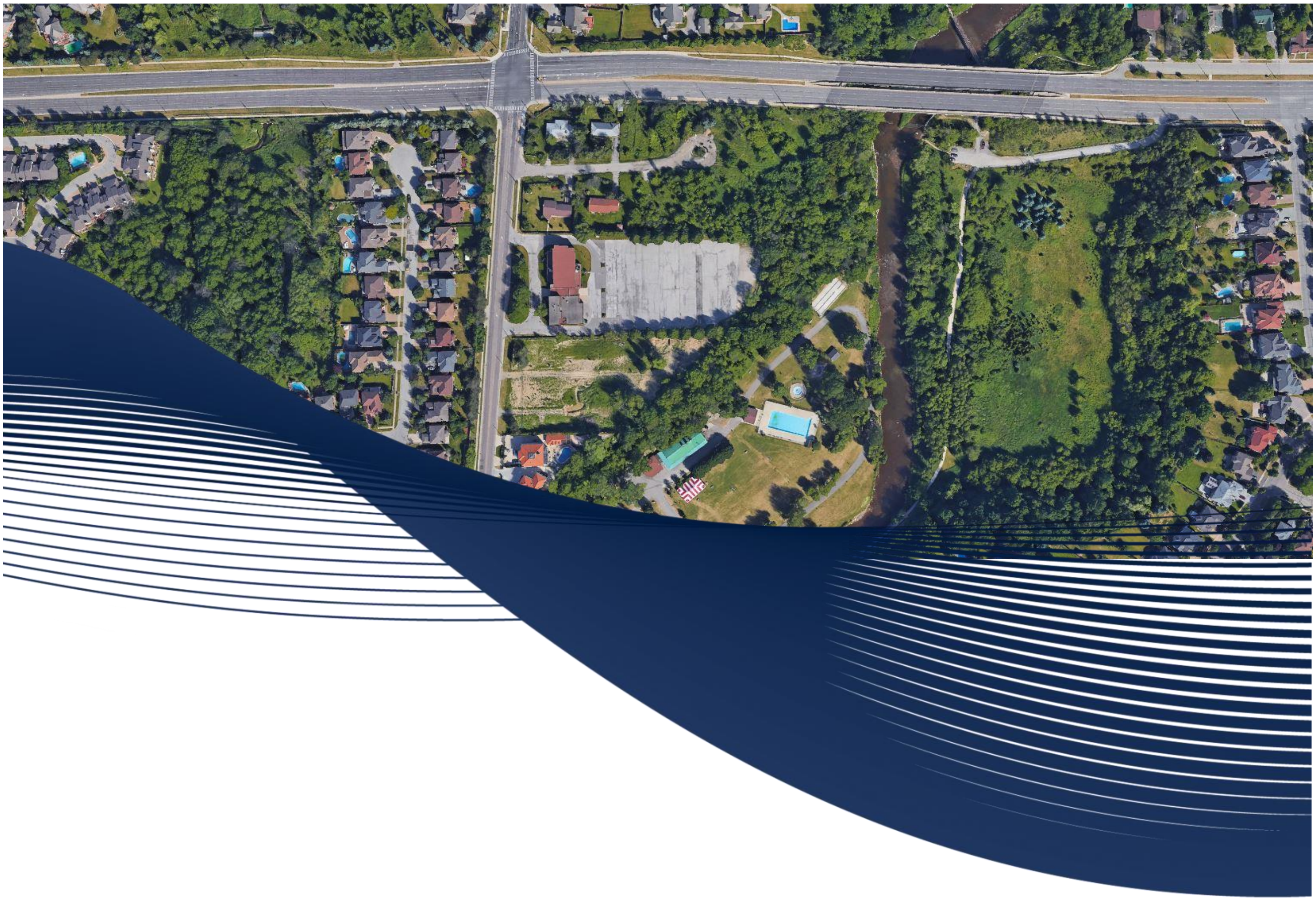
# 2462357 ONTARIO INC.
# (PACE DEVELOPMENTS)

## FUNCTIONAL SERVICING REPORT

The Hazel, City of Mississauga

UD15-0682



MARCH 2019

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## Issues and Revisions Registry

| Identification | Date | Description of issued and/or revision |
|---|---|---|
| Draft Report | May 10, 2017 | For Client Review |
| Final Report | December 1, 2017 | For Submission |
| Revised Report | March 25, 2019 | For Submission |
| | | |
| | | |

## Statement of Conditions

This Report/Study (the “Work”) has been prepared at the request of, and for the exclusive use of, the Owner/Client, and its affiliates (the “Intended User”). No one other than the Intended User has the right to use and rely on the Work without first obtaining the written authorization of Cole Engineering Group Ltd. and its Owner. Cole Engineering Group Ltd. expressly excludes liability to any party except the intended User for any use of, and/or reliance upon, the work.

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## APPENDICES

# 1 Introduction

Cole Engineering Group Ltd. (Cole Engineering) was retained by 2462357 Ontario Inc. (Pace Developments) (the "Owner") to prepare a Functional Servicing Report (FSR), for the re-development of a residential subdivision development (the Hazel), in accordance with the City of Mississauga standards. This report will be submitted in support of a new site plan and supersedes the report submitted in December 17, 2017.

The subject land covers an area of approximately 2.10 ha (5.19 acres) and is situated on Part of Lot 1 and all of Lot 2 and Thorny-Brae Place (Registered Plan 495) and Part of Lots 3 and 4, Range 5 North of Dundas Street, within the City of Mississauga in the Regional Municipality of Peel. The subject property is located at the southeast corner of Mississauga Road and Eglinton Avenue West, and is bounded by existing residential to the north and west, a church to the south and Credit River to the east. The location of the site is illustrated in **Figure LOC-01**. The site is an extension of Thorny-Brae Place with municipal services available at the property limits.

The FSR will address the feasibility associated with providing municipal services, such as shifting the cul-de-sac east, sanitary sewers, storm sewers, watermains and utilities for the subject lands. This report also describes the manner in which stormwater management will be implemented.

The Hazel is developed in conjunction with the Archways T-09002M site plan application located at 4583, 4589 and 4601 Mississauga Road whereby a new storm sewer has been approved and recently constructed in 2018 on Thorny-Brae Place with an outfall to the Credit River. The location of the storm sewer is designed in conjunction with the future Thorny-Brae Place extension to the east with a new watermain, sanitary sewer system, service connections, roadway and utilities will be constructed as part of the Hazel development scheme.

## 1.1 Existing Information

The following documents were available for our review for the preparation of this report:

- Stormwater Management Design Brief – Revised for The Archways and Hazel developments, prepared by Cole Engineering Ltd, dated June 29, 2017;
- A Soil Investigation for Proposed Residential Development 1745, 1765 and 1775 Thorny-Brae Place (Reference No. 1608-S094), prepared by Soil Engineers Ltd. dated October 2016;
- Slope Stability Study Addendum for Proposed Residential Development 1745, 1765 and 1775 Thorny-Brae Place (Reference No. 1608-S094), prepared by Soil Engineers Ltd. dated March 7, 2019;
- Storm Sewer Outfall Opinion Letter – Proposed Residential Development 1745, 1765 and 1775 Thorny-Brae Place (Reference No. 1608-S094), prepared by Soil Engineers Ltd. dated March 1, 2017;
- Restoration Landscape Plan, prepared by Alexander Budrevics & Associates, Landscape Architect, Sheet B1, Project 3022, dated September 12, 2017;
- 1745-1775 Thorny-Brae Place "The Hazel" Fluvial Geomorphological Assessment, prepared by Water's Edge dated February 27, 2017; and
- Thorny-Brae Place Extension Tree Inventory Plan, prepared by Baker Turner Inc. dated September 11, 2017.

## 1.2 Existing Site Conditions

The site is located on existing Thorny-Brae Place which is an existing road, approximately 140m long with a cul-de-sac and urban residential to the north and west, Croatian Park (Church) to the south and Credit River to the east. There are four (4) existing residential dwellings that front onto Thorny-Brae Place. 1775 and 1765 Thorny-Brae Place lie within the limits of the proposed development. The two (2) existing single family dwellings on the south side of Thorny-Brae Place are outside of the limits of the development; therefore, the services and access to these homes need to be maintained throughout construction. The two (2) existing single family dwellings on the north side of Thorny-Brae Place are within the development and will be demolished by the Owner.

The lands are relatively flat sloping from the west to the east with an elevation difference about 1 m across Thorny-Brae Place. The proposed extension of Thorn-Brae Place lies within a steeper terrain with elevation differences of approximately 8 m vertical from the new roadway to the existing headwall. The easterly portion of the site lies within the Credit River Valley Lands with a top of bank and 10m buffer block that has been previously established by the Credit River Conservation (CVC) and the City of Mississauga and reviewed and revised through this application. The existing topography generally drains from the northwest corner of the site to the southeast corner of the site. The flows are conveyed to the existing ditches that border Thorny-Brae Place right-of-way and outlet directly into the Credit River to the east.

# 2 Site Layout

The proposed land use pattern and road are based on the current information provided by RN Design, Dwg SP100, Project # 16041, dated March 20, 2019, received on March 22, 2019 from the Owner's planner, Armstrong Planning and Project Management. The development will include 7 townhouse residential blocks and one (1) single family dwelling resulting in a total of 37 units. The site layout is shown on the current Site Plan in **Figure SP-01**.

Thorny-Brae Place terminates east of the existing cul-de-sac, approximately 170 m east of Mississauga Road. The site proposal includes urbanizing the existing ROW with standard curb and gutter and an extension of Thorny-Brae Place approximately 20 m east; Thorny-Brae Place will terminate at a new cul-de-sac. The right-of-way (ROW) for Thorny-Brae Place is 20.0 m with full municipal services, curbs and gutters. The proposed dwellings on the north side of Thorny-Brae Place will have dual frontage on Eglinton Ave West and Thorny-Brae Place. The dwellings at the south of Thorny Brae Place will front on Thorny-Brae Place. The typical cross-section for the ROW is shown on **Figure TR-01**. A 3m wide walkway block connects Thorny-Brae Place to Eglington Avenue West.

# 3 Water Supply and Distribution

## 3.1 Existing Water Distribution System

The site is within an area which has water supplied by a municipal water distribution system that is operated by the Region of Peel. Water for the existing municipal water distribution system is supplied by water pumped from Lake Ontario and is distributed via Regional and Municipal mains.

The existing watermain system for the surrounding area consists of a piped municipal system. There is an existing 150mm watermain on Thorny-Brae Place with tees off an existing 300 mm watermain on Mississauga Road. The existing 150mm watermain on Thorny-Brae Place reduces to a 50mm watermain east of the existing hydrant and continues east wrapping around the existing cul-de-sac where it extends north to tee into an existing watermain on Eglinton Avenue West. The existing watermain system is shown on **Drawing SS-01 Functional Servicing Plan**. Water demand is based on residential criteria and will need to be confirmed at the detailed design stage. Through consultation with the Regional of Peel the sizing of the proposed watermain will be confirmed.

## 3.2 Proposed Water Distribution

Internal watermains will be sized to provide adequate pressure which will consider the internal looped system, the connections to existing infrastructure, and demand of the development. The internal water distribution system will consist of a proposed 150mm watermain that tees off the existing 300mm watermain on Mississauga Road. The proposed 150mm PVC watermain will reduce to a 50mm copper watermain where it will loop around the bulb of the proposed cul-de-sac. The proposed watermain system is shown on **Drawing SS-01 Functional Servicing Plan**.

The domestic water usage is based on the Average Day Domestic Demand as indicated by the Engineering Department of the Region of Peel. Residential water demand is shown below in **Table 3.1**.

**Table 3.1 – Water Usage**

| Usage | Water Demand |
|---|---|
| Residential | 280 L/c/d |

The expected domestic consumption based on anticipated peak hour demands is 200,340 L/hr; refer to domestic water usage calculation sheet in **Appendix B**.

Fire protection will be provided by hydrants at standard spacing. Hydrants, valves, waterboxes and other appurtenances will be located in accordance with the Region of Peel Standard Design Criteria. Fire suppression flow demand shall meet the minimum 7,000 L/min. as per the Fire Underwriters Survey Document *Water Supply for Public Fire Protection*.

# 4 Sanitary Servicing

## 4.1 Existing Sanitary Sewer System

The existing residential subdivision is currently serviced by a municipal sanitary sewer system. Sanitary flows are collected through the Region of Peel Trunk System and treated at a Regional owned and operated treatment facility. The location of existing sanitary sewers is shown on **Figure SAN-01** and **Drawing SS-01 Functional Servicing Plan**.

## 4.2 Proposed Sanitary Flows

The proposed sanitary discharge flows from the site were calculated based on the proposed development and site information. The data was based on single family detached and row (townhouse) residential flows, extraneous infiltration rates, and peaking factors. The sanitary discharge flow was based on the Region's current design criteria of 365 Lpcd. A 250mm sanitary sewer at minimum 0.5% is sufficient to convey the sanitary flow, while maintaining a minimum velocity of 0.75 m/s, to the existing sanitary sewer on Thorny-Brae Place crossing Mississauga Road. Based on the Region's criteria, a total design flow of 0.00480$m^3$/s (4.80 L/s) was calculated. The design sheet can be found in **Appendix C.**

### 4.3 Proposed Sanitary Connection

The development is proposed to connect directly to an existing sanitary sewer on Thorny-Brae Place. The proposed sanitary sewer will drain east to west within the new ROW of Thorny-Brae Place and discharge into the existing 250mm sanitary sewer on Thorny-Brae Place crossing Mississauga Road. It was assumed that the two (2) existing dwellings on the south of Thorny-Brae Place will later be developed with higher density product; therefore, a density of 175ppha similar to this development was carried for this area in the sewer design calculations. For the calculated peak flow, a 250 mm diameter pipe sloped at a minimum of 0.5% grade (or equivalent pipe capacity) will be required. Refer to **Figure SAN-01 Appendix A,** detailed calculations located in **Appendix C** and **Drawing SS-01 Functional Servicing Plan**.

## 5 Road Network and Grading

### 5.1 Road Network

The subject lands are bounded by Eglinton Avenue West to the north and Mississauga Road to the west. The site plan for the subject lands identifies a single local road with a 20.0m right-of-way. **Figure TR-01** illustrates the typical cross-section for this local roadway. The Traffic Impact Study Proposed by Nextrans Consulting confirms that the development proposal can adequately be accommodated by the recommended transportation network with manageable traffic impact to the adjacent public roadways.

### 5.2 Grading

The overall grading of the development must consider the following boundary conditions:

- Grading constraints of existing property boundaries and adjacent housing type and other adjacent land use conditions for both current and future uses;
- Roadway connections and vertical alignment requirements;
- Storm drainage requirements including generating enough elevation head to accommodate specified outlet elevations; and,
- A gravity drainage system and maintaining downstream sanitary servicing connection elevations.

The existing Thorny-Brae Place is a 170 m asphalt road with a cul-de-sac at the east limit, with ditches running along the limits of the pavement to collect storm drainage. The proposal for this site is to remove the existing cul-de-sac and extend Thorny-Brae Place approximately 20 m east with a new cul-de-sac at the end of the road. Thorny-Brae Place is planned to have an urban cross-section with a sidewalk on both sides of the street and full municipal services such as curb and gutter, storm sewers, sanitary sewers, watermains, street lighting and underground utility accommodations. The design of Thorny-Brae Place is intended to match to the existing grade of the road at Mississauga Road and blend into the east limit of the existing property to the south, in accordance to the City standards. The desirable minimum road gradient of 0.5% and a maximum road gradient of 7% is to be provided. Thorny-Brae Place is designed to convey flows exceeding the capacity of the storm sewers to the south limit of the cul-de-sac and follow the direction of overland flow to Credit River. **Drawing SG-01 Functional Grading Plan** illustrates Thorny-Brae Place runs at a minimum 0.5%.

The soil investigation in **Appendix D** identifies measures to mitigate groundwater in excavation.

# 6 Storm Drainage System

## 6.1 Existing Storm Drainage

The site currently flows onto existing Thorny-Brae Place. The flows are then picked up in the existing roadside ditches and conveyed to a drainage feature in an existing valley depression which ultimately outlets into the Credit River to the east. Additional drainage from the Church lands contribute approximately 1.56 ha. of building, parking lot and landscaped areas into the same valley depression via an internal storm sewer system that outlets from an existing headwall into the Credit River. As part of a proposed development to the south of the Church a 450mm to 750mm diameter storm sewer was installed within the right-of-way of Mississauga Road and Thorny-Brae Place. This storm sewer was sized to also capture storm flows from the proposed site and outlet into the existing headwall.

## 6.2 Design Criteria and SWM Approach

The subject site is located within the Credit River Watershed. The site must therefore meet the local City of Mississauga development requirements, Credit Valley Conservation (CVC) and Ministry of the Environment (MOE) SWM drainage standards. The following design criteria were reviewed for the proposed design:

- Storm sewers are to be designed to the City of Mississauga – 10-year Intensity Duration Frequency (IDF) storm event;
- No quantity storage is required by the CVC and agreed upon by the City due to the close proximity to the Credit River;
- The storm runoff from Thorny-Brae Place is to be collected in the storm sewer constructed as part of the proposed development south of the Church and discharged to the existing headwall which outlets into the valley depression and ultimately into the Credit River; and,
- The rooftop rainwater leaders will discharge onto the ground via splash pads.

## 6.3 Major and Minor Systems

The storm sewer system is shown on **Drawing ST-01 Storm Drainage Plan** and **Drawing SS-01 Functional Servicing Plan**.

Based on City of Mississauga's design criteria, the post-development flows for the minor system will be designed to convey, at minimum, the 10-year storm flow. Major flows in excess of the 10-year storm event on Thorny-Brae Place are conveyed within the right-of-way limits of Thorny-Brae Place and directed to the Mississauga Road right-of-way. Refer to the 10-year storm drainage design chart in **Appendix E**.

### 6.3.1 Quantity Control

Quantity control for the site is not required due to the proximity to the Credit River. An analysis of the proposed site conditions was completed using the Rational Method to determine the post-development peak flows for the site. The time of concentration is assumed to be 21.90 minutes based on the storm drainage design chart and a maximum of 15 minutes for the Church lands.

The post-development 2, 10, and 100-year peak flow at the existing headwall including the corresponding pre-development flows is shown in **Table 6.1** and.

**Table 6.1 – Pre- and Post- Development Peak Flows at the Existing Headwall**

| Storm Event | Pre-Development Peak Flow | Post-Development Peak Flow |
|---|---|---|
| 2-Year | 269.9 L/s | 448.3 L/s |
| 10-Year | 446.9 L/s | 742.3 L/s |
| 100-Year | 634.1 L/s | 1,056.4 L/s |

### 6.3.2 Quality Control Criteria

The use of LID features promotes water balance objectives. LID features may be a combination of at source infiltration, rain barrels, treatment swales, increased topsoil, etc, and will be provided at the detailed design stage.

# 7 Conclusions and Recommendations

This FSR was prepared in support of a Draft Plan application for 1 single residential lot and seven (7) blocks known as The Hazel. Based on a review of municipal services considered in this FSR, it is concluded that it is feasible to provide municipal servicing to The Hazel. The detailed design for water, storm and sanitary servicing shall conform to the City's and Region's design criteria. We conclude and recommend the following:

Water Supply and Distribution

One connections to the existing watermain network on Mississauga Road is proposed to provide a securely looped system and the necessary flows and pressures.

Fire flows to be confirmed with the City and provided at the detailed design stage.

Sanitary Servicing

The expected total sanitary discharge flow from this site, based on unit flows, is approximately 0.00480m$^3$/s (4.80 L/s). A 250 mm sanitary sewer at minimum 0.5% is sufficient to convey the sanitary flows, while maintaining a minimum velocity of 0.75 m/s, to the existing sanitary sewer on Thorny-Brae Place crossing Mississauga Road.

Road Network and Grading

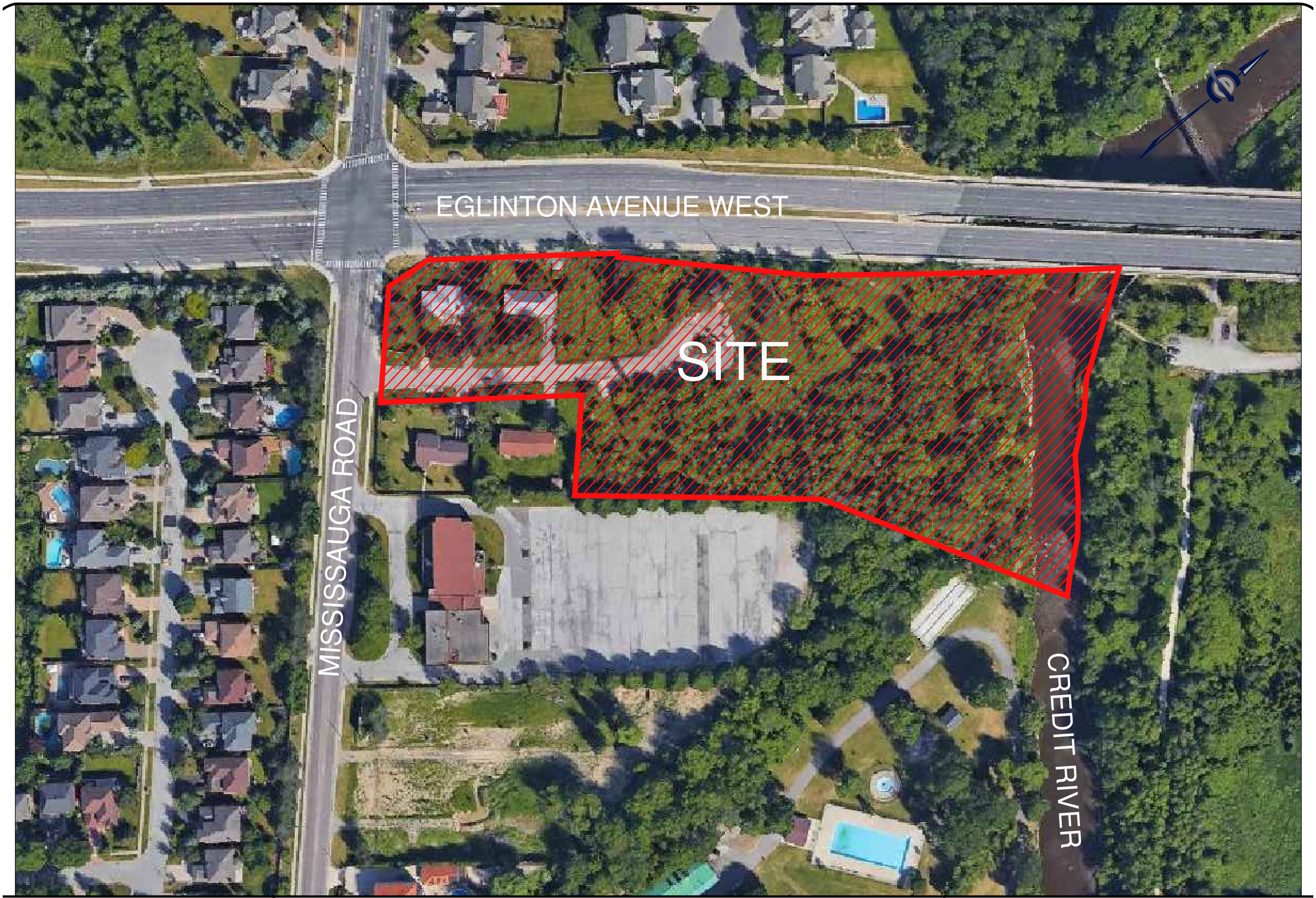
The Hazel development which must conform to existing perimeter conditions and is proposed to match to the existing urban Mississauga Road. Emergency overland flow from the site will outlet to Credit River Valley and existing grades will be matched along property lines.

Storm Drainage System

The proposed storm sewer is designed to convey the 10-year flow (1,113 L/s). Storm runoff from the site will connect to an existing 675mm - 750mm diameter storm sewer recently constructed in 2018 that outlets at the headwall and channel downstream. Quality control for the site will be provided by a combination of LID features may be a combination of at source infiltration, rain barrels, treatment swales, increased topsoil, etc., and will be provided at the detailed design stage.

# APPENDIX A

## Figures and Drawings



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# LOCATION PLAN

PART OF LOT 1 AND ALL OF LOT 2 AND THORNY-BRAE PLACE REGISTERED PLAN 498
AND PART OF LOTS 3 AND 4, RANGE 5 NORTH OF DUNDAS
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

| | | | |
|---|---|---|---|
| DATE: | MAR 2019 | PROJECT No.: | UD15-0682 |
| SCALE: | NTS | FIGURE No.: | LOC-01 |

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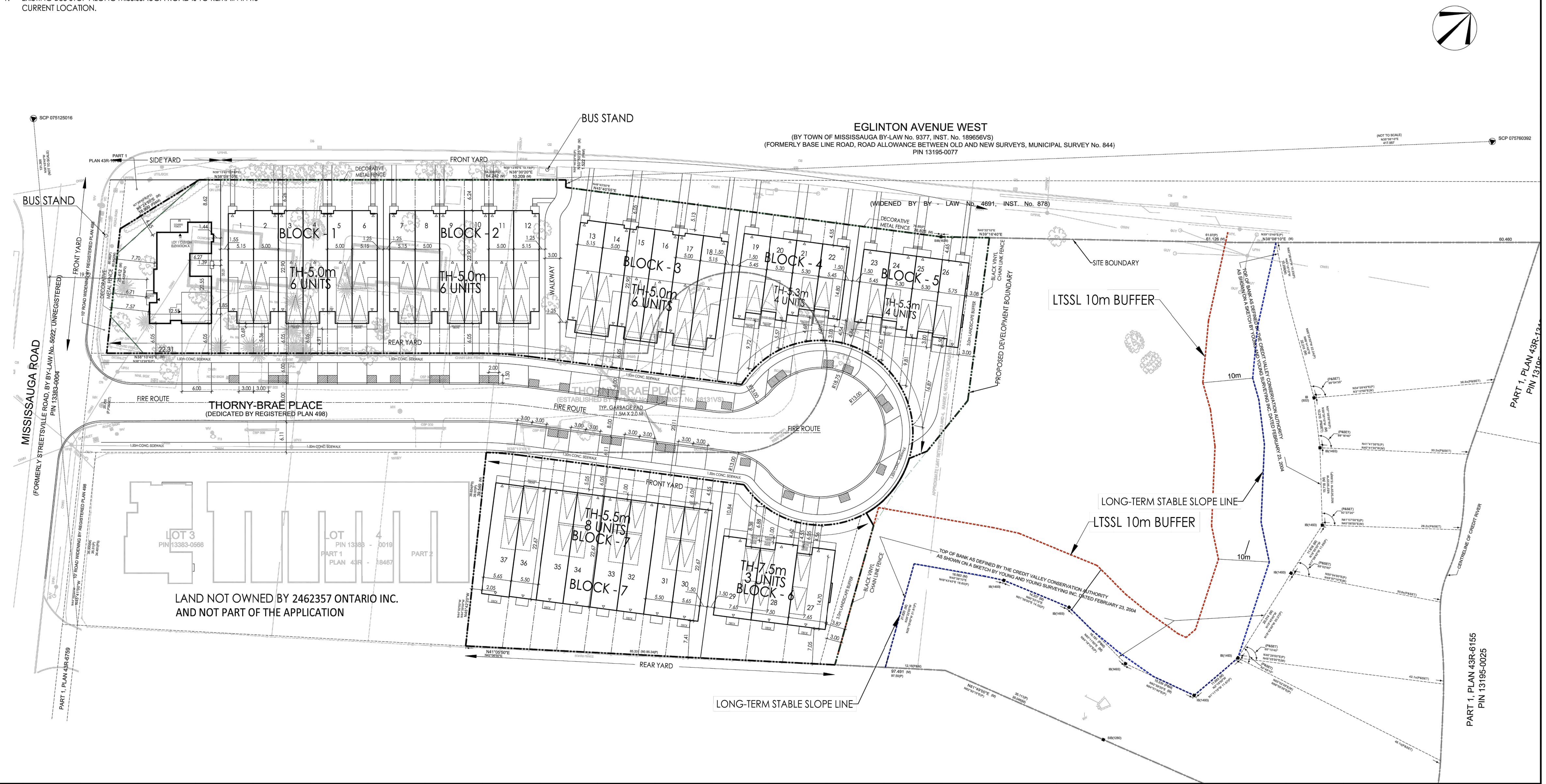
NOTES:

1. EXISTING BUS STOP ALONG MISSISSAUGA ROAD IS TO REMAIN IN ITS CURRENT LOCATION.



## Proposed Statistics

| No. | Lot # | Lot 1 * | Block 1** | | | | | | Block 2** | | | | | | Block 3** | | | | | | Block 4** | | | | Block 5 | | | | Block 6 | | | Block 7 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| 1 | Lot Area (m2) | 607.43 | 235.93 | 176.05 | 176.05 | 176.04 | 176.03 | 225.30 | 225.29 | 176.00 | 175.99 | 176.00 | 176.73 | 241.25 | 267.24 | 175.00 | 175.00 | 175.00 | 175.00 | 232.75 | 239.58 | 152.65 | 134.58 | 166.89 | 173.35 | 150.27 | 185.71 | 362.43 | 368.46 | 222.20 | 315.62 | 259.71 | 202.57 | 204.99 | 207.42 | 209.84 | 212.27 | 214.70 | 312.42 |
| 2 | Lot Frontage (m) | 27.95 | 6.70 | 5.00 | 5.00 | 5.00 | 5.00 | 6.40 | 6.40 | 5.00 | 5.00 | 5.00 | 5.00 | 6.46 | 9.15 | 5.00 | 5.00 | 5.00 | 5.00 | 6.65 | 6.95 | 5.30 | 5.30 | 6.95 | 6.95 | 5.30 | 5.30 | 8.83 | 13.32 | 7.50 | 9.16 | 7.15 | 5.50 | 5.50 | 5.50 | 5.50 | 5.50 | 5.50 | 8.21 |
| 3 | Front Yard (m) | 7.57 | 6.26 | 6.26 | 6.26 | 6.26 | 6.26 | 6.26 | 6.24 | 6.24 | 6.24 | 6.24 | 6.24 | 6.24 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 4.55 | 4.55 | 4.55 | 4.55 | 4.55 | 4.55 | 4.55 | 4.65 | 4.55 | 4.62 | 6.88 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 |
| 4 | Side Yard (m) | Int: 1.44<br>Ext: 4.55 | Int: 1.55 | NA | NA | NA | NA | Int: 1.25 | Int: 1.25 | NA | NA | NA | NA | Int: 1.25 | Int: 1.25 | NA | NA | NA | NA | Int: 1.5 | Int: 1.5 | NA | NA | Int: 1.5 | Int: 1.5 | NA | NA | int: 3.08 | int: 3.87 | NA | Int: 1.5 | Int: 1.5 | NA | NA | NA | NA | NA | NA | int: 2.05 |
| 5 | Rear Yard (m) | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 6.05 | 9.72 | 5.57 | 4.68 | 4.54 | 4.84 | 6.62 | 9.81 | 16.87 | 7.05 | 7.67 | 8.26 | 7.41 | 7.89 | 8.33 | 8.77 | 9.21 | 9.65 | 10.10 | 10.39 |
| 6 | Height (m & Stroey) | 11m & 2 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey | 14m & 3 storey |
| 7 | Landscape Area (m2) | 332.60 | 95.78 | 39.65 | 39.64 | 39.63 | 39.62 | 85.15 | 85.14 | 39.59 | 39.52 | 39.65 | 39.65 | 99.75 | 127.10 | 38.59 | 38.59 | 38.59 | 38.59 | 89.43 | 102.08 | 31.10 | 31.38 | 64.86 | 66.89 | 39.66 | 42.95 | 200.79 | 218.79 | 71.00 | 157.35 | 109.50 | 55.98 | 58.41 | 60.83 | 63.26 | 65.69 | 68.11 | 161.77 |
| 8 | Landscape Area (% of lot area) | 55% | 41% | 23% | 23% | 23% | 23% | 38% | 38% | 22% | 22% | 23% | 22% | 41% | 48% | 22% | 22% | 22% | 22% | 38% | 43% | 20% | 23% | 39% | 39% | 26% | 23% | 55% | 59% | 32% | 50% | 42% | 28% | 28% | 29% | 30% | 31% | 32% | 52% |
| 9 | Floor Area (Incl. garage) (m2) | 202.68 | 112.95 | 109.96 | 109.96 | 109.96 | 109.96 | 112.95 | 112.95 | 109.96 | 109.96 | 109.96 | 109.96 | 112.95 | 112.95 | 109.96 | 109.96 | 109.96 | 109.96 | 112.95 | 89.73 | 83.15 | 76.00 | 76.10 | 76.10 | 76.00 | 83.15 | 89.73 | 123.97 | 121.51 | 123.97 | 128.09 | 124.68 | 124.68 | 124.68 | 124.68 | 124.68 | 124.68 | 128.09 |
| 10 | GFA (not incl. garage) (m2) | 365.88 | 279.61 | 271.40 | 271.40 | 271.40 | 271.40 | 279.61 | 279.61 | 271.40 | 271.40 | 271.40 | 271.40 | 279.61 | 279.61 | 271.40 | 271.40 | 271.40 | 271.40 | 279.61 | 258.50 | 238.75 | 217.33 | 217.63 | 217.63 | 217.33 | 238.75 | 258.50 | 330.36 | 322.75 | 330.35 | 335.45 | 335.45 | 335.45 | 335.45 | 335.45 | 335.45 | 335.45 | 335.45 |
| 11 | GFA (times the lot area) | 0.60 | 1.19 | 1.54 | 1.54 | 1.54 | 1.54 | 1.24 | 1.24 | 1.54 | 1.54 | 1.54 | 1.54 | 1.16 | 1.05 | 1.55 | 1.55 | 1.55 | 1.55 | 1.20 | 1.08 | 1.56 | 1.61 | 1.30 | 1.26 | 1.45 | 1.29 | 0.71 | 0.90 | 1.45 | 1.05 | 1.29 | 1.66 | 1.64 | 1.62 | 1.60 | 1.58 | 1.56 | 1.07 |
| 12 | Parking Spaces | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 13 | Driveway Width (m) | 6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

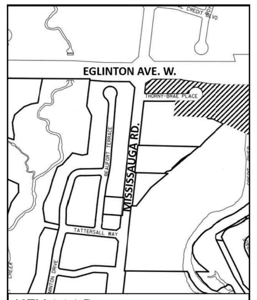
* For the single lot (1), the front yard is considered the lot line abutting Mississauga Road, the exterior side yard is considered the lot line abutting Eglinton Avenue W., and the rear yard is considered the lot line abutting Thorny Brae Place.

For the purpose of determining front lot line and exterior side lot line abutting a street, a daylight triangle is deemed not to exist provided that the minimum distance of the prescribed setbacks, in the By-Law is maintained.

** For the dual frontage towns, front yard is considered the lot line abutting Eglinton Avenue W., and the rear yard is considered the lot line abutting Thorny Brae Place.

File: D:\acadrn projects\16041\Site Planning\Architectural (RN)\Site Plan\16041-SP100.DWG Plotted: Mar 20, 2019 By: RaviP

ALL DIMENSIONS MUST BE VERIFIED BY CONTRACTOR PRIOR TO COMMENCEMENT OF ANY WORK. ANY DISCREPANCIES MUST BE REPORTED DIRECTLY TO RN ARCHITECTS INC.



KEY MAP N.T.S.

| 1745, 1765 & 1775 THRONEY BAY PLACE | | | |
|---|---|---|---|
| 1 | Total Site Area | 21,026 m2 | 2.10 Ha |
| 2 | Greenlands | 12366.1 m2 | 1.23 Ha |
| 3 | Net Developable Area | 8659.90 m2 | 0.87 Ha |
| 4 | Proposed Develoment Area | 8614.60 m2 | 0.86 Ha |

PLAN OF SURVEY OF
PART OF LOT 1 AND
ALL OF LOT 2
REGISTERED PLAN 498 AND
PART OF LOTS 3 AND 4, RANGE 5
NORTH OF DUNDAS STREET,
(GEOGRAPHIC TOWNSHIP OF TORONTO)
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

ISSUED OR REVISION COMMENTS

| NO. | DESCRIPTION | DATE | DWN | CHK |
|---|---|---|---|---|
| 1 | SITE PLAN REVISION | MAY 25 2017 | MA | MA |
| 2 | SITE PLAN REVISION | NOV 29 2017 | MA | MA |
| 3 | SITE PLAN ISSUES FOR SUBMISSION | DEC 04 2017 | MA | MA |
| 4 | REVISED DEVELOPMENT BOUNDARY | FEB 08 2019 | RP | MA |
| 5 | ISSUED FOR ZBA | MAR 20 2019 | RP | MA |

Imagine ▸ Inspire ▸ Create
**RN DESIGN LTD.**
8395 JANE STREET, SUITE 203
VAUGHAN, ONTARIO. L4K 5Y2
T:905-738-3177 | F: 905-738-5449

I, NELSON CUNHA DECLARE THAT I HAVE REVIEWED AND TAKEN DESIGN RESPONSIBILITY FOR THE DESIGN WORK ON BEHALF OF **RN DESIGN LTD**, UNDER DIVISION C, PART-3 SUBSECTION-3.2.4 OF THE BUILDING CODE. I AM QUALIFIED AND THE FIRM IS REGISTERED IN THE APPROPRIATE CLASSES / CATEGORIES.

QUALIFIED DESIGNER BCIN: 21032
FIRM BCIN: 26995
DATE: MAR 20 2019
SIGNATURE:

CLIENT
2462357 Ontario inc.
Pace Developments

PROJECT/LOCATION
1745, 1765 and 1775 Thorny Brae Place, Mississauga ON

DRAWING
CONCEPT PLAN

| DATE<br>OCT-31-2018 | SCALE<br>1:400 |
|---|---|
| DRAWN BY<br>RP | CHECKED BY<br>SMH |
| PROJECT NUMBER<br>16041 | DRAWING NUMBER<br>SP100 |

**COLE ENGINEERING**
70 Valleywood Drive, Markham, ON Canada L3R 4T5
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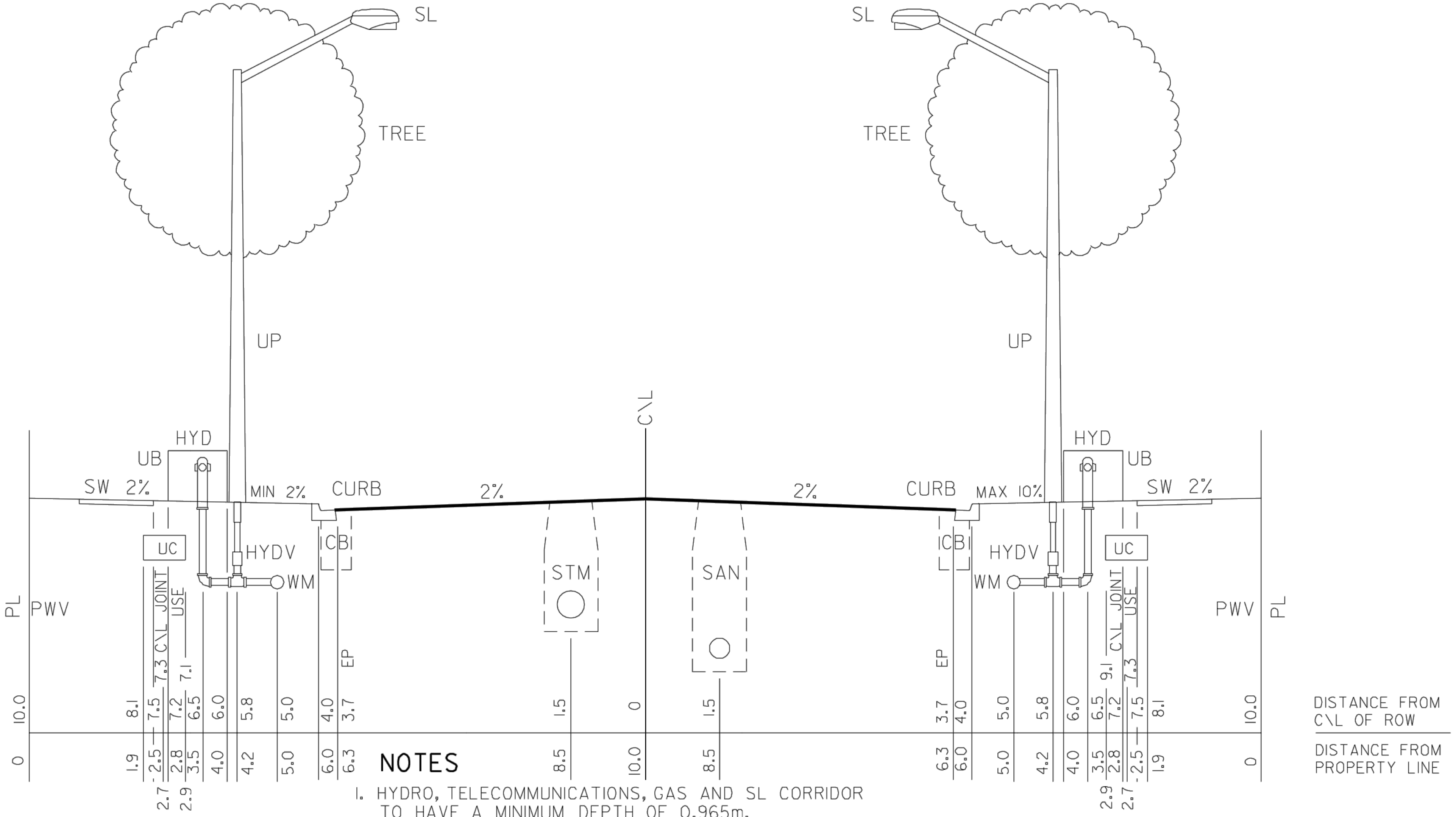
# SITE PLAN

PART OF LOT 1 AND ALL OF LOT 2 AND THORNY-BRAE PLACE REGISTERED PLAN 498
AND PART OF LOTS 3 AND 4, RANGE 5 NORTH OF DUNDAS
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

| DATE: MAR 2019 | PROJECT No.: UD15-0682 |
|---|---|
| SCALE: NTS | FIGURE No.: SP-01 |

S:\2015 PROJECTS\UD\SDM\UD15-0682 2462357ON_HAZELTOWNHOUSES_MISS\400-CADD\402-DESIGN\FIGURES\FSR\UD15-0682 DP-01.DWG

METRIC
ALL DIMENSIONS IN METRES



## NOTES

1. HYDRO, TELECOMMUNICATIONS, GAS AND SL CORRIDOR TO HAVE A MINIMUM DEPTH OF 0.965m.
2. WATERMAIN TO HAVE A MINIMUM COVER OF 1.7m.
3. IF UTILITIES CANNOT BE INSTALLED ACCORDING TO THIS STANDARD THEY ARE TO BE INSTALLED AS CLOSE AS POSSIBLE TO THE PRESCRIBED LOCATION SUBJECT TO THE APPROVAL OF THE TRANSPORTATION AND WORKS DEPARTMENT OF THE CITY OF MISSISSAUGA.
4. A 0.4m - 0.6m CLEARANCE MUST BE MAINTAINED BETWEEN CABLES AND HYDRANTS.
5. A 0.3m CLEARANCE MUST BE MAINTAINED BETWEEN WATERMAINS AND UTILITY POLES.
6. PAVEMENT WIDTH IS MEASURED FROM FACE OF CURB TO FACE OF CURB IN ACCORDANCE TO OPSD STD. 600.05.
7. ROAD WIDTH IS MEASURED FROM EDGE OF PAVEMENT TO EDGE OF PAVEMENT AND IN ACCORDANCE WITH OPSD STD. 600.040 CURB & GUTTER
8. FOR LOCATION OF GAS MAIN WITHIN UTILITY CORRIDOR REFER TO STD. 2211.280

## LEGEND

EP - EDGE OF PAVEMENT
CB - CATCH BASIN
CURB - CURB OR CURB AND GUTTER
C/L - CENTRELINE
GAS - GAS MAIN
HYD - FIRE HYDRANT
HYDV - FIRE HYDRANT VALVE
PWV - PRIVATE WATER VALVE
PL - PROPERTY LINE
SL - STREETLIGHT
SW - SIDEWALK
SAN - SANITARY SEWER
STM - STORM SEWER
UB - UTIITY BOX (HYDRO,TELECOMMUNICATIONS)
UC - UTILITY CORRIDOR (HYDRO,TELECOMM,GAS,SL)
UP - UTILITY POLE
WM - WATERMAIN

**MISSISSAUGA**
**Transportation and Works**

STANDARD
LOCAL RESIDENTIAL ROAD
8.0m ROAD ON 20m ROW

| | | | |
|---|---|---|---|
| EFF. DATE | 2002-01-01 | SCALE | N.T.S. |
| REV. | | STANDARD No. | 2211.070 |

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20.0 m R.O.W.
PART OF LOT 1 AND ALL OF LOT 2 AND THORNY-BRAE PLACE REGISTERED PLAN 498
AND PART OF LOTS 3 AND 4, RANGE 5 NORTH OF DUNDAS
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

| | | | |
|---|---|---|---|
| DATE: | MAR 2019 | PROJECT No.: | UD15-0682 |
| SCALE: | NTS | FIGURE No.: | TR-01 |

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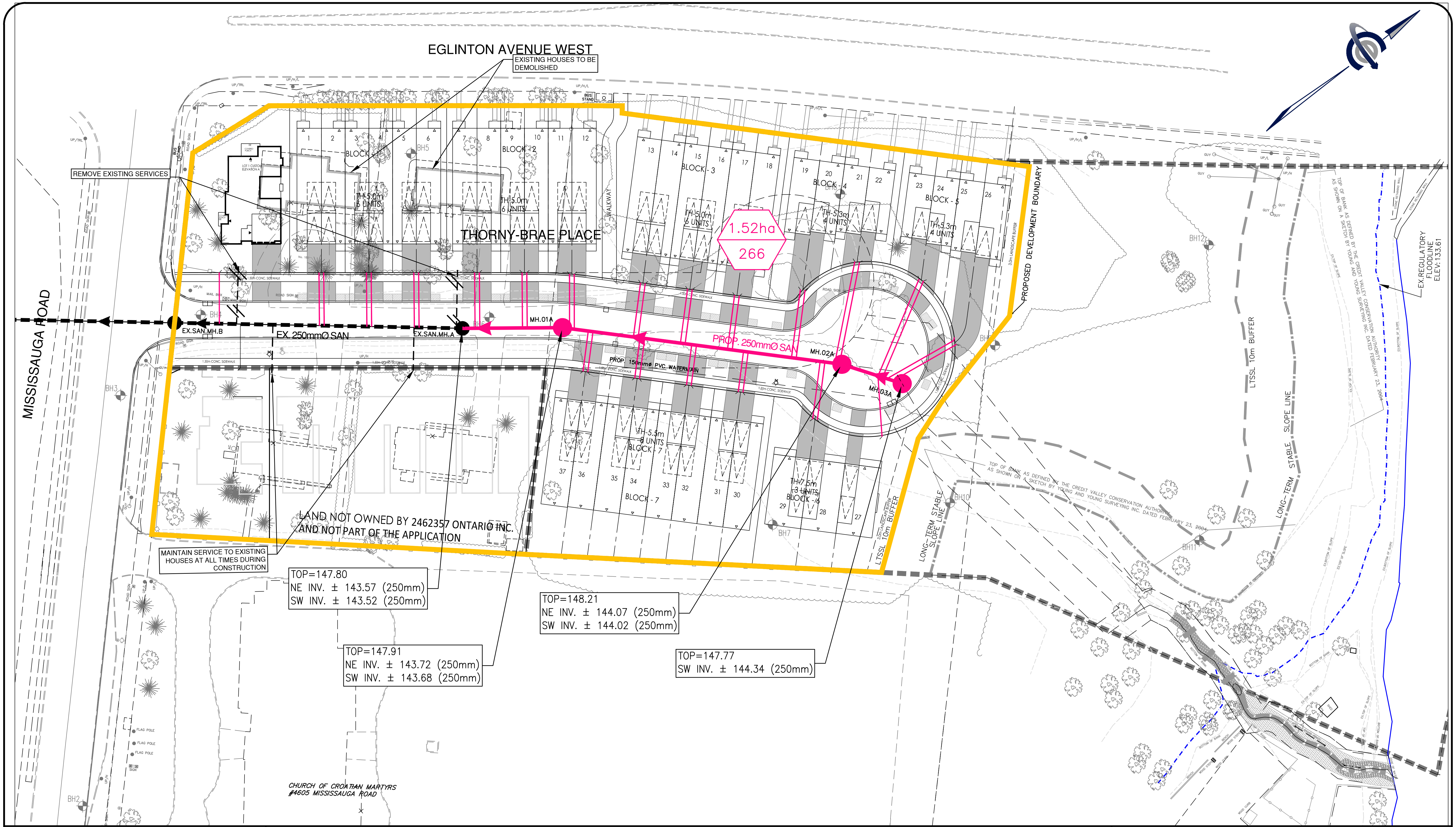

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**ENGINEERING**

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LEGEND

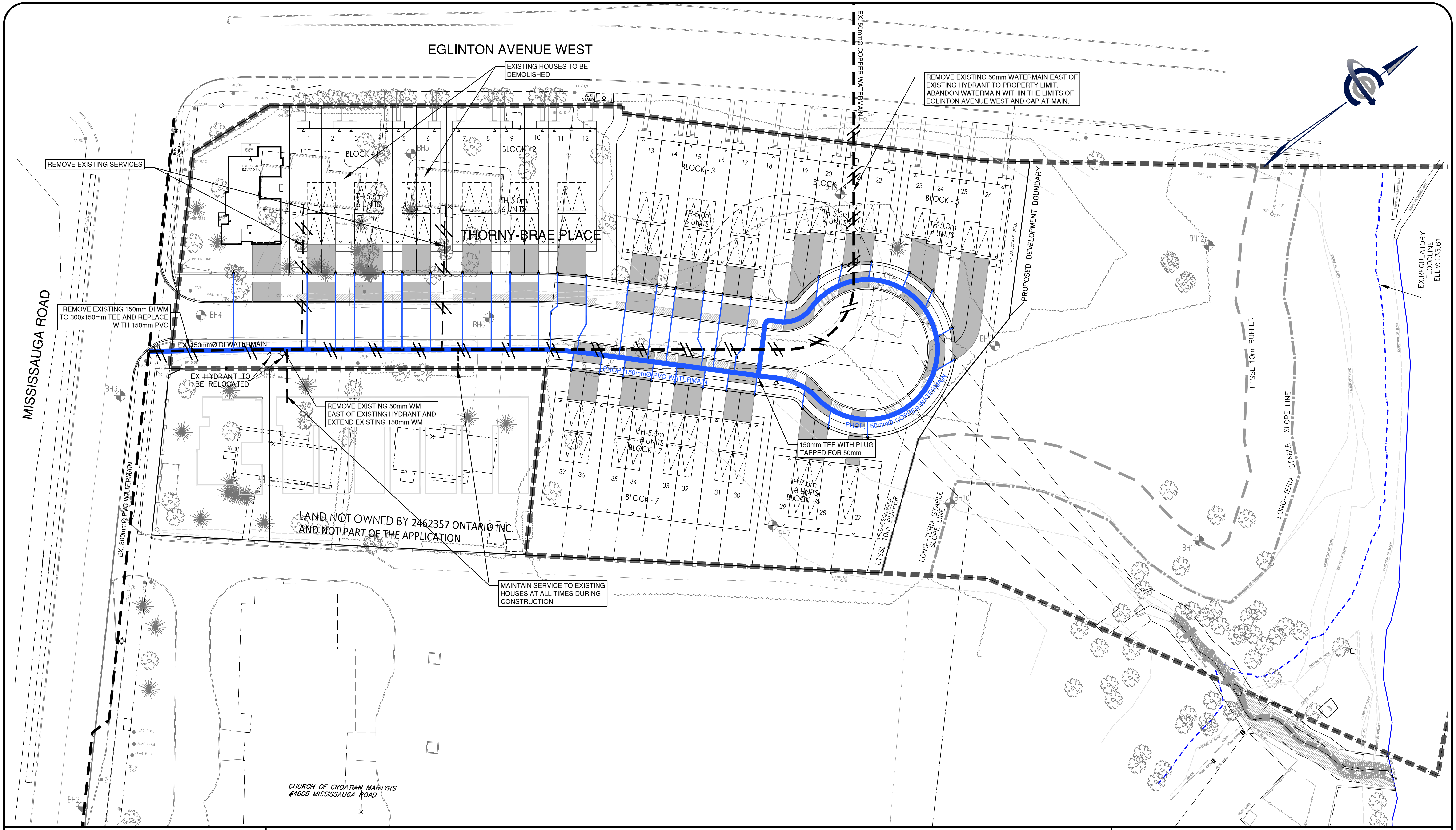
| | |
|---|---|
| ▬ ▬ ▬ | PROPERTY LIMIT |
| ─●─◄─ | EXISTING SANITARY SEWER |
| ─●─◄─ | PROPOSED SANITARY SEWER |
| ▬▬▬ | SANITARY DRAINAGE AREA |
| 1.83 | DRAINAGE AREA (ha) |
| 95 | POPULATION |

# SANITARY SERVICING OVERVIEW

PART OF LOT 1 AND ALL OF LOT 2 AND THORNY-BRAE PLACE REGISTERED PLAN 498
AND PART OF LOTS 3 AND 4, RANGE 5 NORTH OF DUNDAS
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

| | | | |
|---|---|---|---|
| DATE: | MAR 2019 | PROJECT No.: | UD15-0682 |
| SCALE: | 1:750 | FIGURE No.: | SAN-01 |

S:\2015 PROJECTS\UD\SDM\UD15-0682 2462357ON_HAZELTOWNHOUSES_MISS\400-CADD\402-DESIGN\FIGURES\FSR\UD15-0682 SAN-01.DWG



**COLE ENGINEERING**

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T:416.987.6161 / 905.940.6161 F:905.940.2064

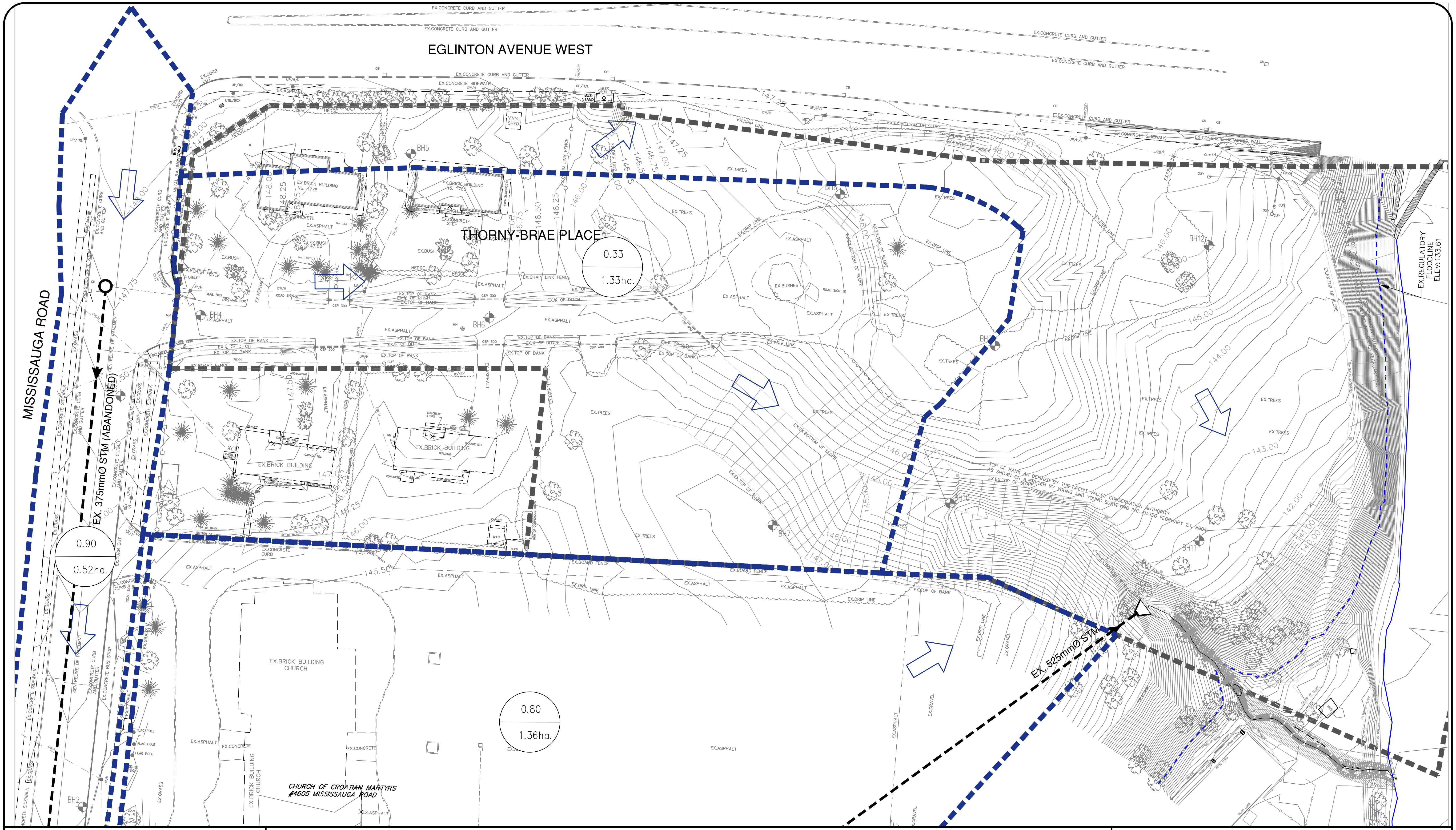
## LEGEND

| | |
|---|---|
| ▬ ▬ ▬ | PROPERTY LIMIT |
| — — — | EXISTING WATERMAIN |
| ━━━ | PROPOSED WATERMAIN |

# WATERMAIN LAYOUT

PART OF LOT 1 AND ALL OF LOT 2 AND THORNY-BRAE PLACE REGISTERED PLAN 498
AND PART OF LOTS 3 AND 4, RANGE 5 NORTH OF DUNDAS
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

| | | | |
|---|---|---|---|
| DATE: | MAR 2019 | PROJECT No.: | UD15-0682 |
| SCALE: | 1:750 | FIGURE No.: | WM-01 |



**COLE ENGINEERING**

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## LEGEND

▬ ▬ ▬ LIMIT OF PROPERTY
–○–◄– EXISTING STORM SEWER
- - - - EXISTING STORM DRAINAGE AREA
⇦ OVERLAND FLOW DIRECTION
0.90 ◄— RUN-OFF COEFFICIENT
0.17ha. ◄— DRAINAGE AREA

## PRE-DEVELOPMENT STORM DRAINAGE AREA PLAN

PART OF LOT 1 AND ALL OF LOT 2 AND THORNY-BRAE PLACE REGISTERED PLAN 498
AND PART OF LOTS 3 AND 4, RANGE 5 NORTH OF DUNDAS
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

| | | | |
|---|---|---|---|
| DATE: | MAR 2019 | PROJECT No.: | UD15-0682 |
| SCALE: | 1:750 | FIGURE No.: | STM-01 |

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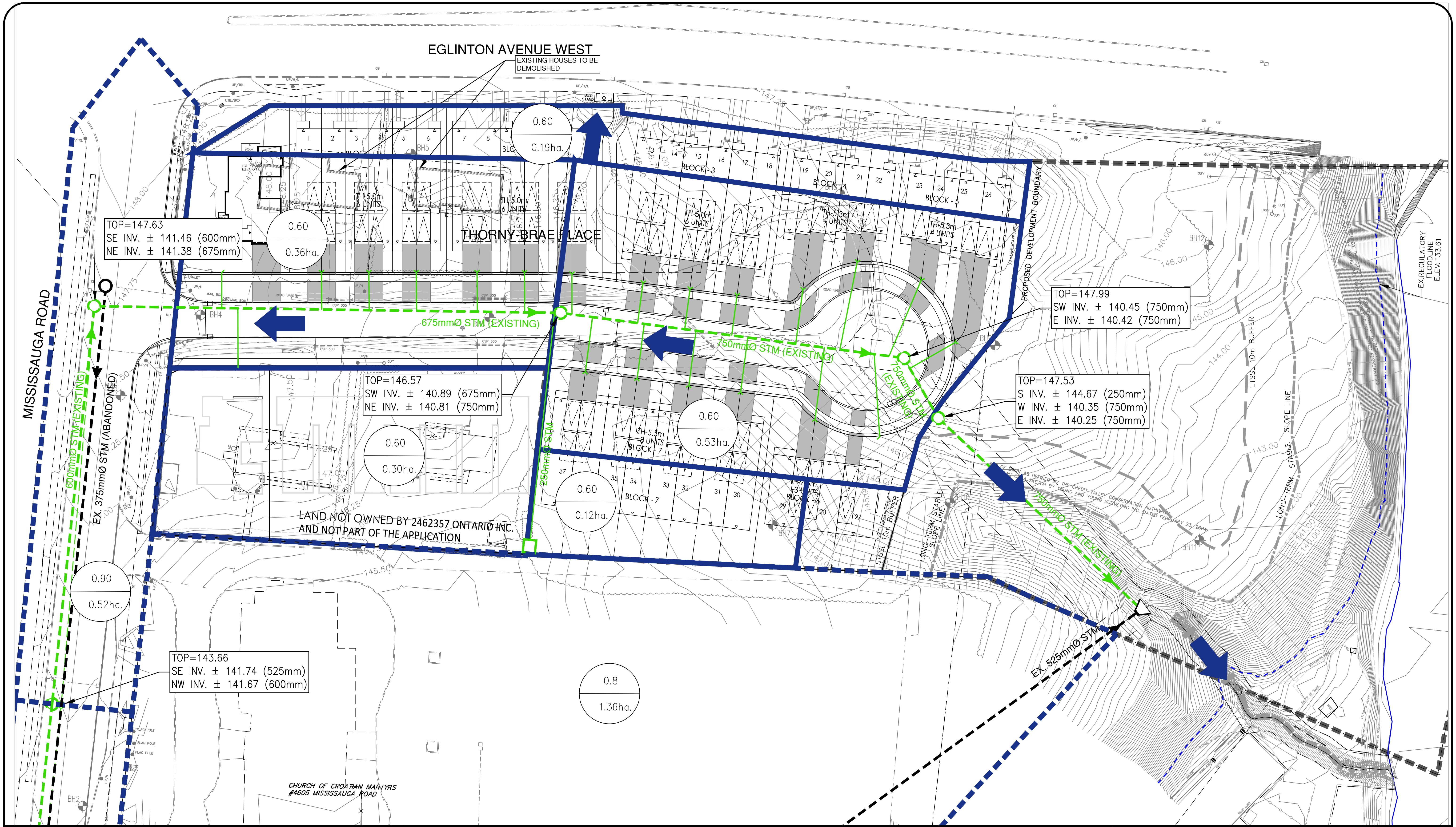

COLE ENGINEERING
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LEGEND

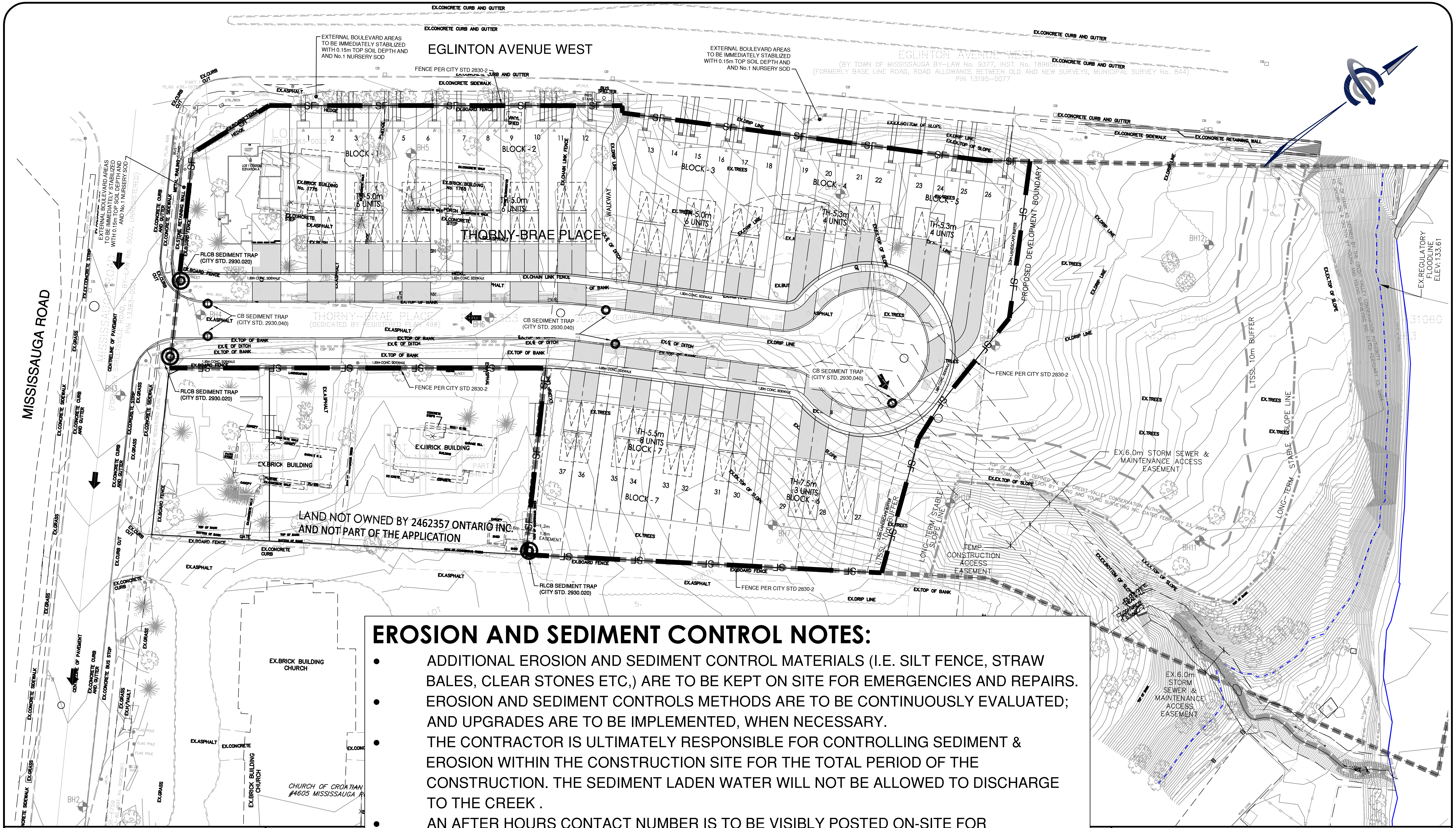
| | |
|---|---|
| ▬ ▬ ▬ | LIMIT OF PROPERTY |
| - -○- -◄ | EXISTING STORM SEWER |
| - -○- -◄ | PROPOSED STORM SEWER |
| - - - - | EXISTING STORM DRAINAGE AREA |
| ——— | STORM DRAINAGE AREA |
| ⬅ | PROPOSED OVERLAND FLOW |
| ⇦ | EXTERNAL OVERLAND FLOW DIRECTION |
| 0.90 | RUN-OFF COEFFICIENT |
| 0.17ha. | DRAINAGE AREA |

## POST-DEVELOPMENT STORM DRAINAGE AREA PLAN

PART OF LOT 1 AND ALL OF LOT 2 AND THORNY-BRAE PLACE REGISTERED PLAN 498
AND PART OF LOTS 3 AND 4, RANGE 5 NORTH OF DUNDAS
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

| | | | |
|---|---|---|---|
| DATE: | MAR 2019 | PROJECT No.: | UD15-0682 |
| SCALE: | 1:750 | FIGURE No.: | STM-02 |

S:\2015 PROJECTS\UD\SDM\UD15-0682 2462357ON_HAZELTOWNHOUSES_MISS\400-CADD\402-DESIGN\FIGURES\FSR\UD15-0682 STM-01-02.DWG



## EROSION AND SEDIMENT CONTROL NOTES:

- ADDITIONAL EROSION AND SEDIMENT CONTROL MATERIALS (I.E. SILT FENCE, STRAW BALES, CLEAR STONES ETC,) ARE TO BE KEPT ON SITE FOR EMERGENCIES AND REPAIRS.
- EROSION AND SEDIMENT CONTROLS METHODS ARE TO BE CONTINUOUSLY EVALUATED; AND UPGRADES ARE TO BE IMPLEMENTED, WHEN NECESSARY.
- THE CONTRACTOR IS ULTIMATELY RESPONSIBLE FOR CONTROLLING SEDIMENT & EROSION WITHIN THE CONSTRUCTION SITE FOR THE TOTAL PERIOD OF THE CONSTRUCTION. THE SEDIMENT LADEN WATER WILL NOT BE ALLOWED TO DISCHARGE TO THE CREEK .
- AN AFTER HOURS CONTACT NUMBER IS TO BE VISIBLY POSTED ON-SITE FOR EMERGENCIES. ALL THE PLANS SHOULD HAVE NAME AND CONTACT INFO OF THE PERSON RESPONSIBLE FOR ESC MEASURES.
- ANY SEDIMENT SPILL FROM THE SITE MUST BE REPORTED TO MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE (CALL SPILL ACTION CENTER AT 1-800-268-6060.)

COLE ENGINEERING
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T:416.987.6161 / 905.940.6161 F:905.940.2064

**EROSION & SEDIMENT CONTROL PLAN**

PART OF LOT 1 AND ALL OF LOT 2 AND THORNY-BRAE PLACE REGISTERED PLAN 498
AND PART OF LOTS 3 AND 4, RANGE 5 NORTH OF DUNDAS
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL

| | | | |
|---|---|---|---|
| DATE: | MAR 2019 | PROJECT No.: | UD15-0682 |
| SCALE: | 1:750 | FIGURE No.: | ESC-01 |

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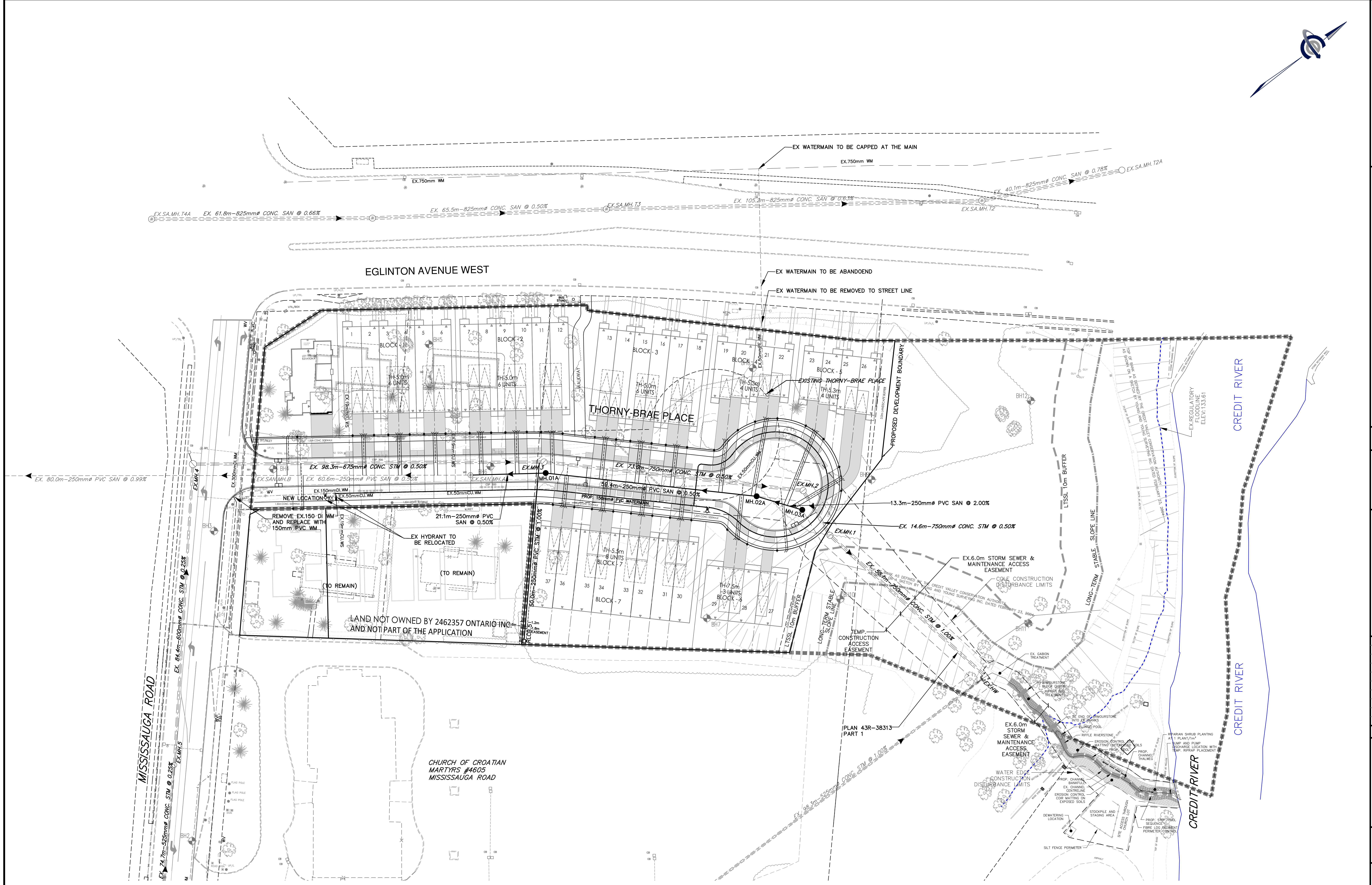
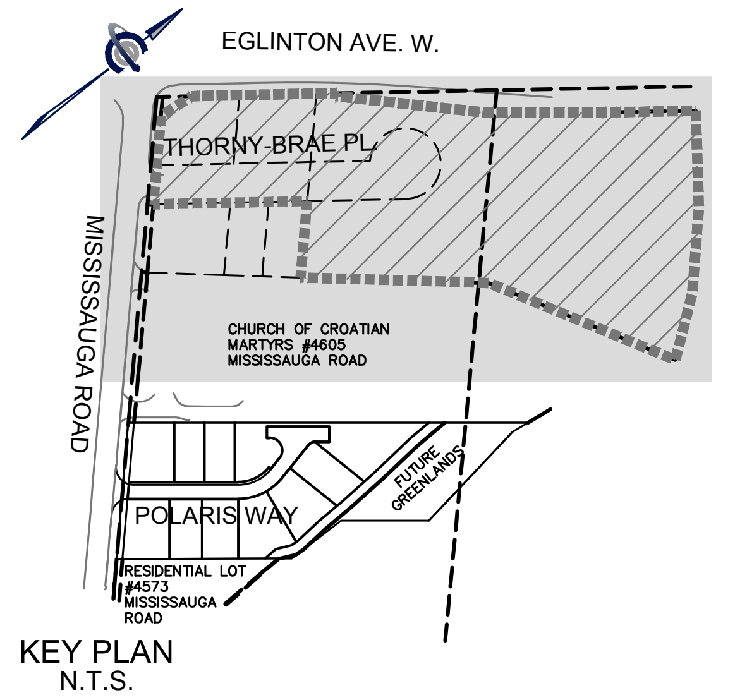




KEY PLAN
N.T.S.

## LEGEND

| | |
|---|---|
| ○ | PROPOSED STORM MANHOLE |
| ⊘ | PROPOSED STORM MANHOLE(BY OTHERS) |
| ● | PROPOSED SANITARY MANHOLE |
| □ | PROPOSED CATCH BASIN |
| ◫ | PROPOSED DOUBLE CATCH BASIN |
| ⊗ | PROPOSED VALVE & BOX |
| ⋈ | PROPOSED VALVE & BOX |
| –⌖ | PROPOSED HYDRANT & VALVE |
| ○ | EXISTING STORM MANHOLE |
| ● | EXISTING SANITARY MANHOLE |
| □ EX.CB. | EXISTING CATCHBASIN |
| ⊗ EX.V&C | EXISTING VALVE & CHAMBER |
| --⌖ EX.H&V | EXISTING HYDRANT & VALVE |
| 4 | PROPOSED LOT NUMBERS |
| —□—□— | PROPOSED ACOUSTIC BARRIER |
| ▬ ▬ ▬ | PROPERTY LINE |
| ▨ | DRIVEWAY WITH PERMEABLE PAVERS |
| ⌖ | EXISTING HYDRANT |
| ⌖ | PROPOSED HYDRANT AND VALVE |

THE DEVELOPER TO VERIFY INVERT ELEVATION AND LOCATION OF ALL UNDERGROUND SERVICES AND UTILITIES PRIOR TO COMMENCING WORK.

EXISTING SERVICING INFORMATION FOR MISSISSAUGA ROAD AND THORNY-BRAE PLACE WAS OBTAINED FROM MUNICIPAL RECORD DRAWINGS: C-33221, C-33222, C-99829, 1156-D, 7235-D
EXISTING SERVICING AND UTILITIES INFORMATION SHOWN ON THIS DRAWING IS NOT TO BE RELIED ON. THE CONTRACTOR TO VERIFY INVERT ELEVATION AND LOCATION OF ALL UNDERGROUND SERVICES AND UTILITIES PRIOR TO COMMENCING WORK.

## SITE PLAN INFORMATION

SCHAEFFER DZALDOV BENNETT LTD.
64 JARDIN DRIVE
CONCORD, ONTARIO L4K 3P3
PHONE: (416) 987-0101
FAX: (905) 761 - 0101

## SURVEY INFORMATION

SCHAEFFER DZALDOV BENNETT LTD.
64 JARDIN DRIVE
CONCORD, ONTARIO L4K 3P3
PHONE: (416) 987-0101
FAX: (905) 761 - 0101

## BENCHMARK

ELEVATIONS SHOWN HEREON ARE REFERRED TO
CITY OF MISSISSAUGA BENCHMARK No. 970,
HAVING A PUBLISHED ELEVATION OF 148.702 METRES.

| NO. | REVISION | DATE | BY |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 3. | 3RD SUBMISSION | MAR 7, 2019 | S.G. |
| 2. | 2ND SUBMISSION | JUNE 6, 2018 | S.G. |
| 1. | PRE-SUBMISSION REVIEW | NOV 22, 2017 | S.G. |

FIRST ☐ SECOND ☐ INTERIM ☐ FINAL
DATE DATE DATE

Region of Peel
working with you

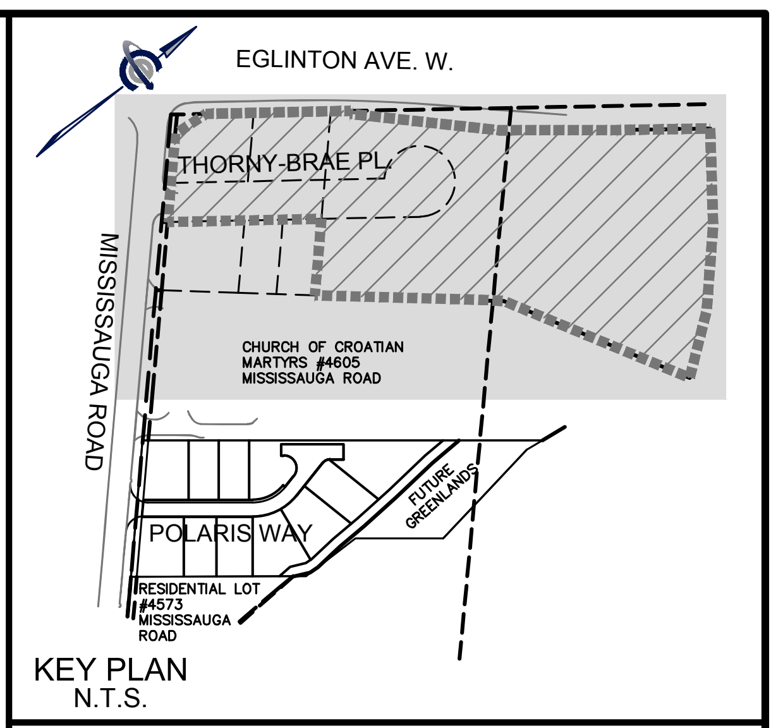
MISSISSAUGA

THE HAZEL
MISSISSAUGA, ON

# FUNCTIONAL SERVICING PLAN

COLE ENGINEERING
70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
T:416.987.6161 / 905.940.6161 F:905.940.2064

| | | |
|---|---|---|
| DESIGNED BY: P.F. | DATE: NOVEMBER 2017 | CHECKED BY: S.G. |
| DRAWN BY: A.A. | PROJECT No.<br>UD15-0682 | APPROVED BY: S.G. |
| SCALE: 1:500 | | DRAWING No.<br>SS-01 |



KEY PLAN
N.T.S.

## LEGEND

| | |
|---|---|
| ○ | PROPOSED STORM MANHOLE |
| ⊘ | PROPOSED STORM MANHOLE(BY OTHERS) |
| ● | PROPOSED SANITARY MANHOLE |
| □ | PROPOSED CATCH BASIN |
| ⊟ | PROPOSED DOUBLE CATCH BASIN |
| ⊗ | PROPOSED VALVE & BOX |
| ⋈ | PROPOSED VALVE & BOX |
| —◇ | PROPOSED HYDRANT & VALVE |
| ○ | EXISTING STORM MANHOLE |
| ● | EXISTING SANITARY MANHOLE |
| □ EX.CB. | EXISTING CATCHBASIN |
| ⊗ EX.V&C | EXISTING VALVE & CHAMBER |
| --◇ EX.H&V | EXISTING HYDRANT & VALVE |
| 4 | PROPOSED LOT NUMBERS |
| —□—□— | PROPOSED ACOUSTIC BARRIER |
| ▬ ▬ ▬ | PROPERTY LINE |
| ▨ | DRIVEWAY WITH PERMEABLE PAVERS |
| ◇ | EXISTING HYDRANT |
| ◇ | PROPOSED HYDRANT AND VALVE |
| ➡ | PROPOSED OVERFLOW DIRECTION |

THE DEVELOPER TO VERIFY INVERT ELEVATION AND LOCATION OF ALL UNDERGROUND SERVICES AND UTILITIES PRIOR TO COMMENCING WORK.

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## SITE PLAN INFORMATION

SCHAEFFER DZALDOV BENNETT LTD.
64 JARDIN DRIVE
CONCORD, ONTARIO L4K 3P3
PHONE: (416) 987-0101
FAX: (905) 761 - 0101

## SURVEY INFORMATION

SCHAEFFER DZALDOV BENNETT LTD.
64 JARDIN DRIVE
CONCORD, ONTARIO L4K 3P3
PHONE: (416) 987-0101
FAX: (905) 761 - 0101

## BENCHMARK

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| NO. | REVISION | DATE | BY |
|---|---|---|---|
| 3. | 3RD SUBMISSION | MAR 7, 2019 | S.G. |
| 2. | 2ND SUBMISSION | JUNE 6, 2018 | S.G. |
| 1. | PRE-SUBMISSION REVIEW | NOV 22, 2017 | S.G. |

FIRST ☐ SECOND ☐ INTERIM ☐ FINAL
DATE DATE DATE

Region of Peel
working with you

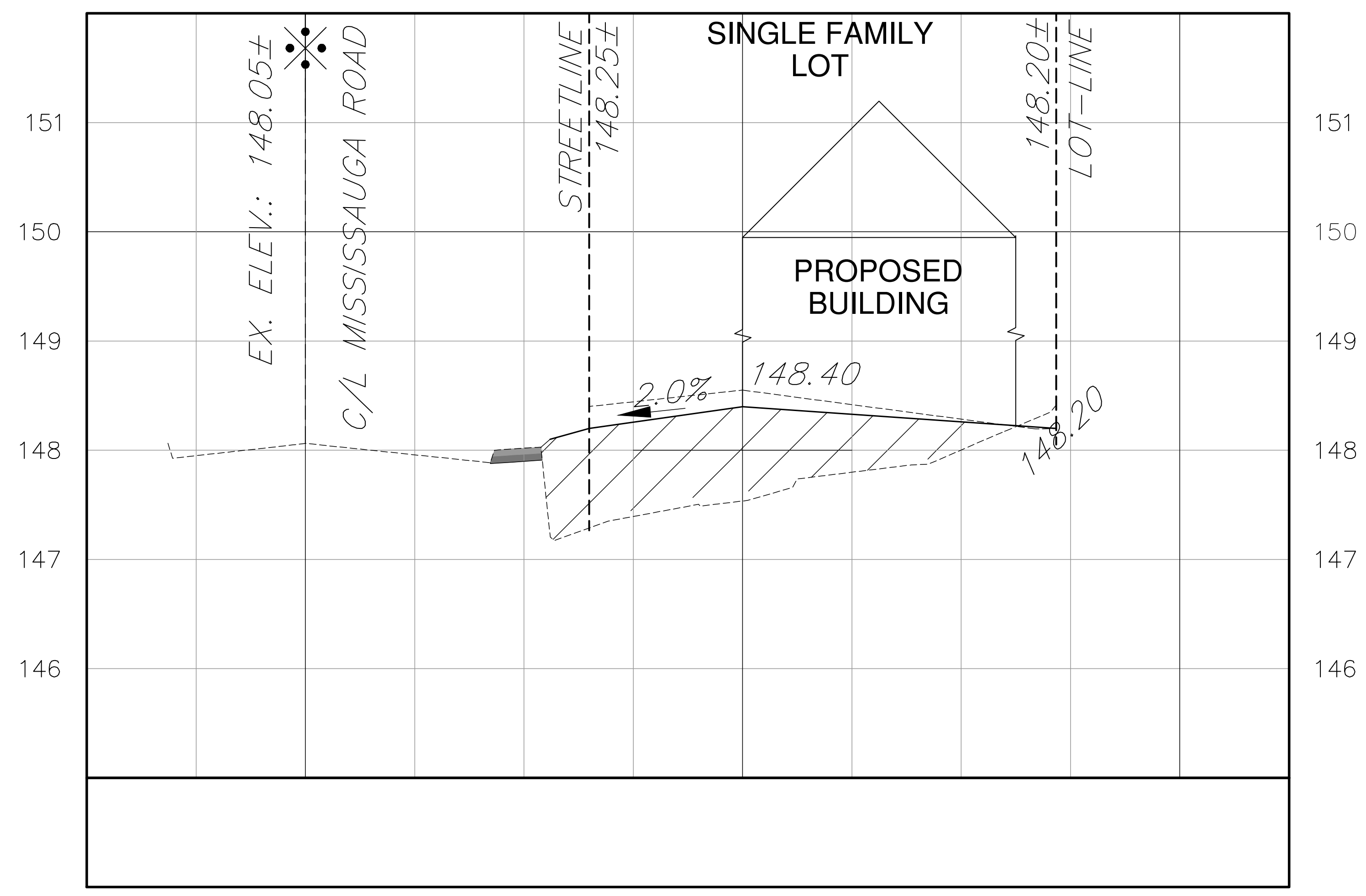
MISSISSAUGA

THE HAZEL
MISSISSAUGA, ON

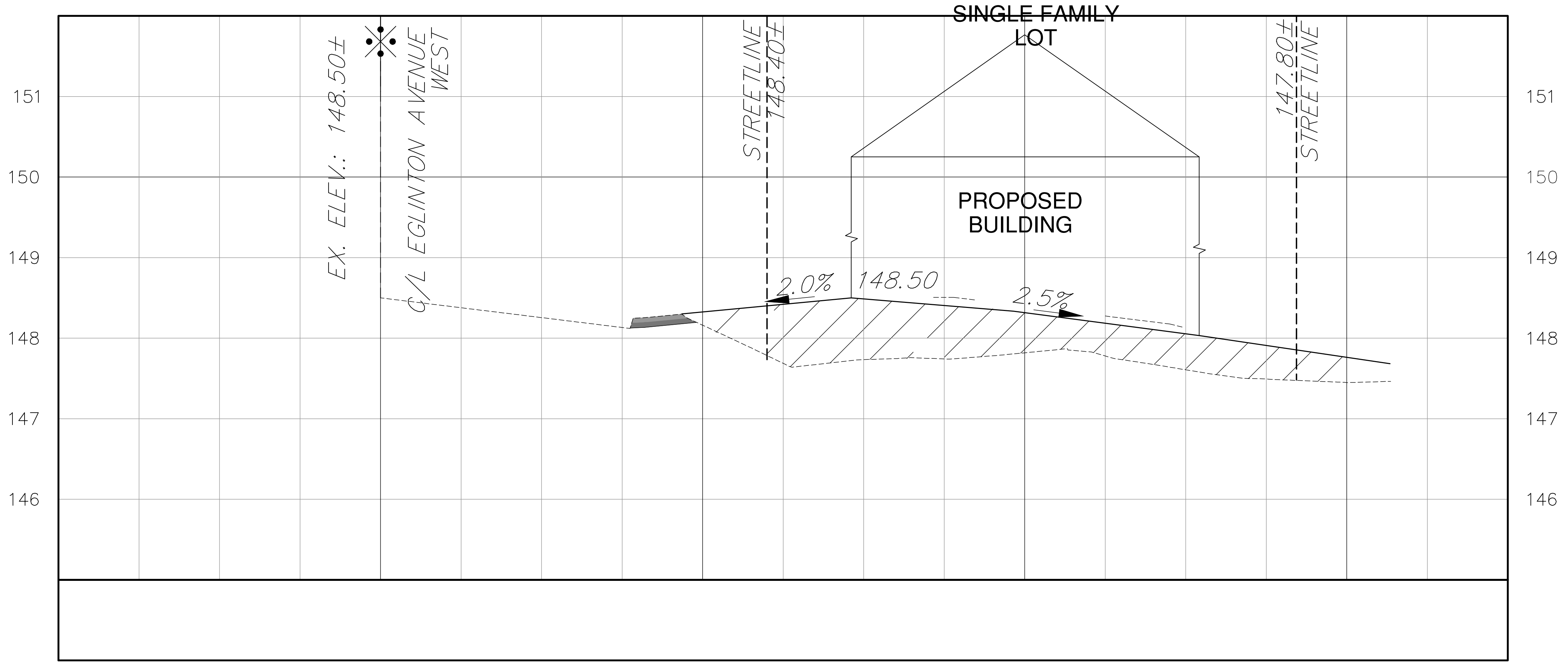
# FUNCTIONAL GRADING PLAN

COLE ENGINEERING
70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
T:416.987.6161 / 905.940.6161 F:905.940.2064

| | | |
|---|---|---|
| DESIGNED BY: P.F. | DATE: NOVEMBER 2017 | CHECKED BY: S.G. |
| DRAWN BY: A.A. | PROJECT No. | APPROVED BY: S.G. |
| SCALE: 1:500 | UD15-0682 | DRAWING No. SG-01 |



SECTION A-A



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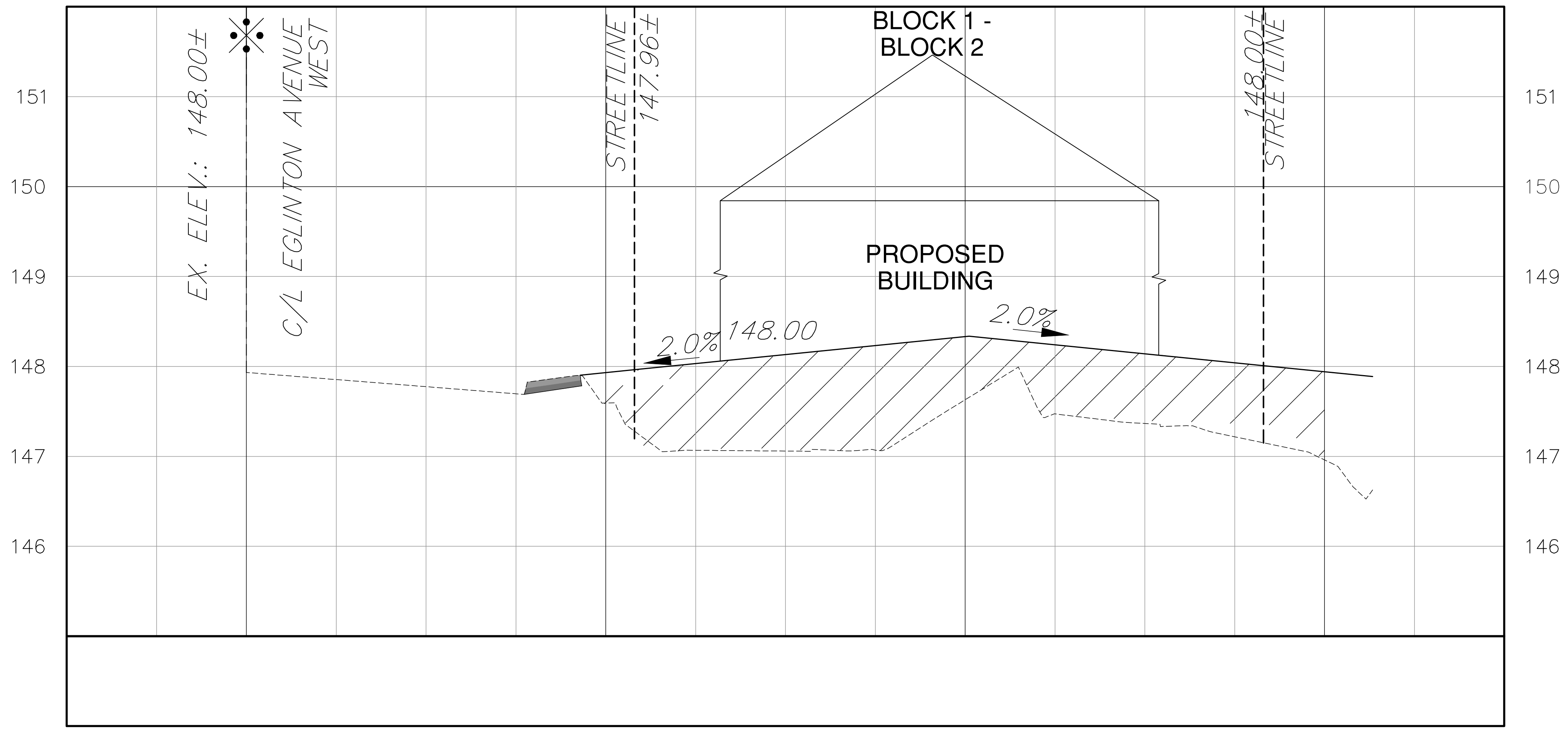

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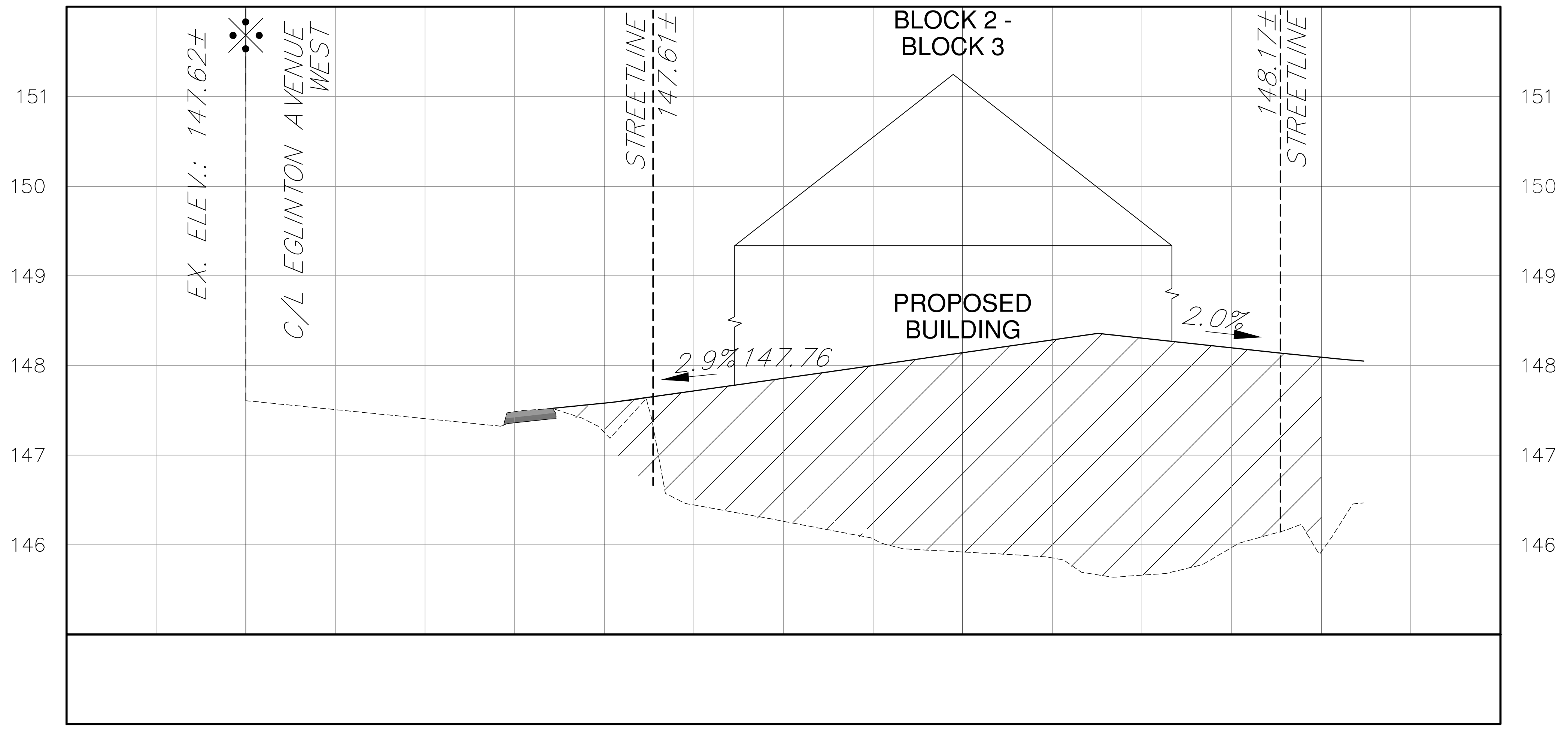

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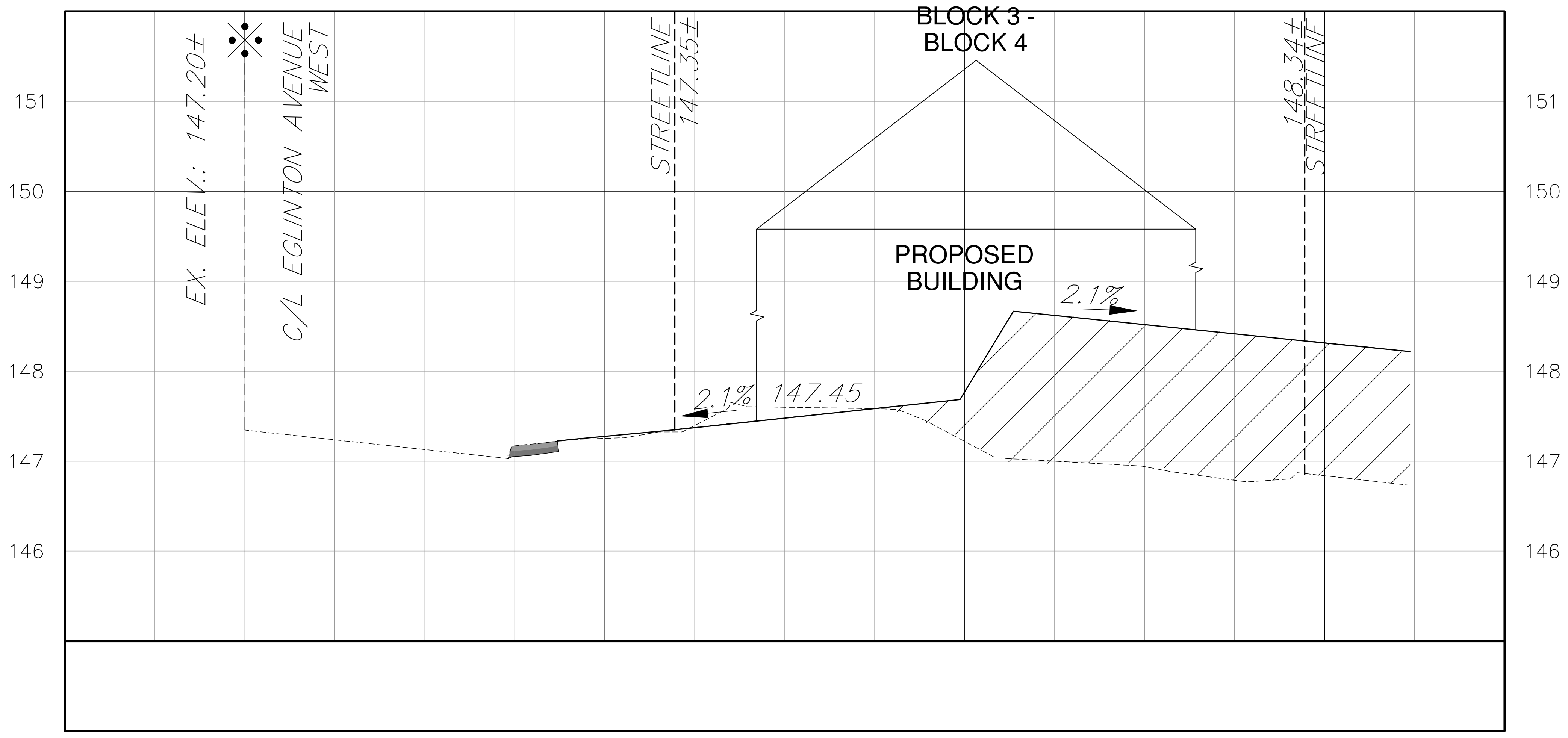
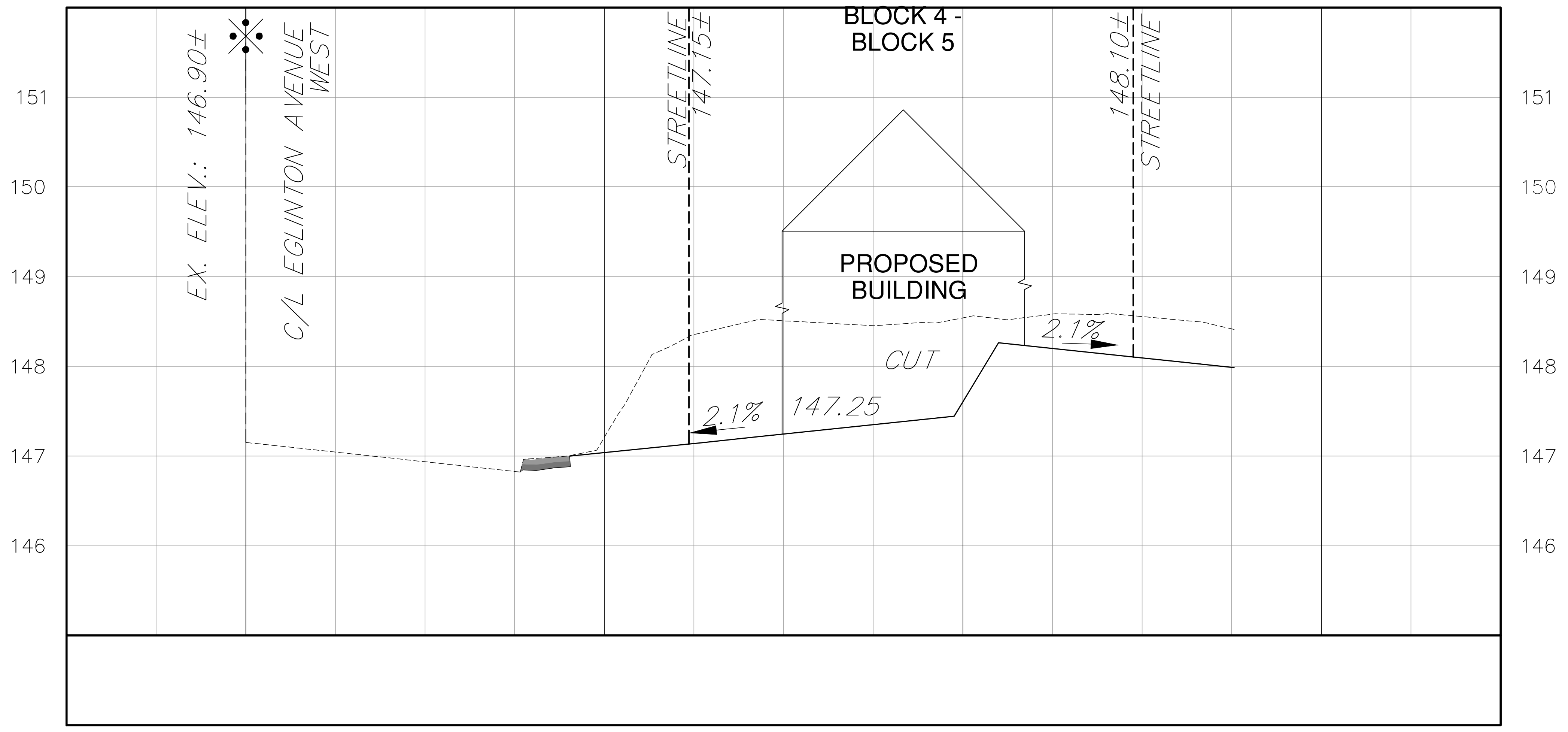
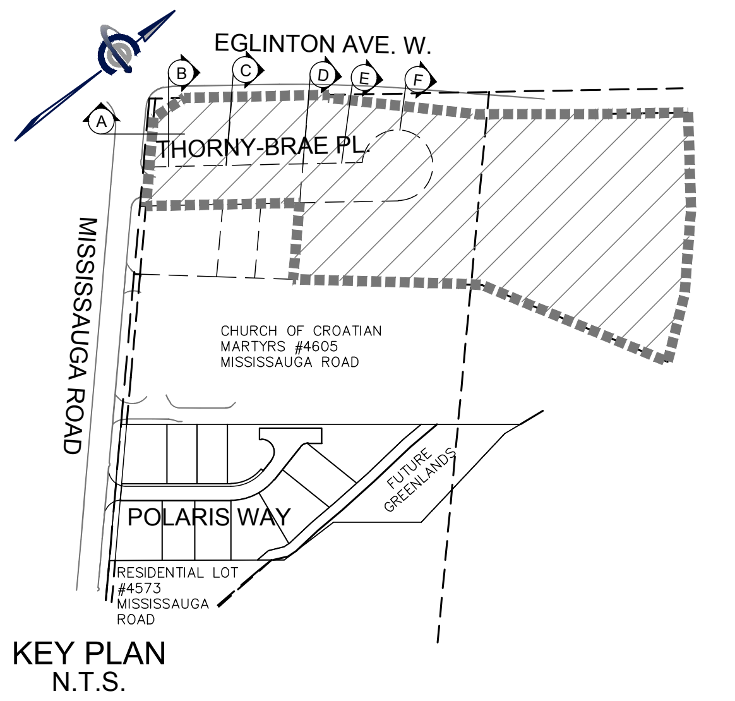


SECTION E-E



SECTION F-F



KEY PLAN
N.T.S.

LEGEND

THE DEVELOPER TO VERIFY INVERT ELEVATION AND LOCATION OF ALL UNDERGROUND SERVICES AND UTILITIES PRIOR TO COMMENCING WORK.

EXISTING SERVICING INFORMATION FOR MISSISSAUGA ROAD AND THORNY-BRAE PLACE WAS OBTAINED FROM MUNICIPAL RECORD DRAWINGS: C-33221, C-33222, C-99829, 1156-D, 7235-D
EXISTING SERVICING AND UTILITIES INFORMATION SHOWN ON THIS DRAWING IS NOT TO BE RELIED ON. THE CONTRACTOR TO VERIFY INVERT ELEVATION AND LOCATION OF ALL UNDERGROUND SERVICES AND UTILITIES PRIOR TO COMMENCING WORK.

SITE PLAN INFORMATION

SCHAEFFER DZALDOV BENNETT LTD.
64 JARDIN DRIVE
CONCORD, ONTARIO L4K 3P3
PHONE: (416) 987-0101
FAX: (905) 761 - 0101

SURVEY INFORMATION

SCHAEFFER DZALDOV BENNETT LTD.
64 JARDIN DRIVE
CONCORD, ONTARIO L4K 3P3
PHONE: (416) 987-0101
FAX: (905) 761 - 0101

BENCHMARK

ELEVATIONS SHOWN HEREON ARE REFERRED TO
CITY OF MISSISSAUGA BENCHMARK No. 970,
HAVING A PUBLISHED ELEVATION OF 148.702 METRES.

| NO. | REVISION | DATE | BY |
|---|---|---|---|
| 3. | 3RD SUBMISSION | MAR 7, 2019 | S.G. |
| 2. | 2ND SUBMISSION | JUNE 6, 2018 | S.G. |
| 1. | PRE-SUBMISSION REVIEW | NOV 22, 2017 | S.G. |

FIRST ☐ SECOND ☐ INTERIM ☐ FINAL
DATE DATE DATE

Region of Peel
working with you

MISSISSAUGA

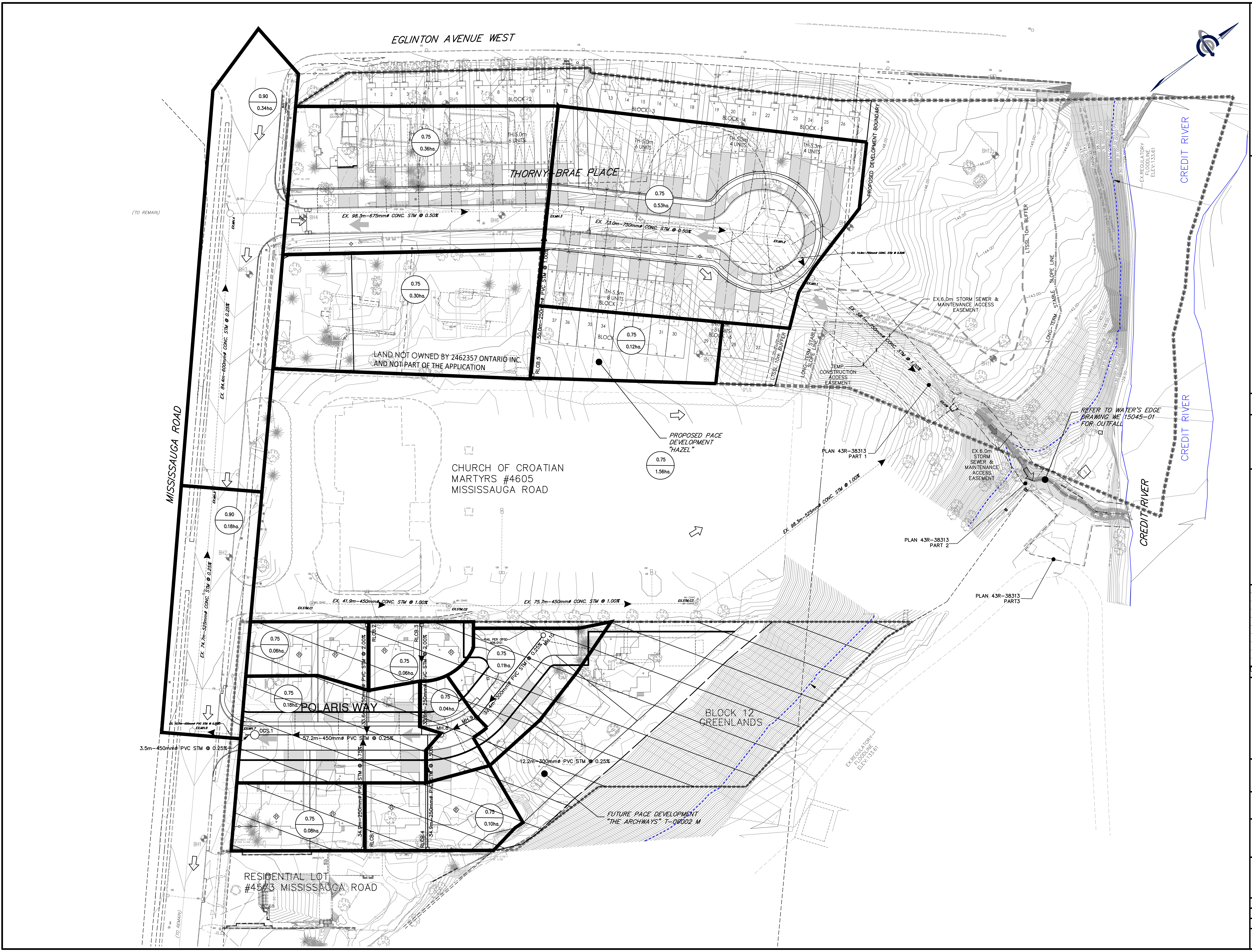
THE HAZEL
MISSISSAUGA, ON

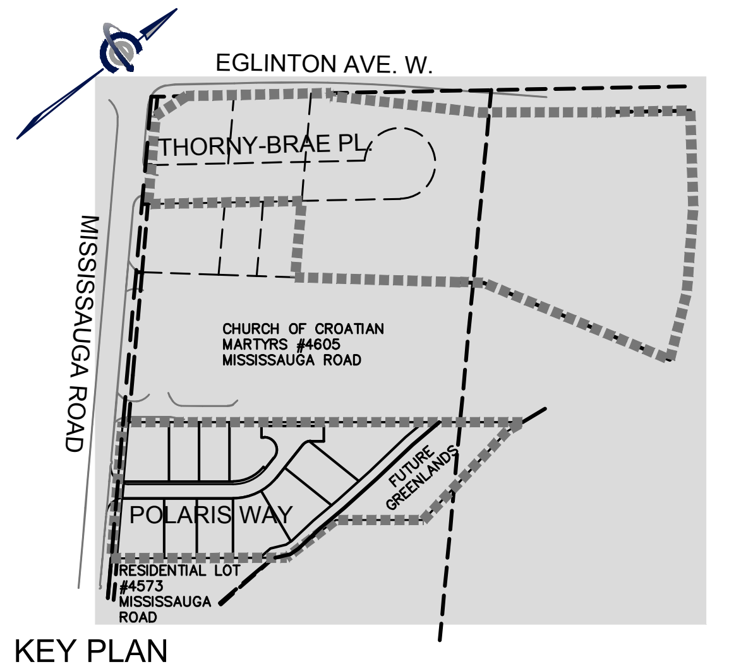
PROPOSED SECTIONS

COLE ENGINEERING
70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
T:416.987.6161 / 905.940.6161 F:905.940.2064

| | | |
|---|---|---|
| DESIGNED BY: P.F. | DATE: NOVEMBER 2017 | CHECKED BY: S.G. |
| DRAWN BY: A.A. | PROJECT No. | APPROVED BY: S.G. |
| SCALE: 1:500 | UD15-0682 | DRAWING No. SEC-1 |

S:\2015 Projects\UD\SDM\UD15-0682 2462357ON_HazelTownhouses_MISS\400-CADD\402-Design\Models\UD15-0682 Base Grading.dwg (Sections)
Mar 07, 2019-10:58am By: Pfiliptsev





KEY PLAN
N.T.S.

## LEGEND

| | |
|---|---|
| ○ | PROPOSED STORM MANHOLE |
| ● | PROPOSED SANITARY MANHOLE |
| □ | PROPOSED CATCH BASIN |
| ◫ | PROPOSED DOUBLE CATCH BASIN |
| ⊗ | PROPOSED VALVE & BOX |
| ⋈ | PROPOSED VALVE & BOX |
| —⌖ | PROPOSED HYDRANT & VALVE |
| ○ | EXISTING STORM MANHOLE |
| ● | EXISTING SANITARY MANHOLE |
| □ EX.CB. | EXISTING CATCHBASIN |
| ⊗ EX.V&C | EXISTING VALVE & CHAMBER |
| --⌖ EX.H&V | EXISTING HYDRANT & VALVE |
| 135 | PROPOSED LOT NUMBERS |
| —□—□— | PROPOSED 2.0m HIGH ACOUSTIC FENCE |
| —□—□—□— | PROPOSED 2.0m HIGH LIGHT DUTY ACOUSTIC FENCE |
| ▪▪▪▪▪ | PROPERTY LINE (2462357 ONTARIO INC.) |
| ▬ | DRAINAGE AREA BOUNDARY |
| 0.45 | RUNOFF COEFFICIENT |
| 0.06ha. | AREA |
| ⇨ | EXISTING OVERLAND FLOW |
| ➡ | PROPOSED OVERLAND FLOW |
| ➡ | FUTURE OVERLAND FLOW |

THE DEVELOPER TO VERIFY INVERT ELEVATION AND LOCATION OF ALL UNDERGROUND SERVICES AND UTILITIES PRIOR TO COMMENCING WORK.

EXISTING SERVICING INFORMATION FOR MISSISSAUGA ROAD AND THORNY-BRAE PLACE WAS OBTAINED FROM MUNICIPAL RECORD DRAWINGS: C-33221, C-33222, C-99829, 1156-D, 7235-D
EXISTING SERVICING AND UTILITIES INFORMATION SHOWN ON THIS DRAWING IS NOT TO BE RELIED ON. THE CONTRACTOR TO VERIFY INVERT ELEVATION AND LOCATION OF ALL UNDERGROUND SERVICES AND UTILITIES PRIOR TO COMMENCING WORK.

### SITE PLAN INFORMATION

SCHAEFFER DZALDOV BENNETT LTD.
64 JARDIN DRIVE
CONCORD, ONTARIO L4K 3P3
PHONE: (416) 987-0101
FAX: (905) 761 - 0101

### SURVEY INFORMATION

SCHAEFFER DZALDOV BENNETT LTD.
64 JARDIN DRIVE
CONCORD, ONTARIO L4K 3P3
PHONE: (416) 987-0101
FAX: (905) 761 - 0101

### BENCHMARK

ELEVATIONS SHOWN HEREON ARE REFERRED TO
CITY OF MISSISSAUGA BENCHMARK No. 970,
HAVING A PUBLISHED ELEVATION OF 148.702 METRES.

| NO. | REVISION | DATE | BY |
|---|---|---|---|
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| | | | |
| 3. | 3RD SUBMISSION | MAR 7, 2019 | S.G. |
| 2. | 2ND SUBMISSION | JUNE 6, 2018 | S.G. |
| 1. | PRE-SUBMISSION REVIEW | NOV 22, 2017 | S.G. |

☐ FIRST DATE ☐ SECOND DATE ☐ INTERIM DATE ☐ FINAL DATE

Region of Peel
working with you

MISSISSAUGA

THE HAZEL
MISSISSAUGA, ON

# STORM DRAINAGE PLAN

COLE ENGINEERING
70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
T:416.987.6161 / 905.940.6161 F:905.940.2064

| | | |
|---|---|---|
| DESIGNED BY: P.F. | DATE: OCTOBER 2015 | CHECKED BY: S.G. |
| DRAWN BY: P.F. | PROJECT No. | APPROVED BY: S.G. |
| SCALE: 1:500 | UD15-0682 | DRAWING No. ST-01 |

S:\2015 Projects\UD\SDM\UD15-0682 2462357ON_HazelTownhouses_MISS\400-CADD\402-Design\Figures\FSR\UD15-0682 ST-01.dwg (ST-01)
Mar 07, 2019-11:54am By: Pfiliptsev

# APPENDIX B

## Domestic Water Calculation Sheet

# REGION OF PEEL

DOMESTIC WATER CALC. SHEET

**PROJECT:** THE HAZEL
**CONSULTANT:** COLE ENGINEERING GROUP LTD.

**PROJECT NO.** UD15-0682
**PREPARED BY:** P.F.
**CHECKED BY:** SG
**LAST REVISED:** February 22, 2019

**Notes**

1. Based on the Region of Peel Design Standards June 2010.
2. Residentail Unit Count is based on the Draft Plan prepared by Armstrong Planning & Project Management, dated February 8, 2019.

| EQUIVALENT POPULATION | | | | | | | WATER USAGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | POPULATION | | | | | | |
| RESIDENTIAL OCCUPANCY DATA | # Units | Area (ha) | Single (greater than 10m frontage) 50 p/ha | Row Dwellings 175 p/ha | PEOPLE / UNIT | AVERAGE DAY SERVICE DEMANDS (L/c/d) | AVERAGE DAY (L/d) | MAX. DAY (L/d) | PEAK HOUR (L/hr) |
| Single Family Detached | 1 | 0.07 | 3.5 | | 3.5 | 280 | 980 | 1,960 | 2,940 |
| Townhouses | 37 | 1.11 | | 194.25 | 5.3 | 280 | 54,390 | 108,780 | 163,170 |
| Future Single Family | 1 | 0.08 | 4 | | 4 | 280 | 1,120 | 2,240 | 3,360 |
| Future Townhouses | 7 | 0.21 | | 36.75 | 5.3 | 280 | 10,290 | 20,580 | 30,870 |
| | | | | | | | | Total Peak Hour | 200,340 |
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# APPENDIX C

## Sanitary Sewer Design Sheet

| LOCATION | FROM M.H. | TO M.H. | AREA (ha) | DENSITY (ppha) | POPULATION | CULULATIVE AREA (ha) | CULULATIVE POPULATION (ha) | SEWAGE FLOW1 ($m^3$/s) | INFILTRATION ($m^3$/s) | FOUNDATION DRAIN3 ($m^3$/s) | TOTAL FLOW 1+2+3 ($m^3$/s) | LENGTH | PIPE DIAMETER (mm) | GRADIENT (%) | CAPACITY ($m^3$/s) | VELOCITY (m/s) | DROP IN LOWER M.H. (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THORNY-BRAE PLACE | MH.03A | MH.02A | 0.19 | 175 | 33 | 0.19 | 33.25 | 0.00056 | 0.00004 | 0.00000 | 0.00060 | 13.34 | 250 | 2.0 | 85.42 | 1.26 | 0.05 |
| THORNY-BRAE PLACE | MH.02A | MH.01A | 0.62 | 175 | 109 | 0.81 | 141.75 | 0.00240 | 0.00016 | 0.00000 | 0.00256 | 59.40 | 250 | 0.5 | 42.71 | 0.86 | 0.045 |
| THORNY-BRAE PLACE | MH.01A | *EX.SAN.MH.A* | 0.18 | 175 | 32 | 0.99 | 173.25 | 0.00293 | 0.00020 | 0.00000 | 0.00313 | 21.08 | 250 | 0.5 | 42.71 | 0.85 | 0.05 |
| *THORNY-BRAE PLACE* | *EX.SAN.MH.A* | *EX.SAN.MH.B* | *0.53* | *175* | *93* | *1.52* | *266.00* | *0.00449* | *0.00030* | *0.00000* | *0.00480* | *60.63* | *250* | *0.5* | *42.71* | *0.86* | |
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**Drainage Area Plan No.** SAN-01
**Consultant** COLE ENGINEERING GROUP LTD.
**Subdivision** THE HAZEL
**Sheet** 1 **of** 1
**Project No.** UD15-0682

Region of Peel
Working for you

**SANITARY SEWER DESIGN SHEET**

**DATE** **February 14, 2019** **REV.** **2**

**APPROVED** **DATE**

# APPENDIX D

## Soil Investigation

**Soil Engineers Ltd.**
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 • TEL: (416) 754-8515 • FAX: (416) 754-8516

| BARRIE | MISSISSAUGA | OSHAWA | NEWMARKET | GRAVENHURST | PETERBOROUGH | HAMILTON |
|---|---|---|---|---|---|---|
| TEL: (705) 721-7863 | TEL: (905) 542-7605 | TEL: (905) 440-2040 | TEL: (905) 853-0647 | TEL: (705) 684-4242 | TEL: (905) 440-2040 | TEL: (905) 777-7956 |
| FAX: (705) 721-7864 | FAX: (905) 542-2769 | FAX: (905) 725-1315 | FAX: (416) 754-8516 | FAX: (705) 684-8522 | FAX: (905) 725-1315 | FAX: (905) 542-2769 |

**A REPORT TO**
**2462357 ONTARIO INC.**

# A SOIL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

**1745, 1765 AND 1775 THORNY BRAE PLACE**

**CITY OF MISSISSAUGA**

**REFERENCE NO. 1608-S094**

**OCTOBER 2016**

## DISTRIBUTION

2 Copies - 2462357 Ontario Inc.
1 Copy - Armstrong Planning & Project Management
1 Copy - Soil Engineers Ltd. (Mississauga)
1 Copy - Soil Engineers Ltd. (Toronto)

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## TABLES

## DIAGRAMS

## ENCLOSURES

# 1.0 INTRODUCTION

In accordance with written authorization dated August 9, 2016, from Mr. Peter Sciavilla of 2462357 Ontario Inc., a soil investigation was carried out for the properties at 1745, 1765 and 1775 Thorny Brae Place, in the City of Mississauga.

The purpose of the investigation was to reveal the subsurface conditions and to determine the engineering properties of the disclosed soils for the design and construction of a proposed residential development.

The geotechnical findings and resulting recommendations are presented in this Report.

## 2.0 SITE AND PROJECT DESCRIPTION

The site is situated on Halton-Peel till plain where drift beds onto shale bedrock at shallow to moderate depths. In places, the drift has been partly eroded by Peel Ponding (glacial lake) and filled with lacustrine sand, silt, clay, and reworked tills.

The subject site, irregular in shape and encompassing an area of 2.04 hectares, is located at the southeast corner of Mississauga Road and Eglinton Avenue West, on the west bank of Credit River. Existing residences fronting onto Thorny Brae Place are located in the west portion of the site, and the east portion is vacant with weed cover and some wooded areas. The east limit of the site is defined by the Credit River valley, and a drainage feature extends from the cul-de-sac of Thorny Brae Place and meanders along the south boundary of the site toward the valley. The site is slightly undulated in some areas, with a general topographic decline toward the valley slope and the drainage feature. The neighbouring areas consist of residential properties to the west and north, and a church to the south.

It is understood that the existing dwellings will be demolished for a new residential development which will consist of detached houses and townhouse blocks. The Thorny Brae Place cul-de-sac will be extended eastward. The development will be provided with municipal water and sewer services.

## 3.0 FIELD WORK

The field work, consisting of 12 boreholes to depths ranging from 3.0 to 6.6 m, was performed on August 30 and 31 and September 9, 2016, at the locations shown on the Borehole Location Plan, Drawing No. 1.

The boreholes were advanced at intervals to the sampling depths by a truck- or track-mounted, continuous-flight power-auger machine equipped for soil sampling. Standard Penetration Tests, using the procedures described on the enclosed “List of Abbreviations and Terms”, were performed at the sampling depths. The test results are recorded as the Standard Penetration Resistance (or ‘N’ values) of the subsoil. The relative density of the granular strata and the consistency of the cohesive strata are inferred from the ‘N’ values. Split-spoon samples were recovered for soil classification and laboratory testing.

Refusal to augering occurred at a depth of 5.5 m at Borehole 12, and NQ size rock coring was carried out to assess the quality and soundness of the bedrock. The quality of the rock has been assessed by applying the ‘Rock Quality Designation’ (RQD) classification, considering the total length of the recovered core pieces 10 cm or longer against the length of the core run. The results are expressed in percent and are recorded on the Borehole Log.

The field work was supervised and the findings were recorded by a geotechnical technician.

The elevation at each of the borehole locations was interpolated from the topographic contours shown on the site plan.

## 4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 12, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2. The engineering properties of the disclosed soils are discussed herein.

The investigation has disclosed that beneath the existing pavement or a layer of topsoil fill with a layer of earth fill in places, the site is underlain by strata of silty clay and/or silty clay till bedding onto shale bedrock.

### 4.1 Pavement Structure (Boreholes 1, 2, 3, 4 and 6)

Boreholes 1, 2 and 3 were drilled along the northbound lane on Mississauga Road. Boreholes 4 and 6 were drilled along Thorny Brae Place. The thickness of the components of the existing pavement structure as disclosed by the boreholes is presented in Table 1.

**Table 1 -** Existing Road Pavement

| Borehole No. | Asphalt Thickness (mm) | Granular Fill Thickness (mm) | Total Thickness (mm) |
|---|---|---|---|
| Mississauga Road | | | |
| 1 | 150 | 460 | 610 |
| 2 | 150 | 460 | 610 |
| 3 | 150 | 460 | 610 |
| Thorny Brae Place | | | |
| 4 | 150 | 310 | 460 |
| 6 | 50 and 100 (layers) | 50 (between asphalt layers) | 200 |

As shown above, the existing road pavement consists of asphaltic concrete, 150 mm thick, overlying a layer of granular fill 0.5 to 0.6 m thick. Two layers of asphalt sandwiching a granular fill were contacted in Borehole 6, having a total thickness of 200 mm. The granular fill consists of crushed gravel or pit-run sand and gravel, with a trace to some silt.

The water content of the granular samples is 3%, indicating a dry condition.

Grain size analyses were performed on 3 representative samples. The results are plotted on Figure 13. Due to excess silt content of more than 10% (but less than 20%), 2 of the tested samples failed to satisfy the gradation requirements of the OPS Specification for Granular 'B'. This indicates that the granular fill is generally not suitable for reuse as a granular base or sub-base material for the pavement. Upon careful salvaging, it may be used for structural backfill and/or for road subgrade stabilization. Bulk samples can be collected during construction for testing to confirm the suitability of the granular fill for road base or sub-base material.

### 4.2 **Topsoil/Topsoil Fill** (Borehole 5 and Boreholes 7 to 12, inclusive)

The revealed topsoil/topsoil fill is 10 to 15 cm in thickness. It is dark brown in colour, indicating an appreciable amount of roots and humus. These materials are unstable and compressible under loads; therefore, the topsoil is considered to be void of engineering value, but can be used for general landscaping purposes. A fertility analysis can determine the suitability of the topsoil as planting soil or for sodding.

Due to its humus content, the topsoil may produce volatile gases and will generate an offensive odour under anaerobic conditions. Therefore, the topsoil must not be buried within the building envelopes or deeper than 1.2 m below the external finished grade.

This is to avoid an adverse impact on the environmental well-being of the developed areas.

### 4.3 **Earth Fill** (All Boreholes, except Boreholes 5 and 10)

The earth fill, extending to depths ranging from 0.5± to 2.1± m, generally consists of silty clay material with occasional topsoil inclusions and roots in places. The earth fill was found to consist of silty sand or sandy silt in Borehole 11.

The natural water content of the samples ranges from 5% to 26%, with a median of 13%, indicating that the fill is damp to very moist, being generally moist.

The obtained ‘N’ values range from 7 to over 50 blows per 30 cm of penetration, with a median of 12, indicating that the earth fill was placed with non-uniform compaction and has since self-consolidated. The high ‘N’ value of over 50 might represent the contact of cobbles or boulders.

The existing clay fill found along Mississauga Road is suitable for light to medium traffic loads. Where the fill is to remain in the road subgrade, it must be proof-rolled and inspected prior to the placement of new granular fill and/or pavement structure. Where serious topsoil inclusions/organics are encountered, the fill must be subexcavated and replaced with properly compacted inorganic fill.

Due to the occasional topsoil and root inclusions and non-uniform compaction, the fill is unsuitable for supporting structures sensitive to movement. For use as structural backfill, it must be subexcavated, inspected, assessed, sorted free of concentrated topsoil inclusions and deleterious materials, if encountered, and properly compacted. If it is impractical to sort the topsoil and other deleterious materials from the fill, the fill must be wasted and replaced with properly compacted inorganic earth fill.

The fill is amorphous in structure; it will ravel and is susceptible to collapse in steep cuts.

One must be aware that the samples retrieved from boreholes 10 cm in diameter may not be truly representative of the geotechnical and environmental quality of the fill, and do not indicate whether the topsoil beneath the earth fill was completely stripped. This should be determined by laboratory testing and/or test pits.

### 4.4 **Silty Clay** (Boreholes 4, 5 and 6)

A layer of silty clay was encountered in the upper zone of the soil stratigraphy, beneath the earth fill or topsoil and extends to depths of 1.4 m and 2.1 m below the prevailing ground surface. It is cohesive, containing a trace of fine sand, occasional silt seams and layers and occasional gravel in places. The laminated structure shows that the silty clay is a lacustrine deposit.

Sample examinations reveal that the clay is generally weathered within the surficial zone of 0.8 to 1.2 m. The ‘N’ values obtained in the clay range from 7 to 62, with a median of 8 blows, indicating that the consistency of the clay is firm to hard, generally being firm.

The Atterberg Limits of 1 representative sample and the water content values of the silty clay samples were determined. The results are plotted on the Borehole Logs and summarized below:

| | |
|---|---|
| Liquid Limit | 31% |
| Plastic Limit | 17% |
| Natural Water Content | 11% to 21% (median 19%) |

The above results show that the clay is a cohesive material with low plasticity. The natural water content generally lies above its plastic limit, confirming the consistency of the clay as disclosed by the ‘N’ values.

A grain size analysis was performed on 1 representative sample; the result is plotted on Figure 14.

Based on the above findings, the deduced engineering properties pertaining to the project are given below:

- High frost susceptibility and soil-adfreezing potential.
- The laminated silt layers are high in water erodibility.
- Low permeability, with an estimated coefficient of permeability of $10^{-7}$ cm/sec, an average infiltration rate of more than 80 min/cm and runoff coefficients of:

| **Slope** | |
|---|---|
| 0% - 2% | 0.15 |
| 2% - 6% | 0.20 |
| 6% + | 0.28 |

- A cohesive-frictional soil, its shear strength is derived from consistency and augmented by the internal friction of the silt. Its shear strength is moisture dependent and, due to the dilatancy of the silt, the overall shear strength of the silty clay is susceptible to impact disturbance; i.e., the disturbance will induce a build-up of pore pressure within the soil mantle, resulting in soil dilation and a reduction of shear strength.
- In steep cuts, the weathered clay will slough readily and a cut face in the sound clay may collapse as the wet silt slowly sloughs.
- A very poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 3% or less.

- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3000 ohm·cm.

### 4.5 **Silty Clay Till** (All Boreholes)

The silty clay till was encountered throughout the investigated area. It is heterogeneous in structure, showing it is a glacial deposit. The till contains a trace of gravel, with occasional sand and silt layers embedded in the deposit. Shale fragments and clay layers were found embedded in the till.

Sample examinations indicated that the surficial till is generally weathered; the weathered zone extends to a depth of 1.2± m below the prevailing ground surface.

The obtained ‘N’ values range from 14 to over 50 blows per 30 cm of penetration, with a median of 40. This indicates that the consistency of the till is stiff to hard, being generally hard.

The Atterberg Limits of 2 representative samples and the natural water content values of all the samples were determined; the results are plotted on the Borehole Logs and summarized below:

| | |
|---|---|
| Liquid Limit | 29% and 30% |
| Plastic Limit | 17% |
| Natural Water Content | 8% to 20% (median 13%) |

The above results show that the till is a cohesive material with low plasticity. The natural water content values generally lie below its plastic limit, confirming the hard consistency of the till as determined by the ‘N’ values.

Grain size analyses were performed on 2 representative samples of the till, and the results are plotted on Figure 15.

Based on the above findings, the soil engineering properties pertaining to the project are given below:

- High frost susceptibility and soil-adfreezing potential.
- Low water erodibility.
- Low permeability, with an estimated coefficient of permeability of $10^{-7}$ cm/sec, an average infiltration rate of more than 80 min/cm and runoff coefficients of:

| **Slope** | |
|---|---|
| 0% - 2% | 0.15 |
| 2% - 6% | 0.20 |
| 6% + | 0.28 |

- A cohesive-frictional soil, its shear strength is derived from consistency and is augmented by internal friction, thus being inversely moisture dependent and, to a lesser extent, dependent on soil density.
- It will generally be stable in a relatively steep cut; however, prolonged exposure will allow infiltrating precipitation to saturate the fissures in the weathered zone and the sand layers, which may lead to localized sloughing.
- A very poor pavement-supportive material, with an estimated CBR value of 3% or less.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3500 ohm·cm.

### 4.6 **Shale Bedrock** (Boreholes 1, 5, 7, 9, 10 and 12)

Shale bedrock was encountered at depths ranging from 3.7± to 5.6± m or at El. 139.9± to 142.4± m. It is greenish-grey in colour, indicating a Georgian Bay formation. The bedrock is thinly to thickly bedded with occasional hard, siltstone, limestone and dolomite bands. The shale is susceptible to disintegration and swelling upon exposure to air and water, with subsequent reversion to a clayey soil, but the laminated limy layers would remain as rock slabs. The presence of shale debris found in the overlying tills renders it is difficult to delineate the actual surface of the bedrock.

The bedrock within the investigated depth can be penetrated with difficulty by power-augering with some difficulty in grinding through the hard layers. The upper layer of the shale within the investigated depth is, therefore, in a weathered condition, which extends to a depth of 2± to 4± m below the surface of the bedrock. The rock mass was assessed by RQD, which has values of 0% and 9% within the investigated depth, showing that the weathered shale is a very poor quality rock.

The shale has a low permeability. Infiltrated precipitation and groundwater from the overburden soils will often permeate the fissures in the rock. Where there are pockets of groundwater trapped in its fissures, this water is often under moderate subterranean artesian pressure but, upon release through excavation, the water is likely to drain readily with a limited yield. The water content values of the samples obtained from the auger and sampler range from 1% to 7%, with a median of 5%. However, the bedrock is in general considered a poor aquifer; therefore, the groundwater yield from the rock will be limited.

The weathered rock can be excavated with considerable effort by a heavy-duty backhoe equipped with a rock-ripper; however, excavation will become progressively more difficult with depth into the sound shale. Efficient removal of the sound shale may require the aid of pneumatic hammering. Excavation into the sound shale, however, is not anticipated for the proposed development.

The excavated spoil will contain large amounts of hard limy and rock slabs, rendering it virtually impossible to obtain uniform compaction. Therefore, unless the spoil is sorted, it is considered unsuitable for engineering applications. Limy shale fragments larger than 15 cm should either be pulverized by mechanical means or left exposed for weathering by freezing and thawing, and wetting. The shale will revert to a clayey soil which can be properly compacted using mechanical means.

### 4.7 Interpretation of Refusal to Augering (Boreholes 6 and 11)

Refusal to augering was contacted at depths of 5.3 m and 3.0 m from grade at Boreholes 6 and 11, respectively. The refusal to augering may indicate the presence of boulders, rock slab or bedrock.

### 4.8 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied. As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 2.

**Table 2 -** Estimated Water Content for Compaction

| Soil Type | Determined Natural Water Content (%) | Water Content (%) for Standard Proctor Compaction | |
|---|---|---|---|
| | | 100% (optimum) | Range for 95% or + |
| Granular Fill | 3 | 6 to 7 | 3 to 12 |
| Earth Fill (Silty Clay) | 5 to 26<br>(median 13) | 17 | 13 to 22 |
| Silty Clay/Silty Clay Till | 8 to 21<br>(median 19) | 17 | 13 to 22 |

The above values show that the in situ soils are generally suitable for 95% or + Standard Proctor compaction. However, the dry till will require the addition of water prior to compaction, or mixing with the wetter inorganic soils for proper structural compaction.

The fill must be sorted free of topsoil inclusions and deleterious materials, if any, prior to its use as structural backfill.

The inorganic clay, clay till, earth fill, and broken shale should be compacted using a heavy-weight, kneading-type roller; the granular fill can be compacted by a smooth roller with or without vibration, depending on the water content of the soils being compacted. The lifts for compaction should be limited to 20 cm, or to a suitable thickness as assessed by test strips performed by the equipment which will be used at the time of construction.

One must be aware that when compacting the clay or clay till on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soil and be transmitted laterally into the soil mantle. Therefore, the lifts of this soil must be limited to 20 cm or less (before compaction). In deep sewer trenches, it is difficult to monitor the lifts during construction. Compaction of backfill at depths over 1.0 m below the road subgrade should, therefore, be carried out on the wet side of the optimum; this allows a wider latitude of lift thickness. Constant wetting of the sound till will be necessary to achieve this requirement.

If the compaction of the soils is carried out with the water content within the range for 95% Standard Proctor dry density but on the wet side of the optimum, the surface of the compacted soil mantle will roll under the dynamic compactive load. This is unsuitable for road construction since each component of the pavement structure is to be placed under dynamic conditions which will induce the rolling action of the subgrade surface and cause structural failure of the new pavement. The foundations or bedding of the underground services, on the other hand, will be placed on a subgrade which will not be subjected to impact loads.  Therefore, the structurally compacted soil mantle with the water content on the wet side or dry side of the optimum will provide adequate subgrade strength for the project construction.

The presence of shale fragments, cobbles and boulders, if encountered, will prevent transmission of the compactive energy into the underlying material to be compacted.  If an appreciable amount of shale fragments and boulders over 15 cm in size is mixed with the material, they must either be sorted or must not be used for structural backfill or the construction of engineered fill.

## 5.0 GROUNDWATER CONDITIONS

All the boreholes remained dry upon completion of the field work. The soil colour changed from brown to grey at depths of 4.0+ m below the prevailing ground surface, indicating that the upper zone of the stratigraphy has oxidized.

The yield of groundwater in excavation, if encountered, is expected to be small and limited in quantity. Perched groundwater derived from infiltrated precipitation will occur at shallow depths during wet seasons. However, its yield will likely be controllable by pumping from sumps.

The shale bedrock is generally considered to be a poor aquifer; therefore, the yield from the bedrock, if encountered, will be limited. In some places, the fissures of the weathered shale contain pockets of groundwater which may sometimes be under moderate artesian pressure. Upon release through excavation, this water is expected to drain readily with continuous pumping from sumps.

## 6.0 DISCUSSION AND RECOMMENDATIONS

The investigation revealed that beneath the pavement structure or a layer of topsoil/topsoil fill, and a layer of earth fill, the site is underlain by a stratum of stiff to hard, generally hard silty clay till, interstratified with a firm to hard, generally firm silty clay deposit and bedding onto shale bedrock at approximate depths ranging from 3.7 to 5.6± m below the prevailing ground surface, or at El. 139.9± to 142.4± m.

The earth fill extends to depths ranging from 0.5± to 2.0± m below the prevailing ground surface, and consists of mainly silty clay material. Sample examinations show that it contains traces of topsoil and roots in places. The surficial zone of the native soils is generally weathered, extending to a depth of 1.2± m from the prevailing ground surface.

All boreholes remained dry upon completion of field work. The overall yield of groundwater in excavation is expected to be small and limited in quantity, and will likely be controllable by pumping from sumps. In some places, the fissures of the weathered shale contain pockets of groundwater which may sometimes be under moderate artesian pressure. Upon release through excavation, this water is expected to drain readily with continuous pumping from sumps.

The revealed findings show the following geotechnical considerations with special attention:

1. The revealed topsoil/topsoil fill must be removed for the project construction. It is void of engineering value, but can be used for general landscaping purposes. It should not be buried within any building envelopes or deeper than 1.2 m below the exterior finished grade.

2. Grain size analyses of granular fill show 2 of the 3 tested samples failed to satisfy the Gradation Requirements of the OPS Specification for Granular 'B' due to excessive silt content. This indicates that the granular fill is generally not suitable for reuse as a base or sub-base material, but upon careful salvaging, may be used for structural backfill and/or for road subgrade stabilization. However, bulk samples can be collected during construction for grain size analysis to confirm the suitability of the granular fill for reuse as base or sub-base material.
3. The existing clay fill found along Mississauga Road is suitable for road expansion with light to medium traffic loads. Where the fill is to remain in the road subgrade, it must be proof-rolled and inspected prior to the placement of new granular fill and/or pavement structure. Where serious topsoil inclusions/organics are encountered, the fill must be subexcavated and replaced with properly compacted inorganic fill.
4. Due to the presence of topsoil and root inclusions, the earth fill is considered unsuitable for structures sensitive to movement. For use as structural backfill, or in pavement and slab-on-grade construction, the fill should be subexcavated, inspected, sorted free of concentrated topsoil inclusions and other deleterious materials, if any, aerated and compacted. Otherwise, it must be wasted and replaced with compacted inorganic earth fill.
5. The sound natural soil is suitable for normal spread and strip footing construction.
6. The soundness of the foundation subgrade must be assessed by either a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to ensure that the subgrade conditions are compatible with the designs of the foundations.
7. A Class 'B' bedding, consisting of compacted 20-mm Crusher-Run Limestone, is recommended for the construction of underground services.

8. Perimeter subdrains and dampproofing of the foundation walls are required for basement construction. The subdrains should be shielded by a fabric filter to prevent blockage by silting, and they must be connected to a positive outlet.
9. Excavation should be carried out in accordance with Ontario Regulation 213/91.
10. Excavation into the hard clay till or weathered shale will require extra effort using heavy-duty mechanical equipment and a rock-ripper will be required to facilitate the excavation into the shale bedrock. Efficient removal of the sound shale may require the aid of pneumatic hammering.
11. Where the underground services are to be cut close to any existing underground services, one must be aware that the backfill for the existing underground services is amorphous in structure, and it is susceptible to sloughing and sudden side collapse. The existing services must be properly secured for the new service construction, and the stability of the new trench and the existing services must be ensured by flattening the slope of the cut. In areas where it will be too narrow to facilitate open cuts and a vertical cut is necessary, it must be carried out in a trench box or be properly shored.

The recommendations appropriate for the project described in Section 2.0 are presented herein. One must be aware that the subsurface conditions may vary between boreholes, and the assessment given herein is general in nature based on the borehole findings. Should this become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

## 6.1 **Foundation**

Based on the Grading Plan prepared by Cole Engineering, the site will be regraded with minor cut and fill, with the overall grading generally matching to the existing condition. The existing drainage channel will be raised to the design grade with engineered fill.

The proposed residential development will include the extension of Thorny Brae Place to the east, with a mixture of townhouses and single residential dwellings on both sides of the road. Normal spread and strip footings for the structures must be placed below the topsoil/topsoil fill, weathered soils and earth fill onto the sound, natural soil or onto engineered fill. As a general guide, the recommended soil pressures for use in the design of the footings, together with the corresponding suitable founding levels, are presented in Table 3.

**Table 3 -** Founding Levels

| **Borehole No.** | **Recommended Maximum Allowable Soil Pressures (SLS)/ Factored Ultimate Soil Bearing Pressures (ULS) and Suitable Founding Level** | | | |
|---|---|---|---|---|
| | **100 kPa (SLS)<br>150 kPa (ULS)** | | **250 kPa (SLS)<br>400 kPa (ULS)** | |
| | **Depth (m)** | **Elevation (m)** | | |
| 4 | 1.5 or + | 146.0 or - | 2.5 or + | 145.0 or - |
| 5 | - | - | 1.2 or + | 145.9 or - |
| 6 | 2.0 or + | 144.8 or - | 2.5 or + | 144.3 or - |
| 7 | - | - | 1.2 or + | 146.1 or - |
| 8 | - | - | 1.0 or + | 147.2 or - |
| 9 | - | - | 1.2 or + | 146.8 or - |
| 10 | 1.0 or + | 142.8 or - | 1.5 or + | 142.3 or - |
| 11 | - | - | 1.5 or + | 141.4 or - |
| 12 | 1.0 or + | 144.7 or - | 1.5 or + | 144.2 or - |

The recommended soil pressures (SLS) for normal foundations incorporate a safety factor of 3. The total and differential settlements of the footings are estimated to be 25 mm and 15 mm, respectively.

Foundations exposed to weathering, or in unheated areas, should have at least 1.2 m of earth cover for protection against frost action, or must be properly insulated.

The footings should meet the requirements specified by the latest Ontario Building Code, and the structures should be designed to resist a minimum earthquake force using Site Classification ‘C’ (very dense soil or soft rock).

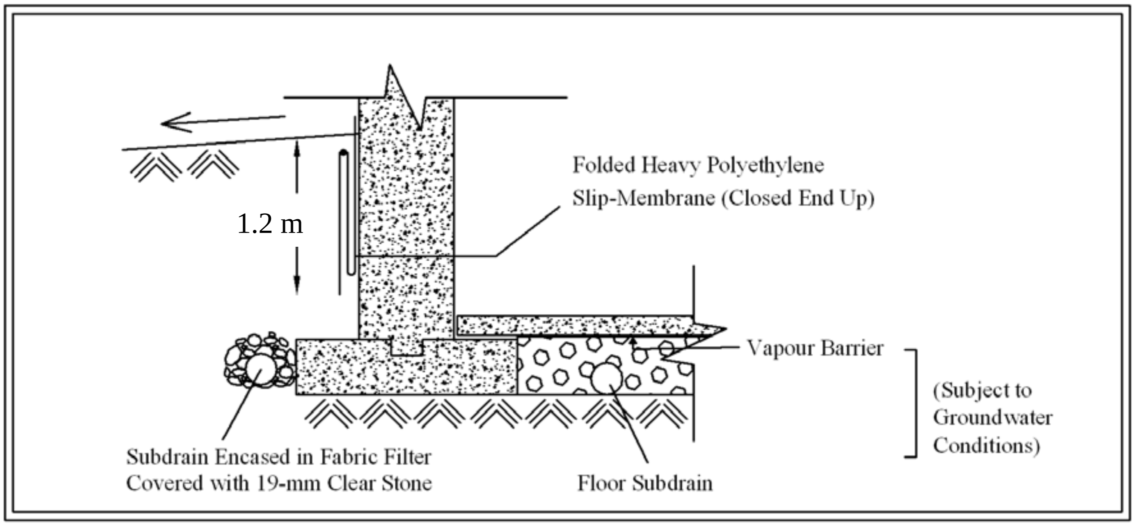
One must be aware the recommended Maximum Allowable Soil Pressures (SLS) and corresponding founding depths are given as a guide for foundation design. The soundness of the foundation subgrade must be assessed by either a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to ensure that the subgrade conditions are compatible with the design of the foundations.

The ground around the buildings must be graded to direct water away from the structure to minimize the frost heave phenomenon generally associated with the disclosed soils.

Perimeter subdrains and dampproofing of the foundation walls are required for basement construction. The subdrains should be shielded by a fabric filter to prevent blockage by silting.

The clay is high in frost heave and soil-adfreezing potential. If it is to be used for the foundation backfill, the foundation walls should be shielded by a polyethylene slipmembrane for protection against soil adfreezing. The recommended measures are schematically illustrated in Diagram 1.

**Diagram 1 -** Frost Protection Measures (Foundations)



The membrane will allow vertical movement of the heaving soil (due to frost) without imposing structural distress on the foundations. The above recommendations should be further assessed and/or confirmed during construction.

## 6.2 **Engineered Fill**

The existing fill can be replaced with and/or upgraded to engineered fill and where earth fill is required to raise the site, or where extended footings are required, the engineering requirements for a certifiable fill for road construction, municipal services, slab-on-grade, and footings designed with a Maximum Allowable Soil Pressure (SLS) of 100 kPa and Factored Ultimate Soil Bearing Pressure (ULS) of 150 kPa for normal footings are presented below:

1. All of the asphalt and topsoil/topsoil fill must be removed; the granular fill, earth fill and weathered soil must be subexcavated, sorted free of topsoil

inclusions, organics and any deleterious materials, if encountered. The subgrade surface must be inspected and proof-rolled prior to any fill placement.

2. Inorganic soils must be used, and they must be uniformly compacted in lifts 20 cm thick to 98% or + of their maximum Standard Proctor dry density up to the proposed lot grade and/or road subgrade. The soil moisture must be properly controlled on the wet side of the optimum. If the foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% of the maximum Standard Proctor compaction.
3. If imported fill is to be used, the hauler is responsible for its environmental quality and must provide a document to certify that the material is free of hazardous contaminants.
4. If the engineered fill is to be left over the winter months, adequate earth cover, or equivalent, must be provided for protection against frost action.
5. The engineered fill must extend over the entire graded area; the engineered fill envelope must be clearly and accurately defined in the field, and they must be precisely documented by qualified surveyors. Foundations partially on engineered fill must be reinforced and designed by a structural engineer to properly distribute the stress induced by the abrupt differential settlement (estimated to be 15± mm) between the natural soils and engineered fill.
6. The engineered fill must not be placed during the period from late November to early April, when freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow.
7. Where the ground is wet due to subsurface water seepage, an appropriate subdrain scheme must be implemented prior to the fill placement, particularly if it is to be carried out on sloping ground or a bank.
8. Where the fill is to be placed on a bank steeper than 1 vertical:3 horizontal, the face of the bank must be flattened to 3 + so that it is suitable for safe operation of the compactor and the required compaction can be obtained.

9. The fill operation must be inspected on a full-time basis by a technician under the direction of a geotechnical engineer.
10. The footing and underground services subgrade must be inspected by the geotechnical consulting firm that inspected the engineered fill placement. This is to ensure that the foundations are placed within the engineered fill envelope, and the integrity of the fill has not been compromised by interim construction, environmental degradation and/or disturbance by the footing excavation.
11. Any excavation carried out in certified engineered fill must be reported to the geotechnical consultant who inspected the fill placement in order to document the locations of excavation and/or to inspect reinstatement of the excavated areas to engineered fill status. If construction on the engineered fill does not commence within a period of 2 years from the date of certification, the condition of the engineered fill must be assessed for re-certification.
12. Despite stringent control in the placement of the engineered fill, variations in soil type and density may occur in the engineered fill. Therefore, the foundations must be properly reinforced and designed by the structural engineer for the project. The total and differential settlements of 25 mm and 15 mm, respectively, should be considered in the design of the foundations founded on engineered fill.

## 6.3 **Underground Services**

The profile drawings for Mississauga Road and Thorny Brae Place, prepared by Cole Engineering, show that new PVC sanitary and concrete storm sewers as well as watermain will be installed to service both the Thorny Brae Place project and ‘The Archways’ development to the south. The proposed invert of the infrastructure will lie at approximately 3.5 to 6.5 m beneath the prevailing ground surface. Based on the borehole findings, these services may remain in the very stiff to hard clay till overburden along Mississauga Road and into the weathered shale in the east end of Thorny Brae Place. Excavation into the sound shale is not anticipated.

At the terminus of the current Thorny Brae Place cul-de-sac, the proposed 750-mm concrete storm sewer will extend through a storm sewer easement and be connected to an existing outfall structure. The existing wing wall will be cored to accommodate the fitting of the new pipe. Findings from nearby boreholes suggest that the existing outfall structure is founded onto hard silty clay till or weathered shale bedrock, which is suitable for supporting the new pipe installation.

The subgrade for the underground services should consist of sound natural soils or properly compacted organic-free earth fill. Where soft soil is encountered, it must be subexcavated and replaced with properly compacted bedding material.

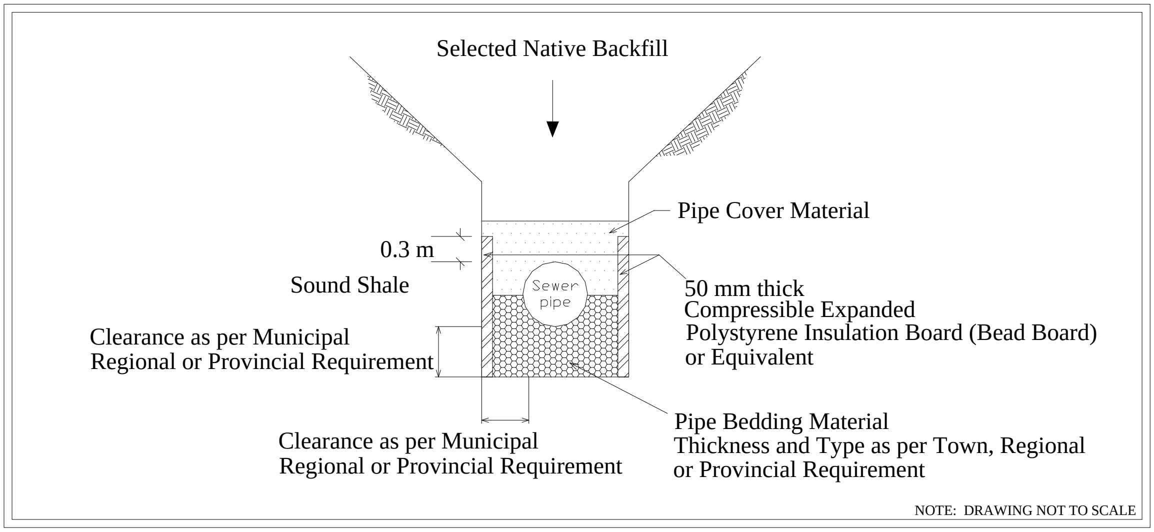
A Class ‘B’ bedding is recommended for the construction of the underground services and should consist of compacted 20-mm Crusher-Run Limestone, or equivalent. Openings to the subdrains and catch basins should be shielded by a fabric filter to prevent silting.

In order to prevent pipe floatation when the service trench is deluged with water, a soil cover at least equal in thickness to the diameter of the pipe should be in place at all times after completion of the pipe installation.

The silty clay and clay till have moderately high corrosivity to buried metal, the pipes should be protected against corrosion. In determining the mode of protection, an electrical resistivity of 3000 ohm·cm should be used. This, however, should be confirmed by testing the soil along the underground services alignment at the time of construction.

Where the pipe is to be placed in sound shale, the trench sides should be slightly sloped rather than vertical due to the residual stress relief and the swelling characteristics of the shale. The side slopes should be no steeper than 2 vertical: 1 horizontal. The rock face can be lined with a cushioning layer such as Styrofoam, then backfilled with fine sand to 0.3 m above the crown of the pipe and flooded. The recommended scheme is illustrated in Diagram 2.

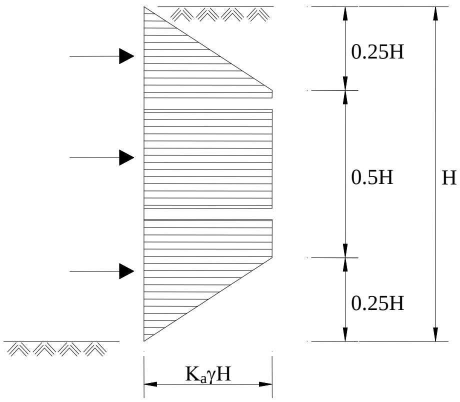
**Diagram 2 -** Sewer Installation in Sound Shale



The construction of services using open-cut method must be carried out in accordance with Ontario Regulation 213/91. In areas where a vertical cut is necessary, it must be carried out in a trench box or be properly shored.

The trench box/shoring structure must be properly designed to sustain the lateral earth pressure, applicable surcharge and hydrostatic pressure, if applicable. The recommended lateral earth pressure distribution for the revealed soils is given in Diagrams 3 and 4.

**Diagram 3 -** Lateral Earth Pressure (Clay, Clay Till or weathered Shale)

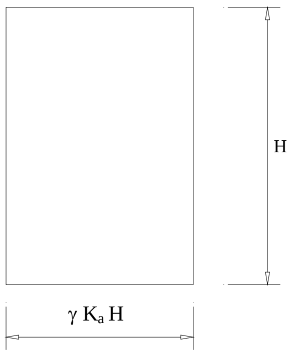


H - Height of Excavation in metres

$\gamma$ - See Section 6.8 (above groundwater)

$K_a$ - Active Lateral Earth Pressure Coefficient (See Section 6.8)

**Diagram 4 -** Lateral Earth Pressure (Earth Fill)



H - Height of Pit in metres

$\gamma$ - Bulk Density

$K_a$ - Active Lateral Earth Pressure refer to Section 6.8

In calculating the lateral earth pressure for the shoring structure, the soil parameters are provided in Section 6.8. The soils above the trench box must be cut at 1 vertical: 1.5 or + horizontal.

## 6.4 Trench Backfilling

The backfill in the trenches should be compacted to at least 95% of its maximum Standard Proctor dry density. In the zone within 1.0 m below the road subgrade, the material should be compacted with the water content 2% to 3% drier than the optimum, and the compaction should be increased to 98% of the its maximum Standard Proctor dry density. This is to provide the required stiffness for pavement construction.

In the lower zone, the compaction should be carried out on the wet side of the optimum; this allows a wider latitude of lift thickness. Wetting of the in situ soil will be necessary to achieve this requirement. Backfill below slabs should be compacted to at least 98% of its maximum Standard Proctor dry density.

The in situ inorganic native soils and granular and clay fills are suitable for use as structural fill. Clay fill containing significant topsoil and organics inclusions is not suitable for reuse as a backfill material.

Any excavated shale should be pulverized to sizes less than 15 cm and thoroughly mixed with the overburden soils prior to backfilling.

In normal underground construction practice, the problem areas of road settlement largely occur adjacent to manholes catch basins and services crossings. In areas which are inaccessible to a heavy compactor, sand backfill should be used and the compaction of the backfill must be carefully performed. The interface of the native soils and the sand backfill will need to be flooded for a period of several days.

The narrow trenches for service crossings should be cut at 1 vertical:2 or + horizontal so that the backfill can be effectively compacted; otherwise, soil arching will prevent the achievement of proper compaction. The lift of each backfill layer should either be limited to a thickness of 20 cm, or the thickness should be determined by test strips at the time of compaction.

One must be aware of possible consequences during trench backfilling and exercise caution as described below:

- When construction is carried out in the winter, allowance should be made for the freezing conditions. Despite stringent backfill monitoring, frozen soil layers may inadvertently be mixed with the structural trench backfill. Should the in situ soil have a water content on the dry side of the optimum, it would be impossible to wet the soil due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent flooding of the backfill when it is required, such as when the trench box is removed. The above will invariably cause backfill settlement that may become evident within 1 to several years, depending on the depth of the trench which has been backfilled.
- In areas where the underground services construction is carried out during the winter months, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. This may result in some settlement as the frost recedes, and repair costs will be incurred prior to the final surfacing of the new pavement.
- To backfill a deep trench, one must be aware that future settlement is to be expected, unless the side of the cut is flattened to at least 1 vertical: 1.5+ horizontal, and the lifts of the fill and its moisture content are stringently controlled; i.e., lifts should be no more than 20 cm (or less if the backfilling conditions dictate) and uniformly compacted to achieve at least 95% of the maximum Standard Proctor dry density, with the moisture content on the wet side of the optimum.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is an open cut or is stabilized by a trench box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand. In a trench stabilized by a trench box, the void left after the removal of the box will be filled by the backfill. It is necessary to backfill this sector with sand, and the compacted backfill must be flooded for 1 day, prior to the placement of the backfill above this sector, i.e., in the upper

sloped trench section. This measure is necessary in order to prevent consolidation of inadvertent voids and loose backfill which will compromise the compaction of the backfill in the upper section. In areas where groundwater movement is expected in the sand fill mantle, anti-seepage collars should be provided.

## 6.5 <u>Garages, Driveways, Interlocking Stone Pavement and Landscaping</u>

Due to the high frost susceptibility nature of the underlying soils, heaving of the pavement is expected to occur during the cold weather. The driveways at the entrances to the garages should be backfilled with non-frost-susceptible granular material, with a frost taper at a slope of 1 vertical:1 horizontal.

The garage floor slab and interior garage foundation walls must be insulated with 50-mm Styrofoam, or equivalent.

Interlocking stone pavement and concrete sidewalk in areas which are sensitive to frost-induced ground movement, such as in front of building entrances, must be constructed on a free-draining non-frost-susceptible granular material such as Granular ‘B’. The material must extend to 0.3 to 1.2 m below the slab or pavement surface, depending on the degree of tolerance for ground movement, and be provided with positive drainage such as weeper subdrains connected to manholes or catch basins. Alternatively, the interlocking stone pavement should be properly insulated with 50-mm Styrofoam, or equivalent.

The grading around structures must be such that it directs runoff away from the structures.

## 6.6 Pavement Design

Knowing that the predominant subsoil at the site consists of clay or clay till, the recommended pavement design for Mississauga Road (classified as a major collector road) and Thorny Brae Place (classified as a minor residential road) are presented in Table 4.

**Table 4 -** Pavement Design

| Course | Thickness (mm) | OPS Specifications |
|---|---|---|
| Asphalt Surface | 40 | HL-3 |
| Asphalt Binder | | |
| Minor Residential | 85 | HL-8 |
| Major Collector | 100 | |
| Granular Base | | |
| Minor Residential | 150 | 20-mm Crusher-Run Limestone or equivalent |
| Major Collector | 200 | |
| Granular Sub-base | 400 | 50-mm Crusher-Run Limestone or equivalent |

Subsequent to service installation on Mississauga Road, the roadway must be restored to either the original thicknesses or to the recommended design noted in the above table. The existing pavement structure, with a total asphalt thickness of 150 mm and granular thickness of 460 mm, is inferred to have the breakdown presented in Table 5. However, these depths should be further confirmed during construction.

**Table 5 -** Existing Pavement Thicknesses at Mississauga Road

| Course | Thickness (mm) | OPS Specifications |
|---|---|---|
| Asphalt Surface | 50 | HL-3 |
| Asphalt Binder | 100 | HL-8 |
| Granular Base | 200 | 20-mm Crusher-Run Limestone or equivalent |
| Granular Sub-base | 260 | 50-mm Crusher-Run Limestone or equivalent |

Where the new pavement configuration differs from the existing road condition, a 1V:3H + taper should be provided to transition between the new and the existing pavement layers.

The granular bases should be compacted to 100% of their maximum Standard Proctor dry density.

In preparation of the subgrade, the topsoil/topsoil fill must be stripped, and the subgrade surface must be proof-rolled. Any soft subgrade, organics, deleterious materials and foreign matter should be subexcavated and replaced by properly compacted, organic-free earth fill or granular material. In the zone within 1.0 m below the pavement subgrade, the backfill should be compacted to at least 98% of its maximum Standard Proctor dry density, with the water content 2% to 3% drier than the optimum. In the lower zone, a 95% or + Standard Proctor compaction is considered adequate.

The pavement subgrade will suffer a strength regression if water is allowed to saturate the mantle. The following measures should, therefore, be incorporated in the construction procedures and pavement design:

- If the pavement construction does not immediately follow the trench backfilling, the subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained.
- Areas adjacent to the pavement should be properly graded to prevent ponding of large amounts of water during the interim construction period.
- Curb subdrains will be required. The subdrains should consist of filter-sleeved weepers to prevent blockage by silting.
- If the pavement is to be constructed during wet seasons and extensively soft subgrade occurs, the granular sub-base should be thickened in order to compensate for the inadequate strength of the subgrade. This can be assessed during construction.

In order to prevent infiltrated precipitation from seeping into the granular bases, since this may inflict frost damage on the pavement, a swale or an intercept subdrain system should be installed along the perimeter where surface runoff may drain onto the pavement. In the paved areas, catch basins should be provided; they should be backfilled with free-draining granular material such as Granular ‘B’. The invert of the subdrains should be at least 0.3 m beneath the underside of the granular sub-base and should be backfilled with free-draining granular material.

## 6.7 **Slope Stability Study**

At the time of report preparation, detailed topographic information of the valley bank at the rear of the subject site was not available for review. A slope stability study addendum will be provided at a later date upon receiving the necessary contour information.

## 6.8 Soil Parameters

The recommended soil parameters for the project design are given in Table 6.

**Table 6 -** Soil Parameters

| **Unit Weight and Bulk Factor** | **Unit Weight (kN/m$^3$)** | **Estimated Bulk Factor** | |
|---|---|---|---|
| | **Bulk** | **Loose** | **Compacted** |
| Earth (Clay) Fill | 21.0 | 1.20 | 0.98 |
| Silty Clay Till | 22.0 | 1.33 | 1.05 |
| Silty Clay | 20.5 | 1.30 | 0.98 |
| Weathered Shale Bedrock | 24.0 | 1.50 | 1.10 |
| **Lateral Earth Pressure Coefficients** | **Active $K_a$** | **At Rest $K_o$** | **Passive $K_p$** |
| Compacted Earth Fill, Silty Clay Till and Silty Clay | 0.40 | 0.58 | 2.50 |
| Weathered Shale | 0.25 | 0.40 | 4.00 |
| **Maximum Allowable Soil Pressure (SLS) For Thrust Block Design** | | | |
| Sound Natural Soils | | 75 kPa | |
| **Coefficients of Friction** | | | |
| Between Concrete and Granular Base | | 0.60 | |
| Between Concrete and Sound Natural Soils | | 0.40 | |

## 6.9 Excavation

**Where the underground services are to be cut close to any existing underground services, one must be aware that the backfill for the existing underground services**

**is amorphous in structure, and is susceptible to sloughing and sudden side collapse. Extreme caution must be exercised when excavating the existing backfilled services trenches; the sides of the cuts in the backfill will readily slough and may collapse suddenly. The existing services must be properly secured for the new service construction. The stability of the new trench and the existing services must be ensured by flattening the slope of the cut, or by shoring or by a trench box.**

Excavation should be carried out in accordance with Ontario Regulation 213/91. For excavation purposes, the types of soils are classified in Table 7.

**Table 7 -** Classification of Soils for Excavation

| Material | Type |
|---|---|
| Sound Shale Bedrock | 1 |
| Sound Tills and Weathered Shale | 2 |
| Existing Earth Fill | 3 |

The yield of groundwater in excavation is expected to be small and limited in quantity which will likely be controllable by pumping from sumps.

In some places, the fissures of the weathered shale contain pockets of groundwater which may sometimes be under moderate artesian pressure. Upon release through excavation, this water is expected to drain readily with continuous pumping from sumps.

The lower layer of the till appears to be a reversion. This soil and the weathered shale will require extra effort for excavation using mechanical means and a rock-ripper will be required to facilitate the excavation. This method can generally be employed to excavate the weathered shale to depths of 2 to 3 m below the bedrock surface.

Excavation into the sound shale can be carried out by a heavy-duty backhoe equipped with a pneumatic chisel. Shale debris larger than 15 cm in size is not suitable for structural backfill.

In the shale bedrock, a cut steeper than 1 vertical:1 horizontal may be allowed, provided the bedding plane of the rock is horizontal. Loose rock protruding from the excavation should be removed for safety.

Prospective contractors should assess the in situ subsurface conditions for soil cuts by digging test pits to at least 0.5 m below the intended bottom of excavation prior to excavating. These test pits should be allowed to remain open for a period of at least 4 hours to assess the trenching conditions.

## 7.0 LIMITATIONS OF REPORT

This report deals with a study of the geotechnical aspects of the proposed project. It was prepared by Soil Engineers Ltd. for the account of 2462357 Ontario Inc. and for review by its designated consultants and government agencies. Use of the report is subject to the conditions and limitations of the contractual agreement. The material in the report reflects the judgement of Hui Wing Yang, B.A.Sc., and Bennett Sun, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

**SOIL ENGINEERS LTD.**

Hui Wing Yang, B.A.Sc.

Bennett Sun, P.Eng.
HWY/BS:dd

LICENSED PROFESSIONAL ENGINEER
CHUN C. B. SUN
Oct 24.2016
PROVINCE OF ONTARIO

# LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

## SAMPLE TYPES

| | |
|---|---|
| AS | Auger sample |
| CS | Chunk sample |
| DO | Drive open (split spoon) |
| DS | Denison type sample |
| FS | Foil sample |
| RC | Rock core (with size and percentage recovery) |
| ST | Slotted tube |
| TO | Thin-walled, open |
| TP | Thin-walled, piston |
| WS | Wash sample |

## PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—●—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

| | |
|---|---|
| WH | Sampler advanced by static weight |
| PH | Sampler advanced by hydraulic pressure |
| PM | Sampler advanced by manual pressure |
| NP | No penetration |

## SOIL DESCRIPTION

Cohesionless Soils:

| 'N' (blows/ft) | Relative Density |
|---|---|
| 0 to 4 | very loose |
| 4 to 10 | loose |
| 10 to 30 | compact |
| 30 to 50 | dense |
| over 50 | very dense |

Cohesive Soils:

| Undrained Shear Strength (ksf) | 'N' (blows/ft) | Consistency |
|---|---|---|
| less than 0.25 | 0 to 2 | very soft |
| 0.25 to 0.50 | 2 to 4 | soft |
| 0.50 to 1.0 | 4 to 8 | firm |
| 1.0 to 2.0 | 8 to 16 | stiff |
| 2.0 to 4.0 | 16 to 32 | very stiff |
| over 4.0 | over 32 | hard |

Method of Determination of Undrained Shear Strength of Cohesive Soils:

| | |
|---|---|
| x 0.0 | Field vane test in borehole; the number denotes the sensitivity to remoulding |
| △ | Laboratory vane test |
| □ | Compression test in laboratory |

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

## METRIC CONVERSION FACTORS

1 ft = 0.3048 metres
1lb = 0.454 kg
1 inch = 25.4 mm
1ksf = 47.88 kPa

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GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 1

**Figure No.:** 1

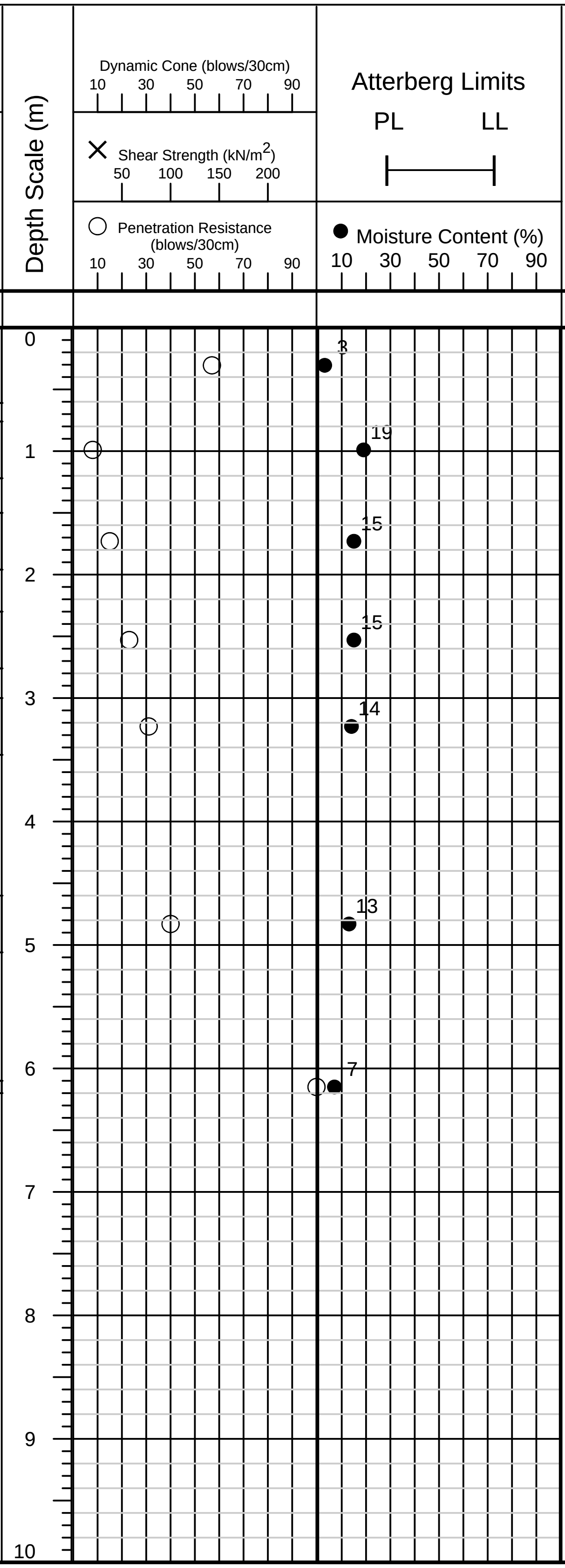
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** September 9, 2016

| Elev. (m) Depth (m) | SOIL DESCRIPTION | SAMPLES | | | Water Level |
|---|---|---|---|---|---|
| | | Number | Type | N-Value | |
| 145.5 | Pavement Surface | | | | |
| 0.0 | **150 mm ASPHALTIC CONCRETE**<br>**460 mm GRANULAR, Fill**<br>some silt | 1 | DO | 57 | |
| 144.9<br>0.6 | Brown/grey<br>**EARTH, Fill** tr. organics<br>silty clay material | 2 | DO | 8 | |
| | | 3 | DO | 15 | |
| 143.4<br>2.1 | Brown, very stiff to hard<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 4 | DO | 23 | |
| | | 5 | DO | 31 | |
| | | 6 | DO | 40 | |
| 139.9<br>5.6 | Grey, weathered<br>**SHALE BEDROCK** | 7 | DO | 50/13 | Dry on completion |
| 139.3<br>6.2 | END OF BOREHOLE | | | | |



**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 2

**Figure No.:** 2

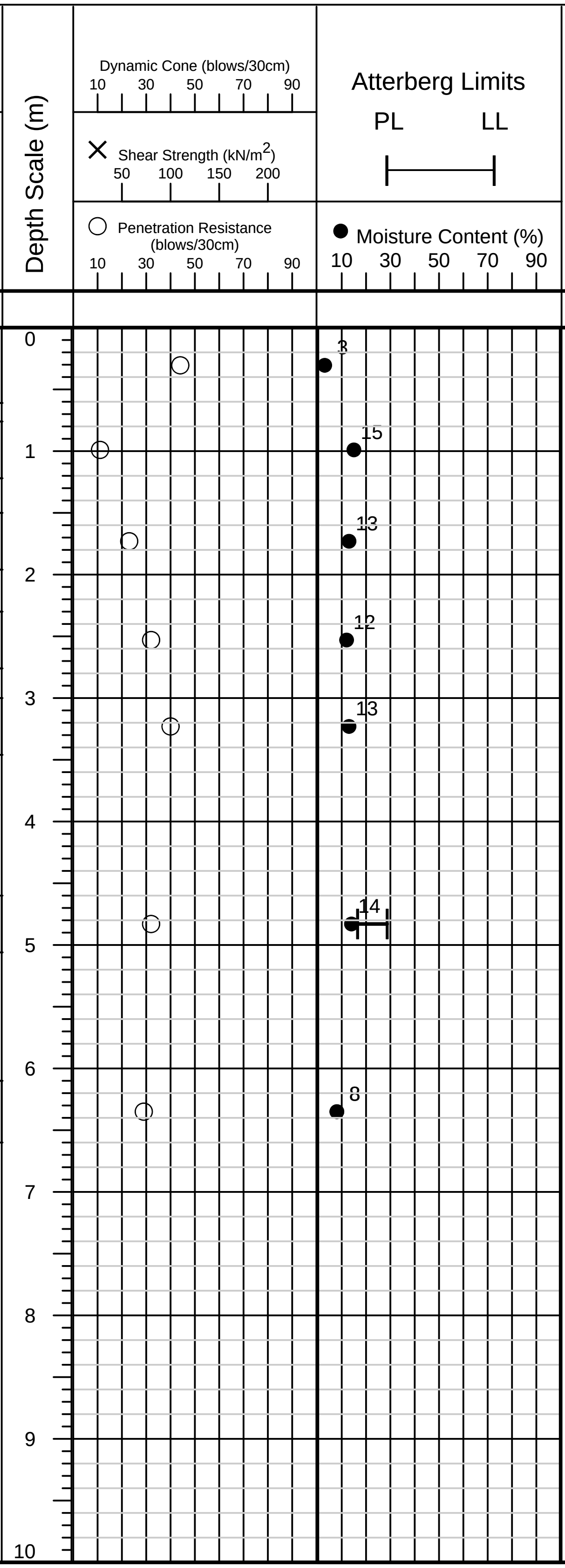
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** September 9, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | SAMPLES Type | SAMPLES N-Value |
|---|---|---|---|---|
| 146.3 | Pavement Surface | | | |
| 0.0 | **150 mm ASPHALTIC CONCRETE**<br>**460 mm GRANULAR, Fill** | 1 | DO | 44 |
| 145.7<br>0.6 | Brown<br>**EARTH, Fill**<br>silty clay and sand fill | 2 | DO | 11 |
| 145.1<br>1.2 | Brown, very stiff to hard<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 3 | DO | 23 |
| | | 4 | DO | 32 |
| | | 5 | DO | 40 |
| | brown<br>grey | 6 | DO | 32 |
| | reverted shale | 7 | DO | 29 |
| 139.7<br>6.6 | END OF BOREHOLE | | | |



**Water Level**

Dry on completion

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**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 3

**Figure No.:** 3

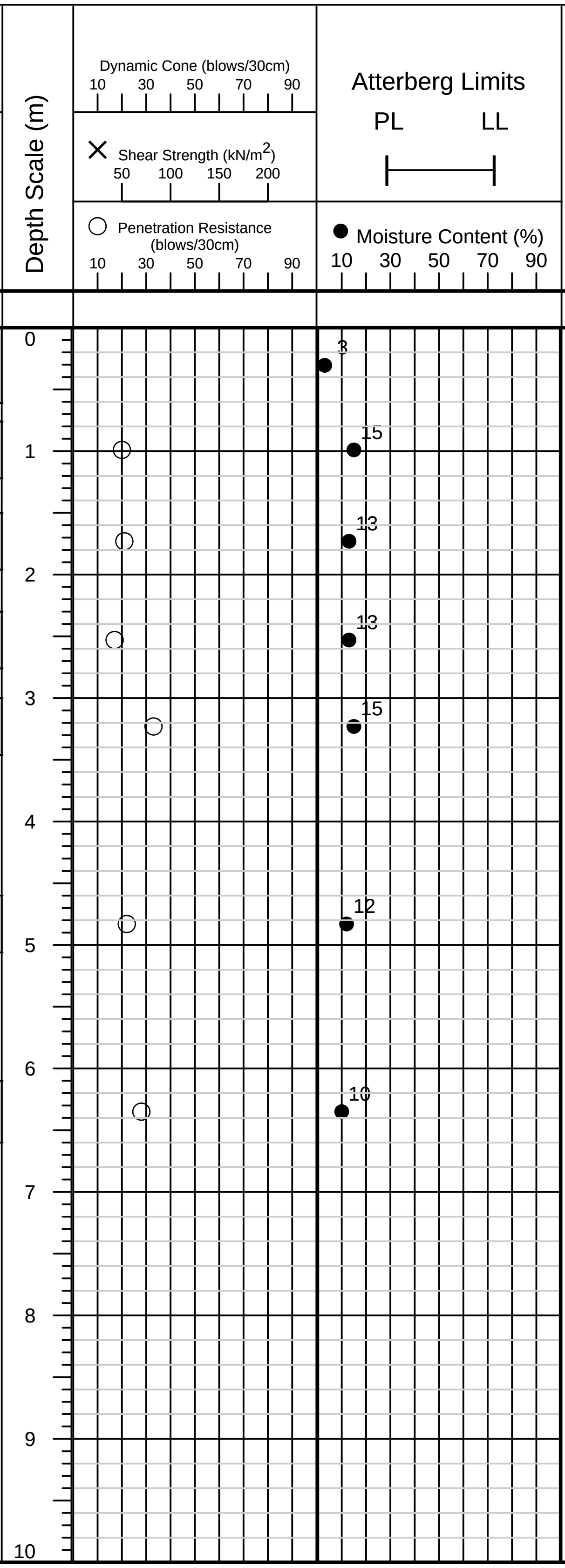
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** September 9, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Water Level |
|---|---|---|---|---|---|
| 147.4 | Pavement Surface | | | | |
| 0.0 | **150 mm ASPHALTIC CONCRETE**<br>**460 mm GRANULAR, Fill**<br>some silt | 1 | DO | - | |
| 146.8<br>0.6 | Brown<br>**EARTH, Fill**<br>silty clay | 2 | DO | 20 | |
| 146.5<br>0.9 | Very stiff to hard<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 3 | DO | 21 | |
| | | 4 | DO | 17 | |
| | | 5 | DO | 33 | |
| | brown<br>grey | | | | |
| | | 6 | DO | 22 | |
| | | 7 | DO | 28 | Dry on completion |
| 140.8<br>6.6 | END OF BOREHOLE | | | | |



**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 4

**Figure No.:** 4

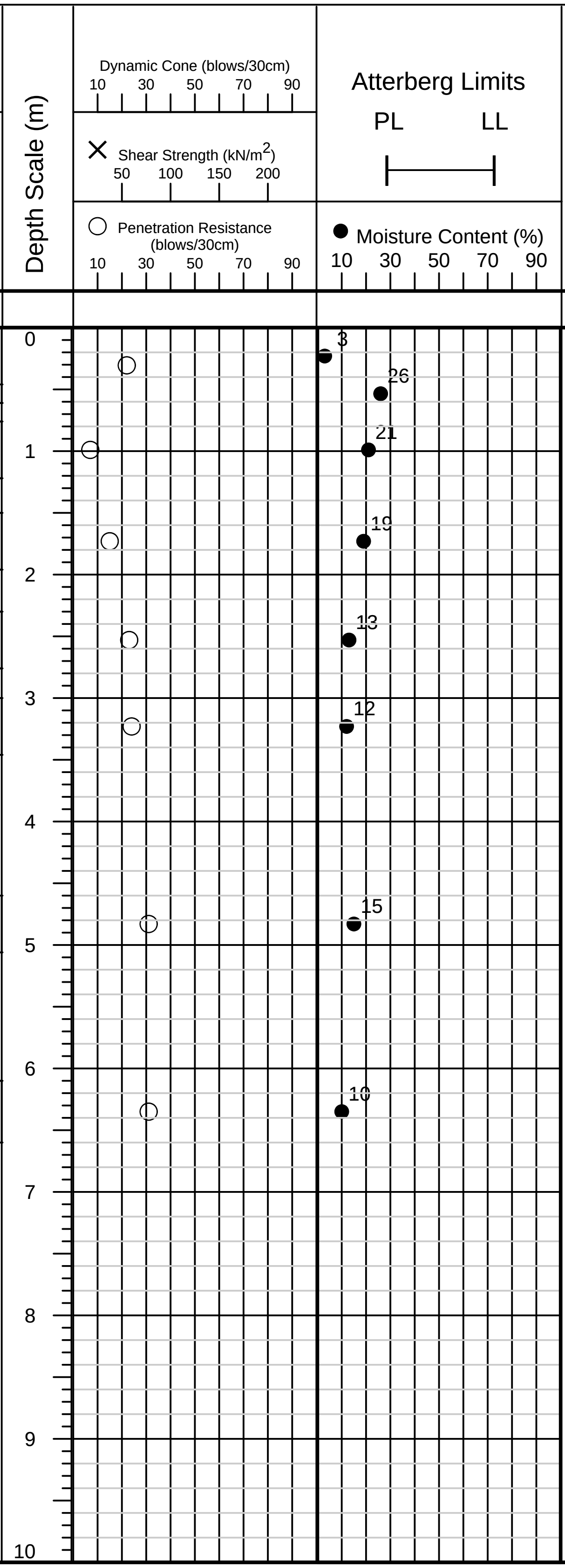
**Project Description:** Proposed Residential Development

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Method of Boring:** Flight-Auger (Solid-Stem)

**Drilling Date:** September 9, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value |
|---|---|---|---|---|
| 147.5 | Pavement Surface | | | |
| 0.0 | **150 mm ASPHALTIC CONCRETE**<br>**310 mm GRANULAR, Fill**<br>a trace of silt | 1A | DO | 22 |
| 147.0<br>0.5 | Brown<br>**EARTH, Fill**<br>silty clay | 1B | | |
| 146.7<br>0.8 | Brown, firm to stiff<br>**SILTY CLAY**<br>with silt layers<br>occ. gravel and sand lenses | 2 | DO | 7 |
| | | 3 | DO | 15 |
| 145.4<br>2.1 | Very stiff<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 4 | DO | 23 |
| | | 5 | DO | 24 |
| | brown<br>grey | 6 | DO | 31 |
| | | 7 | DO | 31 |
| 140.9<br>6.6 | END OF BOREHOLE | | | |



Water Level

Dry on completion

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**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 5

**Figure No.:** 5

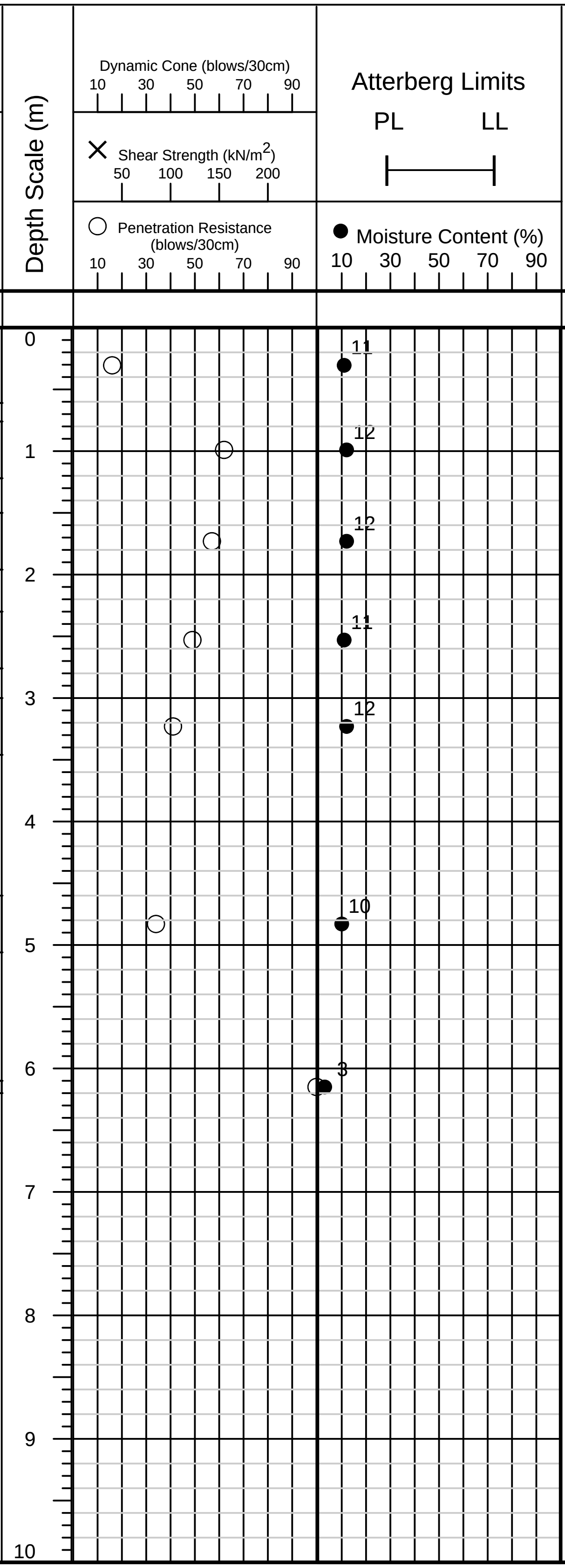
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** August 30, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Water Level |
|---|---|---|---|---|---|
| 147.1 | Ground Surface | | | | |
| 0.0 | **13 cm TOPSOIL** | | | | |
| | Brown, stiff to hard<br>**SILTY CLAY**<br>occ. silt layers<br>weathered | 1 | DO | 16 | |
| | | 2 | DO | 62 | |
| 145.7<br>1.4 | Hard<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 3 | DO | 57 | |
| | | 4 | DO | 49 | |
| | | 5 | DO | 41 | |
| | brown<br>grey | | | | |
| | | 6 | DO | 34 | |
| 141.5<br>5.6 | Grey, weathered<br>**SHALE BEDROCK** | | | | Dry on completion |
| 140.9 | | 7 | DO | 50/15 | |
| 6.2 | END OF BOREHOLE | | | | |



**SOIL ENGINEERS LTD.**

**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 6

**Figure No.:** 6

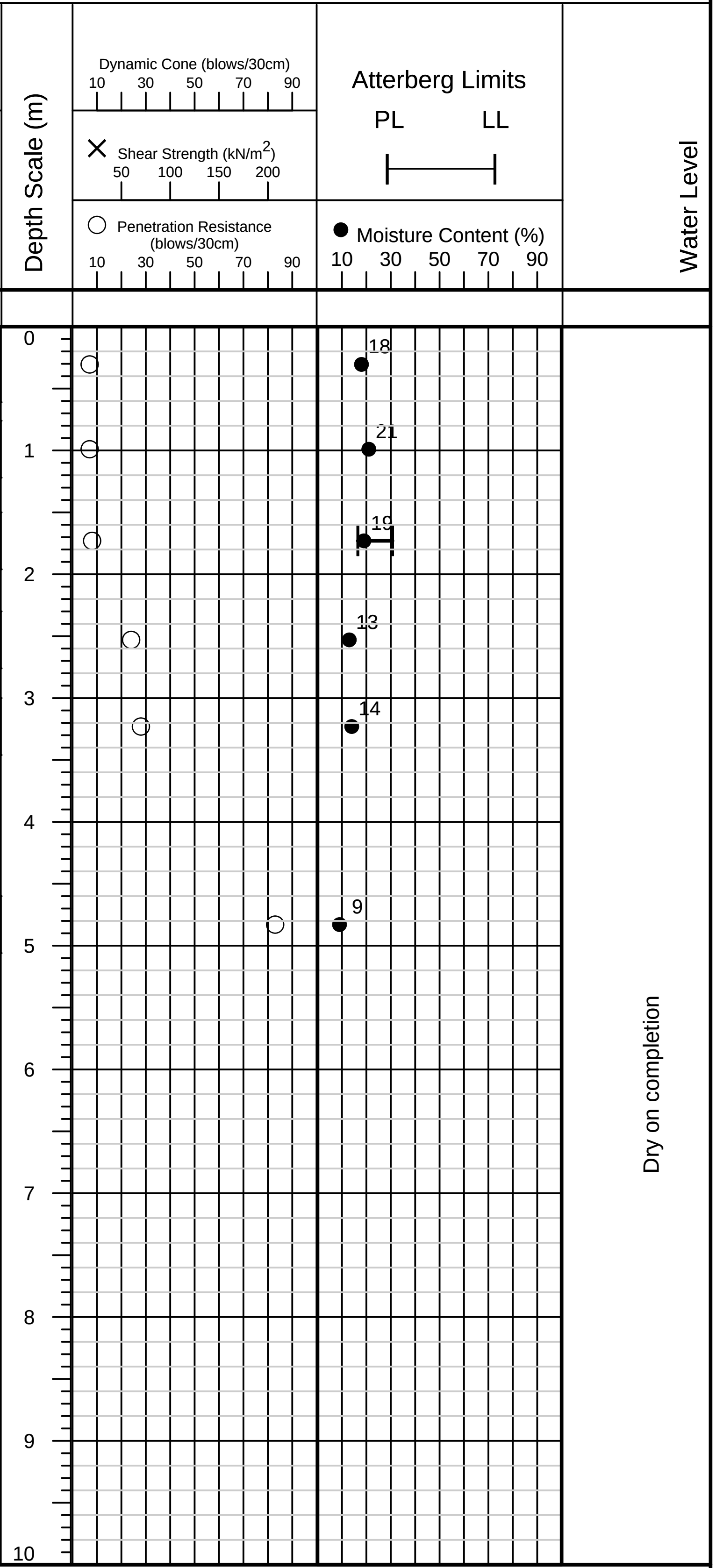
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** September 9, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value |
|---|---|---|---|---|
| 146.8 | Pavement Surface | | | |
| 146.7 | **50 mm ASPHALTIC CONCRETE** | | | |
| 146.6 | **50 mm GRANULAR, Fill** | | | |
| 0.2 | **100 mm ASPHALTIC CONCRETE** | 1 | DO | 7 |
| 146.0<br>0.8 | Dark-brown/grey **EARTH, Fill** silty clay, discoloured | 2 | DO | 7 |
| | Brown, firm **SILTY CLAY** a trace of sand occ. silt layers | 3 | DO | 8 |
| 144.7<br>2.1 | Very stiff to hard **SILTY CLAY, Till** sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders | 4 | DO | 24 |
| | | 5 | DO | 28 |
| | brown<br>grey<br>boulder | 6 | DO | 83 |
| 141.5<br>5.3 | END OF BOREHOLE<br>Refusal to augering on probable bedrock or boulder | | | |



**SOIL ENGINEERS LTD.**

**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 7

**Figure No.:** 7

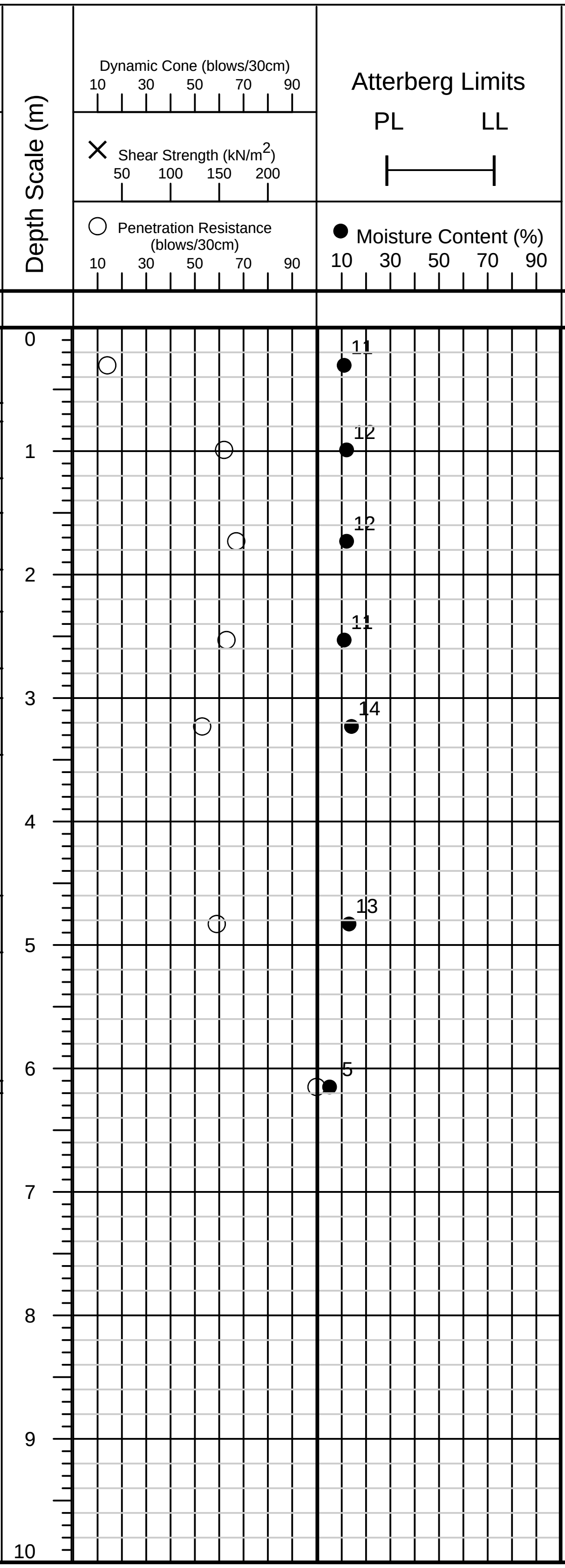
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** August 30, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value |
|---|---|---|---|---|
| 147.3 | Ground Surface | | | |
| 0.0 | **10 cm TOPSOIL, Fill**<br>Brown<br>**EARTH, Fill**<br>silty clay, a trace to some gravel | 1 | DO | 14 |
| 146.5<br>0.8 | Brown, hard weathered<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 2 | DO | 62 |
| | | 3 | DO | 67 |
| | | 4 | DO | 63 |
| | | 5 | DO | 53 |
| | | 6 | DO | 59 |
| 141.7<br>5.6 | Grey, weathered<br>**SHALE BEDROCK** | 7 | DO | 50/8 |
| 141.1<br>6.2 | END OF BOREHOLE | | | |



Water Level: Dry on completion

**SOIL ENGINEERS LTD.**

**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 8

**Figure No.:** 8

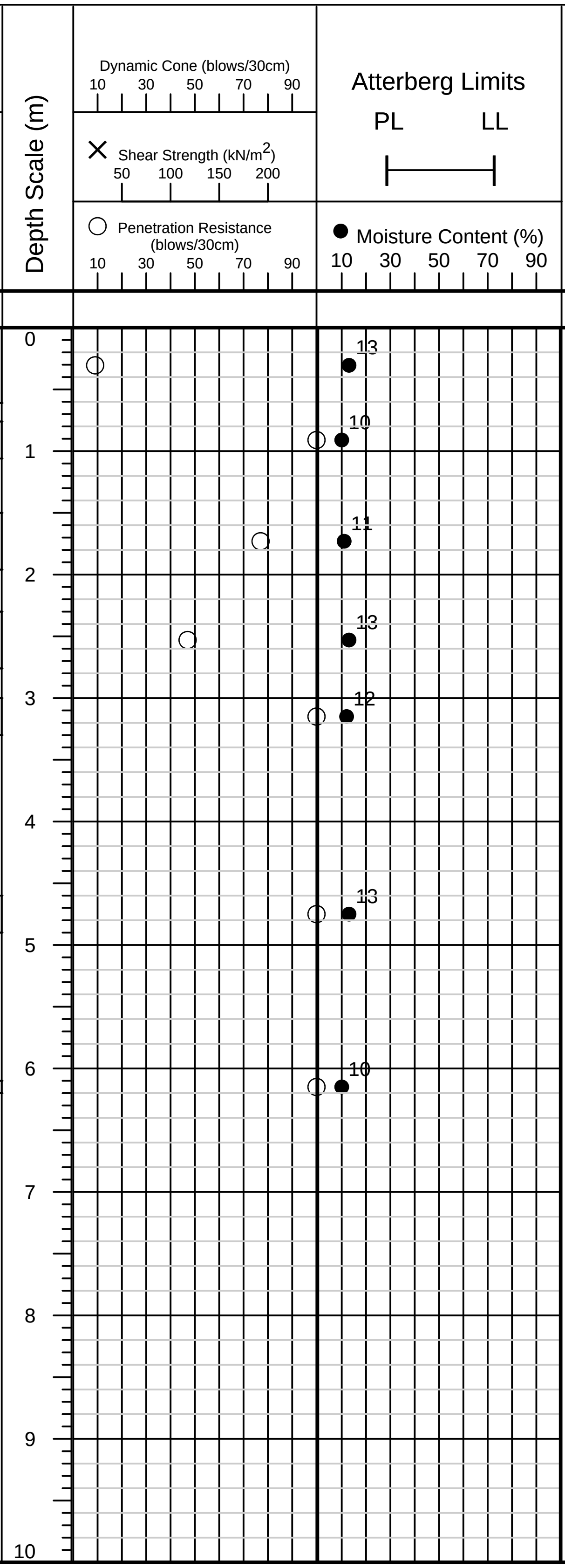
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** August 30, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Water Level |
|---|---|---|---|---|---|
| 148.2 | Ground Surface | | | | |
| 0.0 | **15 cm TOPSOIL, Fill**<br>Brown<br>**EARTH, Fill**<br>silty clay, occ. organics | 1 | DO | 9 | |
| 147.4<br>0.8 | Brown, hard<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 2 | DO | 50/5 | |
| | | 3 | DO | 77 | |
| | | 4 | DO | 47 | |
| | | 5 | DO | 50/13 | |
| | | 6 | DO | 50/10 | |
| | | 7 | DO | 50/13 | Dry on completion |
| 142.0<br>6.2 | END OF BOREHOLE | | | | |



**SOIL ENGINEERS LTD.**

**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 9

**Figure No.:** 9

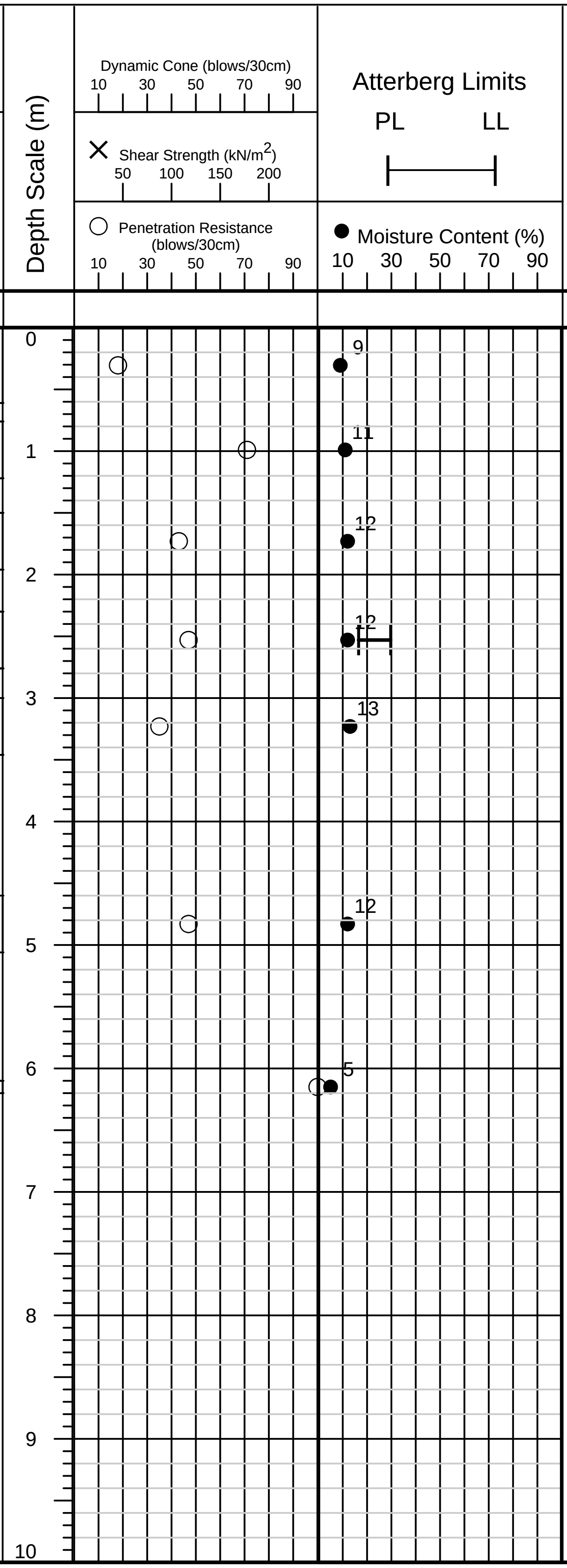
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** August 30, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Water Level |
|---|---|---|---|---|---|
| 148.0 | Ground Surface | | | | |
| 0.0 | **13 cm TOPSOIL, Fill**<br>Brown<br>**EARTH, Fill**<br>silty clay<br>occ. topsoil inclusions and roots | 1 | DO | 18 | |
| 147.2<br>0.8 | weathered<br>Brown, hard<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 2 | DO | 71 | |
| | | 3 | DO | 43 | |
| | | 4 | DO | 47 | |
| | | 5 | DO | 35 | |
| | | 6 | DO | 47 | |
| 142.4<br>5.6 | Grey, weathered<br>**SHALE BEDROCK** | 7 | DO | 50/8 | Dry on completion |
| 141.8<br>6.2 | END OF BOREHOLE | | | | |



**SOIL ENGINEERS LTD.**

**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 10

**Figure No.:** 10

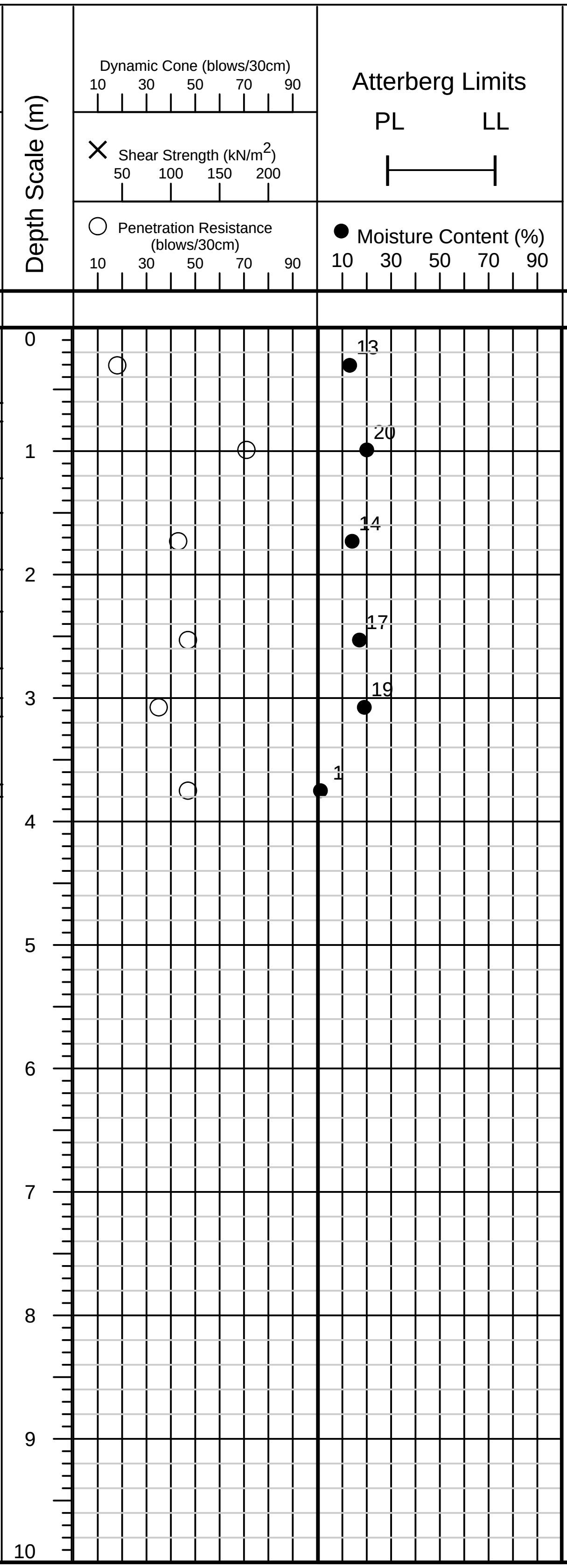
**Project Description:** Proposed Residential Development

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Method of Boring:** Flight-Auger (Solid-Stem)

**Drilling Date:** August 30, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Water Level |
|---|---|---|---|---|---|
| 143.8 | Ground Surface | | | | |
| 0.0 | **10 cm TOPSOIL** | | | | Dry on completion |
| | Brown, stiff to hard<br>**SILTY CLAY, Till**<br>weathered<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders | 1 | DO | 14 | |
| | | 2 | DO | 18 | |
| | | 3 | DO | 28 | |
| | | 4 | DO | 19 | |
| | | 5 | DO | 50/5 | |
| 140.1<br>140.0<br>3.7 | Grey, weathered<br>**SHALE BEDROCK** | 6 | DO | 50/5 | |
| 3.8 | END OF BOREHOLE | | | | |



**SOIL ENGINEERS LTD.**

**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 11

**Figure No.:** 11

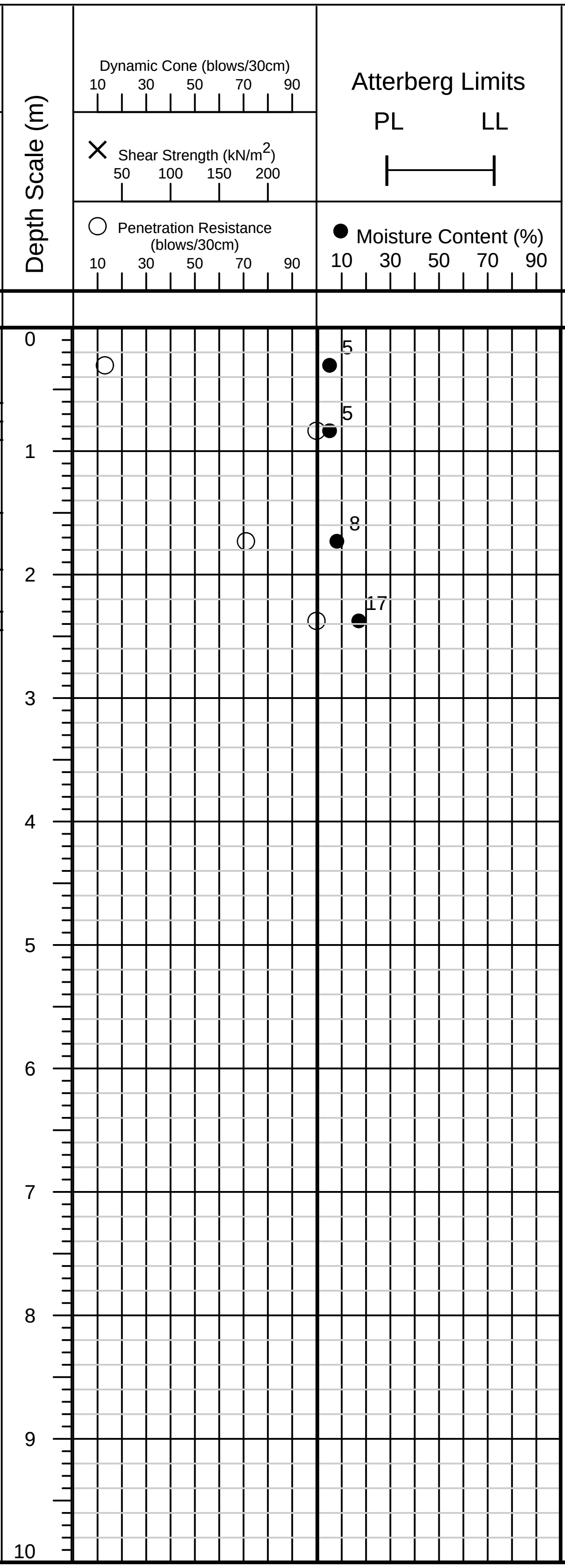
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** August 30, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value |
|---|---|---|---|---|
| 142.9 | Ground Surface | | | |
| 0.0 | **15 cm TOPSOIL, Fill** | | | |
| | Brown<br>**EARTH, Fill**<br>silty sand/sandy silt, some gravel<br>occ. cobbles | 1 | DO | 13 |
| | | 2 | DO | 50/3 |
| 141.5<br>1.4 | Brown, hard<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel<br>occ. sand and silt seams and layers, cobbles and boulders<br>some shale fragments | 3 | DO | 71 |
| | | 4 | DO | 50/13 |
| 139.9<br>3.0 | END OF BOREHOLE<br>Refusal to augering on probable bedrock or boulder | | | |



Water Level

Dry on completion

**SOIL ENGINEERS LTD.**

**Job Number:** 1608-S094

# LOG OF BOREHOLE NO.: 12

**Figure No.:** 12

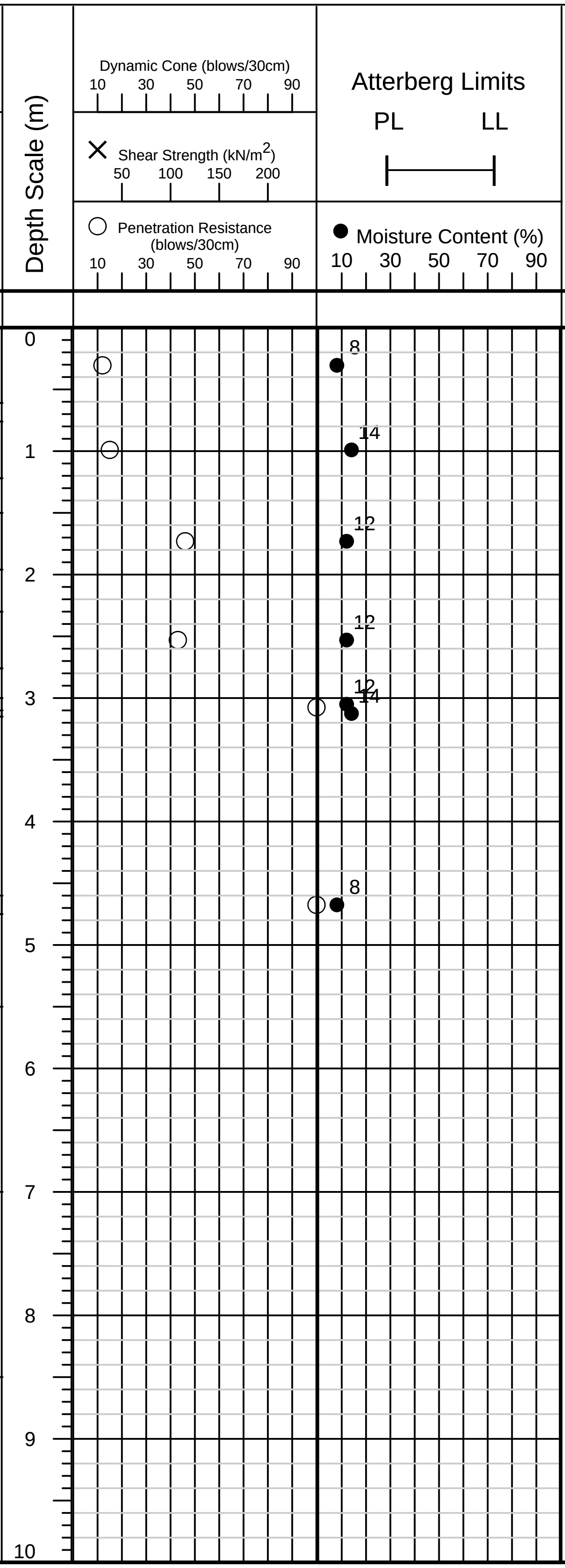
**Project Description:** Proposed Residential Development

**Method of Boring:** Flight-Auger (Solid-Stem)

**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Drilling Date:** August 31, 2016

| Elev. (m)<br>Depth (m) | SOIL DESCRIPTION | SAMPLES Number | Type | N-Value | Water Level |
|---|---|---|---|---|---|
| 145.7 | Ground Surface | | | | |
| 0.0 | **13 cm TOPSOIL, Fill**<br>Brown **EARTH, Fill** silty clay, occ. roots | 1 | DO | 12 | |
| 145.2<br>0.5 | Brown, hard<br>**SILTY CLAY, Till**<br>sandy, a trace of gravel occ. sand and silt seams and layers, cobbles and boulders | 2<br>3<br>4<br>5A<br>5B<br>6 | DO<br>DO<br>DO<br>DO<br><br>DO | 15<br>46<br>43<br>50/15<br><br>50/8 | |
| 140.2<br>5.5 | END OF BOREHOLE<br>Refusal to Augering<br>Grey, weathered<br>**SHALE BEDROCK** | 7<br>8 | RC RQD<br>RC RQD | 53% 0%<br>95% 9.2% | Dry on completion |
| 137.2<br>8.5 | END OF ROCK CORE | | | | |



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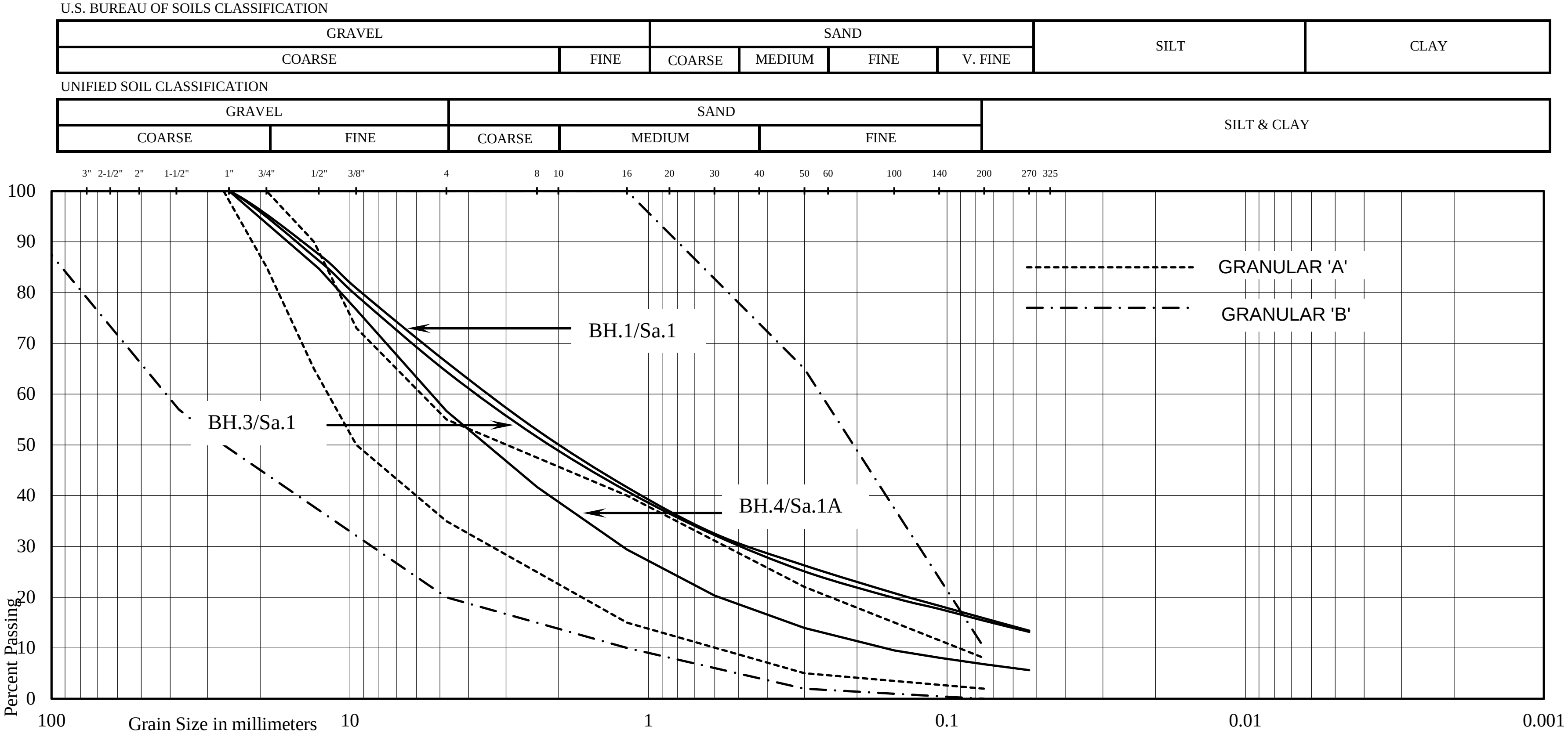
# GRAIN SIZE DISTRIBUTION

Reference No: 1608-S094



|  |  |  |  |
|---|---|---|---|
| BH./Sa. | 1/1 | 3/1 | 4/1A |
| Liquid Limit (%) = | - | - | - |
| Plastic Limit (%) = | - | - | - |
| Plasticity Index (%) = | - | - | - |
| Moisture Content (%) = | 3 | 3 | 3 |
| Estimated Permeability (cm./sec.) = | $10^{-3}$ | $10^{-3}$ | $10^{-2}$ |

Project: Proposed Residential Development

Location: 17456, 1765 and 1775 Thorny Brae Place, City of Mississauga

|  |  |  |  |
|---|---|---|---|
| Borehole No: | 1 | 3 | 4 |
| Sample No: | 1 | 1 | 1A |
| Depth (m): | 0.3 | 0.3 | 0.3 |
| Elevation (m): | 145.2 | 147.1 | 147.2 |

Classification of Sample [& Group Symbol]: GRANULAR, Fill
a tr. to some silt

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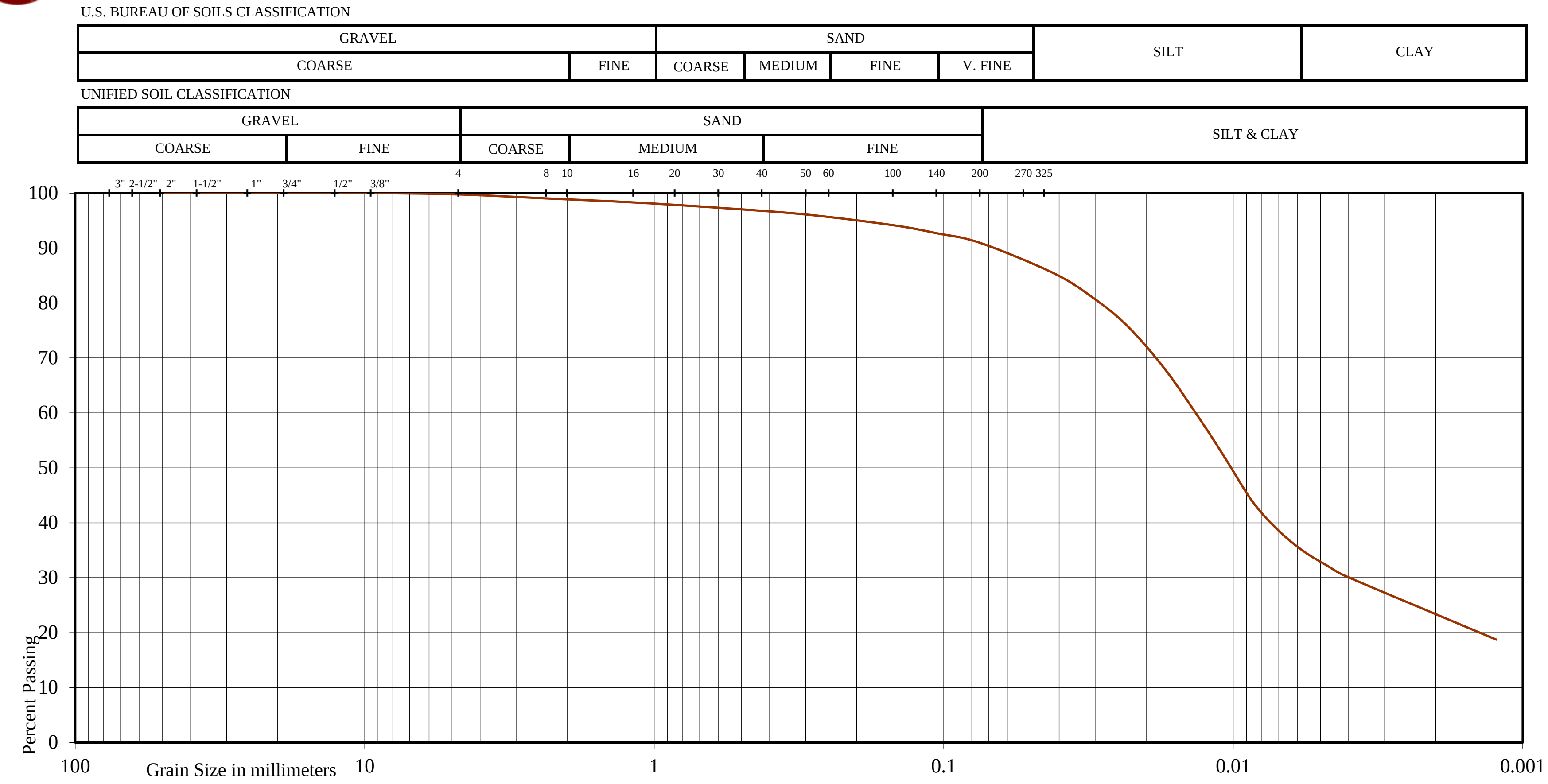
# GRAIN SIZE DISTRIBUTION

Reference No: 1608-S094



Project: Proposed Residential Development

Location: 17456, 1765 and 1775 Thorny Brae Place, City of Mississauga

Liquid Limit (%) = 31

Plastic Limit (%) = 17

Borehole No: 6

Plasticity Index (%) = 14

Sample No: 3

Moisture Content (%) = 19

Depth (m): 1.7

Estimated Permeability

Elevation (m): 145.1

(cm./sec.) = $10^{-7}$

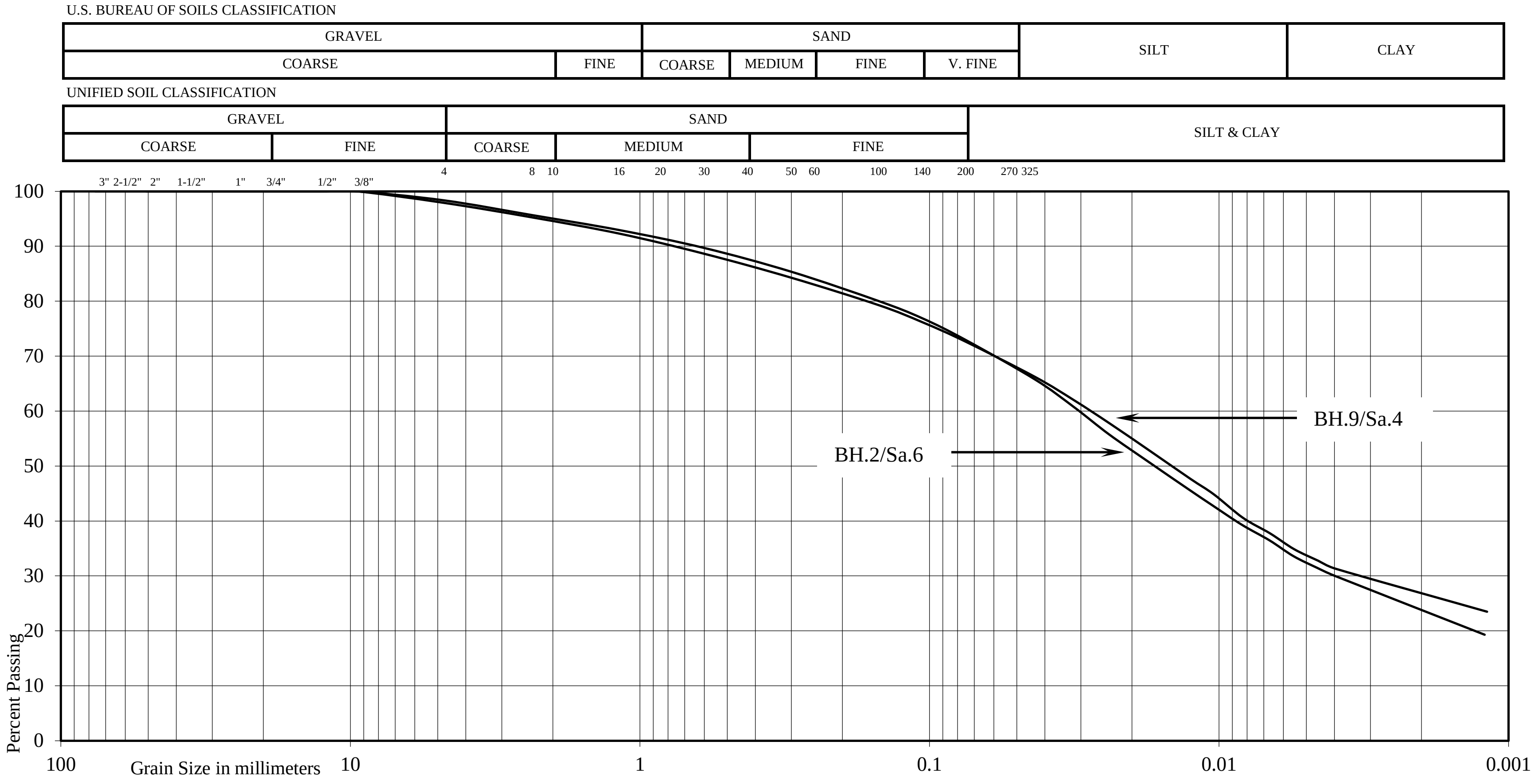
Classification of Sample [& Group Symbol]: SILTY CLAY

a tr. of sand

Figure: 14

# GRAIN SIZE DISTRIBUTION

Reference No: 1608-S094



Project: Proposed Residential Development

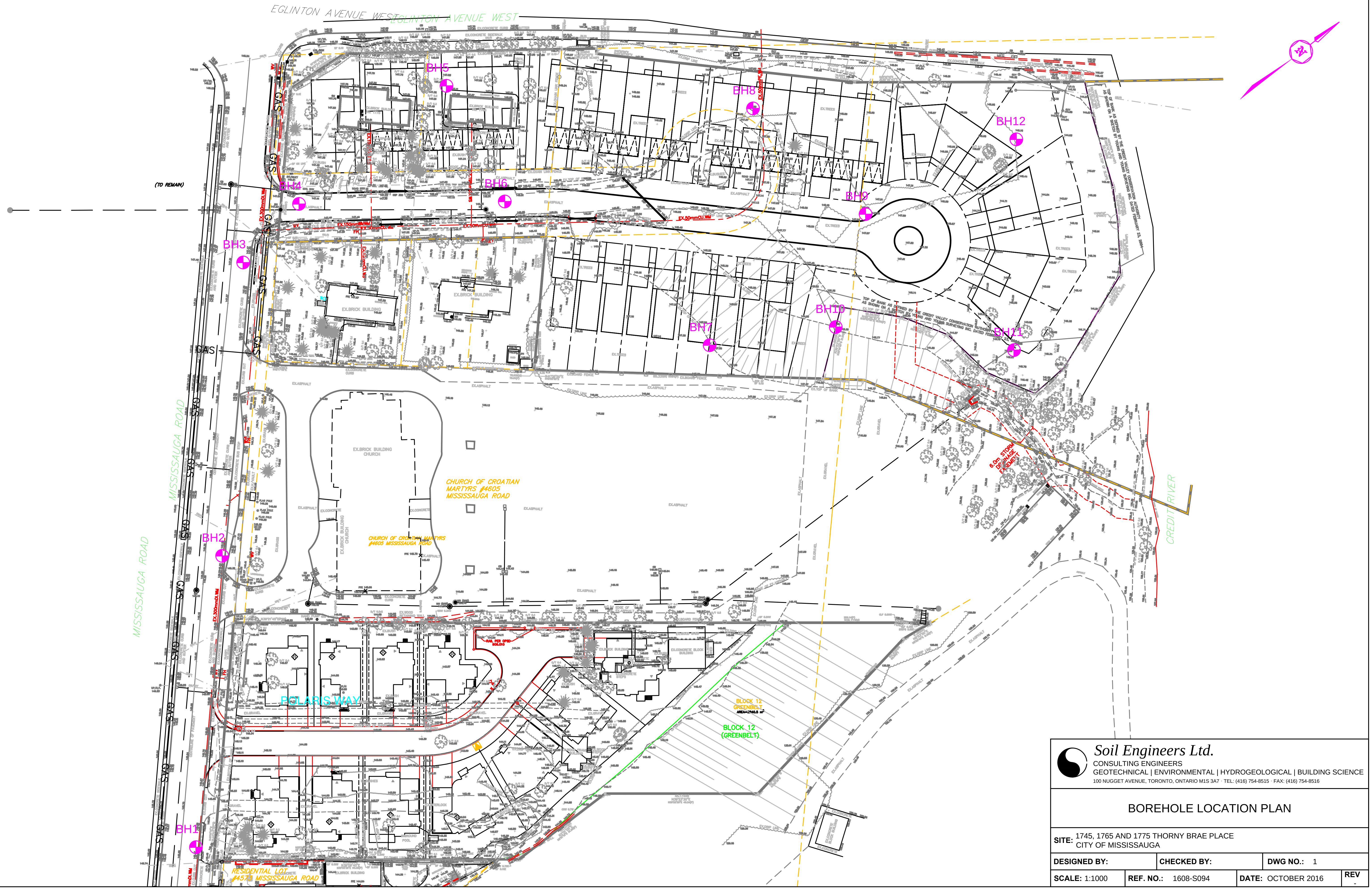
Location: 17456, 1765 and 1775 Thorny Brae Place, City of Mississauga

| | | |
|---|---|---|
| Borehole No: | 2 | 9 |
| Sample No: | 6 | 4 |
| Depth (m): | 4.8 | 2.5 |
| Elevation (m): | 141.5 | 145.5 |

| BH./Sa. | 2/6 | 9/4 |
|---|---|---|
| Liquid Limit (%) = | 29 | 30 |
| Plastic Limit (%) = | 17 | 17 |
| Plasticity Index (%) = | 12 | 13 |
| Moisture Content (%) = | 14 | 12 |
| Estimated Permeability (cm./sec.) = | $10^{-7}$ | $10^{-7}$ |

Classification of Sample [& Group Symbol]: SILTY CLAY, Till
sandy, a tr. of gravel

Figure: 15



**Soil Engineers Ltd.**
CONSULTING ENGINEERS
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE
100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 · TEL: (416) 754-8515 · FAX: (416) 754-8516

# BOREHOLE LOCATION PLAN

**SITE:** 1745, 1765 AND 1775 THORNY BRAE PLACE
CITY OF MISSISSAUGA

**DESIGNED BY:**
**CHECKED BY:**
**DWG NO.:** 1
**SCALE:** 1:1000
**REF. NO.:** 1608-S094
**DATE:** OCTOBER 2016
**REV** -

***Soil Engineers Ltd.***
CONSULTING ENGINEERS
**GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE**

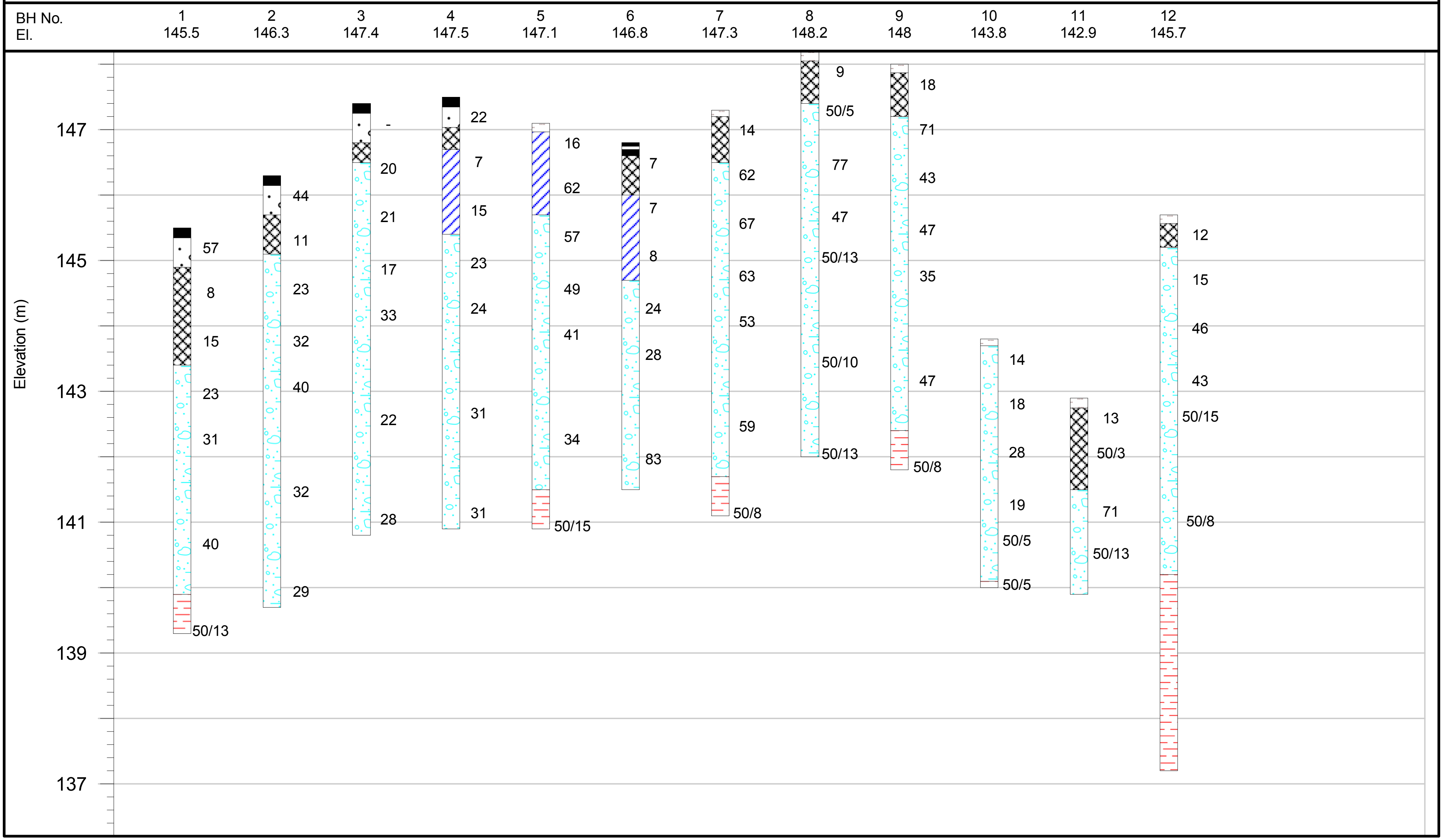
**Subsurface Profile**
**Drawing No. 2**
**Scale: As Shown**

**Job Number:** 1608-S094
**Report Date:** October 2016
**Job Location:** 1745, 1765 and 1775 Thorny Brae Place, City of Mississauga

**Project Description:** Proposed Residential Development

**Legend**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ▤ | TOPSOIL | ⁘ | GRANULAR | ▨ | SILTY CLAY | ☰ | SHALE |
| ■ | PAVEMENT | ▩ | FILL | ⁙ | SILTY CLAY TILL | | |



**Soil Engineers Ltd.**
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100 NUGGET AVENUE, TORONTO, ONTARIO M1S 3A7 • TEL: (416) 754-8515 • FAX: (416) 754-8516

| BARRIE | MISSISSAUGA | OSHAWA | NEWMARKET | GRAVENHURST | PETERBOROUGH | HAMILTON |
|---|---|---|---|---|---|---|
| TEL: (705) 721-7863 | TEL: (905) 542-7605 | TEL: (905) 440-2040 | TEL: (905) 853-0647 | TEL: (705) 684-4242 | TEL: (905) 440-2040 | TEL: (905) 777-7956 |
| FAX: (705) 721-7864 | FAX: (905) 542-2769 | FAX: (905) 725-1315 | FAX: (416) 754-8516 | FAX: (705) 684-8522 | FAX: (905) 725-1315 | FAX: (905) 542-2769 |

March 1, 2017 Reference No. 1608-S094
Page 1 of 3

2462357 Ontario Inc.
30 Wertheim Court
Building A, Unit 3
Richmond Hill, Ontario
L4B 1B9

Attention: Mr. Peter Sciavilla

**Re: Storm Sewer Outfall Opinion Letter**
**Proposed Residential Development**
**1745, 1765 and 1775 Thorny Brae Place**
**City of Mississauga**

Dear Sir:

Further to the Soil Report issued in October 2016 and the Slope Stability Study Addendum issued on December 22, 2016 for the captioned site, we have reviewed the comments sent out by the Credit Valley Conservation (CVC) regarding the proposed storm sewer outlet. We herein present our comments on the proposed design and construction of the outlet relating to geotechnical and/or slope stability issues.

## Storm Sewer Outlet

Based on the latest Structural Details drawing prepared by Cole Engineering, Drawing No. DD-02, it is understood that the proposed 750-mm Ø concrete storm pipe outlet will be installed through a new wing wall, constructed in place and connected to the existing headwall. The existing wing wall will therefore be saw-cut and removed. The gradient of the side slopes upstream and on either side of the headwall is approximately 1V:1.75H to 1V:2+H, which is considered geotechnically stable for use in shale bedrock and the silty clay overburden as discussed in the aforementioned Slope Stability Addendum. Furthermore, the alignment of the pipe will generally run along the bottom of the drainage trench or parallel to the gentler part of the channel rather than perpendicular to the side slopes, which further reduces its impact on the stability of the existing slope.

## Open Cut Construction

As shown on Drawing PP-03, the final stretch of the storm sewer pipe will be constructed by open cut excavation. Vertical trenching, with the use of temporary steel trench box extending to a maximum depth of 3 m, will be used in the installation of the service in the very stiff to hard silty clay till. Where the shoring structure is properly designed to sustain the lateral earth pressures, applicable surcharge and hydrostatic pressure, the proposed practice is deemed geotechnically acceptable and will pose minimal impact to the stability of the existing slope.

Based on the subsoil information from the nearby Boreholes 10 and 11, compacted or self consolidated earth fill may be encountered near the surface. A soil cut of 1V:1H above the trench box is generally acceptable in native clay till or compacted earth fill; however, where loose fill is encountered during construction, the cut must be flattened to 1V:1.5 or + H. The open cut excavation should be inspected by a geotechnical engineer during construction to verify the excavation requirements.

The finished gradient of the trench backfill must match the gradient of the existing slope profile or to 1V:2.5+H, whichever is gentler.

## Erosion Treatment

A review of the Plan, Profile and Cross Section drawing prepared by Water's Edge, Drawing No. WE 15045-01, reveals that in addition to the existing gabion treatment, erosion control and area stabilization schemes, complete riprap bed treatment, Armourstone block checks and stone riffles, will be implemented along the channel downstream of the outfall structure. The channel bankfull width and the extent of treatment/construction will remain well within the proposed 6-m storm sewer and drainage easement. The centerline of the channel will be regraded to 1V:2.5 to 3.5H, which is comparable if not better than the existing profile. While the stabilization of the bottom of slope is enhanced to withstand the anticipated increased drainage flow, the disturbance to the top region of the existing slope will be relatively small or negligible.

In summary, the construction of the storm sewer outlet will not impose an adverse effect on the stability of the existing slope.

The above comments and recommendations are subject to the approval and requirements of the CVC.

All other recommendations stated in the original soil report and slope stability addendum remain applicable without revision.

We trust this letter report is to your satisfaction. However, should any queries arise, please feel free to contact this office.

Yours truly,
**SOIL ENGINEERS LTD.**

LICENSED PROFESSIONAL ENGINEER
Mar 1, 2017
B. P. Y. LEE
100104568
PROVINCE OF ONTARIO

Hui Wing Yang, B.A.Sc.
HWY/BL:

Bernard Lee, P.Eng.

c. Soil Engineers Ltd. (Mississauga) Attn.: Mr. Benjamin Lee

This letter/report/certification was prepared by Soil Engineers Ltd. for the account of the captioned clients and may be relied upon by regulatory agencies. The material in it reflects the writer's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this letter/report/certification, or any reliance on or decisions to be made based upon it, are the responsibility of such third parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this letter/report/certification.

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

| BARRIE | MISSISSAUGA | OSHAWA | NEWMARKET | GRAVENHURST | PETERBOROUGH | HAMILTON |
|---|---|---|---|---|---|---|
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| FAX: (705) 721-7864 | FAX: (905) 542-2769 | FAX: (905) 725-1315 | FAX: (905) 881-8335 | FAX: (705) 684-8522 | FAX: (905) 725-1315 | FAX: (905) 542-2769 |

March 7, 2019
(Revision to Letter Report dated December 22, 2016)

2462357 Ontario Inc.
30 Wertheim Court
Building A, Unit 3
Richmond Hill, Ontario
L4B 1B9

Attention: Mr. Peter Sciavilla

**Re: Revised Slope Stability Study Addendum**
**Proposed Residential Development**
**1745, 1765 and 1775 Thorny Brae Place**
**City of Mississauga**

Dear Sir:

Further to the Soil Report issued in October 2016 and the Slope Stability Study Addendum issued in December 2016 for the captioned site, we have reviewed the comments from the Credit Valley Conservation (CVC) dated June 8, 2018, requesting additional slope sections to be analyzed. We herein present the revised slope stability analysis performed using the updated topographic information provided by Schaeffer Dzaldov Bennett Ltd.

## Slope Stability Analysis

The stability study focuses on the valley slope at the eastern limit of the site (the western bank of Credit River) as well as along a drainage ditch that extends from the southeast corner of the site towards the river. Visual inspection of the slope in 2016 revealed that the upper portion of the valley slope (within the zone of the overburden) is generally well vegetated with trees, shrubs and weeds. Shallow shale bedrock outcrops were observed along the face of the river bank. The upper stretch of the channel is relatively gentle and stable. However, minor surface erosion along steeper sections of the side slopes as well as sloughing along the centerline of the channel was observed downstream to the existing concrete pipe headwall and gabion mat treatment. The bottom of the channel was lined with shale debris. Overall, no sign of deep-seated failure was noted. No active toe erosion was observed along the Credit River.

The Credit River bank has an overall height ranging from 13.0± to 15.0± m, measured from the bottom of slope to the tableland or staked top of bank as established by the CVC (referenced on a sketch dated February 23, 2004), with gradients ranging from 1 vertical:0.5± to 2.0+ horizontal. The depth of the drainage channel is approximately 3± to 4± m, with slope gradients of 1V:2.0± H.

Three cross-sections, Cross-Sections A-A to C-C, as presented on Drawing Nos. 2 to 4, inclusive, were selected for analysis at various steep sections of the Credit River bank slopes. Two cross-sections, Cross-Sections D-D and E-E, located along the north side of the drainage feature as identified by the CVC were added to the analysis and are presented on Drawing Nos. 5 and 6. The locations are shown on Drawing No. 1. The surface profile of each cross-section is interpreted from the contour and spot elevations on the Topographic Plan prepared by Schaeffer Dzaldov Bennett Ltd., dated February 5, 2018. The subsurface profile is interpreted from the Borehole Logs from our Soil Report dated October 2016.

Based on the borehole findings, normal groundwater condition (NGC) was modeled after the dry condition observed upon completion of the field work. In considering the high seasonal groundwater condition, an assumed elevated groundwater condition (EGC) was added at approximately 1.5 m below surface grade in this study.

The slope stability was analyzed using force-moment-equilibrium criteria of the Bishop Method with the soil strength parameters shown in the following table. The shale has been modeled as bedrock with infinite strength.

**Strength Parameters For Slope Stability Analysis**

| | **Unit Weight $\gamma$ (kN/m$^3$)** | **Effective Cohesion c (kPa)** | **Effective Internal Friction Angle $\phi$ (degrees)** |
|---|---|---|---|
| Silty Clay Till | 22.0 | 5 | 30 |
| Earth Fill (Silty Sands) | 20.0 | 0 | 28 |

According to the Ontario Ministry of Natural Resources (OMNR) guideline requirements and the CVC's Slope Stability Definition and Determination Guideline 2014 for active land use, the required minimum Factor of Safety (FOS) under NGC is 1.5, and the FOS stipulated by the CVC under EGC is 1.3. The resulting FOS and corresponding setbacks for the various cross-sections are presented in the following table.

| **Cross-Section** | **FOS under Existing Slope Condition** | | **FOS under Geotechnically Stable Condition** | **Geotechnically Stable Gradient** | **LTSSL Setback from TOB[c] (m)** |
|---|---|---|---|---|---|
| | **Normal [a]** | **Elevated [b]** | **Elevated [b]** | | |
| A-A | 1.286 | 1.286 | 1.834 | 1V:1.4H shale<br>1V:1.7H silty clay<br>1V:2.5H earth fill | 12.0 |
| B-B | 4.2 | 4.2 | 2.243 | | 5.9 |
| C-C | 3.46 | 3.46 | 2.622 | | 1.1 |
| D-D | 2.137 | 1.998 | - | 1V:2.0H | 0.7 |
| E-E | 2.194 | 1.874 | - | 1V:2.2H | 1.1 |

[a] Normal groundwater condition
[b] Elevated groundwater condition
[c] Long-Term Stable Slope Line (LTSSL) setback is shown from the Staked Top of Bank as defined by CVC on February 23, 2004, or from the physical top of slope, whichever is closer to the slope.

The results from the analyses indicate that the existing slope at Cross-Section A-A has a factor of safety (FOS) of 1.29 under both NGC and EGC, which does not meet the aforementioned minimum FOS. Therefore, the stability of the slope at Cross-Section A-A is considered to be geotechnically unacceptable. In order to achieve the required FOS, geotechnically stable gradients of 1V:1.4H and 1V:1.7H are recommended for use in the shale bedrock and silty clay till overburden, respectively. The remodeled slope, yielding a FOS of 1.834 which satisfies the OMNR and CVC requirements, is presented on Drawing No. 2C.

The existing slopes at the locations of Cross-Sections B-B, C-C, D-D and E-E have FOS of 1.5+ under both NGC and EGC, which satisfy the OMNR and CVC requirements for active land use. The result of analyses is presented on Drawing Nos. 3 to 6 (A and B), inclusive. Although the slopes at Cross-Sections B-B and C-C are considered to be geotechnically stable in their current condition, environmental degradation of the exposed shale bedrock should be anticipated and accounted for. Therefore, the geotechnically stable gradients listed in the above table are applied and the sections are remodeled. In earth fill, a stable gradient of 1V:2.5H is used. The remodeled slopes, yielding FOS of 2.243 and 2.622 for Cross-Sections B-B and C-C, respectively, are presented on Drawing Nos. 3C and 4C.

In the absence of an adequate flood plain, the Credit River meanders at the toe of slope. Since no active erosion was observed, a 2 m toe erosion allowance is recommended along the river valley where it consists of shale bedrock. The resulting LTSSL, incorporating the specified stable gradient component and toe erosion setback (where necessary), is established on Drawing No. 1. Where the LTSSL generally coincides with the existing top of slope around the drainage channel, it is aligned with either the physical top of slope or the staked top of bank by CVC, whichever is further inland.

Lastly, a development setback buffer for man-made and environmental degradation of the bank will be required. This is subject to the discretion of the CVC.

In order to prevent the disturbance of the existing stable slope and to enhance the stability of the bank for the proposed project, the following geotechnical constraints should be stipulated:

1. The prevailing vegetative cover must be maintained, since its extraction would deprive the bank of the rooting system that is reinforcement against soil erosion by weathering. If for any reason the vegetation cover is stripped during construction, it must be reinstated to its original, or better than its original, protective condition. Restoration with selective native plantings including deep rooting systems which would penetrate the original buried topsoil must be carried out after the development to ensure bank stability.
2. The topsoil cover on the bank face should not be disturbed, since this provides an insulation and screen against frost wedging and rainwash erosion.
   All new slopes created by cutting into the existing slope must be graded at 1V:2.5H for stability. The slope surface must be properly vegetated. Where new slopes are created with a gradient ranging from 1V:2 to 2.5H, they will be subject to surface erosion and minor surface sloughing even when they are vegetated. Therefore, a permanent erosion control mat together with proper vegetation must be installed on the surface of the slopes to prevent surface erosion. The respective manufacturers should be consulted for the proper installation of the erosion control mats. A new slope with a gradient steeper than 1V:2H should not be allowed.
3. Grading of the land adjacent to the bank must be such that concentrated runoff is not allowed to drain onto the bank face. Landscaping features which may cause runoff to pond at the top of the bank, as well as saturation of the crown of the bank, must not be permitted.
4. Where the construction is carried out near the top of the bank, stripping of topsoil or vegetation and dumping of loose fill over the bank must be prohibited.

The above recommendations are subject to the approval and requirements of the CVC.

All other recommendations stated in the original soil report remain applicable without revision.

We trust this letter report is to your satisfaction. However, should any queries arise, please feel free to contact this office.

Yours truly,
**SOIL ENGINEERS LTD.**

LICENSED PROFESSIONAL ENGINEER
Mar. 7, 2019
H. W. YANG
100126690
PROVINCE OF ONTARIO

Hui Wing Yang, P.Eng.
HWY/BL:cy

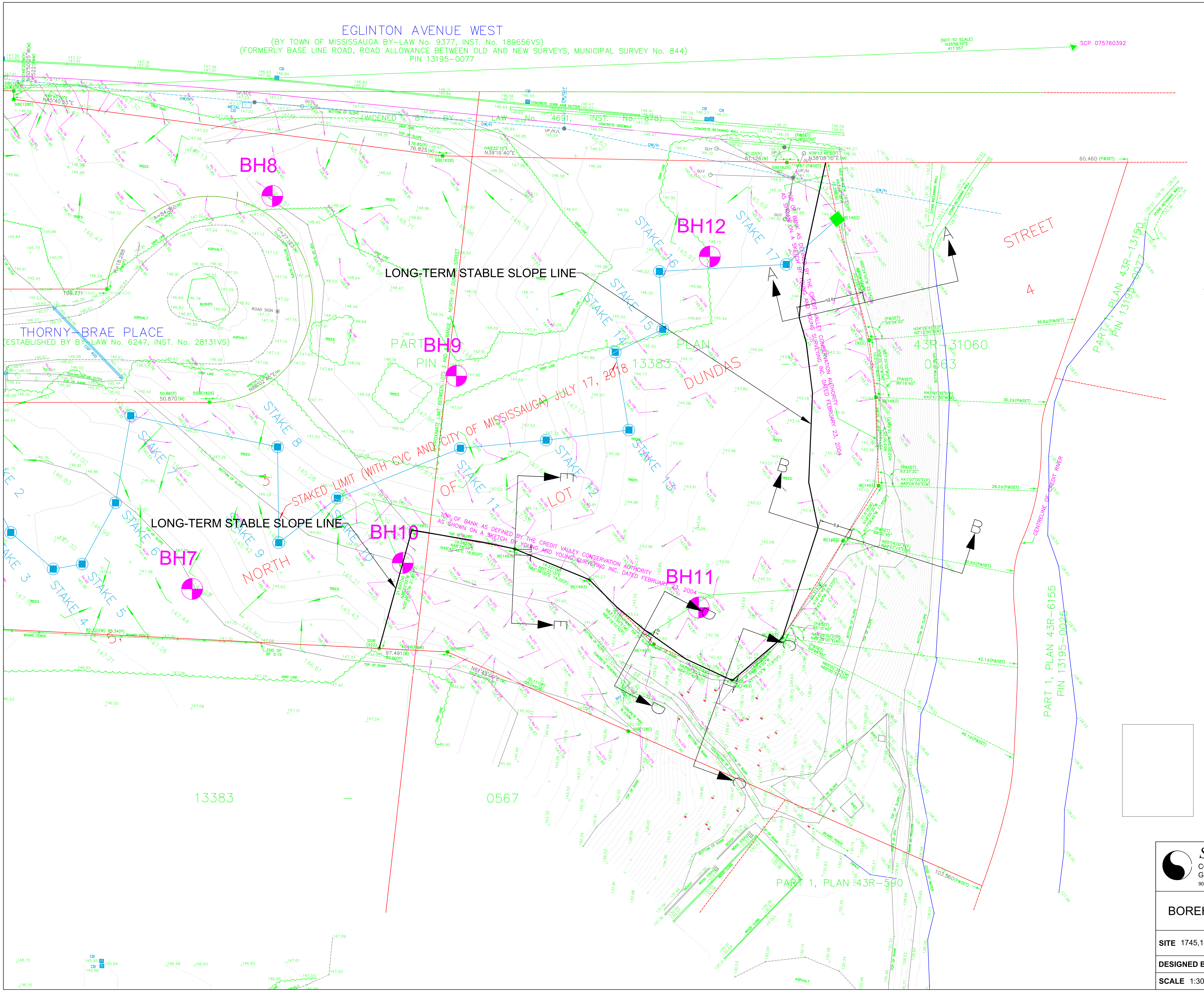
LICENSED PROFESSIONAL ENGINEER
Mar 7, 2019
B. P. Y. LEE
100104560
PROVINCE OF ONTARIO

Bernard Lee, P.Eng.

c. Soil Engineers Ltd. (Mississauga) Attn.: Mr. Benjamin Lee

**ENCLOSURES**

| | |
|---|---|
| Borehole and Cross-Section Location Plan | Drawing No. 1 |
| Cross-Section A-A (Existing/Normal Groundwater Condition) | Drawing No. 2A |
| Cross-Section A-A (Existing/Elevated Groundwater Condition) | Drawing No. 2B |
| Cross-Section A-A (Stable/Elevated Groundwater Condition) | Drawing No. 2C |
| Cross-Section B-B (Existing/Normal Groundwater Condition) | Drawing No. 3A |
| Cross-Section B-B (Existing/Elevated Groundwater Condition) | Drawing No. 3B |
| Cross-Section B-B (Stable/Elevated Groundwater Condition) | Drawing No. 3C |
| Cross-Section C-C (Existing/Normal Groundwater Condition) | Drawing No. 4A |
| Cross-Section C-C (Existing/Elevated Groundwater Condition) | Drawing No. 4B |
| Cross-Section C-C (Stable/Elevated Groundwater Condition) | Drawing No. 4C |
| Cross-Section D-D (Existing/Normal Groundwater Condition) | Drawing No. 5A |
| Cross-Section D-D (Existing/Elevated Groundwater Condition) | Drawing No. 5B |
| Cross-Section E-E (Existing/Normal Groundwater Condition) | Drawing No. 6A |
| Cross-Section E-E (Existing/Elevated Groundwater Condition) | Drawing No. 6B |



PLAN OF SURVEY OF
PART OF LOT 1 AND
ALL OF LOT 2
REGISTERED PLAN 498 AND
PART OF LOTS 3 AND 4, RANGE 5
NORTH OF DUNDAS STREET,
(GEOGRAPHIC TOWNSHIP OF TORONTO)
CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL
SCALE 1:300

10 5 0 10 20

NOTES

| | | |
|---|---|---|
| □ | DENOTES | PLANTED MONUMENT |
| ■ | " | FOUND MONUMENT |
| SIB | " | STANDARD IRON BAR |
| IB | " | IRON BAR |
| SSIB | " | SHORT STANDARD IRON BAR |
| P | " | PLAN 43R-31060 |
| P1 | " | PLAN 43R-18467 |
| P2 | " | PLAN 43R-16785 |
| P3 | " | REGISTERED PLAN 498 |
| R | " | REPLACED FOUND IB(680) WITH SSIB |
| M | " | MEASURED |
| WIT | " | WITNESS |
| OU | " | ORIGIN UNKNOWN |
| 680 | " | C. PEAT, O.L.S. |
| 922 | " | SCHAEFFER DZALDOV BENNETT LTD. |
| 1493 | " | YOUNG & YOUNG SURVEYING INC. |
| 1225 | " | DAVID B. SEARLES SURVEYING LTD. |
| 1629 | " | B.A. JACOBS SURVEYING LTD. |
| 1280 | " | A. KIKAS LIMITED |
| NNS | " | NANFARA & NG SURVEYORS INC. |
| 923 | " | W.P. TARASICK, O.L.S. |
| RIB | " | ROUND IRON BAR |
| BF | " | BOARD FENCE |

BEARINGS ARE UTM GRID, DERIVED FROM SPECIFIED CONTROL POINTS 075125016 AND 075760392, UTM ZONE 17, NAD83 (ORIGINAL).

DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY A COMBINED SCALE FACTOR OF 0.999713.

SPECIFIED CONTROL POINTS (SCPs): UTM ZONE 17, NAD83 (ORIGINAL) COORDINATES TO URBAN ACCURACY PER SEC. 14(2) OF O.REG. 216/10

| POINT ID. | NORTHING | EASTING |
|---|---|---|
| SCP 075125016 | 4824783.177 | 605284.687 |
| SCP 075760392 | 4825175.088 | 605623.335 |

COORDINATES CANNOT, IN THEMSELVES, BE USED TO RE-ESTABLISH CORNERS OR BOUNDARIES SHOWN ON THIS PLAN

## 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 26th DAY OF JANUARY, 2018.

DATE: FEBRUARY 5, 2018.

OPHIR N. DZALDOV
ONTARIO LAND SURVEYOR

SCHAEFFER DZALDOV BENNETT LTD.
ONTARIO LAND SURVEYORS
64 JARDIN DRIVE CONCORD, ONTARIO L4K 3P3 TEL.(905)761-0101

| | | | |
|---|---|---|---|
| DRAWN ACAD/LW | CHECKED WMF | SCALE 1 : 300 | JOB NO. 15-155-09 |

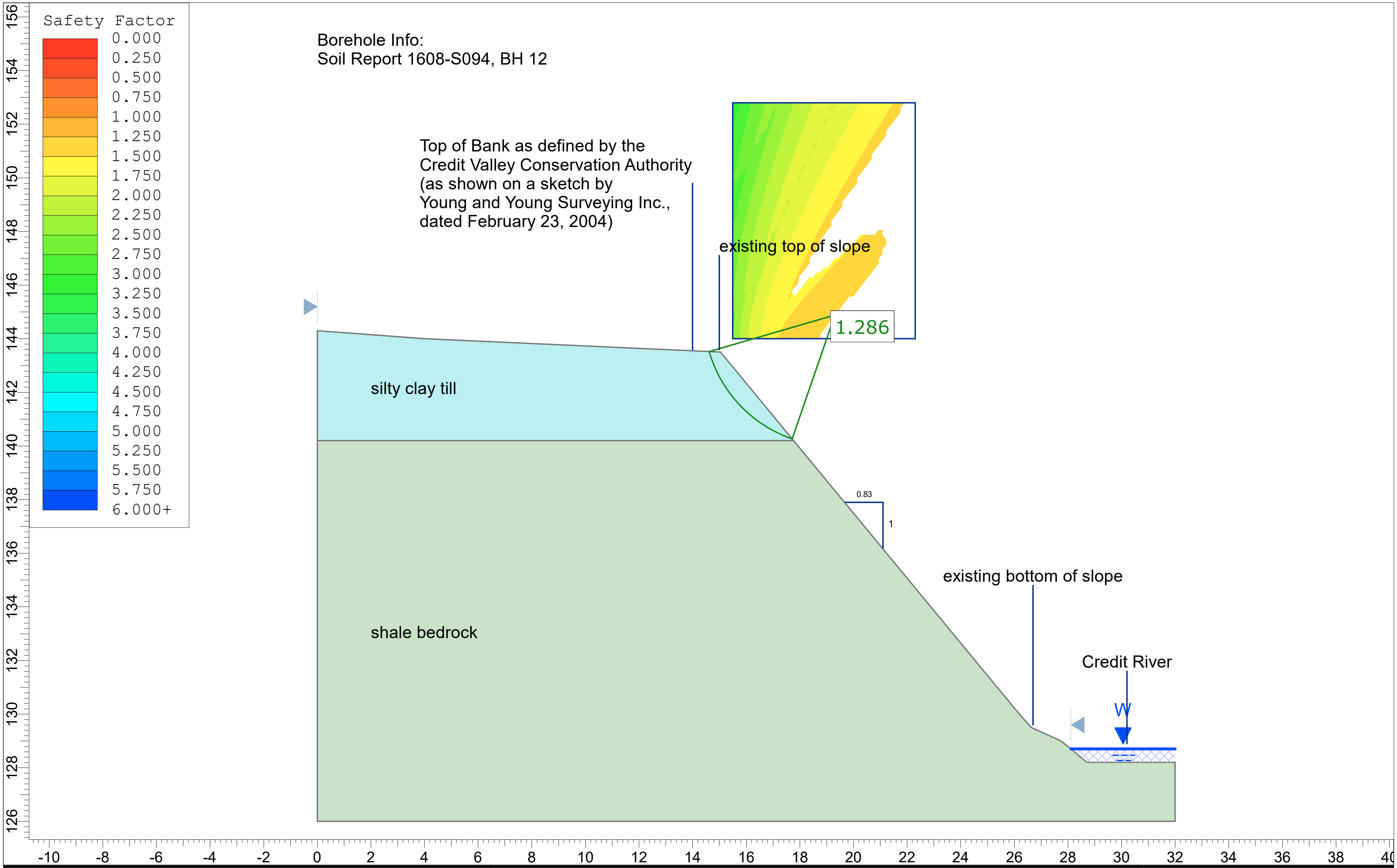
FEBRUARY 5, 2018

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

# BOREHOLE AND CROSS-SECTION LOCATION PLAN

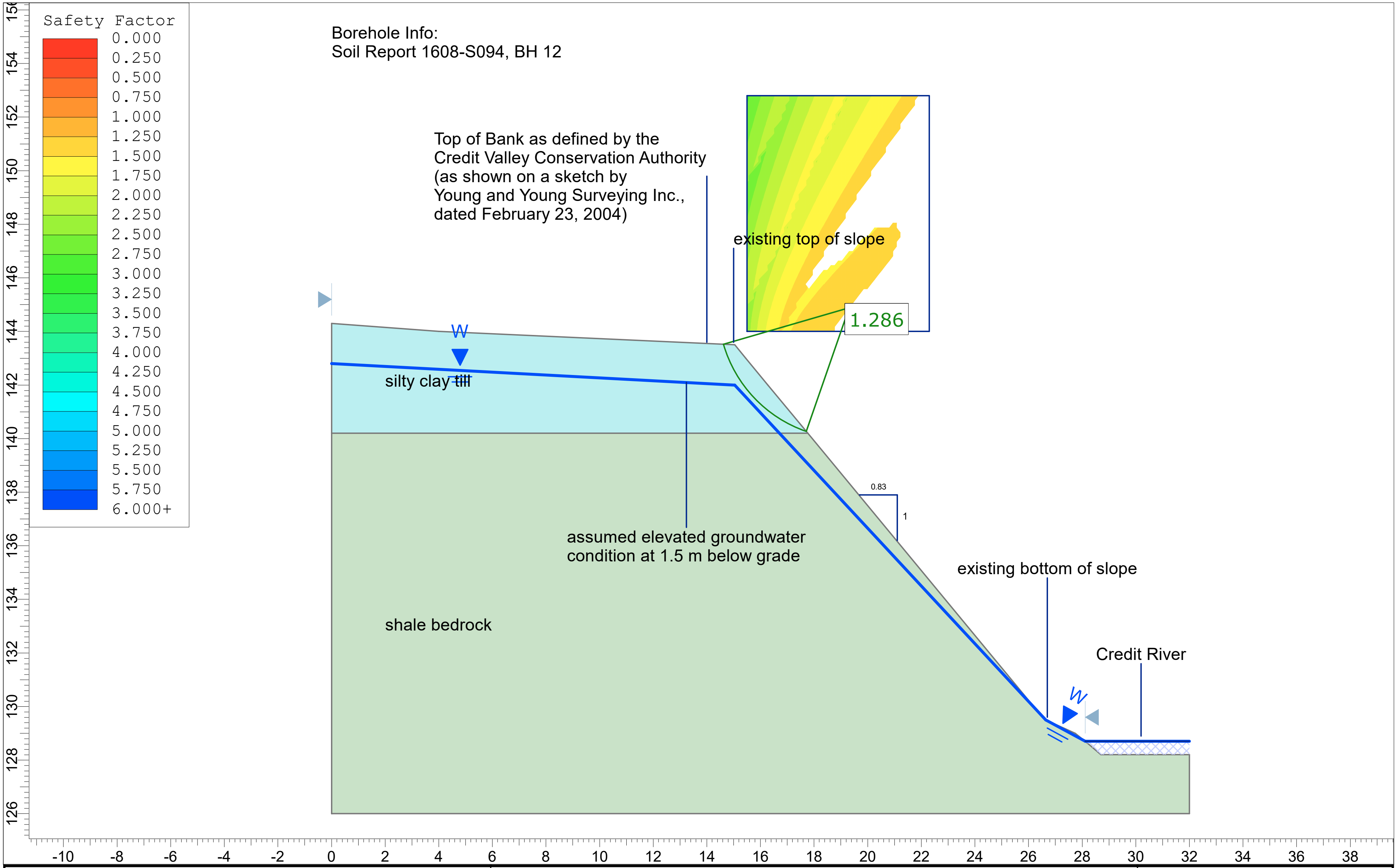
**SITE** 1745,1765 AND 1775 THORNY BRAE PLACE, MISSISSAUGA

| | | | |
|---|---|---|---|
| **DESIGNED BY** | **CHECKED BY** | **DWG NO.** 1 | |
| **SCALE** 1:300 | **REF. NO.** 1608-S094 | **DATE** MARCH 2019 | **REV** 1 |



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

Project Title: Cross-Section A-A - Existing Condition
Load Case: Normal Groundwater Condition (Dry)
Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga
Drawn By: HWY
Checked By: BL
Scale: 1:200
Revision: 1
Date: March 2019
Reference No.: 1608-S094
Drawing No.: 2A



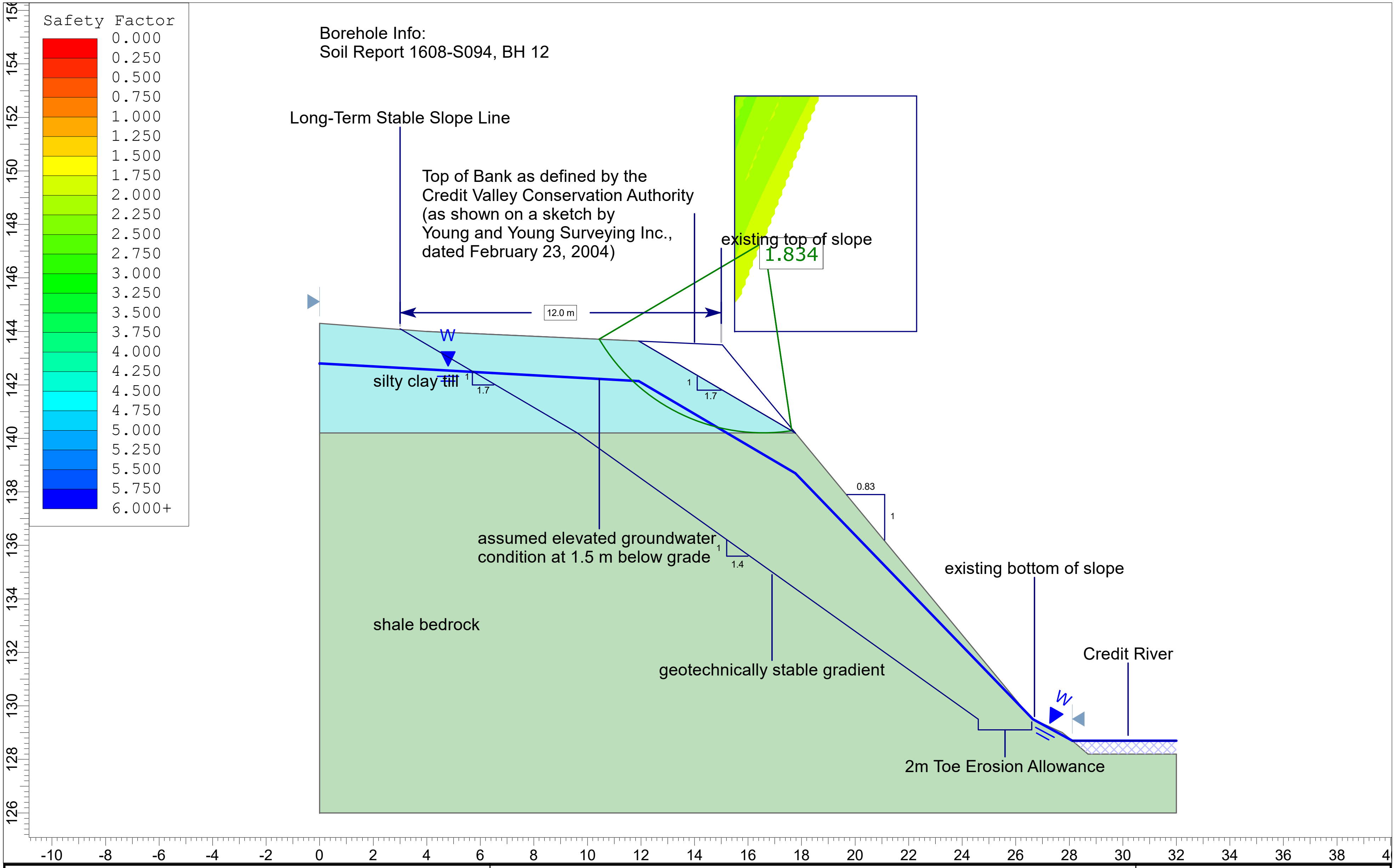
*Soil Engineers Ltd.*
CONSULTING ENGINEERS
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

Project Title
Cross-Section A-A - Existing Condition

Load Case
Elevated Groundwater Condition

Location
1745, 1765 and 1775 Thorny Brae Place, Mississauga

Drawn By HWY
Checked By BL
Scale 1:200
Revision -
Date March 2019
Reference No. 1608-S094
Drawing No. 2B



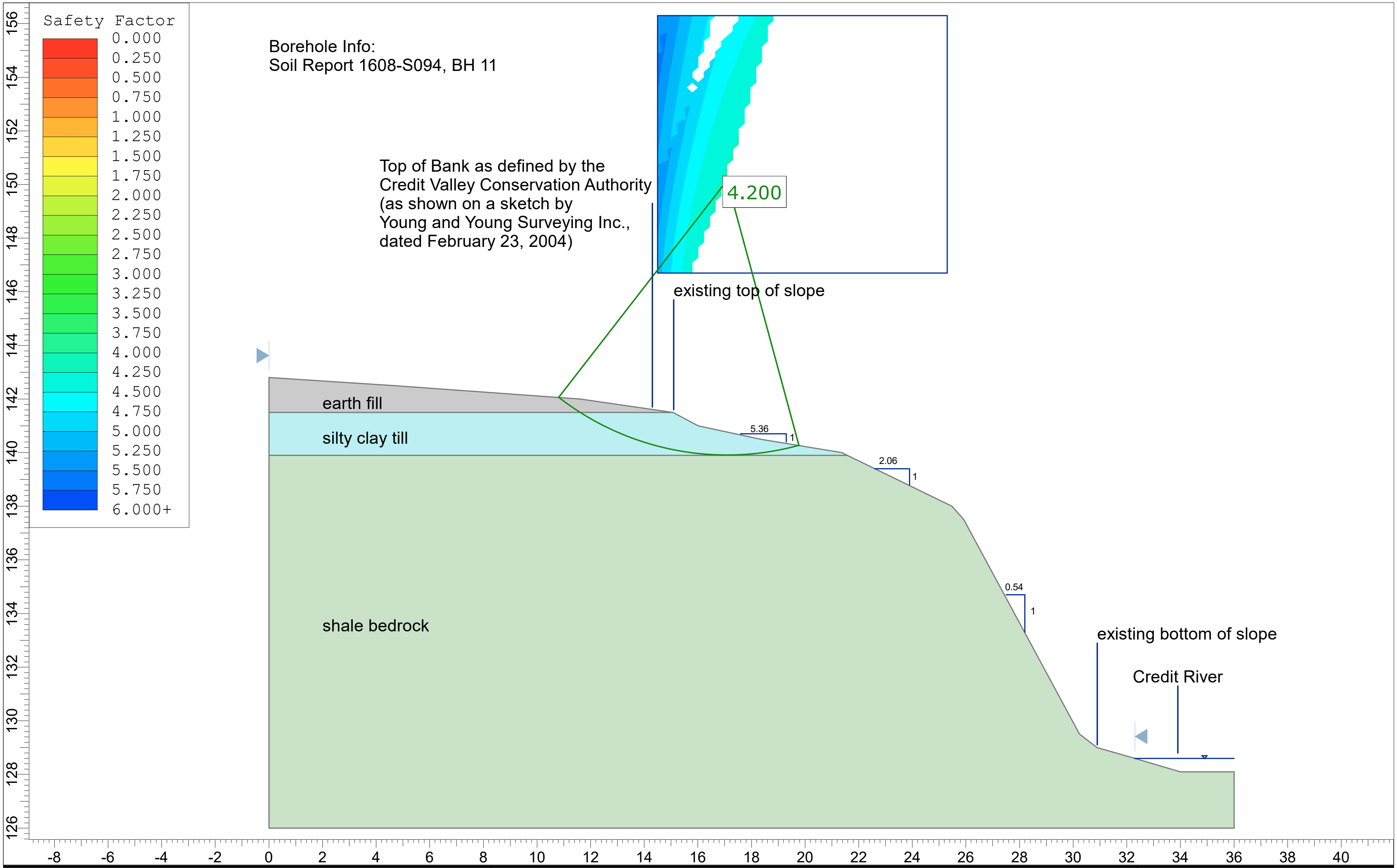
Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

Project Title: Cross-Section A-A - Geotechnically Stable Condition

Load Case: Elevated Groundwater Condition

Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Drawn By | HWY | Checked By | BL | Scale | 1:200 | Revision | - |
| Date | March 2019 | | | Reference No. | 1608-S094 | Drawing No. | 2C |



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

Project Title: Cross-Section B-B - Existing Condition

Load Case: Normal Groundwater Condition (Dry)

Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga

Drawn By: HWY

Checked By: BL

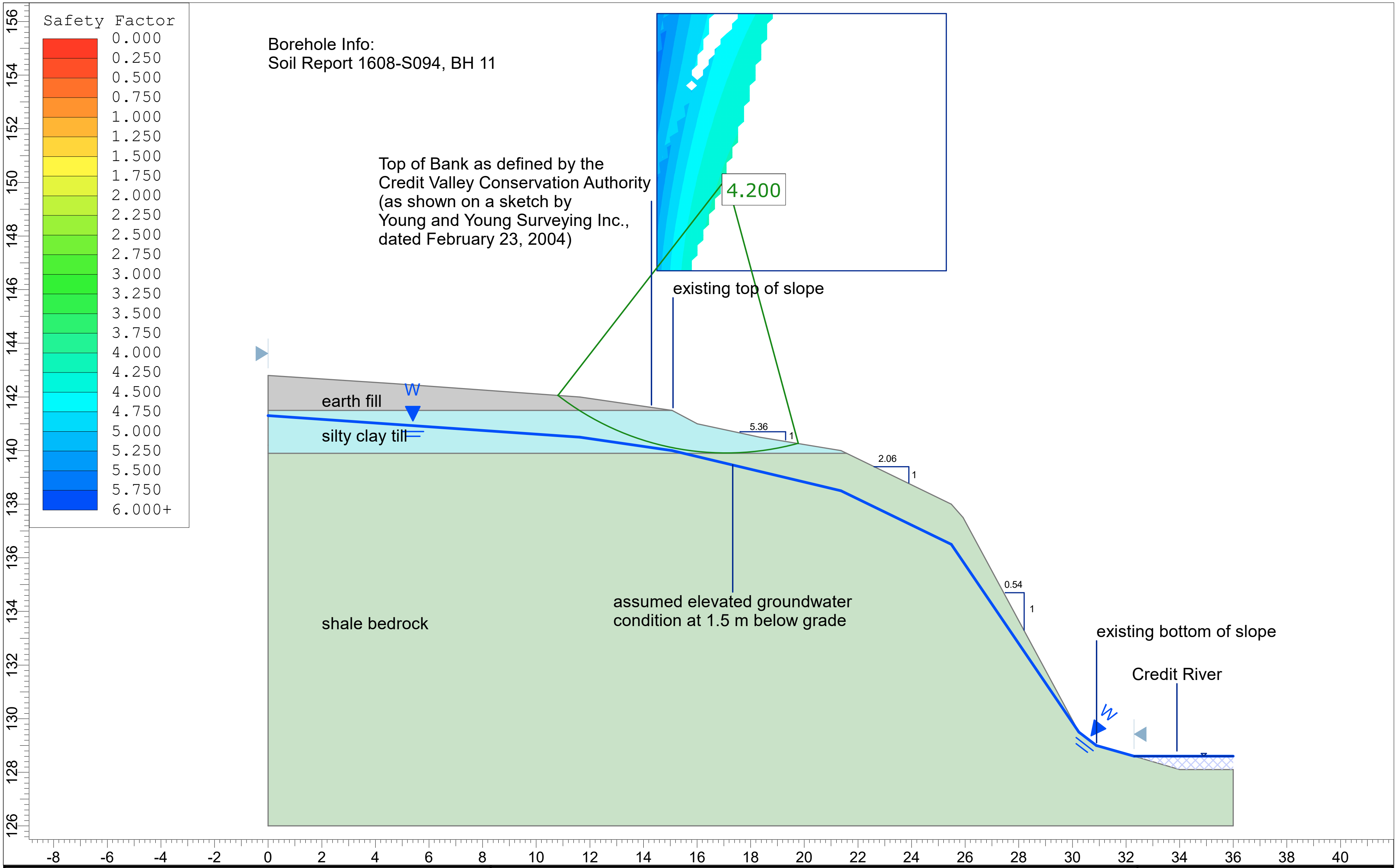
Scale: 1:200

Revision: 1

Date: March 2019

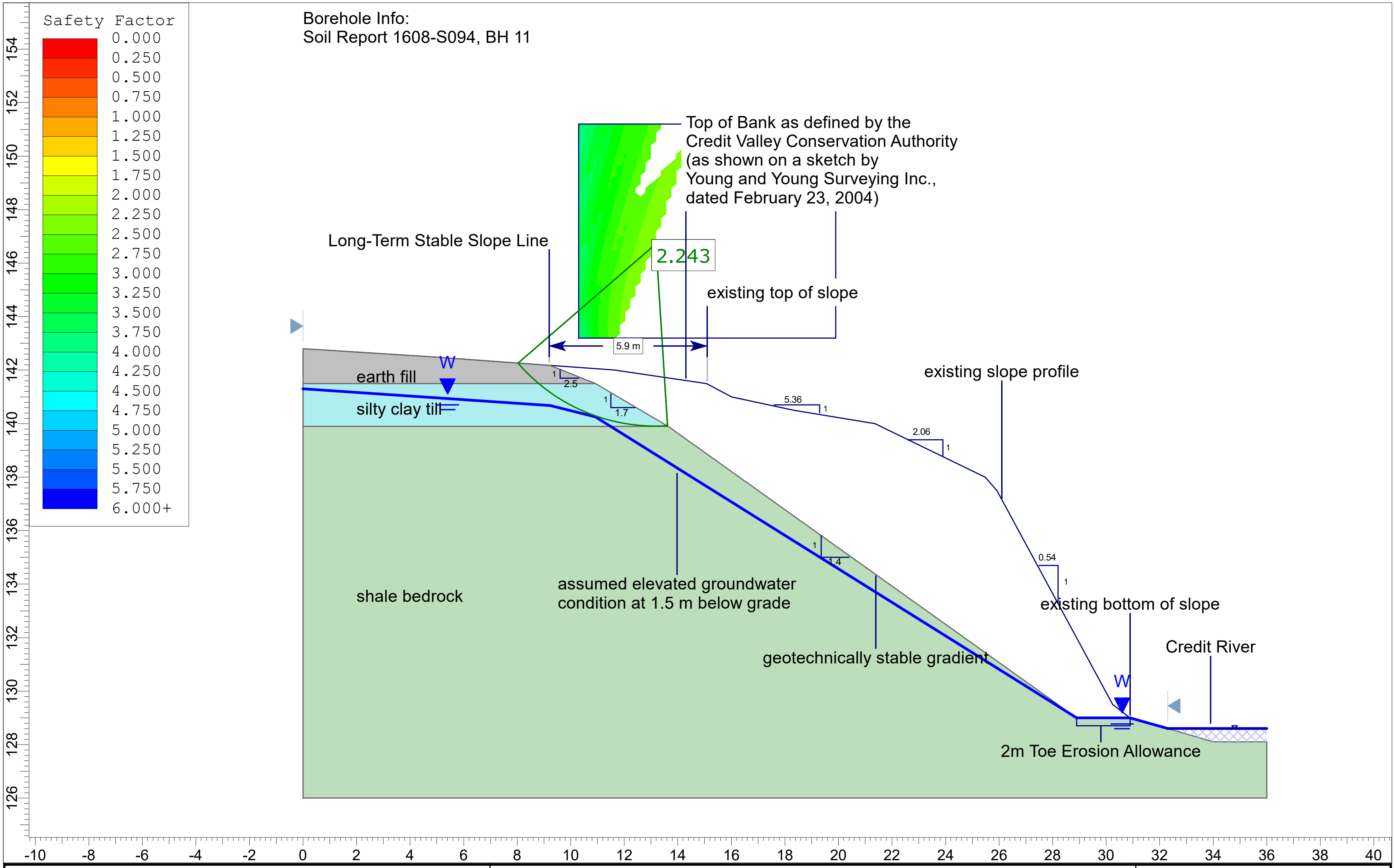
Reference No.: 1608-S094

Drawing No.: 3A



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

Project Title: Cross-Section B-B - Existing Condition
Load Case: Elevated Groundwater Condition
Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga
Drawn By: HWY
Checked By: BL
Scale: 1:200
Revision: -
Date: March 2019
Reference No.: 1608-S094
Drawing No.: 3B



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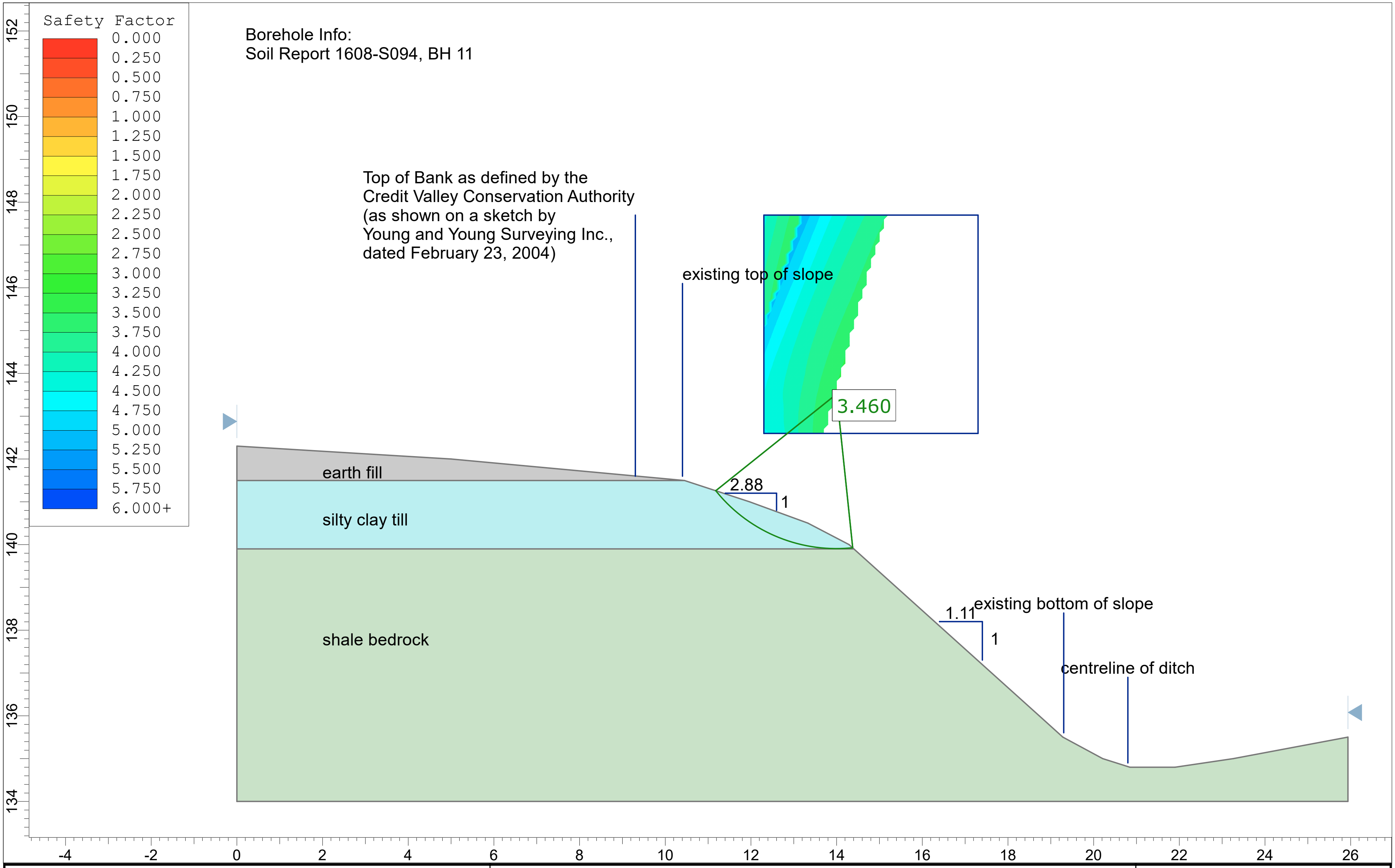
Project Title: Cross-Section B-B - Geotechnically Stable Condition
Load Case: Elevated Groundwater Condition
Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga
Drawn By: HWY
Checked By: BL
Scale: 1:200
Revision: -
Date: March 2019
Reference No.: 1608-S094
Drawing No.: 3C



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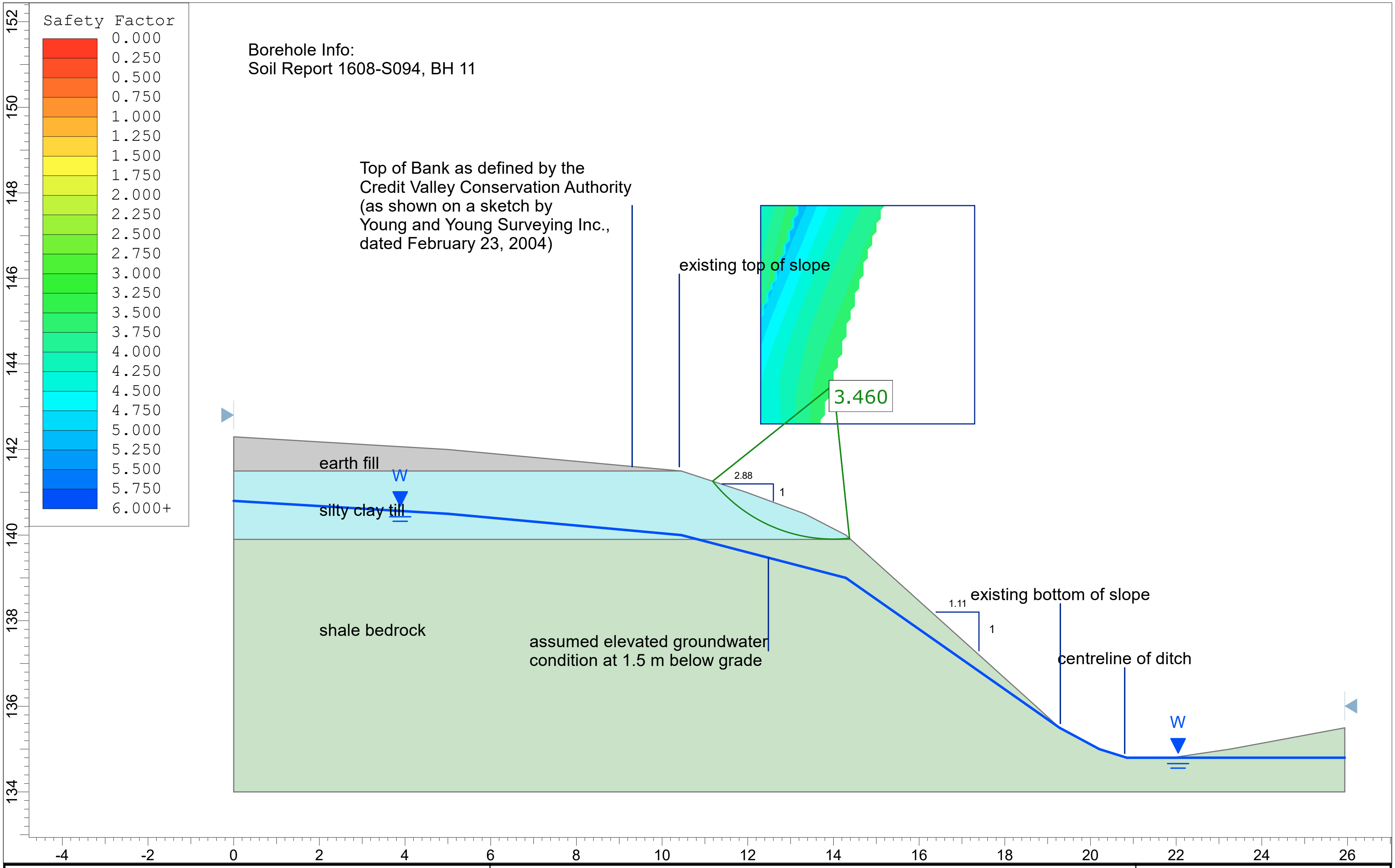
Project Title: Cross-Section C-C - Existing Condition
Load Case: Normal Groundwater Condition (Dry)
Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga
Drawn By: HWY
Checked By: BL
Scale: 1:125
Revision: 1
Date: March 2019
Reference No.: 1608-S094
Drawing No.: 4A



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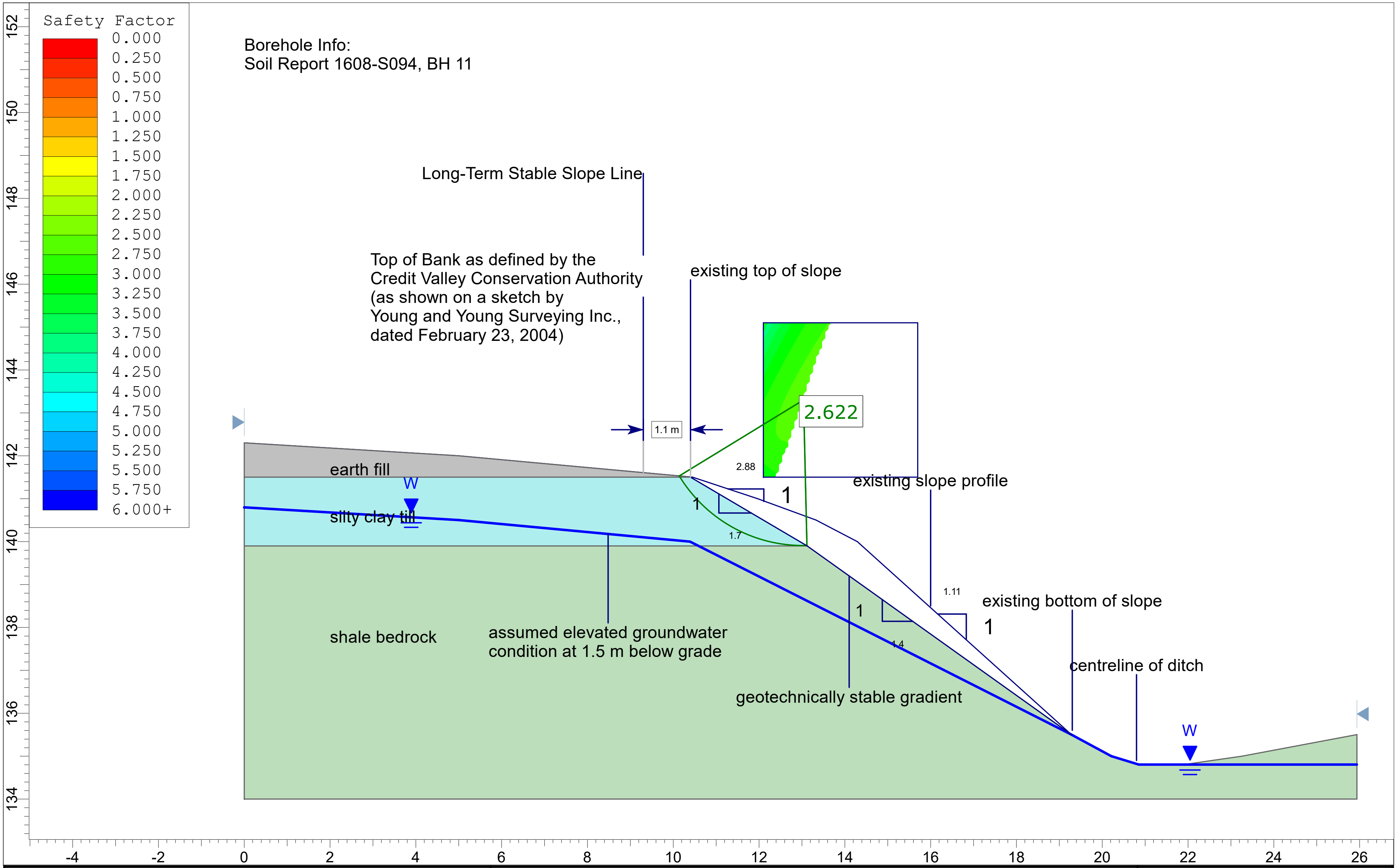
Project Title: Cross-Section C-C - Existing Condition
Load Case: Elevated Groundwater Condition
Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga
Drawn By: HWY
Checked By: BL
Scale: 1:125
Revision: -
Date: March 2019
Reference No.: 1608-S094
Drawing No.: 4B



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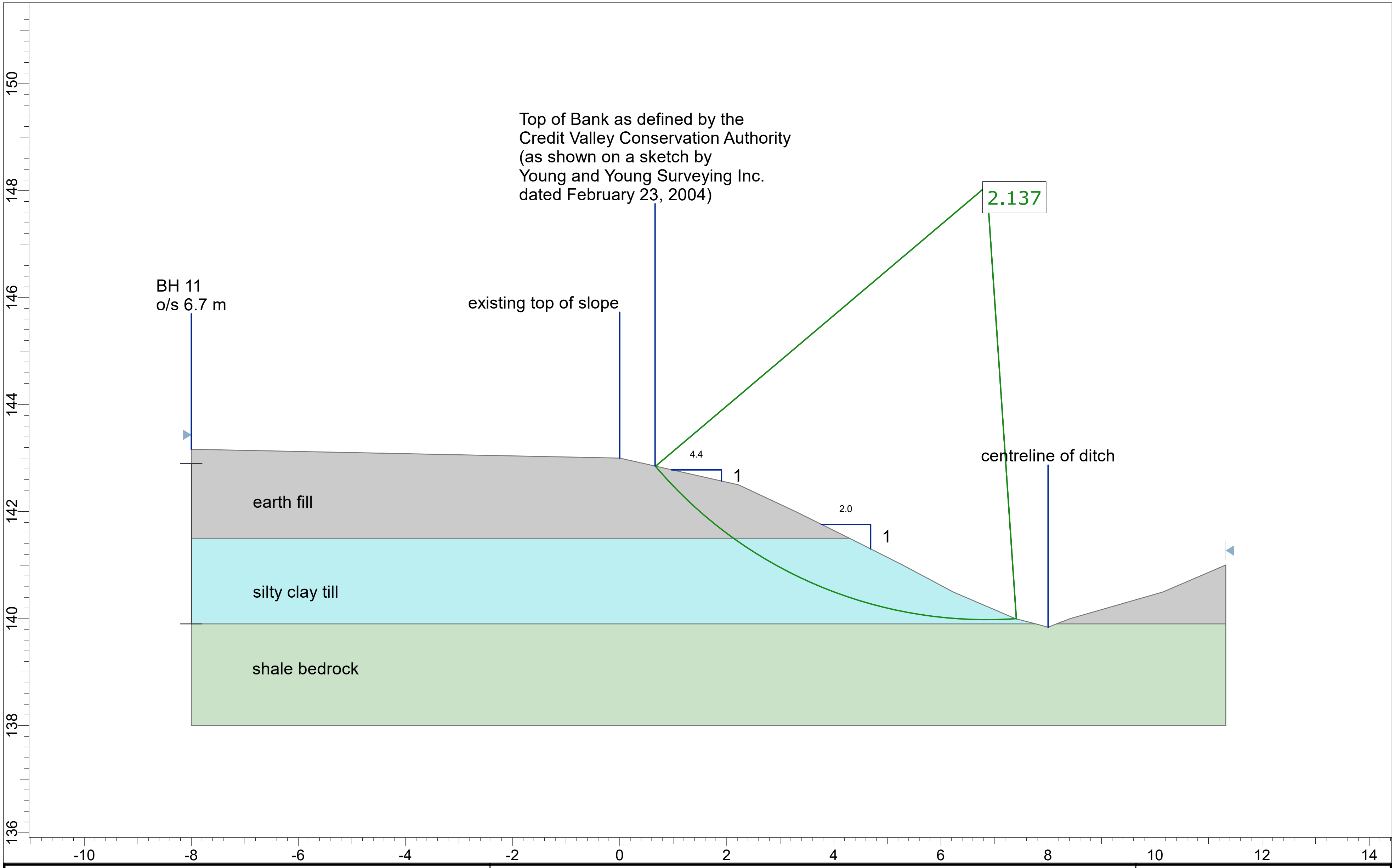
| | | | | | |
|---|---|---|---|---|---|
| Project Title | Cross-Section C-C - Geotechnically Stable Condition | | | Load Case | Elevated Groundwater Condition |
| Location | 1745, 1765 and 1775 Thorny Brae Place, Mississauga | | | | |
| Drawn By HWY | Checked By BL | Scale | 1:125 | Revision | - |
| Date | March 2019 | Reference No. | 1608-S094 | Drawing No. | 4C |



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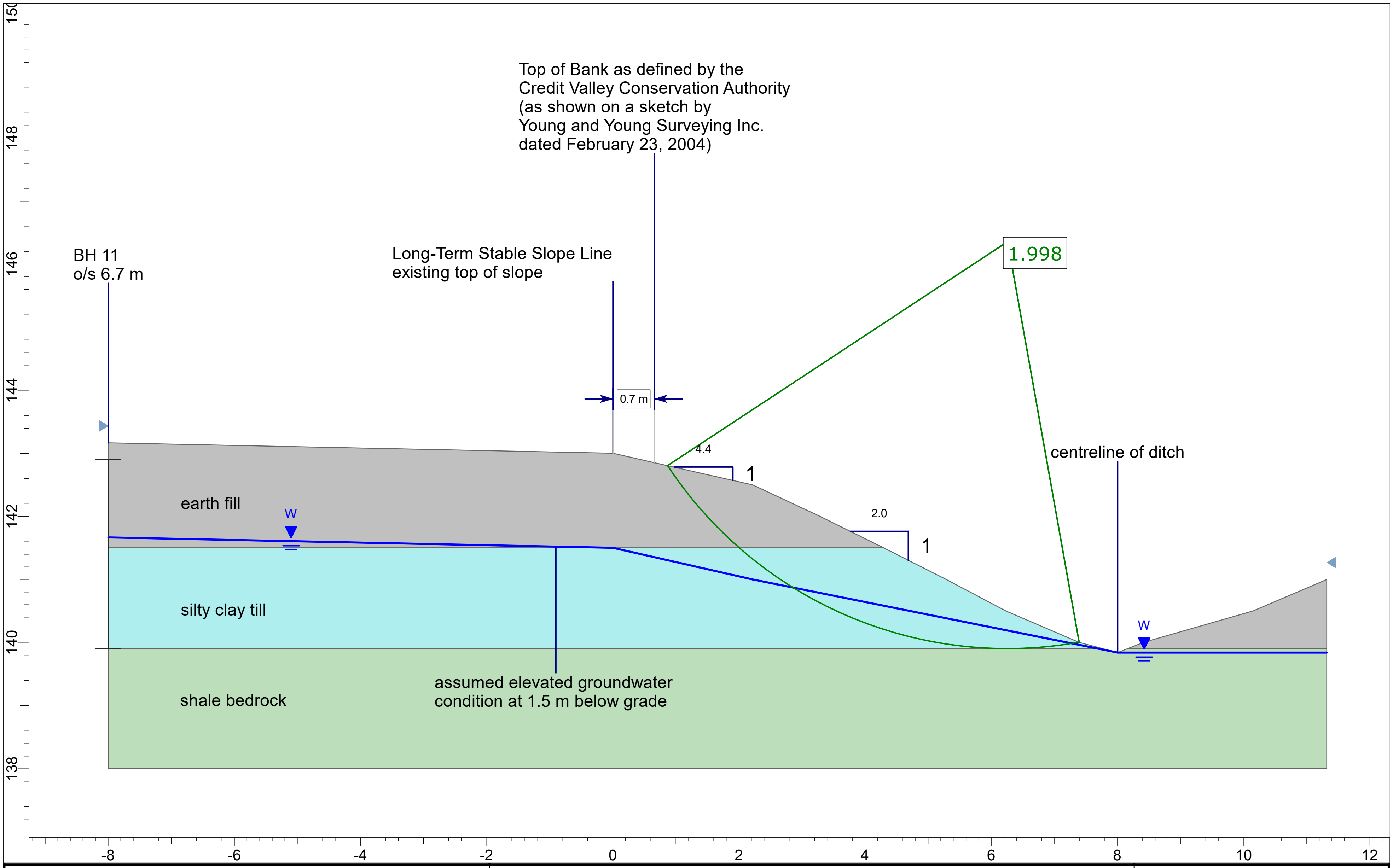
| | | | | | |
|---|---|---|---|---|---|
| Project Title | Cross-Section D-D - Existing Condition | | | Load Case | Normal Groundwater Condition (Dry) |
| Location | 1745, 1765 and 1775 Thorny Brae Place, Mississauga | | | | |
| Drawn By | HWY | Checked By | BL | Scale | 1:100 |
| Revision | - | | | | |
| Date | March 2019 | Reference No. | 1608-S094 | Drawing No. | 5A |



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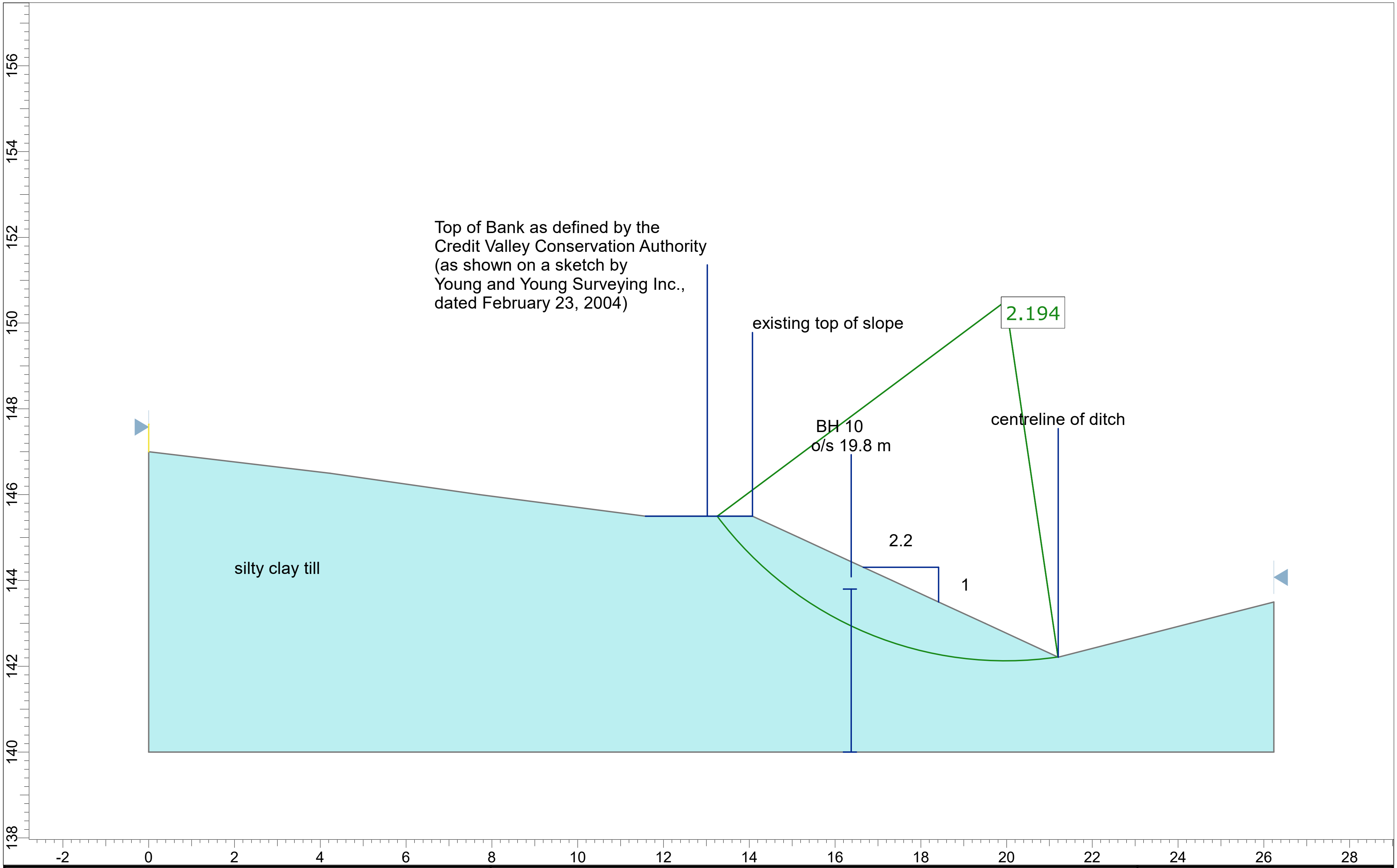
Project Title: Cross-Section D-D - Existing Condition
Load Case: Elevated Groundwater Condition
Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga
Drawn By: HWY
Checked By: BL
Scale: 1:85
Revision: -
Date: March 2019
Reference No.: 1608-S094
Drawing No.: 5B



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Project Title: Cross-Section E-E - Existing Condition

Load Case: Normal Groundwater Condition (Dry)

Location: 1745, 1765 and 1775 Thorny Brae Place, Mississauga

Drawn By: HWY

Checked By: BL

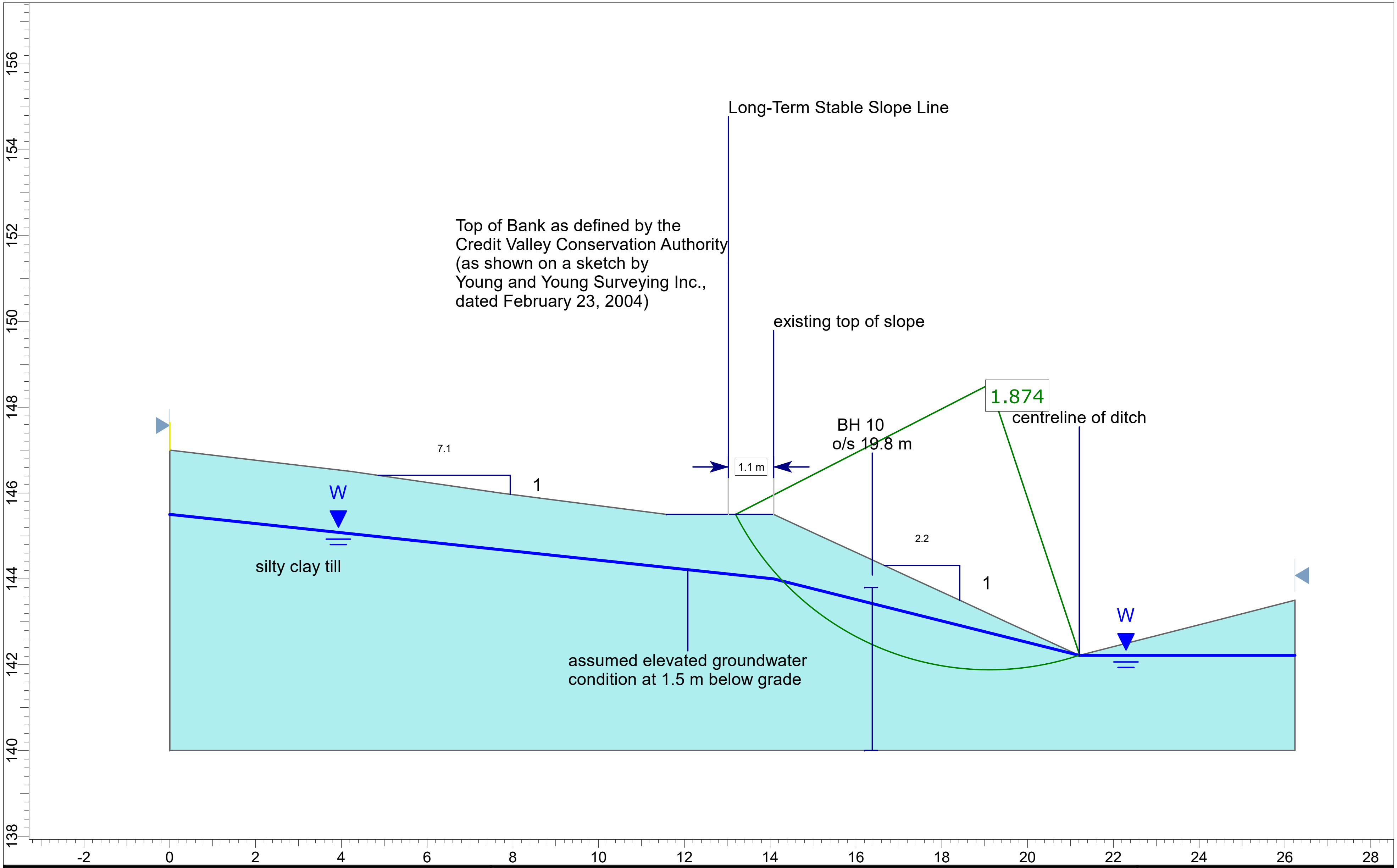
Scale: 1:125

Revision: -

Date: March 2019

Reference No.: 1608-S094

Drawing No.: 6A



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Project Title
Cross-Section E-E - Existing Condition

Load Case
Elevated Groundwater Condition

Location
1745, 1765 and 1775 Thorny Brae Place, Mississauga

Drawn By HWY
Checked By BL
Scale 1:125
Revision -
Date March 2019
Reference No. 1608-S094
Drawing No. 6B

# APPENDIX E

## Storm Drainage Chart Sheets

DEVELOPMENT THE HAZEL
CONSULTANT COLE ENGINEERING GROUP LTD.
MAJOR DRAINAGE AREA NORVAL TO PORT CREDIT SUBWATERSHED

| |
|---|
| *Existing Sewer Info* |
| **External Sewer Info** |

## CITY OF MISSISSAUGA - TRANSPORTATION AND WORKS
## REGIONAL MUNICIPALITY OF PEEL

## STORM DRAINAGE DESIGN CHART
## FOR CIRCULAR DRAINS FLOWING FULL

SHEET No. 1 OF 1
DATE February 19, 2019
DESIGNED BY J.M.
CHECKED BY S.G.

| LOCATION OF SITE STREET | FROM UPSTREAM MH# | TO DOWNSTREAM MH# | ADJACENT CONTRIBUTING AREA $A_A$ ha | RUNOFF COEFFICIENT $C_A$ | AREA TIMES RUNOFF COEFFICIENT $A_A \times C_A$ | ACCUMULATIVE AREA DRAINED BY SECTION $\sum A_A \times A_A$ ha | ACCUMULATIVE AREA TIMES RUNOFF COEFFICIENT FOR FOR SECTION $\sum A_A \times C_A$ | FLOW TIME TO SECTION FROM EXTREME UPSTREAM INLET $tc_f$ min | INITIAL TIME OF CONCENTRATION AT EXTREME UPSTREAM INL. $tc_i$ min | TIME OF CONCENTRATION UPSTREAM END OF SECTION $tc = tc_f + tc_i$ min | INSTENSITY OF RAINFALL i (mm/hr) | QUANTITY OF FLOW TO BE ACCOMMODATED IN SECTION Q=(iAC)/360 ($m^3/s$) | TYPE OF PIPE | MANNINGS ROUGHNESS COEFFICIENT n | SLOPE s % | DIAMETER D mm | LENGTH OF SECTION L m | VELOCITY OF FLOW WITH PIPE FLOWING FULL V m/s | CAPACITY OF PIPE FLOWING FULL Q $m^3/s$ | PIPE INVERT AT UPSTREAM M.H. m | PIPE INVERT AT DOWNSTREAM M.H. m | TIME OF FLOW IN SECTION t = L/(Vx60) min | ACCUMULATED TIME OF FLOW IN SECTION ∑t min | QUANTITY OF FLOW TO BE ACCOMMODATED IN SECTION DIVIDED BY CAPACITY OF PIPE FLOWING FULL Q % | COMMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Polaris Way* | *MH.10* | *MH.9* | *0.11* | *0.75* | *0.083* | *0.11* | *0.083* | *0.00* | *15.00* | *15.00* | *99.17* | *0.023* | *PVC* | *0.013* | *0.25* | *300* | *32.4* | *0.684* | *0.048* | *142.56* | *142.48* | *0.79* | *15.79* | *47%* | |
| *Polaris Way* | *MH.9* | *MH.8* | *0.04* | *0.75* | *0.030* | *0.15* | *0.113* | *0.79* | *15.00* | *15.79* | *96.16* | *0.030* | *PVC* | *0.013* | *0.25* | *300* | *12.2* | *0.684* | *0.048* | *142.43* | *142.40* | *0.30* | *16.09* | *62%* | |
| *Polaris Way* | *RLCB.1* | *MH.8* | *0.08* | *0.75* | *0.060* | *0.08* | *0.060* | *0.00* | *16.00* | *15.00* | *99.17* | *0.017* | *PVC* | *1.013* | *0.75* | *250* | *34.85* | *1.049* | *0.051* | *142.55* | *142.29* | *0.55* | *15.55* | *32%* | |
| *Polaris Way* | *RLCB.2* | *MH.8* | *0.06* | *0.75* | *0.045* | *0.06* | *0.045* | *0.00* | *17.00* | *15.00* | *99.17* | *0.012* | *PVC* | *2.013* | *2.00* | *250* | *33.64* | *1.713* | *0.084* | *143.60* | *142.93* | *0.33* | *15.33* | *15%* | |
| *Polaris Way* | *RLCB.3* | *MH.8* | *0.06* | *0.75* | *0.045* | *0.06* | *0.045* | *0.00* | *18.00* | *15.00* | *99.17* | *0.012* | *PVC* | *3.013* | *2.00* | *250* | *33.64* | *1.713* | *0.084* | *143.40* | *142.73* | *0.33* | *15.33* | *15%* | |
| *Polaris Way* | *RLCB.4* | *MH.8* | *0.10* | *0.75* | *0.075* | *0.10* | *0.075* | *0.00* | *19.00* | *15.00* | *99.17* | *0.021* | *PVC* | *4.013* | *0.50* | *250* | *34.88* | *0.857* | *0.042* | *142.55* | *142.38* | *0.68* | *15.68* | *49%* | |
| *Polaris Way* | *MH.8* | *OGS.1* | *0.18* | *0.75* | *0.135* | *0.63* | *0.472* | *1.09* | *20.00* | *16.09* | *95.08* | *0.125* | *CONC* | *5.013* | *0.25* | *450* | *57.2* | *0.896* | *0.142* | *142.24* | *142.10* | *1.06* | *17.15* | *88%* | |
| *Polaris Way* | *OGS.1* | *MH.7* | *0.00* | *0.00* | *0.000* | *0.63* | *0.472* | *1.06* | *21.00* | *17.15* | *91.43* | *0.120* | *CONC* | *6.013* | *0.25* | *450* | *3.5* | *0.896* | *0.142* | *142.07* | *142.06* | *0.07* | *17.22* | *84%* | |
| *Mississauga Road* | *MH.7* | *MH.6* | *0.00* | *0.00* | *0.000* | *0.63* | *0.472* | *0.07* | *22.00* | *17.22* | *91.22* | *0.120* | *CONC* | *7.013* | *0.25* | *450* | *15.7* | *0.896* | *0.142* | *142.05* | *142.01* | *0.29* | *17.51* | *84%* | *EXISTING* |
| *Mississauga Road* | *MH.6* | *MH.5* | *0.18* | *0.90* | *0.162* | *0.81* | *0.634* | *0.29* | *23.00* | *17.51* | *90.28* | *0.159* | *CONC* | *8.013* | *0.25* | *525* | *74.7* | *0.993* | *0.215* | *141.93* | *141.74* | *1.25* | *18.76* | *74%* | *EXISTING* |
| *Mississauga Road* | *MH.5* | *MH.4* | *0.34* | *0.90* | *0.306* | *1.15* | *0.940* | *1.25* | *24.00* | *18.76* | *86.48* | *0.226* | *CONC* | *9.013* | *0.25* | *600* | *84.4* | *1.086* | *0.307* | *141.67* | *141.46* | *1.30* | *20.06* | *74%* | *EXISTING* |
| *Thorny-Brae Place* | *MH.4* | *MH.3* | *0.66* | *0.75* | *0.495* | *1.81* | *1.435* | *1.30* | *25.00* | *20.06* | *82.91* | *0.331* | *CONC* | *10.013* | *0.50* | *675* | *98.3* | *1.661* | *0.594* | *141.38* | *140.89* | *0.99* | *21.04* | *56%* | *EXISTING* |
| *Thorny-Brae Place* | *MH.3* | *MH.2* | *0.65* | *0.75* | *0.488* | *2.46* | *1.923* | *0.99* | *26.00* | *21.04* | *80.41* | *0.430* | *CONC* | *11.013* | *0.50* | *750* | *73* | *1.782* | *0.787* | *140.81* | *140.45* | *0.68* | *21.73* | *55%* | *EXISTING* |
| *Thorny-Brae Place* | *MH.2* | *MH.1* | *0.00* | *0.00* | *0.000* | *2.46* | *1.923* | *0.68* | *27.00* | *21.73* | *78.78* | *0.421* | *CONC* | *12.013* | *0.50* | *750* | *14.6* | *1.782* | *0.787* | *140.42* | *140.35* | *0.14* | *21.86* | *53%* | *EXISTING* |
| *Valley Outfall* | *MH.1* | *EX.HW* | *0.00* | *0.00* | *0.000* | *2.46* | *1.923* | *0.14* | *28.00* | *21.86* | *78.47* | *0.419* | *CONC* | *13.013* | *1.00* | *750* | *58.1* | *2.520* | *1.113* | *140.25* | *139.67* | *0.38* | *22.25* | *38%* | *EXISTING* |

S:\2015 Projects\UD\SDM\UD15-0682 2462357ON_HazelTownhouses_MISS\300-Design-Engineering\301-Calcs\Sewer Design Sheets\2019 02 14 - FSR\STM\[UD15-0682-STORM-10yr.xls]10yr

# APPENDIX F

## Statement of Limiting Conditions and Assumptions

# Statement of Limiting Conditions and Assumptions

1. This Report/Study (the "Work") has been prepared at the request of, and for the exclusive use of, the Owner, and its affiliates (the "Intended Users"). No one other than the Intended Users has the right to use and rely on the Work without first obtaining the written authorization of Cole Engineering Group Ltd. (Cole Engineering) and its Owner.
2. Cole Engineering expressly excludes liability to any party except the Intended Users for any use of, and/or reliance upon, the Work.
3. Cole Engineering notes that the following assumptions were made in completing the Work:
    a) the land use description(s) supplied to us are correct;
    b) the surveys and data supplied to Cole Engineering by the Owner are accurate;
    c) market timing, approval delivery and secondary source information is within the control of Parties other than Cole Engineering; and
    d) there are no encroachments, leases, covenants, binding agreements, restrictions, pledges, charges, liens or special assessments outstanding, or encumbrances which would significantly affect the use or servicing.

    Investigations have not been carried out to verify these assumptions. Cole Engineering deems the sources of data and statistical information contained herein to be reliable, but we extend no guarantee of accuracy in these respects.
4. Cole Engineering accepts no responsibility for legal interpretations, questions of survey, opinion of title, hidden or inconspicuous conditions of the property, toxic wastes or contaminated materials, soil or sub-soil conditions, environmental, engineering or other factual and technical matters disclosed by the Owner, the Client, or any public agency, which by their nature, may change the outcome of the Work. Such factors, beyond the scope of this Work, could affect the findings, conclusions and opinions rendered in the Work. We have made disclosure of related potential problems that have come to our attention. Responsibility for diligence with respect to all matters of fact reported herein rests with the Intended Users.
5. Cole Engineering practices engineering in the general areas of infrastructure and transportation. It is not qualified to and is not providing legal or planning advice in this Work.
6. The legal description of the property and the area of the site were based upon surveys and data supplied to us by the Owner. The plans, photographs, and sketches contained in this report are included solely to aide in visualizing the location of the property, the configuration and boundaries of the site, and the relative position of the improvements on the said lands.
7. We have made investigations from secondary sources as documented in the Work, but we have not checked for compliance with by-laws, codes, agency and governmental regulations, etc., unless specifically noted in the Work.
8. Because conditions, including capacity, allocation, economic, social, and political factors change rapidly and, on occasion, without notice or warning, the findings of the Work expressed herein, are as of the date of the Work and cannot necessarily be relied upon as of any other date without subsequent advice from Cole Engineering.
9. The value of proposed improvements should be applied only with regard to the purpose and function of the Work, as outlined in the body of this Work. Any cost estimates set out in the Work are based on construction averages and subject to change.
10. Neither possession of the Work, nor a copy of it, carries the right of publication. All copyright in the Work is reserved to Cole Engineering. The Work shall not be disclosed, produced or reproduced, quoted from, or referred to, in whole or in part, or published in any manner, without the express written consent of Cole Engineering and the Owner.
11. The Work is only valid if it bears the professional engineer's seal and original signature of the author, and if considered in its entirety. Responsibility for unauthorized alteration to the Work is denied.