1050 Somerset Avenue
Ottawa, Ontario

Servicing Brief and

Stormwater Management Report

1050 SOMERSET AVENUE
OTTAWA, ONTARIO

SERVICING BRIEF AND STORMWATER MANAGEMENT REPORT

Prepared by:

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File No.: 111152-0
Report Reference No.: R-2012-024
February 2012

NOVATECH ENGINEERING CONSULTANTS LTD.

February 3, 2012

City of Ottawa
Planning and Growth Management Department
Development Review (Urban) Branch
Infrastructure Approvals Division
110 Laurier Avenue West, 4th Floor
Ottawa, Ontario
K1P 1J1

Attention: **Joshua White**

Dear Sir:

Reference: 1050 Somerset Street
Servicing Design Brief
Our File No.: 111152

Enclosed herein is the Servicing Brief and Stormwater Management Report for the proposed development located at 1050 Somerset Street. This report is submitted in support of the rezoning and site plan applications. It outlines how the site will be serviced with sanitary sewer, storm sewer and watermain.

Trusting this report is adequate for your purposes. Should you have any questions, or require addition information, please contact me.

Yours truly,

NOVATECH ENGINEERING CONSULTANTS LTD.

Greg MacDonald, P. Eng.
Senior Project Manager

GM/sb

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1.0 INTRODUCTION

The development planned at 1050 Somerset Street is located on the south-west corner of Somerset Street and Breezehill Avenue in the City of Ottawa, as shown in Figure 1 - Key Plan. The development will consist of a 28-storey high-rise condominium building with 567 square metres of ground floor commercial fronting Somerset Street, 7 two-storey townhouse units located at the rear occupying the first two levels of the building and 264 condominium units on Floors 2 to 28. Five (5) levels of underground parking will be provided with access off of a City Laneway along the west side of the building.

As identified in the City of Ottawa's Zoning By-law (ZBL), the site is currently designated as TM[126]H(15) and TM11[126]H(20) – Traditional Main Street zone which accommodates a broad range of uses including retail, service commercial, office, residential and institutional, including mixed-use buildings. A zoning amendment application will seek to revise the site's current designation to TM11 as well as an increase in height. Specific details are provided in the Planning Rationale submitted as part of the ZBL Amendment application.

The site area is approximately 0.24 hectares. New construction will replace a one storey building which contains a retail store and an automotive repair facility. The current building has an access onto Somerset Street and Breezehill Avenue. Access on Somerset Street is for the shared parking and paved laneway for the retail store and the neighboring properties. The access to the automotive repair facility is off of Breezehill Avenue. A City-owned laneway is located directly adjacent to the west side of the site. The existing conditions are shown in Figure 2 – Existing Conditions.

This servicing design brief will outline how the site will be serviced with sanitary sewer, storm sewer and watermain. A general plan of services and grading plan of the proposed development is included in the back of this report.

2.0 REFERENCES AND SUPPORTING DOCUMENTS

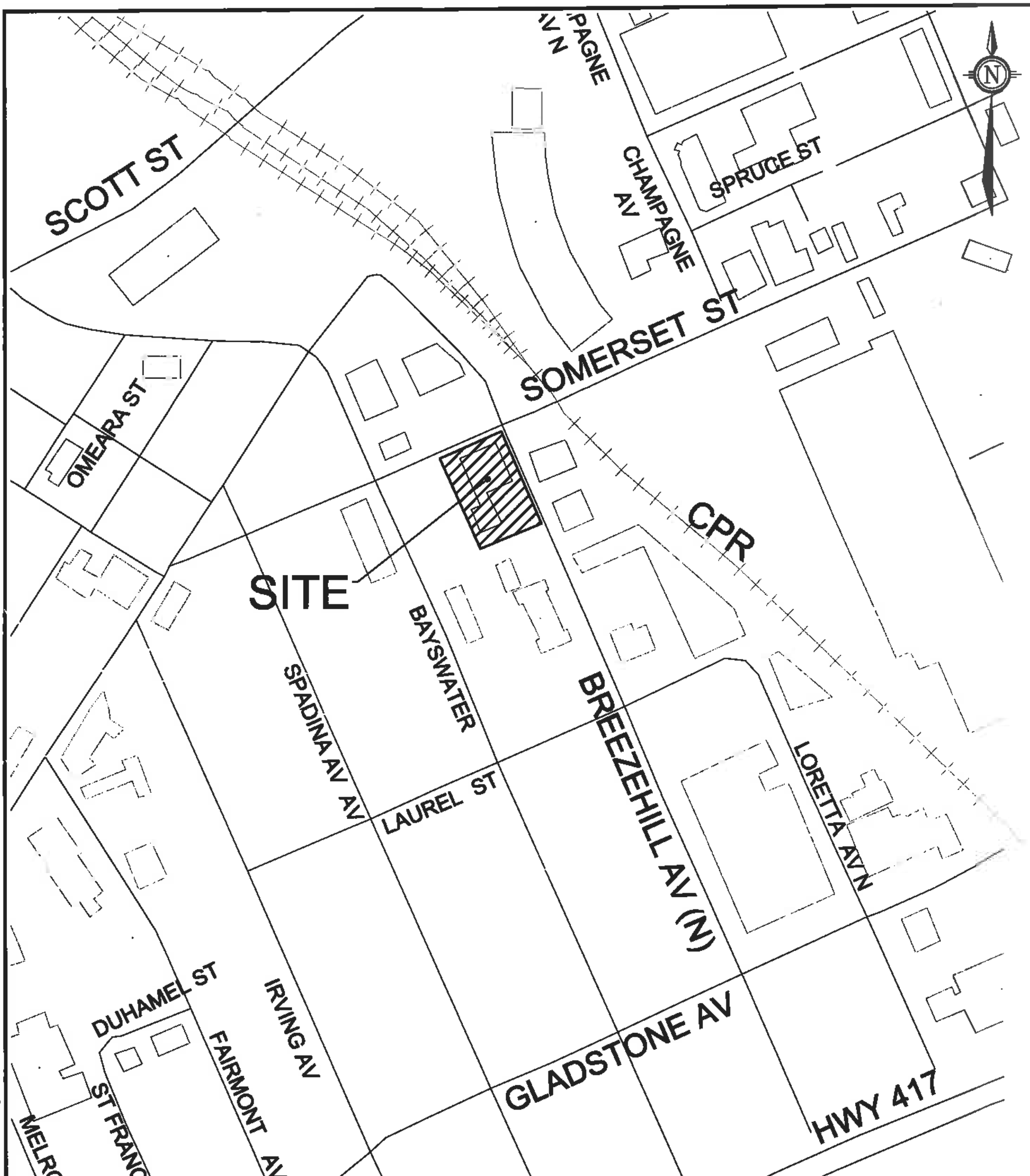
With regards to servicing, supporting documents include the City of Ottawa Sewer Design Guideline for wastewater flow evaluation and the City of Ottawa Design Guidelines for Water Distribution as will be discussed in Section 4.0 and 5.0.

The City of Ottawa Servicing Study Guidelines for Development Applications checklist has been completed and is attached in Appendix C.

3.0 STORM DRAINAGE AND STORMWATER MANAGEMENT

3.1 Study Objectives

The City will require that on-site stormwater management be implemented to control post-development stormwater discharge for both the 5 & 100 year storm events based on an allowable runoff coefficient (C) of 0.50, a time of concentration (T_c) of 20 minutes, and a 5-year storm control. Stormwater management will be achieved through the use of rooftop controls and



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CITY OF OTTAWA
1050 SOMERSET STREET

KEY PLAN

FEB. 2012 111152 FIGURE 1

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CITY OF OTTAWA
1050 SOMERSET STREET

EXISTING
CONDITIONS PLAN

FEB. 2012 111152 FIGURE 2

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surface ponding. Should surplus storage be required, stormwater management alternatives such as storage tanks or super-pipes will be implemented.

3.2 Pre-development Conditions

3.2.1 The Site

The site currently consists of a 1-storey mixed-use building. Existing conditions are shown – Figure 2.

3.2.2 Existing Drainage

Stormwater currently is captured by the roof drains on the flat roof of 1050 Somerset Street and by a catch basin in the rear parking lot. Drainage is conveyed to the storm sewer on Breezehill Avenue.

3.2.3 Criteria and Allowable Release Rate

The approach to the stormwater management design is to not exceed the allowable release rate as specified by the City of Ottawa for the newly developed areas. The allowable release rate will be calculated using a runoff coefficient of 0.50 and a time of concentration of 20 minutes. The allowable release rate for the proposed 0.24 ha site development is calculated to be 23.44 L/s using the Rational Method as follows:

Drainage Area (A) = 0.24 ha
Runoff Coefficient (C) = 0.50
Intensity (I5) = 70.25 mm/hr

Q= 2.78 CIA
Q= 2.78 x 0.50 x 70.25mm/hr x 0.24 ha
Q= 23.44 L/s

3.3 Post-Development Conditions

3.3.1 Development Proposal

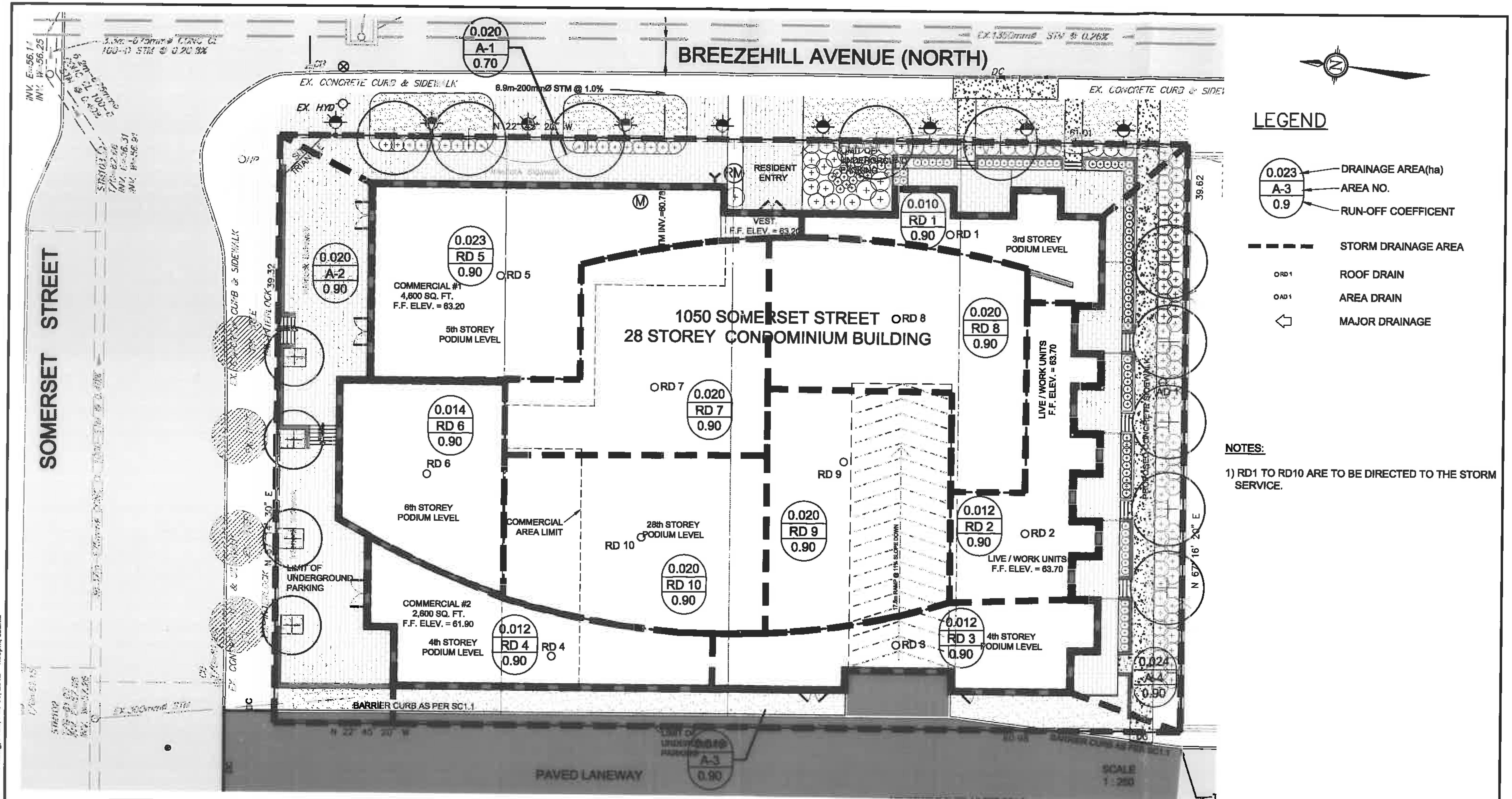
Due to the extent of hard surfaced areas and limited allowable release rate from the site, any runoff in excess of the allowable quantity will be stored on the roof of the proposed building, up to and including the 1:100 year design event.

3.3.2 Post-Development Flow

The post-development flow from the building consists of controlled flow from the building roof and landscaped decks in the rear and uncontrolled overland flows at the front of the buildings. Refer to the attached plans for details and drainage areas.

3.3.2.2 Area A-1 to Area A-3: Uncontrolled Areas

Areas in the front of the buildings along Somerset Street and Breezehill Avenue will flow overland uncontrolled to road catch basins on those streets. Runoff from the parking access ramp will be directed to the sanitary system inside the building. Roof top drainage will be collected and directed



PROPOSED BUILDINGS - ROOF & AREA DRAIN TABLE

ROOF DRAIN ID	ZURN SPECIFICATION	NOTCHES	POST-DEVELOPMENT CONDITIONS			
			1:5 YEAR EVENT		1:100 YEAR EVENT	
			FLOW (L/S)	DEPTH (m)	FLOW (L/S)	DEPTH (m)
RD 1	ZCF121-1W-X4-Z-105-10-77	1	0.39	0.105	0.51	0.137
RD 2 - 4	ZCF121-1W-X4-Z-105-10-77	1	0.40 x 3	0.108	0.52 x 3	0.140
RD 5	ZCF121-1W-X4-Z-105-10-77	1	0.43	0.116	0.55	0.149
RD 6	ZCF121-1W-X4-Z-105-10-77	1	0.41	0.110	0.53	0.142
RD 7 - 10	ZCF121-1W-X4-Z-105-10-77	1	0.425 x 4	0.114	0.545 x 4	0.147
AD 1	ZN-221-2NH-G-P-X-VP-Y	1	2.63	0.045	2.76	0.067
TOTAL			5.49		8.10	

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CITY OF OTTAWA
1050 SOMERSET STREET

STORM WATER MANAGEMENT PLAN

FEB. 2012 111152 FIGURE 3

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to the 1050mm diameter storm sewer on Breezehill via a 200mm diameter storm building sewer. The uncontrolled area for A-1 and A-2 is 0.020 ha each and A-3 is 0.013 ha, respectively. Uncontrolled development flows for the 1:5 and 1:100 year design events are calculated below using the Rational Method (refer to Figure 3 for storm drainage areas).

Area A-1 & A-2

1:5 Year Event

Drainage Area (A) = 0.020 ha
Runoff Coefficient (C) = 0.70
Intensity (I_5) = 70.25 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.70 x 70.25mm/hr x 0.020 ha
Q_5= 2.73 L/s

Drainage Area (A) = 0.020 ha
Runoff Coefficient (C) = 0.90
Intensity (I_5) = 70.25 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.90 x 70.25mm/hr x 0.020 ha
Q_5= 3.52 L/s

1:100 Year Event

Drainage Area (A) = 0.020 ha
Runoff Coefficient (C) = 0.80
Intensity (I_{100}) = 119.95 mm/hr

Q_{100}= 2.78 CIA
Q_{100}= 2.78 x 0.80 x 119.95mm/hr x 0.020 ha
Q_{100}= 5.33 L/s

Drainage Area (A) = 0.020 ha
Runoff Coefficient (C) = 1.00
Intensity (I_{100}) = 119.95 mm/hr

Q_{100}= 2.78 CIA
Q_{100}= 2.78 x 1.00 x 119.95mm/hr x 0.020 ha
Q_{100}= 6.67 L/s

Area A-3

1:5 Year Event

Drainage Area (A) = 0.013 ha
Runoff Coefficient (C) = 0.90
Intensity (I_5) = 70.25 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.90 x 70.25mm/hr x 0.013 ha
Q_5= 2.29 L/s

1:100 Year Event

Drainage Area (A) = 0.013 ha
Runoff Coefficient (C) = 1.00
Intensity (I_{100}) = 119.95 mm/hr

Q_{100}= 2.78 CIA
Q_{100}= 2.78 x 1.00 x 119.95mm/hr x 0.013 ha
Q_{100}= 4.34 L/s

3.3.2.3 Remaining Allowable Release Rate

The maximum allowable storm flow for the remaining areas is the allowable release rate for the entire site less the uncontrolled flow. The following table indicates the allowable release rate for the entire site, the uncontrolled runoff and the remaining allowable release rate for the rest of the site areas for both the 5-year and 100-year storm events.

Table 3.3.1 Remaining Allowable Release Rate Summary

Area		Flow (L/s)	
		5-Year	100-Year
Entire Site (Legal Boundary)	Allowable	23.44	23.44
	Uncontrolled	8.54	16.34
Remaining Allowable Flow		**14.90**	**7.10**

3.3.2.4 Area R-1 to Area R-10: Controlled Development Roof Top Flows

The post-development flow from Areas R-1 to R-10 was calculated using the Rational Method to be 42.49 L/s for the 1:5 year design event and 80.91 L/s for the 1:100 year design event. Both events exceed the maximum allowable flow. Therefore, flow from the building roof will be controlled by Zurn rooftop drains. Flow through these drains is dependent on the height of water above the drain (H- Head) and the number of notches in the drain. Flow from the rooftop area has been summarized in Table 3.3.2a. Roof drain locations are shown in figure 3. Detailed calculations are included in Appendix A.

Table 3.3.2a Rooftop Drain Peak Flows

Area No.	Notches	ZURN ROOFDRAIN CONTROL PARAMETERS			
		1:5 YR EVENT		1:100 YR EVENT	
		Head (m)	Q (L/s)	Head (m)	Q (L/s)
R-1	1	0.105	0.39	0.137	0.51
R-2 to R-4	1	0.108	0.400 x 3 =1.20	0.140	0.52 x 3 = 1.56
R-5	1	0.116	0.43	0.149	0.55
R-6	1	0.110	0.41	0.142	0.53
R-7 to R-10	1	0.114	0.425 x 4 =1.70	0.147	0.545 x 4 = 2.19
Total			2.86		5.34

The Modified Rational Method was used to determine the storage volume required for the various rooftop drainage areas. Based on a controlled flow provided via the Zurn rooftop drains, the ponding depth on the roof above the drains will be approximately 0.100m for the 1:5 year design event and approximately 0.145m for the 1:100 year design event, as determined through iterative calculations between the release rate, head and corresponding storage. Refer to Appendix A for detailed calculations and to the Roof Drain Table shown on 111152-GP and Figure 3 (in back of report).

2.3.2.5 Area A-4: Controlled Development – Ground Surface Flows

The post-development flow from area A-4 (at rear of building) was calculated using the Rational Method to be 4.87 L/s for the 1:5 year design event and 9.53 L/s for the 1:100 year design event. Both events exceed the maximum allowable flow. Flow from the upper and lower decks will be controlled by inlet control devices. Flow from each deck area has been summarized in Table 3.3.2b (refer to Figure 3 for drain locations). Detailed calculations are contained in Appendix A.

Table 3.3.2b Area Drain Inlet Control Flow Summary

Area No.	Area Drain Specification	Structure No.	INLET CONTROL PARAMETERS			
			5-Year Event		100-Year Event	
			Depth (m)	Total Flow (L/s)	Depth (m)	Total Flow (L/s)
A-04	ZN-221-2NH-G-P-X-VP-Y	AD 1	0.045	2.63	0.067	2.76
			Total =	2.63	Total =	2.76

The Modified Rational Method was used to determine the storage volume required for each of the area drains. Based on a controlled flow provided via the Area Drain Restricted Inlet (2 inch dia. pipe), the ponding depth on the lower deck area above the grate will be 0.045 m and 0.067m for the 5-year storm event and 100-year storm event, respectively. This is determined through iterative calculations using the release rate, head, and corresponding storage. Refer to Appendix A for detailed calculations outlining the modified rational method used, the ponding depth, and stage-storage curves for each controlled drainage area.

3.3.2.6 Proposed Flow

The following table summarizes the controlled and uncontrolled flow for both the 1:5 year and 1:100 year design events.

Table 3.3.3 Proposed Post-Development Peak Flows

Area and Type of Control		Flow (L/s)	
		1:5 YR	1:100 YR
R-01 to R-10	Controlled	2.86	5.34
A-04	Controlled	2.63	2.76
Total Controlled Flow		5.49	8.10
Total Uncontrolled Flow		8.54	16.34

The 1:5 year design event post-development flow from the site will be controlled to 14.03 L/s and 24.44 L/s for the 5 year and 100 year design storms, respectively.

3.3.3 Major Overland Flow Route

The site will be graded such that flows in excess of the 100-year storm event will be conveyed overland to Breezehill Avenue and Somerset Street.

3.4 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. 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 undertaken.

4.0 *SANITARY SEWER*

The 28-storey high rise building at 1050 Somerset Street will be serviced by a 150 mm dia. service that will connect to the existing 300 mm dia. sanitary sewer on Breezehill which outlets quickly to the 1050mm diameter Mooney's Bay Collector. The proposed sanitary service connection to the building will be equipped with a full-port backwater valve.

Proposed development flows are presented below.

1050 Somerset Street Sanitary Flows Under Proposed Use

Residential Flow

Residential:
Population = (159units x 1.8persons/unit +105units x 2.1persons/unit + 7unitsx2.7persons/unit)
= 525 persons

Q_{SAN} = 525 persons x 350 L/person/day = 183,750 L/day

Average Sanitary Flow = 183,750 L/day = 2.13 L/sec

Peak Sanitary Flow = 8.50 L/sec (with PF = 4.0)

Commercial Flow

Commercial: Q_{SAN} = 567m^2 x 5 L/m^2/day = 2835 L/day

Average Sanitary Flow = 2835 L/day = 0.03 L/sec

Peak Sanitary Flow = 0.05 L/sec (with PF = 1.5)

Therefore,

Total Average Sanitary Flow = 2.16 L/sec
Total Peak Sanitary Flow = 8.55 L/sec (with PF)

Average Sanitary Flows Under Current Use

Currently, the site is being used as a retail store and an automotive repair facility. Based on this, sanitary flows which were directed to the sanitary sewer on Breezehill are calculated as follows:

1-Storey Building Floor Area = 0.240 ha (1050 Somerset Street)

Q_{ave} = 2400 m2 * 5 L/m2 = 12,000 L/day = 0.14 L/sec
Q_{peak} = 0.14 L/sec * 1.5 = 0.21 L/sec

Therefore,

Total Average Sanitary Flow = 0.14 L/sec
Total Peak Sanitary Flow = 0.21 L/sec (with PF)

Development sanitary flows under the proposed zoning are greater than the flows under existing zoning. Since flows are directed quickly to the City's Mooney's Bay Collector, there are no concerns with the capacity of the receiving sewer system.

5.0 WATER SUPPLY

5.1 Domestic Demand

The proposed 28-storey development will be serviced by a 150mm dia. watermain service, which will connect to the existing 150 mm dia. watermain located on Breezehill Avenue. Estimated domestic water demands for the development have been calculated below as per Table 4.2 of the Ottawa Water Distribution Design Guidelines.

1050 Somerset Residential Demand

Residential Demand

Population = (159units x 1.8persons/unit +105units x 2.1persons/unit + 7unitsx2.7persons/unit)
= 525 persons

Residential Average Demand = 525 persons x 350 L/person/day = 183,750 L/day = 2.13 L/sec

Residential Max Daily Demand = 183,750 L/day x 2.5 = 459,375 L/day = 5.32 L/sec

Residential Max Hourly Demand = 459,375 L/day x 2.2 = 1,010,625 L/day = 11.70 L/sec

Commercial Demand

Commercial Average Demand = 567m^2 x 5 L/m^2/day = 2835 L/day = 0.03 L/sec

Commercial Max Daily Demand = 2835 L/day x 1.5 = 4,252 L/day = 0.04 L/sec

Commercial Max Hourly Demand = 4,252 L/day x 1.8 = 7,782 L/day = 0.09 L/sec

Therefore,

Total Average Water Demand = 2.16 L/sec
Total Max Daily Water Demand = 5.36 L/sec
Total Max Hourly Demand = 11.79 L/sec

Based on the data provided by the City, the existing watermains in the area are adequate to meet the domestic water demands. Refer to Appendix B for watermain data.

5.2 Fire Demand

Section 4.2.11 of the City of Ottawa Water Design Guidelines reads:

"When calculating the fire flow requirements and affected pipe sizing, designers shall use the method developed by the Fire Underwriters Survey.", and

"The requirements for levels of fire protection on private property are covered in Section 7.2.11 of the Ontario Building Code."

The Fire Underwriters Survey is used to assess the performance of the water distribution system on a "City Block" basis rather than an individual building basis. The Ontario Building Code governs the assessment of fire demand for individual buildings.

Section 7.2.11.1 of the Ontario Building Codes states that the design, construction, installation and testing of fire service mains and water service pipe combined with fire service mains shall be in conformance with NFPA 24.

NFPA 24 is the standard for the "Installation of Private Fire Service Mains and their Appurtenances". Chapter 13 of NFPA 24 discusses sizing the private service fire mains for fire protection systems which shall be approved by the authority having jurisdiction, considering the following factors:
- Construction and Occupancy of the building
- Fire Flow and Pressure of the Water Required
- Adequacy of the Water Supply

Specific to this project the building will be sprinklered per Section 3.2.2.45 of the Ontario Building Code (OBC). Section 3.2.5.7 of the OBC requires that an adequate water supply for fire fighting be provided to each building, and references Appendix A of the OBC. Sentence 3 of Section A 3.2.5.7 of the OBC (Appendix A) states that NFPA 13 be used for determining both sprinkler and hose stream demands for a sprinklered building.

The design of the sprinkler system is completed by a Fire Protection Engineer, or typically computed by the sprinkler contractor and approved by the Fire Protection Engineer. The process involves detailed hydraulic calculations based on building layout, pipe runs, head losses, fire pump requirements, etc. At this stage in the development process, e.g. Site Plan Submission, these details are not available. However, using Chapter 7 of NFPA 13, it is possible to provide a fairly accurate estimate of the fire demand for the building. This estimate is provided below.

NFPA Chapter 7 Calculation

28 Storey Residential Building – Light Hazard
Underground Parking – Ordinary Hazard (Group 1)

Section 7.2.3 of NFPA 13, "Water Demand Requirements – Hydraulic Calculation Methods" is used to estimate the hose stream demand and the sprinkler demand. The water demand for sprinklers is estimated using the most remote area in the building. Figure 7.2.3.1.2 – Area/Density Curves is used for the worst case scenario, which in this case is the Ordinary Hazard Classification in the underground parking garage. For this classification, Figure 7.2.3.1.2 provides a density of 0.15 USgpm /ft2 using coverage of 1500 ft2, or 225 gpm (US).

Table 7.2.3.1.1 is used to determine the hose stream demand. For Ordinary Hazard a total combined inside and outside hose stream demand of 250 USgpm is required. Typically, 150 USgpm would be drawn off the hydrant and 100 USgpm off the hose cabinets.

Therefore, total estimated demand would be 225 USgpm + 250 USgpm = 475 USgpm. Adding an allowance for head losses though out the sprinkler system, an estimated fire demand of between 550 – 600 USgpm, or say 600 USgpm (2,270 L/min) would be required.

According to the fire hydrant data provided by the City, the existing watermains on Somerset and Breezehill can deliver this demand. The building will also be equipped with a fire pump, if necessary, to provide the minimum residual pressure at the sprinkler heads.

Reference material from NFPA 13 is contained in Appendix B.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the foregoing, development of the site will be supported by the following:

- Stormwater discharge from the site will be controlled to 24.44 L/Sec during a 100 year event which is very close to the target value of 23.44 L/sec. Storage will be provided on roof tops.
- Stormwater from the ramp to the underground parking levels will be directed to the internal sanitary sewer since the ramp is enclosed.
- The site will be graded such that flows in excess of the 100-year storm event will be conveyed overland to Somerset Street and Breezehill Avenue.
- Temporary erosion and sediment control measures will be implemented during construction.
- Although there will be an increase in sanitary flow to the City sewers, the receiving sewers have sufficient capacity to handle these flows, e.g. the Mooney's Bay Collector.
- The existing watermains on Somerset Street and Breezehill are sufficient to meet both the domestic and fire demands.

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Prepared by:

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Reviewed by:

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G.J. MacDONALD
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Senior Project Manager

APPENDIX A

IDF CURVES, RATIONAL METHOD, RUNOFF

and SWM CALCULATIONS

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 with a time of concentration of 10 min (refer to attached IDF Curves) as specified by the City of Ottawa.

ALLOWABLE RELEASE RATE AS SPECIFIED BY THE CITY

The allowable release rate was calculated for the 0.240-hectare site, using a runoff coefficient of 0.50 and a time of concentration of 20 minutes, as specified by the City of Ottawa.

Drainage Area (A) = 0.240 ha
Runoff Coefficient (C) = 0.50
Intensity (I_5) = 70.25 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.50 x 70.25 x 0.240
Q_5= 23.44 L/s

POST-DEVELOPMENT FLOW

The post-development uncontrolled flows from the building roof. These sample calculation below shows a typical uncontrolled flow calculation for the roof top area. These area are to be controlled by the Zurn roof top drains.

SAMPLE CALCULATION:

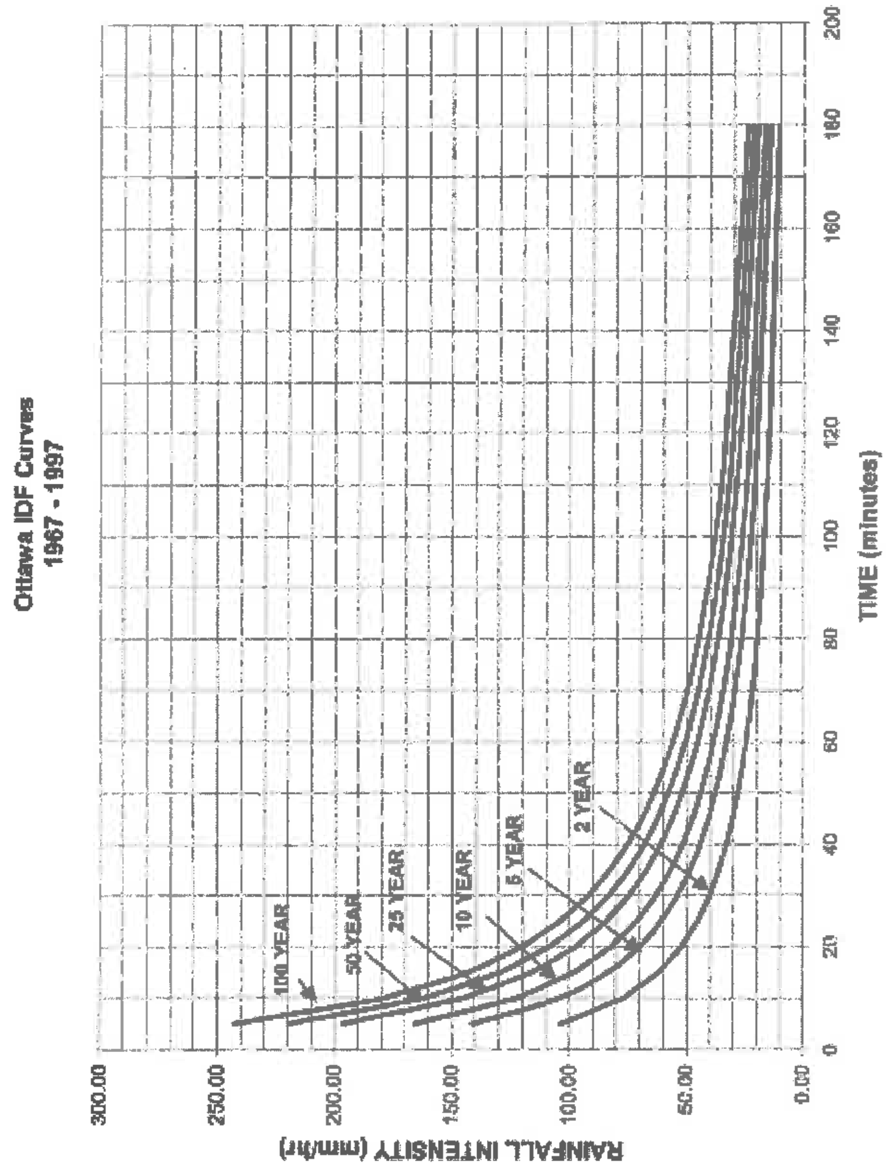
ROOF AREA R-01

Drainage Area (A) = 0.010 ha
Impervious Area = 0.010 ha
Pervious Area = 0.0000 ha
Runoff Coefficient (C_5) = 0.90
Runoff Coefficient (C_{100}) = 1.00 (C_5 x 1.25 or a maximum of 1.00)
Tc = 10 minutes
Intensity (I_5) = 104.19 mm/hr
Intensity (I_{100}) = 178.60 mm/hr

Q_5= 2.78 CIA
Q_5= 2.78 x 0.90 x 104.19 x 0.010ha
Q_5= 2.606 L/s

Q_{100}= 2.78 CIA
Q_{100}= 2.78 x 1.00 x 178.60 x 0.010ha
Q_{100}= 4.964L/s

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



** IDF CURVE FROM OTTAWA SEWER DESIGN GUIDELINES – NOV 2004*

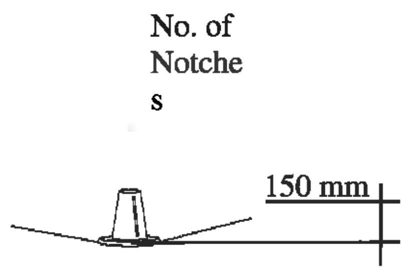
Zurn Roof Drains

Opening	G.P.M. Per Inch of Head	L.P.M. Per Inch (25 mm) of Head	L/s Per Metre of Head	L/s Per 0.15 m of Head
Standard - X1	5.00	22.73	14.92	2.24
Reduced - X2	3.75	17.05	11.19	1.68
Reduced - X3	2.50	11.37	7.46	1.12
Max Reduced - X4	1.25	5.68	3.73	0.56

SAMPLE CALCULATION:

AREA R-01

Number of notches (N) = 1
Head (H) = 0.110 m for 5-year event
Head (H) = 0.142 m for 100-year event



$Q_{5\ all}$ = 11.19 L/s/m/notch x H x N
$Q_{5\ all}$ = 3.73 L/s/m/notch x .11 m x 1 notch
$Q_{5\ all}$ = 0.39 L/s

$Q_{100\ all}$ = 11.19 L/s/m/notch x H x N
$Q_{100\ all}$ = 3.73 L/s/m/notch x .142 m x 1 notch
$Q_{100\ all}$ = 0.51 L/s

1050 SOMERSET STREET

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA R-01 : BUILDING ROOF

OTTAWA IDF CURVE

Area = 0.0100 ha | Qallow = 0.39
C = 0.90 | Vol(max) = 1.73
Notches = 1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	3.53	3.14	0.94
10	104.19	2.61	2.22	1.33
15	83.56	2.09	1.70	1.53
20	70.25	1.76	1.37	1.64
25	60.90	1.52	1.13	1.70
30	53.93	1.35	0.96	1.73
35	48.52	1.21	0.82	1.73
40	44.18	1.11	0.72	1.72
45	40.63	1.02	0.63	1.69
50	37.65	0.94	0.55	1.66
55	35.12	0.88	0.49	1.61
60	32.94	0.82	0.43	1.56
65	31.04	0.78	0.39	1.51
70	29.37	0.73	0.34	1.45
75	27.89	0.70	0.31	1.38
80	26.56	0.66	0.27	1.32
85	25.37	0.63	0.24	1.25
90	24.29	0.61	0.22	1.18

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m^2	V (factor)	V m^3	H m
44	3.000	1.48	0.1
54	3.000	1.97	0.11
64	3.000	2.56	0.12
75	3.000	3.25	0.13
87	3.000	4.07	0.14
100	3.000	5.00	0.15

Linear Interpolation

0.11	0.1	0.11	H =	0.105
1.97	1.48	1.97	1.73	

Qall 0.39

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA R-01 : BUILDING ROOF

OTTAWA IDF CURVE

Area = 0.01 ha | Qallow = 0.51
C = 1.00 | Vol(max) = 3.81
Notches = 1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	6.75	6.24	1.87
10	178.56	4.96	4.45	2.67
15	142.89	3.97	3.46	3.12
20	119.95	3.33	2.82	3.39
25	103.85	2.89	2.38	3.57
30	91.87	2.55	2.04	3.68
35	82.58	2.30	1.79	3.75
40	75.15	2.09	1.58	3.79
45	69.05	1.92	1.41	3.81
50	63.95	1.78	1.27	3.80
55	59.62	1.66	1.15	3.79
60	55.89	1.55	1.04	3.76
65	52.65	1.46	0.95	3.72
70	49.79	1.38	0.87	3.67
75	47.26	1.31	0.80	3.62
80	44.99	1.25	0.74	3.56
85	42.95	1.19	0.68	3.49
90	41.11	1.14	0.63	3.42

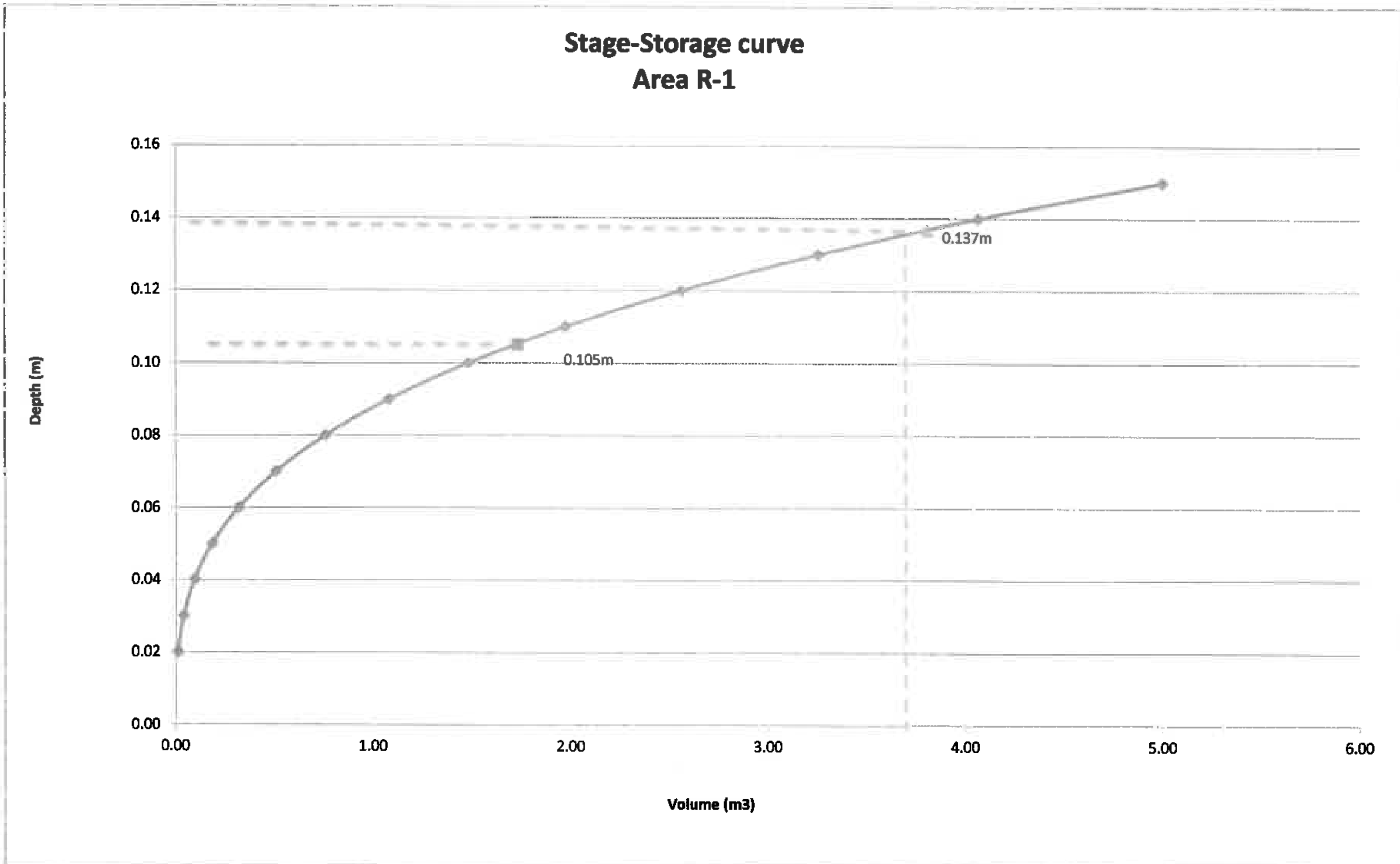
Ponding depth (1:100yr storm)

B m^2	V (factor)	V m^3	H m
44	3.000	1.48	0.1
54	3.000	1.97	0.11
64	3.000	2.56	0.12
75	3.000	3.25	0.13
87	3.000	4.07	0.14
100	3.000	5.00	0.15

Linear interpolation

0.14	0.13	0.14	H =	0.137
4.07	3.25	4.07	3.81	

Qall 0.51


Stage-Storage curve
Area R-1
Depth (m)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
Volume (m3)
0.137m
0.105m

1050 SOMERSET STREET

Project:111152
02/02/2012

REQUIRED STORAGE - 1:5 YEAR EVENT
AREA R-02 TO 04 : BUILDING ROOF

OTTAWA IDF CURVE

Area = 0.0120 ha; C = 0.90; Qallow = 0.40; Vol(max) = 2.22; Notinches = 1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	4.24	3.84	1.15
10	104.19	3.13	2.73	1.64
15	83.56	2.51	2.11	1.90
20	70.25	2.11	1.71	2.05
25	60.90	1.83	1.43	2.14
30	53.93	1.62	1.22	2.19
35	48.52	1.46	1.06	2.22
40	44.18	1.33	0.93	2.22
45	40.63	1.22	0.82	2.21
50	37.65	1.13	0.73	2.19
55	35.12	1.05	0.65	2.16
60	32.94	0.99	0.59	2.12
65	31.04	0.93	0.53	2.08
70	29.37	0.88	0.48	2.02
75	27.89	0.84	0.44	1.97
80	26.56	0.80	0.40	1.91
85	25.37	0.76	0.36	1.84
90	24.29	0.73	0.33	1.78

Qnet = Q - Qallow   Vol = Qnet x time

Ponding depth (1:5yr storm)

B m^2	V (factor)	V m^3	H m
53	3.000	1.78	0.1
65	3.000	2.37	0.11
77	3.000	3.07	0.12
90	3.000	3.91	0.13
105	3.000	4.88	0.14
120	3.000	6.00	0.15

Linear interpolation

0.11	0.1	0.11	H =	0.108
2.37	1.78	2.37	2.22	

Qall 0.40

REQUIRED STORAGE - 1:100 YEAR EVENT
AREA R-02 TO 04 : BUILDING ROOF

OTTAWA IDF CURVE

Area = 0.012 ha; C = 1.00; Qallow = 0.52; Vol(max) = 4.85; Notches = 1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	8.10	7.58	2.27
10	178.56	5.96	5.44	3.26
15	142.89	4.77	4.25	3.82
20	119.95	4.00	3.48	4.18
25	103.85	3.46	2.94	4.42
30	91.87	3.06	2.54	4.58
35	82.58	2.75	2.23	4.69
40	75.15	2.51	1.99	4.77
45	69.05	2.30	1.78	4.82
50	63.95	2.13	1.61	4.84
55	59.62	1.99	1.47	4.85
60	55.89	1.86	1.34	4.84
65	52.65	1.76	1.24	4.82
70	49.79	1.66	1.14	4.79
75	47.26	1.58	1.06	4.75
80	44.99	1.50	0.98	4.71
85	42.95	1.43	0.91	4.66
90	41.11	1.37	0.85	4.60

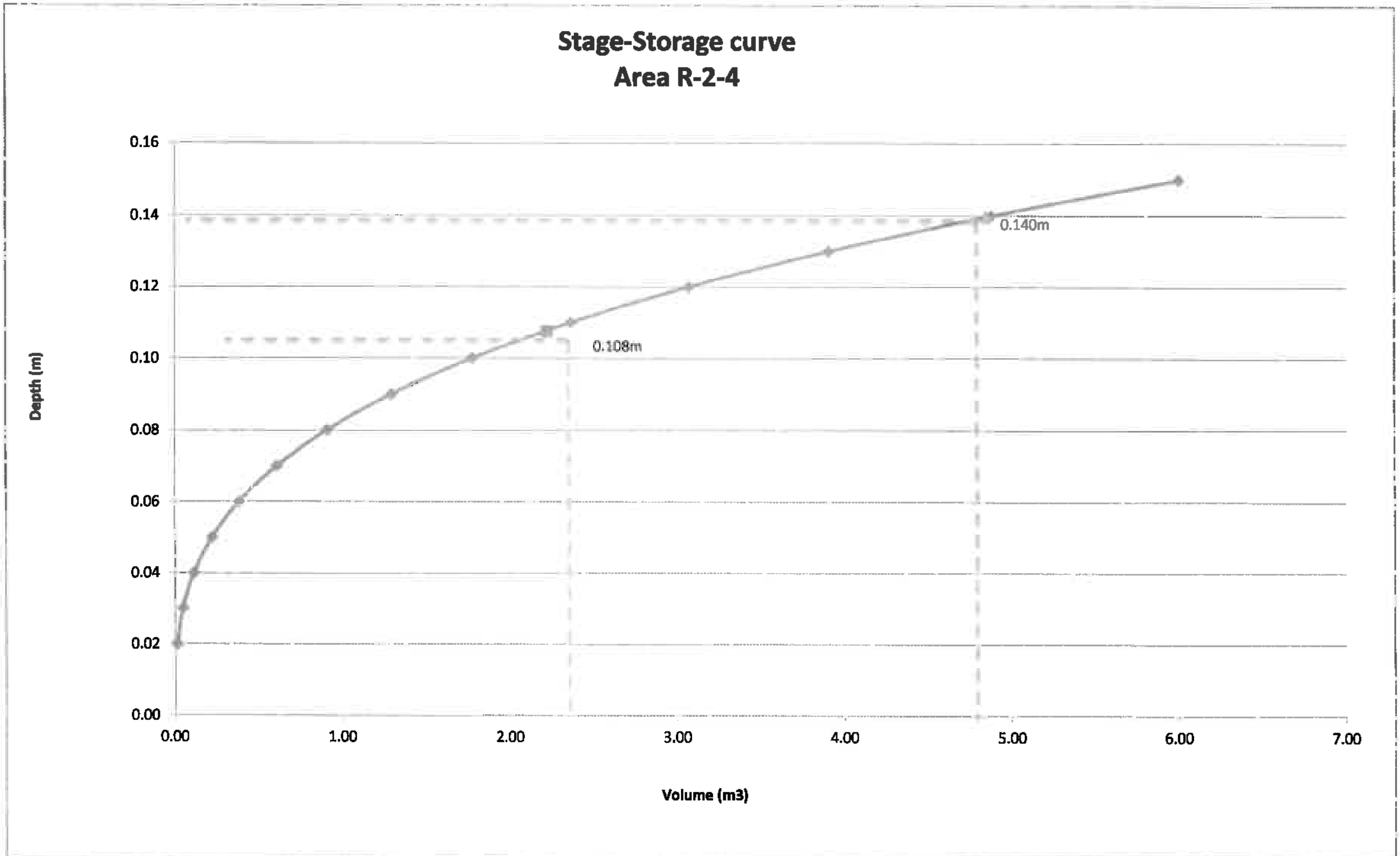
Ponding depth (1:100yr storm)

B m^2	V (factor)	V m^3	H m
53	3.000	1.78	0.1
65	3.000	2.37	0.11
77	3.000	3.07	0.12
90	3.000	3.91	0.13
105	3.000	4.88	0.14
120	3.000	6.00	0.15

Linear interpolation

0.14	0.13	0.14	H =	0.140
4.88	3.91	4.88	4.85	

Qall 0.52


Stage-Storage curve
Area R-2-4
Depth (m)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Volume (m3)
0.140m
0.108m

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA R-05 : BUILDING ROOF

OTTAWA IDF CURVE

Area = 0.023 ha Qallow = 0.43
C = 0.90 Vol(max) = 5.29
Notches = 1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	8.12	7.69	2.31
10	104.19	6.00	5.57	3.34
15	83.56	4.81	4.38	3.94
20	70.25	4.04	3.61	4.34
25	60.90	3.50	3.07	4.61
30	53.93	3.10	2.67	4.81
35	48.52	2.79	2.36	4.96
40	44.18	2.54	2.11	5.07
45	40.63	2.34	1.91	5.15
50	37.65	2.17	1.74	5.21
55	35.12	2.02	1.59	5.25
60	32.94	1.90	1.47	5.28
65	31.04	1.79	1.36	5.29
70	29.37	1.69	1.26	5.29
75	27.89	1.60	1.17	5.29
80	26.56	1.53	1.10	5.27
85	25.37	1.46	1.03	5.25
90	24.29	1.40	0.97	5.23

Qnet = Q - Qallow Vol = Qnet x time

Ponding depth (1:5yr storm)

B m^2	V (factor)	V m^3	H m
102	3.000	3.41	0.1
124	3.000	4.54	0.11
147	3.000	5.89	0.12
173	3.000	7.49	0.13
200	3.000	9.35	0.14
230	3.000	11.50	0.15

Linear interpolation

0.12	0.11	0.12	H =	0.116
5.89	4.54	5.89	5.29	

Qall 0.43

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA R-05 : BUILDING ROOF

OTTAWA IDF CURVE

Area = 0.023 ha Qallow = 0.55
C = 1.00 Vol(max) = 11.22
Notches = 1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	15.52	14.97	4.49
10	178.56	11.42	10.87	6.52
15	142.89	9.14	8.59	7.73
20	119.95	7.67	7.12	8.54
25	103.85	6.64	6.09	9.13
30	91.87	5.87	5.32	9.58
35	82.58	5.28	4.73	9.93
40	75.15	4.80	4.25	10.21
45	69.05	4.42	3.87	10.44
50	63.95	4.09	3.54	10.62
55	59.62	3.81	3.26	10.77
60	55.89	3.57	3.02	10.89
65	52.65	3.37	2.82	10.98
70	49.79	3.18	2.63	11.06
75	47.26	3.02	2.47	11.12
80	44.99	2.88	2.33	11.17
85	42.95	2.75	2.20	11.20
90	41.11	2.63	2.08	11.22

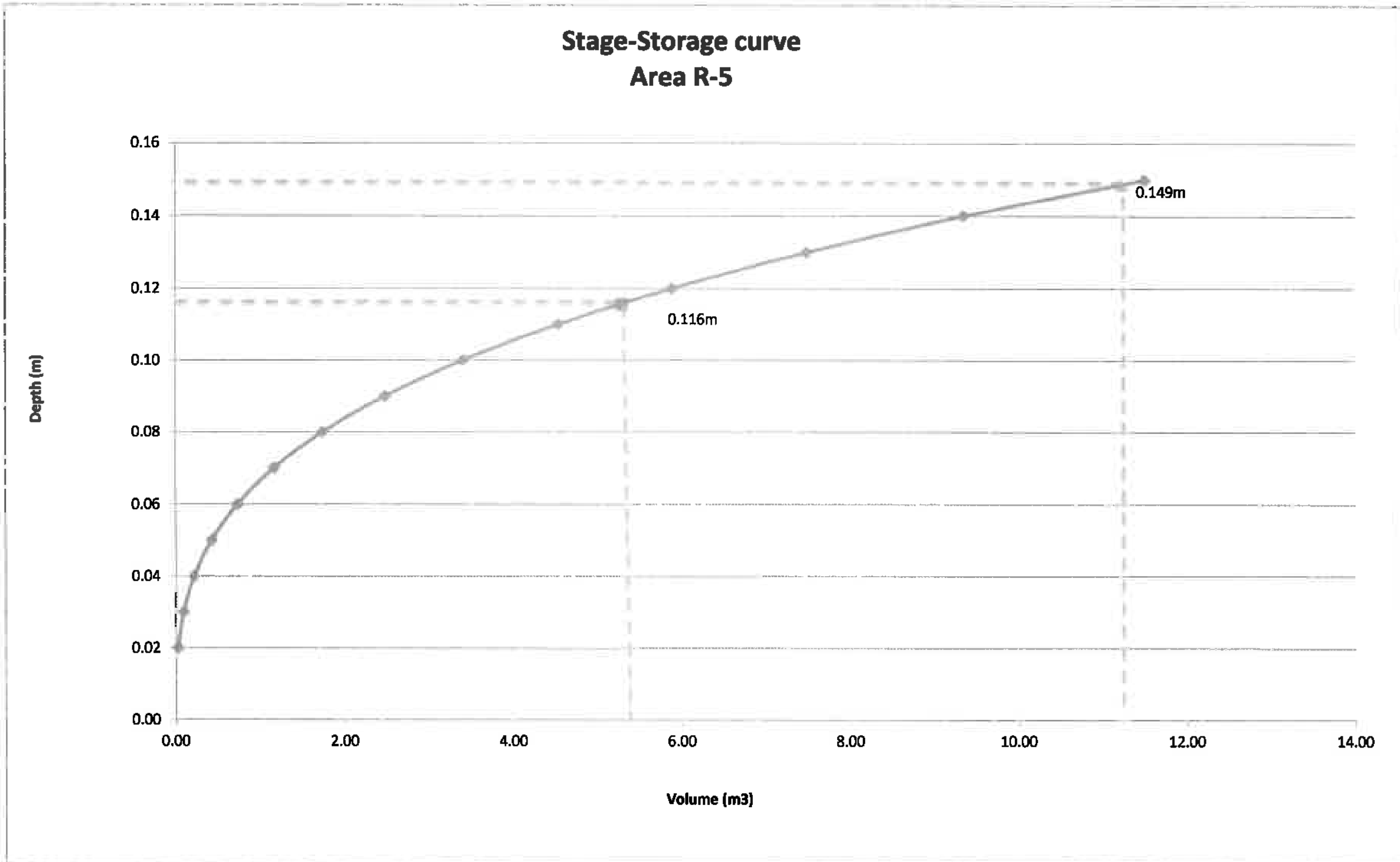
Ponding depth (1:100yr storm)

B m^2	V (factor)	V m^3	H m
102	3.000	3.41	0.1
124	3.000	4.54	0.11
147	3.000	5.89	0.12
173	3.000	7.49	0.13
200	3.000	9.35	0.14
230	3.000	11.50	0.15

Linear interpolation

0.15	0.14	0.15	H =	0.149
11.50	9.35	11.50	11.22	

Qall 0.55


Stage-Storage curve
Area R-5
0.149m
0.116m
Depth (m)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Volume (m3)

REQUIRED STORAGE - 1:5 YEAR EVENT
AREA R-06 : BUILDING ROOF

OTTAWA IDF CURVE

Area = 0.0140 ha — Qallow = 0.41
C = 0.90 — Vol(max) = 2.74
Notches = 1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	4.95	4.54	1.36
10	104.19	3.65	3.24	1.94
15	83.56	2.93	2.52	2.27
20	70.25	2.46	2.05	2.46
25	60.90	2.13	1.72	2.58
30	53.93	1.89	1.48	2.66
35	48.52	1.70	1.29	2.71
40	44.18	1.55	1.14	2.73
45	40.63	1.42	1.01	2.74
50	37.65	1.32	0.91	2.73
55	35.12	1.23	0.82	2.71
60	32.94	1.15	0.74	2.68
65	31.04	1.09	0.68	2.64
70	29.37	1.03	0.62	2.60
75	27.89	0.98	0.57	2.55
80	26.56	0.93	0.52	2.50
85	25.37	0.89	0.48	2.44
90	24.29	0.85	0.44	2.38

Qnet = Q - Qallow — Vol = Qnet x time

Ponding depth (1:5yr storm)

B (m^2)	V (factor)	V (m^3)	H (m)
62	3.000	2.07	0.1
75	3.000	2.76	0.11
90	3.000	3.58	0.12
105	3.000	4.56	0.13
122	3.000	5.69	0.14
140	3.000	7.00	0.15

Linear interpolation

0.11	0.1	0.11	H =	0.110
2.76	2.07	2.76	2.74	

Qall 0.41

REQUIRED STORAGE - 1:100 YEAR EVENT
AREA R-06 : BUILDING ROOF

OTTAWA IDF CURVE

Area = 0.014 ha — Qallow = 0.53
C = 1.00 — Vol(max) = 5.92
Notches = 1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	9.45	8.92	2.67
10	178.56	6.95	6.42	3.85
15	142.89	5.56	5.03	4.53
20	119.95	4.67	4.14	4.97
25	103.85	4.04	3.51	5.27
30	91.87	3.58	3.05	5.48
35	82.58	3.21	2.68	5.64
40	75.15	2.92	2.39	5.75
45	69.05	2.69	2.16	5.83
50	63.95	2.49	1.96	5.88
55	59.62	2.32	1.79	5.91
60	55.89	2.18	1.65	5.92
65	52.65	2.05	1.52	5.92
70	49.79	1.94	1.41	5.91
75	47.26	1.84	1.31	5.89
80	44.99	1.75	1.22	5.86
85	42.95	1.67	1.14	5.82
90	41.11	1.60	1.07	5.78

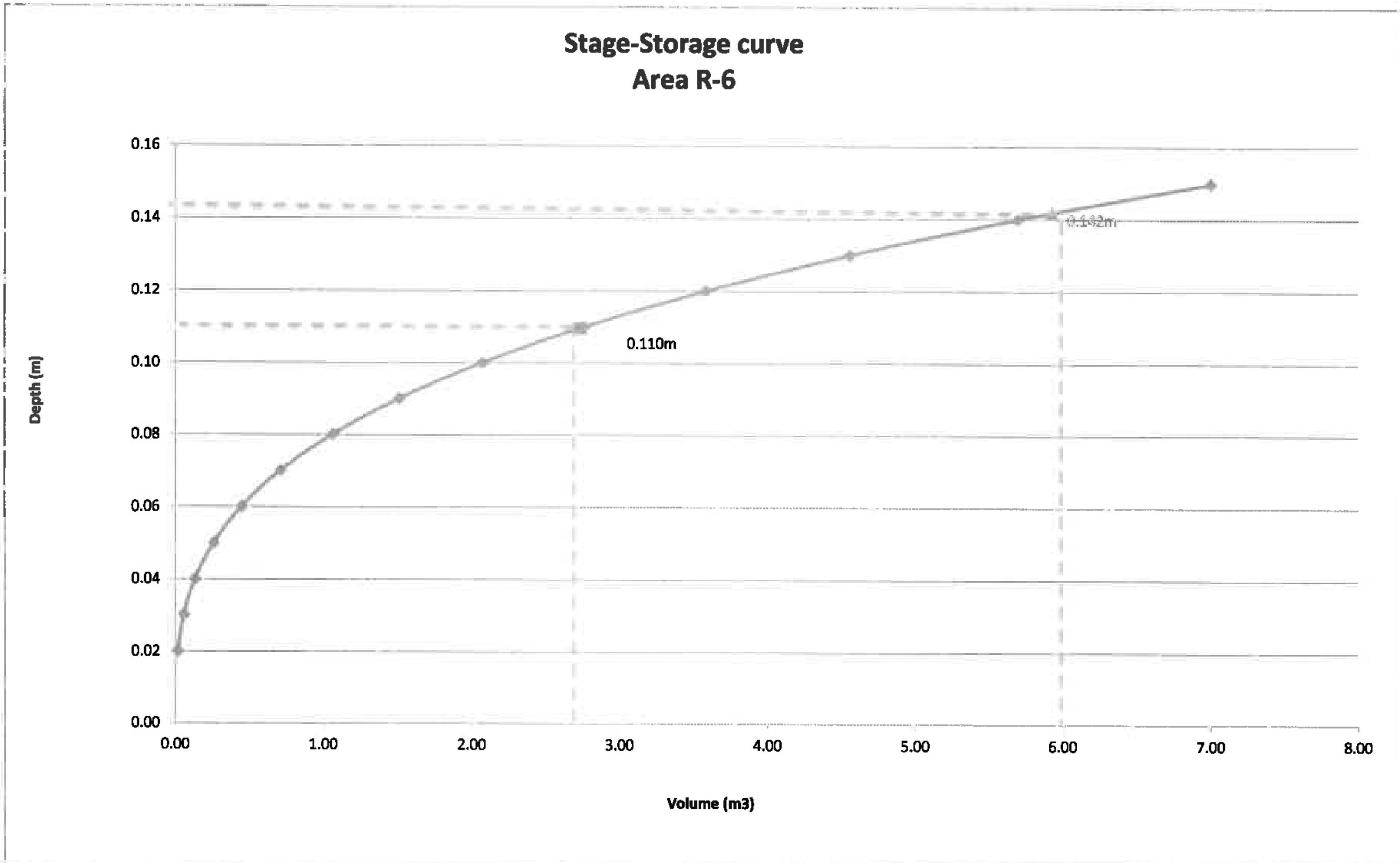
Ponding depth (1:100yr storm)

B (m^2)	V (factor)	V (m^3)	H (m)
62	3.000	2.07	0.1
75	3.000	2.76	0.11
90	3.000	3.58	0.12
105	3.000	4.56	0.13
122	3.000	5.69	0.14
140	3.000	7.00	0.15

Linear interpolation

0.15	0.14	0.15	H =	0.142
7.00	5.69	7.00	5.92	

Qall 0.53


Stage-Storage curve
Area R-6
Depth (m)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.110m
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Volume (m3)

1050 SOMERSET STREET

Project:111152
02/02/2012

REQUIRED STORAGE - 1:5 YEAR EVENT
AREA R-07 TO 10 : BUILDING ROOF

OTTAWA IDF CURVE

Area =	0.0200	ha	Qallow =	0.42
C =	0.90		Vol(max) =	4.41
			Notches =	1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	7.06	6.64	1.99
10	104.19	5.21	4.79	2.87
15	83.56	4.18	3.76	3.38
20	70.25	3.52	3.09	3.71
25	60.90	3.05	2.62	3.93
30	53.93	2.70	2.27	4.09
35	48.52	2.43	2.00	4.21
40	44.18	2.21	1.79	4.29
45	40.63	2.03	1.61	4.34
50	37.65	1.88	1.46	4.38
55	35.12	1.76	1.33	4.40
60	32.94	1.65	1.22	4.41
65	31.04	1.55	1.13	4.40
70	29.37	1.47	1.05	4.39
75	27.89	1.40	0.97	4.37
80	26.56	1.33	0.91	4.34
85	25.37	1.27	0.85	4.31
90	24.29	1.22	0.79	4.27

Qnet = Q - Qallow   Vol = Qnet x time

Ponding depth (1:5yr storm)

B m^2	V (factor)	V m^3	H m
89	3.000	2.96	0.1
108	3.000	3.94	0.11
128	3.000	5.12	0.12
150	3.000	6.51	0.13
174	3.000	8.13	0.14
200	3.000	10.00	0.15

Linear interpolation

0.12	0.11	0.12	H =	0.114
5.12	3.94	5.12	4.41	

Qall 0.42

REQUIRED STORAGE - 1:100 YEAR EVENT
AREA R-07 TO 10 : BUILDING ROOF

OTTAWA IDF CURVE

Area =	0.0200	ha	Qallow =	0.55
C =	1.00		Vol(max) =	9.38
			Notches =	1

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	13.49	12.94	3.88
10	178.56	9.93	9.38	5.63
15	142.89	7.94	7.39	6.66
20	119.95	6.67	6.12	7.34
25	103.85	5.77	5.22	7.84
30	91.87	5.11	4.56	8.20
35	82.58	4.59	4.04	8.49
40	75.15	4.18	3.63	8.71
45	69.05	3.84	3.29	8.88
50	63.95	3.56	3.01	9.02
55	59.62	3.32	2.77	9.12
60	55.89	3.11	2.56	9.21
65	52.65	2.93	2.38	9.27
70	49.79	2.77	2.22	9.32
75	47.26	2.63	2.08	9.35
80	44.99	2.50	1.95	9.37
85	42.95	2.39	1.84	9.38
90	41.11	2.29	1.74	9.37

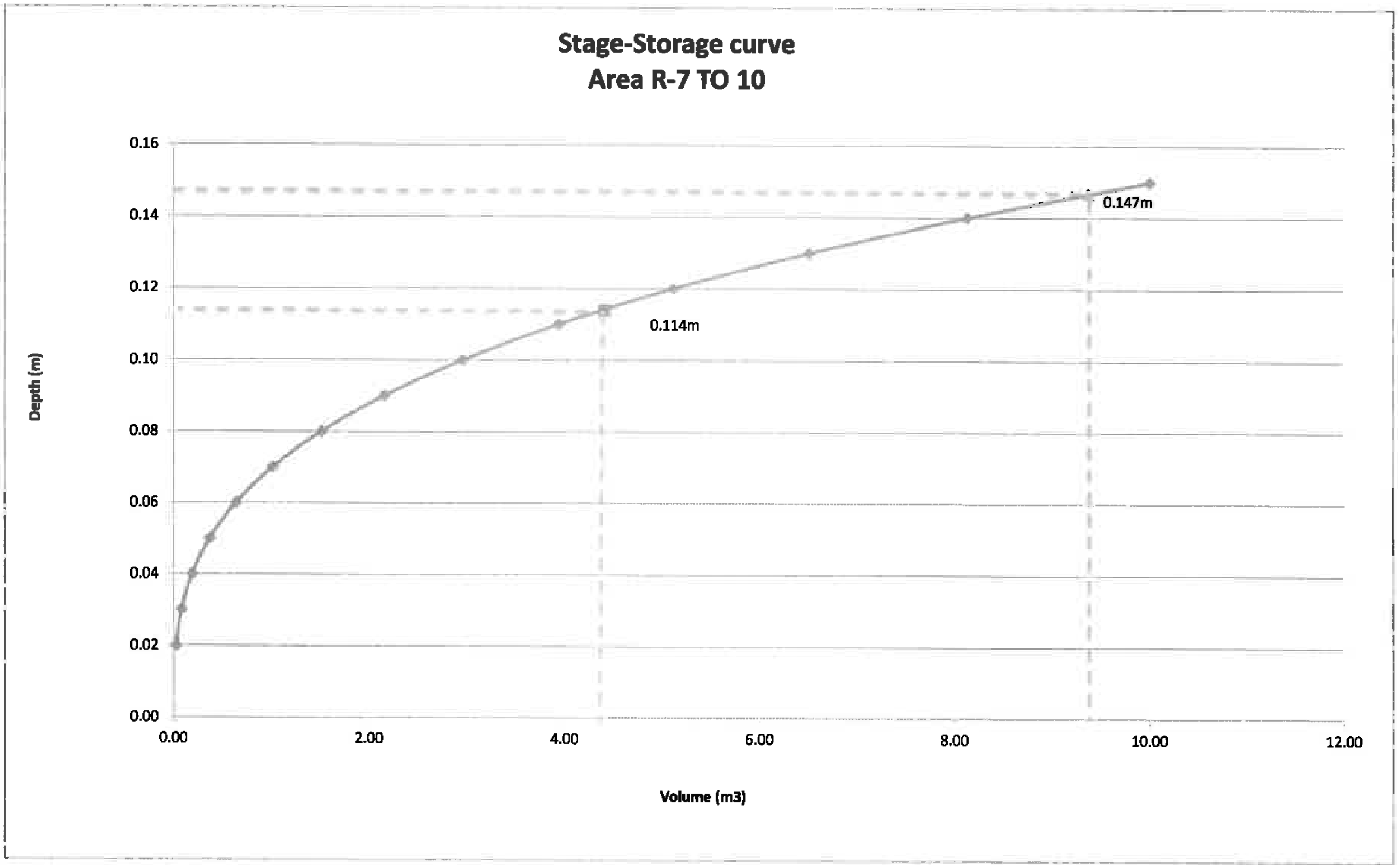
Ponding depth (1:100yr storm)

B m^2	V (factor)	V m^3	H m
89	3.000	2.96	0.1
108	3.000	3.94	0.11
128	3.000	5.12	0.12
150	3.000	6.51	0.13
174	3.000	8.13	0.14
200	3.000	10.00	0.15

Linear interpolation

0.15	0.14	0.15	H =	0.147
10.00	8.13	10.00	9.38	

Qall 0.55


Stage-Storage curve
Area R-7 TO 10
Depth (m)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Volume (m3)
0.147m
0.114m

REQUIRED STORAGE - 1:5 YEAR EVENT

AREA AD-1 : LOWER DECK

OTTAWA IDF CURVE

Area = 0.0240 ha | Qallow = 2.63
C = 0.70 | Vol(max) = 1.34
Dia 51

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	6.59	3.96	1.19
10	104.19	4.87	2.24	1.34
15	83.56	3.90	1.27	1.15
20	70.25	3.28	0.65	0.78
25	60.90	2.84	0.21	0.32
30	53.93	2.52	-0.11	-0.20
35	48.52	2.27	-0.36	-0.76
40	44.18	2.06	-0.57	-1.36
45	40.63	1.90	-0.73	-1.98
50	37.65	1.76	-0.87	-2.61
55	35.12	1.64	-0.99	-3.27
60	32.94	1.54	-1.09	-3.93
65	31.04	1.45	-1.18	-4.60
70	29.37	1.37	-1.26	-5.28
75	27.89	1.30	-1.33	-5.97
80	26.56	1.24	-1.39	-6.67
85	25.37	1.18	-1.45	-7.37
90	24.29	1.13	-1.50	-8.08

Qnet = Q - Qallow   Vol = Qnet x time

Ponding depth (1:5yr storm)

B m^2	V (factor)	V m^3	H m
27	3.000	0.22	0.025
52	3.000	0.61	0.035
86	3.000	1.30	0.045
129	3.000	2.37	0.055
180	3.000	3.91	0.065
240	3.000	6.00	0.075

Linear interpolation

0.055	0.045	0.055	H =	0.045
2.37	1.30	2.37	1.34	

Qall 2.63

REQUIRED STORAGE - 1:100 YEAR EVENT

AREA AD-1 : LOWER DECK

OTTAWA IDF CURVE

Area = 0.024 ha | Qallow = 2.76
C = 0.80 | Vol(max) = 4.38
Dia 51

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	12.95	10.19	3.06
10	178.56	9.53	6.77	4.06
15	142.89	7.63	4.87	4.38
20	119.95	6.40	3.64	4.37
25	103.85	5.54	2.78	4.17
30	91.87	4.90	2.14	3.86
35	82.58	4.41	1.65	3.46
40	75.15	4.01	1.25	3.00
45	69.05	3.69	0.93	2.50
50	63.95	3.41	0.65	1.96
55	59.62	3.18	0.42	1.39
60	55.89	2.98	0.22	0.80
65	52.65	2.81	0.05	0.20
70	49.79	2.66	-0.10	-0.43
75	47.26	2.52	-0.24	-1.07
80	44.99	2.40	-0.36	-1.72
85	42.95	2.29	-0.47	-2.38
90	41.11	2.19	-0.57	-3.05

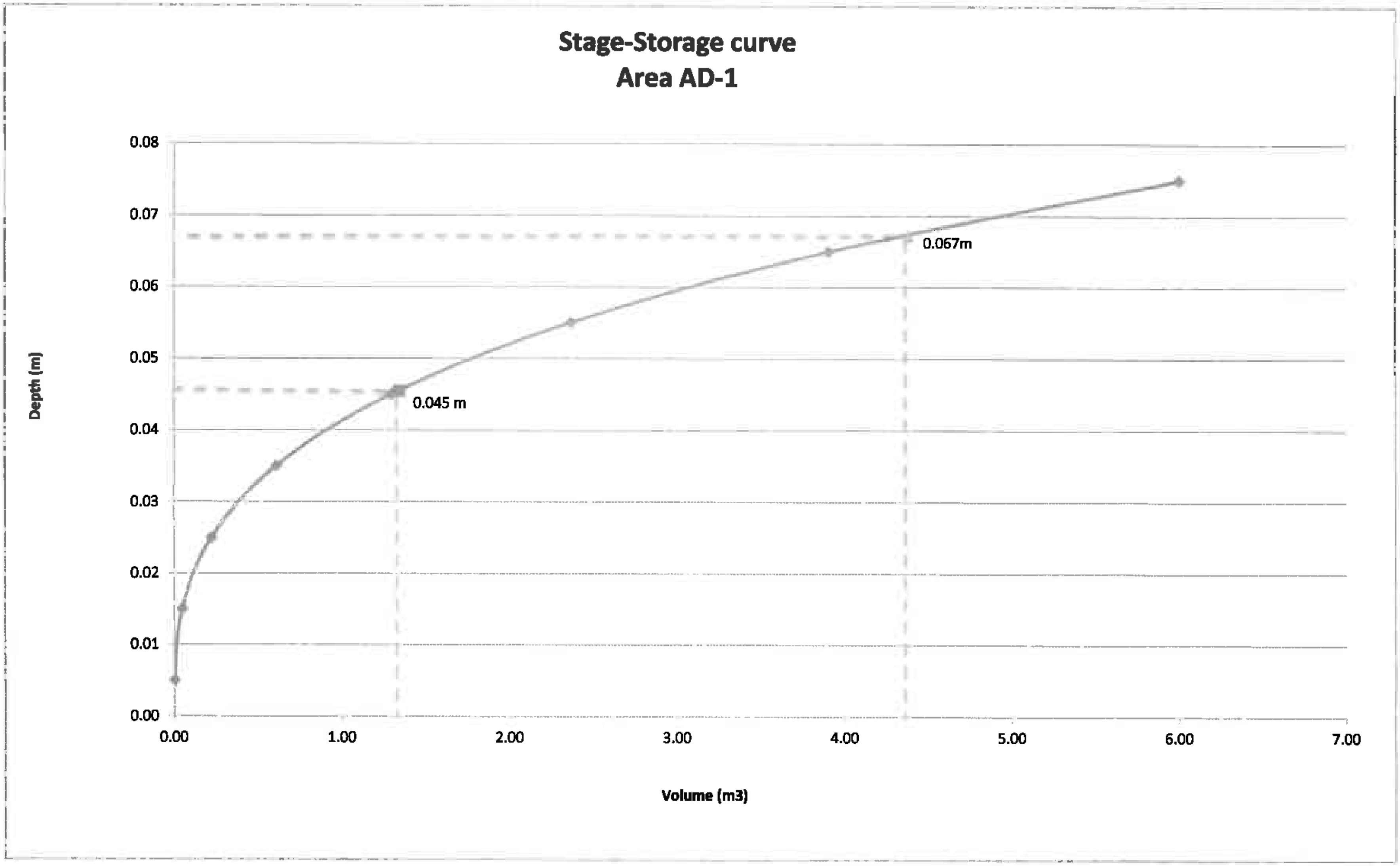
Ponding depth (1:100yr storm)

B m^2	V (factor)	V m^3	H m
27	3.000	0.22	0.025
52	3.000	0.61	0.035
86	3.000	1.30	0.045
129	3.000	2.37	0.055
180	3.000	3.91	0.065
240	3.000	6.00	0.075

Linear interpolation

0.075	0.065	0.075	H =	0.067
6.00	3.91	6.00	4.38	

Qall 2.76


Stage-Storage curve
Area AD-1
Depth (m)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.067m
0.045 m
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Volume (m3)

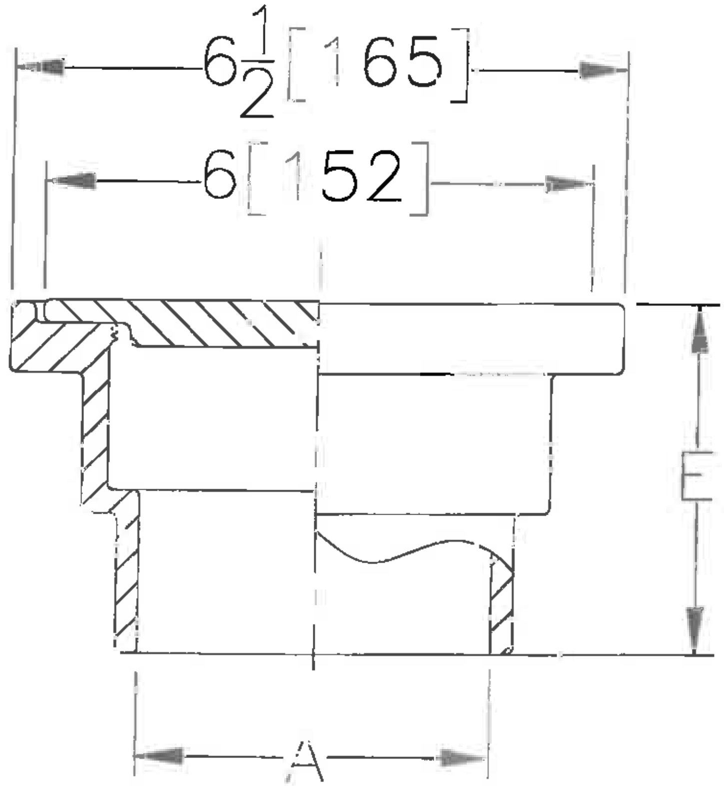
ZURN

Z-221
MEDIUM-DUTY FLOOR DRAIN

SPECIFICATION SHEET

TAG_____

Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice



A Pipe Size Inches / [mm]	Approx. Wt. Lbs. / [kg]	Grate Open Area Sq. In. / [sq cm]
2 - 3 - 4	5	7
[51 - 76 - 102]	[2]	[45]

ENGINEERING SPECIFICATION: ZURN Z-221 Floor Drain, Dura-Coated cast iron body and grate.

OPTIONS (Check/specify appropriate options)

PIPE SIZE

2,3,4 [50,75,100]

(Specify size/type) **OUTLET**

____ NH No-Hub

E BODY HT. DIM.

3 3/4 [95]

SUFFIXES

____ -G Galvanized Cast Iron
____ -P 1/2" [13] Trap Primer Connection
____ -VP Vandal-Proof Secured Top
____ -X Squeezin Backwater Valve
____ -Y Sediment Bucket

REV.	DATE: 11/15/99	C.N. NO. 83329
DWG. NO. 83817	PRODUCT NO. Z-221	

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

APPENDIX B

WATERMAIN AND FIRE INFORMATION

6-4.5.9* For individual fasteners, the loads determined in 6-4.5.6 shall not exceed the allowable loads provided in Figure 6-4.5.9.

The type of fasteners used to secure the bracing assembly to the structure shall be limited to those shown in Figure 6-4.5.9. For connections to wood, through bolts with washers on each end shall be used. Holes for through bolts shall be $^1/_{16}$ in. (1.6 mm) greater than the diameter of the bolt.

Exception No. 1: Where it is not practical to install through bolts due to the thickness of the member or inaccessibility, lag screws shall be permitted. Holes shall be pre-drilled $^1/_8$ in. (3.2 mm) smaller than the maximum root diameter of the lag screw.

Exception No. 2: Other fastening methods are acceptable for use if certified by a registered professional engineer to support the loads determined in accordance with the criteria in 6-4.5.9. Calculations shall be permitted where required by the authority having jurisdiction.

6-4.5.10 Sway bracing assemblies shall be listed for a maximum load rating. The loads shall be reduced as shown in Table 6-4.5.10 for loads that are less than 90 degrees from vertical.

Exception: Where sway bracing utilizing pipe, angles, flats, or rods as shown in Table 6-4.5.8 is used, the components do not require listing. Bracing fittings and connections used with those specific materials shall be listed.

Table 6-4.5.10 Allowable Horizontal Load on Brace Assemblies Based on the Weakest Component of the Brace Assembly

Brace Angle	Allowable Horizontal Load
30–40 degrees from vertical	Listed load rating divided by 2.000
45–59 degrees from vertical	Listed load rating divided by 1.414
60–89 degrees from vertical	Listed load rating divided by 1.155
90 degrees from vertical	Listed load rating

6-4.5.11 Bracing shall be attached directly to feed and cross mains. Each run of pipe between changes in direction shall be provided with both lateral and longitudinal bracing.

Exception: Pipe runs less than 12 ft (3.6 m) in length shall be permitted to be supported by the braces on adjacent runs of pipe.

6-4.5.12 A length of pipe shall not be braced to sections of the building that will move differentially.

6-4.6 Restraint of Branch Lines.

6-4.6.1* Restraint is considered a lesser degree of resisting loads than bracing and shall be provided by use of one of the following:

(1) A listed sway brace assembly
(2) A wraparound U-hook satisfying the requirements of 6-4.5.3, Exception No. 3
(3) No. 12, 440-lb (200-kg) wire installed at least 45 degrees from the vertical plane and anchored on both sides of the pipe
(4) Other approved means

Wire used for restraint shall be located within 2 ft (610 mm) of a hanger. The hanger closest to a wire restraint shall be of a type that resists upward movement of a branch line.

6-4.6.2 The end sprinkler on a line shall be restrained against excessive vertical and lateral movement.

6-4.6.3* Where upward or lateral movement would result in an impact against the building structure, equipment, or finish materials, branch lines shall be restrained at intervals not exceeding 30 ft (9 m).

6-4.6.4* Sprig-ups 4 ft (1.2 m) or longer shall be restrained against lateral movement.

6-4.7 Hangers and Fasteners Subject to Earthquakes.

6-4.7.1 C-type clamps (including beam and large flange clamps) used to attach hangers to the building structure in areas subject to earthquakes shall be equipped with a restraining strap. The restraining strap shall be listed for use with a C-type clamp or shall be a steel strap of not less than 16 gauge thickness and not less than 1 in. (25.4 mm) wide for pipe diameters 8 in. (203 mm) or less and 14 gauge thickness and not less than $1^1/_4$ in. (31.7 mm) wide for pipe diameters greater than 8 in. (203 mm). The restraining strap shall wrap around the beam flange not less than 1 in. (25.4 mm). A lock nut on a C-type clamp shall not be used as a method of restraint. A lip on a "C" or "Z" purlin shall not be used as a method of restraint.

Where purlins or beams do not provide an adequate lip to be secured by a restraining strap, the strap shall be through-bolted or secured by a self-tapping screw.

6-4.7.2 C-type clamps (including beam and large flange clamps), with or without restraining straps, shall not be used to attach braces to the building structure.

6-4.7.3 Powder-driven fasteners shall not be used to attach braces to the building structure.

Exception: Powder-driven fasteners shall be permitted where they are specifically listed for service in resisting lateral loads in areas subject to earthquakes.

6-4.7.4 Powder-driven fasteners shall not be used to attach hangers to the building structure where the systems are required to be protected against earthquakes using a horizontal force factor exceeding 0.50 W_p, where W_p is the weight of the water-filled pipe.

Exception: Powder-driven fasteners shall be permitted where they are specifically listed for horizontal force factors in excess of 0.50 W_p.

Chapter 7 Design Approaches

7-1 General.

7-1.1 Water demand requirements shall be determined from the occupancy hazard fire control approach of Section 7-2.

Exception: Special design approaches as permitted in Section 7-9.

7-1.2 For buildings with two or more adjacent occupancies that are not physically separated by a barrier or partition capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area, the required sprinkler protection for the more demanding occupancy shall extend 15 ft (4.6 m) beyond its perimeter.

7-2 Occupancy Hazard Fire Control Approach.

7-2.1 Occupancy Classifications.

7-2.1.1 Occupancy classifications for this standard relate to sprinkler installations and their water supplies only. They shall not be used as a general classification of occupancy hazards.

7-2.1.2 Occupancies or portions of occupancies shall be classified according to the quantity and combustibility of contents, the expected rates of heat release, the total potential for energy release, the heights of stockpiles, and the presence of flammable and combustible liquids, using the definitions contained in Section 1-4. Classifications are as follows:

Light hazard

Ordinary hazard (Groups 1 and 2)

Extra hazard (Groups 1 and 2)

Special occupancy hazard *(see Section 7-10)*

7-2.2 Water Demand Requirements — Pipe Schedule Method.

7-2.2.1 Table 7-2.2.1 shall be used in determining the minimum water supply requirements for light and ordinary hazard occupancies protected by systems with pipe sized according to the pipe schedules of Section 8-5. Pressure and flow requirements for extra hazard occupancies shall be based on the hydraulic calculation methods of 7-2.3. The pipe schedule method shall be permitted only for new installations of 5000 ft^2 (465 m^2) or less or for additions or modifications to existing pipe schedule systems sized according to the pipe schedules of Section 8-5. Table 7-2.2.1 shall be used in determining the minimum water supply requirements.

Exception No. 1: The pipe schedule method shall be permitted for use in systems exceeding 5000 ft^2 (465 m^2) where the flows required in Table 7-2.2.1 are available at a minimum residual pressure of 50 psi (3.4 bar) at the highest elevation of sprinkler.

Exception No. 2: The pipe schedule method shall be permitted for additions or modifications to existing extra hazard pipe schedule systems.

7-2.2.2 The lower duration value of Table 7-2.2.1 shall be acceptable only where remote station or central station waterflow alarm service is provided.

7-2.2.3* The residual pressure requirement of Table 7-2.2.1 shall be met at the elevation of the highest sprinkler. *(See the Exceptions to 7-2.2.1).*

7-2.2.4 The lower flow figure of Table 7-2.2.1 shall be permitted only where the building is of noncombustible construction or the potential areas of fire are limited by building size or compartmentation such that no open areas exceed 3000 ft^2 (279 m^2) for light hazard or 4000 ft^2 (372 m^2) for ordinary hazard.

Table 7-2.2.1 Water Supply Requirements for Pipe Schedule Sprinkler Systems

Occupancy Classification	Minimum Residual Pressure Required (psi)	Acceptable Flow at Base of Riser (Including Hose Stream Allowance) (gpm)	Duration (minutes)
Light hazard	15	500–750	30–60
Ordinary hazard	20	850–1500	60–90

For SI units, 1 gpm = 3.785 L/min; 1 psi = 0.0689 bar.

7-2.3 Water Demand Requirements — Hydraulic Calculation Methods.

7-2.3.1 General.

7-2.3.1.1* The minimum water supply requirements for a hydraulically designed occupancy hazard fire control sprinkler system shall be determined by adding the hose stream demand from Table 7-2.3.1.1 to the water supply for sprinklers determined in 7-2.3.1.2. This supply shall be available for the minimum duration specified in Table 7-2.3.1.1.

Exception No. 1: An allowance for inside and outside hose shall not be required where tanks supply sprinklers only.

Exception No. 2: Where pumps taking suction from a private fire service main supply sprinklers only, the pump need not be sized to accommodate inside and outside hose. Such hose allowance shall be considered in evaluating the available water supplies.

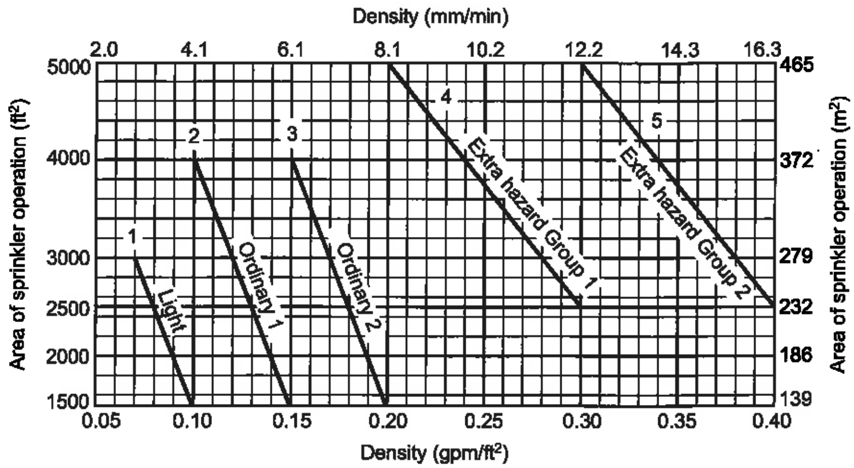
7-2.3.1.2 The water supply for sprinklers only shall be determined either from the area/density curves of Figure 7-2.3.1.2 in accordance with the method of 7-2.3.2 or be based upon the room design method in accordance with 7-2.3.3, at the discretion of the designer. For special areas under consideration, as described in 7-2.3.4, separate hydraulic calculations shall be required in addition to those required by 7-2.3.2 or 7-2.3.3.

Table 7-2.3.1.1† Hose Stream Demand and Water Supply Duration Requirements for Hydraulically Calculated Systems

Occupancy or Commodity Classification	Inside Hose (gpm)	Total Combined Inside and Outside Hose (gpm)	Duration (minutes)
Light hazard	0, 50, or 100	100	30
Ordinary hazard	0, 50, or 100	250	60–90
Extra hazard	0, 50, or 100	500	90–120
Rack storage, Class I, II, and III commodities up to 12 ft (3.7 m) in height	0, 50, or 100	250	90
Rack storage, Class IV commodities up to 10 ft (3.1 m) in height	0, 50, or 100	250	90
Rack storage, Class IV commodities up to 12 ft (3.7 m) in height	0, 50, or 100	500	90
Rack storage, Class I, II, and III commodities over 12 ft (3.7 m) in height	0, 50, or 100	500	90
Rack storage, Class IV commodities over 12 ft (3.7 m) in height and plastic commodities	0, 50, or 100	500	120
General storage, Class I, II, and III commodities over 12 ft (3.7 m) up to 20 ft (6.1 m)	0, 50, or 100	500	90
General storage, Class IV commodities over 12 ft (3.7 m) up to 20 ft (6.1 m)	0, 50, or 100	500	120
General storage, Class I, II, and III commodities over 20 ft (6.1 m) up to 30 ft (9.1 m)	0, 50, or 100	500	120
General storage, Class IV commodities over 20 ft (6.1 m) up to 30 ft (9.1 m)	0, 50, or 100	500	150
General storage, Group A plastics ≤ 5 ft (1.5 m)	0, 50, or 100	250	90
General storage, Group A plastics over 5 ft (1.5 m) up to 20 ft (6.1 m)	0, 50, or 100	500	120
General storage, Group A plastics over 20 ft (6.1 m) up to 25 ft (7.6 m)	0, 50, or 100	500	150

For SI units, 1 gpm = 3.785 L/min.

Figure 7-2.3.1.2 Area/density curves.



7-2.3.1.3 Regardless of which of the two methods is used, the following restrictions shall apply:

(a) For areas of sprinkler operation less than 1500 ft² (139 m²) used for light and ordinary hazard occupancies, the density for 1500 ft² (139 m²) shall be used. For areas of sprinkler operation less than 2500 ft² (232 m²) for extra hazard occupancies, the density for 2500 ft² (232 m²) shall be used.

(b) *For buildings having unsprinklered combustible concealed spaces (as described in 5-13.1.1 and 5-13.7), the minimum area of sprinkler operation shall be 3000 ft² (279 m²).

Exception No. 1: Combustible concealed spaces filled entirely with noncombustible insulation.

*Exception No. 2: *Light or ordinary hazard occupancies where noncombustible or limited combustible ceilings are directly attached to the bottom of solid wood joists so as to create enclosed joist spaces 160 ft³ (4.8 m³) or less in volume.*

*Exception No. 3: *Concealed spaces where the exposed surfaces have a flame spread rating of 25 or less and the materials have been demonstrated to not propagate fire in the form in which they are installed in the space.*

(c) Water demand of sprinklers installed in racks or water curtains shall be added to the ceiling sprinkler water demand at the point of connection. Demands shall be balanced to the higher pressure. *(See Chapter 8.)*

(d) Water demand of sprinklers installed in concealed spaces or under obstructions such as ducts and cutting tables need not be added to ceiling demand.

(e) Where inside hose stations are planned or are required, a total water allowance of 50 gpm (189 L/min) for a single hose station installation or 100 gpm (378 L/min) for a multiple hose station installation shall be added to the sprinkler requirements. The water allowance shall be added in 50-gpm (189-L/min) increments beginning at the most remote hose station, with each increment added at the pressure required by the sprinkler system design at that point.

(f) When hose valves for fire department use are attached to wet pipe sprinkler system risers in accordance with 5-15.5.2, the water supply shall not be required to be added to standpipe demand as determined from NFPA 14, *Standard for the Installation of Standpipe and Hose Systems.*

Exception No. 1: Where the combined sprinkler system demand and hose stream allowance of Table 7-2.3.1.1 exceeds the requirements of NFPA 14, Standard for the Installation of Standpipe and Hose Systems, this higher demand shall be used.

Exception No. 2: For partially sprinklered buildings, the sprinkler demand, not including hose stream allowance, as indicated in Table 7-2.3.1.1 shall be added to the requirements given in NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

(g) Water allowance for outside hose shall be added to the sprinkler and inside hose requirement at the connection to the city water main or a yard hydrant, whichever is closer to the system riser.

(h) The lower duration values in Table 7-2.3.1.1 shall be permitted where remote station or central station waterflow alarm service is provided.

(i) Where pumps, gravity tanks, or pressure tanks supply sprinklers only, requirements for inside and outside hose need not be considered in determining the size of such pumps or tanks.

7-2.3.1.4 Total system water supply requirements shall be determined in accordance with the hydraulic calculation procedures of Section 8-4.

7-2.3.2 Area/Density Method.

7-2.3.2.1 The water supply requirement for sprinklers only shall be calculated from the area/density curves in Figure 7-2.3.1.2 or from Section 7-10 where area/density criteria is specified for special occupancy hazards. When using Figure 7-2.3.1.2, the calculations shall satisfy any single point on the appropriate area/density curve as follows:

(1) Light hazard area/density curve 1
(2) Ordinary hazard (Group 1) area/density curve 2
(3) Ordinary hazard (Group 2) area/density curve 3
(4) Extra hazard (Group 1) area/density curve 4
(5) Extra hazard (Group 2) area/density curve 5

It shall not be necessary to meet all points on the selected curve.

Exception: Sprinkler demand for storage occupancies as determined in Sections 7-3 through 7-8.

7-2.3.2.2 For protection of miscellaneous storage, miscellaneous tire storage, and storage up to 12 ft (3.7 m) in height, the discharge criteria in Table 7-2.3.2.2 shall apply.

APPENDIX C

DEVELOPMENT SERVICING STUDY CHECKLIST

Development Servicing Study Checklist

4.1 General Content	Addressed (Y/N/NA)	Section	Comments
Executive Summary (for larger reports only).	NA		
Date and revision number of the report.	Y	Cover	
Location map and plan showing municipal address, boundary, and layout of proposed development.	Y	Fig 1	
Plan showing the site and location of all existing services.	Y	Fig 2 / GP	
Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	NA		
Summary of Pre-consultation Meetings with City and other approval agencies.	NA		
Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.	NA		
Statement of objectives and servicing criteria.	Y	1	
Identification of existing and proposed infrastructure available in the immediate area.	Y	3,4,5	
Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).	NA		
Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighboring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	Y	GR	

Development Servicing Study Checklist

4.1 General Content	Addressed (Y/N/NA)	Section	Comments
Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.	NA		
Proposed phasing of the development, if applicable.	NA		
Reference to geotechnical studies and recommendations concerning servicing.	Y	2	
All preliminary and formal site plan submissions should have the following information:			
Metric scale	Y		
North arrow (including construction North)	Y		
Key plan	Y		
Name and contact information of applicant and property owner	Y		
Property limits including bearings and	Y		
Existing and proposed structures and parking	Y		
Easements, road widening and rights-of-way	Y		
Adjacent street names	Y		

Development Servicing Study Checklist

4.2 Water	Addressed (Y/N/NA)	Section	Comments
Confirm consistency with Master Servicing Study, if available.	NA		
Availability of public infrastructure to service proposed development.	Y	5	
Identification of system constraints.			
Identify boundary conditions.			
Confirmation of adequate domestic supply and pressure.			
Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.	Y	5 /Appendix C	
Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.			
Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design.	NA		
Address reliability requirements such as appropriate location of shut-off valves.	Y	GP	
Check on the necessity of a pressure zone boundary modification.	NA		
Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range.	Y	5	
Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.	Y	5/GP	
Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.	N		
Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Y	5	
Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.			

Development Servicing Study Checklist

4.3 Wastewater	Addressed (Y/N/NA)	Section	Comments
Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed	Y	4	
Confirm consistency with Master Servicing Study and/or justifications for deviations.	N		
Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.	N		
Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Y	4	
Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)	Y	4, Appendix B	
Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix 'C') format.	N		
Description of proposed sewer network including sewers, pumping stations, and forcemains.	Y	4	
Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).	NA		
Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	NA		
Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N		
Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	NA		
Special considerations such as contamination, corrosive environment etc.	NA		

Development Servicing Study Checklist

4.4 Stormwater	Addressed (Y/N/NA)	Section	Comments
Description of drainage outlets and downstream constraints including legality of outlet (i.e. municipal drain, right-of-way, watercourse, or private property).	Y	3	
Analysis of the available capacity in existing public infrastructure.			
A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns and proposed drainage patterns.	Y	Fig. 3 / GR	
Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.	N		
Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	Y	3	
Description of stormwater management concept with facility locations and descriptions with references and supporting information.	Y	3	
Set-back from private sewage disposal systems.	NA		
Watercourse and hazard lands setbacks.	NA		
Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	NA		
Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	NA		
Storage requirements (complete with calcs) and conveyance capacity for 5 yr and 100 yr events.	Y	3 / Appendix A	
Identification of watercourse within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	NA		
Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.	Y	3	
Any proposed diversion of drainage catchment areas from one outlet to another.	NA		
Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and SWM	Y	3	
If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.	NA		

Development Servicing Study Checklist

4.4 Stormwater	Addressed (Y/N/NA)	Section	Comments
Identification of municipal drains and related approval requirements.	Y	GP	
Description of how the conveyance and storage capacity will be achieved for the development.	Y	3	
100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	y	GR	
Inclusion of hydraulic analysis including HGL elevations.	NA		
Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Y	3 , 4	
Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.	NA		
Identification of fill constrains related to floodplain and geotechnical investigation.	NA		

Development Servicing Study Checklist

4.5 Approval and Permit Requirements	Addressed (Y/N/NA)	Section	Comments
Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.	NA		
Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.	NA		
Changes to Municipal Drains.	NA		
Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	NA		

4.6 Conclusion	Addressed (Y/N/NA)	Section	Comments
Clearly stated conclusions and recommendations.	Y	6	
Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.	NA		
All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario.	Y	6	

ATTACHED PLANS