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

Type of Document:
Plan of Subdivision Submission

Client:
Theberge Homes

Project Number:
OTT-00245003-A0

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Date Submitted:
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Table of Contents

List of Figures

List of Tables

List of Appendices

1 Introduction

1.1 Site Description and Proposed Development

Theberge Homes retained exp Services Inc. (EXP) to undertake a site servicing and stormwater management study in support of a zoning by-law amendment and plan of subdivision application for a proposed development at 1158 Second Line Road in the City of Ottawa. The property is situated on Second Line Road, 270m south of Old Carp Road as shown on Figure A1 in Appendix A.

The existing property consists of two (2) parcels. The northern parcel (PIN 045261418) consists of Parts 1 & 2 on Plan 4R-26462, whereas the southern parcel (PIN 045260207) consists of Parts 1 & 2 on Plan 5R-1175 and Part 1 on Plan 5R-8154. The two parcels combine for a total of 1.229 hectares, of which, a 0.029-hectare portion along Second Line Road will be reserved for a 3.0m road widening. The total site area being developed will be 1.20 hectares.

The development is comprised of forty-seven (47) townhome units. The 1.20-hectare development being proposed by Theberge Homes will consist of a three (3) 4-unit townhome block, one (1) 5-unit townhome block, six (6), 6-unit townhome block, one (1) stormwater block, and one (1) common roadway block. The proposed site is bounded to the south and north by Phases 11 & 12D of the Morgan's Grant Development respectively, to the west by Second Line Road, and east by City of Ottawa owned land which is subject to an easement in favor of Hydro One.

A 6.7m wide private roadway is proposed, configured in a H-pattern, having two entrances onto Second Line Road. All utilities will be located within the common roadway block. Sanitary and storm sewers and water infrastructure will require an 11m easement extending north from the site to Goward Drive and a 6m easement southerly to Whernside Terrace is required for a second watermain connection. Figure A2 in Appendix A illustrates the proposed blocks and easements.

This report will discuss the adequacy of the adjacent municipal storm sewers, sanitary sewers and watermains to convey the storm runoff, sewage flows and provide the water demands that will result from the proposed development. It will identify any sanitary, storm or watermain servicing requirements, and provide a design brief for submission, along with the engineering drawings, for City of Ottawa approval.

1.2 Background Documents

Various design guidelines were referred to in preparing the current report including:

- Sewer Design Guidelines, Second Edition, Document SDG002, October 2012, City of Ottawa including:
- Technical Bulletin ISDTB-2012-4 (20 June 2012)
- Technical Bulletin ISDTB-2014-01 (05 February 2014)
- Technical Bulletin PIEDTB-2016-01 (September 6, 2016)
- Technical Bulletin ISDTB-2018-01 (21 March 2018)
- Technical Bulletin ISDTB-2018-04 (27 June 2018)

- Ottawa Design Guidelines – Water Distribution, July 2010 (WDG001), including:
- Technical Bulletin ISDTB-2014-02 (27 Ma7 2014)
- Technical Bulletin ISTB-2018-02 (21 March 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
- Ontario Building Code 2012, Ministry of Municipal Affairs and Housing.

As the proposed site is within the Morgan's Grant Development, various Master Servicing and Stormwater Management Reports were reviewed in preparation of this report. The following reports, which were provided by City staff, are identified below:

- Master Servicing Study for the Morgan's; Grant Subdivision. J.L. Richards & Associates Limited, February 2001.
- Morgan's Grant Subdivision, Phase 12D Stormwater Management Report, J.L. Richards & Associates Limited, Sept 22, 2005.
- Morgan's Grant, Phase 12D Subdivision, Stormwater Site Management Plan, J.L. Richards & Associates Limited, August 2005.

The first document above provides the sanitary and storm sewer designs for Phases 1 – 9 of Morgan's Grant along with lands west of the Hydro Corridor and east of Second Line Road. This Master Servicing Study also makes an allowance for sanitary flows from Phases 12A-12D, which includes the proposed 1.2-hectare property at 1158 Second Line Road.

The second and third document noted above, provide stormwater design information specifically for the latest Phase of Morgan's Grant (Phase 12D), however the documents include background information for all Phase 12 stages (12A – 12D), since the entire Phase 12 area is serviced by a downstream stormwater management facility.

Additional information on the sanitary, storm and water system designs taken from each noted report, is provided in subsequent sections of this report.

1.3 Existing Infrastructure

The current 1.2-hectare site contains a single-family home that is serviced by a groundwater well and a septic tank and tile field bed. The septic tank and tile field is located between the building and Second Line Road, and a drilled well is located behind the home. The site is almost entirely sloped towards the hydro corridor; however, with a small percentage of the site sloped to Second Line Road. Runoff to Second Line Road is collected and conveyed in the existing roadside ditch.

There are no available municipal services located within Second Line Road (except for a 300mm sewage forcemain servicing Carp). As the site topography slopes easterly to the Hydro corridor with an almost

±4m grade change, the services will be required to connect to the municipal sanitary, storm and water infrastructure within Goward Drive. In addition, a second watermain connection within Whernside Terrace is necessary. Additional information on the water supply requirements is provided later in this report.

An 11.0m wide easement from the site to Goward Drive will be required for the proposed 200mm sanitary sewer, 450mm storm sewer and 200mm watermain. The second 6.0-metre-wide easement extending south towards Whernside Terrace will be necessary for a 200mm watermain. These easements are in accordance with 3.3.1.2 of the City of Ottawa Sewer Design Guidelines, and 3.3.1.2 of the City of Ottawa Water Distribution Design Guidelines.

1.4 Consultation and Permits

A pre-consultation meeting was held between Theberge Homes and the City of Ottawa on July13, 2017 prior to design commencement. This meeting outlined the submission requirements and provided information to assist with the development proposal.

The storm and sanitary sewers will require Environmental Compliance Approvals (ECA's), filed through a direct submission with the MECP. The following summarizes the anticipated Environment Compliance Approvals (ECA's) required by the Ministry of Conservation and Parks (MECP), formerly the Ministry of the Environment and Climate Change (MOECC):

- Municipal and Private Sewage Works for **Sanitary and Storm Sewers**.

- Municipal and Private Sewage Works for the establishment of the **Stormwater Management Works** (SWM) which will include the onsite flow control methods and associated stormwater detention.

Prior to completion of the ECA application, City signoff on the infrastructure design will be necessary and a pre-consultation meeting will be held with the local MECP.

The proposed site is located within the Mississippi Valley Conservation Authority (MVCA) jurisdiction, therefore signoff from the MVCA will be required prior to subdivision and ECA approval. As the proposed site is located within the catchment area tributary to the Morgan's grant SWM Facility (City SWMF-1227), no additional onsite quality control requirements are expected. This will be confirmed with the MVCA.

2 Geotechnical Considerations

A geotechnical investigation was completed by EXP Services Inc, on April 12, 2018, and was prepared to establish the subsurface and groundwater conditions onsite, and to provide and discuss excavation, dewatering, and backfilling requirements. It also provides grade-raise, pavement and foundation design requirements.

In general, the site is treed and contains 150mm to 300mm of topsoil overlaid with sandy silt and silty sand. Below the ground surface, rock refusal depth varied between 0.3m to 1.7m, based on eleven (11) test pits and boreholes.

A maximum grade raise requirement of 2.0m was established for the site.

3 Deviations

As it is proposed to construct a 6.7m private roadway within the development, some minor modifications to the typical cross-sectional elements are necessary. Figure A9 in Appendix A illustrates the proposed cross-section. The following summaries the deviations to the City's Guidelines:

- A private roadway block will be used to contain the sewer, water, and utilities infrastructure. The width of the private roadway block varies between 10.12 m and 15.50 m. As this is a private roadway, the proposed roadway cross-section does not meet the City's Design Guidelines. The closest approved cross-section is a 16.5m residential roadway having a 16.5m roadway (Drawing ROW-16.5).
- In order to maintain the minimum clearance from the watermain to the curb line and have a 3.0m centre-to-centre distance from the watermain to the sanitary sewer, it was necessary to set the sanitary sewer at 1.15m from the centerline of road. This is a deviation from the City's Guidelines, which places the sanitary sewer at the centerline of the roadway.
- Due to the narrow roadway, the storm sewer is 0.70m from the gutter line. This is a deviation from the City's Guidelines, which would have a distance from the gutter line to the centre of the storm of 2.75m.
- Due to the storm sewer location close to the curb line, curb-inlet catchbasins are proposed in several places to provide additional horizontal clearance.

4 Watermain Servicing

4.1 Methodology

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

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

4.2 Design Criteria

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

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

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

4.3 Water Demands

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

Population:

- 47-Townhomes x 2.7 person/unit = 126.9 persons
- Average daily water consumption = 350 L/person/day
- Maximum Day Factor = 9.5 x Avg. Day (from GDWS, Table 3-3)
- Maximum Hour Factor = 14.3 x Avg. Day (from GDWS, Table 3-3)

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

- Average Day = 350x126.9/86,400 = 0.51 L/sec
- Maximum Day = 9.50 x 0.51 = 4.88 L/sec
- Peak Hour = 14.30 x 0.51 = 7.35 L/sec

Detailed calculations of the domestic water demands are provided in Table B1 of Appendix B.

4.4 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 were calculated based on typical values as established by the Fire Underwriters Survey 1999 (FUS). The fire flow requirements were calculated for all blocks. It was determined the most critical building was a 6-unit townhome block (Block #6) having a fire flow requirement of 267 L/sec. For all blocks, the required fire flow (RFF) based on the City's Technical Bulletin ISDTB-2014-02 and ISTB-2018-02 is capped at 167 L/sec.

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

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

where

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

A reduction for low hazard occupancy of -15% for residential dwellings, and an increase for fire area exposure ranging from +38% (min) to +72% (max) was used. Below is a sample calculation of the fire flow requirements for Block 6 (the most critical) residential building.

Required Fire Flow Calculation for Block 6

Type of Construction	= Wood Frame
Coeff Related to Construction	= 1.5
Ground Floor Area	= 538 m^2
Number of Floors	= 2
Fire Flow Requirement, FF	= 200 * 1.5 * √ (A) = 200 * 1.5 * √ (538 * 2) = 10,825 L/min or 11,000 L/min (rounded up)
Occupancy Class	= Limited Combustible
Occupancy Charge	= -15%
Fire Flow Requirement, FF	= 11,000 *-15% = -1,650 L/min = 9,350 L/min
Sprinkler Protection Credit	= 0%
Charges Due to Exposures	= sum for all sides = 22% + 22% + 14% + 14% = 72%
Required Fire Flow (RFF) = 9,350* (+72%)	= 9,350 L/min + 6,732 L/min = 16,082 L/min = 16,000 L/min (rounded to closest 1,000) = 267 L/sec
City cap on RFF	=167 L/sec

Although the calculated fire flow for Block 6 is 267 L/sec, it is capped at 167 L/sec as it meets the necessary conditions of TB-ISDTB-2014-02, specifically 1) Blocks are less than 7 units and 600 m^2 of building area, and 2) there is a 10m minimum separation between backs of adjacent units. The following table summarizes the required fire flows for each residential townhome block.

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

Townhome Block #	Calculated Fire Flow (L/sec)	Capped at 10,000 L/min (167 L/sec) Based on TB 2014-02 (Yes/No)	Required Fire Flow, RFF (L/sec)
Block 1	233	Yes	167
Block 2	250	Yes	167
Block 3	183	Yes	167
Block 4	217	Yes	167
Block 5	200	Yes	167
Block 6	267	Yes	167
Block 7	167	Yes	167
Block 8	183	Yes	167
Block 9	200	Yes	167

The fire flow requirement for all proposed buildings is **167 L/sec (10,000 L/min)** based on the FUS. Please refer to Tables B2 through B10 in Appendix B for detailed calculations using the FUS.

4.5 Boundary Conditions

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

Boundary conditions were obtained from City of Ottawa personnel for hydraulic modeling. Boundary conditions were used for the connection points at either Connection Location # 1 on Goward Drive (J-10) or Connection Location # 2 (J-13) on Whernside Terrace. Refer to Appendix I for the boundary system information provided by City of Ottawa staff. As the City did not provide an HGL boundary condition during maximum day demands that could be used during a fire flow analysis, an HGL at the maximum day demand of 3.0 L/sec was interpolated from the City's provided data.

Table 4-2: Boundary Conditions Provided by City of Ottawa

Condition	HGL in metres (psi) at Location #1 on Goward Drive	HGL (m) at Location #2 on Whernside Terrace
Max HGL	150.9m (70.7 psi)	150.9m (70.7 psi)
Max Day (at 2.5 L/sec)	*147.3m (65.6 psi)	*147.9m (66.5 psi)
Peak Hour (at 4.5 L/sec)	140.2m (55.5 psi)	142.0m (58.1 psi)
Max Day plus FF (at 8,000 L/min)	123.8 m (32.2 psi)	124.9 m (33.7 psi)
Max Day plus FF (at 9,000 L/min)	119.5m (26.1 psi)	120.8m (27.9 psi)
Max Day plus FF (at 10,000 L/min)	118.3m (24.1 psi)	119.8m (26.5 psi)
Note: The HGL at a maximum day demand of 3.0 L/sec was interpolated for use in the fire flow analysis.		

4.6 Modelling Results

The results of the WaterCAD modelling under maximum day plus fire flow and peak hourly conditions based on the boundary condition at Location #1, are summarized in Table 4-3 below. Results for both locations #1 and # 2 are included in Appendix D.

Table 4-3: Summary of Results for Peak Hour (Boundary Location #1)

Label	Demand (L/s)	Elevation (m)	Hydraulic Grade (m)	Pressure (psi)
J-1	0.47	103.94	140.11	51.3
J-2	1.88	103.70	140.11	51.7
J-3	2.03	101.62	140.11	54.6
J-4	0.78	102.85	140.11	52.9
J-5	0.47	103.30	139.89	51.9
J-6	0.63	101.21	140.12	55.2
J-7	0.00	101.04	140.15	55.5
J-9	0.00	102.40	140.15	53.6
J-10	0.00	100.76	140.20	56.0
J-11	0.16	101.70	140.11	54.5
J-12	0.07	101.25	140.12	55.2
J-17	0.00	103.80	140.11	51.5
J-18	0.94	102.00	140.11	54.1
J-19	0.00	101.25	140.11	55.2
J-21	0.00	103.00	140.11	52.7

Table 4-4: Summary Results for Maximum Day Plus Fire Flow (Boundary Location #1)

Hydrant Label	Fire Flow (Needed), RFF (L/sec)	Flow (Total Available) (L/sec)	Satisfies Fire Flow Constraints?
H-1	167.0	146.5	Yes (see note)
H-2	167.0	164.8	Yes (see note)
H-3	167.0	159.7	Yes (see note)
Note: The RFF of 167 L/sec is met with contribution of flows from all three (3) hydrants. Refer to Section 4.7			

The calculated minimum and maximum working pressures anticipated within the development are 51.3 psi and 56.0 psi under peak hour conditions, with an estimated fire flow available at the proposed hydrants FH1, FH2, FH3 of 146 L/sec, 165 L/sec and 160 L/sec respectively. Although the individual available fire flows at any individual hydrant does not meet the required fire flow of 167 L/sec, the combined available flow from the three hydrants exceeds the required 167 L/sec. Additional information on the hydrant spacing requirements is provided in the proceeding section.

4.7 Hydrant Spacing

A review of the hydrant spacing was completed to ensure compliance with Appendix I of Technical Bulletin ISTB-2018-02. All hydrants within 150 metres were reviewed to assess the total possible contribution of flow. For each hydrant the distance to the proposed building was determined to arrive at the contribution of fire flow from each. All hydrants are expected to be of Class AA as per Section 5.1 of Appendix I.

Table 4-5 below summarizes all fire hydrants within a 150m distance from each of the residential blocks. For each hydrant the distance measured along a fire route or roadway was used and its contribution to the required fire flow. A detailed table showing the distances and fire flow from each hydrant to each block can be found in Table B8 of Appendix B.

Table 4-5: Summary of Results for Peak Hour (Boundary Location #1)

Hydrant #	Fire Flow Contribution (L/min)								
	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9
FH-1	5,700	3,800	3,800	3,800	3,800	5,700	5,700	5,700	5,700
FH-2	3,800	3,800	5,700	5,700	5,700	3,800	3,800	3,800	3,800
FH-3	5,700	5,700	5,700	3,800	3,800	3,800	3,800	5,700	3,800
Total (L/min)	15,200	13,300	15,200	13,300	13,300	13,300	13,300	15,200	13,300
FUS RFF in L/min or (L/sec)	10,000 (166.7)	10,000 (166.7)	10,000 (166.7)	10,000 (166.7)	10,000 (166.7)	10,000 (166.7)	10,000 (166.7)	10,000 (166.7)	10,000 (166.7)
Meets FF Requirement (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

From this table the total available contribution of flow from hydrants which are in proximity to each townhome block was estimated at between 13,300 L/min and 15,200 L/min. These values exceed the required fire flows for each residential block as identified in Appendix I of Technical Bulletin ISTB-2018-02.

4.8 Water Age Analysis

A review of the age of the water within the proposed system was completed to ensure than an appropriate size of watermain was selected, which was not unnecessarily oversized. The maximum residence time was estimated based on volume of water within the private system between the connection point on Goward Drive and the property boundary of the proposed site. It was assumed that the most conservative approach was to estimate the total volume of water within the water system assuming a dead-ended system. This analysis assumed the entire site at 1158 Second Line Road would be feed from the connection point at Goward Drive. This is a conservative approach, as in reality water would be feed from both connection (Goward and Whernside Terrace). The following summarizes the watermain lengths, and volumes used in this analysis:

Total length of 200mm watermains = 341 m
Total length of 38mm watermain services = 31 m
Total length of 19mm watermain services = 376 m (47 services at 8m avg. length each)

Volume of water within all watermains/services = 10.85 m^3 or 10,854 litres

Using the demands in Table B1, the time required for full exhaustion of the 10.9 m^3 of water was calculated based on the demands noted in Table B1. In addition, the minimum night demand of 0.051 L/sec was calculated using MOECC Table 3.3 with a minimum peaking factor of 0.10. The following water age estimates are provided in Table 4-6 below.

Table 4-4: Water Age Results

Demand Condition	Demand (L/sec)	Time Required for Full Water Volume Turnover (hours)
Minimum Night	0.051	58.7
Average Day	0.51	5.9
Maximum Day	2.97	1.0
Peak Hour	4.49	0.7

Although a time of 58.7 hours (was calculated based on a minimum demand of 0.051 L/sec), it should be noted that this demand rate would apply only during an 8 hours nighttime period. After the 8-hour nighttime period, an average rate of 0.51 L/sec would apply during the 16-hour daytime. Based on this, the time required for the full exhaustion of 10.9 m^3, would approximately 8.0+5.1 = 13.1 hours.

Similarly, there are 15 existing single-family homes on Goward Drive that are located west of the proposed connection point. For this 200mm diameter watermain, the estimated volume is 3.9 m^3 6based on 10.0m long 19mm diameter services and 123m of 200mm watermain. The time required for the full exhaustion of 3.9 m^3, at a minimum night and average day demands of 0.021 and 0.21 L/sec respectively would be approximately 8.0+4.4 = 12.4 hours.

Therefore, the age of the water within the proposed development is expected to be similar to that of the adjacent existing subdivision.

5 Sanitary Sewer Design

5.1 Design Criteria

The sewage flows were calculated using City of Ottawa design criteria as follows:

- Unit Density (townhomes) =2.7 person/unit
- Average Residential Flow Allowance = 280 L/person/day
- Peaking Factor (Harmon Formula) $=1 + 14 / (4 + (P/1000)^{0.5}) * K$
- Correction Factor, K = 0.8
- Full Flow Velocity = 0.80 m/sec to 3.0 m/sec
- Extraneous Flow Allowance = 0.33 L/ha/sec

5.2 Proposed Sanitary Servicing

The sanitary sewer system is designed based on a population flow, and an area-based infiltration allowance. Using the above noted design criteria for the sanitary sewers, the sewage flows were calculated as follows:

Population:

No of Units:	= 47
Unit Type:	= townhomes
Unit Density	= 2.7 person/unit
47-Townhomes x 2.7 person/unit	= 126.9 persons

Sanitary Flow

Average Residential Flow Allowance	= 280 L/person/day
Correction Factor, K	= 0.8
Peak Factor = $1 + 14 / (4 + (126.9/1000)^{0.5}) * K$	= 3.37
Avg. Domestic Flow = 126.9 x 280 L/person/day x (1/86,400 sec/day)	= 0.41 L/sec
Peak Domestic Flow = 0.41 L/sec x 4.0	= 1.39 L/sec

Extraneous Flows

Extraneous Flow Allowance	= 0.33 L/ha/sec
Q Infiltration = 0.33 L/ha/sec x 1.2005 ha	= 0.40 L/sec

Total Sewage Flow

Total Sanitary Flow = 1.39 + 0.40	**= 1.79 L/sec**

The estimated peak sanitary flow rate from the proposed property is **1.79 L/sec** based on City of Ottawa Design Guidelines.

The permitted flow velocities within the sanitary sewer system range between 0.60 m/sec and 3.0 m/sec under full-flow conditions. All new sanitary sewers within the proposed site development will be 200mm in diameter therefore a sewer slope of 0.32% is necessary to meet the minimum velocity requirement of 0.60 m/sec. Similarly, the maximum permitted slope of a 200mm sanitary sewer would be 8.1% to meet the maximum 3.0 m/sec full-flow velocity.

A sanitary sewer design sheet was prepared to confirm the sanitary sewer pipe diameters and full-flow velocities. The selected pipe slopes range from between 0.4% and 3.2%, having full flow velocities in the range of 0.67 m/sec to 1.86 m/sec. The capacities of the sanitary sewers would therefore be between 21.1 L/sec and 59.6 L/sec.

5.3 Downstream Sanitary Sewer System

The proposed sanitary sewer within the development site will discharge to a 200mm sanitary sewer on Goward Drive. This sanitary sewer was installed during the development of Phase 12D of Morgan's Grant Subdivision. The development at 1158 Second Line Road falls within Phase 12 of this subdivision.

A review of the sanitary sewer design provided in the Master Servicing Study, indicated that the original sanitary drainage area and sewage parameters for Phase 12 were based on the following:

Original Morgan's Grant Phase 12 Sanitary Design

Area	= 27.0 ha
Residential Density	= 4.0 person/unit
Population	= 496 persons
Average Residential Flow Allowance	= 350 L/person/day
Institution Flow Allowance	= 50,000 L/ha/fay
Residential Peaking Factor	= Harmon Formula
Institutional Peaking Factor	= 1.5

In Appendix B of the Master Servicing Study a sanitary sewer design sheet identifies a total peak flow from Phase 12 of 35.4 L/sec. The sanitary sewer design sheet from the MSS is provided in Appendix I, with the specific rows highlighted.

To confirm adequate capacity is available in the downstream system a review of the as-constructed conditions was completed and the peak sewage rates were re-calculated based on current City Guidelines.

Figure A6 in Appendix A illustrates Phase 12 area of Morgan's Grant. It consists of residential, institutional and open space uses. Using the City of Ottawa's urban building GIS layer, it was determined that Phase 12 contains 241 single family, 47 townhomes, and one school. The entire area is 27.9 hectares and is made up of 2.90 hectares of institutional, 2.74 hectares of open space, with the remaining 21.13 hectares being residential / municipal roadways.

The sewage flows for Morgan's Grant Phase 12, based on current City Guidelines were re-calculated as follows:

Townhomes	= 47
Single Family Homes	= 241
Unit Density (Townhomes)	= 2.7 person/unit
Unit Density (Single Family Homes)	= 3.4 person/unit
47-Townhomes x 2.7 person/unit	= 126.9 persons
241-Single Units x 3.4 person/unit	= 819.4 persons
Residential Population = 126.9 + 819.4	= 946.3 persons

Residential Sewage Flow

Residential Flow Allowance	= 280 L/person/day
Correction Factor, K	= 0.8
Peak Factor = $1 + (14 / (4 + (P/1000)^{0.5})) * K$	
Peak Factor = $1 + (14 / (4 + (946.3/1000)^{0.5})) * 0.8$	
Peak Factor = 1 + (2.81) * 0.8	= 3.25
Avg. Domestic Flow = 946.3 x 280 L/person/day x (1/86,400 sec/day)	= 3.07 L/sec
Peak Domestic Flow = 3.07 L/sec x 3.25	= 9.97 L/sec

Institutional Sewage Flow

Institutional Flow Allowance	= 28,000 L/day/ha
Institutional Peaking Factor	= 1.5
Peak Institutional Flow = 28,000 x 2.9 x (1/86,400 sec/day) x 1.5	= 1.41 L/sec

Extraneous Flows

Total Area	= 27.97 hectares
Extraneous Flow Allowance	= 0.33 L/ha/sec
Extraneous Flows = (0.33 x 27.97)	= 9.23 L/sec

Total Sewage Flow

Total Sanitary Flow = 9.97 + 1.41 + 9.23	= 20.61 L/sec

The re-calculated peak sewage flows under developed conditions for the Phase 12 Morgan's Grant subdivision is calculated to be 20.6 L/sec. With the additional 1.79 L/sec of additional sewage flows from the proposed 47-unit development at 1158 Second Line Road the total peak sewage flow would be 22.4 L/sec. It should be noted that the original design was completed based on a higher average wastewater flow allowance. The City of Ottawa's residential flow allowance is now 280 L/person/day as per Technical Bulletin ISTB-2018-01. Therefore, the existing infrastructure is conservatively designed in accordance with today's standard guidelines. It can be concluded that the existing sanitary sewer infrastructure in Morgan's Grants Phase 12 subdivision will be adequate to service the additional peak sanitary flows from the 1158 Second Line Road development.

6 Stormwater Management

6.1 Design Criteria

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

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

6.1.1 Minor System Design Criteria

- The storm sewers have been designed and sized based on the Rational Method and the Manning's Equation under free flow conditions for the 2-year storm using a 10-minute inlet time.
- Inflow rates into the minor system are limited to 100 L/sec, based on the capture rate established for this site as per the Stormwater Site Management Plan for Morgan's Grant Phase 12D. The design assumed five (5) inlets at 20 L/sec per inlet.
- The storm sewer within the Morgan's Grant Subdivision were designed as a minor (pipe) and major drainage (overland) system, or a dual drainage concept. The minor system was designed to convey runoff based on the 5-year storm under free-flow conditions. Inlet control devices (ICD's) are used within the Morgan's Grant Subdivision to limit the capture rate to the minor system.
- Hydraulic Grade Line (HGL) Analysis within the Morgan's Grant Subdivision was prepared based on the 100-year City of Ottawa IDF parameters. The HGL analysis was based on 100-year captured flows.
- The 100-year HGL elevation in the receiving storm sewer was taken from the Morgan's Grant Subdivision Stormwater report and used as the boundary condition for the establishment of an onsite HGL analysis.

6.1.2 Major System Design Criteria

- Rear yard ponding is permitted as per City of Ottawa Guidelines, up to a maximum of 300mm in depth, however the volume cannot be accounted for.
- The maximum permitted 100-year ponding depth on the private streets is 350mm.
- The product of the depth of flow x velocity must be less than 0.6 m/sec under the 100-year storm as per City Guidelines.
- Overland Flow is permitted to be discharged to the Hydro corridor, with not more than 126 m^3 of runoff from the proposed site, as per the Morgan's Grant, Phase 12D SWM report.
- The major system (roadway) has been designed to convey surface runoff easterly to the Hydro One corridor.
- A minimum of 150mm of vertical clearance must be provided between the spill elevation on the street and the ground elevation at the building.

6.2 Runoff Coefficients

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) / 100 + 0.20, with the imperviousness (IMP) as a percentage.

The average runoff coefficient for the overall site area under post-development conditions was calculated as 0.64, whereas the pre-development average runoff coefficient was less than 0.10. Runoff coefficients for individual catchment ranged from 0.39 to 0.92.

6.3 Calculation of Allowable Release Rate

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

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

QALL = 2.78 C I A

where:

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

Q_{ALL} = 2.78 * C * I * A

Q_{ALL} = 2.78 * 0.50 * 70.25 * 1.20

Q_{ALL} = 117.2 L/sec

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

Although the storm sewer system was based on this peak flow, 100 L/sec (or 5 inlets at 20 L/sec/inlet) was used as the minor system capture rate. Since the captured rate of 100 L/sec was used in the Hydraulic Grade Line Analysis for the downstream storm sewers in Morgan's Grant, the allowable discharge rate to the storm sewer system from the site was limited to 100 L/sec. Runoff in excess of the 100 L/sec capture rate will be detained onsite within a dry detention area or will overflow and be stored within the Hydro corridor.

6.4 Pre-Development Conditions

The proposed site is 1.2 hectares in area and is currently undeveloped, except for a single residential home. This home will be demolished for re-development of the site. The topography of the site is generally in an easterly direction, however a small area along Second Line flows westerly towards this roadway. A pre-development drainage plan for the site was prepared using PCSWMM. The watershed delineation routine was used to establish the catchment areas, based on the Digital Raster Acquisition Project of Eastern Ontario (DRAPE) 2m x 2m digital terrain models (DTM). The DTM images were loaded into PCSWMM and the watershed delineation tool was used to establish overland flow routes and catchments. Figure A8 in Appendix A, illustrates the pre-development catchment for the property, along with the catchment tributary to the culvert at Goward Drive. This catchment was generated to allow for sizing of new culverts under the proposed roadways, and to confirm the allowable discharge rates to Second Line Road. The pre-development runoff coefficient for the site was determined to be 0.23.

Using a time of concentration of 20 minutes and an average runoff coefficient of 0.23, the pre-development release rates from the site were estimated at 40.1 L/sec, 54.2 L/sec and 92.5 L/sec for the 2-year, 5-year and 100-year storms respectively. Based on Figure A7, the estimated pre-development flows to each outlet (either Second Line Road or Hydro Corridor) are summarized in Table 6-1 below. Runoff rates based on the Rational Method and PCSWMM compare well.

Table 6-1: Summary of Pre-Development Peak Flows from Proposed Site

Outlet Location	100-year Pre-Development Peak Flow (L/sec)	
	Rational Method	3hr Chicago Storm (PCSWMM)
To Second Line Road	7.4	22.9
To Hydro Corridor	85.1	81.8
Totals	92.5	104.7

6.5 Proposed Conditions

Due to the re-development of the site the overall post development runoff coefficient will increase over existing conditions. The increase in runoff is due to an increase in imperviousness levels (additional hard surfaces, roof areas and hard landscaping). The post-development average runoff coefficient for the site was calculated as 0.64, based on an average runoff coefficient of 0.20 for grassed areas and 0.90 for hard surfaces.

The proposed development will consist of 47 townhomes complete with a 6.7m wide roadway. Each townhome will have either a single or shared double asphalt driveway. The storm sewers will be directed easterly and then outlet northerly to the existing 450mm and 525mm storm sewers on Goward Drive. The roadways will be sloped easterly with low points being located at the easterly limits adjacent to a proposed dry retention area. Overland flow from the roadways will be directed to this retention area, which will have a controlled outlet connected into the onsite storm sewer system. Figure A9 in Appendix A illustrate the storm drainage system and associated catchments.

6.6 Design Methodology

The methodology for the design stormwater management portion of the storm sewer system is as follows:

- Design storm sewer system based on 2-year storm using the Rational Method.
- Restrict inflow rates to the minor system using inlet control devices installed in catchbasins.
- Place appropriate number and the location of inlets to ensure depth of flow and spread of flow meets City guidelines.
- Meet allowable discharge rate to the Goward Drive Storm sewer of not more than 100 L/sec.
- Ensure no more than 126 m^3 of stormwater volume discharges to the Hydro corridor under the 100-year storm event.
- Ensure that resultant 100-year hydraulic grade line does not raise closer than 300mm from the underside of the proposed building footing (USFs).
- Develop a dynamic hydrologic/hydraulic model that provided peak flow hydrographs and water surface profiles which routes runoff from catchments to the outlet.

The site is designed using a dual drainage stormwater model. Dual drainage systems consist of two separate and distinct networks, being a) the minor (or storm sewer) system and b) the major (or street) system. Storm sewer inlets intercept runoff from catchments and links are created between the major system and the minor system.

For this analysis all minor and major system components were included in the PCSWMM model, including inlet control devices (ICDs) in catchbasins, inlet control for catchbasins in flow-by conditions, and storage for catch basins in ponding conditions.

Rating curves were developed for ICD's based on manufactures specifications, for surface and curb-inlet type catchbasins, and for surface ponding areas.

6.7 Storm Sewer Design

Average runoff coefficients were calculated for all drainage areas for sizing of the storm sewers. Post-development drainage areas are illustrated on Figure A8 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.

6.8 Hydrology

PCSWMM was used to create a dual drainage hydrologic/hydraulic model of the storm sewer system. The model accounts for both the minor system (storm sewer) and the major system (roads). Catchbasins were modelled in either a flow-by condition or in a ponding condition. For catchbasins in flow-by conditions inlet capture curves were developed based on the type of curbs used (mountable curb in this case), and the inlet type (either curb inlet catchbasins or surface inlet catchbasins). Ponding areas were modelled as storage nodes with surface ponding represented by area-depth curves above the inlet control devices (ICDs) located at the outlet pipe invert. Calculations of runoff was completed based on the PCSWMM's EPA SWM 5 engine. Catchment parameters were taken from City of Ottawa's SDG002 Design parameters. The following design parameters and assumptions are noted as follows:

- Infiltration losses based on Horton Equation as per City of Ottawa SDG002.
- Impervious and pervious depression storage as per City of Ottawa SDG002.
- 5-year, 3-hour Chicago storm used to review minor system design based on Rational Method.
- 100-year, 3-hour Chicago storm used assess impact of major event and determine peak flows and depth of runoff.
- Runoff coefficient for all subcatchments were determined using area weighting routine and based on actual hard and soft surface areas. Runoff coefficients were calculated from the impervious levels using the relationship C = (IMP x 0.7) + 0.20.
- Subcatchment areas were derived tributary to each surface inlet (catchbasin).
- Subcatchment widths are equal to the subcatchment area divided by the overland flow path length. As per City Guidelines, the subcatchment width is equal to 2 x length or two-sided catchments.
- Inflows from all catchbasins were restricted with inlet control devices (ICDs) necessary to ensure allowable capture rate of not more than 100 L/sec was maintained.
- The volume of surface ponding at low-points were calculated using the prism-formula (V=1/3*A*H).

6.8.1 Catchment Parameters

Figure A8 in Appendix A illustrates the post-development storm drainage system. Flow path lengths for each subcatchment was determined based on the average overland flow path length, with the catchment width being the area/length. Subcatchment slopes were set at 2% for front yards, and 4% for backyards. The following summarizes the general subcatchment parameters used:

Table 6-2: General Subcatchment Parameters

Parameter	PCSWMM Parameter	Value
Infiltration Loss Method		Horton
Maximum Infiltration Rate	Max. Infil. Rate	76 mm/hr
Minimum Infiltration Rate	Min. Infil. Rate	13.2 mm/hr
Decay Constant (1/hr)	Decay Constant	4.14
Manning N (Impervious)	N Impev	0.013
Manning N (Pervious)	N Perv	0.10
Depression Storage – Pervious Surfaces	Dstore Imperv	1.57 mm
Depression Storage – Impervious Surfaces	Dstore Perv	4.67 mm
Zero Percent Impervious	Zero Imper	25%
Subcatchment Slopes	Slope	2% front yards 4% rear yards

Figure 1 and Table 6.3 below presents the individual subcatchment parameters that were developed and used in the PCSWMM model.

Figure 1 - Post Development Catchments

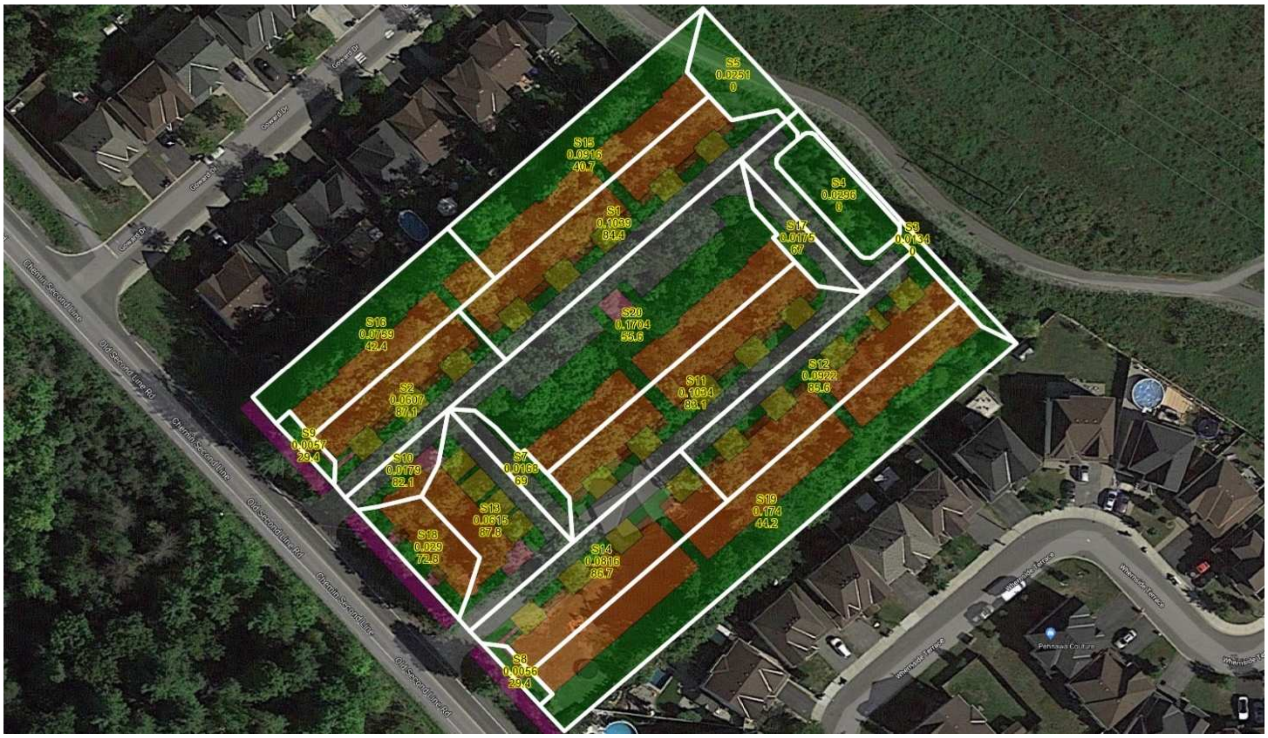


Table 6-3: Post-Development Subcatchment Parameters

Name	Outlet	Area (ha)	Width (m)	Flow Path Length (m)	Slope (%)	IMP (%)	Cavg
S1	Outfall_Second_Line	0.029	26.4	11	2	72.8	0.71
S10	Outfall_Hydro_Corridor	0.0134	44.7	3	2	0	0.2
S11	Outfall_Hydro_Corridor	0.0251	83.7	3	2	0	0.2
S12	CB1	0.0916	83.3	11	4	40.7	0.48
S13	CB6-MAJ	0.1039	148.4	7	2	84.4	0.79
S14	CB2	0.0759	63.3	12	4	42.4	0.5
S15	CB5-maj	0.0607	55.2	11	2	87.1	0.81
S16	Outfall_Second_Line	0.0057	2.9	20	2	29.4	0.41
S17	Outfall_Second_Line	0.0056	18.7	3	2	29.4	0.41
S18	CB9-MAJ	0.0816	74.2	11	2	86.7	0.81
S19	CB10-MAJ	0.0922	83.8	11	2	85.6	0.8
S2	CB3	0.0179	19.9	9	2	82.1	0.77
S20	CB13	0.174	1740	1	4	44.2	0.51
S3	CB3	0.0615	68.3	9	2	87.8	0.81
S4	CB4-MAJ	0.0168	14.0	12	2	69	0.68
S5	CB8-MAJ	0.1704	568	3	4	55.6	0.59
S6	CB12-MAJ	0.1034	94.0	11	2	83.1	0.78
S7	CB8-MAJ	0.0175	35.0	5	2	67	0.67
S8	CB7-MAJ	0.0251	25.1	10	2	70.4	0.69
S9	Drypond	0.0296	11.8	25	2	0	0.2

6.8.2 Storage Node Parameters

All catchbasin will be equipped with (ICDs) to ensure that captured flows do not exceed the allowable rates, and therefore ponding will occur at low points. Catchbasins with flow-by conditions were established as storage nodes however no surface ponding volume was assigned. For storage nodes at low points a stage-volume relationship was assigned based on the maximum depth and area of ponding. Rating curves at ponding locations are provided in Table E8 of Appendix E.

Table 6-4: Storage Node Parameters

Name	[1]Invert (m)	Rim (m)	Depth (m)	Storage Curve	Coeff	Exp	Constant (m^2)	Curve Name
CB1	99.73	101.73	2	FUNCTIONAL	0	0	0.36	*
CB10	99.41	101.41	2	TABULAR	0	0	0	CB10-STORAGE
CB12	99.48	101.48	2	FUNCTIONAL	0	0	0.36	*
CB2	100.1	102.1	2	FUNCTIONAL	0	0	0.36	*
CB3	100.85	102.85	2	TABULAR	0	0	0	CB3-PONDING
CB4	100.84	102.84	2	FUNCTIONAL	0	0	0.36	*
CB5	99.84	102.51	2.67	FUNCTIONAL	0	0	0.36	*
CB6	99.13	101.13	2	TABULAR	0	0	0	CB8-PONDING
CB7	99.12	101.12	2	TABULAR	0	0	0	CB7-PONDING
CB8	99.2	101.2	2	TABULAR	0	0	0	CB8-PONDING
CB9	100.99	102.99	2	FUNCTIONAL	0	0	0.36	*
Dry Pond	98.663	100.8	2.137	TABULAR	0	0	0	DRY-POND
Hydro Corridor	100.8	101	0.2	TABULAR	0	0	0	PARK-STORAGE

Note 1. The invert of the storage node for catchbasins is 0.6m below the outlet elevation. (i.e. sump elevation)

6.8.3 Dry Retention Pond

A dry retention area will be located at the easterly edge of the site and will collect and detain stormwater runoff for large storm events. The size of the retention area is large enough to contain the 100-year event, having a maximum volume of 106 m^3 at its spill elevation. During the 100-year event the maximum modelled volume would be 102 m^3 at a depth of 0.73m. The flowing summarizes the pond parameters used.

- Elevation and area at top of detention area =200 m^2 @ 100.85m
- Elevation and area at bottom of detention area =50 m^2 @ 100.0m
- Emergency spill elevation to park =100.85m

This detention area will not be designed for quality treatment of runoff. Runoff form the storm sewer system will be discharged to the downstream stormwater facility within Phase 12 of Morgan's Grant. The facility was designed for a normal level of water protection (70% TSS)

A copy of certificate of Approval for this stormwater facility is provided in Appendix I for reference. Additionally, the Operation and Maintenance Manual for this stormwater facility was provided by the City of Ottawa, which indicated that water quality sampling performed in 2008, 2009 and 2010, resulting the average TSS removal efficiencies of 91%, 87% and 75 % respectively.

6.8.4 Outlet Node (ICD) Parameters

All catchbasins and the ditch inlet outletting from the dry retention area will be equipped with inlet control devices to ensure that the captured rate entering the Goward Drive storm sewer is less than the allowable rate of 100 L/sec.

Consistent with City guidelines, the ICDs for the rear-yard areas will be located within the roadway catchbasins rather than located in the rear yard catchbasin.

Table 6-5 below summarizes the inlet control devices used in the catchbasin or manholes. Additional information on the outlet node parameters used for modeling of the inlet capacity at flow-by conditions is presented in proceeded sections of this report. Table E10.1 and E10.2 in Appendix E provides the rating curves for various IPEX Tempest inlet control devices.

Table 6-5: Outlet Node (ICD) Parameters

Name	Location	Type	Rating Curve	Curve Name	Max Flow [100yr] (L/sec)
C11-ICD	CB10	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	5.91
C3-ICD	CB3	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	6.73
CB12-ICD	CB12	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	6.73
CB14-ICD	CB13	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	7.76
CB15-ICD	CB1	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	6.9
CB4-ICD	CB4	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	5.3
CB5-ICD	CB5	ICD	TABULAR/DEPTH	ICD-IPEX-TYPEA	12.62
CB6-ICD	CB6	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	5.64
CB7-ICD	CB7	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	6.2
CB8-ICDA	CB8	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	6.16
CB9-ICD	CB9	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	6.73
POND-ICD	Drypond	ICD	TABULAR/DEPTH	ICD-IPEX-LMF80	8.52

6.9 Dual Drainage Modelling Methodology

6.9.1 Model Development

The subcatchment (or storm drainage areas) were developed in Autodesk CIVIL 3D and imported into PCSWMM. PCSWMM was then used to generate impervious levels for each subcatchment with the area-weighting command. Storm sewers and manholes were imported from CIVIL 3D as GIS shape files and the node and conduit elevations and sizes were inputted based on the preliminary sizing completed with the Rational Method analysis. Connections between the catchbasin nodes and the sewer main were converted to OUTLETS to represent the ICDs. Once all the minor system components were inputted, the major system was defined connecting inlets.

The major system was represented as irregular conduits based on a half-street cross-section. The transect editor in PCSWMM was used to establish this transect, which was applied to the majority of the major system. In addition, swale and roadway spill irregular transects were used to represent the overland flows. In flow-by conditions all subcatchments were linked to major system nodes place just upstream (u/s) of the catchbasin storage nodes. Between the u/s node and the catchbasins were represented by a PCSWMM OUTLET. These outlets were established with rating curves to represent the approach-flow and depth, and the inlet capture rate. Additional information on the rating curves under flow-by and ponding conditions is provided in proceeding sections of this report.

Figure 2 – Model Schematic Showing Minor and Major System Components

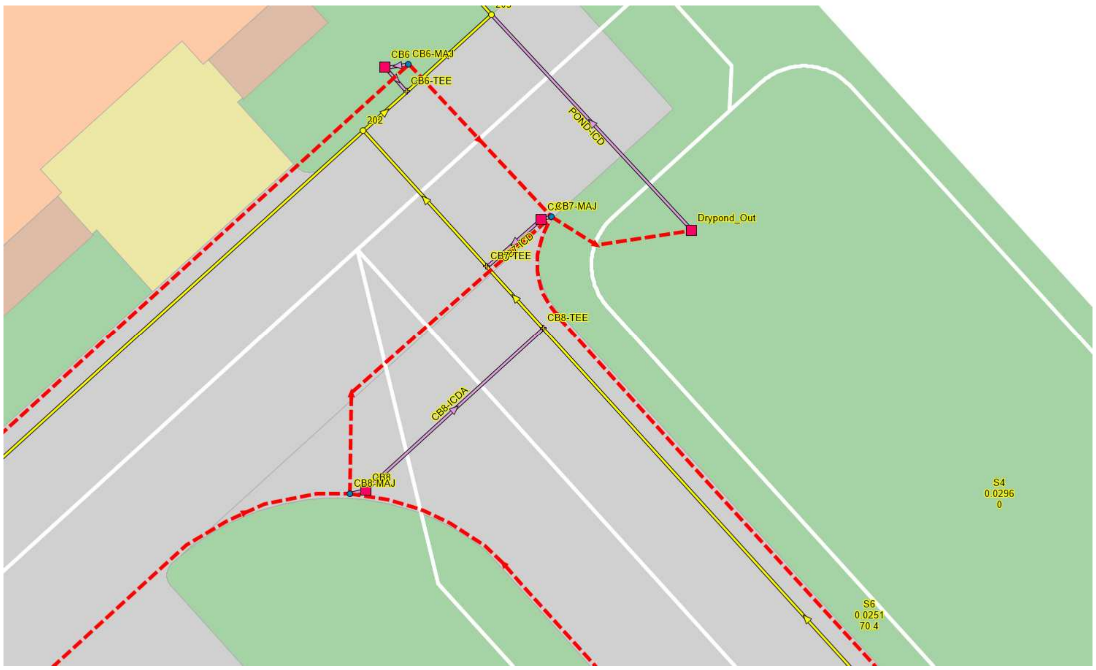
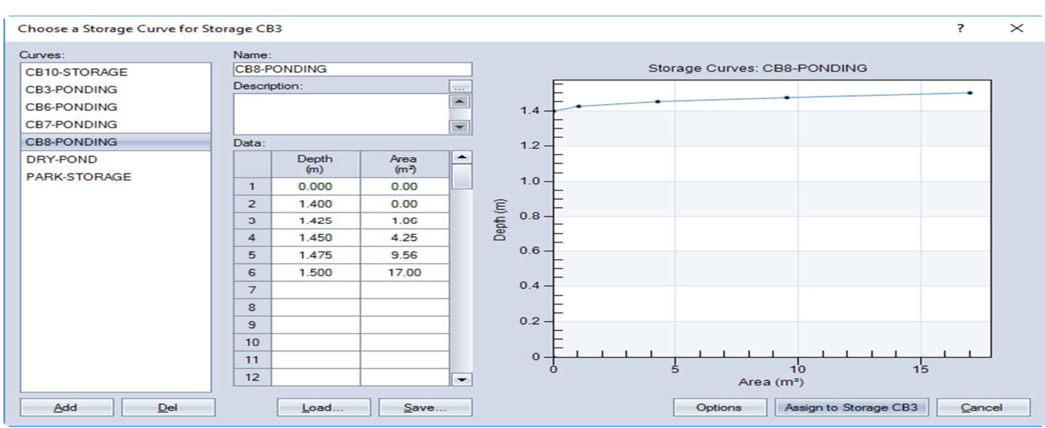


Figure 2 above presents a portion of the PCSWMM model which demonstrates the object connectivity. The subcatchment are illustrates as white polygons, with their area number, area in hectares and percent imperviousness labelled. The yellow lines and circles represent the storm sewer system and manholes, with purple lines representing the OUTLET links (or ICDs). The dashed red lines represent the major system street conduits. Catch basins are shown as red squares and looking closely you can see two OUTLETS connecting the CBs to the storm sewer and the major system nodes. Downstream of each CB represent the ICD, whereas upstream of the CB storage nodes the OUTLET represents the inlet capacity. At ponding locations, the storage nodes were defined based on the depth to the ICD. At all locations the depth from the top of grate to the outlet pipe is 1.4m, therefore the storage of stormwater will only occur starting at a 1.4m depth. The storage rating curves at each catchbasin was modeled similar to the illustration in Figure 3 below.

Figure 3 – Representation of Rating Curves for Modelling of Storage at Ponding Locations



6.9.2 Storm Events Modelled

As this design submission is intended for establishing Draft Plan conditions, seven (7) storm events were modelled at this time. At a later stage during detailed design additional storm distributions and durations will be modelled, however at this stage, the following storm were modelled.

- 3-hour 2-year Chicago storm (timestep 10 mins)
- 3-hour 5-year Chicago storm (timestep 10 mins)
- 3-hour 100-year Chicago storm (timestep 10 mins)
- 3-hour 100-year + 20% Chicago storm (timestep 10 mins)
- Historical storms occurring July 1, 1979, Aug 4, 1988, August 08, 1996

6.9.3 Inlet Control at Flow-By Conditions

The flow-by capture curves are used when an inlet is not located in a ponding area. In this case only a portion of the overland flow is captured, while the remaining flow continues downstream (bypassed). Although the City of Ottawa does not specifically provide rating curves for catchbasins under flow-by conditions, they do provide gutter flow rate curves for either barrier curbs (SC1.1 or OPSD600.110) or mountable curb and gutter (SC1.3 or OPSD 600.020).

The gutter flow rates are provided at longitudinal road slopes of 2%, 4%, 6%, and 8% for flow spreads ranging between 0m to 3m. Along with the gutter flow rates, the inlet capacities of the surface inlets are provided at various spreads.

The inlet capacities of the curb inlet catchbasins were derived from Appendix 7-A.14 through 7-A.17. These pages provide the capture rates (Qc) of the inlets at various approach flows (Qt). Both rating curves for surface type inlets and curb-inlet type catchbasins were based on a roadway with a 3.0% cross fall and longitudinal slopes of 2%. The following Table 6-6 below summarizes the rating curves used for the curb inlet catchbasins in a flow-by condition.

Table 6-6: Rating Curves for Curb Inlet Catchbasin in Flow-By Condition (3% cross fall, 2% slope)

Approach Flow (L/sec)	Total Spread, T (m)	Depth of Flow at Gutter (m)	Inlet Capture Rate (L/sec)
0	0.000	0.000	0
5	0.725	0.022	3
10	0.940	0.028	5
50	1.718	0.052	12
100	2.228	0.067	16
125	2.423	0.073	18
150	2.594	0.078	20
200	2.890	0.087	23
250	3.142	0.094	26

The following Table 6-7 below summarizes the rating curves used for the surface catchbasins with a curb & gutter type curb in a flow-by condition.

Table 6-7: Rating Curves for Surface Catchbasin with Mountable Curb & Gutter in Flow-By Condition (3% cross fall, 2% slope)

Approach Flow (L/sec)	Total Spread, T (m)	Depth of Flow at Gutter (m)	Inlet Capture Rate (L/sec)
0	0.000	0.006	0
5	0.716	0.023	13
10	0.933	0.029	17
50	1.715	0.053	33
100	2.226	0.068	45
125	2.420	0.074	50
150	2.592	0.079	54
200	2.887	0.088	61
250	3.140	0.096	61

Tables E9 and E10 in Appendix E provides additional information on the development of the rating curves for the catchbasin in flow-by conditions. This exercise was completed since PCSWMM does not have the ability to provide Approach Flow versus Capture Flow at flow-by conditions. PCSWMM requires a depth versus captured flow rate instead.

6.10 Modelling Results

The following summarizes the results of various storm events to ensure the design criteria is met. This includes: 1) total discharge rate to Goward Drive storm sewer is less than 100 L/sec, 2) Total overland flow discharge to Second Line Road is less than pre-development levels, and 3) Maximum permitted overflow volume to Hydro Corridor cannot exceed 126 m^3, 4) maximum stored volume in dry pond not to exceed 106m^3 at 0.85 metre depth in the 100-year event.

Table 6-8: Peak Flows at Outfalls

Storm Event	Outfall_Second_Line - Max. Flow (L/sec)	Outfall_Goward_Storm - Max. Flow (L/sec)
Chicago_3h_2yr	5.8	73.4
Chicago_3h_5yr	9.9	83.0
Chicago_3h_100yr	18.8	94.5
Historic_Jul1-79	22.9	96.0
Chicago_3h_100yr + 20%	16.7	93.6
Historic_Aug4-88	12.2	87.6
Historic_Aug8-96	11.3	92.8

6.10.1 Major System Flows / Depth on Streets

In order to confirm the design criteria for the major system has been met, the product of the depth of flow and the velocity was reviewed. In addition, the allowable spread of flow in the 100-year event must not exceed half the roadway. The data form PCSWMM for the major street segments are showed below for the 100-year storm. As shown below in Table 6-9 the velocity x depth is less than the required 0.60 for all roadway segments. In addition, the City guidelines requires the during the minor system (2-year) storm, the maximum spread cannot exceed half the lane width. Therefore, based on a 6.7m total roadway, 1/2 of one lane would be 1.68m. Table 6-10 below shows that for all segments the spread would be less than the permitted 1.68m.

Table 6-9: Review of Major System Depth and Velocity.

Road Segment	Max. Flow (L/sec)	Max. Spread (m)	Max. Velocity (m/s)	[1]Max/Full Depth (ratio)	Velocity x Depth
C7_2-S	42.5	2.21	0.71	0.33	0.035
C4_5-S	29.87	1.68	0.69	0.25	0.026
C8_5-S	75.91	2.14	1.10	0.32	0.053
C9-S_1	3.13	0.54	0.74	0.08	0.009
C9-S_2	2.56	1.47	0.22	0.22	0.007
C15-S	34.49	2.08	0.57	0.31	0.027
Note 1: Max/Full Depth is the percentage of the actual conduit depth (i.e. percentage of 150mm curb depth)					

Table 6-10: Review of Minor System Flow Spread Criteria

Road Segment	Max. Spread (m)
C7_2-S	1.273
C4_5-S	1.005
C8_5-S	1.206
C9-S_1	0.335
C9-S_2	0.737
C7_2-S	1.273

6.11 Hydraulics

6.11.1 Hydraulic Grade Line Analysis

A hydraulic grade line (HGL) analysis was completed to confirm the 100-year water surface profile will be at least 300mm below the proposed underside of footing elevations of the units.

The downstream boundary condition within the Goward Drive storm sewer was taken from the “Morgan’s Grant – Stage 12” Master Design Sheet, which is included in Appendix I. The following summarizes the boundary condition used.

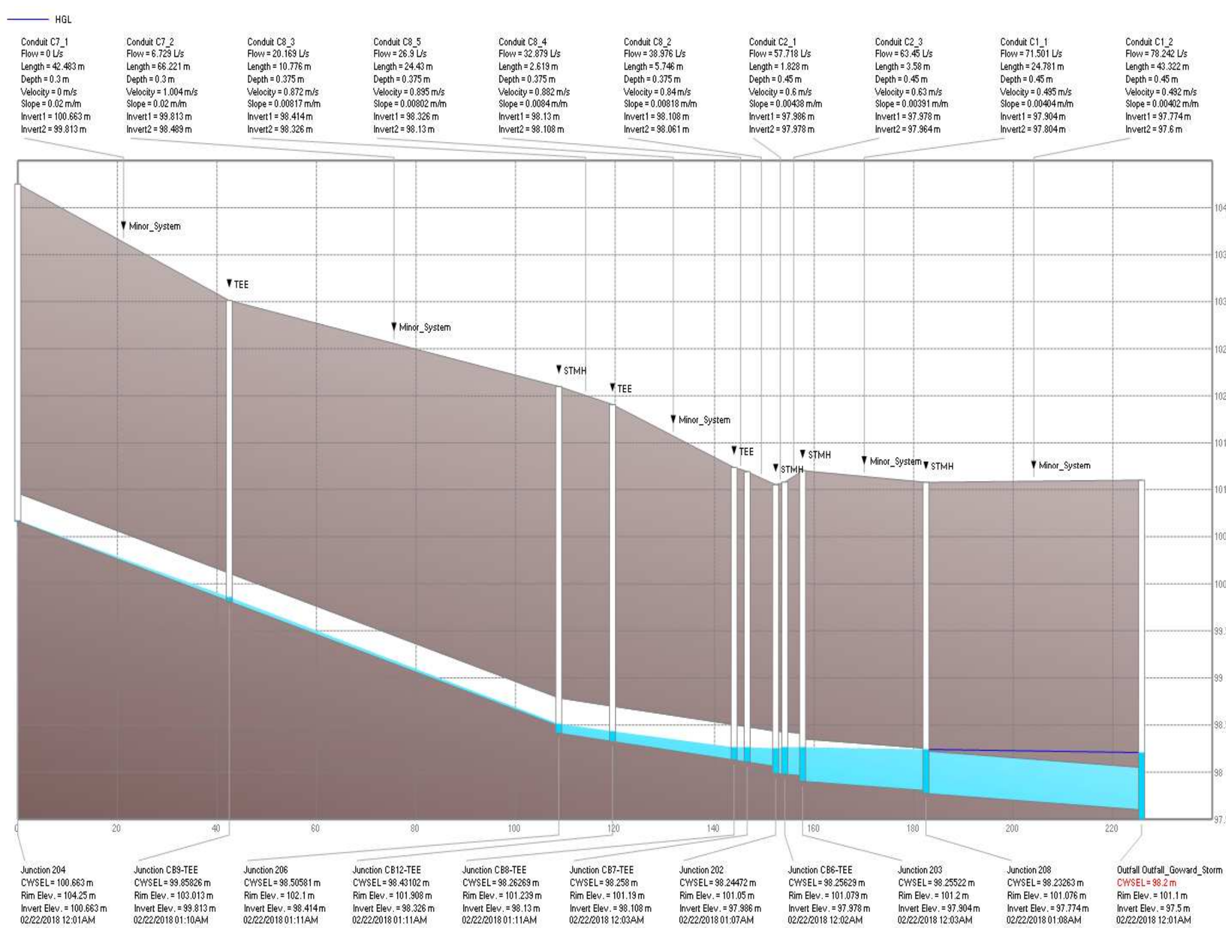
- 100-yr HGL elevation at STMH 907 (connecting manhole) = 98.20m

A steady-state HLG analysis was completed based on free-flow conditions. Free-flow conditions would be a more conservative approach to ensure that the 100-year levels due to surcharging would still have the appropriate clearance to the underside of footing elevations.

Based on this analysis, we can confirm the maximum 100-yr HGL meet the City's clearance requirements. Using captured flows rather than free-flow conditions would result in the HGL being within the storm sewer pipe and not raise above the obvert of the storm sewer system

In addition, the maximum 100-year HLG was plotted from PCSWMM, based on a fixed boundary condition of 98.20m. A profile through the longest section of the site storm sewer system is shown below in Figure 4. It is shown that during the 100-yr event the maximum water surface elevations will remain within the storm sewer system.

Figure 4 – 100-yr HGL Profile



7 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.

8 Conclusions

This report addresses stormwater runoff from the proposed development located at 1158 Second Line Road in the City of Ottawa. The proposed 1.2-hectare development by Theberge Homes is a comprised of forty-seven (47) townhome units. The following summarizes the servicing and stormwater requirements for the site:

- The allowable capture rate from the proposed site was based on the minor system capture rate established as part of the Morgan's Grant Subdivision Phase 12D which was set at 100 L/sec. This capture rate was set just below the 5-year rate for the 1.2-hectare site using a time of concentration of 20 minutes and a runoff coefficient of 0.50, which was calculated at 117.2 L/sec.
- The 100-year pre-development peak flow rate based on the Rational Method was estimated at 7.4 L/sec and 85.1 L/sec to the Second Line ditch and the Hydro Corridor respectively. Dynamic modelling of pre-development flows resulted in peak flows of 27.2 L/sec & 92.7 L/sec for the same storm events.
- Post-development runoff coefficient for the site was calculated at 0.64, with 2-year, 5-year and 100-year peak flows of 189.4 L/sec, 256.8 L/sec and 517.7 L/sec calculated based on the Rational Method. These are total combined peak flows offsite to the west (Seocnd Line) and to the east (Hydro corridor)
- Inlet control devices (ICDs) will be used to control runoff to the allowable discharge rate of 100 L/sec. The Inlet control devices will be installed in all catchbasins as shown on the Site Servicing plan and will control peak flows to a maximum 100-year rate of 94.4 L/sec based on a dual drainage dynamic model.
- Based on dynamic modelling, the total minor system capture rate to the Goward Drive Storm sewer is 73.4 L/sec, 82.9 L/sec and 94.4 L/sec for the 2-year, 5-year and 100-year storm events.
- A dry detention area for stormwater will be used to control runoff. This dry pond will be used for quantity control of runoff only and have a maximum volume of 106 m^3 at a depth of 0.85 metres. The 100-year volume was calculated at 102.8 m^3.
- The proposed development has an estimated peak sewage flow of 1.79 L/sec based on City of Ottawa Guidelines. A new 200mm sewer will be installed with a minimum slope of 0.40% having a full flow capacity of 21.6 L/sec, and full flow velocity of 0.67 m/sec. The sanitary sewer will be connected into the existing municipal sanitary sewer on Goward Drive. A preliminary review of the downstream capacity in the sanitary sewers in Morgan's Grant indicate adequate capacity is available.
- A hydraulic water model was developed to determine the pressures available under peak hour and maximum day plus fire flow conditions. Two boundary conditions were provided by City staff for modelling. Two connections to the existing city water distribution system are necessary as there will be more that 50 residential units on a single watermain feed.
- The calculated minimum and maximum working pressures anticipated within the development is between 51.3 psi and 56.0 psi under peak hourly conditions. The estimated fire flow available at the three proposed hydrants is ±147 L/sec, ±165 L/sec and ±160 L/sec. The total contribution of flow from the three hydrants onsite is an excess of the required fire flow. The maximum estimated fire flow requirement based on the FUS was calculated at 167 L/sec for the largest 6-unit townhome block.
- All units have an underside of footing elevation a minimum of 0.30 metres above the storm sewer hydraulic grade line. An overland flow route is provided for the major storm event.

Appendix A – Figures

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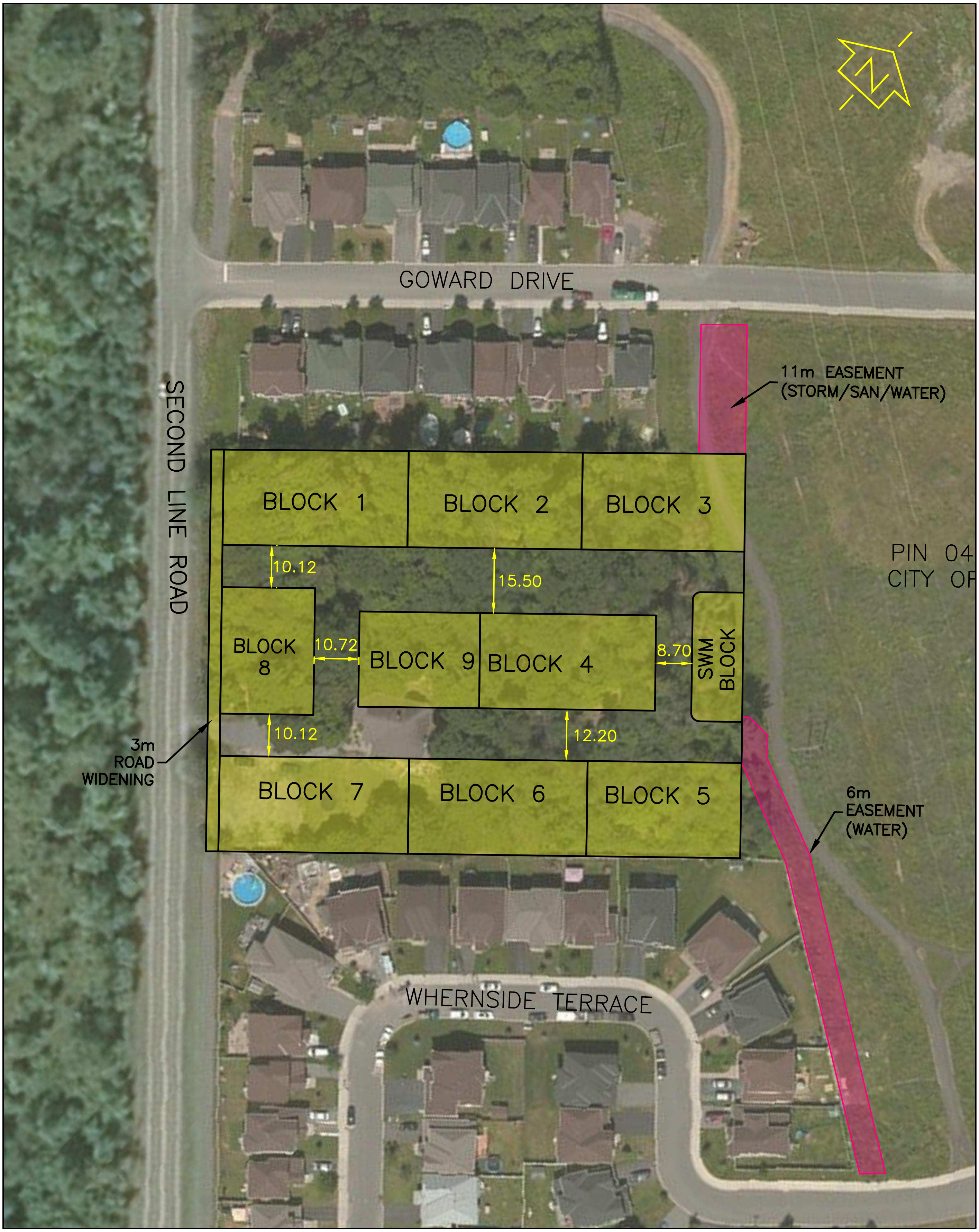
DESIGN JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE 1:10000
DRAWN SAB		SKETCH NO
DATE NOV 2018	SITE LOCATION PLAN	FIG A1
FILE NO 245003		



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DESIGN JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE 1:1250	
DRAWN SAB		SKETCH NO	
DATE NOV 2018	DRAFT PLAN AND EASEMENTS	FIG A2	
FILE NO 245003			

exp Services Inc. 100-2650 Queensview Drive Ottawa, ON K2B 8H6 www.exp.com	DESIGN JLF DRAWN SAB DATE NOV 2018 FILE NO 245003	1158 SECOND LINE RD THEBERGE HOMES WATER MODEL LAYOUT BOUNDARY CONDITON #1	SCALE 1:1250 FIGURE NO FIG A3

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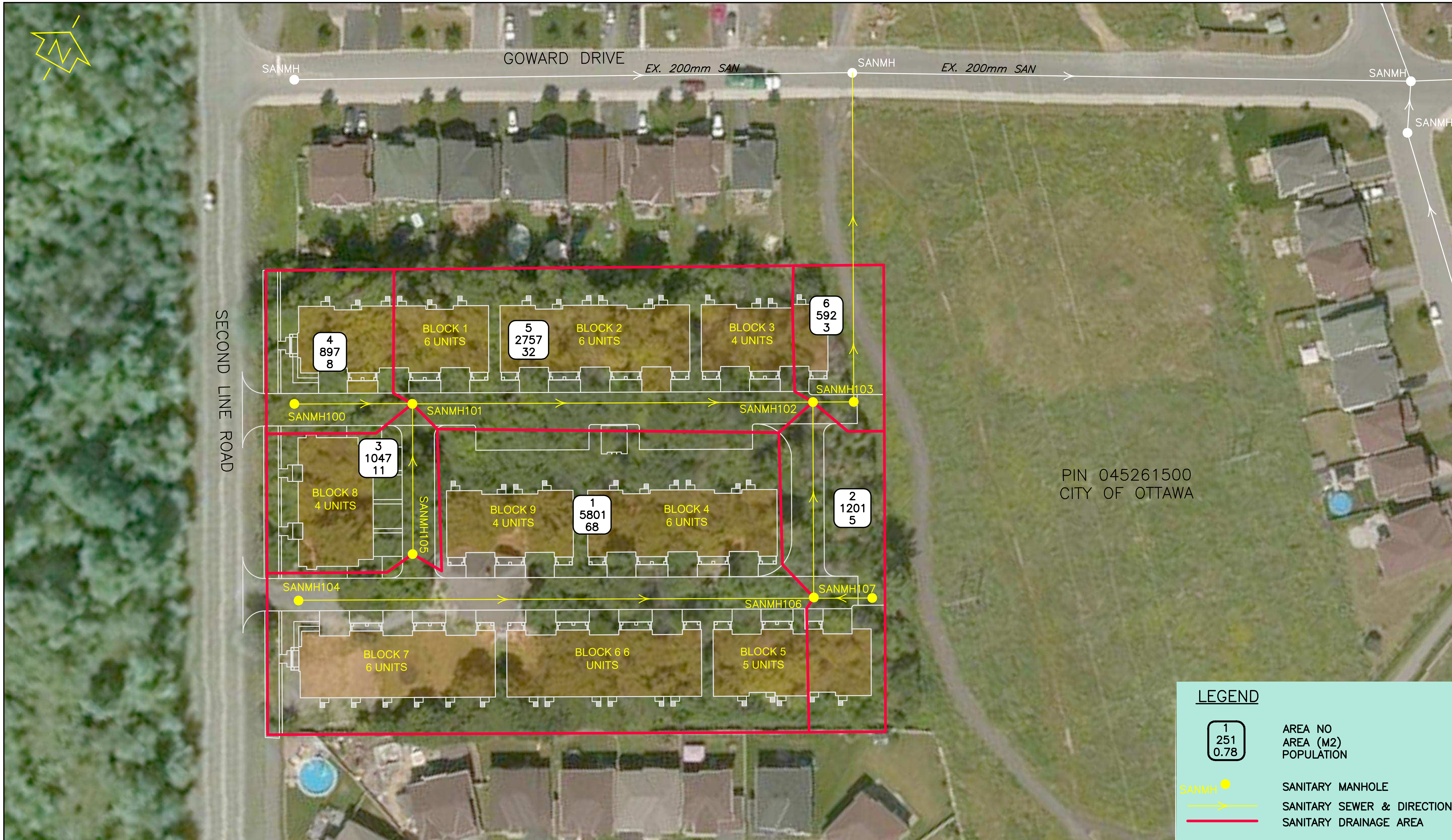
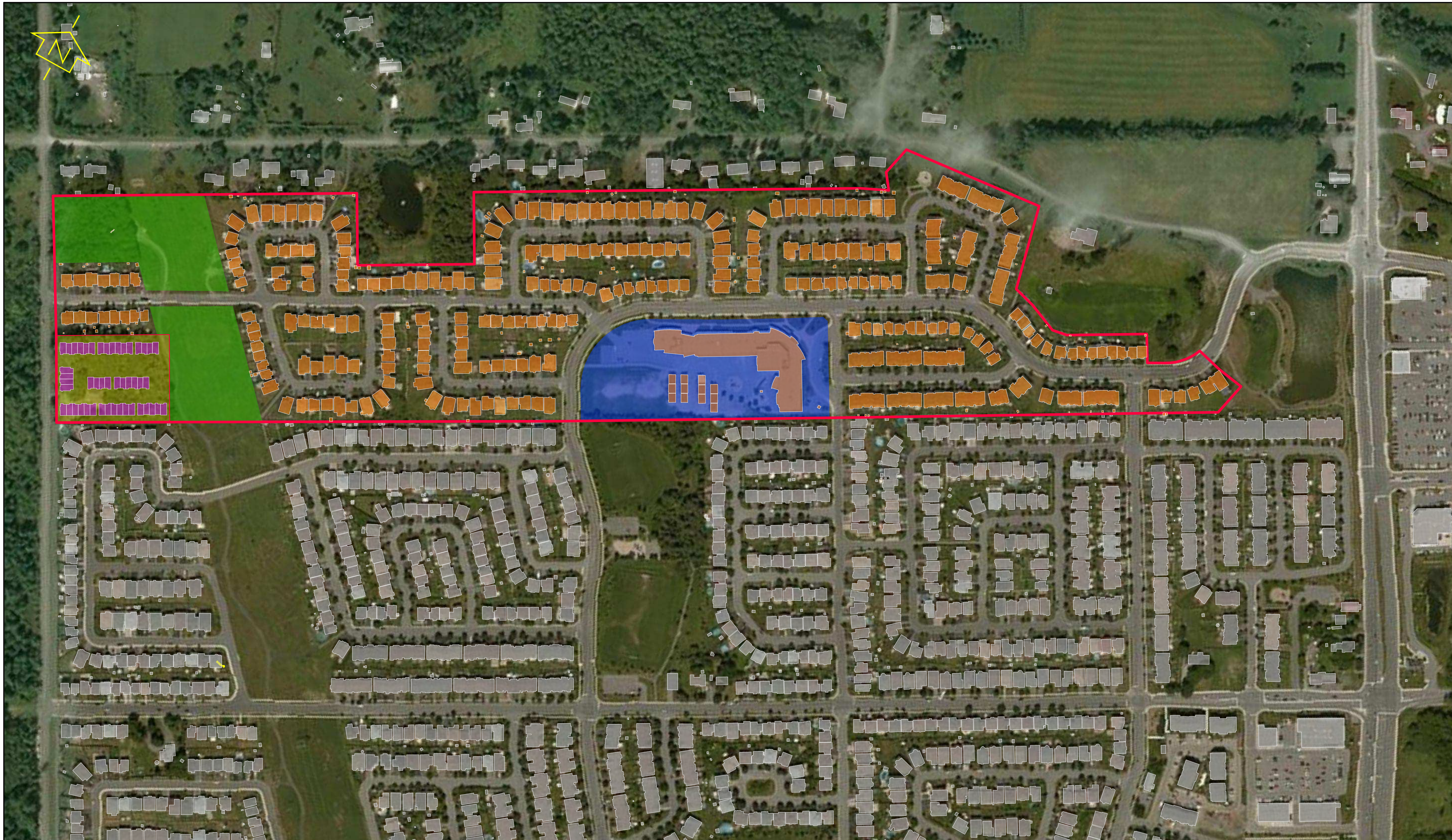
DESIGN JLF		1158 SECOND LINE RD THEBERGE HOMES	SCALE 1:1250
DRAWN SAB			FIGURE NO
DATE NOV 2018		WATER MODEL LAYOUT BOUNDARY CONDITON #2	FIG A4
FILE NO 245003			



DESIGN JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE 1:750
DRAWN MZG		FIGURE NO
DATE NOV 2018	SANITARY DRAINAGE AREA PLAN	FIG A5
FILE NO 245003		



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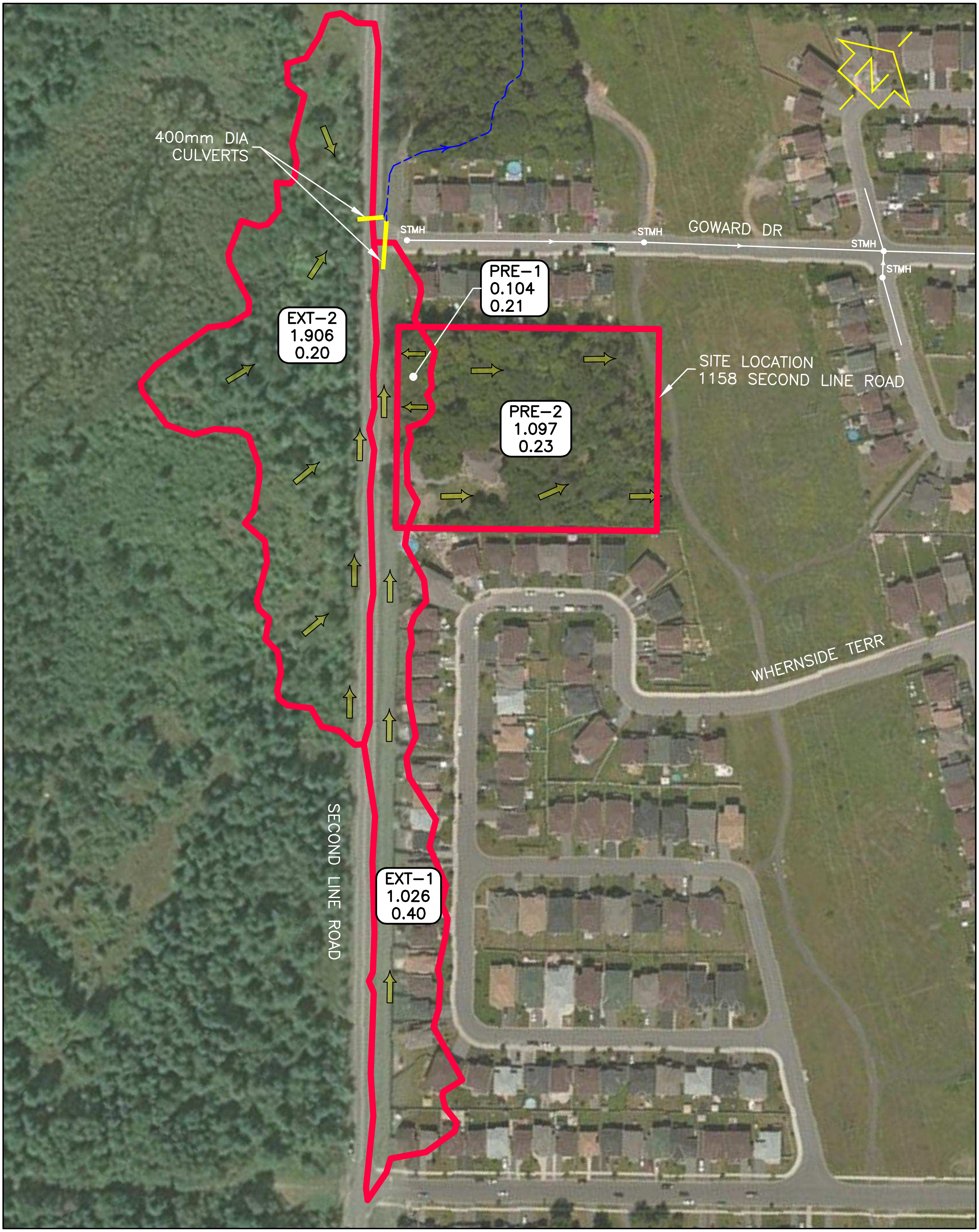
DESIGN	JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE	1:4000
DRAWN	SAB			
DATE	NOV 2018	OFFSITE SANITARY DRIANAGE MORGAN'S GRANT PHASE 12	FIGURE NO	FIG A6
FILE NO	245003			



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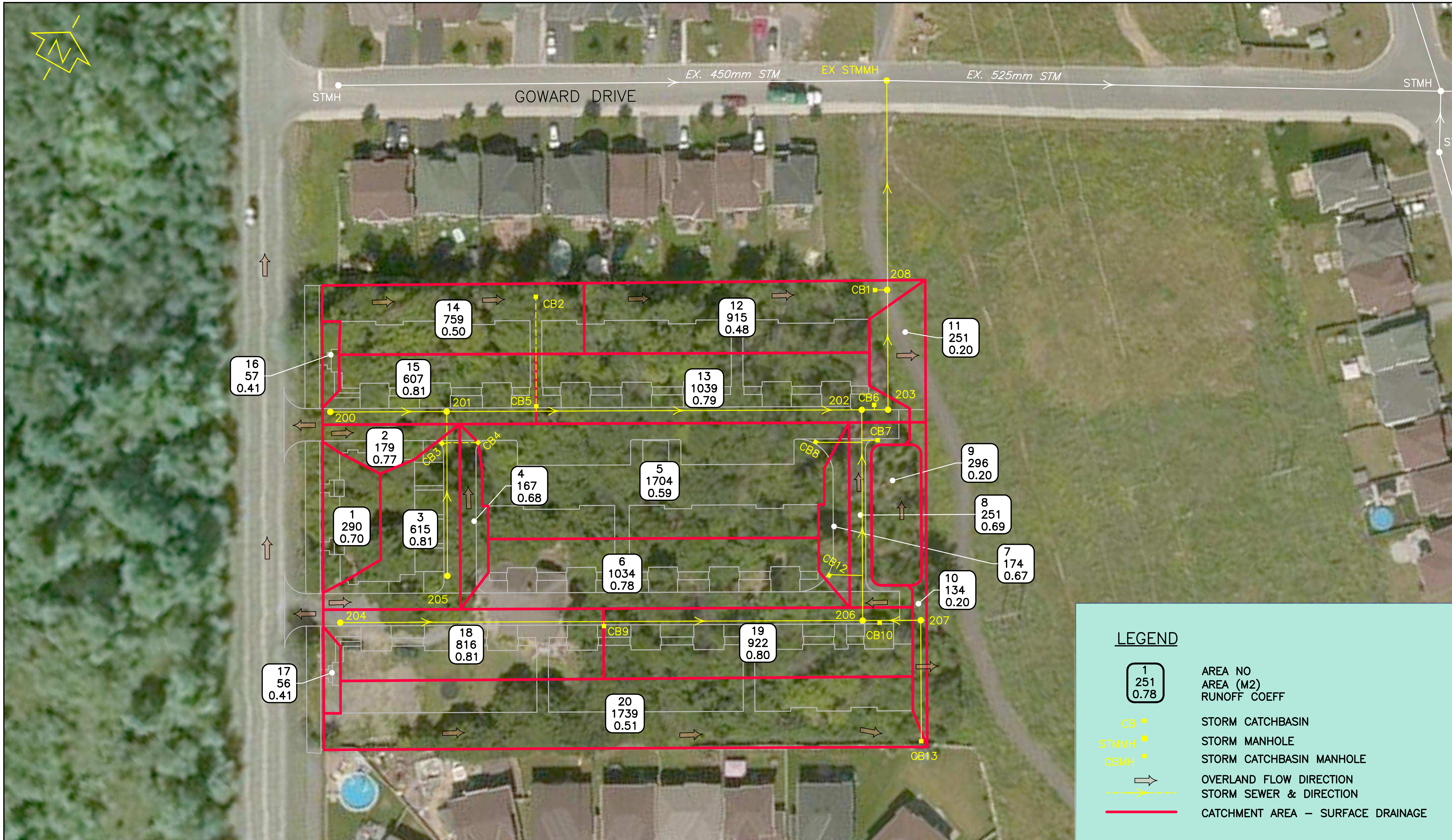
DESIGN JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE 1:2500	
DRAWN SAB		SKETCH NO	
DATE NOV 2018	PRE-DEVELOPMENT CATCHMENTS	FIG A7	
FILE NO 245003			



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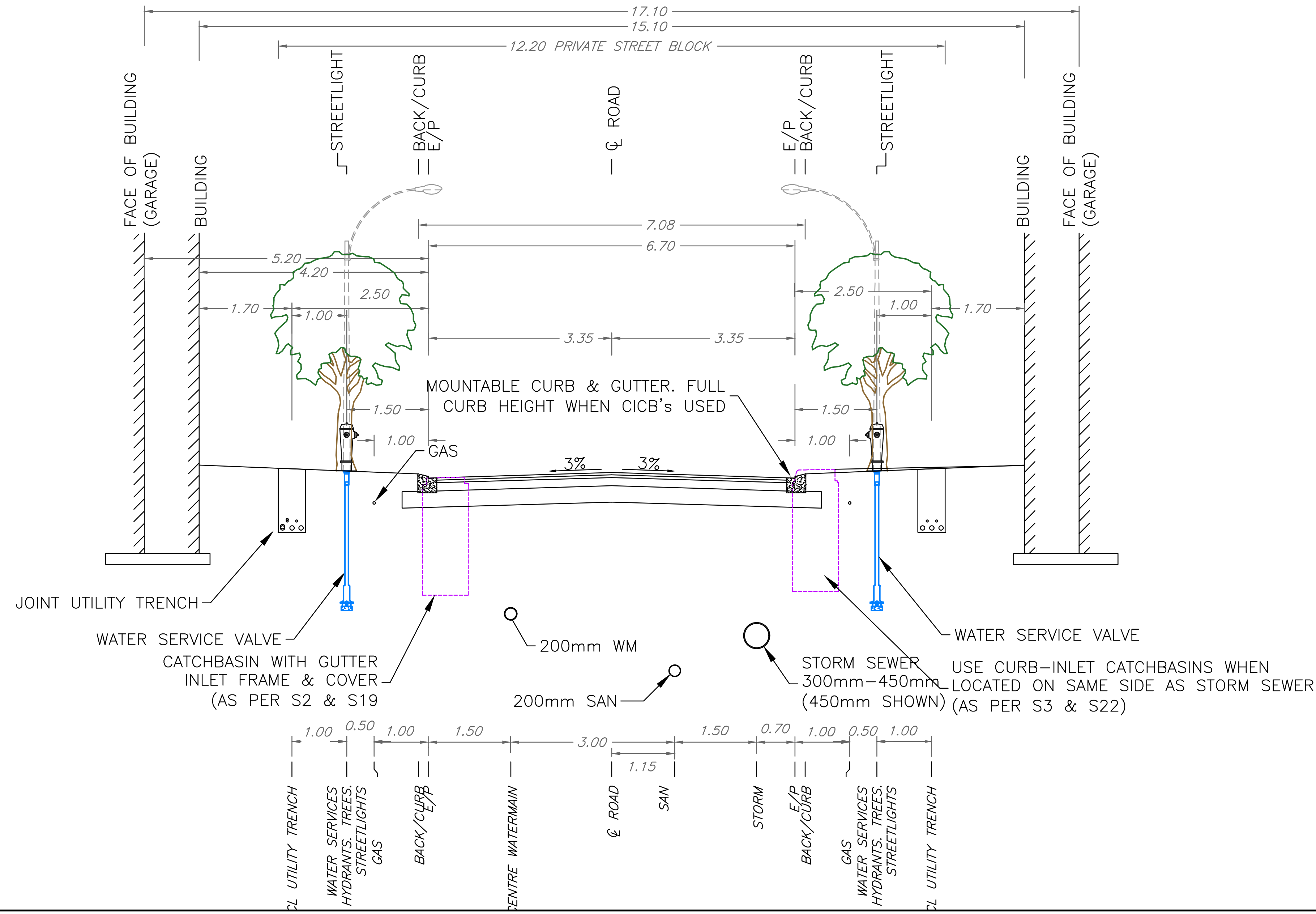
DESIGN	JLF	1158 SECOND LINE ROAD THEBERGE HOMES	SCALE	1:750
DRAWN	MZG		FIGURE NO	
DATE	NOV 2018	POST–DEVELOPMENT CATCHMENTS PLAN		FIG A8
FILE NO	245003			



exp.

DESIGN	JLF
DRAWN	SAB
DATE	NOV 2018
FILE NO	245003

1158 SECOND LINE ROAD
THEBERGE HOMES

TYPICAL PRIVATE ROAD CROSS SECTION

SCALE 1:100

SKETCH NO FIG A9

Appendix B – Water Tables

Table B1: Water Demand Chart

Table B2: Calculation of Fire Flow Requirements (Block 1)

Table B3: Calculation of Fire Flow Requirements (Block 2)

Table B4: Calculation of Fire Flow Requirements (Block 3)

Table B5: Calculation of Fire Flow Requirements (Block 4)

Table B6: Calculation of Fire Flow Requirements (Block 5)

Table B7: Calculation of Fire Flow Requirements (Block 6)

Table B8: Calculation of Fire Flow Requirements (Block 7)

Table B9: Calculation of Fire Flow Requirements (Block 8)

Table B10: Calculation of Fire Flow Requirements (Block 9)

Table B11: Fire Flow Contributions Based on Hydrant Spacing

TABLE B1: Water Demand Chart

Location: 1158 Old Second Line
Project No: OTT-00245003
Designed by: M. Ghadban
Checked By: J.Fitzpatrick
Date Revised: November 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

Proposed Buildings	No. of Units: Singles/Semis/Towns: Single Familty	Semi-Detached	Duplexz	Townhome	Apartments: Bachelor	1 Bedroom	2 Bedroom	3 Bedroom	Avg Apt.	Total Persons (pop)	Average Demand (L/day)	Maximum Demand (L/day) 5.79 x Avg Day	Peak Hourly Demand (L/day) 8.73 x Avg Day	Demands in (L/sec): Avg Day (L/s)	Max Day (L/s)	Max Hour (L/s)
Proposed Buildings																
J-1				3						8.1	2835	16,402	24,745	0.03	0.19	0.29
J-2				12						32.4	11340	65,608	98,978	0.13	0.76	1.15
J-3				13						35.1	12285	71,075	107,227	0.14	0.82	1.24
J-4				5						13.5	4725	27,336	41,241	0.05	0.32	0.48
J-5				3						8.1	2835	16,402	24,745	0.03	0.19	0.29
J-6				4						10.8	3780	21,869	32,993	0.04	0.25	0.38
J-11				1						2.7	945	5,467	8,248	0.01	0.06	0.10
J-18				6						16.2	5670	32,804	49,489	0.07	0.38	0.57
Sub Total for 1158 Second Line Road =				47						126.9	44,415	256,963	387,665.22	0.51	2.97	4.49

TABLE B2: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
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			1030.0 m²	
	Floor 2		515		
	Floor 1		515		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				10,591
Fire Flow (F)	Rounded to nearest 1,000				11,000

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%	-1,650	9,350
	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	9,350
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	9,350
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	9,350
	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	2.4	1	0 to 3	Type A	13.8	2	27.6	1A	22%	49%	4,582	13,932
	Side 2	32	5	30.1 to 45	Type A	13.8	2	27.6	5A	5%			
	Front	13.4	3	10.1 to 20	Type A	23	2	46	3B	13%			
	Back	21	4	20.1 to 30	Type A	36	2	72	4C	9%			

Obtain Required Fire Flow		
	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	14,000
	Total Required Fire Flow (RFF), L/sec =	233
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	Yes
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	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 B3: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
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	Wood Frame	1.5	
	Ordinary Construction	1			
	Non-combustible Construction	0.8			
	Fire Resistive Construction	0.6			
Input Building Floor Areas (A)	Floor 3			1030.0 m²	
	Floor 2		515		
	Floor 1		515		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				10,591
Fire Flow (F)	Rounded to nearest 1,000				**11,000**

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%	-1,650	9,350
	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	9,350
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	9,350
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	9,350
	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)	Fire Flow Total (L/min)
Choose Structure Exposure Distance	Side 1	2.4	1	0 to 3	Type A	13.8	2	27.6	1A	22%	62%	5,797	15,147
	Side 2	2.4	1	0 to 3	Type A	12.2	2	24.4	1A	22%			
	Front	24	4	20.1 to 30	Type A	35	2	70	4C	9%			
	Back	21	4	20.1 to 30	Type A	39	2	78	4C	9%			

Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**15,000**
	Total Required Fire Flow (RFF), L/sec =	**250**
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	**Yes**
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	**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 B4: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
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	Wood Frame	1.5	
	Ordinary Construction	1			
	Non-combustible Construction	0.8			
	Fire Resistive Construction	0.6			
Input Building Floor Areas (A)	Floor 3			680.0 m²	
	Floor 2		340		
	Floor 1		340		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				8,605
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)	Fire Flow Total (L/min)
Choose Structure Exposure Distance	Side 1	2.4	1	0 to 3	Type A	13.8	2	27.6	1A	22%	38%	2,907	10,557
	Side 2	50	6	> 45.1	Type A	0	0	0	6	0%			
	Front	24	4	20.1 to 30	Type A	15	2	30	4A	8%			
	Back	22	4	20.1 to 30	Type A	15	2	30	4A	8%			

Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**11,000**
	Total Required Fire Flow (RFF), L/sec =	**183**
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	**Yes**
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	**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 B5: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
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	Wood Frame	1.5	
	Ordinary Construction	1			
	Non-combustible Construction	0.8			
	Fire Resistive Construction	0.6			
Input Building Floor Areas (A)	Floor 3			1030.0 m²	
	Floor 2		515		
	Floor 1		515		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				10,591
Fire Flow (F)	Rounded to nearest 1,000				**11,000**

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%	-1,650	9,350
	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	9,350
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	9,350
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	9,350
	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	2.4	1	0 to 3	Type A	14	2	28	1A	22%	42%	3,927	13,277
	Side 2	50	6	> 45.1	Type A	0	0	0	6	0%			
	Front	15	3	10.1 to 20	Type A	13.8	2	27.6	3A	12%			
	Back	24	4	20.1 to 30	Type A	13.8	2	27.6	4A	8%			

Obtain Required Fire Flow		
	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**13,000**
	Total Required Fire Flow (RFF), L/sec =	**217**
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	**Yes**
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	**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 B6: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
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	Wood Frame	1.5	
	Ordinary Construction	1			
	Non-combustible Construction	0.8			
	Fire Resistive Construction	0.6			
Input Building Floor Areas (A)	Floor 3			856.0 m²	
	Floor 2		428		
	Floor 1		428		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				9,655
Fire Flow (F)	Rounded to nearest 1,000				10,000

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%	-1,500	8,500
	Limited Combustible	-15%				
	Combustible	0%				
	Free Burning	15%				
	Rapid Burning	25%				
Choose Reduction Due to Sprinkler System	**Adequate** Sprinkler Conforms to NFPA13	-30%	No Sprinkler	0%	0	8,500
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	8,500
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	8,500
	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	2.4	1	0 to 3	Type A	13.8	2	27.6	1A	22%	47%	3,995	12,495
	Side 2	50	6	> 45.1	Type A	0	0	0	6	0%			
	Front	15	3	10.1 to 20	Type A	13	2	26	3A	12%			
	Back	15	3	10.1 to 20	Type A	27	2	54	3B	13%			

Task		
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**12,000**
	Total Required Fire Flow (RFF), L/sec =	**200**
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	**Yes**
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	**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 B7: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
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			1076.0 m²	
	Floor 2		538		
	Floor 1		538		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				10,825
Fire Flow (F)	Rounded to nearest 1,000				**11,000**

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%	-1,650	9,350
	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	9,350
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	9,350
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	9,350
	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	2.4	1	0 to 3	Type A	13.8	2	27.6	1A	22%	72%	6,732	16,082
	Side 2	2.4	1	0 to 3	Type A	13.8	2	27.6	1A	22%			
	Front	15.1	3	10.1 to 20	Type A	40	2	80	3C	14%			
	Back	15.5	3	10.1 to 20	Type A	40	2	80	3C	14%			

Task		
Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**16,000**
	Total Required Fire Flow (RFF), L/sec =	**267**
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	**Yes**
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	**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 B8: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
Building No: **Block 7**

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			1076.0 m²	
	Floor 2		538		
	Floor 1		538		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				10,825
Fire Flow (F)	Rounded to nearest 1,000				**11,000**

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%	-1,650	9,350
	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	9,350
	No Sprinkler	0%				
	Standard Water Supply for Fire Department Hose Line and for Sprinkler System	-10%	Not Standard Water Supply or Unavailable	0%	0	9,350
	Not Standard Water Supply or Unavailable	0%				
	Fully Supervised Sprinkler System	-10%	Not Fully Supervised or N/A	0%	0	9,350
	Not Fully Supervised or N/A	0%				

Choose Structure Exposure Distance

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)	Fire Flow Total (L/min)
Side 1	32	5	30.1 to 45	Type A	0	0	0	5A	5%	54%	5,049	14,399
Side 2	2.4	1	0 to 3	Type A	13.8	2	27.6	1A	22%			
Front	13.4	3	10.1 to 20	Type A	25	2	50	3B	13%			
Back	15	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 =	**14,000**
	Total Required Fire Flow (RFF), L/sec =	**233**
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	**Yes**
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	**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 B9: FIRE FLOW REQURIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
Building No: **Block 8**

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			800.0 m²	
	Floor 2		400		
	Floor 1		400		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				9,334
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	13.4	3	10.1 to 20	Type A	15	2	30	3A	12%	41%	3,137	10,787
	Side 2	13.4	3	10.1 to 20	Type A	15	2	30	3A	12%			
	Front	15	3	10.1 to 20	Type A	13.8	2	27.6	3A	12%			
	Back	32	5	30.1 to 45	Type A	0	0	0	5A	5%			

Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**11,000**
	Total Required Fire Flow (RFF), L/sec =	**183**
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	**Yes**
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	**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 B10: FIRE FLOW REQUIREMENTS BASED ON FIRE UNDERWRITERS SURVEY(FUS) 1999
PROJECT: Second Line Road
Building No: **Block 9**

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			680.0 m²	
	Floor 2		340		
	Floor 1		340		
	Basement (At least 50% below grade, not included)		0		
Fire Flow (F)	F = 220 * C * SQRT(A)				8,605
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	15	3	10.1 to 20	Type A	13.8	2	27.6	3A	12%	55%	4,208	11,858
	Side 2	2.4	1	0 to 3	Type A	13.8	2	27.6	1A	22%			
	Front	15	3	10.1 to 20	Type A	26	2	52	3B	13%			
	Back	24	4	20.1 to 30	Type A	26	2	52	4B	8%			

Obtain Required Fire Flow	Total Required Fire Flow, Rounded to the Nearest 1,000 L/min =	**12,000**
	Total Required Fire Flow (RFF), L/sec =	**200**
	Can the Total Fire Flow be Capped at 10,000 L/min (167 L/sec) based on "TECHNCAL BULLETIN ISTB-2018-02", (yes/no) =	**Yes**
	Total Required Fire Flow (RFF). If RFF < 167 use RFF (L/sec) =	**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 B11: FIRE FLOW CONTRIBUTIONS BASED ON HYDRANT SPACING

Hydrant #	Block 1		Block 2		Block 3		Block 4		Block 5		Block 6		Block 7		Block 8		Block 9		Fire Flow Available at Hydrant Based on Model Results	
	[1]Distance (m)	[2]Fire Flow Contribution (L/min)	Distance (m)	Fire Flow Contribution (L/min)	Distance (m)	Fire Flow Contribution (L/min)	Distance (m)	Fire Flow Contribution (L/min)	Distance (m)	Fire Flow Contribution (L/min)	Distance (m)	Fire Flow Contribution (L/min)	Distance (m)	Fire Flow Contribution (L/min)	Distance (m)	Fire Flow Contribution (L/min)	Distance (m)	Fire Flow Contribution (L/min)	L/min	(L/sec)
FH-1	58	5,700	87	3,800	115	3,800	79	3,800	99	3,800	64	5,700	20	5,700	27	5,700	38	5,700	>16,000	> 267
FH-2	122	3,800	81	3,800	39	5,700	65	5,700	40	5,700	83	3,800	124	3,800	132	3,800	95	3,800	>13,000	> 217
FH-3	62	5,700	19	5,700	48	5,700	128	3,800	103	3,800	147	3,800	98	3,800	67	5,700	99	3,800	>13,000	> 217
Total Firflow Avail in L/min (L/sec)		15,200 (253)		13,300 (222)		15,200 (253)		13,300 (222)		13,300 (222)		13,300 (222)		13,300 (222)		15,200 (253)		13,300 (222)		
FUS RFF in L/min (L/sec)		10,000 (167)		10,000 (167)		10,000 (167)		10,000 (167)		10,000 (167)		10,000 (167)		10,000 (167)		10,000 (167)		10,000 (167)		
Meets Requreiment (Yes/No)		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		

Notes:

[1]Distance is measured along a road or fire route.

[2]Fire Flow Contribution for Class AA Hydrant from Table 1 of Appendix I, ISTB-2018-02

Appendix C – Water Distribution Modelling Results

Boundary Condition 1 Result Tables

- Peak Hour Scenario
  - Junction Table
  - Pipe Table
  - Reservoir Table

- Max Day Plus Fireflow Scenario
  - Junction Table
  - Pipe Table
  - Fire Flow Report
  - Reservoir Table

Boundary Condition 2 Result Tables

- Peak Hour Scenario
  - Junction Table
  - Pipe Table
  - Reservoir Table

- Max Day Plus Fireflow Scenario
  - Junction Table
  - Pipe Table
  - Fire Flow Report
  - Reservoir Table

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Peak Hour Scenario - HGL at Location 1

Junction Table - Time: 0.00 hours

Label	Demand (L/s)	Elevation (m)	Hydraulic Grade (m)	Pressure (psi)
J-1	0.47	103.94	140.11	51.3
J-2	1.88	103.70	140.11	51.7
J-3	2.03	101.62	140.11	54.6
J-4	0.78	102.85	140.11	52.9
J-5	0.47	103.30	139.89	51.9
J-6	0.63	101.21	140.12	55.2
J-7	0.00	101.04	140.15	55.5
J-9	0.00	102.40	140.15	53.6
J-10	0.00	100.76	140.20	56.0
J-11	0.16	101.70	140.11	54.5
J-12	0.07	101.25	140.12	55.2
J-17	0.00	103.80	140.11	51.5
J-18	0.94	102.00	140.11	54.1
J-19	0.00	101.25	140.11	55.2
J-21	0.00	103.00	140.11	52.7

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Length (Scaled) (m)	Diameter (mm)	Hazen-Williams C	Flow (L/s)	Hydraulic Grade (Stop) (m)	Hydraulic Grade (Start) (m)	Velocity (m/s)	Headloss Gradient (m/m)
P-28	J-21	J-5	18.4	38	100.0	0.47	139.89	140.11	0.41	0.01199
P-29	J-1	J-17	15.3	152	130.0	-0.47	140.11	140.11	0.03	0.00001
P-24	H-1	J-17	4.2	155	100.0	0.00	140.11	140.11	0.00	0.00000
P-25	H-2	J-19	3.7	155	100.0	0.00	140.11	140.11	0.00	0.00000
P-26	H-3	J-18	3.0	155	100.0	0.00	140.11	140.11	0.00	0.00000
P-2	J-2	J-3	76.8	204	110.0	-1.42	140.11	140.11	0.04	0.00002
P-3	J-2	J-4	34.6	204	110.0	-0.93	140.11	140.11	0.03	0.00001
P-10	J-7	J-9	121.8	204	110.0	0.00	140.15	140.15	0.00	0.00000
P-11	J-7	J-10	102.0	204	110.0	-7.43	140.20	140.15	0.23	0.00046
P-13	J-11	J-3	17.2	204	110.0	-0.16	140.11	140.11	0.00	0.00000
P-14	J-7	J-12	65.8	204	110.0	7.43	140.12	140.15	0.23	0.00046
P-15	J-12	J-6	15.3	204	110.0	7.36	140.12	140.12	0.23	0.00046
P-1(2)	J-17	J-2	7.7	204	110.0	-0.47	140.11	140.11	0.01	0.00000
P-6(1)	J-4	J-18	35.0	204	110.0	-2.18	140.11	140.11	0.07	0.00005
P-6(2)	J-18	J-6	41.8	204	110.0	-3.12	140.12	140.11	0.10	0.00009
P-7(1)	J-6	J-19	16.6	204	110.0	3.61	140.11	140.12	0.11	0.00012
P-7(2)	J-19	J-3	18.0	204	110.0	3.61	140.11	140.11	0.11	0.00012
P-27	J-4	J-21	6.0	204	110.0	0.47	140.11	140.11	0.01	0.00000
P-21	R-1	J-10	20.5	600	130.0	7.43	140.20	140.20	0.03	0.00000

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Reservoir Table - Time: 0.00 hours

ID	Label	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
64	R-1	Zone - 1	7.43	140.20

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Max Day Plus Fireflow Scenario - HGL at Location 1

Junction Table - Time: 0.00 hours

Label	Demand (L/s)	Elevation (m)	Hydraulic Grade (m)	Pressure (psi)
J-1	0.31	103.94	147.26	61.5
J-2	1.25	103.70	147.26	61.8
J-3	1.35	101.62	147.26	64.8
J-4	0.52	102.85	147.26	63.0
J-5	0.31	103.30	147.16	62.3
J-6	0.42	101.21	147.26	65.4
J-7	0.00	101.04	147.28	65.6
J-9	0.00	102.40	147.28	63.7
J-10	0.00	100.76	147.30	66.1
J-11	0.10	101.70	147.26	64.7
J-12	0.00	101.25	147.26	65.3
J-17	0.00	103.80	147.26	61.7
J-18	0.62	102.00	147.26	64.2
J-19	0.00	101.25	147.26	65.3
J-21	0.00	103.00	147.26	62.8

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Length (Scaled) (m)	Diameter (mm)	Hazen-Williams C	Flow (L/s)	Hydraulic Grade (Stop) (m)	Hydraulic Grade (Start) (m)	Velocity (m/s)	Headloss Gradient (m/m)
P-28	J-21	J-5	18.4	38	100.0	0.31	147.16	147.26	0.27	0.00555
P-29	J-1	J-17	15.3	152	130.0	-0.31	147.26	147.26	0.02	0.00000
P-24	H-1	J-17	4.2	155	100.0	0.00	147.26	147.26	0.00	0.00000
P-25	H-2	J-19	3.7	155	100.0	0.00	147.26	147.26	0.00	0.00000
P-26	H-3	J-18	3.0	155	100.0	0.00	147.26	147.26	0.00	0.00000
P-2	J-2	J-3	76.8	204	110.0	-0.95	147.26	147.26	0.03	0.00001
P-3	J-2	J-4	34.6	204	110.0	-0.62	147.26	147.26	0.02	0.00000
P-10	J-7	J-9	121.8	204	110.0	0.00	147.28	147.28	0.00	0.00000
P-11	J-7	J-10	102.0	204	110.0	-4.88	147.30	147.28	0.15	0.00021
P-13	J-11	J-3	17.2	204	110.0	-0.10	147.26	147.26	0.00	0.00000
P-14	J-7	J-12	65.8	204	110.0	4.88	147.26	147.28	0.15	0.00021
P-15	J-12	J-6	15.3	204	110.0	4.88	147.26	147.26	0.15	0.00021
P-1(2)	J-17	J-2	7.7	204	110.0	-0.31	147.26	147.26	0.01	0.00000
P-6(1)	J-4	J-18	35.0	204	110.0	-1.45	147.26	147.26	0.04	0.00002
P-6(2)	J-18	J-6	41.8	204	110.0	-2.07	147.26	147.26	0.06	0.00004
P-7(1)	J-6	J-19	16.6	204	110.0	2.40	147.26	147.26	0.07	0.00006
P-7(2)	J-19	J-3	18.0	204	110.0	2.40	147.26	147.26	0.07	0.00006
P-27	J-4	J-21	6.0	204	110.0	0.31	147.26	147.26	0.01	0.00000
P-21	R-1	J-10	20.5	600	130.0	4.88	147.30	147.30	0.02	0.00000

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Max Day Plus Fireflow Scenario - HGL at Location 1

Fire Flow Report - Time: 0.00 hours

Label	Fire Flow (Needed) (L/s)	Flow (Total Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?
H-1	0.00	167.00	146.47	146.47	0.0	20.0	False
H-2	0.00	167.00	164.79	164.79	0.0	20.0	False
H-3	0.00	167.00	159.74	159.74	0.0	20.0	False
J-1	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-2	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-3	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-4	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-5	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-6	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-7	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-9	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-10	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-11	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-12	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-17	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-18	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-19	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-21	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)

Reservoir Table - Time: 0.00 hours

ID	Label	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
64	R-1	Zone - 1	4.88	147.30

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Peak Hour Scenario - HGL at Location 2

Junction Table - Time: 0.00 hours

Label	Demand (L/s)	Elevation (m)	Hydraulic Grade (m)	Pressure (psi)
J-1	0.47	103.94	141.89	53.9
J-2	1.88	103.70	141.89	54.2
J-3	2.03	101.62	141.90	57.2
J-4	0.78	102.85	141.89	55.4
J-5	0.47	103.30	141.67	54.5
J-6	0.63	101.21	141.89	57.7
J-8	0.00	101.91	141.96	56.8
J-11	0.16	101.70	141.90	57.1
J-12	0.07	101.25	141.89	57.7
J-13	0.00	101.19	142.00	57.9
J-17	0.00	103.80	141.89	54.1
J-18	0.94	102.00	141.89	56.6
J-19	0.00	101.25	141.89	57.7
J-21	0.00	103.00	141.89	55.2

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Length (Scaled) (m)	Diameter (mm)	Hazen-Williams C	Flow (L/s)	Hydraulic Grade (Stop) (m)	Hydraulic Grade (Start) (m)	Velocity (m/s)	Headloss Gradient (m/m)
P-28	J-21	J-5	18.4	38	100.0	0.47	141.67	141.89	0.41	0.01198
P-29	J-1	J-17	15.3	152	130.0	-0.47	141.89	141.89	0.03	0.00001
P-24	H-1	J-17	4.2	155	100.0	0.00	141.89	141.89	0.00	0.00000
P-25	H-2	J-19	3.7	155	100.0	0.00	141.89	141.89	0.00	0.00000
P-26	H-3	J-18	3.0	155	100.0	0.00	141.89	141.89	0.00	0.00000
P-2	J-2	J-3	76.8	204	110.0	-2.50	141.90	141.89	0.08	0.00006
P-3	J-2	J-4	34.6	204	110.0	0.15	141.89	141.89	0.00	0.00000
P-12	J-8	J-11	123.8	204	110.0	7.43	141.90	141.96	0.23	0.00046
P-13	J-11	J-3	17.2	204	110.0	7.27	141.90	141.90	0.22	0.00045
P-15	J-12	J-6	15.3	204	110.0	-0.07	141.89	141.89	0.00	0.00000
P-16	J-13	J-8	85.5	204	110.0	7.43	141.96	142.00	0.23	0.00046
P-1(2)	J-17	J-2	7.7	204	110.0	-0.47	141.89	141.89	0.01	0.00000
P-6(1)	J-4	J-18	35.0	204	110.0	-1.10	141.89	141.89	0.03	0.00001
P-6(2)	J-18	J-6	41.8	204	110.0	-2.04	141.89	141.89	0.06	0.00004
P-7(1)	J-6	J-19	16.6	204	110.0	-2.74	141.89	141.89	0.08	0.00007
P-7(2)	J-19	J-3	18.0	204	110.0	-2.74	141.90	141.89	0.08	0.00007
P-27	J-4	J-21	6.0	204	110.0	0.47	141.89	141.89	0.01	0.00000
P-20	R-2	J-13	24.8	600	130.0	7.43	142.00	142.00	0.03	0.00000

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Peak Hour Scenario - HGL at Location 2

Reservoir Table - Time: 0.00 hours

ID	Label	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
65	R-2	Zone - 1	7.43	142.00

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Max Day Plus Fireflow Scenario - HGL at Location 2

Junction Table - Time: 0.00 hours

Label	Demand (L/s)	Elevation (m)	Hydraulic Grade (m)	Pressure (psi)
J-1	0.31	103.94	147.25	61.5
J-2	1.25	103.70	147.25	61.8
J-3	1.35	101.62	147.25	64.8
J-4	0.52	102.85	147.25	63.0
J-5	0.31	103.30	147.15	62.2
J-6	0.42	101.21	147.25	65.4
J-8	0.00	101.91	147.28	64.4
J-11	0.10	101.70	147.26	64.7
J-12	0.00	101.25	147.25	65.3
J-13	0.00	101.19	147.30	65.5
J-17	0.00	103.80	147.25	61.7
J-18	0.62	102.00	147.25	64.2
J-19	0.00	101.25	147.25	65.3
J-21	0.00	103.00	147.25	62.8

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Length (Scaled) (m)	Diameter (mm)	Hazen-William s C	Flow (L/s)	Hydraulic Grade (Stop) (m)	Hydraulic Grade (Start) (m)	Velocity (m/s)	Headlos s Gradient (m/m)
P-28	J-21	J-5	18.4	38	100.0	0.31	147.15	147.25	0.27	0.00555
P-29	J-1	J-17	15.3	152	130.0	-0.31	147.25	147.25	0.02	0.00000
P-24	H-1	J-17	4.2	155	100.0	0.00	147.25	147.25	0.00	0.00000
P-25	H-2	J-19	3.7	155	100.0	0.00	147.25	147.25	0.00	0.00000
P-26	H-3	J-18	3.0	155	100.0	0.00	147.25	147.25	0.00	0.00000
P-2	J-2	J-3	76.8	204	110.0	-1.65	147.25	147.25	0.05	0.00003
P-3	J-2	J-4	34.6	204	110.0	0.09	147.25	147.25	0.00	0.00000
P-12	J-8	J-11	123.8	204	110.0	4.88	147.26	147.28	0.15	0.00021
P-13	J-11	J-3	17.2	204	110.0	4.78	147.25	147.26	0.15	0.00021
P-15	J-12	J-6	15.3	204	110.0	0.00	147.25	147.25	0.00	0.00000
P-16	J-13	J-8	85.5	204	110.0	4.88	147.28	147.30	0.15	0.00021
P-1(2)	J-17	J-2	7.7	204	110.0	-0.31	147.25	147.25	0.01	0.00000
P-6(1)	J-4	J-18	35.0	204	110.0	-0.74	147.25	147.25	0.02	0.00001
P-6(2)	J-18	J-6	41.8	204	110.0	-1.36	147.25	147.25	0.04	0.00002
P-7(1)	J-6	J-19	16.6	204	110.0	-1.78	147.25	147.25	0.05	0.00003
P-7(2)	J-19	J-3	18.0	204	110.0	-1.78	147.25	147.25	0.05	0.00003
P-27	J-4	J-21	6.0	204	110.0	0.31	147.25	147.25	0.01	0.00000
P-20	R-2	J-13	24.8	600	130.0	4.88	147.30	147.30	0.02	0.00000

WATERCAD MODEL RESULTS - 1158 SECOND LINE ROAD

Max Day Plus Fireflow Scenario - HGL at Location 2

Fire Flow Report - Time: 0.00 hours

Label	Fire Flow (Needed) (L/s)	Flow (Total Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)	Satisfies Fire Flow Constraints?
H-1	0.00	167.00	134.06	134.06	0.0	20.0	False
H-2	0.00	167.00	148.23	148.23	0.0	20.0	False
H-3	0.00	167.00	142.11	142.11	0.0	20.0	False
J-1	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-2	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-3	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-4	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-5	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-6	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-8	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-11	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-12	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-13	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-17	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-18	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-19	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)
J-21	0.00	(N/A)	(N/A)	(N/A)	0.0	(N/A)	(N/A)

Reservoir Table - Time: 0.00 hours

ID	Label	Zone	Flow (Out net) (L/s)	Hydraulic Grade (m)
65	R-2	Zone - 1	4.88	147.30

Appendix D – Sanitary Design Sheet

Table D1: Sanitary Design Sheet

TABLE D1: SANITARY SEWER CALCULATION SHEET

LOCATION: Street	LOCATION: U/S MH	LOCATION: D/S MH	LOCATION: Area Number	RESEDENTIAL AREAS AND POPULAITONS: Area (ha)	NUMBER OF UNITS: Singles	NUMBER OF UNITS: Semis	NUMBER OF UNITS: Towns	NUMBER OF UNITS: Batch or 1-Bed Apt.	NUMBER OF UNITS: 2-Bed Apt.	NUMBER OF UNITS: 3-Bed Apt.	Total Units	POPULATION: INDIV	POPULATION: ACCU	Peak Factor	Peak Flow (L/sec)	COMMERCIAL AREA (ha): INDIV	COMMERCIAL AREA (ha): ACCU	COMMERCIAL: Peak Flow (L/sec)	INDUSTRIAL AREA (ha): INDIV	INDUSTRIAL AREA (ha): ACCU	INDUSTRIAL: Peak Factor (per MOE)	INSTITUTIONAL: AREA (Ha)	INSTITUTIONAL: ACCU AREA (Ha)	INFILTRATION AREA (ha): INDIV	INFILTRATION AREA (ha): ACCU	INFILT FLOW (L/s)	TOTAL FLOW (L/s)	SEWER DATA: Nom Dia (mm)	Actual Dia (mm)	Slope (%)	Length (m)	Capacity (L/sec)	Q/Q_{CAP} (%)	Full Velocity (m/s)
Private Street	MH 104	MH106	1	0.5801			25				25	67.5	67.5	3.63	0.79									0.5801	0.5801	0.19	0.99	200	201.2	2.05	106.65	47.72	0.02	1.49
Private Street	MH107	MH106	2	0.1201			2				2	5.4	5.4	3.75	0.07									0.1201	0.1201	0.04	0.11	200	201.2	1.04	12.08	33.99	0.00	1.06
	MH106	MH102											72.9	3.62	0.86										0.7002	0.23	1.09	200	201.2	0.64	40.57	26.66	0.04	0.83
Private Street	MH105	MH101	3	0.1047			4				4	10.8	10.8	3.73	0.13									0.1047	0.1047	0.03	0.17	200	201.2	3.22	31.00	59.80	0.00	1.86
Private Street	MH100	MH101	4	0.0897			3				3	8.1	8.1	3.74	0.10									0.0897	0.0897	0.03	0.13	200	201.2	2.00	24.10	47.13	0.00	1.47
Private Street	MH101	MH102	5	0.2757			12				12	32.4	51.3	3.65	0.61									0.2757	0.4701	0.16	0.76	200	201.2	1.20	82.79	36.51	0.02	1.14
Private Street	MH102	MH103	6	0.0592			1				1	2.7	126.9	3.57	1.47									0.0592	1.2295	0.41	1.87	200	201.2	1.32	8.42	38.29	0.05	1.19
	103	108											126.9	3.57	1.47										1.2295	0.41	1.87	200	201.2	0.40	27.69	21.08	0.09	0.66
	108	EXMH											126.9	3.57	1.47										1.2295	0.41	1.87	200	201.2	0.40	40.39	21.08	0.09	0.66
				1.230			47				47	126.9												1.2295							373.69			

Residential Avg. Daily Flow, q (L/p/day) =	280	Commercial Peak Factor =	1.5	(when area >20%)	
Commercial Avg. Daily Flow (L/gross ha/day) =	28,000		1.0	(when area <20%)	
or L/gross ha/sec =	0.324				
Institutianal Avg. Daily Flow (L/day/ha) =	28,000	Institutional Peak Factor =	1.5	(when area >20%)	
or L/gross ha/day =	0.324		1.0	(when area <20%)	
Light Industrial Flow (L/gross ha/day) =	35,000				
or L/gross ha/sec =	0.40509	Residential Correction Factor, K =	0.80		
Light Industrial Flow (L/gross ha/day) =	55,000	Manning N =	0.013		
or L/gross ha/sec =	0.637	Peak extraneous flow, I (L/s/ha) =	0.33	(Total I/I)	

Peak Population Flow, (L/sec) =	P*q*M/86.4	Unit Type	Persons/Unit
Peak Extraneous Flow, (L/sec) =	I*Ac	Singles	3.4
Residential Peaking Factor, M =	1 + (14/(4+P^0.5)) * K	Semi-Detached	2.7
A_c = Cumulative Area (hectares)		Townhomes	2.7
P = Population (thousands)		Batchelor or 1-bed Apt. Unit	1.4
Sewer Capacity, Qcap (L/sec) =	$1/N \; S^{1/2} R^{2/3} A_c$	2-bed Apt. Unit	2.1
(Manning's Equation)		3-bed Apt. Unit	3.1
		4-bed Apt. Unit	3.8

Designed:	Project:
J. Fitzpatrick, P.Eng.	1158 Second Line
Checked:	Location:
B. Thomas, P.Eng.	Ottawa, Ontario
File Reference:	Page No:
245003 Sanitary Design Sheet, Nov 2018.xlsx	1 of 1

Appendix E – Stormwater Design Sheets

Table E1: 2-year Storm Sewer Calculation Sheet

Table E2: 100-year HGL Storm Sewer Calculation Sheet

Table E3: Average Runoff Coefficients (Pre-Development)

Table E4: Pre-Development Runoff Calculations

Table E5: Allowable Runoff Calculations

Table E6: Average Runoff Coefficients (Post-Development)

Table E7: Summary of Post Development Runoff (Uncontrolled and Controlled)

Table E8: Rating Curves for Modelling of Surface Ponding Areas

Table E9: Major System (Street Segment) Characteristics – Curb Inlet Catchbasins

Table E10: Major System (Street Segment) Characteristics – Surface Catchbasins

Table E11.1: Inlet Control Devices (ICD) Types

Table E11.2: Discharge Rates for Various IPEX ICD Models

TABLE E1: 2-YEAR STORM SEWER CALCULATION SHEET

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

From Node	To Node	AREA INFO				FLOW (UNRESTRICTED)							INDIV CAP FLOW (L/s)	CUMUL CAP FLOW (L/s)	SEWER DATA										
		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)			Dia (mm) Actual	Dia (mm) Nominal	Type	Slope (%)	Length (m)	Capacity, Q_{CAP} (L/sec)	Velocity (m/s) Vf	Velocity (m/s) Va	Time in Pipe, Tt (min)	Hydraulic Ratios Q/Q_{CAP}	Hydraulic Ratios Va/Vf
STMH 204	STMMH 206	18	0.0816	0.0816	0.81	0.184	0.184	10.00	76.81	14.11	2-year	14.1	6.7	6.7	299.4	300	PVC	2.05	109.65	137.67	1.96	1.08	1.70	0.10	0.55
STMH 207	STMMH 206	19	0.0922	0.0922	0.80	0.205	0.205						6.7	6.7											
		20	0.1739	0.2661	0.51	0.247	0.452	10.00	76.81	18.94	100-year	34.7	6.7	13.4	251.5	250	PVC	1.00	12.03	60.40	1.21	0.86	0.23	0.57	0.71
STMH 206	STMMH 202	5	0.1704	0.5181	0.59	0.279	0.9148						6.7	26.8											
		6	0.1034	0.6215	0.78	0.224	1.1391						6.7	33.5											
		7	0.0174	0.6389	0.67	0.032	1.1715							33.5											
		8	0.0251	0.6640	0.69	0.048	1.2196	11.70	70.85	3.41	2-year	86.4	6.7	40.2	366.4	375	PVC	0.64	43.57	131.87	1.27	1.17	0.62	0.66	0.92
STMH 205	STMMH 201	2	0.0179	0.0179	0.77	0.038	0.038																		
		3	0.0615	0.0794	0.81	0.138	0.177						6.7	6.7											
		4	0.0167	0.0961	0.68	0.032	0.208	10.00	76.81	2.42	2-year	16.0	6.7	13.4	251.5	250	PVC	3.22	34.00	108.38	2.17	1.28	0.44	0.15	0.59
STMMH 200	STMMH 201							10.00	76.81		2-year				201.2	200	PVC	2.00	24.10	47.10	1.48				
STMMH 201	STMMH 202	14	0.0759	0.1720	0.50	0.106	0.314							13.4											
		15	0.0607	0.2327	0.81	0.137	0.451	10.44	75.15	10.27	2-year	33.9	6.7	20.1	366.4	375	PVC	1.20	85.79	180.57	1.74	1.11	1.28	0.19	0.64
STMMH 202	STMMH 203	13	0.1039	1.0006	0.79	0.228	1.898	12.32	68.92	15.73	2-year	130.8	6.7	67.0	447.9	450	PVC	0.40	5.42	178.05	1.13	1.11	0.08	0.73	0.98
STMMH 203	STMMH 208	9	0.0296	1.0302	0.20	0.016	1.915	12.40	68.68	1.13	2-year	131.5	6.7	73.7	447.9	450	PVC	0.40	24.78	178.05	1.13	1.11	0.37	0.74	0.98
STMMH 208	EX. STMMH	12	0.0915	1.1217	0.48	0.122	2.037	12.77	67.58	8.25	2-year	137.7	6.7	80.4	447.9	450	PVC	0.40	43.31	178.05	1.13	1.11	0.65	0.77	0.98
TOTALS =			**1.1217**			**2.037**																			

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:	Project:	
J. Fitzpatrick, P.Eng.	THEBERGE HOMES	
Checked:	Location:	
B. Thomas, P.Eng.	1158 SECOND LINE ROAD	
Dwg Reference:	File Ref:	Sheet No:
FIGURE A8	**245003 Storm Design Sheets, Nov 23, 2018.xlsx**	1 of 1

TABLE E2: 100-YEAR HGL STORM SEWER CALCULATION SHEET

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

From Node	To Node	AREA INFO: Area No.	AREA INFO: Area (ha)	AREA INFO: ∑ Area (ha)	AREA INFO: Average R	FLOW (UNRESTRICTED): Indiv. 2.78*A*R	FLOW (UNRESTRICTED): Accum. 2.78*A*R	FLOW (UNRESTRICTED): Tc (mins)	FLOW (UNRESTRICTED): I (mm/h)	FLOW (UNRESTRICTED): Indiv. Flow	FLOW (UNRESTRICTED): Return Period	FLOW (UNRESTRICTED): Q (L/s)	INDIV CAP FLOW (L/s)	CUMUL CAP FLOW (L/s)
STMH 204	STMMH 206	18	0.0816	0.0816	0.81	0.184	0.184	10.00	178.56	32.81	100-year	32.8	6.7	6.7
STMH 207	STMMH 206	19	0.0922	0.0922	0.80	0.205	0.205						6.7	6.7
		20	0.1739	0.2661	0.51	0.247	0.452	10.00	178.56	44.02	100-year	80.6	6.7	13.4
STMH 206	STMMH 202	5	0.1704	0.5181	0.59	0.279	0.9148						6.7	26.8
		6	0.1034	0.6215	0.78	0.224	1.1391						6.7	33.5
		7	0.0174	0.6389	0.67	0.032	1.1715							33.5
		8	0.0251	0.6640	0.69	0.048	1.2196	11.39	166.76	8.03	100-year	203.4	6.7	40.2
STMH 205	STMMH 201	2	0.0179	0.0179	0.77	0.038	0.038							
		3	0.0615	0.0794	0.81	0.138	0.177						6.7	6.7
		4	0.0167	0.0961	0.68	0.032	0.208	10.00	178.56	5.64	100-year	37.2	6.7	13.4
STMMH 200	STMMH 201							10.00	178.56		100-year			
STMMH 201	STMMH 202	14	0.0759	0.1720	0.50	0.106	0.314							13.4
		15	0.0607	0.2327	0.81	0.137	0.451	10.37	175.22	23.95	100-year	78.9	6.7	20.1
STMMH 202	STMMH 203	13	0.1039	1.0006	0.79	0.228	1.898	11.94	162.56	37.09	100-year	308.6	6.7	67.0
STMMH 203	STMMH 208	9	0.0296	1.0302	0.20	0.016	1.915	12.02	161.99	2.67	100-year	310.2	6.7	73.7
STMMH 208	EX. STMMH	12	0.0915	1.1217	0.48	0.122	2.037	12.37	159.46	19.47	100-year	324.8	6.7	80.4
TOTALS =			**1.1217**			**2.037**								

From Node	To Node	Area No.	SEWER DATA: Dia (mm) Actual	SEWER DATA: Dia (mm) Nominal	SEWER DATA: Type	SEWER DATA: Slope (%)	SEWER DATA: Length (m)	SEWER DATA: Capacity, Q_{CAP} (L/sec)	Velocity (m/s): Vf	Velocity (m/s): Va	Time in Pipe, Tt (min)	Hydraulic Ratios: Q/Q_{CAP}	Hydraulic Ratios: Va/Vf	Surcharged (Yes?) Under Free Flow	Head Loss (Due to Friction): Friction Factor, f,	Head Loss (Due to Friction): L/D	Head Loss (Due to Friction): $Vf^2/2g$ (m)	Head Loss (Due to Friction): h_f (m)	Head Loss (Due to Bends): Type of d/s mh defl	Head Loss (Due to Bends): Coeff, K	Head Loss (Due to Bends): h_b Minor Losses (m)	Total Losses $h_f + h_b$ (m)	Slope of HGL (ht/L)	EGL Elevations: U/S (m)	EGL Elevations: D/S (m)	HGL Elevations: U/S (m)	HGL Elevations: D/S (m)
STMH 204	STMMH 206	18	299.4	300	PVC	2.05	109.65	137.67	1.96	1.31	1.39	0.24	0.67	No	0.0315	366.28	0.1955	2.254	90 deg	1.32	0.2581	2.512	2.29%	101.38	99.13	101.19	98.93
STMH 207	STMMH 206	19																									
		20	251.5	250	PVC	1.00	12.03	60.40	1.21	1.26	0.16	1.34	1.04	Yes	0.0334	47.84	0.0748	0.119	90 deg	1.32	0.0987	0.218	1.81%	98.87	98.75	98.80	98.68
STMH 206	STMMH 202	5																									
		6																									
		7																									
		8	366.4	375	PVC	0.64	43.57	131.87	1.27	1.32	0.55	1.54	1.04	Yes	0.0294	118.91	0.0822	0.288	90 deg	1.32	0.1085	0.396	0.91%	99.05	98.76	98.97	98.68
STMH 205	STMMH 201	2																									
		3																									
		4	251.5	250	PVC	3.22	34.00	108.38	2.17	1.52	0.37	0.34	0.70	No	0.0334	135.21	0.2409	1.086	90 deg	1.32	0.3179	1.404	4.13%	101.12	100.04	100.88	99.80
STMMH 200	STMMH 201		201.2	200	PVC	2.00	24.10	47.10	1.48					No	0.0359	119.81	0.1111	0.478	0 deg	0.02	0.0022	0.481	1.99%	100.20	99.72	100.09	99.61
STMMH 201	STMMH 202	14																									
		15	366.4	375	PVC	1.20	85.79	180.57	1.74	1.23	1.16	0.44	0.71	No	0.0294	234.13	0.1541	1.062	0 deg	0.02	0.0031	1.065	1.24%	99.72	98.66	99.56	98.50
STMMH 202	STMMH 203	13	447.9	450	PVC	0.40	5.42	178.05	1.13	1.18	0.08	1.73	1.04	Yes	0.0275	12.10	0.0655	0.022	90 deg	1.32	0.0865	0.108	2.00%	98.65	98.63	98.59	98.57
STMMH 203	STMMH 208	9	447.9	450	PVC	0.40	24.78	178.05	1.13	1.18	0.35	1.74	1.04	Yes	0.0275	55.33	0.0655	0.100	0 deg	0.02	0.0013	0.101	0.41%	98.55	98.45	98.48	98.38
STMMH 208	EX. STMMH	12	447.9	450	PVC	0.40	43.31	178.05	1.13	1.18	0.61	1.82	1.04	Yes	0.0275	96.70	0.0655	0.174	90 deg	1.32	0.0865	0.261	0.60%	98.44	98.27	98.38	98.204
																										Boundary Condition ---->	98.197

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:	Project:	
J. Fitzpatrick, P.Eng.	THEBERGE HOMES	
Checked:	Location:	
B. Thomas, P.Eng.	1158 SECOND LINE ROAD	
Dwg Reference:	File Ref:	Sheet No:
FIGURE A8	**245003 Storm Design Sheets, Nov 23, 2018.xlsx**	1 of 1

Darcy-Weisbach Equation

$H = f \times (L/D) \times (V^2/2g) + H_{BENDS}$
friction factor, $f = 8g \times n^2 / (R^{1/3})$
$H_{BENDS} = K\ V^2 / 2g$
g = acc. due to gravity (m/s^2) = 9.81
k = minor loss coefficient

Headloss Coefficients, k

Degree	k =
0 deg	0.02
22 deg	0.14
45 deg	0.40
90 deg	1.32

TABLE E3 - AVERAGE RUNOFF COEFFICIENTS (Pre Development)

Runoff Coeffients C_{gravel} = 0.80 C_{ROOF} = 0.90 C_{GRASS} = 0.20 C_{Conc} = 0.90

Area No.	Gravel Areas (m^2)	A * C_{GRAV}	Roof Areas (m^2)	A * C_{ROOF}	Grassed Areas (m^2)	A * C_{GRASS}	Conc (m^2)	A * C_{CONC}	Sum AC	Total Area (m^2)	C_{AVG}
Entire Site (for info only)	325.4	260.3	214.9	193.4	11432	2286.4	37.7	33.93	2774.1	12010.0	0.23
PRE-1	25.4	20.3			1015	202.9			223.2	1040.0	0.21
PRE-2	300	240.0	214.9	193.4	10417	2083.5	37.7	33.93	2550.8	10970.0	0.23
Totals	325.4	260.3	214.9	193.4	11,432.0	2,286.4	37.7	33.9	2,774.1	12,010.0	0.23

Site % IMP = 4.8%

Average Runoff Coeff = $C_{AVG} = \frac{2,774}{12,010}$ **= 0.23**

TABLE E4 - PRE-DEVELOPMENT RUNOFF CALCULATIONS

Area Description	Area (ha)	Time of Conc, Tc (min)	Storm = 2 yr			Storm = 5 yr			Storm = 100 yr		
			I_2 (mm/hr)	Cavg	Q_{5PRE} (L/sec)	I_5 (mm/hr)	Cavg	Q_{5PRE} (L/sec)	I_{100} (mm/hr)	Cavg	Q_{100PRE} (L/sec)
Entire Site (for info only)	1.2010	20	52.03	0.23	40.1	70.25	0.23	54.2	119.95	0.23	92.5
PRE-1	0.1040	20	52.03	0.21	3.2	70.25	0.21	4.4	119.95	0.21	7.4
PRE-2	1.0970	20	52.03	0.23	36.9	70.25	0.23	49.8	119.95	0.23	85.1
Totals	1.2010				40.1			54.2			92.5

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 E5 - ALLOWABLE RUNOFF CALCULATIONS

Area Description	Area (ha)	Time of Conc, Tc (min)	Storm = 5 yr			Q_{ICD} (L/sec)
			I_5 (mm/hr)	Cavg	Q_{ALLOW} (L/sec)	
Total Site	1.2010	20	70.29	0.50	117.3	100.0
Totals	1.2010				117.3	100.0

Notes

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

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

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

TABLE E6 - AVERAGE RUNOFF COEFFICIENTS (Post Development)

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

Area No.	Asphalt / Conc Areas (m²)	A * C_{ASPH}	Roof Areas (m²)	A * C_{ROOF}	Grassed Areas (m²)	A * C_{GRASS}	Sum AC	[1]Total Area (m²)	[2]C_{AVG}	Comments
Entire Site	*3211*	*2889.5*	*4344.3*	*3909.9*	*4454.2*	*890.8*	*7690.2*	*12009*	*0.64*	*For Info*
S01								290	0.83	From PCSWMM
S02								179	0.88	From PCSWMM
S03								615	0.92	From PCSWMM
S04								168	0.81	From PCSWMM
S05								1704	0.73	From PCSWMM
S06								1034	0.89	From PCSWMM
S07								175	0.80	From PCSWMM
S08								251	0.81	From PCSWMM
S09								296	0.39	From PCSWMM
S10								134	0.41	From PCSWMM
S11								251	0.41	From PCSWMM
S12								916	0.64	From PCSWMM
S13								1039	0.90	From PCSWMM
S14								759	0.65	From PCSWMM
S15								607	0.91	From PCSWMM
S16								57	0.57	From PCSWMM
S17								56	0.58	From PCSWMM
S18								816	0.91	From PCSWMM
S19								922	0.90	From PCSWMM
S20								1740	0.67	From PCSWMM
Total	3,210.5	2,889.5	4,344.3	3,909.9	4,454.2	890.8	7,690.2	12009	0.64	

Site % IMP = 63% Average Runoff Coeff = $C_{AVG} = \frac{7,690}{12,009}$ = 0.64

Notes

1) Areas taken from PCSWMM, CAD

2) Cavg From PCSWMM (Area Weighting)

TABLE E7 - SUMMARY OF POST DEVELOPMENT RUNOFF (Uncontrolled and Controlled)

			Storm = 2 yr				Storm = 5 yr				Storm = 100 yr				
Area No	Area (ha)	Time of Conc, Tc (min)	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)	Comments
S01	0.0290	10	0.83	76.81	5.1	**5.1**	0.83	104.19	7.0	**7.0**	1.00	178.56	14.4	**14.4**	Overland to Second Line
S02	0.0179	10	0.88	76.81	3.4	**6.4**	0.88	104.19	4.6	**6.4**	1.00	178.56	8.9	**6.4**	Outlet CB3
S03	0.0615	10	0.92	76.81	12.0		0.92	104.19	16.3		1.00	178.56	30.5		Outlet CB3
S04	0.0168	10	0.81	76.81	2.9	**2.9**	0.81	104.19	3.9	**3.9**	1.00	178.56	8.3	**6.4**	Outlet CB4
S05	0.1704	10	0.73	76.81	26.5	**3.2**	0.73	104.19	36.0	**3.2**	0.91	178.56	77.1	**3.2**	Oulet CB8
S06	0.1034	10	0.89	76.81	19.6	**6.4**	0.89	104.19	26.6	**6.4**	1.00	178.56	51.3	**6.4**	Outlet CB12
S07	0.0175	10	0.80	76.81	3.0	**3.0**	0.80	104.19	4.0	**3.2**	0.99	178.56	8.6	**3.2**	Outlet CB8
S08	0.0251	10	0.81	76.81	4.4	**4.4**	0.81	104.19	5.9	**6.4**	1.00	178.56	12.5	**6.4**	Outlet CB7
S09	0.0296	10	0.39	76.81	2.5	**6.4**	0.39	104.19	3.4	**6.4**	0.49	178.56	7.2	**6.4**	Outlet Drypond (DICB)
S10	0.0134	10	0.41	76.81	1.2	**1.2**	0.41	104.19	1.6	**1.6**	0.51	178.56	3.4	**3.4**	Overland to Hydro Corridor
S11	0.0251	10	0.41	76.81	2.2	**2.2**	0.41	104.19	3.0	**3.0**	0.51	178.56	6.3	**6.3**	Overland to Hydro Corridor
S12	0.0916	10	0.64	76.81	12.5	**12.5**	0.64	104.19	17.0	**12.6**	0.80	178.56	36.4	**12.6**	Outlet CB1
S13	0.1039	10	0.90	76.81	19.9	**6.4**	0.90	104.19	26.9	**6.4**	1.00	178.56	51.6	**6.4**	Outlet CB6
S14	0.0759	10	0.65	76.81	10.6	**6.4**	0.65	104.19	14.3	**6.4**	0.81	178.56	30.7	**6.4**	Outlet CB2
S15	0.0607	10	0.91	76.81	11.8	**6.4**	0.91	104.19	16.0	**6.4**	1.00	178.56	30.1	**6.4**	Outlet CB5
S16	0.0057	10	0.57	76.81	0.7	**0.7**	0.57	104.19	0.9	**0.9**	0.71	178.56	2.0	**2.0**	Overland to Second Line
S17	0.0056	11	0.58	73.17	0.7	**0.7**	0.58	99.19	0.9	**0.9**	0.72	169.91	1.9	**1.9**	Overland to Second Line
S18	0.0816	12	0.91	69.89	14.4	**6.4**	0.91	94.70	19.5	**6.4**	1.00	162.13	36.8	**6.4**	Outlet CB9
S19	0.0922	13	0.90	66.93	15.5	**6.4**	0.90	90.63	21.0	**6.4**	1.00	155.11	39.8	**6.4**	Outlet CB10
S20	0.1740	14	0.67	64.23	20.7	**6.4**	0.67	86.93	28.0	**6.4**	0.83	148.72	59.9	**6.4**	Outlet CB13
Totals	1.2009				189.4	**93.4**			256.8	**100.2**			517.7	**117.4**	

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)*

100yr Peak to Goward Storm = 89.4

100yr Peak to Second Line = 18.3

100yr Peak to Hydro Corridor = 3.9

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

Avg. Flow Through LMF80 at 1.3m head (L/s) = **6.4**

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

TABLE E8: RATING CURVES FOR MODELLING OF SURFACE PONDING AREAS

Ponding Location	CB3			CB6			CB7			CB8			CB10		
Max. Ponding Surface Area (m2)	4			15			16			17			20		
Max. Pond Elev (m)	102.85			101.15			101.15			101.10			101.45		
Min. Pond (or T/Lid) Elev (m)	102.80			101.05			101.05			101.00			101.35		
Max Ponding Depth (m)	0.050			0.100			0.100			0.100			0.100		
[1]Inv Elev of Storage Node (m)	101.40			99.65			99.65			99.60			99.95		
[2]Permitted 100yr Depth (m)	0.35			0.35			0.35			0.35			0.35		
[3]Allowance for Overland Flow	0.15			0.15			0.15			0.15			0.15		
[4]Storage Node (or Ponding) Rim Elevation (m)	103.30			101.55			101.55			101.50			101.85		
[4]Lid Elev - Inv Elev (m)	1.40			1.40			1.40			1.40			1.40		
Max Ponding Elev (m)	102.85			101.15			101.15			101.10			101.45		
Max Prism Volume (m3)	0.07			0.50			0.53			0.57			0.67		
Pondng Depth - Above Grade (m)	Total Depth (m)	Ponding Area (m^2)	Ponding Volume (m^3)	Total Depth (m)	Ponding Area (m^2)	Ponding Volume (m^3)	Total Depth (m)	Ponding Area (m^2)	Ponding Volume (m^3)	Total Depth (m)	Ponding Area (m^2)	Ponding Volume (m^3)	Total Depth (m)	Ponding Area (m^2)	Ponding Volume (m^3)
-1.400	0.000	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00
0.000	1.400	0.00	0.00	1.400	0.00	0.00	1.400	0.00	0.00	1.400	0.00	0.00	1.400	0.00	0.00
0.025	1.425	1.00	0.01	1.425	0.94	0.01	1.425	1.00	0.01	1.425	1.06	0.01	1.425	1.25	0.01
0.050	1.450	4.00	0.07	1.450	3.75	0.06	1.450	4.00	0.07	1.450	4.25	0.07	1.450	5.00	0.08
0.075				1.475	8.44	0.21	1.475	9.00	0.23	1.475	9.56	0.24	1.475	11.25	0.28
0.100				1.500	15.00	0.50	1.500	16.00	0.53	1.500	17.00	0.57	1.500	20.00	0.67
0.125															
0.150															
0.175															
0.200															
0.225															
0.250															
0.275															
0.300															
0.325															
0.350															
Max Ponding Area (m^2) and Maximum Ponding Volume (m^3)=		4	0.07		15	0.50		16	0.53		17	0.57		20	0.67
Ponding Depth Interval =	0.025														

Notes

1) The invert elevaiton of the storage node represents the invert elevaton in the catchbasin (i.e elevaiton of the ICD)

2) The Permitted Deoth is 0.35m as per Ottawa SDG002

3) The allowance for Overland Flow is an additional 0.15m

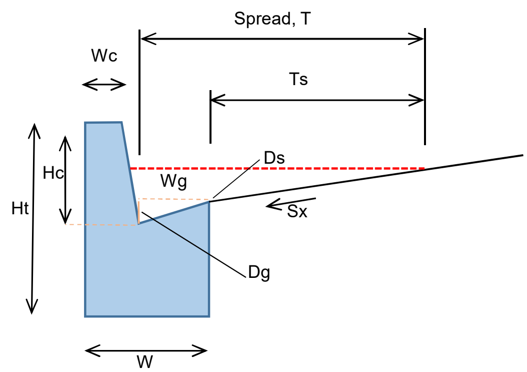
4) The Ponding RIM elevation of the storage node is equal to the differnce between the Max Ponding Elev and the Invert Elev plus an additonal 0.5m (0.35m for ponding during 100-yr event plus 0.15m allowance for overland flo

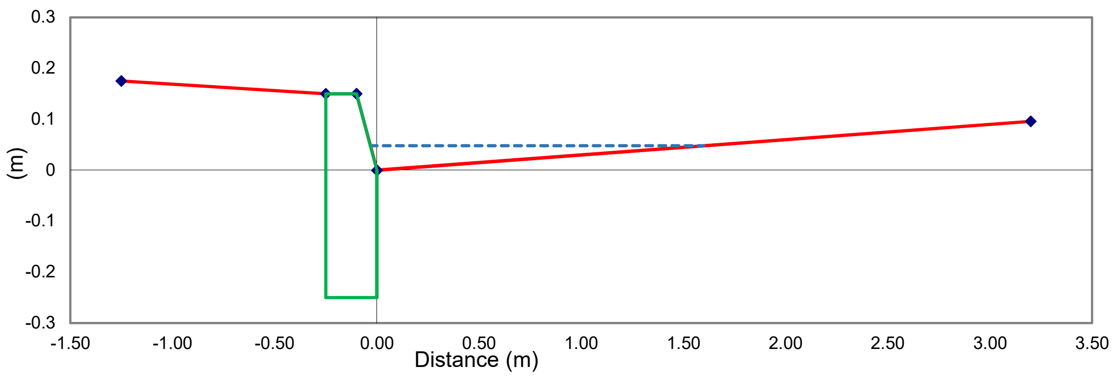
5) Used to Reference Depth from Invert Elev

TABLE E9: MAJOR SYSTEM (STREET SEGMENT) CHARATERISTICS

ROAD AND CURB DATA (For Gutter Grades Up to 8% and Lane Crossfalls Up to 6%)

Asphalt width, W_A (m) =	3.200	*From EOP to CL*
Total Road Width, W_R (m) =	3.200	*Includes gutter*
Lane crossfall, S_X (m/m) =	0.030	*3.0%*
Gutter Grade, S_O (m/m)	0.020	*2.0%*
Curb Type =	SC1.3	*Mountable*
Inlet Type =	S22	*Curb Inlet CB*
Curb height, H_C (m) =	0.150	
Total curb height, H_T (m) =	0.400	
Curb top width, W_C (m) =	0.150	
Curb bottom width, W (m) =	0.250	
Gutter width, W_G (m) =	0.000	
Gutter slope, S_G (m/m) =	0.000	$S_G = D_G / W_G$
Gutter depth, D_G (m) =	0.000	
Mannings, N =	0.013	
Max Spread, T_{MAX} (m) =	1.600	*Max Permitted Spread = 1/2 Asphalt width,* $W_A + W_G$
Max Spread on Asphalt, T_{SMAX} (m) =	1.600	*Max Permitted Spread Over Asphalt =1/2 Asphalt width*
Max Depth at EOP, D_{SMAX}(m) =	0.048	*Based on 1/2 Lane Width*
Max depth over gutter, D_{MAX} (m) =	0.048	$D_{MAX} = D_{SMAX} + D_G$





Overland Gutter and Roadway Flow Based on Road & Curb Type

Street Flow, (L/sec)	Assumed Spread (T)	Spread on Asphalt, Ts=T-Wg	Ds=Ts*Sx	D=Ds+Dg	Road and Gutter Flows (m^3/sec)				
					$Q_{(A+C)}$	$Q_{(C)}$	Gutter Flow, $Q_{(A)}$	Road Flow, $Q_{(B)}$	$Q_{(A+B)}$
0	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000	0.00
5	0.725	0.725	0.022	0.022	0.0000	0.0000	0.0000	0.0050	5.00
10	0.940	0.940	0.028	0.028	0.0000	0.0000	0.0000	0.0100	10.00
50	1.718	1.718	0.052	0.052	0.0000	0.0000	0.0000	0.0500	50.00
100	2.228	2.228	0.067	0.067	0.0000	0.0000	0.0000	0.1000	100.00
125	2.423	2.423	0.073	0.073	0.0000	0.0000	0.0000	0.1250	125.00
150	2.594	2.594	0.078	0.078	0.0000	0.0000	0.0000	0.1500	150.00
200	2.890	2.890	0.087	0.087	0.0000	0.0000	0.0000	0.2000	200.00
250	3.142	3.142	0.094	0.094		0.0000		0.2500	250.00

**Note: Re-iterate to get Steeet Flow Equal to* Q_{A+B} *(use Goal Seak Function)*

INLET CAPACITY, APPROACH FLOW & SPREAD BASED ON

Lane Crossfall = 0.030 m/m

Gutter Grade = 0.020 m/m

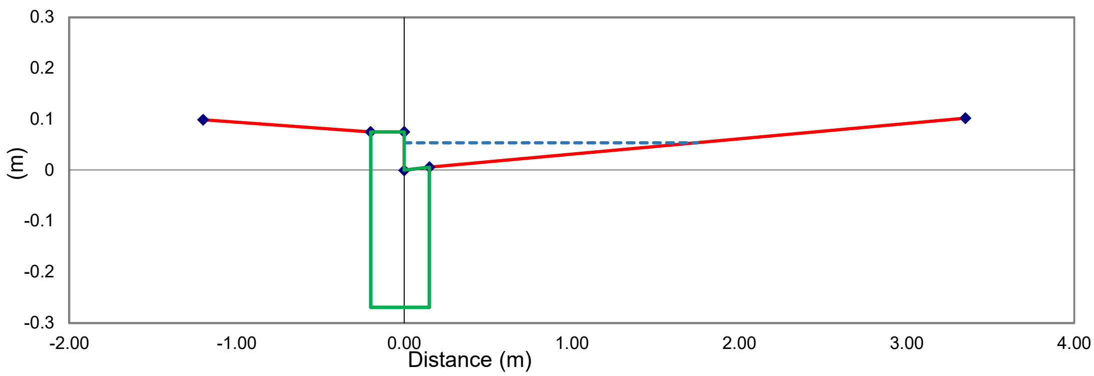
Street Flow, L/sec (m^3/sec)	Total Spread, T (m)	Spread on Asphalt, T_S (metres)	Depth of Flow at Gutter (m)	Inlet Capture Rate (m3/sec)	Inlet Capture Rate (l/sec)
0 (0.000)	0.000	0.000	0.000	0.000	0
5 (0.005)	0.725	0.725	0.022	0.003	3
10 (0.010)	0.940	0.940	0.028	0.005	5
50 (0.050)	1.718	1.718	0.052	0.012	12
100 (0.100)	2.228	2.228	0.067	0.016	16
125 (0.125)	2.423	2.423	0.073	0.018	18
150 (0.150)	2.594	2.594	0.078	0.020	20
200 (0.200)	2.890	2.890	0.087	0.023	23
250 (0.250)	3.142	3.142	0.094	0.026	26

Note: The Total Spread (T), includes Gutter width, (Wg) plus spread on lane, (Ts) for curb & gutter type curbs

TABLE E10: MAJOR SYSTEM (STREET SEGMENT) CHARATERISTICS

ROAD AND CURB DATA (For Gutter Grades Up to 8% and Lane Crossfalls Up to 6%)

Asphalt width, W_A (m) =	3.200	*From EOP to CL*
Total Road Width, W_R (m) =	3.350	*Includes gutter*
Lane crossfall, S_X (m/m) =	0.030	*3.0%*
Gutter Grade, S_O (m/m)	0.020	*2.0%*
Curb Type =	SC1.3	*Mountable Curb and Gutter*
Inlet Type =	S19	*Curb inlet CB*
Curb height, H_C (m) =	0.075	
Total curb height, H_T (m) =	0.350	
Curb top width, W_C (m) =	0.200	
Curb bottom width, W (m) =	0.350	
Gutter width, W_G (m) =	0.150	
Gutter slope, S_G (m/m) =	0.040	$S_G = D_G / W_G$
Gutter depth, D_G (m) =	0.006	
Mannings, N =	0.013	
Max Spread, T_{MAX} (m) =	1.750	*Max Permitted Spread = 1/2 Asphalt width,* $W_A + W_G$
Max Spread on Asphalt, T_{SMAX} (m) =	1.600	*Max Permitted Spread Over Asphalt =1/2 Asphalt width*
Max Depth at EOP, D_{SMAX}(m) =	0.048	*Based on 1/2 Lane Width*
Max depth over gutter, D_{MAX} (m) =	0.054	$D_{MAX} = D_{SMAX} + D_G$



Overland Gutter and Roadway Flow Based on Road & Curb Type

Street Flow, (L/sec)	Assumed Spread (T)	Spread on Asphalt, Ts=T-Wg	Ds=Ts*Sx	D=Ds+Dg	Road and Gutter Flows (m^3/sec)				
					$Q_{(A+C)}$	$Q_{(C)}$	Gutter Flow, $Q_{(A)}$	Road Flow, $Q_{(B)}$	$Q_{(A+B)}$
0	0.000	0.000	0.000	0.006	0.0001	0.0000	0.0001	0.0000	0.12
5	0.716	0.566	0.017	0.023	0.0044	0.0019	0.0024	0.0026	5.00
10	0.933	0.783	0.023	0.029	0.0085	0.0046	0.0038	0.0062	10.00
50	1.715	1.565	0.047	0.053	0.0403	0.0292	0.0110	0.0390	50.00
100	2.226	2.076	0.062	0.068	0.0793	0.0621	0.0173	0.0827	100.00
125	2.420	2.270	0.068	0.074	0.0987	0.0788	0.0199	0.1051	125.00
150	2.592	2.442	0.073	0.079	0.1181	0.0957	0.0224	0.1276	150.00
200	2.887	2.737	0.082	0.088	0.1567	0.1298	0.0269	0.1731	200.00
250	3.140	2.990	0.090	0.096	0.1952	0.1643	0.0310	0.2190	250.00

**Note: Re-iterate to get Steeet Flow Equal to* Q_{A+B} *(use Goal Seak Function)*

INLET CAPACITY, APPROACH FLOW & SPREAD BASED ON

Lane Crossfall = 0.030 m/m

Gutter Grade = 0.020 m/m

Street Flow (L/sec)	Total Spread, T (m)	Spread on Asphalt, T_S (metres)	Depth of Flow at Gutter (m)	Inlet Capture Rate (m3/sec)	Inlet Capture Rate (L/sec)
0	0.000	0.000	0.006	0.000	0
5	0.716	0.566	0.023	0.013	13
10	0.933	0.783	0.029	0.017	17
50	1.715	1.565	0.053	0.033	33
100	2.226	2.076	0.068	0.045	45
125	2.420	2.270	0.074	0.050	50
150	2.592	2.442	0.079	0.054	54
200	2.887	2.737	0.088	0.061	61
250	3.140	2.990	0.096	0.000	61

Note: The Total Spread (T), includes Gutter width, (Wg) plus spread on lane, (Ts) for curb & gutter type curbs

TABLE E11.1: Inlet Control Devices (ICD) Types

Model	Shape	Coeff	Orifice Dia (mm)	Diamond Dimensions (mm)				Orifce Area (mm2)	Orifce Area (mm2)	H (m)	Q (L/sec)
				a	b	c	d				
IPEX-LMF40	Round	0.61	25.2					498.8	0.0005	2.00	1.9
IPEX-LMF45	Round	0.61	29.4					678.9	0.00068	2.00	2.6
IPEX-LMF50	Round	0.61	32.6					834.7	0.00083	2.00	3.2
IPEX-LMF55	Round	0.61	35.6					995.4	0.001	2.00	3.8
IPEX-LMF60	Round	0.61	38.7					1176.3	0.00118	2.00	4.5
IPEX-LMF65	Round	0.61	42					1385.4	0.00139	2.00	5.3
IPEX-LMF70	Round	0.61	45.4					1618.8	0.00162	2.00	6.2
IPEX-LMF75	Round	0.61	48.6					1855.1	0.00186	2.00	7.1
IPEX-LMF80	Round	0.61	52.2					2140.1	0.00214	2.00	8.2
IPEX-LMF85	Round	0.61	55					2375.8	0.00238	2.00	9.1
IPEX-LMF90	Round	0.61	58.3					2669.5	0.00267	2.00	10.2
IPEX-LMF95	Round	0.61	61.6					2980.2	0.00298	2.00	11.4
IPEX-LMF100	Round	0.61	65					3318.3	0.00332	2.00	12.7
IPEX-LMF105	Round	0.61	68					3631.7	0.00363	2.00	13.9
IPEX-MHF-TypeA	Diamond	0.61		78.14	58.34	110.50	28	6693.1	0.00669	1.22	20.0
IPEX MHF-TypeB	Diamond	0.61		94.40	74.60	133.50	28	9499.1	0.0095	1.22	28.3
IPEX MHF-TypeC	Diamond	0.61		108.61	88.81	153.60	28	12384.5	0.01238	1.22	37.0
IPEX-MHF-TypeD	Diamond	0.61		132.37	112.57	187.20	28	18109.9	0.01811	3.05	85.5
IPEX-MHF-TypeF	Diamond	0.61		152.88	133.08	216.20	28	23959.2	0.02396	3.05	113.1

IPEX MHF Diamond With Slot Detail

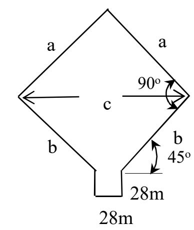
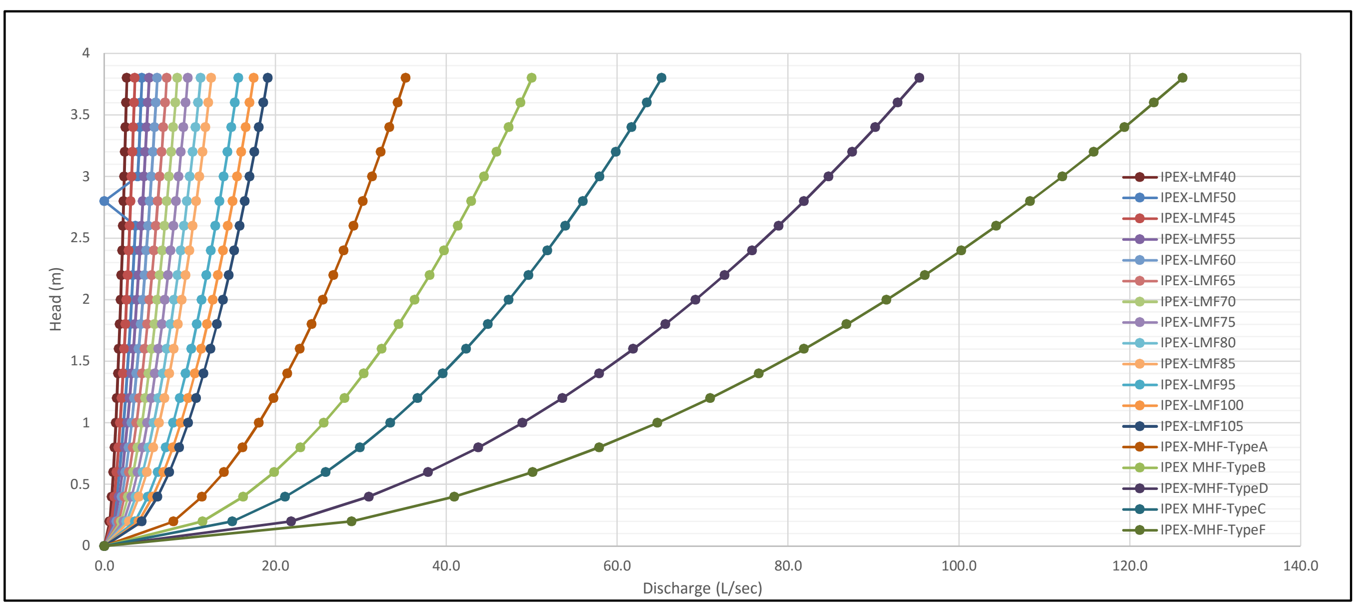


TABLE E11.2 : DISCHARGE RATES FOR VARIOUS IPEX ICD MODELS

Head (m)	ICD Models: IPEX-LMF40	IPEX-LMF45	IPEX-LMF50	IPEX-LMF55	IPEX-LMF60	IPEX-LMF65	IPEX-LMF70	IPEX-LMF75	IPEX-LMF80	IPEX-LMF85	IPEX-LMF90	IPEX-LMF95	IPEX-LMF100	IPEX-LMF105	IPEX-MHF-TypeA	IPEX MHF-TypeB	IPEX MHF-TypeC	IPEX-MHF-TypeD	IPEX-MHF-TypeF
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.2	0.6	0.8	1.0	1.2	1.4	1.7	2.0	2.2	2.6	2.9	3.2	3.6	4.0	4.4	8.1	11.5	15.0	21.9	29.0
0.4	0.9	1.2	1.4	1.7	2.0	2.4	2.8	3.2	3.7	4.1	4.6	5.1	5.7	6.2	11.4	16.2	21.2	30.9	40.9
0.6	1.0	1.4	1.7	2.1	2.5	2.9	3.4	3.9	4.5	5.0	5.6	6.2	6.9	7.6	14.0	19.9	25.9	37.9	50.1
0.8	1.2	1.6	2.0	2.4	2.8	3.3	3.9	4.5	5.2	5.7	6.5	7.2	8.0	8.8	16.2	23.0	29.9	43.8	57.9
1	1.3	1.8	2.3	2.7	3.2	3.7	4.4	5.0	5.8	6.4	7.2	8.1	9.0	9.8	18.1	25.7	33.5	48.9	64.7
1.2	1.5	2.0	2.5	2.9	3.5	4.1	4.8	5.5	6.3	7.0	7.9	8.8	9.8	10.7	19.8	28.1	36.7	53.6	70.9
1.4	1.6	2.2	2.7	3.2	3.8	4.4	5.2	5.9	6.8	7.6	8.5	9.5	10.6	11.6	21.4	30.4	39.6	57.9	76.6
1.6	1.7	2.3	2.9	3.4	4.0	4.7	5.5	6.3	7.3	8.1	9.1	10.2	11.3	12.4	22.9	32.5	42.3	61.9	81.9
1.8	1.8	2.5	3.0	3.6	4.3	5.0	5.9	6.7	7.8	8.6	9.7	10.8	12.0	13.2	24.3	34.4	44.9	65.6	86.9
2	1.9	2.6	3.2	3.8	4.5	5.3	6.2	7.1	8.2	9.1	10.2	11.4	12.7	13.9	25.6	36.3	47.3	69.2	91.6
2.2	2.0	2.7	3.3	4.0	4.7	5.6	6.5	7.4	8.6	9.5	10.7	11.9	13.3	14.6	26.8	38.1	49.6	72.6	96.0
2.4	2.1	2.8	3.5	4.2	4.9	5.8	6.8	7.8	9.0	9.9	11.2	12.5	13.9	15.2	28.0	39.8	51.8	75.8	100.3
2.6	2.2	3.0	3.6	4.3	5.1	6.0	7.1	8.1	9.3	10.4	11.6	13.0	14.5	15.8	29.2	41.4	54.0	78.9	104.4
2.8	2.3	3.1	0.0	4.5	5.3	6.3	7.3	8.4	9.7	10.7	12.1	13.5	15.0	16.4	30.3	42.9	56.0	81.9	108.3
3	2.3	3.2	3.9	4.7	5.5	6.5	7.6	8.7	10.0	11.1	12.5	13.9	15.5	17.0	31.3	44.5	58.0	84.8	112.1
3.2	2.4	3.3	4.0	4.8	5.7	6.7	7.8	9.0	10.3	11.5	12.9	14.4	16.0	17.6	32.4	45.9	59.9	87.5	115.8
3.4	2.5	3.4	4.2	5.0	5.9	6.9	8.1	9.2	10.7	11.8	13.3	14.8	16.5	18.1	33.3	47.3	61.7	90.2	119.4
3.6	2.6	3.5	4.3	5.1	6.0	7.1	8.3	9.5	11.0	12.2	13.7	15.3	17.0	18.6	34.3	48.7	63.5	92.8	122.8
3.8	2.6	3.6	4.4	5.2	6.2	7.3	8.5	9.8	11.3	12.5	14.1	15.7	17.5	19.1	35.3	50.0	65.2	95.4	126.2



Appendix F – Stormwater Modelling Results

PCSWMM Input File (Details)

PCSWMM Output File (Status)

```
[TITLE]
Dual Drianage Model. Removed two CBs and updaed dry pond area


[OPTIONS]
;;Options            Value
;;------------------ ------------
FLOW_UNITS           LPS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
START_DATE           02/22/2018
START_TIME           00:00:00
REPORT_START_DATE    02/22/2018
REPORT_START_TIME    00:00:00
END_DATE             02/22/2018
END_TIME             06:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:01:00
DRY_STEP             00:01:00
ROUTING_STEP         1
ALLOW_PONDING        NO
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     1
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         1
THREADS              4

[EVAPORATION]
;;Type          Parameters
;;------------- ----------
CONSTANT     0.0
DRY_ONLY     NO
```

```
[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
Chicago_3h_100yr INTENSITY 0:05   1.0    TIMESERIES Chicago_3h_100yr
Chicago_3h_2yr   INTENSITY 0:05   1.0    TIMESERIES Chicago_3h_2yr
Historic_Aug4_88 INTENSITY 1:00   1.0    TIMESERIES Historic_Storm_Aug-4-88
Historic_Aug8_96 INTENSITY 1:00   1.0    TIMESERIES Historic_Storm_Aug-8-1996
Historic_Jul1_79 INTENSITY 1:00   1.0    TIMESERIES Historic_Storm_Jul-1-79

[SUBCATCHMENTS]
;;                                                Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
S01              Chicago_3h_100yr Outfall_Second_Line 0.029 72.8     26.364   2        0
S02              Chicago_3h_100yr CB3              0.0179   82.1     19.889   2        0
S03              Chicago_3h_100yr CB3              0.0615   87.8     68.333   2        0
S04              Chicago_3h_100yr CB4-MAJ          0.0168   69       14       2        0
S05              Chicago_3h_100yr CB8-MAJ          0.1704   55.6     568      4        0
S06              Chicago_3h_100yr CB12-MAJ         0.1034   83.1     94       2        0
S07              Chicago_3h_100yr CB8-MAJ          0.0175   67       35       2        0
S08              Chicago_3h_100yr CB7-MAJ          0.0251   70.4     25.1     2        0
S09              Chicago_3h_100yr Drypond          0.0296   0        11.84    2        0
S10              Chicago_3h_100yr Outfall_Hydro_Corridor 0.0134 0    44.667   2        0
S11              Chicago_3h_100yr Outfall_Hydro_Corridor 0.0251 0    83.667   2        0
S12              Chicago_3h_100yr CB1              0.0916   40.7     83.273   4        0
S13              Chicago_3h_100yr CB6-MAJ          0.1039   84.4     148.429  2        0
S14              Chicago_3h_100yr CB2              0.0759   42.4     63.25    4        0
S15              Chicago_3h_100yr CB5-maj          0.0607   87.1     55.182   2        0
S16              Chicago_3h_100yr Outfall_Second_Line 0.0057 29.4    2.85     2        0
S17              Chicago_3h_100yr Outfall_Second_Line 0.0056 29.4    18.667   2        0
S18              Chicago_3h_100yr CB9-MAJ          0.0816   86.7     74.182   2        0
S19              Chicago_3h_100yr CB10-MAJ         0.0922   85.6     83.818   2        0
S20              Chicago_3h_100yr CB13             0.174    44.2     1740     4        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
S01              0.013      0.1        1.57       4.67       25         OUTLET
S02              0.013      0.1        1.57       4.67       25         OUTLET
S03              0.013      0.1        1.57       4.67       25         OUTLET
S04              0.013      0.1        1.57       4.67       25         OUTLET
S05              0.013      0.1        1.57       4.67       25         OUTLET
S06              0.013      0.1        1.57       4.67       25         OUTLET
S07              0.013      0.1        1.57       4.67       25         OUTLET
S08              0.013      0.1        1.57       4.67       25         OUTLET
```

```
S09              0.013      0.1        1.57       4.67       25         OUTLET
S10              0.013      0.1        1.57       4.67       25         OUTLET
S11              0.013      0.1        1.57       4.67       25         OUTLET
S12              0.013      0.1        1.57       4.67       25         OUTLET
S13              0.013      0.1        1.57       4.67       25         OUTLET
S14              0.013      0.1        1.57       4.67       25         OUTLET
S15              0.013      0.1        1.57       4.67       25         OUTLET
S16              0.013      0.1        1.57       4.67       25         OUTLET
S17              0.013      0.1        1.57       4.67       25         OUTLET
S18              0.013      0.1        1.57       4.67       25         OUTLET
S19              0.013      0.1        1.57       4.67       25         OUTLET
S20              0.013      0.1        1.57       4.67       25         OUTLET

[INFILTRATION]
;;Subcatchment   MaxRate    MinRate    Decay      DryTime    MaxInfil
;;-------------- ---------- ---------- ---------- ---------- ----------
S01              76.2       13.2       4.14       7          0
S02              76.2       13.2       4.14       7          0
S03              76.2       13.2       4.14       7          0
S04              76.2       13.2       4.14       7          0
S05              76.2       13.2       4.14       7          0
S06              76.2       13.2       4.14       7          0
S07              76.2       13.2       4.14       7          0
S08              76.2       13.2       4.14       7          0
S09              76.2       13.2       4.14       7          0
S10              76.2       13.2       4.14       7          0
S11              76.2       13.2       4.14       7          0
S12              76.2       13.2       4.14       7          0
S13              76.2       13.2       4.14       7          0
S14              76.2       13.2       4.14       7          0
S15              76.2       13.2       4.14       7          0
S16              76.2       13.2       4.14       7          0
S17              76.2       13.2       4.14       7          0
S18              76.2       13.2       4.14       7          0
S19              76.2       13.2       4.14       7          0
S20              76.2       13.2       4.14       7          0

[JUNCTIONS]
;;               Invert     Max.       Init.      Surcharge  Ponded
;;Name           Elev.      Depth      Depth      Depth      Area
;;-------------- ---------- ---------- ---------- ---------- ----------
200              99.674     3.576      0          0          0
201              99.09      3.51       0          0          0
202              97.986     3.064      0          0          0
203              97.904     3.296      0          0          0
204              100.663    3.587      0          0          0
```

```
205              100.184    3.306      0          0          0
206              98.414     3.686      0          0          0
207              98.66      2.36       0          0          0
208              97.774     3.302      0          0          0
CB1              99.73      2          0          0          0
CB10-DS          101.41     0.1        0          0          0
CB10-MAJ         101.41     0.1        0          0          0
CB10-TEE         98.562     3.37       0          0          0
CB12-MAJ         101.48     0.1        0          0          0
CB12-TEE         98.326     3.582      0          0          0
CB13             98.86      2.3        0          0          0
CB3-TEE          99.35      3.443      0          0          0
CB4-DS           102.82     0.1        0          0          0
CB4-MAJ          102.924    0.016      0          0          0
CB4-TEE          99.338     3.448      0          0          0
CB5-MAJ          102.51     0.1        0          0          0
CB5-TEE          98.868     3.338      0          0          0
CB6-MAJ          101.23     0.17       0          0          0
CB6-TEE          97.978     3.101      0          0          0
CB7-MAJ          101.12     0.1        0          0          0
CB7-TEE          98.108     3.082      0          0          0
CB8-MAJ          101.2      0.1        0          0          0
CB8-TEE          98.13      3.109      0          0          0
CB9-MAJ          102.99     0.1        0          0          0
CB9-TEE          99.813     3.2        0          0          0

[OUTFALLS]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
Outfall_Goward_Storm 97.5   FREE                          NO
Outfall_Second_Line 0       FREE                          NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                        Ponded   Evap.
;;Name           Elev.    Depth    Depth    Curve      Params                       Area     Frac.    Infiltration parameters
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- -------- -----------------------
CB10             99.41    2        0        TABULAR    CB10-STORAGE                 0        0
CB12             99.48    2        0        FUNCTIONAL 0        0        0.36     0        0
CB2              100.1    2        0        FUNCTIONAL 0        0        0.36     0        0
CB3              100.85   2        0        TABULAR    CB3-PONDING                  0        0
CB4              100.84   2        0        FUNCTIONAL 0        0        0.36     0        0
CB5              99.84    2.67     0        FUNCTIONAL 0        0        0.36     0        0
CB6              99.13    2        0        TABULAR    CB8-PONDING                  0        0
CB7              99.12    2        0        TABULAR    CB7-PONDING                  0        0
;PONDING
```

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CB8              99.2     2        0        TABULAR    CB8-PONDING                  0        0
CB9              100.99   2        0        FUNCTIONAL 0          0        0.36     0        0
Drypond          98.6     2.25     0        TABULAR    DRY-POND                     0        0
Outfall_Hydro_Corridor 100.8 0.2   0        TABULAR    PARK-STORAGE                 0        0

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     Init.      Max.
;;Name           Node             Node             Length     N          Offset     Offset     Flow       Flow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
C1               CB2              CB1              68.902     0.01       100.21     101.73     0          0
C1_1             203              208              24.781     0.013      97.904     97.804     0          0
C1_2             208              Outfall_Goward_Storm 43.322 0.013      97.774     97.6       0          0
;Swale
C10-S            CB13             Outfall_Hydro_Corridor 85.457 0.013    101.129    100.8      0          0
;Swale
C12              CB1              Outfall_Hydro_Corridor 36.554 0.01     101.73     100.8      0          0
C15-S            CB12-MAJ         CB8-MAJ          25.72      0.013      101.48     101.2      0          0
C2               CB7-MAJ          Drypond          4.686      0.013      101.12     100        0          0
C2_1             202              CB6-TEE          1.828      0.013      97.986     97.978     0          0
C2_3             CB6-TEE          203              3.58       0.013      97.978     97.964     0          0
C3               200              201              22.916     0.013      99.674     99.215     0          0
C4_1             201              CB5-TEE          18.493     0.013      99.09      98.868     0          0
C4_2             CB5-TEE          202              67.283     0.013      98.868     98.061     0          0
C4_5-S           CB5-MAJ          CB6-MAJ          70.256     0.013      101.51     101.13     0          0
C6               205              CB3-TEE          30.885     0.013      100.184    99.35      0          0
C6_2             CB3-TEE          CB4-TEE          0.403      0.013      99.35      99.338     0          0
C6_6             CB4-TEE          201              6.392      0.013      99.338     99.165     0          0
C6-S             CB8-MAJ          CB7-MAJ          11.5       0.013      101.2      101.12     0          0
C7_1             204              CB9-TEE          42.483     0.013      100.663    99.813     0          0
C7_2             CB9-TEE          206              66.221     0.013      99.813     98.489     0          0
C7_2-S           CB9-MAJ          CB10-MAJ         67.717     0.013      102.99     101.41     0          0
C7-S             CB6-MAJ          CB7-MAJ          6.532      0.013      101.13     101.12     0          0
C8               CB3              CB4-DS           9.199      0.013      102.85     102.82     0          0
C8_2             CB7-TEE          202              5.746      0.013      98.108     98.061     0          0
C8_3             206              CB12-TEE         10.776     0.013      98.414     98.326     0          0
C8_3-S           CB10-MAJ         CB10-DS          6.791      0.013      101.41     101.41     0          0
C8_4             CB8-TEE          CB7-TEE          2.619      0.013      98.13      98.108     0          0
C8_5             CB12-TEE         CB8-TEE          24.43      0.013      98.326     98.13      0          0
C8_5-S           CB10-DS          CB7-MAJ          32.797     0.013      101.41     101.12     0          0
C9_1             207              CB10-TEE         9.67       0.013      98.66      98.562     0          0
C9_2             CB10-TEE         206              2.336      0.013      98.562     98.539     0          0
C9-S_1           CB4-MAJ          CB4-DS           1.81       0.013      102.84     102.82     0          0
C9-S_2           CB4-DS           CB8-MAJ          70.656     0.013      102.82     101.2      0          0
CB12-ICD_1       CB2              CB5              22.638     0.01       100.7      100.47     0          0

[OUTLETS]
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;;               Inlet            Outlet           Outflow    Outlet           Qcoeff/                     Flap
;;Name           Node             Node             Height     Type             QTable           Qexpon     Gate
;;-------------- ---------------- ---------------- ---------- ---------------- ---------------- ---------- ----
C11-ICD          CB10             CB10-TEE         100.01     TABULAR/DEPTH    ICD-IPEX-LMF80              NO
C3-ICD           CB3              CB3-TEE          101.45     TABULAR/DEPTH    ICD-IPEX-LMF80              NO
CB11-IC          CB10-MAJ         CB10             101.41     TABULAR/DEPTH    CICB-IC                     NO
CB12-IC          CB12-MAJ         CB12             101.48     TABULAR/DEPTH    CB-IC                       NO
CB12-ICD         CB12             CB12-TEE         100.08     TABULAR/DEPTH    ICD-IPEX-LMF80              NO
CB14-ICD         CB13             207              99.46      TABULAR/DEPTH    ICD-IPEX-LMF80              NO
CB15-ICD         CB1              208              100.33     TABULAR/DEPTH    ICD-IPEX-LMF80              NO
CB2-IC           CB7-MAJ          CB7              101.12     TABULAR/DEPTH    CB-IC                       NO
CB4-ICA          CB4-MAJ          CB4              102.84     TABULAR/DEPTH    CB-IC                       NO
CB4-ICD          CB4              CB4-TEE          101.44     TABULAR/DEPTH    ICD-IPEX-LMF80              NO
CB5-IC           CB5-MAJ          CB5              102.51     TABULAR/DEPTH    CICB-IC                     NO
CB5-ICD          CB5              CB5-TEE          100.44     TABULAR/DEPTH    ICD-IPEX-TYPEA              NO
CB6-IC           CB6-MAJ          CB6              101.13     TABULAR/DEPTH    CICB-IC                     NO
CB6-ICD          CB6              CB6-TEE          99.73      TABULAR/DEPTH    ICD-IPEX-LMF80              NO
CB7-ICD          CB7              CB7-TEE          99.72      TABULAR/DEPTH    ICD-IPEX-LMF80              NO
CB8-IC           CB9-MAJ          CB9              102.99     TABULAR/DEPTH    CICB-IC                     NO
CB8-ICA          CB8-MAJ          CB8              101.2      TABULAR/DEPTH    CB-IC                       NO
CB8-ICDA         CB8              CB8-TEE          99.928     TABULAR/DEPTH    ICD-IPEX-LMF80              NO
CB9-ICD          CB9              CB9-TEE          101.59     TABULAR/DEPTH    ICD-IPEX-LMF80              NO
POND-ICD         Drypond          203              98.6       TABULAR/DEPTH    ICD-IPEX-LMF80              NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels
;;-------------- ------------ ---------------- ---------- ---------- ---------- ----------
C1               IRREGULAR    Swale            0          0          0          1
C1_1             CIRCULAR     0.45             0          0          0          1
C1_2             CIRCULAR     0.45             0          0          0          1
C10-S            IRREGULAR    Swale            0          0          0          1
C12              IRREGULAR    Swale            0          0          0          1
C15-S            IRREGULAR    Half_3.35m_Street 0         0          0          1
C2               IRREGULAR    Road-Spill-1     0          0          0          1
C2_1             CIRCULAR     0.45             0          0          0          1
C2_3             CIRCULAR     0.45             0          0          0          1
C3               CIRCULAR     0.25             0          0          0          1
C4_1             CIRCULAR     0.375            0          0          0          1
C4_2             CIRCULAR     0.375            0          0          0          1
C4_5-S           IRREGULAR    Half_3.35m_Street 0         0          0          1
C6               CIRCULAR     0.3              0          0          0          1
C6_2             CIRCULAR     0.3              0          0          0          1
C6_6             CIRCULAR     0.3              0          0          0          1
C6-S             IRREGULAR    Road-Spill-1     0          0          0          1
C7_1             CIRCULAR     0.3              0          0          0          1
C7_2             CIRCULAR     0.3              0          0          0          1
```

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C7_2-S           IRREGULAR    Half_3.35m_Street 0          0          0          1
C7-S             IRREGULAR    Road-Spill-1     0          0          0          1
C8               IRREGULAR    Road-Spill-1     0          0          0          1
C8_2             CIRCULAR     0.375            0          0          0          1
C8_3             CIRCULAR     0.375            0          0          0          1
C8_3-S           IRREGULAR    Road-Spill-3,4   0          0          0          1
C8_4             CIRCULAR     0.375            0          0          0          1
C8_5             CIRCULAR     0.375            0          0          0          1
C8_5-S           IRREGULAR    Half_3.35m_Street 0          0          0          1
C9_1             CIRCULAR     0.25             0          0          0          1
C9_2             CIRCULAR     0.25             0          0          0          1
C9-S_1           IRREGULAR    Half_3.35m_Street 0          0          0          1
C9-S_2           IRREGULAR    Half_3.35m_Street 0          0          0          1
CB12-ICD_1       CIRCULAR     0.2              0          0          0          1

[TRANSECTS]

;Half street, width = 3.35m, curb = 0.15m , cross-slope = 0.03m/m, bank-slope = 0.03m/m, bank-height = 0.20m.
NC 0.02     0.02     0.013
X1 Half_3.35m_Street 4        0.0      3.35     0.0       0.0       0.0      0.0      0.0
GR 0.1      0        0        3.35     0.15     3.35     0.2      5.02

;Spill at Street 1/3 and 1/4
;3.35m at 3% and 2.94m at 3.4%
;Max depth 0.10m
NC 0.013    0.013    0.013
X1 Road-Spill-1     3        0.0      0.0      0.0       0.0       0.0      0.0      0.0
GR 0.1      0        0        3.35     0.1      6.29

;Spill at Street 1/4 and 2/4
;3.33m at 3% and 20m at 0.50%
;Max depth 0.10m
NC 0.013    0.013    0.013
X1 Road-Spill-3,4   3        0        0.0      0.0       0.0       0.0      0.0      0.0
GR 0.1      0        0        3.33     0.1      23.33

;REAR YARD SWALE
;MAX DEPTH 300 MM
;WIRHT = 2 M
NC 0.01     0.01     0.01
X1 Swale            3        0.0      0.0      0.0       0.0       0.0      0.0      0.0
GR 0.3      0        0        1        0.3      2

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate  SeepageRate
;;-------------- ---------- ---------- ---------- ---------- ----------
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```
[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
;Inlet Capacity for Standard CB
;3% Crossfall
;2% Gutter Grade
CB-IC            Rating     0.006      0
CB-IC                       0.023      13
CB-IC                       0.029      17
CB-IC                       0.053      33
CB-IC                       0.068      45
CB-IC                       0.074      50
CB-IC                       0.079      54
CB-IC                       0.088      61
CB-IC                       0.096      61

;CICB as per S22
;3% Crossfall
;2% Gutter Grade
CICB-IC          Rating     0.000      0
CICB-IC                     0.022      3
CICB-IC                     0.028      5
CICB-IC                     0.052      12
CICB-IC                     0.067      16
CICB-IC                     0.073      18
CICB-IC                     0.078      20
CICB-IC                     0.087      23
CICB-IC                     0.094      26

ICD-IPEX-LMF100  Rating     0.000      0.000
ICD-IPEX-LMF100             0.200      3.944
ICD-IPEX-LMF100             0.400      5.578
ICD-IPEX-LMF100             0.600      6.831
ICD-IPEX-LMF100             0.800      7.888
ICD-IPEX-LMF100             1.000      8.819
ICD-IPEX-LMF100             1.200      9.661
ICD-IPEX-LMF100             1.400      10.435
ICD-IPEX-LMF100             1.600      11.155
ICD-IPEX-LMF100             1.800      11.832
ICD-IPEX-LMF100             2.000      12.472
ICD-IPEX-LMF100             2.200      13.081
ICD-IPEX-LMF100             2.400      13.662
ICD-IPEX-LMF100             2.600      14.220
ICD-IPEX-LMF100             2.800      14.757
ICD-IPEX-LMF100             3.000      15.275
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ICD-IPEX-LMF100            3.200      15.776
ICD-IPEX-LMF100            3.400      16.261
ICD-IPEX-LMF100            3.600      16.733
ICD-IPEX-LMF100            3.800      17.191

;IPEX-LMF-80
;MAX FLOW 6 L/SEC  AT 1.3m
ICD-IPEX-LMF80   Rating     0.000      0.000
ICD-IPEX-LMF80              0.200      2.544
ICD-IPEX-LMF80              0.400      3.597
ICD-IPEX-LMF80              0.600      4.406
ICD-IPEX-LMF80              0.800      5.087
ICD-IPEX-LMF80              1.000      5.688
ICD-IPEX-LMF80              1.200      6.230
ICD-IPEX-LMF80              1.400      6.730
ICD-IPEX-LMF80              1.600      7.194
ICD-IPEX-LMF80              1.800      7.631
ICD-IPEX-LMF80              2.000      8.044
ICD-IPEX-LMF80              2.200      8.436
ICD-IPEX-LMF80              2.400      8.811
ICD-IPEX-LMF80              2.600      9.171
ICD-IPEX-LMF80              2.800      9.517
ICD-IPEX-LMF80              3.000      9.851
ICD-IPEX-LMF80              3.200      10.174
ICD-IPEX-LMF80              3.400      10.487
ICD-IPEX-LMF80              3.600      10.792
ICD-IPEX-LMF80              3.800      11.087

;iPEX  tYPE A
;20 l/SEC @ 1.4
ICD-IPEX-TYPEA   Rating     0.000      0.000
ICD-IPEX-TYPEA              0.200      8.088
ICD-IPEX-TYPEA              0.400      11.438
ICD-IPEX-TYPEA              0.600      14.008
ICD-IPEX-TYPEA              0.800      16.175
ICD-IPEX-TYPEA              1.000      18.085
ICD-IPEX-TYPEA              1.200      19.811
ICD-IPEX-TYPEA              1.400      21.398
ICD-IPEX-TYPEA              1.600      22.875
ICD-IPEX-TYPEA              1.800      24.263
ICD-IPEX-TYPEA              2.000      25.575
ICD-IPEX-TYPEA              2.200      26.824
ICD-IPEX-TYPEA              2.400      28.017
ICD-IPEX-TYPEA              2.600      29.160
ICD-IPEX-TYPEA              2.800      30.261
ICD-IPEX-TYPEA              3.000      31.323
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ICD-IPEX-TYPEA              3.200      32.351
ICD-IPEX-TYPEA              3.400      33.346
ICD-IPEX-TYPEA              3.600      34.313
ICD-IPEX-TYPEA              3.800      35.253

;MHF Type C
ICD-IPEX-TYPE-C  Rating     0.000      0.000
ICD-IPEX-TYPE-C             0.200      14.965
ICD-IPEX-TYPE-C             0.400      21.163
ICD-IPEX-TYPE-C             0.600      25.920
ICD-IPEX-TYPE-C             0.800      29.930
ICD-IPEX-TYPE-C             1.000      33.462
ICD-IPEX-TYPE-C             1.200      36.656
ICD-IPEX-TYPE-C             1.400      39.593
ICD-IPEX-TYPE-C             1.600      42.327
ICD-IPEX-TYPE-C             1.800      44.895
ICD-IPEX-TYPE-C             2.000      47.323
ICD-IPEX-TYPE-C             2.200      49.633
ICD-IPEX-TYPE-C             2.400      51.840
ICD-IPEX-TYPE-C             2.600      53.957
ICD-IPEX-TYPE-C             2.800      55.993
ICD-IPEX-TYPE-C             3.000      57.959
ICD-IPEX-TYPE-C             3.200      59.859
ICD-IPEX-TYPE-C             3.400      61.702
ICD-IPEX-TYPE-C             3.600      63.490
ICD-IPEX-TYPE-C             3.800      65.230

;IPEX TYPE D
;49 L/sec AT 1m
ICD-IPEX-TYPED   Rating     0.000      0.000
ICD-IPEX-TYPED              0.200      21.883
ICD-IPEX-TYPED              0.400      30.948
ICD-IPEX-TYPED              0.600      37.903
ICD-IPEX-TYPED              0.800      43.766
ICD-IPEX-TYPED              1.000      48.932
ICD-IPEX-TYPED              1.200      53.603
ICD-IPEX-TYPED              1.400      57.898
ICD-IPEX-TYPED              1.600      61.895
ICD-IPEX-TYPED              1.800      65.650
ICD-IPEX-TYPED              2.000      69.201
ICD-IPEX-TYPED              2.200      72.578
ICD-IPEX-TYPED              2.400      75.806
ICD-IPEX-TYPED              2.600      78.901
ICD-IPEX-TYPED              2.800      81.879
ICD-IPEX-TYPED              3.000      84.753
ICD-IPEX-TYPED              3.200      87.533
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ICD-IPEX-TYPED              3.400      90.227
ICD-IPEX-TYPED              3.600      92.843
ICD-IPEX-TYPED              3.800      95.387

;IPEX MHF Type F
ICD-IPEX-TYPE-F  Rating     0.000      0.000
ICD-IPEX-TYPE-F             0.200      28.951
ICD-IPEX-TYPE-F             0.400      40.943
ICD-IPEX-TYPE-F             0.600      50.145
ICD-IPEX-TYPE-F             0.800      57.902
ICD-IPEX-TYPE-F             1.000      64.737
ICD-IPEX-TYPE-F             1.200      70.916
ICD-IPEX-TYPE-F             1.400      76.598
ICD-IPEX-TYPE-F             1.600      81.886
ICD-IPEX-TYPE-F             1.800      86.854
ICD-IPEX-TYPE-F             2.000      91.552
ICD-IPEX-TYPE-F             2.200      96.020
ICD-IPEX-TYPE-F             2.400      100.290
ICD-IPEX-TYPE-F             2.600      104.385
ICD-IPEX-TYPE-F             2.800      108.326
ICD-IPEX-TYPE-F             3.000      112.128
ICD-IPEX-TYPE-F             3.200      115.805
ICD-IPEX-TYPE-F             3.400      119.369
ICD-IPEX-TYPE-F             3.600      122.830
ICD-IPEX-TYPE-F             3.800      126.195

CB10-STORAGE     Storage    0.000      0.00
CB10-STORAGE                1.400      0.00
CB10-STORAGE                1.425      1.25
CB10-STORAGE                1.450      5.00
CB10-STORAGE                1.475      11.25
CB10-STORAGE                1.500      20.00

CB3-PONDING      Storage    0.000      0.00
CB3-PONDING                 1.400      0.00
CB3-PONDING                 1.425      1.00
CB3-PONDING                 1.450      4.00

;SURFACE PONDING AT CB 6
CB6-PONDING      Storage    0.000      0.00
CB6-PONDING                 1.400      0.00
CB6-PONDING                 1.425      0.94
CB6-PONDING                 1.450      3.75
CB6-PONDING                 1.475      8.44
CB6-PONDING                 1.500      15.00
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CB7-PONDING      Storage    0.000      0.00
CB7-PONDING                 1.400      0.00
CB7-PONDING                 1.425      1.00
CB7-PONDING                 1.450      4.00
CB7-PONDING                 1.475      9.00
CB7-PONDING                 1.500      16.00

CB8-PONDING      Storage    0.000      0.00
CB8-PONDING                 1.400      0.00
CB8-PONDING                 1.425      1.06
CB8-PONDING                 1.450      4.25
CB8-PONDING                 1.475      9.56
CB8-PONDING                 1.500      17.00

;DRY POND
DRY-POND         Storage    0          0
DRY-POND                    1.4        0
DRY-POND                    1.401      50
DRY-POND                    2.25       200

PARK-STORAGE     Storage    0          3200
PARK-STORAGE                .1         3790

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
;Rainfall (mm/hr)
Chicago_3h_100yr 02/22/2018 00:00:00   5.126
Chicago_3h_100yr 02/22/2018 00:05:00   5.552
Chicago_3h_100yr 02/22/2018 00:10:00   6.063
Chicago_3h_100yr 02/22/2018 00:15:00   6.688
Chicago_3h_100yr 02/22/2018 00:20:00   7.472
Chicago_3h_100yr 02/22/2018 00:25:00   8.483
Chicago_3h_100yr 02/22/2018 00:30:00   9.839
Chicago_3h_100yr 02/22/2018 00:35:00   11.755
Chicago_3h_100yr 02/22/2018 00:40:00   14.666
Chicago_3h_100yr 02/22/2018 00:45:00   19.606
Chicago_3h_100yr 02/22/2018 00:50:00   29.721
Chicago_3h_100yr 02/22/2018 00:55:00   60.535
Chicago_3h_100yr 02/22/2018 01:00:00   242.704
Chicago_3h_100yr 02/22/2018 01:05:00   113.511
Chicago_3h_100yr 02/22/2018 01:10:00   62.089
Chicago_3h_100yr 02/22/2018 01:15:00   40.024
Chicago_3h_100yr 02/22/2018 01:20:00   29.287
Chicago_3h_100yr 02/22/2018 01:25:00   23.04
Chicago_3h_100yr 02/22/2018 01:30:00   18.986
```

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Chicago_3h_100yr 02/22/2018 01:35:00   16.156
Chicago_3h_100yr 02/22/2018 01:40:00   14.074
Chicago_3h_100yr 02/22/2018 01:45:00   12.48
Chicago_3h_100yr 02/22/2018 01:50:00   11.221
Chicago_3h_100yr 02/22/2018 01:55:00   10.202
Chicago_3h_100yr 02/22/2018 02:00:00   9.361
Chicago_3h_100yr 02/22/2018 02:05:00   8.654
Chicago_3h_100yr 02/22/2018 02:10:00   8.052
Chicago_3h_100yr 02/22/2018 02:15:00   7.534
Chicago_3h_100yr 02/22/2018 02:20:00   7.081
Chicago_3h_100yr 02/22/2018 02:25:00   6.684
Chicago_3h_100yr 02/22/2018 02:30:00   6.331
Chicago_3h_100yr 02/22/2018 02:35:00   6.017
Chicago_3h_100yr 02/22/2018 02:40:00   5.734
Chicago_3h_100yr 02/22/2018 02:45:00   5.479
Chicago_3h_100yr 02/22/2018 02:50:00   5.247
Chicago_3h_100yr 02/22/2018 02:55:00   5.036
Chicago_3h_100yr 02/22/2018 03:00:00   0

;Rainfall (mm/hr)
Chicago_3h_2yr   02/22/2018 00:00:00   2.393
Chicago_3h_2yr   02/22/2018 00:05:00   2.588
Chicago_3h_2yr   02/22/2018 00:10:00   2.823
Chicago_3h_2yr   02/22/2018 00:15:00   3.109
Chicago_3h_2yr   02/22/2018 00:20:00   3.466
Chicago_3h_2yr   02/22/2018 00:25:00   3.927
Chicago_3h_2yr   02/22/2018 00:30:00   4.543
Chicago_3h_2yr   02/22/2018 00:35:00   5.41
Chicago_3h_2yr   02/22/2018 00:40:00   6.721
Chicago_3h_2yr   02/22/2018 00:45:00   8.935
Chicago_3h_2yr   02/22/2018 00:50:00   13.427
Chicago_3h_2yr   02/22/2018 00:55:00   26.893
Chicago_3h_2yr   02/22/2018 01:00:00   103.571
Chicago_3h_2yr   02/22/2018 01:05:00   49.651
Chicago_3h_2yr   02/22/2018 01:10:00   27.587
Chicago_3h_2yr   02/22/2018 01:15:00   17.967
Chicago_3h_2yr   02/22/2018 01:20:00   13.238
Chicago_3h_2yr   02/22/2018 01:25:00   10.466
Chicago_3h_2yr   02/22/2018 01:30:00   8.658
Chicago_3h_2yr   02/22/2018 01:35:00   7.391
Chicago_3h_2yr   02/22/2018 01:40:00   6.455
Chicago_3h_2yr   02/22/2018 01:45:00   5.737
Chicago_3h_2yr   02/22/2018 01:50:00   5.169
Chicago_3h_2yr   02/22/2018 01:55:00   4.707
Chicago_3h_2yr   02/22/2018 02:00:00   4.326
Chicago_3h_2yr   02/22/2018 02:05:00   4.005
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Chicago_3h_2yr   02/22/2018 02:10:00   3.731
Chicago_3h_2yr   02/22/2018 02:15:00   3.494
Chicago_3h_2yr   02/22/2018 02:20:00   3.288
Chicago_3h_2yr   02/22/2018 02:25:00   3.107
Chicago_3h_2yr   02/22/2018 02:30:00   2.945
Chicago_3h_2yr   02/22/2018 02:35:00   2.801
Chicago_3h_2yr   02/22/2018 02:40:00   2.672
Chicago_3h_2yr   02/22/2018 02:45:00   2.555
Chicago_3h_2yr   02/22/2018 02:50:00   2.449
Chicago_3h_2yr   02/22/2018 02:55:00   2.351
Chicago_3h_2yr   02/22/2018 03:00:00   0

;City of Ottawa Historic Storm
;August 4, 1998
Historic_Storm_Aug-4-88            0          0.0
Historic_Storm_Aug-4-88            5          0.1
Historic_Storm_Aug-4-88            10         0.1
Historic_Storm_Aug-4-88            15         0.0
Historic_Storm_Aug-4-88            20         3.7
Historic_Storm_Aug-4-88            25         6.2
Historic_Storm_Aug-4-88            30         101.5
Historic_Storm_Aug-4-88            35         15.5
Historic_Storm_Aug-4-88            40         29.3
Historic_Storm_Aug-4-88            45         19.8
Historic_Storm_Aug-4-88            50         1.5
Historic_Storm_Aug-4-88            55         1.7
Historic_Storm_Aug-4-88            60         5.4
Historic_Storm_Aug-4-88            65         24.6
Historic_Storm_Aug-4-88            70         26.5
Historic_Storm_Aug-4-88            75         34.9
Historic_Storm_Aug-4-88            80         10.2
Historic_Storm_Aug-4-88            85         27.1
Historic_Storm_Aug-4-88            90         104.4
Historic_Storm_Aug-4-88            95         27.5
Historic_Storm_Aug-4-88            100        62.5
Historic_Storm_Aug-4-88            105        31.8
Historic_Storm_Aug-4-88            110        79.8
Historic_Storm_Aug-4-88            115        67.5
Historic_Storm_Aug-4-88            120        156.2
Historic_Storm_Aug-4-88            125        5.1
Historic_Storm_Aug-4-88            130        0.2
Historic_Storm_Aug-4-88            135        0.2
Historic_Storm_Aug-4-88            140        0.2
Historic_Storm_Aug-4-88            145        0.2
Historic_Storm_Aug-4-88            150        0.2
Historic_Storm_Aug-4-88            155        0.2
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Historic_Storm_Aug-4-88           160        0.2
Historic_Storm_Aug-4-88           165        0.2
Historic_Storm_Aug-4-88           170        0.2
Historic_Storm_Aug-4-88           175        69.0
Historic_Storm_Aug-4-88           180        63.7
Historic_Storm_Aug-4-88           185        58.4
Historic_Storm_Aug-4-88           190        47.8
Historic_Storm_Aug-4-88           195        15.9
Historic_Storm_Aug-4-88           200        13.3
Historic_Storm_Aug-4-88           205        8.0
Historic_Storm_Aug-4-88           210        5.3
Historic_Storm_Aug-4-88           215        6.6
Historic_Storm_Aug-4-88           220        2.7
Historic_Storm_Aug-4-88           225        4.0
Historic_Storm_Aug-4-88           230        2.7
Historic_Storm_Aug-4-88           235        4.0
Historic_Storm_Aug-4-88           240        2.7
Historic_Storm_Aug-4-88           245        5.3
Historic_Storm_Aug-4-88           250        4.0
Historic_Storm_Aug-4-88           255        2.7
Historic_Storm_Aug-4-88           260        4.0
Historic_Storm_Aug-4-88           265        2.7
Historic_Storm_Aug-4-88           270        1.3
Historic_Storm_Aug-4-88           275        1.3
Historic_Storm_Aug-4-88           280        0.0
Historic_Storm_Aug-4-88           285        0.0
Historic_Storm_Aug-4-88           290        0.0
Historic_Storm_Aug-4-88           295        0.0
Historic_Storm_Aug-4-88           300        2.7
Historic_Storm_Aug-4-88           305        0.0
Historic_Storm_Aug-4-88           310        0.0
Historic_Storm_Aug-4-88           315        0.0
Historic_Storm_Aug-4-88           320        0.0
Historic_Storm_Aug-4-88           325        0.0
Historic_Storm_Aug-4-88           330        0.0
Historic_Storm_Aug-4-88           335        0.0
Historic_Storm_Aug-4-88           340        1.3
Historic_Storm_Aug-4-88           345        0.0

;City of Ottawa Historic Storm
;August 8, 1996
Historic_Storm_Aug-8-1996           0          4.0
Historic_Storm_Aug-8-1996           5          11.9
Historic_Storm_Aug-8-1996           10         26.5
Historic_Storm_Aug-8-1996           15         13.3
Historic_Storm_Aug-8-1996           20         0.0
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Historic_Storm_Aug-8-1996           25         2.7
Historic_Storm_Aug-8-1996           30         0.0
Historic_Storm_Aug-8-1996           35         8.0
Historic_Storm_Aug-8-1996           40         18.6
Historic_Storm_Aug-8-1996           45         10.6
Historic_Storm_Aug-8-1996           50         21.2
Historic_Storm_Aug-8-1996           55         2.7
Historic_Storm_Aug-8-1996           60         2.7
Historic_Storm_Aug-8-1996           65         15.9
Historic_Storm_Aug-8-1996           70         66.3
Historic_Storm_Aug-8-1996           75         55.7
Historic_Storm_Aug-8-1996           80         122.0
Historic_Storm_Aug-8-1996           85         88.9
Historic_Storm_Aug-8-1996           90         9.3
Historic_Storm_Aug-8-1996           95         8.0
Historic_Storm_Aug-8-1996           100        4.0
Historic_Storm_Aug-8-1996           105        0.0
Historic_Storm_Aug-8-1996           110        2.7
Historic_Storm_Aug-8-1996           115        0.0
Historic_Storm_Aug-8-1996           120        0.0
Historic_Storm_Aug-8-1996           125        0.0
Historic_Storm_Aug-8-1996           130        5.3
Historic_Storm_Aug-8-1996           135        0.0
Historic_Storm_Aug-8-1996           140        0.0
Historic_Storm_Aug-8-1996           145        0.0
Historic_Storm_Aug-8-1996           150        0.0
Historic_Storm_Aug-8-1996           155        0.0
Historic_Storm_Aug-8-1996           160        0.0
Historic_Storm_Aug-8-1996           165        4.0
Historic_Storm_Aug-8-1996           170        53.1
Historic_Storm_Aug-8-1996           175        69.0
Historic_Storm_Aug-8-1996           180        63.7
Historic_Storm_Aug-8-1996           185        58.4
Historic_Storm_Aug-8-1996           190        47.8
Historic_Storm_Aug-8-1996           195        15.9
Historic_Storm_Aug-8-1996           200        13.3
Historic_Storm_Aug-8-1996           205        8.0
Historic_Storm_Aug-8-1996           210        5.3
Historic_Storm_Aug-8-1996           215        6.6
Historic_Storm_Aug-8-1996           220        2.7
Historic_Storm_Aug-8-1996           225        4.0
Historic_Storm_Aug-8-1996           230        2.7
Historic_Storm_Aug-8-1996           235        4.0
Historic_Storm_Aug-8-1996           240        2.7
Historic_Storm_Aug-8-1996           245        5.3
Historic_Storm_Aug-8-1996           250        4.0
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Historic_Storm_Aug-8-1996           255        2.7
Historic_Storm_Aug-8-1996           260        4.0
Historic_Storm_Aug-8-1996           265        2.7
Historic_Storm_Aug-8-1996           270        1.3
Historic_Storm_Aug-8-1996           275        1.3
Historic_Storm_Aug-8-1996           280        0.0
Historic_Storm_Aug-8-1996           285        0.0
Historic_Storm_Aug-8-1996           290        0.0
Historic_Storm_Aug-8-1996           295        0.0
Historic_Storm_Aug-8-1996           300        2.7
Historic_Storm_Aug-8-1996           305        0.0
Historic_Storm_Aug-8-1996           310        0.0
Historic_Storm_Aug-8-1996           315        0.0
Historic_Storm_Aug-8-1996           320        0.0
Historic_Storm_Aug-8-1996           325        0.0
Historic_Storm_Aug-8-1996           330        0.0
Historic_Storm_Aug-8-1996           335        0.0
Historic_Storm_Aug-8-1996           340        1.3
Historic_Storm_Aug-8-1996           345        0.0

;City of Ottawa Historic Storm
;July 1, 1979
Historic_Storm_Jul-1-79           0          0.00
Historic_Storm_Jul-1-79           5          2.30
Historic_Storm_Jul-1-79           10         2.30
Historic_Storm_Jul-1-79           15         8.89
Historic_Storm_Jul-1-79           20         8.89
Historic_Storm_Jul-1-79           25         8.89
Historic_Storm_Jul-1-79           30         8.89
Historic_Storm_Jul-1-79           35         38.10
Historic_Storm_Jul-1-79           40         38.10
Historic_Storm_Jul-1-79           45         38.10
Historic_Storm_Jul-1-79           50         38.10
Historic_Storm_Jul-1-79           55         38.10
Historic_Storm_Jul-1-79           60         38.10
Historic_Storm_Jul-1-79           65         38.10
Historic_Storm_Jul-1-79           70         50.80
Historic_Storm_Jul-1-79           75         50.80
Historic_Storm_Jul-1-79           80         76.20
Historic_Storm_Jul-1-79           85         106.70
Historic_Storm_Jul-1-79           90         106.70
Historic_Storm_Jul-1-79           95         71.10
Historic_Storm_Jul-1-79           100        71.10
Historic_Storm_Jul-1-79           105        30.50
Historic_Storm_Jul-1-79           110        30.50
Historic_Storm_Jul-1-79           115        30.50
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Historic_Storm_Jul-1-79           120        30.50
Historic_Storm_Jul-1-79           125        3.80
Historic_Storm_Jul-1-79           130        3.80
Historic_Storm_Jul-1-79           135        3.80
Historic_Storm_Jul-1-79           140        3.80
Historic_Storm_Jul-1-79           145        3.80
Historic_Storm_Jul-1-79           150        3.80
Historic_Storm_Jul-1-79           155        3.80
Historic_Storm_Jul-1-79           160        3.80
Historic_Storm_Jul-1-79           165        3.80
Historic_Storm_Jul-1-79           170        3.8
Historic_Storm_Jul-1-79           175        3.8
Historic_Storm_Jul-1-79           180        3.8

[REPORT]
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]
Node       200              STMH
Node       201              STMH
Node       202              STMH
Node       203              STMH
Node       204              STMH
Node       205              STMH
Node       206              STMH
Node       207              STMH
Node       208              STMH
Node       CB1              CB
Node       CB10-DS          Major_System
Node       CB10-MAJ         Major_System
Node       CB10-TEE         TEE
Node       CB12-MAJ         Major_System
Node       CB12-TEE         TEE
Node       CB13             CB
Node       CB3-TEE          TEE
Node       CB4-DS           Major_System
Node       CB4-MAJ          Major_System
Node       CB4-TEE          TEE
Node       CB5-MAJ          Major_System
Node       CB5-TEE          TEE
Node       CB6-MAJ          Major_System
Node       CB6-TEE          TEE
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Node       CB7-MAJ          Major_System
Node       CB7-TEE          TEE
Node       CB8-MAJ          Major_System
Node       CB8-TEE          TEE
Node       CB9-MAJ          Major_System
Node       CB9-TEE          TEE
Node       CB10             CICB
Node       CB12             CB
Node       CB2              CB
Node       CB3              CB
Node       CB4              CB
Node       CB5              CICB
Node       CB6              CICB
Node       CB7              CB
Node       CB8              CB
Node       CB9              CICB
Node       Drypond          DICB
Node       Outfall_Hydro_Corridor SURFACE
Link       C1               Major_system
Link       C1_1             Minor_System
Link       C1_2             Minor_System
Link       C10-S            Major_System
Link       C12              Major_System
Link       C15-S            Major_System
Link       C2               Major_System
Link       C2_1             Minor_System
Link       C2_3             Minor_System
Link       C3               Minor_System
Link       C4_1             Minor_System
Link       C4_2             Minor_System
Link       C4_5-S           Major_System
Link       C6               Minor_System
Link       C6_2             Minor_System
Link       C6_6             Minor_System
Link       C6-S             Major_System
Link       C7_1             Minor_System
Link       C7_2             Minor_System
Link       C7_2-S           Major_System
Link       C7-S             Major_System
Link       C8               Major_System
Link       C8_2             Minor_System
Link       C8_3             Minor_System
Link       C8_3-S           Major_System
Link       C8_4             Minor_System
Link       C8_5             Minor_System
Link       C8_5-S           Major_System
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Link       C9_1             Minor_System
Link       C9_2             Minor_System
Link       C9-S_1           Major_System
Link       C9-S_2           Major_System
Link       CB12-ICD_1       ICD
Link       C11-ICD          ICD
Link       C3-ICD           ICD
Link       CB11-IC          INLET-CONTROL
Link       CB12-IC          INLET-CONTROL
Link       CB12-ICD         ICD
Link       CB14-ICD         ICD
Link       CB15-ICD         ICD
Link       CB2-IC           INLET-CONTROL
Link       CB4-ICA          INLET-CONTROL
Link       CB4-ICD          ICD
Link       CB5-IC           INLET-CONTROL
Link       CB5-ICD          ICD
Link       CB6-IC           INLET-CONTROL
Link       CB6-ICD          ICD
Link       CB7-ICD          ICD
Link       CB8-IC           INLET-CONTROL
Link       CB8-ICA          INLET-CONTROL
Link       CB8-ICDA         ICD
Link       CB9-ICD          ICD
Link       POND-ICD         ICD

[MAP]
DIMENSIONS       347912.876234435 5023308.34069922 348086.039777552 5023507.12744658
UNITS            Meters

[COORDINATES]
;;Node           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
200              347940.34        5023370.968
201              347957.305       5023386.371
202              348020.837       5023444.019
203              348024.838       5023447.656
204              347969.614       5023338.73
205              347982.619       5023358.482
206              348050.12        5023411.759
207              348059.005       5023419.829
208              348008.14        5023465.964
CB1              348005.487       5023463.31
CB10-DS          348047.338       5023417.554
CB10-MAJ         348052.046       5023412.663
CB10-TEE         348051.845       5023413.331
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CB12-MAJ         348038.251       5023415.01
CB12-TEE         348042.876       5023419.736
CB13             348074.908       5023402.406
CB3-TEE          347961.861       5023381.347
CB4-DS           347967.08        5023387.19
CB4-MAJ          347966.662       5023385.484
CB4-TEE          347961.585       5023381.643
CB5-MAJ          347970.232       5023398.886
CB5-TEE          347970.995       5023398.811
CB6-MAJ          348022.252       5023446.097
CB6-TEE          348022.197       5023445.237
CB7-MAJ          348026.709       5023441.322
CB7-TEE          348024.694       5023439.76
CB8-MAJ          348020.405       5023432.644
CB8-TEE          348026.459       5023437.824
CB9-MAJ          348001.912       5023367.15
CB9-TEE          348001.108       5023367.236
Outfall_Goward_Storm 347979.082       5023498.073
Outfall_Second_Line 347946.349       5023351.695
CB10             348052.125       5023413.046
CB12             348038.385       5023414.826
CB2              347955.03        5023416.397
CB3              347961.045       5023380.616
CB4              347966.281       5023385.923
CB5              347970.249       5023399.65
CB6              348021.522       5023445.999
CB7              348026.391       5023441.239
CB8              348020.91        5023432.766
CB9              348001.858       5023366.439
Drypond          348031.111       5023440.888
Outfall_Hydro_Corridor 348037.533       5023471.766

[VERTICES]
;;Link           X-Coord          Y-Coord
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C10-S            348078.169       5023413.435
C10-S            348077.723       5023424.19
C10-S            348070.2         5023437.717
C10-S            348065.431       5023446.819
C10-S            348049.983       5023459.921
C12              348005.485       5023465.243
C12              348012.7         5023471.85
C15-S            348037.918       5023415.96
C15-S            348037.599       5023416.599
C15-S            348037.256       5023417.035
C15-S            348036.735       5023417.72
C15-S            348025.838       5023429.755
C15-S            348025.194       5023430.472
C15-S            348024.639       5023431.027
C15-S            348023.539       5023431.747
C15-S            348022.717       5023432.117
C15-S            348022.366       5023432.23
C15-S            348021.599       5023432.477
C2               348028.118       5023440.448
C6-S             348020.457       5023435.801
C7_1             347986.581       5023354.139
C8               347961.124       5023381.736
C8_3-S           348049.829       5023415.093
C8_5-S           348046.554       5023417.569
C8_5-S           348045.888       5023417.695
C8_5-S           348045.319       5023418.033
C8_5-S           348030.992       5023433.659
C8_5-S           348028.016       5023436.966
C8_5-S           348027.038       5023438.059
C8_5-S           348026.666       5023438.552
C8_5-S           348026.425       5023438.934
C8_5-S           348026.31        5023439.347
C8_5-S           348026.264       5023439.616
C8_5-S           348026.28        5023440.152
C8_5-S           348026.432       5023440.737
C9-S_1           347966.671       5023386.257
C9-S_1           347966.757       5023386.558
C9-S_2           348019.343       5023432.651
C9-S_2           348017.722       5023432.341
C9-S_2           348016.56        5023431.82
C9-S_2           348015.29        5023431.06

[POLYGONS]
;;Subcatchment   X-Coord          Y-Coord
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S01              347965.128       5023346.077
S01              347963.426       5023341.39
S01              347942.433       5023364.56
S01              347946.556       5023365.191
S01              347955.691       5023367.554
S02              347958.992       5023374.501
S02              347955.691       5023367.554
S02              347946.556       5023365.191
S02              347942.433       5023364.56
S02              347940.082       5023367.153
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S02	347961.048	5023386.191
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S03	347958.992	5023374.501
S03	347961.048	5023386.191
S03	347986.768	5023357.865
S03	347965.777	5023338.805
S03	347963.426	5023341.39
S03	347965.128	5023346.077
S03	347967.672	5023354.462
S03	347955.691	5023367.554
S03	347958.992	5023374.501
S04	347970.798	5023382.317
S04	347975.839	5023376.763
S04	347976.728	5023377.57
S04	347981.355	5023372.473
S04	347986.002	5023367.355
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S05	347976.728	5023377.57
S05	347975.839	5023376.763
S05	347970.798	5023382.317
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S05	347983.779	5023406.83
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S05	348020.634	5023440.295
S05	348023.164	5023429.846
S05	348028.205	5023424.293
S05	348027.316	5023423.486
S05	348031.936	5023418.395
S05	348022.295	5023409.646
S06	348031.936	5023418.395
S06	348036.587	5023413.272
S06	348046.374	5023411.939
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S06	347981.356	5023372.472
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S06	348031.936	5023418.395
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S07	348046.327	5023411.945
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S07	348031.936	5023418.395
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S07	348028.205	5023424.293
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S07	348020.634	5023440.295
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S08	348045.948	5023419.453
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S08	348046.076	5023419.397
S08	348046.141	5023419.372
S08	348046.207	5023419.35
S08	348046.274	5023419.33
S08	348046.341	5023419.312
S08	348046.409	5023419.297
S08	348046.478	5023419.284
S08	348046.547	5023419.273
S08	348046.616	5023419.265
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S08	348047.574	5023419.403
S08	348047.638	5023419.431

S08	348047.701	5023419.461
S08	348047.763	5023419.492
S08	348047.824	5023419.527
S08	348047.884	5023419.563
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S08	348048.109	5023419.728
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S10	348034.395	5023446.039
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S10	348033.545	5023445.743
S10	348033.487	5023445.704
S10	348033.43	5023445.664
S10	348033.374	5023445.622
S10	348033.32	5023445.578
S10	348033.268	5023445.532
S10	348032.282	5023444.637
S10	348032.349	5023446.05
S10	348029.919	5023448.725
S10	348032.374	5023450.959
S10	348034.715	5023448.401
S11	348012.622	5023472.739
S11	348032.374	5023450.959
S11	348029.919	5023448.725
S11	348027.995	5023450.845
S11	348018.729	5023448.768
S11	348014.09	5023453.877
S11	348009.471	5023458.966
S11	348012.622	5023472.739
S12	347983.885	5023446.386

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S12             348012.622       5023472.739
S12             348009.471       5023458.966
S12             348014.09        5023453.877
S12             347993.86        5023435.508
S12             347974.061       5023417.533
S12             347970.467       5023414.269
S12             347960.652       5023425.081
S12             347983.885       5023446.386
S13             348014.09        5023453.877
S13             348018.729       5023448.768
S13             348027.995       5023450.845
S13             348029.919       5023448.725
S13             348011.032       5023431.576
S13             347972.779       5023396.843
S13             347963.063       5023407.547
S13             347970.467       5023414.269
S13             347993.86        5023435.508
S13             348014.09        5023453.877
S14             347960.652       5023425.081
S14             347970.467       5023414.269
S14             347932.935       5023380.193
S14             347928.485       5023385.457
S14             347925.711       5023382.939
S14             347920.747       5023388.487
S14             347960.652       5023425.081
S15             347963.063       5023407.547
S15             347972.779       5023396.843
S15             347961.048       5023386.191
S15             347940.082       5023367.153
S15             347937.732       5023369.747
S15             347937.873       5023374.801
S15             347932.935       5023380.193
S15             347963.063       5023407.547
S16             347932.935       5023380.193
S16             347937.873       5023374.801
S16             347937.732       5023369.747
S16             347930.373       5023377.866
S16             347925.711       5023382.939
S16             347928.485       5023385.457
S16             347932.935       5023380.193
S17             347973.455       5023335.568
S17             347978.269       5023330.265
S17             347978.269       5023330.265
S17             347982.773       5023325.305
S17             347980.178       5023322.95
S17             347968.127       5023336.211
S17             347973.455       5023335.568
S18             347965.777       5023338.805
S18             347986.768       5023357.865
S18             348008.662       5023377.744
S18             348018.44        5023366.976
S18             347978.269       5023330.265
S18             347973.455       5023335.568
S18             347968.127       5023336.211
S18             347965.777       5023338.805
S19             348055.961       5023420.692
S19             348061.04        5023415.098
S19             348065.569       5023410.092
S19             348018.44        5023366.976
S19             348008.662       5023377.744
S19             348046.35        5023411.965
S19             348055.961       5023420.692
S20             348070.323       5023404.854
S20             348077.551       5023401.287
S20             348050.325       5023376.548
S20             348018.655       5023347.768
S20             347985.263       5023317.376
S20             347980.178       5023322.95
S20             347982.773       5023325.305
S20             347978.269       5023330.265
S20             348018.44        5023366.976
S20             348065.569       5023410.092
S20             348070.323       5023404.854

[SYMBOLS]
;;Gage          X-Coord          Y-Coord
;;-------------- ---------------- ----------------

[PROFILES]
;;Name          Links
;;-------------- ----------
"Node 207 to Node ExSTMH" C7_1 C7_2 C8_3 C8_6 C8_5
"Node 207 to Node ExSTMH" C8_4 C8_2 C2_1 C2_3 C2_4
"Node 207 to Node ExSTMH" C1_1 C1_2
"Node 206 to Node ExSTMH" C6_2 CB12-ICD CB7-ICD POND-ICD
"Node 203 to Node ExSTMH" C3 C4_1 C4_2 C4_5 C4_4
"Node 203 to Node ExSTMH" C2_1 C2_3 C2_4 C1_1 C1_2
"Node CB14 to Node ExSTMH" CB14-ICD C9_1 C9_2 C8_3 C8_6
"Node CB14 to Node ExSTMH" C8_5 C8_4 C8_2 C2_1 C2_3
"Node CB14 to Node ExSTMH" C2_4 C1_1 C1_2
"Node 206 to Node Outfall_Goward_Storm" C6_1 C6_5 C6_4 C6_3 C4_1
"Node 206 to Node Outfall_Goward_Storm" C4_2 C4_5 C4_4 C2_1 C2_3
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"Node 206 to Node Outfall_Goward_Storm" C2_4 C1_1 C1_2
"Node 207 to Node 201" C7_1 C7_2 C8_3 C8_6 C8_5
"Node 207 to Node 201" C8_4 C8_2
"Street 1        " C3 C4_1 C4_2
"Street 2        " C3 C4_1 C4_2
"Street 4        " C8_3 C8_5 C8_4 C8_2
"Outlet          " C1_1 C1_2
"full            " C7_1 C7_2 C8_3 C8_5 C8_4
"full            " C8_2 C2_1 C2_3 C1_1 C1_2
```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

Dual Drianage Model. Removed two CBs and updaed dry pond area

WARNING 09: time series interval greater than recording interval for Rain Gage Historic_Aug4_88
WARNING 09: time series interval greater than recording interval for Rain Gage Historic_Aug8_96
WARNING 09: time series interval greater than recording interval for Rain Gage Historic_Jul1_79
WARNING 03: negative offset ignored for Link C4_5-S
WARNING 03: negative offset ignored for Link C4_5-S
WARNING 03: negative offset ignored for Link C7-S
WARNING 04: minimum elevation drop used for Conduit C8_3-S
WARNING 03: negative offset ignored for Link C9-S_1
WARNING 03: negative offset ignored for Link CB4-ICA
WARNING 03: negative offset ignored for Link CB6-IC
WARNING 02: maximum depth increased for Node CB1
WARNING 02: maximum depth increased for Node CB10-DS
WARNING 02: maximum depth increased for Node CB10-MAJ
WARNING 02: maximum depth increased for Node CB12-MAJ
WARNING 02: maximum depth increased for Node CB13
WARNING 02: maximum depth increased for Node CB4-DS
WARNING 02: maximum depth increased for Node CB4-MAJ
WARNING 02: maximum depth increased for Node CB5-MAJ
WARNING 02: maximum depth increased for Node CB6-MAJ
WARNING 02: maximum depth increased for Node CB7-MAJ
WARNING 02: maximum depth increased for Node CB8-MAJ
WARNING 02: maximum depth increased for Node CB9-MAJ

****
Element Count
****
Number of rain gages 5
Number of subcatchments ... 20
Number of nodes 44
Number of links 53
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
Chicago_3h_100yr	Chicago_3h_100yr	INTENSITY	5 min.
Chicago_3h_2yr	Chicago_3h_2yr	INTENSITY	5 min.
Historic_Aug4_88	Historic_Storm_Aug-4-88	INTENSITY	60 min.
Historic_Aug8_96	Historic_Storm_Aug-8-1996	INTENSITY	60 min.
Historic_Jul1_79	Historic_Storm_Jul-1-79	INTENSITY	60 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
S01	0.03	26.36	72.80	2.0000	Chicago_3h_100yr	Outfall_Second_Line
S02	0.02	19.89	82.10	2.0000	Chicago_3h_100yr	CB3
S03	0.06	68.33	87.80	2.0000	Chicago_3h_100yr	CB3
S04	0.02	14.00	69.00	2.0000	Chicago_3h_100yr	CB4-MAJ
S05	0.17	568.00	55.60	4.0000	Chicago_3h_100yr	CB8-MAJ
S06	0.10	94.00	83.10	2.0000	Chicago_3h_100yr	CB12-MAJ
S07	0.02	35.00	67.00	2.0000	Chicago_3h_100yr	CB8-MAJ
S08	0.03	25.10	70.40	2.0000	Chicago_3h_100yr	CB7-MAJ
S09	0.03	11.84	0.00	2.0000	Chicago_3h_100yr	Drypond
S10	0.01	44.67	0.00	2.0000	Chicago_3h_100yr	Outfall_Hydro_Corridor
S11	0.03	83.67	0.00	2.0000	Chicago_3h_100yr	Outfall_Hydro_Corridor
S12	0.09	83.27	40.70	4.0000	Chicago_3h_100yr	CB1
S13	0.10	148.43	84.40	2.0000	Chicago_3h_100yr	CB6-MAJ
S14	0.08	63.25	42.40	4.0000	Chicago_3h_100yr	CB2
S15	0.06	55.18	87.10	2.0000	Chicago_3h_100yr	CB5-MAJ
S16	0.01	2.85	29.40	2.0000	Chicago_3h_100yr	Outfall_Second_Line
S17	0.01	18.67	29.40	2.0000	Chicago_3h_100yr	Outfall_Second_Line
S18	0.08	74.18	86.70	2.0000	Chicago_3h_100yr	CB9-MAJ
S19	0.09	83.82	85.60	2.0000	Chicago_3h_100yr	CB10-MAJ
S20	0.17	1740.00	44.20	4.0000	Chicago_3h_100yr	CB13

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
200	JUNCTION	99.67	3.58	0.0	
201	JUNCTION	99.09	3.51	0.0	
202	JUNCTION	97.99	3.06	0.0	
203	JUNCTION	97.90	3.30	0.0	
204	JUNCTION	100.66	3.59	0.0	
205	JUNCTION	100.18	3.31	0.0	

206	JUNCTION	98.41	3.69	0.0
207	JUNCTION	98.66	2.36	0.0
208	JUNCTION	97.77	3.30	0.0
CB1	JUNCTION	99.73	2.30	0.0
CB10-DS	JUNCTION	101.41	0.20	0.0
CB10-MAJ	JUNCTION	101.41	0.20	0.0
CB10-TEE	JUNCTION	98.56	3.37	0.0
CB12-MAJ	JUNCTION	101.48	0.20	0.0
CB12-TEE	JUNCTION	98.33	3.58	0.0
CB13	JUNCTION	98.86	2.57	0.0
CB3-TEE	JUNCTION	99.35	3.44	0.0
CB4-DS	JUNCTION	102.82	0.20	0.0
CB4-MAJ	JUNCTION	102.92	0.20	0.0
CB4-TEE	JUNCTION	99.34	3.45	0.0
CB5-MAJ	JUNCTION	102.51	0.20	0.0
CB5-TEE	JUNCTION	98.87	3.34	0.0
CB6-MAJ	JUNCTION	101.23	0.20	0.0
CB6-TEE	JUNCTION	97.98	3.10	0.0
CB7-MAJ	JUNCTION	101.12	0.20	0.0
CB7-TEE	JUNCTION	98.11	3.08	0.0
CB8-MAJ	JUNCTION	101.20	0.20	0.0
CB8-TEE	JUNCTION	98.13	3.11	0.0
CB9-MAJ	JUNCTION	102.99	0.20	0.0
CB9-TEE	JUNCTION	99.81	3.20	0.0
Outfall_Goward_Storm	OUTFALL	97.50	0.55	0.0
Outfall_Second_Line	OUTFALL	0.00	0.00	0.0
CB10	STORAGE	99.41	2.00	0.0
CB12	STORAGE	99.48	2.00	0.0
CB2	STORAGE	100.10	2.00	0.0
CB3	STORAGE	100.85	2.00	0.0
CB4	STORAGE	100.84	2.00	0.0
CB5	STORAGE	99.84	2.67	0.0
CB6	STORAGE	99.13	2.00	0.0
CB7	STORAGE	99.12	2.00	0.0
CB8	STORAGE	99.20	2.00	0.0
CB9	STORAGE	100.99	2.00	0.0
Drypond	STORAGE	98.60	2.25	0.0
Outfall_Hydro_Corridor	STORAGE	100.80	0.20	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	CB2	CB1	CONDUIT	68.9	-2.2066	0.0100
C1_1	203	208	CONDUIT	24.8	0.4035	0.0130
C1_2	208	Outfall_Goward_Storm	CONDUIT	43.3	0.4016	0.0130
C10-S	CB13	Outfall_Hydro_Corridor	CONDUIT	85.5	0.3850	0.0100
C12	CB1	Outfall_Hydro_Corridor	CONDUIT	36.6	2.5450	0.0100
C15-S	CB12-MAJ	CB8-MAJ	CONDUIT	25.7	1.0887	0.0130
C2	CB7-MAJ	Drypond	CONDUIT	4.7	24.6144	0.0130
C2_1	202	CB6-TEE	CONDUIT	1.8	0.4376	0.0130
C2_3	CB6-TEE	203	CONDUIT	3.6	0.3911	0.0130
C3	200	201	CONDUIT	22.9	2.0034	0.0130
C4_1	201	CB5-TEE	CONDUIT	18.5	1.2005	0.0130
C4_2	CB5-TEE	202	CONDUIT	67.3	1.1995	0.0130
C4_5-S	CB5-MAJ	CB6-MAJ	CONDUIT	70.3	1.8222	0.0130
C6	205	CB3-TEE	CONDUIT	30.9	2.7013	0.0130
C6_2	CB3-TEE	CB4-TEE	CONDUIT	0.4	2.9790	0.0130
C6_6	CB4-TEE	201	CONDUIT	6.4	2.7075	0.0130
C6-S	CB8-MAJ	CB7-MAJ	CONDUIT	11.5	0.6957	0.0130
C7_1	204	CB9-TEE	CONDUIT	42.5	2.0012	0.0130
C7_2	CB9-TEE	206	CONDUIT	66.2	1.9998	0.0130
C7_2-S	CB9-MAJ	CB10-MAJ	CONDUIT	67.7	2.3339	0.0130
C7-S	CB6-MAJ	CB7-MAJ	CONDUIT	6.5	1.6843	0.0130
C8	CB3	CB4-DS	CONDUIT	9.2	0.3261	0.0130
C8_2	CB7-TEE	202	CONDUIT	5.7	0.8180	0.0130
C8_3	206	CB12-TEE	CONDUIT	10.8	0.8167	0.0130
C8_3-S	CB10-MAJ	CB10-DS	CONDUIT	6.8	0.0045	0.0130
C8_4	CB8-TEE	CB7-TEE	CONDUIT	2.6	0.8400	0.0130
C8_5	CB12-TEE	CB8-TEE	CONDUIT	24.4	0.8023	0.0130
C8_5-S	CB10-DS	CB7-MAJ	CONDUIT	32.8	0.8843	0.0130
C9_1	207	CB10-TEE	CONDUIT	9.7	1.0135	0.0130
C9_2	CB10-TEE	206	CONDUIT	2.3	0.9846	0.0130
C9-S_1	CB4-MAJ	CB4-DS	CONDUIT	1.8	5.7554	0.0130
C9-S_2	CB4-DS	CB8-MAJ	CONDUIT	70.7	2.2934	0.0130
CB12-ICD_1	CB2	CB5	CONDUIT	22.6	1.0160	0.0100
C11-ICD	CB10	CB10-TEE	OUTLET			
C3-ICD	CB3	CB3-TEE	OUTLET			
CB11-IC	CB10-MAJ	CB10	OUTLET			
CB12-IC	CB12-MAJ	CB12	OUTLET			
CB12-ICD	CB12	CB12-TEE	OUTLET			
CB14-ICD	CB13	207	OUTLET			
CB15-ICD	CB1	208	OUTLET			
CB2-IC	CB7-MAJ	CB7	OUTLET			
CB4-ICA	CB4-MAJ	CB4	OUTLET			
CB4-ICD	CB4	CB4-TEE	OUTLET			
CB5-IC	CB5-MAJ	CB5	OUTLET			
CB5-ICD	CB5	CB5-TEE	OUTLET			
CB6-IC	CB6-MAJ	CB6	OUTLET			
CB6-ICD	CB6	CB6-TEE	OUTLET			

CB7-ICD	CB7	CB7-TEE	OUTLET
CB8-IC	CB9-MAJ	CB9	OUTLET
CB8-ICA	CB8-MAJ	CB8	OUTLET
CB8-ICDA	CB8	CB8-TEE	OUTLET
CB9-ICD	CB9	CB9-TEE	OUTLET
POND-ICD	Drypond	203	OUTLET

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	Swale	0.30	0.30	0.14	2.00	1	1219.24
C1_1	CIRCULAR	0.45	0.16	0.11	0.45	1	181.12
C1_2	CIRCULAR	0.45	0.16	0.11	0.45	1	180.70
C10-S	Swale	0.30	0.30	0.14	2.00	1	509.28
C12	Swale	0.30	0.30	0.14	2.00	1	1309.41
C15-S	Half_3.35m_Street	0.20	0.54	0.13	5.02	1	1100.69
C2	Road-Spill-1	0.10	0.31	0.05	6.29	1	1624.17
C2_1	CIRCULAR	0.45	0.16	0.11	0.45	1	188.62
C2_3	CIRCULAR	0.45	0.16	0.11	0.45	1	178.30
C3	CIRCULAR	0.25	0.05	0.06	0.25	1	84.18
C4_1	CIRCULAR	0.38	0.11	0.09	0.38	1	192.12
C4_2	CIRCULAR	0.38	0.11	0.09	0.38	1	192.04
C4_5-S	Half_3.35m_Street	0.20	0.54	0.13	5.02	1	1424.00
C6	CIRCULAR	0.30	0.07	0.07	0.30	1	158.94
C6_2	CIRCULAR	0.30	0.07	0.07	0.30	1	166.91
C6_6	CIRCULAR	0.30	0.07	0.07	0.30	1	159.13
C6-S	Road-Spill-1	0.10	0.31	0.05	6.29	1	273.05
C7_1	CIRCULAR	0.30	0.07	0.07	0.30	1	136.80
C7_2	CIRCULAR	0.30	0.07	0.07	0.30	1	136.76
C7_2-S	Half_3.35m_Street	0.20	0.54	0.13	5.02	1	1611.57
C7-S	Road-Spill-1	0.10	0.31	0.05	6.29	1	424.85
C8	Road-Spill-1	0.10	0.31	0.05	6.29	1	186.95
C8_2	CIRCULAR	0.38	0.11	0.09	0.38	1	158.58
C8_3	CIRCULAR	0.38	0.11	0.09	0.38	1	158.45
C8_3-S	Road-Spill-3,4	0.10	1.17	0.05	23.33	1	81.37
C8_4	CIRCULAR	0.38	0.11	0.09	0.38	1	160.71
C8_5	CIRCULAR	0.38	0.11	0.09	0.38	1	157.06
C8_5-S	Half_3.35m_Street	0.20	0.54	0.13	5.02	1	991.97
C9_1	CIRCULAR	0.25	0.05	0.06	0.25	1	59.87
C9_2	CIRCULAR	0.25	0.05	0.06	0.25	1	59.01
C9-S_1	Half_3.35m_Street	0.20	0.54	0.13	5.02	1	2530.73
C9-S_2	Half_3.35m_Street	0.20	0.54	0.13	5.02	1	1597.53
CB12-ICD_1	CIRCULAR	0.20	0.03	0.05	0.20	1	42.98

****
Transect Summary
****

Transect Half_3.35m_Street

Area:

0.0005	0.0020	0.0044	0.0079	0.0123
0.0177	0.0241	0.0315	0.0399	0.0492
0.0596	0.0709	0.0832	0.0965	0.1108
0.1261	0.1423	0.1595	0.1778	0.1970
0.2172	0.2383	0.2605	0.2836	0.3078
0.3324	0.3570	0.3816	0.4062	0.4309
0.4555	0.4801	0.5047	0.5294	0.5540
0.5786	0.6032	0.6280	0.6536	0.6801
0.7077	0.7363	0.7658	0.7963	0.8278
0.8603	0.8937	0.9282	0.9636	1.0000

Hrad:

0.0153	0.0306	0.0459	0.0611	0.0764
0.0917	0.1070	0.1223	0.1376	0.1529
0.1682	0.1834	0.1987	0.2140	0.2293
0.2446	0.2599	0.2752	0.2905	0.3057
0.3210	0.3363	0.3516	0.3669	0.3822
0.4118	0.4413	0.4706	0.4998	0.5289
0.5579	0.5867	0.6154	0.6439	0.6723
0.7006	0.7288	0.7570	0.7842	0.8098
0.8339	0.8567	0.8781	0.8985	0.9177
0.9359	0.9531	0.9695	0.9851	1.0000

Width:

0.0267	0.0534	0.0801	0.1068	0.1335
0.1602	0.1869	0.2135	0.2402	0.2669
0.2936	0.3203	0.3470	0.3737	0.4004
0.4271	0.4538	0.4805	0.5072	0.5339
0.5606	0.5873	0.6139	0.6406	0.6673
0.6673	0.6673	0.6673	0.6673	0.6673
0.6673	0.6673	0.6673	0.6673	0.6673
0.6673	0.6673	0.6806	0.7073	0.7339
0.7605	0.7871	0.8137	0.8403	0.8669
0.8935	0.9202	0.9468	0.9734	1.0000

Transect Road-Spill-1

Area:

0.0004	0.0016	0.0036	0.0064	0.0100

0.0144	0.0196	0.0256	0.0324	0.0400
0.0484	0.0576	0.0676	0.0784	0.0900
0.1024	0.1156	0.1296	0.1444	0.1600
0.1764	0.1936	0.2116	0.2304	0.2500
0.2704	0.2916	0.3136	0.3364	0.3600
0.3844	0.4096	0.4356	0.4624	0.4900
0.5184	0.5476	0.5776	0.6084	0.6400
0.6724	0.7056	0.7396	0.7744	0.8100
0.8464	0.8836	0.9216	0.9604	1.0000

Hrad:

0.0200	0.0400	0.0600	0.0800	0.1000
0.1200	0.1400	0.1600	0.1800	0.2000
0.2200	0.2400	0.2600	0.2800	0.3000
0.3200	0.3400	0.3600	0.3800	0.4000
0.4200	0.4400	0.4600	0.4800	0.5000
0.5200	0.5400	0.5600	0.5800	0.6000
0.6200	0.6400	0.6600	0.6800	0.7000
0.7200	0.7400	0.7600	0.7800	0.8000
0.8200	0.8400	0.8600	0.8800	0.9000
0.9200	0.9400	0.9600	0.9800	1.0000

Width:

0.0200	0.0400	0.0600	0.0800	0.1000
0.1200	0.1400	0.1600	0.1800	0.2000
0.2200	0.2400	0.2600	0.2800	0.3000
0.3200	0.3400	0.3600	0.3800	0.4000
0.4200	0.4400	0.4600	0.4800	0.5000
0.5200	0.5400	0.5600	0.5800	0.6000
0.6200	0.6400	0.6600	0.6800	0.7000
0.7200	0.7400	0.7600	0.7800	0.8000
0.8200	0.8400	0.8600	0.8800	0.9000
0.9200	0.9400	0.9600	0.9800	1.0000

Transect Road-Spill-3,4

Area:

0.0004	0.0016	0.0036	0.0064	0.0100
0.0144	0.0196	0.0256	0.0324	0.0400
0.0484	0.0576	0.0676	0.0784	0.0900
0.1024	0.1156	0.1296	0.1444	0.1600
0.1764	0.1936	0.2116	0.2304	0.2500
0.2704	0.2916	0.3136	0.3364	0.3600
0.3844	0.4096	0.4356	0.4624	0.4900
0.5184	0.5476	0.5776	0.6084	0.6400
0.6724	0.7056	0.7396	0.7744	0.8100
0.8464	0.8836	0.9216	0.9604	1.0000

Hrad:

0.0200	0.0400	0.0600	0.0800	0.1000
0.1200	0.1400	0.1600	0.1800	0.2000
0.2200	0.2400	0.2600	0.2800	0.3000
0.3200	0.3400	0.3600	0.3800	0.4000
0.4200	0.4400	0.4600	0.4800	0.5000
0.5200	0.5400	0.5600	0.5800	0.6000
0.6200	0.6400	0.6600	0.6800	0.7000
0.7200	0.7400	0.7600	0.7800	0.8000
0.8200	0.8400	0.8600	0.8800	0.9000
0.9200	0.9400	0.9600	0.9800	1.0000

Width:

0.0200	0.0400	0.0600	0.0800	0.1000
0.1200	0.1400	0.1600	0.1800	0.2000
0.2200	0.2400	0.2600	0.2800	0.3000
0.3200	0.3400	0.3600	0.3800	0.4000
0.4200	0.4400	0.4600	0.4800	0.5000
0.5200	0.5400	0.5600	0.5800	0.6000
0.6200	0.6400	0.6600	0.6800	0.7000
0.7200	0.7400	0.7600	0.7800	0.8000
0.8200	0.8400	0.8600	0.8800	0.9000
0.9200	0.9400	0.9600	0.9800	1.0000

Transect Swale

Area:

0.0004	0.0016	0.0036	0.0064	0.0100
0.0144	0.0196	0.0256	0.0324	0.0400
0.0484	0.0576	0.0676	0.0784	0.0900
0.1024	0.1156	0.1296	0.1444	0.1600
0.1764	0.1936	0.2116	0.2304	0.2500
0.2704	0.2916	0.3136	0.3364	0.3600
0.3844	0.4096	0.4356	0.4624	0.4900
0.5184	0.5476	0.5776	0.6084	0.6400
0.6724	0.7056	0.7396	0.7744	0.8100
0.8464	0.8836	0.9216	0.9604	1.0000

Hrad:

0.0200	0.0400	0.0600	0.0800	0.1000
0.1200	0.1400	0.1600	0.1800	0.2000
0.2200	0.2400	0.2600	0.2800	0.3000
0.3200	0.3400	0.3600	0.3800	0.4000
0.4200	0.4400	0.4600	0.4800	0.5000
0.5200	0.5400	0.5600	0.5800	0.6000
0.6200	0.6400	0.6600	0.6800	0.7000
0.7200	0.7400	0.7600	0.7800	0.8000
0.8200	0.8400	0.8600	0.8800	0.9000
0.9200	0.9400	0.9600	0.9800	1.0000

Width:

0.0200	0.0400	0.0600	0.0800	0.1000

```
           0.1200     0.1400     0.1600     0.1800     0.2000
           0.2200     0.2400     0.2600     0.2800     0.3000
           0.3200     0.3400     0.3600     0.3800     0.4000
           0.4200     0.4400     0.4600     0.4800     0.5000
           0.5200     0.5400     0.5600     0.5800     0.6000
           0.6200     0.6400     0.6600     0.6800     0.7000
           0.7200     0.7400     0.7600     0.7800     0.8000
           0.8200     0.8400     0.8600     0.8800     0.9000
           0.9200     0.9400     0.9600     0.9800     1.0000


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Starting Date ............ 02/22/2018 00:00:00
Ending Date .............. 02/22/2018 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:01:00
Dry Time Step ............ 00:01:00
Routing Time Step ........ 1.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 4
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.086        71.707
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.019        16.022
Surface Runoff ...........         0.066        55.137
Final Storage ............         0.001         0.737
Continuity Error (%) .....        -0.263


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.066         0.662
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.054         0.544
Flooding Loss ............         0.002         0.019
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.008         0.081
Continuity Error (%) .....         2.696


*************************
Highest Continuity Errors
*************************
Node CB2 (42.22%)
Node CB4 (7.99%)
Node CB6 (2.76%)
Node CB9 (2.19%)
Node Drypond (1.97%)


***************************
Time-Step Critical Elements
***************************
None


********************************
Highest Flow Instability Indexes
********************************
All links are stable.
```

****
Routing Time Step Summary
****

Minimum Time Step :	1.00 sec
Average Time Step :	1.00 sec
Maximum Time Step :	1.00 sec
Percent in Steady State :	0.00
Average Iterations per Step :	2.00
Percent Not Converging :	0.01

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
S01	71.71	0.00	0.00	11.64	59.37	0.02	18.86	0.828
S02	71.71	0.00	0.00	7.65	63.25	0.01	11.81	0.882
S03	71.71	0.00	0.00	5.21	65.62	0.04	40.86	0.915
S04	71.71	0.00	0.00	13.27	57.78	0.01	10.84	0.806
S05	71.71	0.00	0.00	18.95	52.29	0.09	108.81	0.729
S06	71.71	0.00	0.00	7.22	63.67	0.07	68.29	0.888
S07	71.71	0.00	0.00	14.10	56.98	0.01	11.33	0.795
S08	71.71	0.00	0.00	12.66	58.38	0.01	16.27	0.814
S09	71.71	0.00	0.00	43.67	28.11	0.01	9.48	0.392
S10	71.71	0.00	0.00	42.78	29.17	0.00	7.86	0.407
S11	71.71	0.00	0.00	42.78	29.17	0.01	14.72	0.407
S12	71.71	0.00	0.00	25.41	45.97	0.04	56.09	0.641
S13	71.71	0.00	0.00	6.66	64.21	0.07	68.75	0.895
S14	71.71	0.00	0.00	24.69	46.67	0.04	46.45	0.651
S15	71.71	0.00	0.00	5.51	65.33	0.04	40.29	0.911
S16	71.71	0.00	0.00	30.53	40.94	0.00	2.86	0.571
S17	71.71	0.00	0.00	30.18	41.39	0.00	3.45	0.577
S18	71.71	0.00	0.00	5.68	65.16	0.05	54.14	0.909
S19	71.71	0.00	0.00	6.15	64.70	0.06	61.09	0.902
S20	71.71	0.00	0.00	23.80	47.73	0.08	109.57	0.666

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
200	JUNCTION	0.00	0.00	99.67	0 00:00	0.00
201	JUNCTION	0.02	0.06	99.15	0 01:06	0.06
202	JUNCTION	0.06	0.18	98.17	0 01:11	0.18
203	JUNCTION	0.10	0.20	98.10	0 01:11	0.20
204	JUNCTION	0.00	0.00	100.66	0 00:00	0.00
205	JUNCTION	0.00	0.00	100.18	0 00:00	0.00
206	JUNCTION	0.03	0.09	98.51	0 01:10	0.09
207	JUNCTION	0.02	0.06	98.72	0 01:03	0.06
208	JUNCTION	0.10	0.21	97.99	0 01:12	0.21
CB1	JUNCTION	0.72	2.07	101.80	0 01:05	2.07
CB10-DS	JUNCTION	0.01	0.08	101.49	0 01:05	0.08
CB10-MAJ	JUNCTION	0.01	0.08	101.49	0 01:05	0.08
CB10-TEE	JUNCTION	0.03	0.08	98.64	0 01:10	0.08
CB12-MAJ	JUNCTION	0.01	0.05	101.53	0 01:05	0.05
CB12-TEE	JUNCTION	0.03	0.11	98.43	0 01:10	0.11
CB13	JUNCTION	0.84	2.46	101.32	0 01:03	2.46
CB3-TEE	JUNCTION	0.02	0.05	99.40	0 01:06	0.05
CB4-DS	JUNCTION	0.00	0.02	102.84	0 01:05	0.02
CB4-MAJ	JUNCTION	0.00	0.02	102.94	0 01:05	0.02
CB4-TEE	JUNCTION	0.02	0.06	99.39	0 01:06	0.06
CB5-MAJ	JUNCTION	0.01	0.05	102.56	0 01:05	0.05
CB5-TEE	JUNCTION	0.03	0.09	98.96	0 01:11	0.09
CB6-MAJ	JUNCTION	0.01	0.06	101.29	0 01:04	0.06
CB6-TEE	JUNCTION	0.06	0.18	98.16	0 01:11	0.18
CB7-MAJ	JUNCTION	0.01	0.05	101.17	0 01:05	0.05
CB7-TEE	JUNCTION	0.05	0.13	98.23	0 01:11	0.13
CB8-MAJ	JUNCTION	0.01	0.07	101.27	0 01:05	0.07
CB8-TEE	JUNCTION	0.05	0.12	98.25	0 01:11	0.12
CB9-MAJ	JUNCTION	0.01	0.05	103.04	0 01:05	0.05
CB9-TEE	JUNCTION	0.01	0.05	99.86	0 01:10	0.05
Outfall_Goward_Storm	OUTFALL	0.00	0.00	97.50	0 00:00	0.00
Outfall_Second_Line	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
CB10	STORAGE	0.85	1.68	101.09	0 01:25	1.68
CB12	STORAGE	0.78	2.00	101.48	0 00:58	2.00
CB2	STORAGE	0.55	0.84	100.94	0 01:16	0.84
CB3	STORAGE	0.98	2.00	102.85	0 01:10	2.00
CB4	STORAGE	0.54	1.47	102.31	0 01:05	1.47
CB5	STORAGE	0.63	1.09	100.93	0 01:15	1.09
CB6	STORAGE	0.72	1.58	100.71	0 01:15	1.58

CB7	STORAGE	0.87	1.79	100.91	0 01:26	1.79
CB8	STORAGE	1.23	1.90	101.10	0 01:32	1.90
CB9	STORAGE	0.68	2.00	102.99	0 01:04	2.00
Drypond	STORAGE	1.65	2.24	100.84	0 01:28	2.24
Outfall_Hydro_Corridor	STORAGE	0.02	0.02	100.82	0 01:51	0.02

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
200	JUNCTION	0.00	0.00	0 00:00	0	0	0.000 ltr
201	JUNCTION	0.00	11.82	0 01:06	0	0.0538	-0.014
202	JUNCTION	0.00	62.33	0 01:11	0	0.328	0.063
203	JUNCTION	0.00	76.33	0 01:11	0	0.501	0.073
204	JUNCTION	0.00	0.00	0 00:00	0	0	0.000 ltr
205	JUNCTION	0.00	0.00	0 00:00	0	0	0.000 ltr
206	JUNCTION	0.00	20.17	0 01:10	0	0.0924	-0.002
207	JUNCTION	0.00	7.76	0 01:03	0	0.034	-0.010
208	JUNCTION	0.00	83.16	0 01:11	0	0.523	0.114
CB1	JUNCTION	56.09	56.09	0 01:05	0.0421	0.0421	1.283
CB10-DS	JUNCTION	0.00	78.27	0 01:05	0	0.0523	0.166
CB10-MAJ	JUNCTION	61.09	103.59	0 01:05	0.0597	0.091	0.115
CB10-TEE	JUNCTION	0.00	13.44	0 01:10	0	0.072	0.006
CB12-MAJ	JUNCTION	68.29	68.29	0 01:05	0.0658	0.0658	-0.060
CB12-TEE	JUNCTION	0.00	26.90	0 01:10	0	0.123	-0.005
CB13	JUNCTION	109.57	109.57	0 01:05	0.0831	0.0831	0.585
CB3-TEE	JUNCTION	0.00	6.73	0 01:10	0	0.0484	0.000
CB4-DS	JUNCTION	0.00	3.13	0 01:05	0	0.00365	1.715
CB4-MAJ	JUNCTION	10.84	10.84	0 01:05	0.00971	0.00971	0.002
CB4-TEE	JUNCTION	0.00	11.82	0 01:06	0	0.0538	0.001
CB5-MAJ	JUNCTION	40.29	40.29	0 01:05	0.0397	0.0397	0.047
CB5-TEE	JUNCTION	0.00	23.40	0 01:10	0	0.0987	-0.280
CB6-MAJ	JUNCTION	68.75	98.62	0 01:05	0.0667	0.0877	-0.037
CB6-TEE	JUNCTION	0.00	67.96	0 01:11	0	0.352	0.002
CB7-MAJ	JUNCTION	16.27	285.45	0 01:05	0.0147	0.183	-0.048
CB7-TEE	JUNCTION	0.00	38.98	0 01:11	0	0.229	0.000
CB8-MAJ	JUNCTION	120.14	157.12	0 01:05	0.0991	0.121	-0.020
CB8-TEE	JUNCTION	0.00	32.88	0 01:11	0	0.189	0.004
CB9-MAJ	JUNCTION	54.14	54.14	0 01:05	0.0532	0.0532	-0.259
CB9-TEE	JUNCTION	0.00	6.73	0 01:04	0	0.0205	0.002
Outfall_Goward_Storm	OUTFALL	0.00	83.15	0 01:12	0	0.522	0.000
Outfall_Second_Line	OUTFALL	25.17	25.17	0 01:05	0.0219	0.0219	0.000
CB10	STORAGE	0.00	20.95	0 01:05	0	0.0386	1.849
CB12	STORAGE	0.00	33.77	0 01:05	0	0.0473	1.027
CB2	STORAGE	46.45	76.51	0 01:05	0.0354	0.047	73.083
CB3	STORAGE	52.67	52.67	0 01:05	0.0517	0.0517	1.366
CB4	STORAGE	0.00	7.70	0 01:05	0	0.00606	8.690
CB5	STORAGE	0.00	14.35	0 01:06	0	0.0456	1.141
CB6	STORAGE	0.00	12.91	0 01:04	0	0.0254	2.836
CB7	STORAGE	0.00	30.92	0 01:05	0	0.0401	1.780
CB8	STORAGE	0.00	48.30	0 01:05	0	0.0671	1.282
CB9	STORAGE	0.00	11.59	0 01:05	0	0.0219	2.243
Drypond	STORAGE	9.48	263.69	0 01:05	0.00832	0.152	2.014
Outfall_Hydro_Corridor	STORAGE	22.59	143.27	0 01:05	0.0112	0.0675	0.495

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate LPS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 ltr	Maximum Ponded Depth Meters
CB12	0.41	27.04	0 01:05	0.016	0.000
CB3	0.17	11.53	0 01:10	0.003	0.000
CB9	0.11	4.86	0 01:05	0.001	0.000

****
Storage Volume Summary
****

	Average	Avg	Evap	Exfil	Maximum	Max	Time of Max	Maximum

Storage Unit	Volume 1000 m3	Pcnt Full	Pcnt Loss	Pcnt Loss	Volume 1000 m3	Pcnt Full	Occurrence days hr:min	Outflow LPS
CB10	0.001	3	0	0	0.010	18	0 01:25	5.91
CB12	0.000	39	0	0	0.001	100	0 00:58	6.73
CB2	0.000	28	0	0	0.000	42	0 01:16	9.72
CB3	0.004	18	0	0	0.020	100	0 01:10	6.73
CB4	0.000	27	0	0	0.001	74	0 01:05	5.30
CB5	0.000	24	0	0	0.000	41	0 01:15	12.62
CB6	0.000	0	0	0	0.003	7	0 01:15	5.64
CB7	0.003	6	0	0	0.017	39	0 01:26	6.20
CB8	0.009	19	0	0	0.031	68	0 01:32	6.16
CB9	0.000	34	0	0	0.001	100	0 01:04	6.73
Drypond	0.047	44	0	0	0.105	99	0 01:28	8.52
Outfall_Hydro_Corridor	0.055	7	0	0	0.067	9	0 01:51	0.00

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
Outfall_Goward_Storm	97.24	24.85	83.15	0.522
Outfall_Second_Line	51.62	1.96	25.17	0.022
System	74.43	26.81	100.67	0.544

****
Link Flow Summary
****

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
C1	CHANNEL	29.97	0 01:05	0.26	0.02	0.62
C1_1	CONDUIT	76.33	0 01:11	1.15	0.42	0.44
C1_2	CONDUIT	83.15	0 01:12	1.17	0.46	0.46
C10-S	CHANNEL	102.17	0 01:05	3.10	0.20	0.34
C12	CHANNEL	18.58	0 01:05	3.23	0.01	0.14
C15-S	CHANNEL	34.49	0 01:05	0.57	0.03	0.31
C2	CHANNEL	254.25	0 01:05	1.73	0.16	0.75
C2_1	CONDUIT	62.33	0 01:11	1.03	0.33	0.41
C2_3	CONDUIT	67.96	0 01:11	1.13	0.38	0.40
C3	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
C4_1	CONDUIT	11.81	0 01:06	0.77	0.06	0.20
C4_2	CONDUIT	23.36	0 01:11	1.07	0.12	0.26
C4_5-S	CHANNEL	29.87	0 01:05	0.69	0.02	0.25
C6	CONDUIT	0.00	0 00:00	0.00	0.00	0.08
C6_2	CONDUIT	6.80	0 01:17	1.10	0.04	0.17
C6_6	CONDUIT	11.82	0 01:06	1.32	0.07	0.18
C6-S	CHANNEL	108.54	0 01:05	0.93	0.40	0.61
C7_1	CONDUIT	0.00	0 00:00	0.00	0.00	0.08
C7_2	CONDUIT	6.73	0 01:10	1.00	0.05	0.15
C7_2-S	CHANNEL	42.50	0 01:05	0.71	0.03	0.33
C7-S	CHANNEL	85.72	0 01:05	1.02	0.20	0.53
C8	CHANNEL	0.00	0 00:00	0.00	0.00	0.09
C8_2	CONDUIT	38.98	0 01:11	1.19	0.25	0.34
C8_3	CONDUIT	20.17	0 01:10	0.87	0.13	0.26
C8_3-S	CHANNEL	78.27	0 01:05	0.13	0.96	0.80
C8_4	CONDUIT	32.88	0 01:11	1.03	0.20	0.33
C8_5	CONDUIT	26.90	0 01:10	0.95	0.17	0.30
C8_5-S	CHANNEL	75.91	0 01:05	1.10	0.08	0.32
C9_1	CONDUIT	7.76	0 01:03	0.68	0.13	0.28
C9_2	CONDUIT	13.44	0 01:10	0.97	0.23	0.32
C9-S_1	CHANNEL	3.13	0 01:05	0.74	0.00	0.08
C9-S_2	CHANNEL	2.56	0 01:05	0.22	0.00	0.22
CB12-ICD_1	CONDUIT	9.72	0 01:22	0.57	0.23	1.00
C11-ICD	DUMMY	5.91	0 01:25			
C3-ICD	DUMMY	6.73	0 01:10			
CB11-IC	DUMMY	20.95	0 01:05			
CB12-IC	DUMMY	33.77	0 01:05			
CB12-ICD	DUMMY	6.73	0 00:58			
CB14-ICD	DUMMY	7.76	0 01:03			
CB15-ICD	DUMMY	6.90	0 01:05			
CB2-IC	DUMMY	30.92	0 01:05			
CB4-ICA	DUMMY	7.70	0 01:05			
CB4-ICD	DUMMY	5.30	0 01:05			
CB5-IC	DUMMY	10.37	0 01:05			
CB5-ICD	DUMMY	12.62	0 01:15			
CB6-IC	DUMMY	12.91	0 01:04			
CB6-ICD	DUMMY	5.64	0 01:15			
CB7-ICD	DUMMY	6.20	0 01:26			
CB8-IC	DUMMY	11.59	0 01:05			
CB8-ICA	DUMMY	48.30	0 01:05			
CB8-ICDA	DUMMY	6.16	0 01:32			

CB9-ICD	DUMMY	6.73	0	01:04
POND-ICD	DUMMY	8.52	0	01:28

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
C1	1.00	0.05	0.89	0.00	0.06	0.00	0.00	0.00	0.83	0.00
C1_1	1.00	0.01	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00
C1_2	1.00	0.01	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00
C10-S	1.00	0.16	0.75	0.00	0.01	0.08	0.00	0.00	0.76	0.00
C12	1.00	0.16	0.77	0.00	0.01	0.06	0.00	0.00	0.78	0.00
C15-S	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.98	0.00
C2	1.25	0.00	0.00	0.00	0.80	0.04	0.00	0.16	0.84	0.00
C2_1	1.80	0.06	0.00	0.00	0.93	0.00	0.00	0.00	0.39	0.00
C2_3	1.00	0.07	0.00	0.00	0.32	0.01	0.00	0.60	0.00	0.00
C3	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C4_1	1.00	0.07	0.02	0.00	0.62	0.30	0.00	0.00	0.91	0.00
C4_2	1.00	0.07	0.00	0.00	0.00	0.15	0.00	0.78	0.15	0.00
C4_5-S	1.00	0.25	0.06	0.00	0.58	0.12	0.00	0.00	0.99	0.00
C6	1.00	0.07	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C6_2	10.12	0.07	0.00	0.00	0.44	0.50	0.00	0.00	0.52	0.00
C6_6	1.00	0.07	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00
C6-S	1.00	0.00	0.00	0.00	0.09	0.91	0.00	0.00	0.00	0.00
C7_1	1.00	0.07	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C7_2	1.00	0.07	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00
C7_2-S	1.00	0.21	0.07	0.00	0.62	0.10	0.00	0.00	0.99	0.00
C7-S	1.00	0.00	0.31	0.00	0.23	0.46	0.00	0.00	0.54	0.00
C8	1.00	0.01	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C8_2	1.00	0.06	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00
C8_3	1.00	0.06	0.00	0.00	0.61	0.33	0.00	0.00	0.70	0.00
C8_3-S	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
C8_4	1.29	0.06	0.00	0.00	0.47	0.46	0.00	0.00	0.38	0.00
C8_5	1.00	0.06	0.00	0.00	0.78	0.16	0.00	0.00	0.85	0.00
C8_5-S	1.00	0.00	0.02	0.00	0.50	0.48	0.00	0.00	0.52	0.00
C9_1	1.00	0.06	0.16	0.00	0.77	0.01	0.00	0.00	0.93	0.00
C9_2	1.19	0.06	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00
C9-S_1	3.14	0.00	0.00	0.00	0.36	0.63	0.00	0.00	0.93	0.00
C9-S_2	1.00	0.00	0.01	0.00	0.84	0.15	0.00	0.00	0.99	0.00
CB12-ICD_1	1.00	0.10	0.07	0.00	0.15	0.03	0.00	0.64	0.07	0.00

****
Conduit Surcharge Summary
****

Conduit	--------- Hours Full -------- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	0.01	0.01	4.96	0.01	0.01
C2	0.01	0.01	4.72	0.01	0.01
CB12-ICD_1	0.27	0.27	0.72	0.01	0.01

Analysis begun on: Mon Dec 03 12:00:47 2018
Analysis ended on: Mon Dec 03 12:00:48 2018
Total elapsed time: 00:00:01

Appendix G – Correspondence

Correspondence from City of Ottawa – Hydraulic Boundary Conditions

Boundary Conditions 1158 Second Line Road

Information Provided

Date provided: 05 April 2018

Provided Information:

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

# of connections 2

Location

Results

Connection 1 - Goward Dr.

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

[1] Ground Elevation = 100.76 m

Connection 2 - Whernside Terr

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

[1] Ground Elevation = 101.19 m

Consideration

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

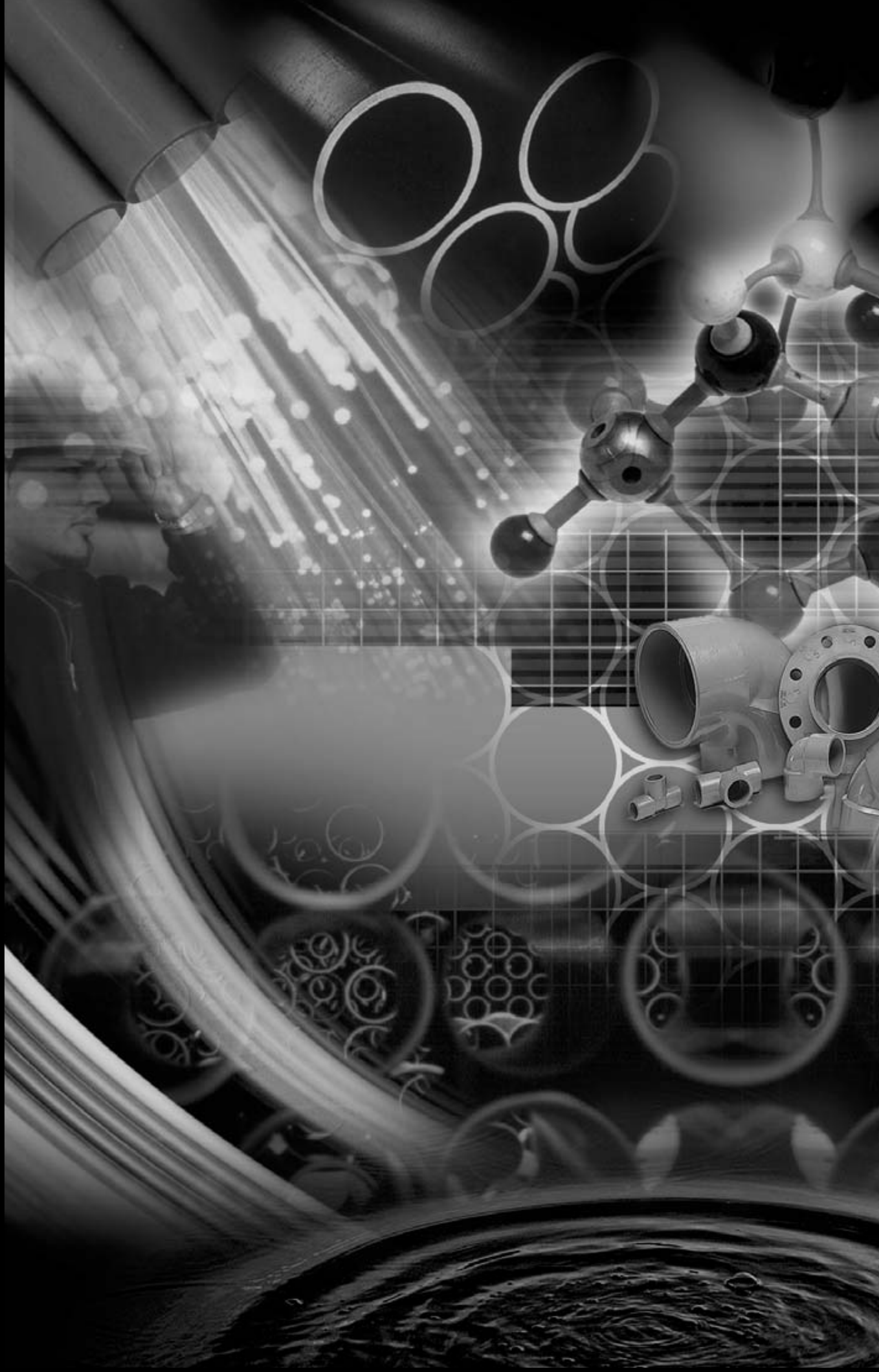
Disclaimer

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

Appendix H – Manufacturer Information

Tempest Inlet Control Devices

Volume III: TEMPEST™ INLET CONTROL DEVICES



Municipal Technical Manual Series

SECOND EDITION

LMF (Low to Medium Flow) ICD

HF (High Flow) ICD

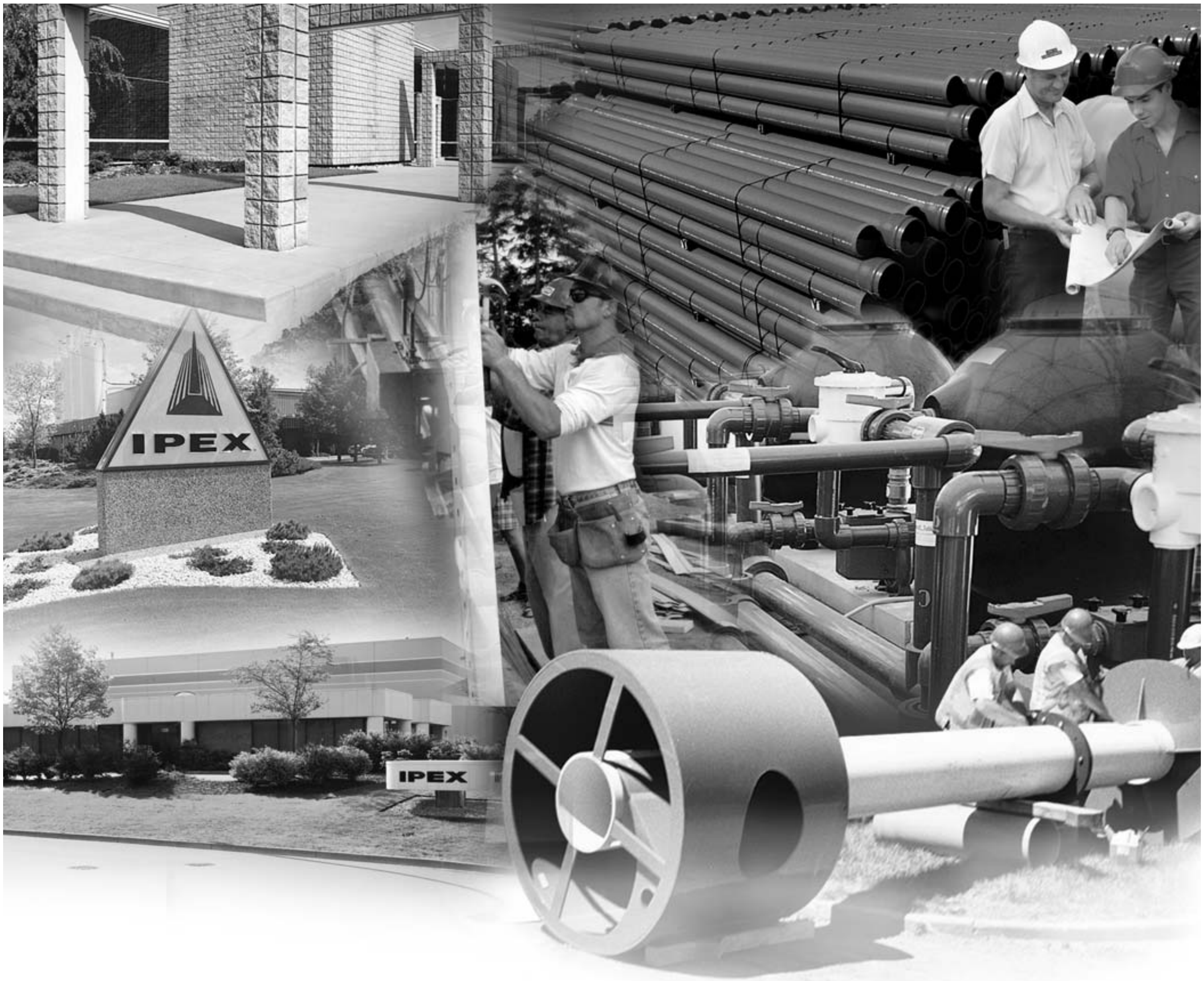
MHF (Medium to High Flow) ICD

IPEX

IPEX Tempest™ Inlet Control Devices

Municipal Technical Manual Series

Vol. I, 2nd Edition



About IPEX

At IPEX, we have been manufacturing non-metallic pipe and fittings since 1951. We formulate our own compounds and maintain strict quality control during production. Our products are made available for customers thanks to a network of regional stocking locations throughout North America. We offer a wide variety of systems including complete lines of piping, fittings, valves and custom-fabricated items.

More importantly, we are committed to meeting our customers' needs. As a leader in the plastic piping industry, IPEX continually develops new products, modernizes manufacturing facilities and acquires innovative process technology. In addition, our staff take pride in their work, making available to customers their extensive thermoplastic knowledge and field experience. IPEX personnel are committed to improving the safety, reliability and performance of thermoplastic materials. We are involved in several standards committees and are members of and/or comply with the organizations listed on this page.

For specific details about any IPEX product, contact our customer service department.

CONTENTS

TEMPEST INLET CONTROL DEVICES Technical Manual

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

PRODUCT INFORMATION: TEMPEST LOW, MEDIUM FLOW (LMF) ICD

Purpose

To control the amount of storm water runoff entering a sewer system by allowing a specified flow volume out of a catch basin or manhole at a specified head. This approach conserves pipe capacity so that catch basins downstream do not become uncontrollably surcharged, which can lead to basement floods, flash floods and combined sewer overflows.

Product Description

Our LMF ICD is designed to accommodate catch basins or manholes with sewer outlet pipes 6" in diameter and larger. Any storm sewer larger than 12" may require custom modification. However, IPEX can custom build a TEMPEST device to accommodate virtually any storm sewer size.

Available in 14 preset flow curves, the LMF ICD has the ability to provide flow rates: 2lps – 17lps (31gpm – 270gpm)

Product Function

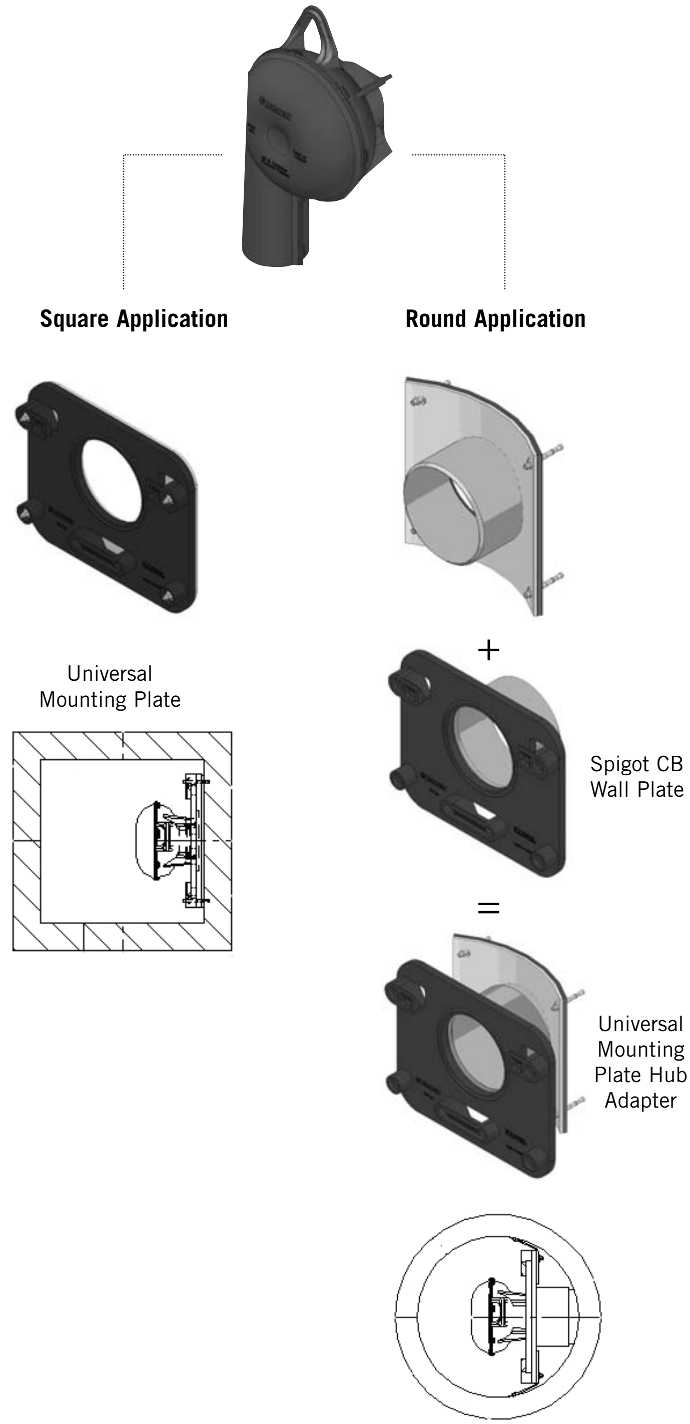
The LMF ICD vortex flow action allows the LMF ICD to provide a narrower flow curve using a larger orifice than a conventional orifice plate ICD, making it less likely to clog. When comparing flows at the same head level, the LMF ICD has the ability to restrict more flow than a conventional ICD during a rain event, preserving greater sewer capacity.

Product Construction

Constructed from durable PVC, the LMF ICD is light weight 8.9 Kg (19.7 lbs).

Product Applications

Will accommodate both square and round applications:



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

Chart 1: LMF 14 Preset Flow Curves

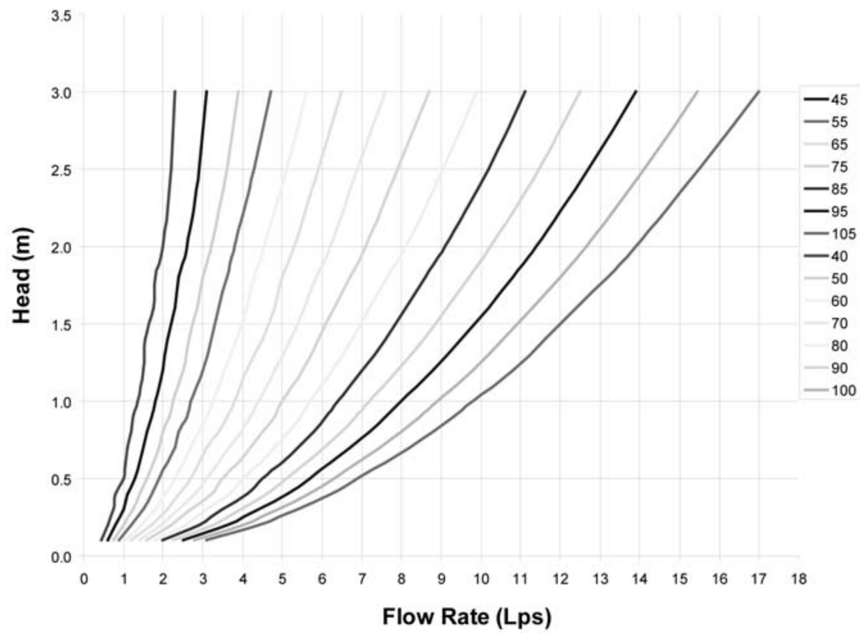
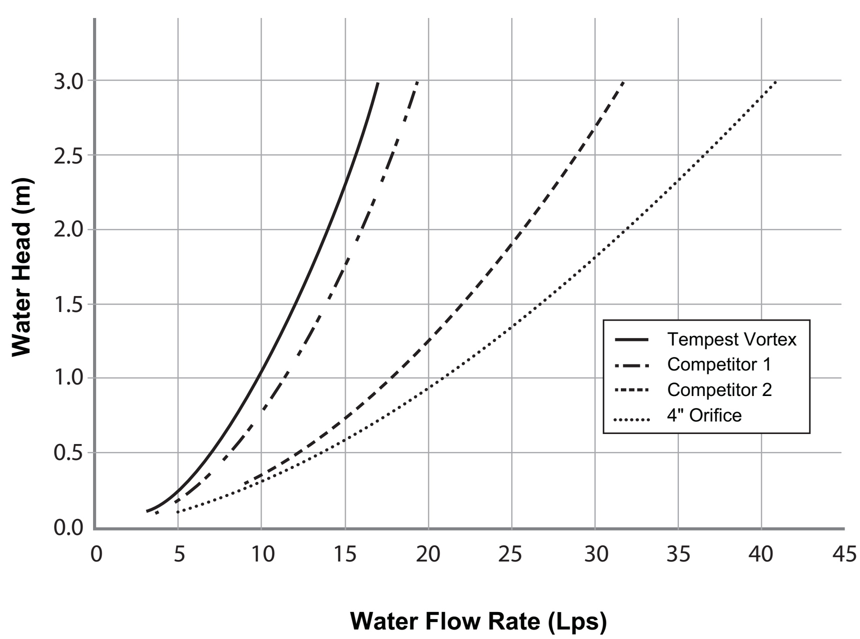


Chart 2: LMF Flow vs. ICD Alternatives



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

PRODUCT INSTALLATION

Instructions to assemble a TEMPEST LMF ICD into a Square Catch Basin:

STEPS:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers, (4) nuts, universal mounting plate, ICD device.
2. Use the mounting wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a minimum of 1-1/2" depth up to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you hit the anchors with the hammer. Remove the nuts from the ends of the anchors.
5. Install the universal mounting plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the wall mounting plate and the catch basin wall.
6. From the ground above using a reach bar, lower the ICD device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the universal mounting plate and has created a seal.

WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- Call your IPEX representative for more information or if you have any questions about our products.

Instructions to assemble a TEMPEST LMF ICD into a Round Catch Basin:

STEPS:

1. Materials and tooling verification.
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers and (4) nuts, spigot CB wall plate, universal mounting plate hub adapter, ICD device.
2. Use the spigot catch basin wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a depth between 1-1/2" to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you hit the anchors with the hammer. Remove the nuts from the ends of the anchors.
5. Install the CB spigot wall plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the spigot wall plate and the catch basin wall.
6. Apply solvent cement on the hub of the universal mounting plate, hub adapter and the spigot of the CB wall plate, then slide the hub over the spigot. Make sure the universal mounting plate is at the horizontal and its hub is completely inserted onto the spigot. Normally, the corners of the universal mounting plate hub adapter should touch the catch basin wall.
7. From ground above using a reach bar, lower the ICD device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the mounting plate and has created a seal.

WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut back the pipe flush to the catch basin wall.
- The solvent cement which is used in this installation is to be approved for PVC.
- The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at www.ipexinc.com.
- Call your IPEX representative for more information or if you have any questions about our products.

PRODUCT TECHNICAL SPECIFICATION

General

Inlet control devices (ICD's) are designed to provide flow control at a specified rate for a given water head level and also provide odour and floatable control. All ICD's will be IPEX Tempest or approved equal.

All devices shall be removable from a universal mounting plate. An operator from street level using only a T-bar with a hook will be able to retrieve the device while leaving the universal mounting plate secured to the catch basin wall face. The removal of the TEMPEST devices listed above must not require any unbolting or special manipulation or any special tools.

High Flow (HF) Sump devices will consist of a removable threaded cap which can be accessible from street level with out entry into the catchbasin (CB). The removal of the threaded cap shall not require any special tools other than the operator's hand.

ICD's shall have no moving parts.

Materials

ICD's are to be manufactured from Polyvinyl Chloride (PVC) or Polyurethane material, designed to be durable enough to withstand multiple freeze-thaw cycles and exposure to harsh elements.

The inner ring seal will be manufactured using a Buna or Nitrile material with hardness between Duro 50 and Duro 70.

The wall seal is to be comprised of a 3/8" thick Neoprene Closed Cell Sponge gasket which is attached to the back of the wall plate.

All hardware will be made from 304 stainless steel.

Dimensioning

The Low Medium Flow (LMF), High Flow (HF) and the High Flow (HF) Sump shall allow for a minimum outlet pipe diameter of 200mm with a 600mm deep Catch Basin sump.

Installation

Contractor shall be responsible for securing, supporting and connecting the ICD's to the existing influent pipe and catchbasin/manhole structure as specified and designed by the Engineer.

PRODUCT INFORMATION: TEMPEST HF & MHF ICD

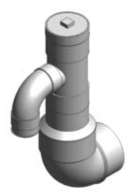
Product Description

Our HF, HF Sump and MHF ICD's are designed to accommodate catch basins or manholes with sewer outlet pipes 6" in diameter or larger. Any storm sewer larger than 12" may require custom modification. However, IPEX can custom build a TEMPEST device to accommodate virtually any storm sewer size.

Available in 5 preset flow curves, these ICDs have the ability to provide constant flow rates: 9lps (143 gpm) and greater

Product Function

TEMPEST HF (High Flow): designed to manage moderate to higher flows 15 L/s (240 gpm) or greater and prevent the propagation of odour and floatables. With this device, the cross-sectional area of the device is larger than the orifice diameter and has been designed to limit head losses. The HF ICD can also be ordered without flow control when only odour and floatable control is required.



TEMPEST HF (High Flow) Sump: The height of a sewer outlet pipe in a catch basin is not always conveniently located. At times it may be located very close to the catch basin floor, not providing enough sump for one of the other TEMPEST ICDs with universal back plate to be installed. In these applications, the HF Sump is offered. The HF Sump offers the same features and benefits as the HF ICD; however, is designed to raise the outlet in a square or round catch basin structure. When installed, the HF sump is fixed in place and not easily removed. Any required service to the device is performed through a clean-out located in the top of the device which can be often accessed from ground level.

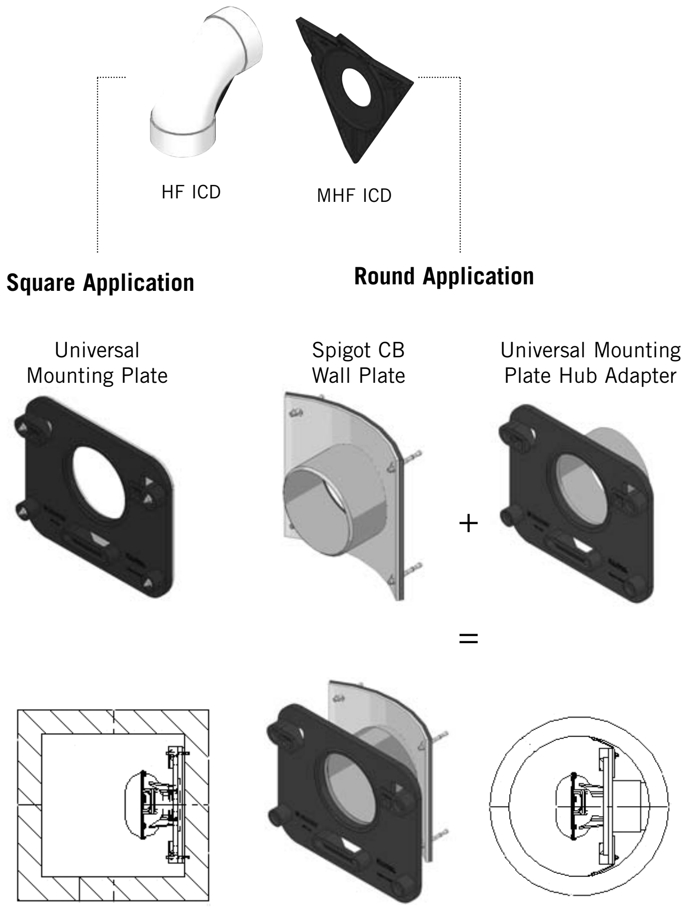
TEMPEST MHF (Medium to High Flow): The MHF plate or plug is designed to control flow rates 9 L/s (143 gpm) or greater. It is not designed to prevent the propagation of odour and floatables.

Product Construction

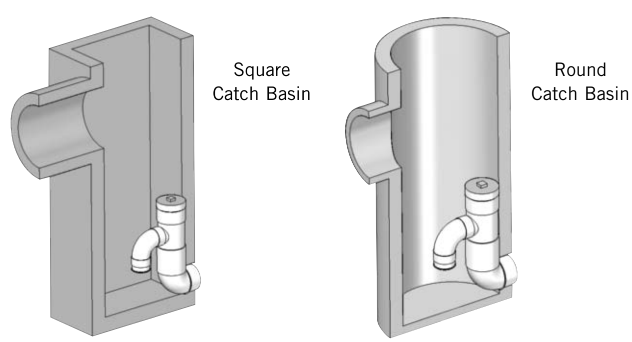
The HF, HF Sump and MHF ICDs are built to be light weight at a maximum weight of 6.8 Kg (14.6 lbs).

Product Applications

The HF and MHF ICD's are available to accommodate both square and round applications:

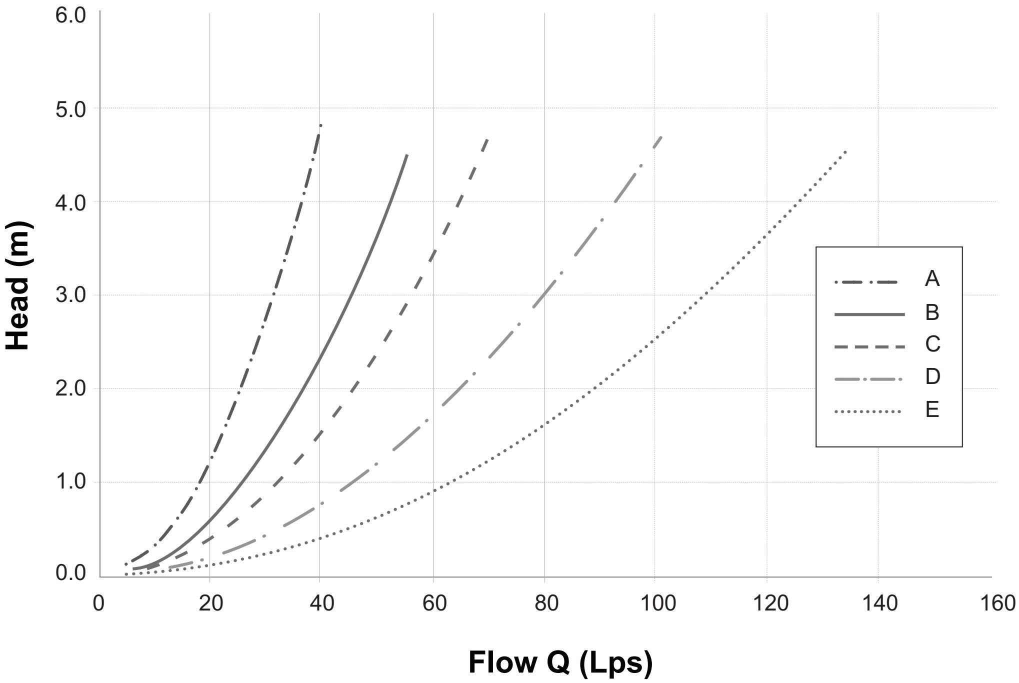


The HF Sump is available to accommodate low to no sump applications in both square and round catch basins:



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

Chart 3: HF & MHF Preset Flow Curves



PRODUCT INSTALLATION

Instructions to assemble a TEMPEST HF or MHF ICD into a Square Catch Basin:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers, (4) nuts, universal mounting plate, ICD device
2. Use the mounting wall plate to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a minimum of 1-1/2" depth up to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you hit the anchors with the hammer. Remove the nuts from the ends of the anchors.
5. Install the universal wall mounting plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the wall mounting plate and the catch basin wall.
6. From the ground above using a reach bar, lower the device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the universal wall mounting plate and has created a seal.

WARNING

- Verify that the outlet pipe doesn’t protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- Call your IPEX representative for more information or if you have any questions about our products.

Instructions to assemble a TEMPEST HF or MHF ICD into a Round Catch Basin:

STEPS:

1. Materials and tooling verification.
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level and marker.
   - Material: (4) concrete anchor 3/8 x 3-1/2, (4) washers and (4) nuts, spigot CB wall plate, universal mounting plate hub adapter, ICD device.
2. Use the round catch basin spigot adaptor to locate and mark the hole (4) pattern on the catch basin wall. You should use a level to ensure that the plate is at the horizontal.
3. Use an impact drill with a 3/8" concrete bit to make the four holes at a depth between 1-1/2" to 2-1/2". Clean the concrete dust from the holes.
4. Install the anchors (4) in the holes by using a hammer. Thread the nuts on the top of the anchors to protect the threads when you hit the anchors with the hammer. Remove the nuts from the ends of the anchors.
5. Install the spigot CB wall plate on the anchors and screw the 4 nuts in place with a maximum torque of 40 N.m (30 lbf-ft). There should be no gap between the spigot CB wall plate and the catch basin wall.
6. Put solvent cement on the hub of the universal mounting plate, hub adapter and the spigot of the CB wall plate, then slide the hub over the spigot. Make sure the universal mounting plate is at the horizontal and its hub is completely inserted onto the spigot. Normally, the corners of the hub adapter should touch the catch basin wall.
7. From ground above using a reach bar, lower the device by hooking the end of the reach bar to the handle of the ICD device. Align the triangular plate portion into the mounting wall plate. Push down the device to be sure it has centered in to the wall mounting plate and has created a seal.

WARNING

- Verify that the outlet pipe doesn’t protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- The solvent cement which is used in this installation is to be approved for PVC.
- The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at www.ipexinc.com.
- Call your IPEX representative for more information or if you have any questions about our products.

Instructions to assemble a TEMPEST HF Sump into a Square or Round Catch Basin:

STEPS:

1. Materials and tooling verification:
   - Tooling: impact drill, 3/8" concrete bit, torque wrench for 9/16" nut, hand hammer, level, mastic tape and metal strapping
   - Material: (2) concrete anchor 3/8 x 3-1/2, (2) washers, (2) nuts, HF Sump pieces (2).
2. Apply solvent cement to the spigot end of the top half of the sump. Apply solvent cement to the hub of the bottom half of the sump. Insert the spigot of the top half of the sump into the hub of the bottom half of the sump.
3. Install the 8" spigot of the device into the outlet pipe. Use the mastic tape to seal the device spigot into the outlet pipe. You should use a level to be sure that the fitting is standing at the vertical.
4. Use an impact drill with a 3/8" concrete bit to make a series of 2 holes along each side of the body throat. The depth of the hole should be between 1-1/2" to 2-1/2". Clean the concrete dust from the 2 holes.
5. Install the anchors (2) in the holes by using a hammer. Put the nuts on the top of the anchors to protect the threads when you hit the anchors. Remove the nuts from the ends of the anchors.
6. Cut the metal strapping to length and connect each end of the strapping to the anchors. Screw the nuts in place with a maximum torque of 40 N.m (30 lbf-ft). The device should be completely flush with the catch basin wall.

WARNING

- Verify that the outlet pipe doesn't protrude into the catch basin. If it does, cut down the pipe flush to the catch basin wall.
- The solvent cement which is used in this installation is to be approved for PVC.
- The solvent cement should not be used below 0°C (32°F) or in a high humidity environment. Refer to the IPEX solvent cement guide to confirm the required curing time or visit the IPEX Online Solvent Cement Training Course available at www.ipexinc.com.
- Call your IPEX representative for more information or if you have any questions about our products.

PRODUCT TECHNICAL SPECIFICATION

General

Inlet control devices (ICD's) are designed to provide flow control at a specified rate for a given water head level and also provide odour and floatable control where specified. All ICD's will be IPEX Tempest or approved equal.

All devices shall be removable from a universal mounting plate. An operator from street level using only a T-bar with a hook shall be able to retrieve the device while leaving the universal mounting plate secured to the catch basin wall face. The removal of the TEMPEST devices listed above shall not require any unbolting or special manipulation or any special tools.

High Flow (HF) Sump devices shall consist of a removable threaded cap which can be accessible from street level with out entry into the catchbasin (CB). The removal of the threaded cap shall not require any special tools other than the operator's hand.

ICD's shall have no moving parts.

Materials

ICD's are to be manufactured from Polyvinyl Chloride (PVC) or Polyurethane material, designed to be durable enough to withstand multiple freeze-thaw cycles and exposure to harsh elements.

The inner ring seal will be manufactured using a Buna or Nitrile material with hardness between Duro 50 and Duro 70.

The wall seal is to be comprised of a 3/8" thick Neoprene Closed Cell Sponge gasket which is attached to the back of the wall plate.

All hardware will be made from 304 stainless steel.

Dimensioning

The Low Medium Flow (LMF), High Flow (HF) and the High Flow (HF) Sump shall allow for a minimum outlet pipe diameter of 200mm with a 600mm deep Catch Basin sump.

Installation

Contractor shall be responsible for securing, supporting and connecting the ICD's to the existing influent pipe and catchbasin/manhole structure as specified and designed by the Engineer.

SALES AND CUSTOMER SERVICE

Canadian Customers call IPEX Inc.

Toll free: (866) 473-9462

www.ipexinc.com

U.S. Customers call IPEX USA LLC

Toll free: (800) 463-9572

www.ipexamerica.com

About the IPEX Group of Companies

As leading suppliers of thermoplastic piping systems, the IPEX Group of Companies provides our customers with some of the largest and most comprehensive product lines. All IPEX products are backed by more than 50 years of experience. With state-of-the-art manufacturing facilities and distribution centers across North America, we have established a reputation for product innovation, quality, end-user focus and performance.

Markets served by IPEX group products are:

- Electrical systems
- Telecommunications and utility piping systems
- PVC, CPVC, PP, ABS, PEX, FR-PVDF and PE pipe and fittings (1/4" to 48")
- Industrial process piping systems
- Municipal pressure and gravity piping systems
- Plumbing and mechanical piping systems
- PE Electrofusion systems for gas and water
- Industrial, plumbing and electrical cements
- Irrigation systems

Products manufactured by IPEX Inc. and distributed in the United States by IPEX USA LLC.

Tempest™ is a trademark of IPEX Branding Inc.

MNMNTPIP110817

IPEX

Appendix I – Background Information

- **Master Design Sheet (Hydraulic Grade Line Analysis). From Stormwater Management Report, Morgan Grant, Phase 12D (Report R-1591.A). 1 page.**
- **5-year Storm Design Sheet. From Stormwater Management Report, Morgan Grant, Phase 12D (Report R-1591.A). 2 pages.**
- **Stormwater Storage / Overland Balance Table. From Stormwater Management Report, Morgan Grant, Phase 12D (Report R-1591.B). 1 page.**
- **Storm Drainage Plan, Morgan's Grant Phase 12D. From Stormwater Management Report, Morgan Grant, Phase 12D (Report R-1591.B). 1 page.**
- **Storm Drainage Plan, Morgan's Grant Phase 12D. 1 page.**
- **Sanitary Drainage Plan, Morgan's Grant Phase 12D. 1 page.**
- **Morgan's Grant Master Sanitary Flows. From Master Servicing Study for the Morgan's Grant Subdivision (Report R-2168). 3 pages.**
- **Master Drainage Plan (Sanitary). From Master Servicing Study for the Morgan's Grant Subdivision (Report R-2168). 1 page.**
- **Pages 3, 4, 5 from Master Servicing Study for the Morgan's Grant Subdivision (Report R-2168). 3 pages.**
- **ECA for Storm and Sanitary Sewers No: 1005-6J6K7W-14**
- **ECA for SWM Facility. No: 9327-54JRK4-14**
- **Morgan's Grant Phase 12D, Goward Drive – Plan & Profile, Drawing # 17732-15. 1 page.**

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

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

STORM SEWER DESIGN SHEET AND HYDRAULIC GRADE LINE ANALYSIS

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

100 YEAR IDF CURVE

Manning's Coefficient (n) = 0.013

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

STREET	From	To	UPSTREAM Pr. Center Line	Obvert	Obvert Drop	Invert	Cover	Pr. Center Line	Obvert	Obvert Drop	Invert	Cover	HEAD LOSS CALCULATION f	L / D	K FRICT	V^2 / 2g (m)	Straight	Expansion	Bend	Major Loss (m)	Minor Loss (m)	Total Losses (m)	Applied Losses (m)	1:100 YR HGL ELEVATIONS Upstr.	Downs.	COVER Top Foot.- HGL Upstr.	Downs.	COVER - HGL Centerline Upstr.	Downs.
KLONDIKE RD.	667A	667	103.200	98.758		98.008	4.442	101.950	98.330		97.580	3.620	0.023	82.677	1.905	0.296	0.044			0.564	0.044	0.608	0.000	98.758	98.330	1.742	0.920	4.442	3.620
KLONDIKE RD.	667	666	101.950	98.330		97.580	3.620	99.550	96.350		95.600	3.200	0.023	131.234	3.024	0.734	0.110			2.221	0.110	2.331	0.000	98.330	96.350	0.920	0.500	3.620	3.200
	666	665	99.550	95.750		95.000	3.800	95.000	91.850		91.100	3.150	0.023	127.953	2.948	1.210	0.182			3.568	0.182	3.749	0.000	95.750	91.850	1.100	0.450	3.800	3.150
PIEKOFF CR.	660	661	100.500	97.441		97.141	3.059	98.500	95.207		94.907	3.293	0.031	333.333	10.425	0.034	0.005			0.359	0.005	0.365	0.365	97.441	95.207	0.359	0.593	3.059	3.293
	661	663	98.500	95.207		94.907	3.293	94.900	91.660		91.360	3.240	0.031	258.530	8.085	0.138		0.138	0.141	1.115	0.279	1.394	1.394	95.207	91.694	0.593	0.506	3.293	3.206
WALLSEND AVE.	655	663	95.250	92.104		91.804	3.146	94.900	91.664		91.364	3.236	0.031	240.814	7.531	0.004	0.001	0.004		0.029	0.004	0.033	0.033	92.104	91.694	0.446	0.506	3.146	3.206
WALLSEND AVE.	663	664	94.900	91.694		91.244	3.206	94.600	91.500		91.050	3.100	0.027	70.866	1.936	0.037	0.006			0.072	0.006	0.077	0.077	91.694	91.500	0.506	0.400	3.206	3.100
	664	665	94.600	91.500		91.050	3.100	95.000	91.210		90.760	3.790	0.027	105.643	2.886	0.048		0.048	0.049	0.140	0.098	0.238	0.238	91.500	91.252	0.400	1.048	3.100	3.748
KLONDIKE RD.	665	665A	95.000	91.252		90.502	3.748	91.800	89.140		88.390	2.660	0.023	79.659	1.836	1.239	0.186	1.239		2.274	1.424	3.698	0.000	91.252	89.140	1.048	-0.040	3.748	2.660
	665A	648	91.800	88.690		87.790	3.110	91.800	88.600		87.700	3.200	0.022	24.606	0.534	0.222	0.033	0.222		0.119	0.256	0.374	0.000	88.690	88.600	0.410	0.500	3.110	3.200
KLONDIKE RD.	648	647	91.800	88.606		87.406	3.194	91.400	88.266		87.066	3.134	0.020	69.718	1.374	0.321	0.048			0.441	0.048	0.489	0.000	88.606	88.266	0.494	0.434	3.194	3.134
WIMBLEDON ST.	548A	548	91.673	88.908		88.608	2.765	91.500	88.852		88.552	2.648	0.031	45.932	1.437	0.000				0.000	0.000	0.000	0.000	88.908	88.852	0.065	-0.052	2.765	2.648
	548	547	91.500	88.852		88.477	2.648	91.400	88.630		88.255	2.770	0.029	145.669	4.229	0.054			0.004	0.227	0.004	0.232	0.000	88.852	88.630	-0.052	0.070	2.648	2.770
	547	546	91.400	88.590		88.215	2.810	91.430	88.554		88.179	2.876	0.029	23.622	0.686	0.054		0.054	0.004	0.037	0.058	0.095	0.000	88.590	88.554	0.110	0.176	2.810	2.876
	546	545	91.430	88.554		88.104	2.876	91.470	88.262		87.812	3.208	0.027	159.668	4.362	0.076	0.011			0.330	0.011	0.341	0.000	88.554	88.262	0.176	0.508	2.876	3.208
	545	647	91.470	88.222		87.772	3.248	91.400	88.054		87.604	3.346	0.027	91.864	2.510	0.078		0.078	0.080	0.197	0.158	0.355	0.000	88.222	88.054	0.548	0.646	3.248	3.346
KLONDIKE RD.	647	646	91.600	88.266		87.066	3.334	91.650	87.821		86.621	3.830	0.020	81.201	1.600	0.367	0.055			0.588	0.055	0.643	0.000	88.266	87.821	0.634	1.129	3.334	3.830
	646	645	91.650	87.820		86.620	3.830	90.400	87.232		86.032	3.168	0.020	80.381	1.584	0.466			0.476	0.738	0.476	1.214	0.000	87.820	87.232	1.130	0.468	3.830	3.168
PENRITH ST.	645	694	90.400	87.170		85.970	3.230	92.000	86.820		85.620	5.180	0.020	57.661	1.136	0.387	0.058			0.440	0.058	0.498	0.000	87.170	86.820	0.530	2.480	3.230	5.180
BRECHIN CR.	696	695	92.850	89.936		89.636	2.914	92.505	89.449		89.149	3.056	0.031	159.777	4.997	0.090		0.090	0.025	0.450	0.115	0.565	0.000	89.936	89.449	0.214	0.356	2.914	3.056
	695	694	92.505	89.449		89.074	3.056	92.000	88.836		88.461	3.164	0.029	229.921	6.675	0.083		0.083	0.085	0.554	0.168	0.722	0.000	89.449	88.836	0.356	0.464	3.056	3.164
PENRITH ST.	694	693	92.000	86.820		85.620	5.180	91.700	86.638		85.438	5.063	0.020	29.938	0.590	0.232			0.014	0.137	0.014	0.151	0.151	88.089	87.938	1.211	1.062	3.911	3.762
	693	692	91.700	86.638		85.438	5.063	92.000	86.455		85.255	5.545	0.020	29.938	0.590	0.236	0.035			0.139	0.035	0.175	0.175	87.938	87.763	1.062	1.537	3.762	4.237
BRECHIN CR.	696	698	92.850	89.936		89.636	2.914	93.100	89.598		89.298	3.502	0.031	110.892	3.468	0.000				0.000	0.000	0.000	0.000	89.936	89.598	0.214	0.802	2.914	3.502
BRECHIN CR.	703	698	93.100	90.245		89.870	2.855	93.100	89.525		89.150	3.575	0.029	188.189	5.464	0.107			0.110	0.587	0.110	0.697	0.000	90.245	89.525	0.155	0.875	2.855	3.575
EALING ST.	698	697	93.100	89.461		89.086	3.639	92.350	88.821		88.446	3.529	0.029	167.979	4.877	0.107	0.016			0.524	0.016	0.540	0.000	89.461	88.821	0.939	0.829	3.639	3.529
	697	692	92.350	88.821		88.446	3.529	92.000	88.282		87.907	3.718	0.029	141.470	4.107	0.124		0.124	0.126	0.509	0.250	0.760	0.000	88.821	88.282	0.829	1.018	3.529	3.718
PENRITH ST.	692	691	92.000	86.455		85.255	5.545	91.200	86.277		85.077	4.923	0.020	26.493	0.522	0.255			0.260	0.133	0.260	0.394	0.394	87.763	87.369	1.537	1.131	4.237	3.831
BRECHIN CR.	704	703	93.000	90.039		89.739	2.961	93.100	89.424		89.124	3.676	0.031	201.772	6.310	0.107		0.107	0.110	0.677	0.217	0.894	0.000	90.039	89.424	0.261	0.976	2.961	3.676
HASELMERE AVE.	703	702	93.100	89.424		89.049	3.676	92.000	88.777		88.402	3.223	0.029	169.816	4.930	0.107	0.016			0.530	0.016	0.546	0.000	89.424	88.777	0.976	0.523	3.676	3.223
	702	701	92.000	88.775		88.400	3.225	91.440	88.054		87.679	3.386	0.029	139.108	4.039	0.157		0.157	0.160	0.634	0.317	0.951	0.000	88.775	88.054	0.525	0.686	3.225	3.386
BRECHIN CR.	705	706	92.880	89.720		89.420	3.160	90.800	87.700		87.400	3.100	0.031	360.236	11.266	0.004		0.004	0.004	0.043	0.008	0.051	0.051	89.720	87.886	0.460	0.214	3.160	2.914
PENRITH ST.	707	706	90.500	87.912		87.537	2.588	90.800	87.590		87.215	3.210	0.029	84.514	2.454	0.006	0.001	0.006		0.015	0.007	0.023	0.023	87.912	87.886	-0.112	0.214	2.588	2.914
PENRITH ST.	706	701	90.800	87.590		87.140	3.210	91.440	87.034		86.584	4.406	0.027	152.012	4.153	0.027	0.004			0.113	0.004	0.117	0.117	87.886	87.769	0.214	0.971	2.914	3.671
PENRITH ST.	701	691	91.440	87.034		86.584	4.406	91.200	86.250		85.800	4.950	0.027	85.739	2.342	0.092		0.092	0.093	0.214	0.185	0.399	0.399	87.769	87.369	0.971	1.131	3.671	3.831
HEYSHAM LANE	691	677	91.300	86.234		85.034	5.066	91.300	85.819		84.619	5.481	0.020	61.844	1.218	0.309			0.315	0.376	0.315	0.691	0.691	87.369	86.679	1.231	1.921	3.931	4.621
WOLISTON CR.	677	676	91.300	85.759		84.559	5.541	90.160	85.244		84.044	4.916	0.020	76.854	1.514	0.317			0.089	0.480	0.089	0.569	0.569	86.679	86.110	1.921	1.350	4.621	4.050
	676	675	90.160	85.214		84.014	4.946	90.150	85.152		83.952	4.998	0.020	9.268	0.183	0.317		0.317	0.089	0.058	0.406	0.464	0.464	86.110	85.646	1.350	1.804	4.050	4.504
	675	674	90.150	85.152		83.802	4.998	89.190	84.704		83.354	4.486	0.019	65.325	1.237	0.209	0.031			0.259	0.031	0.290	0.290	85.646	85.356	1.804	1.134	4.504	3.834
	674	673	89.190	84.704		83.354	4.486	88.400	84.375		83.025	4.025	0.019	47.973	0.909	0.218	0.033			0.198	0.033	0.230	0.230	85.356	85.125	1.134	0.575	3.834	3.275
KETTLEWELL WAY	687	688	90.940	87.878		87.578	3.062	90.600	87.078		86.778	3.522	0.031	187.664	5.869	0.079			0.022	0.464	0.022	0.487	0.000	87.878	87.078	0.362	0.822	3.062	3.522
	688	688A	90.600	87.027		86.727	3.573	90.000	86.873		86.573	3.127	0.031	36.089	1.129	0.117			0.033	0.132	0.033	0.164	0.000	87.027	86.873	0.873	0.427	3.573	3.127
	688A	689	90.000	86.823		86.523	3.177	88.900	85.760		85.460	3.140	0.031	252.953	7.911	0.034			0.035	0.273	0.035	0.308	0.308	86.823	86.090	0.477	0.110	3.177	2.810
PALTON ST.	689	673	88.900	85.422		85.122	3.478	88.400	84.246		83.946	4.154	0.031	257.546	8.055	0.096		0.096	0.098	0.771	0.193	0.965	0.965	86.090	85.125	0.110	0.575	2.810	3.275
WOLISTON CR.	673	672	88.400	84.375		83.025	4.025	87.200	83.954		82.604	3.246	0.019	61.388	1.163	0.238			0.243	0.277	0.243	0.519	0.519	85.125	84.606	0.575	-0.106	3.275	2.594
WOLISTON CR.	678	681	91.228	88.795		88.495	2.433	91.920	88.242		87.942	3.678	0.031	268.701	8.404	0.068			0.019	0.571	0.019	0.590	0.000	88.795	88.242	-0.267	0.978	2.433	3.678
	681	682	91.920	88.192		87.892	3.728	91.790	88.129		87.829	3.661	0.031	34.449	1.077	0.061			0.017	0.066	0.017	0.083	0.000	88.192	88.129	1.028	0.961	3.728	3.661
	682	683	91.790	88.079		87.779	3.711	90.750	87.094		86.794	3.656	0.031	231.955	7.254	0.170	0.026	0.170		1.235	0.196	1.431	0.000	88.079	87.094	1.011	0.956	3.711	3.656
KETTLEWELL WAY	687	683	90.940	87.646		87.346	3.294	90.750	87.084		86.784	3.666	0.031	180.446	5.643	0.061		0.061	0.063	0.346	0.124	0.470	0.000	87.646	87.084	0.594	0.966	3.294	3.666
WOLISTON CR.	683	684	90.750	87.094		86.644	3.656	88.680	85.496		85.046	3.184	0.027	185.696	5.073	0.313	0.047	0.313		1.588	0.360	1.948	0.000	87.094	85.496	0.956	0.484	3.656	3.184
PALTON ST.	689	685	88.900	86.185		85.810	2.715	88.810	85.855		85.480	2.955	0.029	144.357	4.191	0.033	0.005			0.140	0.005	0.145	0.000	86.185	85.855	0.015	0.255	2.715	2.955
	685	684	88.810	85.855		85.480	2.955	88.680	85.466		85.091	3.214	0.029	170.079	4.938	0.006		0.006	0.006	0.031	0.013	0.044	0.044	85.855	85.496	0.255	0.484	2.955	3.184
WOLISTON CR.	684	670	88.680	85.496		84.971	3.184	87.200	84.115		83.590	3.085	0.026	157.855	4.097	0.092		0.092	0.094	0.376	0.186	0.562	0.562	85.496	84.816	0.484	-0.316	3.184	2.384
FLAMBOROUGH WAY	670	671	87.200	84.160		83.410	3.040	87.130	83.938		83.188	3.193	0.023	116.798	2.691	0.032	0.005	0.032		0.086	0.037	0.123	0.123	84.816	84.693	-0.316	-0.263	2.384	2.437
	671	672	87.130	83.968		83.068	3.162	87.200	83.804		82.904	3.396	0.022	119.204	2.585	0.023	0.004	0.023		0.061	0.027	0.088	0.088	84.693	84.606	-0.263	-0.106	2.437	2.594
	672	101	87.200	83.884		82.534	3.316	87.100	83.496		82.146	3.604	0.019	57.743	1.094	0.312		0.312	0.319	0.342	0.631	0.973	0.973	84.606	83.633	-0.106	0.767	2.594	3.467
12-D BLK 248	Hydro Ea.	906																											
12D GOWARD DRIVE	908	907	102.20	99.400		98.943	2.80	101.34	98.224		97.767	3.12	0.027	244.969	6.693	0.176	0.026	0.176		1.178	0.202	1.380	0.000	99.400	98.224	0.398	0.714	2.800	3.116
	907	906	101.34	98.197	0.03	97.664	3.14	100.70	97.738		97.204	2.96	0.026	215.354	5.589	0.091	0.014	0.091		0.507	0.104	0.612	0.000	98.197	97.738	0.741	0.561	3.143	2.963
12D ISHPATINA CRESCENT	804	801	100.96	98.060		97.755	2.90	100.96	97.990		97.685	2.97	0.031	57.185	1.788	0.000				0.000	0.000	0.000	0.000	[illegible]	97.990	0.498	0.568	2.900	2.970
	801	906	100.96	97.950	0.04	97.645	3.01	100.70	97.712		97.407	2.99	0.031	195.210	6.105	0.000				0.000	0.000	0.000	0.000	[illegible]	97.712	0.608	0.586	3.010	2.988
12D BLK 246	705	704																											
FINLAYSON CRESCENT	705	704	101.47	98.670		98.365	2.80	101.33	98.562		98.257	2.77	0.031	29.462	0.921	0.000				0.000	0.000	0.000	0.000	98.670	98.562	0.398	0.366	2.800	2.768
	704	701	101.33	98.522	0.04	98.217	2.81	100.77	98.026		97.721	2.74	0.031	135.630	4.242	0.130		0.130		0.553	0.130	0.683	0.000	98.522	98.026	0.406	0.342	2.808	2.744
	701	700	100.77	98.026		97.645	2.74	100.62	97.862		97.481	2.76	0.029	107.402	3.118	0.064			0.003	0.199	0.003	0.201	0.000	98.026	97.862	0.342	0.356	2.744	2.758
	700	906	100.62	97.712	0.15	97.331	2.91	100.70	97.662		97.281	3.04	0.029	33.412	0.970	0.065		0.065	0.066	0.063	0.131	0.194	0.000	97.712	97.662	0.506	0.636	2.908	3.038
12D GOWARD DRIVE	906	905	100.70	97.662		97.052	3.04	100.66	97.357		96.748	3.30	0.025	110.843	2.751	0.141	0.021			0.388	0.021	[illegible]	0.000	97.662	97.357	0.636	0.901	3.038	3.303
ISHPATINA CRESCENT	804	803	100.96	98.160		97.779	2.80	100.87	97.953		97.572	2.92	0.029	180.814	5.250	0.051			0.014	0.268	0.014	0.282	0.000	98.160	97.953	0.398	0.515	2.800	2.917
	803	802	100.87	97.913	0.04	97.532	2.96	100.86	97.878		97.497	2.98	0.029	31.181	0.905	0.052			0.014	0.047	0.014	0.061	0.000	97.913	97.878	0.555	0.580	2.957	2.982
	802	905	100.86	97.838	0.04	97.457	3.02	100.66	97.635		97.254	3.02	0.029	177.087	5.141	0.050		0.050	0.051	0.260	0.102	0.362	0.000	97.838	97.635	0.620	0.623	3.022	3.025

Connection at MH 907
U/S HGL = 98.225. D/S HGL = 98.197

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

min slope=
min vel = 0.8m/s

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

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OK w 2004 guidelines

CITY OF OTTAWA

MINTO DEVELOPMENTS INC.

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

Proposed road ℄ elev.

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

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

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

12D = 8.462ha   Σ = 15.949ha

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

$\Sigma = 8.885ha$

Total area = 24.837ha

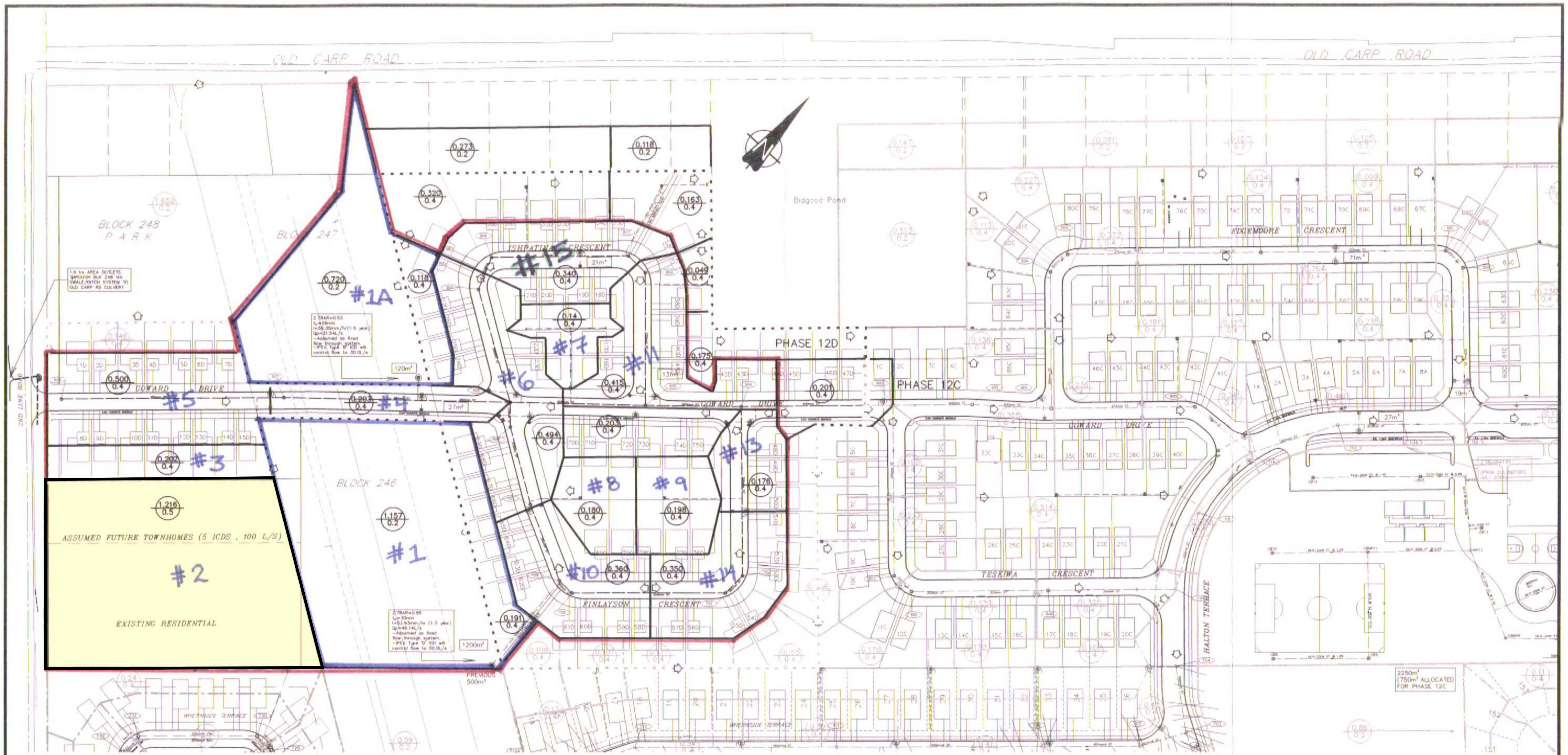
CITY OF OTTAWA
MORGAN'S GRANT PHASE 12D SUBDIVISION
MINTO DEVELOPMENTS INC.

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

JLR Project No. 17732

STORMWATER STORAGE / OVERFLOW BALANCE TABLE

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



= MAJOR OVERLAND FLOW IS ROUTED TO HYDRO EASEMENT

LEGEND

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

3	26/08/05	ISSUED WITH 12D SWM REPORT	L.J.
2	11/07/05	REVISED PER CITY COMMENTS	L.J.
1	11/05/05	ISSUED FOR MOE APPROVAL	L.J.

SCALE 1:1000 (0 10m 20m 30m 40m)

J.L.Richards
ENGINEERS ARCHITECTS PLANNERS

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

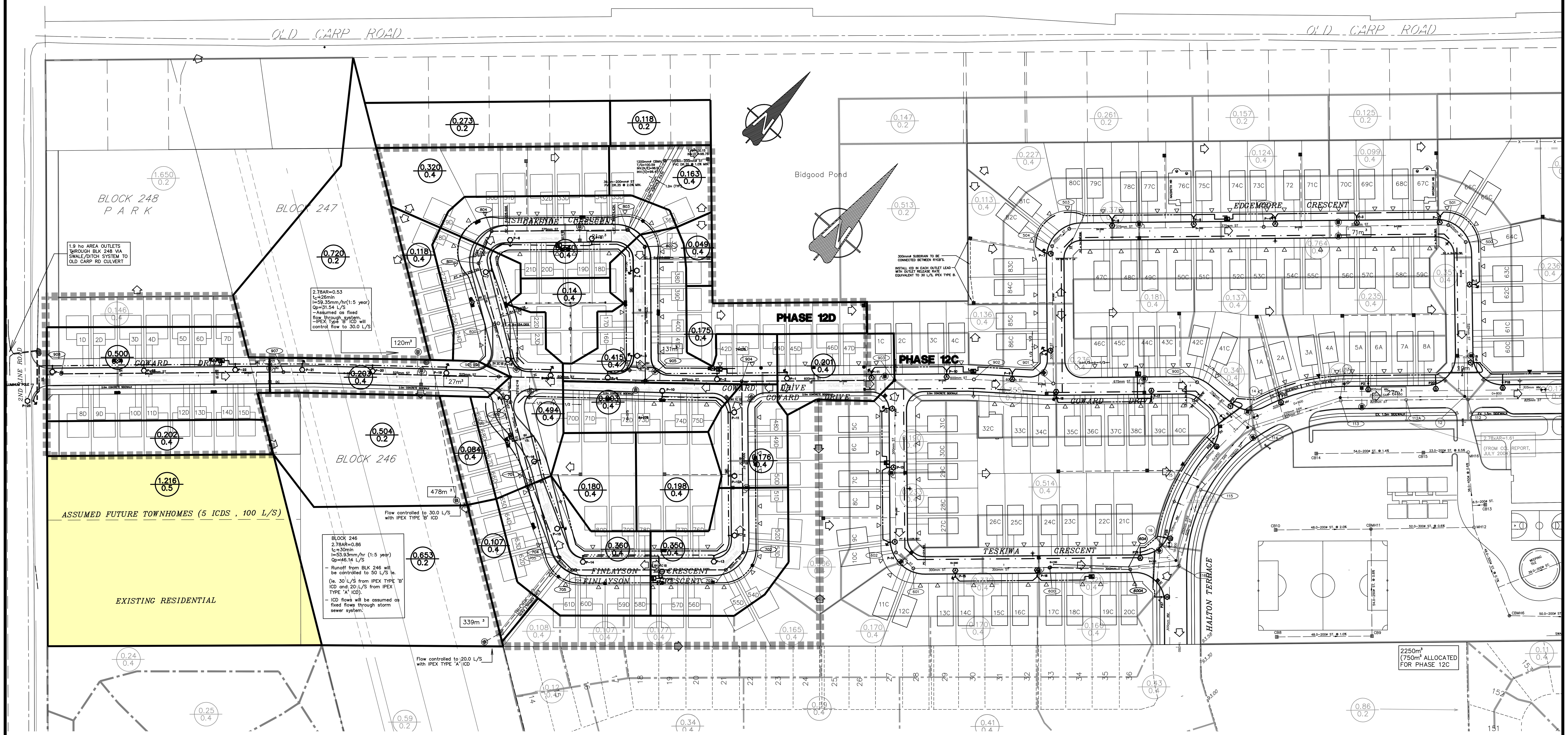
DESIGN J.B.
CHECKED L.J.
DRAWN A.M.
CHECKED
APPROVED

Ottawa

minto

MORGAN'S GRANT
PHASE 12D
STORM DRAINAGE PLAN

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



LEGEND

EXISTING CATCH BASIN

PROPOSED CATCH BASIN

INTERCONNECTED ROADWAY CB C/W ONE 19.8L/S IPEX TYPE 'A' ICD OR CITY APPROVED EQUIVALENT

CATCH BASIN WITH INDIVIDUAL 19.8 L/S IPEX TYPE 'A' ICD OR CITY APPROVED EQUIVALENT

PROPOSED HYDRANT

EXISTING HYDRANT

PHASING LIMITS

EXISTING STORM SEWER & MANHOLE

PROPOSED STORM SEWER & MANHOLE

PROPOSED CATCH BASIN & LEAD

8 LOT NUMBER

PROPOSED OVERLAND DRAINAGE

DRAINAGE AREA LIMITS

0.220 EXISTING AREA IN HECTARES
0.4 'R' RUNOFF COEFFICIENT

0.350 PROPOSED AREA IN HECTARES
0.4 'R' RUNOFF COEFFICIENT

1300m³ PONDING VOLUME

RECORD DRAWING
PRODUCED FROM INFORMATION PROVIDED BY FIELD INSPECTOR
date: MAY 03, 2013
J.L. RICHARDS & ASSOCIATES LIMITED

V:\17732.DS\PHASE 12D\17732 C D-ST 7PH12D.dwg

No.	Date	Revision	By
6	03/05/13	RECORD DRAWING	L.J.
4	18/10/05	REVISED PER HYDRO ONE COMMENTS	L.J.
3	26/08/05	ISSUED WITH 12D SWM REPORT	L.J.
2	11/07/05	REVISED PER CITY COMMENTS	L.J.
1	11/05/05	ISSUED FOR MOE APPROVAL	LJ

SCALE
0 10m 20m 30m 40m
1:1000

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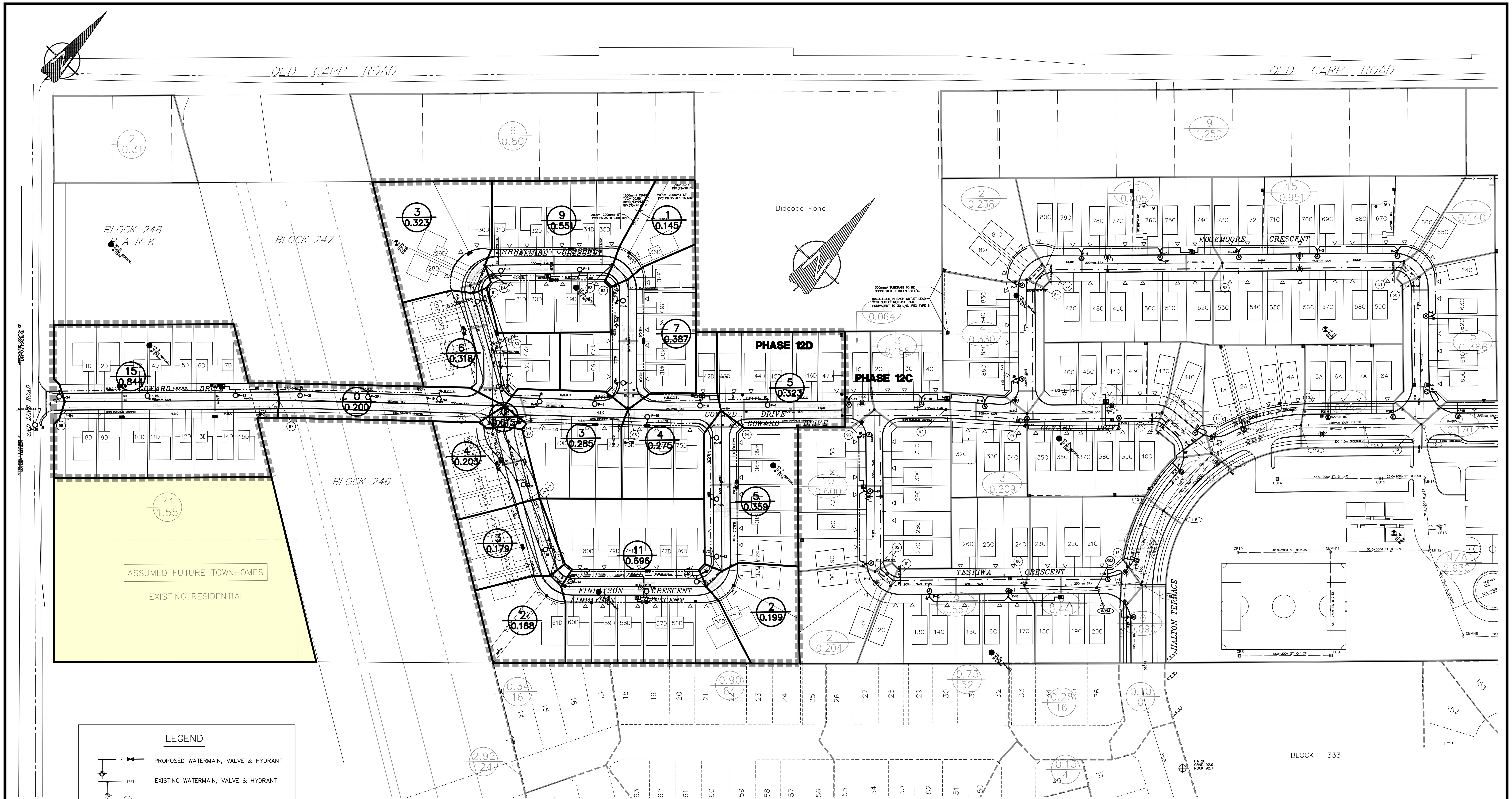
MORGAN'S GRANT
PHASE 12D
STORM DRAINAGE PLAN

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



LEGEND

PROPOSED WATERMAIN, VALVE & HYDRANT

EXISTING WATERMAIN, VALVE & HYDRANT

EXISTING SANITARY SEWER & MANHOLE

PROPOSED SANITARY SEWER & MANHOLE

45D — LOT NUMBER

EXISTING DRAINAGE BOUNDARY

25 — EXISTING NUMBER OF UNITS

0.810 — EXISTING AREA IN HECTARES

PHASE 12D LIMITS

DRAINAGE BOUNDARY

3 — NUMBER OF UNITS

0.321 — AREA IN HECTARES

RECORD DRAWING

PRODUCED FROM INFORMATION PROVIDED BY FIELD INSPECTOR

date: MAY 03, 2013

J.L. RICHARDS & ASSOCIATES LIMITED

3	03/05/13	RECORD DRAWING	L.J.
2	11/07/05	BUILDING FOOTPRINT REVISED	LJ
1	11/05/05	ISSUED FOR MOE APPROVAL	LJ

SCALE

0 10m 20m 30m 40m

HORIZONTAL 1:1000

J.L.Richards
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DESIGN J.B.

CHECKED L.J.

DRAWN M.B.

CHECKED

APPROVED

Ottawa

minto

MORGAN'S GRANT

PHASE 12D

SANITARY DRAINAGE PLAN

JOB. No. 17732

DATED AUGUST 2004

DWG. No. D-SAN 7

q (res) = 350 l/cap/day
q (com) = 50,000 l/ha/day
q (inst) = 50,000 l/ha/day
I = 0.280 l/s/ha
Singles = 4.0 pers / unit
Townhouses = 4.0 pers / unit

CITY OF KANATA

MORGAN'S GRANT MASTER SANITARY FLOWS
16087-01

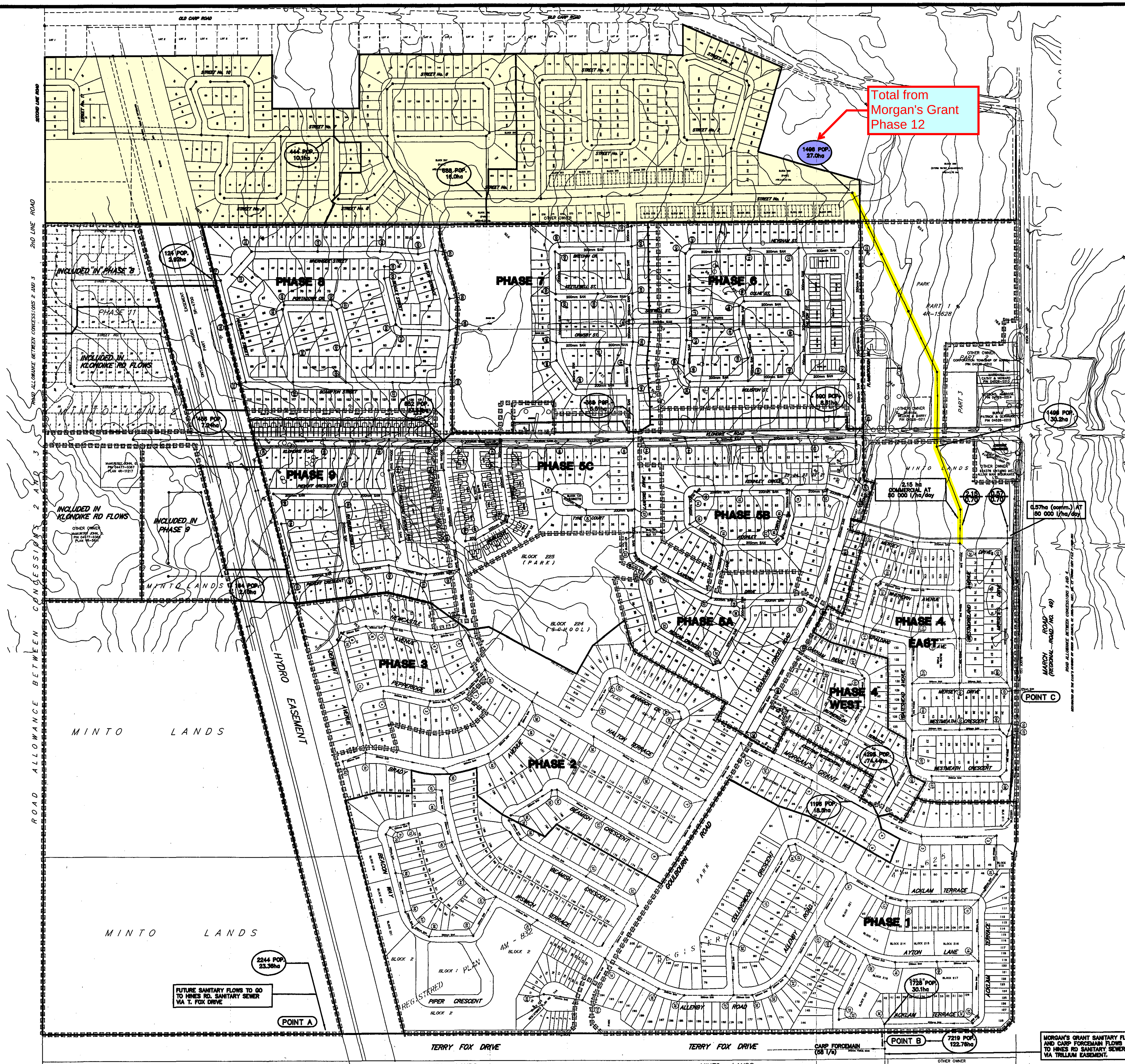
SANITARY SEWER DESIGN SHEET
(Revised: January 31, 2001)
Designed by: G.F.
Checked by: D.G.S.

STREET	M.H. # FROM	M.H. # TO	POPUL. people	AREA ha	CUMMULATIVE POPUL. people	CUMMULATIVE AREA ha	Peaking Factor	POPUL. FLOW l/s	INFIL. FLOW l/s	PEAK FLOW l/s	SEWER DATA DIA. mm	Slope %	CAPAC. l/s	VEL. m/s	LENGTH m	UPSTREAM Ex. Ground	Pr. Center Line	Fill	Obvert	Invert	Cover	DOWNSTREAM Ex. Ground	Pr. Center Line	Fill	Obvert	Invert	Cover	COMMENTS
HALTON TERRACE	152	151	20	0.51	20	0.51	4.00	0.32	0.14	0.47	200	3.00	56.80	1.81	68.60	94.900	95.250	0.35	91.339	91.139	3.91	91.800	92.600	0.80	89.281	89.081	3.32	EXISTING SEWER
PIEKOFF CR.	159	157	20	0.43	20	0.43	4.00	0.32	0.12	0.44	200	2.00	46.38	1.48	79.00	98.500	99.800	1.30	95.718	95.518	4.08	97.600	98.500	0.90	94.138	93.938	4.36	PREVIOUSLY SUBMITTED FOR C. OF A.
U/S Areas West & incl. Hydro Easement (Easement (0.5 ha) & Residential (2.10 ha)		157	164	2.60	164	2.60	4.00	2.66	0.73	3.39	200	0.60	25.40	0.81	3.00													FUTURE SEWER
PIEKOFF CR.	157	156	20	0.41	204	3.44	4.00	3.31	0.96	4.27	200	0.60	25.40	0.81	81.10	97.650	98.500	0.85	94.093	93.893	4.41	96.600	97.800	1.20	93.606	93.406	4.19	PREVIOUSLY SUBMITTED FOR C. OF A.
RAYBURN ST.	162	156	40	0.65	40	0.65	4.00	0.65	0.18	0.83	200	0.70	27.44	0.87	98.90	97.700	98.350	0.65	94.392	94.192	3.96	96.600	97.800	1.20	93.700	93.500	4.10	PREVIOUSLY SUBMITTED FOR C. OF A.
PIEKOFF CR.	156	154	28	0.38	272	4.47	4.00	4.41	1.25	5.66	200	2.00	46.38	1.48	59.50	96.600	97.800	1.20	93.606	93.406	4.19	95.300	93.600	-1.70	92.416	92.216	1.18	PREVIOUSLY SUBMITTED FOR C. OF A.
	154	153	32	0.54	304	5.01	4.00	4.93	1.40	6.33	200	3.00	56.80	1.81	56.20	95.300	93.600	-1.70	92.298	92.098	1.30	94.500	94.700	0.20	90.612	90.412	4.09	PREVIOUSLY SUBMITTED FOR C. OF A.
	153	151	8	0.23	312	5.24	4.00	5.06	1.47	6.52	200	3.00	56.80	1.81	49.20	94.500	94.700	0.20	90.576	90.376	4.12	93.100	93.100	0.00	89.100	88.900	4.00	PREVIOUSLY SUBMITTED FOR C. OF A.
HALTON TERRACE	151	150	0	0.00	332	5.75	4.00	5.38	1.61	6.99	200	0.60	25.40	0.81	41.4	91.800	92.600	0.80	88.481	88.281	4.12	90.800	92.000	1.20	88.233	88.033	3.77	EXISTING SEWER
	150	149	120	0.86	452	6.61	4.00	7.32	1.85	9.17	200	0.60	25.40	0.81	112.80	90.800	92.000	1.20	88.233	88.033	3.77	90.650	91.730	1.08	87.556	87.356	4.17	EXISTING SEWER
	149	148	28	0.24	480	6.85	3.98	7.75	1.92	9.66	200	0.60	25.40	0.81	40.6	90.650	91.730	1.08	87.556	87.356	4.17	91.000	91.800	0.80	87.312	87.112	4.49	EXISTING SEWER
UPSTREAM OF MH 714 (West)		214	124	2.92	124	2.92	4.00	2.01	0.82	2.83	200	0.70	27.44	0.87	95.00													FUTURE SEWER PHASE 8
HASLEMERE ST.	214	215	12	0.24	136	3.16	4.00	2.20	0.88	3.09	200	0.70	27.44	0.87	66.50													FUTURE SEWER PHASE 8
	215	216	16	1.67	152	4.83	4.00	2.46	1.35	3.82	200	0.72	27.83	0.89	90.00													FUTURE SEWER PHASE 8
SCAMPTON ST.	216	218	36	0.46	188	5.29	4.00	3.05	1.48	4.53	200	0.80	29.33	0.93	70.00													FUTURE SEWER PHASE 8
PORTADOWN CR.	220	219	32	0.46	32	0.46	4.00	0.52	0.13	0.65	200	1.62	41.74	1.33	66.00													FUTURE SEWER PHASE 8
	219	218	0	0.11	32	0.57	4.00	0.52	0.16	0.68	200	0.25	16.40	0.52	42.00													FUTURE SEWER PHASE 8
SCAMPTON ST.	218	225	40	0.52	260	6.38	4.00	4.21	1.79	6.00	200	1.50	40.17	1.28	80.50													FUTURE SEWER PHASE 8
PORTADOWN CR.	221	222	20	0.38	20	0.38	4.00	0.32	0.11	0.43	200	2.60	52.88	1.68	67.00													FUTURE SEWER PHASE 8
	222	223	4	0.10	24	0.48	4.00	0.39	0.13	0.52	200	1.20	35.93	1.14	8.50													FUTURE SEWER PHASE 8
	223	224	32	0.44	56	0.92	4.00	0.91	0.26	1.17	200	1.20	35.93	1.14	58.00													FUTURE SEWER PHASE 8
	224	225	8	0.26	64	1.18	4.00	1.04	0.33	1.37	200	0.52	23.65	0.75	56.00													FUTURE SEWER PHASE 8
SCAMPTON ST.	225	227	36	0.49	360	8.05	4.00	5.83	2.25	8.09	200	1.87	44.85	1.43	70.50													FUTURE SEWER PHASE 8
	227	200	28	0.44	388	8.49	4.00	6.29	2.38	8.66	200	1.00	32.80	1.04	74.00													FUTURE SEWER PHASE 8
WHERNSIDE ST.	213	212	24	0.62	24	0.62	4.00	0.39	0.17	0.56	200	0.35	19.40	0.62	52.00													FUTURE SEWER PHASE 8
	212	211	52	0.71	76	1.33	4.00	1.23	0.37	1.60	200	1.44	39.35	1.25	97.00													FUTURE SEWER PHASE 8
	211	206	60	0.78	136	2.11	4.00	2.20	0.59	2.79	200	2.70	53.89	1.72	97.00													FUTURE SEWER PHASE 8
	206	205	16	0.32	152	2.43	4.00	2.46	0.68	3.14	200	3.49	61.27	1.95	53.50													FUTURE SEWER PHASE 8
	205	203	0	0.11	152	2.54	4.00	2.46	0.71	3.17	200	3.26	59.21	1.88	24.50													FUTURE SEWER PHASE 8
HALTON TERRACE	203	202	16	0.35	168	2.89	4.00	2.72	0.81	3.53	200	0.48	22.72	0.72	76.50													FUTURE SEWER PHASE 8
	202	201	8	0.19	176	3.08	4.00	2.85	0.86	3.71	200	0.68	27.04	0.86	47.50													FUTURE SEWER PHASE 8
BEAULY ST.	207	208	8	0.13	8	0.13	4.00	0.13	0.04	0.17	200	0.35	19.40	0.62	25.00													FUTURE SEWER PHASE 8
	208	209	28	0.51	36	0.64	4.00	0.58	0.18	0.76	200	0.76	28.59	0.91	70.50													FUTURE SEWER PHASE 8
	209	210	8	0.17	44	0.81	4.00	0.71	0.23	0.94	200	0.76	28.59	0.91	10.00													FUTURE SEWER PHASE 8
	210	201	16	0.34	60	1.15	4.00	0.97	0.32	1.29	200	1.30	37.39	1.19	75.00													FUTURE SEWER PHASE 8
HALTON TERRACE	201	200	16	0.32	252	4.55	4.00	4.08	1.27	5.36	200	0.92	31.46	1.00	79.50													FUTURE SEWER PHASE 8
HALTON TERRACE	200	148	0	0.21	640	13.25	3.92	10.15	3.71	13.86	200	1.10	34.40	1.09	80.00													FUTURE SEWER PHASE 8
Upstream Areas West of Hydro Easement		167	456	13.01	456	13.01	3.99	7.38	3.64	11.02	250	2.00	84.09	1.71	100.00													FUTURE SEWER
KLONDIKE RD.	167	166	92	0.84	548	13.85	3.95	8.78	3.88	12.65	250	2.20	88.20	1.80	100.00	101.700	101.900	0.20	97.580	97.330	4.32	99.200	99.600	0.40	95.380	95.130	4.22	PREVIOUSLY SUBMITTED FOR C. OF A.
	166	165	88	0.80	636	14.65	3.92	10.09	4.10	14.20	250	4.00	118.92	2.42	97.50	99.200	99.600	0.40	94.780	94.530	4.82	94.400	95.000	0.60	90.880	90.630	4.12	PREVIOUSLY SUBMITTED FOR C. OF A.
PIEKOFF CR.	160	161	48	0.69	48	0.69	4.00	0.78	0.19	0.97	200	2.20	48.62	1.55	102.10	91.450	100.260	8.81	96.844	96.644	3.42	97.700	98.500	0.80	94.600	94.400	3.90	PREVIOUSLY SUBMITTED FOR C. OF A.
	161	163	20	0.34	68	1.03	4.00	1.10	0.29	1.39	200	4.50	69.57	2.21	79.10	97.700	98.500	0.80	94.600	94.400	3.90	93.100	94.800	1.70	91.041	90.841	3.76	PREVIOUSLY SUBMITTED FOR C. OF A.
WALLSEND AVE.	155	163	80	0.54	80	0.54	4.00	1.30	0.15	1.45	200	0.60	25.40	0.81	70.70	94.600	95.350	0.75	91.504	91.304	3.85	93.100	94.900	1.80	91.080	90.880	3.82	PREVIOUSLY SUBMITTED FOR C. OF A.
WALLSEND AVE.	163	164	16	0.15	164	1.72	4.00	2.66	0.48	3.14	200	0.60	25.40	0.81	34.00	93.100	94.900	1.80	90.984	90.784	3.92	93.400	94.600	1.20	90.780	90.580	3.82	PREVIOUSLY SUBMITTED FOR C. OF A.
	164	165	16	0.18	180	1.90	4.00	2.92	0.53	3.45	200	0.60	25.40	0.81	46.70	93.400	94.600	1.20	90.780	90.580	3.82	94.400	95.000	0.60	90.500	90.300	4.50	PREVIOUSLY SUBMITTED FOR C. OF A.
KLONDIKE RD.	165	165A	40	0.35	856	16.90	3.84	13.32	4.73	18.06	250	4.30	123.30	2.51	59.30	94.400	95.000	0.60	90.280	90.030	4.72	91.800	91.800	0.00	87.730	87.480	4.07	PREVIOUSLY SUBMITTED FOR C. OF A.
	165A	148	0	0.00	856	16.90	3.84	13.32	4.73	18.06	250	0.40	37.61	0.77	21.00	91.800	91.800	0.00	87.134	86.884	4.67	91.700	91.800	0.10	87.050	86.800	4.75	PREVIOUSLY SUBMITTED FOR C. OF A.
KLONDIKE RD.	148	147	43	0.28	2019	37.28	3.58	29.30	10.44	39.74	300	0.40	61.15	0.87	85.3	91.700	91.800	0.10	87.016	86.716	4.78	91.400	91.600	0.20	86.675	86.375	4.93	EXISTING SEWER

STREET	M.H. # FROM	M.H. # TO	POPUL. people	AREA ha	CUMMULATIVE POPUL. people	CUMMULATIVE AREA ha	Peaking Factor	POPUL. FLOW l/s	INFIL. FLOW l/s	PEAK FLOW l/s	SEWER DATA DIA. mm	Slope %	CAPAC. l/s	VEL. m/s	LENGTH m	UPSTREAM Ex. Ground	Pr. Center Line	Fill	Obvert	Invert	Cover	DOWNSTREAM Ex. Ground	Pr. Center Line	Fill	Obvert	Invert	Cover	COMMENTS
WIMBLEDON ST.	48A	48	12	0.13	12	0.13	4.00	0.19	0.04	0.23	200	1.00	32.80	1.04	15.0	90.600	91.673	1.07	88.213	88.013	3.46	90.550	91.566	1.02	88.063	87.863	3.50	EXISTING SEWER
	48	47	28	0.38	40	0.51	4.00	0.65	0.14	0.79	200	0.60	25.40	0.81	53.3	90.550	91.566	1.02	88.033	87.833	3.53	90.200	91.400	1.20	87.713	87.513	3.69	EXISTING SEWER
	47	46	12	0.04	52	0.55	4.00	0.84	0.15	1.00	200	0.60	25.40	0.81	9.1	90.200	91.400	1.20	87.683	87.483	3.72	90.200	91.430	1.23	87.628	87.428	3.80	EXISTING SEWER
	46	45	80	0.61	132	1.16	4.00	2.14	0.32	2.46	200	0.60	25.40	0.81	71.9	90.200	91.430	1.23	87.598	87.398	3.83	90.350	91.470	1.12	87.167	86.967	4.30	EXISTING SEWER
	45	147	16	0.17	148	1.33	4.00	2.40	0.37	2.77	200	0.60	25.40	0.81	41.0	90.350	91.470	1.12	87.167	86.967	4.30	91.000	91.600	0.60	86.921	86.721	4.68	EXISTING SEWER
KLONDIKE RD.	147	146	24	0.54	2191	39.15	3.55	31.55	10.96	42.51	300	0.40	61.15	0.87	98.5	91.000	91.600	0.60	86.675	86.375	4.92	91.250	91.650	0.40	86.281	85.981	5.37	EXISTING SEWER
	146	145	44	0.52	2235	39.67	3.55	32.12	11.11	43.23	300	0.60	74.90	1.06	96.8	91.250	91.650	0.40	86.281	85.981	5.37	89.900	90.400	0.50	85.700	85.400	4.70	EXISTING SEWER
PENRITH ST.	207	206	12	0.17	12	0.17	4.00	0.19	0.05	0.24	200	1.00	32.80	1.04	31.0	89.560	90.500	0.94	87.555	87.355	2.95	89.350	90.700	1.35	87.245	87.045	3.45	FUTURE SEWER PHASE 7
BRECHIN ST	205	206	60	0.73	60	0.73	4.00	0.97	0.20	1.18	200	2.30	49.74	1.58	105.8	91.600	93.040	1.44	90.440	90.240	2.60	89.350	90.700	1.35	88.007	87.807	2.69	FUTURE SEWER PHASE 7
PENRITH ST	206	201	20	0.35	92	1.25	4.00	1.49	0.35	1.84	200	0.60	25.40	0.81	69.50	89.350	90.700	1.35	87.245	87.045	3.46	89.910	91.900	1.99	86.828	86.628	5.07	FUTURE SEWER PHASE 7
BRECHIN ST.	204	203	24	0.40	24	0.40	4.00	0.39	0.11	0.50	200	1.00	32.80	1.04	61.4	91.790	93.070	1.28	90.470	90.270	2.60	92.000	93.100	1.10	89.856	89.656	3.24	FUTURE SEWER PHASE 7
WOLISTON ST.	203	202	32	0.38	56	0.78	4.00	0.91	0.22	1.13	200	1.07	33.92	1.08	64.0	92.000	93.100	1.10	89.816	89.616	3.28	91.160	92.460	1.30	89.131	88.931	3.33	FUTURE SEWER PHASE 7
	202	201	24	0.28	80	1.06	4.00	1.30	0.30	1.59	200	1.03	33.28	1.06	50.0	91.160	92.460	1.30	89.091	88.891	3.37	89.910	91.900	1.99	88.576	88.376	3.32	FUTURE SEWER PHASE 7
PENRITH ST.	201	192	16	0.38	188	2.69	4.00	3.05	0.75	3.80	200	0.60	25.40	0.81	71.50	89.910	91.900	1.99	86.828	86.628	5.07	90.700	92.200	1.50	86.399	86.199	5.80	FUTURE SEWER PHASE 7
BRECHIN ST.	196	198	12	0.20	12	0.20	4.00	0.19	0.06	0.25	200	0.40	20.74	0.66	29.8	91.790	92.820	1.03	90.220	90.020	2.60	91.750	93.100	1.35	90.101	89.901	3.00	FUTURE SEWER PHASE 7
BRECHIN ST	200	198	20	0.31	20	0.31	4.00	0.32	0.09	0.41	200	0.90	31.11	0.99	65.1	92.000	93.100	1.10	90.500	90.300	2.60	91.750	93.100	1.35	89.914	89.714	3.19	FUTURE SEWER PHASE 7
ORMSBY ST.	198	197	28	0.33	60	0.84	4.00	0.97	0.24	1.21	200	1.40	38.80	1.24	64.00	91.750	93.100	1.35	89.974	89.674	3.23	91.240	92.500	1.26	88.978	88.778	3.52	FUTURE SEWER PHASE 7
	197	192	24	0.28	84	1.12	4.00	1.36	0.31	1.67	200	1.00	32.80	1.04	49.9	91.240	92.500	1.26	88.938	88.738	3.56	90.700	92.200	1.50	88.439	88.239	3.76	FUTURE SEWER PHASE 7
PENRITH ST.	192	193	8	0.15	280	3.96	4.00	4.54	1.11	5.65	200	0.60	25.40	0.81	34.90	90.700	92.200	1.50	86.369	86.169	5.83	91.000	91.700	0.70	86.160	85.960	5.54	FUTURE SEWER PHASE 7
	193	194	8	0.15	288	4.11	4.00	4.67	1.15	5.82	200	0.60	25.40	0.81	35.1	91.000	91.700	0.70	86.129	85.929	5.57	91.000	92.200	1.20	85.918	85.718	6.28	FUTURE SEWER PHASE 7
BRECHIN ST.	196	195	16	0.47	16	0.47	4.00	0.26	0.13	0.39	200	0.80	29.33	0.93	42.1	91.810	92.930	1.12	90.330	90.130	2.60	89.900	91.400	1.50	89.993	89.793	1.41	FUTURE SEWER PHASE 7
	195	194	44	0.63	60	1.10	4.00	0.97	0.31	1.28	200	0.90	31.11	0.99	85.2	89.900	91.400	1.50	89.953	89.753	1.45	91.000	92.200	1.20	89.186	88.986	3.01	FUTURE SEWER PHASE 7
PENRITH ST.	194	145	20	0.30	368	5.51	4.00	5.96	1.54	7.51	250	0.40	37.56	0.77	73.30	91.000	92.200	1.20	85.942	85.692	6.26	89.900	90.400	0.50	85.650	85.400	4.75	FUTURE SEWER PHASE 7
LAXFORD DR.	145	27	44	0.59	2647	45.77	3.49	37.40	12.82	50.22	300	0.40	61.15	0.87	103.60	89.900	90.400	0.50	85.672	85.372	4.73	89.950	91.000	1.05	85.258	84.958	5.74	EXISTING SEWER
STREET NO. 4	41	40	56	0.97	56	0.97	4.00	0.91	0.27	1.18	200	1.00	32.80	1.04	50.00	90.200	91.420	1.22	87.800	87.600	3.62	90.000	91.160	1.16	87.300	87.100	3.86	EXISTING SEWER
	40	27	16	0.29	72	1.26	4.00	1.17	0.35	1.52	200	1.00	32.80	1.04	72.00	90.000	91.160	1.16	86.626	86.426	4.53	89.950	91.000	1.05	85.906	85.706	5.09	EXISTING SEWER
LAXFORD DR.	27	Stub	16	1.88	2735	48.91	3.48	38.51	13.69	52.21	300	0.44	64.49	0.91	34.80	89.950	91.000	1.05	85.258	84.958	5.74	89.700	91.050	1.35	85.103	84.803	5.95	EXISTING SEWER
	Stub	26	0	0.00	2735	48.91	3.48	38.51	13.69	52.21	300	0.44	64.49	0.91	29.90	89.950	91.000	1.05	85.103	84.803	5.90	89.550	90.520	0.97	84.970	84.670	5.55	EXISTING SEWER
	26	25	0	0.05	2735	48.96	3.48	38.51	13.71	52.22	300	0.43	63.65	0.90	12.00	89.550	90.520	0.97	84.905	84.605	5.61	89.500	90.450	0.95	84.853	84.553	5.60	EXISTING SEWER
	25	24	8	1.99	2743	50.95	3.48	38.61	14.27	52.88	300	0.41	61.83	0.87	20.30	89.500	90.450	0.95	84.805	84.505	5.64	89.400	90.200	0.80	84.722	84.422	5.48	EXISTING SEWER
REDCAR CR.	33	34	40	0.58	40	0.58	4.00	0.65	0.16	0.81	200	0.60	25.40	0.81	79.3	89.400	90.400	1.00	86.846	86.646	3.55	89.500	90.350	0.85	86.370	86.170	3.98	EXISTING SEWER
	34	24	0	0.08	40	0.66	4.00	0.65	0.18	0.83	200	0.60	25.40	0.81	25.0	89.500	90.350	0.85	85.570	85.370	4.78	89.400	90.200	0.80	85.420	85.220	4.78	EXISTING SEWER
LAXFORD DR.	24	22	36	0.60	2819	52.21	3.47	39.57	14.62	54.19	300	0.40	61.15	0.87	95.1	89.400	90.200	0.80	84.720	84.420	5.48	88.500	89.700	1.20	84.340	84.040	5.36	EXISTING SEWER
STREET No. 1 (PHASE 5B)	13	14	4	0.05	4	0.05	4.00	0.06	0.01	0.08	200	0.60	25.40	0.81	11.5	90.000	91.260	1.26	88.021	87.821	3.24	89.900	91.400	1.50	87.952	87.752	3.45	FUTURE PHASE 5B
	14	15	24	0.42	28	0.47	4.00	0.45	0.13	0.59	200	0.60	25.40	0.81	40.0	89.900	91.400	1.50	87.922	87.722	3.48	89.900	90.970	1.07	87.682	87.482	3.29	FUTURE PHASE 5B
	15	16	20	0.42	48	0.89	4.00	0.78	0.25	1.03	200	0.72	27.83	0.89	58.0	89.900	90.970	1.07	87.625	87.425	3.35	89.500	91.000	1.50	87.207	87.007	3.79	FUTURE PHASE 5B
LARK LANE	16	22	0	0.00	48	0.89	4.00	0.78	0.25	1.03	200	4.25	67.61	2.15	79.0	89.500	91.000	1.50	87.567	87.367	3.43	88.600	89.700	1.10	84.210	84.010	5.49	FUTURE PHASE 5B
LAXFORD DR.	22	21	12	0.31	2879	53.41	3.46	40.32	14.95	55.28	300	0.40	61.15	0.87	50.1	88.500	89.700	1.20	84.300	84.000	5.40	88.600	89.700	1.10	84.100	83.800	5.60	EXISTING SEWER
REDCAR CR.	33	32	60	0.66	60	0.66	4.00	0.97	0.18	1.16	200	1.46	39.64	1.26	97.5	89.400	90.400	1.00	86.624	86.424	3.78	87.350	89.350	2.00	85.200	85.000	4.15	EXISTING SEWER
	32	31	8	0.06	68	0.72	4.00	1.10	0.20	1.30	200	1.46	39.63	1.26	10.9	87.350	89.350	2.00	84.819	84.619	4.53	87.000	89.300	2.30	84.660	84.460	4.64	EXISTING SEWER
	31	30	28	0.55	96	1.27	4.00	1.56	0.36	1.91	200	0.58	24.98	0.80	73.4	87.000	89.300	2.30	84.626	84.426	4.67	88.250	88.900	0.65	84.200	84.000	4.70	EXISTING SEWER
	30	21	4	0.13	100	1.40	4.00	1.62	0.39	2.01	200	0.68	27.08	0.86	28.7	88.250	88.900	0.65	84.196	83.996	4.70	88.680	89.700	1.02	84.000	83.800	5.70	EXISTING SEWER
LAXFORD DR.	21	20	44	0.57	3023	55.38	3.44	42.12	15.51	57.63	300	0.81	87.02	1.23	87.2	88.600	89.300	0.70	83.916	83.616	5.38	87.400	86.750	-0.65	83.210	82.910	3.54	EXISTING SEWER
	20	138	0	0.00	3023	55.38	3.44	42.12	15.51	57.63	300	0.60	74.90	1.06	21.3	87.400	88.900	1.50	83.178	82.878	5.72	87.170	86.180	-0.99	83.050	82.750	3.13	EXISTING SEWER
KLONDIKE RD NORTH	144A	144	32	0.45	32	0.45	4.00	0.52	0.13	0.64	200	0.57	24.69	0.79	73.4	90.300	90.500	0.20	86.640	86.440	3.86	90.000	90.200	0.20	86.224	86.024	3.98	PHASE 5B
	144	143	68	0.77	100	1.22	4.00	1.62	0.34	1.96	200	1.22	36.16	1.15	100.0	90.000	90.200	0.20	86.224	86.024	3.98	88.200	88.400	0.20	85.008	84.808	3.39	PHASE 5B
GOULBOURN RD (PHASE 5B)	143	142A	40	0.42	140	1.64	4.00	2.27	0.46	2.73	200	1.83	44.33	1.41	82.0	88.200	88.400	0.20	85.008	84.808	3.39	87.000	87.300	0.30	83.510	83.310	3.79	PHASE 5B
	142A	142	24	0.37	164	2.01	4.00	2.66	0.56	3.22	200	1.75	43.42	1.38	69.0	87.000	87.300	0.30	83.510	83.310	3.79	85.500	85.700	0.20	82.300	82.100	3.40	PHASE 5B
HEYSHAM CR.	177	176	52	0.82	52	0.82	4.00	0.84	0.23	1.07	200	1.10	34.40	1.09	93.9	90.200	91.400	1.20	88.050	87.850	3.35	89.000	90.100	1.10	87.017	86.817	3.08	FUTURE SEWER PHASE 6
	176	175	4	0.11	56	0.93	4.00	0.91	0.26	1.17	200	1.10	34.40	1.09	11.0	89.000	90.100	1.10	86.967	86.767	3.13	89.000	90.150	1.15	86.846	86.646	3.30	FUTURE SEWER PHASE 6
	175	174	48	0.69	104	1.62	4.00	1.69	0.45	2.14	200	1.10	34.40	1.09	89.80	89.000	90.150	1.15	86.796	86.596	3.35	88.050	89.190	1.14	85.808	85.608	3.38	FUTURE SEWER PHASE 6
	174	173	36	0.49	140	2.11	4.00	2.27	0.59	2.86	200	1.10	34.40	1.09	69.70	88.050	89.190	1.14	85.808	85.608	3.38	87.200	88.400	1.20	85.041	84.841	3.36	FUTURE SEWER PHASE 6
PALTON ST.	189	173	24	0.28	24	0.28	4.00	0.39	0.08	0.47	200	1.05	33.61	1.07	78.50													FUTURE SEWER PHASE 6
HEYSHAM CR.	173	172	48	0.43	212	2.82	4.00	3.44	0.79	4.22	200	1.50	40.18	1.28	80.30	87.200	88.400	1.20	85.041	84.841	3.36	86.000	87.200	1.20	83.836	83.636	3.36	FUTURE SEWER PHASE 6
FLAMBOROUGH WAY	172	171	40	0.48	252	3.30	4.00	4.08	0.92	5.01	250	0.40	37.61	0.77	81.90	86.000	87.200	1.20	83.274	83.024	3.93	85.840	87.130	1.29	82.946	82.696	4.18	FUTURE SEWER PHASE 6
	171	170	32	0.41	284	3.71	4.00	4.60	1.04	5.64	250	0.40	37.61	0.77	90.00	85.840	87.130	1.29	82.946	82.696	4.18	85.430	87.200	1.77	82.586	82.336	4.61	FUTURE SEWER PHASE 6

STREET	M.H. # FROM	M.H. # TO	POPUL. people	AREA ha	CUMMULATIVE POPUL. people	CUMMULATIVE AREA ha	Peaking Factor	POPUL. FLOW l/s	INFIL. FLOW l/s	PEAK FLOW l/s	SEWER DATA DIA. mm	Slope %	CAPAC. l/s	VEL. m/s	LENGTH m	UPSTREAM Ex. Ground	Pr. Center Line	Fill	Obvert	Invert	Cover	DOWNSTREAM Ex. Ground	Pr. Center Line	Fill	Obvert	Invert	Cover	COMMENTS
HEYSHAM CR.	177	179	12	0.19	12	0.19	4.00	0.19	0.05	0.25	200	0.60	25.42	0.81	32.90	90.200	91.400	1.20	88.050	87.850	3.35	90.500	91.160	0.66	87.852	87.652	3.31	FUTURE SEWER PHASE 6
	179	180	20	0.30	32	0.49	4.00	0.52	0.14	0.66	200	0.60	25.40	0.81	38.00	90.500	91.160	0.66	87.822	87.622	3.34	90.890	91.770	0.88	87.594	87.394	4.18	FUTURE SEWER PHASE 6
	180	181	4	0.08	36	0.57	4.00	0.58	0.16	0.74	200	0.60	25.36	0.81	16.30	90.890	91.770	0.88	87.564	87.364	4.21	91.000	91.980	0.98	87.467	87.267	4.51	FUTURE SEWER PHASE 6
	181	182	8	0.26	44	0.83	4.00	0.71	0.23	0.95	200	0.60	25.40	0.81	10.40	91.000	91.980	0.98	87.417	87.217	4.56	90.970	91.840	0.87	87.355	87.155	4.49	FUTURE SEWER PHASE 6
	182	183	48	0.72	92	1.55	4.00	1.49	0.43	1.92	200	1.40	38.80	1.24	86.10	90.970	91.840	0.87	87.305	87.105	4.53	89.590	89.740	0.15	86.100	85.900	3.64	FUTURE SEWER PHASE 6
COLNE COURT	187	187A	24	0.46	24	0.46	4.00	0.39	0.13	0.52	200	0.60	25.40	0.81	44.30													FUTURE SEWER PHASE 6
	187A	183	0	0.00	24	0.46	4.00	0.39	0.13	0.52	200	0.60	25.40	0.81	34.00													FUTURE SEWER PHASE 6
HEYSHAM CR.	183	184	40	0.58	156	2.59	4.00	2.53	0.73	3.25	200	1.80	44.00	1.40	76.70	89.590	89.740	0.15	85.951	85.751	3.79	87.300	88.600	1.30	84.570	84.370	4.03	FUTURE SEWER PHASE 6
COLNE COURT	187	188	8	0.18	8	0.18	4.00	0.13	0.05	0.18	200	1.40	38.82	1.24	32.60				86.800	86.600					86.343	86.143		FUTURE SEWER PHASE 6
	188	188A	8	0.20	16	0.38	4.00	0.26	0.11	0.37	200	1.42	39.08	1.24	11.00				86.293	86.093					86.137	85.937		FUTURE SEWER PHASE 6
	188A	189	40	0.52	56	0.90	4.00	0.91	0.25	1.16	200	1.02	33.12	1.05	81.50				86.091	85.891					85.260	85.060		FUTURE SEWER PHASE 6
PALTON ST.	189	185	36	0.33	92	1.23	4.00	1.49	0.34	1.84	200	0.60	25.40	0.81	55.00				85.200	85.000					84.870	84.670		FUTURE SEWER PHASE 6
	185	184	24	0.36	116	1.59	4.00	1.88	0.45	2.32	200	0.60	25.40	0.81	61.80				84.870	84.670					84.499	84.299		FUTURE SEWER PHASE 6
HEYSHAM CR.	184	170	44	0.57	316	4.75	4.00	5.12	1.33	6.45	200	1.80	44.00	1.40	80.30	87.300	88.600	1.30	84.445	84.245	4.15	85.430	87.130	1.70	83.000	82.800	4.13	FUTURE SEWER PHASE 6
FLAMBOROUGH WAY	170	142	0	0.15	600	8.61	3.93	9.56	2.41	11.97	250	0.40	37.61	0.77	82.90	85.430	87.130	1.70	82.586	82.336	4.54	85.500	85.700	0.20	82.254	82.004	3.45	FUTURE SEWER PHASE 6
GOULBOURN RD (PHASE 5B)	142	141	12	0.22	776	10.84	3.87	12.16	3.04	15.20	250	0.35	35.18	0.72	64.0	85.500	85.700	0.20	82.254	82.004	3.45	86.000	85.500	-0.50	82.030	81.780	3.47	PHASE 5B
	141	140	4	0.14	780	10.98	3.87	12.22	3.07	15.29	250	0.35	35.18	0.72	28.5	86.000	85.500	-0.50	82.000	81.750	3.50	86.000	85.800	-0.20	81.900	81.650	3.90	PHASE 5B
STREET No. 1 (PHASE 5B)	13	12	36	0.57	36	0.57	4.00	0.58	0.16	0.74	200	2.00	46.38	1.48	70.0	90.000	91.260	1.26	88.000	87.800	3.26	89.000	90.250	1.25	86.600	86.400	3.65	PHASE 5B
	12	11	36	0.51	72	1.08	4.00	1.17	0.30	1.47	200	2.00	46.38	1.48	70.0	89.000	90.250	1.25	86.600	86.400	3.65	88.000	89.400	1.40	85.200	85.000	4.20	PHASE 5B
STREET No. 1 (PHASE 5B)	16	17	44	0.70	44	0.70	4.00	0.71	0.20	0.91	200	2.00	46.38	1.48	79.0	89.500	91.000	1.50	86.580	86.380	4.42	88.100	89.500	1.40	86.000	85.800	3.50	PHASE 5B
	17	18	4	0.10	48	0.80	4.00	0.78	0.22	1.00	200	1.00	32.80	1.04	12.5	88.100	89.500	1.40	85.955	85.755	3.55	88.000	89.500	1.50	85.830	85.630	3.67	PHASE 5B
	18	19	12	0.20	60	1.00	4.00	0.97	0.28	1.25	200	1.00	32.80	1.04	35.0	88.000	89.500	1.50	85.800	85.600	3.70	88.000	89.500	1.50	85.450	85.250	4.05	PHASE 5B
	19	11	0	0.15	60	1.15	4.00	0.97	0.32	1.29	200	0.60	25.40	0.81	38.0	88.000	89.200	1.20	85.428	85.228	3.77	88.000	89.400	1.40	85.200	85.000	4.20	PHASE 5B
STREET No. 1 (PHASE 5B)	11	10	28	0.35	160	2.58	4.00	2.59	0.72	3.31	200	3.80	63.93	2.03	56.0	88.000	89.400	1.40	85.128	84.928	4.27	86.600	87.000	0.40	83.000	82.800	4.00	PHASE 5B
	10	140	0	0.00	160	2.58	4.00	2.59	0.72	3.31	200	2.00	46.38	1.48	34.0	86.600	87.000	0.40	82.555	82.355	4.45	86.000	85.800	-0.20	81.875	81.675	3.93	PHASE 5B
GOULBOURN RD (PHASE 5B)	140	139	24	0.46	964	14.02	3.81	14.88	3.93	18.80	250	0.35	35.18	0.72	81.0	86.000	85.800	-0.20	81.900	81.650	3.90	86.100	86.300	0.20	81.616	81.366	4.68	PHASE 5B
	139	138	48	0.59	1012	14.61	3.80	15.56	4.09	19.66	250	0.35	35.18	0.72	67.5	86.100	86.300	0.20	81.616	81.366	4.68	86.400	86.100	-0.30	81.380	81.130	4.72	PHASE 5B
GOULBOURN RD	138	137	4	0.35	4039	70.34	3.33	54.48	19.70	74.17	375	0.40	110.88	1.00	70.4	86.000	86.180	0.18	81.359	80.984	4.82	86.250	86.200	-0.05	81.077	80.702	5.12	EXISTING SEWER
GOULBOURN RD	135	136	48	0.66	48	0.66	4.00	0.78	0.18	0.96	200	1.39	38.60	1.23	72.2	88.200	88.300	0.10	84.200	84.000	4.10	86.200	86.450	0.25	83.200	83.000	3.25	EXISTING SEWER
	136	137	20	0.39	68	1.05	4.00	1.10	0.29	1.40	200	0.71	27.63	0.88	70.4	86.200	86.450	0.25	83.200	83.000	3.25	86.100	86.200	0.10	82.700	82.500	3.50	EXISTING SEWER
OAKHAM RIDGE	137	135			4107	71.39	3.32	55.29	19.99	75.28	375	0.40	110.88	1.00	48.0	86.200	86.200	0.00	81.018	80.643	5.18	85.000	85.000	0.00	80.826	80.451	4.17	EXISTING SEWER
	135	134	24	0.40	4131	71.79	3.32	55.57	20.10	75.67	375	0.40	110.88	1.00	61.1	84.200	85.050	0.85	80.826	80.451	4.2	81.900	83.110	1.21	80.582	80.207	2.5	EXISTING SEWER
	134	133	4	0.11	4135	71.90	3.32	55.62	20.13	75.75	375	0.40	110.88	1.00	5.6	81.900	83.110	1.21	80.541	80.166	2.6	81.850	83.000	1.15	80.519	80.144	2.5	EXISTING SEWER
	133	132	28	0.25	4163	72.15	3.32	55.95	20.20	76.15	375	0.40	110.88	1.00	42.9	81.850	83.000	1.15	80.480	80.105	2.5	81.500	82.450	0.95	80.308	79.933	2.1	EXISTING SEWER
	132	130	12	0.23	4175	72.38	3.32	56.09	20.27	76.36	375	0.40	110.88	1.00	45.6	81.500	82.450	0.95	80.307	79.932	2.1	81.800	82.850	1.05	80.125	79.750	2.7	EXISTING SEWER
	131	130	52	0.73	52	0.73	4.00	0.84	0.20	1.05	200	2.52	52.09	1.66	110.0	86.200	86.000	-0.20	82.850	82.650	3.1	81.800	82.850	1.05	80.075	79.875	2.8	EXISTING SEWER
	130	128	36	0.51	4263	73.62	3.31	57.13	20.61	77.75	450	0.20	127.49	0.80	96.2	81.800	82.850	1.05	80.125	79.675	2.7	80.900	81.980	1.08	79.933	79.483	2.0	EXISTING SEWER
	128	4	32	0.54	4295	74.16	3.31	57.51	20.76	78.28	450	0.17	117.54	0.74	62.8	80.900	81.980	1.08	79.903	79.453	2.1	82.100	82.150	0.05	79.796	79.346	2.4	EXISTING SEWER
Phases 1, 2, 3, 4w, 5, 6, 7, 8, 9 based on 4 pers/unit (Point B)	4	36	2924	48.60	7219	122.76	3.09	90.47	34.37	124.84	600	0.10	194.16	0.69														
Minto Lands West of Hydro Easement based on 4 pers/unit (Point A)		36	2244	23.36	2244	23.36	3.55	32.24	6.54	38.78																		
Total for Morgan's Grant Subdivision north of Terry Fox Drive (4 pers/unit) to Hines Rd San. sewer (Points A & B)	36				9463	146.12	2.98	114.18	40.91	155.09																		
Total for Morgan's Grant Subdivision north of Terry Fox Drive (3.05 pers/unit) to Hines Rd San. sewer (Points A & B)	36				7216	146.12	3.09	90.43	40.91	131.35																		
	122	121	24	0.38	24	0.38	4.00	0.39	0.11	0.50	200	3.78	63.76	2.03	63.5	83.500	84.450	0.95	80.400	80.200	4.0	80.900	81.820	0.92	78.000	77.800	3.8	
	121	120	24	0.28	48	0.66	4.00	0.78	0.18	0.96	200	2.53	52.17	1.66	68.0	80.900	81.820	0.92	77.900	77.700	3.9	79.400	80.270	0.87	76.179	75.979	4.1	
Comm (2.15 ha) + Res (27.0 ha)	120	117	328	32.68	1872	33.34	3.61	27.36	9.34	36.70	300	0.40	61.15	0.87	69.5	79.400	80.270	0.87	75.479	75.179	4.8	79.400	80.400	1.00	75.201	74.901	5.2	
	116	119	8	0.14	8	0.14	4.00	0.13	0.04	0.17	200	2.00	46.38	1.48	8.1	82.100	83.340	1.24	79.262	79.062	4.1	82.100	83.300	1.20	79.100	78.900	4.2	
	119	118	24	0.22	32	0.36	4.00	0.52	0.10	0.62	200	2.69	53.78	1.71	37.2	82.100	83.300	1.20	79.000	78.800	4.3	81.550	82.320	0.77	78.000	77.800	4.3	
	118	117	44	0.50	76	0.86	4.00	1.23	0.24	1.47	200	2.21	48.75	1.55	81.1	81.550	82.320	0.77	77.700	77.500	4.6	79.400	80.400	1.00	75.908	75.708	4.5	
	117	110	24	0.31	1972	34.51	3.59	28.68	9.66	38.35	300	0.40	61.15	0.87	70.3	79.400	80.400	1.00	75.201	74.901	5.2	79.600	80.800	1.20	74.920	74.620	5.9	
	111	110	12	0.33	12	12.00	4.00	0.19	3.36	3.55	200	1.91	45.32	1.44	46.0	80.300	81.250	0.95	76.500	76.300	4.8	79.600	80.800	1.20	75.620	75.420	5.2	
	110	109	16	0.30	2000	46.81	3.59	29.05	13.11	42.16	300	0.40	61.15	0.87	66.0	79.600	80.800	1.20	74.920	74.620	5.9	79.900	80.800	0.90	74.656	74.356	6.1	
	115	114	20	0.32	20	0.32	4.00	0.32	0.09	0.41	200	4.49	69.51	2.21	51.2	84.850	85.450	0.60	81.500	81.300	4.0	82.500	83.500	1.00	79.200	79.000	4.3	
	116	114	20	0.30	20	0.30	4.00	0.32	0.08	0.41	200	0.58	[illegible]	0.80	64.5	82.100	83.340	1.24	79.374	79.174	4.0	82.500	83.500	1.00	79.000	78.800	4.5	

Peak Sewage Flow from Phase 12
= 36.70-0.50-0.96 = 35.24 L/sec



				6	02/01/01	REVISED PER PHASE 6, 7 & 8	D.S.
				5	10/11/00	REVISED PER PHASE 9	D.S.
				4	03/10/00	REVISED PER ROC	D.S.
				3	31/07/00	ISSUED FOR APPROVAL-PH. 5B	D.S.
				2	22/06/00	REVISED PHASE 6,7,8 AND 9	D.S.
7	29/01/01	KNUEA ADDED	D.S.	1	15/02/00	ISSUED FOR APPROVAL-PH.5C	D.S.

REGISTERED PROFESSIONAL ENGINEER — D. G. SHILLINGTON — PROVINCE OF ONTARIO — 2/02/01

SCALE
0 25m 50m 75m 100m
HORIZONTAL 1:3000

J.L.Richards & Associates Limited
Consulting Engineers, Architect & Planners
OTTAWA, KINGSTON, SUDBURY, CANADA.

DESIGN
CHECKED D.S.
DRAWN WF/TS
CHECKED
APPROVED

CITY OF KANATA
DEPARTMENT OF ENGINEERING AND PUBLIC WORKS

minto

MORGAN'S GRANT SUBDIVISION
MASTER DRAINAGE PLAN (SANITARY)

DATED NOV. 1999
DWG. No. 1608701-SA1

2.0 SANITARY SEWAGE

2.1 Existing Sanitary Systems

Sanitary sewage generated from the Morgan's Grant Subdivision is conveyed to the following two sanitary sewer outlets:

1) a 375 mm dia. sanitary sewer flowing easterly across March Road approximately 200 m north of Morgan's Grant Way, which eventually outlets into the East March Trunk Sewer; and

2) a 600 mm dia. sanitary sewer crossing Terry Fox Drive approximately 200 m west of March Road, which outlets to the Hines Road sanitary sewer.

The 375 mm dia. sewer collects sanitary sewage from approximately 65 ha, of which Morgan's Grant accounts for approximately 29 ha. This outlet collects sewage for most of Morgan's Grant Phase 4, the commercial area located north of Morgan's Grant Phase 4, and approximately 36 ha of land located north of Morgan's Grant Phase 6. (i.e. KNUEA)

The 600 mm dia. sewer collects sanitary sewage for approximately 125 ha. This outlet collects sewage from all areas included in Morgan's Grant Phases 1, 2 and 3, the westerly portion of Morgan's Grant Phase 4, all areas included in Morgan's Grant Phases 5, 6, 7, 8 and 9 and some of the lands west of the hydro easement adjacent to Klondike Road. This 600 mm dia. Sanitary sewer will also collect sewage from the remainder of the Morgan's Grant lands, west of the hydro easement, via a future sanitary sewer down Terry Fox Drive.

2.2 Sanitary Flows

The design of local sanitary sewers is summarized in the following table (peaking factors for each are shown in parentheses):

Land Use	Sanitary Flow Contribution		
	L/cap/day	L/ha/day	L/s/ha
Residential	350 (Harmon)		
Commercial		50,000 (1.5)	
Institutional		50,000 (1.5)	
Infiltration			0.28 (1.0)

The Harmon peaking factor was calculated for each pipe reach to determine the sanitary peak flows in residential development areas. This peaking factor provides an increased peaking factor for smaller urban areas over larger developments. The following formula is used to derive the Harmon peaking factor:

$$\text{Harmon} = 1 + \frac{14}{(4 + P^{1/2})}$$

A 1.5 peaking factor was utilized for land uses other than residential areas (i.e. institutional, commercial etc.). Sanitary flows estimated with the above information were calculated on the conservative assumption that sanitary peak flows occurred simultaneously.

For purposes of designing flows in local sanitary sewers within the Morgan's Grant Plan of Subdivision, the standard of four persons per unit was used. This results in flows of 38.78 L/s, 125.05 L/s and 49.51 L/s at Points A, B and C on the enclosed Master Drainage Plan (see also enclosed Sanitary Sewer Design Sheet).

Flows from Point A will be conveyed via a future sanitary sewer down Terry Fox Drive to Point B, where flows from Points A and B are combined with the Village of Carp forcemain flows which then travel south through the Trillium easement to the upper end of the Hines Road sewer.

At Terry Fox Drive, the flows from the Morgan's Grant Subdivision are based on 3.05 persons per unit, for consistency with the Region of Ottawa-Carleton Wastewater Master Plan which results in a flow of 131.52 L/s. The Region has advised that, at this point, allowable sanitary flows are as follows:

Morgan's Grant Subdivision	136 L/s	
Village of Carp Forcemain	58 L/s	
	194 L/s	(i.e. 600 mm dia. sanitary at 0.1% has a capacity of 194 L/s)

Sanitary flow from Point C leaving the subdivision, result in projected flows of 49.51 L/s (see enclosed Sanitary Sewer Design Sheet).

The capacity of this sewer crossing under March Road is 96.02 L/s (i.e. 375 mm sanitary at 0.30%).

2.3 Summary

The proposed sanitary sewer servicing scheme has been developed to accommodate all the lands within the boundaries of Morgan's Grant Subdivision as well as the recently acquired KNUEA lands and the Sanitary Sewer Design Sheets demonstrate that all sanitary sewer flows are within the allocations provided by the City of Ottawa (i.e. City of Kanata, Region of Ottawa Carleton)

CONTENT COPY OF ORIGINAL

Ministry of the Environment | Ministère de l'Environnement

Ontario

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 4208-6J7J5T
Issue Date: November 17, 2005

Minto Developments Inc.
427 Laurier Avenue West, No. 300
Ottawa, Ontario
K1R 7Y2

Site Location: Morgan's Grant Subdivision Stage 12D
Part of Lots 11 and 12, Concession 3
Ottawa City, Ontario

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

storm and sanitary sewers to be constructed in the City of Ottawa on Ishpatina Crescent, Goward Drive, and Finlayson Crescent, all in accordance with the application from Minto Developments Inc., dated May 11th, 2005, including final plans and specifications prepared by J.L. Richards & Associates Limited

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
2300 Yonge St., 12th Floor
P.O. Box 2382
Toronto, Ontario
M4P 1E4

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry ofthe Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 17th day of November, 2005

Aziz Ahmed, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

EC/
c: District Manager, MOE Ottawa
Robert L. Phillips, C.E.T., Program Manager,
Infrastructure Approvals West, City of Ottawa
Lee Jablonski, P.Eng., J.L. Richards & Associates Limited

Ministry of the Environment

Ministère de l'Environnement

Ontario

CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 8692-54QSUG

Minto Developments Inc.
427 Laurier Avenue West, Suite 300
Ottawa, Ontario
K1R 7Y2

Site Location: Morgan's Grant
Part of Lot 11, Concession 3
Ottawa City,

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

Stormwater management facility to be located in the southern quadrant of the intersection Old Carp Road and March Road in the City of Ottawa as follows:

- a 5.7 metre, 1500 millimetre diameter inlet sewer discharging into the first chamber of a splitter box;
- a splitter box divided into two(2) chambers, containing: a weir in the first chamber, directing the runoff to the sediment forebay; a weir in the second chamber with its crest 0.5 m above the crest elevation in the first chamber, directing run off to the wet cell via an overflow pipe; a spillway with its invert elevation elevation 0.8 m higher than the crest elevation in the first chamber, directing runoff to the wet cell;
- a sediment forebay with an average depth of 1.3 metres, an average width of 24 metres and a length of 82 metres discharging treated runoff to the wet cell via a weir with the crest at the same level as the weir crest in the first chamber;
- a wet cell consisting of a permanent pool volume of 10,250 cubic metres and an active storage of 13,000 cubic metres and an outlet structure containing a weir with crest elevation 3 metres lower than the weir crest in the first chamber of the splitter box; discharging treated runoff to an existing municipal drain via an approximately 150 metres,1650 millimetre diameter outlet storm sewer running along March Road;

all in accordance with the application from Minto Developments Inc. dated August 14 2001, including design brief, final plans, specifications and other supporting documents prepared by Cumming Cockburn Limited

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

"certificate" means this entire certificate of approval document, issued in accordance with Section 53 of the *Ontario Water Resources Act*, and includes any schedules;
"Director" means any Ministry employee appointed by the Minister pursuant to section 5 of the *Ontario Water Resources Act*;
"District Manager" means the District Manager of the Ottawa District Office of the Ministry;
"Environmental Appeal Board" means the Environmental Review Tribunal established pursuant to the Environmental Review Tribunal Act;
"Ministry" means the Ontario Ministry of the Environment;
"Owner" means Minto Developments Inc. and includes its successors and assignees;
"works" means the sewage works described in the Owner's application, this certificate and in the supporting documentation referred to herein, to the extent approved by this certificate;
" grab sample " means an individual representative sample of sewage collected in acordance with Section 3.1.1 of the Ministry's publication entitled "Protocol for the Sampling and Analysis of Industrial/Municipal Waste Water", dated January 1999, and as amended from time to time;

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITION

(a) Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the works in accordance with the description given in this Certificate, the application for approval of the works and the submitted supporting documents and plans and specifications as listed in this Certificate.

(b) Where there is a conflict between a provision of any submitted document referred to in this Certificate and the Conditions of this Certificate, the Conditions in this Certificate shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

2. EFFLUENT MONITORING AND RECORDING

The Owner shall, establish and carry out , upon commencement of operation of the sewage works, the following monitoring program:

(a) In a given calendar year, at least five rainfall events shall be selected during the period from the beginning of May to the end of September of that year and for each event, composite samples shall be constituted from three (3) grab samples of the storm run off at the inlet to the pond before it discharges to the sediment forebay and four (4) grab samples of the effluent leaving the pond at the outlet structure at approximately 1,2,4,6 and 8 hours from the start of each rainfall event and, the composite samples shall be analyzed for the Total Suspended Solids

(b) The sampling and analyses required in subsection (1) shall be performed in accordance with the Ministry's publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" January 1999 and as amended; or as described in the American Public Health Association's publication " Standard Methods for Examination of Water and Wastewater", 20th Edition, 1998 and as amended;

(c) Pursuant to subsections (1) and (2) the owner shall prepare and submit in writing a monitoring report to the District Manager by the 31st day of October immediately following the monitoring period and which shall include, as a minimum, results of the water quality monitoring program, the stage curve for the outlet weir - validated in the course of the monitoring period - the hyetographs and outlet hydrographs for the storms associated with the said water quality analyses and, an assessment of the facility's performance;

(d) The monitoring program described in subsections (1), (2) and (3) shall begin when approximately 80 % of the land mass tributary to the sewage works have been developed. After its inception, the said monitoring program shall last for a period of no less than
three (3) consecutive years.

3. The Owner shall make all necessary investigations, take all necessary steps and obtain all necessary approvals so as to ensure that the physical structure, siting and operations of the stormwater works do not constitute a safety or health hazard to the general public.

4. The Owner shall ensure that sediment and excessive decaying vegetation are removed from the above noted stormwater management system at such a frequency as to prevent the excessive buildup and potential overflow of sediment and/or decaying vegetation into the receiving watercourse.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the works are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the Certificate and the practice that the Certificate is based on the most current document, if several conflicting documents are submitted for review.

2. Condition No. 2 is included to ensure that the information relating to the operation of the sewage works is made available to Shirley's Brook.

3. Condition 3 is imposed because it is not in the public interest for the Director to approve facilities which, by reason of potential health and safety hazards do not generally comply with legal standards or approval requirements falling outside the purview of this Ministry.

4. Condition 4 is included as regular removal of sediment and excessive decaying vegetation from this approved stormwater management system are required to mitigate the impact of sediment and/or decaying vegetation on the downstream receiving watercourse. It is also required to ensure that adequate storage is maintained in the stormwater management facilities at all times as required by the design.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
2300 Yonge St., 12th Floor
P.O. Box 2382
Toronto, Ontario
M4P 1E4

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry ofthe Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 21st day of December, 2001

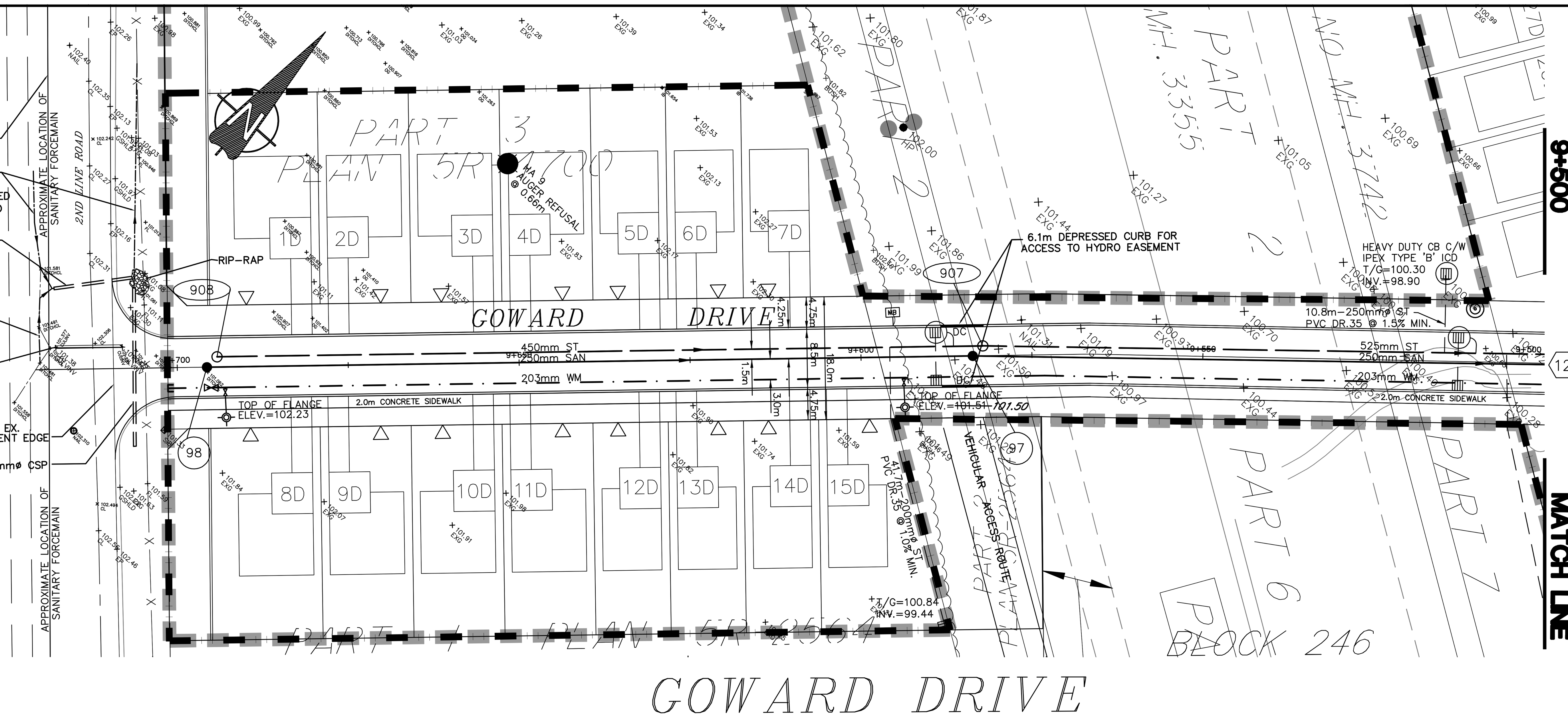
Mohamed Dhalla, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

SK/
c: District Manager, MOE Ottawa
Peter Spal, Cuming Cockburn Limited

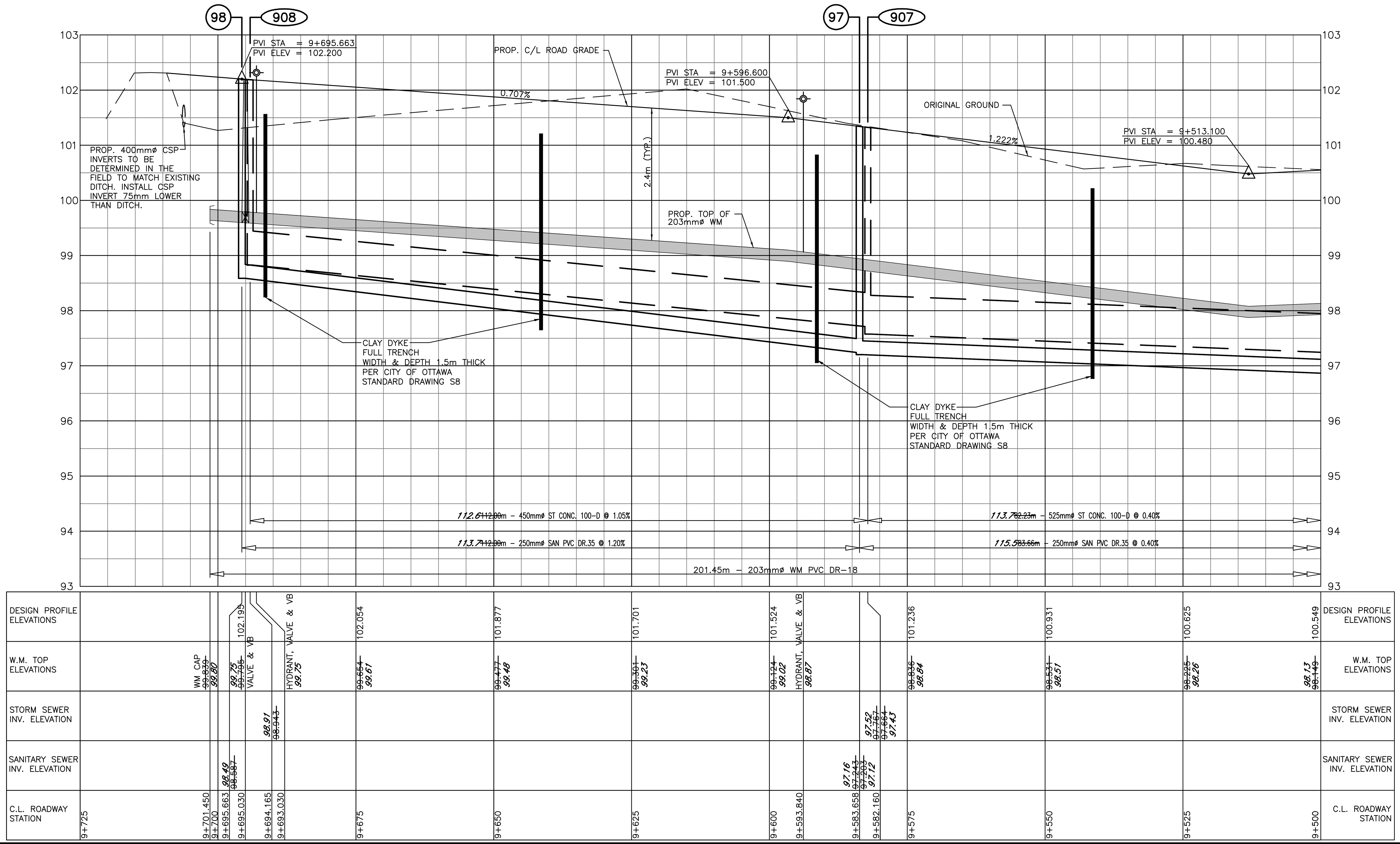
LEGEND

- EXISTING CATCH BASIN
- PROPOSED CATCH BASIN
- INTERCONNECTED ROADWAY CB C/W ONE 19.8L/S IPEX TYPE 'A' ICD OR CITY APPROVED EQUIVALENT
- CATCH BASIN WITH INDIVIDUAL 19.8 L/S IPEX TYPE "A" ICD OR CITY APPROVED EQUIVALENT
- PROPOSED CATCH BASIN / MANHOLE
- PROPOSED CATCH BASIN FOR LANDSCAPED AREAS
- PROPOSED WATERMAIN, VALVE & HYDRANT
- EXISTING WATERMAIN, VALVE & HYDRANT
- WATERMAIN VALVE AND VALVE CHAMBER
- WATERMAIN VALVE AND VALVE BOX
- EXISTING SANITARY SEWER & MANHOLE
- EXISTING STORM SEWER & MANHOLE
- PROPOSED SANITARY SEWER & MANHOLE
- PROPOSED STORM SEWER & MANHOLE
- PROPOSED CATCH BASIN & LEAD
- 30C LOT NUMBER
- 2.0m CONC. CURB AND SIDEWALK
- DC DEPRESSED CURB
- SILT FENCE (OPSD 249.110)
- PHASING LIMIT
- (2) DRAWING NUMBER
- TP 4 81.07 ROCK — TEST PIT SHOWING ELEVATION OF ROCK
- HA 1 AUGER REFUSAL 0.3m DEPTH — HAND AUGER HOLE LOCATION SHOWING DEPTH FROM EXISTING GROUND SURFACE TO REFUSAL (INFERED DEPTH TO BEDROCK)

ALL MANHOLES TO BE 1200mmø UNLESS SHOWN OTHERWISE



GOWARD DRIVE



RECORD DRAWING
PRODUCED FROM INFORMATION PROVIDED BY FIELD INSPECTOR
date: MAY 03, 2013
J.L. RICHARDS & ASSOCIATES LIMITED

NOTES:

1. INSTALL CLAY DYKES AT 50m INTERVALS BEGINNING AT THE LOW END OF THE SEWERS AND PROCEEDING UPSTREAM FOR EACH OF THE THREE STREETS SERVICED. EACH CLAY DYKE SHALL BE CONSTRUCTED OF CLAY GEOTECHNICAL MATERIAL AND PLACED THE FULL HEIGHT AND WIDTH OF THE TRENCH AND BE 1.5m THICK.

No.	Date	Revision	By
6	02/05/13	RECORD DRAWING	L.J.
5	24/11/05	ISSUED FOR CONSTRUCTION	L.J.
4	18/10/05	REVISED PER HYDRO ONE COMMENTS	L.J.
3	11/07/05	REVISED PER CITY COMMENTS	L.J.
2	11/05/05	ISSUED FOR MOE APPROVAL	L.J.
1	15/04/05	ISSUED TO BLASTING CONTRACTOR	L.J.

SCALE
HORIZONTAL 1:500
VERTICAL 1:50

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

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

Ottawa

minto

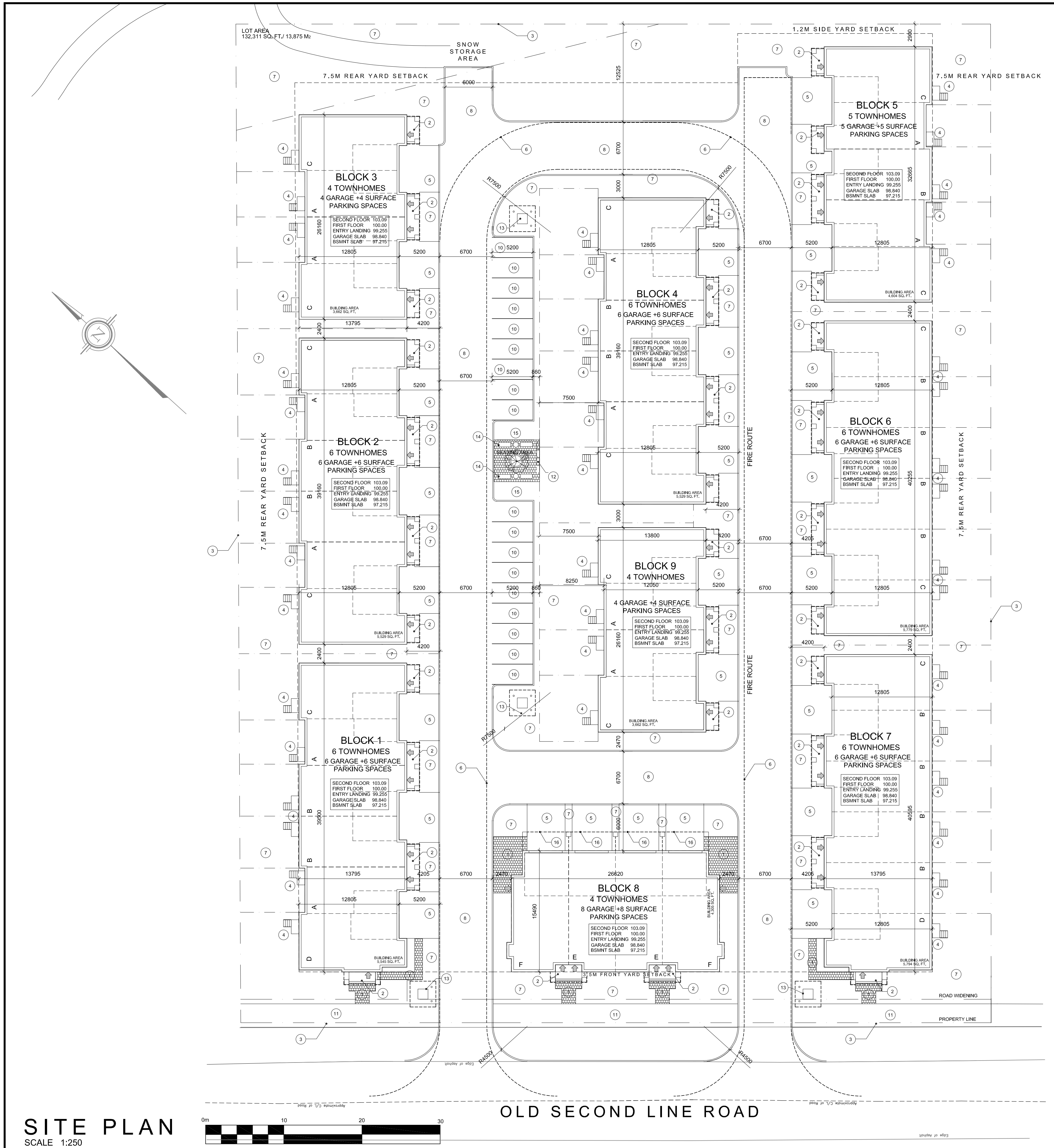
MORGAN'S GRANT
PHASE 12D
GOWARD DRIVE
PLAN & PROFILE
FROM STA. 9+500.00 TO STA. 9+695.66

DATED APRIL 2005
DWG. No. 17732-13

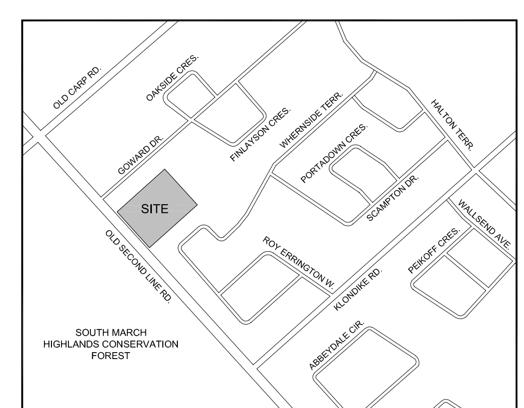
Appendix J – Drawings

Site Plan Drawing

Survey Plan



SITE PLAN
SCALE 1:250



SITE LOCATION PLAN

PROJECT INFORMATION

ZONING	R3

PROJECT STATISTICS

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

BUILDING STATISTICS

TOWNHOMES (WITH ATTACHED GARAGE)	
TOTAL UNITS	49

BUILDING AREAS

BLOCK 1	BUILDING AREA 5,545 SQ. FT. / 515 SQ.M.
BLOCK 2	BUILDING AREA 5,529 SQ. FT. / 513.6 SQ.M.
BLOCK 3	BUILDING AREA 3,662 SQ.FT. / 340 SQ.M.
BLOCK 4	BUILDING AREA 5,529 SQ.FT. / 513.6 SQ.M.
BLOCK 5	BUILDING AREA 4,604 SQ. FT. / 427.7 SQ.M.
BLOCK 6	BUILDING AREA 5,779 SQ. FT. /536.8 SQ.M.
BLOCK 7	BUILDING AREA 5,794 SQ. FT. / 538.3 SQ.M.
BLOCK 8	BUILDING AREA 4,308 SQ. FT. / 380.2 SQ.M.
BLOCK 9	BUILDING AREA 3,662 SQ.FT. / 340 SQ.M.

TOTAL AREA	4,105.2 sq. m. 44,188 sq. ft.
SITE AREA	13,875 sq. m. (132,311 sq. ft.)
LOT COVERAGE	29.5%

CAR PARKING

REQUIRED

TOWNHOMES/GARAGE	- 1.0 PER UNIT (47 UNITS)	47
VISITOR	NOT REQUIERED	0
TOTAL		47

PROVIDED

TOWNHOMES/GARAGE	- 1.0 PER UNIT (43 UNITS)	43
TOWNHOMES/GARAGE	- 2.0 PER UNIT (4 UNITS)	8
TOWNHOMES/DRIVEWAY SURFACE PARKING		51
VISITOR	- 18.0 CONVENIENCE SPACES	18
TOTAL		120

DRAWING NOTES:

1. PRECAST PAVERS
2. PRECAST CONCRETE STAIRS
3. PROPERTY LINE
4. WOOD STAIRS AND LANDING
5. ASPHALT DRIVEWAY
6. FIRE ROUTE
7. GRASS
8. PRIVATE STREET ASPHALT SURFACE
9. COMMUNITY MAILBOXES
10. VISITOR PARKING
11. CONCRETE SIDEWALK
12. DASHED LINE SHOWS BUILDING OVERHANG ABOVE
13. TRANSFORMER LOCATION c/w CONCRETE BOLLARDS; SEE CIVIL DRAWINGS FOR DETAILS.
14. PARK BENCHES
15. SOFT LANDSCAPING
16. EXTENT OF BALCONY ABOVE

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

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

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

DO NOT SCALE DRAWINGS.

NOTATION SYMBOLS:

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

REVISIONS:

No.	DESCRIPTION	DATE
3	REV. AS PER CITY COMMENTS	TBD
2	REV. AS PER HYDRO OTTAWA COMMENTS	JUNE 06 2018
1	SITE PLAN SUBMISSION	APR 13 2018

NORTH ARROW:

LEGAL DESCRIPTION

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

SURVEYOR

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

ARCHITECTURAL DESIGN

URBANDIVA Design Inc.
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Tel: (613) 805-5850

PROJECT DEVELOPER

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Tel: (613) 421-1515
Fax: (613) 695-1944

CIVIL ENGINEER

exp Services Inc.
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Ottawa, ON K2B 8H6
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Fax: (613) 852-8753
bruce.thomas@exp.com

LANDSCAPE ARCHITECT

Gino Aiello
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Nepean, ON K2G5X8
Tel: (613) 852-1343
gino@gjala.com

CLIENT: THEBERGE HOMES

URBANDIVA Design Inc.

PROJECT TITLE:
1158 OLD SECOND LINE
OTTAWA ONTARIO

SHEET TITLE:
SITE PLAN

BCIN: 29498
SCALE: 1:250
PROJECT No. 1802
SHEET No. SP-1

PAPER SIZE: ARCH D
PLOT DATE: Monday, October 15, 2018

TOPOGRAPHIC PLAN OF SURVEY OF

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

FARLEY, SMITH & DENIS SURVEYING LTD. 2018

Scale 1: 200

0 2.5 5 10 15 20 metres

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

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

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

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

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

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

Notes & Legend

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

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
2039786

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

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

03/05/18
Date

Jamie Leslie
Ontario Land Surveyor

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

FARLEY, SMITH & DENIS SURVEYING LTD.

ONTARIO LAND SURVEYORS
CANADA LAND SURVEYORS

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FILE No. : 39-18

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