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FUNCTIONAL SERVICING REPORT

308 Four Mile Creek Road (R.R. #100)
Town of Niagara-On-The-Lake

Revised September 2025

INTRODUCTION

The purpose of this report is to address the servicing needs for the proposed vacant land condominium development in support of the applications for Zoning By-Law Amendment and Draft Plan of Condominium. The subject lands are located at 308 Four Mile Creek Road in the St. David's Community of the Town of Niagara-on-the-Lake; north of York Road, west of Four Mile Creek Road, and south of Millpond Road.

The development site is approximately 1.42 hectares and will be developed in two phases. Phase 1 shall consist of nine townhouse units, while Phase 2 will consist of six townhouse units. Both phases will include asphalt paving, concrete curbs, catch basins, sanitary and water services.

The objectives of this report are as follows:

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

WATER SERVICING

There is an existing fire hydrant connected to the existing Regional 300mm diameter watermain located along Four Mile Creek Road. The hydrant is located on the east side of Four Mile Creek Road, approximately 26m from the northeast corner of the Phase 1. It is proposed to install a 150mm watermain and connect to the existing 150mm watermain hydrant lead and extend it within the site (Phase 1 & Phase 2) to provide domestic water supply and fire protection. Private on-site hydrants will be constructed to ensure adequate fire protection for all buildings within the development.

To calculate the required fire flow, the Fire Underwriters Survey (FUS) has been conducted. The FUS calculations consider different factors such as type of construction, combustibility of contents, and spatial separation from adjacent buildings. FUS calculations have been conducted under the assumption the end units will have an area of 210m^2, two storeys above ground, and are constructed

with firewalls separating each internal townhouse unit. Therefore, the minimum flow rate required at the fire hydrant for Phases 1 and 2 is 85.0 L/s (5,100 L/m). The FUS calculations have been enclosed in Appendix A.

A watermain analysis using the EPANET software has been conducted to model the flows and pressure within the existing and proposed system to ensure sufficient flows will be provided under the fire flow conditions. The model has been calibrated utilizing hydrant flow test data conducted by Niagara Fire Protection on December 1, 2023. The tested hydrants are located fronting 329 and 346 Four Mile Creek Road and the results have been attached in Appendix A.

The model was able to replicate the static and residual flows and pressures in the existing hydrants on Four Mile Creek Road within 5% of the tested and theoretical results. Based on the analysis, the proposed Fire Hydrant No. 1 in Phase 1 will provide approximately 122.4 L/s (7,344 L/min) of fire flow, while the proposed Fire Hydrant No. 2 in Phase 2 will provide approximately 90.3 L/s (5,418L/min). A 150 mm diameter water meter chamber will also be required as part of the water servicing design.

Therefore, it is expected that the existing 300mm diameter watermain on Four Mile Creek Road will adequately provide domestic water supply and fire protection to the proposed development (Phases 1 and 2).

SANITARY SERVICING

There is an existing 300mm diameter sanitary sewer on Four Mile Creek Road which conveys the sanitary flows northerly to the St. David's Pumping Station No. 1 (SPS #1) located approximately 220 metres north of the subject site. It is proposed to connect the new development to the existing sanitary sewer on Four Mile Creek Road and extend it within the site.

Originally, approximately 0.64 hectares of the proposed development were allocated in the original St. David's sanitary sewer design, covering Phase 2 entirely as shown in the attached Drainage Area Plan of the original sanitary sewer design prepared by Dillon Consulting and Figure 1. Under the initial design conditions, it is expected that the 5.65 hectares will serve a population of approximately 150 persons, producing a sanitary peak flow of approximately 3.47 L/s, occupying 5.1% of the 300mm diameter sanitary sewer between MH4 to MH3 (as shown in the Dillion Plan), and 12.1% of the operational firm capacity SPS #1 (28.8 L/s), as identified in Table 4.F.8 of the Niagara Region, 2021 Water and Wastewater Master Servicing Plan Update. Figures 1 and 2, and Dillon Drainage Area Plan are provided in Appendix B.

As shown in Figure 2, three sanitary drainage areas are proposed to allocate the future development. Drainage Area A10 (5.15 hectares) is designated for the proposed residential area, as per the initial Dillon design, and it is expected to produce a sanitary peak flow of 3.29 L/s. Drainage Area (0.35 hectares) may serve a population of approximately 18 persons and generate a peak sanitary flow of

0.33 L/s. Drainage Area A30 (0.56 hectares) is expected to serve a population of approximately 27 persons and produce a peak sanitary flow of approximately 0.51 L/s.

Table 1 summarizes the sanitary peak flows and compares the initial and proposed sanitary sewer conditions. All the sanitary sewer calculations can be found in Appendix B.

Table 1. Sanitary Peak Flow Summary

Area #	Area (ha)	Population (Persons)	Peak Flow (L/s)
Initial Sanitary Sewer Design Conditions			
A1	5.52	147	3.40
A2	0.13	3	0.08
Proposed Sanitary Sewer Design Conditions			
A10	5.15	147	3.29
A20	0.35	18	0.33
A30	0.56	27	0.51

AGM Environmental conducted a sanitary flow monitoring study for SPS#1 between February 19, 2022 and July 23, 2022. The results show a maximum flow of 8.37 L/s and an average flow of 0.26L/s for the 300mm sanitary sewer on Four Mile Creek Road. This maximum sanitary flow represents 12.4% of the existing 300mm sanitary sewer capacity and 29.1% of the SPS#1 operational firm capacity.

The proposed 0.56 hectare Phase 1 and 0.35 hectare Phase 2 areas will service a combined population of approximately 45 persons and generate a peak sanitary flow of 0.84 L/s. This represents 1.2% of the total capacity of the existing 300 mm diameter sanitary sewer on Four Mile Creek Road and 2.9% of the SPS #1 operational firm capacity.

Therefore, it is expected that this will be and adequate addition to the current capacity of the existing 300mm sanitary sewer on Four Mile Creek Road, and the St. David's SPS #1.

STORMWATER MANAGEMENT

There is an existing 675mm storm sewer on Four Mile Creek Road, approximately 30m north of the site, which conveys stormwater flows north to Line 9 Road, then west along line 9 Road before discharging into Four Mile Creek. To service the Phase 1, it is proposed to extend the existing 675mm diameter along Four Mile Creek Road and extend it within the Phase 1. Phase 2 will be served by a separate storm sewer system that will outlet to, or connect with, the existing private box culvert.

A Stormwater Drainage Area Plan was prepared by Upper Canada Consultants (UCC) as part of the Cold Storage (Phase 2) project, delineating the storm drainage areas associated with the design of the existing storm sewer system on Four Mile Creek Road. The site was allocated in the future 0.39 hectares drainage area with a runoff coefficient of 0.65.

PHASE 1

Historically, the Phase 1 lands have been used as a gravel parking lot, with stormwater flowing overland directly to Four Mile Creek, as shown in Figure 3 (Appendix C).

For Phase 1 of the proposed development, the existing 675mm diameter storm sewer on Four Mile Creek Road will be extended to service the site. Stormwater flows from Drainage Area A20 will be collected by the storm sewer system and conveyed to a maintenance hole, which will control flows up to the 100 year design storm before discharging into the extended 675 mm sewer on Four Mile Creek Road. Stormwater flows from Drainage Area A21 will be conveyed as overland sheet flow directly to Four Mile Creek. Figure 4 (Appendix C) illustrates the proposed storm drainage areas and their associated runoff coefficients.

The Modified Rational Method (MRM) was used to determine the peak flows and storage volumes required for the 5 year and 100 year storm events, as shown in Appendix C. Based on the MRM analysis, Table 2 shows the comparison of the existing, proposed and allowable peak flows permitted to discharge to Four Mile Creek and the existing storm sewer on Four Mile Creek Road.

Table 2. Peak Flow Summary

Area #	Area (ha)	Runoff Coefficient		Peak Flows (L/s)		Allowable/Controlled Outflow (L/s)
		Existing	Proposed	Existing	Proposed	
5 Year Design Storm Event						
A10	1.42	0.30		106.4		To Four Mile Creek Rd.
FUT	0.39	0.65		63.3		**63.3**
A20	0.37		0.75		69.3	
A21	0.23		0.75		43.1	To Four Mile Creek
A22	0.24		0.75		44.9	(Phase 1 and 2)
A23	0.13		0.75		24.3	**83.4**
A24	0.46		0.20		23.0	
100 Year Design Storm Event						
A10	1.42	0.30		170.7		To Four Mile Creek
A20	0.37		0.75		111.2	(Phase 1)
A21	0.23		0.75		69.1	**63.3**
A22	0.24		0.75		72.1	(Phase 2)
A23	0.13		0.75		39.1	**25.6**
A24	0.46		0.20		36.9	

As shown, the allowable outflow for Phase 1 (A20) to the Four Mile Creek Road is the 5 year storm design flow of 63.3 L/s. The required storage to control the outflow up to the 100 year design storm to Four Mile Creek Road is 13.0m^3, which is equivalent to 114m of 375mm diameter storm sewer. To limit future storm water flows to allowable conditions, typically a control is placed on the outlet from the site that may include an orifice.

Quantity and quality controls are not required for the stormwater generated from A21 discharging directly to the Four Mile Creek. Therefore, it is expected that there will be adequate stormwater servicing capacity in the existing sewer network to serve the site.

To improve the quality of stormwater, an oil/grit separator will be utilized to provide MECP Enhance Protection (80% TSS removal levels) as required for this type of development. It is estimated that a Hydroworks HD4 will provide 92% TSS removal. The complete stormwater design for this development will be identified as part of the future detailed design. Output calculations for the quality assessment can be found in Appendix D.

PHASE 2

Currently, stormwater from the site flows overland and discharges directly into Four Mile Creek, as shown in Figure 3. It is proposed to collect the stormwater within the site and discharge to the existing 2400mm x 1200mm private box culvert.

From the MRM analysis the allowable outflow for Phase 2 (A22) is 16.0L/s for the 5 year design storm and 25.6L/s for the 100 year design storm, determined as the existing flow from A10, less the future flows from drainage areas A21, A23 and A24. The required stormwater storage to control flows up to the 100 year design storm is 22.8m^3. To meet the allowable conditions for future stormwater flows, an outlet control such as orifice and site stormwater storage will be implemented at the site. The required storage will be achieved using underground superpipes, where approximately 50m of 750mm diameter sewer provides the necessary stormwater storage.

To improve stormwater quality, an oil/grit separator will provide Enhanced Level Protection prior to discharge to Four Mile Creek. The modelling for the Hydroworks unit has indicated that a HD4 unit will provide 94% of TSS removal. The complete stormwater design for this development will be identified as part of the future detailed design. Output calculations for the quality assessment can be found in Appendix D.

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STORMWATER SYSTEM MAINTENANCE PROTOCAL

Regular inspections of the stormwater Maintenance Holes Oil/Grit interceptors 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.

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CONCLUSIONS AND RECOMMENDATIONS

Therefore, based on the above comments, drainage area plans and calculations provided for this site, the following summarizes the servicing for this site:

1. The existing 300mm diameter watermain and the150mm diameter hydrant lead on Four Mile Creek Road are expected to have adequate capacity to provide both domestic water supply and fire protection to service the vacant land condominium development.

2. The receiving 300mm diameter sanitary sewers on Four Mile Creek Road will have adequate capacity to service the Site (Phases 1 and 2).

3. On site stormwater quantity controls are being provided for Phase 1 to limit the flows to the allowable levels up to 100 year design storm, before discharge into the Four Mile Creek Road.

4. On site stormwater quantity controls are being provided for Phase 2 to limit the flows to the allowable levels up to 100 year design storm, before discharge into the Four Mile Creek.

5. Stormwater quality control will be provided to MECP Enhance protection (80% TSS removal) levels prior to discharge from the site (Phases 1 and 2).

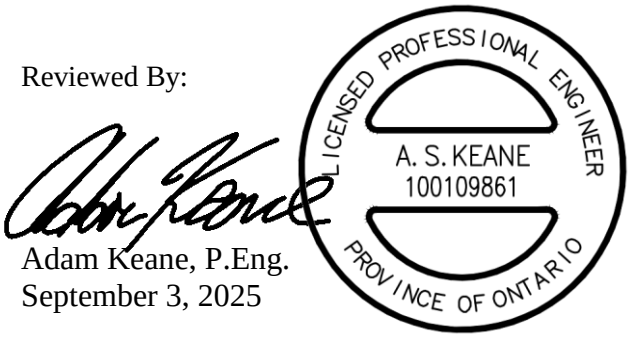
In conclusion, there exists adequate municipal servicing for this development. We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Yours very truly,

Prepared By:

Roberto Duarte, B. Eng.

Reviewed By:



Adam Keane, P.Eng.
September 3, 2025

Encl.

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APPENDICES

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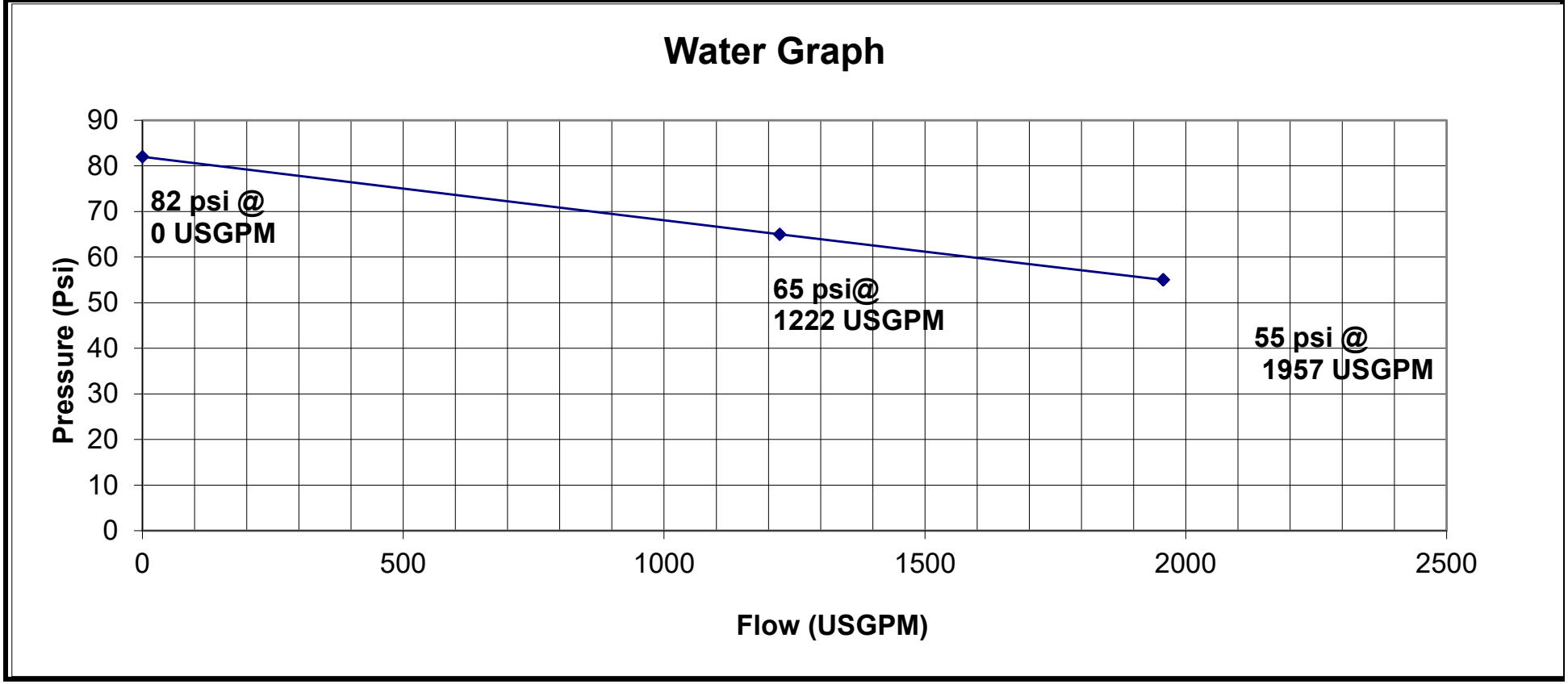
APPENDIX A

Hydrant Flow Test Data – Niagara Regional Fire Protection
Theorical Fire Flow Calculation Sheet
Fire Underwriters Survey – Minimum Fire Flow Calculation Sheet
EPANET Modelling Results
EPANET Modelling Imagery

NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: 329 Four Mile Creek Rd.

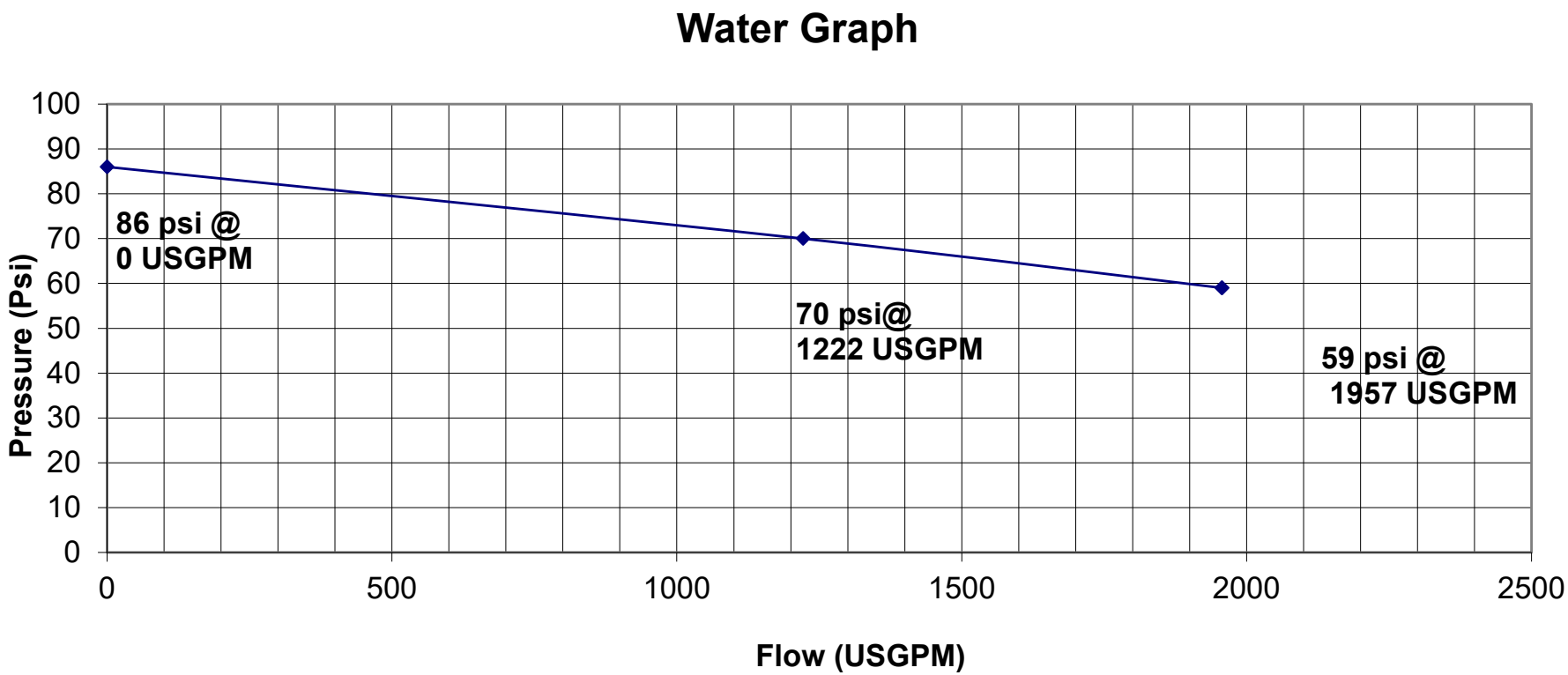
Static Pressure (Psi)		**Pitot Reading 1**	53	**# of Outlets Flowed 1**	1
	82	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	34	**# of Outlets Flowed 3**	2
	65	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	34	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	55	**Outlet Size 3**	2.5	82	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		65	1222
	55		1221.6	55	1957
		Flow 2 Calculated		55	1957
			1956.8	**Date & Time of Test :**	**Dec. 1/2023**
Coefficient value		**Flow 3 Calculated**			**1:30pm**
	0.9		1956.8	**Performed by:**	Beau & Cam



NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: 346 Four Mile Creek Rd.

Static Pressure (Psi)		**Pitot Reading 1**	53	**# of Outlets Flowed 1**	1
	86	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	34	**# of Outlets Flowed 3**	2
	70	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	34	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	59	**Outlet Size 3**	2.5	86	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		70	1222
	59		1221.6	59	1957
		Flow 2 Calculated		59	1957
			1956.8	**Date & Time of Test :**	**Dec. 1/2023**
Coefficient value		**Flow 3 Calculated**			**2:30pm**
	0.9		1956.8	**Performed by:**	Beau & Cam



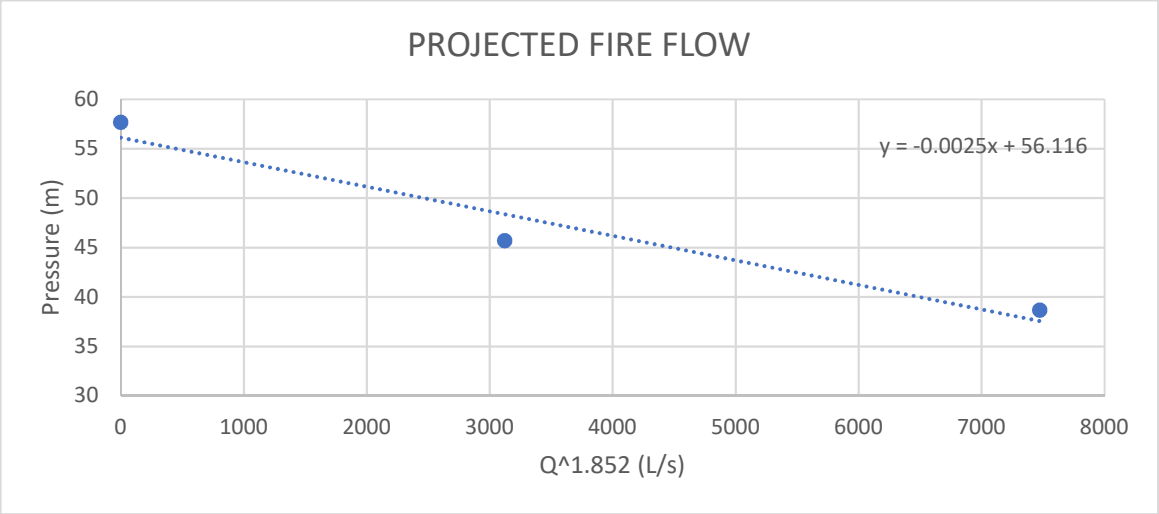
FIRE FLOW CALCULATION SHEET

Project: 308 Four Mile Creek Road, Niagara-On-The-Lake
Project Number: 1520
Date: January 29, 2024
Prepared By: Roberto Duarte, B. Eng
Reviewed By: Jason Schooley, P.Eng.

Flow Test Provided by: Niagara Regional Fire Protection
Data of Test: December 1, 2023
Hydrant Location: 329 FOUR MILE CREEK ROAD

FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	$Q^{1.852}$	PRESSURE (m)
STATIC	82	0	0	0	57.66
RESIDUAL 1	65	1221.6	77.07	3122.62	45.71
RESIDUAL 2	55	1956.8	123.45	7472.59	38.68



FIRE FLOW FORMULA (y = ax + b)

a =	-0.0025
b =	56.116

FIRE FLOW AT A SPECIFIED PRESSURE

Pressure =	20	psi
Pressure =	14.064	m
$Q^{1.852}$ =	16820.80	
Flow, Q =	**191.33**	**L/s**
Flow, Q =	3032.59	USGPM

**Hazen-Williams Equation (1.852)

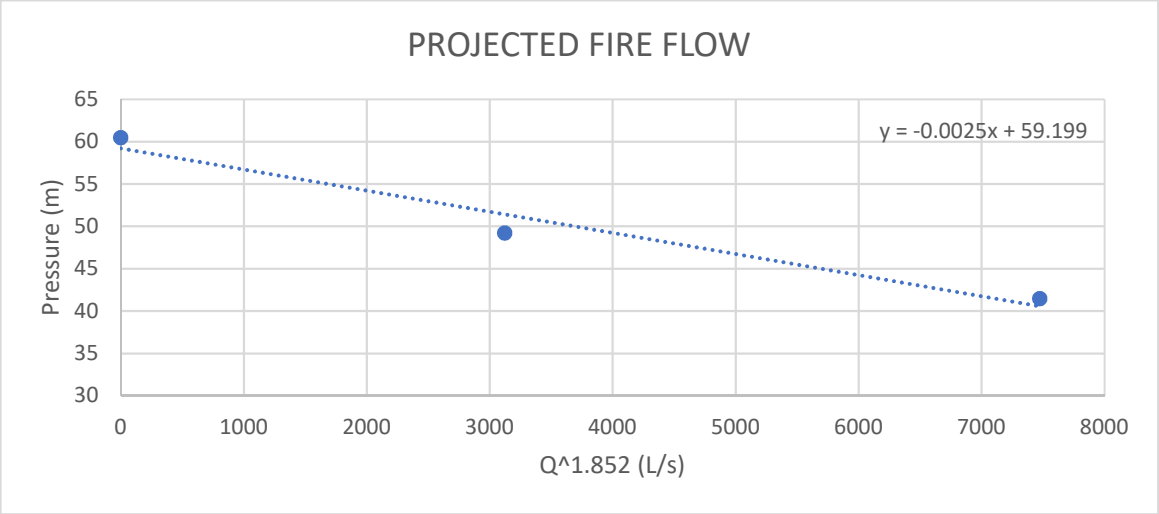
FIRE FLOW CALCULATION SHEET

Project: 308 Four Mile Creek Road, Niagara-On-The-Lake
Project Number: 1520
Date: January 29, 2024
Prepared By: Roberto Duarte, B. Eng
Reviewed By: Jason Schooley, P.Eng.

Flow Test Provided by: Niagara Regional Fire Protection
Data of Test: December 1, 2023
Hydrant Location: 346 FOUR MILE CREEK ROAD

FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	$Q^{1.852}$	PRESSURE (m)
STATIC	86	0	0	0	60.48
RESIDUAL 1	70	1221.6	77.07	3122.62	49.22
RESIDUAL 2	59	1956.8	123.45	7472.59	41.49



FIRE FLOW FORMULA (y = ax + b)

a =	-0.0025
b =	59.199

FIRE FLOW AT A SPECIFIED PRESSURE

Pressure =	20	psi
Pressure =	14.064	m
$Q^{1.852}$ =	18054.00	
Flow, Q =	**198.78**	**L/s**
Flow, Q =	3150.69	USGPM

**Hazen-Williams Equation (1.852)

Fire Underwriters Survey

Water Supply for Public Fire Protection (2020) Calculations

308 Four Mile Creek Road, Niagara-ON-The-Lake

Required Fire Flow in Litres per Minute	F=	5,100	(L/m)
		85.00	(L/s)
		1,347	(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=	210	(m2)
NOTE: Fire Walls that meet or exceed Nation Building Code of Canada (2 hour fire resistance) divide building.			
Total Number of Floors		2	

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:

UNITS 6 & 12		
Distance to Nearest Building to the North	-	0%
Distance to Nearest Building to the South	3.0 m	20%
Distance to Nearest Building to the East	66.0 m	0%
Distance to Nearest Building to the West	-	0%
Total Spacial Separation to Adjacent Structures		20%

Additions

Is roof wood shingles or shakes (Yes/No).	No

EPANET Fire Analysis

Project: 308 Four Mile Creek Road, Niagara-On-The-Lake
File #: 1520
Date: January 29, 2024

Existing Hydrant Calibration

		Flow Test Data				EPANET MODEL	Flow Test Data	EPANET MODEL	
LOCATION	TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	FLOW RATE (L/m)	FLOW RATE (L/m)	PRESSURE (m)	PRESSURE (m)	% Difference
Hydrant Test Data (346 Four Mile Creek)	STATIC	86	0	0.0	0.0	0.0	60.48	*60.76*	0.47%
	RESIDUAL 2	59	1956.8	123.5	7407.3	7407.3	41.49	*41.49*	0.00%
Theoretical Fire Flow		20	3150.69	198.8	11926.6	*11926.6*		*14.06*	
Hydrant Test Data (329 Four Mile Creek)	STATIC	82	0	0.0	0.0	0.0	57.66	*57.88*	0.38%
	RESIDUAL 2	55	1956.8	123.5	7407.3	7407.3	38.68	*38.68*	0.01%
Theoretical Fire Flow		20	3032.59	191.3	11479.6	*11479.6*		*14.06*	

Future Development Test - EPANET Results

Hydrant No.	Hydrant Location	Static Pressure (m)	Modelled Fire Flow (LPM)
1	Phase 1	59.05	7344
2	Phase 2	57.20	5418

***Note: Modelled Fire Flows determined by achieving maximum flow rate at 14.06m of head (20psi)**

Minimum Required Fire Flow for Phases 1 and 2 Townhouses - Per Fire Underwriters Survey Calculations (FUS, 2020)

5100 L/m
85 L/s
1572 Usgpm

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EPANET – Existing Static Modelling Results

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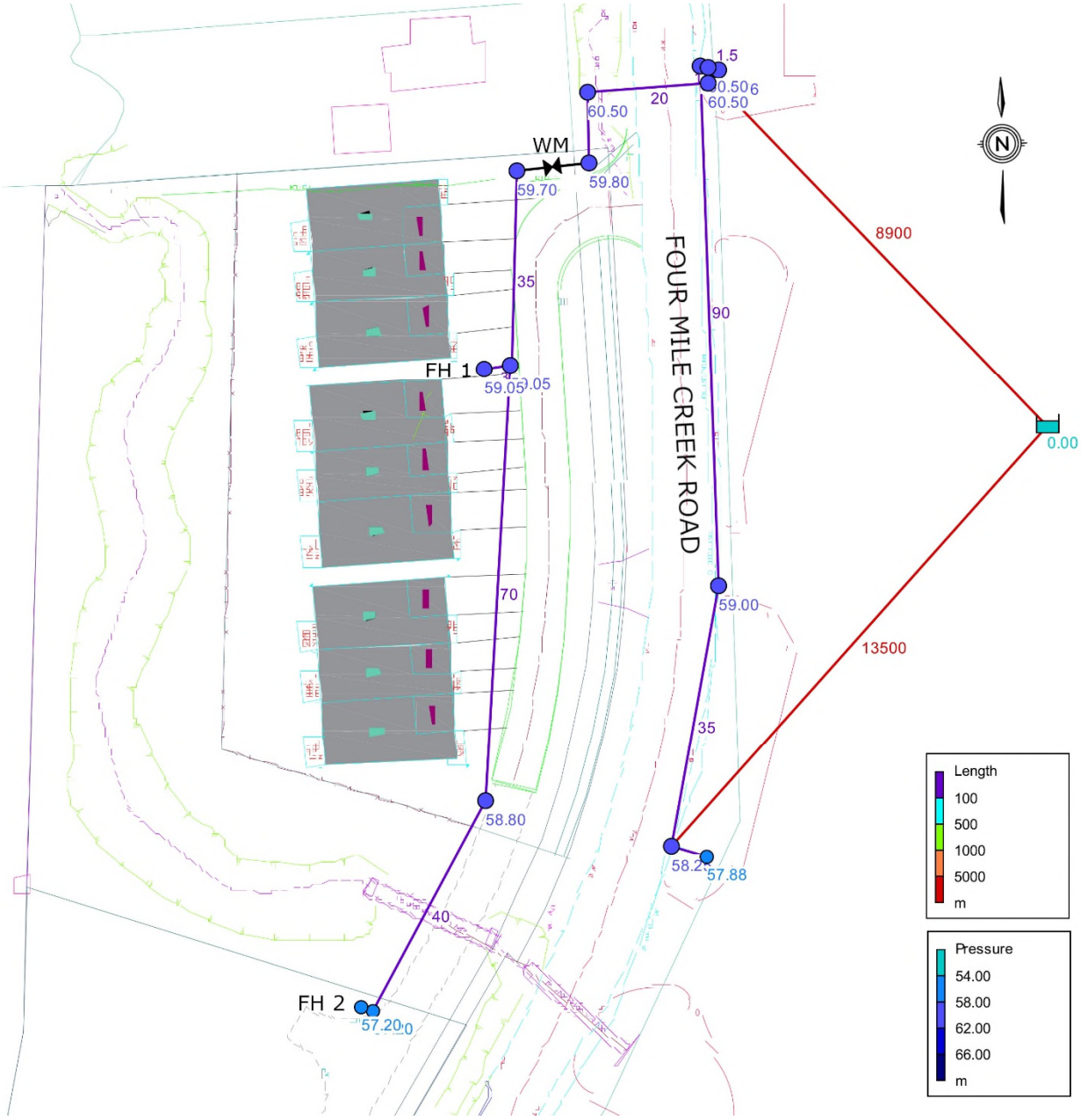
EPANET – Future Static Modelling Results



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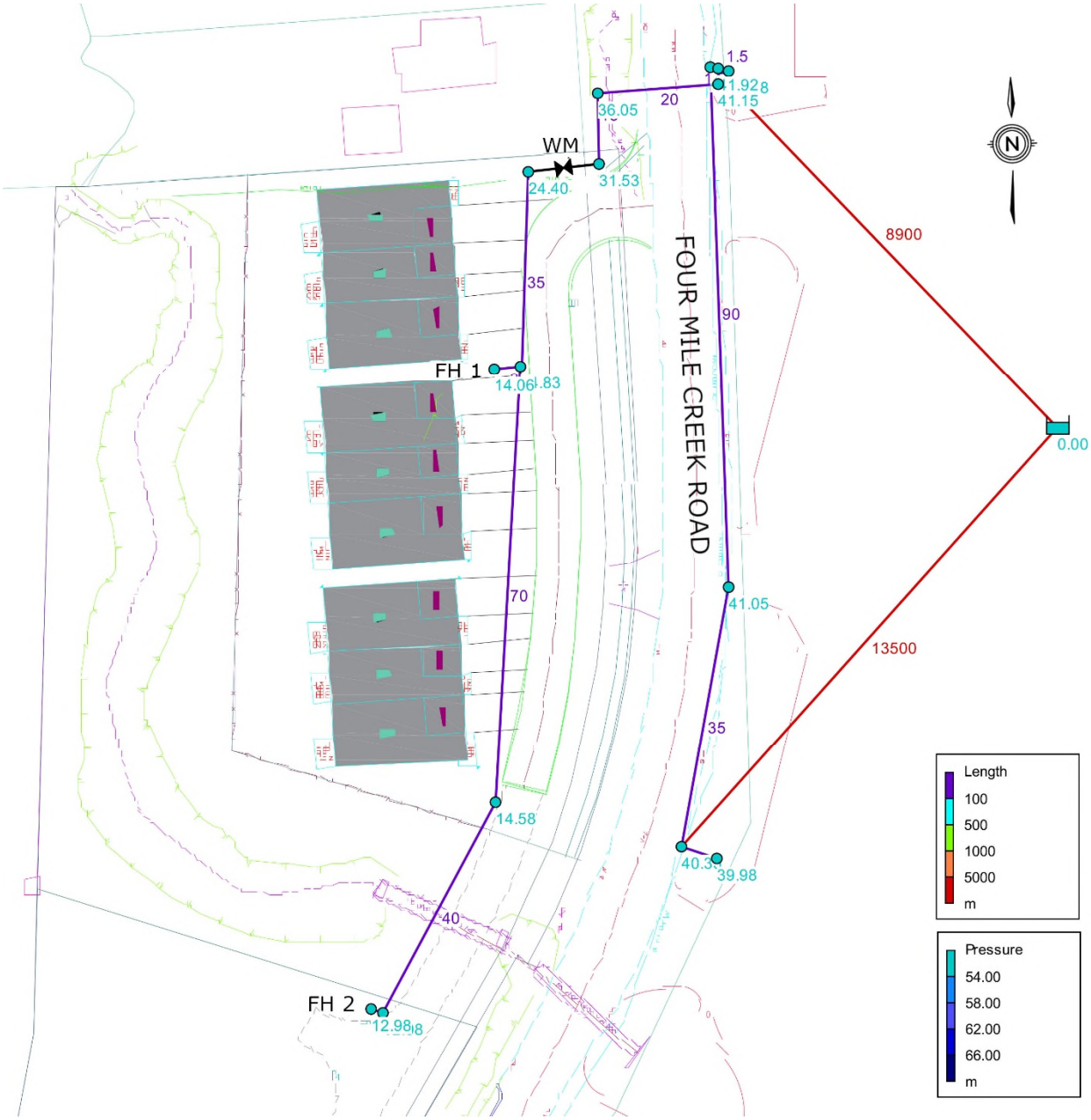
EPANET – Future System Under Fire Flow Conditions Results



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APPENDIX B

Sanitary Drainage Area Plan, Village of St. David's – Dillon Consulting
Figure 3. Original Sanitary Drainage Area Plan
Figure 4. Proposed Sanitary Drainage Area Plan
Sanitary Sewer Design Sheet
Table 4.F.8 – Niagara Region, 2021 Water and Wastewater Master Servicing Plan

PROPOSED SANITARY SEWAGE PUMPING STATION AND FORCEMAIN

PUMP STATION No. 1

FOUR MILE CREEK ROAD

12.0 L. IND.

5.5 L. IND.

8.7 6.3 l/s

KRAFT

0.75 8

0.57 8

0.19 CHURCH

0.53 5

0.34 11

0.22 COMM

0.19 CHURCH

0.26 3

1.04 16

0.41 5

0.72 GOLF

0.29 5

PROP. RES 5.52 147

0.13 3

0.54 22

0.56 COMM

0.30 COMM

0.12 COMM

0.38 COMM

0.31 5

PROP. RES. 13.35 356

0.06 3

0.18 3

0.41 11

0.53 5

0.42 8

FUT. RES 0.51 14

0.39 14

0.23 5

0.52 16

0.32 9

FUT. RES 0.80 21

0.18 3

1.70 COMM

0.53 5

0.49 3

1.04 14

1.05 22

0.57 11

PROP. RES 5.52 147

0.13 3

PROBLEM AREA BOUNDARY

SERVICE AREA

SEE SHEET 41

SEE SHEET 43

G:\CAD\020759\1000\ST DAVIDS DESIGN BUILD\FINAL DESIGN\SANITARY DRAINAGE.DWG MODIFIED: JULY 15, 2003

NOTES:

SYMBOL LEGEND

0.85 / 11 — AREA IN Ha (HECTARES) / POPULATION

NO.	REVISION	DATE	INITIAL
5	FOR CONSTRUCTION	07/15/03	
4	MOE, REGION RE-SUBMISSION	06/12/03	
3	MOE, REGION REVIEW	05/07/03	
2	PROPOSAL SUBMISSION	10/02	
1	CONSTRUCTION ESTIMATE	10/02	

APPROVED

REGISTERED PROFESSIONAL ENGINEER J.A. BRESCHUK 07/16/03 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER G.J. KOMAR 07/16/03 PROVINCE OF ONTARIO

MUNICIPAL

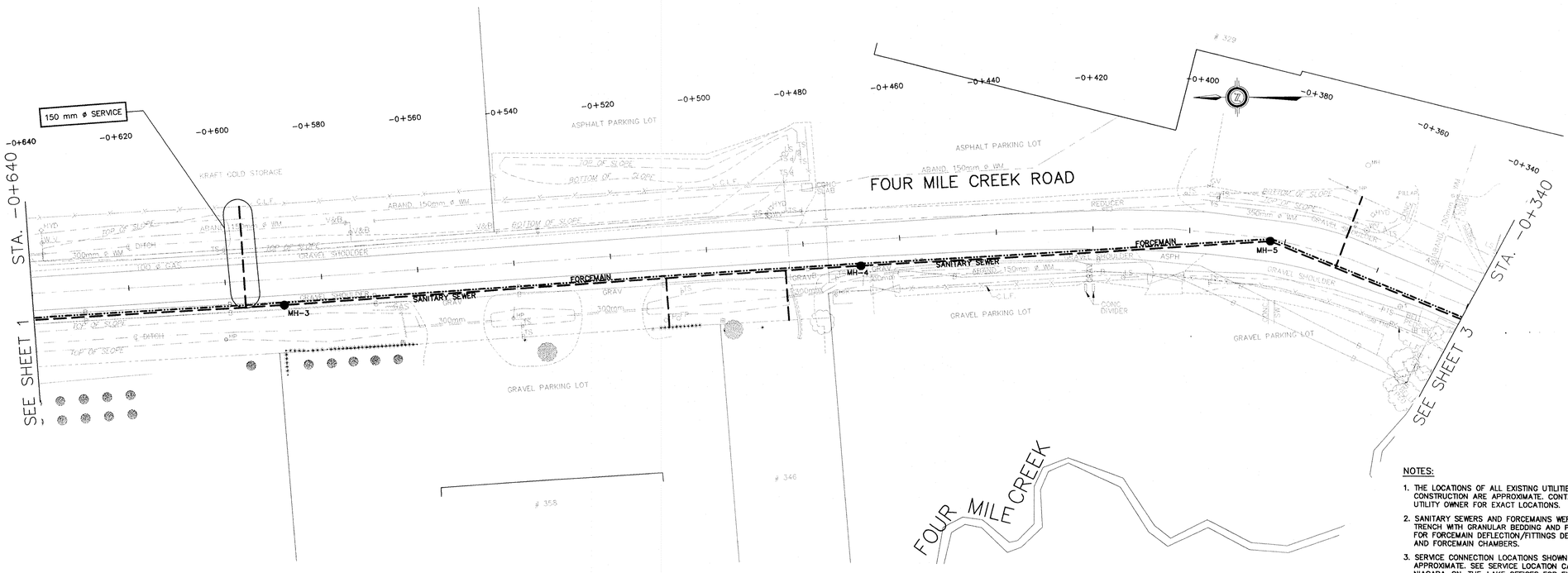
SANITARY DRAINAGE AREA PLAN

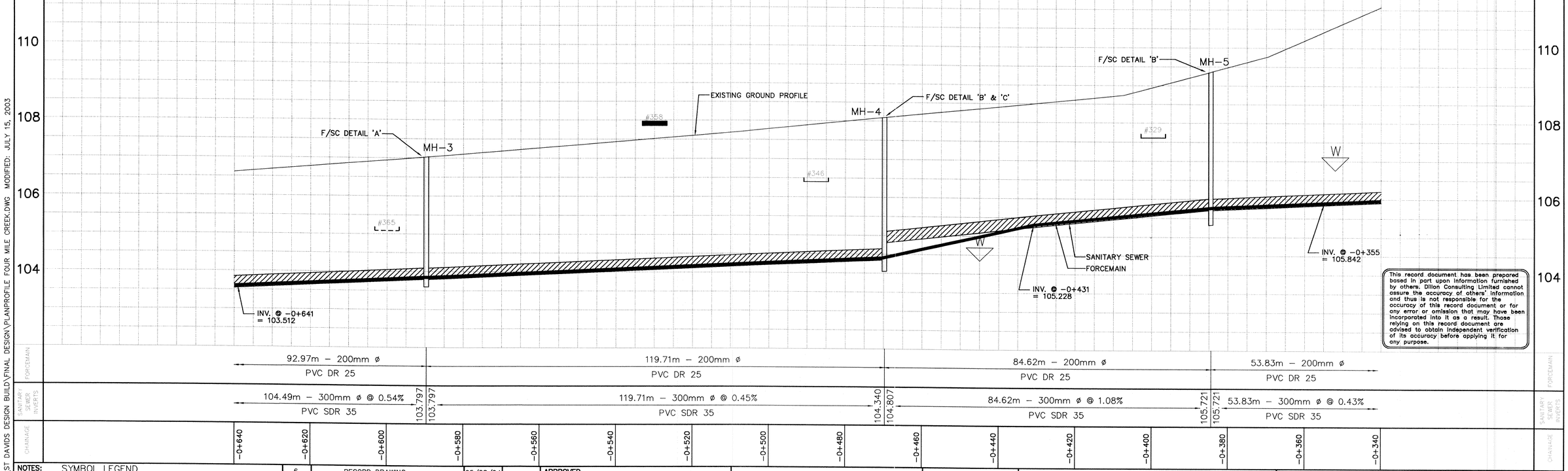
TOWN OF NIAGARA-ON-THE-LAKE

COMMUNAL SANITARY SEWAGE COLLECTION SYSTEM FOR THE VILLAGE OF ST. DAVIDS

DILLON CONSULTING
230 Yorkland Blvd., Suite 800
Toronto, Ontario, M2J 1T5
Phone: (416) 229-4647 Fax: (416)229-4692

DRAWN BY: AES	SCALE: 1:2000	DATE: APR. 1/03	SHEET NO. 42
CHECKED BY: JAB			
CADD SYSTEM AutoCAD	DWG NO.	REV.	CONTRACT





NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES ENCOUNTERED DURING CONSTRUCTION ARE APPROXIMATE. CONTACT THE APPLICABLE UTILITY OWNER FOR EXACT LOCATIONS.
2. SANITARY SEWERS AND FORCEMAINS WERE INSTALLED IN A COMMON TRENCH WITH GRANULAR BEDDING AND PIPE COVER. SEE SHEET 50 FOR FORCEMAIN DEFLECTION/FITTINGS DETAILS AT MAINTENANCE HOLES AND FORCEMAIN CHAMBERS.
3. SERVICE CONNECTION LOCATIONS SHOWN ON THIS DRAWING ARE APPROXIMATE. SEE SERVICE LOCATION CARDS AT THE TOWN OF NIAGARA-ON-THE-LAKE OFFICES FOR EXACT LOCATIONS AND DETAILS.

NOTES: SYMBOL LEGEND

- FORCEMAIN
- SANITARY SEWER
- W WATER MARKER
- BASEMENT MARKER
- BEDROCK MARKER
- MAIN FLR. ELEV.
- BASEMENT MARKER (ASSUMED)

NO.	REVISION	DATE	INITIAL
6	RECORD DRAWING	05/28/04	
5	FOR CONSTRUCTION	07/15/03	
4	MOE, REGION RE-SUBMISSION	06/12/03	
3	MOE, REGION REVIEW	05/07/03	
2	PROPOSAL SUBMISSION	10/02	
1	CONSTRUCTION ESTIMATE	10/02	

APPROVED

MUNICIPAL
PLAN AND PROFILE
-0+640 TO -0+340
FOUR MILE CREEK ROAD

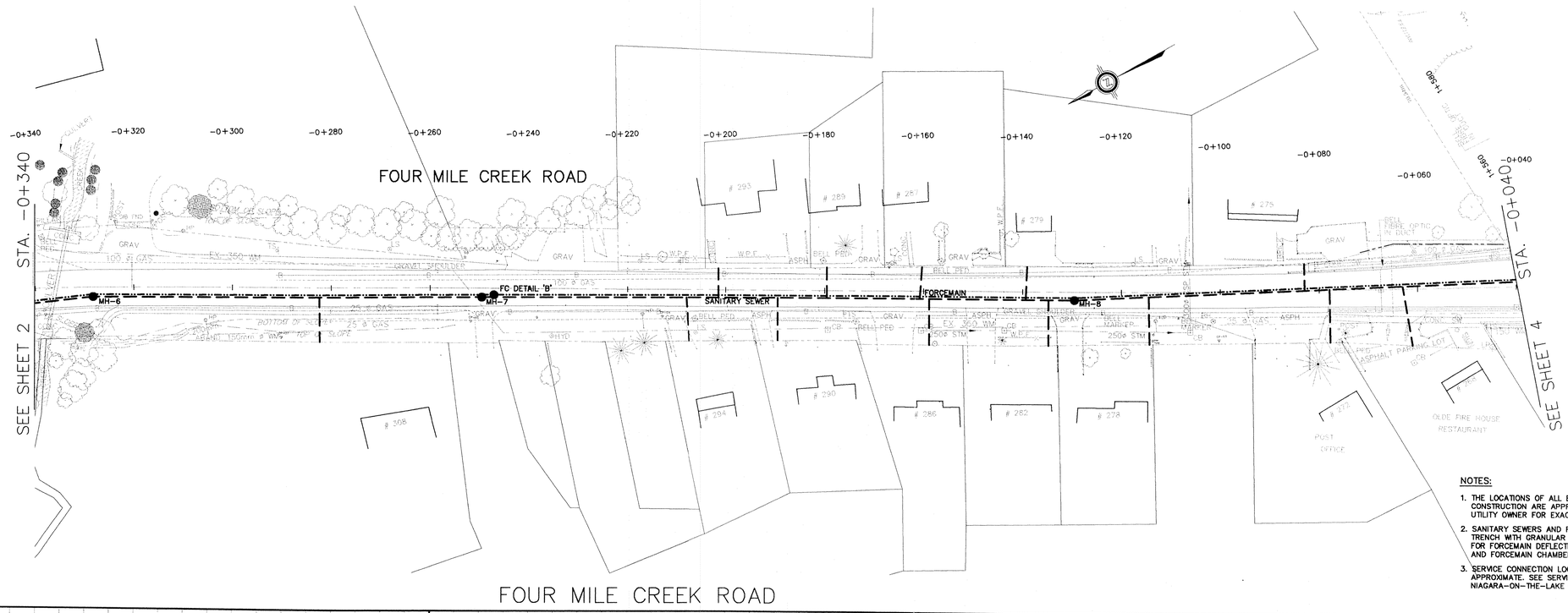
TOWN OF NIAGARA-ON-THE-LAKE

COMMUNAL SANITARY SEWAGE COLLECTION SYSTEM FOR THE VILLAGE OF ST. DAVIDS

DILLON CONSULTING
235 Yorkland Blvd., Suite 800
Toronto, Ontario, M2J 4Y8
Phone: (416) 229-4647 Fax: (416)229-4692

DRAWN BY: JCB GCC CHECKED BY: SM/JAB	SCALE: 1:500H 1:50V	DATE: AUG. 2002	SHEET NO. 2
CADD SYSTEM AutoCAD	DWG NO.	REV.	CONTRACT

G:\CAD\020759\1000\ST DAVIDS DESIGN BUILD\FINAL DESIGN\PLANPROFILE FOUR MILE CREEK.DWG MODIFIED: JULY 15, 2003



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2. SANITARY SEWERS AND FORCEMAINS WERE INSTALLED IN A COMMON TRENCH WITH GRANULAR BEDDING AND PIPE COVER. SEE SHEET 50 FOR FORCEMAIN DEFLECTION/FITTINGS DETAILS AT MAINTENANCE HOLES AND FORCEMAIN CHAMBERS.
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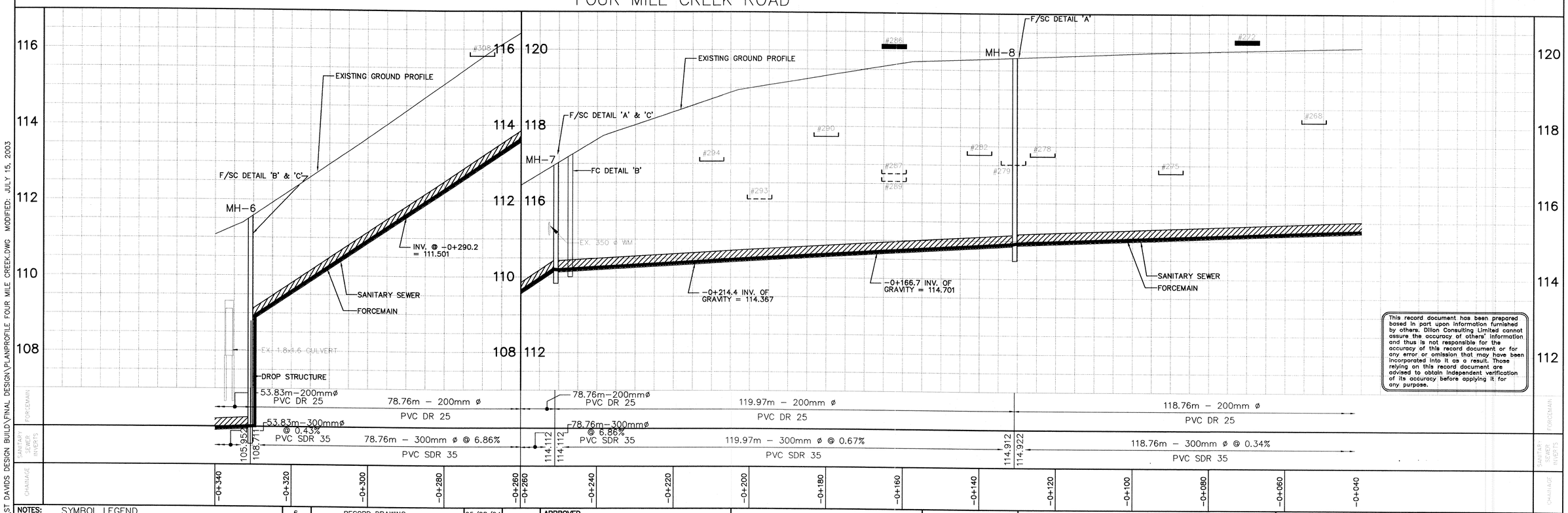

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- SANITARY SEWER
- W WATER MARKER
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NO.	REVISION	DATE	INITIAL
6	RECORD DRAWING	05/28/04	
5	FOR CONSTRUCTION	07/15/03	
4	MOE, REGION RE-SUBMISSION	06/12/03	
3	MOE, REGION REVIEW	05/07/03	
2	PROPOSAL SUBMISSION	10/02	
1	CONSTRUCTION ESTIMATE	10/02	

APPROVED

MUNICIPAL

PLAN AND PROFILE

-0+340 TO -0+040

FOUR MILE CREEK ROAD

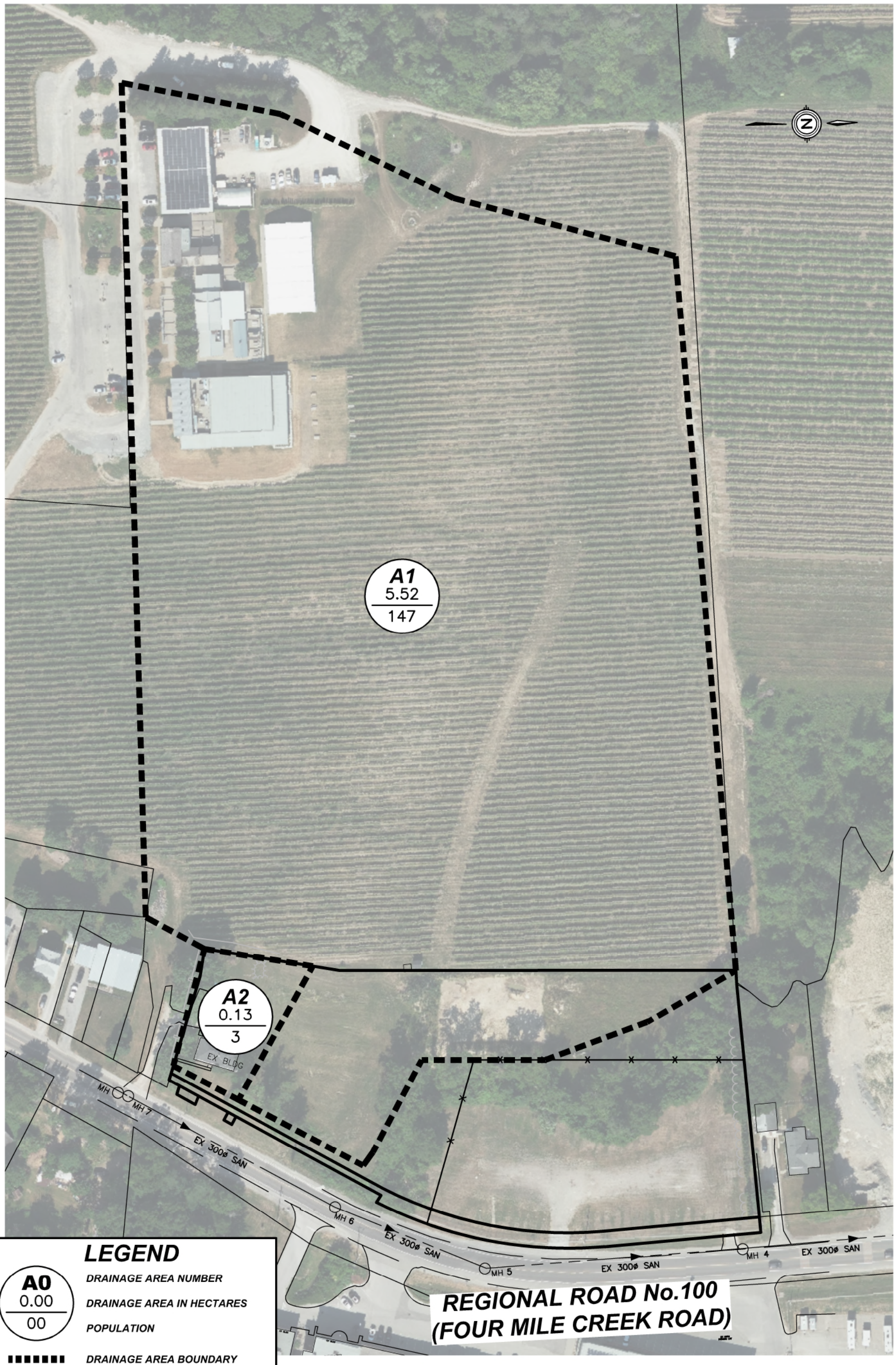
TOWN OF NIAGARA-ON-THE-LAKE

COMMUNAL SANITARY SEWAGE COLLECTION SYSTEM FOR THE VILLAGE OF ST. DAVIDS

DILLON CONSULTING
230 Yorkland Blvd., Suite 800
Toronto, Ontario M2J 1R5
Phone: (416) 229-4647 Fax: (416)229-4692

DRAWN BY: JCB GCC	SCALE: 1:500H 1:50V	DATE: AUG. 2002	SHEET NO. 3
CHECKED BY: SM/JAB			
CADD SYSTEM AutoCAD	DWG NO.	REV.	CONTRACT

G:\CAD\020759\1000\ST DAVIDS DESIGN BUILD\FINAL DESIGN\PLAN\PROFILE FOUR MILE CREEK.DWG MODIFIED: JULY 15, 2003



LEGEND

A0 0.00 / 00 — *DRAINAGE AREA NUMBER*; *DRAINAGE AREA IN HECTARES*; *POPULATION*

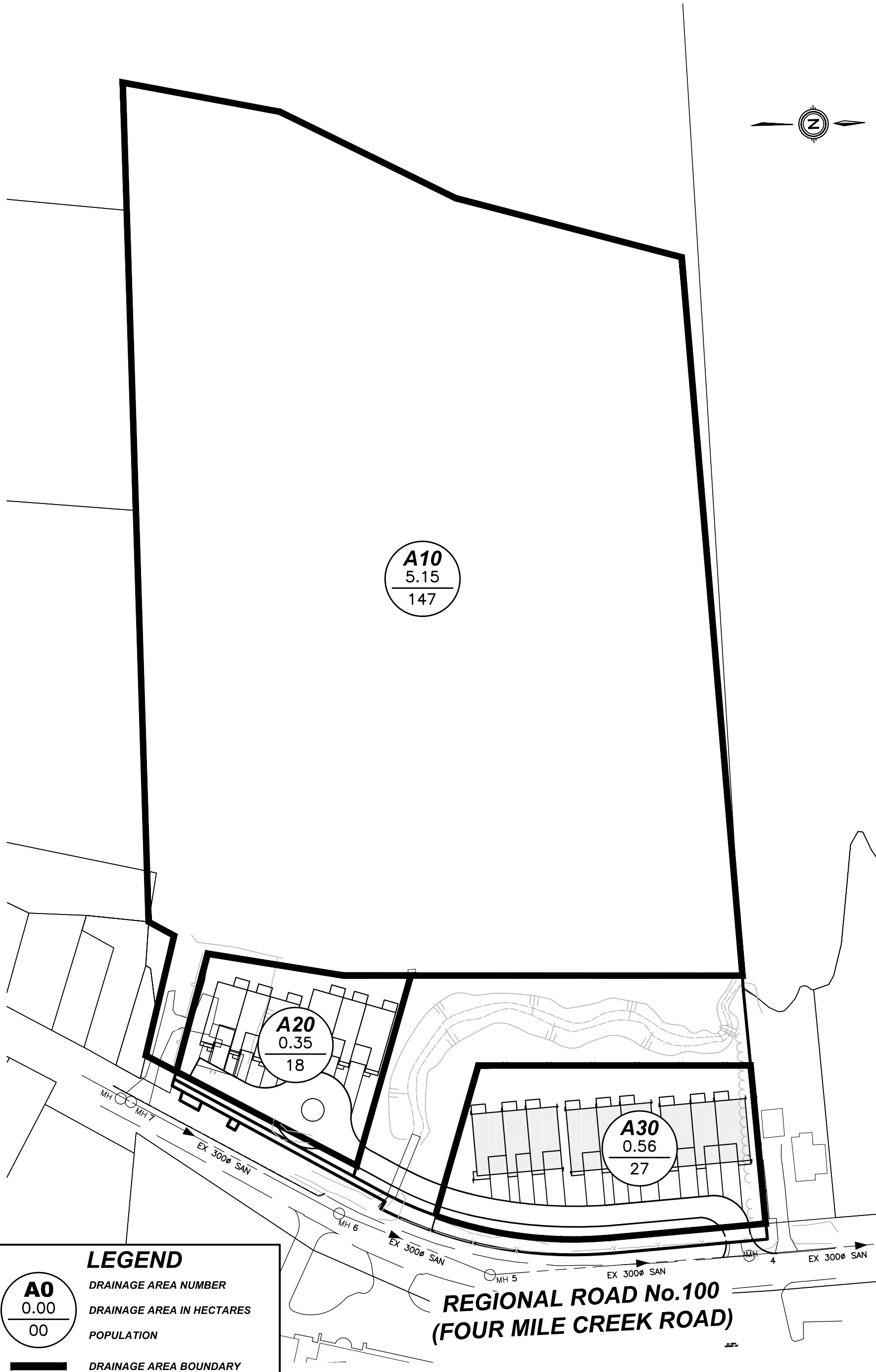
DRAINAGE AREA BOUNDARY

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

308 FOUR MILE CREEK ROAD NIAGARA ON THE LAKE

ORIGINAL SANITARY DRAINAGE AREA

DATE	2023–04–14
SCALE	1:1250 m
REF No.	.
DWG No.	FIGURE 1



LEGEND

A0 / 0.00 / 00 — DRAINAGE AREA NUMBER / DRAINAGE AREA IN HECTARES / POPULATION

DRAINAGE AREA BOUNDARY

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

308 FOUR MILE CREEK ROAD
NIAGARA ON THE LAKE

PROPOSED SANITARY DRAINAGE AREA

DATE	2025–08–15
SCALE	1:1250 m
REF No.	.
DWG No.	FIGURE 2

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

DESIGN FLOWS

RESIDENTIAL: 255 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
INFILTRATION RATE: 0.286 L / s / ha (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 L
POPULATION DENSITY: 3.00 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: TOWN OF NIAGARA-ON-THE-LAKE
PROJECT : 308 Four Mile Creek Road (R.R. #100)
PROJECT NO: 1520

Peaking Factor= $M = 1 + \frac{14}{4 + P^{0.5}}$ Where P = design population in thousands

LOCATION			AREA	RESIDENTIAL						DESIGN FLOW					
Location and Description	**From M.H**	**To M.H.**	**Increment (hectares)**	**Number of Units**	**Population Increment**	**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)**	**Percent Full**
ORIGINAL SANITARY SEWER DESIGN CONDITIONS															
A1			5.52		147	4.19	1.82	1.58	3.40						
A2			0.13		3	4.45	0.04	0.04	0.08						
TOTAL	EX MH 7	EX MH 6	**5.65**		**150**		**1.86**	**1.62**	**3.47**	300	78.8	6.86	3.62	264.23	1.3%
POST-DEVELOPMENT CONDITIONS															
A10	EX MH 7	EX MH 6	5.15		147	4.19	1.82	1.47	3.29	300	78.8	6.86	3.62	264.23	1.2%
A20	PHASE 2		0.35	6	18	4.39	0.23	0.10	0.33						
A30	PHASE 1		0.56	9	27	4.36	0.35	0.16	0.51						
TOTAL	EX MH 4	EX MH 3	**6.06**		**192**		**2.40**	**1.73**	**4.13**	300	119.7	0.45	0.93	67.67	6.1%

F.3.2 Sewage Pumping Station

Table 4.F.8 highlights the sewage pumping station operational firm capacities and the existing and projected flows. The existing average and peak dry weather flows were estimated using the wastewater system model, which was updated using the best available billing, flow monitoring, and SCADA data from 2018 to 2020. Note that the 2051 and post-2051 flows for St. David's #1 and #2 SPS include a 60 L/s flow representing the Queenston SPS.

Table 4.F.8 System Sewage Pumping Station Performance

Station Name	Station Capacity	2021 Flows				2051 Flows			Post-2051 Flows		
	Operational Firm Capacity	Average Dry Weather Flow	Peak Dry Weather Flow	Design Allowance Peak Wet Weather Flow	5-Year Storm Peak Wet Weather Flow	Peak Dry Weather Flow	Design Allowance Peak Wet Weather Flow	5-Year Storm Peak Wet Weather Flow	Peak Dry Weather Flow	Design Allowance Peak Wet Weather Flow	5-Year Storm Peak Wet Weather Flow
	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)	(L/s)
└→Calaguiro SPS	5.5	2.2	3.0	12.1	8.8	3.4	12.5	9.1	4.0	13.1	9.7
└→Central SPS	800.0	185.2	346.3	737.5	5,759.6	504.7	900.5	5,922.6	509.5	905.3	5,927.4
| └→Bender Hill SPS	237.0	98.9	127.0	206.1	450.3	169.8	249.0	493.3	172.8	252.1	496.3
| └→Muddy Run SPS	77.0	8.3	9.9	35.1	70.3	51.3	76.6	111.7	51.4	76.6	111.8
| └→Seneca Street SPS	63.0	6.8	8.6	25.4	108.5	10.9	27.7	110.8	10.9	27.7	110.8
└→Dorchester Road SPS	185.0	53.2	73.4	304.2	445.2	98.0	329.2	470.2	110.8	342.1	483.0
| └→Lundy's Lane SPS	56.3	7.6	10.8	49.7	149.8	27.1	66.3	166.4	29.8	69.1	169.1
| └→Meadowvale SPS	34.0	3.2	4.8	19.1	49.7	6.0	20.4	51.0	6.0	20.4	51.0
| └→Rolling Acres SPS	52.3	3.4	5.3	25.7	76.4	4.9	25.3	76.0	5.8	26.3	77.0
| └→Royal Manor SPS	8.8	1.2	2.2	15.3	21.4	2.1	15.2	21.3	2.1	15.2	21.3
└→Drummond Road SPS	56.7	5.1	7.4	41.5	168.6	15.6	49.7	176.8	15.6	49.7	176.8
└→Kalar Road SPS	463.0	83.5	91.7	291.7	670.9	126.7	350.8	730.0	138.3	362.5	741.6
└→Mewburn SPS	17.1	0.6	0.9	4.5	7.2	2.3	8.5	11.2	5.1	11.3	14.0
└→Neighbourhood SPS	29.0	1.2	2.3	10.2	5.5	2.5	10.4	5.7	4.5	12.3	7.7
└→St. David's #2 SPS[1]	42.9	8.8	8.9	112.7	99	44.1	188.6	174.9	57.9	202.4	188.8
└→St. David's #1 SPS[1]	28.8	8.2	8.2	97.6	86	42.2	172.0	160.4	44.6	174.4	162.8
└→South Side High Lift SPS[2]	609.0	175.2	271.5	1,102.6	1,531.8	486.3	1,390.8	1,820.0	582.8	1,532.8	1,962.0
| └→South Side Low Lift SPS	392.1	42.5	53.4	341.3	614.8	117.1	430.8	704.4	223.0	582.3	855.8
| └→Garner SPS	99.7	6.1	6.3	45.5	46.3	32.4	75.8	76.6	33.9	77.3	78.1
| └→Oakwood SPS	13.0	0.9	1.1	13.9	24.5	1.5	15.3	25.9	2.4	16.2	26.8
| └→Grassy Brook SPS	17.8	1.4	1.5	22.7	21.5	90.5	149.3	148.1	93.7	152.5	151.3

[1]Queenston SPS flows included

[2]Thorold South flows not included to the South Side High Lift SPS as the flows would be conveyed by gravity directly to the South Niagara Falls Plant.

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX C

Drainage Area Plan, Cold Storage, Phase 2 (UCC)
Figure 3. Existing Strom Drainage Area Plan
Figure 4. Proposed Strom Drainage Area Plan
Modified Rational Method – 5 Year Design Storm Event
Modified Rational Method – 100 Year Design Storm Event

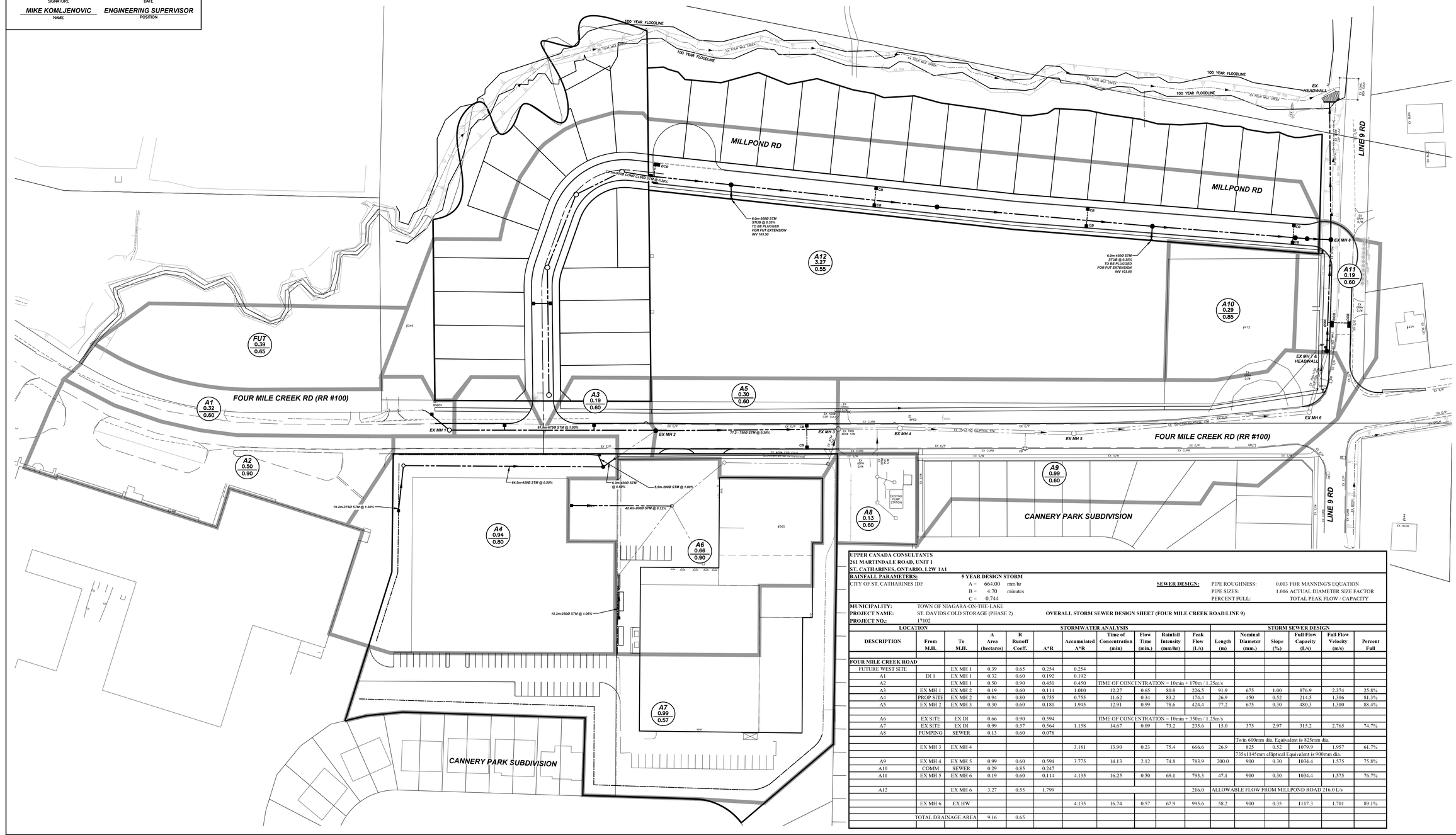
Niagara-on-the-Lake EST.1781

OPERATIONS DEPARTMENT APPROVAL

SIGNATURE	DATE
MIKE KOMLJENOVIC (NAME)	ENGINEERING SUPERVISOR (POSITION)

LEGEND

- A0 / 0.00 / 0.00 — DRAINAGE AREA NUMBER / DRAINAGE AREA IN HECTARES / RUNOFF COEFFICIENT
- DRAINAGE AREA BOUNDARY
- OVERLAND FLOW ROUTE



UPPER CANADA CONSULTANTS
261 MARTINDALE ROAD, UNIT 1
ST. CATHARINES, ONTARIO, L2W 1A1

RAINFALL PARAMETERS: — **5 YEAR DESIGN STORM**
CITY OF ST. CATHARINES IDF
A = 664.00 mm/hr
B = 4.70 minutes
C = 0.744

SEWER DESIGN:
PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 ACTUAL DIAMETER SIZE FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: TOWN OF NIAGARA-ON-THE-LAKE
PROJECT NAME: ST. DAVIDS COLD STORAGE (PHASE 2)
PROJECT NO.: 17102

OVERALL STORM SEWER DESIGN SHEET (FOUR MILE CREEK ROAD/LINE 9)

LOCATION			STORMWATER ANALYSIS								STORM SEWER DESIGN					
DESCRIPTION	From M.H.	To M.H.	A Area (hectares)	R Runoff Coeff.	A*R	Accumulated A*R	Time of Concentration (min)	Flow Time (min.)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Length (m)	Nominal Diameter (mm.)	Slope (%)	Full Flow Capacity (L/s)	Full Flow Velocity (m/s)	Percent Full
FOUR MILE CREEK ROAD																
FUTURE WEST SITE		EX MH 1	0.39	0.65	0.254	0.254										
A1	DI 1	EX MH 1	0.32	0.60	0.192	0.192										
A2		EX MH 1	0.50	0.90	0.450		TIME OF CONCENTRATION = 10min + 170m / 1.25m/s									
A3	EX MH 1	EX MH 2	0.19	0.60	0.114	1.010	12.27	0.65	80.8	226.5	91.9	675	1.00	876.9	2.374	25.8%
A4	PROP SITE	EX MH 2	0.94	0.80	0.755	0.755	11.62	0.34	83.2	174.4	26.9	450	0.52	214.5	1.306	81.3%
A5	EX MH 2	EX MH 3	0.30	0.60	0.180	1.945	12.91	0.99	78.6	424.4	77.2	675	0.30	480.3	1.300	88.4%
A6	EX SITE	EX DI	0.66	0.90	0.594		TIME OF CONCENTRATION = 10min + 350m / 1.25m/s									
A7	EX SITE	EX DI	0.99	0.57	0.564	1.158	14.67	0.09	73.2	235.6	15.0	375	2.97	315.2	2.765	74.7%
A8	PUMPING	SEWER	0.13	0.60	0.078											
												Twin 600mm dia. Equivalent is 825mm dia.				
	EX MH 3	EX MH 4				3.181	13.90	0.23	75.4	666.6	26.9	825	0.52	1079.9	1.957	61.7%
												735x1145mm elliptical Equivalent is 900mm dia.				
A9	EX MH 4	EX MH 5	0.99	0.60	0.594	3.775	14.13	2.12	74.8	783.9	200.0	900	0.30	1034.4	1.575	75.8%
A10	COMM	SEWER	0.29	0.85	0.247											
A11	EX MH 5	EX MH 6	0.19	0.60	0.114	4.135	16.25	0.50	69.1	793.3	47.1	900	0.30	1034.4	1.575	76.7%
A12		EX MH 6	3.27	0.55	1.799					216.0	ALLOWABLE FLOW FROM MILLPOND ROAD 216.0 L/s					
	EX MH 6	EX HW				4.135	16.74	0.57	67.9	995.6	58.2	900	0.35	1117.3	1.701	89.1%
	TOTAL DRAINAGE AREA		9.16	0.65												

#	REVISION	DATE	INIT
.	REVISED PER CITY COMMENTS (2022-12-06)	2022-12-07	JS
2	REVISED PER CITY COMMENTS (2022-10-05)	2022-11-01	JS
1	ISSUED FOR SPA SUBMISSION	2022-04-01	JS
0	ISSUED FOR REVIEW	2022-03-22	JS

NOTES:
1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER, AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING	G.S
DESIGN	J.S
CHECKED BY	J.S
APPROVED BY	J.S

LICENSED PROFESSIONAL ENGINEER — J. P. SCHOOLEY — PROVINCE OF ONTARIO

stdavidscoldstorage

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS
30 Hannover Drive Unit 3
St. Catharines, Ontario
L2W 1A3
Phone: (905)688-9400
Fax: (905)688-5274

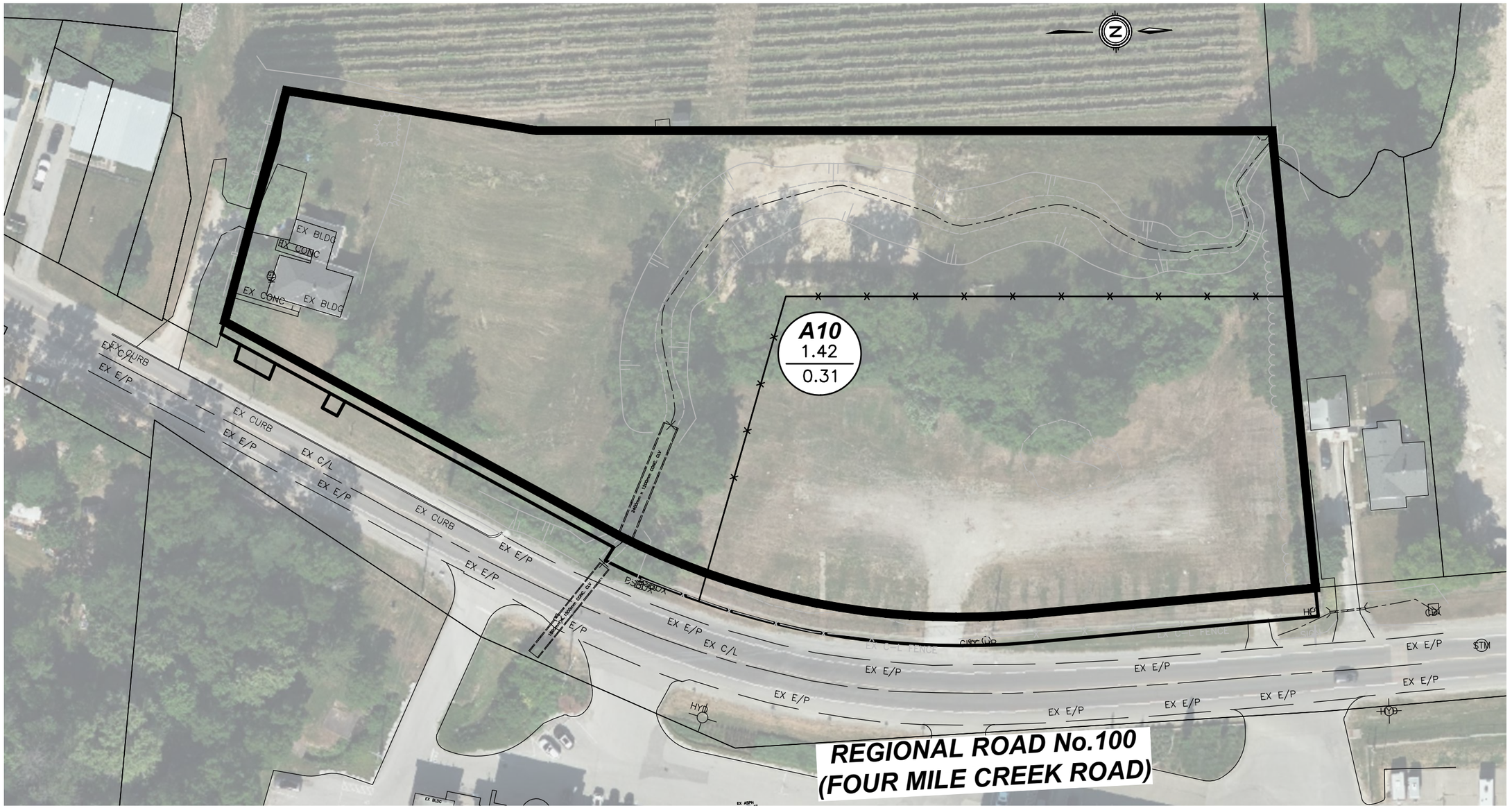
OWNER

COLD STORAGE (PHASE 2)

365 FOUR MILE CREEK ROAD
ST DAVIDS, NOTL

OVERALL STORM DRAINAGE AREA PLAN

CONSULTANT FILE No.	17102
DATE	2022-12-07
PRINTED	2022-12-07
SCALE	1:750 m
REF No.	.
DWG No.	17102-OVR_STM
REV	0



LEGEND

A0 0.00 / 0.00

- DRAINAGE AREA NUMBER
- DRAINAGE AREA IN HECTARES
- RUN-OFF COEFFICIENT
- DRAINAGE AREA BOUNDARY
- OVERLAND FLOW ROUTE

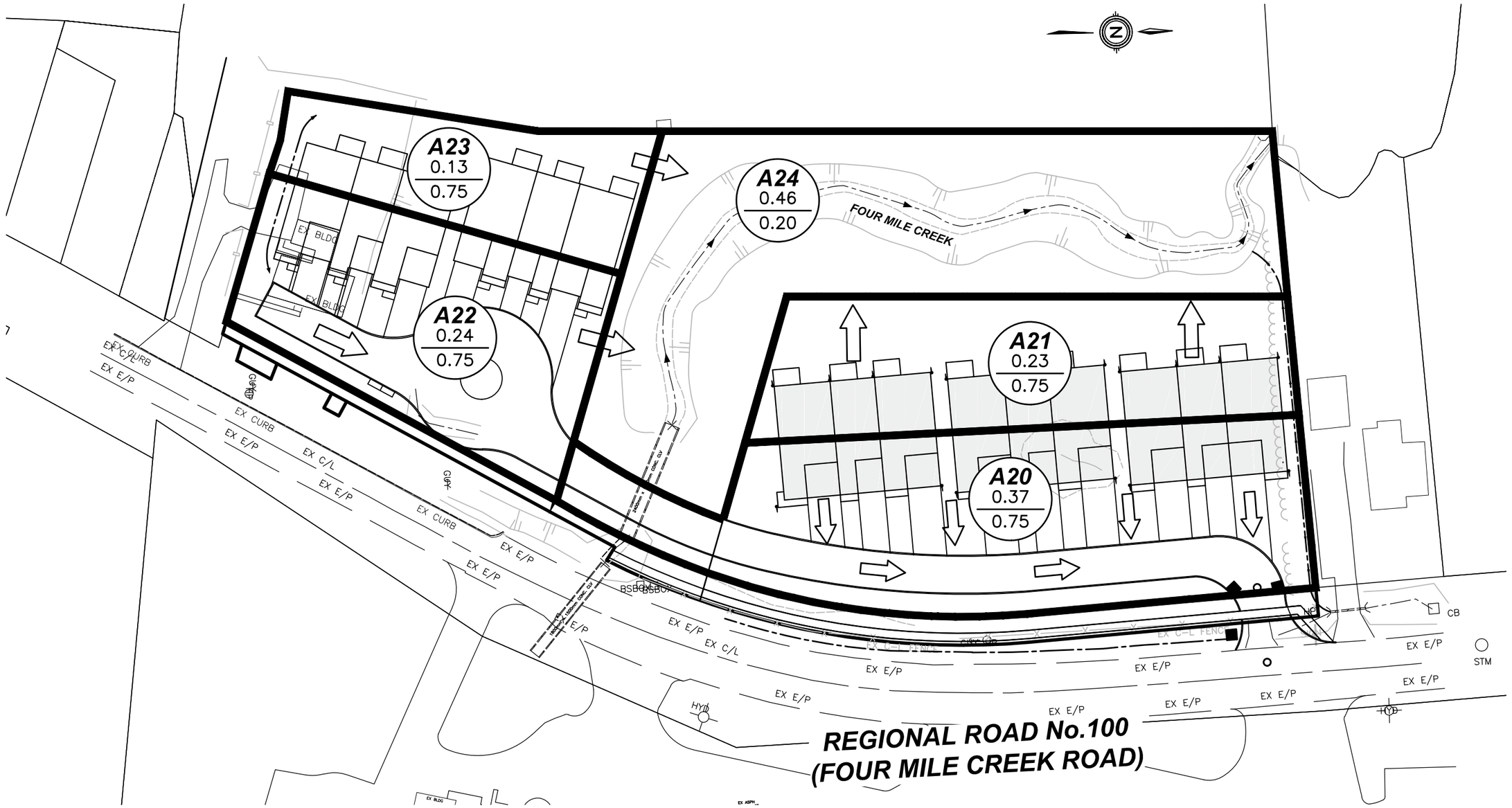
UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

308 FOUR MILE CREEK ROAD NIAGARA ON THE LAKE

EXISTING STORM DRAINAGE AREA

DATE	2023-04-14
SCALE	1:750 m
REF No.	.
DWG No.	FIGURE 3

DRAWING FILE: F:\1520\ENGINEERING\1520_BASE NEW.dwg PLOTTED: Feb 05, 2024 - 11:32am PLOTTED BY: roberto



LEGEND

- **A0** / 0.00 / 0.00 — DRAINAGE AREA NUMBER; DRAINAGE AREA IN HECTARES; RUN-OFF COEFFICIENT
- DRAINAGE AREA BOUNDARY
- OVERLAND FLOW ROUTE

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

308 FOUR MILE CREEK ROAD
NIAGARA ON THE LAKE

PROPOSED STORM DRAINAGE AREA

DATE	2025–08–18
SCALE	1:750 m
REF No.	.
DWG No.	FIGURE 4

DRAWING FILE: F:\1520\SWM\1520_BASE 2025 FSR.dwg PLOTTED: Aug 19, 2025 – 8:58am PLOTTED BY: roberto

STORM SEWER DESIGN SHEET

PROJECT / SUBDIVISION: 308 Four Mile Creek Road, Town of Niagara On The Lake

	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)**
5 YEAR DESIGN STORM EVENT												
PRE-DEVELOPMENT CONDITIONS												
A10	FOUR MILE CREEK			1.42	1.42	10.00	0.00	0.30	0.426	0.426	89.884	**106.4**
FUT	FOUR MILE CREEK RD			0.39	0.39	10.00	0.00	0.65	0.254	0.254	89.884	**63.3**
POST-DEVELOPMENT CONDITIONS												
A20	FOUR MILE CREEK RD (PH 1)			0.37	0.37	10.00	0.00	0.75	0.278	0.278	89.884	**69.3**
A21	FOUR MILE CREEK (PH 1)			0.23	0.23	10.00	0.00	0.75	0.173	0.173	89.884	**43.1**
A22	FOUR MILE CREEK (PH2)			0.24	0.24	10.00	0.00	0.75	0.180	0.180	89.884	**44.9**
A23	FOUR MILE CREEK (PH2)			0.13	0.13	10.00	0.00	0.75	0.098	0.098	89.884	**24.3**
A24	FOUR MILE CREEK			0.46	0.46	10.00	0.00	0.20	0.092	0.092	89.884	**23.0**
							Allowable Discharge to Four Mile Creek Road from A20					**63.3**
							Allowable Discharge to Four Mile Creek from A22					**16.0**

DESIGN BY: **UPPER CANADA CONSULTANTS**
3-30 HANNOVER DRIVE
ST. CATHARINES, ON L2W 1A3
DESIGN BY: **Roberto Duarte, B. Eng.**
DATE: **August 18, 2025**

RAINFALL PARAMETERS:

Time to Upper End = 10 min.

Town of Niagara-on-the-Lake - 5 Year IDF C

a = 664.00 mm/hr

b = 4.70 minutes

c = 0.74

Modified Rational Method (MRM) Required Storage Volume

Project:	308 Four Mile Creek Road
Project No:	1520
Date:	2025-08-18
Design By:	Roberto Duarte, B. Eng.
Description:	*Stormwater Management Plan, Quantity Control Storage Volume Calculation*

Storm Event: **Town of Niagara-on-the-Lake - 5 Year IDF Curve**

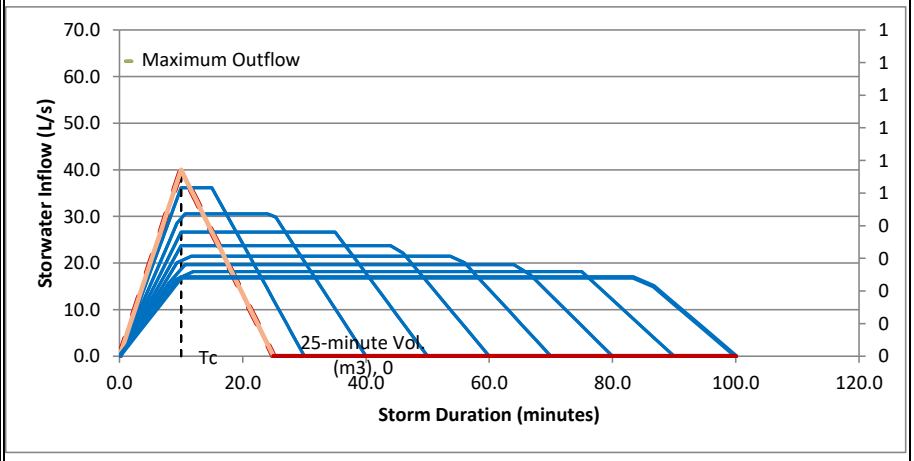
a =	664.00	mm/hr
b =	4.70	minutes
c =	0.74	

Critical Storm Duration:	25.00	minutes	Tail Multiplier (x1-1.5) 1.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	10.00	minutes	
Accumulated Area x R (Ha):	0.180	<-- Area x Runoff Coefficient (Sewer Design Sheet)	
Peak Rainfall Intensity:	79.97	mm/hr	
Peak Inflow at Tc:	39.99	L/s	
Maximum Release Rate:	63.29	<-- 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	63.29	-3.8	***0.0***
0.8	6.66	3.33	63.29	-3.6	***0.0***
1.7	13.33	6.66	63.29	-3.4	***0.0***
2.5	19.99	10.00	63.29	-3.2	***0.0***
3.3	26.66	13.33	63.29	-3.0	***0.0***
4.2	33.32	16.66	63.29	-2.8	***0.0***
5.0	39.99	19.99	63.29	-2.6	***0.0***
5.8	46.65	23.33	63.29	-2.4	***0.0***
6.7	53.31	26.66	63.29	-2.2	***0.0***
7.5	59.98	29.99	63.29	-2.0	***0.0***
8.3	66.64	33.32	63.29	-1.8	***0.0***
9.2	73.31	36.65	63.29	-1.6	***0.0***
10.0	79.97	39.99	63.29	-1.4	***0.0***
10.8	75.53	37.76	63.29	-1.5	***0.0***
11.7	71.09	35.54	63.29	-1.7	***0.0***
12.5	66.64	33.32	63.29	-1.8	***0.0***
13.3	62.20	31.10	63.29	-1.9	***0.0***
14.2	57.76	28.88	63.29	-2.1	***0.0***
15.0	53.31	26.66	63.29	-2.2	***0.0***
15.8	48.87	24.44	63.29	-2.3	***0.0***
16.7	44.43	22.21	63.29	-2.5	***0.0***
17.5	39.99	19.99	63.29	-2.6	***0.0***
18.3	35.54	17.77	63.29	-2.7	***0.0***
19.2	31.10	15.55	63.29	-2.9	***0.0***
20.0	26.66	13.33	63.29	-3.0	***0.0***
20.8	22.21	11.11	63.29	-3.1	***0.0***
21.7	17.77	8.89	63.29	-3.3	***0.0***
22.5	13.33	6.66	63.29	-3.4	***0.0***
23.3	8.89	4.44	63.29	-3.5	***0.0***
24.2	4.44	2.22	63.29	-3.7	***0.0***
25.0	0.00	0.00	63.29	-3.8	***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**



Modified Rational Method (MRM) Required Storage Volume

Project:	308 Four Mile Creek Road
Project No:	1520
Date:	2025-08-18
Design By:	Roberto Duarte, B. Eng.
Description:	*Stormwater Management Plan, Quantity Control Storage Volume Calculation*

Storm Event: **Town of Niagara-on-the-Lake - 5 Year IDF Curve**

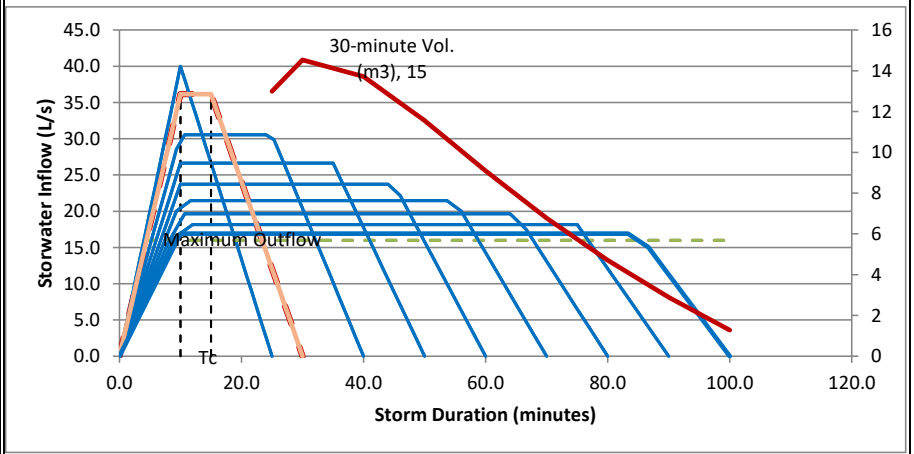
a =	664.00	mm/hr
b =	4.70	minutes
c =	0.74	

Critical Storm Duration:	30.00	minutes	Tail Multiplier (x1-1.5) 1.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	15.00	minutes	
Accumulated Area x R (Ha):	0.180		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	72.29	mm/hr	
Peak Inflow at Tc:	36.15	L/s	
Maximum Release Rate:	15.98		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	4.42		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	15.98	-1.0	0.0
1.0	7.23	3.61	15.98	-0.7	0.0
2.0	14.46	7.23	15.98	-0.5	0.0
3.0	21.69	10.84	15.98	-0.3	0.0
4.0	28.92	14.46	15.98	-0.1	0.0
5.0	36.15	18.07	15.98	0.1	0.1
6.0	43.37	21.69	15.98	0.3	0.5
7.0	50.60	25.30	15.98	0.6	1.0
8.0	57.83	28.92	15.98	0.8	1.8
9.0	65.06	32.53	15.98	1.0	2.8
10.0	72.29	36.15	15.98	1.2	4.0
11.0	72.29	36.15	15.98	1.2	5.2
12.0	72.29	36.15	15.98	1.2	6.4
13.0	72.29	36.15	15.98	1.2	7.6
14.0	72.29	36.15	15.98	1.2	8.8
15.0	72.29	36.15	15.98	1.2	10.1
16.0	67.47	33.74	15.98	1.1	11.1
17.0	62.65	31.33	15.98	0.9	12.0
18.0	57.83	28.92	15.98	0.8	12.8
19.0	53.01	26.51	15.98	0.6	13.5
20.0	48.19	24.10	15.98	0.5	13.9
21.0	43.37	21.69	15.98	0.3	14.3
22.0	38.56	19.28	15.98	0.2	14.5
23.0	33.74	16.87	15.98	0.1	***14.5***
24.0	28.92	14.46	15.98	-0.1	14.4
25.0	24.10	12.05	15.98	-0.2	14.2
26.0	19.28	9.64	15.98	-0.4	13.8
27.0	14.46	7.23	15.98	-0.5	13.3
28.0	9.64	4.82	15.98	-0.7	12.6
29.0	4.82	2.41	15.98	-0.8	11.8
30.0	0.00	0.00	15.98	-1.0	10.9

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	13.0 m3	50 Min	11.6 m3	80 Min	4.7 m3
30 Min	**14.5 m3**	60 Min	9.1 m3	90 Min	2.9 m3
40 Min	13.7 m3	70 Min	6.8 m3	100 Min	1.3 m3



STORM SEWER DESIGN SHEET

PROJECT / SUBDIVISION: 308 Four Mile Creek Road, Town of Niagara On The Lake

	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)**
100 YEAR DESIGN STORM EVENT												
PRE-DEVELOPMENT CONDITIONS												
A10	FOUR MILE CREEK RD			1.42	1.42	10.00	0.00	0.30	0.426	0.426	144.260	**170.7**
POST-DEVELOPMENT CONDITIONS												
A20	FOUR MILE CREEK RD (PH 1)			0.37	0.37	10.00	0.00	0.75	0.278	0.278	144.260	**111.2**
A21	FOUR MILE CREEK (PH 1)			0.23	0.23	10.00	0.00	0.75	0.173	0.173	144.260	**69.1**
A22	FOUR MILE CREEK (PH2)			0.24	0.24	10.00	0.00	0.75	0.180	0.180	144.260	**72.1**
A23	FOUR MILE CREEK (PH2)			0.13	0.13	10.00	0.00	0.75	0.098	0.098	144.260	**39.1**
A24	FOUR MILE CREEK			0.46	0.46	10.00	0.00	0.20	0.092	0.092	144.260	**36.9**
							Allowable Discharge to Four Mile Creek Road from A20					**63.3**
							Allowable Discharge to Four Mile Creek from A22					**25.6**

DESIGN BY: **UPPER CANADA CONSULTANTS**
3-30 HANNOVER DRIVE
ST. CATHARINES, ON L2W 1A3
DESIGN BY: **Roberto Duarte, B. Eng.**
DATE: **August 18, 2025**

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
Town of Niagara-on-the-Lake - 100 Year IDF

a = 980.00 mm/hr
b = 3.70 minutes
c = 0.73

Modified Rational Method (MRM) Required Storage Volume

Project:	308 Four Mile Creek Road (Phase 1)
Project No:	1520
Date:	2025-08-18
Design By:	Roberto Duarte, B. Eng.
Description:	*Stormwater Management Plan, Quantity Control Storage Volume Calculation*

Storm Event: **Town of Niagara-on-the-Lake - 100 Year IDF Curve**

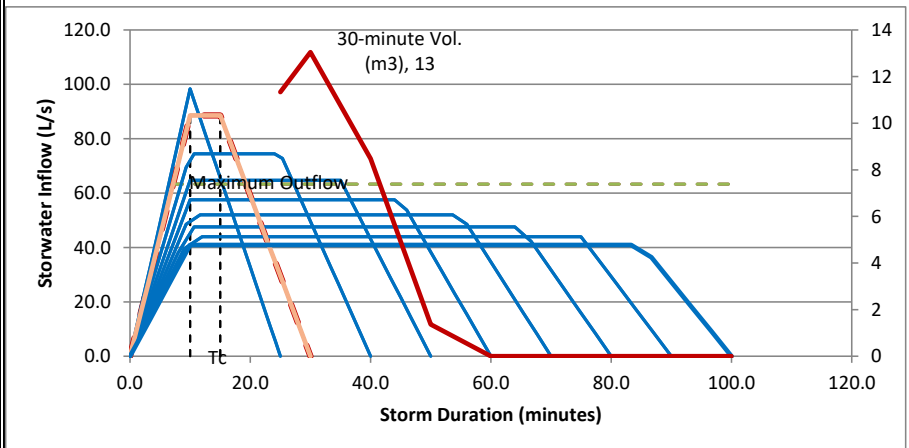
a =	980.00	mm/hr
b =	3.70	minutes
c =	0.73	

Critical Storm Duration:	30.00	minutes	Tail Multiplier (x1-1.5) 1.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	15.00	minutes	
Accumulated Area x R (Ha):	0.278		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	114.88	mm/hr	
Peak Inflow at Tc:	88.55	L/s	
Maximum Release Rate:	63.30		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	7.15		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	63.30	-3.8	0.0
1.0	11.49	8.86	63.30	-3.3	0.0
2.0	22.98	17.71	63.30	-2.7	0.0
3.0	34.46	26.57	63.30	-2.2	0.0
4.0	45.95	35.42	63.30	-1.7	0.0
5.0	57.44	44.28	63.30	-1.1	0.0
6.0	68.93	53.13	63.30	-0.6	0.0
7.0	80.41	61.99	63.30	-0.1	0.0
8.0	91.90	70.84	63.30	0.5	0.5
9.0	103.39	79.70	63.30	1.0	1.4
10.0	114.88	88.55	63.30	1.5	3.0
11.0	114.88	88.55	63.30	1.5	4.5
12.0	114.88	88.55	63.30	1.5	6.0
13.0	114.88	88.55	63.30	1.5	7.5
14.0	114.88	88.55	63.30	1.5	9.0
15.0	114.88	88.55	63.30	1.5	10.5
16.0	107.22	82.65	63.30	1.2	11.7
17.0	99.56	76.75	63.30	0.8	12.5
18.0	91.90	70.84	63.30	0.5	12.9
19.0	84.24	64.94	63.30	0.1	***13.0***
20.0	76.59	59.03	63.30	-0.3	12.8
21.0	68.93	53.13	63.30	-0.6	12.2
22.0	61.27	47.23	63.30	-1.0	11.2
23.0	53.61	41.32	63.30	-1.3	9.9
24.0	45.95	35.42	63.30	-1.7	8.2
25.0	38.29	29.52	63.30	-2.0	6.2
26.0	30.63	23.61	63.30	-2.4	3.8
27.0	22.98	17.71	63.30	-2.7	1.1
28.0	15.32	11.81	63.30	-3.1	0.0
29.0	7.66	5.90	63.30	-3.4	0.0
30.0	0.00	0.00	63.30	-3.8	0.0

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	11.3 m3	50 Min	1.4 m3	80 Min	0.0 m3
30 Min	**13.0 m3**	60 Min	0.0 m3	90 Min	0.0 m3
40 Min	8.5 m3	70 Min	0.0 m3	100 Min	0.0 m3



Modified Rational Method (MRM) Required Storage Volume

Project:	308 Four Mile Creek Road (Phase 2)
Project No:	1520
Date:	2025-08-18
Design By:	Roberto Duarte, B. Eng.
Description:	*Stormwater Management Plan, Quantity Control Storage Volume Calculation*

Storm Event: **Town of Niagara-on-the-Lake - 100 Year IDF Curve**

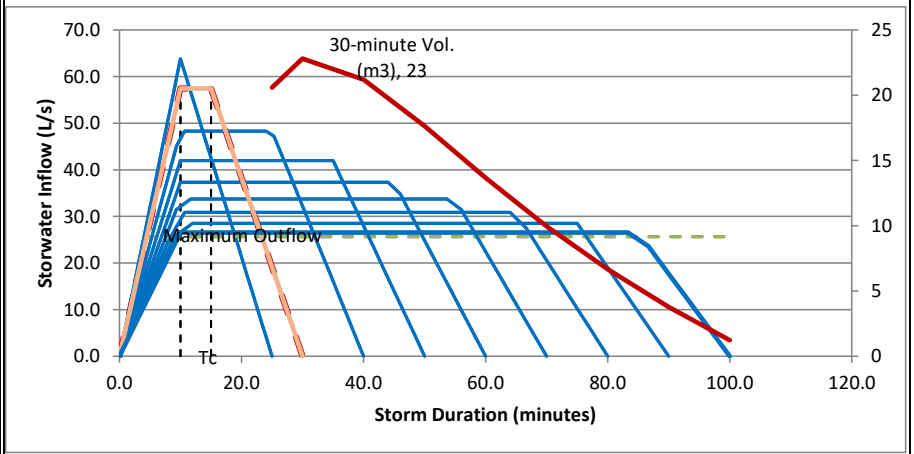
a =	980.00	mm/hr
b =	3.70	minutes
c =	0.73	

Critical Storm Duration:	30.00	minutes	Tail Multiplier (x1-1.5) 1.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	15.00	minutes	
Accumulated Area x R (Ha):	0.180		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	114.88	mm/hr	
Peak Inflow at Tc:	57.44	L/s	
Maximum Release Rate:	25.65		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	4.46		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	25.65	-1.5	0.0
1.0	11.49	5.74	25.65	-1.2	0.0
2.0	22.98	11.49	25.65	-0.8	0.0
3.0	34.46	17.23	25.65	-0.5	0.0
4.0	45.95	22.98	25.65	-0.2	0.0
5.0	57.44	28.72	25.65	0.2	0.2
6.0	68.93	34.46	25.65	0.5	0.7
7.0	80.41	40.21	25.65	0.9	1.6
8.0	91.90	45.95	25.65	1.2	2.8
9.0	103.39	51.70	25.65	1.6	4.4
10.0	114.88	57.44	25.65	1.9	6.3
11.0	114.88	57.44	25.65	1.9	8.2
12.0	114.88	57.44	25.65	1.9	10.1
13.0	114.88	57.44	25.65	1.9	12.0
14.0	114.88	57.44	25.65	1.9	13.9
15.0	114.88	57.44	25.65	1.9	15.8
16.0	107.22	53.61	25.65	1.7	17.5
17.0	99.56	49.78	25.65	1.4	18.9
18.0	91.90	45.95	25.65	1.2	20.2
19.0	84.24	42.12	25.65	1.0	21.1
20.0	76.59	38.29	25.65	0.8	21.9
21.0	68.93	34.46	25.65	0.5	22.4
22.0	61.27	30.63	25.65	0.3	22.7
23.0	53.61	26.80	25.65	0.1	***22.8***
24.0	45.95	22.98	25.65	-0.2	22.6
25.0	38.29	19.15	25.65	-0.4	22.3
26.0	30.63	15.32	25.65	-0.6	21.6
27.0	22.98	11.49	25.65	-0.8	20.8
28.0	15.32	7.66	25.65	-1.1	19.7
29.0	7.66	3.83	25.65	-1.3	18.4
30.0	0.00	0.00	25.65	-1.5	16.9

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	20.6 m3	50 Min	17.6 m3	80 Min	6.7 m3
30 Min	**22.8 m3**	60 Min	13.7 m3	90 Min	3.8 m3
40 Min	21.2 m3	70 Min	9.9 m3	100 Min	1.2 m3



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX D

Hydroworks – Hydrodome Simulation (Phase 1)
Hydroworks – Hydrodome Simulation (Phase 2)
Oil/Grit Sample Inspection Report

Hydroworks Output File (Phase 1)

```
          ************************************************
          *      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 *
          ************************************************

          308 Four Mile Creek Road
          Town of Niagara-On-The-Lake

        ########################################
        #  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       #
##################################################

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   NAMEG:     Drains                          Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to     Channel  Width  Length    Slope   Slope    Slope   Depth   Depth   ings   Flow
umber    ID #      NGTO:    Type     (m)     (m)     (m/m)   (m/m)    (m/m)     (m)     (m)   "N"   (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-  CHANNEL      WIDTH     AREA  PERCENT     SLOPE     RESISTANCE  FACTOR     DEPRES. STORAGE(MM) INFILTRATION    DECAY RATE GAGE  MAXIMUM
       MENT NO.  OR INLET       (M)     (HA)  IMPERV.     (M/M)      IMPERV.      PERV.    IMPERV.     PERV.      RATE(MM/HR)     (1/SEC)     NO.  VOLUME
                                                                                                                MAXIMUM MINIMUM                      (MM)
 ---  --------   -------- --------- --------  -----   -------     -------  --------    ------    ------      ----   -------  -------  ------ -------
  1        300        200     60.83     0.37  78.00    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).           0.37
IMPERVIOUS AREA (HECTARES).....            0.29
PERVIOUS AREA (HECTARES).......            0.08
TOTAL WIDTH (METERS)...........           60.83
PERCENT IMPERVIOUSNESS.........           78.00
```

```
*******************************************************
*      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      #
#############################################
```

AND USE LNAME)	BUILDUP EQUATION TYPE (METHOD)	FUNCTIONAL DEPENDENCE OF BUILDUP PARAMETER(JACGUT)	LIMITING BUILDUP QUANTITY (DDLIM)	BUILDUP POWER (DDPOW)	BUILDUP COEFF. (DDFACT)	CLEANING INTERVAL IN DAYS (CLFREQ)	AVAIL. FACTOR FRACTION (AVSWP)	DAYS SINCE LAST SWEEPING (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
----------  ---------
       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        0.12     2.00  0.0E+00
   Totals (Loads in kg or other)    0.12     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

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

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   6175140   1566672

************************************************
*     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   *
*********************************************
                                                          Millimeters over
                                                cubic meters  Total Basin
Total Precipitation (Rain plus Snow)                 71271.     19263.
Total Infiltration                                   15584.      4212.
Total Evaporation                                     5528.      1494.
Surface Runoff from Watersheds                       50717.     13708.
Total Water remaining in Surface Storage                 0.         0.
Infiltration over the Pervious Area...               15584.     19146.
                    --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........               71829.     19414.
Total Precipitation + Initial Storage.               71271.     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.................................       -0.783 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...........            50717.     13708.
Baseflow.................................                0.
Groundwater Subsurface Inflow............                0.         0.
Evaporation Loss from Channels...........                0.         0.
Channel/Pipe/Inlet Outflow...............            50717.     13708.
Initial Storage + Inflow.................            50717.     13708.
Final Storage + Outflow..................            50717.     13708.
*********************************************
* 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                           3383.       914.
Final Subsurface Storage                             3383.       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

					PERVIOUS AREA			IMPERVIOUS AREA		TOTAL SUBCATCHMENT AREA		
SUBCATCHMENT NO.	GUTTER OR INLET NO.	AREA (HA)	PERCENT IMPER.	TOTAL SIMULATED RAINFALL (MM)	RUNOFF DEPTH (MM)	TOTAL LOSSES (MM)	PEAK RUNOFF RATE (CMS)	RUNOFF DEPTH (MM)	PEAK RUNOFF RATE (CMS)	RUNOFF DEPTH (MM)	PEAK RUNOFF RATE (CMS)	PEAK UNIT RUNOFF (MM/HR)
300	200	0.37	78.01	9262.47	121.288********		0.031	17536.881	0.157	13705.451	0.188	184.545

*** 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				0.19				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#
#             of concentration times volume/second  #
##################################################

Total Su NDIM =  0
METRIC =  2
```

	Total Su
Inputs	
1. INITIAL SURFACE LOAD.....	8.
2. TOTAL SURFACE BUILDUP.....	6778.
3. INITIAL CATCHBASIN LOAD.....	0.
4. TOTAL CATCHBASIN LOAD.....	0.
5. TOTAL CATCHBASIN AND SURFACE BUILDUP (2+4).....	6778.
Remaining Loads	
6. LOAD REMAINING ON SURFACE...	3.
7. REMAINING IN CATCHBASINS....	0.
8. REMAINING IN CHANNEL/PIPES..	0.
Removals	
9. STREET SWEEPING REMOVAL.....	544.
10. NET SURFACE BUILDUP (2-9)...	6235.
11. SURFACE WASHOFF.....	6231.
12. CATCHBASIN WASHOFF.....	0.
13. TOTAL WASHOFF (11+12).....	6231.
14. LOAD FROM OTHER CONSTITUENTS	0.
15. PRECIPITATION LOAD.....	0.
15a.SUM SURFACE LOAD (13+14+15).	6231.
16. TOTAL GROUNDWATER LOAD.....	0.
16a.TOTAL I/I LOAD.....	0.
17. NET SUBCATCHMENT LOAD (15a-15b-15c-15d+16+16a)....	6231.
>>Removal in channel/pipes (17a, 17b):	
17a.REMOVE BY BMP FRACTION.....	0.
17b.REMOVE BY 1st ORDER DECAY...	0.
18. TOTAL LOAD TO INLETS.....	6231.
19. FLOW WT'D AVE.CONCENTRATION mg/l (INLET LOAD/TOTAL FLOW).....	123.
Percentages	
20. STREET SWEEPING (9/2).....	8.
21. SURFACE WASHOFF (11/2).....	92.
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 (um)	%	Specific Gravity	Settling Velocity (m/s)	Critical Peclet Number
20.	20.0	2.65	0.000267	0.080977
60.	20.0	2.65	0.002319	0.160673
150.	20.0	2.65	0.012234	0.284537
400.	20.0	2.65	0.047806	0.524584
2000.	20.0	2.65	0.180097	1.431405

```
******************************************************
*                                                    *
*              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	0.063	0.063	99.6	87.2
HD 4	0.063	0.063	99.6	91.7
HD 5	0.063	0.063	99.6	94.7
HD 6	0.063	0.063	99.6	96.6
Unavailabl	0.063	0.063	99.6	97.9
HD 8	0.063	0.063	99.6	98.5
HD 10	0.063	0.063	99.6	99.2
HD 12	0.063	0.063	99.6	99.6

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

HD 4
```

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	5275.	5236.	123.	108.	14.	0.	99.2	88.3
1972.	6783.	6290.	161.	149.	12.	5.	92.7	89.5
1973.	6762.	6762.	174.	161.	13.	0.	100.0	92.5
1974.	6907.	6864.	187.	176.	11.	0.	99.4	94.1
1975.	5849.	5849.	160.	146.	14.	0.	100.0	91.2
1976.	8706.	8595.	199.	185.	14.	2.	98.7	92.2
1977.	9328.	9188.	193.	170.	22.	2.	98.5	87.6
1978.	7448.	7448.	185.	166.	19.	0.	100.0	89.7
1979.	8912.	8826.	211.	194.	17.	1.	99.0	91.3
1980.	7184.	7184.	199.	183.	16.	0.	100.0	92.0
1981.	9911.	9911.	221.	207.	14.	0.	100.0	93.8
1982.	6983.	6983.	181.	170.	11.	0.	100.0	94.0
1983.	9209.	9189.	230.	210.	20.	0.	99.8	91.2
1984.	7418.	7418.	178.	162.	17.	0.	100.0	90.7
1985.	6472.	6472.	176.	163.	14.	0.	100.0	92.3
1986.	9433.	9433.	240.	224.	16.	0.	100.0	93.2
1987.	9750.	9712.	240.	221.	19.	0.	99.6	91.8
1988.	7794.	7794.	202.	187.	15.	0.	100.0	92.6
1989.	8592.	8592.	195.	184.	11.	0.	100.0	94.5
1990.	9740.	9740.	247.	233.	14.	0.	100.0	94.4
1991.	9126.	9126.	231.	215.	17.	0.	100.0	92.8
1992.	11604.	11604.	266.	241.	25.	0.	100.0	90.6
1993.	7900.	7900.	229.	214.	14.	0.	100.0	93.8
1994.	8453.	8397.	186.	164.	22.	1.	99.3	87.7
1995.	9809.	9809.	222.	202.	21.	0.	100.0	90.7
1998.	2555.	2555.	87.	79.	8.	0.	100.0	91.0
1999.	6234.	6234.	173.	158.	15.	0.	100.0	91.4
2000.	7163.	7163.	148.	129.	19.	0.	100.0	87.0
2001.	5681.	5681.	141.	134.	7.	0.	100.0	95.3
2002.	5931.	5931.	165.	154.	11.	0.	100.0	93.6
2003.	6747.	6747.	170.	154.	16.	0.	100.0	90.7
2004.	8072.	8072.	173.	158.	15.	0.	100.0	91.4
2005.	5834.	5793.	132.	115.	17.	0.	99.3	87.0

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

308 Four Mile Creek Road
Town of Niagara-On-The-Lake

Date Mo/Da/Year	Time Hr:Min	Flow cum/s	Total Su mg/l
Flow wtd means.....		0.000	123.
Flow wtd std devs..		0.001	67.
Maximum value.....		0.188	291.
Minimum value.....		0.000	0.
Total loads.....		50712.	6234.
		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... September   3, 2025               *
*          Time...          9: 3:15. 39              *
*   Ending Date... September   3, 2025               *
*          Time...          9: 3:17.859              *
*  Elapsed Time...               0.047 minutes.      *
*  Elapsed Time...               2.820 seconds.      *
**************************************************
```

Hydroworks Output File (Phase 2)

```
          ************************************************
          *      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 *
          ************************************************
          308 Four Mile Creek Road
          Town of Niagara-On-The-Lake
        ########################################
        #  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       #
##################################################

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   NAMEG:     Drains                          Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to     Channel  Width  Length    Slope   Slope    Slope   Depth   Depth   ings   Flow
umber    ID #      NGTO:    Type     (m)    (m)     (m/m)   (m/m)    (m/m)     (m)     (m)   "N"   (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-  CHANNEL      WIDTH     AREA  PERCENT    SLOPE    RESISTANCE  FACTOR    DEPRES. STORAGE(MM) INFILTRATION   DECAY RATE GAGE  MAXIMUM
       MENT NO.  OR INLET       (M)     (HA)  IMPERV.    (M/M)     IMPERV.     PERV.   IMPERV.     PERV.      RATE(MM/HR)     (1/SEC)     NO.  VOLUME
                                                                                                          MAXIMUM MINIMUM                      (MM)
 ---  ---------   -------- --------- --------  -----   -------    -------  --------    ------    ------     ----   -------  --------  ------ -------
  1        300        200     48.99     0.24  78.00    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).           0.24
IMPERVIOUS AREA (HECTARES)......           0.19
PERVIOUS AREA (HECTARES)........           0.05
TOTAL WIDTH (METERS)............          48.99
PERCENT IMPERVIOUSNESS..........          78.00
```

```
*********************************************************
*      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)	A1 (MM/HR-M^B1)	FLOW CONSTANTS 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        #
#############################################
```

AND USE LNAME)	BUILDUP EQUATION TYPE (METHOD)	FUNCTIONAL DEPENDENCE OF BUILDUP PARAMETER(JACGUT)	LIMITING BUILDUP QUANTITY (DDLIM)	BUILDUP POWER (DDPOW)	BUILDUP COEFF. (DDFACT)	CLEANING INTERVAL IN DAYS (CLFREQ)	AVAIL. FACTOR FRACTION (AVSWP)	DAYS SINCE LAST SWEEPING (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
----------  --------
       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         0.10     2.00  0.0E+00
   Totals (Loads in kg or other)    0.10     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

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

         308 Four Mile Creek Road
         Town of Niagara-On-The-Lake

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 =                    2056357
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   6147627   1556261

***********************************************
*     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   *
*********************************************
                                                          Millimeters over
                                                cubic meters  Total Basin
Total Precipitation (Rain plus Snow)                 46230.     19263.
Total Infiltration                                   10105.      4210.
Total Evaporation                                     3517.      1466.
Surface Runoff from Watersheds                       33011.     13755.
Total Water remaining in Surface Storage                 0.         0.
Infiltration over the Pervious Area...               10105.     19138.
                    --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........               46633.     19431.
Total Precipitation + Initial Storage.               46230.     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.................................       -0.872 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...........            33011.     13755.
Baseflow.................................                0.
Groundwater Subsurface Inflow............                0.         0.
Evaporation Loss from Channels...........                0.         0.
Channel/Pipe/Inlet Outflow...............            33011.     13755.
Initial Storage + Inflow.................            33011.     13755.
Final Storage + Outflow..................            33011.     13755.
*********************************************
* 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                            2194.       914.
Final Subsurface Storage                              2194.       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	0.24	78.019	262.47	130.184********		0.021	17595.570	0.102	13753.187	0.123	185.691

*** 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				0.12				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#
#             of concentration times volume/second  #
#####################################################

Total Su NDIM =  0
METRIC =  2
```

	Total Su
Inputs	
1. INITIAL SURFACE LOAD.....	5.
2. TOTAL SURFACE BUILDUP.....	4428.
3. INITIAL CATCHBASIN LOAD.....	0.
4. TOTAL CATCHBASIN LOAD.....	0.
5. TOTAL CATCHBASIN AND SURFACE BUILDUP (2+4).....	4428.
Remaining Loads	
6. LOAD REMAINING ON SURFACE...	2.
7. REMAINING IN CATCHBASINS....	0.
8. REMAINING IN CHANNEL/PIPES..	0.
Removals	
9. STREET SWEEPING REMOVAL.....	352.
10. NET SURFACE BUILDUP (2-9)...	4075.
11. SURFACE WASHOFF.....	4073.
12. CATCHBASIN WASHOFF.....	0.
13. TOTAL WASHOFF (11+12).....	4073.
14. LOAD FROM OTHER CONSTITUENTS	0.
15. PRECIPITATION LOAD.....	0.
15a.SUM SURFACE LOAD (13+14+15).	4073.
16. TOTAL GROUNDWATER LOAD.....	0.
16a.TOTAL I/I LOAD.....	0.
17. NET SUBCATCHMENT LOAD (15a-15b-15c-15d+16+16a)....	4073.
>>Removal in channel/pipes (17a, 17b):	
17a.REMOVE BY BMP FRACTION.....	0.
17b.REMOVE BY 1st ORDER DECAY...	0.
18. TOTAL LOAD TO INLETS.....	4073.
19. FLOW WT'D AVE.CONCENTRATION mg/l (INLET LOAD/TOTAL FLOW).....	123.
Percentages	
20. STREET SWEEPING (9/2).....	8.
21. SURFACE WASHOFF (11/2).....	92.
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 (um)	%	Specific Gravity	Settling Velocity (m/s)	Critical Peclet Number
20.	20.0	2.65	0.000267	0.080977
60.	20.0	2.65	0.002319	0.160673
150.	20.0	2.65	0.012234	0.284537
400.	20.0	2.65	0.047806	0.524584
2000.	20.0	2.65	0.180097	1.431405

****
* *
* 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	0.016	0.016	97.0	90.4
HD 4	0.016	0.016	97.0	93.7
HD 5	0.016	0.016	97.0	95.5
HD 6	0.016	0.016	97.0	96.8
Unavailabl	0.016	0.016	97.0	97.6
HD 8	0.016	0.016	97.0	98.1
HD 10	0.016	0.016	97.0	98.1
HD 12	0.016	0.016	97.0	98.1

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

HD 4

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	3435.	3033.	76.	72.	4.	4.	88.3	90.2
1972.	4417.	3939.	103.	99.	4.	5.	89.2	91.1
1973.	4403.	4373.	113.	107.	5.	1.	99.3	94.3
1974.	4497.	4353.	120.	117.	3.	3.	96.8	95.6
1975.	3808.	3643.	102.	96.	6.	2.	95.7	92.4
1976.	5667.	5404.	127.	122.	4.	4.	95.4	93.4
1977.	6072.	5773.	122.	113.	9.	5.	95.1	89.3
1978.	4848.	4773.	119.	112.	7.	2.	98.5	92.7
1979.	5800.	5537.	135.	129.	6.	4.	95.5	92.6
1980.	4677.	4555.	128.	121.	7.	2.	97.4	92.8
1981.	6451.	6344.	144.	139.	4.	1.	98.3	96.4
1982.	4544.	4504.	118.	115.	3.	1.	99.1	97.0
1983.	5991.	5814.	146.	140.	6.	5.	97.0	93.1
1984.	4828.	4814.	116.	109.	7.	0.	99.7	93.8
1985.	4215.	4190.	115.	110.	5.	0.	99.4	95.6
1986.	6139.	6063.	155.	150.	5.	2.	98.8	95.5
1987.	6345.	6147.	155.	147.	8.	2.	96.9	93.7
1988.	5072.	4928.	131.	126.	5.	1.	97.2	95.3
1989.	5589.	5354.	125.	122.	3.	3.	95.8	95.6
1990.	6336.	6257.	159.	154.	5.	2.	98.8	95.3
1991.	5937.	5804.	149.	143.	6.	2.	97.8	94.6
1992.	7549.	7412.	171.	162.	9.	3.	98.2	93.1
1993.	5141.	5103.	149.	144.	5.	1.	99.3	96.4
1994.	5502.	5043.	115.	109.	6.	7.	91.7	89.3
1995.	6379.	6130.	138.	131.	7.	7.	96.1	90.5
1998.	1667.	1662.	57.	54.	3.	0.	99.7	94.2
1999.	4061.	3965.	112.	107.	5.	1.	97.6	94.4
2000.	4659.	4563.	95.	88.	6.	2.	97.9	91.4
2001.	3700.	3700.	92.	89.	3.	0.	100.0	96.9
2002.	3864.	3845.	107.	103.	4.	0.	99.5	95.6
2003.	4395.	4344.	110.	103.	7.	1.	98.8	93.2
2004.	5255.	5244.	113.	107.	6.	0.	99.8	94.6
2005.	3801.	3435.	82.	76.	6.	4.	90.4	88.5

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

  308 Four Mile Creek Road
 Town of Niagara-On-The-Lake

     Date     Time        Flow   Total Su
 Mo/Da/Year  Hr:Min        cum/s  mg/l
 ----------  -------    -------  --------
Flow wtd means.....         0.000      123.
Flow wtd std devs..         0.001       67.
Maximum value......         0.123      291.
Minimum value......         0.000        0.
Total loads........        33008.     4075.
                         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... September   3, 2025               *
*          Time...          9:32:35.267              *
*   Ending Date... September   3, 2025               *
*          Time...          9:32:38. 64              *
*  Elapsed Time...               0.047 minutes.      *
*  Elapsed Time...               2.797 seconds.      *
**************************************************
```

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

SAMPLE INSPECTION REPORT

Owner:

Location:

Manhole Oil/Grit Separator:

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: