FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

SHEARLING HEIGHTS ESTATES LTD.

PROPOSED MIXED-USE DEVELOPMENT

TOWN OF MILTON

PROJECT 2017 - 4568 **FEBRUARY 2026**

Revision	Description	Prepared		Checked	
		By	Date	By	Date
7.0	New Servicing Concept	M. Singh	February 2026	S. Katukurunde	February 2026
6.0	Revised per comments	M. Singh	August 2024	S. Katukurunde	August 2024
5.0	Revised Design	M. Singh	February 2024	S. Katukurunde	February 2024
4.0	Revised per comments	M. Singh	November 2023	S. Katukurunde	November 2023
3.0	Detailed Design Submission	M. Singh S. Ramsoomair	February 2023	S. Katukurunde	February 2023
2.0	Addressed Comments	M. Singh	June 2022	S. Katukurunde	June 2022
1.0	Updated Draft Plan Addressed Comments	S. Katukurunde M. Singh	April 2022	K. Shahbikian	April 2022
0.0	Original Submission	S. Katukurunde M. Singh	June 2021	K. Shahbikian	June 2021

SCHAEFFERS
CONSULTING ENGINEERS

6 Ronrose Drive
Concord, Ontario L4K 4R3

CONTENTS

CONTENTS I
Figures i
Tables i
Appendices i

1.0 INTRODUCTION **1**
1.1 Objective 1
1.2 Background 1
1.3 Existing Conditions & Topography 4
1.4 Proposed Development Plan and Population 4

2.0 WATER SUPPLY **6**
2.1 Existing Water Supply Servicing 6
2.2 Municipal Water Design Criteria 6
2.3 Proposed Water Supply Servicing 7
2.4 Proposed Water Supply Demands 7
2.5 Hydraulic Modelling 8
2.6 Water Age Analysis 9

3.0 SANITARY SERVICING **11**
3.1 Existing Sanitary Infrastructure 11
3.2 Sanitary Design Criteria 11
3.3 Proposed Sanitary Servicing 11
3.4 Design Flows 12
3.5 Downstream Analysis 12

4.0 STORMWATER MANAGEMENT **15**
4.1 Existing Infrastructure 15
4.2 Design Criteria 15
4.3 Proposed Stormwater Management Scheme 17
4.4 Quantity Control 18
4.5 Quality Control 19
4.6 Erosion Control and Water Balance 19
4.7 Drainage to Indian Creek Tributary 20
4.8 Emergency Overflows 21
4.9 Full Capture Locations 21

5.0 SUMMARY **24**

Figures

Figure 1-1: Location Plan 3
Figure 1-2: Development Plan 5
Figure 2-1: Water Supply Servicing Plan 10
Figure 3-1: Sanitary Servicing Plan 14
Figure 4-1: Pre-Development Drainage Plan 16
Figure 4-2: Post Development Drainage Plan 22
Figure 4-3: Proposed Site Servicing Plan 23

Tables

Table 1-1: Estimated Population 4
Table 2-1: Water Supply Demands 8
Table 2-2: Water Supply Modelling Results – Pressure Range 9
Table 3-1: Sanitary Flow Summary 12
Table 3-2: Downstream Capacity Analysis of Sanitary Sewers 13
Table 4-1: Full Capture Design 21

Appendices

Appendix A: Water Supply Background & Calculations

Appendix B: Sanitary Background & Calculations

Appendix C: Stormwater Management

Appendix D: Engineering Drawings

1.0 INTRODUCTION

1.1 Objective

This report is provided in support of the proposed development of the Major Node located at the Northeast intersection of Britannia Road and Bronte Street South known as Shearling Heights Estates Ltd. The property is legally defined as Block 360 on Plan 20M-1184, parts of Lot 6, Concession 2, within the Regional Municipality of Halton, in the Town of Milton. The Registered Plan is provided in **Appendix A**.

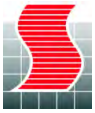
The 2.11 ha property is located to the North of Britannia Road, East of Bronte Street South, and is enveloped by the Main Sail Estates Subdivision. A location plan is provided in **Figure 1-1.**

This report evaluates existing and proposed water supply, sanitary and stormwater management services within and surrounding the subject property, thereby demonstrating the serviceability of the proposed development.

1.2 Background

The following material has been reviewed during the preparation of this Functional Servicing Report:

- "*Boyne Survey Block 2: Final Subwatershed Impact Study*", dated August 25, 2016, by MTE;
- "*Water and Wastewater Linear Design Manual*", dated December 2025, version 7, by Regional Municipality of Halton;
- "*Town of Milton: Engineering and Parks Standards Manual*" dated September 2024, by Town of Milton;
- "*2022 Development Charges Background Study*", dated December 15, 2021, by Regional Municipality of Halton;
- "*2022 Development Charges Update Water/Wastewater Technical Report*", dated September 2021, by GM BluePlan Engineering;
- "*Main Sail Estates Subdivision, Stormwater Management Design Report*" Ver. 5, August 2016, by TMIG;
- "*Main Sail Estates Subdivision, Site Specific Water and Wastewater Functional Servicing Report*" April 2015, by TMIG;
- Ministry of Environment Stormwater Management Planning and Design Manual (MOE,

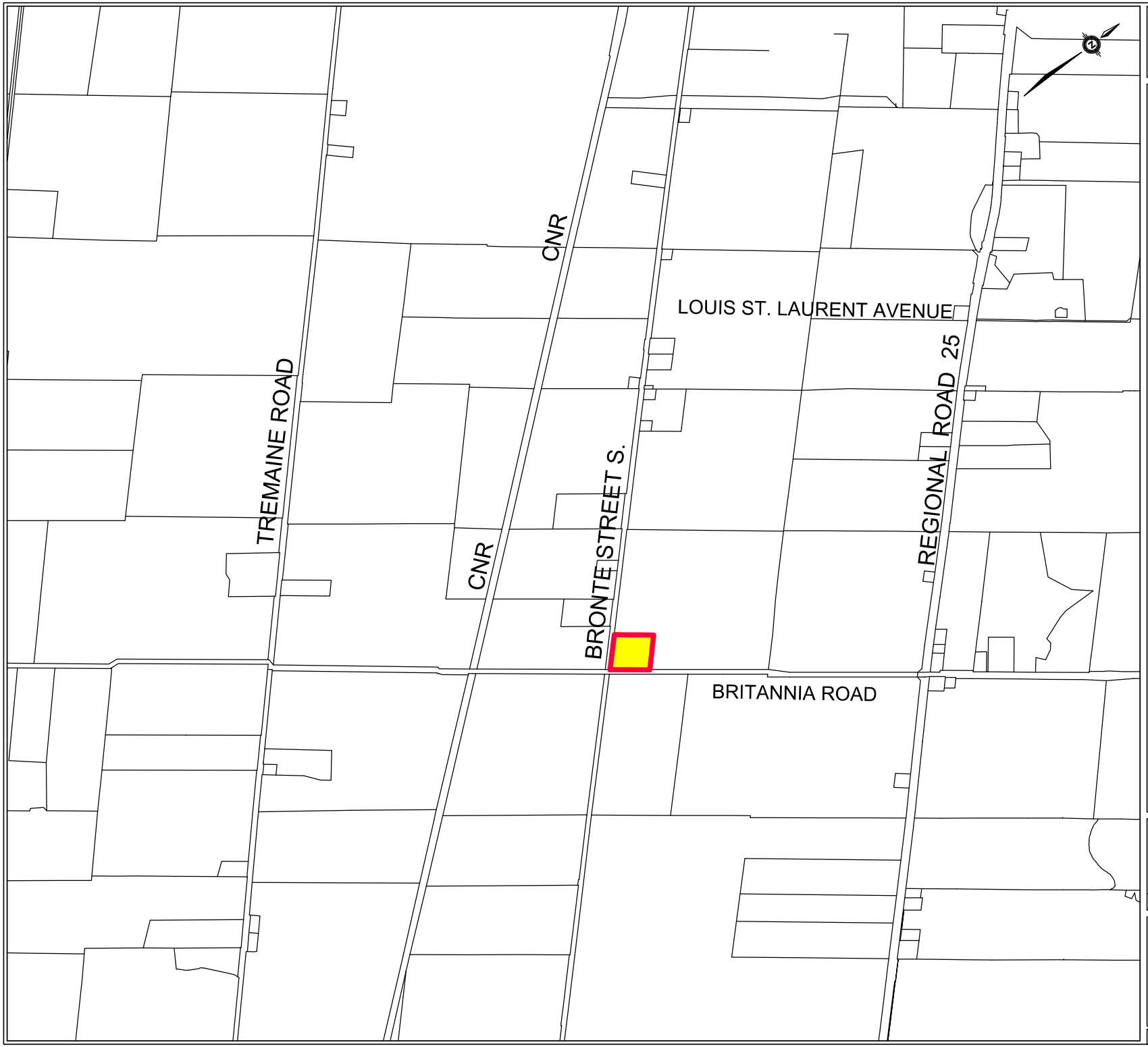


March 2003);

- *Hydrogeological Assessment, Britannia Road and Bronte Street South,* dated February 24, 2026 by Grounded Engineering;
- *Geotechnical Engineering Report, Britannia Road and Bronte Street South,* February 24, 2026 by Grounded Engineering;
- "*Water Supply for Public Fire Protection*", dated 2020, by Fire Underwriters Survey;
- *LID Feasibility Letter, Britannia Road and Bronte Street,* dated February 18, 2022 by Grounded Engineering;
- *SWM Pond H Verification,* dated August 2025 by Schaeffer & Associates Ltd.

W:\4500's\4568 - Britannia and Bronte Condominium\Drawings\Location Plan\2026-02-23-4568-Location Plan.dwg

Phil Gotfried



SHEARLING HEIGHTS

LEGEND

SUBJECT SITE

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 1.1
LOCATION PLAN

2017-4568	FEBRUARY 2026	SCALE: N.T.S.

1.3 Existing Conditions & Topography

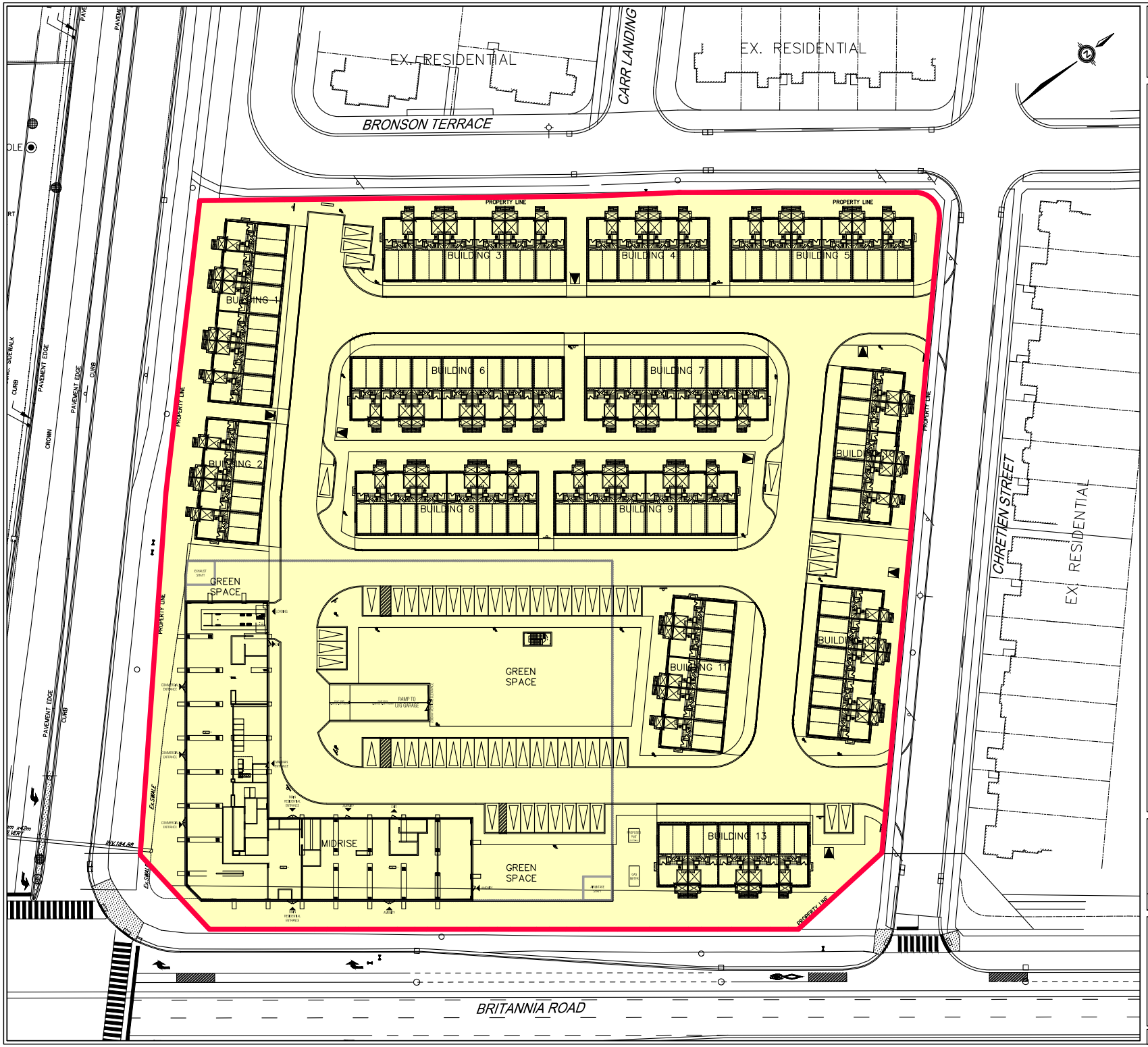
Available survey topography and the referenced SIS suggest that the subject site is within the Indian Creek Watershed (Figure 4.2, SIS enclosed in Appendix C). The existing site drainage falls southwest towards the Bronte Street and Britannia Road intersection. The site in pre-developed state is open land with a runoff coefficient of C = 0.25. According to geotechnical study conducted for the site by Grounded Engineering (2026), it is underlain by clayey silt till over sandy silt till soils. Relevant background information is provided in **Appendix C.**

1.4 Proposed Development Plan and Population

The subject site has an area of 2.11 ha. The proposed land use for the site is primarily residential with some commercial, consisting of multiple 3 storey townhouse blocks and a 7-storey midrise building. The development plan proposes 223 total units; 152 units proposed for the midrise building and 71 units proposed for the townhouses (Buildings 1 to 13). The development plan is provided in **Figure 1-2**. The population was calculated as per latest Halton Region criteria. Based on these criteria, the expected design population of the subject site is 487 persons, as shown in **Table 1-1**.

Table 1-1: Estimated Population

Land Use	Population Density	Units/Area	Design Population
Townhouse	2.9 ppu	71	206
Apartment	1.7 ppu	152	259
Commercial	37.4 m^2/employee	0.08 ha	22
Total		**223 units**	**487**



SHEARLING HEIGHTS

LEGEND

SUBJECT SITE

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 1.2
SITE PLAN

2017-4568	FEBRUARY 2026	SCALE: N.T.S.

2.0 WATER SUPPLY

2.1 Existing Water Supply Servicing

The subject property is located within the Boyne West Area within Halton Region's Pressure Zone M4. As per the FSR by TMIG, regional trunk mains along Bronte Street (400 mm diameter) and Britannia Road (750mm diameter) exist along each road. A 150mm diameter stub is constructed at the north to service the subject site. Alternatively, a 200mm diameter watermain is constructed along Chretien Street which can be used to service the subject site. Please refer to the *Below Ground Services Plan*, drawing BGP3, by TMIG, dated January 2015 for the existing water supply services in **Appendix A**.

2.2 Municipal Water Design Criteria

The proposed water supply scheme will be designed in accordance with the Region of Halton Water and Wastewater Linear Design Manual (December 2025). The following summarizes the relevant design criteria.

- The system shall be designed to provide sufficient flow and pressure to meet the greater of the Maximum Daily Demand Plus Fire Flow or the Maximum Hourly Demand;
- Average Demand of 230 L/capita/day for residential land uses;
- Fire Flows are calculated in accordance with Water Supply for Public Fire Protection;
- Maximum Day and Peak Hour factors shall be 1.9 and 3.0, respectively;
- Minimum watermain size of 150mmØ for residential areas;
- Hazen-Williams formula used in computing watermain sizes with the following coefficients:

Pipe Diameter (mm)	Hazen-Williams Coefficient 'C'
150	100
200-250	110
300-600	120
>600	130

- Operating pressure requirements are noted as follows:

Description	Pressure
Normal Operation	Desired: 350-550 kPa (50-80 psi) Minimum: 275 kPa (40 psi)

Description	Pressure
Maximum Pressure	700 kPa (100 psi)
Minimum Pressure (Maximum Daily Demand Plus Fire Flow)	140 kPa (20 psi)

2.3 Proposed Water Supply Servicing

The proposed development requires water supply for the midrise building and the townhouse lots. Servicing of the midrise building will be facilitated by a 250mmØ watermain connection to the existing 400mmØ watermain on Bronte Street. The proposed watermain connection will split into a 250mmØ fire service line and a 100mmØ water service line by a tee connection to the main line. A backflow preventer will be installed on the fire line, and a water meter and backflow preventer will be installed on the water service line.

Servicing of the townhouse lots will be provided by a private watermain network within the site which is serviced by two 200mmØ connections to the existing 200mmØ watermain on Chretien Street. A meter and backflow prevention chamber are provided for each connection.

Furthermore, there are four fire hydrants proposed within the site. Two hydrants are proposed above the underground structure of the midrise building, which are serviced by mechanical plumbing. Note, all proposed hydrants shall be Class AA in accordance with NFPA 291 standards. There are also two existing hydrants external to the subject site, which are required for fire protection: one hydrant along Chretien Street and one hydrant on Bronson Terrace. The proposed Siamese connections for the midrise building will be located within 45 m of a fire hydrant. Refer to **Figure 2-1** for the proposed water supply servicing scheme.

2.4 Proposed Water Supply Demands

The water supply demands for the subject site were determined using an average consumption rate of 230 L/capita/day for residential land uses, in accordance with the Halton Region's Water and Wastewater Linear Design Manual (December 2025). Based on the demand criteria, the total average water demand for the subject site is 1.30 L/s. The Maximum Day and Peak Hour demands were calculated based on peaking factors of 1.9 and 3.0, respectively. Refer to **Table 2-1** below for a summary of the water demands for the subject site.

Table 2-1: Water Supply Demands

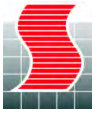
Tenure Type	Average Day Demand (L/s)	Max Day Demand (L/s)	Peak Hour Demand (L/s)	Fire Flow (L/s)	Max Day + Fire Flow (L/s)
Townhouse	0.55	1.04	1.65	300	301.04
Midrise Building	0.75	1.42	2.24	167	168.09
TOTAL	1.30	2.46	3.89	300	302.46

Furthermore, the fire flow demands for the subject site were determined in accordance with the Water Supply for Public Fire Protection (2020) guidelines by the Fire Underwriters Survey (FUS). The required fire flow for the midrise building is 167 L/s based on a Type II (Non-combustible) construction, and an automatic sprinkler system in accordance with NFPA 13 guidelines with standard connection. The fire flow demands were also calculated for each townhouse block, resulting in a critical fire flow of 300 L/s for Building 6. Each townhouse block was assumed to be of Type V (Wood Frame) construction. The total floor areas were based on the building statistics provided by the architectural consultants (Ian Robertson Design and GC Architects). Refer to **Appendix A** for supporting calculations for the water demand and fire flow of the subject site.

A hydrant test was conducted on Chretien Street on June 2nd, 2021 by EBAL Engineering Ltd. The results of the test indicate a static pressure of 90 psi (621 kPa) and a flow of 111 L/s at a residual pressure of 80 psi (552 kPa). A hydrant test analysis was conducted to determine the available theoretical flow in the watermain at a residual pressure of 20 psi (140 kPa). Based on the hydrant test analysis, the available flow along the watermain is 318 L/s. Since the available flow of 318 L/s is greater than the total required flow for the subject site (302.46 L/s), the existing watermain infrastructure is expected to support the proposed development. Refer to **Appendix A** for the hydrant test and analysis results.

2.5 Hydraulic Modelling

A WaterCAD model was prepared to analyze the proposed watermain network for the subject site. The model has been setup based on a fixed-head reservoir set at an elevation of 248.29 m, based on the results of the hydrant test. The hydrant test conducted on Chretien Street yielded a static pressure of 90 psi. As a result, the reservoir level was established based on the pressure head and the ground elevation at the test hydrant (63.29 m [90 psi] + 185 m [ground] = 248.29 m).



The WaterCAD model was used to analyze the proposed development under the following demand scenarios: Average Day Demand, Maximum Day Demand, Peak Hour Demand, and Maximum Day Demand plus Fire Flow. The modelling results demonstrate that the water supply system can provide sufficient pressure and flow to the proposed development during normal operational conditions and fire scenarios in accordance with the Town's design guidelines.

Table 2-2 summarizes the pressure ranges within the proposed development for each of the demand scenarios during normal and fire conditions. Model outputs are provided in the **Appendix A**.

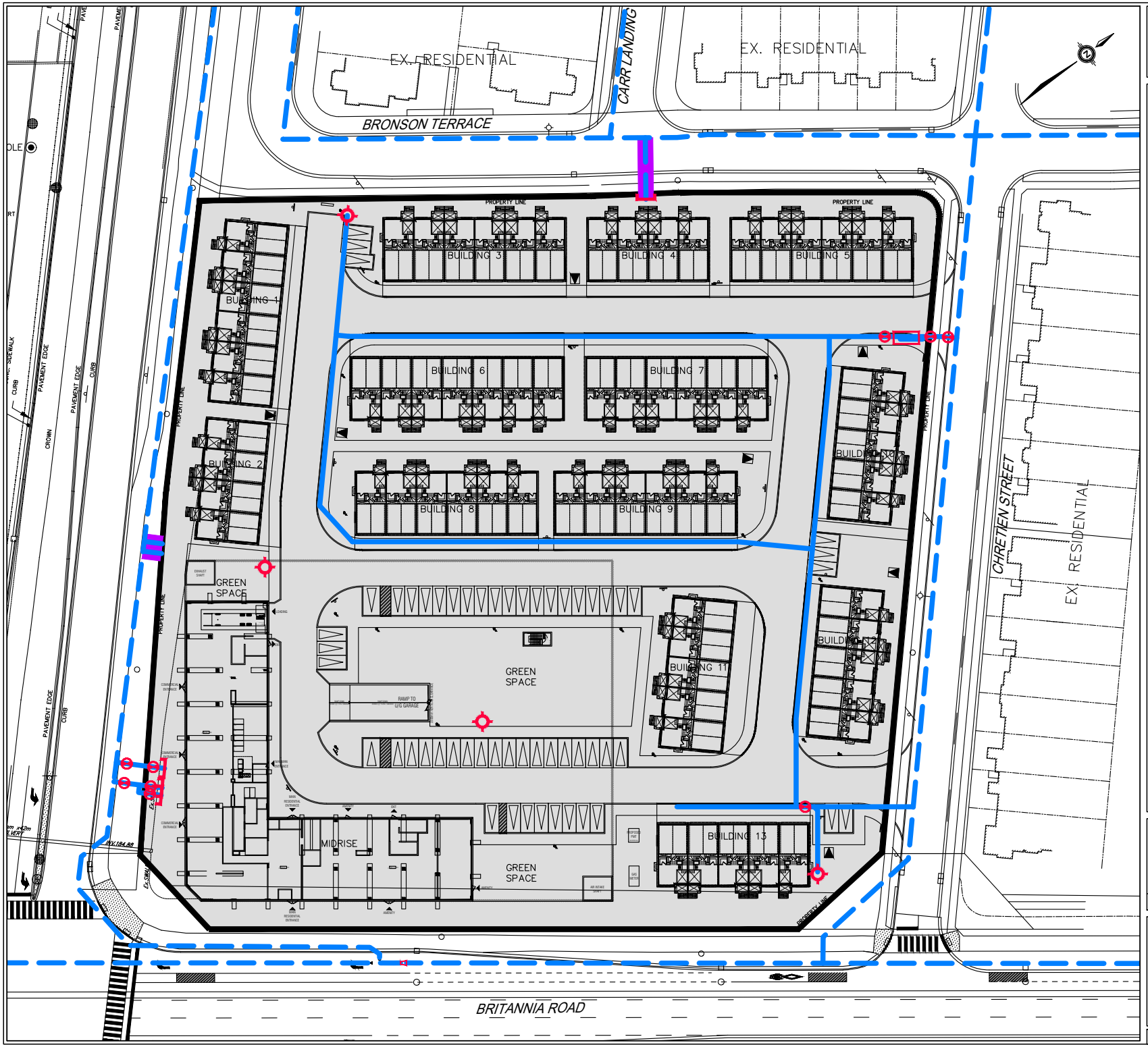
Table 2-2: Water Supply Modelling Results – Pressure Range

Demand Scenario	Minimum Pressure	Maximum Pressure
Average Day	80.0 psi [552 kPa]	86.3 psi [595 kPa]
Maximum Day	79.5 psi [548 kPa]	86.3 psi [595 kPa]
Peak Hour	78.9 psi [544 kPa]	86.3 psi [595 kPa]
Maximum Day plus Fire Flow	31.0 psi [214 kPa]	83.7 psi [577 kPa]

2.6 Water Age Analysis

A water turnover calculation was completed to ensure the proposed system is compliant with water age recommendations for water supply distribution systems. An occupancy of 25% and minimum consumption rate of 70% of the average consumption rate were assumed for the purposes of calculating water age. The water age calculated for the proposed watermain system is 1.67 days. Per "Effects of Water Age on Distribution System Water Quality" (AWWA, 2002), a maximum water turnover rate of 3 days is recommended, thus the proposed system is sufficient. Refer to the water age analysis calculations in **Appendix A**.

Mohandeep Singh



SHEARLING HEIGHTS

LEGEND

- SUBJECT SITE
- EXISTING WATERMAINS
- PROPOSED WATERMAINS
- EXISTING WATERMAINS TO BE ABANDONED OR DECOMMISSIONED

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 2.1
WATER SUPPLY SERVICING PLAN

2017-4568	FEBRUARY 2026	SCALE: N.T.S.

3.0 SANITARY SERVICING

3.1 Existing Sanitary Infrastructure

The subject site is located within the existing Mid-Halton wastewater drainage area, and will be serviced by the Mid-Halton WWTP. Based on available texts referenced in Section 1.2, a 1200mm diameter Trunk sewer exists that drains east along Britannia Road. An existing sanitary sewer runs along the east side of the subject site on Chretien Street which can be used as the outlet for the subject site. Ultimately, all waste water generated from the subject site will flow to the existing 1200mm Trunk sewer on Britannia.

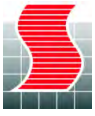
3.2 Sanitary Design Criteria

The proposed sanitary servicing of the subject site will be designed in accordance with the Region of Halton design criteria for wastewater systems. These criteria, where applicable to the proposed development, are summarized below.

- Design flow is equal to the Average Dry Weather Flow multiplied by the Average Peak Wastewater Flow Factor, plus the Inflow/Infiltration Allowance;
- The Average Dry Weather Flow is based on 215 L/capita per day;
- For residential areas, the peak sanitary flow factor is based on the Harmon formula ($M = 1 + 14/(4 + P^{0.5})$), where P is population in thousands;
- Except under unusual circumstances, infiltration allowance shall be determined at 0.28×10^{-3} $m^3/s/ha$ for all types of land use;
- For residential areas, minimum pipe size shall be 200mmØ in diameter;
- Maximum velocity shall not be greater than 3.00 m/s with pipe flowing full, and minimum velocity shall not be less than 0.60 m/s at actual flow.

3.3 Proposed Sanitary Servicing

Internal sanitary sewers that will be 200mmØ in diameter are proposed to service the buildings within the subject site. One connection to the existing 200mmØ sanitary sewer on Chretien Street is proposed. This will be accomplished via breaking into the existing sanitary sewer and constructing a new manhole, MH1A. A control manhole will be provided at the property line. From here, wastewater will flow north along the 200mm sanitary sewer on Chretien Street and ultimately to the



1200mm diameter Trunk main flowing east along Britannia Road. Please refer to the proposed sanitary servicing scheme in **Figure 3.1** as well as the engineering drawings in **Appendix D**.

3.4 Design Flows

The sanitary flow rate for the proposed development was calculated as per the Region design criteria. With an estimated population of 487 persons over an area of 2.11 hectares, the total expected design flow is 5.41 L/s from the subject site. The calculations are provided in **Appendix B** and have been summarized in **Table 3-1**.

Table 3-1: Sanitary Flow Summary

Area (ha)	Expected Population	Average Sewage Flow (L/s)	Harmon Peaking Factor	Peak Flow (L/s)	Infiltration (L/s)	Total Flow (L/s)
2.11	487	1.21	3.98	4.82	0.59	**5.41**

3.5 Downstream Analysis

The subject site was initially zoned as a commercial land use with a design population of 189 persons which was considered during the detailed design of sanitary services within the Main Sail Estates Subdivision. The expected population from the proposed development plan is 487. Thus, the peak flow from the subject site (5.41 L/s) is larger than considered during the design of sanitary sewers for the Main Sail Estates Subdivision (3.10 L/s). This results in a surplus peak flow of 2.31 L/s being conveyed within the system.

The following analysis was conducted by adding the extra peak flow (2.31 L/s) as a constant flow to the original design flow as per the design sheets. The analysis considered both the nominal capacities of the sewers (as shown on the design sheets) as well as the actual capacities (calculated). Based on the analysis which is summarized in **Table 3-2**, no surcharging is anticipated as the sewers have adequate conveyance capacity. Furthermore, it should be noted that the depth of the surcharged sewer is considerable, being approximately 5 metres below grade (see Drawing P19 in **Appendix B**). As such, no adverse impacts are anticipated. The below ground services plan (BGP3) for the Main Sail Estates Subdivision prepared by TMIG and associated sanitary design sheets used for this analysis are attached in **Appendix B**.

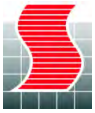
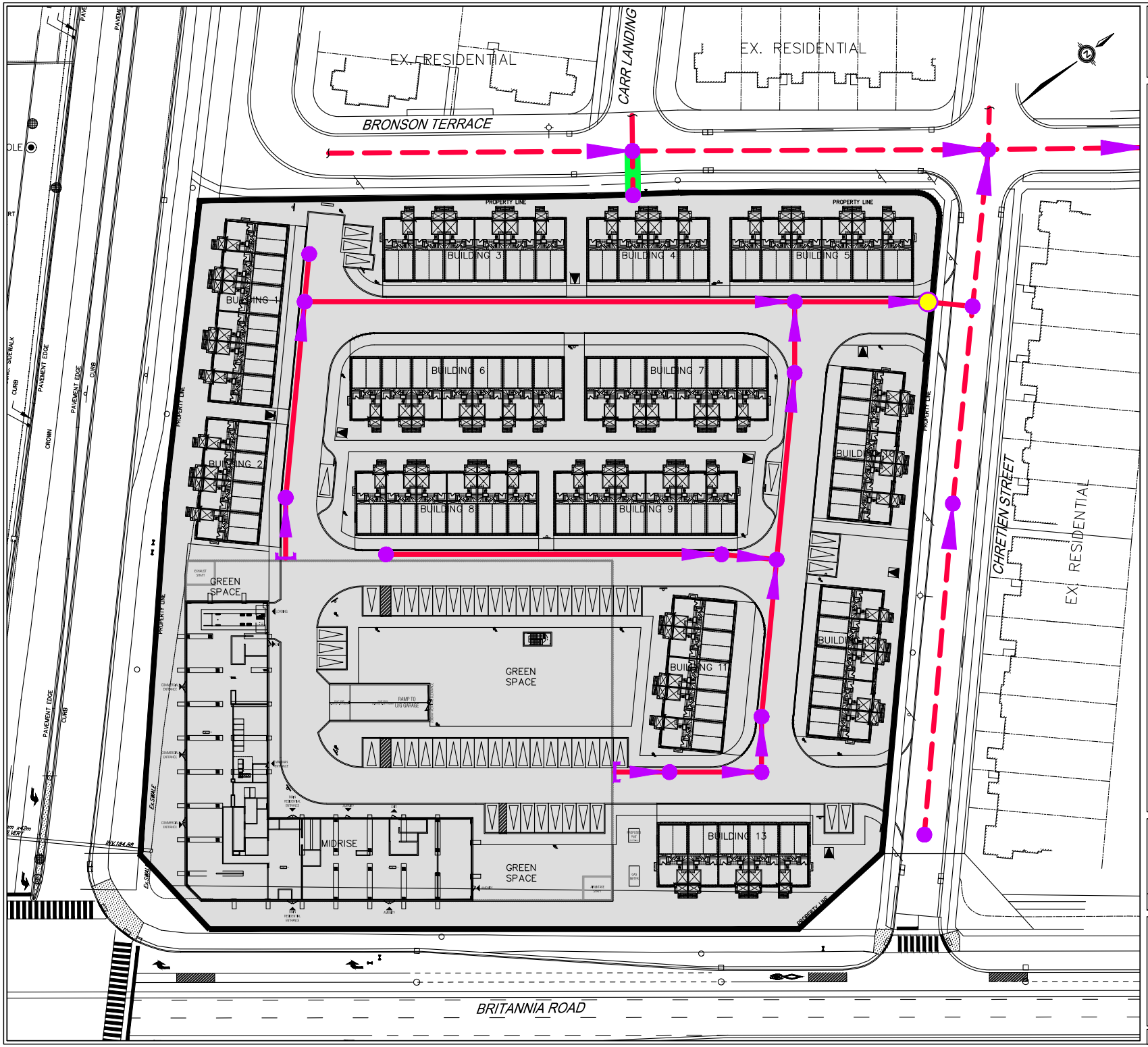


Table 3-2: Downstream Capacity Analysis of Sanitary Sewers

Sewer Segment (MH to MH)	Peak Flow (L/s) (Original)	Peak Flow (L/s) (Proposed)	Capacity of Sewer (L/s) (nominal)	Capacity of Sewer (L/s) (actual)	Surcharge (%) (nominal)	Surcharge (%) (actual)
MH67A to MH69A	1.49	6.90*	32.80	34.22	0	0
MH69A to MH78A	17.57	19.88	23.19	24.20	0	0
MH78A to MH81A	20.82	23.13	42.05	43.87	0	0
MH81A to MH91A	22.15	24.46	42.05	43.87	0	0
MH91A to MH93A	25.66	27.97	42.05	43.87	0	0
MH93A to MH96A	114.11	116.42	122.73	128.04	0	0
MH96A to MH97A	114.74	117.05	123.98	129.34	0	0
MH97A to EX. MH9A	114.74	117.05	123.98	129.34	0	0

**Note, for this section of pipe, the entire design flow of 5.41 L/s was added to the original design flow as per the TMIG design sheets rather than the surplus peak flow of 2.31 L/s as this particular section of pipe was not originally designed to accept any sanitary flow from the subject site.*



SHEARLING HEIGHTS

LEGEND

- SUBJECT SITE
- EXISTING SANITARY SEWER
- PROPOSED SANITARY SEWER
- EXISTING SANITARY SEWER TO BE ABANDONED
- PROPOSED CONTROL MANHOLE

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 3.1
SANITARY SERVICING PLAN

2017-4568	FEBRUARY 2026	SCALE: N.T.S.

4.0 STORMWATER MANAGEMENT

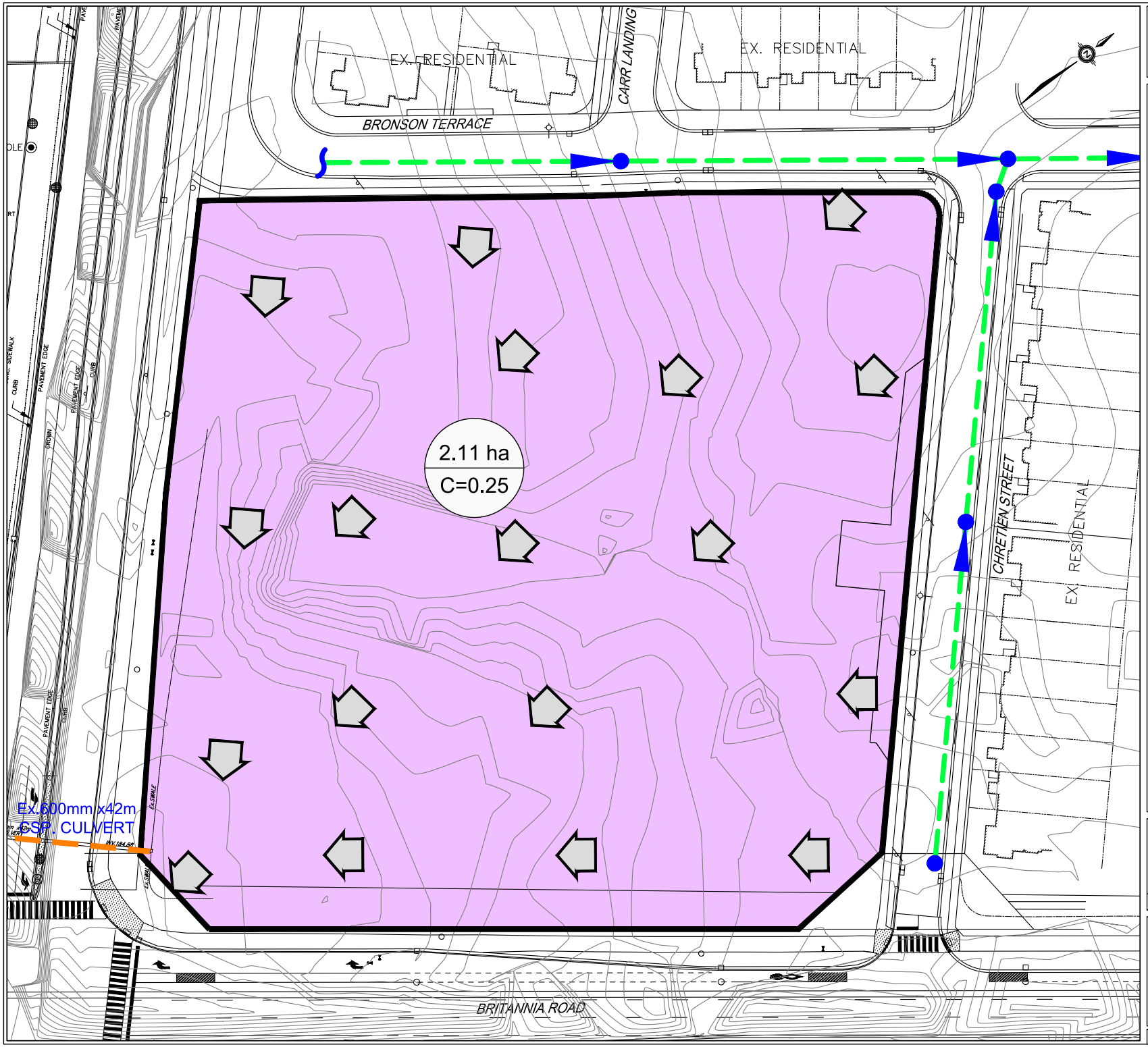
4.1 Existing Infrastructure

As part of the Britannia Road urbanization project, the twin 900mmØ diameter CSP culverts which crossed Bronte Street South at the southwest corner of the site were removed. A 600mmØ CSP culvert has been constructed crossing Bronte Street. Please refer to the drawing by Wood (December 2015) in **Appendix C. Figure 4.1** illustrates the pre-development drainage of the subject site as mentioned in Section 1.3. The existing site drainage falls southwest towards the Bronte Street and Britannia Road intersection and culvert. SWM Pond 'H' is located east of the subject site which services the surrounding subdivision.

4.2 Design Criteria

The stormwater flow calculations are based on the following design guidelines outlined in the Town of Milton's "Engineering and Parks Standards Manual" (2024).

- Storm sewers shall be designed using Rational Method; Q = 2.78 CIA/1000, where Q is the flow rate in m^3/s, C is the runoff coefficient (dimensionless), I is rainfall intensity in mm/hr and A is area in hectares;
- Internal storm sewer design should be based on Town of Milton's Rainfall Intensity Duration Frequency equations and a minimum time of concentration of 10 min. I = A/(T + B)^C, where I is rainfall intensity in mm/hr, Tc is time of Concentration in hours;
- Quantity control as per available capacity within existing storm sewer system for the 100-year event;
- Quality control measures to provide 80% TSS removal for enhanced protection;
- Erosion control and water balance will be provided by the on-site retention of 5mm of runoff.



SHEARLING HEIGHTS

LEGEND

- SUBJECT SITE
- DRAINAGE AREA
- OVERLAND FLOW DRAINAGE DIRECTION
- EXISTING STORM SEWERS

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 4.1
EXISTING CONDITIONS

2017-4568	FEBRUARY 2026	SCALE: N.T.S.

4.3 Proposed Stormwater Management Scheme

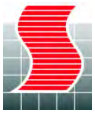
It is proposed to use a dual drainage concept, minor and major systems, to provide stormwater management for the site. The systems will be designed as per outlined guidelines in the Town of Milton's "Engineering and Parks Standards Manual" dated September 2024. The storm servicing concept proposes one outlet to Chretien Street where appropriate quantity control and quality control will be provided. Please refer to Figure 4.2 and Figure 4.3 for the proposed drainage plan and storm servicing plan respectively. The engineering drawings are provided in **Appendix D**.

Approximately 1.89 ha is proposed to be fully captured (up to and including the 100-year storm) and conveyed to the Chretien Street outlet. Drainage from this area is proposed to be controlled to 54.5 L/s (100-year storm) and discharged to the existing storm sewer along Chretien Street. This flow will ultimately discharge into SWM Pond H located east of the subject site. Note that the release rate was based on the capacity of the Chretien Street sewer and uncontrolled flows. A storage system within the site will provide the necessary storage while an orifice tube at the Chretien Street outlet will attenuate the discharging flow. Quality control for flows discharging to Chretien Street is proposed to be provided with a proposed Oil and Grit Separator (OGS) that will be located just downstream of the storage system. Note that this drainage will eventually be serviced by SWM Pond H for further quality control. Emergency flows from this area will discharge overland to Chretien Street after which they will be following the existing grading to Bronson Terrace or Britannia Road.

The remaining site area, approximately 0.22 ha, will drain uncontrolled due to grading constraints. Approximately 0.08 ha of this area will drain uncontrolled to Bronson Terrace, and another 0.04 ha will drain to Chretien Street, where both areas will be conveyed to the SWM pond. The remaining 0.09 ha uncontrolled area will drain to Bronte Street and be conveyed to a tributary of Indian Creek (I-NE-1B).

As the site was not originally proposed to drain to the pond, a hydrologic verification was completed by WSP (pond designer) who confirmed that the pond can safely accommodate flow from the subject site provided on-site controls are provided for 2 to 100-year storms. This analysis included the Regional Storm scenario as no Regional controls as proposed. The memo prepared by WSP is provided in **Appendix C** for reference.

A best management approach is pursued to satisfy on site erosion control and water balance. 300mm of topsoil is proposed on site where possible to maximize on site retention and infiltration. The proposed townhouse units will have disconnected roof leads to promote drainage across green space



areas. Furthermore, a storage tank is proposed to capture a 5mm rain fall event from clean water sources on site for water reusing purposes.

4.4 Quantity Control

Approximately 1.89 ha of the site is proposed to drain to SWM Pond H via controlled discharge to the Chretien Street sewer. Approximately 0.13 ha will drain uncontrolled to the pond via Bronson Terrace and Chretien Street. The drainage area is shown on **Figure 4-2**. The controlled area will be captured and discharged from the site through a storage pipe system at a maximum release rate of 54.5 L/s for the 100-year event through the use of a 125mmØ orifice tube (invert 185.21m) to the proposed OGS unit (further discussed in Section 4.6) and eventually the Chretien Street storm sewer (see Figure 4-3). Flow from the uncontrolled area will be captured by the existing sewer system on Bronson Terrace and Chretien Street. Both the Chretien Street and Bronson Terrace sewers ultimately carry flows to SWM Pond H east of the subject site.

The maximum allowable release rate of 80.5 L/s was determined based on the residual capacity of the existing storm sewers that are designed to accommodate 5-year flows as per Town criteria. Please note, as per Town criteria, the sewer pipes are not to exceed 85% of full flow capacity (q/Q) for 5-year design flows. Based on TMIG's design sheets, this limit has been exceeded for certain sections of pipe. Given the standard also mentions designing the sewers to operate under free flow conditions without surcharging up to the 5-year flow, it is proposed to add an additional flow of 80.5 L/s during the 100-year event to the existing sewer system while ensuring the system maintains free flow conditions. Note, the 100-year uncontrolled flow from the 0.13 ha area being captured by existing sewers was determined be 22.6 L/s as per Rational Method calculations. As such, the controlled release rate for the subject site was determined to be 54.5 L/s (80.5 – 22.6). A downstream analysis was done for each section of pipe flowing towards SWM Pond H which considered the controlled and uncontrolled flows. This total flow of 80.5 L/s (54.5 L/s controlled + 22.6 L/s uncontrolled) was added to the design flows as per the design sheets prepared by TMIG and a new q/Q percentage was determined. This analysis confirmed that the sewers would not be expected to exceed their full flow capacities (q/Q < 100%).

The storage requirement to attenuate the 100-year storm to 54.5 L/s was determined to be 752 m^3. This is proposed to be achieved by Greenstorm modular storage boxes underneath the roadways. Please refer to drawings provided in **Appendix C**. The storage system will provide approximately 833 m^3 of storage at a high-water level (HWL) of 187.06m. Full storage calculations are provided in

Appendix C. The storm sewer design sheets and Below Ground Services Plan (BGP3) prepared by TMIG are also provided in **Appendix C**. Note that as per the hydrogeological report prepared by Grounded Engineering (2026), long-term groundwater discharge is anticipated with a flow of 0.4 L/s. The storage pipe system requirement assumes a conservative inflow of 8 L/s. Hence, no capacity constraints are anticipated should groundwater be drained to the storage pipe system.

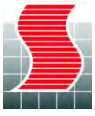
4.5 Quality Control

Quality control is proposed to be provided via a two-step treatment train approach consisting of an OGS unit with the remaining treatment achieved by the existing SWM pond. Runoff discharging from the storage pipe system is proposed to be treated by an OGS unit prior to entering the storm sewer on Chretien Street. The unit has been sized by the manufacturer (Stormcon) for a drainage area of 2.11 ha with an imperviousness of 85%. A HydroStorm HS 8 unit is proposed (or approved equivalent) which will treat 100% of annual runoff to provide 60% TSS removal (ETV PSD). Please refer to **Appendix C** for the OGS unit's specifications. Further TSS removal will be provided by SWM Pond H's permanent pool which has sufficient storage to accommodate the subject site.

The permanent pool of Pond H has been designed to treat an area of 38.94 ha with an imperviousness of 67% for enhanced protection. This requirement was determined to be 6781 m^3 as per TMIG's SWM report. To be conservative, the permanent pool requirement for the entire site was determined (area = 2.11 ha, imperviousness = 85%). Based on calculations that are provided in **Appendix C**, the additional permanent pool storage volume requirement was determined to be 443 m^3 for enhanced protection providing 80% TSS removal. As such, the total required permanent pool volume is 7224 m^3. Per TMIG's SWM report, the provided volume for the permanent pool was 19800 m^3 which far exceeds the requirement. Hence, it can be concluded that the pond can sufficiently treat the subject site.

4.6 Erosion Control and Water Balance

Based on Geotechnical study results revealed in the Block 2 SIS, the subject site is underlain by layers of composite clays (Clay Silt Till, as per BH 4 of SIS Geotechnical Investigation) that limit on-site infiltration. Note, this is supported by the latest geotechnical study conducted by Grounded Engineering (2026) which states clayey silt till soils over sandy silt till soils. The referenced report by TMIG includes a post to pre water balance analysis conducted by R. J. Burnside Associates Ltd. that demonstrates the use of additional topsoil, assisted by strategic diversion techniques to maximize



runoff diverted to pervious areas, is sufficient to meet pre-development annual infiltration (94% of pre-development infiltration).

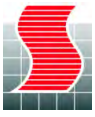
An average infiltration rate of 5mm/hour has been calculated for the study area of Block 2 SIS, and the SIS does not encourage the implementation subsurface designs such as trenches and bio-retention facilities due to the impermeable nature of subsurface soils, and issues with long-term function and maintenance of such facilities. This is consistent with the findings from the Hydrogeological Assessment completed by Grounded Engineering (2026) that determined an average infiltration rate of 4.2 mm/hr and concluded limited effectiveness of LIDs for groundwater recharge purposes as per their LID Feasibility Letter (2022). The letter is provided in **Appendix C**.

The use of passive infiltration techniques is proposed to promote on-site infiltration as a best effort. All green space areas on site are proposed to have 300mm of additional topsoil. This will retain rainfall and promote long-term infiltration. Where feasible, roof leaders are proposed to be disconnected to green space areas to further promote onsite retention and infiltration. The Hydrogeological Assessment by Grounded Engineering (2026) suggested stormwater planters, tree pits, bioswales, raingardens and permeable pavers as potential LID measures although it was also stated in their report and LID Feasibility Letter (2022), the low permeability soils would limit their feasibility and effectiveness. It is to note that a significant portion of the site is limited by the underground parking structure where LID measures are not suitable. For the townhouse portion of the site, grading and spatial constraints prevent the use of tree planters. Limited green space prevents the use of rain gardens and bioswales. Permeable pavers would have limited effectiveness due to the underlying soil conditions.

As the total area of the subject site is less than 5 ha, it is proposed the retain 5mm of runoff on-site to satisfy erosion control criteria. Based on a composite post-development runoff coefficient of C = 0.80, the total retention requirement is 84.4 m^3 (2.11 ha x 0.80 x 5mm). This is proposed to be provided by a storage tank within the mid-rise building dedicated for collecting clean runoff from the roof for water re-use purposes. The tank has been sized to provide 92 m^3 of storage. Potential water reuses include site irrigation, car washing, grey water and mechanical cooling. Please note that a best management approach will be undertaken to ensure the tank is drained within 48 to 72 hours.

4.7 Drainage to Indian Creek Tributary

Please note that as per the latest SWM concept, as the majority of the site is being proposed to drain to the SWM pond, only a small area of approximately 0.09 ha on the west side will drain



uncontrolled to Indian Creek via Bronte Street. The runoff coefficient for this area was determined to be 0.59, generating an AC (area * runoff coefficient) of 0.05. Due to grading and servicing constraints, this area was not able to be captured. Considering the pre-development area to the Indian Creek watershed was much higher, 2.11 ha, with a substantially higher AC of 0.53, no adverse impacts to the watercourse are expected as a result of this small uncontrolled area.

4.8 Emergency Overflows

During emergency situations or in cases where the storm event exceeds the 100-yr return period (i.e., Regional Storm), water is expected to rise up to grade and overflow to Chretien Street. Given the service connections of the townhouse units, sump pumps are proposed to ensure the basement connections are protected in case of emergency situations.

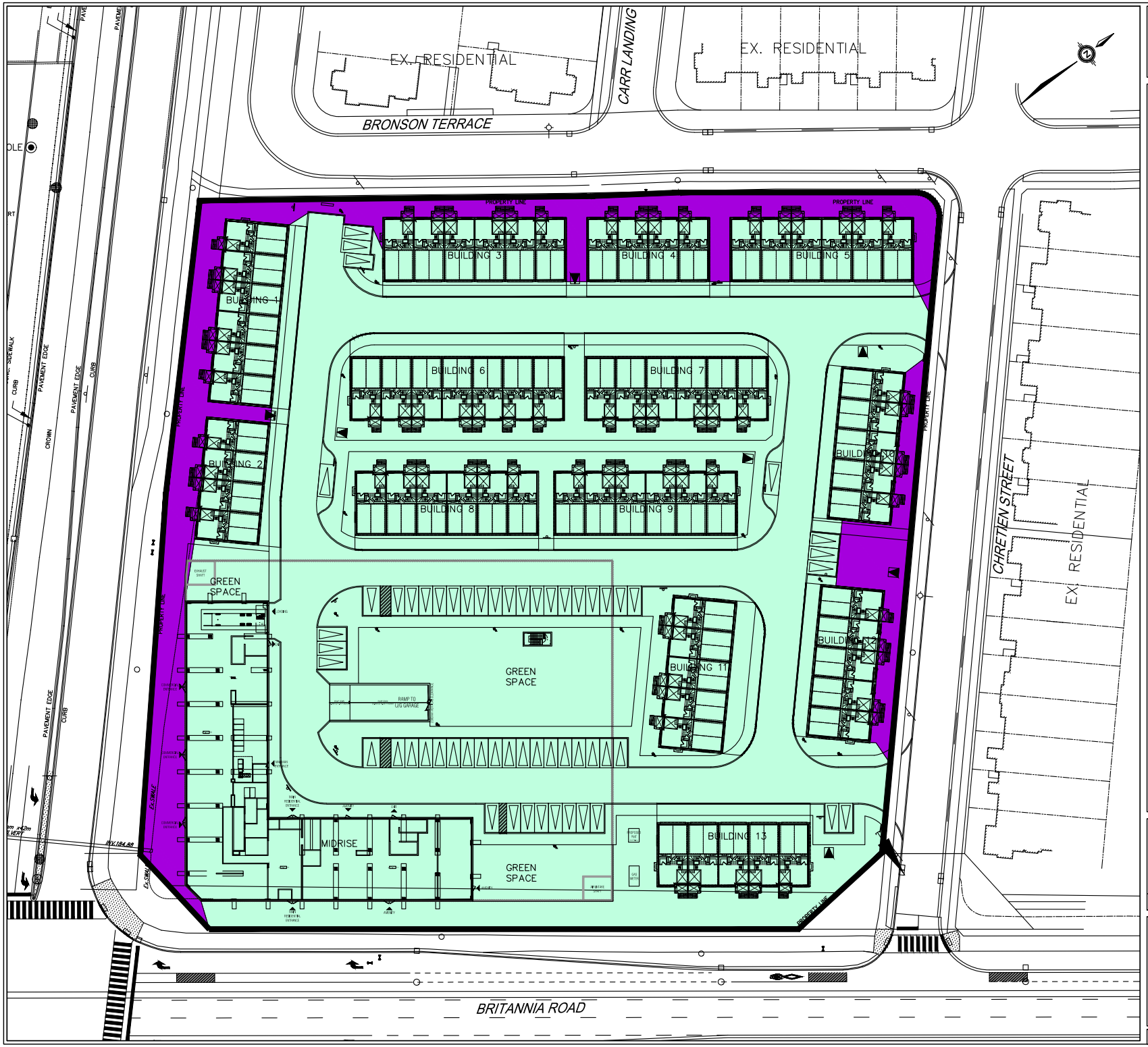
4.9 Full Capture Locations

Two full capture locations are proposed on the east side at low points on the roadway. These will be located at MH2 and MH9 (see **Figure 4.3**). Twin honeycomb grates are proposed at each manhole. Sufficient ponding will be provided for each capture location. Each manhole has been designed to fully capture the 100-year flow with the consideration of 50% clogging. This will ensure no major flows spill to Chretien Street during major storm events. **Table 4-1** below summarizes the full capture design. Full calculations are provided in **Appendix C**.

Table 4-1: Full Capture Design

Location	Grate Type	Ponding Depth	100-year Flow	Design Capacity (with 50% clogging)
MH2	Honeycomb (OPSD 403.01)	170mm	154 L/s	168 L/s
MH9	Honeycomb (OPSD 403.01)	200mm	183 L/s	208 L/s

Phil Gotfried



SHEARLING HEIGHTS

LEGEND

SUBJECT SITE

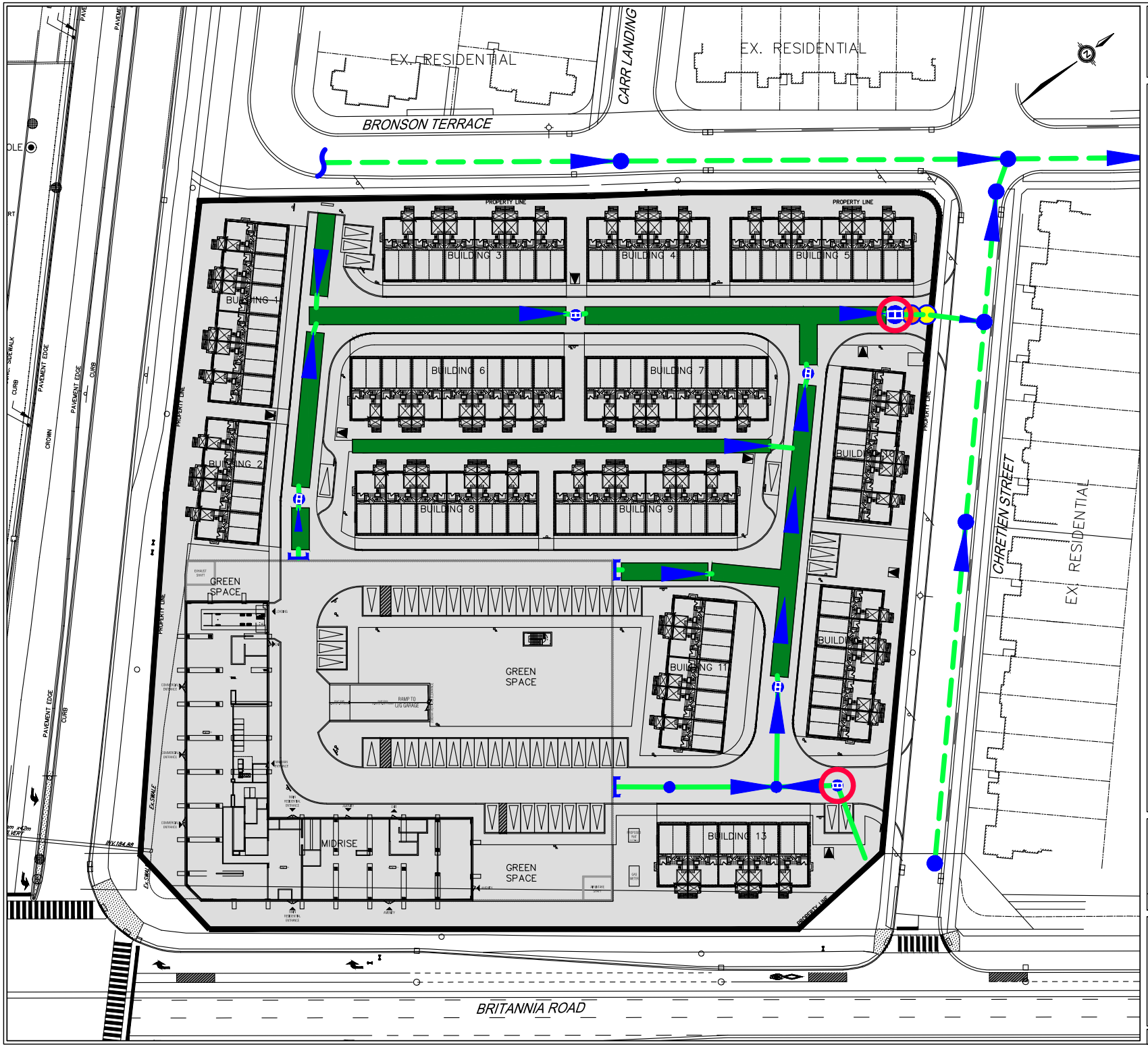
CONTROLLED DRAINAGE AREA
TO POND H
AREA = 01.89ha
COEFFICIENT = 0.84

UNCONTROLLED AREA
AREA = 0.22ha
COEFFICIENT = 0.46

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 4.2
PROPOSED DRAINAGE PLAN

2017-4568	FEBRUARY 2026	SCALE: N.T.S.



SHEARLING HEIGHTS

LEGEND

- SUBJECT SITE
- EXISTING STORM SEWERS
- PROPOSED STORM SEWERS
- PROPOSED GREENSTORM TANK
- PROPOSED OIL GRIT SEPARATOR
- PROPOSED CONTROL MANHOLE
- FULL CAPTURE LOCATION

SCHAEFFERS CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 4.3
STORM SERVICING PLAN

2017-4568	FEBRUARY 2026	SCALE: N.T.S.

5.0 SUMMARY

This report has been prepared to demonstrate the adequacy of storm, sanitary, and water supply services for the proposed development of the Major Node, defined as Block 360 of Plan 20M-1184, within the Town of Milton.

Water Supply Servicing

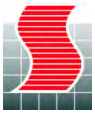
Water supply servicing for the subject is proposed via three connections. Two connections are proposed to be made to the 200mm diameter watermain along Chretien Street. This watermain will run through the internal roads and service the townhomes. The third connection is proposed to be made to the 400mm diameter watermain along Bronte Street to service the midrise building. A mechanical engineer shall confirm the internal servicing within the parking structure. The analysis conducted for the site reveal that the internal servicing is sufficient to meet all necessary demands whilst conforming to design criteria. All residential and fire flow requirements are satisfied in all of the demand scenarios. A hydrant test was conducted and confirmed available pressure within the system.

Sanitary Servicing

Sanitary services for buildings within the subject site will be provided via connection to proposed 200mm diameter internal sewers. One connection to the existing 200mmØ sanitary sewer on Chretien Street is proposed through a new manhole (MH1A). A downstream capacity analysis was conducted for the system due to a higher design population for the subject site than was considered in the original design for the Main Sail Estates Subdivision by TMIG. The analysis demonstrated that no surcharging is anticipated in the downstream sewer system.

Stormwater Management

The SWM system will collect drainage from a majority of the site in a storage pipe system and discharge flows at a maximum release rate of 54.5 L/s for the 100-year event to the existing municipal sewer along Chretien Street with uncontrolled flow discharging directly to the sewers on Bronson Terrace and Chretien Street. The storage pipe system is sized to provide the necessary storage to ensure that the 100-year storm can be controlled to a release rate of 54.5 L/s. A downstream capacity analysis of the storm sewers based on 5-year storm design sheets has demonstrated that the system can operate under free flow conditions with the addition of the controlled and uncontrolled flows. Two full capture locations are proposed on the internal roadway



that will ensure no major flows spill to Chretien Street (up to and including the 100-year event). A majority of the site will eventually drain to SWM Pond H. A hydrologic verification in this respect was done by WSP that confirmed the site will cause no adverse impacts to the SWM pond from a capacity standpoint. The permanent pool was examined as part of this report and has considerable surplus storage to accommodate the site so no quality control issues are anticipated. As an additional measure, an OGS unit is proposed at the outlet of the storage system to provide TSS removal.

Erosion Control & Water Balance

Erosion control and water balance are to be achieved by a 5 mm retention concept. A storage tank within the mid-rise building with 92 m^3 of available storage is proposed for water re-use on site. To promote on-site infiltration, additional topsoil of 300mm is proposed where applicable and roofs are proposed to discharge to green space areas where possible.

We trust you will find the contents of this report satisfactory. Please contact the undersigned if you have any questions or concerns.

Respectfully Submitted,

SCHAEFFER & ASSOCIATES LTD.

Mohandeep Singh, M.Eng., ENV SP, P.Eng.
Water Resources Engineer



Sadh Katukurunde, P.Eng.
Junior Associate

APPENDICES

Appendix A: Water Supply & Background

Shearling Heights

Town of Milton

Population Estimate

Project: 2017-4568

Design Population (PPU Basis)			
Type	**Density** (ppu)**	**Units**	**Population**
Townhouse	2.9	71	206
Apartment (Studio, 1B, 1B+D)	1.7	110	187
Apartment (2B, 2B+D)	1.7	42	72
Commercial	(37.4 sq.m/emp, 808 sq.m)		22
Total		223	**487**

*** Per Halton Region Water & Wastewater Linear Design Manual (December 2025)*

Shearling Heights

Town of Milton

Water Supply Demand

Project: 2017-4568

Average Day Demand

Population	Demand Rate (L/day/cap)	Average Daily Demand (L/s)	
206	230	**0.55**	*(towns)*
281	230	**0.75**	*(mid-rise)*
487		**1.30**	*(TOTAL)*

Peak Hour Demand

Average Daily Demand (L/s)	Peak Hour Factor	Peak Hour Demand (L/s)	
0.55	3.00	**1.65**	*(towns)*
0.75	3.00	**2.24**	*(mid-rise)*
1.30		**3.89**	*(TOTAL)*

Maximum Day Demand + Fire Flow

Average Daily Demand (L/s)	Max Day Factor	Max Day Demand (L/s)	Fire Flow (L/s)	Max Daily + Fire Flow (L/s)	
0.55	1.90	1.04	300	**301.04**	*(towns)*
0.75	1.90	1.42	166.67	**168.09**	*(mid-rise)*
1.30		2.46	300	**302.46**	*(TOTAL)*

Shearling Heights
4568
24-Feb-26

Water Turnover Rate

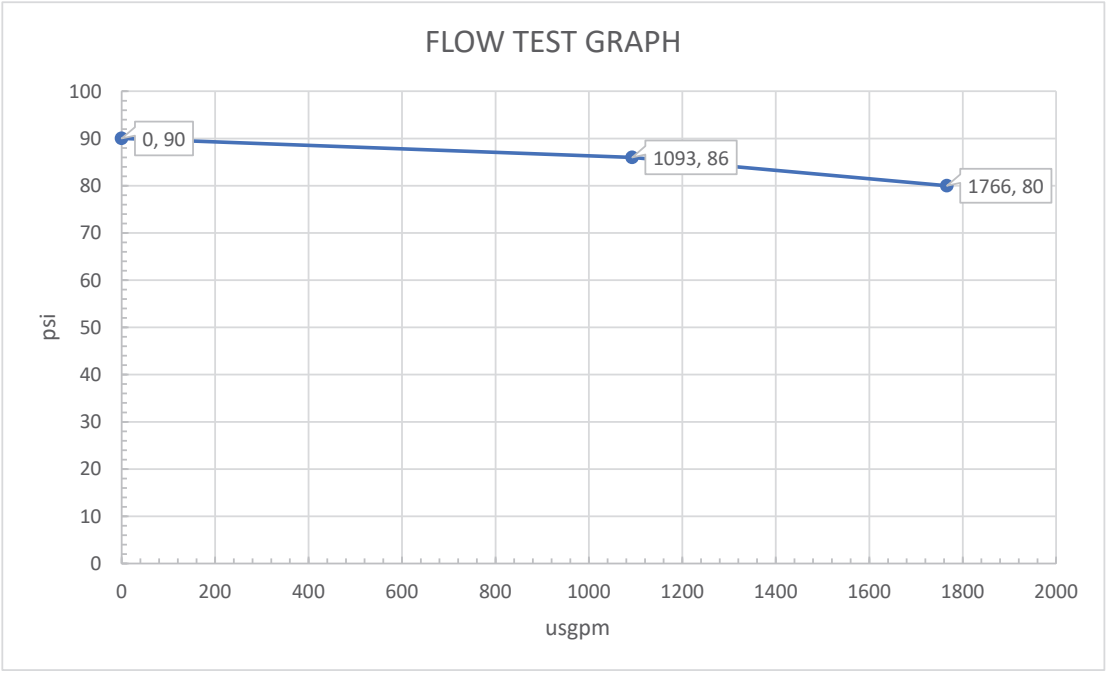
Average Consumption: 0.23 m^3/cap/day
Minimum Consumption (70%): 0.16 m^3/cap/day

Turnover Rate Calculation

Street/Stage Name	Length	Diameter	Area	Volume (m^3)	25% Population	Minimum Consumption	Water Turnover
	(m)	(mm)	(m^2)	(m^3)	(-)	(m^3/day)	(Day)
Private Site (Townhouses)	21.18	150	0.02	13.84	52	8.29	1.67
	428.5	200	0.03				

FLOW TEST REPORT

Name of risk:									
Address	1550 Chretien Street & Britannia, Milton								
Date:	6/2/2021			Time	10:15am		Size of Main		12”
Static	Pitot. 1 (2.5")	Flow 1	Res. Pres. 1	Pitot 2a (2.5")	Flow 2a	Pitot 2b (2.5")	Flow 2b	Flow 2a+2b	Res. pres. 2
90	42	**1093**	**86**	30	923	25	843	**1766**	**80**





Note: Flow Test was performed as per NFPA 291.

Shearling Heights

Project No. 4658

Test 1 - EBAL Engineering Ltd.

Flow Test Results of June 2, 2021

Location: Residual: 1587 Chretien St

Flow: 1550 Chretien St

Test Results			
Flow US. GPM	Residual Pressure psi	Flow L/s	Residual Presure kPa
0	90	0	621
1093	86	69	593
1766	80	111	552

For a total required flow demand of **302.46 L/s** the equivalent residual pressure is

182 **kPa**

26 **psi**

For a residual pressure of **20 psi** or **140 kPa** the equivalent flow is

318 **L/s**

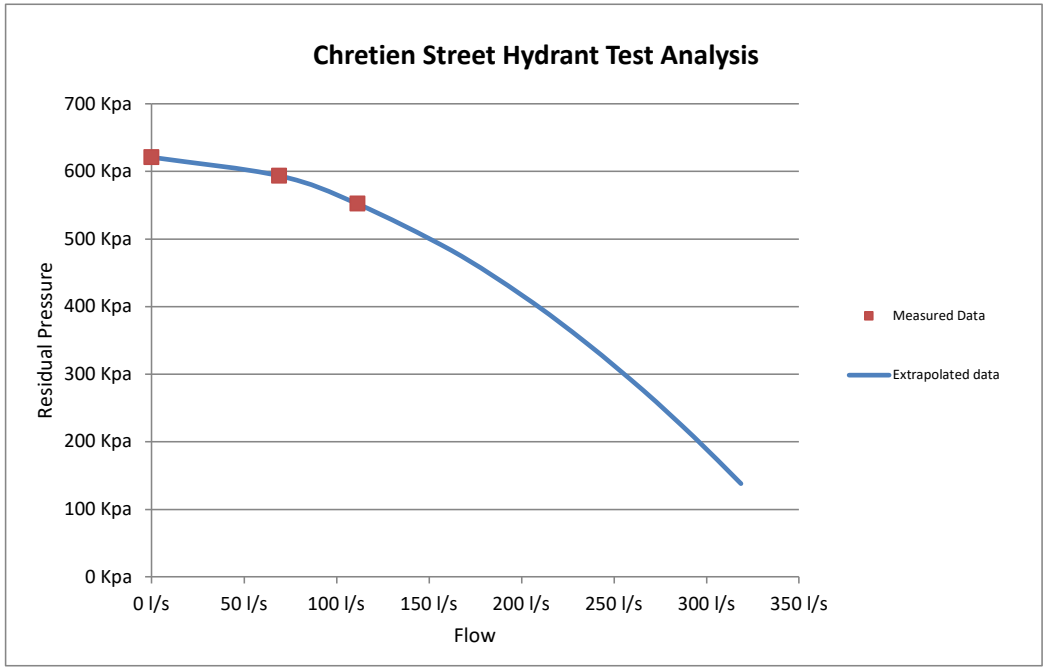
5041 **USGPM**

4197 **IGPM**

1 USG = 3.785 litres

1 IG = 4.546 litres

1 psi = 6.9 kpa



Required Fire Flow Calculations (FUS 2020) - Midrise Building

Project Title:	Shearling Heights
Project No.:	2017-4568
Municipality	Milton
Building/Parcel:	Midrise Building

Required Fire Flow

A - Construction Type

Type of Construction: Type II - Non-Combustible (Unprotected metal structural components, masonry or metal walls)

Construction C Value: 0.8

B - Floor Area

If Construction C Value < 1.0:

Are the vertical openings and exterior vertical communications properly protected (1 hour rating)? No

3,168.00 m^2 Total floor area of 2 largest adjoining floors

7,937.00 m^2 Total floor area of up to 8 floors immediately above 2 largest adjoining floors

1,632 m^2 Total floor area of the largest floor

3,264 m^2 Total floor area of the 2 floors which immediately adjoin to the largest floor

7137 m^2 *Total Floor Area Considered for RFF Calculation (Fire-resistive construction)*

Height in Storeys

storeys

C - Required Fire Flow (Rounded, Unadjusted)

15000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy

Occupancy Group:	C - Residential
Category:	Residential occupancies
Sub-category:	-
Occupancy and Contents:	Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*

12750 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System

Is an automatic sprinkler system in accordance with NFPA 13 present? Yes

Is the water supply standard for both the system and fire department hose required? Yes

Is the system fully supervised? No

-40% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side

11 m Building Separation

Apply corresponding maximum exposure charge? Yes

15% *Adjustment for North Side*

East Side

35 m Building Separation

Apply corresponding maximum exposure charge? Yes

0% *Adjustment for East Side*

South Side

31 m Building Separation

Apply corresponding maximum exposure charge? Yes

0% *Adjustment for South Side*

West Side

31 m Building Separation

Apply corresponding maximum exposure charge? Yes

0% *Adjustment for West Side*

15% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

10000	L/min	
167	L/s	**Required Fire Flow**
2642	USGPM	

Required Fire Flow Calculations (FUS 2020) - 7 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 7 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1493 m^2 Gross Floor Area
1493 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
13000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
11050 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
14.7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
15% *Adjustment for North Side*

East Side
4 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
16% *Adjustment for East Side*

South Side
9.9 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 42.5 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 128 m-stories
20% *Adjustment for South Side*

West Side
15.5 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for West Side*

62% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

18000 L/min
300 L/s **Required Fire Flow**
4756 USGPM

Required Fire Flow Calculations (FUS 2020) - 6 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 6 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1281 m^2 Gross Floor Area
1281 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
12000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
10200 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
14.7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
15% *Adjustment for North Side*

East Side
13.3 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for East Side*

South Side
9.9 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 30.2 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 91 m-stories
19% *Adjustment for South Side*

West Side
4 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
16% *Adjustment for West Side*

61% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

16000 L/min
267 L/s **Required Fire Flow**
4227 USGPM

Required Fire Flow Calculations (FUS 2020) - 5 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 5 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,070 m^2 Gross Floor Area
1070 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
11000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
9350 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
16% *Adjustment for North Side*

East Side
23.6 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 30.1 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 90 m-stories
8% *Adjustment for East Side*

South Side
17.1 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 4 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 12 m-stories
10% *Adjustment for South Side*

West Side
16.1 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 30.1 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 90 m-stories
14% *Adjustment for West Side*

48% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

14000 L/min
233 L/s **Required Fire Flow**
3699 USGPM

Required Fire Flow Calculations (FUS 2020) - 4 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 4 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,067 m^2 Gross Floor Area
1067 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
11000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
9350 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
26.5 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.2 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 37 m-stories
2% *Adjustment for North Side*

East Side
4 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
16% *Adjustment for East Side*

South Side
14.8 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 24.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 73 m-stories
13% *Adjustment for South Side*

West Side
4 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
16% *Adjustment for West Side*

47% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

14000 L/min
233 L/s **Required Fire Flow**
3699 USGPM

Required Fire Flow Calculations (FUS 2020) - 6 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 6 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,281 m^2 Gross Floor Area
1281 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
12000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
10200 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
26.5 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 2 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 6 m-stories
0% *Adjustment for North Side*

East Side
14.7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 24.1 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 72 m-stories
13% *Adjustment for East Side*

South Side
3 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
21% *Adjustment for South Side*

West Side
31 m Building Separation
Apply corresponding maximum exposure charge? Yes
0% *Adjustment for West Side*

34% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

14000 L/min
233 L/s **Required Fire Flow**
3699 USGPM

Required Fire Flow Calculations (FUS 2020) - 4 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 4 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,067 m^2 Gross Floor Area
1067 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
11000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
9350 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
3 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
21% *Adjustment for North Side*

East Side
15.7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.2 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 37 m-stories
11% *Adjustment for East Side*

South Side
11 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for South Side*

West Side
31 m Building Separation
Apply corresponding maximum exposure charge? Yes
0% *Adjustment for West Side*

43% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

13000 L/min
217 L/s **Required Fire Flow**
3435 USGPM

Required Fire Flow Calculations (FUS 2020) - 6 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 6 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,281 m^2 Gross Floor Area
1281 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
12000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
10200 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
22.2 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
10% *Adjustment for North Side*

East Side
4 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
16% *Adjustment for East Side*

South Side
14.8 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
15% *Adjustment for South Side*

West Side
18.5 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for West Side*

52% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

16000 L/min
267 L/s **Required Fire Flow**
4227 USGPM

Required Fire Flow Calculations (FUS 2020) - 6 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 6 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,281 m^2 Gross Floor Area
1281 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
12000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
10200 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
25.7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
10% *Adjustment for North Side*

East Side
23 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
2% *Adjustment for East Side*

South Side
14.8 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 30.2 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 91 m-stories
14% *Adjustment for South Side*

West Side
4 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
16% *Adjustment for West Side*

42% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

14000 L/min
233 L/s **Required Fire Flow**
3699 USGPM

Required Fire Flow Calculations (FUS 2020) - 6 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 6 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,281 m^2 Gross Floor Area
1281 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
12000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
10200 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
9.9 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
20% *Adjustment for North Side*

East Side
3 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
21% *Adjustment for East Side*

South Side
31 m Building Separation
Apply corresponding maximum exposure charge? Yes
0% *Adjustment for South Side*

West Side
15.7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for West Side*

52% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

16000	L/min	
267	L/s	**Required Fire Flow**
4227	USGPM	

Required Fire Flow Calculations (FUS 2020) - 6 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 6 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,281 m^2 Gross Floor Area
1281 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
12000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
10200 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
9.9 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
20% *Adjustment for North Side*

East Side
17.7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for East Side*

South Side
11.8 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.2 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 37 m-stories
11% *Adjustment for South Side*

West Side
3 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
21% *Adjustment for West Side*

63% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

17000 L/min
283 L/s **Required Fire Flow**
4491 USGPM

Required Fire Flow Calculations (FUS 2020) - 5 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 5 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,070 m^2 Gross Floor Area
1070 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
11000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
9350 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
16.7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for North Side*

East Side
23.6 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
10% *Adjustment for East Side*

South Side
7 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
16% *Adjustment for South Side*

West Side
14.5 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 36.3 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 109 m-stories
15% *Adjustment for West Side*

52% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

14000 L/min
233 L/s **Required Fire Flow**
3699 USGPM

Required Fire Flow Calculations (FUS 2020) - 5 Unit w/o Firewall

Project Title: Shearling Heights
Project No.: 2017-4568
Municipality Milton
Building/Parcel: 5 Unit w/o Firewall

Required Fire Flow

A - Construction Type
Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area
If Construction C Value >= 1.0:
1,070 m^2 Gross Floor Area
1070 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)
11000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy
Occupancy Group: C - Residential
Category: Residential occupancies
Sub-category: -
Occupancy and Contents: Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
9350 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System
Is an automatic sprinkler system in accordance with NFPA 13 present? No
Is the water supply standard for both the system and fire department hose required? No
Is the system fully supervised? No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side
11.8 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for North Side*

East Side
16.1 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 30.2 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 91 m-stories
14% *Adjustment for East Side*

South Side
13.6 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 12.7 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 38 m-stories
11% *Adjustment for South Side*

West Side
31 m Building Separation
Apply corresponding maximum exposure charge? Yes
0% *Adjustment for West Side*

36% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

13000 L/min
217 L/s **Required Fire Flow**
3435 USGPM

Required Fire Flow Calculations (FUS 2020) - 5 Unit w/o Firewall

Project Title:	Shearling Heights
Project No.:	2017-4568
Municipality	Milton
Building/Parcel:	5 Unit w/o Firewall

Required Fire Flow

A - Construction Type

Type of Construction: Type V - Wood Frame (Structure essentially all combustible)
Construction C Value: 1.5

B - Floor Area

If Construction C Value >= 1.0:

1,070 m^2 Gross Floor Area
1070 m^2 Total Floor Area Considered for RFF Calculation (Non fire-resistive construction)
*Includes all storeys, excludes basements at least 50% below grade

Height in Storeys
3 storeys

C - Required Fire Flow (Rounded, Unadjusted)

11000 L/min *Required Fire Flow (Unadjusted)*

Adjustments

D - Fire Hazard Occupancy

Occupancy Group:	C - Residential
Category:	Residential occupancies
Sub-category:	-
Occupancy and Contents:	Limited Combustible

-15% *Total Adjustment for Fire Hazard Occupancy*
9350 L/min *Required Fire Flow (Unadjusted)*

E - Sprinkler System

Is an automatic sprinkler system in accordance with NFPA 13 present?	No
Is the water supply standard for both the system and fire department hose required?	No
Is the system fully supervised?	No

0% *Total Adjustment for Sprinkler System*

F - Building Exposure

North Side

13.6 m Building Separation
Apply corresponding maximum exposure charge? No
Is the building exposed to the subject building fully protected with an automatic sprinkler system? No
Is there a fire wall (minimum 2-hr rating, protected per NBC) between the subject building and exposed building? No
Length of exposed building facing wall 18 m
Height of exposed building facing wall 12 m
Length-height factor of exposing face 54 m-stories
12% *Adjustment for North Side*

East Side

35 m Building Separation
Apply corresponding maximum exposure charge? Yes
0% *Adjustment for East Side*

South Side

31 m Building Separation
Apply corresponding maximum exposure charge? Yes
0% *Adjustment for South Side*

West Side

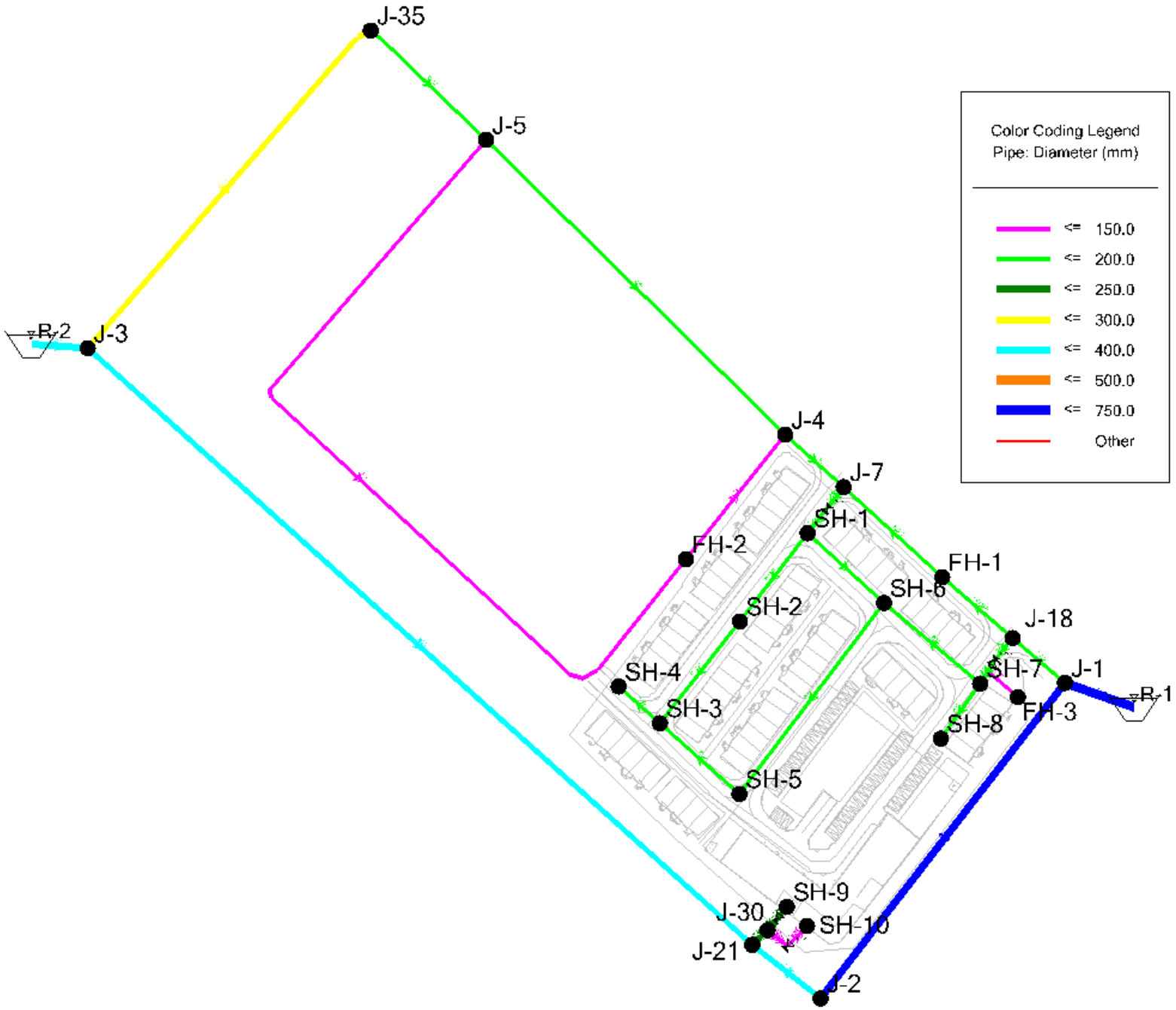
35 m Building Separation
Apply corresponding maximum exposure charge? Yes
0% *Adjustment for West Side*

12% *Total Adjustment for Building Exposure*

G - Net Required Fire Flow

10000 L/min
167 L/s **Required Fire Flow**
2642 USGPM

WaterCAD Model Layout



Scenario: Average Day Condition
Current Time Step: 0.000 h
FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)	Pressure Head (m)
109	SH-10	188.85	0.75	245.23	80.0	56.38
122	SH-3	189.05	0.07	246.87	82.1	57.82
124	SH-5	188.90	0.07	246.87	82.3	57.97
135	SH-4	188.65	0.07	246.87	82.6	58.22
165	SH-2	188.38	0.00	246.87	83.0	58.49
130	SH-8	188.14	0.07	246.87	83.4	58.73
126	SH-6	188.13	0.07	246.87	83.4	58.74
132	FH-3	187.88	0.00	246.87	83.7	58.99
101	SH-1	187.80	0.07	246.87	83.8	59.07
128	SH-7	187.77	0.07	246.87	83.9	59.10
148	SH-9	188.85	0.00	248.29	84.4	59.44
142	J-30	188.52	0.00	248.29	84.8	59.77
118	J-21	188.52	0.00	248.29	84.8	59.77
55	FH-2	187.98	0.00	248.29	85.6	60.31
50	J-4	187.74	0.00	248.29	85.9	60.55
86	J-7	187.70	0.00	248.29	86.0	60.59
145	FH-1	187.58	0.00	248.29	86.2	60.71
106	J-18	187.50	0.00	248.29	86.3	60.79

W:\4500's\4568 - Britannia and Bronte Condominium\WaterCAD\2026-02-23-4568-Main Sail Estates-PD M4.wtg

Scenario: Max Day + Fire Condition
Current Time Step: 0.000 h
FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)	Pressure Head (m)
109	SH-10	188.85	1.42	244.87	79.5	56.02
122	SH-3	189.05	0.13	245.65	80.3	56.60
124	SH-5	188.90	0.13	245.65	80.6	56.75
135	SH-4	188.65	0.13	245.65	80.9	57.00
165	SH-2	188.38	0.00	245.65	81.3	57.27
130	SH-8	188.14	0.13	245.65	81.6	57.51
126	SH-6	188.13	0.13	245.65	81.6	57.52
132	FH-3	187.88	0.00	245.65	82.0	57.77
101	SH-1	187.80	0.13	245.65	82.1	57.85
128	SH-7	187.77	0.13	245.65	82.2	57.88
148	SH-9	188.85	0.00	248.29	84.4	59.44
142	J-30	188.52	0.00	248.29	84.8	59.77
118	J-21	188.52	0.00	248.29	84.8	59.77
55	FH-2	187.98	0.00	248.29	85.6	60.31
50	J-4	187.74	0.00	248.29	85.9	60.55
86	J-7	187.70	0.00	248.29	86.0	60.59
145	FH-1	187.58	0.00	248.29	86.2	60.71
106	J-18	187.50	0.00	248.29	86.3	60.79

W:\4500's\4568 - Britannia and Bronte Condominium\WaterCAD\2026-02-23-4568-Main Sail Estates-PD M4.wtg

Scenario: Max Day + Fire Condition
Current Time Step: 0.000 h
Fire Flow Node FlexTable: Fire Flow Results Table

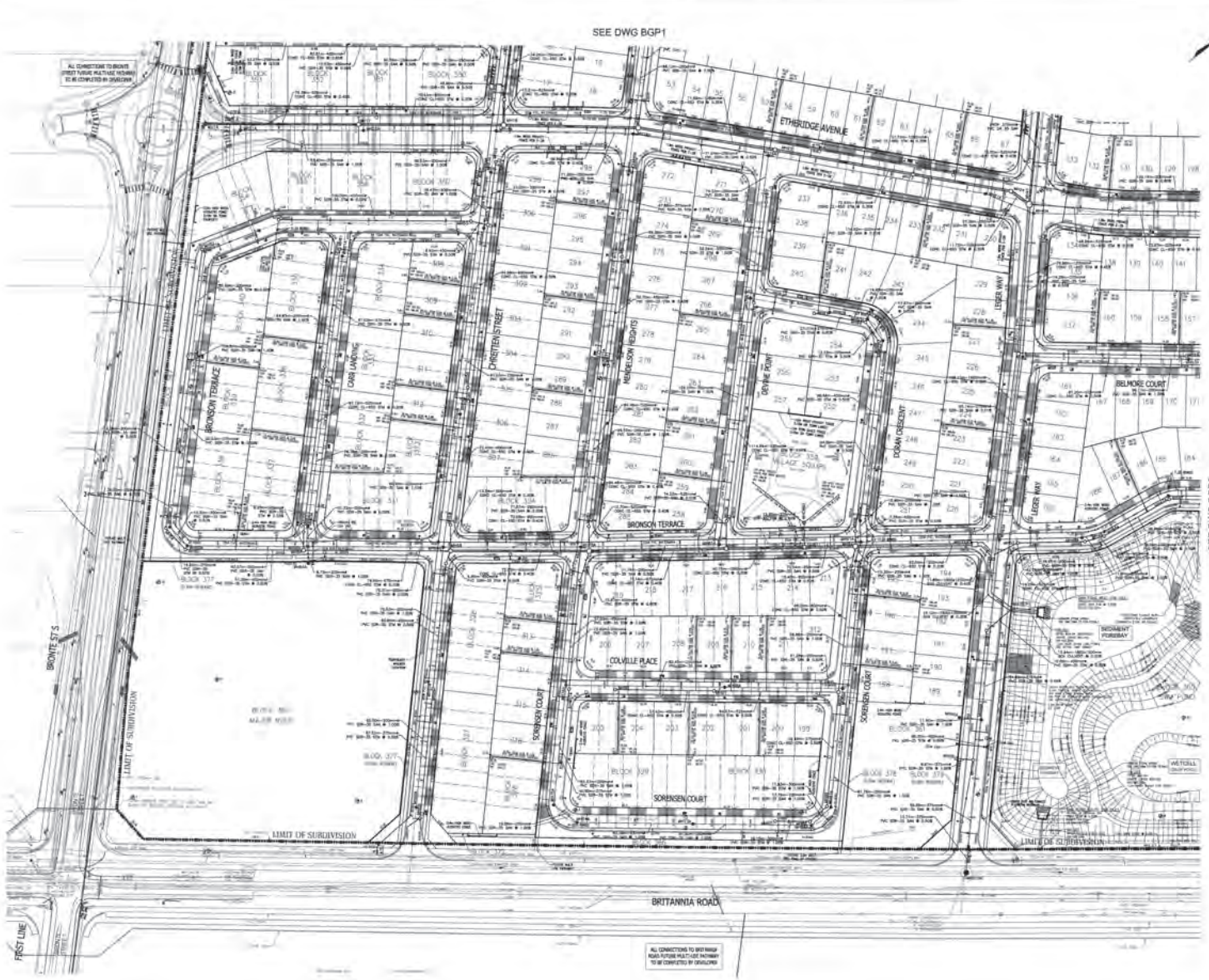
Label	Elevation (m)	Satisfies Fire Flow Constraints?	Demand (L/s)	Fire Flow (Needed) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Calculated Residual @ Total Flow Needed) (psi)	Hydraulic Grade (m)
SH-2	188.38	True	0.00	300.00	300.00	334.32	31.0	245.65
SH-5	188.90	True	0.13	266.67	266.80	310.54	34.9	245.65
SH-4	188.65	True	0.13	233.33	233.46	273.64	35.3	245.65
SH-3	189.05	True	0.13	233.33	233.46	309.97	44.4	245.65
SH-6	188.13	True	0.13	283.33	283.46	398.88	48.2	245.65
SH-1	187.80	True	0.13	233.33	233.46	406.08	58.9	245.65
SH-7	187.77	True	0.13	233.33	233.46	419.32	59.9	245.65
SH-8	188.14	True	0.13	166.67	166.80	325.18	62.6	245.65
FH-3	187.88	True	0.00	90.00	90.00	224.70	69.2	245.65
FH-2	187.98	True	0.00	90.00	90.00	198.44	70.4	248.29
SH-9	188.85	True	0.00	166.67	166.67	500.00	76.6	248.29
FH-1	187.58	True	0.00	90.00	90.00	500.00	83.7	248.29

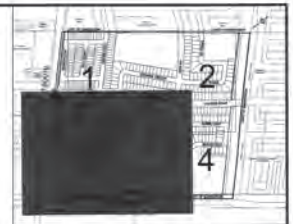
Scenario: Peak Hour Condition
Current Time Step: 0.000 h
FlexTable: Junction Table

ID	Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)	Pressure Head (m)
109	SH-10	188.85	2.24	244.41	78.9	55.56
122	SH-3	189.05	0.21	244.61	78.9	55.56
124	SH-5	188.90	0.21	244.61	79.1	55.71
135	SH-4	188.65	0.21	244.61	79.4	55.96
165	SH-2	188.38	0.00	244.61	79.8	56.24
130	SH-8	188.14	0.21	244.61	80.2	56.47
126	SH-6	188.13	0.21	244.61	80.2	56.48
132	FH-3	187.88	0.00	244.61	80.5	56.73
101	SH-1	187.80	0.21	244.61	80.6	56.81
128	SH-7	187.77	0.21	244.61	80.7	56.84
148	SH-9	188.85	0.00	248.29	84.4	59.44
142	J-30	188.52	0.00	248.29	84.8	59.77
118	J-21	188.52	0.00	248.29	84.8	59.77
55	FH-2	187.98	0.00	248.29	85.6	60.31
50	J-4	187.74	0.00	248.29	85.9	60.55
86	J-7	187.70	0.00	248.29	86.0	60.59
145	FH-1	187.58	0.00	248.29	86.2	60.71
106	J-18	187.50	0.00	248.29	86.3	60.79

W:\4500's\4568 - Britannia and Bronte Condominium\WaterCAD\2026-02-23-4568-Main Sail Estates-PD M4.wtg

Appendix B: Sanitary & Background





LEGEND

NOTE: SUMP PUMPS TO BE INSTALLED ON ALL LOTS

BENCHMARK:

LOCAL BENCHMARK:

No.	By	Date	Comments	Approved
10	DAS	JAN 2017	ISSUED FOR REVIEW	
9	DAS	NOV 2016	REVISED PER TOWN COMMENTS	
8	DAS	AUG 2016	REVISED PER TOWN COMMENTS	
7	DWG	JUNE 2016	[illegible]	
6	DWG	JUNE 2016	[illegible]	
5	DWG	MAY 2016	[illegible]	

TOWN OF MILTON
ENGINEERING SERVICES DEPARTMENT

DIRECTOR OF ENGINEERING SERVICES

D. N. SCOTT

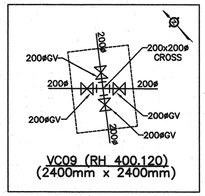
TMIG
The Municipal Infrastructure Group Ltd
8800 Dufferin Street
Suite 300
Vaughan, ON
L4K 0C2
p. 905.738.5757
f. 905.738.0015

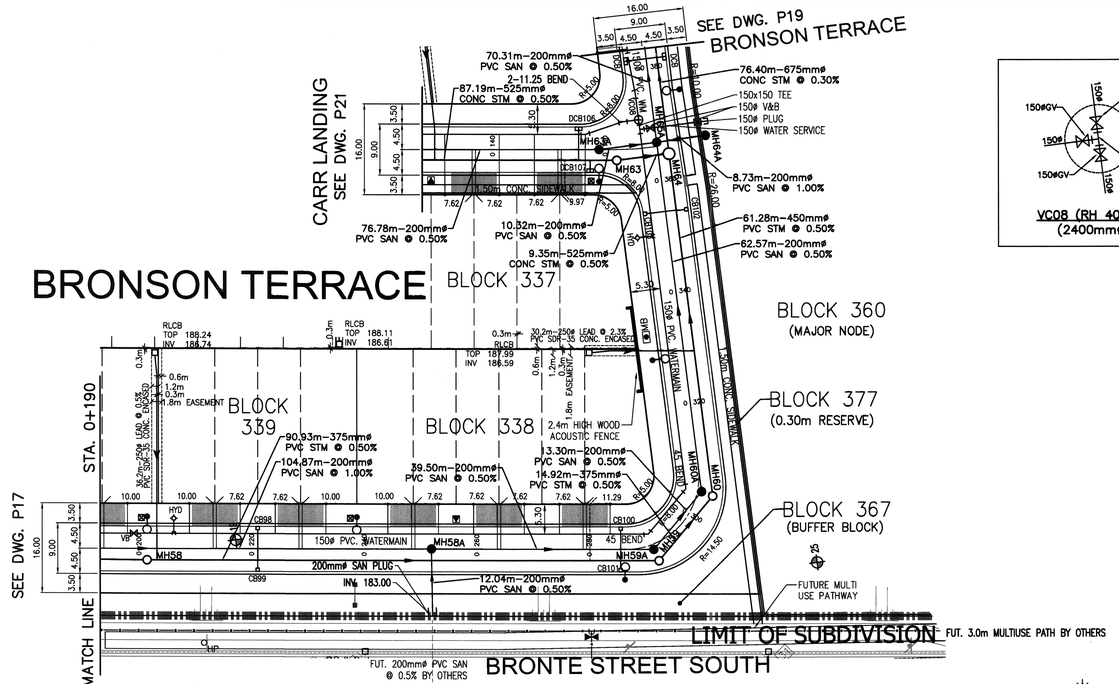
MAIN SAIL ESTATES INC.
SUBDIVISION

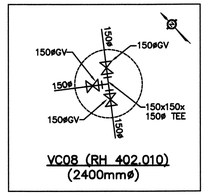
BELOW GROUND
SERVICES PLAN

SCALE: 1:1000	PROJECT No: 12108
DATE: JAN 2015	
DESIGNED BY: W.C.	DRAWN BY: CAD
CHECKED BY: D.S.	CHECKED BY: K.B.
PROJECT No./YEAR No.: 241-149564	DRAWING No: BGP3

DM - 1005


200ø
200ø
200ø

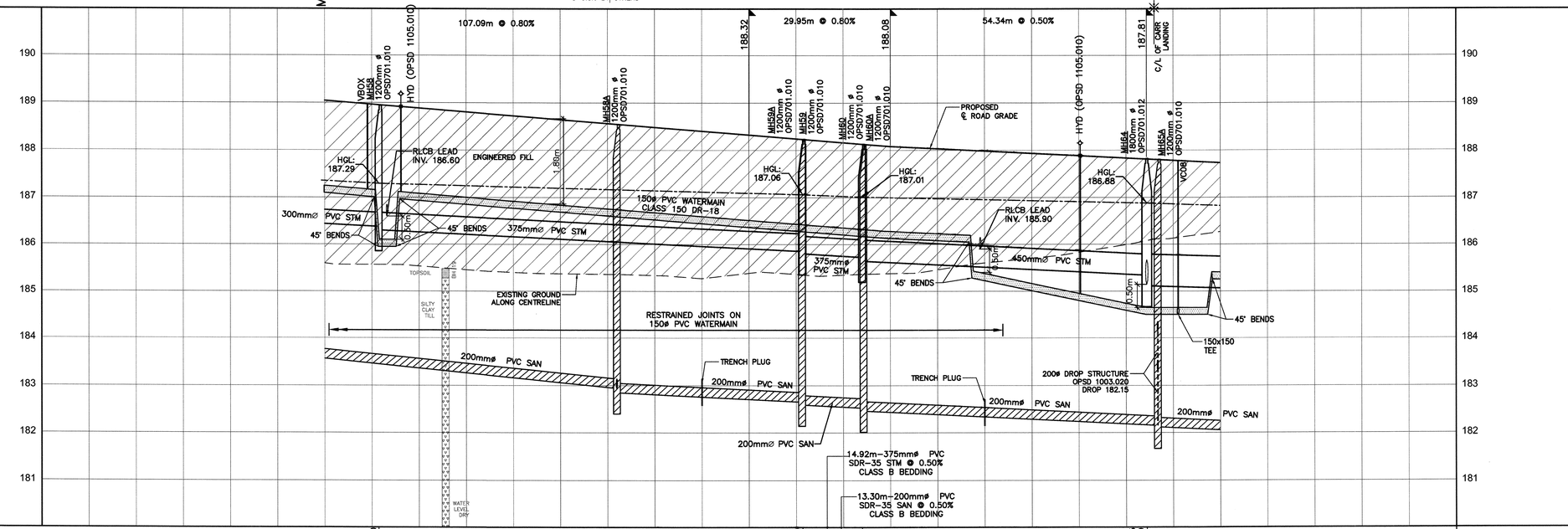




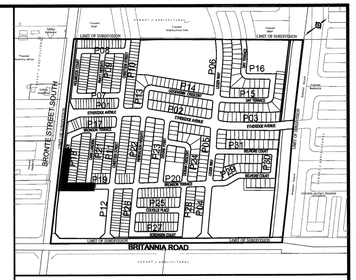
VC08 (RH 402.010)
(2400mmø)

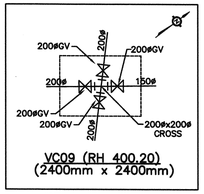
PAVEMENT DESIGN (Minor Collector)

COURSE	THICKNESS (mm)	OPS SPECIFICATIONS
ASPHALT SURFACE COURSE	40	HL–3
ASPHALT BINDER COURSE	80	HL–8
GRANULAR BASE	150	GRANULAR 'A'
GRANULAR SUB–BASE	375	GRANULAR 'B' TYPE II

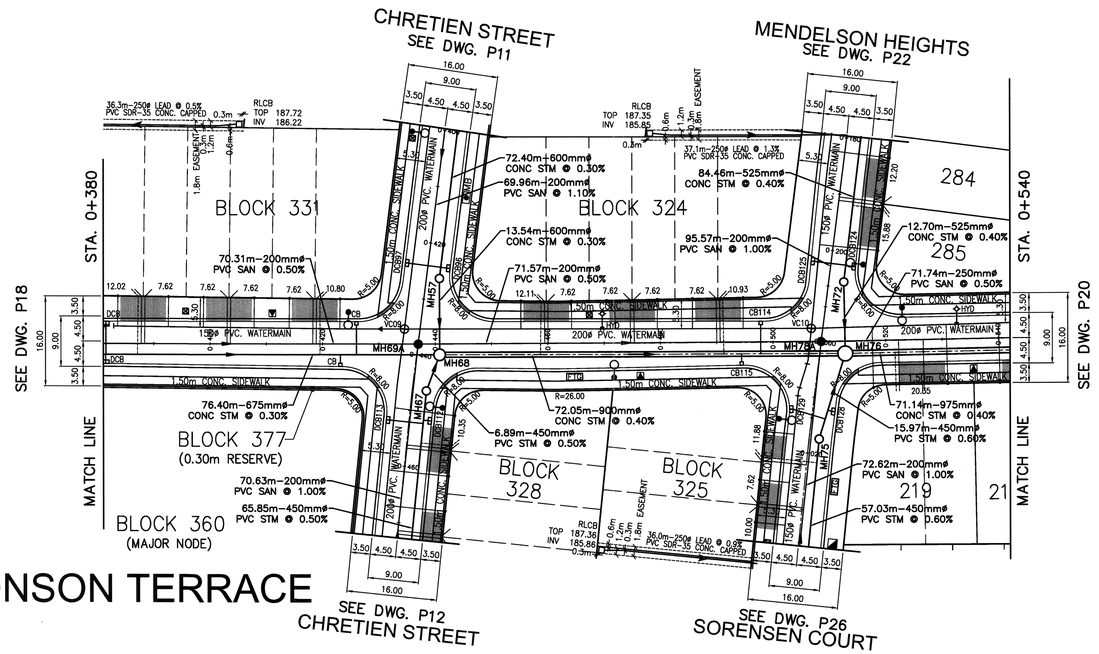


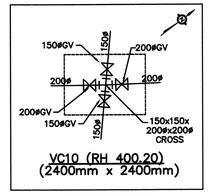
55.30m–300mmø PVC SDR–35 STM @ 0.50% CLASS B BEDDING		90.93m–375mmø PVC SDR–35 STM @ 0.50% CLASS B BEDDING			61.28m–450mmø PVC SDR–35 STM @ 0.50% CLASS B BEDDING			76.40m–675mmø CONC CL–650 STM @ 0.30% CLASS B BEDDING			PROPOSED STORM SEWER INVERTS
NW185.390 SE185.305		NW185.850 E185.800			W185.725 NE185.645			NW185.145 SW185.339 SE184.144		NE185.114	
104.87m–200mmø PVC SDR–35 SAN @ 1.00% CLASS B BEDDING			39.50m–200mmø PVC SDR–35 SAN @ 0.50% CLASS B BEDDING			62.57m–200mmø PVC SDR–35 SAN @ 0.50% CLASS B BEDDING			70.31m–200mmø PVC SDR–35 SAN @ 0.50% CLASS B BEDDING			PROPOSED SANITARY SEWER INVERTS
	NW182.940 SW182.940 SE182.850			NW182.852 E182.592		W182.525 NE182.465			NW183.322 SW183.172 SE184.144 NE182.122			
185.57 188.96	185.46 188.80	185.37 188.64	185.34 188.48	185.38 188.32	185.35 188.16	185.46 188.03	185.70 187.93	185.99 187.83	186.27 187.73			PROPOSED CENTRELINE ELEVATIONS
0+200	0+220	0+240	0+260	0+280	0+300	0+320	0+340	0+360	0+380			CENTERLINE CHAINAGE





VC09 (RH 400.20)
(2400mm x 2400mm)

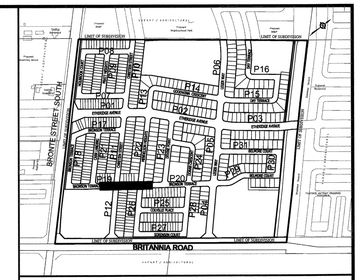




VC10 (RH 400.20)
(2400mm x 2400mm)

PAVEMENT DESIGN (Minor Collector)

COURSE	THICKNESS (mm)	OPS SPECIFICATIONS
ASPHALT SURFACE COURSE	40	HL–3
ASPHALT BINDER COURSE	80	HL–8
GRANULAR BASE	150	GRANULAR 'A'
GRANULAR SUB–BASE	375	GRANULAR 'B' TYPE II



LEGEND

- PROPOSED SANITARY MANHOLE
- PROPOSED STORM MANHOLE
- CB PROPOSED CATCHBASIN
- DCB PROPOSED CATCHBASIN
- PROPOSED VALVE & CHAMBER
- VB PROPOSED VALVE & BOX
- HYD PROPOSED HYDRANT & VALVE
- 21 BOREHOLE
- 34 PROPOSED LOT NUMBERS
- WATERBOX LOCATIONS
- PROPOSED DRIVEWAY LOCATION
- SANITARY SERVICE CONNECTION (TYP.)
- STORM SERVICE CONNECTION (TYP.)
- LIMIT OF SUBDIVISION
- LIMIT OF PHASE
- BLACK VINYL CHAIN LINK FENCE
- WOOD ACOUSTIC FENCE
- 1.5m IRON EAGLE FENCE 0.10m ON TOWN LANDS
- 1.8m WOOD PRIVACY FENCE
- DEAD END BARRICADE PER OPSD 912.532
- HYDRO TRANSFORMER
- CABLE TV PEDESTAL
- BELL PEDESTAL
- STREET LIGHTS
- MB MAIL BOX

WATERMAIN IN FILL NOTES:

1. NO WATERMAIN TO BE LAID ON FILL UNTIL THE FIELD DENSITY TEST REPORTS HAVE BEEN SUBMITTED TO AND APPROVED BY THE REGION.
2. FILL TO BE PLACED TO 600mm MIN. ABOVE THE OBVERT OF THE WATERMAIN AND TO 3.0m EITHER SIDE, COMPACTED TO MIN. 100% STD. DENSITY IN 300mm LIFTS.
3. TESTS SHALL BE TAKEN ALONG CENTRE LINE OF WATERMAIN AND 1.50m TO EITHER SIDE OF WATERMAIN AT A MAX. INTERVAL OF 30.0m FOR EACH 600mm LIFT.
4. ALL HYDRANTS, TEE BRANCH VALVES AND HORIZONTAL BENDS ARE TO BE MECHANICALLY RESTRAINED WITH THE RODS IN ADDITION TO CONCRETE BLOCKING.
5. NO JOINT DEFLECTION IS ALLOWED IN FILL AREAS.

BENCHMARKS:

ELEVATIONS HEREON ARE DERIVED FROM THE MINISTRY OF TRANSPORTATION BENCHMARK No. 00819828155, A TABLET IN CONCRETE CULVERT UNDER BRITANNIA ROAD WEST, 1.4km WEST OF HWY 25, 75.4m WEST OF FIRST LINE RD, 6.3m NORTH OF CENTRELINE OF BRITANNIA ROAD WEST. TABLET IS SET VERTICALLY IN TOP OF NORTH END OF CULVERT, 33cm SOUTH OF NORTH END OF CULVERT, 32cm WEST OF EAST FACE OF CULVERT. ELEVATION = 185.351 METRES.

LOCAL BENCHMARK:

CC ON SOUTH END OF CONCRETE CULVERT UNDER BRITANNIA ROAD WEST, AS SHOWN ON FACE OF PLAN. ELEVATION = 184.15 METRES.

No.	By	Date	Description	Approval
12	D.N.S.	JAN 2017	ISSUED FOR MYLARS	
11	D.N.S.	NOV 2016	REVISED PER TOWN COMMENTS	
10	D.N.S.	OCT 2016	ISSUED FOR ROUNDABOUT CHANGES	
9	D.N.S.	AUG 2016	ISSUED FOR CHANGE ORDER/CONSTRUCTION	
8	D.N.S.	AUG 2016	REVISED PER TOWN COMMENTS	

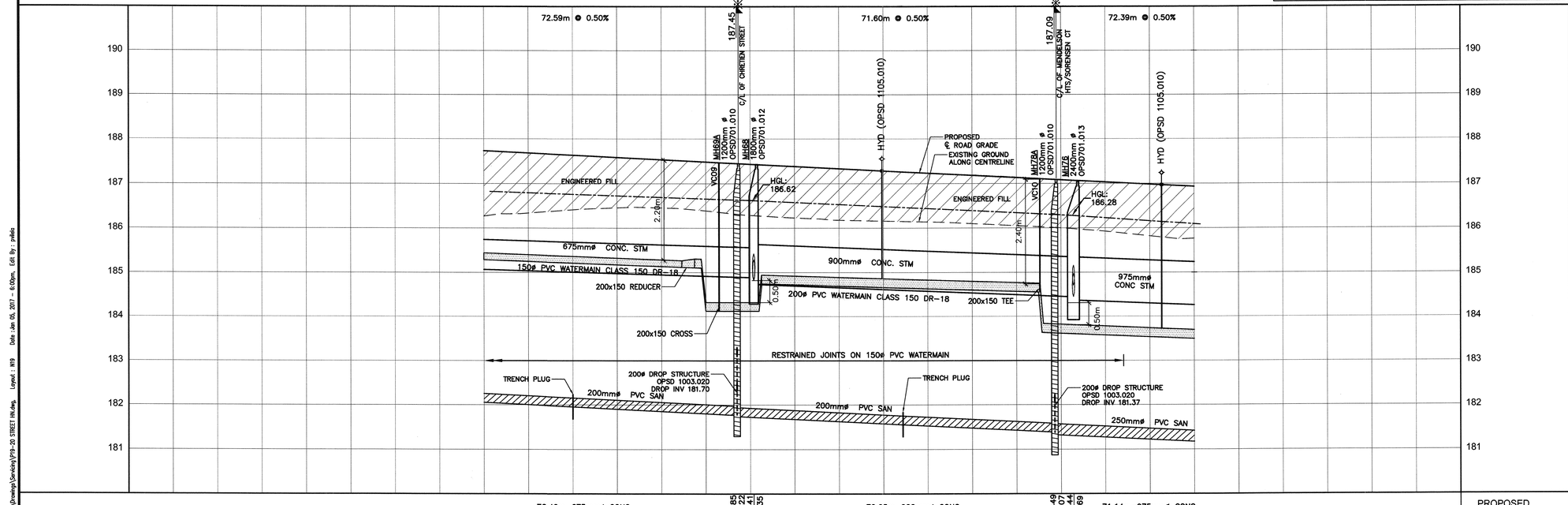
TOWN OF MILTON
ENGINEERING SERVICES DEPARTMENT

4/13/17
DIRECTOR OF ENGINEERING SERVICES

Professional Stamp:
LICENSED PROFESSIONAL ENGINEER
D. N. SCOTT
4/17/17
PROVINCE OF ONTARIO

Regional:
DESIGN OF WASTEWATER AND WATER SERVICES APPROVED SUBJECT TO DETAIL CONSTRUCTION CONFORMING TO HALTON STANDARDS AND SPECIFICATIONS AND LOCATION APPROVAL FROM AREA MUNICIPALITY.

Signed:
Legislative & Planning Services, Halton Region
Date:



PROPOSED STORM SEWER INVERTS			76.40m–675mmϕ CONC CL–65D STM @ 0.30% CLASS B BEDDING					SW184.885 NW184.822 SE184.641 NE184.735			72.05m–900mmϕ CONC CL–65D STM @ 0.40% CLASS B BEDDING				NW184.449 SE184.707 SW184.444 NE184.569	71.14m–975mmϕ CONC CL–65D STM @ 0.40% CLASS B BEDDING					
PROPOSED SANITARY SEWER INVERTS			70.31m–200mmϕ PVC SDR–35 SAN @ 0.50% CLASS B BEDDING					SW181.771 NW181.705 SE183.109 NE181.743			71.57m–200mmϕ PVC SDR–35 SAN @ 0.50% CLASS B BEDDING				NW182.050 SE182.037 SW181.385 NE181.327	71.74m–250mmϕ PVC SDR–35 SAN @ 0.50% CLASS B BEDDING					
PROPOSED CENTRELINE ELEVATIONS	186.27	187.73		186.41	187.63		186.45	187.53		186.29	187.43		186.18	187.33		186.14	187.23		186.05	187.13		185.92	187.03		185.76	186.93
CENTERLINE CHAINAGE	0+380			0+400			0+420			0+440			0+460			0+480			0+500			0+520			0+540	

TMIG
The Municipal Infrastructure Group Ltd
8800 Dufferin Street, Suite 200, Vaughan, ON L4K 0C5
p: 905.738.5700
f: 905.738.0065

MAIN SAIL ESTATES INC.
SUBDIVISION

BRONSON TERRACE

STA. 0+380 TO STA. 0+540
FROM 32m WEST OF CARR LANDINGTO 34.8m EAST OF MENDELSON HEIGHTS

SCALE: HOR. 1:500	VER. 1:50	PROJECT No.	12108
DATE: AUG 2016			
DESIGNED BY: W.G.	DRAWN BY: CAD	DRAWING No.	P19
CHECKED BY: D.S.	CHECKED BY: E.B.		
PROJECT No./24T No.:	24T-14006 M		

File : C:\Projects\2012\12108 – Tristan Main Sail Subdivision Milton\Drawings\Servicing\P19–20 STREET PR.dwg Layout : P19 Date : Jan 05, 2017 – 8:00am Edit By : pvieles

DM - 1005

SANITARY SEWER DESIGN

The Regional Municipality of Halton

Project No. 12108
Location Trinison Main Sail Subdivision
Town of Milton

Date August 2016
Designed By IM
Checked By BG

Street	Manhole From	Manhole To	Length in metres	Tributary Area Hectare Increment Res. S.F.	Townhouse	Semi	Inst	Comm.	Total	Population Tributary Increment Res. S.F.	Townhouse	Semi	Inst	Comm.	Total	Average Increment L/s	Average Total L/s	Peaking Factor	Max. Flow L/s	Infiltration L/s	Max. Flow Expect L/s	SEWER Size (mm)	Slope (%)	Q (L/s)	V m/s Full Flow	Act. Flow	PIPE Type	Class	REMARKS CAPACITY
TRINISON (MAINSAIL ESTATE)																													
External - Fieldgate Mixed Use	Commercial	Stub	3.0	0				14.28	14.28	0.00	0.00	0.00	0.00	1285.20	1285.20	4.09	4.09063	3.73	15.25	4.08	19.33	250	0.50	42.050	0.86	0.83			45.97
External - Church Lands	Stub	MH24A	3.0	35.74					50.02	2680.09	0.00	0.00	0.00		3865.20	8.53	12.62072	3.34	42.11	14.31	56.42	375	0.50	123.977	1.12	1.09			45.91
Leger Way	MH24A	MH25A	43.9	0.16					50.21	10.45	0.00	0.00	0.00		3975.65	0.03	12.65398	3.34	42.21	14.36	56.57	375	0.40	110.889	1.00	1.00			51.02
Leger Way	MH25A	MH27A	76.4	0.36					50.56	19.25	0.00	0.00	0.00		3994.90	0.06	12.71525	3.33	42.39	14.46	56.85	375	0.40	110.889	1.00	1.00			51.27
School Blk 368	MH26A	MH27A	10.3				2.77		2.77	0.00	0.00	0.00	111		110.80	0.35	0.35266	4.23	1.49	0.79	2.28	200	1.00	32.798	1.04	0.57			6.96
Leger Way	MH27A	MH37A	56.3	0.27					53.60	14.85	0.00	0.00	0		4120.55	0.05	13.11518	3.32	43.57	15.33	58.90	375	0.50	123.977	1.12	1.10			47.50
Day Terrace	MH28A	MH29A	32.5	0.14					0.14	7.70	0.00	0.00	0.00		7.70	0.02	0.02451	4.42	0.11	0.29	0.39	200	1.00	32.798	1.04	0.13			1.20
Day Terrace	MH29A	MH30A	57.6	0.25					0.39	13.75	0.00	0.00	0.00		21.45	0.04	0.06827	4.38	0.30	0.29	0.58	200	1.00	32.798	1.04	0.18			1.78
Day Terrace	MH30A	MH31A	12.5	0.15					0.54	8.25	0.00	0.00	0.00		29.70	0.03	0.09453	4.36	0.41	0.29	0.70	200	1.00	32.798	1.04	0.22			2.13
Day Terrace	MH31A	MH32A	72.2	0.41					0.95	22.55	0.00	0.00	0.00		52.25	0.07	0.16630	4.31	0.72	0.29	1.00	200	0.85	30.239	0.95	0.32			3.32
Day Terrace	MH32A	MH33A	12.6	0.07					1.02	3.85	0.00	0.00	0.00		56.10	0.01	0.17856	4.30	0.77	0.29	1.06	200	0.50	23.192	0.74	0.33			4.57
Day Terrace	MH33A	MH34A	55.4	0.25					1.27	13.75	0.00	0.00	0.00		69.85	0.04	0.22232	4.28	0.95	0.36	1.32	200	0.50	23.192	0.74	0.38			5.67
Day Terrace	MH34A	MH35A	11.5	0.17					1.44	9.35	0.00	0.00	0.00		79.20	0.03	0.25208	4.27	1.08	0.41	1.49	200	0.50	23.192	0.74	0.39			6.42
Day Terrace	MH35A	MH36A	121.4	0.82					2.26	45.10	0.00	0.00	0.00		124.30	0.14	0.39563	4.22	1.67	0.65	2.31	200	0.50	23.192	0.74	0.46			9.98
Day Terrace	MH36A	MH37A	30.4	0.16					2.42	8.80	0.00	0.00	0.00		133.10	0.03	0.42364	4.21	1.78	0.69	2.47	200	0.50	23.192	0.74	0.47			10.67
Goodwin Crescent	MH16A	MH22A	58.0	0.71					0.71	39.05	0.00	0.00	0.00		39.05	0.12	0.12429	4.34	0.54	0.29	0.82	200	1.00	32.798	1.04	0.26			2.51
Goodwin Crescent	MH22A	MH23A	89.6	0.66					1.37	36.30	0.00	0.00	0.00		75.35	0.12	0.23983	4.26	1.03	0.39	1.42	200	1.00	32.798	1.04	0.45			4.32
Goodwin Crescent	MH23A	MH37A	11.6	0					1.37	0.00	0.00	0.00	0.00		75.35	0.00	0.23983	4.26	1.03	0.39	1.42	200	1.00	32.798	1.04	0.45			4.32
Leger Way	MH37A	MH40A	79.5	0.13					57.52	7.15	0.00	0.00	0.00		4336.15	0.02	13.80140	3.30	45.57	16.45	62.02	375	0.50	123.977	1.12	1.11			50.02
External - Chrisben Street	MH57A(EXT.)	MH2A	10.5	5.78					5.78	434.00	0.00	0.00	0.00		434.00	1.36	1.38137	4.01	5.53	1.65	7.19	200	0.50	23.192	0.74	0.65			30.98
Chrisben Street	MH2A	MH3A	35.6				0.16		5.94	0.00	0.00	16.00	0.00		450.00	0.05	1.43229	4.00	5.73	1.70	7.42	200	0.50	23.192	0.74	0.65			32.01
Hollbrook Court	MH1A	MH3A	134.5		0.61				0.61	0.00	82.35	0.00	0.00		82.35	0.26	0.26211	4.27	1.12	0.29	1.40	200	0.50	23.192	0.74	0.39			6.05
Chrisben Street	MH3A	MH4A	53.8			0.34			6.89	0.00	0.00	34.00	0.00		566.35	0.11	1.80262	3.95	7.11	1.97	9.08	200	0.50	23.192	0.74	0.69			39.17
Chrisben Street	MH4A	MH13A	81.2			0.59			7.48	0.00	0.00	59.00	0.00		625.35	0.19	1.99041	3.92	7.81	2.14	9.95	200	1.50	40.170	1.28	1.05			24.78
External - Fieldgate District Park	Park	SCHOOL	100.0	0				16.19	16.19	0.00	0.00	0.00	647.60	0.00	647.60	2.06	2.06123	3.91	8.07	4.63	12.70	200	0.50	23.192	0.74	0.74			54.75
External - SCHOOL	SCHOOL	MH5A	50.0	0				6.77	22.96	0.00	0.00	0.00	270.80	0.00	918.40	0.86	2.92315	3.82	11.16	6.57	17.74	200	0.50	23.192	0.74	0.80			76.51
Hollbrook Court	MH5A	MH6A	73.3		0.38				23.34	0.00	51.30	0.00	0.00		969.70	0.16	3.08643	3.81	11.75	6.68	18.43	200	0.50	23.192	0.74	0.81			79.47
Hollbrook Court	MH6A	MH7A	41.5		0.19				23.53	0.00	25.65	0.00	0.00		995.35	0.08	3.16807	3.80	12.04	6.73	18.77	200	0.50	23.192	0.74	0.81			80.94
Hollbrook Court	MH7A	MH8A	13.5						23.53	0.00	0.00	0.00	0.00		995.35	0.00	3.16807	3.80	12.04	6.73	18.77	250	0.50	42.050	0.86	0.83			44.64
Hollbrook Court	MH8A	MH11A	63.3						23.53	0.00	0.00	0.00	0.00		995.35	0.00	3.16807	3.80	12.04	6.73	18.77	250	0.50	42.050	0.86	0.83			44.64
Pratt Heights	MH9A	MH10A	165.2		0.94				0.94	0.00	126.90	0.00	0.00		126.90	0.40	0.40391	4.21	1.70	0.29	1.99	200	1.25	36.670	1.17	0.69			5.42
Pratt Heights	MH10A	MH11A	13.3						0.94	0.00	0.00	0.00	0.00		126.90	0.00	0.40391	4.21	1.70	0.29	1.99	200	0.50	23.192	0.74	0.43			6.57
Holbrook Court	MH11A	MH12A	60.4						24.47	0.00	0.00	0.00	0.00		1122.25	0.00	3.57198	3.77	13.46	7.00	20.45	250	0.50	42.050	0.86	0.84			48.64
Holbrook Court	MH12A	MH13A	9.3						24.47	0.00	0.00	0.00	0.00		1122.25	0.00	3.57198	3.77	13.46	7.00	20.45	250	0.50	42.050	0.86	0.84			48.64
Chrisben Street	MH13A	MH15A	48.9			0.22			32.17	0.00	0.00	22.00	0.00		1769.60	0.07	5.63241	3.63	20.43	9.20	29.63	250	0.50	42.050	0.86	0.91			70.46
Etheridge Avenue	MH51A	MH52A	63.9		0.60				0.60	0.00	81.00	0.00	0.00		81.00	0.26	0.25781	4.27	1.10	0.29	1.39	200	1.00	32.798	1.04	0.44			4.23
Etheridge Avenue	MH52A	MH15A	69.9		0.57				1.17	0.00	76.95	0.00	0.00		157.95	0.24	0.50273	4.18	2.10	0.33	2.44	200	1.00	32.798	1.04	0.58			7.43
Etheridge Avenue	MH15A	MH18A	71.3						33.34	0.00	0.00	0.00	0.00		1927.55	0.00	6.13514	3.60	22.08	9.54	31.61	250	0.50	42.050	0.86	0.93			75.17
Goodwin Crescent	MH16A	MH17A	14.5	0.16					0.16	8.80	0.00	0.00	0.00		8.80	0.03	0.02801	4.42	0.12	0.29	0.41	200	1.00	32.798	1.04	0.13			1.25
Goodwin Crescent	MH17A	MH18A	68.1	0.35					0.51	19.25	0.00	0.00	0.00		28.05	0.06	0.06926	4.36	0.39	0.29	0.68	200	2.00	46.384	1.48	0.21			1.46

SANITARY SEWER DESIGN

The Regional Municipality of Halton

Project No. 12108
Location Trinison Main Sail Subdivision
Town of Milton

Date August 2016
Designed By IM
Checked By BG

Street	Manhole From	Manhole To	Length in metres	Tributary Area Hectare Increment Res. S.F.	Tributary Area Hectare Increment Townhouse	Semi	Inst	Comm	Total	Population Tributary Increment Res. S.F.	Townhouse	Semi	Inst	Comm.	Total	Average Increment L/s	Average Total L/s	Peaking Factor	Max. Flow L/s	Infiltration L/s	Max. Flow Expect L/s	SEWER Size (mm)	Slope (%)	Q (L/s)	V m/s Full Flow	V m/s Act. Flow	PIPE Type	Class	REMARKS CAPACITY
Etheridge Avenue	MH18A	MH19A	71.0	0.33					34.18	18.15	0.00	0.00	0.00		1973.75	0.06	6.28219	3.59	22.55	9.78	32.33	250	0.50	42.050	0.86	0.93			76.88
Etheridge Avenue	MH19A	MH21A	114.6	0.85					35.03	46.75	0.00	0.00	0.00		2020.50	0.15	6.43099	3.58	23.04	10.02	33.06	250	0.50	42.050	0.86	0.94			78.61
Etheridge Avenue	MH21A	MH40A	27.1	0.09					35.12	4.95	0.00	0.00	0.00		2025.45	0.02	6.44674	3.58	23.09	10.04	33.13	250	0.50	42.050	0.86	0.94			78.80
Etheridge Avenue	MH38A	MH39A	64.1	0.66					0.66	36.30	0.00	0.00	0.00		36.30	0.12	0.11554	4.34	0.50	0.29	0.79	200	1.00	32.798	1.04	0.25			2.40
Etheridge Avenue	MH39A	MH40A	120.1	0.76					1.42	41.80	0.00	0.00	0.00		78.10	0.13	0.24858	4.27	1.06	0.41	1.47	200	0.80	29.336	0.93	0.47			5.00
Leger Way	MH40A	MH44A	74.3	0.38					94.44	20.90	0.00	0.00	0.00		6460.60	0.07	20.56325	3.14	64.57	27.01	91.58	375	0.50	123.977	1.12	1.21			73.87
Bellmore Court	MH41A	MH42A	10.4	0.06					0.06	3.30	0.00	0.00	0.00		3.30	0.01	0.01050	4.45	0.05	0.29	0.33	200	1.00	32.798	1.04	0.10			1.01
Bellmore Court	MH42A	MH43A	91.0	0.55					0.61	30.25	0.00	0.00	0.00		33.55	0.10	0.10679	4.35	0.46	0.29	0.75	200	1.00	32.798	1.04	0.23			2.29
Bellmore Court	MH43A	MH44A	86.2	0.43					1.04	23.65	0.00	0.00	0.00		57.20	0.08	0.18206	4.30	0.78	0.30	1.08	200	1.00	32.798	1.04	0.33			3.30
Leger Way	MH44A	MH53A	95.7	0.73					96.21	40.15	0.00	0.00	0.00		6557.95	0.13	20.87310	3.13	65.41	27.52	92.93	375	0.51	125.211	1.13	1.22			74.22
Chrebin Street	MH52A	MH54A	20.5			0.22			0.22	0.00	0.00	22.00	0.00		22.00	0.07	0.07002	4.37	0.31	0.29	0.59	200	1.00	32.798	1.04	0.19			1.81
Chrebin Street	MH54A	MH55A	97.0			0.78			1.00	0.00	0.00	78.00	0.00		100.00	0.25	0.31829	4.24	1.35	0.29	1.64	200	1.00	32.798	1.04	0.51			4.99
Chrebin Street	MH55A	MH69A	70.0		0.09	0.13			1.22	0.00	12.15	13.00	0.00		125.15	0.06	0.39834	4.22	1.68	0.35	2.03	200	1.10	34.399	1.09	0.57			5.90
Bronson Terrace	MH56A	MH57A	30.0		0.15				0.15	0.00	20.25	0.00	0.00		20.25	0.06	0.06445	4.38	0.28	0.29	0.57	200	1.00	32.798	1.04	0.18			1.73
Bronson Terrace	MH57A	MH58A	104.9		0.47				0.62	0.00	63.45	0.00	0.00		83.70	0.20	0.26641	4.26	1.14	0.29	1.42	200	1.00	32.798	1.04	0.45			4.34
External - Boarllower	MH63A(EXT.)	MH58A	12.0	3.57					3.57	484.00	0.00	0.00	0.00		484.00	1.54	1.54051	3.58	6.13	1.02	7.15	200	0.50	23.192	0.74	0.65			30.85
Bronson Terrace	MH58A	MH59A	99.5		0.23				4.42	0.00	31.05	0.00	0.00		598.75	0.10	1.90574	3.93	7.49	1.26	8.76	200	0.50	23.192	0.74	0.68			37.77
Bronson Terrace	MH59A	MH60A	13.3						4.42	0.00	0.00	0.00	0.00		598.75	0.00	1.90574	3.93	7.49	1.26	8.76	200	0.50	23.192	0.74	0.68			37.77
Bronson Terrace	MH60A	MH65A	62.6						4.42	0.00	0.00	0.00	0.00		598.75	0.00	1.90574	3.93	7.49	1.26	8.76	200	0.50	23.192	0.74	0.68			37.77
Carr Landing	MH61A	MH62A	64.9		0.64				0.64	0.00	86.40	0.00	0.00		86.40	0.28	0.27500	4.26	1.17	0.29	1.46	200	1.00	32.798	1.04	0.46			4.44
Carr Landing	MH62A	MH63A	76.8		0.53				1.17	0.00	71.55	0.00	0.00		157.95	0.23	0.50273	4.18	2.10	0.33	2.44	200	0.50	23.192	0.74	0.47			10.51
Carr Landing	MH63A	MH65A	10.3						1.17	0.00	0.00	0.00	0.00		157.95	0.00	0.50273	4.18	2.10	0.33	2.44	200	0.50	23.192	0.74	0.47			10.51
Com. Blk 370	MH64A	MH65A	8.7					2.10	2.10	0.00	0.00	0.00	0.00	189.00	189.00	0.60	0.60156	4.16	2.50	0.60	3.10	200	1.00	32.798	1.04	0.64			9.46
Bronson Terrace	MH65A	MH66A	70.3		0.28				7.97	0.00	37.80	0.00	0.00		983.50	0.12	3.13035	3.80	11.91	2.28	14.19	200	0.50	23.192	0.74	0.76			61.18
Chrebin Street	MH66A	MH67A	65.5		0.36				0.36	0.00	48.60	0.00	0.00		48.60	0.15	0.15469	4.32	0.67	0.29	0.95	200	1.00	32.798	1.04	0.30			2.91
Chrebin Street	MH67A	MH69A	70.8		0.30				0.66	0.00	40.50	0.00	0.00		89.10	0.13	0.28359	4.26	1.21	0.29	1.49	200	1.00	32.798	1.04	0.47			4.55
Bronson Terrace	MH68A	MH70A	71.5		0.26				10.11	0.00	35.10	0.00	0.00		1232.85	0.11	3.92400	3.74	14.67	2.89	17.57	200	0.50	23.192	0.74	0.80			75.74
Mendelson Heights	MH70A	MH71A	99.4	0.80					0.80	44.00	0.00	0.00	0.00		44.00	0.14	0.14005	4.33	0.61	0.29	0.89	200	1.00	32.798	1.04	0.28			2.72
Mendelson Heights	MH71A	MH72A	95.6	0.50		0.07			1.37	27.50	0.00	7.00	0.00		78.50	0.11	0.24986	4.27	1.07	0.39	1.46	200	1.00	32.798	1.04	0.46			4.45
Sorensen Court	MH73A	MH74A	60.4		0.28				0.28	0.00	37.80	0.00	0.00		37.80	0.12	0.12031	4.34	0.52	0.29	0.81	200	1.00	32.798	1.04	0.25			2.46
Sorensen Court	MH74A	MH75A	15.1		0.10				0.38	0.00	13.50	0.00	0.00		51.30	0.04	0.16328	4.31	0.70	0.29	0.99	200	1.00	32.798	1.04	0.31			3.02
Sorensen Court	MH75A	MH76A	62.5		0.26				0.64	0.00	35.10	0.00	0.00		86.40	0.11	0.27500	4.26	1.17	0.29	1.46	200	1.00	32.798	1.04	0.46			4.44
Sorensen Court	MH76A	MH78A	72.6		0.29				0.93	0.00	39.15	0.00	0.00		125.55	0.12	0.39961	4.22	1.58	0.29	1.97	200	1.00	32.798	1.04	0.55			6.01
Bronson Terrace	MH78A	MH81A	71.7	0.06		0.24			12.71	3.30	0.00	24.00	0.00		1464.20	0.09	4.66036	3.69	17.18	3.64	20.82	250	0.50	42.050	0.86	0.85			49.51
Devine Point	MH 16A	MH79A	74.3	0.44					0.44	24.20	0.00	0.00	0.00		24.20	0.06	0.07703	4.37	0.34	0.29	0.62	200	1.00	32.798	1.04	0.19			1.90
Devine Point	MH79A	MH81A	129.3	0.68					1.12	37.40	0.00	0.00	0.00		61.60	0.12	0.19606	4.30	0.84	0.32	1.16	200	0.50	23.192	0.74	0.37			5.01
Bronson Terrace	MH81A	MH91A	73.5			0.26			14.09	0.00	0.00	26.00	0.00		1551.80	0.06	4.93918	3.67	18.12	4.03	22.15	250	0.50	42.050	0.86	0.85			52.68
Doran Crescent	MH82A	MH83A	20.0	0.27					0.27	14.85	0.00	0.00	0.00		14.85	0.05	0.04727	4.40	0.21	0.29	0.49	200	1.00	32.798	1.04	0.16			1.51

SANITARY SEWER DESIGN

The Regional Municipality of Halton

Project No. 12108
Location Trimson Main Sail Subdivision
Town of Milton

Date August 2016
Designed By IM
Checked By BG

Street	Manhole From	Manhole To	Length in metres	Tributary Area Hectare Increment Res. S.F.	Townhouse	Semi	Inst	Comm.	Tributary Area Hectare Total	Population Tributary Increment Res. S.F.	Townhouse	Semi	Inst	Comm.	Population Tributary Total	Average Increment L/s	Average Flow L/s	Peaking Factor	Max. Flow L/s	Infiltration L/s	Max. Flow Expect L/s	SEWER Size (mm)	Slope (%)	Q (L/s)	V m/s Full Flow	V m/s Act. Flow	PIPE Type	Class	REMARKS CAPACITY
Doran Crescent	MH83A	MH84A	13.7						0.27	0.00	0.00	0.00	0.00		14.85	0.00	0.04727	4.40	0.21	0.29	0.49	200	0.50	23.192	0.74	0.16			2.13
Doran Crescent	MH84A	MH85A	94.7	1.01					1.28	55.55	0.00	0.00	0.00		70.40	0.18	0.22407	4.28	0.96	0.37	1.33	200	0.50	23.192	0.74	0.38			5.72
Doran Crescent	MH85A	MH81A	11.0						1.28	0.00	0.00	0.00	0.00		70.40	0.00	0.22407	4.28	0.96	0.37	1.33	200	1.00	32.798	1.04	0.42			4.04
Sorensen Court	MH87A	MH86A	61.5		0.39				0.39	0.00	52.65	0.00	0.00		52.65	0.17	0.16758	4.31	0.72	0.29	1.01	200	1.00	32.798	1.04	0.31			3.07
Sorensen Court	MH86A	MH87A	13.8						0.39	0.00	0.00	0.00	0.00		52.65	0.00	0.16758	4.31	0.72	0.29	1.01	200	1.00	32.798	1.04	0.31			3.07
Sorensen Court	MH87A	MH88A	61.6						0.39	0.00	0.00	0.00	0.00		52.65	0.00	0.16758	4.31	0.72	0.29	1.01	200	1.00	32.798	1.04	0.31			3.07
Colville Place	MH76A	MH88A	82.4			0.56			0.56	0.00	0.00	56.00	0.00		56.00	0.18	0.17824	4.30	0.77	0.29	1.05	200	1.00	32.798	1.04	0.33			3.21
Colville Place	MH88A	MH89A	64.3	0.17		0.27			1.00	9.35	0.00	27.00	0.00		92.35	0.12	0.29394	4.25	1.25	0.29	1.54	200	0.50	23.192	0.74	0.40			6.62
Sorensen Court	MH89A	MH90A	66.9			0.35			1.74	0.00	0.00	35.60	0.00		180.00	0.11	0.57292	4.16	2.39	0.50	2.88	200	1.00	32.798	1.04	0.62			8.79
Sorensen Court	MH90A	MH91A	10.3						1.74	0.00	0.00	0.00	0.00		180.00	0.00	0.57292	4.16	2.39	0.50	2.88	200	1.00	32.798	1.04	0.62			8.79
Bronson Terrace	MH91A	MH93A	72.9						17.11	0.00	0.00	0.00	0.00		1802.20	0.00	5.73617	3.62	20.77	4.89	25.66	250	0.50	42.050	0.86	0.89			61.03
Belmore Court	MH41A	MH45A	57.0	0.24					0.24	13.20	0.00	0.00	0.00		13.20	0.04	0.04201	4.40	0.18	0.29	0.47	200	1.00	32.798	1.04	0.15			1.44
Belmore Court	MH45A	MH46A	9.3	0.06					0.30	3.30	0.00	0.00	0.00		16.50	0.01	0.05252	4.39	0.23	0.29	0.52	200	1.00	32.798	1.04	0.16			1.58
Belmore Court	MH46A	MH47A	86.0	0.51					0.81	28.05	0.00	0.00	0.00		44.55	0.09	0.14180	4.32	0.61	0.29	0.90	200	1.00	32.798	1.04	0.28			2.74
Belmore Court	MH47A	MH48A	36.1	0.24					1.05	13.20	0.00	0.00	0.00		57.75	0.04	0.18381	4.30	0.79	0.30	1.09	200	1.00	32.798	1.04	0.34			3.33
Belmore Court	MH48A	MH49A	11.9	0.06					1.11	3.30	0.00	0.00	0.00		61.05	0.01	0.19431	4.30	0.83	0.32	1.15	200	1.00	32.798	1.04	0.37			3.51
Belmore Court	MH49A	MH93A	42.8						1.11	0.00	0.00	0.00	0.00		61.05	0.00	0.19431	4.30	0.83	0.32	1.15	200	1.00	32.798	1.04	0.37			3.51
Leger Way	MH93A	MH96A	94.8	0.28					114.71	15.40	0.00	0.00	0.00		8436.60	0.05	26.85260	3.03	81.30	32.81	114.11	375	0.49	122.731	1.11	1.26			92.97
Leger Way	MH95A	MH96A	11.4					0.40	0.40	0.00	0.00	0.00	0.00	36.00	36.00	0.11	0.11458	4.34	0.50	0.29	0.78	200	1.00	32.798	1.04	0.24			2.39
Leger Way	MH96A	MH97A	65.7	0.3					115.41	16.50	0.00	0.00	0.00		8489.10	0.05	27.01970	3.02	81.73	33.01	114.74	375	0.50	123.977	1.12	1.27			92.55
Leger Way	MH97A	EX MH9A	13.7						115.41	0.00	0.00	0.00	0.00		8489.10	0.00	27.01970	3.02	81.73	33.01	114.74	375	0.50	123.977	1.12	1.27			92.55

Residential Design Parameters:

Flow (m3/cap /day) - 0.3
Single Family Density (pers/ha) - 55.0
Townhouse Density (pers/ha) - 135.0
Semi-Detached Density (pers/ha) - 100.0
Minimum Pipe Size - 200.0 mm

Commercial Design Parameters:

Flow (m3/ha./day) - 24 750
Density (persons/ha) - 90

Community Services Design Parameters:

Flow (m3/ha./day) - 11 000
Density (persons/ha) - 40

Industrial Design Parameters:

Flow (m3/ha./day) - 34 375
Density (persons/ha) - 125

Infiltration Rate - 0.000286 m3/s/ha
mannings 'n' - 0.0130
Peaking Factor - Res. Harmon
Comm. & ind.
Modified Harmon

Shearling Heights

Town of Milton

Sanitary Demand

Project: 2017-4568

Area (ha)	Expected Population	Avg. Sewage Flow (L/s)*	Harmon Peaking Factor	Peak Flow (L/s)	Infiltration (L/s)**	Total Flow (L/s)
2.11	487	1.21	3.98	4.82	0.59	**5.41**

**Based on Halton criteria of 215 L/c/d*

***Based on Halton criteria of 0.28 L/ha/s*

Shearling Heights

Town of Milton

Sanitary Downstream Analysis

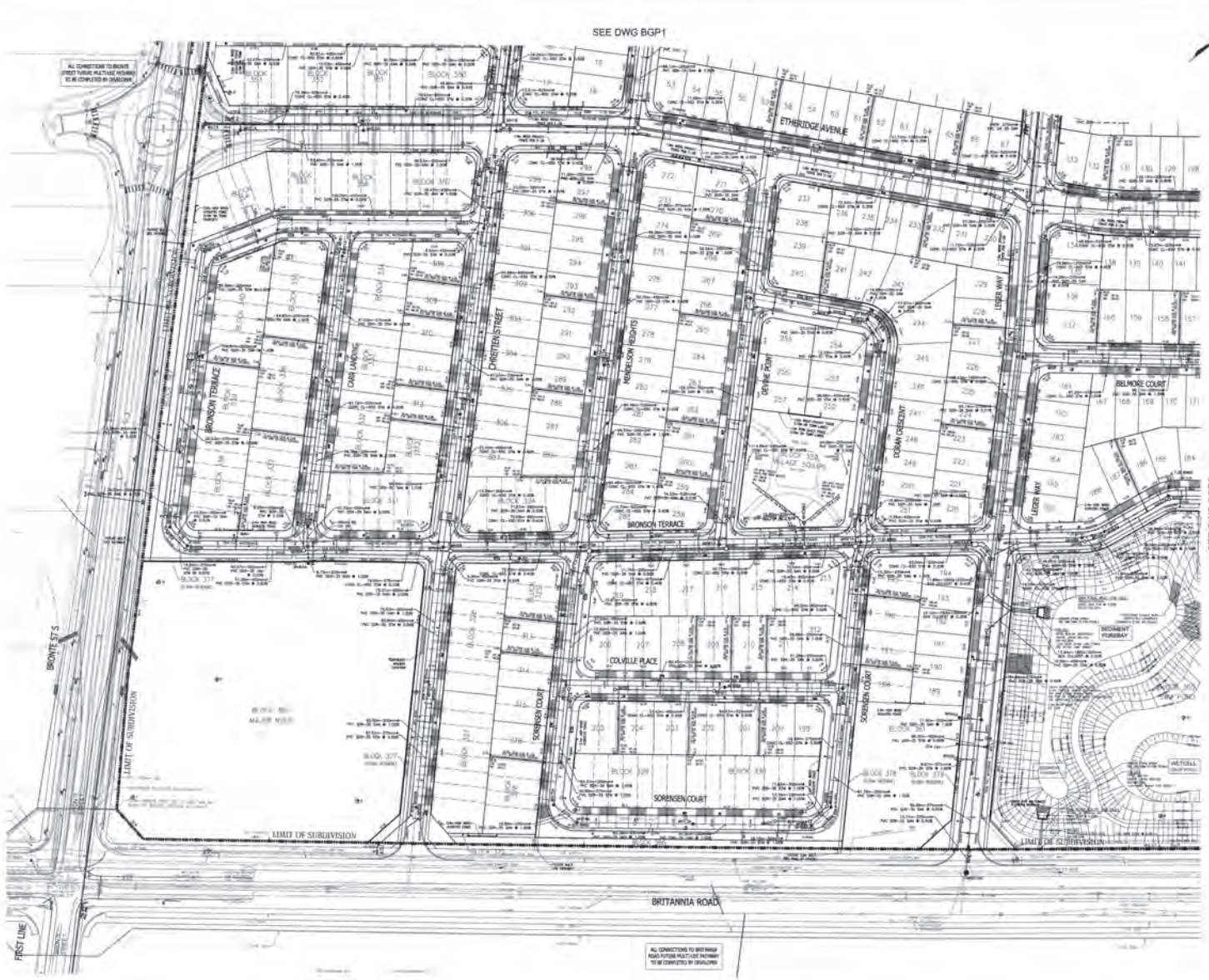
Project: 2017-4568

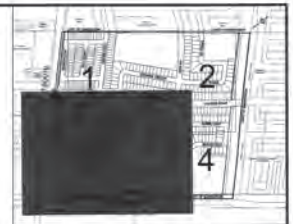
Surplus Peak Flow *2.31 L/s*

Sewer		Peak Flow (L/s)	Peak Flow (L/s)	Capacity	Capacity	Surcharge	Surcharge
Start	End	(Original)	(Proposed)	(nominal)	(actual)	Nominal	Actual
67A	69A	1.49	6.90	32.80	34.22	**0.0%**	**0.0%**
69A	78A	17.57	19.88	23.19	24.20	**0.0%**	**0.0%**
78A	81A	20.82	23.13	42.05	43.87	**0.0%**	**0.0%**
81A	91A	22.15	24.46	42.05	43.87	**0.0%**	**0.0%**
91A	93A	25.66	27.97	42.05	43.87	**0.0%**	**0.0%**
93A	96A	114.11	116.42	122.73	128.04	**0.0%**	**0.0%**
96A	97A	114.74	117.05	123.98	129.34	**0.0%**	**0.0%**
97A	EX.9A	114.74	117.05	123.98	129.34	**0.0%**	**0.0%**

Appendix C

Stormwater Management & Background





LEGEND

NOTE: SUMP PUMPS TO BE INSTALLED ON ALL LOTS

BENCHMARK:

LOCAL BENCHMARK:

No.	By	Date	Comments	Approved
10	DAS	JAN 2017	ISSUED FOR REVIEW	
9	DAS	NOV 2016	REVISED PER TOWN COMMENTS	
8	DAS	AUG 2016	REVISED PER TOWN COMMENTS	
7	DWG	JUNE 2016	[illegible]	
6	DWG	JUNE 2016	[illegible]	
5	DWG	MAY 2016	[illegible]	

TOWN OF MILTON
ENGINEERING SERVICES DEPARTMENT

DIRECTOR OF ENGINEERING SERVICES

D. N. SCOTT

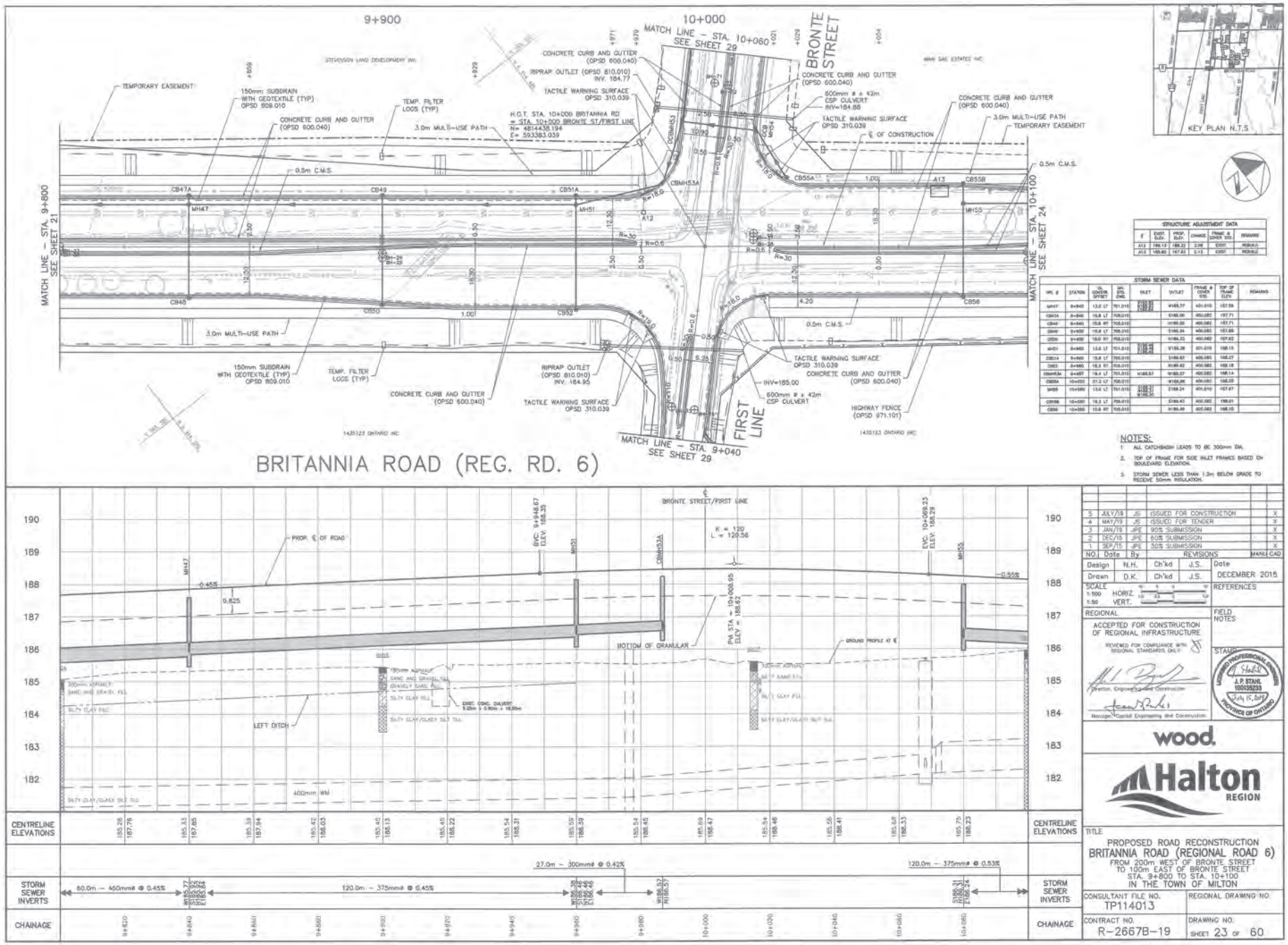
TMIG
The Municipal Infrastructure Group Ltd
8800 Dufferin Street
Suite 300
Vaughan, ON
L4K 0C2
p. 905.738.5757
f. 905.738.0015

MAIN SAIL ESTATES INC.
SUBDIVISION

BELOW GROUND
SERVICES PLAN

SCALE: 1:1000	PROJECT No: 12108
DATE: JAN 2015	
DESIGNED BY: W.C.	DRAWN BY: CAD
CHECKED BY: D.S.	CHECKED BY: K.B.
PROJECT No./YEAR No.: 241-149564	DRAWING No: BGP3

DM - 1005



STRUCTURE ADJUSTMENT DATA

#	EXIST. ELEV.	PROP. ELEV.	CHANGE	FRAME & COVER SIZE	REMARKS
A12	186.12	186.32	0.08	EXIST.	REBUILD
A13	185.80	187.85	0.13	EXIST.	REBUILD

STORM SEWER DATA

MH, #	STATION	OFFSET	S/S, D/S, SWL	INLET	OUTLET	FRAME & COVER SIZE	TOP OF FRAME ELEV.	REMARKS
MH47	9+840	13.0 LT	701.010		W185.77	600.010	187.58	
CB47A	9+840	15.8 LT	705.010		S185.00	450.082	187.71	
CB49	9+840	15.8 RT	705.010		W185.00	450.082	187.71	
CBMH53A	9+900	15.8 LT	705.010		S186.34	450.082	187.99	
CB50	9+900	15.0 RT	705.010		W186.33	450.082	187.82	
MH51	9+960	13.0 LT	701.010		W185.38	601.010	188.15	
CB51A	9+960	15.8 LT	705.010		S186.83	450.082	188.27	
CB52	9+980	15.3 RT	705.010		W186.82	450.082	188.18	
CBMH53B	9+987	19.4 LT	701.010	W186.57	W185.57	450.082	188.14	
CB55A	10+005	21.2 LT	705.010		W185.88	450.082	188.28	
MH55	10+080	13.0 LT	701.010	W186.24 W186.30	E186.24	601.010	187.87	
CB55B	10+080	19.3 LT	705.010		S186.43	600.082	188.01	
CB56	10+050	15.8 RT	705.010		W186.46	600.082	188.10	

NOTES:
1. ALL CATCHBASIN LEADS TO BE 300mm DIA.
2. TOP OF FRAME FOR SIDE INLET FRAMES BASED ON BOULEVARD ELEVATION.
3. STORM SEWER LESS THAN 1.2m BELOW GRADE TO RECEIVE 50mm INSULATION.

NO.	Date	By	REVISIONS	MANU CAD
5	JULY/19	JS	ISSUED FOR CONSTRUCTION	X
4	MAY/19	JS	ISSUED FOR TENDER	X
3	JAN/19	JPE	90% SUBMISSION	X
2	DEC/15	JPE	60% SUBMISSION	X
1	SEP/15	JPE	30% SUBMISSION	X

Design	N.H.	Ch'kd	J.S.	Date
Drawn	D.K.	Ch'kd	J.S.	DECEMBER 2015

SCALE 1:500 HORIZ. 1:50 VERT.

REFERENCES

FIELD NOTES

REGIONAL

ACCEPTED FOR CONSTRUCTION OF REGIONAL INFRASTRUCTURE
REVIEWED FOR COMPLIANCE WITH REGIONAL STANDARDS ONLY

Director, Engineering and Construction

Manager, Capital Engineering and Construction

STAMP: J.P. STAHL 100135233 July 15, 2019 PROVINCE OF ONTARIO

wood.

Halton REGION

TITLE
PROPOSED ROAD RECONSTRUCTION
BRITANNIA ROAD (REGIONAL ROAD 6)
FROM 200m WEST OF BRONTE STREET
TO 100m EAST OF BRONTE STREET
STA. 9+800 TO STA. 10+100
IN THE TOWN OF MILTON

CONSULTANT FILE NO. TP114013

REGIONAL DRAWING NO.

CONTRACT NO. R-2667B-19

DRAWING NO. SHEET 23 OF 60

R-2667B-19 23 of 60

Town of Milton
Storm Drainage Design Chart
FOR CIRCULAR DRAINS FLOWING FULL

Trinison Main Sail

Street	From	To	Catchment Area ID	Parks and open space Area ha	Single res Area ha	Semis Area ha	Towns, Apartments , Schools, Churches, Commercial Area ha	Area (4) ha	Runoff 'C' (5)	Section Area (4)x(5) ha	Accum Section Area (7) ha	Rainfall Intensity 'I' (8) mm/hr	Flow 2.78 x (7) x (8) 'Q' L/s	Length m	Slope m/m	Dia mm	Full Flow Capacity L/s	Full Flow Velocity m/s	Flow Time in Pipe (10)/(14)/60 min	Time of Conc. min	Time of Conc. Down-stream m	MH Inlet Invert (20)-(19) m	MH Loss m	MH Outlet Invert (18)-(17) m	Q/Qf %	Notes
HOLBROOK COURT	MH 1	MH 2	1				0.550	0.55	0.75	0.412	0.412	105.25	**120.6**	100.00	0.0100	375	175.3	1.59	1.05	10.00	11.05				68.80	
	MH 2	MH 4					0.000	0.00	0.00	0.000	0.412	99.92	**114.5**	11.58	0.0100	375	175.3	1.59	0.12	11.05	11.17				65.32	
CHRETIEN ST.	MH 3	MH 4	2			0.119		0.12	0.60	0.072	0.072	105.25	**21.0**	24.66	0.0100	300	96.7	1.37	0.30	10.00	10.30				21.68	
CHRETIEN ST.	MH 4	MH 5	3			0.397	0.046	0.44	0.62	0.273	0.757	99.35	**209.0**	53.29	0.0060	525	333.1	1.54	0.58	11.17	11.75				62.74	
	MH 5	MH 14	4			0.469	0.041	0.51	0.61	0.312	1.069	96.70	**287.4**	76.57	0.0060	525	333.1	1.54	0.83	11.75	12.58				86.26	
HOLBROOK COURT	MH 6	MH 7	5				0.170	0.17	0.75	0.128	0.128	105.25	**37.3**	69.05	0.0050	300	68.4	0.97	1.19	10.00	11.19				54.56	
	MH 7	MH 8	6				0.126	0.13	0.75	0.094	0.222	99.26	**61.2**	49.69	0.0050	375	124.0	1.12	0.74	11.19	11.93				49.38	
	MH 8	MH 9						0.00	0.00	0.000	0.222	95.91	**59.2**	11.34	0.0050	375	124.0	1.12	0.17	11.93	12.10				47.71	
	MH 9	MH 12	7				0.312	0.31	0.75	0.234	0.455	95.18	**120.5**	60.51	0.0065	450	229.9	1.45	0.70	12.10	12.79				52.43	
PRATT HEIGHTS	MH 10	MH 11	8				0.740	0.74	0.75	0.555	0.555	105.25	**162.4**	65.55	0.0075	450	246.9	1.55	0.70	10.00	10.70				65.77	
	MH 11	MH 12						0.00	0.00	0.000	0.555	101.61	**156.8**	10.03	0.0050	450	201.6	1.27	0.13	10.70	10.84				77.77	
HOLBROOK COURT	MH 12	MH 13	9			0.074	0.234	0.31	0.71	0.220	1.230	92.29	**315.7**	64.07	0.0035	675	497.3	1.39	0.77	12.79	13.56				63.48	
	MH 13	MH 14						0.00	0.00	0.000	1.230	89.33	**305.5**	9.96	0.0030	675	460.4	1.29	0.13	13.56	13.69				66.36	
CHRETIEN ST.	MH 14	MH 15	10			0.091	0.051	0.14	0.65	0.092	2.392	88.85	**590.7**	34.26	0.0050	750	787.2	1.78	0.32	13.69	14.01				75.04	
	MH 15	MH 18						0.00	0.00	0.000	2.392	87.69	**583.0**	13.31	0.0030	825	786.2	1.47	0.15	14.01	14.16				74.15	
Bronte Street	External	MH 16	11				2.200	2.20	0.90	1.980	1.980	105.25	**579.3**	1.00	0.0070	825	1201.0	2.25	0.01	10.00	10.01				48.24	
ETHERIDGE AVE.	MH 16	MH 17	12				0.418	0.42	0.75	0.314	2.294	105.21	**670.8**	79.39	0.0040	825	907.8	1.70	0.78	10.01	10.79				73.89	
	MH 17	MH 18	13				0.412	0.41	0.75	0.309	2.603	101.20	**732.2**	75.43	0.0030	900	991.5	1.56	0.81	10.79	11.59				73.85	
ETHERIDGE AVE.	MH 18	MH 21	14		0.135	0.145		0.28	0.55	0.154	5.148	87.15	**1247.4**	69.96	0.0040	975	1417.4	1.90	0.61	14.16	14.78				88.01	
GOODWIN CR.	MH 19	MH 20	15		0.228			0.23	0.50	0.114	0.114	105.25	**33.4**	12.45	0.0100	300	96.7	1.37	0.15	10.00	10.15				34.49	
	MH 20	MH 21	16		0.329			0.33	0.50	0.165	0.279	104.44	**80.9**	62.08	0.0060	375	135.8	1.23	0.84	10.15	10.99				59.57	
ETHERIDGE AVE.	MH 21	MH 22	17		0.419			0.42	0.50	0.209	5.637	85.05	**1332.7**	71.99	0.0035	1050	1615.5	1.87	0.64	14.78	15.42				82.49	
	MH 22	MH 23	18		0.557			0.56	0.50	0.278	5.915	82.96	**1364.2**	72.93	0.0035	1050	1615.5	1.87	0.65	15.42	16.07				84.44	
	MH 23	MH 24	19		0.396			0.40	0.50	0.198	6.113	80.97	**1375.9**	51.73	0.0035	1050	1615.5	1.87	0.46	16.07	16.53				85.17	
	MH 24	MH 41						0.00	0.00	0.000	6.113	79.61	**1352.9**	11.72	0.0035	1050	1615.5	1.87	0.10	16.53	16.64				83.74	
GOODWIN CR.	MH 19	MH 25	20		0.479			0.48	0.50	0.240	0.240	105.25	**70.1**	99.30	0.0050	375	124.0	1.12	1.47	10.00	11.47				56.57	
	MH 25	MH 26	21		0.637			0.64	0.50	0.319	0.558	97.94	**152.0**	86.47	0.0050	450	201.6	1.27	1.14	11.47	12.61				75.39	
	MH 26	MH 37						0.00	0.00	0.000	0.558	93.03	**144.4**	10.89	0.0050	450	201.6	1.27	0.14	12.61	12.75				71.61	

Town of Milton
Storm Drainage Design Chart
FOR CIRCULAR DRAINS FLOWING FULL

Trinison Main Sail

Street	From	To	Catchment Area ID	Parks and open space Area	Single res Area	Semis Area	Towns, Apartments, Schools, Churches, Commercial Area	Area (4)	Runoff 'C' (5)	Section Area (4)x(5)	Accum Section Area (7)	Rainfall Intensity 'I' (8)	Flow 2.78 x (7) x (8) 'Q'	Length	Slope	Dia.	Full Flow Capacity	Full Flow Velocity	Flow Time in Pipe (10)/(14)/60	Time of Conc.	Time of Conc. Down-stream	MH Inlet Invert (20)-(19)	MH Loss	MH Outlet Invert (18)-(17)	Q/Qf	Notes
				ha	ha	ha	ha	ha		ha	ha	mm/hr	L/s	m	m/m	mm	L/s	m/s	min	min	m	m	m	m	%	
LEGER WAY	MH 27	MH 28	22		0.242			0.24	0.50	0.121	0.121	105.25	**35.4**	48.78	0.0100	300	96.7	1.37	0.59	10.00	10.59				36.61	
	MH 28	MH 29	23		0.391			0.39	0.50	0.195	0.316	102.16	**89.9**	65.98	0.0050	375	124.0	1.12	0.98	10.59	11.57				72.48	
School Blk 358	MH 30	MH 29	24				2.687	2.69	0.75	2.015	2.015	76.38	**427.9**	8.06	0.0100	600	614.0	2.17	0.06	17.71	17.77				69.69	
LEGER WAY	MH 29	MH 37	25		0.142			0.14	0.50	0.071	2.403	76.22	**509.1**	54.86	0.0035	750	658.6	1.49	0.61	17.77	18.39				77.29	
DAY TERRACE	MH 31	MH 32	26		0.136			0.14	0.50	0.068	0.068	105.25	**19.9**	13.26	0.0100	300	96.7	1.37	0.16	10.00	10.16				20.55	
	MH 32	MH 33	27		0.238			0.24	0.50	0.119	0.187	104.39	**54.2**	58.38	0.0100	300	96.7	1.37	0.71	10.16	10.87				56.06	
	MH 33	MH 34						0.00	0.00	0.000	0.187	100.78	**52.3**	12.24	0.0100	300	96.7	1.37	0.15	10.87	11.02				54.12	
	MH 34	MH 35	28		0.520			0.52	0.50	0.260	0.447	100.06	**124.3**	60.37	0.0100	375	175.3	1.59	0.63	11.02	11.66				70.89	
	MH 35	MH 36	29		0.209			0.21	0.50	0.104	0.551	97.12	**148.8**	61.28	0.0060	450	220.8	1.39	0.74	11.66	12.39				67.38	
	MH 36	MH 37	30		0.390			0.39	0.50	0.195	0.746	93.93	**194.9**	33.61	0.0050	525	304.1	1.40	0.40	12.39	12.79				64.08	
LEGER WAY	MH 37	MH 41	31		0.257			0.26	0.50	0.129	3.835	74.66	**796.0**	73.30	0.0040	825	907.8	1.70	0.72	18.39	19.11				87.68	
ETHERIDGE AVE	MH 38	MH 39	32		0.636			0.64	0.50	0.318	0.318	105.25	**93.0**	77.36	0.0100	375	175.3	1.59	0.81	10.00	10.81				53.07	
	MH 39	MH 40	33		0.545			0.54	0.50	0.272	0.590	101.08	**165.9**	73.57	0.0050	525	304.1	1.40	0.87	10.81	11.69				54.55	
	MH 40	MH 41	34		0.312			0.31	0.50	0.156	0.747	96.98	**201.3**	46.96	0.0050	525	304.1	1.40	0.56	11.69	12.24				66.19	
LEGER WAY	MH 41	MH TEE 45	35		0.374			0.37	0.50	0.187	10.881	72.92	**2205.7**	76.96	0.0045	1200	2615.3	2.31	0.55	19.11	19.66				84.34	
BELMORE COURT	MH 43	MH 44	36		0.643			0.64	0.50	0.321	0.321	105.25	**94.0**	93.72	0.0100	375	175.3	1.59	0.98	10.00	10.98				53.61	
	MH 44	MH TEE 45	37		0.637			0.64	0.50	0.319	0.640	100.24	**178.3**	87.20	0.0050	525	304.1	1.40	1.03	10.98	12.02				58.63	
LEGER WAY	MH TEE 45	MH TEE 96	38		0.566			0.57	0.50	0.283	11.804	71.63	**2350.7**	106.23	0.0025	1200x1800	3947.9	1.90	0.93	19.66	20.59				59.54	box
BRONSON TERRACE	MH 52	MH 53	40				0.540	0.54	0.75	0.405	0.405	105.25	**118.5**	100.00	0.0050	450	201.6	1.27	1.31	10.00	11.31				58.78	
	MH 53	MH 55						0.00	0.00	0.000	0.405	98.67	**111.1**	8.90	0.0050	450	201.6	1.27	0.12	11.31	11.43				55.11	
CHRETIEN ST.	MH 54	MH 55	41			0.134	0.053	0.19	0.64	0.120	0.120	105.25	**35.2**	33.02	0.0050	300	68.4	0.97	0.57	10.00	10.57				51.45	
CHRETIEN ST.	MH 55	MH 56	42			0.364	0.052	0.42	0.62	0.257	0.783	98.13	**213.5**	84.58	0.0030	600	336.3	1.19	1.19	11.43	12.62				63.48	
	MH 56	MH 57	43			0.239	0.206	0.44	0.67	0.298	1.080	93.00	**279.4**	72.40	0.0030	600	336.3	1.19	1.01	12.62	13.63				83.07	
	MH 57	MH 68						0.00	0.00	0.000	1.080	89.07	**267.5**	13.54	0.0030	600	336.3	1.19	0.19	13.63	13.82				79.55	
BRONSON TERRACE	MH 51	MH 58	39				0.122	0.12	0.75	0.092	0.092	105.25	**26.8**	55.30	0.0050	300	68.4	0.97	0.95	10.00	10.95				39.15	
	MH 58	MH 59	44				0.300	0.30	0.75	0.225	0.317	100.39	**88.3**	90.93	0.0050	375	124.0	1.12	1.35	10.95	12.30				71.25	
	MH 59	MH 60						0.00	0.00	0.000	0.317	94.30	**83.0**	14.92	0.0050	375	124.0	1.12	0.22	12.30	12.52				66.93	
	MH 60	MH 64	45				0.167	0.17	0.75	0.125	0.442	93.38	**114.7**	61.28	0.0050	450	201.6	1.27	0.81	12.52	13.33				56.91	
CARR LANDING	MH 61	MH 62	46				0.390	0.39	0.75	0.293	0.293	105.25	**85.6**	61.03	0.0050	375	124.0	1.12	0.91	10.00	10.91				69.03	
	MH 62	MH 63	47				0.493	0.49	0.75	0.370	0.663	100.62	**185.3**	87.19	0.0050	525	304.1	1.40	1.03	10.91	11.94				60.94	
	MH 63	MH 64						0.00	0.00	0.000	0.663	95.86	**176.6**	9.35	0.0050	525	304.1	1.40	0.11	11.94	12.05				58.06	

Town of Milton
Storm Drainage Design Chart
FOR CIRCULAR DRAINS FLOWING FULL

Trinison Main Sail

Street	From	To	Catchment Area ID	Parks and open space Area	Single res Area	Semis Area	Towns, Apartments , Schools, Churches, Commercial Area	Area (4)	Runoff 'C' (5)	Section Area (4)x(5)	Accum Section Area (7)	Rainfall Intensity 'I' (8)	Flow 2.78 x (7) x (8) 'Q'	Length	Slope	Dia.	Full Flow Capacity	Full Flow Velocity	Flow Time in Pipe (10)/(14)/60	Time of Conc.	Time of Conc. Down-stream	MH Inlet Invert (20)-(19)	MH Loss	MH Outlet Invert (18)-(17)	Q/Qf	Notes
				ha	ha	ha	ha	ha		ha	ha	mm/hr	L/s	m	m/m	mm	L/s	m/s	min	min	m	m	m	m	%	
BRONSON TERRACE	MH 64	MH 68	48				0.349	0.35	0.75	0.262	1.366	90.20	**342.6**	76.40	0.0030	675	460.4	1.29	0.99	13.33	14.32				74.40	
CHRETIEN ST.	MH 65	MH 66	49				0.300	0.30	0.75	0.225	0.225	105.25	**65.8**	67.52	0.0050	375	124.0	1.12	1.00	10.00	11.00				53.10	
	MH 66	MH 67	50				0.199	0.20	0.75	0.150	0.375	100.15	**104.3**	65.85	0.0050	450	201.6	1.27	0.87	11.00	11.87				51.73	
	MH 67	MH 68						0.00	0.00	0.000	0.375	96.17	**100.1**	6.89	0.0050	450	201.6	1.27	0.09	11.87	11.96				49.67	
BRONSON TERRACE	MH 68	MH 76	51				0.225	0.22	0.75	0.169	2.990	95.78	**796.1**	72.05	0.0040	900	1144.9	1.80	0.67	11.96	12.63				69.53	
MENDELSON HEIGHTS	MH 69	MH 70	52		0.328	0.045		0.37	0.51	0.191	0.191	100.97	**53.6**	47.68	0.0050	375	124.0	1.12	0.71	10.83	11.54				43.23	
	MH 70	MH 71	53		0.298	0.071		0.37	0.52	0.192	0.383	105.25	**112.0**	56.75	0.0040	450	180.3	1.13	0.83	10.00	10.83				62.12	
	MH 71	MH 72	54		0.368	0.178	0.089	0.63	0.56	0.357	0.740	105.25	**216.6**	84.46	0.0040	525	272.0	1.26	1.12	10.00	11.12				79.63	
	MH 72	MH 76						0.00	0.00	0.000	0.740	99.59	**204.9**	12.70	0.0040	525	272.0	1.26	0.17	11.12	11.29				75.34	
SORENSON COURT	MH 73	MH 74	55			0.162	0.302	0.46	0.70	0.324	0.324	105.25	**94.9**	40.90	0.0100	375	175.3	1.59	0.43	10.00	10.43				54.11	
	MH 74	MH 75	56			0.258	0.168	0.43	0.66	0.281	0.605	103.00	**173.2**	57.03	0.0060	450	220.8	1.39	0.68	10.43	11.11				78.43	
	MH 75	MH 76						0.00	0.00	0.000	0.605	99.62	**167.5**	15.97	0.0060	450	220.8	1.39	0.19	11.11	11.31				75.86	
BRONSON TERRACE	MH 76	MH 80	57		0.108	0.144		0.25	0.56	0.141	4.476	92.97	**1156.7**	71.14	0.0040	975	1417.4	1.90	0.62	12.63	13.25				81.61	
DEVINE POINT	MH 77	MH 78	58		0.353			0.35	0.50	0.176	0.176	105.25	**51.6**	52.24	0.0100	300	96.7	1.37	0.64	10.00	10.64				53.36	
	MH 78	MH 79	59		0.731			0.73	0.50	0.366	0.542	101.95	**153.6**	114.64	0.0050	525	304.1	1.40	1.36	10.64	12.00				50.50	
	MH 79	MH 80						0.00	0.00	0.000	0.542	95.61	**144.0**	14.22	0.0050	525	304.1	1.40	0.17	12.00	12.17				47.37	
BRONSON TERRACE	MH 80	MH 81	60			0.146		0.15	0.60	0.088	5.105	90.50	**1284.4**	40.75	0.0030	1050	1495.7	1.73	0.39	13.25	13.64				85.88	
Park Blk 359	CBMH 82	MH 81	61	0.323				0.32	0.60	0.194	0.194	105.25	**56.8**	12.65	0.0050	375	124.0	1.12	0.19	10.00	10.19				45.78	
BRONSON TERRACE	MH 81	MH 94	62			0.068		0.07	0.60	0.041	5.340	89.02	**1321.5**	26.49	0.0030	1050	1495.7	1.73	0.26	13.64	13.90				88.36	
DORAN CRESCENT	MH 83	MH 84	63		0.375			0.37	0.50	0.187	0.187	105.25	**54.8**	27.01	0.0050	375	124.0	1.12	0.40	10.00	10.40				44.23	
	MH 84	MH 85						0.00	0.00	0.000	0.187	103.14	**53.7**	12.22	0.0050	375	124.0	1.12	0.18	10.40	10.58				43.34	
	MH 85	MH 86	64		0.510			0.51	0.50	0.255	0.442	102.22	**125.7**	99.68	0.0050	450	201.6	1.27	1.31	10.58	11.89				62.36	
	MH 86	MH 94						0.00	0.00	0.000	0.442	96.06	**118.1**	7.78	0.0050	450	201.6	1.27	0.10	11.89	12.00				58.60	
SORENSON COURT	MH 87	MH 88	65				0.242	0.24	0.75	0.182	0.182	105.25	**53.2**	18.15	0.0100	300	96.7	1.37	0.22	10.00	10.22				54.96	
	MH 88	MH 89						0.00	0.00	0.000	0.182	104.08	**52.6**	11.83	0.0100	300	96.7	1.37	0.14	10.22	10.37				54.35	
	MH 89	MH 92	66			0.064	0.141	0.20	0.70	0.144	0.325	103.33	**93.4**	59.44	0.0050	375	124.0	1.12	0.88	10.37	11.25				75.36	
COLVILLE PLACE	MH 90	MH 91	67			0.522	0.098	0.62	0.62	0.386	0.386	105.25	**113.0**	51.43	0.0050	450	201.6	1.27	0.68	10.00	10.68				56.07	
	MH 91	MH 92	68			0.396	0.075	0.47	0.62	0.294	0.680	101.75	**192.5**	64.63	0.0050	525	304.1	1.40	0.77	10.68	11.44				63.29	
SORENSON COURT	MH 92	MH 93	69		0.070	0.395		0.47	0.58	0.272	1.278	98.08	**348.4**	66.25	0.0050	600	434.2	1.54	0.72	11.44	12.16				80.25	
	MH 93	MH 94						0.00	0.00	0.000	1.278	94.90	**337.1**	10.40	0.0050	600	434.2	1.54	0.11	12.16	12.27				77.65	

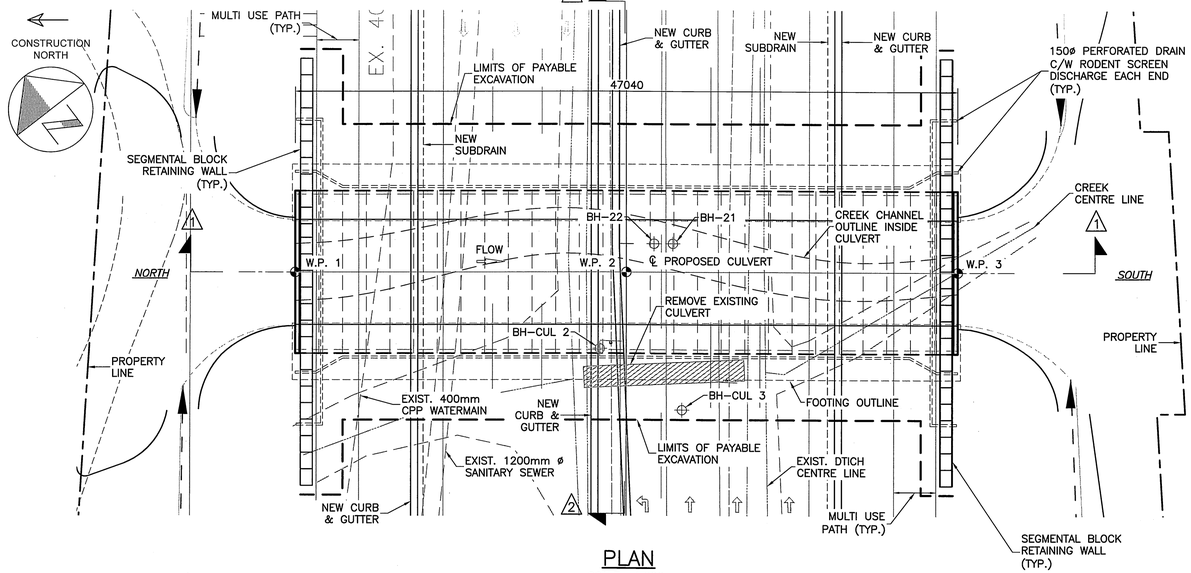
Town of Milton
Storm Drainage Design Chart
FOR CIRCULAR DRAINS FLOWING FULL

Trinison Main Sail

Street	From	To	Catchment Area ID	Parks and open space Area	Single res Area	Semis Area	Towns, Apartments , Schools, Churches, Commercial Area	Area (4)	Runoff 'C' (5)	Section Area (4)x(5)	Accum Section Area (7)	Rainfall Intensity 'I' (8)	Flow 2.78 x (7) x (8) 'Q'	Length	Slope	Dia.	Full Flow Capacity	Full Flow Velocity	Flow Time in Pipe (10)/(14)/60	Time of Conc.	Time of Conc. Down-stream	MH Inlet Invert (20)-(19)	MH Loss	MH Outlet Invert (18)-(17)	Q/Qf	Notes
				ha	ha	ha	ha	ha		ha	ha	mm/hr	L/s	m	m/m	mm	L/s	m/s	min	min	m	m	m	m	%	
BRONSON TERRACE	MH 94	MHTEE 95	70		0.208	0.052		0.26	0.52	0.135	7.195	89.02	**1780.7**	62.04	0.0030	1200	2135.4	1.89	0.55	13.64	14.19				83.39	Box
	MHTEE 95	MH TEE 96						0.00	0.00	0.000	7.195	87.05	**1741.2**	11.89	0.0040	1200x1800	4993.7	2.40	0.08	14.19	14.27				34.87	Box
BELMORE COURT	MH 46	MH 47	71		0.709			0.71	0.50	0.354	0.354	105.25	**103.7**	97.42	0.0100	375	175.3	1.59	1.02	10.00	11.02				59.14	
	MH 47	MH 48	72		0.194			0.19	0.50	0.097	0.451	100.05	**125.5**	38.89	0.0050	450	201.6	1.27	0.51	11.02	11.53				62.27	
	MH 48	MH 49						0.00	0.00	0.000	0.451	97.67	**122.5**	10.31	0.0050	450	201.6	1.27	0.14	11.53	11.67				60.79	
	MH 49	MH 50	73		0.186			0.19	0.50	0.093	0.544	97.05	**146.9**	34.91	0.0050	450	201.6	1.27	0.46	11.67	12.13				72.85	
	MH 50	MH TEE 96						0.00	0.00	0.000	0.544	95.04	**143.8**	14.29	0.0050	525	304.1	1.40	0.17	12.13	12.30				47.30	
LEGER WAY	MH TEE 96	MH TEE 97	74		0.272		0.025	0.30	0.52	0.155	19.699	69.59	**3810.7**	34.12	0.0030	1200x1800	4324.7	2.08	0.27	20.59	20.87				88.11	Box
Block 361 - Commercial	MH 98	MH 100	75				0.406	0.41	0.90	0.365	0.365	105.25	**106.8**	8.97	0.0100	375	175.3	1.59	0.09	10.00	10.09				60.90	
LEGER WAY	MH 100	MH 101	76				0.153	0.15	0.90	0.138	0.503	104.75	**146.4**	68.00	0.0050	450	201.6	1.27	0.89	10.09	10.99				72.60	
	MH 101	MH TEE 97	-					0.00	0.00	0.000	0.503	100.22	**140.0**	16.86	0.0050	450	201.6	1.27	0.22	10.99	11.21				69.47	
Blk 375 - SWMP	MH TEE 97	HEAD WALL	-					0.00	0.00	0.000	20.201	69.01	**3875.6**	13.94	0.0030	1200x1800	4324.7	2.08	0.11	20.87	20.98				89.62	Box
Britannia Road	MH301	HEAD WALL	79				3.800	3.80	0.90	3.420	3.420	105.25	**1000.7**	14.00	0.0025	1050	1365.4	1.58	0.15	10.00	10.15				73.29	
DAY TERRACE	MH 102	MH 103	77		0.315			0.31	0.50	0.157	0.157	105.25	**46.0**	53.24	0.0100	300	96.7	1.37	0.65	10.00	10.65				47.58	
	MH 103	MH 104	78		0.200			0.20	0.50	0.100	0.257	101.89	**72.9**	43.41	0.0050	375	124.0	1.12	0.64	10.65	11.29				58.81	
		to Mattarny																								

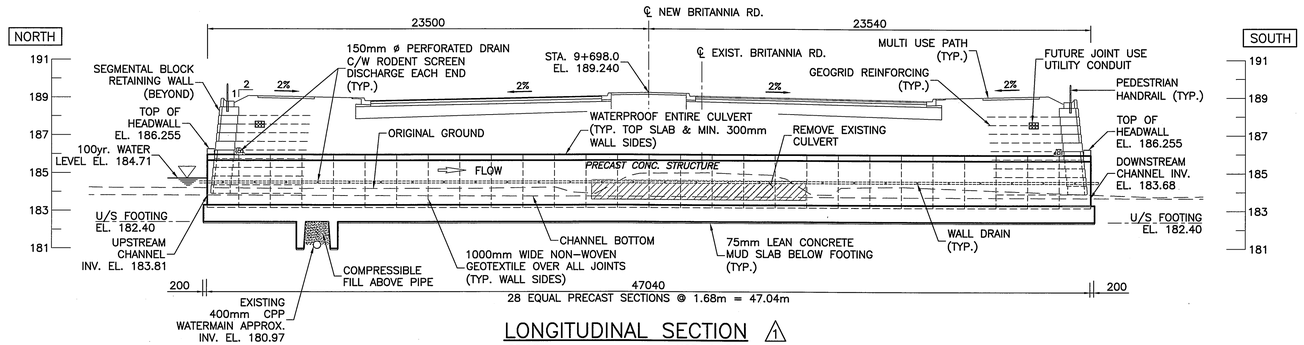
Design by:	IM	Contract Name:	Main Sail Subdivision	Storm Return Period:	5	year	Drainage Area - 32.063 ha
Checked by:	BG	Location:	Town of Milton	Mannings "n" -	0.013		Design Storm - Milton
Page No.	4 of 4	Contract No.	12108	Entry Time -	10.00		A - 959
Date:	5-Aug-16						B - 5.7
	Final Submission						C - 0.8024





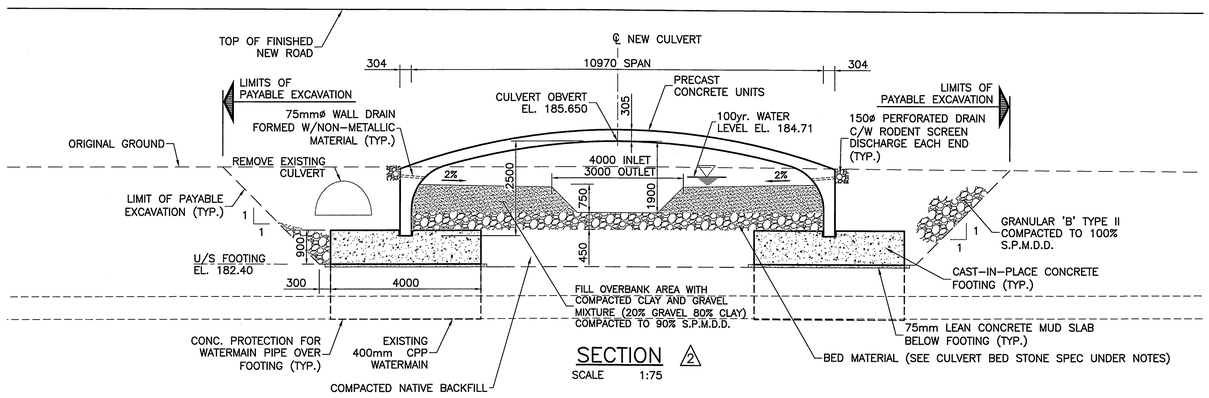
PLAN

SCALE 1:200



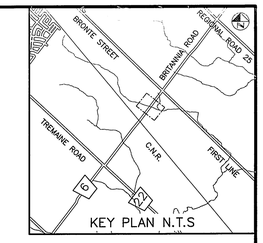
LONGITUDINAL SECTION 1

SCALE HOR. 1:150
VER. 1:150



SECTION 2

SCALE 1:75



COORDINATE TABLE

CONTROL	NORTHING	EASTING	ELEVATION*	℄ ROAD OFFSET	STATION
W.P. 1	4814212.416	593181.097	185.955	23.50 (NORTH)	9+698
W.P. 2	4814198.155	593199.775	185.955	0.00	9+698
W.P. 3	4814183.872	593218.486	185.955	23.54 (SOUTH)	9+698

* ELEVATION IS MEASURED TO TOP OF CULVERT SLAB AT APEX.

NOTES:

1. DESIGN SHALL CONFORM TO CANADIAN HIGHWAY BRIDGE DESIGN CODE CAN/CSA-S6-14, DESIGN LOADING IS CL-625-ONT.
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS OF THE EXISTING AND PROPOSED WORK AND ALL DETAILS ON SITE AND REPORT DISCREPANCIES TO THE CONTRACT ADMINISTRATOR BEFORE PROCEEDING WITH THE WORK.
3. ALL SERVICES ARE TO BE ACCURATELY LOCATED PRIOR TO CONSTRUCTION AND ADEQUATE PROTECTION PROVIDED AT ALL TIMES. ANY INTERFERENCE OF EXISTING SERVICES OR UTILITIES WITH PROPOSED STRUCTURE OR CONSTRUCTION OPERATIONS IS TO BE REPORTED TO THE CONTRACT ADMINISTRATOR PRIOR TO THE COMMENCING OF CONSTRUCTION.
4. THE SPECIFIED COMPRESSIVE CONCRETE STRENGTH (AT 28 DAYS) SHALL BE:
   FOR PRECAST UNITS: 40 MPa CLASS F-1
   FOR CAST-IN-PLACE: 30 MPa CLASS F-1
   FOR MUD SLAB: 20 MPa
5. CLEAR COVER TO REINFORCING STEEL IN CONCRETE SHALL BE:
   PRECAST CONCRETE
   - DECK SOFFIT 40mm ±10mm
   - REMAINDER 50mm ±10mm

   CAST-IN-PLACE CONCRETE
   - 100mm ±25mm - CONCRETE AGAINST OR PERMANENTLY EXPOSED TO EARTH
   - 70mm ±20mm - REMAINDER, UNLESS OTHERWISE NOTED.
6. DETAIL, BEND, PLACE AND SUPPORT REINFORCING STEEL TO CONFORM TO THE STRUCTURAL STANDARDS DRAWING SS12-1, UNLESS NOTED OTHERWISE.
7. EXPOSED EDGES TO BE CHAMFERED 20x20 EXCEPT AS NOTED.
8. REINFORCING SHALL BE DEFORMED BARS CONFORMING TO CSA STANDARD G30.18-09 (R2014), GRADE 400W.
9. PROVIDE PRECAST REINFORCED CONCRETE UNITS FOR THE SIZE, DEPTH AND LOADS INDICATED ON THE DRAWINGS, DETAILS FOR HEADER WALLS TO BE AS SHOWN IN TYP. DETAILS DRAWINGS.
10. PROVIDE WATER TIGHT JOINTS BETWEEN ALL PRECAST CONCRETE SEGMENTS AS PER MANUFACTURER SPECIFICATIONS.
11. DIMENSIONS AND ELEVATIONS SHOWN TO EXISTING CONDITIONS ARE TO BE FIELD VERIFIED.
12. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER STRUCTURAL DETAIL DRAWINGS.
13. SOIL BEARING CAPACITY:
    SERVICEABILITY LIMIT STATE: 200 KPa (UNFACTORED)
    ULTIMATE LIMIT STATE 300 KPa (FACTORED)

    THE GEOTECHNICAL ENGINEER TO VERIFY THIS REQUIREMENT PRIOR TO PLACING CONCRETE
14. DO NOT SCALE THESE DRAWINGS.

CONSTRUCTION NOTES:

1. BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH SIDES OF CULVERT KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.
2. THE SUB-BASE SHALL BE FREE FROM FROZEN MATERIAL AND SHALL BE COMPACTED TO SPECIFICATIONS. FROZEN AND SOFTENED MATERIALS SHALL BE REMOVED AND REPLACED WITH SUITABLE COMPACTED MATERIALS. OBTAIN ACCEPTANCE REGARDING SUB-BASE MATERIAL AND COMPACTION FROM THE CONTRACT ADMINISTRATOR PRIOR TO PLACING CONCRETE.
3. ROADWAY PROTECTION SYSTEM SHALL BE DESIGNED TO PERFORMANCE LEVEL 2 CRITERIA. LIMITS OF ROADWAY PROTECTION SYSTEM TO BE DETERMINED BY THE CONTRACTOR. ROADWAY PROTECTION SYSTEM SHALL BE SUFFICIENT FOR ALL ACCESS AND WORKING PLATFORMS

APPLICABLE STANDARDS:

OPSD 3190.100 WALLS RETAINING AND ABUTMENT WALL DRAIN

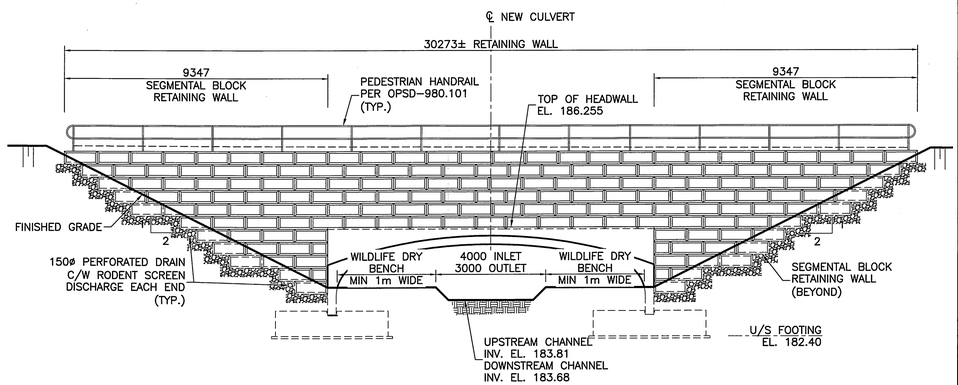
LEGEND

——— NEW CONSTRUCTION

——— EXISTING CONSTRUCTION

CULVERT BED STONE SPECIFICATION

% PASSING	STONE DIA.
D84	400
D50	300
D10	250
VOIDS	GRAN 'B'



CULVERT SOUTH ELEVATION (NORTH SIMILAR)

SCALE 1:50

R-2667B-19

Drawing: P:\WORK\TP114013\STR\DWG\CROSSING #2 (INDIAN-1B)\TP114013-C2-S1.DWG
Layout Tab: S1
Date: 09/20/2019 Time: 09:13:13 AM

K. ALBAZI — LICENSED PROFESSIONAL ENGINEER — Aug 23/19 — PROVINCE OF ONTARIO

M. GALLOWAY — LICENSED PROFESSIONAL ENGINEER — 100167280 — 23 AUG 2019 — PROVINCE OF ONTARIO

NO.	DATE	BY	REVISIONS	MANU	CAD
1	19-08-23	M.G.	ISSUED FOR CONSTRUCTION		X

DESIGN	K.S	CH'KD	K.A.	DATE	APRIL 2019
DRAWN	M.E.	CH'KD	K.S.		
SCALE	AS SHOWN			REFERENCES	

FIELD NOTES

STAMP

REGIONAL

ACCEPTED FOR CONSTRUCTION OF REGIONAL INFRASTRUCTURE

REVIEWED FOR COMPLIANCE WITH REGIONAL STANDARDS ONLY.

Director, Engineering and Construction

Manager, Capital Engineering and Construction

wood.

Halton REGION

TITLE
ROAD RECONSTRUCTION
BRITANNIA ROAD (REGIONAL ROAD 6)
IN THE TOWN OF MILTON

GENERAL ARRANEMENT
CULVERT CROSSING #2 (INDIAN-1B)

CONSULTANT FILE NO.	REGIONAL DRAWING NO.
TP114013	
CONTRACT NO.	DRAWING NO.
R-2667B-19	SHEET S27 OF S38

Boyne Survey Block 1

SUBWATERSHED IMPACT STUDY

BOYNE SURVEY ▪ MILTON PHASE 3

SUBWATERSHED IMPACT STUDY FOR BLOCK 1

TOWN OF MILTON ▪ FINAL DECEMBER 2018 ▪ ADDENDUM JUNE 2019

The Municipal Infrastructure Group Ltd.
8800 Dufferin Street, Suite 200
Vaughan ON CA L4K 0C5
tel: 905.738.5700 fax: 905.738.0065
email: info@tmig.ca

In association with:

Savanta Inc.
37 Bellevue Terrace
St. Catharines ON CA L2S 1P4
tel: 1.800.810.3281 fax: 905.704.4474

AquaLogic Consulting
324 St. Paul Street
Burlington ON CA L7R 3J9
tel: 905.637.1862

Burnside
16775 Yonge Street, Suite 200
Newmarket, Ontario, L3Y 8J4
tel: 905.953.8967 fax: 905.953.8945

Prepared on behalf of:

The Milton Phase 3 West Landowners Group

4 Watercourses and Natural Channel Design

4.1 Overview

The ***SUS*** (November 2015) and the ***FSEMS*** (November 2015) provide constraint rankings for the environmental features on the Subject Lands and these have been revised as necessary for the purposes of this SIS. As illustrated on **Figure 4-1** there are two drainage systems that traverse SIS Block 1. Watercourses I-NE-2A and I-NE-1B, tributaries of Bronte Creek in the Indian Creek watershed, convey drainage in a south-westerly direction to the main branch of Indian Creek. **Section 2.2.3** summarizes the ***SUS*** watercourse assessment (constraint ranking), which is supported by ***SIS*** watercourse and fisheries studies (**Section 2.3.2.2**).

The ***FSEMS*** delineated these systems into several discrete reaches, which are shown and labelled on **Figure 4-1**. In this SIS for Block 1, Tributary I-NE-2A generally refers to the system comprised of sub-reaches I-NE-2A, I-NE-2A-1 and I-NE-2A-3 from the ***FSEMS***. Based on the 2017 re-assessment, reaches I-NE-2A-4 and I-NE-2A-8 should now be considered part of this watercourse, given the hydrological regime change due to upstream SWM Pond discharge. The reach within the North Wetland NHSU has been designated as reach I-NE-2A-8 and it has remained a High Constraint Stream. Tributary I-NE-1B in this SIS refers generally refers to sub-reach I-NE-1B-1 from the ***FSEMS***. The sub-reaches from the ***FSEMS*** have also been referenced in this SIS where warranted to describe specific elements of the existing and proposed NHS.

Tributaries I-NE-2A and I-NE-1B are rated overall as medium constraint watercourses that will be retained in an open channel form, realigned and enhanced. These reaches have undergone extensive straightening and modification for agricultural drainage purposes, as such; they are not as sensitive to relocation and would benefit from enhancements such as the re-establishment of a meandering plan form with functioning floodplain, and development of a riffle-pool morphology. Vegetation and wildlife habitat design considerations within stream corridors and buffers are addressed in **Section 2.4**.

4.2 Geomorphic Assessment

Preliminary natural channel design analysis has been undertaken for the tributaries of Indian Creek that traverse the Boyne Survey SIS Block 1 lands. The ***FSEMS*** and ***CFCP*** established goals and objectives for channel realignment improvements over existing conditions. *The Natural Channel and Wetland Corridor Preliminary Design* (AquaLogic, March 2018) has undertaken feature characterization and design rationale for the preliminary design elements.

The Natural Channel and Wetland Corridor Preliminary Design (AquaLogic, March 2018) is included in **Appendix D**, and the key findings and recommendations from that study are summarized below.

4.2.1 Existing Geomorphic Conditions

The tributary study reaches are 1st order headwater features with pre-development drainage areas of approximately 0.94 km^2 and 1.61 km^2 for Tributaries I-NE-2A and I-NE-1B, respectively, at the downstream study area limit at Britannia Road. The catchment areas north of Louis St. Laurent Avenue are dominated by urbanizing residential land use, while the specific study block is generally agricultural row crop land use with some natural woodlot and wetland. The study reaches fall within a very shallow muted moraine topography that has been heavily ploughed and flattened over decades of farming.

The existing drainage features flow through historically altered and straightened pathways with a mix of wet meadow, cattail stands, and some swamp thicket conditions. The passage of time since former alteration has allowed gradual re-naturalization. The tributaries are weakly defined in competent native till plain soils, consisting of clay to sandy-silt with some gravel and occasional cobbles. The active flow or bankfull channel is difficult to observe due to encroached vegetation with matted or vegetative edge transitions generally defining where water flows. Small dimension low flow features are seen near Britannia Road. Flow paths are occasionally braided or transient through dense groundcover. The relatively low bankfull discharge and

altered cross-section, combined with the high density of vegetation, results in relatively narrow width to depth ratios where bankfull conditions can even be seen. Each tributary is well connected to its wide flat flood plain and the high levels of stem and rooting density result in limited planform adjustment.

Low flow discharge varies from ephemeral to intermittent with occasional minor refuge features holding water. When conditions are favourable for continuous wet weather or seasonal flow, the defined low flow feature width appears to vary from a few centimetres up to 1 m and is up to 25 cm deep in run-pools. The deeper run-pool features are nonetheless often choked with vegetation.

4.2.2 Proposed Natural Channel Corridors

The proposed natural channel corridors consist of central bankfull run and run-pool channels with integrated on-line and off-line wetland features of variable depth, shape, and hydroperiod response. Design rationale, channel gradient, and flow regime information has been used for characterization of cross-section, planform, and profile conditions. The anticipated central channel form will be highly encroached with a dense cover of herbaceous groundcover and shrub thicket vegetation that is adapted to intra-annual flows. The proposed corridors will be diverse and complex linear wetland channel corridor environments. The proposed corridors will be dynamically stable and self-sustaining over time.

Objectives presented in ***FSEMS*** and ***CFCP*** have been addressed in terms of general ecological performance, specific feature types, and specific feature quantity. The preliminary design discussion provided in the Natural Channel and Wetland Corridor Preliminary Design (AquaLogic, March 2018) is recommended as the benchmark for detailed design of the natural channel corridors. The detailed design of wetland replication areas will conform to the wetland mitigation strategy provided in **Appendix B5**.

4.2.3 Meander Belt Analysis

Meander belt analysis was undertaken to refine the meander belt widths presented in the ***FSEMS***. The analysis is documented in **Appendix D**. A review of aerial photographs from 1969, 1989 and 2010 found no evidence of expansive meander belt adjustment. Instead, Regional regressional relationships for Southern Ontario were used, and 10% factor of safety was added to each side to yield the total meander belt width. A meander belt width of 21 m was calculated for Tributary I-NE-1B.

A meander belt width of 18 m was calculated for the southerly reaches of Tributary I-NE-2A (I-NE-2A, I-NE-2A-1 and I-NE-2A-3). The Implementation Principles included with the ***FSEMS*** state that the meander belt width is to be not less than 20 m in any location. Therefore, a 20 m wide meander belt has been applied to the southerly reaches of Tributary I-NE-2A.

In addition, a meander belt analysis has been completed for the watercourse reach adjacent to SWM Pond A (tributary I-NE-2A-4). The Implementation Principles had identified tributary I-NE-2A-4 as a 10m wide NHS block to convey upstream surface flows around the adjacent SWM facility (SWM Pond A) in a vegetated swale. However, recent comments from Conservation Halton (April 2017) have indicated that all of Tributary I-NE-2A, including this reach, is to be regulated due to the permanency of flow. As outlined in the *Meander Belt Width Calculations for I-NE-2A-4 (*GEO Morphix Ltd., October 5, 2017), which is included in **Appendix D**, a meander belt width of 13.2 m provides sufficient width to address the theoretical erosion hazard for this reach. The meander belt width of 13.2 m for reach I-NE-2A-4 was agreed to by all parties (Conservation Halton, Town of Milton and Region of Halton) at a meeting on December 8, 2017.

4.3 Hydraulic Analysis

Tributaries I-NE-2A and I-NE-1B are proposed to be maintained and enhanced within the Block 1 SIS Lands. Hydraulic analyses (using HEC-RAS) have been conducted for both watercourses to demonstrate that the proposed development will be protected against flooding from the two tributaries for all storms up to the Regional Storm event. The riparian storage analysis is also included to demonstrate that the under proposed conditions the riparian storage provided is equal to or greater than existing conditions. The proposed culverts for road crossings of the

watercourse are included in the model to verify the conveyance of all storm events up to and including the Regional Storm event.

4.3.1 Existing Conditions

The existing conditions hydraulic modeling for tributaries I-NE-2A and I-NE-1B was completed by AMEC as part of ***FSEMS***/***SUS*** (November 2015). The existing hydraulic model was obtained from AMEC in HEC RAS format and was used as basis of SIS Block 1 analysis. The existing model along with details from the ***FSEMS*** (November 2015) provided the following existing conditions data:

***Table 4-1**: Existing Hydraulic Conditions*

Tributary ID	Flow Node	Drainage Area (ha) (at Britannia Rd)	Reach Slope (%)
I-NE-2A	8.530	138.62	0.30 – 2.0
I-NE-1B	9.120	126.30	0.38 – 2.0

(1) Drainage Areas indicated based on Table 4.3.1 CFCP November 2015.

(2) Flow Node ID refers to DGW 4, FSEMS November 2015

The flow nodes specified above in ***Table 4-1*** are located at Britannia Road, the downstream study area limit.

The existing flows used in the HEC-RAS models are summarized in ***Table 4-2*****.** The existing conditions model completed by AMEC as pat of the ***SUS*** applied only one flow node at the downstream end for both tributaries. Therefore, the existing flows for tributary I-NE-2A were prorated by drainage area to reflect two intermediate flow change locations, calculated using the MTO transposition of flood discharge equation. Refer to **Appendix E** for detailed calculations. The existing conditions model for Tributary I-NE-1B continues to use one flow node at the downstream end.

***Table 4-2**: Existing Frequency Flows (m^3/s)*

Tributary ID	Hec Ras Flow Node (cross section ID)	Regional Storm	100 year	50 year	20 year	10 year	5 year	2 year	1.25 year
I-NE-2A	8000	*4.70*	*1.59*	*1.37*	*1.10*	*0.91*	*0.72*	*0.45*	*0.28*
	4000	*8.40*	*2.84*	*2.46*	*1.97*	*1.63*	*1.28*	*0.81*	*0.50*
	3000	10.70	3.62	3.13	2.51	2.07	1.63	1.03	0.64
I-NE-1B	8000	10.00	3.29	2.86	2.30	1.90	1.50	0.94	0.59

(1) Interpolated flows for I-NE-2A, pro-rated by drainage area based on the MTO transposition of flood discharges equation [Q2 = Q1 (A2/A1)^-0.75].

(2) Source for the main flow node: HEC-RAS Model Indian.prj, from the Sixteen Mile Creek Areas 2 and 7 Subwatershed Update Study, Town of Milton, Final Report (AMEC Earth and Environmental, November 2015); And TABLE 3.2.1 of FSEMS (November 2015)

A survey of the existing culvert crossings along Britannia Road has been undertaken by Rady Pentek & Edward Surveying Ltd (RPE). **Figure 4-1** illustrates the culverts in and around the study area. Culvert crossing data pertinent to the SIS Block 1 study area are provided in ***Table 4-3***.

***Table 4-3**: Existing Crossing Data*

Culvert ID	Tributary ID	Culvert Location (Britannia Road)	Upstream Invert (m)	DS Invert (m)	Length (m)	Size (m)	Top of Road Elevation (m)
2	INE-2A	458 m east of Tremaine Rd	182.09	181.96	15	*Bridge* 2.4 x 1.1	183.75
3	INE-1B	310 m west of First Line	183.71	183.68	22	*Arch CSP* 1.5 x 0.9	185.00

(1) Culvert ID references Figure 4-1.

(2) Culverts under Britannia Road are proposed to be replaced as part of Halton Region's proposed expansion of Britannia Road.

The existing conditions and surveyed culvert crossing information were used in the existing conditions hydraulic model for SIS Block 1. The HEC-RAS model for Tributary I-NE-2A begins immediately downstream of Britannia Road. The downstream boundary condition is set to the normal water depth, based on the slope of the reach leading south from Britannia Road. The HEC-RAS model is not sensitive to the downstream boundary condition, as the existing Britannia Road culvert influences flood levels within SIS Block 1. The HEC-RAS model for Tributary I-NE-1B extends approximately 1 km downstream of Britannia Road, and the downstream boundary condition therefore has no influence on flood levels at and upstream of Britannia Road.

The existing conditions model is attached in **Appendix E**, and the existing Regional Storm floodplain is illustrated on **Figure 4-2**.

4.3.2 Proposed Conditions

Channelization of the floodplain is proposed for both tributaries within SIS Block 1. The watercourse corridors are to contain the Regional Storm flows within a reasonable width. A natural channel concept design has been undertaken to establish the appropriate geomorphic form and function for the tributaries to be channelized. The proposed watercourse corridor configurations were used to prepare the proposed conditions HEC-RAS model.

The realigned watercourses will have typical cross sections that are trapezoidal in shape with variable side slopes up to a maximum steepness of 3H:1V. Tributary I-NE-2A has a bottom width that varies from 50.0 m to 13.2 m and Tributary I-NE-1B has a bottom width of 21 m. The design of both watercourse corridors incorporates a low flow channel that varies in width from 3.5 m to 4.0 m (bankfull width). The floodplain gradient ranges from 0.2% to 1.8% for Tributary I-NE-2A, while for tributary I-NE-1B the gradient ranges from 0.2% to 0.83%. **Figure 4-3** through **Figure 4-15** illustrate the conceptual plan form, profile and typical cross section for both I-NE-2A and I-NE-1B. The proposed cross section geometry was incorporated into the HEC-RAS hydraulic model. Cross sections downstream of Britannia Road continue to utilize the existing geometry.

Assumptions for Manning's roughness coefficients were based on standards used by the Town of Milton and Conservation Halton, as well as literature data for varying flooding conditions, level of vegetation, etc. A value of 0.045 was used for the low flow / bankfull channel (the trapezium or low flow for a natural channel), which assumes a winding natural stream with pools, stones and vegetation; and a value of 0.085 was used for the valley floor (beyond the extent of the low flow / bankfull channel) and the side slopes of the natural channel corridor. The Manning's n of 0.085 assumes that the natural channel corridor will be fully vegetated with medium brush and some trees.

The proposed conditions HEC-RAS model uses the same flows as existing condition with the understanding that post-development release rates to both tributaries will be attenuated to the pre-development rates. ***Table 4-4*** summarizes the proposed condition scenario flows.

***Table 4-4**: Proposed Frequency Flows (m^3/s)*

Tributary ID	Hec Ras Flow Node (cross section ID)	Regional Storm	100 year	50 year	20 year	10 year	5 year	2 year	1.25 year
I-NE-2A	12500	*4.70*	*1.59*	*1.37*	*1.10*	*0.91*	*0.72*	*0.45*	*0.28*
	7500	*8.40*	*2.84*	*2.46*	*1.97*	*1.63*	*1.28*	*0.81*	*0.50*
	4400	10.70	3.62	3.13	2.51	2.07	1.63	1.03	0.64
I-NE-1B	8000	10.00	3.29	2.86	2.30	1.90	1.50	0.94	0.59

(1) Interpolated flows for I-NE-2A, pro-rated by drainage area based on the MTO transposition of flood discharges equation [Q2 = Q1 (A2/A1)^-0.75].

(2) Source: HEC-RAS Model Indian.prj, from the Sixteen Mile Creek Areas 2 and 7 SUS, Town of Milton, Final Report (November 2015); And TABLE 3.2.1 of FSEMS (November 2015)

Halton Region is proposing to widen Britannia Road to a major urban arterial with four lanes and a total right-of-way of 47.0 m. The hydraulic analyses for both Tributaries I-NE-2A and I-NE-2B are based on the latest information available from the on-going detailed design of Britannia Road. The culvert sizes specified in the Britannia Road Transportation Corridor Improvements – Tremaine Road to Highway 407 - Hydraulic Analysis draft report (August 2012) as well as the Britannia Road Reconstruction drawings prepared by Amec Foster Wheeler, dated November 2015, have been incorporated into the proposed hydraulic model. More information on these and other proposed culvert crossings can be found in **Section 4.3.3**.

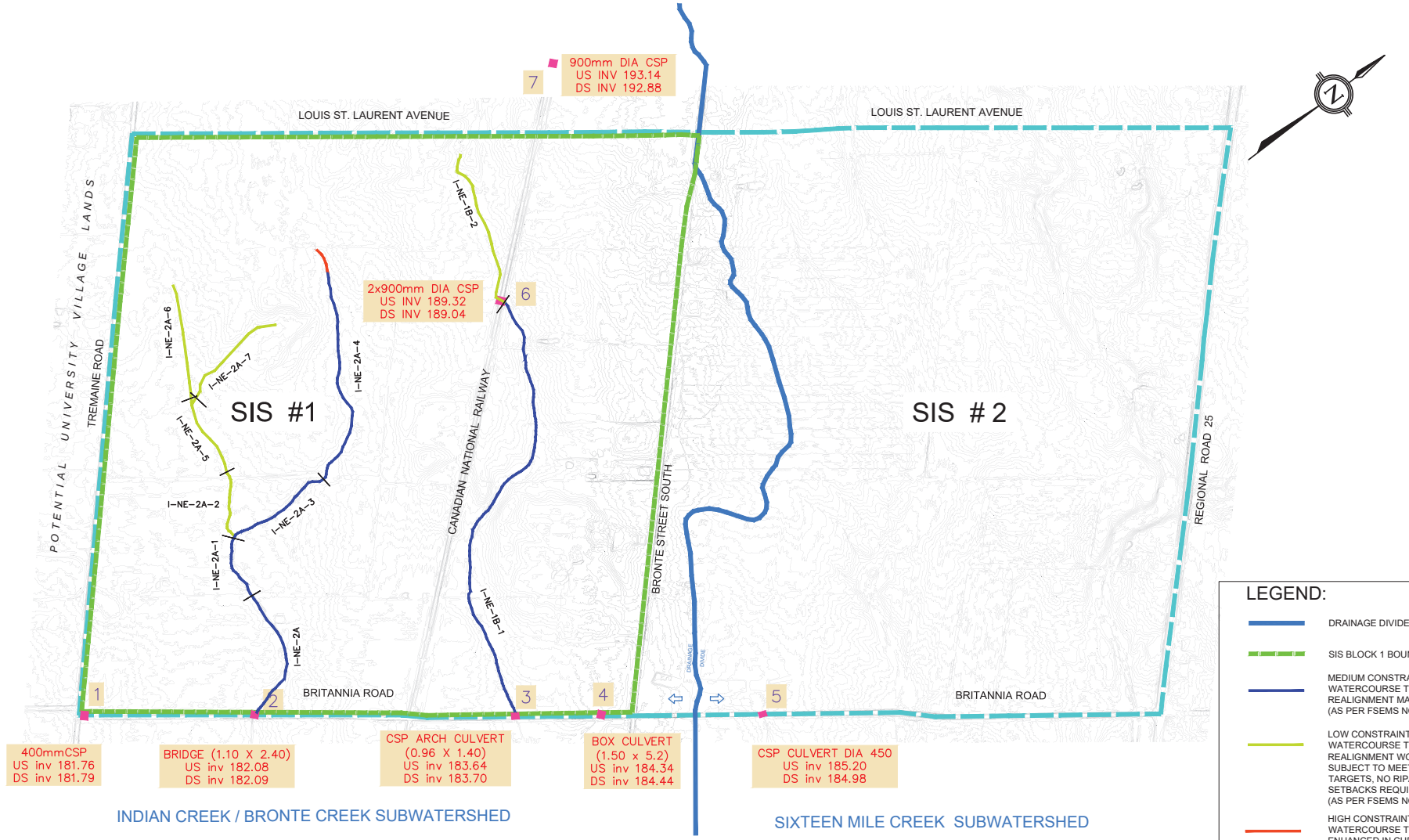
The proposed conditions model is included in **Appendix E** and the proposed Regional storm floodplain is illustrated on **Figure 4-16**. The analysis demonstrates that the Regional storm floodplain will be safely contained within the NHS corridors.

The HEC-RAS model for Tributary I-NE-2A was extended upstream through the watercourse reach adjacent to SWM Pond A (tributary I-NE-2A-4) and further upstream to include the proposed thicket swamp replication area. Additionally, three existing cross sections were added upstream of proposed thicket swamp, through the North Wetland NHSU, ending the proposed model just south of Louis St. Laurent Avenue. Drainage to the I-NE-2A system originates from a stormwater management pond (SWM Pond i10) north of Louis St. Laurent Avenue. This drainage will continue to flow through the North Wetland NHS Unit, and will then be conveyed through the proposed wide wetland thicket swamp block south of the woodlot.

The Implementation Principles had identified tributary I-NE-2A-4 as a 10 m wide NHS block to convey upstream surface flows around the adjacent SWM facility (SWM Pond A) in a vegetated swale. However, recent comments from Conservation Halton (April 2017) have indicated that all of Tributary I-NE-2A, including tributary I-NE-2A-4, is to be regulated due to the permanency of flow. Therefore, tributary I-NE-2A-4 has been designed within a 39 m wide corridor and will convey the upstream drainage through this reach between the Neighbourhood Park on the west side and SWM Pond A on the east side. **Figure 4-4** shows the proposed watercourse adjacent to SWM Pond A.

A cross section through the 39 m wide corridor is provided as **Figure 4-9**. As was agreed to by all parties (Conservation Halton, Town of Milton and Region of Halton) at a meeting on December 8, 2017, the watercourse reach will have a bottom width of 13.2m and variable side slopes as steep as 3H:1V. The 39 m wide corridor includes 10m buffers on either side of the watercourse, these 10m buffers can be graded as steep as 3H:1V. Additionally, the 10 m buffer on the east side overlaps 5 m into the SWM Pond block, which will also include a 4 m trail / access road.

The contributing drainage to watercouse reach I-NE-2A-4 is comprised of the discharge from SWM Pond i10 in Milton Phase 2 (north of Louis St Laurent Avenue), a small portion of the Louis St. Laurent Avenue right-of-way, the North Wetland NHS Unit and the recreated wetland thicket swamp. The HEC-RAS model provided in **Appendix E** demonstrate that the proposed 39 m wide corridor can convey the proposed Regional Storm flow rate of 4.70 m^3/s.



LEGEND:

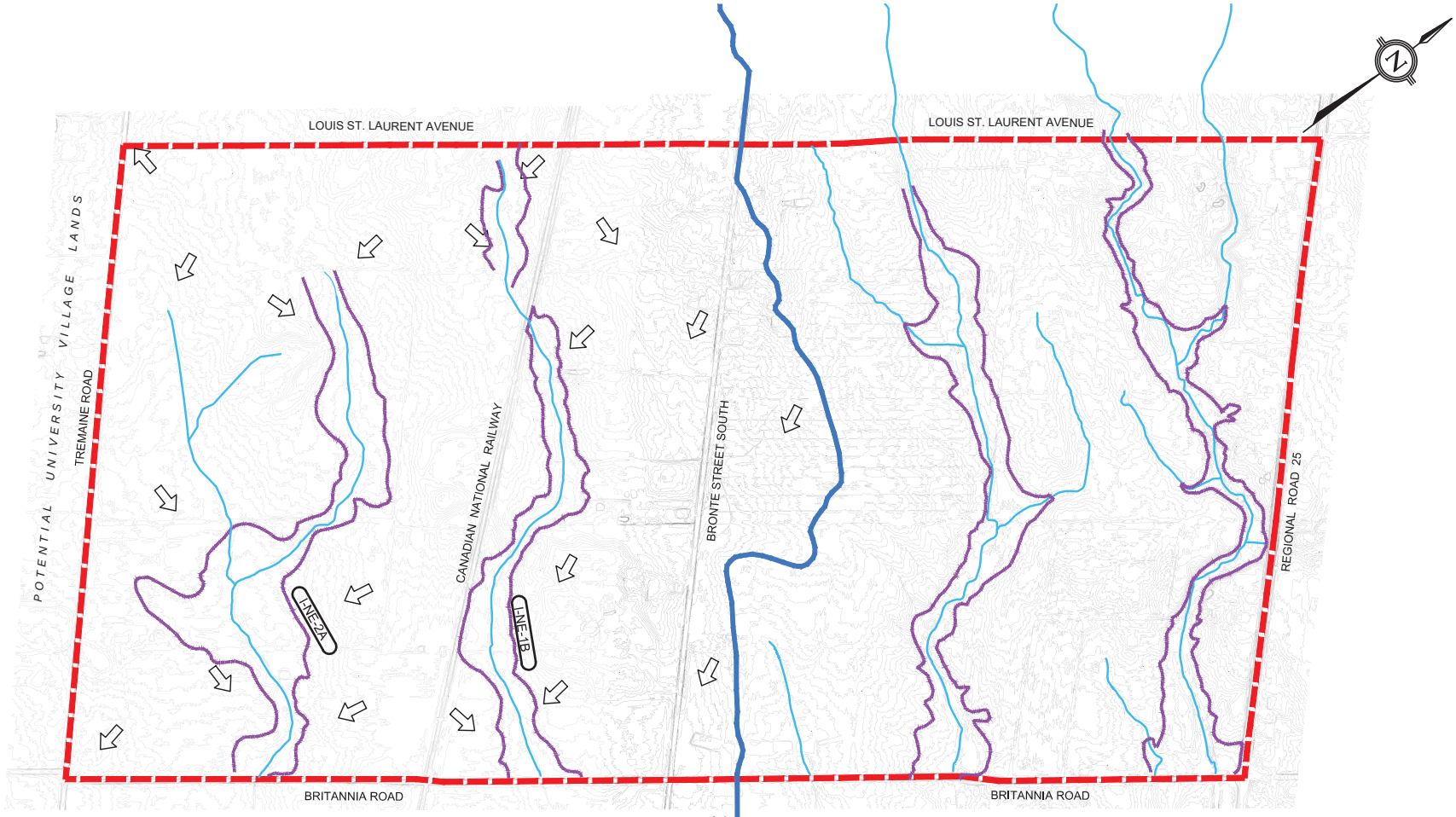
- DRAINAGE DIVIDE
- SIS BLOCK 1 BOUNDARY
- MEDIUM CONSTRAINT STREAM: WATERCOURSE TO REMAIN OPEN REALIGNMENT MAY BE ACCEPTABLE (AS PER FSEMS NOVEMBER 2015)
- LOW CONSTRAINT STREAM: WATERCOURSE TO REMAIN OPEN AND REALIGNMENT WOULD BE ACCEPTABLE, SUBJECT TO MEETING STEAM DENSITY TARGETS, NO RIPARIAN CORRIDOR OR SETBACKS REQUIRED (AS PER FSEMS NOVEMBER 2015)
- HIGH CONSTRAINT STREAM: WATERCOURSE TO BE PROTECTED/ ENHANCED IN CURRENT FORM AND LOCATION (AS PER FSEMS NOVEMBER 2015)

TMIG
The Municipal Infrastructure Group Ltd
8800 Dufferin Street,
Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

SUBWATERSHED IMPACT STUDY BLOCK 1
MILTON PHASE III WEST
EXISTING CROSSING STRUCTURES AND WATERCOURSE RATING

SCALE: 1:10,000		PROJECT No. 10144
DATE: DECEMBER 2018		
DESIGNED BY:	DRAWN BY: CAD	FIGURE No. 4-1
CHECKED BY:	CHECKED BY:	

File : G:\Projects\2010\10144 - Milton Phase 3 West\SIS\Drawings\SIS Figures December 2018 - Final\FIGURE 4-1 EXISTING CROSSING STRUCTURES.dwg, Layout: 4-1 Date: Nov 29, 2018 - 1:47pm, Edit By: emma



TMIG
The Municipal Infrastructure Group Ltd
8800 Dufferin Street,
Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

SUBWATERSHED IMPACT STUDY BLOCK 1
MILTON PHASE III WEST
EXISTING CONDITIONS FLOOD PLAIN MAPPING

SCALE: 1:10,000		PROJECT No. 10144
DATE: DECEMBER 2018		
DESIGNED BY:	DRAWN BY: CAD	FIGURE No. 4-2
CHECKED BY:	CHECKED BY:	

File: G:\Projects\2010\10144 - Milton Phase 3 West\SIS\Drawings\SIS Figures December 2018 - Final\FIGURE 4-2 Existing Conditions Flood Plain Mapping.dwg, Layout: 4-2 Date: Nov 29, 2018 - 1:49pm, Edit By: amira

4.3.3 Proposed Crossings

The general design criteria applicable to the sizing of the watercourse crossings within the study area are summarized below.

- Natural substrate through open footing design (open span culverts).
- Low flow channel through the culvert. If multiple cell culverts are to be used, the low flow should be directed through one of the culverts.
- The minimum span opening recommended (three times bankfull) to address fluvial considerations including watercourse form and functions (not spanning meander belt) and accommodate wildlife passage (not large mammals) as appropriate.
- As per Milton standards, road crossing of major watercourses under arterial roads shall be designed to convey the 1:100 year to Regional Storm event, and for all major events the maximum water depth at the crown of road will be 0.15 m.

Within the Block 1 SIS lands two new culverts are proposed to convey flows and maintain wildlife passage through the NHS system: one where the proposed East-West Collector Road crosses Tributary I-NE-2A (approximately 420 m north of Britannia Road); and another where the proposed Community Connector Road crosses the proposed recreated wetland thicket swamp. As outlined in **Section 2.4.1.8**, the proposed road crossings will be designed as enhanced wildlife crossings (focused on movement of small sensitive terrestrial wildlife).

The opening size of the proposed East-West Collector Road crossing of Tributary I-NE-2A will be three times the bankfull width of 3.5 m, resulting in a minimum span of 10.5 m. Therefore a 10.97 m x 2.75 m open span culvert is proposed. A summary of the proposed culvert configuration and watercourse details is included in **Appendix D**.

The northern Community Connector Road crossing of the proposed recreated wetland thicket swamp has limited upstream drainage area, which is not large enough to warrant fluvial geomorphologic considerations. Therefore, the opening size was based on conveyance of the Regional Storm event and accommodation of wildlife passage. A 4.0 m wide x 1.5 m open footing box culvert is proposed.

A pedestrian bridge is also proposed to cross tributary I-NE-2A to connect the trail on the east side of the NHS corridor to the school blocks and neighbourhood park on the west side of the NHS corridor, as shown on **Figure 4-4** and **Figure 5-4**. The pedestrian bridge will be designed according to the Town standard (Std. No. E-42 – Pedestrian and Vehicle Service Bridge) and is proposed to span the narrower section of the watercourse adjacent to SWM Pond A, thus providing the required open footing design, and accommodating wildlife passage. At detailed design the location of the pedestrian bridge can be finalized to ensure that it provides connectivity between the trail on the east side of the NHS corridor and the public spaces on the west side.

In addition, replacement culverts are proposed under Britannia Road as part of the proposed widening of Britannia Road. Preliminary design information from the Region of Halton indicates that a 7.32 m x 2.50 m open span culvert would be installed at Tributary I-NE-2A, and a 10.97 m x 2.50 m open span culvert would be installed at Tributary I-NE-1B. These proposed culverts have been reflected in the proposed conditions hydraulic model.

The predicted performance of the culverts is summarized in ***Table 4-5***. The HEC-RAS model is included in **Appendix E.**

***Table 4-5**: Conceptual Design of Road Crossing*

Location	Tributary ID	Culvert Size [1] (m)	Proposed Regional Peak Flow (m^3/s)	Freeboard[2] (m)	
				100 Year	Regional
East-West Collector Road	I-NE-2A	10.97 x 2.75	10.7	2.3	1.9
Community Connector Road	NHS	4.0 x 1.5	4.70	1.3	0.9

[1] *culvert height measured relative to top of bankfull channel*
[2] *freeboard elevation is defined as 1.0m lower than the proposed top of road elevation*

The ***CFCP*** sets out criteria for minimum and average distances for road and rail crossings. Crossings are to be a minimum of 100 m apart, and the average distance between crossings should be at least 500 m.

For Tributary I-NE-2A, the East-West Collector Road crossing is located approximately 420 m upstream of Britannia Road. The next crossing upstream is located approximately 730 m upstream of the Collector Road crossing, equating to an average distance of 575 m between crossings.

Note that there are no crossings of Tributary I-NE-1B upstream of Britannia Road.

4.3.4 Interim Condition

Depending on the timing of construction for culvert replacement along Britannia Road, the proposed culverts under Britannia Road may not be replaced at the same time as the construction of the proposed developments and channels. In the event that the culverts under Britannia Road have not yet been replaced, an interim condition model has been created using HEC-RAS to analyze the overtopping of various storm events above the existing crossing along Britannia Road.

The interim condition is a modification of the proposed condition scenario with the Britannia Road culvert altered to the same characteristics as the existing condition culverts. The flows, proposed channel geometry, and culverts within the study area remain the same as the proposed conditions model. The following ***Table 4-6*** summarize the findings. The interim condition hydraulic model output is included in **Appendix E**.

***Table 4-6**: Freeboard Assessment for Existing Britannia crossings under Interim Conditions scenario*

Location	Tributary ID	Minimum Top of Road Elevation (m)	Freeboard Elevation (m)	Freeboard Event	Overtopping Event
Britannia Rd	I-NE-2A	183.75	182.75	<2 year	Regional
	I-NE-1B	185.00	184.00	<2 year	20 year

4.3.5 Riparian Storage

One of the objectives of the channel design is to maintain the riparian storage between existing and proposed conditions. Riparian storage is defined as the volume of water in the stream corridors for a given discharge, ignoring the effect of man-made structures such as culverts and bridges. HEC-RAS hydraulic models have been prepared to determine the riparian storage in the tributaries flowing through the study area for both existing and proposed conditions.

The riparian storage analysis has been summarized in ***Table 4-7*** and ***Table 4-8*** for the existing and proposed conditions of the tributaries flowing through the study area. The changes in

riparian storage volumes are summarized in ***Table* 4-9.** The existing and proposed conditions hydraulic models developed for the Riparian Storage Analyses are included in **Appendix E.**

***Table 4-7**: Riparian Storage Analysis – Existing Conditions*

Storm Event	Storage (1000 m^3) for Reach	
	I-NE-2A	I-NE-1B
2 year	2.74	14.71
5 year	4.23	21.91
10 year	5.24	26.44
20 year	6.16	30.72
50 year	7.47	36.29
100 year	8.46	40.45
Regional	22.08	89.55

***Table 4-8**: Riparian Storage Analysis – Proposed Conditions*

Storm Event	Storage (1000 m^3) for Reach	
	I-NE-2A	I-NE-1B
2 year	3.83	16.30
5 year	5.85	23.74
10 year	7.11	28.34
20 year	8.24	32.63
50 year	9.68	38.15
100 year	10.78	42.14
Regional	22.53	89.79

***Table 4-9**: Change in Riparian Storage*

Storm Event	Storage (1000 m^3) for Reach	
	I-NE-2A	I-NE-1B
2 year	1.09	1.59
5 year	1.62	1.83
10 year	1.87	1.90
20 year	2.08	1.91
50 year	2.21	1.86
100 year	2.32	1.69
Regional	0.45	0.24

As can be seen above in ***Table 4-9***, the proposed conditions riparian storage volumes are greater than the existing conditions volumes for all storm events.

4.3.6 Timing and Sequencing

Based on the fish species present, in-stream work for the proposed channels should be completed as per Agency recommendations.

4.4 Drainage Density

The ***FSEMS*** (Nov 2015) included a preliminary drainage density analysis, which compared the existing stream lengths to proposed stream lengths. The intent of this exercise was to demonstrate that the Tertiary Plan, as proposed, with the realigned (blue) watercourses and existing swales in the Indian Creek watershed, all other existing natural features retained within the NHS and swales anticipated to be on the future landscape in schools and parks, would adequately satisfy regional drainage density targets on a watershed scale (i.e., for the Indian and Sixteen Mile Creek watersheds). The findings show that the overall drainage density targets will be exceeded (as identified in *Appendix J* of the ***FSEMS*** (Nov 2015)).

The tertiary plan drainage density calculation provided in the ***FSEMS*** showed that there is a surplus of 39% stream length for the Indian Creek watershed. To ensure that the drainage density targets are being met in the SIS Block 1 area the channel lengths from the current Tertiary Plan dated March 2018 have been compared FSEMS analysis. ***Table 4-10*** summarizes the findings.

Table 4-10*: Channel Lengths for Indian Creek*

Channel Type	Existing[1] (km)	Proposed (FSEMS) [2] (km)	Tertiary Plan (March 2018) [3] (km)
Medium Constraint Streams	2.97	2.89	2.81
Swales	1.37	2.39	2.64
Total	4.34	5.28	5.45

[1] *From Table 5.1.6 of the Nov 2015 FSEMS*
[2] *From Parish memo included as Appendix J to the Nov 2015 FSEMS*
[3] *Details of the calculations are provided on Appendix F7*

As shown in ***Table 4-10***, the channel lengths exceed the lengths estimated in the ***FSEMS***, which already significantly exceeded the existing stream lengths. The channel lengths used for the calculation are illustrated on **Figure 4-17** and detailed calculations are included in **Appendix F7**.

4.5 Development Limit Summary

A number of factors influence the total width of the protected stream corridors through the Block 1 SIS lands.

Meander Belt: The meander belt is a zone within which the proposed enhanced channel can naturally migrate over time. Meander belt widths for Tributaries I-NE-2A and I-NE-1B were described in **Section 4.2.2**

Replacement of Lost Wetland Function: As per the Implementation Principles included in the ***FSEMS***, it is proposed to remove two isolated wetland features adjacent the CNR corridor and replace their function within Tributary I-NE-2A. The width of the channel corridor has been

increased in some reaches for the re-created wetlands. More information on these elements of the proposed NHS is provided in **Section 2.4.1.5**.

Conveyance and Riparian Storage: **Section 4.3** demonstrated that the proposed stream corridors can safely convey all flows up to the Regional Storm event and provide sufficient riparian storage.

Grading: The meander belt and re-created wetlands govern the base width of the channel corridors. Variable side slopes up to a maximum steepness of 3H:1V are proposed to match proposed grades on either side of the channel. More information on the proposed grading for the Block can be found in **Section 6.4.**

Buffers: Requirements for buffers on either side of the channel were established in the Implementation Principles included in the ***FSEMS***. The realigned I-NE-2A and I-NE-1B stream corridors that are being maintained within the SIS Block 1 lands will have 10 m buffers on either side. A 15 m setback is required for the majority of the realigned stream corridors on the side that contains a trail. The only exception is the watercourse reach (tributary I-NE-2A-4) that runs adjacent to the mid-block SWM Pond. In this area, the 10 m buffer on the east side overlaps 5 m into the SWM Pond block, which will also include a 4 m trail / access road.

A 15 m buffer is proposed between the CN railway and future development, with the exception where CNR abuts the channel I-NE-1B. At this location the channel block itself will act as a buffer between the CNR right of way and future development.

The widths of these individual component and the cumulative corridor widths for Tributaries I-NE-2A and I-NE-1B are summarized in ***Table 4-11***.

***Table 4-11**: Development Limit Summary*

Reach	Description	Total Meander Belt Width (m)	Width for Wetland Compensation (m)	Total Average Side Slope Width (m)	Total Buffer Width (m)	Total Corridor Width (m)	Total Width from Implementation Principles (m)
I-NE-2A, I-NE-2A-1	Britannia Road to Collector Road	20	10.5	12.0	25.0	67.5	57.5
I-NE-2A-3	Collector Road to SWM Pond A	20	varies	12.0	25.0	60.5 to 55.0	52.5
I-NE-2A-4	Adjacent to SWM Pond A	13.2	-	varies	20	39.0	10.0
Wetland Thicket	SWM Pond A to North Wetland	n/a	45.0	-	35.0	80.0	75.0
I-NE-1B-1	East-West Alignment Upstream of Britannia Road	21	-	9.0	25.0	55.0	55.00
I-NE-1B-1	North-South Alignment, Upstream to SWM Pond D	21	-	10.5	25.0[1]	60.0	55.0
I-NE-1B-1	Upstream of SWM Pond D	21	-	10.5	25.0[1]	59.0	55.0

[1] The 10 m buffer is provided on the west side of the channel congruent with the CNR 15 m setback

5 Stormwater Management

5.1 Background and Objectives

The Subwatershed Update Study (***SUS***, Nov 2015) provides guidelines for the management of stormwater under post development land use conditions. These guidelines have been developed through an integrated stormwater management plan for the proposed urban development, which included hydrologic modelling of the watersheds. Based on the hydrologic modelling, the ***SUS*** (Nov 2015) recommends that stormwater management (SWM) facilities be provided for control of water quality, water quantity, and erosion control. Within the Indian Creek watershed the SWM facilities were sized using unitary storage and discharge criteria determined using the HSP-F hydrologic model and continuous simulation modelling.

SIS Block 1 is located within the Indian Creek watershed. The proposed development plan for SIS Block 1 includes six SWM facilities, SWM Ponds A, B1, B2, C, D and E, to provide the required stormwater management controls.

5.1.1 Quality Control

Quality control for all facilities shall be based on the Enhanced Level criteria as established by the MOE SWM Planning and Design Manual (March 2003), which defines the volume of the permanent pool within a SWM facility. The enhanced water quality storage requirements are presented in ***Table 5-1***.

Table 5-1*: Enhanced Water Quality Storage Requirements – MOE 2003*

Protection Level	SWMP Type	Storage Volume (m^3/ha for Impervious Levels)			
		35%	***55%***	***70%***	***85%***
Enhanced Protection (Formerly Level 1)	Wetlands	80	105	120	140
	Wet Ponds	140	190	225	250
	Hybrid Wet Ponds / Wetlands	110	150	175	195

Note*: Of the specified storage volume for wet facilities, 40 m^3/ha is extended detention*

5.1.2 Thermal Mitigation

If not mitigated, water discharged from stormwater management facilities during the summer months can be much warmer than the water in the receiving drainage systems, potentially impacting the aquatic habitat and species in the downstream receiving systems. The SWM facilities in SIS Block 1 are proposed to be wet detention ponds. Relative to constructed wetlands, wet ponds maintain a much deeper pool of water. Bottom draw outlets are proposed to empty the extended detention storage volume by drawing cooler water from the base of the permanent pool.

Other thermal mitigation measures may be considered during detailed design and will consider the latest research from the STEP program as well as data from current monitoring programs for recent development in the Town of Milton. These additional measures include:

- Creating a 3 m deep permanent pool area in the vicinity of the bottom draw outlet pipe to create a zone of deeper, cooler water. If possible, the volume of the deeper pool should be equivalent to the runoff volume from a 10 mm storm event;
- Orienting SWM ponds in a north-south direction;
- Configuring SWM ponds with large length-to-width ratios (minimum 3:1, preferred from 4:1 to 5:1);
- Selecting plants to maximize shading of the SWM facility, particularly along the south and west edges;
- Constructing cooling trenches at the SWM pond outlets (within the receiving channel corridors);

- Installing shade plantings at the storm outfall;
- Maximizing infiltration of storm runoff (upstream of the SWM facility) to the extent feasible, ideally in areas close to the channel corridors to allow the infiltrated water to emerge as groundwater discharge in the surrounding watercourses.

While all of the above will be explored during detailed design of the SWM facilities, analyses were undertaken to determine the size of cooling trench that would be required to reduce the discharge temperature to a maximum of 26ºC. This represents the upper limit of a cool-warm thermal regime, as per Chu et. Al. (2009). The analyses were based on the approach presented in the Study Report – Thermal Impacts of Urbanization Including Preventative and Mitigation Techniques (Credit Valley Conservation, January 2011). Taking the largest SWM facility as an example (SWM Pond B1, 43.9 ha drainage area), the analyses predict that a 10 m long, 2 m wide cooling trench with an effective depth of 0.5 m could theoretically reduce pond discharge temperatures to no more than 26ºC with a factor of safety of between 3 and 5. Calculations are included in **Appendix F5**. Additional analyses of cooling trenches and any other thermal mitigation measures will be undertaken during detailed design of the SWM facilities in Block 1.

5.1.3 Quantity Control Storage

Stormwater management runoff control criteria were defined in the ***FSEMS*** (Nov 2015) based upon the hydrologic modeling completed to date using the HSP-F model, and further refined through discussions with the Town and AMEC (See **Appendix F1**). The stormwater management storage requirements have been summarized in ***Table 5-2*** and ***Table 5-3*** for reaches I-NE-2A and I-NE-1B respectively. Requirements for extended detention will be refined further as required, based upon hydrologic verification of the proposed land use and stormwater management plan provided in this SIS.

SWM Ponds have been sized to attenuate the stormwater runoff from a Regional Storm event in order to mitigate the impacts on development on adjacent watercourses and protect the development from high intensity flood events.

***Table 5-2**: Peak Flow and Storage Requirements for Reach I-NE-2A*

Storage Component	Cumulative Storage Required (m^3/impervious ha)	Discharge (m^3/s/ha)
Erosion Control / Extended Detention	375	0.00084
25 Year	550	0.012
100 Year	800	0.024
Regional Storm	1550	0.066

***Note**: Values based on correspondence from AMEC provided in Appendix F1.*

***Table 5-3**: Peak Flow and Storage Requirements for Reach I-NE-1B*

Storage Component	Cumulative Storage Required (m^3/impervious ha)	Discharge (m^3/s/ha)
Erosion Control / Extended Detention	150	0.0009
25 Year	275	0.0220
100 Year	400	0.032
Regional Storm	675	0.095

***Note**: Values based on correspondence from AMEC provided in Appendix F1.*

5.1.4 Release Rates

The stormwater management facilities for the proposed SIS Block 1 lands will be designed to control the erosion, 25 year, 100 year and Regional Storm post development flow from the site to the required release rates specified in ***Table 5-2*** and ***Table 5-3***. Considerations for the design of the outlet structure will include the following:

- Required release rates obtained through the design of orifices and weirs sized to meet the requirements;
- Bottom-draw outlet may be used for frequent flow events to minimize the water temperature input to Indian Creek; and,
- Provision of riparian vegetation from the pond outlet to the receiving watercourse.

5.2 Hydrologic Characterization

The existing drainage areas are described in the ***FSEMS*** (Nov 2015). Based on the existing topographic information, the existing drainage is analyzed as shown on **Figure 5-1**. **Figure 5-1** provides further delineation of the existing drainage patterns within and in close proximity to the SIS Block 1 lands. As shown, the SIS Block 1 lands are divided into five subcatchments based on the direction of flow. The area labelled Subcatchment 201 on the west side of the site has a drainage area of 126.8 ha and drains to Indian Creek Tributary I-NE-2A. Subcatchment 202 on the east side of the site, has a drainage area of 108.2 ha and drains to Indian Creek Tributary I-NE-1B. The subcatchment, labelled 203, has the smallest drainage area of 0.97 ha and drains in a westerly direction towards a ditch alongside Tremaine Road. Subcatchment 204, located in the southwest corner of the site, has a drainage area of 7.8 ha and drains southwest to a tributary of Indian Creek. The final Subcatchment 205, located in the southeast corner of the site, has a drainage area of 4.6 ha and drains southeast to Indian Creek Tributary I-NE-1B.

Section 3.8 outlines a water balance for the area as well as infiltration methods and LID measures.

5.3 Stormwater Management Strategy

As part of the preliminary design process, a review of potential stormwater management practices (SWMPs) that could be incorporated into the proposed development design was completed. A treatment train approach was adopted, considering lot-level, conveyance and end-of-pipe stormwater management practices.

Opportunities to strategically incorporate LID approaches have been considered in developing the stormwater management strategy for the SIS Block 1 lands. An LID measures feasibility matrix is provided in **Appendix F8**, which summarizes a number of LID measures for consideration, along with an evaluation of each LID measure. However, these measures generally require more detailed analysis of site-specific conditions to establish applicability and effectiveness, and thus will be explored further at the detailed design stage.

5.3.1 Lot Level Control Measures

The opportunity to implement lot level control measures will be explored during the detailed design stage. Within the context of the stormwater management objectives described in **Section 5.1**, lot level controls can be used to supplement end-of-pipe controls. Lot level controls for the residential lots, school and park blocks include:

- *Increased topsoil* – Increasing the topsoil used in residential developments allows for greater on-site retention of stormwater within the topsoil layer and further encourage both infiltration and evapotranspiration. It is also proposed to direct roof runoff to the grassed areas to make full use of the additional topsoil depth. Up to 300 mm topsoil depth is also recommended for parks and landscaped portions of school blocks. The document “Preserving and Restoring Healthy Soil: Best Practices for Urban Construction” (TRCA, June 2012) should be referenced during detailed design such that reasonable soil management practices can be implemented during construction.

- *Reduced lot grading* – This approach applies flatter grades across the property to slow down runoff and further encourage both infiltration and evapotranspiration. Lot grading will be implemented in accordance with Town standards.
- *Site preparation* – Consideration will be given to using site preparation methods before the application of topsoil in order to mitigate the impacts of compaction during earth works and construction. Examples of this include shallow tilling and scarification of areas prior to soil placement, and the use of soil amendments to increase organic content.

Other control measures such as rain gardens, buffer strips and bio-retention areas will also be explored at the detailed design stage. However, lot level measures such as soak-away pits are not proposed in Block 1 due to the limited infiltration capacity of the native soils.

5.3.2 Conveyance Measures

The preliminary grading and servicing investigations for Block 1 assume that storm runoff will be conveyed to the end-of-pipe stormwater management ponds via traditional storm sewer systems. During detailed design, Town of Milton staff will be consulted to determine if and where more innovative stormwater conveyance measures could be applied, such as enhanced vegetated swales, bio-retention swales, rain gardens, enhanced street tree pits, etc. These conveyance measures could further reduce peak flow rates and runoff volumes and improve water quality. Given the limited infiltration capacity of the soils in Block 1, such conveyance measures would incorporate an underdrain to carry the filtered stormwater to the storm sewer system and stormwater management ponds.

5.3.3 End-of-Pipe Measures

End-of-pipe measures receive stormwater runoff from the conveyance system and are designed to attenuate peak flows and improve water quality through the detention and slow release of stormwater runoff. The implementation of end-of-pipe facilities offer a number of significant practical benefits in terms of providing Municipal control, ease of maintenance, ability to serve large drainage areas, and a high degree of effectiveness in runoff management, as required for mitigation of flooding, erosion and water quality impacts. Moreover, it is recognized that end-of-pipe facilities represent the most reliable and efficient means of achieving stormwater quantity control.

End-of-pipe facility techniques, including wet ponds, wetlands and hybrid systems, have been considered for the SIS Block 1 lands.

Wetlands

The constructed wetland is one of the preferred end-of-pipe SWM facilities for water quality enhancement. Wetlands are normally more land-intensive than wet ponds because of their shallower depths (both in permanent pool and in active storage zone). They are suitable for providing the storage needed for erosion control purposes, but will generally be limited in their quantity (i.e., flood) control role because of the restrictions on active storage depth. Wetland facilities are not preferred within the SIS Block 1 lands for a number of reasons:

1. the potential for nuisance species (i.e. mosquitoes) due to shallow permanent pool depth;
2. the potential to increase downstream water temperatures in in the receiving drainage systems due to shallow permanent pool depth; and
3. the extensive land area required to provide water quantity control for the Regional Storm event due to the maximum active depth of 1 m.

Therefore, wetland facilities have not been selected for the SIS Block 1 lands.

Wet Ponds

Wet Ponds are the most common end-of-pipe SWM facility employed in Ontario. They are less land-intensive than wetland systems and are normally reliable in operation, especially during adverse conditions (e.g., winter/spring). Wet Ponds can be designed to efficiently provide for water quality, erosion and quantity control, reducing the need for multiple end-of-pipe facilities. Wet Ponds can be designed with extensive landscaping and associated recreational amenities,

contributing to the character of the community. Wet Pond facilities are the preferred SWM facility within the SIS Block 1 lands for a number of reasons:

1. Wet Ponds are preferred over Wetlands under current Town of Milton standards, as they are generally recognized to reduce the number of nuisance species (i.e. mosquitoes) due to the deeper permanent pool;
2. Relative to constructed wetlands, Wet Ponds maintain a much deeper pool of water. The use of bottom draw outlets enables the facility to empty the extended detention storage volume by drawing cooler water from the base of the permanent pool thus providing thermal mitigation as described in **Section 5.1.2**; and
3. Wet Ponds are the least land-intensive SWM facilities as they can be designed to depths up to 3 m, thus providing water quantity control for the Regional Storm event within a smaller footprint.

Hybrid Wet Pond/Wetland Systems

Hybrid wet pond / wetland systems consist simply of a wet pond element and a wetland element. The system provides for the deep water component which will be least impacted by winter/spring conditions and the wetland component which provides enhanced biological removal during the summer months. In terms of land requirements, it falls between the amounts needed for wet ponds and constructed wetlands. Hybrid facilities are not preferred within the SIS Block 1 lands for a number of reasons:

1. Although Hybrid facilities introduce deeper pools at the forebay and outlet (which aids in thermal mitigation), the potential for nuisance species (i.e. mosquitoes) is still present in the shallower permanent pool depths of the wetland component; and
2. Active storage depth restrictions apply to Hybrid systems, therefore the land area required to provide water quantity control for the Regional Storm event are 1.5 times more than Wet Pond requirements.

Therefore, hybrid facilities have not been selected for the SIS Block 1 lands.

Traditional Wet Ponds are proposed to service the SIS Block 1 lands. As noted in **Section 5.1.2**, the deep pools of water in Wet Ponds can be effective in mitigating thermal impacts on the downstream drainage systems when combined with bottom draw outlets. Additionally, Wet Ponds are generally recognized as the best SWM facility for reducing the number of nuisance species (i.e. mosquitoes) due to the deeper permanent pool depths and are the least land-intensive SWM facility. Details of the stormwater management ponds are included in **Section 5.5.2**.

5.4 Stormwater Management Facility Design

The majority of the existing drainage from SIS Block 1 drains to two tributaries of Indian Creek. The proposed grading for the site is designed to direct the majority of major and minor system flows to stormwater management facilities prior to entering the Indian Creek tributaries.

5.4.1 Major System Drainage Areas

All of the overland flow from each drainage area within SIS Block 1 will be directed to a SWM facility constructed within that drainage area. An overland flow analysis has been undertaken, based on the preliminary site grading, to confirm that the proposed roadways are capable of conveying the overland flow from SIS Block 1. The analysis is detailed in **Appendix F4**, and demonstrates that there is sufficient road capacity for the anticipated overland flows to ponds A, B1, B2, C and E. Additionally, a swale has been sized to convey flows from Bronte Street and from the mixed use nodes located at the south west corner of Bronte Street and Louis St Laurent to Pond D. These calculations are also found in **Appendix F4**. The overland flow analysis will be refined during detailed design as part of the overall grading and servicing design for the road network. Should the major system flow exceed the conveyance capacity of any given road the storm sewer will be sized to accommodate the flows in excess of the road capacity. At detailed design, the major system design for the development area are to be coordinated with the major system design for Britannia Road to ensure runoff is captured and conveyed to SWM Pond B2, C and E.

Preliminary proposed major system drainage boundaries and site grading are shown on **Figure 5-2**. **Table 5-4** summarizes the tributary drainage areas of the proposed stormwater management ponds. Additional detail with respect to the derivation of imperviousness values is provided in **Appendix F1**.

Table 5-4: *Summary of Pond Tributary Drainage Areas*

Pond ID	Tributary Area (hectares)	Imperviousness (%)	Runoff Coefficient
A	37.4	67	0.67
B1	43.9	68	0.68
B2	18.6	60	0.62
C	27.3	69	0.68
D	35.1	71	0.70
E	28.6	75	0.72

5.4.2 Minor System

The minor system will be designed to accommodate the 5-year storm event flows. Flows that are greater than the 5-year storm event will be conveyed overland to the stormwater management facilities. The invert elevations of storm sewers at the inlet to SWM ponds should be established such that the storm sewer system is not surcharged during a 5-year storm event, taking into consideration the extended detention elevation in the SWM pond for the 5-year storm. This should be confirmed during final design by conducting a hydraulic grade line analysis demonstrating that the minor storm sewer system is not surcharged during a 5-year storm event.

The inlets to the SWM ponds have been set at the normal water level in the facilities. This is the standard practice of most other GTA municipalities, although it is recognized that the Town of Milton Engineering and Parks Development Standards Manual generally requires inlets to be located at the extended detention water level in stormwater management ponds. Within Block 1, achieving this criterion would require the entire site to be raised from between 0.35 m and 0.85 m, and would require a further 800,000 m^3 of fill to be imported to the Block. The development areas will already be significantly higher than the bounding roadways (Tremaine Road, Britannia Road, Bronte Street), and raising the site an additional 0.65 m on average would further increase the height of the development relative to the bounding roadways. The elevations of the inlets to the SWM Ponds in Block 1 will be discussed further with Town of Milton staff during preliminary and detailed design of the subdivisions within the Block. In addition, at detailed design, the minor system design for the development area are to be coordinated with the minor system design for Britannia Road to ensure runoff is captured and conveyed to SWM Pond B2, C and E.

5.4.3 Areas Not Draining to Stormwater Management Ponds

Within the SIS Block 1 lands there is one area (the Shadybrook major node/high density residential block) where drainage cannot be directed to the proposed stormwater management ponds. It is located north of Britannia Road and west of Bronte Street at the south-east corner of SIS Block 1. The requirement to match existing grades and anticipated entrances from Bronte Street and Britannia Road places this area too low to drain to SWM Pond E. More information on the grading for these and other areas in Block 1 can be found in **Section 6.4**. Under existing conditions, approximately 4.6 ha of agricultural field drains to an existing 1.50 m x 5.20 m box culvert under Britannia Road a short distance west of Bronte Street. The system then drains in a south-westerly direction to join the main branch of Tributary I-NE-1B approximately 100 m south of Britannia Road (See **Figure 5-1**). Therefore, the area will be designed to provide on-site water quality and quantity control and discharged to the existing 1.50 m x 5.20 m box culvert under Britannia Road.

Adjacent to the channel blocks clean surface runoff from rear lots, and portions of the park and school blocks abutting the NHS corridor will drain directly to the channel.

Additionally, an external area from the SIS Block 2 lands (a 2.12 ha Major Node/High Density Block, part of the Main Sail Development (24T-14006/M)) located east of Bronte Street is proposed to drain west across Bronte Street through the existing twin 900mm diameter CSPs. It is not possible to drain this area to the proposed SWM Pond E. The Block 2 SIS proposed that on-site controls be used to control the stormwater runoff from this area to pre-development levels. Controlled runoff will be conveyed, through the existing twin 900mm diameter CSPs, and through Bronte Street and Britannia Road right of ways, to the existing 1.50 m x 5.20 m box culvert under Britannia Road.

The existing twin 900mm diameter CSP located at the intersection of Britannia Road and Bronte Street, which are proposed to convey the controlled runoff, are to be removed during the widening of Britannia Road. A 900mm diameter concrete pipe is proposed to be installed 45m north of the intersection to maintain existing drainage function of the twin 900mm diameter CSPs. The 900mm diameter concrete pipe will convey flows to the existing 1.50 m x 5.20 m box culvert under Britannia Road and ultimately to the main branch of Tributary I-NE-1B. This work will need to be coordinated with the Town of Milton, Halton Region and Conservation Halton to ensure the conveyance of runoff to Tributary I-NE-1B is maintained.

5.4.3.1 *On-Site Water Quality Treatment*

The Shadybrook major node/high density residential block will be designed to provide Enhanced level water quality treatment, in accordance with the MOE SWM Planning & Design Manual (March 2003). A treatment train approach will be used to achieve the 80% total suspended solids (TSS) removal requirements. The following are a few of the low impact development (LID) strategies and best management practices that could be implemented to provide water quality treatment.

Soakaway Pits / Infiltration Chambers / Bioretention Facilities – These facilities are underground and can be placed in landscaped or paved areas. Water quality is provided through storage volume provided in the filter media or chambers. They can be sized to provide varying degrees of TSS removal.

Oil and Grit Separators – Oil and grit separators (OGS) can be used to remove up to 60% of the TSS (OGSs that have been evaluated using ETV ISO 14034 are recognized by Conservation Halton to provide 60% TSS removal and unevaluated units are only recognized to provide 50% TSS removal). These devices can be placed upstream of filtration or infiltration facilities to provide pre-treatment and assist in achieving the required enhanced water quality treatment.

Vegetated Filter Strips / Swales – Where grades allow stormwater can be conveyed through vegetated swales or across vegetated filter strips to assist with the removal of TSS.

The detailed design of the required water quality treatment will be completed at the site plan design stage.

5.4.3.2 *On-Site Water Quantity Attenuation*

The Shadybrook major node/high density residential blocks will be designed to provide on-site water quantity attenuation to control the post development flows to pre-development levels. Preliminary calculations were made to determine the volume of runoff required to be attenuated on-site.

The allowable flows from the major node/high density residential block were calculated using the Rational Method. The pre-development peak discharge rates were determined for the existing undeveloped 4.6 ha parcel, which currently conveys flows to the existing 1.50 x 5.20 m box culvert on Britannia Road (refer to **Figure 5-1** for pre-development drainage areas). ***Table 5-5*** summarizes the allowable flows from the major node/high density residential block.

***Table 5-5**: Allowable Flows from the Shadybrook Major Node to the Indian Creek Tributary*

Design Event	Allowable Flows (m^3/s)
2 year	0.078
5 year	0.104
10 year	0.121
25 year	0.143
50 year	0.159
100 year	0.175

Detailed calculations are provided in **Appendix F6**.

In order to achieve the target release rates in the post-development scenario, stormwater will need to be stored on-site and released at controlled pre-development levels. The Modified Rational Method was used to determine the approximate storage volume that will be required on-site for the major node within Shadybrook. The require storage volumes and target release rates for the major node/high density residential block are summarized below in ***Table 5-6***.

***Table 5-6**: Summary of Required Storage Volumes and Target Release Rates for the Shadybrook Major Node*

Storage Component	Cumulative Storage Required (m^3)	Discharge (m^3/s)
5 Year	166	0.104
100 Year	273	0.175

Detailed calculations are provided in **Appendix F6**.

On-site storage can be provide using low impact development (LID) strategies and best management practices. The following options are available for consideration during the detailed design stage:

Roof Drain Controls – Runoff generated on the rooftop can be detained and discharged at a restricted release rate of 42 L/s/ha of rooftop during the 100-year event. Rooftop controls are an effective water quantity attenuation tool if the proposed development includes flat roofed buildings.

Parking Lot Storage – Runoff generated on large paved surfaces can be detained on the surface, either through inlet controls or an orifice plate or tube within the subsurface storm sewer system. This allows for surface ponding thus creating a surface detention system.

Underground Storage Tank / Pipe Storage – Oversized pipes and underground tanks can be used to provide a subsurface detention system. The subsurface detention system is used in combination with an orifice plate or tube within the subsurface storm sewer system to control the runoff to the target release rates.

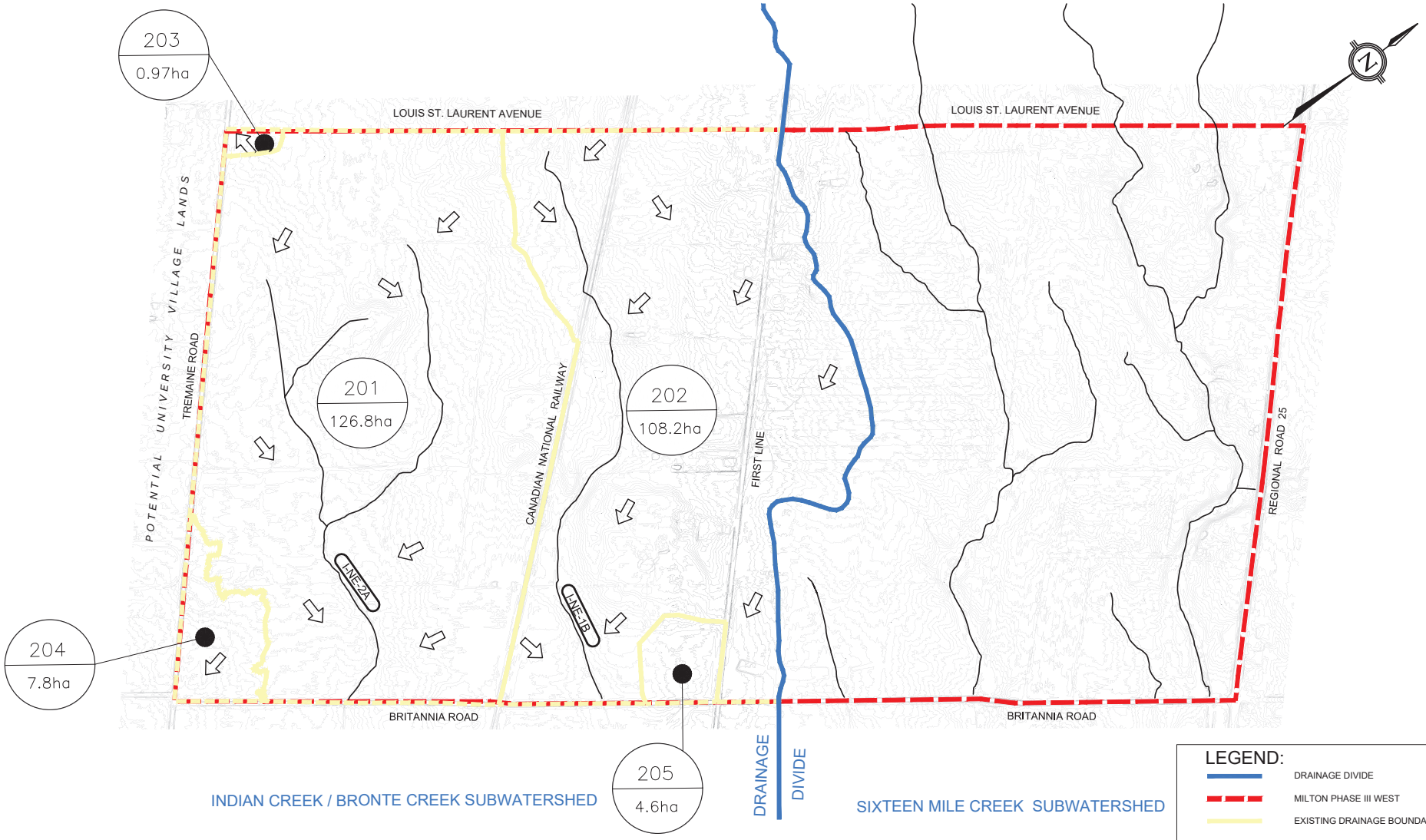
The detailed design of the on-site controls will be completed at the site plan design stage.

5.4.4 Canadian National Railway (CNR) Drainage

The Canadian National Railway (CNR) runs north-south through the middle of SIS Block 1 and the proposed development of the block will alter the existing drainage patterns. Under existing conditions drainage areas from west of the CNR lands are conveyed through culverts under the existing tracks where flows are conveyed to the existing tributary I-NE-1B on the east side of the tracks or are conveyed within existing CNR ditches to Britannia Road.

At the north end, a drainage area of approximately 12.09 ha is tributary to the culvert located approximately 430m south of Louis St. Laurent Avenue (Culvert A) as illustrated on **Figure 5-3**. Currently the existing tributary I-NE-1B-2 is conveyed under the CNR tracks through this culvert to the east side of the CNR lands where flows continues in the I-NE-1B watercourse. Under proposed conditions approximately 10.2 ha of this drainage area will be diverted to tributary I-NE-2A, as the I-NE-1B-2 tributary is to be removed (the drainage conveyance function of tributary I-NE-1B-2 has been replicated in the existing ditch to the east of the CNR tracks). Therefore, in the proposed condition, only the lands owned by the CNR will continue to drain through the existing CNR ditches and through Culvert A. Under proposed conditions, flows from Culvert A will be conveyed to the realigned I-NE-1B watercourse on the east side on the CNR tracks. Therefore, the proposed development will not impact the flood conditions of the CNR lands tributary to Culvert A as a positive outlet will be maintained.

There are two additional culverts that cross under the CNR lands: Culvert B, located just south of the North CNR wetland; and Culvert C, located east of the South CNR wetland. Currently the drainage areas associated with the two wetland pockets 4.19 ha for the North CNR wetland and 4.54 ha for the South CNR wetland are conveyed through culverts B and C respectively. The runoff from the wetland pockets as well as runoff from the 3.55 ha of CNR lands is conveyed through the existing CNR ditches, which are approximately 0.5m deep, south to Britannia Road. However, during large storm events these ditches spill onto the lands east of the CNR tracks and are conveyed south in the I-NE-1B watercourse. Similar to the area to the north, the majority of the existing drainage area will be diverted to tributary I-NE-2A under proposed conditions and only the lands owned by the CNR will continue to drain through the existing CNR ditches and through culverts B and C. Under proposed conditions, flows from culverts B and C will be conveyed through the existing CNR ditches to Britannia Road. As the drainage area tributary to the existing ditches has been reduced to 3.55 ha (29% of the existing drainage area) the existing CNR ditches have sufficient capacity to convey these flows without overtopping. The expected flow from the remaining 3.55 ha of CNR lands is 0.16 m^3/s for the 100-year storm event and the capacity of the existing 0.5m deep ditch is 0.88m^3/s (refer to Appendix F10 for detailed calculations). Therefore, the proposed development will not impact the flood conditions of the CNR lands tributary to culverts B and C as a positive outlet will be maintained.

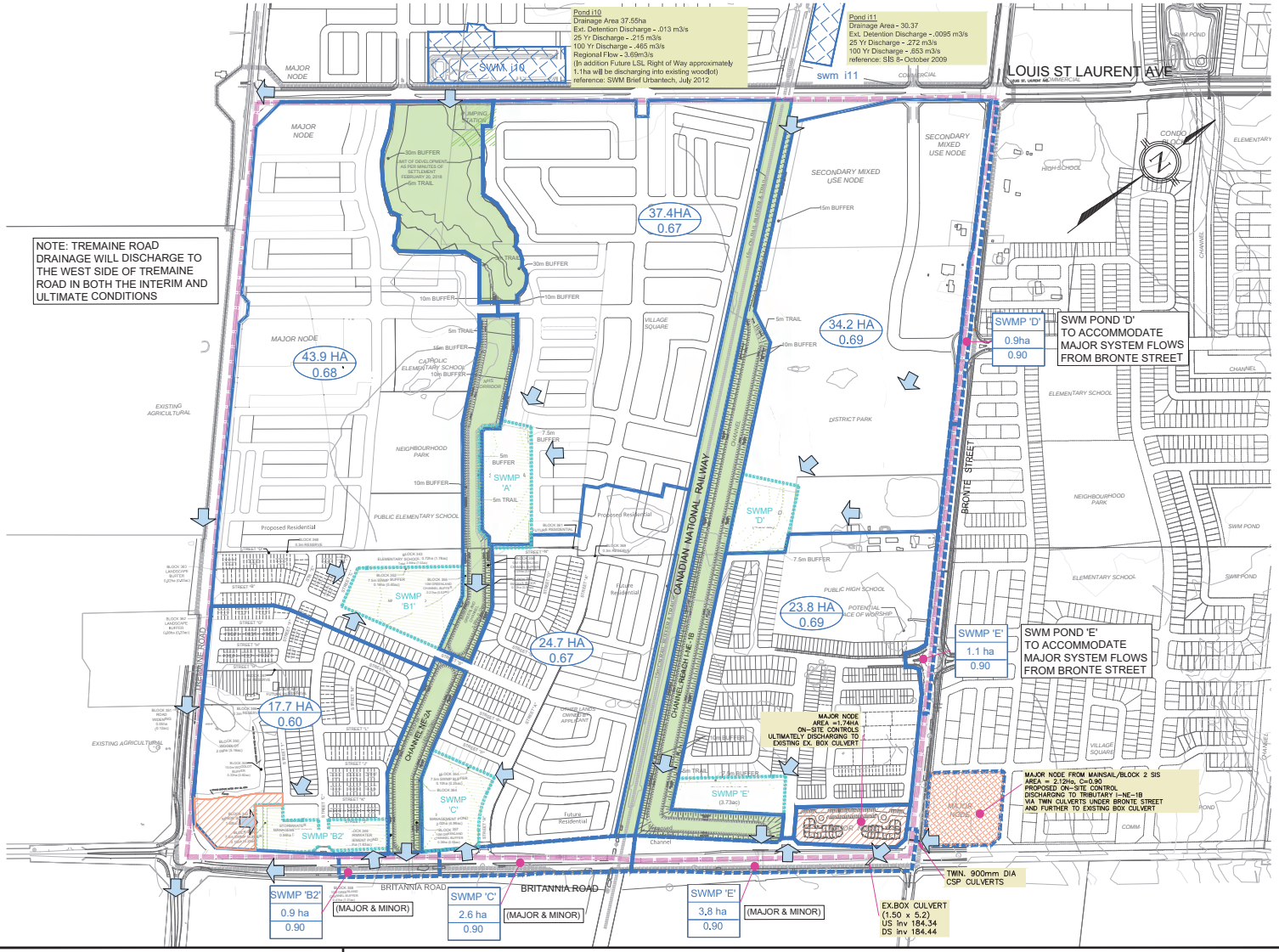


TMIG
The Municipal Infrastructure Group Ltd
8800 Dufferin Street,
Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

SUBWATERSHED IMPACT STUDY BLOCK 1
MILTON PHASE III WEST
PREDEVELOPMENT DRAINAGE AREAS

SCALE: 1:10,000		PROJECT No. 10144
DATE: DECEMBER 2018		
DESIGNED BY:	DRAWN BY: CAD	FIGURE No. 5-1
CHECKED BY:	CHECKED BY:	

File: G:\Projects\2010\10144 - Milton Phase 3 West SIS\Drawings\SIS Figures December 2018 - Final\FIGURE 5-1 PRE DEVELOPMENT AREA.dwg, Layout: 5-1 Date: Nov 30, 2018 - 1:18pm, Edit By: emara



LEGEND:

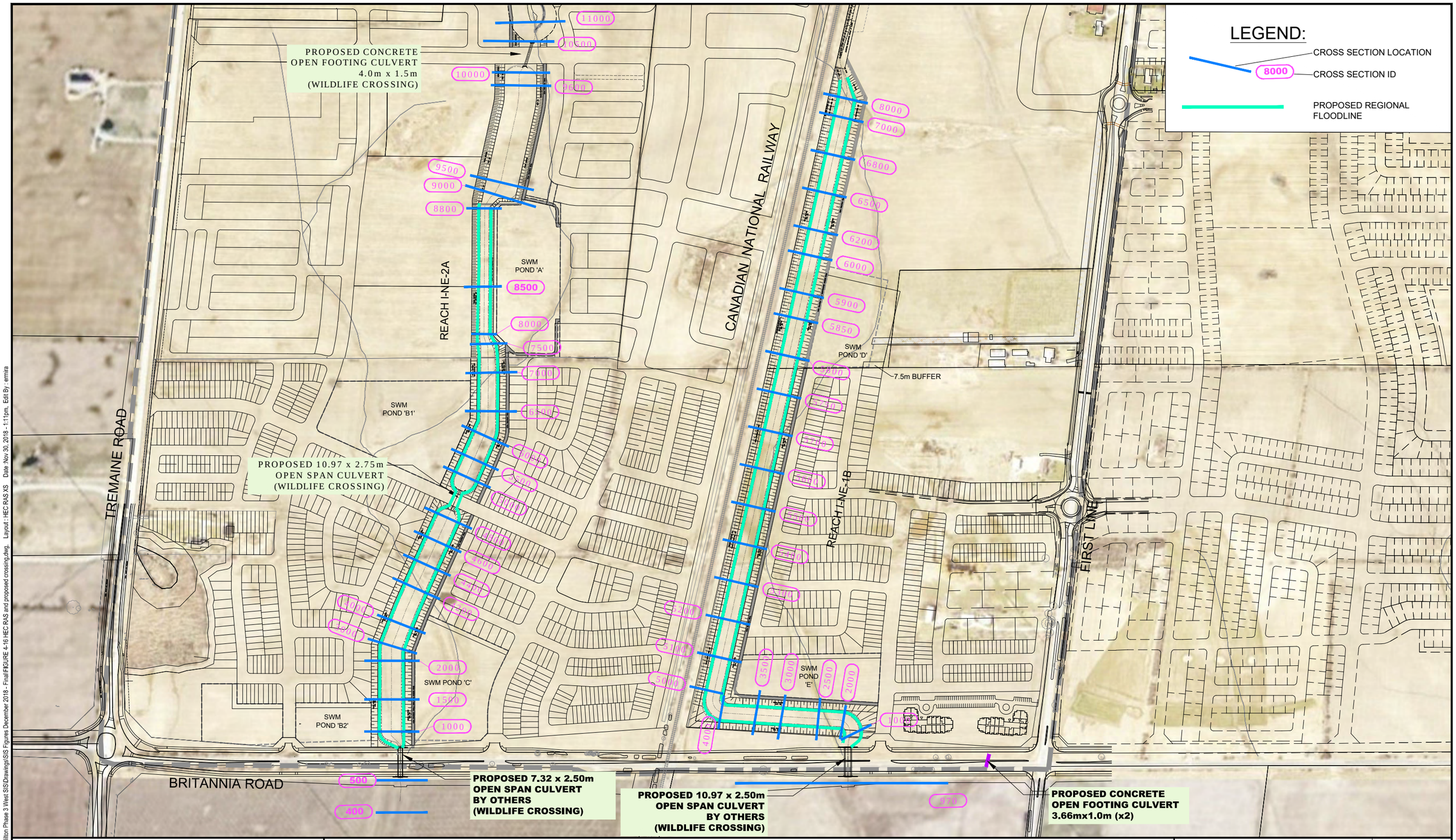
- SIS BLOCK 1 BOUNDARY
- PROPOSED DRAINAGE AREA FROM BLOCK 1 SIS
- PROPOSED EXTERNAL DRAINAGE AREA
- 25.80HA / 0.25 — DRAINAGE AREA / RUNOFF COEFFICIENT
- SWMP 'D' / 0.9ha / 0.90 — CONTRIBUTING POND ID / DRAINAGE AREA / RUNOFF COEFFICIENT
- SIS BLOCK 1 AREAS POTENTIAL FOR SITE CONTROLS
- EXTERNAL DRAINAGE AREA FROM SIS BLOCK 2 DISCHARGING VIA EXISTING CROSSING UNDER BRONTE STREET AND BRITANNIA ROAD
- OVERLAND FLOW DIRECTION

TMIG
The Municipal Infrastructure Group Ltd
8800 Dufferin Street, Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

SUBWATERSHED IMPACT STUDY BLOCK 1
MILTON PHASE III WEST
PROPOSED DRAINAGE AREAS

SCALE: N.T.S		PROJECT No. 10144
DATE: DECEMBER 2018		
DESIGNED BY:	DRAWN BY: CAD	FIGURE No. 5-2
CHECKED BY:	CHECKED BY:	

File : G:\Projects\2010\10144 - Milton Phase 3 West SIS\Drawings\SIS Figures April 2019 - Final Addendum\FIGURE 5-2 PROPOSED DRAINAGE AREAS.dwg Layout: : 11x17 Date: Apr 16, 2019 - 2:22pm, Edit By: emara



TMIG
The Municipal Infrastructure Group Ltd
8800 Dufferin Street,
Suite 200
Vaughan, ON
L4K 0C5
p: 905.738.5700
f: 905.738.0065

SUBWATERSHED IMPACT STUDY BLOCK 1
MILTON PHASE III WEST
HEC-RAS SECTION AND PROPOSED CROSSING LOCATION

SCALE: N.T.S.		PROJECT No. 10144
DATE: DECEMBER 2018		
DESIGNED BY:	DRAWN BY: CAD	FIGURE No. 4.16
CHECKED BY:	CHECKED BY:	

File - G:\Projects\2010\10144 - Milton Phase 3 West SIS\Drawings\SIS Figures December 2018 - Final\FIGURE 4-16 HEC RAS and proposed crossing.dwg Layout - HEC RAS XS Date: Nov 30, 2018 - 1:11pm, Edit By: emira

Milton Phase 3, Boyne Survey Area, Block 2

Main Sail Estates Subdivision Stormwater Management Design Report

VERSION 5 ▪ AUGUST 2016

REPORT PREPARED FOR

Trinison Management Corp.

8600 Dufferin Street
Vaughan, Ontario L4K 5P5

REPORT PREPARED BY

THE MUNICIPAL INFRASTRUCTURE GROUP LTD.
8800 DUFFERIN STREET, SUITE 200
VAUGHAN, ON L4K 0C5
(905) 738-5700

TMIG PROJECT NUMBER 12108

1 INTRODUCTION

1.1 Objective

This report is provided in support of the stormwater management design for the proposed Main Sail Estates Subdivision in the Town of Milton.

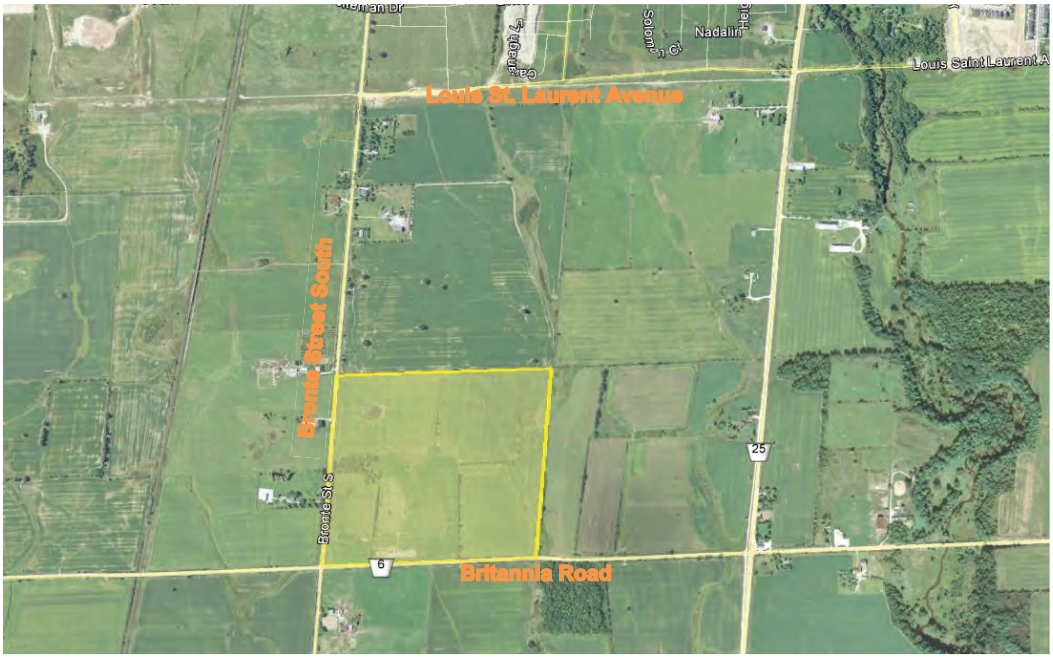
The objective of this report is to demonstrate that the storm sewer system and the stormwater management (SWM) facility, SWM Pond 'H', have been designed following the recommendations set out in the Functional Stormwater and Environmental Management Strategy (FSEMS), prepared by AMEC, dated November 2015 and the Boyne Survey Block 2 Subwatershed Impact Study (SIS), prepared by MTE, dated August 25, 2016, as well as the subsequent discussions and agreements with the Town of Milton and AMEC. This report demonstrates that SWM Pond 'H' will provide the appropriate water quality treatment and water quantity attenuation such that the applicable criteria are satisfied. The detailed design drawing set should be referenced in conjunction with the review of this report. Copies of the SWM Pond drawings are provided in **Appendix E**.

Details of the design criteria and sizing methods of the storm sewer system and SWM Pond 'H' are included in subsequent sections of this report.

1.2 Location

The Main Sail Estates Subdivision is located immediately north of Britannia Road and east of Bronte Street in the Town of Milton. The subject site location is shown in **Figure 1.1**. SWM Pond 'H' is located in the south-east corner of the subject site.

Figure 1-1: Site Location



3 STORMWATER MANAGEMENT

A comprehensive stormwater management plan has been prepared for the subject site. Stormwater Management (SWM) Pond 'H', located in the south-east corner of the subject site, has been designed to accommodate the major storm system flows for an area of approximately 37.36 ha and the minor storm system flows for an area of 38.94 ha. The overall drainage area to SWM Pond 'H' accounts for the majority of the Main Sail Estates Subdivision, an area of 32.94 ha, as well as 2.9 ha from the future Britannia Road right-of-way and 3.1 ha (minor system flows) or 1.55 ha (major system flows) from the future Bronte Street South right-of-way. TMIG has coordinated the design of SWM Pond 'H' with the Town of Milton, the Region of Halton and their design consultant AMEC Foster Wheeler to ensure that the pond can accommodate stormwater runoff from the future widening of these adjacent major roads. No other external areas are expected to drain into SWM Pond 'H'.

Part of the SWM Pond 'G' block is also located within Mail Sail Estates Subdivision, at the north-east corner of the property. SWM Pond 'G' will be designed as part of Church Lands subdivision located immediately north of Main Sail Estates Subdivision site. The majority of the area draining into SWM Pond 'G' will come from the Church Lands, with a minor contributing area from the Main Sail Estates Subdivision lands (approximately 0.5 ha). The SWM Pond 'G' detailed design will be submitted under a separate report prepared by David Schaeffer Engineering Ltd (DSEL).

Stormwater runoff from the major node block (2.12 ha) located at the south-west corner of the subject site will be treated and attenuated on-site before being discharged in a westerly direction, crossing under Bronte Street and ultimately contributing into Indian Creek Tributary I-NE-1B. The detailed design of the required water quality treatment and on-site controls will be completed at the site plan design stage.

The proposed SWM Pond 'H' is to be constructed concurrently with the subject site and will provide water quality treatment, erosion control and water quantity attenuation in accordance with the criteria set out in the Boyne Survey Block 2 SIS and the revised information provided in the Sizing for Facilities H and G, Boyne Survey Block 2 Area document (provided in **Appendix A**).

3.1 Design Criteria

The design criteria used for the stormwater management system for the Main Sail Estates Subdivision was taken from the Town of Milton design standards, the MOE Stormwater Management Planning and Design Manual (SWMP&DM), the Boyne Survey Block 2 SIS and the Sizing for Facilities H and G, Boyne Survey Block 2 Area document (a copy is provided in **Appendix A**). These standards include:

- Minor system/storm sewers designed to convey 5 year storm flows.
- Storm events greater than the 5-year event up to the 100-year event will be conveyed overland to the pond via the roads, as per Town standards.
- SWM Pond 'H' to provide Enhanced level water quality treatment, based on the MOE SWMP&DM (March 2003).
- SWM Pond 'H' to provide erosion control and water quantity attenuation based on the rates provided in the Sizing for Facilities H and G, Boyne Survey Block 2 Area document. The required release rates and storage volume are summarized in **Table 3-1**.

Table 3-1: Summary of Water Quantity Peak Flow and Storage Requirements

Storage Component	Cumulative Storage Required (m^3)	Discharge (m^3/s)
Erosion Control / Extended Detention	10,968	0.025
25 Year	19,194	0.330
100 Year	26,323	1.170
Regional	50,142	1.950

- SWM pond side slopes include 5:1 slopes at the normal water level fringe (1m vertically above and below the NWL); 3:1 slopes below the NWL fringe; and 4:1 slopes above the NWL fringe up to the Regional Storm Water Level, as per the Town of Milton SWM pond design criteria.
- Extended detention and flood control storage for design storms up to the Regional Storm event. The specified rates and storage are based on the hydrologic modeling completed to date using the HSP-F model and refined by the latest AMEC analysis.
- An emergency outlet for the Regional Storm flow, such that all lots adjacent to the SWM facility will not be submerged during the Regional Storm event.
- A 4m wide maintenance access route from a municipal road with a maximum slope of 10:1 and a maximum cross-fall of 2%. The access road will be used to facilitate the access to the forebay and outlet structure for maintenance.
- A 7.5m buffer is required when the SWM pond is adjacent to residential lots.

3.2 Hydrology

Hydrologic modeling was not completed as part of the stormwater management design for this site as SWM facilities are sized based on rates provided in the Sizing for Facilities H and G, Boyne Survey Block 2 Area document (provided as **Appendix A**). These rates were determined using the HSP-F hydrologic model and continuous simulation modelling completed by AMEC. The storage and discharge rates for SWM Pond 'H' are summarized above in **Table 3-1**.

3.3 Minor System Flows

The minor system is designed to accommodate the 5 year storm event flows as per the Town of Milton design standards; design sheets are included in **Appendix C**. The subject site has been graded in a manner such that flows greater than the 5 year storm event will be conveyed overland to the stormwater management facility.

Site grade constraints do not support the design of a full depth municipal storm sewer system capable of accommodating gravity connection to basement foundation systems. Accordingly, a large portion of the sewer system will be constructed at minimum depth, deep enough for frost protection.

In order to ensure that basements are properly drained, homes within this development will be equipped with sump pumps. In general, these sump pumps will drain to the rear yard. In cases where the lot drains to the front or side and a sidewalk is present, the sump pump will drain to a storm sewer lateral.

3.4 Major System Flows/ROW capacity

Overland flows will be directed via the subdivision road right-of-ways (ROWs) to the SWM pond. One overland flow inlet is proposed for SWM Pond 'H', which is provided midway along the eastern edge of the SWM pond block. The major system flows to the SWM pond will not exceed the width of the road allowance, and in no case will the depth of flow exceed 30 cm at the gutter or 15 cm at the crown, in accordance with the Town of Milton criteria. For all classes of roads, the product of depth of water (m) at the gutter and the velocity of flow (m/s) shall not exceed 0.65 m^2/s.

An overland flow analysis has been undertaken for the Main Sail Estates Subdivision based on the site grading and current proposed development plan. The majority of the runoff from the subject site will be directed towards the SWM pond via Bronson Terrace (Street 'N'), which has a 16 m wide road ROW and Leger Way (Street 'B'), which has a 20 m wide road ROW. Therefore the capacity of Bronson Terrace and Leger Way were verified as they represent the worst case scenarios.

The rational method was used to calculate the expected major flows along Leger Way (Street 'B'). The maximum anticipated overland flow rate for Leger Way was calculated to be 2.9 m^3/s, based on an overall drainage area of 34.33 ha (which is the 29.88 ha contributing drainage area from the Main Sail Estates Subdivision, the 1.2 ha drainage area from the east half of Bronte Street, and the 3.25 ha from Britannia Road). The maximum capacity of the 20 m ROW was calculated using the Manning's equation. The ROW capacity was calculated to be 2.96 m^3/s, which is greater than the anticipated maximum overland flow rate of 2.9 m^3/s.

Similarly, the major flows along Bronson Terrace (Street 'N') was calculated to be 2.1 m^3/s, based on an overall drainage area of 19.82 ha (which is the 18.62 ha contributing drainage area from the Main Sail Estates Subdivision and the 1.2 ha drainage area from the east half of Bronte Street). The maximum capacity of the 16 m ROW was calculated using the Manning's equation. The ROW capacity was calculated to be 2.19 m^3/s, which is greater than the anticipated maximum overland flow rate of 2.1 m^3/s.

For further details, refer to the calculations provided in **Appendix B**. The following table summarizes the results of this analysis:

Table 3-2: Overland Flow Summary

Proposed Roadway	Tributary Area (ha)	Max Flow within ROW (m^3/s)**	ROW Width (m)	Road Capacity (m^3/s)
Leger Way / 20m ROW	34.33	2.9	20	2.96
Street N / 16m ROW	19.82	2.1	16	2.19

**The maximum flow within ROW was calculated using Rational Method for cross sections throughout the drainage system; the displayed value is the major system peak flow minus the minor system peak flow for the section of road with greatest tributary drainage area. Values shown are for the critical sections of road determined by sampling throughout the entire subdivision.

The analysis demonstrates that there is sufficient road capacity for the anticipated overland flows. In addition the proposed overland flow path proposed within the SWM pond block is designed to convey the required major flow into the pond. Detailed Calculations are provided in **Appendix B.**

3.5 Stormwater Management Facility Design

As per the recommendations in the FSEMS and the Boyne Survey Block 2 SIS, the majority of the subject site is tributary to SWM Pond 'H'. SWM Pond 'H' is located at the low point of the proposed Main Sail Estates Subdivision. Flows from SWM Pond 'H' will discharge into the proposed realigned channel SWS-1A. SWM Pond 'H' has been designed as a wet pond facility.

All efforts were made in designing the SWM pond to ensure that the configuration of both the forebay and the wet cell provide the maximum use of the block in terms of providing maximum storage volume and maximum flow length to maximize sediment settling and runoff cooling. In addition, the wet cell has been designed with a 1.5 m deep permanent pool that deepens to 3 m at the outlet structure and the SWM Pond outlet has been designed as a bottom draw outlet to ensure the flows out of the pond to the receiving watercourse are drawn from the cooler and deeper depths of the permanent pool. Landscaping plans that will form part of the submission drawing set, incorporate a riparian planting strategy to provide shading of the pond embankments; enhancing the reduction to temperatures of the runoff leaving the SWM pond. A wetland pool will also be provided within the proposed realigned channel SWS-1A at the pond outlet, this along with shading from the plantings will help mitigate the water temperature.

The proposed grading for the site is designed to direct the majority of major and minor system flows to SWM Pond 'H' prior to entering tributary SWS-1A. All attempts were made to direct major and minor system drainage to the proposed SWM facility. Runoff from roof leaders will be directed to grass swales.

Based on the proposed storm drainage plan and the proposed plan of development **Table 3-3** summarizes the total drainage areas contributing into SWM Pond 'H' and the corresponding imperviousness.

Table 3-3: Drainage Areas to Stormwater Management Pond 'H'

Area Breakdown / Proposed Land Use	Drainage Area	Imperviousness
	(ha)	*(%)*
Elementary School	2.75	79%
Residential Lots (Single)	9.79	50%
Residential Lots (Townhouse/Apartment)	4.55	79%
Residential Lots (Semi-detached)	3.10	57%
Parks	0.32	43%
Open Space / Buffers	0.26	7%
Local Commercial	0.40	90%
SWM Pond	2.88	50%
Right of Way / Roads	8.89	71%
Road/ROW (Britannia Road and a portion of Bronte St.)	3.80 (3.32 major)	90%
Road/ROW (Bronte St.)	2.20 (1.1 major)	90%
Total Drainage Area (ha)	**38.94 (37.36 major system)**	
Weighted Imperviousness (%)	**67%**	

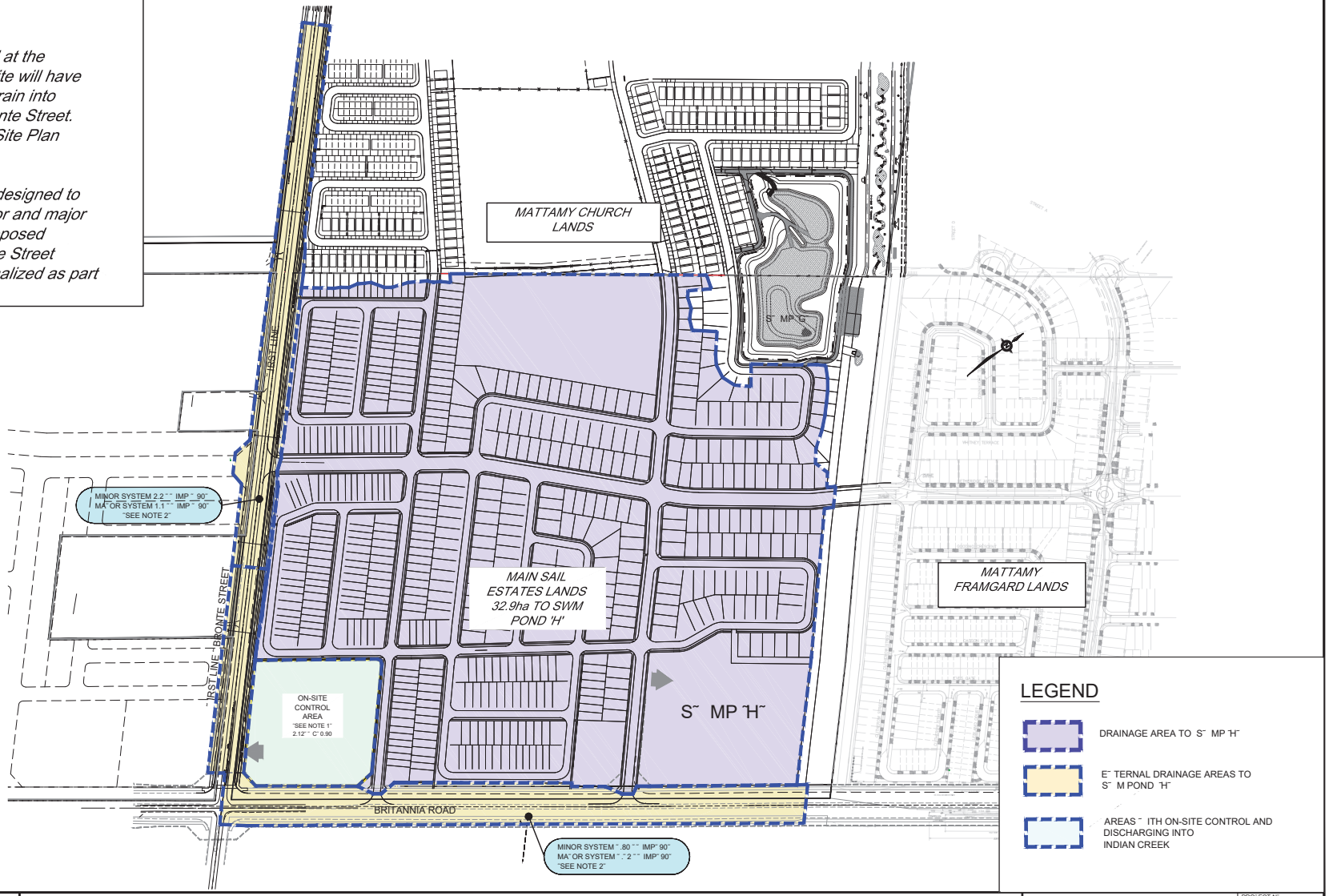
The major roads adjacent to Main Sail Estates, Britannia Road and Bronte Street, are planned to be widened in the near future, as such the proposed drainage areas from these roads have been included in the sizing of SWM Pond 'H'. TMIG has coordinated the design of SWM Pond 'H' with the Town of Milton, the Region of Halton and their design consultant AMEC Foster Wheeler to ensure that the pond can accommodate stormwater runoff from the adjacent major roads.

Although the detailed design of Britannia Road is not yet finalized, the detailed design of SWM Pond 'H' included major system (overland flow) and minor system (control manhole, inlet pipe and headwall) stormwater flow inlets into the facility for the Britannia Road drainage to accommodate their future needs.

Notes:

1. *Major Node Block located at the southwest corner of the site will have on-site controls and will drain into existing culvert under Bronte Street. Details to be provided at Site Plan stage.*

2. *SWM Pond 'H' has been designed to accommodate future minor and major system flows from the proposed Britannia Road and Bronte Street widening. Details to be finalized as part of the road design.*



TMIG
The Municipal Infrastructure Group Ltd
8800 D ; S ON L4K 0C5
: 905.7 8.5700
: 905.7 8.0065

BOYNE SUR EY MILTON

MAIN SAIL ESTATES INC. SUBD ISION

PROPOSED DRAINAGE AREA PLAN

SCALE: 1 : 4 500			PRO ECT N . 12108
DATE: AUGUST 2016			
DESIGNED BY: E.T.	DRA N BY:CAD		IGURE N . - 1
CHECKED BY: L.R.	CHECKED BY:		

File: G:\Projects\2012\12108 - Trinison Main Sail Subdivision Milton\Drawings\Report Figures - SWM Ponds\Figure 3-1 - PROPOSED DRAINAGE AREA (Aug 2016).dwg Layout: FIGURE 3-1 Date: Aug 12, 2016 - 9:03am Edit By: rchung

Additionally, there is a 2.12 ha major node block in the south-west corner of the subject site. Although the Boyne Survey Block 2 SIS had originally noted this area to be 1.1 ha in size the revised information provided in the Sizing for Facilities H and G, Boyne Survey Block 2 Area document (provided in **Appendix A**), which supersedes the Boyne Survey Block 2 SIS was based on the larger major node size of 2.12 ha being directed towards the Indian Creek subwatershed.

The stormwater runoff from the 2.12 ha major node block will be treated and attenuated on-site before being discharged in a westerly direction, crossing under Bronte Street and ultimately contributing into Indian Creek Tributary I-NE-1B. The detailed design of the required water quality treatment and on-site controls will be completed at the site plan design stage. The allowable flows from the major node are outlined below:

Table 3-4: Allowable Flows from the Major Node to Indian Creek Tributary I-NE-1B

Design Event	Allowable Flows (m^3/s)
2 year	0.424
5 year	0.565
10 year	0.660
25 year	0.779
50 year	0.864
100 year	0.952

Detailed calculations are provided in **Appendix B.**

3.5.1 Facility Sizing

The proposed SWM facility has been designed as an enhanced quality wet pond, servicing post-development flows from the subject site and the external areas. The total drainage area serviced by SWM Pond 'H' is 38.94 ha and has an average imperviousness of 67%. SWM Pond 'H' will provide water quality treatment, erosion control and water quantity attenuation in accordance with the criteria set out in the Town of Milton design manual, the MOE Stormwater Management Planning and Design Manual (SWMP&DM), the Boyne Survey Block 2 SIS and the Sizing for Facilities H and G, Boyne Survey Block 2 Area document. The following sections detail the specific criteria that apply to each requirement, and **Section 3.5.5** summarizes the required and provided values.

3.5.2 Water Quality

Water quality treatment has been provided in accordance with the MOE SWM Planning & Design Manual. SWM Pond 'H' has been designed to an Enhanced level of protection, which is consistent with the SWM design criteria. With a total tributary area of 38.94 ha and an average imperviousness of 67% the SWM facility requires a permanent pool volume of 6,781 m^3.

The total permanent pool volume provided within SWM Pond 'H' is 19,800 m^3, which exceeds the volume required. Detailed calculations are provided in **Appendix B**.

3.5.3 Erosion Control / Extended Detention

The erosion control storage volume and release rates for SWM Pond 'H' were established in the Sizing for Facilities H and G, Boyne Survey Block 2 Area document. The total required erosion control storage volume is 10,968 m^3, with a controlled outflow of 25 L/s.

An extended detention storage volume of 11,290 m^3, which exceeds the required storage volume, has been provided within SWM Pond 'H' between the elevations of 183.25 m (normal water level) and 183.85m. The erosion control release rate is 25 L/s. Detailed calculations are provided in **Appendix B.**

3.5.4 Water Quantity Control

The water quantity attenuation criteria were determined in the Sizing for Facilities H and G, Boyne Survey Block 2 Area document, based on hydrologic modeling completed using the HSP-F hydrologic model. The storage volume and discharge criteria for SWM Pond 'H' were summarized above in **Table 3-1**.

The required storage volumes are: 19,194 m^3 for the 25 year event, 26,323 m^3 for the 100 year event and 50,142 m^3 for the Regional Storm event.

The quantity control volumes provided within the wet pond are: 19,700 m^3 for the 25 year event, 27,300 m^3 for the 100 year event and 52,700 m^3 for the Regional Storm event, all of which exceed the required storage volumes.

Detailed calculations are provided in **Appendix B.**

3.5.5 Storage-Discharge Relationship

The storage-discharge relationship for SWM Pond 'H' is provided in **Table 3-5**, with the required storage volumes compared to the provided storage volumes and the associated release rates.

Table 3-5: Storage Discharge Rates

Design Event	Required		Provided	
	Storage (m^3)	Discharge (m^3/s)	Storage (m^3)	Discharge (m^3/s)
Extended Detention	10,968	0.025	11,290	0.025
25 year	19,194	0.330	19,700	0.330
100 year	26,323	1.170	27,300	1.170
Regional	50,142	1.950	52,700	1.856

As shown in **Table 3-5**, the provided volumes are greater than the required volumes and the designed discharges are less than or equal to the required discharges; therefore, all the requirements have been satisfied. Detailed calculations are provided in **Appendix B.**

3.5.6 Forebay Sizing

The sediment forebay has been designed as per the MOE SWMP&DM to pre-treat the incoming flows. The sediment forebay design calculations are provided in **Appendix B**.

As per the recommendations of the MOE manual the forebay provided in facility SWM Pond 'H' has been designed with a length to width ratio higher than 2:1, and all required geometric dimensions of the forebay have been provided.

The detailed design drawing set is provided in **Appendix E**.

3.5.7 Facility Outflow Details/Outlet sizing

SWM Pond 'H' has been designed based on the recommendations of the Sizing for Facilities H and G, Boyne Survey Block 2 Area document, the Boyne Survey Block 2 SIS and the FSEMS. Discharge from SWM Pond 'H' will be provided through a multi-stage outlet configuration. The outlet design will ensure that outflows to tributary SWS-1-A are controlled to the target release rates for erosion control; the 25 year and the 100 year return period events; and the Regional Storm event.

A bottom draw reversed sloped pipe, controlled by an orifice plate, is proposed to provide erosion control / extended detention. The submerged end of the pipe will be installed with a Hickenbottom (perforated) pipe

surrounded with a gravel jacket and filter cloth to prevent blockage of the perforated pipe. The orifice plate will control outflow from the pond to the erosion control target release rate. A 125 mm diameter orifice set at an invert elevation 183.25m, which is the normal water level of the permanent pool storage volume of the facility. The Hickenbottom pipe was designed with sufficient perforations to ensure that the 125 mm diameter orifice plate would control the flows (refer to calculations in **Appendix B**).

In addition to the erosion control orifice attenuating the outflow from SWM Pond 'H', flows will be discharged through two (2) ditch inlet catchbasins set at different elevations and controlled with orifice plates.

As can be seen in the detailed design drawings, SWM Pond 'H' has one (1) ditch inlet catch basin, with a top elevation of 183.85 m, set above the extended detention level. Flows into this catchbasin will be conveyed to the control manhole via a 450 mm storm sewer, and will be controlled by a 392 mm diameter orifice set at an invert elevation of 183.25 m. This outlet structure will control the 2 through 25 year design storms.

The second ditch inlet catch basin has been set at an elevation of 184.55 m, which is above the 25 year storage level. Flows into this catchbasin will be conveyed to the control manhole via a 600 mm orifice tube set at an invert elevation of 183.70 m. This outlet structure will control the 25 through 100 year design storms and the Regional storm event.

The combination of the three outlet structures will ensure that the target release rates from all storm events up to the Regional storm are achieved.

The characteristics of the orifices and weirs within the control outlet structures are summarized in **Table 3-6.**

Table 3-6: Characteristics of the Orifices and Weirs within the Control Structure

Control	Inv. Elev. (m)	Diameter (mm)	Lip Elev. (m)	Description
Orifice 1	183.25	125	n/a	Extended Detention
Orifice 2	183.25	392	183.85	2 year to 25 year
Orifice 3	183.70	600	184.55	25 yr to Regional

Detailed calculations for the sizing of the outlet structure are included in **Appendix B**. Control Manhole details are provided in **Drawings SWM05 and SWM06** attached in **Appendix E.**

Controlled flows from the outlet structure will be directed through the 1350 mm diameter storm outfall pipe and into a wetland pool prior to spilling into the receiving watercourse (SWS-1-A). The SWM Pond outfall pipe is sized as a 1350 mm diameter storm pipe at 0.4% slope with a maximum capacity of 3.52 m^3/s.

3.5.8 Emergency Outlet

SWM pond 'H' is designed with an emergency spillway sized as a trapezoidal weir with a bottom width of 15 m and depth of 0.3 m. The weir is set at an invert of 185.70m, equal to the expected Regional Storm water level in the pond. The emergency spillway will discharge into tributary SWS-1A and has a maximum capacity of 5.35 m^3/s.

3.6 Pond Operation

The inlet pipe to the SWM pond is an 1800 mm by 1200 mm concrete box and is sized to adequately convey the 5 year design storm. The major system flows from the subdivision will enter the SWM pond via the overland flow route.

A stage-storage-discharge curve was developed to model the performance of each outlet control under the different storm events to demonstrate that the target outflows are obtained. **Table 3-7** demonstrates that this

pond operates by controlling outflows from the pond to a flow below the target values. Details of the stage-storage-discharge relationship are provided in **Appendix B.**

Table 3-7: Summary of SWM Pond H Operating Characteristics

Pond Component	Stage (m)	Depth above Permanent Pool (m)	Provided Storage Volume (m^3)	Design Release Rate (m^3/s)
Permanent Pool	183.25	---	19,800	---
Extended Detention	183.85	0.6	11,290	0.025
25 year	184.25	1.0	19,700	0.330
100 year	184.60	1.35	27,300	1.170
Regional Storm	185.70	2.45	52,700	1.856

The controlled flows will be conveyed safely into the receiving watercourse via the proposed storm outfall pipe.

3.7 Access Road

A 4.0 m wide asphalt access road/trail has been provided to access all structures in order to facilitate routine inspection and maintenance activities. The access road is graded with a cross-slope of 2%.

7 CONCLUSIONS

In summary, the design of SWM Pond 'H' within the Main Sail Estates development area meets the requirements outlined within Town of Milton design standards, the MOE Stormwater Management Planning and Design Manual (SWMP&DM), the Boyne Survey Block 2 SIS and the Sizing for Facilities H and G, Boyne Survey Block 2 Area document.

It is our opinion that the information and level of detail contained in this report is adequate to obtain the required approvals for the stormwater management component of the proposed development. We trust you will find the contents of this report satisfactory. Please contact the undersigned if you have any questions or concerns.

Sincerely,
The Municipal Infrastructure Group Ltd.



Lana Russell, P.Eng.
Water Resources Engineer

APPENDIX A

Sizing for Facilities H and G, Boyne Survey Block 2 Area

Lana Russell

From: Farrell, Aaron <aaron.farrell@amecfw.com>
Sent: Sunday, October 25, 2015 8:13 AM
To: Lana Russell
Cc: martin.bateson@milton.ca; diana.jiona@milton.ca; Trimble, Jennifer; Finelli, Tony; David Scott
Subject: Bronte Street and Britannia Road Reconstruction - Sizing for Facilities H and G, Boyne Survey Block 2 Area

Hello Lana.

As requested at the October 7, 2015 meeting, we have revisited the sizing of Facilities 'H' and 'G' based upon the split flow for the major system of Bronte Street, as well as the reduced drainage area to Facility 'H' from Britannia Road discussed at the meeting. As per your request, the storage-discharge relationships provided in our September 18, 2015 memorandum have been revised, predicated upon adjusting the storage volumes within the facility based upon the revision to the drainage area from the roadways as noted above.

The revised storage-discharge relationships for the facilities are provided below:

Facility 'H'

Operating Condition	Cumulative Storage (m^3)	Discharge (m^3/s)
Extended Detention	10,968	0.025
25 Year	19,194	0.33
100 Year	26,323	1.17
Regional Storm	50,142	1.95

Facility 'G'

Operating Condition	Cumulative Storage (m^3)	Discharge (m^3/s)
Extended Detention	11,616	0.028
25 Year	20,328	0.38
100 Year	28,024	1.30
Regional Storm	56,550	2.19

As noted in my previous message, could you please advise when minutes from the October 7 meeting will be circulated for review and comment. In addition, could you please confirm that TMIG has corresponded with David Schaeffer Engineering and Mattamy Homes regarding this matter, and whether TMIG will continue to do so and secure the appropriate approval from those parties for the revised sizing provided above.

I'll be away this week with limited access to e-mail, and will address any questions or follow-up requirements upon my return.

Regards,

Aaron.

Aaron Farrell M. Eng., P.Eng.
Associate, Amec Foster Wheeler, Environment & Infrastructure
3215 North Service Road, Burlington, Ontario L7N 3G2, Canada
T +1 (905) 335-2353 ext.231 M +1 (289) 208-4936
aaron.farrell@amecfw.com amecfw.com

Be more sustainable - think before you print.



This message is the property of Amec Foster Wheeler plc and/or its subsidiaries and/or affiliates and is intended only for the named recipient(s). Its contents (including any attachments) may be confidential, legally privileged or otherwise protected from disclosure by law. Unauthorised use, copying, distribution or disclosure of any of it may be unlawful and is strictly prohibited. We assume no responsibility to persons other than the intended named recipient(s) and do not accept liability for any errors or omissions which are a result of email transmission. If you have received this message in error, please notify us immediately by reply email to the sender and confirm that the original message and any attachments and copies have been destroyed and deleted from your system. This disclaimer applies to any and all messages originating from us and set out above. If you do not wish to receive future unsolicited commercial electronic messages from us, **please forward this email to: unsubscribe@amecfw.com and include "Unsubscribe" in the subject line**. If applicable, you will continue to receive invoices, project communications and similar factual, non-commercial electronic communications.

Please click http://amecfw.com/email-disclaimer for notices and company information in relation to emails originating in the UK, Italy or France.

APPENDIX B

Stormwater Management Calculations

Main Sail Estates

Town of Milton
Project # : 12108
Date: August 2016

Stage-Discharge-Storage Operation - SWMP H

Input:

Control used	Control	Inv. Elev. (m)	D or L (mm or m)	Lip Elev. (m)	Description
y	Orifice 1	183.25	125	183.25	Erosion
y	Orifice 2	183.25	392	183.85	2 to 100 yr
y	Orifice 3	183.70	600	184.55	25 to Regional
n	Orifice 4	183.25	0		
n	Weir "A"	200.00	0.0	200.00	
n	Weir "B"	200.00	0	200.00	

* Orifice tube C=0.8 used

Orifice: $Q=CA(2gH)^{0.5}$

$Q=Cd*L*H^{3/2}$ (broad crested) (considers end contractions)

Pond WS Elev (m)	Orifice 1 Head (m)	Orifice 1 Outflow (m^3/s)	Orifice 2 Head (m)	Orifice 2 Outflow (m^3/s)	Orifice 3 Head (m)	Orifice 3 Outflow (m^3/s)	Orifice 4 Head (m)	Orifice 4 Outflow (m^3/s)	Weir "A" Head (m)	Weir "A" Discharge Coefficient	Weir "A" Outflow (m^3/s)	Weir "B" Head (m)	Weir "B" Discharge Coefficient	Weir "B" Outflow (m^3/s)	Total Outflow (m^3/s)	Pond Storage (m^3)	Design Storm	Total Drawdown Time (hr)
183.25	na	0.000	na	0.000	na	0.000	0.00	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.000	-		
183.30	na	0.003	na	0.000	na	0.000	0.05	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.003	903.37		74.46
183.35	na	0.007	na	0.000	na	0.000	0.10	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.007	1,806.74		111.69
183.40	0.09	0.010	na	0.000	na	0.000	0.15	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.010	2,710.11		136.86
183.45	0.14	0.012	na	0.000	na	0.000	0.20	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.012	3,613.49		156.94
183.50	0.19	0.015	na	0.000	na	0.000	0.25	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.015	4,516.86		174.13
183.55	0.24	0.016	na	0.000	na	0.000	0.30	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.016	5,420.23		189.41
183.60	0.29	0.018	na	0.000	na	0.000	0.35	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.018	6,323.60		203.30
183.65	0.34	0.020	na	0.000	na	0.000	0.40	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.020	7,318.11		217.41
183.70	0.39	0.021	na	0.000	na	0.000	0.45	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.021	8,312.62		230.58
183.75	0.44	0.022	na	0.000	na	0.000	0.50	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.022	9,307.13		242.97
183.80	0.49	0.024	na	0.000	na	0.000	0.55	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.024	10,301.64		254.71
183.85	0.54	0.025	na	0.000	na	0.000	0.60	0.000	0.00	1.83	0.000	0.00	1.83	0.00	**0.025**	**11,296.15**	**Ext Detention**	265.89
183.90	0.59	0.026	0.45	0.223	na	0.000	0.65	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.249	12,290.66		267.00
183.95	0.64	0.027	0.50	0.235	na	0.000	0.70	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.262	13,285.17		268.05
184.00	0.69	0.028	0.55	0.247	na	0.000	0.75	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.275	14,279.68		269.06
184.05	0.74	0.029	0.60	0.258	na	0.000	0.80	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.287	15,366.38		270.11
184.10	0.79	0.030	0.65	0.268	na	0.000	0.85	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.298	16,453.09		271.13
184.15	0.84	0.031	0.70	0.278	na	0.000	0.90	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.309	17,539.79		272.10
184.20	0.89	0.032	0.75	0.288	na	0.000	0.95	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.320	18,626.50		273.05
184.25	0.94	0.033	0.80	0.297	na	0.000	1.00	0.000	0.00	1.83	0.000	0.00	1.83	0.00	**0.330**	**19,713.20**	**25 yr**	273.96
184.30	0.99	0.033	0.85	0.306	na	0.000	1.05	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.340	20,799.90		274.85
184.35	1.04	0.034	0.90	0.315	na	0.000	1.10	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.349	21,886.61		275.71
184.40	1.09	0.035	0.95	0.324	na	0.000	1.15	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.359	22,973.31		276.56
184.45	1.14	0.036	1.00	0.332	na	0.000	1.20	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.368	24,060.02		277.38
184.50	1.19	0.037	1.05	0.340	na	0.000	1.25	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.377	25,146.72		278.18
184.55	1.24	0.037	1.10	0.348	na	0.000	1.30	0.000	0.00	1.83	0.000	0.00	1.83	0.00	0.386	26,233.42		278.96
184.60	1.29	0.038	1.15	0.356	0.60	0.78	1.35	0.000	0.00	1.83	0.000	0.00	1.83	0.00	**1.170**	**27,320.13**	**100yr**	279.22
184.65	1.34	0.039	1.20	0.364	0.65	0.81	1.40	0.000	0.00	1.83	0.000	0.00	1.83	0.00	1.210	28,406.83		279.47
184.70	1.39	0.040	1.25	0.371	0.70	0.84	1.45	0.000	0.00	2.83	0.000	0.00	2.83	0.00	1.249	29,493.54		279.71
184.75	1.44	0.040	1.30	0.378	0.75	0.87	1.50	0.000	0.00	3.83	0.000	0.00	3.83	0.00	1.287	30,580.24		279.94
184.80	1.49	0.041	1.35	0.386	0.80	0.90	1.55	0.000	0.00	4.83	0.000	0.00	4.83	0.00	1.323	31,666.94		280.17
184.85	1.54	0.042	1.40	0.393	0.85	0.92	1.60	0.000	0.00	5.83	0.000	0.00	5.83	0.00	1.358	32,753.65		280.39
184.90	1.59	0.042	1.45	0.400	0.90	0.95	1.65	0.000	0.00	6.83	0.000	0.00	6.83	0.00	1.393	33,840.35		280.61
184.95	1.64	0.043	1.50	0.406	0.95	0.98	1.70	0.000	0.00	7.83	0.000	0.00	7.83	0.00	1.426	34,927.06		280.82
185.00	1.69	0.044	1.55	0.413	1.00	1.00	1.75	0.000	0.00	8.83	0.000	0.00	8.83	0.00	1.459	36,013.76		281.03
185.05	1.74	0.044	1.60	0.420	1.05	1.03	1.80	0.000	0.00	9.83	0.000	0.00	9.83	0.00	1.491	37,212.21		281.25
185.10	1.79	0.045	1.65	0.426	1.10	1.05	1.85	0.000	0.00	10.83	0.000	0.00	10.83	0.00	1.522	38,410.65		281.47
185.15	1.84	0.046	1.70	0.433	1.15	1.07	1.90	0.000	0.00	11.83	0.000	0.00	11.83	0.00	1.553	39,609.10		281.68
185.20	1.89	0.046	1.75	0.439	1.20	1.10	1.95	0.000	0.00	12.83	0.000	0.00	12.83	0.00	1.583	40,807.54		281.89
185.25	1.94	0.047	1.80	0.445	1.25	1.12	2.00	0.000	0.00	13.83	0.000	0.00	13.83	0.00	1.612	42,005.99		282.10
185.30	1.99	0.048	1.85	0.451	1.30	1.14	2.05	0.000	0.00	14.83	0.000	0.00	14.83	0.00	1.641	43,204.43		282.30
185.35	2.04	0.048	1.90	0.457	1.35	1.16	2.10	0.000	0.00	15.83	0.000	0.00	15.83	0.00	1.670	44,402.88		282.50
185.40	2.09	0.049	1.95	0.463	1.40	1.19	2.15	0.000	0.00	16.83	0.000	0.00	16.83	0.00	1.697	45,601.33		282.70
185.45	2.14	0.049	2.00	0.469	1.45	1.21	2.20	0.000	0.00	17.83	0.000	0.00	17.83	0.00	1.725	46,799.77		282.89
185.50	2.19	0.050	2.05	0.475	1.50	1.23	2.25	0.000	0.00	18.83	0.000	0.00	18.83	0.00	1.752	47,998.22		283.08
185.55	2.24	0.050	2.10	0.481	1.55	1.25	2.30	0.000	0.00	19.83	0.000	0.00	19.83	0.00	1.779	49,196.66		283.27
185.60	2.29	0.051	2.15	0.486	1.60	1.27	2.35	0.000	0.00	20.83	0.000	0.00	20.83	0.00	1.805	50,395.11		283.45
185.65	2.34	0.052	2.20	0.492	1.65	1.29	2.40	0.000	0.00	21.83	0.000	0.00	21.83	0.00	1.831	51,593.55		283.64
185.70	2.39	0.052	2.25	0.498	1.70	1.31	2.45	0.000	0.00	22.83	0.000	0.00	22.83	0.00	**1.856**	**52,792.00**	**Regional**	283.82

Trinity Point Developments
8700 Dufferin St
Vaughan, ON L4K 4S6

File No. 20-294
February 18, 2022

Attention: Gabriel DiMartino

Subject: LID Feasibility Letter
Britannia Road and Bronte Street, Toronto, Ontario

Grounded Engineering Inc. ("Grounded") is pleased to provide you with this LID Feasibility Letter for the site known as Britannia Road and Bronte Street, in Toronto, Ontario.

Trinity Point Developments retained Grounded Engineering Inc. to complete a Hydrogeological Assessment for the property located on the northeast corner lot at the intersection of Britannia Road and Bronte Street South, Milton, Ontario (the Property). This letter is intended to reference and supplement the Hydrogeological Assessment (Revision 3 completed February 6, 2022), providing an opinion on the feasibility of implementing low-impact developments (LIDs) given the soil conditions on the Property.

Near the ground surface, the soils on the Property comprise a clayey silt glacial till. Guelph Permeameter infiltration tests were completed in the clayey silt till, yielding a soil infiltration rate of 4.2 mm/hr. The clayey silt conditions and corresponding low infiltration rate are not conducive to groundwater recharge. Water will infiltrate very slowly, and this will limit the effectiveness of LIDs which are intended to allow groundwater recharge.

It will not be possible to maintain pre-development levels of groundwater recharge given the low infiltration rates on the Property. Best efforts should still be made to reduce the deficit of post-development infiltration/groundwater recharge using LIDs. Potential LID measures are included in the Hydrogeological Assessment.

We trust that the information contained in this letter is sufficient for your present requirements. If we can be of further assistance, please do not hesitate to contact us.

Matthew Garcia, BASc, EIT

Mathew Bielaski, P. Eng., QP RA-ESA
Principal



GEOTECHNICAL ENGINEERING REPORT

PREPARED FOR:
Shearling Heights Estates Ltd
1681 Langstaff Rd
Vaughan, ON L4K 5T3

ATTENTION:
Carmina Tupe

Britannia Road and Bronte Street South | Milton, Ontario

Grounded Engineering Inc.
File No. 20-294 (Rev7)
Issued February 24, 2026

49 Mobile Drive, Toronto ON M4A 1H5 | (647) 264-7909 | groundedeng.ca | Grounded Engineering

TABLE OF CONTENTS

1 INTRODUCTION 4

2 GROUND CONDITIONS 5
2.1 SOIL STRATIGRAPHY 5
2.1.1 Earth Fill 6
2.1.2 Clayey Silt Till 6
2.1.3 Sandy Silt Till 6
2.2 GROUNDWATER 6
2.3 FROST HEAVE SUSCEPTIBILITY OF SOILS 7
2.4 FOR THE PURPOSES, CORROSIVITY AND SULPHATE ATTACK 8

3 GEOTECHNICAL ENGINEERING RECOMMENDATIONS 9
3.1 FOUNDATION DESIGN PARAMETERS 9
3.1.1 General Foundation Recommendations 10
3.1.2 Townhouse Foundations 10
3.1.2.1 Spread Footings on Native Soils 10
3.1.2.2 Spread Footings on Engineered Fill 11
3.1.3 Midrise Structure and P1 Foundations 12
3.1.3.1 Spread Footings on Clayey Silt Till 12
3.1.3.2 Raft Foundation 13
3.2 SEISMIC SITE DESIGNATION 14
3.3 EARTH PRESSURE DESIGN PARAMETERS 15
3.4 SLAB ON GRADE DESIGN PARAMETERS 16
3.5 LONG-TERM GROUNDWATER AND SEEPAGE CONTROL 17
3.6 SITE SERVICING 18
3.6.1 Bedding 19
3.6.2 Backfill 19

4 PAVEMENT ENGINEERING RECOMMENDATIONS 19
4.1 UNDERGROUND PARKING STRUCTURE 19
4.2 ASPHALT PAVEMENT 20
4.2.1 Pavement Subgrade Preparation 20
4.2.2 Asphalt Pavement Design 21
4.2.3 Susceptibility to Frost Damage 22
4.2.4 Pavement Drainage 22

5 CONSIDERATIONS FOR CONSTRUCTION 23
5.1 EXCAVATIONS 23
5.2 SHORT TERM GROUNDWATER CONTROL 24
5.3 EARTH-RETENTION SHORING SYSTEMS 24
5.3.1 Lateral Earth Pressure Distribution 24
5.3.2 Soldier Pile Toe Embedment 25
5.3.3 Lateral Bracing Elements 26
5.4 SITE WORK 26
5.5 ENGINEERING REVIEW 27

6 LIMITATIONS AND RESTRICTIONS 28
6.1 INVESTIGATION PROCEDURES 28
6.2 SITE AND SCOPE CHANGES 29
6.3 REPORT USE 29

7 CLOSURE 30

FIGURES

Figure 1 – Key Plan
Figure 2A – Borehole Location Plan – Proposed Conditions (Site Plan)
Figure 2B – Borehole Location Plan – Proposed Conditions (P1)
Figure 3 – Subsurface Profile

TABLES

Table 1 – Groundwater Level Monitoring Summary

APPENDICES

Appendix A – Borehole Logs; Abbreviations and Terminology
Appendix B – Geotechnical Laboratory Results
Appendix C – Chemical Analysis, Corrosivity Parameters
Appendix D – Typical Details
Appendix E – Engineered Fill Specifications

1 Introduction

Shearling Heights Estates Ltd has retained Grounded Engineering Inc. to provide geotechnical engineering design advice for their proposed “Shearling Heights” development on the northeast corner lot at the intersection of Britannia Road and Bronte Street South, in Milton, Ontario.

The proposed project includes constructing 13 double-car garage townhouse buildings with residential basements in the northern, central, and southeastern portions of the site, and a 7-storey midrise structure with one underground parking level on the southwestern portion of the site. The townhouse basements are at approximately Elev. 186.9 to 185.6± m (approximately 2.2± m below final grade) based on provided grading plans. The southwest underground parking structure (P1) is set at about Elev. 183.66 m.

A revision history of this geotechnical report for this site is as follows:

- Original (March 1, 2021), included geotechnical engineering for townhouse blocks with residential basements, and townhouse blocks and multiple mid-rise buildings set on top of a P2 underground parking structure
- Revision 1 (May 12, 2021), included clarifications for townhouse descriptions and updated architectural drawing references.
- Revision 2 (February 8, 2022), referenced updated architectural drawings with adjusted tower heights.
- Revision 3 (February 29, 2024), referenced updated architectural drawings with modified basement elevations.
- Revision 4 (March 14, 2024), referenced updated architectural drawings for application consistency purposes.
- Revision 5 (October 30, 2025), referenced updated architectural drawings with modified basement elevations.
- Revision 6 (current, February 4, 2026), referenced updated architectural drawings with a P1 underground parking structure.
- **Revision 7 (current, February 24, 2026)** of this report includes references to updated architectural drawings minor site plan changes.

Grounded has been provided with the following drawings to assist in the understanding of the scope of work:

- Site Survey, prepared by R-PE Surveying (June 11, 2020).
- Updated Site Survey, prepared by R-PE Surveying (Received October 22, 2024).
- Architectural Drawings, “Trinity Point-Shearling Heights”; Project 2268.24, dated February 13, 2026, prepared by Graziani + Corazza Architects.
- Architectural Drawings, “Typ. 6 Unit Blk.”; Project No. 25-11, dated September 12, 2025 (Preliminary), prepared by Ian Robertson Design.
- Site Grading Plan, “Main Sail Estates Subdivision Major Node”; Project No. 2017 - 4568, received January 21, 2026, prepared by Schaeffers Consulting Engineers.

Grounded's subsurface investigation of the site to date includes fourteen (14) boreholes (Boreholes 101 to 114) which were advanced from January 4th to 11th, 2021.

Based on the borehole findings, geotechnical engineering advice for the proposed development is provided for foundations, seismic site classification, earth pressure design, slab on grade design, basement drainage, and pavement design. Construction considerations including excavation, groundwater control, and geostructural engineering design advice are also provided.

Grounded Engineering must conduct the on-site evaluation of founding subgrade as foundation and slab construction proceeds. This is a vital and essential part of the geotechnical engineering function and must not be grouped together with other "third-party inspection services". Grounded will not accept responsibility for foundation performance if Grounded is not retained to carry out all the foundation evaluations during construction.

2 Ground Conditions

The borehole results are detailed on the attached borehole logs. Our assessment of the relevant stratigraphic units is intended to highlight the strata as they relate to geotechnical engineering. The ground conditions reported here will vary between and beyond the borehole locations.

The stratigraphic boundary lines shown on the borehole logs are assessed from non-continuous samples supplemented by drilling observations. These stratigraphic boundary lines represent transitions between soil types and should be regarded as approximate and gradual. They are not exact points of stratigraphic change.

Elevations are measured relative to geodetic datum (NAD83). Aquafor Beech Ltd. was retained to survey the elevations of temporary benchmarks relative to geodetic datum, and the temporary benchmarks were used in surveying borehole elevations. The horizontal coordinates are provided relative to the Universal Transverse Mercator (UTM) geographic coordinate system.

2.1 Soil Stratigraphy

The following stratigraphic summary is based on the results of the boreholes and the geotechnical laboratory testing.

A subsurface profile showing stratigraphy and engineering units is appended.

"Existing grade" and "grade" refers to the site grade elevation at the time of our borehole investigation (January 2021). Since completion of the borehole investigation, stockpiles from the site have been removed; the new site grades were documented in the updated site survey by R-PE Surveying.

2.1.1 Earth Fill

Stockpiles of fill were noted across the site during the time of our investigation (January 2021). At existing grade, all boreholes observed a layer of earth fill that extends to depths of 1.5 to 4.6 m below grade (Elev. 189.6 to 184.0 m). The earth fill varies in composition but generally consists of clayey silt and sandy silt with trace gravel. It contains trace rootlets, wood fragments, asphalt, and rock fragments. The earth fill is typically dark brown to dark brown with black, and moist.

Due to the variation and inconsistent placement of the earth fill material, the consistency/relative density of the earth fill varies but is on average firm/loose.

2.1.2 Clayey Silt Till

Underlying the fill materials, boreholes encountered a native clayey silt glacial till at depths of 1.5 to 4.6 m below grade (Elev. 189.6 to 184.0 m) and extending to depths of 7.6 to 10.7 m below grade (Elev 178.9 to 176.7 m). Boreholes 101, 102, and 110 observed weathering in this deposit at a depth of 2.3 m below grade (Elev. 187.3 to 185.7 m) and extending to depths of 3.0 to 3.8 m below grade (Elev. 185.0 to 184.2 m). The clayey silt till generally consists of some sand, trace gravel, and trace rock fragments. The weathered layers are generally blackish grey to dark brown with black, and moist. The unweathered till is generally reddish brown and moist.

Standard Penetration Test (SPT) results (N-Values) measured in the clayey silt till range from 6 to 37 blows per 300 mm of penetration (“bpf”). In general, the clayey silt till is stiff to very stiff above Elev. 181± m, and only stiff to firm below Elev. 181± m.

2.1.3 Sandy Silt Till

Underlying the clayey silt till, boreholes encountered a dense to very dense sandy silt glacial till (the “sandy silt till” unit) at depths of 7.6 to 10.7 m below grade (Elev. 178.9 to 176.7 m). The sandy silt till consists of trace clay, trace gravel, and trace rock fragments. It is typically reddish brown and moist. In Boreholes 104 and 106, the sandy silt till transitions to a silty sand glacial till at depths of 10.7 and 12.2 m below grade (Elev. 177.3 and 176.8 m). The silty sand till consists of trace to some gravel and trace clay. It is reddish grey and wet. The sandy silt to silty sand till extended beyond the depth of investigation (Elev. 176 to 172± m).

Standard Penetration Test (SPT) results (N-Values) measured in this unit range from 23 to more than 50 blows per 300 mm of penetration (“bpf”), indicating a relative density ranging from compact to very dense (on average, very dense).

2.2 Groundwater

Monitoring wells were installed in Boreholes 101 to 103, 107, 108, 112, and 114, and stabilized groundwater levels were measured in each of the monitoring wells after the completion of drilling.

A detailed table of monitoring well observation data is appended.

Groundwater levels fluctuate with time depending on the amount of precipitation and surface runoff, and may be influenced by known or unknown dewatering activities at nearby sites.

The design groundwater table for engineering purposes is at Elev. 184.8± m. Please note:

- Boreholes 102 and 103 were screened within the earth fill and are therefore not considered when determining the design groundwater table.
- The higher water level measured in Borehole 107 in 2021 was unstabilized.

The groundwater table is in all the native soil units. The clayey silt till deposit has a low permeability and will yield only minor seepage in the long-term. There is also infiltrated stormwater perched in the earth fill, which is flowing down towards the groundwater table.

2.3 Frost Heave Susceptibility of Soils

Frost heave occurs in a) frost-susceptible soils, when there is b) a source of water (e.g., the groundwater table or stormwater infiltration) and c) those soils with a source of water are exposed to freezing temperatures.

Frost susceptibility in soils refers to the tendency of soils to grow ice lenses and heave during freezing. This tendency varies between soil types, with fine-grained soils with low cohesion and high capillarity generally having the highest susceptibility.

The U.S. Army Corps of Engineers (USACE) provides a classification system[1] relating soil types to different levels of frost susceptibility. The Canadian Foundation Engineering Manual ("CFEM") 5th Edition adopts and updates this frost design screening criteria approach (see table below). Frost-susceptible soils are classified in groups, F1 to F4, generally coinciding with increasing order of susceptibility. Soil in the latter groups tend to have higher rates of frost heave and lower strength after freeze-thaw cycles.

[1] U.S. Army Corps of Engineers. April 1984. Pavement Criteria for Seasonal Frost Conditions. Engineer Manual No. 1110-3-138.

CFEM 5th Ed. Table 14.1, Frost Design Soil Classification adapted from USACE

Frost Group	Soil Type	Percentage Finer than 0.02 mm, by Weight	Typical USCS[2] Soil Types
F1	Gravelly soils	3-10	GW, GP, GM, GW-GM, GP-GM
F2	Gravelly soils	10-20	GM, GW-GM, GP-GM
	Sands	3-15	SW, SP, SM, SW-SM, SP-SM
F3	Gravelly soils	> 20	GM-GC
	Sands, except very fine silty sands	> 15	SM, SC
	Clays, PI > 12	-	CL, CH
F4	All silts	-	ML, MH
	Very fine silty sands	> 15	SM
	Clays, PI < 12	-	CL, CL-ML
	Varved clays and other fined-grained, banded sediments	-	CL and ML; CL, ML, and SM; CL, CH, ML, and SM

The table above is interpreted by Grounded as follows:

- All soils in these groups are frost-susceptible to some degree per the USACE.
- Non-frost susceptible groups are not listed.
- Within each group, the soil's frost susceptibility can vary from very low to very high, though this has never been quantitatively standardized.
- Soils in the F4 groups are especially susceptible to frost.

The site soils are classified by their Frost Group (level of frost susceptibility) according to their grain size data and USCS classification.

Stratum	Percentage Finer than 0.02 mm, by Weight	USCS Symbol	Frost Group
Earth Fill	Est. 55% or higher	CL*	F3/F4
Clayey Silt Till	55 to 70%	CL	F3/F4

* inferred

2.4 For the purposes, Corrosivity and Sulphate Attack

Five (5) soil samples were submitted for corrosivity testing parameters (pH, Resistivity, Electrical Conductivity, Redox Potential, Sulphate, Sulphide and Chloride). The Certificate of Analyses and interpretation sheet is appended.

The soil samples were analysed for soluble sulphate concentration and compared to the Canadian Standard CAN3/CSA A23.1-M94 Table 3, *Additional Requirements for Concrete*

[2] ASTM D2487-17

Subjected to Sulphate Attack. Corrosivity parameters are also used for assessing soil corrosivity applicable to cast iron alloys, according to the 10-point soil evaluation procedure described in the American Water Work Association (AWWA) C-105-18 standard[3].

The analytical results only provide an indication of the potential for corrosion. The results of this analysis are in reference to only the soil samples collected from specific locations, and soil chemistry may vary between and beyond the locations of the analysed samples. In summary:

- 4 of the 5 samples have negligible sulphate concentrations.
- *The soluble sulphate content of sample BH113-SS6 indicates a potential for sulphate attack in the vicinity of Borehole 113. The Class of Exposure is S-2 in this location.*
- 3 of the 5 samples scored more than 10 points and corrosion protective measures are therefore recommended for cast iron alloys.

3 Geotechnical Engineering Recommendations

Based on the factual data summarized above, we are providing the following geotechnical engineering design recommendations. Contractors must review the factual data while bidding or scoping services for this project and must provide their own opinion as to means, methods, and schedule.

This report assumes that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards, and guidelines of practice. If there are any changes to the site development features, or there is any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Grounded should be retained to review the implications of these changes with respect to the contents of this report.

3.1 Foundation Design Parameters

The proposed project includes constructing 13 double-car garage townhouse buildings with basements in the northern, central, and southeastern portions of the site, and a 7-storey midrise structure with one underground parking level on the southwestern portion of the site. The townhouse basements are at approximately Elev. 186.9 to 185.6± m (approximately 2.2± m below grade) based on provided grading plans. The underground parking structure (P1) is set at about Elev. 183.66 m.

The following foundation options have been considered in our analysis.

- Townhouses: Shallow conventional spread footings on native soil or engineered fill
- Midrise Structure with P1:

[3] ANSI/AWWA C105/A21.5-18, Appendix A

- Conventional spread footings
- Raft foundation on cohesive till

3.1.1 General Foundation Recommendations

Grounded should be retained by the Owner to review the structural engineering drawings prior to issue or construction, to ensure that the recommendations in this report have been appropriately implemented.

Footings stepped from one elevation to another should be offset at a slope not steeper than 7 vertical to 10 horizontal. This requirement exists to avoid undermining adjacent footings at the higher elevation.

When exposed to ambient environmental temperatures in this area, the design earth cover for frost protection of foundations and grade beams is 1.2 metres. This also applies to unheated structures up to 1 level below grade.

The founding subgrade must be cleaned of all unacceptable materials and approved by Grounded prior to pouring concrete for the footings. Such unacceptable materials may include disturbed or caved soils, ponded water, or similar as indicated by Grounded during founding subgrade inspection.

Per Section 2.3, the conditions that create frost heave (high groundwater table, highly frost-susceptible soils, and freezing temperatures) exist at this site. Foundation subgrades must be protected against frost damage. If protection from frost is not provided during winter months, frost damage will result in a loss of soil strength and bearing capacity. During the winter, adequate temporary frost protection for the footing bases and concrete must be provided if construction proceeds during freezing weather conditions.

3.1.2 Townhouse Foundations

The earth fill soils are considered unsuitable for the support of the proposed townhouse foundations. Foundations may be made on native soil or engineered fill. Footings resting on ground improved soils are also feasible.

3.1.2.1 Spread Footings on Native Soils

Conventional spread footings (formed and cast in place, or as drilled piles) can be made to bear on the undisturbed native stiff to very stiff clayey silt till. Elevations of this till in the borehole locations around the proposed townhouses area are tabulated below. Conventional spread footings made to bear on this soil may be designed using a maximum factored geotechnical resistance at ULS of 250 kPa. The net geotechnical reaction at SLS is 150 kPa, for an estimated total settlement of 25 mm.

	BH101	BH102	BH103	BH104	BH105	BH106	BH107	BH108	BH110	BH111	BH114
Approx. Basement FFEs near Borehole (m)	186.8 (BLG. 1)	186.0 (BLG. 4)	185.7 (BLG. 5)	186.6 (BLG. 3 and 6)	186.2 (BLG. 7)	186.8 (BLG. 2)	186.7 (BLG. 8 and 9)	185.4 (BLG. 10)	186.1 (BLG. 11)	185.4 (BLG. 12)	185.8 (BLG. 13)
Elevation of Top of Clayey Silt Till (m)	185.7	185.7	185.3	184.4	185.4	184.2	187.3	185.9	184.8	186.2	185.0
Depth of Clayey Silt Till below FFE (m)	**1.1**	0.3	0.4	**2.2**	**0.8**	**2.6**	n/a (Above)	n/a (Above)	**1.3**	n/a (Above)	0.8

The townhouse basement FFEs vary between Elev. 186.8 and 185.4± m. Understanding that footings must be a minimum 0.5 m below FFE for bearing capacity purposes, subexcavation of the earth fill materials is anticipated in several locations, as shown in the table above.

The capacities provided above are based on individual spread footing foundations that are 1 to 3 m wide, spaced one footing width apart, and embedded a minimum of 0.5 m below FFE. These minimum requirements apply in conjunction with the above recommended geotechnical resistance regardless of loading considerations. The geotechnical reaction at SLS refers to an estimated settlement which for practical purposes is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

3.1.2.2 Spread Footings on Engineered Fill

Where there are deeper existing fills present (e.g. Boreholes 104 and 106, and possibly other areas between and beyond the boreholes), another option is for the proposed townhomes to be supported by conventional spread footing foundations resting on an engineered fill pad. An engineered fill specification is appended. It fully describes the engineered fill requirements for this site including site preparation, materials, lateral extents, placement, inspections, typical reinforcing steel requirements, notes on construction, and certification. Engineered fill would require the removal of all existing fill in the areas of the Boreholes 104, 106, and possibly other areas between and beyond the boreholes, and replacement with the engineered fill pad designed to take structural loads.

So long as the engineered fill is placed and compacted as indicated per the specification (including full-time inspection), spread footings resting on engineered fill constructed using common earth fill may be designed using a net geotechnical reaction of 150 kPa at SLS (for an estimated total settlement of 25 mm) and a factored geotechnical resistance of 225 kPa at ULS. These footings must be placed at least 0.6 m into the engineered fill strata.

Footings for buildings closest to the P1 structure (e.g., Buildings 2, 8, and 9) may need to be stepped down per the recommendations in Section 3.1.1. Some of these footings will be made to bear on native soil (see section above for capacities). Any single grid line should be supported fully on either engineered fill or on native soils.

For footings supported on engineered fill, the minimum width for conventional strip footings must be 0.6 m, and the minimum width of individual spread footings must be 1 m. The maximum widths

are 1.2 and 3.0 m respectively. These requirements apply in conjunction with the above recommended geotechnical resistance regardless of loading considerations. The geotechnical reaction at SLS refers to a settlement which for practical purposes is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

Engineered fill can be expected to experience post-construction settlement on the order of 1 percent of the depth of the engineered fill. The time period over which this settlement occurs depends on the composition of the engineered fill as follows (after initial placement):

- Sand or gravel soil – several days
- Silt soil – several weeks
- Clay or clayey soil – several months

The timing of foundation construction must consider the post-construction settlement of the engineered fill.

3.1.3 Midrise Structure and P1 Foundations

3.1.3.1 Spread Footings on Clayey Silt Till

Conventional spread footings for the proposed P1 structure may bear on the clayey silt till approximately 1 m below FFE. These foundation capacities are limited by a weaker compressible layer of firm to stiff clayey silt at around Elev. 181± m (e.g. Boreholes 109, 112, 113).

Conventional spread footings made to bear on stiff to hard clayey silt till at approximate Elev. 182.7± m (i.e., about 1 m below FFE) may be designed using a maximum factored geotechnical resistance at ULS of 400 kPa. The net geotechnical reaction at SLS is 275 kPa, for an estimated total settlement of 25 mm.

These capacities are likely sufficient for support of the portion of the P1 structure that is not supporting the proposed 7-storey building (structural engineer to confirm). They may also be feasible for the support of a 7-storey midrise building.

The capacities for spread footings on the stiff to hard clayey silt till at approximately Elev. 182.7± m are provided based on individual spread footing foundations that are a minimum 1 to maximum 3 m wide, spaced one footing width apart, and embedded no lower than Elev. 182± m with a minimum of 0.7 m below FFE. These minimum requirements apply in conjunction with the above recommended geotechnical resistance regardless of loading considerations. The geotechnical reaction at SLS refers to an estimated settlement which for practical purposes is linear and non-recoverable. Differential settlement is related to column spacing, column loads, and footing sizes.

The SLS capacity is estimated using conventional assumptions on footing uniformity and spacing, and is applicable for a first round of foundation design. In reality, a detailed spread footing plan includes many different footing sizes, spacings, and depths. Footings will influence each other if they are spaced closer than 1 footing width apart, which is almost always needed in

structural foundation design. As such, the initial SLS capacity is conservative as it anticipates these complexities.

To remove the standard simplifying assumptions and provide a more realistic estimate of footing settlement, Grounded should be retained by the Owner to numerically model the estimated settlement of the detailed foundation design acting as a whole. Once an initial foundation plan is completed by the structural engineer and provided to us, Grounded will model the footing pressures, sizes, and spacings to estimate the settlement at each individual footing location. These estimated settlements are then sent back to the structural engineer to assess the total and differential settlements of the entire foundation system acting as a whole, and whether or not they are within tolerable limits. The structural design is then modified as required.

3.1.3.2 Raft Foundation

As requested by the structural engineer, a 17 x 60 m raft underlying the tower is considered in the bearing capacity discussion below. Raft slabs for a podium structure will be subjected to much less load, and will not govern design.

Considering a lowest P1 FFE of about 183.66± m, it is assumed that a raft would be founded around 2 m lower (Elev. 181.66± m), on undisturbed very stiff to hard clayey silt till but just above the weaker stiff to firm till.

The preliminary raft design parameters assume a uniform load at the base of the raft. In reality, raft loads are non-uniform; they are typically highest at the core and lowest at the perimeter. The preliminary parameters below are provided as the initial step in determining raft feasibility (a structural task). The detailed design process is described below.

Bulk excavation to underside of raft elevation (Elev. 181.66 m) will induce a reduction in effective stress of 90 kPa, which is the unload stress. Utilizing preliminary soil stiffness parameters, analysis of a uniformly loaded raft foundation shows that a uniform total applied SLS bearing pressure of 120 kPa (incorporating a 0.9 factor as per the CFEM 5th edition) at the base of the raft will generate an estimated 25± mm of settlement. Similarly, a uniform geotechnical reaction at SLS of 190 kPa will generate an estimated 50± mm of settlement.

The modulus of subgrade reaction for design of a raft slab is a function of the size of the raft, the applied load, and whether loading is within the recompression range or the virgin range. On the basis of our preliminary stiffness parameters and the assumption of uniform raft loading, the preliminary modulus of subgrade reaction appropriate for 17 x 60 m raft design at this site is about 2,700 kPa/m for loads over 90 kPa SLS.

The maximum factored geotechnical resistance at ULS of this 17 x 60 m raft foundation is 250 kPa. Raft foundation design is typically governed by service load criteria.

Detailed raft design is an iterative process between the structural and the geotechnical engineer. Once a draft structural design is completed by the structural engineer, the resulting non-uniform raft pressure distribution is provided to us (typically as a contour plot of SLS pressures). Grounded

then models that non-uniform pressure distribution to more accurately estimate the settlement at each point under the raft. The resulting estimated settlement distribution is then sent back to the structural engineer to assess the total and differential settlements under the raft, as well as lateral impacts on adjacent footings and structures. The structural design is then modified as required.

During construction, the subgrade at founding elevation should be cut neat, inspected, and immediately protected by a mud slab (lean concrete) to provide a working surface. The subsurface must not be proofrolled as this activity would further weaken these soils. The raft slab is then constructed on top of the mud slab. Prior to pouring the mud mat and foundation, the foundation subgrade must be cleaned of all deleterious materials such as softened, disturbed or caved materials, or standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the raft foundation base and concrete must be provided.

Differential settlement is related to real non-uniform raft load distribution and must be assessed as part of the detailed design process. Impacts to adjacent structures caused by settlement within the raft's lateral zone of influence will also need to be reviewed by the structural engineer.

It is assumed that this basement will be designed as a drained structure. Tiedowns to resist buoyancy are not required in this case.

3.2 Seismic Site Designation

The Ontario Building Code (2024) stipulates the methodology for earthquake load and effects analysis and design, as set out in Subsection 4.1.8. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration, and the site classification.

The site designation, X, is determined using the average shear wave velocity, V_{s30}, calculated from in situ measurements of shear wave velocity, in accordance with ground profiles provided in Table 4.1.8.4.-A. For all other ground profiles, the site designation is X_V, where V is the value of V_{s30}. At sites where V_{s30} is not available, the site designation is X_S, where S is the Site Class as determined from rational analysis of average undrained shear strength (s_u) or energy-corrected average standard penetration resistance (SPT N-values) in accordance with Table 4.1.8.4.-B.

The structural commentaries to the NBC 2020, on which the OBC 2024 are based, have been recently released. Based on the structural commentaries, site designation must be evaluated in the top 30 m of site stratigraphy.

At this site, the boreholes observe generally stiff to very stiff cohesive till overlying very dense sandy silt till. The stratigraphy in the upper 15 m, projected to 30m has an average SPT-N value between 15 and 50 bpf. Based on this information, the site designation for seismic analysis is **X_D**, per Table 4.1.8.4.-B of the Ontario Building Code (2024).

We have determined the site designation based on rational analysis of energy-corrected average standard penetration resistance (SPT N-values) with assumed N-values for the stratigraphy beyond the investigation depth. The National Building Code 2020 (and the OBC 2024) provides the option of calculating the seismic hazard (i.e. spectral acceleration) directly from average V_{s30} measurement. Consideration should be given to conducting site-specific shear wave testing (Multichannel Analysis of Surface Waves (MASW) testing or downhole shear wave testing) as part of a future scope of work, to determine the average shear wave velocity in the 30 metres of stratigraphy (Vs_{30}). Shear wave testing will result in the least conservative seismic site designation.

3.3 Earth Pressure Design Parameters

At this site, the design parameters for structures subject to unbalanced earth pressures such as basement walls and retaining walls are shown in the table below.

Stratigraphic Unit	γ	φ	K_a	K_o	K_p
Compact Granular Fill Granular 'B' (OPSS.MUNI 1010)	21	32	0.31	0.47	3.26
Existing Earth Fill	18	29	0.35	0.52	2.88
Clayey Silt Till Above Elev. 181± m	22	32	0.31	0.47	3.26
Clayey Silt Till Below Elev. 181± m	22	29	0.35	0.52	2.88
Sandy Silt Till	22	36	0.26	0.41	3.85

γ = soil bulk unit weight (kN/m^3)
φ = internal friction angle (degrees)
K_a = active earth pressure coefficient (Rankine, dimensionless)
K_o = at-rest earth pressure coefficient (Rankine, dimensionless)
K_p = passive earth pressure coefficient (Rankine, dimensionless)

These earth pressure parameters assume that grade is horizontal behind the retaining structure. If retained grade is inclined, these parameters do not apply and must be re-evaluated.

The following equation can be used to calculate the unbalanced earth pressure imposed on walls:

$$P = K[\gamma(h - h_w) + \gamma' h_w + q] + \gamma_w h_w$$

P = horizontal pressure (kPa) at depth h
h = the depth at which P is calculated (m)
K = earth pressure coefficient
h_w = height of groundwater (m) above depth h
γ = soil bulk unit weight (kN/m^3)
γ' = submerged soil unit weight (γ - 9.8 kN/m^3)
q = total surcharge load (kPa)

If the wall backfill is drained such that hydrostatic pressures on the wall are effectively eliminated, this equation simplifies to:

$$P = K[\gamma h + q]$$

Where walls are made directly against shoring, prefabricated composite drainage panel covering the blind side of the wall is used to provide drainage. Water from the composite drainage panel is collected and discharged through the basement wall in solid ports directly to the sumps. This is discussed in Section 3.5.

The possible effects of frost on retaining earth structures must be considered. In frost-susceptible soils, pressures induced by freezing pore water are basically irresistible. Insulation typically addresses this issue. Alternatively, non-frost-susceptible backfill may be specified.

Foundation resistance to sliding is proportional to the friction between the subgrade and the base of the footing. The factored geotechnical resistance to friction ($\mathbf{R_f}$) at ULS provided in the following equation:

$$R_f = \Phi N \tan \varphi$$

R_f	=	frictional resistance (kN)
Φ	=	reduction factor per CFEM 5th Ed. (0.8 for cohesionless soils or rock; 0.6 for cohesive soils)
N	=	normal load at base of footing (kN)
φ	=	internal friction angle (see table above)

3.4 Slab on Grade Design Parameters

The slab-on-grade parameters provided here apply to a conventional slab on grade and drained basement approach only. Raft foundation design parameters are provided in Section 3.1.

Townhouse basement slabs on grade will be made on earth fill or undisturbed native soils based on the borehole findings in 2021. The existing earth fill, if not removed and replaced with engineered fill, must be proof rolled under the observation of Grounded. Any areas of excess deflection or observed deleterious materials must be removed and replaced with Granular B (OPSS 1010) compacted in thin lifts to 98% SPMDD.

Per Section 2.3, the conditions that create frost heave (high groundwater table, highly frost-susceptible soils, and freezing temperatures) exist at this site. These soils must be protected against frost damage which would result in a loss of soil strength and bearing capacity. At this site, any slabs on grade exposed to frost (prolonged freezing temperatures) must be finished, heated, and/or adequately protected from frost before the onset of prolonged freezing temperatures, to prevent slab cracking caused by frost damage.

It is expected that the P1 structure will be exposed to frost heave conditions. If it is unheated, the slab on grade would be exposed to frost damage on a yearly basis. To mitigate this risk, two options are available:

1. A raft foundation extending below frost penetration depth can be used to support the P1 structure.

2. The frost-susceptible soils within frost penetration depth (1.2 m below P1 FFE) can be sub-excavated and replaced with non-frost susceptible granular fill that is adequately drained.

At the proposed lowest P1 elevation, the undisturbed native soils will provide adequate subgrade for the support of a conventional slab on grade.

Engineered fill, native soils, or proof rolled and compacted existing fill at this site will provide adequate subgrade for the support of a conventional slab on grade. The moduli of subgrade reaction for slab-on-grade design are as follows for the given subgrades:

- Existing earth fill or engineered fill, compacted: 10,000 kPa/m
- Undisturbed native soils: 20,000 kPa/m

For the townhouses, the slab on grade must be provided with a drainage layer and capillary moisture break, which is achieved by forming the slab on a minimum 200 mm thick layer of 19 mm clear stone (OPSS.MUNI 1004) vibrated to a dense state.

A permanent drainage system including subfloor drains is required (see section below). In this case, the slab on grade must be provided with a drainage layer and capillary moisture break, which is achieved by forming the slab on a minimum 300 mm thick layer of 19 mm clear stone (OPSS.MUNI 1004) vibrated to a dense state. In the case of the townhome basements, the clear stone layer can be 200 mm thick.

Given the nature of the native soils at this site, recompaction or proof rolling of the **undisturbed native subgrade** will weaken these materials. These activities should be specifically prohibited when preparing native subgrade. The subgrade should be cut neat and inspected by Grounded prior to placement of the capillary moisture break and construction of the slab. Disturbed or otherwise unacceptable material (as determined by Grounded) must be subexcavated and replaced with Granular B (OPSS.MUNI 1010) compacted to a minimum of 98% SPMDD. The slab on grade should not be placed on frozen subgrade, to prevent excessive settlement of the slab as the subgrade thaws. Areas of frozen subgrade should be removed during subgrade preparation.

3.5 Long-Term Groundwater and Seepage Control

To limit seepage to the extent practicable, exterior grades adjacent to foundation walls should be sloped at a minimum 2 percent gradient away from the wall for 1.2 m minimum.

For a conventional drained basement approach, perimeter and subfloor drainage systems are required. Subfloor drainage collects and removes the seepage that infiltrates under the floor. Perimeter drainage collects and removes seepage that infiltrates at the foundation walls. Perimeter drainage must be collected and conveyed directly to the building sumps, and not discharged into the subfloor drainage system, the granular layer, or beneath the floor slab.

Subfloor drainage pipes are to be spaced at an average 6 m (measured on-centres).

The basement walls are to be fully drained to eliminate hydrostatic pressure. How the drainage system is installed depends on whether the basement wall is made in an open cut or over a shored excavation face. Where drained basement walls are made directly against shoring, prefabricated composite drainage panel covering the blind side of the wall is used to provide drainage. Seepage from the composite drainage panel is collected and discharged through the basement wall in solid ports directly to the sumps.

In an open cut excavation, basement wall drainage is installed directly against the basement wall from the open cut side. Perimeter foundation drains made in this application comprise perforated pipe (minimum 100 mm diameter) surrounded by a granular filter of OPSS.MUNI HL-8 Coarse Aggregate providing a minimum 300 mm of cover over the drain pipe.

Although the basement will be made as a drained structure, the relative humidity at the interface between the foundation wall and the soil/shoring system will still be 100%. A layer of waterproofing placed between the drainage layer and the foundation wall is recommended to protect interior finishes and reinforcing steel from moisture. The building science engineer should confirm this and can provide further advice, as well as specifications for waterproofing products.

Typical basement drainage details are appended.

The perimeter and subfloor drainage systems are critical structural elements since they eliminate hydrostatic pressure from acting on the basement walls and floor slab. The sumps that ensure the performance of these systems must have a duplexed pump arrangement providing 100% redundancy, and they must be on emergency power. The sumps should be sized by the mechanical engineer to adequately accommodate the estimated volume of water seepage.

The permanent dewatering requirements are provided in Grounded's Hydrogeological Report (File No. 20-294).

If any water is to be discharged to the storm or sanitary sewers, the Region of Halton will require a Permit to Discharge in the short term, and a Discharge Agreement in the long-term.

For the townhouses, the perimeter drainage system should be connected directly to the municipal storm system if possible, or else discharged at grade away from the townhouses. Flow must not be directed into the drainage layer.

3.6 Site Servicing

All services must have at least 1.2 metres of earth cover or equivalent insulation for frost protection.

Where site services are not installed below the basement levels of the proposed development, the following recommendations apply.

3.6.1 Bedding

The soil subgrade encountered within the proposed site servicing trenches on site may consist of either earth fill or native soil. If earth fill is encountered, the subgrade must be compacted in place to a minimum 98% SPMDD. The trench base must be inspected for obvious loose, wet, or disturbed material. Any unsuitable material must be subexcavated and replaced with imported fill compacted to 98% SPMDD.

Bedding material below the groundwater table must consist of well graded granular fill such as Granular A (OPSS.MUNI 1010). Clear stone is specifically prohibited below the groundwater table. The bedding material must be compacted to a minimum 95% SPMDD.

Where trenches are above the groundwater table, bedding material may consist of 19 mm clear stone (OPSS.MUNI 1004) or similar, vibrated to a dense state. Where the bedding material consists of clear stone, the bedding must be separated from the subgrade with a non-woven geotextile.

3.6.2 Backfill

Excavated earth fill and native soils on site will constitute adequate backfill material if the soil meets the backfill specifications:

- Any deleterious material in the earth fill is removed prior to reuse as backfill.
- Backfill materials are not frozen.
- The moisture content is within 2% of optimum, or moisture conditioned to within 2% of optimum.
- The backfill must be compacted to a minimum 98% SPMDD.

4 Pavement Engineering Recommendations

4.1 Underground Parking Structure

It is expected that some of the pavements will be placed on top of the reinforced concrete parking structure and not on soil subgrade. In this case, the pavements resting on parking structure should consist of the following:

Component	Compaction Requirement	Pavement on Concrete Parking Structure Minimum Component Thickness
Asphalt Top Lift HL-3 (OPSS.MUNI 1150), and PG 58-28 (OPSS.MUNI 1101)	OPSS.MUNI 310	40 mm
Asphalt Base Course HL-8 (OPSS.MUNI 1150), and PG 58-28 (OPSS.MUNI 1101)	OPSS.MUNI 310	50 mm

Component	Compaction Requirement	Pavement on Concrete Parking Structure Minimum Component Thickness
Granular Base Course Granular A (OPSS.MUNI 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm
Total Thickness		**240 mm**

A waterproof membrane will be required between the asphalt and concrete parking structure deck. For pavements placed on top of the underground parking structure, all drainage, waterproofing, and protection considerations for these areas must be designed separately and in conjunction with the civil engineering design of the underground parking structure. Wherever they have to connect to the adjacent roadways or driveways, those adjacent pavement profiles will be different and so taper transitions and run-outs must be designed for the connections.

4.2 Asphalt Pavement

The following design pertains to asphaltic concrete pavements ('pavement') where the pavement will **rest on soil subgrade** as described above.

The following Ontario Provincial Standards Specifications (OPSS.MUNI) apply to the pavement construction and material requirements:

- OPSS.MUNI 310 - Hot Mix Asphalt
- OPSS.MUNI 501 - Compacting
- OPSS.MUNI 1010 - Aggregates – Base, Subbase, Select Subgrade, and Backfill Material
- OPSS.MUNI 1101 - Performance Graded Asphalt Cement
- OPSS.MUNI 1150 - Hot Mix Asphalt

The pavement construction and material should also follow the relevant city specifications, as applicable.

The City may eventually assume the roads. The municipality has its own minimum pavement design requirements which will have to be followed for the making of any of the pavement surfaces that will eventually become a municipal responsibility.

4.2.1 Pavement Subgrade Preparation

The subgrade must be adequately prepared prior to pavement construction.

Topsoil and existing wet or organic rich earth fill soils are considered unsuitable for the pavement subgrade. These materials must be stripped down to acceptable subgrade prior to pavement construction.

Existing earth fill, if cleared of organic rich or wet soils, and native subgrade will provide adequate subgrade for the support of the pavement. The subgrade must be proof-rolled and inspected under the supervision of Grounded for obvious loose or disturbed soils or where there is deleterious materials or moisture. These areas can either be recompacted in place and retested or replaced with Granular B in lifts 150 mm thick or less, and compacted to a minimum of 98% SPMDD.

The subgrade for all pavement structures shall be frost tapered at a 3H to 1V slope to match with existing pavement structures, to reduce differential settlements due to frost heave.

4.2.2 Asphalt Pavement Design

Minimum and performance asphaltic concrete pavement designs are outlined in the tables below.

The following **basic pavement design** will last for 8 to 10 years before significant maintenance is required, depending on the traffic volume.

Basic **Pavement Structure**	**Compaction Requirement**	**Car Parking Minimum Component Thickness**	**Bus/Truck Traffic Minimum Component Thickness**
Asphalt Top Lift HL-3 (OPSS.MUNI 1150), and PG 58-28 (OPSS.MUNI 1101)	OPSS.MUNI 310	65 mm	40 mm
Asphalt Base Course HL-8 (OPSS.MUNI 1150), and PG 58-28 (OPSS.MUNI 1101)	OPSS.MUNI 310	N/A	50 mm
Granular Base Course 19 mm diameter crusher run limestone or Granular A (OPSS.MUNI 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm	150 mm
Granular Subbase Course 50 mm diameter crusher run limestone or Granular B Type II (OPSS.MUNI 1010)	98% Standard Proctor Maximum Dry Density (ASTM-D698)	300 mm	400 mm
Total Thickness		**515 mm**	**640 mm**

The following **performance pavement design** will last approximately twice as long before significant maintenance is required. The performance pavement design considers that the top layer of asphalt will be damaged over time, and therefore, will contribute less to the structural strength of the asphalt.

Performance Pavement Structure	Compaction Requirement	Car Parking Minimum Component Thickness	Bus/Truck Traffic Minimum Component Thickness
Asphalt Top Lift HL-3 (OPSS.MUNI 1150), and PG 58-28 (OPSS.MUNI 1101)	OPSS.MUNI 310	40 mm	40 mm
Asphalt Base Course HL-8 (OPSS.MUNI 1150), and PG 58-28 (OPSS.MUNI 1101)	OPSS.MUNI 310	50 mm	80 mm
Granular Base Course 19 mm diameter crusher run limestone or Granular A (OPSS.MUNI 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm	150 mm
Granular Subbase Course 50 mm diameter crusher run limestone or Granular B Type II (OPSS.MUNI 1010)	98% Standard Proctor Maximum Dry Density (ASTM-D698)	400 mm	500 mm
Total Thickness		**640 mm**	**770 mm**

4.2.3 Susceptibility to Frost Damage

As established on the Site Grading Plan by Schaeffers, the elevations of the top of proposed pavements range from Elev. 189± to 187.5± m.

The most effective ways of dealing with potential frost heave are to construct a good subsurface drainage system, and to stay well above the groundwater table. Per Section 2.3, there are frost-susceptible soils at this site, but the groundwater table will be below frost penetration depth during pavement construction, mitigating frost heave potential of the pavements. Subgrade must be protected from frost per the recommendations in the Site Work section below. Pavements must be adequately drained (section below) to mitigate frost damage risk.

4.2.4 Pavement Drainage

Adequate drainage of the pavement subgrade is required. Prior to paving, the subgrade should be free of any depressions and sloped at a minimum grade of 2% to provide positive drainage. Perforated plastic subdrains (100 mm diameter) should be designed to collect subgrade water and positively outlet it at the catch basins. Typical pavement drainage details are appended.

Controlling surface water is important in keeping pavements in good maintenance. Grading adjacent pavement areas must be designed so that water is not allowed to pond adjacent to the outside edges of the pavement or curb.

5 Considerations for Construction

5.1 Excavations

Excavations must be carried out in accordance with the *Occupational Health and Safety Act – Regulation 213/91 – Construction Projects (Part III - Excavations, Section 222 through 242).* These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. For practical purposes:

- The earth fill is a Type 3 soil
- The clayey silt till is a Type 2 soil
- The sandy silt and silty sand tills are Type 4 soils, or Type 3 soils if dewatered

In accordance with the regulation's requirements, the soil must be suitably sloped and/or braced where workers must enter a trench or excavation deeper than 1.2 m. Safe excavation slopes (of no more than 3 m in height) by soil type are stipulated as follows, per Section 234:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 239 and 241 of the Act and Regulations and include provisions for timbering, shoring and moveable trench boxes. Any excavation slopes greater than 3 m in height should be checked by Grounded for global stability issues.

Larger obstructions (e.g. buried concrete debris, other obstructions) not directly observed in the boreholes are likely present in the earth fill. Similarly, larger inclusions (e.g. cobbles and boulders) may be encountered in the native soils. The size and distribution of these obstructions cannot be predicted with boreholes, as the split spoon sampler is not large enough to capture particles of this size. Provision must be made in excavation contracts to allocate risks associated with the time spent and equipment utilized to remove or penetrate such obstructions when encountered.

Excess soil is governed by Ontario Regulation 406/19: On-Site and Excess Soil Management (ESM). The Project Leader (typically the owner) may be required to file a notice in the excess soil registry and a Qualified Person (within the meaning of O.Reg. 153/04) may be required to prepare the associated planning documents and/or develop and implement a tracking system in accordance with the Soil Rules, to track each load of excess soil during its transportation and deposit before removing excess soil from the project area.

5.2 Short Term Groundwater Control

Considerations pertaining to groundwater discharge quantities and quality are discussed in Grounded's hydrogeological report for the site, under separate cover.

The groundwater table at Elev. 184.8± m is above the bulk excavation level for P1 and near bulk excavation level for the townhouse structures. The groundwater table is present in the clayey silt till deposit which has a low permeability and will yield only minor seepage in the long-term. There is also infiltrated stormwater perched in the earth fill, which is flowing down towards the groundwater table.

Seepage into excavations above Elev. 181.6 m may be allowed to drain into the excavation and then controlled by a conventional sump pump arrangement. Nevertheless, delays in excavation will occur as the seepage is controlled and these delays should be anticipated in the construction schedule.

If excavations (or drill holes for soldier piles, see below) below Elev. 181.6 m are required, there is a risk for basal instability due to the piezometric (groundwater pressure) head in the lower sandy silt till. It will therefore be necessary to depressurize the lower sandy silt till prior to these excavations. The lower wet sandy silt till must be depressurized to preserve the in-situ integrity of the native soils. If the lower sandy silt till is not depressurized prior to excavation below Elev. 181.6 m, the native soils will become disturbed by basal heave or the ingress of groundwater, rendering the advice provided for undisturbed subgrade conditions inapplicable. In this case, a professional dewatering contractor should be consulted to review the subsurface conditions and to design a site-specific dewatering system. It is the dewatering contractor's responsibility to assess the factual data and to provide recommendations on dewatering system requirements.

The Region of Halton will require Discharge Agreements in the short and long-terms, if any water is to be discharged to the storm or sanitary sewers. It should be noted that securing a permit to take water on a permanent basis may not be supported by regulatory agencies.

5.3 Earth-Retention Shoring Systems

No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided.

Excavation zone of influence guidelines are appended. If shoring is preferred over open cut excavations, or is required for any reason, the following advice is recommended.

5.3.1 Lateral Earth Pressure Distribution

If the shoring is supported with a single level of earth anchor or bracing, a triangular earth pressure distribution like that used for the basement wall design is appropriate.

Where multiple rows of lateral supports are used to support the shoring walls, research has shown that a distributed pressure diagram more realistically approximates the earth pressure on a shoring system of this type, when restrained by pre-tensioned anchors. A multi-level supported shoring system can be designed based on an earth pressure distribution with a maximum pressure defined by:

$$P = 0.8\,K[\gamma H + q] + \gamma_w h_w$$

P = maximum horizontal pressure (kPa)
K = earth pressure coefficient (see Section 3.3)
H = total depth of the excavation (m)
h_w = height of groundwater (m) above the base of excavation
γ = soil bulk unit weight (kN/m3)
q = total surcharge loading (kPa)

Where shoring walls are drained to effectively eliminate hydrostatic pressure on the shoring system (e.g. pile and lagging walls), h_w is equal to zero.

In cohesive soils, the multi-level lateral earth pressure distribution is trapezoidal, uniformly increasing from zero to the maximum pressure defined in the equation above over the top and bottom quarter (H/4) of the shoring.

5.3.2 Soldier Pile Toe Embedment

Soldier pile toes will be made in the undisturbed clayey silt till. Soldier pile toes resist horizontal movement due to the passive earth pressure acting on the toe below the base of excavation.

There are zones of soil in the subgrade that are wet, cohesionless, and permeable. Augered holes for piles made into these soils will be prone to caving and blowback. To prevent groundwater issues (groundwater inflow, caving and blowback into the drill holes, disturbance to placed concrete, etc.) during drilling and installation, construction methods such as utilizing temporary liners, pre-advancing liners deeper than the augered holes, mud/slurry/polymer drilling techniques, tremie pour concrete, or other methods as deemed necessary by the shoring contractor are required. Concrete for shoring piles and fillers must be placed by tremie method wherever there is more than 300 mm of water or fluid at the base of the drill hole.

The piezometric head in the lower sandy silt till could case basal heave and groundwater inflow for any drill holes advanced below Elev. 181.6 m . To protect drill holes against basal disturbance caused by the inflow of groundwater, and to prevent loss of ground, it will be necessary at this site to control the bases of any drill holes below Elev. 181.6 m. This may include dewatering to below the drill hole depths prior to installation, or the use of drilling muds (slurry, polymer, etc.), pre-advancing casing, or other techniques as deemed necessary by the shoring contractor.

5.3.3 Lateral Bracing Elements

The shoring system at this site will require lateral bracing. If feasible, the shoring system should be supported by pre-stressed soil anchors (tiebacks) extending into the subgrade of the adjacent properties. To limit the movement of the shoring system as much as is practically possible, tiebacks are installed and stressed as excavation proceeds. The use of tiebacks through adjacent properties requires the consent (through encroachment agreements) of the adjacent property owners.

It is expected that post-grouted anchors in tension can be designed using the following maximum factored geotechnical resistances at ULS within the specified strata:

- In the clayey silt till, up to 50 to 80 kN/m of adhered anchor length (at a nominal borehole diameter of 150 mm). Considerations for the potential creep over time of post-grouted anchors made in the lower firm clayey silt till (to Elev. 179± m) is required during shoring design.
- In the very dense sandy silt till, up to 80 to 100 kN/m of adhered anchor length (at a nominal borehole diameter of 150 mm)

These capacities are provided assuming that a site-specific tension load test is performed, implying a resistance factor of 0.6.

Production tiebacks require a minimum 3 m socket length.

At least one prototype anchor per tieback level must be performance-tested to 200% of the design load to demonstrate the anchor capacity and validate design assumptions. For temporary applications, the performance test anchor may be used as a production anchor.

Every production anchor must be proof tested to 133% of design load, and then locked in at 100% of design load.

The very stiff to hard till below the proposed FFE is suitable for the placement of raker foundations. Raker footings established on the till at an inclination of 45 degrees can be designed for a maximum factored geotechnical resistance at ULS of 200 kPa.

5.4 Site Work

To better protect wet undisturbed subgrade, excavations exposing wet soils must be cut neat, inspected, and then immediately protected with a skim coat of concrete (i.e. a mud mat). Wet sands are susceptible to degradation and disturbance due to even mild site work, frost, weather, or a combination thereof.

The effects of work on site can greatly impact soil integrity. Care must be taken to prevent this damage. Site work carried out during periods of inclement weather may result in the subgrade becoming disturbed, unless a granular working mat is placed to preserve the subgrade soils in

their undisturbed condition. Subgrade preparation activities should not be conducted in wet weather and the project must be scheduled accordingly.

If site work causes disturbance to the subgrade, removal of the disturbed soils and the use of granular fill material for site restoration or underfloor fill will be required at additional cost to the project.

It is construction activity itself that often imparts the most severe loading conditions on the subgrade. Special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during placement of the granular base and other work may be required, especially if construction is carried out during unfavourable weather.

Adequate temporary frost protection for the founding subgrade must be provided if construction proceeds in freezing weather conditions. The subgrade at this site is susceptible to frost damage. The slab on grade should not be placed on frozen subgrade, to prevent excess settlement of the slab as the subgrade thaws. Areas of frozen subgrade should be removed during subgrade preparation. Depending on the project context, consideration should be given to frost effects (heaving, softening, etc.) on exposed subgrade surfaces.

5.5 Engineering Review

By issuing this report, Grounded Engineering has assumed the role of Geotechnical Engineer of Record for this site. Grounded should be retained to review the structural engineering drawings prior to issue or construction to ensure that the recommendations in this report have been appropriately implemented.

All foundation installations must be reviewed in the field by Grounded, the Geotechnical Engineer of Record, as they are constructed. The on-site review of foundation installations and the condition of the founding subgrade as the foundations are constructed is as much a part of the geotechnical engineering design function as the design itself; it is also required by Section 4.2.2.3. of the 2024 Ontario Building Code. If Grounded is not retained to carry out foundation engineering field review during construction, then Grounded accepts no responsibility for the performance or non-performance of the foundations, even if they are constructed in general conformance with the engineering design advice contained in this report.

House foundations designed under Part 9 of the Building Code are approved by local building inspectors. Prior to placing concrete for foundations of dwellings, the foundation areas must be cleaned of all deleterious materials such as topsoil, fill, and softened, disturbed, or caved materials, as well as any standing water.

Strict procedures must be maintained during construction to maintain the integrity of the subgrade to the extent possible. The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the boreholes. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the

subgrade should be monitored by Grounded at the time of construction to confirm material quality, and thickness.

A visual pre-construction survey of adjacent lands and buildings is recommended to be completed prior to the start of any construction. This documents the baseline condition and can prevent unwarranted damage claims. Any shoring system, regardless of the execution and design, has the potential for movement. Small changes in stress or soil volume can cause cracking in adjacent buildings.

6 Limitations and Restrictions

Grounded should be retained by the Owner to review the structural and geostructural engineering drawings prior to issue or construction to ensure that the recommendations in this report have been appropriately implemented.

6.1 Investigation Procedures

The geotechnical engineering analysis and advice provided are based on the factual borehole information observed and recorded by Grounded. The investigation methodology and engineering analysis methods used to carry out this scope of work are consistent with conventional standard practice by Grounded as well as other geotechnical consultants, working under similar conditions and constraints (time, financial and physical).

Borehole drilling services were provided to Grounded by a specialist professional contractor. The drilling was observed and recorded by Grounded's field supervisor on a full-time basis. Drilling was conducted using conventional drilling rigs equipped with hollow stem augers. As drilling proceeded, groundwater observations were made in the boreholes. Based on examination of recovered borehole samples, our field supervisor made a record of borehole and drilling observations. The field samples were secured in air-tight clean jars and bags and taken to the Grounded soil laboratory where they were each logged and reviewed by the geotechnical engineering team and the senior reviewer.

The Split-Barrel Method technique (ASTM D1586) was used to obtain the soils samples. The sampling was conducted at conventional intervals and not continuously. As such, stratigraphic interpolation between samples is required and stratigraphic boundary lines do not represent exact depths of geological change. They should be taken as gradual transition zones between soil or rock types.

A carefully conducted, fully comprehensive investigation and sampling scope of work carried out under the most stringent level of oversight may still fail to detect certain ground conditions. As such, users of this report must be aware of the risks inherent in using engineered field investigations to observe and record subsurface conditions. As a necessary requirement of working with discrete test locations, Grounded has assumed that the conditions between test

locations are the same as the test locations themselves, for the purposes of providing geotechnical engineering advice.

It is not possible to design a field investigation with enough test locations that would provide complete subsurface information, nor is it possible to provide geotechnical engineering advice that completely identifies or quantifies every element that could affect construction, scheduling, or tendering. Contractors undertaking work based on this report (in whole or in part) must make their own determination of how they may be affected by the subsurface conditions, based on their own analysis of the factual information provided and based on their own means and methods. Contractors using this report must be aware of the risks implicit in using factual information at discrete test locations to infer subsurface conditions across the site and are directed to conduct their own investigations as needed.

6.2 Site and Scope Changes

Natural occurrences, the passage of time, local construction, and other human activity all have the potential to directly or indirectly alter the subsurface conditions at or near the project site. Contractual obligations related to groundwater or stormwater control, disturbed soils, frost protection, etc. must be considered with attention and care as they relate this potential site alteration.

The geotechnical engineering advice provided in this report is based on the factual observations made from the site investigations as reported. It is intended for use by the owner and their retained design team. If there are changes to the features of the development or to the scope, the interpreted subsurface information, geotechnical engineering design parameters, advice, and discussion on construction considerations may not be relevant or complete for the project. Grounded should be retained to review the implications of such changes with respect to the contents of this report.

6.3 Report Use

The authorized users of this report are Shearling Heights Estates Ltd and their design team, for whom this report has been prepared. Grounded Engineering Inc. maintains the copyright and ownership of this document. Reproduction of this report in any format or medium requires explicit prior authorization from Grounded Engineering Inc.

The Town of Milton or Region of Halton may also make use of and rely upon this report, subject to the limitations as stated.

7 Closure

If the design team has any questions regarding the discussion and advice provided, please do not hesitate to have them contact our office. We trust that this report meets your requirements at present.

For and on behalf of our team,

GROUNDED ENGINEERING



Matthew Garcia, P.Eng.
Project Engineer

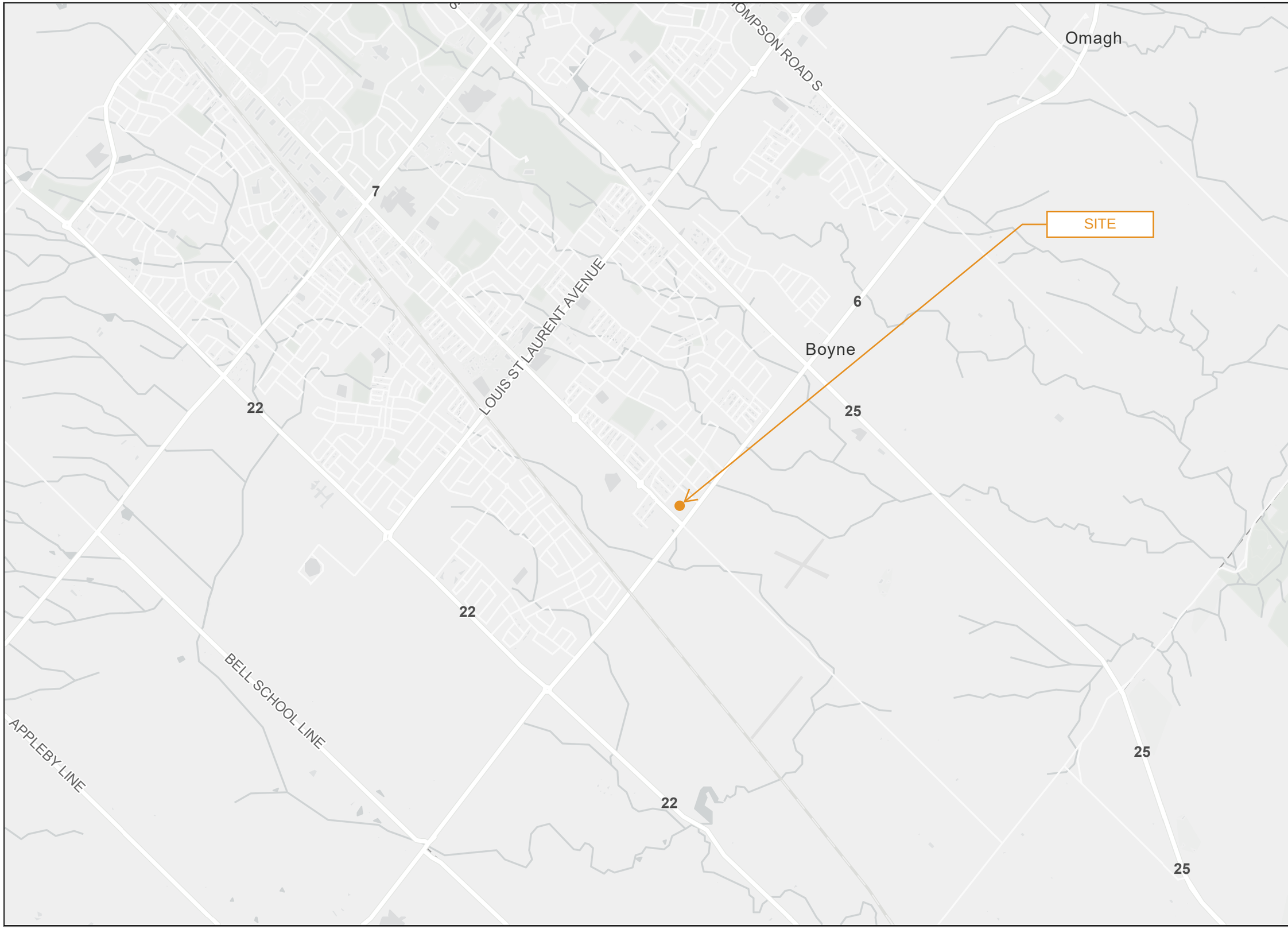


Michael Diez de Aux, M.A.Sc., P.Geo., P.Eng.
Principal

Jason Crowder, Ph.D., P.Eng.
Principal

FIGURES





GROUNDED ENGINEERING

49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- APPROXIMATE SITE LOCATION

Note

Reference

ArcGIS. 2024

Project

BRITANNIA ROAD AND BRONTE STREET SOUTH, MILTON, ONTARIO

Figure Title

KEY PLAN

North

TRUE PROJECT

Date

FEBRUARY 2026

Scale

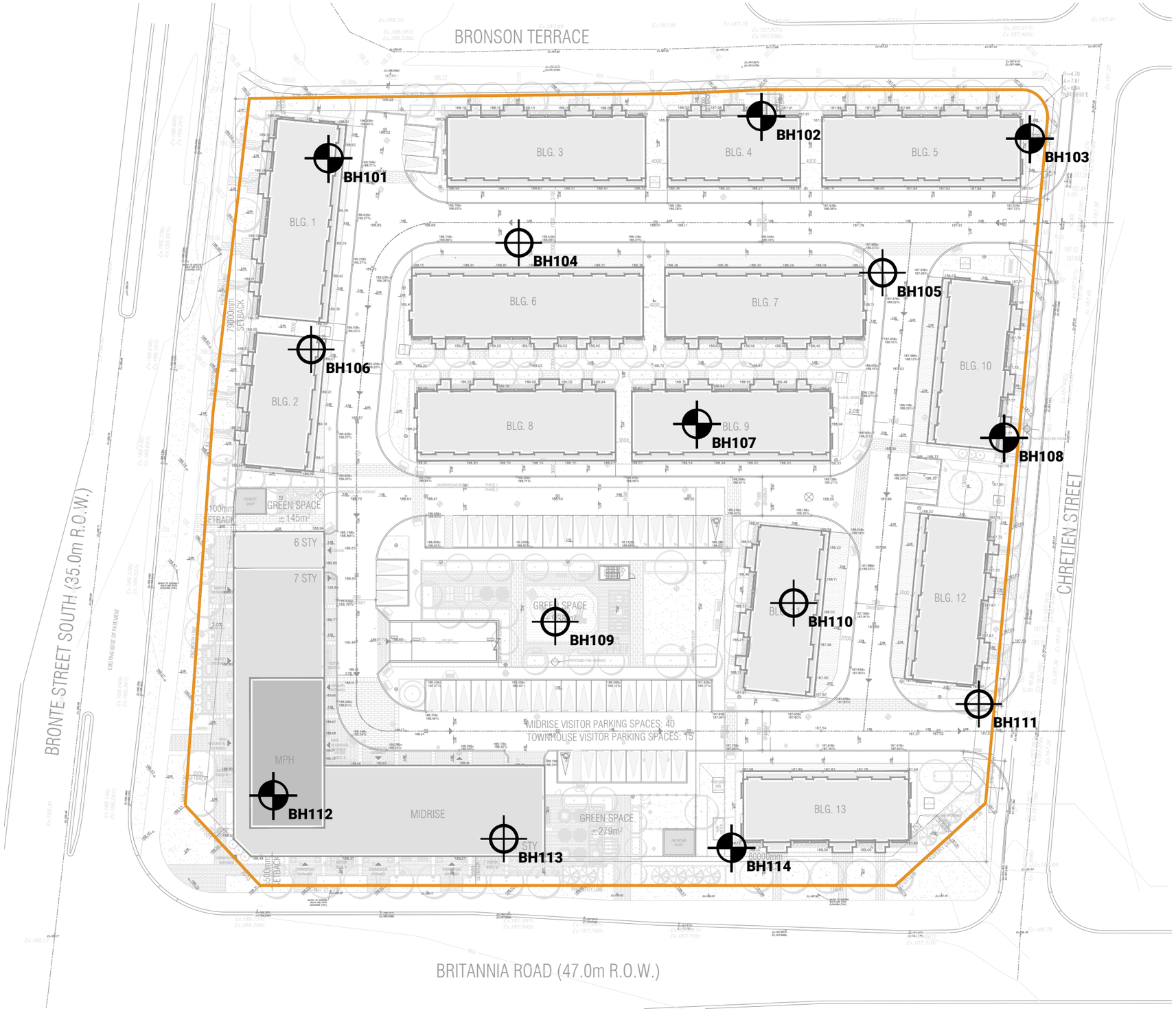
N.T.S.

Job No

20-294

Figure No

FIGURE 1



GROUNDED ENGINEERING
49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

APPROXIMATE PROPERTY BOUNDARY

MONITORING WELL/BOREHOLE BY GROUNDED

Note

Overlaid on Site Plan architectural drawing.

Reference

Architectural Drawings, "Trinity Point-Shearling Heights"; Project 2268.24, dated February 13, 2026 (Draft for SPA), prepared by Graziani + Corazza Architects.

Project

BRITANNIA ROAD AND BRONTE STREET SOUTH, MILTON, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN PROPOSED CONDITIONS (SITE PLAN)

North

TRUE

PROJECT

Date

FEBRUARY 2026

Scale

AS INDICATED

Job No

20-294

Figure No

FIGURE 2A



0m 15m 30m

GROUNDED ENGINEERING

49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- MONITORING WELL/BOREHOLE BY GROUNDED
- APPROXIMATE EXTENT OF MIDRISE ABOVE

Note

Overlaid on P1 architectural drawing. Excludes unfinished townhouse basements.

Reference

Architectural Drawings, "Trinity Point-Shearling Heights", Project 2268.24, dated February 13, 2026 (Draft for SPA), prepared by Graziani + Corazza Architects.

Project

BRITANNIA ROAD AND BRONTE STREET SOUTH, MILTON, ONTARIO

Figure Title

BOREHOLE LOCATION PLAN PROPOSED CONDITIONS (P1)

North

TRUE
PROJECT

Date

FEBRUARY 2026

Scale

AS INDICATED

Job No

20-294

Figure No

FIGURE 2B

PROPOSED MIDRISE BUILDING

PROPOSED TOWNHOUSE BUILDING BLOCKS

P1 FFE
183.66± m

TOWNHOUSE BASEMENT
ELEV. VARIES
186.8 to 185.6± m

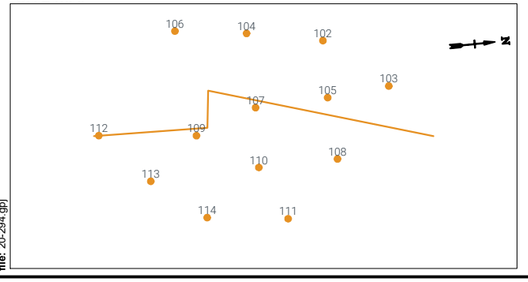
GWT
184.8± m

BH 112 BH 113 BH 109 BH 114 BH 110 BH 101 BH 106 BH 104 BH 107 BH 102 BH 111 BH 105 BH 108 BH 103

Elevation (m)

192 190 188 186 184 182 180 178 176 174 172 170

SITE MAP



file: 20-294.gpj

Boreholes Equally Spaced

BOREHOLE STRATIGRAPHY LEGEND

- Fill
- Silty Sand Till
- Clayey Silt
- Clayey Silt Till
- Sandy Silt Till

GROUNDED ENGINEERING

49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- FILL
- GRAVELS (gravel to gravelly sand)
- SILT TO SAND (not till)
- COHESIONLESS TILLS
- COHESIVE SOILS (clayey silt to clay, incl. tills)
- DISTURBED/REWORKED/ORGANIC

BH 101 BOREHOLES BY GROUNDED

T-BH7 BOREHOLES BY OTHERS

- water level, unstabilized
- water level, stabilized (latest)
- water level, stabilized (highest)

Project

BRITANNIA RD AND BRONTE ST S, MILTON ON

Figure Title

SUBSURFACE PROFILE

Date

FEBRUARY 2026

Scale

AS INDICATED

Job No

20-294

Figure No

FIGURE 3

TABLES



TABLE 1:
GROUNDWATER LEVEL MONITORING SUMMARY
BRITANNIA RD AND BRONTE ST S, MILTON, ON

Well ID	Ground Surface Elev. (masl)	Well Screen Interval		Soil Strata	Grounded Engineering																Minimum Elev. (Lowest)		Maximum Elev. (Highest)		Seasonal Fluctuation	Number of Monitoring Events
					Jan. 12, 2021		Jan. 29, 2021		Mar. 02, 2021		Mar. 28, 2021		Apr. 18, 2021		Feb. 16, 2024		Jan. 20, 2025		July 21, 2025							
		(mbgs)	(masl)		(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(±m)	
BH101	188.0	9.1 - 12.2	178.9 - 175.8	Sandy Silt Till	3.7	184.3	3.7	184.3	3.8	184.2	3.7	184.3	3.6	184.4	3.6	184.4	3.9	184.1	NA	-	3.9	184.1	3.6	184.4	0.2	7
BH102	188.0	1.5 - 4.6	186.5 - 183.4	Clayey Silt Till / Fill	dry	dry	dry	dry	dry	dry	4.1	183.9	4.0	184.0	0.6	187.4	0.6	187.4	2.7	185.3	4.1	183.9	0.6	187.4	3.5	8
BH103	187.6	1.5 - 4.6	186.1 - 183.0	Clayey Silt Till / Fill	dry	dry	4.2	183.4	3.1	184.5	2.9	184.7	2.9	184.7	2.1	185.5	1.9	185.7	1.8	185.9	4.2	183.4	1.8	185.9	2.4	8
BH107	189.6	10.7 - 13.7	178.9 - 175.9	Sandy Silt Till	4.4*	185.2*	5.4	184.2	5.5	184.1	5.5	184.1	5.4	184.2	5.4	184.3	4.8	184.8	NA	-	5.5	184.1	4.8	184.8	0.7	7
BH108	187.4	12.2 - 15.2	175.2 - 172.2	Sandy Silt Till	3.4	184.0	3.5	183.9	3.6	183.8	3.6	183.8	3.5	183.9	3.3	184.1	NA	-	NA	-	3.6	183.8	3.4	184.0	0.2	6
BH112	185.5	7.6 - 10.7	177.9 - 174.8	Sandy Silt Till	1.8	183.7	1.6	183.9	1.7	183.8	1.6	183.9	1.6	183.9	1.5	184.0	NA	-	NA	-	1.8	183.7	1.6	183.9	0.2	6
BH114	186.5	9.1 - 12.2	177.4 - 174.3	Sandy Silt Till	7.6	178.9	2.6	183.9	2.7	183.8	2.6	183.9	2.6	184.0	2.4	184.1	2.4	184.1	2.8	183.7	7.6	178.9	2.4	184.1	5.2	8

mbgs = metres below existing ground surface
masl = metres above sea level
* = unstabilized groundwater level
NA = not available, unable to access monitoring well

APPENDIX A



BOREHOLE LOG TERMINOLOGY

GROUNDED ENGINEERING

SAMPLING/TESTING METHODS

SS: split spoon sample

AS: auger sample

GS: grab sample

FV: shear vane

DP: direct push

PMT: pressuremeter test

ST: shelby tube

CORE: soil coring

RUN: rock coring

SYMBOLS & ABBREVIATIONS

MC: moisture content

LL: liquid limit

PL: plastic limit

NP: non-plastic

γ: soil unit weight (bulk)

G_s: specific gravity

S_u: undrained shear strength

▽ unstabilized water level

▼ water level measurement

▼ highest water level measurement

ENVIRONMENTAL SAMPLES

M&I: metals and inorganic parameters

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

VOC: volatile organic compound

PHC: petroleum hydrocarbon

BTEX: benzene, toluene, ethylbenzene and xylene

PPM: parts per million

FIELD MOISTURE (based on tactile inspection)

DRY: no observable pore water

MOIST: inferred pore water, not observable (i.e. grey, cool, etc.)

WET: visible pore water

COHESIONLESS

Relative Density	N-Value
Very Loose	<4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	>50

COHESIVE

Consistency	N-Value	Su (kPa)
Very Soft	<2	<12
Soft	2 - 4	12 - 25
Firm	4 - 8	25 - 50
Stiff	8 - 15	50 - 100
Very Stiff	15 - 30	100 - 200
Hard	>30	>200

COMPOSITION

Term	% by weight
trace silt	<10
some silt	10 - 20
silt***y***	20 - 35
sand ***and*** silt	>35

ASTM STANDARDS

ASTM D1586 Standard Penetration Test (SPT)
Driving a 51 mm O.D. split-barrel sampler ("split spoon") into soil with a 63.5 kg weight free falling 760 mm. The blows required to drive the split spoon 300 mm ("bpf") after an initial penetration of 150 mm is referred to as the N-Value.

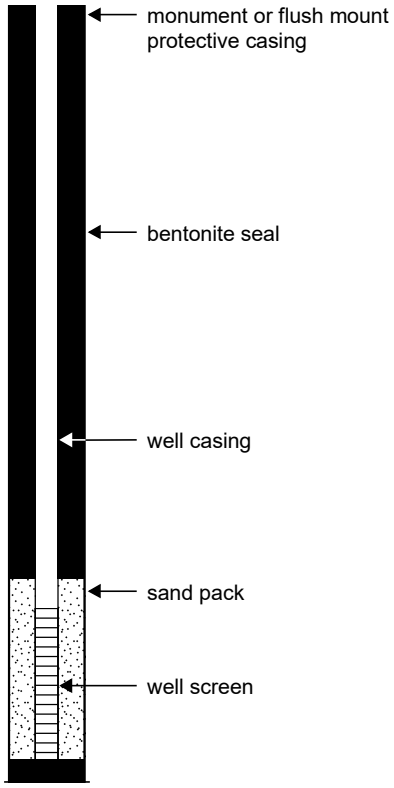
ASTM D3441 Cone Penetration Test (CPT)
Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm^2 into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

ASTM D2573 Field Vane Test (FVT)
Pushing a four blade vane into soil and rotating it from the surface to determine the torque required to shear a cylindrical surface with the vane. The torque is converted to the shear strength of the soil using a limit equilibrium analysis.

ASTM D1587 Shelby Tubes (ST)
Pushing a thin-walled metal tube into the in-situ soil at the bottom of a borehole, removing the tube and sealing the ends to prevent soil movement or changes in moisture content for the purposes of extracting a relatively undisturbed sample.

ASTM D4719 Pressuremeter Test (PMT)
Place an inflatable cylindrical probe into a pre-drilled hole and expanding it while measuring the change in volume and pressure in the probe. It is inflated under either equal pressure increments or equal volume increments. This provides the stress-strain response of the soil.

WELL LEGEND



GROUNDED ENGINEERING

Date Started : Jan 8, 2021
Position : E: 593287, N: 4814571 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 101

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	sample number	sample type	SPT N-value
188.0	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace rootlets, very soft to firm, brown, wet		1	SS	2
	...at 0.8 m, moist		2	SS	3
	...at 1.5 m, trace organics, trace plastic fragments, brown with dark brown		3	SS	8
185.7 / 2.3	**CLAYEY SILT**, trace sand, trace gravel, trace rootlets, stiff, blackish grey, moist (WEATHERED)		4	SS	10
			5	SS	11
184.2 / 3.8	**CLAYEY SILT**, some sand, trace gravel, very stiff, reddish brown, moist (GLACIAL TILL)		6	SS	24
			7	SS	25
			8	SS	20
	...at 7.6 m, grey, stiff		9	SS	12
178.9 / 9.1	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, very dense, reddish brown (GLACIAL TILL)		10	SS	75 / 225mm
	...at 10.7 m, silt and sand, wet		11	SS	50 / 125mm
175.7 / 12.3			12	SS	50 / 100mm

hollow stem augers OD=215 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 188 187 186 185 184 183 182 181 180 179 178 177 176

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR	SA	SI	CL
3	15	47	35
5	38	51	6

END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	3.7	184.3
Jan 29, 2021	3.7	184.3
Mar 2, 2021	3.8	184.2
Mar 28, 2021	3.7	184.3
Apr 18, 2021	3.6	184.4
Feb 16, 2024	3.6	184.4
Jan 20, 2025	3.9	184.1

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

BOREHOLE LOG 102

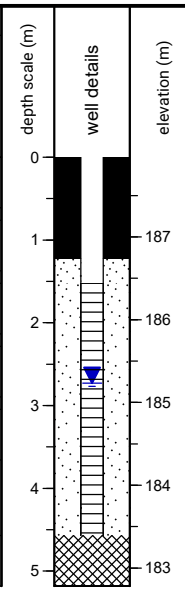
Date Started : Jan 4, 2021
Position : E: 593329, N: 4814637 (UTM 17T)
Elev. Datum : Geodetic

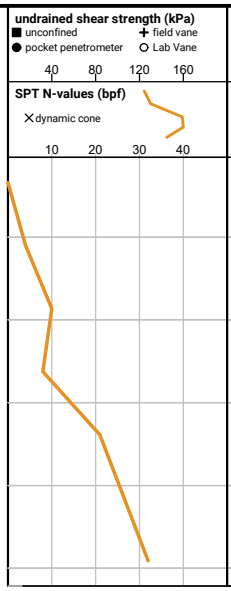
File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

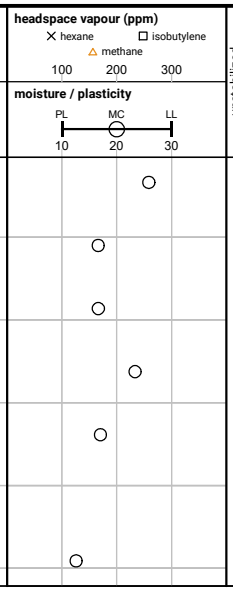
drill method : G78

elev depth (m)	description	graphic log	sample number	sample type	SPT N-value
188.0	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace rootlets, very soft, dark brown, moist		1	SS	0
	...at 0.8 m, firm		2	SS	4
	...at 1.5 m, stiff		3	SS	10
185.7					
2.3	**CLAYEY SILT**, trace sand, trace gravel, trace rootlets, stiff, blackish grey, moist (WEATHERED)		4	SS	8
185.0					
3.0	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, reddish brown, moist (GLACIAL TILL)		5	SS	21
	...at 4.6 m, trace rock fragments		6	SS	32
182.8					
5.2	**END OF BOREHOLE**				

hollow stem augers OD=215 mm







unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	dry	n/a
Jan 29, 2021	dry	n/a
Mar 2, 2021	dry	n/a
Mar 28, 2021	4.1	183.9
Apr 18, 2021	4.0	184.0
Feb 16, 2024	0.6	187.4
Jan 20, 2025	0.6	187.4
Jul 21, 2025	2.7	185.3

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

Date Started : Jan 4, 2021
Position : E: 593361, N: 4814675 (UTM 17T)
Elev. Datum : Geodetic

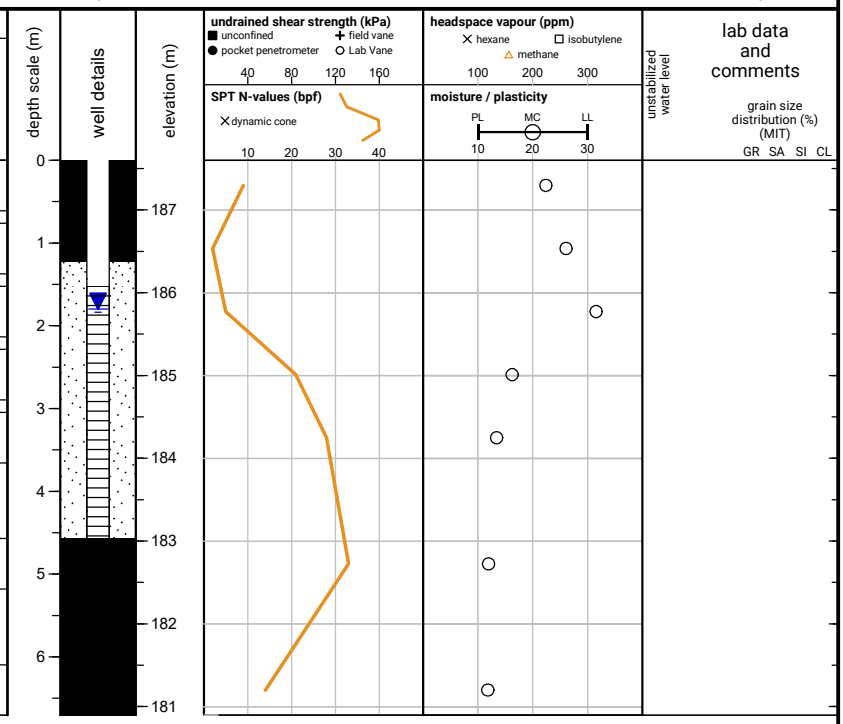
BOREHOLE LOG 103

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
187.6	**GROUND SURFACE**				
	FILL, clayey silt, trace gravel, trace rock fragments, trace organics, stiff to very stiff, dark brown, moist		1	SS	9
			2	SS	2
			3	SS	5
185.3					
2.3	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		4	SS	21
	...at 3.0 m, trace rock fragments, reddish brown		5	SS	28
			6	SS	33
	...at 6.1 m, dark brown, stiff		7	SS	14
180.9					
6.7	**END OF BOREHOLE**				

hollow stem augers OD=215 mm



Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	dry	n/a
Jan 29, 2021	4.2	183.4
Mar 2, 2021	3.1	184.5
Mar 28, 2021	2.9	184.7
Apr 18, 2021	2.9	184.7
Feb 16, 2024	2.1	185.5
Jan 20, 2025	1.9	185.7
Jul 21, 2025	1.8	185.8

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 6, 2021
Position : E: 593319, N: 4814589 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 104

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
189.0	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, very stiff, dark brown with black, moist		1	SS	19
	...at 0.8 m, firm		2	SS	8
	...at 1.5 m, trace rootlets		3	SS	6
			4	SS	5
			5	SS	4
	...at 3.8 m, very stiff		6	SS	18
184.4 / 4.6	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, reddish brown, moist (GLACIAL TILL)		7	SS	20
			8	SS	38
	...at 6.1 m, trace rock fragments		9	SS	37
			10	SS	14
	...at 9.1 m, sandy		11	SS	10
178.3 / 10.7	**SANDY SILT**, trace clay, trace gravel, very dense, greyish brown, moist (GLACIAL TILL)		12	SS	64 / 225mm
176.8 / 12.2	**SILTY SAND**, some gravel, trace rock fragments, trace clay, compact, reddish grey, wet (GLACIAL TILL)		13	SS	24
175.2 / 13.8	...at 13.7 m, very dense		14	SS	50 / 100mm

END OF BOREHOLE

Borehole was dry upon completion of drilling.

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13

well details

elevation (m): 189 188 187 186 185 184 183 182 181 180 179 178 177 176

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR	SA	SI	CL
8	25	41	26
15	57	25	3

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 4, 2021
Position : E: 593365, N: 4814636 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 105

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
188.4	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace wood fragments, organic odour, soft to stiff, dark brown with black, moist		1	SS	5
			2	SS	2
			3	SS	8
	...at 2.3 m, trace rootlets		4	SS	12
185.4					
3.0	**CLAYEY SILT**, trace sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		5	SS	15
	...at 3.8 m, trace rock fragments, reddish brown		6	SS	28
			7	SS	26
183.2					
5.2	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

Borehole was dry upon completion of drilling.

depth scale (m): 0, 1, 2, 3, 4, 5

well details

elevation (m): 188, 187, 186, 185, 184

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 7, 2021
Position : E: 593313, N: 4814544 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 106

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : GT8

elev / depth (m)	description	graphic log	number	type	SPT N-value
188.0	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, soft to very stiff, brown, moist		1	SS	5
			2	SS	2
	...at 1.5 m, trace rootlets		3	SS	3
	...at 2.3 m, trace wood fragments		4	SS	6
	...at 3.0 m, trace rock fragments, dark grey		5	SS	10
184.2 / 3.8	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, stiff, reddish brown, moist (GLACIAL TILL)		6	SS	9
	...at 4.6 m, hard		7	SS	30
			8	SS	35
	...at 6.1 m, very stiff		9	SS	25
	...at 7.6 m, greyish brown, stiff		10	SS	9
178.9 / 9.1	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, dense, reddish brown, moist (GLACIAL TILL)		11	SS	36
177.3 / 10.7	**SILTY SAND**, trace clay, trace gravel, very dense, brown, wet (GLACIAL TILL)		12	SS	50 / 125mm
175.6 / 12.4			13	SS	50 / 50mm

hollow stem augers OD=215 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 188 187 186 185 184 183 182 181 180 179 178 177 176

undrained shear strength (kPa)
■ unconfined ✚ field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

END OF BOREHOLE

Borehole was dry upon completion of drilling.

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 6, 2021
Position : E: 593366, N: 4814590 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 107

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
189.6	**GROUND SURFACE**				
	FILL, sandy silt, trace gravel, trace organics, trace rootlets, organic odour, compact, dark brown with black, moist		1	SS	16
			2	SS	10
			3	SS	5
187.3 / 2.3	**CLAYEY SILT**, some sand, trace gravel, trace rootlets, organic odour, stiff to very stiff, dark brown with black, moist (WEATHERED)		4	SS	12
			5	SS	20
			6	SS	16
185.0 / 4.6	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff to hard, reddish brown, moist (GLACIAL TILL)		7	SS	22
			8	SS	27
			9	SS	32
			10	SS	16
			11	SS	10
178.9 / 10.7	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		12	SS	42
			13	SS	50 / 125mm
175.8 / 13.8	**END OF BOREHOLE**		14	SS	50 / 75mm

hollow stem augers OD=215 mm

depth scale (m) | well details | elevation (m)

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160
SPT N-values (bpf): dynamic cone; 10 20 30 40
headspace vapour (ppm): hexane, isobutylene, methane; 100 200 300
moisture / plasticity: PL MC LL; 10 20 30
unstabilized water level

lab data and comments
grain size distribution (%) (MIT) GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	4.4	185.2
Jan 29, 2021	5.4	184.2
Mar 2, 2021	5.5	184.1
Mar 28, 2021	5.5	184.1
Apr 18, 2021	5.4	184.2
Feb 16, 2024	5.4	184.2
Jan 20, 2025	4.8	184.8

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

BOREHOLE LOG 108

Date Started : Jan 4, 2021
Position : E: 593404, N: 4814638 (UTM 17T)
Elev. Datum : Geodetic

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

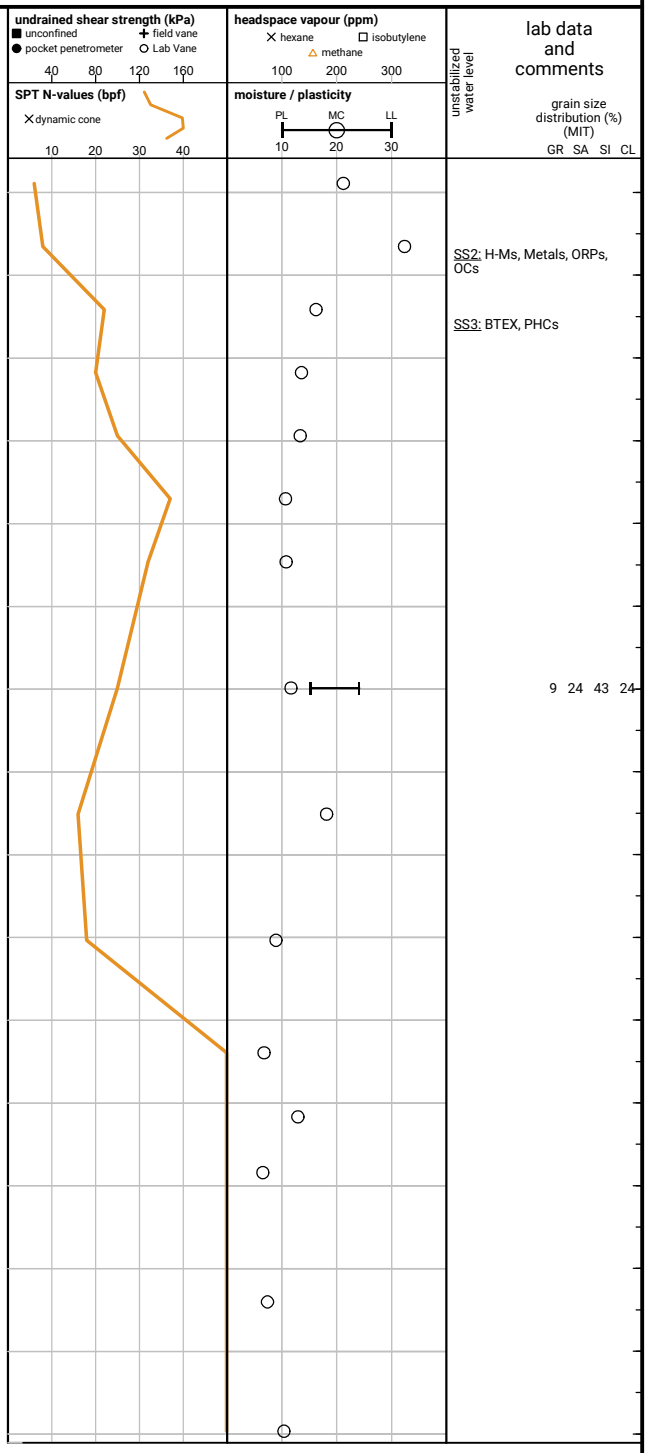
drill method : G78

hollow stem augers OD=215 mm

elev / depth (m)	description	number	type	SPT N-value
187.4	**GROUND SURFACE**			
	FILL, clayey silt, trace sand, trace gravel, trace rock fragments, trace asphalt, trace organics, firm, dark brown, moist	1	SS	6
	...at 0.8 m, stiff	2	SS	8
185.9 / 1.5	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, brown with grey, moist (GLACIAL TILL)	3	SS	22
		4	SS	20
	...at 3.0 m, trace rock fragments	5	SS	25
	...at 3.8 m, reddish brown	6	SS	37
		7	SS	32
	...at 6.1 m, sandy	8	SS	25
	...at 7.6 m, grey	9	SS	16
		10	SS	18
176.7 / 10.7	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, very dense, reddish brown, moist (GLACIAL TILL)	11	SS	50 / 125mm
	...at 11.4 m, trace rock fragments	12	SS	50 / 150mm
	...at 12.2 m, silty sand, trace limestone fragments	13	SS	50 / 125mm
		14	SS	50 / 50mm
171.9 / 15.5		15	SS	50 / 125mm

END OF BOREHOLE

Borehole was dry upon completion of drilling.



GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	3.4	184.0
Jan 29, 2021	3.5	183.9
Mar 2, 2021	3.6	183.8
Mar 28, 2021	3.6	183.8
Apr 18, 2021	3.5	183.9
Feb 16, 2024	3.3	184.1

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 5, 2021
Position : E: 593380, N: 4814551 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 109

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

hollow stem augers OD=215 mm

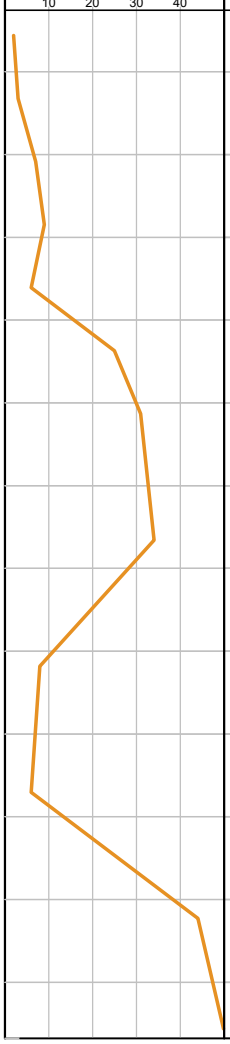
elev depth (m)	description	graphic log	number	type	SPT N-value
188.7	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, trace rock fragments, organic odour, very soft, dark brown, moist		1	SS	2
	...at 0.8 m, wet, soft		2	SS	3
	...at 1.5 m, sandy		3	SS	7
	...at 2.3 m, trace wood fragments		4	SS	9
	...at 3.0 m, dark brown with black		5	SS	6
184.7	...at 3.8 m, very stiff		6A	SS	
4.0			6B	SS	25
	CLAYEY SILT, some sand, trace gravel, trace rock fragments, very stiff to hard, reddish brown, moist (GLACIAL TILL)		7	SS	31
			8	SS	34
	...at 7.6 m, greyish brown, stiff		9	SS	8
	...at 9.1 m, soft		10	SS	6
178.0					
10.7	**SANDY SILT**, some clay, some gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		11	SS	44
176.3			12	SS	50 / 75mm
12.4	**END OF BOREHOLE**				

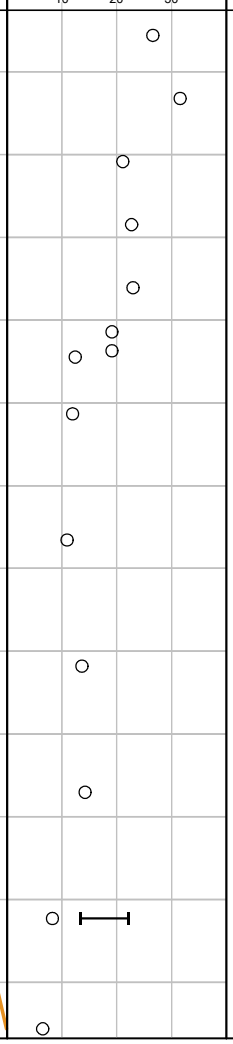
Borehole was dry upon completion of drilling.

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 188 187 186 185 184 183 182 181 180 179 178 177





unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR SA SI CL

10 29 42 19

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

BOREHOLE LOG 110

Date Started : Jan 5, 2021
Position : E: 593404, N: 4814588 (UTM 17T)
Elev. Datum : Geodetic

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
187.1	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, stiff, dark brown, moist		1	SS	11
			2	SS	12
	...at 1.5 m, organic odour		3	SS	13
184.8					
2.3	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, hard to very stiff, reddish brown, moist (GLACIAL TILL)		4	SS	13
			5	SS	32
			6	SS	23
			7	SS	26
	...at 6.1 m, grey, firm		8	SS	6
	...at 7.6 m, firm		9	SS	9
178.0					
9.1	**SANDY SILT**, trace gravel, trace rock fragments, compact, reddish brown, moist (GLACIAL TILL)		10	SS	23
176.3					
10.8	...at 10.7 m, silty sand		11	SS	50 / 100mm

hollow stem augers OD=215 mm

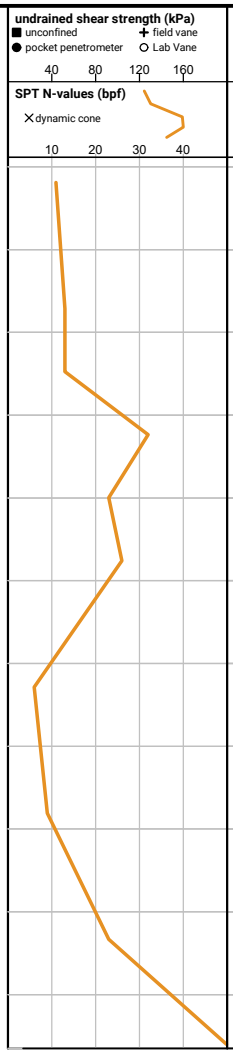
END OF BOREHOLE

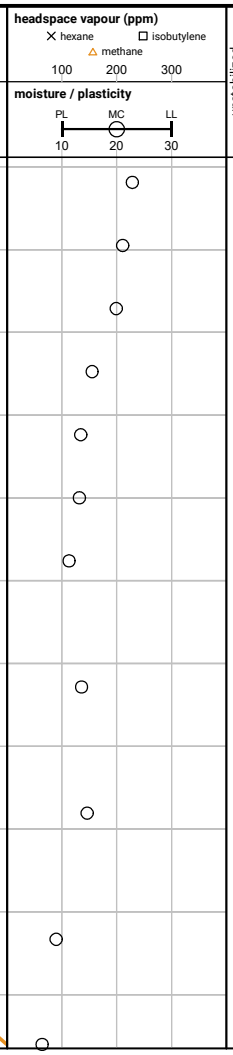
Borehole was dry upon completion of drilling.

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10

well details

elevation (m): 187 186 185 184 183 182 181 180 179 178 177





unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

Date Started : Jan 5, 2021
Position : E: 593438, N: 4814603 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 111

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
187.7	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, trace rock fragments, stiff, dark brown, moist		1	SS	12
	...at 0.8 m, brow		2	SS	4
186.2 / 1.5	**CLAYEY SILT**, trace sand, trace gravel, very stiff, black with grey, moist (GLACIAL TILL)		3	SS	17
			4	SS	20
	...at 3.0 m, some sand, trace rock fragments, reddish brown		5	SS	23
			6	SS	25
			7	SS	25
			8	SS	19
	...at 7.6 m, grey, stiff		9	SS	9
178.6 / 9.1	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, very dense, reddish brown with grey, moist (GLACIAL TILL)		10	SS	50 / 50mm
			11	SS	78 / 275mm
176.6 / 11.1	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11

well details

elevation (m): 187 186 185 184 183 182 181 180 179 178 177

undrained shear strength (kPa)
■ unconfined ● pocket penetrometer + field vane ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

Borehole was dry upon completion of drilling.

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

Date Started : Jan 11, 2021
Position : E: 593374, N: 4814490 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 112

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
185.5	**GROUND SURFACE**				
	FILL, clay and silt, trace sand, trace gravel, trace organics, very soft to stiff, dark brown, wet		1	SS	2
	...at 0.8 m, clayey silt, brown with grey, moist		2	SS	8
184.0 / 1.5	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff to hard, reddish brown, moist (GLACIAL TILL)		3	SS	19
			4	SS	23
			5	SS	26
			6	SS	30
			7	SS	23
	...at 6.1 m, grey, stiff		8	SS	11
177.9 / 7.6	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		9	SS	47
			10	SS	91 / 275mm
	...at 10.7 m, silty sand, wet		11	SS	96 / 250mm
174.4 / 11.1					

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11

elevation (m): 185 184 183 182 181 180 179 178 177 176 175

well details

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160

SPT N-values (bpf): dynamic cone; 10 20 30 40

headspace vapour (ppm): hexane, isobutylene, methane; 100 200 300

moisture / plasticity: PL MC LL; 10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT) GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

END OF BOREHOLE

Unstabilized water level measured at 10.9 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	1.8	183.7
Jan 29, 2021	1.6	183.9
Mar 2, 2021	1.7	183.8
Mar 28, 2021	1.6	183.9
Apr 18, 2021	1.6	183.9
Feb 16, 2024	1.5	184.0

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 8, 2021
Position : E: 593406, N: 4814520 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 113

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev / depth (m)	description	graphic log	number	type	SPT N-value
185.9	**GROUND SURFACE**				
	FILL, clay and silt, trace sand, trace gravel, trace organics, very soft to stiff, dark brown, wet		1	SS	2
	...at 0.8 m, clayey silt, browm with grey, moist		2	SS	13
184.4 / 1.5	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff to hard, reddish brown, moist (GLACIAL TILL)		3	SS	19
	...at 2.3 m, sandy		4	SS	29
			5	SS	27
			6	SS	31
			7	SS	19
	...at 6.1 m, grey, stiff		8	SS	11
	...at 7.6 m, grey		9	SS	30
176.8 / 9.1	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		10	SS	45
			11	SS	64
173.4 / 12.5	...at 12.2 m, wet		12	SS	50 / 125mm

hollow stem augers OD=215 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 185 184 183 182 181 180 179 178 177 176 175 174

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

7 23 42 28

END OF BOREHOLE

Borehole was dry upon completion of drilling.

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

Date Started : Jan 11, 2021
Position : E: 593432, N: 4814553 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 114

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
186.5	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, very soft, dark brown, wet		1	SS	2
	...at 0.8 m, brown with grey, moist, stiff		2	SS	12
185.0					
1.5	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff, reddish brown, moist (GLACIAL TILL)		3	SS	22
			4	SS	27
			5	SS	28
			6	SS	24
			7	SS	21
	...at 6.1 m, stiff		8	SS	14
178.9					
7.6	**SANDY SILT**, some clay, trace gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		9	SS	30
			10	SS	38
			11	SS	50 / 125mm
174.1			12	SS	50 / 100mm
12.4					

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 186 185 184 183 182 181 180 179 178 177 176 175

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: H-Ms, Metals, ORPs

SS3: BTEX, OCs, PHCs

END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

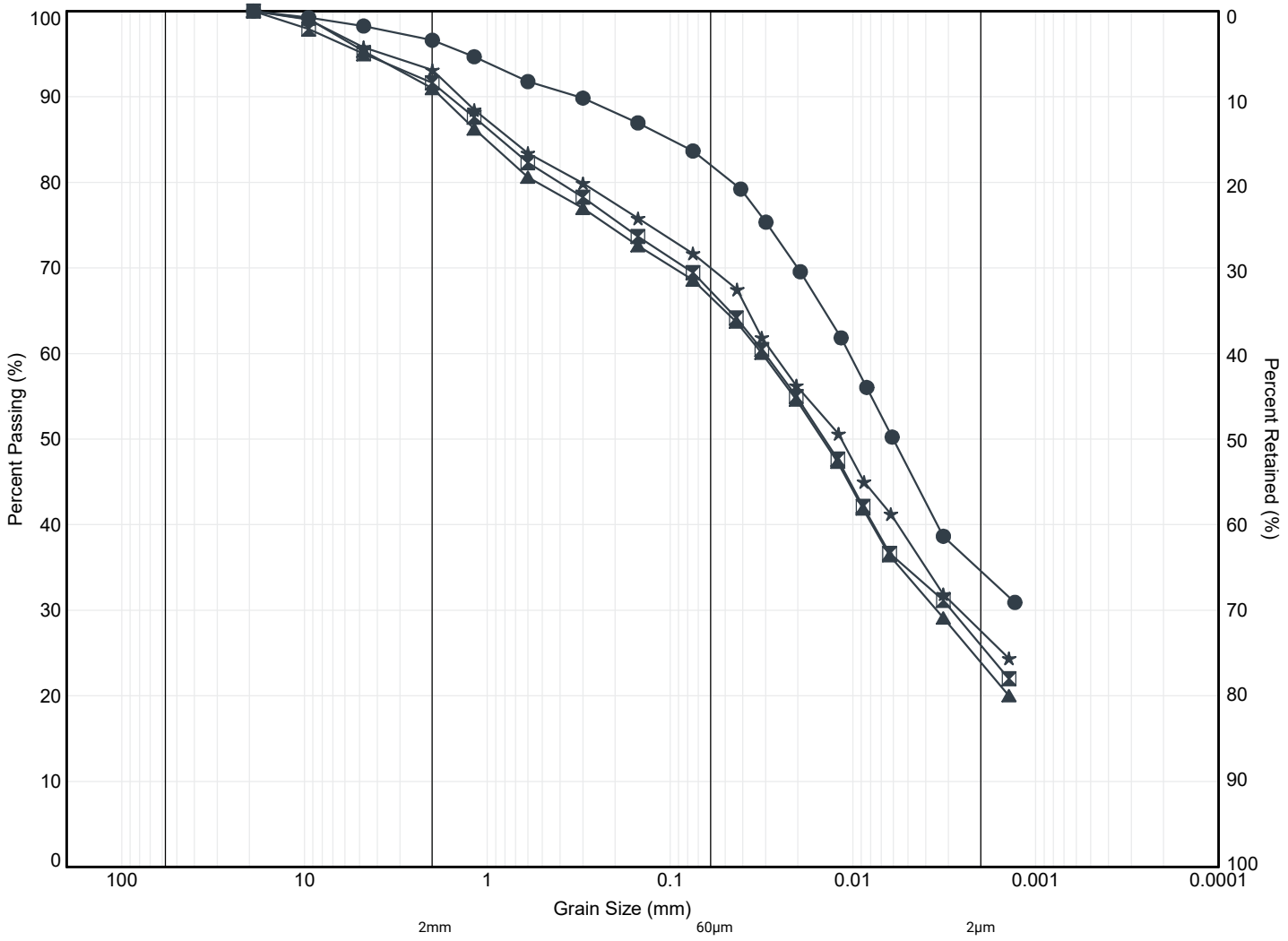
date	depth (m)	elevation (m)
Jan 12, 2021	7.6	178.9
Jan 29, 2021	2.6	183.9
Mar 2, 2021	2.7	183.8
Mar 28, 2021	2.6	183.9
Apr 18, 2021	2.6	183.9
Feb 16, 2024	2.4	184.1
Jan 20, 2025	2.4	184.1
Jul 21, 2025	2.8	183.7

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

APPENDIX B





MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

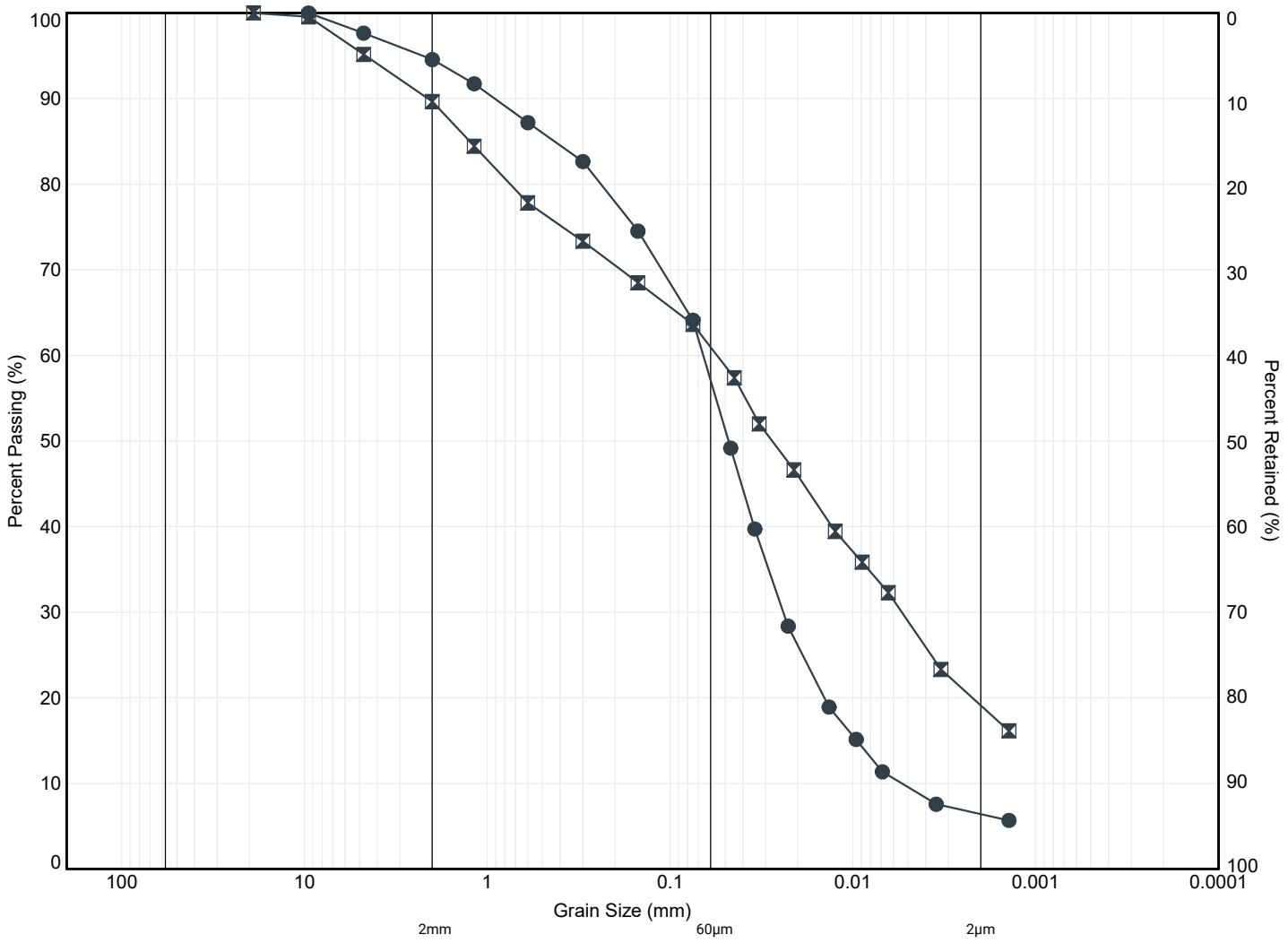
MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**101**	SS6	4.1	183.9	3	15	47	35
⊠	**104**	SS11	9.5	179.5	8	25	41	26
▲	**108**	SS8	6.4	181.0	9	24	43	24
★	**113**	SS4	2.6	183.3	7	23	42	28

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**
CLAYEY SILT

File No.: **20-294**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

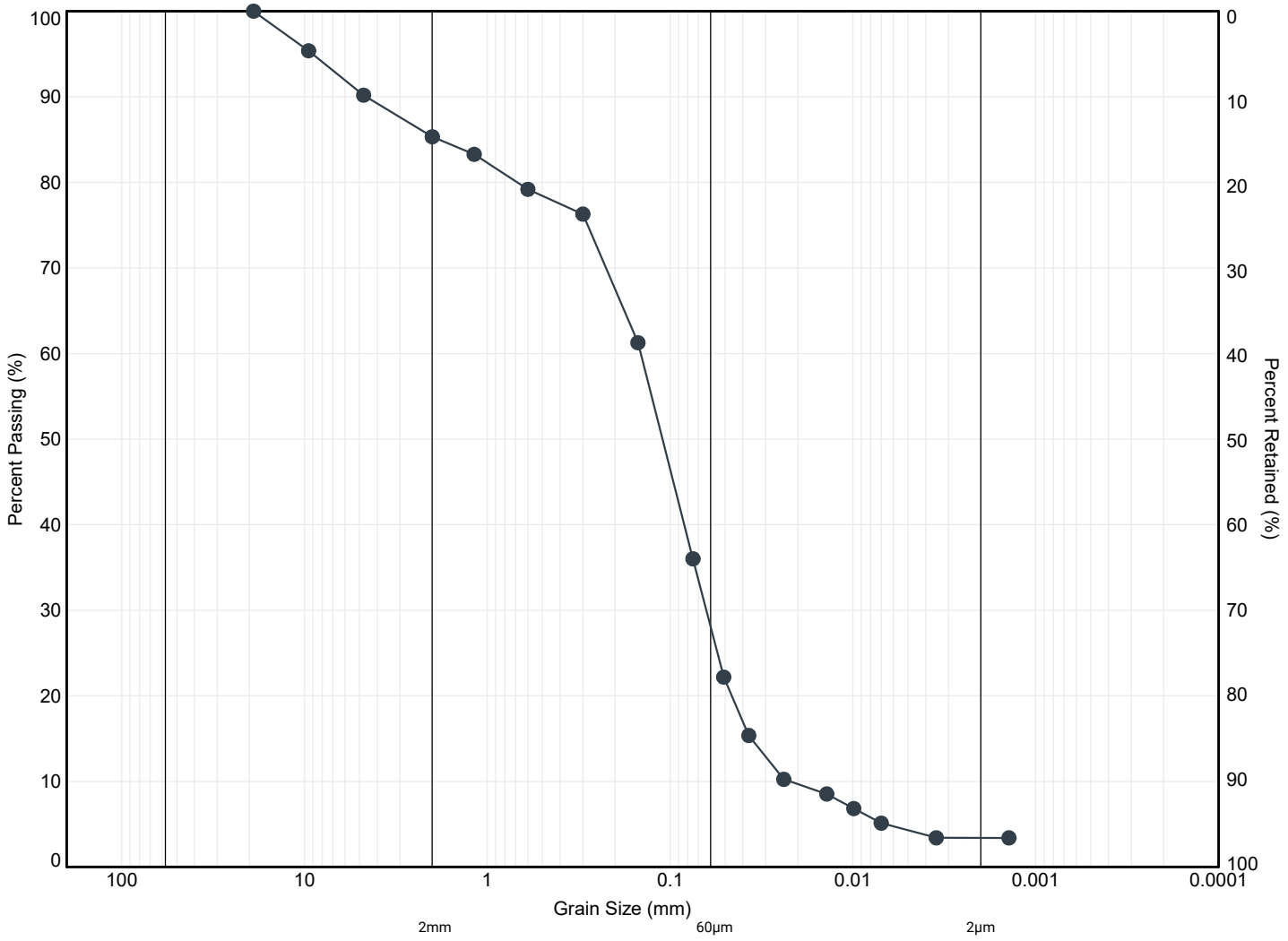
MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**101**	SS11	10.7	177.3	5	38	51	6
⊠	**109**	SS11	11.0	177.8	10	29	42	19

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**
SANDY SILT

File No.: **20-294**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

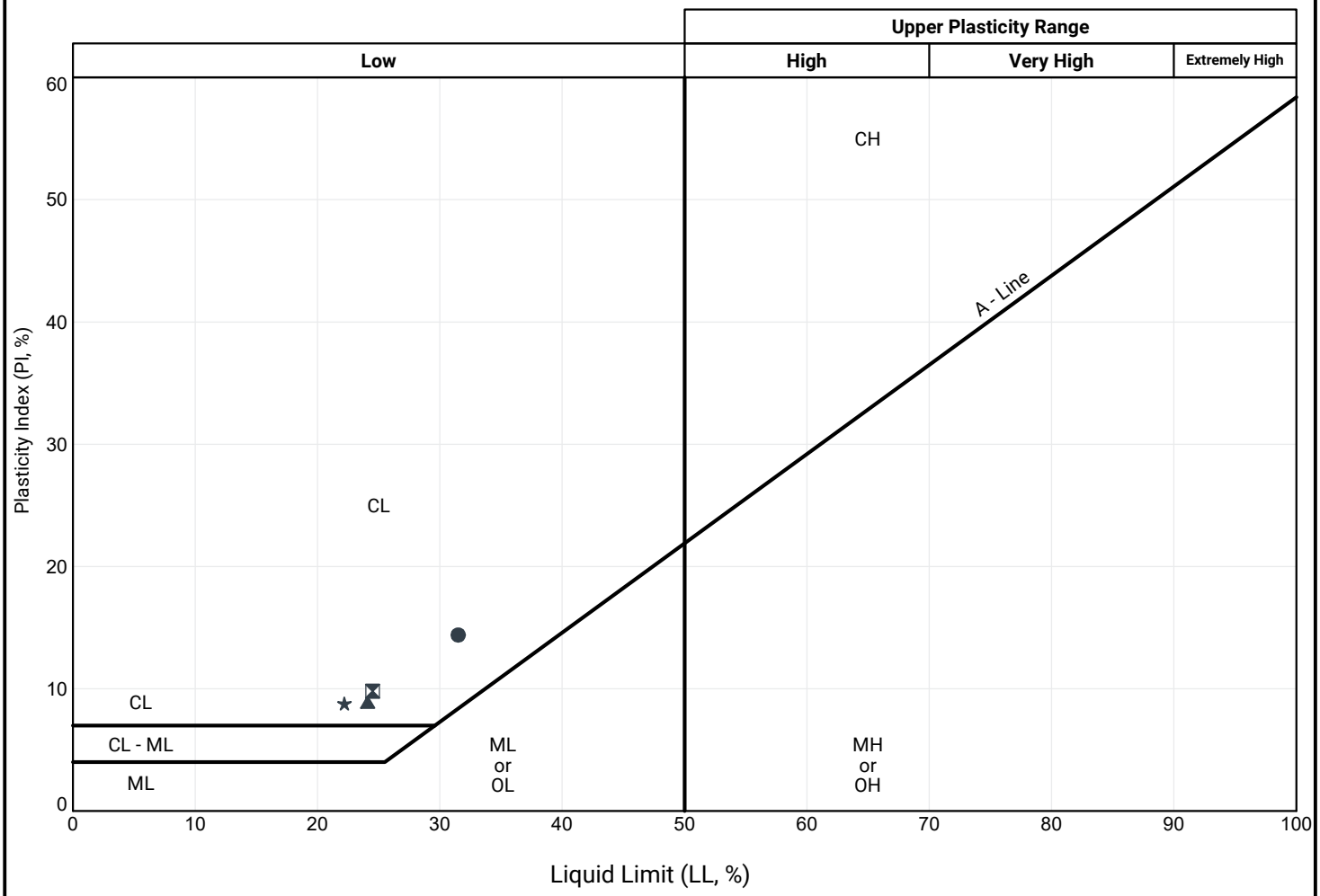
MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**104**	SS13	12.5	176.5	15	57	25	3

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**
SILTY SAND

File No.: **20-294**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)
●	**101**	SS6	4.1	183.9	32	17	15
⊠	**104**	SS11	9.5	179.5	25	15	9
▲	**108**	SS8	6.4	181.0	24	15	9
★	**109**	SS11	11.0	177.8	22	13	9

GROUNDED ENGINEERING

Title: **ATTERBERG LIMITS CHART**

File No.: **20-294**

APPENDIX C



CORROSIVITY (BVL)

BV Labs Job Number: C110991
Report Date: 2021/01/22

Grounded Engineering Inc.
Client Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S, MILTON

Sampler Initials: KS

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID			OPN366	OPN367	OPN368	OPN369	OPN370
Sampling Date			2021/01/08 14:00	2021/01/06 14:00	2021/01/05 16:00	2021/01/11 13:30	2021/01/08 14:00
COC Number			806784-04-01	806784-04-01	806784-04-01	806784-04-01	806784-04-01
	UNITS	**RDL**	**BH101-SS5**	**BH109-SS7**	**BH111-SS5**	**BH112-SS6**	**BH113-SS6**
Calculated Parameters							
Resistivity	ohm-cm		2400	1200	2900	1100	430
CONVENTIONALS							
Redox Potential	mV	N/A	218	226	208	211	205
Inorganics							
Soluble (20:1) Chloride (Cl-)	ug/g	20	51	<20	<20	52	23
Conductivity	umho/cm	2	411	847	342	935	2340
Available (CaCl2) pH	pH		7.1	7.72	7.6	7.75	7.7
Soluble (20:1) Sulphate (SO4)	ug/g	20	<20	750	200	880	3200
Sulphide	mg/kg	0.5	2.2 (1)	3.2 (1)	2.0 (1)	2.5 (2)	1.7 (1)
Physical Testing							
Moisture-Subcontracted	%	0.3	21	13	16	13	11

RDL = Reportable Detection Limit
N/A = Not Applicable

INTERPRETATION

AWWA C-105 Standard	**Points**	**Points**	**Points**	**Points**	**Points**
% Moisture	**1**	**2**	**2**	**2**	**2**
pH					
Is pH bet 6.5-7.5 ?	YES	NO	NO	NO	NO
Is Redox Potential < 100 mv?	NO	NO	NO	NO	NO
Are Sulphides present ?	NO	NO	NO	NO	NO
If above three conditions are met, pH is assigned 3 points					
pH - Score	**0**	**0**	**0**	**0**	**0**
Redox Potential	**0**	**0**	**0**	**0**	**0**
Resistivity	**2**	**10**	**1**	**10**	**10**
Acid Volatile Sulphides	**0**	**0**	**0**	**0**	**0**
TOTAL SCORE (AWWA C-105)	**3**	**12**	**3**	**12**	**12**

Sample	**BH101-SS5**	**BH109-SS7**	**BH111-SS5**	**BH112-SS6**	**BH113-SS6**
Corrosion Protection Recommended?	**No**	**YES**	**No**	**YES**	**YES**
Anions and Nutrients (Soil)					
Sulphate %	Not Detected	0.08%	0.02%	0.09%	0.32%
CLASS OF EXPOSURE	**Negligible**	**Negligible**	**Negligible**	**Negligible**	**Severe (S-2)**

Your Project #: 20-294
Your C.O.C. #: 806784-04-02, 806784-04-01

Attention: Matthew Garcia

Grounded Engineering Inc.
12 Banigan Drive
Toronto, ON
CANADA M4H 1E9

Report Date: 2021/01/22
Report #: R6490447
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C110991
Received: 2021/01/14, 14:35

Sample Matrix: Soil
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract)	5	2021/01/18	2021/01/19	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	5	2021/01/18	2021/01/18	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 3)	5	N/A	2021/01/19	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	5	N/A	2021/01/20	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	5	2021/01/18	2021/01/18	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	5	2021/01/14	2021/01/18	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	5	2021/01/18	2021/01/19	CAM SOP-00464	EPA 375.4 m
Redox Potential (2, 4)	5	N/A	N/A		

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by BVLabs Calgary via Mississauga
(2) This test was performed by Sub from Campo to Env. Testing Canada (Eurofins)
(3) Offsite analysis requires that subcontracted moisture be reported.
(4) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode.

Your Project #: 20-294
Your C.O.C. #: 806784-04-02, 806784-04-01

Attention: Matthew Garcia

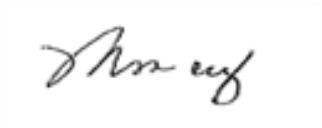
Grounded Engineering Inc.
12 Banigan Drive
Toronto, ON
CANADA M4H 1E9

Report Date: 2021/01/22
Report #: R6490447
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C110991
Received: 2021/01/14, 14:35

Encryption Key



Marijane Cruz
Senior Project Manager
22 Jan 2021 17:11:57

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Marijane Cruz, Senior Project Manager
Email: Marijane.Cruz@bureauveritas.com
Phone# (905)817-5756

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C110991
Report Date: 2021/01/22

Grounded Engineering Inc.
Client Project #: 20-294
Sampler Initials: KS

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		OPN366			OPN366			OPN367		
Sampling Date		2021/01/08 14:00			2021/01/08 14:00			2021/01/06 14:00		
COC Number		806784-04-01			806784-04-01			806784-04-01		
	UNITS	BH101-SS5	RDL	QC Batch	BH101-SS5 Lab-Dup	RDL	QC Batch	BH109-SS7	RDL	QC Batch
Calculated Parameters										
Resistivity	ohm-cm	2400		7150396				1200		7150396
Inorganics										
Soluble (20:1) Chloride (Cl-)	ug/g	51	20	7155233				<20	20	7155233
Conductivity	umho/cm	411	2	7154919				847	2	7154919
Available (CaCl2) pH	pH	7.10		7154956				7.72		7154956
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	7155208				780	40	7155208
Sulphide	mg/kg	2.2 (1)	0.5	7162050	1.5	0.5	7162050	3.2 (1)	0.5	7162050
Physical Testing										
Moisture-Subcontracted	%	21	0.30	7158093				13	0.30	7158093

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Sample contained greater than 10% headspace at time of extraction.
Sample extracted past method-specified hold time. Analyzed past method specified hold time

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C110991
Report Date: 2021/01/22

Grounded Engineering Inc.
Client Project #: 20-294
Sampler Initials: KS

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		OPN368		OPN369			OPN369		
Sampling Date		2021/01/05 16:00		2021/01/11 13:30			2021/01/11 13:30		
COC Number		806784-04-01		806784-04-01			806784-04-01		
	UNITS	BH111-SS5	RDL	BH112-SS6	RDL	QC Batch	BH112-SS6 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Resistivity	ohm-cm	2900		1100		7150396			
Inorganics									
Soluble (20:1) Chloride (Cl-)	ug/g	<20	20	52	20	7155233			
Conductivity	umho/cm	342	2	935	2	7154919	953	2	7154919
Available (CaCl2) pH	pH	7.60		7.75		7154956			
Soluble (20:1) Sulphate (SO4)	ug/g	200	20	880	40	7155208			
Sulphide	mg/kg	2.0 (1)	0.5	2.5 (2)	0.5	7162050			
Physical Testing									
Moisture-Subcontracted	%	16	0.30	13	0.30	7158093			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
(1) Sample contained greater than 10% headspace at time of extraction.
Sample extracted past method-specified hold time. Analyzed past method specified hold time
(2) Sample contained greater than 10% headspace at time of extraction.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C110991
Report Date: 2021/01/22

Grounded Engineering Inc.
Client Project #: 20-294
Sampler Initials: KS

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		OPN370		
Sampling Date		2021/01/08 14:00		
COC Number		806784-04-01		
	UNITS	BH113-SS6	RDL	QC Batch
Calculated Parameters				
Resistivity	ohm-cm	430		7150396
Inorganics				
Soluble (20:1) Chloride (Cl-)	ug/g	23	20	7155233
Conductivity	umho/cm	2340	2	7154919
Available (CaCl2) pH	pH	7.70		7154956
Soluble (20:1) Sulphate (SO4)	ug/g	3200	200	7155208
Sulphide	mg/kg	1.7 (1)	0.5	7162050
Physical Testing				
Moisture-Subcontracted	%	11	0.30	7158093

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
(1) Sample contained greater than 10% headspace at time of extraction. Sample extracted past method-specified hold time. Analyzed past method specified hold time

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C110991
Report Date: 2021/01/22

Grounded Engineering Inc.
Client Project #: 20-294
Sampler Initials: KS

TEST SUMMARY

BV Labs ID: OPN366
Sample ID: BH101-SS5
Matrix: Soil

Collected: 2021/01/08
Shipped:
Received: 2021/01/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7155233	2021/01/18	2021/01/19	Deonarine Ramnarine
Conductivity	AT	7154919	2021/01/18	2021/01/18	Tarunpreet Kaur
Moisture (Subcontracted)	BAL	7158093	N/A	2021/01/19	Sneha Bashyal
Sulphide in Soil	SPEC	7162050	N/A	2021/01/20	Marjolen Busslinger
pH CaCl2 EXTRACT	AT	7154956	2021/01/18	2021/01/18	Neil Dassanayake
Resistivity of Soil		7150396	2021/01/18	2021/01/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7155208	2021/01/18	2021/01/19	Deonarine Ramnarine
Redox Potential	COND	7164624	2021/01/22		Marijane Cruz

BV Labs ID: OPN366 Dup
Sample ID: BH101-SS5
Matrix: Soil

Collected: 2021/01/08
Shipped:
Received: 2021/01/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide in Soil	SPEC	7162050	N/A	2021/01/20	Marjolen Busslinger

BV Labs ID: OPN367
Sample ID: BH109-SS7
Matrix: Soil

Collected: 2021/01/06
Shipped:
Received: 2021/01/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7155233	2021/01/18	2021/01/19	Deonarine Ramnarine
Conductivity	AT	7154919	2021/01/18	2021/01/18	Tarunpreet Kaur
Moisture (Subcontracted)	BAL	7158093	N/A	2021/01/19	Sneha Bashyal
Sulphide in Soil	SPEC	7162050	N/A	2021/01/20	Marjolen Busslinger
pH CaCl2 EXTRACT	AT	7154956	2021/01/18	2021/01/18	Neil Dassanayake
Resistivity of Soil		7150396	2021/01/18	2021/01/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7155208	2021/01/18	2021/01/19	Deonarine Ramnarine
Redox Potential	COND	7164624	2021/01/22		Marijane Cruz

BV Labs ID: OPN368
Sample ID: BH111-SS5
Matrix: Soil

Collected: 2021/01/05
Shipped:
Received: 2021/01/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7155233	2021/01/18	2021/01/19	Deonarine Ramnarine
Conductivity	AT	7154919	2021/01/18	2021/01/18	Tarunpreet Kaur
Moisture (Subcontracted)	BAL	7158093	N/A	2021/01/19	Sneha Bashyal
Sulphide in Soil	SPEC	7162050	N/A	2021/01/20	Marjolen Busslinger
pH CaCl2 EXTRACT	AT	7154956	2021/01/18	2021/01/18	Neil Dassanayake
Resistivity of Soil		7150396	2021/01/18	2021/01/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7155208	2021/01/18	2021/01/19	Deonarine Ramnarine
Redox Potential	COND	7164624	2021/01/22		Marijane Cruz

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C110991
Report Date: 2021/01/22

Grounded Engineering Inc.
Client Project #: 20-294
Sampler Initials: KS

TEST SUMMARY

BV Labs ID: OPN369
Sample ID: BH112-SS6
Matrix: Soil

Collected: 2021/01/11
Shipped:
Received: 2021/01/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7155233	2021/01/18	2021/01/19	Deonarine Ramnarine
Conductivity	AT	7154919	2021/01/18	2021/01/18	Tarunpreet Kaur
Moisture (Subcontracted)	BAL	7158093	N/A	2021/01/19	Sneha Bashyal
Sulphide in Soil	SPEC	7162050	N/A	2021/01/20	Marjolen Busslinger
pH CaCl2 EXTRACT	AT	7154956	2021/01/18	2021/01/18	Neil Dassanayake
Resistivity of Soil		7150396	2021/01/18	2021/01/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7155208	2021/01/18	2021/01/19	Deonarine Ramnarine
Redox Potential	COND	7164624	2021/01/22		Marijane Cruz

BV Labs ID: OPN369 Dup
Sample ID: BH112-SS6
Matrix: Soil

Collected: 2021/01/11
Shipped:
Received: 2021/01/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7154919	2021/01/18	2021/01/18	Tarunpreet Kaur

BV Labs ID: OPN370
Sample ID: BH113-SS6
Matrix: Soil

Collected: 2021/01/08
Shipped:
Received: 2021/01/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7155233	2021/01/18	2021/01/19	Deonarine Ramnarine
Conductivity	AT	7154919	2021/01/18	2021/01/18	Tarunpreet Kaur
Moisture (Subcontracted)	BAL	7158093	N/A	2021/01/19	Sneha Bashyal
Sulphide in Soil	SPEC	7162050	N/A	2021/01/20	Marjolen Busslinger
pH CaCl2 EXTRACT	AT	7154956	2021/01/18	2021/01/18	Neil Dassanayake
Resistivity of Soil		7150396	2021/01/18	2021/01/18	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7155208	2021/01/18	2021/01/19	Deonarine Ramnarine
Redox Potential	COND	7164624	2021/01/22		Marijane Cruz

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Results relate only to the items tested.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C110991
Report Date: 2021/01/22

QUALITY ASSURANCE REPORT

Grounded Engineering Inc.
Client Project #: 20-294
Sampler Initials: KS

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7154919	Conductivity	2021/01/18			102	90 - 110	<2	umho/cm	2.0	10
7154956	Available (CaCl2) pH	2021/01/18			100	97 - 103			0.056	N/A
7155208	Soluble (20:1) Sulphate (SO4)	2021/01/19	NC	70 - 130	104	70 - 130	<20	ug/g	5.5	35
7155233	Soluble (20:1) Chloride (Cl-)	2021/01/19	NC	70 - 130	106	70 - 130	<20	ug/g	6.1	35
7158093	Moisture-Subcontracted	2021/01/19					<0.30	%		
7162050	Sulphide	2021/01/20							NC	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

BV Labs Job #: C110991
Report Date: 2021/01/22

Grounded Engineering Inc.
Client Project #: 20-294
Sampler Initials: KS

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Harry (Peng) Liang, Senior Analyst

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Marijane Cruz, Senior Project Manager

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel: (905) 817-5700 Toll-free 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

14-Jan-21 14:35
Marijane Cruz
C110991

Page 1 of 1

INVOICE TO:	REPORT TO:	PROJECT INFORMATION:
Company Name: #36876 Grounded Engineering Inc.	Company Name: Grounded Engineering	Quotation #: C04975
Attention: ~~Jeremy Bobro~~ Matthew Garcia	Attention: ~~Jeremy Bobro~~ Matthew Garcia	P.O. #:
Address: 12 Banigan Drive, Toronto ON M4H 1E9	Address: 12 Banigan Dr, Toronto ON M4H 1G9	Project: ~~20-287~~ 20-294 KSE ENV-883
Tel: (647) 264-~~7953~~ 7950 Fax:	Tel: (647) 264-~~7953~~ 7950 Fax:	Project Name:
Email: mgarcia~~jbobro~~@groundedeng.ca	Email: mgarcia~~jbobro~~@groundedeng.ca	Site #:
		Sampled By:

Bottle Order #: 806784
COC #: C#806784-04-01
Project Manager: Marijane Cruz

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
- ☐ Table 1 ☐ Res/Park ☐ Medium/Fine
- ☐ Table 2 ☐ Ind/Comm ☑ Coarse
- ☑ Table 3 ☐ Agri/Other ☐ For RSC
- ☐ Table ___

Other Regulations
- ☐ CCME ☐ Sanitary Sewer Bylaw
- ☐ Reg 558 ☐ Storm Sewer Bylaw
- ☐ MISA Municipality ___
- ☐ PWQO ☐ Reg 406 Table ___
- ☐ Other ___

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ___

Field Filtered (please circle): Metals / Hg / Cr VI

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	O.Reg 153 Metals & Inorganics (Soil) Soil corrosivity Package	O.Reg 153 PAHs (Soil) TCLP	O.Reg 153 PCBs (Soil)	O.Reg 153 PHCs, BTEX/F1-F4 (Soil)	O.Reg 153 VOCs by HS (Soil)	O.Reg 558 TCLP Benzo(a)pyrene	O.Reg 558 TCLP Inorganics Package	O.Reg 558 TCLP Leachate Preparation	O.Reg 558 TCLP PCBs	O.Reg 558 TCLP VOCs by HS	# of Bottles	Comments
1		BH 101-SS5	21/01/08	14:00	Soil	X										1	TCLP analysis as per
2		BH 109-SS 7	21/01/06	14:00		X										1	~~HCE, VOC, PCB, BaP~~
3		BH 111-SS5	21/01/05	16:00		X										1	
4		BH 112-SS6	21/01/11	13:30		X										1	
5		BH 113-SS6	21/01/08	14:00		X										1	
6		~~TCLP~~	~~21/01/11~~	~~13:30~~			*									3	
7																	
8																	
9																	
10																	

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___ ☐
Rush Confirmation Number: ___ *(call lab for #)*

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Kishani Sundarabajan	21/01/11	14:00	[illegible]	21/01/14	14:35	

Laboratory Use Only No ice

Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	6.8 | 6	Present		
		Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

Certificate of Analysis

Client: Bureau Veritas Canada (2019) Inc
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Marijane Cruz
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc

Report Number: 1946466
Date Submitted: 2021-01-18
Date Reported: 2021-01-22
Project: C110991
COC #: 869156

Dear Marijane Cruz:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Addrine Thomas 2021.01.22 15:47:18 -05'00'

Addrine Thomas, Inorganics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: http://www.cala.ca/scopes/2602.pdf.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

Client: Bureau Veritas Canada (2019) Inc
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Marijane Cruz
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc

Report Number: 1946466
Date Submitted: 2021-01-18
Date Reported: 2021-01-22
Project: C110991
COC #: 869156

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.			
					1538580 Soil 2021-01-08 OPN366-BH101-SS5	1538581 Soil 2021-01-06 OPN367-BH109-SS7	1538582 Soil 2021-01-05 OPN368-BH111-SS5	1538583 Soil 2021-01-11 OPN369-BH112-SS6
Redox Potential	REDOX Potential		mV		218	226	208	211

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.
					1538584 Soil 2021-01-08 OPN370-BH113-SS6
Redox Potential	REDOX Potential		mV		205

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

Client: Bureau Veritas Canada (2019) Inc
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Ms. Marijane Cruz
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc

Report Number: 1946466
Date Submitted: 2021-01-18
Date Reported: 2021-01-22
Project: C110991
COC #: 869156

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 395420 **Analysis/Extraction Date** 2021-01-22 **Analyst** R R **Method** C SM2580B			
REDOX Potential	273 mV	101	

Guideline = *** = Guideline Exceedence**

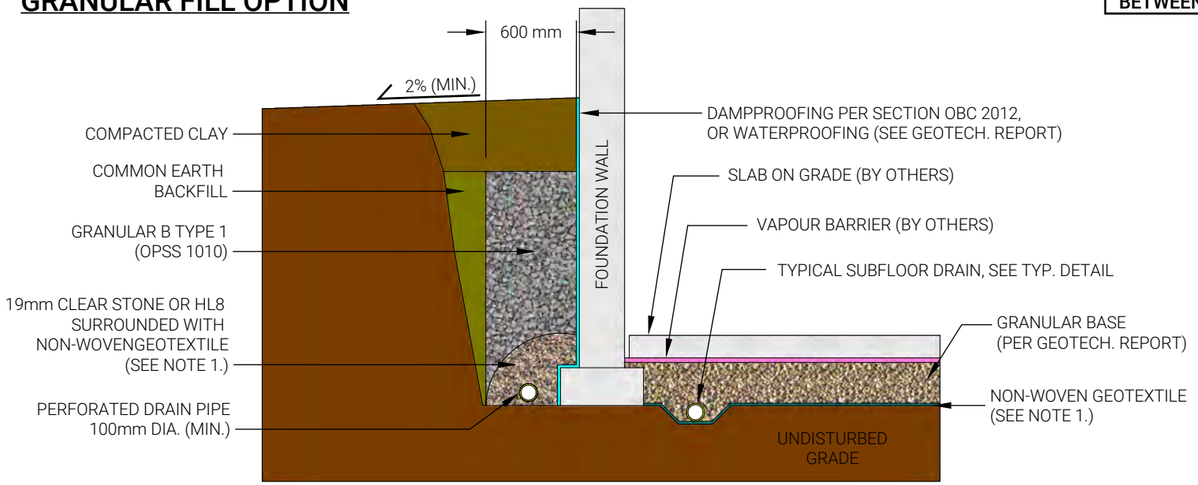
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

APPENDIX D

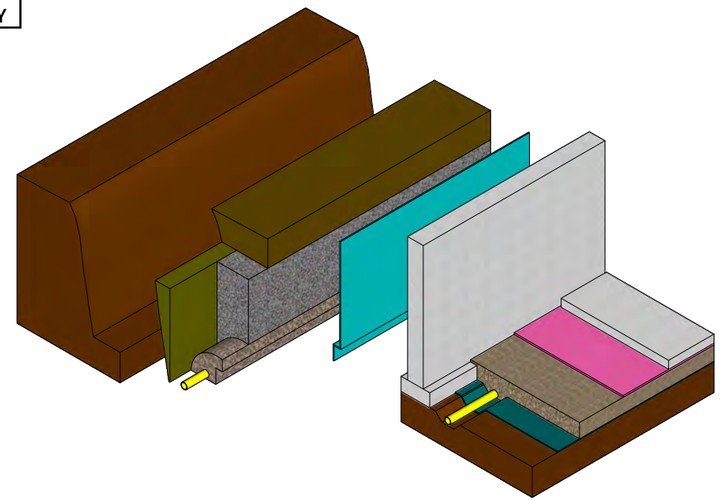


GRANULAR FILL OPTION



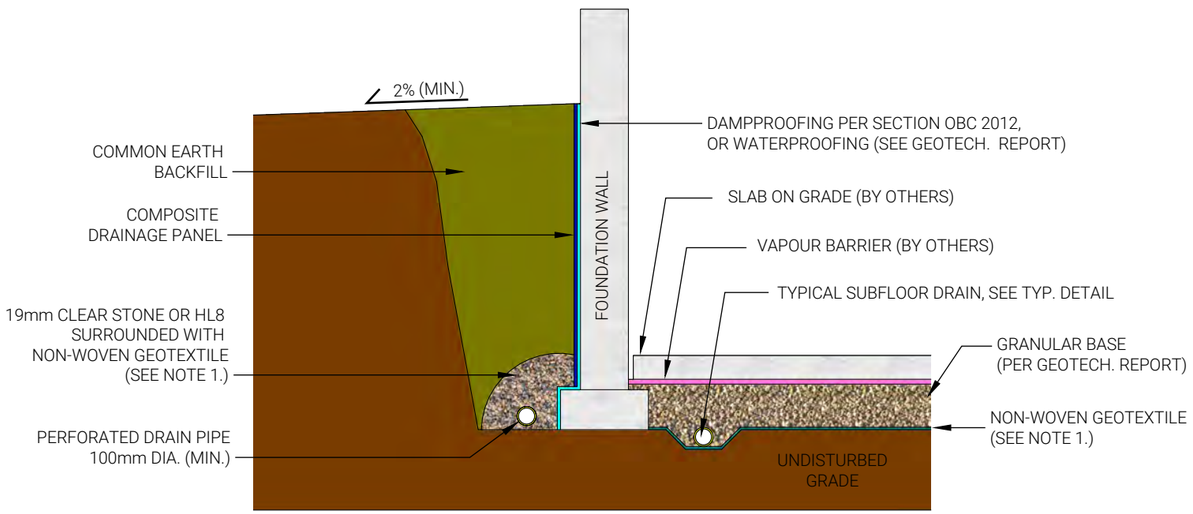
SECTIONAL VIEW

OBJECTS ARE COLOR-CODED BETWEEN TWO VIEWS FOR CLARITY

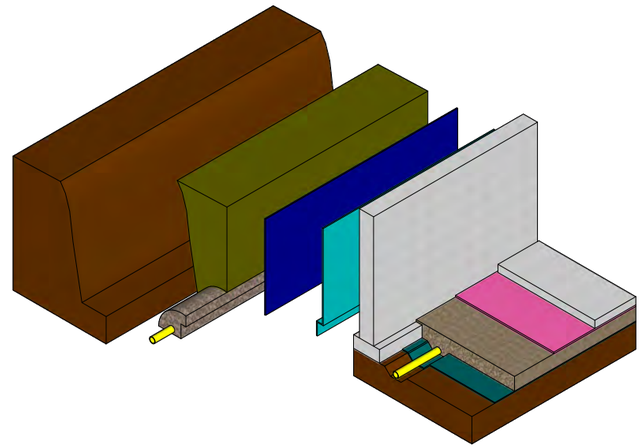


ISOMETRIC VIEW

GEO-COMPOSITE DRAINAGE PANEL OPTION



SECTIONAL VIEW



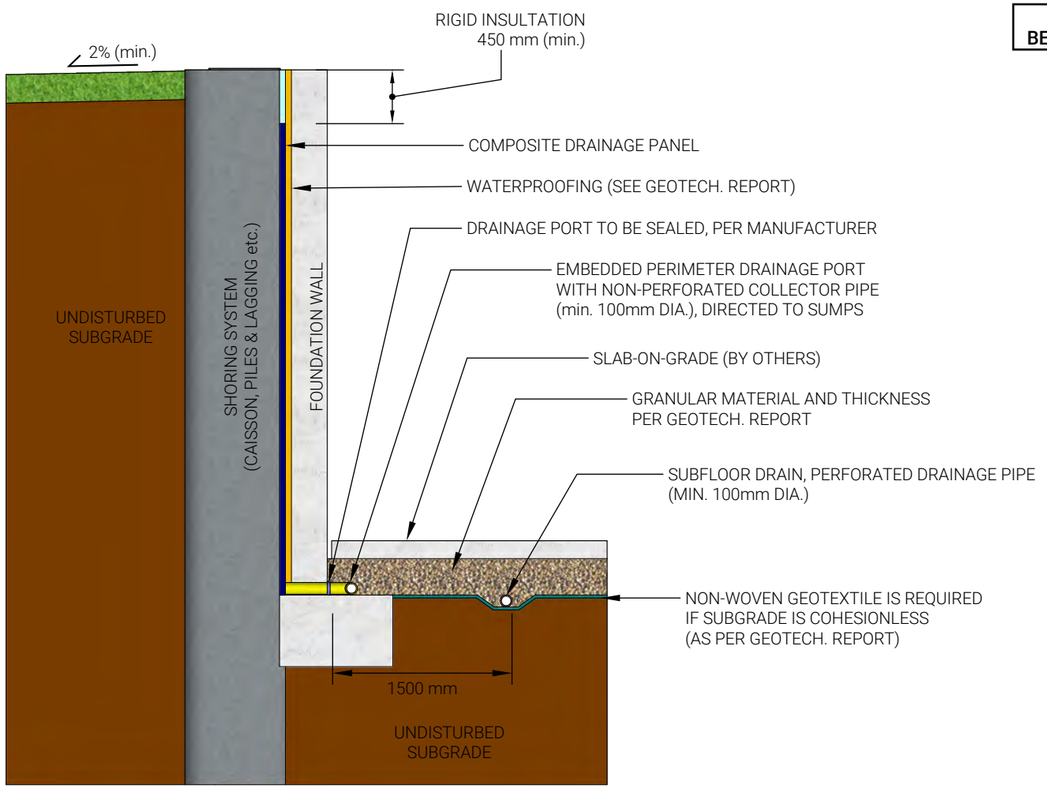
ISOMETRIC VIEW

NOTES
1. A NON-WOVEN GEOTEXTILE WITH AN APPARENT OPENING SIZE OF < 0.250mm AND A TEAR RESISTANCE OF > 200 N.

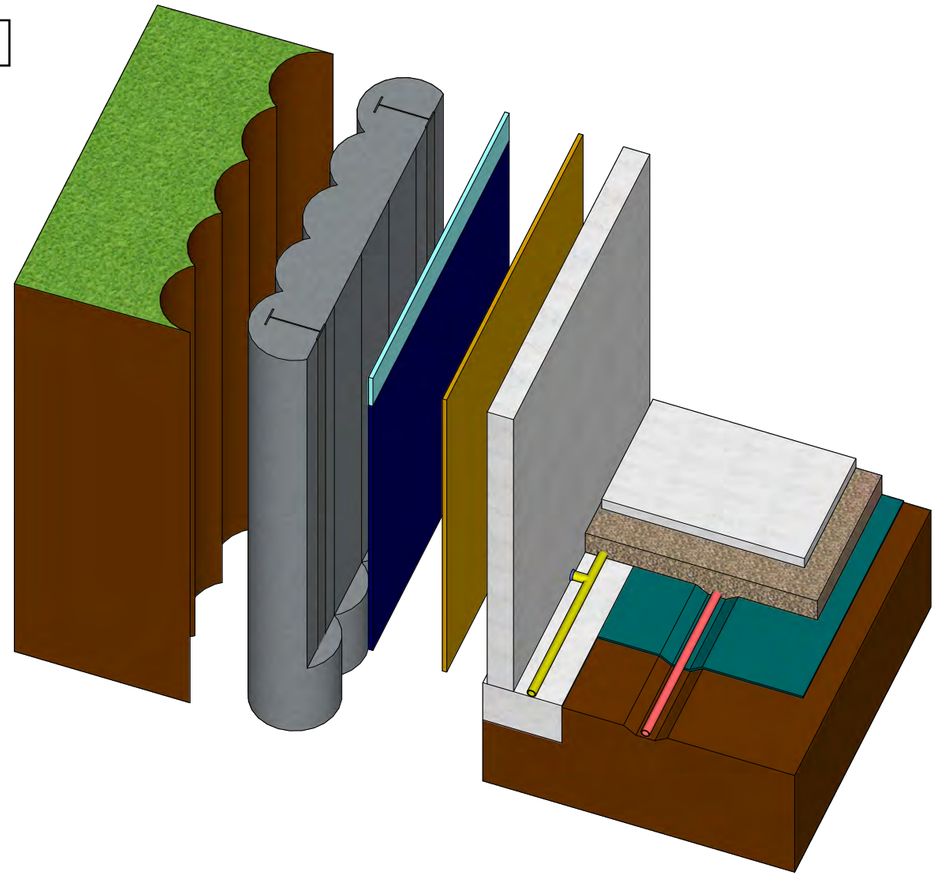
GROUNDED ENGINEERING

Title

BASEMENT DRAINAGE TYPICAL DETAIL



OBJECTS ARE COLOR-CODED BETWEEN TWO VIEWS FOR CLARITY



SECTIONAL VIEW

ISOMETRIC VIEW

SUBFLOOR DRAINAGE SYSTEM

1. THE SUBFLOOR DRAINS SHOULD BE SET IN PARALLEL ROWS, IN ONE DIRECTION, AND SPACED AS PER THE GEOTECHNICAL REPORT.
2. THE INVERT OF THE PIPES SHOULD BE A MINIMUM OF 300mm BELOW THE UNDERSIDE OF THE SLAB-ON-GRADE.
3. A CAPILLARY MOISTURE BARRIER (I.E. DRAINAGE LAYER) CONSISTING OF A MINIMUM 200 mm LAYER OF CLEAR STONE (OPSS MUNI 1004) COMPACTED TO A DENSE STATE (OR AS PER THE GEOTECHNICAL REPORT). WHERE VEHICULAR TRAFFIC IS REQUIRED, THE UPPER 50 mm OF THE CAPILLARY MOISTURE BARRIER MAY BE REPLACED WITH GRANULAR A (OPSS MUNI 1010) COMPACTED TO A MINIMUM 98% SPMDD.
4. A NON-WOVEN GEOTEXTILE MUST SEPARATE THE SUBGRADE FROM THE SUBFLOOR DRAINAGE LAYER IF THE SUBGRADE IS COHESIONLESS. THE NON-WOVEN GEOTEXTILE MAY CONSIST OF TERRAFIX 360R OR AN APPROVED EQUIVALENT.

PERIMETER DRAINAGE SYSTEM

1. FOR A DISTANCE OF 1.2m FROM THE BUILDING, THE GROUND SURFACE SHOULD HAVE A MINIMUM 2% GRADE.
2. PREFABRICATED COMPOSITE DRAINAGE PANEL (CONTINUOUS COVER, AS PER MANUFACTURER'S REQUIREMENTS) IS RECOMMENDED BETWEEN THE BASEMENT WALL AND RIGID SHORING WALL. THE DRAINAGE PANEL MAY CONSIST OF MIRADRAIN 6000 OR AN APPROVED EQUIVALENT.
3. PERIMETER DRAINAGE IS TO BE COLLECTED IN NON-PERFORATED PIPES AND CONVEYED DIRECTLY TO THE BUILDING SUMPS.
4. PERIMETER DRAINAGE PORTS SHOULD BE SPACED A MAXIMUM 3m ON-CENTRE. EACH PORT SHOULD HAVE A MINIMUM CROSS-SECTIONAL AREA OF 1500 mm2.

GENERAL NOTES

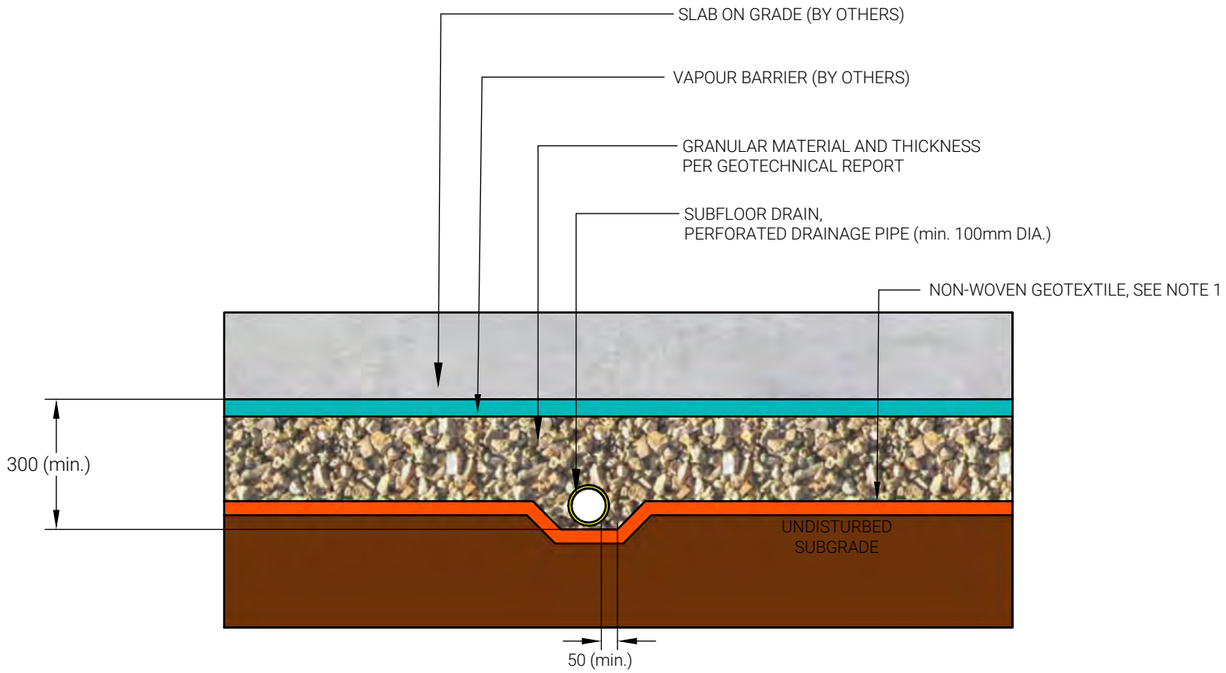
1. THERE SHOULD BE NO STRUCTURAL CONNECTION BETWEEN THE SLAB-ON-GRADE AND THE FOUNDATION WALL OR FOOTING.
2. THERE SHOULD BE NO CONNECTION BETWEEN THE SUBFLOOR AND PERIMETER DRAINAGE SYSTEMS.
3. THIS IS ONLY A TYPICAL BASEMENT DRAINAGE DETAIL. THE GEOTECHNICAL REPORT SHOULD BE CONSULTED FOR SITE SPECIFIC RECOMMENDATIONS.
4. THE FINAL BASEMENT DRAINAGE DESIGN SHOULD BE REVIEWED BY THE GEOTECHNICAL ENGINEER TO CONFIRM THE DESIGN IS ACCEPTABLE.

GROUNDED ENGINEERING

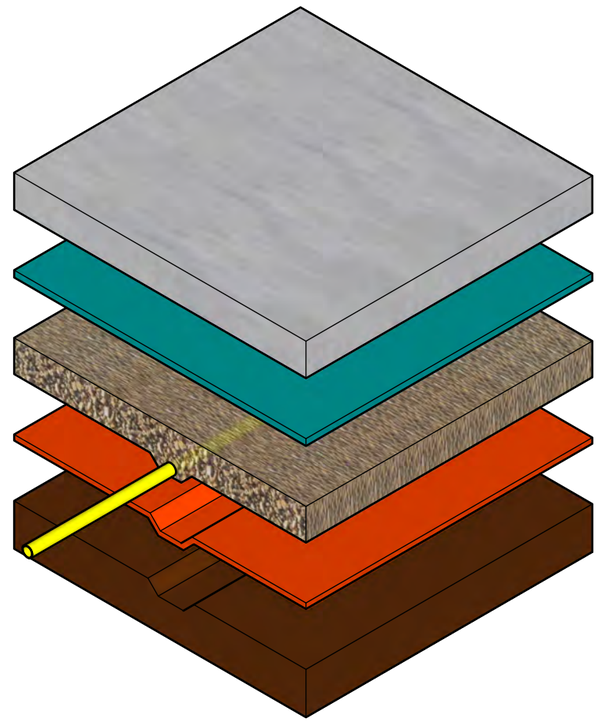
Title

BASEMENT DRAINAGE SHORING SYSTEM TYPICAL DETAILS

OBJECTS ARE COLOR-CODED BETWEEN TWO VIEWS FOR CLARITY



SECTIONAL VIEW



ISOMETRIC VIEW

NOTES

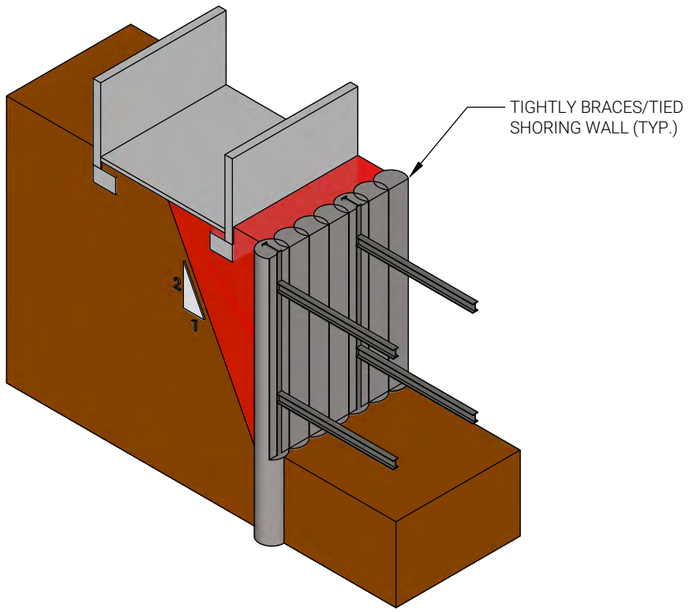
1. WHEN THE SUBGRADE CONSISTS OF COHESIONLESS SOIL, IT MUST BE SEPARATED FROM THE SUBFLOOR DRAINAGE LAYER USING A NON-WOVEN GEOTEXTILE (WITH AN APPARENT OPENING SIZE OF < 0.250mm AND A TEAR RESISTANCE OF > 200 N).

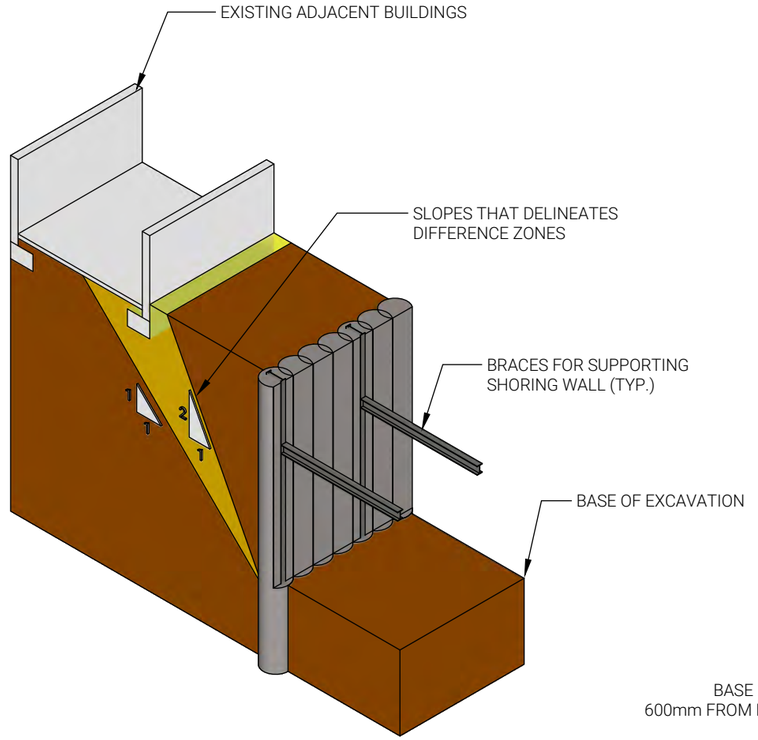
2. TYPICAL SCHEMATIC ONLY. MUST BE READ IN CONJUNCTION WITH GEOTECHNICAL REPORT.

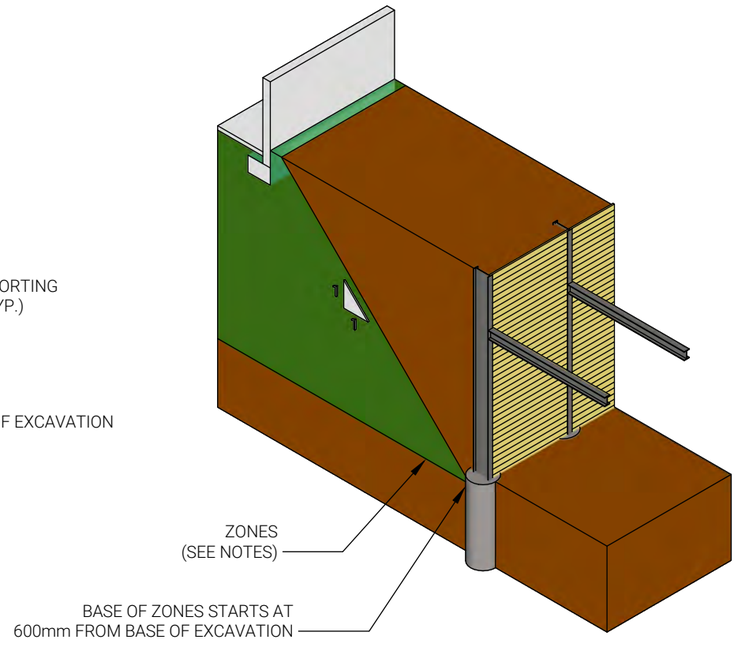
GROUNDED ENGINEERING

Title

BASEMENT SUBDRAIN TYPICAL DETAIL







ZONE A (RED)

FOUNDATIONS WITHIN THIS ZONE OFTEN REQUIRE UNDERPINNING OR SHORING SYSTEM. HORIZONTAL AND VERTICAL PRESSURES ON EXCAVATION WALL OF NON-UNDERPINNED FOUNDATION MUST BE CONSIDERED

ZONE B (YELLOW)

FOUNDATIONS WITHIN THIS ZONE OFTEN DO NOT REQUIRE UNDERPINNING BUT MAY REQUIRE SHORING SYSTEM. HORIZONTAL AND VERTICAL PRESSURES ON EXCAVATION WALL OF NON-UNDERPINNED FOUNDATION MUST BE CONSIDERED

ZONE C (GREEN)

FOUNDATIONS WITHIN THIS ZONE USUALLY DO NOT REQUIRE UNDERPINNING OR SHORING SYSTEM

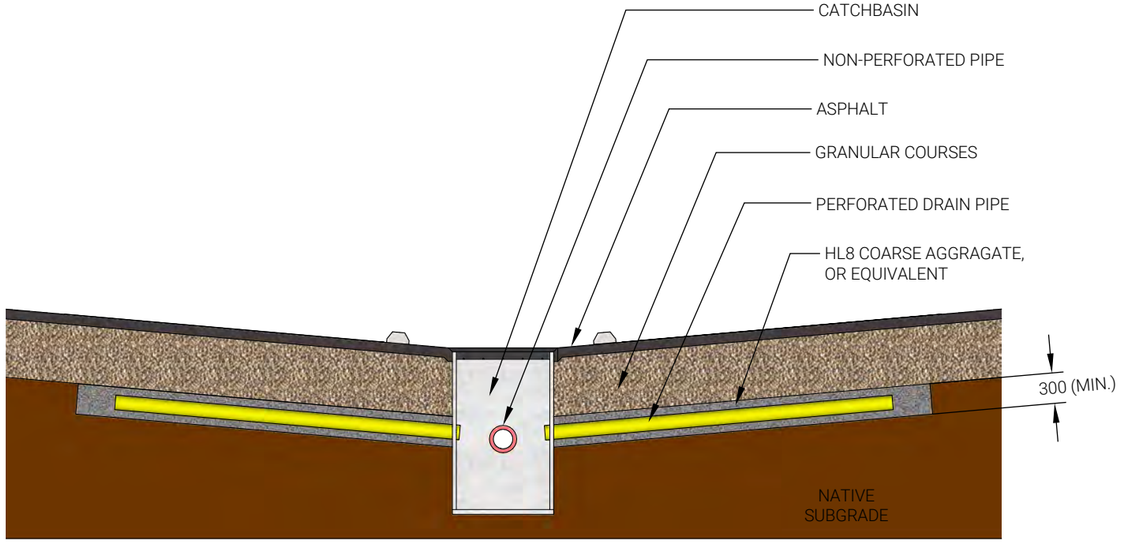
NOTES:
1. USER'S GUIDE - NBC 2005 STRUCTURAL COMMENTARIES (PART 4 OF DIVISION B) - COMMENTARY K.

GROUNDED ENGINEERING

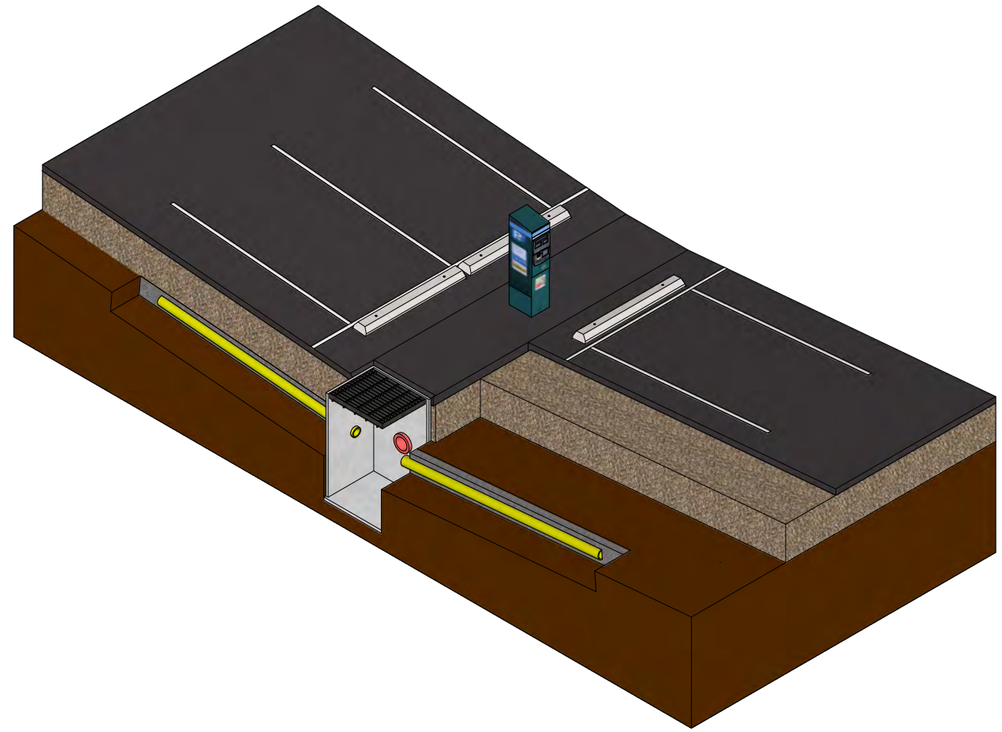
Title

EXCAVATION ZONE OF INFLUENCE GUIDELINES

OBJECTS ARE COLOR-CODED BETWEEN TWO VIEWS FOR CLARITY



SECTIONAL VIEW



ISOMETRIC

GROUNDED ENGINEERING

Title

LONGITUDINAL SUBDRAIN CONNECTION TO CATCHBASIN

APPENDIX E



1 GENERAL

These specifications are suitable for use as a technical specification only, relating to the engineering aspects as discussed in Grounded's corresponding geotechnical report for the site. If this technical specification is to be used as a tender document, the geotechnical report and this technical specification must be read in conjunction with the relevant supporting tender documents, prepared by others.

This specification must be read in conjunction with Grounded's geotechnical report for the site. Wherever there is conflicting advice, Grounded's geotechnical report for the site governs.

1.1 Description

Engineered Fill refers to earthworks (earth fill) designed and constructed with engineering inspection and testing to support foundations at SLS loads for a design net geotechnical reaction.

Site preparation for Engineered Fill operations must only be conducted under the full time inspection and testing of a Third Party Testing Agency (Testing Engineer), with review by the Geotechnical Engineer, in order to ensure adequate compaction and fill quality.

Poured concrete foundation walls must be provided with nominal reinforcing steel to provide stiffening of the foundation walls and to protect against excessive crack formation within the foundation walls.

The Engineered Fill to be constructed is shown on the Design Drawings prepared by the Design Civil Engineer and as described by these specifications. The work included in this section includes the following:

1. Topsoil stripping from the ground surface below all Engineered Fill areas,
2. Test pit excavating into the subgrade to a) investigate subgrade suitability for the support of Engineered Fill and b) observe and document any prior existing fill materials,
3. Proof-rolling of the subgrade below all Engineered Fill areas, to detect the presence and extent of unstable ground conditions,
4. Excavating and removing unstable/unacceptable subgrade materials, or the implementation of other approved subgrade stabilization measures (as required) prior to the placement of Engineered Fill,
5. Surveying of ground elevations prior to placing Engineered Fill,
6. Supply, placement, and compaction of approved clean earth as specified herein, with full time inspection and testing,
7. Surveying of ground elevations on completion of Engineered Fill placement,
8. Providing and maintaining survey layout of the Engineered Fill areas, and monitoring of ground elevations throughout the construction of Engineered Fill.

1.2 The Project Parties

1. The term Contractor shall refer to the individual or firm who will be carrying out the earthworks related to preparation and construction of Engineered Fill.
2. The term Testing Engineer shall refer to the individual or firm who will be carrying out the full time inspection and testing of the earthworks related to preparation and construction of Engineered Fill.

3. The term Geotechnical Engineer shall refer to Grounded Engineering.

4. The term Design Civil Engineer shall refer to the individual or firm who will be carrying out the Site Grading Design (pre-grading), the determination of Design Foundation Grades for the structures on the site, and the choice of lots and site areas to receive Engineered Fill.

2 MATERIALS

2.1 Definitions

1. Topsoil is the layer of naturally organic soil typically found at the ground surface and commonly in the range of about 100 to 300 mm thick.

2. Earth Fill is soil material which has been placed by humans and has not been deposited by nature over a long period of time.

3. Subgrade Soil is the “in situ” (in place) native soil beneath any earth fill and/or topsoil layer(s).

4. Disturbed Soil is soil material which was originally deposited naturally but has since been disturbed or reworked in place, usually by agriculture activities. Disturbed Soil may or may not be suitable Subgrade Soil; see our Geotechnical Report.

5. Weathered Soil is soil material which is naturally deposited but weathered in place due to its exposure to the elements. Weathered Soil may or may not be suitable Subgrade Soil; see our Geotechnical Report.

6. Engineered Fill soils must consist of clean earth materials, not excessively wet, free of organics and topsoil, free of deleterious materials such as building rubble, wood, plant materials. It is placed in thin lifts of no more than 150 mm in thickness. Cohesionless soils such as sand or gravel are the easiest to place and compact.

7. All values stated in metric units shall be considered as accurate.

3 ENGINEERED FILL DESIGN

3.1 Design Foundation Pressure

1. Engineered Fill can be expected to experience post-construction settlement on the order of 1 percent of the depth of the Engineered Fill. The time (after initial placement) over which this settlement typically occurs depends on the composition of the Engineered Fill as follows:

   a) sand or gravel soil; several days
   b) silt soil; several weeks
   c) clay or clayey soil; several months.

   The placement of Engineered Fill might also result in post-construction settlement of the natural soil.

   The timing of foundation construction must consider the post-construction settlement of the Engineered Fill and the foundation soil.

2. Unless otherwise stated, the Engineered Fill is to be placed over the entire lot area or site area.

3. Engineered Fill is to extend up to at least 1 m above the highest level of required foundation support. Typically, this can be within 1 m of the design final grades. Additional common fill can be placed over the Engineered Fill to provide protection against environmental factors such as wind, frost, precipitation, and the like.

4. An allowable design foundation pressure (net geotechnical reaction at SLS for 25 mm of settlement) of 150 kPa is typically recommended for the Engineered Fill, unless it consists of glaciolacustrine silt and clay in which case a lower design foundation pressure will need to be determined on a site specific basis. Foundations shall have minimum widths of 0.8 m for continuous strip footings, and minimum dimensions of 1 m for column footings.

5. At the foundation level, sufficient Engineered Fill shall be constructed to ensure that it extends at least 1.0 m laterally beyond the edge of any foundations, and that it extends outward within an area defined by a 1 to 1 line downward from the edge of any Engineered Fill.

6. Foundations placed on the Engineered Fill must be provided with nominal reinforcing steel for stiffening of basement foundation walls and for protection against excessive minor cracking. The reinforcing steel must consist of 2-15M bars continuous at the top of the foundation wall, and 2-15M bars continuous at the bottom of the foundation walls.

7. At the time of foundation construction, foundation excavations must be reviewed by the Geotechnical Engineer to confirm suitable bearing capacity of the Engineered Fill. The Geotechnical Engineer must inspect the foundation subgrade immediately after excavation, and must inspect the foundation subgrade immediately prior to placement of concrete for footings. The Geotechnical Engineer must also inspect the placement of reinforcing steel in the foundation walls. Written approval must be obtained from the Geotechnical Engineer prior to,

   a) placement of footing concrete, and
   b) placement of foundation wall concrete.

4 CONSTRUCTION

4.1 Survey Layout

1. The survey layout shall be carried out and maintained throughout the construction of Engineered Fill activities. A suitable layout stake shall be placed at the corners of the start and finish of every block or work area to receive Engineered Fill.

2. At least two temporary survey elevation benchmarks shall be provided for every work area to receive Engineered Fill, to assist in monitoring the level of the Engineered Fill as it is constructed. Benchmark positions may need to be reviewed by Grounded if consolidation settlement is expected to influence their elevations.

3. The ground elevations of the subgrade approved for receiving Engineered Fill shall be surveyed and recorded on a regular grid pattern. Engineered Fill shall not be placed on any work area without the written approval of the Testing Engineer.

4. The ground elevations of the Engineered Fill on each work area shall be surveyed and recorded on a regular grid pattern at the end of each day during the placement of Engineered Fill.

5. On completion of Engineered Fill construction, the final ground elevations shall be surveyed and recorded on a regular grid pattern.

4.2 Topsoil Stripping

1. The Geotechnical Engineer must observe the stripping of topsoil from the areas proposed for Engineered Fill, from start to finish.

2. Topsoil must be stripped from the entire building site area. The Geotechnical Engineer must photograph the work areas which have been suitably stripped.

4.3 Test Holes Into Subgrade

1. After topsoil has been stripped, the exposed subgrade must be investigated for the presence of old buried fill or deleterious material, which may be unsuitable (as determined by the Testing Engineer or the Geotechnical Engineer) for the support of Engineered Fill.

2. Exploratory test pits must be dug using a small backhoe, on a suitable pattern, to observe an appropriate representation of the entire site area.

3. The Testing Engineer or Geotechnical Engineer must observe the digging and backfilling of the test pits; must log the test pit stratigraphy; must obtain soil samples at maximum depth intervals of 0.3m; and must photograph each dug test pit.

4. If the test pits discover any old buried fill or deleterious materials, it must be excavated and removed from the Engineering Fill area down to undisturbed, stable native soil.

5. All test pits must be properly backfilled and compacted in thin lifts (max. 150mm thickness) to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent. The Testing Engineer or Geotechnical Engineer must observe the backfilling and compaction of the test pits.

4.4 Subgrade Proof-rolling

1. Prior to placing any Engineered Fill, the exposed subgrade must be proofrolled under the observation of the Testing Engineer.

2. If unstable subgrade conditions are encountered, the unstable subgrade must be sub-excavated. If wet site conditions exist during filling, stabilization with granular materials may be required.

4.5 Engineered Fill Placement

1. Engineered fill must not be placed without the approval of the Testing Engineer. Prior to placing any Engineered Fill, the topsoil must be stripped, the subgrade must be investigated for old buried fill or deleterious material, the subgrade must be proof-rolled, and the subgrade elevations must be surveyed.

2. Prior to the placement of Engineered Fill, the source or borrow area for the Engineered Fill must be evaluated for its suitability both geotechnically and environmentally. Samples of the proposed fill material must be obtained and tested by the Testing Engineer. The samples must be tested in a geotechnical laboratory for Standard Proctor Maximum Dry Density. Samples must also be tested per the requirements of Ontario Regulation 406/19, prior to approval of the material for use as Engineered Fill. The results of the lab testing must be approved by the Geotechnical Engineer and the results of the environmental testing must be approved by the site Qualified Person, prior to import.

3. The Engineered Fill must be placed in maximum loose lift thicknesses of 150 mm. Each lift of Engineered Fill must be compacted with a heavy roller, to at least 98 percent Standard Proctor Maximum Dry Density (SPMDD), at the optimum water content plus or minus 2 percent.

4. Field density tests must be taken by the Testing Engineer, on each lift of Engineered Fill, on each lot area. Any Engineered Fill which is tested and found to not meet the specifications, shall be either removed or, reworked and retested.

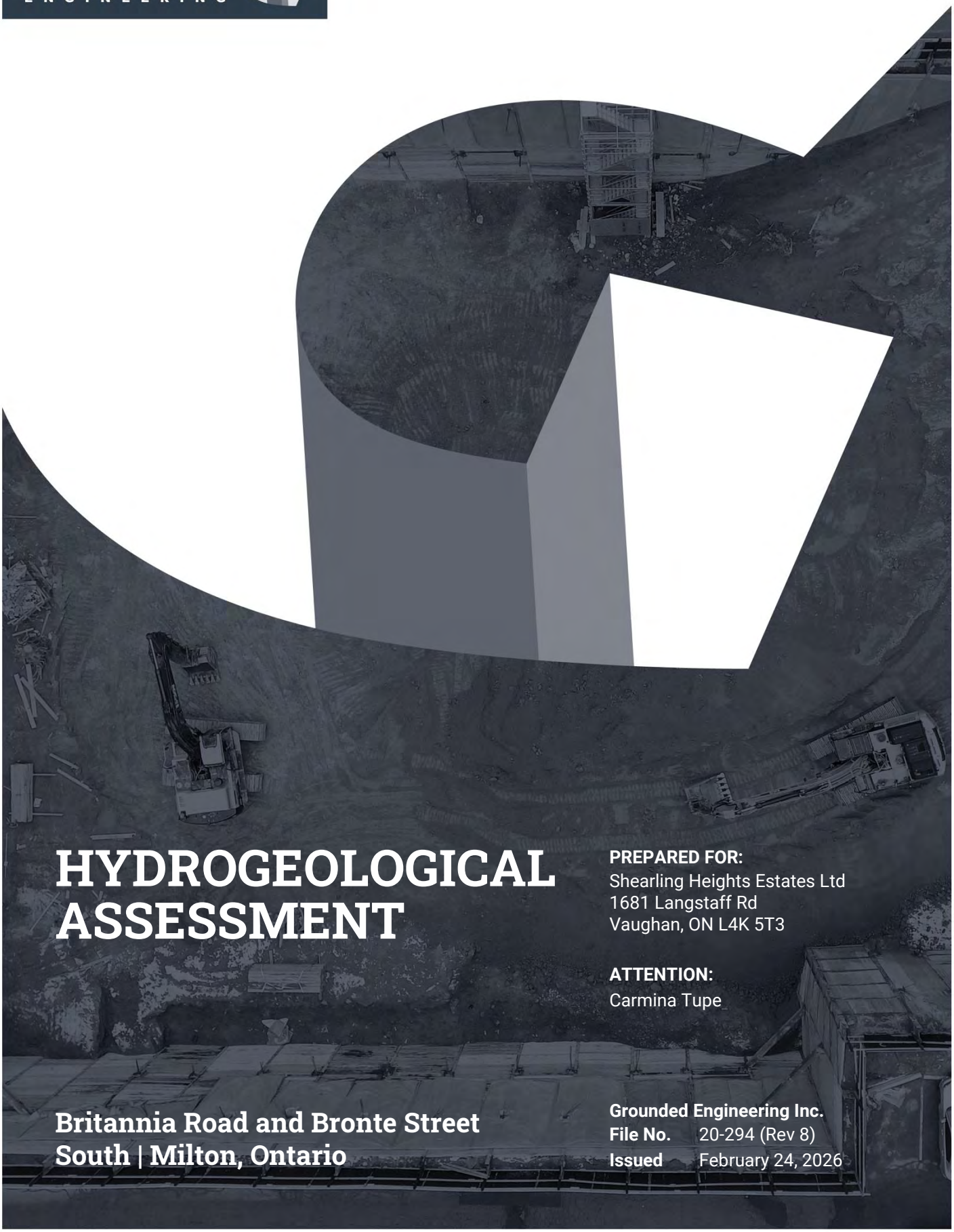
5. Engineered fill must not be placed during the period of the year when cold weather occurs, i.e. when there are freezing ambient temperatures during the daytime and overnight.

4.6 Certification

1. The Testing Engineer shall provide written summaries of the compaction and lab testing to the Geotechnical Engineer on a frequency of not less than every two weeks.

2. Upon Completion of the Engineered Fill placement the Testing Engineer will provide certification to the Geotechnical Engineer of General Compliance with this specification.

3. Upon receipt of the certification from the Testing Engineer, the Geotechnical Engineer will provide the owner with a Certificate of Engineered Fill



HYDROGEOLOGICAL ASSESSMENT

PREPARED FOR:
Shearling Heights Estates Ltd
1681 Langstaff Rd
Vaughan, ON L4K 5T3

ATTENTION:
Carmina Tupe

Britannia Road and Bronte Street South | Milton, Ontario

Grounded Engineering Inc.
File No. 20-294 (Rev 8)
Issued February 24, 2026

49 Mobile Drive, Toronto ON M4A 1H5 | (647) 264-7909 | groundedeng.ca | Grounded Engineering

TABLE OF CONTENTS

1 INTRODUCTION 4
1.1 Background 4
1.2 Scope of Work 4
2 SITE INFORMATION 5
2.1 Site Location and Description 5
2.2 Topography & Drainage 6
2.3 Regional Physiography 6
2.4 Regional Geology and Soils 6
2.5 Regional Hydrogeology 7
2.6 Regional Climate 7
2.7 Groundwater Resources 8
2.8 Subsurface Investigation 8
2.9 Groundwater Level Monitoring 9
2.10 Groundwater Quality 10
2.11 Hydraulic Conductivity 10
2.11.1 In Situ Permeability Test (Single Well Response Test) 10
2.11.2 Grain Size Analysis 11
2.12 Infiltration Testing 11
2.13 Surface Water Features 12
2.14 Review of Current Regulatory Requirements 12
3 DISCUSSION AND ANALYSIS 13
3.1 Proposed Development Plan 13
3.2 Summary of Hydrogeologic Conditions 13
3.3 Water Balance Analysis 14
3.4 Groundwater Control Requirements 15
3.5 Assessment of Potential Impact 16
3.5.1 Sewage Works 16
3.5.2 Zone of Influence (ZOI) 17
3.5.3 Natural Environment 17
3.5.4 Local Drinking Water Wells 17
3.5.5 Contamination Source 17
3.6 Mitigation Measures to Maintain Hydrogeologic Functions 18
3.6.1 Maintenance of Groundwater Recharge 18
3.6.2 Maintenance of Groundwater Transmission Pathways 18
4 CONCLUSIONS AND RECOMMENDATIONS 19
4.1 Signatures 19
5 REFERENCES 21
6 LIMITATIONS AND RESTRICTIONS 22
6.1 Report Use 22

FIGURES

Figure 1 – Site Location Plan
Figure 2A – Borehole and Monitoring Well Location Plan – Existing Conditions
Figure 2B – Borehole and Monitoring Well Location Plan – Proposed Conditions (Site Plan)
Figure 2C – Borehole and Monitoring Well Location Plan – Proposed Conditions (P1)
Figure 3 – Subsurface Profile
Figure 4 – MECP Well Location Plan

TABLES

Table 1- Groundwater Level Monitoring Summary

APPENDICES

Appendix A – Plan of Survey and Proposed Conditions Plan
Appendix B – Topographic Map
Appendix C – Source Water Protection Plan and Watershed Map
Appendix D – Well Records
Appendix E – Geological Map
Appendix F – Borehole Logs
Appendix G – Grain Size Analysis and HydrogeoSieve XL Data
Appendix H – Certificate of Analysis
Appendix I – Aquifer Response Tests
Appendix J – Infiltration Testing Analysis
Appendix K – Regulatory Information
Appendix L – Water Balance
Appendix M – Finite Element Model

1 Introduction

1.1 Background

Trinity Point Developments retained Grounded Engineering Inc. to complete a Hydrogeological Assessment for the property located on the northeast corner lot at the intersection of Britannia Road and Bronte Street South, Milton, Ontario (the Property). The site location is presented in Figure 1.

Based on the architectural drawings (reference below), the proposed development consists of 13 double-car garage townhouse blocks with basements in the northern, central, and southeastern portions of the site, and a 7-storey midrise structure with one underground parking level on the southwestern portion of the site. This hydrogeological assessment has been prepared in support of the rezoning of the property. The survey and site plan are provided in Appendix A.

A brief revision history of this hydrogeological assessment report for this site is as follows:

- Original report, labeled Revision 1 (April 19, 2021), included hydrogeological engineering for townhouse blocks with residential basements, and townhouse blocks and multiple mid-rise buildings set on top of a P2 underground parking structure
- Revision 2 (May 12, 2021), included clarifications for townhouse descriptions and updated architectural drawing references.
- Revision 3 (February 18, 2022), referenced updated architectural drawings with adjusted tower heights.
- Revision 4 (February 29, 2024), referenced updated architectural drawings with modified basement elevations.
- Revision 5 (March 14, 2024), referenced updated architectural drawings for application consistency purposes.
- Revision 6 (October 30, 2025), referenced updated architectural drawings with modified basements elevations.
- Revision 7 (January 26, 2026), referenced updated architectural drawings with a P1 underground parking structure.
- **Revision 8 (current)** of this report includes references to updated architectural drawings minor site plan changes.

The hydrogeological assessment was undertaken to evaluate hydrogeological conditions of the proposed development on the Property and to develop a plan to manage risk of potential impacts associated with activities related to the proposed land use.

1.2 Scope of Work

A summary of the scope of work is provided below:

- Background Information Review: Available background geologic and hydrogeological information for the Property and surrounding areas were reviewed. This includes a review of the Ministry of the Environment, Conservation and Parks (MECP) well records, watershed information by Conservation Halton and the Halton Region, and results of previous studies and subsurface investigations.
- Groundwater Level Monitoring: Groundwater level monitoring was conducted in order to assess the groundwater flow conditions.
- Hydraulic Conductivity Test: In-situ hydraulic conductivity tests were conducted in select monitoring wells to assess hydraulic conductivity of the strata. The underlying soils were assessed in order to determine potential dewatering requirements.
- Water Balance: A water balance and assessment of infiltration rates for existing (pre-development) and post development conditions was completed to determine the feasibility of the proposed development.

2 Site Information

2.1 Site Location and Description

The Property is approximately rectangular in shape, with a total area of 2.12 hectares. The Property is currently an empty, undeveloped field. The existing site conditions are presented in Appendix A.

The immediate neighboring areas are serviced with municipal piped water and sewage services. The surrounding areas are occupied with residential subdivisions or are empty lots.

The Property information is provided below:

Address	Britannia Road and Bronte Street South, Milton, Ontario
Area	2.12 ha
Legal Description	Block 360 on Plan 20M-1184, Part of Lot 6, Concession 2, N.S. (Trafalgar)
UTM Coordinates	E: 593376 m N: 4814565 m (UTM 17T)
Current Land Use	Vacant
Property Owner Information	Shearling Heights Estate Inc. c/o Trinity Point Developments 1681 Langstaff Rd Vaughan, ON L4K 5T3
Person who has engaged the Qualified Person to conduct the assessment	Gabriel DiMartino Senior Vice President, Development Trinity Point Developments

2.2 Topography & Drainage

The Ministry of Natural Resources and Forestry (MNRF) and Ministry of Energy, Northern Development and Mines (MENDM) database were searched to obtain topographic and geological maps of Ontario for review. The maps are provided in Appendix B and E respectively, and the information obtained is summarized below:

Records	Information
Topographic Maps	The elevation of the Property varies, ranging from 194 to 185± masl. It has multiple hills, but generally slopes downward towards to the south.
Hydrology	There is a stormwater retention pond 300 m east of the Property. The groundwater flow is expected to flow locally and regionally to the southeast, towards Lake Ontario.
Run Offs	Storm water at the Property is expected to drain towards ditches within the Property, and towards catch basins and landscaped areas on the municipal roads adjacent to the site.

2.3 Regional Physiography

From a regional perspective the Property is situated within the physiographic region known as the West St. Lawrence Lowlands. The West St. Lawrence Lowlands consist of a limestone plain (Elev. 200-250 masl) that is separated by a broad, shale lowland from broader dolomite and limestone plateau west of Lake Ontario. This plateau is bounded by the Niagara Escarpment. From the escarpment, the plateau slopes gently southwest to lakes Huron and Erie (Elev. 173 masl). Glaciation has mantled this region with several layers of glacial till (i.e., an unsorted mixture of clay, sand, etc.), the youngest forming extensive, undulating till plains, often enclosing rolling drumlin fields.

The Property is located within the Indian Creek Subwatershed of the Bronte Creek watershed according to Conservation Halton. The Property is not located within any wellhead/source protection area. The source protection area and watershed maps are presented in Appendix C.

2.4 Regional Geology and Soils

Based on the published information, the regional geology is described as below.

Records	Information
Geological Maps	Overburden: The overburden at the Property consists of fine-textured glaciolacustrine deposits comprised of silt and clay, minor sand and gravel, interbedded silt and clay and gritty, pebbly flow till, and rainout deposits. Bedrock:

Records	Information
	The bedrock at the Property is of the Queenston Formation and is comprised of shale, siltstone, minor limestone, and sandstone. Depth to Bedrock: An Ontario Well Records Search indicated that bedrock is approximately 18 m below ground surface.

It should be noted that the subsurface soil and rock conditions described above represent generalized conditions only and should not be considered site specific. The information is presented in Appendix E.

2.5 Regional Hydrogeology

The regional hydrogeologic conditions were assessed through reviewing of the water well records, geologic mapping, published information from Conservation Halton, and the results of previous investigations completed within the vicinity of the site and for the Property. Based on the information, the below hydrostratigraphic units were defined in the vicinity of the Property.

Glacial Till (Aquifer):

The till material in the region is comprised of silt and clay. It has a low permeability and conducts limited quantities of groundwater. The till is observed to extend to depths of approximately 13 m below ground surface around the property.

Queenston Formation Bedrock (Aquifer):

The Queenston Formation Bedrock generally consists of shale and minor limestone. The bedrock is typically located at depths of approximately 18 m below ground surface in the vicinity of the property. Wells installed into the bedrock typically have limited groundwater yielded.

2.6 Regional Climate

The following general climate data for the Property was obtained from Halton Region Source Protection Area Assessment Report for Indian Creek Subwatershed, dated October 2017.

Mean annual precipitation	937 mm
Mean annual evapotranspiration	637 mm
Mean annual water surplus	300 mm

It is noted that the above are average values, which are representative in a regional context. There will be seasonal and annual variations in these values. However, the average values will govern long-term groundwater recharge and discharge rates. Therefore, average values are appropriate for assessment of hydrogeologic conditions at the site.

2.7 Groundwater Resources

Private well records from the MECP well record database were reviewed for wells located within a 250 m radius of the Property. A total of 9 well records were retrieved from the well record database. The MECP well record is presented in Appendix D. A summary of data obtained is presented in the following table.

Total Number of Wells	**9**
Wells completed in Overburden	1 (11%)
Bedrock	2 (22%)
Unknown	6 (67%)
Depth Ranges	
50 ft. or less	7 (78%)
51 ft. to 100 ft.	2 (22%)
Water Use	
Monitoring/Test Holes	0 (0%)
Water Supply (domestic/public/livestock)	2 (22%)
Abandoned	5 (56%)
Unknown	2 (22%)

The above summary indicates that most local wells registered in the area likely obtained their water supply from the overburden aquifer. The wells were generally used for water supply for domestic purposes. It is unlikely that these wells installed for domestic use are still existing given that they were installed in the 1950s to 1970s, and they are now located in developed areas serviced with municipal water.

2.8 Subsurface Investigation

A subsurface investigation was conducted by Grounded Engineering Inc. at the Property in January 2021. The investigation details are described below. Borehole logs are presented in Appendix F. The location of the boreholes is shown on Figure 2A. A subsurface cross section is shown in Figure 4.

Boreholes	BH101 to BH114
Monitoring Wells	BH101, BH102, BH103, BH107, BH108, BH112, and BH114
Well Depth	5.2 to 15.5 mbgs

The stratigraphy beneath the investigated areas of the Property generally consists of the following:

Geological Units	Description
Earth Fill	Stockpiles of fill were noted across the site during the time of our investigation. At existing grade, all boreholes observed a layer of earth fill that extends to depths of 1.5 to 4.6 m below grade (Elev. 189.6 to 184.0 m). The earth fill varies in composition but generally consists of clayey silt and sandy silt with trace gravel. It contains trace rootlets, wood fragments, asphalt, and rock fragments. The earth fill is typically dark brown to dark brown with black, and moist.
Clayey Silt Till	Underlying the fill materials, boreholes encountered a native clayey silt glacial till at depths of 1.5 to 4.6 m below grade (Elev. 189.6 to 184.0 m) and extending to depths of 7.6 to 10.7 m below grade (Elev 178.9 to 176.7 m). Boreholes 101, 102, and 110 observed weathering in this deposit at a depth of 2.3 m below grade (Elev. 187.3 to 185.7 m) and extending to depths of 3.0 to 3.8 m below grade (Elev. 185.0 to 184.2 m). The clayey silt till generally consists of some sand, trace gravel, and trace rock fragments. The weathered layers are generally blackish grey to dark brown with black, and moist. The unweathered till is generally reddish brown and moist.
Sandy Silt Till	Underlying the clayey silt till, boreholes encountered a dense to very dense sandy silt glacial till at depths of 7.6 to 10.7 m below grade (Elev. 178.9 to 176.7 m). The sandy silt till consists of trace clay, trace gravel, and trace rock fragments. It is typically reddish brown and moist. In Boreholes 104 and 106, the sandy silt till transitions to a silty sand glacial till at depths of 12.2 and 10.7 m below grade (Elev. 176.8 and 177.3 m). The silty sand till consists of trace to some gravel and trace clay. It is reddish grey and wet. The sandy silt to silty sand till extended beyond the depth of investigation (Elev. 176 to 172 m).

2.9 Groundwater Level Monitoring

A total of 7 monitoring wells were installed on the Property. Groundwater level measurements were made as part of the hydrogeological assessment. A detailed table of monitoring well information is appended.

Observations pertaining to the depth of the water level and caving were made in the open boreholes immediately after completion of drilling and are reported on the borehole logs. The measured water levels along with other borehole details are presented in Appendix F. Our findings are generally consistent with the groundwater level monitoring data from nearby boreholes in the Main Sail Estates Inc. Subdivision as reported by R.J. Burnside & Associates Ltd (2015). Groundwater levels are summarized in the following table:

Groundwater levels may be influenced by climatic variations, seasonal fluctuations and presence of underground services and structures. For design purposes, the groundwater table is set at Elev. 184.3 masl. Groundwater levels measured in February 2024 showed elevated levels in BH102 and BH103. These groundwater levels are an outlier, likely caused from infiltrated storm water in the fill. The groundwater flows southwards locally.

2.10 Groundwater Quality

A groundwater sample was obtained from the monitoring wells on-site and submitted for laboratory analysis on January 27, 2025. Monitoring well construction details are provided Table 1. The sample was analyzed with respect to the Halton Sewer Discharge Criteria. The results of the groundwater testing are presented in Appendix H and summarized below.

Region of Halton Sewer Bylaw	Exceedance
Sanitary & Combined Sewer Discharge Criteria	Dissolved Sulphate (Limit 1,500 mg/L, Result 3,100 mg/L)
Storm Sewer Criteria	None

The groundwater sample **exceeded** the **Limits for Sanitary and Combined Sewer Discharge** for the parameters listed above.

The groundwater sample **met** the **Limits for Storm Sewer Discharge** for all parameters analyzed.

2.11 Hydraulic Conductivity

2.11.1 In Situ Permeability Test (Single Well Response Test)

In situ single well response tests (SWRT) were conducted on five (5) monitoring wells, to assess the hydraulic conductivity of the underlying soil. The tests were conducted by drawing down the water levels (rising head test). The monitoring wells screened in clayey silt till and fill were dry at the time of initial monitoring, and SWRTs were not conducted in them.

Data from the SWRT was analyzed using the Bouwer and Rice method (1976). The table below summarizes the results of the hydraulic conductivity testing. The analysis graphs of the tests are presented in Appendix I.

Monitoring Well	Well Screen Elevation (masl)	Screened Geological Unit	Hydraulic Conductivity (m/s)
BH101	178.9 – 175.8	Sandy Silt Till	2.2×10^{-7}
BH107	178.9 – 175.9	Sandy Silt Till	8.5×10^{-8}
BH108	175.2 – 172.2	Sandy Silt Till	3.7×10^{-7}
BH112	177.9 – 174.8	Sandy Silt Till	5.3×10^{-8}
BH114	177.4 – 174.3	Sandy Silt Till	4.4×10^{-8}

Based on the SWRT analysis, the hydraulic conductivity of the underlying sandy silt till ranges from 4.4×10^{-8} to 3.7×10^{-7} m/s.

2.11.2 Grain Size Analysis

Grain size analyses were conducted on representative soil samples using sieves and hydrometers. The analysis is summarized below and presented in Appendix G.

The hydraulic conductivities of various soil types can also be estimated from grain size analyses. An assessment of the grain sizes was conducted using the excel-based tool, HydrogeoSieve XL (*HydrogeoSieve XL ver.2.2, J.F. Devlin, University of Kansas, 2015*). HydrogeoSieve XL compares the results of the grain size analyses against fifteen (15) different analytical methods.

Given our experience in the area as well as published literature, some of the geometric means provided for the soil were biased low by one or more methods. In these instances, the values determined by these methods were excluded from the mean. The table below illustrates the hydraulic conductivity values estimated from the mean of the analytical methods where the soil met the applicable analysis criteria. The results of the analysis are also presented in Appendix G.

Sample ID	Soil Description	Applicable Analysis Methods	Hydraulic Conductivity (m/s)
BH101 SS6	Clayey silt, some sand, trace gravel	Sauerbrei, Barr & Alyamani and Sen	1.1×10^{-9}
BH101 SS11	Silt and sand, trace gravel, trace clay	Sauerbrei, Barr & Alyamani and Sen	1.4×10^{-7}
BH104 SS11	Clayey silt, sandy, trace gravel	Sauerbrei, Barr & Alyamani and Sen	3.9×10^{-9}
BH104 SS13	Silty sand, some gravel, trace clay	Sauerbrei, Barr & Alyamani and Sen	1.1×10^{-6}
BH108 SS8	Clayey silt, sandy, trace gravel	Sauerbrei, Barr & Alyamani and Sen	4.5×10^{-9}
BH109 SS11	Sandy silt, some clay, some gravel	Sauerbrei, Barr & Alyamani and Sen	1.0×10^{-8}
BH113 SS4	Clayey silt, some sand, trace gravel	Sauerbrei, Barr & Alyamani and Sen	2.8×10^{-9}
GP1*	Silt and clay, some sand, trace gravel	Sauerbrei, Barr & Alyamani and Sen	7.9×10^{-10}
GP2*	Silt and clay, some sand, trace gravel	Sauerbrei, Barr & Alyamani and Sen	5.9×10^{-10}

** indicates sample from Guelph Permeameter test attempt on December 3rd. These tests were attempted in the vicinity of tests completed on April 7th.*

Based on the in-situ testing and grain size analysis, the Property generally consists of moderate to low permeability soils and is not considered to be significant in terms of groundwater recharge.

2.12 Infiltration Testing

On April 7th, 2021, Grounded conducted two (2) in-situ infiltration tests, in two (2) locations to support a water balance, using a Guelph Permeameter. The infiltration tests were completed in unsaturated soils and carried out in accordance with the methodology recommended by the Toronto Region Conservation Authority (TRCA). The location of the infiltration testing is presented on Figure 2A. Flow rates over the duration of each test were nearly stagnant.

The results of the infiltration tests are presented in Appendix J and summarized below.

Test ID	Ground Surface Elev. (masl)	Approx. Test Depth (mbgs)	Approx. Test Elev. (masl)	Soil Description	Field Saturated Hydraulic Conductivity (m/s)	Infiltration Rate (mm/hr)	Factored Infiltration Rate (mm/hr)
GP1A	189.3	0.3	189	Silt and clay, some sand	3.53×10^{-9}	10.2	4.1
GP2A	187.8	0.3	187.5	Silt and clay, some sand	3.28×10^{-9}	10.7	4.3

* A Factor of Safety of 2.5 has been applied to the measured rates, as determined by TRCA guidelines.

Borehole logs indicate that the strata within 1.5 m of the tested layers is the same strata encountered across the site, indicating a continuous soil horizon. The mean factored infiltration rate obtained from the Guelph Permeameter test results is 4.2 mm/hr.

2.13 Surface Water Features

A site inspection was conducted to assess the presence of surface water features on/or bounding the Property. The inspection includes the following:

- Inspection of surface and groundwater interactions and associated features
- Inspection of areas of actual and potential groundwater discharge
- Inspection of swales and drainage courses
- Evidence of phreatophytic vegetation, which may indicate seasonally high groundwater levels and/or groundwater discharge and seepage

The site inspection was conducted on December 10th, 2020. The Property is hilly with some low-lying areas and shallow trenches which would allow ponding of water. There is young vegetation scattered in the low-lying areas of the Property. Surface water looks likely to flow south overland into ditches and towards catch basins on municipal roads.

2.14 Review of Current Regulatory Requirements

Current regulatory requirements associated with water supply and hydrogeology in connection with the proposed development were reviewed. This includes the review of the Conservation Halton Regulatory Plan. Relevant information is presented in Appendix K.

The Property is not located within Conservation Halton Approximate Regulatory Limits mapping area.

3 Discussion and Analysis

3.1 Proposed Development Plan

The proposed development plan is presented in Appendix A.

The proposed project consists of 13 double-car garage townhouse blocks with basements in the northern, central, and southeastern portions of the site, and a 7-storey midrise structure with one underground parking level on the southwestern portion of the site. The following summarizes the proposed land coverage areas for the development:

Land Coverage Type	Areas
Building Envelope	0.87 ha
Hard Surface Paving	1.25 ha
Landscape areas for infiltration	0 ha
Total Area	**2.12 ha**

3.2 Summary of Hydrogeologic Conditions

For design purposes, the stabilized groundwater table is at Elev. 184.8± m. The groundwater table is present in all the native soil units. The lowest (P1) FFE is at about Elev. 183.66 m. Townhouse basements vary between Elev. 186.9 and 185.6± m.

For the P1 structure, bulk and foundation excavations will extend below the design groundwater table within the clayey silt till which has a low permeability and will yield only minor seepage in the long-term. The proposed shoring at the site will consist of conventional permeable soldier piling and lagging for present purposes.

On this basis, seepage into excavations may be allowed to drain into the excavation and then controlled by a conventional sump pump arrangement. Nevertheless, delays in excavation will occur as the seepage is controlled and these delays should be anticipated in the construction schedule.

A professional dewatering contractor must be consulted to review the subsurface conditions and to design a site-specific dewatering system. It is the dewatering contractor's responsibility to assess the factual data and to provide recommendations on dewatering system requirements.

A fully drained underground structure is proposed.

The above hydrogeologic features and functions were considered in assessing the potential impact of the proposed development. This information was used to provide mitigating measures to ensure that hydrogeologic function is not adversely affected during the proposed development.

3.3 Water Balance Analysis

A water balance model was prepared for the Property to assess the distribution of rainfall run-off and infiltration for existing (pre- and post-development) conditions (Appendix L). The model is based on Halton Region Climate Data presented in Section 2.6. Typical recharge rates used in calculations were taken from MOEE Table 3 approach in the MOEE Hydrogeological Technical Information Requirement for Land Development Applications (1995). The recharge rate is representative of the soil types found across the surficial soils at the Property. The water balance for pre-and post-development conditions is summarized below:

Pre-Development Water Balance

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Existing Landscaped/Bare Areas	21,233	19,895	13,525	2,123	4,247

The post-development water balance accounts for hard-surfaced areas created by buildings and pavements. The areas for the proposed land types are determined from architectural drawings provided by Graziani + Corazza Architects Inc.

Post-Development Water Balance

	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Proposed Development	11,520	10,795	-	-	10,795
Hard Surface Paving	8,383	7,854	-	-	7,854
Landscaped Area for Infiltration	1,330	1,246	-	133	266

The volume of surface water run-off available from residential roof tops was calculated to be 9,715 m^3. This volume of water will be available as a resource, to maintain groundwater recharge and function. The volume of roof run-off available is compared to the difference in infiltration volume between pre-development and post-development, as noted below:

Potential Post-Development Infiltration Deficit (m^3)	Volume of Roof Run-off Available (m^3)
1,990	9,715

The water balance calculation indicated that there is a decrease in infiltration post-development. A minimum of 20% volume of roof run-off will need to be captured to match the pre-development infiltration rates at the Property. Storm water management and mitigation measures are required to maintain the overall infiltration rates at the Property.

3.4 Groundwater Control Requirements

The finite element model (FEM) modelling method was used to conduct numerical analysis for groundwater seepage and to determine the short-term (construction) and long-term dewatering requirements.

The following design considerations and values have been incorporated into the numerical modelling:

- For midrise building foundations made on the clayey silt till, positive dewatering is not anticipated. Dewatering will be limited to sump and pumps for excavations made within the clayey silt till.
- The townhouse bulk excavation is above the groundwater table, with foundation excavations in clayey silt till which will not yield free-flowing water. These are excluded from the finite element model as they will yield negligible groundwater seepage. In the short term, the townhouse basements are assumed to only yield rainfall.
- In the long term, the townhouse basements are above the groundwater table, and are assumed to only collect infiltrated stormwater.
- A Factor of Safety of 3 was used for all groundwater seepage volume calculations.

The FEM results are summarized below and presented in Appendix M.

Short Term (Construction) Groundwater Quantity – Safety Factor of 3.0 Used					
Groundwater Seepage		**Design Rainfall Event (32 mm)**		**Total Daily Water Takings**	
L/day	**L/min**	**L/day**	**L/min**	**L/day**	**L/min**
25,000	17.4	285,000	197.9	310,000	215.3

As required by Ontario Regulation 63/16, a plan for discharge must consider the conveyance of stormwater from a 100-year storm. The additional volume that will be generated in the occurrence of a 100-year storm event (94 mm) is approximately 1,071,000 L/day.

The groundwater control system is required to be designed by a dewatering contractor. The groundwater must be dewatered prior to excavation in order to maintain a stable working base in the excavation.

Mitigation measures based on dewatering and infiltration requirements as per the MECP are discussed in Section 3.6.

Long Term (Permanent) Groundwater Quantity – Safety Factor of 3 Used					
Groundwater Seepage		Infiltration Design Rainfall Event (32 mm)		Total Daily Water Takings	
L/day	L/min	L/day	L/min	L/day	L/min
25,000	17.4	7,000	4.9	32,000	22.2

Regulatory Requirements	
Environmental Activity and Sector Registry (EASR) Posting	Required
Short Term Permit to Take Water (PTTW)	Not Required
Long Term Permit to Take Water (PTTW)	Not Required

3.5 Assessment of Potential Impact

The Property will be serviced with municipal piped water, storm sewers, and sanitary sewers. The proposed development does not pose significant concern with respect to potential impact to groundwater quality in the area.

3.5.1 Sewage Works

Negative impacts to sewage works may occur in terms of the quantity or quality of the groundwater discharged. This report provided the estimated quantity of the water that will be discharged. However, this report does not speak to the sewer capacities. The sewer capacity analysis is provided under a separate cover by the civil consultant.

The quality of the proposed groundwater discharge is discussed in Section 2.10. As noted, the groundwater sampled exceeded the Halton Limits for Sanitary and Combined Sewer Discharge.

Additional treatment will be required before the water can be discharged to sanitary and combined sewers to avoid impacts to sewage works by groundwater quality.

3.5.2 Zone of Influence (ZOI)

The Zone of Influence (ZOI) with respect to groundwater was calculated based on the estimated groundwater taking rate and the hydraulic conductivity of the unit which water will be taken at the Property.

The ZOI was calculated using the Sichardt equation below.

$$R_0 = 3000(\Delta H)\sqrt{K}$$

ΔH	=	dewatering thickness (m)
K	=	hydraulic conductivity (m/s)
R_0	=	radius of influence (m)

The ZOI with respect to groundwater seepage at the site is summarized as follows.

Zone of Influence (ZOI)		
	Short Term (Construction), m	**Long Term (Permanent), m**
Pile and Lagging Scenario	2.5	2.5

3.5.3 Natural Environment

There are no natural waterbodies within the ZOI that will be affected by the proposed construction dewatering or permanent drainage. Any groundwater which will be taken from the site will be discharged (if required) into the City's sewer systems and not into any natural water body. As such, there will be no impact to the natural environment caused by the water takings at the site.

3.5.4 Local Drinking Water Wells

The site and surrounding area are provided with municipal piped water and sewer supply. Historic wells dating as far back as the 1950s are likely no longer in use due to the more recent developments in the area. As such, there is no anticipated impact to drinking water wells.

3.5.5 Contamination Source

The site and immediate surrounding area currently consist of residential areas. These lands are not anticipated to be a source of potential contamination and are not expected to provide an Area of Potential Environmental Concern for the site. As such, the pumping of groundwater at the site is not anticipated to facilitate the movement of potential contaminants onto the site.

3.6 Mitigation Measures to Maintain Hydrogeologic Functions

3.6.1 Maintenance of Groundwater Recharge

The existing groundwater recharge rate at the Property is approximately 100 mm/a. This recharge occurs in a broad diffuse manner over the entire site. Mitigation measures are available to maintain recharge rates. There are no wetlands in the immediate vicinity of the Property. The nearest water body is located approximately 0.3 km to the northeast. There will be no direct surface runoff from the Property to the water body.

Appropriate low-impact development (LID) techniques which can be applied include maintenance of overall groundwater recharge across the site area. In order to mitigate the infiltration deficit for the Property, an effort should be made to implement LID methods. There is a surplus of water available following development to maintain groundwater recharge and function. The following LID measures can be considered for the proposed development, but the soil infiltration rate of 4.2 mm/hr, as determined by infiltration testing, is low and may limit their feasibility:

- Stormwater planters adjacent to proposed buildings
- Extended tree pits
- Bio-swales or rain gardens within the landscaped areas of the Property

Infiltration rates can potentially be improved by permeable pavers on sidewalks, driveways, and/or roadways. Note that the overall effectiveness of permeable pavers will still be limited by the low infiltration rate of the native soils.

3.6.2 Maintenance of Groundwater Transmission Pathways

As previously indicated, the soils present on the Property are of low permeabilities. No significant groundwater flow or transmission zones were encountered on the Property. However, the overall continuity of the groundwater flow at the Property should be maintained, where practical. Generally, the groundwater transmission pathways can be maintained through the following means:

- Bedding materials beneath underground services may serve as a subdrain to collect and convey groundwater. To prevent drainage of groundwater along bedding materials, clay trench plugs should be provided at all manhole locations in order to cut off the granular bedding.
- The excavation of any underground services or utilities across permeable layers may interrupt the groundwater flow. It is recommended that trench backfilling be carried out with materials that are similar to the materials that have been excavated.

Groundwater flow may occur into the open shallow excavations if more permeable deposits (such as sand or gravel) are encountered. Localized groundwater flow into shallow excavations can be controlled by utilizing localized sumps and pumps at the base of the excavations. In addition to this, it is recommended that any excavations should be staged or constructed in such a manner to avoid the collection of overland drainage.

4 Conclusions and Recommendations

The Property, currently an empty field, is proposed development includes constructing 13 double-car garage townhouse blocks with basements) in the northern, middle, and southeastern portions of the site, and a 7-storey midrise structure with one underground parking level on the southwestern portion of the site. The following conclusions and recommendations are made in consideration of the proposed development:

- The site is characterized by earth fill overlying a native clayey silt till overlying a sandy silt to silty sand till. These deposits generally have low permeability. As such, they generally cause slower recharge rates and groundwater movement.
- Groundwater control, including positive dewatering or relief wells, will be required mitigate basal heave and maintain the integrity of the subgrade for foundation and slab-on-grade support.
- In order to maintain groundwater recharge for the Property, LID methods should be implemented. There is a surplus of water available following development to maintain groundwater recharge and function. Approximately 20% of roof runoff would need to be captured to match pre-development infiltration.
- Treatment of groundwater is required before it can be discharged to Halton Sanitary and Combined Sewers.

4.1 Signatures

The Hydrogeological Assessment was conducted by Matthew Garcia, P.Eng., under the supervision of Matthew Bielaski, P.Eng., QP $_{\text{RA-ESA}}$.

We trust that this report meets your requirements at present.

For and on behalf of our team,

GROUNDED ENGINEERING



Matthew Garcia, P.Eng.
Project Engineer



Matthew Bielaski, P.Eng., QP RA-ESA
Principal

5 References

1. ArcGIS. *WebMap*. https://www.arcgis.com/home/webmap/viewer.html Accessed: January 2021.
2. Conservation Halton. Regulation Limits Search. https://camaps.maps.arcgis.com/apps/webappviewer/index.html?id=a2928bf280194294a4027111f8ff284a Accessed: March 8, 2021.
3. Conservation Halton Map Gallery. *Conservation Halton Watersheds*. 2018. Retrieved from: https://conservationhalton-camaps.opendata.arcgis.com/pages/map-gallery Accessed: March 8, 2021.
4. Graziani + Corazza Architects Inc. *Shearling Heights Architectural Drawings*. February 13, 2026.
5. Grounded Engineering Inc. *Geotechnical Engineering Report, Britannia Road and Bronte Street South, Milton*. File No. 20-294 (Rev 5). October 29, 2025.
6. Halton-Hamilton Source Protection Region. *Assessment Report for the Halton Region Source Protection Area Version 3.5*. October 12, 2017.
7. Ministry of Environment, Conservation and Parks. *Source Protection Information Atlas*. Retrieved from : https://www.gisapplication.lrc.gov.on.ca/SourceWaterProtection/Index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-US Accessed: March 8, 2021.
8. Natural Resources Canada. *The Atlas of Canada - Toporama*. Retrieved from https://atlas.gc.ca/toporama/en/index.html Accessed: March 8, 2021.
9. Ontario. *Well Records - Water Well Information System*. Accessed: March 8, 2021.
10. Ontario Geological Survey. 2000. *Quaternary Geology, Seamless Coverage of the Province of Ontario*. Ontario Geological Survey. Data Set 14 - Revised.
11. Ontario Geological Survey. 2006. *Bedrock Topography and Overburden Thickness Mapping, Southern Ontario*. Miscellaneous Release - Data 207.
12. Ontario Geological Survey. 2010. *Surficial Geology of Southern Ontario*. Ontario Geological Survey. Miscellaneous Release - Data 128-REV.
13. Ontario MOEE. *MOEE Hydrogelogical Technical Information Requirements for Land Development Applications*. April 1995.
14. R-PE Surveying Ltd. *Survey and Topography of Block 360 Plan 20M-1184*. Job No. 20-096. June 11, 2020.
15. WSP Canada Inc. *Hydrogeological Investigation Main Sail Estates Subdivision, Milton, Toronto*. Project No. 151-62866-00. May 26, 2016.

6 Limitations and Restrictions

The assessment should not be considered a comprehensive investigation that eliminates all risks of encountering environmental problems. The information presented in this report is based on information collected during the completion of the Hydrogeological Assessment by Grounded Engineering Inc. It was based on the conditions on the Hydrogeological Assessment at the time of the site inspection supplemented by a review of historical information to assess the environmental conditions regarding the Property.

There is no warranty expressed or implied by this report regarding the hydrogeologic conditions of the Property. Professional judgement was exercised in gathering and analysing information collected by our staff, as well as that submitted by others. The conclusions presented are the product of professional care and competence and cannot be construed as an absolute guarantee.

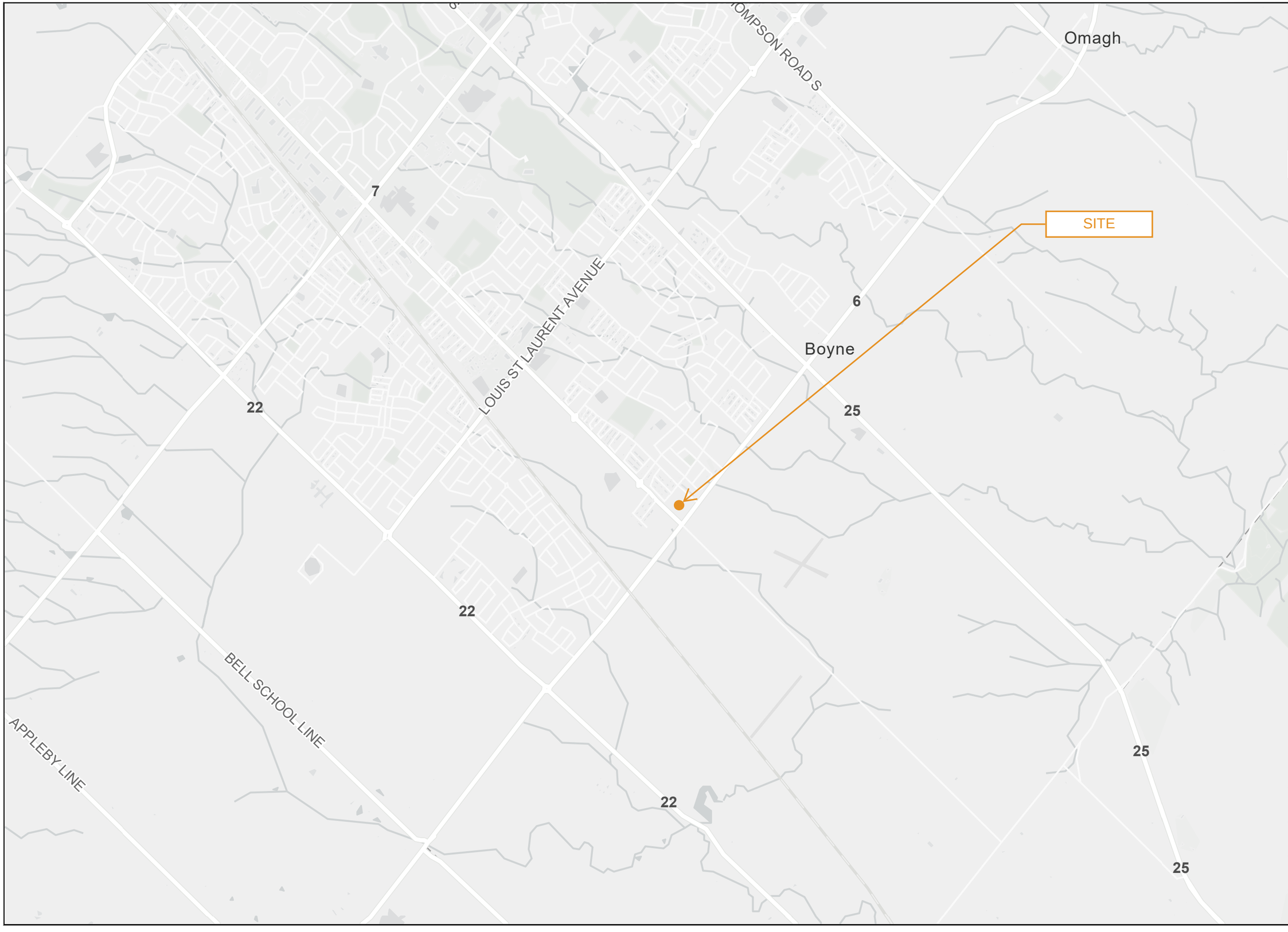
If new information regarding the hydrogeological condition of the Property is identified during future work, or outstanding responses from regulatory agencies indicate outstanding issues on file with respect to the Property, Grounded Engineering Inc. should be notified so that we may re-evaluate the findings of this assessment and provide amendments.

6.1 Report Use

The authorized users of this report are Shearling Heights Estates Ltd, for whom this report has been prepared. Grounded Engineering Inc. maintains the copyright and ownership of this document. Reproduction of this report in any format or medium requires explicit prior authorization from Grounded Engineering Inc.

FIGURES





GROUNDED ENGINEERING

49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- APPROXIMATE SITE LOCATION

Note

Reference

ArcGIS. 2024

Project

BRITANNIA ROAD AND BRONTE STREET SOUTH, MILTON, ONTARIO

Figure Title

SITE LOCATION PLAN

North

TRUE PROJECT

Date

FEBRUARY 2026

Scale

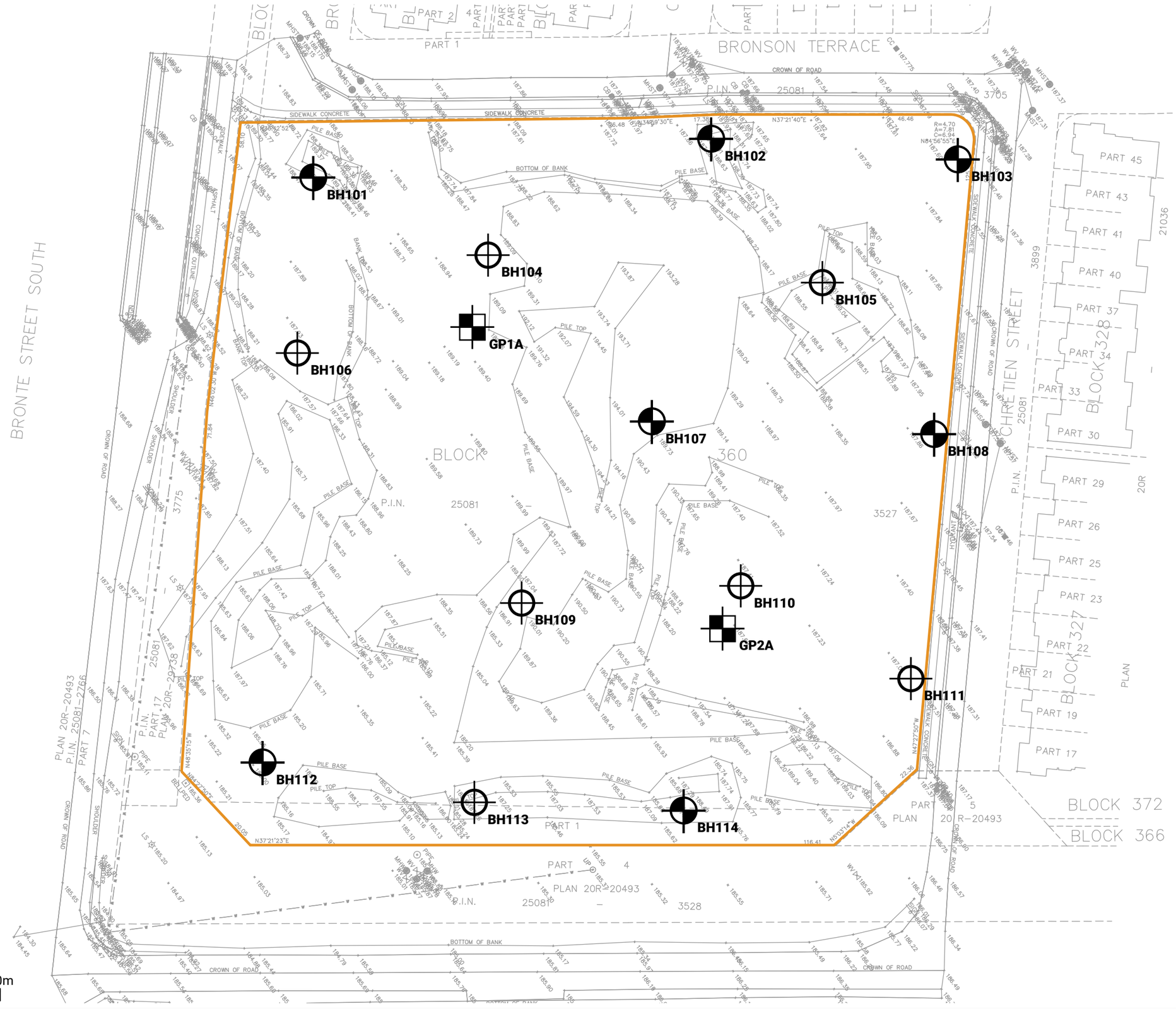
NTS

Job No

20-294

Figure No

FIGURE 1



GROUNDED ENGINEERING

49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- MONITORING WELL/BOREHOLE BY GROUNDED
- GUELPH PERMEAMETER TEST

Note
Boreholes were drilled in 2021, prior to the time that the shown site survey was completed.

Reference
Site Survey, prepared by 4Sight Utility Engineers (Completed May 2024).

Project
BRITANNIA ROAD AND BRONTE STREET SOUTH, MILTON, ONTARIO

Figure Title
BOREHOLE AND MONITORING WELL LOCATION PLAN EXISTING CONDITIONS

North
TRUE
PROJECT

Date
FEBRUARY 2026

Scale
AS INDICATED

Job No
20-294

Figure No
FIGURE 2A



GROUNDED ENGINEERING

49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- MONITORING WELL/BOREHOLE BY GROUNDED

Note

Overlaid on Site Plan architectural drawing.

Reference

Architectural Drawings, "Trinity Point-Shearling Heights"; Project 2268.24, dated February 13, 2026 (Draft for SPA), prepared by Graziani + Corazza Architects.

Project

BRITANNIA ROAD AND BRONTE STREET SOUTH, MILTON, ONTARIO

Figure Title

BOREHOLE AND MONITORING WELL LOCATION PLAN
PROPOSED CONDITIONS (SITE PLAN)

North

TRUE
PROJECT

Date

FEBRUARY 2026

Scale

AS INDICATED

Job No

20-294

Figure No

FIGURE 2B



0m 15m 30m

GROUNDED ENGINEERING
49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- MONITORING WELL/BOREHOLE BY GROUNDED
- APPROXIMATE EXTENT OF MIDRISE ABOVE

Note
Overlaid on P1 architectural drawing. Excludes unfinished townhouse basements.

Reference
Architectural Drawings, "Trinity Point-Shearling Heights", Project 2268.24, dated February 13, 2026 (Draft for SPA), prepared by Graziani + Corazza Architects.

Project
BRITANNIA ROAD AND BRONTE STREET SOUTH, MILTON, ONTARIO

Figure Title
BOREHOLE AND MONITORING WELL LOCATION PLAN PROPOSED CONDITIONS (P1)

North
TRUE
PROJECT

Date
FEBRUARY 2026

Scale
AS INDICATED

Job No
20-294

Figure No
FIGURE 2C

PROPOSED MIDRISE BUILDING

PROPOSED TOWNHOUSE BUILDING BLOCKS

P1 FFE
183.66± m

TOWNHOUSE BASEMENT
ELEV. VARIES
186.9 to 185.6± m

GWT
184.8± m

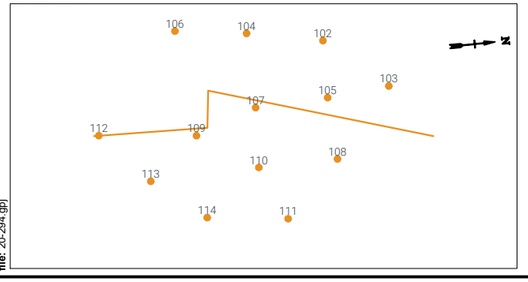
BH 112 BH 113 BH 109 BH 114 BH 110 BH 101 BH 106 BH 104 BH 107 BH 102 BH 111 BH 105 BH 108 BH 103

Elevation (m)

192 190 188 186 184 182 180 178 176 174 172 170

Boreholes Equally Spaced

SITE MAP



file: 20-294.gpj

BOREHOLE STRATIGRAPHY LEGEND

- Fill
- Silty Sand Till
- Clayey Silt
- Clayey Silt Till
- Sandy Silt Till

GROUNDED ENGINEERING

49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- FILL
- GRAVELS (gravel to gravelly sand)
- SILT TO SAND (not till)
- COHESIONLESS TILLS
- COHESIVE SOILS (clayey silt to clay, incl. tills)
- DISTURBED/REWORKED/ORGANIC

BH 101 BOREHOLES BY GROUNDED

T-BH7 BOREHOLES BY OTHERS

- water level, unstabilized
- water level, stabilized (latest)
- water level, stabilized (highest)

Project

BRITANNIA RD AND BRONTE ST S, MILTON ON

Figure Title

SUBSURFACE PROFILE

Date

FEBRUARY 2026

Scale

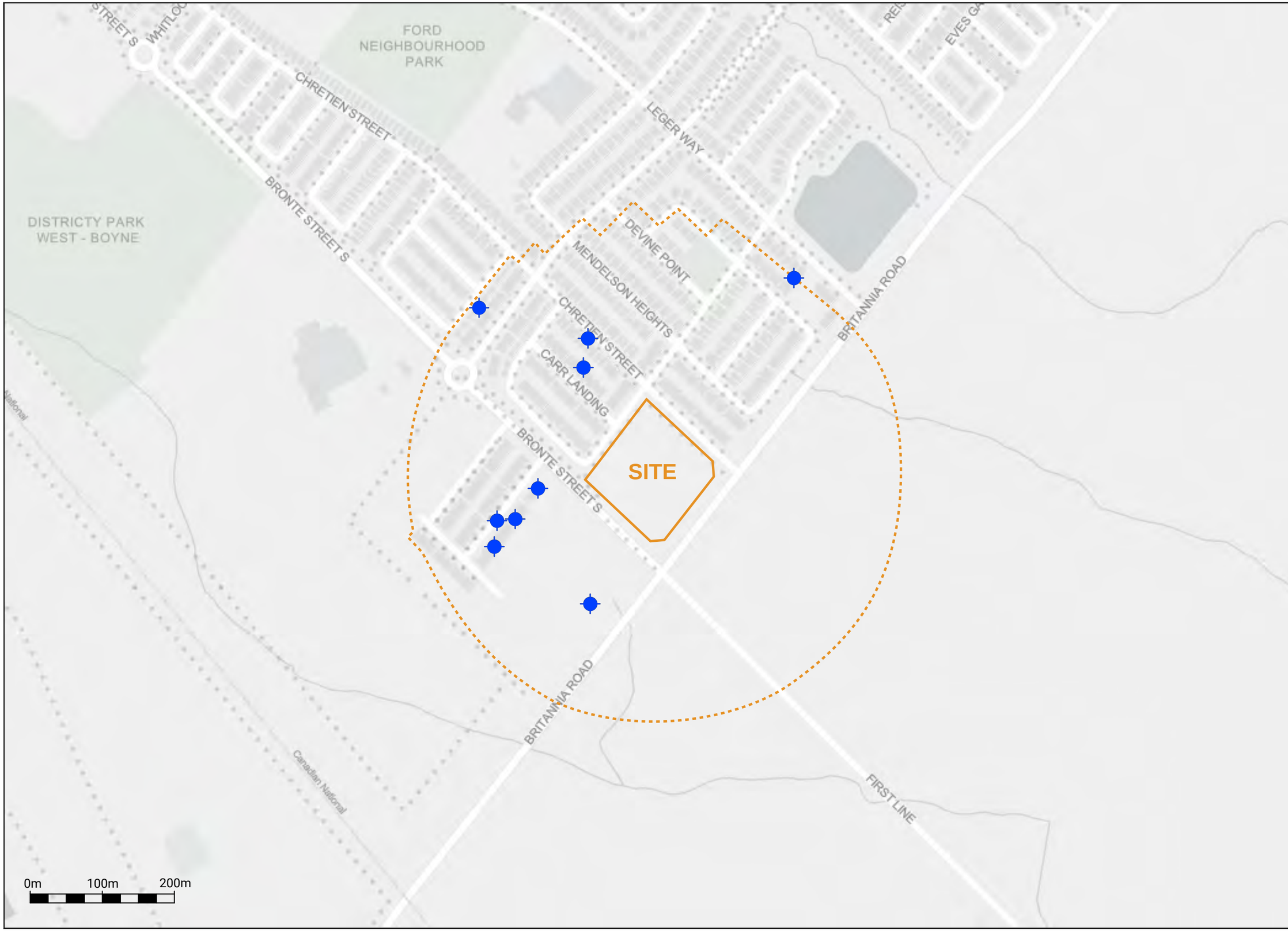
AS INDICATED

Job No

20-294

Figure No

FIGURE 3



GROUNDED
ENGINEERING
49 MOBILE DRIVE, TORONTO, ONT., M4A 1H5
www.groundedeng.ca

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- STUDY AREA (250 m)
- MECP WELL LOCATIONS

Note

Reference
ArcGIS. 2021.

Project
BRITANNIA ROAD AND BRONTE STREET SOUTH, MILTON, ONTARIO

Figure Title
MECP WELL LOCATION PLAN

North
TRUE
PROJECT

Date
FEBRUARY 2026

Scale
AS INDICATED

Job No
20-294

Figure No
FIGURE 4

APPENDIX A



PLAN OF SURVEY AND TOPOGRAPHY OF BLOCK 360 PLAN 20M–1184 TOWN OF MILTON REGIONAL MUNICIPALITY OF HALTON

SCALE 1:500

10m 5m 0m 10m 20m 30m 40metres

R–PE SURVEYING LTD., O.L.S.

METRIC

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.



NOTES

■	DENOTES MONUMENT FOUND
□	DENOTES MONUMENT SET
SIB	DENOTES STANDARD IRON BAR
SSIB	DENOTES SHORT STANDARD IRON BAR
P.I.N.	DENOTES PROPERTY IDENTIFIER NUMBER
PL	DENOTES PLAN 20M–1184
CALC'D	DENOTES CALCULATED FROM PL
MEAS	DENOTES MEASURED
(RPE)	DENOTES R–PE SURVEYING LTD, O.L.S.
(950)	DENOTES CUNNINGHAM McCONNELL LIMITED O.L.S.
(WIT)	DENOTES WITNESS
MH	DENOTES MANHOLE
MHSA	DENOTES MANHOLE SANITARY
MHST	DENOTES MANHOLE STORM
CB	DENOTES CATCH BASIN
UP	DENOTES UTILITY POLE
LS	DENOTES LAMP STANDARD
ORP	DENOTES OBSERVED REFERENCE POINT
–W–	DENOTES OVERHEAD WIRE
INV.	DENOTES INVERT ELEVATION

DUE TO ONGOING CONSTRUCTION ACTIVITY, ALL SET MONUMENTS ARE SHORT STANDARD IRON BARS.

INTEGRATION NOTE

BEARINGS ARE UTM GRID, DERIVED FROM OBSERVED REFERENCE POINTS Ⓐ AND Ⓑ USING CANNET REAL TIME NETWORK (RTN) No. 20120110009, UTM ZONE 17, NAD83 (CSRS) (CBNV6–2010.0)

COORDINATES ARE UTM ZONE 17, NAD83 (CSRS) (CBNV6–2010.0), TO URBAN ACCURACY PER SEC. 14 (2) OF O.REG. 216/10, AND CANNOT, IN THEMSELVES, BE USED TO RE–ESTABLISH CORNERS OR BOUNDARIES SHOWN ON THIS PLAN.

POINT ID	NORTHING	EASTING
ORP Ⓐ	4814683.22	593364.08
ORP Ⓑ	4814483.34	593388.21
RTN 20120110009	4801633.53	597944.45

DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.999679.

BENCHMARK NOTE

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO MTO FIRST ORDER VERTICAL BENCHMARK NUMBER 00819828155 HAVING AN ORTHOMETRIC ELEVATION OF 185.351 METRES. ELEVATIONS ARE REFERENCED TO THE CANADIAN GEODETIC VERTICAL DATUM OF 1928, 1978 ADJUSTMENT (CGVD–1928:1978).

BENCHMARK LOCATED ON A CONCRETE CULVERT UNDER BRITANNIA RD W, 1.4 KM WEST OF HWY 25, 75.4 M WEST OF FIRST LINE RD, 6.3 M NORTH OF THE CENTRELINE OF BRITTANIA RD W (HALTON REG RD 6). TABLET IS SET VERTICALLY IN THE TOP OF NORTH END OF SAID CULVERT, 33 CM SOUTH OF NORTH END OF CULVERT, 32 CM WEST OF EAST FACE OF CULVERT.

SURVEYOR'S CERTIFICATE

I CERTIFY THAT:

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON THE 8TH DAY OF JUNE , 2020

DATE JUNE 11TH , 2020

S. GOONEWARDENA
ONTARIO LAND SURVEYOR

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
2119245

THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR
In accordance with Regulation 1026, Section 29(3).

R–PE SURVEYING LTD.
ONTARIO LAND SURVEYORS
643 Chrislea Road, Suite 7
Woodbridge, Ontario L4L 8A3
Tel.(416)635–5000 Fax (416)635–5001
Tel.(905)264–0881 Fax (905)264–2099
Website: www.r–pe.ca

DRAWN: J.W. CHECKED: S.G.
JOB No. 20–096 CAD FILE No. 20096tp01a

© R–PE SURVEYING LTD. O.L.S. 2020.



THIS DRAWING, AS AN INSTRUMENT OF SERVICE, IS PROVIDED BY AND IS THE PROPERTY OF GRAZIANI + CORAZZA ARCHITECTS INC. THE CONTRACTOR MUST VERIFY AND ACCEPT RESPONSIBILITY FOR ALL DIMENSIONS AND CONDITIONS ON SITE AND MUST NOTIFY GRAZIANI + CORAZZA ARCHITECTS INC. OF ANY VARIATIONS FROM THE SUPPLIED INFORMATION. GRAZIANI + CORAZZA ARCHITECTS INC. IS NOT RESPONSIBLE FOR THE ACCURACY OF SURVEY, STRUCTURAL, MECHANICAL, ELECTRICAL, AND OTHER ENGINEERING INFORMATION SHOWN ON THIS DRAWING. REFER TO THE APPROPRIATE ENGINEERING DRAWINGS BEFORE PROCEEDING WITH THE WORK. CONSTRUCTION MUST CONFORM TO ALL APPLICABLE CODES AND REQUIREMENTS OF THE AUTHORITIES HAVING JURISDICTION. UNLESS OTHERWISE NOTED, NO INVESTIGATION HAS BEEN UNDERTAKEN OR REPORTED ON BY THIS OFFICE IN REGARDS TO THE ENVIRONMENTAL CONDITION OF THIS SITE.

THIS DRAWING IS NOT TO BE SCALED. ALL ARCHITECTURAL SYMBOLS INDICATED ON THIS DRAWING ARE GRAPHIC REPRESENTATIONS ONLY.

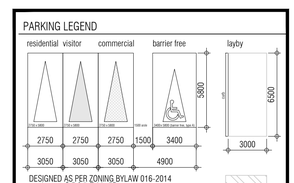
CONDITIONS FOR ELECTRONIC INFORMATION TRANSFER:

ELECTRONIC INFORMATION IS SUPPLIED TO THE OTHER ASSOCIATED FIRMS TO ASSIST THEM IN THE EXECUTION OF THEIR WORK / REVIEW. THE RECIPIENT FIRMS MUST DETERMINE THE COMPLETENESS / APPROPRIATENESS / RELEVANCE OF THE INFORMATION IN RESPECT TO THEIR PARTICULAR RESPONSIBILITY.

GRAZIANI + CORAZZA ARCHITECTS INC. SHALL NOT BE RESPONSIBLE FOR:
1. ERRORS, OMISSIONS, INCOMPLETENESS DUE TO LOSS OF INFORMATION IN WHOLE OR PART WHEN INFORMATION IS TRANSFERRED.
2. TRANSMISSION OF ANY VIRUS OR DAMAGE TO THE RECEIVING ELECTRONIC SYSTEM WHEN INFORMATION IS TRANSFERRED.

01. FEB.XX.2026 issued for SPA EC

PARKING LEGEND

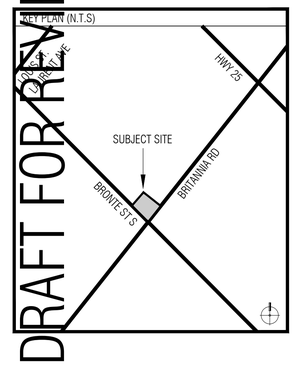


DESIGNED AS PER ZONING BYLAW 016-2014
section no. S.5.8 i) Table 5D

CLEAR PATH

DRAFT FOR REVIEW

KEY PLAN (N.T.S)



ISSUED FOR REVISIONS

GRAZIANI + CORAZZA ARCHITECTS
8400 JANE STREET, BUILDING D, SUITE 300 CONCORD, ONTARIO L4K 4L8
T 905.795.2601 F 905.795.2644 WWW.GC-ARCHITECTS.COM

Proposed Mixed-Use Development

Shearling Heights

Trinity Point Developments

Milton Ontario

PROJECT ARCHITECT:	E.CORAZZA
ASSISTANT DESIGNER:	K.KORB
DRAWN BY:	K.K + A.P
CHECKED BY:	D.BIASE
PLOT DATE:	FEB.13.2026
JOB #	2268.24

Site Plan

1:500 A101

TITLEBLOCK SIZE: 610 x 900

TABLE 1



TABLE 1:
GROUNDWATER LEVEL MONITORING SUMMARY
BRITANNIA RD AND BRONTE ST S, MILTON, ON

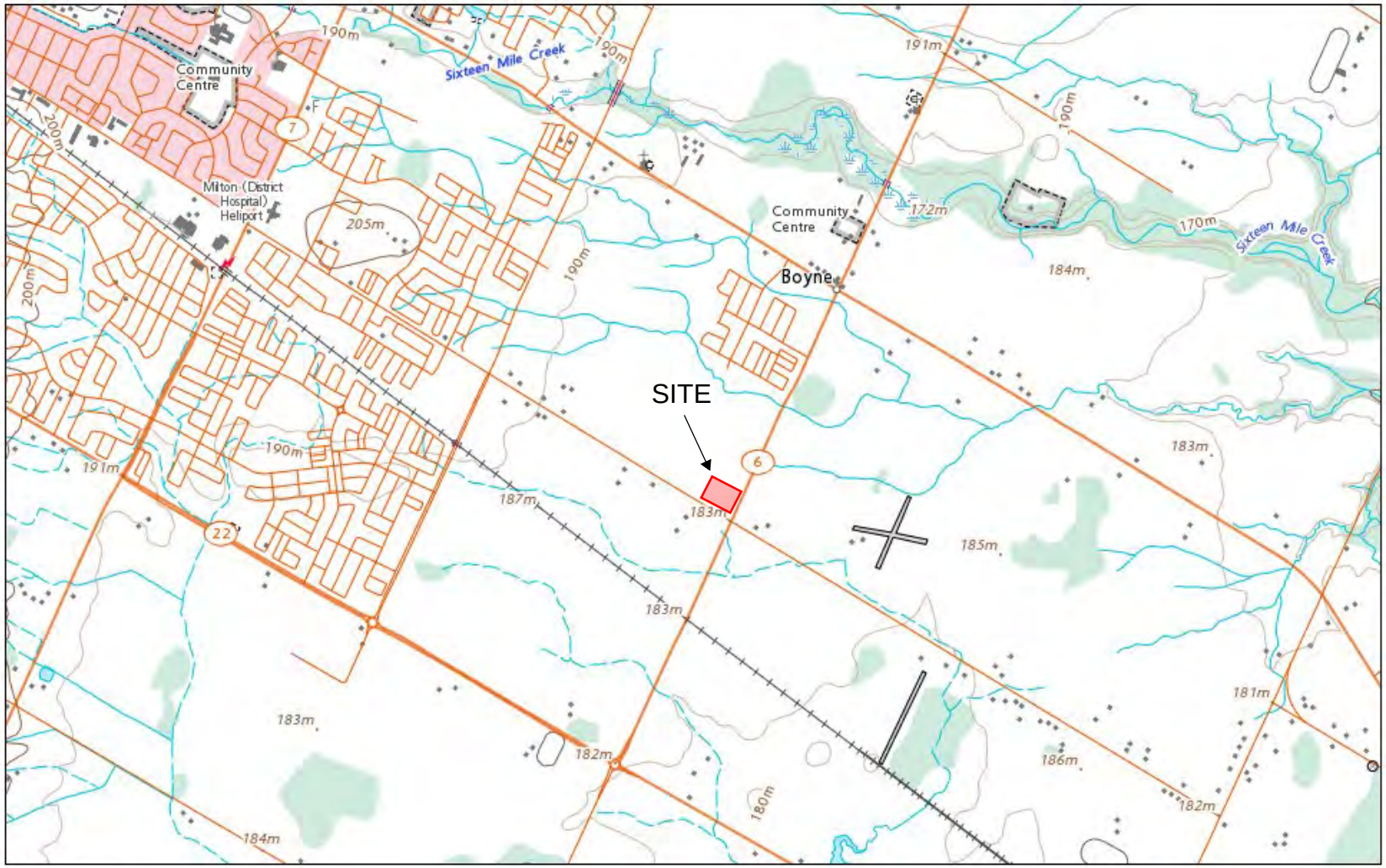
Well ID	Ground Surface Elev. (masl)	Well Screen Interval		Soil Strata	Grounded Engineering																Minimum Elev. (Lowest)		Maximum Elev. (Highest)		Seasonal Fluctuation	Number of Monitoring Events
					Jan. 12, 2021		Jan. 29, 2021		Mar. 02, 2021		Mar. 28, 2021		Apr. 18, 2021		Feb. 16, 2024		Jan. 20, 2025		July 21, 2025							
		(mbgs)	(masl)		(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(±m)	
BH101	188.0	9.1 - 12.2	178.9 - 175.8	Sandy Silt Till	3.7	184.3	3.7	184.3	3.8	184.2	3.7	184.3	3.6	184.4	3.6	184.4	3.9	184.1	NA	-	3.9	184.1	3.6	184.4	0.2	7
BH102	188.0	1.5 - 4.6	186.5 - 183.4	Clayey Silt Till / Fill	dry	dry	dry	dry	dry	dry	4.1	183.9	4.0	184.0	0.6	187.4	0.6	187.4	2.7	185.3	4.1	183.9	0.6	187.4	3.5	8
BH103	187.6	1.5 - 4.6	186.1 - 183.0	Clayey Silt Till / Fill	dry	dry	4.2	183.4	3.1	184.5	2.9	184.7	2.9	184.7	2.1	185.5	1.9	185.7	1.8	185.9	4.2	183.4	1.8	185.9	2.4	8
BH107	189.6	10.7 - 13.7	178.9 - 175.9	Sandy Silt Till	4.4*	185.2*	5.4	184.2	5.5	184.1	5.5	184.1	5.4	184.2	5.4	184.3	4.8	184.8	NA	-	5.5	184.1	4.8	184.8	0.7	7
BH108	187.4	12.2 - 15.2	175.2 - 172.2	Sandy Silt Till	3.4	184.0	3.5	183.9	3.6	183.8	3.6	183.8	3.5	183.9	3.3	184.1	NA	-	NA	-	3.6	183.8	3.4	184.0	0.2	6
BH112	185.5	7.6 - 10.7	177.9 - 174.8	Sandy Silt Till	1.8	183.7	1.6	183.9	1.7	183.8	1.6	183.9	1.6	183.9	1.5	184.0	NA	-	NA	-	1.8	183.7	1.6	183.9	0.2	6
BH114	186.5	9.1 - 12.2	177.4 - 174.3	Sandy Silt Till	7.6	178.9	2.6	183.9	2.7	183.8	2.6	183.9	2.6	184.0	2.4	184.1	2.4	184.1	2.8	183.7	7.6	178.9	2.4	184.1	5.2	8

mbgs = metres below existing ground surface
masl = metres above sea level
* = unstabilized groundwater level
NA = not available, unable to access monitoring well

APPENDIX B



Toporama



March 8, 2021

1:30,000

0 0.25 0.5 1 mi

0 0.4 0.8 1.6 km

Natural Resources Canada Ressources naturelles Canada

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2021.
© Sa Majesté la Reine du chef du Canada, représentée par le ministre de Ressources naturelles Canada, 2021.

Canada

APPENDIX C



Source Water Protection Map



Legend

- Source Protection Areas
- Issue Contributing Areas
- WHPA Groundwater Under Direct Influence (WHPA-E)
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Intake Protection Zone 1
- Event Based Areas
- Intake Protection Zone 2
- Assessment Parcel

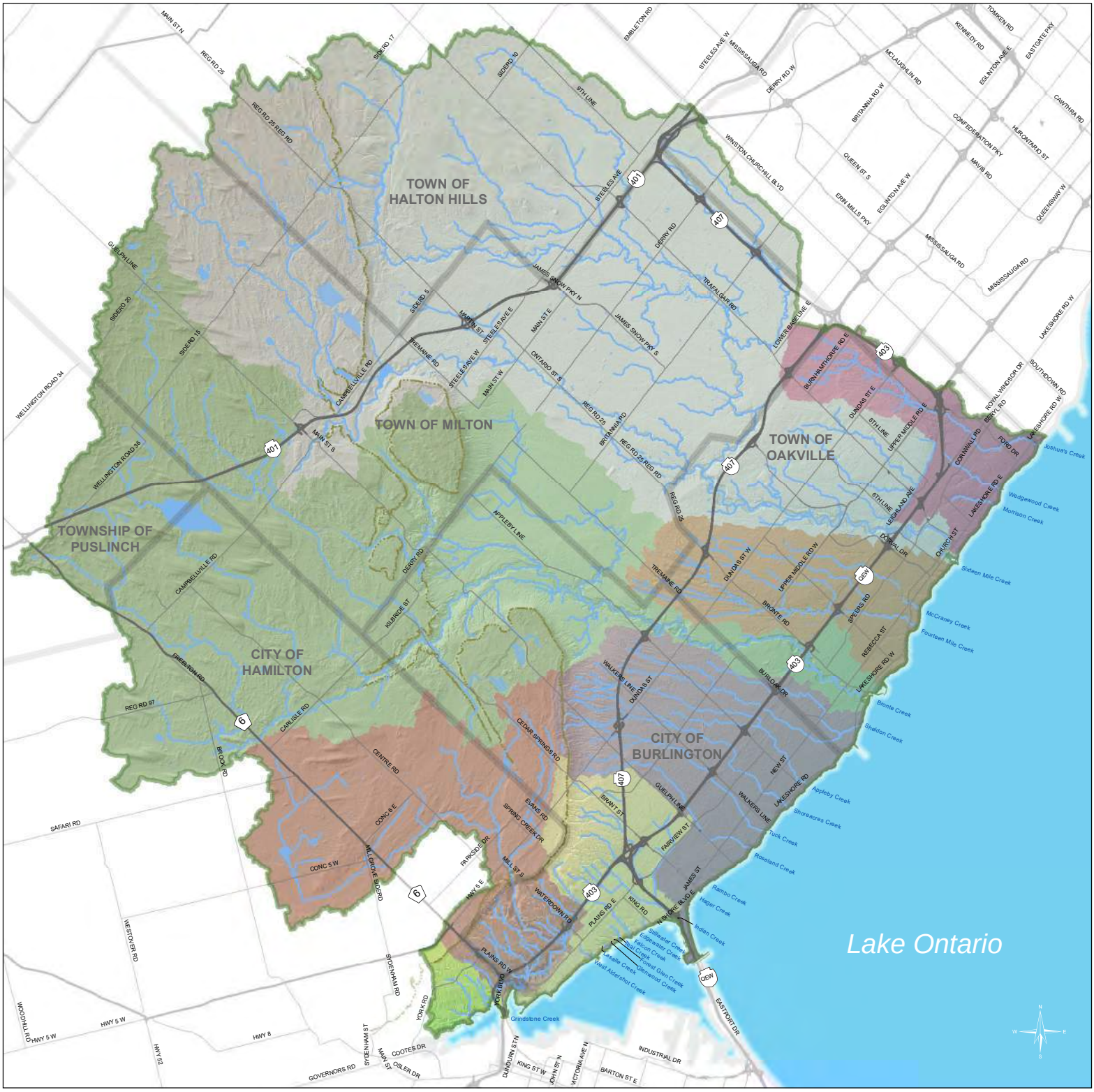
This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

© Queen's Printer for Ontario, 2021

Map Created: 3/8/2021
Map Center: 43.47829 N, -79.84506 W

Conservation Halton Watersheds



Legend

- Expressway / Highway
- Arterial Roads
- Creeks & Waterbodies
- Niagara Escarpment
- Municipal Boundaries

Watersheds

- Bronte Creek
- Burlington Urban Creeks
- Grindstone Creek
- North Cootes Paradise
- North Shore
- Oakville East Urban Creeks
- Oakville West Urban Creeks
- Sixteen Mile Creek

0 1 2 4 6 8 10 Kilometres

This mapping was produced by Conservation Halton and should be used for information purposes only. Data sources used in its production are of varying quality and accuracy and all boundaries should be considered approximate. Conservation Halton disclaims all responsibility for any and all mistakes or inaccuracies in the information and further disclaims all liability for loss or damage, which may result from the use of this information. This map is protected by copyright (© 2018) and may not be reproduced without written consent from Conservation Halton. Any copying, redistribution or republication the content thereof, for commercial gain is strictly prohibited. Produced by Conservation Halton GISP

APPENDIX D



Water Well Records

March 8, 2021
5:19:56 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
MILTON TOWN (TRAFALG	17 593214 4814553 W	2015-11 7472						7255182 (Z224514) A	
MILTON TOWN (TRAFALG NS 01 006	17 593157 4814506 W	2016-03 7556	36			DO		7262912 (Z226393) A	
MILTON TOWN (TRAFALG NS 01 006	17 593214 4814554 W	2015-11 7472						7255120 (Z224515) A156026 A	
MILTON TOWN (TRAFALG NS 01 006	17 593154 4814473 W	1970-02 3637	30	FR 0016 FR 0025	10/40//:	DO		2803312 ()	BRWN LOAM 0001 BRWN CLAY 0016 GREY CLAY STNS 0021 BRWN MSND GRVL SILT 0041
MILTON TOWN (TRAFALG NS 01 006	17 593180 4814511 W	1955-01 1642	6 6	MN 0072	18//1/:	DO		2802463 ()	BLUE CLAY 0024 CLAY MSND STNS 0062 RED SHLE 0073
MILTON TOWN (TRAFALG NS 01 006	17 593288 4814397 W	1955-01 1642	6 6	MN 0084	18//0/:	NU		2802462 () A	BLUE CLAY 0022 CLAY MSND GRVL 0060 RED SHLE 0085
MILTON TOWN (TRAFALG NS 02 006	17 593129 4814802 W	2012-04 7407	24 42		1///:	DO		7180170 (Z136890) A	
MILTON TOWN (TRAFALG NS 02 006	17 593274 4814722 W	2010-01 7219	30			NU		7141644 (Z107398) A093064 A	0005
MILTON TOWN (TRAFALG NS 02 006	17 593276 4814759 W	2010-01 7219	30		0///:	NU		7141643 (Z107402) A093065 A	

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX E




Ontario
Ontario Geological Survey
8b Fine-textured glaciolacustrine deposits
silt and clay, minor sand and gravel
Interbedded silt and clay and gritty, pebbly flow till and rainout deposits
8b Fine-textured glaciolacustrine deposits
Dee Way
Zdest Crescent
Cochrane Terrace
Monaghan Crescent
Leger Way
Louis Saint Laurent Ave
McDougall Crossing
Speers Cl
Rotiss Cl
Biasotti Cl
Potts Terrace
Scott Blvd
Castle Way
Etherington Way
Seivert Pl
Savoline Blvd
Sales Ct
Whaley Way
Pickersgill Crescent
Cedric Terrace
Durno Ct
Dymott Ave
Tremaine Rd
Regional Road 25
Regional Road 22
Pan Am Blvd
Bronte St S
6
1 Line
© 2021 Google
1086 m
Google Earth
1985
Imagery Date: 6/8/2018 17 T 593389.23 m E 4814840.68 m N elev 186 m eye alt 4.88 km


Ontario
Ontario Geological Survey
55a
Shale, limestone, dolostone, siltstone
Queenston Formation
Martin St
Main St E
Bronte St N
Ontario St S
Ferguson Dr
James Snow Pkwy
Sixth Line
Tremaine Rd
Main St W
Pringle Ave
Scott Blvd
Laurier Ave
Yates Dr
Thompson Rd S
Steeles Ave W
Farmstead
Fourth Line
Bronte St S
Britannia Rd W
Regional Road 22
Britannia Rd
Appleby Line
1 Line
Lower Base Line
Regional Road 25
Express Toll Route (Toll road)
407
Guelph Line
2674 m
© 2021 Google
Google Earth
1985
17 T 588189.22 m E 4819167.97 m N elev 210 m eye alt 11.87 km

APPENDIX F



BOREHOLE LOG TERMINOLOGY

GROUNDED ENGINEERING

SAMPLING/TESTING METHODS

SS: split spoon sample

AS: auger sample

GS: grab sample

FV: shear vane

DP: direct push

PMT: pressuremeter test

ST: shelby tube

CORE: soil coring

RUN: rock coring

SYMBOLS & ABBREVIATIONS

MC: moisture content

LL: liquid limit

PL: plastic limit

NP: non-plastic

γ: soil unit weight (bulk)

G_s: specific gravity

S_u: undrained shear strength

▽ unstabilized water level

▼ water level measurement

▼ highest water level measurement

ENVIRONMENTAL SAMPLES

M&I: metals and inorganic parameters

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

VOC: volatile organic compound

PHC: petroleum hydrocarbon

BTEX: benzene, toluene, ethylbenzene and xylene

PPM: parts per million

FIELD MOISTURE (based on tactile inspection)

DRY: no observable pore water

MOIST: inferred pore water, not observable (i.e. grey, cool, etc.)

WET: visible pore water

COHESIONLESS

Relative Density	N-Value
Very Loose	<4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	>50

COHESIVE

Consistency	N-Value	Su (kPa)
Very Soft	<2	<12
Soft	2 - 4	12 - 25
Firm	4 - 8	25 - 50
Stiff	8 - 15	50 - 100
Very Stiff	15 - 30	100 - 200
Hard	>30	>200

COMPOSITION

Term	% by weight
trace silt	<10
some silt	10 - 20
silt***y***	20 - 35
sand ***and*** silt	>35

ASTM STANDARDS

ASTM D1586 Standard Penetration Test (SPT)
Driving a 51 mm O.D. split-barrel sampler ("split spoon") into soil with a 63.5 kg weight free falling 760 mm. The blows required to drive the split spoon 300 mm ("bpf") after an initial penetration of 150 mm is referred to as the N-Value.

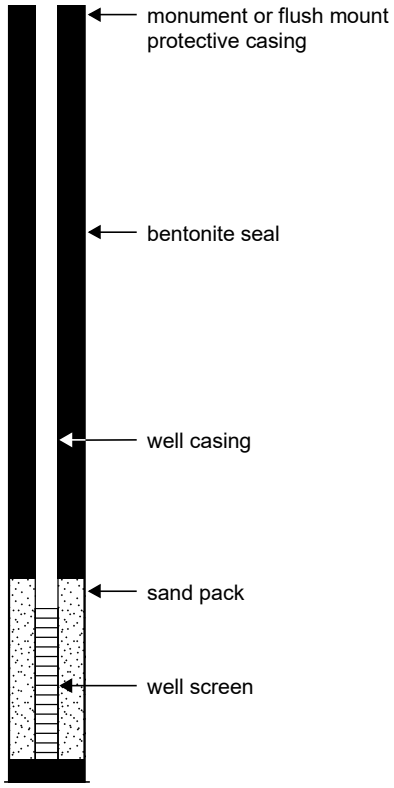
ASTM D3441 Cone Penetration Test (CPT)
Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm^2 into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

ASTM D2573 Field Vane Test (FVT)
Pushing a four blade vane into soil and rotating it from the surface to determine the torque required to shear a cylindrical surface with the vane. The torque is converted to the shear strength of the soil using a limit equilibrium analysis.

ASTM D1587 Shelby Tubes (ST)
Pushing a thin-walled metal tube into the in-situ soil at the bottom of a borehole, removing the tube and sealing the ends to prevent soil movement or changes in moisture content for the purposes of extracting a relatively undisturbed sample.

ASTM D4719 Pressuremeter Test (PMT)
Place an inflatable cylindrical probe into a pre-drilled hole and expanding it while measuring the change in volume and pressure in the probe. It is inflated under either equal pressure increments or equal volume increments. This provides the stress-strain response of the soil.

WELL LEGEND



GROUNDED ENGINEERING

Date Started : Jan 8, 2021
Position : E: 593287, N: 4814571 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 101

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	sample number	sample type	SPT N-value
188.0	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace rootlets, very soft to firm, brown, wet		1	SS	2
	...at 0.8 m, moist		2	SS	3
	...at 1.5 m, trace organics, trace plastic fragments, brown with dark brown		3	SS	8
185.7 / 2.3	**CLAYEY SILT**, trace sand, trace gravel, trace rootlets, stiff, blackish grey, moist (WEATHERED)		4	SS	10
			5	SS	11
184.2 / 3.8	**CLAYEY SILT**, some sand, trace gravel, very stiff, reddish brown, moist (GLACIAL TILL)		6	SS	24
			7	SS	25
			8	SS	20
	...at 7.6 m, grey, stiff		9	SS	12
178.9 / 9.1	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, very dense, reddish brown (GLACIAL TILL)		10	SS	75 / 225mm
	...at 10.7 m, silt and sand, wet		11	SS	50 / 125mm
175.7 / 12.3			12	SS	50 / 100mm

hollow stem augers OD=215 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 188 187 186 185 184 183 182 181 180 179 178 177 176

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR	SA	SI	CL
3	15	47	35
5	38	51	6

END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	3.7	184.3
Jan 29, 2021	3.7	184.3
Mar 2, 2021	3.8	184.2
Mar 28, 2021	3.7	184.3
Apr 18, 2021	3.6	184.4
Feb 16, 2024	3.6	184.4
Jan 20, 2025	3.9	184.1

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

BOREHOLE LOG 102

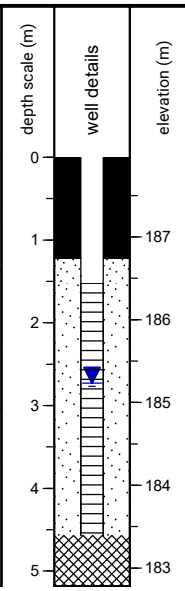
Date Started : Jan 4, 2021
Position : E: 593329, N: 4814637 (UTM 17T)
Elev. Datum : Geodetic

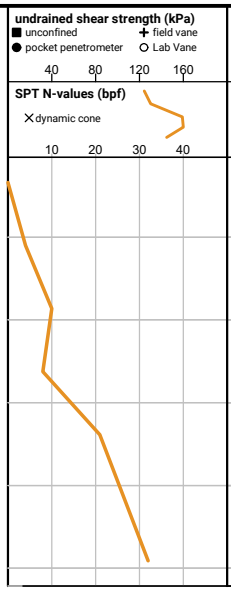
File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

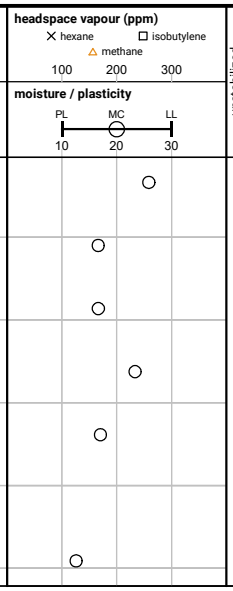
drill method : G78

elev depth (m)	description	graphic log	sample number	sample type	SPT N-value
188.0	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace rootlets, very soft, dark brown, moist		1	SS	0
	...at 0.8 m, firm		2	SS	4
	...at 1.5 m, stiff		3	SS	10
185.7					
2.3	**CLAYEY SILT**, trace sand, trace gravel, trace rootlets, stiff, blackish grey, moist (WEATHERED)		4	SS	8
185.0					
3.0	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, reddish brown, moist (GLACIAL TILL)		5	SS	21
	...at 4.6 m, trace rock fragments		6	SS	32
182.8					
5.2	**END OF BOREHOLE**				

hollow stem augers OD=215 mm







unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	dry	n/a
Jan 29, 2021	dry	n/a
Mar 2, 2021	dry	n/a
Mar 28, 2021	4.1	183.9
Apr 18, 2021	4.0	184.0
Feb 16, 2024	0.6	187.4
Jan 20, 2025	0.6	187.4
Jul 21, 2025	2.7	185.3

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

Date Started : Jan 4, 2021
Position : E: 593361, N: 4814675 (UTM 17T)
Elev. Datum : Geodetic

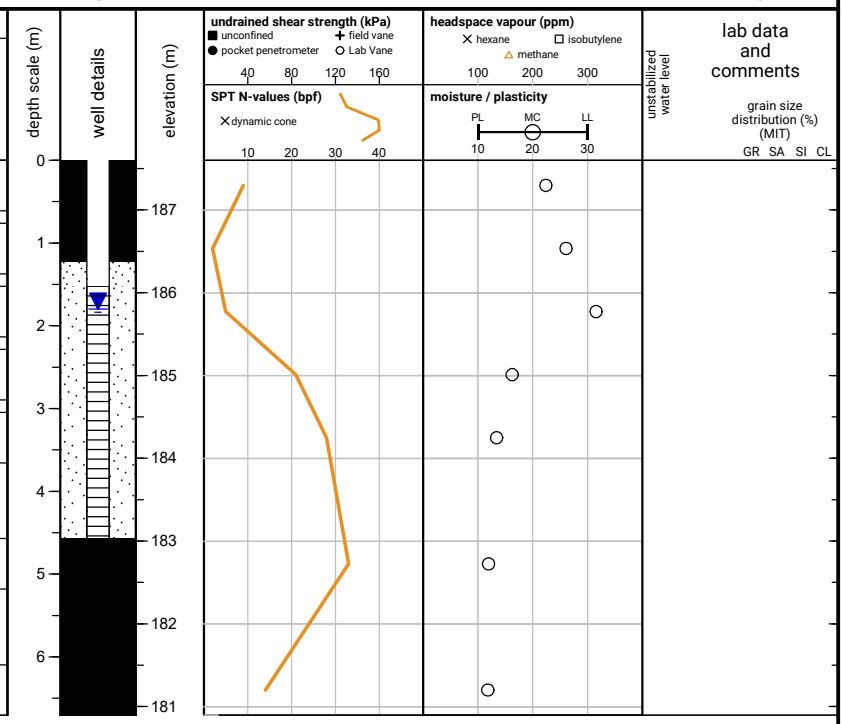
BOREHOLE LOG 103

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
187.6	**GROUND SURFACE**				
	FILL, clayey silt, trace gravel, trace rock fragments, trace organics, stiff to very stiff, dark brown, moist		1	SS	9
			2	SS	2
			3	SS	5
185.3					
2.3	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		4	SS	21
	...at 3.0 m, trace rock fragments, reddish brown		5	SS	28
			6	SS	33
	...at 6.1 m, dark brown, stiff		7	SS	14
180.9					
6.7	**END OF BOREHOLE**				

hollow stem augers OD=215 mm



Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	dry	n/a
Jan 29, 2021	4.2	183.4
Mar 2, 2021	3.1	184.5
Mar 28, 2021	2.9	184.7
Apr 18, 2021	2.9	184.7
Feb 16, 2024	2.1	185.5
Jan 20, 2025	1.9	185.7
Jul 21, 2025	1.8	185.8

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 6, 2021
Position : E: 593319, N: 4814589 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 104

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
189.0	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, very stiff, dark brown with black, moist		1	SS	19
	...at 0.8 m, firm		2	SS	8
	...at 1.5 m, trace rootlets		3	SS	6
			4	SS	5
			5	SS	4
	...at 3.8 m, very stiff		6	SS	18
184.4 / 4.6	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, reddish brown, moist (GLACIAL TILL)		7	SS	20
			8	SS	38
	...at 6.1 m, trace rock fragments		9	SS	37
			10	SS	14
	...at 9.1 m, sandy		11	SS	10
178.3 / 10.7	**SANDY SILT**, trace clay, trace gravel, very dense, greyish brown, moist (GLACIAL TILL)		12	SS	64 / 225mm
176.8 / 12.2	**SILTY SAND**, some gravel, trace rock fragments, trace clay, compact, reddish grey, wet (GLACIAL TILL)		13	SS	24
175.2 / 13.8	...at 13.7 m, very dense		14	SS	50 / 100mm

END OF BOREHOLE

Borehole was dry upon completion of drilling.

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13

well details

elevation (m): 189 188 187 186 185 184 183 182 181 180 179 178 177 176

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR	SA	SI	CL
8	25	41	26
15	57	25	3

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 4, 2021
Position : E: 593365, N: 4814636 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 105

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
188.4	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace wood fragments, organic odour, soft to stiff, dark brown with black, moist		1	SS	5
			2	SS	2
			3	SS	8
	...at 2.3 m, trace rootlets		4	SS	12
185.4					
3.0	**CLAYEY SILT**, trace sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		5	SS	15
	...at 3.8 m, trace rock fragments, reddish brown		6	SS	28
			7	SS	26
183.2					
5.2	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

Borehole was dry upon completion of drilling.

depth scale (m): 0, 1, 2, 3, 4, 5

well details

elevation (m): 188, 187, 186, 185, 184

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 7, 2021
Position : E: 593313, N: 4814544 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 106

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : GT8

elev / depth (m)	description	graphic log	number	type	SPT N-value
188.0	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, soft to very stiff, brown, moist		1	SS	5
			2	SS	2
	...at 1.5 m, trace rootlets		3	SS	3
	...at 2.3 m, trace wood fragments		4	SS	6
	...at 3.0 m, trace rock fragments, dark grey		5	SS	10
184.2 / 3.8	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, stiff, reddish brown, moist (GLACIAL TILL)		6	SS	9
	...at 4.6 m, hard		7	SS	30
			8	SS	35
	...at 6.1 m, very stiff		9	SS	25
	...at 7.6 m, greyish brown, stiff		10	SS	9
178.9 / 9.1	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, dense, reddish brown, moist (GLACIAL TILL)		11	SS	36
177.3 / 10.7	**SILTY SAND**, trace clay, trace gravel, very dense, brown, wet (GLACIAL TILL)		12	SS	50 / 125mm
175.6 / 12.4			13	SS	50 / 50mm

hollow stem augers OD=215 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 188 187 186 185 184 183 182 181 180 179 178 177 176

undrained shear strength (kPa)
■ unconfined ✚ field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

END OF BOREHOLE

Borehole was dry upon completion of drilling.

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 6, 2021
Position : E: 593366, N: 4814590 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 107

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
189.6	**GROUND SURFACE**				
	FILL, sandy silt, trace gravel, trace organics, trace rootlets, organic odour, compact, dark brown with black, moist		1	SS	16
			2	SS	10
			3	SS	5
187.3 / 2.3	**CLAYEY SILT**, some sand, trace gravel, trace rootlets, organic odour, stiff to very stiff, dark brown with black, moist (WEATHERED)		4	SS	12
			5	SS	20
			6	SS	16
185.0 / 4.6	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff to hard, reddish brown, moist (GLACIAL TILL)		7	SS	22
			8	SS	27
			9	SS	32
			10	SS	16
			11	SS	10
178.9 / 10.7	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		12	SS	42
			13	SS	50 / 125mm
175.8 / 13.8	**END OF BOREHOLE**		14	SS	50 / 75mm

hollow stem augers OD=215 mm

depth scale (m) | well details | elevation (m)

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160
SPT N-values (bpf): dynamic cone; 10 20 30 40
headspace vapour (ppm): hexane, isobutylene, methane; 100 200 300
moisture / plasticity: PL MC LL; 10 20 30
unstabilized water level

lab data and comments
grain size distribution (%) (MIT) GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	4.4	185.2
Jan 29, 2021	5.4	184.2
Mar 2, 2021	5.5	184.1
Mar 28, 2021	5.5	184.1
Apr 18, 2021	5.4	184.2
Feb 16, 2024	5.4	184.2
Jan 20, 2025	4.8	184.8

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

BOREHOLE LOG 108

Date Started : Jan 4, 2021
Position : E: 593404, N: 4814638 (UTM 17T)
Elev. Datum : Geodetic

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

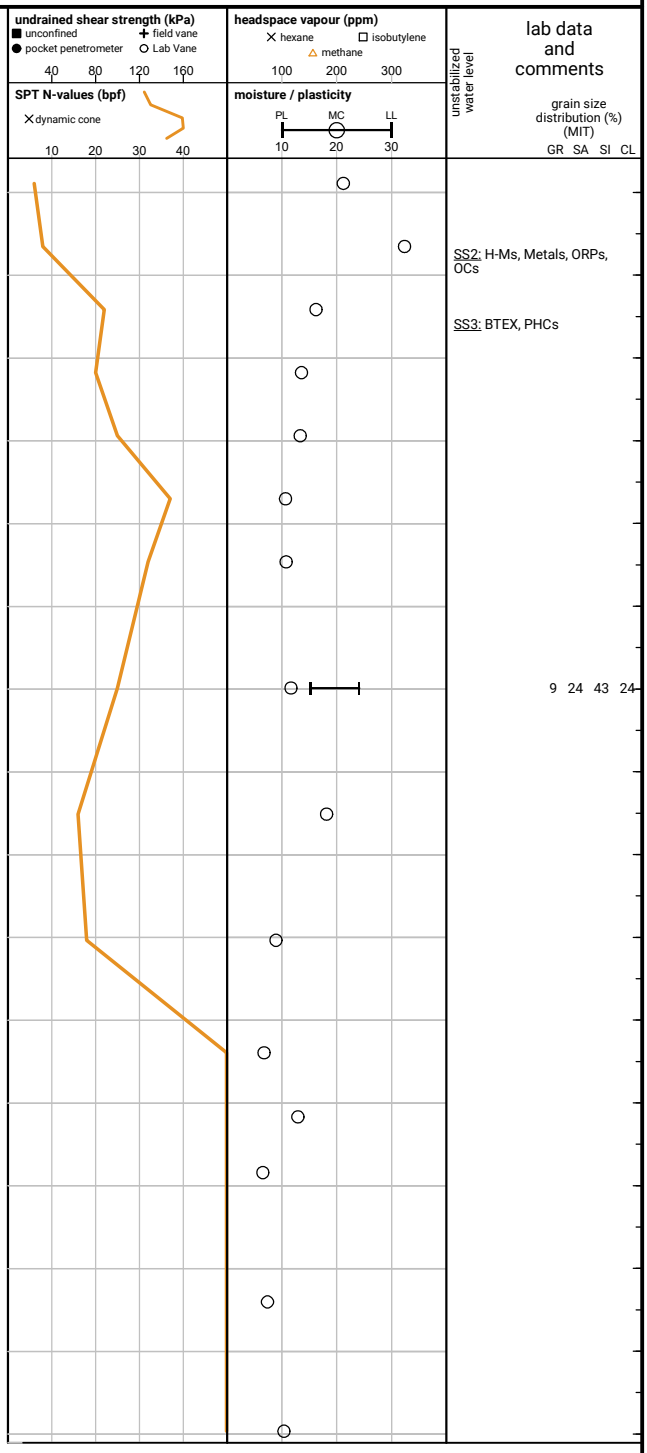
drill method : G78

hollow stem augers OD=215 mm

elev / depth (m)	description	number	type	SPT N-value
187.4	**GROUND SURFACE**			
	FILL, clayey silt, trace sand, trace gravel, trace rock fragments, trace asphalt, trace organics, firm, dark brown, moist	1	SS	6
	...at 0.8 m, stiff	2	SS	8
185.9 / 1.5	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, brown with grey, moist (GLACIAL TILL)	3	SS	22
		4	SS	20
	...at 3.0 m, trace rock fragments	5	SS	25
	...at 3.8 m, reddish brown	6	SS	37
		7	SS	32
	...at 6.1 m, sandy	8	SS	25
	...at 7.6 m, grey	9	SS	16
		10	SS	18
176.7 / 10.7	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, very dense, reddish brown, moist (GLACIAL TILL)	11	SS	50 / 125mm
	...at 11.4 m, trace rock fragments	12	SS	50 / 150mm
	...at 12.2 m, silty sand, trace limestone fragments	13	SS	50 / 125mm
		14	SS	50 / 50mm
171.9 / 15.5		15	SS	50 / 125mm

END OF BOREHOLE

Borehole was dry upon completion of drilling.



GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	3.4	184.0
Jan 29, 2021	3.5	183.9
Mar 2, 2021	3.6	183.8
Mar 28, 2021	3.6	183.8
Apr 18, 2021	3.5	183.9
Feb 16, 2024	3.3	184.1

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 5, 2021
Position : E: 593380, N: 4814551 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 109

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

hollow stem augers OD=215 mm

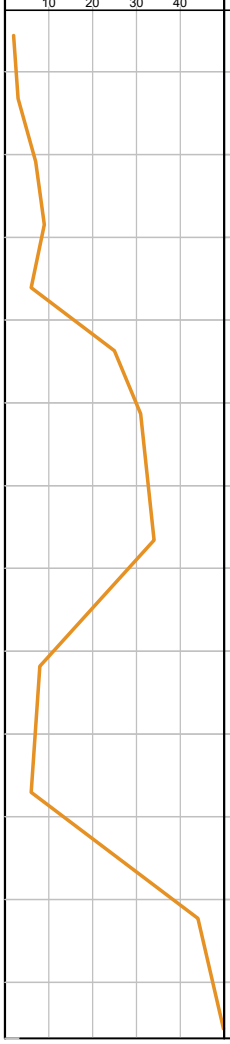
elev depth (m)	description	graphic log	number	type	SPT N-value
188.7	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, trace rock fragments, organic odour, very soft, dark brown, moist		1	SS	2
	...at 0.8 m, wet, soft		2	SS	3
	...at 1.5 m, sandy		3	SS	7
	...at 2.3 m, trace wood fragments		4	SS	9
	...at 3.0 m, dark brown with black		5	SS	6
184.7	...at 3.8 m, very stiff		6A	SS	
4.0			6B	SS	25
	CLAYEY SILT, some sand, trace gravel, trace rock fragments, very stiff to hard, reddish brown, moist (GLACIAL TILL)		7	SS	31
			8	SS	34
	...at 7.6 m, greyish brown, stiff		9	SS	8
	...at 9.1 m, soft		10	SS	6
178.0					
10.7	**SANDY SILT**, some clay, some gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		11	SS	44
176.3			12	SS	50 / 75mm
12.4	**END OF BOREHOLE**				

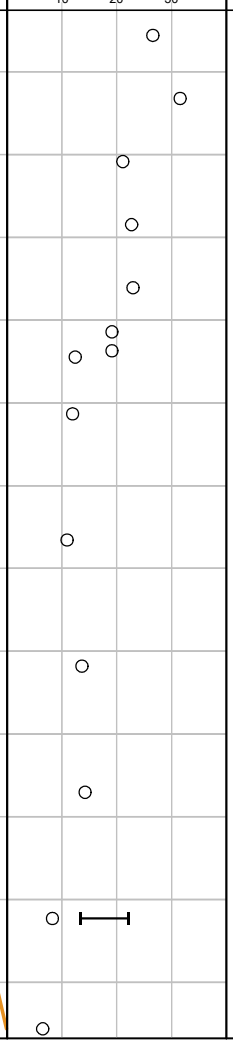
Borehole was dry upon completion of drilling.

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 188 187 186 185 184 183 182 181 180 179 178 177





unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR SA SI CL

10 29 42 19

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

BOREHOLE LOG 110

Date Started : Jan 5, 2021
Position : E: 593404, N: 4814588 (UTM 17T)
Elev. Datum : Geodetic

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
187.1	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, stiff, dark brown, moist		1	SS	11
			2	SS	12
	...at 1.5 m, organic odour		3	SS	13
184.8					
2.3	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, hard to very stiff, reddish brown, moist (GLACIAL TILL)		4	SS	13
			5	SS	32
			6	SS	23
			7	SS	26
	...at 6.1 m, grey, firm		8	SS	6
	...at 7.6 m, firm		9	SS	9
178.0					
9.1	**SANDY SILT**, trace gravel, trace rock fragments, compact, reddish brown, moist (GLACIAL TILL)		10	SS	23
176.3					
10.8	...at 10.7 m, silty sand		11	SS	50 / 100mm

hollow stem augers OD=215 mm

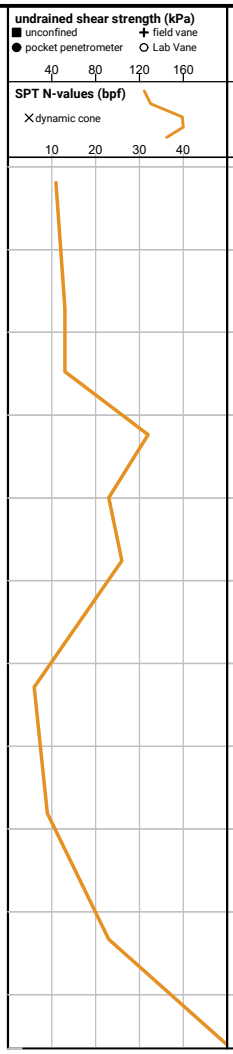
END OF BOREHOLE

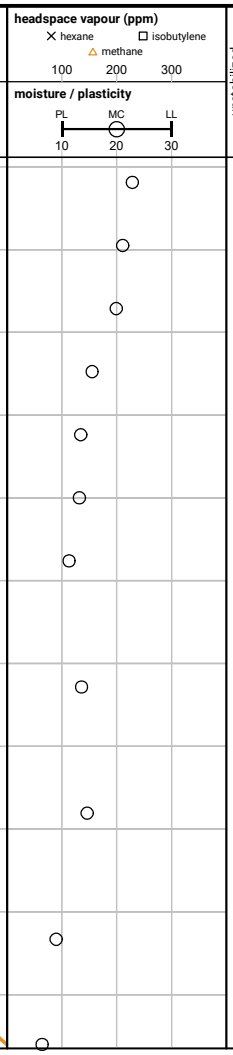
Borehole was dry upon completion of drilling.

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10

well details

elevation (m): 187 186 185 184 183 182 181 180 179 178 177





unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

Date Started : Jan 5, 2021
Position : E: 593438, N: 4814603 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 111

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev depth (m)	description	graphic log	number	type	SPT N-value
187.7	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, trace rock fragments, stiff, dark brown, moist		1	SS	12
	...at 0.8 m, brow		2	SS	4
186.2 / 1.5	**CLAYEY SILT**, trace sand, trace gravel, very stiff, black with grey, moist (GLACIAL TILL)		3	SS	17
			4	SS	20
	...at 3.0 m, some sand, trace rock fragments, reddish brown		5	SS	23
			6	SS	25
			7	SS	25
			8	SS	19
	...at 7.6 m, grey, stiff		9	SS	9
178.6 / 9.1	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, very dense, reddish brown with grey, moist (GLACIAL TILL)		10	SS	50 / 50mm
			11	SS	78 / 275mm
176.6 / 11.1	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11

well details

elevation (m): 187 186 185 184 183 182 181 180 179 178 177

undrained shear strength (kPa)
■ unconfined ● pocket penetrometer + field vane ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

Borehole was dry upon completion of drilling.

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

Date Started : Jan 11, 2021
Position : E: 593374, N: 4814490 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 112

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
185.5	**GROUND SURFACE**				
	FILL, clay and silt, trace sand, trace gravel, trace organics, very soft to stiff, dark brown, wet		1	SS	2
	...at 0.8 m, clayey silt, brown with grey, moist		2	SS	8
184.0 / 1.5	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff to hard, reddish brown, moist (GLACIAL TILL)		3	SS	19
			4	SS	23
			5	SS	26
			6	SS	30
			7	SS	23
	...at 6.1 m, grey, stiff		8	SS	11
177.9 / 7.6	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		9	SS	47
			10	SS	91 / 275mm
	...at 10.7 m, silty sand, wet		11	SS	96 / 250mm
174.4 / 11.1					

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11

elevation (m): 185 184 183 182 181 180 179 178 177 176 175

well details

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160

SPT N-values (bpf): dynamic cone; 10 20 30 40

headspace vapour (ppm): hexane, isobutylene, methane; 100 200 300

moisture / plasticity: PL MC LL; 10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT) GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

END OF BOREHOLE

Unstabilized water level measured at 10.9 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
Jan 12, 2021	1.8	183.7
Jan 29, 2021	1.6	183.9
Mar 2, 2021	1.7	183.8
Mar 28, 2021	1.6	183.9
Apr 18, 2021	1.6	183.9
Feb 16, 2024	1.5	184.0

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Jan 8, 2021
Position : E: 593406, N: 4814520 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 113

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

elev / depth (m)	description	graphic log	number	type	SPT N-value
185.9	**GROUND SURFACE**				
	FILL, clay and silt, trace sand, trace gravel, trace organics, very soft to stiff, dark brown, wet		1	SS	2
	...at 0.8 m, clayey silt, browm with grey, moist		2	SS	13
184.4 / 1.5	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff to hard, reddish brown, moist (GLACIAL TILL)		3	SS	19
	...at 2.3 m, sandy		4	SS	29
			5	SS	27
			6	SS	31
			7	SS	19
	...at 6.1 m, grey, stiff		8	SS	11
	...at 7.6 m, grey		9	SS	30
176.8 / 9.1	**SANDY SILT**, trace clay, trace gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		10	SS	45
			11	SS	64
173.4 / 12.5	...at 12.2 m, wet		12	SS	50 / 125mm

hollow stem augers OD=215 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 185 184 183 182 181 180 179 178 177 176 175 174

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: H-Ms, Metals, ORPs, OCs

SS3: BTEX, PHCs

7 23 42 28

END OF BOREHOLE

Borehole was dry upon completion of drilling.

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

Date Started : Jan 11, 2021
Position : E: 593432, N: 4814553 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 114

File No. : 20-294 **Project** : Britannia Rd and Bronte St S, Milton, ON **Client** : Trinity Point

drill method : G78

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
186.5	**GROUND SURFACE**				
	FILL, clayey silt, trace sand, trace gravel, trace organics, very soft, dark brown, wet		1	SS	2
	...at 0.8 m, brown with grey, moist, stiff		2	SS	12
185.0					
1.5	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff, reddish brown, moist (GLACIAL TILL)		3	SS	22
			4	SS	27
			5	SS	28
			6	SS	24
			7	SS	21
	...at 6.1 m, stiff		8	SS	14
178.9					
7.6	**SANDY SILT**, some clay, trace gravel, trace rock fragments, dense to very dense, reddish brown, moist (GLACIAL TILL)		9	SS	30
			10	SS	38
			11	SS	50 / 125mm
174.1			12	SS	50 / 100mm
12.4					

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

well details

elevation (m): 186 185 184 183 182 181 180 179 178 177 176 175

undrained shear strength (kPa)
■ unconfined + field vane
● pocket penetrometer ○ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene △ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

SS2: H-Ms, Metals, ORPs

SS3: BTEX, OCs, PHCs

END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.

GROUNDWATER LEVELS

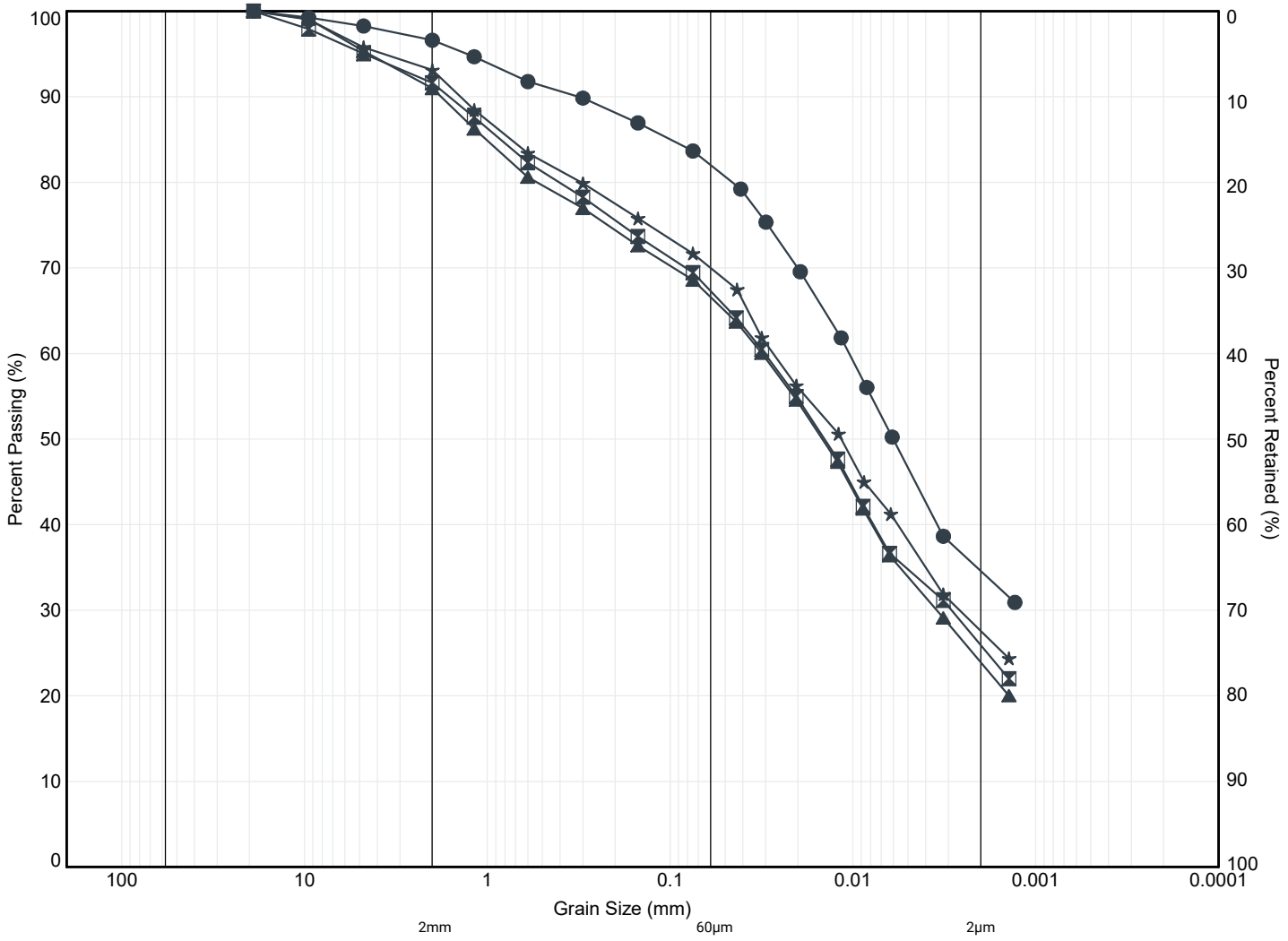
date	depth (m)	elevation (m)
Jan 12, 2021	7.6	178.9
Jan 29, 2021	2.6	183.9
Mar 2, 2021	2.7	183.8
Mar 28, 2021	2.6	183.9
Apr 18, 2021	2.6	183.9
Feb 16, 2024	2.4	184.1
Jan 20, 2025	2.4	184.1
Jul 21, 2025	2.8	183.7

file: 20-294.gpj

Tech : KS | **PM** : MG | **Rev** : MD

APPENDIX G





MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

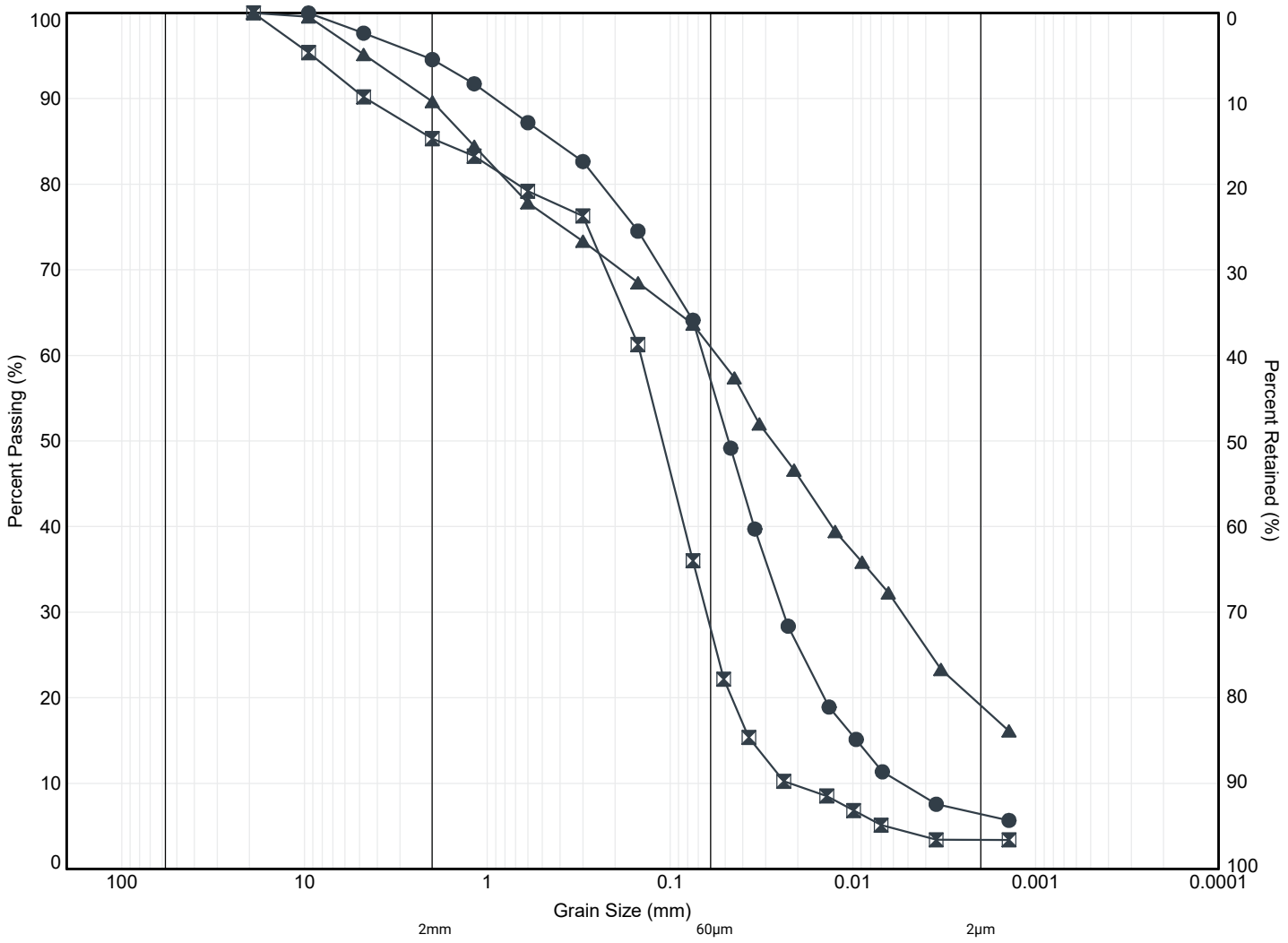
MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**101**	SS6	4.1	183.9	3	15	47	35
⊠	**104**	SS11	9.5	179.5	8	25	41	26
▲	**108**	SS8	6.4	181.0	9	24	43	24
★	**113**	SS4	2.6	183.3	7	23	42	28

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**
CLAYEY SILT

File No.: **20-294**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**101**	SS11	10.7	177.3	5	38	51	6
⊠	**104**	SS13	12.5	176.5	15	57	25	3
▲	**109**	SS11	11.0	177.8	10	29	42	19

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**
SANDY SILT TO SILTY SAND TILL

File No.: **20-294**

K from Grain Size Analysis Report

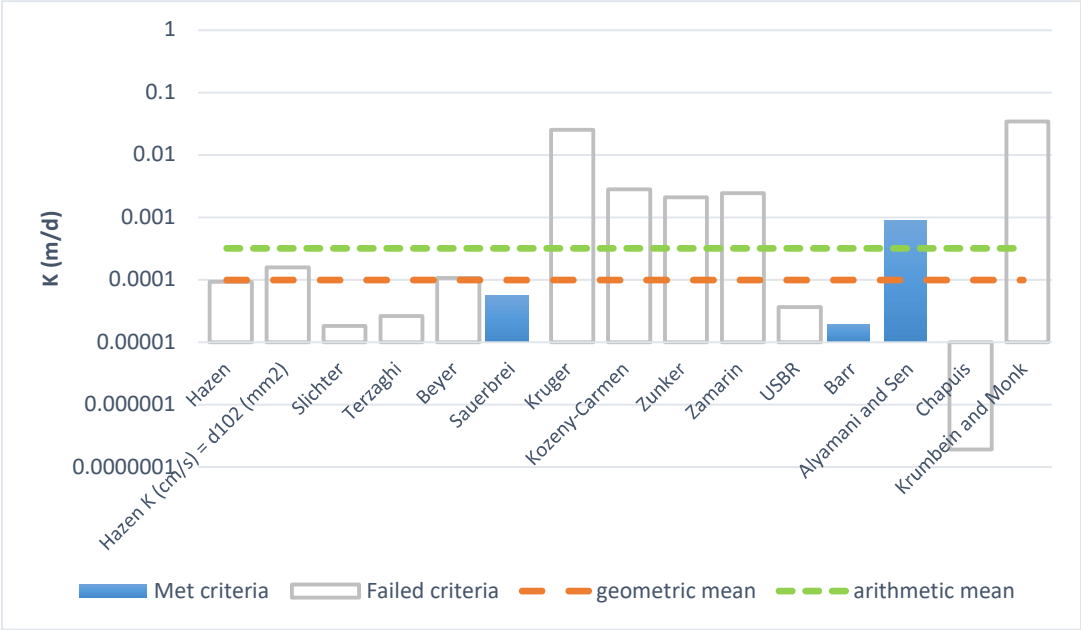
Date: Feb. 18, 2021

Sample Name: BH101 SS6

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.1E-07	1.1E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.8E-07	1.8E-09	0.00	
Slichter	2.1E-08	2.1E-10	0.00	
Terzaghi	3.0E-08	3.0E-10	0.00	
Beyer	1.2E-07	1.2E-09	0.00	
Sauerbrei	6.5E-08	6.5E-10	0.00	
Kruger	2.9E-05	2.9E-07	0.03	
Kozeny-Carmen	3.3E-06	3.3E-08	0.00	
Zunker	2.4E-06	2.4E-08	0.00	
Zamarin	2.8E-06	2.8E-08	0.00	
USBR	4.2E-08	4.2E-10	0.00	
Barr	2.3E-08	2.3E-10	0.00	
Alyamani and Sen	1.0E-06	1.0E-08	0.00	
Chapuis	2.2E-10	2.2E-12	0.00	
Krumbein and Monk	4.0E-05	4.0E-07	0.03	
geometric mean	1.1E-07	1.1E-09	0.00	
arithmetic mean	3.7E-07	3.7E-09	0.00	

K from Grain Size Analysis Report

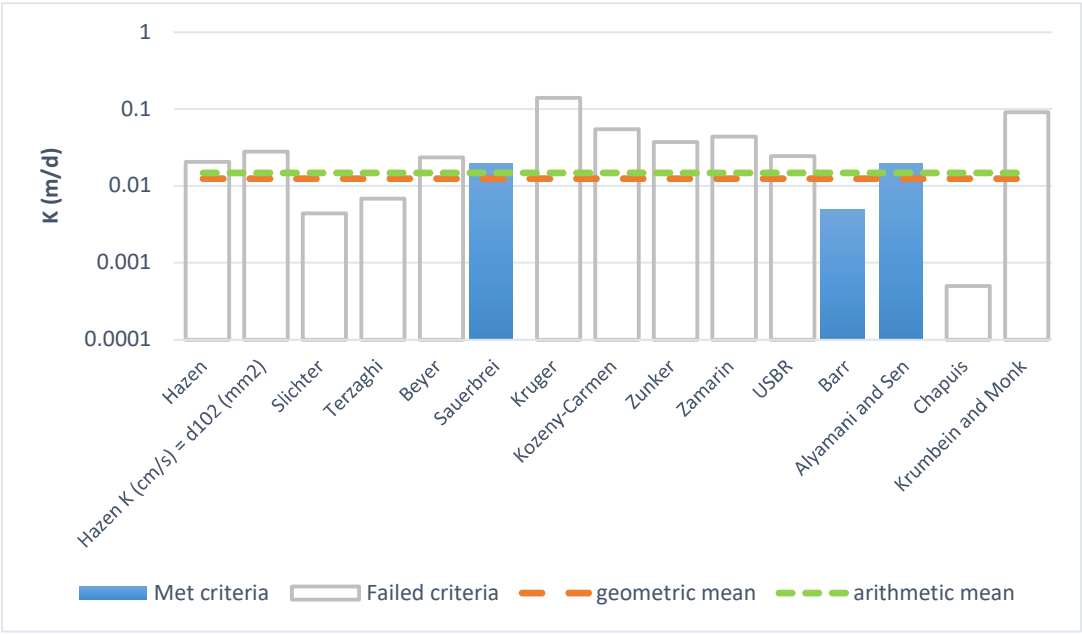
Date: Feb. 18, 2021

Sample Name: BH101 SS11

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy silt low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.4E-05	2.4E-07	0.02	
Hazen K (cm/s) = d_{10} (mm)	3.2E-05	3.2E-07	0.03	
Slichter	5.1E-06	5.1E-08	0.00	
Terzaghi	7.9E-06	7.9E-08	0.01	
Beyer	2.7E-05	2.7E-07	0.02	
Sauerbrei	2.3E-05	2.3E-07	0.02	
Kruger	1.6E-04	1.6E-06	0.14	
Kozeny-Carmen	6.3E-05	6.3E-07	0.05	
Zunker	4.3E-05	4.3E-07	0.04	
Zamarin	5.1E-05	5.1E-07	0.04	
USBR	2.8E-05	2.8E-07	0.02	
Barr	5.7E-06	5.7E-08	0.00	
Alyamani and Sen	2.3E-05	2.3E-07	0.02	
Chapuis	5.8E-07	5.8E-09	0.00	
Krumbein and Monk	1.1E-04	1.1E-06	0.09	
geometric mean	1.4E-05	1.4E-07	0.01	
arithmetic mean	1.7E-05	1.7E-07	0.01	

K from Grain Size Analysis Report

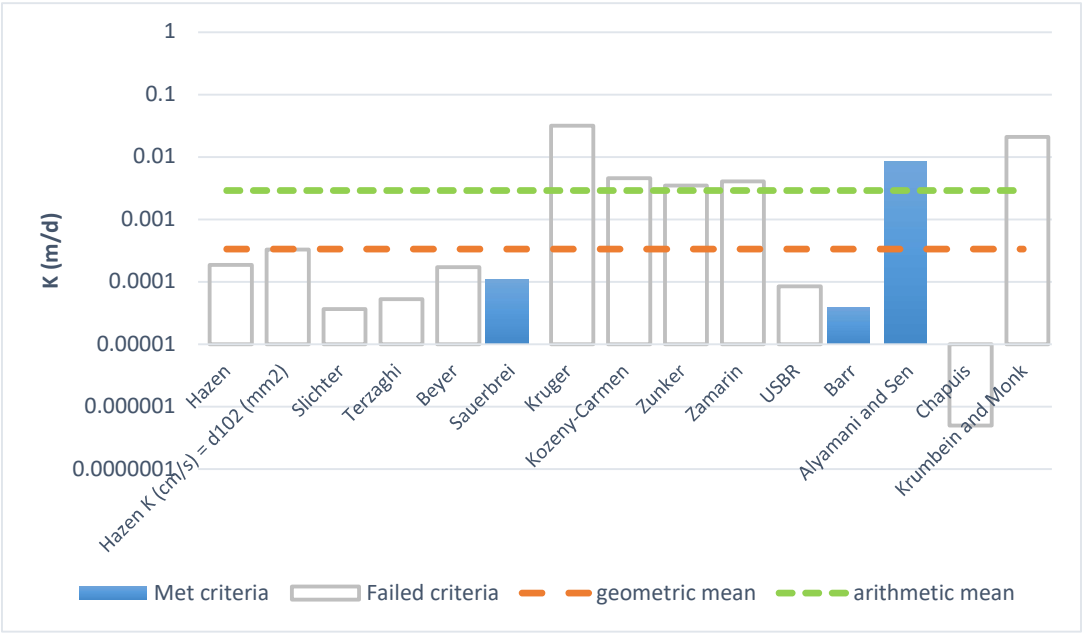
Date: Feb. 18, 2021

Sample Name: BH104 SS11

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.2E-07	2.2E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	3.8E-07	3.8E-09	0.00	
Slichter	4.2E-08	4.2E-10	0.00	
Terzaghi	6.1E-08	6.1E-10	0.00	
Beyer	2.0E-07	2.0E-09	0.00	
Sauerbrei	1.3E-07	1.3E-09	0.00	
Kruger	3.7E-05	3.7E-07	0.03	
Kozeny-Carmen	5.3E-06	5.3E-08	0.00	
Zunker	4.0E-06	4.0E-08	0.00	
Zamarin	4.7E-06	4.7E-08	0.00	
USBR	9.8E-08	9.8E-10	0.00	
Barr	4.6E-08	4.6E-10	0.00	
Alyamani and Sen	9.9E-06	9.9E-08	0.01	
Chapuis	5.7E-10	5.7E-12	0.00	
Krumbein and Monk	2.4E-05	2.4E-07	0.02	
geometric mean	3.9E-07	3.9E-09	0.00	
arithmetic mean	3.4E-06	3.4E-08	0.00	

K from Grain Size Analysis Report

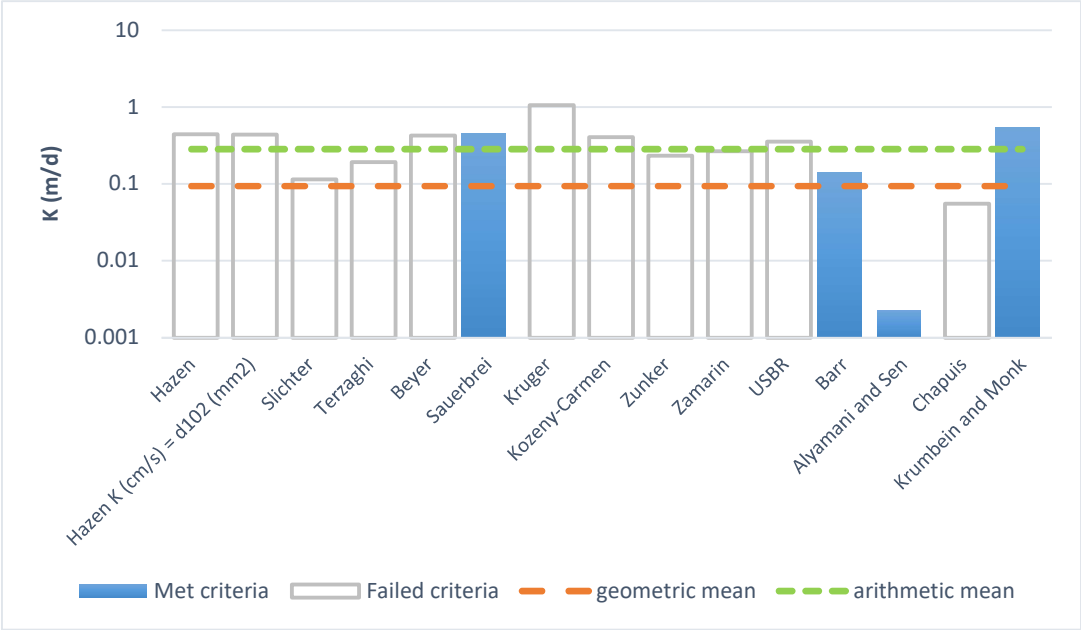
Date: Feb. 18, 2021

Sample Name: BH104 SS13

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.2E-04	5.2E-06	0.44	
Hazen K (cm/s) = d_{10} (mm)	5.1E-04	5.1E-06	0.44	
Slichter	1.3E-04	1.3E-06	0.11	
Terzaghi	2.2E-04	2.2E-06	0.19	
Beyer	4.9E-04	4.9E-06	0.43	
Sauerbrei	5.2E-04	5.2E-06	0.45	
Kruger	1.2E-03	1.2E-05	1.06	
Kozeny-Carmen	4.7E-04	4.7E-06	0.41	
Zunker	2.7E-04	2.7E-06	0.23	
Zamarin	3.1E-04	3.1E-06	0.27	
USBR	4.1E-04	4.1E-06	0.36	
Barr	1.6E-04	1.6E-06	0.14	
Alyamani and Sen	2.6E-06	2.6E-08	0.00	
Chapuis	6.4E-05	6.4E-07	0.06	
Krumbein and Monk	6.3E-04	6.3E-06	0.54	
geometric mean	1.1E-04	1.1E-06	0.09	
arithmetic mean	3.3E-04	3.3E-06	0.28	

K from Grain Size Analysis Report

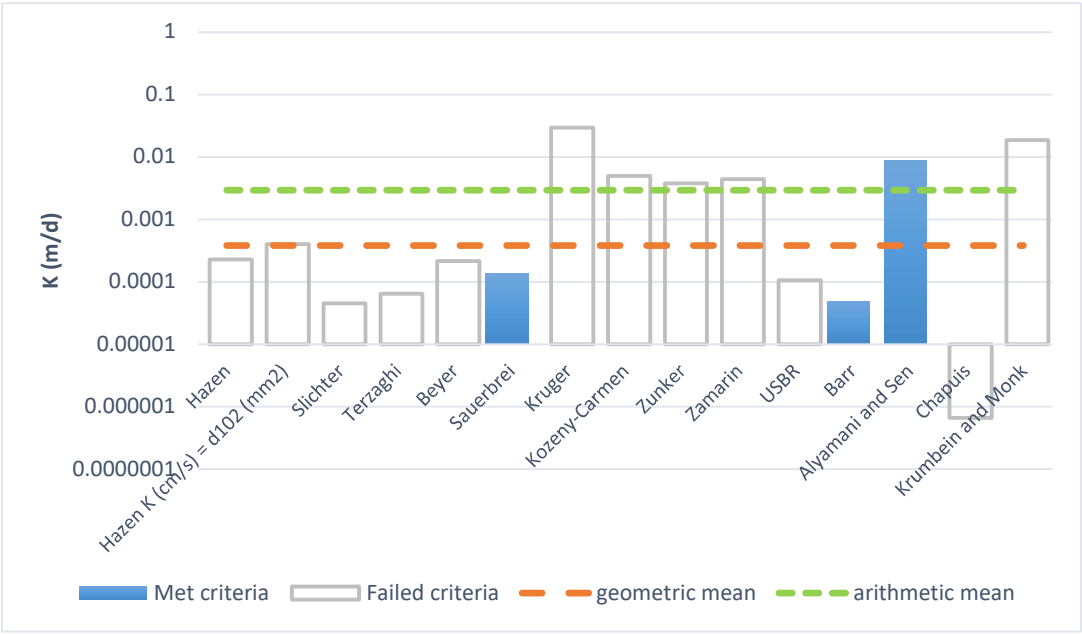
Date: Feb. 18, 2021

Sample Name: BH108 SS8

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.6E-07	2.6E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	4.7E-07	4.7E-09	0.00	
Slichter	5.2E-08	5.2E-10	0.00	
Terzaghi	7.4E-08	7.4E-10	0.00	
Beyer	2.5E-07	2.5E-09	0.00	
Sauerbrei	1.6E-07	1.6E-09	0.00	
Kruger	3.4E-05	3.4E-07	0.03	
Kozeny-Carmen	5.8E-06	5.8E-08	0.00	
Zunker	4.4E-06	4.4E-08	0.00	
Zamarin	5.1E-06	5.1E-08	0.00	
USBR	1.2E-07	1.2E-09	0.00	
Barr	5.6E-08	5.6E-10	0.00	
Alyamani and Sen	1.0E-05	1.0E-07	0.01	
Chapuis	7.6E-10	7.6E-12	0.00	
Krumbein and Monk	2.2E-05	2.2E-07	0.02	
geometric mean	4.5E-07	4.5E-09	0.00	
arithmetic mean	3.4E-06	3.4E-08	0.00	

K from Grain Size Analysis Report

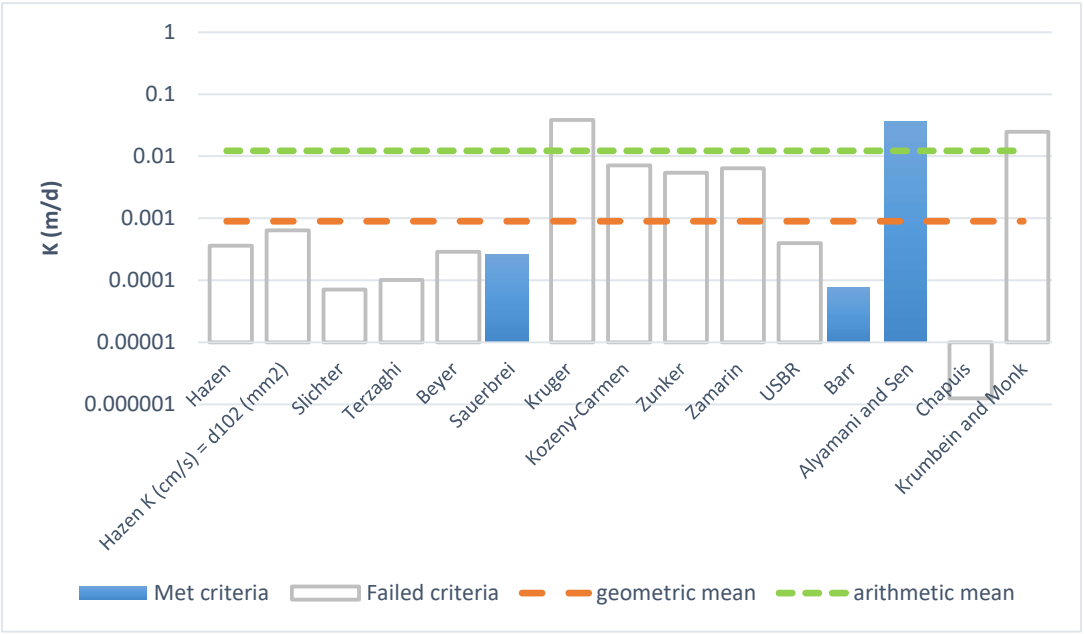
Date: Feb. 18, 2021

Sample Name: BH109 SS11

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy gravelly silt with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	4.2E-07	4.2E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	7.4E-07	7.4E-09	0.00	
Slichter	8.2E-08	8.2E-10	0.00	
Terzaghi	1.2E-07	1.2E-09	0.00	
Beyer	3.3E-07	3.3E-09	0.00	
Sauerbrei	3.1E-07	3.1E-09	0.00	
Kruger	4.5E-05	4.5E-07	0.04	
Kozeny-Carmen	8.3E-06	8.3E-08	0.01	
Zunker	6.3E-06	6.3E-08	0.01	
Zamarin	7.4E-06	7.4E-08	0.01	
USBR	4.6E-07	4.6E-09	0.00	
Barr	8.8E-08	8.8E-10	0.00	
Alyamani and Sen	4.2E-05	4.2E-07	0.04	
Chapuis	1.4E-09	1.4E-11	0.00	
Krumbein and Monk	2.9E-05	2.9E-07	0.02	
geometric mean	1.0E-06	1.0E-08	0.00	
arithmetic mean	1.4E-05	1.4E-07	0.01	

K from Grain Size Analysis Report

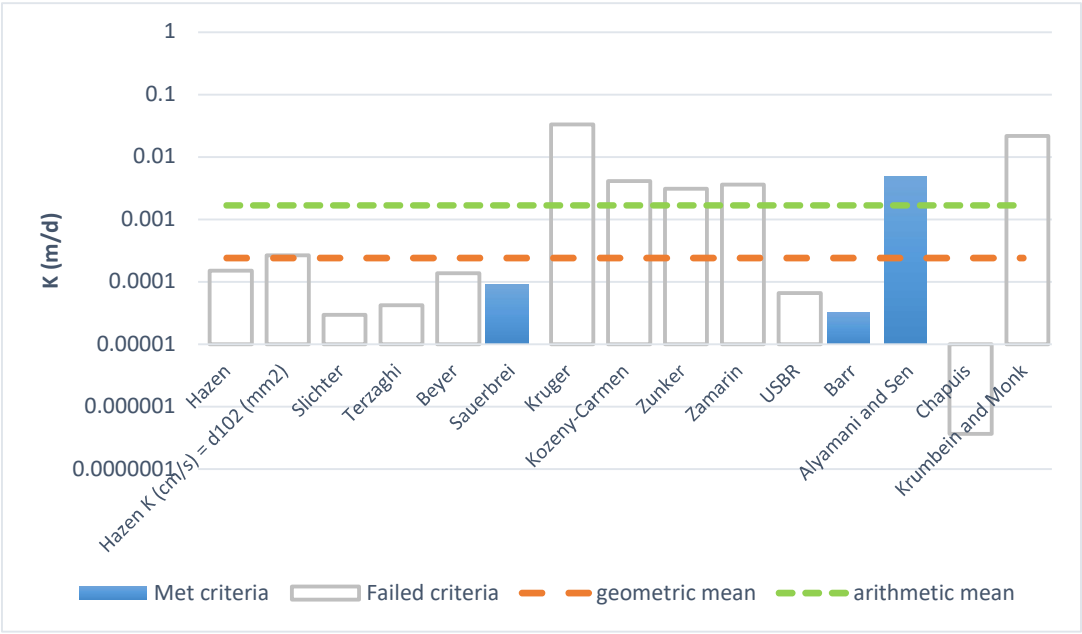
Date: Feb. 18, 2021

Sample Name: BH113 SS4

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.7E-07	1.7E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	3.1E-07	3.1E-09	0.00	
Slichter	3.4E-08	3.4E-10	0.00	
Terzaghi	4.9E-08	4.9E-10	0.00	
Beyer	1.6E-07	1.6E-09	0.00	
Sauerbrei	1.0E-07	1.0E-09	0.00	
Kruger	3.9E-05	3.9E-07	0.03	
Kozeny-Carmen	4.8E-06	4.8E-08	0.00	
Zunker	3.6E-06	3.6E-08	0.00	
Zamarin	4.2E-06	4.2E-08	0.00	
USBR	7.6E-08	7.6E-10	0.00	
Barr	3.7E-08	3.7E-10	0.00	
Alyamani and Sen	5.7E-06	5.7E-08	0.00	
Chapuis	4.2E-10	4.2E-12	0.00	
Krumbein and Monk	2.5E-05	2.5E-07	0.02	
geometric mean	2.8E-07	2.8E-09	0.00	
arithmetic mean	2.0E-06	2.0E-08	0.00	

K from Grain Size Analysis Report

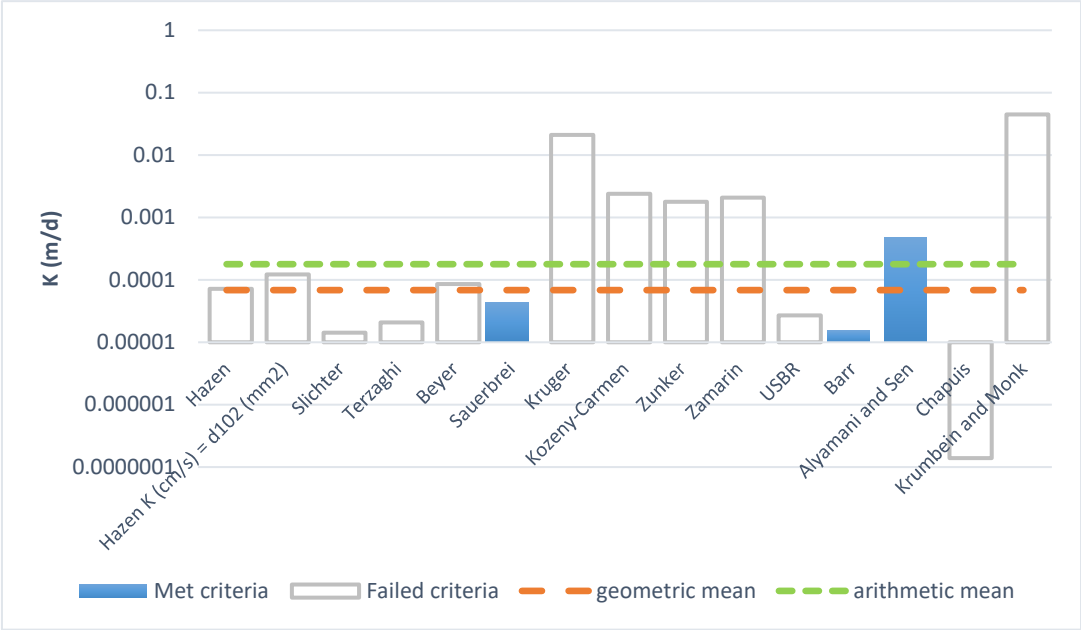
Date: Feb. 18, 2021

Sample Name: GP1

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	8.3E-08	8.3E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.4E-07	1.4E-09	0.00	
Slichter	1.7E-08	1.7E-10	0.00	
Terzaghi	2.4E-08	2.4E-10	0.00	
Beyer	9.9E-08	9.9E-10	0.00	
Sauerbrei	5.1E-08	5.1E-10	0.00	
Kruger	2.4E-05	2.4E-07	0.02	
Kozeny-Carmen	2.8E-06	2.8E-08	0.00	
Zunker	2.1E-06	2.1E-08	0.00	
Zamarin	2.4E-06	2.4E-08	0.00	
USBR	3.1E-08	3.1E-10	0.00	
Barr	1.8E-08	1.8E-10	0.00	
Alyamani and Sen	5.6E-07	5.6E-09	0.00	
Chapuis	1.6E-10	1.6E-12	0.00	
Krumbein and Monk	5.2E-05	5.2E-07	0.04	
geometric mean	7.9E-08	7.9E-10	0.00	
arithmetic mean	2.1E-07	2.1E-09	0.00	

K from Grain Size Analysis Report

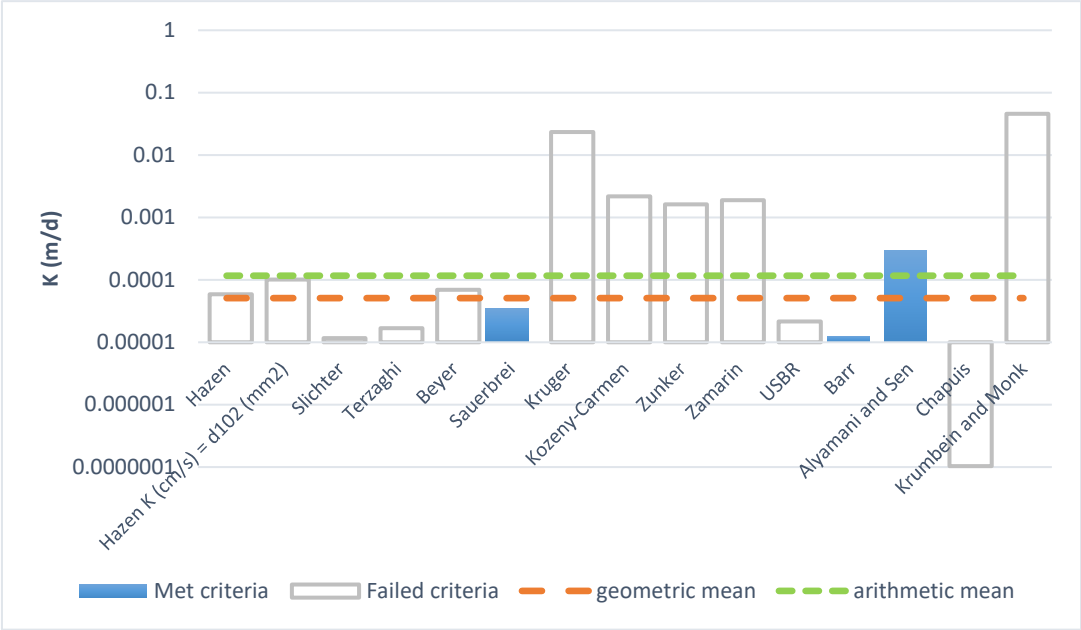
Date: Feb. 18, 2021

Sample Name: GP2

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	6.8E-08	6.8E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.2E-07	1.2E-09	0.00	
Slichter	1.3E-08	1.3E-10	0.00	
Terzaghi	1.9E-08	1.9E-10	0.00	
Beyer	8.0E-08	8.0E-10	0.00	
Sauerbrei	4.1E-08	4.1E-10	0.00	
Kruger	2.7E-05	2.7E-07	0.02	
Kozeny-Carmen	2.5E-06	2.5E-08	0.00	
Zunker	1.9E-06	1.9E-08	0.00	
Zamarin	2.2E-06	2.2E-08	0.00	
USBR	2.5E-08	2.5E-10	0.00	
Barr	1.5E-08	1.5E-10	0.00	
Alyamani and Sen	3.5E-07	3.5E-09	0.00	
Chapuis	1.2E-10	1.2E-12	0.00	
Krumbein and Monk	5.3E-05	5.3E-07	0.05	
geometric mean	5.9E-08	5.9E-10	0.00	
arithmetic mean	1.3E-07	1.3E-09	0.00	

APPENDIX H



Your Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Your C.O.C. #: 1031461-01-01

Attention: Hailey O'Blenes

Grounded Engineering Inc.
1 Banigan Drive
Toronto, ON
CANADA M4H 1G3

Report Date: 2025/01/27
Report #: R8476332
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C506253
Received: 2025/01/20, 16:20

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbonaceous BOD	1	2025/01/21	2025/01/26	CAM SOP-00427	SM 24 5210B m
Total Cyanide	1	2025/01/21	2025/01/21	CAM SOP-00457	OMOE E3015 5 m
Fluoride	1	2025/01/21	2025/01/22	CAM SOP-00449	SM 24 4500-F C m
Mercury in Water by CVAA	1	2025/01/22	2025/01/23	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by Axial ICP	1	2025/01/21	2025/01/21	CAM SOP-00408	EPA 6010D m
E.coli, (CFU/100mL)	1	N/A	2025/01/20	CAM SOP-00552	SM9222B, MECP E3371
Animal and Vegetable Oil and Grease	1	N/A	2025/01/24	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease	1	2025/01/24	2025/01/24	CAM SOP-00326	EPA1664B m,SM5520B m
PAH Compounds in Water by GC/MS (SIM)	1	2025/01/22	2025/01/23	CAM SOP-00318	EPA 8270E
Phenols (4AAP)	1	N/A	2025/01/21	CAM SOP-00444	OMOE E3179 m
pH	1	2025/01/22	2025/01/23	CAM SOP-00413	SM 24th-4500H+ B
Sulphate by Automated Turbidimetry	1	N/A	2025/01/23	CAM SOP-00464	SM 24 4500-SO42- E m
Total Kjeldahl Nitrogen in Water	1	2025/01/21	2025/01/22	CAM SOP-00938	SM 4500-N B m
Mineral/Synthetic O & G (TPH Heavy Oil) (1)	1	2025/01/24	2025/01/24	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids	1	2025/01/22	2025/01/23	CAM SOP-00428	SM 24 2540D m
Volatile Organic Compounds in Water	1	N/A	2025/01/22	CAM SOP-00228	EPA 8260D

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Your Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Your C.O.C. #: 1031461-01-01

Attention: Hailey O'Blenes

Grounded Engineering Inc.
1 Banigan Drive
Toronto, ON
CANADA M4H 1G3

Report Date: 2025/01/27
Report #: R8476332
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C506253

Received: 2025/01/20, 16:20

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease

Encryption Key

Marijane Cruz
Senior Project Manager
27 Jan 2025 15:49:31

Please direct all questions regarding this Certificate of Analysis to:
Marijane Cruz, Senior Project Manager
Email: Marijane.Cruz@bureauveritas.com
Phone# (905)817-5756

==========

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

Bureau Veritas Job #: C506253
Report Date: 2025/01/27

Grounded Engineering Inc.
Client Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Sampler Initials: MD

HALTON SANITARY & COMBINED BYLAW (2-03)

Bureau Veritas ID				ANIR73			ANIR73		
Sampling Date				2025/01/20 14:30			2025/01/20 14:30		
COC Number				1031461-01-01			1031461-01-01		
	UNITS	Criteria	Criteria-2	SW-UF-BH107	RDL	QC Batch	SW-UF-BH107 Lab-Dup	RDL	QC Batch
Calculated Parameters									
Total Animal/Vegetable Oil and Grease	mg/L	150	-	1.4	0.50	9861889			
Inorganics									
Total Carbonaceous BOD	mg/L	300	-	<2	2	9862001			
Fluoride (F-)	mg/L	10	-	0.19	0.10	9862698			
Total Kjeldahl Nitrogen (TKN)	mg/L	100	-	0.61	0.10	9862392			
pH	pH	6.0:10.0	6.5:8.5	7.43		9863384			
Phenols-4AAP	mg/L	1	-	<0.0010	0.0010	9862652			
Total Suspended Solids	mg/L	350	-	210	20	9862520			
Dissolved Sulphate (SO4)	mg/L	1500	-	**3100**	10	9862305			
Total Cyanide (CN)	mg/L	2	-	<0.0050	0.0050	9862032			
Petroleum Hydrocarbons									
Total Oil & Grease	mg/L	-	-	1.4	0.50	9864641			
Total Oil & Grease Mineral/Synthetic	mg/L	-	-	<0.50	0.50	9864643			
Metals									
Total Aluminum (Al)	mg/L	50	-	3	1	9862086	3	1	9862086
Total Antimony (Sb)	mg/L	5	-	<0.2	0.2	9862086	<0.2	0.2	9862086
Total Arsenic (As)	mg/L	1	-	<0.1	0.1	9862086	<0.1	0.1	9862086
Total Beryllium (Be)	mg/L	5	-	<0.005	0.005	9862086	<0.005	0.005	9862086
Total Cadmium (Cd)	mg/L	1	-	<0.02	0.02	9862086	<0.02	0.02	9862086
Total Chromium (Cr)	mg/L	3	-	<0.1	0.1	9862086	<0.1	0.1	9862086
Total Cobalt (Co)	mg/L	5	-	<0.02	0.02	9862086	<0.02	0.02	9862086
Total Copper (Cu)	mg/L	3	-	<0.1	0.1	9862086	<0.1	0.1	9862086
Total Iron (Fe)	mg/L	50	-	6.7	0.2	9862086	6.6	0.2	9862086
Total Lead (Pb)	mg/L	3	-	<0.1	0.1	9862086	<0.1	0.1	9862086
Total Manganese (Mn)	mg/L	5	-	0.37	0.01	9862086	0.37	0.01	9862086
Mercury (Hg)	mg/L	0.05	-	<0.00010	0.00010	9863304			
Total Molybdenum (Mo)	mg/L	5	-	0.14	0.05	9862086	<0.05	0.05	9862086
Total Nickel (Ni)	mg/L	3	-	<0.05	0.05	9862086	<0.05	0.05	9862086

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Halton Sanitary & Combined Sewer Bylaw (2-03)
Criteria-2: Halton Storm Sewer ByLaw

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C506253
Report Date: 2025/01/27

Grounded Engineering Inc.
Client Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Sampler Initials: MD

HALTON SANITARY & COMBINED BYLAW (2-03)

Bureau Veritas ID				ANIR73			ANIR73		
Sampling Date				2025/01/20 14:30			2025/01/20 14:30		
COC Number				1031461-01-01			1031461-01-01		
	UNITS	Criteria	Criteria-2	SW-UF-BH107	RDL	QC Batch	SW-UF-BH107 Lab-Dup	RDL	QC Batch
Total Phosphorus (P)	mg/L	10	-	<0.5	0.5	9862086	<0.5	0.5	9862086
Total Selenium (Se)	mg/L	5	-	<0.2	0.2	9862086	<0.2	0.2	9862086
Total Silver (Ag)	mg/L	5	-	<0.1	0.1	9862086	<0.1	0.1	9862086
Total Tin (Sn)	mg/L	5	-	<0.2	0.2	9862086	<0.2	0.2	9862086
Total Titanium (Ti)	mg/L	5	-	0.05	0.05	9862086	<0.05	0.05	9862086
Total Zinc (Zn)	mg/L	3	-	<0.05	0.05	9862086	<0.05	0.05	9862086
Polyaromatic Hydrocarbons									
Naphthalene	mg/L	0.14	-	<0.000050	0.000050	9863136			
Volatile Organics									
Benzene	mg/L	0.01	-	<0.00020	0.00020	9862238			
Chloroform	mg/L	0.04	-	<0.00020	0.00020	9862238			
1,4-Dichlorobenzene	mg/L	0.08	-	<0.00040	0.00040	9862238			
Ethylbenzene	mg/L	0.16	-	<0.00020	0.00020	9862238			
Methylene Chloride(Dichloromethane)	mg/L	2.0	-	<0.0020	0.0020	9862238			
Tetrachloroethylene	mg/L	1.0	-	<0.00020	0.00020	9862238			
Toluene	mg/L	0.016	-	<0.00020	0.00020	9862238			
Trichloroethylene	mg/L	0.4	-	<0.00020	0.00020	9862238			
Surrogate Recovery (%)									
D10-Anthracene	%	-	-	103		9863136			
D14-Terphenyl (FS)	%	-	-	81		9863136			
D8-Acenaphthylene	%	-	-	103		9863136			
4-Bromofluorobenzene	%	-	-	102		9862238			
D4-1,2-Dichloroethane	%	-	-	106		9862238			
D8-Toluene	%	-	-	97		9862238			

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Halton Sanitary & Combined Sewer Bylaw (2-03)
Criteria-2: Halton Storm Sewer ByLaw

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C506253
Report Date: 2025/01/27

Grounded Engineering Inc.
Client Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Sampler Initials: MD

HALTON STORM SEWER BYLAW (2-03)

Bureau Veritas ID			ANIR73		
Sampling Date			2025/01/20 14:30		
COC Number			1031461-01-01		
	UNITS	Criteria	SW-UF-BH107	RDL	QC Batch
Microbiological					
Escherichia coli	CFU/100mL	200	<10	10	9861985

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Halton Storm Sewer ByLaw

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C506253
Report Date: 2025/01/27

Grounded Engineering Inc.
Client Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Sampler Initials: MD

TEST SUMMARY

Bureau Veritas ID: ANIR73
Sample ID: SW-UF-BH107
Matrix: Water

Collected: 2025/01/20
Shipped:
Received: 2025/01/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Carbonaceous BOD	DO	9862001	2025/01/21	2025/01/26	Frank Zhang
Total Cyanide	SKAL/CN	9862032	2025/01/21	2025/01/21	Prgya Panchal
Fluoride	ISE	9862698	2025/01/21	2025/01/22	Nachiketa Gohil
Mercury in Water by CVAA	CV/AA	9863304	2025/01/22	2025/01/23	Maninder Kaur
Total Metals Analysis by Axial ICP	ICPX	9862086	2025/01/21	2025/01/21	Medhat Nasr
E.coli, (CFU/100mL)	PL	9861985	N/A	2025/01/20	Jessica (Ya Ping) Qiang
Animal and Vegetable Oil and Grease	BAL	9861889	N/A	2025/01/24	Automated Statchk
Total Oil and Grease	BAL	9864641	2025/01/24	2025/01/24	Jay Hareshkumar Vaghasia
PAH Compounds in Water by GC/MS (SIM)	GC/MS	9863136	2025/01/22	2025/01/23	Jonghan Yoon
Phenols (4AAP)	TECH/PHEN	9862652	N/A	2025/01/21	Chandra Nandlal
pH	AT	9863384	2025/01/22	2025/01/23	Nachiketa Gohil
Sulphate by Automated Turbidimetry	SKAL	9862305	N/A	2025/01/23	Massarat Jan
Total Kjeldahl Nitrogen in Water	SKAL	9862392	2025/01/21	2025/01/22	Rajni Tyagi
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	9864643	2025/01/24	2025/01/24	Jay Hareshkumar Vaghasia
Total Suspended Solids	BAL	9862520	2025/01/22	2025/01/23	Razieh Tabesh
Volatile Organic Compounds in Water	GC/MS	9862238	N/A	2025/01/22	Manpreet Sarao

Bureau Veritas ID: ANIR73 Dup
Sample ID: SW-UF-BH107
Matrix: Water

Collected: 2025/01/20
Shipped:
Received: 2025/01/20

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Metals Analysis by Axial ICP	ICPX	9862086	2025/01/21	2025/01/21	Medhat Nasr

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.3°C

Sample ANIR73 [SW-UF-BH107] : Metals Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C506253
Report Date: 2025/01/27

QUALITY ASSURANCE REPORT

Grounded Engineering Inc.
Client Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Sampler Initials: MD

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Reagent Blank		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS	% Recovery	QC Limits
9862238	4-Bromofluorobenzene	2025/01/22	102	70 - 130	100	70 - 130	101	%						
9862238	D4-1,2-Dichloroethane	2025/01/22	104	70 - 130	103	70 - 130	100	%						
9862238	D8-Toluene	2025/01/22	98	70 - 130	100	70 - 130	100	%						
9863136	D10-Anthracene	2025/01/22	104	50 - 130	104	50 - 130	107	%						
9863136	D14-Terphenyl (FS)	2025/01/22	87	50 - 130	103	50 - 130	98	%						
9863136	D8-Acenaphthylene	2025/01/22	101	50 - 130	91	50 - 130	99	%						
9862001	Total Carbonaceous BOD	2025/01/26					<2	mg/L	NC	30			93	80 - 120
9862032	Total Cyanide (CN)	2025/01/21	107	80 - 120	109	80 - 120	<0.0050	mg/L	NC	20				
9862086	Total Aluminum (Al)	2025/01/21	NC (1)	80 - 120	104	80 - 120	<0.1	mg/L	0.037	20	<0.1	mg/L		
9862086	Total Antimony (Sb)	2025/01/21	NC (1)	80 - 120	109	80 - 120	<0.02	mg/L	NC	20	<0.02	mg/L		
9862086	Total Arsenic (As)	2025/01/21	NC (1)	80 - 120	106	80 - 120	<0.01	mg/L	NC	20	<0.01	mg/L		
9862086	Total Beryllium (Be)	2025/01/21	NC (1)	80 - 120	106	80 - 120	<0.0005	mg/L	NC	20	<0.0005	mg/L		
9862086	Total Cadmium (Cd)	2025/01/21	NC (1)	80 - 120	105	80 - 120	<0.002	mg/L	NC	20	<0.002	mg/L		
9862086	Total Chromium (Cr)	2025/01/21	NC (1)	80 - 120	108	80 - 120	<0.01	mg/L	NC	20	<0.01	mg/L		
9862086	Total Cobalt (Co)	2025/01/21	NC (1)	80 - 120	105	80 - 120	<0.002	mg/L	NC	20	<0.002	mg/L		
9862086	Total Copper (Cu)	2025/01/21	NC (1)	80 - 120	107	80 - 120	<0.01	mg/L	NC	20	<0.01	mg/L		
9862086	Total Iron (Fe)	2025/01/21	NC (1)	80 - 120	105	80 - 120	<0.02	mg/L	0.54	20	<0.02	mg/L		
9862086	Total Lead (Pb)	2025/01/21	NC (1)	80 - 120	105	80 - 120	<0.01	mg/L	NC	20	<0.01	mg/L		
9862086	Total Manganese (Mn)	2025/01/21	NC (1)	80 - 120	104	80 - 120	<0.001	mg/L	0.21	20	<0.001	mg/L		
9862086	Total Molybdenum (Mo)	2025/01/21	NC (1)	80 - 120	109	80 - 120	<0.005	mg/L	NC	20	<0.005	mg/L		
9862086	Total Nickel (Ni)	2025/01/21	NC (1)	80 - 120	105	80 - 120	<0.005	mg/L	NC	20	<0.005	mg/L		
9862086	Total Phosphorus (P)	2025/01/21	NC (1)	80 - 120	110	80 - 120	<0.05	mg/L	NC	20	<0.05	mg/L		
9862086	Total Selenium (Se)	2025/01/21	NC (1)	80 - 120	108	80 - 120	<0.02	mg/L	NC	20	<0.02	mg/L		
9862086	Total Silver (Ag)	2025/01/21	NC (1)	80 - 120	101	80 - 120	<0.01	mg/L	NC	20	<0.01	mg/L		
9862086	Total Tin (Sn)	2025/01/21	NC (1)	80 - 120	107	80 - 120	<0.02	mg/L	NC	20	<0.02	mg/L		
9862086	Total Titanium (Ti)	2025/01/21	NC (1)	80 - 120	107	80 - 120	<0.005	mg/L	0.40	20	<0.005	mg/L		
9862086	Total Zinc (Zn)	2025/01/21	NC (1)	80 - 120	103	80 - 120	<0.005	mg/L	NC	20	<0.005	mg/L		
9862238	1,4-Dichlorobenzene	2025/01/22	102	70 - 130	103	70 - 130	<0.00040	mg/L	NC	30				
9862238	Benzene	2025/01/22	98	70 - 130	97	70 - 130	<0.00020	mg/L	NC	30				
9862238	Chloroform	2025/01/22	101	70 - 130	99	70 - 130	<0.00020	mg/L	NC	30				

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		Reagent Blank		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	Value	UNITS	% Recovery	QC Limits
9862238	Ethylbenzene	2025/01/22	99	70 - 130	98	70 - 130	<0.00020	mg/L	NC	30				
9862238	Methylene Chloride(Dichloromethane)	2025/01/22	100	70 - 130	97	70 - 130	<0.0020	mg/L	NC	30				
9862238	Tetrachloroethylene	2025/01/22	96	70 - 130	97	70 - 130	<0.00020	mg/L	NC	30				
9862238	Toluene	2025/01/22	98	70 - 130	98	70 - 130	<0.00020	mg/L	NC	30				
9862238	Trichloroethylene	2025/01/22	102	70 - 130	101	70 - 130	<0.00020	mg/L	0.75	30				
9862305	Dissolved Sulphate (SO4)	2025/01/23	NC	75 - 125	98	80 - 120	<1.0	mg/L	1.7	20				
9862392	Total Kjeldahl Nitrogen (TKN)	2025/01/22	95	80 - 120	98	80 - 120	<0.10	mg/L	19	20			97	80 - 120
9862520	Total Suspended Solids	2025/01/23			96	80 - 120	<10	mg/L	11	20				
9862652	Phenols-4AAP	2025/01/21	99	80 - 120	105	80 - 120	<0.0010	mg/L	1.4	20				
9862698	Fluoride (F-)	2025/01/22	101	80 - 120	103	80 - 120	<0.10	mg/L	5.2	20				
9863136	Naphthalene	2025/01/22	95	50 - 130	99	50 - 130	<0.000050	mg/L	NC	30				
9863304	Mercury (Hg)	2025/01/23	100	75 - 125	98	80 - 120	<0.00010	mg/L	NC	20				
9863384	pH	2025/01/23			102	98 - 103			0.58	N/A				
9864641	Total Oil & Grease	2025/01/24			99	80 - 110	<0.50	mg/L	0.51	25				
9864643	Total Oil & Grease Mineral/Synthetic	2025/01/24			97	65 - 130	<0.50	mg/L	0.52	25				

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Reagent Blank: A blank matrix containing all reagents used in the analytical procedure. Used to determine any analytical contamination.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Matrix Spike not calculated. Original sample and matrix spike sample were analyzed at a dilution, due to high target analytes, or sample matrix interference

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

Bureau Veritas Job #: C506253
Report Date: 2025/01/27

Grounded Engineering Inc.
Client Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Sampler Initials: MD

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Cristina Carriere, Senior Scientific Specialist

Jessica (Ya Ping) Qiang, Analyst II

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

C506253
2025/01/20 16:20

Bureau Veritas
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel (905) 817-5700 Toll-free 800-563-6266 Fax (905) 817-5777 www.bvna.com

Page | of

NONT-2025-01-2885

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#36876 Grounded Engineering Inc.	Company Name:		Quotation #:	C35487
Attention:	Hailey O'Blenes	Attention:	Hailey O'Blenes	P.O. #:	
Address:	1 Banigan Drive Toronto ON M4H 1G3	Address:		Project:	20-294
Tel:	(709) 687-3178 Fax:	Tel:	(709) 687-3178 Fax:	Project Name:	
Email:	hoblenes@groundedeng.ca	Email:	hoblenes@groundedeng.ca	Site #:	Britannia Rd & Bronte St
				Sampled By:	MO

Bottle Order #: 1031461
COC #: C#1031461-01-01
Project Manager: Marijane Cruz

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)
- [ ] Table 1 [ ] Res/Park [ ] Medium/Fine
- [ ] Table 2 [ ] Ind/Comm [ ] Coarse
- [ ] Table 3 [ ] Agri/Other [ ] For RSC
- [ ] Table ___

Other Regulations
- [ ] CCME
- [ ] Reg 558
- [ ] MISA
- [ ] PWQO
- [ ] Other
- [x] Sanitary Sewer Bylaw
- [x] Storm Sewer Bylaw
- Municipality: Halton
- [ ] Reg 406 Table

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ____

Field Filtered (please circle): Metals / Hg / Cr VI

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):
- Halton Sanitary & Combined Bylaw (2-03)
- Halton Storm Sewer Bylaw (2-03)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: [x]
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ____ Time Required: ____ [ ]
Rush Confirmation Number: ____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered	Halton Sanitary & Combined Bylaw (2-03)	Halton Storm Sewer Bylaw (2-03)	# of Bottles	Comments
1		SW-UF-BH07	25-01-20	14:30	GW		X	X	14	
2										
3										
4										
5										
6										
7										
8										
9										
10										

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
MARY OAKA	25/01/20	16:00		25/01/20	16:20	

Laboratory Use Only
Time Sensitive | Temperature (°C) on Recei: 6.1 8.8 | Custody Seal Present / Intact: Yes / No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/COC-TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/ENVIRONMENTAL-LABORATORIES/RESOURCES/CHAIN-CUSTODY-FORMS-COCS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

White: Bureau Veritas Yellow: Client

Bureau Veritas Canada (2019) Inc.

Bureau Veritas Job #: C506253
Report Date: 2025/01/27

Grounded Engineering Inc.
Client Project #: 20-294
Site Location: BRITANNIA RD & BRONTE ST S
Sampler Initials: MD

Exceedance Summary Table – Halton Sanitary Sewer

Result Exceedances

Sample ID	Bureau Veritas ID	Parameter	Criteria	Result	DL	UNITS
SW-UF-BH107	ANIR73-02	Dissolved Sulphate (SO4)	1500	3100	10	mg/L

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.

Exceedance Summary Table – Halton Storm Sewer

Result Exceedances

Sample ID	Bureau Veritas ID	Parameter	Criteria	Result	DL	UNITS
No Exceedances						

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.

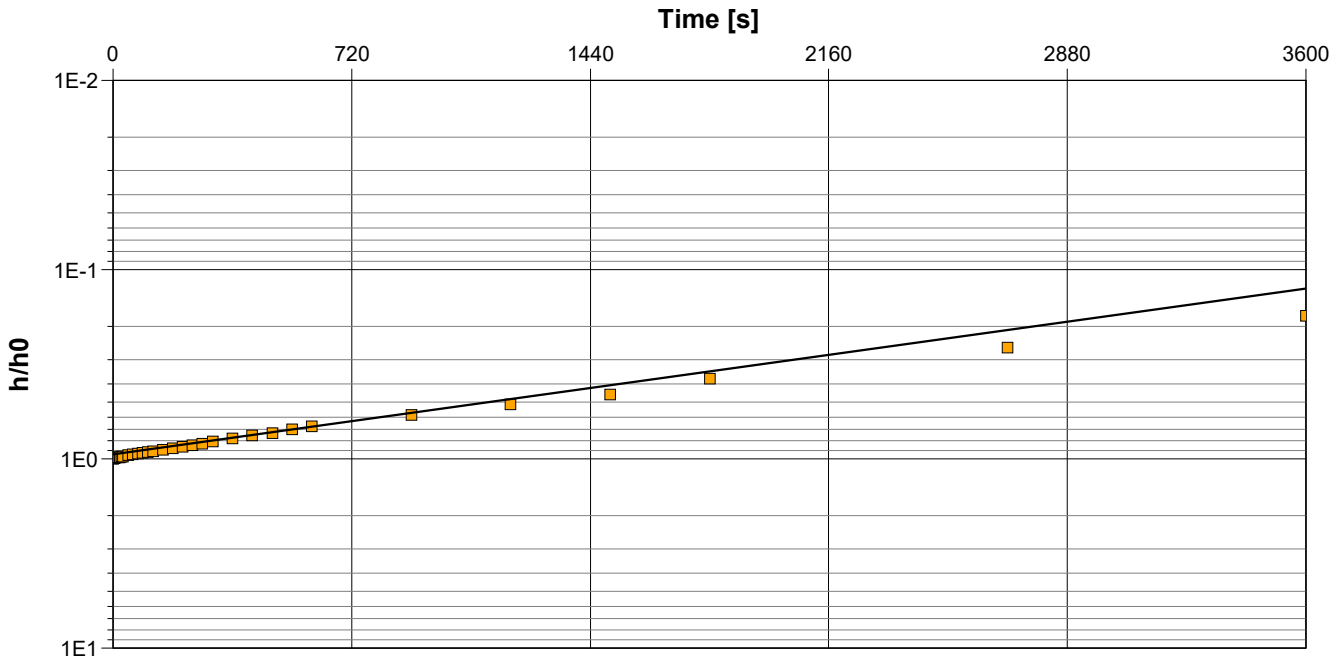
Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

APPENDIX I



GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: Britannia Road and Bronte Street
	Number: 20-294
	Client: Trinity Point

Location: Milton, Ontario	Slug Test: RHT BH101	Test Well: BH101
Test Conducted by: KS		Test Date: 2021-01-12
Analysis Performed by: MG	RHT BH101	Analysis Date: 2021-02-18
Aquifer Thickness: 12.20 m		

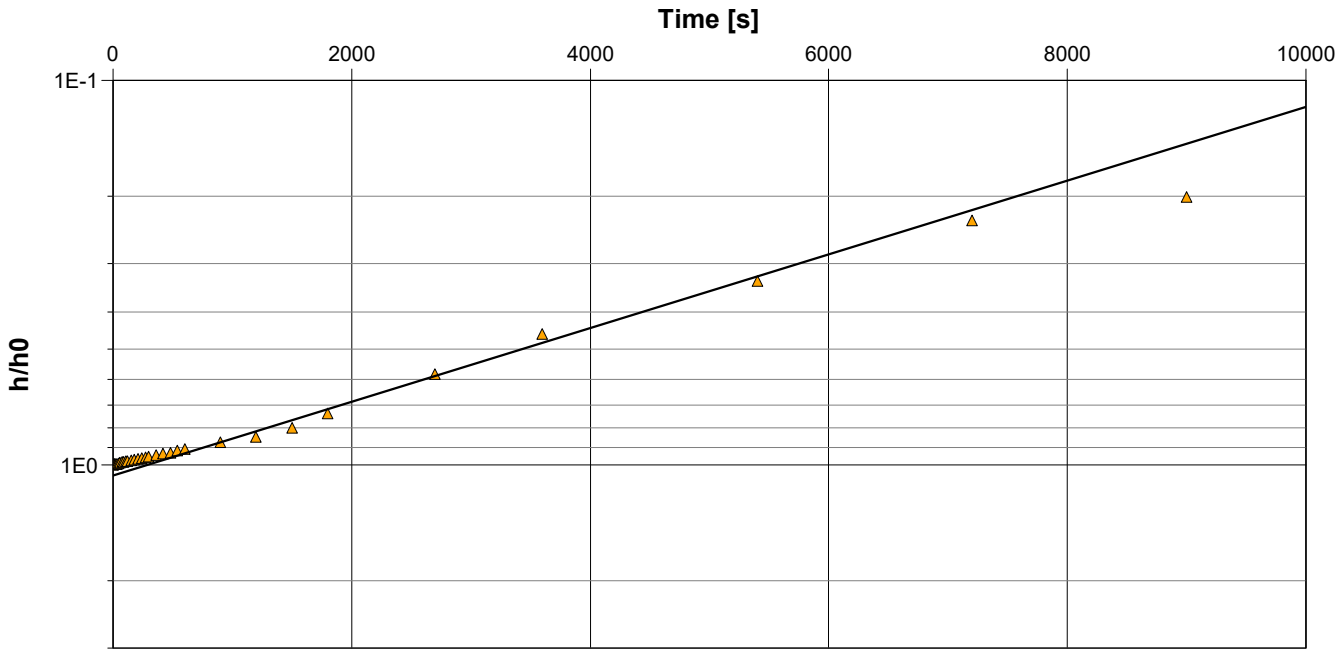


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101	2.15×10^{-7}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: Britannia Road and Bronte Street
	Number: 20-294
	Client: Trinity Point

Location: Milton, Ontario	Slug Test: RHT BH107	Test Well: BH107
Test Conducted by: KS		Test Date: 2021-01-12
Analysis Performed by: MG	RHT BH107	Analysis Date: 2021-02-18
Aquifer Thickness: 13.70 m		

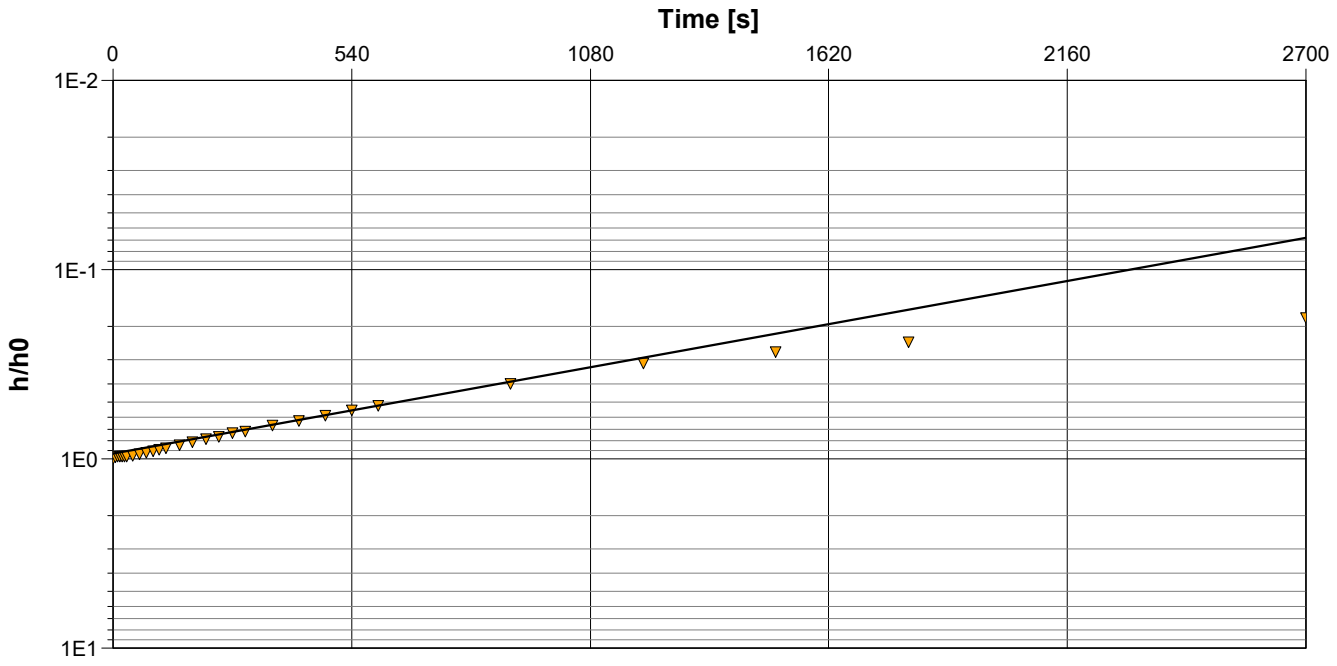


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH107	8.46×10^{-8}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: Britannia Road and Bronte Street
	Number: 20-294
	Client: Trinity Point

Location: Milton, Ontario	Slug Test: RHT BH108	Test Well: BH108
Test Conducted by: KS		Test Date: 2021-01-12
Analysis Performed by: MG	RHT BH108	Analysis Date: 2021-02-18
Aquifer Thickness: 15.20 m		

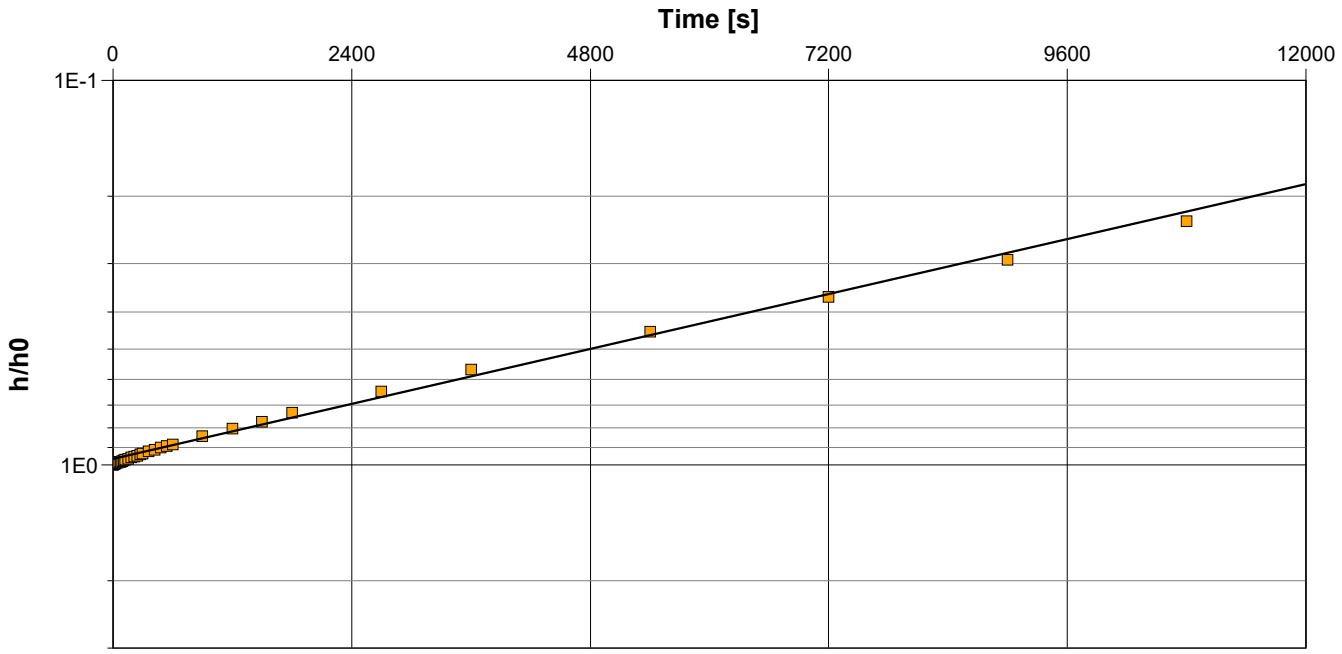


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH108	3.73×10^{-7}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: Britannia Road and Bronte Street
	Number: 20-294
	Client: Trinity Point

Location: Milton, Ontario	Slug Test: RHT BH112	Test Well: BH112
Test Conducted by: KS		Test Date: 2021-01-12
Analysis Performed by: MG	RHT BH112	Analysis Date: 2021-02-18
Aquifer Thickness: 10.70 m		

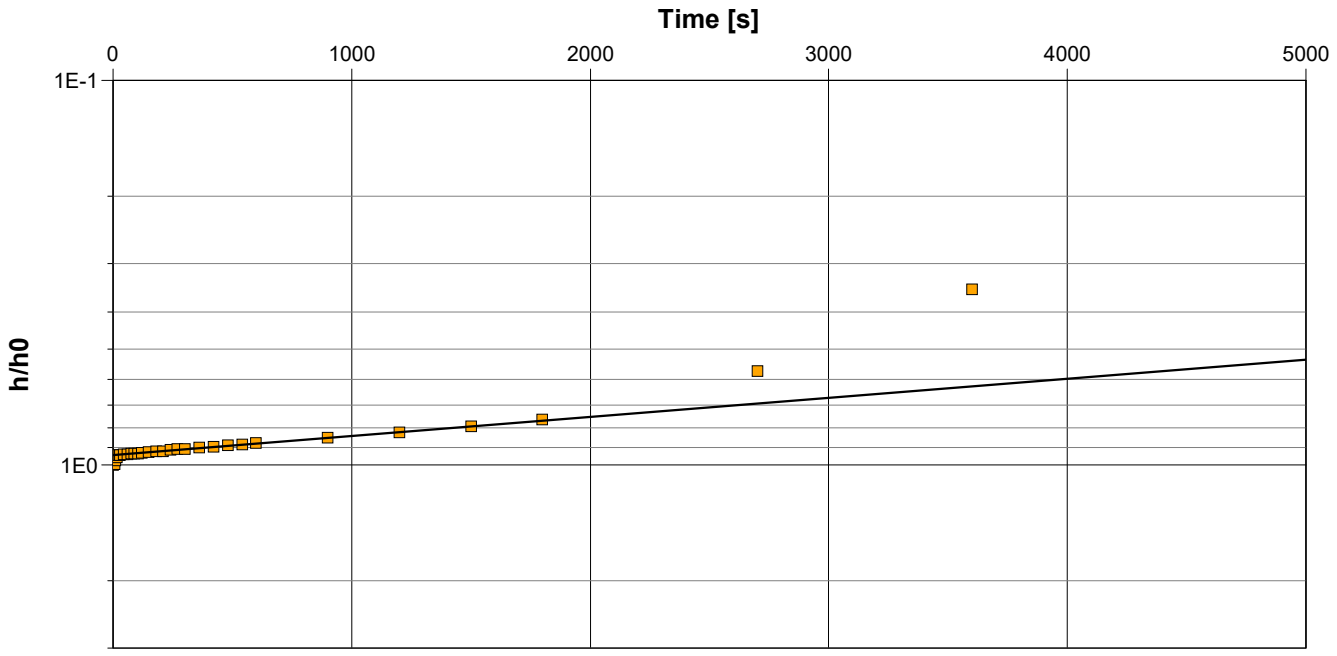


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH112	5.25×10^{-8}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: Britannia Road and Bronte Street
	Number: 20-294
	Client: Trinity Point

Location: Milton, Ontario	Slug Test: RHT BH114	Test Well: BH114
Test Conducted by: KS		Test Date: 2021-01-12
Analysis Performed by: MG	RHT BH114	Analysis Date: 2021-02-18
Aquifer Thickness: 12.20 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH114	4.37×10^{-8}	

APPENDIX J



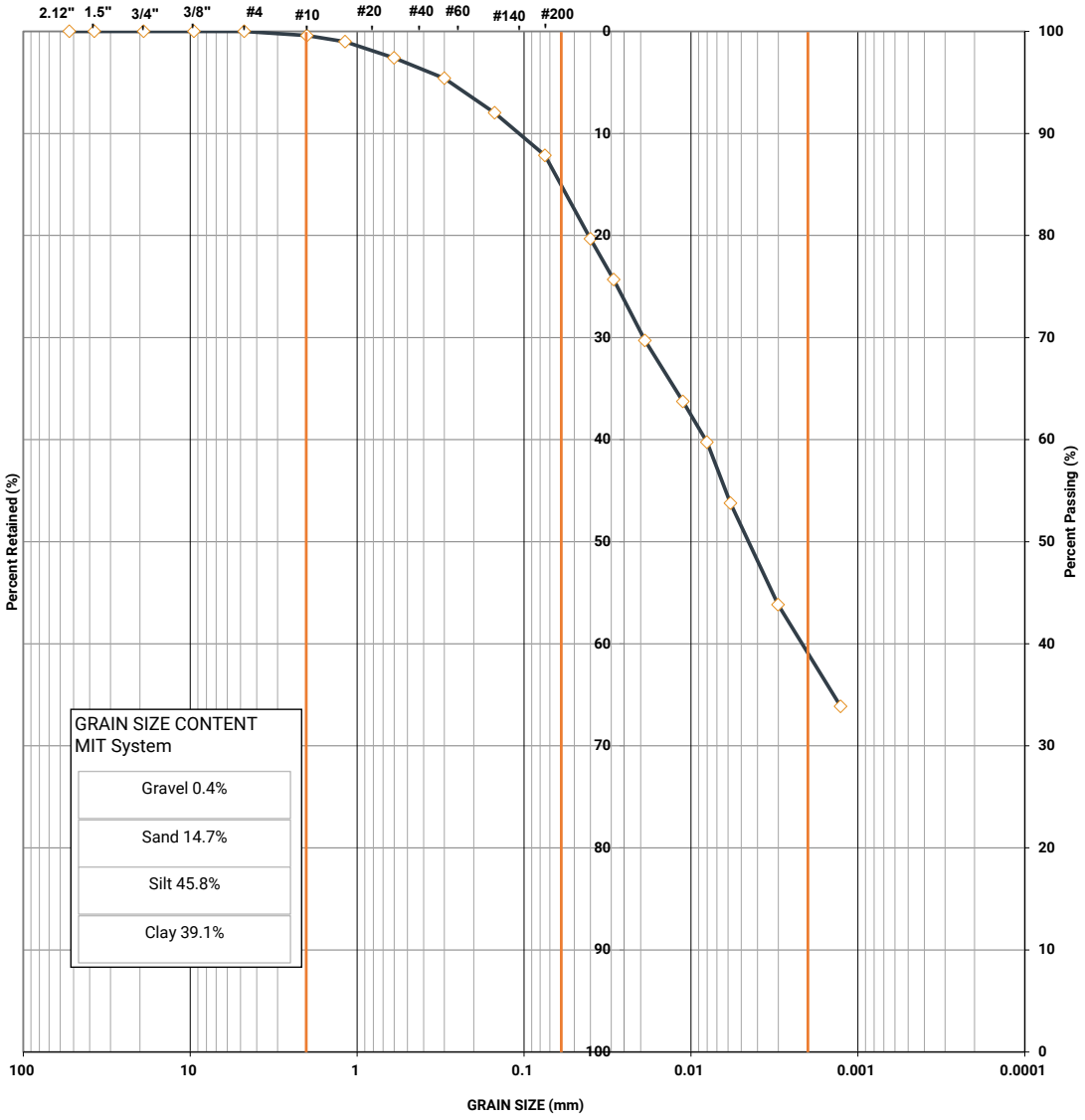
SIEVE AND HYDROMETER ANALYSIS

PROJECT: **Britannia Road and Bronte St S**
LOCATION: **Milton, Ontario**
CLIENT: **Trinity Point**
Borehole : **GP1**
Sample : **GP1**
Sample Depth : **0.3m**
SAMPLE DESCRIPTION: **Silt and clay, some sand**

FILE NO.: **20-294**
LAB NO.: **0**
SAMPLE DATE: **2020-12-10**
SAMPLED BY: **MG**

GRAIN SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZES



MIT SYSTEM	GRAVEL	COARSE	MEDIUM	FINE	SILT	CLAY
		SAND				

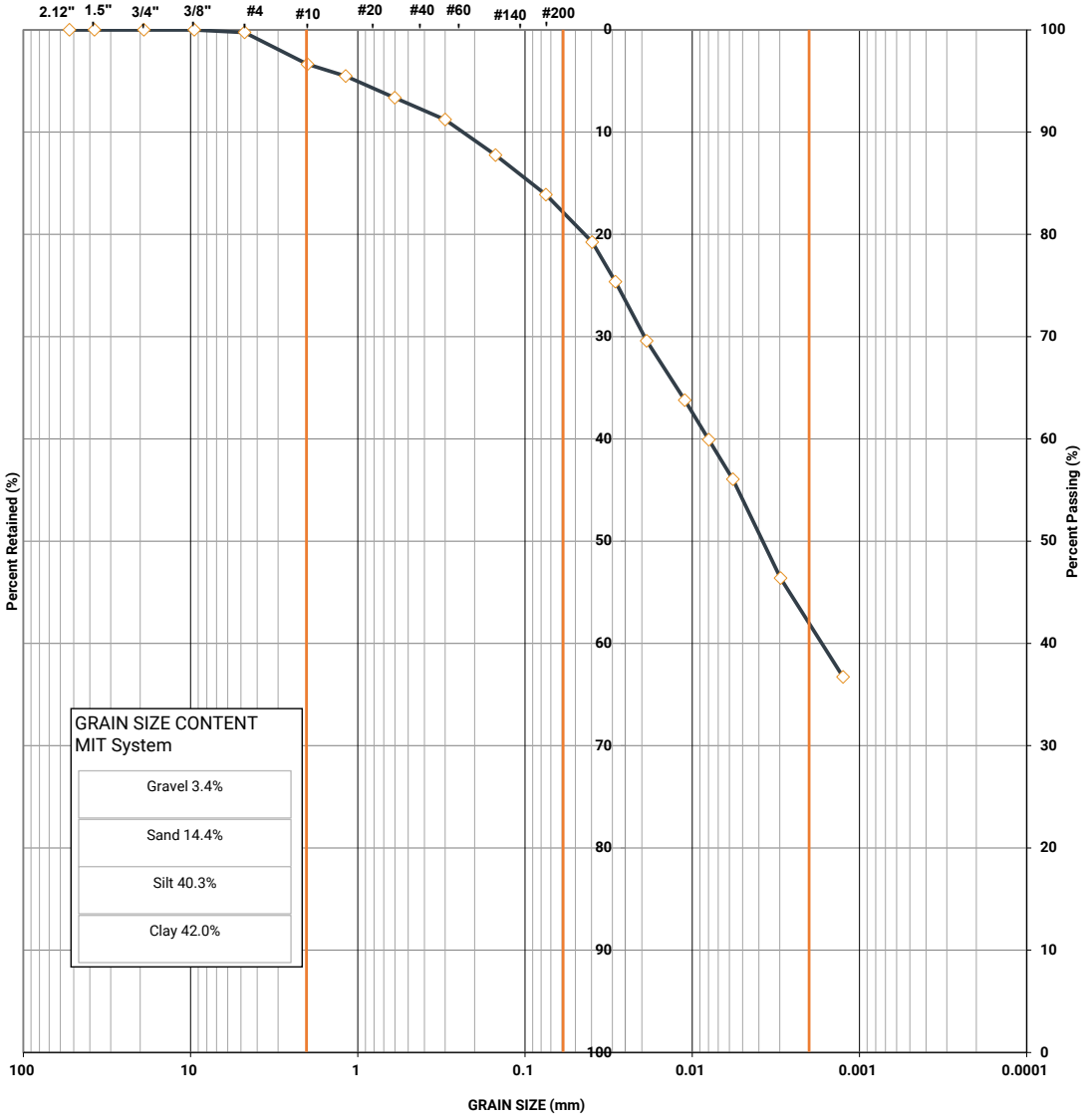
SIEVE AND HYDROMETER ANALYSIS

PROJECT: **Britannia Road and Bronte St S**
LOCATION: **Milton, Ontario**
CLIENT: **Trinity Point**
Borehole : **GP2**
Sample : **GP2**
Sample Depth : **0.35m**
SAMPLE DESCRIPTION: **Silt and clay, some sand**

FILE NO.: **20-294**
LAB NO.: **0**
SAMPLE DATE: **2020-12-10**
SAMPLED BY: **MG**

GRAIN SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZES



MIT SYSTEM	GRAVEL	COARSE	MEDIUM	FINE	SILT	CLAY
		SAND				

TEST GP1A

SOILMOISTURE® **Guelph Permeameter**

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

Enter water Head Height ("H" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0170

Res Type	2.16		
H	10		
a	3	α*=	0.04 cm $^{-1}$
H/a	3.333		
a*	0.04	C =	1.290234
C0.01	1.218	Q =	0.000612
C0.04	1.29		
C0.12	1.288	K_{fs} =	3.53E-07 cm/sec
C0.36	1.288		2.12E-05 cm/min
C	1.29		3.53E-09 m/sec
R	0.017		8.34E-06 inch/min
Q	6E-04		1.39E-07 inch/sec
pi	3.142		
		Φ_m =	8.83E-06 cm ^{2} /min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

Enter water Head Height ("H" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

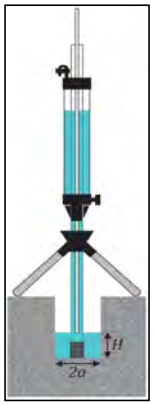
Steady State Rate of Water Level Change ("R" in cm/min): 0.0170

Res Type	2.16		
H	10		
a	3	α*=	0.04 cm $^{-1}$
H/a	3.33333		
a*	0.04	C =	1.290234
C0.01	1.21841	Q =	0.000612
C0.04	1.29023		
C0.12	1.28754	K_{fs} =	3.53E-07 cm/sec
C0.36	1.28754		2.12E-05 cm/min
C	1.29023		3.53E-09 m/ses
R	0.017		8.34E-06 inch/min
Q	0.00061		1.39E-07 inch/sec
pi	3.1415		
		Φ_m =	8.83E-06 cm ^{2} /min

Average

K_{fs} = 3.53E-07 cm/sec
2.12E-05 cm/min
3.53E-09 m/s
8.34E-06 inch/min
1.39E-07 inch/sec

Φ_m = 8.83E-06 cm ^{2} /min



Double Head Method

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):

Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

α*= 0 cm $^{-1}$

α= #DIV/0!

Steady State Rate of Water Level Change ("R1" in cm/min): 4.6000

Steady State Rate of Water Level Change ("R2" in cm/min): 13.2000

Q_1 = 0

Q_2 = 0

Res Type:	0		
H1/a:	#DIV/0!	C_1 =	0
H2/a:	#DIV/0!		
C1-0.01:	#DIV/0!	C_2 =	0
C2-0.01:	#DIV/0!		
C1-0.04:	#DIV/0!	G_1 =	#DIV/0!
C2-0.04:	#DIV/0!		
C1-0.12:	#DIV/0!	G_2 =	#DIV/0!
C2-0.12:	#DIV/0!		
C1-0.36:	#DIV/0!	G_3 =	#DIV/0!
C2-0.36:	#DIV/0!		
G-Denominator:	0	G_4 =	#DIV/0!

K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm ^{2} /min

Θ_{fs} = 0.65 cm ^{3} /cm ^{3}

Θ_i = 0.4 cm ^{3} /cm ^{3}

Sorptivity #DIV/0! (cm min $^{-½}$)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

TEST GP2A

SOILMOISTURE® **Guelph Permeameter**

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

Enter water Head Height ("H" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0200

Res Type	2.16
H	10
a	3
H/a	3.333
a*	0.04
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.29
R	0.020
Q	7E-04
pi	3.142

α^*= 0.04 cm^{-1}

C = 1.290234

Q = 0.00072

K_{fs} = 4.16E-07 cm/sec
2.49E-05 cm/min
4.16E-09 m/sec
9.82E-06 inch/min
1.64E-07 inch/sec

Φ_m = 1.04E-05 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

Enter water Head Height ("H" in cm): 20

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0200

Res Type	2.16
H	20
a	3
H/a	6.66667
a*	0.04
C0.01	1.7546
C0.04	1.90307
C0.12	1.98019
C0.36	1.98019
C	1.90307
R	0.020
Q	0.00072
pi	3.1415

α^*= 0.04 cm^{-1}

C = 1.903071

Q = 0.00072

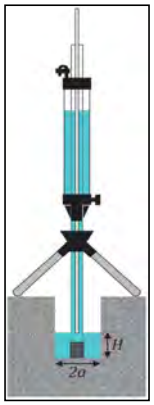
K_{fs} = 2.40E-07 cm/sec
1.44E-05 cm/min
2.40E-09 m/ses
5.67E-06 inch/min
9.45E-08 inch/sec

Φ_m = 6.00E-06 cm^2/min

Average

K_{fs} = 3.28E-07 cm/sec
1.97E-05 cm/min
3.28E-09 m/s
7.74E-06 inch/min
1.29E-07 inch/sec

Φ_m = 8.19E-06 cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):

Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

α^*= 0 cm^{-1}

α= #DIV/0!

Steady State Rate of Water Level Change ("R1" in cm/min): 4.6000

Steady State Rate of Water Level Change ("R2" in cm/min): 13.2000

Q_1 = 0

Q_2 = 0

Res Type:	0
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!
G-Denominator:	0

C_1 = 0

C_2 = 0

G_1 = #DIV/0!

G_2 = #DIV/0!

G_3 = #DIV/0!

G_4 = #DIV/0!

K_{fs} = #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

Φ_m = #DIV/0! cm^2/min

Θ_{fs} = 0.65 cm^3/cm^3

Θ_i = 0.4 cm^3/cm^3

Sorptivity #DIV/0! $(cm\ min^{-\frac{1}{2}})$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

APPENDIX K



Conservation Halton Regulations Mapping



3/8/2021, 3:30:46 PM

- Parcels
- Approximate Regulation Limit
- Spill Arrows
- Spill Lines
- Conservation Halton

1:9,028

0 0.07 0.15 0.3 mi

0 0.13 0.25 0.5 km

CH GIS, Conservation Halton, 2020, Esri Community Maps Contributors, City of Burlington, Province of Ontario, Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada, Conservation

Conservation Halton, 2020

APPENDIX L



Water Balance - Shearling Heights

1. Climate Information

Precipitation	937	mm/a	0.94 m/a *
Evapotranspiration	637	mm/a	0.64 m/a *
Water Surplus	300	mm/a	0.30 m/a

2. Infiltration Rates

Selected Approach **Table 3**

Table 2 Approach - Infiltration Factors

Topography - (Flat land, rolling land, hilly land)		*	
Soil - (Tight impervious clay, etc...)		*	
Cover - (Cultivated lands, woodland)		*	
TOTAL:	0		
Infiltration (Infiltration Factor x Water Surplus)	0	mm/a	0 m/a
Run-off (Water Surplus - Infiltration)	300	mm/a	0.3 m/a

Table 3 Approach - Typical Recharge Rates

coarse sand and gravel	250+	mm/a *	
fine to medium sand	200 - 250	mm/a *	
silty sand to sandy silt	150 - 200	mm/a *	
silt	125 - 150	mm/a *	
clayey silt	100 - 125	mm/a *	
clay	< 100	mm/a *	

The site development area is underlain by clayey silt till.

Based on the above, the recharge rate is	100	mm/a	0.100 m/a
with runoff of	200	mm/a	0.200 m/a

3. Property Statistics - Pre-development

Area Covered by Existing Building	0	m^2	0.00 ha
Area Covered by Existing Hard Surface Paving	0	m^2	0.00 ha
Area Covered by Existing Landscaped area	21,233	m^2	2.12 ha
TOTAL	21,233	m^2	2.12 ha

4. Property Statistics - Post-development

Area Covered by Building with Additions	11,520	m^2	1.15 ha
Area Covered by Hard Surface Paving	8,383	m^2	0.84 ha
Area Covered by Landscaped Area	1,330	m^2	0.13 ha
TOTAL:	21,233	m^2	2.12 ha

*Based on published information

Water Balance - Shearling Heights

5. Annual Water Balance Before Building Additions

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building (entire site)	0	0	-	-	-	0
Hard Surface Paving	0	0	-	-	-	0
Landscape Area (entire site)	21,233	19,895	13,525	-	2,123	4,247
TOTAL	**21,233**	**19,895**	**13,525**	**0**	**2,123**	**4,247**

6. Annual Water Balance After Building Additions

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building (entire site)	11,520	10,795	-	-	-	10,795
Hard Surface Paving	8,383	7,854	-	-	-	7,854
Landscape Area (entire site)	1,330	1,246	847	-	133	266
TOTAL	**21,233**	**19,895**	**847**	**0**	**133**	**18,915**

7. Comparison of Pre-Development (before buidling additions) and Post-Development (after building additions)

	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Pre-Development	19,895	13,525	-	2,123	4,247
Post-Development	19,895	847	-	133	18,915

8. Requirement for Infiltration of Roof Runoff

Volume of roof (building additions) run-off captured (90%)	9,715	m^3
Volume of post-development infiltration without roof run-off	133	m^3
Volume of roof run-off required to match pre-development infiltration rates	1,990	m^3
Percentage of roof run-off (building additions roof) required to match pre-development infiltration	20%	

APPENDIX M



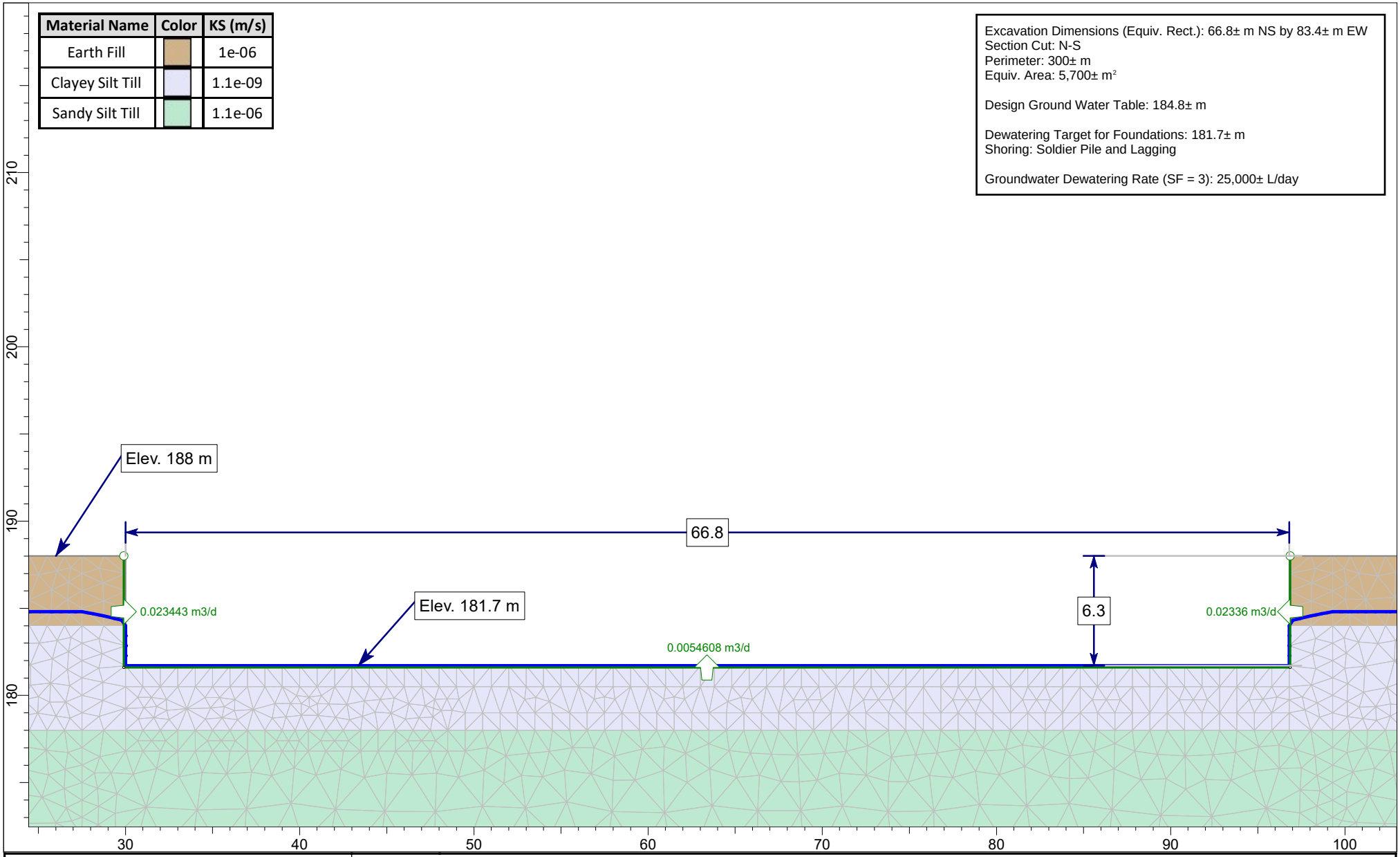
Material Name	Color	KS (m/s)
Earth Fill		1e-06
Clayey Silt Till		1.1e-09
Sandy Silt Till		1.1e-06

Excavation Dimensions (Equiv. Rect.): 66.8± m NS by 83.4± m EW
Section Cut: N-S
Perimeter: 300± m
Equiv. Area: 5,700± m²

Design Ground Water Table: 184.8± m

Dewatering Target for Foundations: 181.7± m
Shoring: Soldier Pile and Lagging

Groundwater Dewatering Rate (SF = 3): 25,000± L/day



GROUNDED ENGINEERING

File	20-294 | Shearling Heights (Britannia Rd & Bronte St), Milton, ON
Analysis	Dewatering: P1, Permeable Shoring - Short-Term (No active DW)
Ref.	
RS2 File	20-294 FEM - AK.slmd
Scale	1:300
Eng	MG

SLIDEINTERPRET 9.040

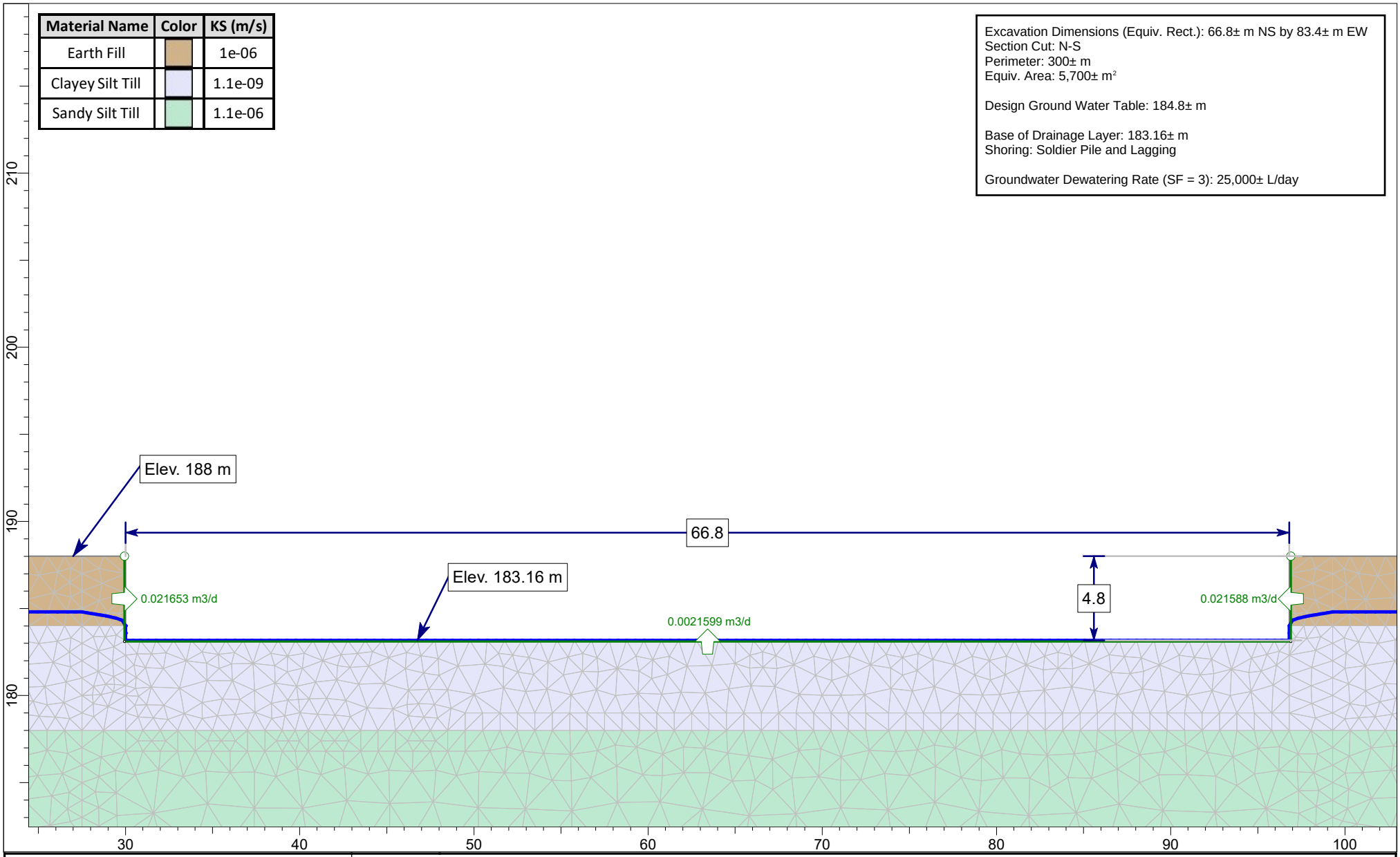
Material Name	Color	KS (m/s)
Earth Fill		1e-06
Clayey Silt Till		1.1e-09
Sandy Silt Till		1.1e-06

Excavation Dimensions (Equiv. Rect.): 66.8± m NS by 83.4± m EW
Section Cut: N-S
Perimeter: 300± m
Equiv. Area: 5,700± m²

Design Ground Water Table: 184.8± m

Base of Drainage Layer: 183.16± m
Shoring: Soldier Pile and Lagging

Groundwater Dewatering Rate (SF = 3): 25,000± L/day



GROUNDED ENGINEERING

File	20-294 | Shearling Heights (Britannia Rd & Bronte St), Milton, ON
Analysis	Dewatering: P1, Permeable Shoring - Long-Term
Ref.	
RS2 File	20-294 FEM - AK.slmd
Scale	1:300
Eng	MG

SLIDEINTERPRET 9.040

SHORT TERM - PERMEABLE SHORING

P2 Excavation Dimensions [m]	
N-S	66.8
E-W	83.4
Area (m2)	5571
Perimeter (m)	300

Rainfall Data		
Year	2	100
Hour	3	12
Depth (mm)	25	94
Depth (m)	0.025	0.094

Section		Flow [m3/day]	Length [m]	Volume [L/day]
Base		0.0054608	83.4	455
Sides		0.023443	300	7,042
Total				7,498
Factor of Safety	3.0			22,493

Storm Events	
2 Year [L/day]	100 Year [L/day]
284,663	1,071,000

Summary	L/day	L/min
Groundwater	25,000	17.4
Rainfall	285,000	197.9
Total	310,000	215.3

LONG TERM - PERMEABLE SHORING

P2 Excavation Dimensions [m]	
N-S	66.8
E-W	83.4
Area (m2)	5571
Perimeter (m)	300

Rainfall Data		
Year	2	100
Hour	3	12
Depth (mm)	25	94
Depth (m)	0.025	0.094

Section		Flow [m3/day]	Length [m]	Volume [L/day]
Base		0.0021599	83.4	180
Sides		0.021653	300	6,496
Total				6,676
Factor of Safety	3.0			20,028

Infiltration [L/day]
6015

Summary	L/day	L/min
Groundwater	25,000	17.4
Infiltration	7,000	4.9
Total	32,000	22.2

BOYNE SURVEY BLOCK 2

FINAL

Subwatershed Impact Study

Project Location:
Town of Milton

Prepared for:
Block 2
Land Owners Group

Prepared by:
MTE Consultants Inc.
1016 Sutton Drive, Unit A
Burlington, ON L7L 6B8

Draft: June 28, 2013
Revised: March 28, 2014
Revised: July 3, 2015
Final: August 25, 2016

MTE File No.: 10477-100



3.8 Impact Assessment and Development Considerations

3.8.1 *Water Balance*

In order to assess potential impacts on the groundwater conditions, a water balance analysis has been completed to determine the pre-development recharge volumes and post development recharge volumes that would be expected based on the change of land use. The FSEMS requires that surface water recharge to groundwater be maintained at pre-development conditions.

A water balance is an accounting of the water resources within a given area. The water balance is a relatively simple concept and may be estimated from the following:

$$P = ET + R + I$$

where each component is expressed in mm/year per m^2 of area

P = Total Precipitation
ET = Evapotranspiration/Evaporation
R = Surface Water Runoff
I = Infiltration

Precipitation (P)
The precipitation value is based on the long term average annual precipitation as reported by Environment Canada at the Georgetown Climate Station, which is 877.4 mm/yr. The average is calculated during the period between 1981 and 2010.

Evapotranspiration/Evaporation (ET)
Evapotranspiration/evaporation (ET) components are based on the land surface cover, vegetation, perviousness soil moisture, geography and climate.

Surface Water Runoff (R)
Surface water runoff can vary depending on the amount of impervious surface, terrain and soil type.

Infiltration (I)
The amount of infiltration is largely dependent on soil type, and topography.

Values for ET, R and I have been estimated, based on the climate data from the Georgetown Weather Station using the Thornthwaite & Mather Method (1957).(See Appendix B7)

Pre- and post-development land uses, including estimated percent impervious are shown in Table 3.5.

Table 3.5 Land Use

June 2015

Land Use	Area	Impervious Area		Imp. Area Connected Directly to Stm. Sewer		Imp. Area Discharged to Grassed Area		Perv. Area w/150mm Topsoil	Perv. Area w/450mm Topsoil
	ha.	%	ha.	%	ha.	%	ha.	ha.	ha.
Pre Development									
Existing homesteads	11	5.0%	0.55	0%	-	5.0%	0.55	10.45	
Woodlot	2.5	0.0%	-	0%	-		-	2.50	
Agricultural Land	199	0.0%	-	0%	-		-	199.00	
Totals	**212.5**		**0.55**		**-**		**0.55**	**211.95**	
Post Development									
Parks	5.58	10.0%	0.56	0%	-	10.0%	0.56	-	5.02
Local Commercial	2.76	90.0%	2.48	90%	2.48	0.0%	-	-	0.28
Major Node	10.95	90.0%	9.86	90%	9.86	0.0%	-	-	1.10
Schools	16.22	65.0%	10.54	65%	10.54	0.0%	-	-	5.68
Residential	94.25	60.0%	56.55	8%	7.54	52.0%	49.01	-	37.70
Roads					-				
-26m	3.54	76.2%	2.70	76%	2.70	0.0%	-	0.84	-
-24m	7.01	77.9%	5.46	78%	5.46	0.0%	-	1.55	-
-20m	3.88	67.5%	2.62	68%	2.62	0.0%	-	1.26	-
-16m	33.88	75.0%	25.41	75%	25.41	0.0%	-	8.47	-
SWM Ponds	12.14	50.0%	6.07	50%	6.07	0.0%	-	-	6.07
Channels	19.79	0.0%	-	0%	-	0.0%	-	-	19.79
Natural Areas	2.50	0.0%	-	0%	-	0.0%	-	2.50	-
Totals	**212.50**		**122.25**		**72.68**		**49.57**	**14.62**	**75.63**
			57.5%		**34.2%**		**23.3%**	**6.9%**	**35.6%**
								12.12	12.07
									37.70
									25.86

The pre- and post-development water balances, with no proposed measures to mitigate lost infiltration are shown in Table 3.6.1. This shows a net loss of 122,384 cu.m of infiltration per year.

Based on the geological conditions encountered during the drilling program, on-site soils are considered to be of low permeability and are not ideal for the implementation of infiltration facilities. However, it is recognized that even in these types of soils, a variety of infiltration measures can be implemented to assist in supplementing post development groundwater recharge.

The lost infiltration may be supplemented by Low Impact Development (LID) measures. The basic premise of LID measures is to try to manage stormwater to minimize the volume of runoff and increase potential for infiltration through the use of various best management practices and design techniques. "Active" LID measures are defined as constructed facilities such as trenches, basins, or galleries that have a primary function related to stormwater management (e.g. storage, treatment, infiltration, etc.). "Passive" LID measures on the other hand are not specific facilities or infrastructure, rather they are practices applied generically to a development landscape (e.g. increased topsoil thicknesses, roof downspout disconnection).

There are various "active" infiltration methods that can be used to increase infiltration including construction of filter swales adjacent to parking lot pavement, bioretention facilities, rain gardens, green roofs, permeable pavement, and subsurface infiltration trenches, basins and galleries. In general the MOECC suggests that for these types of LID (infiltration) measures to be effective, soils should have a minimum infiltration rate of 15 mm/hour. The infiltration rates in this area are less than 5 mm/hour. Therefore, the effectiveness of these types of LID measures is difficult to predict for the Study Area. In addition, these types of LID measures are generally more costly to install, and require some degree of ongoing maintenance.

There are also a number of "passive" LID measures that can be considered to increase infiltration such as increased topsoil thicknesses, directing roof water to grassed areas and rear yards, and grading designs incorporating long side and rear yard swales. These types of LID measures are relatively inexpensive to install, and do not require any ongoing maintenance. In addition, they can be used over a widespread area resulting in a significant impact.

Within public land uses such as parks and school areas, both active and passive LID measures described above should be encouraged. On private lands (i.e. residential lots), it is recommended that passive measures be required and enforced through the Plan of Subdivision process. Active LID measures can also be encouraged on private lands through public education processes. However, the extent of implementation and long term maintenance of active LID measures on private lands is difficult to predict.

An LID measures feasibility matrix is presented in Table 3.7 which summarizes a number of LID measures for consideration along with an evaluation of each LID measure. These LID techniques have the potential to manage infiltration by providing additional water volumes to areas where infiltration can be enhanced. Consideration and design of these measures should be completed at the detailed design stage based on a more detailed understanding of grading (cut/fill) requirements and local soil conditions.

Given the unpredictability of the effectiveness and extent of implementation of active LID measures described above, it is not recommended that they be relied upon to establish the post development water balance. Therefore, the use of passive LID measures has been explored in order to establish the initial post development water balance for the Study Area. Any additional implementation of active LID measures will serve to further enhance post development infiltration to groundwater.

Therefore, the following combination of passive LID measures has been evaluated:

- increased topsoil thicknesses,
- directing roof water to grassed areas and rear yards, and
- grading designs incorporating long side and rear yard swales.

Increasing the depth of topsoil increases the potential average annual infiltration. However, to take full advantage of this potential increase in infiltration, it is necessary to direct additional runoff from adjacent impervious areas to the area with additional topsoil (see Appendix B7 for additional details on the effectiveness of increased topsoil depth). The existing depth of topsoil in the Study Area is approximately 200mm. It is proposed to replace this with 450mm of topsoil in all post development pervious areas except road boulevard areas where only 200mm will be replaced.

For pervious areas without additional runoff from adjacent impervious areas, the ET, R and I components of the water balance equation were estimated by adjusting the values obtained from the Thornthwaite & Mather Method (1957), as described in Appendix B7.

For residential areas with roof water directed to grade (Imp. Area Discharged to Grassed Area), the ET, R and I components of the water balance equation were estimated using a continuous simulation hydrologic model for a typical residential lot. The GAWSER hydrologic model was used, with 39 years of continuous simulation (see Appendix B7 for additional details).

The post-development water balance with the proposed increased topsoil depth is shown in Table 3.6.2. This shows a net gain of 54,938 cu.m of infiltration per year. This water balance estimate is considered conservative, and does not account for any additional infiltration that could be provided from the following sources:

- additional LID measures as described in Table 3.7.
- proposed wetland pockets within the channel blocks
- SWM ponds

On this basis, it is concluded that post-development infiltration to ground water can be maintained at pre-development conditions, and it is recommended that increased topsoil depths of 450mm be required on all post-development pervious areas.

It should be noted that the water balance will have to be reviewed and confirmed at the draft plan and detailed design stage based on actual densities and percent imperviousness proposed at that time.

Table 3.6.1 Water Balance Scenario 1

June 2015

Scenario 1 - Standard 150mm Topsoil Depth								
	Area ha.	**Precipitation**	**ET**	**Surface Runoff**	**Infiltration**	**Runoff Volume m3**	**Infiltration Volume m3**	**Comments**
Pre Development								
Existing homesteads	11	877.4	560	206	111	22,660	12,210	Urban Lawns/Clay
Woodlot	2.5	877.4	585	146	146	3,650	3,650	Mature Forests/Clay
Agricultural Land	199	877.4	575	182	121	362,180	240,790	Moderately Rooted Crops/Clay
Total Pre-Development	**212.5**					**388,490**	**256,650**	
Post Development								
Impervious Area Directly Connected to Storm Sewer	72.68	877.4	175	702.4	0	510,499	-	
Boulevard Areas - Standard 0.15m Topsoil	12.12	877.4	560	206	111	24,973	13,456	Urban lawns/Clay
Grassed Area (without Imp. Area discharged to grade) -Standard 0.15m Topsoil	12.07	877.4	560	206	111	24,864	13,398	Urban lawns/Clay
Grassed Area (with roofs/Imp area discharged to grade) - Standard 0.15m Topsoil	37.70	877.4	560	206	111	77,662	41,847	Urban lawns/Clay
Impervious Area (roofs, etc) discharged to Grassed Areas - Standard 0.15m Topsoil	49.57	877.4	175	647	55	320,903	27,262	Approx 50% additonal infiltration of roof runoff over perv. area
SWM Blocks and Channels - Standard 0.15m Topsoil	25.86	877.4	579	164	134	42,410	34,652	Pasture-Shrubs/Clay
Woodlot	2.50	877.4	585	146	146	3,650	3,650	Mature Forests/Clay
Total Post Development	**212.50**	**877.4**	**341**	**473**	**63**	**1,004,962**	**134,266**	
					Net Gain/(Net Loss)		**(122,384)**	

Note: See Appendix B7 for source of values for Evaapotranspiration/Evaporation (ET), Surface Runoff (R) and Infiltration (I)

Table 3.6.2 Water Balance Scenario 2

September 4, 2015

Scenario 2 - Enhanced 450mm Topsoil Depth	Area Ha.	Precipitation mm	ET mm	Surface Runoff mm	Infiltration	Runoff Volume m3	Infiltration Volume m3	Comments
Pre Development								
Existing homesteads	11	877.4	560	206	111	22,660	12,210	Urban Lawns/Clay
Woodlot	2.5	877.4	585	146	146	3,650	3,650	Mature Forests/Clay
Agricultural Land	199	877.4	575	182	121	362,180	240,790	Moderately Rooted Crops/Clay
Total Pre-Development	**212.5**					**388,490**	**256,650**	
Post Development								
Impervious Area Directly Connected to Storm Sewer	72.68	877.4	175	702.4	0	510,499	-	
Boulevard Areas - Standard 0.15m Topsoil	12.12	877.4	560	206	111	24,973	13,456	Urban lawns/Clay
Grassed Area (without Imp. Area discharged to grade) - **Enhanced 0.45m Topsoil**	12.07	877.4	565	120	192.4	14,484	23,223	Urban Lawn/ET Increased slightly / R decreased, but no less than fine sand
Grassed Area (with roofs/Imp area discharged to grade) - **Enhanced 0.45m Topsoil**	37.70	877.4	565	120	192.4	45,240	72,535	Urban Lawn/ET Increased slightly / R decreased, but no less than fine sand
Additional infiltration of runoff from roofs over Pervious area					387.6 [1]		146,125	Based on GAWSER modelling infiltration is approximately 580mm per year with 450mm depth of topsoil.
Total Infiltration in Pervious area with 450mm of topsoil					580 [2]			
Equivalent Infiltration over impervious area					295 [3]			
Impervious Area (roofs, etc) discharged to Grassed Areas - **Enhanced 0.45m Topsoil**	49.57	877.4	175	408	295	202,040		
SWM Blocks and Channels - **Enhanced 0.45m Topsoil**	25.86	877.4	584	90	203.4	23,274	52,599	Pasture-Shrubs/ET Increased slightly /R decreased, but no less than fine sand
Woodlot	2.50	877.4	585	146	146	3,650	3,650	Mature Forest/Clay
Total Post Development	**212.50**					**824,160**	**311,588**	
					Net Gain/(Net Loss)		**54,938**	

Note: See Appendix B7 for source of values for Evaapotranspiration/Evaporation (ET), Surface Runoff (R) and Infiltration (I)

[1] Additional infiltration of runoff from roofs over Pervious Area = 580 - 192.4 = 387.6mm

[2] GAWSER Model predicted 580mm infiltration for 450mm topsoil depth.

[3] Volume of infiltration of runoff from roofs over Pervious area / Impervious area = Equivalent infiltration from Impervious area (146,125m3 / 49.57ha = 295mm) This is used to estimate Runoff Volume for Impervious Roof Area.

R.J. Burnside & Associates Limited 17345 Leslie Street, Suite 200 Newmarket ON L3Y 0A4 CANADA
telephone (905) 953-8967 **fax** (905) 953-8945 **web** www.rjburnside.com

BURNSIDE
[THE DIFFERENCE IS OUR PEOPLE]

May 27, 2016

Via: Email

Ms. Lana Russell
Water Resource Engineer/Project Manager
The Municipal Infrastructure Group Ltd.
8800 Dufferin Street, Suite 200
Vaughan ON L4K 0C5

Dear Ms. Russell:

Re: Main Sail Estates Post Development Water Balance
Project No.: 300035199.0000

As part of a Hydrogeological Assessment for the Main Sail lands (*Updated Hydrogeological Assessment, Draft Plan of Subdivision 24T-14006M Mail Sail Estates, Milton*, Burnside, June, 2015), Burnside had completed pre-development water balance and a post-development water balance analyses that indicated that, without mitigation, there was the potential for infiltration to be reduced by about 53%. The report recommended the use of Low Impact Development (LID) measures to promote infiltration in the developed area to mitigate this potential loss. It is our understanding TMIG has proposed the direction of roof runoff to pervious areas as a LID measure in the residential areas. In addition, the topsoil depth will be increased in the pervious areas within the residential development areas as a measure to provide additional retention of runoff as well as to promote infiltration. We understand that increased topsoil depth is also being proposed for the park and school areas as well as in the SWM Pond block and along the channel.

It is our understanding that Conservation Halton (CH) has requested that the post-development water balance for the Mail Sail Estates subdivision be calculated with the proposed LID measures in place. Quantification of surficial LID measures is a challenging task as there are no widely accepted LID quantification methods or standards. Burnside has developed a detailed spreadsheet model that presents an analysis based on reasonable assumptions of the proposed measures and the approach to the calculation of the water balance scenarios is similar to approaches outlined in the document *"Hydrogeological Assessment Submissions - Conservation Authority Guidelines for Development Applications"*, June 2013. It is noted, however, that all of the values presented in the spreadsheet model are estimates, and in some cases, values may vary over several orders of magnitude. As such, the margins of error for the calculated infiltration component values are potentially quite large. The margins of error are recognized, but for the purposes of this assessment, the numbers used in the water balance calculations are considered useful for relative comparison of pre- to post-development conditions, with and without LID measures in place.

The following sections outline our approach to the water balance assessment and provide our results.

1.0 Approach and Methodology

The analytical approach to calculate the water balance involves monthly soil-moisture balance calculations to determine the infiltration volumes based on existing and post-development land uses. A soil-moisture balance approach assumes that soils do not release water as potential recharge while a soil moisture deficit exists. During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

The MOECC SWM Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used and a corresponding runoff component was calculated. These water balance component calculations are shown on Table WB-1.

2.0 Water Balance Assessment

2.1 Pre-Development Infiltration

The calculated water balance components from Table WB-1 are used to assess the pre-development water balance scenario based on the existing land use characteristics (open space/agricultural lands). Table WB-2 shows the estimated volume of infiltration that would be generated in pre-development conditions based on the above assumptions (about 61,000 m^3/year).

2.2 Post-Development Infiltration (No LID)

A multi-residential development is proposed for the subject site and the breakdown of post-development land use and representative percentages of imperviousness was provided by TMIG (Table WB-2). Table WB-2 indicates the estimated volume of infiltration that would occur under post-development conditions with no mitigation (i.e., no LID measures in place). Under these conditions it is noted that there would potentially be a 55% reduction in infiltration within the developed area, as compared to the existing pre-development scenario due to the introduction of impervious surfaces.

2.3 Post-Development Conditions with LID

TMIG has advised that the following LID measures will be incorporated into the stormwater management plans for the development.

- All roof leaders are to be disconnected and discharged to pervious areas.
- Increased topsoil depth is proposed for residential areas, parks, schools, SWM pond and channel blocks. The intention with increased topsoil depth is to aid retention of runoff and promote more infiltration in these areas.

For the water balance calculations, the post-development scenario with LID has been created assuming that 75% of the residential roof runoff will be directed to 75% of the pervious areas (we assumed side and rear yards) with thicker topsoil to promote storage/infiltration. Although it is our understanding that all downspouts will be disconnected, we have used 75% to be conservative in the event that water is intercepted/redirected by homeowners. The water volumes available for runoff and infiltration in such a scenario are presented in Table WB-3.

With downspout disconnection, the pervious areas would receive normal precipitation as well as extra water from the roof runoff. Over the available pervious areas, this would be equivalent to providing an additional depth of water that then increases the infiltration component in the pervious areas. The equivalent depth of added water varies with the amount of roof and pervious area available, so as shown on Table WB-3, the potential increase in infiltration has been calculated separately for each of the proposed housing forms (i.e., single detached, semi-detached and townhouses). The amount of infiltration that occurs under existing conditions is generally limited by the water availability (i.e., climate and water surplus) as opposed to the soil characteristics, so as shown by these calculations, in the presence of additional water availability, the potential infiltration rates can go up significantly. As such, direction of roof runoff to pervious areas is considered to be an effective LID measure.

Table WB-4 presents the water balance calculations with such LID measures in place within the residential areas. The results show that under this LID scenario (75% of roof runoff being diverted to pervious areas), the potential infiltration deficit would be significantly reduced in the development area, with infiltration volumes within 6% of the calculated volumes in the pre-development scenario (Tables WB-2 and WB-4). Given the conservative assumptions and margins of error in the calculations, this is considered to be a very good result that demonstrates the effectiveness of such LID measures.

It is noted that we have only attempted to quantify LID measures in the residential areas on Table WB-4, however, TMIG has indicated that additional topsoil thickness will also be placed in parks, school yards, SWM Pond blocks and the channel blocks to try to promote more infiltration in these areas. The use of additional topsoil to enhance infiltration in these areas was examined in the subwatershed impact study (Subwatershed Impact Study Block 2-Boyne Survey Secondary Plan, MTE, July 2015) and suggested infiltration may be enhanced by more than 50%. Assuming a similar enhancement over the Main Sail Estate lands would mean an additional 1,830 m^3/year from the channel and an additional 1,110 m^3/year from the SWM Ponds. These additional volumes (total of 2,940 m^3/year) would be adequate to provide up to 99% of the deficit in infiltration in the developed area.

3.0 Conclusions

The evaluation of the water balance, under pre-, post- and post-development with LID measures (i.e., roof runoff diversion to pervious areas within residential areas of the subdivision) was undertaken. This analysis indicates that this LID scenario was sufficient to significantly reduce the post-development infiltration deficit (94% of the pre-development infiltration would be maintained). When coupled with LID measures in other areas of the development, i.e., the placement of increased topsoil depths in parks, school yards, SWM Pond blocks and channel blocks, the post-development infiltration deficit will be further reduced.

Within the scope of the assumptions made for the calculations, it is concluded that the pre-development infiltration volumes can be maintained through implementation of the proposed LID measures for stormwater management within the Main Sail Development.

Yours truly,

R.J. Burnside & Associates Limited

Dwight Smikle, M.Sc., P.Geo.
Senior Hydrogeologist
DS/JT:cl

Joanne Thompson, M.Sc., P.Geo.
Senior Leader, Development Hydrogeology

Enclosure(s)

Other than by the addressee, copying or distribution of this document, in whole or in part, is not permitted without the express written consent of R.J. Burnside & Associates Limited.

In the preparation of the various instruments of service contained herein, R.J. Burnside & Associates Limited was required to use and rely upon various sources of information (including but not limited to: reports, data, drawings, observations) produced by parties other than R.J. Burnside & Associates Limited. For its part R.J. Burnside & Associates Limited has proceeded based on the belief that the third party/parties in question produced this documentation using accepted industry standards and best practices and that all information was therefore accurate, correct and free of errors at the time of consultation. As such, the comments, recommendations and materials presented in this instrument of service reflect our best judgment in light of the information available at the time of preparation. R.J. Burnside & Associates Limited, its employees, affiliates and subcontractors accept no liability for inaccuracies or errors in the instruments of service provided to the client, arising from deficiencies in the aforementioned third party materials and documents.

R.J. Burnside & Associates Limited makes no warranties, either express or implied, of merchantability and fitness of the documents and other instruments of service for any purpose other than that specified by the contract.

WATER BALANCE CALCULATIONS
Main Sail Estates
Milton Block 1, Milton

PROJECT No.300035199

BURNSIDE

TABLE WB-1

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 150 mm (shallow to moderate rooted vegetation in silty clay)

Precipitation data from Georgetown WWTP Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	
Average Temperature (Degree C)	-6.3	-5.2	-0.9	6.0	12.3	17.4	20.0	19.0	14.8	8.4	2.8	-2.9	**7.1**	<--From Environment Canada
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.30	3.89	6.59	8.16	7.52	5.16	2.18	0.42	0.00	**35.2**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	27.81	59.56	86.07	99.80	94.34	72.56	39.80	12.56	0.00	**493**	
Adjusting Factor for U (Latitude 43° 52' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961), pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	31	75	110	129	113	75	38	10	0	**582**	
PRE-DEVELOPMENT WATER BALANCE COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	68	60	57	76	79	75	74	79	86	68	88	66	**877**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	0	31	75	110	129	113	75	38	10	0	**582**	
P - PET	68	60	57	45	4	-35	-55	-34	11	30	78	66	**296**	
Change in Soil Moisture Storage	0	0	0	0	0	-35	-55	-34	11	30	78	5	**0**	
Soil Moisture Storage max 150 mm	150	150	150	150	150	115	59	26	36	67	145	150		
Actual Evapotranspiration (AET)	0	0	0	31	75	110	129	113	75	38	10	0	**582**	
Soil Moisture Deficit max 150 mm	0	0	0	0	0	35	91	124	114	83	5	0		
Water Surplus - available for infiltration or runoff	68	60	57	45	4	0	0	0	0	0	0	61	**296**	
Potential Infiltration (based on MOECC methodology*; independent of temperature)	34	30	29	23	2	0	0	0	0	0	0	30	**148**	
Potential Surface Water Runoff (independent of temperature)	34	30	29	23	2	0	0	0	0	0	0	30	**148**	
IMPERVIOUS AREA WATER SURPLUS														
Annual Precipitation (P)	877	mm/yr												
Potential Evaporation (PE) from impervious areas (assume 15%)	132	mm/yr												
P-PE (surplus available for runoff from impervious areas)	746	mm/yr												

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage	150 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003
*MOECC SWM infiltration calculations		
topography - rolling land	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - relatively tight silty clay materials with fractures	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - predominantly cultivated land	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	0.5	
Latitude of site (or climate station)	43 °N.	

WATER BALANCE CALCULATIONS
Main Sail Estates
Milton Block 1, Milton

PROJECT No.300035199

BURNSIDE

TABLE WB-2

Land Use Description	Approx. Land Area* (m^2)	Estimated Impervious Fraction for Land Use	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area* (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration in Pervious Area* (m/a)	Infiltration Volume in Pervious Area (m^3/a)	Total Annual Runoff Volume (m^3/a)	Total Annual Infiltration Volume (m^3/a)
Exising Land Use												
Open Space/ Agricultural Land	412,000	0.00	0	0.746	0	412,000	0.148	60,885	0.148	60,885	60,885	60,885
TOTAL PRE-DEVELOPMENT	**412,000**		**0**		**0**	**412,000**		**60,885**		**60,885**	**60,885**	**60,885**
Post-Development Land Use (no LID)												
Single Detached Residential	115,200	0.43	49,536	0.746	36,942	65,664	0.148	9,704	0.148	9,704	46,646	9,704
Semi Detached Residential	37,300	0.57	21,261	0.746	15,856	16,039	0.148	2,370	0.148	2,370	18,226	2,370
Townhouses/ Apartments	40,800	0.79	32,232	0.746	24,037	8,568	0.148	1,266	0.148	1,266	25,303	1,266
Elementary School	27,500	0.79	21,725	0.746	16,202	5,775	0.148	853	0.148	853	17,055	853
Commercial	12,100	0.93	11,253	0.746	8,392	847	0.148	125	0.148	125	8,517	125
Major Node	10,600	0.93	9,858	0.746	7,352	742	0.148	110	0.148	110	7,461	110
Parks	5,500	0.07	385	0.746	287	5,115	0.148	756	0.148	756	1,043	756
Open Space/ Buffers	2,300	0.00	0	0.746	0	2,300	0.148	340	0.148	340	340	340
SWM Pond	30,200	0.50	15,100	0.746	11,261	15,100	0.148	2,231	0.148	2,231	13,492	2,231
Greenland Channel	24,800	0.00	0	0.746	0	24,800	0.148	3,665	0.148	3,665	3,665	3,665
Road Widening (Boulevard)	15,200	0.07	1,064	0.746	793	14,136	0.148	2,089	0.148	2,089	2,883	2,089
Local Roads/ROW	90,500	0.71	64,255	0.746	47,919	26,245	0.148	3,878	0.148	3,878	51,797	3,878
TOTAL POST-DEVELOPMENT	**412,000**		**226,669**		**169,040**	**185,331**		**27,388**		**27,388**	**196,428**	**27,388**
										% Change from Pre to Post	323	55
										Effect of development (with no mitigation)	3.2 times increase in runoff	55% reduction of infiltration

* figures from Table WB-1

To balance pre- to post-,
the infiltration target (m^3/a)= **33,497**

BURNSIDE

TABLE WB-3

Post-Development Monthly Water Balance Components With Direction of 75% Roof Runoff to 75% Pervious Areas in Residential Areas with Increased Topsoil Depth
Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 100 mm (urban lawns in silty clay soils)
Precipitation data from Georgetown WWTP Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	
Average Temperature (Degree C) from Georgetown WWTP Climate Station 1981-2010	-6.3	-5.2	-0.9	6.0	12.3	17.4	20.0	19.0	14.8	8.4	2.8	-2.9	7.1	<--From Environment Canada
Heat index: i = (t/5)^1.514	0.00	0.00	0.00	1.36	3.83	6.59	8.16	7.52	5.16	2.18	0.42	0.00	35.2	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	27.81	59.58	86.07	99.80	94.34	72.56	39.80	12.56	0.00	493	
Adjusting Factor for U (Latitude 43° 44' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961), pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	31	75	110	129	113	75	38	10	0	582	
COMPONENTS - Pervious Areas in Single Detached with Mitigation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P) From Georgetown WWTP Climate Station 1981-2010	68	60	57	76	79	75	74	79	66	68	88	66	877	
Potential Evaporation (PE) from impervious areas (assume up to 15% of P)	10	9	9	11	12	11	11	12	13	10	13	10	132	
P-PE (surplus water from impervious areas, e.g., roof runoff capture)	58	51	49	65	67	64	62	67	73	58	75	56	746	
Roof runoff directed over pervious area (see Note 1)	54	48	45	61	63	59	58	63	69	54	70	52	697	
Total water supply directed to backyards (rain plus total roof runoff)	122	108	103	137	142	134	132	142	155	123	159	118	1574	
Potential Evapotranspiration from pervious areas (PET)	0	0	0	31	75	110	129	113	75	38	10	0	582	
Total water available to pervious areas - PET = total potential surplus on pervious areas	122	108	103	106	67	24	3	29	79	85	149	118	993	
Change in Soil Moisture Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	
Soil Moisture Storage max 100 mm	100	100	100	100	100	100	100	100	100	100	100	100		
Actual Evapotranspiration (AET) = PET	0	0	0	31	75	110	129	113	75	38	10	0	582	
Soil Moisture Deficit max 100 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total water surplus available for infiltration or runoff on pervious areas	122	108	103	106	67	24	3	29	79	85	149	118	993	
Potential Infiltration (based on MOE methodology*, independent of temperature)	73	65	62	64	40	14	2	17	48	51	89	71	596	
Potential Surface Water Runoff (independent of temperature)	49	43	41	42	27	10	1	12	32	34	59	47	397	
COMPONENTS - Pervious Areas in Semi-Detached with Mitigation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P) From Georgetown WWTP Climate Station 1981-2010	68	60	57	76	79	75	74	79	66	68	88	66	877	
Potential Evaporation (PE) from impervious areas (assume up to 15% of P)	10	9	9	11	12	11	11	12	13	10	13	10	132	
P-PE (surplus water from impervious areas, e.g., roof runoff capture)	58	51	49	65	67	64	62	67	73	58	75	56	746	
Roof runoff directed over pervious area (see Note 1)	51	45	43	58	60	57	56	60	65	52	67	50	665	
Total water supply directed to backyards (rain plus total roof runoff)	119	105	101	134	139	132	129	139	152	120	155	115	1542	
Potential Evapotranspiration from pervious areas (PET)	0	0	0	31	75	110	129	113	75	38	10	0	582	
Total water available to pervious areas - PET = total potential surplus on pervious areas	119	105	101	103	64	21	0	26	76	82	145	115	960	
Change in Soil Moisture Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	
Soil Moisture Storage max 100 mm	100	100	100	100	100	100	100	100	100	100	100	100		
Actual Evapotranspiration (AET) = PET	0	0	0	31	75	110	129	113	75	38	10	0	582	
Soil Moisture Deficit max 100 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total water surplus available for infiltration or runoff on pervious areas	119	105	101	103	64	21	0	26	76	82	145	115	960	
Potential Infiltration (based on MOECC methodology*, independent of temperature)	72	63	60	62	39	13	0	16	46	49	87	69	576	
Potential Surface Water Runoff (independent of temperature)	48	42	40	41	26	9	0	10	30	33	58	46	384	
COMPONENTS - Pervious Areas in Townhomes/ Apartments with Mitigation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P) From Georgetown WWTP Climate Station 1981-2010	68	60	57	76	79	75	74	79	66	68	88	66	877	<--From Environment Canada
Potential Evaporation (PE) from impervious areas (assume up to 15% of P)	10	9	9	11	12	11	11	12	13	10	13	10	132	
P-PE (surplus water from impervious areas, e.g., roof runoff capture)	58	51	49	65	67	64	62	67	73	58	75	56	746	
Roof runoff directed over pervious area (see Note 1)	117	104	99	132	137	130	127	137	149	118	153	114	1519	
Total water supply directed to pervious areas (rain plus total roof runoff)	185	164	156	209	217	204	201	217	236	187	242	180	2396	
Potential Evapotranspiration from pervious areas (PET)	0	0	0	31	75	110	129	113	75	38	10	0	582	
Total water available to pervious areas - PET = total potential surplus on pervious areas	185	164	156	178	141	94	72	103	160	149	231	180	1815	
Change in Soil Moisture Storage	0	0	0	0	0	0	0	0	0	0	0	0	0	
Soil Moisture Storage max 100 mm	100	100	100	100	100	100	100	100	100	100	100	100		
Actual Evapotranspiration (AET) = PET	0	0	0	31	75	110	129	113	75	38	10	0	582	
Soil Moisture Deficit max 100 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total water surplus available for infiltration or runoff on pervious areas	185	164	156	178	141	94	72	103	160	149	231	180	1815	
Potential Infiltration (based on MOECC methodology*, independent of temperature)	111	98	94	107	85	57	43	62	96	89	139	108	1089	
Potential Surface Water Runoff (independent of temperature)	74	66	63	71	57	38	29	41	64	59	93	72	726	

Post-Development Water Balance Inputs

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage - Urban Lawns - Silty Clay	100 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003
*MOECC SWM infiltration calculations		
topography - rolling land - graded	0.25	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils -silty clay materials with fractures, thicker topsoil to promote storage/infiltration	0.25	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawn	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	0.6	
Latitude of site (or climate station)	43 °N	

Note 1: Roof Runoff Capture a Ratio
Ratio of Roof Areas to Receiving Pervious Areas

Single Detached Residential - assume 3/4 roof (32% of lot area) directed to 3/4 pervious areas (34.5% of lot area)	0.93
Semi-Detached Residential - assume 3/4 roof (31% of lot area) directed to pervious area (34.5% of lot area)	0.89
Townhomes - assume 3/4 roof (41% of lot area) directed to 3/4 pervious area (20% of lot area is pervious)	2.04

WATER BALANCE CALCULATIONS
Main Sail Estates
Milton Block 1, Milton

PROJECT No.300035199

BURNSIDE

TABLE WB-4

Example Water Balance for Main Sail With Direction of 75% Roof Runoff to Pervious Areas in Residential Areas and Increased Topsoil Depth

Land Use Description		Approx. Land Area (m^2)	Estimated Impervious Fraction for Land Use*	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Pre-Development Land Use													
Open Field / Agricultural		412,000	0.000	0	0.746	0	412,000	0.148	60,885	0.148	60,885	60,885	60,885
TOTAL PRE-DEVELOPMENT		**412,000**		**0**		**0**	**412,000**		**60,885**		**60,885**	**60,885**	**60,885**
Post-Development Land Use													
Single Detached Residential	Roof Runoff Directed to Pervious Areas (assume 3/4 of roof)	37,152	1.00	37,152	0.746	0	0	0.148	0	0.148	0	0***	0
	Roofs and Driveways not Directed to Pervious Areas	25,056	1.00	25,056	0.746	18,686	0	0.148	0	0.148	0	18,686	0
	Pervious Areas Receiving Roof Runoff (assume 3/4 of pervious	39,744	0.00	0	0.746	0	39,744	0.397	15,781	0.596	23,672	15,781	23,672
	Pervious Areas Not Receiving Roof Runoff	13,248	0.00	0	0.746	0	13,248	0.148	1,958	0.148	1,958	1,958	1,958
Semi-Detached Residential	Roof Runoff Directed to Pervious Areas (assume 3/4 of roof)	11,470	1.00	11,470	0.746	8,554	0	0.148	0	0.148	0	0***	0
	Roofs and Driveways not Directed to Pervious Areas	8,672	1.00	8,672	0.746	6,467	0	0.148	0	0.148	0	6,467	0
	Pervious Areas Receiving Roof Runoff (assume 3/4 of pervious	12,869	0.00	0	0.746	0	12,869	0.384	4,943	0.576	7,414	4,943	7,414
	Pervious Areas Not Receiving Roof Runoff	4,290	0.00	0	0.746	0	4,290	0.148	634	0.148	634	634	634
Townhouses	Roof Runoff Directed to Pervious Areas (assume 3/4 of roof)	16,830	1.00	16,830	0.746	12,551	0	0.148	0	0.148	0	0***	0
	Roofs and Driveways not Directed to Pervious Areas	12,954	1.00	12,954	0.746	9,661	0	0.148	0	0.148	0	9,661	0
	Pervious Areas Receiving Roof Runoff (assume 3/4 of pervious	8,262	0.00	0	0.746	0	8,262	0.726	5,997	1.089	8,996	5,997	8,996
	Pervious Areas Not Receiving Roof Runoff	2,754	0.00	0	0.746	0	2,754	0.148	407	0.148	407	407	407
Elementary School		27,500	0.79	21,725	0.746	16,202	5,775	0.148	853	0.148	853	17,055	853
Commercial		12,100	0.93	11,253	0.746	8,392	847	0.148	125	0.148	125	8,517	125
Major Node		10,600	0.93	9,858	0.746	7,352	742	0.148	110	0.148	110	7,461	110
Parks		5,500	0.07	385	0.746	287	5,115	0.148	756	0.148	756	1,043	756
Open Space/ Buffers		2,300	0.00	0	0.746	0	2,300	0.148	340	0.148	340	340	340
SWM Pond		30,200	0.50	15,100	0.746	11,261	15,100	0.148	2,231	0.148	2,231	13,492	2,231
Greenland Channel		24,800	0.00	0	0.746	0	24,800	0.148	3,665	0.148	3,665	3,665	3,665
Road Widening		15,200	0.07	1,064	0.746	793	14,136	0.148	2,089	0.148	2,089	2,883	2,089
Local Roads/ROW		90,500	0.71	64,255	0.746	47,919	26,245	0.148	3,878	0.148	3,878	51,797	3,878
TOTAL POST-DEVELOPMENT		**412,000**		**235,774**		**148,124**	**176,226**		**43,768**		**57,129**	**170,787**	**57,129**
											% Change from Pre to Post	281	6
											Effect of development	2.8 times increase in runoff	6% reduction of infiltration

** figures from Tables WB-1 and WB-3

*** runoff directed to pervious areas is accounted for in pervious area infiltration and runoff totals

To balance pre- to post-, the infiltration target (m^3/a)= **3,757**

SCHAEFFERS
CONSULTING ENGINEERS

6 Ronrose Drive
Concord, Ontario L4K 4R3
Tel: (905) 738-6100
Fax: (905) 738-6875
E-Mail: general@schaeffers.com
T.O. Line: (416) 213-5590

MEMORANDUM

To: **Eeshan Kumar**
Senior Water Resources Engineer
WSP Canada

From: **Sadh Katukurunde,** *P.Eng.*
Junior Associate
Mohandeep Singh, *M.Eng., P.Eng.*
Water Resources Engineer

Date: **August 2025**

Our File: **2017-4568**

Subject: **SWM Pond H Verification**
Shearling Heights
Britannia Road & Bronte Street S.
Town of Milton, Halton Region

INTRODUCTION

Schaeffers Consulting Engineers (SCE) has prepared this memorandum in support of the proposed stormwater management strategy (SWM) for the subject development, Shearling Heights. The development, located on the northeast corner of Britannia Road and Bronte Street South in the Town of Milton, is proposing to convey its stormwater to an existing stormwater management pond, SWM Pond H. This pond was not originally designed to accept this drainage. As part of the Town of Milton approval process, WSP Canada, have been asked to verify the capacity of the existing SWM Pond H and the receiving watercourse. The purpose of this memorandum is to provide WSP Canada the necessary information as it pertains to the subject development, to complete the pond verification analysis. It should be noted that the original SWM proposal was to drain approximately 30% of the site (approx. 0.7 ha) to the SWM pond which was approved in principle by the

Town of Milton. The current proposal is to convey a majority of the site to the pond, approximately 1.9 ha or about 90% of the subject lands.

SWM DETAILS

The SWM proposal will consist of both uncontrolled and controlled area which is highlighted on the attached drainage plan – Figure 2. The controlled area of 1.92 ha as shown on the figure, is proposed to be fully captured and controlled to 69 L/s and discharged to the Chretien Street storm sewer which will ultimately drain to the SWM pond. This will be the case up to and including the 100-year storm. Storage will be provided by a storage pipe system equipped with an orifice to provide attenuation. Note, a conservative sump pump flow of 8 L/s was considered in the design to account for groundwater. Calculations are provided in the attachments. The rating curve is summarized in Table 2. Approximately 0.20 ha will drain uncontrolled (see Figure 2) towards Britannia Road and Bronte Street South, away from the SWM pond. For the Regional storm which is not proposed to be controlled, approximately 0.72 ha of the site is proposed to drain to the existing SWM pond as overland flow through the existing ROWs (Chretien Street, Bronson Terrace). The approximate extent of this area is shown on Figure 2. The remaining area of the site will drain south towards Britannia Road via Chretien Street and then west towards Bronte Street South, away from the SWM pond. Note, this grading approach is consistent with the previously approved SWM concept by the Town of Milton. Please note that Regional controls are not being proposed due to the impractical nature of providing Regional storage on-site as it would be considerably large whereas storage space is limited. Erosion control will be provided via retaining 5mm on site, approximately 91 m^3, in a water reuse tank. SWM details are summarized in the following table.

Table 1: SWM Summary

Proposed Drainage Area to Pond *(controlled, up to and including 100yr, see Figure 2 in attachments)*	Area = 1.92 ha Runoff C = 0.85 Imperviousness = 0.93
Regional/Emergency Drainage Area to Pond *(uncontrolled)* *(This is a portion of the total 1.92 ha drainage area, see Figure 2 in attachments)*	Area = 0.72 ha Runoff C = 0.85 Imperviousness = 0.93
Existing Drainage Area *(not draining to pond, see Figure 1 in attachments)*	Area = 2.12 ha Runoff C = 0.25 Imperviousness = 0.07
External Drainage Area	N/A
100 Year Release Rate (to storm sewer)	69 L/s
SWM Concept	Storage Pipe equipped with an orifice tube providing 100-year controls.
Rating Curve	Orifice Tube = 150 mm dia Invert = 185.21m HWL = 186.69m *See Attachments*
Storage Summary	Required Storage = 705 m^3 Available Storage = 784 m^3 *See Attachments*
Outlet	Chretien Street storm sewer HGL = 185.49m
Erosion Control	On-site 5mm retention (water reuse tank) Storage = 91 m^3
LID Measures	N/A

Table 2: Rating Curve

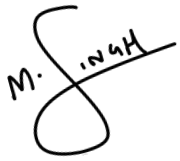
Elevation (m)	Water Depth (m)	Effective Head (m)	Flow (L/s)	Active Storage (m^3)
185.21 (orifice invert)	0.28	0.00	0.0	0.0
185.59	0.38	0.10	20.0	6.8
185.99	0.78	0.50	44.0	222.7
186.19	0.98	0.70	52.0	375.2
186.24	1.03	0.75	54.0	415.2
186.29	1.08	0.80	56.0	452.8
186.69	1.48	1.20	69.0	705.1

CONCLUSION

We trust that this memorandum fulfills WSP's requirements to complete the pond verification analysis. Should you have any questions regarding this document, please do not hesitate to contact the undersigned.

Sincerely,

SCHAEFFER & ASSOCIATES LTD.

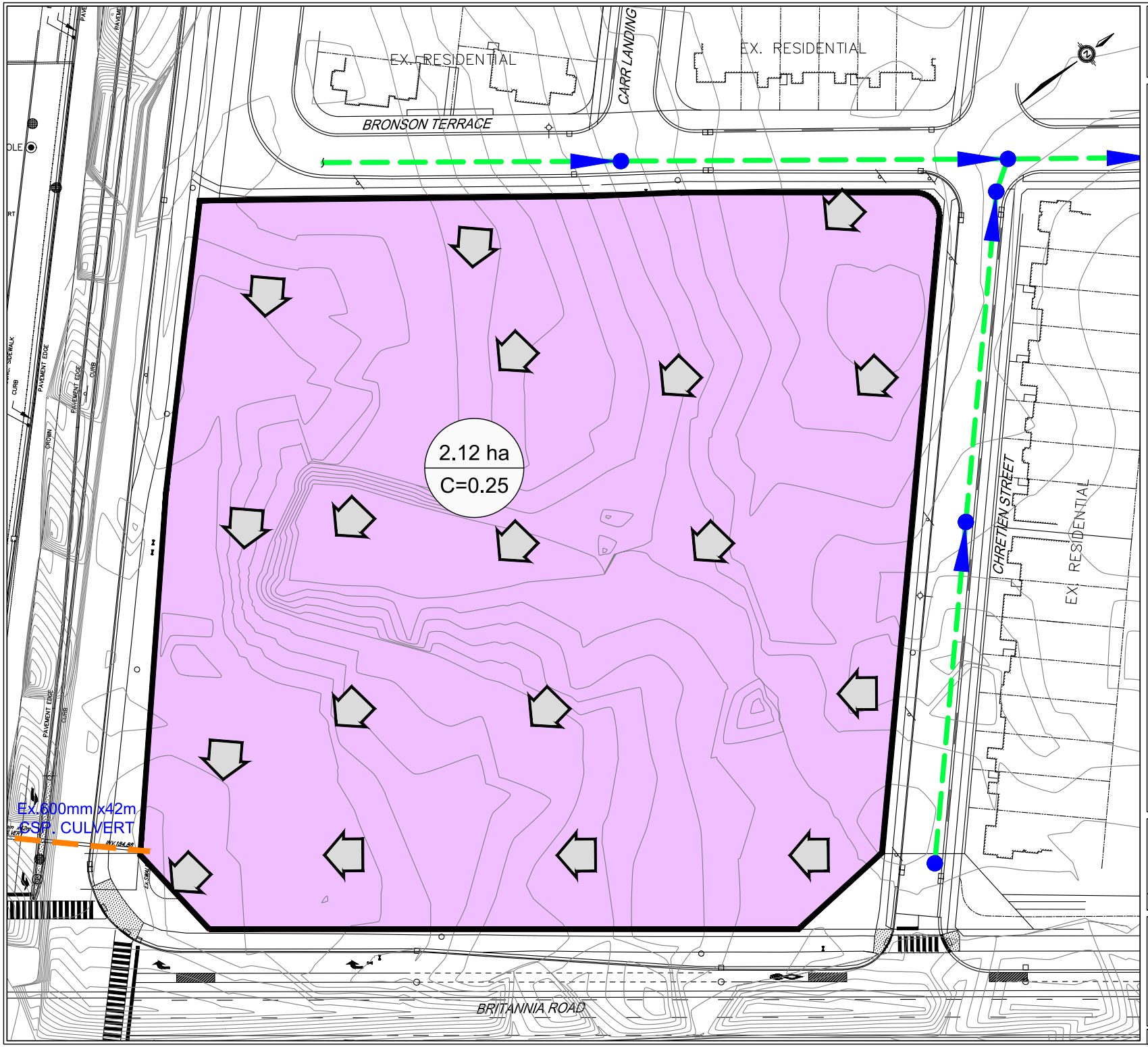


Mohandeep Singh, M.Eng., P.Eng.
Water Resources Engineer



Sadh Katukurunde, P.Eng.
Junior Associate

ATTACHMENTS



SHEARLING HEIGHTS

LEGEND

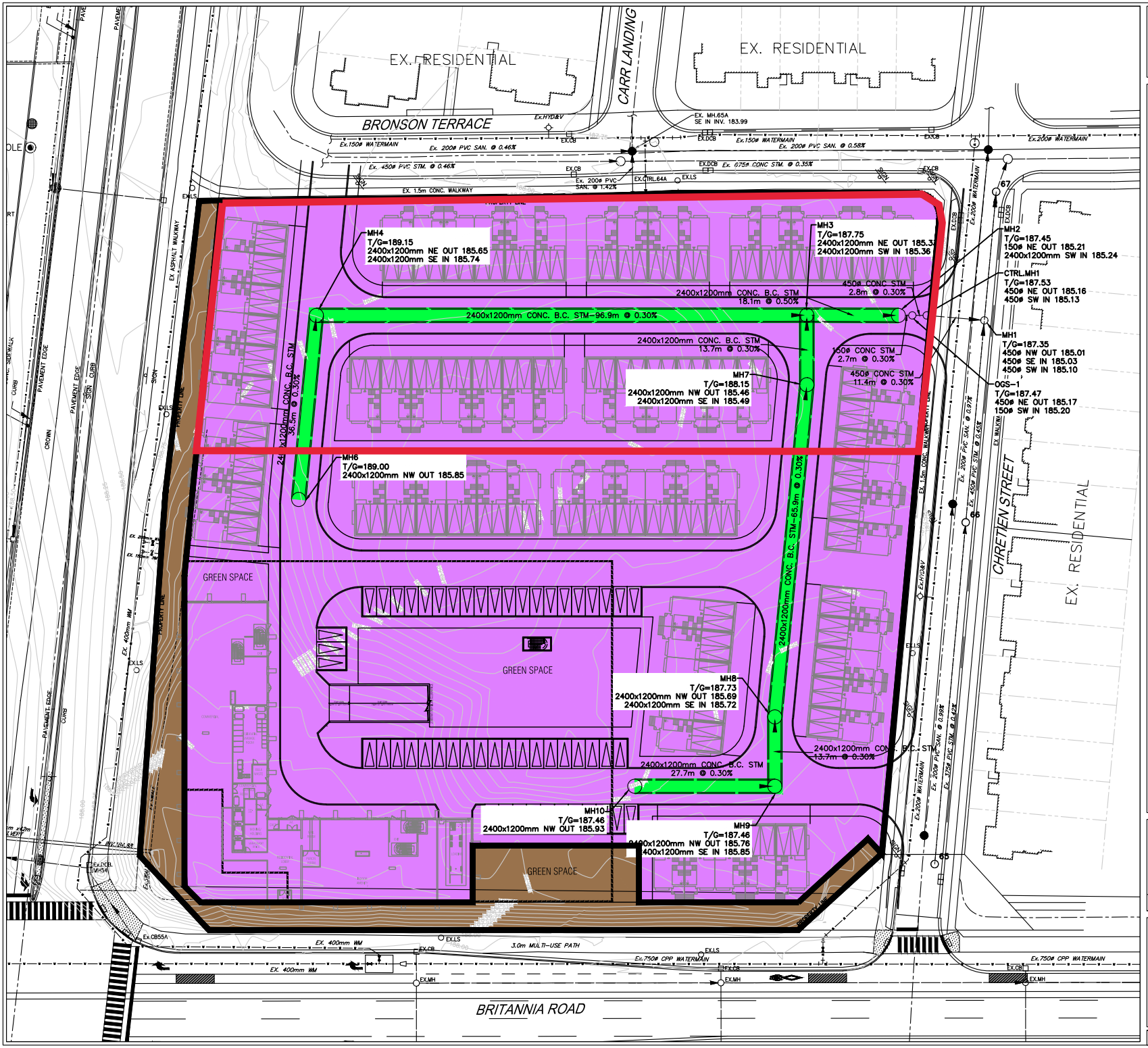
- SUBJECT SITE
- PRE DEVELOPMENT DRAINAGE AREA
- OVERLAND FLOW DRAINAGE DIRECTION
- EXISTING STORM SEWERS

SCHAEFFERS CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 1
EXISTING CONDITIONS

2017-4568	AUGUST 2024	SCALE: N.T.S.

Phil Gotfried



SHEARLING HEIGHTS

LEGEND

- CONTROLLED DRAINAGE AREA = 1.92ha
- UNCONTROLLED DRAINAGE AREA = 0.20ha
- PROPOSED STORM BOX SEWERS
- REGIONAL UNCONTROLLED TO POND AREA = 0.72ha

SCHAEFFERS
CONSULTING ENGINEERS
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel: (905) 738-6100 Email: general@schaeffers.com
www.schaeffers.com

FIGURE 2
STORM SERVICING PLAN

2017-4568	AUGUST 2025	SCALE: N.T.S.

SWM Storage

Schaeffers Consulting Engineers

Project Name: Shearling Heights

Modified Rational Method - Tank

Area (ha) =	1.920
C =	0.85
Allowable Release Rate (l/s) =	69.0
Actual Release Rate (l/s) =	69.0

Release Rate from Sump Pump (l/s) =	8.00
Release from Roof (l/s) =	0.00

100 Year Storm

Design Storm =	Town of Milton
A =	1435
B =	5.2
C =	0.7751

						Total	Maximum	Required
Time	Intensity	Rainfall	Runoff	Sump Pump	Total	Runoff	Release	Storage
(min)	100 year	Runoff	Roof	Tank	Runoff	Volume	Volume	Volume
	(mm/hr)	(l/s)	(l/s)	(l/s)	(l/s)	(m^3)	(m^3)	(m^3)
10	174.10	789.90	0.00	8.00	797.90	478.74	41.40	437.34
11	165.71	751.83	0.00	8.00	759.83	501.49	45.54	455.95
12	158.20	717.73	0.00	8.00	725.73	522.52	49.68	472.84
13	151.42	686.97	0.00	8.00	694.97	542.07	53.82	488.25
14	145.27	659.07	0.00	8.00	667.07	560.34	57.96	502.38
15	139.66	633.63	0.00	8.00	641.63	577.47	62.10	515.37
16	134.53	610.34	0.00	8.00	618.34	593.61	66.24	527.37
17	129.81	588.92	0.00	8.00	596.92	608.86	70.38	538.48
18	125.45	569.15	0.00	8.00	577.15	623.32	74.52	548.80
19	121.41	550.84	0.00	8.00	558.84	637.07	78.66	558.41
20	117.66	533.82	0.00	8.00	541.82	650.18	82.80	567.38
21	114.16	517.95	0.00	8.00	525.95	662.70	86.94	575.76
22	110.90	503.13	0.00	8.00	511.13	674.70	91.08	583.62
23	107.84	489.25	0.00	8.00	497.25	686.20	95.22	590.98
60	56.32	255.50	0.00	8.00	263.50	948.61	248.40	700.21
65	53.18	241.28	0.00	8.00	249.28	972.19	269.10	703.09
70	**50.42**	**228.75**	**0.00**	**8.00**	**236.75**	**994.35**	**289.80**	**704.55**
75	47.97	217.62	0.00	8.00	225.62	1015.27	310.50	704.77
80	45.77	207.65	0.00	8.00	215.65	1035.12	331.20	703.92
85	43.79	198.67	0.00	8.00	206.67	1054.03	351.90	702.13
90	42.00	190.54	0.00	8.00	198.54	1072.09	372.60	699.49
95	40.36	183.12	0.00	8.00	191.12	1089.40	393.30	696.10
100	38.87	176.34	0.00	8.00	184.34	1106.04	414.00	692.04
105	37.49	170.11	0.00	8.00	178.11	1122.07	434.70	687.37
110	36.23	164.36	0.00	8.00	172.36	1137.55	455.40	682.15

Required Storage (m^3):	**705.0**

Shearling Heights
Town of Milton
Orifice Structure in Superpipe

CALCULATE DIAMETER KNOWING Q & H	
Q(m^3/s)=	0.070
Td(m) =	1.43
Approx A=	0.0165
Approx D=	145
A(m^2) =	0.017
D(mm) =	**147**

Control Manhole Orifice		
DIA (mm)=	**150**	
AREA m^2=	0.018	
COEFF =	**0.80**	
GRAVITY =	9.81	
K =	1.0	
D/S HGL=	185.49	m
Orifice Inv.=	185.21	m

Effective Head m	Depth Water At CTL MH m	Qp m^3/s	TOTAL FLOW Qp m^3/s	ELEVATION of Water m
0.00	0.280	0.000	0.000	185.49
0.100	0.380	0.020	0.020	185.59
0.500	0.780	0.044	0.044	185.99
0.700	0.980	0.052	0.052	186.19
0.750	1.030	0.054	0.054	186.24
0.800	1.080	0.056	0.056	186.29
1.200	1.480	0.069	0.069	186.69

ORIFICE FLOW Q(m^3/s)= COEF*AREA*(2*GRAVITY*HEAD/K)^0.5

WEIR FLOW Q(m^3/s)= CLH^1.5 C=1.5

Schaeffers Consulting Engineers

Printed: 19-Aug-25

SCHAEFFERS Consulting Engineers
6 Ronrose Drive, Concord, Ontario L4K 4R3
Tel.: (905) 738-6100
Fax: (905) 738-6875
design@schaeffers.com
SCHAEFFER & ASSOCIATES LTD.

TOWN OF MILTON

186.69

Width 2400
Depth 1200

Designed By:
Checked By:
Date: August 19, 2025
File No.: 4568

Pipe	MH		Inverts		Size (Nominal Diameter Ø)	Length	Slope	Actual Diameter	Obverts		Is Pipe lower than HWL		d/Dia value		a/Area		Cross Sectional Flow		Volume		Volume
			U/S	D/S					U/S	D/S	U/S	D/S	U/S	D/S	U/S	D/S	U/S	D/S	Full/Partial both ends	Full/Partial one end	
	From	To	[masl]	[masl]	[mm]	[m]	[m/m]	[mm]	[masl]	[masl]	F/P/N	F/P/N	--	--	--	--	[m^2]	[m^2]			[m^3]
1	6	4	185.85	185.74	2400 X 1200	36.5	0.30%	NA	187.05	186.94	P	P	0.70	0.79	0.75	0.85	2.15	2.44	83.83	0.00	83.83
2	4	3	185.65	185.36	2400 X 1200	96.9	0.30%	NA	186.85	186.56	P	F	0.87	1.00	0.91	1.00	2.63	2.88	267.20	0.00	267.20
3	3	2	185.33	185.24	2400 X 1200	18.1	0.50%	NA	186.53	186.44	F	F	1.00	1.00	1.00	1.00	2.88	2.88	52.13	0.00	52.13
4	10	9	185.93	185.85	2400 X 1200	27.7	0.29%	NA	187.13	187.05	P	P	0.63	0.70	0.66	0.75	1.91	2.15	56.29	0.00	56.29
5	9	8	185.76	185.72	2400 X 1200	13.7	0.29%	NA	186.96	186.92	P	P	0.78	0.81	0.83	0.86	2.38	2.47	33.22	0.00	33.22
6	8	7	185.69	185.49	2400 X 1200	65.9	0.30%	NA	186.89	186.69	P	F	0.83	1.00	0.89	1.00	2.56	2.88	179.09	0.00	179.09
7	7	3	185.46	185.42	2400 X 1200	13.7	0.29%	NA	186.66	186.62	F	F	1.00	1.00	1.00	1.00	2.88	2.88	39.46	0.00	39.46

---> Input Values
---> Calculated Values

SUBTOTAL	**711.23 m3**
BACKWATER LOSS	**6.17 m3**
TOTAL	**705.06 m3**

SHEARLING HEIGHTS **4568**

Uncontrolled Flow

Town of Milton

Rainfall intensity

Design Storm Event	A	B	C	I (mm/hr)
2-Year	779.0	6.0	0.8206	80.064
5-Year	959.0	5.7	0.8024	105.252
10-Year	1089.0	5.7	0.7955	121.812
25-Year	1234.0	5.5	0.7863	143.007
50-Year	1323.0	5.3	0.7786	158.183
100-Year	1435.0	5.2	0.7751	174.102

Note:
T=10 minutes
I=A x T^C

Peak Runoff Generated On - Site

Runoff Coefficient, C	**0.85**	
Drainage Area	**0.20**	ha
2-Year Peak Flow, Q2	37.8	l/s
5-Year Peak Flow, Q5	49.7	l/s
10-Year Peak Flow, Q10	57.6	l/s
25-Year Peak Flow, Q25	67.6	l/s
50-Year Peak Flow, Q50	74.8	l/s
100-Year Peak Flow, Q100	**82.3**	l/s

Hydroworks Sizing Summary

Shearling Hieights Milton

10-29-2025

Recommended Size: HydroStorm HS 8

Hydroworks Sizing Program Version 5.8.5

A HydroStorm HS 8 is recommended to provide 60 % annual TSS removal based on a drainage area of 2.12 (ha) with an imperviousness of 85 % and Toronto Central, Ontario rainfall for the ETV particle size distribution.

The recommended HydroStorm HS 8 treats 98 % of the annual runoff and provides 62 % annual TSS removal for the Toronto Central rainfall records and ETV particle size distribution.

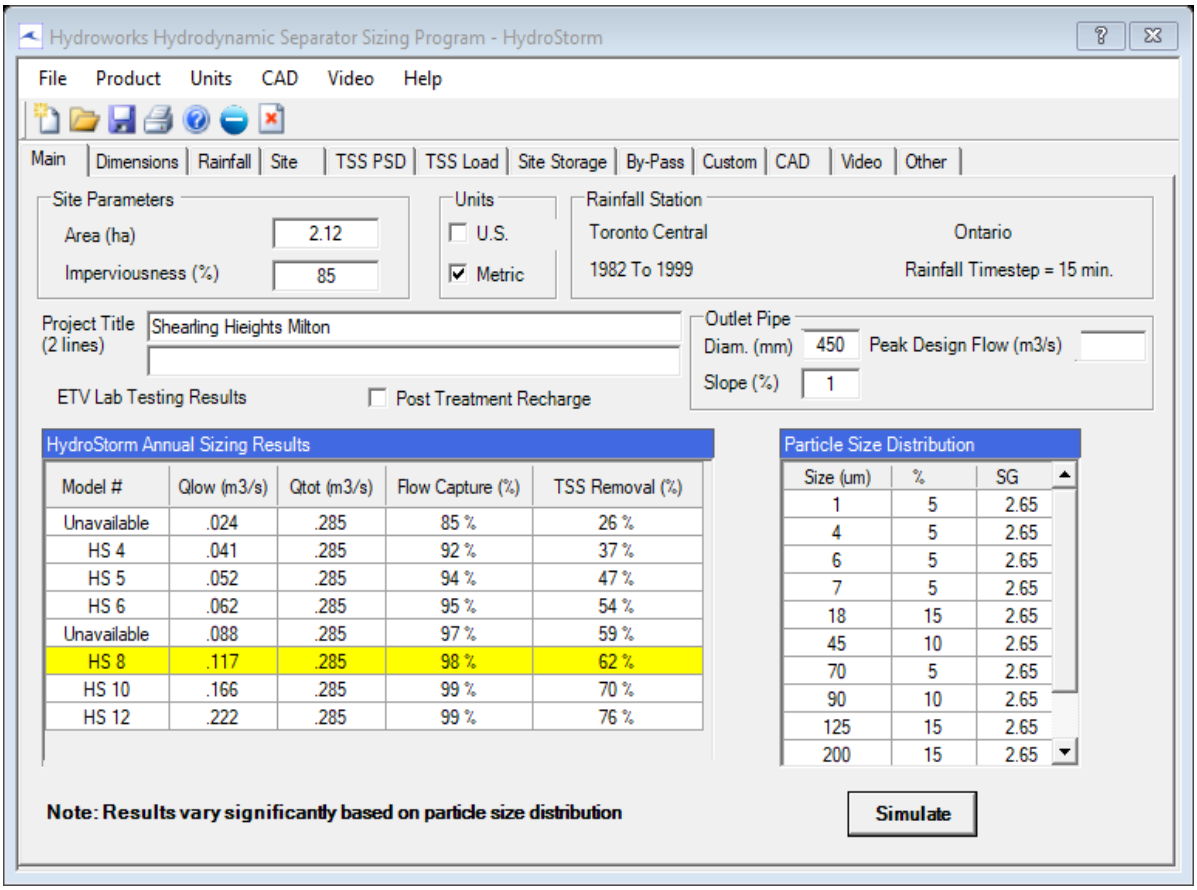
The HydroStorm has a headloss coefficient (K) of 1.04. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .29 (m3/s) for the given 450 (mm) pipe diameter at 1% slope. The headloss was calculated to be 170 (mm) based on a flow depth of 450 (mm) (full pipe flow).

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

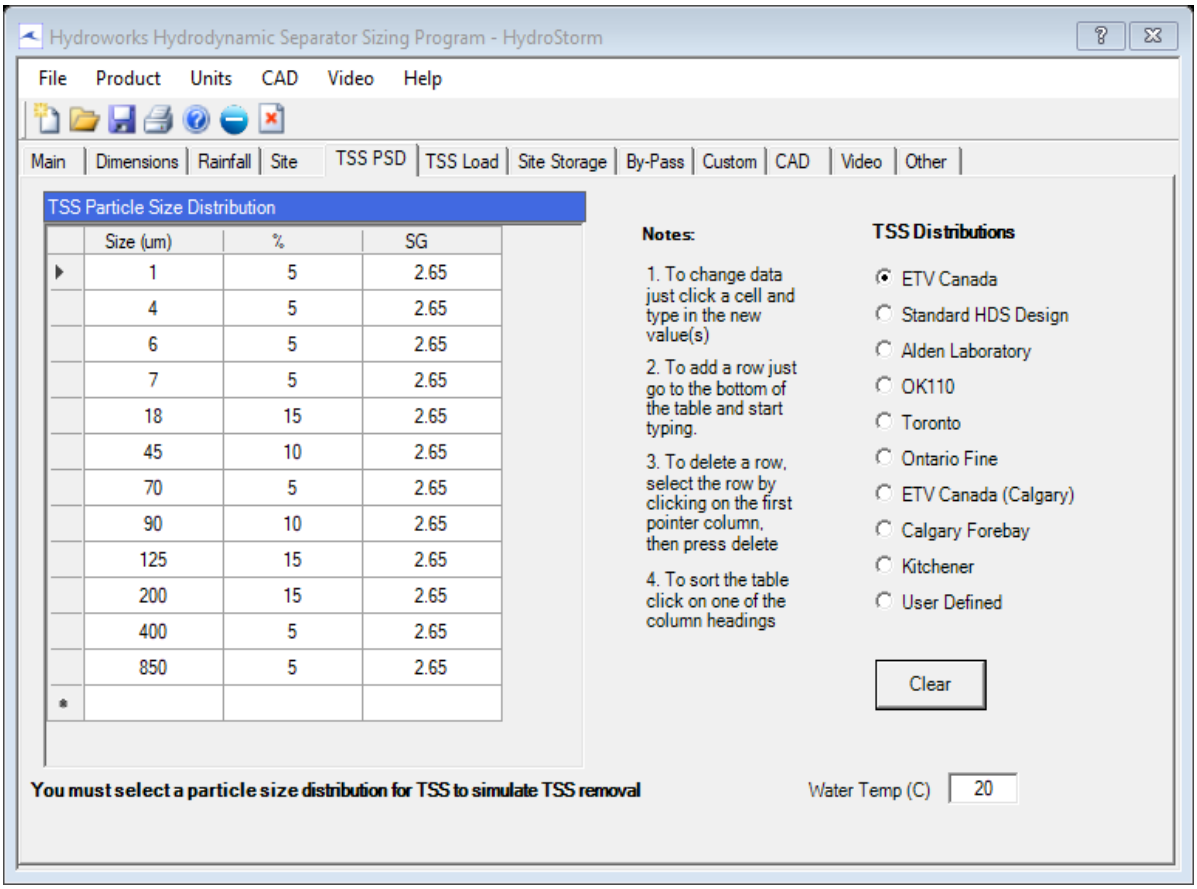
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroStorm .

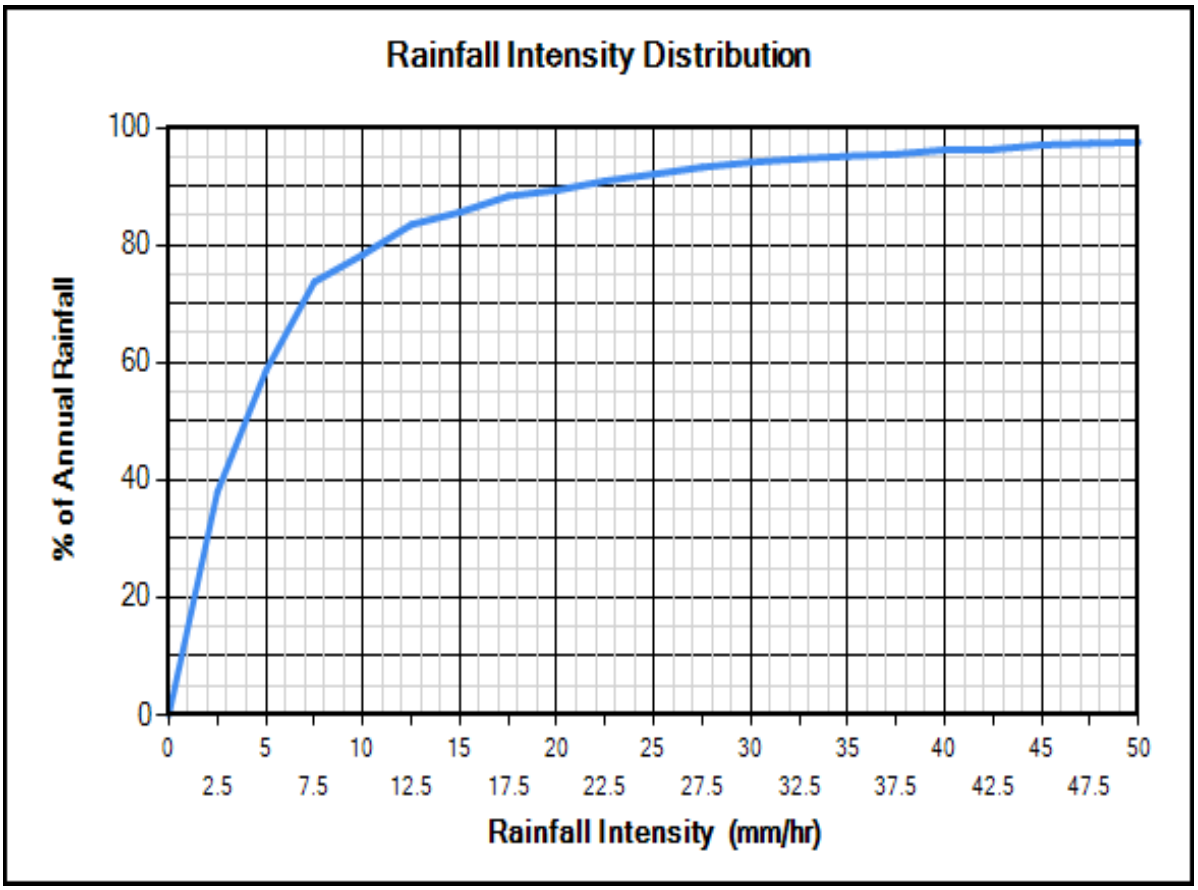
TSS Removal Sizing Summary



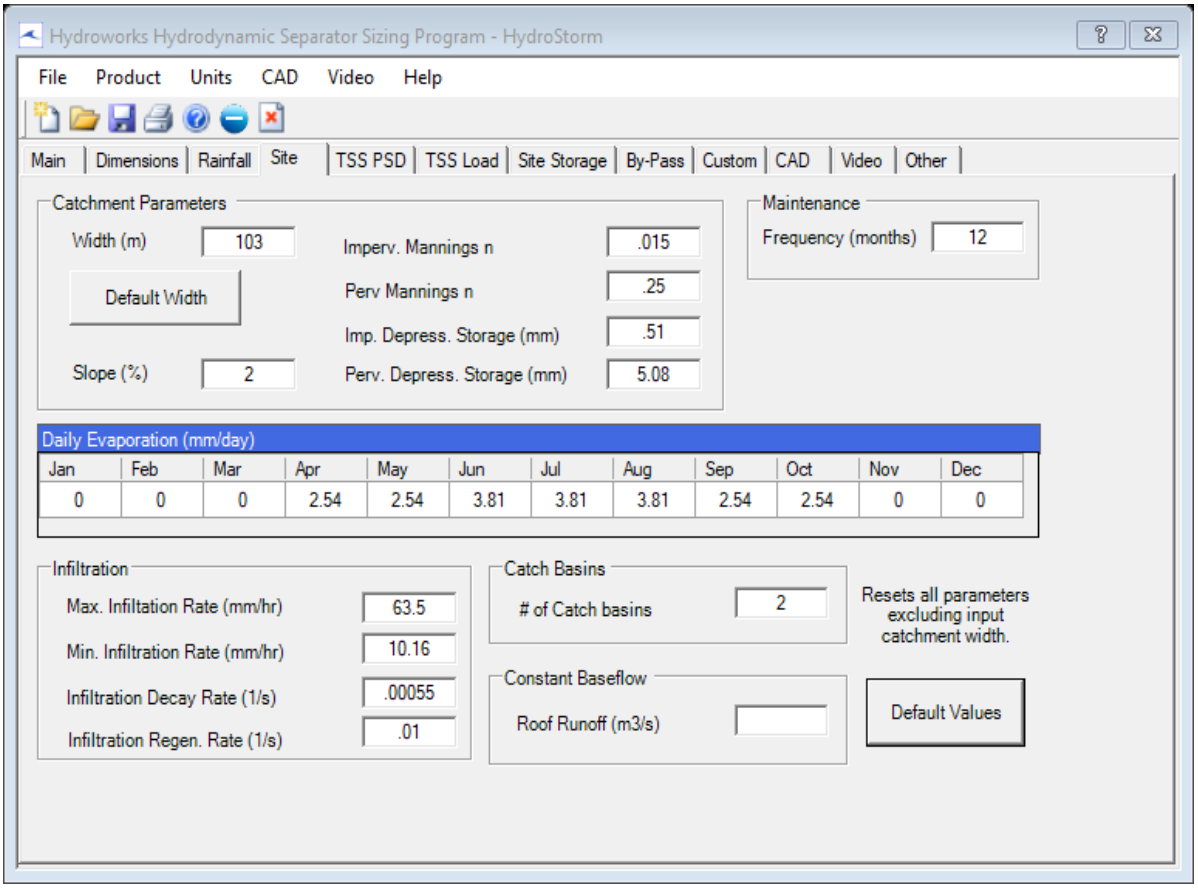
TSS Particle Size Distribution



Rainfall Station - Toronto Central, Ontario(1982 To 1999)



Site Physical Characteristics



Dimensions And Capacities

Hydroworks Hydrodynamic Separator Sizing Program - HydroStorm

File Product Units CAD Video Help

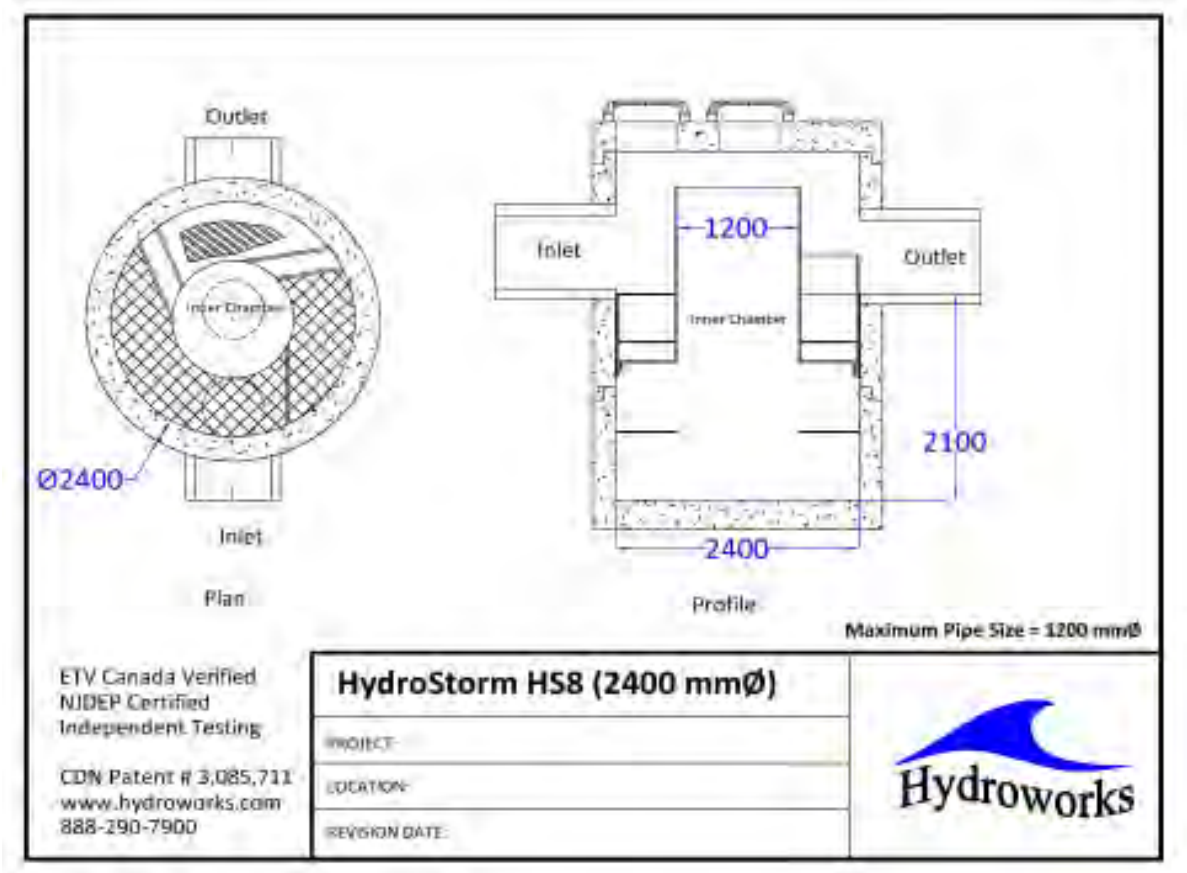
Main | Dimensions | Rainfall | Site | TSS PSD | TSS Load | Site Storage | By-Pass | Custom | CAD | Video | Other

Dimensions and Capacities

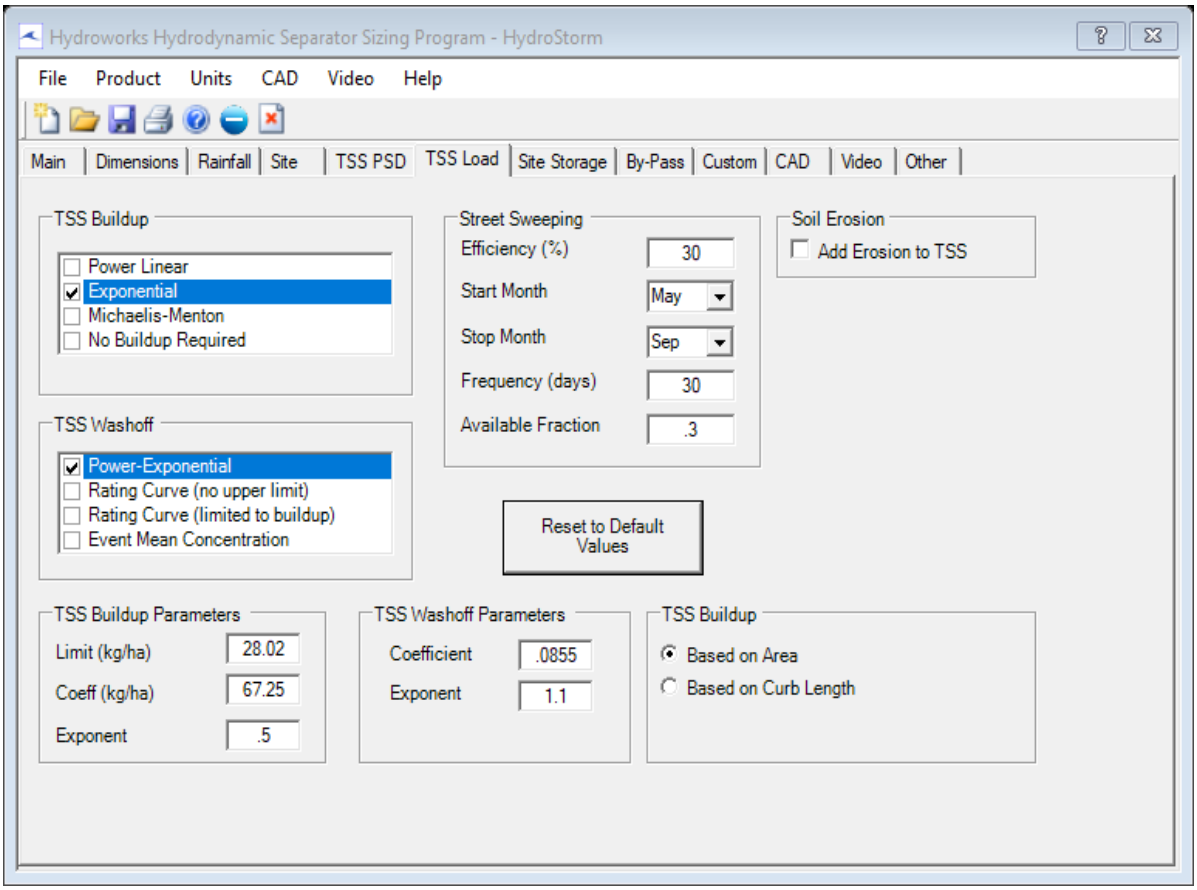
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HS 3	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
HS 7	2.13	1.98	1575	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4327	13.2	20
HS 12	3.66	3.35	7164	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

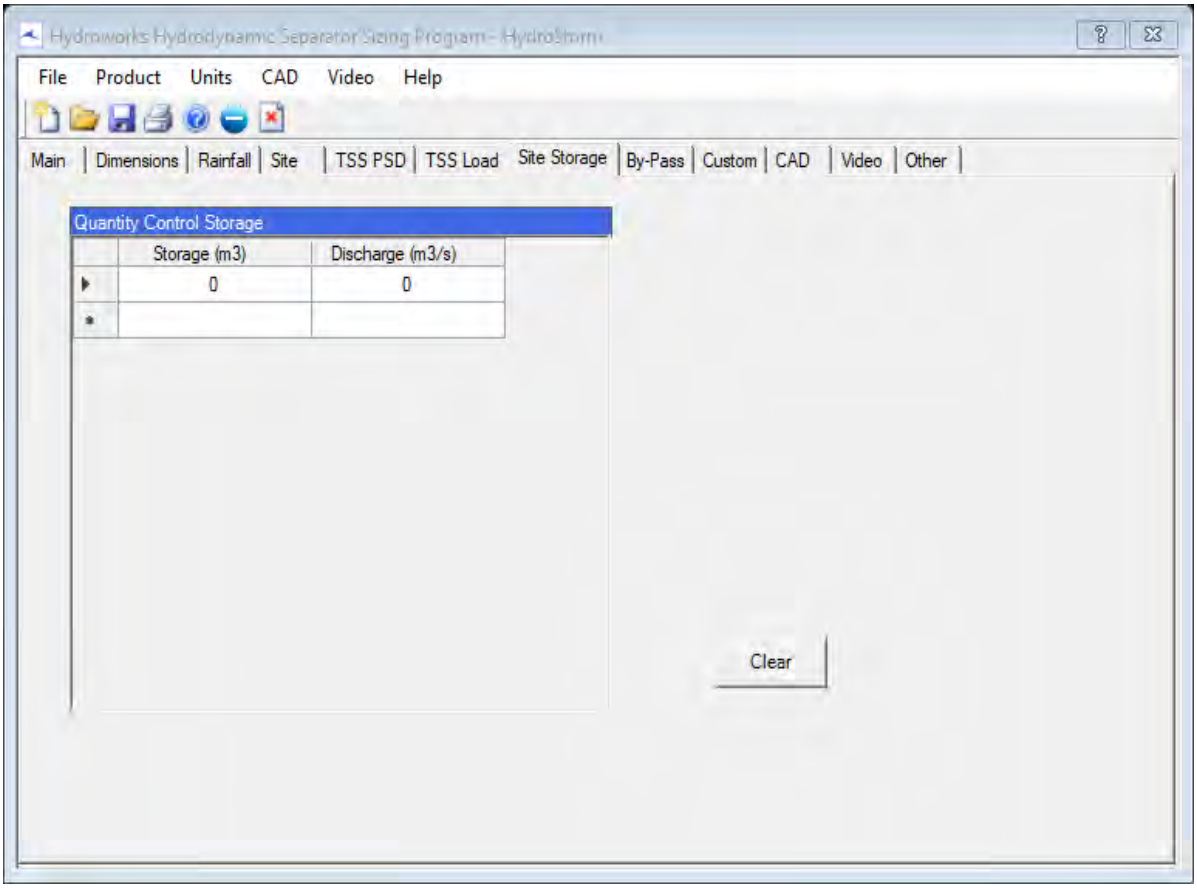
Generic HS 8 CAD Drawing



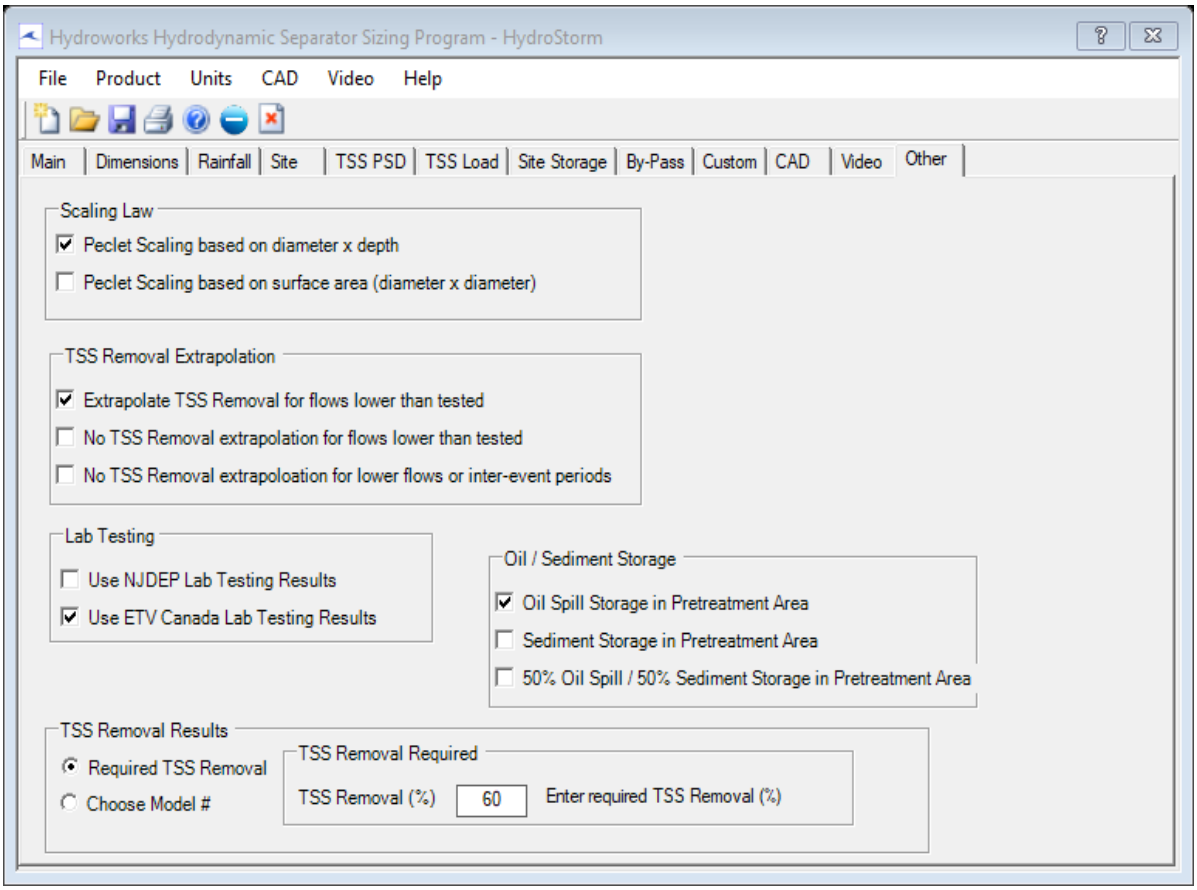
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.8.5
Copyright Hydroworks, LLC, 2024
1-800-290-7900
www.hydroworks.com

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

DRAWING INDEX

TITLE	SHEET NO
COVER SHEET	1 OF 17
SYSTEM LAYOUT SHEET&SYSTEM CALCULATION SHEET	2-15 OF 17
SYSTEM OVERLAY SHEET	16 OF 17
DETAIL SHEET	17 OF 17

PROJECT INFORMATION			
SITE CONTACT	PHIL ALLEN	416-286-5990	PHILALLEN@STORMCON.CA
ENGINEER / TECHNICAL SPECIALIST	ALESSANDRO RAIMONDO	437-779-7457	ARAIMONDO@CONCASTPIPE.COM
PROJECT NO:	2025-156		

COMMENTS:

REVISION	DATE	COMMENT	BY
01	11/04/2025	REVISED PER MARKUPS	JD
02	11/07/2025	REVISED PER MARKUPS	JD

GENERAL NOTES

1. COORDINATE WITH MANUFACTURER'S REPRESENTATIVE/DISTRIBUTOR FOR PRE-CONSTRUCTION MEETING AND SITE INSPECTION DURING INSTALLATION.
2. ENGINEERING DRAWINGS SUPERSEDE ALL PROVIDED DOCUMENTATION. REFER TO SITE ENGINEERS FOR ADDITIONAL INSTRUCTIONS.
3. COORDINATE GREENSTORM INSTALLATION ACTIVITIES WITH OTHER SITE ACTIVITIES.
4. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
5. PRESENCE OF GROUND WATER ABOVE THE BASE OF THE SYSTEM MUST BE IDENTIFIED TO STORMCON. ALL PUBLISHED MAXIMUM AND MINIMUM INSTALLATION DEPTHS ASSUME THE GROUND WATER IS AT OR BELOW THE BASE OF THE SYSTEM UNLESS OTHERWISE NOTED.
6. CONFIRM GEOTECHNICAL SOIL EVALUATION BY A QUALIFIED ENGINEER TO DETERMINE SUITABILITY OF STRUCTURAL INSTALLATION.
7. CONFIRM FOR BURIED UNDERGROUND UTILITIES INCLUDING GAS, ELECTRICAL, PIPELINES OR CONDUITS.
8. ROOTS FROM SURROUNDING TREES MAY DAMAGE THE SYSTEM. PROJECT ENGINEER OF RECORD TO ENSURE ADEQUATE SEPARATION FROM ALL TREES.
9. PROTECT THE INSTALLATION AGAINST DAMAGE WITH CONSTRUCTION TAPE, FENCING OR OTHER MEANS TILL THE CONSTRUCTION IS COMPLETE.
10. ENSURE THAT CONSTRUCTION FOLLOWS APPLICABLE FEDERAL, PROVINCIAL, LOCAL, MUNICIPAL AND LOCAL LAWS, ORDINANCES, REGULATIONS AND SAFETY REQUIREMENTS.
11. VEHICULAR LOADING IS PROHIBITED UNTIL BACKFILLED AS PER MANUFACTURER'S INSTALLATION GUIDELINES. THE USE OF EQUIPMENT OVER GREENSTORM CHAMBERS IS LIMITED:
    - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
    - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE CONSTRUCTION GUIDE.
    - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE CONSTRUCTION GUIDE.

CHECK - REQUIRED MATERIALS AND EQUIPMENT

12. ALL GREENSTORM CHAMBERS AND ACCESSORIES AS SPECIFIED IN THE ENGINEER'S PLANS INCLUDING NON-WOVEN GEOTEXTILE, CONNECTORS, QUADS, SIDEWALLS ADAPTER, RISER AND LINER WHERE APPLICABLE.
13. RECIPROCATING SAW OR ROUTER.
14. TRANSIT OR LASER LEVEL MEASURING DEVICE.
15. COMPACTION EQUIPMENT WITH MAXIMUM GROSS VEHICLE WEIGHT OF 12,000 LBS (5,440 KGS).
16. ACCEPTABLE FILL MATERIAL AS SHOWN IN INSTALLATION INSTRUCTIONS.
17. QUANTITIES FOR GEOSYNTHETIC ARE APPROXIMATE AND MAY VARY BASED ON OVERLAP, WASTAGE.
18. CHECK GREENSTORM CHAMBERS FOR DAMAGE PRIOR TO INSTALLATION. DO NOT USE DAMAGED CHAMBERS, CONTACT YOUR SUPPLIER IMMEDIATELY TO REPORT DAMAGE OR PACKING-LIST DISCREPANCIES.

NOTES FOR BIDDING AND INSTALLATIONS

1. CONTRACTORS ARE EXPECTED TO COMPREHEND AND USE THE MOST CURRENT INSTALLATION INSTRUCTIONS PRIOR TO BEGINNING A SYSTEM INSTALLATION. FOR THE MOST CURRENT INSTRUCTIONS, CONTACT STORMCON AT (289) 380-3742 OR VISIT WWW.STORMCON.CA.
2. CONTACT STORMCON AT LEAST TWO WEEKS PRIOR TO SYSTEM INSTALLATION TO ARRANGE FOR A PRE-CONSTRUCTION MEETING.
3. USE GREENSTORM INSTALLATION INSTRUCTIONS AS A GUIDELINE ONLY FOR MINIMUM/MAXIMUM REQUIREMENTS. ACTUAL DESIGN MAY VARY. REFER TO APPROVED CONSTRUCTION DRAWINGS FOR JOB-SPECIFIC DETAILS. ENGINEERING DRAWINGS SUPERSEDE ALL PROVIDED DOCUMENTATION.
4. THE FOUNDATION STONE SHALL BE LEVEL AND COMPACTED PRIOR TO CHAMBER INSTALLATION.
5. ANY DISCREPANCIES WITH THE SYSTEM SUB-GRADE SOIL'S BEARING CAPACITY MUST BE REPORTED TO THE GEOTECHNICAL ENGINEER.
6. CONTRACTOR TO REFER TO GREENSTORM INSTALLATION INSTRUCTIONS CONCERNING VEHICULAR TRAFFIC. RESPONSIBILITY FOR PREVENTING VEHICLES THAT EXCEED REQUIREMENTS SPECIFIED FROM TRAVELING ACROSS OR PARKING OVER THE CHAMBER SYSTEM LIES SOLELY WITH THE CONTRACTOR THROUGHOUT THE ENTIRE SITE CONSTRUCTION PROCESS. THE PLACEMENT OF WARNING TAPE, TEMPORARY FENCING, AND/OR APPROPRIATELY LOCATED SIGNS IS HIGHLY RECOMMENDED.
7. TRAFFIC OF INSTALLATION EQUIPMENT OR OTHER VEHICULAR TRAFFIC OVER TOP OF THE GREENSTORM STORMWATER SYSTEM IS STRICTLY RESTRICTED AND PROHIBITED UNTIL SATISFACTORY COVER AND COMPACTION IS ACHIEVED ACCORDING TO MANUFACTURER'S INSTALLATION INSTRUCTIONS.
8. EROSION AND SEDIMENT-CONTROL MEASURES MUST MEET LOCAL CODES AND THE DESIGN ENGINEER'S SPECIFICATIONS THROUGHOUT THE ENTIRE SITE CONSTRUCTION PROCESS.
9. GREENSTORM SYSTEMS MUST BE DESIGNED AND INSTALLED IN ACCORDANCE WITH STORMCON'S MINIMUM REQUIREMENTS. FAILURE TO DO SO WILL VOID THE LIMITED WARRANTY.

STORMCON

69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1

SALES@STORMCON.CA
WWW.STORMCON.CA

NOTE: THESE SHOP DRAWINGS MAY CONTAIN COMPONENTS INCLUDING, BUT NOT LIMITED TO, MANHOLES, CATCH BASINS, STORM PIPES AND FITTINGS, MANIFOLDS, CASTINGS AND OTHER NECESSARY APPURTENANCES THAT MAY NOT BE SUPPLIED BY STORMCON. IT IS THE RESPONSIBILITY OF THE CONTRACTOR AND/OR SUPPLIER TO CONFIRM THE MATERIALS PROVIDED.

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCON'S MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

PROPOSED SYSTEM 1 ELEVATIONS

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

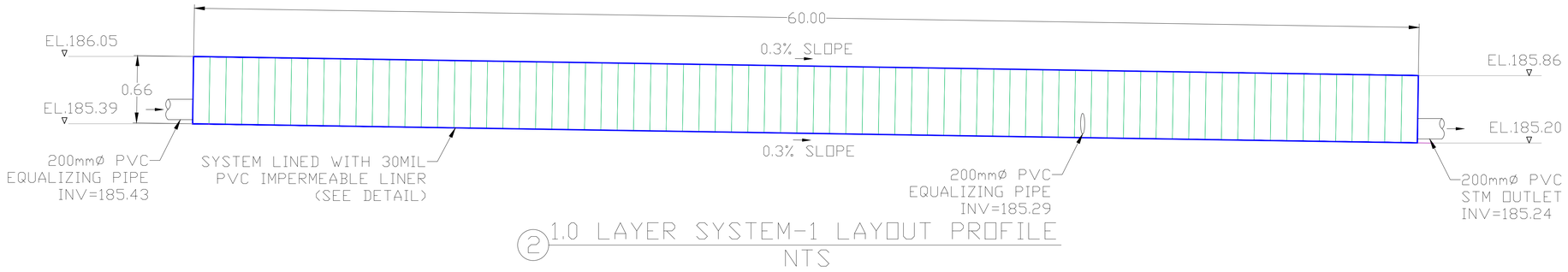
188.01	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
187.44	MINIMUM ALLOWABLE GRADE
185.86	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
185.20	GREENSTORM BASE ELEVATION
185.05	BOTTOM OF EXCAVATION
<185.20	SEASONAL HIGH GROUNDWATER ELEVATION

GREENSTORM STORMWATER MANAGEMENT SYSTEM

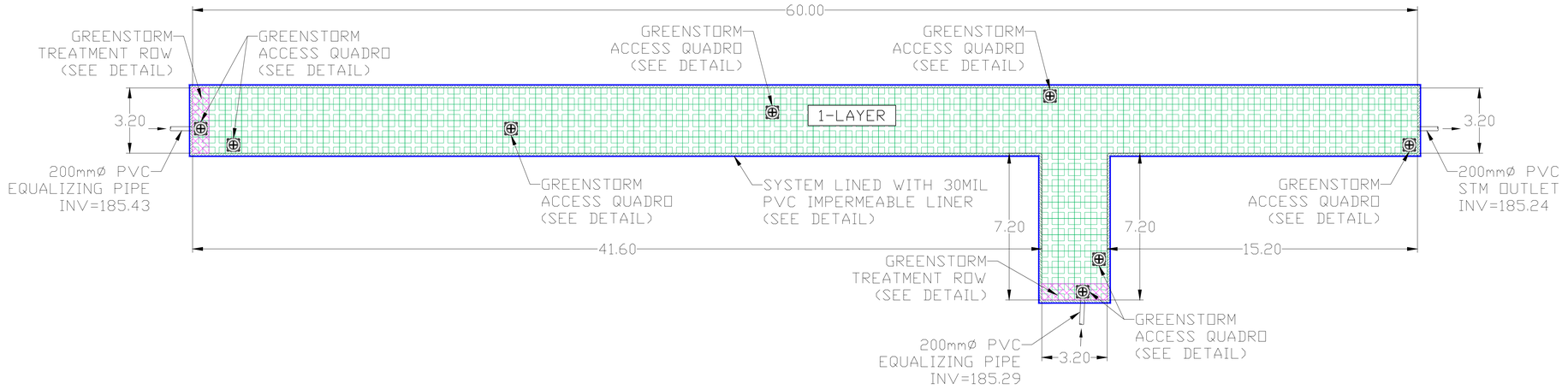
TOTAL STORAGE PROVIDED: 136.25 m^3
DETENTION VOLUME ABOVE 185.24: 135.43 m^3
RETENTION VOLUME BELOW 185.24: 0.82 m^3
STORAGE VOID RATIO: 0.96
SYSTEM AREA: 215.04 m^2
DEPTH OF EMBEDMENT STONE: 0.00 m
DEPTH OF BEDDING STONE: 0.00 m
STONE PERIMETER: 0.00 m

GREENSTORM LEGEND

- GREENSTORM ST BLOCK
- GREENSTORM SIDEWALL GRID WITH 8 OZ NON-WOVEN GEOTEXTILE
- GREENSTORM TREATMENT ROW
- GREENSTORM ACCESS QUADRO
- 30MIL PVC IMPERMEABLE LINER



② 1.0 LAYER SYSTEM-1 LAYOUT PROFILE
NTS



① SYSTEM-1 LAYOUT PLAN
NTS

NOTE:*ALL EXTERNAL SYSTEM STRUCTURES, INLET/OUTLET PIPES, AND PROPOSED ELEVATIONS MUST BE DESIGNED AND APPROVED BY PROJECT ENGINEER OF RECORD. PROJECT ENGINEER OF RECORD MUST ENSURE CHAMBER BURIAL REQUIREMENTS ARE MET.

MATERIALS LIST SUPPLIED BY STORMCON
(SYSTEM MATERIALS LIST - SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)

GREENSTORM-ST	664	PIECES
SINGLE LAYER CONNECTOR	600	PIECES
MULTI LAYER CONNECTOR	0	PIECES
SIDEWALL GRID	176	PIECES
HALF BLOCK SIDEWALL GRID	0	PIECES
HALF BLOCK COVER PLATE	0	PIECES
HALF BLOCK COVER PLATE QUADRO CONTROL	0	PIECES
QUADRO CONTROL	8	PIECES
QUADRO ADAPTERS	8	PIECES
EXTENSION PIPE	24	METER
CAST IRON COVER	8	PIECES
NO. OF 525mmØ PIPE ADAPTER	0	PIECES
NO. OF 450mmØ PIPE ADAPTER	0	PIECES
MIDDLE GRID	0	PIECES
MIDDLE GRID QUADRO CONTROL	0	PIECES
8 OZ NON-WOVEN GEOTEXTILE	1470	SQ. METER
30MIL PVC IMPERMEABLE LINER	750	SQ. METER
LINER TAPE	420	METER
GREENSTORM FULL TREATMENT ROW	8	PIECES
GREENSTORM HALF TREATMENT ROW	0	PIECES
100MM SUBDRAIN	0	METER

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-1 LAYOUT SHEET STORAGE TANK

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	2 OF 17

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Main Sail Estates Subdivision - S1
Address	
City	Town of Milton, ON
Country	Canada
Date	November 7, 2025

System Details

Chamber Model	**GreenStorm-ST**
Number of Layers	**1.0**
Height of Chambers	0.66 m
Storage Void Ratio	96%
GreenStorm Perimeter	**140.80** m
System Perimeter	**140.80**
GreenStorm Area	**215.04** m^2
System Area	**215.04** m^2
GreenStorm Base Elevation	**185.20** m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^3
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**188.01**	m
Lowest Finished Grade	**187.44**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
660	7.23	0.00	0.00	0.00	136.25	185.860
625	5.16	0.00	0.00	0.00	129.02	185.825
600	5.16	0.00	0.00	0.00	123.86	185.800
575	5.16	0.00	0.00	0.00	118.70	185.775
550	5.16	0.00	0.00	0.00	113.54	185.750
525	5.16	0.00	0.00	0.00	108.38	185.725
500	5.16	0.00	0.00	0.00	103.22	185.700
475	5.16	0.00	0.00	0.00	98.06	185.675
450	5.16	0.00	0.00	0.00	92.90	185.650
425	5.16	0.00	0.00	0.00	87.74	185.625
400	5.16	0.00	0.00	0.00	82.58	185.600
375	5.16	0.00	0.00	0.00	77.41	185.575
350	5.16	0.00	0.00	0.00	72.25	185.550
325	5.16	0.00	0.00	0.00	67.09	185.525
300	5.16	0.00	0.00	0.00	61.93	185.500
275	5.16	0.00	0.00	0.00	56.77	185.475
250	5.16	0.00	0.00	0.00	51.61	185.450
225	5.16	0.00	0.00	0.00	46.45	185.425
200	5.16	0.00	0.00	0.00	41.29	185.400
175	5.16	0.00	0.00	0.00	36.13	185.375
150	5.16	0.00	0.00	0.00	30.97	185.350
125	5.16	0.00	0.00	0.00	25.80	185.325
100	5.16	0.00	0.00	0.00	20.64	185.300
75	5.16	0.00	0.00	0.00	15.48	185.275
50	5.16	0.00	0.00	0.00	10.32	185.250
25	5.16	0.00	0.00	0.00	5.16	185.225
0	0.00	0.00	0.00	0.00	0.00	185.200

1.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

STORMCON

69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1

SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-1 CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	3 OF 17

PROPOSED 1-LAYER SYSTEM 2 ELEVATIONS

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

188.69	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
188.01	MINIMUM ALLOWABLE GRADE
186.10	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
185.44	GREENSTORM BASE ELEVATION
185.29	BOTTOM OF EXCAVATION
<185.20	SEASONAL HIGH GROUNDWATER ELEVATION

PROPOSED 2-LAYER SYSTEM 2 ELEVATIONS

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

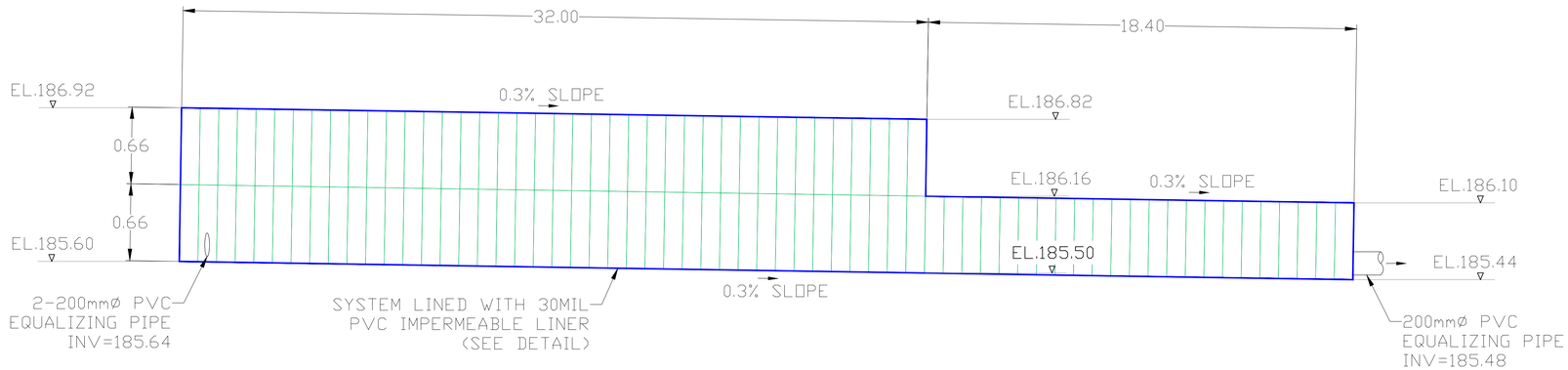
188.85	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
188.69	MINIMUM ALLOWABLE GRADE
186.82	GREENSTORM STORAGE TOP ELEVATION LEVEL 2
186.16	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
185.50	GREENSTORM BASE ELEVATION
185.35	BOTTOM OF EXCAVATION
<185.20	SEASONAL HIGH GROUNDWATER ELEVATION

GREENSTORM STORMWATER MANAGEMENT SYSTEM

TOTAL STORAGE PROVIDED: 167.07 m^3
DETENTION VOLUME ABOVE 185.48: 166.25 m^3
RETENTION VOLUME BELOW 185.48: 0.82 m^3
STORAGE VOID RATIO: 0.96
SYSTEM AREA: 161.28 m^2
DEPTH OF EMBEDMENT STONE: 0.00 m
DEPTH OF BEDDING STONE: 0.00 m
STONE PERIMETER: 0.00 m

GREENSTORM LEGEND

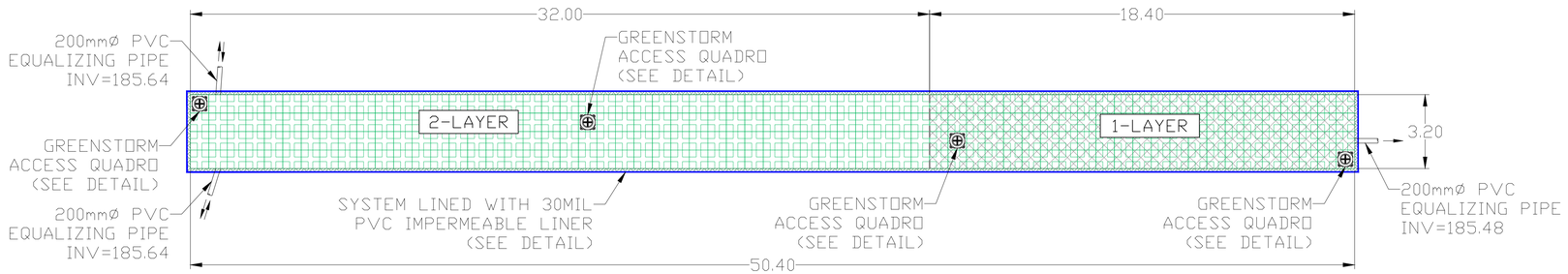
- GREENSTORM ST BLOCK
- GREENSTORM SIDEWALL GRID WITH 8 OZ NON-WOVEN GEOTEXTILE
- GREENSTORM ACCESS QUADRO
- 30MIL PVC IMPERMEABLE LINER



② 1.0 & 2.0 LAYER SYSTEM-2 LAYOUT PROFILE
NTS

NOTE:*ALL EXTERNAL SYSTEM STRUCTURES, INLET/OUTLET PIPES, AND PROPOSED ELEVATIONS MUST BE DESIGNED AND APPROVED BY PROJECT ENGINEER OF RECORD. PROJECT ENGINEER OF RECORD MUST ENSURE CHAMBER BURIAL REQUIREMENTS ARE MET.

MATERIALS LIST SUPPLIED BY STORMCON (SYSTEM MATERIALS LIST - SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
GREENSTORM-ST	816	PIECES
SINGLE LAYER CONNECTOR	500	PIECES
MULTI LAYER CONNECTOR	300	PIECES
SIDEWALL GRID	222	PIECES
HALF BLOCK SIDEWALL GRID	0	PIECES
HALF BLOCK COVER PLATE	0	PIECES
HALF BLOCK COVER PLATE QUADRO CONTROL	0	PIECES
QUADRO CONTROL	8	PIECES
QUADRO ADAPTERS	4	PIECES
EXTENSION PIPE	10	METER
CAST IRON COVER	4	PIECES
NO. OF 525mmØ PIPE ADAPTER	0	PIECES
NO. OF 450mmØ PIPE ADAPTER	0	PIECES
MIDDLE GRID	0	PIECES
MIDDLE GRID QUADRO CONTROL	0	PIECES
8 OZ NON-WOVEN GEOTEXTILE	1250	SQ. METER
30MIL PVC IMPERMEABLE LINER	630	SQ. METER
LINER TAPE	360	METER
GREENSTORM FULL TREATMENT ROW	0	PIECES
GREENSTORM HALF TREATMENT ROW	0	PIECES
100MM SUBDRAIN	0	METER



① SYSTEM-2 LAYOUT PLAN
NTS

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1

SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-2 LAYOUT SHEET STORAGE TANK

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	4 OF 17

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Main Sail Estates Subdivision - S2a
Address	
City	Town of Milton, ON
Country	Canada
Date	November 10, 2025

System Details

	GreenStorm-ST	
Chamber Model		
Number of Layers	**1.0**	
Height of Chambers	0.66	m
Chamber Length	18.40	m
Chamber Width	3.20	m
Storage Void Ratio	96%	
System Perimeter	43.20	m
GreenStorm Area	58.88	m^2
System Area	58.88	m^2
GreenStorm Base Elevation	**185.44**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^3
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**188.69**	m
Lowest Finished Grade	**188.01**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
660	1.98	0.00	0.00	0.00	37.31	186.100
625	1.41	0.00	0.00	0.00	35.33	186.065
600	1.41	0.00	0.00	0.00	33.91	186.040
575	1.41	0.00	0.00	0.00	32.50	186.015
550	1.41	0.00	0.00	0.00	31.09	185.990
525	1.41	0.00	0.00	0.00	29.68	185.965
500	1.41	0.00	0.00	0.00	28.26	185.940
475	1.41	0.00	0.00	0.00	26.85	185.915
450	1.41	0.00	0.00	0.00	25.44	185.890
425	1.41	0.00	0.00	0.00	24.02	185.865
400	1.41	0.00	0.00	0.00	22.61	185.840
375	1.41	0.00	0.00	0.00	21.20	185.815
350	1.41	0.00	0.00	0.00	19.78	185.790
325	1.41	0.00	0.00	0.00	18.37	185.765
300	1.41	0.00	0.00	0.00	16.96	185.740
275	1.41	0.00	0.00	0.00	15.54	185.715
250	1.41	0.00	0.00	0.00	14.13	185.690
225	1.41	0.00	0.00	0.00	12.72	185.665
200	1.41	0.00	0.00	0.00	11.30	185.640
175	1.41	0.00	0.00	0.00	9.89	185.615
150	1.41	0.00	0.00	0.00	8.48	185.590
125	1.41	0.00	0.00	0.00	7.07	185.565
100	1.41	0.00	0.00	0.00	5.65	185.540
75	1.41	0.00	0.00	0.00	4.24	185.515
50	1.41	0.00	0.00	0.00	2.83	185.490
25	1.41	0.00	0.00	0.00	1.41	185.465
0	0.00	0.00	0.00	0.00	0.00	185.440

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Main Sail Estates Subdivision - S2b
Address	
City	Town of Milton, ON
Country	Canada
Date	November 10, 2025

System Details

	GreenStorm-ST	
Chamber Model		
Number of Layers	**2.0**	
Height of Chambers	1.32	m
Chamber Length	32.00	m
Chamber Width	3.20	m
Storage Void Ratio	96%	
System Perimeter	70.40	m
GreenStorm Area	102.40	m^2
System Area	102.40	m^2
GreenStorm Base Elevation	**185.50**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^3
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**188.85**	m
Lowest Finished Grade	**188.69**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
1320	4.42	0.00	0.00	0.00	129.76	186.820
1275	2.46	0.00	0.00	0.00	125.34	186.775
1250	2.46	0.00	0.00	0.00	122.88	186.750
1225	2.46	0.00	0.00	0.00	120.42	186.725
1200	2.46	0.00	0.00	0.00	117.96	186.700
1175	2.46	0.00	0.00	0.00	115.51	186.675
1150	2.46	0.00	0.00	0.00	113.05	186.650
1125	2.46	0.00	0.00	0.00	110.59	186.625
1100	2.46	0.00	0.00	0.00	108.13	186.600
1075	2.46	0.00	0.00	0.00	105.68	186.575
1050	2.46	0.00	0.00	0.00	103.22	186.550
1025	2.46	0.00	0.00	0.00	100.76	186.525
1000	2.46	0.00	0.00	0.00	98.30	186.500
975	2.46	0.00	0.00	0.00	95.85	186.475
950	2.46	0.00	0.00	0.00	93.39	186.450
925	2.46	0.00	0.00	0.00	90.93	186.425
900	2.46	0.00	0.00	0.00	88.47	186.400
875	2.46	0.00	0.00	0.00	86.02	186.375
850	2.46	0.00	0.00	0.00	83.56	186.350
825	2.46	0.00	0.00	0.00	81.10	186.325
800	2.46	0.00	0.00	0.00	78.64	186.300
775	2.46	0.00	0.00	0.00	76.19	186.275
750	2.46	0.00	0.00	0.00	73.73	186.250
725	2.46	0.00	0.00	0.00	71.27	186.225
700	2.46	0.00	0.00	0.00	68.81	186.200
675	2.46	0.00	0.00	0.00	66.36	186.175
650	2.46	0.00	0.00	0.00	63.90	186.150
625	2.46	0.00	0.00	0.00	61.44	186.125
600	2.46	0.00	0.00	0.00	58.98	186.100
575	2.46	0.00	0.00	0.00	56.52	186.075
550	2.46	0.00	0.00	0.00	54.07	186.050
525	2.46	0.00	0.00	0.00	51.61	186.025
500	2.46	0.00	0.00	0.00	49.15	186.000
475	2.46	0.00	0.00	0.00	46.69	185.975
450	2.46	0.00	0.00	0.00	44.24	185.950
425	2.46	0.00	0.00	0.00	41.78	185.925
400	2.46	0.00	0.00	0.00	39.32	185.900
375	2.46	0.00	0.00	0.00	36.86	185.875
350	2.46	0.00	0.00	0.00	34.41	185.850
325	2.46	0.00	0.00	0.00	31.95	185.825
300	2.46	0.00	0.00	0.00	29.49	185.800
275	2.46	0.00	0.00	0.00	27.03	185.775
250	2.46	0.00	0.00	0.00	24.58	185.750
225	2.46	0.00	0.00	0.00	22.12	185.725
200	2.46	0.00	0.00	0.00	19.66	185.700
175	2.46	0.00	0.00	0.00	17.20	185.675
150	2.46	0.00	0.00	0.00	14.75	185.650
125	2.46	0.00	0.00	0.00	12.29	185.625
100	2.46	0.00	0.00	0.00	9.83	185.600
75	2.46	0.00	0.00	0.00	7.37	185.575
50	2.46	0.00	0.00	0.00	4.92	185.550
25	2.46	0.00	0.00	0.00	2.46	185.525
0	0.00	0.00	0.00	0.00	0.00	185.500

1.0 & 2.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-2 CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	5 OF 17

PROPOSED SYSTEM 3 ELEVATIONS

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

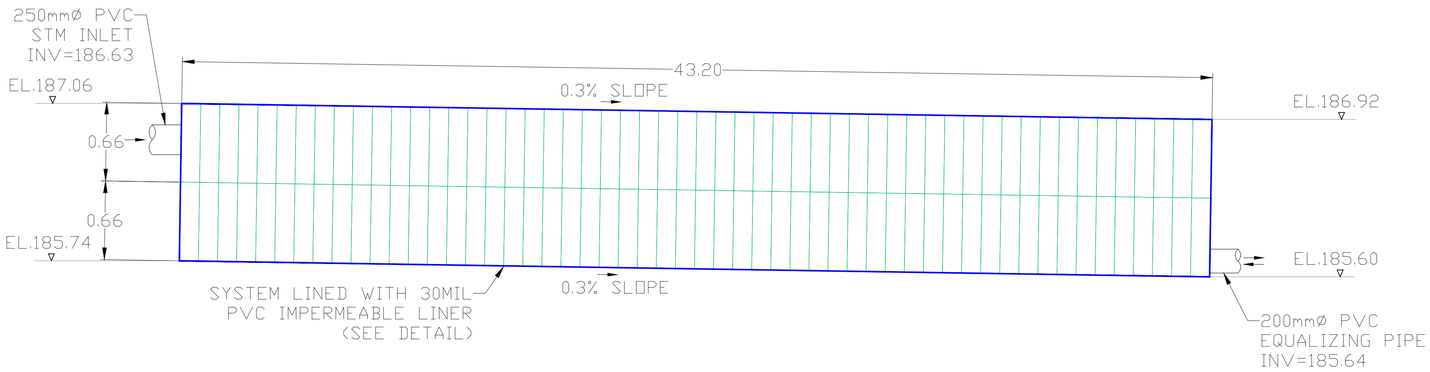
189.00	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
188.85	MINIMUM ALLOWABLE GRADE
186.92	GREENSTORM STORAGE TOP ELEVATION LEVEL 2
186.24	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
185.60	GREENSTORM BASE ELEVATION
185.45	BOTTOM OF EXCAVATION
<185.20	SEASONAL HIGH GROUNDWATER ELEVATION

GREENSTORM STORMWATER MANAGEMENT SYSTEM

TOTAL STORAGE PROVIDED: 168.69 m^3
DETENTION VOLUME ABOVE 185.64: 167.87 m^3
RETENTION VOLUME BELOW 185.64: 0.82 m^3
STORAGE VOID RATIO: 0.96
SYSTEM AREA: 133.12 m^2
DEPTH OF EMBEDMENT STONE: 0.00 m
DEPTH OF BEDDING STONE: 0.00 m
STONE PERIMETER: 0.00 m

GREENSTORM LEGEND

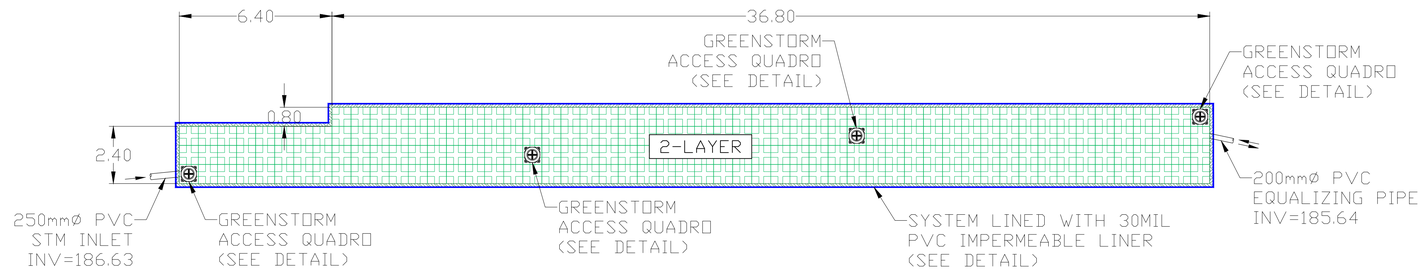
- GREENSTORM ST BLOCK
- GREENSTORM SIDEWALL GRID WITH 8 OZ NON-WOVEN GEOTEXTILE
- GREENSTORM ACCESS QUADRO
- 30MIL PVC IMPERMEABLE LINER



2 2.0 LAYER SYSTEM-3 LAYOUT PROFILE
NTS

NOTE:*ALL EXTERNAL SYSTEM STRUCTURES, INLET/OUTLET PIPES, AND PROPOSED ELEVATIONS MUST BE DESIGNED AND APPROVED BY PROJECT ENGINEER OF RECORD. PROJECT ENGINEER OF RECORD MUST ENSURE CHAMBER BURIAL REQUIREMENTS ARE MET.

MATERIALS LIST SUPPLIED BY STORMCON (SYSTEM MATERIALS LIST - SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
GREENSTORM-ST	820	PIECES
SINGLE LAYER CONNECTOR	400	PIECES
MULTI LAYER CONNECTOR	400	PIECES
SIDEWALL GRID	232	PIECES
HALF BLOCK SIDEWALL GRID	0	PIECES
HALF BLOCK COVER PLATE	0	PIECES
HALF BLOCK COVER PLATE QUADRO CONTROL	0	PIECES
QUADRO CONTROL	12	PIECES
QUADRO ADAPTERS	4	PIECES
EXTENSION PIPE	12	METER
CAST IRON COVER	4	PIECES
NO. OF 525mmØ PIPE ADAPTER	0	PIECES
NO. OF 450mmØ PIPE ADAPTER	0	PIECES
MIDDLE GRID	0	PIECES
MIDDLE GRID QUADRO CONTROL	0	PIECES
8 OZ NON-WOVEN GEOTEXTILE	1090	SQ. METER
30MIL PVC IMPERMEABLE LINER	550	SQ. METER
LINER TAPE	320	METER
GREENSTORM FULL TREATMENT ROW	0	PIECES
GREENSTORM HALF TREATMENT ROW	0	PIECES
100MM SUBDRAIN	0	METER



1 SYSTEM-3 LAYOUT PLAN
NTS

STORMCON

69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1

SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-3 LAYOUT SHEET STORAGE TANK

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	6 OF 17

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Main Sail Estates Subdivision - S3
Address	
City	Town of Milton, ON
Country	Canada
Date	November 7, 2025

System Details

	GreenStorm-ST	
Chamber Model		
Number of Layers	**2.0**	
Height of Chambers	1.32	m
Storage Void Ratio	96%	
GreenStorm Perimeter	**92.80**	m
System Perimeter	**92.80**	
GreenStorm Area	**133.12**	m^2
System Area	**133.12**	m^2
GreenStorm Base Elevation	**185.60**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^3
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**189.00**	m
Lowest Finished Grade	**188.85**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
1320	5.75	0.00	0.00	0.00	168.69	186.920
1275	3.19	0.00	0.00	0.00	162.94	186.875
1250	3.19	0.00	0.00	0.00	159.74	186.850
1225	3.19	0.00	0.00	0.00	156.55	186.825
1200	3.19	0.00	0.00	0.00	153.35	186.800
1175	3.19	0.00	0.00	0.00	150.16	186.775
1150	3.19	0.00	0.00	0.00	146.96	186.750
1125	3.19	0.00	0.00	0.00	143.77	186.725
1100	3.19	0.00	0.00	0.00	140.57	186.700
1075	3.19	0.00	0.00	0.00	137.38	186.675
1050	3.19	0.00	0.00	0.00	134.18	186.650
1025	3.19	0.00	0.00	0.00	130.99	186.625
1000	3.19	0.00	0.00	0.00	127.80	186.600
975	3.19	0.00	0.00	0.00	124.60	186.575
950	3.19	0.00	0.00	0.00	121.41	186.550
925	3.19	0.00	0.00	0.00	118.21	186.525
900	3.19	0.00	0.00	0.00	115.02	186.500
875	3.19	0.00	0.00	0.00	111.82	186.475
850	3.19	0.00	0.00	0.00	108.63	186.450
825	3.19	0.00	0.00	0.00	105.43	186.425
800	3.19	0.00	0.00	0.00	102.24	186.400
775	3.19	0.00	0.00	0.00	99.04	186.375
750	3.19	0.00	0.00	0.00	95.85	186.350
725	3.19	0.00	0.00	0.00	92.65	186.325
700	3.19	0.00	0.00	0.00	89.46	186.300
675	3.19	0.00	0.00	0.00	86.26	186.275
650	3.19	0.00	0.00	0.00	83.07	186.250
625	3.19	0.00	0.00	0.00	79.87	186.225
600	3.19	0.00	0.00	0.00	76.68	186.200
575	3.19	0.00	0.00	0.00	73.48	186.175
550	3.19	0.00	0.00	0.00	70.29	186.150
525	3.19	0.00	0.00	0.00	67.09	186.125
500	3.19	0.00	0.00	0.00	63.90	186.100
475	3.19	0.00	0.00	0.00	60.70	186.075
450	3.19	0.00	0.00	0.00	57.51	186.050
425	3.19	0.00	0.00	0.00	54.31	186.025
400	3.19	0.00	0.00	0.00	51.12	186.000
375	3.19	0.00	0.00	0.00	47.92	185.975
350	3.19	0.00	0.00	0.00	44.73	185.950
325	3.19	0.00	0.00	0.00	41.53	185.925
300	3.19	0.00	0.00	0.00	38.34	185.900
275	3.19	0.00	0.00	0.00	35.14	185.875
250	3.19	0.00	0.00	0.00	31.95	185.850
225	3.19	0.00	0.00	0.00	28.75	185.825
200	3.19	0.00	0.00	0.00	25.56	185.800
175	3.19	0.00	0.00	0.00	22.36	185.775
150	3.19	0.00	0.00	0.00	19.17	185.750
125	3.19	0.00	0.00	0.00	15.97	185.725
100	3.19	0.00	0.00	0.00	12.78	185.700
75	3.19	0.00	0.00	0.00	9.58	185.675
50	3.19	0.00	0.00	0.00	6.39	185.650
25	3.19	0.00	0.00	0.00	3.19	185.625
0	0.00	0.00	0.00	0.00	0.00	185.600

2.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-3 CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	7 OF 17

PROPOSED SYSTEM 4 ELEVATIONS

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

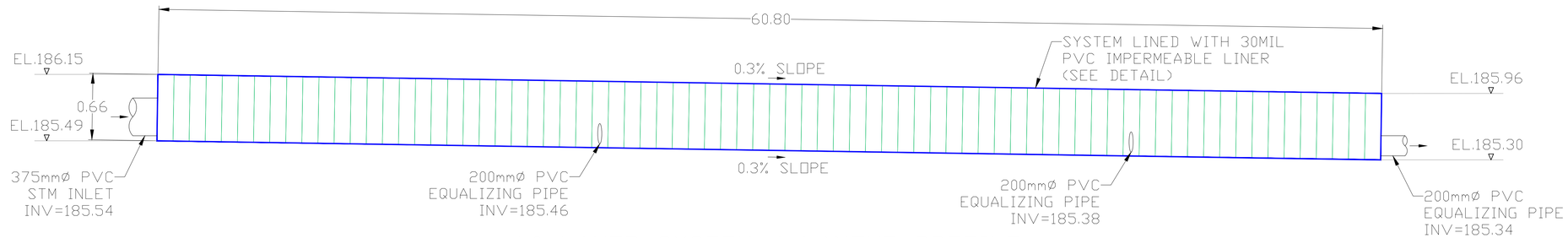
188.09	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
187.80	MINIMUM ALLOWABLE GRADE
185.96	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
185.30	GREENSTORM BASE ELEVATION
185.15	BOTTOM OF EXCAVATION
<185.20	SEASONAL HIGH GROUNDWATER ELEVATION

GREENSTORM STORMWATER MANAGEMENT SYSTEM

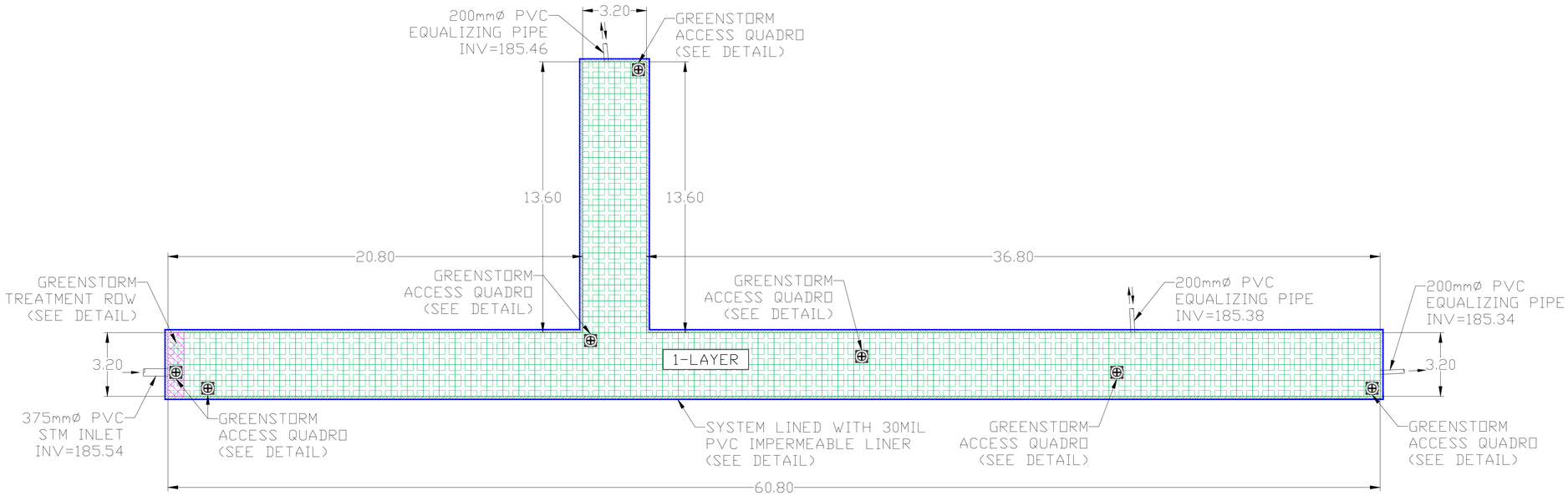
TOTAL STORAGE PROVIDED: 150.85 m^3
DETENTION VOLUME ABOVE 185.34: 150.03 m^3
RETENTION VOLUME BELOW 185.34: 0.82 m^3
STORAGE VOID RATIO: 0.96
SYSTEM AREA: 238.08 m^2
DEPTH OF EMBEDMENT STONE: 0.00 m
DEPTH OF BEDDING STONE: 0.00 m
STONE PERIMETER: 0.00 m

GREENSTORM LEGEND

- GREENSTORM ST BLOCK
- GREENSTORM SIDEWALL GRID WITH 8 OZ NON-WOVEN GEOTEXTILE
- GREENSTORM TREATMENT ROW
- GREENSTORM ACCESS QUADRO
- 30MIL PVC IMPERMEABLE LINER



② 1.0 LAYER SYSTEM-4 LAYOUT PROFILE
NTS



① SYSTEM-4 LAYOUT PLAN
NTS

NOTE:*ALL EXTERNAL SYSTEM STRUCTURES, INLET/OUTLET PIPES, AND PROPOSED ELEVATIONS MUST BE DESIGNED AND APPROVED BY PROJECT ENGINEER OF RECORD. PROJECT ENGINEER OF RECORD MUST ENSURE CHAMBER BURIAL REQUIREMENTS ARE MET.

MATERIALS LIST SUPPLIED BY STORMCON
(SYSTEM MATERIALS LIST - SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)

GREENSTORM-ST	737	PIECES
SINGLE LAYER CONNECTOR	700	PIECES
MULTI LAYER CONNECTOR	0	PIECES
SIDEWALL GRID	194	PIECES
HALF BLOCK SIDEWALL GRID	0	PIECES
HALF BLOCK COVER PLATE	0	PIECES
HALF BLOCK COVER PLATE QUADRO CONTROL	0	PIECES
QUADRO CONTROL	7	PIECES
QUADRO ADAPTERS	7	PIECES
EXTENSION PIPE	21	METER
CAST IRON COVER	7	PIECES
NO. OF 525mmØ PIPE ADAPTER	0	PIECES
NO. OF 450mmØ PIPE ADAPTER	0	PIECES
MIDDLE GRID	0	PIECES
MIDDLE GRID QUADRO CONTROL	0	PIECES
8 OZ NON-WOVEN GEOTEXTILE	1630	SQ. METER
30MIL PVC IMPERMEABLE LINER	820	SQ. METER
LINER TAPE	470	METER
GREENSTORM FULL TREATMENT ROW	4	PIECES
GREENSTORM HALF TREATMENT ROW	0	PIECES
100MM SUBDRAIN	0	METER

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-4 LAYOUT SHEET STORAGE TANK

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	8 OF 17

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Main Sail Estates Subdivision - S4
Address	
City	Town of Milton, ON
Country	Canada
Date	November 7, 2025

System Details

	GreenStorm-ST	
Chamber Model		
Number of Layers	**1.0**	
Height of Chambers	0.66	m
Storage Void Ratio	96%	
GreenStorm Perimeter	**155.20**	m
System Perimeter	**155.20**	
GreenStorm Area	**238.08**	m^2
System Area	**238.08**	m^2
GreenStorm Base Elevation	**185.30**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^2
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**188.09**	m
Lowest Finished Grade	**187.80**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
660	8.00	0.00	0.00	0.00	150.85	185.960
625	5.71	0.00	0.00	0.00	142.85	185.925
600	5.71	0.00	0.00	0.00	137.13	185.900
575	5.71	0.00	0.00	0.00	131.42	185.875
550	5.71	0.00	0.00	0.00	125.71	185.850
525	5.71	0.00	0.00	0.00	119.99	185.825
500	5.71	0.00	0.00	0.00	114.28	185.800
475	5.71	0.00	0.00	0.00	108.56	185.775
450	5.71	0.00	0.00	0.00	102.85	185.750
425	5.71	0.00	0.00	0.00	97.14	185.725
400	5.71	0.00	0.00	0.00	91.42	185.700
375	5.71	0.00	0.00	0.00	85.71	185.675
350	5.71	0.00	0.00	0.00	79.99	185.650
325	5.71	0.00	0.00	0.00	74.28	185.625
300	5.71	0.00	0.00	0.00	68.57	185.600
275	5.71	0.00	0.00	0.00	62.85	185.575
250	5.71	0.00	0.00	0.00	57.14	185.550
225	5.71	0.00	0.00	0.00	51.43	185.525
200	5.71	0.00	0.00	0.00	45.71	185.500
175	5.71	0.00	0.00	0.00	40.00	185.475
150	5.71	0.00	0.00	0.00	34.28	185.450
125	5.71	0.00	0.00	0.00	28.57	185.425
100	5.71	0.00	0.00	0.00	22.86	185.400
75	5.71	0.00	0.00	0.00	17.14	185.375
50	5.71	0.00	0.00	0.00	11.43	185.350
25	5.71	0.00	0.00	0.00	5.71	185.325
0	0.00	0.00	0.00	0.00	0.00	185.300

1.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-4 CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	9 OF 17

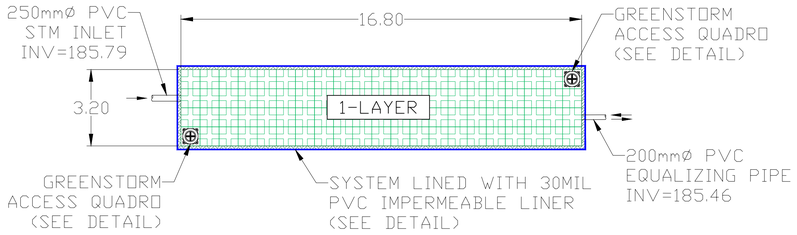
PROPOSED SYSTEM 5 ELEVATIONS

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

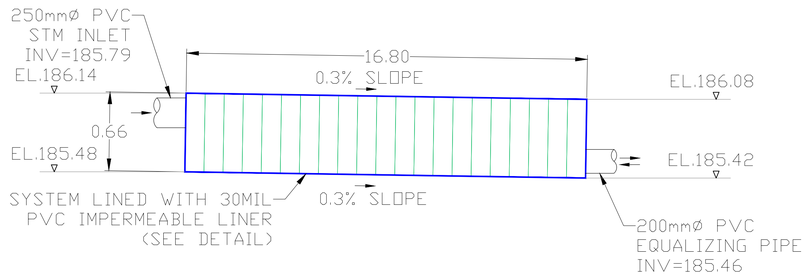
188.20	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
188.09	MINIMUM ALLOWABLE GRADE
186.08	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
185.42	GREENSTORM BASE ELEVATION
185.27	BOTTOM OF EXCAVATION
<185.20	SEASONAL HIGH GROUNDWATER ELEVATION

GREENSTORM STORMWATER MANAGEMENT SYSTEM

TOTAL STORAGE PROVIDED: 34.06 m^3
DETENTION VOLUME ABOVE 185.46: 33.01 m^3
RETENTION VOLUME BELOW 185.46: 1.05 m^3
STORAGE VOID RATIO: 0.96
SYSTEM AREA: 53.76 m^2
DEPTH OF EMBEDMENT STONE: 0.00 m
DEPTH OF BEDDING STONE: 0.00 m
STONE PERIMETER: 0.00 m



1 SYSTEM-5 LAYOUT PLAN
NTS



2 1.0 LAYER SYSTEM-5 LAYOUT PROFILE
NTS

NOTE:*ALL EXTERNAL SYSTEM STRUCTURES, INLET/OUTLET PIPES, AND PROPOSED ELEVATIONS MUST BE DESIGNED AND APPROVED BY PROJECT ENGINEER OF RECORD. PROJECT ENGINEER OF RECORD MUST ENSURE CHAMBER BURIAL REQUIREMENTS ARE MET.

MATERIALS LIST SUPPLIED BY STORMCON (SYSTEM MATERIALS LIST - SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
GREENSTORM-ST	166	PIECES
SINGLE LAYER CONNECTOR	200	PIECES
MULTI LAYER CONNECTOR	0	PIECES
SIDEWALL GRID	50	PIECES
HALF BLOCK SIDEWALL GRID	0	PIECES
HALF BLOCK COVER PLATE	0	PIECES
HALF BLOCK COVER PLATE QUADRO CONTROL	0	PIECES
QUADRO CONTROL	2	PIECES
QUADRO ADAPTERS	2	PIECES
EXTENSION PIPE	6	METER
CAST IRON COVER	2	PIECES
NO. OF 525mmØ PIPE ADAPTER	0	PIECES
NO. OF 450mmØ PIPE ADAPTER	0	PIECES
MIDDLE GRID	0	PIECES
MIDDLE GRID QUADRO CONTROL	0	PIECES
8 OZ NON-WOVEN GEOTEXTILE	380	SQ. METER
30MIL PVC IMPERMEABLE LINER	190	SQ. METER
LINER TAPE	110	METER
GREENSTORM FULL TREATMENT ROW	0	PIECES
GREENSTORM HALF TREATMENT ROW	0	PIECES
100MM SUBDRAIN	0	METER

GREENSTORM LEGEND

GREENSTORM ST BLOCK

GREENSTORM SIDEWALL GRID WITH 8 OZ NON-WOVEN GEOTEXTILE

GREENSTORM ACCESS QUADRO

30MIL PVC IMPERMEABLE LINER

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-5 LAYOUT SHEET STORAGE TANK

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	10 OF 17

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Main Sail Estates Subdivision - S5
Address	
City	Town of Milton, ON
Country	Canada
Date	November 7, 2025

System Details

Chamber Model	**GreenStorm-ST**	
Number of Layers	**1.0**	
Height of Chambers	0.66	m
Chamber Length	16.80	m
Chamber Width	3.20	m
Storage Void Ratio	96%	
System Perimeter	40.00	m
GreenStorm Area	53.76	m^2
System Area	53.76	m^2
GreenStorm Base Elevation	**185.42**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^3
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**188.20**	m
Lowest Finished Grade	**188.09**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
660	1.81	0.00	0.00	0.00	34.06	186.080
625	1.29	0.00	0.00	0.00	32.26	186.045
600	1.29	0.00	0.00	0.00	30.97	186.020
575	1.29	0.00	0.00	0.00	29.68	185.995
550	1.29	0.00	0.00	0.00	28.39	185.970
525	1.29	0.00	0.00	0.00	27.10	185.945
500	1.29	0.00	0.00	0.00	25.80	185.920
475	1.29	0.00	0.00	0.00	24.51	185.895
450	1.29	0.00	0.00	0.00	23.22	185.870
425	1.29	0.00	0.00	0.00	21.93	185.845
400	1.29	0.00	0.00	0.00	20.64	185.820
375	1.29	0.00	0.00	0.00	19.35	185.795
350	1.29	0.00	0.00	0.00	18.06	185.770
325	1.29	0.00	0.00	0.00	16.77	185.745
300	1.29	0.00	0.00	0.00	15.48	185.720
275	1.29	0.00	0.00	0.00	14.19	185.695
250	1.29	0.00	0.00	0.00	12.90	185.670
225	1.29	0.00	0.00	0.00	11.61	185.645
200	1.29	0.00	0.00	0.00	10.32	185.620
175	1.29	0.00	0.00	0.00	9.03	185.595
150	1.29	0.00	0.00	0.00	7.74	185.570
125	1.29	0.00	0.00	0.00	6.45	185.545
100	1.29	0.00	0.00	0.00	5.16	185.520
75	1.29	0.00	0.00	0.00	3.87	185.495
50	1.29	0.00	0.00	0.00	2.58	185.470
25	1.29	0.00	0.00	0.00	1.29	185.445
0	0.00	0.00	0.00	0.00	0.00	185.420

1.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-5 CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	11 OF 17

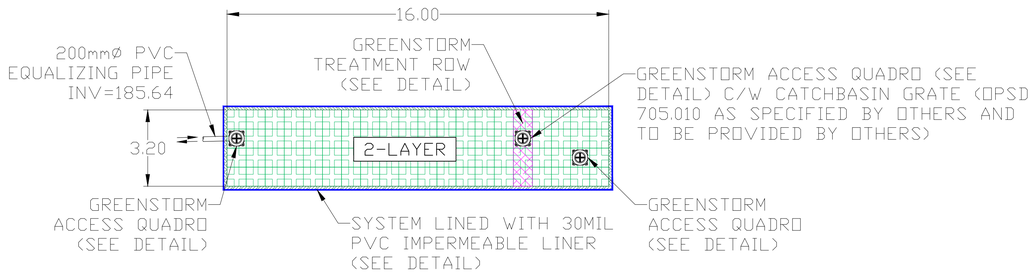
PROPOSED SYSTEM 6 ELEVATIONS

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

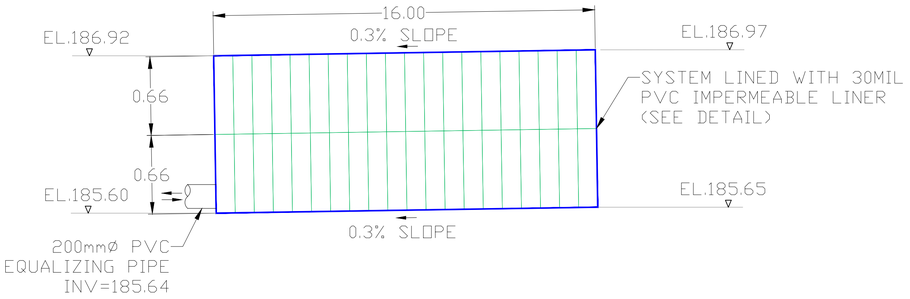
188.85	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
188.30	MINIMUM ALLOWABLE GRADE
186.92	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
186.26	GREENSTORM BASE ELEVATION
185.60	BOTTOM OF EXCAVATION
<185.20	SEASONAL HIGH GROUNDWATER ELEVATION

GREENSTORM STORMWATER MANAGEMENT SYSTEM

TOTAL STORAGE PROVIDED: 51.09 m^3
DETENTION VOLUME ABOVE 185.64: 50.27 m^3
RETENTION VOLUME BELOW 185.64: 0.82 m^3
STORAGE VOID RATIO: 0.96
SYSTEM AREA: 40.32 m^2
DEPTH OF EMBEDMENT STONE: 0.00 m
DEPTH OF BEDDING STONE: 0.00 m
STONE PERIMETER: 0.00 m



1 SYSTEM-6 LAYOUT PLAN
NTS



2 2.0 LAYER SYSTEM-6 LAYOUT PROFILE
NTS

NOTE:*ALL EXTERNAL SYSTEM STRUCTURES, INLET/OUTLET PIPES, AND PROPOSED ELEVATIONS MUST BE DESIGNED AND APPROVED BY PROJECT ENGINEER OF RECORD. PROJECT ENGINEER OF RECORD MUST ENSURE CHAMBER BURIAL REQUIREMENTS ARE MET.

MATERIALS LIST SUPPLIED BY STORMCON (SYSTEM MATERIALS LIST - SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)		
GREENSTORM-ST	243	PIECES
SINGLE LAYER CONNECTOR	200	PIECES
MULTI LAYER CONNECTOR	200	PIECES
SIDEWALL GRID	96	PIECES
HALF BLOCK SIDEWALL GRID	0	PIECES
HALF BLOCK COVER PLATE	0	PIECES
HALF BLOCK COVER PLATE QUADRO CONTROL	0	PIECES
QUADRO CONTROL	9	PIECES
QUADRO ADAPTERS	3	PIECES
EXTENSION PIPE	6	METER
CAST IRON COVER	2	PIECES
NO. OF 525mmØ PIPE ADAPTER	0	PIECES
NO. OF 450mmØ PIPE ADAPTER	0	PIECES
MIDDLE GRID	0	PIECES
MIDDLE GRID QUADRO CONTROL	0	PIECES
8 OZ NON-WOVEN GEOTEXTILE	370	SQ. METER
30MIL PVC IMPERMEABLE LINER	190	SQ. METER
LINER TAPE	110	METER
GREENSTORM FULL TREATMENT ROW	0	PIECES
GREENSTORM HALF TREATMENT ROW	0	PIECES
100MM SUBDRAIN	0	METER

GREENSTORM LEGEND

GREENSTORM ST BLOCK

GREENSTORM SIDEWALL GRID WITH 8 OZ NON-WOVEN GEOTEXTILE

GREENSTORM ACCESS QUADRO

30MIL PVC IMPERMEABLE LINER

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-6 LAYOUT SHEET STORAGE TANK

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	12 OF 17

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Main Sail Estates Subdivision - S6
Address	
City	Town of Milton, ON
Country	Canada
Date	November 7, 2025

System Details

Chamber Model	**GreenStorm-ST**	
Number of Layers	**2.0**	
Height of Chambers	1.32	m
Chamber Length	16.80	m
Chamber Width	2.40	m
Storage Void Ratio	96%	
System Perimeter	38.40	m
GreenStorm Area	40.32	m^2
System Area	40.32	m^2
GreenStorm Base Elevation	**185.60**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^2
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**188.85**	m
Lowest Finished Grade	**188.30**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
1320	1.74	0.00	0.00	0.00	51.09	186.920
1275	0.97	0.00	0.00	0.00	49.35	186.875
1250	0.97	0.00	0.00	0.00	48.38	186.850
1225	0.97	0.00	0.00	0.00	47.42	186.825
1200	0.97	0.00	0.00	0.00	46.45	186.800
1175	0.97	0.00	0.00	0.00	45.48	186.775
1150	0.97	0.00	0.00	0.00	44.51	186.750
1125	0.97	0.00	0.00	0.00	43.55	186.725
1100	0.97	0.00	0.00	0.00	42.58	186.700
1075	0.97	0.00	0.00	0.00	41.61	186.675
1050	0.97	0.00	0.00	0.00	40.64	186.650
1025	0.97	0.00	0.00	0.00	39.67	186.625
1000	0.97	0.00	0.00	0.00	38.71	186.600
975	0.97	0.00	0.00	0.00	37.74	186.575
950	0.97	0.00	0.00	0.00	36.77	186.550
925	0.97	0.00	0.00	0.00	35.80	186.525
900	0.97	0.00	0.00	0.00	34.84	186.500
875	0.97	0.00	0.00	0.00	33.87	186.475
850	0.97	0.00	0.00	0.00	32.90	186.450
825	0.97	0.00	0.00	0.00	31.93	186.425
800	0.97	0.00	0.00	0.00	30.97	186.400
775	0.97	0.00	0.00	0.00	30.00	186.375
750	0.97	0.00	0.00	0.00	29.03	186.350
725	0.97	0.00	0.00	0.00	28.06	186.325
700	0.97	0.00	0.00	0.00	27.10	186.300
675	0.97	0.00	0.00	0.00	26.13	186.275
650	0.97	0.00	0.00	0.00	25.16	186.250
625	0.97	0.00	0.00	0.00	24.19	186.225
600	0.97	0.00	0.00	0.00	23.22	186.200
575	0.97	0.00	0.00	0.00	22.26	186.175
550	0.97	0.00	0.00	0.00	21.29	186.150
525	0.97	0.00	0.00	0.00	20.32	186.125
500	0.97	0.00	0.00	0.00	19.35	186.100
475	0.97	0.00	0.00	0.00	18.39	186.075
450	0.97	0.00	0.00	0.00	17.42	186.050
425	0.97	0.00	0.00	0.00	16.45	186.025
400	0.97	0.00	0.00	0.00	15.48	186.000
375	0.97	0.00	0.00	0.00	14.52	185.975
350	0.97	0.00	0.00	0.00	13.55	185.950
325	0.97	0.00	0.00	0.00	12.58	185.925
300	0.97	0.00	0.00	0.00	11.61	185.900
275	0.97	0.00	0.00	0.00	10.64	185.875
250	0.97	0.00	0.00	0.00	9.68	185.850
225	0.97	0.00	0.00	0.00	8.71	185.825
200	0.97	0.00	0.00	0.00	7.74	185.800
175	0.97	0.00	0.00	0.00	6.77	185.775
150	0.97	0.00	0.00	0.00	5.81	185.750
125	0.97	0.00	0.00	0.00	4.84	185.725
100	0.97	0.00	0.00	0.00	3.87	185.700
75	0.97	0.00	0.00	0.00	2.90	185.675
50	0.97	0.00	0.00	0.00	1.94	185.650
25	0.97	0.00	0.00	0.00	0.97	185.625
0	0.00	0.00	0.00	0.00	0.00	185.600

2.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

STORMCON

69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1

SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-6 CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	13 OF 17

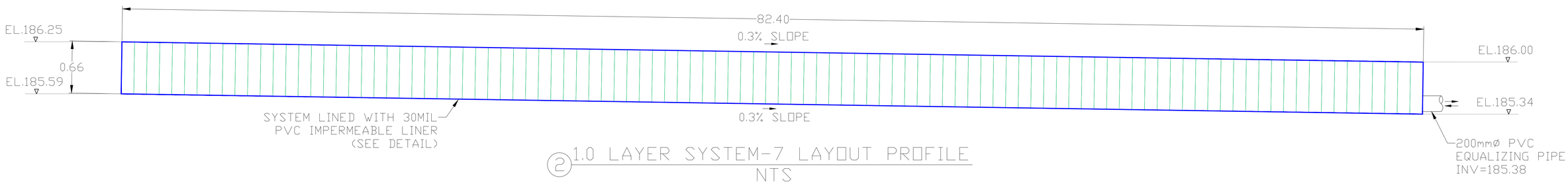
PROPOSED SYSTEM 7 ELEVATIONS

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

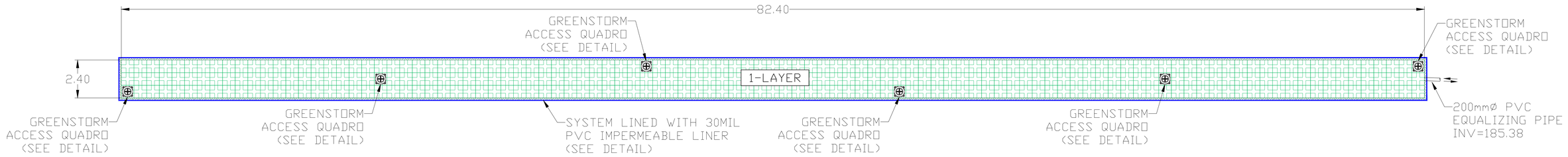
189.32	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
187.93	MINIMUM ALLOWABLE GRADE
186.00	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
185.34	GREENSTORM BASE ELEVATION
185.19	BOTTOM OF EXCAVATION
<185.20	SEASONAL HIGH GROUNDWATER ELEVATION

GREENSTORM STORMWATER MANAGEMENT SYSTEM

TOTAL STORAGE PROVIDED: 125.30 m^3
DETENTION VOLUME ABOVE 185.38: 124.48 m^3
RETENTION VOLUME BELOW 185.38: 0.82 m^3
STORAGE VOID RATIO: 0.96
SYSTEM AREA: 197.76 m^2
DEPTH OF EMBEDMENT STONE: 0.00 m
DEPTH OF BEDDING STONE: 0.00 m
STONE PERIMETER: 0.00 m



2 1.0 LAYER SYSTEM-7 LAYOUT PROFILE
NTS



1 SYSTEM-7 LAYOUT PLAN
NTS

NOTE:*ALL EXTERNAL SYSTEM STRUCTURES, INLET/OUTLET PIPES, AND PROPOSED ELEVATIONS MUST BE DESIGNED AND APPROVED BY PROJECT ENGINEER OF RECORD. PROJECT ENGINEER OF RECORD MUST ENSURE CHAMBER BURIAL REQUIREMENTS ARE MET.

MATERIALS LIST SUPPLIED BY STORMCON
(SYSTEM MATERIALS LIST - SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)

GREENSTORM-ST	612	PIECES
SINGLE LAYER CONNECTOR	600	PIECES
MULTI LAYER CONNECTOR	0	PIECES
SIDEWALL GRID	212	PIECES
HALF BLOCK SIDEWALL GRID	0	PIECES
HALF BLOCK COVER PLATE	0	PIECES
HALF BLOCK COVER PLATE QUADRO CONTROL	0	PIECES
QUADRO CONTROL	6	PIECES
QUADRO ADAPTERS	6	PIECES
EXTENSION PIPE	24	METER
CAST IRON COVER	6	PIECES
NO. OF 525mmØ PIPE ADAPTER	0	PIECES
NO. OF 450mmØ PIPE ADAPTER	0	PIECES
MIDDLE GRID	0	PIECES
MIDDLE GRID QUADRO CONTROL	0	PIECES
8 OZ NON-WOVEN GEOTEXTILE	1430	SQ. METER
30MIL PVC IMPERMEABLE LINER	720	SQ. METER
LINER TAPE	410	METER
GREENSTORM FULL TREATMENT ROW	0	PIECES
GREENSTORM HALF TREATMENT ROW	0	PIECES
100MM SUBDRAIN	0	METER

GREENSTORM LEGEND

GREENSTORM ST BLOCK

GREENSTORM SIDEWALL GRID WITH 8 OZ NON-WOVEN GEOTEXTILE

GREENSTORM ACCESS QUADRO

30MIL PVC IMPERMEABLE LINER

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-7 LAYOUT SHEET STORAGE TANK

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	14 OF 17

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Main Sail Estates Subdivision - S7
Address	
City	Town of Milton, ON
Country	Canada
Date	November 7, 2025

System Details

Chamber Model	**GreenStorm-ST**	
Number of Layers	**1.0**	
Height of Chambers	0.66	m
Chamber Length	82.40	m
Chamber Width	2.40	m
Storage Void Ratio	96%	
System Perimeter	169.60	m
GreenStorm Area	197.76	m^2
System Area	197.76	m^2
GreenStorm Base Elevation	**185.34**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^3
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**189.32**	m
Lowest Finished Grade	**187.93**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
660	6.64	0.00	0.00	0.00	125.30	186.000
625	4.75	0.00	0.00	0.00	118.66	185.965
600	4.75	0.00	0.00	0.00	113.91	185.940
575	4.75	0.00	0.00	0.00	109.16	185.915
550	4.75	0.00	0.00	0.00	104.42	185.890
525	4.75	0.00	0.00	0.00	99.67	185.865
500	4.75	0.00	0.00	0.00	94.92	185.840
475	4.75	0.00	0.00	0.00	90.18	185.815
450	4.75	0.00	0.00	0.00	85.43	185.790
425	4.75	0.00	0.00	0.00	80.69	185.765
400	4.75	0.00	0.00	0.00	75.94	185.740
375	4.75	0.00	0.00	0.00	71.19	185.715
350	4.75	0.00	0.00	0.00	66.45	185.690
325	4.75	0.00	0.00	0.00	61.70	185.665
300	4.75	0.00	0.00	0.00	56.95	185.640
275	4.75	0.00	0.00	0.00	52.21	185.615
250	4.75	0.00	0.00	0.00	47.46	185.590
225	4.75	0.00	0.00	0.00	42.72	185.565
200	4.75	0.00	0.00	0.00	37.97	185.540
175	4.75	0.00	0.00	0.00	33.22	185.515
150	4.75	0.00	0.00	0.00	28.48	185.490
125	4.75	0.00	0.00	0.00	23.73	185.465
100	4.75	0.00	0.00	0.00	18.98	185.440
75	4.75	0.00	0.00	0.00	14.24	185.415
50	4.75	0.00	0.00	0.00	9.49	185.390
25	4.75	0.00	0.00	0.00	4.75	185.365
0	0.00	0.00	0.00	0.00	0.00	185.340

1.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

STORMCON

69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1

SALES@STORMCON.CA
WWW.STORMCON.CA

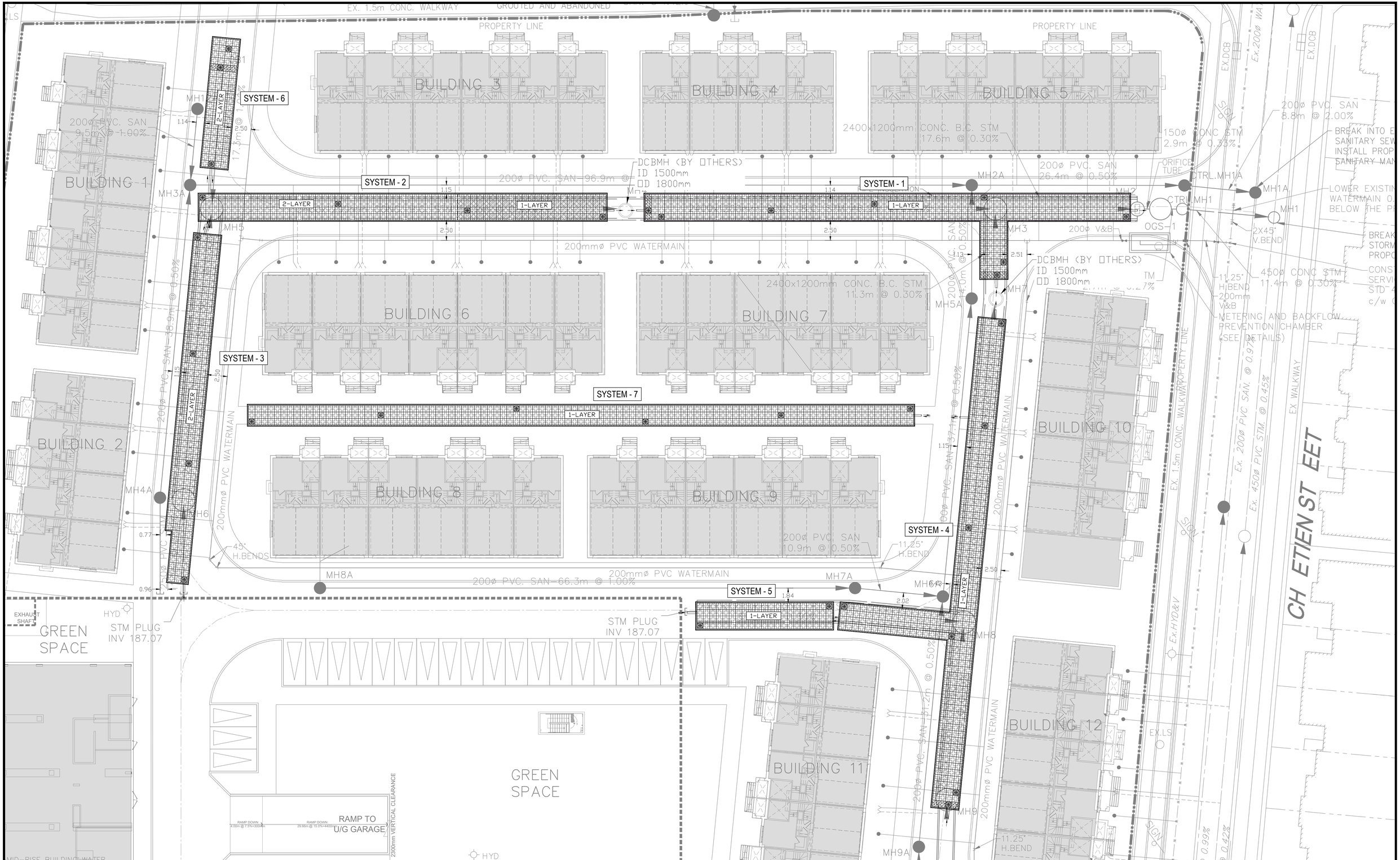
THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM-7 CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	15 OF 17



STORMCON

69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1

SALES@STORMCON.CA
WWW.STORMCON.CA

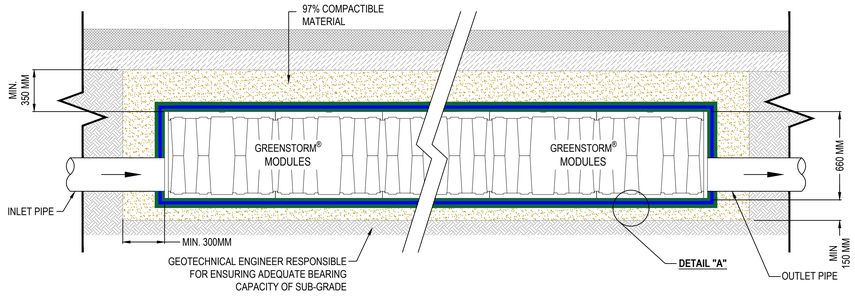
THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

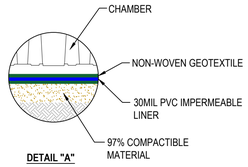
MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

SYSTEM OVERLAY SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	16 OF 17





BEDDING & BACKFILL REQUIREMENTS:

BEDDING:

NON-COHESIVE, NON-FROZEN EARTHWORK MATERIAL WITH A MAXIMUM GRAIN SIZE OF 32mm. DEGREE OF COMPACTION D_p SHOULD BE LARGER THAN OR EQUAL TO 97%. BELOW TRAFFIC AREAS, EV2 SHOULD BE LARGER THAN OR EQUAL TO 45 MN/m^2 OR CBR SHOULD BE LARGER THAN OR EQUAL TO 12% AT THE TOP EDGE OF THE BEARING. PREFERABLY MADE OF CRUSHED STONES (e.g. 2/5mm), GRAVEL OR SAND.

LATERAL BACKFILL AND COVER:

NON-COHESIVE, NON-FROZEN EARTHWORK MATERIAL WITH A MAXIMUM GRAIN SIZE OF 32mm. DISTRIBUTED EVENLY AND COMPACTED IN LAYERS OF MAX. 0.30m. DEGREE OF COMPACTION D_p SHOULD BE LARGER THAN OR EQUAL TO 97%. BELOW TRAFFIC AREAS, EV2 SHOULD BE LARGER THAN OR EQUAL TO 45 MN/m^2 OR CBR SHOULD BE LARGER THAN OR EQUAL TO 12% AT THE TOP EDGE OF THE BEARING.

IMPORTANT CHARACTERISTICS OF THE GEOTEXTILE

- THICKNESS ≥ 2 mm
- PUNCTURE RESISTANCE 2.0 kN
- GEOTEXTILE CLASS 3
- CHARACTERISTIC OPENING WIDTH 0.08 mm
- kf VALUE (at 20 kPa): 6 x 10^{-2} m/s
- WATER PERMEABILITY ACC. TO EN ISO 11058: 80 l/sm^2
- MASS PER UNIT AREA 200 g/m^2
- RESISTANCE: ANTICIPATED RESISTANCE OF UP TO 50 YEARS IN ALL NATURAL SOIL TYPES WITH 4 ≤ pH ≤ 9 AND SOIL TEMPERATURE OF ≤ 25°C (B.4.2.2 EN ISO 13438)

LEGEND

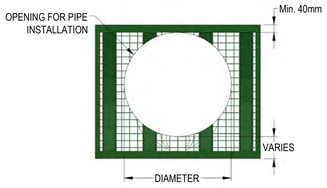
30MIL PVC IMPERMEABLE LINER

NON-WOVEN GEOTEXTILE

TYPICAL ONE LAYER GREENSTORM CROSS SECTION

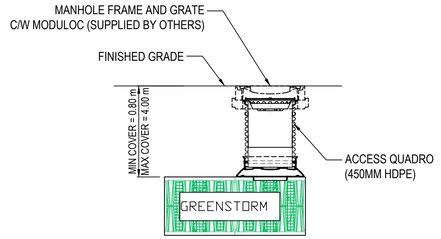
FULL CONNECTION OPTIONS
Dia 100mm, 150 mm, 200 mm, 250 mm, 300 mm AND 375 mm

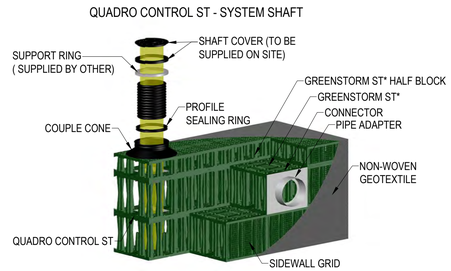




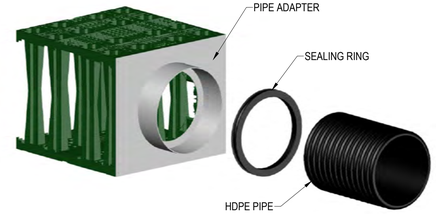
SIDE PANEL WITH DIRECT PIPE CUT

STANDARD SIDE PANEL WITH DIRECT PIPE CUT

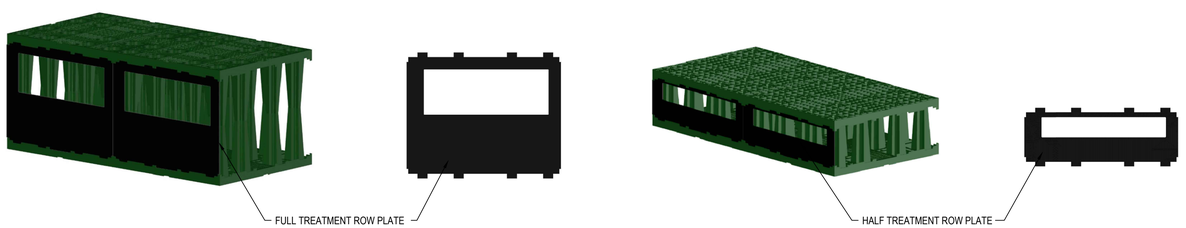




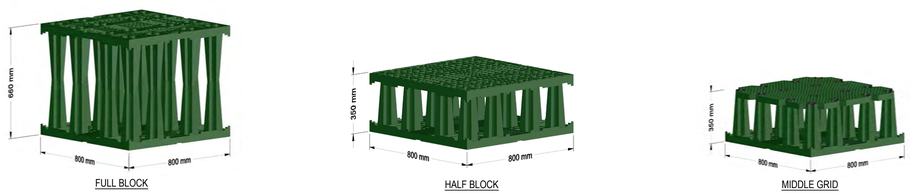
GREENSTORM ACCESS QUADRO DETAIL(WHERE APPLICABLE)



STANDARD ADAPTER PANEL WITH DIA 450 AND 525



STANDARD TREATMENT ROW DETAIL (WHERE APPLICABLE)



STANDARD GREENSTORM BLOCK DETAIL

STORMCON
69 CONNIE CRESCENT
CONCORD, ON, L4K 3W1
SALES@STORMCON.CA
WWW.STORMCON.CA

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGNED IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCONS MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

MAIN SAIL ESTATES SUBDIVISION
TOWN OF MILTON, ON

DETAILS SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2025-156	DATE:	10/31/2025
DESIGNED BY:	JD	CHECKED BY:	ADR
SCALE:	N.T.S.	SHEET NO:	17 OF 17

SWM CALCS

Shearling Heights

Town of Milton

Runoff Coefficients

Project: 2017-4568

Overall Area

	Area (ha)	Runoff C.	AC
Green Space	0.33	0.25	0.084
Green Space over Parking Slab	0.05	0.90	0.043
Impervious Areas	1.73	0.90	1.555
TOTAL	**2.11**		**1.682**

Weighted Coefficient	**0.80**
TIMP	**0.85**

Drainage Area to Storage Pipe

	Area (ha)	Runoff C.	AC
Green Space	0.19	0.25	0.047
Green Space over Parking Slab	0.05	0.90	0.043
Impervious Areas	1.66	0.90	1.490
TOTAL	**1.89**		**1.581**

Weighted Coefficient	**0.84**
TIMP	**0.91**

Uncontrolled - Total

	Area (ha)	Runoff C.	AC
Impervious	0.07	0.90	0.064
Pervious	0.15	0.25	0.037
TOTAL	**0.22**		**0.101**

Weighted Coefficient	**0.46**
TIMP	**0.38**

Uncontrolled - West

	Area (ha)	Runoff C.	AC
Impervious	0.05	0.90	0.043
Pervious	0.05	0.25	0.011
TOTAL	**0.09**		**0.054**

Weighted Coefficient	**0.59**
TIMP	**0.55**

Uncontrolled - North

	Area (ha)	Runoff C.	AC
Impervious	0.01	0.90	0.011
Pervious	0.07	0.25	0.017
TOTAL	**0.08**		**0.028**

Weighted Coefficient	**0.35**
TIMP	**0.21**

Uncontrolled - East

	Area (ha)	Runoff C.	AC
Impervious	0.01	0.90	0.010
Pervious	0.03	0.25	0.008
TOTAL	**0.04**		**0.019**

Weighted Coefficient	**0.42**
TIMP	**0.31**

Weighted Coefficient (North + East)	**0.37**
TIMP	**0.25**

SHEARLING HEIGHTS **4568**

Uncontrolled Flow - North & East

Town of Milton

Rainfall intensity

Design Storm Event	A	B	C	I (mm/hr)
2-Year	779.0	6.0	0.8206	80.064
5-Year	959.0	5.7	0.8024	105.252
10-Year	1089.0	5.7	0.7955	121.812
25-Year	1234.0	5.5	0.7863	143.007
50-Year	1323.0	5.3	0.7786	158.183
100-Year	1435.0	5.2	0.7751	174.102

Note:
T=10 minutes
I=A x T^C

Peak Runoff Generated On - Site

Runoff Coefficient, C	**0.37**	
Drainage Area	**0.13**	ha
2-Year Peak Flow, Q2	10.4	l/s
5-Year Peak Flow, Q5	13.6	l/s
10-Year Peak Flow, Q10	15.8	l/s
25-Year Peak Flow, Q25	18.5	l/s
50-Year Peak Flow, Q50	20.5	l/s
100-Year Peak Flow, Q100	**22.6**	l/s

Mail Sail Estates Subdivision
SWM Pond H
Water Quality Control Requirements

Table: Water Quality Storage Requirements Based on Receiving Waters

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enchanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hydrid Wet Pond/Wetlands	110	150	175	195
	Wet Pond	140	190	225	250

* For wet ponds, all of the storage, except for 40 m^3/ha represents the permanent pool volume. The 40 m^3/ha represents extended detention storage.
Source: 2003 SWM Planning & Design Manual

SWM Pond
Input:

Weighted Imperviousness =	85%	
Area =	2.11	ha
Level of Protection:	1	
SWMP Type :	Wet Pond	

Calculation:

Total Storage Volume =	250	m^3/ha	→	528	m^3
Permanent Pool Volume =	**210**	m^3/ha	→	**443**	**m^3**
Active Storage Volume =	40	m^3/ha	→	84	m^3

Shearling Heights
Town of Milton
Orifice Structure in Superpipe

CALCULATE DIAMETER KNOWING Q & H	
Q(m^3/s)=	0.070
Td(m) =	1.43
Approx A=	0.0165
Approx D=	145
A(m^2) =	0.017
D(mm) =	**147**

Control Manhole Orifice		
DIA (mm)=	**125**	
AREA m^2=	0.012	
COEFF =	**0.80**	
GRAVITY =	9.81	
K =	1.0	
D/S HGL=	185.49	m
Orifice Inv.=	185.21	m

Effective Head m	Depth Water At CTL MH m	Qp m^3/s	TOTAL FLOW Qp m^3/s	ELEVATION of Water m
0.00	0.280	0.000	0.000	185.49
0.100	0.380	0.014	0.014	185.59
0.500	0.780	0.031	0.031	185.99
0.700	0.980	0.036	0.036	186.19
0.750	1.030	0.038	0.038	186.24
0.800	1.080	0.039	0.039	186.29
1.570	1.850	0.054	0.0545	187.06

ORIFICE FLOW Q(m^3/s)= COEF*AREA*(2*GRAVITY*HEAD/K)^0.5

WEIR FLOW Q(m^3/s)= CLH^1.5 C=1.5

Schaeffers Consulting Engineers

Printed: 22-Feb-26

SWM Storage

Schaeffers Consulting Engineers

Project Name: Shearling Heights

Modified Rational Method - Tank

Area (ha) =	1.892
C =	0.84
Allowable Release Rate (l/s) =	57.9
Actual Release Rate (l/s) =	54.5

Release Rate from Sump Pump (l/s) =	8.00
Release from Roof (l/s) =	0.00

100 Year Storm

Design Storm =	Town of Milton
A =	1435
B =	5.2
C =	0.7751

						Total	Maximum	Required
Time	Intensity	Rainfall	Runoff	Sump Pump	Total	Runoff	Release	Storage
(min)	100 year	Runoff	Roof	Tank	Runoff	Volume	Volume	Volume
	(mm/hr)	(l/s)	(l/s)	(l/s)	(l/s)	(m^3)	(m^3)	(m^3)
10	174.10	769.22	0.00	8.00	777.22	466.33	32.70	433.63
11	165.71	732.15	0.00	8.00	740.15	488.50	35.97	452.53
12	158.20	698.94	0.00	8.00	706.94	509.00	39.24	469.76
13	151.42	668.98	0.00	8.00	676.98	528.05	42.51	485.54
14	145.27	641.82	0.00	8.00	649.82	545.85	45.78	500.07
15	139.66	617.05	0.00	8.00	625.05	562.54	49.05	513.49
16	134.53	594.37	0.00	8.00	602.37	578.27	52.32	525.95
17	129.81	573.51	0.00	8.00	581.51	593.14	55.59	537.55
18	125.45	554.25	0.00	8.00	562.25	607.23	58.86	548.37
19	121.41	536.42	0.00	8.00	544.42	620.63	62.13	558.50
20	117.66	519.84	0.00	8.00	527.84	633.41	65.40	568.01
21	114.16	504.40	0.00	8.00	512.40	645.62	68.67	576.95
22	110.90	489.96	0.00	8.00	497.96	657.31	71.94	585.37
23	107.84	476.44	0.00	8.00	484.44	668.53	75.21	593.32
60	56.32	248.81	0.00	8.00	256.81	924.53	196.20	728.33
65	53.18	234.96	0.00	8.00	242.96	947.56	212.55	735.01
70	50.42	222.76	0.00	8.00	230.76	969.20	228.90	740.30
75	47.97	211.92	0.00	8.00	219.92	989.64	245.25	744.39
80	45.77	202.22	0.00	8.00	210.22	1009.03	261.60	747.43
85	43.79	193.47	0.00	8.00	201.47	1027.50	277.95	749.55
90	42.00	185.55	0.00	8.00	193.55	1045.16	294.30	750.86
95	**40.36**	**178.33**	**0.00**	**8.00**	**186.33**	**1062.08**	**310.65**	**751.43**
100	38.87	171.72	0.00	8.00	179.72	1078.35	327.00	751.35
105	37.49	165.65	0.00	8.00	173.65	1094.02	343.35	750.67
110	36.23	160.05	0.00	8.00	168.05	1109.15	359.70	749.45

Required Storage (m^3):	**752.0**

Town of Milton

Shearling Heights
MH2

Job: 2017-4568 November 2025

Input:

Design Specification (OPSD)	403.01	
100-Year Overland Flow =	0.154	m^3/s
Catchbasin Type =	2	*
Number of Catchbasins =	1	
Allowable Depth of Ponding =	170	mm
Actual Depth of Ponding =	170	mm

Output:

Flow Capacity per Inlet =	0.336	m^3/s **
Flow Capacity per Inlet with 50% Blockage =	0.168	m^3/s
Number of Inlet =	1	
Total Flow Capacity with 50% Blockage =	0.168	m^3/s

Total flow capacity with 50% blockage is greater than the incoming 100-Year overland flow, therefore the inlet structure is sized adequately.

Notes:

* Catchbasin Type (1 for single, 2 for twin)

** Calculation based on MTO Design Chart 4.19: Inlet Capacity at Road Sag

Allowable Depth of Ponding is based on Grading Plans

Town of Milton

Shearling Heights
MH9

Job: 2017-4568 November 2025

Input:

Design Specification (OPSD)	403.01	
100-Year Overland Flow =	0.183	m^3/s
Catchbasin Type =	2	*
Number of Catchbasins =	1	
Allowable Depth of Ponding =	200	mm
Actual Depth of Ponding =	200	mm

Output:

Flow Capacity per Inlet =	0.416	m^3/s **
Flow Capacity per Inlet with 50% Blockage =	0.208	m^3/s
Number of Inlet =	1	
Total Flow Capacity with 50% Blockage =	0.208	m^3/s

Total flow capacity with 50% blockage is greater than the incoming 100-Year overland flow, therefore the inlet structure is sized adequately.

Notes:

* Catchbasin Type (1 for single, 2 for twin)

** Calculation based on MTO Design Chart 4.19: Inlet Capacity at Road Sag

Allowable Depth of Ponding is based on Grading Plans

Shearling Heights

Town of Milton

Minor System Capacity

Project: 2017-4568

Pipe Section		current flow (L/s)	full flow (L/s)	current q/Q	residual (L/s)	length (m)	added flow (L/s)	proposed flow (L/s)	new q/Q
start	end								
60	**64**	114.7	**201.6**	56.9%	86.9	61.28	13.6	**128.3**	**63.6%**
64	**68**	342.6	**460.4**	74.4%	117.8	76.40	13.6	**356.2**	**77.4%**
66	**67**	104.3	**201.6**	51.7%	97.3	65.85	66.9	**171.2**	**84.9%**
67	**68**	100.1	**201.6**	49.7%	101.5	6.89	66.9	**167.0**	**82.8%**
68	**76**	796.1	**1144.9**	69.5%	348.8	72.05	80.5	**876.6**	**76.6%**
76	**80**	1156.7	**1417.4**	81.6%	260.7	71.14	80.5	**1237.2**	**87.3%**
80	**81**	1284.4	**1495.7**	85.9%	211.3	40.75	80.5	**1364.9**	**91.3%**
81	**94**	1321.5	**1495.7**	88.4%	174.2	26.49	80.5	**1402.0**	**93.7%**
94	**95**	1780.7	**2135.4**	83.4%	354.7	62.04	80.5	**1861.2**	**87.2%**
95	**96**	1741.2	**4993.7**	34.9%	3252.5	11.89	80.5	**1821.7**	**36.5%**
96	**97**	3810.7	**4324.7**	88.1%	514.0	34.12	80.5	**3891.2**	**90.0%**
97	**HW**	3875.6	**4324.7**	89.6%	449.1	13.94	80.5	**3956.1**	**91.5%**

Appendix D: Engineering Drawings

(refer to submission package)