

Brown Bear Development Ltd.

901 Essa Road, City of Barrie

**Functional Servicing and Stormwater Management Report
(FSR/SWM)**

December 22, 2023

901 Essa Road, City of Barrie

Functional Servicing and Stormwater Management Report (FSR/SWM)

December 22, 2023

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1 Introduction

1.1 Background

Arcadis Professional Services (Canada) Inc. was retained by “Brown Bear Development Ltd.” (the “Owner”) to prepare a site-specific Functional Servicing and Stormwater Management Report (FSSR), for a proposed residential development at 901 Essa Road in Barrie, Ontario (the “Subject Lands”), in accordance with the City of Barrie (the “City”) and Nottawasaga Valley Conservation Authority (the “Conservation”) development guidelines. The FSSR is to support official plan and zoning bylaw amendments.

The total site developable area is approximately 0.89 ha and is located along Salem Road, between Brown Bear Street and Essa Road.

Refer to **Plate 1** for an aerial view of the site.



PLATE 1: Site Aerial Photo (Source: maps.google.ca)

The western portion of the site is designated as Block 281, and the eastern portion of the site has the municipal address of 901 Essa Road. The western portion of the property (Block 281) has an area of approximately 0.35 ha, and the eastern portion of the Property (901 Essa Road) has an area of approximately 0.79 ha. The combined areas of 0.35 ha and 0.79 ha has included the future road widening blocks to be conveyed to the City. Block 281 is currently used as a construction staging area for the adjacent subdivision development by Crisdawn Construction. The 901 Essa Road Property currently includes a residential building, a garage, and a gravel parking area. The existing properties to the north include a mix of residential, commercial, and institutional land uses. The site is proposed to develop the lands to include a new residential and retail-use building comprised of two multi-storey high towers (Tower A and Tower B), including two levels of underground parking.

2 Existing Conditions

The subject lands are 1.14 ha but the developable area is 0.89 ha; it is mainly comprised of open area and an existing residential unit. Block 281 is used as a construction staging area for the adjacent existing subdivision with an established existing access mud mat from Salem Road.

2.1 Existing Roads

Currently, the subject lands are accessible with entrances from Salem Road and Essa Road, which are existing rural City right-of-ways with ditches, and two (2) to three (3) lanes of traffic and right-of-way widths to be widened in the near future to be arterial collectors. Brown Bear Street is an existing urbanized local 18.0 m right-of-way to be assumed by the City.

2.2 Topography and Drainage

The subject land varies in slope intensity, but the site is relatively flat. There are minor high points near the existing building and the boundary line of Block 281/901 Essa Road within the site; with the site generally draining toward ditches located on the north side of the site and Essa Road. Refer to **DAP-1** – Predevelopment Drainage Area Plan located- in **Appendix C**.

2.3 Existing Storm Services

There is an existing 375 mm diameter storm sewer located along Brown Bear Street to the west of the property. The storm sewer drains north, and outlets into to an existing stormwater management pond designed to service the overall subdivision area, including the subject site. There is also an existing private storm easement on the north part of the property, which provides a minor and major storm outlet for the existing condominium development to the north.

2.4 Existing Sanitary Services

There is an existing 250 mm diameter sanitary sewer located along Brown Bear Street to the west of the property. Located on the north side of Salem Road at the daylight is an existing sanitary control manhole constructed to service the subject site. The sanitary flows are directed west toward Brown Bear Street, and then toward the north along Brown Bear Street's 250 mm diameter sanitary sewers.

2.5 Existing Water Supply and Distribution

There is an existing 300 mm diameter watermain located along Brown Bear Street with existing fire hydrants. The subject site will be serviced through the watermain on Brown Bear Street.

2.6 Existing Utilities

The nearest residential development is located adjacent to the subject site to the north and west. Utilities such as: hydro, gas, telephone, and cable services are present within the existing residential development subdivision. There are existing streetlights located along Brown Bear Street and Essa Road, and existing overhead power lines on Salem Road and Essa Road.

3 Proposed Conditions

The proposed development will consist of a residential and retail building with two multi-storey high towers (totalling 437 units), outdoor amenities/landscaped area, parking areas, private laneway (fire route) and future road widening.

Refer to **Appendix A** for a preliminary site plan of the development by Kirkor Architects & Planners.

3.1 Roads

The proposed development will have one (1) vehicular access from the existing Brown Bear Street. The laneway will consist of a 7.5 m pavement width at the site access and will taper to a 6.5 m pavement width internally. There is proposed parking located in the middle of the site, and an underground parking ramp access on the west side of the building. There are two loading areas located within each tower.

3.2 Grading

The grading strategy for the proposed development will respect and match into the existing grades along the northern and western property lines. The site has respected the southern Salem Road and eastern Essa Road future ultimate right-of-way property elevations. In the interim, it will match into the existing ground at the property limits. The proposed site grading will direct runoff away from the building onto the private laneway, there is a proposed swale at the north of the site that will capture runoff through a proposed area drain. A proposed catch basin is located on the east side of the site within the landscaped area. All proposed area drains and catch basins will direct runoff to the storm tank located in the underground parking area within the building. There is a small area of the site located at the west and south that will be controlled via grassed swale and area drains to direct runoff to the storm tank located within the building.

Refer to **GR-1 in Appendix B** where a preliminary grading plan shows the proposed grading approach. As a general guideline for the proposed site grading, the following City standards will be observed:

- Minimum – maximum road grading (including sidewalks) of 0.5% - 8%.
- Maximum transition grade of 3:1 for slope.
- Minimum – maximum driveway grade of 2% to 6%.
- Minimum – maximum swales of 2% to 6% and depth of swale of 150 mm to 600 mm.
- Other site surfaces shall be constructed to a minimum grading of two percent (2.0%).

The proposed site grading is constrained by the existing grades along the site perimeter, we will however ensure smooth transitions between proposed and existing ground. Any drainage alteration will not have a negative effect on the neighbouring properties. The majority of overland flows from the development will be conveyed towards the private lane and into the storm tank located within the underground parking. In case of catch basin/outlet blockage, as an emergency outlet the overland flow will drain toward Brown Bear Street via the private laneway entrance. A swale is proposed to the north of the site, while swale/area drains are also proposed along the west and south perimeter of the property.

Coordination of the grading along the south and east property lines will be required, as there are plans for future road widenings of Essa Road and Salem Road. The preliminary ultimate grading design has been provided along these property lines based on design drawings for the future road widening provided by R.J. Burnside & Associates Ltd. dated July 7, 2021.

Grading of the site and building accesses will ensure barrier free walkways to main entrances. Pedestrians will have access throughout the development via sidewalks to the various building entrances.

3.3 Sanitary Infrastructure

The total design flow from the proposed development is 15.02 L/s as per the design guidelines of the City of Barrie Engineering Design Standards (2017).

The sewer connection and invert has been conceptually designed and are shown in the site servicing Drawing **SS-1** in **Appendix B**.

A minimum of 2.5m of depth on the sanitary connection sewer has been provided to allow gravity connection to the building. During detailed design, the sanitary connection for the site will be sized based on the design flow (detailed below) and in accordance with the City design standards.

In accordance with the City's Design Criteria, residential sewage flows shall be calculated on the basis of the following for residential areas:

- Residential Average Daily Domestic Flow – 225 litres/person/day (lpcd).
- Infiltration Allowance for new development – 0.1 litres/sec/hectare.
- Peaking factor – minimum 2.0 and maximum 4.0.
- Velocity – minimum 0.6 m/s and maximum 3.0 m/s.

All sanitary sewers shall be sized to handle the theoretical daily peak flow per the City's requirement, the sanitary sewage flows have been estimated using the following formula:

$$Q = \frac{PqM}{86.4} + IA$$

The subject lands are zoned for specific residential and commercial use, the following population density has been used as shown in the following **Table 3.1**, along with the calculated sanitary flow values for the subject lands. The ground level of the proposed building is planned to be commercial/retail, as such the area of the floorplan (0.036 hectares) was used in conjunction with the City of Barrie design criteria for commercial developments (28 m³/day/ha) in order to calculate the sanitary design flow for the ground floor.

Table 3-1 Sanitary Flow Calculation Values

Housing Type	Persons /Unit	Area (Ha)	Units	Population	Peak Factor	Design Flow (L/Sec)	Infiltration (L/Sec)	Total Flow (L/Sec)
Apartment	1.67	0.89	437	730	3.9	14.83	0.09	14.92
Retail		0.036				0.10		0.10
Total								15.02

Reviewing the existing sanitary design sheets and drainage area plan provided by R.J. Burnside for the existing sanitary sewer system on Brown Bear Street, the site was assumed to be commercial with an approximate calculated flow of 0.458 L/s. The calculated total sanitary flow for the proposed development is higher than the previous assumed flow shown in the existing sanitary design sheets. Given the estimated capacity of the sewers in the design sheets, the proposed development's sanitary flows can be accommodated by the existing sanitary sewers on Brown Bear Street through to the last leg of sanitary sewer on Mabern Street. Refer to **Appendix D** for the existing sanitary design sheets for the adjacent development by R.J. Burnside & Associates Ltd.

3.4 Stormwater Management

This section provides a stormwater management (SWM) review of the existing and proposed conditions.

The following documents were used in the preparation of this assessment:

- Bear Creek Ridge, City of Barrie, Stormwater Management Report, R.J. Burnside & Associates Limited, May 2018;
- Bear Creek Ridge, City of Barrie, Functional Servicing and Stormwater Management Report, R.J. Burnside & Associates Limited, November 2, 2017;

The stormwater management criteria for this development are based on the requirements of the City of Barrie, and the analysis provided in the subdivision SWM and FSR, and the requirements include:

- An area of 0.35 ha with a runoff coefficient C value of 0.60 has been allotted for the subject lands, with a connection to the existing 375mm storm sewer on Brown Bear Street (Area C1 on Burnside Drawing No. C302).
- Stormwater quantity controls up to the 100-year storm event are provided in the existing subdivision stormwater management pond to the north, based on a maximum allowable imperviousness of 77 percent (Areas M106 and R105 on FIG-4 in the subdivision SWM Report).
- Stormwater quality controls to an Enhanced Protection Level are provided in the existing subdivision stormwater management pond to the north, based on a maximum allowable imperviousness of 77 percent.
- Infiltration and phosphorus control are provided using a combination of Low Impact Development (LID) techniques throughout the subdivision, including the stormwater management pond, infiltration galleries, and catch basin inserts to retain sediment.

The SWM pond for the subdivision north of the subject site was designed to provide stormwater quantity control, stormwater quality control, and phosphorus attenuation. However, peak flow controls will be required for the 5-year storm event to the allowable rate allocated for the site.

3.4.1 Existing Drainage Conditions

The western portion of the site (Block 281) drains west toward Brown Bear Street. The eastern portion of the site (municipal address of 901 Essa Road.) drains east toward Essa Road. Refer to **Drawing DAP-1** in **Appendix C** for the existing drainage area plan.

Block 281 is currently used as a construction staging area for the adjacent subdivision development, and the 901 Essa Road Property is currently under residential use.

3.4.2 Proposed Drainage Conditions

Based on the current site plan, the proposed development will consist of an apartment building, a private laneway, parking areas and landscaped areas. An on-site storm sewer system will capture the 5-year storm runoff from the internal roads, buildings, hardscape, and landscaped areas, and this runoff will be routed to a SWM storage tank. For storms greater than the 5-year storm, overland flow routes will be created, generally following the internal roads, with flows spilling to Brown Bear Road at the proposed driveway entrance. The storm sewer and overland flow will convey stormwater to the existing subdivision SWM pond to the north of the site. Refer to **Drawing DAP-2** in **Appendix C** for the proposed drainage area plan.

3.4.3 Stormwater Quantity Control

Based on FIG-4 of the SWM Report provided by R.J. Burnside (included in **Appendix A**), the subject lands have been allocated a total imperviousness of 77 percent. The total site imperviousness is proposed to be 80 percent. On-site attenuation will be provided to reduce peak flows to the required levels outlined below.

Based on Burnside Drawing No. C302, an area of 0.35 ha with a runoff coefficient of 0.60 has been allocated to outlet to the 375 mm diameter storm sewer on Brown Bear Street. Based on this area, the allowable 5-year peak flow to the storm sewer is 0.064 m³/s. Refer to **Appendix C** for calculations.

A three-hour duration storm derived from City of Barrie rainfall IDF data was used for the stormwater management modelling for the 5-year storm event to determine the volume of on-site storage required to attenuate the flow to the required level. The total depth of rainfall for the modelled storm is as indicated in **Table 3.2**.

Table 3-2 Rainfall Depths

Return Event	Storm Duration (Hours)	Rainfall Depth (mm)
5 Year	3	47.0

The proposed conditions have been modelled using Visual OTTHYMO, and modelling variables are summarized in **Table 3.3** with the detailed modelling output included in **Appendix C**.

Table 3.3 provides a summary of the proposed drainage areas and modelling variables. Refer to Drawing **DAP-2** for the proposed conditions drainage area plan.

Table 3-3 Visual OTTHYMO Modelling Variables

Catchment ID	Description	Area (Ha)	TIMP/XIMP	Gradient (%)	Perv. Mannings N	TP (Hours)	Pervious CN
A-1	Developing Site	0.870	0.802	1	0.250	-	72
Total		0.870	0.802				

Underground stormwater storage will be provided in a SWM tank to be located in the P1 and P2 parking levels at the southwest part of the proposed building. Site drainage from Area A-1 will be directed to the SWM tank via catch basins and area drains. Since a gravity outlet is not feasible given the depth of the storage tank, the outlet from the tank will be fitted with pumps (designed by mechanical engineer at detail design stage) to provide flow attenuation prior to runoff discharging to the Brown Bear Street storm sewer, with a maximum pumped release rate of 64 L/s.

A total of 135 m³ of active tank storage is proposed in the underground storage tank to attenuate the 5-year storm event.

Additional stormwater quantity storage and attenuation could also be provided on rooftop area using control flow roof drains. This option will be explored at final design.

The target and proposed peak flows from the site are summarized in **Table 3.4**, and the Visual OTTHYMO model output is included in **Appendix D**. Refer to the engineering drawings in **Appendix B** for locations and details of stormwater management controls.

Table 3-4 **Peak Discharges**

Return Event	2 Year Target	Proposed Conditions
	Peak Discharge (m ³ /s)	Peak Discharge (m ³ /s)
5 Year	0.064	0.064

As indicated in **Table 3.4**, the proposed design results in the 5-year peak flow from the property meeting the peak flow target value.

3.4.4 Stormwater Quality Control & Phosphorous Control

Stormwater quality controls are required to meet an Enhanced Protection with 80 percent total TSS removal, as defined by the Ministry of the Environment, Conservation & Parks (MECP) 2003 Stormwater Management Planning and Design (SWMPD) Manual.

Stormwater quality control, infiltration, and phosphorus control are provided using a combination of LID techniques throughout the adjacent subdivision, including the stormwater management pond, infiltration galleries, and catch basin inserts to retain sediment and phosphorus. The site will include 0.1726 ha of pervious landscaped amenity space to provide additional retention of runoff.

3.5 Water Supply System

3.5.1 Existing System

The subject site is located within the City's Pressure Zone (PZ) 3S, which is mainly supplied from the Big Bay Booster Station (BS) and the Mapleview Drive Elevated Tank (ET). The ET provides water storage and maintains system pressure for the PZ3S. The (Top Water Level, TWL) is approximately equal to 350m.

The subject site has existing municipal water infrastructures as noted:

- i. A 300mm diameter watermain is located along Koda Street
- ii. A 300mm diameter watermain is located along Brown Bear Street west of the site.

As per City's hydrant flow test in 2019, the estimated available system head / pressure along the existing pipelines in the vicinity of the proposed development are as follows:

- Flow along Koda Street: Available flow is approximate 240 L/s at 20 psi.
- Flow along Brown Bear Street: Available flow is approximate 163 L/s at 20 psi.

Two hydrant tests were recently conducted on November 3, 2023, similar results were found:

- Flow along Koda Street: Available flow is approximate 210 L/s at 20 psi.
- Flow along Brown Bear Street: Available flow is approximate 197 L/s at 20 psi and the test results were used as the boundary water supply for modelling analysis.

3.5.2 Proposed Water Supply

A water connection (for fire and domestic flow) will be made to the existing 300 mm watermain along Brown Bear Street. See watermain servicing plan as shown in **Appendix B**. Flow supply to the area in the vicinity of the site is from the 300 mm watermain along Brown Bear Street.

For the purposes of this report, the City's 2022 Design Criteria for Water Transmission and Distribution Design Standard were used to estimate the system design pressure and demand for the development.

Population	High Density (apartment dwellings): 1.67 persons per unit
Average Day Demand (ADD)	Domestic - 225 litres/capita/day
Commercial / Institutional	28m ³ /ha/day
Peak Factors	As Per Design Guidelines for Drinking –Water Systems, Ministry Environment Conservation and Park (MECP) 2008, the peaking factors for population 300 to 1000 are shown below: Maximum Day Demand (MDD): Peaking Factor 2.75 of ADD Peak Hour Demand (PHD): Peaking Factor 4.13 of ADD
Fire Flow	As per the City's guidelines, the Fire Underwriters Survey (FUS) was accepted and selected for the fire flow calculation for the proposed development.
System Pressure	Minimum pressure during peak hourly demand: 275kPa Preferred Operating Pressure Range: 350 to 485kPa Maximum Pressure Under Minimum Hour Demand: 700kPa Minimum Pressure During Maximum Day + Fire Flow: 140 kPa

C- Factors	150mm	C=100
	200 and 250mm	C=110 300 mm C=120

3.5.3 Estimated Water Demand

Based on the site statistic data for the proposed development, and the estimated residential population and water demand are shown in **Table 3.5**. The estimated water demands are 1.6L/s, 4.6L/s, and 6.9L/s for Average Day Demand (ADD), Maximum Day Demand (MDD), and Peak Hour Demand (PHD), respectively.

The required fire flow was determined in accordance to the calculations from the FUS. The following assumptions have been made for the fire flow estimations:

- Consist of fire-resistive construction with vertical openings and exterior communications adequately protected (one hour rating).
- Consist of Limited Combustible occupancy.
- Provision of automatic sprinkler protection systems (including adequately designed system confirming to NFPA sprinkler standards, standard water supply system and fire department hose lines, and fully supervised system).

Based on the above assumptions, the required fire flow (see **Appendix E** for details) is approximately 117L/s.

Table 3-5 Estimated Water Demand

Housing Type	Commercial Area (HA)	Persons/ Unit	Units	Population	Water Demand (L/s)			
					ADD	MDD	PHD	Fire Flow
Apartment	-	1.67	437	743	1.9	5.4	8.0	117
Retail	0.036	-	-	-	0.01	0.03	0.05	
Sub-Total	0.036	-	437	743	1.9	5.4	8.0	-

3.5.4 Proposed System Pressure

Two hydrant tests were conducted and indicated that adequate potable water supply and fire protection is available at the service connection to the subject site.

The WaterCAD hydraulic model was used to estimate the system pressures along the watermain for the proposed development conditions. A dummy reservoir was used in model as the water supply boundary. These represented the available system head and flow on Brown Bear Road at the 2nd hydrant from Salem Road.

The estimated system heads/pressures for the proposed development under normal operation conditions (i.e., ADD, MDD, and PHD) are summarized in **Table 3.6** (see also see **Appendix E** for the field hydrant test results).

Table 3-6 Proposed System Head and Pressure

Design Condition	System Head (m)	System Pressure (kPa)
Normal Operations (ADD, MDD and PHD)	348 (345)*	352 (322)*
Maximum Day + Fire Flow 100L/s	336 (331)*	242 (210)*

*Lower system heads (around 3 m lower) and pressures may be detected near the subject site, when the Maplevue Drive ET is near its low water level.

As shown in **Table 3.6**, there are no significant pressure reductions with the proposed development under the normal operation conditions (ADD, MDD and PHD). The estimated system pressure near the subject site connection is approximately 314 kPa under proposed development conditions.

The estimated static system pressure ranges from 322 to 348 kPa under the normal operations (ADD, MDD and PHD). These meet the City's suggested pressure ranges between 275 kPa to 700 kPa under the normal operating conditions.

As shown in **Table 3.6**, a fire flow under the MDD demand is greater than 210 kPa. The available fire flows at the existing hydrant along Brown Bear Road near the service connection for the proposed development. The available fire flow at the service connection is greater than the required fire flow 117 L/s (at pressure 140 kPa) for the subject development. It meets the City's minimum pressure requirement of 140 kPa under the MDD plus fire flow conditions - See **Appendix E** for details.

3.5.5 Hydrant Coverage

There are two existing fire hydrants along Brown Bear Street in the vicinity of the proposed development. Two additional hydrants are to be proposed within subject site. These hydrants will provide the necessary coverage for the residential development block. Refer to **Drawing SS-01** in **Appendix B**.

3.5.6 Proposed Watermain Connections

From the property line, both the domestic and fire water services will be brought into the P1 parking level. A water meter and a backflow preventer will be provided for the domestic water service while a double check detector assembly will be provided for the fire water service. The proposed water service will be connected to the existing 200 mm diameter watermain along Brown Bear Street. The proposed connection will be designed and installed as per City Standard.

Refer to **Drawing SS-01** for **Site Servicing Plan** in **Appendix B**.

3.6 Utilities

Utilities such as: hydro, gas, telephone, and cable services are present and can be extended to service the proposed development from the existing subdivision adjacent to the subject site. Use of these utilities will be verified and confirmed at the detail design phase.

4 Erosion and Sediment Control

Prior to construction, erosion and sediment control measures will be required in accordance with the City of Barrie, County of Simcoe and Nottawasaga Valley Region Conservation Authority. Details of these controls has been provided, refer to the preliminary erosion and sediment control plan **ESC-1** in **Appendix B**. The plan includes the following as a minimum:

- Silt fences erected around the site perimeter before any grading or topsoil stripping begins on the site to protect adjacent areas from migration of sediment in runoff.
- Re-establishment/maintenance of the existing “mud mat” at the construction entrance to the site to minimize the amount of sediment transported off site by construction vehicles.
- Stabilization of all disturbed areas to minimize the opportunity for erosion.
- Stabilization of slopes greater than 5:1 using suitable methods (e.g. erosion control mats, tackifier and seed, etc.) as soon as practical.
- Use of temporary sediment traps, swales, catch basin protection filters to control sedimentation.

5 Conclusions and Recommendations

This report demonstrates that the proposed 901 Essa Road Residential Development is feasible from a civil engineering and stormwater management (SWM) perspective in accordance with the City of Barrie, County of Simcoe, and Nottawasaga Valley Region Conservation Authority (NVCA) Engineering Design Standards. The following summarizes key aspects of the design:

- The proposed site grading will achieve compliant site gradients and match into the existing and ultimate road widening grades at its limits.
- The proposed development will outlet sanitary sewage into municipal infrastructure by connecting into the existing sanitary manhole at daylight of Brown Bear Street and Salem Road.
- Stormwater management and storm design for the proposed development will provide quantity control using a SWM storage tank to control the 5-year peak flow to required levels for the receiving storm sewer. A downstream stormwater management pond will attenuate the proposed conditions peak flows for events up to 100-year storm to the required levels.
- The proposed development will connect to the existing 300mm diameter watermain located on Brown Bear Street to satisfy domestic water demand and fire flow requirements. A field hydrant testing is recommended to be preformed along the existing watermain in the vicinity of the subject site. The test results will be used to fine-tune the findings and recommendations on the water system in the report.

We trust the foregoing in conjunction with the functional engineering drawings are satisfactory to demonstrate the development's feasibility from a municipal engineering perspective to support the rezoning application for the development. Should there be any questions or if further information required, please do not hesitate to contact Arcadis Professional Services (Canada) Inc.

Figures



LOCATION PLAN
901 ESSA ROAD,
CITY OF BARRIE, ONTARIO

DATE: NOVEMBER 2022

PROJECT No.: 141031

SCALE: N.T.S.

FIGURE No.: 1

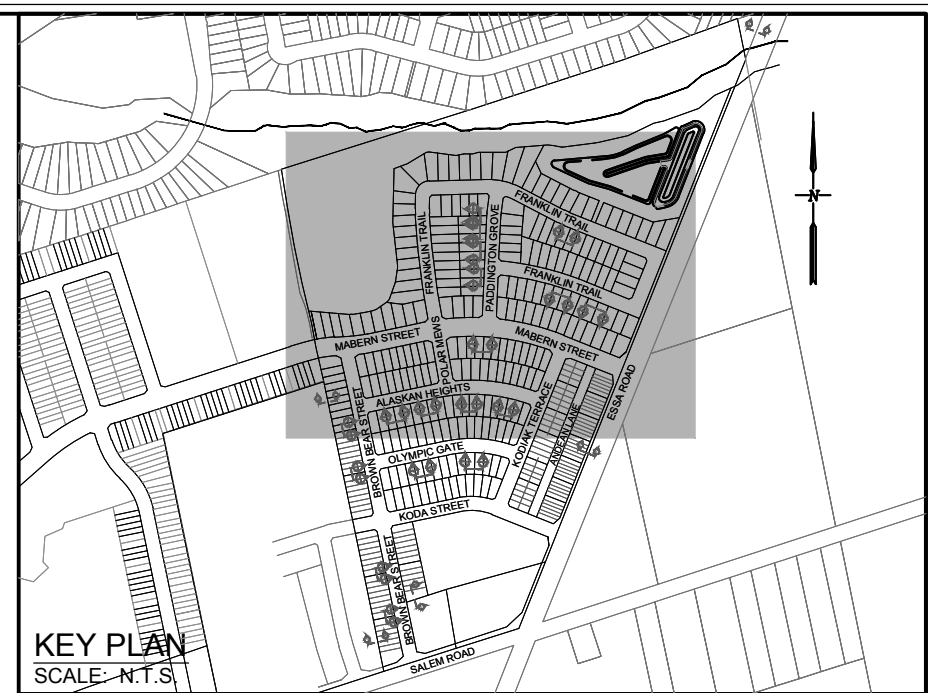


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Appendix A

Background Information



LEGEND	
	SUBCATCHMENT I.D.
	RUNOFF COEFFICIENT
	DRAINAGE AREA IN HECTARES
	EXTERNAL SUBCATCHMENT I.D.
	RUNOFF COEFFICIENT
	DRAINAGE AREA IN HECTARES
	STORM SEWER TRIBUTARY BOUNDARY BY JONES CONSULTANT
	RLCB/SINGLE CATCHBASIN
	DOUBLE CATCHBASIN
	SANITARY MANHOLE
	CATCHBASIN MANHOLE
	PROPOSED OVERLAND FLOW DIRECTION
	EXISTING OVERLAND FLOW DIRECTION
	PROPOSED OVERLAND LOT FLOW DIRECTION

SURVEY NOTES:

- ORIGINAL TOPOGRAPHIC SURVEY AND CADD INFORMATION PROVIDED BY RUDY MAK SURVEYING LIMITED.
- ELEVATIONS SHOWN HEREON ARE GEODETIC BASED ON THE CITY OF BARRIE'S WEBSITE.

HORIZONTAL & VERTICAL CONTROL MONUMENTS:

- ELEVATION ARE GEODETIC IN ORIGIN AND WERE DERIVED FROM SPECIFIED CONTROL POINTS 03120110001 (ELEVATION = 312.51, CGVD-1928:1978) AND 03120110003 (ELEVATION = 309.87, CGVD-1928:1978).

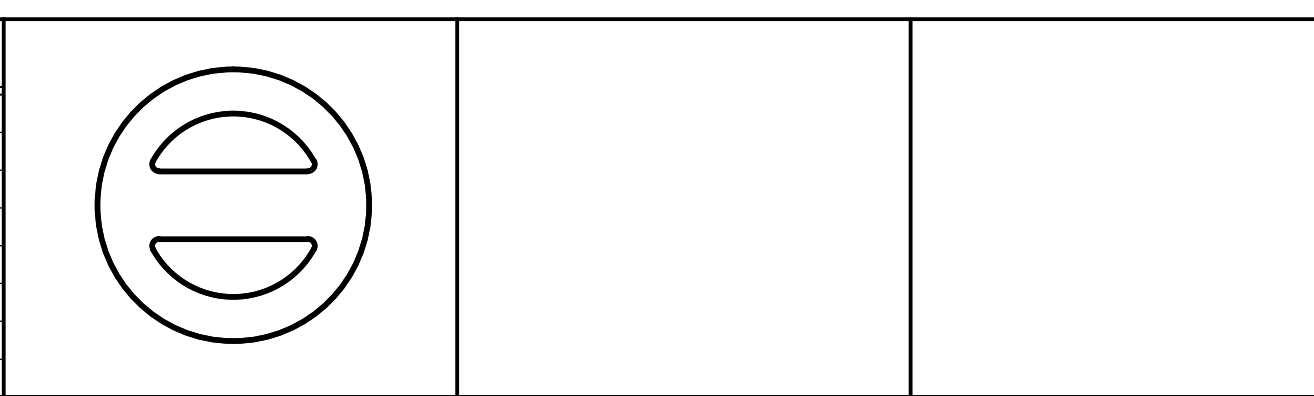
LOCAL BENCHMARK:

- SITE BENCHMARK IS THE TOP OF THE CONTROL MONUMENT 03120110001 HAVING AN ELEVATION OF 312.51

BEARING NOTE

- BEARINGS ARE UTM GRID, DERIVED FROM SPECIFIED CONTROL POINTS 03120110001 AND 03120110003, UTM ZONE 17, NAD 83 (ORIGINAL).
- FOR BEARING COMPARISONS, A ROTATION OF 00°50'45" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLAN 51R-35523.

No.	Issue / Revision	Date	Auth.
3	ISSUED FOR SECOND SUBMISSION	18/06/09	SW
4	ISSUED FOR CONSTRUCTION	18/07/10	SW
5	ISSUED FOR THIRD SUBMISSION	18/07/17	SW
6	ISSUED FOR FOURTH SUBMISSION	18/08/17	SW
7	ISSUED FOR FIFTH SUBMISSION	18/09/20	SW
8	REVISED TO REFLECT MUNICIPAL ASSET ID'S	18/10/24	SW
9	FINAL FOR REGISTRATION	19/01/16	SW
10	AS-CONSTRUCTED (UNDERGROUND)	19/07/29	SW



Barrie
ENGINEERING DEPARTMENT

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Drawing Title

BEAR CREEK RIDGE DEVELOPMENT

STORM DRAINAGE AREA PLAN (2 OF 2)

Drawn PH	Checked SW	Designed SW	Checked EG	Date 18/02/28	Drawing No.
Project No. 300032668		Contract No. D12-422		Revision No. 10	C302
Scale 1:750					

AS-CONSTRUCTED

STORM SEWER DESIGN SHEET: (5 Year Storm)



Bear Creek Ridge, City Of Barrie

Project #: 032868
Date: 11-Jul-18
Designed: PH
Checked: SW

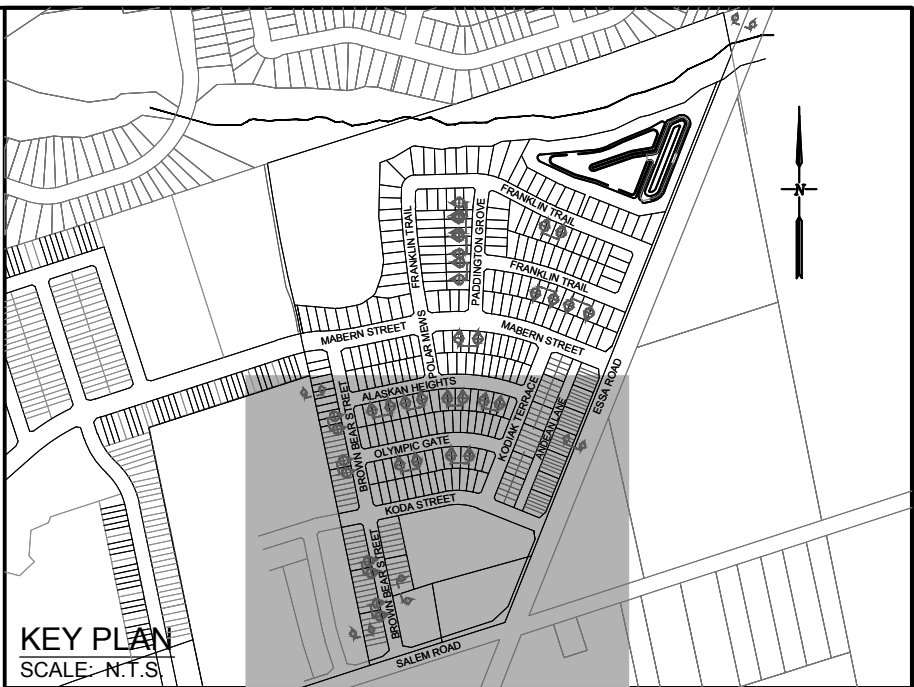
Min. Diameter = 300 mm
Mannings 'n' = 0.013
Starting Tc = 10 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$ where Tc is in minutes
A = 853.608
B = 4.699
C = 0.766
(5 Yr)

Min. Velocity = 0.75 m/s
Max. Velocity = 4.00 m/s

NOMINAL PIPE SIZE USED

DESCRIPTION	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (‰)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
S36	DBBR04038	DBBR04036	0.32	0.30	0.10	0.10	108.9	0.029			0.029	53.1	1.53	300	0.120	1.69	10.00	0.52	10.52	24%
S37	DBBR04036	DBBR04035	0.04	0.30	0.01	0.11	106.0	0.032			0.032	12.1	1.49	300	0.118	1.67	10.52	0.12	10.64	27%
S35	DBBR04035	DBBR04028	0.40	0.30	0.12	0.23	105.4	0.067			0.067	77.6	1.49	375	0.214	1.94	10.64	0.67	11.31	31%
S35	DBBR04028	DBBR04029				0.23	102.0	0.065			0.065	5.6	1.96	375	0.245	2.22	11.31	0.04	11.35	26%
S22	DBBR04040	DBBR04042	0.51	0.30	0.15	0.15	108.9	0.046			0.046	50.4	0.69	375	0.146	1.32	10.00	0.64	10.64	32%
S21	DBBR04042	DBBR04045	0.37	0.30	0.11	0.26	105.4	0.077			0.077	61.1	0.88	375	0.164	1.49	10.64	0.68	11.32	47%
S20	DBBR04045	DBBR04047	0.26	0.30	0.08	0.34	102.0	0.097			0.097	34.6	0.93	375	0.169	1.53	11.32	0.38	11.70	57%
S20	DBBR04047	DBBR04051				0.34	100.2	0.095			0.095	9.3	0.97	450	0.281	1.77	11.70	0.09	11.79	34%
S19	DBBR04052	DBBR04051	0.25	0.30	0.08	0.08	108.9	0.023			0.023	11.1	0.81	300	0.087	1.23	10.00	0.15	10.15	26%
S26	DBBR04051	DBBR04019	0.63	0.30	0.19	0.61	99.8	0.168			0.168	91.2	0.45	675	0.564	1.58	11.79	0.96	12.75	30%
S26	DBBR04019	DBBR04017				0.61	95.5	0.161			0.161	12.6	2.36	675	1.291	3.61	12.75	0.06	12.81	12%
M10	DBBR03939	DBBR03941	0.46	0.50	0.23	0.23	108.9	0.070			0.070	84.9	1.38	300	0.114	1.61	10.00	0.88	10.88	61%
M8	DBBR03941	DBBR03904	0.35	0.50	0.18	0.41	104.2	0.117			0.117	81.7	1.04	375	0.179	1.62	10.88	0.84	11.72	66%
M9	DBBR03904	DBBR03901				0.41	100.1	0.113			0.113	9.9	2.02	375	0.249	2.26	11.72	0.07	11.79	45%
S23	DBBR03894	DBBR03893	0.28	0.30	0.08	0.08	108.9	0.025			0.025	27.5	0.51	450	0.204	1.28	10.00	0.36	10.36	12%
S32	DBBR03936	DBBR03933	0.18	0.30	0.05	0.05	108.9	0.016			0.016	46.1	1.04	300	0.099	1.40	10.00	0.55	10.55	17%
S3	DBBR03932	DBBR03933	0.32	0.30	0.10	0.10	108.9	0.029			0.029	20.6	1.84	300	0.131	1.86	10.00	0.19	10.19	22%
M7	DBBR03933	DBBR03930	0.03	0.50	0.02	0.17	105.9	0.049			0.049	17.0	0.53	375	0.128	1.16	10.55	0.25	10.80	38%
M8	DBBR03930	DBBR03923	0.18	0.50	0.09	0.26	104.6	0.074			0.074	57.9	0.50	375	0.124	1.12	10.80	0.86	11.66	60%
S6	DBBR03927	DBBR03923	0.45	0.30	0.14	0.14	108.9	0.041			0.041	61.4	1.55	300	0.120	1.70	10.00	0.60	10.60	34%
M11	DBBR03923	DBBR03922	0.03	0.50	0.02	0.41	100.4	0.113			0.113	11.6	1.73	375	0.231	2.09	11.66	0.09	11.75	49%
M12	DBBR03922	DBBR03919	0.17	0.50	0.09	0.49	99.9	0.136			0.136	58.1	1.82	375	0.237	2.14	11.75	0.45	12.20	58%
M13	DBBR03919	DBBR03899	0.25	0.50	0.13	0.62	97.9	0.163			0.167	67.8	1.02	450	0.288	1.81	12.20	0.62	12.82	58%
M13	DBBR03899	DBBR03893				0.62	95.2	0.163			0.163	7.8	0.39	525	0.269	1.24	12.82	0.10	12.93	61%
S17	DBBR03893	DBBR03891	0.39	0.30	0.12	0.73	94.8	0.193			0.193	54.0	0.48	675	0.582	1.63	12.93	0.55	13.48	33%
S16	DBBR03891	DBBR04056	0.35	0.30	0.11	0.84	92.6	0.215			0.215	52.2	0.44	750	0.738	1.67	13.48	0.52	14.00	29%
S15	DBBR04056	DBBR04004	0.46	0.30	0.14	0.98	90.6	0.245			0.245	56.7	0.46	750	0.755	1.71	14.00	0.55	14.56	32%
C1	COMMERCIAL	DBBR03974	0.35	0.60	0.21	0.21	260.9	0.152			0.152									
M6	DBBR03974	DBBR03968	0.33	0.50	0.17	0.38	108.9	0.113			0.113	65.2	1.06	375	0.181	1.63	10.00	0.66	10.66	63%
404	DBBR03963	DBBR03962	0.04	0.20	0.01	0.01	108.9	0.002			0.002	7.4	4.38	250	0.202	2.86	10.00	0.04	10.04	1%
A1/100yr 24hr-SCS FROM JONES' SSWMR OCT 16, and M14	CBMH06	DBBR03972	0.04	0.50	0.02	0.02	108.9	0.006	0.033	0.033	0.039	28.0	3.39	450	0.525	3.30	10.00	0.14	10.14	7%
Drainage Easement	DBBR03972	DBBR03968				0.02	108.1	0.006		0.033	0.039	7.4	4.08	450	0.576	3.62	10.14	0.03	10.18	7%
M5	DBBR03968	DBBR03966	0.21	0.50	0.11	0.50	105.3	0.146	0.033	0.179	41.9	0.72	450	0.242	1.52	10.66	0.46	11.12	74%	
M4	DBBR03966	DBBR03956	0.49	0.50	0.25	0.75	102.9	0.213	0.033	0.246	60.1	0.63	525	0.341	1.58	11.12	0.64	11.76	72%	
M4	DBBR03956	DBBR03955				0.75	99.9	0.207	0.033	0.240	4.0	0.76	525	0.375	1.73	11.76	0.04	11.80	64%	
S38	DBBR03997	DBBR03977	0.11	0.30	0.03	0.03	108.9	0.010			0.010	13.7	1.46	300	0.117	1.65	10.00	0.14	10.14	9%
M3	DBBR03954	DBBR03955					108.9					15.1	1.98	300	0.136	1.92	10.00	0.13	10.13	
S1	DBBR03962	DBBR03955	0.28	0.30	0.08	0.09	108.7	0.027			0.027	35.7	2.46	300	0.152	2.15	10.04	0.28	10.32	18%
M3	DBBR03955	DBBR03952	0.09	0.50	0.05	0.88	99.7	0.244	0.033	0.277	16.5	0.85	525	0.396	1.83	11.80	0.15	11.95	70%	
M2	DBBR03952	DBBR03949	0.28	0.50	0.14	1.02	99.0	0.281	0.033	0.314	57.5	0.64	600	0.491	1.74	11.95	0.55	12.50	64%	
S4	DBBR03987	DBBR03949	0.70	0.30	0.21	0.21	108.9	0.064			0.064	62.9	1.94	300	0.135	1.91	10.00	0.55	10.55	47%
M1	DBBR03949	DBBR03945	0.21	0.50	0.11	1.34	96.6	0.358	0.033	0.391	15.8	0.82	600	0.556	1.97	12.50	0.13	12.63	70%	
M1	DBBR03945	DBBR03943				1.34	96.0	0.356	0.033	0.389	34.5	0.75	675	0.728	2.03	12.63	0.28	12.92	53%	
S11	DBBR03943	DBBR03995	0.44	0.30	0.13	1.47	94.8	0.387	0.033	0.420	92.6	0.92	675	0.806	2.25	12.92	0.68	13.60	52%	
S11	DBBR03995	DBBR03977				1.47	92.1	0.376	0.033	0.409	8.1	0.37	675	0.511	1.43	13.60	0.09	13.70	80%	
S12	DBBR03977	DBBR03979	0.32	0.30	0.10	1.60	91.7	0.407	0.033	0.440	51.3	0.55	750	0.826	1.87	13.70	0.46	14.15	53%	
S13	DBBR03979	DBBR04004	0.44	0.30	0.13	1.73	90.0	0.432	0.033	0.465	67.3	0.46	750	0.755	1.71	14.15	0.66	14.81	62%	
S9	DBBR03917	DBBR03913	0.51	0.30	0.15	0.15	108.9	0.046			0.046	52.1	0.69	300	0.080	1.14	10.00	0.76	10.76	58%
S8	DBBR03913	DBBR03911	0.21	0.30	0.06	0.22	104.8	0.063			0.063	23.9	1.34	300	0.112	1.58	10.76	0.25	11.02	56%
S7	DBBR03906	DBBR03911	0.80	0.30	0.24	0.24	108.9	0.073			0.073	75.5	0.89	300	0.091	1.29	10.00	0.97	10.97	80%
S14	DBBR03911	DBBR04003	0.10	0.30	0.03	0.49	103.5	0.140			0.140	63.9	1.21	450	0.314	1.97	11.02	0.54	11.56	45%
S14	DBBR04003	DBBR04004				0.49	100.8	0.136			0.136	11.3	1.04	450	0.291	1.83	11.56	0.10	11.66	47%
S18	DBBR04004	DBBR04005	0.29	0.30	0.09	3.28	87.7	0.798	0.033	0.831	17.6	0.68	1050	2.252	2.60	14.81	0.11	14.92	37%	
S18	DBBR04005	DBBR03980				3.28	87.3	0.795	0.033	0.828	60.9	0.43	1050	1.791	2.07	14.92	0.49	15.41	46%	
S25	DBBR03980	DBBR03840	0.38	0.30	0.11	3.39	85.7	0.807	0.033	0.840	70.5	0.47	1050	1.872	2.16	15.41	0.54	15.96	45%	
S28	DBBR03840	DBBR04010	0.07	0.30	0.02	3.41	83.9	0.796	0.033	0.829	25.4	0.83	1050	2.488	2.87	15.96	0.15	16.10	33%	
S27	DBBR04010	DBBR04011	0.04	0.30	0.01	3.42	83.5	0.794	0.033	0.827	11.5	0.61	1050	2.133	2.46	16.10	0.08	16.18		



- LEGEND**
- L1** AREA ID NUMBER (RESIDENTIAL)
 - 4 45** NUMBER OF UNITS
 - AREA IN HECTARES**
 - C1** AREA ID NUMBER (COMMERCIAL/MIX USE)
 - 1.06** AREA IN HECTARES
 - 0.324** FLOW RATE (LITER/SECOND)
 - SANMH13** SANITARY SEWER/MANHOLE
 - SANITARY SINGLE HOUSE CONNECTION**
 - SANITARY SEWER TRIBUTARY BOUNDARY**

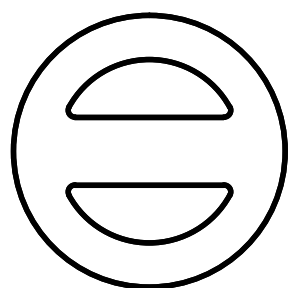
- SURVEY NOTES:**
1. ORIGINAL TOPOGRAPHIC SURVEY AND CADD INFORMATION PROVIDED BY RUDY MAK SURVEYING LIMITED.
 2. ELEVATIONS SHOWN HEREON ARE GEODETIC BASED ON THE CITY OF BARRIE'S WEBSITE.
- HORIZONTAL & VERTICAL CONTROL MONUMENTS:
- ELEVATION ARE GEODETIC IN ORIGIN AND WERE DERIVED FROM SPECIFIED CONTROL POINTS 03120110001 (ELEVATION = 312.51, CGVD-1928:1978) AND 03120110003 (ELEVATION = 309.87, CGVD-1928:1978).
- LOCAL BENCHMARK:
- SITE BENCHMARK IS THE TOP OF THE CONTROL MONUMENT 03120110001 HAVING AN ELEVATION OF 312.51
- BEARING NOTE
- BEARINGS ARE UTM GRID, DERIVED FROM SPECIFIED CONTROL POINTS 03120110001 AND 03120110003, UTM ZONE 17, NAD 83 (ORIGINAL).
 - FOR BEARING COMPARISONS, A ROTATION OF 00°50'45" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLAN 51R-35523.

Notes

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

AS-CONSTRUCTED

No.	Issue / Revision	Date	Auth.
3	ISSUED FOR SECOND SUBMISSION	18/06/09	SW
4	ISSUED FOR CONSTRUCTION	18/07/10	SW
5	ISSUED FOR THIRD SUBMISSION	18/07/17	SW
6	ISSUED FOR FOURTH SUBMISSION	18/08/17	SW
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9	FINAL FOR REGISTRATION	19/01/16	SW
10	AS-CONSTRUCTED (UNDERGROUND)	19/07/29	SW



Barrie
ENGINEERING DEPARTMENT



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Client
CRISDAWN CONSTRUCTION INC.
27 CLAPPERTON STREET
BARRIE, ON
L4M 3E6

Drawing Title				Drawing No.
BEAR CREEK RIDGE DEVELOPMENT				C305
SANITARY DRAINAGE AREA PLAN (2 OF 2)				
Drawn PH	Checked SW	Designed SW	Checked EG	
Project No. 300032868	Contract No. D12-422	Revision No. 10	Date 18/02/28	
Scale 1:750	0 10 20 40m			

SANITARY SEWER DESIGN																	DESIGN SHEET												
Development Details Basis																	FILE NO 32868												
Numbers in blue or text in red are equations (Harmon or Babbitt peaking factor where; M ≥ 2), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use.																	CONTRACT / PROJECT Bear Creek Ridge Subdivision												
Q _p = P*q*M/86.4 Q _e = I*A Q _{tot} = Q _p + Q _e + Q _c																	225 litres/person/day. (Peak extraneous flow: I= 0.1L/s/ha over development area) (Total peak flow as the sum of peak population flow and peak extraneous flow)												
STREET	AREA ID	MAINTENANCE HOLE		DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBIT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q _p (l/s)	AREA (ha)	AREA (ACC) (ha)	Q _e (l/s)	COMMERCIAL/ INDUSTRIAL FLOW RATE (l/s/ha)	COMMERCIAL/ INDUSTRIAL FLOW	Q _c (l/s)	Q _{tot} (l/s)	L (m)	D (mm)	S (%)	Q _f FULL (l/s)	d/D ⁽²⁾	d/D ⁽³⁾ >0.5 or >0.85	Velocity FULL (m/s)	Velocity Partial ⁽¹⁾ (m/s)	Velocity ⁽⁴⁾ > 0.6 (m/s)	
		FROM	TO																										
Franklin Trail	L1	SAP33216	SAP33214	5	5	3.13	16.00	16.00	11.433	4.393	11.433	0.476	0.33	0.33	0.033				0.509	56.1	200	2.30	49.741	0.071	Ok	1.58	0.50	n/a	
ESSA ⁽⁶⁾	EXT	EXT	SAP33215	261	261	3.13	817.00	817.00	5.206	3.855	5.206	11.077	10.44	10.44	1.044				12.121										
ESSA ⁽⁶⁾	EXT	EXT	SAP33215						MIXED USE										0.324	5.01	5.01	6.559	BY OTHERS						
Franklin Trail	L2	SAP33215	SAP33214		261	3.13		817.00	5.206	3.855	5.206	11.077		25.91	2.591			5.01	18.680	13.3	250	1.20	65.143	0.366	Ok	1.33	1.10	Ok	
Franklin Trail	L2	SAP33214	SAP33213	1	267	3.13	4.00	837.00	5.181	3.848	5.181	11.293	0.09	26.33	2.633			5.01	18.939	14.4	300	0.28	51.169	0.421	Ok	0.72	0.64	Ok	
Franklin Trail	L3	SAP33213	SAP33212	14	281	3.13	44.00	881.00	5.128	3.835	5.128	11.766	0.75	27.08	2.708			5.01	19.486	103.3	300	0.38	59.610	0.393	Ok	0.84	0.72	Ok	
Franklin Trail	L4	SAP33212	SAP33211	12	293	3.13	36.00	919.00	5.085	3.823	5.085	12.170	0.70	27.78	2.778			5.01	19.960	94.5	300	0.36	58.020	0.404	Ok	0.82	0.71	Ok	
Franklin Trail	L5	SAP33211	SAP33210	2	295	3.13	7.00	926.00	5.077	3.821	5.077	12.244	0.15	27.93	2.793			5.01	20.049	17.9	300	0.34	56.386	0.411	Ok	0.80	0.70	Ok	
Franklin Trail	L6	SAP33221	SAP33220	13	13	3.13	41.00	41.00	9.471	4.331	9.471	1.011	0.61	0.61	0.061				1.072	90.2	200	1.96	45.918	0.105	Ok	1.46	0.59	Check	
Franklin Trail	L7	SAP33220	SAP33219	6	19	3.13	19.00	60.00	8.777	4.298	8.777	1.371	0.26	0.87	0.087				1.458	41.8	200	1.63	41.874	0.127	Ok	1.33	0.61	Ok	
Franklin Trail	L8	SAP33219	SAP33218	6	25	3.13	19.00	79.00	8.307	4.270	8.307	1.709	0.31	1.18	0.118				1.827	50.2	200	1.37	38.390	0.148	Ok	1.22	0.61	Ok	
Paddington Grove	L9	SAP33222	SAP33218	3	3	3.13	10.00	10.00	12.559	4.415	12.559	0.327	0.16	0.16	0.016				0.343	38.7	200	3.28	59.401	0.054	Ok	1.89	0.50	n/a	
Paddington Grove	L10	SAP33218	SAP33217	11	39	3.13	35.00	124.00	7.591	4.217	7.591	2.451	0.52	1.86	0.186				2.637	76.4	200	1.34	37.967	0.178	Ok	1.21	0.68	Ok	
Paddington Grove	L11	SAP33217	SAP33210	1	40	3.13	4.00	128.00	7.543	4.213	7.543	2.514	0.11	1.97	0.197				2.711	26.9	200	4.73	71.332	0.133	Ok	2.27	1.06	n/a	
Franklin Trail	L12	SAP33210	SAP33209	12	347	3.13	38.00	1092.00	4.913	3.775	4.913	13.971	0.65	30.55	3.055			5.01	22.038	82.3	300	0.43	63.411	0.406	Ok	0.90	0.78	Ok	
Franklin Trail	L13	SAP33209	SAP33208	2	349	3.13	7.00	1099.00	4.906	3.773	4.906	14.042	0.17	30.72	3.072			5.01	22.127	13.8	300	0.58	73.645	0.375	Ok	1.04	0.87	Ok	
Franklin Trail	L14	SAP33208	SAP33207	2	351	3.13	7.00	1106.00	4.900	3.771	4.900	14.114	0.14	30.86	3.086			5.01	22.212	26.6	300	0.26	49.308	0.470	Ok	0.70	0.65	Ok	
Franklin Trail	L15	SAP33207	SAP33206	11	362	3.13	35.00	1141.00	4.870	3.762	4.870	14.470	0.56	31.42	3.142			5.01	22.624	70.0	300	0.39	60.390	0.424	Ok	0.85	0.76	Ok	
Franklin Trail	L16	SAP33206	SAP33205	6	368	3.13	19.00	1160.00	4.854	3.758	4.854	14.662	0.40	31.82	3.182			5.01	22.857	77.5	300	0.39	60.390	0.426	Ok	0.85	0.76	Ok	
Andean Lane	M1	SAP33247	SAP33248	38	38	2.34	89.00	89.00	8.111	4.257	8.111	1.880	0.61	0.61	0.061				1.941	109.9	200	1.96	45.918	0.140	Ok	1.46	0.72	Ok	
Andean Lane	M2	SAP33248	SAP33226	30	68	2.34	71.00	160.00	7.213	4.182	7.213	3.006	0.49	1.10	0.110				3.116	105.4	200	0.79	29.152	0.220	Ok	0.93	0.60	Ok	
Mabern Street	L17	SAP33227	SAP33226	2	2	3.13	7.00	7.00	13.488	4.428	13.488	0.246	0.15	0.15	0.015				0.261	26.5	200	1.81	44.126	0.055	Ok	1.40	0.37	Check	
Mabern Street	L18	SAP33226	SAP33225	4	74	3.13	13.00	180.00	7.046	4.164	7.046	3.303	0.24	1.49	0.149				3.452	43.1	200	0.86	30.416	0.227	Ok	0.97	0.63	Ok	
Koda Street	L31	SAP33242	SAP33241	4	4	3.13	13.00	13.00	11.917	4.403	11.917	0.403	0.15	0.15	0.015				0.418	25.1	200	2.08	47.303	0.066	Ok	1.51	0.46	n/a	
Koda Street	L19	SAP33241	SAP33240	3	7	3.13	10.00	23.00	10.632	4.372	10.632	0.637	0.15	0.30	0.030				0.667	36.5	200	1.95	45.801	0.084	Ok	1.46	0.52	Check	
Kodiak Terrace	M3	SAP33240	SAP33239	9	16	2.34	22.00	45.00	9.297	4.324	9.297	1.089	0.21	0.51	0.051				1.140	74.0	200	1.85	44.611	0.110	Ok	1.42	0.59	Check	
Olympic Gate	L20	SAP33237	SAP33238	7	7	3.13	22.00	22.00	10.727	4.375	10.727	0.615	0.28	0.28	0.028				0.643	45.5	200	2.02	46.615	0.082	Ok	1.48	0.52	n/a	
Olympic Gate	L21	SAP33238	SAP33239	8	15	3.13	26.00	48.00	9.177	4.318	9.177	1.147	0.31	0.59	0.059				1.206	49.9	200	1.98	46.151	0.111	Ok	1.47	0.62	Ok	
Kodiak Terrace	M4	SAP33239	SAP33234	9	40	2.34	22.00	115.00	7.706	4.226	7.706	2.308	0.21	1.31	0.131				2.439	70.8	200	0.95	31.968	0.186	Ok	1.02	0.59	Check	
Kodiak Terrace	M5	SAP33234	SAP33225	9	49	2.34	22.00	137.00	7.441	4.204	7.441	2.855	0.22	1.53	0.153				2.808	76.9	200	1.05	33.608	0.195	Ok	1.07	0.64	Ok	
Mabern Street	L22	SAP33225	SAP33224	8	131	3.13	26.00	343.00	6.193	4.053	6.193	5.532	0.35	3.37	0.337				5.869	50.4	200	0.54	24.102	0.336	Ok	0.77	0.62	Ok	
Mabern Street	L23	SAP33224	SAP33223	9	140	3.13	29.00	372.00	6.093	4.037	6.093	5.903	0.41	3.78	0.378				6.281	48.4	200	0.50	23.192	0.355	Ok	0.74	0.62	Ok	
Mabern Street	L24	SAP33223	SAP33205	8	148	3.13	26.00	398.00	6.012	4.023	6.012	6.231	0.48	4.26	0.426				6.657	66.4	200	0.55	24.324	0.357	Ok	0.77	0.65	Ok	
Alaskan Heights	L25	SAP33232	SAP33231	7	7	3.13	22.00	22.00	10.727	4.375	10.727	0.615	0.27	0.27	0.027				0.642	35.3	200	1.90	45.210	0.083	Ok	1.44	0.50	Check	
Alaskan Heights	L26	SAP33231	SAP33230	10	17	3.13	32.00	54.00	8.964	4.308	8.964	1.261	0.29	0.56	0.056				1.317	47.0	200	1.77	43.635	0.119	Ok	1.39	0.61	Ok	
Alaskan Heights	L27	SAP33230	SAP33229	4	21	3.13	13.00	67.00	8.585	4.287	8.585	1.498	0.28	0.84	0.084				1.582	28.6	200	1.51	40.303	0.135	Ok	1.28	0.61	Ok	
Alaskan Heights	L28	SAP33228	SAP33229	20	20	3.13	63.00	63.00	8.692	4.293	8.692	1.426	0.81	0.81	0.081				1.507	104.6	200	1.99	46.268	0.123	Ok	1.47	0.66	Ok	
Polar Mews																													

Lot Number San Service
As-Built Invert

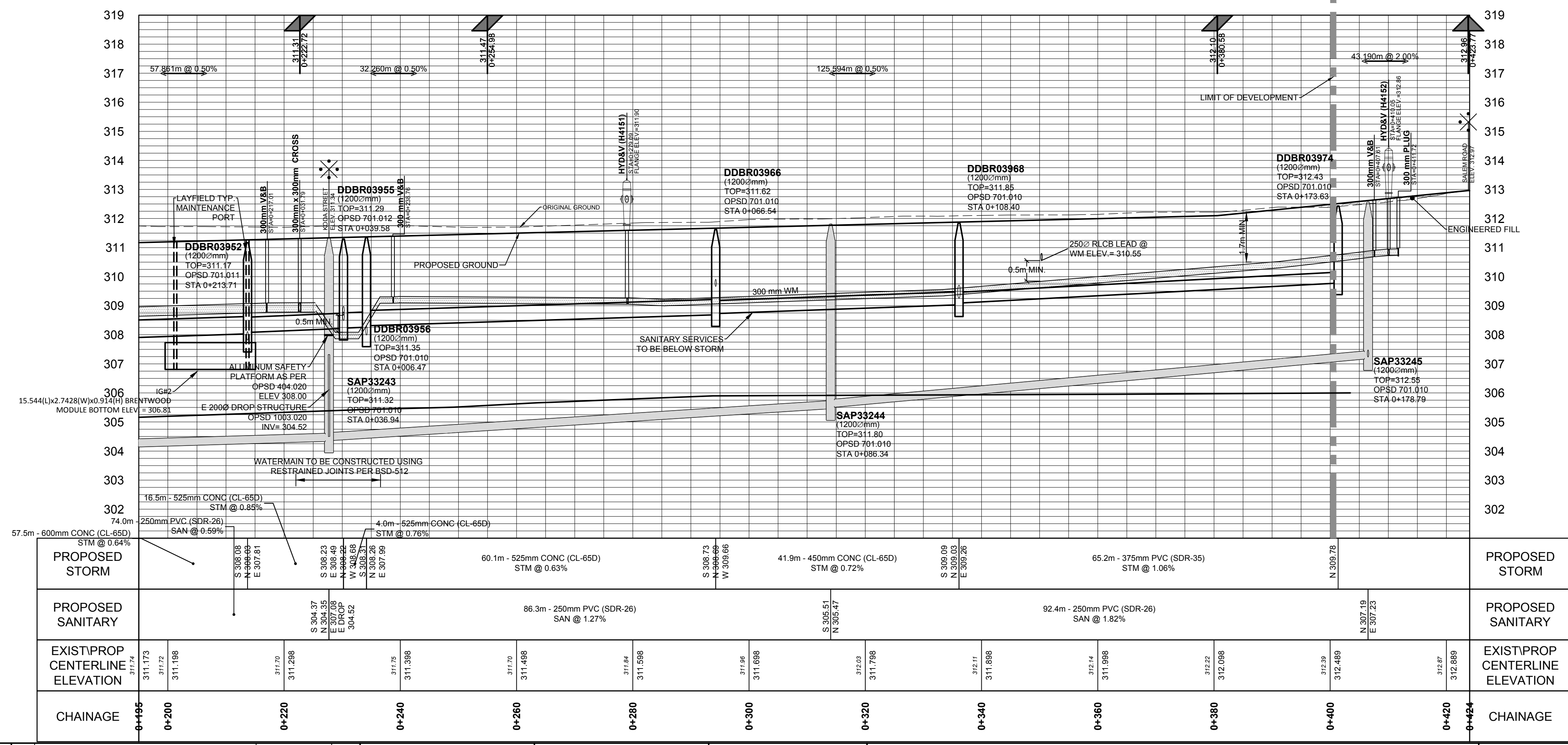
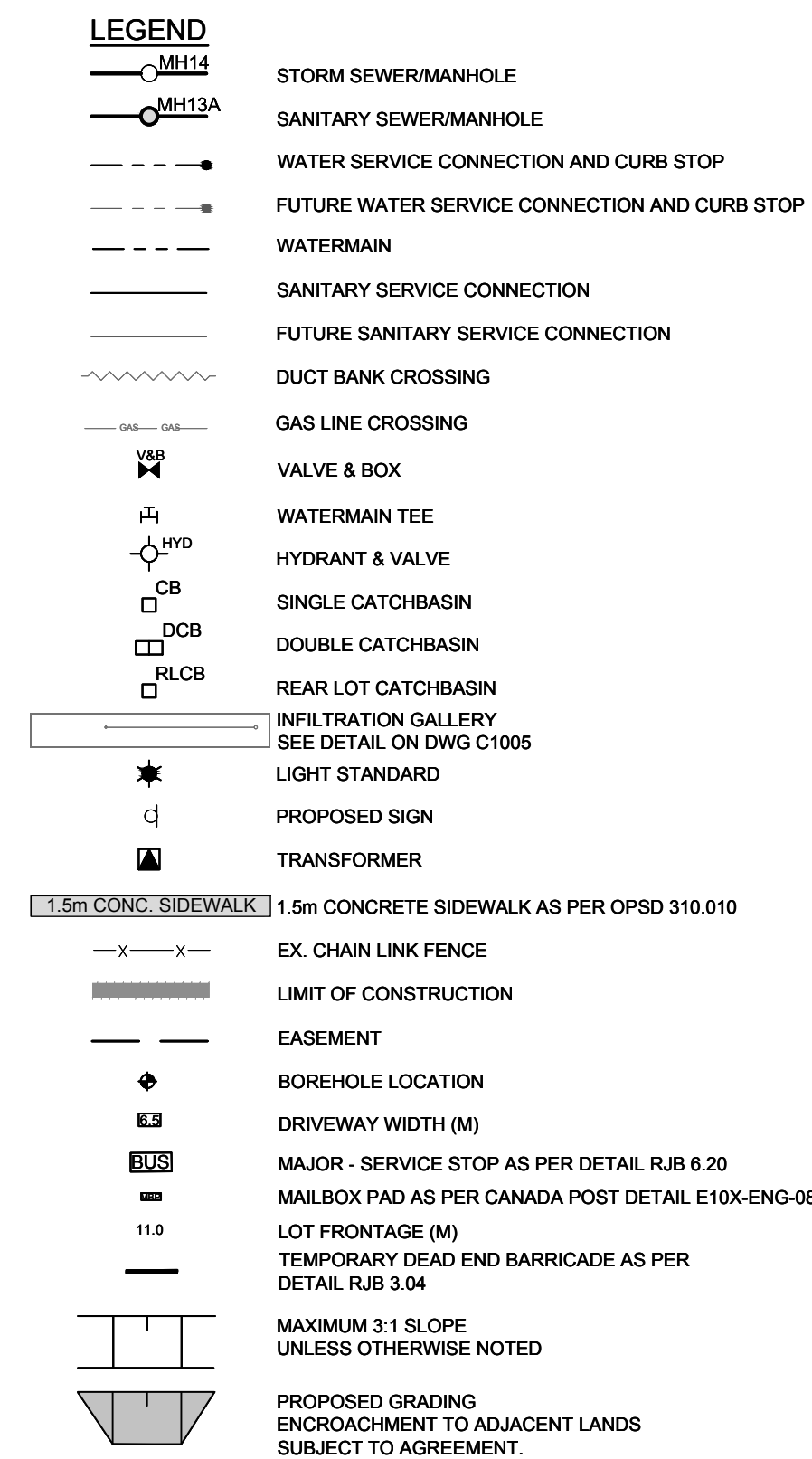
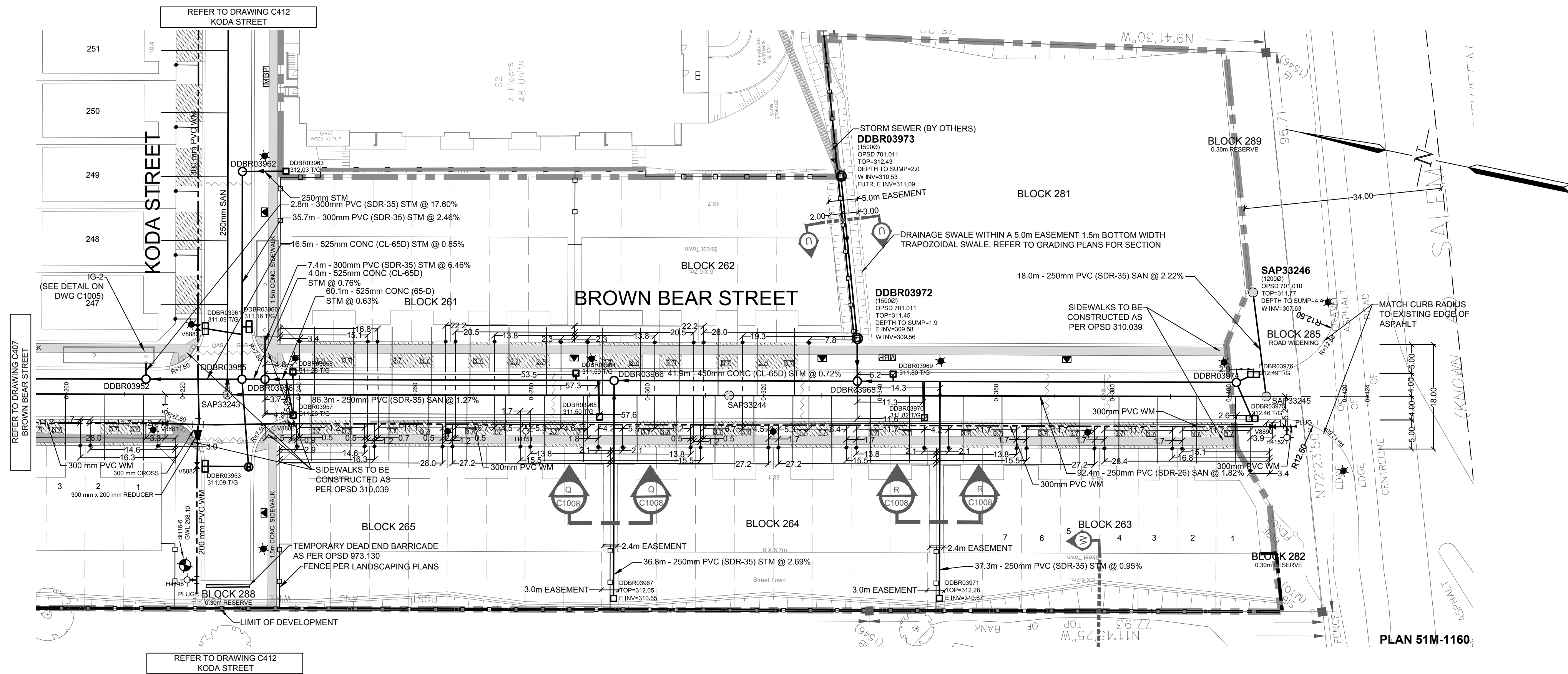
Brown Bear Street
Block 261 - 7 308.61
Block 261 - 6 308.21
Block 261 - 5 308.42
Block 261 - 4 308.48
Block 261 - 3 309.10
Block 261 - 2 309.04
Block 261 - 1 309.03

Block 262 - 6 309.24
Block 262 - 5 309.17
Block 262 - 4 309.38
Block 262 - 3 309.11
Block 262 - 2 309.27
Block 262 - 1 309.22

Block 263 - 1 309.69
Block 263 - 2 309.72
Block 263 - 3 309.45
Block 263 - 4 309.41
Block 263 - 5 309.30
Block 263 - 6 309.26
Block 263 - 7 309.19
Block 263 - 8 309.43

Block 264 - 1 309.24
Block 264 - 2 309.18
Block 264 - 3 309.12
Block 264 - 4 309.09
Block 264 - 5 308.86
Block 264 - 6 309.29
Block 264 - 7 309.05
Block 264 - 8 308.88

Block 265 - 1 308.82
Block 265 - 2 309.01
Block 265 - 3 308.81
Block 265 - 4 308.77
Block 265 - 5 308.80
Block 265 - 6 308.70
Block 265 - 7 308.64
Block 265 - 8 308.71



PAVEMENT DESIGN:
ALL ROAD PAVEMENT STRUCTURES TO HAVE MINIMUM COMPACTED THICKNESS. ALL MATERIAL SHALL BE AS PER CURRENT OPS SPECIFICATIONS.

(8m ROW (PER CITY OF BARRIE STANDARDS))
• 40mm - HL3 SURFACE COURSE ASPHALT
• 70mm - HL4 OR HL8 BINDER COURSE ASPHALT
• 150mm - GRANULAR 'A' BASE
• 300mm - GRANULAR 'B' SUB-BASE

(24/25m ROW (PER CITY OF BARRIE STANDARDS))
• 40mm - HL3 SURFACE COURSE ASPHALT
• 100mm - HL4 OR HL8 BINDER COURSE ASPHALT
• 150mm - GRANULAR 'A' BASE
• 400mm - GRANULAR 'B' SUB-BASE

SURVEY NOTES:
1. ORIGINAL TOPOGRAPHIC SURVEY AND CADD INFORMATION PROVIDED BY RUDY MAK SURVEYING LIMITED.
2. ELEVATIONS SHOWN HEREON ARE GEODETIC BASED ON THE CITY OF BARRIE'S WEBSITE.

HORIZONTAL & VERTICAL CONTROL MONUMENTS:
• ELEVATION ARE GEODETIC IN ORIGIN AND WERE DERIVE DFROM SPECIFIED CONTROL POINTS 03120110001 (ELEVATION = 312.51, CGVD-1928-1978) AND 03120110003 (ELEVATION = 309.67, CGVD-1928-1978).

LOCAL BENCHMARK:
• SITE BENCHMARK IS THE TOP OF THE CONTROL MONUMENT 03120110001 HAVING AN ELEVATION OF 312.51

BEARING NOTE
• BEARINGS ARE UTM GRID, DERIVED FROM SPECIFIED CONTROL POINTS 03120110001 AND 03120110003, UTM ZONE 17, NAD 83 (ORIGINAL).
• FOR BEARING COMPARISONS, A ROTATION OF 0°50'45" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLAN 51R-35523.

Notes
1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

AS-CONSTRUCTED

No.	Issue / Revision	Date	Auth.
3	ISSUED FOR SECOND SUBMISSION	18/06/09	SW
4	ISSUED FOR CONSTRUCTION	18/07/10	SW
5	ISSUED FOR THIRD SUBMISSION	18/07/17	SW
6	ISSUED FOR FOURTH SUBMISSION	18/08/17	SW
7	ISSUED FOR FIFTH SUBMISSION	18/09/20	SW
8	REVISED TO REFLECT MUNICIPAL ASSET ID'S	18/10/24	SW
9	FINAL FOR REGISTRATION	19/01/16	SW
10	AS-CONSTRUCTED (UNDERGROUND)	19/07/29	SW

Barrie
ENGINEERING DEPARTMENT

BURNSIDE

R. J. Burnside & Associates Limited
128 Wellington St. W., Suite 301
Barrie, Ontario L4N 6J6
telephone (705) 797-2047
fax (705) 797-2037
web www.rjburnside.com

CRISDAWN CONSTRUCTION INC.
27 CLAPPERTON STREET
BARRIE, ON
L4M 3E6

C408



Catchment	Size (ha)	% Imp
EX101	0.67	45.0
EX102	0.59	45.0
EX103	0.29	44.2
H100	1.01	74.0
H101	0.04	14.0
H102	0.03	31.0
H103	0.01	0.0
H104	0.02	14.3
H105	0.06	30.9
H106	0.02	18.5
H107	0.06	3.5
M101	0.32	65.8
M102	0.27	65.4
M103	0.09	63.8
M104	0.49	64.1
M105	0.25	64.4
M106	0.69	70.6
M107	0.03	66.3
M108	0.21	68.4
M109	0.36	75.8
M110	0.47	78.6
M111	0.07	69.1
M112	0.15	67.5
M113	0.28	65.1
NHS1	6.01	0.0
POND_Catch	2.41	20.4
R101	0.40	80.0
R102	2.22	80.0
R103	0.66	80.0
R104	0.82	80.0
R105	0.71	80.0
S101	0.26	75.5
S102	0.12	69.2
S103	0.16	69.5
S104	0.70	65.6
S105	0.18	66.1
S106	0.27	68.0
S107	0.80	62.4
S108	0.23	63.7
S109	0.22	64.2
S110	0.27	64.3
S111	0.34	64.2
S112	0.43	74.5
S113	0.44	66.8
S114	0.10	58.3
S115	0.46	66.6
S116	0.34	66.5
S117	0.39	66.4
S118	0.29	62.9
S119	0.25	56.8
S120	0.26	59.5
S121	0.28	71.5
S122	0.60	63.5
S123	0.12	78.6
S124	0.14	71.0
S125	0.39	70.9
S126	0.63	63.2
S127	0.04	89.3
S128	0.07	74.7
S129	0.29	69.1
S130	0.14	71.2
S131	0.04	83.1
S132	0.12	70.7
S133	0.49	63.0
S134	0.28	73.3
S135	0.40	67.6
S136	0.32	70.3
S137	0.04	75.3
Category	Area	%Imp
Internal to Pond	17.19	0.60
Internal UnCtrl'd	1.55	0.45
External ROW	4.41	0.87
Developable Area	19.75	0.60
Catchments	66	
BCR Property	25.76	0.46
Area TOTAL	30.56	0.51

LEGEND

- CATCHMENT AREA
- ASSUMED GOOD/POOR INFILTRATION TRANSITION



CRISDAWN CONSTRUCTION INC.

Figure Title

SALEM NORTH

POST-DEVELOPEMENT DRAINAGE PLAN

Client

Drawn

AJV

Checked

JM

Date

17/10/17

Scale

1:5000

Project No.

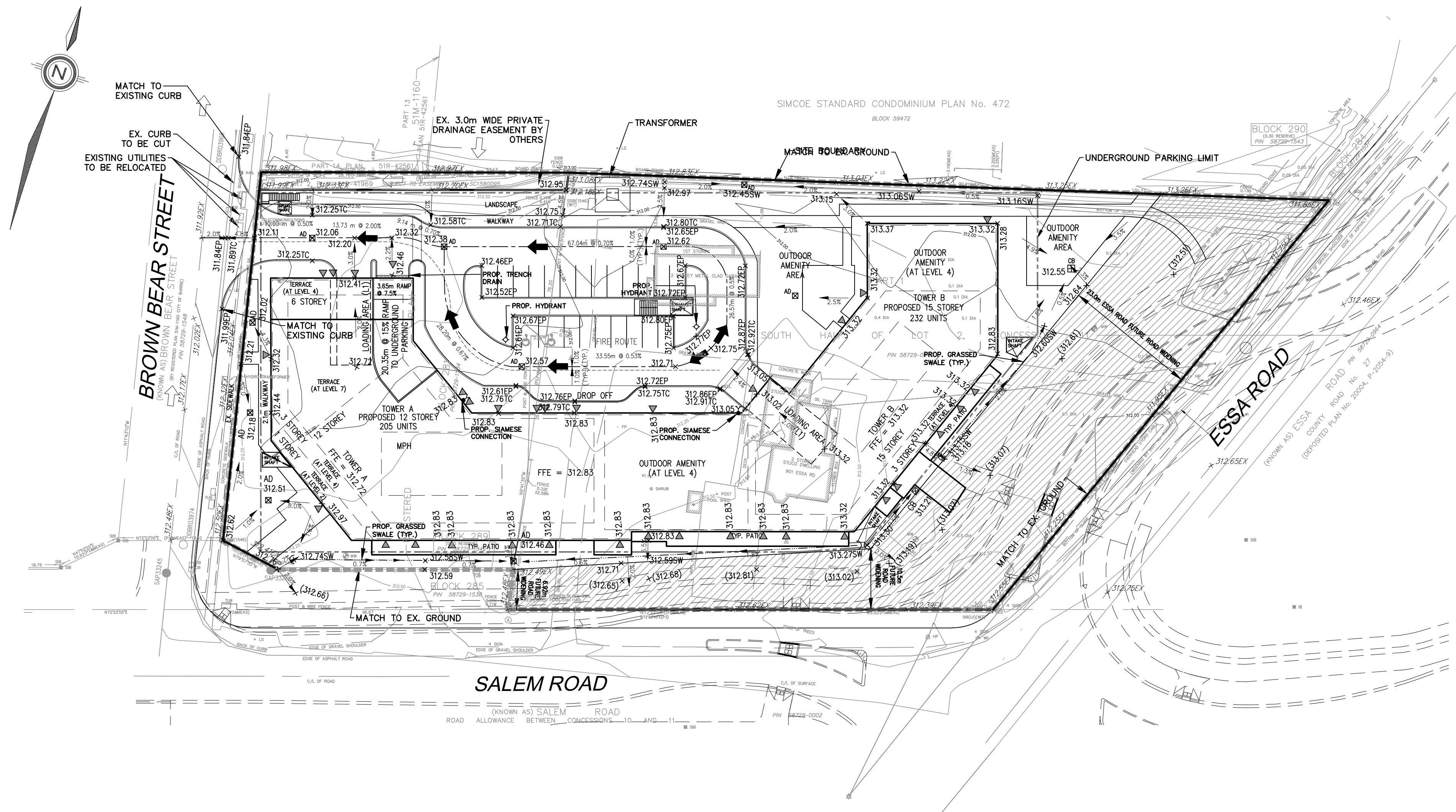
032868

Figure No.

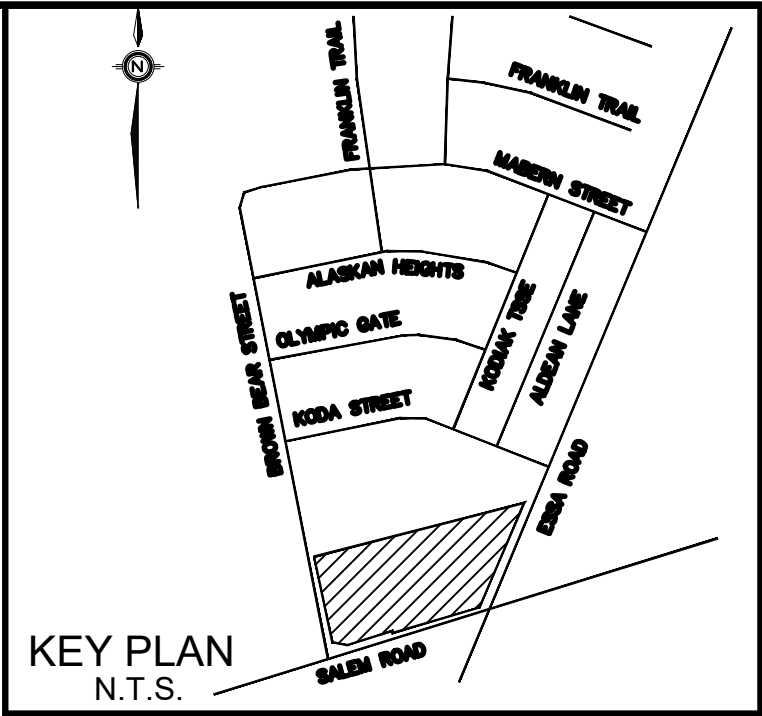
FIG-4

Appendix B

Engineering Plans



NOTE:
FOR FUTURE ROAD WIDENING OF
ESSA ROAD & SALEM ROAD,
REFER TO R.J. BURNSIDE &
ASSOCIATES LTD. DWGS DATED
JULY 7, 2021



- LEGEND**
- EXISTING CONTOUR
EXISTING GRADE
PROPOSED GRADE (EP-EDGE OF PAVEMENT, TC-TOP OF CURB)
ULTIMATE RIGHT-OF-WAY GRADE
EXISTING SANITARY MANHOLE
EXISTING CATCH BASIN
PROPOSED CATCHBASIN MANHOLE
PROPOSED REAR YARD CATCHBASIN LEAD
PROPOSED AREA DRAIN
PROPOSED CATCH BASIN
SITE BOUNDARY
PROPOSED 3:1 SLOPE
100-YEAR OVERLAND FLOW DIRECTION
EX. 100 YEAR OVERLAND FLOW DIRECTION
DEPRESSED CURB
BUILDING ENTRANCE/ACCESS

- LIST OF DRAWINGS**
- GR-1 - SITE GRADING PLAN
SS-1 - SITE SERVICING PLAN
ESC-1 - EROSION AND SEDIMENT CONTROL PLAN

SITE PLAN INFORMATION	SURVEYOR INFORMATION
KIRKOR ARCHITECTS & PLANNERS PHONE: (416) 665-6060 E-MAIL: roland@kirkorarchitects.com	J.D. BARNES LTD. 142 COMMERCIAL PARK DRIVE, UNIT V BARRIE, ON L4N 6W8 PHONE: (705) 739-6770 FAX: (705) 739-6771 E-MAIL: buelting@jbarnes.com

BENCHMARK INFORMATION:
ELEVATIONS SHOWN HERE ARE RELATED TO GEODETTIC DATUM AND
ARE REFERRED TO THE CITY OF BARRIE BENCHMARK NO. 03120110002
ELEVATION = 312.852m.

NO.	REVISION	DATE	BY
2	SECOND FSR SUBMISSION FOR OPA/ZPA	12/19/2023	BH
1	FIRST FSR SUBMISSION FOR OPA/ZPA	11/30/2022	BH

ACCEPTED TO BE IN ACCORDANCE WITH THE CITY OF BARRIE STANDARDS.
THIS ACCEPTANCE IS NOT TO BE CONSTRUED AS VERIFICATION OF
ENGINEERING CONTENT.

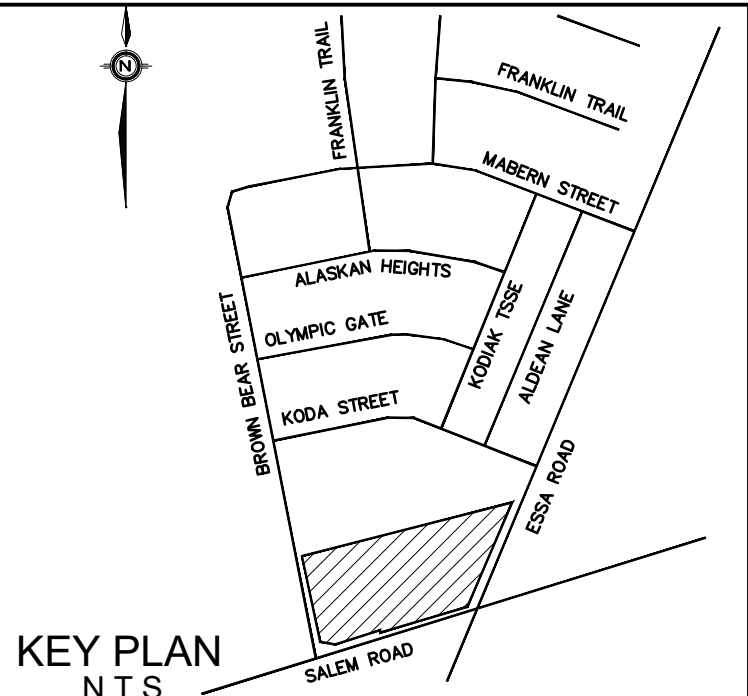
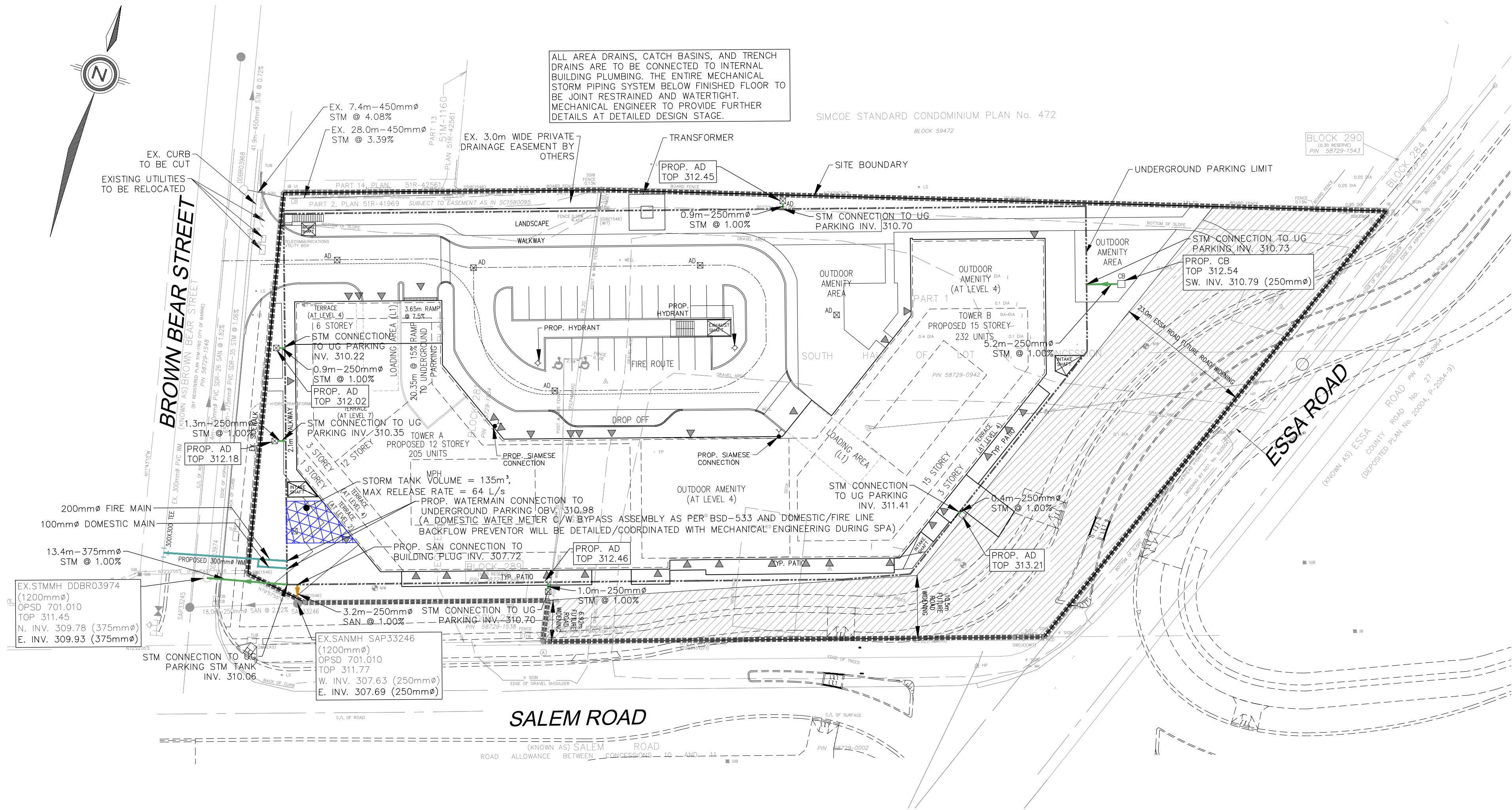
MANAGER, DEVELOPMENT ENGINEERING DATE

901 ESSA ROAD
BROWN BEAR DEV. LTD
CITY OF BARRIE, COUNTY OF SIMCOE

PRELIMINARY GRADING PLAN

ARCADIS
Unit 300 - 8133 Warden Avenue
Markham ON L6G 1B3 Canada
tel 905 763 2322 fax 905 763 9983
arcadis.com

DESIGNED BY: ML	DATE: NOVEMBER 2022	CHECKED BY: BH
DRAWN BY: ML	PROJECT No.	DRAWING No.
SCALE: 1:500	141031	GR-1



- LEGEND**
- PROPOSED STORM SEWER
 - PROPOSED SANITARY SEWER
 - PROPOSED WATERMAIN
 - PROPOSED AREA DRAIN
 - PROPOSED CATCH BASIN
 - PROPOSED DOUBLE CATCH BASIN
 - PROPOSED VALVE & BOX
 - PROPOSED HYDRANT & VALVE
 - EXISTING STORM MANHOLE
 - EXISTING SANITARY MANHOLE
 - EXISTING CATCHBASIN
 - EXISTING VALVE & CHAMBER
 - EXISTING HYDRANT & VALVE
 - UNDERGROUND PARKING BOUNDARY
 - BUILDING ENTRANCE/ACCESS

- LIST OF DRAWINGS**
- | NO. | REVISION | DATE | BY |
|-----|-----------------------------------|------------|----|
| 2 | SECOND FSR SUBMISSION FOR OPA/ZPA | 12/19/2023 | BH |
| 1 | FIRST FSR SUBMISSION FOR OPA/ZPA | 11/30/2022 | BH |

SITE PLAN INFORMATION KIRKOR ARCHITECTS & PLANNERS PHONE: (416) 665-6000 E-MAIL: roselar@kirkorarchitects.com	SURVEYOR INFORMATION J.D. BARNES LTD. 142 COMMERCE PARK DRIVE, UNIT V BARRIE, ON L4N 8W8 PHONE: (705) 739-6770 FAX: (705) 739-6771 E-MAIL: houlting@jbarnes.com
---	--

BENCHMARK INFORMATION:
ELEVATIONS SHOWN HERE ARE RELATED TO GEODETIC DATUM AND ARE REFERRED TO THE CITY OF BARRIE BENCHMARK No. 03120110002. ELEVATION = 312.652m.

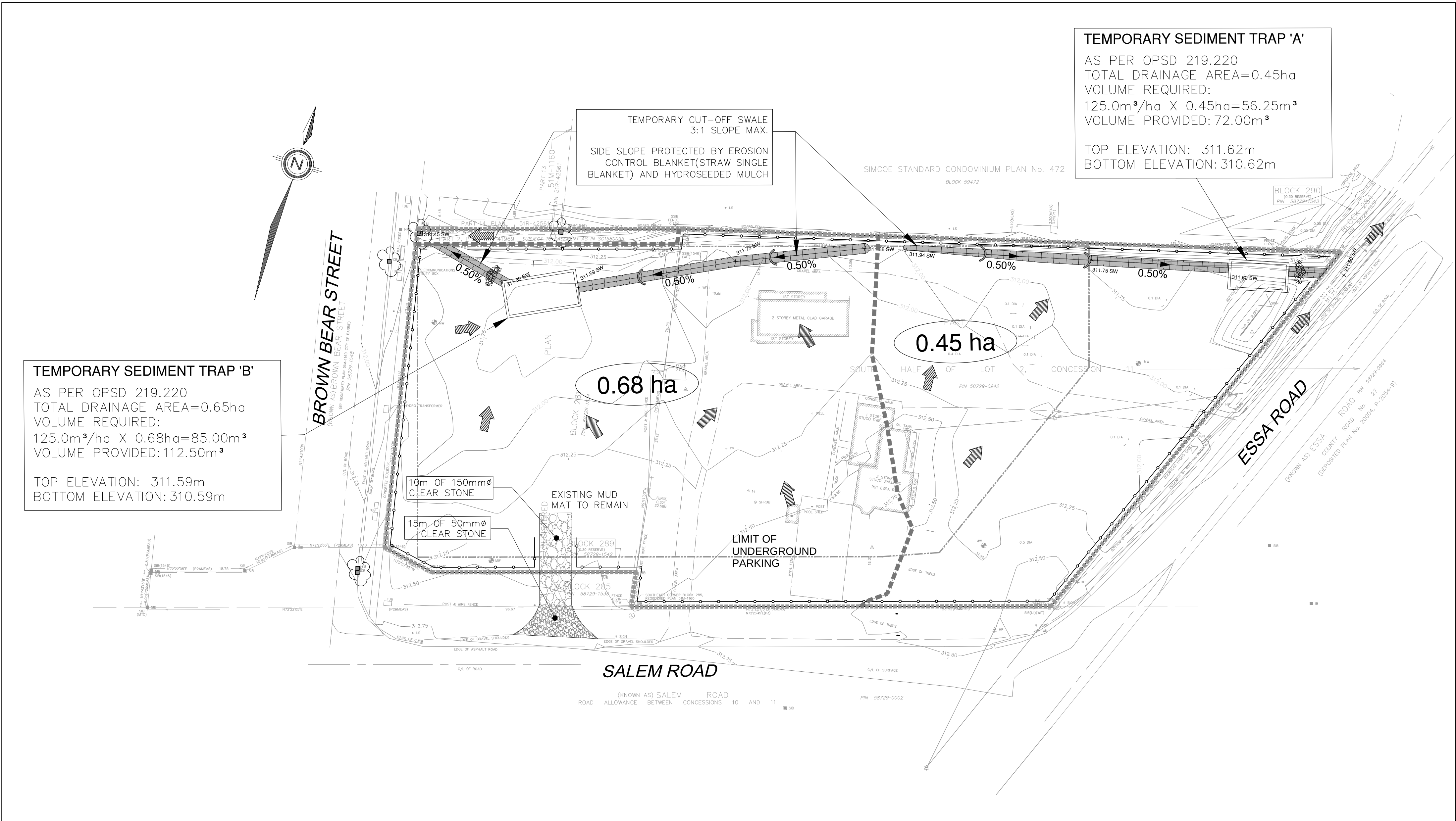
NO.	REVISION	DATE	BY
2	SECOND FSR SUBMISSION FOR OPA/ZPA	12/19/2023	BH
1	FIRST FSR SUBMISSION FOR OPA/ZPA	11/30/2022	BH

ACCEPTED TO BE IN ACCORDANCE WITH THE CITY OF BARRIE STANDARDS. THIS ACCEPTANCE IS NOT TO BE CONSTRUED AS VERIFICATION OF ENGINEERING CONTENT.

MANAGER, DEVELOPMENT ENGINEERING	DATE
901 ESSA ROAD BROWN BEAR DEV. LTD CITY OF BARRIE, COUNTY OF SIMCOE	
PRELIMINARY SITE SERVICING PLAN	

ARCADIS
Unit 300 - 81133 Warden Avenue
Markham ON L6G 1B3 Canada
tel 905 763 2322 fax 905 763 9883
arcadis.com

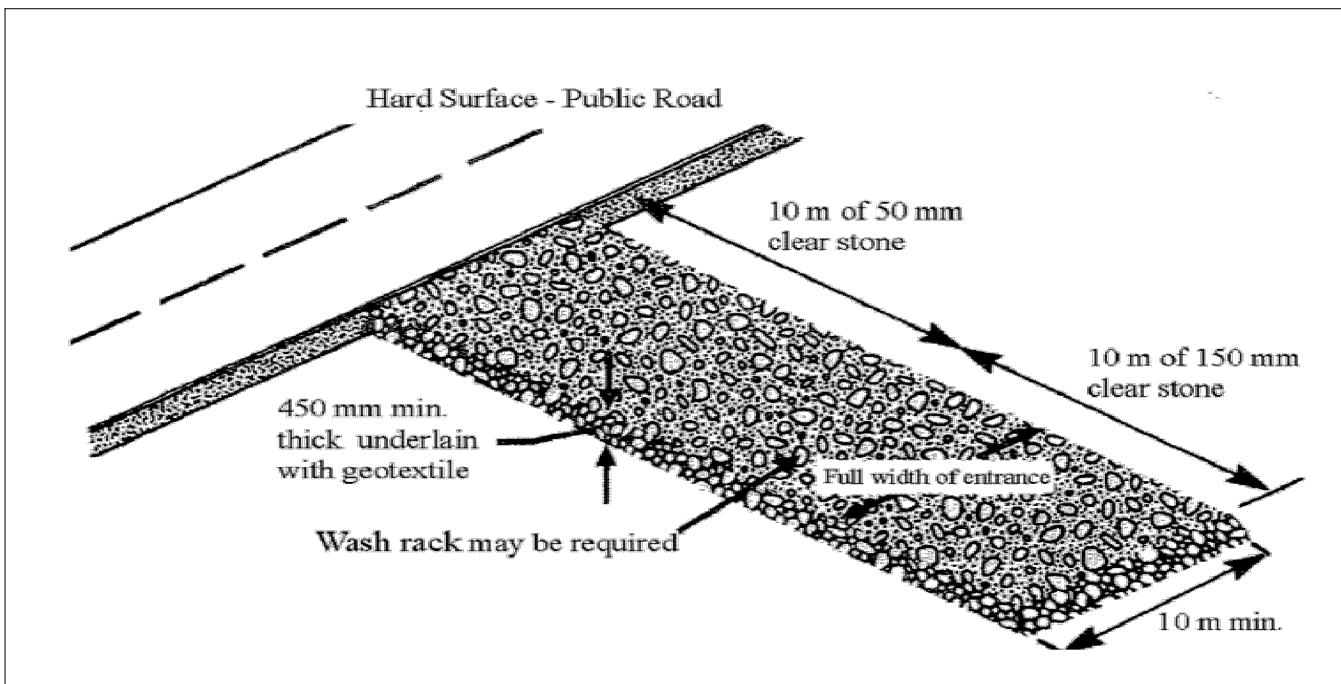
DESIGNED BY: ML	DATE: NOVEMBER 2022	CHECKED BY: BH
DRAWN BY: ML	PROJECT No. 141031	DRAWING No. SS-1
SCALE: 1:500		



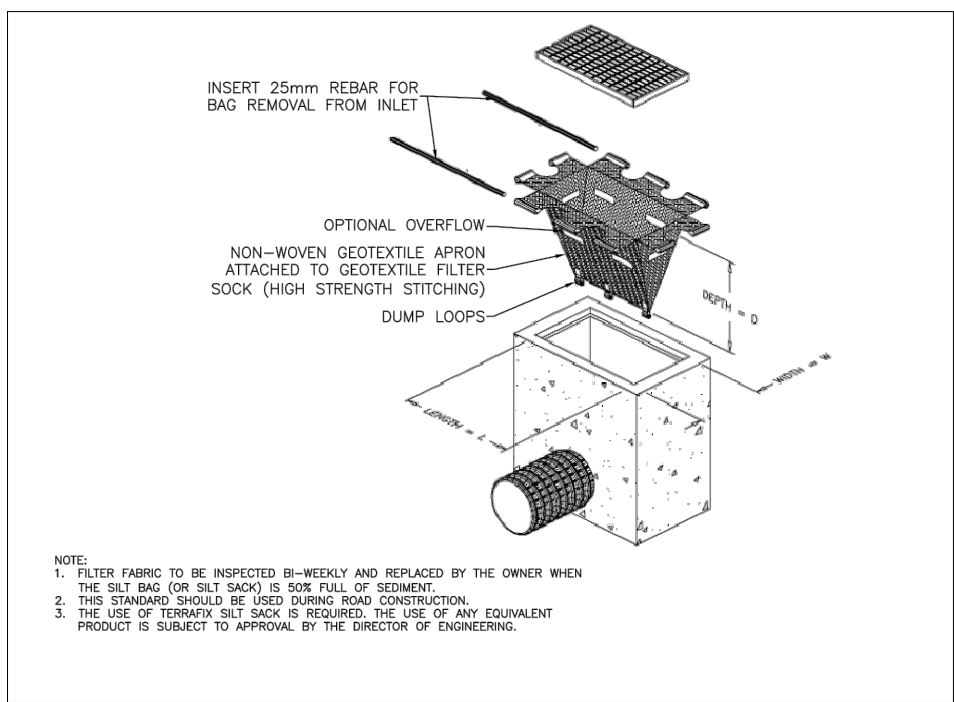
CONSTRUCTION SEQUENCE

1. INSTALL SEDIMENT FENCE AND MAINTAIN/RE-ESTABLISH EXISTING TEMPORARY CONSTRUCTION ACCESS.
2. PROTECT EXISTING CATCHBASINS ON BROWN BEAR STREET WITH SEDIMENT TRAPS.
3. CLEAR AND GRUB EXISTING VEGETATION, CLEAR EX. TREES AS PER RECOMMENDATIONS OF ARBORIST REPORT.
4. INSTALL TEMPORARY SEDIMENT TRAPS AS NOTED ON THIS DRAWING.
5. CONSTRUCT TEMPORARY CUT-OFF SWALES AND PLACE FILTREXX CHECK DAMS AS NOTED ON THE DRAWING.
6. STRIP TOPSOIL, FILL TO BE EXPORTED OFF-SITE (TO BE CONFIRMED)
7. COMPLETE EARTHWORK OPERATION.
8. COMPLETE SERVICING OPERATION.
9. COMPLETE BASE ASPHALT.

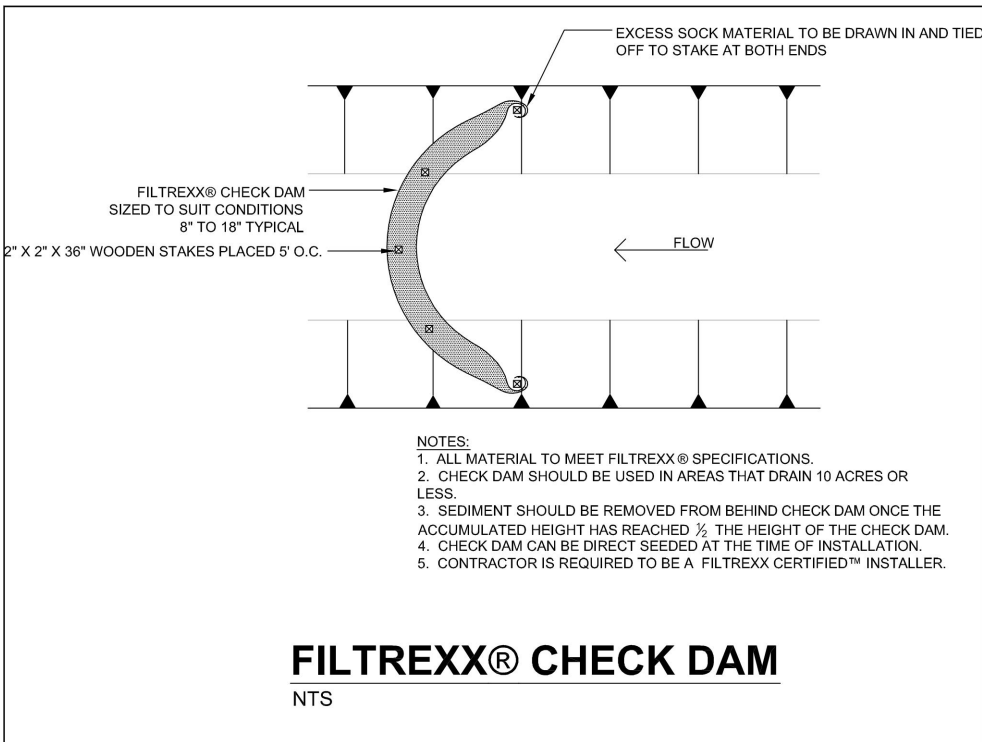
ESC PLAN
SCALE 1:500



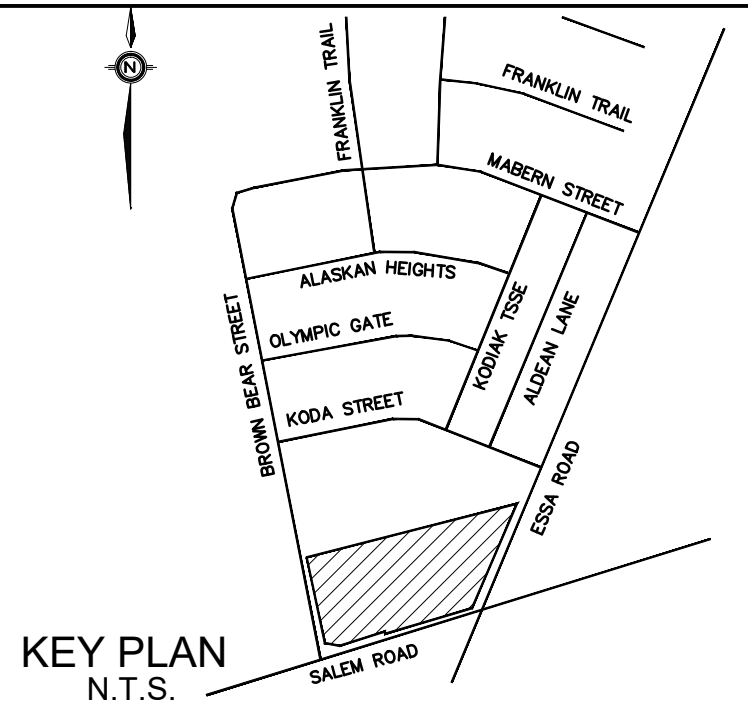
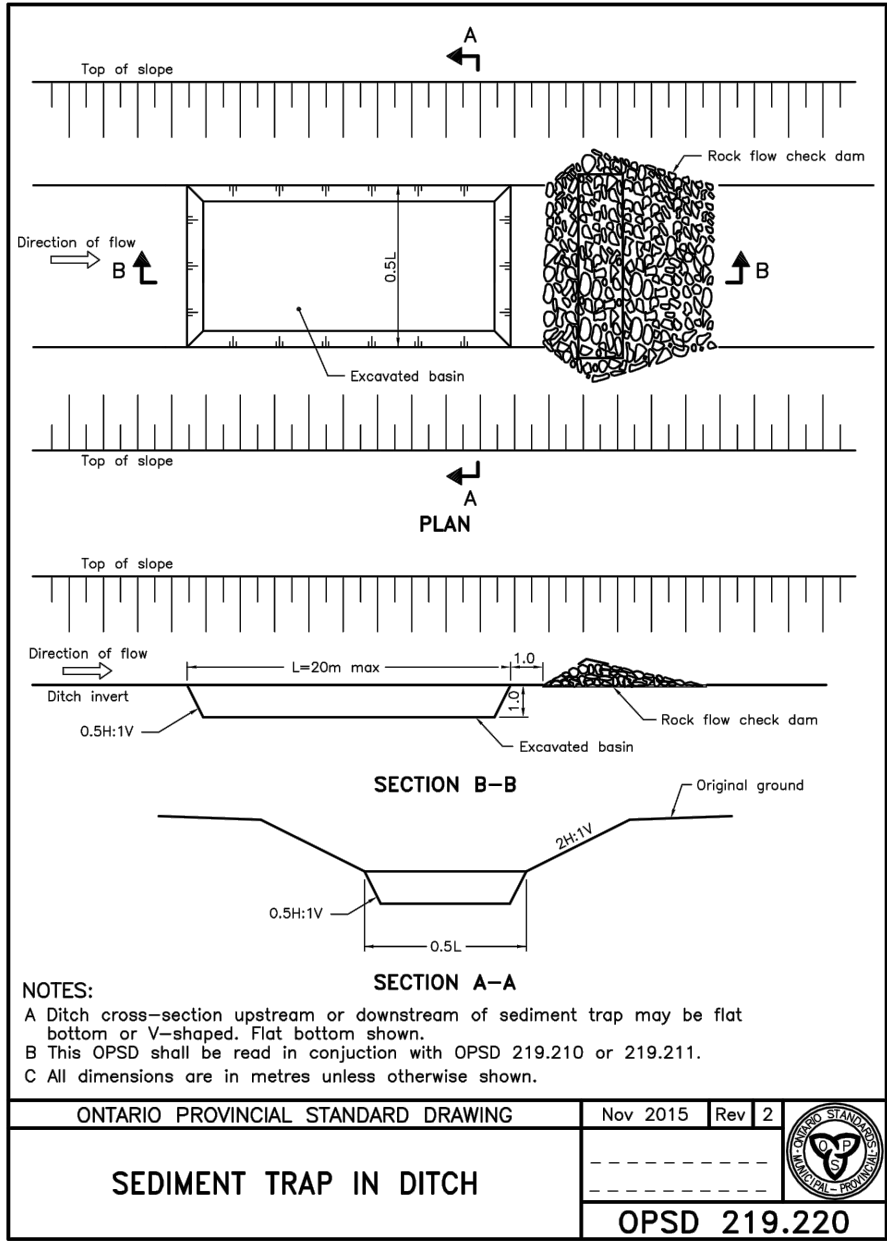
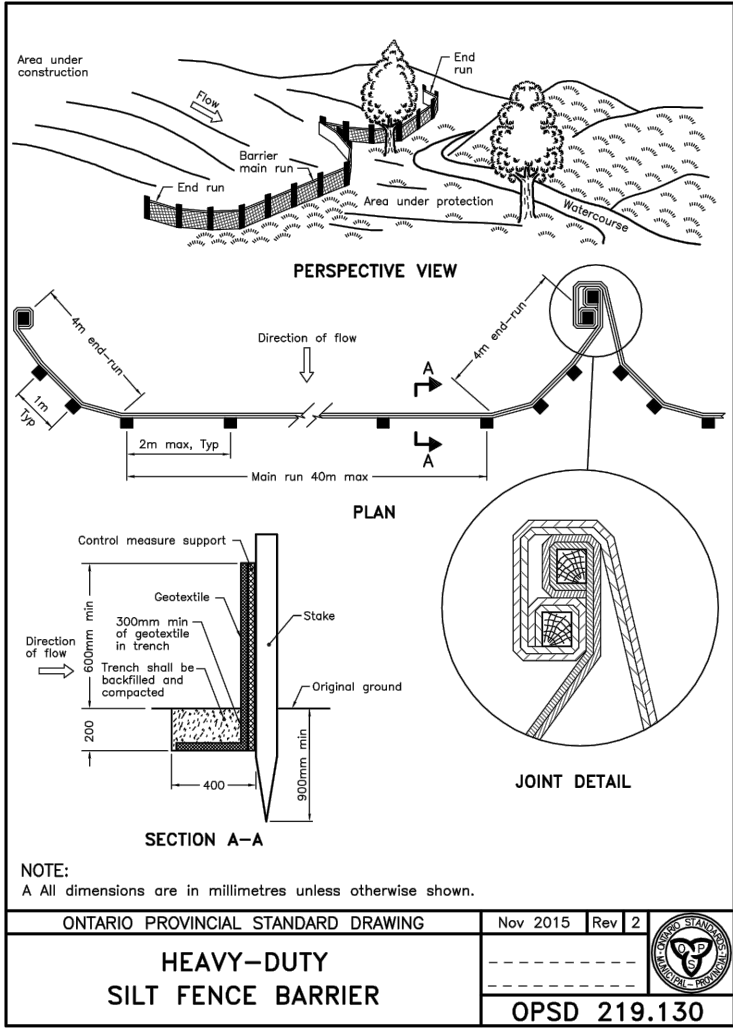
TEMPORARY CONSTRUCTION ACCESS (MUD-MAT)



TEMPORARY ROAD CB SEDIMENT TRAP



FILTREXX® CHECK DAM
NTS



KEY PLAN
N.T.S.

LEGEND

- LIMIT OF PROPERTY
- EXISTING GROUND CONTOUR ELEVATION
- EXISTING OVERLAND FLOW DIRECTION
- TEMPORARY SEDIMENT CONTROL FENCE
- DRAINAGE DIVIDE
- DRAINAGE AREA
- TEMPORARY FILTREXX CHECK (SEE DETAIL ON THIS DWG)
- EXISTING CATCH BASIN SEDIMENT PROTECTION
- TEMPORARY CUT-OFF SWALE
- TEMPORARY SWALE BOTTOM ELEVATION

CONTRACTOR TO BE RESPONSIBLE FOR LOCATION OF ALL EXIST. UG & OVERHEAD UTILITIES. VARIOUS UTILITIES CONCERNED TO BE GIVEN REQUIRED ADVANCE NOTICE PRIOR TO ANY DIGGING FOR STAKE OUT. THE CONSULTANT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE LOCATION OF EXISTING UTILITIES AS INDICATED ON THIS DRAWING.

LIST OF DRAWINGS

- GR-1 - SITE GRADING PLAN
- SS-1 - SITE SERVICING PLAN
- ESC-1 - EROSION AND SEDIMENT CONTROL PLAN

SITE PLAN INFORMATION

KIRKOR ARCHITECTS & PLANNERS
PHONE: (416) 665-6000
E-MAIL: r.kirkor@kirkorarchitects.com

SURVEYOR INFORMATION

J.D. BARNES LTD.
142 COMMERCE PARK DRIVE, UNIT V
BARRIE, L4N 8W8
PHONE: (705) 739-6770
FAX: (705) 739-6771
E-MAIL: j.barnes@barnes.com

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ELEVATION = 312.852m.

NO.	REVISION	DATE	BY
2	SECOND FSR SUBMISSION FOR OPA/ZPA	12/19/2023	BH
1	FIRST FSR SUBMISSION FOR OPA/ZPA	11/30/2022	BH



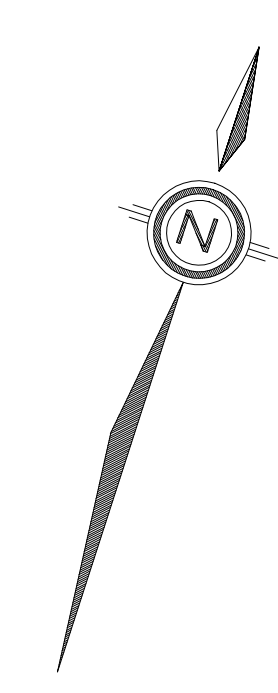
MANAGER, DEVELOPMENT ENGINEERING DATE
901 ESSA ROAD
BROWN BEAR DEV. LTD
CITY OF BARRIE, COUNTY OF SIMCOE
PRELIMINARY EROSION AND
SEDIMENT CONTROL PLAN



DESIGNED BY: ML	DATE: NOVEMBER 2022	CHECKED BY: BH
DRAWN BY: ML	PROJECT No. 141031	DRAWING No. ESC-1
SCALE: AS SHOWN		

Appendix C

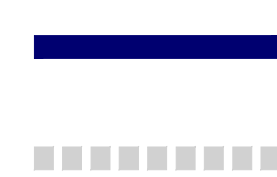
Stormwater Data Analysis



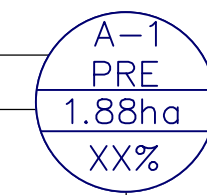
ARCADIS IBI GROUP
Unit 300 – 8133 Warden Avenue
Markham ON L6G 1B3 Canada
tel 905 763 2322 fax 905 763 9983
ibigroup.com

LEGEND

STORM DRAINAGE
AREA
PROPERTY LIMIT



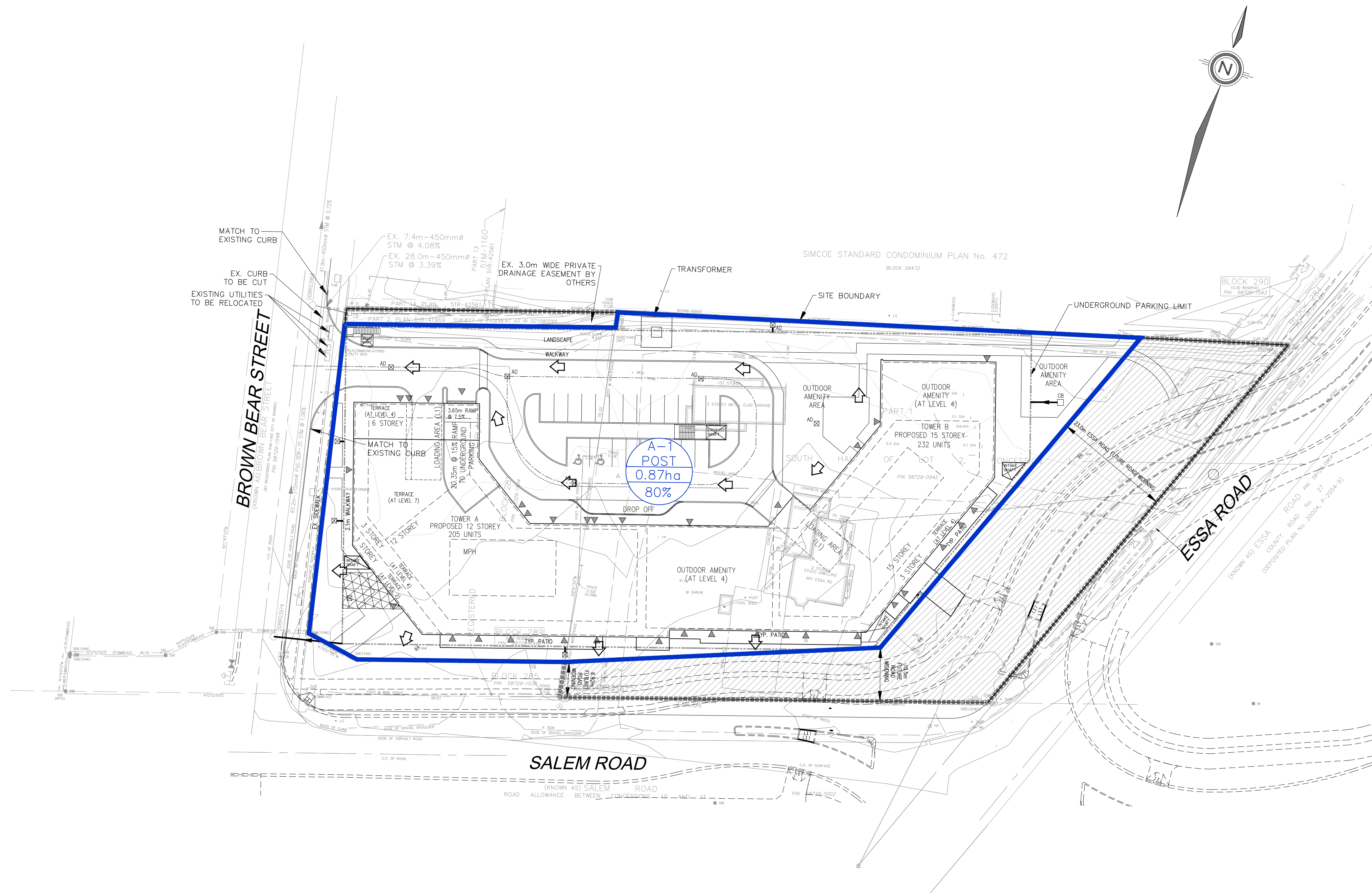
AREA
UNITS
PERCENT
IMPERVIOUS



BROWN BEAR DEVELOPMENT PRE-DEVELOPMENT DRAINAGE AREA PLAN

901 ESSA ROAD
CITY OF BARRIE
COUNTY OF SIMCOE

DATE:	NOVEMBER 2022	PROJECT No.:	141031
SCALE:	1:500	FIGURE No.:	DAP-1



LEGEND

PROPOSED STORM SEWER



EXISTING STORM SEWER



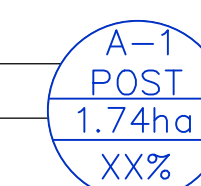
STORM DRAINAGE
AREA



PROPERTY LIMIT



AREA ID
AREA



PERCENT
IMPERVIOUS

BROWN BEAR DEVELOPMENT POST-DEVELOPMENT DRAINAGE AREA PLAN

901 ESSA ROAD
CITY OF BARRIE
COUNTY OF SIMCOE

DATE:	DECEMBER 2023	PROJECT No.:	141031
SCALE:	1:500	FIGURE No.:	DAP-2

**141031 - 901 Essa Road, City of Barrie
Target Peak Flow Calculations**

	Area (ha)	C
Alloted Site Area	0.350	0.60
Total	0.350	0.60

Rainfall Data: (5 year storm)		Catchment Data:	
City of Barrie IDF		Area =	0.350 ha
	A = 843.019	Existing Conditions	
	B = 4.582	Runoff Coeff. =	0.60
	C = 0.763	Inlet Time =	10 minutes
	i = 109.1 mm/hr	Peak Flow =	0.064 m³/s
	$i = A / (t+B)^C$		

=====

V V I SSSSS U U A L (v 6.2.2015)
V V I SS U U A A L
V V I SS U U AAAAA L
V V I SS U U A A L
VV I SSSSS UUUUU A A LLLLL

000 TTTTT TTTTT H H Y Y M M 000 TM
O O T T H H Y Y MM MM O O
O O T T H H Y M M O O
000 T T H H Y M M 000

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***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\V02\voin.dat

Output filename:

C:\Users\andy.kroess\AppData\Local\Civica\VH5\2ff44154-97db-4a14-8228-d97de5d40d07\5de4754b-d149-41c0-a1c6-0017ab995f0e\

Summary filename:

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DATE: 12-20-2023

TIME: 10:51:09

USER:

COMMENTS: _____

** SIMULATION : 5 Year Storm - Barrie **

| CHICAGO STORM |
Ptotal= 47.01 mm

IDF curve parameters: A= 853.608
B= 4.699
C= 0.766

used in: $INTENSITY = A / (t + B)^C$

Duration of storm = 3.00 hrs

Storm time step = 5.00 min

Time to peak ratio = 0.33

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
0.00	4.32	0.75	21.13	1.50	11.20	2.25	5.52
0.08	4.68	0.83	47.65	1.58	9.97	2.33	5.25
0.17	5.12	0.92	149.77	1.67	9.00	2.42	5.01
0.25	5.67	1.00	61.12	1.75	8.22	2.50	4.79
0.33	6.37	1.08	34.23	1.83	7.57	2.58	4.59
0.42	7.30	1.17	23.87	1.92	7.03	2.67	4.41
0.50	8.60	1.25	18.43	2.00	6.57	2.75	4.24
0.58	10.57	1.33	15.09	2.08	6.17	2.83	4.09
0.67	13.95	1.42	12.84	2.17	5.83	2.92	3.95

| CALIB |
| STANDHYD (0001) | Area (ha)= 0.87
| ID= 1 DT= 5.0 min | Total Imp(%)= 80.20 Dir. Conn.(%)= 80.20

	IMPERVIOUS	PERVIOUS (i)	
Surface Area (ha)=	0.70	0.17	
Dep. Storage (mm)=	1.00	1.50	
Average Slope (%)=	1.00	2.00	
Length (m)=	76.14	40.00	
Mannings n =	0.013	0.250	
Max.Eff.Inten.(mm/hr)=	149.77	30.31	
over (min)	5.00	10.00	
Storage Coeff. (min)=	1.85 (ii)	5.28 (ii)	
Unit Hyd. Tpeak (min)=	5.00	10.00	
Unit Hyd. peak (cms)=	0.32	0.16	
			TOTALS
PEAK FLOW (cms)=	0.28	0.01	0.283 (iii)
TIME TO PEAK (hrs)=	1.00	1.08	1.00
RUNOFF VOLUME (mm)=	46.01	14.35	39.74
TOTAL RAINFALL (mm)=	47.01	47.01	47.01
RUNOFF COEFFICIENT =	0.98	0.31	0.85

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 72.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.

(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| RESERVOIR(0003) |
| IN= 2---> OUT= 1 |
DT= 5.0 min

OVERFLOW IS OFF

OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
0.0000	0.0000	0.0640	0.0135
0.0630	0.0065	0.0000	0.0000

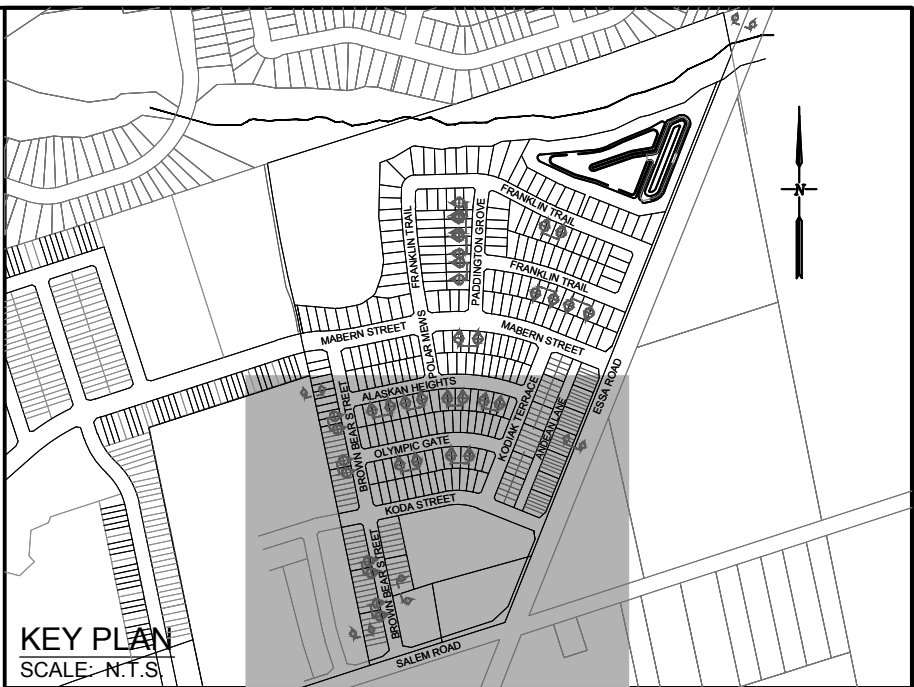
	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW : ID= 2 (0001)	0.870	0.283	1.00	39.74
OUTFLOW: ID= 1 (0003)	0.870	0.064	1.25	39.72

PEAK FLOW REDUCTION [Qout/Qin](%)= 22.63
TIME SHIFT OF PEAK FLOW (min)= 15.00
MAXIMUM STORAGE USED (ha.m.)= 0.0135

FINISH
=====

Appendix D

Sanitary Data Analysis



- LEGEND**
- L1** AREA ID NUMBER (RESIDENTIAL)
 - 4 45** NUMBER OF UNITS
 - AREA IN HECTARES**
 - C1** AREA ID NUMBER (COMMERCIAL/MIX USE)
 - 1.06** AREA IN HECTARES
 - 0.324** FLOW RATE (LITER/SECOND)
 - SANMH13** SANITARY SEWER/MANHOLE
 - SANITARY SINGLE HOUSE CONNECTION**
 - SANITARY SEWER TRIBUTARY BOUNDARY**

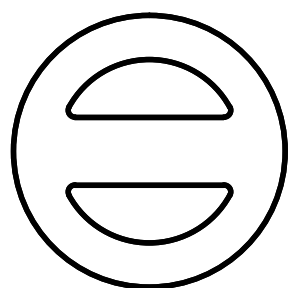
- SURVEY NOTES:**
1. ORIGINAL TOPOGRAPHIC SURVEY AND CADD INFORMATION PROVIDED BY RUDY MAK SURVEYING LIMITED.
 2. ELEVATIONS SHOWN HEREON ARE GEODETIC BASED ON THE CITY OF BARRIE'S WEBSITE.
- HORIZONTAL & VERTICAL CONTROL MONUMENTS:
- ELEVATION ARE GEODETIC IN ORIGIN AND WERE DERIVED FROM SPECIFIED CONTROL POINTS 03120110001 (ELEVATION = 312.51, CGVD-1928:1978) AND 03120110003 (ELEVATION = 309.87, CGVD-1928:1978).
- LOCAL BENCHMARK:
- SITE BENCHMARK IS THE TOP OF THE CONTROL MONUMENT 03120110001 HAVING AN ELEVATION OF 312.51
- BEARING NOTE
- BEARINGS ARE UTM GRID, DERIVED FROM SPECIFIED CONTROL POINTS 03120110001 AND 03120110003, UTM ZONE 17, NAD 83 (ORIGINAL).
 - FOR BEARING COMPARISONS, A ROTATION OF 00°50'45" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLAN 51R-35523.

Notes

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

AS-CONSTRUCTED

No.	Issue / Revision	Date	Auth.
3	ISSUED FOR SECOND SUBMISSION	18/06/09	SW
4	ISSUED FOR CONSTRUCTION	18/07/10	SW
5	ISSUED FOR THIRD SUBMISSION	18/07/17	SW
6	ISSUED FOR FOURTH SUBMISSION	18/08/17	SW
7	ISSUED FOR FIFTH SUBMISSION	18/09/20	SW
8	REVISED TO REFLECT MUNICIPAL ASSET ID'S	18/10/24	SW
9	FINAL FOR REGISTRATION	19/01/16	SW
10	AS-CONSTRUCTED (UNDERGROUND)	19/07/29	SW



Barrie
ENGINEERING DEPARTMENT



R.J. Burnside & Associates Limited
128 Wellington St. W., Suite 301
Barrie, Ontario, L4N 8J6
telephone (705) 797-2047
fax (705) 797-2037
web www.rjburnside.com

Client
CRISDAWN CONSTRUCTION INC.
27 CLAPPERTON STREET
BARRIE, ON
L4M 3E6

Drawing Title				Drawing No.
BEAR CREEK RIDGE DEVELOPMENT				C305
SANITARY DRAINAGE AREA PLAN (2 OF 2)				
Drawn PH	Checked SW	Designed SW	Checked EG	
Project No. 300032868	Contract No. D12-422	Revision No. 10	Date 18/02/28	
Scale 1:750				

SANITARY SEWER DESIGN																				DESIGN SHEET									
Development Details Basis																				FILE NO 32868									
																				CONTRACT / PROJECT Bear Creek Ridge Subdivision									
Barrie n ≥ 0.013 M = 5/P^{0.2} Babbitt				Numbers in blue or text in red are equations (Harmon or Babbitt peaking factor where; M ≥ 2), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use. Q_p = P^{0.7}M/86.4 Q_e = I^{1.4} Q_{tot} = Q_p + Q_e + Q_c (Peak population flow where: q = 225 L/day/person; P = population in thousands) (Peak extraneous flow: I= 0.1L/s/ha over development area) (Total peak flow as the sum of peak population flow and peak extraneous flow) 225 litres/person/day.																									
STREET	AREA ID	MAINTENANCE HOLE		DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBITT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q _p (l/s)	AREA (ha)	AREA (ACC) (ha)	Q _e (l/s)	COMMERCIAL/ INDUSTRIAL FLOW RATE (l/s/ha)	COMMERCIAL/ INDUSTRIAL FLOW	Q _c (l/s)	Q _{tot} (l/s)	L (m)	D (mm)	S (%)	Q _f FULL (l/s)	d/D ⁽²⁾	d/D ⁽³⁾ >0.5 or >0.85	Velocity FULL (m/s)	Velocity Partial ⁽¹⁾ (m/s)	Velocity ⁽⁴⁾ > 0.6 (m/s)	
		FROM	TO																										
Franklin Trail	L1	SAP33216	SAP33214	5	5	3.13	16.00	16.00	11.433	4.393	11.433	0.476	0.33	0.33	0.033				0.509	56.1	200	2.30	49.741	0.071	Ok	1.58	0.50	n/a	
ESSA ⁽⁶⁾	EXT	EXT	SAP33215	261	261	3.13	817.00	817.00	5.206	3.855	5.206	11.077	10.44	10.44	1.044				12.121										
ESSA ⁽⁶⁾	EXT	EXT	SAP33215										15.47	15.47	1.547	0.324	5.01	5.01	6.559	BY OTHERS									
Franklin Trail	L2	SAP33215	SAP33214		261	3.13		817.00	5.206	3.855	5.206	11.077	26.91	2.591	5.01	18.680	13.3	250	1.20	65.143	0.366	Ok	1.33	1.10	Ok			Ok	
Franklin Trail	L2	SAP33214	SAP33213	1	267	3.13	4.00	837.00	5.181	3.848	5.181	11.293	0.09	26.33	2.633	5.01	18.939	14.4	300	0.28	51.169	0.421	Ok	0.72	0.64	Ok			Ok
Franklin Trail	L3	SAP33213	SAP33212	14	281	3.13	44.00	881.00	5.128	3.835	5.128	11.766	0.75	27.08	2.708	5.01	19.486	103.3	300	0.38	59.610	0.393	Ok	0.84	0.72	Ok			Ok
Franklin Trail	L4	SAP33212	SAP33211	12	293	3.13	36.00	919.00	5.085	3.823	5.085	12.170	0.70	27.78	2.778	5.01	19.960	94.5	300	0.36	58.020	0.404	Ok	0.82	0.71	Ok			Ok
Franklin Trail	L5	SAP33211	SAP33210	2	295	3.13	7.00	926.00	5.077	3.821	5.077	12.244	0.15	27.93	2.793	5.01	20.049	17.9	300	0.34	56.386	0.411	Ok	0.80	0.70	Ok			Ok
Franklin Trail	L6	SAP33221	SAP33220	13	13	3.13	41.00	41.00	9.471	4.331	9.471	1.011	0.61	0.61	0.061				1.072	90.2	200	1.96	45.918	0.105	Ok	1.46	0.59	Check	
Franklin Trail	L7	SAP33220	SAP33219	6	19	3.13	19.00	60.00	8.777	4.296	8.777	1.371	0.26	0.87	0.087				1.458	41.8	200	1.63	41.874	0.127	Ok	1.33	0.61	Ok	
Franklin Trail	L8	SAP33219	SAP33218	6	25	3.13	19.00	79.00	8.307	4.270	8.307	1.18	0.31	1.18	0.118				1.827	50.2	200	1.37	38.390	0.148	Ok	1.22	0.61	Ok	
Paddington Grove	L9	SAP33222	SAP33218	3	3	3.13	10.00	10.00	12.559	4.415	12.559	0.327	0.16	0.16	0.016				0.343	38.7	200	3.28	59.401	0.054	Ok	1.89	0.50	n/a	
Paddington Grove	L10	SAP33221	SAP33217	11	39	3.13	35.00	124.00	7.591	4.217	7.591	2.451	0.52	1.86	0.186				2.637	76.4	200	1.34	37.967	0.178	Ok	1.21	0.68	Ok	
Paddington Grove	L11	SAP33217	SAP33210	1	40	3.13	4.00	128.00	7.543	4.213	7.543	2.514	0.11	1.97	0.197				2.711	26.9	200	4.73	71.332	0.133	Ok	2.27	1.06	n/a	
Franklin Trail	L12	SAP33210	SAP33209	12	347	3.13	36.00	1092.00	4.913	3.775	4.913	13.971	0.65	30.55	3.055	5.01	22.038	82.3	300	0.43	63.411	0.406	Ok	0.90	0.78	Ok			Ok
Franklin Trail	L13	SAP33209	SAP33208	2	349	3.13	7.00	1099.00	4.906	3.773	4.906	14.042	0.17	30.72	3.072	5.01	22.127	13.8	300	0.58	73.645	0.375	Ok	1.04	0.87	Ok			Ok
Franklin Trail	L14	SAP33208	SAP33207	2	351	3.13	7.00	1106.00	4.900	3.771	4.900	14.114	0.14	30.86	3.086	5.01	22.212	26.6	300	0.26	49.308	0.470	Ok	0.70	0.65	Ok			Ok
Franklin Trail	L15	SAP33207	SAP33206	11	362	3.13	35.00	1141.00	4.870	3.762	4.870	14.470	0.56	31.42	3.142	5.01	22.624	70.0	300	0.39	60.390	0.424	Ok	0.85	0.76	Ok			Ok
Franklin Trail	L16	SAP33206	SAP33205	6	368	3.13	19.00	1160.00	4.854	3.758	4.854	14.662	0.40	31.82	3.182	5.01	22.857	77.5	300	0.39	60.390	0.426	Ok	0.85	0.76	Ok			Ok
Andean Lane	M1	SAP33247	SAP33248	38	38	2.34	89.00	89.00	8.111	4.257	8.111	1.880	0.61	0.61	0.061				1.941	109.9	200	1.96	45.918	0.140	Ok	1.46	0.72	Ok	
Andean Lane	M2	SAP33248	SAP33226	30	68	2.34	71.00	160.00	7.213	4.162	7.213	3.006	0.49	1.10	0.110				3.116	105.4	200	0.79	29.152	0.220	Ok	0.93	0.60	Ok	
Mabern Street	L17	SAP33227	SAP33226	2	2	3.13	7.00	7.00	13.488	4.428	13.488	0.246	0.15	0.15	0.015				0.261	26.5	200	1.81	44.126	0.055	Ok	1.40	0.37	Check	
Mabern Street	L18	SAP33226	SAP33225	4	74	3.13	13.00	180.00	7.046	4.164	7.046	3.303	0.24	1.49	0.149				3.452	43.1	200	0.86	30.416	0.227	Ok	0.97	0.63	Ok	
Koda Street	L31	SAP33242	SAP33241	4	4	3.13	13.00	13.00	11.917	4.403	11.917	0.403	0.15	0.15	0.015				0.418	25.1	200	2.08	47.303	0.066	Ok	1.51	0.46	n/a	
Koda Street	L19	SAP33241	SAP33240	3	7	3.13	10.00	23.00	10.632	4.372	10.632	0.637	0.15	0.30	0.030				0.667	36.5	200	1.95	45.801	0.084	Ok	1.46	0.52	Check	
Kodiak Terrace	M3	SAP33240	SAP33239	9	16	2.34	22.00	45.00	9.297	4.324	9.297	1.089	0.21	0.51	0.051				1.140	74.0	200	1.85	44.611	0.110	Ok	1.42	0.59	Check	
Olympic Gate	L20	SAP33237	SAP33238	7	7	3.13	22.00	22.00	10.727	4.375	10.727	0.615	0.28	0.28	0.028				0.643	45.5	200	2.02	46.615	0.082	Ok	1.48	0.52	n/a	
Olympic Gate	L21	SAP33238	SAP33239	8	15	3.13	26.00	48.00	9.177	4.318	9.177	1.147	0.31	0.59	0.059				1.206	48.9	200	1.98	46.151	0.111	Ok	1.47	0.62	Ok	
Kodiak Terrace	M4	SAP33239	SAP33234	9	40	2.34	22.00	115.00	7.706	4.226	7.706	2.308	0.21	1.31	0.131				2.439	70.8	200	0.95	31.968	0.186	Ok	1.02	0.59	Check	
Kodiak Terrace	M5	SAP33234	SAP33225	9	49	2.34	22.00	137.00	7.441	4.204	7.441	2.855	0.22	1.53	0.153				2.808	76.9	200	1.05	33.608	0.195	Ok	1.07	0.64	Ok	
Mabern Street	L22	SAP33225	SAP33224	8	131	3.13	26.00	343.00	6.193	4.053	6.193	5.532	0.35	3.37	0.337				5.869	50.4	200	0.54	24.102	0.336	Ok	0.77	0.62	Ok	
Mabern Street	L23	SAP33224	SAP33223	9	140	3.13	29.00	372.00	6.093	4.037	6.093	5.903	0.41	3.78	0.378				6.281	48.4	200	0.50	23.192	0.355	Ok	0.74	0.62	Ok	
Mabern Street	L24	SAP33223	SAP33205	8	148	3.13	26.00	398.00	6.012	4.023	6.012	6.231	0.48	4.26	0.426				6.657	66.4	200	0.55	24.324	0.357	Ok	0.77	0.65	Ok	
Alaskan Heights	L25	SAP33232	SAP33231	7	7	3.13	22.00	22.00	10.727	4.375	10.727	0.615	0.27	0.27	0.027				0.642	35.3	200	1.90	45.210	0.083	Ok	1.44	0.50	Check	
Alaskan Heights	L26	SAP33231	SAP33230	10	17	3.13	32.00	54.00	8.964	4.308	8.964	1.261	0.29	0.56	0.056				1.317	47.0	200	1.77	43.635	0.119	Ok	1.39	0.61	Ok	
Alaskan Heights	L27	SAP33230	SAP33229	4	21	3.13	13.00	67.00	8.585	4.287	8.585	1.498	0.28	0.84	0.084				1.582	28.6	200	1.51	40.303	0.135	Ok	1.28	0.61	Ok	
Alaskan Heights	L28	SAP33228	SAP33229	20	20	3.13	63.00	63.00	8.692	4.293	8.692	1.426	0.81	0.81	0.081				1.507	104.6	200	1.99	46.268	0.123	Ok	1.47	0.66	Ok	
Polar Mews		SAP33229	SAP33205		41	3.13		130.00	7.519	4.211	7.519	2.546		1.65	0.165				2.711	76.8	200	2.12	47.765	0.161	Ok	1.52	0.80	n/a	
Mabern Street	L29	SAP33205	SAP33204	10	567	3.13	32.00	1720.00	4.486	3.636	4.486	20.094	0.50	36.23	3.623	5.01	28.929	66.5	375	0.29	94.418	0.379	Ok	0.85	0.72	Ok			Ok
Mabern Street	L30	SAP33204	SAP33203	8	575	3.13	26.00	1746.00	4.473	3.631	4.473	20.336	0.40	36.63	3.663	5.01	29.212	51.7	375	0.27	91.104	0.389	Ok	0.82	0.71	Ok			Ok
Salem Road	C1	SAP33246	SAP33245		437	1.67		730				0.89 ha	0.89 ha	0.089 L/s	0.103 L/s	0.10 L/s	0.10 L/s												
Commercial Block	C1	SITE	SAP33245									14.83 L/s	1.66	1.66	0.166	0.324	0.34	0.34	0.438	60.0	250	2.00	84.100	0.053	Ok	1.71	0.42	n/a	
Brown Bear Street	M6	SAP33245	SAP33244	14	14	2.34	33.00	33.00	9.892	4.348	9.892	0.850	0.44	1.52	0.152				16.37 L/s	0.35	92.4	250	1.82	80.226	0.090	Ok	1.63	0.59	Check
Brown Bear Street	M7	SAP33244	SAP33243	22	36	2.34	52.00	85.00	8.186	4.262	8.186	1.812	0.59	2.11	0.211				0.35	86.3	250	1.27	67.017	0.128	Ok	1.37	0.62	Ok	
Apartment Block	H1	SAP33249	SAP33242	120	120	1.67	201.00	201.00	6.892	4.147	6.892	3.607	1.26	1.26	0.126				17.39 L/s	0.35									
Koda Street	L32	SAP33242	SAP33243	7	127	3.13	22.00	223.00	6.750	4.130	6.750	3.920	0.35	1.61	0.161				18.75 L/s	0.35	90.4	250	1.50	72.833	0.160	Ok	1.48	0.79	Ok

Appendix E

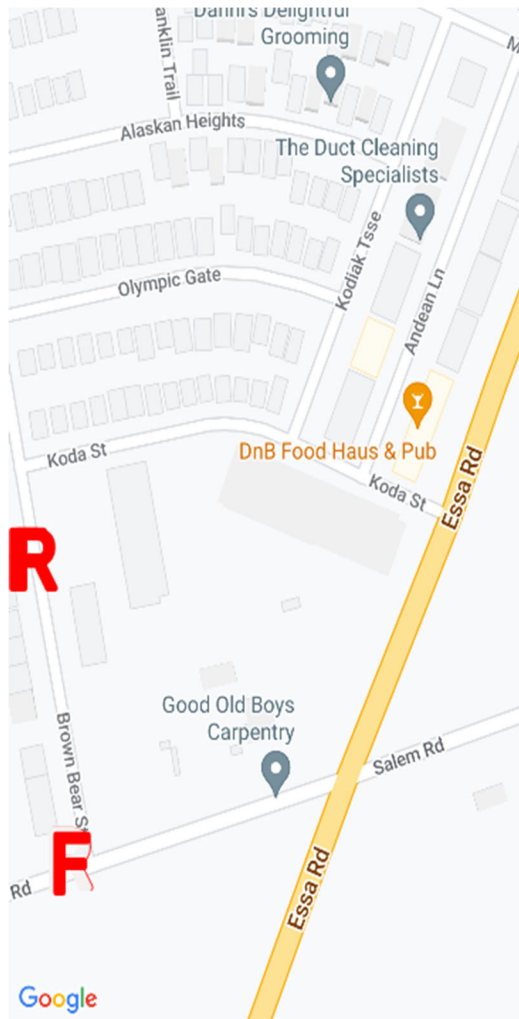
Water Data Analysis

EDC-FF-06 Hydrant Flow Testing

NOTE: Hydrants tested according to NFPA 291: Recommended Practice for Fire Flow Testing and Marking of Hydrants

Date of Testing	02-Nov-2023
Project Number:	141031
Test ID	H2023-053
Site Location / Address:	Brown Bear Site (Barrie)
Region / Municipality	Barrie
Hydrants Opened By:	Barrie
Tested by:	Daniel S James W

HYDRANT TEST LOCATION - RESIDUAL HYDRANT=R, FLOW HYDRANT=F
(NORTH AT TOP)



Test Data

Time of Test 1:22 PM
Pipe Size (mm) 300
Flow Hydrant Test Location (description) Brown Bear St and 1st Hydrant North of Salem Rd
Residual Hydrant Test Location (description) Brown Bear St and 2nd Hydrant North of Salem Rd
Static Pressure(PSIG) 51

Q1 Test Data (1 Orifice)

# OUTLETS	ORIFICE SIZE(IN)	PITOT PRESSURE(PSIG)	FLOW(USGPM)	RESIDUAL PRESSURE(PSIG)
1	2.5	25	839	47

QT Test Data (2 Orifices)

# OUTLETS	ORIFICE SIZE(IN)	PITOT PRESSURE(PSIG)	FLOW(USGPM)	RESIDUAL PRESSURE(PSIG)
2	2.5	20	1501	43

Calculations

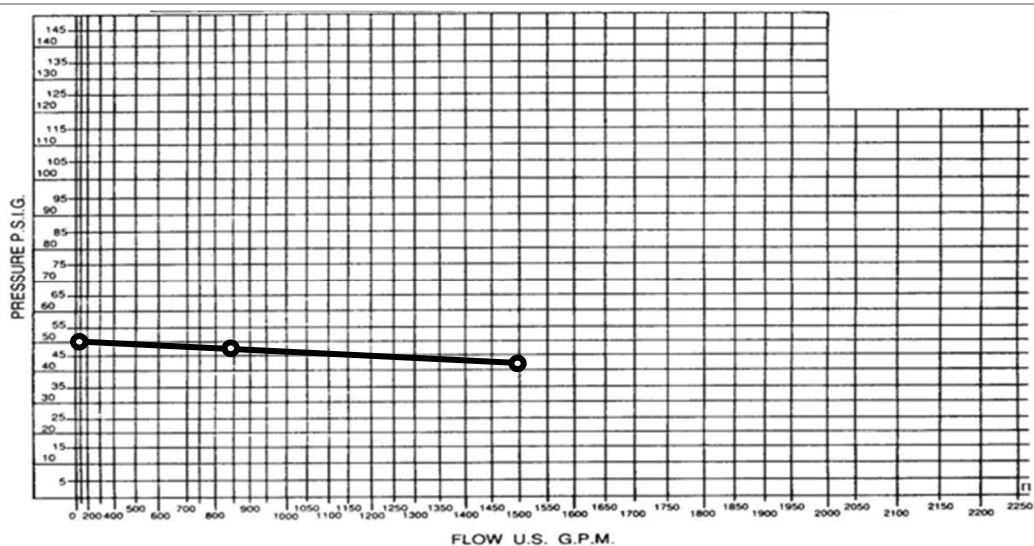
FORMULA: $Q = 29.83 \text{ cd}^2 \sqrt{p}$Where: c- coefficient of discharge (1 in smooth pipe)
 d- pipe diameter (inches)
p- pitot reading (psig)

Q1 - 1 Orifice(s) $Q1 = (29.83)(0.9)(2.5)^2 \sqrt{25} = 839$

QT - 2 Orifice(s) $QT = 2(29.83)(0.9)(2.5)^2 \sqrt{20} = 1501$

Static Pressure(PSIG) 51

Test Results Plot



Estimated Available Flow at Pressure 20 psi

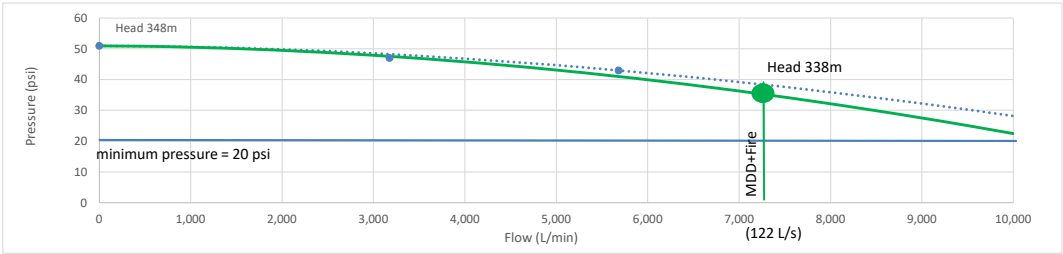
WATER SYSTEM PRESSURE

Project:	901 Essa Rd Dev	Proj.#	141031
Date:	2023-12-22		
Calc'd by:	SK		

Hydrant Flow Test Results		Test 1
Flow Hydrant Test Location:	F1, Brown Bear St and 1st Hydrant North of Salem Rd	
Residual Hydrant Test Location:	R1, Brown Bear St and 2nd Hydrant North of Salem Rd	
Main Size:	200mm Diameter	Test Time: 1:22 PM
Test Date:	2023-11-02	
Tested By:	James W and Daniel S	

Number of Outlets & Orifice Size	Pilot Pressure (psi)	Flow (US GPM)	Flow (L/min)	Residual Pressure (psi)	Estimated Residual Pressure* (psi)
0	0	0	0	51	51
1 x 2.5"	25	839	3,176	47	47
2 x 2.5"	20	1,501	5,682	43	41

*Estimated Residual Pressure: For a conservative design, it assumed that the residual pressure (at the maximum tested flow rate) would be reduced by 10 psi, which was used to estimate the available flow at 20 psi.



Where,

$$Q_r = Q_t \left(\frac{P_s - P_r}{P_s - P_t} \right)^{0.54}$$

Q_r = Projected Flow Rate
 Q_t = Flow Rate from Flow Test = 5682 L/min
 P_s = Static Pressure = 51 psi
 P_r = Desired System Pressure
 P_t = Residual Presure inTest = 41 psi

Pressure Under Fire Suppression (P_{f1}) =	20.0	psi	
Calculated Flow Rate (Q_{f1}) =	11,808	L/min	3,119 USGPM 197 L/s
Pressure Under Normal Operation (P_{n2}) =	40.0	psi	
Calculated Flow Rate (Q_{n2}) =	5,982	L/min	1,580 USGPM 100 L/s

Hydrant Flow Testing

IBI GROUP

NOTE: Hydrants tested according to NFPA 291: Recommended Practice for Fire Flow Testing and Marking of Hydrants

Date of Testing	02-Nov-2023
Project Number:	141031
Test ID	H2023-054
Site Location / Address:	Brown Bear Site (Barrie)
Region / Municipality	Barrie
Hydrants Opened By:	Barrie
Tested by:	Daniel S James W

HYDRANT TEST LOCATION - RESIDUAL HYDRANT=R, FLOW HYDRANT=F
(NORTH AT TOP)



Test Data

Time of Test	1:42 PM
Pipe Size (mm)	200
Flow Hydrant Test Location (description)	On Koda St, 1st hydrant west of Essa Rd
Residual Hydrant Test Location (description)	On Koda St, 2nd hydrant west of Essa Rd
Static Pressure(PSIG)	52

Q1 Test Data (1 Orifice)

# OUTLETS	ORIFICE SIZE(IN)	PITOT PRESSURE(PSIG)	FLOW(USGPM)	RESIDUAL PRESSURE(PSIG)
1	2.5	32	949	48

QT Test Data (2 Orifices)

# OUTLETS	ORIFICE SIZE(IN)	PITOT PRESSURE(PSIG)	FLOW(USGPM)	RESIDUAL PRESSURE(PSIG)
2	2.5	19	1463	45

Calculations

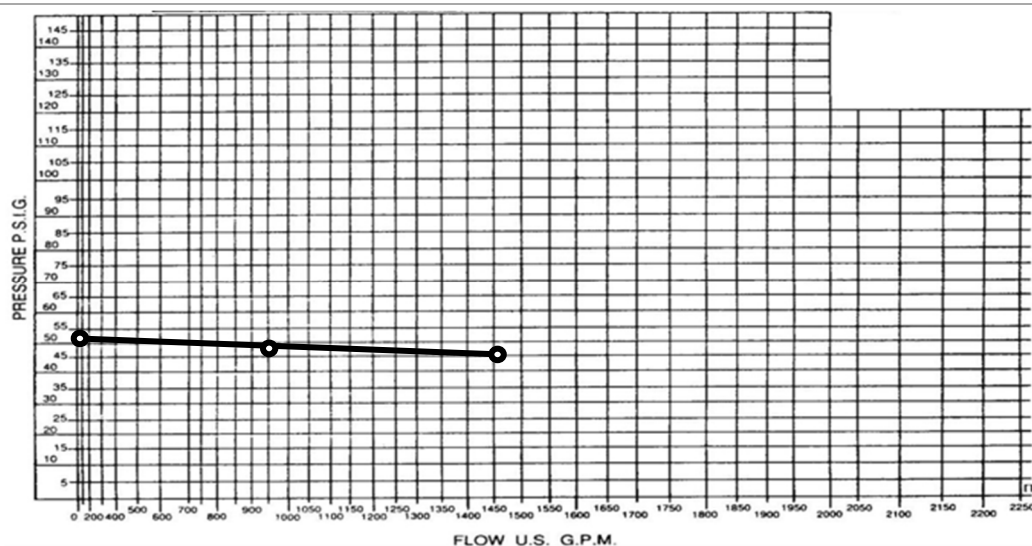
FORMULA: $Q = 29.83 \text{ cd}^2 \sqrt{p}$Where: c- coefficient of discharge (1 in smooth pipe)
 d- pipe diameter (inches)
p- pitot reading (psig)

Q1 - 1 Orifice(s) $Q1 = (29.83)(0.9)(2.5)^2 \sqrt{32} = 949$

QT - 2 Orifice(s) $QT = 2(29.83)(0.9)(2.5)^2 \sqrt{19} = 1463$

Static Pressure(PSIG) 52

Test Results Plot



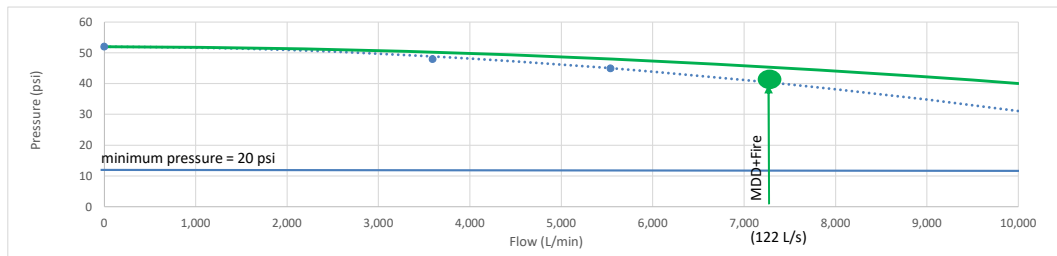
Estimated Available Flow at Pressure 20 psi**WATER SYSTEM PRESSURE**

Project:	901 Essa Rd Dev	Proj.#	141031
Date:	2023-12-22		
Calc'd by:	SK		

Hydrant Flow Test Results		Test 2
Flow Hydrant Test Location:	F1, On Koda St, 1st hydrant west of Essa Rd	
Residual Hydrant Test Location:	R1, On Koda St, 2nd hydrant west of Essa Rd	
Main Size:	200mm Diameter	Test Time: 1:42 PM
Test Date:	2023-11-02	
Tested By:	James W and Daniel S	

Number of Outlets & Orifice Size	Pilot Pressure (psi)	Flow (US GPM)	Flow (L/min)	Residual Pressure (psi)	Estimated Residual Pressure* (psi)
0	0	0	0	52	52
1 x 2.5"	32	949	3,592	48	48
2 x 2.5"	19	1,463	5,538	45	42

*Estimated Residual Pressure: For a conservative design, it assumed that the residual pressure (at the maximum tested flow rate) would be reduced by 10 psi, which was used to estimate the available flow at 20 psi.



$$Q_R = Q_T \left(\frac{P_s - P_r}{P_s - P_t} \right)^{0.54}$$

Where,

Q_r = Projected Flow Rate

Q_t = Flow Rate from Flow Test = 5538 L/min

P_s = Static Pressure = 52 psi

P_r = Desired System Pressure

P_t = Residual Pressure in Test = 48 psi

Pressure Under Fire Suppression (P_{f1}) =	20.0	psi	
Calculated Flow Rate (Q_{f1}) =	12,583	L/min	3,324 USGPM 210 L/s
Pressure Under Normal Operation (P_{f2}) =	40.0	psi	
Calculated Flow Rate (Q_{f2}) =	10,023	L/min	2,648 USGPM 167 L/s

901 Essa Road Development

FIRE FLOW DEMAND CALCULATIONS

Project Name: 901 Essa Road Development
Project Number: 141031
Date: Dec-2023
Designed By: SK

Based on the Water Supply for Public Fire Protection Manual, 1999 by the Fire Underwriters Survey

Step 1: Calculate Fire Flow (based on area)

Construction Coefficient =	0.6	
Largest Floor Area =	3,416	m2
Floor Above =	1,761	m2
Floor Below =	3,345	m2
Area =	4,693	m2
Fire Flow (F) =	9,000	L/min

F = required fire flow (L/min)

C = coefficient related to type of construction

0.6 for fire resistive

0.8 for non combustible (i.e. unprotected metal buildings)

1.0 for ordinary construction

1.5 for wood frame construction

A = total floor area excluding basements 50% below grade

* If vertical openings are inadequately protected, consider two largest two largest adjoining floors plus 50% of each of any floors above up to eight floors.

* If vertical openings are adequately protected (one hour rating), consider largest floor area + 25% of two immediately floors.

$$F = 220C\sqrt{A}$$

Step 2: Adjustment for Building Occupancy (shall not be less than 2000 L/s)

Occupancy Adjustment =	-15%
F ₁ = Fire Flow x Adjustment =	7650 L/min

Non-Combust.	-25%	Free Burning	15%
Limited Comb.	-15%	Rapid Burning	25%
Combustible	No change		

Step 3: Adjust F1 for Fire Suppression System

Sprinkler Adjustment =	50%
F ₂ = F ₁ x Adjustment =	3,825 L/min

Automatic Sprinklers (monitored)	-50%
Adequately Designed System	-30%

Step 4: Adjust F1 for Exposure / Proximity (shall not exceed 75%)

Proximity Adjustment =	40%	(max 75%)
F ₃ = F ₁ x Factor =	3,060	L/min

Separation	Adjustment	Separation	Adjustment
0m to 3m	25%	20.1m to 30m	10%
3.1m to 10m	20%	30.1m to 45m	5%
10.1m to 20m	15%		

Step 5: Calculate Adjusted Fire Flow (shall not be less than 2000 L/min or greater than 45,000 L/min)

F ₁ =	7,650	L/min
- F ₂ =	3,825	L/min
+ F ₃ =	3,060	L/min
Fire Flow =	7,000	L/min
Fire Flow =	117	L/s
Total Demand (Fire Flow + MDD) =	122	L/s

$$\text{Fire Flow} = F_1 - F_2 + F_3$$

Checks:

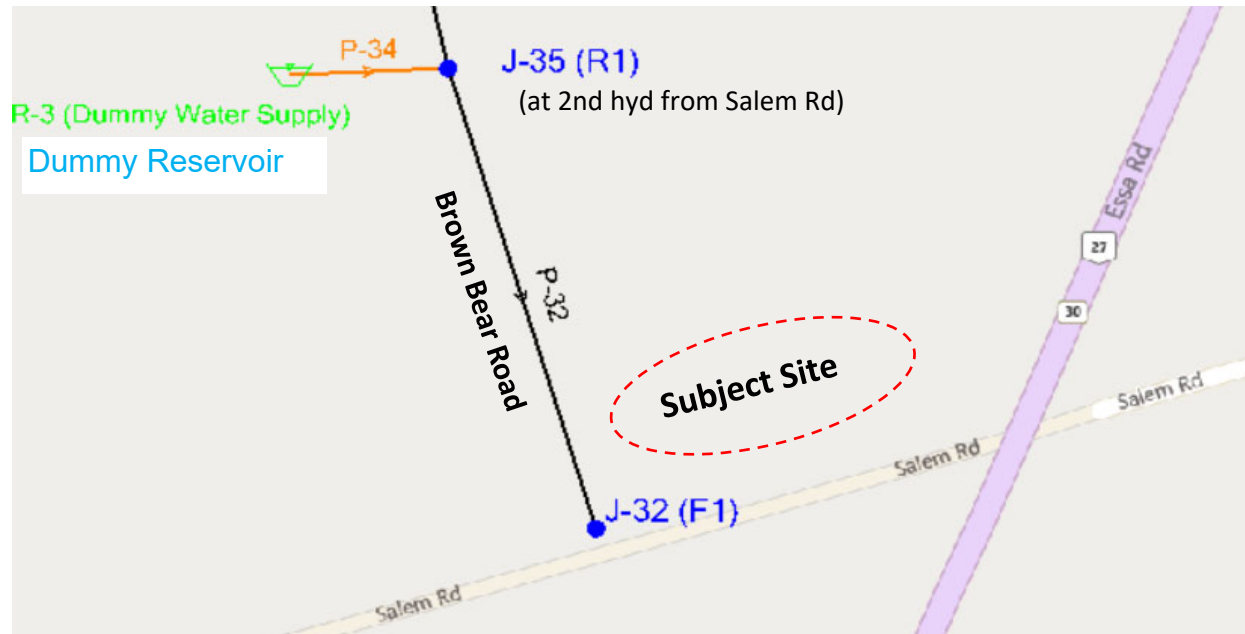
Fire Flow greater than 2000 L/min

Fire Flow less than 45,000 L/min

Project: 141031, 901 Essa Rd Development

Date: December 2023

Model Layout



l41031, 901 Essa Rd Development
 cember 2023

Junction Table					
Label	Demand	Elevation	Hydraulic Grade	Pressure	Remark
	(L/s)	(m)	(m)	(kPa)	
J-32 (F1)	1.9	312.0	348.0	352	
J-35 (R1)	0.0	312.0	348.0	352	
J-32 (F1)	5.4	312.0	348.0	352	
J-35 (R1)	0.0	312.0	348.0	352	
J-32 (F1)	8.0	312.0	348.0	352	
J-35 (R1)	0.0	312.0	348.0	352	
J-32 (F1)	122.0	312.0	336.3	242	
J-35 (R1)	0.0	312.0	338.0	256	

Project: 141031, 901 Essa Rd Development

Date: December 2023

Scenario	Pipe Table										
	Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	Hazen-Williams C	Flow (Absolute) (L/s)	Velocity (m/s)	Headloss (m)	Initial Status	Remark
ADD	P-32	J-35 (R1)	J-32 (F1)	155.0	300	120	2	0.0	0.0	Open	
	P-34	R-3 (Dummy Water Supply)	J-35 (R1)	48.0	999	130	2	0.0	0.0	Open	dummy pipe
MDD	P-32	J-35 (R1)	J-32 (F1)	155.0	300	120	5	0	0	Open	
	P-34	R-3 (Dummy Water Supply)	J-35 (R1)	48.0	999	130	5	0	0	Open	dummy pipe
PHD	P-32	J-35 (R1)	J-32 (F1)	155.0	300	120	8	0	0	Open	
	P-34	R-3 (Dummy Water Supply)	J-35 (R1)	48.0	999	130	8	0	0	Open	dummy pipe
MDD+Fire	P-32	J-35 (R1)	J-32 (F1)	155.0	300	120	122	2	2	Open	
	P-34	R-3 (Dummy Water Supply)	J-35 (R1)	48.0	999	130	122	0	0	Open	dummy pipe

From: Sheyda Dorraj
Sent: Wednesday, September 12, 2018 2:06 PM
To: Gary Matthie
Cc: Ralph Scheunemann; Frank Palka
Subject: RE: Bear Creek Ridge Fire Flows

Hi Gary,

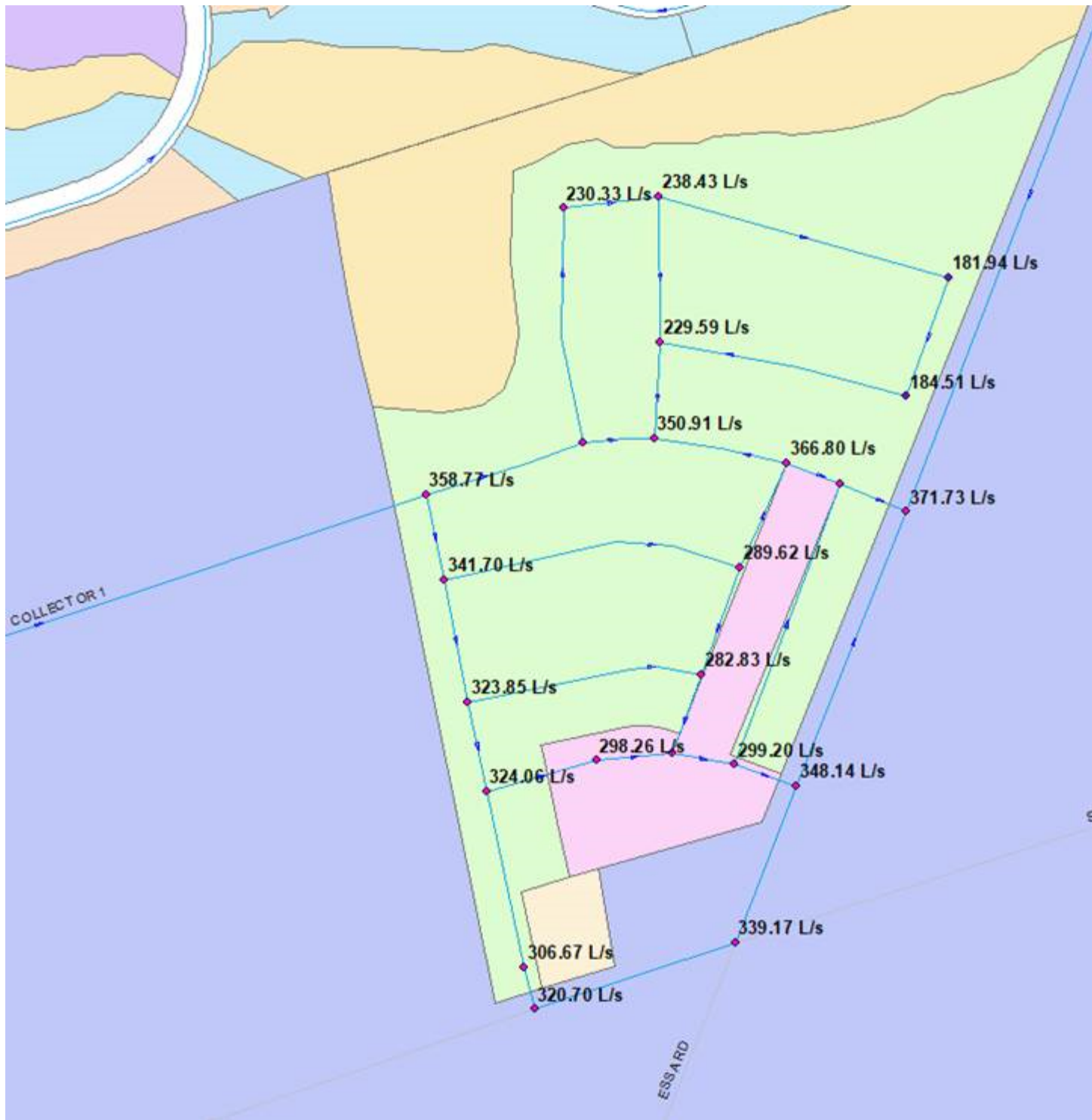
As discussed, the modeling results indicate adequate fire flow for the proposed apartment buildings based on following scenario and watermain layout:

1. Proposed 400mm watermain along Essa from Dunn St to Koda St.
 - a. From Dunn St to Athabaska Rd: City project
 - b. From Athabaska Rd to Salem Rd: Development project
2. Proposed 300mm wm along Dunn St, extending/looping the existing 300mm wm with 300mm wm from King St
3. Proposed 300mm internal wm along Mabern St connecting to future 300mm wm along County Rd 27
4. Proposed 300mm internal wm along Brown Bear St
5. Proposed 300mm/200mm internal wms along Koda St

Figure below shows the available FF under 2016 MDD+FF scenario with maximum velocity at 5m/s.



Please note that the preferred watermain layout is looping the proposed 400mm wm along Essa Rd with 300mm internal wm along Brown Bear St via the future 300mm wm at Salem Rd. With this scenario, the minimum required fire flow of 283 L/s for commercial can be achieved.



In order to meet the required fire flow (250 L/s) at Koda St, the proposed 300mm/200mm wms should be looped with the proposed 400mm wm at Essa.



Thanks,

Sheyda Dorraj, P.Eng., M.Eng.

Senior Water Technologist
Engineering Department
705.739.4220
Ext 4491

From: Sam Webb [<mailto:Sam.Webb@rjburnside.com>]
Sent: September 11, 2018 4:40 PM
To: Ralph Scheunemann <Ralph.Scheunemann@barrie.ca>
Cc: Sheyda Dorraj <Sheyda.Dorraj@barrie.ca>; Gary Matthie <Gary.Matthie@barrie.ca>; Frank Palka <Frank.Palka@barrie.ca>; Hugh Johnston <hjohnston@prattdevelopment.ca>; Bryan Richardson <Bryan.Richardson@rjburnside.com>
Subject: Bear Creek Ridge Fire Flows

Hello Ralph,

Thanks for the phone call today.

We look forward to an update tomorrow once Sheyda has reviewed the memo.

We feel the watermain discussion can be split into two different approvals items, which are;

1. Construction of the Internal Watermain

We have now submitted a memo which concludes that the ultimate construction of the Salem Secondary plan watermain provides adequate fire flows to meet the new modeling criteria. From talking with Frank and Gary last week, the City does not want to unnecessarily upsize internal watermain to meet the fire flow requirements in the interim conditions. As such, we will have to advance the external watermain construction to meet the required flows prior to occupancies. We understand that the watermain sizing on Koda Street may need to be upsized to a 300mm to meet the site plan flow in the interim, but we see no reason why the watermain construction across the rest of the site cannot advance under the pre-servicing agreement.

2. External works required for Occupancies

We understand that the City will want confirmation that the full fire flow requirements for the subdivision will be provided. Fire flows will be provided by advancing multiple construction projects over 2018 and 2019. We agree that this has to be resolved soon, but see no reason to keep the construction waiting on the internal watermain, or the Essa Road 400mm watermain to Athabaska, as we all know that these are required and the design is finalized. We will review the comments/recommendation provided by Sheyda and yourself on the Memo and will work in the next couple of weeks to provide a construction plan and schedule.

Thanks,

 **BURNSIDE**
Sam Webb, P.Eng.

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128 Wellington Street West, Suite 301, Barrie, Ontario L4N 8J6
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Thank you.

Appendix F

Geotechnical Report



Terraprobe

*Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing*

**PRELIMINARY GEOTECHNICAL INVESTIGATION AND
ENGINEERING REPORT
PROPOSED MIXED-USE DEVELOPMENT
901 ESSA ROAD AND BROWN BEAR STREET
BARRIE, ONTARIO**

Prepared For: **Brown Bear Dev Ltd**
200 Consumers Road, #212
Toronto, Ontario
M2J 4R4

Attention: Mr. Mohammed Raja

File No. 3-22-0008-01
March 21, 2022

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Distribution of Report:

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FIGURES:

Figure 1 –	Site Location Plan
Figure 2A –	Borehole Location Plan – Existing Condition
Figure 2B -	Borehole Location Plan – Proposed Condition

APPENDICES:

Appendix A –	Borehole Logs
Appendix B –	Geotechnical Laboratory Data
Appendix C -	Basement Drainage Details
Appendix D -	Guidelines for Underpinning Soils



1.0 THE PROJECT

Terraprobe Inc. (Terraprobe) was retained by Brown Bear Dev Ltd to conduct a preliminary subsurface investigation and prepare a geotechnical design report for the re-development of a parcel of land located on the north side of Salem Road, between Essa Road and Brown Bear Street, in the City of Barrie, Ontario. A site location plan is provided as Figure 1.

This report encompasses the geotechnical investigation conducted for the property to assess its geotechnical suitability for the intended re-development. The field investigation consisted of advancing a total of five (5) exploratory boreholes (Boreholes 1 to 5) across the site. The objective of the geotechnical investigation was to determine the prevailing subsurface soil and groundwater conditions, in order to provide geotechnical engineering recommendations for the design of proposed building foundations, basement floor-slab, earthquake and earth pressure design parameters, basement drainage, shoring design parameters, pipe bedding and installation of underground utilities. In addition, comments are also included on the pertinent project construction aspects including excavation, backfill and groundwater control.

Terraprobe was also retained to conduct a Phase One Environmental Site Assessment (ESA) and hydrogeological study for the property. The findings of the phase one ESA and hydrogeological study are reported under separate covers.

2.0 SITE AND PROJECT DESCRIPTION

The property is located on the north side of Salem Road, between Essa Road and Brown Bear Street, in the City of Barrie, Ontario. Moreover, the western portion of the site is known as 'Block 281,' and the eastern portion of the site has the current municipal address of 901 Essa Road, Barrie, Ontario.

The western portion of the Property, ('Block 281'), is located at the northeast corner of the intersection of Salem Road and Brown Bear Street; Block 281 is roughly rectangular in shape with an area of approximately 0.35 hectares (0.87 acres). The eastern portion of the Property, 901 Essa Road, is located at the northwest corner of the intersection of Essa Road and Salem Road; this portion is irregular in shape with an area of approximately 0.79 hectares (1.96 acres). Block 281 is currently used as a construction staging area for the neighbouring subdivision. The 901 Essa Road Property is occupied by a two-storey residential building, a single-storey workshop/structure, and gravel parking areas. The surrounding properties are a mix of residential, commercial, and institutional land use.

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated Jan. 2022 prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing structures and construct a new 12-storey mixed residential and commercial use building supported over three levels of underground parking. The underground parking finished floor elevations (FFE) were not provided at the time of this report, however, it is understood that the lowest (P3) FFE it is expected to be set at a depth of about 9.95 m $\pm$ below existing grade, i.e., at about Elev. 302.3 m $\pm$, based on an average ground surface

elev. of 312.2 m±. The geotechnical investigation was therefore conducted to assess the geotechnical suitability of the property for the intended development. The geotechnical investigation consisted of advancing a total of five (5) boreholes across the site to obtain subsurface soil and groundwater information.

3.0 INVESTIGATION PROCEDURE

The field investigation was conducted on February 7, 8, 9 and 14, 2022, and consisted of drilling and sampling a total of five (5) exploratory boreholes (Boreholes 1 to 5) extending to the depths ranging from about 15.4 to 15.5 m below existing ground surface.

The boreholes were staked out by Terraprobe based on the existing site features. The approximate borehole locations are shown on enclosed Borehole Location Plans (Figure 2A – Existing Condition and Figure 2B – Proposed Condition).

Various utility locate agencies (including a private locate company) were contacted by Terraprobe to clear the borehole locations prior to the commencement of the field investigation.

The ground surface elevations at the borehole locations were surveyed by Terraprobe. Borehole elevations are provided relative to Geodetic Datum (NAD). The horizontal coordinates are reported relative to the Universal Transverse Mercator geographic coordinate system (UTM Zone 17T). It should be noted that the elevations provided on the Borehole Logs are approximate and provided only for the purpose of relating borehole soil stratigraphy and should not be used or relied on for other purposes.

The borings were drilled by a specialist drilling contractor using a track mounted drill rig power auger and sampled at regular intervals with a conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D 1586). The field work (drilling, sampling, and testing) was observed full time and recorded by a Terraprobe field staff, who logged the boring and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into plastic jars and transported to our geotechnical laboratory for detailed inspection and testing. The borehole samples were examined (tactile) in detail by a geotechnical engineer and classified according to visual and index properties. Geotechnical laboratory testing consisted of water content determination on all samples, while a Sieve and Hydrometer analysis was conducted on four (4) selected soil samples (Borehole 1, Sample 6; Borehole 2, Sample 10; Borehole 4, Sample 12 and Borehole 5, Sample 9). The measured natural water contents of individual samples and the results of the Sieve and Hydrometer analyses tests are plotted on the enclosed borehole logs at respective sampling depths. The results of the Sieve and Hydrometer analyses tests are also summarized in Section 4.5 of this report and appended.

Groundwater levels were observed in the open boreholes upon completion of drilling. Monitoring wells were installed in Boreholes 1 to 4 to facilitate groundwater monitoring and for hydrogeological purposes. The results of the groundwater monitoring are summarized in Section 4.6 of this report.

4.0 SUBSURFACE CONDITIONS

The specific soil conditions encountered at each borehole location are described in greater detail on the Borehole Logs, with a summary of the general subsurface soil conditions outlined below. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions at the site.

It should be noted that the subsurface conditions are confirmed at the borehole locations only and may vary between and beyond the borehole locations. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.

4.1 Topsoil

Surficial topsoil with thickness of about 600 mm was encountered at the ground surface in Boreholes 3, 4 and 5. The topsoil was dark brown to black in colour and had a silt matrix.

The above noted topsoil thicknesses was measured through the collar of the boreholes and are approximate. The topsoil is expected to vary between and beyond the boreholes. We recommend that a shallow test pit investigation be carried out to determine precise topsoil thickness present at the site for quantity estimation and costing purposes (if required).

4.2 Earth Fill

A layer of earth fill was encountered from the ground surface in Boreholes 1 and 2 and extended to a depth of about 1.1 and 1.5 m below grade, respectively. The earth fill material consisted of sand with trace to some gravel, trace silt, occasional rock fragments and some organics and brick fragments in the upper levels in Borehole 1.

Standard Penetration Test results (N-values) obtained from the sand earth fill zone ranged from 38 to greater than 50 blows per 300 mm of penetration or less, indicating a dense to very dense relative density. However, the elevated 'N' values may be due to the presence of rock fragments in the fill.

The in-situ moisture contents of the earth fill samples ranged from 9 to 13 percent by weight, indicating a generally moist condition. Elevated moisture contents may be attributable to possible the presence of organic matter in the fill.

4.3 Gravelly Sand to Sand

A cohesionless deposit of gravelly sand to sand was encountered below the fill in Boreholes 1 and 2 and below the surficial topsoil layer in Boreholes 3 to 5 and extended to a depth ranging from 7.6 to 10.9 m below grade. Sand and gravel zone was noted between 4.6 and 6.6 m depth in Borehole 1 and stone fragments were present in the deposit. The deposit generally became water bearing below about 6.1 to 7.6 m depth.

The Standard Penetration Test results (N-Value) obtained from gravelly sand to sand deposit ranged from 9 to greater than 50 blows per 300 mm of penetration, indicating a loose to very dense relative density (generally dense to very dense). The low 'N' of 9 blows per 300 mm of penetration recorded at 7.6 m depth in Borehole 1 is likely due to disturbance of the soil from augers.

The in-situ moisture contents of the gravelly sand to sand samples ranged from 2 to 26 percent by weight, indicating a moist to wet condition, i.e., generally moist and becoming wet below 6.1 to 7.6 m depth below grade.

4.4 Silty Sand Glacial Till

Silty sand glacial till was encountered below the gravelly sand to sand deposit and extended to the depth of investigation in all boreholes, i.e., depth ranging from 15.4 to 15.5 m below grade.

The till contained clayey silt zone at 11 m depth in Borehole 1 and occasional embedded permeable sand zones, and occasional rock fragments (cobbles) were noted in the deposit.

It should be noted that glacial till deposit may contain larger size particles (cobbles and boulders) that are not specifically identified in the boreholes. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples of the particles of this size.

The Standard Penetration Test result (N-Value) obtained from silty sand till deposit ranged from 11 to over 50 blows per 300 mm of penetration, indicating a compact to very dense (typically very dense) relative density.

Measured moisture contents of silty sand till soil samples varied from 5 to 17 percent by weight, indicating a generally moist to locally wet condition.

4.5 Geotechnical Laboratory Test Results

The geotechnical laboratory testing consisted of natural moisture content determination for all samples from the boreholes, while Sieve and Hydrometer analysis tests were conducted on selected soil samples. The test results are plotted on the enclosed Borehole Logs at respective sampling depths.

The results (graphs) of the Sieve and Hydrometer (grain size) analysis are appended, and a summary of these results is presented as follows:

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage (by mass)				Descriptions (MIT System)
		Gravel	Sand	Silt	Clay	
Borehole 1, Sample 6	4.8	38	59	3	0	SAND AND GRAVEL, trace silt
Borehole 2, Sample 10	10.8	8	76	11	5	SAND, some silt, trace gravel, trace clay
Borehole 4, Sample 12	13.8	2	59	31	8	SILTY SAND, trace clay, trace gravel
Borehole 5, Sample 9	9.3	16	53	22	9	SILTY SAND, some gravel, trace clay

4.6 Groundwater

Observations pertaining to the depth of groundwater level and caving were made in the open boreholes immediately after completion of drilling in all boreholes and are noted on the enclosed Borehole Logs. Monitoring wells were installed in Boreholes 1 to 4 to facilitate groundwater level monitoring and for the purpose of Terraprobe's geotechnical and hydrogeological studies. The groundwater readings taken on February 17, 2022, are noted on the enclosed Borehole Logs. A summary of these observations is provided as follows:

Borehole No.	Ground Surface Elevation (m)	Depth of Boring below Grade (m)	Depth to Cave below Grade (m)	Groundwater Level Depth/Elevation (m)	
				At the Time of Drilling	Monitoring Well Feb. 17, 2022
1	312.1	15.4	Not measured	7.6/304.5	7.8/304.3
2	312.6	15.5	Not measured	8.0/304.6	8.0/304.6
3	312.1	15.4	Not measured	8.3/303.8	8.3/303.8

Borehole No.	Ground Surface Elevation (m)	Depth of Boring below Grade (m)	Depth to Cave below Grade (m)	Groundwater Level Depth/Elevation (m)	
				At the Time of Drilling	Monitoring Well Feb. 17, 2022
4	311.8	15.5	Not measured	7.6/304.2	8.3/303.5
5	312.4	15.5	Not measured	Not measured	Monitoring well not installed

The site is underlain by cohesionless gravelly sand to sand followed by glacial till deposit of relatively low to moderate permeability. The till contains occasional embedded permeable sand/silt zones. The till matrix is expected to yield only low amounts of free-flowing water in the short-term, however the relatively permeable silt/sand zone(s) in the till and the cohesionless gravelly sand to sand when wet, will result in considerable groundwater seepage. The prevailing stabilized groundwater table at the site is inferred to be Elev. 304.6 metres $\pm$ in the gravelly sand to sand deposit.

The water levels noted above may fluctuate seasonally depending upon the amount of precipitation and surface runoff.

5.0 PRELIMINARY GEOTECHNICAL DESIGN

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use by the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

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

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated Jan. 2022 prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing structures and construct a new 12-storey mixed residential and commercial use building supported over three levels of underground parking. The underground parking finished floor elevations (FFE) were not provided at the time of this report, however, it is understood that the lowest (P3) FFE it is expected to be set at a depth of about 9.95 m $\pm$ below existing grade, i.e., at about Elev. 302.3 m $\pm$, based on an average ground surface elev. of 312.2 m $\pm$.

5.1 Foundation Design Parameters

5.1.1 Spread Footings

The lowest basement level P3 is expected to have a finished floor elevation set at a depth of about 9.95 m $\pm$ (Elev. 302.3 $\pm$ m) below existing grade, and rest below the prevailing groundwater table. Spread footing foundations for the lowest level (P3) will likely be set at about 1.0 m below lowest FFE, i.e., Elev. 301.2 m $\pm$ and below the prevailing groundwater table. The soils below elevation of 302.3 m $\pm$ generally consists of very dense sands underlain by very dense glacial till.

Conventional spread footings made to bear on the dense to very dense sands or glacial till below Elev. 302.3 metres $\pm$ may be designed using a maximum factored geotechnical resistance at ULS of 750 kPa. The maximum net geotechnical reaction at SLS is 500 kPa, for an estimated total settlement of 25 mm. For the bearing pressures given above, the minimum width of continuous strip footings supported must be 0.5 m, and the minimum size of isolated footings must be 1.0 m x 1.0 m. These dimensions apply regardless of loading considerations, in conjunction with the above recommended geotechnical resistance. The settlement at SLS will occur as load is applied and is linear and non-recoverable. Differential settlement is a function of spacing, loading and foundation size.

All of the foundation excavations will extend below the prevailing groundwater table for P3 basement level as the excavation will penetrate through upper cohesionless water bearing gravelly sand to sand. The gravelly sand to sand deposit will yield free-flowing water when penetrated.

The groundwater table must be dewatered to a minimum 1.2 m below the deepest excavation prior to excavation, to preserve the in-situ integrity of the native soils. If the subsurface is not dewatered prior to excavation, the native soils will become disturbed by the ingress of groundwater and the above recommendations for bearing capacity will not be valid.

A dewatering contractor must be retained to review the site dewatering requirements and provide a dewatering plan for the site.

Prior to pouring concrete for the footings, the footing subgrade must be cleaned of all deleterious materials such as softened, disturbed, or caved materials or standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided.

Footings stepped from one level to another must be at a slope not exceeding 7 vertical to 10 horizontal.

The design earth cover for frost protection of foundations exposed to ambient environmental temperatures is 1.5 metres in the Barrie area.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided. Native soils tend to weather rapidly and deteriorate on exposure to the atmosphere and surface water. Hence, foundation bases which remain open for an extended period of time should be protected by a skim coat of lean concrete.

5.2 Earthquake Design Parameters

The Ontario Building Code stipulates the methodology for earthquake design analysis. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration, and the site classification.

Under Ontario Regulation 88/19, the ministry amended Ontario's Building Code (O. Reg 332/12) to further harmonize Ontario's Building Code with the 2015 National Codes. These changes will help reduce red tape for businesses and remove barriers to interprovincial trade throughout the country. The amendments are based on code change proposals the ministry consulted in 2016 and 2017. The majority of the amendments came into effect on January 1, 2020, which includes structural sufficiency of buildings to withstand external forces and improve resilience.

Seismic hazard is defined in the Ontario Building Code (OBC) by uniform hazard spectra (UHS) at spectral coordinates of 0.2s, 0.5s, 1.0s and 2.0s and a probability of exceedance of 2% in 50 years. The OBC method uses a site classification system defined by the average soil/bedrock properties (e.g., shear wave velocity (v_s), Standard Penetration Test (SPT) resistance, and undrained shear strength (s_u) in the top 30 meters of the site stratigraphy below the foundation level, as set out in the Ontario Building Code. There are 6 site classes from A to F, decreasing in ground stiffness from A, hard rock, to E, soft soil; with site class F used to denote problematic soils (e.g., sites underlain by thick peat deposits and/or liquefiable soils). The site class is then used to obtain peak ground acceleration (PGA), peak ground velocity (PGV) site coefficients F_a and F_v , respectively, used to modify the UHS to account for the effects of site-specific soil conditions.

Based on the above noted information, it is recommended that the site designation for seismic analysis be 'Site Class C', as per the Ontario Building Code. Consideration may be given to conducting a site-specific Multichannel Analysis of Surface Waves (MASW) at this site to confirm the average shear wave velocity in the top 30 metres of the site stratigraphy.

The values of the site coefficient for design spectral acceleration at period T , $F(T)$, and of similar coefficients $F(PGA)$ and $F(PGV)$ shall conform to Tables 4.1.8.4.B. to 4.1.8.4.I. using linear interpolation for intermediate values of PGA.

5.3 Earth Pressure Design Parameters

The parameters used in the determination of earth pressures acting on retaining walls are defined below.

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

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

Stratum/Parameter	ϕ	γ	K_a	K_o	K_p
Compact Granular Fill Granular 'B' (OPSS 1010)	32	21.0	0.31	0.47	3.25
Existing Earth Fill	29	19.0	0.35	0.52	2.88
Dense to Very Dense Gravelly Sand to Sand	36	21.0	0.26	0.41	3.85
Cohesionless Glacial Till	34	21.0	0.28	0.44	3.54

Walls subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

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

where,

- P = the horizontal pressure at depth, h (m)
- K = the earth pressure coefficient
- h_w = the depth below the groundwater level (m)
- γ = the bulk unit weight of soil, (kN/m³)
- γ' = the submerged unit weight of the exterior soil, ($\gamma - 9.8$ kN/m³)
- q = the complete surcharge loading (kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall that would otherwise act in conjunction with the earth pressure, this equation can be simplified to:

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

This equation assumes that free-draining granular backfill such as Granular 'B' (OPSS.MUNI 1010) is used and effective drainage is provided. Consideration must also be given to the possible effects of frost on structures retaining earth. Pressures induced by freezing in frost-susceptible soils exert pressures and are effectively irresistible.

The factored geotechnical resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction (**R**) depends on the normal load of the soil contact (**N**) and the frictional resistance of the soil (**tan φ**) expressed as $R_f = N \tan \phi$, which is the unfactored resistance. The factored geotechnical resistance at ULS is $R_f = 0.8 N \tan \phi$.

5.4 Slab-on-Grade Design Parameters

The P3 slab is to be set at Elev. 302.3 m± and will be made on the dense to very dense native gravelly sand to sand or glacial till. The native soil constitutes an adequate subgrade for the support of a slab-on-grade provided adequate dewatering is in place. The modulus of subgrade reaction appropriate for the design of a fully drained slab-on-grade resting on the granular drainage layer resting on the dense to very dense native soils is 40,000 kPa/m.

Prior to the construction of the slab, it is recommended that the subgrade be proof-rolled and inspected under the supervision of Terraprobe for obvious loose or disturbed areas as exposed, or for areas containing excessively deleterious materials or moisture. These areas shall be recompacted in place and retested, or else replaced with Granular B placed as engineered fill (in lifts 150 mm thick or less and compacted to a minimum of 98 % SPMDD).

It is necessary that building floor slabs be provided with a capillary moisture barrier and drainage layer. The drainage layer, which should comprise a minimum of 200 mm of HL8 coarse aggregate or 19 mm clear stone (OPSS.MUNI 1004), vibrated to a dense state. The new slab will be made on cohesionless soil below the groundwater table and therefore, the subgrade must be separated from the drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent) with a minimum 900 mm overlap below the HL-8 Coarse Aggregate or 19 mm clear stone; otherwise, without proper filtering there may be entry of fines from the surrounding subgrade soils into the bedding. This loss of ground could result in a loss of support of the slab and clogging of the subfloor drainage system.

The water level in the subgrade must be lowered from inside the excavation at least 1.2 m below the lowest excavation elevation prior to excavation for the duration of below-grade construction. To preserve the integrity of the subgrade once the subgrade elevation is reached, a skim coat of lean concrete could be applied to create a trafficable surface.

Regardless of the approach to slab construction, the floor slabs that are to have bonded floor finishes (such as tiles with adhesives) should be provided with a capillary moisture and vapour barrier. The floor

manufacturers have specific requirements for moisture and vapour barrier, therefore, the floor designer/architect must ensure that a provision of appropriate moisture and vapour barrier conforming to specific floor finish product requirements is incorporated in the project specifications. Adequate testing must be carried out to ensure acceptable levels of moisture and relative humidity in the concrete slab prior to the installation of floor finish(es). Studies indicate that a provision of 200 mm thick 19 mm clear stone base (OPSS.MUNI 1004) under the slab helps provide a good capillary moisture break provided the granular base is positively drained. However, this provision does not replace the floor manufacturers' specific requirement(s) for a moisture and vapour barrier.

The under-slab vapour retarder specifications, selection and installation shall conform to ASTM E1745 and ASTM E1643. The moisture vapour measurement tests shall conform to RH: ASTM F2170, RH: ASTM F2420 and Calcium Chloride: ASTM F1869. The Surface Applied Moisture Vapour Barrier system shall meet the guidelines established in ASTM F3010-13.

5.5 Basement Drainage

A separate Hydrogeological Study has been prepared by Terraprobe for this site (File. No. 3-22-0008-46), which provides the approximate amount of daily temporary (construction) and permanent groundwater collection and discharge.

To assist in maintaining dry basements and preventing seepage, it is recommended that exterior grades around the building be sloped away at a 2 % gradient or more, for a distance of at least 1.2 metres. Provision of subfloor drainage is required in conjunction with the perimeter drainage of the structure, to collect and remove the water that infiltrates at the building perimeter and under the floor. Perimeter and subfloor drainage are required throughout below grade areas.

It is recommended that the subfloor drainage system consists of minimum 100 mm diameter perforated pipes wrapped in filter fabric spaced at a maximum spacing of 5 metres on centre. The pipes must be surrounded by a minimum of 100 mm of 19 mm clear stone/HL-8 Coarse Aggregate, and the pipe inverts should be a minimum 300 mm below the base of the slab. The elevator pits/sumps can be drained separately with an independent lower pumping sump or can be designed as waterproof structures which are below the drainage level. A typical basement subdrain detail is provided in Appendix C. The subfloor drains can be constructed in trenches as shown in the typical detail, or alternatively they can be constructed on a flat subgrade subexcavated at least 300 mm below the base of the slab. The subdrain system should be outlet to a suitable discharge point under gravity flow or connected to a sump located in the lowest level of the basement. The water from the sump must be pumped out to a suitable discharge point/positive outlet. The installation of the drains as well as the outlet must conform to the applicable plumbing code requirements.

Prefabricated drainage composites, such as CCW MiraDRAIN 6000 series® (or Terrafix Terradrain 200®, or approved equivalent) should be incorporated between the shoring and the cast-in-place concrete

foundation wall to make a drained cavity. Drainage from the cavity must be collected at the base of the wall in non-perforated pipes and conveyed directly to the sumps using a solid pipe (separate from the subfloor drainage system) to remove collected water at the building sumps. The flow to the building sump from the subsurface drainage will be governed largely by the building perimeter drainage collection during rainfall and runoff events. Typical shored excavation drainage details are provided in Appendix C.

The drainage system is a critical structural element since it keeps water pressure from acting on the basement floor slab or on the foundation walls. As such, the sump that ensures the performance of this system must have a duplexed pump arrangement for 100% pumping redundancy and these pumps must be on emergency power. The size of the pump should be adequate to accommodate the anticipated groundwater and storm event flows. The subdrain system should be outlet to a suitable discharge point under gravity flow or connected to a sump located in the lowest level of the basement. The water from the sump must be pumped out to a suitable discharge point/positive outlet. The installation of the drains as well as the outlet must conform to the applicable plumbing code requirements.

It must be noted that basement drainage provisions will need to be designed in conjunction with the findings of the hydrogeological report. The water volumes to be discharged in both short-term and long-term as well as City sewer capacity to allow groundwater discharge into the City sewers are critical factors to decide on basement drainage approach. Depending upon the groundwater volume to be discharged in the long-term, its chemical quality as well as sewer capacity a fully waterproofed (“Bath-tub”) option may have to be adopted particularly for 3 or more levels of basement/underground parking structure. These recommendations must be reviewed and revised based on the findings of the additional building location specific boreholes during detailed design stage, if required.

5.6 Site Servicing

5.6.1 Bedding

In general, the existing native gravelly sand to sand soils and earth fill compacted to a minimum of 98% SPMDD, or neatly cut glacial till, will provide adequate support for buried services on a conventional well graded granular base material. Where disturbance of the trench base has occurred, such as due to groundwater seepage or construction traffic, the disturbed soils should be sub-excavated and replaced with suitably compacted granular fill.

Granular bedding material should consist of a conventional Class ‘B’ bedding, such as Granular ‘A’, conforming to OPSS.MUNI 1010 specification. The use of HL 8 coarse aggregate or 19 mm clear stone (OPSS.MUNI 1004) bedding is also acceptable, however only in conjunction with a suitable geotextile filter (Terrafix 360R or equivalent); otherwise without proper filtering, there may be entry of fines from the surrounding soils into the subfloor drainage layer. This loss of ground could result in a loss of support to the pipes and possible future settlements. The bedding material should be compacted to a minimum of 98%

SPMDD. Clear stone type bedding material should be vibrated to a dense state. The bedding material should conform to the pertinent City and Region Specifications.

5.6.2 Backfill

In general, excavated soils encountered on site may be re-used as backfill, provided the moisture content of these materials is within 2% of optimum to ensure adequate compaction, and the trenches are wide enough to accommodate a large compaction roller, and the soil is free of any deleterious material (e.g., topsoil, debris). Any native material with higher in-situ moisture content could be put aside to dry or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content could be wasted and replaced with imported material which can be readily compacted.

The backfill should consist of clean earth and should be placed in lifts of 150 mm thickness or less and compacted to a minimum of 95% SPMDD (in non-settlement sensitive areas) and 98% SPMDD (in settlement sensitive areas) at a water content within 2% of optimum. Existing native soils will be difficult to place and compact successfully in narrow trench excavations, where large compaction equipment could not operate. For narrow trench excavations, it is recommended that free draining granular material, such as OPSS.MUNI 1010 Granular 'B' be used in order to allow for adequate compaction using vibratory equipment. The placement and inspection of any earth fill as backfill must be conducted under the full-time observation of the geotechnical engineer.

The site soils may be difficult to handle and compact if they become wet as a result of inclement weather or seepage. Hence, it can be expected that earthworks carried out during wet periods (i.e., spring and fall) of the year may result in increased earthwork costs. The site soils have a low to moderate susceptibility to frost effects. If the building has flush entrances, care must be taken in detailing the exterior slabs/sidewalks, providing insulation and/or drainage and/or non-frost susceptible backfill/frost slab to maintain the flush threshold during freezing weather conditions.

5.7 Pavement Above Underground Parking Structure

It is understood that the project would also include new pavements/driveways constructed at grade over the underground parking concrete deck. The following design is provided for the pavement above parking structure.

5.7.1 Typical Pavement Above Parking Garage

A typical Pavement Components make-up above a concrete deck slab are as follows:

- Reinforced Concrete Slab Substrate
- Waterproofing with Protection Board (to be specified by Architect)

- Drainage Board (to be specified by Architect)
- Filter Fabric (to be specified by Architect)
- Min 300 mm Base Granular 'A' or 19 mm Crusher run limestone
- 70 mm HL8
- 40 mm HL3

The parking garage concrete structure must be designed to support the applicable loads of vehicles, i.e., fire trucks, delivery trucks, etc. which will likely access the driveways.

The HL 3 and HL 8 hot mix asphalt mixes should be designed, produced, and placed in conformance with OPSS 1150 and OPSS. MUNI 310 requirements and pertinent City standards.

The Granular 'A' or 19 mm Crusher Run Limestone should meet City's standards. Granular materials should be compacted to 100 percent SPMDD at ± 2 percent of the OMC.

PG 58-28, conforming to OPSS.MUNI 1101 is recommended in the HMA surface and binder courses. Tack coat SS-1 should be applied between hot mix asphalt binder course and surface course.

5.7.2 Drainage

Drainage measures shall be provided for the pavement above the garage deck. This is typically provided by provision of 2 to 3 % grade on the garage deck and installing a subdrain system. A perimeter drain at the edge(s) of the garage deck should be considered in addition to above noted subdrain system.

6.0 DESIGN CONSIDERATION FOR CONSTRUCTABILITY

6.1 Excavations

Excavations must be carried out in accordance with the Occupational Health and Safety Act, Ontario Regulation 213/91 (as amended), Construction Projects, Part III - Excavations, Section 222 through 242. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety.

For practical purposes, the earth fill and native gravelly sand to sand are considered Type 3 soils (Type 4 when wet) and native glacial till is considered Type 2 soil.

Where workers must enter a trench or excavation the soil must be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates safe slopes of excavation by soil type as follows:

Soil Type	Base of Slope	Steepest Slope Inclination
1	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
2	within 1.2 metres of bottom of trench	1 horizontal to 1 vertical
3	from bottom of trench	1 horizontal to 1 vertical
4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the Act and Regulations and include provisions for timbering, shoring and moveable trench boxes.

The subsurface soils can be removed by conventional excavation equipment. Excavations at this site may encounter construction debris, deleterious materials and other obstructions in the earth fill and native cobble/boulder obstructions in the glacial till. Larger size particles (cobbles and boulders) that are not specifically identified in the boreholes may be present in the native soils. The size and distribution of cobbles/boulders/obstructions cannot be predicted with boreholes, as the sampler size is insufficient to secure representative particles of this size. The risk and responsibility for the removal and disposal of cobbles/boulders/obstructions must be addressed in the contract documents for foundations, excavations, and shoring contractors.

6.2 Groundwater Control

Groundwater control and considerations pertaining to groundwater and drainage are discussed in Terraprobe's Hydrogeological Study for the site under a separate cover (File No. 3-22-0008-46).

For design purposes, the stabilized groundwater table at the site is Elev. 304.6 m $\pm$. In general, the bulk excavation to the P3 level (assumed FFE of Elev. 302.3 m $\pm$) will extend approximately 2.0 to 3.0 m below the stabilized groundwater table (Elev. 304.6 m $\pm$) at this site and excavations for foundations, elevator pits and sumps will extend even deeper below the stabilized groundwater table.

Within the zone of excavation, the glacial till is considered a low to moderate permeability material, which will typically preclude significant free-flow of water. However, the earth fill and native cohesionless gravelly sand to sand are considered high permeability materials, which will permit the free-flow of water when wet. In addition, the glacial till deposit is expected to include relatively permeable silt/sand zones which may yield free-flowing water when penetrated.

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated Jan. 2022 prepared by Chamberlain Architect Services Limited, and the understood preliminary building design concept, it is expected that the foundations will be made below the stabilized groundwater table at this site at about Elev. 301.2 m $\pm$. The groundwater table must be lowered by positive dewatering to a minimum of

1.2 m below the lowest excavation elevation prior to any excavation and maintained at that level during construction. If the subgrade soils are not dewatered prior to excavation and maintained throughout construction, the subgrade soils will become disturbed, and the recommendations provided in Section 5.1 for bearing capacity will not be valid.

It must be noted that seasonal fluctuations in the groundwater table may result in higher groundwater levels than observed and reported.

The subsurface information must be provided to a professional dewatering contractor who will be responsible for the design and installation of the dewatering systems. The dewatering system must be properly installed and screened to ensure that sediment and fine soils are not removed, which could result in settlement of the ground or structures near the site. Once the dewatering method and shoring system are designed, Terraprobe should be retained to evaluate the potential impacts (i.e., settlement) to nearby structures and land caused by lowering the water table.

The dewatering system must remain on until such time as the subfloor drainage system and sumps are fully operational.

6.3 Shoring Design

The site is bounded by existing municipal roadway Essa Road to the east, Salem Road to the south, Brown Bear Street to the west and a few sparse building structures to the north. No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided. Underpinning guidelines are provided as Appendix D.

Where excavations cannot be sloped, they can be supported using a shoring system such as soldier piles and lagging shoring or a continuous interlocking caisson wall shoring. Continuous interlocking caisson wall shoring is to be used where the excavation must be constructed as a rigid shoring system, to preserve the integrity and support of the soil beneath existing foundations of the adjacent buildings in a state approximating the at-rest condition or for groundwater cut-off, for the bulk excavation.

The shoring system would best be supported by pre-stressed soil anchors extending beneath the adjacent lands. Pre-stressed anchors are installed and stressed in advance of excavation and this limits movement of the shoring system as much as is practically possible. The use of anchors on adjacent properties requires the consent of the adjacent landowners, expressed in encroachment agreements. The City Transportation and Works Department negotiates “permits” for encroachment in City lands, which are generally allowed.

Decisions regarding shoring methods and sequencing are the responsibility of the Contractor. Temporary shoring should be carried out by a licensed Professional Engineer experienced in shoring design.

The detailed design of the proposed building was not available at the time of preparation of this report. The sections along the perimeter of the site will likely have to be shored to preserve the integrity of the boundary conditions (adjacent structures and roads). No excavation shall extend below a line cast as one vertical to one horizontal (1V:1H) from foundations of the existing structures without adequate alternate support being provided. Where the adjacent building foundations are removed from the excavation, a foundation which lies above a line drawn upward at 7 vertical to 10 horizontal (7V:10H) from the closest excavation edge is within the zone of potential influence of the excavation, and support for the existing foundations must be carefully assessed and possibly augmented.

The groundwater levels measured on February 17, 2022, in the monitoring wells installed in Boreholes 1 to 4 indicated that the groundwater levels ranged from about 7.8 to 8.3 m below existing grade (about Elev. 303.5 m to Elev. 304.6 m) in the boreholes. For design purposes, the stabilized groundwater table is at about Elev. 304.6 m $\pm$).

Consideration should be given to an impermeable shoring system (i.e., interlocking caisson wall) to support the excavation and around the entire perimeter for groundwater control purposes due to the presence of wet cohesionless gravelly sand/sand materials encountered within the excavation depth (P3). Convectional soldier piles and lagging shoring may be used provided adequate positive dewatering is carried out to lower the groundwater table to 1.2 m below the lowest excavation level as determined by the shoring designer.

6.3.1 Lateral Earth Pressure Distribution

If the shoring is supported with a single level of earth anchor or bracing, a triangular earth pressure distribution similar to that used for the basement wall design is appropriate. Where multiple supports are used to support the excavation, research has shown that a distributed pressure diagram more realistically approximates the earth pressure on a shoring system of this type, when restrained by pre-tensioned anchors. For the cohesionless soils along the extent of the excavation, the multi-level supported shoring can be designed based on a rectangular earth pressure distribution with a maximum pressure defined by:

$$P = 0.65 K (\gamma H + q)$$

where,	P	=	the horizontal pressure at depth, H (kPa)
	K	=	the earth pressure coefficient (see Section 5.3)
	H	=	the total depth of the excavation (m)
	γ	=	the bulk unit weight of soil, (kN/m ³)
	q	=	the complete surcharge loading (kPa)

For groundwater pressure distribution along the shoring wall in conjunction with the above soil pressures, the stabilized groundwater table should be taken at Elev. 304.6 $\pm$ m. The groundwater pressure distribution is only applicable where an impermeable boundary condition (a continuous interlocking caisson wall) is

created along the perimeter of the excavation. Conventional soldier pile and lagging system does not experience the water pressures, as water is allowed to drain freely through the wall/lagging.

6.3.2 Caisson and Soldier Pile Toe Embedment

Caisson and soldier pile toes should be made in the very dense glacial till or sands and silts below Elev. 303.2 metres $\pm$. The horizontal resistance of the soldier pile toes will be developed by embedment below the base of excavation, where resistance is developed from passive earth pressure. It is noted that the resistance from these soils will be different depending on whether the soils are dewatered or remain below the groundwater level. Where soils exist beneath the groundwater level, the unit weight of the soil is diminished by buoyancy. The design of the shoring will therefore have to consider the construction plan and sequence with respect to depth of groundwater control.

The soils at this site are cohesionless, permeable and sufficiently wet such that augered borings made into these soils will be unstable. It is necessary to advance temporarily cased holes to prevent excess caving during the soldier pile and all augered hole installations. Drill holes for piles, caissons, and/or fillers, utilizing temporary liners, mud drilling techniques, and/or other methods as deemed necessary by the contractor may be required to prevent issues such as: groundwater inflow or loss of soil into the drill holes, and disturbance to placed concrete, basal instability, and loss of bearing.

The groundwater table must be lowered a minimum of 1.2 m below the lowest excavation elevation prior to any excavation and maintained at that level during construction.

6.3.3 Lateral Bracing Elements

If anchor support is necessary and determined to be feasible, the shoring system should be supported by pre-stressed soil anchors extending beneath the adjacent lands. Pre-stressed anchors are installed and stressed in advance of excavation and this limits movement of the shoring system as much as is practically possible. It will be necessary to secure encroachment agreements from the Region/City and the adjacent landowners, in order to use soil anchors on the adjoining properties. Pre-construction condition surveys should be carried out for the adjacent structures to establish existing conditions prior to excavation and mitigate the possibility of spurious claims for excavation induced damages. Access to the properties for such surveys must be part of any encroachment agreements. A careful evaluation of the subsurface soil conditions is required by the shoring designer to establish appropriate levels/elevations and design the soil anchors. The anchor design will be governed by the weakest material in the profile. It is imperative that a detailed design is carried out at different anchor levels/locations, and anchors must be tested at each level.

Conventional earth anchors could be made with continuous hollow stem augers or alternatively post grouted anchors can be made. The design adhesion for earth anchors is controlled as much by the installation technique as the soil and therefore a proto-type anchor must be made in each anchor level executed to demonstrate the anchor capacity and validate the design assumptions. A prototype anchor must be made to

demonstrate the anchor capacity (performance tested to 200% of the design load). All production anchors must be proof-tested to 133% of the design load, to validate the design assumptions.

The subsurface soils are sufficiently cohesionless, permeable and/or wet that augered holes could experience caving. It will be necessary to advance temporarily cased holes to maintain sidewall support and to prevent the ingress of water during installation, use slurry, etc. or other means or methods deemed necessary by the contractor.

Conventional earth anchors made in the generally dense gravelly sand to sand or glacial till may be designed using a working adhesion of 50 to 60 kPa. It is expected that post-grouted anchors can be made such that an anchor will likely carry about 60 to 80 kN/m of adhered anchor length (at a nominal diameter of 150 mm) in the dense tills and sands depending upon the material type as confirmed by a performance/load test. It should be noted that these values are provided as preliminary guidance only and the actual anchor performance must be verified by a performance/load test. Regardless, the subsurface soil information should be reviewed by the shoring designer to decide on the suitable type of earth anchors and anchor capacity to be employed at this site.

If adjacent landowners are not agreeable to anchored support, then internal bracing or rakers would be necessary. The compact to very sands are suitable for the placement of raker foundations. Raker footings established on the undisturbed (dewatered) compact to dense native soils at an inclination of 45 degrees can be designed for a maximum factored geotechnical resistance at ULS of 350 kPa.

6.4 Site Work

The soils found at this site will become weakened when subjected to traffic, particularly when wet. If there is site work carried out during periods of wet weather, then it can be expected that the subgrade will be disturbed unless an adequate granular working surface is provided to protect the integrity of the subgrade soils from construction traffic. Subgrade preparation works cannot be adequately accomplished during wet weather and the project must be scheduled accordingly. The disturbance caused by the traffic can result in the removal of disturbed soil and use of granular fill material for site restoration or underfloor fill that is not intrinsic to the project requirements.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during paving and other work may be required, especially if construction is carried out during unfavourable weather.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the founding subgrade and concrete must be provided. The soil at this site is highly susceptible to frost damage.

Consideration must be given to frost effects, such as heave or softening, on exposed soil surfaces in the context of this particular project development.

Prior to pouring concrete for the footings, the footing subgrade must be cleaned of deleterious materials, softened, disturbed, or caved materials, and any standing water. The footing excavations must be inspected and approved by Terraprobe to ensure the bearing capacities stated above are applicable. If soft soils are encountered at the proposed bearing depths during footing excavation, sub-excavation to competent soil is required under the direction of the geotechnical engineer. Furthermore, native soils tend to weather and deteriorate on exposure to the atmosphere or to surface water, therefore foundation bases that will remain open and exposed to the atmosphere for an extended period of time shall be protected by applying a skim coat of lean concrete. If construction is to proceed in freezing conditions, temporary frost protection for the footing bases and concrete must be provided.

6.5 Quality Control

The proposed structure will be founded on spread footing foundations. The foundation installations must be field reviewed by the geotechnical engineer as they are constructed. The on-site review of the condition of the foundation soil as the foundations are constructed is an integral part of the geotechnical design function and is required by the current Ontario Building Code. If Terraprobe is not retained to carry out foundation evaluations during construction, then Terraprobe accepts no responsibility for the performance or non-performance of the foundations, even if they are ostensibly constructed in accordance with the conceptual design advice contained in this report.

The long-term performance of the slab on grade is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible. The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the borings. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the subgrade and the compaction of all fill should be monitored by Terraprobe at the time of construction to confirm material quality, thickness and to ensure adequate compaction.

The requirements for fill placement on this project have been stipulated relative to Standard Proctor Maximum Dry Density as determined by ASTM D698. In situ determinations of density during fill and asphaltic placement on site are required to demonstrate that the specified placement density is achieved. Terraprobe is a CNSC certified operator of appropriate nuclear density gauges for this work and can provide sampling and testing services for the project as necessary, with our qualified technical staff.

Concrete will be specified in accordance with the requirements of CAN3 - CSA A23.1. Terraprobe maintains a CSA certified concrete laboratory and can provide concrete sampling and testing services for the project as necessary.

Terraprobe provides quality control services for Building Envelope, Roofing and Structural Steel, as necessary, for the Structural and Architectural quality control requirements of the project. Terraprobe is certified by the Canadian Welding Bureau under W178.1-1996.

7.0 LIMITATIONS AND USE OF REPORT

7.1 Procedures

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained from this investigation.

The drilling work was carried out by a drilling contractor and was observed and recorded by Terraprobe on a full-time basis. The boreholes were made by a continuous flight power auger machine using solid and hollow stem augers. A Terraprobe technician logged the boreholes and examined the samples as they were obtained. The samples obtained were sealed in clean, air-tight containers and transferred to the Terraprobe laboratory, where they were reviewed for consistency of description by a geotechnical engineer. Groundwater observations were made in the boreholes as drilling proceeded.

The samples of the strata penetrated were obtained using the technique, Split-Barrel Method, ASTM D1586. The samples were taken at intervals. The conventional interval sampling procedure used for this investigation does not recover continuous samples of soil at any borehole location. There is consequently some interpolation of the borehole layering between samples and indications of changes in stratigraphy as shown on the borehole logs are approximate.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. A comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information and geotechnical advice to completely identify all aspects of the site and works that could affect construction costs, techniques, equipment, and scheduling. Contractors bidding on or undertaking work on the project must be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, and their approach to the construction works, cognizant of the risks implicit in the subsurface investigation activities.

The subsurface soil and groundwater conditions encountered in the boreholes are presented on the attached Borehole Logs. The stratigraphic boundaries indicated on the Borehole Logs are inferred from non-continuous samples and observations of drilling resistance and typically represent a transition from one soil type to another. These boundaries should not be interpreted to represent exact planes of geological change. The subsurface conditions have been confirmed in a series of widely spaced boreholes and will vary between and beyond the borehole locations. The discussion has been simplified in terms of the major soil strata for the purposes of geotechnical design.

7.2 Changes in Site and Scope

It must be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. In particular, caution should be exercised in the consideration of contractual responsibilities as they relate to control of seepage, disturbance of soils, and frost protection.

The design parameters provided, and the engineering advice offered in this report is based on the factual data obtained from this investigation made at the site by Terraprobe and is intended for use by the owner and its retained design consultants in the design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters, advice, and comments relating to constructability issues and quality control may not be relevant or complete for the project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

7.3 Use of Report

This report is prepared for the express use of Brown Bear Dev Ltd and their retained design consultants. It is not for use by others. This report is copyright of Terraprobe Inc., and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe, Brown Bear Dev Ltd and their retained design consultants are authorized users.

It is recognized that municipal/regional governing bodies, in their capacity as the planning and building authority under Provincial statutes, will make use of and rely upon this report, cognizant of the limitations thereof, both as are expressed and implied.

We trust this report meets with your requirements. Should you have any questions regarding the information presented, please do not hesitate to contact our office.

Sincerely,

Terraprobe Inc.



Osbert (Ozzie) Benjamin, P.Eng.
Senior Project Manager, Geotechnical

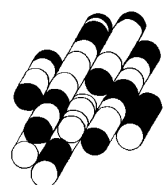


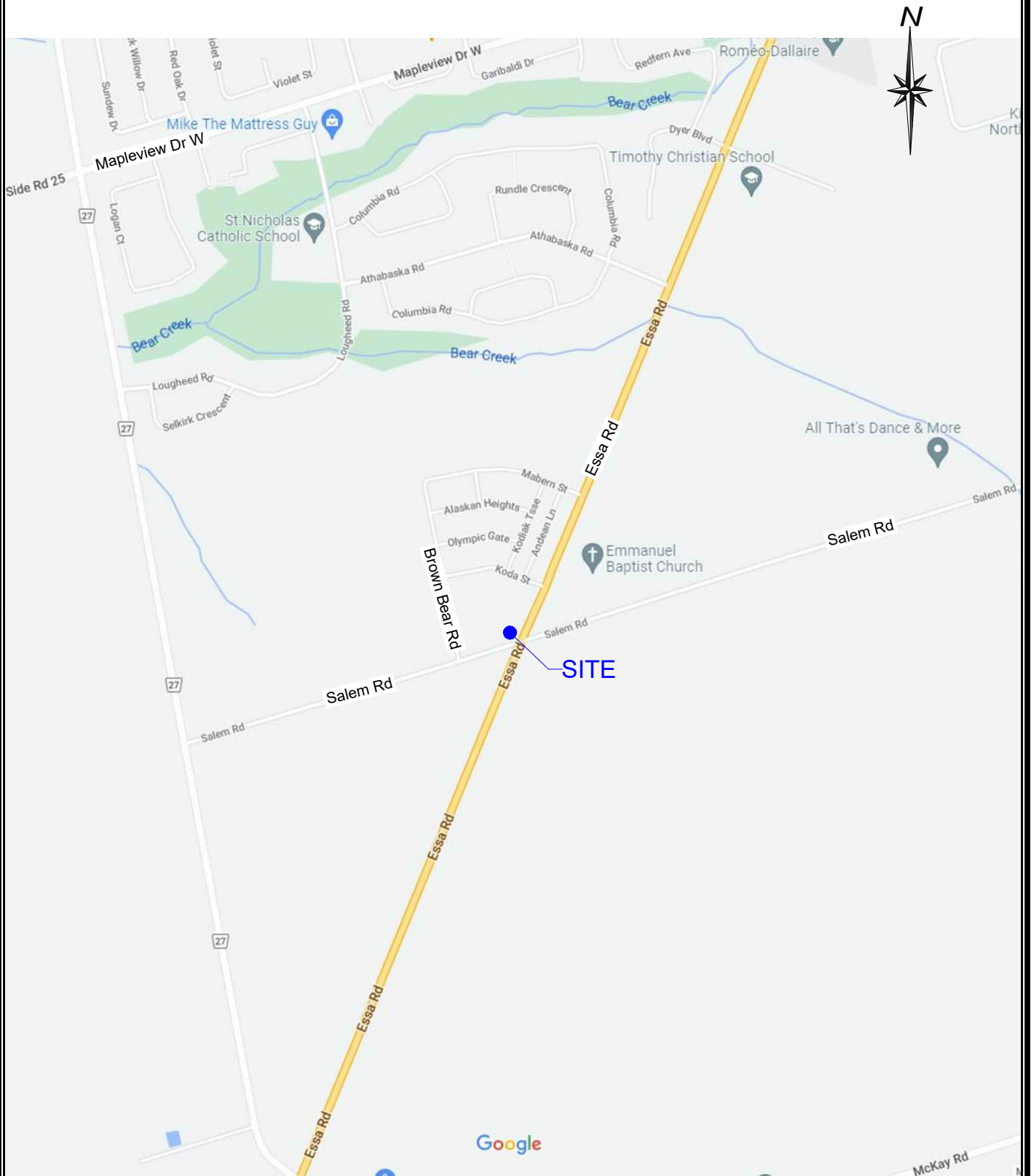
Mike Tanos, P.Eng.
Review Principal



FIGURES

TERRAPROBE INC.





REFERENCE
Map data © 2022 Google

80 0 200m
SCALE



Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

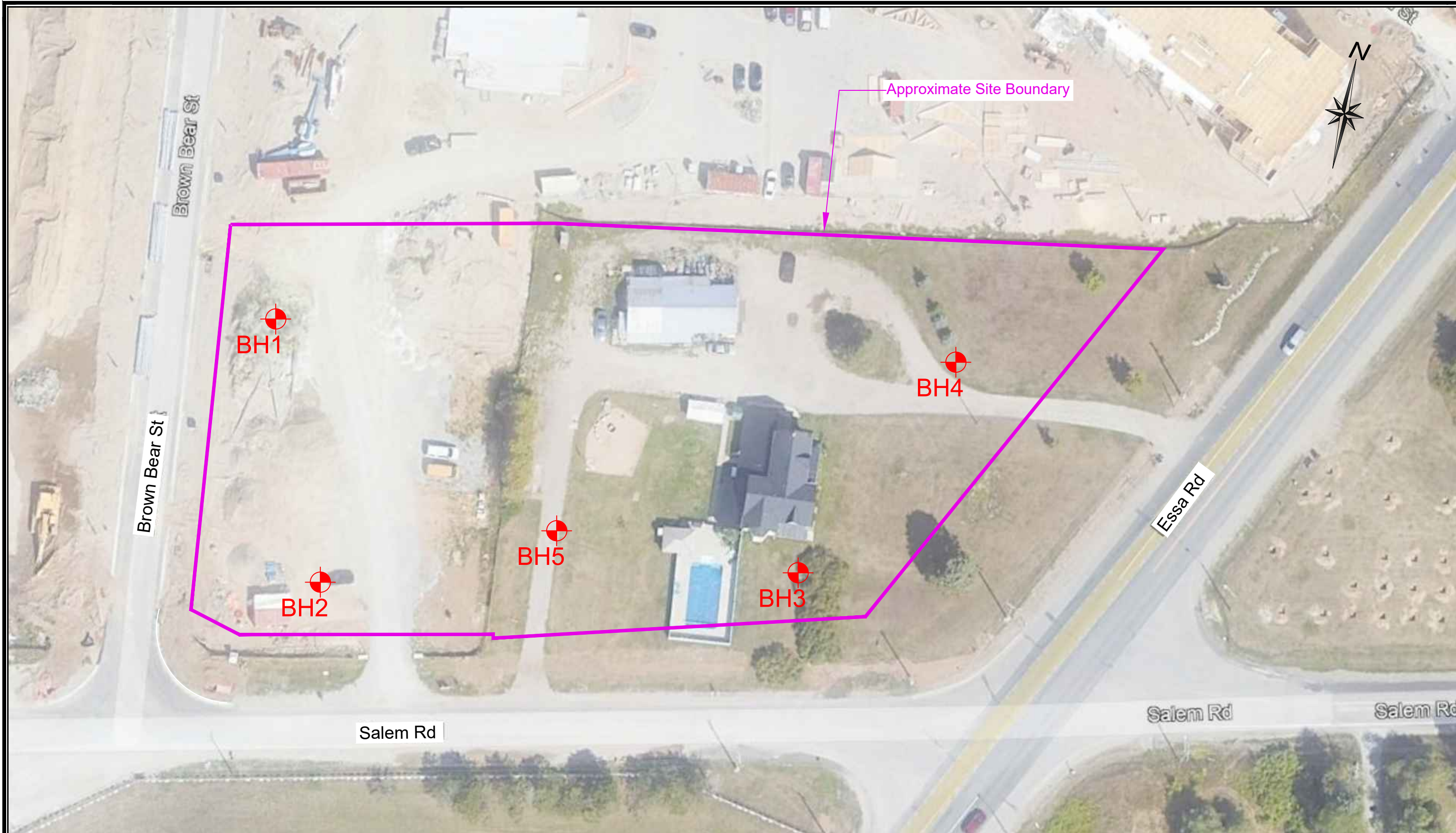
SITE LOCATION PLAN

File. No.:

3-22-0008-01

FIGURE :

1



REFERENCE
Image © 2022 Google Earth

LEGEND
Approximate Borehole Location

4 2 0 10m
SCALE 1:600

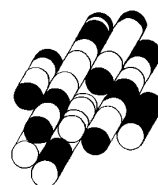
 **Terraprobe**
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:	BOREHOLE LOCATION PLAN EXISTING CONDITION
File No.	3-22-0008-01

FIGURE :
2A

APPENDIX A

TERRAPROBE INC.





SAMPLING METHODS		PENETRATION RESISTANCE
AS	auger sample	Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.). Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."
CORE	cored sample	
DP	direct push	
FV	field vane	
GS	grab sample	
SS	split spoon	
ST	shelby tube	
WS	wash sample	

COHESIONLESS SOILS		COHESIVE SOILS			COMPOSITION	
Compactness	‘N’ value	Consistency	‘N’ value	Undrained Shear Strength (kPa)	Term (e.g)	% by weight
very loose	< 4	very soft	< 2	< 12	<i>trace</i> silt	< 10
loose	4 – 10	soft	2 – 4	12 – 25	<i>some</i> silt	10 – 20
compact	10 – 30	firm	4 – 8	25 – 50	<i>silty</i>	20 – 35
dense	30 – 50	stiff	8 – 15	50 – 100	sand <i>and</i> silt	> 35
very dense	> 50	very stiff	15 – 30	100 – 200		
		hard	> 30	> 200		

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis		Unstabilized water level
w, w _c	water content		1 st water level measurement
w _L , LL	liquid limit		2 nd water level measurement
w _P , PL	plastic limit		Most recent water level measurement
I _P , PI	plasticity index		Undrained shear strength from field vane (with sensitivity)
k	coefficient of permeability	3.0 +	
γ	soil unit weight, bulk	C _c	compression index
G _s	specific gravity	c _v	coefficient of consolidation
φ'	internal friction angle	m _v	coefficient of compressibility
c'	effective cohesion	e	void ratio
C _u	undrained shear strength	PID	photoionization detector
		FID	flame ionization detector

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 8, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

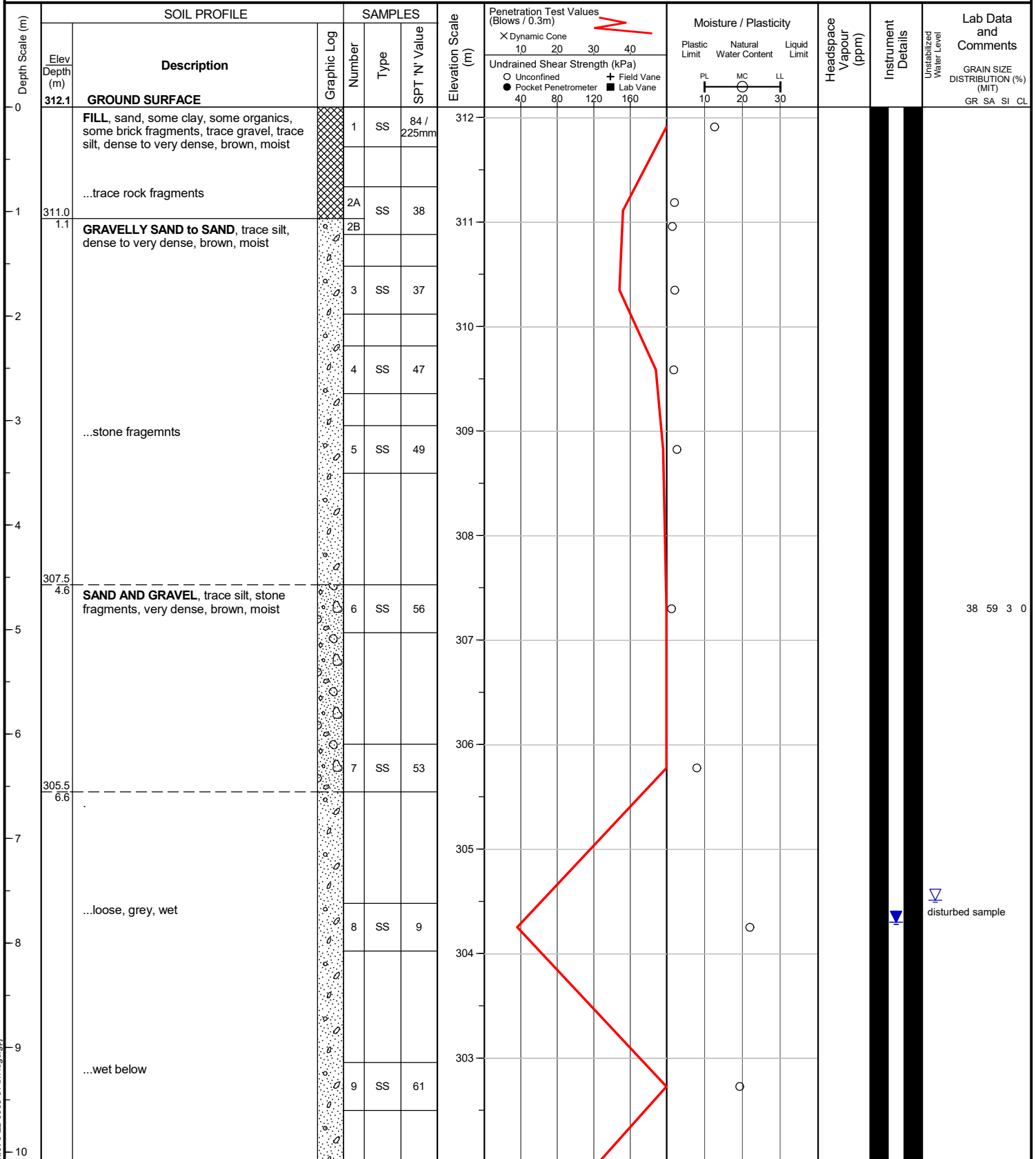
Checked by : OB

Position : E: 601688, N: 4907612 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers

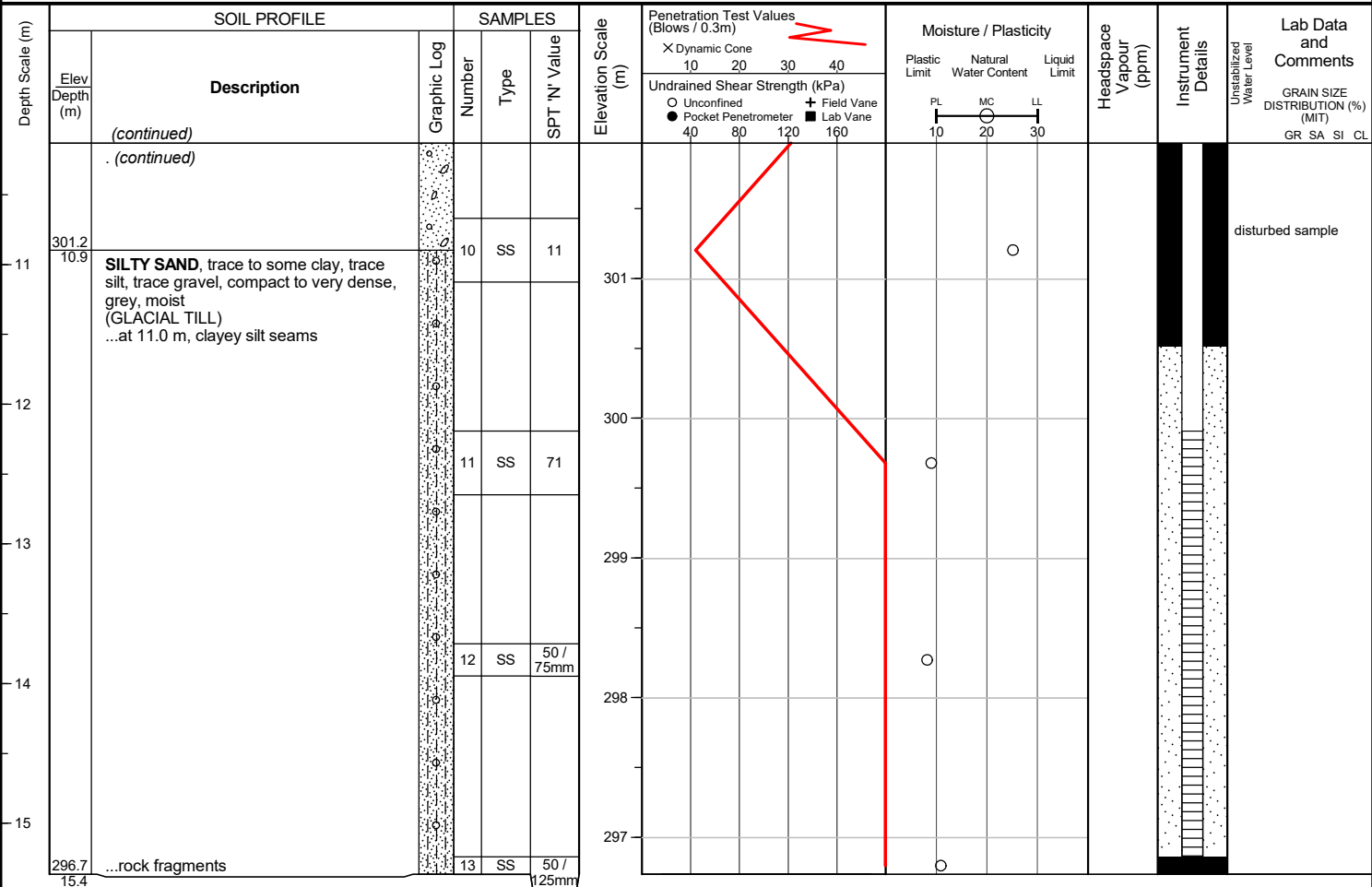


file: 3-22-0008-01 bh logs.gpj

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Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 8, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601688, N: 4907612 (UTM 17T)	Elevation Datum : Geodetic
Rig type : Track-mounted	Drilling Method : Hollow stem augers



END OF BOREHOLE

Unstabilized water level measured at 7.6 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	7.8	304.3

Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 7, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

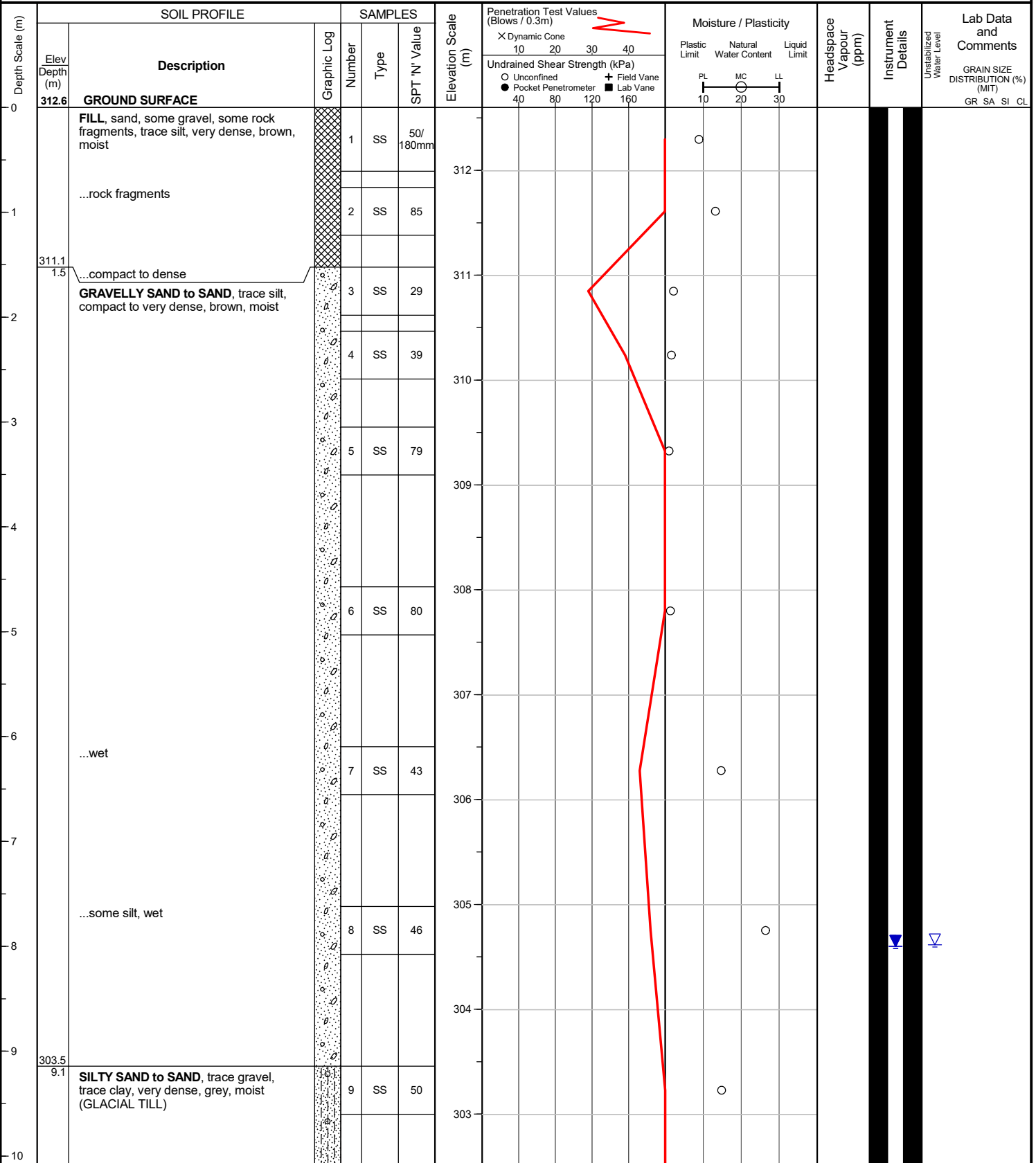
Checked by : OB

Position : E: 601714, N: 4907571 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers



(continued next page)

Project No. : 3-22-0008-01 Client : Brown Bear Dev. Ltd. Originated by : CB
 Date started : February 7, 2022 Project : 901 Essa Road and Brown Bear Street Compiled by : GO
 Sheet No. : 2 of 2 Location : Barrie, Ontario Checked by : OB

Position : E: 601714, N: 4907571 (UTM 17T) Elevation Datum : Geodetic
 Rig type : Track-mounted Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)				Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Undrained Shear Strength (kPa)				Plastic Limit	Natural Water Content	Liquid Limit			
		(continued)						10	20	30	40						
11		SILTY SAND to SAND, trace gravel, trace clay, very dense, grey, moist (GLACIAL TILL) (continued)					302										8 76 11 5
		...wet		10	SS	100 / 200mm											
12		...some clay, some gravel, wet		11	SS	50 / 150mm	301										
							300										
13							299										
14		...rock fragments		12	SS	50 / 125mm	298										
15																	
	297.1			13	SS	50 / 75mm											
	15.5																

END OF BOREHOLE

Unstabilized water level measured at 8.0 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS
 Date Water Depth (m) Elevation (m)
 Feb 17, 2022 8.0 304.6

Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 8, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

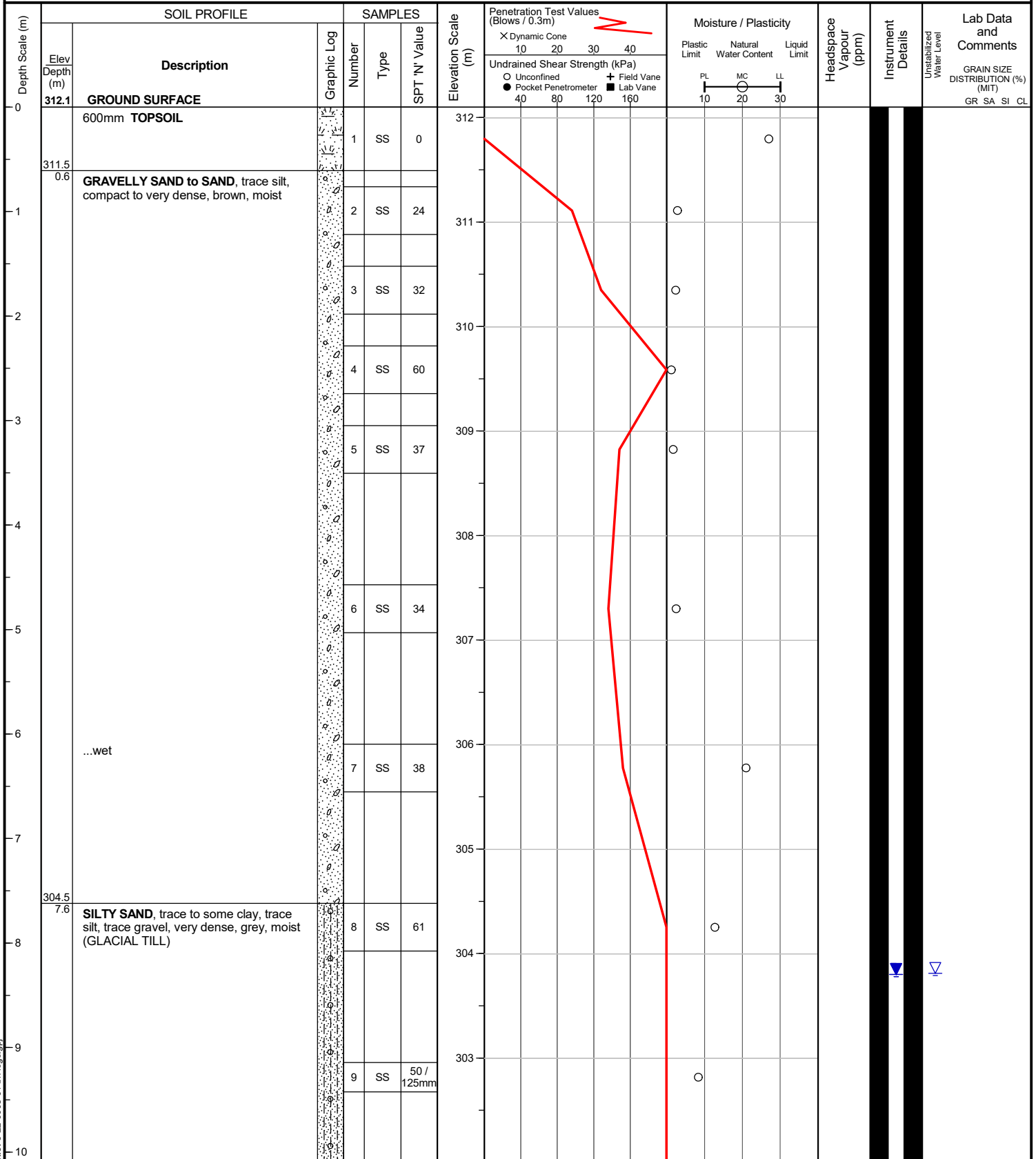
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Position : E: 601807, N: 4907602 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers



(continued next page)

Project No. : 3-22-0008-01 Client : Brown Bear Dev. Ltd. Originated by : CB
 Date started : February 8, 2022 Project : 901 Essa Road and Brown Bear Street Compiled by : GO
 Sheet No. : 2 of 2 Location : Barrie, Ontario Checked by : OB

Position : E: 601807, N: 4907602 (UTM 17T) Elevation Datum : Geodetic
 Rig type : Track-mounted Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Dynamic Cone	Undrained Shear Strength (kPa)	Plastic Limit	Natural Water Content	Liquid Limit			
		(continued)						10 20 30 40	40 80 120 160	PL	MC	LL			
		SILTY SAND , trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL) (continued)													
11				10	SS	50 / 150mm	301								
12				11	SS	50 / 150mm	300								
13							299								
14				12	SS	50 / 150mm	298								
15							297								
	296.7 15.4			13	SS	50 / 125mm									

END OF BOREHOLE

Unstabilized water level measured at 8.3 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS
 Date Feb 17, 2022 Water Depth (m) 8.3 Elevation (m) 303.8

Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 9, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

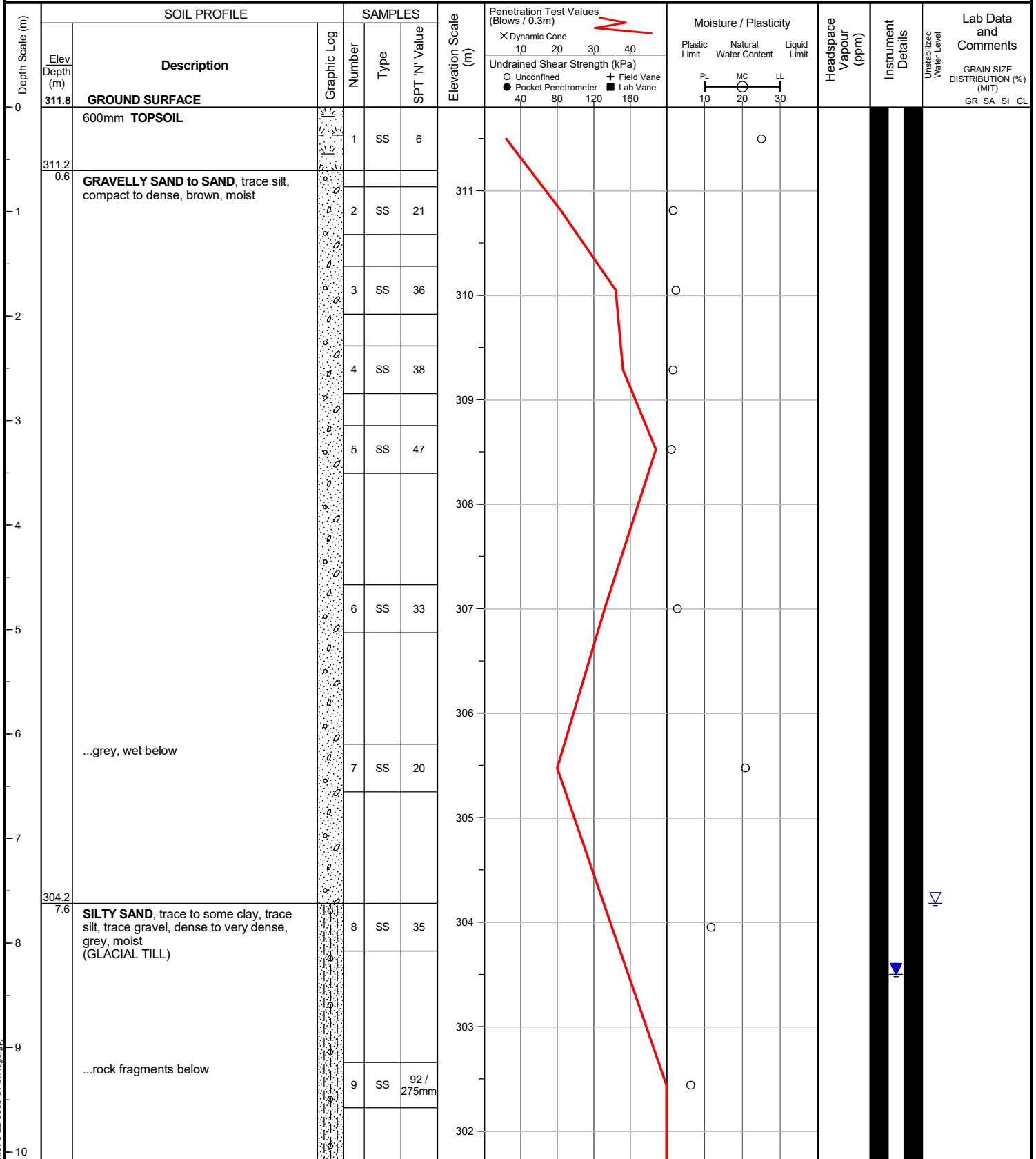
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Position : E: 601826, N: 4907647 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers



(continued next page)

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 9, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601826, N: 4907647 (UTM 17T)	Elevation Datum : Geodetic
Rig type : Track-mounted	Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)				Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments	
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		X Dynamic Cone				Plastic Limit	Natural Water Content	Liquid Limit				
								10	20	30	40							
								Undrained Shear Strength (kPa)										
								○ Unconfined ● Pocket Penetrometer	+ Field Vane ■ Lab Vane		PL MC LL 10 20 30							
		(continued)						40 80 120 160										
11		SILTY SAND, trace to some clay, trace silt, trace gravel, dense to very dense, grey, moist (GLACIAL TILL) (continued)		10	SS	50 / 75mm	301						○					
12																		
13				11	SS	50 / 75mm							○					
14				12	SS	50 / 75mm	298						○					
15																		

END OF BOREHOLE

Unstabilized water level measured at 7.5 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS		
Date	Water Depth (m)	Elevation (m)
Feb 17, 2022	8.3	303.5

Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 14, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

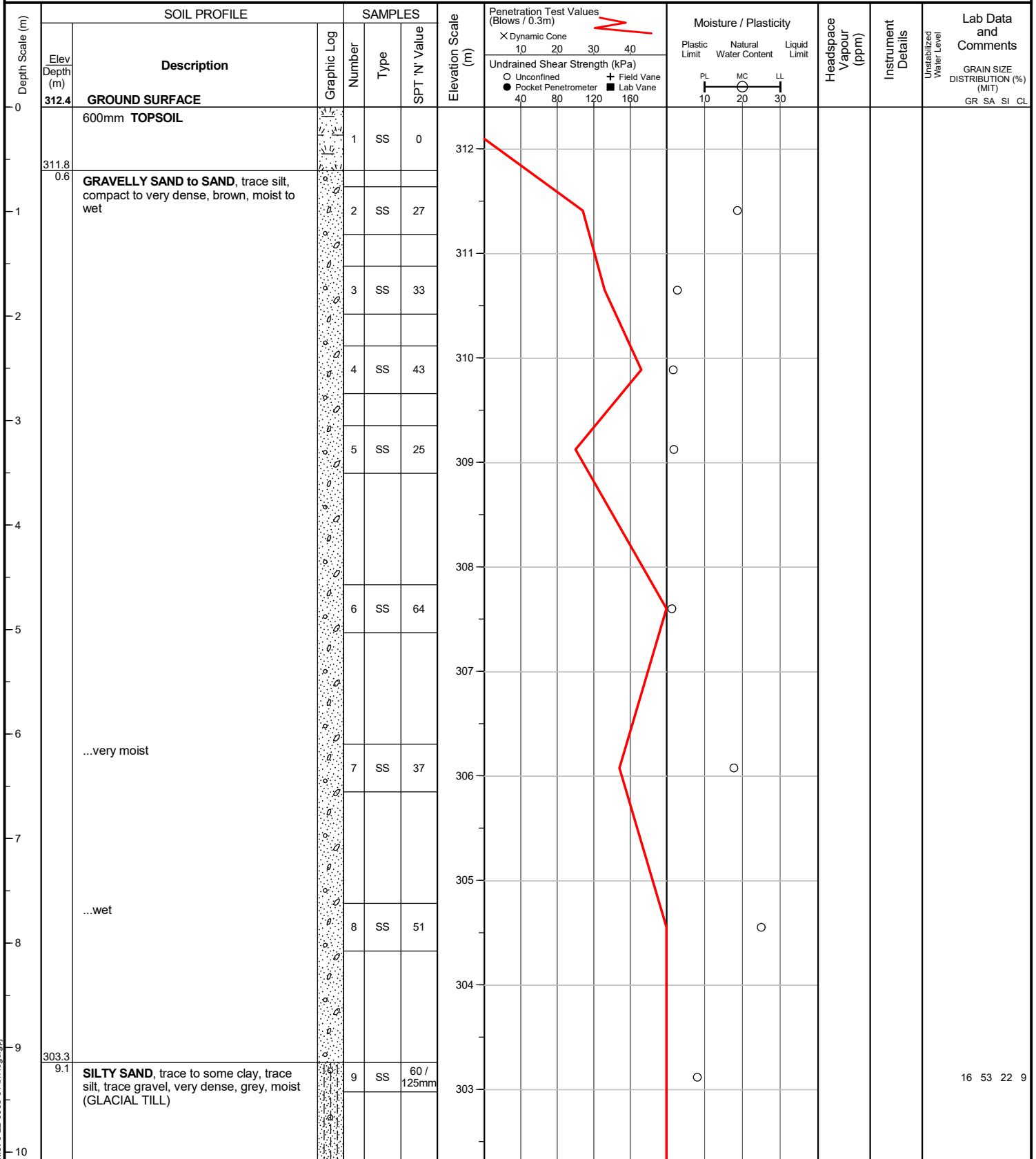
Checked by : OB

Position : E: 601757, N: 4907589 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers



file: 3-22-0008-01 bh logs.gpj

(continued next page)

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 14, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601757, N: 4907589 (UTM 17T)	Elevation Datum : Geodetic
Rig type : Track-mounted	Drilling Method : Hollow stem augers

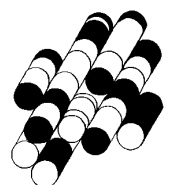
Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		X Dynamic Cone 10 20 30 40	Undrained Shear Strength (kPa) ○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane 40 80 120 160	Plastic Limit Natural Water Content Liquid Limit PL MC LL 10 20 30					
		(continued)													
301.7 10.7		SILTY SAND, trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL) (continued)					302								
301.3 11.1		GRAVELLY SAND, very dense, brown, wet		10	SS	69 / 250mm									
							301								
				11	SS	50 / 100mm	300								
							299								
				12	SS	100 / 225mm									
							298								
							297								
296.9				13	SS	50 / 150mm									

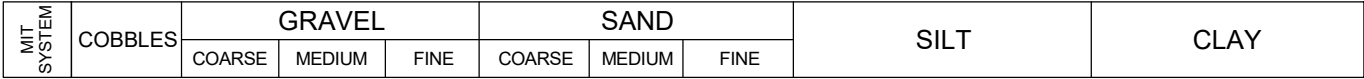
END OF BOREHOLE

Water level and cave not measured upon completion of drilling.

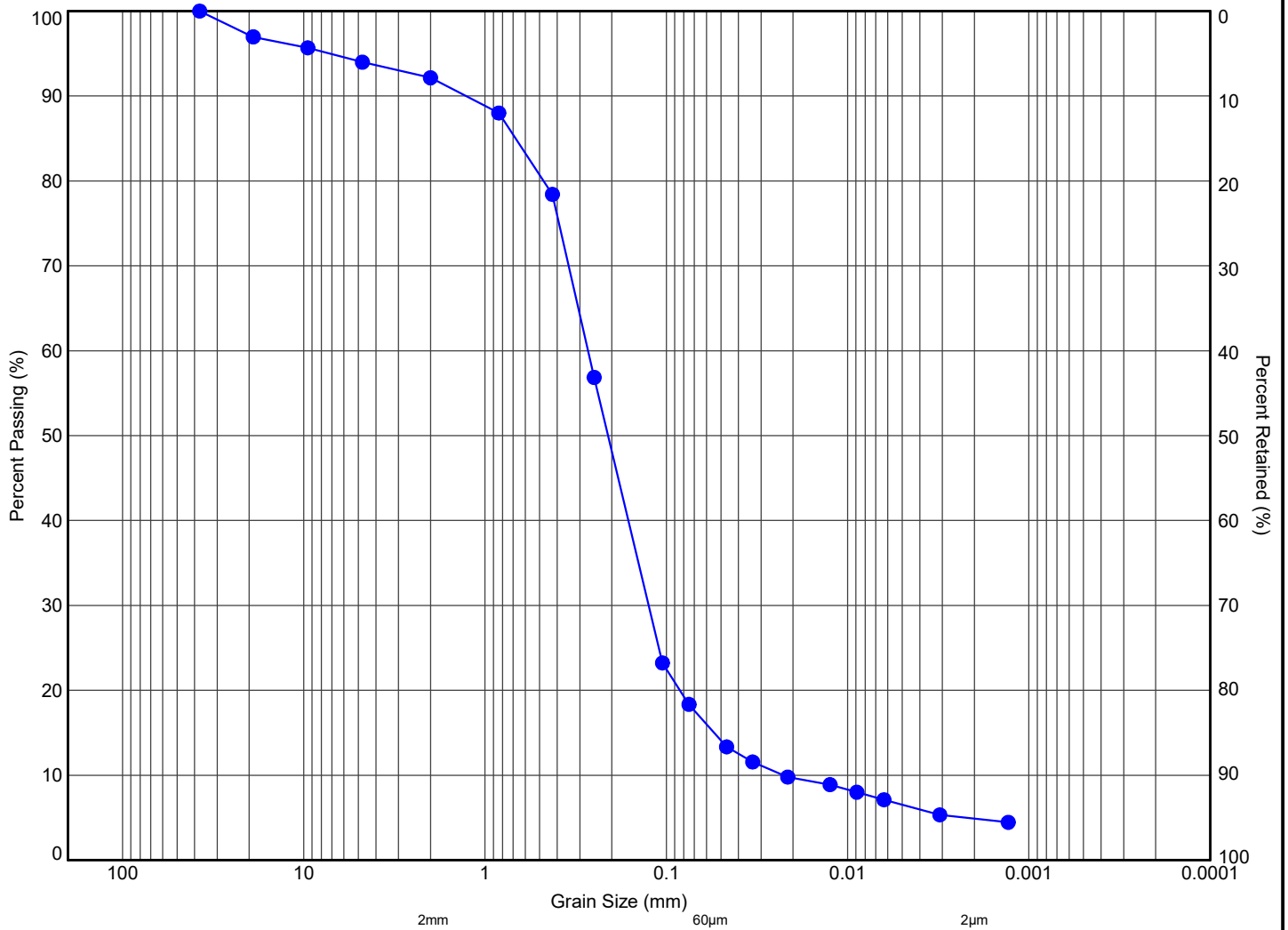
APPENDIX B

TERRAPROBE INC.





 Terraprobe 11 Indell Lane, Brampton Ontario L6T 3Y3 (905) 796-2650	Title: GRAIN SIZE DISTRIBUTION SAND AND GRAVEL, TRACE SILT
	File No.: 3-22-0008-01



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 2	SS10	10.8	301.8	8	76	11	5		



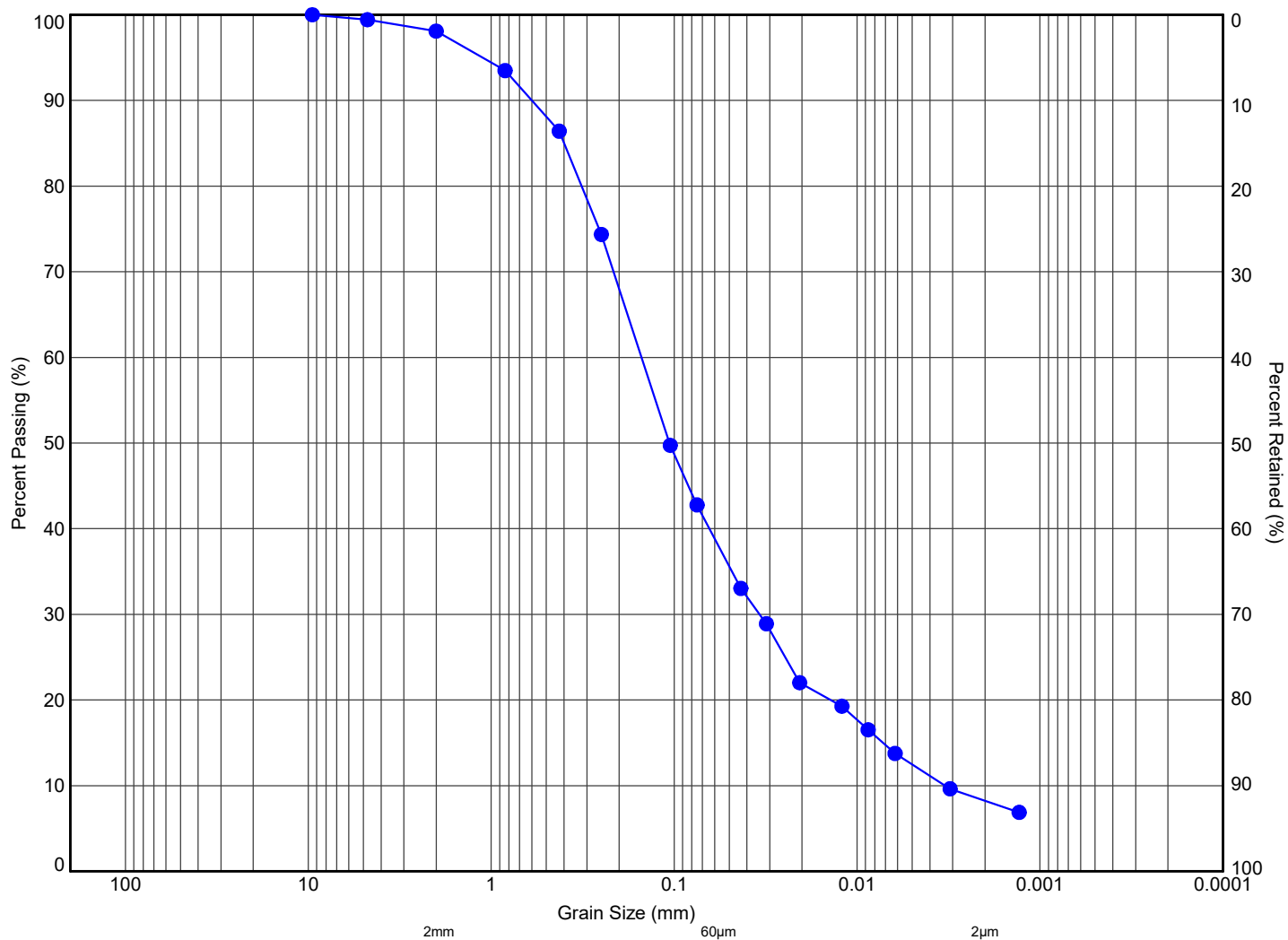
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SAND, SOME SILT, TRACE GRAVEL, TRACE CLAY**

File No.:

3-22-0008-01



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 4	SS12	13.8	298.0	2	59	31	8		



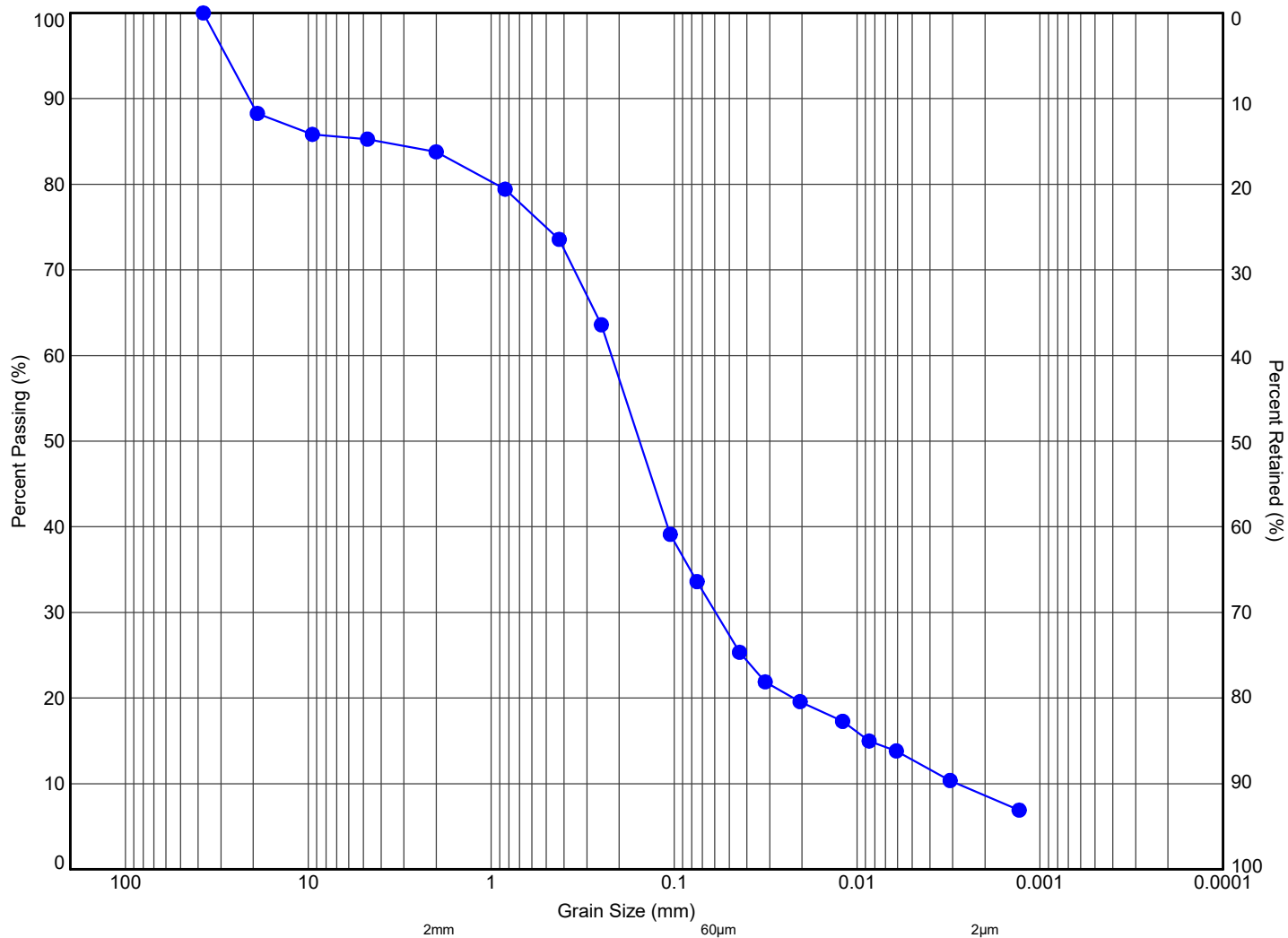
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SILTY SAND, TRACE CLAY, TRACE GRAVEL**

File No.:

3-22-0008-01



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 5	SS9	9.3	303.1	16	53	22	9		



11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

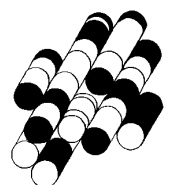
**GRAIN SIZE DISTRIBUTION
SILTY SAND, SOME GRAVEL, TRACE CLAY**

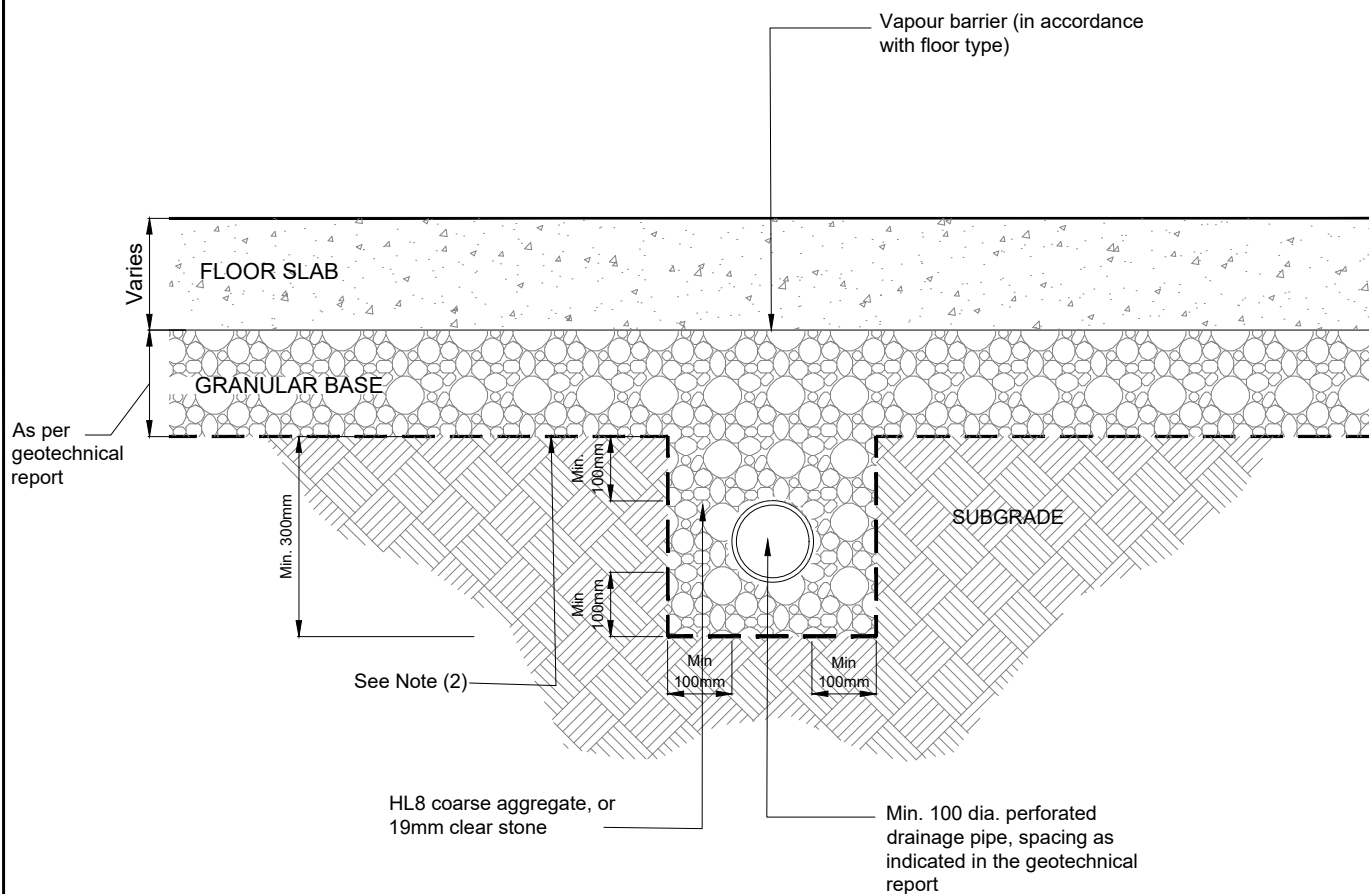
File No.:

3-22-0008-01

APPENDIX C

TERRAPROBE INC.





NOTES:

1. Typical schematic only. Must be read in conjunction with Geotechnical Report.
2. When the subgrade consists of cohesionless soil, it must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).
3. Not to Scale

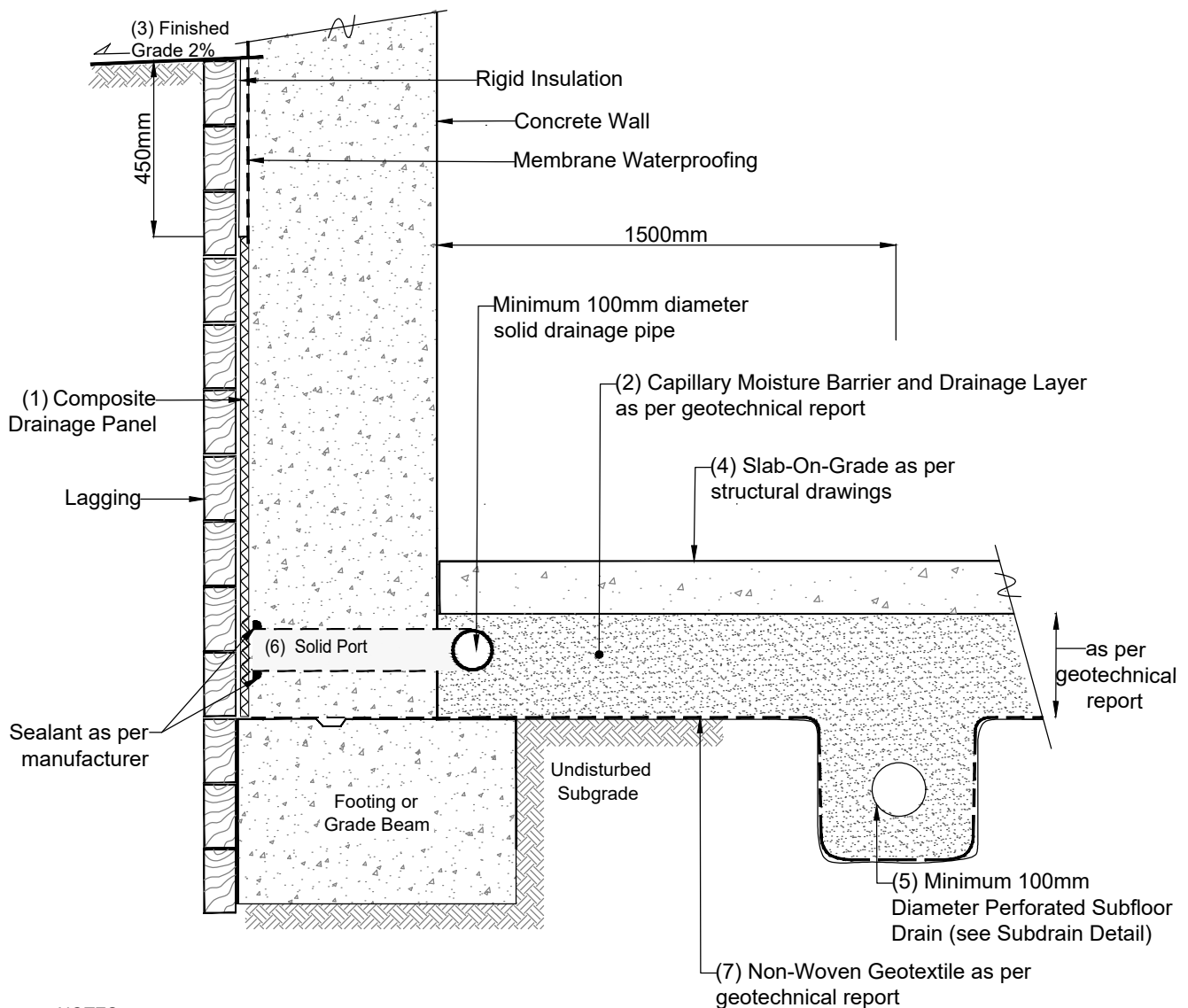


Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

TYPICAL BASEMENT SUBDRAIN DETAIL



NOTES

- 1) Prefabricated composite drainage panels to consist of Miradrain 6000, or approved equivalent. Panels should provide continuous cover as per manufacturer's requirements.
- 2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS. MUNI 1004), or as indicated in geotechnical report, compacted to a dense state. Upper 50mm can be replaced with Granular "A" (OPSS. MUNI 1010) compacted to 98% SPMDD where vehicular traffic is required. A vapour barrier may be required depending on floor type.
- 3) Exterior finished grade away from wall at a minimum grade of 2% for min. 1.2m.
- 4) Building floor slab-on-grade shall not be structurally connected to foundation wall or footing.
- 5) Subfloor drain invert to be a minimum of 300mm below underside of floor slab, to be set in parallel rows, one way, and at the spacing specified in the geotechnical report. Don't connect subfloor drains to perimeter drains.
- 6) Embedded ports to be set a distance of maximum 3m on-centre. Each port to have a minimum cross-sectional area of 1500mm². Perimeter drainage must be collected and conveyed directly to the building sumps in solidpipe.
- 7) When the subgrade consists of a cohesionless soil, the subgrade must be separated from the subfloor drainage layer using a non-woven geotextile (Terrafix 360R or approved equivalent).
- 8) Geotechnical report contains specific details. Final detail must be reviewed before system is considered acceptable to use.

N.T.S.

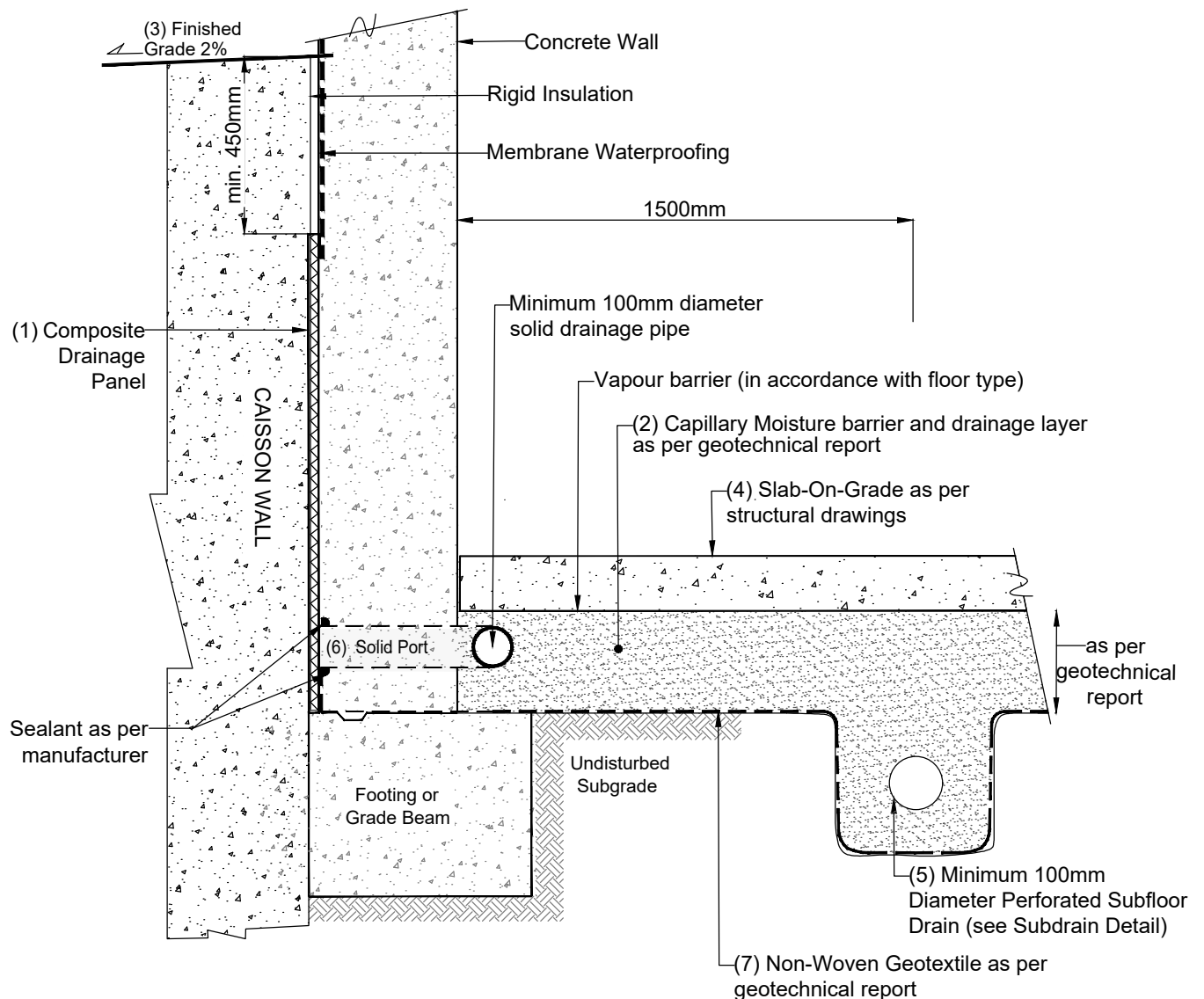


Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

SCHEMATIC DRAINAGE DETAIL
SOLDIER PILE & LAGGING SHORING SYSTEM
(DRAINED BASEMENT CONDITION)



NOTES

- 1) Prefabricated composite drainage panels to consist of Miradrain 6000, or approved equivalent. Panels should provide continuous cover as per manufacturer's requirements.
- 2) Capillary moisture barrier/drainage layer to consist of a minimum 200mm layer of 19mm clear stone (OPSS. MUNI 1004), or as indicated in geotechnical report, compacted to a dense state. Upper 50mm can be replaced with Granular "A" (OPSS. MUNI 1010) compacted to 98% SPMD where vehicular traffic is required. A vapour barrier may be required depending on floor type.
- 3) Exterior finished grade away from wall at a minimum grade of 2% for min. 1.2m.
- 4) Building floor slab-on-grade shall not be structurally connected to foundation wall or footing.
- 5) Subfloor drain invert to be a minimum of 300mm below underside of floor slab, to be set in parallel rows, one way, and at the spacing specified in the geotechnical report. Don't connect subfloor drains to perimeter drains.
- 6) Embedded ports to be set a distance of maximum 3m on-centre. Each port to have a minimum cross-sectional area of 1500mm². Perimeter drainage must be collected and conveyed directly to the building sumps in solidpipe.
- 7) When the subgrade consists of a cohesionless soil, the subgrade must be separated from the subfloor drainage layer using a non-woven geotextile (TerraFix 360R or approved equivalent).
- 8) Geotechnical report contains specific details. Final detail must be reviewed before system is considered acceptable to use.

N.T.S



Terraprobe

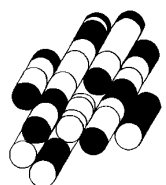
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

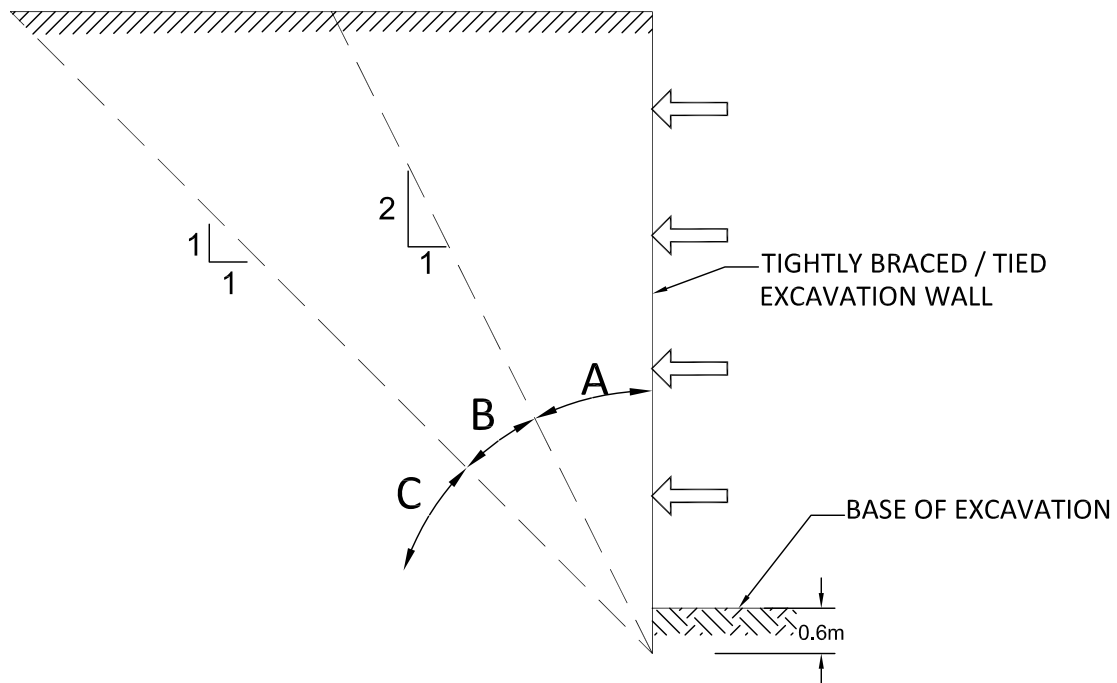
Title:

SCHEMATIC DRAINAGE DETAIL CAISSON WALL SHORING SYSTEM (DRAINED BASEMENT CONDITION)

APPENDIX D

TERRAPROBE INC.





Zone A: Foundations within this zone often require underpinning. Horizontal and vertical pressures on excavation wall of non-underpinned foundations must be considered.

Zone B: Foundation within this zone often do not require underpinning. Horizontal and vertical pressures on excavation wall of non-underpinned foundations must be considered.

Zone C: Foundations within this zone usually do not require underpinning.

REFERENCE:

User's Guide - NBC 2005 Structural Commentaries
(Part 4 of Division B) - Commentary K



Terraprobe

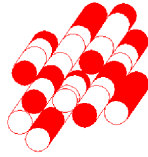
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

GUIDELINES FOR UNDERPINNING SOILS

Appendix G

Hydrogeological Report



Terraprobe

*Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing*

**PRELIMINARY HYDROGEOLOGICAL STUDY
PROPOSED MIXED-USE DEVELOPMENT
901 ESSA ROAD AND BROWN BEAR STREET
BARRIE, ONTARIO**

Prepared for: **Brown Bear Dev Ltd**
200 Consumers Rd. #212
Toronto, ON M2J 4R4

Attention: Mr. Mohammed Raja

File No. 3-22-0008-46

Issued: April 7, 2022

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Terraprobe Inc.

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www.terraprobe.ca

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Appendix C Borehole Logs
Appendix D Grain Size Analysis
Appendix E Aquifer Response Tests
Appendix F Laboratory Certificates of Analysis
Appendix G Water Balance Analysis
Appendix H Dewatering Analysis



1.0 INTRODUCTION

Terraprobe Inc. (Terraprobe) was retained by Brown Bear Dev Ltd. to conduct a preliminary hydrogeological study for Property located on the northwest corner of the intersection of Essa Road and Salem Road in Barrie, Ontario. The western portion of the site is known as ‘Block 281,’ and the eastern portion of the site has the current municipal address of 901 Essa Road, Barrie, Ontario. The general location of the Site is shown on **Figure 1**.

The western portion of the Property, ‘Block 281’ is roughly rectangular in shape with an area of approximately 0.35 hectares (0.87 acres), and is currently used as a construction staging area for the neighboring subdivision. The eastern portion of Property (901 Essa Road) covers an area of approximately 0.79 hectares (1.96 acres) and currently consists of a two-storey residential building, a single-storey workshop/structure, and gravel parking areas. Following the re-design and reconfiguration of Essa Road, the total remaining developable land of 901 Essa Road Property will be reduced to approximately 0.88 hectares (2.18 acres).

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated January 2022 prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing structures and construct a new 12-storey mixed residential and commercial use building supported over three (3) levels of underground parking. It is understood that the proposed development will be fully serviced with municipal water and sewage.

The purpose of this report is to assess local and regional hydrogeological conditions and the potential impacts of the proposed development on the groundwater system and to provide information regarding the requirements for groundwater control for the development.

The report addresses the following areas:

- Identifying the geological and hydrogeological setting of the Site;
- Confirming shallow groundwater level and shallow groundwater flow direction beneath the Site;
- Calculations of water balance for existing (pre-development) and post-development conditions and assessment of infiltration rates to establish the requirements for maintaining groundwater recharge at the property;
- Assessing groundwater quality against applicable sewer discharge guidelines;
- Evaluate potential short-term construction dewatering needs for the Site;
- Identifying potential impacts to the nearby groundwater receptors, including water supply wells and natural heritage features pertaining to the Site;
- Providing mitigation plan on the potential impacts to the groundwater receptors associated to the Site; and,
- Providing recommendations on any needs for applying for Permit to Take Water (PTTW) or posting Environmental Activity and Sector Registry (EASR) with the Ministry of the Environment, Conservation and Parks (MECP).



2.0 SCOPE OF WORK

The scope of work for the study consisted of the following:

- **Review of available background information:** Available background information for the Site and the project was reviewed. This included the results of geotechnical investigations of the Property and available information regarding the proposed design and construction concepts for the development. In addition, information from public sources, including geologic mapping and MECP well record.
- **Borehole Drilling:** The field investigation was conducted on February 7, 8, 9 and 14, 2022, and consisted of drilling and sampling a total of five (5) exploratory boreholes (BH1 to BH5), extending to depths ranging from about 15.4 to 15.5 m below existing ground surface. The ground surface elevations at the borehole locations were surveyed by Terraprobe. Borehole elevations are provided relative to Geodetic Datum (NAD). The horizontal coordinates are reported relative to the Universal Transverse Mercator geographic coordinate system (UTM Zone 17T).
- **Well Installation:** To measure the groundwater level and investigate the quality of groundwater, all four (4) boreholes (BH1 to BH4) were instrumented with monitoring well as a part of the current investigation. Upon installation, an elevation survey of the monitoring wells relative to a local datum was completed so that relative groundwater flow direction can be assessed.
- **Groundwater sampling and analysis:** Groundwater quality was assessed in comparison with the City of Barrie Sewer Use By-Law limits to evaluate the potential discharge options.
- **Completion of hydraulic conductivity testing:** Groundwater levels within the monitoring wells installed by Terraprobe were monitored to confirm groundwater levels beneath the Site. Hydraulic conductivity testing was conducted within selected three (3) installed monitoring wells (BH1 to BH3) to confirm the hydraulic conductivity of the sub-soil profile within the screened intervals.
- **Dewatering Assessment:** Evaluated potential short-term construction dewatering and long-term foundation drainage needs for the Site utilizing the finite element model SLIDE.2017
- **Analysis of potential impacts of groundwater control:** Analysis was conducted to assess the potential impacts of groundwater control on local structures, water wells, and surface water features.
- **Water Balance Assessment:** Calculations of water balance for existing (pre-development) and post-development conditions and assessment of infiltration rates to establish the requirements for maintaining groundwater recharge at the property.

The above scope of work was prepared in accordance with all of the following: Ontario Water Resources Act, and Ontario Regulation 387/04.



3.0 APPLICABLE REGULATIONS AND POLICIES

3.1 Nottawasaga Valley Conservation Authority (NVCA) Policies and Regulations (O. Reg. 172/06)

Under Section 28 of the Conservation Authorities Act, local conservation authorities are mandated to protect the health and integrity of the regional greenspace system and to maintain or improve the hydrological and ecological functions performed by valley and stream corridors. The NVCA, through its regulatory mandate, is responsible for issuing permits under Ontario Regulation (**Ont. Reg. 172/06**), *Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* for development proposal or Site alteration work to shorelines and watercourses within the regulated areas.

NVCA Regulated Area online mapping was reviewed. It is our understanding that the Site is not located within an NVCA Regulated Area. As such, it is **not** anticipated that a permit from the NVCA under Ont. Reg. 172/06 will be required for the proposed development.

3.2 Clean Water Act 2006

The NVCA watershed is within the South Georgian Bay Lake Simcoe Source Protection Region. The South Georgian Bay Lake Simcoe Source Protection Plan was established under the Clean Water Act, 2006, approved on January 26, 2015, and requires, among other things, that the municipal Official Plans be brought into conformity with the Source Protection Plan policies in accordance with Section 26 of the Planning Act. Focusing exclusively on municipal drinking water supply, a component of the provincially approved Source Protection Plan is the delineation of key groundwater related vulnerable areas: including Wellhead Protection Areas (WHPAs), Highly Vulnerable Aquifers (HVAs), And Significant Groundwater Recharge Areas (SGRAs). The objectives of source water protection are to identify areas where municipal drinking water sources may be at risk from quantity or quality threats, to assess the level of risk, and to put in place measures to eliminate or manage the threat.

Based on the review of MECP's Source Protection Information Atlas and Nottawasaga Valley Conservation Authority (NVCA) interactive mapping following information was obtained related to the subject property:

Associated Policy Area	Applicability
Conservation Authority	Nottawasaga Valley Conservation Authority
Source Protection Area	Nottawasaga Valley Source Protection Area
Watershed	Nottawasaga Valley Watershed
Subwater Shed	Bear Creeks – Middle Nottawasaga River Subwatershed
MECP District	City of Barrie
NVCA Regulated Area	No
Wellhead Protection Area (WHPA)	No
Significant Groundwater Recharge Area (SGRA).	Yes; Score: 6



Associated Policy Area	Applicability
Highly Vulnerable Aquifer (HVA)	Yes
Wellhead Protection Areas (WHPA - Q) or Recharge Management Area	WHPA Q2: Yes, Stress: Low
Intake Protection Zone (IPZ)	No
Intake Protection Zone Q (IPZ-Q)	No
Oak Ridges Moraine (ORM)	No
Niagara Escarpment Plan Area	No
Greenbelt Protection Act Area	No

Refer to **Appendix A** for associated regulatory mapping details.

3.3 Permit to Take Water (PTTW) Section 34 of the Ontario Water Resource Act

MECP website was reviewed for any active PTTW application records within a 1.0 km radius of the Site on March 23, 2022. Record review indicates that there is no active PTTW within 1.0 km from the Site.

3.4 Hydrogeological Assessment Submission Guidelines 2013

The Conservation Authority Guidelines for Development Applications (June 2013) was reviewed as a part of this assessment. This guidance document provides a list of recommended requirements for hydrogeological investigations. Nottawasaga Valley Conservation Authority (NVRCA) has adopted these guidelines for hydrogeological assessments. The methodology adopted for conducting this hydrogeological assessment is based on the Conservation Authority Guidelines.

4.0 DESCRIPTION OF SITE CONDITIONS

4.1 Site Location and Description

The Property is located on the northwest corner of the intersection of Essa Road and Salem Road in Barrie, Ontario. The western portion of the site is known as 'Block 281,' and the eastern portion of the site has the current municipal address of 901 Essa Road, Barrie, Ontario. The general location of the Site is shown on **Figure 1**.

The western portion of the Property, 'Block 281' is roughly rectangular in shape with an area of approximately 0.35 hectares (0.87 acres), and is currently used as a construction staging area for the neighboring subdivision. The eastern portion of Property (901 Essa Road) covers an area of approximately 0.79 hectares (1.96 acres) and currently consists of a two-storey residential building, a single-storey workshop/structure, and gravel parking areas. Following the re-design and reconfiguration of Essa Road, the total remaining developable land of 901 Essa Road Property will be reduced to approximately 0.88 hectares (2.18 acres).

Based on the architectural drawing set (Project: Brown Bear Apartments; Project No. 122001) dated Jan. 2022 prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing structures and construct a new 12-storey mixed residential and commercial use building supported over three levels of underground parking. It is understood that the proposed development will be fully serviced with municipal water and sewage.

Based on the advanced boreholes, the Site elevation varies from approximately $311.8 \pm$ masl to $312.6 \pm$ masl (meters above sea level) towards the west. Furthermore, based on the review of Oak Ridges Moraine Groundwater Program (OGRMP), it indicated that the Site lies on a topographic ridge between two Bear Creek headwater tributaries, and slopes northwest, north and northeast towards Bear Creek tributaries, located approximately 500 m northwest and 550 m north of the Property, which ultimately drains into Nottawasaga Bay located approximately 33 km northwest of the Property. **Figure 5** further indicates the topography of the Site. Regional groundwater flow direction is expected northwest and north towards Bear Creek tributary following local topography.

4.2 Regional Geology and Physiography

Based on published geological information for the area, the Site is located within the physiographic region known as the Peterborough Drumlin Field (31). The drumlins are composed of sand, gravel, and boulder till and are separated by low-lying wetland areas composed of fine-grained soils. (Chapman and Putnam 1984). Based on the Ontario Geological Survey (OGS) mapping, the surficial geology at the Site consists of Ice-contact stratified deposits of sand and gravel, minor silt, clay and till (6). **Figure 3** illustrates the mapped surficial geology for the Site and the surrounding area. **Figure 4** shows the location of the Site within the regional physiography map.

Bedrock was not contacted over the current subsurface investigation. However, the review of the Oak Ridges Moraine Groundwater Program (ORMGP) database indicates the underlying bedrock at the Site is Lindsay formation (fine- to coarse-grained, fossiliferous, commonly nodular, argillaceous limestone; upper member (Collingwood) is black, organic-rich, fissile, very fine-grained limestone). Based on the

review of the Oak Ridges Moraine Groundwater Program (OGRMP) cross-section tool, bedrock lies at an elevation of approximately 117 masl, and depth to bedrock at the Site is approximately 194 m below ground surface.

4.3 Regional Hydrogeology

The geology of an area determines the distribution and movement of groundwater (i.e., hydrogeology). Hydrostratigraphy refers to the spatial mapping of geological units based on their water-bearing properties (e.g., aquifers and aquitards). Due to the variety and spatial heterogeneity of the unconsolidated geological deposits within the NVCA watershed, the Hydrostratigraphy of the region is complex. The NVCA watershed is characterized by a series of four regional aquifers, denoted as A1 (Oak Ridges Moraine equivalent), A2 (Thorncliffe Formation equivalent), A3 and A4. Each of the regional aquifers are separated by an aquitard unit or confining bed which is a much less permeable geologic unit in comparison to an aquifer. Broadly, the regional groundwater flow paths correspond to the local surface drainage and flow towards the Nottawasaga River and its tributaries, or to Georgian Bay (NVCA Integrated Watershed Management Plan -2018)

4.4 Watershed Setting

Based on NVRCA Sub watershed mapping, the Property is located within the Bear Creek Sub-watershed of the Middle Nottawasaga River Watershed. All of the lands within the Nottawasaga Valley watershed ultimately drain into Nottawasaga Bay via one of the tributary rivers. The Bear Creek sub-watershed is one of the 3 sub-watersheds that make up the Middle Nottawasaga River watershed. Middle Nottawasaga River has a total combined length of 464.2 km (includes all branches) or about 8% of the total combined watercourse length of the entire Nottawasaga Valley watershed. With headwaters located in the eastern and southern part of the sub-watershed (south of Essa Road), it flows in a north/ northwesterly direction until draining into Nottawasaga Bay. The NVCA land uses are split between agriculture (approximately 47%), natural heritage (35% of the total area), and urban and built-up areas represents less than 5% of the NVCA watershed area; only 40% of urban lands are classified as 'impervious' (NVCA Integrated Watershed Management Plan -2018)

4.5 Local Surface Water and Natural Heritage Features

Mapping from the Ontario Ministry of Natural Resources and Forestry (MNR) was to determine if water bodies, wetland and woodland features were present on the Property and within the Study Area. The Ontario Ministry of Natural Resources National Heritage Information Centre database for listings of Areas of Natural or Scientific Interest (ANSIs) was reviewed. The natural heritage map is presented in **Figure 6**. The information is summarized below.



Water Bodies	Property	No water bodies were identified on the Property
	Study Area	The nearest surface water feature is Bear Creek tributary, located approximately 500 m northwest of the Property which ultimately drains into Nottawasaga Bay, located approximately 33 km northwest of the Property
Wetlands	Property	<u>Provincially Significant</u> - No Provincially Significant wetlands are present on the Property <u>Non- Provincially Significant</u> - No Non- Provincially Significant wetlands are present on the Property. <u>Unevaluated</u> - No Unevaluated wetlands are present on the Property.
	Study Area	<u>Provincially Significant</u> - The closest Provincially Significant Evaluated Wetland is present approximately 2.3 km east from the Property <u>Non- Provincially Significant</u> - The closest Non-Provincially Significant Evaluated Wetland is present approximately 1.5 km southwest from the Property <u>Unevaluated</u> - Unevaluated wetland is present within the Study Area, approximately 215 m southeast from the Property
Woodlands	Property	Woodland areas are identified on the western portion of the Property.
	Study Area	The closest woodland areas were identified in the adjacent to the northern boundary of the Property.
ANSIs	Property	<u>Provincially Significant Life Science ANSI</u> - No Life Science ANSIs were identified on the Property. <u>Provincially Significant Earth Science ANSI</u> - No Earth Science ANSIs were identified on the Property.
	Study Area	<u>Provincially Significant Life Science ANSI</u> - No Life Science ANSIs were identified in the Study Area. <u>Provincially Significant Earth Science ANSI</u> - No Earth Science ANSIs were identified in the Study Area.

Furthermore, as indicated earlier, the Property is not located within the Niagara Escarpment Plan Area, the Oak Ridges Moraine Plan Area and the Greenbelt Protection Act area



4.6 Local Ground Water Resources

MECP well record database was reviewed for well records located within a radius of 500 m from the approximate Site boundary. The locations of the well records in the Study Area are presented on **Figure 7**, with the details for each well summarized in **Appendix B**. A total of 38 wells were located within the 500 m radius. A summary of data obtained from record review is presented in Table below:

Number of the Well Records	38
Water Use (Final Status)	
Observation-Monitoring and Test holes	9 (24 %)
Abandoned-Other	10 (26 %)
Water Supply - Industrial	1 (3 %)
Water Supply - Domestic	15 (39 %)
Unknown/Other Status	3 (8 %)

The above summary indicates that 26 % of the wells in the study areas are registered as water supply wells completed in the year 1964 to 2005, with depths ranging from 6.0 mbgs to 50.9 mbgs. Moreover, no municipal water supply wells were found within 500 m radius of the Site.

4.6.1 Barrie Well Supply

Based on the review of *Lakes Simcoe and Couchiching-Black River SPA Part 1 2014 Updated Assessment Report, Chapter 8, City of Barrie*, it is indicated that the aquifers underlying the City of Barrie are part of a regionally extensive and complex aquifer system, within which four major sand and gravel aquifer units have been identified. Locally, these are referred to as the upper (Aquifer A1), intermediate (Aquifer A2) and lower (Aquifer A3 and A4) aquifers.

Aquifer A1 is largely unconfined under all of the central and most other parts of the City and is therefore susceptible to contamination from surface activities. The portions of the upper aquifer identified in the Oro-Medonte and upland areas immediately west of the City correspond to the regional Aquifer A1, which is mapped as ice contact stratified drift. Aquifer A2 is regionally extensive. The aquifer is complex within the central core area of Barrie, where it consists of inter-layered sand and silt/clay materials. The aquifer is overlain by 5 to 20 or more metres of confining materials in most areas, reported to consist of clayey and silty sediments. The lower aquifers, A3 and A4, are extensive sand and gravel aquifers, which form the source of the majority of Barrie's groundwater supply. These aquifers are in direct contact with one another under the central Barrie area, as well as further to the west. Based on the base elevation of the Kempenfelt Bay and the known elevation of the upper surface of Aquifer A3, it is interpreted that the aquifer is in contact with Kempenfelt Bay in areas to the east. Wells 3A, 5, and 12 are all constructed in the deeper Aquifer A4. Wells 7, 9, 11, 13, 14, 15, 17, and 18 are located approximately in the center of the combined A3/A4 aquifer, whereas the remaining wells (Wells 4 and 16) are located in the upper part of the Aquifer 3.



4.6.2 Results of Door-to-Door Survey

The private well survey requires to contact residents within the study area to collect information and water samples from private wells to assess groundwater uses in the area. Due to the current COVID-19 restrictions that have been imposed by the provincial government, and to ensure health and safety, the private well survey has been placed on hold.



5.0 RESULTS OF SUBSURFACE INVESTIGATION

The field investigation was conducted on February 7, 8, 9 and 14, 2022, and consisted of drilling and sampling a total of five (5) exploratory boreholes (BH1 to BH5) extending to depths ranging from about 15.4 to 15.5 m below existing ground surface. The borings were drilled by a specialist drilling contractor using a track/truck-mounted drill rig power auger and mud rotary drilling techniques and sampled at regular intervals with conventional 50 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D 1586).

The fieldwork (drilling, sampling, and testing) was observed full time and recorded by a Terraprobe field staff, who logged the boring and examined the samples as they were obtained. To measure the groundwater level and investigate the quality of groundwater, all four (4) boreholes (BH1 to BH4) were instrumented with monitoring well as a part of the current investigation. The monitoring well consisted of a 50 mm diameter PVC screen with a length of PVC riser pipe, 10-ft slotted screen. Upon installation, an elevation survey of the monitoring wells relative to a local datum was completed so that relative groundwater flow direction can be assessed.

The borehole and monitoring well locations are outlined on **Figure 2**. The soil samples were observed and recorded by a member of our field engineering staff, who logged the borings and examined the samples as they were obtained. All samples obtained during the investigation were sealed into plastic jars and transported to our testing laboratory for detailed inspection and testing.

5.1 Local Site Setting

Based on the review of the geotechnical report **File No. 3-22-0008-01**; the subsurface soil stratigraphy is indicated below. The following stratigraphy is based on the borehole findings, as well as the geotechnical laboratory testing conducted on selected representative soil samples. The stratigraphic boundaries indicated on the Borehole Logs are inferred from non-continuous samples and observations of drilling resistance and typically represent a transition from one soil type to another. These boundaries should not be interpreted to represent exact planes of geological change. The subsurface conditions have been confirmed in a series of widely spaced boreholes and will vary between and beyond the borehole locations.

5.1.1 Surficial Topsoil/ Earth Fill Material

Surficial topsoil with thickness ranging from about 600 mm was encountered at the ground surface in BH 3, 4 and 5. Underlying the surficial topsoil at borehole BH1 and BH2, a layer of fill was encountered and extended to a depth of about 1.1 and 1.5 m below grade respectively. The earth fill material consisted of sand with trace to some gravel, trace silt, occasional rock fragments and some organics and brick fragments in the upper levels in borehole BH1.



5.1.2 Native Soils

Undisturbed native soil deposits underlie the topsoil / earth fill deposits, which extended to the full depth of investigation are as follows:

- **Gravelly Sand to Sand:** A layer of gravelly sand to sand was encountered below the earth fill in borehole BH1 and BH2, below surficial topsoil in boreholes BH3 to BH5 and extended to a depth ranging from 7.6 to 10.9 m below grade. Moisture contents of the gravelly sand to sand samples indicated generally moist conditions and becoming wet below 6.1 to 7.6 m depth below grade.
- **Silty Sand Glacial Till:** Silty sand glacial till is the predominant subsurface deposit present in the boreholes and was encountered below the gravelly sand to sand deposit in all boreholes. The silty sand till deposit extended to the depth explored in all boreholes, i.e., depth ranging from 15.4 to 15.5 m below grade. The till contained clayey silt zone at 11 m depth in borehole BH1 and occasional embedded permeable sand zones, and occasional rock fragments (cobbles) were noted in the deposit. Measured moisture contents of silty sand till soil samples indicate a generally moist to locally wet condition.

The detailed stratigraphic conditions are presented on the accompanying borehole logs provided in **Appendix C**. A subsurface profile of the Site is provided in **Figure 9**. Characterization of the various soil types, including grain size analysis, was conducted and is presented in **Appendix D**. Additional information pertaining to soil stratigraphy is discussed in the geotechnical report by Terraprobe under a separate cover (**File No. 3-22-0008-01**).

5.2 Monitoring Well Installation

Monitoring wells were installed in four (4) boreholes (BH1 to BH4) for groundwater monitoring and to investigate groundwater quality. The monitoring wells were constructed using 50-mm diameter PVC riser pipes and screens, which were installed in each of the selected geotechnical boreholes in accordance with Ontario Regulation (O. Reg.) 903. Filter sand was placed around the well screen to approximately 0.6 m above the top of the screen. The wells were then backfilled with bentonite to approximately 0.3 m below the ground surface. All monitoring wells were surveyed using an R10 Trimble GPS relative to a geodetic datum. The details are provided below:

Well ID	Well Diameter (mm)	Ground Surface Elevation (masl)	Top of Screen		Bottom of Screen		Screened Geological Units (Native)
			Depth (mbgs)	Elev. (masl)	Depth (mbgs)	Elev. (masl)	
BH 1	50	312.1	12.2	299.9	15.2	296.9	Silty Sand (Till)
BH 2	50	312.6	12.2	300.4	15.2	297.4	Silty Sand (Till)
BH 3	50	312.1	12.2	299.9	15.2	296.9	Silty Sand (Till)
BH 4	50	311.8	12.2	299.6	15.2	296.6	Silty Sand (Till)

Note: masl: meters above sea level, mbgs: meters below ground surface



Additional details of the monitoring well installation is presented on the enclosed borehole logs provided in **Appendix C**.

5.3 Groundwater Monitoring

The groundwater elevations were monitored in the installed four (4) monitoring wells (BH1 to BH5). Groundwater measurements were conducted on February 17, 2022 (after the well development-stabilized water levels) as a part of in-situ hydrogeological testing at the Site. The groundwater elevations in the monitoring wells are presented below:

Well ID	Ground Surface Elevation (masl)	February 17, 2022	
		Groundwater Depth (mbgs)	Groundwater Elevation (masl)
BH 1	312.1	7.8	304.3
BH 2	312.6	8.0	304.6
BH 3	312.1	8.3	303.8
BH 4	311.8	8.3	303.5

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the above groundwater level recordings, it is noted that groundwater level varies from $303.5 \pm$ masl to $304.6 \pm$ masl in the lower glacial till deposit across the property. In order to establish shallow groundwater flow elevations and pattern it is recommended to install additional monitoring wells in the upper cohesionless gravelly sand to sand deposit.

Regional and local groundwater flow direction in the overburden appears to be northeast towards Bear Creek tributary and corresponds to the local topography of the Site. The local groundwater flow direction may fluctuate seasonally depending on the magnitude of precipitation and surface runoff, which will affect infiltration of surface water in particular at times such as significant snowmelt and rainfall events. In order to capture the seasonal groundwater fluctuations and flow patterns at the Site, additional groundwater monitoring is required. The groundwater elevations and flow direction are shown in **Figure 8**.

The monitoring wells installed at the Site need to be maintained in accordance with Ontario Water Resources Act, O. Reg. 903/90. When the wells are no longer required for monitoring or sampling, these wells will need to be appropriately decommissioned by a licensed well contractor as outlined in the Regulation.

5.4 Estimation of Hydraulic Conductivity

5.4.1 Estimation from Grain Size Distribution

In order to estimate the hydraulic conductivity (K) from the grain size distribution curves an excel based tool/program HydrogeoSieveXL (Devlin, J.F. 2015) is used that calculates the hydraulic conductivity from grain size distribution curves using 15 different methods. HydrogeoSieveXL was found to calculate K values essentially identical to those reported in the literature, using the published grain-size distribution

curves. This program is developed by J.F Devlin, Department of Geology, University of Kansas (Developed April 29, 2014, most recent update September, 2016). HydrogeoSieveXL presents the completed data table, a grain size distribution curve, an extensive list of grain size characteristics from which effective grain diameters are calculated, a histogram of grain size distribution presented in terms of conventional grain size classes and 15 estimates of K calculated from the formulas. Geometric and arithmetic means of the estimated K values are also calculated. The complete report for each sample is provided in along with the grain size results in **Appendix D**. The results of the estimates are summarized below:

Borehole No./Sample ID	Sampling Depth (mbgs)	Sampling Elevation (masl)	Soil Description (Native)	Estimated Hydraulic Conductivity (m/s) (Geometric Mean)
Borehole 1, Sample 6	4.8	307.3	SAND AND GRAVEL, trace silt	7.2×10^{-5}
Borehole 2, Sample 10	10.8	301.8	SAND, some silt, trace gravel, trace clay	3.0×10^{-6}
Borehole 4, Sample 12	13.8	298.0	SILTY SAND, trace clay, trace gravel	1.6×10^{-7}
Borehole 5, Sample 9	9.3	303.1	SILTY SAND, some gravel, trace clay	1.4×10^{-7}

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the grain size distribution analysis, the hydraulic conductivity of the upper cohesionless gravelly sand to sand deposit is estimated in order of 10^{-5} m/s. Moreover, the hydraulic conductivity of the lower silty sand glacial till is estimated in order ranging from 10^{-6} m/s to 10^{-7} m/s.

5.4.2 Estimation from In-situ Hydraulic Testing

The hydraulic conductivity was also determined based on single well response tests (Bail Tests), as per the hydrogeological investigation completed on all selected three (3) monitoring wells (BH1 to BH3). The monitoring wells were developed in advance of the testing event, which involves the purging and removal of groundwater from the monitoring wells to remove remnants of clay, silt and other debris introduced into the monitoring well during construction and to induce the flow of formation groundwater through the well screens, thereby improving the transmissivity of the subsoil strata formation at the well screen depths. The Solinst Dataloggers (pressure transducers) were programmed to record the water levels at one (1) second of the interval throughout the tests. The data from the tests were analyzed using the Bouwer and Rice method (1976) included in the Aquifer Test V.7 software package. The results of the analysis are presented in **Appendix E**. The hydraulic properties of the strata applicable to the Site are as follows:



Monitoring Well ID	Top of Well Screen Elevation (masl)	Bottom of Well Screen Elevation (masl)	Screened Geological Units	Hydraulic Conductivity (m/s)
BH 1	299.9	296.9	Silty Sand (Till)	5.9×10^{-7}
BH 2	300.4	297.4	Silty Sand (Till)	1.4×10^{-6}
BH 3	299.9	296.9	Silty Sand (Till)	4.6×10^{-7}

Note: masl: meters above sea level, mbgs: meters below ground surface

Based on the single well response tests, the hydraulic conductivity of the native silty sand glacial till is estimated in order ranging from 10^{-6} m/s to 10^{-7} m/s.

5.4.3 Estimation from Literature

According to Freeze and Cherry (1979), the typical hydraulic conductivity of the strata investigated at the site are:

Soil Unit	Estimated Hydraulic Conductivity Range (m/s)
Earth Fill	10^{-6}
Sand and Gravel	$10^{-2} - 10^{-5}$
Silty Sand Glacial Till (Native)	$10^{-6} - 10^{-12}$

Based on the analyses, the hydraulic conductivity calculated from the single well response testing and grain size analyses are consistent with the published values associated with the geological material tested.

5.5 Groundwater Quality

One (1) unfiltered groundwater sample was collected by Terraprobe and analyzed by a Canadian laboratory accredited and licensed by the Standards Council of Canada and or Canadian Association for Laboratory Accreditation. The sample was collected directly from monitoring well BH4 on February 24, 2022. The monitoring well BH4 was developed and purged prior to sample collection. The sample was compared to the following:

- Sanitary Sewer Discharge - The City of Barrie - By-Law No. 2012-172
- Storm Sewer Discharge - The City of Barrie - By-Law No. 2012-172

In summary, the groundwater quality results indicate the following:

- The unfiltered sample **exceeds** the permissible limits for Barrie Sewer Use - Sanitary Sewers Discharge for: Chloride (Guideline Limit: 1500 mg/L, Reported Detection Limit RDL: 1.2 mg/L, Result: **1550 mg/L**); and
- The unfiltered sample **meets** the permissible limits for Barrie Sewer Use - Storm Sewers Discharge for all the parameters analyzed.

The groundwater quality test results, and the certificate of analysis are presented in **Appendix F**.

6.0 DISCUSSION AND ANALYSIS

The impact assessment details that are applicable to the Property are discussed below:

6.1 Water Balance Assessment

The Site is located in the Recharge Management Area - Well Head Protection Area WHPA Q2. WHPA Q2- refers to the area where activities that reduce recharge may be a threat. An evaluation of water balance was completed in order to estimate the potential impacts that may occur due to proposed development in terms of recharge/discharge characteristics. The water balance is the amount of water entering and leaving a control volume during a given time period. The purpose of water balance analysis is to estimate the pre-development and post-development infiltration and run-off. The maintenance of pre-development 'recharge' is a general requirement in the Oak Ridges Moraine Conservation Plan, Nottawasaga Valley Protection Plan and the Provincial Policy Statement that is often captured in municipal Official Plans. The water balance analysis is conducted for the entire site considering it as one catchment and one drainage outlet.

6.1.1 Water Balance Methodology

One of the objectives during development should be to ensure that the overall volume of groundwater recharge is maintained or enhanced. A water balance for the Site was prepared to assess the distribution of rainfall, runoff, and infiltration for pre-development and post-development conditions. Based on the Canadian Climate Normals 1981-2010 Station for Barrie WPCC station (Climate ID: 6110557), the mean annual **precipitation** is considered as 933 mm/yr. The mean annual **actual evapotranspiration** is considered as 517 mm/yr. using Thornthwaite and Matther approach.

The volume of surplus water, i.e. $933 \text{ mm/yr.} - 517 \text{ mm/yr.} = 416 \text{ mm/yr.}$, that infiltrates into the soil was determined by applying an infiltration factor to the surplus volume based on topography, soil type and land cover as per Table 3.1, MOE SWMPD Manual (2003). Based on the Table 3.1 approach, the infiltration factor is estimated as 0.65, considering the topography as rolling topography (0.2), fine sand (0.4) and cover as urban lawn/ shallow rooted crop (0.05). The infiltration factors for the post-development conditions were considered the same as the pre-development conditions. Based on the MOE Manual, the water holding capacity for urban lawns/ shallow rooted crops and fine sand is 50 mm. For the purpose of modeling pre-development conditions within the Site, gravel driveways will be assumed impervious (such as asphalt).

Based on the above information, a conceptual model of groundwater flow and water balance was developed. A water balance was conducted for the post-development conditions for the entire Site, using the proposed land use statistics information and property development plan provided in the Presentation Set dated January 2022, titled Brown Bear Apartment by Chamberlain Architect Services Limited. The post-development water balance accounts for hard-surfaced areas created by buildings and pavements. The post-development conditions will result in a surplus of water available from run-off. The surplus of water available from roof runoff can be used for infiltration into the shallow groundwater system.



The following assumptions were applied for the pre-and post-development water balance:

- No infiltration will occur beneath the hard surface areas, including asphalt/concrete surfaced parking areas and walkways or driveways.
- It is assumed that there will be 10% of evaporation in hard-surface areas/impervious surfaces, and the remaining will contribute to run-off.
- Run-off from parking areas will be directed towards storm sewers and is not included in the infiltration calculations.
- Infiltration rates in open areas of the property (landscaped areas) will occur at rates similar to those for pre-development conditions.
- There will be no infiltration beneath hard-surface areas including, building, pavements, and walkways.

6.1.2 Water Balance Analysis:

Based on the Climate data, annual precipitation of 933 mm/yr., is considered and actual evapotranspiration of 517 mm/yr. There is a water surplus of 416 mm/yr., occurring at the Site that can either infiltrate into the subsurface or go as a run-off. As indicated above, the rate of infiltration was based on the Table 3.1, MOE SWMPD Manual (2003) and is considered as 270 mm/yr. The water balance for pre-development conditions for the entire Site is summarized in the Table below:

Summary of Site Statistics (Pre-development)

Land Use	Area (ha)	Area (m ²)
Building Footprint/Envelope	0.04	448
Hardscape/Impervious	0.19	1,919
Softscape/Pervious (Undeveloped Area)	0.65	6,494
Total	0.89	8,861

Pre- Development Water Balance (Entire Site)

	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Proposed Development	8,861	8,267	3,357	221	1,756	2,933

Development of an area affects the natural water balance of the Site. The most significant difference is the addition of impervious surfaces as a type of surface cover. Impervious surfaces prevent the infiltration of water into the soils. Net effect of the construction of impervious surfaces is that most of the precipitation that falls onto the impervious surfaces becomes surplus water and direct runoff. The natural permeability of the ground surface changes by reducing the currently undeveloped land/ open space and vegetation at the Site and replacing part of these areas with less permeable/ impervious surfaces such as building roofs, roads, and driveways. The development will result in an increased volume of runoff and a reduction in infiltration. Pre-development conditions result in approximately 1,756 m³ of water available for infiltration to the groundwater system, as mentioned in the above table.



Based on the post-development plan, a summary of proposed land use and water balance calculations for the post-development are provided below:

Summary of Site Statistics (Post-development)

Land Use	Area (ha)	Area (m ²)
Building Footprint/Envelope	0.36	3,630
Hardscape/Impervious	0.27	2,725
Softscape/Pervious (Undeveloped Area)	0.25	2,507
Total	0.89	8,861

Post- Development Water Balance without Mitigation (Entire Site)

	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Proposed Development	8,861	8,267	1,296	593	678	5,701

In the post-development, the water balance calculations show that development has the potential to reduce the natural infiltration by 1,078 m³/yr., and to increase the runoff by 2,768 m³/yr. Conservation Ontario Guidelines (Conservation Ontario, 2013) suggest a target of 80% of the predevelopment infiltration being maintained in the post-development conditions. Calculations for the Site are indicative of the post-development infiltration being at a level of about 39 % of the pre-development infiltration.

As such, opportunities to capture run-off and provide secondary infiltration in greenspace areas will be required to increase post-development infiltration. This indicates that with the proper storm, water management and mitigation measures are required to maintain the overall infiltration rates at the property.

Infiltration of rooftop runoff and vegetated surfaces may be permitted if current site conditions demonstrate no existing contamination. If roof top runoff water is re-infiltrated through stormwater management features, a total of 2,743 m³/yr. of water could be available for infiltration under post-development conditions (assuming 90% available of the roof run-off captured). The volume of roof run-off available is compared to the difference in infiltration between pre-development and post-development, as noted in the Table below:

Roof runoff Infiltration Deficit and Volume of Available Roof Run-off (Entire Site)

	Potential Post-Development Infiltration Deficit (m ³)	Volume of Roof Run-off Available (m ³)
Proposed Development	1,078	2,743

As noted, the volume of roof runoff exceeds the infiltration deficit. This indicates approximately 39% of the effective roof runoff captured will be required to compensate for the target 80% post-development infiltration deficit. This indicates that, with proper stormwater management and mitigation measures, the overall infiltration rates at the property can be maintained.

The water balance calculations are provided in **Appendix G**.



6.2 Groundwater Control and Dewatering Requirements

6.2.1 Construction Requirements and Methodology

Based on the architectural drawing set (Project Brown Bear Apartments, Salem & Essa Road Barrie, ON) dated January, 2022, prepared by Chamberlain Architect Services Limited, it is proposed to demolish the existing houses and construct a new 12-storey mixed residential and commercial use building supported over three (3) levels of underground parking.

Based on the review of the geotechnical investigation report prepared by Terraprobe **File No. 3-22-0008-01**, it is indicated it is understood that the lowest basement level P3 is expected to have a finished floor elevation set at a depth of about $9.95 \pm \text{m}$ (Elev. $302.3 \pm \text{m}$) below the existing grade (based on average ground surface elevation of $312.2 \pm \text{m}$). The spread footing foundations for the lowest level (P3) will likely be set at about 1.0 m below lowest FFE, i.e., Elev. $301.3 \pm \text{m}$ and below the prevailing groundwater table. The conventional spread footings are made to bear on the drained the dense to very dense sands or glacial till below Elev. $302.3 \pm \text{m}$.

All of the foundation excavations will extend below the prevailing groundwater table for P3 basement levels. Foundation excavations will penetrate through upper cohesionless gravelly sand to sand. The gravelly sand to sand deposit will yield free-flowing water when penetrated. The groundwater table must be dewatered to a minimum of 1.2 m below the deepest excavation prior to excavation to preserve the in-situ integrity of the native soils.

Based on the above groundwater level recordings, it is noted that groundwater level varies from $303.5 \pm \text{masl}$ to $304.6 \pm \text{masl}$ in the lower glacial till deposit across the property. In order to establish shallow groundwater flow elevations and pattern it is recommended to install additional monitoring wells in the upper cohesionless gravelly sand to sand deposit. Due to this limited information the design water level is based on the in-situ moisture conditions of the collected samples. Moisture contents of the gravelly sand to sand samples indicated wet conditions at Elev. $306.5 \pm \text{m}$ based on BH2 SS7. Considering one meter of seasonal fluctuation across the site, the design water level elevation is considered at Elev. $307.5 \pm \text{m}$ i.e., 4.75 mbgs as a preliminary estimate. This should be further confirmed by advancing shallow monitoring wells across the Site.

To better control groundwater during construction, a fully continuous interlocking concrete caisson wall socketed into the low-permeability cohesionless till may be considered as one potential approach to shoring the excavation. This shoring approach will provide a fully-continuous temporary groundwater cut-off barrier, which will enable the site to be dewatered during construction without inducing more flow into the excavation. The final shoring system and construction method were unknown at this stage. As such, a permeable shoring and an impermeable shoring (interlocked caisson wall) was assessed based on the current soil conditions and shallow groundwater table.

The continuous interlocking caisson wall shoring system is considered to support the entire excavation perimeter. Caisson toes (piles and fillers) should be advanced deep enough (i.e., **a minimum of 4 m below the bulk excavation**), precluding horizontal groundwater flow in the excavation. The depth of caisson wall toe embedment can be further refined based on vertical exit gradient and seepage considerations for the toe stability during the design detail stage. It is recommended that a professional

dewatering contractor be consulted to review the subsurface conditions and to design a site-specific dewatering system. It is the dewatering contractor's responsibility to make an assessment of the factual data and to provide recommendations on dewatering system requirements.

If the proposed development is designed water tight structure, then a private water drainage system will not be required. However, the structure must then be designed to resist hydrostatic pressure and uplift forces. If the proposed development is not water tight structure, then a private water drainage system will be required which will consists of sub-slab drainage system or foundation drainage/weeping tile system in conjunction with a perimeter drainage system to avoid wet conditions in the P3 underground level. The permanent drainage system is intended to collect passive groundwater seepage flow from the surrounding soils. For the purpose of dewatering (long term) assessment, the sub drainage system is assumed to be at about 0.5 m below the slab of P3 underground parking.

Note: For further details on the geotechnical design considerations and constructability, please refer to the geotechnical report prepared by Terraprobe under a separate cover (**File No. 3-22-0008-01**)

The Site development details as discussed above are summarized as below:

Proposed Development						
Structure	Above Grade Levels	Below Grade Levels				Design Groundwater Level (masl)
		Level #	Lowest Finished Floor		Approximate Foundation Elevation (masl)*	
			Depth (mbgs)	Elevation (masl)		
Proposed building with 3-level underground parking structure (P3).	12	3	± 9.95	± 302.3	± 301.3	± 307.5

Note: masl: meters above sea level, mbgs: meters below ground surface

*1.0 m below lowest FFE conventional spread footings are made to bear on the drained the dense to very dense sands or glacial till.

6.2.2 Groundwater Extraction and Discharge Requirements

A finite element numerical analysis utilizing computer software (Slide 7.014, developed by Rocscience Inc.) was conducted to assess the water taking requirements (short term and long term) in support of the proposed development. The hydraulic parametrization of the generalized numerical model is based on the grain size analyses, field hydraulic testing and published data that incorporates the permeability of different strata encountered during the investigation. The finite element model results are presented in **Appendix H**. For the purpose of accessing groundwater seepage rates, following considerations were made:

- Bulk Excavation set to 0.5 m below the lowest FFE at Elev. 301.8 ± m;
- Underside of the foundations set to 1.0 m below the lowest FFE at Elev. 301.3 ± m;
- Design water level of Elev. 307.5 ± m to account for the highest observed water table elevation;
- Design dewatering target set 1.2 m below the P3 foundation's underside at Elev. 300.1 ± m
- Impermeable shoring system (interlocking drilled caissons) along the excavation perimeter, with pile tips (caisson shoring wall) minimum of 4 m below the bulk excavation set at

Elev. $297.8 \pm m$. The depth of the caisson wall toe embedment can be further refined based on vertical exit gradient consideration for the toe stability during the design detail stage;

- Short term dewatering assumes caissons hydraulic conductivity of 1×10^{-10} m/s and long term assumes caissons hydraulic conductivity of 1×10^{-8} m/s incorporating the decay of concrete over time;
- Safety factor S.F of 1.5 is applied on the groundwater flow with the inclusion of 27 mm design rainfall event based on of Intensity-duration-frequency (IDF) curves (Ontario Ministry of Transportation) for 2-hour period for a 2-year event;
- Steady State simulation was performed for dewatering assessment; and
- Hydraulic conductivity for earth fill, gravelly sand to sand deposit and silty sand (till) is assigned as 1×10^{-6} m/s, 1×10^{-5} m/s and 1.5×10^{-6} m/s respectively.

The short-term control of ground water should take into account stormwater management from rainfall events. A dewatering system should take into account the removal of rainfall from the excavation. A value of 27 mm rainfall over a 2-hour period for a 2-year event was used to determine the incidental precipitation volumes to the proposed excavations based on the review of Intensity-duration-frequency (IDF) curves (Ontario Ministry of Transportation). Should the shoring system/methodology, construction procedures and foundation recommendations/requirements based on the geotechnical report differ, the groundwater seepage assessment will be revised, and an updated hydrogeological assessment report will be provided. The water taking requirements at the Property are as follows:

Conventional Drained Foundations - Permeable Shoring						
Scenario	Groundwater Seepage S.F. 1.5 Used		27 mm Design Rainfall Event		Total Volume	
	L/day	L/min	L/day	L/min	L/day	L/min
Short Term (Construction)	342,500	237.8	198,500	137.8	541,000	375.7
Long Term (Post Construction)	315,500	219.1	6,000	4.2	321,500	223.3
Conventional Drained Foundations - Impermeable Shoring						
Scenario	Groundwater Seepage S.F. 1.5 Used		27 mm Design Rainfall Event		Total Volume	
	L/day	L/min	L/day	L/min	L/day	L/min
Short Term (Construction)	88,000	61.1	198,500	137.8	286,500	198.96
Long Term (Post Construction)	72,500	50.3	6,000	4.2	78,500	54.5



As required by Ontario Regulation 63/16, a plan for discharge must consider the conveyance of stormwater from a 100-year storm. The additional volume based on the excavation area that will be generated in the occurrence of a 100-year storm event (102.7 mm) is approximately 755,000 L/day (524.3 L/min).

The finite element model results are presented in **Appendix H**.

6.2.3 Permitting Requirements

The Ministry of Environment, Conservation and Parks (MECP) regulates construction water taking over 400,000 L/day to obtain a Category 3 Permit to Take Water (PTTW) prior to any construction dewatering activities. Based on the estimated dewatering volumes of 541,000 L/day, a Category 3 PTTW prior to the dewatering activities for the proposed works will be required if the excavation activities will be completed using permeable shoring. The Ministry of Environment, Conservation and Parks (MECP) regulates construction water taking over 50,000 L/day and less than 400,000 L/day to obtain an Environmental Activity Sector Registry (EASR) Posting the MECP prior to any construction dewatering activities. Based on the estimated dewatering volumes of 286,500 L/day, an Environmental Activity Sector Registry (EASR) Posting from the MECP prior to the dewatering activities for the proposed works will be required if the excavation activities will be completed using impermeable shoring (interlocking caissons). Moreover, a Sewer Discharge Agreement must be obtained to permit discharge into the City's sewers prior to any temporary construction dewatering discharge.

Furthermore, as the estimated dewatering volumes in long term are greater than 50,000 L/day (for permeable and impermeable shoring), a long-term permit to take water PTTW will be required. However, a Sewer Discharge Permit must be obtained to permit discharge into the City's sewers. It will be necessary to confirm the location of the discharge points, and the capacity of the receiving sewer as part of the permit application. The permit will provide conditions for monitoring of flow and analysis of ground water quality. However, if the proposed development is designed water tight structure, then a private water drainage system will not be required. However, the structure must then be designed to resist hydrostatic pressure and uplift forces.

Groundwater taking estimates are based on the assumed construction duration, excavation dimensions, construction sequencing, and methodology, therefore should there be changes in these items, revised groundwater taking volumes will be required. It is contractor's responsibility to determine the type and extent of the dewatering system required. It should be noted that the actual required dewatering effort will depend on several factors, including excavation depth, sequencing, season and weather conditions and the length of time the excavation is left open. It should be noted that the interpretation of the dewatering estimates presented in this report and selection of an appropriate dewatering program is the responsibility of contractor. Installation of roadway protection system and any other shoring considerations is the sole responsibility of the contractor.



6.2.4 Zone of Influence (ZOI)

The Zone of Influence (ZOI) for dewatering, also known as Radius of Influence (R_o) with respect to maximum drawdown required was calculated based on the estimated groundwater taking rate and the hydraulic conductivity of the unit from which the groundwater will be taken at the Property. The ZOI was calculated using the Sichart's equation below:

Equation: $R_o = 3000 * dH * \sqrt{K}$

Where:

dH is the dewatering thickness (m) = Highest Observed Water level (m) - Dewatering Target (m)

K is the hydraulic conductivity (m/s) of water bearing deposit

The ZOI for the proposed building excavation with respect to groundwater at the Property is estimated to be $70 \pm \text{m}$, considering average hydraulic conductivity of 10^{-5} m/s for the native gravelly sand to sand deposit and dewatering thickness dH as $307.5 \text{ m} - 300.1 \text{ m} = 7.4 \text{ m}$

However, if an impermeable shoring system is considered for the proposed excavation and construction, the ZOI will be limited to the excavation box.



7.0 IMPACT ASSESSMENT

7.1 Discharge of Pumped Groundwater

This report provided the estimated quality of the water discharge. However, this report does not speak about the sewer capacities. The sewer capacity analysis will be provided under a separate cover by the civil consultant. The quality of the proposed groundwater discharge is provided in the Section 5.5. As noted in that section, the groundwater sample meets the Limits for City of Barrie Storm Sewer Discharge and exceeds City of Barrie Storm Sanitary Discharge. As such, no additional treatment will be required before the groundwater can be discharged to the Storm Sewer. However, treatment of exceeded parameters is required before the groundwater can be discharged to the Sanitary Sewer. The final design for any dewatering effluent is the responsibility of the retained contractor undertaking construction and a team designing the pre-treatment system.

7.2 Impacts to Natural Environment

There are no provincially significant, evaluated, surface water features and/or unevaluated wetlands within the close proximity of the Site or within the estimated zone of influence. Furthermore, if the excavation works will be advanced using an impermeable shoring system (caisson wall), the zone of influence will be limited to the excavation box. Any groundwater that will be taken from the site will be discharged (if required) into the City's sewer systems and not into any natural water body. As such, there will be no impact to the natural environment caused by the water takings at the Property.

7.3 Local Wells and Zone of Influence

The proposed development will be municipally serviced and there is no proposed on-site groundwater use for the development. Furthermore, based on the well record search no domestic and municipal water supply wells were found within the estimated zone of influence. It is further noted that the excavation and shoring activities will not be constructed within the municipal supply aquifer. During the construction period, the radius of influence will be limited in its lateral extent and will not extend horizontally to the location of the municipal production wellhead. It is unlikely that impacts from the proposed development will affect municipal water taking resources in the study area. However, it is recommended to complete the well survey program prior to the start of the construction to establish the local groundwater use in the study area. If the excavation activities are completed using the permeable shoring, it is recommended to monitor the local domestic wells within the study area during pre-construction, construction and post construction to determine the impact of dewatering on local resources.

7.4 Groundwater Quality and Contamination Sources

The area of the proposed development is located in the Highly Vulnerable Aquifer (HVA). HVAs are those areas where an aquifer may be more prone to contamination. These areas have been identified where there is little or no protection from an overlying aquitard (a protective layer of low permeability materials). The infiltration of rooftop runoff and vegetated surfaces may be permitted if current site conditions demonstrate no existing contamination. Depending on the land use, runoff from urban



developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, bacteria and viruses. For groundwater, generally with the exception of the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater flow through the soils. Under proposed development, the quality of water directed to pervious areas for infiltration is not expected to contain any contaminant of concerns. Considering the nature of the proposed development, it is anticipated that there will not be any contributing contaminants that may affect the background ground water quality in the area.

At the time of preparation of this report, Terraprobe is not aware of any Environmental Site Assessments (ESAs) conducted at the Property.

7.5 Anthropogenic Transport Pathways

Four (4) monitoring wells at depth 15.2 mbgs were installed during the site investigation conducted by Terraprobe to gather information regarding the groundwater quality and elevation at the Property and are not considered to be a risk to the groundwater resource. The monitoring wells installed at the Site need to be maintained in accordance with Ontario Water Resources Act, O. Reg. 903/90. However, the wells will be abandoned when no longer in use for monitoring (i.e., at the time of construction).

Moreover, it is found that three (3) observation wells (Map ID: 20, 21 and 22) completed in the 2018 are located on the Site with depths ranging from 3.1 mbgs to 4.6 mbgs. It is required to maintain or decommission these wells in accordance with O.Reg. 903 and Ministry of the Environment, Conservation and Parks (MECP) standards to ensure the structural integrity of the wells and to prevent them from becoming a transport pathway for any possible contamination.

7.6 Settlement Considerations

The site is bounded by existing municipal roadway Essa Road to the east, Salem Road to the south, Brown Bear Street to the west and a few sparse building structures to the north. No excavation shall extend below the foundations of existing adjacent structures without adequate alternative support being provided. It is recommended that a professional geotechnical engineer is contacted in advance of earthwork, and the shoring requirements for the site will have to be examined in detail with respect to the site boundary constraints. The shoring requirements for the site will have to be examined in detail with respect to the proximity of existing structures and site boundary constraints. The site conditions must be carefully assessed by the shoring designer to select appropriate type of shoring system in light of the close proximity of the existing buildings. It is imperative that the shoring system provides adequate support to the existing building foundations.

A settlement monitoring plan should be submitted by contractor detailing the frequency of pre construction / post- construction baseline data collection and daily readings during construction, monitoring on the tracks, monitoring locations, alert and review levels, and reporting process for the issue of survey data including the establishment of stop work process and implementation of remedial measures. For further details on the geotechnical design considerations and constructability, please refer to the geotechnical report by Terraprobe under a separate cover (**File No. 3-22-0008-01**).



8.0 MITIGATION MEASURES

8.1 Maintenance of Groundwater Recharge

The Site is mapped as Significant Groundwater Recharge Area (SGRA). As per the Source Water Protection Technical Rules, SGRAs in the NVCA watershed occur where the estimated average annual groundwater recharge rates are greater than the threshold rate (232 mm/yr.). SGRAs occur predominantly within areas of sand and gravel. Significant groundwater recharge areas are widespread throughout the NVCA watershed, due to the sandy nature of the area (NVCA Integrated Watershed Management Plan - 2018). It is encouraged in areas deemed to be a SGRA that recharge rates are maintained where development or site alternation is proposed.

The existing groundwater recharge rates at the Site are approximated as 270 mm/yr. These recharge rates are based on the property specific conditions. This recharge occurs in a broad diffuse manner over the entire Site. Gravelly sand to sand underlain by silty sand glacial till is the predominant subsurface deposit present in the boreholes and was encountered below the surficial topsoil or earth fill consisting of sand with trace to some gravel, and trace silt deposit in all boreholes. The gravelly sand to sand extended to 7.6 to 10.9 m with permeability estimated in the order of 10^{-5} m/s indicating high permeabilities. This indicates a possible recharge contribution to the shallow groundwater. This should be addressed by maintaining the overall ground water recharge across the Site area. The management of groundwater recharge at the Site following development is recommended where it is feasible and should be designed using a Best Management Practice approach. Runoff from the proposed development will conform to the stormwater management report for the Site.

As per CVC-TRCA (2010), the recommended vertical separation between the base of the given infiltration augmentation option and the high groundwater table is at least one meter; however, distances of less than one meter of separation in soils having higher infiltration potential may still be effective. Based on the available water level recordings, it is noted that groundwater level in the overburden varies from Elev. 303.5 ± masl to 304.6 ± masl in the lower glacial till. In order to establish shallow groundwater flow elevations and pattern it is recommended to install additional monitoring wells in the upper cohesionless gravelly sand to sand deposit. The suitability of using the proper infiltration options should be provided in the Stormwater Management Report/Functional Servicing Report. Final design of the LID measures should be reviewed in conjunction with the storm water management plan for the Site. If low-impact development (LID) techniques are being considered as part of the post-development design, consideration should be given to conducting field percolation tests.

Furthermore, as indicated earlier, the water balance calculations show that development has the potential to reduce the natural infiltration by 1,078 m³/yr. Conservation Ontario Guidelines (Conservation Ontario, 2013) suggest a target of 80% of the predevelopment infiltration being maintained in the post-development conditions. Final design of the infiltration measures provided in the FSR report should address these infiltration targets estimated in water balance calculations.

Furthermore, the soils present on the property are of higher permeabilities which would provide potential pathways for groundwater discharge. The future development will also be connected to municipal



servicing through underground utility lines. The future development may disrupt the shallow groundwater flow, and its continuity should be maintained where practical. However, it is recommended that the excavation of the building foundation and any underground services or utilities across the site must be backfilled using material of similar permeabilities.

8.2 Dewatering Monitoring, Mitigation and Contingency Measures

The proposed monitoring during water taking activities is to include the following tasks, methods, and details at a minimum:

1. The daily record should include: the total time (in hours) spent pumping, the quantity and types of pumps used, and the measured flow rates;
2. Daily water taking monitoring shall be performed, including maintenance of a daily record of water taking volumes, rates and durations for each approved water taking source;
3. The daily record shall be maintained in graphical and digital formats and shall be made available for inspection by the MECP, upon request;
4. The flow rates for each pump used should be measured by installing a properly calibrated and functioning flow measuring device on each discharge hose;
5. The quality of groundwater to be removed during the construction activities should be re-assessed before and during construction dewatering activities according to the requirements that would be established under the municipal sewer use discharge agreement to determine if the water may be disposed of directly to the local sanitary sewer without treatment;
6. A log should be maintained of site activities and any significant events which may affect the volume or quality of discharge. This should include the following: description of the general depth and extent of excavation, noting of the duration and intensity of rainfall events, records of discharge durations and volumes, and noting of any unusual activities which may affect the quality or volume of ground water discharge; and
7. A settlement monitoring plan should be submitted by contractor detailing the frequency of pre-construction / post- construction baseline data collection and daily readings during construction, monitoring on the tracks, monitoring locations, alert and review levels, and reporting process for the issue of survey data including the establishment of stop work process and implementation of remedial measures.

If the conditions and/or limitations authorized in the EASR/PTTW are exceeded, contractor is advised to notify a local member (EASR/PTTW coordinator) of the MECP immediately. The following contingency actions are proposed to re-establish compliance with the EASR/PTTW in the event of unforeseen or unacceptable impacts as a result of the proposed water taking:

1. If the daily water taking volumes are found to exceed those authorized in the EASR, it is recommended that the local MECP staff be notified. The water taking volumes should be restricted to maintain compliance with the limits specified in the EASR until measures can be taken to decrease the volumes of water taking. We also recommend that contractor be required



to incorporate a contingency plan as part of the dewatering and groundwater management plan.

2. If groundwater fails to meet the Sewer Discharge Limits, on-Site treatment of groundwater to the Sewer Discharge Limits would be required before discharge. Alternatively, the groundwater may be discharged directly into containment vessels that can be taken off-site to an appropriate waste receiver or treatment.
3. If groundwater dewatering related ground settlements (e.g., unacceptable levels of ground settlements) occur, groundwater dewatering operations should be ceased or reduced. We recommend that contractor be required to incorporate a contingency plan in the settlement plan that details remedial actions to address the geotechnical issues.

9.0 CLOSURE

We trust this report meets with your requirements. Should you have any questions regarding the information presented, please do not hesitate to contact our office.

Yours truly,

Terraprobe Inc.



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Project Manager



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Project Manager-Hydrogeology



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Associate, Senior Project Manager



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LIMITATIONS

This report was prepared by **Terraprobe Inc.**, for the use of **Brown Bear Dev Ltd.**, and is intended to provide an assessment of the hydrogeological condition the property located at **901 Essa Road, Barrie**. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Terraprobe accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report, including consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The assessment should not be considered a comprehensive audit that eliminates all risks. The information presented in this report is based on information collected during the completion of the subsurface investigation conducted by Terraprobe Inc. It is based on conditions at the property at the time of the site inspection. The subsurface conditions were assessed based on information collected at specific borehole and monitoring well locations. The actual subsurface conditions between the sampling points may vary.

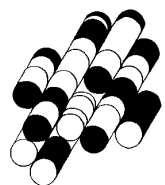
There is no warranty expressed or implied by this report regarding the condition of the property. Professional judgment was exercised in gathering and analyzing information collected by our staff, as well as that submitted by others. The conclusions presented are the product of professional care and competence, and cannot be construed as an absolute guarantee.

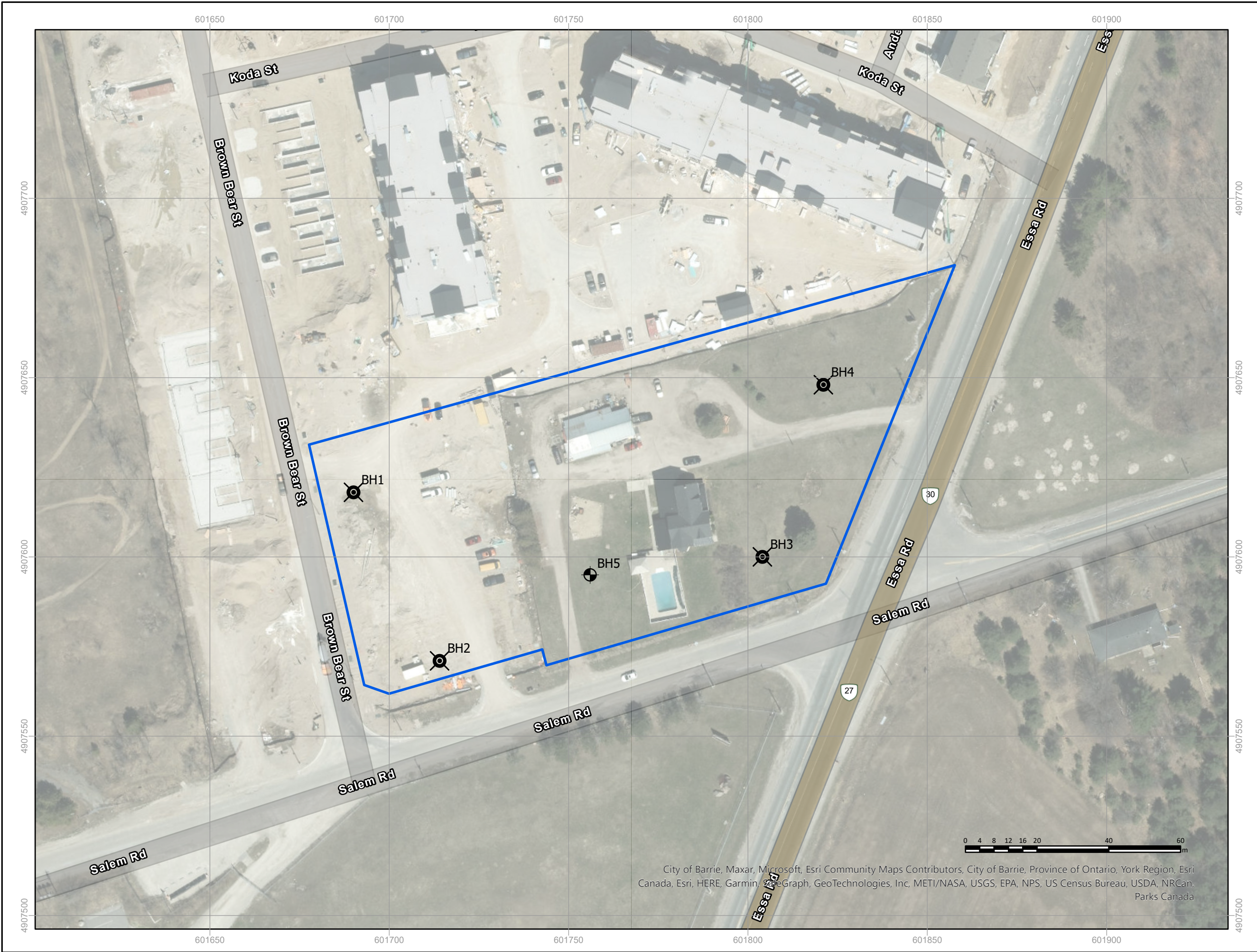
In the event that during future work new information regarding the condition of the property is encountered, or the proposed development is changed from that which was provided to Terraprobe with respect to the property, Terraprobe should be notified in order that we may re-evaluate the findings of this assessment and provide amendments, as required.



FIGURES

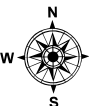
TERRAPROBE INC.







Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing



References:
ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/
Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User
Community, Basemaps

Key Map



City of Barrie, Province of Ontario, York Region,
Esri Canada, Esri, HERE, Garmin, SafeGraph,
GeoTechnologies, Inc, METI/NASA, USGS, EPA,
NPS, US Census Bureau, USDA, NRCan, Parks
Canada

Notes:

Legend:

-  Approximate Site Boundary
-  Approximate Monitoring Well Location
-  Approximate Borehole Location

Project Title:

Preliminary Hydrogeological Assessment

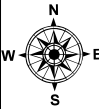
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901 Essa Road, Barrie, Ontario

Figure Title:

Borehole and Monitoring Well Plan

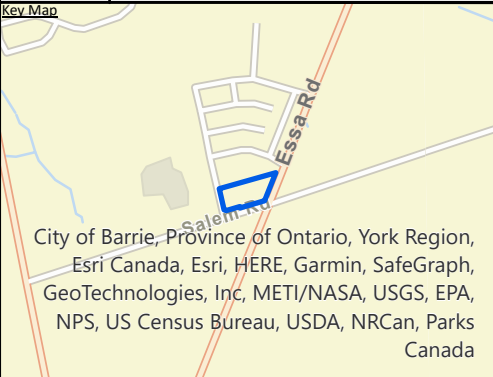
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Drawn By: SSK	Scale: As Shown
Reviewed By: UA	Figure No.: 2
Date: March 2022	



References:

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Basemaps

Key Map



City of Barrie, Province of Ontario, York Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

Notes:

Legend:

Approximate Site Boundary

Project Title:
Preliminary Hydrogeological Assessment

Site Location:
901 Essa Road, Barrie, Ontario

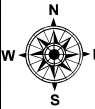
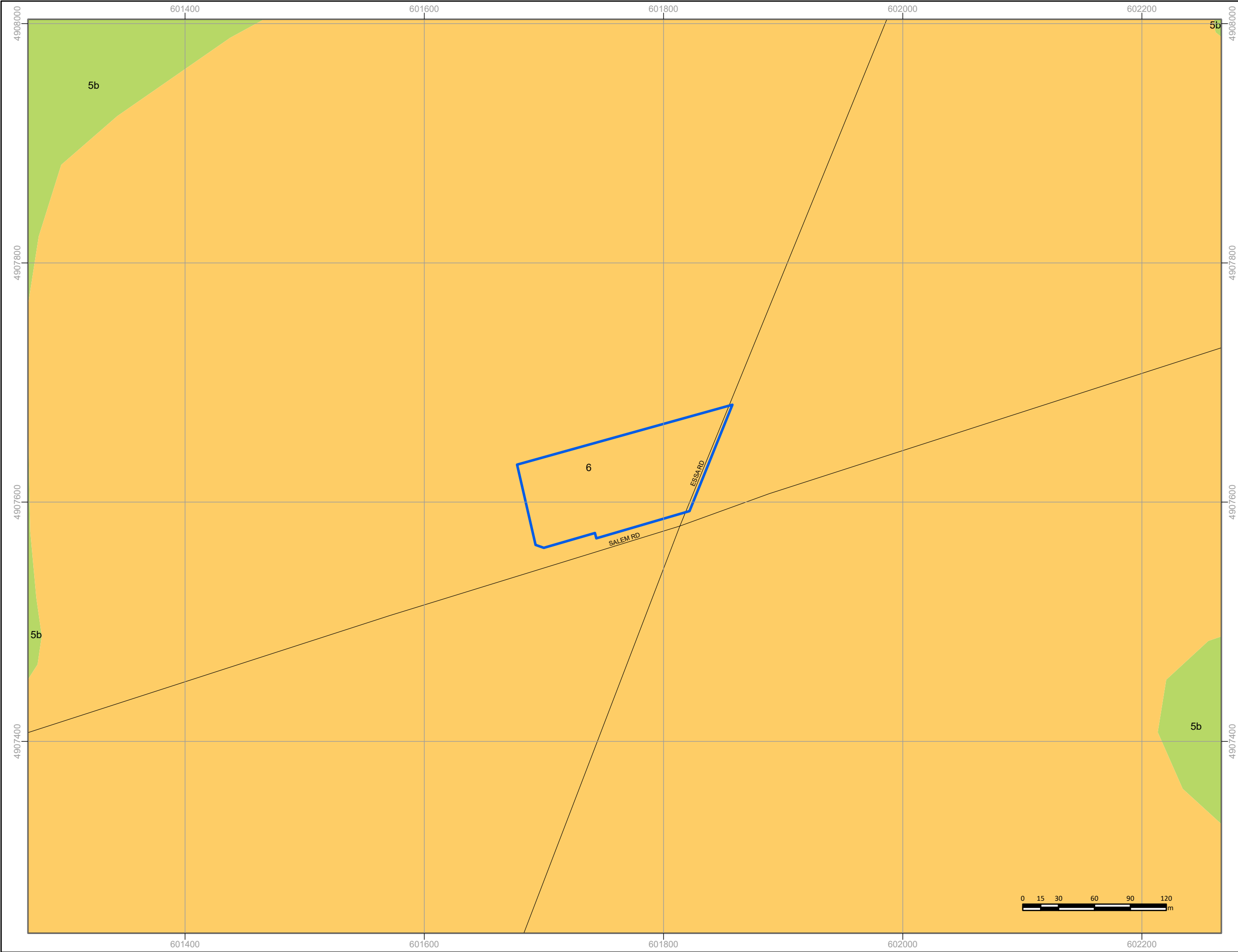
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Site Location Plan

Designed By: MM	File No.: 3-22-0008-46
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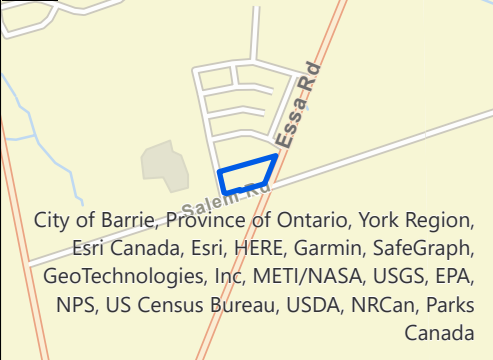
Date: March 2022	1
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References:

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Key Map



Notes:

Legend:

- Approximate Site Boundary
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- Collector

Project Title:

Preliminary Hydrogeological Assessment

Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

Surficial Geology Map

Designed By:

MM

File No.:

3-22-0008-46

Drawn By:

SSK

Scale:

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Reviewed By:

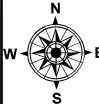
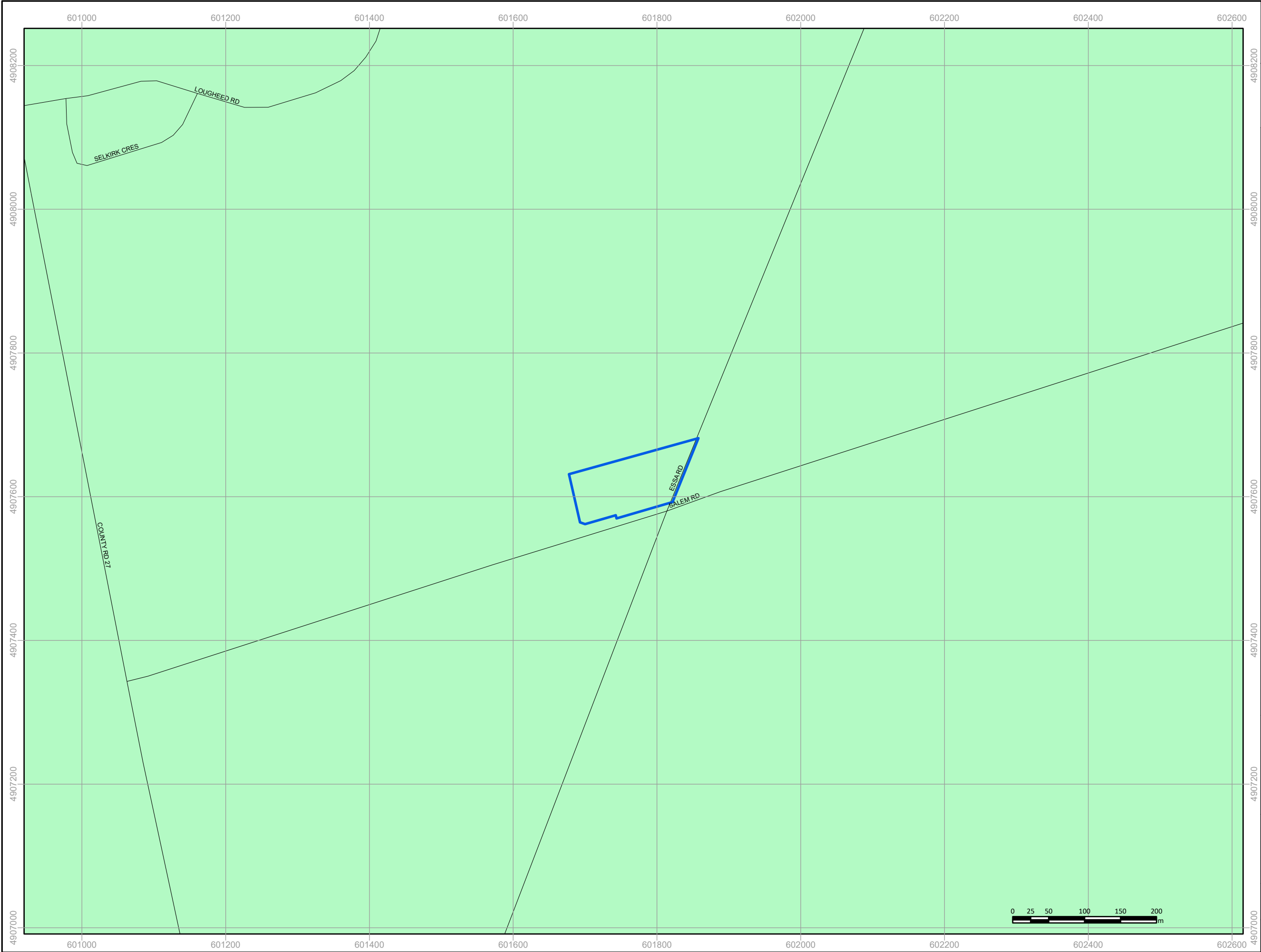
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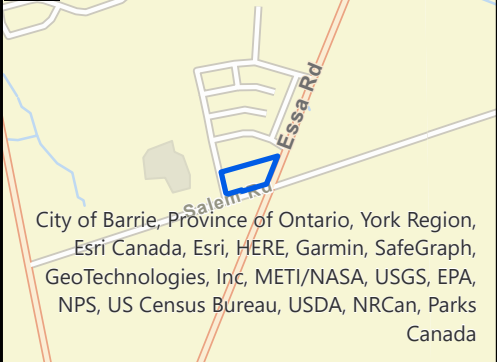
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Key Map



Notes:

Legend:

- Approximate Site Boundary
- Collector
- Local / Street
- 31, Peterborough Drumlin Field

Project Title:

Preliminary Hydrogeological Assessment

Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

Physiography Map

Designed By:

MM

File No.:

3-22-0008-46

Drawn By:

SSK

Scale:

As Shown

Reviewed By:

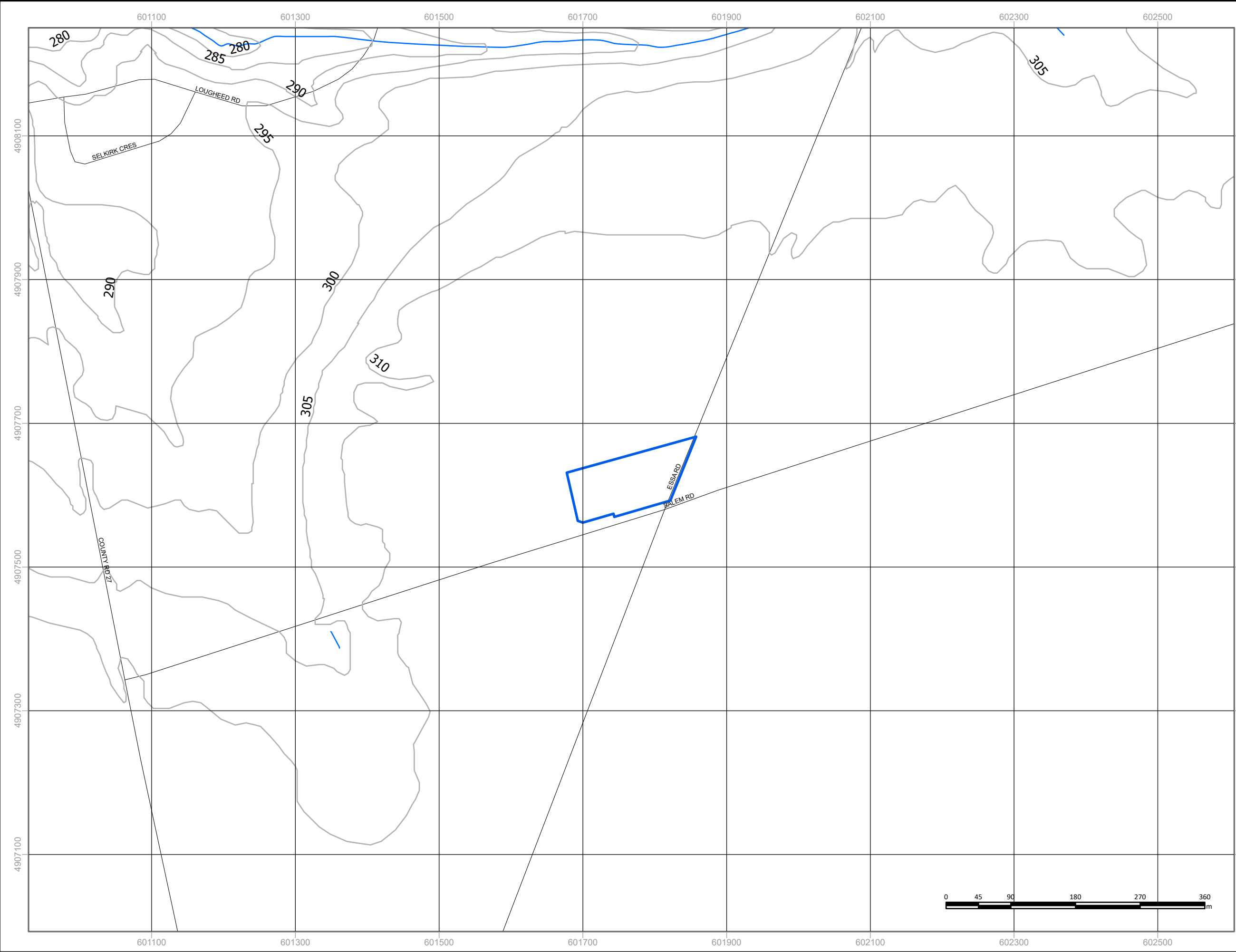
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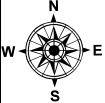
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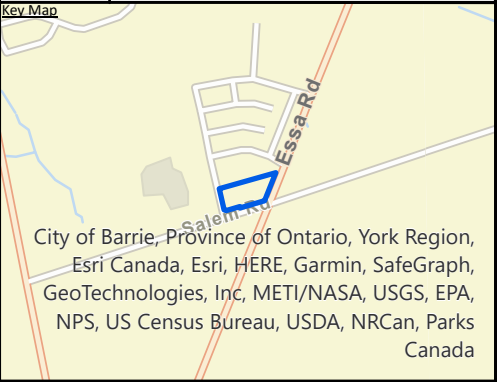


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Construction Materials, Inspection & Testing



References:
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Key Map



City of Barrie, Province of Ontario, York Region,
Esri Canada, Esri, HERE, Garmin, SafeGraph,
GeoTechnologies, Inc, METI/NASA, USGS, EPA,
NPS, US Census Bureau, USDA, NRCan, Parks
Canada

Notes:

Legend:

-  Approximate Site Boundary
-  City of Barrie; Topographic Contours
-  Collector
-  Local / Street
-  Water Course

Project Title:

Preliminary Hydrogeological Assessment

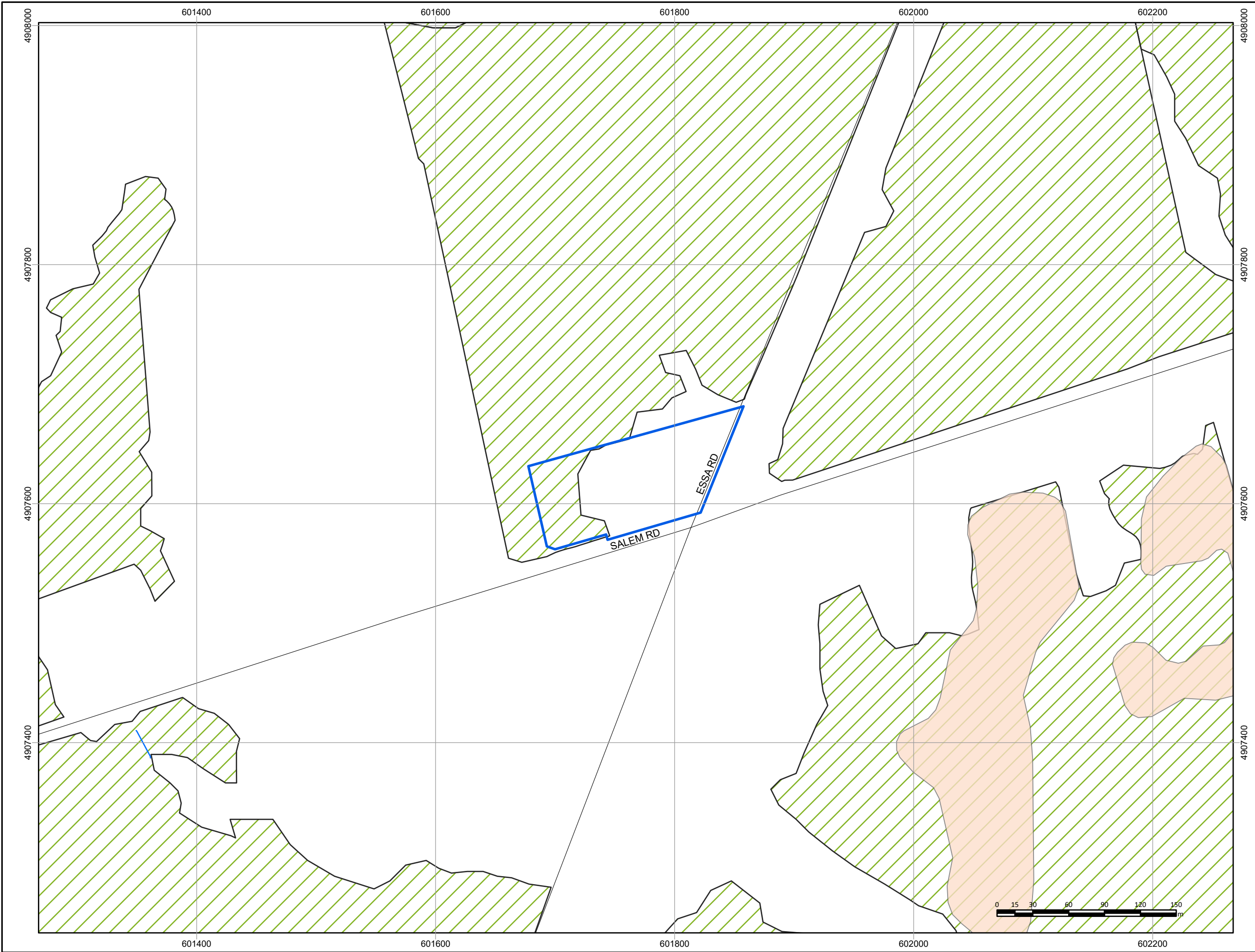
Site Location:

901 Essa Road, Barrie, Ontario

Figure Title:

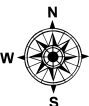
Topography Map

Designed By: MM	File No.: 3-22-0008-46
Drawn By: SSK	Scale: As Shown
Reviewed By: UA	Figure No.: 5
Date: March 2022	

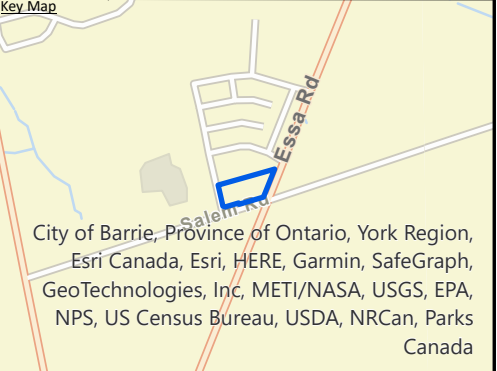




Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing



References:
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City of Barrie, Province of Ontario, York Region,
Esri Canada, Esri, HERE, Garmin, SafeGraph,
GeoTechnologies, Inc, METI/NASA, USGS, EPA,
NPS, US Census Bureau, USDA, NRCan, Parks
Canada

Notes:

Legend:

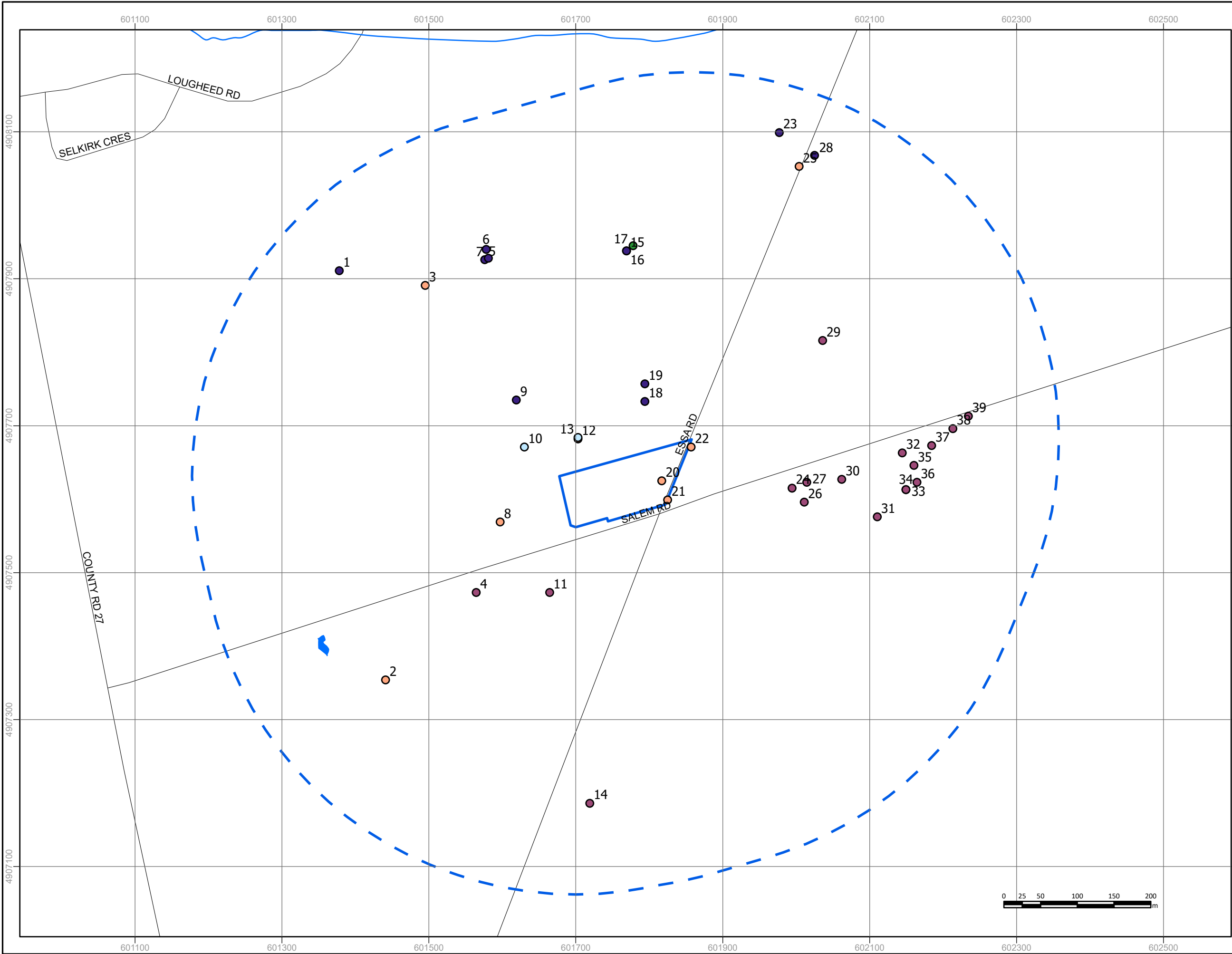
-  Approximate Site Boundary
-  Collector
-  Water Course
-  Wetland Features-Not evaluated
-  Wooded Area

Project Title:
Preliminary Hydrogeological Assessment

Site Location:
901 Essa Road, Barrie, Ontario

Figure Title:
Natural Heritage Feature Map

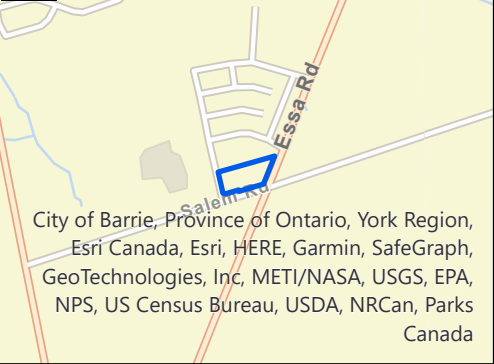
Designed By: MM	File No.: 3-22-0008-46
Drawn By: SSK	Scale: As Shown
Reviewed By: UA	Figure No.: 6
Date: March 2022	



References:

ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus Ds, USDA, USGS, AeroGRID, IGN, and the GIS User Community produced by Terraprobe Inc. Copyright (c) Queen's Printer 2020. Water Well Information System Ministry of the Environment, Conservation and Parks, 2020

Key Map



City of Barrie, Province of Ontario, York Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCan, Parks Canada

Notes:

Legend:

- Approximate Site Boundary
- Approximate Study Area; 500m
- Water Course
- Collector
- Local / Street
- Unknown
- Abandoned-Other
- Observation Wells
- Other Status
- Water Supply

Project Title:
Preliminary Hydrogeological Assessment

Site Location:
901 Essa Road, Barrie, Ontario

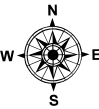
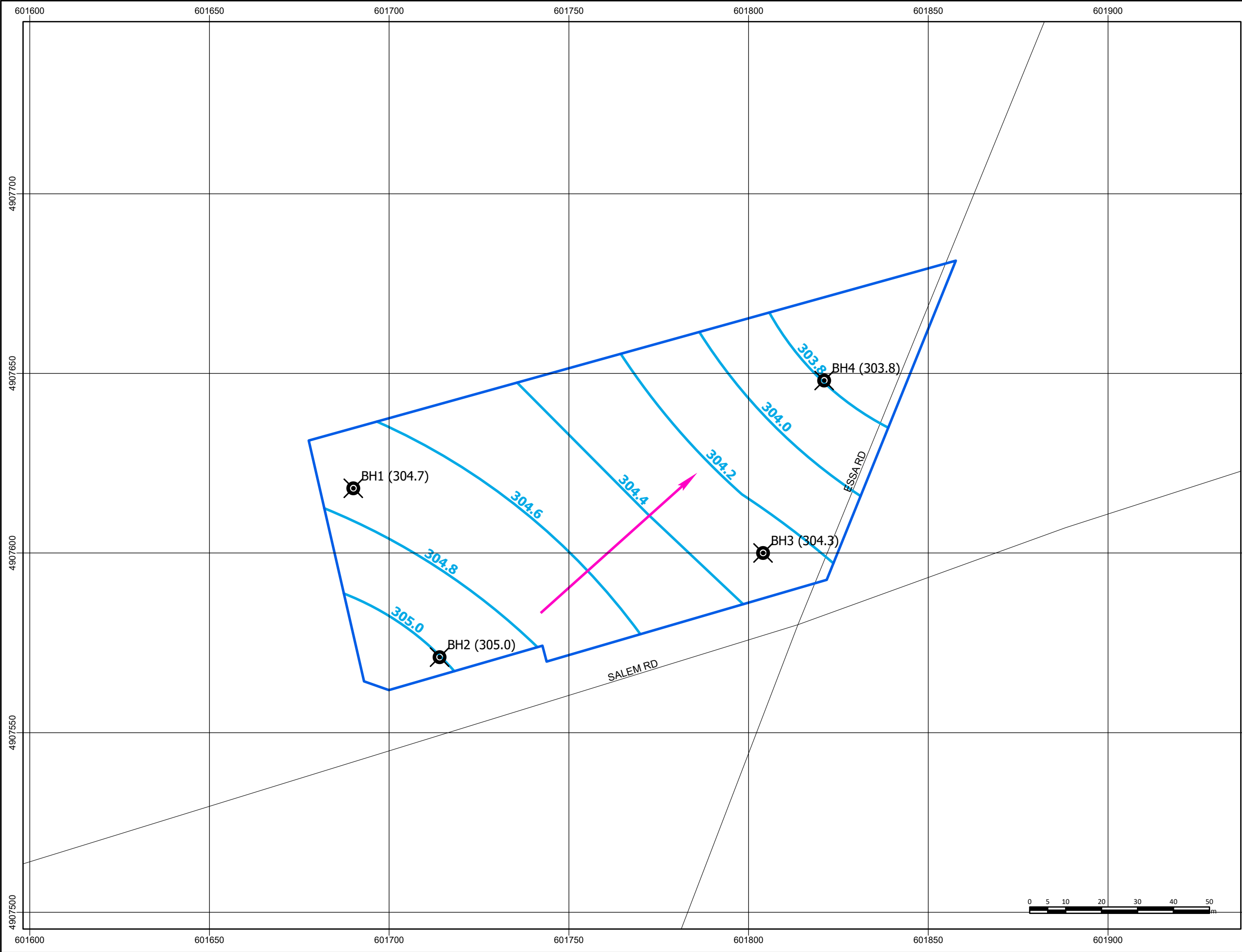
Figure Title:
MECP Well Records Map

Designed By: MM	File No.: 3-22-0008-46
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Drawn By: SSK	Scale: As Shown
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Reviewed By: UA	Figure No.:
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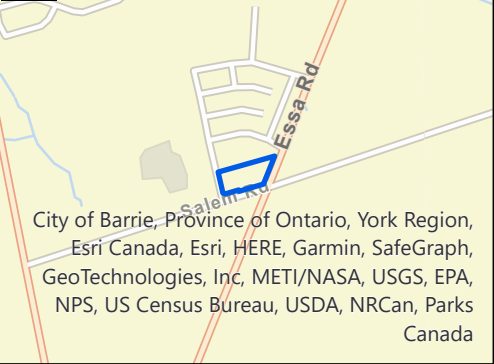
Date: March 2022



References:

Service Layer Credits: © Topography, Water Body and Watercourse Map was Produced by Terraprobe Inc. under license from the Ministry of Ministry of Natural Resources and Forestry (MNR). Copyright (c) is hold by the Queen's Printer for Ontario 2015.

Key Map



Notes:

Legend:

- Approximate Site Boundary
- Collector
- Interpreted Groundwater Contours
- Interpreted Groundwater Flow Direction
- Approximate Monitoring Well Location (Groundwater Elevation as on Feb 18, 2022)

Project Title:
Preliminary Hydrogeological Assessment

Site Location:
901 Essa Road, Barrie, Ontario

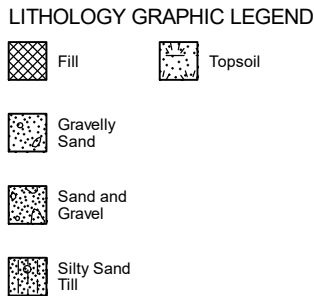
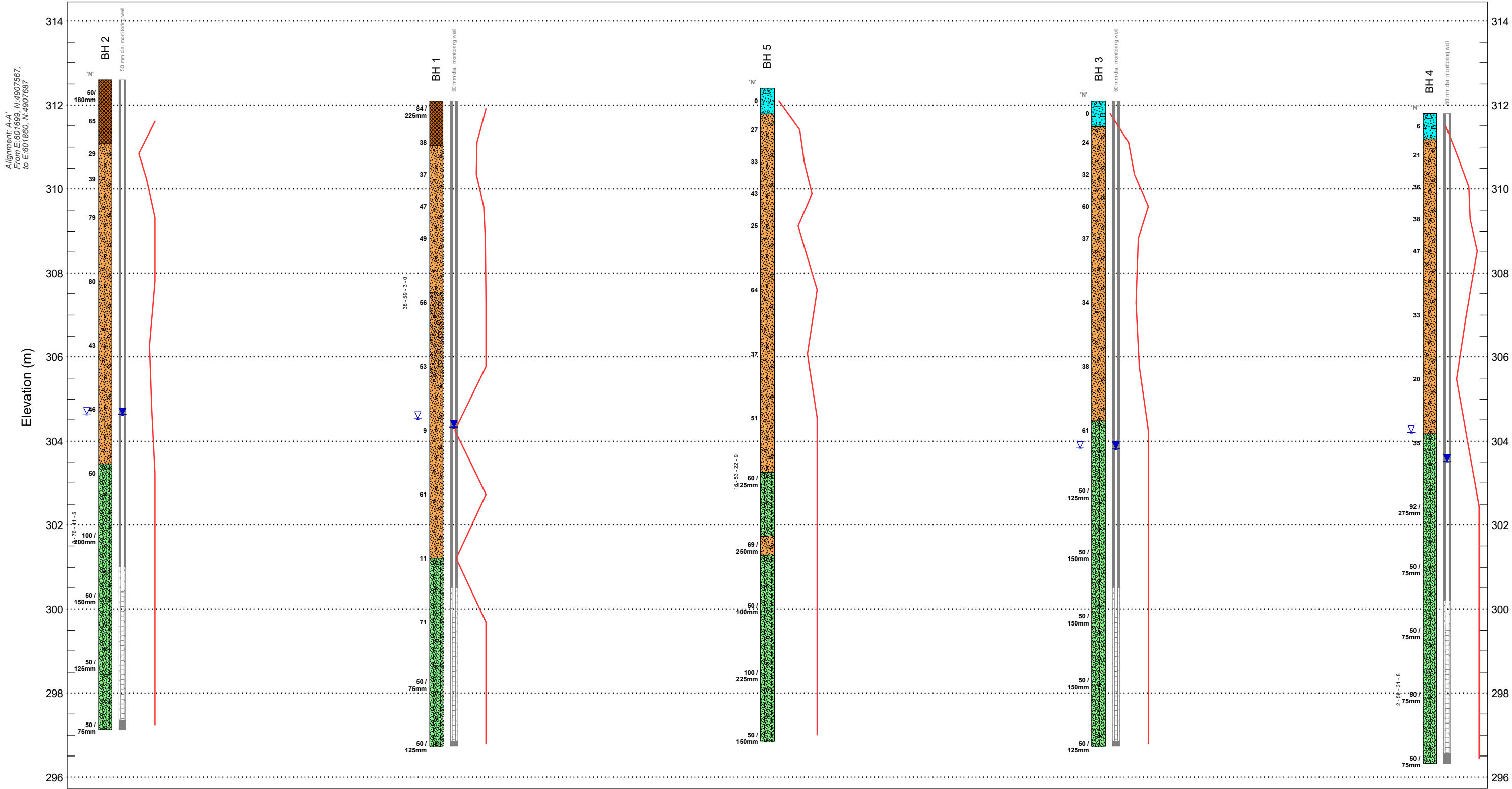
Figure Title:
Groundwater Flow Direction

Designed By: MM	File No.: 3-22-0008-46
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Drawn By: SSK	Scale: As Shown
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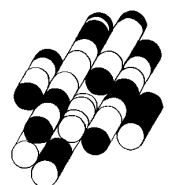
Reviewed By: UA	Figure No.: 8
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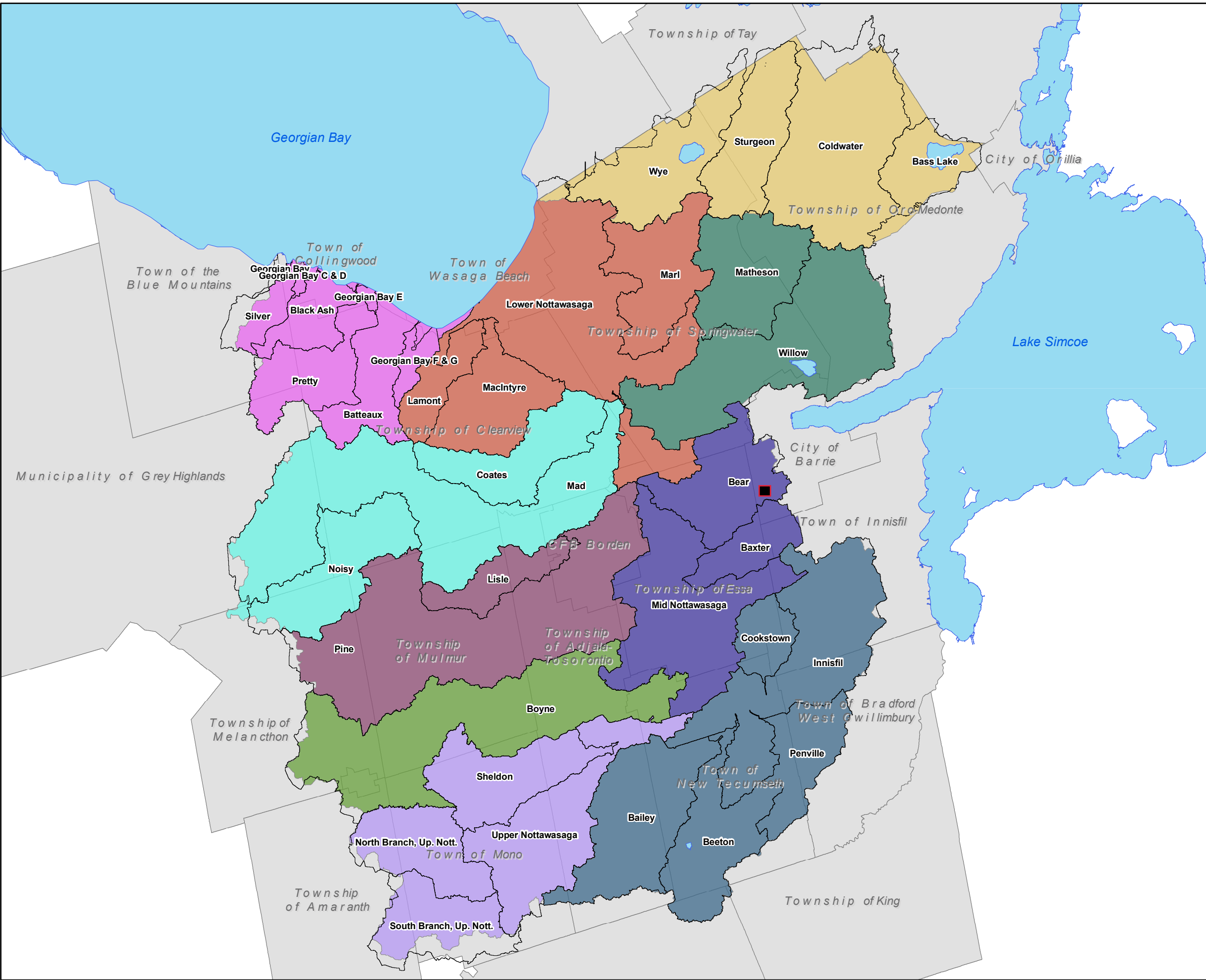
Date: March 2022



APPENDIX A

TERRAPROBE INC.





NVCA Watersheds

Figure 3.1-1

Legend

-  Lakes
-  Drainage Areas
-  Municipal Boundary

Subwatershed

-  Blue Mountains Watersheds
-  Boyne River Subwatershed
-  Innisfil Creek Subwatershed
-  Lower Nottawasaga River Reach
-  Mad River Subwatershed
-  Middle Nottawasaga River Reach
-  Pine River Subwatershed
-  Severn Sound Watersheds
-  Upper Nottawasaga River Subwatershed
-  Willow Creek Subwatershed

**ecosystem
recovery inc.**
PROFESSIONAL ENGINEERS



NAD 1983 UTM 17

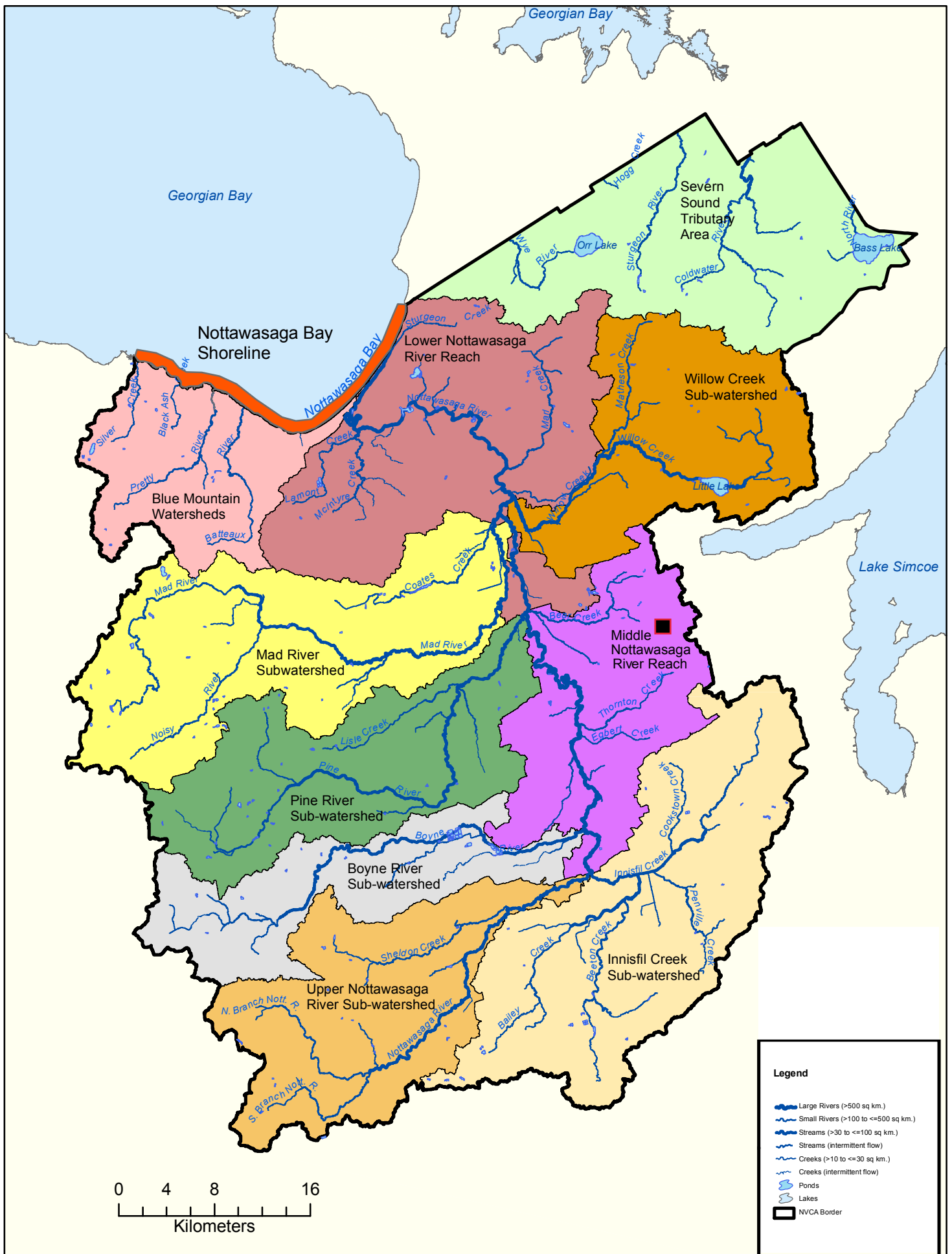
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Project: NVCA IWMP

Date: 2018-05-30

Data Sources: NVCA, 2017: Subwatersheds,
Municipal Boundary





NVCA Drainage Map (source: NVCA IWMP, 2018)



Nottawasaga Valley
Conservation Authority

Regulated Areas

23-Mar-2022

Information Resources for Regulated Properties

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NVCA Contact Information

(705) 424-1479

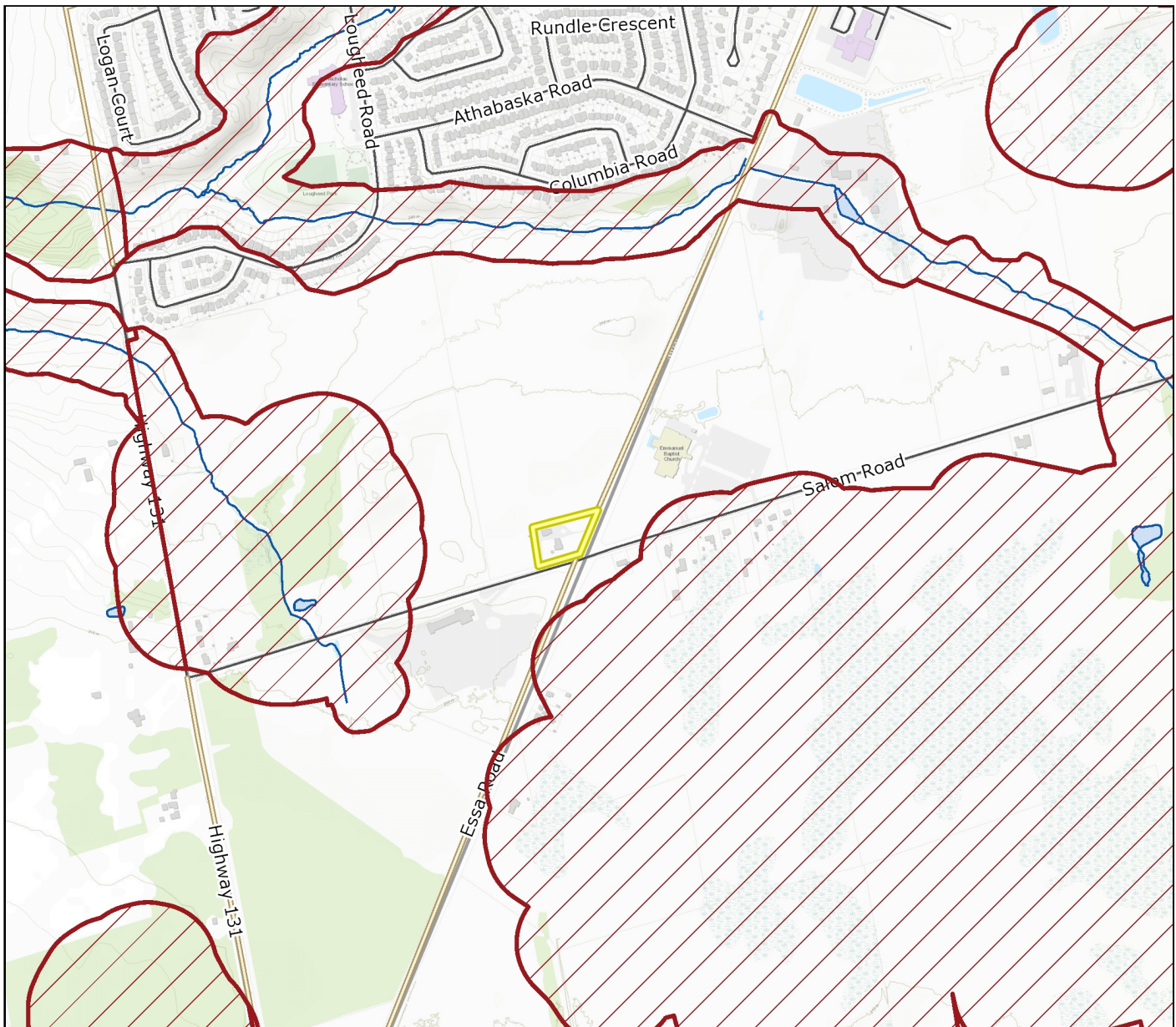
8195 8th Line,
Utopia, ON L0M 1T0

www.nvca.on.ca

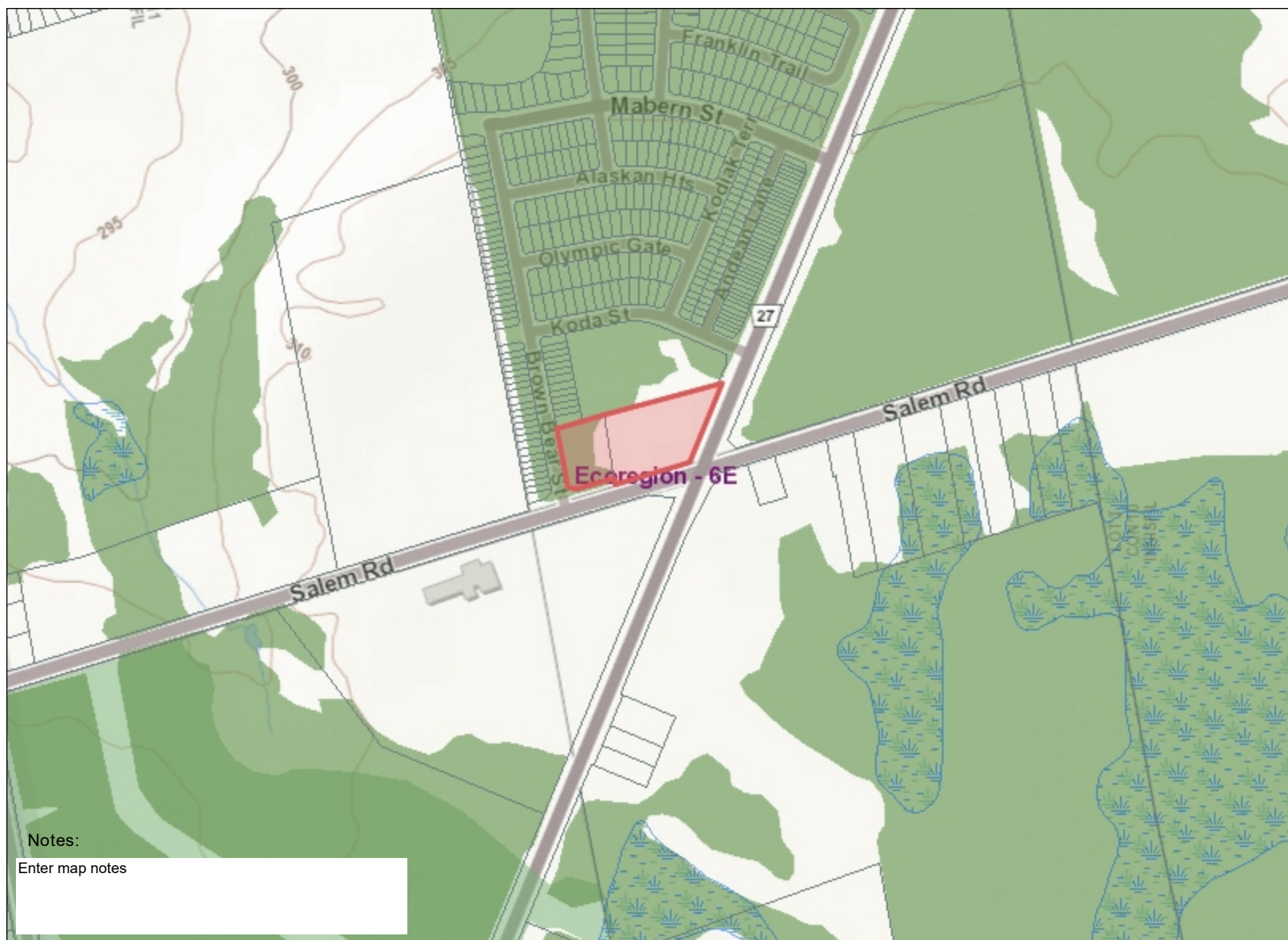
Monday to Friday

8:30 a.m. to 4:30 p.m.

except between 12:00 p.m. - 1:00 p.m.

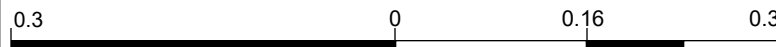


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Notes:

Enter map notes



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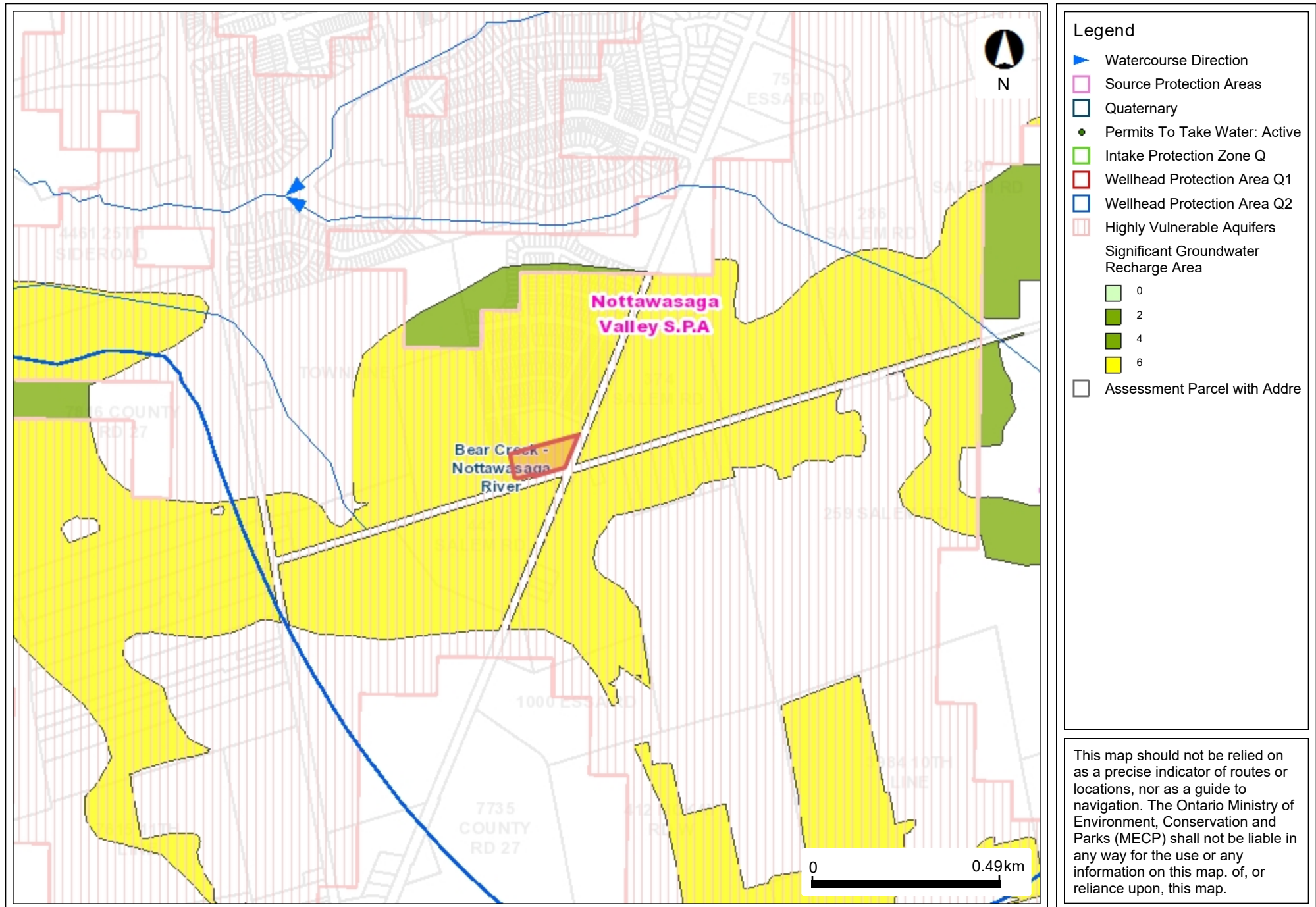
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GTA 2005 / SWOOP 2006 / Simcoe-Muskoka-Dufferin © FirstBase Solutions, 2005 / 2006 / 2008
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Legend

-  Assessment Parcel
-  Ecoregion
-  ORM Boundary
-  NEP Parks and Open Space System
-  NEP Minor Urban Centres
- ANSI
-  Earth Science Provincially Significant/sciences de la terre d'importance provinciale
-  Earth Science Regionally Significant/sciences de la terre d'importance régionale
-  Life Science Provincially Significant/sciences de la vie d'importance provinciale
-  Life Science Regionally Significant/sciences de la vie d'importance régionale
- Evaluated Wetland
-  Provincially Significant/considérée d'importance provinciale
-  Non-Provincially Significant/non considérée d'importance provinciale
-  Unevaluated Wetland
-  Woodland
-  Natural Heritage System



Source Protection Mapping



- Legend**
- Watercourse Direction
 - Source Protection Areas
 - Quaternary
 - Permits To Take Water: Active
 - Intake Protection Zone Q
 - Wellhead Protection Area Q1
 - Wellhead Protection Area Q2
 - Highly Vulnerable Aquifers
 - Significant Groundwater Recharge Area
 - 0
 - 2
 - 4
 - 6
 - Assessment Parcel with Address

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Features

WHPA Q Policy Area

-  WHPA-Q1
-  WHPA-Q1/Q2
-  WHPA-Q2

WHPA Q Risk Level

-  Significant
-  Moderate
-  Low

Lakes

-  SGBLS Source Protection Boundary

Lower Tier Municipality

-  Assessment Parcel

Roads

-  Hwy 400 Series
-  Highway, Arterials
-  Local Road

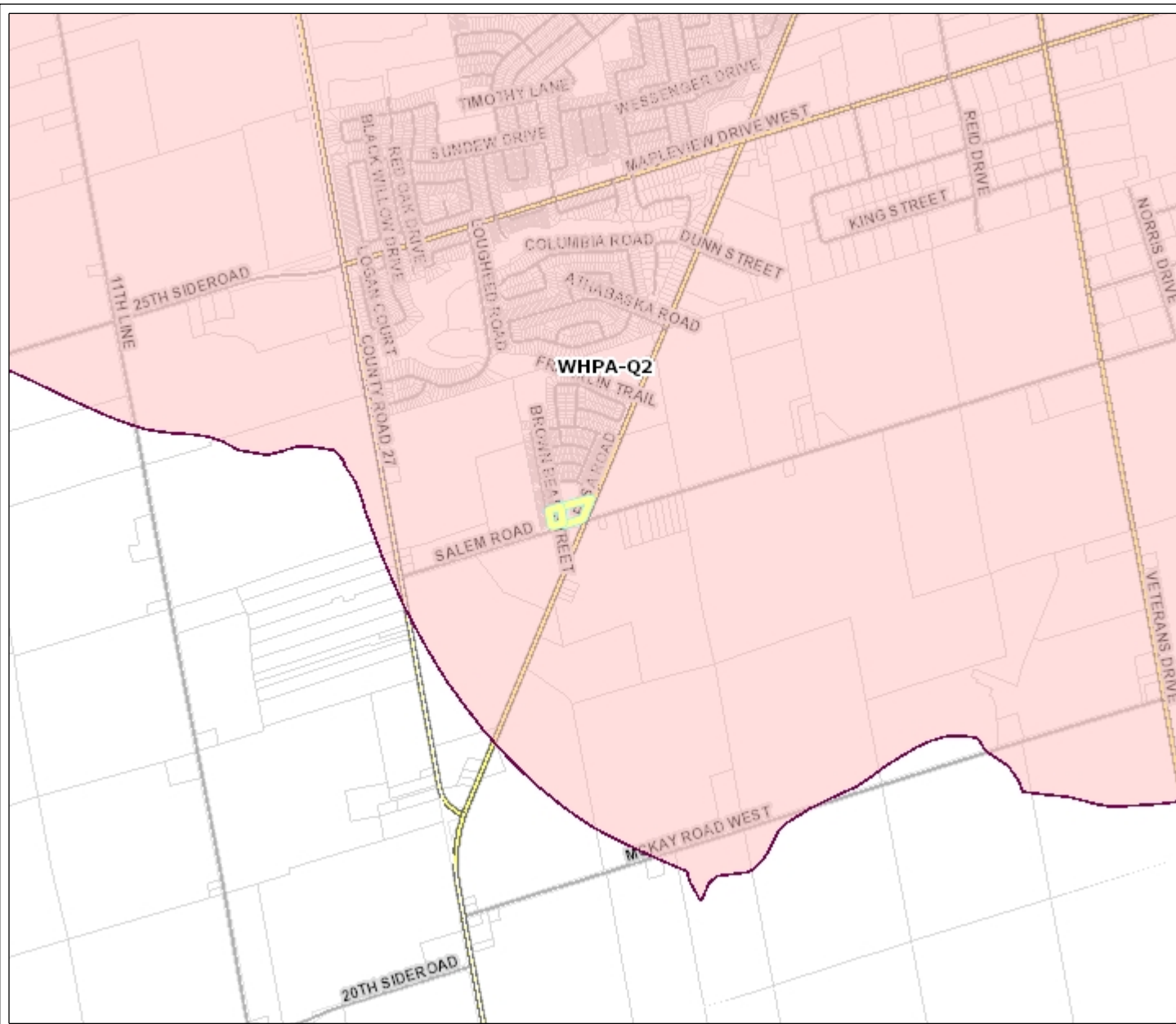
Printed On:
3/23/2022



WGS_1984_Web_Mercator_Auxiliary_Sphere

Mapped By:

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Scale 1: 25,964





Nottawasaga Valley
Conservation Authority

Highly Vulnerable Aquifers

23-Mar-2022

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(705) 424-1479

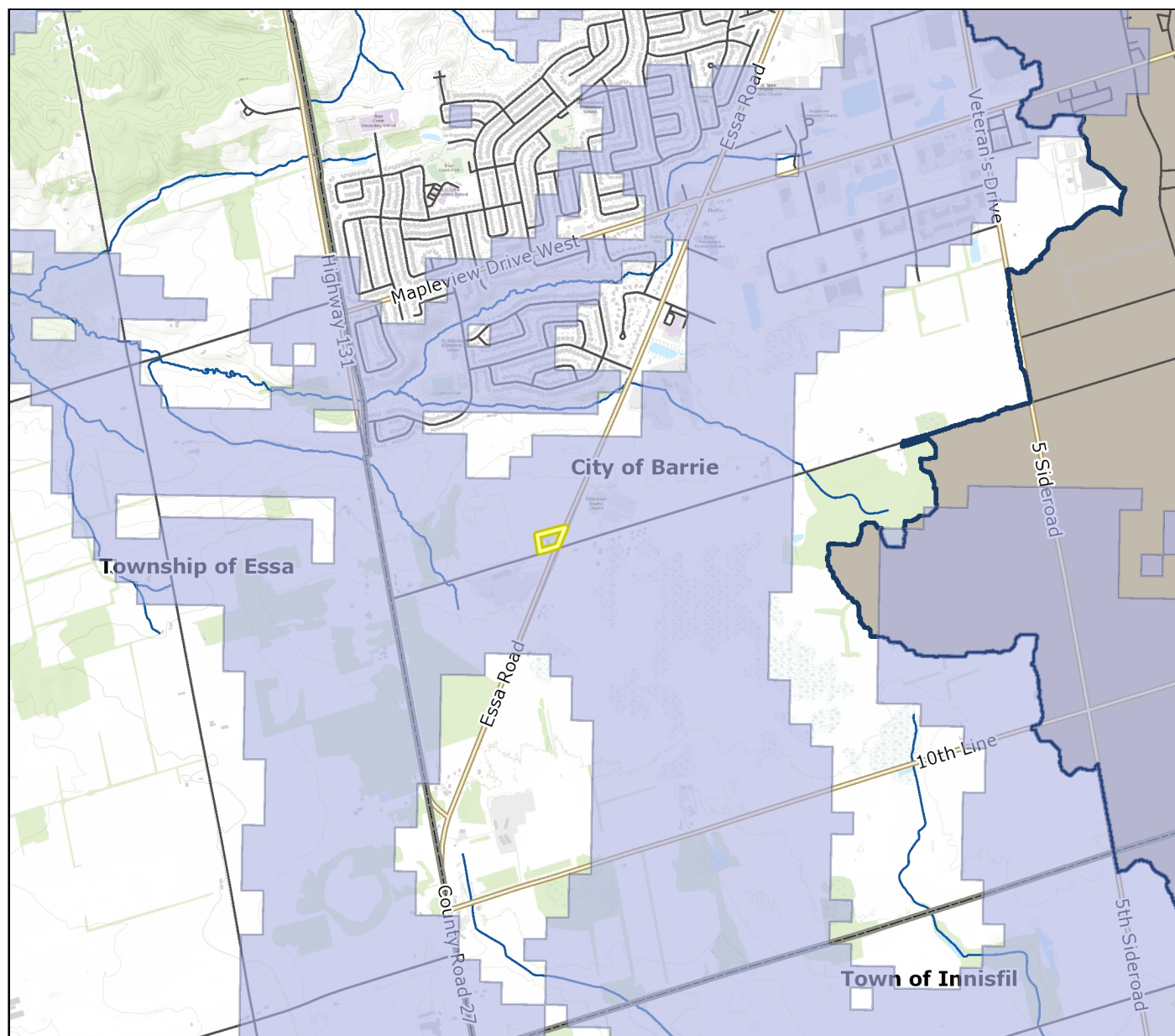
8195 8th Line,
Utopia, ON L0M 1T0

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8:30 a.m. to 4:30 p.m.

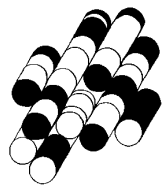
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APPENDIX B

TERRAPROBE INC.



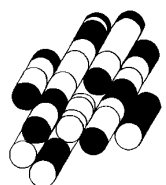
MECP Well Records Summary										
WELL ID	MECP* WWR ID	Construction Method	Well Depth (m)**	Well Usage		Water Found (mbgs)**	Static Water Level (mbgs)**	Top of Screen Depth (mbgs)**	Bottom of Screen Depth (mbgs)**	Date Completed
				Final Status	First Use					
1	7339765			Abandoned-Other						May 28, 2019
2	7176147	Rotary (Convent.)	4.6	Observation Wells	Monitoring	0.6		1.5	4.6	October 18, 2011
3	7176146	Rotary (Convent.)	7.6	Observation Wells	Monitoring	4.0		4.6	7.6	October 19, 2011
4	5710487	Boring	8.5	Water Supply	Domestic	4.6	4.0			October 7, 1973
5	7339768			Abandoned-Other			3.1			June 17, 2019
6	7319538			Abandoned-Other	Not Used					July 30, 2018
7	7339770			Abandoned-Other			4.0			June 17, 2019
8	7048667	Boring	25.6	Observation Wells	Monitoring					August 2, 2007
9	7319539			Abandoned-Other	Not Used					July 30, 2018
10	7353251	Auger	7.3	Other Status	Monitoring					October 17, 2019
11	5715880	Rotary (Convent.)	47.2	Water Supply	Industrial	39.7	33.2	40.0	41.5	January 31, 1979
12	7306468	Auger	4.6	Observation Wells	Monitoring	4.6		3.1	4.6	January 25, 2018
13	7333266			Other Status						April 9, 2019
14	5734437	Cable Tool	13.1	Water Supply	Domestic	12.8	1.2	11.9	12.8	June 23, 1999
15	7354623		6.7	Observation Wells	Other					June 17, 2019
16	7339771			Abandoned-Other			3.4			June 17, 2019
17	7308428									February 7, 2018
18	7319537			Abandoned-Other	Not Used					July 30, 2018
19	7319536			Abandoned-Other	Not Used					July 30, 2018
20	7319523	Rotary (Convent.)	3.1	Observation Wells	Monitoring	2.4	2.4	1.5	3.1	August 20, 2018
21	7319522	Rotary (Convent.)	4.6	Observation Wells	Monitoring	2.4	2.4	3.1	4.6	August 20, 2018
22	7319525	Rotary (Convent.)	4.6	Observation Wells	Monitoring	3.7	3.7	3.1	4.6	August 20, 2018
23	7339773			Abandoned-Other			5.5			June 17, 2019
24	5701248	Boring	12.2	Water Supply	Domestic	8.5	3.7			August 12, 1964
25	7319524	Rotary (Convent.)	3.1	Observation Wells	Monitoring	2.1	2.1	1.5	3.1	August 20, 2018
26	5734726	Cable Tool	48.5	Water Supply	Domestic	48.5	36.3	47.6	48.5	November 16, 1999
27	5709516	Cable Tool	50.9	Water Supply	Domestic	42.7	6.1	50.0	50.9	August 14, 1972
28	7328955	Other Method		Abandoned-Other	Monitoring	0.6		0.5	0.9	December 12, 2018
29	5739780	Cable Tool	6.0	Water Supply	Domestic	44.0	35.2	45.7	48.8	January 4, 2005
30	5739342	Cable Tool	24.1	Water Supply	Domestic	22.0	3.1			July 23, 2004
31	5701249	Boring	6.1	Water Supply	Domestic	2.7	2.7			October 12, 1965
32	5710004	Boring	7.0	Water Supply	Domestic	3.7	0.9			March 4, 1973
33	5710285	Cable Tool		Water Supply	Domestic	9.8	38.4	45.1	46.1	September 11, 1973
34	5723468	Cable Tool	45.4	Water Supply	Domestic	42.7	34.8	44.5	45.4	June 22, 1988
35	5719417	Cable Tool	46.9	Water Supply	Domestic	45.1	35.7	45.4	46.7	September 19, 1984
36	5709995	Boring	10.7	Water Supply	Domestic	6.1	6.1			March 5, 1973
37	5731407	Cable Tool	45.1	Water Supply	Domestic	42.7	36.0	43.6	44.5	March 6, 1995
38	5709996	Boring	9.1	Water Supply	Domestic	4.6	4.6	14.0	17.7	March 6, 1973

*Ministry of Environment, Conservation and Parks

** meters below ground surface

APPENDIX C

TERRAPROBE INC.





Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 8, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

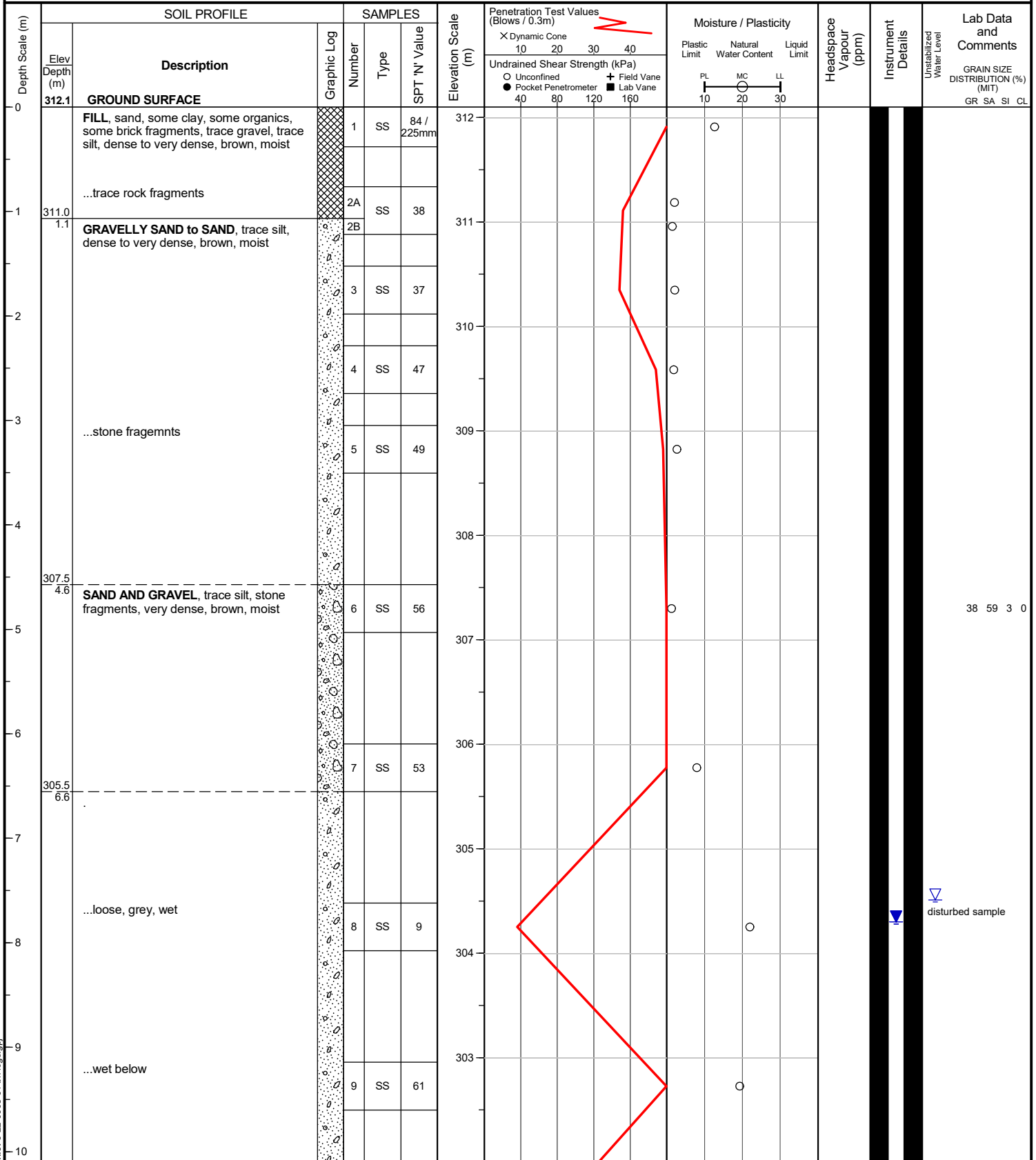
Checked by : OB

Position : E: 601688, N: 4907612 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

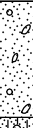
Drilling Method : Hollow stem augers



(continued next page)

Project No. : 3-22-0008-01 Client : Brown Bear Dev. Ltd. Originated by : CB
 Date started : February 8, 2022 Project : 901 Essa Road and Brown Bear Street Compiled by : GO
 Sheet No. : 2 of 2 Location : Barrie, Ontario Checked by : OB

Position : E: 601688, N: 4907612 (UTM 17T) Elevation Datum : Geodetic
 Rig type : Track-mounted Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		X Dynamic Cone	Undrained Shear Strength (kPa)	Plastic Limit	Natural Water Content	Liquid Limit			
		(continued)						10 20 30 40							
		(continued)						40 80 120 160		PL MC LL					
11	301.2 10.9	SILTY SAND , trace to some clay, trace silt, trace gravel, compact to very dense, grey, moist (GLACIAL TILL) ...at 11.0 m, clayey silt seams		10	SS	11	301								disturbed sample
12				11	SS	71	300								
13							299								
14				12	SS	50 / 75mm	298								
15	296.7 15.4	...rock fragments		13	SS	50 / 125mm	297								

END OF BOREHOLE

Unstabilized water level measured at 7.6 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS
 Date Water Depth (m) Elevation (m)
 Feb 17, 2022 7.8 304.3



Project No. : 3-22-0008-01

Date started : February 7, 2022

Sheet No. : 1 of 2

Client : Brown Bear Dev. Ltd.

Project : 901 Essa Road and Brown Bear Street

Location : Barrie, Ontario

Originated by : CB

Compiled by : GO

Checked by : OB

Position : E: 601714, N: 4907571 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Dynamic Cone	Undrained Shear Strength (kPa)	Plastic Limit	Natural Water Content	Liquid Limit			
0	312.6	GROUND SURFACE													
		FILL, sand, some gravel, some rock fragments, trace silt, very dense, brown, moist		1	SS	50/180mm									
		...rock fragments		2	SS	85									
1															
	311.1	...compact to dense		3	SS	29									
	1.5	GRAVELLY SAND to SAND, trace silt, compact to very dense, brown, moist		4	SS	39									
2															
				5	SS	79									
3															
				6	SS	80									
4															
				7	SS	43									
5															
		...wet		8	SS	46									
6															
		...some silt, wet													
7															
8															
9	303.5	SILTY SAND to SAND, trace gravel, trace clay, very dense, grey, moist (GLACIAL TILL)		9	SS	50									
	9.1														
10															

Project No. : 3-22-0008-01 Client : Brown Bear Dev. Ltd. Originated by : CB
 Date started : February 7, 2022 Project : 901 Essa Road and Brown Bear Street Compiled by : GO
 Sheet No. : 2 of 2 Location : Barrie, Ontario Checked by : OB

Position : E: 601714, N: 4907571 (UTM 17T) Elevation Datum : Geodetic
 Rig type : Track-mounted Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)				Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Undrained Shear Strength (kPa)				Plastic Limit	Natural Water Content	Liquid Limit			
		(continued)						10	20	30	40						
11		SILTY SAND to SAND, trace gravel, trace clay, very dense, grey, moist (GLACIAL TILL) (continued)					302										8 76 11 5
		...wet		10	SS	100 / 200mm											
12		...some clay, some gravel, wet		11	SS	50 / 150mm	301										
							300										
13							299										
14		...rock fragments		12	SS	50 / 125mm											
							298										
15																	
	297.1			13	SS	50 / 75mm											
	15.5																

END OF BOREHOLE

Unstabilized water level measured at 8.0 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS
 Date Water Depth (m) Elevation (m)
 Feb 17, 2022 8.0 304.6

Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 8, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

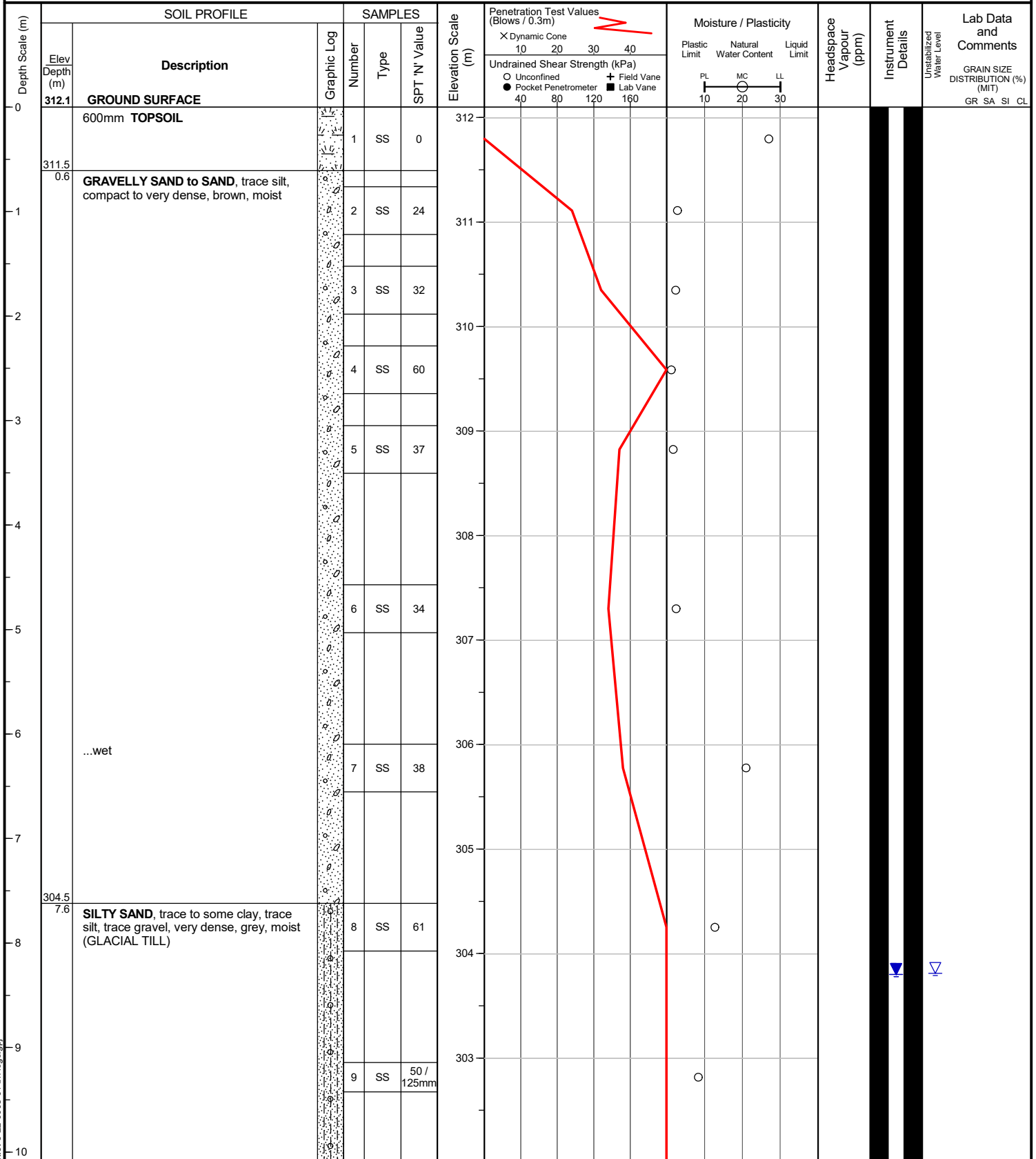
Checked by : OB

Position : E: 601807, N: 4907602 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

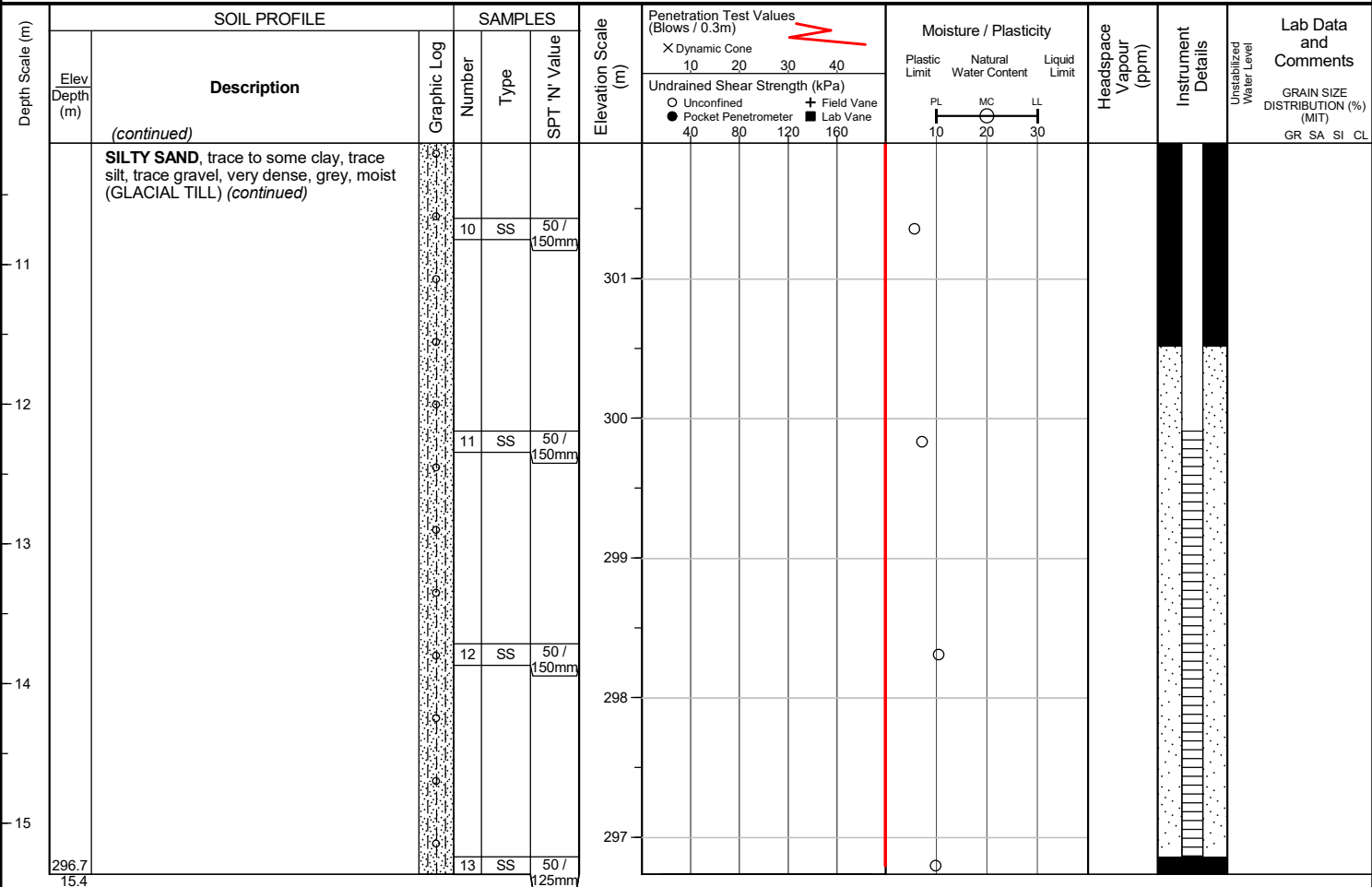
Drilling Method : Hollow stem augers



(continued next page)

Project No. : 3-22-0008-01	Client : Brown Bear Dev. Ltd.	Originated by : CB
Date started : February 8, 2022	Project : 901 Essa Road and Brown Bear Street	Compiled by : GO
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : OB

Position : E: 601807, N: 4907602 (UTM 17T)	Elevation Datum : Geodetic
Rig type : Track-mounted	Drilling Method : Hollow stem augers



END OF BOREHOLE

Unstabilized water level measured at 8.3 m below ground surface; borehole cave not measured upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

<u>Date</u>	<u>Water Depth (m)</u>	<u>Elevation (m)</u>
Feb 17, 2022	8.3	303.8



Project No. : 3-22-0008-01

Date started : February 9, 2022

Sheet No. : 1 of 2

Client : Brown Bear Dev. Ltd.

Project : 901 Essa Road and Brown Bear Street

Location : Barrie, Ontario

Originated by : CB

Compiled by : GO

Checked by : OB

Position : E: 601826, N: 4907647 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		X Dynamic Cone	Undrained Shear Strength (kPa)	Plastic Limit	Natural Water Content	Liquid Limit			
0	311.8	GROUND SURFACE													
		600mm TOPSOIL		1	SS	6									
1	311.2	GRAVELLY SAND to SAND, trace silt, compact to dense, brown, moist		2	SS	21	311								
	0.6														
				3	SS	36	310								
2				4	SS	38	309								
3		...grey, wet below		5	SS	47	308								
4															
				6	SS	33	307								
5															
6		SILTY SAND, trace to some clay, trace silt, trace gravel, dense to very dense, grey, moist (GLACIAL TILL)		7	SS	20	306								
7															
8	304.2			8	SS	35	304								
	7.6	...rock fragments below													
9				9	SS	92 / 275mm	303								
10							302								

file: 3-22-0008-01 bh logs.gpj



Originated by : CB

Compiled by : GO

Checked by : OB

Drilling Method : Hollow stem augers

50 mm dia. monitoring well installed.

WATER LEVEL READINGS		
<u>Date</u>	<u>Water Depth (m)</u>	<u>Elevation (m)</u>
Feb 17, 2022	8.3	303.5

Project No. : 3-22-0008-01

Client : Brown Bear Dev. Ltd.

Originated by : CB

Date started : February 14, 2022

Project : 901 Essa Road and Brown Bear Street

Compiled by : GO

Sheet No. : 1 of 2

Location : Barrie, Ontario

Checked by : OB

Position : E: 601757, N: 4907589 (UTM 17T)

Elevation Datum : Geodetic

Rig type : Track-mounted

Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Dynamic Cone	Undrained Shear Strength (kPa)	Plastic Limit	Natural Water Content	Liquid Limit			
0	312.4	GROUND SURFACE													
		600mm TOPSOIL		1	SS	0	312								
-1	311.8 0.6	GRAVELLY SAND to SAND, trace silt, compact to very dense, brown, moist to wet		2	SS	27									
							311								
				3	SS	33									
-2															
				4	SS	43	310								
-3															
				5	SS	25	309								
-4															
				6	SS	64	308								
-5															
							307								
-6		...very moist													
				7	SS	37	306								
-7															
							305								
-8		...wet													
				8	SS	51	304								
-9	303.3 9.1	SILTY SAND, trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL)		9	SS	60 / 125mm	303								16 53 22 9
-10															

(continued next page)

Project No. : 3-22-0008-01 Client : Brown Bear Dev. Ltd. Originated by : CB
 Date started : February 14, 2022 Project : 901 Essa Road and Brown Bear Street Compiled by : GO
 Sheet No. : 2 of 2 Location : Barrie, Ontario Checked by : OB

Position : E: 601757, N: 4907589 (UTM 17T) Elevation Datum : Geodetic
 Rig type : Track-mounted Drilling Method : Hollow stem augers

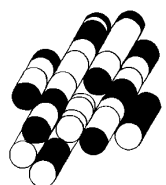
Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)				Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		X Dynamic Cone				Plastic Limit	Natural Water Content	Liquid Limit			
		(continued)						10	20	30	40						
								Undrained Shear Strength (kPa)				MC					
								○ Unconfined + Field Vane ● Pocket Penetrometer ■ Lab Vane				PL					
								40	80	120	160	10	20	30			
11	301.7 10.7	SILTY SAND , trace to some clay, trace silt, trace gravel, very dense, grey, moist (GLACIAL TILL) (continued)					302										
	301.3 11.1	GRAVELLY SAND , very dense, brown, wet		10	SS	69 / 250mm											
12							301										
				11	SS	50 / 100mm	300										
13							299										
14				12	SS	100 / 225mm	298										
15							297										
	296.9 15.5			13	SS	50 / 150mm	297										

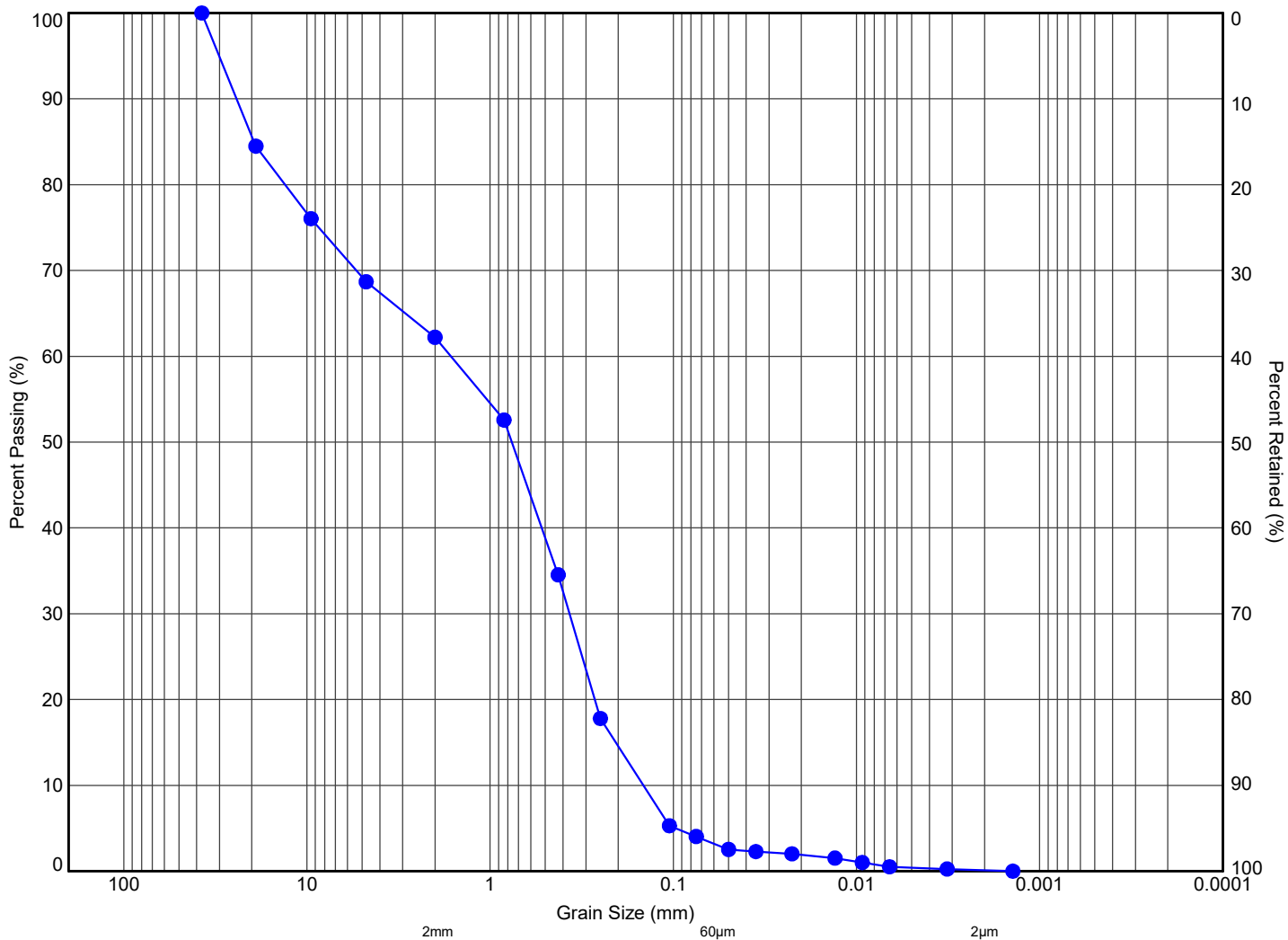
END OF BOREHOLE

Water level and cave not measured upon completion of drilling.

APPENDIX D

TERRAPROBE INC.





MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)
1	SS6	4.8	307.3	38	59	3	0	



11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SAND AND GRAVEL, TRACE SILT**

File No.:

3-22-0008-01

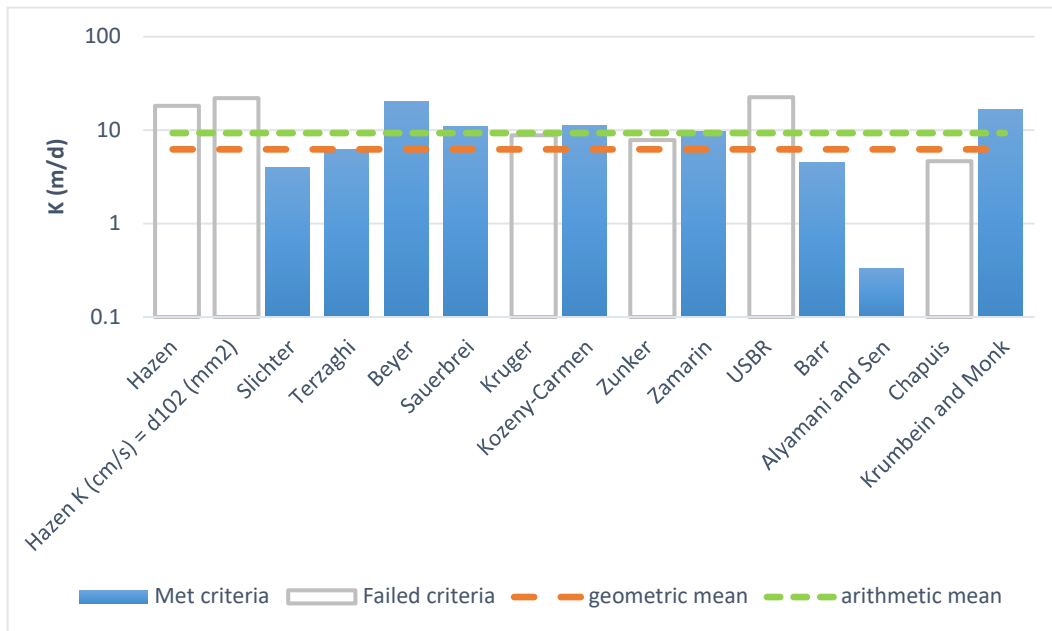


K from Grain Size Analysis Report

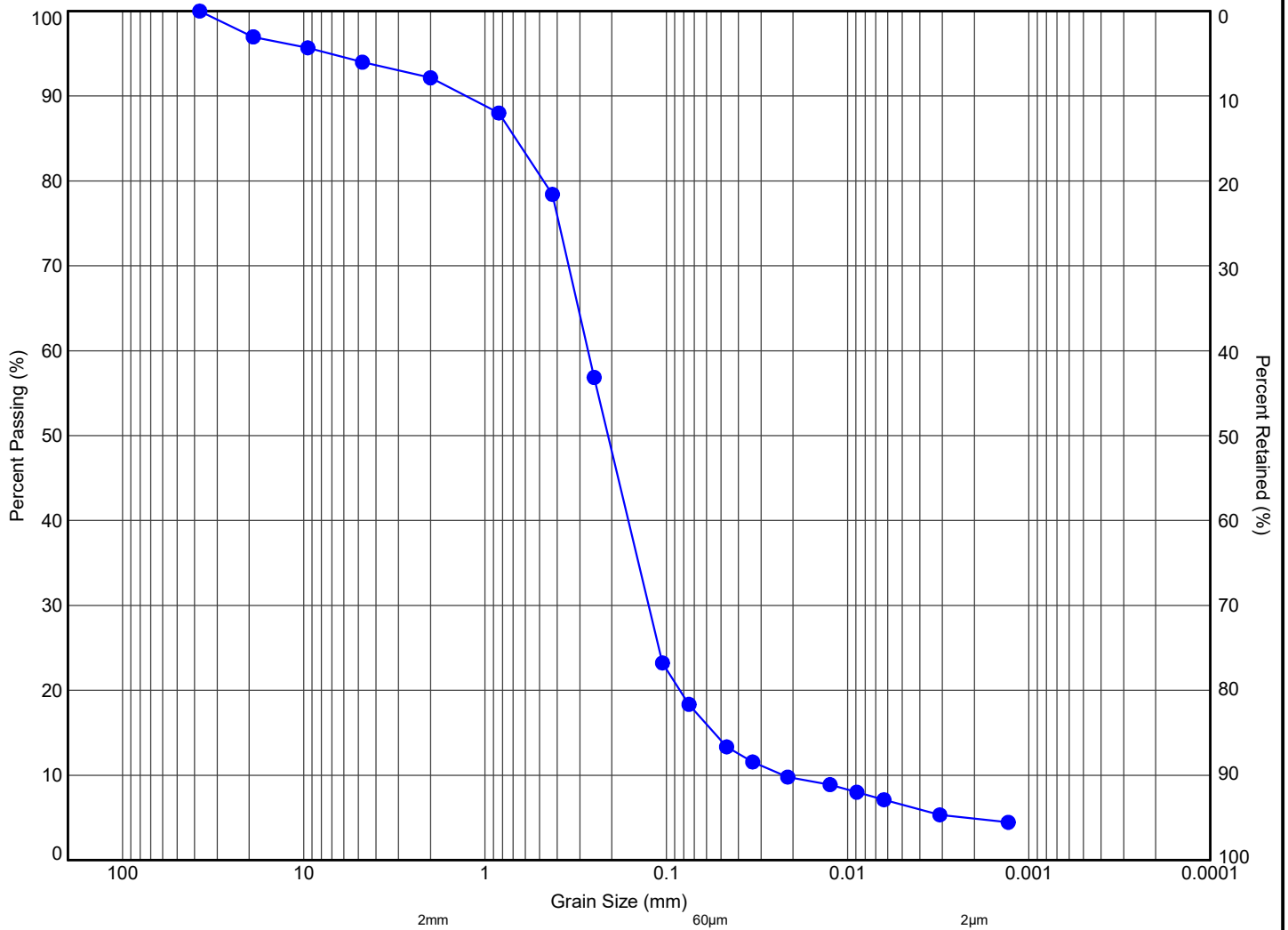
Sample Name: Borehole 1 Sample 6 Elevation (m) 307.3

Mass Sample (g): 384.3 T (°C) 23

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.1E-02	2.1E-04	18.19	
Hazen K (cm/s) = d ₁₀ (mm)	2.5E-02	2.5E-04	22.02	
Slichter	4.6E-03	4.6E-05	3.97	
Terzaghi	7.2E-03	7.2E-05	6.25	
Beyer	2.4E-02	2.4E-04	20.37	
Sauerbrei	1.3E-02	1.3E-04	10.80	
Kruger	1.0E-02	1.0E-04	8.79	
Kozeny-Carmen	1.3E-02	1.3E-04	11.23	
Zunker	9.0E-03	9.0E-05	7.81	
Zamarin	1.1E-02	1.1E-04	9.62	
USBR	2.6E-02	2.6E-04	22.41	
Barr	5.2E-03	5.2E-05	4.50	
Alyamani and Sen	3.8E-04	3.8E-06	0.33	
Chapuis	5.4E-03	5.4E-05	4.64	
Krumbein and Monk	1.9E-02	1.9E-04	16.68	
geometric mean	7.2E-03	7.2E-05	6.25	
arithmetic mean	1.1E-02	1.1E-04	9.31	



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 2	SS10	10.8	301.8	8	76	11	5		



Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SAND, SOME SILT, TRACE GRAVEL, TRACE CLAY**

File No.:

3-22-0008-01

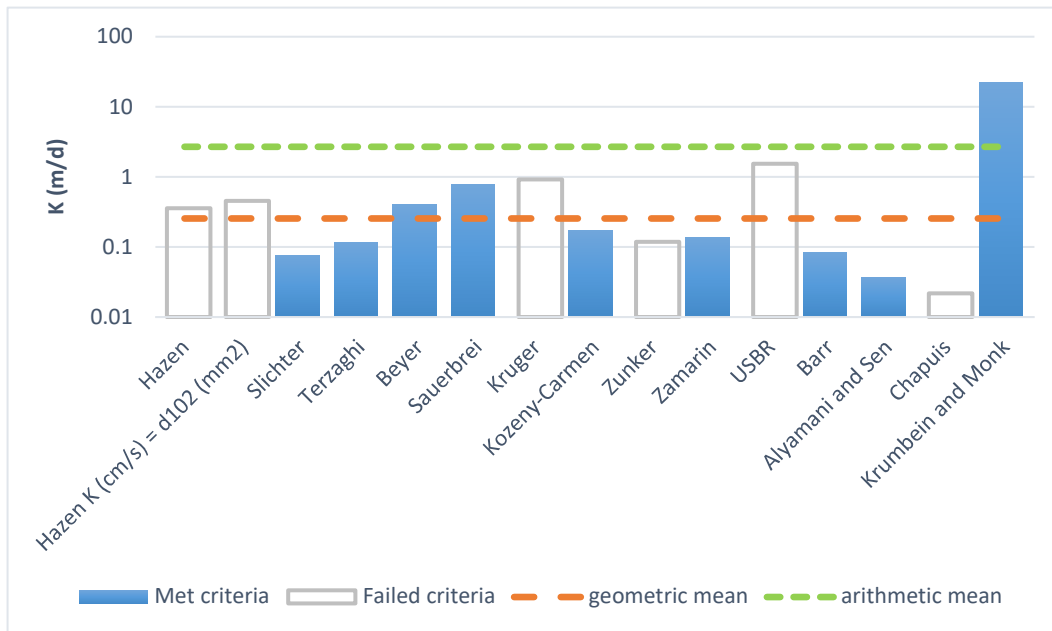


K from Grain Size Analysis Report

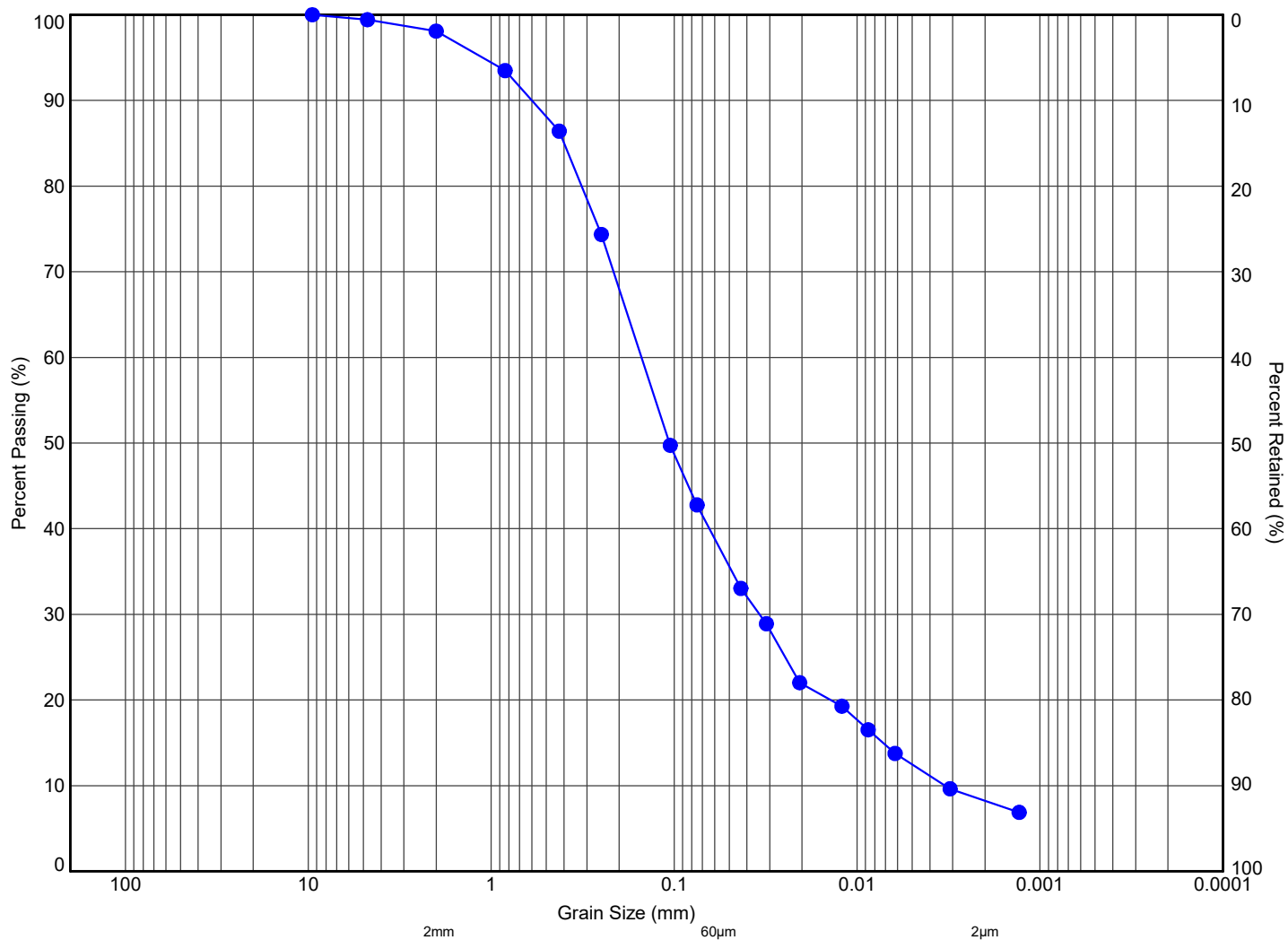
Sample Name: Borehole 2 Sample 10 Elevation (m) 301.8

Mass Sample (g): 406.4 T (°C) 23

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	4.1E-04	4.1E-06	0.35	
Hazen K (cm/s) = d ₁₀ (mm)	5.2E-04	5.2E-06	0.45	
Slichter	8.7E-05	8.7E-07	0.08	
Terzaghi	1.4E-04	1.4E-06	0.12	
Beyer	4.7E-04	4.7E-06	0.41	
Sauerbrei	9.0E-04	9.0E-06	0.77	
Kruger	1.1E-03	1.1E-05	0.92	
Kozeny-Carmen	2.0E-04	2.0E-06	0.17	
Zunker	1.4E-04	1.4E-06	0.12	
Zamarin	1.6E-04	1.6E-06	0.14	
USBR	1.8E-03	1.8E-05	1.54	
Barr	9.8E-05	9.8E-07	0.08	
Alyamani and Sen	4.3E-05	4.3E-07	0.04	
Chapuis	2.5E-05	2.5E-07	0.02	
Krumbein and Monk	2.6E-02	2.6E-04	22.49	
geometric mean	3.0E-04	3.0E-06	0.26	
arithmetic mean	3.1E-03	3.1E-05	2.70	



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 4	SS12	13.8	298.0	2	59	31	8		



11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SILTY SAND, TRACE CLAY, TRACE GRAVEL**

File No.:

3-22-0008-01

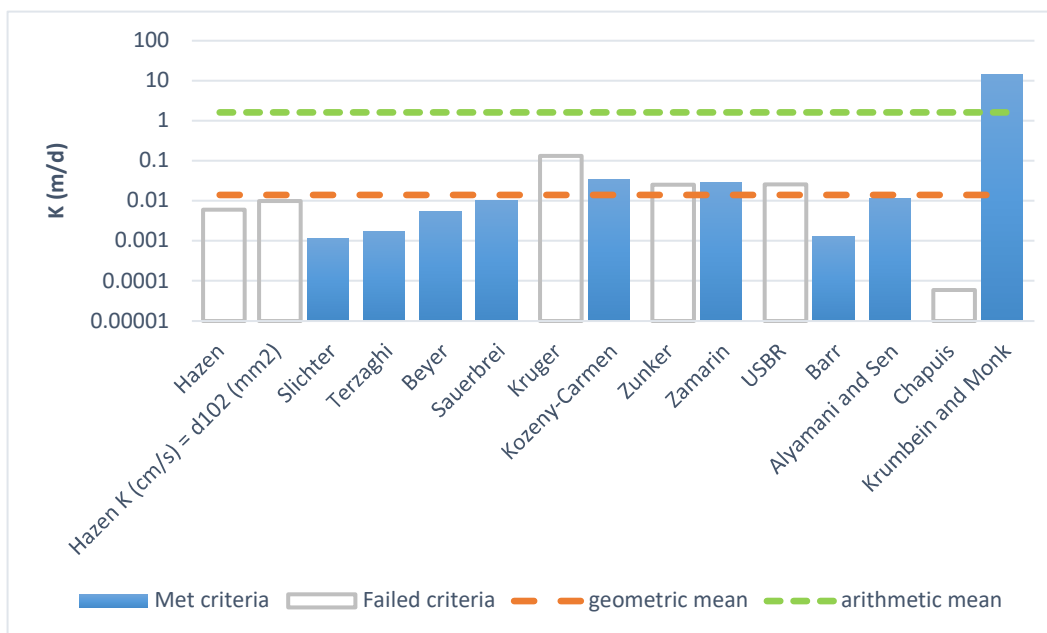


K from Grain Size Analysis Report

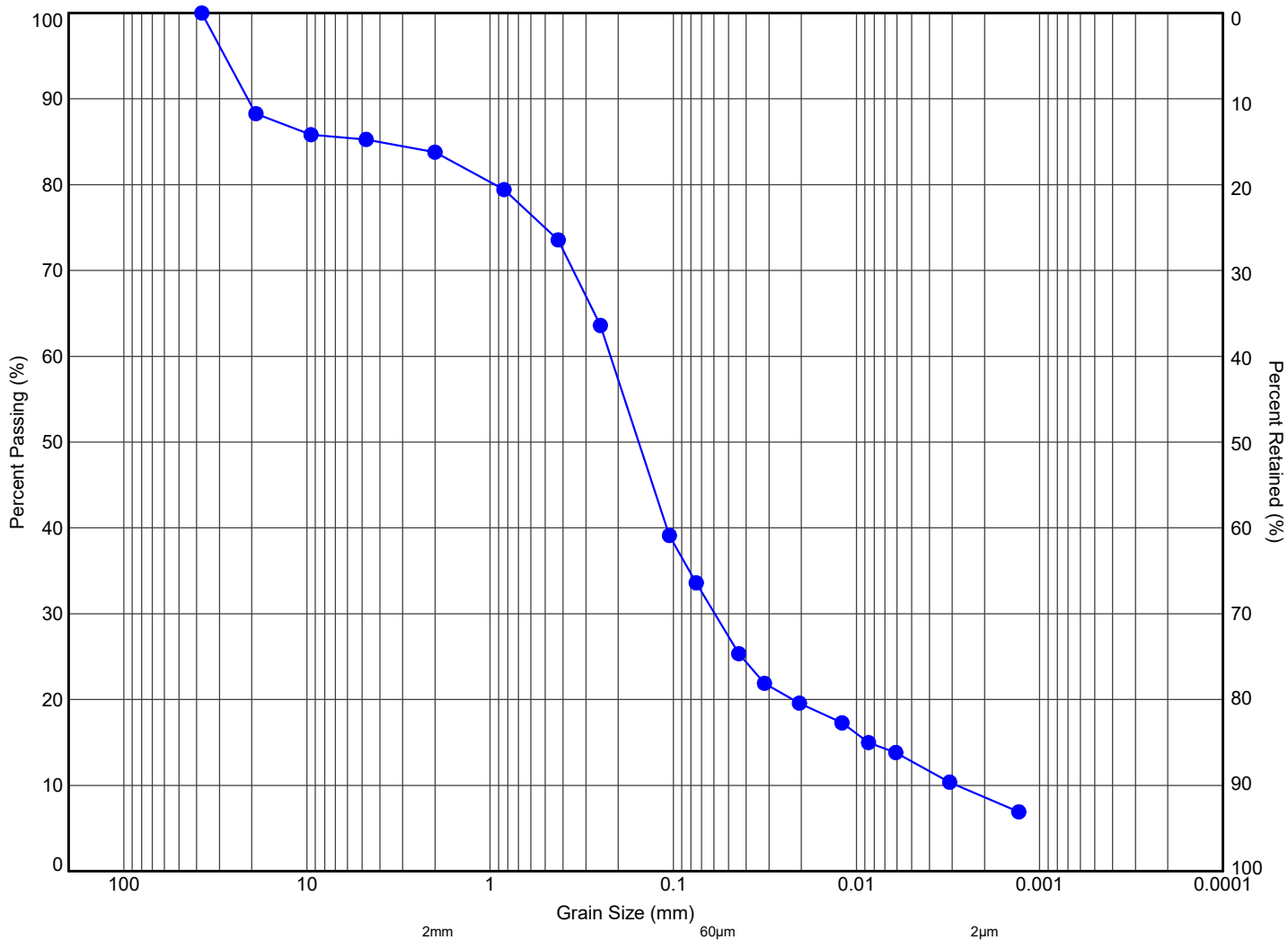
Sample Name: Borehole 4 Sample 12 Elevation (m) 298

Mass Sample (g): 384.6 T (oC) 23

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	7.0E-06	7.0E-08	0.01	
Hazen K (cm/s) = d ₁₀ (mm)	1.1E-05	1.1E-07	0.01	
Slichter	1.4E-06	1.4E-08	0.00	
Terzaghi	2.0E-06	2.0E-08	0.00	
Beyer	6.4E-06	6.4E-08	0.01	
Sauerbrei	1.2E-05	1.2E-07	0.01	
Kruger	1.5E-04	1.5E-06	0.13	
Kozeny-Carmen	3.8E-05	3.8E-07	0.03	
Zunker	2.9E-05	2.9E-07	0.03	
Zamarin	3.4E-05	3.4E-07	0.03	
USBR	3.0E-05	3.0E-07	0.03	
Barr	1.5E-06	1.5E-08	0.00	
Alyamani and Sen	1.4E-05	1.4E-07	0.01	
Chapuis	6.9E-08	6.9E-10	0.00	
Krumbein and Monk	1.7E-02	1.7E-04	14.45	
geometric mean	1.6E-05	1.6E-07	0.01	
arithmetic mean	1.9E-03	1.9E-05	1.62	



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM									
Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	(Fines, %)	
● 5	SS9	9.3	303.1	16	53	22	9		



11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

**GRAIN SIZE DISTRIBUTION
SILTY SAND, SOME GRAVEL, TRACE CLAY**

File No.:

3-22-0008-01

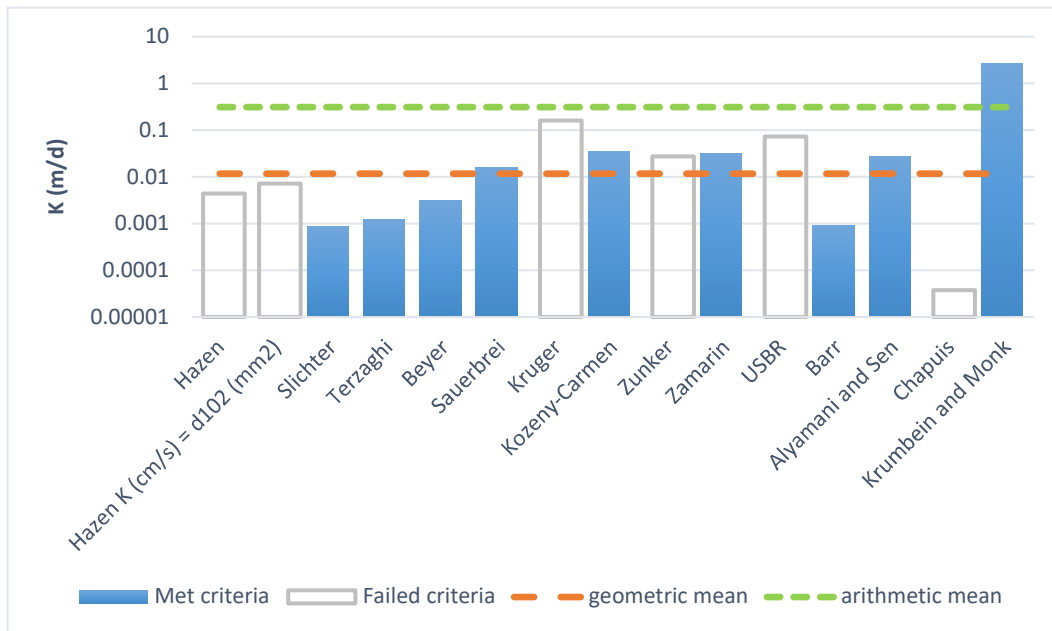


K from Grain Size Analysis Report

Sample Name: Borehole 5 Sample 9 Elevation (m) 303.1

Mass Sample (g): 345.9 T (°C) 23

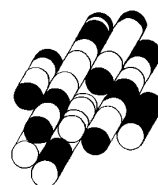
Poorly sorted sand low in fines

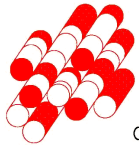


Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.0E-06	5.0E-08	0.00	
Hazen K (cm/s) = d ₁₀ (mm)	8.3E-06	8.3E-08	0.01	
Slichter	9.9E-07	9.9E-09	0.00	
Terzaghi	1.4E-06	1.4E-08	0.00	
Beyer	3.7E-06	3.7E-08	0.00	
Sauerbrei	1.8E-05	1.8E-07	0.02	
Kruger	1.8E-04	1.8E-06	0.16	
Kozeny-Carmen	4.1E-05	4.1E-07	0.04	
Zunker	3.1E-05	3.1E-07	0.03	
Zamarin	3.7E-05	3.7E-07	0.03	
USBR	8.3E-05	8.3E-07	0.07	
Barr	1.1E-06	1.1E-08	0.00	
Alyamani and Sen	3.2E-05	3.2E-07	0.03	
Chapuis	4.4E-08	4.4E-10	0.00	
Krumbein and Monk	3.1E-03	3.1E-05	2.70	
geometric mean	1.4E-05	1.4E-07	0.01	
arithmetic mean	3.6E-04	3.6E-06	0.31	

APPENDIX E

TERRAPROBE INC.





Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

Bail Test Analysis Report

Project: 901 Essa Road and Brown Bear Street

Number: 3-22-0008-46

Client: Brown Bear Dev. Ltd.

Location: Barrie, Ontario

Bail Test: BH 1

Test Well: BH 1

Test Conducted by: CB

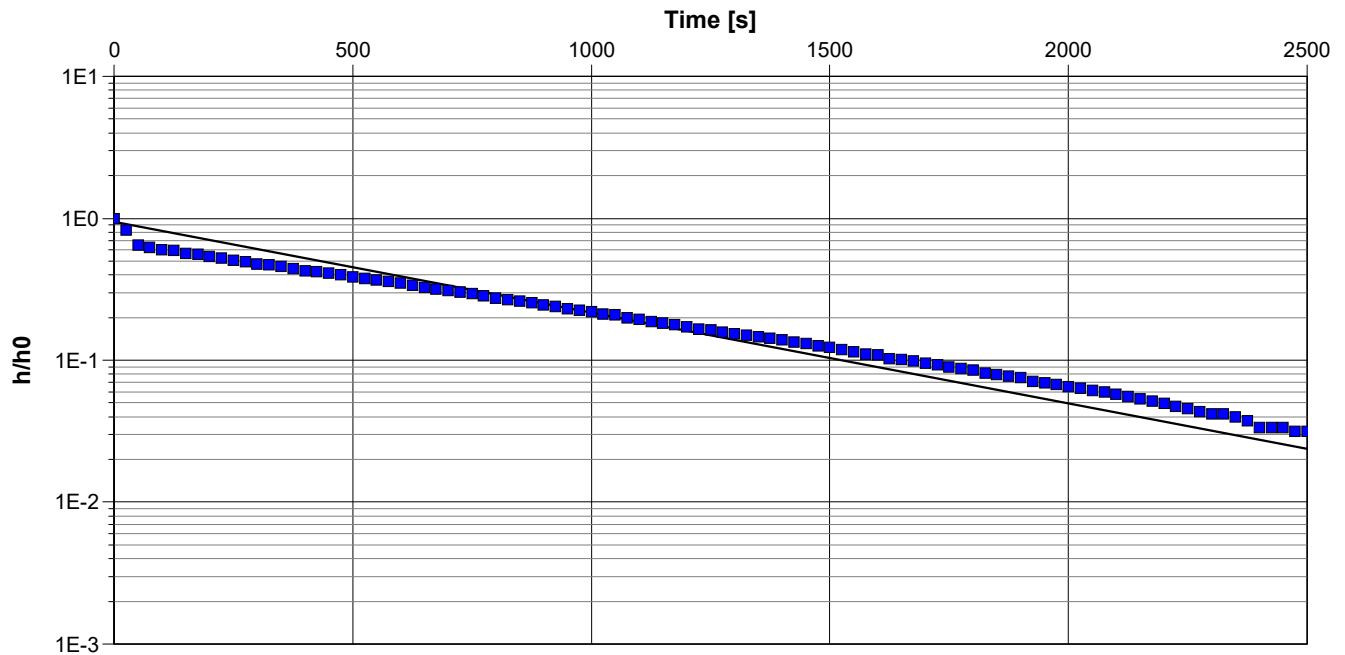
Test Date: 2022-03-18

Analysis Performed by: UA

BH 1

Analysis Date: 2022-03-28

Aquifer Thickness: 7.00 m



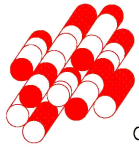
Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH 1

5.91×10^{-7}



Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

Bail Test Analysis Report

Project: 901 Essa Road and Brown Bear Street

Number: 3-22-0008-46

Client: Brown Bear Dev. Ltd.

Location: Barrie, Ontario

Bail Test: BH 2

Test Well: BH 2

Test Conducted by: CB

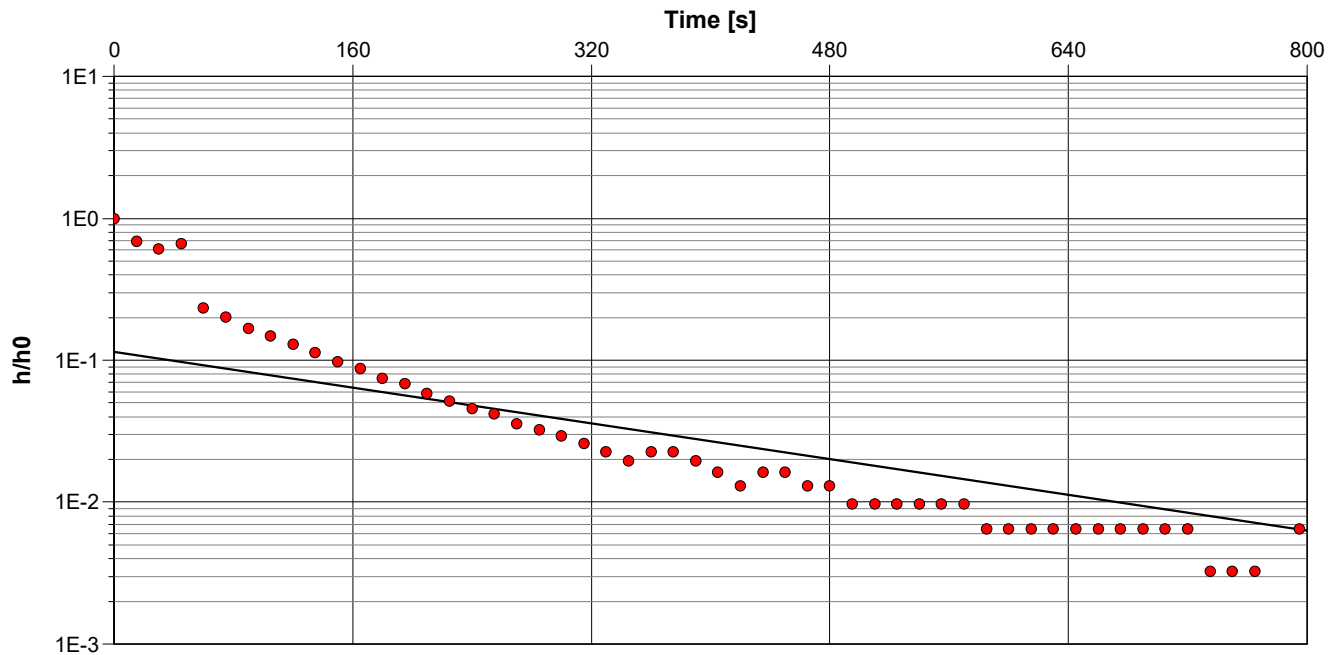
Test Date: 2022-03-18

Analysis Performed by: UA

BH 2

Analysis Date: 2022-03-28

Aquifer Thickness: 7.00 m



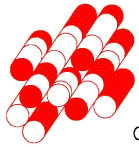
Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH 2

1.44×10^{-6}



Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

Bail Test Analysis Report

Project: 901 Essa Road and Brown Bear Street

Number: 3-22-0008-46

Client: Brown Bear Dev. Ltd.

Location: Barrie, Ontario

Bail Test: BH 3

Test Well: BH 3

Test Conducted by: CB

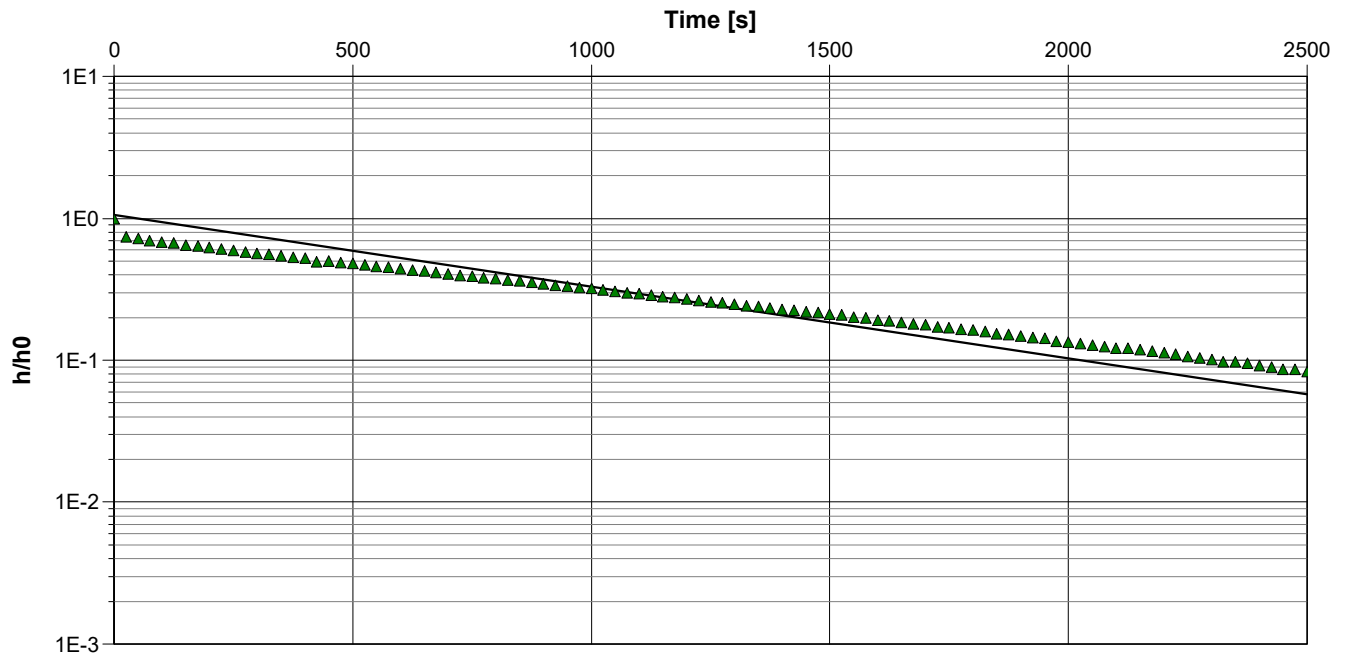
Test Date: 2022-03-14

Analysis Performed by: UA

BH 3

Analysis Date: 2022-03-28

Aquifer Thickness: 7.00 m



Calculation using Bouwer & Rice

Observation Well

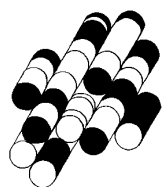
Hydraulic Conductivity
[m/s]

BH 3

4.58×10^{-7}

APPENDIX F

TERRAPROBE INC.



CLIENT NAME: TERRAPROBE INC.
220 BAYVIEW DRIVE, UNIT 25
BARRIE, ON L4N4Y8
(705) 739-8355

ATTENTION TO: Justin Rumney

PROJECT: 3-22-0008-46

AGAT WORK ORDER: 22T867040

TRACE ORGANICS REVIEWED BY: Pinkal Patel, Report Reviewer

WATER ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

DATE REPORTED: Mar 03, 2022

PAGES (INCLUDING COVER): 15

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

VERSION 1: March 03, 2022 excluding precious metals

Disclaimer:

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
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- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Barrie Sanitary - Organics

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

		SAMPLE DESCRIPTION:		BH4
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2022-02-24 10:30
Parameter	Unit	G / S	RDL	3551749
Oil and Grease (animal/vegetable) in water	mg/L	150	0.5	0.70
Oil and Grease (mineral) in water	mg/L	15	0.5	<0.5
Dichloromethane	mg/L	0.09	0.0006	<0.0006
Benzene	mg/L	0.01	0.0004	<0.0004
Trichloroethylene	mg/L	0.05	0.0004	<0.0004
Toluene	mg/L	0.02	0.0004	0.0012
Tetrachloroethene	mg/L	0.06	0.0004	<0.0004
Ethylbenzene	mg/L	0.06	0.0002	<0.0002
1,1,2,2-Tetrachloroethane	mg/L	0.06	0.0002	<0.0002
1,4-Dichlorobenzene	mg/L	0.08	0.0002	<0.0002
1,2-Dichlorobenzene	mg/L	0.05	0.0002	<0.0002
Xylenes (Total)	mg/L	0.3	0.0002	<0.0002
Hexachlorobenzene	mg/L	0.0001	0.00001	<0.00001
Naphthalene	mg/L		0.0003	<0.0003
Acenaphthylene	mg/L		0.00011	<0.00011
Acenaphthene	mg/L		0.00010	<0.00010
Fluorene	mg/L		0.0002	<0.0002
Phenanthrene	mg/L		0.00011	<0.00011
Anthracene	mg/L		0.00007	<0.00007
Fluoranthene	mg/L		0.00012	<0.00012
Pyrene	mg/L		0.00012	<0.00012
Benzo(a)anthracene	mg/L		0.00008	<0.00008
Chrysene	mg/L		0.00005	<0.00005
Benzo(b)fluoranthene	mg/L		0.00003	<0.00003
Benzo(k)fluoranthene	mg/L		0.00006	<0.00006
Benzo(a)pyrene	mg/L		0.001	<0.001
Indeno(1,2,3-cd)pyrene	mg/L		0.00003	<0.00003
Dibenzo(a,h)anthracene	mg/L		0.00009	<0.00009
Benzo(ghi)perylene	mg/L		0.00006	<0.00006

Certified By:

Prakash Patel



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Barrie Sanitary - Organics

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

		SAMPLE DESCRIPTION:		BH4
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2022-02-24 10:30
Parameter	Unit	G / S	RDL	3551749
Total PAHs	mg/L	0.005	0.0003	<0.0003
Surrogate	Unit	Acceptable Limits		
Toluene-d8	% Recovery	50-140	107	
4-Bromofluorobenzene	% Recovery	50-140	98	
TCMX	%	50-140	93	
Acridine-d9	%	50-140	85	
Naphthalene-d8	%	50-140	79	
Terphenyl-d14	%	50-140	88	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Limits for Sanitary Sewer Discharge - The City of Barrie - By-Law No. 2012-172
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3551749 Dilution factor=2
The voc sample was diluted because it was foamy. The reporting detection limit has been corrected for the dilution factor used.
Oil and Grease animal/vegetable is a calculated parameter. The calculated value is the difference between Total O&G and Mineral O&G.
Xylenes total is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

BOD5

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

SAMPLE DESCRIPTION: BH4
SAMPLE TYPE: Water
DATE SAMPLED: 2022-02-24
10:30

Parameter	Unit	G / S: A	G / S: B	RDL	3551749
Biochemical Oxygen Demand, Total	mg/L	15	300	2.00	4.00[<A]

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Limits for Storm Sewer Discharge - The City of Barrie - By-Law No. 2012-172, B Refers to Limits for Sanitary Sewer Discharge - The City of Barrie - By-Law No. 2012-172
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Analysis performed at AGAT Halifax (unless marked by *)

Certified By:



Nivine Basly



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
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CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Barrie Sanitary Sewer Use By-law - Inorganics

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

SAMPLE DESCRIPTION: BH4					
SAMPLE TYPE: Water					
DATE SAMPLED: 2022-02-24 10:30					
Parameter	Unit	G / S: A	G / S: B	RDL	3551749
pH	pH Units	6.0-9.5	6.0-9.5	NA	7.81
Chemical Oxygen Demand	mg/L	600		5	16[<A]
Total Suspended Solids	mg/L	350	15	10	<10[<B]
Total Phosphorus	mg/L	10		0.02	<0.02[<A]
Total Kjeldahl Nitrogen	mg/L	100		0.10	0.62[<A]
Fluoride	mg/L	10		0.13	<0.13[<A]
Chloride	mg/L	1500		1.2	1550[>A]
Sulphate	mg/L	1500		0.95	55.8[<A]
Sulphide	mg/L	1.0		0.01	<0.01[<A]
Phenols	mg/L	0.1		0.002	0.033[<A]
Total Cyanide	mg/L	1.2		0.002	0.005[<A]
Total Aluminum	mg/L	50		0.010	0.310[<A]
Total Antimony	mg/L	5.0		0.020	<0.020[<A]
Total Arsenic	mg/L	1.0		0.015	<0.015[<A]
Total Barium	mg/L	5.0		0.020	0.214[<A]
Total Bismuth	mg/L	5.0		0.010	<0.010[<A]
Total Cadmium	mg/L	0.7	0.001	0.001	<0.001[<B]
Total Chromium	mg/L	2.0	0.08	0.015	<0.015[<B]
Total Cobalt	mg/L	5.0		0.020	<0.020[<A]
Total Copper	mg/L	2.0	0.01	0.010	<0.010[<B]
Total Iron	mg/L	50		0.050	0.370[<A]
Total Lead	mg/L	0.7	0.05	0.010	<0.010[<B]
Total Manganese	mg/L	5.0		0.020	0.289[<A]
Total Mercury	mg/L	0.01		0.0002	<0.0002[<A]
Total Molybdenum	mg/L	5.0		0.020	0.030[<A]
Total Nickel	mg/L	2.0	0.05	0.020	<0.020[<B]
Total Selenium	mg/L	1.0		0.002	0.002[<A]
Total Silver	mg/L	0.4		0.020	<0.020[<A]
Total Tin	mg/L	5.0		0.025	<0.025[<A]

Certified By:



Justin Rumney



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

SAMPLING SITE: 901 Essa Rd, Barrie ON

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Barrie Sanitary Sewer Use By-law - Inorganics

DATE RECEIVED: 2022-02-24

DATE REPORTED: 2022-03-02

SAMPLE DESCRIPTION: BH4
SAMPLE TYPE: Water
DATE SAMPLED: 2022-02-24
10:30
3551749

Parameter	Unit	G / S: A	G / S: B	RDL	
Total Vanadium	mg/L	5.0		0.020	<0.020[<A]
Total Zinc	mg/L	2.0	0.04	0.020	<0.020[<B]

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to Limits for Sanitary Sewer Discharge - The City of Barrie - By-Law No. 2012-172, B Refers to Limits for Storm Sewer Discharge - The City of Barrie - By-Law No. 2012-172

Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3551749 Dilution required, RDL has been increased accordingly.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



Nvine Basly



AGAT Laboratories

Exceedance Summary

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Justin Rumney

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
3551749	BH4	ON Barrie SN	Barrie Sanitary Sewer Use By-law - Inorganics	Chloride	mg/L	1500	1550



Quality Assurance

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Trace Organics Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Barrie Sanitary - Organics															
Oil and Grease (animal/vegetable) in water	3523681		2.11	2.13	NA	< 0.5	95%	70%	130%	108%	70%	130%	106%	70%	130%
Oil and Grease (mineral) in water	3523681		< 0.5	< 0.5	NA	< 0.5	87%	70%	130%	81%	70%	130%	72%	70%	130%
Dichloromethane	3543521		<0.0003	<0.0003	NA	< 0.0003	100%	50%	140%	93%	60%	130%	105%	50%	140%
Benzene	3543521		<0.0002	<0.0002	NA	< 0.0002	79%	50%	140%	75%	60%	130%	75%	50%	140%
Trichloroethylene	3543521		0.0030	0.0026	15.9%	< 0.0002	73%	50%	140%	72%	60%	130%	119%	50%	140%
Toluene	3543521		<0.0002	<0.0002	NA	< 0.0002	73%	50%	140%	89%	60%	130%	74%	50%	140%
Tetrachloroethene	3543521		<0.0002	<0.0002	NA	< 0.0002	76%	50%	140%	99%	60%	130%	75%	50%	140%
Ethylbenzene	3543521		<0.0001	<0.0001	NA	< 0.0001	75%	50%	140%	78%	60%	130%	74%	50%	140%
1,1,2,2-Tetrachloroethane	3543521		<0.0001	<0.0001	NA	< 0.0001	83%	50%	140%	116%	60%	130%	114%	50%	140%
1,4-Dichlorobenzene	3543521		<0.0001	<0.0001	NA	< 0.0001	115%	50%	140%	108%	60%	130%	101%	50%	140%
1,2-Dichlorobenzene	3543521		<0.0001	<0.0001	NA	< 0.0001	116%	50%	140%	103%	60%	130%	96%	50%	140%
Hexachlorobenzene	3525090		< 0.00001	< 0.00001	NA	< 0.00001	94%	50%	140%	102%	50%	140%	91%	50%	140%
Naphthalene	3533006		< 0.0003	< 0.0003	NA	< 0.0003	85%	50%	140%	96%	50%	140%	79%	50%	140%
Acenaphthylene	3533006		< 0.00011	< 0.00011	NA	< 0.00011	76%	50%	140%	84%	50%	140%	82%	50%	140%
Acenaphthene	3533006		< 0.00010	< 0.00010	NA	< 0.00010	82%	50%	140%	72%	50%	140%	84%	50%	140%
Fluorene	3533006		< 0.0002	< 0.0002	NA	< 0.0002	84%	50%	140%	96%	50%	140%	76%	50%	140%
Phenanthrene	3533006		< 0.00011	< 0.00011	NA	< 0.00011	75%	50%	140%	85%	50%	140%	85%	50%	140%
Anthracene	3533006		< 0.00007	< 0.00007	NA	< 0.00007	86%	50%	140%	84%	50%	140%	89%	50%	140%
Fluoranthene	3533006		< 0.00012	< 0.00012	NA	< 0.00012	84%	50%	140%	79%	50%	140%	85%	50%	140%
Pyrene	3533006		< 0.00012	< 0.00012	NA	< 0.00012	79%	50%	140%	85%	50%	140%	84%	50%	140%
Benzo(a)anthracene	3533006		< 0.00008	< 0.00008	NA	< 0.00008	82%	50%	140%	84%	50%	140%	76%	50%	140%
Chrysene	3533006		< 0.00005	< 0.00005	NA	< 0.00005	84%	50%	140%	76%	50%	140%	85%	50%	140%
Benzo(b)fluoranthene	3533006		< 0.00003	< 0.00003	NA	< 0.00003	79%	50%	140%	82%	50%	140%	89%	50%	140%
Benzo(k)fluoranthene	3533006		< 0.00006	< 0.00006	NA	< 0.00006	85%	50%	140%	69%	50%	140%	85%	50%	140%
Benzo(a)pyrene	3533006		< 0.001	< 0.001	NA	< 0.001	84%	50%	140%	85%	50%	140%	84%	50%	140%
Indeno(1,2,3-cd)pyrene	3533006		< 0.00003	< 0.00003	NA	< 0.00003	79%	50%	140%	79%	50%	140%	73%	50%	140%
Dibenzo(a,h)anthracene	3533006		< 0.00009	< 0.00009	NA	< 0.00009	86%	50%	140%	85%	50%	140%	89%	50%	140%
Benzo(ghi)perylene	3533006		< 0.00006	< 0.00006	NA	< 0.00006	85%	50%	140%	84%	50%	140%	85%	50%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

Jim Kal Patel

Quality Assurance

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Water Analysis															
RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Barrie Sanitary Sewer Use By-law - Inorganics

pH	3550559		7.68	7.70	0.3%	NA	102%	90%	110%						
Chemical Oxygen Demand	3551749	3551749	16	16	NA	< 5	97%	90%	110%	100%	90%	110%	94%	70%	130%
Total Suspended Solids	3549578		<10	<10	NA	< 10	98%	80%	120%						
Total Phosphorus	3547318		<0.02	<0.02	NA	< 0.02	96%	70%	130%	101%	80%	120%	98%	70%	130%
Total Kjeldahl Nitrogen	3554776		1.63	1.66	1.8%	< 0.10	99%	70%	130%	104%	80%	120%	90%	70%	130%
Fluoride	3552721		<0.05	<0.05	NA	< 0.05	104%	70%	130%	104%	80%	120%	101%	70%	130%
Chloride	3552721		34.1	33.9	0.6%	< 0.10	93%	70%	130%	105%	80%	120%	106%	70%	130%
Sulphate	3552721		161	160	0.6%	< 0.10	100%	70%	130%	104%	80%	120%	NA	70%	130%
Sulphide	3552639		<0.01	<0.01	NA	< 0.01	101%	90%	110%	100%	90%	110%	100%	80%	120%
Phenols	3552639		<0.002	<0.002	NA	< 0.002	99%	90%	110%	95%	90%	110%	97%	80%	120%
Total Cyanide	3505429		<0.002	<0.002	NA	< 0.002	101%	70%	130%	92%	80%	120%	106%	70%	130%
Total Aluminum	3551749	3551749	0.310	0.311	0.3%	< 0.010	97%	70%	130%	103%	80%	120%	101%	70%	130%
Total Antimony	3551749	3551749	<0.020	<0.020	NA	< 0.020	100%	70%	130%	97%	80%	120%	92%	70%	130%
Total Arsenic	3551749	3551749	<0.015	<0.015	NA	< 0.015	97%	70%	130%	101%	80%	120%	104%	70%	130%
Total Barium	3551749	3551749	0.214	0.220	2.8%	< 0.020	102%	70%	130%	100%	80%	120%	108%	70%	130%
Total Bismuth	3551749	3551749	<0.010	<0.010	NA	< 0.010	91%	70%	130%	101%	80%	120%	80%	70%	130%
Total Cadmium	3551749	3551749	<0.001	<0.001	NA	< 0.001	99%	70%	130%	98%	80%	120%	92%	70%	130%
Total Chromium	3551749	3551749	<0.015	<0.015	NA	< 0.015	100%	70%	130%	101%	80%	120%	101%	70%	130%
Total Cobalt	3551749	3551749	<0.020	<0.020	NA	< 0.020	99%	70%	130%	108%	80%	120%	103%	70%	130%
Total Copper	3551749	3551749	<0.010	<0.010	NA	< 0.010	99%	70%	130%	101%	80%	120%	96%	70%	130%
Total Iron	3551749	3551749	0.370	0.373	0.8%	< 0.050	101%	70%	130%	108%	80%	120%	99%	70%	130%
Total Lead	3551749	3551749	<0.010	<0.010	NA	< 0.010	95%	70%	130%	93%	80%	120%	88%	70%	130%
Total Manganese	3551749	3551749	0.289	0.291	0.7%	< 0.020	101%	70%	130%	107%	80%	120%	103%	70%	130%
Total Mercury	3548601		<0.0002	<0.0002	NA	< 0.0002	98%	70%	130%	101%	80%	120%	93%	70%	130%
Total Molybdenum	3551749	3551749	0.030	0.032	NA	< 0.020	102%	70%	130%	101%	80%	120%	108%	70%	130%
Total Nickel	3551749	3551749	<0.020	<0.020	NA	< 0.020	97%	70%	130%	106%	80%	120%	97%	70%	130%
Total Selenium	3551749	3551749	0.002	0.003	NA	< 0.002	111%	70%	130%	100%	80%	120%	101%	70%	130%
Total Silver	3551749	3551749	<0.020	<0.020	NA	< 0.020	97%	70%	130%	106%	80%	120%	94%	70%	130%
Total Tin	3551749	3551749	<0.025	<0.025	NA	< 0.025	97%	70%	130%	97%	80%	120%	98%	70%	130%
Total Vanadium	3551749	3551749	<0.020	<0.020	NA	< 0.020	97%	70%	130%	104%	80%	120%	107%	70%	130%
Total Zinc	3551749	3551749	<0.020	0.020	NA	< 0.020	97%	70%	130%	99%	80%	120%	88%	70%	130%

Comments: NA signifies Not Applicable.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.

BOD5

Biochemical Oxygen Demand, Total 3548749 <20.0 <20.0 NA < 20.0 102% 70% 130%

Quality Assurance

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

Water Analysis (Continued)

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Comments: If RPD value is NA, the results of the duplicates are less than 5x the RDL and the RPD will not be calculated.

Certified By:



Method Summary

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Oil and Grease (animal/vegetable) in water	VOL-91-5011	EPA SW-846 3510C & SM 5520	BALANCE
Oil and Grease (mineral) in water	VOL-91-5011	EPA SW-846 3510C & SM 5520	BALANCE
Dichloromethane	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Benzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Trichloroethylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Toluene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Tetrachloroethene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Xylenes (Total)	VOL-91-5001	modified from EPA 5030B & EPA 8260D	CALCULATION
Toluene-d8	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Hexachlorobenzene	ORG-91-5112	EPA SW-846 3510C & 8081B	GC/ECD
TCMX	ORG-91-5112	EPA SW-846 3510 & 8081	GC/ECD
Naphthalene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Acenaphthylene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Acenaphthene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Fluorene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Phenanthrene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Anthracene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Fluoranthene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Pyrene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(a)anthracene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Chrysene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(b)fluoranthene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(k)fluoranthene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(a)pyrene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS



Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

ATTENTION TO: Justin Rumney

SAMPLING SITE: 901 Essa Rd, Barrie ON

SAMPLED BY: Cole Burmeister

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Indeno(1,2,3-cd)pyrene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Dibenzo(a,h)anthracene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Benzo(ghi)perylene	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Acridine-d9	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Naphthalene-d8	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Terphenyl-d14	ORG-91-5105	modified from EPA 3510C and EPA 8270E	GC/MS
Total PAHs	ORG-91-5105	modified from EPA 3510C and EPA 8270E	CALCULATION



Method Summary

CLIENT NAME: TERRAPROBE INC.

PROJECT: 3-22-0008-46

SAMPLING SITE: 901 Essa Rd, Barrie ON

AGAT WORK ORDER: 22T867040

ATTENTION TO: Justin Rumney

SAMPLED BY: Cole Burmeister

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Biochemical Oxygen Demand, Total	INOR-121-6023	SM 5210 B	INCUBATOR
pH	INOR-93-6000	modified from SM 4500-H+ B	PC TITRATE
Chemical Oxygen Demand	INOR-93-6042	modified from SM 5220 A and SM 5220 D	SPECTROPHOTOMETER
Total Suspended Solids	INOR-93-6028	modified from EPA 1684, ON MOECC E3139, SM 2540C, D	BALANCE
Total Phosphorus	INOR-93-6022	modified from SM 4500-P B and SM 4500-P E	SPECTROPHOTOMETER
Total Kjeldahl Nitrogen	INOR-93-6048	modified from EPA 351.2 and SM 4500-NORG D	LACHAT FIA
Fluoride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphide	INOR-93-6054	modified from SM 4500 S2- D	SPECTROPHOTOMETER
Phenols	INOR-93-6072	modified from SM 5530 D	LACHAT FIA
Total Cyanide	INOR-93-6051	modified from MOECC E3015; SM 4500-CN- A, B, & C	TECHNICON AUTO ANALYZER
Total Aluminum	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Antimony	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Arsenic	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Barium	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Bismuth	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cadmium	MET -93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Chromium	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cobalt	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Copper	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Iron	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Lead	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Manganese	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Mercury	MET-93-6100	modified from EPA 245.2 and SM 3112 B	CVAAS
Total Molybdenum	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Nickel	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Selenium	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Silver	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Tin	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 22T867040

PROJECT: 3-22-0008-46

ATTENTION TO: Justin Rumney

SAMPLING SITE: 901 Essa Rd, Barrie ON

SAMPLED BY: Cole Burmeister

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Vanadium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Zinc	MET-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Terraprobe
Contact: Justin
Address: 220 Bayview Dr. Unit 25, Barrie, ON, L4N 4Y8
Phone: _____ Fax: _____
Reports to be sent to:
1. Email: jrumney@terraprobe.ca
2. Email: cburmeister@terraprobe.ca

Project Information:

Project: 3-22-0008-46
Site Location: 901 Essa Rd. Barrie, ON
Sampled By: Cole Burmeister
AGAT Quote #: _____ PO: _____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Company: Terraprobe
Contact: Lorena Rossi
Address: 11 Indell Lane, Brampton, ON L6T 3Y3
Email: lrossi@terraprobe.ca
Bill To Same: Yes ☒ No ☐

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04 ☐ Excess Soils R406 ☒ Sewer Use
☐ Ind/Com ☐ Table _____ ☒ Sanitary ☒ Storm
☐ Res/Park ☐ Table _____ ☐ Barrie ☐ Region
☐ Agriculture ☐ Regulation 558 ☐ Prov. Water Quality Objectives (PWQO)
Soil Texture (Check One) ☐ CCME ☐ Other
☐ Coarse ☐ Fine ☐ Indicate One

Is this submission for a Record of Site Condition?

☐ Yes ☐ No

Report Guideline on Certificate of Analysis

☒ Yes ☐ No

Sample Matrix Legend

B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Laboratory Use Only

Work Order #: 22T867040
Cooler Quantity: 1 medium
Arrival Temperatures: 8.1 | 8.3 | 8.4
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: Bagged Ice

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays

For 'Same Day' analysis, please contact your AGAT CPM

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y	Metals	Metals	BTEX, Analyze	PAHs	PCBs	VOC	Landfill TOLP: E	Excess SPLP:	Excess pH, IC	Salt -	PH	Cya	TK	CO	oil	Org	Sulf	Poten
BH4	02/24/22	10:30 AM	22	water	Sewer Set	N				X		X					X	X	X	X	X	X	X	
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		PM																						

Samples Relinquished By (Print Name and Sign):

Cole Burmeister Cole Burmeister

Samples Relinquished By (Print Name and Sign):

Samples Relinquished By (Print Name and Sign):

Date

02/24/22

Date

Date

Time

Time

Time

Samples Received By (Print Name and Sign):

Anthony Dasilva Dasilva

Samples Received By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Date

Date

Date

Time

Time

Time

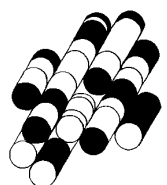
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APPENDIX G

TERRAPROBE INC.



APPENDIX G - Water Balance - 901 Essa Road, Barrie

File No. 3-22-0008-46

1. Climate Information

Precipitation ¹	933 mm/a	0.93 m/a
Actual Evapotranspiration ¹	517 mm/a	0.52 m/a
Precipitation Surplus	416 mm/a	0.42 m/a

2. Infiltration Rates

Table 2 Approach - Infiltration Factors ²		(Pre and Post Development)	
Rolling Land, Fine Sany Loam, Urban Lawns			
Infiltration	270 mm/a	0.270 m/a	
Run-off	146 mm/a	0.146 m/a	

3. Property Statistics

			%
Building Area/Coverage	448 m ²	0.04 ha	5
Hardscape/Impervious	1,919 m ²	0.19 ha	22
Softscape/Landscape (Undeveloped area)	6,494 m ²	0.65 ha	73
TOTAL	8,860.80 m²	0.89 ha	100
Post-Development Coverage			
Building Area/Coverage (Roof Runoff)	3,630 m ²	0.36 ha	41
Hardscape/Impervious (Paved area)	2,725 m ²	0.27 ha	31
Softscape/Landscape	2,507 m ²	0.25 ha	28
TOTAL:	8,860.80 m²	0.89 ha	100

Notes/References:

Water Balance Analysis Method: Thornthwaite and Matther approach

1 Canadian Climate Normals 1981-2010 Station Data for Barrie WPCC Climate Station

2 MOE, June 2003, Stormwater Management Planning and Design Manual

APPENDIX G - Water Balance - 901 Essa Road, Barrie
File No. 3-22-0008-46

4. Annual Water Balance (Pre Development)

Land Use	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Building Area/Coverage	448	418	nil	42	nil	376
Hardscape/Impervious	1,919	1,790	nil	179	nil	1,611
Softscape/Landscape	6,494	6,059	3,357	nil	1,756	946
TOTAL	8,861	8,267	3,357	221	1,756	2,933

6. Annual Water Balance (Post Development)

Land Use	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Building Area/Coverage	3,630	3,386	nil	339	nil	3,048
Hardscape/Impervious	2,725	2,542	nil	254	nil	2,288
Softscape/Landscape	2,507	2,339	1,296	nil	678	365
TOTAL	8,861	8,267	1,296	593	678	5,701

7. Comparison of Pre-Development (before building additions) and Post-Development (after building additions)

	Precipitation (m ³)	Evapotranspiration (m ³)	Evaporation (m ³)	Infiltration (m ³)	Run-Off (m ³)
Pre-Development	8,267	3,357	221	1,756	2,933
Post-Development	8,267	1,296	593	678	5,701
Difference	0	-2,061	372	-1,078	2,768

8. Requirement for Infiltration Maintenance from roof run-off

Volume of roof run-off captured (90%) (roof run-off available in post development) 2,743 m³

Volume of roof run-off required to match pre-development infiltration rates (Infiltration deficit in post development) 1,078 m³

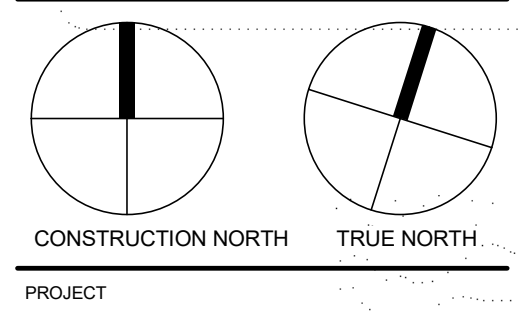
Percentage of roof run-off required to match pre-development infiltration 39%

NO.	ISSUED	DATE
	CLIENT REVIEW	2022-01-12
	CLIENT REVIEW	2022-01-19

DO NOT SCALE DRAWINGS. USE ONLY DRAWINGS MARKED ISSUED FOR CONSTRUCTION. VERIFY CONFIGURATIONS AND DIMENSIONS ON SITE BEFORE BEGINNING WORK. NOTIFY ARCHITECT IMMEDIATELY OF ANY ERRORS, OMISSIONS OR DISCREPANCIES. CHAMBERLAIN ARCHITECT SERVICES LIMITED AND CHAMBERLAIN CONSTRUCTION SERVICES LIMITED HAVE SIMILAR OWNERSHIP. CHAMBERLAIN ARCHITECT SERVICES LIMITED HAS COPYRIGHT. CONSTRUCTING A SUBSTANTIALLY SIMILAR BUILDING WITHOUT PERMISSION MAY INFRINGE THE COPYRIGHT OWNERS RIGHTS. MAKING UNLAWFUL CHANGES TO PLANS AND DOES NOT NECESSARILY AVOID COPYRIGHT INFRINGEMENT. INFRINGEMENT IS NOT A DEFENSE TO COPYRIGHT INFRINGEMENT. ©

CLIENT
SEAL

RESIDENTIAL PARKING
Required Barrier Free Parking Over 100 spaces 1 space plus 3% of required parking spaces
Residential building containing more than 3 dwelling units 1.5 spaces per dwelling unit Met
COMMERCIAL PARKING
4.6.2.3 Parking - Multiple Uses
b) Multiple Uses in Commercial Zones: A minimum of 1 parking space per 24m² of gross floor area shall be required except where residential uses are in combination with another use, in which case the residential use components shall be at the rate identified in Table 4.6 and the additional multiple uses shall be at a rate of 1 parking space per 24m².
4.6.2.5.1 Notwithstanding any provisions to the contrary, structural columns in a parking structure may encroach into a parking space provided that the minimum width of the parking space is not less than 2.5m. Encroachment into the standard parking space width of 2.7m is not permitted where a wall, fence or similar full length obstruction is abutting any parking space. (By-law 2016-003)
COMMERCIAL LOADING SPACES
4.7.1 General Provisions
For any industrial or commercial use, permanent loading spaces shall be provided and maintained on the same lot in accordance with the following provisions:
Gross Floor Area Number of Spaces
1,000m² - 2,499m² 1 space
SMALL CAR PARKING
14.4.3 Parking and Driveway Regulations
Notwithstanding the provisions of Section 4.6.2 a maximum of 10% of the minimum parking spaces required for any non-residential parking may be for small vehicle parking spaces. Additional parking spaces provided over and above the minimum requirements may be for small vehicle parking. The dimension of a small vehicle parking space shall have a width of 2.3m and a length of 4.6m.
BICYCLE PARKING
14.4.2 Bicycle parking spaces shall be provided in accordance with the following:
a) A minimum of 0.2 spaces per unit shall be provided in all apartment units including walk-up apartments.
b) Additional spaces shall be provided for all non-residential uses in the NMMU at a rate of one bicycle parking space for every 7% of required nonresidential vehicular parking spaces in the Neighbourhood Mixed Use zone.
Required 1.5 / unit x 407 unit = 611 parking
1 / 24m² x 1083 m² = 46 parking
Total 657 parking (21 to be barrier free)
Met
Required 0.2 / unit x 405 unit = 81 bicycle parking
46 Parking x 7% = 4 bicycle parking
Total 85 bicycle parking



BROWN BEAR APARTMENTS

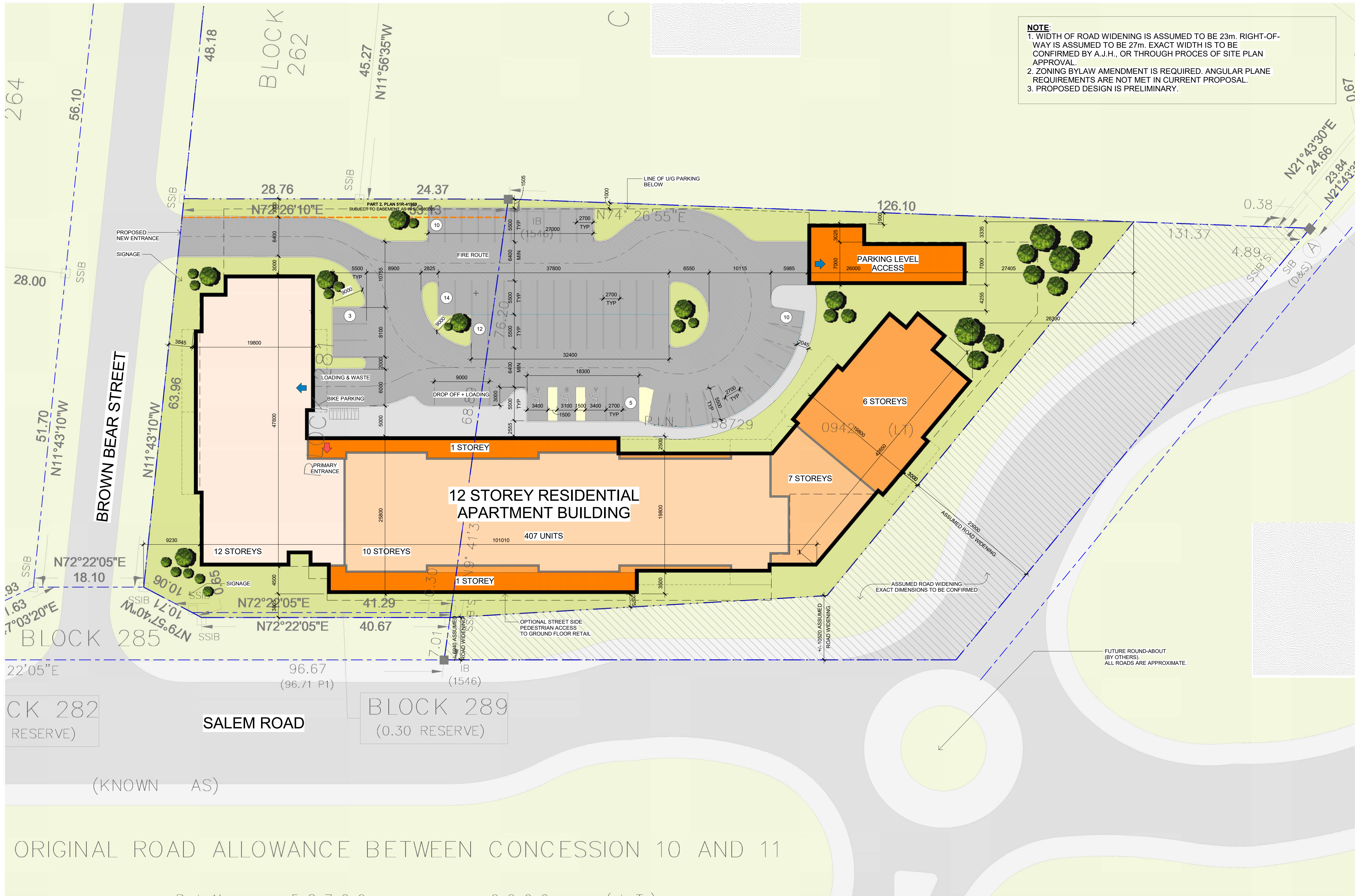
SALEM & ESSA ROAD
BARRIE, ON.

SHEET NAME

SITE PLAN

START DATE JAN. 2022
DRAWN BY MC
CHECKED BY LC
SCALE As indicated
PROJECT NO. 122001
DRAWING

A001



NOTE:
1. WIDTH OF ROAD WIDENING IS ASSUMED TO BE 23m. RIGHT-OF-WAY IS ASSUMED TO BE 27m. EXACT WIDTH IS TO BE CONFIRMED BY A.J.H., OR THROUGH PROCES OF SITE PLAN APPROVAL.
2. ZONING BYLAW AMENDMENT IS REQUIRED. ANGULAR PLANE REQUIREMENTS ARE NOT MET IN CURRENT PROPOSAL.
3. PROPOSED DESIGN IS PRELIMINARY.

1 SITE PLAN A001 1:300

GROSS FLOOR AREA (SUMMARY)			
FLOOR SPACE	AREA (m ²)	AREA (ft ²)	%
COMMERCIAL	1083.3 m ²	11661 ft ²	4%
COMMON	5076.9 m ²	54648 ft ²	17%
RESIDENTIAL - UNITS	24105.1 m ²	259466 ft ²	89%
	30265.4 m ²	325774 ft ²	100%

SUITE MIX (SUMMARY)		
UNIT TYPE	COUNT	%
1 BR	164	40%
1 BR + DEN	179	44%
2 BR	57	14%
3 BR	7	2%
	407	100%

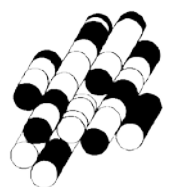
BICYCLE PARKING SCHEDULE		
LEVEL	DESCRIPTION	COUNT
T/O GROUND FLOOR	0.6m x 1.8m	8
T/O PARKING LEVEL 1	0.6m x 1.8m	78
TOTAL PARKING		86

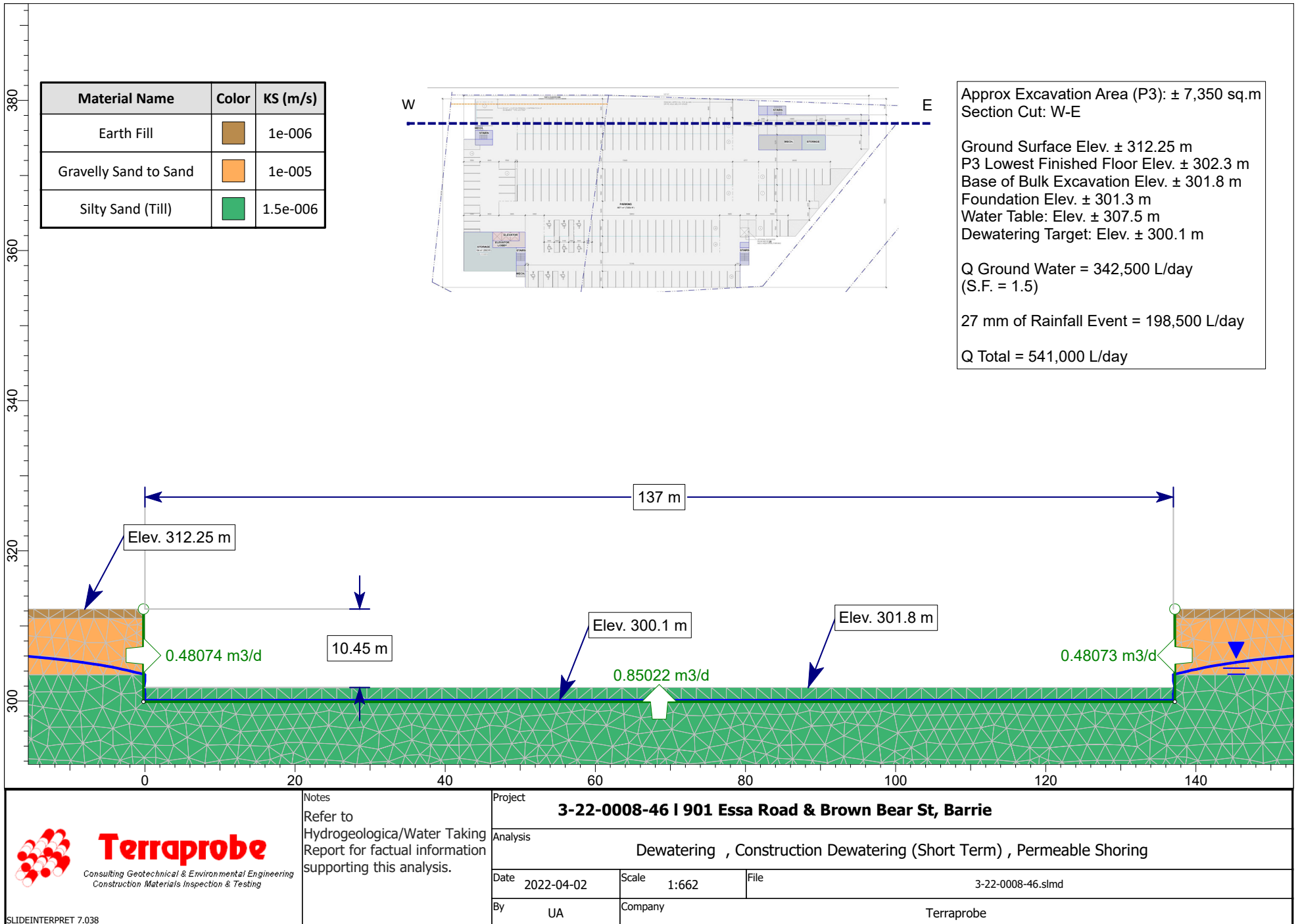
PARKING SCHEDULE		
TYPE	DESCRIPTION	COUNT
T/O GROUND FLOOR		
ACC. PARKING (TYPE A)	3.4m x 5.5m	2
ACC. PARKING (TYPE B)	3.1m x 5.5m	1
LOADING	3.0m x 9.0m	1
TYPICAL PARKING	2.7m x 5.5m	51
		55
T/O PARKING LEVEL 1		
ACC. PARKING (TYPE A)	3.4m x 5.5m	6
ACC. PARKING (TYPE B)	3.1m x 5.5m	3
TYPICAL PARKING	2.7m x 5.5m	200
		209
T/O PARKING LEVEL 2		
ACC. PARKING (TYPE A)	3.4m x 5.5m	6
ACC. PARKING (TYPE B)	3.1m x 5.5m	3
TYPICAL PARKING	2.7m x 5.5m	200
		209
T/O PARKING LEVEL 3		
ACC. PARKING (TYPE A)	3.4m x 5.5m	6
ACC. PARKING (TYPE B)	3.1m x 5.5m	3
TYPICAL PARKING	2.7m x 5.5m	200
		209
TOTAL PARKING		682

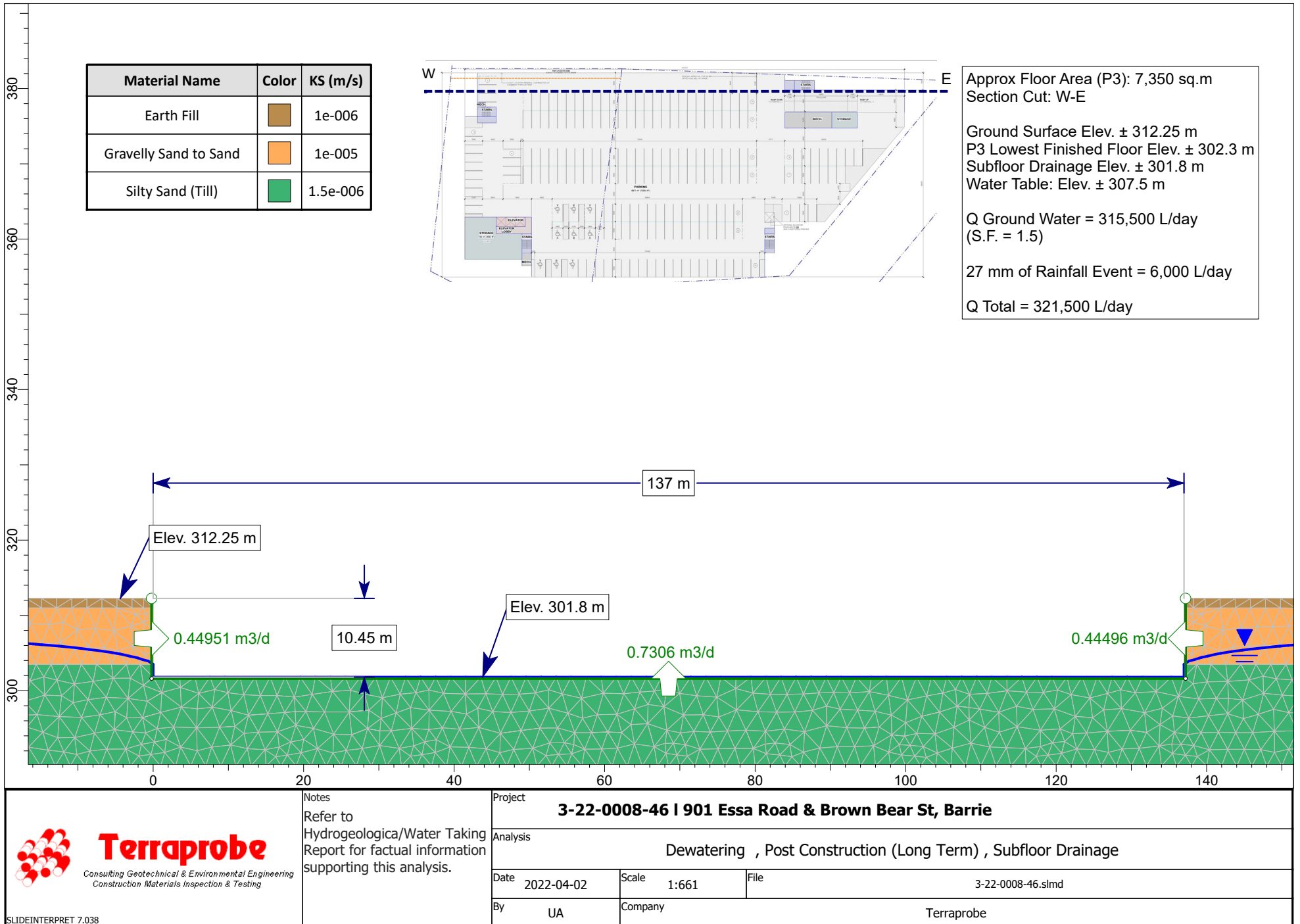
SITE STATISTICS			
DESCRIPTION	AREA (m ²)	AREA (ft ²)	%
BUILDING FOOTPRINT			
BUILDING FOOTPRINT	3629.60 m ²	39069 ft ²	41.0%
	3629.60 m ²	39069 ft ²	41.0%
HARD LANDSCAPE			
ASPHALT	2375.64 m ²	25571 ft ²	26.8%
SIDEWALK	348.94 m ²	3756 ft ²	3.9%
	2724.59 m ²	29327 ft ²	30.7%
SOFT LANDSCAPE			
LANDSCAPE	2506.62 m ²	26981 ft ²	28.3%
	2506.62 m ²	26981 ft ²	28.3%
TOTAL SITE AREA	8860.80 m ²	95377 ft ²	100.0%

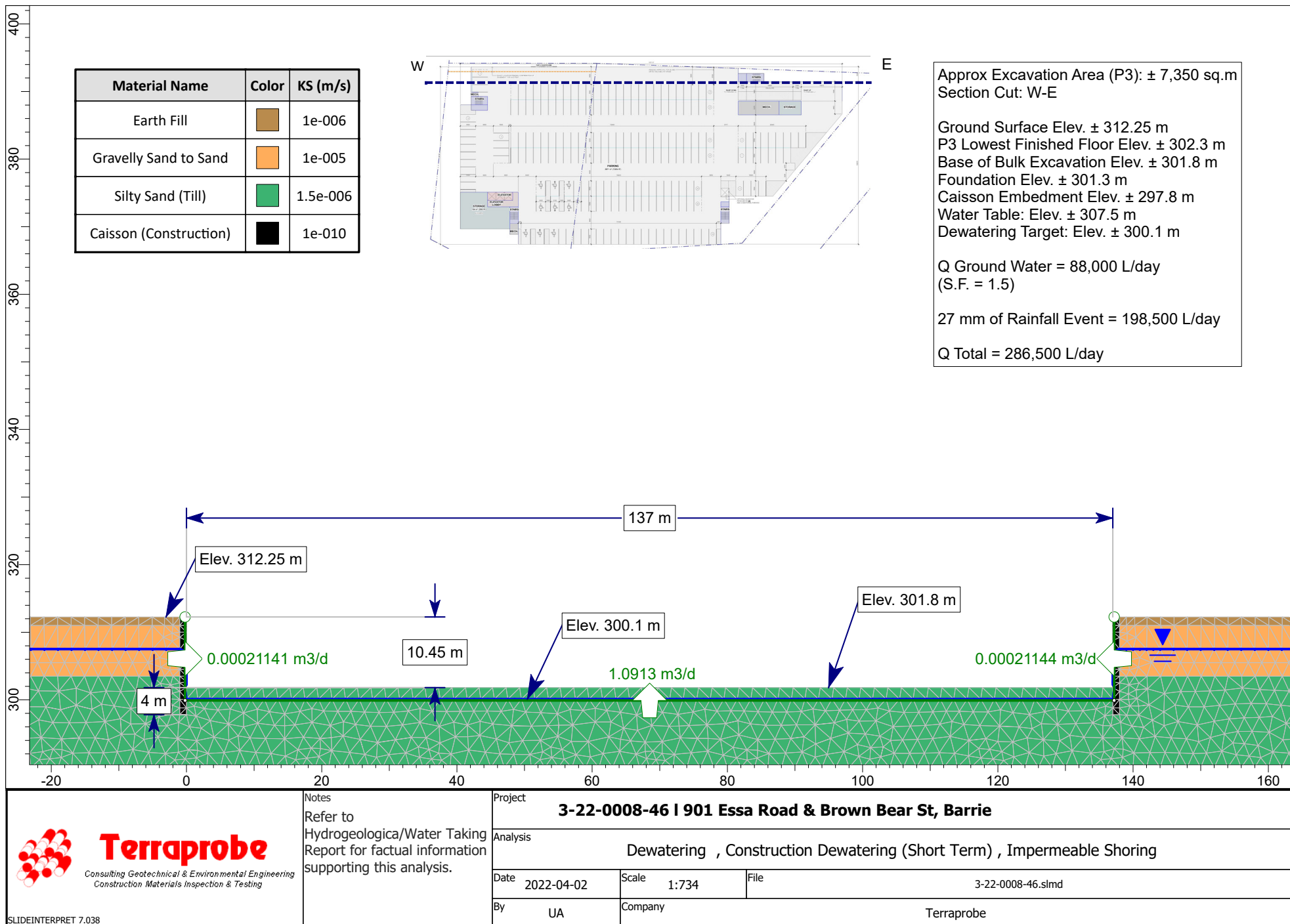
APPENDIX H

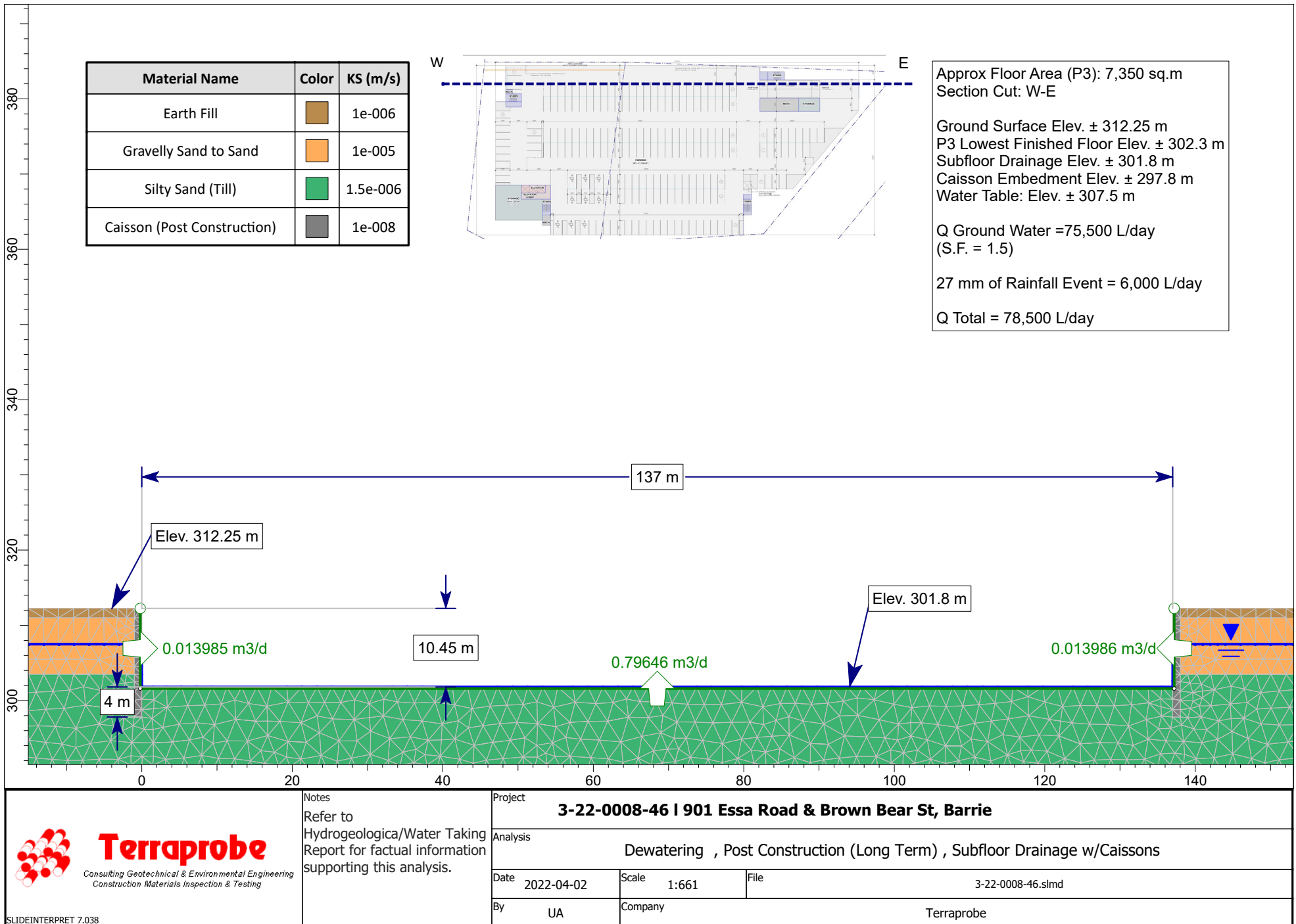
TERRAPROBE INC.











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