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UCC File: 25028

FUNCTIONAL SERVICING REPORT

519 THOROLD ROAD, WELLAND
July 2025

INTRODUCTION

This report is to address the servicing needs for the proposed 22 unit condominium development located on the south side of Thorold Road, east of Clare Avenue and west of South Pelham Road. The development is located at 519 Thorold Road, Welland which has historically been a single detached dwelling.

The development site is approximately 0.45 hectares and includes 22 condominium units in 4 blocks. The site shall include associated asphalt parking lot, concrete curb, catch basins, storm sewers, sanitary servicing, and water servicing.

The objectives of this study are as follows:

1. Identify domestic and fire protection water service needs for the site
2. Identify sanitary servicing needs for the site
3. Identify stormwater management needs for the site

WATER SERVICING

There is an existing 300mm diameter AC watermain located on the south side of Thorold Road fronting the development site. It is proposed to construct a 150mm diameter water service to provide both domestic water supply and fire protection to the proposed building as per the Ontario Building Code standards. Adequate fire protection will be provided for the buildings on the site by an on-site fire hydrant. A 150mm diameter water meter and water meter chamber will be located at the entrance to the site with a 150mm diameter pipe connecting with the existing watermain on Thorold Road.

The estimated peak domestic and commercial water demands have been summarized in Table 1 below for the proposed 22 units (66 persons), using an average residential flow rate of 270 L/capita/day. Domestic peaking factors for the maximum daily demand and maximum hourly demand were interpolated from the Table 3-3 of the Ministry of Environment Design Guidelines for Drinking Water Systems.

Table 1. Estimated Peak Water Demand	
Estimated Peak Domestic Water Demand	
Average Domestic Demand *270 L/cap/day; 66 persons*	**0.21 L/s**
Maximum Day Domestic Peaking Factor	8.1
Maximum Day Domestic Demand	**1.67 L/s**
Peak Hour Domestic Peaking Factor	12.23
Peak Hour Domestic Demand	**2.57 L/s**

A fire hydrant analysis has been prepared and attached in Appendix A for the proposed hydrant on site using calculations and specifications found in the Fire Underwriters Survey (1999), to ensure protection is available with a residual pressure of 140kPa under fire flow conditions. As shown in the Fire Underwriters Survey calculation sheet, the required flow for the central condo block building is approximately 153.7L/s with considerations for proximity of nearby buildings and construction type. The hydrant calculation sheet shows that a calculated hydrant flow rate of 162.9L/s will be provided by the proposed hydrant using the known static pressure of 379kPa (55psi). Therefore, per the Fire Underwriters Survey, the proposed hydrant will provide sufficient water supply for the building on this site. Additionally, the existing fire hydrant located on the south side of Thorold Road (between #505 and #519) can be also provide additional fire protection needs. Based on the information above, the proposed townhouse development will have adequate fire protection.

SANITARY SERVICING

The proposed development will outlet to the existing 300mm diameter sanitary sewer on Thorold Road. The existing 300mm diameter sanitary sewer on Thorold Road has a capacity of 54.33L/s. The proposed development shall have an approximate outflow of 1.36L/s which will occupy approximately 2.5% of the existing sanitary sewer. It is expected that this will be an acceptable addition to the current capacity of the existing sewer. All sanitary sewer calculations can be found in Appendix B for reference.

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STORMWATER MANAGEMENT

Historically, the property at 519 Thorold Road contained a single detached dwelling. The stormwater generated from this site currently flows via overland flow to tow outlets. The first outlet is a ditch inlet catch basin at the northern limits of the property, which discharges into the existing 525mm diameter storm sewer on Thorold Road. The second outlet is located at the southeast corner of the site and flows towards Maple Park. Figure 1 (Appendix C) shows the existing drainage areas contributing stormwater flows.

Figure 2 outlines the overall future drainage areas, where Drainage Areas A10 and A20 encompass the areas to be provided quantity controls prior to discharging to the existing Thorold Road storm sewer. Drainage Area A30 conveys stormwater flows directly to the existing road allowance for Thorold Road.

Quantity Controls

Using the Modified Rational Method (MRM), the existing allowable peak flows and associated required storage were determined. Since the existing storm sewer system on Thorold Road was designed to the 2 year event, all future conditions discharging to the sewer must be controlled to less than the 2 year existing levels. Table 1 outlines the peak flows and allowable conditions for the proposed development. All MRM calculations can be seen in Appendix C.

Table 2. Peak Stormwater Flows

Design Storm (Return Period)	Total Peak Flows (L/s)							
	Existing Conditions		Future Conditions					
			To be Controlled		Direct Uncontrolled		Allowable	
Outlet	A	B	A	B	A	B	A	B
2 Year	27.4	27.7	66.9	0	2.8	20.6	24.7	27.7
5 Year	32.2	32.5	78.5	0	3.3	24.2	24.2	32.5
100 Year	50.8	51.2	123.9	0	5.2	51.2	24.2	51.2

Based on the results from Table 2, the increased imperviousness due to the development justifies the need for stormwater quantity controls.

5 Year Design Storm

The stormwater generated by the 5 year which discharges to the existing storm sewer on Thorold Road (Outlet A) must be controlled to 2 year allowable rate of 24.2 L/s. According to the MRM calculations in Appendix C, 46.4m^3 of storage is required to adequately reduce the stormwater peak flows to allowable levels during the 5 year event. The storage will be provided by the internal site sewers.

The size and configuration of all internal sewers will be determined as part of the Detailed Engineering Design. For the 2, and 5 year events, the future peak stormwater flows at Outlet B are less than existing levels, therefore no quantity controls are required.

100 Year Storm Event

To provide quantity controls for the 100 year storm event, excess runoff that does not enter the storm sewers on Thorold Road will be conveyed as overland flow to Outlet B, which discharges to the southeast ditch. The allowable peak flow at Outlet A is restricted to 24.2 L/s (2 year allowable peak flow), while the allowable peak flow at Outlet B is 51.2 L/s. The site's storm sewer system will be designed to convey the 5 year post development peak flow with an additional 15 percent surcharge, resulting in a capacity of 90.3 L/s.

Under post development conditions, the total 100 year peak flow at Outlet A is 123.9 L/s. After limiting the flow at this outlet to 24.2 L/s, the remaining 33.7 L/s will be conveyed overland to Outlet B. Based on the MRM calculation sheet provided in Appendix C, the total post-development peak flow at Outlet B is 71.8 L/s.

To achieve the required quantity controls, storage volumes of 59.4 m^3 and 2.6 m^{3}are needed at Outlets A and B, respectively, during the 100 year event. A total of 62.0 m^3 of storage will be provided through a combination of underground superpipe storage and surface storage. The final configuration will be confirmed as part of the Detailed Engineering Design.

In summary, the proposed combination of surface, and superpipe storage will adequately satisfy the requirements to reduce peak flows to allowable levels for both the 5 year and 100 year storm events.

Quality Controls

To improve stormwater quality levels for this site, a stormwater oil/grit separator is proposed. The location of the OGS will be determined as part of the Detailed Engineering Design. For Enhanced Protection as per the City of Welland CLI Permit, oil/grit separators are required to provide a minimum average of 80% Total Suspended Solids (TSS) removal. The contributing drainage area from the proposed development and adjacent lands to the proposed oil/grit separator is 0.48 hectares with an impervious coverage of approximately 69%. Considering the ETV Canada particle distribution, the Hydroworks modelling software has indicated that an HD5 will provide 84% TSS overall removal and capture 100% of the stormwater flows. Therefore, A Hydroworks

HD5 is proposed for the site development. The modelling output file has been provided in Appendix D.

MAINTENANCE OF STORMWATER MANAGEMENT FACILITY

HD5 Oil/Grit Separator

The function of the proposed stormwater quality protection facility, a stormwater oil/grit separator, will require maintenance on an annual basis. The following is a summary of the maintenance activities required.

Regular inspections of the stormwater Maintenance Hole (MH) oil/grit interceptor will indicate whether maintenance is required or not. They should be made after every significant storm during the first two years of operation to ensure that it is functioning properly. This will translate into an average of six inspections per year.

Points of regular inspections are as follows:

a) Is there sediment in the separator sump? The level of sediment can be measured from the surface without entry into the oil/grit separator via a dipstick tube equipped with a ball valve (Sludge Judge) or with a graduated pole with a flat plate attached to the bottom.

b) Is there oil in the separator sump? This can be checked from the surface by inserting a dipstick in the 150mm vent tube. The presence of oil is usually indicated by an oily sheen, frothing or unusual colouring. The separator should be cleaned in the event of a major spill contamination.

c) Is there debris or trash at the inlet weir and drop pipe? This can be observed from the surface without entry into the separator. Clogging at the inlet drop pipe will cause stormwater to bypass the sedimentation section and continue downstream without treatment.

d) Completion of the Inspection Report (a sample report is included in Appendix D for reference purposes). These reports will provide details about the operation and maintenance requirements for this type of stormwater quality device. After an evaluation period (usually 2 years) this information will be used to maximize efficiency and minimize the costs of operation and maintenance for the maintenance hole oil/grit separator.

Typically, stormwater MH oil/grit separators are cleaned out using vacuum pumping. No entry into the unit is required for maintenance. Cleaning should occur annually or whenever the accumulation reaches sediment storage specified by the manufacturer and after any major spills have occurred. Oil levels greater than 2.5 centimeters should be removed immediately by a licensed waste management firm.

Generally, the sediment removed from the separator will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options. The Ministry of Environment, Conservation and Parks publishes sediment disposal guidelines which should be consulted for up-to-date information pertaining to the exact parameters and acceptable levels for the various disposal options. The preferred option is an off-site disposal, arranged by a licensed waste management firm.

The future owners of a Hydroworks facility are provided with an Owner's Manual upon installation, which explains the function, maintenance requirements and procedures for the facility with extensive use It is recommended to follow the manufacturers instructions to allow the oil/grit separator to perform as intended.

I have a site that has two existing stormwater outlets. One outlet is to storm sewers on a road, and the other is to a ditch at the rear of the property. For my new design, I want to take all stormwater to the storm sewers for the minor events, and only use the ditch outlet for overland flows for the major events. When calculating the storage requirements for the minor events, can I calculate it as if the entire site is existing draining to the sewer? Otherwise I would need to store much more.

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CONCLUSIONS AND RECOMMENDATIONS

Therefore, based on the above comments and design calculations provided for this site, the following summarizes the servicing for this site.

1. The existing 300mm diameter watermain will have sufficient capacity to provide both domestic and fire protection water supply.

2. The existing 300mm diameter sanitary sewer on Thorold Road will have adequate capacity for the proposed residential development.

3. Stormwater quantity controls are being provided on site to the allowable capacity of the existing storm sewer system on Thorold Road.

4. Stormwater quality controls will be provided to MECP Enhanced Protection (80% TSS removal) levels before outletting from the site.

5. The site stormwater overland route is to the southeast ditch which conveys through Maple Park.

In conclusion, there exists adequate municipal infrastructure to service the proposed development. We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Yours very truly,

Prepared By:

Taia Mussari, B.Eng.

Encl.

Reviewed By:

Adam Keane, P.Eng.
Revised July 11, 2025

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APPENDICES

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APPENDIX A

Fire Underwriters Survey Calculation Sheet
Hydrant Analysis

Fire Underwriters Survey

Water Supply for Public Fire Protection (1999) Calculations

19 THOROLD ROAD - 3-STOREY CONDOMINIUM BLOCK

Required Fire Flow in Litres per Minute	F=	9,223	(L/m)
		153.71	(L/s)
		2,436	(USgmp)
Type of Construction			
Ordinary Construction (brick or other masonry walls, combustible floor and interior).	C=	1.00	
Total Floor Area in square metres (including all stories, excluding basements at least 50% below grade)	A=	301	(m2)
NOTE: Fire Walls that meet or exceed Nation Building Code of Canada (2 hour fire resistance) divide building.			
Total Number of Floors		3	
2. Combustibility of Contents *(may not reduce fire flow demand below 2,000 L/min)*			
Limited Combustible	=	-15%	
3. Sprinkler Systems			
Is there a complete automatic sprinkler protection system per NFPA (Yes/No).	No	0%	
Water supply standard for both system and fire department hose lines (Yes/No).	No	0%	
Is system fully monitored (Yes/No).	No	0%	
Total Sprinker Reduction to Overall Fire Flow Demand		0%	
4. Spacial Separation of Neighbouring Structures (within 45 metres)			
Location of Building:			
North 3-Storey Apartment Building			
Distance to Nearest Building to the North	24.0 m	10%	
Distance to Nearest Building to the South	12.5 m	15%	
Distance to Nearest Building to the East	10.9 m	15%	
Distance to Nearest Building to the West	14.6 m	15%	
Total Spacial Separation to Adjacent Structures		55%	
Additions			
Is roof wood shingles or shakes (Yes/No).	No		

Headloss in a Single Ended Lead for Fire Hydrant

Project:	519 THOROLD ROAD
Project Number:	25028
Date:	July 10, 2025
Prepared by:	T. Mussari, B.Eng

Proposed Hydrant: On Site

Single Lead Length (m):	45.0m		
Single Lead Diameter (mm):	150mm		0.15m
Internal W/M Loop Length (m):	0.0m	0.0m	
Internal W/M Loop Diameter (mm):	000mm	000mm	
Hydrant Elevation (m):	181.88m		
Theoretical Flow at 20PSI (L/s):	163 L/s		2582 USgpm
Reduced Hydrant Flow (L/s):	147 L/s		2324 USgpm
Hydrant Rating (NFPA 291):	BLUE		
Fire Pressure (PSI):	20PSI		137895.14 Pa
Backflow Preventor:	None		.0 PSI
Fireflow Meter:	Sensus 8" F2 Fireline		2.9 PSI

	SINGLE	INTERNAL	
Total Number of 90° Elbows:	0	0	ke = 0.9
Valves:	1	0	ke = 0.2
Total Number of 45° Elbows:	0	0	ke = 0.4
Reducer:	0	0	ke = 0.06
Increaser:	0	0	ke = 0.15
Number Tee Fittings (straight):	1	0	ke = 0.4
Number of Tee Fittings (turn):	0	0	ke = 1.8

Known Hydrant - 519/505 Thorold Road, Welland

Approximate Elevation (m):	181.81m		
Known Static Pressure (PSI):	55PSI		379211.64 Pa
Feeder Main Diameter (mm):	300mm		0.30m

		INTERNAL LOOP	
Calculated Headloss	SINGLE	SMALL	LARGE
D:	0.15	0.00	0.00
Re:	9.16E+05	6.87E+15	6.87E+15
V2:	9.22 m/s	1.04E+21	1.04E+21
Q:	0.1629 m3/s	0.0814 m3/s	0.0814 m3/s
A:	0.018 m2	0.000 m2	0.000 m2
y:	1.51E-06		
ks:	0.0000015		
f:	0.012	0.012	0.012
Density:	9810		
g:	9.81 m2/s		

Bernoulli Terms

P1:	38.66 m	P2:	14.06 m
V1:	0.07 m	V2:	4.33 m
z1:	181.81m	Z2:	181.88m
		Fittings:	2.60 m
		Backflow:	0.00 m
		Fire:	2.06 m
		Straight:	15.61 m
TOTAL HEAD 1:	220.53 m	=	220.53 m

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APPENDIX B

Sanitary Sewer Calculation Sheet

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3-30 HANNOVER DRIVE
ST.CATHARINES, ONTARIO, L2W 1A3

DESIGN FLOWS

RESIDENTIAL: 375 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
INFILTRATION RATE: 0.286 LITRES/HECTARE (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 LITRES/H
POPULATION DENSITY 3.0 PERSONS / UNIT

SEWER DESIGN

PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 IMPERIAL EQUIVALENT FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: CITY OF WELLAND
PROJECT : 519 THOROLD ROAD
PROJECT NO: 25028

S A N I T A R Y S E W E R D E S I G N S H E E T

LOCATION			AREA					ACCUMULATED PEAK FLOW				DESIGN FLOW					
Description	From M.H	To M.H.	Increment (hectares)	Accumulated (hectares)	Number of Units	Population Increment	Total Population Served	Peaking Factor	Flow (L/s)	Infiltration Flow L/s	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Length (m)	Pipe Slope (%)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Check Percent Full
SITE			0.45	0.45	22	66	66	4.29	1.23	0.13	1.36						
THOROLD ROAD				0.45			66	4.29	1.23	0.13	1.36	300	116.0	0.20	0.618	45.12	3.0%

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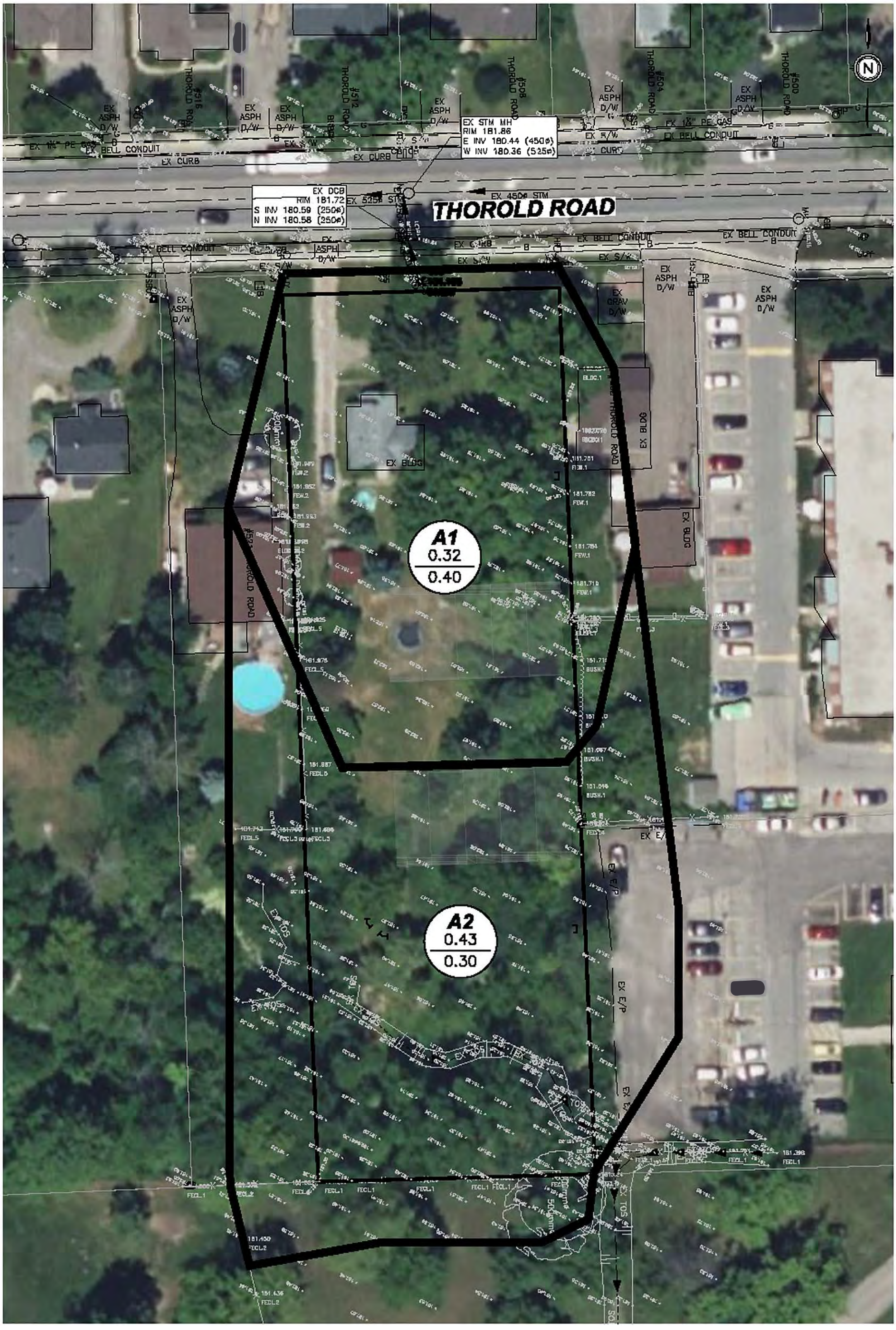
APPENDIX C

Figure 1 – Existing Storm Drainage Area Plan
Figure 2 – Proposed Storm Drainage Area Plan
Modified Rational Method – Peak Flow Calculations



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519 THOROLD ROAD

CITY OF WELLAND

EXISTING OVERALL STORM DRAINAGE AREA

DATE	YYYY-MM-DD
SCALE	1:500 m
REF No.	
DWG No.	FIGURE 1

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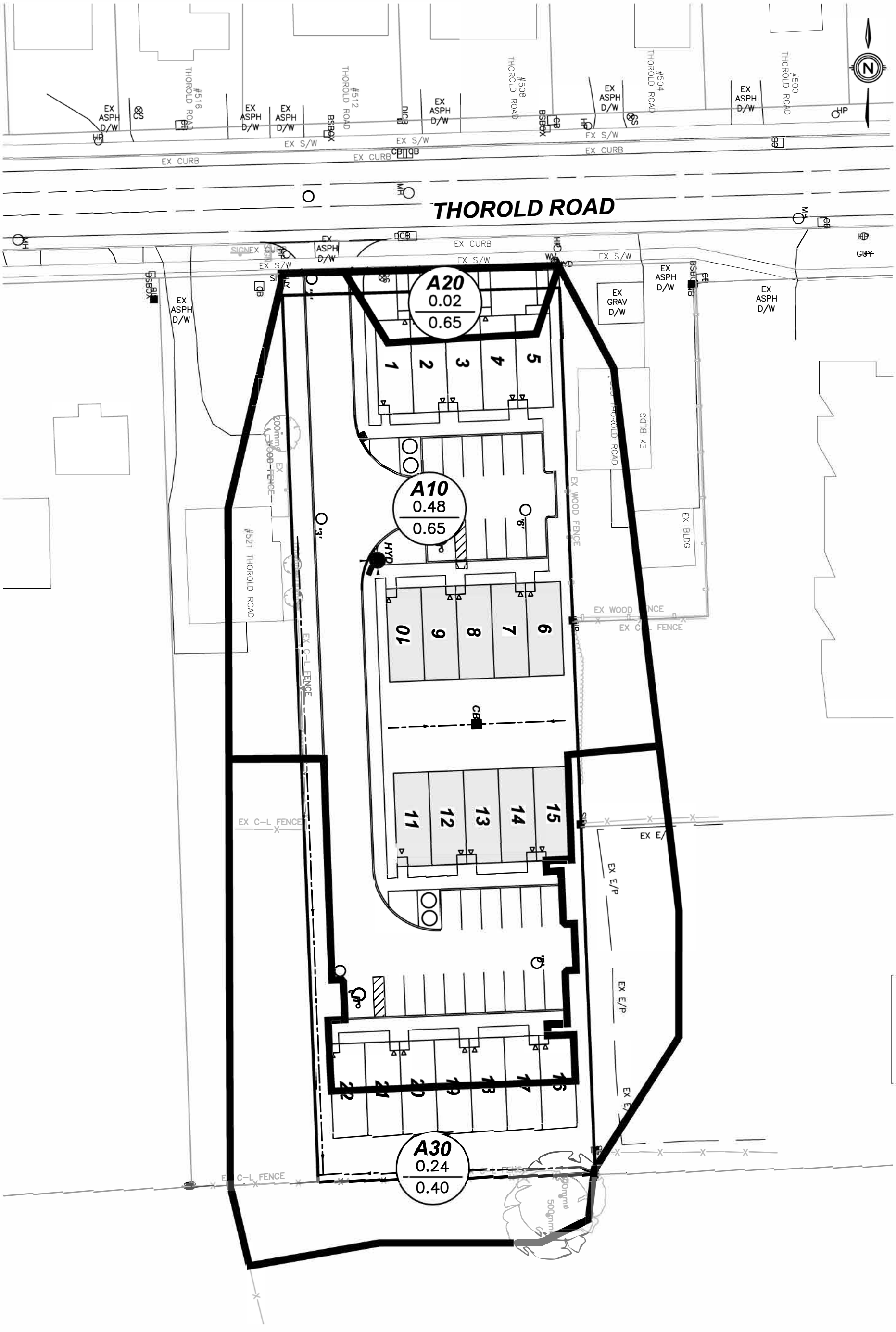

UPPER CANADA CONSULTANTS *ENGINEERS / PLANNERS*	**519 THOROLD ROAD** ***CITY OF WELLAND*** ***PROPOSED*** ***OVERALL STORM DRAINAGE AREA***	DATE YYYY–MM–DD SCALE 1:500 m REF No. . DWG No. ***FIGURE 2***

30 Hannover Drive Unit 3
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STORMWATER DESIGN SHEET

2 YEAR DESIGN STORM EVENT - OUTLET A

PROJECT: 519 THOROLD ROAD, CITY OF WELLAND

	LOCATION					TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	FROM M.H.	TO M.H.	PIPE LENGTH (m)	INCREMENT AREA (hectares)	TOTAL AREA (hectares)	TO UPPER END (min)	IN SECTION (min)	RUNOFF COEFF	SECTION A X R	ACCUMLD A x R	RAINFALL INTENSITY (mm/hr)	PEAK FLOW (L/s)
PRE-DEVELOPMENT CONDITIONS - 2 YEAR												
A1	SITE	OUTLET A		0.32	0.32	10.00	10.00	0.400	0.128	0.128	77.186	27.4
POST-DEVELOPMENT CONDITIONS - 2 YEAR												
A10	SITE	OUTLET A		0.48	0.48	10.00	10.00	0.650	0.312	0.312	77.186	**66.9**
A20 - Uncontrolled	SITE	OUTLET A		0.02	0.02	10.00	10.00	0.650	0.013	0.013	77.186	2.8
TOTAL ALLOWABLE PEAK OUTFLOW - 2 YEAR (OUTLET A)												**24.7**

DESIGN BY: **UPPER CANADA CONSULTANTS**
30 HANNOVER DRIVE, UNIT 3
CITY OF WELLAND
DESIGN BY: **T. MUSSARI, B.ENG**
DATE: **JUNE 2025**

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
City of Welland - 2 Year IDF Curve

a = 755.00 mm/hr
b = 8.00 minutes
c = 0.79

Modified Rational Method (MRM) Required Storage Volume

2 YEAR STORM EVENT - OUTET A

519 THOROLD ROAD
Project No.: 25028
Date: JUNE 2025
Design By: T. MUSSARI, B.ENG

Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 2 Year IDF Curve**

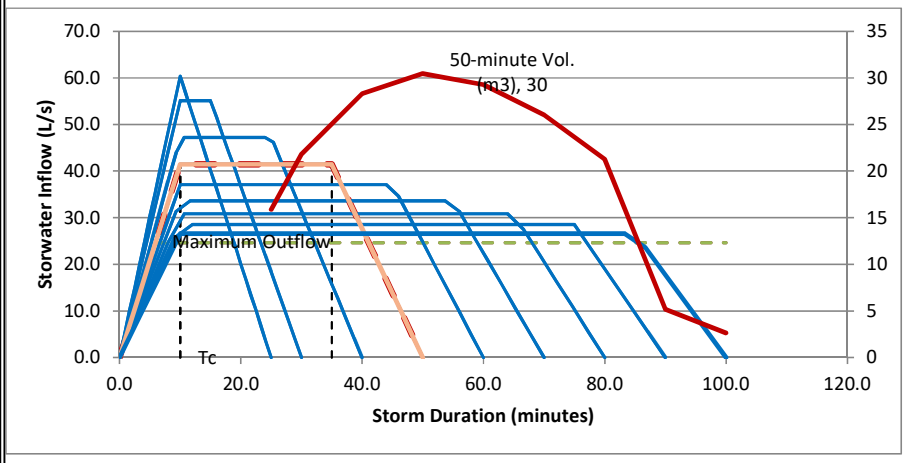
a =	755.00	mm/hr
b =	8.00	minutes
c =	0.79	

Critical Storm Duration:	50.00	minutes	Tail Multiplier (x1-11.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	35.00	minutes	
Accumulated Area x R (Ha):	0.312		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	47.85	mm/hr	
Peak Inflow at Tc:	41.47	L/s	
Maximum Release Rate:	24.66		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	5.95		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	24.66	-1.5	0.0
1.7	7.97	6.91	24.66	-1.8	0.0
3.3	15.95	13.82	24.66	-1.1	0.0
5.0	23.92	20.73	24.66	-0.4	0.0
6.7	31.90	27.64	24.66	0.3	0.3
8.3	39.87	34.55	24.66	1.0	1.3
10.0	47.85	41.47	24.66	1.7	3.0
11.7	47.85	41.47	24.66	1.7	4.7
13.3	47.85	41.47	24.66	1.7	6.3
15.0	47.85	41.47	24.66	1.7	8.0
16.7	47.85	41.47	24.66	1.7	9.7
18.3	47.85	41.47	24.66	1.7	11.4
20.0	47.85	41.47	24.66	1.7	13.1
21.7	47.85	41.47	24.66	1.7	14.7
23.3	47.85	41.47	24.66	1.7	16.4
25.0	47.85	41.47	24.66	1.7	18.1
26.7	47.85	41.47	24.66	1.7	19.8
28.3	47.85	41.47	24.66	1.7	21.5
30.0	47.85	41.47	24.66	1.7	23.1
31.7	47.85	41.47	24.66	1.7	24.8
33.3	47.85	41.47	24.66	1.7	26.5
35.0	47.85	41.47	24.66	1.7	28.2
36.7	42.53	36.86	24.66	1.2	29.4
38.3	37.21	32.25	24.66	0.8	30.2
40.0	31.90	27.64	24.66	0.3	***30.5***
41.7	26.58	23.04	24.66	-0.2	30.3
43.3	21.26	18.43	24.66	-0.6	29.7
45.0	15.95	13.82	24.66	-1.1	28.6
46.7	10.63	9.21	24.66	-1.5	27.0
48.3	5.32	4.61	24.66	-2.0	25.0
50.0	0.00	0.00	24.66	-2.5	22.6

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	15.9 m3	50 Min	**30.5 m3**	80 Min	21.3 m3
30 Min	21.8 m3	60 Min	29.3 m3	90 Min	5.2 m3
40 Min	28.3 m3	70 Min	26.0 m3	100 Min	2.6 m3



STORMWATER DESIGN SHEET

2 YEAR DESIGN STORM EVENT - OUTLET B

PROJECT: 519 THOROLD ROAD, CITY OF WELLAND

	LOCATION					TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	FROM M.H.	TO M.H.	PIPE LENGTH (m)	INCREMENT AREA (hectares)	TOTAL AREA (hectares)	TO UPPER END (min)	IN SECTION (min)	RUNOFF COEFF	SECTION A X R	ACCUMLD A x R	RAINFALL INTENSITY (mm/hr)	PEAK FLOW (L/s)
PRE-DEVELOPMENT CONDITIONS - 2 YEAR												
A2	SITE	OUTLET		0.43	0.43	10.00	10.00	0.300	0.129	0.129	77.186	27.7
POST-DEVELOPMENT CONDITIONS - 2 YEAR												
A10				0.24	0.24	10.00	10.00	0.400	0.096	0.096	77.186	**20.6**
TOTAL ALLOWABLE PEAK OUTFLOW - 2 YEAR												**27.7**

DESIGN BY: **UPPER CANADA CONSULTANTS**
30 HANNOVER DRIVE, UNIT 3
CITY OF WELLAND
DESIGN BY: **T. MUSSARI, B.ENG**
DATE: **JUNE 2025**

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
City of Welland - 2 Year IDF Curve

a = 755.00 mm/hr
b = 8.00 minutes
c = 0.79

Modified Rational Method (MRM) Required Storage Volume

2 YEAR STORM EVENT - OUTLET B

519 THOROLD ROAD
Project No.: 25028
Date: JUNE 2025
Design By: T. MUSSARI, B.ENG

Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 2 Year IDF Curve**

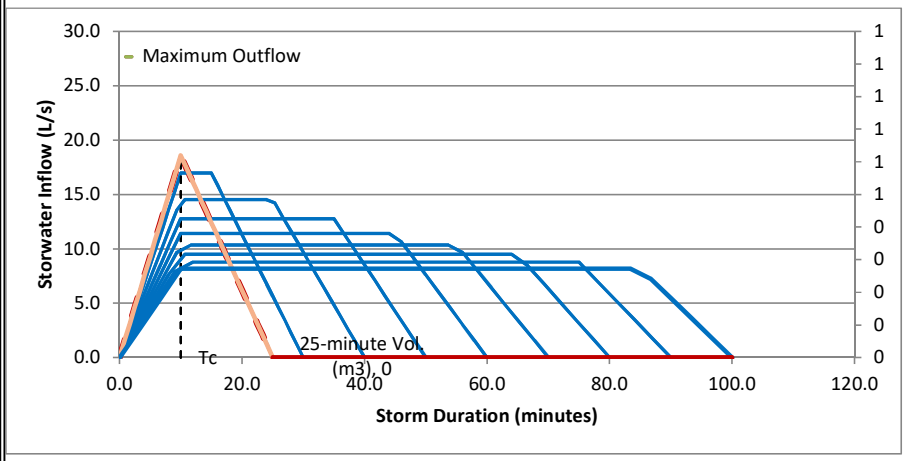
a =	755.00	mm/hr
b =	8.00	minutes
c =	0.79	

Critical Storm Duration:	25.00 minutes	Tail Multiplier (x1-11.5
Tc From Design:	10.00 minutes	
Storm Tail Time:	10.00 minutes	
Accumulated Area x R (Ha):	0.096	<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	69.66 mm/hr	
Peak Inflow at Tc:	18.58 L/s	
Maximum Release Rate:	27.66	<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	OUTLET CAPACITY LARGER THAN INLET	

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	27.66	-1.7	***0.0***
0.8	5.80	1.55	27.66	-1.3	***0.0***
1.7	11.61	3.10	27.66	-1.2	***0.0***
2.5	17.41	4.64	27.66	-1.2	***0.0***
3.3	23.22	6.19	27.66	-1.1	***0.0***
4.2	29.02	7.74	27.66	-1.0	***0.0***
5.0	34.83	9.29	27.66	-0.9	***0.0***
5.8	40.63	10.84	27.66	-0.8	***0.0***
6.7	46.44	12.38	27.66	-0.8	***0.0***
7.5	52.24	13.93	27.66	-0.7	***0.0***
8.3	58.05	15.48	27.66	-0.6	***0.0***
9.2	63.85	17.03	27.66	-0.5	***0.0***
10.0	69.66	18.58	27.66	-0.5	***0.0***
10.8	65.79	17.54	27.66	-0.5	***0.0***
11.7	61.92	16.51	27.66	-0.6	***0.0***
12.5	58.05	15.48	27.66	-0.6	***0.0***
13.3	54.18	14.45	27.66	-0.7	***0.0***
14.2	50.31	13.42	27.66	-0.7	***0.0***
15.0	46.44	12.38	27.66	-0.8	***0.0***
15.8	42.57	11.35	27.66	-0.8	***0.0***
16.7	38.70	10.32	27.66	-0.9	***0.0***
17.5	34.83	9.29	27.66	-0.9	***0.0***
18.3	30.96	8.26	27.66	-1.0	***0.0***
19.2	27.09	7.22	27.66	-1.0	***0.0***
20.0	23.22	6.19	27.66	-1.1	***0.0***
20.8	19.35	5.16	27.66	-1.1	***0.0***
21.7	15.48	4.13	27.66	-1.2	***0.0***
22.5	11.61	3.10	27.66	-1.2	***0.0***
23.3	7.74	2.06	27.66	-1.3	***0.0***
24.2	3.87	1.03	27.66	-1.3	***0.0***
25.0	0.00	0.00	27.66	-1.4	***0.0***

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	**0.0 m3**	50 Min	**0.0 m3**	80 Min	**0.0 m3**
30 Min	**0.0 m3**	60 Min	**0.0 m3**	90 Min	**0.0 m3**
40 Min	**0.0 m3**	70 Min	**0.0 m3**	100 Min	**0.0 m3**



STORMWATER DESIGN SHEET

5 YEAR DESIGN STORM EVENT - OUTLET A

PROJECT: 519 THOROLD ROAD, CITY OF WELLAND

LOCATION						TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	FROM M.H.	TO M.H.	PIPE LENGTH (m)	INCREMENT AREA (hectares)	TOTAL AREA (hectares)	TO UPPER END (min)	IN SECTION (min)	RUNOFF COEFF	SECTION A X R	ACCUMLD A x R	RAINFALL INTENSITY (mm/hr)	PEAK FLOW (L/s)
PRE-DEVELOPMENT CONDITIONS - 2 YEAR												
A1	SITE	OUTLET A		0.32	0.32	10.00	10.00	0.400	0.128	0.128	77.186	27.4
PRE-DEVELOPMENT CONDITIONS - 5 YEAR												
A1	SITE	OUTLET A		0.32	0.32	10.00	10.00	0.400	0.128	0.128	90.598	32.2
POST-DEVELOPMENT CONDITIONS - 5 YEAR												
A10	SITE	OUTLET A		0.48	0.48	10.00	10.00	0.650	0.312	0.312	90.598	**78.5**
A20 - Uncontrolled	SITE	OUTLET A		0.02	0.02	10.00	10.00	0.650	0.013	0.013	90.598	3.3
TOTAL ALLOWABLE PEAK OUTFLOW - 2 YEAR (OUTLET A)												**24.2**

DESIGN BY: **UPPER CANADA CONSULTANTS**
30 HANNOVER DRIVE, UNIT 3
CITY OF WELLAND
DESIGN BY: **T. MUSSARI, B.ENG**
DATE: **JUNE 2025**

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
City of Welland - 5 Year IDF Curve

a = 830.00 mm/hr
b = 7.30 minutes
c = 0.78

Modified Rational Method (MRM) Required Storage Volume

5 YEAR STORM EVENT - OUTLET A

519 THOROLD ROAD
Project No.: 25028
Date: JUNE 2025
Design By: T. MUSSARI, B.ENG

Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 5 Year IDF Curve**

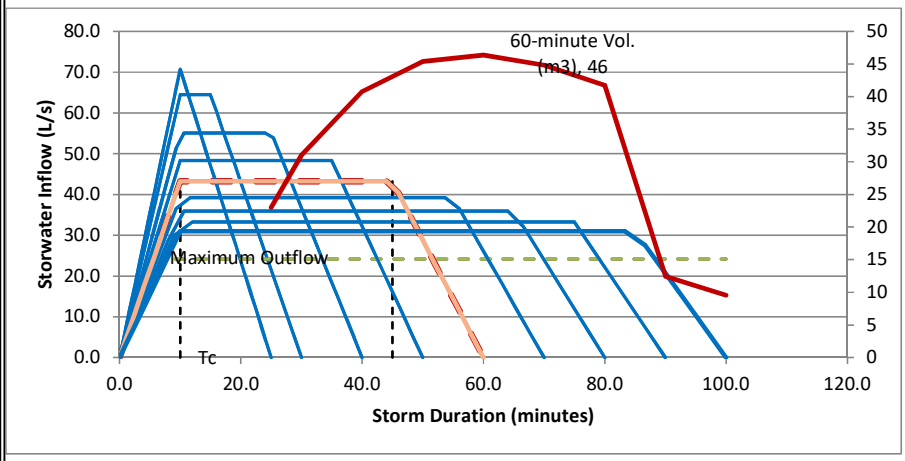
a =	830.00	mm/hr
b =	7.30	minutes
c =	0.78	

Critical Storm Duration:	60.00	minutes	Tail Multiplier (x1-11.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	45.00	minutes	
Accumulated Area x R (Ha):	0.312		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	49.87	mm/hr	
Peak Inflow at Tc:	43.22	L/s	
Maximum Release Rate:	24.17		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	5.59		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	24.17	-1.5	0.0
2.0	9.97	8.64	24.17	-1.9	0.0
4.0	19.95	17.29	24.17	-0.8	0.0
6.0	29.92	25.93	24.17	0.2	0.2
8.0	39.90	34.58	24.17	1.2	1.5
10.0	49.87	43.22	24.17	2.3	3.7
12.0	49.87	43.22	24.17	2.3	6.0
14.0	49.87	43.22	24.17	2.3	8.3
16.0	49.87	43.22	24.17	2.3	10.6
18.0	49.87	43.22	24.17	2.3	12.9
20.0	49.87	43.22	24.17	2.3	15.2
22.0	49.87	43.22	24.17	2.3	17.5
24.0	49.87	43.22	24.17	2.3	19.7
26.0	49.87	43.22	24.17	2.3	22.0
28.0	49.87	43.22	24.17	2.3	24.3
30.0	49.87	43.22	24.17	2.3	26.6
32.0	49.87	43.22	24.17	2.3	28.9
34.0	49.87	43.22	24.17	2.3	31.2
36.0	49.87	43.22	24.17	2.3	33.5
38.0	49.87	43.22	24.17	2.3	35.8
40.0	49.87	43.22	24.17	2.3	38.0
42.0	49.87	43.22	24.17	2.3	40.3
44.0	49.87	43.22	24.17	2.3	42.6
46.0	46.55	40.34	24.17	1.9	44.5
48.0	39.90	34.58	24.17	1.2	45.8
50.0	33.25	28.82	24.17	0.6	***46.4***
52.0	26.60	23.05	24.17	-0.1	46.2
54.0	19.95	17.29	24.17	-0.8	45.4
56.0	13.30	11.53	24.17	-1.5	43.9
58.0	6.65	5.76	24.17	-2.2	41.7
60.0	0.00	0.00	24.17	-2.9	38.8

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	23.0 m3	50 Min	45.4 m3	80 Min	41.7 m3
30 Min	31.0 m3	60 Min	**46.4 m3**	90 Min	12.5 m3
40 Min	40.8 m3	70 Min	44.8 m3	100 Min	9.6 m3



STORMWATER DESIGN SHEET

5 YEAR DESIGN STORM EVENT - OUTLET B

PROJECT: 519 THOROLD ROAD, CITY OF WELLAND

	LOCATION					TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	FROM M.H.	TO M.H.	PIPE LENGTH (m)	INCREMENT AREA (hectares)	TOTAL AREA (hectares)	TO UPPER END (min)	IN SECTION (min)	RUNOFF COEFF	SECTION A X R	ACCUMLD A x R	RAINFALL INTENSITY (mm/hr)	PEAK FLOW (L/s)
PRE-DEVELOPMENT CONDITIONS - 5 YEAR												
A2	SITE	OUTLET		0.43	0.43	10.00	10.00	0.300	0.129	0.129	90.598	32.5
POST-DEVELOPMENT CONDITIONS - 5 YEAR												
A10				0.24	0.24	10.00	10.00	0.400	0.096	0.096	90.598	**24.2**
TOTAL ALLOWABLE PEAK OUTFLOW - 5 YEAR												**32.5**

DESIGN BY: **UPPER CANADA CONSULTANTS**
30 HANNOVER DRIVE, UNIT 3
CITY OF WELLAND
DESIGN BY: **T. MUSSARI, B.ENG**
DATE: **JUNE 2025**

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
City of Welland - 5 Year IDF Curve

a = 830.00 mm/hr
b = 7.30 minutes
c = 0.78

Modified Rational Method (MRM) Required Storage Volume

2 YEAR STORM EVENT - OUTLET B

519 THOROLD ROAD
Project No.: 25028
Date: JUNE 2025
Design By: T. MUSSARI, B.ENG

Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 5 Year IDF Curve**

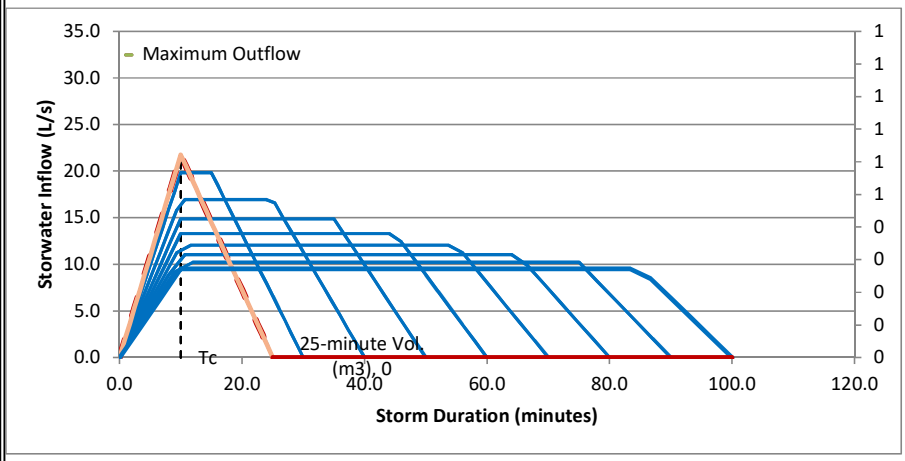
a =	830.00	mm/hr
b =	7.30	minutes
c =	0.78	

Critical Storm Duration:	25.00	minutes	Tail Multiplier (x1-11.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	10.00	minutes	
Accumulated Area x R (Ha):	0.096		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	81.58	mm/hr	
Peak Inflow at Tc:	21.75	L/s	
Maximum Release Rate:	32.46		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	OUTLET CAPACITY LARGER THAN INLET		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	32.46	-1.9	***0.0***
0.8	6.80	1.81	32.46	-1.5	***0.0***
1.7	13.60	3.63	32.46	-1.4	***0.0***
2.5	20.39	5.44	32.46	-1.4	***0.0***
3.3	27.19	7.25	32.46	-1.3	***0.0***
4.2	33.99	9.06	32.46	-1.2	***0.0***
5.0	40.79	10.88	32.46	-1.1	***0.0***
5.8	47.59	12.69	32.46	-1.0	***0.0***
6.7	54.38	14.50	32.46	-0.9	***0.0***
7.5	61.18	16.32	32.46	-0.8	***0.0***
8.3	67.98	18.13	32.46	-0.7	***0.0***
9.2	74.78	19.94	32.46	-0.6	***0.0***
10.0	81.58	21.75	32.46	-0.5	***0.0***
10.8	77.05	20.55	32.46	-0.6	***0.0***
11.7	72.51	19.34	32.46	-0.7	***0.0***
12.5	67.98	18.13	32.46	-0.7	***0.0***
13.3	63.45	16.92	32.46	-0.8	***0.0***
14.2	58.92	15.71	32.46	-0.8	***0.0***
15.0	54.38	14.50	32.46	-0.9	***0.0***
15.8	49.85	13.29	32.46	-1.0	***0.0***
16.7	45.32	12.09	32.46	-1.0	***0.0***
17.5	40.79	10.88	32.46	-1.1	***0.0***
18.3	36.26	9.67	32.46	-1.1	***0.0***
19.2	31.72	8.46	32.46	-1.2	***0.0***
20.0	27.19	7.25	32.46	-1.3	***0.0***
20.8	22.66	6.04	32.46	-1.3	***0.0***
21.7	18.13	4.83	32.46	-1.4	***0.0***
22.5	13.60	3.63	32.46	-1.4	***0.0***
23.3	9.06	2.42	32.46	-1.5	***0.0***
24.2	4.53	1.21	32.46	-1.6	***0.0***
25.0	0.00	0.00	32.46	-1.6	***0.0***

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	**0.0 m3**	50 Min	**0.0 m3**	80 Min	**0.0 m3**
30 Min	**0.0 m3**	60 Min	**0.0 m3**	90 Min	**0.0 m3**
40 Min	**0.0 m3**	70 Min	**0.0 m3**	100 Min	**0.0 m3**



STORMWATER DESIGN SHEET

100 YEAR DESIGN STORM EVENT - OUTLETS A & B

PROJECT: 519 THOROLD ROAD, CITY OF WELLAND

LOCATION						TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	FROM M.H.	TO M.H.	PIPE LENGTH (m)	INCREMENT AREA (hectares)	TOTAL AREA (hectares)	TO UPPER END (min)	IN SECTION (min)	RUNOFF COEFF	SECTION A X R	ACCUMLD A x R	RAINFALL INTENSITY (mm/hr)	PEAK FLOW (L/s)
PRE-DEVELOPMENT CONDITIONS - 100 YEAR												
A1	SITE	OUTLET A		0.32	0.32	10.00	10.00	0.400	0.128	0.128	142.985	50.8
A2	SITE	OUTLET B		0.43	0.43	10.00	10.00	0.300	0.129	0.129	142.985	51.2
POST-DEVELOPMENT CONDITIONS - 100 YEAR												
A10	SITE	OUTLET A		0.48	0.48	10.00	10.00	0.650	0.312	0.312	142.985	**123.9**
A20 - Uncontrolled	SITE	OUTLET A		0.02	0.02	10.00	10.00	0.650	0.013	0.013	142.985	5.2
A30	SITE	OUTLET B		0.24	0.24	10.00	10.00	0.400	0.096	0.096	142.985	**38.1**
OUTLET A												
TOTAL ALLOWABLE PEAK OUTFLOW - 100 YEAR (OUTLET A)												45.7
TOTAL ALLOWABLE PEAK OUTFLOW - 5 YEAR (OUTLET A)												**24.2**
5 YEAR POST-DEVELOPMENT FLOW + 15% SURCHARGING												**90.3**
OUTLET B												
TOTAL ALLOWABLE PEAK OUTFLOW - 100 YEAR (OUTLET B)												**51.2**
100 YEAR OVERLAND FLOW - SOUTHEAST DITCH												**33.7**
TOTAL 100 YEAR POST DEVLOPMENT FLOW - (OUTLET B)												**71.8**

DESIGN BY: **UPPER CANADA CONSULTANTS**
30 HANNOVER DRIVE, UNIT 3
CITY OF WELLAND
DESIGN BY: **T. MUSSARI, B.ENG**
DATE: **JUNE 2025**

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
City of Welland - 100 Year IDF Curve

a =	1020.00	mm/hr
b =	4.70	minutes
c =	0.73	

Modified Rational Method (MRM) Required Storage Volume

100 YEAR STORM EVENT - OUTLET A

519 THOROLD ROAD
Project No.: 25028
Date: JUNE 2025
Design By: T. MUSSARI, B.ENG

Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 100 Year IDF Curve**

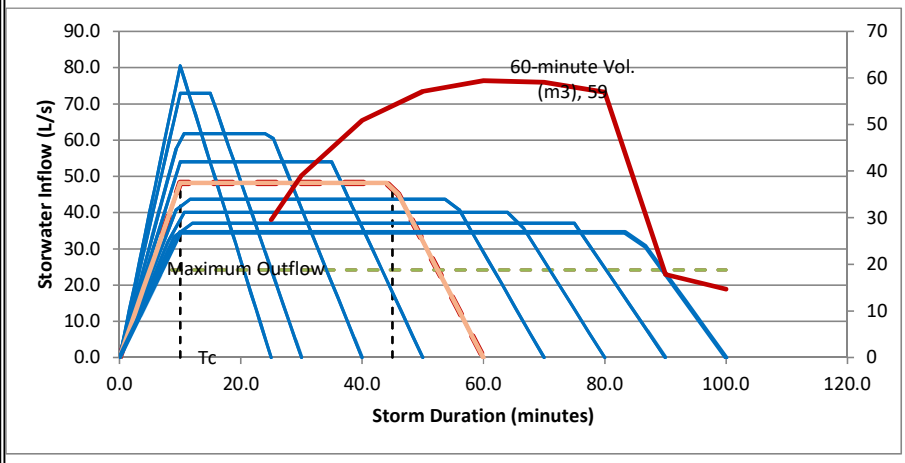
a =	1020.00	mm/hr
b =	4.70	minutes
c =	0.73	

Critical Storm Duration:	60.00	minutes	Tail Multiplier (x1-11.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	45.00	minutes	
Accumulated Area x R (Ha):	0.227		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	76.32	mm/hr	
Peak Inflow at Tc:	48.17	L/s	
Maximum Release Rate:	24.20		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	5.02		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	24.20	-1.5	0.0
2.0	15.26	9.63	24.20	-1.7	0.0
4.0	30.53	19.27	24.20	-0.6	0.0
6.0	45.79	28.90	24.20	0.6	0.6
8.0	61.05	38.54	24.20	1.7	2.3
10.0	76.32	48.17	24.20	2.9	5.2
12.0	76.32	48.17	24.20	2.9	8.0
14.0	76.32	48.17	24.20	2.9	10.9
16.0	76.32	48.17	24.20	2.9	13.8
18.0	76.32	48.17	24.20	2.9	16.7
20.0	76.32	48.17	24.20	2.9	19.5
22.0	76.32	48.17	24.20	2.9	22.4
24.0	76.32	48.17	24.20	2.9	25.3
26.0	76.32	48.17	24.20	2.9	28.2
28.0	76.32	48.17	24.20	2.9	31.1
30.0	76.32	48.17	24.20	2.9	33.9
32.0	76.32	48.17	24.20	2.9	36.8
34.0	76.32	48.17	24.20	2.9	39.7
36.0	76.32	48.17	24.20	2.9	42.6
38.0	76.32	48.17	24.20	2.9	45.4
40.0	76.32	48.17	24.20	2.9	48.3
42.0	76.32	48.17	24.20	2.9	51.2
44.0	76.32	48.17	24.20	2.9	54.1
46.0	71.23	44.96	24.20	2.5	56.6
48.0	61.05	38.54	24.20	1.7	58.3
50.0	50.88	32.12	24.20	0.9	59.2
52.0	40.70	25.69	24.20	0.2	***59.4***
54.0	30.53	19.27	24.20	-0.6	58.8
56.0	20.35	12.85	24.20	-1.4	57.5
58.0	10.18	6.42	24.20	-2.1	55.3
60.0	0.00	0.00	24.20	-2.9	52.4

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	29.6 m3	50 Min	57.1 m3	80 Min	57.0 m3
30 Min	39.0 m3	60 Min	**59.4 m3**	90 Min	17.8 m3
40 Min	50.9 m3	70 Min	59.1 m3	100 Min	14.7 m3



Modified Rational Method (MRM) Required Storage Volume

100 YEAR STORM EVENT - OUTLET B

519 THOROLD ROAD
Project No.: 25028
Date: JUNE 2025
Design By: T. MUSSARI, B.ENG

Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 100 Year IDF Curve**

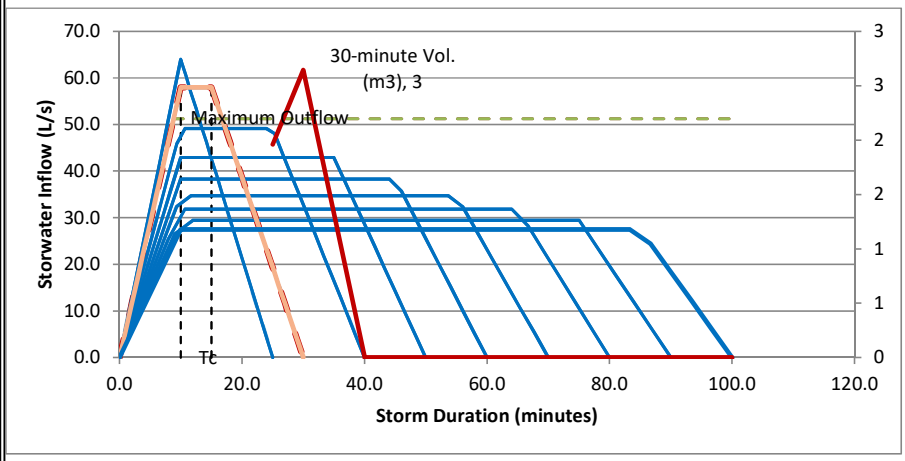
a =	1020.00	mm/hr
b =	4.70	minutes
c =	0.73	

Critical Storm Duration:	30.00	minutes	Tail Multiplier (x1-11.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	15.00	minutes	
Accumulated Area x R (Ha):	0.181		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	115.44	mm/hr	
Peak Inflow at Tc:	57.95	L/s	
Maximum Release Rate:	51.24		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	8.84		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	51.24	-3.1	0.0
1.0	11.54	5.79	51.24	-2.7	0.0
2.0	23.09	11.59	51.24	-2.4	0.0
3.0	34.63	17.38	51.24	-2.0	0.0
4.0	46.17	23.18	51.24	-1.7	0.0
5.0	57.72	28.97	51.24	-1.3	0.0
6.0	69.26	34.77	51.24	-1.0	0.0
7.0	80.81	40.56	51.24	-0.6	0.0
8.0	92.35	46.36	51.24	-0.3	0.0
9.0	103.89	52.15	51.24	0.1	0.1
10.0	115.44	57.95	51.24	0.4	0.5
11.0	115.44	57.95	51.24	0.4	0.9
12.0	115.44	57.95	51.24	0.4	1.3
13.0	115.44	57.95	51.24	0.4	1.7
14.0	115.44	57.95	51.24	0.4	2.1
15.0	115.44	57.95	51.24	0.4	2.5
16.0	107.74	54.09	51.24	0.2	**2.6**
17.0	100.05	50.22	51.24	-0.1	2.6
18.0	92.35	46.36	51.24	-0.3	2.3
19.0	84.65	42.50	51.24	-0.5	1.8
20.0	76.96	38.63	51.24	-0.8	1.0
21.0	69.26	34.77	51.24	-1.0	0.0
22.0	61.57	30.91	51.24	-1.2	0.0
23.0	53.87	27.04	51.24	-1.5	0.0
24.0	46.17	23.18	51.24	-1.7	0.0
25.0	38.48	19.32	51.24	-1.9	0.0
26.0	30.78	15.45	51.24	-2.1	0.0
27.0	23.09	11.59	51.24	-2.4	0.0
28.0	15.39	7.73	51.24	-2.6	0.0
29.0	7.70	3.86	51.24	-2.8	0.0
30.0	0.00	0.00	51.24	-3.1	0.0

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	2.0 m3	50 Min	0.0 m3	80 Min	0.0 m3
30 Min	**2.6 m3**	60 Min	0.0 m3	90 Min	0.0 m3
40 Min	0.0 m3	70 Min	0.0 m3	100 Min	0.0 m3



UPPER CANADA CONSULTANTS
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APPENDIX D

Hydroworks HD4 Output File
Sample Inspection Checklist

UPPER CANADA CONSULTANTS
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HYDROWORKS OUTPUT FILE

```
*************************************************
*      Storm Water Management Sizing Model      *
*               Hydroworks, LLC                 *
*                Version 4.4                    *
*                                               *
*        Continuous Simulation Program          *
*              Based on SWMM 4.4H               *
*              Hydroworks, LLC                  *
*               Graham Bryant                   *
*                2003 - 2021                    *
*************************************************

                  Developed by

*************************************************
*               Hydroworks, LLC                 *
*             Metcalf & Eddy, Inc.              *
*            University of Florida              *
*       Water Resources Engineers, Inc.         *
*      (Now Camp Dresser & McKee, Inc.)         *
*              Modified SWMM 4.4                *
*************************************************

          Distributed and Maintained by

*************************************************
*                                               *
*                Hydroworks, LLC                *
*                 888-290-7900                  *
*              www.hydroworks.com               *
*                                               *
*************************************************

*************************************************
*     If any problems occur executing this      *
*     model, contact Mr. Graham Bryant at       *
*     Hydroworks, LLC by phone at 888-290-7900  *
*     or by e-mail: support@hydroworks.com      *
*************************************************

*************************************************
*     This model is based on EPA SWMM 4.4       *
*  "Nature is full of infinite causes which     *
*   have never occurred in experience" da Vinci *
*************************************************


*************************************************
* Entry made to the Rain Block                  *
* Created by the University of Florida - 1988   *
* Updated by Oregon State University, March 2000 *
*************************************************

519 THOROLD ROAD
CITY OF WELLAND

HydroDome Simulation

 ########################################
 #  Precipitation Block Input Commands  #
 ########################################

Station Name.........................  St. Catherines A

Station Location.....................  Ontario

Station, ISTA........................    7287

Beginning date, IYBEG (Yr/Mo/Dy).....  1971/ 1/ 1

Ending date, IYEND (Yr/Mo/Dy).........  2005/12/31

Minimum interevent time, MIT..........     1

Number of ranked storms, NPTS.........    10

NWS format, IFORM (See text)..........     1

Print storm summary, ISUM (O-No 1-Yes)     0

Print all rainfall, IYEAR (O-No 1-Yes)     0

Save storm event data on NSCRAT(1)....     0
(IFILE =0 -Do not save, =1 -Save data)

IDECID 0 - Create interface file
       1 - Create file and analyze
       2 - Synoptic analysis..........     2

Plotting position parameter, A........  0.40

Storm event statistics, NOSTAT........  1100


KODEA (from optional group B0)........     2
```

```
     = 0, Do not include NCDC cumulative values.
     = 1, Average NCDC cumulative values.
     = 2, Use NCDC cumulative value as inst. rain.

    KODEPR (from optional group B0).......     0
     Print NCDC special codes in event summary:
     = 0, only on days with events.
     = 1, on all days with codes present.
     Codes: A = accumulated value, I = incomplete value,
            M = missing value,     O = other code present

*********************************************************
*  Precipitation output created using the Rain block   *
*  Number of precipitation stations...        1        *
*********************************************************

Location Station Number
-------- --------------
       1.     7287


STATION ID ON PRECIP. DATA INPUT FILE = 7287
REQUESTED STATION ID =     7287  CHECK TO BE SURE THEY MATCH.



$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only.  Data placed on interface file
are at correct 15-min. intervals.
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

#################################################
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and  #
# McKee, Inc., March 2002.                      #
#################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                    Tom Robbins     #
#################################################

                  519 THOROLD ROAD

                  CITY OF WELLAND

Snowmelt parameter - ISNOW.....................          0

Number of rain gages - NRGAG...................          1

Horton infiltration equation used - INFILM.....          2
Maximum infiltration volume is limited to RMAXINF input on  subcatchment lines.
Infiltration volume regenerates during  non rainfall periods.

Quality is simulated - KWALTY..................          1

IVAP is negative.  Evaporation will be set to zero
    during time steps with rainfall.

Read evaporation data on line(s) F1 (F2) - IVAP..          1

Hour of day at start of storm - NHR............          1

Minute of hour at start of storm - NMN.........          1

Time TZERO at start of storm (hours)...........      1.017

Use Metric units for I/O - METRIC..............          1
 ===> Ft-sec units used in all internal computations

Runoff input print control...                             0

Runoff graph plot control....                             1

Runoff output print control..                             0

Print headers every 50 lines - NOHEAD (0=yes, 1=no)       0

Print land use load percentages -LANDUPR (0=no, 1=yes)    0

Limit number of groundwater convergence messages to 10000 (if simulated)

Month, day, year of start of storm is:             1/ 1/1971

Wet time step length (seconds).......                   300.

Dry time step length (seconds).......                   900.

Wet/Dry time step length (seconds)...                   450.

Simulation length is......                      20051231.0 Yr/Mo/Dy

Percent of impervious area with zero detention depth    25.0

Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
```

REGEN = ... 0.01000

****
* Processed Precipitation will be read from file *
****

############################
Data Group F1
Evaporation Rate (mm/day)
############################

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
0.00	0.00	0.00	2.54	2.54	3.81	3.81	3.81	2.54	2.54	0.00	0.00

****
* C H A N N E L A N D P I P E D A T A *
****

Input equen umber	NAMEG: Channel ID #	Drains to NGTO:	Channel Type	Width (m)	Length (m)	Invert Slope (m/m)	L Side Slope (m/m)	R Side Slope (m/m)	Intial Depth (m)	Max Depth (m)	Mann- ings "N"	Full Flow (cms)
1	201	200	Dummy	0.0	0.0	0.0000	0.0000	0.0000	0.0	0.0	0.0000	0.00E+00

****
* S U B C A T C H M E N T D A T A *
****

NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS

SUBCATCH- MENT NO.	CHANNEL OR INLET	WIDTH (M)	AREA (HA)	PERCENT IMPERV.	SLOPE (M/M)	RESISTANCE IMPERV.	FACTOR PERV.	DEPRES. IMPERV.	STORAGE(MM) PERV.	INFILTRATION RATE(MM/HR) MAXIMUM	INFILTRATION RATE(MM/HR) MINIMUM	DECAY RATE (1/SEC)	GAGE NO.	MAXIMUM VOLUME (MM)
1	300	200	69.28	0.48	69.00	0.0200	0.015	0.250	0.510	5.080	63.50	10.16	0.00055	1	101.60000

TOTAL NUMBER OF SUBCATCHMENTS... 1
TOTAL TRIBUTARY AREA (HECTARES). 0.48
IMPERVIOUS AREA (HECTARES)..... 0.33
PERVIOUS AREA (HECTARES)..... 0.15
TOTAL WIDTH (METERS)..... 69.28
PERCENT IMPERVIOUSNESS..... 69.00

****
* U P S T R E A M S T O R A G E D A T A *
****

Storage (m3)	Flow (m3/s)
0.	0.000
72.	0.074

****
* G R O U N D W A T E R I N P U T D A T A *
****

SUB-CATCH NUMBER	CHANNEL OR INLET	ELEVATIONS GROUND (M)	BOTTOM (M)	STAGE (M)	BC (M)	TW (M)	FLOW CONSTANTS A1 (MM/HR-M^B1)	B1	A2 (MM/HR-M^B2)	B2	A3 (MM/HR-M^2)
0	602	3.05	0.00	0.00	0.61	0.61	3.484E-04	2.600	0.000E+00	1.000	0.00E+00

****
* G R O U N D W A T E R I N P U T D A T A (CONTINUED) *
****

S O I L P R O P E R T I E S

SUBCAT. NO.	POROSITY	SATURATED HYDRAULIC CONDUCTIVITY (mm/hr)	WILTING POINT	FIELD CAPACITY	INITIAL MOISTURE	MAX. DEEP PERCOLATION (mm/hr)	PERCOLATION PARAMETERS HCO	PCO	ET PARAMETERS DEPTH OF ET (m)	FRACTION OF ET TO UPPER ZONE
0	.4000	127.000	.1500	.3000	.3000	5.080E-02	10.00	4.57	4.27	0.350

****
* Arrangement of Subcatchments and Channel/Pipes *
****
* See second subcatchment output table for connectivity *
* of subcatchment to subcatchment flows. *
****

Channel or Pipe
201 No Tributary Channel/Pipes
No Tributary Subareas.....

INLET
200 Tributary Channel/Pipes... 201
Tributary Subareas..... 300

```
**********************************************************
* Hydrographs will be stored for the following   1 INLETS *
**********************************************************
          200

#####################################################
#              Quality Simulation                   #
#####################################################
#      General Quality Control Data Groups          #
#####################################################

 Description                            Variable       Value
 -----------                            --------       -----

 Number of quality constituents.....    NQS.......         1

 Number of land uses.................   JLAND.......       1

 Standard catchbasin volume.........    CBVOL.......      1.22 cubic meters

 Erosion is not simulated.........      IROS........         0

 DRY DAYS PRIOR TO START OF STORM...    DRYDAY.......      3.00 DAYS

 DRY DAYS REQUIRED TO RECHARGE
 CATCHBASIN CONCENTRATION TO
 INITIAL VALUES..................... DRYBSN.......      5.00 DAYS

 DUST AND DIRT
 STREET SWEEPING EFFICIENCY......... REFFDD.......     0.300

 DAY OF YEAR ON WHICH STREET
 SWEEPING BEGINS.................... KLNBGN.......       120

 DAY OF YEAR ON WHICH STREET
 SWEEPING ENDS...................... KLNEND.......       270


############################################
#     Land use data on data group J2       #
############################################

                                                                LIMITING                          CLEANING  AVAIL.    DAYS SINCE
                                                                BUILDUP    BUILDUP  BUILDUP       INTERVAL  FACTOR      LAST
AND USE   BUILDUP EQUATION TYPE   FUNCTIONAL DEPENDENCE OF     QUANTITY   POWER    COEFF.        IN DAYS   FRACTION   SWEEPING
LNAME)            (METHOD)        BUILDUP PARAMETER(JACGUT)  (DDLIM)    (DDPOW)  (DDFACT)      (CLFREQ)  (AVSWP)    (DSLCL)
-------   --------------------    -------------------------  --------   -------  --------      --------  -------    ---------
Urban De  EXPONENTIAL(1)                  AREA(1)           2.802E+01     0.500    67.250       30.000     0.300     30.000


#############################################
#     Constituent data on data group J3     #
#############################################

                              Total Su
                              --------
Constituent units........     mg/l
Type of units............          0
KALC.....................          2
Type of buildup calc.....   EXPONENTIAL(2)
KWASH....................          0
Type of washoff calc.....  POWER EXPONEN.(0)
KACGUT...................          1
Dependence of buildup....        AREA(1)
LINKUP...................          0
Linkage to snowmelt......  NO SNOW LINKAGE
Buildup param 1 (QFACT1).         28.020
Buildup param 2 (QFACT2).          0.500
Buildup param 3 (QFACT3).         67.250
Buildup param 4 (QFACT4).          0.000
Buildup param 5 (QFACT5).          0.000
Washoff power (WASHPO)...          1.100
Washoff coef. (RCOEF)....          0.086
Init catchb conc (CBFACT)        100.000
Precip. conc. (CONCRN)...          0.000
Street sweep effic (REFF)          0.300
Remove fraction (REMOVE).          0.000
1st order QDECAY, 1/day..          0.000
Land use number..........              1


************************************************
* Constant Groundwater Quality Concentration(s) *
************************************************

 Total Susp has a concentration of..    0.0000   mg/l

***********************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                               *
***********************************************

  CHANNEL/   CONSTITUENT
     PIPE Total Susp
----------  --------
```

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```
      201     0.000
*****************************************************
*     Subcatchment surface quality on data group L1 *
*****************************************************

                            Total   Number   Input
                     Land    Gutter     of    Loading
            Land     Use    Length   Catch-  load/ha
      No.  Usage     No.      Km     Basins   Total Su
    ------ --------  ----   -------- --------  -------
   1        300 Urban De  1         0.14     2.00  0.0E+00
   Totals (Loads in kg or other)    0.14     2.00  0.0E+00

    **********************
    *    DATA GROUP M1    *
    **********************

TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT..        1
NUMBER OF TIME STEPS BETWEEN PRINTINGS..INTERV..        0
STARTING AND STOPPING PRINTOUT DATES............        0        0


    **********************
    *    DATA GROUP M3    *
    **********************

CHANNEL/INLET PRINT DATA GROUPS......       -200

===> WARNING !! STORAGE UNIT IS FLOODING.  EXCESS VOLUME CONVEYED AS DISCHARGE

          ****************************************
          * Rainfall from Nat. Weather Serv. file  *
          * in units of hundredths of an inch      *
          ****************************************

         519 THOROLD ROAD
         CITY OF WELLAND

Rainfall Station    St. Catherines A
State/Province      Ontario

Rainfall Depth Summary (mm)

Year     Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec    Total

1971.     31.    0.    0.    0.    0.    0.  126.   93.   52.   60.   29.    0.    391.
1972.      0.    0.    0.   47.   65.  100.   39.  115.   63.   90.    1.    0.    521.
1973.      0.    0.    0.  103.   77.   71.   53.   29.   63.  139.    0.    0.    534.
1974.      0.    0.    0.   67.  105.   62.   50.   31.   74.   37.  110.    0.    536.
1975.      0.    0.    0.    0.    0.   94.   78.   76.   73.   56.   59.    6.    442.
1976.      0.    0.    0.  119.  136.   87.  101.   60.   72.   73.   13.    1.    662.
1977.      0.    0.    0.   94.   29.   69.   57.  150.  230.   71.    0.    1.    701.
1978.      0.    0.    0.   72.   43.   72.   43.   86.  156.   95.    0.    0.    567.
1979.      0.    0.    0.   84.   92.   33.   91.   88.   84.  129.   71.    0.    673.
1980.      0.    0.    0.   81.   39.  122.   60.   32.   79.   96.   45.    0.    554.
1981.      0.    0.    0.   91.   71.  106.  122.   61.  123.   91.   84.    0.    749.
1982.      0.    0.    0.   28.   65.   97.   36.   66.   82.   25.  143.    0.    544.
1983.      0.    0.    0.   78.  100.   65.   55.  106.   75.  122.   92.    0.    694.
1984.      0.    0.    0.   31.  113.  136.   19.   51.  144.   24.   44.    0.    562.
1985.      0.    0.   67.   32.   52.   64.   40.   94.   42.  109.    0.    1.    501.
1986.      0.    0.    0.   93.  113.   60.   85.   83.   98.   80.   43.   65.    719.
1987.      0.    2.   11.   77.   42.   80.  122.   97.   99.   71.   94.   34.    730.
1988.      0.    0.   41.   71.   42.   21.  110.   82.   70.   68.   75.    5.    585.
1989.      0.    0.   13.   63.  137.  108.   36.   45.   89.   73.   84.    0.    647.
1990.      0.    2.   38.   99.  124.   44.   68.   95.   56.  112.   96.    0.    735.
1991.      0.    0.   86.  124.   67.   31.   85.   57.   79.   64.   61.   28.    682.
1992.      0.    0.   29.  127.   56.   92.  185.  116.   77.   47.  103.   38.    869.
1993.      3.    0.    7.   83.   56.   86.   32.   61.   71.   92.   80.   38.    610.
1994.      0.    0.   44.   88.  105.  124.   48.   77.  117.   15.    0.   15.    633.
1995.    112.   23.   16.   48.   37.   60.  123.   66.    8.  137.   94.    0.    724.
1998.      0.    0.    0.    0.   51.   54.   64.   29.    9.    0.    1.    0.    207.
1999.      0.    0.    0.   79.   59.   35.   61.   58.  116.   78.    0.    0.    487.
2000.      0.    0.    0.  123.  134.  216.   51.    0.    0.    0.   10.    0.    534.
2001.      0.    0.    0.   56.   88.   45.   25.   30.   81.  129.    0.    0.    454.
2002.      0.    0.    0.   73.  104.   64.   53.   49.   52.   65.    8.    0.    468.
2003.      0.    0.    0.   10.  163.   77.   81.   64.   67.   73.    2.    0.    537.
2004.      0.    0.    0.  131.  126.   99.  115.   40.   88.   17.    0.    0.    616.
2005.      0.    0.    0.   38.   42.   78.   53.  120.  112.    0.    0.    0.    443.

Total Rainfall Depth for Simulation Period    19310. (mm)


Rainfall Intensity Analysis (mm/hr)

(mm/hr)   (#)       (%)       (mm)       (%)

  2.50  21481      74.6      6454.      33.4
  5.00   3585      12.4      3088.      16.0
  7.50   1973       6.8      2886.      14.9
 10.00    575       2.0      1233.       6.4
 12.50    389       1.4      1070.       5.5
 15.00    194       0.7       660.       3.4
 17.50    210       0.7       846.       4.4
 20.00     66       0.2       306.       1.6
 22.50     92       0.3       487.       2.5
 25.00     39       0.1       232.       1.2
 27.50     37       0.1       246.       1.3
```

30.00	34	0.1	245.	1.3
32.50	29	0.1	228.	1.2
35.00	5	0.0	42.	0.2
37.50	10	0.0	90.	0.5
40.00	10	0.0	97.	0.5
42.50	12	0.0	124.	0.6
45.00	9	0.0	99.	0.5
47.50	1	0.0	12.	0.1
50.00	3	0.0	37.	0.2
>50.00	49	0.2	829.	4.3

Total # of Intensities 28803

Daily Rainfall Depth Analysis (mm)

(mm)	(#)	(%)	(mm)	(%)
2.50	1077	38.9	1247.	6.5
5.00	507	18.3	1850.	9.6
7.50	326	11.8	2006.	10.4
10.00	226	8.2	1958.	10.1
12.50	150	5.4	1672.	8.7
15.00	111	4.0	1495.	7.7
17.50	100	3.6	1620.	8.4
20.00	67	2.4	1260.	6.5
22.50	45	1.6	958.	5.0
25.00	37	1.3	881.	4.6
27.50	23	0.8	609.	3.2
30.00	20	0.7	575.	3.0
32.50	20	0.7	631.	3.3
35.00	12	0.4	405.	2.1
37.50	8	0.3	290.	1.5
40.00	9	0.3	350.	1.8
42.50	4	0.1	165.	0.9
45.00	4	0.1	173.	0.9
47.50	2	0.1	91.	0.5
50.00	4	0.1	192.	1.0
>50.00	15	0.5	882.	4.6

Total # Days with Rain 2767

```
************************************************
*      End of time step DO-loop in Runoff      *
************************************************

Final Date (Mo/Day/Year)   =                   1/ 1/2006
Total number of time steps =                     2056363
Final Julian Date  =                             2006001
Final time of day  =                                2. seconds.
Final time of day  =                             0.00   hours.
Final running time =                        306816.0000   hours.
Final running time =                         12784.0000    days.

************************************************
*     Extrapolation Summary for Watersheds       *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls      *
************************************************
```

Subcatch	# Steps	# Calls	Subcatch	# Steps	# Calls	Subcatch	# Steps	# Calls
300	6173142	1566846						

```
************************************************
*     Extrapolation Summary for Channel/Pipes    *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls       *
************************************************
```

Chan/Pipe	# Steps	# Calls	Chan/Pipe	# Steps	# Calls	Chan/Pipe	# Steps	# Calls
201	0	0						

```
*********************************************
*       Continuity Check for Surface Water   *
*********************************************
```

	cubic meters	Millimeters over Total Basin
Total Precipitation (Rain plus Snow)	92460.	19263.
Total Infiltration	28513.	5940.
Total Evaporation	6351.	1323.
Surface Runoff from Watersheds	58234.	12132.
Total Water remaining in Surface Storage	0.	0.
Infiltration over the Pervious Area...	28513.	19162.

Infiltration + Evaporation + Surface Runoff + Snow removal + Water remaining in Surface Storage + Water remaining in Snow Cover.....	93098.	19396.
Total Precipitation + Initial Storage.	92460.	19263.

```
The error in continuity is calculated as
*************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -         *
```

```
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-----------------------------------*
* Precipitation + Initial Snow Cover  *
***************************************
Error.................................       -0.691 Percent

*********************************************
*       Continuity Check for Channel/Pipes   *
*********************************************
                                                          Millimeters over
                                                cubic meters  Total Basin
Initial Channel/Pipe Storage.................                0.         0.
Final Channel/Pipe Storage...................                0.         0.
Surface Runoff from Watersheds...............            58234.     12132.
Baseflow.....................................                0.
Groundwater Subsurface Inflow................                0.         0.
Evaporation Loss from Channels...............                0.         0.
Channel/Pipe/Inlet Outflow...................            58234.     12132.
Initial Storage + Inflow.....................            58234.     12132.
Final Storage + Outflow......................            58234.     12132.
*********************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ---------------------------------    *
*  Final Storage + Outflow  + Evaporation  *
*********************************************
Error.....................................      0.000 Percent

*************************************************
*     Continuity Check for Subsurface Water       *
*************************************************
                                                          Millimeters over
                                                cubic meters      Subsurface Basin

Total Infiltration                                         0.         0.
Total Upper Zone ET                                        0.         0.
Total Lower Zone ET                                        0.         0.
Total Groundwater flow                                     0.         0.
Total Deep percolation                                     0.         0.
Initial Subsurface Storage                              4389.       914.
Final Subsurface Storage                                4389.       914.
Upper Zone ET over Pervious Area                           0.         0.
Lower Zone ET over Pervious Area                           0.         0.

****************************************
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET -    *
* Groundwater Flow - Deep Percolation    *
* -------------------------------------- *
*     Infiltration + Initial Storage     *
****************************************
Error ....................................     0.000 Percent
```

SUMMARY STATISTICS FOR SUBCATCHMENTS

SUBCATCHMENT NO.	GUTTER OR INLET NO.	AREA (HA)	PERCENT IMPER.	TOTAL SIMULATED RAINFALL (MM)	PERVIOUS AREA TOTAL RUNOFF DEPTH (MM)	PERVIOUS AREA TOTAL LOSSES (MM)	PERVIOUS AREA PEAK RUNOFF RATE (CMS)	IMPERVIOUS AREA RUNOFF DEPTH (MM)	IMPERVIOUS AREA PEAK RUNOFF RATE (CMS)	TOTAL SUBCATCHMENT AREA RUNOFF DEPTH (MM)	TOTAL SUBCATCHMENT AREA PEAK RUNOFF RATE (CMS)	TOTAL SUBCATCHMENT AREA PEAK UNIT RUNOFF (MM/HR)
300	200	0.48	69.019	262.47	101.892********		0.05017	534.227	0.180	12130.202	0.230	174.090

*** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

SUMMARY STATISTICS FOR CHANNEL/PIPES

CHANNEL NUMBER	FULL FLOW (CMS)	FULL VELOCITY (M/S)	FULL DEPTH (M)	MAXIMUM COMPUTED INFLOW (CMS)	MAXIMUM COMPUTED OUTFLOW (CMS)	MAXIMUM COMPUTED DEPTH (M)	MAXIMUM COMPUTED VELOCITY (M/S)	TIME OF OCCURRENCE DAY	TIME OF OCCURRENCE HR.	LENGTH OF SURCHARGE (HOUR)	MAXIMUM SURCHARGE VOLUME (CU-M)	RATIO OF MAX. TO FULL FLOW	RATIO OF MAX. DEPTH TO FULL DEPTH
201				0.00				1/ 0/1900	0.00				
200				0.23				8/14/1972	14.25				

TOTAL NUMBER OF CHANNELS/PIPES = 2

*** NOTE *** THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

```
#####################################################
#            Runoff Quality Summary Page            #
# If NDIM = 0 Units for:   loads    mass rates      #
#             METRIC = 1    lb        lb/sec        #
#             METRIC = 2    kg        kg/sec        #
# If NDIM = 1 Loads are in units of quantity        #
#             and mass rates are quantity/sec       #
# If NDIM = 2 loads are in units of concentration   #
#             times volume and mass rates have units#
```

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```
                #            of concentration times volume/second  #
                ######################################################

               Total Su NDIM =  0
               METRIC =  2

                                    Total Su
                                    --------
Inputs
------
 1. INITIAL SURFACE LOAD........       10.
 2. TOTAL SURFACE BUILDUP.......     8273.
 3. INITIAL CATCHBASIN LOAD.....        0.
 4. TOTAL CATCHBASIN LOAD.......        0.
 5. TOTAL CATCHBASIN AND
    SURFACE BUILDUP (2+4).......     8273.

Remaining Loads
---------------
 6. LOAD REMAINING ON SURFACE...        4.
 7. REMAINING IN CATCHBASINS....        0.
 8. REMAINING IN CHANNEL/PIPES..        0.

Removals
--------
 9. STREET SWEEPING REMOVAL.....      712.
10. NET SURFACE BUILDUP (2-9)...     7561.
11. SURFACE WASHOFF.............     7555.
12. CATCHBASIN WASHOFF..........        0.
13. TOTAL WASHOFF (11+12).......     7555.
14. LOAD FROM OTHER CONSTITUENTS        0.
15. PRECIPITATION LOAD..........        0.
15a.SUM SURFACE LOAD (13+14+15).     7555.
16. TOTAL GROUNDWATER LOAD......        0.
16a.TOTAL I/I LOAD..............        0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....     7555.
>>Removal in channel/pipes (17a, 17b):
17a.REMOVE BY BMP FRACTION......        0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........     7555.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      130.

Percentages
-----------
20. STREET SWEEPING (9/2).......        9.
21. SURFACE WASHOFF (11/2)......       91.
22. NET SURFACE WASHOFF(11/10)..      100.
23. WASHOFF/SUBCAT LOAD(11/17)..      100.
24. SURFACE WASHOFF/INLET LOAD
    (11/18).....................      100.
25. CATCHBASIN WASHOFF/
    SUBCATCHMENT LOAD (12/17)...        0.
26. CATCHBASIN WASHOFF/
    INLET LOAD (12/18)..........        0.
27. OTHER CONSTITUENT LOAD/
    SUBCATCHMENT LOAD (14/17)...        0.
28. INSOLUBLE FRACTION/
    INLET LOAD (14/18)..........        0.
29. PRECIPITATION/
    SUBCATCHMENT LOAD (15/17)...        0.
30. PRECIPITATION/
    INLET LOAD (15/18)..........        0.
31. GROUNDWATER LOAD/
    SUBCATCHMENT LOAD (16/17)...        0.
32. GROUNDWATER LOAD/
    INLET LOAD (16/18)..........        0.
32a.INFILTRATION/INFLOW LOAD/
    SUBCATCHMENT LOAD (16a/17)..        0.
32b.INFILTRATION/INFLOW LOAD/
    INLET LOAD (16a/18).........        0.
32c.CH/PIPE BMP FRACTION REMOVAL/
    SUBCATCHMENT LOAD (17a/17)..        0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/
    SUBCATCHMENT LOAD (17b/17)..        0.
33. INLET LOAD SUMMATION ERROR
    (18+8+6a+17a+17b-17)/17.....        0.

CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.


*********************************************************
*            TSS Particle Size Distribution             *
*********************************************************
   Diameter    %     Specific    Settling Velocity   Critical Peclet
     (um)             Gravity        (m/s)                Number


       2.     5.0      2.65         0.000003            0.054484
       5.     5.0      2.65         0.000017            0.061150
```

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8.	10.0	2.65	0.000043	0.067744
20.	15.0	2.65	0.000267	0.093400
50.	10.0	2.65	0.001629	0.152500
75.	5.0	2.65	0.003548	0.196250
100.	10.0	2.65	0.006044	0.235000
150.	15.0	2.65	0.012234	0.297500
250.	15.0	2.65	0.026615	0.391296
500.	5.0	2.65	0.060604	0.602917
1000.	5.0	2.65	0.111334	0.928988

****
*
* Summary of TSS Removal *
*
****

TSS Removal based on Lab Performance Curve

Model #	Low Q Treated (cms)	High Q Treated (cms)	Runoff Treated (%)	TSS Removed (%)
Unavailabl	0.100	0.100	99.9	73.0
HD 4	0.100	0.100	99.9	79.1
HD 5	0.100	0.100	99.9	83.6
HD 6	0.100	0.100	99.9	87.0
HD 7	0.100	0.100	99.9	89.8
HD 8	0.100	0.100	99.9	92.1
HD 10	0.100	0.100	99.9	95.2
HD 12	0.100	0.100	99.9	97.2

****
*
* Summary of Annual Flow Treatmnet & TSS Removal *
*
****

HD 5

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	13326.	13326.	149.	122.	27.	0.	100.0	82.0
1972.	16911.	16543.	201.	167.	34.	0.	97.8	82.9
1973.	16944.	16944.	210.	175.	35.	0.	100.0	83.2
1974.	17288.	17288.	225.	193.	32.	0.	100.0	85.8
1975.	14715.	14715.	193.	159.	34.	0.	100.0	82.4
1976.	21859.	21859.	243.	203.	41.	0.	100.0	83.3
1977.	23452.	23452.	238.	191.	48.	0.	100.0	80.0
1978.	18707.	18707.	224.	184.	41.	0.	100.0	81.9
1979.	22377.	22377.	258.	216.	42.	0.	100.0	83.8
1980.	17990.	17990.	239.	200.	40.	0.	100.0	83.5
1981.	24896.	24896.	268.	228.	41.	0.	100.0	84.8
1982.	17534.	17534.	218.	185.	33.	0.	100.0	84.9
1983.	23134.	23134.	279.	234.	45.	0.	100.0	83.8
1984.	18609.	18609.	216.	179.	37.	0.	100.0	82.7
1985.	16237.	16237.	212.	178.	34.	0.	100.0	83.9
1986.	23662.	23662.	290.	246.	44.	0.	100.0	84.7
1987.	24495.	24495.	292.	245.	47.	0.	100.0	83.9
1988.	19598.	19598.	244.	208.	36.	0.	100.0	85.2
1989.	21592.	21592.	237.	202.	35.	0.	100.0	85.4
1990.	24471.	24471.	299.	255.	43.	0.	100.0	85.5
1991.	22923.	22923.	280.	237.	43.	0.	100.0	84.6
1992.	29120.	29120.	326.	269.	56.	0.	100.0	82.8
1993.	19799.	19799.	274.	236.	38.	0.	100.0	86.3
1994.	21256.	21256.	227.	186.	41.	0.	100.0	82.0
1995.	24625.	24625.	271.	223.	47.	0.	100.0	82.6
1998.	6366.	6366.	103.	86.	18.	0.	100.0	83.0
1999.	15628.	15628.	208.	173.	34.	0.	100.0	83.5
2000.	17994.	17994.	182.	145.	37.	0.	100.0	79.4
2001.	14233.	14233.	170.	146.	24.	0.	100.0	85.9
2002.	14862.	14862.	198.	167.	31.	0.	100.0	84.5
2003.	16901.	16901.	205.	170.	35.	0.	100.0	83.0
2004.	20271.	20271.	211.	173.	37.	0.	100.0	82.2
2005.	14668.	14668.	161.	128.	33.	0.	100.0	79.7

****
*
* Summary of Toronto Rainfall Intensities *
*
****

Rainfall Intensity (mm/h)	Flow (L/s)	Percentage %
1.50	1.4	34.4
2.25	2.2	12.2
3.00	2.9	9.2
3.75	3.6	6.9
4.75	4.5	6.7
5.75	5.5	5.0
8.00	7.7	7.3
10.00	9.6	4.3
15.50	14.8	6.4
23.25	22.2	7.7

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**************************************************
*  Summary of Quantity and Quality Results at    *
*  Location       200  INFlow in cms.            *
*  Values are instantaneous at indicated time step *
**************************************************

  519 THOROLD ROAD
 CITY OF WELLAND

     Date     Time        Flow   Total Su
 Mo/Da/Year  Hr:Min        cum/s  mg/l
 ----------  -------    -------  --------
Flow wtd means.....        0.001      130.
Flow wtd std devs..        0.002      170.
Maximum value......        0.211     2187.
Minimum value......        0.000        0.
Total loads........       58094.     7549.
                        Cub-Met  KILOGRAM

===> Runoff simulation ended normally.

===> SWMM 4.4    simulation ended normally.
     Always check output file for possible warning messages.

**********************************************************
*       SWMM 4.4    Simulation Date and Time Summary  *
**********************************************************
* Starting Date... July       10, 2025                *
*          Time...          16:39: 4.934               *
*   Ending Date... July       10, 2025                *
*          Time...          16:39: 8. 51               *
*  Elapsed Time...               0.052 minutes.       *
*  Elapsed Time...               3.117 seconds.       *
**********************************************************
```

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SAMPLE INSPECTION REPORT

Owner:

Location: 392 / 398 Thorold Road, Welland

Manhole Oil/Grit Separator: HD4

Type of Inspection ☐ Monthly ☐ Annually ☐ Special

Inlet/Outlet Information

	Inlet		Outlet	
Clear of Debris	☐ Yes	☐ No	☐ Yes	☐ No
Build Up of Sediment	☐ Yes	☐ No	☐ Yes	☐ No

Action Taken:

Sediment Tank Information

A. Manhole Sump Depth: ± m from cover rim (to be as-constructed verified)

B. Measurement from Rim to Sediment Level: m

C. Depth of Sediment: m (A - B)

Note: If the measured depth of sediment is greater than **200mm** then sediment removal is required.

Presence of Contaminants

Oil	☐ Yes	☐ No	Depth	m
Foam	☐ Yes	☐ No	Depth	m

Action Taken:

Name of Regulatory Agency Telephone No.:

Transaction No.:

Name of Licensed Waste Management Collector Telephone No.:

Transaction No.:

Owner Notification ☐ Yes ☐ No Other:

Time: Date:

Name of Inspector:

Signed: Date: