Site Servicing &
Stormwater Management Report
219 Bayfield Street
Barrie, ON

File 21-664
April 2022

Prepared by

WMI & Associates Limited
119 Collier Street, Barrie Ontario L4M 1H5

Table of Contents

Appendices

1.0 Background

1.1 General

WMI & Associates Limited has been retained by Hillcorp Investment and Development Inc. to prepare a Site Servicing and Stormwater Management Report in support of a proposed real estate office development located at 219 Bayfield Street, in the city of Barrie.

This report presents an investigation of existing services and drainage patterns, and a detailed design of stormwater management controls in support of a re-zoning and site plan application for the subject lands. Fundamental servicing and drainage objectives, as detailed in this report, are based on pre-consultation information from the City of Barrie as well as typical City standards and best management practices as set out by the Ministry of the Environment, Conservation and Parks (MECP). Plan and profile drawings of the surrounding municipal roads were also referenced to determine the extent of existing utilities and municipal infrastructure.

1.2 Site Description

The subject site comprises of 0.10ha and is located at the south-east corner of Grove Street East and Bayfield Street. It consists of the current 219 Bayfield Street property as well as the former 223 Bayfield Street. The site is located in a mixed use area comprising a variety of residential built form developments, as well as other offices and small commercial properties. It is bound to the north and west by Grove Street East and Bayfield Street, respectively, and to the east and south by low-rise residential homes, 13 Grove Street East and 215 Bayfield Street, respectively. The property is legally referred to as Part of Lot 4, East Side of Mill Road, Registered Plan 13, in the City of Barrie, County of Simcoe. This report is based upon a Site Plan prepared by Innovative Planning Solutions (IPS) dated November 25, 2021. The Site Plan, and Site Location Plan are contained in **Appendix A** for reference.

The site currently contains one (1) single family residential dwelling, a grassed lawn with a few trees, a gravel driveway accessed from Bayfield Street, and a small gravel parking lot.

The proposed development will convert the existing residential building to a real estate office and is to include a new parking lot, walkways, and landscaped areas. The vehicular access is proposed to be from Grove Street East, approximately 40m east of the Bayfield Street and Grove Street East intersection.

2.0 Stormwater Management

2.1 Existing Topography and Pre-Development Drainage

The site is predominantly drained via overland sheet flow, with the majority of the site drainage flowing to the south-east onto private residential properties, and a small portion flowing to the west into the Bayfield Street drainage system. Existing site grades are moderately sloped, generally in the range of 5-15%; however, the grades along the south and east sides of the existing building are flatter, in the order of 1-5%.

The storm drainage plan for the Bayfield Street Resurfacing and Intersection Improvements prepared by the City of Barrie Municipal Works Department (Drawing # SANSTM from project 2002-002) details the catchment areas and drainage patterns along Bayfield Street and surrounding streets. It is noted that the drainage area from this drawing generally correlates with the observed pre-development drainage based on actual site topography.

From this information, the pre-development drainage boundaries can be delineated for the subject site. The western portion of the site, referred herein as catchment PRE1, comprises an area of 0.03ha, a runoff coefficient of 0.70, and flows to Bayfield Street. The remaining eastern portion of the site, herein referred to as catchment PRE2, comprises an area of 0.07ha with a runoff coefficient of 0.50, and drains to the south-east.

Refer to the Pre-Development Drainage Plan, **Figure 2**, contained in **Appendix A**. A copy of the Drainage Plan from the Bayfield Street Resurfacing and Intersection Improvements project is contained in **Appendix B.**

2.2 Subsurface Conditions

Based on data from the Soils Map of Simcoe County, published by the Canada Department of Agriculture (1959), the predominant soil deposit in the area is identified as Vasey Sandy Loam and Tioga Loamy Sand. These soils are considered to have good drainage characteristics, and are classified within Hydrologic Soils Group ‘AB’. For the purposes of design, the native soils percolation rate is assumed to be 15mm/hr.

The Runoff Coefficients associated with the site were computed by calculating weighted values based on corresponding land uses and soil types. The Hydrologic Soil Groups were determined in accordance with the Ontario Ministry of Transportation (MTO) Soil Classification System.

Refer to **Appendix B** for the Soils Map and supporting information.

2.3 Design Criteria Guidelines

The stormwater management design principles for the proposed development are to incorporate the policies and criteria of The Ministry of the Environment, Conservation, and Parks (MECP) and the City of Barrie, and are to incorporate low impact development (LID) features as a part of the stormwater management system. From this, the stormwater management design criteria for the subject site are summarized below:

- The City of Barrie rainfall intensity-duration-frequency (IDF) curves will be used to determine the peak design flows and runoff volumes for each of the design storm events analyzed.

- Quantity controls are to be provided to attenuate peak flows to pre-development levels for all storm events.

- Quality control will be provided at an 'enhanced' level as defined by The Ministry of the Environment's (MOE) Stormwater Management Planning and Design Manual (March 2003).

- Low Impact Development (LID) initiatives are to be employed in an effort to preserve pre-development hydrology (water balance initiatives).

- Erosion and sediment control measures will be implemented prior to and during the construction of the development and maintained until the site is stabilized.

2.4 Post-Development Drainage

Drainage patterns in the post-development condition will strive to match pre-development conditions as closely as possible. The western portion of the site, herein referred to as catchment POST1, comprises of landscaped areas and walkways and will continue to sheet flow on to Bayfield similar to PRE1.

The south/east portion of the site herein referred to as catchment POST2B, comprises perimeter walkways, landscaped areas and the existing building. This area will continue to drain to the south-east as in PRE2 via uncontrolled surface drainage, since this area cannot be directed to Bayfield Street or Grove Street East due to grading constraints. Specifically, drainage from the existing building rooftop will be directed eastward via area drains and roof leader pipes that will outlet to a sub-surface infiltration trench located east of the existing building.

The north/east portion of the site, herein referred to as catchment POST2A, consists of the proposed parking lot and is proposed to drain northward into the Grove Street East storm drainage system. Draining the parking lot towards the north is an exception to matching pre-development drainage patterns, however it is desired to direct this area to a suitable storm sewer outlet, and it was determined that outletting to Grove Street East is the only viable option due to the availability of a storm sewer connection. It is noted that a connection to

Bayfield Street is not viable due to the distant location of the Bayfield Street storm sewer (it is located on the western side of the road), and prohibitive utility conflicts across the frontage of the site along Bayfield Street.

Table 1 below summarizes the uncontrolled pre-development peak flows for various return period design storms.

Table 1: Pre-Development Uncontrolled Peak Flows

Catchment I.D.	A (ha)	T_C (min.)	C	Q_2 (m^3/s)	Q_5 (m^3/s)	Q_{10} (m^3/s)	Q_{25} (m^3/s)	Q_{50} (m^3/s)	Q_{100} (m^3/s)
PRE1	0.03	10	0.70	0.005	0.006	0.007	0.010	0.011	0.013
PRE2	0.07	10	0.50	0.008	0.011	0.012	0.016	0.019	0.022

Table 2 below summarizes the uncontrolled post-development peak flows for various return period design storms.

Table 2: Post-Development Uncontrolled Peak Flows

Catchment I.D.	A (ha)	T_C (min.)	C	Q_2 (m^3/s)	Q_5 (m^3/s)	Q_{10} (m^3/s)	Q_{25} (m^3/s)	Q_{50} (m^3/s)	Q_{100} (m^3/s)
POST1	0.02	10	0.50	0.002	0.003	0.004	0.005	0.005	0.006
POST2A	0.03	10	0.91	0.006	0.008	0.010	0.012	0.014	0.015
POST2B	0.05	10	0.38	0.004	0.006	0.007	0.009	0.010	0.012
POST2 (Total)	0.08	10	0.58	0.011	0.014	0.016	0.021	0.025	0.029

Since the post-development flow from POST1 is less than the PRE1 flow, quantity controls are not required for this catchment. Similarly, POST2B flows are significantly less than the PRE2 peak flow therefore no quantity control is proposed for this sub-catchment as this runoff to neighbouring properties is minimized. The total post-development flow for POST 2 (POST2A + POST2B) is greater than the PRE2 flows, however, the flow increase is minimal and it is proposed to be accommodated by the Grove Street East municipal storm sewer system without applying quantity controls as detailed in **Section 2.5**.

Refer to **Figure 3** for the Post-Development Drainage Plan, contained in **Appendix A** and to **Appendix B** for the storm drainage calculations.

2.5 Grove Street East Drainage

The drainage for the parking lot is to be directed to the existing municipal storm sewer on Grove Street East by means of an internal storm sewer. Specifically, all parking lot runoff will be directed to an internal storm sewer system consisting of an oil/grit separator (OGS), and will then outlet to the existing Double Catch Basin (DCB) on the south side of Grove Street East. For larger storm events (up to the 100-year design storm and Regional design storm) or in the event of a blockage in the sewer system, ponding will occur within the parking lot up to a depth of 0.10m prior to spilling onto Grove Street East.

To determine if the Grove Street East storm sewer can accommodate the added flows from the subject site's parking lot, a capacity analysis check of the municipal sewer has been undertaken. From this analysis, it is determined that the capacity of the 300mm dia. storm sewer at the existing DCB is 139 L/s and approximately 11% of capacity sewer is utilized under the existing peak flow condition. The additional flows from the proposed parking lot will increase the peak flows by 7.99 L/s, which equates to a 5.7% utilization increase, for a total of 16.4% of the capacity of the existing storm sewer. Therefore, the proposed increase in flow from the parking lot can be accommodated by the Grove Street East storm sewer system without quantity controls.

2.6 Quality Control

In determining the best approach to provide quality control for the proposed development, various factors were considered, as follows:

- Existing land characteristics and uses (soil, topography, treatment area, location, etc.);
- Local requirements and maintenance considerations with regard to quality control;
- Facility feasibility & proximity to a suitable stormwater outlet and receiving drainage system(s);
- Utilizing an 'integrated treatment train' approach to treat stormwater runoff;
- Ability to utilize landscaped areas and providing water balance and nutrient uptake benefits.

To provide runoff quality control at an enhanced level (80% Total Suspended Solids removal), an oil/grit separator (OGS) is proposed for runoff from POST2A, which comprises the proposed internal parking lot and where contaminated runoff is expected to be generated.

Stormwater runoff from POST1 and POST2B are not proposed to be provided with any mechanical quality control features since these areas largely comprise of landscaped areas which do not produce contaminated runoff and the grass swales and overland flow will provide filtration and infiltration of the drainage as well as promoting evapotranspiration and nutrient uptake.

The sizing details for the OGS can be found in **Appendix B**.

2.7 Water Balance Controls

Water Balance Controls are also proposed in accordance with the City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines which stipulates that sites with drainage areas less than or equal to 5ha shall provide a minimum infiltration of the first 5mm of any given rainfall event.

The site is designed to minimize changes to water balance between the pre-development and post-development condition. It is noted that the soils present in the area are generally characterized as having good permeability so it is proposed to utilize infiltration-based solutions to promote onsite water balance.

This design proposes Low Impact Development (LID) measures to promote infiltration, through an infiltration trench, grass swales, as well as by sheet flow across grass/landscaped areas. The infiltration trench has been sized to retain the runoff volume from a rainfall depth of 5mm over the total site impervious area of $570m^2$ for a total required volume of $2.85m^3$. The area draining to the infiltration trench only includes the rooftop of the existing building and some of the landscaped area surrounding it, for an area of $115m^2$. The required infiltration volume of 2.85m3 over the actual tributary area of $115m^2$ equates to a 25mm depth of rainfall over this catchment area which is a reasonable sizing metric in accordance with typical soak-away pit / infiltration trench design guidelines from the Ministry of the Environment Stormwater Management Planning and Design Manual (2003).

The first 5mm of rainfall over the pervious landscaped areas is expected to be infiltrated through the native soils, therefore providing the 5mm of retention volume over just the impervious areas is in accordance with the prescribed targets. It is also noted that evapotranspiration will occur within the proposed grass swales and through the landscaped areas (via sheet flow), which further promotes water balance and supports the integrated treatment train approach for stormwater management.

The calculations for the proposed infiltration trench can be found in **Appendix B**.

2.8 Phosphorus Removal Initiatives

In accordance with the City of Barrie standards, the phosphorus loading is to be compared between the post-development and pre-development condition as well as to detail how the loading is minimized from the site.

Given site layout constraints, and favourable soils conditions, the preferred mechanism for providing phosphorus control of stormwater runoff is by way of infiltrating rooftop runoff into the native soils. To achieve a high-level of infiltration, an infiltration trench is proposed to be integrated onsite with area drains and directly connected roof leaders.

To quantify the effectiveness of the proposed BMP, a pre- and post-development phosphorous loading analysis was undertaken using the Ministry of the Environment (MOE) Lake Simcoe Phosphorous Budget Tool.

The phosphorus removal efficiency of a perforated pipe / infiltration system, as determined through studies referenced in support of the development of the TP Tool, is 87%. From this pre-determined value and the characteristics of the subject site, the TP Tool indicates that the total post-development phosphorous export from the site is **0.17kg/yr** with the perforated pipe BMP, whereas the phosphorus export from the site without the BMP is **0.18kg/yr**. This represents an **8.7%** TP load reduction with the implementation of the proposed BMPs.

For supporting calculations, refer to the MOE Phosphorus Project Development Summary located in **Appendix B**.

3.0 Site Grading

The detailed grading for the proposed residential development will meet the requirements of the site layout and stormwater management strategy. The following highlights the proposed features:

- A retaining wall 0.3-2.0m in height is required north and west of the existing building and along the eastern perimeter of the proposed parking lot to facilitate the elevation and grading requirements of the parking lot and permit accessible access and grading to match existing elevations around the building.

- The proposed walkway from the parking lot to the building entrance is graded as a ramp due to the grade difference between the existing front entry and the parking lot, which is much higher in elevation.

- Site grades along the perimeter of the walkways, landscaped features and the parking lot will be graded between 2%-3:1, and will adequately tie into existing grades at property line so to not adversely impact adjacent properties.

Refer to the Grading Plan drawing contained within the engineering drawing set (forming a part of the ZBA/SPA submission package) for further details.

4.0 Sanitary Servicing

The site currently contains a 150mm dia. sanitary service connection to the existing building on the site, which is connected to the existing 250mm dia. sanitary sewer on Bayfield Street. It is proposed to continue to utilize the existing sanitary connection to service the proposed office use.

The peak sanitary sewage flow for the subject property under the former residential use, assuming 3-bedroom dwelling, is equal to 0.079 L/s, whereas the sanitary flow under the proposed office use is 0.091 L/s.

In comparing the existing condition with the proposed condition it can be seen that the proposed sanitary sewage flow is greater than the existing sanitary sewage flow by 0.012 L/s which is a 15% increase. It is determined that the existing sanitary lateral has capacity of 22.5 L/s which far exceeds the proposed sanitary sewage flow, therefore it is expected that the minor increase in flow can easily be accommodated.

Refer to **Appendix C** for supporting sanitary sewage flow calculations.

5.0 Water Servicing

There are existing 300mm and 100 mm diameter municipal watermains located on Bayfield Street and Grove Street East, respectively, from which there are numerous water service connections and fire hydrants servicing the adjacent residential and commercial lands. There is an existing 19mm diameter service connection to the existing building at 219 Bayfield Street from the Bayfield Street watermain and an existing 19mm diameter water service from the Grove Street East watermain for the former 223 Bayfield Street property which has since been decommissioned.

The existing water demand for this property in residential use, based on an assumed 3-bedroom dwelling, has a Peak Hourly Demand (PHD) of 0.223 L/s. The proposed water demand under the office use has a PHD of 0.082 L/s.

From comparing the proposed domestic water demand versus the existing domestic water demand it can be seen that the peak hourly demand for the proposed condition is less than the existing condition demand and can therefore be accommodated by the existing water service and municipal watermain infrastructure.

The water demand calculations are included in **Appendix C** for reference.

5.1 Fire Protection

An existing fire hydrant is located directly adjacent to the subject site at the south-east corner of Bayfield Street and Grove Street East, and additional municipal fire hydrants are located at regular intervals to the north and south of the site along Grove Street East and Bayfield Street. The closest hydrant (at the south-east corner of Grove Street East and Bayfield Street) is approximately 20m from the main entrance of the existing building.

The City of Barrie requires that fire hydrant flow tests be completed for all development applications to ensure adequate pressure and fire flows are available in the existing municipal infrastructure to service new development. A fire flow test was completed in November 2021 to confirm the available flows and pressures. From this, the available fire flow within the municipal water distribution system is confirmed to be 230.6 L/s.

The City's Water Transmission and Distribution Policies and Design Guidelines (2021) presents a range of minimum fire flow requirements based on local area land uses. Such ranges of minimum fire flows that would be applicable for the subject scenario would from that from Residential uses (100L/s), Townhomes (150L/s), Apartments (200L/s), commercial lands (283L/s), and Mixed-use (subject to site specific review).

Given the site's locale within a mixed-use area that comprises a variety of land uses including single family and multi-family residential, apartment buildings, and other former residential homes which are converted to office buildings, it is our opinion that the available fire flow of 230.6L/s is sufficient.

The fire flow testing results and fire flow calculations are included in **Appendix C** for reference.

6.0 Sediment and Erosion Controls

Effective erosion and sediment control must be established prior to construction commencement and maintained until the site has been stabilized. Proactive measures will be required to limit the amount of sediment travelling downstream. Where site grading is required, exposure of the soil during construction should be minimized to avoid erosion and sedimentation.

Silt Fence: Silt fence will be placed on the down slope of all excavated material to prevent sediment transport onto adjacent properties and the municipal roadways. Periodic inspections and repairs to the silt fence should be performed regularly, as well as after every rainfall event.

Storm Sewer Inlets: Filter cloth complete with clear stone cover at storm sewer inlet structures (i.e. catchbasins and area drains), will ensure sediment laden overland runoff during construction is filtered before entering the municipal storm sewer system.

Mud Mat: Mud tracking from construction traffic must be controlled through the use of a mud-mat consisting of large diameter rip-rap located at the construction site entrance/exit.

Monitoring and Inspection: Erosion monitoring and sediment removal should be undertaken every week, and after every rainfall event. All damaged or clogged control devices or fencing must be repaired immediately.

Refer to the Erosion and Sediment Control drawing contained within the engineering drawing set for further details.

7.0 Summary

This Site Servicing and Stormwater Management Report demonstrates how the proposed 219 Bayfield Street real estate office development can be serviced by existing municipal services, and that storm runoff will not impose any adverse effects on the surrounding environment or neighbouring properties.

Specifically:

- Storm drainage from the parking lot will be provided by an internal storm sewer that will discharge to the existing storm drainage system on Grove Street East. Drainage from landscaped areas and the existing building will match existing drainage patterns.

- Peak flow attenuation is not proposed since the additional flows are negligible and it is demonstrated that the Grove Street East municipal storm system is able to accommodate the minor increase in peak flows that are directed towards it.

- An enhanced level of quality control (80% TSS removal minimum) will be provided by LIDs and an oil/grit separator.

- Water balance and phosphorus removal will be provided via stormwater retention within an infiltration trench.

- Fire and potable water servicing demands can be accommodated by the existing fire hydrants and the existing 19mm dia. water service, respectively.

- Sanitary servicing demand will be accommodated by the existing 150mm dia. sanitary service.

- The use of silt fence, clear stone and filter cloth inlet protection, a construction mud mat, and vegetated buffers will provide adequate sediment and erosion controls during construction.

The site servicing and stormwater management designs described herein can be constructed and maintained to service the subject development. This Report and the associated engineering design drawings are based on information provided at the time of their preparation, and are considered only applicable to the proposed works as described in this report. Any changes subsequent to the report and drawings date of issuance should be reviewed by WMI & Associates Limited to ensure applicability with the design contained within these documents.

Based on the above we recommend that this report be accepted in support of planning level and site plan approvals.

Should you have any questions, or require additional information, please contact the undersigned.

Prepared by:

WMI & Associates Limited

Chris Jungkunz, EIT

Jonathan P. Reimer, P.Eng.

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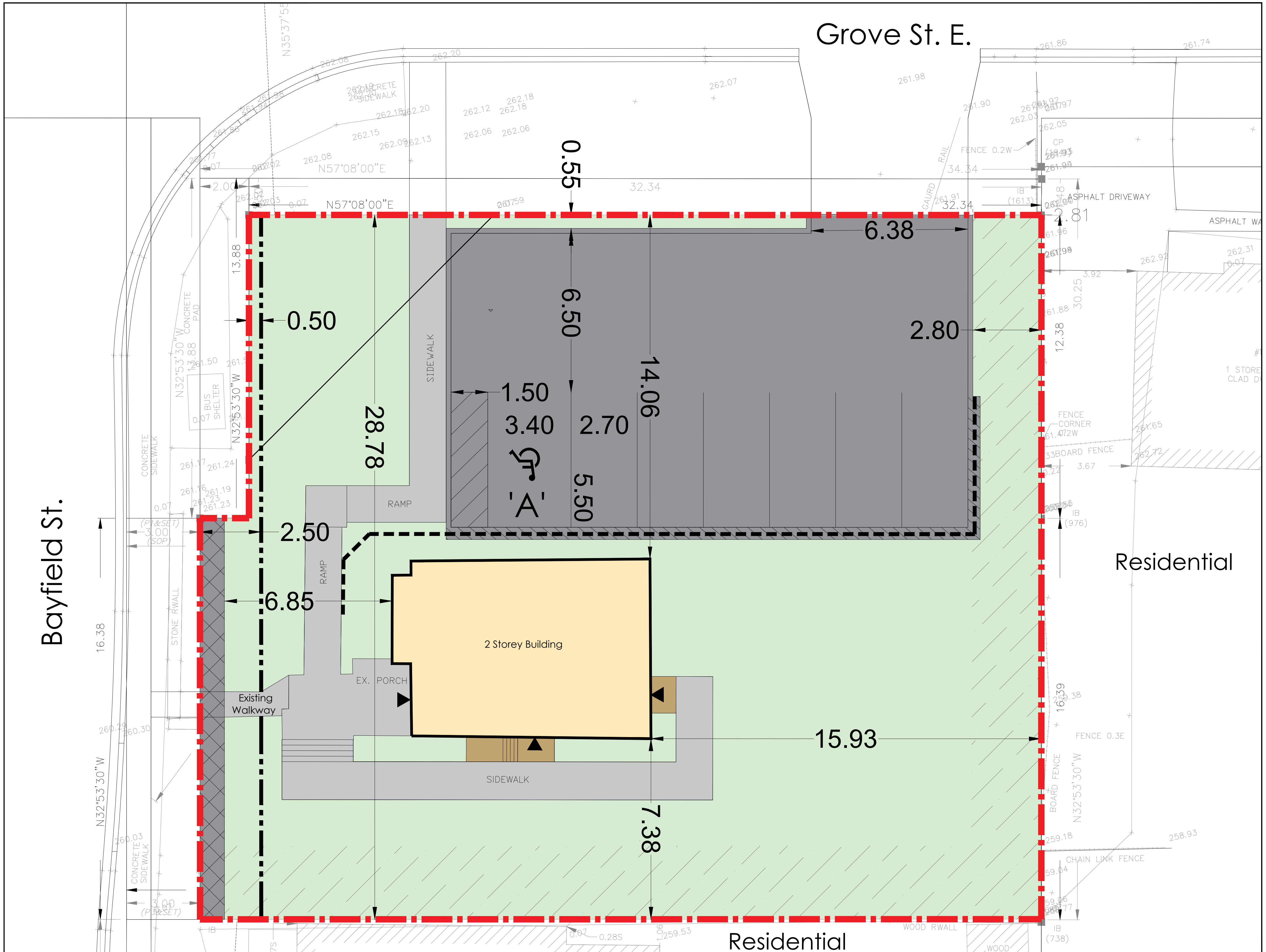
APPENDIX A

FIGURES / DRAWINGS



Key Map

LEGEND

- Subject Site Area: 962.7m²
- Existing 2 Storey Dwelling G.F.A.: 146.1m²
- 1.0m Road Widening Area: 16.3m²
- Landscaping Buffer
- Existing Porch
- Entrance / Exit
- Transportation Master Plan ultimate 34.0m ROW widening
- Retaining Wall

TRANSITION CENTRE COMMERCIAL (C2)		
Provisions	Required	Provided
Lot Area (min.)	--	946.4m²
Lot Frontage (min.)	--	28.78m
Front Yard (min.)	--	6.85m
Side Yard (min.) (3)	1.8m	7.38m
Side Yard Adjoining Residential Zone (min.)	6.0m	7.38m
Side Yard Adjoining Street (min.)	3.0m	14.06m
Rear Yard Setback (min.)	--	15.93m
Rear Yard Setback Adjoining Residential Zone (min.)	7.0m	15.93m
Lot Coverage (max.)	--	8%
Gross Floor Area (max. % of lot area)	400%	16%
Building Height (max.)	15.0m	<15.0m
Required Parking: Office	7 spaces (1 space / 30.0m² of GFA - tandem not permitted)	7 spaces incl. 1 Type 'A' B.F. space
Parking Aisle (min.)	6.4m	6.5m
Landscaped Buffer Areas: Adjacent to Residential Zones (4.8.2.1)	3.0m	2.8m (rear yard) 3.0m (side yard)

Source: City of Barrie Comprehensive Zoning By-Law 2009 - 141

0 5 10m N

Date:	Nov. 6, 2020	Drawn By:	A.S.
File:	20-981	Checked By:	K.G.

219 BAYFIELD STREET, BARRIE

SCHEDULE OF REVISIONS

No.	Date	Description	By
5	October 28, 2021	Add proposed patio;	A.S.
6	Nov. 25, 2021	Revise parking lot location;	A.S.
7	Feb. 24, 2022	Revise parking lot configuration; Update zoning matrix;	A.S.
8	Mar. 15, 2022	Remove patio;	A.S.

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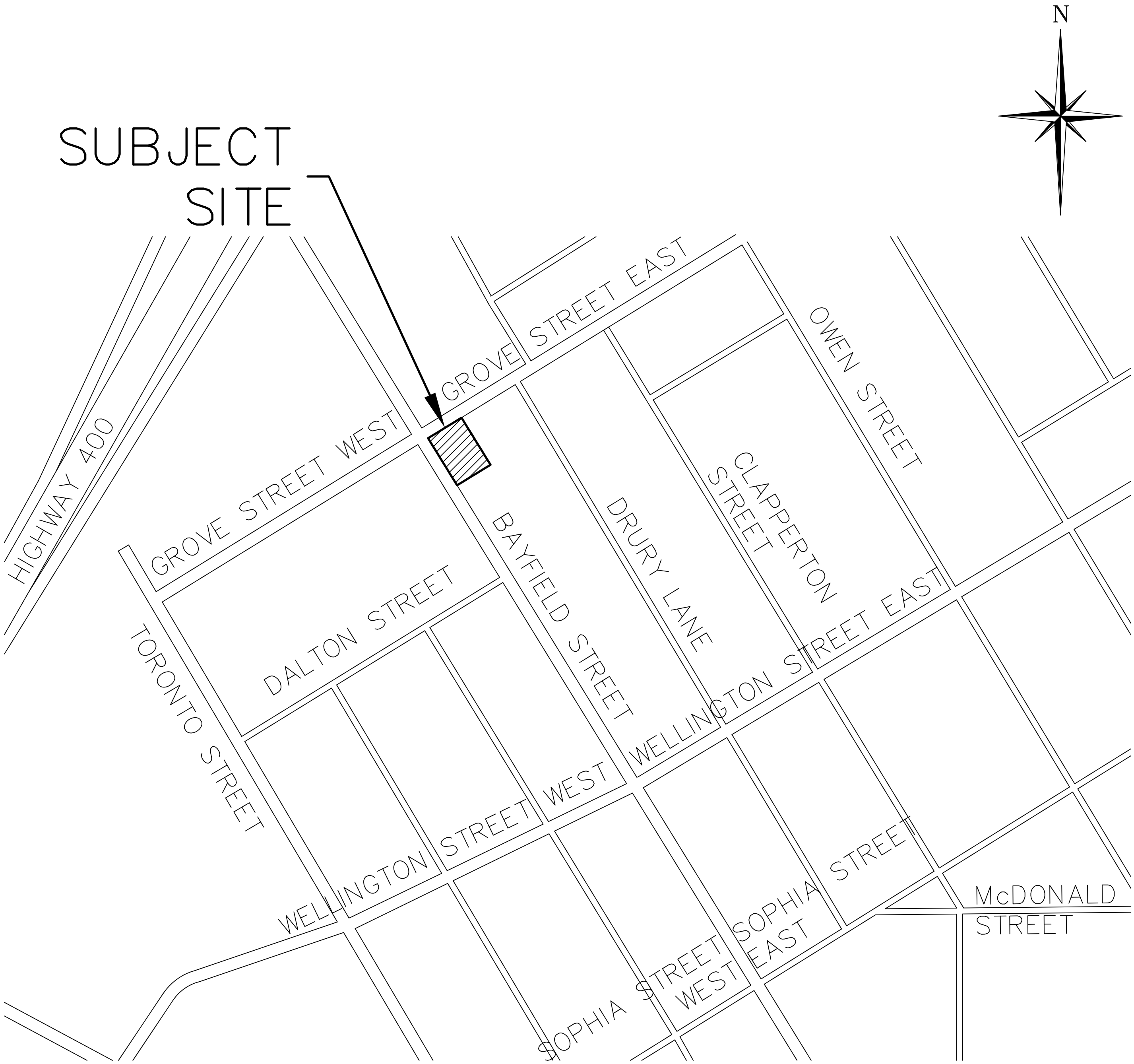

Drawing Title

SITE LOCATION PLAN

Project Title

219 BAYFIELD STREET

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
CJ	JR	FIG1
Scale	Project No.	
N.T.S.	21-664	

Drawing Title

PRE–DEVELOPMENT DRAINAGE PLAN

Project Title

219 BAYFIELD STREET

WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
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Drawn By	Checked By	Figure No.
CJ	JR	FIG2
Scale 1:300	Project No. 21–664	

Legend:

0	CATCHMENT IDENTIFICATION
0.00	CATCHMENT AREA (HA)
	LIMITS OF CATCHMENT AREA
	LIMITS OF EXTERNAL CATCHMENT AREA
	OVERLAND FLOW DIRECTION

Drawing Title

POST-DEVELOPMENT DRAINAGE PLAN

Project Title

219 BAYFIELD STREET

WMI & Associates Limited
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Barrie, Ontario
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Drawn By	Checked By	Figure No.
CJ	JR	FIG3
Scale 1:300	Project No. 21-664	

APPENDIX B

STORM DRAINAGE CALCULATIONS

where,

Q	= the design flow in (m^3/s)
C	= the site specific runoff coefficient
A	= the drainage area (ha)
i	= rainfall intensity (mm/hr)

The rainfall intensity shall be calculated in accordance with the following table and equation:

Table 3.1: Barrie WPCC IDF Curve Parameters - Adjusted to Account for Climate Change

Parameter	Return Period					
	2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
A	678.085	853.608	975.865	1146.275	1236.152	1426.408
B	4.699	4.699	4.699	4.922	4.699	5.273
C	0.781	0.766	0.760	0.757	0.751	0.759

Rainfall Intensity, I (mm/hr) = $A/(t+B)^C$, where t is time duration in minutes

Parameters based on rain gauge data for the period 1979 – 2003 for the Barrie WPCC Station #6110557

Based on a review of the literature, the IDF intensity values for Barrie WPCC Station were increased by 15% before calculating a, b, c values to account for climate change.

$$i = \frac{A}{(t_d + B)^C}$$

where,

i	= the rainfall intensity (mm/hr)
t_d	= the storm duration (minutes)
A, B, C	= a function of the local intensity-duration data.

The storm duration is set to the time of concentration (i.e. the sewer inlet time plus the time of travel in the pipe or channel) for the total cumulative drainage area to the node of interest. The maximum inlet time for the first pipe of a storm sewer system is 10 minutes.

The runoff coefficient shall be calculated in accordance with the following table:

VASEY	TIOGA
sandy loam Vasl 71,700 sandy loam — steep phase Vasl-s 17,500 sandy loam — stony phase Vasl-b 13,400	loamy sand Tis 75,500 sandy loam Tisl 44,500 fine sandy loam Tif 17,900 loamy sand — stony phase Tis-b 5,800 loamy sand — eroded phase Tis-e 1,300 loamy sand — steep phase Tis-s 8,500
Light grey, calcareous and non-calcareous, sandy loam till.	Grey
Good.	Good.
Smooth, moderately to steeply sloping.	Smooth, gently to irregular, steeply sloping.
Moderately to very stony.	Stonefree to moc
Slightly to medium acid.	Medium
Brown Podzolic and Grey-Brown Podzolic	Podz

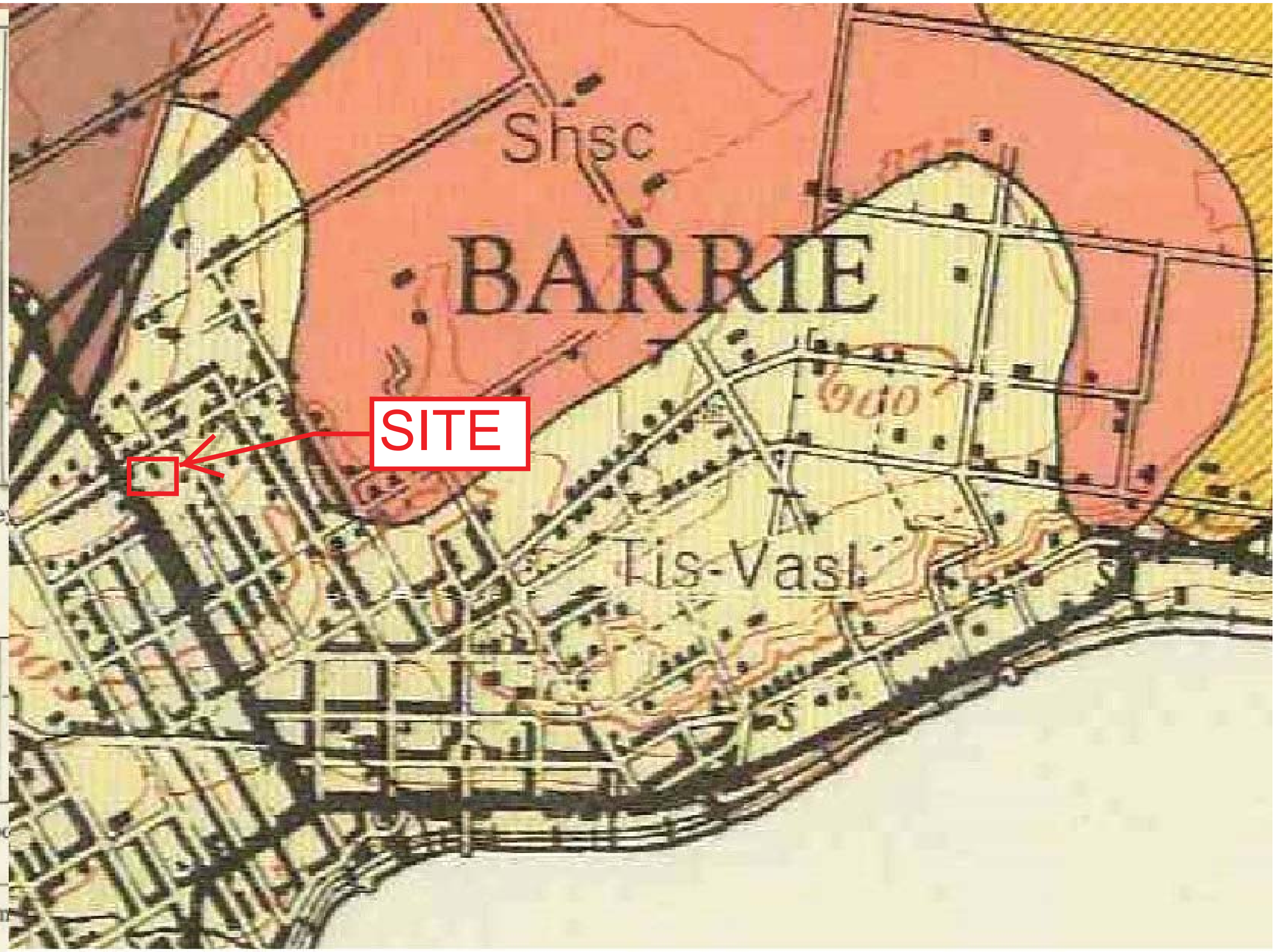

CHART H2-6A (Cont'd)

CHART H2-6A - continued

Soils Series	Soil Texture	Hyd. Soil Grp.	Soils Series	Soil Texture	Hyd. Soil Grp.	Soils Series	Soil Texture	Hyd. Soil Grp.
"	si l	BC	Uplands	s	A			
Snedden	si c l	C	"	s l	A			
Solmesville	c l	C	Upsala	f s	AB			
South Bay	c l	D	Vars	l	B			
"	c	D	Vasey	s l	AB			
Spohn	s /g /		"	l	B			
	c	BC	Vergennes	si l	BC			
Springvale	s l	A	"	l	BC			
Stafford	l	B	"	c	C			
Stockdale	si l/f		Vincent	si l	BC			
	s	B	"	si c l	C			
St. Clem.	s l	A	"	c l	D			
"	si c l	C	Vineland	s l	AB			
St. Jacobs	l	B	Wabi	s l	A			
St. Peter	s /g	A	"	l	B			
St. Rosalie	c	C	Wabigoon	c	C			
St. Samuel	s	B	Waterloo	s	A			
"	s l	B	"	s l	A			
St. Thomas	s	A	Watrin	s	B			
Sullivan	s	A	Waupoos	c l	D			
"	s l	A	"	c	D			
Sutton Bay	s	B	Wauseon	s l	B			
"	s l	B	Wayside	s	AB			
Tansley	c	D	Welland	c	C			
Tavistock	s l	AB	Wellesley	s l	AB			
"	si l	BC	"	si c l	C			
Tecumseth	s	AB	Wemyss	s l	AB			
			Wendigo	s	A			
Teeswater	si l	B	"	s l + r	AB			
Temisk'g	r &c	C	"	s l	AB			
Tennyson	s l	A	Wendover	c l	D			
Thames	c l	D	"	c	D			
Thorah	s	B	Westmeath	s	A			
Thornloe	c	C	Whitby	l	BC			
Thwaites	si l	BC	White Lake	s /g	A			
Tioga	s	A	Whitfield	si l	B			
"	s l	A	Wiarton	l	B			
Toledo	si l	BC	"	si l	BC			
"	si c l	C	Wilmot	s l	B			
"	c l	C	"	si c l	C			
"	c	C	Winona	s l	AB			
Trafalgar	c	D	Woburn	s l	A			
Trent	s	AB	"	l	B*			
Tuscola	s l	AB	Wolford	c l	D			
"	si l	BC	Wolsey	si c	C			
Tweed	s l	A	Wooler	si l/f				
"	s l + r	AB		s	AB			
"	r	AB	Woolwich	l	BC			
Undiffer'd	s l + r	AB or B(dep. on depth)	Worthing.	s /g /c	BC			
			Wyevale	s /g	A			

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RUNOFF COEFFICIENT CALCULATIONS
"C" SPREADSHEET

Date: Jan 26, 2022 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

RUNOFF COEFFICIENT NUMBERS

Land Cover		Hydrologic Soil Groups		
		A-AB	**B-BC**	**C-D**
Cultivated Land	0 - 5% grade	0.22	0.35	0.55
	5 - 10% grade	0.3	0.45	0.6
	10 - 30% grade	0.4	0.65	0.7
Pasture Land	0 - 5% grade	0.1	0.28	0.4
	5 - 10% grade	0.15	0.35	0.45
	10 - 30% grade	0.22	0.4	0.55
Woodlot or Cutover	0 - 5% grade	0.08	0.25	0.35
	5 - 10% grade	0.12	0.3	0.42
	10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands		0.05	0.05	0.05
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.95	0.95	0.95
Gravel	(not used for proposed parking or storage areas)	0.4	0.5	0.6
Residential	Single Family	0.3	0.4	0.5
	Multiple (i.e. semi, townhouse, apartment, etc.)	0.5	0.6	0.7
Industrial	Light	0.55	0.65	0.75
	Heavy	0.65	0.75	0.85
Commercial		0.6	0.7	0.8
Unimproved Areas		0.1	0.2	0.3
Lawn	< 2% grade	0.05	0.11	0.17
	2 - 7% grade	0.1	0.16	0.22
	> 7% grade	0.15	0.25	0.35

Ref: Runoff Coefficient Numbers - Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual", MTO. (1997)

<<< **Elements Requiring Input Information**

POST-DEVELOPMENT CONDITION - POST1

Land Cover		Hydrologic Soil Groups		
		A-AB	**B-BC**	**C-D**
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.0097		
Gravel	(not used for proposed parking or storage areas)	0.0017		
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade	0.0063		
	> 7% grade	0.0048		

Total Area (ha) = 0.02 **Runoff Coefficient, C = 0.50**

POST-DEVELOPMENT CONDITION - POST2A

Land Cover		Hydrologic Soil Groups		
		A-AB	**B-BC**	**C-D**
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.0277		
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade			
	> 7% grade	0.0015		

Total Area (ha) = 0.03 **Runoff Coefficient, C = 0.91**

POST-DEVELOPMENT CONDITION - POST2B

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.0119		
Gravel	(not used for proposed parking or storage areas)	0.0083		
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade	0.0226		
	> 7% grade	0.0023		

Total Area (ha) = 0.05 **Runoff Coefficient, C =** **0.38**

X:\Projects\2021\21-664\Design\Storm\[220126(21-664)_C_CALCS.xlsx]C CALCS

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RATIONAL METHOD CALCULATIONS

Date: Jan. 26, 2022 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: Barrie WPCC Station + 15% to account for climate change

2-year		5-year		10-year		25-year		50-year		100-year	
A =	678.085	A =	853.608	A =	975.865	A =	1146.275	A =	1236.152	A =	1426.408
B =	4.699	B =	4.699	B =	4.699	B =	4.922	B =	4.699	B =	5.273
C =	0.781	C =	0.766	C =	0.760	C =	0.757	C =	0.751	C =	0.759

Rational Method Formula

$$Q = \frac{C \times I \times A}{360} \quad (m^3/s)$$

where, C = Runoff Coefficient
I = Rainfall Intensity, (mm/hr)
A = Drainage Area, (ha)

Rainfall Intensity Equation (2-100 year storm events)

$$I_{2-100} = \frac{A}{(B + T_C)^C} \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient
T_C = Time of Concentration, (min)

Runoff Coefficient Equations
Based on MTO Drainage Manual (1984), page BD-4

2-year	C_2 =	C
5-year	C_5 =	C
10-year	C_{10} =	C
25-year	C_{25} =	1.10 x C
50-year	C_{50} =	1.20 x C
100-year	C_{100} =	1.25 x C

For storms having a return period of more than 10 years, the Runoff Coefficient, C, will be increased as indicated above, up to a maximum value of 1.

Rainfall Intensity Equation (25mm storm event)
Based on the MOE SWMP Manual (2003), Eq'n 4.9

$$I_{25mm} = (43 \times C) + 5.9 \quad (mm/hr)$$

where, C = Runoff Coefficient

Catchment I.D.	A (ha)	T_C (min.)	C	Q_{25mm} (m^3/s)	Q_2 (m^3/s)	Q_5 (m^3/s)	Q_{10} (m^3/s)	Q_{25} (m^3/s)	Q_{50} (m^3/s)	Q_{100} (m^3/s)
PRE1	0.03	10.0	0.7	0.002	0.005	0.006	0.007	0.010	0.011	0.013
PRE2	0.07	10.0	0.5	0.003	0.008	0.011	0.012	0.016	0.019	0.022
POST1	0.02	10.0	0.5	0.001	0.002	0.003	0.004	0.005	0.005	0.006
POST2A	0.03	10.0	0.91	0.003	0.006	0.008	0.010	0.012	0.014	0.015
POST2B	0.05	10.0	0.38	0.001	0.004	0.006	0.007	0.009	0.010	0.012
POST2 (Total)	0.08	10.0	0.58	0.004	0.011	0.014	0.016	0.021	0.025	0.029

Note: PRE1 has an allowable runoff coefficient of 0.7 as per the City of Barrie drawing SANSTM 2002-002-002.
PRE2 has an allowable runoff coefficient of 0.5 as per the City of Barrie drawing SANSTM 2002-002-002.

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STORMWATER MANAGEMENT CALCULATIONS
INFILTRATION TRENCH DESIGN

Date: 26-Jan-22 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

Purpose: An infiltration trench is proposed on-site to provide quality control, water balance, and phosphorus control. The required retention volume is 5mm over the total impervious area of 570m^2 while maintaining a maximum draw down time of 48 hours.

[ ] <<< **Elements Requiring Input Information**

Infiltration Volume:

Total Area = **0.057** ha
Runoff Volume = **5** mm

Infiltration Volume = A (ha) x RV (mm) x 10 m^3
= 0.057 ha x 5 mm x 10 m^3
= **2.85** m^3

Max. Allowable Depth:
Based on the Ministry of the Environment's (MOE) Stormwater Management Design Manual dated March 2003, Page 4-20, Equation 4.2: Maximum Allowable Depth is:

$d = \frac{PT}{1000} = \frac{15 \quad 48}{1000} = \mathbf{0.72}$ m

where,
d = maximum allowable depth (m)
P = percolation rate (Table 4.4 of MOE Manual OR Geotechnical/Hydrogeological Assessments) (mm/hr)
T = draw down time (24-48hr) (hr)

Provided Depth = **0.60** m

Min. Bottom Area:
Based on the Ministry of the Environment's (MOE) Stormwater Management Design Manual dated March 2003, Page 4-26, Equation 4.3: Infiltration Bottom Area is:

Min. Required Bottom Area:

$A = \frac{1000\ V}{P\ n\ t} = \frac{1000 \quad 2.85}{15 \quad 0.4 \quad 48} = \mathbf{9.9}$ m^2

where,
A = bottom area (m^2)
V = runoff volume to be infiltrated (m^3)
P = percolation rate of surrounding native soil (mm/hr)
n = porosity of the storage media (0.4 for clear stone/1.0 for infiltration basins)
t = retention time (hr)

Provided Bottom Area = **12.5** m^2

Excavation Volume:

Min. Required Excavation Volume = Infiltration Volume/porosity of the storage media
= $\frac{2.85}{0.4}$ < (0.4 for clear stone/1.0 for infiltration basins)
= **7.1** m^3

Provided Excavation Volume = L x W x D m^3
= **5** m x **2.5** m x **0.6** m
= **7.5** m^3

Soil Cover:
Based on the Ministry of the Environment's (MOE) Stormwater Management Design Manual dated March 2003, Page 4-21, Figure 4.4: Soil Cover for Trenches (based on frost heave potential).

Min. Soil Cover = **0.7** m

Notes:
- Based on the soil map of the property, the existing native soils are shown to be loamy sand. For the purposes of design, the native soils percolation rate is assumed to be 15mm/hr.
- The required infilitration volume of 2.85m^3 over the actual tributary area of 115m^2 equates to a 25mm depth rainfall which is a reasonable sizing metric in accordance with soakaway pit / infiltration trench design guidelines from the MOE SWMPDM.

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Storm Sewer Design Sheet
219 Bayfield Street - Existing Condition

<<< **Elements Requiring Input Information**

Rational Method Calculation:

$Q = 2.78*(C_F*C*I*A)$

where,
Q = peak flow rate (L/s)
C_F = runoff coefficient factor for storms **> 10-yr** (C_F = 1.0 for the 2, 5 & 10-yr storm events and C_F = 1.1, 1.2 & 1.25 for the 25, 50 & 100-yr storm events respectively)
C = runoff coefficient
I = rainfall intensity (mm/hr)
A = area (ha)

Manning's Formula Calculation:

$V = (k*R^{2/3}*S^{1/2}) / n$ $Q = V*A$

MOE Velocity Requirements: 0.8m/s - 6.0m/s
where,
V = mean velocity (m/s)
k = 1.0 for SI units
R = hydraulic radius (m)
S = friction slope (m/m)
n = Mannings Coefficient **0.013**

Rainfall Intensity Calculation:

$I = \frac{A}{(T+B)^C}$

Rainfall IDF Data: **Barrie WPCC 1979-2003 adjusted for climate change**

	5-year	100-year
A =	**853.608**	**1426.408**
B =	**4.699**	**5.273**
C =	**0.766**	**0.759**
Runoff Coeff. Factors, C_F =	1.00	1.25

where,
I = Rainfall Intensity (mm/hr)
T = Time of Concentration (min.)
A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient

Date: Jan 26, 2022
Project No: 21-664
Prepared by: CJ

Location			Runoff Calculation Data										Sewer Calculation Data								Sewer Profile Data					
Street	Upstream MH	Downstream MH	Drainage Areas (ha) C = 0.20	C = 0.40	C = 0.70	C = 0.91	Individual 2.78CA	Accumulated 2.78CA	Time of Concentration (mins)	Storm Event	Rainfall Intensity (mm/hr)	Peak Runoff Flow (L/s)	Diameter (mm)	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Pipe Flow Time (mins)	Pipe Storage Volume (m^3)	Fall in Sewer (m)	Drop in MH (m) DS	Top of Grate Elevation (m) US	DS	Invert Elevation (m) US	DS
Grove St E	**EX DCB1**	**EX STM MH1**			**0.07**		0.14	0.14	10.00	**5-year**	108.92	14.84	**300**	**1.90**	**7.5**	139.06	1.91	0.07	0.5	0.14			**INPUT VALUE**		**INPUT VALUE**

Sum of Drainage Areas (ha): 0.00 0.00 0.07 0.00
Total Drainage Area (ha): 0.07

NOTES: Existing Peak Flow % of Storm Sewer Capacity = 14.84/139.06 = 10.7%

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Storm Sewer Design Sheet
219 Bayfield Street - Proposed Condition

<<< **Elements Requiring Input Information**

Rational Method Calculation:

$Q = 2.78*(C_F*C*I*A)$

where,

Q = peak flow rate (L/s)
C_F = runoff coefficient factor for storms **> 10-yr** (C_F = 1.0 for the 2, 5 & 10-yr storm events and C_F = 1.1, 1.2 & 1.25 for the 25, 50 & 100-yr storm events respectively)
C = runoff coefficient
I = rainfall intensity (mm/hr)
A = area (ha)

Manning's Formula Calculation:

$V = (k*R^{2/3}*S^{1/2}) / n$ $Q = V*A$

MOE Velocity Requirements: 0.8m/s - 6.0m/s

where,

V = mean velocity (m/s)
k = 1.0 for SI units
R = hydraulic radius (m)
S = friction slope (m/m)
n = Mannings Coefficient **0.013**

Rainfall Intensity Calculation:

$I = \frac{A}{(T+B)^C}$

Rainfall IDF Data: **Barrie WPCC 1979-2003 adjusted for climate change**

	5-year	100-year
A =	**853.608**	**1426.408**
B =	**4.699**	**5.273**
C =	**0.766**	**0.759**
Runoff Coeff. Factors, C_F =	1.00	1.25

where,

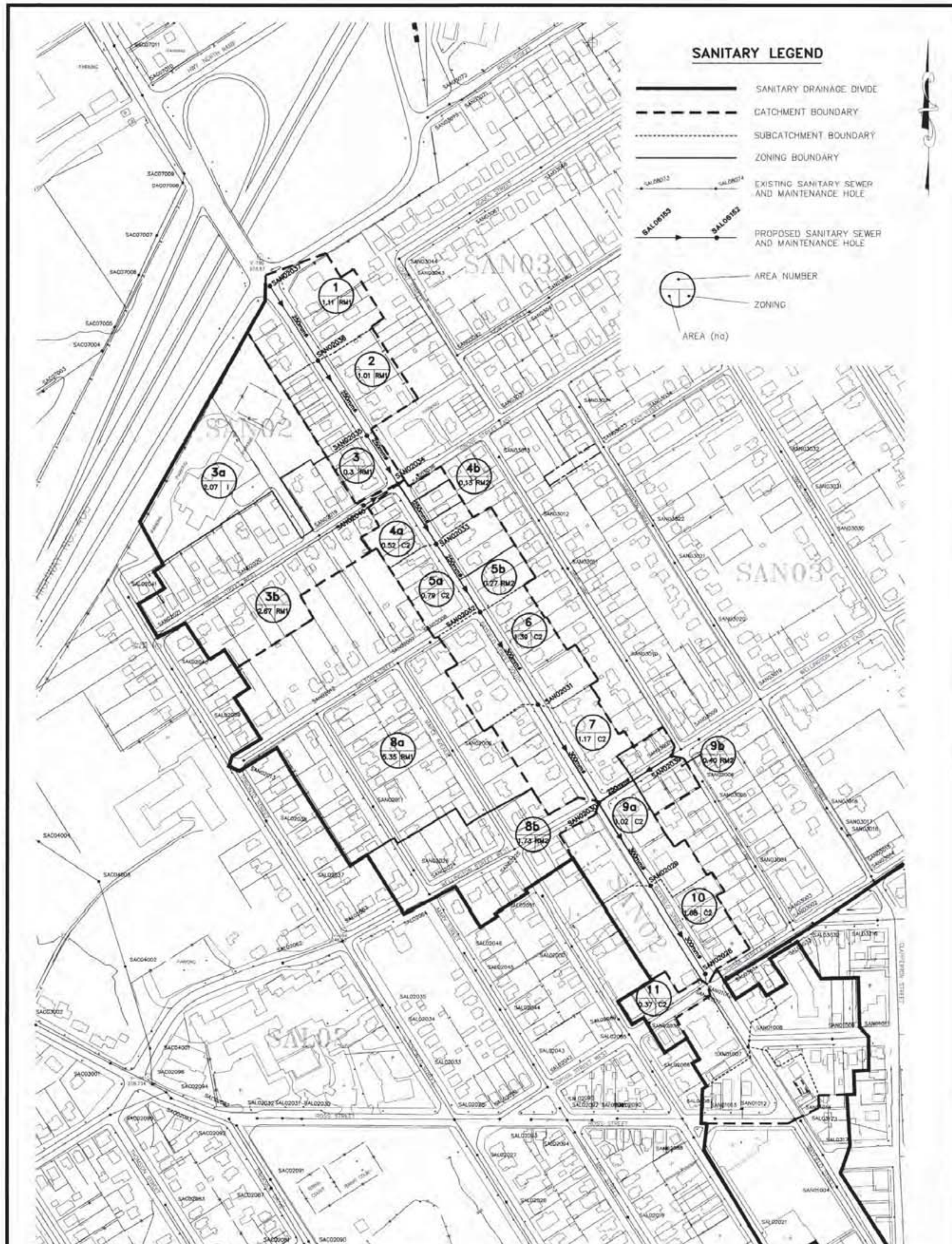
I = Rainfall Intensity (mm/hr)
T = Time of Concentration (min.)
A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
C = Rainfall IDF Coefficient

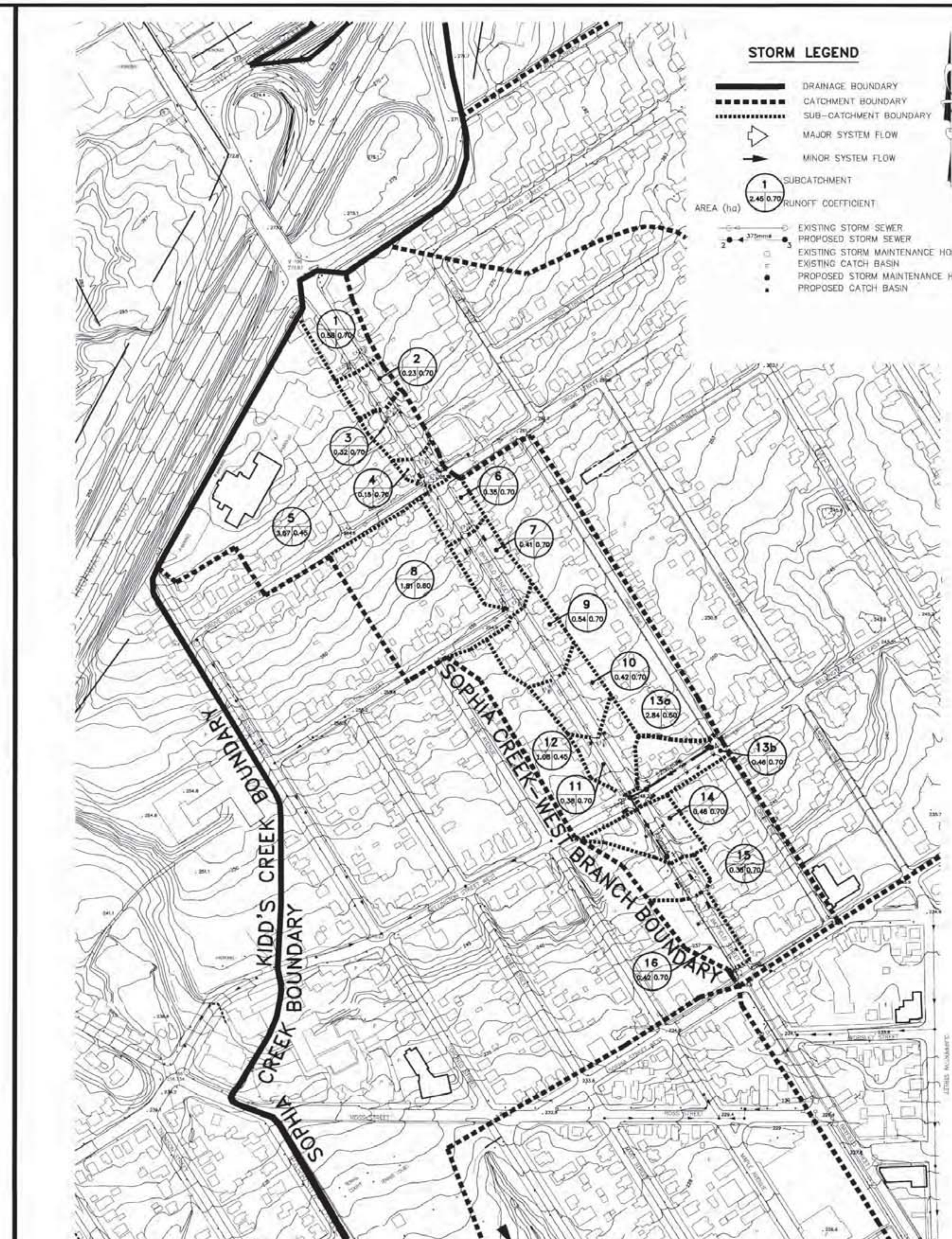
Date: Jan 26, 2022
Project No: 21-664
Prepared by: CJ

Location			Runoff Calculation Data										Sewer Calculation Data							Sewer Profile Data					
Street	Upstream MH	Downstream MH	Drainage Areas (ha) C = 0.20	C = 0.40	C = 0.70	C = 0.91	Individual 2.78CA	Accumulated 2.78CA	Time of Concentration (mins)	Storm Event	Rainfall Intensity (mm/hr)	Peak Runoff Flow (L/s)	Diameter (mm)	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Pipe Flow Time (mins)	Pipe Storage Volume (m^3)	Fall in Sewer (m)	Drop in MH (m) DS	Top of Grate Elevation (m) US	Top of Grate Elevation (m) DS	Invert Elevation (m) US	Invert Elevation (m) DS
Internal	**OGS1**	**MH2**				**0.03**	0.08	0.08	10.00	**5-year**	108.92	8.27	**300**	**0.80**	**9.1**	90.23	1.24	0.12	0.7	0.07					
Internal	**MH2**	**EX DCB1**				**0.00**	0.00	0.08	10.12	**5-year**	108.23	8.21	**300**	**0.70**	**7.4**	84.40	1.16	0.11	0.5	0.05					
Grove St E	**EX DCB1**	**EX STM MH1**			**0.07**		0.14	0.21	10.23	**5-year**	107.64	22.83	**300**	**1.90**	**7.5**	139.06	1.91	0.07	0.5	0.14			**INPUT VALUE**		**INPUT VALUE**

	C = 0.20	C = 0.40	C = 0.70	C = 0.91
Sum of Drainage Areas (ha):	0.00	0.00	0.07	0.03
Total Drainage Area (ha):	0.10			

NOTES: **Additional Peak Flow from Parking Lot = 22.83-14.84 = 7.99 L/s (see existing condition Storm Sewer Design Sheet for existing peak flows)**
Parking Lot Peak Flow % of Storm Sewer Capacity = 7.99/139.06 = 5.7%
Combined Peak Flow % of Storm Sewer Capacity = 22.83/139.06 = 16.4%





GENERAL NOTES

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BENCH MARKS

MONUMENT # 84U119
232.450 – DEEP BM IN 0.2m DIA. MH. IN QUEEN'S PARK NEAR INTERSECTION OF TORONTO & ROSS STREET, 10.8m SOUTH OF SOUTH EDGE OF SOUTH SIDEWALK ON ROSS STREET, 44m FROM NORTHEAST CORNER OF SIDEWALK INTERSECTION AT ROSS & TORONTO STREET.

BEARINGS ARE UTM GRID BEARINGS AND ARE REFERRED TO THE CENTRAL MERIDIAN IN ZONE 17 (NAD27) AND ARE DERIVED FROM OBSERVATIONS ON MRR CONTROL MONUMENTS 001673109 (N=4915476.882, E=604467.676) AND 010860477 (N=4916740.110, E=603674.965).

DISTANCES SHOWN HEREON ARE GROUND DISTANCES AND CAN BE CONVERTED TO GRID DISTANCES BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.999694.

NO.	REVISIONS	DATE	APPROVED

CITY OF BARRIE
APPROVED
DATE: Mar. 14, 2002
R. W. McArthur, P.Eng.
DIRECTOR OF MUNICIPAL WORKS

LICENSED PROFESSIONAL ENGINEER
R. J. FORWARD
March 14/2002
PROVINCE OF ONTARIO

BAYFIELD STREET
RESURFACING AND INTERSECTION IMPROVEMENTS

SANITARY AND STORM DRAINAGE PLAN

CITY of BARRIE
MUNICIPAL WORKS DEPARTMENT

SCALE HOR. 1:2500	VERT. ——		DRAWING NO. 2002–02
DESIGN M.D.N./A.J.S.	DRAWN M.D.N.		SHEET NO. SANSTM
REVIEWED R.J.F.	DATE 2002.02.15		

Database Version: **V 2.0 Release Update**
Update Date: **30-Mar-12**

Project DEVELOPMENT Summary

DEVELOPMENT: 21-664: 219 Bayfield Street
Subwatershed: Barrie Creeks

Total Pre-Development Area (ha):	**0.100**	Total Pre-Development Phosphorus Load (kg/yr):	**0.13**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Residential	0.1	1.32	0.13

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Comm/Industrial	0.09	1.82	Dry swales	0%	0.16
			dry swales		
High Intensity - Comm/Industrial	0.01	1.82	Perforated Pipe Infiltration/Exfiltration Systems	87%	0.00
			infiltrate post-development rooftop runoff into native sandy soils		

Post-Development Area Altered:	**0.10**
Total Pre-Development Area:	**0.10**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**0.13**
Post-Development:	**0.18**
Change (Pre - Post):	**-0.05**
38% Net Increase in Load	
Post-Development (with BMPs):	**0.17**
Change (Pre - Post):	**-0.03**
25.88% Net Increase in Load	

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

01/21/2022

Province:	Ontario
City:	Barrie
Nearest Rainfall Station:	BARRIE-ORO
Climate Station Id:	6117700
Years of Rainfall Data:	14
Site Name:	
Drainage Area (ha):	0.03
Runoff Coefficient 'c':	0.95
Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	0.97
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	No
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Project Name:	219 Bayfield Street
Project Number:	21-664
Designer Name:	Chris Jungkunz
Designer Company:	WMI & Associates
Designer Email:	cjungkunz@wmiengineering.ca
Designer Phone:	249-535-1341
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	99
EFO6	100
EFO8	100
EFO10	100
EFO12	100

Recommended Stormceptor EFO Model:	**EFO4**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**99**
Water Quality Runoff Volume Capture (%):	**> 90**

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

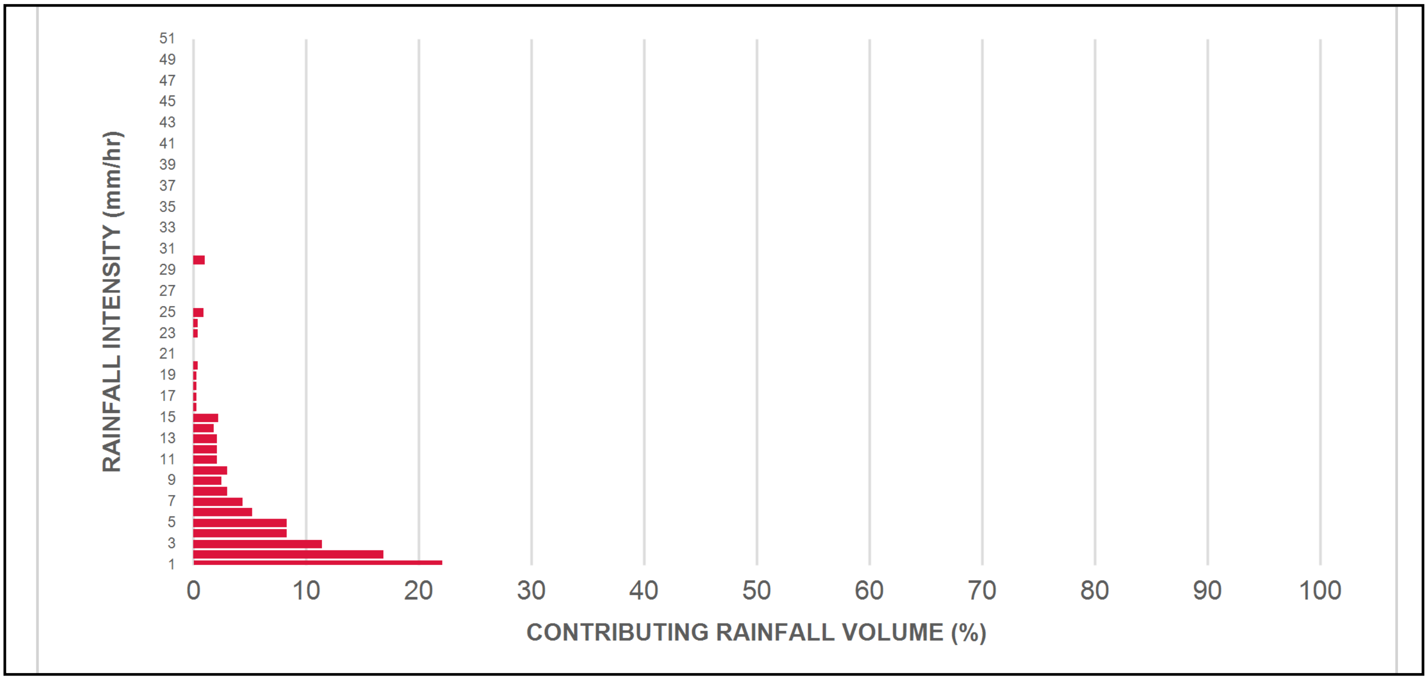
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

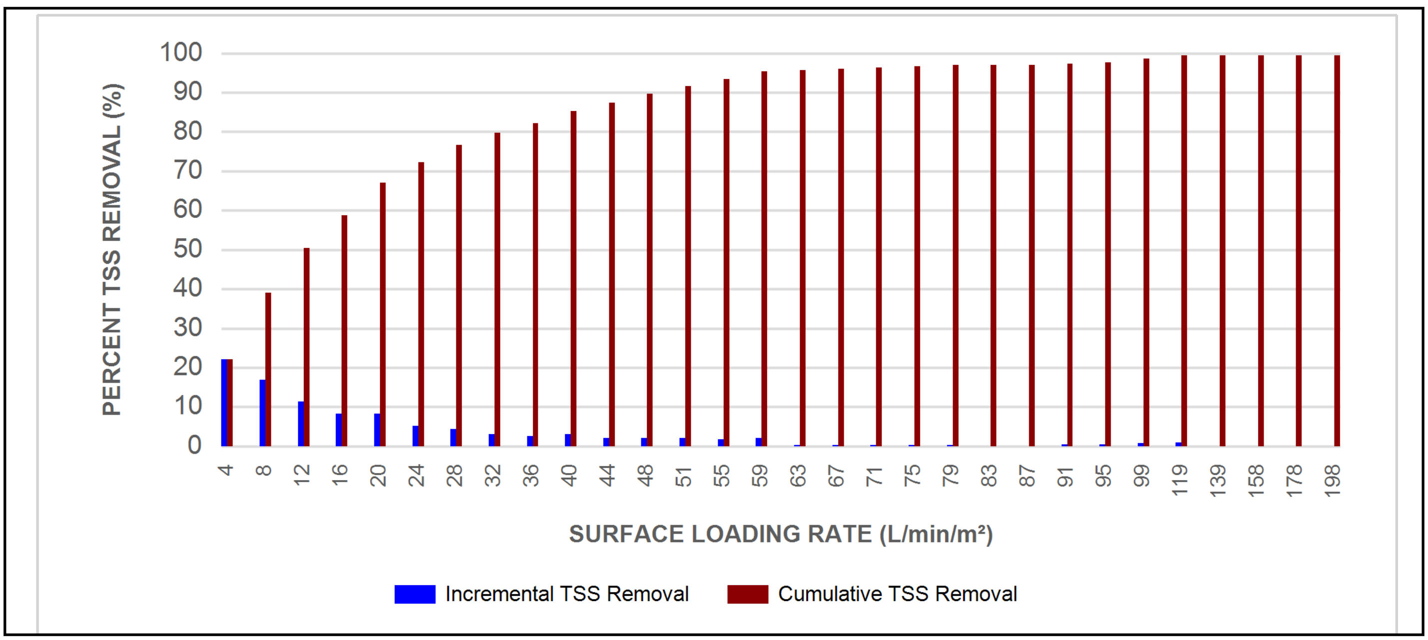
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	22.1	22.1	0.08	5.0	4.0	100	22.1	22.1
2	16.9	39.0	0.16	10.0	8.0	100	16.9	39.0
3	11.4	50.4	0.24	14.0	12.0	100	11.4	50.4
4	8.3	58.8	0.32	19.0	16.0	100	8.3	58.8
5	8.3	67.0	0.40	24.0	20.0	100	8.3	67.0
6	5.2	72.2	0.48	29.0	24.0	100	5.2	72.2
7	4.4	76.6	0.55	33.0	28.0	100	4.4	76.6
8	3.0	79.7	0.63	38.0	32.0	100	3.0	79.7
9	2.5	82.2	0.71	43.0	36.0	100	2.6	82.2
10	3.0	85.3	0.79	48.0	40.0	100	3.0	85.3
11	2.1	87.4	0.87	52.0	44.0	100	2.1	87.4
12	2.1	89.6	0.95	57.0	48.0	100	2.1	89.6
13	2.1	91.7	1.03	62.0	51.0	98	2.1	91.6
14	1.8	93.4	1.11	67.0	55.0	98	1.7	93.4
15	2.2	95.6	1.19	71.0	59.0	96	2.1	95.4
16	0.3	95.9	1.27	76.0	63.0	96	0.3	95.7
17	0.3	96.2	1.35	81.0	67.0	96	0.3	96.0
18	0.3	96.5	1.43	86.0	71.0	94	0.3	96.3
19	0.3	96.9	1.51	90.0	75.0	94	0.3	96.7
20	0.4	97.2	1.58	95.0	79.0	91	0.3	97.0
21	0.0	97.2	1.66	100.0	83.0	91	0.0	97.0
22	0.0	97.2	1.74	105.0	87.0	91	0.0	97.0
23	0.4	97.6	1.82	109.0	91.0	90	0.4	97.4
24	0.4	98.1	1.90	114.0	95.0	90	0.4	97.7
25	0.9	99.0	1.98	119.0	99.0	89	0.8	98.6
30	1.0	100.0	2.38	143.0	119.0	88	0.9	99.4
35	0.0	100.0	2.77	166.0	139.0	85	0.0	99.4
40	0.0	100.0	3.17	190.0	158.0	83	0.0	99.4
45	0.0	100.0	3.57	214.0	178.0	81	0.0	99.4
50	0.0	100.0	3.96	238.0	198.0	78	0.0	99.4
Estimated Net Annual Sediment (TSS) Load Reduction =								**99 %**

Climate Station ID: 6117700 *Years of Rainfall Data*: 14

RAINFALL DATA FROM BARRIE-ORO RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

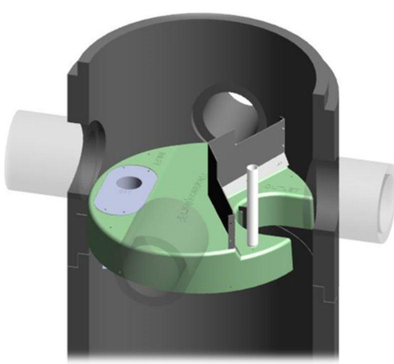
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

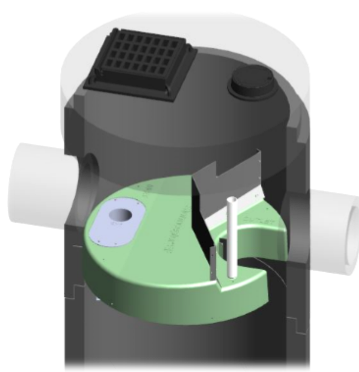
DESIGN FLEXIBILITY

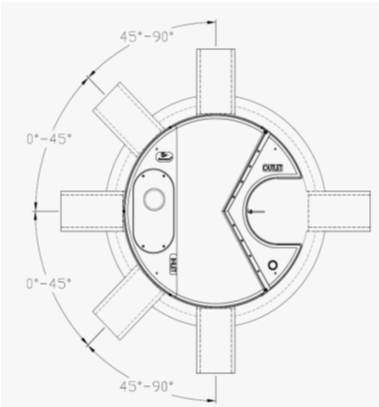
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR
"OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing shall be determined using historical rainfall data and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m2 to 2600 L/min/m2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

APPENDIX C

WATER & SANITARY CALCULATIONS

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
p (705) 797-2027 f (705) 797-2028

TOTAL DAILY SANITARY DESIGN FLOW CALCULATIONS

Date: 26-Jan-22 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
- City of Barrie Sanitary Sewage Collection System Policies and Design Guidelines 2017
- Ontario Building Code (OBC), 2012, Division B, Part 8, Table 8.2.1.3.A. Residential Occupancy & Table 8.2.1.3.B. Other Occupancies

Existing Condition:

Establishment:	# of people	# of water closets	# of fuel outlets	# of seats	Gross Floor Area (m^2)	Land Area (ha)	Total Daily Design Sanitary Sewage Volume		Total Daily Design Sanitary Sewage Flow (L/day)
Residential Uses:									
Dwelling (3-bedroom)*	6						225	L/person	1,350
Subtotal =	6								1,350

Harmon Formula, $M = 1 + \frac{14}{(4 + P^{0.5})}$

where, P = Design population in 1000s

Peaking Factor, M =	4.43
Peak Total Daily Design Sanitary Sewage Flow (L/day) =	5,981
Peak Extraneous Unit Flow (L/s/ha) =	0.10
Land Area (ha) =	0.10
Peak Extraneous Flow (L/day) =	864
Peak Total Daily Design Flow (L/day) =	6,845
Total Average Daily Design Flow (L/day) =	1,350
Peak Total Daily Design Flow (L/sec) =	0.079

Note:
* Building is assumed to have 3 bedrooms, c/w 2 people per bedroom.
** Total Design Daily Volume of 225 L/person from City of Barrie standards.

X:\Projects\2021\21-664\Design\Sanitary\[220126_Total_Daily_Sanitary_Design_Flow_Calcs_Ex.xlsx]Sani_Design_Flows

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
p (705) 797-2027 f (705) 797-2028

TOTAL DAILY SANITARY DESIGN FLOW CALCULATIONS

Date: 26-Jan-22 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
- City of Barrie Sanitary Sewage Collection System Policies and Design Guidelines 2017
- Ontario Building Code (OBC), 2012, Division B, Part 8, Table 8.2.1.3.A. Residential Occupancy & Table 8.2.1.3.B. Other Occupancies

Proposed Condition:

Establishment:	# of people	# of water closets	# of fuel outlets	# of seats	Gross Floor Area (m^2)	Land Area (ha)	Total Daily Design Sanitary Sewage Volume		Total Daily Design Sanitary Sewage Flow (L/day)
Commercial/Institutional & Industrial Uses:									
Office					292.2		75	L/9.3m^2	2,356
								L/seat	0
								L / 1.0m^2	0
								m^3/(ha*d)	0
Subtotal =					**292.2**				**2,356**

Peaking Factor =	**3**
Peak Total Daily Design Sanitary Sewage Flow (L/day) =	**7,069**
Peak Extraneous Unit Flow (L/s/ha) =	**0.10**
Land Area (ha) =	**0.10**
Peak Extraneous Flow (L/day) =	**829**
Peak Total Daily Design Flow (L/day) =	**7,899**

Total Average Daily Design Flow (L/day) =	**2,356**
Peak Total Daily Design Flow (L/sec) =	**0.091**

Note:

Peaking factor of 3 based on typical 8 hour shifts (24/8 = 3)

X:\Projects\2021\21-664\Design\Sanitary\[220126_Total_Daily_Sanitary_Design_Flow_Calcs_Pr.xlsx]Sani_Design_Flows

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MANNING'S PIPE EQUATION
EXISTING SANITARY SERVICE

Date: 26-Jan-22 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

Mannings' Equation		
Pipe Diameter (mm) =	150	
Area =	0.018	m^2
Slope (%) =	2.00	
Manning 'n' =	0.013	
Nom'l Pipe Capacity, Q =	0.022	m^3/sec
Actual Pipe Capacity, Q =	**0.022**	m^3/sec
=	22.469	L/sec

Box Culvert		
Height =	0.00	
Width =	0	
Q =	0.00	
Velocity		
1.22		m/s
1.27		m/s
R=	**0.0375**	
Sf=	**0.0200**	

NOTE: The peak flow this pipe is required to convey is 0.091L/sec (refer to the Total Daily Sanitary Design Flow Calculations proposed spreadsheet).

X:\Projects\2021\21-664\Design\Sanitary\[220126_Mannings_Pipe_Eqn_Service.xlsx]Mannings_Pipe

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TOTAL DAILY DOMESTIC WATER SUPPLY FLOW CALCULATIONS

Date: 26-Jan-22 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References: - Ontario Building Code (OBC), 2012, Division B, Part 8, Table 8.2.1.3.A. Residential Occupancy & Table 8.2.1.3.B. Other Occupancies
- Ministry of the Environment (MOE), Design Guidelines for Drinking-Water Systems (2008), Chapter 3

Existing Condition:

Establishment:	# of people	# of water closets	# of fuel outlets	# of seats	Gross Floor Area (m^2)	Land Area (ha)	Total Daily Design Volume		Avg Day Demand ADD (L/s)	Max Day Demand MDD (L/s)	Peak Hourly Demand PHD (L/s)
Residential Uses:											
								L/person	0.00	0.00	0.00
Dwelling (3 bedroom)*	**6**						**225**	L/person	0.016	0.148	0.223
Subtotal =	**6**								**0.016**	**0.148**	**0.223**
Refer to Table 3-1 and/or Table 3.3 of the MOE Design Guidelines for Drinking-Water Systems (2008) >>>									**Peaking Factor =**	**9.5**	**14.3**

Notes:

* Building is assumed to have 3 bedrooms, c/w 2 people per bedroom.

** Total Design Daily Volume of 225 L/person from City of Barrie standards.

X:\Projects\2021\21-664\Design\Water\[220126_Total_Daily_Domestic_Water_Supply_Flow_Calcs_Ex.xlsx]Water_Supply_Flows

WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
p (705) 797-2027 f (705) 797-2028

TOTAL DAILY DOMESTIC WATER SUPPLY FLOW CALCULATIONS

Date: 26-Jan-22 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
- City of Barrie Water Transmission and Distribution Policies and Design Standard - August 2021
- Ontario Building Code (OBC), 2012, Division B, Part 8, Table 8.2.1.3.A. Residential Occupancy & Table 8.2.1.3.B. Other Occupancies
- Ministry of the Environment (MOE), Design Guidelines for Drinking-Water Systems (2008), Chapter 3

Proposed Condition:

Establishment:	# of people	# of water closets	# of fuel outlets	# of seats	Gross Floor Area (m^2)	Land Area (ha)	Total Daily Design Volume		Avg Day Demand ADD (L/s)	Max Day Demand MDD (L/s)	Peak Hourly Demand PHD (L/s)
Commercial Uses:											
Office Building					292.2		75	L/9.3m2	0.027	0.041	0.082
Subtotal =					**292.2**				**0.027**	**0.041**	**0.082**
									***Peaking Factor =**	**1.5**	**3**

Note:
* Typical commerical peaking factors have been applied for the MDD and PHD based on a conservative estimate of the ADD which is assumed to be the Maximum Daily Sewage Flow as calculated using the above referenced OBC Tables.

X:\Projects\2021\21-664\Design\Water\[220126_Total_Daily_Domestic_Water_Supply_Flow_Calcs_Pr.xlsx]Water_Supply_Flows

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Watermain Headloss Calculations
219 Bayfield Street

<<< **Elements Requiring Input Information**

Velocity, $V = \frac{Q}{A}$ (m/s)

where, Q = Flow (m^3/s)

A = Cross-Sectional Area (m^2)

Minor Head Loss, $H_L = (K_1+K_2+K_3\ldots) \times V^2/2g$

where, $\sum K = (K_1+K_2+K_3\ldots)$

V = mean velocity (m/s)

g = 9.81 (acceleration due to gravity, m/s^2)

Hazen -Williams Equation (re-arranged for Friction Slope)

(Friction Head Loss Calculation)

Friction Slope, $S = \frac{(V)^{1/0.54}}{(0.85CR^{0.63})^{1/0.54}} \times 100$ (m/100m)

where, V = mean velocity (m/s)

k = 0.85 for SI units

C = Roughness Coefficient

R = hydraulic radius (m)

Total Head Loss = Friction Head Loss + Minor Head Loss

Pressure (psi) = Pressure Head (m) x 1.422

Total HGL = Ground Elev. + Pressure Head

Date: 26-Jan-22
Project No: 21-664
Prepared by: CJ

Description	Pipe Design Coefficient C	Forcemain Flow (L/s)	Forcemain Diameter (mm)	Forcemain Velocity (m/s)	Forcemain Unit Friction Head Loss (m/100m)	Forcemain Distance (m)	Forcemain Friction Head Loss (m)	Sum of Minor Loss Coeff. ∑K=	Minor Head Loss (m)	Total Head Loss (m)	Total Pressure Loss (psi)	Pressure @ Pt. A (psi)	Pressure Head @ Pt. A (m)	Ground Elev. @ Pt. A (m)	Total HGL @ Pt. A (m)	Ground Elev. @ Pt. B (m)	Total HGL @ Pt. B (m)	Pressure Head @ Pt. B (m)	Pressure @ Pt. B (psi)
219 Bayfield Street Water Service	**100**	**0.082**	**19**	0.29	1.38	**17.40**	0.24	**1.12**	0.00	0.24	0.35	**87**	61.18	**260.06**	321.24	**260.40**	321.00	60.60	**86.17**

NOTES: **- Loss Coefficient:** **1 - 90° Bends @ K=1**
2 - Valves @ K=0.12

-Peak Hourly Demand from Total Daily Domestic Use sheet found to be 0.082L/s
-The starting pressure for the watermain has been taken from the Vipond Inc. fire flow test results dated November 2, 2021 having a static pressure of 87psi.

FLOW TEST RESULTS

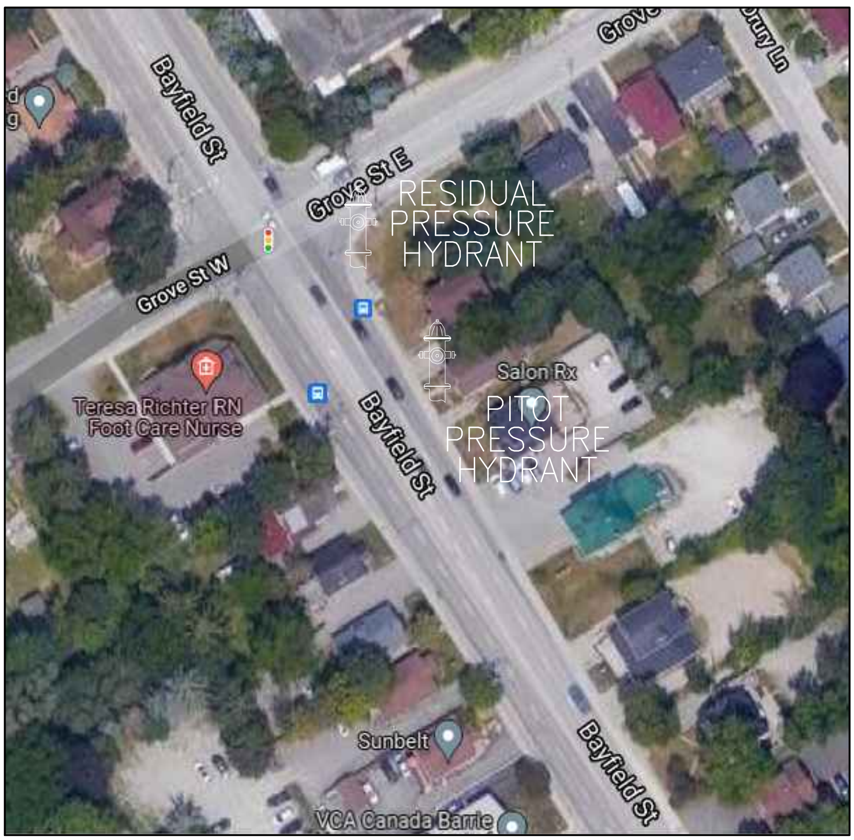
DATE : NOV 2, 2021 TIME : 12:30 PM

LOCATION : 219 BAYFIELD ST

BARRIE

ONTARIO

TEST BY : VIPOND FIRE PROTECTION AND LOCAL PUC



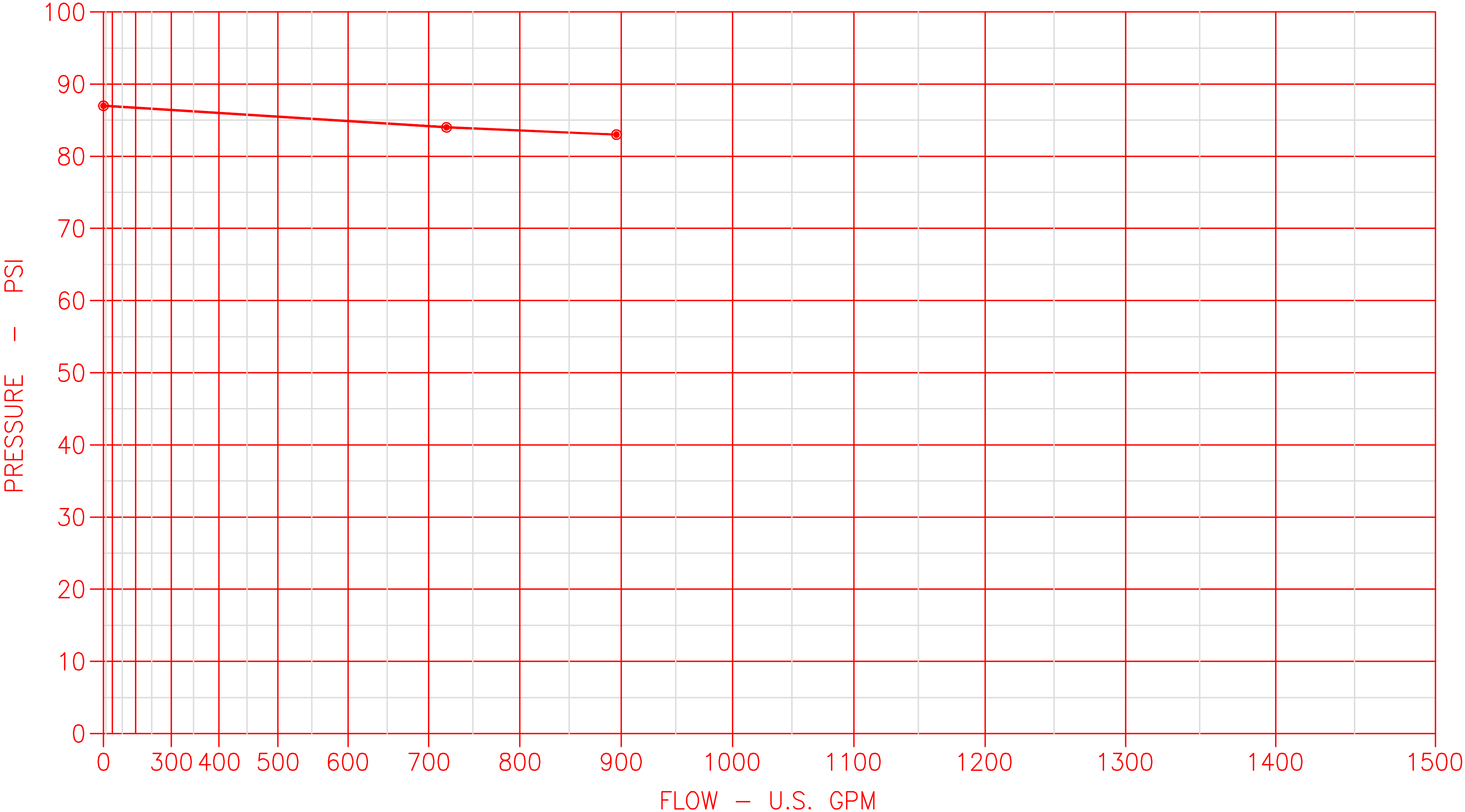
STATIC PRESSURE : 87 PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-3/4	0.995	84	67	729
2	1	2-1/2	0.90	83	28	893
3	2	2-1/2	0.90			

FIRST FOR FIRE, LIFE SAFETY & SECURITY
VIPOND INC
est. 1945

219 BAYFIELD ST	BY : LEN K./KRYSTIAN K
CITY OF BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : VIPOND & PUC
	DATE : NOV 2, 2021

STATIC:	RESIDUAL:			FLOW:
87 PSI	TEST#1	84 PSI	@	729 GPM
	TEST#2	83 PSI	@	893 GPM
	TEST#3	PSI	@	GPM



WMI & Associates Limited
119 Collier Street, Barrie, Ontario L4M 1H5
p (705) 797-2027 f (705) 797-2028

FIRE FLOW ANALYSIS CALCULATIONS

Bayfield Street: Grove Street East 2-1/2" Nozzle

Date: 26-Jan-22 **Project No.:** 21-664

Project: 219 Bayfield Street **Prepared By:** CJ

<<< **Elements Requiring Input Information**

Fire Flow Calculations

Flow test data from Vipond at the municipal hydrant located on Bayfield Street at the Grove Street East intersection dated November 2, 2021.

Static Pressure	**87**	**psi**	600 kPa
Residual Pressure (residual during single port test flow)	**83**	**psi**	572 kPa
Flow (single port test flow on hydrant)	**893**	**USGPM**	56 L/s

City of Barrie Water Transmission and Distribution Policies and Design Guidelines (Aug. 2021)
4.3. Watermain Design Criteria

Section 4.3.1. Fire Flows shall meet the following criteria:

- Large Residential Lots: minimum 70 L/s @ 20 psi
- Residential: 100 L/s @ 20 psi
- Townhouse: 155 L/s @ 20 psi
- Apartment: 200 L/s @ 20 psi
- High Rise Residential/Downtown/Mixed: Calculations required to be provided
- Institutional: 200 L/s @ 20 psi
- Commercial: 283 L/s @ 20 psi
- Industrial: 333 L/s @ 20 psi

Hydrant Flow Calculations

$\mathbf{Q_A = Q_T * \sqrt{(h_a/h_t)}}$ where,

Q_A = Flow at 20 psi (138kpa)
Q_T = Flow at Test
h_a = Pressure Drop Available (static - min. allowable)
h_t = Pressure Drop at Test (static - residual at tested flow)

Q_A = 893 √ ((87 - 20) / (87 - 83))
Q_A = 3655 USGPM @ 20 psi
Q_A = 230.6 L/s @ 20 psi

X:\Projects\2021\21-664\Design\Water\Fire Protection\[220126_City_of_Barrie_Fire Flow_Calcs.xlsx]Fire Flow Test (2-1_2")