Functional Servicing & Stormwater Management Report
123 Robert Street East
Town of Penetanguishene

File 20-620
January 2021

Prepared by

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119 Collier Street, Barrie Ontario L4M 1H5

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1.0 Background

1.1 General

WMI & Associates Limited has been retained by 2006316 Ontario Inc. to prepare a Functional Servicing and Preliminary Stormwater Management Report in support of a proposed townhome development located at 123 Robert Street East, in the Town of Penetanguishene.

This report presents an investigation of existing services and drainage patterns, and conceptual designs of proposed services and stormwater management controls in support of a re-zoning application for the subject lands. Fundamental servicing and drainage objectives, as detailed in this report, are based on pre-consultation information from the Town of Penetanguishene as well as typical Town 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 municipal infrastructure.

1.2 Site Description

The subject site comprises 1.17ha and is located between Burke Street to the north, Robert Street East to the south and Lecarron Avenue to the west. This report is based upon a Concept Plan and Draft Plan of Subdivision prepared by Celeste Phillips Planning Inc. dated July 20, 2020, and January 18, 2021, respectively. The Concept Plan, Draft Plan, and a Site Location Plan are contained in **Appendix A** for reference.

The site currently contains one (1) single family residential dwelling and is otherwise undeveloped, consisting of tree cover. It is bound by existing low density residential lands to the north, east, west and south. The development proposed comprises seven (7) residential townhome blocks ranging from 4-6 units for a total of 33 units. 22 of the proposed townhome units are proposed as freehold units, with frontage directly onto Burke Street to the north (18 units) and Robert Street East to the south (4 units). The remaining 11 units located at the southwest area of the property are proposed as rental units, and which are to be accessed via an internal/private road that connects to both Robert Street East and Lecarron Avenue.

The developer's plan is to build out the project in phases, with the 11 rental units being the final standalone phase. As such, the conceptual designs described herein are intended to accommodate the desired phasing scheme.

This report demonstrates how the proposed residential development can be serviced by existing municipal infrastructure and how storm drainage will function. The level of detail presented is sufficient to support planning level approvals and shall serve as a basis for detailed design. The conceptual designs described herein are based on Town of Penetanguishene, Ontario Ministry of the Environment, Conservation and Parks

(MECP) and Ontario Building Code (OBC) policies and design guidelines. Refer to concept Site Servicing and Grading Plans contained in **Appendix A** for conceptual design details which are discussed throughout this report.

2.0 Stormwater Management

2.1 Existing Topography and Pre-Development Drainage

The site is predominantly drained via overland sheet flow from the northeast to the southwest, ultimately onto Lecarron Avenue and Robert Street East. Existing site grades are moderately sloped, generally in the range of 5-20%, however, there is a flatter/low lying area located the southwest corner adjacent to the Lecarron Avenue and Robert Street East intersection.

Drainage to Robert Street East and Lecarron Avenue is collected by existing asphalt gutters and poorly defined roadside ditches (on Lecarron Avenue), and is ultimately conveyed through a 300mm dia. municipal culvert inlet at the northeast corner of the Robert Street East and Lecarron Avenue intersection. This culvert inlet forms a part of a municipal storm sewer system that continues to drain westward through the Robert Street East right of way. A narrow strip of the boulevard along the southern side of Burke Street drains westward and then southward onto Lecarron Avenue via a similar asphalt gutter and poorly defined ditch system.

The southwestern portion of the site, encompassing the area that is to include the 11 rental unit site, is herein referred to as catchment PRE-B throughout this report. The remaining northern and western site areas, that are to comprise the freehold townhome units, are herein referred to as catchment PRE-A. Refer to the Pre-development Drainage Plan, **Figure 2**, contained in **Appendix A**.

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. These soils are considered to have good to imperfect drainage characteristics, and are classified within Hydrologic Soils Group ‘AB’.

A Test Pit Investigation has also been conducted on the subject site, by Soil Engineers Ltd., dated October 5, 2020. This investigation consisted of 5 test pits to depths of 2.5m to 3.0m below the ground surface. The surficial soils consist of topsoil, to depths of 0.3 – 0.4m. The soils at depth consist of weathered silty sand and sand till, to depths of 0.5-1.2m, as well as silty sand till, sand, and sandy silt till to the termination of each test pit. No groundwater was encountered at the time of digging the pits nor was it observed during a follow up visit that was conducted to measure the levels in the 2 standpipes that were installed at two of the test pit locations.

A Hydrogeological Analysis and Water Balance Analysis has also been conducted by Wilson Associates, dated October 24, 2020, to further assess the local groundwater conditions, soils permeability, and to provide a water budget analysis. The Water Balance Analysis reveals that 1,171m3/year of runoff from impervious surfaces is to be infiltrated in order to restore water balance to pre-development levels. This equates to a daily infiltration volume of 39.0m3, conservatively assuming that this yearly volume is to be infiltrated over 30 days throughout the year.

The Hydrogeological Study further reveals that the shallow soils exhibit a percolation rate of approximately 25min/cm (24 mm/hr).

A review of the MECP's Source Protection Information Atlas reveals that the subject site is within a Wellhead Protection Area Q1 and Q2 zone. Adherence to the Q1 and Q2 policies is to be achieved by providing infiltration equivalent to that of existing conditions. The aforementioned infiltration volume targets as determined through the water balance analysis is the target that shall be adhered to in order to address this requirement.

The Test Pit Investigation and Hydrogeological Analysis and Water Balance Analysis are contained in **Appendix E** for reference.

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 Town of Penetanguishene, 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 Orillia-Brain 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, while also accounting for existing drainage conditions from surrounding lands.

The post-development catchments are delineated to accommodate the desired phasing scheme- with Area ‘A’ comprising the proposed freehold townhome units on Burke St. and Robert Street east, and Area ‘B’ comprising the 11 rental units at the corner of Robert Street East and Lecarron Avenue.

Area “A” lands are broken down into 2 catchments: A1 and A2. Catchment A1 encompasses the majority of the area; it consists of the rear roof tops and backyard/ landscape areas that will drain through internal catchbasins and a storm sewer system, and which will outlet to Lecarron Avenue to the west. Catchment A2 consists of front yard rooftops and driveway/landscape areas which are proposed to be captured by soak away pits (the front ½ of rooftops) and drain via sheet flow directly onto the adjacent municipal roadways.

Area “B” lands are delineated into 2 catchments. Catchment B1 comprises the majority of the site including the buildings, rooftops as well as the internal roads for internal capture and conveyance via a private storm sewer, whereas catchment B2 comprises perimeter areas which cannot be captured internally (due to grading constraints), and will sheet flow directly onto Lecarron Avenue and Robert Street East.

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

Table 1A: 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_{25} (m^3/s)	Q_{100} (m^3/s)
PRE-A	0.75	10.0	0.16	0.028	0.037	0.055	0.076
PRE-B	0.42	10.0	0.16	0.015	0.020	0.031	0.043

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

Table 1B: 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_{25} (m^3/s)	Q_{100} (m^3/s)
A1	0.43	10.0	0.52	0.052	0.068	0.102	0.142
A2	0.32	10.0	0.64	0.047	0.062	0.093	0.130
TOTAL A1+A2	**0.75**	**10.0**	**0.57**	**0.099**	**0.130**	**0.196**	**0.271**
B1	0.35	10.0	0.74	0.060	0.079	0.118	0.164
B2	0.07	10.0	0.32	0.005	0.007	0.010	0.014
TOTAL B1+B2	**0.42**	**10.0**	**0.67**	**0.065**	**0.086**	**0.128**	**0.178**

Since the total A1 + A2 post development flow exceeds the PRE-A pre-development flow, and since the total B1 + B2 post-development flow exceeds the PRE-B pre-development flow, quantity controls are required to attenuate post-development peak flows.

Refer to **Figure 3** for the Post-Development Drainage Plan, contained in **Appendix A**.

2.5 Quantity Control

To achieve release rates equivalent to pre-development levels for Areas A and B, peak flow attenuation is required. The allowable release rates for catchments A1 and B1 are summarized in Table 2 below.

Table 2: Allowable Release Rates

Catchment I.D.	Q_2 (m^3/s)	Q_5 (m^3/s)	Q_{25} (m^3/s)	Q_{100} (m^3/s)
PRE-A	0.028	0.037	0.055	0.076
A2 (uncontrolled)*	0.017	0.022	0.034	0.047
A1 allowable release = PRE-A <u>less</u> A2 (uncontrolled)	**0.011**	**0.015**	**0.021**	**0.029**
PRE-B	0.015	0.020	0.031	0.043
B2 (uncontrolled)	0.005	0.007	0.010	0.014
B1 allowable release = PRE-B <u>less</u> B2 (uncontrolled)	**0.010**	**0.013**	**0.021**	**0.029**

*flows are from the A2 area less the front 1/2 of rooftops from units 1-18, 30-33

2.5.1 Area A Attenuation:

Attenuation within Area A is to be achieved primarily by the internal storm sewer system and underground storage chambers within catchment A1. Catchbasins and storm sewers will capture and convey flows westward into the underground storage system located at the eastern end of the site, adjacent to Lecarron Avenue, and immediately to the north of the proposed private road that is to service the 11 rental unit (Area B) site. This will be controlled via a single orifice within a manhole structure, and will then outlet southward to a proposed ditch located within the eastern boulevard of Lecarron Avenue.

Runoff from the majority of catchment A2 (comprising front yard landscape and driveway areas) is not proposed to be attenuated however, the proposed soak away pits will retain a relatively large volume of water - a 25mm rainfall depth over the contributing rooftop areas - which translates to zero runoff from this area totaling 0.14ha. Since rainfall events of this magnitude account for approximately 97% of rainfall events in a year (as referenced from 1981-2010 precipitation statistics obtained from the Government of Canada’s Canadian Climate Normals data for the Midland water pollution control plant), the soak away pits will effectively eliminate runoff from all but the most intense storms (3% of greater of annual rainfall events).

To compensate for the unattenuated catchment A2 area, peak flows from catchment A1 will be over controlled, such that the overall flow from catchments A1 and A2 combined will be less than or equal to PRE-A flows.

2.5.2 Area B Attenuation:

Peak flow attenuation from Area B will be achieved by way of underground storage within storm sewers, storm chambers, and manhole structures, as well as via surface ponding within the internal private roadway (for storm events greater than the 5-year storm event). This will be controlled via a single orifice contained within a manhole and outlet via a sewer outlet to the ditch within Lecarron Avenue.

Runoff from catchment B2 cannot be reasonably captured by the internal storm drainage system due to grading constraints, as such these flows will discharge uncontrolled to Lecarron Avenue and Robert Street East. Catchment B1 flows will be over controlled to compensate for the uncontrolled discharge from catchment B2.

Table 3 below provides a summary of the post-development controlled peak flows and maximum storage volumes required to achieve the overall release rates to less than or equal to pre-development levels for Areas A and B.

Table 3: Post-Development Controlled Peak Flows and Max Storage Volumes

Catchment I.D.	Q_2 (m^3/s)	Q_5 (m^3/s)	Q_{25} (m^3/s)	Q_{100} (m^3/s)	Max Storage (m^3)
A1	0.011	0.015	0.015	0.015	112
A2 (uncontrolled)*	0.017	0.022	0.034	0.047	35
TOTAL 'A'	**0.028**	**0.037**	**0.049**	**0.062**	
B1	0.010	0.013	0.021	0.029	102
B2 (uncontrolled)	0.005	0.007	0.010	0.014	-
TOTAL 'B'	**0.015**	**0.020**	**0.031**	**0.043**	

*flows are from the A2 area less the front 1/2 of rooftops from units 1-18, 30-33

In comparing pre-development peak flows from Table 1A and the controlled flows from Table 3, it can be seen that the total post-development release rates for all storm events can be achieved to pre-development levels for both the Area A and Area B catchments. Specifically, peak flow alteration from Area A will be achieved by underground detention storage within catchment A1 to a maximum volume of 112 m^3 during the 100 year storm event, and within the catchment A2 soak away pits to a maximum volume of 35 m^3.

Peak flow alteration for Area B will be achieved via underground pipe/chamber storage and above ground roadway ponding within catchment B1, to a maximum volume of 102 m^3 during the 100 year storm event.

For supporting conceptual storm drainage and stormwater management calculations, refer to **Appendix B**.

2.6 Quality Control

To provide runoff quality control at an enhanced level (80% Total Suspended Solids removal), an oil/grit separator (OGS) is proposed for runoff from Catchment B1, which comprises the proposed internal road and driveways for the proposed rental units (the primary source of contaminated runoff).

Runoff from Catchment A1 is not proposed to be quality controlled since this area largely comprises landscaped areas which produces uncontaminated runoff. Flows from catchments B2 and A2 are also not proposed to be quality controlled since these are perimeter areas which cannot reasonably be controlled internally due to topographical constraints.

It should be noted that many of the landscape areas throughout the site are proposed to drain through grass swales, which increases the flow path and promotes further infiltration, thereby keeping with the treatment train approach for stormwater management.

Detailed quality control calculations will be provided at the detailed design stage.

2.7 Water Balance Controls

Water Balance Controls are also proposed in accordance with Sourcewater Protection Policies. Specifically, the site is within a wetland protection Q2 area. The land use planning policies under the south Georgian Bay Lake Simcoe Region Source Protection Plan dictates that pre-development water balance is to be maintained in wetland protection Q2 areas. The Hydrogeological Study and Water Balance Analysis, prepared by Wilson Associates for this project, identifies that three 39 m^3 of runoff from impervious areas is to be infiltrated per day, in order to maintain water balance to pre-development lands. It is noted that the soils present in the area are generally characterized as having moderate permeability (an estimated infiltration rate of 24m/hr), so it is expected that infiltration based water balance measures can be implemented.

The conceptual design proposes a number of Low Impact Development (LID) measures to promote infiltration, namely through soak away pits as well as within the clear stone base of underground storm pipes and chambers.

The volumetric capacity of the soak away pits are intended to be maximized to provide the greatest peak flow attenuation benefits (as detailed previously in this report), while also adhering to the typical maximum physical dimensions (as guided by the MOE Stormwater Management Planning and Design Manual). This is to ensure that effective quality and water balance controls will also be achieved, and to ensure sufficient long term performance.

It is also noted that evapotranspiration will occur through the proposed grass swales and through the perimeter landscape areas, which further promotes water balance and supports the integrated treatment train approach for stormwater management.

LID facilities will be constructed within this development to the greatest extent that is possible and practical, to ensure that pre-development water balance levels are maintained. For preliminary runoff retention calculations for the proposed soak away pits and underground storm pipes/chambers, refer to **Appendix B**.

3.0 Site Grading

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

- Internal road grades will generally be highest at the northwest end of the site and slope towards the south to Robert Street East. Internal road slopes will be in the order of 0.5% to 1.0% to facilitate ponding within the private road; however steeper slopes in the order of 2.0% to 7.0% will be required within the proposed driveways connecting to Lecarron Avenue and Robert Street East.

- Front yard grades for the units fronting onto Burke Street and Robert Street East will be sloped at 2 to 6% towards the roads.

- Perimeter grades within landscaped areas and around the proposed buildings will generally be between 2.0% to 8.0%, with some areas containing 3:1 slopes as required to match property line grades and grading transitions at the Phase 1 and Phase 2 boundaries.

- Retaining walls will be required along the southwestern property boundary and between the townhome blocks comprising units 30 to 33 and 25 to 29 to facilitate more abrupt grading transitions.

Refer to **Figure 5** for the Grading Concept Plan, contained in **Appendix A**.

4.0 Sanitary Servicing

The site currently contains one (1) residential sanitary service connection (to the existing dwelling on the site), from the existing 200mm dia. sanitary sewer on Robert Street East. Burke Street also has a 200mm dia. sanitary sewer which services to existing residences on the north side of the road, across from the subject site.

The proposed townhome units fronting directly onto Burke Street and Robert Street East are to have new service connections to the existing sanitary sewers on Burke Street and Robert Street East. The proposed 11 unit site of at the corner of Lecarron Avenue and Robert Street East is to be serviced by an internal 200mm dia. sanitary sewer and associated sanitary service laterals to each unit. This internal sewer will connect to the existing municipal sewer via a dog-house manhole connection on Robert Street East.

The existing sewer on Burke Street is to accommodate the largest proportion of new flows from this development, from 18 of the proposed units. The current capacity of this sewer, at the critical section between existing manholes #21 and #22 is 50 L/s. The design flow from the proposed 18 units is 1.13 L/s. This increase in flow equates to 2.3% of the existing pipe capacity. Similarly for the 11 unit site draining to the Robert Street East sewer, the increase in flow from the proposed units is 0.75 L/s, which equates to an additional 1.3% of existing pipe capacity (ex. capacity between manhole #4 and #5 is 56 L/s).

Since the proposed development has a negligible impact on the existing sewers they are draining into, in terms of design flow versus existing pipe capacity, it is anticipated that the expected increase in sanitary sewer flow can be accommodated by the existing municipal sewage system.

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

5.0 Water Servicing

There are existing 150mm and 200mm diameter municipal watermains located on Burke St. and Robert Street East, respectively, from which there are numerous water service connections and fire hydrants servicing the adjacent residential lands. There are 2 existing service connections in the vicinity of the existing dwelling on the subject site, both of which connect to the Robert Street East watermain.

Service to the 22 proposed units fronting onto Burke Street and Robert Street East is to be accomplished by individual service connections to the existing Burke Street and Robert Street East watermains. The 11 units fronting onto the proposed internal road are to be fed by a new 100mm dia. potable-service watermain, along with individual service connections to each unit. This watermain will tie into the 200mm diameter Robert Street East watermain.

5.1 Fire Protection

Fire protection to the Burke Street and Robert Street East units will be via existing fire hydrants located on these streets. A new hydrant is proposed on the Robert Street East watermain, immediately to the east of the new internal road servicing the 11 rental units, to provide adequate coverage for those units.

As the subject site is located within an established residential neighborhood that currently contains potable and fire water servicing, it is presumed that the existing watermains can accommodate the proposed development. A hydrant flow test can be conducted at the detailed design stage if required to confirm sufficient capacity.

Refer to **Appendix B** for supporting water service calculations.

6.0 Utilities

Existing hydro, gas and telecom infrastructure is presently servicing the existing residences across from the subject site along Burke Street and Robert Street East.

Based on the utility services that currently service the existing residential area, it is anticipated that utility servicing can be provided for all units within the proposed development. Specific utility servicing requirements will be confirmed at the detailed design stage.

7.0 Traffic Impact Assessment

The following traffic impact assessment provides calculations of estimated vehicular trips, as well as considerations and opinions with regard to site traffic (volume) impacts, sight distance and parking/ circulation/ site entrance geometry.

7.1 Trip Generation Analysis

Trip generation rates were estimated using data from the Institute of Transportation Engineers' (ITE) Trip Generation Manual, 10th Edition. The multi-family detached housing datasets for both low-rise (up to 2 stories) and mid-rise (3 stories and greater) residential developments were referenced to determine a viable trip generation rate for the proposed townhome units (which are envisioned to comprise either 2 or 3 stories). The data for the 'Weekday Peak hour of Adjacent Street Traffic, One Hour Between 4pm and 6pm' time period is utilized since it results in conservative estimates of trips (based on both datasets).

In comparing the data from the low-rise and mid-rise multi-family residential datasets, it is determined that an average rate of approximately 20 peak-hour trips for the proposed 33 units would be a conservative estimate for the site. This is an approximate average of the calculated 23 peak hour trips for the low rise multi-family data set, and the 16 peak hour trips for the mid-rise multi-family data set, under the weekday peak hour of adjacent street traffic, 1 hour between 4pm and 6pm data sets.

Refer to **Appendix C** for supporting Trip Generation Calculations

7.2 Trip Distribution and Volume Impacts

From the review of the local road network and likely travel destinations such as shopping centres, employment lands and recreation facilities/attractions relative to the location of primary arterial roads through the Town (namely Robert Street East, County Road 93, Fuller Avenue and Thompsons Road), it is estimated that the distribution of trips would be evenly split, such that 50% of the new trips generated from the development will travel to/ from Robert Street westbound, and Robert Street eastbound.

The minor increase in vehicular trips and distribution split as a result of the proposed development is insignificant and will not adversely impact traffic movements and capacities on local area roadways. Therefore, it is expected that the development can be accommodated by existing roads without retrofits or improvements.

7.3 Sight-Distance Analysis

Ontario's Ministry of Transportation (MTO) outlines specific sight-distance geometry criteria to ensure safe vehicular movement to and from intersecting roadways and to ensure that through traffic on the adjacent roadway will have adequate time and space for manoeuvrability and braking. Based on an assumed speed of 60km/ hr on Robert Street East, Lecarron Avenue and Burke Street, the minimum required stopping sight-distance is approximately 80m as referenced from MTO Geometric Design Standards for Ontario Highways Manual, Figure E3-6 (refer to **Appendix C**).

From a review of existing site conditions and sight-lines from the vantage point of the proposed driveways, as well as the intersections of the private road at Lecarron Avenue and Robert Street East, visibility is noted to be adequate, since there are no notable obstructions that would detrimentally impede sightlines. Based on these observations, sight-distance from the proposed site access location is noted to be satisfactory.

7.4 Parking / Circulation and Site Entrances

The townhome units are to contain private driveways and single car garages to accommodate residential parking requirements.

The proposed internal/ private roadway is envisioned to comprise an urbanized cross section, consisting of barrier curbs, a sidewalk on one side, and a road width of 6.0m. The centerline of road radius will be a minimum of 12.0m in accordance with Town standards and Ontario Building Code requirements for fire accesses.

8.0 Sediment and Erosion Controls

Effective erosion and sediment control must be established prior to construction commencement and maintained until the site has been stabilized. Pro-active 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.

<u>Silt Fence:</u> 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.

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

<u>Mud Mat:</u> 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.

<u>Monitoring and Inspection:</u> 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.

9.0 Summary

This Functional Servicing and Stormwater Management Report demonstrates how the proposed 123 Robert Street East townhome development can be serviced by existing municipal services, how vehicular traffic can be accommodated, how storm runoff can be controlled so to not impose any adverse effects on the surrounding environment.

Specifically:

- Storm drainage will be provided by 2 internal storm sewer systems, one which will service the units fronting onto Burke Street and Robert Street East and the other which will service the 11 units fronting onto the proposed internal road. Both systems will discharge to the existing storm drainage system on Lecarron Avenue and Robert Street East.

- Peak flow attenuation will be provided by soak away pits, underground storage pipes and chambers, as well as by surface storage on the proposed internal road.

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

- Water balance will be provided by infiltration based LIDs - including soak away pits and underground storage/infiltration chambers.

- Fire and potable water servicing will be provided by the existing municipal watermains on Burke Street and Robert Street East.

- Sanitary sewer servicing will be provided by existing sanitary sewers on Burke Street and Robert Street East.

- An estimated 20 peak hour vehicular trips can be accommodated by existing roads without retrofit, and sight-distances from all access points is sufficient.

- 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.

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

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

Prepared by:

WMI & Associates Limited

Jonathan P. Reimer, P.Eng.

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Appendix A

Figures and Concept Plans

CONCEPT PLAN

33 UNITS

123 Robert Street East
Town of Penetanguishene
County of Simcoe

LEGEND

Subject Lands	Total Area:	1.173ha (2.90ac)
	Developable:	1.077ha (2.66ac)
	No. of Units:	33
	Density:	30.6 u/ha

- 8.0m Street Row House Dwelling (R4 Zone)
- 7.6m Row House Dwelling (R3 Zone)
- Open Space / Landscaped Area
- Potential 3.0m Road Widening

ZONING REQUIREMENTS

	R4 Zone		R3 Zone	
	Required	Proposed	Required	Proposed
Number of Units		22		11
Lot Area	220m²	236m²	2,530m²	3,968.6m²
Lot Frontage	7.5m	8.0m	30m	68m
Front Yard	6.0m	6.0m	3.0m	4.5m
Ext. Side Yard	4.5m	4.5m	3.0m	7.0m
Int. Side Yard	1.5m	1.5m	2.0m	7.5m
Rear Yard	7.5m	**2.5m**	7.5m	**2.6m**
Height (max)	11.0m	<11.0m	11.0m	<11.0m
Coverage (max)	40%	**55%**	35%	32%
Gross Floor Area	32m²	>32m²	32m²	>32m²
Parking Spaces	-	2 / unit	-	2 / unit

Note: This drawing is for discussion purposes only.
Source: Survey prepared by John M. Hard, Dec. 1982. County of Simcoe interactive map.

0 10 20 30 40m
Scale: 1 : 1,000

N

Drawn By: A.M. Date: July 20, 2020

Prepared for: 2006316 Ontario Inc. o/a Inter Spec Construction Services

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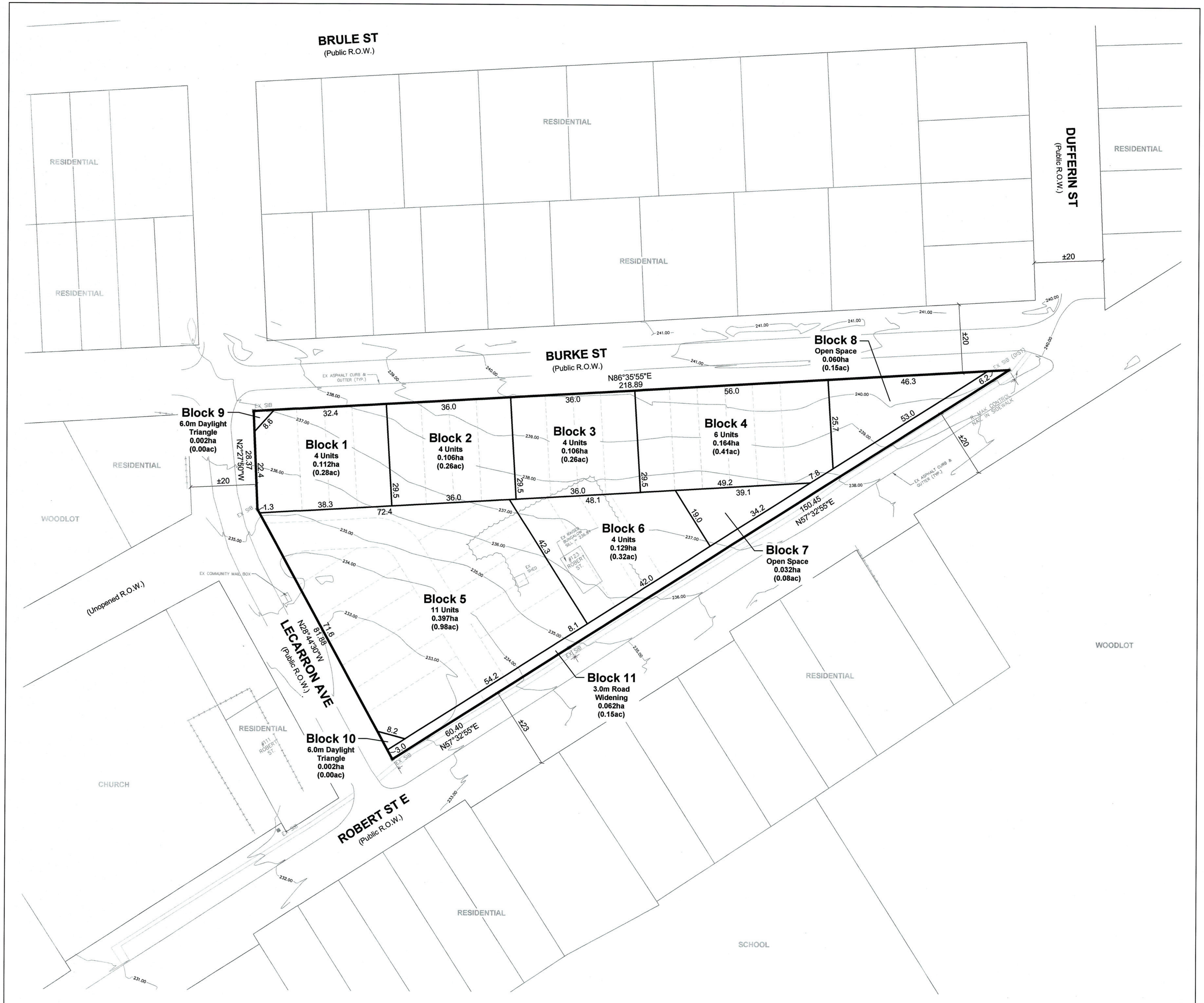
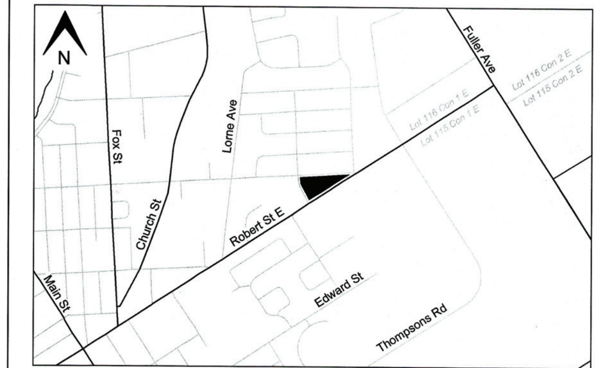


KEY MAP



Scale 1 : 15,000

LAND USE SCHEDULE

USE	BLOCKS	UNITS	AREA ha	AREA ac	AREA %
STREET ROW HOUSE DWELLING UNITS	1 - 4, 6	22	0.617	1.52	52.7
ROW HOUSE DWELLING UNITS	5	11	0.397	0.98	33.8
OPEN SPACE	7, 8		0.092	0.23	7.9
ROAD WIDENING & DAYLIGHT TRIANGLE	9 - 11		0.066	0.16	5.6
TOTAL		33	1.172	2.90	100

OWNER'S CERTIFICATE

I, BRYAN MACPHERSON, BEING THE REGISTERED OWNER OF THE SUBJECT LANDS, HEREBY AUTHORIZE CELESTE PHILLIPS PLANNING INC. TO PREPARE AND SUBMIT A DRAFT PLAN OF SUBDIVISION FOR APPROVAL.

DATE: ______________ ______________

BRYAN MACPHERSON, PRESIDENT
2006316 ONTARIO INC.

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN ON THIS PLAN.

DATE: Jan. 15, 2021 [signature]

RUDY MAK, O.L.S.
RUDY MAK SURVEYING LTD.

ADDITIONAL INFORMATION
REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT

a) AS SHOWN
b) AS SHOWN
c) AS SHOWN
d) AS SHOWN
e) AS SHOWN
f) AS SHOWN
f1) NONE
g) AS SHOWN
h) MUNICIPAL WATER
i) SILTY SAND TILL, SAND, AND SANDY SILT TILL
j) AS SHOWN
k) FULL MUNICIPAL SERVICES
l) AS SHOWN

No.	DATE	REVISION	BY

DRAFT PLAN OF SUBDIVISION

123 ROBERT STREET EAST
PART OF LOT 116, CONCESSION 1 EAST OF PENETANGUISHENE RD
TOWN OF PENETANGUISHENE
COUNTY OF SIMCOE

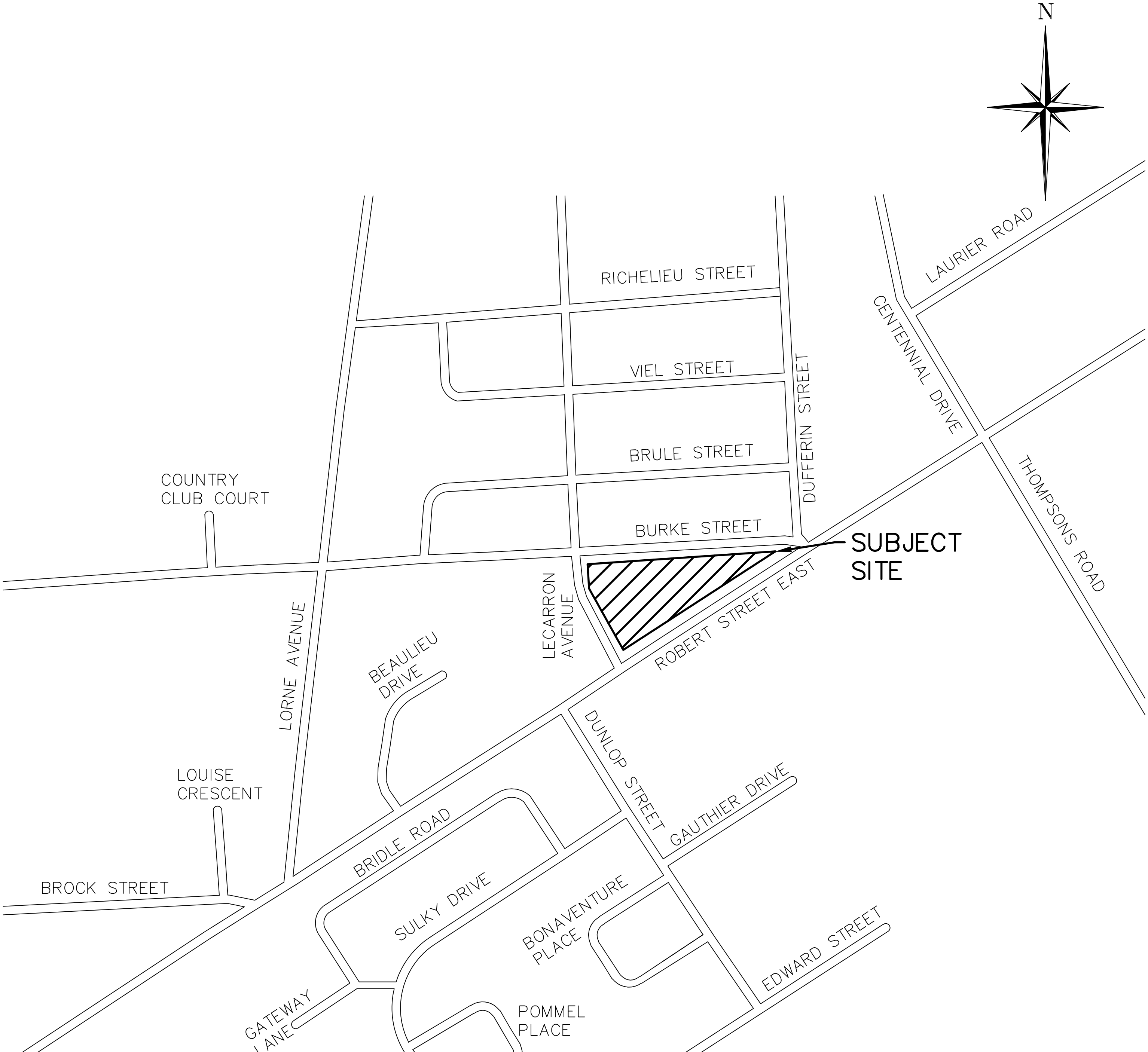
Stamp

N

Scale 1 : 500
0 5 10 15 20 25m

celeste PHILLIPS PLANNING INC.
85 Bayfield Street, Suite 300
Barrie, ON L4M 3A7
T: 705 797 8977
C: 705 730 8850
celeste@cplan.ca

Date: January 18, 2021
Drawn By: AM
Checked By: CP



Drawing Title

SITE LOCATION PLAN

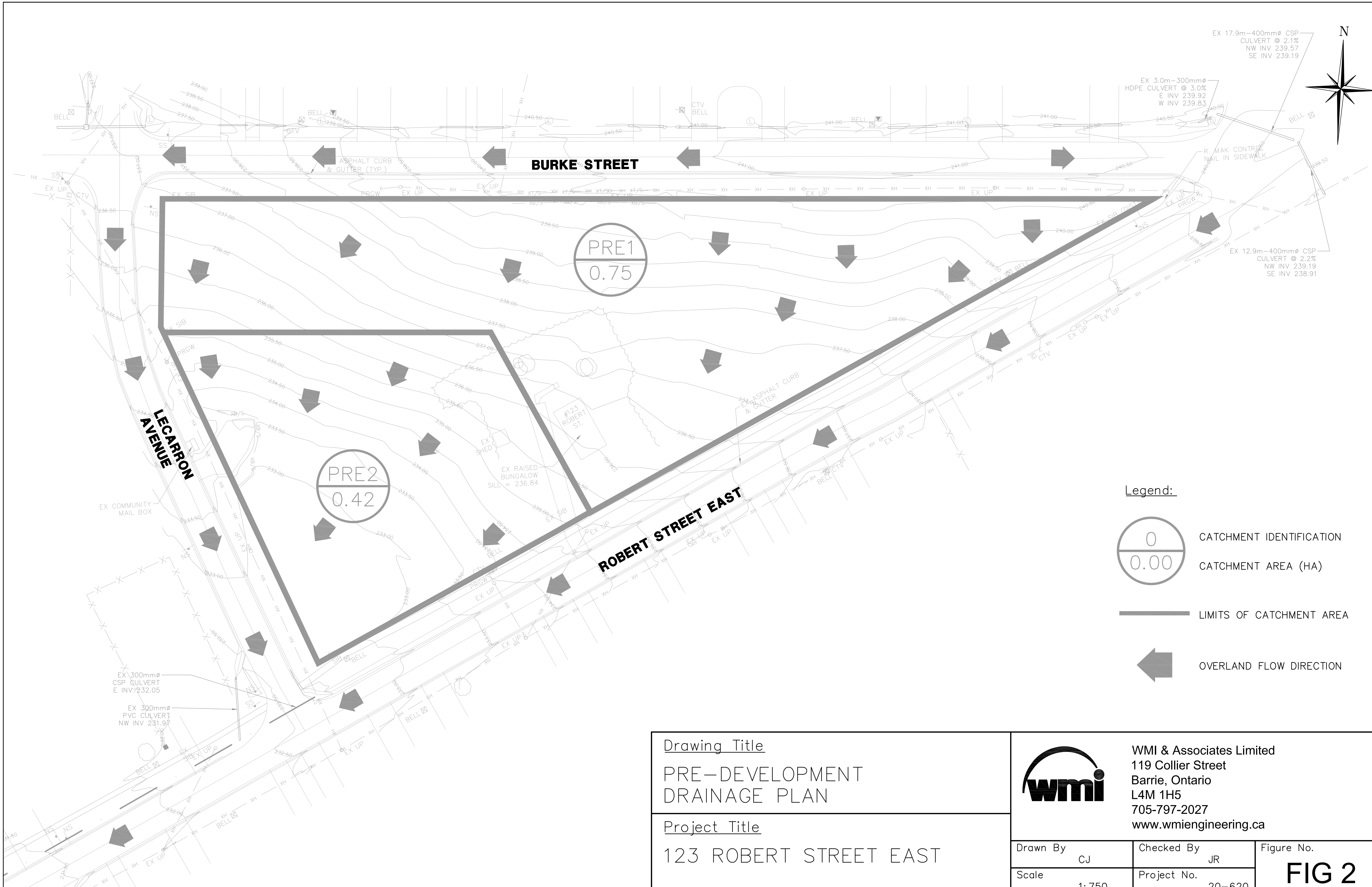
Project Title

123 ROBERT STREET EAST

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

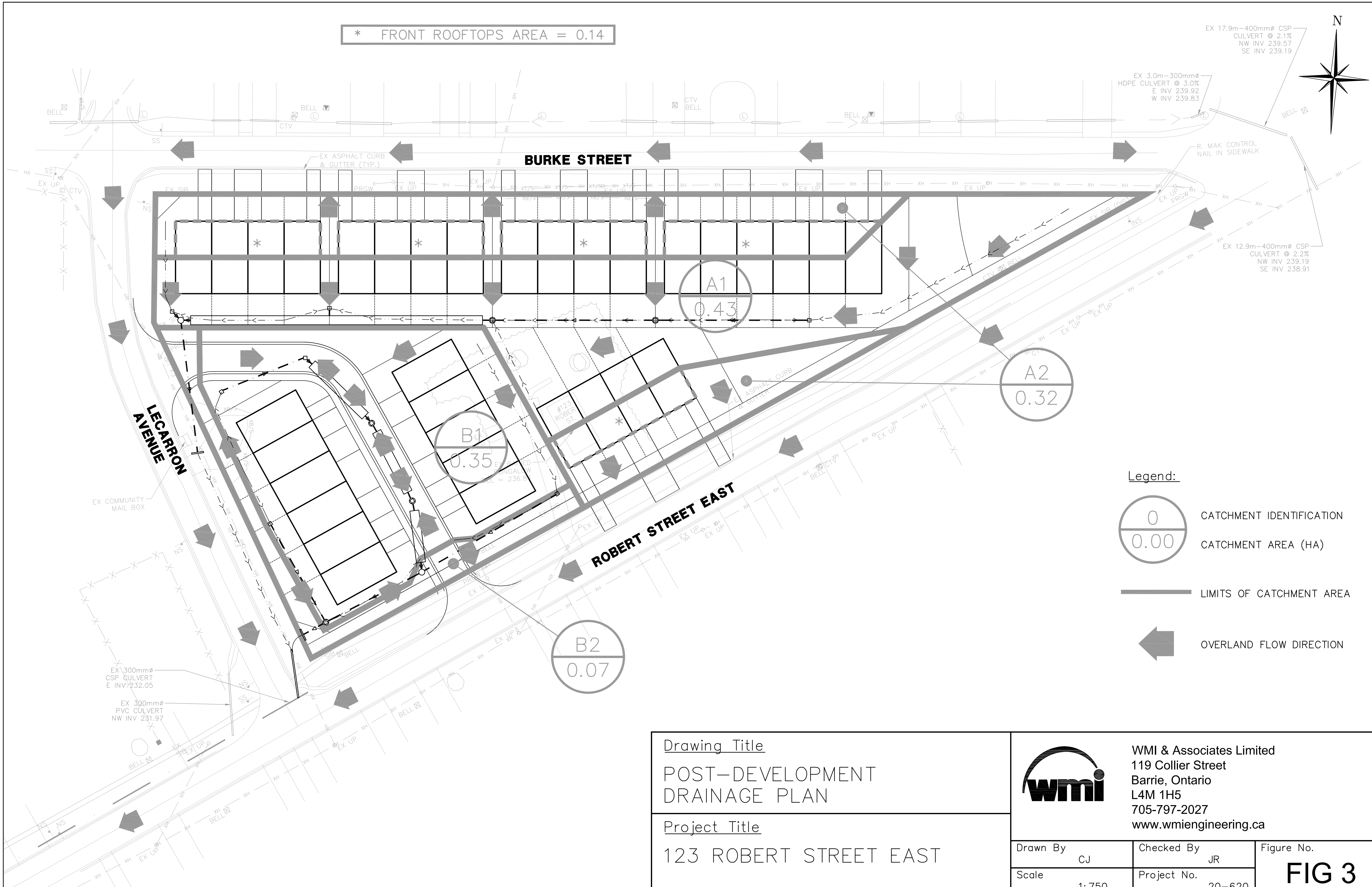
Drawn By	Checked By	Figure No.
CJ	JR	FIG1
Scale	Project No.	
N.T.S.	20-620	

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\CAD\WMI\Issue_No1\20-620_Base.dwg, FIG1, 1:25.4



Drawing Title	WMI & Associates Limited	
PRE–DEVELOPMENT DRAINAGE PLAN	119 Collier Street, Barrie, Ontario, L4M 1H5, 705-797-2027, www.wmiengineering.ca	
Project Title: 123 ROBERT STREET EAST	Drawn By: CJ	Checked By: JR
	Scale: 1:750	Project No.: 20–620
	Figure No.: FIG 2	

\\WMI–SERVER\wmi–server\Data\Projects\2020\20–620\CAD\WMI\Issue_No1\20–620_Base.dwg, FIG2–PRE, 1:1



Drawing Title

POST–DEVELOPMENT DRAINAGE PLAN

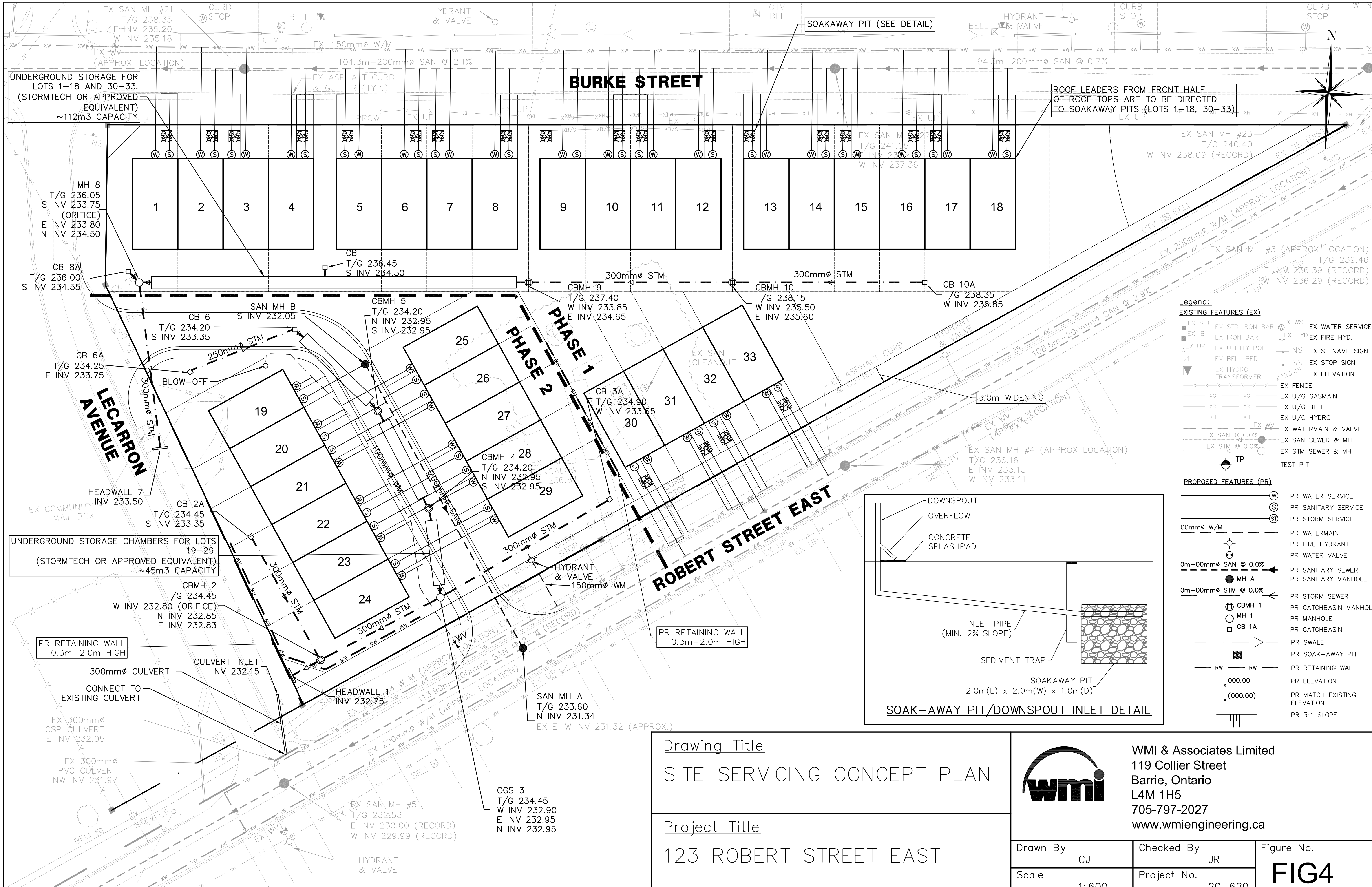
Project Title

123 ROBERT STREET EAST

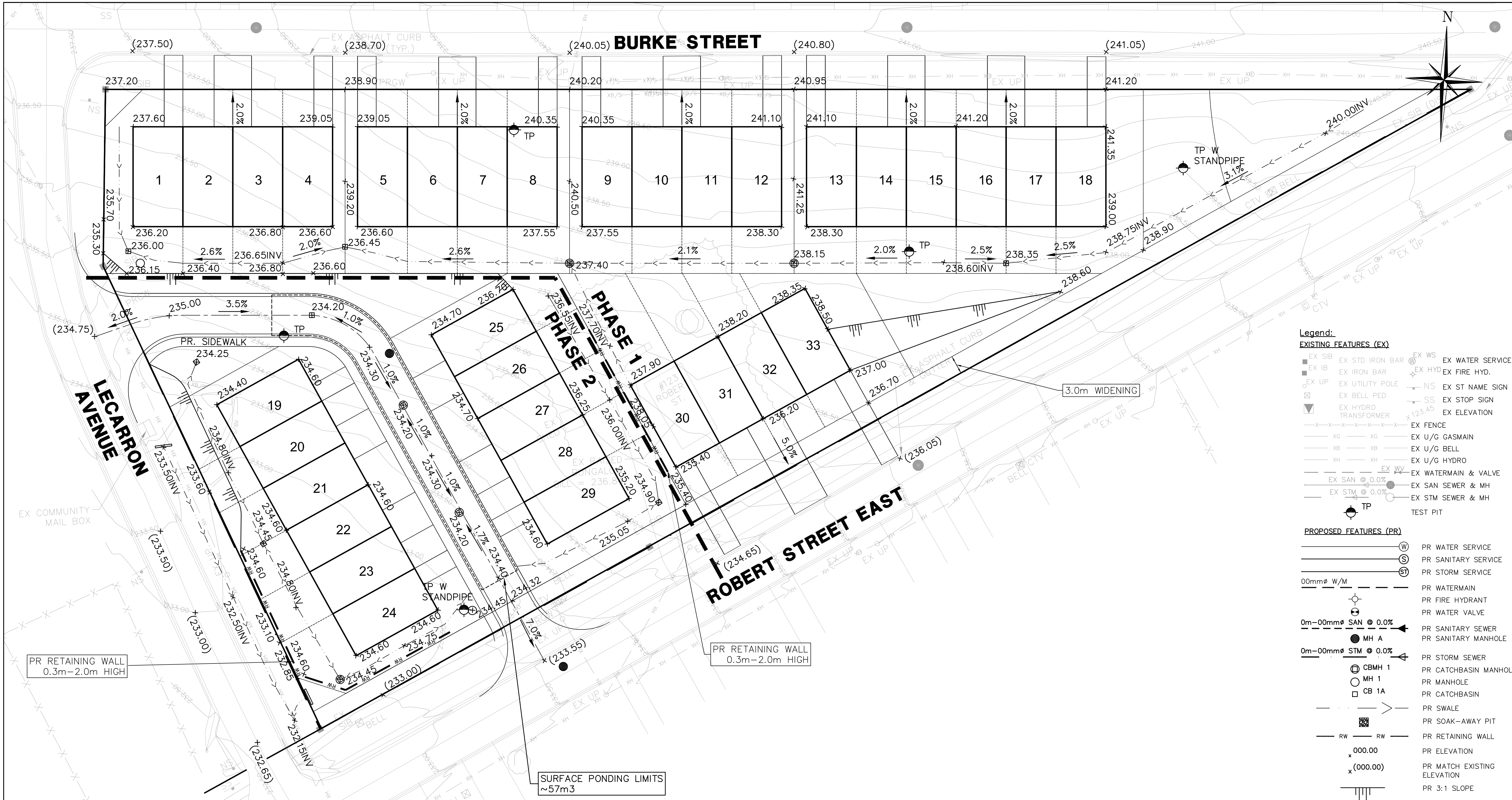
WMI & Associates Limited
119 Collier Street
Barrie, Ontario
L4M 1H5
705-797-2027
www.wmiengineering.ca

Drawn By	Checked By	Figure No.
CJ	JR	FIG 3
Scale 1:750	Project No. 20–620	

\\WMI–SERVER\wmi–server\Data\Projects\2020\20–620\CAD\WMI\Issue_No1\20–620_Base.dwg, FIG3–POST, 1:25.4



\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\CAD\WMI\Issue_No1\20-620_Base.dwg, FIG4 -SS, 1:25.4



Drawing Title

GRADING CONCEPT PLAN

Project Title

123 ROBERT STREET EAST

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

Drawn By	Checked By	Figure No.
CJ	JR	FIG5
Scale 1:600	Project No. 20-620	

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\CAD\WMI\Issue_No1\20-620_Base.dwg, FIG5 - LGR, 1:25.4

Appendix B

Storm Drainage, Sanitary and Water Calculations

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

RUNOFF COEFFICIENT CALCULATIONS
"C" SPREADSHEET

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

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**

PRE-DEVELOPMENT CONDITION - CATCHMENT PRE-A

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	0.33		
	10 - 30% grade	0.33		
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.01		
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	0.09		
	> 7% grade			

Total Area (ha) = 0.75 **Runoff Coefficient, C =** **0.16**

PRE-DEVELOPMENT CONDITION - CATCHMENT PRE-B

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	0.10		
	5 - 10% grade			
	10 - 30% grade	0.29		
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.01		
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	0.03		
	> 7% grade			

Total Area (ha) = 0.42 **Runoff Coefficient, C =** **0.16**

POST-DEVELOPMENT CONDITION - CATCHMENT A1

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.)	0.22		
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	0.21		
	> 7% grade	0.01		

Total Area (ha) = 0.43 **Runoff Coefficient, C = 0.52**

POST-DEVELOPMENT CONDITION - CATCHMENT A2

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.)	0.20		
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	0.12		
	> 7% grade			

Total Area (ha) = 0.32 **Runoff Coefficient, C = 0.64**

POST-DEVELOPMENT CONDITION - CATCHMENT B1

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.)	0.26		
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	0.08		
	> 7% grade	0.01		

Total Area (ha) = 0.35 **Runoff Coefficient, C = 0.74**

POST-DEVELOPMENT CONDITION - CATCHMENT B2

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.)	0.02		
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	0.06		

Total Area (ha) = 0.07 **Runoff Coefficient, C = 0.32**

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

RATIONAL METHOD CALCULATIONS

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

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

Rainfall Intensity-Duration-Frequency Coefficients from: Orillia, ON

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

$$I_{2\text{-}100} = A \times (T_C / 60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = 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)
PRE-A	**0.75**	**10.0**	**0.16**	**0.004**	**0.028**	**0.037**	**0.042**	**0.055**	**0.066**	**0.076**
PRE-B	**0.42**	**10.0**	**0.16**	**0.002**	**0.015**	**0.020**	**0.024**	**0.031**	**0.037**	**0.043**
A1	0.43	10.0	0.52	0.018	0.052	0.068	0.079	0.102	0.124	0.142
A2	0.32	10.0	0.64	0.019	0.047	0.062	0.072	0.093	0.113	0.130
TOTAL A1+A2	**0.75**	**10.0**	**0.57**	**0.036**	**0.099**	**0.130**	**0.152**	**0.196**	**0.237**	**0.271**
B1	0.35	10.0	0.74	0.027	0.060	0.079	0.092	0.118	0.143	0.164
B2	0.07	10.0	0.32	0.001	0.005	0.007	0.008	0.010	0.012	0.014
TOTAL B1+B2	**0.42**	**10.0**	**0.67**	**0.027**	**0.065**	**0.086**	**0.100**	**0.128**	**0.156**	**0.178**

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_Rational_Method_Calcs(A,B).xlsx]sheet1

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

MODIFIED RATIONAL METHOD CALCULATIONS - CATCHMENT B1
2-year Design Storm Event

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: http://www.mto.gov.on.ca/IDF_Curves/terms.shtml

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

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 (2-100 year storm events)

$$I_{2\text{-}100} = A \times (t_d/60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_report tables.xlsx]table 2

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
B1	2-year	0.35	0.74	0.74	10	2	0.010

NOTES: 2-year target flow is 0.010 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	82.9	0.060	35.80	6.00	29.80	
12	72.6	0.052	37.62	6.60	31.02	
14	64.9	0.047	39.23	7.20	32.03	
16	58.9	0.042	40.68	7.80	32.88	
18	54.1	0.039	42.00	8.40	33.60	
20	50.1	0.036	43.22	9.00	34.22	
22	46.7	0.034	44.36	9.60	34.76	
24	43.8	0.032	45.42	10.20	35.22	
26	41.4	0.030	46.42	10.80	35.62	
28	39.2	0.028	47.36	11.40	35.96	
30	37.3	0.027	48.26	12.00	36.26	
32	35.6	0.026	49.12	12.60	36.52	
34	34.0	0.024	49.93	13.20	36.73	
36	32.6	0.023	50.72	13.80	36.92	
38	31.4	0.023	51.47	14.40	37.07	
40	30.2	0.022	52.19	15.00	37.19	
42	29.2	0.021	52.89	15.60	37.29	
44	28.2	0.020	53.56	16.20	37.36	
46	27.3	0.020	54.21	16.80	37.41	
48	26.5	0.019	54.84	17.40	37.44	
50	25.7	0.018	55.46	18.00	37.46	**37.5**
52	25.0	0.018	56.05	18.60	37.45	
54	24.3	0.017	56.63	19.20	37.43	
56	23.7	0.017	57.19	19.80	37.39	
58	23.1	0.017	57.74	20.40	37.34	
60	22.5	0.016	58.28	21.00	37.28	
62	22.0	0.016	58.80	21.60	37.20	
64	21.5	0.015	59.31	22.20	37.11	
66	21.0	0.015	59.81	22.80	37.01	
68	20.5	0.015	60.29	23.40	36.89	
70	20.1	0.014	60.77	24.00	36.77	

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MODIFIED RATIONAL METHOD CALCULATIONS - CATCHMENT B1
5-year Design Storm Event

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: http://www.mto.gov.on.ca/IDF_Curves/terms.shtml

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

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 (2-100 year storm events)

$$I_{2\text{-}100} = A \times (t_d/60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_report tables.xlsx]table 2

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
B1	5-year	0.35	0.74	0.74	10	2	0.013

NOTES: 5-year target flow is 0.013 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	109.6	0.079	47.31	7.80	39.51	
12	96.0	0.069	49.75	8.58	41.17	
14	85.9	0.062	51.90	9.36	42.54	
16	78.0	0.056	53.84	10.14	43.70	
18	71.6	0.051	55.61	10.92	44.69	
20	66.3	0.048	57.25	11.70	45.55	
22	61.9	0.045	58.77	12.48	46.29	
24	58.1	0.042	60.19	13.26	46.93	
26	54.8	0.039	61.53	14.04	47.49	
28	52.0	0.037	62.80	14.82	47.98	
30	49.4	0.036	64.00	15.60	48.40	
32	47.2	0.034	65.15	16.38	48.77	
34	45.1	0.032	66.24	17.16	49.08	
36	43.3	0.031	67.29	17.94	49.35	
38	41.6	0.030	68.30	18.72	49.58	
40	40.1	0.029	69.27	19.50	49.77	
42	38.7	0.028	70.21	20.28	49.93	
44	37.4	0.027	71.11	21.06	50.05	
46	36.3	0.026	71.98	21.84	50.14	
48	35.2	0.025	72.83	22.62	50.21	
50	34.1	0.025	73.65	23.40	50.25	
52	33.2	0.024	74.45	24.18	50.27	**50.3**
54	32.3	0.023	75.23	24.96	50.27	
56	31.4	0.023	75.99	25.74	50.25	
58	30.6	0.022	76.72	26.52	50.20	
60	29.9	0.022	77.44	27.30	50.14	
62	29.2	0.021	78.14	28.08	50.06	
64	28.5	0.021	78.83	28.86	49.97	
66	27.9	0.020	79.50	29.64	49.86	
68	27.3	0.020	80.15	30.42	49.73	
70	26.7	0.019	80.79	31.20	49.59	

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MODIFIED RATIONAL METHOD CALCULATIONS - CATCHMENT B1
25-year Design Storm Event

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: http://www.mto.gov.on.ca/IDF_Curves/terms.shtml

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

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 (2-100 year storm events)

$$I_{2-100} = A \times (t_d/60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_report tables.xlsx]table 2

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
B1	25-year	0.35	0.74	0.81	10	5	0.021

NOTES: 25-year target flow is 0.021 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	149.4	0.118	70.94	12.60	58.34	
15	111.4	0.088	79.37	15.75	63.62	
20	90.5	0.072	85.95	18.90	67.05	
25	77.0	0.061	91.43	22.05	69.38	
30	67.5	0.053	96.17	25.20	70.97	
35	60.4	0.048	100.36	28.35	72.01	
40	54.8	0.043	104.15	31.50	72.65	
45	50.4	0.040	107.60	34.65	72.95	
50	46.7	0.037	110.79	37.80	72.99	**73.0**
55	43.6	0.034	113.75	40.95	72.80	
60	40.9	0.032	116.52	44.10	72.42	
65	38.6	0.031	119.14	47.25	71.89	
70	36.6	0.029	121.61	50.40	71.21	
75	34.8	0.028	123.95	53.55	70.40	
80	33.2	0.026	126.19	56.70	69.49	
85	31.8	0.025	128.33	59.85	68.48	
90	30.5	0.024	130.37	63.00	67.37	
95	29.3	0.023	132.34	66.15	66.19	
100	28.3	0.022	134.24	69.30	64.94	
105	27.3	0.022	136.06	72.45	63.61	
110	26.4	0.021	137.83	75.60	62.23	
115	25.6	0.020	139.53	78.75	60.78	
120	24.8	0.020	141.19	81.90	59.29	
125	24.1	0.019	142.79	85.05	57.74	
130	23.4	0.019	144.35	88.20	56.15	
135	22.8	0.018	145.87	91.35	54.52	
140	22.2	0.018	147.35	94.50	52.85	
145	21.6	0.017	148.79	97.65	51.14	
150	21.1	0.017	150.19	100.80	49.39	
155	20.6	0.016	151.56	103.95	47.61	
160	20.1	0.016	152.90	107.10	45.80	

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MODIFIED RATIONAL METHOD CALCULATIONS - CATCHMENT B1
100-year Design Storm Event

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: http://www.mto.gov.on.ca/IDF_Curves/terms.shtml

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

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 (2-100 year storm events)

$$I_{2\text{-}100} = A \times (t_d/60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_report tables.xlsx]table 2

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
B1	100-year	0.35	0.74	0.93	10	2	0.029

NOTES: 100-year target flow is 0.029 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	182.3	0.164	98.37	17.40	80.97	
12	159.8	0.144	103.48	19.14	84.34	
14	143.0	0.129	108.01	20.88	87.13	
16	129.8	0.117	112.10	22.62	89.48	
18	119.3	0.107	115.83	24.36	91.47	
20	110.5	0.099	119.27	26.10	93.17	
22	103.2	0.093	122.47	27.84	94.63	
24	96.9	0.087	125.47	29.58	95.89	
26	91.5	0.082	128.30	31.32	96.98	
28	86.7	0.078	130.97	33.06	97.91	
30	82.5	0.074	133.50	34.80	98.70	
32	78.7	0.071	135.92	36.54	99.38	
34	75.3	0.068	138.23	38.28	99.95	
36	72.3	0.065	140.44	40.02	100.42	
38	69.5	0.063	142.57	41.76	100.81	
40	67.0	0.060	144.62	43.50	101.12	
42	64.7	0.058	146.59	45.24	101.35	
44	62.5	0.056	148.50	46.98	101.52	
46	60.6	0.054	150.35	48.72	101.63	
48	58.7	0.053	152.14	50.46	101.68	**101.7**
50	57.0	0.051	153.87	52.20	101.67	
52	55.4	0.050	155.56	53.94	101.62	
54	54.0	0.049	157.20	55.68	101.52	
56	52.6	0.047	158.80	57.42	101.38	
58	51.2	0.046	160.36	59.16	101.20	
60	50.0	0.045	161.88	60.90	100.98	
62	48.8	0.044	163.36	62.64	100.72	
64	47.7	0.043	164.81	64.38	100.43	
66	46.7	0.042	166.22	66.12	100.10	
68	45.7	0.041	167.61	67.86	99.75	
70	44.7	0.040	168.96	69.60	99.36	

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MODIFIED RATIONAL METHOD CALCULATIONS - CATCHMENT A1
2-year Design Storm Event

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: http://www.mto.gov.on.ca/IDF_Curves/terms.shtml

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

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 (2-100 year storm events)

$$I_{2-100} = A \times (t_d/60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_report tables.xlsx]table 2

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	2-year	0.43	0.52	0.52	10	2	0.011

NOTES: 2-year target flow is 0.011 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	82.9	0.052	30.90	6.60	24.30	
12	72.6	0.045	32.47	7.26	25.21	
14	64.9	0.040	33.86	7.92	25.94	
16	58.9	0.037	35.12	8.58	26.54	
18	54.1	0.034	36.26	9.24	27.02	
20	50.1	0.031	37.31	9.90	27.41	
22	46.7	0.029	38.29	10.56	27.73	
24	43.8	0.027	39.21	11.22	27.99	
26	41.4	0.026	40.07	11.88	28.19	
28	39.2	0.024	40.89	12.54	28.35	
30	37.3	0.023	41.67	13.20	28.47	
32	35.6	0.022	42.40	13.86	28.54	
34	34.0	0.021	43.11	14.52	28.59	
36	32.6	0.020	43.78	15.18	28.60	**28.6**
38	31.4	0.019	44.43	15.84	28.59	
40	30.2	0.019	45.06	16.50	28.56	
42	29.2	0.018	45.66	17.16	28.50	
44	28.2	0.018	46.24	17.82	28.42	
46	27.3	0.017	46.80	18.48	28.32	
48	26.5	0.016	47.35	19.14	28.21	
50	25.7	0.016	47.88	19.80	28.08	
52	25.0	0.016	48.39	20.46	27.93	
54	24.3	0.015	48.89	21.12	27.77	
56	23.7	0.015	49.37	21.78	27.59	
58	23.1	0.014	49.85	22.44	27.41	
60	22.5	0.014	50.31	23.10	27.21	
62	22.0	0.014	50.76	23.76	27.00	
64	21.5	0.013	51.20	24.42	26.78	
66	21.0	0.013	51.63	25.08	26.55	
68	20.5	0.013	52.05	25.74	26.31	
70	20.1	0.012	52.46	26.40	26.06	

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MODIFIED RATIONAL METHOD CALCULATIONS - CATCHMENT A1
5-year Design Storm Event

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: http://www.mto.gov.on.ca/IDF_Curves/terms.shtml

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

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 (2-100 year storm events)

$$I_{2\text{-}100} = A \times (t_d/60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_report tables.xlsx]table 2

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	5-year	0.43	0.52	0.52	10	2	0.015

NOTES: 5-year target flow is 0.015 m^3/s

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	109.6	0.068	40.85	9.00	31.85	
12	96.0	0.060	42.95	9.90	33.05	
14	85.9	0.053	44.81	10.80	34.01	
16	78.0	0.048	46.48	11.70	34.78	
18	71.6	0.044	48.01	12.60	35.41	
20	66.3	0.041	49.42	13.50	35.92	
22	61.9	0.038	50.74	14.40	36.34	
24	58.1	0.036	51.96	15.30	36.66	
26	54.8	0.034	53.12	16.20	36.92	
28	52.0	0.032	54.22	17.10	37.12	
30	49.4	0.031	55.25	18.00	37.25	
32	47.2	0.029	56.24	18.90	37.34	
34	45.1	0.028	57.19	19.80	37.39	
36	43.3	0.027	58.09	20.70	37.39	**37.4**
38	41.6	0.026	58.96	21.60	37.36	
40	40.1	0.025	59.80	22.50	37.30	
42	38.7	0.024	60.61	23.40	37.21	
44	37.4	0.023	61.39	24.30	37.09	
46	36.3	0.023	62.15	25.20	36.95	
48	35.2	0.022	62.88	26.10	36.78	
50	34.1	0.021	63.59	27.00	36.59	
52	33.2	0.021	64.28	27.90	36.38	
54	32.3	0.020	64.95	28.80	36.15	
56	31.4	0.020	65.60	29.70	35.90	
58	30.6	0.019	66.24	30.60	35.64	
60	29.9	0.019	66.86	31.50	35.36	
62	29.2	0.018	67.46	32.40	35.06	
64	28.5	0.018	68.05	33.30	34.75	
66	27.9	0.017	68.63	34.20	34.43	
68	27.3	0.017	69.20	35.10	34.10	
70	26.7	0.017	69.75	36.00	33.75	

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MODIFIED RATIONAL METHOD CALCULATIONS - CATCHMENT A1
25-year Design Storm Event

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: http://www.mto.gov.on.ca/IDF_Curves/terms.shtml

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

$$I_{2-100} = A \times (t_d/60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
t_d = Storm Duration, (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.

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_report tables.xlsx]table 2

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	25-year	0.43	0.52	0.57	10	5	0.015

^

NOTES: 25-year target flow is 0.021 m^3/s

actual release rate for 10-100yr storm events shall be <=5yr flow since the release rate will be discharged underground via a 5-year capacity sewer outlet.

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	149.4	0.102	61.24	9.00	52.24	
15	111.4	0.076	68.52	11.25	57.27	
20	90.5	0.062	74.20	13.50	60.70	
25	77.0	0.053	78.93	15.75	63.18	
30	67.5	0.046	83.02	18.00	65.02	
35	60.4	0.041	86.65	20.25	66.40	
40	54.8	0.037	89.91	22.50	67.41	
45	50.4	0.034	92.89	24.75	68.14	
50	46.7	0.032	95.64	27.00	68.64	
55	43.6	0.030	98.20	29.25	68.95	
60	40.9	0.028	100.60	31.50	69.10	
65	38.6	0.026	102.85	33.75	69.10	**69.1**
70	36.6	0.025	104.99	36.00	68.99	
75	34.8	0.024	107.01	38.25	68.76	
80	33.2	0.023	108.94	40.50	68.44	
85	31.8	0.022	110.79	42.75	68.04	
90	30.5	0.021	112.56	45.00	67.56	
95	29.3	0.020	114.25	47.25	67.00	
100	28.3	0.019	115.89	49.50	66.39	
105	27.3	0.019	117.47	51.75	65.72	
110	26.4	0.018	118.99	54.00	64.99	
115	25.6	0.017	120.46	56.25	64.21	
120	24.8	0.017	121.89	58.50	63.39	
125	24.1	0.016	123.28	60.75	62.53	
130	23.4	0.016	124.62	63.00	61.62	
135	22.8	0.016	125.93	65.25	60.68	
140	22.2	0.015	127.21	67.50	59.71	
145	21.6	0.015	128.45	69.75	58.70	
150	21.1	0.014	129.66	72.00	57.66	
155	20.6	0.014	130.85	74.25	56.60	
160	20.1	0.014	132.00	76.50	55.50	

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MODIFIED RATIONAL METHOD CALCULATIONS - CATCHMENT A1
100-year Design Storm Event

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Rainfall Intensity-Duration-Frequency Coefficients from: http://www.mto.gov.on.ca/IDF_Curves/terms.shtml

2-year		5-year		10-year		25-year		50-year		100-year	
A =	22.5	A =	29.9	A =	34.8	A =	40.9	A =	45.5	A =	50.0
B =	-0.728	B =	-0.725	B =	-0.724	B =	-0.723	B =	-0.722	B =	-0.722

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)

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 (2-100 year storm events)

$$I_{2\text{-}100} = A \times (t_d/60)^B \quad (mm/hr)$$

where, A = Rainfall IDF Coefficient
B = Rainfall IDF Coefficient
t_d = Storm Duration, (min)

Runoff Volume

$$V_{Runoff} = Q_{Runoff} \times t_d \quad (m^3)$$

where, Q_{Runoff} = Runoff Peak Flow Rate, (m^3/sec)
t_d = Storm Duration, (sec)

Released Volume

$$V_{Released} = Q_{Released} \times (t_d + T_C)/2 \quad (m^3)$$

where, $Q_{Released}$ = Max. Release Rate, (m^3/sec)
t_d = Storm Duration, (sec)
T_C = Time of Concentration, (sec)

Max. Storage Required

$$V_{Storage} = V_{Runoff} - V_{Released} \quad (m^3)$$

V_{Runoff} = Runoff Volume, (m^3)
$V_{Released}$ = Released Volume, (m^3)

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Storm\[201218_report tables.xlsx]table 2

Catchment I.D.	Storm Event	Area A (ha)	Runoff Coeff. C	Runoff Coeff. C_{MOD}	Time of Conc. T_C (min.)	Storm Time Step (min.)	Release Rate (m^3/s)
A1	100-year	0.43	0.52	0.65	10	5	0.015

^

NOTES: 100-year target flow is 0.029 m^3/s

actual release rate for 10-100yr storm events shall be <=5yr flow since the release rate will be discharged underground via a 5-year capacity sewer outlet.

Storm Duration t_d (min.)	Rainfall Intensity (mm/hr)	Runoff Peak Flow Rate (m^3/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Required (m^3)
10	182.3	0.142	84.92	9.00	75.92	
15	136.0	0.106	95.06	11.25	83.81	
20	110.5	0.086	102.97	13.50	89.47	
25	94.1	0.073	109.56	15.75	93.81	
30	82.5	0.064	115.26	18.00	97.26	
35	73.8	0.057	120.30	20.25	100.05	
40	67.0	0.052	124.85	22.50	102.35	
45	61.5	0.048	129.01	24.75	104.26	
50	57.0	0.044	132.84	27.00	105.84	
55	53.2	0.041	136.41	29.25	107.16	
60	50.0	0.039	139.75	31.50	108.25	
65	47.2	0.037	142.89	33.75	109.14	
70	44.7	0.035	145.87	36.00	109.87	
75	42.6	0.033	148.69	38.25	110.44	
80	40.6	0.032	151.39	40.50	110.89	
85	38.9	0.030	153.96	42.75	111.21	
90	37.3	0.029	156.42	45.00	111.42	
95	35.9	0.028	158.79	47.25	111.54	
100	34.6	0.027	161.07	49.50	111.57	**111.6**
105	33.4	0.026	163.27	51.75	111.52	
110	32.3	0.025	165.40	54.00	111.40	
115	31.3	0.024	167.46	56.25	111.21	
120	30.3	0.024	169.45	58.50	110.95	
125	29.4	0.023	171.38	60.75	110.63	
130	28.6	0.022	173.26	63.00	110.26	
135	27.8	0.022	175.09	65.25	109.84	
140	27.1	0.021	176.87	67.50	109.37	
145	26.4	0.021	178.60	69.75	108.85	
150	25.8	0.020	180.29	72.00	108.29	
155	25.2	0.020	181.94	74.25	107.69	
160	24.6	0.019	183.56	76.50	107.06	

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STORMWATER MANAGEMENT CALCULATIONS
RETENTION - SOAK AWAY PIT DESIGN

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

References: Ministry of the Environment (MOE), Stormwater Management Planning & Design Manual (2003) Section 4.5.6

*It is proposed to provide soak-away pits capable of retaining a 25mm depth of rainfall over the front 1/2 of the buildings' rooftop area (Units 1-18 + 30-33)

Water Storage Volume:

Rooftop Area = 1400 m2
Rainfall Depth = 25 mm

Required Water Storage Volume = A (m2) x RV (mm) / 1000 (m^3)
= **35.0** m^3

Required Gross Infiltration Facility Volume = Required Storage/Voids Ratio of clear stone

$$= \frac{35.0}{0.4} \; m^3$$

= 87.5 m^3

From the Ministry of the Environment's (MOE) Stormwater Management Design Manual dated March 2003, Page 4-20, Equation 4.2 The maximum allowable soak-away pit/ infiltration trench depth is:

$$D_{max} = \frac{P\,T}{1000}$$

where, P = percolation rate of surrounding native soil (mm/hr)
t = retention time (hr)

$$= \frac{24 \text{ mm/hr} \times 48 \text{ hr}}{1000}$$

= 1.15 m

Infiltration Facility Dimensions:

Qty: 22

Provided Volume: = L x W x D m^3 x Qty
= 2.0 m x 2.00 m x 1.00 m x 22
= 88.00 m^3

Provided Storage Volume (Voids): = Vol. x 0.4 (voids)
= **35.2** m^3

Total Provided Infiltration Storage Volume: = **35.2 m^3**

Notes: The primary upper native soils on this site are estimated to have a percolation rate of 24mm/hr (25 min/cm). This is based on the findings of Wilson Associates Hydrogeological Study and Water Balance Analysis dated October 24, 2020.

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STORMWATER MANAGEMENT CALCULATIONS
RETENTION - PERFORATED PIPE / DETENTION CHAMBER BEDDING DESIGN- CATCHMENT A1

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

References: Ministry of the Environment (MOE), Stormwater Management Planning & Design Manual (2003) Section 4.5.6

*It is proposed to provide runoff retention through the granular based of the proposed underground sewers/ detention chambers, capable of retaining 5mm depth of rainfall over the tributary impervious area.

Water Storage Volume:

Catchment A1 area	=	4300	m2
Impervious Area	=	2200	m2
Rainfall Depth	=	5	mm

Required Water Storage Volume = A (m2) x RV (mm) / 1000 (m^3)

= **11.0** m^3

Required Gross Infiltration Facility Volume = Required Storage/Voids Ratio of clear stone

$$= \frac{11.0}{0.4} \; m^3$$

= 27.5 m^3

From the Ministry of the Environment's (MOE) Stormwater Management Design Manual dated March 2003, Page 4-20, Equation 4.2 The maximum allowable soak-away pit/ infiltration trench depth is:

$$D_{max} = \frac{P\,T}{1000}$$

where, P = percolation rate of surrounding native soil (mm/hr)
t = retention time (hr)

$$= \frac{24 \text{ mm/hr} \times 48 \text{ hr}}{1000}$$

= 1.15 m

Infiltration Facility Dimensions:

total length of granular base (approx): 65 m width of granular base: 2.5 m

Provided Volume: = L x W x D m^3 x Qty
= 65.0 m x 2.50 m x 0.30 m
= 48.75 m^3

Provided Storage Volume (Voids): = Vol. x 0.4 (voids)
= **19.5** m^3

Total Provided Infiltration Storage Volume: = **19.5** m^3

Notes: The primary upper native soils on this site are estimated to have a percolation rate of 24mm/hr (25 min/cm). This is based on the findings of Wilson Associates Hydrogeological Study and Water Balance Analysis dated October 24, 2020.

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STORMWATER MANAGEMENT CALCULATIONS
RETENTION - PERFORATED PIPE / DETENTION CHAMBER BEDDING DESIGN- CATCHMENT B1

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

References: Ministry of the Environment (MOE), Stormwater Management Planning & Design Manual (2003) Section 4.5.6

*It is proposed to provide runoff retention through the granular based of the proposed underground sewers/ detention chambers, capable of retaining 5mm depth of rainfall over the tributary impervious area.

Water Storage Volume:

Catchment B1 area	=	3500	m2
Impervious Area	=	2600	m2
Rainfall Depth	=	5	mm

Required Water Storage Volume = A (m2) x RV (mm) / 1000 (m^3)
= **13.0** m^3

Required Gross Infiltration Facility Volume = Required Storage/Voids Ratio of clear stone

$$= \frac{13.0}{0.4} \ m^3$$

= 32.5 m^3

From the Ministry of the Environment's (MOE) Stormwater Management Design Manual dated March 2003, Page 4-20, Equation 4.2 The maximum allowable soak-away pit/ infiltration trench depth is:

$$D_{max} = \frac{P\ T}{1000}$$

where, P = percolation rate of surrounding native soil (mm/hr)
t = retention time (hr)

$$= \frac{24 \text{ mm/hr} \times 48 \text{ hr}}{1000}$$

= 1.15 m

Infiltration Facility Dimensions:

total length of granular base (approx): 45 m width of granular base: 2.5 m

Provided Volume: = L x W x D m^3 x Qty
= 45.0 m x 2.50 m x 0.30 m
= 33.75 m^3

Provided Storage Volume (Voids): = Vol. x 0.4 (voids)
= **13.5** m^3

Total Provided Infiltration Storage Volume: = **13.5** m^3

Notes: The primary upper native soils on this site are estimated to have a percolation rate of 24mm/hr (25 min/cm). This is based on the findings of Wilson Associates Hydrogeological Study and Water Balance Analysis dated October 24, 2020.

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Climate Normals 1981-2010 Station Data

Metadata including Station Name, Province, Latitude, Longitude, Elevation, Climate ID, WMO ID, TC ID

STATION_NAME	PROVINCE	LATITUDE	LONGITUDE	ELEVATION	CLIMATE_I	WMO_ID	TC_ID
MIDLAND WATER POLLUTION CONTROL PLANT	ON	44°45'28.056" N	79°52'31.014" W	180.0 m	6115127		

Legend

A = WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for either temperature or precipitation)

B = At least 25 years

C = At least 20 years

D = At least 15 years

1981 to 2010 Canadian Climate Normals station data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Days with Precipitation														
>= 0.2 mm	17	11.7	11.2	11.6	13.1	11.1	10.3	11.1	12.9	15.6	16.4	16.8	158.6	D
>= 5 mm	8.4	5.1	4.2	4.8	6.1	5	4.2	5	5.4	6.4	8	7.7	70	D
>= 10 mm	4.2	2.5	2.1	2	3.3	3.1	2.2	2.5	3.3	3.1	3.8	3.5	35.5	D
>= 25 mm	0.4	0.22	0.29	0.26	0.58	0.65	0.5	0.55	0.9	0.3	0.45	0.37	5.5	D

WMI Calculation:

total >=0.2mm:	158.6
total >=25mm:	5.5
% <25mm:	0.9653

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TOTAL DAILY SANITARY DESIGN FLOW CALCULATIONS
18 UNITS TO BURKE ST. SEWER

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

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

Total Daily Design Flow Calculations

References: -Town of Penetanguishene Land Development Engineering Policy, April 2009
- 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 Sewage Works (2008), Chapter 5

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/s)
Residential Uses:									
Townhouses (18 units @ 2.75 ppu)	**49.5**						**400**	L/person	0.23
Subtotal =	**49.5**								**0.23**

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

where, P = Design population in 1000s

Peaking Factor, M =	**4.32**
Peak Total Design Sanitary Sewage Flow (L/s) =	**0.99**
Peak Extraneous Unit Flow (L/s/ha) =	**0.19**
Land Area (ha) =	**0.75**
Peak Extraneous Flow (L/s) =	**0.143**
Peak Total Design Flow (L/s) =	**1.13**

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TOTAL DAILY SANITARY DESIGN FLOW CALCULATIONS
11 UNIT SITE TO ROBERT ST. EAST SEWER

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
-Town of Penetanguishene Land Development Engineering Policy, April 2009
- 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 Sewage Works (2008), Chapter 5

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/s)
Residential Uses:									
Townhouses (11 units @ 2.75 ppu)	**30.25**						**400**	L/person	0.14
Subtotal =	**30.25**								**0.14**

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

where, P = Design population in 1000s

Peaking Factor, M =	**4.35**
Peak Total Design Sanitary Sewage Flow (L/s) =	**0.61**
Peak Extraneous Unit Flow (L/s/ha) =	**0.19**
Land Area (ha) =	**0.75**
Peak Extraneous Flow (L/s) =	**0.143**
Peak Total Design Flow (L/s) =	**0.75**

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TOTAL DAILY SANITARY DESIGN FLOW CALCULATIONS
ALL UNITS

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
-Town of Penetanguishene Land Development Engineering Policy, April 2009
- 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 Sewage Works (2008), Chapter 5

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/s)
Residential Uses:									
Townhouses (33 units @ 2.75 ppu)	90.75						400	L/person	0.42
Subtotal =	**90.75**								**0.42**

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

where, P = Design population in 1000s

Peaking Factor, M =	**4.25**
Peak Total Design Sanitary Sewage Flow (L/s) =	**1.79**
Peak Extraneous Unit Flow (L/s/ha) =	**0.19**
Land Area (ha) =	**1.17**
Peak Extraneous Flow (L/s) =	**0.222**
Peak Total Design Flow (L/s) =	**2.01**

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MANNING'S PIPE EQUATION
EXISITNG BURKE ST. SANITARY SEWER CAPACITY- MH21 - MH22

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

Mannings' Equation		
Pipe Diameter (mm) =	200	
Area =	0.031	m^2
Slope (%) =	2.16	
Manning 'n' =	0.013	
Nom'l Pipe Capacity, Q =	0.048	m^3/sec
Actual Pipe Capacity, Q =	**0.050**	m^3/sec

Box Culvert		
Height =	0.00	
Width =	0	
Q =	0.00	
Velocity		
1.53		m/s
1.60		m/s
R=	**0.05**	
Sf=	**0.0216**	

NOTE: The total peak design flow from the 18 units draining to the Burke St. sewer is 1.13L/s (0.00113m3/s).

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MANNING'S PIPE EQUATION
EXISITNG ROBERT ST. EAST SANITARY SEWER CAPACITY- MH4 - MH5

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

Mannings' Equation		
Pipe Diameter (mm) =	200	
Area =	0.031	m^2
Slope (%) =	2.70	
Manning 'n' =	0.013	
Nom'l Pipe Capacity, Q =	0.054	m^3/sec
Actual Pipe Capacity, Q =	**0.056**	m^3/sec

Box Culvert	
Height =	0.00
Width =	0
Q =	0.00

Velocity	
1.72	m/s
1.79	m/s
R=	**0.05**
Sf=	**0.0270**

NOTE: The total peak design flow from the 11 unit site draining to the Robert St. East sewer is 0.75L/s (0.00075m3/s).

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Sanitary\[201218_Mannings_Pipe_Eqn.xlsx]BurkeSt

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TOTAL DAILY DOMESTIC WATER SUPPLY FLOW CALCULATIONS
11 RENTAL UNITS

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

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

Total Daily Design Flow Calculations

References:
- -Town of Penetanguishene Land Development Engineering Policy, April 2009
- 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)
Residential Uses:											
Townhouses (11 units @ 2.75 ppu)	**30.25**						**400**	L/person	0.14	1.33	2.00
Subtotal =	**30.25**								**0.14**	**1.33**	**2.00**
Refer to Table 3-1 and/or Table 3.3 of the MOE Design Guidelines for Drinking-Water Systems (2008) >>>									**Peaking Factor =**	**9.49**	**14.29**

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Water\[201218_Total_Daily_Domestic_Water_Supply_Flow_Calcs_11_rental_units.xlsx]Water_Supply_Flows

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TOTAL DAILY DOMESTIC WATER SUPPLY FLOW CALCULATIONS
22 FREEHOLD UNITS

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
-Town of Penetanguishene Land Development Engineering Policy, April 2009
- 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)
Residential Uses:											
Townhouses (22 units @ 2.75 ppu)	60.5						400	L/person	0.28	2.33	3.52
Subtotal =	**60.5**								**0.28**	**2.33**	**3.52**
Refer to Table 3-1 and/or Table 3.3 of the MOE Design Guidelines for Drinking-Water Systems (2008) >>>									**Peaking Factor =**	**8.33**	**12.55**

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Water\[201218_Total_Daily_Domestic_Water_Supply_Flow_Calcs_22_subdv_units.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
ALL UNITS

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

<<< **Elements Requiring Input Information**

Total Daily Design Flow Calculations

References:
- Town of Penetanguishene Land Development Engineering Policy, April 2009
- 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)
Residential Uses:											
Townhouses (33 units @ 2.75 ppu)	**90.75**						**400**	L/person	0.42	3.01	4.54
Subtotal =	**90.75**								**0.42**	**3.01**	**4.54**
Refer to Table 3-1 and/or Table 3.3 of the MOE Design Guidelines for Drinking-Water Systems (2008) >>>									**Peaking Factor =**	**7.17**	**10.81**

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Water\[201218_Total_Daily_Domestic_Water_Supply_Flow_Calcs_ALL_Units.xlsx]Water_Supply_Flows

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

Watermain Headloss Calculations
123 Robert St. East- (11 Rental Unit Site)

[ ] <<< **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: 18-Dec-20
Project No: 20-620
Prepared by: JR

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)
PR. INTERNAL / PRIVATE ROAD	**100**	**1.33**	**100**	0.17	0.07	**65.00**	0.05	**1.00**	0.00	0.05	0.07	**60**	42.19	**233.50**	275.69	**234.50**	275.64	41.14	**58.51**

NOTES: **The Sum of minor losses due to bends, water valves, and other appurtenances is estimated to be 1.00.**

Appendix C

Traffic Calculations

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

TRIP GENERATION SPREADSHEET

VEHICLE TRIP ENDS VS. DWELLING UNITS
ON A WEEKDAY, PEAK HOUR OF ADJACENT STREET TRAFFIC, ONE HOUR BETWEEN 7AM AND 9AM

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

References: Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th edition

Development	ITE Code & Land Use	Independent Variable	Total Trips- From Fitted Curve Equation [Ln(T) = 0.95Ln(X) - 0.51]
123 Robert St. East	220: Multi-Family Housing (Low-Rise)	33 units	**17**

Notes:
This analysis is based on the Concept Plan for the 123 Robert St. East Development, prepared by Celeste Phillips Planning Inc., dated July 20, 2020.

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Traffic\[201218_TripGen.xlsx]AM_low_rise

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

TRIP GENERATION SPREADSHEET

VEHICLE TRIP ENDS VS. DWELLING UNITS
ON A WEEKDAY, PEAK HOUR OF ADJACENT STREET TRAFFIC, ONE HOUR BETWEEN 4PM AND 6PM

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

References: Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th edition

Development	ITE Code & Land Use	Independent Variable	Total Trips- From Fitted Curve Equation [Ln(T) = 0.89Ln(X) - 0.02]
123 Robert St. East	220: Multi-Family Housing (Low-Rise)	33 units	**23**

Notes:
This analysis is based on the Concept Plan for the 123 Robert St. East Development, prepared by Celeste Phillips Planning Inc., dated July 20, 2020.

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Traffic\[201218_TripGen.xlsx]AM_low_rise

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

TRIP GENERATION SPREADSHEET

VEHICLE TRIP ENDS VS. DWELLING UNITS
ON A WEEKDAY, PEAK HOUR OF ADJACENT STREET TRAFFIC, ONE HOUR BETWEEN 7AM AND 9AM

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

References: Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th edition

Development	ITE Code & Land Use	Independent Variable	Total Trips- From Fitted Curve Equation [Ln(T) = 0.98Ln(X) - 0.98]
123 Robert St. East	221: Multi-Family Housing (Mid-Rise)	33 units	**12**

Notes:
This analysis is based on the Concept Plan for the 123 Robert St. East Development, prepared by Celeste Phillips Planning Inc., dated July 20, 2020.

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Traffic\[201218_TripGen.xlsx]AM_low_rise

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

TRIP GENERATION SPREADSHEET

VEHICLE TRIP ENDS VS. DWELLING UNITS
ON A WEEKDAY, PEAK HOUR OF ADJACENT STREET TRAFFIC, ONE HOUR BETWEEN 4PM AND 6PM

Date: 18-Dec-20 **Project No.:** 20-620

Project: 123 Robert St. East **Prepared By:** JR

References: Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th edition

Development	ITE Code & Land Use	Independent Variable	Total Trips- From Fitted Curve Equation [Ln(T) = 0.96Ln(X) - 0.63]
123 Robert St. East	221: Multi-Family Housing (Mid-Rise)	33 units	**16**

Notes:
This analysis is based on the Concept Plan for the 123 Robert St. East Development, prepared by Celeste Phillips Planning Inc., dated July 20, 2020.

\\WMI-SERVER\wmi-server\Data\Projects\2020\20-620\Design\Traffic\[201218_TripGen.xlsx]AM_low_rise

A - Minimum Stopping Sight Distance, Table E3-1.
A_1 - Distance travelled in 3 s, Table E3-2.
B - Safe Sight Distance for P vehicle, crossing 2-lane highway from stop.
C - Safe Sight Distance for P vehicle, turning left into 2-lane highway across P vehicle approaching from left.
D - Safe Sight Distance for P vehicle to turn left into 2-lane highway and attain assumed operating speed before being overtaken by P vehicle approaching in same direction at design speed.
E - Safe Sight Distance for P vehicle to turn right into 2-lane highway and attain assumed operating speed before being overtaken by P vehicle approaching in same direction at design speed.

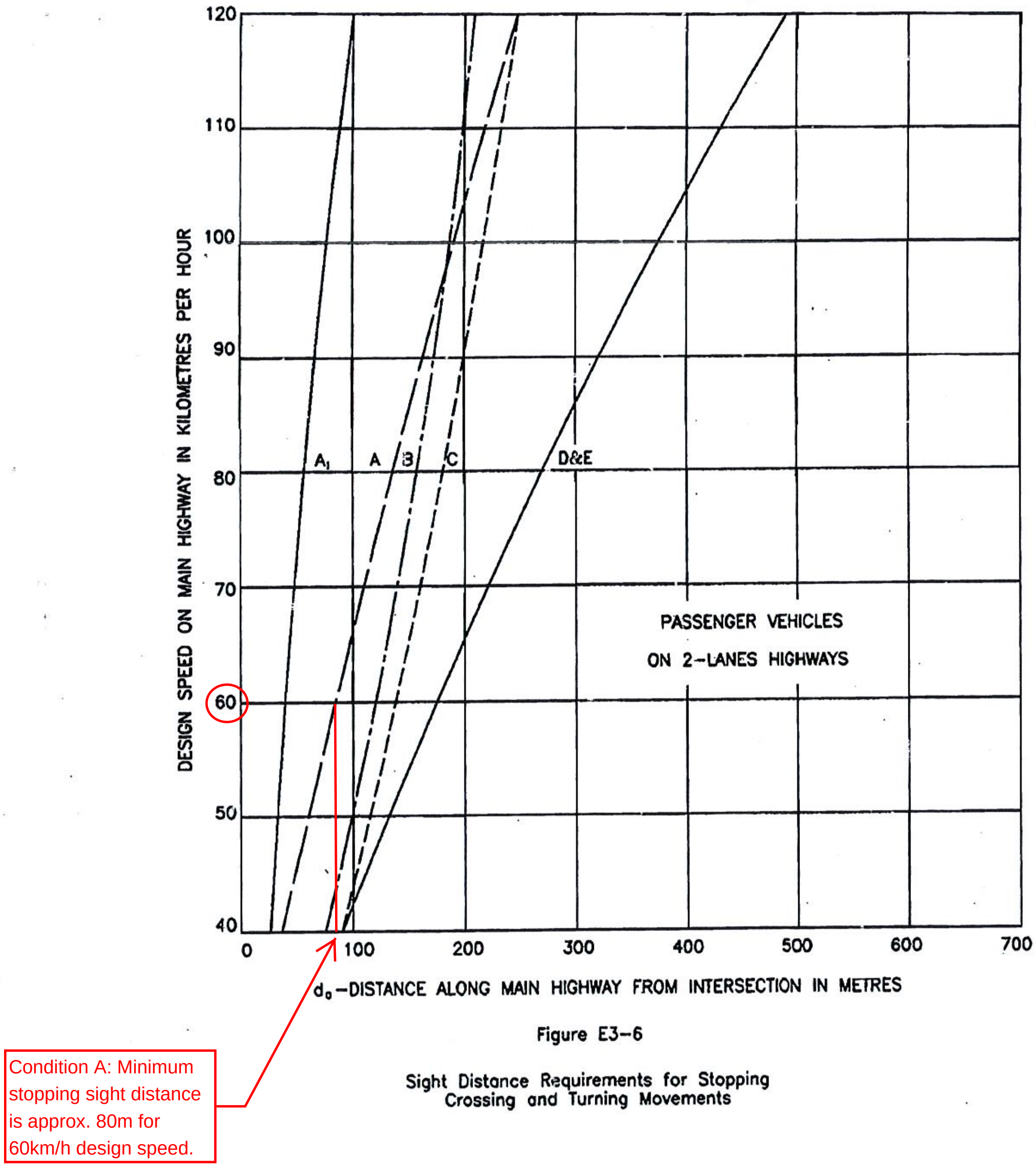
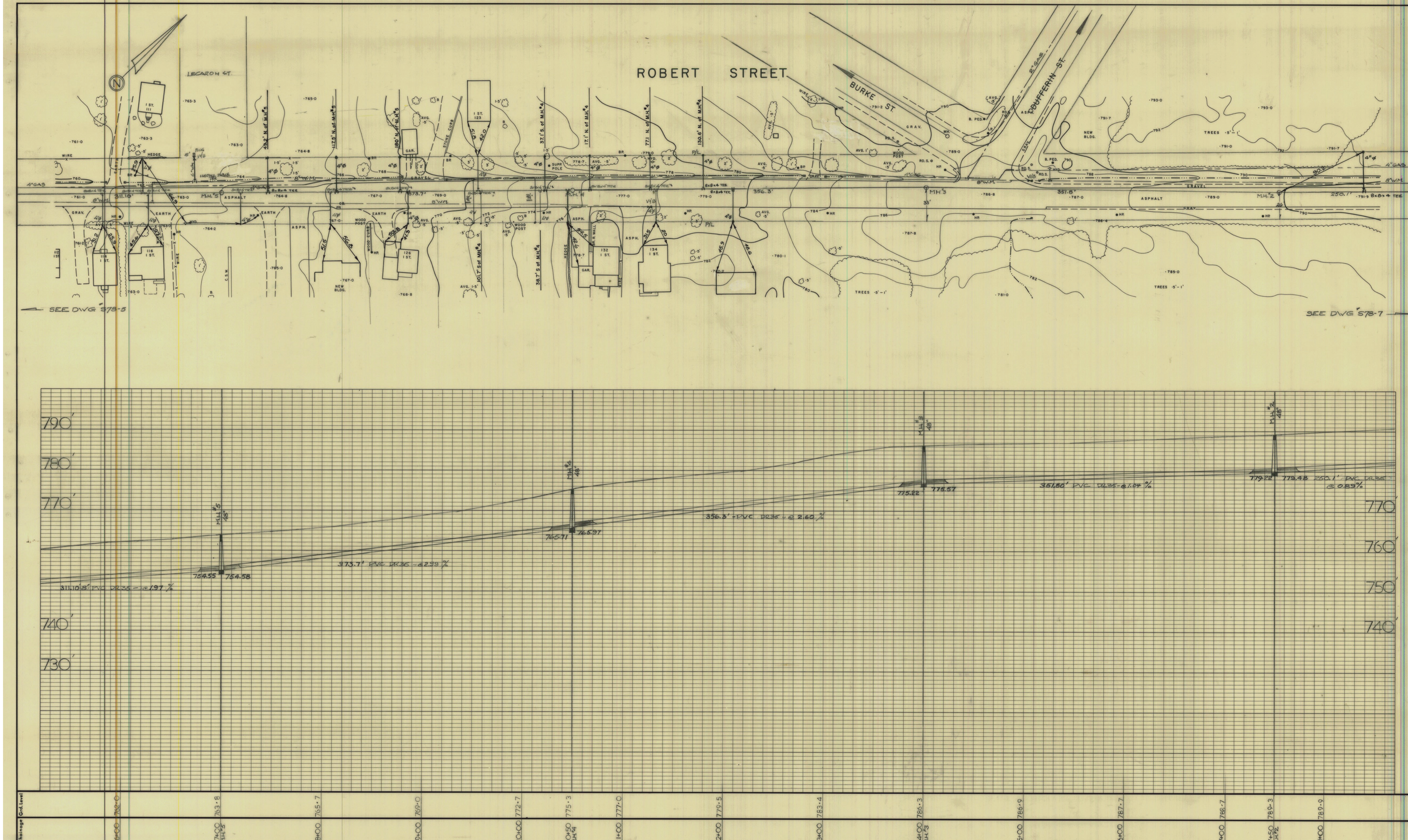


Figure E3–6

Sight Distance Requirements for Stopping Crossing and Turning Movements

Appendix D

Town of Penetanguishene
Plan and Profile Drawings

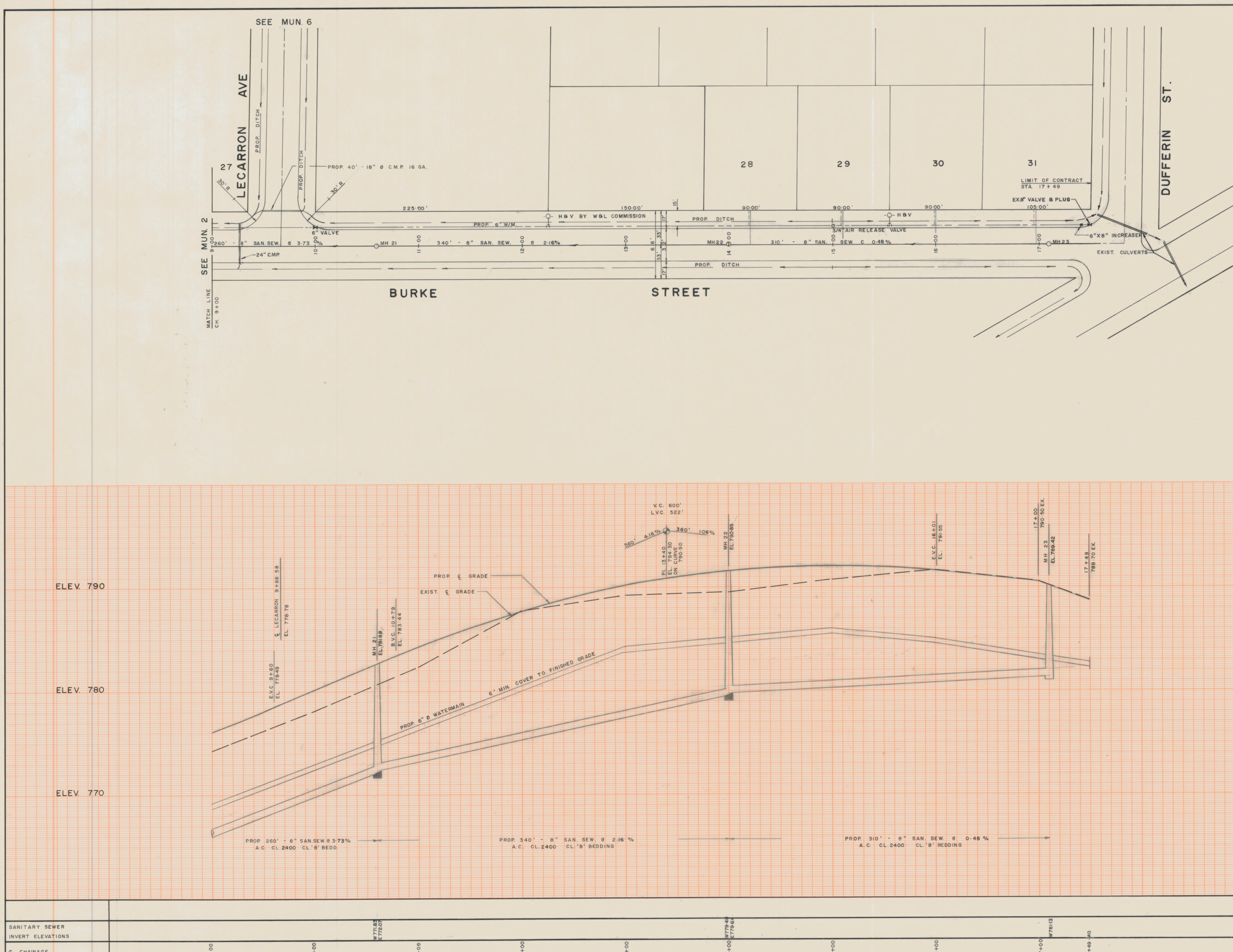


Nº.	Revision	Date	Initial
1	INSTALL 6" W/M. - LT. STA 16+75 - LECARON ST.	FEB '87	[illegible]
2	INSTALL 2-3/4" W/S. - STA. 19+50(RT.) / STA 20+10(RT.)	FEB '87	[illegible]

REGISTERED PROFESSIONAL ENGINEER
CIVIL
PHILIP H. JONES
PROVINCE OF ONTARIO

Town of Penetanguishene
Public Works Department

Dsn.	Dwg.	Ckd.	
Scale	Hor. 1" = 40' Ver. 1" = 10'		ROBERT ST. E. SANITARY SEWER
Date	DEC. 1977	Drawing Nº.	578-6



NOTE:
1) BENCH MARK - TOP S.I.B. NORTH EAST CORNER OF BURKE STREET & LECARRON AVE. ELEV. 779·96
2) INSTALL CULVERTS AT DRIVEWAYS AS DIRECTED BY THE ENGINEER.
SINGLE DRIVEWAYS - 20' - 15" Ø C.M.P. 16 GA.
DOUBLE DRIVEWAYS - 30' - 15" Ø C.M.P. 16 GA.

AS BUILT DRAWING
DATE 22/10/74

NO.	DESCRIPTION	DATE	DWN.	CKD.
1	EXIST. CULVERTS LOCATION	MAY/74	P.W.	F.D.

REVISIONS

APPROVED BY | DATE

ETIENNE BRULE HEIGHTS II

TOWN OF PENETANGUISHENE

UNDERGROUND SERVICES

BURKE STREET

FROM STA. 9+00 TO STA. 17+49·40

UNDERWOOD McLELLAN & ASSOCIATES LIMITED

CONSULTING PROFESSIONAL ENGINEERS

ONTARIO
MANITOBA SASKATCHEWAN ALBERTA BRITISH COLUMBIA

DRAWN BY	J.S.	DESIGNED BY	F.D.
CHECKED BY	F.D.	CHECKED BY	G.T.B.
DATE DRAWN	FEB. 1974	SCALE	HOR. 1" = 40' VER. 1" = 4'
JOB Nº	52-02 1880-01	DRAWING Nº	MUN. 3
SHEET	OF		

ATLAS-HELIO

Appendix E

Test Pit Investigation (By Soil Engineers Ltd.) & Hydrogeological Analysis and Water Balance Analysis (By Wilson Associates)

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

October 5, 2020 Reference No. 2009-C128

2006316 Ontario Inc.
2953 Highway No. 27, P.O. Box 249
Bondhead, ON L0G 1B0

Attention: Mr. Bryan MacPherson

Re: Test Pit Investigation for
Proposed Townhouse Development
123 Robert Street East
Town of Penetanguishene

Dear Sir,

We visited the site on September 16, 2020 to inspect five (5) test pits in order to facilitate a geotechnical assessment of the subsurface conditions for the design and construction of a proposed townhouse development with a private lane. The test pit locations, labeled TP1 through TP5, are plotted on Drawing No.1, enclosed.

Five (5) test pits were excavated by a track mounted excavator to depths ranging from 2.5 m to 3.0 m below the prevailing ground surface. A summary of the subsurface findings is presented below:

Table 1 – Summary of Subsurface Findings

TP1	TP2	TP3
Topsoil 0.3 m	Topsoil 0.3 m	Topsoil 0.3 m
Silty sand (weathered) 1.2 m	Silty sand (weathered) 0.9 m	Sand till (weathered) 0.9 m
Silty sand till to termination @ 3.0 m	Sand to termination @ 2.7 m	Sandy silt till to termination @ 2.7 m

Table 1 – Summary of Subsurface Findings (continued)

TP4	TP5	
Topsoil 0.4 m	Topsoil 0.3 m	
Silty sand (weathered) 0.5 m	Silty sand (weathered) 0.7 m	
Silty sand till to termination @ 2.5 m	Silty sand till to termination @ 2.9 m	

Soil Characteristics

The test pits generally extended through an overburden of topsoil and weathered soils, terminating into a native stratum of dense, silty sand till (TP1, TP4 and TP5), sand (TP2) and sandy silt till (TP3) capable of sustaining a maximum Allowable Soil Pressure of 150 kPa.

The topsoil encountered in all test pits is considered unstable and highly compressible under loads. It will undergo long-term decomposition and settlement and is not capable of supporting structures. Any structures or underground services must be placed beneath the topsoil and weathered soils, onto the sound natural soils. Due to the presence of weathered soils, the subgrade should be inspected by a geotechnical technician under the supervision of a geotechnical engineer prior to installation of underground services.

Excavation should be carried out in accordance with Ontario Regulation 213/91. For excavation purposes, the types of soils are classified below in Table 2:

Table 2 – Classification of Soils for Excavation

Material	Type
Native sound tills	2
Weathered Soils, Drained Sand	3
Saturated Soils	4

Samples of the native soils were retrieved from the site for grainsize and permeability analyses. The grain size distribution curves are enclosed for your reference in Figures 1 and 2, with the results summarized below in Table 3:

Table 3 – Estimated Soil Permeability/Percolation

Location	Depth (mbgs)	Material Type (United Soil Classification)	Estimated Permeability (cm/sec)
TP1	3.0	SILTY SAND TILL, traces of clay and gravel	10^{-4}
TP2	2.5-3.0	FINE TO MEDIUM SAND, a trace of silt	10^{-2}

Water Level Measurement

A follow-up visit was completed on September 30, 2020 for the purpose of obtaining a water level reading from the standpipes installed in TP1 and TP5. A summary of our findings is presented below:

Table 4 – Water Level Measurement

Date of Reading	Location	Water Level (mbgs)
September 30, 2020	TP1	dry
September 30, 2020	TP5	dry

Underground Services

The subgrade for the underground services should consist of sound natural soils or properly compacted, inorganic earth fill. Where topsoil, earth fill or badly weathered soils are encountered, it should be subexcavated and replaced with bedding material compacted to ≥95% of the Standard Proctor dry density.

A Class 'B' bedding, consisting of properly compacted 20 mm Crusher-Run Limestone, or equivalent, is recommended for the construction of the underground services.

The onsite inorganic soils and granular fill are generally suitable for use as trench backfill. However, the soils should be sorted free of any organics and/or deleterious materials prior to backfilling. Aeration or wetting of the soils may be required at the time of backfilling in order to achieve the required degree of compaction

Pavement Design

Based on the general soil characteristics at the site (see Figures 1 through 4, enclosed), the onsite soils generally consist of good pavement-supportive materials. The recommended pavement design for the private lane is presented below in Table 5:

Table 5 – Pavement Design

Course	Thickness (mm)	OPS Specifications	Required Degree of Compaction
Asphalt Surface	75	HL-4 (or equivalent)	≥92%
Granular Base	150	Granular 'A' (or equivalent)	≥100%
Granular Sub-base	300	Granular 'B' Type I (or equivalent)	≥100%

In preparation of the subgrade, any topsoil must be stripped and the subgrade surface must be thoroughly proof rolled to assess the subgrade strength and integrity. Any soft subgrade, organics, deleterious materials and foreign matter should be sub-excavated and replaced with properly compacted inorganic earth fill. The final subgrade must consist of uniform material and should be fine graded towards the drainage systems (if present).

Curb subdrains are recommended. The subdrains should consist of filter-sleeved weepers to prevent blockage by silting and should be covered with at least 150 mm of Granular 'A', or equivalent.

We trust this letter is explicit and meets your present needs, however, should any queries arise please feel free to contact this office.

Yours very truly,
SOIL ENGINEERS LTD.

Darcy Heitzner, C.Tech., rcji
Manager – Barrie Office
DH:
Encl.

Cc: W.M.I. & Associates Ltd.
Attn: Mr. Jonathan Reimer, P.Eng.

Drawing No. 1
123 Robert Street East
Reference No. 2009-C128
October 5, 2020

ZONING REQUIREMENTS

	R4 Zone		R3 Zone	
	Required	Proposed	Required	Proposed
Number of Units		22		11
Lot Area	220m²	238m²	2,530m²	3,968.6m²
Lot Frontage	7.5m	8.0m	30m	68m
Front Yard	6.0m	6.0m	3.0m	4.5m
Ext. Side Yard	4.5m	4.5m	3.0m	7.0m
Int. Side Yard	1.5m	1.5m	2.0m	7.5m
Rear Yard	7.5m	2.5m	7.5m	2.8m
Height (max)	11.0m	<11.0m	11.0m	<11.0m
Coverage (max)	40%	55%	35%	32%
Gross Floor Area	32m²	>32m²	32m²	>32m²
Parking Spaces	-	2 / unit	-	2 / unit

CONCEPT PLAN

33 UNITS

123 Robert Street East
Town of Penetanguishene
County of Simcoe

LEGEND

- Subject Lands
  - Total Area: 1.173ha (2.90ac)
  - Developable: 1.077ha (2.66ac)
  - No. of Units: 33
  - Density: 30.6 u/ha
- 8.0m Street Row House Dwelling (R4 Zone)
- 7.6m Row House Dwelling (R3 Zone)
- Open Space / Landscaped Area
- Potential 3.0m Road Widening

Note: This drawing is for discussion purposes only.
Source: Survey prepared by John M. Hare, Dec. 1982
County of Simcoe interactive map.

0 10 20 30 40m
Scale: 1:1,000

N

Drawn By: A.M. Date: July 20, 2020

Prepared for: 2306516 Ontario Inc.
c/o Inter Spec Construction Services

celeste PHILLIPS PLANNING INC.
86 Bayfield Street, Unit 300,
Barrie, Ontario, L4M 3A7
T: 705 797 8977
C: 705 730 8850
celeste@cplan.ca

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

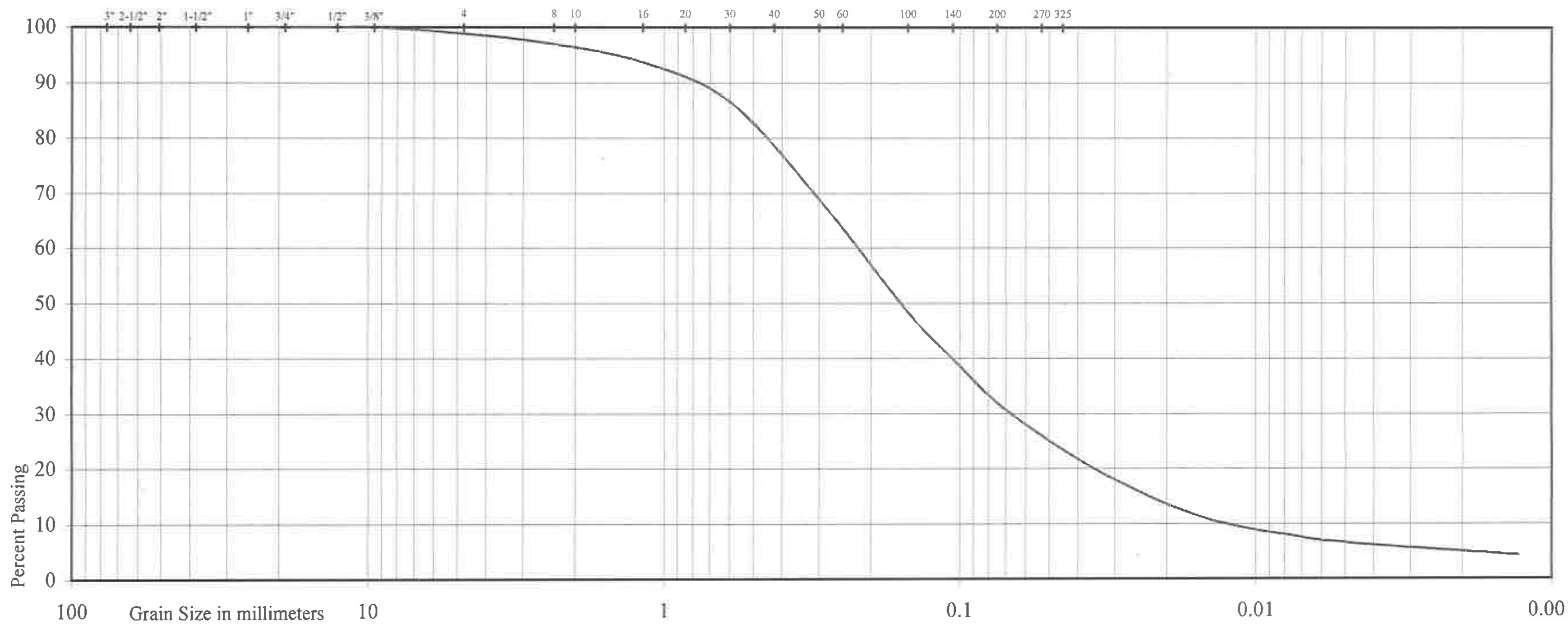
Reference No: 2009-C128

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: 123 Robert Street East, Town of Penetanguishene

Location: 123 Robert Street East

Test Pit No: 1

Sample No:

Depth (m): 3.0

Elevation (m):

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = 10^{-4}

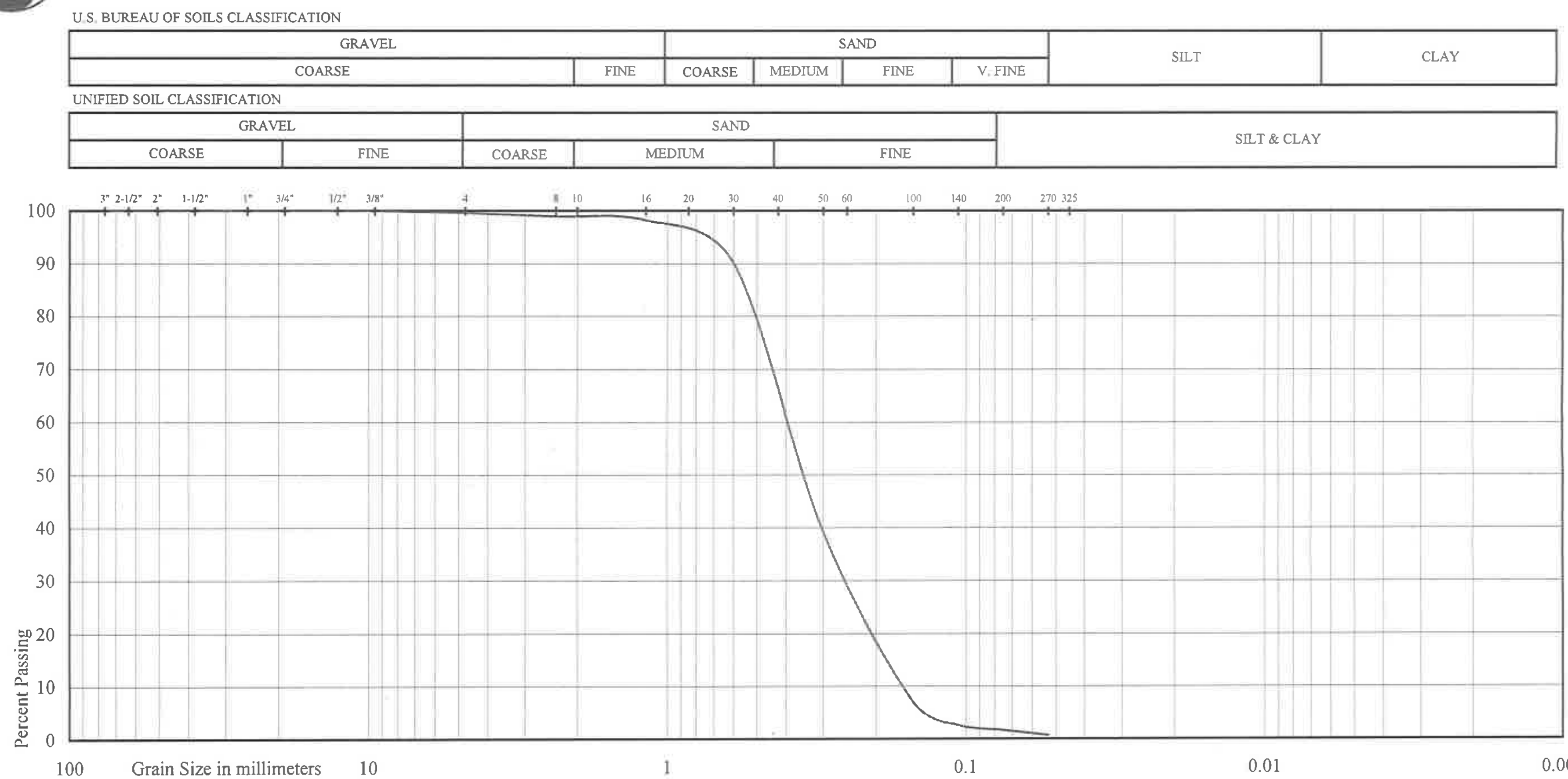
Classification of Sample [& Group Symbol]: SILTY SAND, TILL
traces of clay and gravel

Figure: 1

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2009-C128



Project: 123 Robert Street East, Town of Penetanguishene

Location: 123 Robert Street East

Test Pit No: 2

Sample No:

Depth (m): 2.5 - 3.0

Elevation (m):

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = 10^{-2}

Classification of Sample [& Group Symbol]: FINE TO MEDIUM SAND

a trace of silt

Figure: 2

Ian D. Wilson Associates Ltd.
since 1974

Tel: 519.233.3500
Fax: 519.233.3501

P. O. Box 299
Clinton, Ontario
N0M 1L0

Wilson Associates

Consulting Hydrogeologists

October 24, 2020

Mr. Jonathan Reimer, P.Eng.
WMI & Associates Limited
119 Collier Street,
Barrie, ON
L4M 1H5

Dear Mr. Reimer:

Re: Hydrogeological Study and Water Balance Analysis
Proposed Residential Development
123 Robert Street East, Town of Penetanguishene

It is proposed to develop an existing 1.1790ha property at 123 Robert Street East, in the Town of Penetanguishene, as a 33-unit row house residential development.

As requested by WMI & Associates, this report has been prepared to address the requirements of the June 2013 "Hydrogeological Assessment Submissions: Conservation Authority Guidelines for Development Applications" (the CA Guideline).

Provided for this study were the following documentation:

- Test Pit Investigation for Proposed Townhouse Development, 123 Robert Street East, Soil Engineers Ltd. (SEL), October 5, 2020.
- Concept Plan, July 20, 2020, Celeste Philips Planning Inc.

Copies of the above documentation are attached for reference.

LOCATION AND HYDROGEOLOGICAL SETTING

The subject lands at 123 Robert Street East occupy a 1.1790ha parcel situated in the triangle formed by Burke Street to the north, Robert Street East to the southeast and Lecarron Ave. to the west. The site currently contains a single house fronting on Robert Street East, and apart from the area surrounding the house, is largely undeveloped and forested. The site exhibits a relatively steep slope to the southwest, with an overall relief of approximately 8 metres.

No surface water bodies are located on-site, however wetlands (unevaluated) are mapped by the Simcoe County website to be situated about 40m to 50m to the west and east of the subject property.

Lands surrounding the site are mainly developed as residential properties, except for forest and mapped wetland to the east.

The subject lands are located within the Simcoe Uplands physiographic region of southern Ontario, an area of northern Simcoe County characterized by till upland plains and steep-sided, flat floored valleys.

According to Ontario Geological Survey Open File Map 194 "Quaternary Geology of the Penetanguishene and Christian Island Areas", the upper soils in the vicinity of the site consist of glaciolacustrine coarse-grained deposits of fine to very fine sand, likely overlying silty sand till. The SEL logs for five exploratory test pits completed on the property are consistent with the quaternary geology mapping, reporting mainly a silty sand overlying a silty sand till.

The wetland mapped to the west and east likely function as a result of local drainage from the upper coarse-grained deposits and the relatively low permeability of the underlying silty sand till.

As the area is municipally serviced, few water well records are available in the close vicinity from which to characterize the sequence of overburden formations. Ministry of the Environment, Conservation and Parks (MECP) water well records for distant (i.e. ≥1km) wells (a representative record is attached) suggest that much of the upper overburden is coarse-grained, apart from the shallow silty sand till.

According to interpretation provided by the 2005 North Simcoe Municipal Groundwater Study (NSMGS), the bedrock surface in the area is situated at an approximate elevation of 140m above sea level (masl) (per Figure 4.5.2 of the NSMGS). As such, the overburden will be in the range of 100m deep beneath the site. The NSMGS reports the majority of the lower overburden to be granular in the vicinity of Penetanguishene.

The bedrock beneath the site consists mainly of limestone and dolostone of the Simcoe Group.

Although the area is municipally serviced, municipal and historical water wells will have obtained potable groundwater from aquifers in the lower overburden. The bedrock beneath the site is not locally typically used as a source of potable groundwater due to the likelihood of obtaining lower yields of aesthetically-poorer quality groundwater.

According to the Simcoe County website interactive mapping, the site is located within Well Head Protection Areas WHPA-C, WHPA-D and WHPA-Q1. The Payette Drive municipal wells are located about 900m to the north. The Simcoe County website interactive mapping indicates that the site is mapped as a highly vulnerable aquifer.

WATERTABLE

SEL reports that no groundwater was encountered at the five on-site test pits, the test pits completed to depths of 2.5m to 3.0m. More distant water well records suggest that the watertable surface is likely to be very deep in the area, where perched watertable conditions are not present.

Locally (i.e. the area between Penetang Harbour and Midland Bay), Figures 4.4.1 and 4.4.2 of the NSMGS indicates a groundwater divide between the Harbour and Bay, and deep overburden groundwater will travel either west or east from the site.

WATER BUDGET ANALYSIS

The following assumptions are made for this assessment:

- Based on the relatively small site area and consistent relief, the site is assumed to act as one catchment. The site is considered to exhibit a steep topography (per the 1995 MECP definitions referenced by the CA guideline) and silty sand/silty sand till soil conditions (upper soils reported by SEL).
- According to calculations provided by WMI & Associates Limited, the 1.1790ha site currently exhibits a pervious area of 97.9% (1.1545ha) and an impervious area of 2.1% (0.0245ha). The proposed development of the site will exhibit a pervious area of 43.3% (0.5110ha) and an impervious area of 56.7% (0.6680ha).
- The water surplus for the site is assumed to be 454.6mm/year (rounded to 455mm/year), based on the 1981-2010 precipitation normal for the closest Environment Canada weather station - Midland WPCP weather station (1040.6mm/year, rounded to 1041mm/year) and the actual evapotranspiration rate as identified for Penetanguishene and Tay Point subwatershed by the 2015 Severn Sound Source Protection Area Approved Assessment Report (Table 3.2-3 - actual evapotranspiration 586mm/year).

The following tables provide a water budget analysis following the general guidance of the April 2013 Conservation Authority Guidelines for Hydrogeological Assessments.

Table 1 - Water Budget - Current Conditions

Under current conditions, the site exhibits a pervious area of 97.9% (1.1545ha) and an impervious area of 2.1% (0.0245ha).

Catchment Designation	Site		
	Pervious	Impervious	Totals
Area (m^2)	11545	245	11790
Pervious Area (m^2)	11545	0	11545
Impervious Area (m^2)	0	245	245
Impervious Factors (Per MECP Guidelines referenced by CA Guideline)			
Topography Infiltration Factor	Steep 0.10	Steep 0.10	
Soil Infiltration Factor	Medium 0.2	Medium 0.2	
Land Cover Infiltration Factor	Cleared 0.1	Cleared 0.1	
MECP Infiltration Factor	0.4	0.4	
Actual Infiltration Factor	0.4	0.4	
Run-Off Coefficient	0.6	1	
Runoff from Impervious Surfaces*	0	0.8	
Inputs (per Unit Area)			
Precipitation (mm/year)	1041	1041	1041
Run-On (mm/year)	0	0	0
Other Inputs (mm/year)	0	0	0
Total Inputs (mm/year)	1041	1041	1041
Outputs (per Unit Area)			
Precipitation Surplus (mm/year)	455	833	462
Net Surplus (mm/year)	455	833	462
Evapotranspiration (mm/year)	586	208	578
Infiltration (mm/year)	182	0	178
Impervious Area Infiltration (mm/year)	0	0	0
Total Infiltration (mm/year)	182	0	178
Runoff Pervious Areas (mm/year)	273	0	267
Runoff Impervious Areas (mm/year)	0	833	18
Total Runoff (mm/year)	273	833	285
Total Outputs (mm/year)	1041	1041	1041
Difference (Inputs - Outputs) (mm/year)	0	0	0

Inputs (Volume)			
Precipitation (m^3/year)	12018	255	12273
Run-On (m^3/year)	0	0	0
Other Inputs (m^3/year)	0	0	0
Total Inputs (m^3/year)	12018	255	12273
Outputs (Volume)			
Precipitation Surplus (m^3/year)	5253	204	5457
Net Surplus (m^3/year)	5253	204	5457
Evapotranspiration (m^3/year)	6765	51	6816
Infiltration (m^3/year)	2101	0	2101
Impervious Area Infiltration (m^3/year)	0	0	0
Total Infiltration (m^3/year)	2101	0	2101
Runoff Pervious Areas (m^3/year)	3152	0	3152
Runoff Impervious Areas (m^3/year)	0	204	204
Total Runoff (m^3/year)	3152	204	3356
Total Outputs (m^3/year)	12018	255	12273
Difference (Inputs - Outputs) (m^3/year)	0	0	0

Note: * Per guidelines, evaporation from impervious areas assumed to be 20% of precipitation.

** Minor differences attributable to rounding.

Table 2 - Water Budget - Post-Development Conditions

Under post-development conditions, the proposed re-development of the site will exhibit a pervious area of 43.3% (0.5110ha) and an impervious area of 56.7% (0.6680ha).

Catchment Designation	Site		
	Pervious	Impervious	Totals
Area (m^2)	5110	6680	11790
Pervious Area (m^2)	5110	0	5110
Impervious Area (m^2)	0	6680	6680
Impervious Factors (Per MECP Guidelines referenced by CA Guideline)			
Topography Infiltration Factor	Steep 0.10	Steep 0.10	
Soil Infiltration Factor	Medium 0.2	Medium 0.2	
Land Cover Infiltration Factor	Cleared 0.1	Cleared 0.1	
MECP Infiltration Factor	0.4	0.4	
Actual Infiltration Factor	0.4	0.4	
Run-Off Coefficient	0.6	1	
Runoff from Impervious Surfaces*	0	0.8	
Inputs (per Unit Area)			
Precipitation (mm/year)	1041	1041	1041
Run-On (mm/year)	0	0	0
Other Inputs (mm/year)	0	0	0
Total Inputs (mm/year)	1041	1041	1041
Outputs (per Unit Area)			
Precipitation Surplus (mm/year)	455	833	669
Net Surplus (mm/year)	455	833	669
Evapotranspiration (mm/year)	586	208	372
Infiltration (mm/year)	182	0	79
Impervious Area Infiltration (mm/year)	0	0	0
Total Infiltration (mm/year)	182	0	79
Runoff Pervious Areas (mm/year)	273	0	118
Runoff Impervious Areas (mm/year)	0	833	472
Total Runoff (mm/year)	273	833	590
Total Outputs (mm/year)	1041	1041	1041
Difference (Inputs - Outputs) (mm/year)	0	0	0

Inputs (Volume)			
Precipitation (m^3/year)	5320	6954	12274
Run-On (m^3/year)	0	0	0
Other Inputs (m^3/year)	0	0	0
Total Inputs (m^3/year)	5320	6954	12274
Outputs (Volume)			
Precipitation Surplus (m^3/year)	2325	5564	7889
Net Surplus (m^3/year)	2325	5564	7889
Evapotranspiration (m^3/year)	2995	1389	4384
Infiltration (m^3/year)	930	0	930
Impervious Area Infiltration (m^3/year)	0	0	0
Total Infiltration (m^3/year)	930	0	930
Runoff Pervious Areas (m^3/year)	1395	0	1395
Runoff Impervious Areas (m^3/year)	0	5564	5564
Total Runoff (m^3/year)	1395	5564	6959
Total Outputs (m^3/year)	5320	6953	12273
Difference (Inputs - Outputs) (m^3/year)	0	-1**	-1**

Note: * Per guidelines, evaporation from impervious areas assumed to be 20% of precipitation.

** Minor differences attributable to rounding.

Table 3 - Water Budget - Post-Development Conditions with Mitigation

Based on the above assessment, approximately 1,171m^3/year (21%) of the runoff from the impervious areas of the site will need to be infiltrated on the site in order to maintain the overall rate of infiltration relative to pre-development conditions.

Catchment Designation	Site		
	Pervious	Impervious	Totals
Area (m^2)	5110	6680	11790
Pervious Area (m^2)	5110	0	5110
Impervious Area (m^2)	0	6680	6680
Impervious Factors (Per MECP Guidelines referenced by CA Guideline)			
Topography Infiltration Factor	Steep 0.10	Steep 0.10	
Soil Infiltration Factor	Medium 0.2	Medium 0.2	
Land Cover Infiltration Factor	Cleared 0.1	Cleared 0.1	
MECP Infiltration Factor	0.4	0.4	
Actual Infiltration Factor	0.4	0.4	
Run-Off Coefficient	0.6	1	
Runoff from Impervious Surfaces*	0	0.8	
Inputs (per Unit Area)			
Precipitation (mm/year)	1041	1041	1041
Run-On (mm/year)	0	0	0
Other Inputs (mm/year)	0	0	0
Total Inputs (mm/year)	1041	1041	1041
Outputs (per Unit Area)			
Precipitation Surplus (mm/year)	455	833	669
Net Surplus (mm/year)	455	833	669
Evapotranspiration (mm/year)	586	208	372
Infiltration (mm/year)	182	0	79
Impervious Area Infiltration (mm/year)	0	175	99
Total Infiltration (mm/year)	182	175	178
Runoff Pervious Areas (mm/year)	273	0	118
Runoff Impervious Areas (mm/year)	0	658	373
Total Runoff (mm/year)	273	658	491
Total Outputs (mm/year)	1041	1041	1041

Difference (Inputs - Outputs) (mm/year)	0	0	0
Inputs (Volume)			
Precipitation (m^3/year)	5320	6954	12274
Run-On (m^3/year)	0	0	0
Other Inputs (m^3/year)	0	0	0
Total Inputs (m^3/year)	5320	6954	12274
Outputs (Volume)			
Precipitation Surplus (m^3/year)	2325	5564	7889
Net Surplus (m^3/year)	2325	5564	7889
Evapotranspiration (m^3/year)	2995	1389	4384
Infiltration (m^3/year)	930	0	930
Impervious Area Infiltration (m^3/year)	0	1171	1171
Total Infiltration (m^3/year)	930	0	2101
Runoff Pervious Areas (m^3/year)	1395	0	1395
Runoff Impervious Areas (m^3/year)	0	4393	4393
Total Runoff (m^3/year)	1395	4393	5788
Total Outputs (m^3/year)	5320	6953	12273
Difference (inputs - Outputs) (m^3/year)	0	-1**	-1**

Note: * Per guidelines, evaporation from impervious areas assumed to be 20% of precipitation.

** Minor differences attributable to rounding.

Table 4 - Water Budget Summary

Characteristic	Site				
	Current	Post-Development	% Change (Current to Post)	Post Development with Mitigation	% Change (Current to Post with Mitigation)
Inputs (Volumes)					
Precipitation (m^3/year)	12273	12274	0	12274	0
Run-On (m^3/year)	0	0	0	0	0
Other Inputs (m^3/year)	0	0	0	0	0
Total Inputs (m^3/year)	12273	12274	0	12274	0
Outputs (Volumes)					
Precipitation Surplus (m^3/year)	5457	7889	45	7889	45
Net Surplus (m^3/year)	5457	7889	45	7889	45
Evapotranspiration (m^3/year)	6816	4384	-36	4384	-36
Infiltration (m^3/year)	2101	930	-56	930	-56
Impervious Area Infiltration (m^3/year)	0	0	0	1171	21
Total Infiltration (m^3/year)	2101	930	-56	2101	0
Runoff Pervious Areas (m^3/year)	3152	1395	-56	1395	-56
Runoff Impervious Areas (m^3/year)	204	5564	+5360 m^3/year	4393	+4189 m^3/year
Total Runoff (m^3/year)	3356	6959	107	5788	72
Total Outputs (m^3/year)	12273	12273	0	12273	0

Mitigation assumes that 21% of runoff from the impervious areas of the site can be infiltrated on-site, or about 1,171m^3/year. It is assumed that most of this will be infiltrated into grass swales, infiltration galleries, or other equivalent Low Impact Development (LID) measures. According to the grain-size analyses for the upper overburden deposits provided in the SEL report (attached), the primary upper native soil (i.e. a silty sand till) will exhibit a percolation rate (T-time) in the range of 25min/cm (per Ontario Building Code guidelines for Unified Soil Classification Type "SC"), or about 0.6m/day. Conservatively assuming that the impervious area drainage of 1,171m^3/year is to be infiltrated over 30 days throughout the year, approximately 39m^3 of water needs to be infiltrated per day. Based on an infiltration rate of 0.6m/day, LID measures with a total site footprint of at least 65m^2 are required.

SUMMARY

1. The upper overburden in the vicinity of the site is reported to be silty sand overlying a silty sand till.

2. SEL reports that no groundwater was encountered at the five on-site test pits, the test pits completed to depths of 2.5m to 3.0m.

3. The site is located within Well Head Protection Areas WHPA-C, WHPA-D and WHPA-Q1. The Payette Drive municipal wells are located about 900m to the north. The Simcoe County website interactive mapping indicates that the site is mapped as a highly vulnerable aquifer.

4. Based on known site conditions (i.e. medium soils, steep relief (per MECP definition), cleared cover), an MECP infiltration factor of 0.4 is indicated for the site.

5. Water budget analysis indicates that the development proposal of the site will reduce overall infiltration by about 56% from pre-development conditions.

6. Due to the calculated loss in overall infiltration of the development proposal in comparison to pre-development conditions, infiltration enhancement measures must be adopted to infiltrate approximately 21% of runoff from impervious surfaces. It is assumed that most of this will be infiltrated into grass swales, infiltration galleries, or other equivalent Low Impact Development (LID) measures (see above for minimum LID areas). The infiltration measures need to be maintained in a low-sediment condition to avoid infiltration loss over time.

Should there be any questions regarding the above information and analysis, please feel free to contact this office.

Yours sincerely.
IAN D. WILSON ASSOCIATES LIMITED

Geoffrey Rether, P.Geo.

PROFESSIONAL GEOSCIENTIST
GEOFFREY B. RETHER
PRACTISING MEMBER
0426
ONTARIO

CONCEPT PLAN

33 UNITS

123 Robert Street East
Town of Penetanguishene
County of Simcoe

LEGEND

- Subject Lands
  - Total Area: 1.173ha (2.90ac)
  - Developable: 1.077ha (2.66ac)
  - No. of Units: 33
  - Density: 30.6 u/ha
- 8.0m Street Row House Dwelling (R4 Zone)
- 7.6m Row House Dwelling (R3 Zone)
- Open Space / Landscaped Area
- Potential 3.0m Road Widening

ZONING REQUIREMENTS

	R4 Zone		R3 Zone	
	Required	Proposed	Required	Proposed
Number of Units		22		11
Lot Area	220m²	236m²	2,530m²	3,968.6m²
Lot Frontage	7.5m	8.0m	30m	68m
Front Yard	6.0m	6.0m	3.0m	4.5m
Ext. Side Yard	4.5m	4.5m	3.0m	7.0m
Int. Side Yard	1.5m	1.5m	2.0m	7.5m
Rear Yard	7.5m	**2.5m**	7.5m	**2.6m**
Height (max)	11.0m	<11.0m	11.0m	<11.0m
Coverage (max)	40%	**55%**	35%	32%
Gross Floor Area	32m²	>32m²	32m²	>32m²
Parking Spaces	-	2 / unit	-	2 / unit

Note: This drawing is for discussion purposes only.
Source: Survey prepared by John M. Hard, Dec. 1982. County of Simcoe interactive map.

0 10 20 30 40m
Scale: 1:1,000

N

Drawn By: A.M.
Date: July 20, 2020

Prepared for: 2006316 Ontario Inc. o/a Inter Spec Construction Services

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celeste@cplan.ca

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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

October 5, 2020

Reference No. 2009-C128

2006316 Ontario Inc.
2953 Highway No. 27, P.O. Box 249
Bondhead, ON L0G 1B0

Attention: Mr. Bryan MacPherson

**Re: Test Pit Investigation for
Proposed Townhouse Development
123 Robert Street East
Town of Penetanguishene**

Dear Sir,

We visited the site on September 16, 2020 to inspect five (5) test pits in order to facilitate a geotechnical assessment of the subsurface conditions for the design and construction of a proposed townhouse development with a private lane. The test pit locations, labeled TP1 through TP5, are plotted on Drawing No.1, enclosed.

Five (5) test pits were excavated by a track mounted excavator to depths ranging from 2.5 m to 3.0 m below the prevailing ground surface. A summary of the subsurface findings is presented below:

Table 1 – Summary of Subsurface Findings

TP1	TP2	TP3
Topsoil 0.3 m	Topsoil 0.3 m	Topsoil 0.3 m
Silty sand (weathered) 1.2 m	Silty sand (weathered) 0.9 m	Sand till (weathered) 0.9 m
Silty sand till to termination @ 3.0 m	Sand to termination @ 2.7 m	Sandy silt till to termination @ 2.7 m

Table 1 – Summary of Subsurface Findings (continued)

TP4	TP5	
Topsoil 0.4 m	Topsoil 0.3 m	
Silty sand (weathered) 0.5 m	Silty sand (weathered) 0.7 m	
Silty sand till to termination @ 2.5 m	Silty sand till to termination @ 2.9 m	

Soil Characteristics

The test pits generally extended through an overburden of topsoil and weathered soils, terminating into a native stratum of dense, silty sand till (TP1, TP4 and TP5), sand (TP2) and sandy silt till (TP3) capable of sustaining a maximum Allowable Soil Pressure of 150 kPa.

The topsoil encountered in all test pits is considered unstable and highly compressible under loads. It will undergo long-term decomposition and settlement and is not capable of supporting structures. Any structures or underground services must be placed beneath the topsoil and weathered soils, onto the sound natural soils. Due to the presence of weathered soils, the subgrade should be inspected by a geotechnical technician under the supervision of a geotechnical engineer prior to installation of underground services.

Excavation should be carried out in accordance with Ontario Regulation 213/91. For excavation purposes, the types of soils are classified below in Table 2:

Table 2 – Classification of Soils for Excavation

Material	Type
Native sound tills	2
Weathered Soils, Drained Sand	3
Saturated Soils	4

Samples of the native soils were retrieved from the site for grainsize and permeability analyses. The grain size distribution curves are enclosed for your reference in Figures 1 and 2, with the results summarized below in Table 3:

Table 3 – Estimated Soil Permeability/Percolation

Location	Depth (mbgs)	Material Type (United Soil Classification)	Estimated Permeability (cm/sec)
TP1	3.0	SILTY SAND TILL, traces of clay and gravel	10^{-4}
TP2	2.5-3.0	FINE TO MEDIUM SAND, a trace of silt	10^{-2}

Water Level Measurement

A follow-up visit was completed on September 30, 2020 for the purpose of obtaining a water level reading from the standpipes installed in TP1 and TP5. A summary of our findings is presented below:

Table 4 – Water Level Measurement

Date of Reading	Location	Water Level (mbgs)
September 30, 2020	TP1	dry
September 30, 2020	TP5	dry

Underground Services

The subgrade for the underground services should consist of sound natural soils or properly compacted, inorganic earth fill. Where topsoil, earth fill or badly weathered soils are encountered, it should be subexcavated and replaced with bedding material compacted to ≥95% of the Standard Proctor dry density.

A Class 'B' bedding, consisting of properly compacted 20 mm Crusher-Run Limestone, or equivalent, is recommended for the construction of the underground services.

The onsite inorganic soils and granular fill are generally suitable for use as trench backfill. However, the soils should be sorted free of any organics and/or deleterious materials prior to backfilling. Aeration or wetting of the soils may be required at the time of backfilling in order to achieve the required degree of compaction

Pavement Design

Based on the general soil characteristics at the site (see Figures 1 through 4, enclosed), the onsite soils generally consist of good pavement-supportive materials. The recommended pavement design for the private lane is presented below in Table 5:

Table 5 – Pavement Design

Course	Thickness (mm)	OPS Specifications	Required Degree of Compaction
Asphalt Surface	75	HL-4 (or equivalent)	≥92%
Granular Base	150	Granular 'A' (or equivalent)	≥100%
Granular Sub-base	300	Granular 'B' Type I (or equivalent)	≥100%

In preparation of the subgrade, any topsoil must be stripped and the subgrade surface must be thoroughly proof rolled to assess the subgrade strength and integrity. Any soft subgrade, organics, deleterious materials and foreign matter should be sub-excavated and replaced with properly compacted inorganic earth fill. The final subgrade must consist of uniform material and should be fine graded towards the drainage systems (if present).

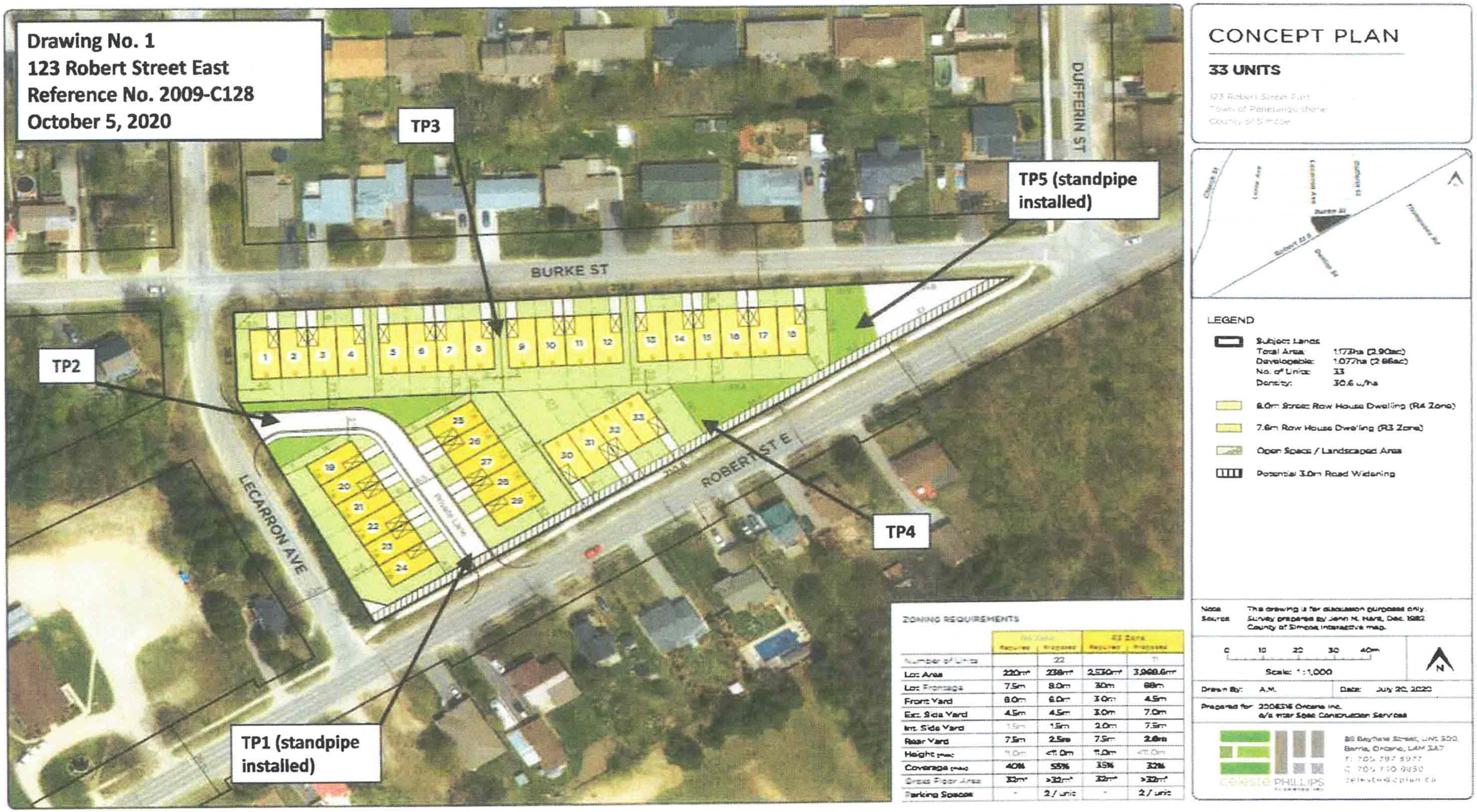
Curb subdrains are recommended. The subdrains should consist of filter-sleeved weepers to prevent blockage by silting and should be covered with at least 150 mm of Granular 'A', or equivalent.

We trust this letter is explicit and meets your present needs, however, should any queries arise please feel free to contact this office.

Yours very truly,
SOIL ENGINEERS LTD.

Darcy Heitzner, C.Tech., rcji
Manager – Barrie Office
DH:
Encl.

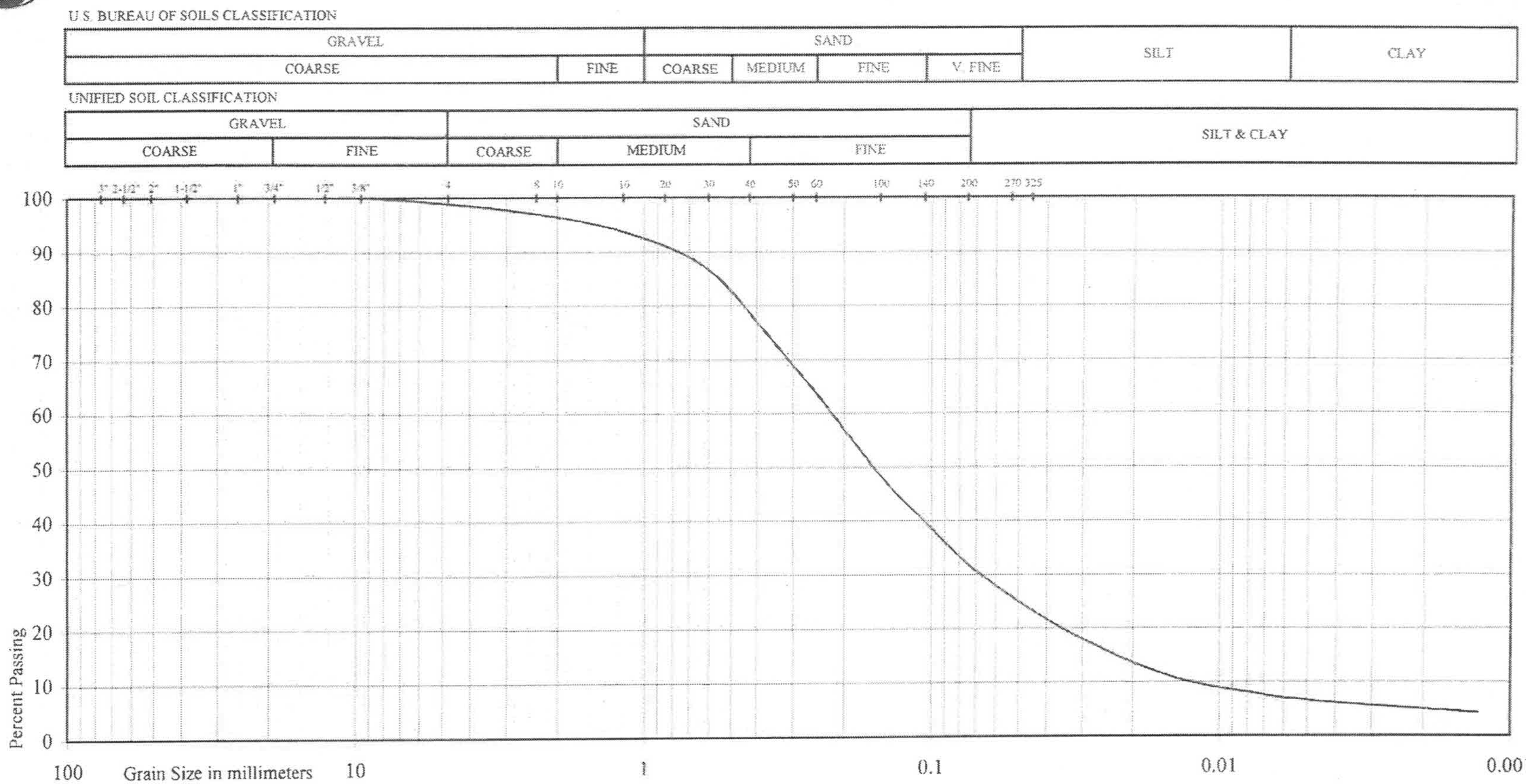
Cc: W.M.I. & Associates Ltd.
Attn: Mr. Jonathan Reimer, P.Eng.


Drawing No. 1
123 Robert Street East
Reference No. 2009-C128
October 5, 2020
TP1 (standpipe installed)
TP2
TP3
TP4
TP5 (standpipe installed)
BURKE ST
DUFFERIN ST
LECARRON AVE
ROBERT ST E
Private Lane
CONCEPT PLAN
33 UNITS
LEGEND
Subject Lands
Total Area: 1.173ha (2.90ac)
Developable: 1.077ha (2.66ac)
No. of Units: 33
Density: 30.6 u/ha
8.0m Street Row House Dwelling (R4 Zone)
7.6m Row House Dwelling (R3 Zone)
Open Space / Landscaped Area
Potential 3.0m Road Widening
Note: This drawing is for discussion purposes only.
Source: Survey prepared by John N. Hard, Dec. 1982
County of Simcoe interactive map.
0 10 20 30 40m
Scale: 1:1,000
N
Drawn By: A.M.
Date: July 20, 2020
Prepared for: 2306316 Ontario Inc.
c/o Inter Spec Construction Services
celeste PHILLIPS
85 Bayfield Street, Unit 300
Barrie, Ontario, L4M 3A7
ZONING REQUIREMENTS
Required | Proposed | Required | Proposed
Number of Units | | 22 | | 11
Lot Area | 220m² | 238m² | 2,530m² | 3,968.6m²
Lot Frontage | 7.5m | 8.0m | 30m | 68m
Front Yard | 6.0m | 6.0m | 3.0m | 4.5m
Ext. Side Yard | 4.5m | 4.5m | 3.0m | 7.0m
Int. Side Yard | 1.5m | 1.5m | 2.0m | 7.5m
Rear Yard | 7.5m | 2.5m | 7.5m | 2.8m
Height (max) | 11.0m | <11.0m | 11.0m | <11.0m
Coverage (max) | 40% | 55% | 35% | 32%
Gross Floor Area | 32m² | >32m² | 32m² | >32m²
Parking Spaces | - | 2 / unit | - | 2 / unit

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2009-C128



Project: 123 Robert Street East, Town of Penetanguishene

Location: 123 Robert Street East

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = 10^{-4}

Test Pit No: 1

Sample No:

Depth (m): 3.0

Elevation (m):

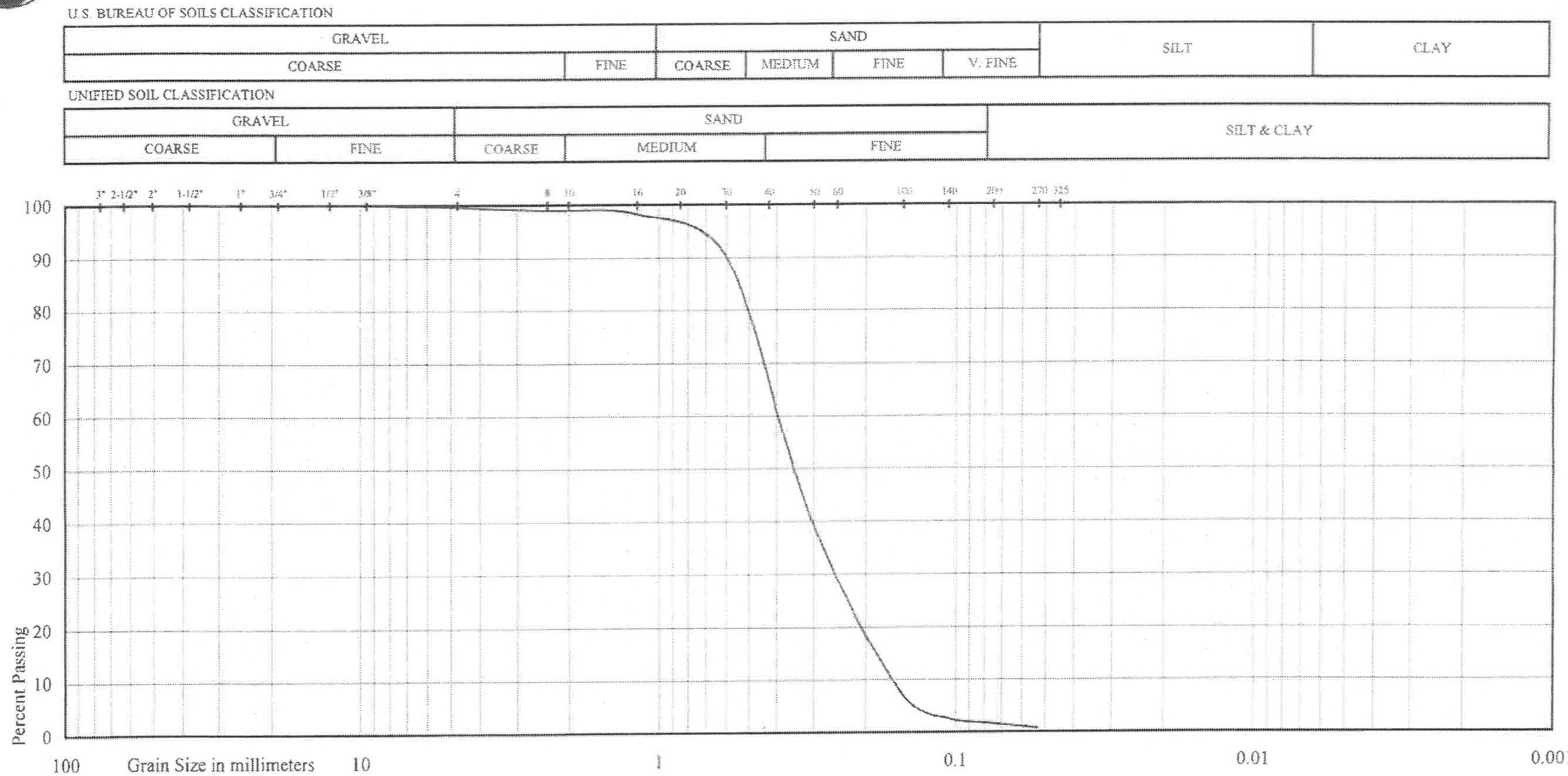
Classification of Sample [& Group Symbol]: SILTY SAND, TILL
traces of clay and gravel

Figure: 1

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2009-C128



Project: 123 Robert Street East, Town of Penetanguishene

Location: 123 Robert Street East

Test Pit No: 2

Sample No:

Depth (m): 2.5 - 3.0

Elevation (m):

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = -

Estimated Permeability (cm./sec.) = 10^{-2}

Classification of Sample [& Group Symbol]:	FINE TO MEDIUM SAND a trace of silt

Figure: 2

31 D/13 W

Ministry of the Environment
Ontario

The Ontario Water Re[sources Act]
WATER WELL RE[CORD]

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

(11) 57X9375 MUNICIP 57012 CON PR E 02

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON, BLOCK, TRACT, SURVEY, ETC.	LOT
[redacted]	TAY	II PRE	115

[redacted] PENETANG RR1

DATE COMPLETED: DAY 25 MO 07 ~~JULY~~ YR 84

58700 | 5 | RC | ELEVATION 0750 | 6 | BASIN CODE 22

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	TO
BROWN	TOP SOIL			0	1
"	GRAVEL	SAND STONES		1	80
"	SAND		DRY SAND	80	112
GREY	SAND	SILT CLAY	RUNNY SAND	112	115
"	"	CLAY	SANDY CLAY	115	150
BROWN	GRAVEL	SAND	CLEAN WATER BEDROCK	150	160

NOV 20 1986

(31) 0001602 | 00806112812 | 01126 2868 | 01152280605 | 01502 2805 | 01606112891

32

(41) WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
150	☒ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
160	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL
	☐ FRESH ☐ SULPHUR ☐ SALTY ☐ MINERAL

(51) CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	TO
06 / 6¼	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE	.188	+2	0159
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE			
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET
MATERIAL ~~AND TYPE~~ | DEPTH TO TOP OF SCREEN FEET

(61) PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

(71) PUMPING TEST

PUMPING TEST METHOD: ☒ PUMP ☐ BAILER
PUMPING RATE: 0015 GPM
DURATION OF PUMPING: 01 HOURS 30 MINS

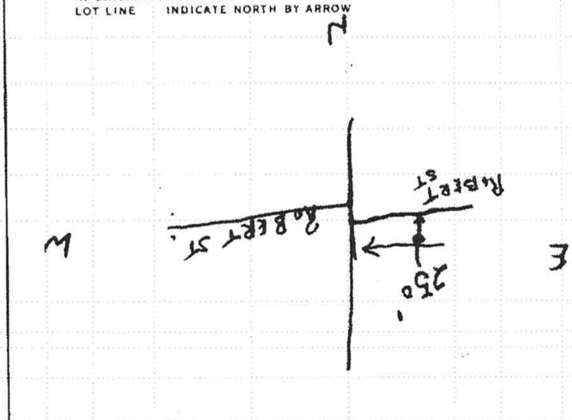
STATIC LEVEL	WATER LEVEL END OF PUMPING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
142 FEET	155 FEET	155 FEET	155 FEET	155 FEET	155 FEET

WATER LEVELS DURING: ☐ PUMPING ☒ RECOVERY

IF FLOWING, GIVE RATE: GPM
PUMP INTAKE SET AT: FEET
WATER AT END OF TEST: ☒ CLEAR ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING: 156 FEET
RECOMMENDED PUMPING RATE: 0015 GPM

2753 LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW



001 191 01
DRILLERS REMARKS

FINAL STATUS OF WELL 1
☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED

WATER USE 01
☒ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ OTHER ☐ COMMERCIAL ☐ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ NOT USED

METHOD OF DRILLING 4
☐ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☒ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: Mightons Well Drilling Ltd — LICENCE NUMBER: 3602
ADDRESS: #3 Stayner
NAME OF DRILLER OR BORER: Larry Mighton — LICENCE NUMBER:
SIGNATURE OF CONTRACTOR: Donald M. Mighton — SUBMISSION DATE: DAY 3 MO 9 YR 84

OFFICE USE ONLY

DATA SOURCE: 1 | CONTRACTOR: 3602 | DATE RECEIVED: 180984
DATE OF INSPECTION | INSPECTOR

CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506-4-77 FORM 7