Site Servicing and Stormwater Management Report 1158 Second Line Road Ottawa, Ontario

Type of Document:
Plan of Subdivision Submission

Client:
Theberge Homes

Project Number:
OTT-00245003-A0

Prepared By: Jason Fitzpatrick, P.Eng.

Reviewed By: Bruce Thomas, P.Eng.

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Date Submitted:
April 2018

Site Servicing and Stormwater Management Report

1158 Second Line Road, Ottawa, Ontario

Type of Document:
Plan od Subdivison Submission

Client:
Theberge Homes

Project Number:
OTT-00245003-A0

Prepared By:
exp
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada
T: 613 688-1899
F: 613 225-7337
www.exp.com

LICENSED PROFESSIONAL ENGINEER
J.L. FITZPATRICK
2018-04-16
PROVINCE OF ONTARIO

Jason Fitzpatrick, P.Eng
Project Engineer
Infrastructure Services

Bruce Thomas, P.Eng.
Senior Project Manager
Infrastructure Services

Date Submitted:
April 2018

Legal Notification

This report was prepared by **exp** Services Inc. for the account of **Theberge Homes.**

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

Table of Contents

List of Figures

List of Tables

List of Appendices

1 Introduction

Theberge Homes retained **exp** Services Inc. (EXP) to undertake a site servicing and stormwater management study in support of a zoning by-law amendment and plan of subdivision applications for a proposed development at 1158 Second Line Road in the City of Ottawa. The property is situated on Second Line Road, 270m south of Old Carp Road in the City of Ottawa, Ontario as shown on Figure 1 in Appendix A.

The development is comprised of forty-nine (49) townhome units. This report will discuss the adequacy of the adjacent municipal storm sewers, sanitary sewers and watermains to convey the storm runoff, sewage flows and provide the water demands that will result from the proposed development.

The 1.23-hectare development being proposed by Theberge Homes will consist of a five (5) 4-unit townhome blocks, one (1) 5-unit townhome block, and four (4), 6-unit townhome blocks. A single dwelling unit is currently located on the property.

There are municipal sanitary sewers, storm sewers and watermains within Goward Drive that will be utilized to service the development.

This report will identify any sanitary, storm or watermain servicing requirements, and provide a design brief for submission, along with the engineering drawings, for City of Ottawa approval.

2 Referenced Guidelines

Various documents were referred to in preparing the current report including:

- Sewer Design Guidelines, Second Edition, Document SDG002, October 2012, City of Ottawa (Guidelines) including:
- Technical Bulletin ISDTB-2012-4 (20 June 2012)
- Technical Bulletin ISDTB-2014-01 (05 February 2014)
- Technical Bulletin PIEDTB-2016-01 (September 6, 2016)
- Technical Bulletin ISDTB-2018-01 (21 March 2018)
- Ontario Ministry of Transportation (MTO) Drainage Manual, 1995-1997
- Ottawa Design Guidelines – Water Distribution, July 2010 (WDG001).
    - Stormwater Management Planning and Design Manual, Ontario Ministry of the Environment and Climate Change, March 2003 (SMPDM)
    - Design Guidelines for Drinking-Water Systems, Ontario Ministry of the Environment and Climate Change, 2008 (GDWS)
- Fire Underwriters Survey, Water Supply for Public Fire Protection (FUS), 1999
- Ontario Building Code 2012, Ministry of Municipal Affairs and Housing.

3 Sanitary Sewer Design

The sanitary sewer system is designed based on a population flow, and an area based infiltration allowance. The flows were calculated using City of Ottawa design guidelines as follows:

Population:

49-Town homes x 2.7 person/unit	= 132.3
	= 133 Persons

Sanitary Flow

Average Domestic Flow	= 280 L/person/day
Domestic Flow = 133 x 280 L/person/day x (1/86,400 sec/day)	= 0.43 L/sec
Peak Factor = 1 + 14 / (4 + $(43.2/1000)^{0.5}$)	= 4.0 (4.0 Max)
Q Peak Domestic = 0.175 L/sec x 4.0	= 1.72 L/sec

Infiltration:

Q Infiltration = 0.33 L/ha/sec x 1.23 ha	= 0.41 L/sec

Total Peak Sewage Flow:

Total Sanitary Flow = 1.72 + 0.41	**= 2.13 L/sec**

4 Watermain Servicing

A. Methodology

The water distribution system proposed for this development is designed in accordance with the City of Ottawa Design Guidelines (July 2010). The following steps indicate the basic methodology that was used in the hydraulic analysis:

- A water distribution model was created by adding junction nodes at intersections and creating watermains between the junctions.
- For each junction node the water demand was determined based on the number of contributing homes and the corresponding population.
- The water consumption rates were calculated for the maximum day and maximum hour conditions.
- Hydraulic boundary conditions were set from the information obtained from the City of Ottawa.
- The required fire flow was determined, and
- The proposed water distribution model was simulated in and the results compared with the City of Ottawa criteria.

B. Design Criteria

A summary of design parameters used in the water distribution model were taken from Section 4.0 of the City's Guidelines, and are as follows:

- Population Density (Townhome) = 2.7 person/unit
- Average daily water consumption (Residential) = 350 L/cap/day
- Maximum Day Factor (4.32 x Avg. Day)
- Maximum Hour Factor (6.5 x Avg. Day)
- C factor (200 mm – 300 mm) 110
- Minimum Allowable Pressure = 275 kPa (40 psi)
- Maximum Allowable Pressure = 690 kPa (100 psi)
- Minimum Static Pressure (Under Fire Flow Conditions) = 140 kPa (20 psi)

Please note that the maximum day and peak hour factors, noted above, were determined based on MOECC GDWS Table 3-3 as the population of the proposed development is less than 500 persons. This requirement is noted in Section 4.2.8 of the City's WDG001.

4.1 Water Demands

The domestic water demands are estimated below, utilizing parameters from the SDG002 and the GDWS. The following summarizes the parameters used.

- Population:

49-Townhome (Row) x 2.7 person/unit	= 132.3
25- Existing Single-Family x 3.4 person/unit	= 85.0
	= 217.3 Persons

- Average daily water consumption = 350 L/person/day
- Number of residents = 217.3
- Maximum Day Factor = 4.32 x Avg. Day (from GDWS, Table 3-3)
- Maximum Hour Factor = 6.5 x Avg. Day (from GDWS, Table 3-3)

The average, maximum day and peak hour domestic (residential) demands for the building are as follows:

- Average Day = 350 x 217.3 / 86,400 sec/day = 0.88 L/sec
- Maximum Day = 4.32 x 0.88 = 3.8 L/sec
- Peak Hour = 6.5 x 0.88 = 5.72 L/sec

Detailed calculations of the domestic water demands are provided in Table C1 of Appendix C.

4.2 Fire Flow Requirements

Water for fire protection will be available utilizing the proposed fire hydrants located along the proposed private roadway. The required fire flows for the proposed site was calculated based on typical values as established by the Fire Underwriters Survey 1999. The fire flow requirements were calculated for all blocks. It was determined the most critical building was a 6-Unit Block having a fire flow requirement of 150 L/sec.

The following equation from the Fire Underwriters document “Water Supply for Public Fire Protection”, 1991, was used for calculation of the on-site supply rates required to be supplied by the hydrants:

$$F = 200 * C * \sqrt{(A)}$$

where

F = Required Fire flow in Litres per minute
C = Coefficient related to type of Construction
A = Total Floor Area in square metres

A reduction for low hazard occupancy of -25% for residential dwellings, and an increase for fire area exposure of +70% (max) was used. Below is a sample calculation of the fire flow requirements for Block 4 (most critical) residential building.

6-Unit Block

F =	200 * 1.0 * √ (527.5m2 x 2 storeys)	= 7146 L/min or 7,000 L/min (rounded to 1,000)
F =	7000 L/min * (-25% non-combustible)	= 5,250 L/min
F =	5,250 L/min * (+75% exposure factor)	= 9,188 L/min

F(required) = 9,000 L/min or 150 L/sec

The following summarizes the total required fire flow including reductions/increases due to factors effecting burning.

- 4 Unit Block: 117 L/sec (7,000 L/min)
- 5 Unit Block: 133 L/sec (8,000 L/min)
- 6 Unit Block: 150 L/sec (9,000 L/min)

The fire flow requirement for the proposed building is **150 L/sec (9,000 L/min)** based on the FUS. Please refer to Tables C2 through Table C4 in Appendix C for detailed calculations using the FUS method.

4.3 Boundary Conditions

Boundary conditions were provided for modelling purposes. WaterCAD modelling software was used to calculate pressures and flows under maximum day plus fire flow and peak hour conditions.

Boundary conditions were obtained from City of Ottawa personnel for the purpose of hydraulic modeling. Boundary conditions were used for the connection points at either Connection # 1 on Goward Drive (J-10) or Connection Location #2 (J-13) on Whernside Terrace. Refer to Appendix I for information provided by City of Ottawa staff.

Condition	Location #1 Goward	Location #2 Whernside Terrace
Max Day plus Fire Flow (9000 L/min)	119.5m	120.8m
Peak Hour	140.2m	142.0m

4.4 Modelling Results

The results of the WaterCAD modelling under maximum day plus fire flow and peak hourly conditions based on the boundary condition at Location #1, are summarized in Table 4-1 below. Results for both locations #1 and # 2 are included in Appendix D.

Table 4-1: Summary of Results for Peak Hour (Boundary Location #1)

Label	Demand (L/s)	Elevation (m)	Hydraulic Grade (m)	Pressure (psi)
J-1	0.22	103.98	140.17	51.4
J-2	0.65	103.74	140.18	51.7
J-3	0.72	102.10	140.18	54.1
J-4	0.58	102.60	140.18	53.3
J-5	0.22	103.30	140.17	52.3
J-6	0.79	101.13	140.18	55.4
J-7	0.63	101.40	140.19	55.1
J-8	0.00	101.00	140.19	55.6
J-9	0.72	102.40	140.19	53.6
J-10	0.00	100.76	140.20	56.0
J-11	0.14	102.35	140.19	53.7
J-12	0.07	101.25	140.19	55.3
J-14	0.36	101.50	0.36	140.19
J-15	0.36	100.80	0.36	140.20

Table 4-2: Summary Results for Maximum Day Plus Fire Flow (Boundary Location #2)

Label	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?
J-1	150.00	11.30	150.14	11.44	20.0	20.1	False
J-2	150.00	163.26	150.43	163.69	20.0	20.4	True
J-3	150.00	175.06	150.48	175.54	20.0	22.5	True
J-4	150.00	165.58	150.38	165.96	20.0	21.0	True
J-5	150.00	11.31	150.14	11.45	20.0	20.2	False
J-6	150.00	174.58	150.52	175.10	20.0	23.0	True
J-7	150.00	166.35	150.42	166.77	20.0	21.4	True
J-8	150.00	200.00	150.00	200.00	20.0	37.4	True
J-9	150.00	124.52	150.48	125.00	20.0	20.0	False
J-10	150.00	168.09	150.00	168.09	20.0	20.0	True
J-11	150.00	184.71	150.10	184.81	20.0	21.4	True
J-12	150.00	177.49	150.05	177.54	20.0	20.0	True
J-13	150.00	200.00	150.12	200.12	20.0	57.9	True
J-14	150.00	200.00	150.24	200.24	20.0	25.3	True
J-15	150.00	167.90	150.24	168.14	20.0	20.0	True

n/a not applicable. Junctions J-1 and J-5 are services. J-9 is not within site.

The calculated minimum and maximum working pressures anticipated within the development are 51.7 psi and 56.0 psi under peak hour conditions, with an estimated fire flow available at the proposed hydrant # 1 (J-3) near Block 4 of ± 174 L/sec, which is greater than the required 150 L/sec for a 6-unit townhome block.

5 Stormwater Management

5.1 Design Criteria

The storm sewer system was designed in conformance with the latest version of the City of Ottawa Design Guidelines (October 2012). Section 5 “Storm and Combined Sewer Design”, and Section 8 “Stormwater Management” from the design manual were referenced.

The allowable release rate for the site is limited to a 2-year storm event using a time of concentration of 10 minutes and a runoff coefficient of 0.40 as per Section 5.1.5.1 of the SDG002. Flows in excess of the 2-year and up to the 100-year storm event will be detained onsite.

Minor System Design Criteria

- The storm sewers have been designed and sized based on the Rational Method and the Manning’s Equation under free flow conditions for the 2-year storm using a 10 minute inlet time.
- Inflow rates into the minor system are limited to 100 L/sec, which is based on the capture rate established for this site as per the Stormwater Site Management Plan for Morgan’s Grant Phase 12D.
- The storm sewer within the Morgan’s Grant Subdivision were designed as a minor (pipe) and major drainage (overland) system, or a dual drainage concept. The minor system was designed to convey runoff based on the 5-year storm under free-flow conditions.
- A separate foundation drainage and surface drainage networks are proposed, with the surface drainage works sized to convey and detain a 100-year storm, whereas the foundation drainage system is sized to convey foundation drainage only.

Major System Design Criteria

- The major system has been designed to accommodate onsite detention with sufficient capacity to attenuate the 100-year design storm. Any excess of runoff above the 100-year event will flow overland offsite.
- Onsite storage is provided for up to the 100-year design storm. Although there is a maximum allowable ponding depth of 300mm on the ground surface, the entire 100-year storm will be stored within underground chambers. Calculation of the required onsite storage volumes is supported by calculations provided in Appendix F.
- Calculation of the required storage volumes has been prepared based on the Modified Rational Method as identified in Section 8.3.10.3 of the City’s Sewer Guidelines.

5.2 Runoff Coefficients

Runoff coefficients used for post-development conditions were based on actual areas measured in CAD. Runoff coefficients for impervious surfaces (roofs, asphalt, and concrete) were taken as 0.90, whereas pervious surfaces (grass/landscaping) were taken as 0.20.

Average runoff coefficients for all catchments were calculated using PCSWMM’s area weighting routine. This modelling software has a GIS engine which allows for catchment (or polygon) definition including attributes. The runoff coefficients for all catchments were area weighted to derive at average runoff coefficients based on hard surfaces (concrete or asphalt) having an imperviousness of 100%, soft surfaces (landscaping surfaces) having a zero percent imperviousness. The conversion from an imperviousness percent to a runoff coefficient was taken as C=[IMP]*0.70 +20.

The average runoff coefficient for the overall site area under post-development conditions was calculated as 0.64, whereas the pre-development average runoff coefficient was less than 0.10.

5.3 Calculation of Allowable Release Rate

To control runoff from the site it will be necessary to limit post-development flows to the allowable capture based on previous Morgan's Grant, Phase 12D design.

The allowable release rate from the site was set just below the design peak flow rate for the minor system. From the original storm design sheet, the storm sewer was sized based on a 5-year level of service with a runoff coefficient of 0.50 and a time of concentration of 20 minutes. The following parameters will be used to determine the allowable release rates from the proposed site to the existing sewer on Goward Drive, using the Rational Formula.

Q_{ALL} = 2.78 C I A

Where:

Q_{ALL}	=	Peak Discharge (L/sec)
C	=	Runoff Coefficient (C=0.50)
I	=	Average Rainfall Intensity for return period (70.25 mm/hr)
	=	$732.951/(Tc+6.199)^{0.810}$ (5-year)
Tc	=	Time of concentration (20 mins)
A	=	Drainage Area (1.20 hectares)

The peak design flow, based on the 5-year storm, was estimated at 117.2 L/sec. This peak storm flow was taken from the third row of the original storm design sheet for the Morgan's Grant Phase 12D, and is attached for reference in Appendix H.

Although the downstream storm sewers were sized for this peak flow, a total of 100 L/sec (or 5 inlets at 20 L/sec/inlet) was selected as the minor system capture rate. This flow was used to establish the 100-year hydraulic grade line.

Therefore, the minor system capture rate from the site was limited to 100 L/sec in the 100-year event under post-development conditions. All remaining storm runoff in excess of 100 L/sec is detained onsite.

5.4 Pre-Development Conditions

Although pre-development peak flows did not govern the storm sewer design, the peak flows under pre-development conditions was estimated for comparison. The pre-development runoff coefficient for the site was determined to be 0.04. The existing site only includes one residential home, which will be demolished for the re-development of the site.

Using a time of concentration (T_C) of 20 minutes and an average runoff coefficient of 0.04, the pre-development release rates from the site were estimated at 6.6, 8.9 and 19.0 L/sec for the 2-year, 5-year and 100-year storms respectively.

5.5 Calculation of Post-Development Runoff

As a result of the changes onsite the overall post development runoff coefficient will increase over existing conditions. The increase in runoff will be the result of changes due to site development (i.e. additional hard surfaces, roof areas and hard landscaping).

The post-development average runoff coefficient for the site was calculated as 0.64, based on an average runoff coefficient of 0.20 for grassed areas and 0.90 for hard surfaces.

Based on the storm drainage areas the 2-year, 5-year and 100-year post-development peak flows are calculated based on the Rational Method and are summarized in the Table 5-5 below with detailed calculations provided in Table F5 of Appendix E.

Table 5-5: Summary of Post-Development Flows

Area No	Area (ha)	Tc (min)	Storm = 2-year			Storm = 5-year			Storm = 100-year		
			C_{AVG}	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	Q (L/sec)	Q_{CAP} (L/sec)
1	0.0955	10	0.71	14.5	(43.0)	0.71	19.6	(50.5)	0.89	42.1	(82.0)
2	0.0552	10	0.80	9.4		0.80	12.8		1.00	27.4	
3	0.1161	10	0.75	18.6		0.75	25.2		0.94	54.0	
4	0.0742	10	0.50	7.9		0.50	10.7		0.63	23.0	
5	0.0680	10	0.76	11.0		0.76	15.0		0.95	32.0	
6	0.0583	10	0.75	9.3		0.75	12.7		0.94	27.1	
7	0.1539	10	0.77	25.3		0.77	34.3		0.96	73.5	
8	0.0438	10	0.73	6.8		0.73	9.3		0.91	19.8	
9	0.0263	10	0.72	4.0		0.72	5.5		0.90	11.7	
10	0.0559	10	0.81	9.7		0.81	13.1		1.00	27.8	
11	0.0436	10	0.49	4.6		0.49	6.2		0.61	13.2	
12	0.1701	10	0.47	17.1		0.47	23.2		0.59	49.6	
13	0.1814	10	0.50	19.4		0.50	26.3		0.63	56.3	
14	0.0209	10	0.40	1.8		0.40	2.4		0.50	5.2	
15	0.0310	10	0.64	4.2	4.2	0.64	5.7	5.7	0.80	12.3	12.3
16	0.0068	10	0.20	0.3	0.3	0.20	0.4	0.4	0.25	0.8	0.8
Totals	1.2008			163.9	**47.5**		222.4	**56.6**		476.0	**95.2**

Flows in (brackets) under Q_{CAP} denotes flows that are controlled.

In summary, the 2-year, 5-year and 100-year post-development flows are 163.9 L/sec, 222.4 L/sec and 476.0 L/sec respectively. Flow control devices will be used to restrict these runoff rates from the site to **47.5** L/sec, **56.6** L/sec and **95.2** L/sec for the 2-year, 5-year and 100-year storms respectively. Further details regarding the onsite detention and storage methods are provided in the proceeding section.

5.6 Storm Sewer Design

Average runoff coefficients were calculated for all drainage areas for sizing of the storm sewers. Post-development drainage areas are illustrated on Figure 3 in Appendix A. Average runoff coefficients were calculated for each catchment and inlet times of 10 minutes were used as per City of Ottawa Guidelines.

A minimum 300mm diameter storm sewer is proposed for the main line storm sewer capturing surface runoff. A minimum 200mm diameter storm sewer is proposed for the foundation drainage system.

All new storm sewers were sized for the 2-year peak flow. Design sheets for the 2-year sizing of the storm sewer system are included in Appendix E.

5.7 Flow Control & Stormwater Storage

It will be necessary to control runoff to the allowable rate; therefore, runoff will be detained using an inlet control device (ICD) within the storm system. This will ensure that sufficient stormwater detention is provided and that the peak flows entering the existing storm sewer on Goward Drive will be equal to or less than the allowable rate.

The following itemizes the design methodology used:

- For the entire catchment tributary to the ICD, the drainage area and average runoff coefficient was calculated. The average runoff coefficient was calculated with the area weighting routine in PCSWMM. The drainage area information for the catchment is provided in Table F10.
- The volume available in chambers was taken from the Manufacture’s literature, which is provided in Appendix H for reference.
- The total storage available in the underground chambers was estimated based on the above Manufacturer’s data and the required 100-year volume as estimated using the Modified Rational Method.
- Inputted the type of ICD, outlet pipe invert, and outlet pipe diameter to obtain the maximum head and discharge rate for the selected ICD. The ICD information selected in provided in Table F13 with the associated Manufactures’ technical brochure in Appendix H.
- A combination stage-storage and storage-discharge table (Table E14) was generated to summarize the discharge rates and storage volumes based on the ICD selected and chamber storage volumes provided.
- Tables for the 2-year, 5-year, and 100-yr storage requirements, based on the Modified Rational Method (MRM) were used for various release rates to overlay onto the combination stage-storage and storage-discharge curves. Tables F17 through F18 illustrate the MRM at different release rates, whereas Table F17 provides the storage volumes at the actual discharge rates.
- The intersection of the stage-discharge rates and the MRM volumes provide the actual 2-yr, 5-yr, and 100-yr storage, release rates and elevations.
- A summary Table (F20) is provided indicating the 2-year, 5-year and 100-year data for: release rate, storage volume, depth, and elevation (or stage).

The following Table 5-6 summarizes the ICDs that are proposed.

Table 5-6: Summary of ICDs

Area No	ICD Location	Controlled Rate (L/sec)	Min Elev. (m)	Max Elev. (m)	Head (m)	ICD Type / Model
1-14	STM MH 213	82.0	98.50	100.176	1.676	IPEX HF Type F

5.8 Storage Requirements

Stormwater storage requirements and associated controlled release rates within the site are summarized below in Table 5-7. Detailed calculations using the Modified Rational Method of the onsite storage requirements are provided in Appendix F.

Table 5-7: Summary of Storage Requirements and Release Rates

<table>
<tr><th rowspan="2">Area No.</th><th rowspan="2">Area (ha)</th><th colspan="3">Release Rate (L/s)</th><th colspan="3">Storage Required (m^3)</th><th rowspan="2">Storage Provided (m3)</th><th rowspan="2">Control Location</th><th rowspan="2">Control Type</th></tr>
<tr><th>2-yr</th><th>5-yr</th><th>100-yr</th><th>2-yr</th><th>5-yr</th><th>100-yr</th></tr>
<tr><td>1</td><td>0.0955</td><td rowspan="14">43.0</td><td rowspan="14">50.5</td><td rowspan="14">82.0</td><td rowspan="14">79.6</td><td rowspan="14">79.6</td><td rowspan="14">287.1</td><td rowspan="14">292.0
55-Chambers</td><td rowspan="14">ICD at STMH213</td><td rowspan="14">Tempest MHF Type F</td></tr>
<tr><td>2</td><td>0.0552</td></tr>
<tr><td>3</td><td>0.1161</td></tr>
<tr><td>4</td><td>0.0742</td></tr>
<tr><td>5</td><td>0.0680</td></tr>
<tr><td>6</td><td>0.0583</td></tr>
<tr><td>7</td><td>0.1539</td></tr>
<tr><td>8</td><td>0.0438</td></tr>
<tr><td>9</td><td>0.0263</td></tr>
<tr><td>10</td><td>0.0559</td></tr>
<tr><td>11</td><td>0.0436</td></tr>
<tr><td>12</td><td>0.1701</td></tr>
<tr><td>13</td><td>0.1814</td></tr>
<tr><td>14</td><td>0.0209</td></tr>
<tr><td>15</td><td>0.0310</td><td>4.2</td><td>5.7</td><td>12.3</td><td>none</td><td>none</td><td>none</td><td>none</td><td>Uncontrolled</td><td></td></tr>
<tr><td>16</td><td>0.0068</td><td>0.3</td><td>0.4</td><td>0.8</td><td>none</td><td>none</td><td>none</td><td>none</td><td>Uncontrolled</td><td></td></tr>
<tr><td>Total</td><td>1.20</td><td>47.5</td><td>56.6</td><td>1.2</td><td>79.6</td><td>116.8</td><td>287.1</td><td>292.0</td><td></td><td></td></tr>
</table>

6 Erosion and Sediment Control

During all construction activities, erosion and sedimentation shall be controlled by the following techniques:

- extent of exposed soils shall be limited at any given time,
- exposed areas shall be re-vegetated as soon as possible,
- filter cloth shall be installed between frame and cover of all new catch basins and catch basin manholes,
- filter cloth shall be installed between frame and cover of the existing catch basins and catch basin manholes as identified on the site grading and erosion control plan,
- light duty silt fencing will be used to control runoff around the construction area. Silt fencing locations are identified on the site grading and erosion control plan.
- visual inspection shall be completed daily on sediment control barriers and any damage repaired immediately. Care will be taken to prevent damage during construction operations,
- In some cases barriers may be removed temporarily to accommodate the construction operations. The affected barriers will be reinstated at night when construction is completed,
- Sediment control devices will be cleaned of accumulated silt as required. The deposits will be disposed of as per the requirements of the contract,
- during the course of construction, if the engineer believes that additional prevention methods are required to control erosion and sedimentation, the contractor will install additional silt fences or other methods as required to the satisfaction of the engineer, and
- Construction and maintenance requirements for erosion and sediment controls are to comply with Ontario Provincial Standard Specification (OPSS) OPSS 805, and City of Ottawa specifications.

7 Conclusions

This report addresses stormwater runoff from the proposed development located at 1158 Second Line Road in the City of Ottawa. The proposed 1.2-hectare development by Theberge Homes is a comprised of forty-nine (49) townhome units. The following summarizes the servicing and stormwater requirements for the site:

- The allowable capture rate from the proposed site was based on the minor system capture rate established as part of the Morgan's Grant Subdivision Phase 12D, which was set a 100 L/sec. This capture rate was based on the 5-year storm design for the 1.2-hectare site using a time of concentration of 20 minutes and a runoff coefficient of 0.50 for a peak flow of 117.2 L/sec.
- Post-development runoff coefficient for the site was calculated at 0.64, with a 2-year, 5-year and 100-yr peak flows of 163.9 L/sec, 222.4 L/sec and 476.0 L/sec respectively. Flow control devices will be used to restrict these runoff rates from the site to **47.5** L/sec, **56.6** L/sec and **95.2** L/sec for the 2-year, 5-year and 100-year storms respectively. Therefore, stormwater rrunoff from the site is controlled to less than the allowable rate of 100 L/sec.
- One Inlet control devices (ICD) will be used to control runoff to the allowable discharge rate of 100 L/sec. The Inlet control device will be installed in the most downstream manhole of the storm system as shown on the Site Servicing plan, and will control peak flows to 82.0 L/sec at 1.7m of head.
- A total peak flow of 95.2 L/sec will occur, which includes the 82.0 L/sec of controlled flow and 13.1 L/sec of uncontrolled runoff from the site. A separate foundation drainage system and surface drainage system is proposed.
- The estimated storage required to control peak flows to the allowable release rate was 287.1 m^3 based on the Modified Rational Method, with a total storage volume of 292 m^3 provided.
- The proposed development has an estimated peak sewage flow of 2.12 L/sec based on City of Ottawa Guidelines. A new 200mm sewer will be installed with a minimum slope of 0.49% having a full flow capacity of 23.3 L/sec. The sanitary sewer will be connected into the existing municipal sanitary sewer on Goward Drive.
- A hydraulic water model was developed to determine the pressures available under peak hour and maximum day plus fire flow conditions. Two possible boundary conditions were provided by City staff for modelling. Two connections to the existing city water distribution system are is necessary was there would be more that 50 residential units on a single feed without the second connection.
- The calculated minimum and maximum working pressures anticipated within the development are 51.7 psi and 56.0 psi under peak hourly conditions, with an estimated fire flow available at the proposed hydrant # 1 (J-3) near Block 4 of ± 174 L/sec, which is greater than the required 150 L/sec for a 6-unit townhome block. Correspondence from the City staff indicate an excess of this amount is available. The maximum estimated fire flow requirement based on the FUS was calculated at 150 L/sec for the largest 6-unit townhome block. Two fire hydrants are proposed to provide fire protection.
- The storm sewer system is sized to accommodate the 2-year design storm under free flow conditions.
- All units have an underside of footing elevation a minimum of 0.30 metres above the storm sewer hydraulic grade line. An overland flow route is provided for the major storm event.
- Erosion and sediment control methods will be used during construction to limit erosion potential.

Appendix A – Figures

Figure A1: Site Location Plan

Figure A2: Sanitary Drainage Areas

Figure A3: Post-Development Catchment Areas

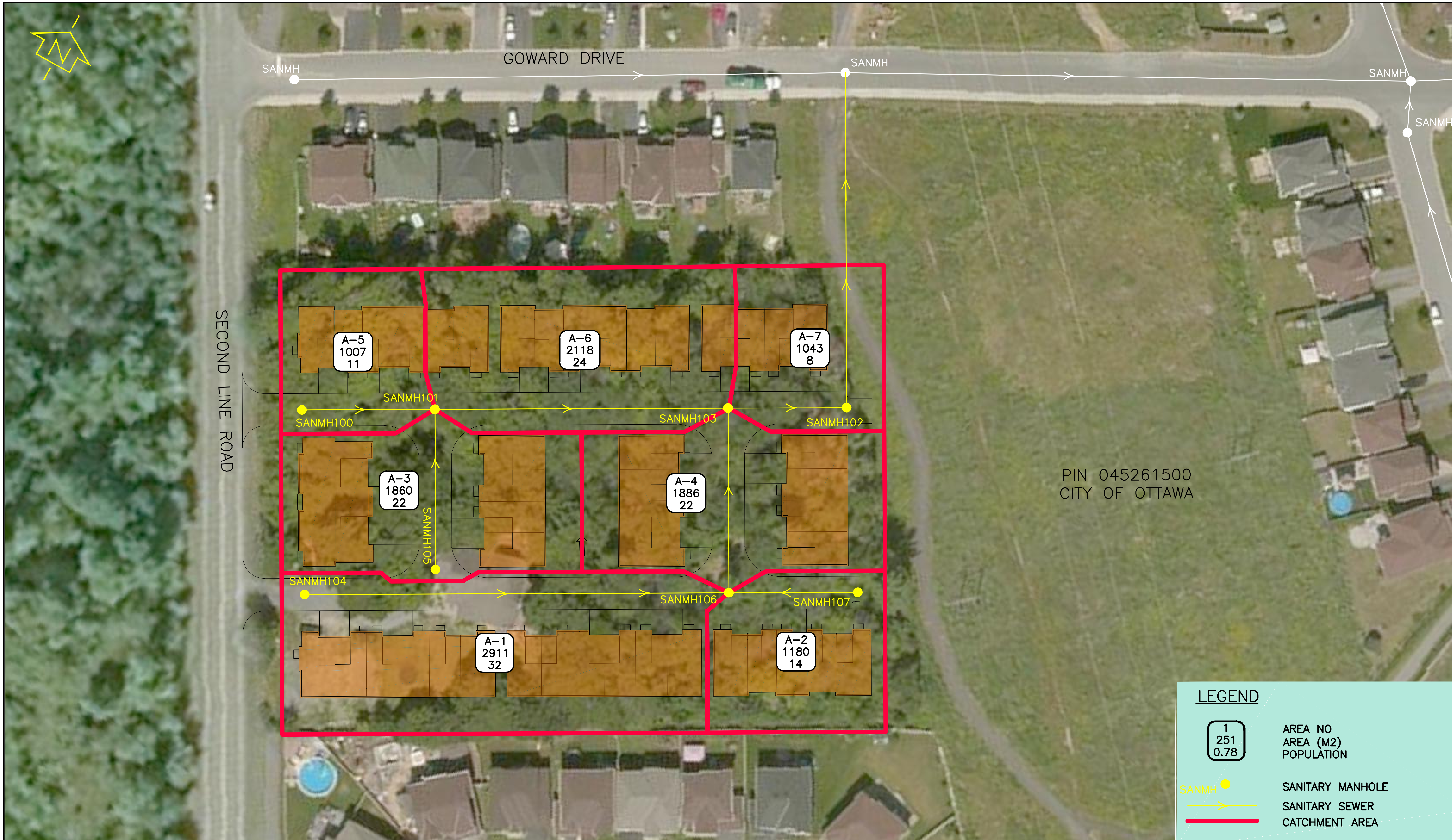
Figure A4: Site Plan

Figure A5: Survey Plan

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

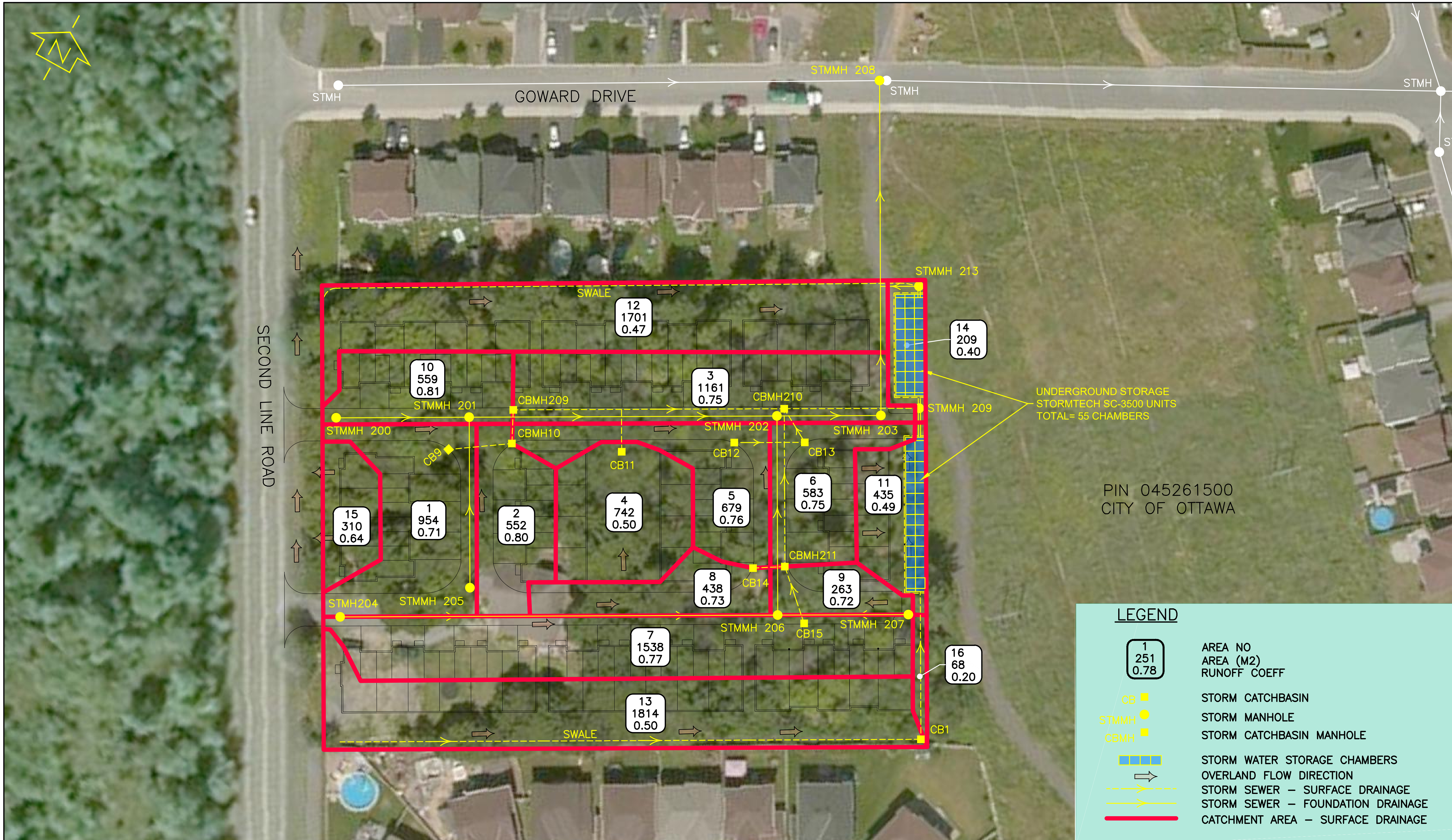
www.exp.com

DESIGN JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE 1:10000
DRAWN SAB		SKETCH NO
DATE APR 2018	SITE LOCATION PLAN	FIG 1
FILE NO 245003		



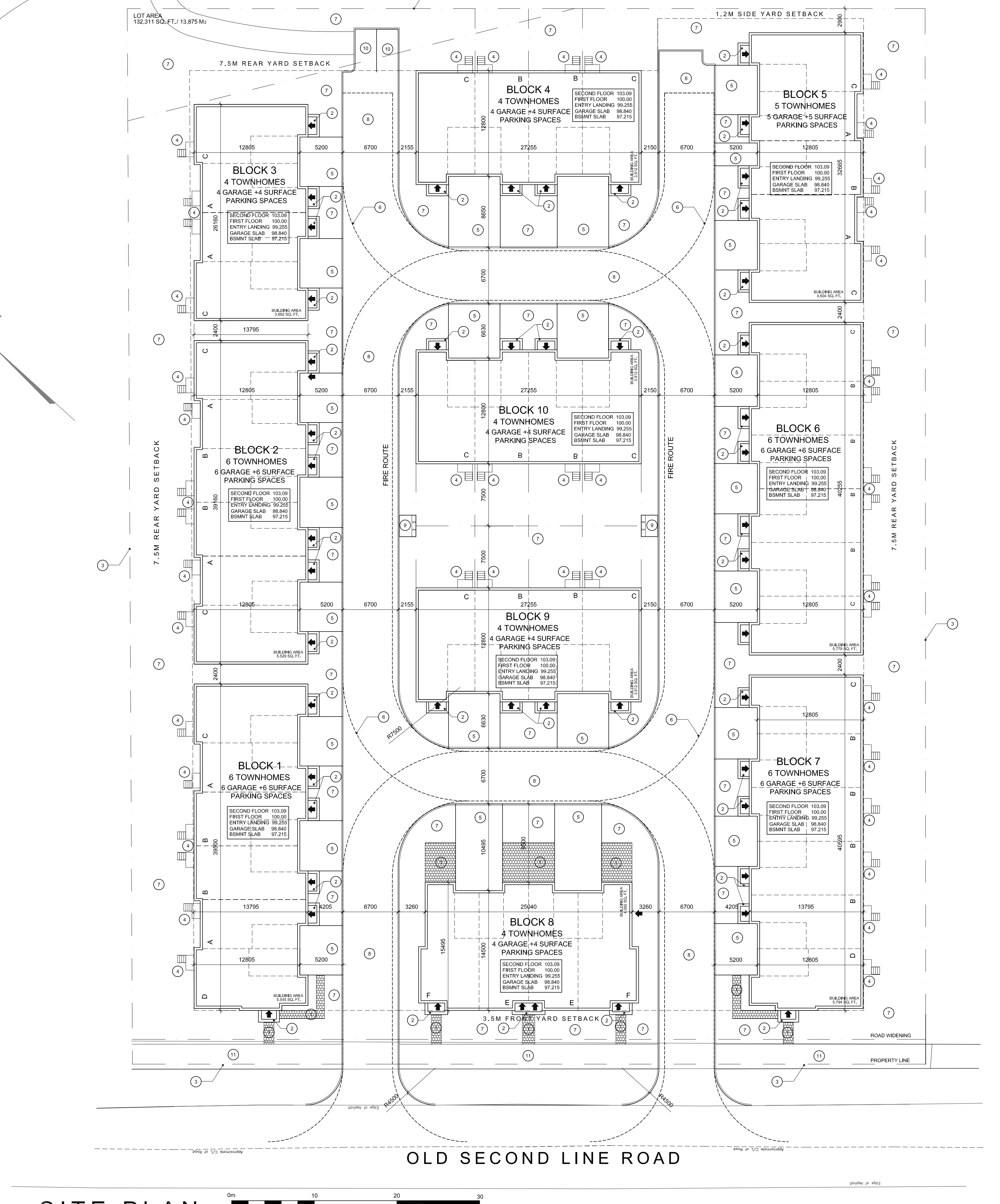
exp Services Inc.
100, 2650 Queensview Drive
Ottawa, ON K2B 8H6
www.exp.com

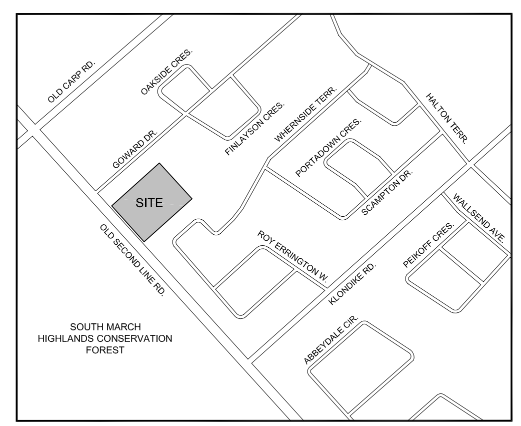
DESIGN	JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE	1:750
DRAWN	SAB		FIGURE NO	FIG 2
DATE	APR 2018	SANITARY DRAINAGE AREA PLAN		
FILE NO	245003			



exp Services Inc.
100, 2650 Queensview Drive
Ottawa, ON K2B 8H6
www.exp.com

DESIGN	JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE	1:750
DRAWN	SAB		FIGURE NO	
DATE	APR 2018	POST-DEVELOPMENT CATCHMENTS PLAN	FIG 3	
FILE NO	245003			





SITE LOCATION PLAN

PROJECT INFORMATION

ZONING	R3

PROJECT STATISTICS

BUILDING HEIGHT	10.0 M
MIN. FRONT & CORNER YARD SETBACK	3.5-4.2 M
MIN. INTERIOR YARD SETBACK	1.2 M
MIN. REAR YARD SETBACK	7.5 M

BUILDING STATISTICS

TOWNHOMES (WITH ATTACHED GARAGE)	
TOTAL UNITS	49

BUILDING AREAS

BLOCK 1	BUILDING AREA 5,545 SQ. FT. / 515 SQ.M.
BLOCK 2	BUILDING AREA 5,529 SQ. FT. / 513.6 SQ.M.
BLOCK 3	BUILDING AREA 3,662 SQ. FT. / 340 SQ.M.
BLOCK 4	BUILDING AREA 3,912 SQ. FT. /363.4 SQ.M.
BLOCK 5	BUILDING AREA 4,604 SQ. FT. / 427.7 SQ.M.
BLOCK 6	BUILDING AREA 5,779 SQ. FT. /536.8 SQ.M.
BLOCK 7	BUILDING AREA 5,794 SQ. FT. / 538.3 SQ.M.
BLOCK 8	BUILDING AREA 4,092 SQ. FT. / 380.2 SQ.M.
BLOCK 9	BUILDING AREA 3,912 SQ. FT. / 363.4 SQ.M.
BLOCK 10	BUILDING AREA 3,912 SQ. FT. / 363.4 SQ.M.

TOTAL AREA	4,341.8 sq. m. 46,734.75 sq. ft.
SITE AREA	13,875 sq. m. (132,311 sq. ft.)
LOT COVERAGE	31.2%

CAR PARKING

REQUIRED

TOWNHOMES/GARAGE	- 1.0 PER UNIT (49 UNITS)	49
VISITOR	NOT REQUIRED	0
TOTAL		49

PROVIDED

TOWNHOMES/GARAGE	- 1.0 GARAGE + 1.0 DRIVEWAY SURFACE SPACE PER UNIT (49 UNITS)	98
VISITOR	- 2.0 CONVENIENCE SPACES	2
TOTAL		100

DRAWING NOTES:

1. PRECAST PAVERS
2. PRECAST CONCRETE STAIRS
3. PROPERTY LINE
4. WOOD STAIRS AND LANDING
5. ASPHALT DRIVEWAY
6. FIRE ROUTE
7. GRASS
8. PRIVATE STREET ASPHALT SURFACE
9. COMMUNITY MAILBOXES
10. VISITOR PARKING
11. CONCRETE SIDEWALK

IT IS THE RESPONSIBILITY OF THE APPROPRIATE CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE AND TO REPORT ALL ERRORS AND/OR OMISSIONS TO THE ARCHITECT.

ALL CONTRACTORS MUST COMPLY WITH ALL PERTINENT CODES AND BY-LAWS.

THIS DRAWING MAY NOT BE USED FOR CONSTRUCTION UNTIL SIGNED BY THE ARCHITECT.

DO NOT SCALE DRAWINGS.

NOTATION SYMBOLS:

- 00 — INDICATES DRAWING NOTES, LISTED ON EACH SHEET.
- 00 — INDICATES ASSEMBLIE TYPE: REFER TO TYPICAL ASSEMBLIES SCHEDUAL.
- 00 — INDICATES WINDOW TYPE: REFER TO WINDOW ELEVATIONS AND DETAILS ON A900 SERIES.
- 000 — INDICATES DOOR TYPE: REFER TO DOOR SCHEDULE AND DETAILS ON A900 SERIES.
- 00 / A000 TITLE SCALE — DETAIL NUMBER; DETAIL REFERENCE PAGE

No.	DESCRIPTION	DATE
1	PRELIMINARY FOR FINAL REVIEW	APR 11 2018

REVISIONS:

NORTH ARROW:

LEGAL DESCRIPTION
Topographic Plan of Survey of
Part of Lot 11
Concession 3
Geographic Township of March
City of Ottawa

SURVEYOR
Farley, Smith & Denis Surveying ltd
190 Colonnade Road
Ottawa Ontario K2E7J5
Tel: (613) 727-8226

PROJECT DEVELOPER
Theberge Homes
904 Lady Ellen Place
Ottawa Ontario K1Z 5L5
Tel: (613) 421-1515
Fax: (613) 695-1944

CIVIL ENGINEER
exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Tel: (613) 688-1899
Fax: (613) 852-8753
bruce.thomas@exp.com

LANDSCAPE ARCHITECT
Gino Aiello
50 Camelot Drive
Nepean, ON K2G5X8
Tel: (613) 852-1343
gino@gjala.com

CLIENT: THEBERGE HOMES

URBANDIVA Design Inc.

PROJECT TITLE: 1158 OLD SECOND LINE

OTTAWA ONTARIO

SHEET TITLE: SITE PLAN

SCALE: 1:250

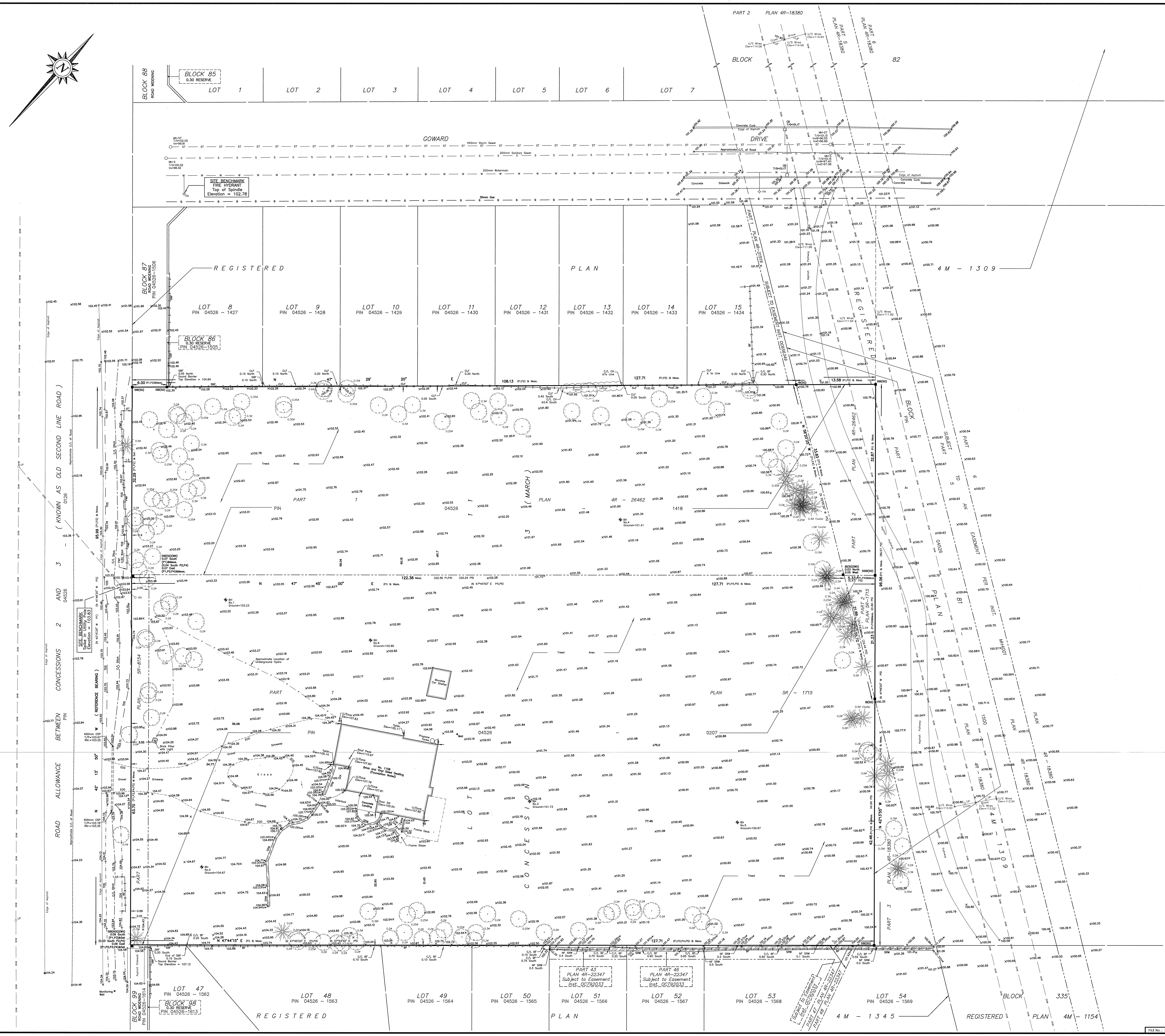
PROJECT No. 1802

SHEET No. SP-1

PAPER SIZE: ARCH D

PLOT DATE: Wednesday, April 11, 2018

347999, 5023393



TOPOGRAPHIC PLAN OF SURVEY OF

PART OF LOT 11
CONCESSION 3
GEOGRAPHIC TOWNSHIP OF MARCH
CITY OF OTTAWA

FARLEY, SMITH & DENIS SURVEYING LTD. 2018

Scale 1: 200

0 2.5 5 10 15 20 metres

Metric Note
Distances and coordinates on this plan are in metres and can be converted to feet by dividing by 0.3048.

Distance Note
Distances shown on this plan are ground distances and can be converted to grid distances by multiplying by the combined scale factor of 0.99991.

Bearing Note
Bearings are grid and are referred to the easterly limit of Second Line Road having a bearing of N 42° 13' 50" W as shown on Registered Plan 4M-1309 and are referred to the Central Meridian of MTM Zone 9 (76°30' West Longitude) Nad-83 (Original).

Elevation Notes
1. Elevations shown are geodetic and are referred to Geodetic Datum CGVD-1928 :1978.
2. It is the responsibility of the user of this information to verify that the job benchmark has not been altered or disturbed and that it's relative elevation and description agrees with the information shown on this drawing.

Utility Notes
1. This drawing cannot be accepted as acknowledging all of the utilities and it will be the responsibility of the user to contact the respective utility authorities for confirmation.
2. Only visible surface utilities were located.
3. Underground utility data derived from City of Ottawa utility sheet reference:A-N-20.
4. Sanitary and storm sewer grades were derived from field measurement.
5. A field location of underground plant by the pertinent utility authority is mandatory before any work involving breaking ground, probing, excavating etc.

Note
Trees located within 5m corridor of subject boundary only.

Notes & Legend

—□—	Denotes	Survey Monument Planted
—■—	"	Survey Monument Found
SIB	"	Standard Iron Bar
SSIB	"	Short Standard Iron Bar
IB	"	Iron Bar
(Wit)	"	Witness
Meas	"	Measured
(P1)	"	Plan 4R-26462
(P2)	"	Registered Plan 4M-1309
(P3)	"	Registered Plan 4M-1345
(P4)	"	Plan 4R-20110
(P5)	"	Plan 5R-1715
○ MH-ST	"	Maintenance Hole (Storm)
○ MH-S	"	Maintenance Hole (Sanitary)
—— ST ——	"	Underground Storm Sewer
—— S ——	"	Underground Sanitary Sewer
—— W ——	"	Underground Water
—— P ——	"	Underground Electrical
—— OHW ——	"	Overhead Wires
○UP	"	Utility Pole
○ AN	"	Anchor
□ DI	"	Ditch Inlet
CSP	"	Corrugated Steel Pipe
FH	"	Fire Hydrant
Inv.	"	Invert
T/G	"	Top of Grate
T/P	"	Top of Pipe
BH	"	Borehole
Ø	"	Diameter
CLF	"	Chain Link Fence
PWF	"	Post and Wire Fence
BF	"	Board Fence
SBF	"	Sound Barrier Fence
SRW	"	Irregular Stone Retaining Wall
WRW	"	Wood Retaining Wall
RF	"	Rail Fence
C/L	"	Centreline
NF	"	North Face
CH	"	Cedar Hedge
tow	"	Top of Wall
U/S	"	Underside
U/Eave	"	Underside of Eave
EOG	"	Edge of Gravel
TpFdn	"	Top of Foundation
Elev	"	Elevation
+65.00	"	Location of Elevations
+65.00	"	Top of Concrete Curb Elevation
———	"	Property Line
(circle)	"	Deciduous Tree
(star)	"	Coniferous Tree

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
2039786

THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR
In accordance with Regulation 1026, Section 29 (3).

Surveyor's Certificate
I certify that :
1. This survey and plan are correct and in accordance with the Surveys Act, the Surveyors Act and the Regulations made under them.
2. The survey was completed on the 28th day of February, 2018.

03/05/18
Date

Jamie Leslie
Ontario Land Surveyor

TOPOGRAPHIC DATA WAS COLLECTED UNDER WINTER CONDITIONS. SNOW COVER AND ICE PRECLUDE DETERMINING LOCATION AND ELEVATION OF SOME TOPOGRAPHICAL DATA THAT IS OTHERWISE VISIBLE.

FARLEY, SMITH & DENIS SURVEYING LTD.

ONTARIO LAND SURVEYORS
CANADA LAND SURVEYORS

190 COLONNADE ROAD, OTTAWA, ONTARIO K2E 7J5
TEL. (613) 727-8226 FAX. (613) 727-1826

FILE No. : 39-18

Appendix B – Sanitary Design Sheet

Table B1: Sanitary Design Sheet

TABLE B1 -SANITARY SEWER CALCULATION SHEET

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUST			INST		C+I+I	INFILTRATION			Peak FLOW (L/s)	SEWER DATA						
					POPULATION																			Dia.		Slope	Length	Capacity		
Street	From	To	Area No.	Area (ha)	1-Bed Apt	2-Bed Apt	Towns	Individual Population	Cumulative Population	Peak Factor	Peak Flow (L/sec)	AREA (Ha)	ACCU AREA (Ha)	AREA (Ha)	ACCU AREA (Ha)	Peak Factor (per MOE)	AREA (Ha)	ACCU AREA (Ha)	PEAK FLOW (L/s)	AREA (ha)	ACCU AREA (Ha)	INFILT FLOW (L/s)		(mm)	actual	(%)	(m)	(L/s)	Full Velocity (m/s)	Qpeak/ Qcap
1158 Second Line																														
Block 6, 7	MH 104	MH106	A-1	0.2911			12	32	32	4.00	0.41									0.2911	0.2911	0.10	0.51	200	201.16	2.36	87.68	51.17	1.61	0.01
Block 5	MH107	MH106	A-2	0.1180			5	14	14	4.00	0.18									0.1180	0.1180	0.04	0.22	200	201.16	2.00	26.79	47.10	1.48	0.00
Block 4, 10	MH106	MH103	A-4	0.1886			8	22	68	4.00	0.88									0.1860	0.5951	0.20	1.08	200	201.16	2.90	41.18	56.72	1.78	0.02
Block 8, 9	MH105	MH101	A-3	0.1860			8	22	90	4.00	1.17									0.1886	0.1886	0.06	1.23	200	201.16	3.02	33.12	57.88	1.82	0.02
Block 1	MH100	MH101	A-5	0.1007			4	11	101	4.00	1.31									0.1007	0.1007	0.03	1.34	200	201.16	2.70	27.50	54.73	1.72	0.02
Block 1,2,3	MH101	MH103	A-6	0.2118			9	24	125	4.00	1.62									0.2118	0.5011	0.17	1.79	200	201.16	2.90	60.61	56.72	1.78	0.03
Block 3	MH103	MH102	A-7	0.1043			3	8	133	4.00	1.72									0.1043	1.2005	0.40	2.12	200	201.16	0.49	24.49	23.32	0.73	0.09
	MH102	EXMH	A-8						133	4.00	1.72										1.2005	0.40	2.12	200	201.16	0.50	69.28	23.55	0.74	0.09
				1.2005			49	133													1.2005	0.40								

Average Daily Flow (L/p/day) = 280 L/person/day
Commercial Flow (L/s/ha) = 50,000 L/gross ha/day
0.579 or L/gross ha/sec
Industrial Flow (L/s/ha) = 35,000 L/gross ha/day
0.405 or L/gross ha/sec
Max Res Peak Factor = 4.0
Commercial / Inst Peak Factor = 1.5

Population Densities — Persons Per Unit
Singles = 3.4
Townhouse (row units) = 2.7
2-Bedroom Apt = 2.1
1-Bedroom Apt = 1.4

Q(p) = Peak Population Flow = PqM/86.4 + Iac (L/sec)
Q(i) = Peak Extraneous Flow = I * Ac (L/sec)
A_i = Individual; Area (hectares)
A_c = Cumulative Area (hectares)
M = Peaking Factor = 1 + (14/(4+P^0.5))
P = Population (thousands of persons)
Qcap, (Manning) = 1/n $S^{1/2} R^{2/3} A_{c\ Manr}$ (L/sec)
Manning N = 0.013
I = Peak extraneous flow (L/s/ha) = 0.33

Date Completed:
2018/04/05

Designed: **M.Ghadban, EIT.**
Project: **1158 Second Line**
Checked: **J. Fitzpatrick, P.Eng.**
Location: **Ottawa, Ontario**
Dwg Reference: **Site Servicing Plan (Dwg No. SS1)**
File Ref: **245003 Sanitary Design Sheet April 2018**
Sheet No: **1 of 1**

Appendix C – Water Tables

Table C1: Water Demand Chart

Table C2: Calculation of Fire Flow Requirements (4 unit block)

Table C3: Calculation of Fire Flow Requirements (5 unit block)

Table C4: Calculation of Fire Flow Requirements (6 unit block)

TABLE C1: Water Demand Chart

Location: 1158 Old Second Line
Project No: 245012
Designed by: M. Ghadban
Checked By: J.Fitzpatrick
Date Revised: April 2018

Water Consumption
Residential = **350** L/cap/day

Population Densities

Single Family	3.4	person/unit
Semi-Detahced	2.7	person/unit
Duplex	2.3	person/unit
Townhome (Row)	2.7	person/unit
Bachelor Apartment	1.4	person/unit
1 Bedroom Apartment	1.4	person/unit
2 Bedroom Apartment	2.1	person/unit
3 Bedroom Apartment	3.1	person/unit
Avg. Aptartment	1.8	person/unit

	No. of Units										Demands in (L/sec)					
	Singles/Semis/Towns				Apartments							Maximum Demand (L/day)	Peak Hourly Demand (L/day)			
Proposed Buildings	Single Family	Semi-Detached	Duplexz	Townhome	Bachelor	1 Bedroom	2 Bedroom	4 Bedroom	Avg Apt.	Total Persons (pop)	Average Demand (L/day)	4.32 x Avg Day	6.50 x Avg Day	Avg Day (L/s)	Max Day (L/s)	Max Hour (L/s)
Proposed Buildings																
J-1				3						8.1	2835	12,238	18,435	0.03	0.14	0.21
J-2				9						24.3	8505	36,714	55,305	0.10	0.42	0.64
J-3				10						27.0	9450	40,793	61,450	0.11	0.47	0.71
J-4				9						24.3	8505	36,714	55,305	0.10	0.42	0.64
J-5				3						8.1	2835	12,238	18,435	0.03	0.14	0.21
J-6				11						29.7	10395	44,872	67,595	0.12	0.52	0.78
J-11				3						8.1	2835	12,238	18,435	0.03	0.14	0.21
J-12				1						2.7	945	4,079	6,145	0.01	0.05	0.07
Existing Homes																
J-7	7									23.8	8330	35,958	54,167	0.10	0.42	0.63
J-8																
J-9	8									27.2	9520	41,095	61,905	0.11	0.48	0.72
J-10																
J-13	2									6.8	2380	10,274	15,476	0.03	0.12	0.18
J-14	4									13.6	4760	20,548	30,953	0.06	0.24	0.36
J-15	4									13.6	4760	20,548	30,953	0.06	0.24	0.36
Totals =	25			49						217.3	76055	328,309	494,560	0.88	3.80	5.72

TABLE C2: CALCULATION OF FIRE FLOW REQURIEMENTS
Calculation Based on Fire Underwriters Survey, 1999
1158 Old Second Line Road, 4 unit block

An estimate of the Fire Flow required for a given fire area may be estimated by:

$$F = 220 \times C \times \sqrt{A}$$

where F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Ordinary Construction	1		
	Ordinary Construction	1				
	Non-combustible Construction	0.8				
	Fire Resistive Construction	0.6				
Input Building Floor Areas (A)	Third Floor (if any)		0	745.2 m²		
	Second Floor (if any)		372.58			
	First Floor		372.58			
	Basement (At least 50% below grade, not included)		0			
Fire Flow (F)	$F = 220 \times C \times \sqrt{A}$					6,005
Round Fire Flow (F)	Round to nearest 1,000					**6,000**
	Reductions/Increases Due to Factors Effecting Burning					
Choose Combustibility of Building Contents	Non-combustible	-25%	Non-combustible	-25%	-1,500	4,500
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	No Sprinkler	0%	0	4,500
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	4,500
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	4,500
	Not Fully Supervised or N/A	0%				
Choose Structure Exposure Distance	North Side	15%	10.1 m to 20.0 m	60%	2,700	7,200
	East Side	15%	10.1 m to 20.0 m			
	South Side	15%	10.1 m to 20.0 m			
	West Side	15%	10.1 m to 20.0 m			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =					**7,000**
	Total Required Fire Flow, L/s =					**117**

TABLE C3: CALCULATION OF FIRE FLOW REQURIEMENTS
Calculation Based on Fire Underwriters Survey, 1999
1158 Old Second Line Road, 5 unit block

An estimate of the Fire Flow required for a given fire area may be estimated by:

$$F = 220 \times C \times \sqrt{A}$$

where F = required fire flow in litres per minute
A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)
C = coefficient related to the type of construction

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Ordinary Construction	1		
	Ordinary Construction	1				
	Non-combustible Construction	0.8				
	Fire Resistive Construction	0.6				
Input Building Floor Areas (A)	Third Floor (if any)		0	878.4 m²		
	Second Floor (if any)		439.2			
	First Floor		439.2			
	Basement (At least 50% below grade, not included)		0			
Fire Flow (F)	$F = 220 \times C \times \sqrt{A}$					6,520
Round Fire Flow (F)	Round to nearest 1,000					**7,000**
	Reductions/Increases Due to Factors Effecting Burning					
Choose Combustibility of Building Contents	Non-combustible	-25%	Non-combustible	-25%	-1,750	5,250
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	No Sprinkler	0%	0	5,250
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	5,250
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	5,250
	Not Fully Supervised or N/A	0%				
Choose Structure Exposure Distance	North Side	15%	10.1 m to 20.0 m	50%	2,625	7,875
	East Side	0%	45.1 m or Greater			
	South Side	15%	10.1 m to 20.0 m			
	West Side	20%	3.1 m to 10.0 m			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =					**8,000**
	Total Required Fire Flow, L/s =					**133**

TABLE C4: CALCULATION OF FIRE FLOW REQURIEMENTS

Calculation Based on Fire Underwriters Survey, 1999

1158 Old Second Line Road, 6 unit block

An estimate of the Fire Flow required for a given fire area may be estimated by:

$$F = 220 \quad x \; C \; x \; \sqrt{A}$$

where F = required fire flow in litres per minute

A = total floor area in m^2 (including all storeys, but excluding basements at least 50% below grade)

C = coefficient related to the type of construction

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Ordinary Construction	1		
	Ordinary Construction	1				
	Non-combustible Construction	0.8				
	Fire Resistive Construction	0.6				
Input Building Floor Areas (A)	Third Floor (if any)		0	1055.0 m²		
	Second Floor (if any)		527.5			
	First Floor		527.5			
	Basement (At least 50% below grade, not included)		0			
Fire Flow (F)	$F = 220 \; x \; C \; x \; \sqrt{A}$					7,146
Round Fire Flow (F)	Round to nearest 1,000					**7,000**
	Reductions/Increases Due to Factors Effecting Burning					
Choose Combustibility of Building Contents	Non-combustible	-25%	Non-combustible	-25%	-1,750	5,250
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	No Sprinkler	0%	0	5,250
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	5,250
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	5,250
	Not Fully Supervised or N/A	0%				
Choose Structure Exposure Distance	North Side	10%	20.1 m to 30.0 m	75%	3,938	9,188
	East Side	25%	0 m to 3.0 m			
	South Side	15%	10.1 m to 20.0 m			
	West Side	25%	0 m to 3.0 m			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =					**9,000**
	Total Required Fire Flow, L/s =					**150**

Appendix D – WATERCAD Results

Table D1: Boundary Condition 1 Results

Figure D1: Boundary Condition 1 Location

Table D2: Boundary Condition 2 Results

Figure D2: Boundary Condition 2 Location

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Peak Hour Scenario - HGL at Location 1

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1	103.98	0.22	140.17	51.4
J-2	103.74	0.65	140.18	51.7
J-3	102.10	0.72	140.18	54.1
J-4	102.60	0.58	140.18	53.3
J-5	103.30	0.22	140.17	52.3
J-6	101.13	0.79	140.18	55.4
J-7	101.40	0.63	140.19	55.1
J-8	101.00	0.00	140.19	55.6
J-9	102.40	0.72	140.19	53.6
J-10	100.76	0.00	140.20	56.0
J-11	102.35	0.14	140.19	53.7
J-12	101.25	0.07	140.19	55.3
J-14	101.50	0.36	140.19	54.9
J-15	100.80	0.36	140.20	55.9

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Length (Scaled) (m)	Diameter (mm)	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)
P-1	J-1	J-2	24	50	110.0	-0.22	0.11	0.00065
P-2	J-2	J-3	57	204	110.0	-0.82	0.02	0.00001
P-3	J-2	J-4	33	204	110.0	-0.05	0.00	0.00000
P-4	J-4	J-5	25	50	110.0	0.22	0.11	0.00065
P-6	J-4	J-6	57	204	110.0	-0.85	0.03	0.00001
P-7	J-6	J-3	33	204	110.0	0.31	0.01	0.00000
P-10	J-7	J-9	120	204	110.0	0.72	0.02	0.00001
P-11	J-7	J-10	103	204	110.0	-3.37	0.10	0.00011
P-12	J-8	J-11	121	204	110.0	1.37	0.04	0.00002
P-13	J-11	J-3	32	204	110.0	1.23	0.04	0.00002
P-14	J-7	J-12	68	204	110.0	2.02	0.06	0.00004
P-15	J-12	J-6	29	204	110.0	1.95	0.06	0.00004
P-17	J-8	J-14	59	204	110.0	-1.37	0.04	0.00002
P-18	J-10	J-15	9	204	110.0	2.09	0.06	0.00004
P-19	J-14	J-15	89	155	110.0	-1.73	0.09	0.00012
P-21	R-1	J-10	21	600	130.0	5.46	0.02	0.00000

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
64	R-1	140.20	Zone - 1	5.46	140.20

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Max Day Plus Fireflow Scenario - HGL at Location 1

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1	103.98	0.14	140.19	51.4
J-2	103.74	0.43	140.19	51.7
J-3	102.10	0.48	140.19	54.1
J-4	102.60	0.38	140.19	53.4
J-5	103.30	0.14	140.19	52.4
J-6	101.13	0.52	140.19	55.4
J-7	101.40	0.42	140.19	55.1
J-8	101.00	0.00	140.19	55.6
J-9	102.40	0.48	140.19	53.6
J-10	100.76	0.00	140.20	56.0
J-11	102.35	0.10	140.19	53.7
J-12	101.25	0.05	140.19	55.3
J-14	101.50	0.24	140.19	54.9
J-15	100.80	0.24	140.20	55.9

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Length (Scaled) (m)	Diameter (mm)	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)
P-1	J-1	J-2	24	50	110.0	-0.14	0.07	0.00028
P-2	J-2	J-3	57	204	110.0	-0.53	0.02	0.00000
P-3	J-2	J-4	33	204	110.0	-0.04	0.00	0.00000
P-4	J-4	J-5	25	50	110.0	0.14	0.07	0.00028
P-6	J-4	J-6	57	204	110.0	-0.56	0.02	0.00000
P-7	J-6	J-3	33	204	110.0	0.21	0.01	0.00000
P-10	J-7	J-9	120	204	110.0	0.48	0.01	0.00000
P-11	J-7	J-10	103	204	110.0	-2.24	0.07	0.00005
P-12	J-8	J-11	121	204	110.0	0.90	0.03	0.00001
P-13	J-11	J-3	32	204	110.0	0.80	0.02	0.00001
P-14	J-7	J-12	68	204	110.0	1.34	0.04	0.00002
P-15	J-12	J-6	29	204	110.0	1.29	0.04	0.00002
P-17	J-8	J-14	59	204	110.0	-0.90	0.03	0.00001
P-18	J-10	J-15	9	204	110.0	1.38	0.04	0.00002
P-19	J-14	J-15	89	155	110.0	-1.14	0.06	0.00006
P-21	R-1	J-10	21	600	130.0	3.62	0.01	0.00000

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Max Day Plus Fireflow Scenario - HGL at Location 1

Fire Flow Report - Time: 0.00 hours

Label	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?
J-1	0.00	10.84	150.14	10.98	0.0	20.2	False
J-2	0.00	197.85	150.43	198.28	0.0	20.4	True
J-3	0.00	200.00	150.48	200.48	0.0	26.6	True
J-4	0.00	200.00	150.38	200.38	0.0	21.4	True
J-5	0.00	10.87	150.14	11.01	0.0	20.2	False
J-6	0.00	200.00	150.52	200.52	0.0	29.1	True
J-7	0.00	200.00	150.42	200.42	0.0	37.5	True
J-8	0.00	200.00	150.00	200.00	0.0	23.5	True
J-9	0.00	156.10	150.48	156.58	0.0	20.0	True
J-10	0.00	200.00	150.00	200.00	0.0	56.0	True
J-11	0.00	200.00	150.10	200.10	0.0	24.6	True
J-12	0.00	200.00	150.05	200.05	0.0	31.1	True
J-14	0.00	200.00	150.24	200.24	0.0	23.1	True
J-15	0.00	200.00	150.24	200.24	0.0	53.6	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
64	R-1	140.20	Zone - 1	3.62	140.20

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

www.exp.com

DESIGN JLF	1158 SECOND LINE RD THEBERGE HOMES		SCALE 1:1250
DRAWN SAB			
DATE 03/2018	WATER MODEL LAYOUT BOUNDARY CONDITON AT "A"		FIGURE NO FIG D1
FILE NO 245003			

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Peak Hour Scenario - HGL at Location 2

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1	103.98	0.22	141.95	53.9
J-2	103.74	0.65	141.97	54.3
J-3	102.10	0.72	141.97	56.6
J-4	102.60	0.58	141.97	55.9
J-5	103.30	0.22	141.95	54.9
J-6	101.13	0.79	141.97	58.0
J-7	101.40	0.63	141.97	57.6
J-8	101.00	0.00	141.98	58.2
J-9	102.40	0.72	141.96	56.2
J-10	100.76	0.00	141.97	58.5
J-11	102.35	0.14	141.97	56.2
J-12	101.25	0.07	141.97	57.8
J-13	101.19	0.18	142.00	57.9
J-14	101.50	0.36	141.98	57.5
J-15	100.80	0.36	141.97	58.4

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Length (Scaled) (m)	Diameter (mm)	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)
P-1	J-1	J-2	24	50	110.0	-0.22	0.11	0.00065
P-2	J-2	J-3	57	204	110.0	-1.13	0.03	0.00001
P-3	J-2	J-4	33	204	110.0	0.26	0.01	0.00000
P-4	J-4	J-5	25	50	110.0	0.22	0.11	0.00065
P-6	J-4	J-6	57	204	110.0	-0.54	0.02	0.00000
P-7	J-6	J-3	33	204	110.0	-1.33	0.04	0.00002
P-10	J-7	J-9	120	204	110.0	0.72	0.02	0.00001
P-11	J-7	J-10	103	204	110.0	-1.42	0.04	0.00002
P-12	J-8	J-11	121	204	110.0	3.32	0.10	0.00010
P-13	J-11	J-3	32	204	110.0	3.18	0.10	0.00010
P-14	J-7	J-12	68	204	110.0	0.07	0.00	0.00000
P-15	J-12	J-6	29	204	110.0	0.00	0.00	0.00000
P-16	J-13	J-8	68	204	110.0	5.46	0.17	0.00026
P-17	J-8	J-14	59	204	110.0	2.14	0.07	0.00005
P-18	J-10	J-15	9	204	110.0	-1.42	0.04	0.00002
P-19	J-14	J-15	89	155	110.0	1.78	0.09	0.00013
P-20	R-2	J-13	16	600	130.0	5.64	0.02	0.00000

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
65	R-2	142.00	Zone - 1	5.64	142.00

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Max Day Plus Fireflow Scenario - HGL at Location 2

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-1	103.98	0.14	141.98	53.9
J-2	103.74	0.43	141.98	54.3
J-3	102.10	0.48	141.98	56.6
J-4	102.60	0.38	141.98	55.9
J-5	103.30	0.14	141.98	54.9
J-6	101.13	0.52	141.98	58.0
J-7	101.40	0.42	141.98	57.6
J-8	101.00	0.00	141.99	58.2
J-9	102.40	0.48	141.98	56.2
J-10	100.76	0.00	141.99	58.5
J-11	102.35	0.10	141.99	56.3
J-12	101.25	0.05	141.98	57.8
J-13	101.19	0.12	142.00	57.9
J-14	101.50	0.24	141.99	57.5
J-15	100.80	0.24	141.99	58.5

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Length (Scaled) (m)	Diameter (mm)	Hazen-Williams C	Flow (L/s)	Velocity (m/s)	Headloss Gradient (m/m)
P-1	J-1	J-2	24	50	110.0	-0.14	0.07	0.00028
P-2	J-2	J-3	57	204	110.0	-0.74	0.02	0.00001
P-3	J-2	J-4	33	204	110.0	0.17	0.01	0.00000
P-4	J-4	J-5	25	50	110.0	0.14	0.07	0.00028
P-6	J-4	J-6	57	204	110.0	-0.35	0.01	0.00000
P-7	J-6	J-3	33	204	110.0	-0.88	0.03	0.00001
P-10	J-7	J-9	120	204	110.0	0.48	0.01	0.00000
P-11	J-7	J-10	103	204	110.0	-0.94	0.03	0.00001
P-12	J-8	J-11	121	204	110.0	2.20	0.07	0.00005
P-13	J-11	J-3	32	204	110.0	2.10	0.06	0.00004
P-14	J-7	J-12	68	204	110.0	0.04	0.00	0.00000
P-15	J-12	J-6	29	204	110.0	-0.01	0.00	0.00000
P-16	J-13	J-8	68	204	110.0	3.62	0.11	0.00012
P-17	J-8	J-14	59	204	110.0	1.42	0.04	0.00002
P-18	J-10	J-15	9	204	110.0	-0.94	0.03	0.00001
P-19	J-14	J-15	89	155	110.0	1.18	0.06	0.00006
P-20	R-2	J-13	16	600	130.0	3.74	0.01	0.00000

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Max Day Plus Fireflow Scenario - HGL at Location 2

Fire Flow Report - Time: 0.00 hours

Label	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?
J-1	0.00	11.30	150.14	11.44	0.0	20.1	False
J-2	0.00	163.26	150.43	163.69	0.0	20.4	True
J-3	0.00	175.06	150.48	175.54	0.0	22.5	True
J-4	0.00	165.58	150.38	165.96	0.0	21.0	True
J-5	0.00	11.31	150.14	11.45	0.0	20.2	False
J-6	0.00	174.58	150.52	175.10	0.0	23.0	True
J-7	0.00	166.35	150.42	166.77	0.0	21.4	True
J-8	0.00	200.00	150.00	200.00	0.0	37.4	True
J-9	0.00	124.52	150.48	125.00	0.0	20.0	False
J-10	0.00	168.09	150.00	168.09	0.0	20.0	True
J-11	0.00	184.71	150.10	184.81	0.0	21.4	True
J-12	0.00	177.49	150.05	177.54	0.0	20.0	True
J-13	0.00	200.00	150.12	200.12	0.0	57.9	True
J-14	0.00	200.00	150.24	200.24	0.0	25.3	True
J-15	0.00	167.90	150.24	168.14	0.0	20.0	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
65	R-2	142.00	Zone - 1	3.74	142.00

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

www.exp.com

exp.

DESIGN	JLF	1158 SECOND LINE RD THEBERGE HOMES	SCALE 1:1250
DRAWN	SAB		FIGURE NO
DATE	03/2018	WATER MODEL LAYOUT BOUNDARY CONDITON AT "B"	FIG D2
FILE NO	245003		

Appendix E – Storm Sewer Design Sheets

Table E1: 2-year Storm Sewer Calculation Sheet

Table E2: 5-year Storm Sewer Calculation Sheet

Table E3: 100-year Storm Sewer Calculation Sheet

TABLE E1: 2-YEAR STORM SEWER CALCULATION SHEET

Return Period Storm = **2-year** (5-years, 100-years)
Default Inlet Time= 10 (minutes)
Manning Coefficient = 0.013 (dimensionless)

From Node	To Node	Driange Type	SURFACE AREAS(ha) Area No.	Area (ha)	∑ Area (ha)	Average R	Foundation Drianage No of Bldgs	∑ Bldgs	Flow (L/sec)	FLOW (UNRESTRICTED) Indiv. 2.78*A*R	Accum. 2.78*A*R	Tc (mins)	I (mm/h)	Indiv. Flow	Return Period	Q (L/s)	Q Total (L/s)	SEWER DATA Dia (mm) Actual	Dia (mm) Nominal	Type	Slope (%)	Length (m)	Capacity, Q_{CAP} (L/sec)	Velocity (m/s) Vf	Va	Time in Pipe, Tt (min)	Hydraulic Ratios Q/Q_{CAP}	Va/Vf
CB9	CBMH10	SURFACE	1	0.0954	0.0954	0.71				0.19	0.188	10.00	76.81	14.46	2-year	14.5	14.5	201.2	200	PVC	5.42	12.00	77.54	2.43	1.56	0.13	0.19	0.64
CBMH10	CBMH209	SURFACE	2	0.0552	0.1506	0.80				0.12	0.311	10.13	76.31	9.37	2-year	23.7	23.7	251.5	250	PVC	3.01	6.97	104.79	2.10	1.41	0.08	0.23	0.67
CBMH209	CBMH210	SURFACE	10	0.0559	0.2065	0.81				0.13	0.437																	
			4	0.0742	0.2807	0.50				0.10	0.540	10.21	76.00	7.84	2-year	41.0	41.0	299.4	300	PVC	2.52	56.01	152.64	2.17	1.52	0.61	0.27	0.70
CB15	CBMH211	SURFACE	7	0.1538	0.1538	0.77				0.33	0.329	10.00	76.81	25.29	2-year	25.3	25.3	251.5	250	PVC	6.54	12.39	154.46	3.10	1.83	0.11	0.16	0.59
CB14	CBMH211	SURFACE	8	0.0438	0.0438	0.73				0.09	0.089	10.00	76.81	6.83	2-year	6.8	6.8	201.2	200	PVC	9.50	6.59	102.66	3.22	1.54	0.07	0.07	0.48
CBMH211	CBMH210	SURFACE	5	0.0679	0.2655	0.76				0.14	0.562																	
			6	0.0583	0.3238	0.75				0.12	0.683	10.11	76.37	9.28	2-year	52.2	52.2	366.4	375	PVC	2.91	32.65	281.19	2.71	1.73	0.31	0.19	0.64
CBMH210	STMH209	SURFACE	3	0.1161	0.7206	0.75				0.24	1.465	10.83	73.78	17.86	2-year	108.1	108.1	1525.0	1500	CONC	0.40	27.92	4672.21	2.53	0.78	0.59	0.02	0.31
SWALE 2	CB1	SURFACE	13	0.1814	0.1814	0.50				0.25	0.2521	10.00	76.81	19.37		19.4	19.4											
CB1	CHAMBERS	SURFACE	16	0.0068	0.1882	0.20				0.00	0.2559	10.00	76.81	0.29	2-year	19.7	19.7	201.2	200	PVC	1.00	30.92	33.31	1.04	0.94	0.55	0.59	0.90
CHAMBERS	STMH209	SURFACE	11	0.0435	0.2317	0.49				0.06	0.3152	10.55	74.76	4.43	2-year	23.6	23.6	600.0	600	HDPE	1.00	6.02	614.01	2.17	0.67	0.15	0.04	0.31
STMH209	CHAMBERS	SURFACE	14	0.0209	0.9732	0.40				0.02	1.8037	11.42	71.76	1.67	2-year	129.4	129.4	600.0	600	HDPE	1.00	2.55	614.01	2.17	1.43	0.03	0.21	0.66
SWALE 1	CBMH213	SURFACE	12	0.1701	0.1701	0.47				0.22	0.2223	10.00	76.81	17.07		17.1	17.1											
CHAMBERS	CBMH213	SURFACE			1.1433						2.0260	11.45	71.66		2-year	145.2	145.2	600.0	600	HDPE	1.00	2.25	614.01	2.17	1.45	0.03	0.24	0.67
CBMH213	TEE(203-208)	SURFACE									2.0260	11.45	71.66		2-year	145.2	145.2	299.4	300	PVC	3.34	7.94	175.72	2.50	2.48	0.05	0.83	0.99
STMH204	STMH206	FOUNDATION					12	12	5.4								5.4	201.2	200	PVC	2.27	90.46	50.18	1.57	0.87	1.74	0.11	0.55
STMH207	STMH206	FOUNDATION					5	5	2.3								2.3	201.2	200	PVC	1.20	28.21	36.49	1.14	0.55	0.86	0.06	0.48
STMH206	STMH202	FOUNDATION					8	25	11.3								11.3	201.2	200	PVC	2.90	41.18	56.72	1.78	1.19	0.58	0.20	0.67
STMH205	STMH201	FOUNDATION					8	8	3.6								3.6	201.2	200	PVC	2.95	35.26	57.21	1.79	0.86	0.68	0.06	0.48
STMH200	STMH201	FOUNDATION					5	5	2.3								2.3	201.2	200	PVC	2.98	27.50	57.50	1.80	0.56	0.82	0.04	0.31
STMH201	STMH202	FOUNDATION					8	21	9.5								9.5	201.2	200	PVC	2.86	63.61	56.33	1.77	1.04	1.02	0.17	0.59
STMH202	STMH203	FOUNDATION					3	49	22.1			0.58	155.61				22.1	251.5	250	PVC	0.42	21.49	39.14	0.79	0.56	0.64	0.56	0.71
STMH203	TEE (203-208)	FOUNDATION						49	22.1			1.22	144.57				22.1	447.9	450	PVC	0.42	27.92	182.45	1.16	0.66	0.70	0.12	0.57
TEE (203-208)	STMH208	OUTLET PIPE			1.1433			49	22.1		2.0260	11.47	71.57		2-year	145.0	167.1	447.9	450	PVC	0.30	69.27	154.20	0.98	1.02	1.13	1.08	1.04
	FLOW CONTROLLED																											
TOTALS =				**1.143**		**0.64**				**2.0260**																		

Definitions:
Q = 2.78*AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Watershed Area (hectares)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficients (dimensionless)

Drainage Types
FOUNDATI = Drainage From Foundation
SURFACE = Drainage From Surface Inlets
COMBIN = Drainage From Both Foundations & Inlets

Foundation Drain Allowance (L/s/unit) = **0.45**

Ottawa Rainfall Intensity Values from Sewer Design Guidelines, SDG002

	a	b	c
2-year	732.951	6.199	0.810
5-year	998.071	6.053	0.814
100-year	1735.688	6.014	0.820

Designed: **J. Fitzpatrick, P.Eng.**	Project: **THEBERGE HOMES**	
Checked: **B. Thomas, P.Eng.**	Location: **1158 SECOND LINE ROAD**	
Dwg Reference: **FIGURE 3**	File Ref: **245003 Storm Design Sheet**	Sheet No: **1 of 1**

TABLE E2: 5-YEAR STORM SEWER CALCULATION SHEET

Return Period Storm = **5-year** (5-years, 100-years)
Default Inlet Time= 10 (minutes)
Manning Coefficient = 0.013 (dimensionless)

From Node	To Node	Drianage Type	SURFACE AREAS(ha)				Foundation Drianage			FLOW (UNRESTRICTED)							Q Total (L/s)	SEWER DATA						Velocity (m/s)			Hydraulic Ratios	
			Area No.	Area (ha)	∑ Area (ha)	Average R	No of Bldgs	∑ Bldgs	Flow (L/sec)	Indiv. 2.78*A*R	Accum. 2.78*A*R	Tc (mins)	I (mm/h)	Indiv. Flow	Return Period	Q (L/s)		Dia (mm) Actual	Dia (mm) Nominal	Type	Slope (%)	Length (m)	Capacity, Q_{CAP} (L/sec)	Vf	Va	Time in Pipe, Tt (min)	Q/Q_{CAP}	Va/Vf
CB9	CBMH10	SURFACE	1	0.0954	0.0954	0.71				0.19	0.188	10.00	104.19	19.62	5-year	19.6	19.6	201.2	200	PVC	5.42	12.00	77.54	2.43	1.63	0.12	0.25	0.67
CBMH10	CBMH209	SURFACE	2	0.0552	0.1506	0.80				0.12	0.311	10.12	103.55	12.71	5-year	32.2	32.2	251.5	250	PVC	3.01	6.97	104.79	2.10	1.47	0.08	0.31	0.70
CBMH209	CBMH210	SURFACE	10	0.0559	0.2065	0.81				0.13	0.437																	
			4	0.0742	0.2807	0.50				0.10	0.540	10.20	103.14	10.64	5-year	55.7	55.7	299.4	300	PVC	2.52	56.01	152.64	2.17	1.54	0.61	0.36	0.71
CB15	CBMH211	SURFACE	7	0.1538	0.1538	0.77				0.33	0.329	10.00	104.19	34.30	5-year	34.3	34.3	251.5	250	PVC	6.54	12.39	154.46	3.10	2.08	0.10	0.22	0.67
CB14	CBMH211	SURFACE	8	0.0438	0.0438	0.73				0.09	0.089	10.00	104.19	9.26	5-year	9.3	9.3	201.2	200	PVC	9.50	6.59	102.66	3.22	1.71	0.06	0.09	0.53
CBMH211	CBMH210	SURFACE	5	0.0679	0.2655	0.76				0.14	0.562																	
			6	0.0583	0.3238	0.75				0.12	0.683	10.10	103.67	12.60	5-year	70.8	70.8	366.4	375	PVC	2.91	32.65	281.19	2.71	1.81	0.30	0.25	0.67
CBMH210	STMH209	SURFACE	3	0.1161	0.7206	0.75				0.24	1.465	10.81	100.10	24.23	5-year	146.7	146.7	1525.0	1500	CONC	0.40	27.92	4672.21	2.53	0.78	0.59	0.03	0.31
SWALE 2	CB1	SURFACE	13	0.1814	0.1814	0.50				0.25	0.2521	10.00	104.19	26.27		26.3	26.3											
CB1	CHAMBERS	SURFACE	16	0.0068	0.1882	0.20				0.00	0.2559	10.00	104.19	0.39	5-year	26.7	26.7	201.2	200	PVC	1.00	30.92	33.31	1.04	1.02	0.50	0.80	0.98
CHAMBERS	STMH209	SURFACE	11	0.0435	0.2317	0.49				0.06	0.3152	10.50	101.61	6.02	5-year	32.0	32.0	600.0	600	HDPE	1.00	6.02	614.01	2.17	1.00	0.10	0.05	0.46
STMH209	CHAMBERS	SURFACE	14	0.0209	0.9732	0.40				0.02	1.8037	11.40	97.32	2.26	5-year	175.5	175.5	600.0	600	HDPE	1.00	2.55	614.01	2.17	1.52	0.03	0.29	0.70
SWALE 1	CBMH213	SURFACE	12	0.1701	0.1701	0.47				0.22	0.2223	10.00	104.19	23.16		23.2	23.2											
CHAMBERS	CBMH213	SURFACE			1.1433						2.0260	11.43	97.20		5-year	196.9	196.9	600.0	600	HDPE	1.00	2.25	614.01	2.17	1.52	0.02	0.32	0.70
CBMH213	TEE(203-208)	SURFACE									2.0260	11.43	97.20		5-year	196.9	196.9	299.4	300	PVC	3.34	7.94	175.72	2.50	2.60	0.05	1.12	1.04
STMH204	STMH206	FOUNDATION					12	12	5.4								5.4	251.5	250	PVC	2.27	90.46	91.00	1.83	0.84	1.80	0.06	0.46
STMH207	STMH206	FOUNDATION					5	5	2.3								2.3	251.5	250	PVC	1.20	28.21	66.16	1.33	0.41	1.14	0.03	0.31
STMH206	STMH202	COMBIN					8	25	11.3								11.3	251.5	250	PVC	2.90	41.18	102.85	2.06	1.13	0.60	0.11	0.55
STMH205	STMH201	FOUNDATION					8	8	3.6								3.6	251.5	250	PVC	2.95	35.26	103.74	2.08	0.65	0.91	0.03	0.31
STMH200	STMH201	FOUNDATION					5	5	2.3								2.3	201.2	200	PVC	2.98	27.50	57.50	1.80	0.56	0.82	0.04	0.31
STMH201	STMH202	FOUNDATION					8	21	9.5								9.5	201.2	200	PVC	2.86	63.61	56.33	1.77	1.04	1.02	0.17	0.59
STMH202	STMH203	COMBIN					3	49	22.1			0.60	213.29				22.1	299.4	300	PVC	0.42	21.49	62.31	0.89	0.62	0.58	0.35	0.70
STMH203	TEE (203-208)	COMBIN						49	22.1			1.18	199.33				22.1	447.9	450	PVC	0.42	27.92	182.45	1.16	0.66	0.70	0.12	0.57
TEE (203-208)	STMH208	COMBIN			1.1433			49	22.1		2.0260	11.46	97.09		5-year	196.7	218.7	447.9	450	PVC	0.30	69.27	154.20	0.98	1.02	1.13	1.42	1.04
TOTALS =				**1.143**		**0.64**				**2.0260**																		

Definitions:
Q = 2.78*AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Watershed Area (hectares)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficients (dimensionless)

Drainage Types
FOUNDATI = Drainage From Foundation
SURFACE = Drainage From Surface Inlets
COMBIN = Drainage From Both Foundations & Inlets

Foundation Drain Allowance (L/s/unit) = **0.45**

Ottawa Rainfall Intensity Values from Sewer Design Guidelines, SDG002

	a	b	c
2-year	732.951	6.199	0.810
5-year	998.071	6.053	0.814
100-year	1735.688	6.014	0.820

Designed: **J. Fitzpatrick, P.Eng.**	Project: **THEBERGE HOMES**	
Checked: **B. Thomas, P.Eng.**	Location: **1158 SECOND LINE ROAD**	
Dwg Reference: **FIGURE 3**	File Ref: **245003 Storm Design Sheet**	Sheet No: **1 of 1**

TABLE E3: 100-YEAR STORM SEWER CALCULATION SHEET

Return Period Storm = **100-year** (5-years, 100-years)
Default Inlet Time= 10 (minutes)
Manning Coefficient = 0.013 (dimensionless)

From Node	To Node	Drianage Type	SURFACE AREAS(ha)				Foundation Drianage			FLOW (UNRESTRICTED)							Q Total (L/s)	SEWER DATA										
			Area No.	Area (ha)	∑ Area (ha)	Average R	No of Bldgs	∑ Bldgs	Flow (L/sec)	Indiv. 2.78*A*R	Accum. 2.78*A*R	Tc (mins)	I (mm/h)	Indiv. Flow	Return Period	Q (L/s)		Dia (mm) Actual	Dia (mm) Nominal	Type	Slope (%)	Length (m)	Capacity, Q_{CAP} (L/sec)	Velocity (m/s) Vf	Velocity (m/s) Va	Time in Pipe, Tt (min)	Hydraulic Ratios Q/Q_{CAP}	Hydraulic Ratios Va/Vf
CB9	CBMH10	SURFACE	1	0.0954	0.0954	0.71				0.19	0.188	10.00	178.56	33.62	100-year	33.6	33.6	201.2	200	PVC	5.42	12.00	77.54	2.43	1.72	0.12	0.43	0.71
CBMH10	CBMH209	SURFACE	2	0.0552	0.1506	0.80				0.12	0.311	10.12	177.50	21.79	100-year	55.2	55.2	251.5	250	PVC	3.01	6.97	104.79	2.10	1.49	0.08	0.53	0.71
CBMH209	CBMH210	SURFACE	10	0.0559	0.2065	0.81				0.13	0.437																	
			4	0.0742	0.2807	0.50				0.10	0.540	10.19	176.80	18.23	100-year	95.5	95.5	299.4	300	PVC	2.52	56.01	152.64	2.17	1.98	0.47	0.63	0.91
CB15	CBMH211	SURFACE	7	0.1538	0.1538	0.77				0.33	0.329	10.00	178.56	58.79	100-year	58.8	58.8	251.5	250	PVC	6.54	12.39	154.46	3.10	2.19	0.09	0.38	0.71
CB14	CBMH211	SURFACE	8	0.0438	0.0438	0.73				0.09	0.089	10.00	178.56	15.87	100-year	15.9	15.9	201.2	200	PVC	9.50	6.59	102.66	3.22	1.90	0.06	0.15	0.59
CBMH211	CBMH210	SURFACE	5	0.0679	0.2655	0.76				0.14	0.562																	
			6	0.0583	0.3238	0.75				0.12	0.683	10.09	177.70	21.60	100-year	121.4	121.4	299.4	300	PVC	2.91	32.65	164.02	2.33	2.29	0.24	0.74	0.98
CBMH210	STMH209	SURFACE	3	0.1161	0.7206	0.75				0.24	1.465	10.67	172.68	41.80	100-year	253.0	253.0	447.9	450	CONC	1.00	27.92	281.52	1.79	1.79	0.26	0.90	1.00
SWALE 2	CB1	SURFACE	13	0.1814	0.1814	0.50				0.25	0.2521	10.00	178.56	45.02		45.0	45.0											
CB1	CHAMBERS	SURFACE	16	0.0068	0.1882	0.20				0.00	0.2559	10.00	178.56	0.68	100-year	45.7	45.7	201.2	200	PVC	4.20	30.92	68.26	2.14	1.97	0.26	0.67	0.92
CHAMBERS	STMH209	SURFACE	11	0.0435	0.2317	0.49				0.06	0.3152	10.26	176.20	10.44	100-year	55.5	55.5	600.0	600	HDPE	1.00	6.02	614.01	2.17	1.15	0.09	0.09	0.53
STMH209	CHAMBERS	SURFACE	14	0.0209	0.9732	0.40				0.02	1.8037	10.93	170.51	3.96	100-year	307.5	307.5	600.0	600	HDPE	1.00	2.55	614.01	2.17	1.54	0.03	0.50	0.71
SWALE 1	CBMH213	SURFACE	12	0.1701	0.1701	0.47				0.22	0.2223	10.00	178.56	39.69		39.7	39.7											
CHAMBERS	CBMH213	SURFACE			1.1433						2.0260	10.95	170.28		100-year	345.0	345.0	600.0	600	HDPE	1.00	2.25	614.01	2.17	1.54	0.02	0.56	0.71
CBMH213	TEE(203-208)	SURFACE									2.0260	10.95	170.28		100-year	345.0	345.0	299.4	300	PVC	3.34	7.94	175.72	2.50	2.60	0.05	1.96	1.04
STMH204	STMH206	FOUNDATION					12	12	5.4								5.4	251.5	250	PVC	2.27	90.46	91.00	1.83	0.84	1.80	0.06	0.46
STMH207	STMH206	FOUNDATION					5	5	2.3								2.3	251.5	250	PVC	1.20	28.21	66.16	1.33	0.41	1.14	0.03	0.31
STMH206	STMH202	FOUNDATION					8	25	11.3								11.3	251.5	250	PVC	2.90	41.18	102.85	2.06	1.13	0.60	0.11	0.55
STMH205	STMH201	FOUNDATION					8	8	3.6								3.6	251.5	250	PVC	2.95	35.26	103.74	2.08	0.65	0.91	0.03	0.31
STMH200	STMH201	FOUNDATION					5	5	2.3								2.3	251.5	250	PVC	2.98	27.50	104.26	2.09	0.65	0.71	0.02	0.31
STMH201	STMH202	FOUNDATION					8	21	9.5								9.5	201.2	200	PVC	2.86	63.61	56.33	1.77	1.04	1.02	0.17	0.59
STMH202	STMH203	FOUNDATION					3	49	22.1			0.60	368.49				22.1	251.5	250	PVC	0.42	21.49	39.14	0.79	0.56	0.64	0.56	0.71
STMH203	TEE (203-208)	OUTLET						49	22.1			1.25	341.46				22.1	447.9	450	PVC	0.42	27.92	182.45	1.16	0.66	0.70	0.12	0.57
TEE (203-208)	STMH208	OUTLET			1.1433			49	22.1		2.0260	10.98	170.08		100-year	344.6	366.6	447.9	450	PVC	0.30	69.27	154.20	0.98	1.02	1.13	2.38	1.04
TOTALS =				**1.143**		**0.64**				**2.026**																		

Definitions:
Q = 2.78*AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Watershed Area (hectares)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficients (dimensionless)

Drainage Types
FOUNDATION = Drainage From Foundation
SURFACE = Drainage From Surface Inlets
OUTLET = Drainage From Both Foundations & Inlets

Foundation Drain Allowance (L/s/unit) = **0.45**

Ottawa Rainfall Intensity Values from Sewer Design Guidelines, SDG002

	a	b	c
2-year	732.951	6.199	0.810
5-year	998.071	6.053	0.814
100-year	1735.688	6.014	0.820

Designed: **J. Fitzpatrick, P.Eng.**	Project: **THEBERGE HOMES**	
Checked: **B. Thomas, P.Eng.**	Location: **1158 SECOND LINE ROAD**	
Dwg Reference: **FIGURE 3**	File Ref: **245003 Storm Design Sheet**	Sheet No: **1 of 1**

Appendix F – SWM Design Sheets

TABLE F1 - AVERAGE RUNOFF COEFFICIENTS (Pre Development)

Runoff Coeffients		C_{gravel} =	0.80	C_{ROOF} =	0.90	C_{GRASS} =	0.20	C_{Conc} =	0.90		
Area No.	Gravel Areas (m^2)	A * C_{GRAV}	Roof Areas (m^2)	A * C_{ROOF}	Grassed Areas (m^2)	A * C_{GRASS}	Conc (m^2)	A * C_{CONC}	Sum AC	Total Area (m^2)	C_{AVG}
Entire Site	325.4	260.3	214.9	193.4	11427	0.20	37.7	0.90	454.9	12005.5	0.04
Totals	325.4	260.3	214.9	193.4	11,427.5	0.2	37.7	0.9	454.9	12,005.5	0.04
Site % IMP = 4.8%								Average Runoff Coeff =	**C_{AVG} =**	**455 / 12,006**	**= 0.04**

TABLE F2 - PRE-DEVELOPMENT RUNOFF CALCULATIONS

Area Description	Area (ha)	Time of Conc, Tc (min)	Storm = 2 yr			Storm = 5 yr			Storm = 100 yr		
			I_2 (mm/hr)	Cavg	Q_{5PRE} (L/sec)	I_5 (mm/hr)	Cavg	Q_{5PRE} (L/sec)	I_{100} (mm/hr)	Cavg	Q_{100PRE} (L/sec)
Total Site	1.2006	20	52.03	0.04	6.6	70.25	0.04	8.9	119.95	0.047	19.0
Totals	1.2006				6.6			8.9			19.0

Notes

2-yr Storm Intensity, I = 732.951/(Tc+6.199)$^{0.810}$ (City of Ottawa)

5-yr Storm Intensity, I = 998.071/(Tc+6.035)$^{0.814}$ (City of Ottawa)

100-yr Storm Intensity, I = 1735.688/(Tc+6.014)$^{0.820}$ (City of Ottawa)

Cavg for 100-year is increased by 25%

TABLE F3 - ALLOWABLE RUNOFF CALCULATIONS

Area Description	Area (ha)	Time of Conc, Tc (min)	Storm = 5 yr			Q_{ICD} (L/sec)
			I_5 (mm/hr)	Cavg	Q_{ALLOW} (L/sec)	
Total Site	1.2006	20	70.29	0.50	117.3	100.0
Totals	1.2006				117.3	100.0

Notes

Allowable Capture Rate is based on 5-year storm at Tc=20 minutes.

QICD is the Controlled Release Rate as per Morgan's Grant, Phase 12D SWM Report

5-yr Storm Intensity, I = 998.071/(Tc+6.035)$^{0.814}$ (City of Ottawa)

TABLE F4 - AVERAGE RUNOFF COEFFICIENTS (Post Development)

Runoff Coeffients $C_{ASPH/CONC}$ = 0.90 C_{ROOF} = 0.90 C_{GRASS} = 0.20

Area No.	Asphalt / Conc Areas (m^2)	A * C_{ASPH}	Roof Areas (m^2)	A * C_{ROOF}	Grassed Areas (m^2)	A * C_{GRASS}	Sum AC	[1]Total Area (m^2)	[2]C_{AVG}	Comments
Entire Site	*3208*	*2886.8*	*4344.3*	*3909.9*	*4454.2*	*890.8*	*7687.5*	*12006*	*0.64*	*For Info*
1								955	0.71	
2								552	0.80	
3								1161	0.75	
4								742	0.50	
5								680	0.76	
6								583	0.75	
7								1539	0.77	
8								438	0.73	
9								263	0.72	
10								559	0.81	
11								436	0.49	
12								1701	0.47	
13								1814	0.50	
14								209	0.40	
15								310	0.64	
16								68	0.20	
Total	3,207.5	2,886.8	4,344.3	3,909.9	4,454.2	890.8	7,687.5	12008	0.64	

Site % IMP = 63% Average Runoff Coeff = $C_{AVG} = \frac{7,687}{12,008}$ = 0.64

Notes

1) Areas taken from PCSWMM, CAD

2) Cavg From PCSWMM (Area Weighting)

TABLE F5 - SUMMARY OF POST DEVELOPMENT RUNOFF (Uncontrolled and Controlled)

Area No	Area (ha)	Time of Conc, Tc (min)	Storm = 2 yr				Storm = 5 yr				Storm = 100 yr				Comments
			C_{AVG}	I_2 (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	I_5 (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	C_{AVG}	I_{100} (mm/hr)	Q (L/sec)	Q_{CAP} (L/sec)	
1	0.0955	10	0.71	76.81	14.5		0.71	104.19	19.6		0.89	178.56	42.1		
2	0.0552	10	0.80	76.81	9.4		0.80	104.19	12.8		1.00	178.56	27.4		
3	0.1161	10	0.75	76.81	18.6		0.75	104.19	25.2		0.94	178.56	54.0		
4	0.0742	10	0.50	76.81	7.9		0.50	104.19	10.7		0.63	178.56	23.0		
5	0.0680	10	0.76	76.81	11.0		0.76	104.19	15.0		0.95	178.56	32.0		
6	0.0583	10	0.75	76.81	9.3		0.75	104.19	12.7		0.94	178.56	27.1		
7	0.1539	10	0.77	76.81	25.3	**43.0**	0.77	104.19	34.3	**50.5**	0.96	178.56	73.5	**82.0**	To Underground Storage. Flow Controlled at STMH
8	0.0438	10	0.73	76.81	6.8		0.73	104.19	9.3		0.91	178.56	19.8		
9	0.0263	10	0.72	76.81	4.0		0.72	104.19	5.5		0.90	178.56	11.7		
10	0.0559	10	0.81	76.81	9.7		0.81	104.19	13.1		1.00	178.56	27.8		
11	0.0436	10	0.49	76.81	4.6		0.49	104.19	6.2		0.61	178.56	13.2		
12	0.1701	10	0.47	76.81	17.1		0.47	104.19	23.2		0.59	178.56	49.6		
13	0.1814	10	0.50	76.81	19.4		0.50	104.19	26.3		0.63	178.56	56.3		
14	0.0209	10	0.40	76.81	1.8		0.40	104.19	2.4		0.50	178.56	5.2		
15	0.0310	10	0.64	76.81	4.2	**4.2**	0.64	104.19	5.7	**5.7**	0.80	178.56	12.3	**12.3**	overland (uncontrolled)
16	0.0068	10	0.20	76.81	0.3	**0.3**	0.20	104.19	0.4	**0.4**	0.25	178.56	0.8	**0.8**	overland (uncontrolled)
Totals	1.2008				163.9	**47.5**			222.4	**56.6**			476.0	**95.2**	

Notes

2-yr Storm Intensity, $I = 732.951/(Tc+6.199)^{0.810}$ (City of Ottawa)

5-yr Storm Intensity, $I = 998.071/(Tc+6.035)^{0.814}$ (City of Ottawa)

100-yr Storm Intensity, $I = 1735.688/(Tc+6.014)^{0.820}$ (City of Ottawa)

Time of Concentration (min), Tc = **10 mins**

For Flows under column Qcap which are shown in brackets (0.0), denotes flows that are uncontrolled

TABLE F6 - SUMMARY OF SURFACE STORAGE (NOT USED)

Drainage Area	Ponding Number	T/G	Max W/L (m)	Area (m²)	Depth(m)	Total Volume (c.m.)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
Subtotal						

TABLE F7 - SUMAMRY OF UNDERGROUND PIPE STORAGE

Drainage Area Located	U/S Manhole	D/S Manhole	Length (m)	Pipe Dia (mm)	Pipe Area (m2) or Trench Vol (m3/m)	Volume (c.m.)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11	Chambers		30.63		4.6	142.2
12						
13						
14	Chambers		64.60		2.3	149.9
15						
16						
Subtotal			95.23			**292.0**
** Trench Area is Volume per metre (5.068 m3 per 2.184m long chambers)*						

TABLE F8 - SUMMARY OF UNDERGROUND MANHOLE/CATCHBASIN STORAGE (NOT USED)

Drainage Area Located	No.	Size	T/G (m)	Inv Elev (m)	Sump Elev (m)	Storage Depth (m)	Area (s.m.)	Volume (c.m.)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
Subtotal								

TOTAL STORAGE AVAILABLE (Pipe, Structure, Surface) cu.m. = **292.0**

TABLE F9 - SUMMARY OF TOTAL STORAGE REQUIRED & PROVIDED

Area No.	Area (ha)	Cavg (2-yr)	Cavg (5-yr)	Cavg (100-yr)	Release Rate (L/s)			Control Method	Storage Required (m^3)			Storage Provided (m^3)				
					2-yr	5-yr	100-yr		2-yr	5-yr	100-yr	Roof	Surface	Chambers	Structure	Total
1	0.0955	0.71	0.71	0.89												
2	0.0552	0.80	0.80	1.00												
3	0.1161	0.75	0.75	0.94												
4	0.0742	0.50	0.50	0.63												
5	0.0680	0.76	0.76	0.95												
6	0.0583	0.75	0.75	0.94												
7	0.1539	0.77	0.77	0.96	43.0	50.5	82.0	ICD AT STMH213	79.6	116.8	287.1			292.0		292.0
8	0.0438	0.73	0.73	0.91												
9	0.0263	0.72	0.72	0.90												
10	0.0559	0.81	0.81	1.00												
11	0.0436	0.49	0.49	0.61												
12	0.1701	0.47	0.47	0.59												
13	0.1814	0.50	0.50	0.63												
14	0.0209	0.40	0.40	0.50												
15	0.0310	0.64	0.64	0.80	4.2	5.7	12.3	none	none	none	none					none
16	0.0068	0.20	0.20	0.25	0.3	0.4	0.8	none	none	none	none					none
Totals =	**1.201**				**47.5**	**56.6**	**95.2**		**79.6**	**116.8**	**287.1**			**292.0**		**292.0**

Table F9 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **1-14 (Storage)**

C_{AVG} = 0.65 (2-yr)

C_{AVG} = 0.65 (5-yr)

C_{AVG} = 0.81 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 1.1630 (hectares)

Duration (min)	Release Rate = 43.0 (L/sec)					Release Rate = 50.5 (L/sec)					Release Rate = 82.0 (L/sec)				
	Return Period = 2 (years)					Return Period = 5 (years)					Return Period = 100 (years)				
	IDF Parameters, A = 732.951			, B =	0.810	IDF Parameters, A = 998.071				0.814	IDF Parameters, A = 1735.688				0.820
	($I = A/(T_c+C)$)			, C =	6.199	($I = A/(T_c+C)$)			, C =	6.053	($I = A/(T_c+C)$)			, C =	6.014
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	351.4	43.00	308.4	0.00	230.5	484.3	50.500	433.8	0.00	398.6	1047.1	82.000	965.1	0.00
2	133.3	280.2	43.00	237.2	28.46	182.7	383.9	50.500	333.4	40.01	315.0	827.5	82.000	745.5	89.46
4	111.7	234.8	43.00	191.8	46.03	152.5	320.5	50.500	270.0	64.80	262.4	689.3	82.000	607.3	145.75
6	96.6	203.1	43.00	160.1	57.63	131.6	276.5	50.500	226.0	81.35	226.0	593.7	82.000	511.7	184.21
8	85.5	179.6	43.00	136.6	65.56	116.1	244.0	50.500	193.5	92.88	199.2	523.3	82.000	441.3	211.81
10	76.8	161.4	43.00	118.4	71.04	104.2	219.0	50.500	168.5	101.07	178.6	469.0	82.000	387.0	232.23
12	69.9	146.9	43.00	103.9	74.79	94.7	199.0	50.500	148.5	106.92	162.1	425.9	82.000	343.9	247.60
14	64.2	135.0	43.00	92.0	77.27	86.9	182.7	50.500	132.2	111.04	148.7	390.7	82.000	308.7	259.28
16	59.5	125.0	43.00	82.0	78.76	80.5	169.1	50.500	118.6	113.84	137.5	361.3	82.000	279.3	268.15
18	55.5	116.6	43.00	73.6	79.49	75.0	157.5	50.500	107.0	115.61	128.1	336.5	82.000	254.5	274.81
20	52.0	109.3	43.00	66.3	79.61	70.3	147.6	50.500	97.1	116.56	120.0	315.1	82.000	233.1	279.71
22	49.0	103.0	43.00	60.0	79.22	66.1	139.0	50.500	88.5	116.83	112.9	296.5	82.000	214.5	283.17
24	46.4	97.5	43.00	54.5	78.41	62.5	131.4	50.500	80.9	116.53	106.7	280.2	82.000	198.2	285.43
26	44.0	92.5	43.00	49.5	77.25	59.3	124.7	50.500	74.2	115.77	101.2	265.8	82.000	183.8	286.70
28	41.9	88.1	43.00	45.1	75.79	56.5	118.7	50.500	68.2	114.60	96.3	252.9	82.000	170.9	287.11
30	40.0	84.1	43.00	41.1	74.07	53.9	113.3	50.500	62.8	113.09	91.9	241.3	82.000	159.3	286.78
32	38.3	80.6	43.00	37.6	72.12	51.6	108.5	50.500	58.0	111.27	87.9	230.9	82.000	148.9	285.81
34	36.8	77.3	43.00	34.3	69.97	49.5	104.0	50.500	53.5	109.19	84.3	221.4	82.000	139.4	284.28
36	35.4	74.3	43.00	31.3	67.65	47.6	100.0	50.500	49.5	106.88	81.0	212.7	82.000	130.7	282.26
38	34.1	71.6	43.00	28.6	65.17	45.8	96.3	50.500	45.8	104.35	77.9	204.7	82.000	122.7	279.80
40	32.9	69.1	43.00	26.1	62.55	44.2	92.9	50.500	42.4	101.64	75.1	197.4	82.000	115.4	276.94
Max =					**79.61**					**116.83**					**287.11**

Notes

1) Peak flow is equal to the product of 2.78 x C x I x A

2) Rainfall Intensity, $I = A/(Tc+C)^B$

3) Release Rate = Min (Release Rate, Peak Flow)

4) Storage Rate = Peak Flow - Release Rate

5) Storage = Duration x Storage Rate

6) Maximium Storage = Max Storage Over Duration

7) Parameters a,b,c are for City of Ottawa

TABLE F10 - DRAINAGE AREA INFORMATION

Area No:	Area (ha)	Cavg (2yr)	Cavg (5yr)	Cavg (100yr)
Areas 1-14	1.16300	0.65	**0.65**	**0.81**

TABLE F11 - STORMTECH MC-3500 CHAMBER - CUMULATIVE STORAGE BY DEPTH TABLE

Chamber Length =	2.184

Depth Above Bottom of Storage Trench (Sorted by Depth in Descending Order)			Cumulative Volume	
			MC-3500 Chamber	MC-3500 End Cap
(in)	(mm)	(m)	(m3)	(m3)
66	1676	1.6764	5.068	1.330
65	1651	1.6510	5.019	1.314
64	1626	1.6256	4.971	1.298
63	1600	1.6002	4.922	1.281
62	1575	1.5748	4.874	1.265
61	1549	1.5494	4.825	1.249
60	1524	1.5240	4.777	1.233
59	1499	1.4986	4.728	1.217
58	1473	1.4732	4.680	1.201
57	1448	1.4478	4.631	1.185
56	1422	1.4224	4.583	1.169
55	1397	1.3970	4.534	1.152
54	1372	1.3716	4.486	1.136
53	1346	1.3462	4.436	1.120
52	1321	1.3208	4.385	1.104
51	1295	1.2954	4.331	1.088
50	1270	1.2700	4.276	1.071
49	1245	1.2446	4.216	1.054
48	1219	1.2192	4.150	1.037
47	1194	1.1938	4.080	1.020
46	1168	1.1684	4.007	1.003
45	1143	1.1430	3.932	0.985
44	1118	1.1176	3.855	0.966
43	1092	1.0922	3.775	0.948
42	1067	1.0668	3.694	0.929
41	1041	1.0414	3.611	0.910
40	1016	1.0160	3.526	0.890
39	991	0.9906	3.440	0.871
38	965	0.9652	3.352	0.850
37	940	0.9398	3.263	0.830
36	914	0.9144	3.173	0.809
35	889	0.8890	3.081	0.788
34	864	0.8636	2.989	0.767
33	838	0.8382	2.895	0.745
32	813	0.8128	2.800	0.723
31	787	0.7874	2.705	0.701
30	762	0.7620	2.608	0.678
29	737	0.7366	2.511	0.655
28	711	0.7112	2.416	0.631
27	686	0.6858	2.314	0.607
26	660	0.6604	2.214	0.583
25	635	0.6350	2.114	0.559
24	610	0.6096	2.013	0.539
23	584	0.5842	1.911	0.510
22	559	0.5588	1.809	0.485
21	533	0.5334	1.706	0.460
20	508	0.5080	1.603	0.434
19	483	0.4826	1.499	0.409
18	457	0.4572	1.395	0.383
17	432	0.4318	1.290	0.357
16	406	0.4064	1.184	0.331
15	381	0.3810	1.079	0.305
14	356	0.3556	0.973	0.278
13	330	0.3302	0.866	0.252
12	305	0.3048	0.759	0.225
11	279	0.2794	0.652	0.199
10	254	0.2540	0.544	0.172
9	229	0.2286	0.436	0.145
8	203	0.2032	0.388	0.129
7	178	0.1778	0.339	0.113
6	152	0.1524	0.291	0.097
5	127	0.1270	0.242	0.081
4	102	0.1016	0.194	0.064
3	76	0.0762	0.145	0.048
2	51	0.0508	0.097	0.032
1	25	0.0254	0.048	0.016
0	0	0.0000	0.000	0.000

Depth Above Bottom of Storage Trench (Sorted by Depth in Asccending Order)			Cumulative Volume	
			MC-3500 Chamber	MC-3500 End Cap
(in)	(mm)	(m)	(m3)	(m3)
0	0	0.0000	0.000	0.000
1	25	0.0254	0.048	0.016
2	51	0.0508	0.097	0.032
3	76	0.0762	0.145	0.048
4	102	0.1016	0.194	0.064
5	127	0.1270	0.242	0.081
6	152	0.1524	0.291	0.097
7	178	0.1778	0.339	0.113
8	203	0.2032	0.388	0.129
9	229	0.2286	0.436	0.145
10	254	0.2540	0.544	0.172
11	279	0.2794	0.652	0.199
12	305	0.3048	0.759	0.225
13	330	0.3302	0.866	0.252
14	356	0.3556	0.973	0.278
15	381	0.3810	1.079	0.305
16	406	0.4064	1.184	0.331
17	432	0.4318	1.290	0.357
18	457	0.4572	1.395	0.383
19	483	0.4826	1.499	0.409
20	508	0.5080	1.603	0.434
21	533	0.5334	1.706	0.460
22	559	0.5588	1.809	0.485
23	584	0.5842	1.911	0.510
24	610	0.6096	2.013	0.539
25	635	0.6350	2.114	0.559
26	660	0.6604	2.214	0.583
27	686	0.6858	2.314	0.607
28	711	0.7112	2.416	0.631
29	737	0.7366	2.511	0.655
30	762	0.7620	2.608	0.678
31	787	0.7874	2.705	0.701
32	813	0.8128	2.800	0.723
33	838	0.8382	2.895	0.745
34	864	0.8636	2.989	0.767
35	889	0.8890	3.081	0.788
36	914	0.9144	3.173	0.809
37	940	0.9398	3.263	0.830
38	965	0.9652	3.352	0.850
39	991	0.9906	3.440	0.871
40	1016	1.0160	3.526	0.890
41	1041	1.0414	3.611	0.910
42	1067	1.0668	3.694	0.929
43	1092	1.0922	3.775	0.948
44	1118	1.1176	3.855	0.966
45	1143	1.1430	3.932	0.985
46	1168	1.1684	4.007	1.003
47	1194	1.1938	4.080	1.020
48	1219	1.2192	4.150	1.037
49	1245	1.2446	4.216	1.054
50	1270	1.2700	4.276	1.071
51	1295	1.2954	4.331	1.088
52	1321	1.3208	4.385	1.104
53	1346	1.3462	4.436	1.120
54	1372	1.3716	4.486	1.136
55	1397	1.3970	4.534	1.152
56	1422	1.4224	4.583	1.169
57	1448	1.4478	4.631	1.185
58	1473	1.4732	4.680	1.201
59	1499	1.4986	4.728	1.217
60	1524	1.5240	4.777	1.233
61	1549	1.5494	4.825	1.249
62	1575	1.5748	4.874	1.265
63	1600	1.6002	4.922	1.281
64	1626	1.6256	4.971	1.298
65	1651	1.6510	5.019	1.314
66	1676	1.6764	5.068	1.330

TABLE F12 - STORMTECH MC-3500 CHAMBER - CUMULATIVE STORAGE BY DEPTH TABLE

Length per Chamber, From Manufacturer (m)	2.184	No Chamber Req'd	55
End Cap Length, From Manufacturer (m)	0.673	No End Caps Req'd	10
L = Total Length of Chambers (m)	50	- Trench length (m)	125.9
Bottom Width of Chambers, From Manufacturer (m)	1.956	- Trench width (m)	2.60
Dsit form Chamber to Edge of Trench (m)	0.300		
Bottom Width of Trench Width + 2 x dist to edge, W (m)	**2.556**	- Bottom Area (m2)	327.3

Total Trench Length (actual) Including End Caps =	**75.60**
Maximium Trench Volume (m^3)	**292.0**

Water Depth (in)	Water Depth (m)	Total Storage Volume Per Chamber (m3)	Volume Per End Cap (m3)	Total Storage Volume in Trench (m3)
0	0.000	0.000	0.000	0.000
1	0.025	0.048	0.016	2.800
2	0.051	0.097	0.032	5.655
3	0.076	0.145	0.048	8.455
4	0.102	0.194	0.064	11.310
5	0.127	0.242	0.081	14.120
6	0.152	0.291	0.097	16.975
7	0.178	0.339	0.113	19.775
8	0.203	0.388	0.129	22.630
9	0.229	0.436	0.145	25.430
10	0.254	0.544	0.172	31.640
11	0.279	0.652	0.199	37.850
12	0.305	0.759	0.225	43.995
13	0.330	0.866	0.252	50.150
14	0.356	0.973	0.278	56.295
15	0.381	1.079	0.305	62.395
16	0.406	1.184	0.331	68.430
17	0.432	1.290	0.357	74.520
18	0.457	1.395	0.383	80.555
19	0.483	1.499	0.409	86.535
20	0.508	1.603	0.434	92.505
21	0.533	1.706	0.460	98.430
22	0.559	1.809	0.485	104.345
23	0.584	1.911	0.510	110.205
24	0.610	2.013	0.539	116.105
25	0.635	2.114	0.559	121.860
26	0.660	2.214	0.583	127.600
27	0.686	2.314	0.607	133.340
28	0.711	2.416	0.631	139.190
29	0.737	2.511	0.655	144.655
30	0.762	2.608	0.678	150.220
31	0.787	2.705	0.701	155.785
32	0.813	2.800	0.723	161.230
33	0.838	2.895	0.745	166.675
34	0.864	2.989	0.767	172.065
35	0.889	3.081	0.788	177.335
36	0.914	3.173	0.809	182.605
37	0.940	3.263	0.830	187.765
38	0.965	3.352	0.850	192.860
39	0.991	3.440	0.871	197.910
40	1.016	3.526	0.890	202.830
41	1.041	3.611	0.910	207.705
42	1.067	3.694	0.929	212.460
43	1.092	3.775	0.948	217.105
44	1.118	3.855	0.966	221.685
45	1.143	3.932	0.985	226.110
46	1.168	4.007	1.003	230.415
47	1.194	4.080	1.020	234.600
48	1.219	4.150	1.037	238.620
49	1.245	4.216	1.054	242.420
50	1.270	4.276	1.071	245.890
51	1.295	4.331	1.088	249.085
52	1.321	4.385	1.104	252.215
53	1.346	4.436	1.120	255.180
54	1.372	4.486	1.136	258.090
55	1.397	4.534	1.152	260.890
56	1.422	4.583	1.169	263.755
57	1.448	4.631	1.185	266.555
58	1.473	4.680	1.201	269.410
59	1.499	4.728	1.217	272.210
60	1.524	4.777	1.233	275.065
61	1.549	4.825	1.249	277.865
62	1.575	4.874	1.265	280.720
63	1.600	4.922	1.281	283.520
64	1.626	4.971	1.298	286.385
65	1.651	5.019	1.314	289.185
66	1.676	5.068	1.330	292.040

Sorted in Assending Order			Sorted in Assending Order		
Water Depth (in)	Water Depth (m)	Total Storage Volume in Trench (m3)	Water Depth (in)	Water Depth (m)	Total Storage Volume in Trench (m3)
0	0.000	0.000	66	1.676	292.04
1	0.025	2.800	65	1.651	289.19
2	0.051	5.655	64	1.626	286.39
3	0.076	8.455	63	1.600	283.52
4	0.102	11.310	62	1.575	280.72
5	0.127	14.120	61	1.549	277.87
6	0.152	16.975	60	1.524	275.07
7	0.178	19.775	59	1.499	272.21
8	0.203	22.630	58	1.473	269.41
9	0.229	25.430	57	1.448	266.56
10	0.254	31.640	56	1.422	263.76
11	0.279	37.850	55	1.397	260.89
12	0.305	43.995	54	1.372	258.09
13	0.330	50.150	53	1.346	255.18
14	0.356	56.295	52	1.321	252.22
15	0.381	62.395	51	1.295	249.09
16	0.406	68.430	50	1.270	245.89
17	0.432	74.520	49	1.245	242.42
18	0.457	80.555	48	1.219	238.62
19	0.483	86.535	47	1.194	234.60
20	0.508	92.505	46	1.168	230.42
21	0.533	98.430	45	1.143	226.11
22	0.559	104.345	44	1.118	221.69
23	0.584	110.205	43	1.092	217.11
24	0.610	116.105	42	1.067	212.46
25	0.635	121.860	41	1.041	207.71
26	0.660	127.600	40	1.016	202.83
27	0.686	133.340	39	0.991	197.91
28	0.711	139.190	38	0.965	192.86
29	0.737	144.655	37	0.940	187.77
30	0.762	150.220	36	0.914	182.61
31	0.787	155.785	35	0.889	177.34
32	0.813	161.230	34	0.864	172.07
33	0.838	166.675	33	0.838	166.68
34	0.864	172.065	32	0.813	161.23
35	0.889	177.335	31	0.787	155.79
36	0.914	182.605	30	0.762	150.22
37	0.940	187.765	29	0.737	144.66
38	0.965	192.860	28	0.711	139.19
39	0.991	197.910	27	0.686	133.34
40	1.016	202.830	26	0.660	127.60
41	1.041	207.705	25	0.635	121.86
42	1.067	212.460	24	0.610	116.11
43	1.092	217.105	23	0.584	110.21
44	1.118	221.685	22	0.559	104.35
45	1.143	226.110	21	0.533	98.43
46	1.168	230.415	20	0.508	92.51
47	1.194	234.600	19	0.483	86.54
48	1.219	238.620	18	0.457	80.56
49	1.245	242.420	17	0.432	74.52
50	1.270	245.890	16	0.406	68.43
51	1.295	249.085	15	0.381	62.40
52	1.321	252.215	14	0.356	56.30
53	1.346	255.180	13	0.330	50.15
54	1.372	258.090	12	0.305	44.00
55	1.397	260.890	11	0.279	37.85
56	1.422	263.755	10	0.254	31.64
57	1.448	266.555	9	0.229	25.43
58	1.473	269.410	8	0.203	22.63
59	1.499	272.210	7	0.178	19.78
60	1.524	275.065	6	0.152	16.98
61	1.549	277.865	5	0.127	14.12
62	1.575	280.720	4	0.102	11.31
63	1.600	283.520	3	0.076	8.46
64	1.626	286.385	2	0.051	5.66
65	1.651	289.185	1	0.025	2.80
66	1.676	292.040	0	0.000	0.00

TABLE F13 - INLET CONTROL DEVICE INFORMATION

Control Type	Orifice Type	Info for Plug-Type ICDs							
		Orifice Coeff	Orifice Area (mm^2)	Outlet Pipe Invert (m) & Diameter	Outlet Pipe Invert (m) & Diameter	Orifice Centroid Elev (m)	Max Elev (m)	Max Head (m)	Max Discharge (L/sec)
ICD - IPEX MHF	19-MHF-TypeF	0.61	**23959**	98.35	0.300	**98.50**	100.176	**1.676**	**83.95**

TABLE E14 - STORAGE-DISCHARGE & STAGE STORAGE INFORMATION

Stage / Elev (m)	ICD Flow		Storage Volume (m3)	Comments
	Head Above ICD Orifice (m)	ICD FLow (L/s)		
100.176	1.676	83.96	292.04	Max Storage
100.151	1.651	83.32	289.19	
100.126	1.626	82.67	286.39	
100.100	1.600	82.03	283.52	
100.075	1.575	81.37	280.72	
100.049	1.549	80.71	277.87	
100.024	1.524	80.05	275.07	
99.999	1.499	79.38	272.21	
99.973	1.473	78.70	269.41	
99.948	1.448	78.02	266.56	
99.922	1.422	77.33	263.76	
99.897	1.397	76.64	260.89	
99.872	1.372	75.94	258.09	
99.846	1.346	75.23	255.18	
99.821	1.321	74.52	252.22	
99.795	1.295	73.80	249.09	
99.770	1.270	73.07	245.89	
99.745	1.245	72.34	242.42	
99.719	1.219	71.60	238.62	
99.694	1.194	70.85	234.60	
99.668	1.168	70.09	230.42	
99.643	1.143	69.32	226.11	
99.618	1.118	68.55	221.69	
99.592	1.092	67.77	217.11	
99.567	1.067	66.97	212.46	
99.541	1.041	66.17	207.71	
99.516	1.016	65.36	202.83	
99.491	0.991	64.54	197.91	
99.465	0.965	63.70	192.86	
99.440	0.940	62.86	187.77	
99.414	0.914	62.01	182.61	
99.389	0.889	61.14	177.34	
99.364	0.864	60.26	172.07	
99.338	0.838	59.37	166.68	
99.313	0.813	58.46	161.23	
99.287	0.787	57.54	155.79	
99.262	0.762	56.60	150.22	
99.237	0.737	55.65	144.66	
99.211	0.711	54.68	139.19	
99.186	0.686	53.70	133.34	
99.160	0.660	52.69	127.60	
99.135	0.635	51.67	121.86	
99.110	0.610	50.63	116.11	
99.084	0.584	49.56	110.21	
99.059	0.559	48.47	104.35	
99.033	0.533	47.36	98.43	
99.008	0.508	46.22	92.51	
98.983	0.483	45.05	86.54	
98.957	0.457	43.84	80.56	
98.932	0.432	42.61	74.52	
98.906	0.406	41.34	68.43	
98.881	0.381	40.02	62.40	
98.856	0.356	38.67	56.30	
98.830	0.330	37.26	50.15	
98.805	0.305	35.80	44.00	
98.779	0.279	34.27	37.85	
98.754	0.254	32.68	31.64	
98.729	0.229	31.00	25.43	
98.703	0.203	29.23	22.63	
98.678	0.178	27.34	19.78	
98.652	0.152	25.31	16.98	
98.627	0.127	23.11	14.12	
98.602	0.102	20.67	11.31	
98.576	0.076	17.90	8.46	
98.551	0.051	14.61	5.66	
98.525	0.025	10.33	2.80	
98.500	0.000	0.00	0.00	Centroid Elev
98.35	0.000	0.00	0.00	Inv elev
Interval =		0.025		

CHART F15 - STORAGE-DISCHARGE & STAGE STORAGE CURVE

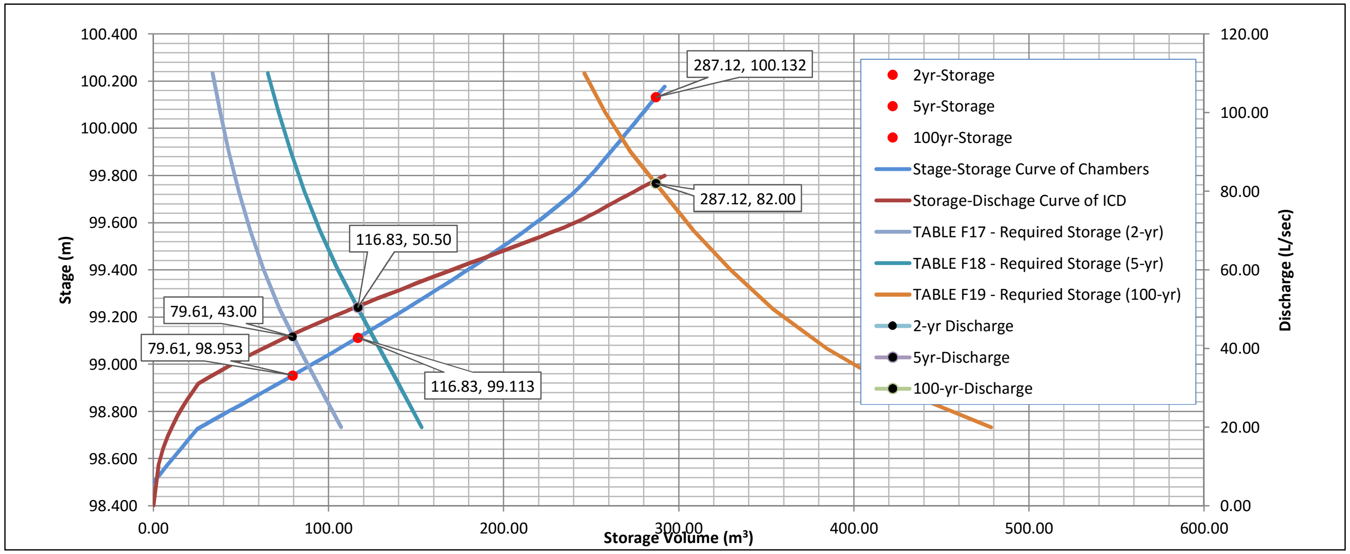


TABLE F16 - Storage Volume Requirements for 5 Year and 100 Year Storms

Area No: **Areas 1-14**

C_{AVG} = 0.65 (2-yr)

C_{AVG} = 0.65 (5-yr)

C_{AVG} = 0.81 (100-yr, 5-yr + 25% to Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 1.163 (hectares)

Duration (min)	Release Rate = 43.00 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199; (I = A/(T_c+C))					Release Rate = 50.50 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, 0.814, C = 6.053; (I = A/(T_c+C))					Release Rate = 82.00 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820, C = 6.014; (I = A/(T_c+C))				
	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)	Rainfall Intensity, I (mm/hr)	Peak Flow (L/sec)	Release Rate (L/sec)	Storage Rate (L/sec)	Storage (m^3)
0	167.2	351.4	43.00	308.4	0.00	230.5	484.4	50.500	433.9	0.00	398.6	1047.1	82.000	965.1	0.00
2	133.3	280.2	43.00	237.2	28.46	182.7	383.9	50.500	333.4	40.01	315.0	827.5	82.000	745.5	89.46
4	111.7	234.8	43.00	191.8	46.03	152.5	320.5	50.500	270.0	64.80	262.4	689.3	82.000	607.3	145.76
6	96.6	203.1	43.00	160.1	57.63	131.6	276.5	50.500	226.0	81.36	226.0	593.7	82.000	511.7	184.22
8	85.5	179.6	43.00	136.6	65.56	116.1	244.0	50.500	193.5	92.89	199.2	523.3	82.000	441.3	211.82
10	76.8	161.4	43.00	118.4	71.05	104.2	219.0	50.500	168.5	101.08	178.6	469.1	82.000	387.1	232.24
12	69.9	146.9	43.00	103.9	74.80	94.7	199.0	50.500	148.5	106.92	162.1	425.9	82.000	343.9	247.62
14	64.2	135.0	43.00	92.0	77.27	86.9	182.7	50.500	132.2	111.04	148.7	390.7	82.000	308.7	259.29
16	59.5	125.0	43.00	82.0	78.77	80.5	169.1	50.500	118.6	113.85	137.5	361.3	82.000	279.3	268.16
18	55.5	116.6	43.00	73.6	79.50	75.0	157.6	50.500	107.1	115.62	128.1	336.5	82.000	254.5	274.82
20	52.0	109.3	43.00	66.3	**79.61**	70.3	147.6	50.500	97.1	116.56	120.0	315.1	82.000	233.1	279.72
22	49.0	103.0	43.00	60.0	79.23	66.1	139.0	50.500	88.5	**116.83**	112.9	296.5	82.000	214.5	283.18
24	46.4	97.5	43.00	54.5	78.42	62.5	131.4	50.500	80.9	116.54	106.7	280.2	82.000	198.2	285.45
26	44.0	92.5	43.00	49.5	77.26	59.3	124.7	50.500	74.2	115.78	101.2	265.8	82.000	183.8	286.71
28	41.9	88.1	43.00	45.1	75.80	56.5	118.7	50.500	68.2	114.61	96.3	252.9	82.000	170.9	287.12
30	40.0	84.2	43.00	41.2	74.08	53.9	113.3	50.500	62.8	113.10	91.9	241.3	82.000	159.3	286.80
32	38.3	80.6	43.00	37.6	72.13	51.6	108.5	50.500	58.0	111.28	87.9	230.9	82.000	148.9	285.83
Max =					**79.61**					**116.83**					**287.12**

TABLE F17 - Required Storage (2-yr)

Runoff Coeffcient, C =			0.65		Duration Interval (min) =		1					
Drainage Area (ha) =			1.163		Release Rate Start (min) =		20					
Return Period (yrs) =			2		Release Rate Interval (min) =		10					
		Release Rate -->	20	30	40	50	60	70	80	90	100	110
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
0	167.2	351.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	148.1	311.3	17.5	16.9	16.3	15.7	15.1	14.5	13.9	13.3	12.7	12.1
2	133.3	280.2	31.2	30.0	28.8	27.6	26.4	25.2	24.0	22.8	21.6	20.4
3	121.5	255.3	42.3	40.5	38.7	36.9	35.1	33.3	31.5	29.7	27.9	26.1
4	111.7	234.8	51.5	49.1	46.7	44.3	41.9	39.5	37.1	34.7	32.3	29.9
5	103.6	217.7	59.3	56.3	53.3	50.3	47.3	44.3	41.3	38.3	35.3	32.3
6	96.6	203.1	65.9	62.3	58.7	55.1	51.5	47.9	44.3	40.7	37.1	33.5
7	90.7	190.5	71.6	67.4	63.2	59.0	54.8	50.6	46.4	42.2	38.0	33.8
8	85.5	179.6	76.6	71.8	67.0	62.2	57.4	52.6	47.8	43.0	38.2	33.4
9	80.9	170.0	81.0	75.6	70.2	64.8	59.4	54.0	48.6	43.2	37.8	32.4
10	76.8	161.4	84.8	78.8	72.8	66.8	60.8	54.8	48.8	42.8	36.8	30.8
11	73.2	153.8	88.3	81.7	75.1	68.5	61.9	55.3	48.7	42.1	35.5	28.9
12	69.9	146.9	91.4	84.2	77.0	69.8	62.6	55.4	48.2	41.0	33.8	26.6
13	66.9	140.7	94.1	86.3	78.5	70.7	62.9	55.1	47.3	39.5	31.7	23.9
14	64.2	135.0	96.6	88.2	79.8	71.4	63.0	54.6	46.2	37.8	29.4	21.0
15	61.8	129.8	98.8	89.8	80.8	71.8	62.8	53.8	44.8	35.8	26.8	17.8
16	59.5	125.0	100.8	91.2	81.6	72.0	62.4	52.8	43.2	33.6	24.0	14.4
17	57.4	120.7	102.7	92.5	82.3	72.1	61.9	51.7	41.5	31.3	21.1	10.9
18	55.5	116.6	104.3	93.5	82.7	71.9	61.1	50.3	39.5	28.7	17.9	7.1
19	53.7	112.8	105.8	94.4	83.0	71.6	60.2	48.8	37.4	26.0	14.6	3.2
20	52.0	109.3	107.2	95.2	83.2	71.2	59.2	47.2	35.2	23.2	11.2	-0.8
Maximum Storage Rate =			107.2	95.2	83.2	72.1	63.0	55.4	48.8	43.2	38.2	33.8

TABLE F18 - Required Storage (5-yr)

Runoff Coeffcient, C =			0.65		Duration Interval (min) =		1					
Drainage Area (ha) =			1.163		Release Rate Start (min) =		20					
Return Period (yrs) =			5		Release Rate Interval (min) =		10					
		Release Rate -->	20	30	40	50	60	70	80	90	100	110
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
0	230.5	484.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	203.5	427.7	24.5	23.9	23.3	22.7	22.1	21.5	20.9	20.3	19.7	19.1
2	182.7	383.9	43.7	42.5	41.3	40.1	38.9	37.7	36.5	35.3	34.1	32.9
3	166.1	349.0	59.2	57.4	55.6	53.8	52.0	50.2	48.4	46.6	44.8	43.0
4	152.5	320.5	72.1	69.7	67.3	64.9	62.5	60.1	57.7	55.3	52.9	50.5
5	141.2	296.7	83.0	80.0	77.0	74.0	71.0	68.0	65.0	62.0	59.0	56.0
6	131.6	276.5	92.3	88.7	85.1	81.5	77.9	74.3	70.7	67.1	63.5	59.9
7	123.3	259.1	100.4	96.2	92.0	87.8	83.6	79.4	75.2	71.0	66.8	62.6
8	116.1	244.0	107.5	102.7	97.9	93.1	88.3	83.5	78.7	73.9	69.1	64.3
9	109.8	230.7	113.8	108.4	103.0	97.6	92.2	86.8	81.4	76.0	70.6	65.2
10	104.2	219.0	119.4	113.4	107.4	101.4	95.4	89.4	83.4	77.4	71.4	65.4
11	99.2	208.5	124.4	117.8	111.2	104.6	98.0	91.4	84.8	78.2	71.6	65.0
12	94.7	199.0	128.9	121.7	114.5	107.3	100.1	92.9	85.7	78.5	71.3	64.1
13	90.6	190.5	133.0	125.2	117.4	109.6	101.8	94.0	86.2	78.4	70.6	62.8
14	86.9	182.7	136.7	128.3	119.9	111.5	103.1	94.7	86.3	77.9	69.5	61.1
15	83.6	175.6	140.0	131.0	122.0	113.0	104.0	95.0	86.0	77.0	68.0	59.0
16	80.5	169.1	143.1	133.5	123.9	114.3	104.7	95.1	85.5	75.9	66.3	56.7
17	77.6	163.1	146.0	135.8	125.6	115.4	105.2	95.0	84.8	74.6	64.4	54.2
18	75.0	157.6	148.6	137.8	127.0	116.2	105.4	94.6	83.8	73.0	62.2	51.4
19	72.5	152.4	151.0	139.6	128.2	116.8	105.4	94.0	82.6	71.2	59.8	48.4
20	70.3	147.6	153.2	141.2	129.2	117.2	105.2	93.2	81.2	69.2	57.2	45.2
Maximum Storage Rate =			153.2	141.2	129.2	117.2	105.4	95.1	86.3	78.5	71.6	65.4

TABLE F19 - Requried Storage (100-yr)

Runoff Coeffcient, C =	0.81	Duration Interval (min) = 5
Drainage Area (ha) =	1.163	Release Rate Start (min) = 20
Return Period (yrs) =	100	Release Rate Interval (min) = 10

		Release Rate -->	20	30	40	50	60	70	80	90	100	110
Duration (min)	Rainfall Intensity (mm/hr)	Peak Flow (L/sec)	Storage Required (m^3)									
0	398.6	1047.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	178.6	469.1	269.4	263.4	257.4	251.4	245.4	239.4	233.4	227.4	221.4	215.4
20	120.0	315.1	354.1	342.1	330.1	318.1	306.1	294.1	282.1	270.1	258.1	246.1
30	91.9	241.3	398.4	380.4	362.4	344.4	326.4	308.4	290.4	272.4	254.4	236.4
40	75.1	197.4	425.8	401.8	377.8	353.8	329.8	305.8	281.8	257.8	233.8	209.8
50	64.0	168.0	444.0	414.0	384.0	354.0	324.0	294.0	264.0	234.0	204.0	174.0
60	55.9	146.8	456.6	420.6	384.6	348.6	312.6	276.6	240.6	204.6	168.6	132.6
70	49.8	130.8	465.3	423.3	381.3	339.3	297.3	255.3	213.3	171.3	129.3	87.3
80	45.0	118.2	471.3	423.3	375.3	327.3	279.3	231.3	183.3	135.3	87.3	39.3
90	41.1	108.0	475.2	421.2	367.2	313.2	259.2	205.2	151.2	97.2	43.2	-10.8
100	37.9	99.6	477.4	417.4	357.4	297.4	237.4	177.4	117.4	57.4	-2.6	-62.6
110	35.2	92.5	478.3	412.3	346.3	280.3	214.3	148.3	82.3	16.3	-49.7	-115.7
120	32.9	86.4	478.2	406.2	334.2	262.2	190.2	118.2	46.2	-25.8	-97.8	-169.8
130	30.9	81.2	477.1	399.1	321.1	243.1	165.1	87.1	9.1	-68.9	-146.9	-224.9
140	29.2	76.6	475.3	391.3	307.3	223.3	139.3	55.3	-28.7	-112.7	-196.7	-280.7
150	27.6	72.5	472.8	382.8	292.8	202.8	112.8	22.8	-67.2	-157.2	-247.2	-337.2
160	26.2	68.9	469.7	373.7	277.7	181.7	85.7	-10.3	-106.3	-202.3	-298.3	-394.3
170	25.0	65.7	466.1	364.1	262.1	160.1	58.1	-43.9	-145.9	-247.9	-349.9	-451.9
180	23.9	62.8	462.1	354.1	246.1	138.1	30.1	-77.9	-185.9	-293.9	-401.9	-509.9
190	22.9	60.2	457.7	343.7	229.7	115.7	1.7	-112.3	-226.3	-340.3	-454.3	-568.3
200	22.0	57.7	453.0	333.0	213.0	93.0	-27.0	-147.0	-267.0	-387.0	-507.0	-627.0
Maximum Storage Rate =			478.3	423.3	384.6	354.0	329.8	308.4	290.4	272.4	258.1	246.1

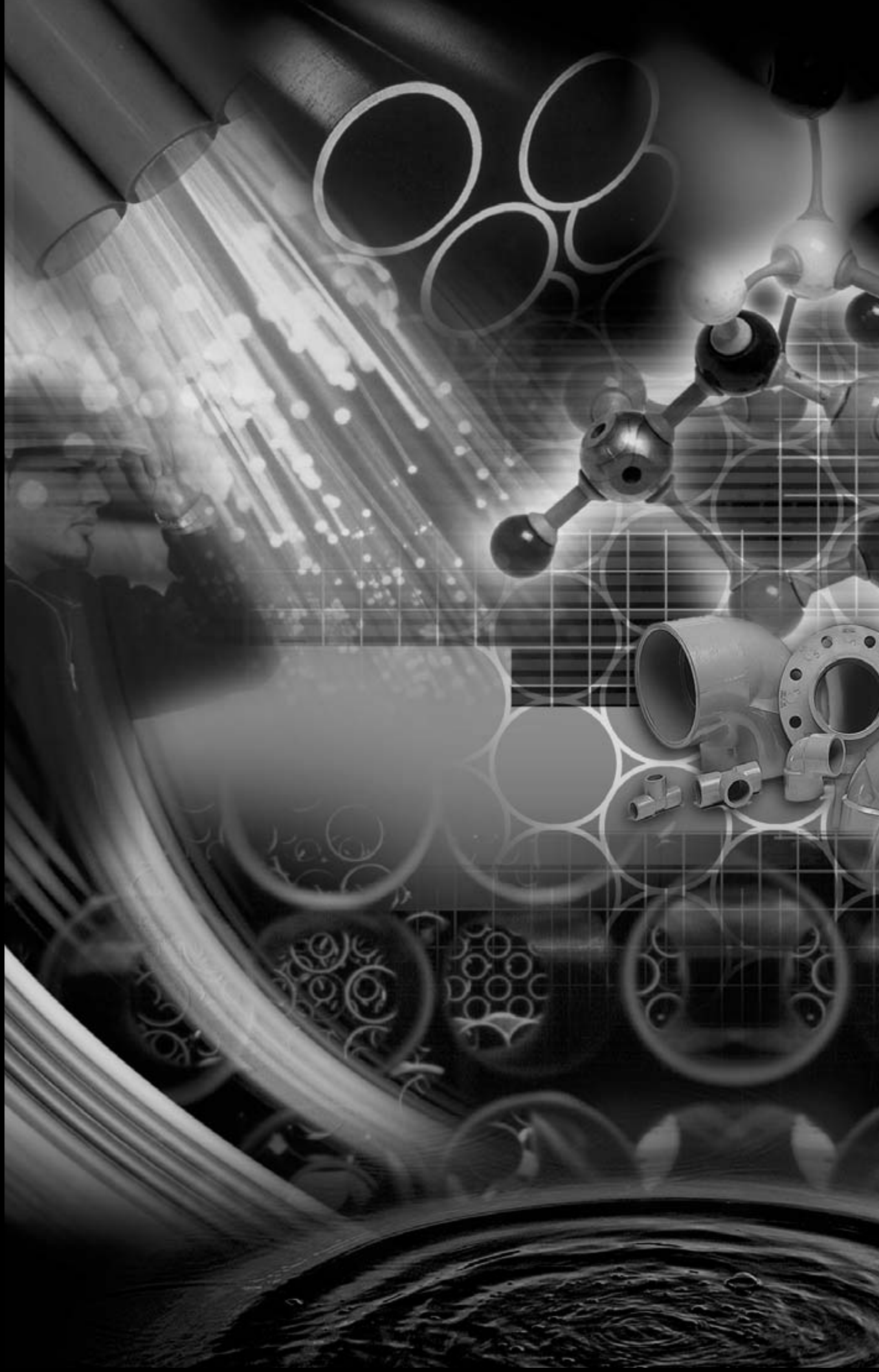
TABLE F20 - SUMMARY OF RESULTS

Area Number	**Areas 1-14**
Control Type	**ICD - IPEX MHF**
Orifice Type	**19-MHF-TypeF**
ICD Outlet Pipe Invert (m)	**98.35**
ICD Outlet Pipe Diameter (mm)	**300**
2-year Release Rate (L/sec):	**43.65**
2-year Storage Volume (m3):	**79.61**
2-year Depth (m):	**0.453**
2-year Stage / Elev (m):	**98.953**
5-year Release Rate (L/sec):	**50.76**
5-year Storage Volume (m3):	**116.83**
5-year Depth (m):	**0.613**
5-year Stage / Elev (m):	**99.113**
100-year Release Rate (L/sec):	**82.84**
100-year Storage Volume (m3):	**287.12**
100-year Depth (m):	**1.632**
100-year Stage / Elev (m):	**100.132**

Appendix G – Manufacturer Information

- **Tempest Inlet Control Devices (Cover, Page 9)**
- **StormTech MC-3500 & MC-4500 Design Manual (Cover, 2, 3, 16, 17)**

Volume III: TEMPEST™ INLET CONTROL DEVICES



Municipal Technical Manual Series

SECOND EDITION

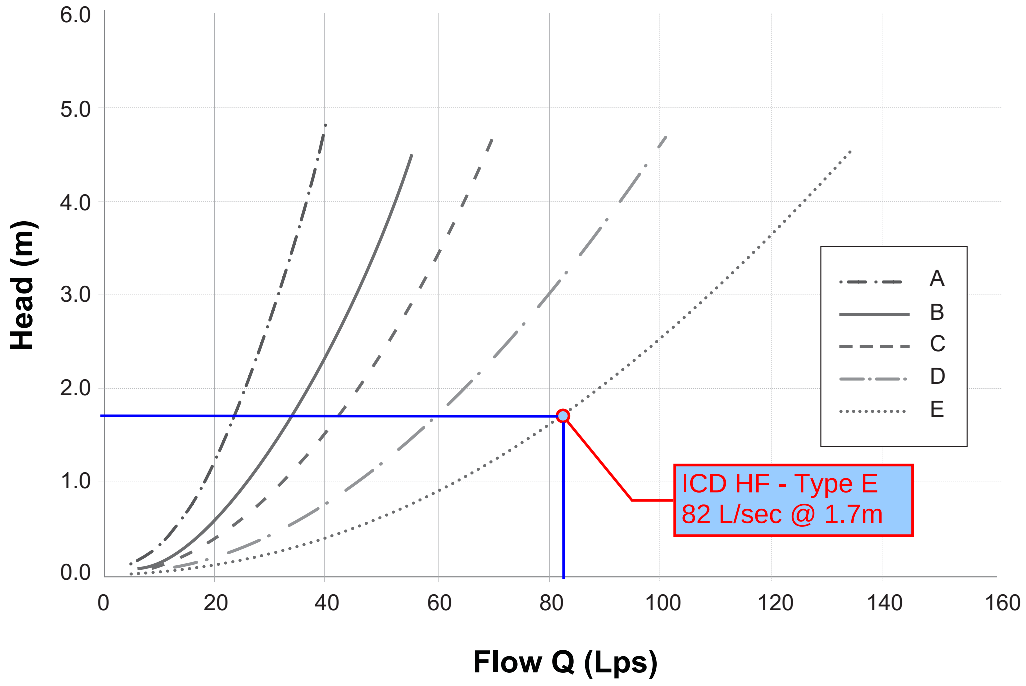
LMF (Low to Medium Flow) ICD

HF (High Flow) ICD

MHF (Medium to High Flow) ICD

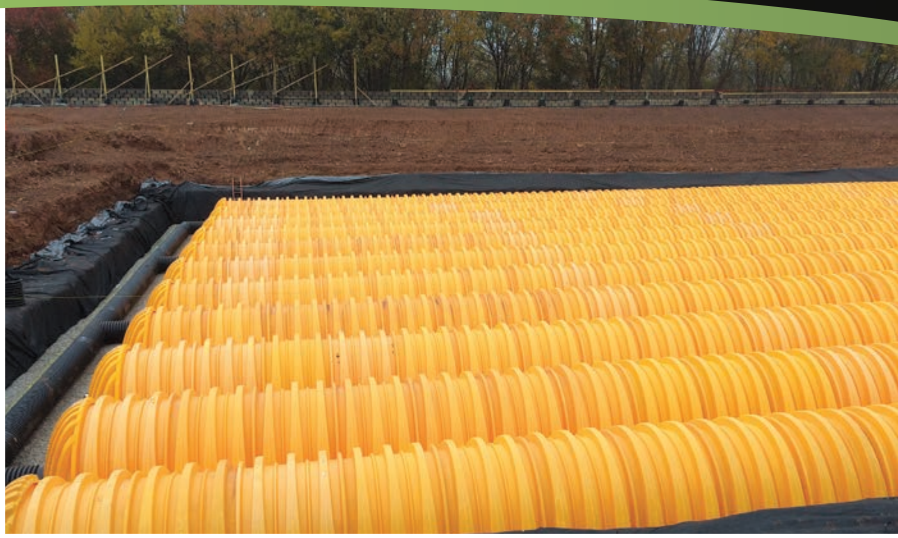
IPEX

Chart 3: HF & MHF Preset Flow Curves



MC-3500 & MC-4500 Design Manual

StormTech® Chamber Systems for Stormwater Management



*THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™*

StormTech MC-3500 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for commercial and municipal applications.

StormTech MC-3500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	90” (2286 mm) x 77” (1956 mm) x 45” (1143 mm)
Chamber Storage	109.9 ft^3 (3.11 m^3)
Min. Installed Storage*	178.9 ft^3 (5.06 m^3)
Weight	134 lbs (60.8 kg)

*This assumes a minimum of 12” (300 mm) of stone above, 9” (230 mm) of stone between chambers/end caps and 40% stone porosity.

StormTech MC-3500 End Cap (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	26.5” (673 mm) x 71” (1803 mm) x 45.1” (1145 mm)
Chamber Storage	14.9 ft^3 (0.42 m^3)
Min. Installed Storage*	46.0 ft^3 (1.30 m^3)
Weight	49 lbs (22.2 kg)

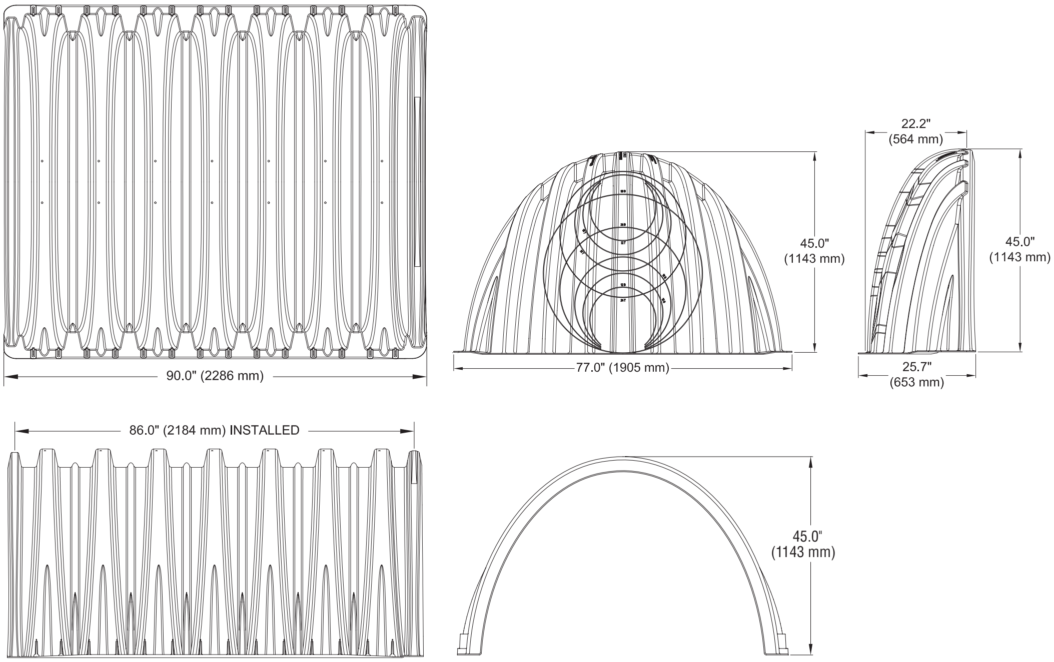
*This assumes a minimum of 12” (300 mm) of stone above, 9” (230 mm) of stone below, 6” (150 mm) of stone perimeter, 9” (230 mm) between chambers/end caps and 40% stone porosity.

Shipping

15 chambers/pallet

16 end caps/pallet

7 pallets/truck



StormTech MC-3500 Chamber

Storage Volume Per Chamber/End Cap ft³ (m³)

	Bare Unit Storage ft³ (m³)	Chamber/End Cap and Stone Volume — Stone Foundation Depth in. (mm)			
		9 (230)	12 (300)	15 (375)	18 (450)
MC-3500 Chamber	109.9 (3.11)	178.9 (5.06)	184.0 (5.21)	189.2 (5.36)	194.3 (5.5)
MC-3500 End Cap	14.9 (0.42)	46.0 (1.33)	47.7 (1.35)	49.4 (1.40)	51.1 (1.45)

NOTE: Assumes 9" (230 mm) row spacing, 40% stone porosity, 12" (300 mm) stone above and includes the bare chamber/end cap volume. End cap volume assumes 6" (150 mm) stone perimeter.

Amount of Stone Per Chamber

ENGLISH tons (yd³)	Stone Foundation Depth			
	9"	12"	15"	18"
MC-3500	9.1 (6.4)	9.7 (6.9)	10.4 (7.3)	11.1 (7.8)
End Cap	4.1 (2.9)	4.3 (3.0)	4.5 (3.2)	4.7 (3.3)
METRIC kg (m³)	230 mm	300 mm	375 mm	450 mm
MC-3500	8220 (4.9)	8831 (5.3)	9443 (5.6)	10054 (6.0)
End Cap	3699 (2.2)	3900(2.3)	4100 (2.5)	4301 (2.6)

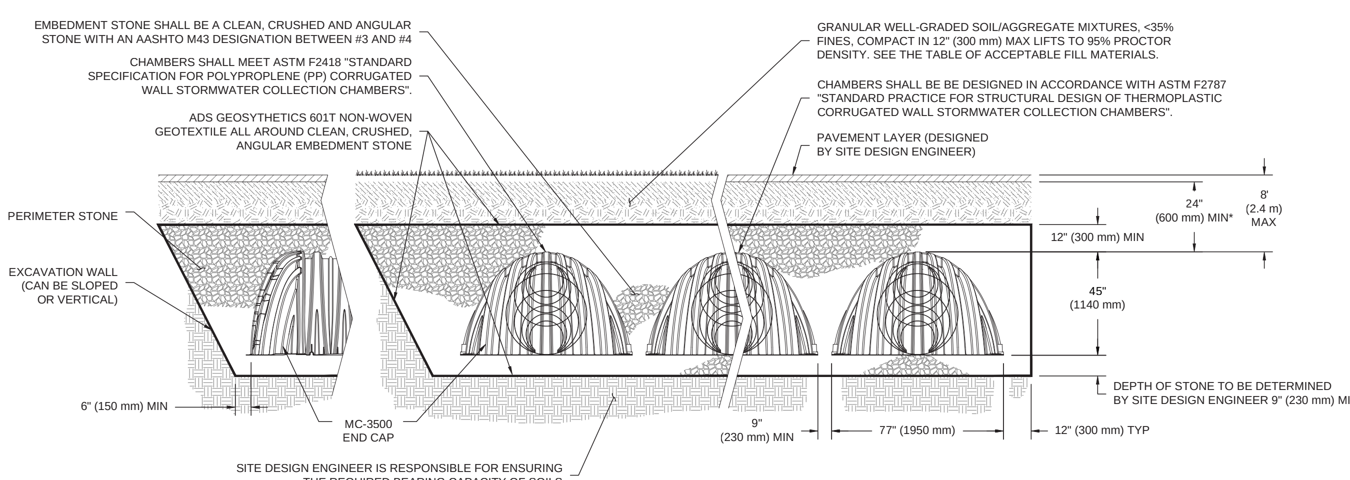
NOTE: Assumes 12" (300 mm) of stone above, and 9" (230 mm) row spacing, and 6" (150 mm) of perimeter stone in front of end caps.

Volume of Excavation Per Chamber/End Cap yd³ (m³)

	Stone Foundation Depth			
	9" (230 mm)	12" (300 mm)	15"(375 mm)	18"(450 mm)
MC-3500	12.4 (9.5)	12.8 (9.8)	13.3 (10.2)	13.8 (10.5)
End Cap	4.1 (3.1)	4.2 (3.2)	4.4 (3.3)	4.5 (3.5)

NOTE: Assumes 9" (230 mm) separation between chamber rows and 24" (600 mm) of cover. The volume of excavation will vary as the depth of cover increases.

General Cross Section



*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 30" (750 mm).

Special applications will be considered on a project by project basis. Please contact our application department should you have a unique application for our team to evaluate.

5.0 Cumulative Storage Volumes

StormTech

Tables 7 and **8** provide cumulative storage volumes for the MC-3500 chamber and end cap. These tables can be used to calculate the stage-storage relationship for the retention or detention system. Digital spreadsheets in which the number of chambers and end caps can be input for quick cumulative storage calculations are available at www.stormtech.com. For assistance with site-specific calculations or input into routing software, contact the StormTech Technical Services Department.

TABLE 7 – MC-3500 Incremental Storage Volume Per Chamber

Assumes 40% stone porosity. Calculations are based upon a 9" (230 mm) stone base under the chambers, 12" (300 mm) of stone above chambers, and 9" (230 mm) of spacing between chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft^3 (m^3)	Total System Cumulative Storage ft^3 (m^3)
66 (1676)	0.00	178.96 (5.068)
65 (1651)	0.00	177.25 (5.019)
64 (1626)	0.00	175.54 (4.971)
63 (1600)	Stone 0.00	173.83 (4.922)
62 (1575)	Cover 0.00	172.11 (4.874)
61 (1549)	0.00	170.40 (4.825)
60 (1524)	0.00	168.69 (4.777)
59 (1499)	0.00	166.98 (4.728)
58 (1473)	0.00	165.27 (4.680)
57 (1448)	0.00	163.55 (4.631)
56 (1422)	0.00	161.84 (4.583)
55 (1397)	0.00	160.13 (4.534)
54 (1372)	109.95 (3.113)	158.42 (4.486)
53 (1346)	109.89 (3.112)	156.67 (4.436)
52 (1321)	109.69 (3.106)	154.84 (4.385)
51 (1295)	109.40 (3.098)	152.95 (4.331)
50 (1270)	109.00 (3.086)	151.00 (4.276)
49 (1245)	108.31 (3.067)	148.88 (4.216)
48 (1219)	107.28 (3.038)	146.55 (4.150)
47 (1194)	106.03 (3.003)	144.09 (4.080)
46 (1168)	104.61 (2.962)	141.52 (4.007)
45 (1143)	103.04 (2.918)	138.86 (3.932)
44 (1118)	101.33 (2.869)	136.13 (3.855)
43 (1092)	99.50 (2.818)	133.32 (3.775)
42 (1067)	97.56 (2.763)	130.44 (3.694)
41 (1041)	95.52 (2.705)	127.51 (3.611)
40 (1016)	93.39 (2.644)	124.51 (3.526)
39 (991)	91.16 (2.581)	121.47 (3.440)
38 (965)	88.86 (2.516)	118.37 (3.352)
37 (948)	86.47 (2.449)	115.23 (3.263)
36 (914)	84.01 (2.379)	112.04 (3.173)
35 (889)	81.49 (2.307)	108.81 (3.081)
34 (864)	78.89 (2.234)	105.54 (2.989)
33 (838)	76.24 (2.159)	102.24 (2.895)
32 (813)	73.52 (2.082)	98.90 (2.800)
31 (787)	70.75 (2.003)	95.52 (2.705)
30 (762)	67.92 (1.923)	92.12 (2.608)
29 (737)	65.05 (1.842)	88.68 (2.511)
28 (711)	62.12 (1.759)	85.21 (2.413)
27 (686)	59.15 (1.675)	81.72 (2.314)
26 (680)	56.14 (1.590)	78.20 (2.214)
25 (635)	53.09 (1.503)	74.65 (2.114)
24 (610)	49.99 (1.416)	71.09 (2.013)
23 (584)	46.86 (1.327)	67.50 (1.911)
22 (559)	43.70 (1.237)	63.88 (1.809)
21 (533)	40.50 (1.147)	60.25 (1.706)
20 (508)	37.27 (1.055)	56.60 (1.603)
19 (483)	34.01 (0.963)	52.93 (1.499)
18 (457)	30.72 (0.870)	49.25 (1.395)
17 (432)	27.40 (0.776)	45.54 (1.290)
16 (406)	24.05 (0.681)	41.83 (1.184)
15 (381)	20.69 (0.586)	38.09 (1.079)
14 (356)	17.29 (0.490)	34.34 (0.973)
13 (330)	13.88 (0.393)	30.58 (0.866)
12 (305)	10.44 (0.296)	26.81 (0.759)
11 (279)	6.98 (0.198)	23.02 (0.652)
10 (254)	3.51 (0.099)	19.22 (0.544)
9 (229)	0.00	15.41 (0.436)
8 (203)	0.00	13.70 (0.388)
7 (178)	0.00	11.98 (0.339)
6 (152)	Stone 0.00	10.27 (0.291)
5 (127)	Foundation 0.00	8.56 (0.242)
4 (102)	0.00	6.85 (0.194)
3 (76)	0.00	5.14 (0.145)
2 (51)	0.00	3.42 (0.097)
1 (25)	0.00	1.71 (0.048)

NOTE: Add 1.71 ft^3 (0.030 m^3) of storage for each additional inch (25 mm) of stone foundation.
Contact StormTech for cumulative volume spreadsheets in digital format.

5.0 Cumulative Storage Volume

StormTech

TABLE 8 – MC-3500 Incremental Storage Volume Per End Cap

Assumes 40% stone porosity. Calculations are based upon a 9” (230 mm) stone base under the chambers, 12” (300 mm) of stone above end caps, and 9” (230 mm) of spacing between end caps and 6” (150 mm) of stone perimeter.

Depth of Water in System Inches (mm)	Cumulative End Cap Storage ft^3 (m^3)	Total System Cumulative Storage ft^3 (m^3)
66 (1676)	0.00	46.96 (1.330)
65 (1651)	0.00	46.39 (1.314)
64 (1626)	0.00	45.82 (1.298)
63 (1600)	Stone 0.00	45.25 (1.281)
62 (1575)	Cover 0.00	44.68 (1.265)
61 (1549)	0.00	44.11 (1.249)
60 (1524)	0.00	43.54 (1.233)
59 (1499)	0.00	42.98 (1.217)
58 (1473)	0.00	42.41 (1.201)
57 (1448)	0.00	41.84 (1.185)
56 (1422)	0.00	41.27 (1.169)
55 (1397)	0.00	40.70 (1.152)
54 (1372)	15.64 (0.443)	40.13 (1.136)
53 (1346)	15.64 (0.443)	39.56 (1.120)
52 (1321)	15.63 (0.443)	38.99 (1.104)
51 (1295)	15.62 (0.442)	38.41 (1.088)
50 (1270)	15.60 (0.442)	37.83 (1.071)
49 (1245)	15.56 (0.441)	37.24 (1.054)
48 (1219)	15.51 (0.439)	36.64 (1.037)
47 (1194)	15.44 (0.437)	36.02 (1.020)
46 (1168)	15.35 (0.435)	35.40 (1.003)
45 (1143)	15.25 (0.432)	34.77 (0.985)
44 (1118)	15.13 (0.428)	34.13 (0.966)
43 (1092)	14.99 (0.424)	33.48 (0.948)
42 (1067)	14.83 (0.420)	32.81 (0.929)
41 (1041)	14.65 (0.415)	32.13 (0.910)
40 (1016)	14.45 (0.409)	31.45 (0.890)
39 (991)	14.24 (0.403)	30.75 (0.871)
38 (965)	14.00 (0.396)	30.03 (0.850)
37 (948)	13.74 (0.389)	29.31 (0.830)
36 (914)	13.47 (0.381)	28.58 (0.809)
35 (889)	13.18 (0.373)	27.84 (0.788)
34 (864)	12.86 (0.364)	27.08 (0.767)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft^3 (m^3)	Total System Cumulative Storage ft^3 (m^3)
33 (838)	12.53 (0.355)	26.30 (0.745)
32 (813)	12.18 (0.345)	25.53 (0.723)
31 (787)	11.81 (0.335)	24.74 (0.701)
30 (762)	11.42 (0.323)	23.93 (0.678)
29 (737)	11.01 (0.312)	23.12 (0.655)
28 (711)	10.58 (0.300)	22.29 (0.631)
27 (686)	10.13 (0.287)	21.45 (0.607)
26 (680)	9.67 (0.274)	20.61 (0.583)
25 (635)	9.19 (0.260)	19.75 (0.559)
24 (610)	8.70 (0.246)	18.88 (0.559)
23 (584)	8.19 (0.232)	18.01 (0.510)
22 (559)	7.67 (0.217)	17.13 (0.485)
21 (533)	7.13 (0.202)	16.24 (0.460)
20 (508)	6.59 (0.187)	15.34 (0.434)
19 (483)	6.03 (0.171)	14.43 (0.409)
18 (457)	5.46 (0.155)	13.52 (0.383)
17 (432)	4.88 (0.138)	12.61 (0.357)
16 (406)	4.30 (0.122)	11.69 (0.331)
15 (381)	3.70 (0.105)	10.76 (0.305)
14 (356)	3.10 (0.088)	9.83 (0.278)
13 (330)	2.49 (0.071)	8.90 (0.252)
12 (305)	1.88 (0.053)	7.96 (0.225)
11 (279)	1.26 (0.036)	7.02 (0.199)
10 (254)	0.63 (0.018)	6.07 (0.172)
9 (229)	0.00	5.12 (0.145)
8 (203)	0.00	4.55 (0.129)
7 (178)	0.00	3.99 (0.113)
6 (152)	Stone 0.00	3.42 (0.097)
5 (127)	Foundation 0.00	2.85 (0.081)
4 (102)	0.00	2.28 (0.064)
3 (76)	0.00	1.71 (0.048)
2 (51)	0.00	1.14 (0.032)
1 (25)	0.00	0.56 (0.016)

NOTE: Add 0.56 ft^3 (0.016 m^3) of storage for each additional inch (25 mm) of stone foundation.
Contact StormTech for cumulative volume spreadsheets in digital format.

Appendix H – Background Information

- **Master Design Sheet (Hydraulic Grade Line Analysis)**
- **Storm Design Sheet**
- **Overland Flow Balance Sheet**
- **Storm Drainage Plan**

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

J.L. Richards
& Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

MORGAN'S GRANT - STAGE 12 - Minto Developments Inc.

(MASTER DESIGN SHEET)
CITY OF OTTAWA
JLR No.: 17732

STORM SEWER DESIGN SHEET AND
HYDRAULIC GRADE LINE ANALYSIS

Date: September 3, 2003
Revised : December 17, 2004
Revised : August 24, 2005
Designed by: G.F.
Checked by: L.J.
Updated by: J.B.
Checked by: L.J.

100 YEAR IDF CURVE

Manning's Coefficient (n) = 0.013

STREET	MANHOLE NUMBER From	To	AREAS WITH UNRESTRICTED FLOWS (ha) 0.2	0.38	0.4	0.45	0.5	0.55	0.6	0.7	0.95	1:100 YR PEAK FLOW GENERATION 2.78AR	2.78AR CUMM	Time min	Intens. mm/hr	Peak Flow L/s	Total CB With ICD: ICD Type 'A' @ 20.0 l/s	CUMM @ 20.0 l/s	ICD Flow (l/s)	External Flow (l/s)	CUMM Ext. Flow (l/s)	1:100 yr Capt. Flow (l/s)	Q_d/Q_{cap}	SEWER DATA Dia (mm)	Slope %	Q full (l/s)	V full (m/s)	V partial (m/s)	Depth of flow (m)	V surch (m/s)	Length (m)	Flow Time (min)
KLONDIKE RD.	667A	667										0.00	14.07	28.92	84.81	1192.95		35	700		212.00	912.00	0.95	750	0.68	957.73	2.10	2.41	0.587	2.00	63.00	0.50
KLONDIKE RD.	667	666			0.220		0.240		0.030			0.63	14.70	28.92	84.81	1246.23	2	37	740		212.00	952.00	0.58	750	1.98	1634.25	3.58	3.80	0.411	2.09	100.00	0.47
	666	665			0.160		0.160					0.40	15.10	29.39	83.83	1265.48	1	38	760		212.00	972.00	0.42	750	4.00	2322.80	5.09	4.87	0.343	2.13	97.50	0.32
PIEKOFF CR.	660	661			0.730							0.81	0.81	20.00	110.77	89.92	3	3	60		0.00	60.00	0.40	300	2.20	149.60	2.05	1.93	0.134	0.82	101.60	0.83
	661	663			0.530		0.070					0.69	1.50	20.83	107.57	161.18	3	6	120		0.00	120.00	0.56	300	4.50	214.03	2.93	3.06	0.162	1.64	78.80	0.45
WALLSEND AVE.	655	663			0.120		0.320					0.58	0.58	20.00	110.77	64.05	1	1	20		0.00	20.00	0.26	300	0.60	78.14	1.07	0.91	0.104	0.27	73.40	1.14
WALLSEND AVE.	663	664										0.00	2.08	21.27	105.92	219.97		7	140		0.00	140.00	0.61	450	0.60	230.39	1.40	1.46	0.256	0.85	32.40	0.38
	664	665			0.350		0.160					0.61	2.69	21.66	104.56	281.08	1	8	160		0.00	160.00	0.69	450	0.60	230.39	1.40	1.50	0.279	0.97	48.30	0.57
KLONDIKE RD.	665	665A					0.160					0.22	18.01	29.71	83.18	1497.73	1	47	940		212.00	1152.00	0.53	750	3.48	2166.59	4.75	4.93	0.389	2.53	60.70	0.21
	665A	648										0.00	18.01	29.92	82.75	1490.00	0	47	940		212.00	1152.00	0.96	900	0.40	1194.45	1.82	2.09	0.713	1.75	22.50	0.21
KLONDIKE RD.	648	647	0.890		0.260		0.160					1.01	40.25	27.90	87.03	3502.76	4	111	2220		212.00	2432.00	0.95	1200	0.40	2572.39	2.20	2.51	0.939	2.08	85.00	0.64
WIMBLEDON ST.	548A	548										0.00	0.00	20.00	110.77	0.00		0	0		0.00	0.00	0.00	300	0.40	63.80	0.87	0.00	0.000	0.00	14.00	0.27
	548	547					0.720					1.00	1.00	20.27	109.71	109.80	3	3	60		0.00	60.00	0.52	375	0.40	115.68	1.01	1.03	0.194	0.53	55.50	0.91
	547	546					0.230					0.32	1.32	21.18	106.27	140.33		3	60		0.00	60.00	0.52	375	0.40	115.68	1.01	1.03	0.194	0.53	9.00	0.15
	546	545					0.530					0.74	2.06	21.33	105.73	217.52	3	6	120		0.00	120.00	0.64	450	0.40	188.11	1.15	1.22	0.261	0.73	73.00	1.06
	545	647					0.220					0.31	2.36	22.39	102.08	241.21	1	7	140		0.00	140.00	0.74	450	0.40	188.11	1.15	1.24	0.293	0.85	42.00	0.61
KLONDIKE RD.	647	646			0.610							0.68	43.29	28.55	85.61	3705.83	3	121	2420		212.00	2632.00	0.96	1200	0.45	2728.43	2.34	2.68	0.951	2.25	99.00	0.71
	646	645			0.920							1.02	44.31	29.25	84.11	3726.91	3	124	2480		212.00	2692.00	0.85	1200	0.60	3150.52	2.70	3.02	0.866	2.31	98.00	0.61
PENRITH ST.	645	694			0.130							0.14	44.45	29.86	82.87	3684.03	1	110	2200		212.00	2412.00	0.84	1200	0.50	2869.68	2.46	2.75	0.853	2.07	70.30	0.48
BRECHIN CR.	696	695			0.420							0.47	0.47	20.00	110.77	51.73	2	2	40		0.00	40.00	0.40	300	1.00	100.88	1.38	1.33	0.131	0.55	48.70	0.59
	695	694			0.340							0.38	0.85	20.59	108.47	91.67	1	3	60		0.00	60.00	0.39	375	0.70	153.03	1.34	1.28	0.164	0.53	87.60	1.09
PENRITH ST.	694	693			0.190							0.21	45.51	30.34	81.93	3728.58	1	114	2280		212.00	2492.00	0.87	1200	0.50	2876.02	2.46	2.80	0.866	2.13	36.50	0.25
	693	692			0.320							0.36	45.87	30.58	81.45	3735.74	1	115	2300		212.00	2512.00	0.87	1200	0.50	2876.02	2.46	2.78	0.878	2.15	36.50	0.25
BRECHIN CR.	696	698										0.00	0.00	20.00	110.77	0.00		0	0		0.00	0.00	0.00	300	1.00	100.88	1.38	0.00	0.000	0.00	33.80	0.41
BRECHIN CR.	703	698	1.940		0.460							1.59	1.59	20.00	110.77	176.14	3	3	60		0.00	60.00	0.33	375	1.00	183.28	1.61	1.45	0.149	0.53	71.70	0.74
EALING ST.	698	697										0.00	1.59	20.74	107.88	171.54		3	60		0.00	60.00	0.33	375	1.00	182.91	1.60	1.45	0.149	0.53	64.00	0.66
	697	692			0.290							0.32	1.91	21.41	105.44	201.67	1	4	80		0.00	80.00	0.44	375	1.00	182.91	1.60	1.56	0.175	0.70	53.90	0.56
PENRITH ST.	692	691			0.240							0.27	48.05	30.83	80.97	3890.54	1	120	2400		212.00	2612.00	0.87	1200	0.55	3016.39	2.58	2.93	0.866	2.24	32.30	0.21
BRECHIN CR.	704	703	0.860		0.300							0.81	0.81	20.00	110.77	89.92	3	3	60		0.00	60.00	0.59	300	1.00	100.88	1.38	1.45	0.168	0.82	61.50	0.74
HASELMERE AVE.	703	702										0.00	0.81	20.74	107.89	87.58		3	60		0.00	60.00	0.33	375	1.00	182.91	1.60	1.45	0.149	0.53	64.70	0.67
	702	701			0.290							0.32	1.13	21.41	105.42	119.57	1	4	80		0.00	80.00	0.38	375	1.36	213.31	1.87	1.75	0.160	0.70	53.00	0.47
BRECHIN CR.	705	706			0.320							0.36	0.36	20.00	110.77	39.41	1	1	20		0.00	20.00	0.15	300	1.84	136.84	1.88	1.41	0.076	0.27	109.80	0.98
PENRITH ST.	707	706			0.680							0.76	0.76	20.00	110.77	83.76	2	2	40		0.00	40.00	0.22	375	1.00	182.91	1.60	1.34	0.118	0.35	32.20	0.33
PENRITH ST.	706	701			0.520							0.58	1.69	20.98	107.01	180.87	3	6	120		0.00	120.00	0.45	450	0.80	266.03	1.62	1.58	0.215	0.73	69.50	0.71
PENRITH ST.	701	691			0.210							0.23	3.06	21.89	103.77	317.33	1	11	220		0.00	220.00	0.52	450	2.00	420.63	2.56	2.61	0.233	1.34	39.20	0.25
HEYSHAM LANE	691	677			0.480							0.53	51.64	31.04	80.58	4161.03	2	133	2660		212.00	2872.00	0.95	1200	0.55	3016.39	2.58	2.96	0.939	2.46	75.40	0.49
WOLISTON CR.	677	676			0.750							0.83	52.47	31.52	79.68	4180.90	2	135	2700		212.00	2912.00	0.97	1200	0.55	3016.39	2.58	2.97	0.951	2.49	93.70	0.60
	676	675										0.00	52.47	32.13	78.59	4123.81		135	2700		212.00	2912.00	0.97	1200	0.55	3016.39	2.58	2.97	0.951	2.49	11.30	0.07
	675	674			0.940		0.230					1.36	53.84	32.20	78.46	4224.15	4	139	2780		212.00	2992.00	0.76	1350	0.50	3937.30	2.66	2.89	0.892	2.02	89.60	0.56
	674	673			0.750		0.110					0.99	54.82	32.76	77.49	4248.18	3	142	2840		212.00	3052.00	0.78	1350	0.50	3937.30	2.66	2.91	0.905	2.07	65.80	0.41
KETTLEWELL WAY	687	688			0.240							0.27	0.27	20.00	110.77	29.56	1	1	20		0.00	20.00	0.17	300	1.40	119.32	1.64	1.25	0.082	0.27	57.20	0.58
	688	688A			0.260							0.29	0.56	20.58	108.49	60.32	1	2	40		0.00	40.00	0.34	300	1.40	119.37	1.64	1.51	0.119	0.55	11.00	0.11
	688A	689			0.360							0.40	0.96	20.70	108.06	103.34	1	3	60		0.00	60.00	0.51	300	1.38	118.47	1.62	1.64	0.152	0.82	77.10	0.79
PALTON ST.	689	673			0.140		0.260					0.52	1.47	21.49	105.16	154.95	2	5	100		0.00	100.00	0.81	300	1.50	123.47	1.69	1.88	0.207	1.37	78.50	0.77
WOLISTON CR.	673	672			0.430		0.240					0.81	57.11	33.17	76.79	4385.43	2	149	2980		212.00	3192.00	0.81	1350	0.50	3937.30	2.66	2.96	0.933	2.16	84.20	0.53
WOLISTON CR.	678	681			0.390							0.43	0.43	20.00	110.77	48.04	2	2	40		0.00	40.00	0.48	300	0.68	82.88	1.14	1.15	0.146	0.55	81.90	1.20
	681	682										0.00	0.43	21.20	106.18	46.05		2	40		0.00	40.00	0.51	300	0.60	78.14	1.07	1.10	0.152	0.55	10.50	0.16
	682	683			0.500							0.56	0.99	21.37	105.60	104.51	3	5	100		0.00	100.00	0.84	300	1.39	119.07	1.63	1.83	0.213	1.37	70.70	0.72
KETTLEWELL WAY	687	683			0.190							0.21	0.21	20.00	110.77	23.40	1	1	20		0.00	20.00	0.20	300	1.02	101.99	1.40	1.10	0.091	0.27	55.00	0.66
WOLISTON CR.	683	684			0.650							0.72	1.92	22.09	103.08	198.31	4	10	200		0.00	198.31	0.49	450	1.88	408.04	2.49	2.48	0.224	1.21	84.90	0.57
PALTON ST.	689	685			0.090							0.10	0.10	20.00	110.77	11.09	1	1	20		0.00	11.09	0.08	375	0.60	141.68	1.24	0.81	0.069	0.10	55.00	0.74
	685	684			0.250		0.170					0.51	0.61	20.74	107.90	66.29	1	2	40		0.00	40.00	0.28	375	0.60	141.68	1.24	1.08	0.137	0.35	64.80	0.87
WOLISTON CR.	684	670			0.360		0.070					0.50	3.04	22.66	101.20	307.23	3	15	300		0.00	300.00	0.52	525	1.64	574.56	2.57	2.62	0.272	1.34	84.20	0.55
FLAMBOROUGH WAY	670	671					0.620					0.86	3.90	23.20	99.47	387.70	2	17	340	21.13	21.13	361.13	0.62	750	0.25	580.71	1.27	1.32	0.434	0.79	89.00	1.16
	671	672					0.650					0.90	4.80	24.37	96.01	460.94	3	20	400	24.23	45.36	445.36	0.61	900	0.15	732.66	1.12	1.16	0.512	0.68	109.00	1.63
	672	101										0.00	61.91	33.70	75.92	4700.20	1	170	3400		257.36	3657.36	0.94	1350	0.49	3897.72	2.64	3.02	1.042	2.48	79.20	0.50
			UNRESTRICTED REAR YARD FLOWS-PHASE 12 (ha)																													
BLK 248	Hydro Ea.	906										0.00	0.00	26.00	91.60	0.00	0	0.00	0	30	30.00	30.00										
GOWARD DRIVE	908	907			0.202							0.22	0.22	20.00	110.77	24.88	6	6.00	120	0	0.00	144.88	0.48	450	1.05	304.78	1.86	1.86	0.219	0.88	112.00	1.01
	907	906										0.00	0.22	21.01	106.90	24.01	1	7.00	140	0	0.00	164.01	0.58	525	0.40	283.76	1.27	1.33	0.288	0.73	114.87	1.51
														22.51																		
ISHPATINA CRESCENT	804	801										0.00	0.00	20.00	110.77	0.00	0	0.00	0	0	0.00	0.00	0.00	300	0.40	63.80	0.87	0.00	0.000	0.00	17.43	0.33
	801	906										0.00	0.00	20.33	109.45	0.00	0	0.00	0	0	0.00	0.00	0.00	300	0.40	63.80	0.87	0.00	0.000	0.00	59.50	1.13
														21.47																		
BLK 246	705	704										0.00	0.00	30.00	82.59	0.00	0	0.00	0	50	50.00	50.00										
FINLAYSON CRESCENT	705	704										0.00	0.00	20.00	110.77	0.00	0	0.00	0	0	0.00	0.00	0.00	300	1.20	110.51	1.51	0.00	0.000	0.00	8.98	0.10
	704	701										0.00	0.00	20.10	110.37	0.00	1	1.00	20	0	50.00	70.00	0.63	300	1.20	110.51	1.51	1.60	0.174	0.96	41.34	0.45
	701	700			0.180							0.20	0.20	20.55	108.60	21.74	0	1.00	20	0	50.00	91.74	0.79	375	0.40	115.68	1.01	1.12	0.255	0.80	40.92	0.67
	700	906										0.00	0.20	21.23	106.10	21.24	0	1.00	20	0	50.00	91.24	0.79	375	0.40	115.68	1.01	1.13	0.251	0.80	12.73	0.21
														21.43																		
GOWARD DRIVE	906	905			0.140							0.16	0.58	22.51	101.67	59.02	3	11.00	220	0	80.00	359.02	0.84	600	0.45	429.70	1.47	1.66	0.421	1.23	67.57	0.76
														23.28	99.24																	
ISHPATINA CRESCENT	804	803	0.391		0.483							0.75	0.75	20.00	110.77	83.57	1	1.00	20	0	0.00	103.57	1.03	375	0.30	100.18	0.88	1.00	0.324	0.91	68.89	1.31
	803	802										0.00	0.75	21.31	105.81	79.83	0	1.00	20	0	0.00	99.83	1.00	375	0.30	100.18	0.88	1.01	0.309	0.88	11.88	0.23
	802	905			0.049							0.05	0.81	21.53	105.00	84.94	0	1.00	20	0	0.00	104.94	1.05	375	0.30	100.18	0.88	1.00	0.331	0.92	67.47	1.28

STREET	From	To	UPSTREAM Pr. Center Line	Obvert	Obvert Drop	Invert	Cover	DOWNSTREAM Pr. Center Line	Obvert	Obvert Drop	Invert	Cover	HEAD LOSS CALCULATION f	L / D	K FRICT	V^2 / 2g (m)	Straight	Expansion	Bend	Major Loss (m)	Minor Loss (m)	Total Losses (m)	Applied Losses (m)	1:100 YR HGL ELEVATIONS Upstr.	Downs.	COVER Top Foot.- HGL Upstr.	Downs.	COVER - HGL Centerline Upstr.	Downs.
KLONDIKE RD.	667A	667	103.200	98.758		98.008	4.442	101.950	98.330		97.580	3.620	0.023	82.677	1.905	0.296	0.044			0.564	0.044	0.608	0.000	98.758	98.330	1.742	0.920	4.442	3.620
KLONDIKE RD.	667	666	101.950	98.330		97.580	3.620	99.550	96.350		95.600	3.200	0.023	131.234	3.024	0.734	0.110			2.221	0.110	2.331	0.000	98.330	96.350	0.920	0.500	3.620	3.200
	666	665	99.550	95.750		95.000	3.800	95.000	91.850		91.100	3.150	0.023	127.953	2.948	1.210	0.182			3.568	0.182	3.749	0.000	95.750	91.850	1.100	0.450	3.800	3.150
PIEKOFF CR.	660	661	100.500	97.441		97.141	3.059	98.500	95.207		94.907	3.293	0.031	333.333	10.425	0.034	0.005			0.359	0.005	0.365	0.365	97.441	95.207	0.359	0.593	3.059	3.293
	661	663	98.500	95.207		94.907	3.293	94.900	91.660		91.360	3.240	0.031	258.530	8.085	0.138		0.138	0.141	1.115	0.279	1.394	1.394	95.207	91.694	0.593	0.506	3.293	3.206
WALLSEND AVE.	655	663	95.250	92.104		91.804	3.146	94.900	91.664		91.364	3.236	0.031	240.814	7.531	0.004	0.001	0.004		0.029	0.004	0.033	0.033	92.104	91.694	0.446	0.506	3.146	3.206
WALLSEND AVE.	663	664	94.900	91.694		91.244	3.206	94.600	91.500		91.050	3.100	0.027	70.866	1.936	0.037	0.006			0.072	0.006	0.077	0.077	91.694	91.500	0.506	0.400	3.206	3.100
	664	665	94.600	91.500		91.050	3.100	95.000	91.210		90.760	3.790	0.027	105.643	2.886	0.048		0.048	0.049	0.140	0.098	0.238	0.238	91.500	91.252	0.400	1.048	3.100	3.748
KLONDIKE RD.	665	665A	95.000	91.252		90.502	3.748	91.800	89.140		88.390	2.660	0.023	79.659	1.836	1.239	0.186	1.239		2.274	1.424	3.698	0.000	91.252	89.140	1.048	-0.040	3.748	2.660
	665A	648	91.800	88.690		87.790	3.110	91.800	88.600		87.700	3.200	0.022	24.606	0.534	0.222	0.033	0.222		0.119	0.256	0.374	0.000	88.690	88.600	0.410	0.500	3.110	3.200
KLONDIKE RD.	648	647	91.800	88.606		87.406	3.194	91.400	88.266		87.066	3.134	0.020	69.718	1.374	0.321	0.048			0.441	0.048	0.489	0.000	88.606	88.266	0.494	0.434	3.194	3.134
WIMBLEDON ST.	548A	548	91.673	88.908		88.608	2.765	91.500	88.852		88.552	2.648	0.031	45.932	1.437	0.000				0.000	0.000	0.000	0.000	88.908	88.852	0.065	-0.052	2.765	2.648
	548	547	91.500	88.852		88.477	2.648	91.400	88.630		88.255	2.770	0.029	145.669	4.229	0.054			0.004	0.227	0.004	0.232	0.000	88.852	88.630	-0.052	0.070	2.648	2.770
	547	546	91.400	88.590		88.215	2.810	91.430	88.554		88.179	2.876	0.029	23.622	0.686	0.054		0.054	0.004	0.037	0.058	0.095	0.000	88.590	88.554	0.110	0.176	2.810	2.876
	546	545	91.430	88.554		88.104	2.876	91.470	88.262		87.812	3.208	0.027	159.668	4.362	0.076	0.011			0.330	0.011	0.341	0.000	88.554	88.262	0.176	0.508	2.876	3.208
	545	647	91.470	88.222		87.772	3.248	91.400	88.054		87.604	3.346	0.027	91.864	2.510	0.078		0.078	0.080	0.197	0.158	0.355	0.000	88.222	88.054	0.548	0.646	3.248	3.346
KLONDIKE RD.	647	646	91.600	88.266		87.066	3.334	91.650	87.821		86.621	3.830	0.020	81.201	1.600	0.367	0.055			0.588	0.055	0.643	0.000	88.266	87.821	0.634	1.129	3.334	3.830
	646	645	91.650	87.820		86.620	3.830	90.400	87.232		86.032	3.168	0.020	80.381	1.584	0.466			0.476	0.738	0.476	1.214	0.000	87.820	87.232	1.130	0.468	3.830	3.168
PENRITH ST.	645	694	90.400	87.170		85.970	3.230	92.000	86.820		85.620	5.180	0.020	57.661	1.136	0.387	0.058			0.440	0.058	0.498	0.000	87.170	86.820	0.530	2.480	3.230	5.180
BRECHIN CR.	696	695	92.850	89.936		89.636	2.914	92.505	89.449		89.149	3.056	0.031	159.777	4.997	0.090		0.090	0.025	0.450	0.115	0.565	0.000	89.936	89.449	0.214	0.356	2.914	3.056
	695	694	92.505	89.449		89.074	3.056	92.000	88.836		88.461	3.164	0.029	229.921	6.675	0.083		0.083	0.085	0.554	0.168	0.722	0.000	89.449	88.836	0.356	0.464	3.056	3.164
PENRITH ST.	694	693	92.000	86.820		85.620	5.180	91.700	86.638		85.438	5.063	0.020	29.938	0.590	0.232			0.014	0.137	0.014	0.151	0.151	88.089	87.938	1.211	1.062	3.911	3.762
	693	692	91.700	86.638		85.438	5.063	92.000	86.455		85.255	5.545	0.020	29.938	0.590	0.236	0.035			0.139	0.035	0.175	0.175	87.938	87.763	1.062	1.537	3.762	4.237
BRECHIN CR.	696	698	92.850	89.936		89.636	2.914	93.100	89.598		89.298	3.502	0.031	110.892	3.468	0.000				0.000	0.000	0.000	0.000	89.936	89.598	0.214	0.802	2.914	3.502
BRECHIN CR.	703	698	93.100	90.245		89.870	2.855	93.100	89.525		89.150	3.575	0.029	188.189	5.464	0.107			0.110	0.587	0.110	0.697	0.000	90.245	89.525	0.155	0.875	2.855	3.575
EALING ST.	698	697	93.100	89.461		89.086	3.639	92.350	88.821		88.446	3.529	0.029	167.979	4.877	0.107	0.016			0.524	0.016	0.540	0.000	89.461	88.821	0.939	0.829	3.639	3.529
	697	692	92.350	88.821		88.446	3.529	92.000	88.282		87.907	3.718	0.029	141.470	4.107	0.124		0.124	0.126	0.509	0.250	0.760	0.000	88.821	88.282	0.829	1.018	3.529	3.718
PENRITH ST.	692	691	92.000	86.455		85.255	5.545	91.200	86.277		85.077	4.923	0.020	26.493	0.522	0.255			0.260	0.133	0.260	0.394	0.394	87.763	87.369	1.537	1.131	4.237	3.831
BRECHIN CR.	704	703	93.000	90.039		89.739	2.961	93.100	89.424		89.124	3.676	0.031	201.772	6.310	0.107		0.107	0.110	0.677	0.217	0.894	0.000	90.039	89.424	0.261	0.976	2.961	3.676
HASELMERE AVE.	703	702	93.100	89.424		89.049	3.676	92.000	88.777		88.402	3.223	0.029	169.816	4.930	0.107	0.016			0.530	0.016	0.546	0.000	89.424	88.777	0.976	0.523	3.676	3.223
	702	701	92.000	88.775		88.400	3.225	91.440	88.054		87.679	3.386	0.029	139.108	4.039	0.157		0.157	0.160	0.634	0.317	0.951	0.000	88.775	88.054	0.525	0.686	3.225	3.386
BRECHIN CR.	705	706	92.880	89.720		89.420	3.160	90.800	87.700		87.400	3.100	0.031	360.236	11.266	0.004		0.004	0.004	0.043	0.008	0.051	0.051	89.720	87.886	0.460	0.214	3.160	2.914
PENRITH ST.	707	706	90.500	87.912		87.537	2.588	90.800	87.590		87.215	3.210	0.029	84.514	2.454	0.006	0.001	0.006		0.015	0.007	0.023	0.023	87.912	87.886	-0.112	0.214	2.588	2.914
PENRITH ST.	706	701	90.800	87.590		87.140	3.210	91.440	87.034		86.584	4.406	0.027	152.012	4.153	0.027	0.004			0.113	0.004	0.117	0.117	87.886	87.769	0.214	0.971	2.914	3.671
PENRITH ST.	701	691	91.440	87.034		86.584	4.406	91.200	86.250		85.800	4.950	0.027	85.739	2.342	0.092		0.092	0.093	0.214	0.185	0.399	0.399	87.769	87.369	0.971	1.131	3.671	3.831
HEYSHAM LANE	691	677	91.300	86.234		85.034	5.066	91.300	85.819		84.619	5.481	0.020	61.844	1.218	0.309			0.315	0.376	0.315	0.691	0.691	87.369	86.679	1.231	1.921	3.931	4.621
WOLISTON CR.	677	676	91.300	85.759		84.559	5.541	90.160	85.244		84.044	4.916	0.020	76.854	1.514	0.317			0.089	0.480	0.089	0.569	0.569	86.679	86.110	1.921	1.350	4.621	4.050
	676	675	90.160	85.214		84.014	4.946	90.150	85.152		83.952	4.998	0.020	9.268	0.183	0.317		0.317	0.089	0.058	0.406	0.464	0.464	86.110	85.646	1.350	1.804	4.050	4.504
	675	674	90.150	85.152		83.802	4.998	89.190	84.704		83.354	4.486	0.019	65.325	1.237	0.209	0.031			0.259	0.031	0.290	0.290	85.646	85.356	1.804	1.134	4.504	3.834
	674	673	89.190	84.704		83.354	4.486	88.400	84.375		83.025	4.025	0.019	47.973	0.909	0.218	0.033			0.198	0.033	0.230	0.230	85.356	85.125	1.134	0.575	3.834	3.275
KETTLEWELL WAY	687	688	90.940	87.878		87.578	3.062	90.600	87.078		86.778	3.522	0.031	187.664	5.869	0.079			0.022	0.464	0.022	0.487	0.000	87.878	87.078	0.362	0.822	3.062	3.522
	688	688A	90.600	87.027		86.727	3.573	90.000	86.873		86.573	3.127	0.031	36.089	1.129	0.117			0.033	0.132	0.033	0.164	0.000	87.027	86.873	0.873	0.427	3.573	3.127
	688A	689	90.000	86.823		86.523	3.177	88.900	85.760		85.460	3.140	0.031	252.953	7.911	0.034			0.035	0.273	0.035	0.308	0.308	86.823	86.090	0.477	0.110	3.177	2.810
PALTON ST.	689	673	88.900	85.422		85.122	3.478	88.400	84.246		83.946	4.154	0.031	257.546	8.055	0.096		0.096	0.098	0.771	0.193	0.965	0.965	86.090	85.125	0.110	0.575	2.810	3.275
WOLISTON CR.	673	672	88.400	84.375		83.025	4.025	87.200	83.954		82.604	3.246	0.019	61.388	1.163	0.238			0.243	0.277	0.243	0.519	0.519	85.125	84.606	0.575	-0.106	3.275	2.594
WOLISTON CR.	678	681	91.228	88.795		88.495	2.433	91.920	88.242		87.942	3.678	0.031	268.701	8.404	0.068			0.019	0.571	0.019	0.590	0.000	88.795	88.242	-0.267	0.978	2.433	3.678
	681	682	91.920	88.192		87.892	3.728	91.790	88.129		87.829	3.661	0.031	34.449	1.077	0.061			0.017	0.066	0.017	0.083	0.000	88.192	88.129	1.028	0.961	3.728	3.661
	682	683	91.790	88.079		87.779	3.711	90.750	87.094		86.794	3.656	0.031	231.955	7.254	0.170	0.026	0.170		1.235	0.196	1.431	0.000	88.079	87.094	1.011	0.956	3.711	3.656
KETTLEWELL WAY	687	683	90.940	87.646		87.346	3.294	90.750	87.084		86.784	3.666	0.031	180.446	5.643	0.061		0.061	0.063	0.346	0.124	0.470	0.000	87.646	87.084	0.594	0.966	3.294	3.666
WOLISTON CR.	683	684	90.750	87.094		86.644	3.656	88.680	85.496		85.046	3.184	0.027	185.696	5.073	0.313	0.047	0.313		1.588	0.360	1.948	0.000	87.094	85.496	0.956	0.484	3.656	3.184
PALTON ST.	689	685	88.900	86.185		85.810	2.715	88.810	85.855		85.480	2.955	0.029	144.357	4.191	0.033	0.005			0.140	0.005	0.145	0.000	86.185	85.855	0.015	0.255	2.715	2.955
	685	684	88.810	85.855		85.480	2.955	88.680	85.466		85.091	3.214	0.029	170.079	4.938	0.006		0.006	0.006	0.031	0.013	0.044	0.044	85.855	85.496	0.255	0.484	2.955	3.184
WOLISTON CR.	684	670	88.680	85.496		84.971	3.184	87.200	84.115		83.590	3.085	0.026	157.855	4.097	0.092		0.092	0.094	0.376	0.186	0.562	0.562	85.496	84.816	0.484	-0.316	3.184	2.384
FLAMBOROUGH WAY	670	671	87.200	84.160		83.410	3.040	87.130	83.938		83.188	3.193	0.023	116.798	2.691	0.032	0.005	0.032		0.086	0.037	0.123	0.123	84.816	84.693	-0.316	-0.263	2.384	2.437
	671	672	87.130	83.968		83.068	3.162	87.200	83.804		82.904	3.396	0.022	119.204	2.585	0.023	0.004	0.023		0.061	0.027	0.088	0.088	84.693	84.606	-0.263	-0.106	2.437	2.594
	672	101	87.200	83.884		82.534	3.316	87.100	83.496		82.146	3.604	0.019	57.743	1.094	0.312		0.312	0.319	0.342	0.631	0.973	0.973	84.606	83.633	-0.106	0.767	2.594	3.467
GOWARD DRIVE	908	907	102.20	99.400		98.943	2.80	101.34	98.224		97.767	3.12	0.027	244.969	6.693	0.176	0.026	0.176		1.178	0.202	1.380	0.000	99.400	98.224	0.398	0.714	2.800	3.116
	907	906	101.34	98.197	0.03	97.664	3.14	100.70	97.738		97.204	2.96	0.026	215.354	5.589	0.091	0.014	0.091		0.507	0.104	0.612	0.000	98.197	97.738	0.741	0.561	3.143	2.963
ISHPATINA CRESCENT	804	801	100.96	98.060		97.755	2.90	100.96	97.990		97.685	2.97	0.031	57.185	1.788	0.000				0.000	0.000	0.000	0.000	98.060	97.990	0.498	0.568	2.900	2.970
	801	906	100.96	97.950	0.04	97.645	3.01	100.70	97.712		97.407	2.99	0.031	195.210	6.105	0.000				0.000	0.000	0.000	0.000	97.950	97.712	0.608	0.586	3.010	2.988
FINLAYSON CRESCENT	705	704	101.47	98.670		98.365	2.80	101.33	98.562		98.257	2.77	0.031	29.462	0.921	0.000				0.000	0.000	0.000	0.000	98.670	98.562	0.398	0.366	2.800	2.768
	704	701	101.33	98.522	0.04	98.217	2.81	100.77	98.026		97.721	2.74	0.031	135.630	4.242	0.130		0.130		0.553	0.130	0.683	0.000	98.522	98.026	0.406	0.342	2.808	2.744
	701	700	100.77	98.026		97.645	2.74	100.62	97.862		97.481	2.76	0.029	107.402	3.118	0.064			0.003	0.199	0.003	0.201	0.000	98.026	97.862	0.342	0.356	2.744	2.758
	700	906	100.62	97.712	0.15	97.331	2.91	100.70	97.662		97.281	3.04	0.029	33.412	0.970	0.065		0.065	0.066	0.063	0.131	0.194	0.000	97.712	97.662	0.506	0.636	2.908	3.038
GOWARD DRIVE	906	905	100.70	97.662		97.052	3.04	100.66	97.357		96.748	3.30	0.025	110.843	2.751	0.141	0.021			0.388	0.021	0.409	0.000	97.662	97.357	0.636	0.901	3.038	3.303
ISHPATINA CRESCENT	804	803	100.96	98.160		97.779	2.80	100.87	97.953		97.572	2.92	0.029	180.814	5.250	0.051			0.014	0.268	0.014	0.282	0.000	98.160	97.953	0.398	0.515	2.800	2.917
	803	802	100.87	97.913	0.04	97.532	2.96	100.86	97.878		97.497	2.98	0.029	31.181	0.905	0.052			0.014	0.047	0.014	0.061	0.000	97.913	97.878	0.555	0.580	2.957	2.982
	802	905	100.86	97.838	0.04	97.457	3.02	100.66	97.635		97.254	3.02	0.029	177.087	5.141	0.050		0.050	0.051	0.260	0.102	0.362	0.000	97.838	97.635	0.620	0.623	3.022	3.025

Filename: V:\17732.DS\Phase 12D\Design\Morgan's Grant HGL Analysis for Carp Road Pond.XLS

min slope=
min vel = 0.8m/s

Printed on 8/24/2005 at 2:19 PM

J.L. Richards
& Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

CITY OF OTTAWA

MINTO DEVELOPMENTS INC.

MORGAN'S GRANT SUBDIVISION - PHASE 12D
JLR NO. 17732

OK w 2004 guidelines

Proposed road ¢ Elev.

STORM SEWER DESIGN SHEET
Rev. No. 0: MOE Submission for Phase 12D - May 11/ 2005
Rev. No. 1: City Comments for Phase 12D - July 11/ 2005
Rev. No. 2: City Comments for Phase 12D - August 11/ 2006
Rev. No. 3: Issued with Phase 12D SWM Report - August 24/ 2007
Designed by: J.B.
Checked by: L.J./G.F.

DESIGN PARAMETERS
Manning's Coefficient, n = 0.013
IDF CURVE = 5 year

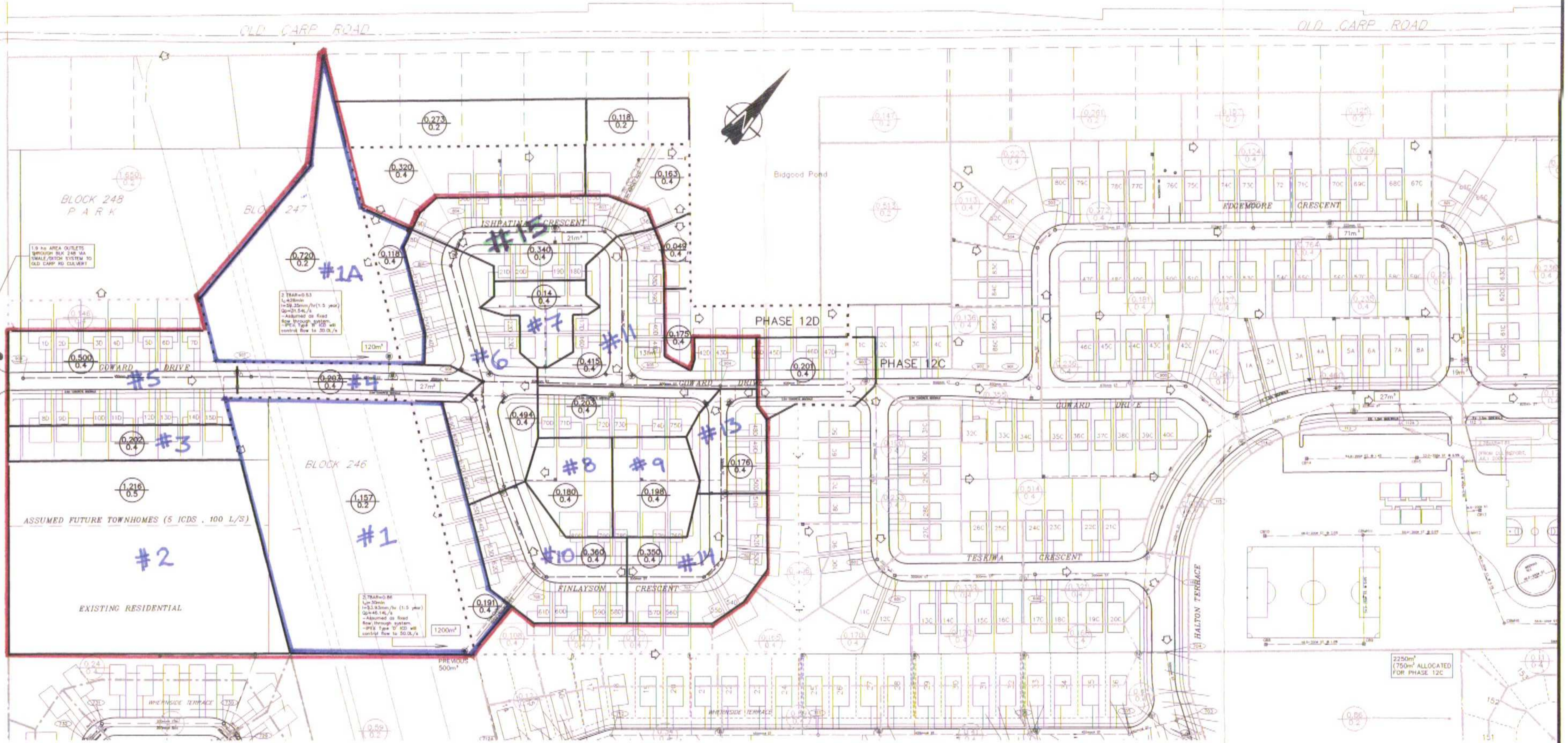
STREET	M.H. #		AREAS FOR "R" in (ha)							PEAK FLOW COMPUTATION					SEWER							UPSTREAM					DOWNSTREAM				COMMENTS
	FROM	TO	0.2	0.3	0.4	0.45	0.5	0.6	0.7	2.78AR	2.78AR (CUM.)	TIME (min.)	INTENS. (mm/hr)	PEAK FL. (L/s)	DIA. (mm)	SLOPE (%)	CAPAC. (L/s)	VEL. (m/s)	LENGTH (m)	FL.TIME (min.)	RESIDUAL CAP. (L/s)	Pr. Center Line	Obvert Drop	Obvert	Invert	Cover	Pr. Center Line	Obvert	Invert	Cover	
BLK 248	Hydro Ea.	906	0.720		0.118					0.53	0.53	26.00	59.35	31.54	-	-	-	-	-	-	-										**Flow controlled to 30 L/s**
GOWARD DRIVE	908	907			0.702		1.216			2.47	2.47	20.00	70.25	173.58	450	1.05	304.76	1.86	112.00	1.01	131.18	102.20		99.400	98.943	2.80	101.34	98.224	97.767	3.12	**PHASE 12D**
	907	906			0.203					0.23	2.70	21.01	68.12	213.69	525	0.40	283.74	1.27	114.87	1.51	70.05	101.34	0.027	98.197	97.664	3.14	100.70	97.738	97.204	2.96	**+ Fixed flowrate from Blks 247/248 (30 L/s)**
												22.51																			
ISHPATINA CRESCENT	804	801								0.00	0.00	20.00	70.25	0.00	300	0.40	63.80	0.87	17.43	0.33	63.80	100.96		98.060	97.755	2.90	100.96	97.990	97.685	2.97	**PHASE 12D**
	801	906								0.00	0.00	20.33	69.53	0.00	300	0.40	63.80	0.87	59.50	1.13	63.80	100.96	0.040	97.950	97.645	3.01	100.70	97.712	97.407	2.99	**PHASE 12D**
												21.47																			
BLK 246	705	704	1.157		0.191					0.86	0.86	30.00	53.93	46.14	-	-	-	-	-	-	-										**Flow controlled to 50 L/s**
FINLAYSON CRESCENT	705	704								0.00	0.00	20.00	70.25	50.00	300	1.20	110.50	1.51	8.98	0.10	60.50	101.47		98.670	98.365	2.80	101.33	98.562	98.257	2.77	**+ Fixed flowrate from Blk 246 (50 L/s)**
	704	701			0.360					0.40	0.40	20.10	70.03	78.04	300	1.20	110.50	1.51	41.34	0.45	32.46	101.33	0.040	98.522	98.217	2.81	100.77	98.026	97.721	2.74	**PHASE 12D**
	701	700			0.180					0.20	0.60	20.55	69.06	91.47	375	0.40	115.67	1.01	40.92	0.67	24.21	100.77		98.026	97.645	2.74	100.62	97.862	97.481	2.76	**PHASE 12D**
	700	906								0.00	0.60	21.23	67.67	90.63	375	0.40	115.67	1.01	12.73	0.21	25.04	100.62	0.150	97.712	97.331	2.91	100.70	97.662	97.281	3.04	**PHASE 12D**
												21.44																			
GOWARD DRIVE	906	905			0.837					0.93	4.23	22.51	65.18	355.56	600	0.45	429.67	1.47	67.57	0.76	74.12	100.70		97.662	97.052	3.04	100.66	97.357	96.748	3.30	**PHASE 12D**
												23.28																			
ISHPATINA CRESCENT	804	803	0.391		0.823					1.13	1.13	20.00	70.25	79.56	375	0.30	100.18	0.88	68.89	1.31	20.61	100.96		98.160	97.779	2.80	100.87	97.953	97.572	2.92	**PHASE 12D**
	803	802								0.00	1.13	21.31	67.51	76.46	375	0.30	100.18	0.88	11.88	0.23	23.72	100.87	0.040	97.913	97.532	2.96	100.86	97.878	97.497	2.98	**PHASE 12D**
	802	905			0.049					0.05	1.19	21.53	67.06	79.60	375	0.30	100.18	0.88	67.47	1.28	20.57	100.86	0.040	97.838	97.457	3.02	100.66	97.635	97.254	3.02	**PHASE 12D**
												22.81																			
GOWARD DRIVE	905	904			0.415					0.46	5.88	23.28	63.79	454.85	600	0.70	535.90	1.84	48.61	0.44	81.04	100.66	0.041	97.316	96.707	3.34	100.91	96.976	96.367	3.93	**PHASE 12D**
												23.72																			
FINLAYSON CRESCENT	705	703								0.00	0.00	20.00	70.25	0.00	300	0.35	59.68	0.82	77.42	1.58	59.68	101.47		98.670	98.365	2.80	101.33	98.399	98.094	2.93	**PHASE 12D**
	703	702								0.00	0.00	21.58	66.97	0.00	300	0.35	59.68	0.82	12.38	0.25	59.68	101.33	0.040	98.359	98.054	2.97	101.23	98.316	98.011	2.91	**PHASE 12D**
12D	702	904			0.548					0.61	0.61	21.83	66.47	40.51	300	0.45	67.67	0.93	86.27	1.55	27.16	101.23	0.040	98.276	97.971	2.95	100.91	97.887	97.583	3.02	**PHASE 12D**
												23.38																			
GOWARD DRIVE	904	903			0.552					0.61	7.10	23.72	63.02	527.41	600	1.20	701.66	2.40	77.00	0.53	174.24	100.91	0.963	96.013	95.404	4.90	99.50	95.089	**94.480**	4.41	PHASE 12C
	903	902								0.00	7.10	24.25	62.11	520.99	600	1.73	842.47	2.89	40.00	0.23	321.49	99.50	0.100	94.990	94.380	4.51	97.59	94.298	93.688	3.29	PHASE 12C
	902	901			0.355					0.39	7.49	24.48	61.73	542.64	600	1.84	868.37	2.98	40.00	0.22	325.73	97.59	0.600	93.698	93.088	3.89	95.75	92.962	92.353	2.79	PHASE 12C
	901	900			0.417					0.46	7.96	24.71	61.37	568.35	675	0.85	807.97	2.19	72.50	0.55	239.62	95.75	0.465	92.497	91.812	3.25	94.95	91.882	91.196	3.07	PHASE 12C
	900	114								0.00	7.96	25.26	60.48	561.32	750	1.09	1212.49	2.66	36.90	0.23	651.16	94.95	0.293	91.589	90.827	3.36	94.69	91.187	**90.425**	3.50	PHASE 12C
												25.49																			
TESKIWA CRESCENT	903	602			0.496					0.55	0.55	20.00	70.25	38.75	300	0.50	71.33	0.98	86.90	1.48	32.58	99.50		96.575	96.270	2.93	98.94	96.141	95.836	2.80	PHASE 12C
	602	601			0.233					0.26	0.81	21.48	67.16	54.44	300	0.75	87.36	1.20	12.30	0.17	32.92	98.94	0.040	96.101	95.796	2.84	98.79	96.008	95.703	2.78	PHASE 12C
	601	600			0.339					0.38	1.19	21.65	66.82	79.36	300	2.65	164.21	2.25	69.00	0.51	84.85	98.79	0.040	95.968	95.663	2.82	96.93	94.140	93.835	2.79	PHASE 12C
	600	116								0.00	1.19	22.16	65.83	78.19	300	3.23	181.29	2.48	64.50	0.43	103.11	96.93	0.266	93.874	93.569	3.06	95.50	91.790	**91.486**	3.71	PHASE 12C
HALTON TERRACE	116	115			0.321					0.36	1.54	22.60	65.02	100.43	525	0.70	375.35	1.68	41.10	0.41	274.92	95.50	0.279	91.531	90.998	3.97	95.30	91.244	90.710	4.06	PHASE 12A
	115	114			0.594					0.66	2.21	23.00	64.28	141.74	525	0.70	375.35	1.68	40.80	0.40	233.61	95.30	0.040	91.204	90.670	4.10	94.65	90.918	90.385	3.73	PHASE 12A
												23.41																			
HALTON TERRACE	114	113			0.478					0.53	10.69	25.49	60.12	722.98	825	0.60	1159.90	2.10	46.10	0.37	436.92	94.65	0.040	90.878	90.040	3.77	94.05	90.601	89.763	3.45	PHASE 12A
	113	112A			0.460					0.51	11.21	25.86	59.56	747.44	825	0.65	1207.26	2.19	33.00	0.25	459.82	94.05	0.030	90.571	89.733	3.48	94.10	90.357	89.519	3.74	PHASE 12A
	112A	112								1.61	12.82	26.11	59.18	838.48	825	0.65	1207.26	2.19	31.00	0.24	368.79	94.10		90.357	89.519	3.74	94.25	90.155	89.317	4.09	+School Flow (2.78xAC = 1.61) from CCL
												26.11																			
EDGEMOORE CRESCENT	901	504	0.513		0.249					0.56	0.56	20.00	70.25	39.49	300	0.50	71.33	0.98	69.30	1.18	31.84	95.75		93.150	92.845	2.60	95.61	92.804	92.499	2.81	PHASE 12C
	504	503								0.00	0.56	21.18	67.76	38.09	300	1.00	100.87	1.38	12.30	0.15	62.78	95.61	0.040	92.764	92.459	2.85	95.51	92.641	92.336	2.87	PHASE 12C
	503	502	0.408		0.599					0.89	1.46	21.33	67.46	98.16	375	0.85	168.62	1.48	98.00	1.10	70.46	95.51		92.641	92.260	2.87	94.60	91.808	91.427	2.79	PHASE 12C
	502	501	0.282		0.987					1.25	2.71	22.43	65.32	176.99	525	0.35	265.41	1.19	93.00	1.30	88.42	94.60		91.808	91.274	2.79	94.44	91.482	90.949	2.96	PHASE 12C
	501	500								0.00	2.71	23.74	62.99	170.65	525	0.35	265.41	1.19	12.30	0.17	94.76	94.44	0.040	91.442	90.909	3.00	94.38	91.399	90.866	2.98	PHASE 12C
	500	112			0.586					0.65	3.36	23.91	62.69	210.70	525	1.23	497.55	2.23	79.30	0.59	286.85	94.38	0.134	91.265	90.732	3.12	94.25	90.290	**89.756**	3.96	PHASE 12C
												24.51																			
HALTON TERRACE	112	111			0.170					0.19	16.37	26.11	59.18	1048.57	825	1.00	1497.43	2.71	76.70	0.47	448.85	94.25	0.030	90.125	89.287	4.12	92.51	89.358	88.520	3.15	PHASE 12A
												26.58																			

12D = 8.462ha
Σ = 15.949ha

STREET	M.H. #		AREAS FOR "R" in (ha)							PEAK FLOW COMPUTATION					SEWER							UPSTREAM					DOWNSTREAM				COMMENTS
	FROM	TO	0.2	0.3	0.4	0.45	0.5	0.6	0.7	2.78AR	2.78AR (CUM.)	TIME (min.)	INTENS. (mm/hr)	PEAK FL. (L/s)	DIA. (mm)	SLOPE (%)	CAPAC. (L/s)	VEL. (m/s)	LENGTH (m)	FL.TIME (min.)	RESIDUAL CAP. (L/s)	Pr. Center Line	Obvert Drop	Obvert	Invert	Cover	Pr. Center Line	Obvert	Invert	Cover	
MUSKEGO CRESCENT	402	111			0.222					0.25	0.25	*20.00*	70.25	17.34	300	0.87	94.09	1.29	78.77	1.02	76.75	92.06		89.473	89.168	2.59	92.51	88.788	88.483	3.72	PHASE 12B
												21.02																			
HALTON TERRACE	111	110			0.200					2.46	19.08	26.58	58.48	1195.63	825	1.20	1640.35	2.97	72.40	0.41	444.72	92.51	0.017	88.771	87.933	3.74	91.00	87.902	87.064	3.10	+School Flow (2.78xAC = 2.24) from CCL
	110	109			0.579					0.64	19.72	26.99	57.90	1221.74	825	1.20	1640.35	2.97	81.90	0.46	418.61	91.00	0.560	87.342	86.504	3.66	90.10	86.359	85.521	3.74	PHASE 12A
												27.45																			
MUSKEGO CRESCENT	402	401			0.236					0.26	0.26	*20.00*	70.25	18.44	300	0.80	90.22	1.24	13.84	0.19	71.79	92.06		89.179	88.874	2.88	91.96	89.068	88.763	2.89	PHASE 12B
	401	400	0.334		0.427					0.66	0.92	20.19	69.84	64.46	300	2.30	153.08	2.10	74.30	0.59	88.62	91.96	0.040	89.028	88.723	2.93	90.24	87.317	87.012	2.92	PHASE 12B
	400	303	0.195		0.976					1.19	2.12	20.78	68.59	145.19	375	1.74	241.26	2.12	70.02	0.55	96.07	90.24		87.317	86.936	2.92	88.84	86.099	85.718	2.74	PHASE 12B
												21.33																			
DUNOLLIE CRESCENT	304	303					0.154			0.21	0.21	*20.00*	70.25	15.04	300	0.30	55.25	0.76	11.22	0.25	40.21	88.65		86.134	85.829	2.52	88.84	86.100	85.796	2.74	PHASE 12B
												20.25																			
DUNOLLIE CRESCENT	303	109			0.240					0.27	2.60	21.33	67.46	175.25	525	0.36	269.18	1.20	85.61	1.18	93.93	88.84		86.099	85.565	2.74	90.10	85.791	85.257	4.31	PHASE 12B
												22.51																			
HALTON TERRACE	109	108			0.130	0.460	0.147			0.92	23.24	27.45	57.25	1410.62	825	1.20	1640.35	2.97	66.80	0.37	229.73	90.10		85.791	84.953	4.31	88.53	84.990	84.151	3.54	PHASE 12A
												27.82																			
DUNOLLIE CRESCENT	302A	302	0.216				0.085			0.24	0.24	*20.00*	70.25	16.74	300	0.50	71.33	0.98	15.18	0.26	54.59	88.53		85.387	85.082	3.14	88.45	85.311	85.006	3.14	PHASE 12B
	302	301					0.716			1.00	1.23	20.26	69.69	85.96	375	0.35	108.20	0.95	69.40	1.22	22.24	88.45		85.311	84.930	3.14	88.20	85.068	84.687	3.13	PHASE 12B
	301	300					0.288			0.40	1.63	21.48	67.17	109.74	375	0.40	115.67	1.01	9.99	0.16	5.94	88.20	0.040	85.028	84.647	3.17	88.27	84.988	84.607	3.28	PHASE 12B
	300	108								0.00	1.63	21.64	66.84	109.21	450	0.20	133.01	0.81	90.70	1.87	23.80	88.27		84.988	84.531	3.28	88.53	84.807	84.350	3.72	PHASE 12B
												23.51																			
HALTON TERRACE	108	107				0.500				0.63	25.50	27.82	56.74	1526.82	1050	0.45	1910.95	2.14	31.70	0.25	384.13	88.53		84.807	83.740	3.72	88.75	84.664	83.597	4.09	PHASE 12A
	107	106								0.00	25.50	28.07	56.40	1518.28	1050	0.45	1910.95	2.14	43.10	0.34	392.67	88.75	0.040	84.624	83.557	4.13	88.05	84.430	83.363	3.62	PHASE 12A
												28.40																			
McBRIEN STREET	203	202			0.130					0.14	0.14	*20.00*	70.25	10.16	300	1.52	124.37	1.70	98.50	0.96	114.21	90.71		87.706	87.401	3.00	89.09	86.209	85.904	2.88	PHASE 12A
	202	201					0.690			0.96	1.10	20.96	68.21	75.28	375	0.85	168.62	1.48	74.40	0.84	93.35	89.09		86.209	85.828	2.88	88.60	85.576	85.195	3.02	PHASE 12A
	201	200								0.00	1.10	21.80	66.53	73.43	375	0.85	168.62	1.48	12.70	0.14	95.20	88.60	0.030	85.546	85.165	3.05	88.35	85.438	85.057	2.91	PHASE 12A
	200	106								0.00	1.10	21.94	66.25	73.12	375	1.75	241.95	2.12	20.90	0.16	168.83	88.35	0.030	85.408	85.027	2.94	87.92	85.043	84.662	2.88	PHASE 12A
												22.11																			
HALTON TERRACE	106	105				0.447				0.56	27.16	28.40	55.95	1599.90	1050	0.55	2112.63	2.36	41.00	0.29	512.74	88.05	0.040	84.390	83.323	3.66	87.25	84.165	83.098	3.09	PHASE 12A
	105	Ex. 101	0.465		0.312	0.652	0.084			1.54	28.70	28.69	55.57	1675.06	1200	0.40	2572.29	2.20	88.70	0.67	897.23	87.05	0.215	83.950	82.730	3.10	87.10	83.595	82.376	3.51	PHASE 12A
												29.36																			

$\Sigma = 8.885$ha

Total area = 24.837ha



LEGEND

EXISTING CATCH BASIN	EXISTING STORM SEWER & MANHOLE
PROPOSED CATCH BASIN	PROPOSED STORM SEWER & MANHOLE
INTERCONNECTED ROADWAY CB C/W ONE 19.8L/S IPEX TYPE 'A' ICD OR CITY APPROVED EQUIVALENT	PROPOSED CATCH BASIN & LEAD
CATCH BASIN WITH INDIVIDUAL 19.8 L/S IPEX TYPE 'A' ICD OR CITY APPROVED EQUIVALENT	LOT NUMBER
PROPOSED HYDRANT	PROPOSED OVERLAND DRAINAGE
EXISTING HYDRANT	DRAINAGE AREA LIMITS
PHASING LIMITS	(0.220 / 0.4) EXISTING AREA IN HECTARES / 'R' RUNOFF COEFFICIENT
	(0.350 / 0.4) PROPOSED AREA IN HECTARES / 'R' RUNOFF COEFFICIENT
	1300m³ PONDING VOLUME

= MAJOR OVERLAND FLOW IS ROUTED TO HYDRO EASEMENT

No.	Date	Revision	By
3	26/08/05	ISSUED WITH 12D SWM REPORT	L.J.
2	11/07/05	REVISED PER CITY COMMENTS	L.J.
1	11/05/05	ISSUED FOR MOE APPROVAL	L.J.

SCALE 1:1000

J.L.Richards
ENGINEERS ARCHITECTS PLANNERS
J.L. Richards & Associates Limited
864 Lady Ellen Place
Ottawa, ON Canada
K1Z 5M2
Tel: 613 728 3571
Fax: 613 728 6012

DESIGN J.B.
CHECKED L.J.
DRAWN A.M.
CHECKED
APPROVED

Ottawa

minto

MORGAN'S GRANT
PHASE 12D
STORM DRAINAGE PLAN

JOB No. 17732
DATED APRIL 2005
DWG. No. D-ST 7

CITY OF OTTAWA
MORGAN'S GRANT PHASE 12D SUBDIVISION
MINTO DEVELOPMENTS INC.

Designed by: J.B.
Checked by: G.F.
Date: August 2005

JLR Project No. 17732

STORMWATER STORAGE / OVERFLOW BALANCE TABLE

DRAINAGE AREA				INLET FLOW				STORAGE (m^3)			OVERFLOW		SURPLUS
CATCHMENT	AREA #	"C" FACTOR	AREA (Ha)	INLETS (l/s) 20.00	13.40	Unrest. RYCBs	Equiv. Flow	REQUIRED LOCAL (m^3)	LOCAL + OVERFLOW (m^3)	PROVIDED (m^3)	(m^3)	TO AREA #	STORAGE m^3
ISHPATINA	#15	0.400	0.340	1	0	0	20	29.51	29.51	20.60	8.91	#11	
FINLAYSON	#14	0.400	0.350	1	0	0	20	30.72	30.72	0.00	30.72	#13	
FINLAYSON (at GOWARD)	#13	0.400	0.176	1	0	0	20	11.88	42.61	0.00	42.61	#11	
GOWARD	#11	0.400	0.618	2	0	0	40	51.73	103.26	131.30	-28.04	#6	28.04
FINLAYSON	#10	0.400	0.360	1	0	0	20	31.95	31.95	0.00	31.95	#6	
RY (73, 74, 75, 76, 77, 78)	#9	0.400	0.198	0	0	34	34	10.61	10.61	0.00	10.61	#8	
RY (70, 71, 72, 79, 80)	#8	0.400	0.180	0	0	34	34	8.90	19.51	0.00	19.51	#6	
RY (16-23)	#7	0.400	0.140	0	0	62	62	0.00	0.00	0.00	0.00	#6	
GOWARD (at FINLAYSON/ISHPATINA)	#6	0.400	0.494	2	0	0	40	37.97	89.43	0.00	89.43	#4	
GOWARD	#5	0.400	0.500	1	0	0	20	50.26	50.26	0.00	50.26	#4	
GOWARD	#4	0.400	0.203	1	0	0	20	14.47	154.16	27.08	127.08	#1	
FUTURE TOWNHOUSES	#2	0.500	1.216	5	0	0	100	126.46	126.46	0.00	126.46	#1	
RY(8-15)	#3	0.400	0.202	0	0	34	34	10.99	10.99	0.00	10.99	#1	
BLK 246 and RY of units 62-69	#1	0.228	1.348	2.5	0	0	50	64.19	328.72	1213.00	**-884.28**	-	884.28

Appendix I – Correspondence

Boundary Conditions 1158 Second Line Road

Information Provided

Date provided: 05 April 2018

Provided Information:

Scenario	Demand	
	L/min	L/s
Average Daily Demand	30.6	0.5
Maximum Daily Demand	178.2	3.0
Peak Hour	269.4	4.5
Fire Flow Demand	8000	133
Fire Flow Demand	9000	150
Fire Flow Demand	11000	183

# of connections 2

Location

Results

Connection 1 - Goward Dr.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	150.9	71.4
Peak Hour	140.2	56.2
Max Day plus Fire (8,000 l/min)	123.8	32.9
Max Day plus Fire (9,000 l/min)	119.5	26.7
Max Day plus Fire (10,000 l/min)	118.3	25.1

[1] Ground Elevation = 100.76 m

Connection 2 - Whernside Terr

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	150.9	70.6
Peak Hour	142.0	55.5
Max Day plus Fire (8,000 l/min)	124.9	33.7
Max Day plus Fire (9,000 l/min)	120.8	27.9
Max Day plus Fire (10,000 l/min)	119.9	26.5

[1] Ground Elevation = 101.19 m

Consideration

1. Maximum fire flow city will accommodate for about 1158 Second Line Road property is 10,000 L/min.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.