UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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File: 22115

FUNCTIONAL SERVICING REPORT

1570 Niagara Stone Road, Niagara-On-The-Lake

Revised November 2024

INTRODUCTION

The purpose of this report is to address the servicing needs for the proposed residential subdivision development in support of the applications for Zoning By-Law Amendment. The subject land is located at 1570 Niagara Stone Road in the Virgil Community of the Town of Niagara-on-the-Lake; north of Field Road, west of Niagara Stone Road, south of Penner Street, and east of Elden Street. The site has historically been fully developed as the location of the Cornerstone Community Church.

The development site is approximately 0.47 hectare and shall consist of 8 townhouse units, and 24 apartment units in a 4-storey building. The proposed development will include associated asphalt access and parking areas, concrete curb, catch basins, storm sewers, and sanitary sewers.

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 municipal 150mm diameter watermain on Elden Street. It is proposed to connect a 150mm diameter water service to the existing 150mm watermain to provide both domestic water supply and fire protection.

Table 1 summarizes the projected water demand calculations for the proposed development. The water demands were calculated based on the 2021 Niagara Water Master Servicing Plan Update (MSPU), and an assumed per capita rate of 2.5 persons for the apartment units and 3.0 persons per unit for the townhouse units was apply.

Table 1. Water Demand Calculations								
Number of Units	Density (ppu)	Population (persons)	Avg. Day Demand Rate (L/cap/day)	Avg. Day Demand (L/s)	Max Day Demand		Peak Hour Demand	
					Peak Factor	(L/s)	Peak Factor	(L/s)
8 (Towns)	3.0	24	240	0.07	1.65	0.11	3.00	0.20
24 (Apartments)	2.5	60	240	0.16	1.65	0.28	3.00	0.50
TOTAL		84	240	0.23	1.65	0.39	3.00	0.70

As shown on Table 1, It is expected than the proposed development generates an Average Day Demand of 0.23L/s, using a rate of 240L/cap/day for residential per 2021 MSPU. A peak factor of 1.65 was apply to calculate the expected Max Day Demand of 0.39L/s, and the Peak Hour Demand of 0.70L/s was calculated using a peak factor of 3.0 per 2021 MSPU.

Fire protection will be provided for the proposed development with one private fire hydrant within the site. The location of the proposed hydrant will be identified as part of the detailed engineering design.

To calculate the required fire flow, the Fire Underwriters Survey (FUS 2020) has been conducted for the 4-storey building. The FUS calculations consider different factors such as the type of construction, combustibility of contents, and spatial separation from adjacent buildings. The FUS calculations have determined that a minimum fire flow of 241.54 L/s must be provided without the inclusion of sprinklers. According to FUS Table 8, the suggested required fire flow for Row Housing with exposure distances less than 3m is 133.33 L/s. Additionally, a fire hydrant flow test was conducted by Niagara Regional Fire Protection on March 1, 2024. The test for the existing hydrant located at 14 Field Road and fronting Elden Street has determined that 413.73 L/s of fire flow will be provided. The FUS fire flow calculations and the fire hydrant flow test results have been enclosed in Appendix A.

Therefore, the existing water supply on Elden Street will adequately provide domestic water supply and fire protection to the 28-unit apartment building and the 14 townhouse units.

SANITARY SERVICING

There is an existing 250mm diameter sanitary sewer along Elden Street that conveys sanitary flows northerly to an existing 350mm diameter sanitary sewer on Penner Street, which then conveys the flows westerly. It is proposed to connect the new development to the existing 250mm sanitary sewer on Elden Street and extend it within the site.

The existing 250mm diameter sanitary sewer on Elden Street has a full flow capacity of approximately 40.21 L/s, and the 350mm diameter sanitary sewer on Penner Street has a full flow capacity of 83.35 L/s.

Figure 1, attached in Appendix B, delineates the existing sanitary drainage areas and population contributing to the existing sanitary sewer system. Under the existing conditions, the 250mm sewer on Elden Street is receiving a peak sanitary flow of approximately 0.57 L/s, utilizing 1.4% of the 250mm sanitary sewer total capacity. The existing sanitary peak flow discharging to the 350mm sewer (from MH 68 to MH 67) on Penner Street is approximately 40.07 L/s, flowing at approximately 48.1% of the total capacity.

It is proposed to construct 8 townhouse units and a 24-unit apartment building with an estimated equivalent population of 84 persons, as shown in Figure 2, attached in Appendix B. The 250mm diameter sanitary sewer along Elden Street is expected to receive a peak sanitary flow of approximately 1.53 L/s, including existing residential usage, which will utilize 3.8% of the sewer's total capacity. Additionally, a peak sanitary flow of approximately 40.90 L/s is anticipated in the downstream 350mm sanitary sewer on Penner Street (from MH 68 to MH 67), utilizing 49.1% of its full capacity.

Therefore, it is expected that this addition will be adequate for the current capacity of the existing sanitary 250mm sanitary sewer on Elden Street and the downstream 350mm sanitary sewer on Penner Street. All the sanitary sewer calculations and supporting plans can be found in Appendix B.

STORMWATER MANAGEMENT

As part of the site development, the following is a summary of the stormwater management plan. The criteria provided by the Town of Niagara-On-The-Lake for this development include the requirement to control stormwater flows from this site up to and including a 100-year design storm event and to provide stormwater quality controls to MECP (70% TSS removal) levels before outletting from the site.

The majority of the stormwater flows on the site are conveyed to Elden Street and Field Road. Flows directed to Elden Street are collected via road catch basins and directed to the existing 375mm diameter storm sewer, which conveys stormwater flows southerly to the existing 1350mm diameter storm sewer on Field Road, flowing west to ultimately discharge into Four Mile Creek. It is proposed to extend the existing 375mm diameter storm sewer approximately 38 meters north on Elden Street, and connect the proposed development to the extended 375mm storm sewer.

Figure 3, Attached in Appendix C, shows the existing Storm Drainage Areas and their associated Runoff Coefficients. Under the existing conditions, around 62% (0.2 ha) of the drainage area A1 land use corresponds to the asphalt parking lot and existing buildings, while the remaining 38% (0.12 ha) of land cover corresponds to grasses. The majority of the land cover for drainage area A3

consists of the asphalt parking lot and buildings. The drainage area impervious has been determined and converted to a Runoff Coefficient for the existing site drainage areas.

The proposed drainage areas and associated Runoff Coefficient from impervious areas are shown in Figure 4, attached in Appendix C. The drainage area being collected by the site stormwater system is 0.49 hectares (A10), the existing area draining to Elden Street is 0.36 hectares (A20), and the area flowing to Field Road is 0.39 hectares (A30).

The existing 375mm diameter storm sewer on Elden Street has a full flow capacity of approximately 258.78L/s, and is flowing at 64.9% of the total capacity, under the existing conditions for a 100 year design storm event. Storm sewer calculations can be found in Appendix C.

The Modified Rational Method (MRM) was used to determine the peak flows and storage volume required for the 100 year storm events as shown in Appendix C. From the MRM analysis, Table 2 shows the comparison for the existing, proposed and allowable stormwater peak flows permitted to discharge Elden Street and Field Road.

Table 2. Peak Flow Summary

Area #	Area (ha)	Runoff Coefficient		Peak Flows (L/s)		Allowable/Controlled Outflow (L/s)
		Existing	Proposed	Existing	Proposed	
100 Year Design Storm Event						
A1	0.32	0.64		82.1		
A2	0.37	0.58		86.0		
A3	0.45	0.85		153.3		
A10	0.49		0.68		133.5	84.4 (Elden St.)
A20	0.36		0.58		83.7	
A30	0.39		0.85		132.8	153.3 (Field Rd.)

As shown, the existing allowable outflow to Elden Street storm sewer system is the existing flows from A1 and A2, less the proposed flows from A20 or 84.4L/s. The required storm storage to control to the outflow to 84.4 L/s is 10 m^3. In order to meet the existing allowable conditions for future stormwater flows, and outlet control such as orifice and site stormwater storage, will be implemented at the site. The stormwater will be achieved through the use of underground storage. It is estimated that 61m of 450mm diameter storm sewer will provide storage for the 100 year storm event.

To improve the quality of stormwater, typically an oil/grit separator provide the required Total Suspended Solids (TSS) removal, as required for this type of development. The complete stormwater design for this development shall be identified as part of future detailed design.

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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 150mm diameter watermain on Elden Street is expected to have adequate capacity to provide both domestic water supply and fire protection to service the proposed development.

2. The receiving 250mm diameter sanitary sewers on Elden Street will have adequate capacity to service the Site.

3. Stormwater quantity controls are being provided on site to the allowable capacity of the existing 375mm diameter stormwater sewer on Elden Street.

4. Stormwater quality control will be provided to MECP Normal protection (70% TSS removal) levels prior to discharge from the site.

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.

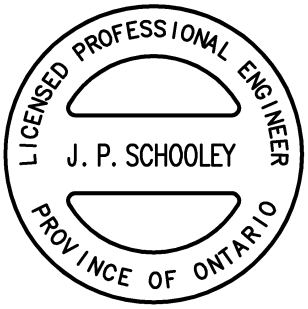
Yours very truly,

Prepared By:

Roberto A. Duarte, B. Eng.

Reviewed by:

Jason Schooley, P.Eng.



Encl.

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APPENDICES

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APPENDIX A

Fire Underwriters Survey (FUS)
Fire Flow Calculation Sheet
Fire Hydrant Testing & Inspection Report

Fire Underwriters Survey

Water Supply for Public Fire Protection (2020) Calculations

1570, Niagara Stone Road, Niagara-On-The-Lake (4 Storey Building)

Required Fire Flow in Litres per Minute	F=	14,493	(L/m)
		241.54	(L/s)
		3,829	(USgmp)
Type of Construction			
Non-Combustible Construction (unprotected metal structural components, masonry or metal walls).	C=	0.80	
Total Floor Area in square metres	A=	1043	(m2)
NOTE: All vertical openings are protected. Therefore, use only the largest floor area (667 m2) plus 25% of each of the two adjoining floors.			
Total Number of Floors		4	
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:			
1570, Niagara Stone Road, Niagara-On-The-Lake (4 Storey Building)			
Distance to Nearest Building to the North	18.7 m	15%	
Distance to Nearest Building to the South	3.5 m	20%	
Distance to Nearest Building to the East	11.7 m	15%	
Distance to Nearest Building to the West	32.3 m	5%	
Total Spacial Separation to Adjacent Structures		55%	
Additions			
Is roof wood shingles or shakes (Yes/No).	No		

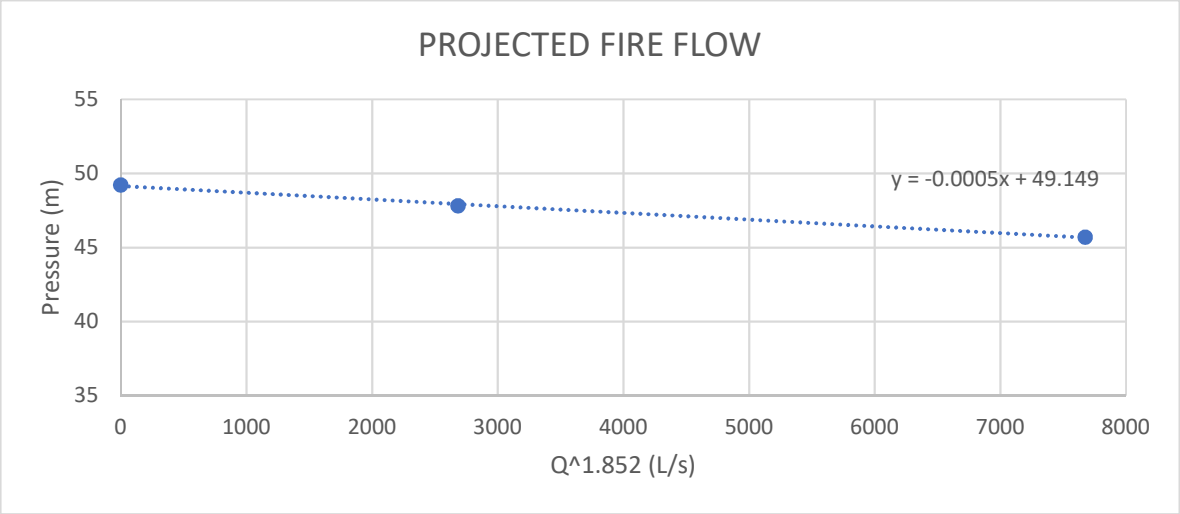
FIRE FLOW CALCULATION SHEET

Project: 1570 Niagara Stone Road
Project Number: 22115
Date: March 4, 2024
Prepared By: Roberto A. Duarte, B.Eng.
Reviewed By: Jason Schooley, P.Eng.

Flow Test Provided by: Niagara Regional Fire Protection
Data of Test: March 1, 2024
Hydrant Location: 14 Field Road

FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	$Q^{1.852}$	PRESSURE (m)
STATIC	70	0	0	0	49.22
RESIDUAL 1	68	1125.6	71.01	2683.43	47.82
RESIDUAL 2	65	1985.4	125.26	7676.11	45.71



FIRE FLOW FORMULA (y = ax + b)

a =	-0.0005
b =	49.149

FIRE FLOW AT A SPECIFIED PRESSURE

Pressure =	20	psi
Pressure =	14.064	m
$Q^{1.852}$ =	70170.00	
Flow, Q =	**413.73**	**L/s**
Flow, Q =	6557.71	USGPM

PRESSURE AT SPECIFIED FIRE FLOW

Flow (Q) =	0	L/s
$Q^{1.852}$	0.00	
Pressure =	49.15	m
Pressure =	69.89	psi

**Hazen-Williams Equation (1.852)

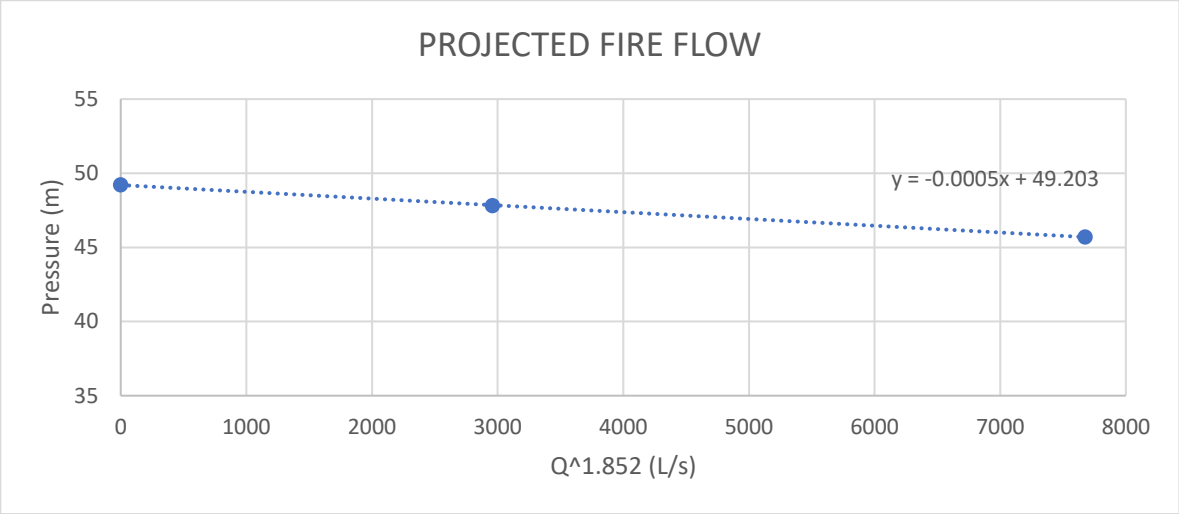
FIRE FLOW CALCULATION SHEET

Project: 1570 Niagara Stone Road
Project Number: 22115
Date: March 4, 2024
Prepared By: Roberto A. Duarte, B.Eng.
Reviewed By: Jason Schooley, P.Eng.

Flow Test Provided by: Niagara Regional Fire Protection
Data of Test: March 1, 2024
Hydrant Location: 660 Penner Street

FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	$Q^{1.852}$	PRESSURE (m)
STATIC	70	0	0	0	49.22
RESIDUAL 1	68	1186.5	74.86	2958.49	47.82
RESIDUAL 2	65	1985.4	125.26	7676.11	45.71



FIRE FLOW FORMULA (y = ax + b)

a =	-0.0005
b =	49.203

FIRE FLOW AT A SPECIFIED PRESSURE

Pressure =	20	psi
Pressure =	14.064	m
$Q^{1.852}$ =	70278.00	
Flow, Q =	**414.07**	**L/s**
Flow, Q =	6563.15	USGPM

PRESSURE AT SPECIFIED FIRE FLOW

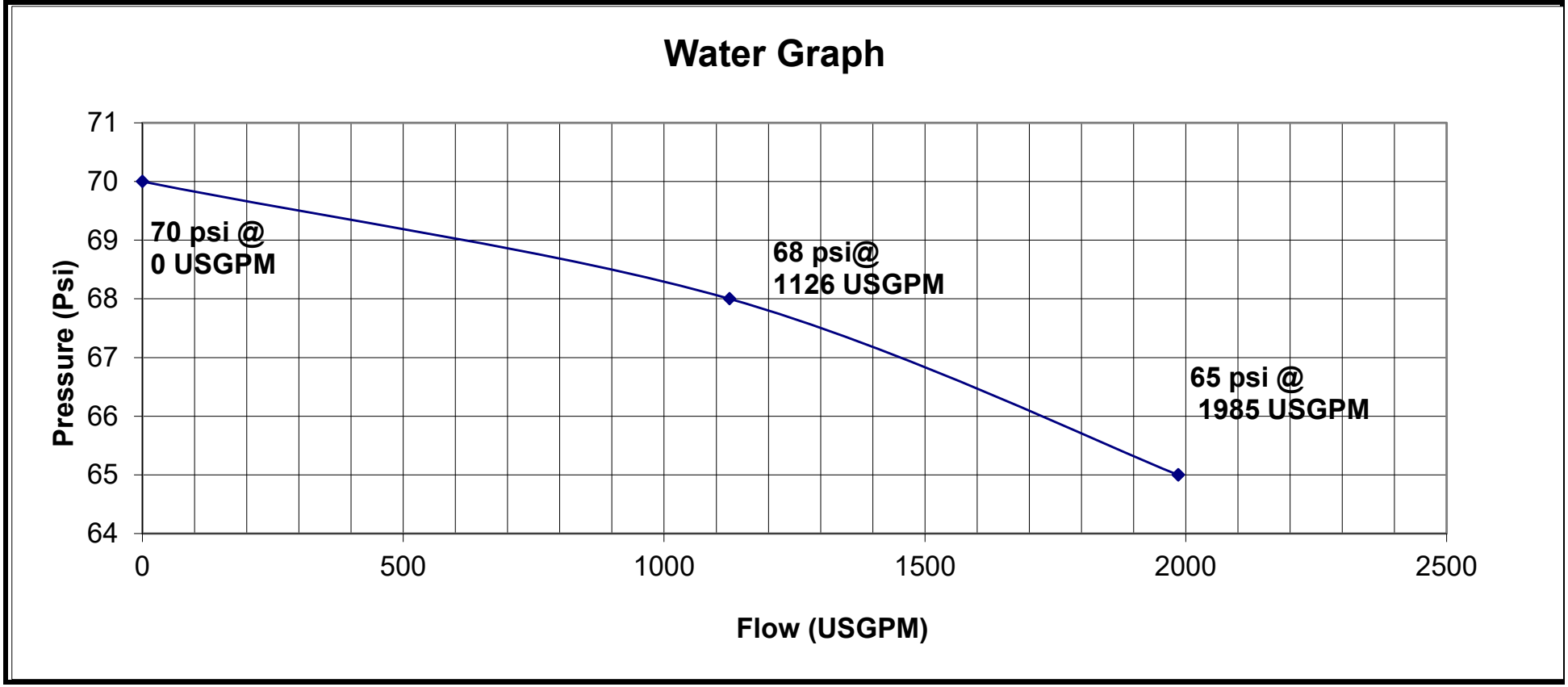
Flow (Q) =	0	L/s
$Q^{1.852}$	0.00	
Pressure =	49.20	m
Pressure =	69.97	psi

**Hazen-Williams Equation (1.852)

NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: 14 Field Rd.

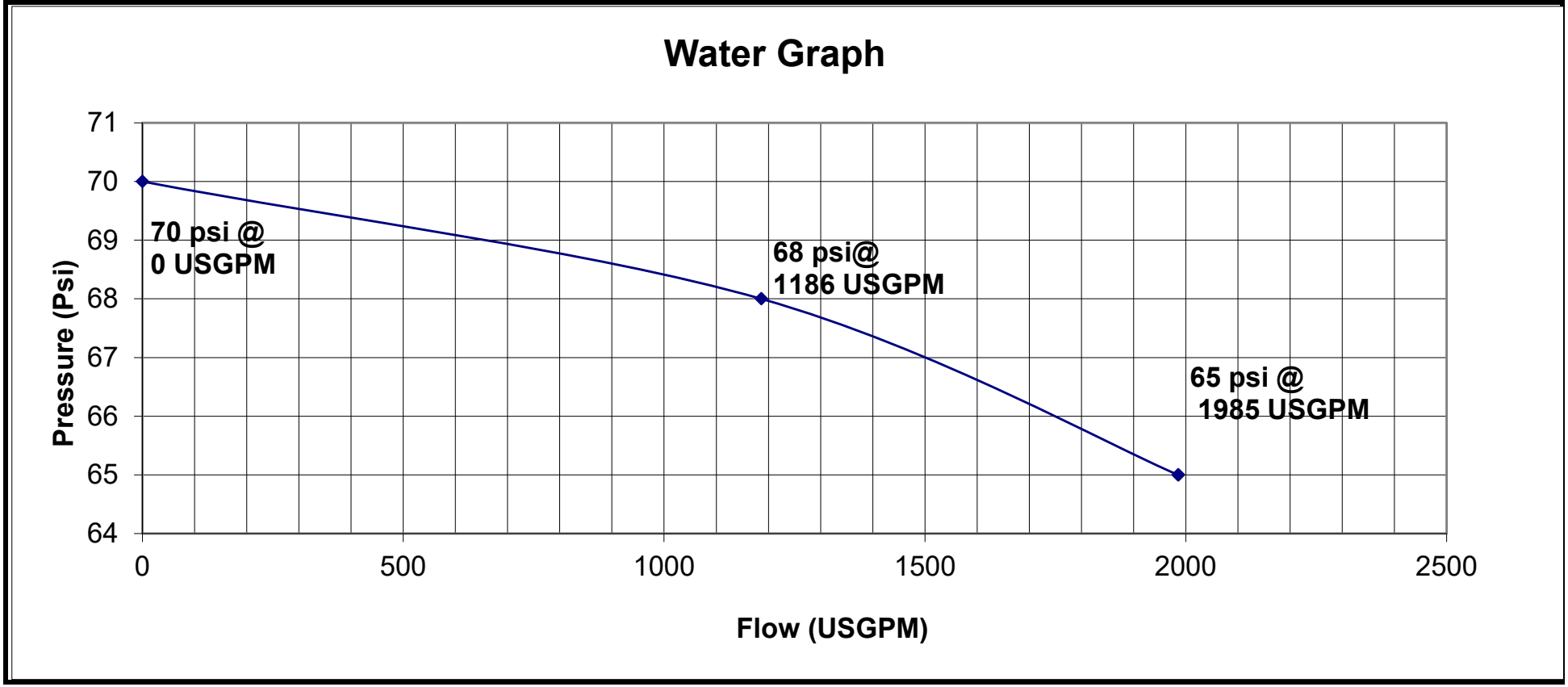
Static Pressure (Psi)		**Pitot Reading 1**	45	**# of Outlets Flowed 1**	1
	70	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	35	**# of Outlets Flowed 3**	2
	68	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	35	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	65	**Outlet Size 3**	2.5	70	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		68	1126
	65		1125.6	65	1985
		Flow 2 Calculated		65	1985
			1985.4	**Date & Time of Test :**	**March 1/2024**
Coefficient value		**Flow 3 Calculated**			**11:00am**
	0.9		1985.4	**Performed by:**	Beau & Cam



NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: Corner of Elden and Penner

Static Pressure (Psi)		**Pitot Reading 1**	50	**# of Outlets Flowed 1**	1
	70	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	35	**# of Outlets Flowed 3**	2
	68	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	35	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	65	**Outlet Size 3**	2.5	70	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		68	1186
	65		1186.5	65	1985
		Flow 2 Calculated		65	1985
			1985.4	**Date & Time of Test :**	**March 1/2024**
Coefficient value		**Flow 3 Calculated**			**11:45am**
	0.9		1985.4	**Performed by:**	Beau & Cam



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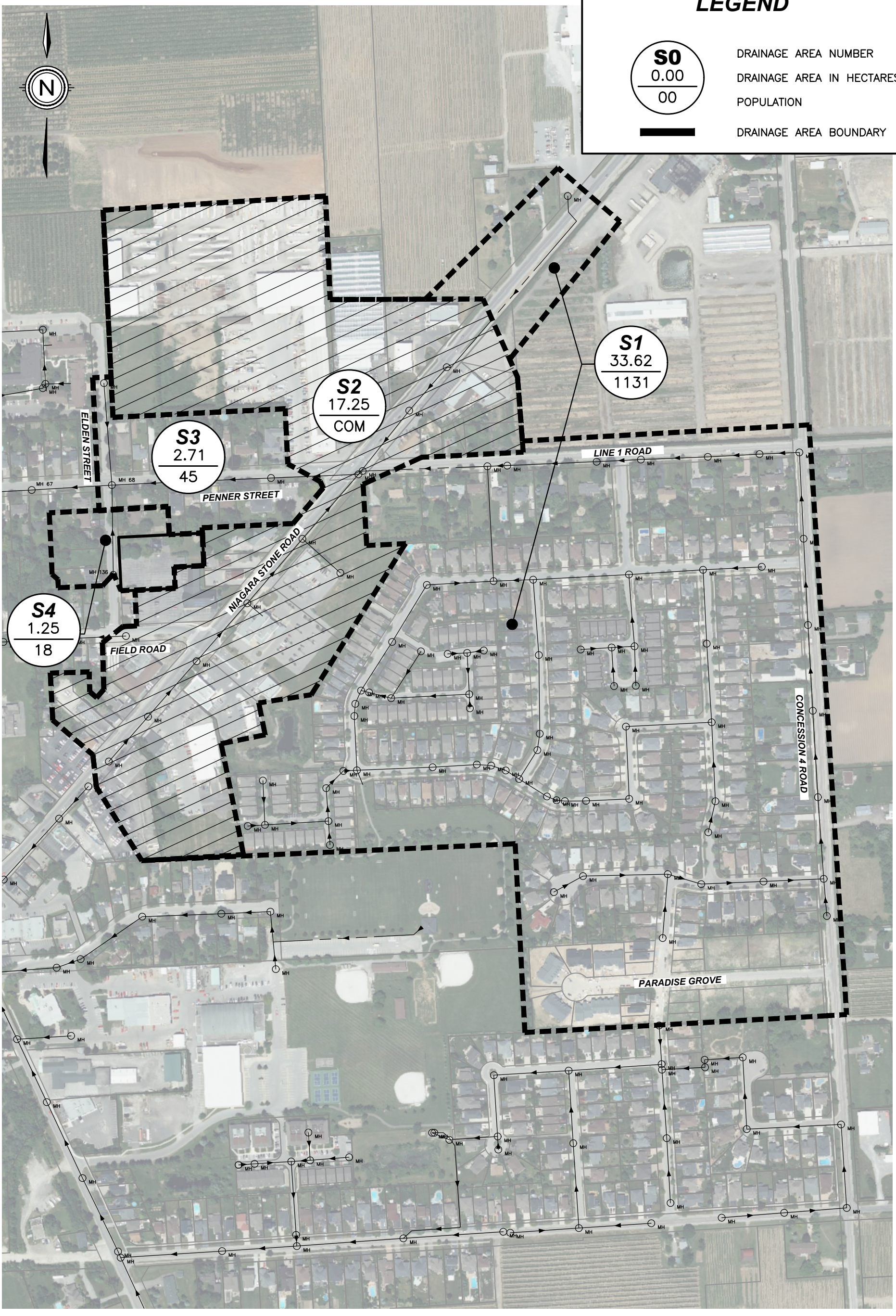
APPENDIX B

Figure 1. Existing Sanitary Drainage Area Plan.
Figure 2. Proposed Sanitary Drainage Area Plan.
Sanitary Sewer Design Sheet.

LEGEND

S0 / 0.00 / 00	DRAINAGE AREA NUMBER / DRAINAGE AREA IN HECTARES / POPULATION
▬	DRAINAGE AREA BOUNDARY



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1570 NIAGARA STONE ROAD
TOWN OF NIAGARA-ON-THE-LAKE

EXISTING SANITARY DRAINAGE AREA PLAN

DATE	2024–02–06
SCALE	1:4000 m
REF No.	.
DWG No.	*FIGURE 1*

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LEGEND

S0
0.00
00

DRAINAGE AREA NUMBER
DRAINAGE AREA IN HECTARES
POPULATION
DRAINAGE AREA BOUNDARY

N

S10
33.62
1131

S20
17.25
COM

S30
2.71
45

S40
0.48
84

S50
0.77
15

ELDEN STREET
PENNER STREET
NIAGARA STONE ROAD
FIELD ROAD
LINE 1 ROAD
CONCESSION 4 ROAD
PARADISE GROVE

1570 NIAGARA STONE ROAD
TOWN OF NIAGARA-ON-THE-LAKE

PROPOSED SANITARY DRAINAGE AREA PLAN

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DATE	2024-02-06
SCALE	1:4000 m
REF No.	.
DWG No.	FIGURE 2

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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 / s / ha)
POPULATION DENSITY:	3.0	PERSONS / TOWNHOUSE UNIT
	2.5	PERSONS / APARTMENT UNIT
COMM./INSTITUTIONAL DENSITY:	28.0	m3 / ha / Day (PER MECP)

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 : 1570 Niagara Stone Road
PROJECT NO: 22115

SANITARY SEWER DESIGN SHEET

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

LOCATION			AREA		POPULATION				ACCUMULATED PEAK FLOW				DESIGN FLOW					
Location and Description	From M.H	To M.H.	Increment (hectares)	Accumulated (hectares)	Number of Units	Population Density (Person/Unit)	Population Increment	Total Population Served	Peaking Factor	Flow (L/s)	Infiltration Flow L/s	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Length (m)	Pipe Slope (%)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Percent Full
PRE-DEVELOPMENT CONDITIONS																		
S1 - NIAGARA STONE RD			33.62	33.62	377	3	1131	1131	3.76	12.57	9.62	22.18						
S2 - NIAGARA STONE RD			17.25	50.87				1131	2.00	11.18	14.55	38.30						
S3 - PENNER STREET			2.71	53.58	15	3	45	1176	3.75	13.03	15.32	39.53						
S4 - ELDEN STREET	MH 136	MH 68	1.25	1.25	6	3	18	18	4.00	0.21	0.36	0.57	250	98.8	0.42	0.79	40.21	1.4%
PENNER STREET	MH 68	MH 67		54.83				1194	3.75	13.21	15.68	40.07	350	91.2	0.30	0.84	83.35	48.1%
POST-DEVELOPMENT CONDITIONS																		
S10 - NIAGARA STONE RD			33.62	33.62	377	3	1131	1131	3.76	12.57	9.62	22.18						
S20 - NIAGARA STONE RD			17.25	50.87				1131	2.00	11.18	14.55	38.30						
S30 - PENNER STREET			2.71	53.58	15	3	45	1176	3.75	13.03	15.32	39.53						
S40 - SITE (TOWNHOUSE UNITS)	MH 136	MH 68	0.48	0.48	8	3	24	24	4.00	0.28	0.14	0.42						
SITE (APPARTMENT UNITS)	MH 136	MH 68		0.48	24	2.5	60	84	4.00	0.99	0.14	1.13						
S50 - ELDEN STREET	MH 136	MH 68	0.77	1.25	5	3	15	99	4.00	1.17	0.36	1.53	250	98.8	0.42	0.79	40.21	3.8%
PENNER STREET	MH 68	MH 67		54.83				1275	3.73	14.03	15.68	40.90	350	91.2	0.30	0.84	83.35	49.1%

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APPENDIX C

Weighted Impervious Calculation Sheet
Figure 3. Existing Strom Drainage Area Plan.
Figure 4. Proposed Strom Drainage Area Plan.
Storm Sewer Design Sheet (100 Year Storm Event).
Modified Rational Method – Peak Stormwater Flows for 5 Year Storm Event
Modified Rational Method – Peak Stormwater Flows for 100 Year Storm Event

Weighted Percent Impervious Calculations

Project Name:	Cornerstone Condominium
UCC Project Number:	22115
Date:	August 6, 2024

Existing Conditions - A1

Area Type	Area (m^2)	% Impervious	Impervious Area (m^2)
Buildings & Concrete Walkway	216	100%	216.0
Asphalt Road/Parking	1,762	100%	1,762.0
Landscape/Greenspace	1,187	0.1%	1.2
		Total Catchment Impervious Area (m^2)	1,979
		Total Catchment Area (m^2)	3,165
		Weighted Percent Impervious (%)	62.5%
		Weighted Runoff Coefficent [c]	0.64

Existing Conditions - A2 / proposed Conditions A20

Area Type	Area (m^2)	% Impervious	Impervious Area (m^2)
Buildings	1,304	100%	1,304.0
Concrete Sidewalk	124	100%	124.0
Asphalt Road & Driveway	584	100%	584.0
Landscape/Greenspace	1,655	0.1%	1.7
		Total Catchment Impervious Area (m^2)	2,014
		Total Catchment Area (m^2)	3,667
		Weighted Percent Impervious (%)	54.9%
		Weighted Runoff Coefficent [c]	0.58

Existing Conditions - A3 / proposed Conditions A30

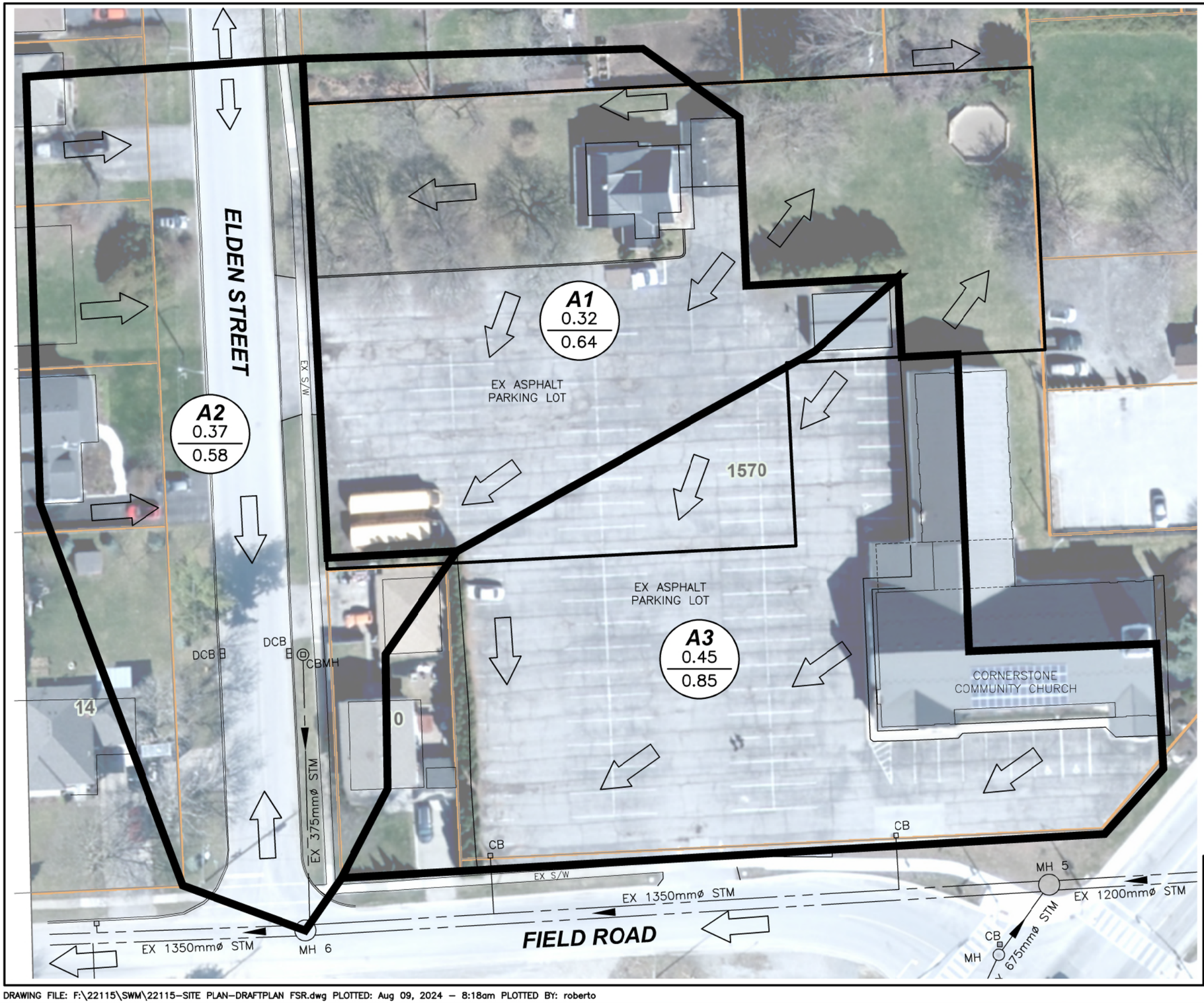
Area Type	Area (m^2)	% Impervious	Impervious Area (m^2)
Buildings	720	100%	720.0
Concrete Sidewalk	115	100%	115.0
Asphalt Road & Driveway	3,378	100%	3,378.0
Landscape/Greenspace	290	0.1%	0.3
		Total Catchment Impervious Area (m^2)	4,213
		Total Catchment Area (m^2)	4,503
		Weighted Percent Impervious (%)	93.6%
		Weighted Runoff Coefficent [c]	0.85

Proposed Conditions - A10

Area Type	Area (m^2)	% Impervious	Impervious Area (m^2)
Buildings & Concrete Walkway	2,295	100%	2,295.0
Asphalt Road/Parking	1,000	100%	1,000.0
Landscape/Greenspace	1,523	0.1%	1.5
		Total Catchment Impervious Area (m^2)	3,297
		Total Catchment Area (m^2)	4,818
		Weighted Percent Impervious (%)	68.4%
		Weighted Runoff Coefficent [c]	0.68

1570 NIAGARA STONE ROAD
TOWN OF NIAGARA-ON-THE-LAKE

EXISTING STORM DRAINAGE AREA PLAN



N

LEGEND

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

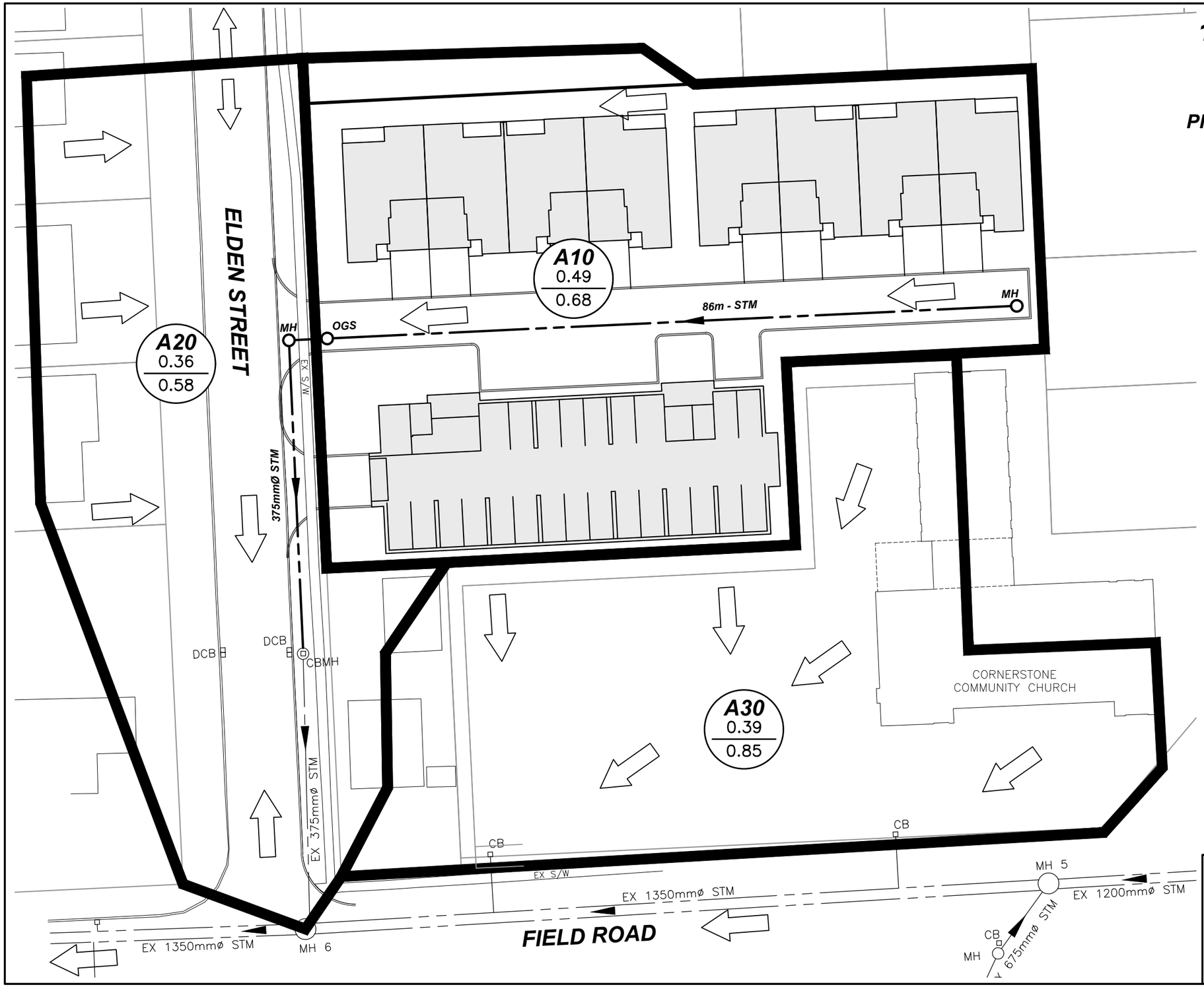
UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

DATE	2024–02–06
SCALE	1:500 m
REF No.	.
DWG No.	FIGURE 3

DRAWING FILE: F:\22115\SWM\22115–SITE PLAN–DRAFTPLAN FSR.dwg PLOTTED: Aug 09, 2024 – 8:18am PLOTTED BY: roberto

1570 NIAGARA STONE ROAD
TOWN OF NIAGARA-ON-THE-LAKE

PROPOSED STORM DRAINAGE AREA PLAN



N

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

DATE	2024-11-01
SCALE	1:500 m
REF No.	.
DWG No.	FIGURE 4

DRAWING FILE: F:\22115\SWM\22115-SITE PLAN-DRAFTPLAN FSR.dwg PLOTTED: Nov 04, 2024 - 2:28pm PLOTTED BY: roberto

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

STORM SEWER DESIGN

MUNICIPALITY: NIAGARA-ON-THE-LAKE
PROJECT: 1570 NIAGARA STONE ROAD
UCC PROJECT NO.: 22115

A = 980.00 mm/hr 100 YEAR DESIGN IDF
B = 3.70 minutes
C = 0.732

PIPE ROUGHNESS = 0.013
PIPE CONVERSION FACTOR = 1.016

DESCRIPTION			STORMWATER ANALYSIS										STORM SEWER DESIGN					
LOCATION	FROM MH	TO MH	AREA (ha)	ACCUMLTD AREA (ha)	RUNOFF COEFFICNT	A*R	ACCUMLTD A*R	T of C (min.)	PIPE TIME (min.)	T of C (sum)	INTENSITY (mm/hr)	FLOW (L/s)	LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (L/s)	VELOCITY (m/s)	PERCENT FULL
ELDEN STREET	SITE	EX CBMH	0.32	0.32	0.64	0.205	0.205	10.00		10.00	144.3	82.1						
ELDEN STREET	EX CBMH	EX MH 6	0.37	0.69	0.58	0.215	0.419	10.00	0.25	10.25	144.3	168.1	33.8	375	2.00	258.78	2.3	64.9%
FIELD ROAD	EX MH 6	EX MH 7										168.1	95.0	1350	0.28	2947.58	2.0	5.7%

STORM SEWER DESIGN SHEET

PROJECT / SUBDIVISION: 1570 Niagara Stone 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												
A1	SITE			0.32	0.32	10.00	0.00	0.640	0.205	0.205	89.884	**51.1**
A2	ELDEN STREET			0.37	0.37	10.00	0.00	0.580	0.215	0.215	89.884	**53.6**
A3	FIELD ROAD			0.45	0.45	10.00	0.00	0.850	0.383	0.383	89.884	**95.5**
POST-DEVELOPMENT CONDITIONS												
A10	SITE			0.49	0.49	10.00	0.00	0.680	0.333	0.333	89.884	**83.2**
A20	ELDEN STREET			0.36	0.36	10.00	0.00	0.580	0.209	0.209	89.884	**52.1**
A30	FIELD ROAD			0.39	0.39	10.00	0.00	0.850	0.332	0.332	89.884	**82.8**
									Allowable Discharge to Elden Street			**52.6**
									Allowable Discharge to Field Road			**95.5**

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

DATE: **November 4, 2024**

RAINFALL PARAMETERS:
Time to Upper End = 10 min.
Town of Niagara-on-the-Lake - 5 Year IDF Curve

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

Modified Rational Method (MRM) Required Storage Volume

Project:	1570 Niagara Stone Road
Project No:	22115
Date:	2024-11-04
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**

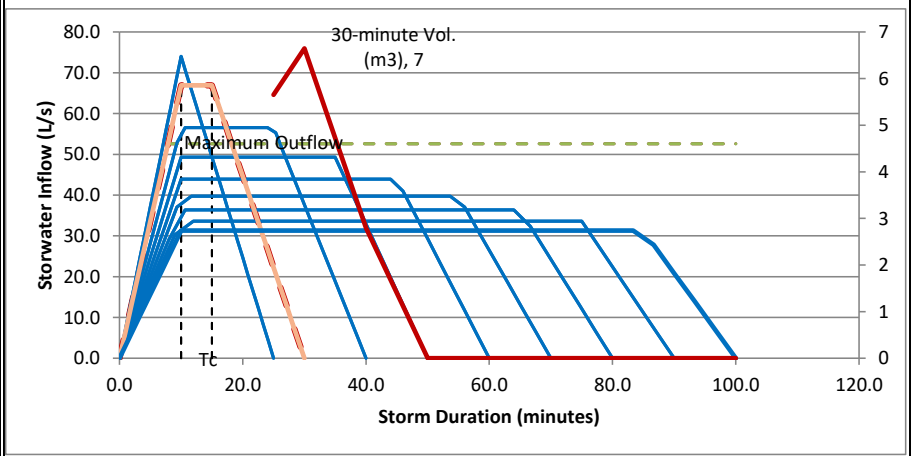
a =	664.00	mm/hr
b =	4.70	minutes
c =	0.74	

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):	0.333		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	72.29	mm/hr	
Peak Inflow at Tc:	66.91	L/s	
Maximum Release Rate:	52.58		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	7.86		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	52.58	-3.2	0.0
1.0	7.23	6.69	52.58	-2.8	0.0
2.0	14.46	13.38	52.58	-2.4	0.0
3.0	21.69	20.07	52.58	-2.0	0.0
4.0	28.92	26.76	52.58	-1.5	0.0
5.0	36.15	33.45	52.58	-1.1	0.0
6.0	43.37	40.15	52.58	-0.7	0.0
7.0	50.60	46.84	52.58	-0.3	0.0
8.0	57.83	53.53	52.58	0.1	0.1
9.0	65.06	60.22	52.58	0.5	0.5
10.0	72.29	66.91	52.58	0.9	1.4
11.0	72.29	66.91	52.58	0.9	2.2
12.0	72.29	66.91	52.58	0.9	3.1
13.0	72.29	66.91	52.58	0.9	4.0
14.0	72.29	66.91	52.58	0.9	4.8
15.0	72.29	66.91	52.58	0.9	5.7
16.0	67.47	62.45	52.58	0.6	6.3
17.0	62.65	57.99	52.58	0.3	6.6
18.0	57.83	53.53	52.58	0.1	***6.6***
19.0	53.01	49.07	52.58	-0.2	6.4
20.0	48.19	44.61	52.58	-0.5	6.0
21.0	43.37	40.15	52.58	-0.7	5.2
22.0	38.56	35.69	52.58	-1.0	4.2
23.0	33.74	31.22	52.58	-1.3	2.9
24.0	28.92	26.76	52.58	-1.5	1.4
25.0	24.10	22.30	52.58	-1.8	0.0
26.0	19.28	17.84	52.58	-2.1	0.0
27.0	14.46	13.38	52.58	-2.4	0.0
28.0	9.64	8.92	52.58	-2.6	0.0
29.0	4.82	4.46	52.58	-2.9	0.0
30.0	0.00	0.00	52.58	-3.2	0.0

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	5.7 m3	50 Min	0.0 m3	80 Min	0.0 m3
30 Min	**6.6 m3**	60 Min	0.0 m3	90 Min	0.0 m3
40 Min	2.8 m3	70 Min	0.0 m3	100 Min	0.0 m3



STORM SEWER DESIGN SHEET

PROJECT / SUBDIVISION: 1570 Niagara Stone 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												
A1	SITE			0.32	0.32	10.00	0.00	0.640	0.205	0.205	144.260	**82.1**
A2	ELDEN STREET			0.37	0.37	10.00	0.00	0.580	0.215	0.215	144.260	**86.0**
A3	FIELD ROAD			0.45	0.45	10.00	0.00	0.850	0.383	0.383	144.260	**153.3**
POST-DEVELOPMENT CONDITIONS												
A10	SITE			0.49	0.49	10.00	0.00	0.680	0.333	0.333	144.260	**133.5**
A20	ELDEN STREET			0.36	0.36	10.00	0.00	0.580	0.209	0.209	144.260	**83.7**
A30	FIELD ROAD			0.39	0.39	10.00	0.00	0.850	0.332	0.332	144.260	**132.8**
									Allowable Discharge to Elden Street			**84.4**
									Allowable Discharge to Field Road			**153.3**

DESIGN BY: **UPPER CANADA CONSULTANTS**
3-30 HANNOVER DRIVE
ST. CATHARINES, ON L2W 1A3
DESIGN BY: **Roberto Duarte, B. Eng.**
DATE: **November 4, 2024**

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

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

Modified Rational Method (MRM) Required Storage Volume

Project:	1570 Niagara Stone Road, NOTL
Project No:	22115
Date:	2024-11-04
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):	0.333		<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	114.88	mm/hr	
Peak Inflow at Tc:	106.33	L/s	
Maximum Release Rate:	84.39		<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	7.94		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	84.39	-5.1	0.0
1.0	11.49	10.63	84.39	-4.4	0.0
2.0	22.98	21.27	84.39	-3.8	0.0
3.0	34.46	31.90	84.39	-3.1	0.0
4.0	45.95	42.53	84.39	-2.5	0.0
5.0	57.44	53.16	84.39	-1.9	0.0
6.0	68.93	63.80	84.39	-1.2	0.0
7.0	80.41	74.43	84.39	-0.6	0.0
8.0	91.90	85.06	84.39	0.0	0.0
9.0	103.39	95.69	84.39	0.7	0.7
10.0	114.88	106.33	84.39	1.3	2.0
11.0	114.88	106.33	84.39	1.3	3.4
12.0	114.88	106.33	84.39	1.3	4.7
13.0	114.88	106.33	84.39	1.3	6.0
14.0	114.88	106.33	84.39	1.3	7.3
15.0	114.88	106.33	84.39	1.3	8.6
16.0	107.22	99.24	84.39	0.9	9.5
17.0	99.56	92.15	84.39	0.5	10.0
18.0	91.90	85.06	84.39	0.0	***10.0***
19.0	84.24	77.97	84.39	-0.4	9.6
20.0	76.59	70.88	84.39	-0.8	8.8
21.0	68.93	63.80	84.39	-1.2	7.6
22.0	61.27	56.71	84.39	-1.7	5.9
23.0	53.61	49.62	84.39	-2.1	3.8
24.0	45.95	42.53	84.39	-2.5	1.3
25.0	38.29	35.44	84.39	-2.9	0.0
26.0	30.63	28.35	84.39	-3.4	0.0
27.0	22.98	21.27	84.39	-3.8	0.0
28.0	15.32	14.18	84.39	-4.2	0.0
29.0	7.66	7.09	84.39	-4.6	0.0
30.0	0.00	0.00	84.39	-5.1	0.0

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	8.8 m3	50 Min	0.0 m3	80 Min	0.0 m3
30 Min	**10.0 m3**	60 Min	0.0 m3	90 Min	0.0 m3
40 Min	3.5 m3	70 Min	0.0 m3	100 Min	0.0 m3