Site Servicing and Stormwater Management Report Oak Ridge Gate, Phase II Ottawa, Ontario

Type of Document:
Site Plan Submission

Client:
Ashcroft Homes

Project Number:
OTT-00245036-A0

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Date Submitted:
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1 Introduction

Ashcroft Homes retained EXP Services Inc. (EXP) to undertake a site servicing and stormwater management study in support of a site plan application for a proposed residential development in the east end of the City of Ottawa. The site is situated between Trim Road and Breezewood Street as shown on Figure 1 in Appendix A.

The 0.8631-hectare development consists of six blocks comprised of fourteen (14) townhome units and forty-eight (48) 2-bedroom stacked apartment 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 adequate water pressures that will result from the proposed development.

There are municipal sanitary sewers, storm sewers and watermains within Trim Road, Breezewood Street and east of the proposed site that will be utilized to service the development.

This report will identify the 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:

- City of Ottawa Sewer Design Guidelines, Second Edition, October 2012, (SDG002) including:
    - Technical Bulletin ISDTB-2012-4 (June 20, 2012)
    - Technical Bulletin ISDTB-2014-01 (February 05, 2014)
    - Technical Bulletin PIEDTB-2016-01 (September 06, 2016)
    - Technical Bulletin ISDTB-2018-01 (March 21, 2018)
- Ottawa Design Guidelines – Water Distribution, July 2010 (WDG001), including:
    - Technical Bulletin ISDTB-2014-02 (May 27, 2014)
    - Technical Bulletin ISTB-2018-02 (March 21, 2018)
- Ontario Ministry of Transportation (MTO) Drainage Manual, 1995-1997
- 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
- Stormwater Management Report Trim Road Subdivision (November 2002)

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

14 – townhomes x 2.7 persons/unit =	37.8
48 – 2-bedroom apartments x 2.1 person/unit =	100.8
	138.6 persons

Sanitary Flow

Average Domestic Flow =	280 L/person/day
Domestic Flow = 138.6 x 280 L/person/day x (1/86,400 sec/day) =	0.45 L/sec
Peak Factor = $1 + (14 / (4 + (138.6/1000)^{0.5})) \times 0.8$ =	3.56 (4.0 Max)
Q Peak Domestic = 0.45 L/sec x 3.56 =	1.60 L/sec

Infiltration

Q Infiltration = 0.33 L/ha/sec x 0.8631 ha	= 0.28 L/sec

Total Peak Sewage Flow

Total Sanitary Flow = 1.60 + 0.28	**= 1.88 L/sec**

The total peak sewage flow was determined to be approximately 1.88 L/sec. A minimum 200 mm sanitary sewer at a minimum slope of 0.70% having a full flow capacity of 28.6 L/sec will be used.

4 Watermain Servicing

A. Methodology

The water distribution system proposed for this development is designed in accordance with the City of Ottawa Design Guidelines (WDG001) including the latest technical bulletins. 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 using City of Ottawa guidelines (WDG001) and subsequent bulletins, based on the Fire Underwriters Survey (FUS) method, and
- The proposed water distribution model was simulated 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 (townhomes) = 2.7 person/unit
- Population Density (2-bedroom apartment) = 2.1 person/unit
- Average daily water consumption (residential) = 350 L/cap/day
- Maximum Day Factor (2.50 x Avg. Day)
- Maximum Hour Factor (5.5 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)

4.1 Water Demands

The domestic water demands are estimated below, utilizing parameters from the WDG001. Based on the location of the boundary conditions provided by the City of Ottawa, existing homes had to be included in the design analysis. Possible future development adjacent, and south, of the site was also taken into consideration for sizing of the watermain. The following summarizes the parameters used.

- Population:
  - Proposed 14 - townhomes * 2.7 person/unit 37.8
  - Proposed 48 - 2-bedroom apartments x 2.1 person/unit 100.8
  - Existing 72 - townhomes * 2.7 person/unit 194.4
  - Existing 40 - 2-bedroom apartments * 2.1 person/unit 84.0
  - Existing 14 - Single Family * 3.4 person/unit 47.6
  - Future 7 - Townhomes * 2.7 person/unit 18.9
  - Future 48 - 2-bedroom * 2.1 person/unit <u>100.8</u>
  - Total 584.3 Persons

- Average daily water consumption = 350 L/person/day
- Number of residents = 584.3 persons
- Maximum Day Factor = 2.5 x Avg. Day (WDG001 Table 4.2)
- Maximum Hour Factor = 5.5 x Avg. Day (WDG001 Table 4.2)

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

- Average Day = 350 x 584 / 86,400 sec/day = 2.37 L/sec
- Maximum Day = 2.37 L/sec x 2.5 = 5.92 L/sec
- Peak Hour = 2.37 L/sec x 5.5 = 13.02 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 and the City if Ottawa protocol for application of the FUS method (ISTB-2018-02).

The fire flow requirements were calculated for all blocks. It was determined the most critical building within the proposed development was Block 2 having a fire flow requirement of 200 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 * √ (A)

where

F = Required Fire flow in Litres per minute
C = Coefficient related to type of Construction (1.0 for Blocks 2-5, or 1.5 for Blocks 1,6)
A = Total Floor Area in square metres

A reduction for low hazard occupancy of -15% for residential dwellings, and an increase for fire area exposure of +51% (max) was used. Below is a sample calculation of the fire flow requirements for Block 2 (the most critical) residential building.

Block 2

F = 220 * 1.5 * √ (459m^2 x 4 storeys) = 9,427 L/min or 9,000 L/min (rounded to 1,000)
F = 9000 L/min * (-15% non-combustible) = 7,650 L/min
F = 7,650 L/min * (+51% exposure factor) = 11,552 L/min

F(required) = 11,552 L/min (rounded to 12,000 L/min or 200 L/sec)

The following summarizes the required fire flows for all buildings, which include the reductions, and/or increases due to occupancy, sprinklers (if used) and exposures. These fire flows have been calculated base on the FUS method and the City of Ottawa Water Distribution Guidelines (WDG001), and the latest Technical Bulletin.

Table 4-1: Summary of Fire Flow Requirements for All Buildings

Building #	Description	[1]No of Storeys	Fire Flow, F (L/min)	[2]Type of Constr. Coeff, C	[3]Reduction Due to Occupancy (%)	[4]Total Increase due to Exposures (%)	[5]Required Fire Flow in L/min (L/sec)
Block 1	townhome	2	9,000	1.5	-15%	+47%	11,000 (183)
Block 2	apartment	3+	9,000	1.0	-15%	+51%	12,000 (200)
Block 3	apartment	3+	7,000	1.0	-15%	+18%	7,000 (117)
Block 4	apartment	3+	7,000	1.0	-15%	+21%	7,000 (117)
Block 5	apartment	3+	9,000	1.0	-15%	+46%	11,000 (183)
Block 6	townhome	2	9,000	1.5	-15%	+35%	10,000 (167)

Notes:
1 - If basements are included (<50% below grade) then denoted as +.
2 -Types of constructions are 1.0 for ordinary construction or 1.5 for wood frame construction.
3 - Reductions due to Occupancy are -25% for non-combustible or -15% for limited combustible.
3 – Increase due to exposures were calculated based on FUS and technical bulletin ISTB-2018-02.
5 – Required Fire Flows are rounded to nearest 1,000 L/min.

The fire flow requirement for the proposed site is **12,000 L/min (200 L/sec)** based on the most critical unit. Please refer to Tables C2 through Table C6 in Appendix C for detailed calculations using the FUS method.

4.3 Boundary Conditions

Boundary conditions were obtained from City of Ottawa personnel for hydraulic modeling. Boundary conditions were used for the connection points at either Boundary Condition # 1 at Trim Road/Valin Street (WaterCAD junction J1), Boundary Condition #2 at Breezewood and Hallendale Street (WaterCAD junction J5). An additional Boundary Condition #3 at Breezewood at Blue Thistle Place (WaterCAD junction J4) was not used in the modelling. Refer to Appendix I for information provided by City of Ottawa staff.

Table 4-2: Summary of Boundary Conditions

Boundary Condition Number and (Location)	Peak Hour Hydraulic Grade (m)	[1]Maximum Day Plus Fire Flow [@200 L/sec] Hydraulic Grade (m)
Location #1 (Trim Road & Valin Street)	124.9	124.96
Location #2 (Breezewood Street & Hallendale Street)	124.8	106.10
Location #3 (Breezewood Street & Blue Thistle Place/Merlot Way)	124.8	109.02

Notes:
1-The maximum Day Plus Fire Flow HGL was interpolated at 200 L/sec from City of Ottawa Provided Data.

4.4 Modelling Scenarios

A total of eight (8) scenarios were analyzed. The eight scenarios consisted of four (4) parent scenarios which included two child sub-scenarios for each parent. In general terms, for each of the four scenarios the maximum day plus fire flow and peak hour conditions were analyzed.

The performance of the proposed water distribution system within the development was analyzed under each scenario. The inclusion of water demands from the future development lands located south of the proposed site were added to the hydraulic model for scenario 4. The following summarizes the modelling scenario was analyzed.

Scenario 1A	Max Day Plus FF	Single Feed from Breezewood/Hallendale.
Scenario 1B	Peak Hour	Single Feed from Breezewood/Hallendale.
Scenario 2A	Max Day Plus FF	Single Feed from Trim Road.
Scenario 2B	Peak Hour	Single Feed from Trim Road.
Scenario 3A	Max Day Plus FF	Feeds from Breezewood/Hallendale & Valin/Trim (proposed).
Scenario 3B	Peak Hour	Feeds from Breezewood/Hallendale & Valin/Trim (proposed).
Scenario 4A	Max Day Plus FF	Feeds from Breezewood/Hallendale and Valin/Trim (ultimate).
Scenario 4B	Peak Hour	Feeds from Breezewood/Hallendale and Valin/Trim (ultimate).

Scenarios 3A and 3B above were modelled from boundary condition #1 (J1) and include existing residential units on both Breezewood, Hallendale and Valin. Please refer to Figures A2 and A3 for the water demand allocation and the distribution layouts. Scenarios 4A and 4B include all of the same modeling demands and pipe elements as Scenarios 3A and 3B, but includes demands, junctions and pipe segments for future development land located south of the proposed site. These two scenarios are for ultimate build-out conditions.

4.5 Modelling Results

The results of the WaterCAD modelling under maximum day plus fire flow and peak hourly conditions are summarized in Table 4-3 and Table 4-4 below for Scenarios 3A and 3B, which represent the proposed conditions. These results are based on a hydraulic boundary condition at locations #1 (Trim Road at Valin Street). The complete results for all scenarios are provided in Appendix D, with a summary in Table 4-5 below.

Table 4-3: Summary of Results of Scenario 3B for Peak Hour

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J1	88.28	1.12	124.90	52
J2	87.41	2.24	124.90	53
J3	87.75	0.00	124.90	53
J4	87.77	2.06	124.88	53
J5	88.17	1.84	124.88	52
J6	88.10	1.11	124.89	52
J7	88.10	0.00	124.89	52
J8	88.10	0.61	124.88	52
J9	88.20	0.00	124.89	52
J10	87.79	0.37	124.89	53
J11	87.78	0.37	124.89	53
J12	87.65	0.61	124.88	53
J13 (see note 1)	87.66	(N/A)	(N/A)	(N/A)
Notes: *1-Under this Scenario J13 is not used.*				

The calculated minimum and maximum working pressures anticipated within the development are 52 psi and 53 psi under peak hour conditions for all junctions.

Table 4-4: Summary Results of Scenario 3A for Maximum Day Plus Fire Flow

Label	Fire Flow (Needed) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Satisfies Fire Flow Constraints?
J6	200.00	200.50	>200.5	True
J9	200.00	200.00	>200.0	True

Under Maximum Day + Fire Flow conditions fire flows in excess of the required 200 L/sec is available, and therefore meets the City of Ottawa watermain design criteria.

Table 4-5: Summary Peak Hour and Max Day Plus Fire Flow Results for All Scenarios

Scenario	Peak Hour Pressures		Available Fire Flows at J6, J9 in L/sec (Satisfies Fire Flow Requirement?)
	Min (psi)	Max (psi)	
1A – Max Day Plus FF, Single feed from Breezewood			74, 94 (No)
1B – Peak Hour, Single feed from Breezewood	52	53	
2A – Max Day Plus FF, Single feed from Trim Rd			197, >200 (No)
2B – Peak Hour, Single feed from Trim	52	53	
3A – Max Day Plus FF, Feeds from Breezewood &Trim (proposed)			>200, >200 (yes)
3B – Peak Hour. Feeds from Breezewood &Trim (proposed)	52	53	
4A – Max Day Plus FF, Feeds from Breezewood &Trim (ultimate)			>200, >200 (Yes)
4B – Peak Hour. Feeds from Breezewood &Trim (ultimate)	52	53	

In summary, under all scenarios, water pressures under peak hour conditions would meet the minimum 40 psi as per City of Ottawa Guidelines. However, under Maximum Day plus fire flow conditions it is evident that a single feed from either Breezewood (Scenario 1A), or Trim Road (Scenario 2A), would not have adequate supply flows to meet design criteria. Under scenario 2A, an estimated fire flow of 197 L/sec falls just short of the required 200 L/sec for the most critical residential Block #2.

Watermain connections (feeds) from both Breezewood and Trim Road will be necessary to provide the required fire flows more than 200 L/sec within the proposed development. The installation of a 200mm watermain (WaterCAD pipe segment P-1) in front of Block 6 will be necessary to provide adequate fire flows for the future development lands located south of the site. The calculated fire flows available within the future development based on a 200mm watermain connection looped through Blue Thistle Place (WaterCAD pipes P-9, P-10) would be ±280 L/sec. As per Section 4.3.2 of the WDG001, a second watermain connection for the proposed development is required, not only to provide proper fire flows, but to provide a redundant supply as there would be more than 50 proposed residential units.

4.6 Fire Hydrant Spacing

A review of Appendix I of the City's technical bulletin ISTB-2018-02 was completed to confirm adequate hydrant spacing within the proposed development.

Although a single hydrant located near junction J9 would have adequate coverage for all residential units, Appendix I was used to compare the fire flow requirements to the contribution of available fire flows at each proposed hydrant. Based on the distances from the two proposed onsite hydrants, and assuming that each hydrant is a class AA hydrant as per Section 5.2.2, each hydrant would have a fire flow contribution of 5700 L/min. An existing hydrant at Breezewood/Hallendale would have a minimum fire flow contribution of 3,800 L/min at noted in Table 1 of Appendix I. A fourth hydrant directly west of the site on Trim Road would also have a minimum fire flow contribution of 3,800 L/min due to it's distance to onsite building.

The total theoretical contribution of flows from hydrants, based on the proposed spacing and location of existing hydrants would be 5700*2 + 2*3800 = 19,000 L/min. This confirms that proper hydrant spacing is provided within the development for fire fighting purposes.

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 5-year storm event using a time of concentration of 20 minutes and a runoff coefficient of 0.50. These parameters were implemented for the overall Oakridge Gate Subdivision (Stormwater Management Report Trim Road Subdivision, 2002). Flows in excess of the 5-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 on Breezewood is limited to 84.3 L/sec.

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 350mm on the ground surface, the entire 2-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 + 0.20, where IMP is a fraction.

The average runoff coefficient for the overall site area under post-development conditions was calculated as 0.68, whereas the pre-development average runoff coefficient was less than 0.20.

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. From the original storm design sheet, the storm sewers were 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 stub on Chinon Place, 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)
	=	$998.071/(Tc+6.053)^{0.814}$ (5-year)
Tc	=	Time of concentration (20 mins)
A	=	Drainage Area (0.8631 hectares)

The minor system capture rate from the site will be limited to 84.3 L/sec. All remaining storm runoff in excess of 84.3 L/sec will be detained onsite.

5.4 Pre-Development Conditions

Although pre-development peak flows did not dictate the storm sewer design, the peak flows under pre-development conditions were estimated for comparison. The pre-development runoff coefficient for the site was determined to be 0.20. Using a time of concentration (T_C) of 20 minutes and an average runoff coefficient of 0.2, the pre-development release rates from the site were estimated at 25.0 L/sec, 33.7 L/sec and 72.0 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).

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 F.

Table 5-5: Summary of Post-Development Flows

Area No	Area (ha)	2-year Storm		5-year Storm		100-year Storm	
		Q (L/sec)	Q_{CAP} (L/sec)	Q (L/sec)	Q_{CAP} (L/sec)	Q (L/sec)	Q_{CAP} (L/sec)
1	0.0604	5.9	1.7	8.0	2.3	17.1	5.0
2	0.0294	2.7	1.7	3.7	2.3	7.9	5.0
3	0.1250	21.7	2.8	29.5	3.8	62.0	8.0
4	0.1317	22.2	2.8	30.1	3.7	64.4	8.0
5	0.1227	20.5	4.2	27.9	5.6	59.7	12.0
6	0.0821	14.3		19.4		40.8	
7	0.0656	6.7	2.1	9.0	2.8	19.3	6.0
8	0.0326	2.5	2.1	3.4	2.8	7.2	6.0
9	0.0774	10.1	6.0	13.7	8.0	29.4	10.0
10	0.0538	5.7	2.1	7.7	2.8	16.5	6.0
11	0.0408	6.4	5.0	8.6	6.0	18.5	8.0
12	0.0302	5.7	5.0	7.7	6.0	15.0	8.0
13	0.0114	0.5	(0.5)	0.7	(0.7)	1.4	(1.4)
Totals	**0.8631**	**124.7**	**35.8**	**169.2**	**46.9**	**359.1**	**83.4**

Note: Flows in (brackets) under Q_{CAP} denotes flows that are uncontrolled.

In summary, the uncontrolled 2-year, 5-year and 100-year post-development flows are **124.7 L/sec**, **169.2 L/sec** and **359.1 L/sec** respectively. Flow control devices will be used to restrict these runoff rates to **35.8 L/sec**, **46.9 L/sec** and **83.4 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 Drawing STM in 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. 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 inlet control devices (ICDs) within the storm system. This will ensure that sufficient stormwater detention is provided and that the peak flows entering the existing storm sewer on Chinon Place 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 and average runoff coefficient information for each catchment is provided in Table F5.
- The allowable release rate was determined for the site based on the 5-year event with a runoff coefficient of 0.5.
- The peak flow based on the 2-year, 5-year, and 100-year events were determined.
- The site was design for no overland flow, and no ponding in the 2-year event as well which resulted in underground storage.
- The total storage available in the underground chambers was estimated based on the Manufacturer's data.
- 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 table is provided in the STM drawing.
- The volume available in chambers was taken from the Manufacture's literature, which is provided in Appendix H for reference.
- A summary Table (F10) 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.	Max Head (m)	Max Flow (L/sec)	ICD Control Location	ICD Manufacturer	Type	Model
1	1.0	5.0	CB4	IPEX	Tempest	LMF-75
2	0.7	5.0	CB8	IPEX	Tempest	LMF-80
3	1.4	8.0	CBMH207	IPEX	Tempest	LMF-85
4	1.3	8.0	CBMH208	IPEX	Tempest	LMF-90
5,6	1.5	12.0	CBMH206	IPEX	Tempest	LMF-105
7	1.7	6.0	CB13	IPEX	Tempest	LMF-70
8	2.7	6.0	CB12	IPEX	Tempest	LMF-65
9	1.1	10.0	CB9	IPEX	Tempest	LMF-105
10	1.1	6.0	CB7	IPEX	Tempest	LMF-80
11	1.3	8.0	CB2	IPEX	Tempest	LMF-90
12	1.1	8.0	CB1	IPEX	Tempest	LMF-95

5.8 Stormwater 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

Drainage Area No.	100-year Storage Required (m^3)	[1]Maximum Storage Provided (m^3)
1	7.8	13.3
2	1.7	7.3
3	43.5	61.0
4	45.8	61.3
5 & 6	73.9	95.9
7	8.5	6.2
8	1.1	1.4
9	12.2	12.8
10	6.5	12.7
11	6.3	6.9
12	4.2	5.2
13 (uncontrolled)	n/a	n/a
Totals	211.6	283.9
Notes *1-Storage provided is a combination of surface and underground storage.*		

In order to comply with no ponding in the 2-year event, as well as being able to store all water on site from the 100-year event, underground storage chambers were required. Of the total volume of storage provided as shown in Table 5-7, Table 5-8 below summarizes the storage chambers required to meet city requirements.

Table 5-8: Summary of Provided Stormwater Storage in Underground Chambers

Drainage Area Located	Volume (m^3)
3	17.0
4	17.0
5&6	25.0
Totals	59.0

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 Oak Ridge Gate, Phase II in the City of Ottawa. The proposed 0.8631-hectare development by Ashcroft Homes is a comprised of forty-eight (48) 2-bedroom stacked apartment units and fourteen (14) townhome units. The following summarizes the servicing and stormwater requirements for the site:

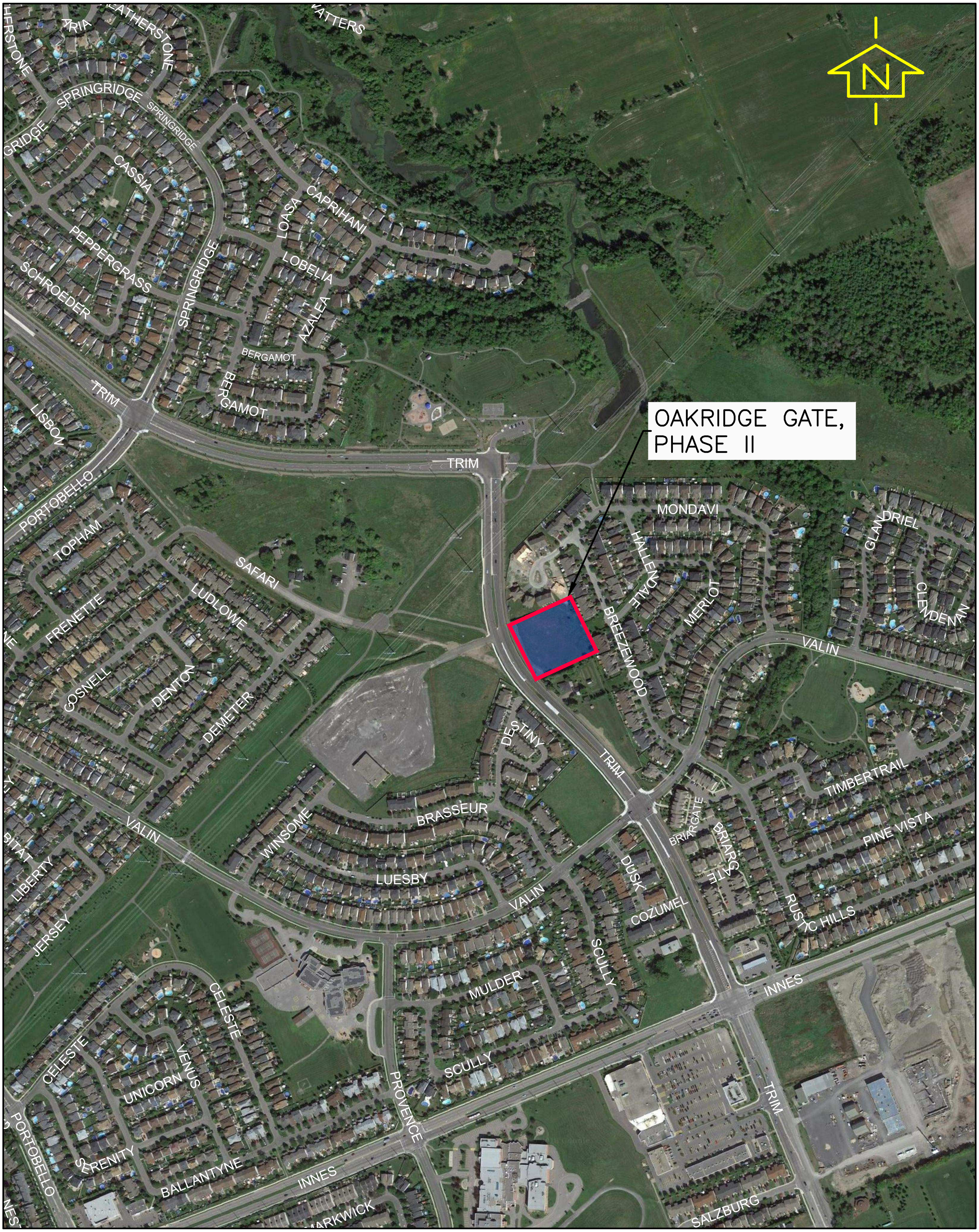
- The allowable capture rate from the proposed site was based on the minor system capture rate established was set at 84.3 L/sec. This capture rate was based on the 5-year storm design for the 0.8631-hectare site using a time of concentration of 20 minutes and a runoff coefficient of 0.50 for a peak flow of 84.3L/sec.
- Post-development average runoff coefficient for the site was calculated at 0.68, with a 2-year, 5-year and 100-yr peak flows of 124.7 L/sec, 169.2 L/sec and 359.1 L/sec respectively. Flow control devices will be used to restrict these runoff rates from the site to 35.8 L/sec, 46.9 L/sec and 83.4 L/sec for the 2-year, 5-year and 100-year storms respectively. Therefore, stormwater runoff from the site is controlled to less than the allowable rate of 84.3 L/sec.
- Multiple Inlet control devices (ICD) will be used to control runoff to the allowable discharge rate of 84.3 L/sec. The Inlet control devices will be installed within catch basins of each catchment area as shown on the Site Servicing plan, and will control peak flows to 83.4 L/sec. The peak flow of 83.4 L/sec includes 82.0 L/sec of controlled minor system flow and 1.4 L/sec of uncontrolled runoff from the site.
- The storm sewer system is sized to accommodate the 2-year design storm under free flow conditions. Underground storage was required to fulfil this requirement. All units have an underside of footing elevation a minimum of 0.8 metres above the storm sewer hydraulic grade line. An overland flow route is provided for the major storm event.
- The estimated storage required to control peak flows to the allowable release rate was 211.6 m^3 based on the Modified Rational Method, with a total storage volume of 283.9 m^3 provided. Where 59 m^3 are underground chambers to ensure no ponding in the 2-year event.
- The proposed development has an estimated peak sewage flow of 1.88 L/sec based on City of Ottawa Guidelines. A new 200mm sewer will be installed with a minimum slope of 0.70%. The sanitary sewer will be connected into the existing municipal sanitary sewer stub on Chinon Place.
- A hydraulic water model was developed to determine the pressures available under peak hour and maximum day plus fire flow conditions. It was determined that two watermain connections would be required to provide the necessary fire flows to the development. Two connections to the existing city water distribution system is also necessary as 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 52 psi and 53 psi under peak hour conditions, with an estimated fire flow available within the development exceeding the required 200 L/sec.
- Fire flow requirements and hydrant spacing has been designed in accordance with the City's Technical Bulletin ISTB-2018-02. The fire flow requirements for all residential blocks were calculated ranging between 7,000 L/min to 12,000 L/min. Townhome blocks were capped at 167 L/sec as they meet the requirements of ISDTB-2014-02, whereas the fire flow requirements for the apartment units ranged from 7,000 L/min – 12,000 L/min. Two fire hydrants are proposed to provide fire protection in excess of the maximum fire flow requirement of 200 L/sec.
- Erosion and sediment control methods will be used during construction to limit erosion potential.

Appendix A – Figures

Figure A1: Site Location Plan

Figure A2: Water Demand Areas

Figure A3: Water Model



exp Services Inc. 100-2650 Queensview Drive Ottawa, ON K2B 8H6 www.exp.com	DESIGN MZG DRAWN MZG DATE APR 2018 FILE NO 245003	OAKRIDGE GATE, PHASE II ASHCROFT HOMES SITE LOCATION PLAN	SCALE 1: 7500 SKETCH NO FIG 1

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LEGEND

SINGLES
TOWNHOMES
APARTMENTS
DEMAND AREA
SITE BOUNDARY

DESIGN JLF	OAKRIDGE GATE PHASE II ASHCORFT HOMES	SCALE 1:1250
DRAWN SAB		FIGURE NO
DATE 05/2018	WATER DEMAND AREAS	FIG A2
FILE NO 245036		

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LEGEND

SINGLES
TOWNHOMES
APARTMENTS

DESIGN	JLF	OAKRIDGE GATE PHASE II ASHCORFT HOMES	SCALE	1:1250
DRAWN	SAB		FIGURE NO	
DATE	05/2018	WATER MODEL		FIG A3
FILE NO	245036			

Appendix B – Sanitary Design Sheet

Table B1: Sanitary Sewer Calculation 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						
Street	From	To	Area No.	Area (ha)	POPULATION 1-Bed Apt	2-Bed Apt	Towns	INDIV POP	CUMUL POP	Peak Factor	Peak Flow (L/sec)	AREA (Ha)	ACCU AREA (Ha)	AREA (Ha)	ACCU AREA (Ha)	Factor (per MOE)	AREA (Ha)	ACCU AREA (Ha)	PEAK FLOW (L/s)	AREA (ha)	ACCU AREA (Ha)	INFILT FLOW (L/s)		Dia. (mm)	actual	Slope (%)	Length (m)	Capacity (L/s)	Full Velocity (m/s)	Qpeak/ Qcap
Oakridge Gate																														
Block 3,4	MH105	MH103	3	0.3260		16		33.6	33.60	**3.68**	0.40									0.3260	0.3260	0.11	0.51	200	201.16	0.70	58.81	27.87	0.88	0.02
Block 5,6	MH104	MH103	2	0.2650		16	7	52.5	52.50	**3.65**	0.62									0.2650	0.2650	0.09	0.71	200	201.16	0.80	41.03	29.79	0.94	0.02
Block 1,2	MH 102	MH103	1	0.2720		16	7	52.5	52.50	**3.65**	0.62									0.2720	0.2720	0.09	0.71	200	201.16	0.80	39.13	29.79	0.94	0.02
	MH103	MH101							138.60	**3.56**	1.60										0.8630	0.28	1.88	250	251.46	1.00	30.34	60.40	1.22	0.03
	MH 101	MH 100							138.60	**3.56**	1.60										0.8630	0.28	1.88	250	251.46	0.70	19.57	50.53	1.02	0.04
	MH 100	*EX MH*							*138.60*	***3.56***	*1.60*										*0.8630*	*0.28*	*1.88*	*250*	*251.46*	*0.40*	*18.00*	*38.20*	*0.77*	*0.05*
Totals				0.8630		48	14	138.6													0.8630									

Average Daily Flow (L/person/day) = 280
Commercial Flow (L/gross ha/day) = 28,000
or L/gross ha/sec = 0.324
Industrial Flow (L/gross ha/day) = 35,000
or L/gross ha/sec = 0.405
Max Res Peak Factor = 4.0
Commercial / Inst Peak Factor = 1.5
K factor = 0.80

<u>Population Densities</u>	<u>Persons Per Unit</u>
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
Q(i) = Peak Extraneous Flow = I * A_I (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}, (L/sec)
Manning N = 0.013
I = Peak extraneous flow (L/s/ha) = 0.33

Designed: **M.Ghadban, EIT.**	Project: **Oakridge Gate, Phase II**	
Checked: **J. Fitzpatrick, P.Eng.**	Location: **Ottawa, Ontario**	
Dwg Reference: **Sanitary Drainage Plan, SAN**	File Ref: **245036 Sanitary Design Sheet, June 2018**	Sheet No: **1 of 1**

Appendix C – Water Tables

TABLE C1: Water Demand Chart

Location:	Oak Ridge Gate - Phase II
Project No:	245036
Designed by:	M. Ghadban
Checked By:	J.Fitzpatrick
Date Revised:	June 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

Junction Number	No. of Units									Total Persons (pop)	Demands in (L/sec)					
	Singles/Semis/Towns				Apartments						Average Demand (L/day)	Maximum Demand (L/day)	Peak Hourly Demand (L/day)	Avg Day (L/s)	Max Day (L/s)	Max Hour (L/s)
	Single Family	Semi	Duplex	Townhome	Bachelor	1 Bedroom	2 Bedroom	4 Bedroom	Avg Apt.			2.50 x Avg Day	5.50 x Avg Day			
J1							24			50.4	17640	44,100	97,020	0.20	0.51	1.12
J2	7			16			16			100.6	35210	88,025	193,655	0.41	1.02	2.24
J3																
J4	5			28						92.6	32410	81,025	178,255	0.38	0.94	2.06
J5	2			28						82.4	28840	72,100	158,620	0.33	0.83	1.84
J6				**6**			**16**			49.8	17430	43,575	95,865	0.20	0.50	1.11
J7																
J8				**4**			**8**			27.6	9660	24,150	53,130	0.11	0.28	0.61
J9																
J10							**8**			16.8	5880	14,700	32,340	0.07	0.17	0.37
J11							**8**			16.8	5880	14,700	32,340	0.07	0.17	0.37
J12				**4**			**8**			27.6	9660	24,150	53,130	0.11	0.28	0.61
J13				7			48			119.7	41895	104,738	230,423	0.48	1.21	2.67
Totals =	14			93			136			584.3	204,505	511,263	1,124,778	2.37	5.92	13.02

	Total Units	Total Persons
Existing Units.	126	326.0
Proposed Units.	62	138.6
Future Development Units.	55	119.7

TABLE C2: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Oakridge Gate, Phase II
Building No: Block 1

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

F = 220 * C * 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 Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Wood Frame	1.5	
	Ordinary Construction	1			
	Non-combustible Construction	0.8			
	Fire Resistive Construction	0.6			
Input Building Floor Areas (A)	Floor 3			806.8 m²	
	Floor 2		403.4		
	Floor 1		403.4		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				9,373
Fire Flow (F)	Rounded to nearest 1,000				**9,000**

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-1,350	7,650
	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	7,650
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	7,650
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	7,650
	Not Fully Supervised or N/A	0%				

Task	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposing Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
Choose Structure Exposure Distance	Side 1	16	3	10.1 to 20	Type A	12.5	2	25	3A	12%	47%	3,596	11,246
	Side 2	16.5	3	10.1 to 20	Type A	12.5	2	25	3A	12%			
	Front	22	4	20.1 to 30	Type A	32	2	64	4C	9%			
	Back	14	3	10.1 to 20	Type A	32	2	64	3C	14%			

Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**11,000**
	Total Required Fire Flow, L/s =	**183**
	Total Capped Fire Flow based on "TECHNCAL BULLETIN ISTB-2018-02", L/s =	**167**

Exposure Charges for Exposing Walls of Wood Frame Construction (from Table G5)

Type A	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE C3: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Oakridge Gate, Phase II
Building No: Block 2

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

F = 220 * C * 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 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)	Floor 3		459	1836.0 m²	
	Floor 2		459		
	Floor 1		459		
	Basement (At least 50% below grade, not included)		459		
Fire Flow (F)	F = 220 * C * SQRT(A)				9,427
Fire Flow (F)	Rounded to nearest 1,000				**9,000**

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-1,350	7,650
	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	7,650
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	7,650
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	7,650
	Not Fully Supervised or N/A	0%				

Task	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposing Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
Choose Structure Exposure Distance	Side 1	11	3	10.1 to 20	Type A	13	3	39	3B	13%	51%	3,902	11,552
	Side 2	11	3	10.1 to 20	Type A	13	3	39	3B	13%			
	Front	22	4	20.1 to 30	Type A	33	3	99	4D	10%			
	Back	18	3	10.1 to 20	Type A	33	3	99	3D	15%			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =												**12,000**
	Total Required Fire Flow, L/s =												**200**

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)
Exposure Charges for E Wood-Frame or non-conbustible
Type B Ordinary or fire-resisitve with unprotected openings
Type C Ordinary or fire-resisitve with semi-protected openings
Type D Ordinary or fire-resisitve with nlank wall
Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE C4: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Oakridge Gate, Phase II
Building No: **Block 3**

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

F = 220 * C * 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 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)	Floor 3		232	928.0 m²	
	Floor 2		232		
	Floor 1		232		
	Basement (At least 50% below grade, not included)		232		
Fire Flow (F)	F = 220 * C * SQRT(A)				6,702
Fire Flow (F)	Rounded to nearest 1,000				7,000

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-1,050	5,950
	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	5,950
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	5,950
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	5,950
	Not Fully Supervised or N/A	0%				

Task	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposing Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
Choose Structure Exposure Distance	Side 1	18	3	10.1 to 20	Type A	13	3	39	3B	13%	18%	1,071	7,021
	Side 2	100	6	> 45.1	Type A	13	3	39	6	0%			
	Front	48	6	> 45.1	Type A	17	3	51	6	0%			
	Back	32	5	30.1 to 45	Type A	17	3	51	5B	5%			
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

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Exposure Charges for E	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with nlank wall
	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE C5: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Oakridge Gate, Phase II
Building No: Block 4

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

F = 220 * C * 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 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)	Floor 3		232	928.0 m²	
	Floor 2		232		
	Floor 1		232		
	Basement (At least 50% below grade, not included)		232		
Fire Flow (F)	F = 220 * C * SQRT(A)				6,702
Fire Flow (F)	Rounded to nearest 1,000				7,000

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-1,050	5,950
	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	5,950
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	5,950
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	5,950
	Not Fully Supervised or N/A	0%				

Task	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposing Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
Choose Structure Exposure Distance	Side 1	12	3	10.1 to 20	Type A	13	3	39	3B	13%	21%	1,250	7,200
	Side 2	100	6	> 45.1	Type A	13	3	39	6	0%			
	Front	48	6	> 45.1	Type A	17	3	51	6	0%			
	Back	25	4	20.1 to 30	Type A	17	3	51	4B	8%			
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**

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Exposure Charges for E	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with nlank wall
	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE C6: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Oakridge Gate, Phase II
Building No: Block 5

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

F = 220 * C * 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 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)	Floor 3		459	1836.0 m²	
	Floor 2		459		
	Floor 1		459		
	Basement (At least 50% below grade, not included)		459		
Fire Flow (F)	F = 220 * C * SQRT(A)				9,427
Fire Flow (F)	Rounded to nearest 1,000				9,000

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-1,350	7,650
	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	7,650
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	7,650
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	7,650
	Not Fully Supervised or N/A	0%				

Task	Exposures	Separation Dist (m)	Cond	Separation Conditon	Exposing Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
Choose Structure Exposure Distance	Side 1	11	3	10.1 to 20	Type A	13	3	39	3B	13%	46%	3,519	11,169
	Side 2	25	4	20.1 to 30	Type A	13	3	39	4B	8%			
	Front	23	4	20.1 to 30	Type A	33	3	99	4D	10%			
	Back	12	3	10.1 to 20	Type A	33	3	99	3D	15%			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =												**11,000**
	Total Required Fire Flow, L/s =												**183**

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Exposure Charges for E	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with nlank wall
	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

TABLE C7: FIRE FLOW REQURIEMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Oakridge Gate, Phase II
Building No: **Block 6**

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

F = 220 * C * 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 Total (L/min)
Choose Building Frame (C)	Wood Frame	1.5	Wood Frame	1.5	
	Ordinary Construction	1			
	Non-combustible Construction	0.8			
	Fire Resistive Construction	0.6			
Input Building Floor Areas (A)	Floor 3			806.8 m²	
	Floor 2		403.4		
	Floor 1		403.4		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				9,373
Fire Flow (F)	Rounded to nearest 1,000				9,000

Reductions/Increases Due to Factors Effecting Burning

Task	Options	Multiplier	Input	Value Used	Fire Flow Change (L/min)	Fire Flow Total (L/min)
Choose Combustibility of Building Contents	Non-combustible	-25%	Limited Combustible	-15%	-1,350	7,650
	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	7,650
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	7,650
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	7,650
	Not Fully Supervised or N/A	0%				

Task	Exposures	Separ-ation Dist (m)	Cond	Separation Conditon	Exposing Wall type	Exposed Wall Length: Length (m)	No of Storeys	Length-height Factor	Sub-Conditon	Charge (%)	Total Charge (%)	Total Exposure Charge (L/min)	
Choose Structure Exposure Distance	Side 1	16.5	3	10.1 to 20	Type A	12.5	2	25	3A	12%	35%	2,678	10,328
	Side 2	100	6	> 45.1	Type A	12.5	2	25	6	0%			
	Front	23	4	20.1 to 30	Type A	32	2	64	4C	9%			
	Back	14	3	10.1 to 20	Type A	32	2	64	3C	14%			
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =												**10,000**
	Total Required Fire Flow, L/s =												**167**

Exposure Charges for Exposing Walls of Wood Frame Construciton (from Table G5)

Exposure Charges for E	Wood-Frame or non-conbustible
Type B	Ordinary or fire-resisitve with unprotected openings
Type C	Ordinary or fire-resisitve with semi-protected openings
Type D	Ordinary or fire-resisitve with nlank wall
	Ordinary or fire-resisitve with blank wall

Conditons for Separation

Separation Dist	Condition
0m to 3m	1
3.1m to 10m	2
10.1m to 20m	3
20.1m to 30m	4
30.1m to 45m	5
> 45.1m	6

Appendix D – WATERCAD Results

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 1A: MAX DAY PLUS FIREFLOW

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J5	88.17	0.83	106.10	25
J6	88.10	0.50	106.10	26
J3	87.75	(N/A)	(N/A)	(N/A)
J9	88.20	0.00	106.10	25
J10	87.79	0.17	106.10	26
J12	87.65	0.28	106.10	26
J7	88.10	0.00	106.10	26
J8	88.10	0.28	106.10	26
J13	87.66	(N/A)	(N/A)	(N/A)
J4	87.77	(N/A)	(N/A)	(N/A)
J2	87.41	(N/A)	(N/A)	(N/A)
J1	88.28	(N/A)	(N/A)	(N/A)
J11	87.78	0.17	106.10	26

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)	Is Active?
P-1	J12	J6	46	204	110.0	-0.28	0.01	0.00000	True
P-2	J6	J5	68	204	110.0	-1.40	0.04	0.00002	True
P-3	J6	J9	37	204	110.0	0.34	0.01	0.00000	True
P-6	J10	J3	41	204	110.0	(N/A)	(N/A)	(N/A)	True
P-7	J6	J7	4	204	110.0	0.28	0.01	0.00000	True
P-8	J7	J8	28	108	100.0	0.28	0.03	0.00003	True
P-9	J12	J13	44	204	110.0	(N/A)	(N/A)	(N/A)	True
P-10	J4	J13	67	204	110.0	(N/A)	(N/A)	(N/A)	True
P-11	J5	J4	88	204	110.0	(N/A)	(N/A)	(N/A)	True
P-12	J3	J1	292	393	120.0	(N/A)	(N/A)	(N/A)	True
P-13	J1	J2	115	297	120.0	(N/A)	(N/A)	(N/A)	True
P-14	J2	J4	148	204	110.0	(N/A)	(N/A)	(N/A)	True
P-15	J1	R1	30	600	130.0	(N/A)	(N/A)	(N/A)	True
P-16	J4	R3	24	600	130.0	(N/A)	(N/A)	(N/A)	True
P-17	J5	R2	20	600	100.0	-2.23	0.01	0.00000	True
P-18	J9	J11	13	204	100.0	0.34	0.01	0.00000	True
P-19	J11	J10	7	204	100.0	0.17	0.01	0.00000	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
56	R2	0.00	<None>	2.23	106.10
57	R3	0.00	<None>	(N/A)	(N/A)
58	R1	0.00	<None>	(N/A)	(N/A)

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

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?
J6	0.00	93.94	200.50	94.44	0	20	False
J9	0.00	74.64	200.00	74.64	0	20	False
J10	0.00	70.92	200.17	71.09	0	20	False
J12	0.00	76.95	200.28	77.23	0	20	False
J13	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 1B: PEAK HOUR

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J5	88.17	1.84	124.80	52
J6	88.10	1.11	124.79	52
J3	87.75	(N/A)	(N/A)	(N/A)
J9	88.20	0.00	124.79	52
J10	87.79	0.37	124.79	53
J12	87.65	0.61	124.79	53
J7	88.10	0.00	124.79	52
J8	88.10	0.61	124.79	52
J13	87.66	(N/A)	(N/A)	(N/A)
J4	87.77	(N/A)	(N/A)	(N/A)
J2	87.41	(N/A)	(N/A)	(N/A)
J1	88.28	(N/A)	(N/A)	(N/A)
J11	87.78	0.37	124.79	53

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)	Is Active?
P-1	J12	J6	46	204	110.0	-0.61	0.02	0.00000	True
P-2	J6	J5	68	204	110.0	-3.07	0.09	0.00009	True
P-3	J6	J9	37	204	110.0	0.74	0.02	0.00001	True
P-6	J10	J3	41	204	110.0	(N/A)	(N/A)	(N/A)	True
P-7	J6	J7	4	204	110.0	0.61	0.02	0.00001	True
P-8	J7	J8	28	108	100.0	0.61	0.07	0.00012	True
P-9	J12	J13	44	204	110.0	(N/A)	(N/A)	(N/A)	True
P-10	J4	J13	67	204	110.0	(N/A)	(N/A)	(N/A)	True
P-11	J5	J4	88	204	110.0	(N/A)	(N/A)	(N/A)	True
P-12	J3	J1	292	393	120.0	(N/A)	(N/A)	(N/A)	True
P-13	J1	J2	115	297	120.0	(N/A)	(N/A)	(N/A)	True
P-14	J2	J4	148	204	110.0	(N/A)	(N/A)	(N/A)	True
P-15	J1	R1	30	600	130.0	(N/A)	(N/A)	(N/A)	True
P-16	J4	R3	24	600	130.0	(N/A)	(N/A)	(N/A)	True
P-17	J5	R2	20	600	100.0	-4.91	0.02	0.00000	True
P-18	J9	J11	13	204	100.0	0.74	0.02	0.00001	True
P-19	J11	J10	7	204	100.0	0.37	0.01	0.00000	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
56	R2	0.00	<None>	4.91	124.80
57	R3	0.00	<None>	(N/A)	(N/A)
58	R1	0.00	<None>	(N/A)	(N/A)

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 2A: MAX DAY PLUS FIRE FLOW

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J5	88.17	(N/A)	(N/A)	(N/A)
J6	88.10	0.50	124.96	52
J3	87.75	0.00	124.96	53
J9	88.20	0.00	124.96	52
J10	87.79	0.17	124.96	53
J12	87.65	0.28	124.96	53
J7	88.10	0.00	124.96	52
J8	88.10	0.28	124.96	52
J13	87.66	(N/A)	(N/A)	(N/A)
J4	87.77	(N/A)	(N/A)	(N/A)
J2	87.41	(N/A)	(N/A)	(N/A)
J1	88.28	0.51	124.96	52
J11	87.78	0.17	124.96	53

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)	Is Active?
P-1	J12	J6	46	204	110.0	-0.28	0.01	0.00000	True
P-2	J6	J5	68	204	110.0	(N/A)	(N/A)	(N/A)	True
P-3	J6	J9	37	204	110.0	-1.06	0.03	0.00001	True
P-6	J10	J3	41	204	110.0	-1.40	0.04	0.00002	True
P-7	J6	J7	4	204	110.0	0.28	0.01	0.00000	True
P-8	J7	J8	28	108	100.0	0.28	0.03	0.00003	True
P-9	J12	J13	44	204	110.0	(N/A)	(N/A)	(N/A)	True
P-10	J4	J13	67	204	110.0	(N/A)	(N/A)	(N/A)	True
P-11	J5	J4	88	204	110.0	(N/A)	(N/A)	(N/A)	True
P-12	J3	J1	292	393	120.0	-1.40	0.01	0.00000	True
P-13	J1	J2	115	297	120.0	(N/A)	(N/A)	(N/A)	True
P-14	J2	J4	148	204	110.0	(N/A)	(N/A)	(N/A)	True
P-15	J1	R1	30	600	130.0	-1.91	0.01	0.00000	True
P-16	J4	R3	24	600	130.0	(N/A)	(N/A)	(N/A)	True
P-17	J5	R2	20	600	100.0	(N/A)	(N/A)	(N/A)	True
P-18	J9	J11	13	204	100.0	-1.06	0.03	0.00002	True
P-19	J11	J10	7	204	100.0	-1.23	0.04	0.00002	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
56	R2	0.00	<None>	(N/A)	(N/A)
57	R3	0.00	<None>	(N/A)	(N/A)
58	R1	0.00	<None>	1.91	124.96

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 2A: MAX DAY PLUS FIRE FLOW

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?
J6	0.00	196.35	200.50	196.85	0	20	False
J9	0.00	243.17	200.00	243.17	0	20	True
J10	0.00	299.59	200.17	299.76	0	21	True
J12	0.00	164.57	200.28	164.85	0	20	False
J13	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 2B: PEAK HOUR

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J5	88.17	(N/A)	(N/A)	(N/A)
J6	88.10	1.11	124.89	52
J3	87.75	0.00	124.90	53
J9	88.20	0.00	124.89	52
J10	87.79	0.37	124.90	53
J12	87.65	0.61	124.89	53
J7	88.10	0.00	124.89	52
J8	88.10	0.61	124.89	52
J13	87.66	(N/A)	(N/A)	(N/A)
J4	87.77	(N/A)	(N/A)	(N/A)
J2	87.41	(N/A)	(N/A)	(N/A)
J1	88.28	1.12	124.90	52
J11	87.78	0.37	124.89	53

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)	Is Active?
P-1	J12	J6	46	204	110.0	-0.61	0.02	0.00000	True
P-2	J6	J5	68	204	110.0	(N/A)	(N/A)	(N/A)	True
P-3	J6	J9	37	204	110.0	-2.33	0.07	0.00005	True
P-6	J10	J3	41	204	110.0	-3.07	0.09	0.00009	True
P-7	J6	J7	4	204	110.0	0.61	0.02	0.00001	True
P-8	J7	J8	28	108	100.0	0.61	0.07	0.00012	True
P-9	J12	J13	44	204	110.0	(N/A)	(N/A)	(N/A)	True
P-10	J4	J13	67	204	110.0	(N/A)	(N/A)	(N/A)	True
P-11	J5	J4	88	204	110.0	(N/A)	(N/A)	(N/A)	True
P-12	J3	J1	292	393	120.0	-3.07	0.03	0.00000	True
P-13	J1	J2	115	297	120.0	(N/A)	(N/A)	(N/A)	True
P-14	J2	J4	148	204	110.0	(N/A)	(N/A)	(N/A)	True
P-15	J1	R1	30	600	130.0	-4.19	0.01	0.00000	True
P-16	J4	R3	24	600	130.0	(N/A)	(N/A)	(N/A)	True
P-17	J5	R2	20	600	100.0	(N/A)	(N/A)	(N/A)	True
P-18	J9	J11	13	204	100.0	-2.33	0.07	0.00007	True
P-19	J11	J10	7	204	100.0	-2.70	0.08	0.00008	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
56	R2	0.00	<None>	(N/A)	(N/A)
57	R3	0.00	<None>	(N/A)	(N/A)
58	R1	0.00	<None>	4.19	124.90

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 3A: MAX DAY PLUS FIRE FLOW

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J5	88.17	0.83	124.96	52
J6	88.10	0.50	124.96	52
J3	87.75	0.00	124.96	53
J9	88.20	0.00	124.96	52
J10	87.79	0.17	124.96	53
J12	87.65	0.28	124.96	53
J7	88.10	0.00	124.96	52
J8	88.10	0.28	124.96	52
J13	87.66	(N/A)	(N/A)	(N/A)
J4	87.77	0.94	124.96	53
J2	87.41	1.02	124.96	53
J1	88.28	0.51	124.96	52
J11	87.78	0.17	124.96	53

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)	Is Active?
P-1	J12	J6	46	204	110.0	-0.28	0.01	0.00000	True
P-2	J6	J5	68	204	110.0	0.49	0.01	0.00000	True
P-3	J6	J9	37	204	110.0	-1.55	0.05	0.00003	True
P-6	J10	J3	41	204	110.0	-1.89	0.06	0.00004	True
P-7	J6	J7	4	204	110.0	0.28	0.01	0.00000	True
P-8	J7	J8	28	108	100.0	0.28	0.03	0.00003	True
P-9	J12	J13	44	204	110.0	(N/A)	(N/A)	(N/A)	True
P-10	J4	J13	67	204	110.0	(N/A)	(N/A)	(N/A)	True
P-11	J5	J4	88	204	110.0	-0.34	0.01	0.00000	True
P-12	J3	J1	292	393	120.0	-1.89	0.02	0.00000	True
P-13	J1	J2	115	297	120.0	2.30	0.03	0.00001	True
P-14	J2	J4	148	204	110.0	1.28	0.04	0.00002	True
P-15	J1	R1	30	600	130.0	-4.70	0.02	0.00000	True
P-16	J4	R3	24	600	130.0	(N/A)	(N/A)	(N/A)	True
P-17	J5	R2	20	600	100.0	(N/A)	(N/A)	(N/A)	True
P-18	J9	J11	13	204	100.0	-1.55	0.05	0.00003	True
P-19	J11	J10	7	204	100.0	-1.72	0.05	0.00004	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
56	R2	0.00	<None>	(N/A)	(N/A)
57	R3	0.00	<None>	(N/A)	(N/A)
58	R1	0.00	<None>	4.70	124.96

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 3A: MAX DAY PLUS FIRE FLOW

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?
J6	0.00	300.00	200.50	300.50	0	22	True
J9	0.00	300.00	200.00	300.00	0	28	True
J10	0.00	300.00	200.17	300.17	0	34	True
J12	0.00	216.35	200.28	216.63	0	20	True
J13	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 3B: PEAK HOUR

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J5	88.17	1.84	124.88	52
J6	88.10	1.11	124.89	52
J3	87.75	0.00	124.90	53
J9	88.20	0.00	124.89	52
J10	87.79	0.37	124.89	53
J12	87.65	0.61	124.88	53
J7	88.10	0.00	124.89	52
J8	88.10	0.61	124.88	52
J13	87.66	(N/A)	(N/A)	(N/A)
J4	87.77	2.06	124.88	53
J2	87.41	2.24	124.90	53
J1	88.28	1.12	124.90	52
J11	87.78	0.37	124.89	53

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)	Is Active?
P-1	J12	J6	46	204	110.0	-0.61	0.02	0.00000	True
P-2	J6	J5	68	204	110.0	1.07	0.03	0.00001	True
P-3	J6	J9	37	204	110.0	-3.40	0.10	0.00011	True
P-6	J10	J3	41	204	110.0	-4.14	0.13	0.00016	True
P-7	J6	J7	4	204	110.0	0.61	0.02	0.00001	True
P-8	J7	J8	28	108	100.0	0.61	0.07	0.00012	True
P-9	J12	J13	44	204	110.0	(N/A)	(N/A)	(N/A)	True
P-10	J4	J13	67	204	110.0	(N/A)	(N/A)	(N/A)	True
P-11	J5	J4	88	204	110.0	-0.77	0.02	0.00001	True
P-12	J3	J1	292	393	120.0	-4.14	0.03	0.00001	True
P-13	J1	J2	115	297	120.0	5.07	0.07	0.00003	True
P-14	J2	J4	148	204	110.0	2.83	0.09	0.00008	True
P-15	J1	R1	30	600	130.0	-10.33	0.04	0.00000	True
P-16	J4	R3	24	600	130.0	(N/A)	(N/A)	(N/A)	True
P-17	J5	R2	20	600	100.0	(N/A)	(N/A)	(N/A)	True
P-18	J9	J11	13	204	100.0	-3.40	0.10	0.00013	True
P-19	J11	J10	7	204	100.0	-3.77	0.12	0.00016	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
56	R2	0.00	<None>	(N/A)	(N/A)
57	R3	0.00	<None>	(N/A)	(N/A)
58	R1	0.00	<None>	10.33	124.90

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 4A: MAX DAY PLUS FIRE FLOW

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J5	88.17	0.83	124.95	52
J6	88.10	0.50	124.95	52
J3	87.75	0.00	124.96	53
J9	88.20	0.00	124.96	52
J10	87.79	0.17	124.96	53
J12	87.65	0.28	124.95	53
J7	88.10	0.00	124.95	52
J8	88.10	0.28	124.95	52
J13	87.66	1.21	124.95	53
J4	87.77	0.94	124.95	53
J2	87.41	1.02	124.96	53
J1	88.28	0.51	124.96	52
J11	87.78	0.17	124.96	53

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)	Is Active?
P-1	J12	J6	46	204	110.0	-0.84	0.03	0.00001	True
P-2	J6	J5	68	204	110.0	0.58	0.02	0.00000	True
P-3	J6	J9	37	204	110.0	-2.20	0.07	0.00005	True
P-6	J10	J3	41	204	110.0	-2.54	0.08	0.00006	True
P-7	J6	J7	4	204	110.0	0.28	0.01	0.00000	True
P-8	J7	J8	28	108	100.0	0.28	0.03	0.00003	True
P-9	J12	J13	44	204	110.0	0.56	0.02	0.00000	True
P-10	J4	J13	67	204	110.0	0.65	0.02	0.00001	True
P-11	J5	J4	88	204	110.0	-0.25	0.01	0.00000	True
P-12	J3	J1	292	393	120.0	-2.54	0.02	0.00000	True
P-13	J1	J2	115	297	120.0	2.86	0.04	0.00001	True
P-14	J2	J4	148	204	110.0	1.84	0.06	0.00004	True
P-15	J1	R1	30	600	130.0	-5.91	0.02	0.00000	True
P-16	J4	R3	24	600	130.0	(N/A)	(N/A)	(N/A)	True
P-17	J5	R2	20	600	100.0	(N/A)	(N/A)	(N/A)	True
P-18	J9	J11	13	204	100.0	-2.20	0.07	0.00006	True
P-19	J11	J10	7	204	100.0	-2.37	0.07	0.00007	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
56	R2	0.00	<None>	(N/A)	(N/A)
57	R3	0.00	<None>	(N/A)	(N/A)
58	R1	0.00	<None>	5.91	124.96

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 4A: MAX DAY PLUS FIRE FLOW

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?
J5	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)
J6	0.00	300.00	200.50	300.50	0	26	True
J3	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)
J9	0.00	300.00	200.00	300.00	0	31	True
J10	0.00	300.00	200.17	300.17	0	36	True
J12	0.00	286.56	200.28	286.84	0	20	True
J7	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)
J8	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)
J13	0.00	279.55	201.21	280.76	0	20	True
J4	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)
J2	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)
J1	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)
J11	0.00	(N/A)	(N/A)	(N/A)	0	(N/A)	(N/A)

WATERCAD MODEL RESULTS - OAKRIDGE GATE PHASE II

SCENARIO 4B: PEAK HOUR

Junction Table - Time: 0.00 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J5	88.17	1.84	124.87	52
J6	88.10	1.11	124.87	52
J3	87.75	0.00	124.90	53
J9	88.20	0.00	124.88	52
J10	87.79	0.37	124.89	53
J12	87.65	0.61	124.87	53
J7	88.10	0.00	124.87	52
J8	88.10	0.61	124.87	52
J13	87.66	2.67	124.87	53
J4	87.77	2.06	124.87	53
J2	87.41	2.24	124.89	53
J1	88.28	1.12	124.90	52
J11	87.78	0.37	124.88	53

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)	Is Active?
P-1	J12	J6	46	204	110.0	-1.84	0.06	0.00004	True
P-2	J6	J5	68	204	110.0	1.28	0.04	0.00002	True
P-3	J6	J9	37	204	110.0	-4.85	0.15	0.00021	True
P-6	J10	J3	41	204	110.0	-5.59	0.17	0.00027	True
P-7	J6	J7	4	204	110.0	0.61	0.02	0.00001	True
P-8	J7	J8	28	108	100.0	0.61	0.07	0.00012	True
P-9	J12	J13	44	204	110.0	1.23	0.04	0.00002	True
P-10	J4	J13	67	204	110.0	1.44	0.04	0.00002	True
P-11	J5	J4	88	204	110.0	-0.56	0.02	0.00000	True
P-12	J3	J1	292	393	120.0	-5.59	0.05	0.00001	True
P-13	J1	J2	115	297	120.0	6.29	0.09	0.00005	True
P-14	J2	J4	148	204	110.0	4.05	0.12	0.00015	True
P-15	J1	R1	30	600	130.0	-13.00	0.05	0.00001	True
P-16	J4	R3	24	600	130.0	(N/A)	(N/A)	(N/A)	True
P-17	J5	R2	20	600	100.0	(N/A)	(N/A)	(N/A)	True
P-18	J9	J11	13	204	100.0	-4.85	0.15	0.00025	True
P-19	J11	J10	7	204	100.0	-5.22	0.16	0.00029	True

Reservoir Table - Time: 0.00 hours

ID	Label	Elevation (m)	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
56	R2	0.00	<None>	(N/A)	(N/A)
57	R3	0.00	<None>	(N/A)	(N/A)
58	R1	0.00	<None>	13.00	124.90

Appendix E – Storm Sewer Design Sheets

Table E1: 2-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)

		SURFACE AREAS(ha)				FLOW (UNRESTRICTED)							FLOW (RESTRICTED)			SEWER DATA								Hydraulic Ratios	
U/S Manhole	D/S Manhole	Area No.	Area (ha)	∑ Area (ha)	Average R	Indiv. 2.78*A*R	Accum. 2.78*A*R	Tc (mins)	I (mm/h)	Indiv. Flow	Return Period	Q (L/s)	ICD TYPE	[1]Indiv Q_{ICD} (L/s)	ACCUM. Q_{ICD} (L/s)	Dia (mm) Actual	Dia (mm) Nominal	Type	Slope (%)	Length (m)	Capacity, Q_{CAP} (L/sec)	Velocity (m/s)	Time in Pipe, Tt (min)	Q/Q_{CAP}	Q_{ICD}/Q_{CAP}
STMH 205	**STMH 203**																								
	CB13	7	0.0656	0.0656	0.47	0.086	0.086	10.00	76.81	6.58	2-year			2.06		251.46	250	PVC	0.70	33.26	50.53	1.01	0.55	0.13	0.04
	CB12	8	0.0326	0.0982	0.36	0.033	0.118	10.00	76.81	2.51	2-year			2.06		201.16	200	PVC	5.03	14.91	74.70	2.34	0.11	0.03	0.03
	CB 10	5	0.1227	0.2209	0.78	0.266	0.384	10.00	76.81	20.43	2-year			2.08		201.16	200	PVC	1.00	3.71	33.31	1.04	0.06	0.61	0.06
	CB11	6	0.0821	0.3030	0.81	0.185	0.569	10.00	76.81	14.20	2-year			2.08		201.16	200	PVC	1.00	11.41	33.31	1.04	0.18	0.43	0.06
	CB2	11	0.0408	0.3438	0.73	0.083	0.652	10.00	76.81	6.36	2-year			5.00		201.16	200	PVC	1.00	2.41	33.31	1.04	0.04	0.19	0.15
				0.3438			0.652	10.55	74.77		2-year	48.8			13.3	299.36	300	PVC	0.70	59.79	80.45	1.14	0.87	0.61	
STMH 202	**STMH 203**																								
	CB4	1	0.0604	0.0604	0.45	0.076	0.076	10.00	76.81	5.80	2-year			1.72		251.46	250	PVC	4.18	29.18	123.48	2.48	0.20	0.05	0.01
	CB 8	2	0.0294	0.0898	0.43	0.035	0.111	10.00	76.81	2.70	2-year			1.72		251.46	250	PVC	4.73	29.17	131.36	2.63	0.18	0.02	0.01
	CBMH207	3	0.1250	0.2148	0.81	0.281	0.392	10.00	76.81	21.62	2-year			2.80		251.46	250	PVC	1.00	2.86	60.40	1.21	0.04	0.36	0.05
				0.2148			0.392	10.18	76.10		2-year	29.8			6.2	299.36	300	PVC	0.80	45.99	42.20	1.22	0.63	0.71	
STMH 204	**STMH 203**																								
	CB7	10	0.0538	0.0538	0.49	0.073	0.073	10.00	76.81	5.63	2-year			2.06		251.46	250	PVC	2.78	29.12	100.70	2.02	0.24	0.06	0.02
	CB9/CB15	9	0.0774	0.1312	0.61	0.131	0.205	10.00	76.81	10.08	2-year			6.00		251.46	250	PVC	3.10	29.67	106.34	2.13	0.23	0.09	0.06
	CBHM 208	4	0.1317	0.2629	0.79	0.289	0.494	10.00	76.81	22.22	2-year			2.75		201.16	200	PVC	1.00	2.86	33.31	1.04	0.05	0.67	0.08
				0.2629			0.494	10.23	75.93		2-year	37.5			10.8	299.36	300	PVC	0.80	42.05	86.00	1.22	0.57	0.44	
STMH 203	**STMH 201**																								
	CB1	12	0.0302	0.8517	0.88	0.074	1.612	10.00	76.81	5.67	2-year			5.00		201.16	200	PVC	1.00	1.37	33.31	1.04	0.02	0.17	0.15
							1.612	11.42	71.76		2-year	115.7			35.3	366.42	375	PVC	1.00	31.82	164.84	1.59	0.33	0.70	
STMH 201	**STMH 200**			0.8517			1.612	11.75	70.68		2-year	113.9			35.3	366.42	375	PVC	1.33	19.57	190.10	1.83	0.18	0.60	
STMH 200	***EX STMH***			*0.8517*			*1.612*	*11.93*	*70.11*		*2-year*	*113.0*			*35.3*	*366.42*	*375*	*PVC*	*2.06*	*16.50*	*236.58*	*2.28*	*0.12*	*0.48*	
TOTALS =			**0.8517**		**0.68**	**1.612**																			

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)

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: **M. Ghadban, EIT**	Project: **Ashcroft Homes**	
Checked: **J. Fitzpatrick, P.Eng.**	Location: **Oakridge Gate - Phase II**	
Dwg Reference: **Storm Drainage Plan, STM**	File Ref: **245036 Storm Design Sheet, June 2018**	Sheet No: **1 of 1**

Appendix F – SWM Design Sheets

Table F1: Average Runoff Coefficients (Pre-Development)

Table F2: Pre-Development Runoff Calculations

Table F3: Allowable Runoff Calculations

Table F3: Calculation of Average Runoff Coefficients (Post-Development)

Table F4: Average Runoff Coefficients (Pre-Development)

Table F5: Summary of Post Development Runoff (Uncontrolled and Controlled)

Table F6: Summary of Surface Storage

Table F7: Summary of Underground Pipe/Trench Storage

Table F8: Summary of Underground Manhole/Catchbasin Storage

Table F9: Summary of Underground Chamber Storage

Table F10: Summary of Total Storage Required & Provided

Table F11: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 1

Table F12: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 2

Table F13: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 3

Table F14: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 4

Table F15: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 5,6

Table F16: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 7

Table F17: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 8

Table F18: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 9

Table F19: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 10

Table F20: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 11

Table F21: Storage Volumes for 2-year, 5-Year and 100-Year Storms – Area 12

TABLE F1 - AVERAGE RUNOFF COEFFICIENTS (Pre Development)

Runoff Coeffients		C_{gravel} =	0.80	C_{ROOF} =	0.90	C_{GRASS} =	0.20		
Area No.	Gravel Areas (m^2)	A * C_{GRAV}	Roof Areas (m^2)	A * C_{ROOF}	Grassed Areas (m^2)	A * C_{GRASS}	Sum AC	Total Area (m^2)	C_{AVG}
Site					8632	1726.4	1726.4	8632.0	0.20
Totals	0.0	0.0	0.0	0.0	8,632.0	1,726.4	1,726.4	8,632.0	0.20
Site % IMP = 0%					Average Runoff Coeff =		**C_{AVG} =**	**1,726 / 8,632**	**= 0.20**

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_{2PRE} (L/sec)	I_5 (mm/hr)	Cavg	Q_{5PRE} (L/sec)	I_{100} (mm/hr)	Cavg	Q_{100PRE} (L/sec)
Site	0.8632	20	52.03	0.20	25.0	70.25	0.20	33.7	119.95	0.25	72.0
Totals	0.8632				25.0			33.7			72.0

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		
			I_5 (mm/hr)	Cavg	Q_{ALLOW} (L/sec)
Site	0.8632	20	70.25	0.50	84.3
Totals	0.8632				84.3

Notes

Allowable Capture Rate is based on 5-year storm at Tc=20 minutes. Taken from Stormwater Management Report, Trim Road Subdivison,Trow Associates,

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} =	0.90	C_{ROOF} =	0.90	C_{GRASS} =	0.20			
Area No.	Asphalt Areas (m^2)	A * C_{ASPH}	Roof Areas (m^2)	A * C_{ROOF}	Grassed Areas (m^2)	A * C_{GRASS}	Sum AC	Total Area (m^2)	C_{AVG}
1							274.8	604.00	0.46
2							126.7	294.00	0.43
3							1017.5	1,250.00	0.81
4							1037.8	1,317.00	0.79
5							962.0	1,227.00	0.78
6							669.1	821.00	0.82
7							311.6	656.00	0.48
8							116.7	326.00	0.36
9							473.7	774.00	0.61
10							265.2	538.00	0.49
11							297.8	408.00	0.73
12							265.5	302.00	0.88
13							22.8	114.00	0.20
Total							5841.2	8,631.0	
Site % IMP = 0%					Average Runoff Coeff =		C_{AVG} =	5,841 / 8,631	= 0.68

Notes
Cavg form 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			
			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	0.0604	10.0	0.46	76.81	5.9	**1.7**	0.46	104.19	8.0	**2.3**	0.57	178.56	17.1	**5.0**
2	0.0294	10.0	0.43	76.81	2.7	**1.7**	0.43	104.19	3.7	**2.3**	0.54	178.56	7.9	**5.0**
3	0.1250	10.0	0.81	76.81	21.7	**2.8**	0.81	104.19	29.5	**3.8**	1.00	178.56	62.0	**8.0**
4	0.1317	10.0	0.79	76.81	22.2	**2.8**	0.79	104.19	30.1	**3.7**	0.99	178.56	64.4	**8.0**
5	0.1227	10.0	0.78	76.81	20.5	**4.2**	0.78	104.19	27.9	**5.6**	0.98	178.56	59.7	**12.0**
6	0.0821	10.0	0.82	76.81	14.3		0.82	104.19	19.4		1.00	178.56	40.8	
7	0.0656	10.0	0.48	76.81	6.7	**2.1**	0.48	104.19	9.0	**2.8**	0.59	178.56	19.3	**6.0**
8	0.0326	10.0	0.36	76.81	2.5	**2.1**	0.36	104.19	3.4	**2.8**	0.45	178.56	7.2	**6.0**
9	0.0774	10.0	0.61	76.81	10.1	**6.0**	0.61	104.19	13.7	**8.0**	0.77	178.56	29.4	**10.0**
10	0.0538	10.0	0.49	76.81	5.7	**2.1**	0.49	104.19	7.7	**2.8**	0.62	178.56	16.5	**6.0**
11	0.0408	10.0	0.73	76.81	6.4	**5.0**	0.73	104.19	8.6	**6.0**	0.91	178.56	18.5	**8.0**
12	0.0302	10.0	0.88	76.81	5.7	**5.0**	0.88	104.19	7.7	**6.0**	1.00	178.56	15.0	**8.0**
13	0.0114	10.0	0.20	76.81	0.5	**(0.5)**	0.20	104.19	0.7	**(0.7)**	0.25	178.56	1.4	**(1.4)**
Totals	**0.8631**				**124.7**	**35.8**			**169.2**	**46.9**			**359.1**	**83.4**

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

Drainage Area	Ponding Number	T/G	Max W/L (m)	Area (m²)	Depth(m)	Total Volume (c.m.)
1						
2						
3	P3	87.90	88.18	467	0.28	43.6
4	P4	87.90	88.18	470	0.28	43.9
5	P5,P6	87.70	88.00	700	0.30	70.0
6						
7						
8	P8	87.64	87.74	12	0.10	0.4
9						
10						
11	P11	88.00	88.15	116	0.15	5.8
12	P12	88.00	88.18	80	0.18	4.8
13						
Subtotal						**168.5**

TABLE F7 - SUMMARY OF UNDERGROUND PIPE/TRENCH STORAGE

Drainage Area Located	MH From	MH To	Type	Length (m)	Pipe Dia (m)	Perf / Non Perf	Pipe Area (s.m.)	Perforated Pipes		Non-Perf	Total Volume (c.m.)
								[1]Volume of Clear Stone ($0.32m^3/m$)	Volume (c.m.)	Volume (c.m.)	
1	CBE16	CB4	HDPE	35	0.25	PERF	0.049	0.320	12.93	0.0	12.9
2	CBE14	CB8	HDPE	18.4	0.25	PERF	0.049	0.320	6.80	0.0	6.8
3							0.000	0.00	0.00	0.0	0.0
4							0.000	0.00	0.00	0.0	0.0
5							0.000	0.00	0.00	0.0	0.0
6							0.000	0.00	0.00	0.0	0.0
7	CBE17	CB13	HDPE	15	0.25	PERF	0.049	0.320	5.54	0.0	5.5
8							0.000	0.00	0.00	0.0	0.0
9	CBE15/15A	CB9	HDPE	33.4	0.25	PERF	0.049	0.320	12.33	0.0	12.3
10	CBE17	CB7	HDPE	33.2	0.25	PERF	0.049	0.320	12.25	0.0	12.3
11	CB3	CB2	PVC	6.7	0.20	NON-PERF	0.031	0.00	0.00	0.21	0.2
12							0.000	0.00	0.00	0.0	0.0
13							0.000	0.00		0.0	0.0
Subtotal									**49.85**	**0.21**	**50.06**

Notes

Based on void ratio of 0.40 and trench depth of 1.0 as per City Standard S29

TABLE F8 - SUMMARY OF UNDERGROUND MANHOLE/CATCHBASIN STORAGE

Drainage Area Located	No.	No. of Structures	Size	T/G (m)	Inv Elev (m)	Sump Elev (m)	Storage Depth (m)	Area (s.m.)	Volume (c.m.)
								0.00	0.0
1	CB4	1	0.60	88.00	86.88	86.28	1.12	0.36	0.40
2	CB8	1	0.60	87.35	85.95	85.35	1.40	0.36	0.50
3	CB5	1	0.60	87.9	86.70	86.10	1.20	0.36	0.43
4	CB6	1	0.60	87.9	86.80	86.20	1.10	0.36	0.40
5	CB10	1	0.60	87.70	86.45	85.85	1.25	0.36	0.45
6	CB11	1	0.60	87.70	86.45	85.85	1.25	0.36	0.45
7	CB13	1	0.60	87.30	85.52	84.92	1.78	0.36	0.64
8	CB12	1	0.60	87.64	84.97	84.37	2.67	0.36	0.96
9	CB8	1	0.60	87.35	86.18	85.58	1.17	0.36	0.42
10	CB7	1	0.6	88.00	86.80	86.20	1.20	0.36	0.43
11	CB2/CB3	2	0.60	88.00	86.80	86.20	1.20	0.36	0.86
12	CB1	1	0.60	88.15	87.00	86.40	1.15	0.36	0.41
13									
0									
Subtotal									**6.37**

TABLE F9 - SUMMARY OF UNDERGROUND CHAMBER STORAGE

Drainage Area Located	Top of Chamber (m)	Inv Elev (m)	Inv Subdrain (m)	Volume (c.m.)
3	86.54	85.40	85.17	17.0
4	86.54	85.40	85.17	17.0
5 6	86.32	85.18	84.95	25.0
Subtotal				**59.0**

TOTAL STORAGE AVAILABLE cu.m. =	**283.9**

Notes:

Chamber Volumes taken from Manufacturer's Design Calculator

TABLE F10 - 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	Chambers	Pipe/Trench	MH/CB	Surface	Total
1	0.0604	0.46	0.46	0.57	1.72	2.3	5.0	ICD	2.72	3.67	7.81		12.93	0.40		13.34
2	0.0294	0.43	0.43	0.54	1.72	2.3	5.0	ICD	0.59	0.80	1.72		6.80	0.50		7.30
3	0.1250	0.81	0.81	1.00	2.80	3.8	8.0	ICD	15.59	20.88	43.51	17.0		0.43	43.6	61.02
4	0.1317	0.79	0.79	0.99	2.75	3.7	8.0	ICD	16.15	21.63	45.84	17.0		0.40	43.9	61.26
5	0.1227	0.78	0.78	0.98	4.16	5.6	12.0	ICD	25.79	34.54	73.88	25.0		0.45	70.0	95.90
6	0.0821	0.82	0.82	1.00										0.45		
7	0.0656	0.48	0.48	0.59	2.06	2.8	6.0	ICD	2.97	4.00	8.54		5.54	0.64		6.18
8	0.0326	0.36	0.36	0.45	2.06	2.8	6.0	ICD	0.39	0.53	1.14			0.96	0.4	1.36
9	0.0774	0.61	0.61	0.77	6.00	8.0	10.0	ICD	2.52	3.50	12.16		12.33	0.42		12.75
10	0.0538	0.49	0.49	0.62	2.06	2.8	6.0	ICD	2.24	3.03	6.47		12.25	0.43		12.69
11	0.0408	0.73	0.73	0.91	5.00	6.0	8.0	ICD	1.08	1.76	6.32		0.21	0.86	5.8	6.87
12	0.0302	0.88	0.88	1.00	5.00	6.0	8.0	ICD	0.78	1.34	4.19			0.41	4.8	5.21
13	0.0114	0.20	0.20	0.25	0.49	0.7	1.4									
Totals =	**0.8631**				**35.8**	**46.9**	**83.4**		**70.8**	**95.7**	**211.6**	**59.0**	**50.06**	**6.4**	**168.5**	**283.9**

Table F11 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 1**
C_{AVG} = 0.46 (2-yr)
C_{AVG} = 0.46 (5-yr)
C_{AVG} = 0.57 (100-yr, Max 1.0)
Time Interval = 2 (mins)
Drainage Area = 0.0604 (hectares)

Duration (min)	Release Rate = 1.7 (L/sec)					Release Rate = 2.3 (L/sec)					Release Rate = 5.0 (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	12.8	1.72	11.1	0.00	230.5	17.6	2.334	15.3	0.00	398.6	38.1	5.000	33.1	0.00
2	133.3	10.2	1.72	8.5	1.02	182.7	14.0	2.334	11.6	1.39	315.0	30.1	5.000	25.1	3.01
4	111.7	8.5	1.72	6.8	1.64	152.5	11.7	2.334	9.3	2.24	262.4	25.1	5.000	20.1	4.81
6	96.6	7.4	1.72	5.7	2.04	131.6	10.1	2.334	7.7	2.78	226.0	21.6	5.000	16.6	5.97
8	85.5	6.5	1.72	4.8	2.31	116.1	8.9	2.334	6.5	3.14	199.2	19.0	5.000	14.0	6.73
10	76.8	5.9	1.72	4.1	2.49	104.2	8.0	2.334	5.6	3.38	178.6	17.1	5.000	12.1	7.23
12	69.9	5.3	1.72	3.6	2.61	94.7	7.2	2.334	4.9	3.53	162.1	15.5	5.000	10.5	7.55
14	64.2	4.9	1.72	3.2	2.68	86.9	6.6	2.334	4.3	3.62	148.7	14.2	5.000	9.2	7.73
16	59.5	4.5	1.72	2.8	2.71	80.5	6.1	2.334	3.8	3.66	137.5	13.1	5.000	8.1	7.81
18	55.5	4.2	1.72	2.5	2.72	75.0	5.7	2.334	3.4	3.67	128.1	12.2	5.000	7.2	7.81
20	52.0	4.0	1.72	2.3	2.71	70.3	5.4	2.334	3.0	3.64	120.0	11.5	5.000	6.5	7.75
22	49.0	3.7	1.72	2.0	2.67	66.1	5.1	2.334	2.7	3.59	112.9	10.8	5.000	5.8	7.63
24	46.4	3.5	1.72	1.8	2.62	62.5	4.8	2.334	2.4	3.52	106.7	10.2	5.000	5.2	7.47
26	44.0	3.4	1.72	1.6	2.56	59.3	4.5	2.334	2.2	3.43	101.2	9.7	5.000	4.7	7.27
28	41.9	3.2	1.72	1.5	2.49	56.5	4.3	2.334	2.0	3.33	96.3	9.2	5.000	4.2	7.05
30	40.0	3.1	1.72	1.3	2.41	53.9	4.1	2.334	1.8	3.21	91.9	8.8	5.000	3.8	6.79
32	38.3	2.9	1.72	1.2	2.32	51.6	3.9	2.334	1.6	3.09	87.9	8.4	5.000	3.4	6.51
34	36.8	2.8	1.72	1.1	2.22	49.5	3.8	2.334	1.4	2.95	84.3	8.0	5.000	3.0	6.22
36	35.4	2.7	1.72	1.0	2.12	47.6	3.6	2.334	1.3	2.81	81.0	7.7	5.000	2.7	5.90
38	34.1	2.6	1.72	0.9	2.01	45.8	3.5	2.334	1.2	2.66	77.9	7.4	5.000	2.4	5.57
40	32.9	2.5	1.72	0.8	1.90	44.2	3.4	2.334	1.0	2.50	75.1	7.2	5.000	2.2	5.22
Max =					**2.72**					**3.67**					**7.81**

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 F12 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 2**

C_{AVG} = 0.43 (2-yr)

C_{AVG} = 0.43 (5-yr)

C_{AVG} = 0.54 (100-yr, Max 1.0)

Time Interval = 5 (mins)

Drainage Area = 0.0294 (hectares)

Duration (min)	Release Rate = 1.7 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810; (I = A/(T_c+C)), C = 6.199					Release Rate = 2.3 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, 0.814; (I = A/(T_c+C)), C = 6.053					Release Rate = 5.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820; (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	5.9	1.72	4.2	0.00	230.5	8.1	2.334	5.8	0.00	398.6	17.6	5.000	12.6	0.00
5	103.6	3.6	1.72	1.9	0.58	141.2	5.0	2.334	2.6	0.79	242.7	10.7	5.000	5.7	1.71
10	76.8	2.7	1.72	1.0	0.59	104.2	3.7	2.334	1.3	0.80	178.6	7.9	5.000	2.9	1.72
15	61.8	2.2	1.72	0.5	0.41	83.6	2.9	2.334	0.6	0.55	142.9	6.3	5.000	1.3	1.16
20	52.0	1.8	1.72	0.1	0.13	70.3	2.5	2.334	0.1	0.17	120.0	5.3	5.000	0.3	0.34
25	45.2	1.6	1.72	-0.1	-0.19	60.9	2.1	2.334	-0.2	-0.28	103.8	4.6	5.000	-0.4	-0.64
30	40.0	1.4	1.72	-0.3	-0.56	53.9	1.9	2.334	-0.4	-0.78	91.9	4.0	5.000	-1.0	-1.72
35	36.1	1.3	1.72	-0.5	-0.95	48.5	1.7	2.334	-0.6	-1.31	82.6	3.6	5.000	-1.4	-2.86
40	32.9	1.2	1.72	-0.6	-1.35	44.2	1.6	2.334	-0.8	-1.87	75.1	3.3	5.000	-1.7	-4.06
45	30.2	1.1	1.72	-0.7	-1.77	40.6	1.4	2.334	-0.9	-2.44	69.1	3.0	5.000	-2.0	-5.29
50	28.0	1.0	1.72	-0.7	-2.20	37.7	1.3	2.334	-1.0	-3.02	64.0	2.8	5.000	-2.2	-6.55
55	26.2	0.9	1.72	-0.8	-2.64	35.1	1.2	2.334	-1.1	-3.62	59.6	2.6	5.000	-2.4	-7.84
60	24.6	0.9	1.72	-0.9	-3.08	32.9	1.2	2.334	-1.2	-4.22	55.9	2.5	5.000	-2.5	-9.14
65	23.2	0.8	1.72	-0.9	-3.53	31.0	1.1	2.334	-1.2	-4.84	52.6	2.3	5.000	-2.7	-10.46
70	21.9	0.8	1.72	-0.9	-3.98	29.4	1.0	2.334	-1.3	-5.46	49.8	2.2	5.000	-2.8	-11.79
75	20.8	0.7	1.72	-1.0	-4.44	27.9	1.0	2.334	-1.4	-6.08	47.3	2.1	5.000	-2.9	-13.14
80	19.8	0.7	1.72	-1.0	-4.91	26.6	0.9	2.334	-1.4	-6.71	45.0	2.0	5.000	-3.0	-14.49
85	18.9	0.7	1.72	-1.1	-5.37	25.4	0.9	2.334	-1.4	-7.35	43.0	1.9	5.000	-3.1	-15.85
90	18.1	0.6	1.72	-1.1	-5.84	24.3	0.9	2.334	-1.5	-7.98	41.1	1.8	5.000	-3.2	-17.22
95	17.4	0.6	1.72	-1.1	-6.31	23.3	0.8	2.334	-1.5	-8.62	39.4	1.7	5.000	-3.3	-18.60
100	16.7	0.6	1.72	-1.1	-6.78	22.4	0.8	2.334	-1.5	-9.27	37.9	1.7	5.000	-3.3	-19.99
Max =					**0.59**					**0.80**					**1.72**

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 F13 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 3**

C_{AVG} = 0.81 (2-yr)

C_{AVG} = 0.81 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.1250 (hectares)

Duration (min)	Release Rate = 2.8 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951, B = 0.810 (I = A/(T_c+C), C = 6.199					Release Rate = 3.8 (L/sec) Return Period = 5 (years) IDF Parameters, A = 998.071 0.814 (I = A/(T_c+C), C = 6.053					Release Rate = 8.0 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688 0.820 (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	47.3	2.80	44.5	0.00	230.5	65.2	3.800	61.4	0.00	398.6	138.5	8.000	130.5	0.00
2	133.3	37.7	2.80	34.9	4.19	182.7	51.7	3.800	47.9	5.75	315.0	109.5	8.000	101.5	12.18
4	111.7	31.6	2.80	28.8	6.91	152.5	43.1	3.800	39.3	9.44	262.4	91.2	8.000	83.2	19.96
6	96.6	27.3	2.80	24.5	8.83	131.6	37.2	3.800	33.4	12.03	226.0	78.5	8.000	70.5	25.39
8	85.5	24.2	2.80	21.4	10.26	116.1	32.8	3.800	29.0	13.94	199.2	69.2	8.000	61.2	29.39
10	76.8	21.7	2.80	18.9	11.35	104.2	29.5	3.800	25.7	15.40	178.6	62.0	8.000	54.0	32.43
12	69.9	19.8	2.80	17.0	12.22	94.7	26.8	3.800	23.0	16.55	162.1	56.3	8.000	48.3	34.81
14	64.2	18.2	2.80	15.4	12.91	86.9	24.6	3.800	20.8	17.46	148.7	51.7	8.000	43.7	36.69
16	59.5	16.8	2.80	14.0	13.47	80.5	22.8	3.800	19.0	18.20	137.5	47.8	8.000	39.8	38.21
18	55.5	15.7	2.80	12.9	13.93	75.0	21.2	3.800	17.4	18.80	128.1	44.5	8.000	36.5	39.43
20	52.0	14.7	2.80	11.9	14.30	70.3	19.9	3.800	16.1	19.29	120.0	41.7	8.000	33.7	40.42
22	49.0	13.9	2.80	11.1	14.61	66.1	18.7	3.800	14.9	19.68	112.9	39.2	8.000	31.2	41.22
24	46.4	13.1	2.80	10.3	14.86	62.5	17.7	3.800	13.9	20.00	106.7	37.1	8.000	29.1	41.86
26	44.0	12.5	2.80	9.7	15.06	59.3	16.8	3.800	13.0	20.26	101.2	35.2	8.000	27.2	42.37
28	41.9	11.9	2.80	9.1	15.22	56.5	16.0	3.800	12.2	20.46	96.3	33.5	8.000	25.5	42.77
30	40.0	11.3	2.80	8.5	15.35	53.9	15.3	3.800	11.5	20.62	91.9	31.9	8.000	23.9	43.06
32	38.3	10.8	2.80	8.0	15.44	51.6	14.6	3.800	10.8	20.73	87.9	30.5	8.000	22.5	43.28
34	36.8	10.4	2.80	7.6	15.51	49.5	14.0	3.800	10.2	20.81	84.3	29.3	8.000	21.3	43.42
36	35.4	10.0	2.80	7.2	15.56	47.6	13.5	3.800	9.7	20.86	81.0	28.1	8.000	20.1	43.49
38	34.1	9.6	2.80	6.8	15.58	45.8	13.0	3.800	9.2	20.88	77.9	27.1	8.000	19.1	43.51
40	32.9	9.3	2.80	6.5	15.59	44.2	12.5	3.800	8.7	20.88	75.1	26.1	8.000	18.1	43.47
Max =					**15.59**					**20.88**					**43.51**

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 F14 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 4**

C_{AVG} = 0.79 (2-yr)

C_{AVG} = 0.79 (5-yr)

C_{AVG} = 0.99 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.1317 (hectares)

Duration (min)	Release Rate = 2.8 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, (I = A/(T_c+C), C = 6.199					Release Rate = 3.7 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, 0.814, (I = A/(T_c+C), C = 6.053					Release Rate = 8.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820, (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	48.2	2.75	45.5	0.00	230.5	66.5	3.735	62.8	0.00	398.6	143.8	8.000	135.8	0.00
2	133.3	38.5	2.75	35.7	4.29	182.7	52.7	3.735	49.0	5.88	315.0	113.6	8.000	105.6	12.67
4	111.7	32.2	2.75	29.5	7.08	152.5	44.0	3.735	40.3	9.66	262.4	94.6	8.000	86.6	20.79
6	96.6	27.9	2.75	25.1	9.05	131.6	38.0	3.735	34.2	12.32	226.0	81.5	8.000	73.5	26.46
8	85.5	24.7	2.75	21.9	10.51	116.1	33.5	3.735	29.8	14.29	199.2	71.8	8.000	63.8	30.64
10	76.8	22.2	2.75	19.4	11.64	104.2	30.1	3.735	26.3	15.80	178.6	64.4	8.000	56.4	33.84
12	69.9	20.2	2.75	17.4	12.54	94.7	27.3	3.735	23.6	16.98	162.1	58.5	8.000	50.5	36.34
14	64.2	18.5	2.75	15.8	13.25	86.9	25.1	3.735	21.3	17.93	148.7	53.6	8.000	45.6	38.33
16	59.5	17.2	2.75	14.4	13.84	80.5	23.2	3.735	19.5	18.70	137.5	49.6	8.000	41.6	39.94
18	55.5	16.0	2.75	13.3	14.32	75.0	21.6	3.735	17.9	19.33	128.1	46.2	8.000	38.2	41.25
20	52.0	15.0	2.75	12.3	14.71	70.3	20.3	3.735	16.5	19.84	120.0	43.3	8.000	35.3	42.31
22	49.0	14.1	2.75	11.4	15.03	66.1	19.1	3.735	15.3	20.26	112.9	40.7	8.000	32.7	43.18
24	46.4	13.4	2.75	10.6	15.30	62.5	18.0	3.735	14.3	20.60	106.7	38.5	8.000	30.5	43.88
26	44.0	12.7	2.75	9.9	15.52	59.3	17.1	3.735	13.4	20.88	101.2	36.5	8.000	28.5	44.44
28	41.9	12.1	2.75	9.3	15.70	56.5	16.3	3.735	12.6	21.11	96.3	34.7	8.000	26.7	44.89
30	40.0	11.6	2.75	8.8	15.84	53.9	15.6	3.735	11.8	21.28	91.9	33.1	8.000	25.1	45.24
32	38.3	11.1	2.75	8.3	15.95	51.6	14.9	3.735	11.2	21.42	87.9	31.7	8.000	23.7	45.49
34	36.8	10.6	2.75	7.9	16.03	49.5	14.3	3.735	10.5	21.52	84.3	30.4	8.000	22.4	45.67
36	35.4	10.2	2.75	7.5	16.09	47.6	13.7	3.735	10.0	21.58	81.0	29.2	8.000	21.2	45.79
38	34.1	9.8	2.75	7.1	16.13	45.8	13.2	3.735	9.5	21.62	77.9	28.1	8.000	20.1	45.84
40	32.9	9.5	2.75	6.7	16.15	44.2	12.7	3.735	9.0	21.63	75.1	27.1	8.000	19.1	45.84
Max =					**16.15**					**21.63**					**45.84**

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 F15 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 5,6**

C_{AVG} = 0.80 (2-yr)

C_{AVG} = 0.80 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 5 (mins)

Drainage Area = 0.2048 (hectares)

Duration (min)	Release Rate = 4.2 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810; (I = A/(T_c+C), C = 6.199					Release Rate = 5.6 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, 0.814; (I = A/(T_c+C), C = 6.053					Release Rate = 12.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820; (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	75.8	4.16	71.7	0.00	230.5	104.5	5.644	98.9	0.00	398.6	227.0	12.000	215.0	0.00
5	103.6	47.0	4.16	42.8	12.84	141.2	64.0	5.644	58.4	17.51	242.7	138.2	12.000	126.2	37.85
10	76.8	34.8	4.16	30.7	18.40	104.2	47.2	5.644	41.6	24.96	178.6	101.7	12.000	89.7	53.80
15	61.8	28.0	4.16	23.8	21.46	83.6	37.9	5.644	32.2	29.02	142.9	81.4	12.000	69.4	62.42
20	52.0	23.6	4.16	19.4	23.32	70.3	31.9	5.644	26.2	31.45	120.0	68.3	12.000	56.3	67.55
25	45.2	20.5	4.16	16.3	24.48	60.9	27.6	5.644	22.0	32.95	103.8	59.1	12.000	47.1	70.69
30	40.0	18.2	4.16	14.0	25.19	53.9	24.5	5.644	18.8	33.86	91.9	52.3	12.000	40.3	72.55
35	36.1	16.4	4.16	12.2	25.60	48.5	22.0	5.644	16.4	34.35	82.6	47.0	12.000	35.0	73.53
40	32.9	14.9	4.16	10.7	25.78	44.2	20.0	5.644	14.4	34.54	75.1	42.8	12.000	30.8	73.88
45	30.2	13.7	4.16	9.6	25.79	40.6	18.4	5.644	12.8	34.50	69.1	39.3	12.000	27.3	73.75
50	28.0	12.7	4.16	8.6	25.66	37.7	17.1	5.644	11.4	34.29	64.0	36.4	12.000	24.4	73.24
55	26.2	11.9	4.16	7.7	25.43	35.1	15.9	5.644	10.3	33.93	59.6	33.9	12.000	21.9	72.42
60	24.6	11.1	4.16	7.0	25.11	32.9	14.9	5.644	9.3	33.46	55.9	31.8	12.000	19.8	71.36
65	23.2	10.5	4.16	6.3	24.71	31.0	14.1	5.644	8.4	32.89	52.6	30.0	12.000	18.0	70.10
70	21.9	9.9	4.16	5.8	24.26	29.4	13.3	5.644	7.7	32.23	49.8	28.3	12.000	16.3	68.66
75	20.8	9.4	4.16	5.3	23.75	27.9	12.6	5.644	7.0	31.51	47.3	26.9	12.000	14.9	67.07
80	19.8	9.0	4.16	4.8	23.19	26.6	12.0	5.644	6.4	30.72	45.0	25.6	12.000	13.6	65.35
85	18.9	8.6	4.16	4.4	22.59	25.4	11.5	5.644	5.9	29.88	43.0	24.5	12.000	12.5	63.52
90	18.1	8.2	4.16	4.1	21.96	24.3	11.0	5.644	5.4	28.99	41.1	23.4	12.000	11.4	61.59
95	17.4	7.9	4.16	3.7	21.29	23.3	10.6	5.644	4.9	28.06	39.4	22.5	12.000	10.5	59.58
100	16.7	7.6	4.16	3.4	20.60	22.4	10.2	5.644	4.5	27.10	37.9	21.6	12.000	9.6	57.48
Max =					**25.79**					**34.54**					**73.88**

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 F16 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 7**

C_{AVG} = 0.48 (2-yr)

C_{AVG} = 0.48 (5-yr)

C_{AVG} = 0.59 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0656 (hectares)

Duration (min)	Release Rate = 2.1 (L/sec)					Release Rate = 2.8 (L/sec)					Release Rate = 6.0 (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	14.5	2.06	12.4	0.00	230.5	20.0	2.801	17.2	0.00	398.6	43.2	6.000	37.2	0.00
2	133.3	11.5	2.06	9.5	1.14	182.7	15.8	2.801	13.0	1.56	315.0	34.1	6.000	28.1	3.37
4	111.7	9.7	2.06	7.6	1.83	152.5	13.2	2.801	10.4	2.50	262.4	28.4	6.000	22.4	5.38
6	96.6	8.4	2.06	6.3	2.27	131.6	11.4	2.801	8.6	3.09	226.0	24.5	6.000	18.5	6.65
8	85.5	7.4	2.06	5.3	2.56	116.1	10.1	2.801	7.3	3.48	199.2	21.6	6.000	15.6	7.47
10	76.8	6.7	2.06	4.6	2.75	104.2	9.0	2.801	6.2	3.73	178.6	19.3	6.000	13.3	8.00
12	69.9	6.1	2.06	4.0	2.87	94.7	8.2	2.801	5.4	3.89	162.1	17.6	6.000	11.6	8.32
14	64.2	5.6	2.06	3.5	2.94	86.9	7.5	2.801	4.7	3.97	148.7	16.1	6.000	10.1	8.49
16	59.5	5.2	2.06	3.1	2.97	80.5	7.0	2.801	4.2	4.00	137.5	14.9	6.000	8.9	8.54
18	55.5	4.8	2.06	2.7	2.96	75.0	6.5	2.801	3.7	3.99	128.1	13.9	6.000	7.9	8.50
20	52.0	4.5	2.06	2.4	2.93	70.3	6.1	2.801	3.3	3.94	120.0	13.0	6.000	7.0	8.39
22	49.0	4.2	2.06	2.2	2.88	66.1	5.7	2.801	2.9	3.87	112.9	12.2	6.000	6.2	8.21
24	46.4	4.0	2.06	2.0	2.81	62.5	5.4	2.801	2.6	3.77	106.7	11.6	6.000	5.6	7.99
26	44.0	3.8	2.06	1.7	2.73	59.3	5.1	2.801	2.3	3.65	101.2	11.0	6.000	5.0	7.73
28	41.9	3.6	2.06	1.6	2.63	56.5	4.9	2.801	2.1	3.52	96.3	10.4	6.000	4.4	7.43
30	40.0	3.5	2.06	1.4	2.53	53.9	4.7	2.801	1.9	3.37	91.9	9.9	6.000	3.9	7.11
32	38.3	3.3	2.06	1.3	2.41	51.6	4.5	2.801	1.7	3.21	87.9	9.5	6.000	3.5	6.75
34	36.8	3.2	2.06	1.1	2.29	49.5	4.3	2.801	1.5	3.03	84.3	9.1	6.000	3.1	6.37
36	35.4	3.1	2.06	1.0	2.16	47.6	4.1	2.801	1.3	2.85	81.0	8.8	6.000	2.8	5.98
38	34.1	3.0	2.06	0.9	2.02	45.8	4.0	2.801	1.2	2.66	77.9	8.4	6.000	2.4	5.56
40	32.9	2.8	2.06	0.8	1.88	44.2	3.8	2.801	1.0	2.46	75.1	8.1	6.000	2.1	5.13
Max =					**2.97**					**4.00**					**8.54**

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 F17 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 8**

C_{AVG} = 0.36 (2-yr)

C_{AVG} = 0.36 (5-yr)

C_{AVG} = 0.45 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0326 (hectares)

Duration (min)	Release Rate = 2.1 (L/sec) Return Period = 2 (years) IDF Parameters, A = 732.951 , B = 0.810 ($I = A/(T_c+C)$) , C = 6.199					Release Rate = 2.8 (L/sec) Return Period = 5 (years) IDF Parameters, A = 998.071 0.814 ($I = A/(T_c+C)$) , C = 6.053					Release Rate = 6.0 (L/sec) Return Period = 100 (years) IDF Parameters, A = 1735.688 0.820 ($I = A/(T_c+C)$) , 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	5.4	2.06	3.4	0.00	230.5	7.5	2.801	4.7	0.00	398.6	16.2	6.000	10.2	0.00
2	133.3	4.3	2.06	2.3	0.27	182.7	5.9	2.801	3.1	0.38	315.0	12.8	6.000	6.8	0.81
4	111.7	3.6	2.06	1.6	0.37	152.5	4.9	2.801	2.1	0.52	262.4	10.6	6.000	4.6	1.11
6	96.6	3.1	2.06	1.1	0.39	131.6	4.3	2.801	1.5	0.53	226.0	9.2	6.000	3.2	1.14
8	85.5	2.8	2.06	0.7	0.34	116.1	3.8	2.801	1.0	0.46	199.2	8.1	6.000	2.1	1.00
10	76.8	2.5	2.06	0.4	0.26	104.2	3.4	2.801	0.6	0.35	178.6	7.2	6.000	1.2	0.74
12	69.9	2.3	2.06	0.2	0.15	94.7	3.1	2.801	0.3	0.20	162.1	6.6	6.000	0.6	0.41
14	64.2	2.1	2.06	0.0	0.02	86.9	2.8	2.801	0.0	0.02	148.7	6.0	6.000	0.0	0.03
16	59.5	1.9	2.06	-0.1	-0.13	80.5	2.6	2.801	-0.2	-0.18	137.5	5.6	6.000	-0.4	-0.40
18	55.5	1.8	2.06	-0.3	-0.29	75.0	2.4	2.801	-0.4	-0.40	128.1	5.2	6.000	-0.8	-0.87
20	52.0	1.7	2.06	-0.4	-0.45	70.3	2.3	2.801	-0.5	-0.63	120.0	4.9	6.000	-1.1	-1.36
22	49.0	1.6	2.06	-0.5	-0.63	66.1	2.1	2.801	-0.7	-0.86	112.9	4.6	6.000	-1.4	-1.88
24	46.4	1.5	2.06	-0.6	-0.81	62.5	2.0	2.801	-0.8	-1.11	106.7	4.3	6.000	-1.7	-2.41
26	44.0	1.4	2.06	-0.6	-0.99	59.3	1.9	2.801	-0.9	-1.37	101.2	4.1	6.000	-1.9	-2.96
28	41.9	1.4	2.06	-0.7	-1.18	56.5	1.8	2.801	-1.0	-1.63	96.3	3.9	6.000	-2.1	-3.52
30	40.0	1.3	2.06	-0.8	-1.38	53.9	1.7	2.801	-1.1	-1.89	91.9	3.7	6.000	-2.3	-4.09
32	38.3	1.2	2.06	-0.8	-1.58	51.6	1.7	2.801	-1.1	-2.16	87.9	3.6	6.000	-2.4	-4.68
34	36.8	1.2	2.06	-0.9	-1.78	49.5	1.6	2.801	-1.2	-2.44	84.3	3.4	6.000	-2.6	-5.27
36	35.4	1.1	2.06	-0.9	-1.98	47.6	1.5	2.801	-1.3	-2.72	81.0	3.3	6.000	-2.7	-5.87
38	34.1	1.1	2.06	-1.0	-2.19	45.8	1.5	2.801	-1.3	-3.00	77.9	3.2	6.000	-2.8	-6.47
40	32.9	1.1	2.06	-1.0	-2.40	44.2	1.4	2.801	-1.4	-3.28	75.1	3.0	6.000	-3.0	-7.09
Max =					**0.39**					**0.53**					**1.14**

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 F18 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 9**

C_{AVG} = 0.61 (2-yr)

C_{AVG} = 0.61 (5-yr)

C_{AVG} = 0.77 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0774 (hectares)

Duration (min)	Release Rate = 6.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810, C = 6.199 ($I = A/(T_c+C)$)					Release Rate = 8.0 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, B = 0.814, C = 6.053 ($I = A/(T_c+C)$)					Release Rate = 10.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, B = 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	22.0	6.00	16.0	0.00	230.5	30.4	8.000	22.4	0.00	398.6	65.6	10.000	55.6	0.00
2	133.3	17.6	6.00	11.6	1.39	182.7	24.1	8.000	16.1	1.93	315.0	51.9	10.000	41.9	5.02
4	111.7	14.7	6.00	8.7	2.09	152.5	20.1	8.000	12.1	2.90	262.4	43.2	10.000	33.2	7.97
6	96.6	12.7	6.00	6.7	2.42	131.6	17.3	8.000	9.3	3.36	226.0	37.2	10.000	27.2	9.79
8	85.5	11.3	6.00	5.3	2.52	116.1	15.3	8.000	7.3	3.50	199.2	32.8	10.000	22.8	10.94
10	76.8	10.1	6.00	4.1	2.47	104.2	13.7	8.000	5.7	3.43	178.6	29.4	10.000	19.4	11.64
12	69.9	9.2	6.00	3.2	2.31	94.7	12.5	8.000	4.5	3.22	162.1	26.7	10.000	16.7	12.02
14	64.2	8.5	6.00	2.5	2.07	86.9	11.4	8.000	3.4	2.90	148.7	24.5	10.000	14.5	12.16
16	59.5	7.8	6.00	1.8	1.76	80.5	10.6	8.000	2.6	2.49	137.5	22.6	10.000	12.6	12.14
18	55.5	7.3	6.00	1.3	1.41	75.0	9.9	8.000	1.9	2.02	128.1	21.1	10.000	11.1	11.97
20	52.0	6.9	6.00	0.9	1.02	70.3	9.3	8.000	1.3	1.50	120.0	19.7	10.000	9.7	11.69
22	49.0	6.5	6.00	0.5	0.60	66.1	8.7	8.000	0.7	0.94	112.9	18.6	10.000	8.6	11.33
24	46.4	6.1	6.00	0.1	0.15	62.5	8.2	8.000	0.2	0.34	106.7	17.6	10.000	7.6	10.89
26	44.0	5.8	6.00	-0.2	-0.32	59.3	7.8	8.000	-0.2	-0.29	101.2	16.7	10.000	6.7	10.38
28	41.9	5.5	6.00	-0.5	-0.80	56.5	7.4	8.000	-0.6	-0.94	96.3	15.8	10.000	5.8	9.82
30	40.0	5.3	6.00	-0.7	-1.31	53.9	7.1	8.000	-0.9	-1.62	91.9	15.1	10.000	5.1	9.22
32	38.3	5.0	6.00	-1.0	-1.83	51.6	6.8	8.000	-1.2	-2.31	87.9	14.5	10.000	4.5	8.58
34	36.8	4.8	6.00	-1.2	-2.36	49.5	6.5	8.000	-1.5	-3.02	84.3	13.9	10.000	3.9	7.90
36	35.4	4.7	6.00	-1.3	-2.90	47.6	6.3	8.000	-1.7	-3.75	81.0	13.3	10.000	3.3	7.19
38	34.1	4.5	6.00	-1.5	-3.45	45.8	6.0	8.000	-2.0	-4.49	77.9	12.8	10.000	2.8	6.45
40	32.9	4.3	6.00	-1.7	-4.01	44.2	5.8	8.000	-2.2	-5.24	75.1	12.4	10.000	2.4	5.69
Max =					**2.52**					**3.50**					**12.16**

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 F19 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 10**

C_{AVG} = 0.49 (2-yr)

C_{AVG} = 0.49 (5-yr)

C_{AVG} = 0.62 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0538 (hectares)

	2-year	5-year	100-year
Release Rate =	2.1 (L/sec)	2.8 (L/sec)	6.0 (L/sec)
Return Period =	2 (years)	5 (years)	100 (years)
IDF Parameters, A =	732.951 , B = 0.810	998.071 0.814	1735.688 0.820
(I = A/(T_c+C)	, C = 6.199	, C = 6.053	, C = 6.014

Duration (min)	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	12.3	2.06	10.3	0.00	230.5	17.0	2.801	14.2	0.00	398.6	36.7	6.000	30.7	0.00
2	133.3	9.8	2.06	7.8	0.93	182.7	13.5	2.801	10.7	1.28	315.0	29.0	6.000	23.0	2.76
4	111.7	8.2	2.06	6.2	1.48	152.5	11.2	2.801	8.4	2.03	262.4	24.2	6.000	18.2	4.36
6	96.6	7.1	2.06	5.1	1.82	131.6	9.7	2.801	6.9	2.48	226.0	20.8	6.000	14.8	5.34
8	85.5	6.3	2.06	4.2	2.03	116.1	8.6	2.801	5.8	2.77	199.2	18.4	6.000	12.4	5.93
10	76.8	5.7	2.06	3.6	2.16	104.2	7.7	2.801	4.9	2.93	178.6	16.5	6.000	10.5	6.27
12	69.9	5.2	2.06	3.1	2.22	94.7	7.0	2.801	4.2	3.01	162.1	14.9	6.000	8.9	6.44
14	64.2	4.7	2.06	2.7	2.24	86.9	6.4	2.801	3.6	3.03	148.7	13.7	6.000	7.7	6.47
16	59.5	4.4	2.06	2.3	2.23	80.5	5.9	2.801	3.1	3.01	137.5	12.7	6.000	6.7	6.41
18	55.5	4.1	2.06	2.0	2.19	75.0	5.5	2.801	2.7	2.95	128.1	11.8	6.000	5.8	6.27
20	52.0	3.8	2.06	1.8	2.13	70.3	5.2	2.801	2.4	2.85	120.0	11.1	6.000	5.1	6.07
22	49.0	3.6	2.06	1.5	2.05	66.1	4.9	2.801	2.1	2.74	112.9	10.4	6.000	4.4	5.81
24	46.4	3.4	2.06	1.4	1.95	62.5	4.6	2.801	1.8	2.61	106.7	9.8	6.000	3.8	5.52
26	44.0	3.2	2.06	1.2	1.84	59.3	4.4	2.801	1.6	2.46	101.2	9.3	6.000	3.3	5.19
28	41.9	3.1	2.06	1.0	1.73	56.5	4.2	2.801	1.4	2.29	96.3	8.9	6.000	2.9	4.83
30	40.0	3.0	2.06	0.9	1.60	53.9	4.0	2.801	1.2	2.12	91.9	8.5	6.000	2.5	4.44
32	38.3	2.8	2.06	0.8	1.46	51.6	3.8	2.801	1.0	1.93	87.9	8.1	6.000	2.1	4.03
34	36.8	2.7	2.06	0.6	1.32	49.5	3.6	2.801	0.8	1.73	84.3	7.8	6.000	1.8	3.60
36	35.4	2.6	2.06	0.5	1.17	47.6	3.5	2.801	0.7	1.53	81.0	7.5	6.000	1.5	3.16
38	34.1	2.5	2.06	0.4	1.02	45.8	3.4	2.801	0.6	1.32	77.9	7.2	6.000	1.2	2.70
40	32.9	2.4	2.06	0.4	0.86	44.2	3.3	2.801	0.5	1.10	75.1	6.9	6.000	0.9	2.22
Max =					**2.24**					**3.03**					**6.47**

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 F20 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 11**

C_{AVG} = 0.73 (2-yr)

C_{AVG} = 0.73 (5-yr)

C_{AVG} = 0.91 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0408 (hectares)

Duration (min)	Release Rate = 5.0 (L/sec); Return Period = 2 (years); IDF Parameters, A = 732.951, B = 0.810; ($I = A/(T_c+C)$), C = 6.199					Release Rate = 6.0 (L/sec); Return Period = 5 (years); IDF Parameters, A = 998.071, 0.814; ($I = A/(T_c+C)$), C = 6.053					Release Rate = 8.0 (L/sec); Return Period = 100 (years); IDF Parameters, A = 1735.688, 0.820; ($I = A/(T_c+C)$), 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	13.8	5.00	8.8	0.00	230.5	19.1	6.000	13.1	0.00	398.6	41.3	8.000	33.3	0.00
2	133.3	11.0	5.00	6.0	0.72	182.7	15.1	6.000	9.1	1.10	315.0	32.6	8.000	24.6	2.95
4	111.7	9.3	5.00	4.3	1.02	152.5	12.6	6.000	6.6	1.59	262.4	27.2	8.000	19.2	4.60
6	96.6	8.0	5.00	3.0	1.08	131.6	10.9	6.000	4.9	1.76	226.0	23.4	8.000	15.4	5.54
8	85.5	7.1	5.00	2.1	1.00	116.1	9.6	6.000	3.6	1.73	199.2	20.6	8.000	12.6	6.06
10	76.8	6.4	5.00	1.4	0.82	104.2	8.6	6.000	2.6	1.58	178.6	18.5	8.000	10.5	6.29
12	69.9	5.8	5.00	0.8	0.57	94.7	7.8	6.000	1.8	1.33	162.1	16.8	8.000	8.8	6.32
14	64.2	5.3	5.00	0.3	0.27	86.9	7.2	6.000	1.2	1.01	148.7	15.4	8.000	7.4	6.21
16	59.5	4.9	5.00	-0.1	-0.07	80.5	6.7	6.000	0.7	0.64	137.5	14.2	8.000	6.2	5.99
18	55.5	4.6	5.00	-0.4	-0.44	75.0	6.2	6.000	0.2	0.22	128.1	13.3	8.000	5.3	5.68
20	52.0	4.3	5.00	-0.7	-0.83	70.3	5.8	6.000	-0.2	-0.22	120.0	12.4	8.000	4.4	5.30
22	49.0	4.1	5.00	-0.9	-1.24	66.1	5.5	6.000	-0.5	-0.69	112.9	11.7	8.000	3.7	4.86
24	46.4	3.8	5.00	-1.2	-1.67	62.5	5.2	6.000	-0.8	-1.18	106.7	11.0	8.000	3.0	4.38
26	44.0	3.6	5.00	-1.4	-2.11	59.3	4.9	6.000	-1.1	-1.69	101.2	10.5	8.000	2.5	3.86
28	41.9	3.5	5.00	-1.5	-2.57	56.5	4.7	6.000	-1.3	-2.22	96.3	10.0	8.000	2.0	3.30
30	40.0	3.3	5.00	-1.7	-3.03	53.9	4.5	6.000	-1.5	-2.76	91.9	9.5	8.000	1.5	2.71
32	38.3	3.2	5.00	-1.8	-3.51	51.6	4.3	6.000	-1.7	-3.32	87.9	9.1	8.000	1.1	2.10
34	36.8	3.0	5.00	-2.0	-3.99	49.5	4.1	6.000	-1.9	-3.88	84.3	8.7	8.000	0.7	1.47
36	35.4	2.9	5.00	-2.1	-4.47	47.6	3.9	6.000	-2.1	-4.45	81.0	8.4	8.000	0.4	0.82
38	34.1	2.8	5.00	-2.2	-4.97	45.8	3.8	6.000	-2.2	-5.03	77.9	8.1	8.000	0.1	0.15
40	32.9	2.7	5.00	-2.3	-5.47	44.2	3.7	6.000	-2.3	-5.62	75.1	7.8	8.000	-0.2	-0.53
Max =					**1.08**					**1.76**					**6.32**

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 F21 - Storage Volumes for 2-year, 5-Year and 100-Year Storms

Area No: **Area 12**

C_{AVG} = 0.88 (2-yr)

C_{AVG} = 0.88 (5-yr)

C_{AVG} = 1.00 (100-yr, Max 1.0)

Time Interval = 2 (mins)

Drainage Area = 0.0302 (hectares)

Duration (min)	Release Rate = 5.0 (L/sec)					Release Rate = 6.0 (L/sec)					Release Rate = 8.0 (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	12.3	5.00	7.3	0.00	230.5	17.0	6.000	11.0	0.00	398.6	33.5	8.000	25.5	0.00
2	133.3	9.8	5.00	4.8	0.58	182.7	13.5	6.000	7.5	0.90	315.0	26.4	8.000	18.4	2.21
4	111.7	8.2	5.00	3.2	0.78	152.5	11.3	6.000	5.3	1.26	262.4	22.0	8.000	14.0	3.37
6	96.6	7.1	5.00	2.1	0.77	131.6	9.7	6.000	3.7	1.34	226.0	19.0	8.000	11.0	3.95
8	85.5	6.3	5.00	1.3	0.63	116.1	8.6	6.000	2.6	1.23	199.2	16.7	8.000	8.7	4.19
10	76.8	5.7	5.00	0.7	0.40	104.2	7.7	6.000	1.7	1.01	178.6	15.0	8.000	7.0	4.19
12	69.9	5.2	5.00	0.2	0.11	94.7	7.0	6.000	1.0	0.71	162.1	13.6	8.000	5.6	4.04
14	64.2	4.7	5.00	-0.3	-0.22	86.9	6.4	6.000	0.4	0.35	148.7	12.5	8.000	4.5	3.77
16	59.5	4.4	5.00	-0.6	-0.58	80.5	5.9	6.000	-0.1	-0.06	137.5	11.5	8.000	3.5	3.41
18	55.5	4.1	5.00	-0.9	-0.98	75.0	5.5	6.000	-0.5	-0.50	128.1	10.8	8.000	2.8	2.97
20	52.0	3.8	5.00	-1.2	-1.39	70.3	5.2	6.000	-0.8	-0.98	120.0	10.1	8.000	2.1	2.48
22	49.0	3.6	5.00	-1.4	-1.82	66.1	4.9	6.000	-1.1	-1.48	112.9	9.5	8.000	1.5	1.95
24	46.4	3.4	5.00	-1.6	-2.27	62.5	4.6	6.000	-1.4	-1.99	106.7	9.0	8.000	1.0	1.38
26	44.0	3.2	5.00	-1.8	-2.73	59.3	4.4	6.000	-1.6	-2.53	101.2	8.5	8.000	0.5	0.77
28	41.9	3.1	5.00	-1.9	-3.20	56.5	4.2	6.000	-1.8	-3.08	96.3	8.1	8.000	0.1	0.14
30	40.0	3.0	5.00	-2.0	-3.68	53.9	4.0	6.000	-2.0	-3.64	91.9	7.7	8.000	-0.3	-0.52
32	38.3	2.8	5.00	-2.2	-4.17	51.6	3.8	6.000	-2.2	-4.21	87.9	7.4	8.000	-0.6	-1.19
34	36.8	2.7	5.00	-2.3	-4.66	49.5	3.7	6.000	-2.3	-4.79	84.3	7.1	8.000	-0.9	-1.89
36	35.4	2.6	5.00	-2.4	-5.16	47.6	3.5	6.000	-2.5	-5.38	81.0	6.8	8.000	-1.2	-2.60
38	34.1	2.5	5.00	-2.5	-5.67	45.8	3.4	6.000	-2.6	-5.97	77.9	6.5	8.000	-1.5	-3.32
40	32.9	2.4	5.00	-2.6	-6.18	44.2	3.3	6.000	-2.7	-6.57	75.1	6.3	8.000	-1.7	-4.06
Max =					**0.78**					**1.34**					**4.19**

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

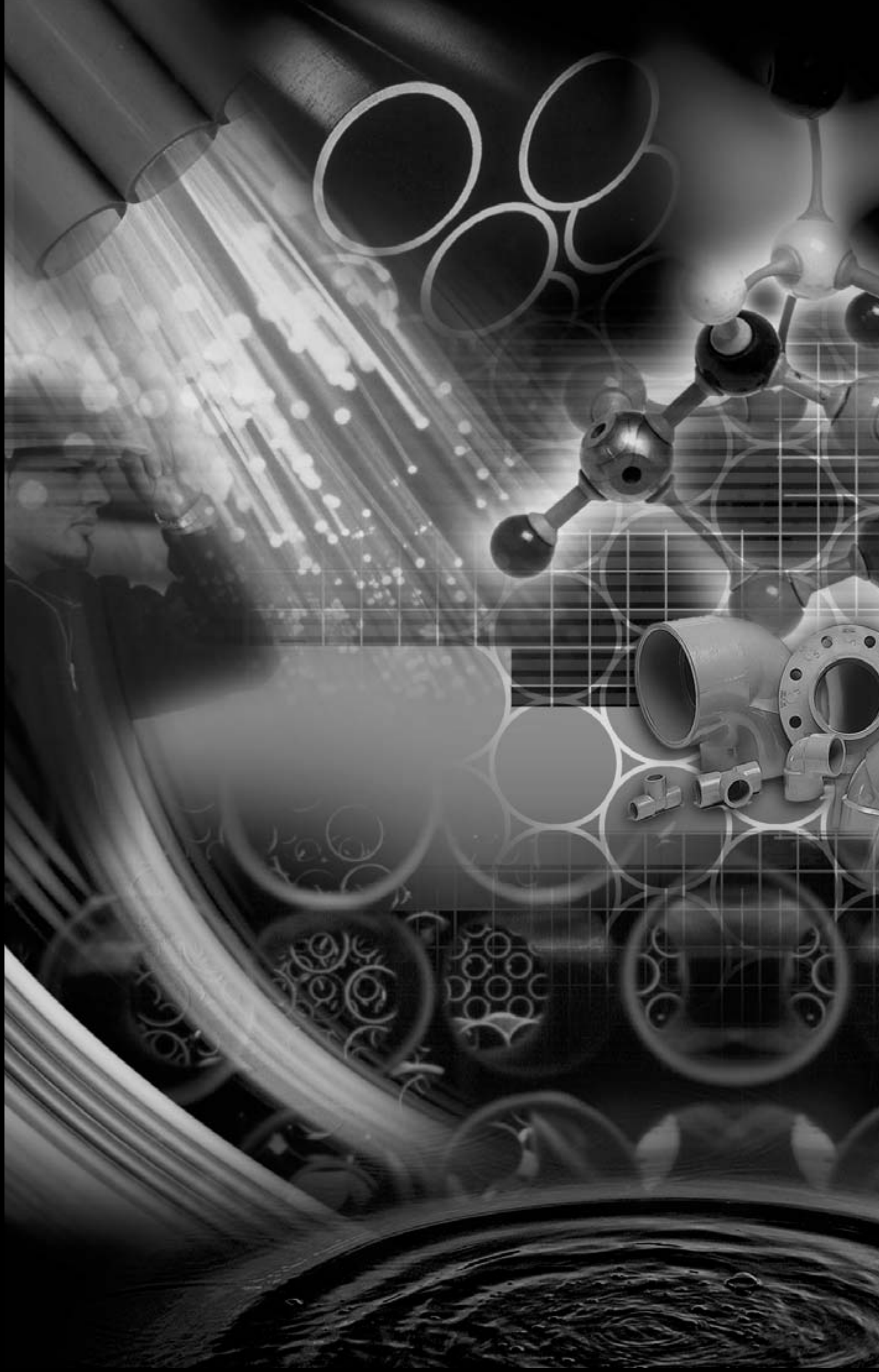
7) Parameters a,b,c are for City of Ottawa

Appendix G – Manufacturer Information

IPEX Tempest Inlet Control Devices. Municipal Technical Manual Series (Cover page, page 5)

StormTech MC-350 & MC-4500 Design Manual (Cover page, pages 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 1: LMF 14 Preset Flow Curves

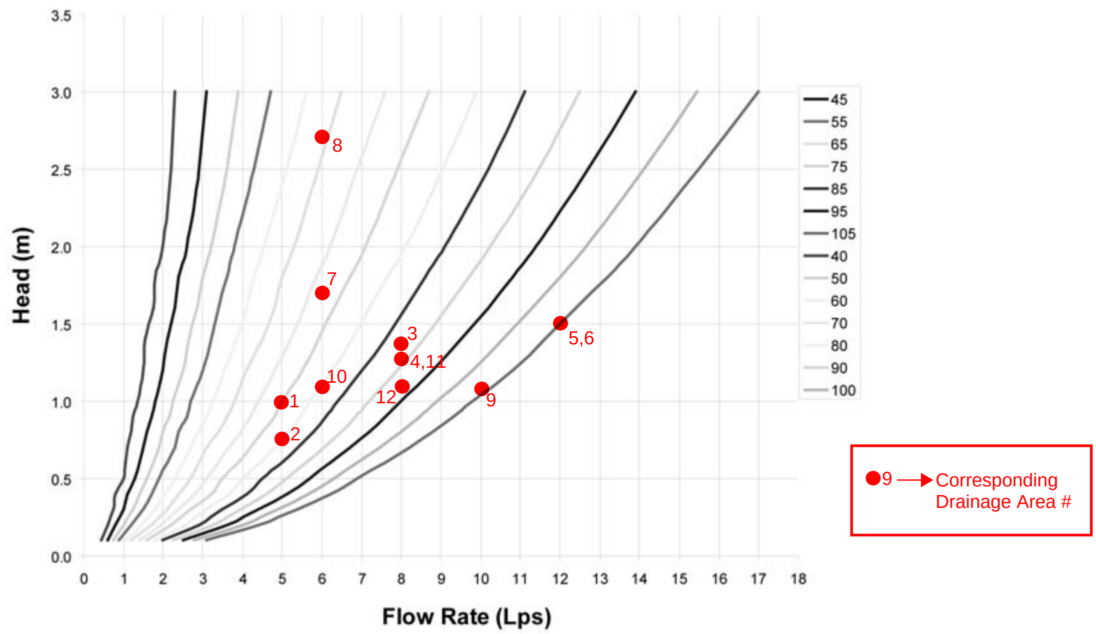
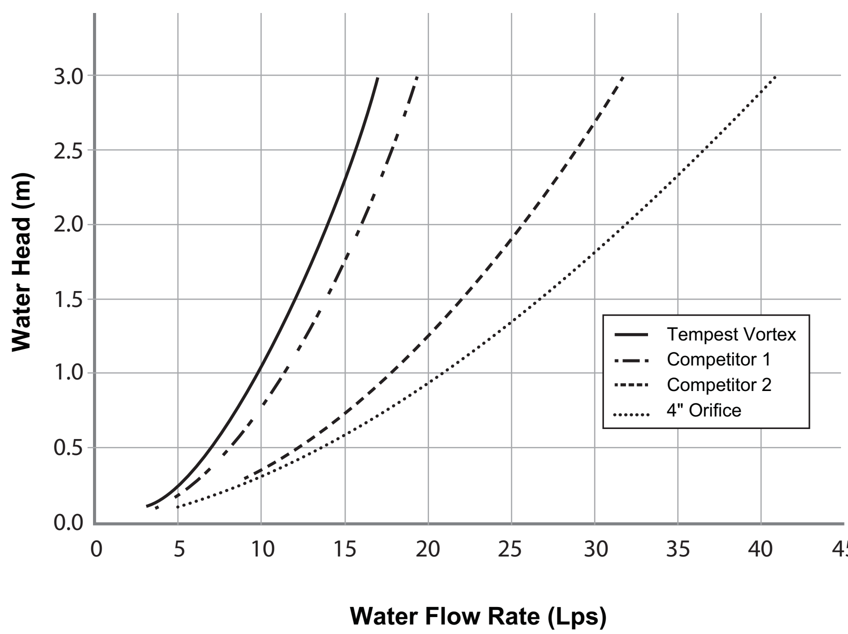


Chart 2: LMF Flow vs. ICD Alternatives



NOTE: Do not use or test the products in this manual with compressed air or other gases including air-over-water-boosters

StormTech®

MC-3500 & MC-4500 Design Manual

StormTech® Chamber Systems for Stormwater Management

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

ADS®

StormTech MC-3500 Chamber

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)

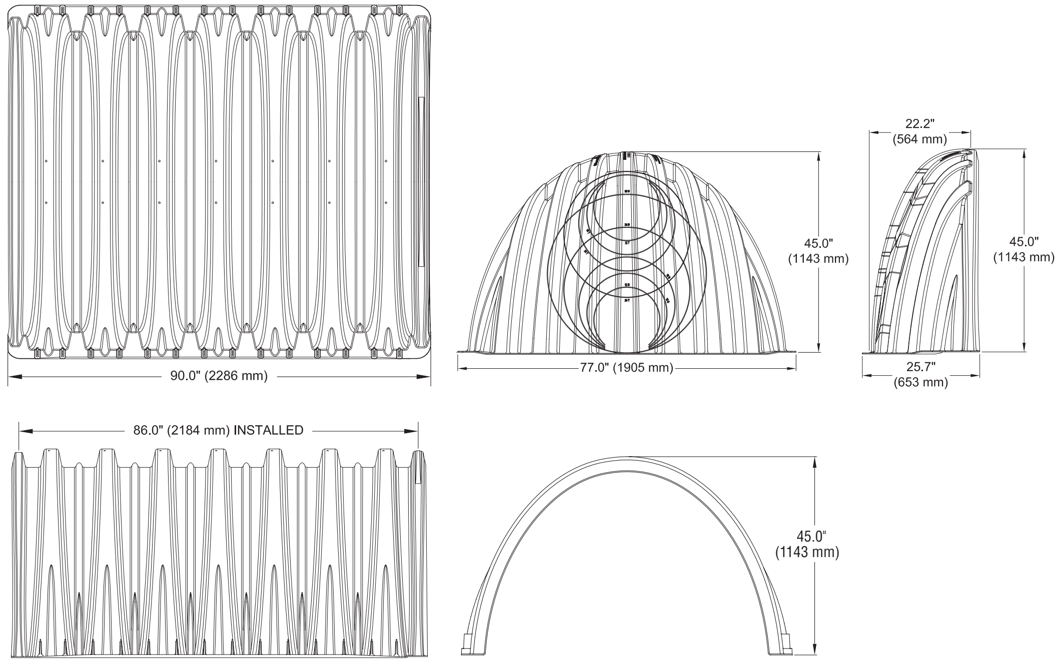
Nominal Chamber Specifications

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)

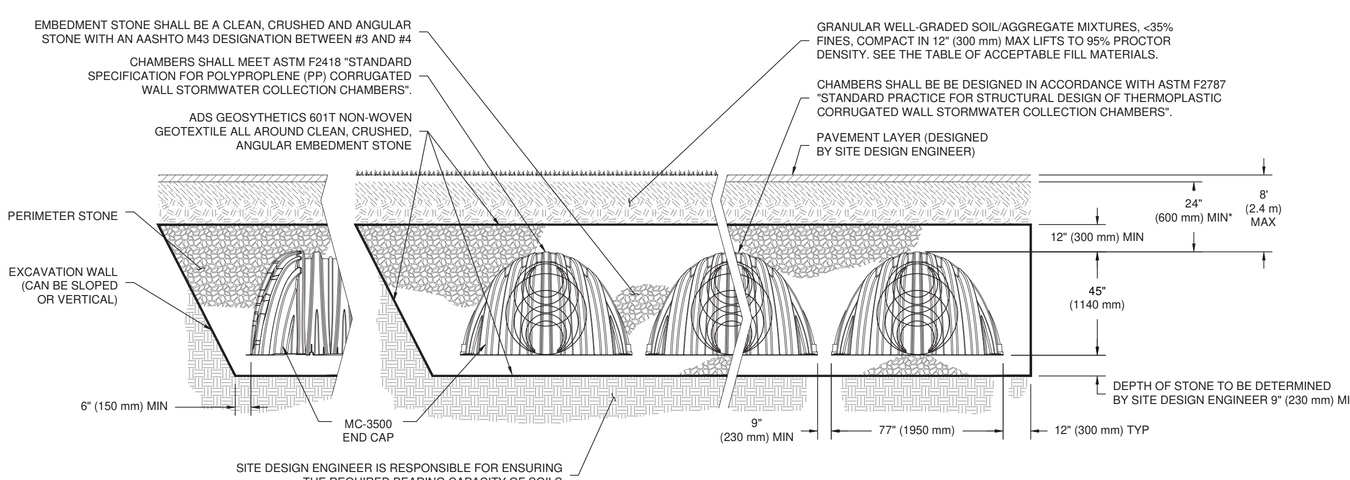
NOTE: Assumes 12" (300 mm) of stone above, and 9" (230 mm) row spacing, and 6" (150 mm) of perimeter stone in front of end caps.

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.

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 ft³ (m³)	Total System Cumulative Storage ft³ (m³)
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 ft³ (0.030 m³) of storage for each additional inch (25 mm) of stone foundation.
Contact StormTech for cumulative volume spreadsheets in digital format.

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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

Storm Sewer Design Sheet 5-Year (Trim Road Subdivision, Trow Consulting, Nov 2002)

Storm Drainage Plan, SD1 (Trim Road Subdivision, Trow Consulting, Nov 2002)

STORM SEWER COMPUTATION FORM

5 Year Rational Method

Client:	Ashcroft Homes
Project:	Trim Road Subdivision
Location:	City of Ottawa (Former City of Cumberland)
Date:	November 12, 2002
Designed by:	J. Fitzpatrick, P.Eng
Checked by:	B. Thomas, P.Eng.

$Q=2.78C_{avg}IA$		(m3/sec)
Time of concentration, T_{conc} =	20.0	min
Manning, n =	0.013	(dimensionless)
I = Rainfall Intensity = 50*(Tc/60)^-0.724 (100 year)		(mm/hr)
I =Rainfall Intensity = 879/(Tc^0.77+2.8) (5-year)		(mm/hr)

DRAINAGE AREA INFORMATION				AREA INFO						PEAK FLOW, RAINFALL INFO						SEWER DATA										
	Manhole			Runoff Coefficient, Area (ha)												DIAMETER										
Location / Street	From	To	Area No.	Parks 0.30	Singles 0.45	Mixed 0.50	ROW 0.60	Asphalt 0.90	C_{avg}	Sum Area (ha)	AC_{avg}	Sum AC_{avg}	T_{conc} (min)	Intensity I (mm/hr)	Peak Flow $Q=2.78C_{avg}IA$ (L/sec)	Nom. (mm)	Act. (mm)	Pipe Type	Pipe Class	Slope %	Pipe Capacity, Mannings Eqn (L/Sec)	Full Flow Velocity (m/sec)	Length (m)	Time (min)	Fall (m)	Reserve Capacity, (Unresticted for Design Storm) (L/sec)
Street 7	164	168	126				1.042		0.60	4.506	0.63	2.29	23.31	62.3	397.3	750	762	CONC	CL-100D	0.30%	636.13	1.39	134.60	1.61	0.404	238.86
Street 8	166	167	121, 122		0.545				0.45	0.545	0.25	0.25	20.00	68.5	46.7	375	375	CONC	CL-100D	0.30%	96.03	0.87	100.80	1.93	0.302	49.36
Street 3	169	167	120		0.389				0.45	0.389	0.18	0.18	20.00	68.5	33.3	375	375	CONC	CL-100D	0.30%	96.03	0.87	74.10	1.42	0.222	62.72
	167	168	125		1.709				0.45	2.643	0.77	1.19	21.93	64.7	214.0	600	610	CONC	CL-100D	0.30%	351.46	1.20	142.20	1.97	0.427	137.45
Street 7	168	119	30,28A		0.398					7.55		3.48	24.92	59.8	578.9	750	762	CONC	CL-100D	0.30%	636.13	1.39	84.30	1.01	0.253	57.18
Trim Road	171	172	94A, 127 (See Note 2)			1.664	1.190		0.54	2.85	1.55	1.55	20.00	68.5	294.2	525	533	CONC	CL-100D	0.54%	329.04	1.47	280.00	3.16	1.512	34.84
Valin Street	172	173								2.854		1.55	23.16	62.6	269.0	525	533	CONC	CL-100D	0.54%	329.04	1.47	62.48	0.71	0.337	60.03
	173	119	128		0.786				0.45	3.640	0.35	1.90	23.87	61.4	324.5	525	533	CONC	CL-100D	0.54%	329.04	1.47	43.97	0.50	0.237	4.57
	119	120	28B		0.077				0.45	11.26	0.03	5.06	25.93	58.4	821.2	825	839	CONC	CL-100D	0.50%	1061.59	1.92	46.86	0.41	0.234	240.40
	120	121	20B, 20C, 24, 23A		0.318				0.45	11.58	0.14	5.21	26.34	57.8	836.2	825	839	CONC	CL-100D	0.50%	1061.59	1.92	60.82	0.53	0.304	225.39
	121	122	25		0.118				0.45	11.70	0.05	5.26	26.86	57.1	834.2	825	839	CONC	CL-100D	0.60%	1160.59	2.10	51.87	0.41	0.310	326.34
	122	123	20A,20D,26		0.668				0.45	12.37	0.30	5.56	27.28	56.5	873.5	825	839	CONC	CL-100D	0.64%	1196.35	2.16	63.00	0.49	0.400	322.83
Mondavi Street	123	124	13A,17		0.717				0.45	43.49	0.32	19.64	33.59	49.5	2701.0	1350	1371	CONC	CL-100D	0.40%	3508.17	2.38	45.24	0.32	0.180	807.15
	124	125	13B, 13C,16B,12B		0.447				0.45	43.93	0.20	19.84	33.90	49.2	2712.1	1350	1371	CONC	CL-100D	0.40%	3511.80	2.38	105.34	0.74	0.420	799.71
	125	126	5A,5B,5C,5D,12A		1.095				0.45	45.03	0.49	20.33	34.64	48.5	2740.8	1350	1371	CONC	CL-100D	0.40%	3510.48	2.38	67.77	0.47	0.270	769.68
	126	127	4		0.155				0.45	45.18	0.07	20.40	35.12	48.1	2725.9	1350	1371	CONC	CL-100D	0.45%	3730.89	2.53	73.96	0.49	0.333	1004.99
	127	110	3A,3B,3C		0.490	0.182			0.46	45.85	0.31	20.71	35.60	47.6	2742.7	1350	1371	CONC	CL-100D	0.45%	3719.56	2.52	73.78	0.49	0.330	976.84
Hallendale Cres	105	106	14A		0.426				0.45	0.43	0.19	0.19	20.00	68.5	36.5	300	305	CONC	CL-100D	0.50%	71.39	0.98	42.05	0.72	0.210	34.91
	106	107			0.000				0.45	0.43	0.00	0.19	20.72	67.0	35.7	300	305	CONC	CL-100D	0.50%	71.46	0.98	8.03	0.14	0.040	35.75
	107	108	7B		0.068				0.45	0.49	0.03	0.22	20.85	66.7	41.2	300	305	CONC	CL-100D	0.50%	71.46	0.98	19.54	0.33	0.098	30.21
Merlot Way	111	108	11A,11B,11C,11D,11E		0.610				0.45	0.61	0.27	0.27	20.00	68.5	52.2	375	375	CONC	CL-100D	0.50%	123.91	1.12	94.10	1.40	0.470	71.67
Hallendale Cres	108	109	8,9		0.219				0.45	1.36	0.10	0.60	21.19	66.1	109.4	375	375	CONC	CL-100D	0.50%	124.01	1.12	69.96	1.04	0.350	14.60
	109	110	10		0.300				0.45	1.66	0.14	0.73	22.23	64.2	130.4	375	375	CONC	CL-100D	0.69%	145.96	1.32	14.43	0.18	0.100	15.60
Mondavi Street	110	101	1B			0.095			0.50	47.61	0.05	21.49	36.09	47.2	2820.5	1350	1371	CONC	CL-100D	0.50%	3932.71	2.66	40.98	0.26	0.205	1112.20
Breezewood Street	119	118	29A, 29			0.669			0.50	0.67	0.33	0.33	20.00	68.5	63.7	300	305	CONC	CL-100D	0.60%	78.28	1.07	47.21	0.73	0.283	14.63
	118	117	27B			0.066			0.50	0.74	0.03	0.37	20.73	67.0	68.4	300	305	CONC	CL-100D	0.60%	78.28	1.07	13.39	0.21	0.080	9.85
	117	116	22A,22B,27A,23B			0.665			0.50	1.40	0.33	0.70	20.94	66.6	129.5	375	375	CONC	CL-100D	0.60%	135.81	1.23	81.88	1.11	0.491	6.26
Merlot Way	111	112			0.000				0.45	0.00	0.00	0.00	20.00	68.5	0.0	300	305	CONC	CL-100D	0.50%	71.46	0.98	7.72	0.13	0.039	71.46
	112	113	16A,11F		0.176				0.45	0.18	0.08	0.08	20.13	68.2	15.0	300	305	CONC	CL-100D	0.50%	71.46	0.98	39.44	0.67	0.197	56.45
	113	114	15A,15B,15C,15D,15E,14C,14B		1.070				0.45	1.25	0.48	0.56	20.80	66.8	104.2	375	375	CONC	CL-100D	0.50%	123.98	1.12	86.36	1.28	0.432	19.79
	114	115	19		0.116				0.45	1.36	0.05	0.61	22.09	64.5	109.8	375	375	CONC	CL-100D	0.50%	123.98	1.12	41.28	0.61	0.206	14.16
	115	116			0.000				0.45	1.36	0.00	0.61	22.70	63.4	108.0	375	375	CONC	CL-100D	0.50%	123.98	1.12	43.40	0.64	0.217	15.99
Breezewood Street	116	104	18A,18B,18C,33A,33B			1.555			0.50	4.32	0.78	2.09	22.05	64.5	374.9	525	533	CONC	CL-100D	1.39%	527.90	2.37	88.17	0.62	1.226	153.02
	104	103	7A,7C,32A,32B,32C			1.566			0.50	5.88	0.78	2.87	22.67	63.4	506.6	750	762	CONC	CL-100D	0.40%	734.54	1.61	65.68	0.68	0.263	227.94
	103	102	6			0.056			0.50	5.94	0.03	2.90	23.35	62.3	502.3	750	762	CONC	CL-100D	0.45%	779.62	1.71	71.01	0.69	0.320	277.30
Mondavi Street	102	101	31A,31B,31C,31D,1B1,1A			1.410			0.50	7.35	0.71	3.61	24.05	61.2	613.2	750	762	CONC	CL-100D	1.49%	1418.64	3.11	51.60	0.28	0.770	805.44
Outlet	101	STMH5	1B2, 2, 2A			0.192			0.50	55.15	0.10	25.19	36.35	47.0	3291.1	1500	1487	CONC	CL-100D	0.30%	3805.57	2.19	82.35	0.63	0.250	514.47
	STMH5	H.W.			0.000				0.45	55.15	0.00	25.19	36.98	46.5	3254.5	1800	1791	CONC	CL-100D	0.15%	4392.79	1.74	29.50	0.28	0.044	1138.33
Totals				**2.35**	**37.82**	**9.01**	**5.93**			**55.11**																

Designed by: ____________________ Approved by: ____________________

Notes
1) For Area 94B. A drainange area of 2.63 ha with C=0.60, Tconc=20min was estimated to match MRC required flow of 300 L/sec at Innes & Valin Street.
2) This includes area 94A (1.19 ha) and Area 127 (1.664). Area 127 was estimated with C=0.50. 294 Lsec was allowed for.

Oakridge Gate, Phase II
PROPOSED RESIDENTIAL (BY OTHERS)
FUTURE FRANK KENNY EXTENSION
TO SWM POND
EX STMH 5 (CCL)
MH (MRC)
MRC DESIGN
Qpeak= 208 L/sec 450mm DIA AT 0.64%
MRC DESIGN
Qpeak= 551 L/sec 750mm DIA AT 0.30%
TROW DESIGN
Qpeak= 3019 L/sec 1500mm DIA AT 0.30%
MRC DESIGN
Qpeak= 368 L/sec 600mm DIA AT 0.46%
MONDAVI STREET
MERLOT WAY
HALLENDALE CRESCENT
BREEZEWOOD STREET
VALIN STREET
GALANDREL CRESCENT
TRIM ROAD
LIMIT OF DEVELOPMENT (BY JD PATTERSON)
TOP OF SLOPE (BY JD PATTERSON)
TRIBUTARY TO CARDINAL CREEK
PROPOSED CULVERT 1400mm DIA
AREA = 145.5 HA
Tpeak = 3.45 HRS
C=0.40
Q25 = 1.87 m3/sec
1400mm CSP @ 1.0%
EXIST. 2-900mm CSPs
LEGEND
DENOTES INDIVIDUAL DRAINAGE AREA BOUNDARY
PROPOSED STORM MANHOLE
PROPOSED CATCH BASIN
STORM DRAINAGE AREA NUMBER
AREA (HECTARES)
RUNOFF COEFFICIENT
STORM DRAINAGE AREA CONTRIBUTING TO SEWERS IN PHASES 1A, 1b, 2 & 3 OF ASHCROFT HOMES DEVELOPMENT.
4 ISSUED AS PER CITY COMMENTS 06/11/02 B.K. B.M.T.
3 REVISED AS PER CITY COMMENTS RESUBMITTED FOR MOEE APPROVAL 09/09/02 B.K. B.M.T.
2 ISSUED FOR MOE APPROVAL 26/06/02 B.K. B.M.T.
1 REVISED AS PER CITY COMMENTS REISSUED FOR CITY APPROVAL 29/05/02 B.K. B.M.T.
No. DESCRIPTION DATE BY APP'D
REVISIONS
HORIZONTAL 1:500
VERTICAL 1:50
Trow Consulting Engineers Ltd.
154 Colonnade Road South, Ottawa, Ontario K2E 7J5
Tel: (613) 225-9940 Fax: (613) 225-7337
Parent Company of Oliver, Mangione, McCalla & Associates
CLIENT
ASCROFT HOMES LTD.
PROJECT
TRIM ROAD SUBDIVISION
TITLE
STORM DRAINAGE PLAN
design by C.C. COLLINS
drawn by C.C. COLLINS
checked by B.M. THOMAS
date 16/1/02
scale HORIZ 1:1000
project no. MP15103A
drawing no. SD1

Appendix I – Correspondence

Boundary Conditions Oakridge Gate 2

Information Provided

Date provided: 23 February 2017

Provided Information:

Scenario	Demand	
	L/min	L/s
Average Daily Demand	36	0.6
Maximum Daily Demand	180	3.0
Peak Hour	270	4.5
Fire Flow Demand # 1	7000	117.0
Fire Flow Demand # 2	8000	133.3
Fire Flow Demand # 3	13000	216.7

# of connections 3

Location

Results

Connection 1 - Trim Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	130.3	59.7
Peak Hour	124.9	52.0
Max Day plus Fire (7,000 l/min)	124.8	54.3
Max Day plus Fire (8,000 l/min)	124.8	51.9
Max Day plus Fire (13,000 l/min)	125.0	52.2

[1] Ground Elevation = 88.28 m

Connection 2 - Mondavi St and Rustic Hills Cres

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	130.2	59.8
Peak Hour	124.8	52.0
Max Day plus Fire (7,000 l/min)	119.4	44.3
Max Day plus Fire (8,000 l/min)	117.3	41.4
Max Day plus Fire (13,000 l/min)	103.3	21.5

[1] Ground Elevation = 88.18 m

Connection 3 - Blue Thistle Pl and Rustic Hills Cres

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	130.2	60.4
Peak Hour	124.8	52.6
Max Day plus Fire (7,000 l/min)	120.4	46.4
Max Day plus Fire (8,000 l/min)	118.7	44.0
Max Day plus Fire (13,000 l/min)	106.6	26.8

[1] Ground Elevation = 87.75 m

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.

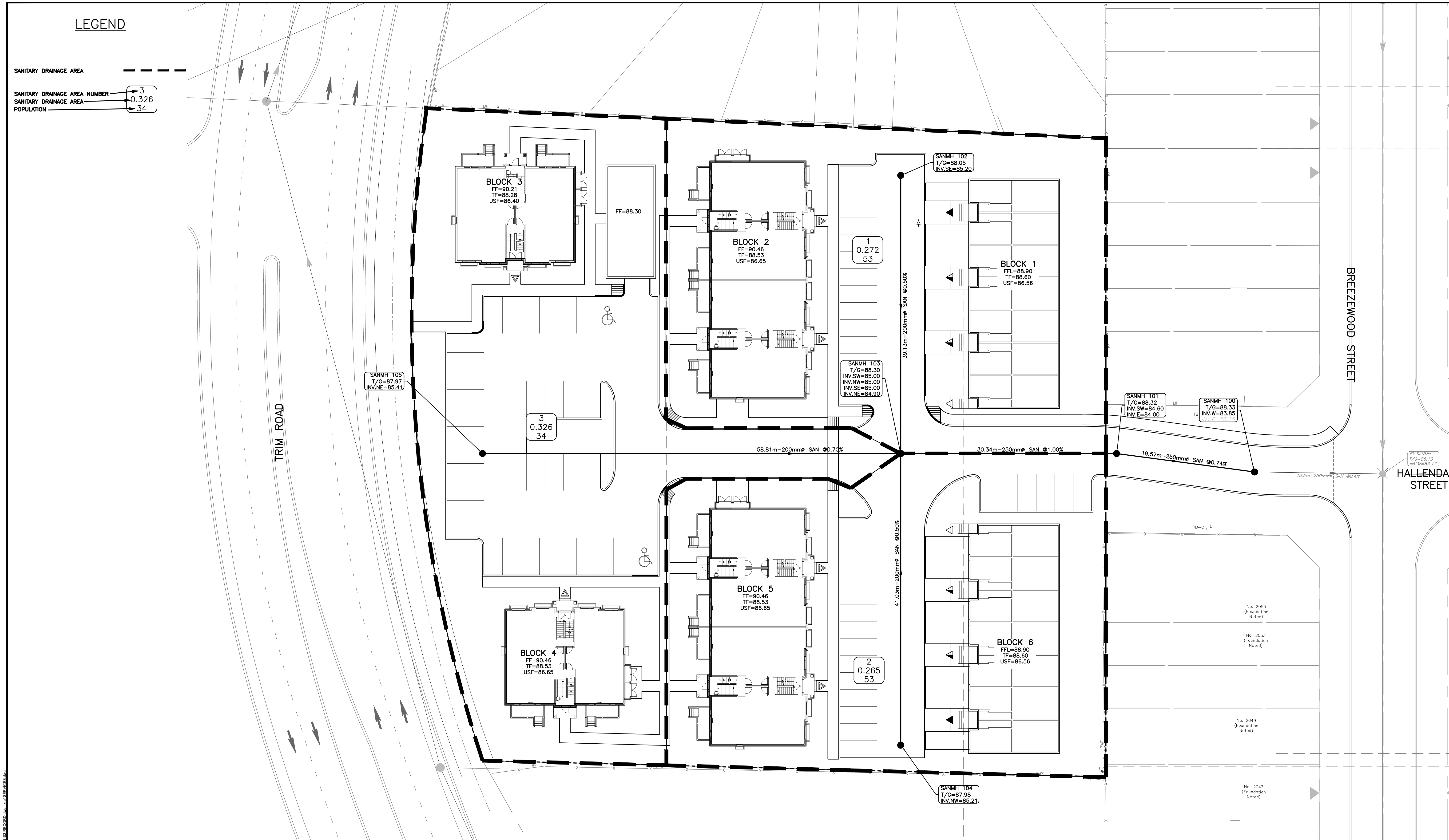
Appendix J – Drawings

Drawing SAN: Sanitary Drainage Plan (11x17 Reduction)

Drawing STM: Storm Drainage Plan (11x17 Reduction)

Drawing SP-1: Preliminary Site Plan (11x17 Reduction)

Drawing: Draft Plan of Survey (11x17 Reduction)



REV	REVISION DESCRIPTION	DATE	BY	APPD
1	FOR CITY REVIEW	18/05/18	MZG	BMT

SCALE: 0 2m 4m 10m HORIZONTAL 1:250

NORTH

DESIGNED BY

REVIEWED BY

CLIENT: ASHCROFT HOMES
18 ANTARES DRIVE
OTTAWA, ON. K2E 1A9

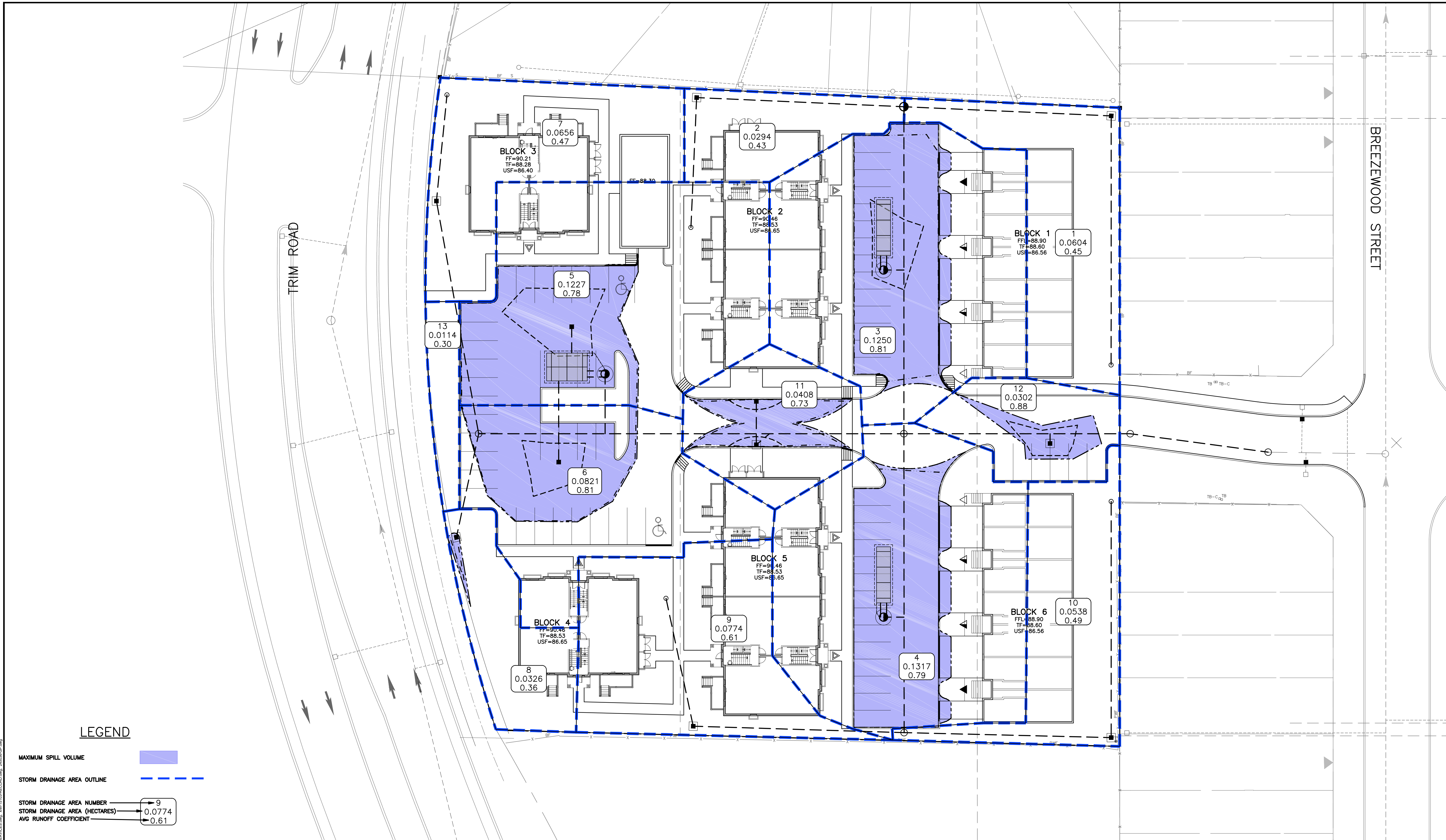
exp Services Inc.
2650 Queensview Drive, Unit 100
Ottawa, ON K2B 8H6
Canada
www.exp.com
• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

BASEPLAN: SAB
DESIGN: MZG
CHECKED: BMT
CAD: SAB
PROJECT MANAGER: BMT
APPROVED: BMT

PROJECT: OAKRIDGE GATE, PHASE II

TITLE: SANITARY DRAINAGE PLAN

PROJECT No.: OTT-00245036-A0
SURVEY: AOV
DATE: APRIL 2018
DRAWING No.: SAN



LEGEND

MAXIMUM SPILL VOLUME

STORM DRAINAGE AREA OUTLINE

STORM DRAINAGE AREA NUMBER — 9
STORM DRAINAGE AREA (HECTARES) — 0.0774
AVG RUNOFF COEFFICIENT — 0.61

REV	REVISION DESCRIPTION	DATE	BY	APPD
2	SERVICING REPORT	06/06/18	MZG	BMT
1	CONCEPT ISSUED TO CLIENT	23/03/18	SAB	BMT

SCALE: 0 5m 10m 20m HORIZONTAL 1:500

CLIENT: ASHCROFT HOMES, 18 ANTARES DRIVE, OTTAWA, ON. K2E 1A9

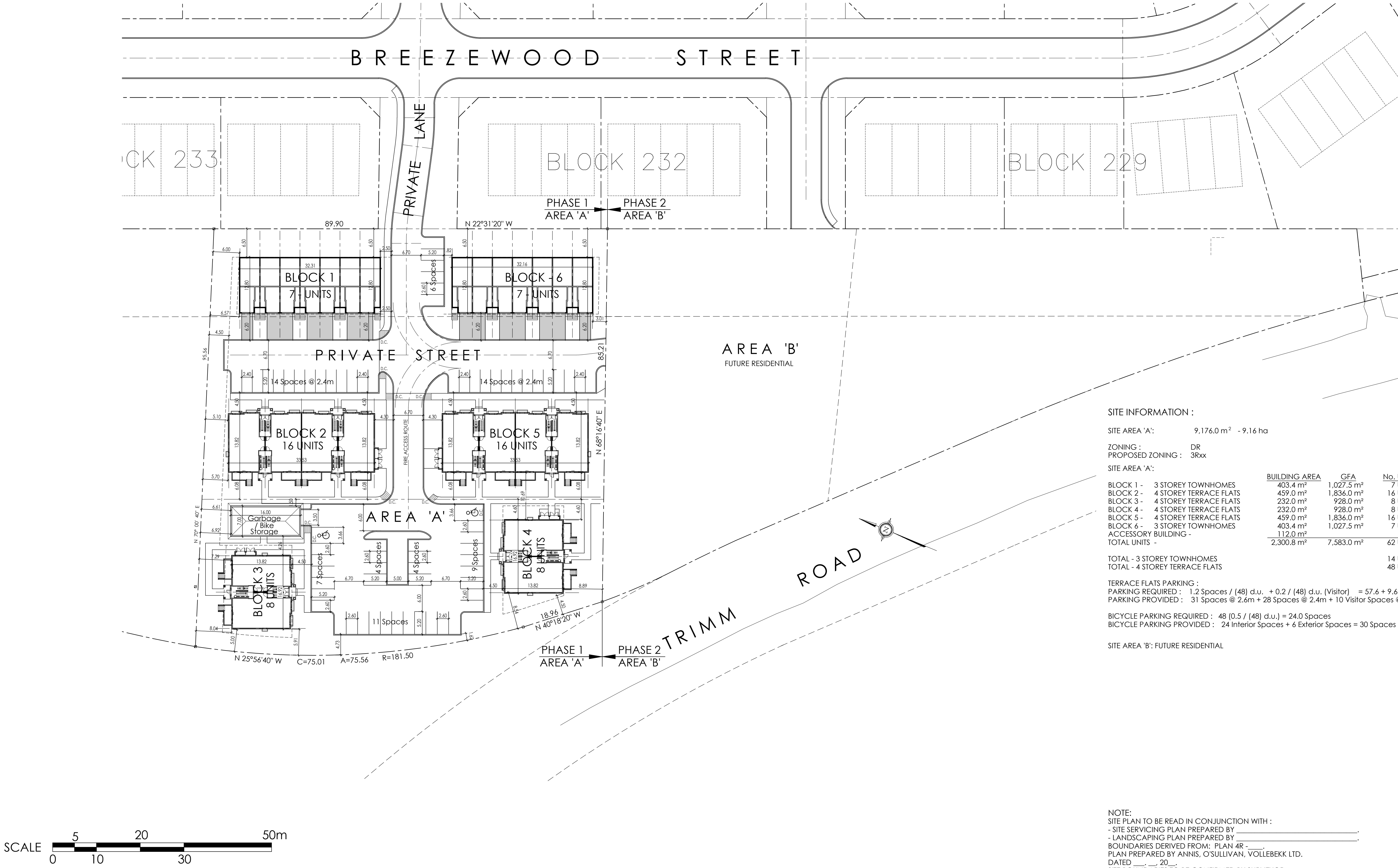
exp Services Inc.
• BUILDINGS • EARTH & ENVIRONMENT • ENERGY • INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

BASEPLAN: SAB
DESIGN: MZG
CHECKED: BMT
CAD: SAB
PROJECT MANAGER: BMT
APPROVED: BMT

PROJECT: OAKRIDGE GATE, PHASE II

TITLE: STORM DRAINAGE PLAN

PROJECT No.: OTT-00245036-A0
SURVEY: AOV
DATE: APRIL 2018
DRAWING No.: STM



SITE INFORMATION :

SITE AREA 'A': 9,176.0 m^2 - 9.16 ha

ZONING : DR
PROPOSED ZONING : 3Rxx

SITE AREA 'A':

		BUILDING AREA	GFA	No. UNITS
BLOCK 1 -	3 STOREY TOWNHOMES	403.4 m^2	1,027.5 m^2	7 UNITS
BLOCK 2 -	4 STOREY TERRACE FLATS	459.0 m^2	1,836.0 m^2	16 UNITS
BLOCK 3 -	4 STOREY TERRACE FLATS	232.0 m^2	928.0 m^2	8 UNITS
BLOCK 4 -	4 STOREY TERRACE FLATS	232.0 m^2	928.0 m^2	8 UNITS
BLOCK 5 -	4 STOREY TERRACE FLATS	459.0 m^2	1,836.0 m^2	16 UNITS
BLOCK 6 -	3 STOREY TOWNHOMES	403.4 m^2	1,027.5 m^2	7 UNITS
ACCESSORY BUILDING -		112.0 m^2		
TOTAL UNITS -		2,300.8 m^2	7,583.0 m^2	62 UNITS
TOTAL - 3 STOREY TOWNHOMES				14 UNITS
TOTAL - 4 STOREY TERRACE FLATS				48 UNITS

TERRACE FLATS PARKING :
PARKING REQUIRED : 1.2 Spaces / (48) d.u. + 0.2 / (48) d.u. (Visitor) = 57.6 + 9.6 = 67.2 Spaces
PARKING PROVIDED : 31 Spaces @ 2.6m + 28 Spaces @ 2.4m + 10 Visitor Spaces @ 2.6m = 69 Spaces

BICYCLE PARKING REQUIRED : 48 (0.5 / (48) d.u.) = 24.0 Spaces
BICYCLE PARKING PROVIDED : 24 Interior Spaces + 6 Exterior Spaces = 30 Spaces

SITE AREA 'B': FUTURE RESIDENTIAL

NOTE:
SITE PLAN TO BE READ IN CONJUNCTION WITH :
- SITE SERVICING PLAN PREPARED BY ______________________.
- LANDSCAPING PLAN PREPARED BY ______________________.
BOUNDARIES DERIVED FROM: PLAN 4R -____.
PLAN PREPARED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
DATED ___. __, 20__.
SITE BOUNDARIES TO BE CONFIRMED BY SURVEYOR.

M. David Blakely Architect Inc.
2200 Prince of Wales Dr. - Suite 101
Ottawa, Ontario K2E 6Z9
Phone (613) 226-8811 Fax (613) 226-7942

GENERAL NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR CHECKING AND VERIFYING ALL DIMENSIONS, ANY DISCREPANCY MUST BE REPORTED TO M. DAVID BLAKELY ARCHITECT INC.
2. ALL WORK AND MATERIALS TO BE IN COMPLIANCE WITH ALL CODES, REGULATIONS AND BY-LAWS.
3. ADDITIONAL DRAWINGS MAY BE ISSUED FOR CLARIFICATION TO ASSIST THE PROPER EXECUTION OF WORK. SUCH DRAWINGS WILL HAVE THE SAME MEANING AND INTENT AS IF THEY WERE INCLUDED IN THE CONTRACT DOCUMENTS.
4. DO NOT SCALE DRAWINGS.
5. THIS DRAWING SHALL NOT BE USED FOR PERMIT OR CONSTRUCTION UNLESS THE DRAWING BEARS THE ARCHITECT'S SEAL AND SIGNATURE.
6. THIS REPRODUCTION SHALL NOT BE ALTERED.

CONSTRUCTION NORTH

REVISIONS

No.	DATE	DESCRIPTION	INIT.
10.			
9.			
8.			
7.			
6.	12/07/18	PHASE TWO REMOVED FROM PLAN	SM
5.	04/07/18	FOR SITE PLAN, BOUNDARIES, SURVEY	SM
4.	14/12/17	BUILDING AREAS ADDED TO PLAN	SM
3.	13/10/17	REVISED MODEL TYPES	SM
2.	21/08/17	FOR REVIEW - PHASE TWO ADDED	SM
1.	12/07/17	FOR REVIEW	SM

REVISIONS

No.	DATE	DESCRIPTION	INIT.
20.			
19.			
18.			
17.			
16.			
15.			
14.			
13.			
12.			
11.			

A - DETAIL NUMBER
B - SHEET NUMBER (DETAIL REQUIRED)
C - SHEET NUMBER (DETAIL LOCATION)

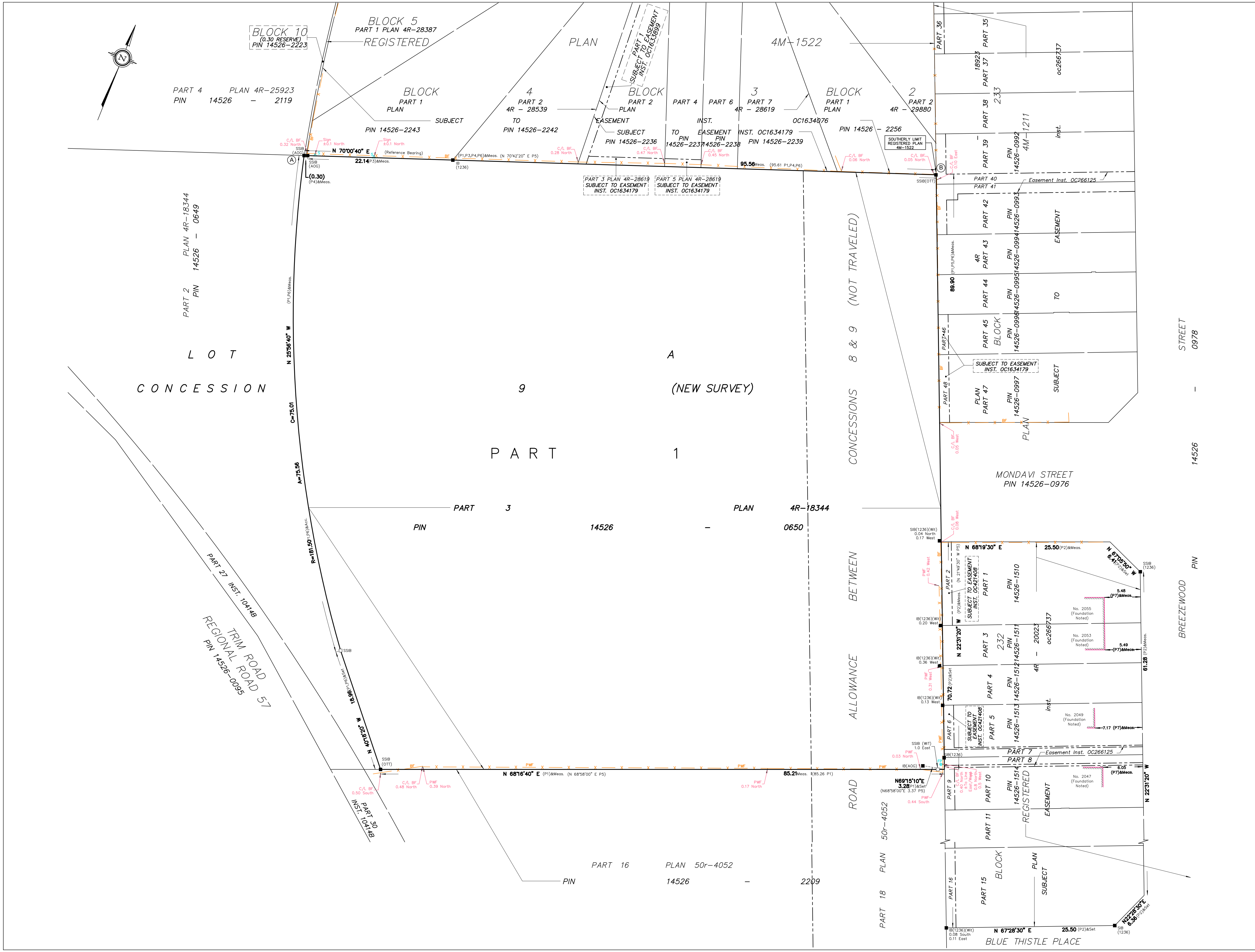
SEAL

PROJECT
PLANNED UNIT DEVELOPMENT
OAKRIDGE GATE
BREEZEWOOD STREET
OTTAWA, ONTARIO

CLIENT
ASHCROFT HOMES

DRAWING TITLE
PRELIMINARY SITE PLAN

DATE	SCALE	SHEET No.
JULY, 2017.	1:400	SP-1
DRAWN BY: SBM	CHECKED MDB	



File No.

I REQUIRE THIS PLAN TO BE DEPOSITED UNDER THE LAND TITLES ACT.

DATE:______________

____
V. ANDREW SHELP
ONTARIO LAND SURVEYOR

PLAN 4R-

RECEIVED AND DEPOSITED

DATE: ______________

____
REPRESENTATIVE FOR LAND REGISTRAR FOR THE LAND TITLES DIVISION OF OTTAWA-CARLETON NO. 4.

SCHEDULE

PART	LOT	CONCESSION	PIN	AREA (sq.m.)
1	PART OF THE ROAD ALLOWANCE	8 & 9	14526-0650	8616.7
	PART OF LOT A	9		

DRAFT PLAN OF SURVEY OF

PART OF LOT A
CONCESSION 9 (NEW SURVEY)
AND
PART OF ROAD ALLOWANCE
AS CLOSED BY BY-LAW No.___
BETWEEN CONCESSIONS 8 AND 9
Geographic Township of Cumberland
CITY OF OTTAWA

Surveyed by Annis, O'Sullivan, Vollebekk Ltd.
Scale 1 : 250

10 7.5 5.0 2.5 0 5 10 Metres

Metric

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

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 Land Titles Act and the regulations made under them.
2. The survey was completed on the __ day of _________, 2018.

__________ Date

________________ V. Andrew Shelp, Ontario Land Surveyor

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
(AOG)	-	Annis, O'Sullivan, Vollebekk Ltd.
(P1)	-	Plan 4R-18344
(P2)	-	Plan 4R-20023
(P3)	-	Plan by (AOG) dated January 22, 2015
(P4)	-	Registered Plan 4M-1522
(P5)	-	Plan 50R-4052
(P6)	-	Plan 4R-25923
(P7)	-	Plan by (1236) dated December 23, 2004
Δ s	-	Sign
CLF	-	Chain Link Fence
BF	-	Board Fence
PWF	-	Post and Wire
● FP	-	Flag Pole
Ø	-	Diameter
C/L	-	Centreline
◯	-	Deciduous Tree

Bearings are grid, derived from Can-Net 2016 Real Time Network GPS observations on reference points A and B, shown hereon, having a bearing of N70°00'40"W and are referenced to Specified Control Points 01919680184 and 019198434761, MTM Zone 9 (76°30' West Longitude) NAD-83 (original).

Distances shown on this plan are ground distances and can be converted to grid distances by multiplying by the combined scale factor of 0.999974.

Coordinate values are to urban accuracy in accordance with O. Reg. 216/10.

. 01919680184	Northing	5040610.16	Easting	384736.56
. 019198434761	Northing	5036178.12	Easting	372436.11
. Point A	Northing	5037820.06	Easting	386246.53
. Point B	Northing	5037852.73	Easting	386336.33

Caution: Coordinates cannot, in themselves, be used to re-establish corners or boundaries shown on this plan.

ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
14 Concourse Gate, Suite 500
Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com
Ontario Land Surveyors

Job No.18592-17 Ashcroft Pt3 Pl4R-18344 RP F | GS