UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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File: 24104

FUNCTIONAL SERVICING REPORT

Vaughan Seed Flats
111 Victoria Street, Welland
February 2025

INTRODUCTION

Upper Canada Consultants has been retained to undertake and provide a Functional Servicing Report to address the servicing needs and requirements as part of a Zoning Approval for the proposed development. The project site is located at the above noted address situated, south of Victoria Street, west of Hester Lane and east of Burgar Street. The development site was historically the location of the Vaughan Seed Company until a fire in 2008. Since this event, the property has remained vacant land.

The proposed development site is approximately 0.22 hectares and shall consist of a 4-storey, 35-unit residential apartment building including associated asphalt road, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

The objectives of this study are as follows:

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

WATER SERVICING

There is an existing 150mm diameter Cast Iron municipal watermain located on Victoria Street fronting the proposed development site. It is proposed to construct a 150mm diameter service to provide both domestic water supply and fire protection for the proposed apartment building. An existing water service, previously utilized to service the property, will be decommissioned as part of development of the site.

There are two hydrants located in proximity to the development at the following locations:

- Fronting the development site on Victoria Street, approximately 59m east of the Burgar Street.
- Southwest corner of the intersection of Victoria Street and Burgar Street.

Hydrant Flow Tests were conducted by Niagara Regional Fire Protection on the above noted hydrants on Victoria Street with the results and additional fire flow calculations included in Appendix A. The fire flow calculations determined that the hydrants at the intersections of Burgar

Street and Hester Lane would produce flows of approximately 116.7L/s and 123.6L/s respectively under fire flow conditions.

Both existing hydrants will be located within 90 metres of the proposed building principle entrance. The proposed building is expected to be constructed with an internal sprinkler system. A Fire Department connection will be placed within 45m of the existing hydrant fronting the site on Victoria Street per OBC specifications. The buildings' internal Sprinkler System Engineer will provide the minimum flow calculations and requirements necessary to provide adequate fire protection for the proposed building as part of future building permit submissions. The building's fire suppression system must be designed and constructed to ensure that the existing watermain system has sufficient capacity to provide an adequate fire water supply.

Per the buildings details, the proposed development will result in a total population of 84 persons utilizing a density of 2.4 persons/apartment (35 units) per the Niagara Regional Official Plan. Per the 2021 Regional Water Master Servicing Plan Update, 240 L/cap/day is attributed as the average daily demand. Therefore, the average, maximum day, and peak hour domestic requirements will be 20,160L/cap/day, 55,440L/cap/day, and 83,261L/cap/day, respectively.

SANITARY SERVICING

There is an existing 300mm diameter sanitary sewer on Victoria Street fronting the development conveying flows westerly towards Burgar Street. It is proposed to discharge sanitary flows from the proposed building to the Victoria Street sanitary sewer.

Historically, the Victoria Street sanitary sewer was constructed as a Combined Sewer, although through a sewer separation project in 2004, the catch basins on Victoria Street were disconnected from the sewer and reconnected to the 600mm diameter storm sewer on the north side of the road allowance.

An analysis has been conducted on the sanitary sewer immediately fronting the proposed development site utilizing Plan and Profile drawings provided by the City of Welland. The analysis (Appendix B) utilizes a peak residential flow rate of 255 L/cap/day per the Niagara Regional Master Servicing Plan Update (MSPU, 2021), as well as an infiltration rate 0.286 per the MECP Design Guidelines. A population value of 2.4 persons/unit has been utilized per the Niagara Regional Official Plan.

The analysis concludes that the proposed development will discharge a peak sanitary flow of approximately 1.12 L/s to the Victoria Street sanitary sewer from a population of 84 persons. This will occupy 3.1% of the existing 300mm diameter sanitary sewer. As this sewer has substantially more capacity due to the previously conducted sewer separation program, it is expected that the downstream sanitary sewer system will have adequate capacity for the proposed development.

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STORMWATER MANAGEMENT PLAN

As part of the site development for the proposed residential apartment development, the following is a summary of the stormwater management plan.

The criteria provided by the City of Welland for this development includes the requirement to control future development stormwater flows to allowable levels from this site for the 5 and 100 year design storm events. It is also required to improve stormwater quality levels to MECP Normal Protection (70% TSS removal) levels prior to discharge to the existing storm sewer on Victoria Street per the City of Welland CLI permit approval.

Existing Conditions

The following storm sewers are in proximity to the proposed development site:

- 300mm diameter sewer conveying flows northerly on Hester Lane
- 600mm diameter sewer conveying flows westerly on Victoria Street
- 2100mm diameter sewer conveying flows northerly on Burgar Street

Stormwater flows from the subject site are conveyed to the existing storm sewer system on Hester Lane and Victoria Street surrounding property, and directed westerly, ultimately discharging to the existing trunk sewer on Burgar Street. As shown on the Existing Overall Storm Drainage Area Plan (Figure 1, Appendix C), Drainage Area EX1 outlines the existing drainage area for the development site and includes minor portions of the surrounding properties.

Proposed Conditions

It is proposed to construct an apartment building and associated parking lot on the subject lands. Figure 2 (Appendix C) outlines the Future Overall Storm Drainage Area Plan for the proposed development. Drainage Area A10 (Runoff Coefficient of 0.77) represents the lands that will convey stormwater flows into the site storm sewer system.

Quantity Analysis

An analysis has been conducted of the 600mm diameter storm sewer on Victoria Street to determine the available capacity for the proposed development per the Storm Sewer Calculation Sheet in Appendix C. The analysis conservatively assumes that the 200mm diameter and 300mm diameter storm sewer discharging to the 600mm diameter storm sewer are at 100% capacity during the 5 year design storm event. As well, Drainage Area EX2 has been delineated on Figure 1 specifically for the catch basins on Victoria Street discharging to the 600mm diameter storm sewer. The Storm Sewer Calculation Sheet concludes that the Victoria Street storm sewer has a minimum available capacity of approximately **66.0L/s** during the 5 year design storm event.

Due to the proposed site conditions and nature of the surrounding properties, stormwater modelling will also be completed for the 100 year design storm event. As it is known that sewers have an additional 15% capacity under surcharged conditions, the Victoria Street storm sewer would have a minimum available capacity of **76.0L/s** during the 100 year design storm event.

Using the Modified Rational Method, the existing and allowable peak stormwater flow rates have been determined for the proposed development during the 5 and 100 year design storm events using the City of Welland IDF curves. A preliminary analysis has been conducted to determine the expected storage requirement for the development. All Modified Rational Method calculations have been included in Appendix C.

Table 1. Peak Stormwater Flows (L/s)			
Design Storm Event	**Allowable Peak Flows (L/s)**	**Future Peak Flows (L/s)**	
		***A10**	**A10 (Allowable)**
5 Year	66.0	49.8	66.4
100 Year	76.0	78.6	76.0
Note: Peak flow values with (*) represent flows without stormwater quantity controls			

As outlined in Table 1 above, during the 5 year design storm event, the Victoria Street 600mm diameter storm sewer will have sufficient capacity to accommodate stormwater flows from the site. However, during the 100 year design storm event, future peak stormwater flows from the development will be slightly greater than the capacity of the existing storm sewer. It is proposed to provide quantity controls to restrict peak stormwater flows prior to discharge from the site.

A 250mm diameter control orifice tube will be utilized to provide quantity controls for peak stormwater flows discharging from the site to the existing 600mm diameter storm sewer on Victoria Street fronting the site. The control pipe will be located between STM 'MH'2 at the entrance of the site, and the connection at the existing municipal storm sewer. The internal storm sewer system will provide a minimum of 9.4m^3 of storage for stormwater flows backing up in the system up to the lowest rim elevation of 180.90 (CB'3').

Table 2 below outlines the future stormwater characteristics for the proposed stormwater management system within Drainage Area A10 during the modelled storm events.

Table 2. Stormwater Management System Characteristics				
Design Storm	**Allowable Peak Flows (L/s)**	**Peak Outflow (L/s)**	**Storage (m^3)**	**Elevation (m)**
5 Year	66.0	40.6	0.3	178.86
100 Year	76.0	64.0	0.4	179.00

As per Table 2, stormwater flows will be restricted to less than maximum allowable levels up to and including the 100-year design storm event. Stormwater backing up within the internal system will remain will below the lowest catch basin rim elevation of 180.90.

Per the Storm Sewer Design Sheet in Appendix C, the existing 600mm diameter storm sewer on Victoria Street will be at a maximum capacity of 89.5% under the conservative assumption that the 200mm and 300mm diameter upstream storm sewers discharging to the upstream manhole are at a full capacity of 100%. Therefore, it is expected that the existing downstream municipal storm sewer system will have sufficient capacity for the proposed development.

Quality Analysis

It is required to provide stormwater quality enhancements to a MECP Normal Protection (70% TSS removal) standard prior to discharge from the site in alignment with the City of Welland CLI Permit. For this development, it is proposed to install CB Shield devices within the internal parking catch basins to provide the necessary stormwater quality enhancements. The ETV-verified CB Shields devices function by acting as a buffer for stormwater dropping and scouring the catch basin. This allows sediments within the stormwater to sufficiently settle and accumulate within the catch basin sump.

An Overall TSS Removal Calculation Sheet has been included in Appendix D outlining the effective TSS removal provided by the combination of CB Shield quality enhancement devices and rooftop/landscape non-TSS producing areas. The calculation utilizes sediment removal rates based on certified ETV testing analysis provided by the manufacturer. The calculation concludes that an effective TSS removal rate of 75.5% will be provided for stormwater flows discharging to the downstream system. Therefore, sufficient stormwater quality enhancement will be provided by the proposed stormwater management plan.

MAINTENANCE OF STORMWATER MANAGEMENT FACILITY

CB Shield

The CB Shield will need to be inspected to determine if the settled suspended solids need to be removed from the catch basin sump. This facility needs inspection after every significant storm during the first two years of operation to ensure that it is working properly. This will translate into an average of six inspections per year.

Points of regular inspection are as follows:

- Is there sediment in the catch sump? The level of sediment can be measured from the surface without entry into the catch basin via a graduated ole with a flat plate attached to the bottom.
- Is there oil in the catch basin sump? This can be checked visually from the surface. The presence of oils usually indicated by an oily sheen, frothing, or unusual coloring. The separator should be cleaned in the event of a major spill contamination.

Typically, stormwater CB Shield separators are cleaned out using vacuum pumping. No entry into the unit is required for maintenance and cleaning should occur annually or whenever the accumulation reaches 30 percent of the sediment storage 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.

A CB Shield Operations Manual is enclosed in Appendix D for maintenance references.

Occasionally, the 250mm diameter orifice tube at the site entrance may become blocked by debris. In this case, it will need to be cleared to allow the stormwater to pass through and to prevent excessive stormwater accumulation on site. Regular preventative maintenance is suggested to avoid potential stormwater issues.

CONCLUSIONS AND RECOMMENDATIONS

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

1. The existing 150mm diameter watermain will have sufficient capacity to provide both domestic and fire protection water supply.

2. The existing 300mm diameter municipal sanitary sewer on Victoria Street will have adequate capacity for the proposed residential development.

3. Stormwater quantity controls will be provided to allowable conditions up to and including the 100-year design storm event.

4. The site extreme stormwater overland route from the road system is to the Victoria Street road allowance.

5. Stormwater quality protection will be provided to Normal Protection (70% TSS removal) levels.

Based on the above and the accompanying calculations, 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,

LICENSED PROFESSIONAL ENGINEER
K. N. TIESSEN
100581347
PROVINCE OF ONTARIO

Kurt Tiessen, P.Eng.
February 18, 2025
Encl.

APPENDICES

UPPER CANADA CONSULTANTS
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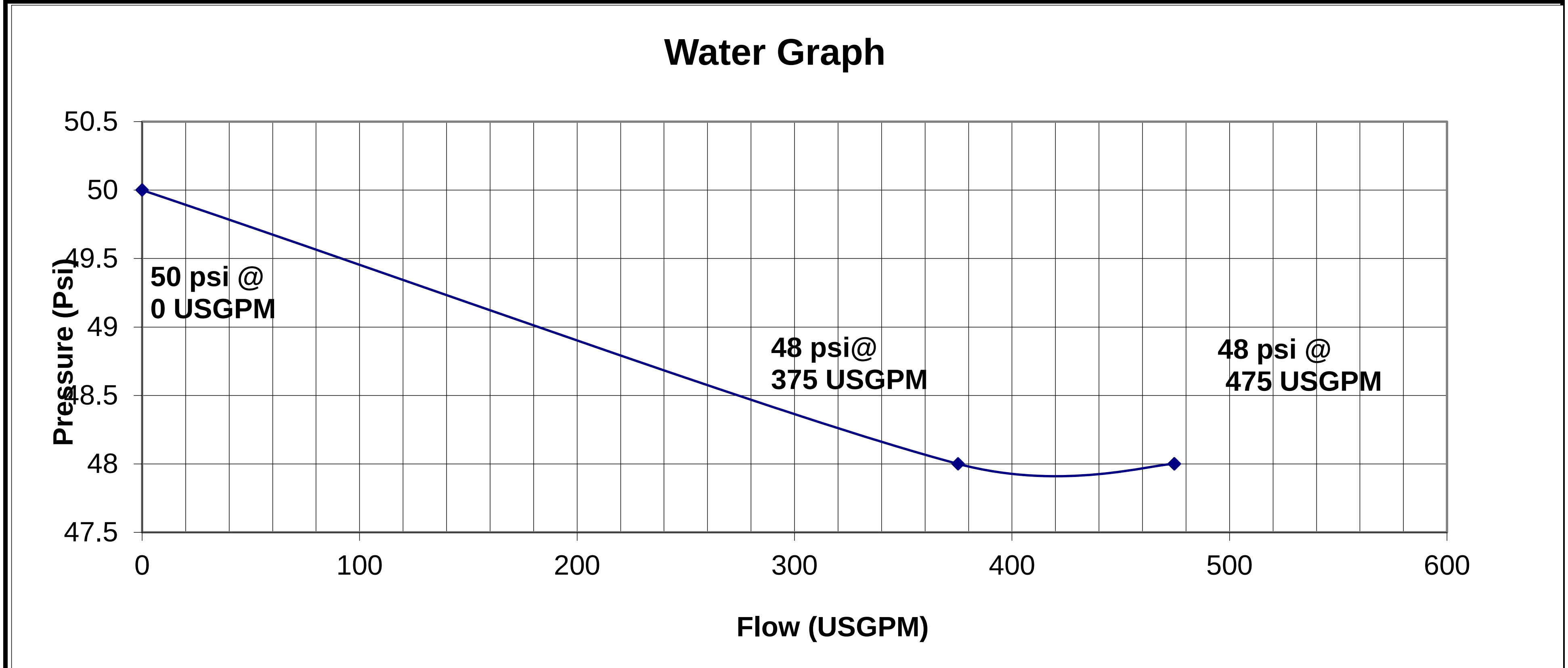
APPENDIX A

Hydrant Flow Test Results – Niagara Regional Fire Protection
Hydrant Fire Flow Calculations

NIAGARA REGIONAL FIRE PROTECTION INC.					
Flow Test Location: Corner of Victoria and Hester					
Static Pressure (Psi)		**Pitot Reading 1**	5	**# of Outlets Flowed 1**	1
	50	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	2	**# of Outlets Flowed 3**	2
	48	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	2	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	48	**Outlet Size 3**	2.5	50	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		48	375
	48		375.2	48	475
		Flow 2 Calculated		48	475
			474.6	**Date & Time of Test :**	**Dec. 16/2024**
Coefficient value		**Flow 3 Calculated**			**9:00AM**
	0.9		474.6	**Performed by:**	Mike & Cam



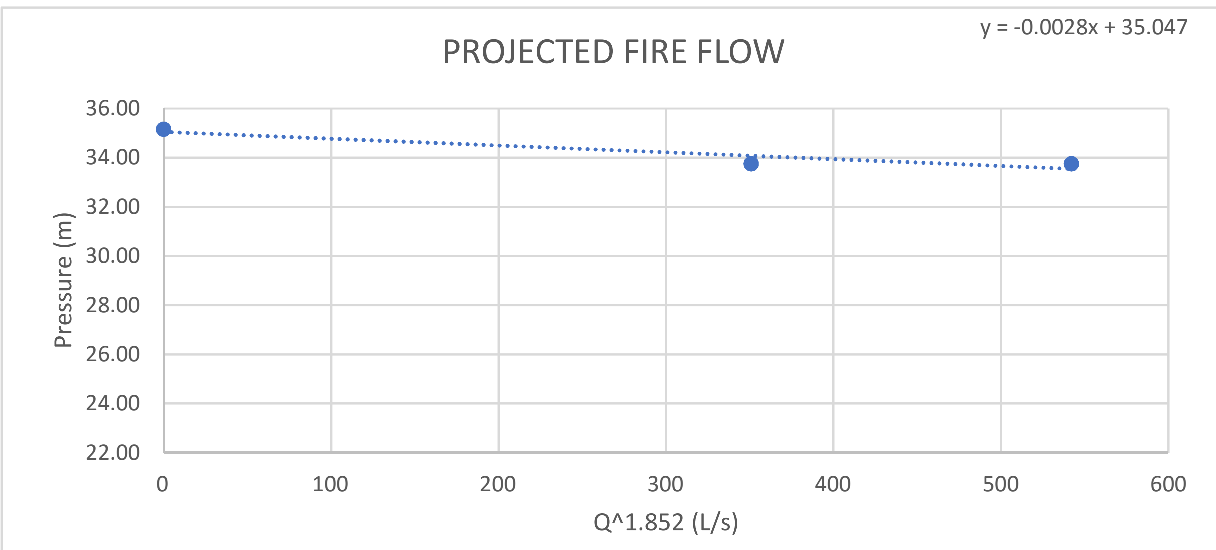
FIRE FLOW CALCULATION SHEET

Project: Victoria Apartment, Welland
Project Number: 24104
Date: December 16, 2024
Prepared By: Kurt Tiessen, EIT
Reviewed By: Jason Schooley, P.Eng.

Flow Test Provided by: Niagara Regional Fire Protection
Data of Test: December 16, 2024
Hydrant Location: Corner of Victoria and Hester

FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	$Q^{1.852}$	PRESSURE (m)
STATIC	50	0	0	0	35.16
RESIDUAL 1	48	375.2	23.67	350.80	33.75
RESIDUAL 2	48	474.6	29.94	542.11	33.75



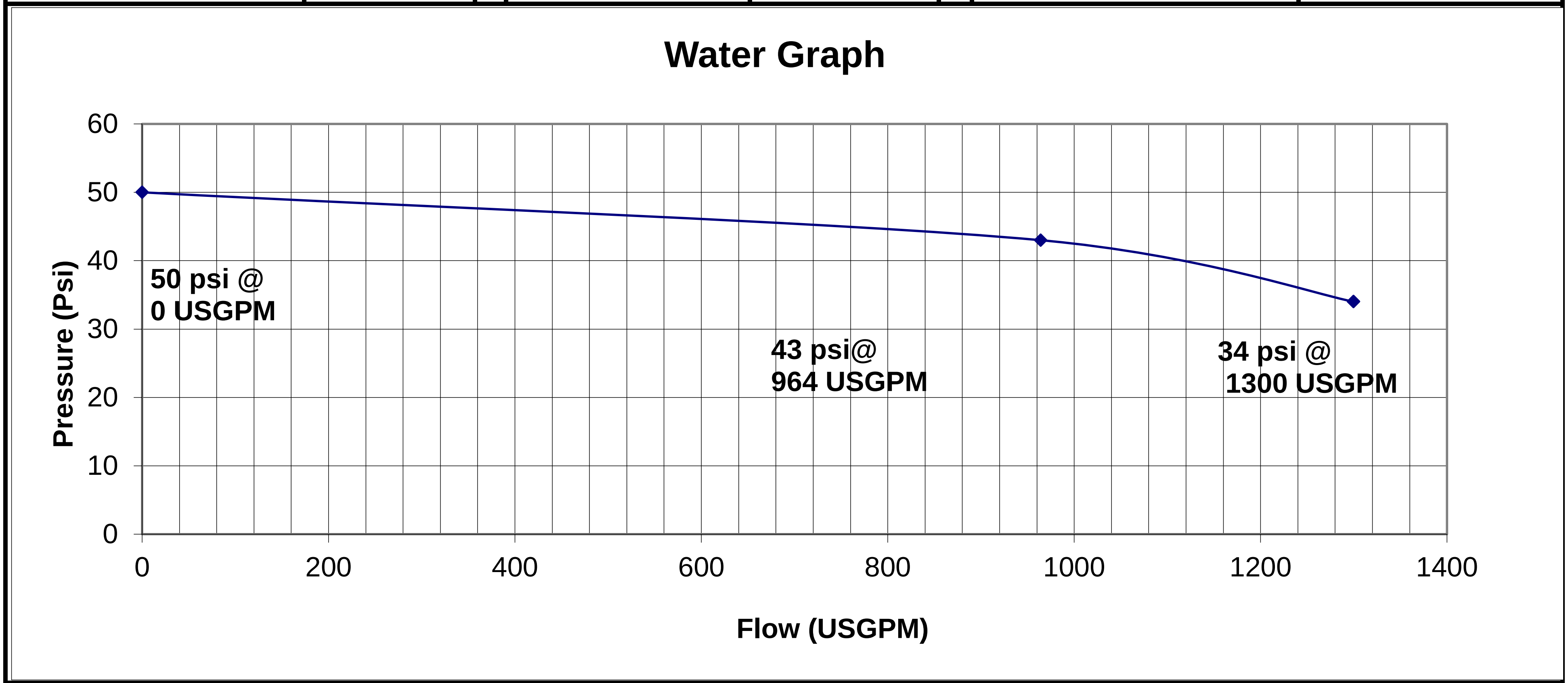
FIRE FLOW FORMULA (y = ax + b)

a = -0.0028
b = 35.047

FIRE FLOW AT A SPECIFIED PRESSURE

Pressure = 20 psi
Pressure = 14.064 m
$Q^{1.852}$ = 7493.93
Flow, Q = 123.64 L/s
Flow, Q = 1959.82 USGPM

NIAGARA REGIONAL FIRE PROTECTION INC.					
Flow Test Location: Corner of Victoria and Burger					
Static Pressure (Psi)		**Pitot Reading 1**	33	**# of Outlets Flowed 1**	1
	50	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	15	**# of Outlets Flowed 3**	2
	43	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	15	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	34	**Outlet Size 3**	2.5	50	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		43	964
	34		963.9	34	1300
		Flow 2 Calculated		34	1300
			1299.7	**Date & Time of Test :**	**Dec. 16/2024**
Coefficient value		**Flow 3 Calculated**			**9:30AM**
	0.9		1299.7	**Performed by:**	Mike & Cam

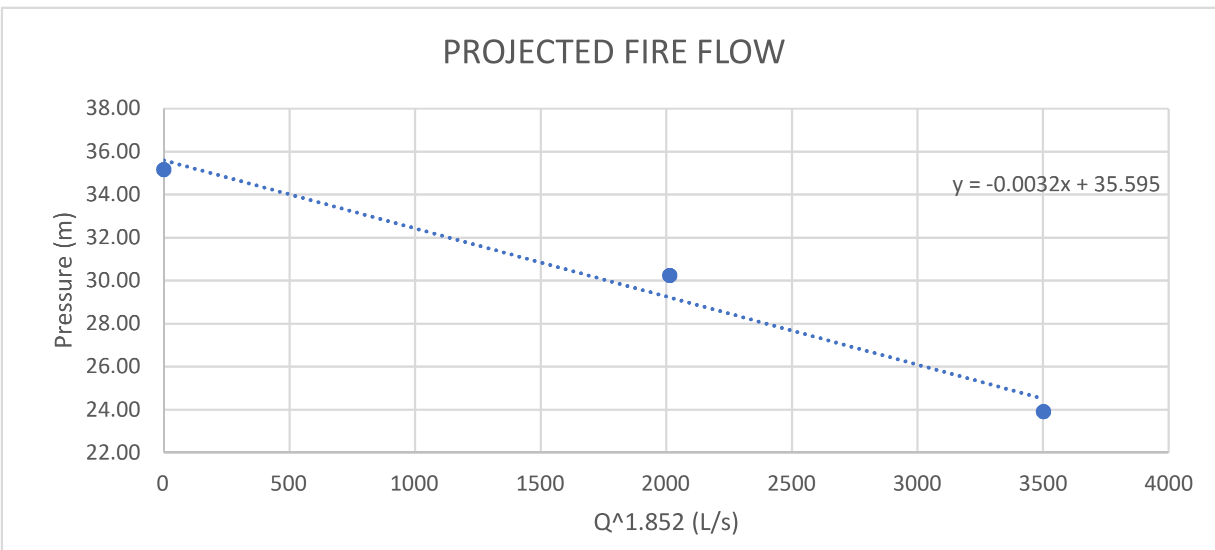


FIRE FLOW CALCULATION SHEET

Project:	Victoria Apartment, Welland
Project Number:	24104
Date:	December 16, 2024
Prepared By:	Kurt Tiessen, EIT
Reviewed By:	Jason Schooley, P.Eng.
Flow Test Provided by:	Niagara Regional Fire Protection
Data of Test:	December 16, 2024
Hydrant Location:	Corner of Victoria and Burger

FLOW TEST RESULTS

TEST	PRESSURE (psi)	FLOW RATE (USGPM)	FLOW RATE (L/s)	$Q^{1.852}$	PRESSURE (m)
STATIC	50	0	0	0	35.16
RESIDUAL 1	43	963.9	60.81	2013.51	30.24
RESIDUAL 2	34	1299.7	82.00	3502.39	23.91



FIRE FLOW FORMULA (y = ax + b)

a = -0.0032
b = 35.595

FIRE FLOW AT A SPECIFIED PRESSURE

Pressure = 20 psi
Pressure = 14.064 m
$Q^{1.852}$ = 6728.44
Flow, Q = 116.66 L/s
Flow, Q = 1849.05 USGPM

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APPENDIX B

Peak Sanitary Flow Calculation Sheet

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

DESIGN FLOWS			**SEWER DESIGN**		
RESIDENTIAL:	255	LITRES/PERSON/DAY (AVERAGE DAILY FLOW)	PIPE ROUGHNESS:	0.013	FOR MANNING'S EQUATION
INFILTRATION RATE:	0.286	L / s / ha (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 L / s / ha)	PIPE SIZES:	1.016	IMPERIAL EQUIVALENT FACTOR
POPULATION DENSITY:	2.4	PERSONS / UNIT	PERCENT FULL:		TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: CITY OF WELLAND
PROJECT : VAUGHAN SEED FLATS
PROJECT NO: 24104

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 (persons/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**
111 VICTORIA ST.	STUB	SEWER	0.22	0.22	35	2.4	84	84	4.26	1.06	0.06	1.12	200	10.0	0.60	0.82	26.50	4.2%
VICTORIA ST.	SEWER	EX MH		0.22				84	4.26	1.06	0.06	1.12	300	84.4	0.13	0.50	36.37	3.1%

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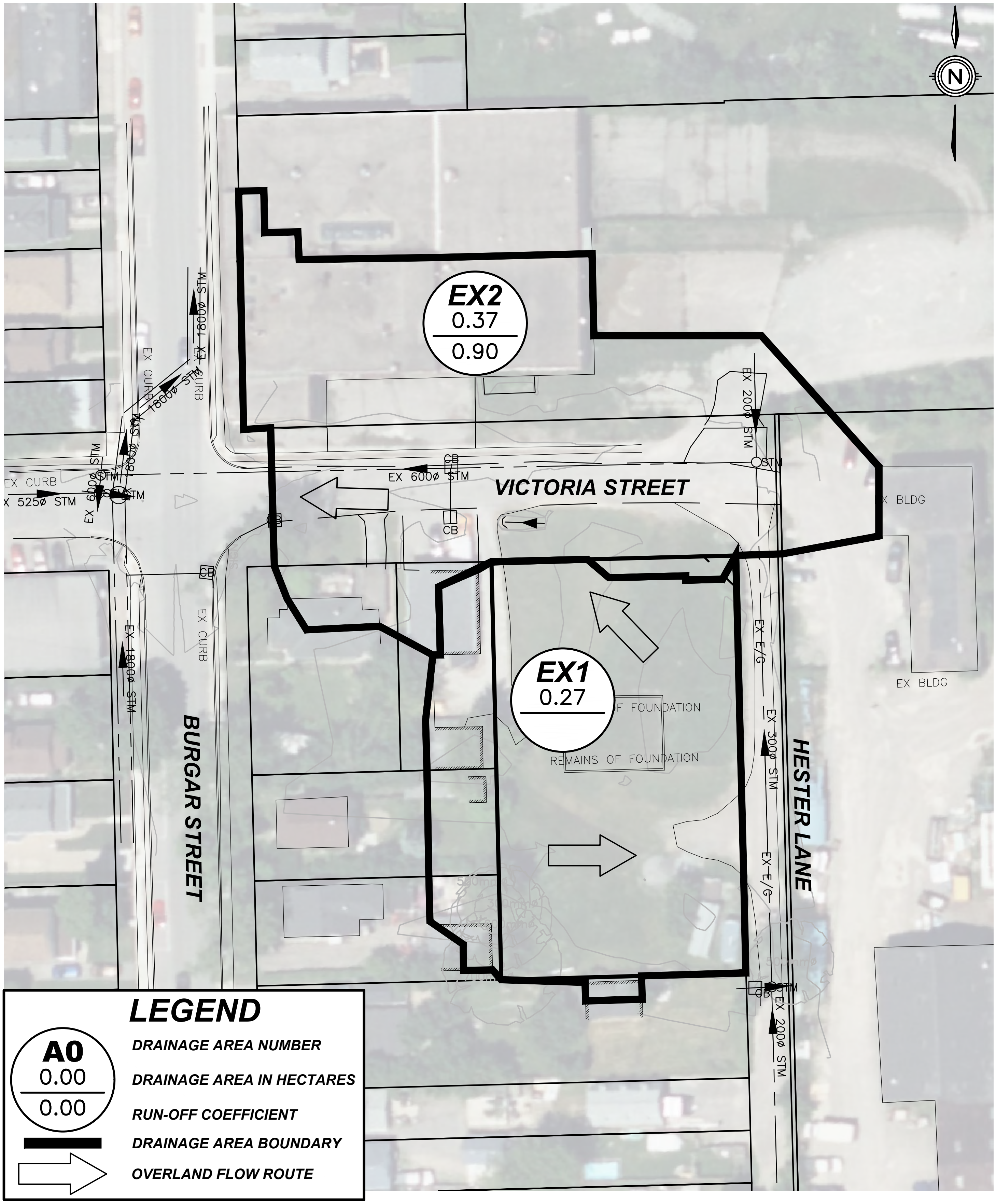
APPENDIX C

Figure 1 – Existing Overall Storm Drainage Area Plan
Figure 2 – Proposed Overall Storm Drainage Area Plan
Weighted Impervious Calculation Sheet
Storm Sewer Analysis Calculation Sheet
Modified Rational Method Calculations – Peak Flow and Storage Requirement
Stage-Storage-Discharge Calculation Sheet



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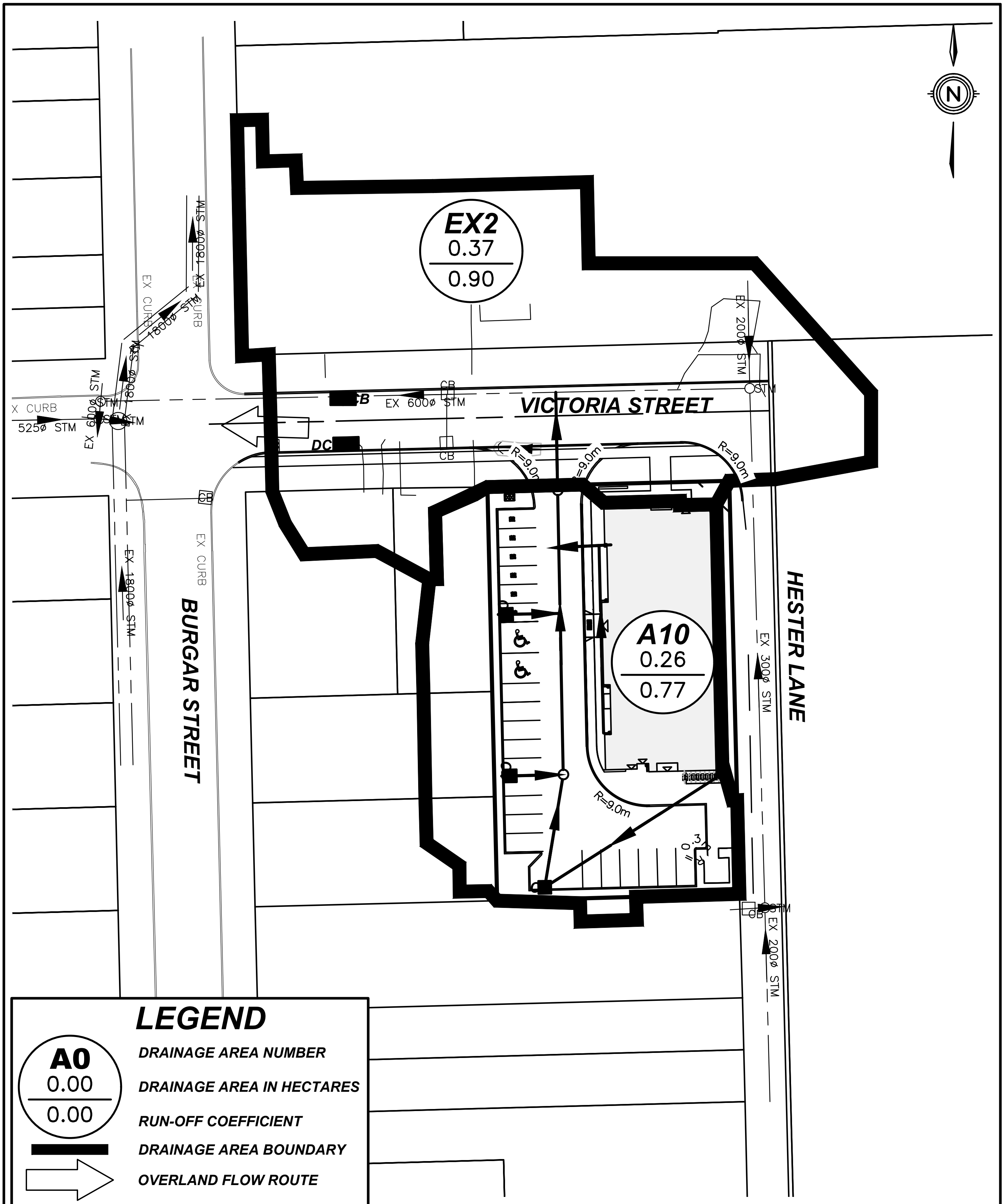
111 VICTORIA STREET

CITY OF WELLAND

EXISTING OVERALL STORM DRAINAGE AREA PLAN

DATE	2024–02–20
SCALE	1:750 m
REF No.	24104
DWG No.	FIGURE 1

DRAWING FILE: F:\24104\Engineering\24104–BASE.dwg PLOTTED: Feb 20, 2025 – 1:17pm PLOTTED BY: kurt



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111 VICTORIA STREET

CITY OF WELLAND

FUTURE OVERALL STORM DRAINAGE AREA PLAN

DATE	2024–02–18
SCALE	1:750 m
REF No.	24104
DWG No.	FIGURE 2

DRAWING FILE: F:\24104\Engineering\24104–BASE.dwg PLOTTED: Feb 20, 2025 – 1:21pm PLOTTED BY: kurt

Weighted Imperviousness Percentage Calculation Worksheet

Project Name:	Victoria Apartment
Project Number:	24104
Date:	December 2024
Person:	K.Tiessen

A10 - PROPOSED CONDITIONS

	Footprint	*Runoff Coefficient*	*Effective Impervious Area*
Existing Parking Lot/Driveway	118.4 m^2	0.80	94.7 m^2
Existing Buildings	211.8 m^2	0.90	190.6 m^2
Proposed Buildings	663.1 m^2	0.90	596.8 m^2
Asphalt Parking Areas & Concrete Sidewalk	1119.4 m^2	0.90	1007.5 m^2
Landscape/Greenspace	454.2 m^2	0.20	90.8 m^2
TOTAL CATCHMENT IMPERVIOUS AREAS			1,980 m^2
TOTAL CATCHMENT AREA			2,567 m^2
		EFFECTIVE RUNOFF COEFFICIENT	**0.77**

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STORM SEWER DESIGN

VICTORIA STREET STORM SEWER ANALYSIS - AVAILABLE CAPACITY CALCULATIONS

MUNICIPALITY: CITY OF WELLAND — A = 830.00 mm/hr — 5 YEAR DESIGN IDF
PROJECT: 111 VICTORIA STREET APARTMENTS — B = 7.30 minutes — PIPE ROUGHNESS = 0.013
UCC PROJECT NO.: 24104 — C = 0.777 — 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
EXISTING CONDITIONS																		
200Ø - INDUSTRIAL LANDS	EX MH F5-159A	EX MHV3	*0.171*	0.17	0.90	0.154	0.154	10.00	0.01	10.01	90.6	38.7	1.0	200	1.3	38.73	1.2	**100.0%**
300Ø - HESTER LANE	EX	EX MHV3	*0.302*	0.30	0.90	0.272	0.272	10.00	0.02	10.02	90.6	68.4	1.0	300	0.5	68.45	0.9	**100.0%**
EX2 - VICTORIA STREET	EX MHV3	EX MHV2	0.37	0.84	0.90	0.330	0.756	10.00	1.81	11.81	90.6	**190.3**	95.4	600	0.2	**256.3**	0.9	74.2%
											AVAILABLE FLOW DURING 5 YEAR EVENT					**66.0**	L/S	
										AVAILABLE FLOW DURING 100 YEAR EVENT (+15%)						**76.0**	L/S	
FUTURE CONDITIONS																		
200Ø - INDUSTRIAL LANDS	EX MH F5-159A	EX MHV3	*0.171*	0.17	0.90	0.154	0.154	10.00	0.01	10.01	90.6	38.7	1.0	200	1.3	38.73	1.2	**100.0%**
300Ø - HESTER LANE	EX	EX MHV3	*0.302*	0.30	0.90	0.272	0.272	10.00	0.02	10.02	90.6	68.4	1.0	300	0.5	68.45	0.9	**100.0%**
										PER FSR - SITE TO DISCHARGE 40.6L/s DURING 5 YR EVENT								
A10 - 111 VICTORIA STREET	MH 2	SEWER	0.257	0.257	*0.628*	0.161	0.161	10.00	0.01	10.01	90.6	**40.6**	1.0	250	1.0		1.2	
EX2 - VICTORIA STREET	EX MHV3	EX MHV2	0.36	1.09	0.90	0.324	0.911	10.00	1.81	11.81	90.6	**229.3**	95.4	600	0.2	**256.3**	0.9	89.5%

NOTE: Above calculations assume 200mm diameter and 300mm diameter storm sewers entering EX MHV3 are at 100% capacity.

STORM SEWER DESIGN SHEET

PROJECT: 111 VICTORIA STREET, CITY OF WELLAND

LOCATION						TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	**FROM M.H.**	**TO M.H.**	**PIPE LENGTH (m)**	**INCREMENT AREA (hectares)**	**TOTAL AREA (hectares)**	**TO UPPER END (min)**	**IN SECTION (min)**	**RUNOFF COEFF**	**SECTION A X R**	**ACCUMLD A x R**	**RAINFALL INTENSITY (mm/hr)**	**PEAK FLOW (L/s)**
EXISTING CONDITIONS						*Calibrated AR Value to match 5 Yr Allowable Flow Rate of 66.0L/s*						
Minimum Available Capacity during 5 Yr Design Storm Event						*10.00*				*0.2622*	*90.598*	66.0
FUTURE CONDITIONS												
A10 - Controlled	SITE	OUTLET		0.257	0.26	10.00	0.00	0.77	0.198	0.198	90.598	49.8
ALLOWABLE PEAK OUTFLOW - A10												66.0
PROVIDED OUTFLOW - A10 250mm Diameter Control Orifice Tube												**40.6**

DESIGN BY: **UPPER CANADA CONSULTANTS**
30 HANNOVER DRIVE, UNIT 3
ST. CATHARINES, ON L2W 1A3

DESIGN BY: **J.SCHOOLEY, P.ENG.**
DATE: **FEBRUARY 2025**

RAINFALL PARAMETERS:

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

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

Modified Rational Method (MRM) Required Storage Volume

Project:	111 VICTORIA STREET, WELLAND
Project No:	24104
Date:	DECEMBER 2024
Design By:	J. SCHOOLEY, P.ENG.
Description:	STORMWATER MANAGEMENT PLAN

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

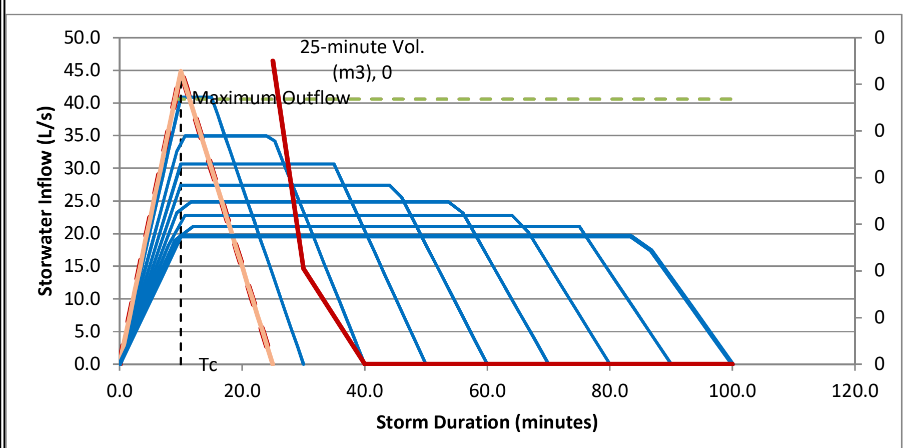
a =	830.00	mm/hr
b =	7.30	minutes
c =	0.78	

Critical Storm Duration:	25.00	minutes	Tail Multiplier (x1-1 1.5
Tc From Design:	10.00	minutes	
Storm Tail Time:	10.00	minutes	
Accumulated Area x R (Ha):	0.198	<-- Area x Runoff Coefficient (Sewer Design Sheet)	
Peak Rainfall Intensity:	81.58	mm/hr	
Peak Inflow at Tc:	44.84	L/s	
Maximum Release Rate:	40.60	<-- Outlet Full Flow Capacity (Design Sheet)	
Time When Outlet Exceeded:	9.05		

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	40.60	-2.4	0.0
0.8	6.80	3.74	40.60	-1.8	0.0
1.7	13.60	7.47	40.60	-1.7	0.0
2.5	20.39	11.21	40.60	-1.5	0.0
3.3	27.19	14.95	40.60	-1.3	0.0
4.2	33.99	18.68	40.60	-1.1	0.0
5.0	40.79	22.42	40.60	-0.9	0.0
5.8	47.59	26.16	40.60	-0.7	0.0
6.7	54.38	29.90	40.60	-0.5	0.0
7.5	61.18	33.63	40.60	-0.3	0.0
8.3	67.98	37.37	40.60	-0.2	0.0
9.2	74.78	41.11	40.60	0.0	0.0
10.0	81.58	44.84	40.60	0.2	0.2
10.8	77.05	42.35	40.60	0.1	***0.3***
11.7	72.51	39.86	40.60	0.0	0.3
12.5	67.98	37.37	40.60	-0.2	0.1
13.3	63.45	34.88	40.60	-0.3	0.0
14.2	58.92	32.39	40.60	-0.4	0.0
15.0	54.38	29.90	40.60	-0.5	0.0
15.8	49.85	27.40	40.60	-0.7	0.0
16.7	45.32	24.91	40.60	-0.8	0.0
17.5	40.79	22.42	40.60	-0.9	0.0
18.3	36.26	19.93	40.60	-1.0	0.0
19.2	31.72	17.44	40.60	-1.2	0.0
20.0	27.19	14.95	40.60	-1.3	0.0
20.8	22.66	12.46	40.60	-1.4	0.0
21.7	18.13	9.97	40.60	-1.5	0.0
22.5	13.60	7.47	40.60	-1.7	0.0
23.3	9.06	4.98	40.60	-1.8	0.0
24.2	4.53	2.49	40.60	-1.9	0.0
25.0	0.00	0.00	40.60	-2.0	0.0

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	**0.3 m3**	50 Min	0.0 m3	80 Min	0.0 m3
30 Min	0.1 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



STORM SEWER DESIGN SHEET

PROJECT: 111 VICTORIA STREET, CITY OF WELLAND

LOCATION						TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	**FROM M.H.**	**TO M.H.**	**PIPE LENGTH (m)**	**INCREMENT AREA (hectares)**	**TOTAL AREA (hectares)**	**TO UPPER END (min)**	**IN SECTION (min)**	**RUNOFF COEFF**	**SECTION A X R**	**ACCUMLD A x R**	**RAINFALL INTENSITY (mm/hr)**	**PEAK FLOW (L/s)**
EXISTING CONDITIONS						*Calibrated AR Value to match 100 Yr Allowable Flow Rate of 76.0L/s*						
Minimum Available Capacity during 5 Yr Design Storm Event + 15%						*10.00*				*0.1913*	*142.985*	76.0
FUTURE CONDITIONS												
A10 - Controlled	SITE	OUTLET		0.257	0.26	10.00	0.00	0.77	0.198	0.198	142.985	78.6
ALLOWABLE PEAK OUTFLOW - A10												76.0
PROVIDED OUTFLOW - A10 250mm Diameter Control Orifice Tube												**64.0**

DESIGN BY: **UPPER CANADA CONSULTANTS**
30 HANNOVER DRIVE, UNIT 3
ST. CATHARINES, ON L2W 1A3

DESIGN BY: **J.SCHOOLEY, P.ENG.**
DATE: **FEBRUARY 2025**

RAINFALL PARAMETERS:

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

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

Modified Rational Method (MRM) Required Storage Volume

Project:	111 VICTORIA STREET, WELLAND
Project No:	24104
Date:	DECEMBER 2024
Design By:	J. SCHOOLEY, P.ENG.
Description:	STORMWATER MANAGEMENT PLAN

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

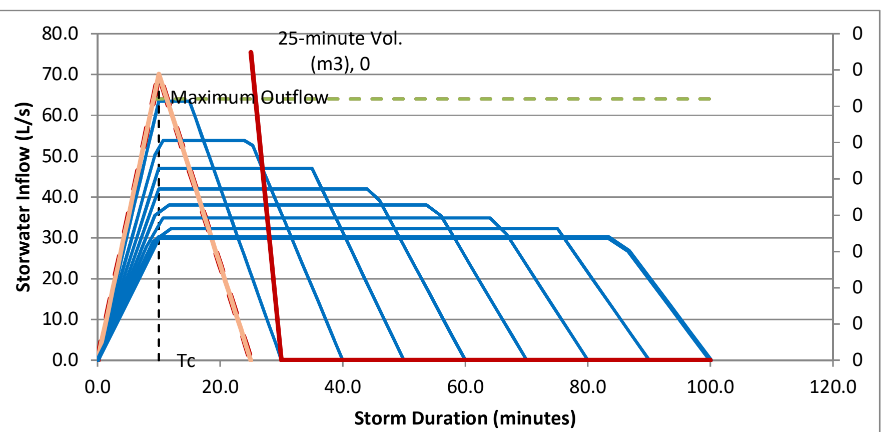
a =	1020.00	mm/hr
b =	4.70	minutes
c =	0.73	

Critical Storm Duration:	25.00	minutes Tail Multiplier (x1-1 1.5
Tc From Design:	10.00	minutes
Storm Tail Time:	10.00	minutes
Accumulated Area x R (Ha):	0.198	<-- Area x Runoff Coefficient (Sewer Design Sheet)
Peak Rainfall Intensity:	127.48	mm/hr
Peak Inflow at Tc:	70.07	L/s
Maximum Release Rate:	64.00	<-- Outlet Full Flow Capacity (Design Sheet)
Time When Outlet Exceeded:	9.13	

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	64.00	-3.8	0.0
0.8	10.62	5.84	64.00	-2.9	0.0
1.7	21.25	11.68	64.00	-2.6	0.0
2.5	31.87	17.52	64.00	-2.3	0.0
3.3	42.49	23.36	64.00	-2.0	0.0
4.2	53.12	29.20	64.00	-1.7	0.0
5.0	63.74	35.04	64.00	-1.4	0.0
5.8	74.36	40.88	64.00	-1.2	0.0
6.7	84.98	46.72	64.00	-0.9	0.0
7.5	95.61	52.55	64.00	-0.6	0.0
8.3	106.23	58.39	64.00	-0.3	0.0
9.2	116.85	64.23	64.00	0.0	0.0
10.0	127.48	70.07	64.00	0.3	0.3
10.8	120.39	66.18	64.00	0.1	***0.4***
11.7	113.31	62.29	64.00	-0.1	0.3
12.5	106.23	58.39	64.00	-0.3	0.1
13.3	99.15	54.50	64.00	-0.5	0.0
14.2	92.07	50.61	64.00	-0.7	0.0
15.0	84.98	46.72	64.00	-0.9	0.0
15.8	77.90	42.82	64.00	-1.1	0.0
16.7	70.82	38.93	64.00	-1.3	0.0
17.5	63.74	35.04	64.00	-1.4	0.0
18.3	56.66	31.14	64.00	-1.6	0.0
19.2	49.57	27.25	64.00	-1.8	0.0
20.0	42.49	23.36	64.00	-2.0	0.0
20.8	35.41	19.46	64.00	-2.2	0.0
21.7	28.33	15.57	64.00	-2.4	0.0
22.5	21.25	11.68	64.00	-2.6	0.0
23.3	14.16	7.79	64.00	-2.8	0.0
24.2	7.08	3.89	64.00	-3.0	0.0
25.0	0.00	0.00	64.00	-3.2	0.0

Variable Storm Duration Storage Requirements

Duration	*Max Storage*	*Duration*	*Max Storage*	*Duration*	*Max Storage*
25 Min	**0.4 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



Underground Superpipe Stage Storage Discharge Calculations

Project Name: 111 VICTORIA STREET APARTMENT
Project No.: 24104
Date: FEBRUARY 2025

		MH 1 TO MH 2			CB 3 TO MH 2		CB 4 TO MH 2		CB 5 TO SEWER		TOTAL STORAGE VOLUME	Orifice	Total Outflow
Controlling Rim Elev:	**180.90**	MH 1	Pipe	MH 2	Pipe	CB 3	Pipe	CB 4	Pipe	CB 4			
Invert:		178.60	179.57	179.57	179.70	179.70	179.77	179.77	179.90	179.90		Dia (m) = 0.254	
Pipe Diameter:			0.305		0.200		0.200		0.200			Cd = 0.60	
Structure/Pipe Length:		1200	41.7	1200	17.00	;00x600mr	8.70	;00x600mr	8.80	;00x600mr		Invert (m) = 178.60	
													DISCHARGE
Elevation (m)		(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	Total (m^3)	Orifice (m^3/s)	(L/s)
180.90		2.60	3.05	1.50	0.53	0.43	0.27	0.41	0.28	0.36	9.4	0.197	196.6
180.00		1.58	3.05	0.49	0.53	0.11	0.27	0.08	0.14	0.04	6.3	0.149	149.4
179.90		1.47	3.05	0.37	0.53	0.07	0.19	0.05	-	-	5.7	0.143	143.2
179.80		1.36	2.46	0.26	0.27	0.04	0.03	0.01	-	-	4.4	0.137	136.7
179.70		1.24	1.24	0.15	-	-	-	-	-	-	2.6	0.130	129.9
179.60		1.13	0.15	0.03	-	-	-	-	-	-	1.3	0.123	122.8
179.50		1.02	-	-	-	-	-	-	-	-	1.0	0.115	115.1
179.40		0.90	-	-	-	-	-	-	-	-	0.9	0.107	107.0
179.30		0.79	-	-	-	-	-	-	-	-	0.8	0.098	98.1
179.20		0.68	-	-	-	-	-	-	-	-	0.7	0.088	88.4
179.10		0.57	-	-	-	-	-	-	-	-	0.6	0.077	77.4
179.00		0.45	-	-	-	-	-	-	-	-	0.5	0.065	64.7
178.995	**100 YR**	**0.45**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.4**	**0.064**	**64.0**
178.90		0.34	-	-	-	-	-	-	-	-	0.3	0.049	48.7
178.860	**5 YR**	**0.29**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.3**	**0.041**	**40.6**
178.80		0.23	-	-	-	-	-	-	-	-	0.2	0.024	23.6
178.70		0.11	-	-	-	-	-	-	-	-	0.1	#NUM!	-
178.60		-	-	-	-	-	-	-	-	-	0.0	#NUM!	-

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX D

Quality Enhancement – TSS Removal Calculation Sheet
CB Shield- Annual Sediment Removal Rate Chart
CB Shield Operations Manual

Net TSS Removal Calculation Sheet

Project:	111 Victoria Street Apartment
UCC Project Number:	24104
Date:	February 2025

The following calculation should be read in conjunction with the 'Average Annual Sediment Removal Rates (%) using a CB Shield' Chart. The calculations are based on the assumption that grassed areas and building rooftops contribute an insignificant amount of total suspended solids (TSS) to the stormwater system and only the sidewalk and asphalt parking lot areas are considered sources of TSS.

CB #3 - Drainage Area A2

Total Drainage Area (m^2) 495.7

Per CB Shield Analysis chart - 54% TSS Removal Rate (.05 ha at 100% imperviousness)

Area Type	Area (m^2)	Effective Quality Enhancement (%)	Total (m^3)
Grass/Roof	83.1	100%	83.1
Asphalt/Sidewalk (CB Shield)	412.6	54%	222.8
	495.7		305.9
Effective Stormwater Quality Enhancement for CB #3			**61.7%**

CB #4 - Drainage Area A3

Total Drainage Area (m^2) 648.5

Per CB Shield Analysis chart - 54% TSS Removal Rate (.07 ha at 80% imperviousness)

Area Type	Area (m^2)	Effective Quality Enhancement (%)	Total (m^3)
Grass/Roof	322.5	100%	322.5
Asphalt/Sidewalk (CB Shield)	326.0	54%	176.0
	648.5		498.5
Effective Stormwater Quality Enhancement for CB #4			**76.9%**

CB #5 - Drainage Area A3

Total Drainage Area (m^2) 745.2

Per CB Shield Analysis chart - 51% TSS Removal Rate (.10 ha at 100% imperviousness)

Area Type	Area (m^2)	Effective Quality Enhancement (%)	Total (m^3)
Grass/Roof	135.6	100%	135.6
Asphalt/Sidewalk (CB Shield)	609.6	51%	310.9
	745.2		446.5
Effective Stormwater Quality Enhancement for CB #5			**59.9%**

Remainder of Site

Total Drainage Area (m^2) 821.8

Area Type	Area (m^2)	Effective Quality Enhancement (%)	Total (m^3)
Grass/Roof	796.3	100%	796.3
Sidewalk	25.5	0%	0.0
	821.8		796.3
Effective Stormwater Quality Enhancement for site remainder			**96.9%**

Effective TSS Removal Calculation For Site

Total Area of Site Drainage Area (m^2)	2711.20
Total TSS Removal Area	2047.24
Effective Total TSS Removed	***75.5%***

Average Annual Sediment Removal Rates (%) using a CB Shield (based on ETV Sediment - 1 to 1000 micron Particle Size Distribution)						
Area to CB (ha)	**Imperviousness[1] (%)**					
	20%	35%	50%	65%	80%	100%
0.02	57%	57%	57%	57%	56%	56%
0.05	56%	56%	56%	55%	55%	54%
0.10	56%	55%	54%	53%	52%	51%
0.20	54%	53%	51%	49%	48%	46%
0.30	53%	50%	48%	46%	45%	43%
0.40	51%	48%	46%	44%	42%	40%
0.50	50%	47%	44%	42%	40%	38%
0.60	49%	45%	43%	40%	39%	36%

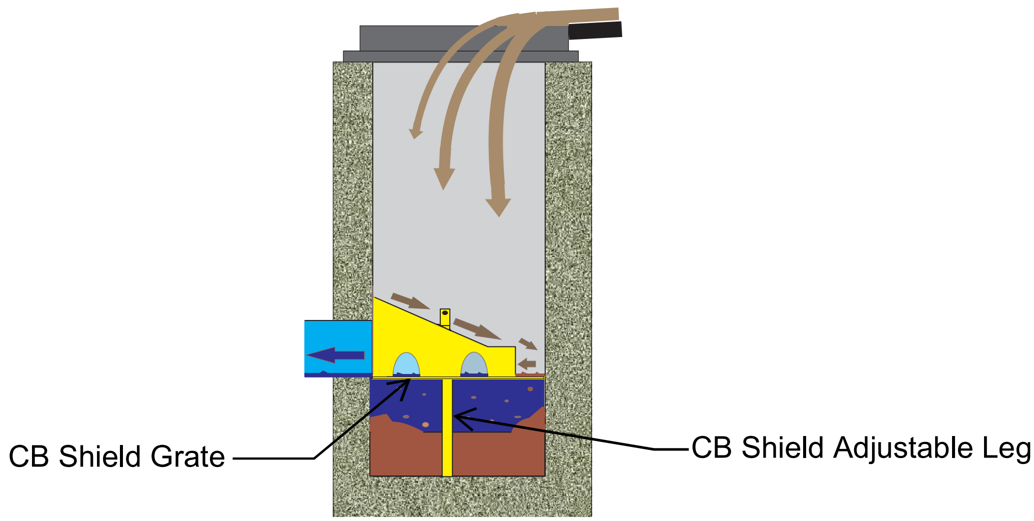
Notes:

1. Runoff Coefficient 'C' is approximately equal to 0.05 + 0.9*Impervious Fraction.
2. Above chart is based on long term continuous hydrologic analysis of Toronto, Ontario (Bloor St) rainfall data.
3. Assumes 0.6 m sump in CB and that maintenance is performed (i.e. CB cleaning) when required by sediment/pollutant build-up or otherwise.
4. See accompanying chart for suggested maintenance scheduling - AND - get CB Shield Inc. to monitor it for you in field.
5. Sediment/Pollutant removal rates based on third party certified laboratory testing using ETV sediment (PSD analysis available on request).
6. See additional discussion regarding scour protection from CB Shield during more infrequent runoff events.

CB Shield Operations Manual

Installing CB Shield

It is important the catch basin frame and cover is aligned properly with the catch basin below
If it is misaligned it may be difficult to install the CB Shield insert
Determine the depth of the sump (i.e. the distance from the invert of the outlet pipe to the bottom of the catch basin). If the catch basin is in service the sump depth will be the depth of the water. The grate section of the CB Shield insert should be the same elevation as the water depth in the sump.



Adjust the leg of the CB Shield to achieve the appropriate elevation
The CB Shield is lowered into place with the rope attached to the top of the leg. The high side of the sloped plate should face the wall with the outlet pipe. (The incoming water should be directed to the wall furthest from the outlet)
The flexible plastic skirt around the outer edges of the CB Shield insert may interfere with some misaligned frame and grates. If so a slice can be cut into the skirt with a utility knife at the point of interference.
Make sure the grate is at the desired level or remove CB Shield and re-adjust the leg length.

Inspecting a CB Shield Enhanced Catch Basin

Open grate
A lifting rope is attached to the top of the centered leg of the CB Shield insert. Lift and remove the insert.
Inspect CB Shield for any possible damage. Quite often leaves will accumulate on the grate. This can actually improve the Shield's ability to capture sediment and assist in preventing leave litter from being washed down stream.
Use a Sludge Judge to measure the sediment depth in 4 - 6 locations of the sump.
If the sediment depth is 300mm – 600mm deep it is recommended that the unit be cleaned.

Cleaning a CB Shield Enhanced Catch Basin

Open grate and remove CB Shield with lift rope.
Clean catch basin as usual with a Vacuum truck.
Clean CB Shield (if needed) and re-install into catch basin.
If there is any significant damage to a CB Shield please send a picture and its location to CB Shield Inc. (info@cbshield.com).