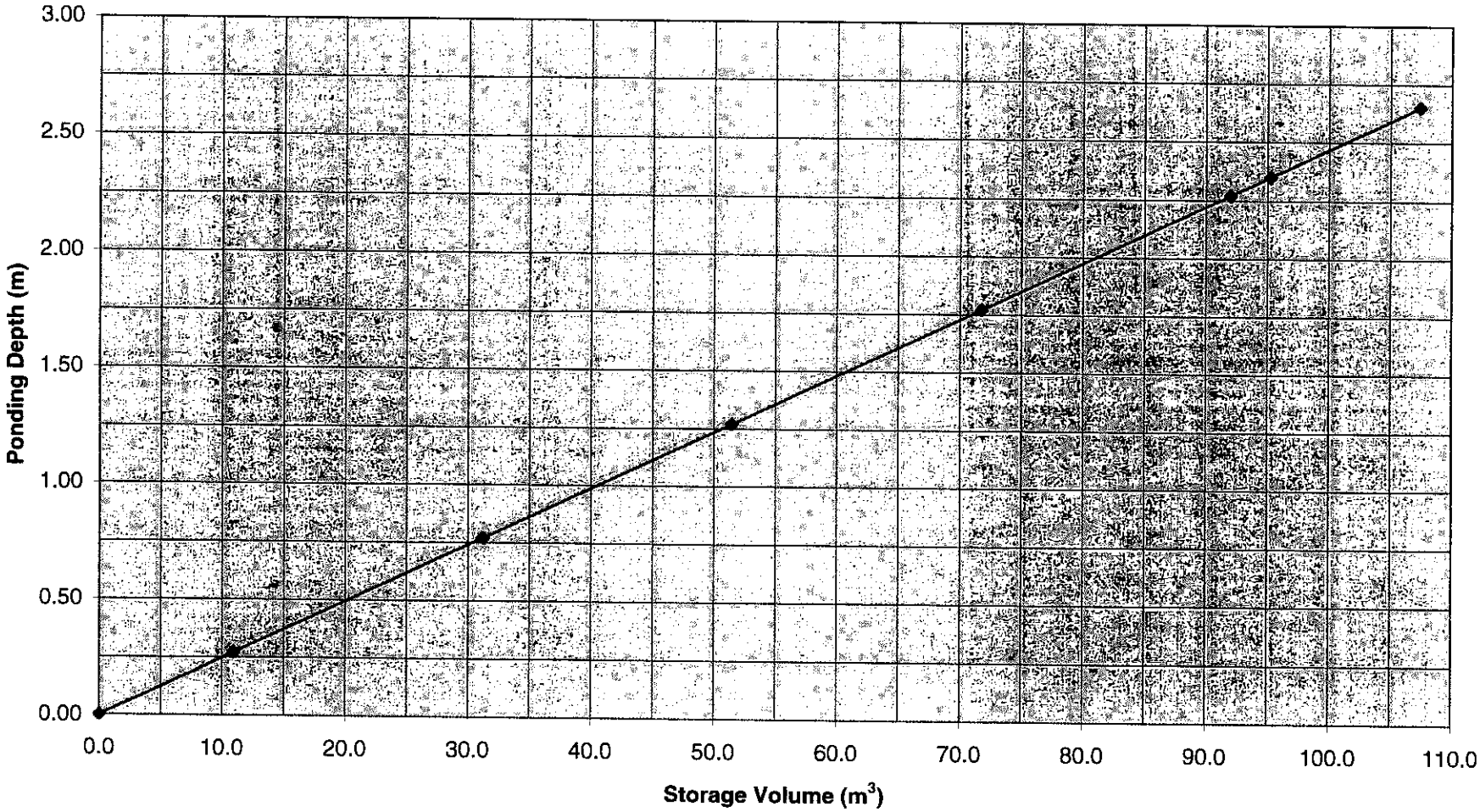
BANK AND SLATER
PROJECT No. 109026
REQUIRED STORAGE - 1:100 YEAR EVENT
AREA A-3

OTTAWA IDF CURVE

Area =	0.306	ha	Qallow =	25.30	L/s
C =	1.00		Vol(max) =	95.13	m3

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	206.46	181.16	54.35
10	178.56	151.90	126.60	75.96
15	142.89	121.56	96.26	86.63
20	119.95	102.04	76.74	92.09
25	103.85	88.34	63.04	94.56
30	91.87	78.15	52.85	95.13
35	82.58	70.25	44.95	94.39
40	75.15	63.92	38.62	92.70
45	69.05	58.74	33.44	90.29
50	63.95	54.40	29.10	87.31
55	59.62	50.72	25.42	83.89
60	55.89	47.55	22.25	80.09
65	52.65	44.79	19.49	75.99
70	49.79	42.36	17.06	71.63
75	47.26	40.20	14.90	67.05
80	44.99	38.27	12.97	62.27
85	42.95	36.54	11.24	57.32
90	41.11	34.97	9.67	52.23

BANK AND SLATER TOWER III
Stage Storage Curve: Area A-3
Stormwater Storage Tank



APPENDIX C

JOHN MEUNIER – HYDROVEX INFORMATION

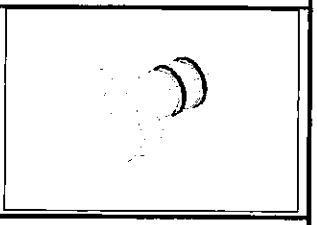
JOHN MEUNIER

DATA SHEET
(S)VHV
VERTICAL HYDROVEX VALVE

GENERAL INFORMATION

APPLICATION : STORMWATER

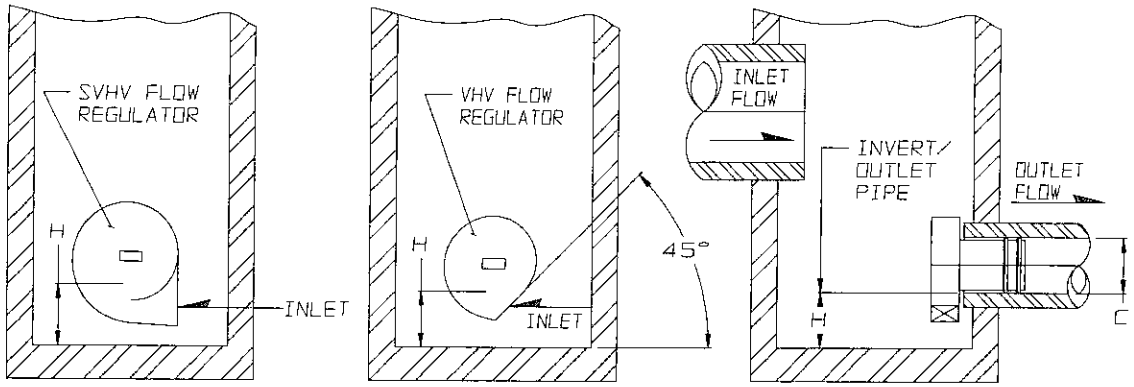
PROJECT :	Bank & Slater St. Towers	**MODEL**	75 VHV-1
LOCATION :	Ottawa		
FILE N°:	0,00	**Quantity**	1
CLIENT:	0	**Location**	0



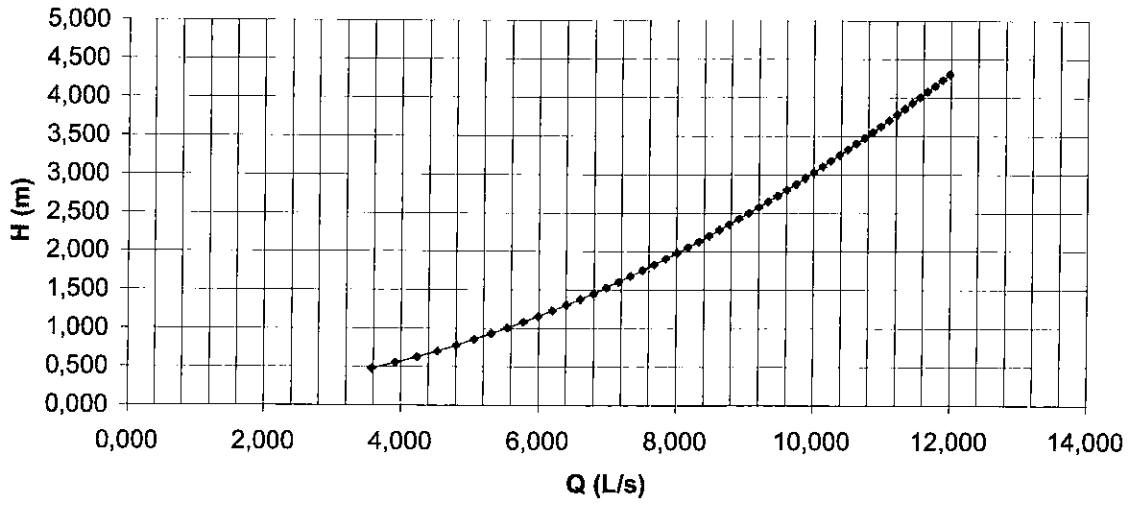
DIMENSIONS Interior Diameter (DI) of the outlet pipe (C) 200 mm DR-35

Maximum water level (MWL)	1,88	m
Minimum clearance (H)	152	mm
Minimum manhole Diameter (B)	600	mm
Design Flow rate	7,8	l/s

TYPICAL MANHOLE INSTALLATION
INSTALLATION



DISCHARGE CURVE VORTEX VALVE



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JOHN MEUNIER

LOCATION	0
MAXIMUM PASSING DIAMETER OF SPHERE	SEE DIM B
FLOW RATE (Q) l/s	7,8
DESIGN HEAD (H) m	1,88
WEIGTH OF UNIT (kg)	10
PROJECT	Bank & Slater St. Towers
MODEL	75 VHV-1