



Barrie Holiday Inn Express 326 Bryne Drive

Revised Final Hydrogeological Investigation Report

Project Location:

326 Bryne Drive, Barrie, ON

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1.0 Introduction

MTE Consultants Inc. (MTE) was retained by Mataj Architects Inc. to conduct a Hydrogeological Investigation for a proposed commercial development at municipal address 326 Bryne Drive in Barrie, Ontario (herein referred to as the 'Site'). The Site is currently comprised of three lots with municipal addresses 316, 326, and 336 Bryne Drive in Barrie; however, MTE understands these lots are proposed to be consolidated into one lot under municipal address 326 Bryne Drive. **Figure 1** illustrates the Site location.

MTE understands that the proposed development includes two hotel buildings complete with parking and landscaped areas. In addition, it is understood that the development will be completed in two phases: Phase 1 includes a six-story hotel with 100 guest rooms and Phase 2 includes a six-store hotel with 90 guest rooms. The Hydrogeological Investigation pertains to both the Phase 1 and Phase 2 works as the hydrogeological information provided herein encompasses the entire Site. The Impact Assessment provided herein pertains only to Phase 1 of the development since the design documents for Phase 2 of the development were not available at the time of this report. An additional impact assessment is required once the Phase 2 design is available.

1.1 Scope and Methodology

The objectives of this report are to 1) investigate the suitability of the Site for the proposed development, 2) evaluate potential hydrogeological impacts on groundwater and surface water resources, and 3) address comments provided by the Lake Simcoe Region Conservation Authority (LSRCA) pertaining to the Site. In order to meet these objectives, the following scope of work was implemented:

1) Background Review:

- Site description.
- Neighboring land uses.
- Development Features.
- Ontario Geologic Survey Mapping.
- Ministry of the Environment, Conservation and Parks (MECP) well records.
- Lake Simcoe Region Source Protection Committee Assessment Report and Source Protection Plan.

2) Field Investigation:

- Conduct infiltration testing within the limits of the proposed infiltration gallery.
- Advance test pits to assess the fill material observed at the Site during the geotechnical investigation.
- Collect manual groundwater level measurements to determine groundwater flow direction.
- Install electronic pressure transducers (data loggers) within the existing groundwater monitoring wells to facilitate continuous groundwater level monitoring.
- Field test monitoring wells to determine hydraulic conductivity and average linear groundwater velocity.

- Collect groundwater quality samples to document pre-construction conditions.
- 3) Analysis and Reporting:
- Summarize geology and hydrogeology.
 - Preparation of geological cross-sections through the Site.
 - Assess potential hydrogeological impacts from the proposed development on the Site.
 - Assess shallow groundwater system properties:
 - Horizontal hydraulic gradient;
 - Average linear groundwater velocity; and
 - Shallow groundwater flow patterns.

This report should be read in conjunction with the following reports which have also been completed for the Site:

- Report on Geotechnical Investigation, 326, 326 and 335 Bryne Drive, Barrie, Ontario, prepared for Meridian Credit Union by Toronto Investigation Ltd., dated March 8, 2019.
- Holiday Inn Express Stormwater Management Report prepared for 2599974 Ontario Inc. by MTE Consultants Inc., dated December 12, 2019.

2.0 Site Description

The Site comprises an area of approximately 1.6 hectares (3.9 acres) and is located approximately 260 m northeast of the Bryne Drive and Caplan Avenue intersection. The Study Area, defined as lands within 500 m of the Site Boundary, is illustrated on **Figure 2**. Existing Features are illustrated on **Figure 3**.

The Site is currently vacant with no buildings present. The ground surface is generally grass-covered with some bare patches. Some piles of brush and concrete were observed at the Site during completion of the field activities.

Schedule A of the City of Barrie Official Plan identifies the Site as within a 'General Industrial' area. There are no surface water features within, or transecting, the Site.

2.1 Adjacent Land Use

The Site is bounded by Bryne Drive to the south and east with mixed industrial and commercial properties present beyond. A commercial property is present to the west and vacant grassed and wooded areas are present to the north. Lover's Creek is present approximately 58 m northwest and 122 m north of the Site.

The area immediately north of the Site is designated a Level 3 Natural Heritage Resource, as shown on Schedule H of the City of Barrie Official Plan. The Official Plan defines a Level 3 Natural Heritage Resource as "significant and supporting components of the Natural Heritage Resource network within the City".

2.2 Topography and Drainage

The ground surface at the Site is generally flat with elevations typically ranging between 302.3 to 303.9 meters above mean sea level (mamsl) across the Site, sloping downwards towards the north. Surface water runoff therefore drains to the north across the Site towards the adjacent green space and Lover's Creek tributary.

The Site is located within the Lover's Creek Subwatershed. Lover's Creek drains directly into Lake Simcoe.

2.3 Development Design

The Design Documents for Phase 1 of the proposed development are provided in **Appendix A**.

Municipal Servicing

It is understood the at the proposed development will be serviced via municipal water, sanitary sewers, and storm sewers which are anticipated to be installed to conventional depths. Refer to Drawing No. C2.2 (Site Servicing Plan) for additional details pertaining to the Site servicing.

Stormwater Management (SWM)

The proposed post development stormwater management methods at the Site, as outlined in the SWM report completed for the Site, include the following:

- Infiltration of rooftop drainage via an infiltration gallery located in the south portion of the Site;
- Passive infiltration in pervious areas of the Site; and
- Conveyance of runoff from the parking lot to the municipal storm sewer system.

Refer to the SWM report, completed under separate cover, for additional details pertaining to the post-development SWM strategy for the Site.

3.0 Field Program

3.1 Borehole Advancement and Monitoring Well Construction

A geotechnical investigation was completed for the Site by Toronto Inspection Inc. in March 2019. The geotechnical investigation included advancing 15 boreholes to depths ranging between 6.4 to 9.8 meters below ground surface (mbgs). Three of these boreholes were completed as groundwater monitoring wells.

The overburden sediments reportedly encountered at the Site were described to consist of topsoil and fill (silty sand to sand) underlain by native silty sand, sandy silt and sand deposits. Bedrock was not encountered in any of the boreholes advanced at the Site. It is the opinion of the geotechnical consultant that the fill material observed at the Site represents material "disturbed during the farming process" and is not material that has been brought to the Site from an off-site source.

The monitoring wells at the Site were surveyed by MTE to a geodetic benchmark. Borehole and monitoring well locations are illustrated on **Figure 3**. Borehole logs are included in the geotechnical report, provided in **Attachment B**.

Representative samples of the native sand deposit were collected at borehole locations BH-2 (0.9 mbgs) and BH-7 (1.5 mbgs). The grain size distribution curves provided in the geotechnical report indicate the samples consisted of coarse- to medium-grained sand.

3.2 Test Pits

A total of six test pits were advanced at the Site as part of the hydrogeological investigation to assess shallow overburden sediments at the Site, in particular the presence or absence of perched water in the fill or native deposits within the Site. The locations of the test pits are illustrated on **Figure 3**. Test pit logs are provided in **Appendix C**.

At the time of the test pitting activities, perched water was not observed to be present in the fill or native deposits at the Site.

3.3 Water Well Record Search

Private Wells

Hydrogeological data related to 11 private supply wells within 500 m of the Site were obtained from water well records on file with the MECP. The final status of these 11 wells were as follows:

- Six wells were listed as being industrial, livestock or domestic water supply wells;
- One well was listed as a monitoring and test hole; and
- Four wells were listed as “abandoned”.

Municipal Supply Well

The closest municipal well is located approximately 3.9 km northwest of the Site, labelled Well-19 in Chapter 8 (City of Barrie) of the Lake Simcoe and Couchiching River SPA Part 1 Assessment Report.

3.4 Groundwater Levels

The three monitoring wells installed during the geotechnical investigation were used to characterize the aquifer properties beneath the Site. Manual groundwater levels were collected from these monitoring wells to allow for shallow groundwater flow direction interpretations. In addition, data loggers were installed in each of these monitoring wells. Data loggers measure the pressure of water (in cm) above the logger, which can then be compensated for atmospheric pressure to determine a water level. The data loggers were set to record a measurement every hour and were installed at the Site on March 18, 2020. The continuous groundwater level information collected by the data loggers allows for an assessment of seasonal groundwater trends and responses to precipitation events.

MTE collected Site-wide groundwater level measurements on March 18 and May 12, 2020. Manually measured groundwater levels and elevations within the monitoring wells are presented in **Table 1**. Hydrographs illustrating continuous groundwater elevations within the monitoring wells at the Site are provided in **Appendix D**.

Groundwater elevations measured by the data loggers were observed to range between 299.46 mamsl (BH-15) and 300.34 mamsl (BH-1) during the monitoring period, with the highest fluctuation measured at BH-1 of 0.27 m. Total daily precipitation data (in mm) is also shown on the hydrographs which was provided from the weather station located at the Barrie Landfill, located approximately 6 km from the Site. As shown, groundwater levels at the Site do not appear to fluctuate in response to precipitation events based on the information collected to date.

3.5 Monitoring Well Development and Groundwater Sampling

The existing monitoring wells were developed using Waterra™ Surge Blocks to remove any accumulated sediments from the bottom of the well and to remove fine materials from the well screen and sand pack. Monitoring well development was deemed complete once a minimum of three well volumes of water was removed, and the water was observed to be clear.

MTE collected groundwater samples from all three monitoring wells on March 18, 2020. Prior to sample collection, MTE measured various parameters (e.g. temperature, specific conductivity, pH, dissolved oxygen, and turbidity) with a Horiba meter and flow-through cell. Sampling commenced once it was observed that these parameters had stabilized.

The samples were placed in laboratory supplied sample containers and transported on ice to ALS Laboratories in Waterloo, Ontario. Standard QA/QC protocols were followed as outlined by MECP guidance documents.

3.6 Hydraulic Conductivity (K) Testing

Qualitatively, hydraulic conductivity (K) is a parameter describing the ease with which groundwater flows through a porous medium. Relatively large K values are attributed to permeable units, i.e. sand and gravel, while small values are attributed to less permeable material, i.e. silt or clay. Representative values for hydraulic conductivity for various soil types are presented in Freeze and Cherry (1979).

MTE conducted single well hydraulic response tests on the three on-Site monitoring wells in March 2020. A recovery test (i.e. rising head test) was selected as the testing method due to the water column being located within the well screens. Recovery testing included purging the well dry, after development with a surge block, and using a data logger to record the pressure (in centimeters of water) above the logger during recovery. This pressure was then compensated for atmospheric pressure to calculate a water level and elevation. The data logger was programmed to record a reading every 0.5 seconds to adequately capture the well recovery.

Prior to analysis, recovery data was normalized to compare coincidence between tests. Coincidence between tests suggests assumptions underlying conventional analysis methods can be considered valid (Butler et. al., 2003). A single representative test from the each well was selected and analyzed using the Hvorslev method (Fetter, 2001) as research has shown that the Hvorslev method produces hydraulic conductivity values larger than the Bouwer & Rice method and are therefore considered to better represent the true hydraulic conductivity (closer to a pump test value) (Ismael, 2016).

4.0 Regional Geology and Hydrogeology

4.1 Physiography

The Site is located within the physiographic region known as the Peterborough Drumlin Field, which comprises an area of approximately 4,500 km². The region extends from Hastings County in the east to Simcoe County in the west and includes the drumlins south of the Oak Ridges Moraine in Northumberland County (Chapman and Putnam, 1984). This region is also characterized by various eskers (gravel ridges) and deep valleys leading northward (Chapman and Putnam, 1984). **Figure 4** illustrates the Site is located within a Drumlinized Till Plain physiographic landform.

4.2 Quaternary Geology

Quaternary geology mapping (**Figure 5**) illustrates the Site is located within a glaciofluvial ice-contact stratified deposit comprised of fine- to very coarse-grained sand, gravelly sand and gravel, with minor amounts of silt, clay, and flow tills. This material is characterized as having a high permeability.

4.3 Groundwater Discharge

The Barrie Creeks, Lover's Creek, and Hewitt's Creek Subwatershed Plan (SWP, 2012) describes the relationship between shallow groundwater in the vicinity of the Site to nearby Lover's Creek. Relevant points concerning the portion of Lover's Creek closest to the Site are:

- The creek functions as the headwaters of a tributary that discharges to the main branch of Lover's Creek approximately 3.2 km downstream.
- Baseflow measurement indicate that the creek is dry or had flows too low to measure (SWP, Figure 4-9)
- The Tier 2 Water Budget and Water Quantity Stress Assessment reported the creek to contain both gaining and losing reaches (SWP, Figure 4-10). The model used to create Figure 4-10 is described in the SWP as not representing the extreme upper reaches of the stream as well as the downstream reaches.
- An identification of discharge areas based on shallow water levels (SWP, Figure 4-11) does not include the creek.
- The creek is not identified as an ecologically sensitive recharge area (SWP, Figure 4-15). "Ecologically Significant Groundwater Recharge Areas (ESGRAs) are identified as areas of land that are responsible for supporting groundwater systems that sustain sensitive features like coldwater streams and wetlands." (SWP, page 161)
- Both field work conducted historically and as part of the SWP (SWP, Figure 5-2); and MNR mapping (SWP, Figure 5-13) indicate that the creek is a cool-water feature.

From this information, MTE concludes that while the tributary of Lover's Creek located near the Site may receive some contribution from groundwater, it is not dependent on this contribution and is not a significant groundwater discharge feature.

4.4 Paleozoic Bedrock Geology

Paleozoic geology mapping (**Figure 6**) illustrates the Site is located within the Lindsay Formation of Ordovician age. The Lindsay formation is characterized as fine- to coarse-grained fossiliferous, commonly nodular, argillaceous limestone (Burt and Dodge, 2011).

Bedrock was reportedly not encountered during the drilling program completed during the geotechnical investigation. According to drift thickness mapping provided by the Ministry of Northern Development and Mines, the depth to bedrock in the vicinity of the Site is approximately 250 mbgs.

5.0 Local Hydrogeological Setting

Boreholes and monitoring wells installed by Toronto Inspection Inc. were used to interpret local hydrostratigraphic units and generate two local geological cross-sections. The geological cross-sections (Cross-section A-A' and Cross-section B-B') are presented on **Figures 7 and 8**, their locations are shown on Figure 3.

Geological Cross-Section A-A' (Figure 7):

- Extends approximately 155.6 m from west to east through the Site;
- Illustrates generally flat to gently undulating topography;
- Illustrates the shallow subsurface to generally be comprised of topsoil overlying fill comprised of silty sand to sand, underlain by native coarse-grained sediments (sand);
- Illustrates the fill unit to be present across the majority of the Site to a maximum depth of approximately 1.4 mbgs; and
- Illustrates the groundwater table at the Site ranges between approximately 300.4 to 299.5 mamsl.

Geological Cross-Section B-B' (Figure 8):

- Extends approximately 253.6 m from north to south through the Site and the area immediately north of the Site;
- Illustrates topography generally slopes downwards, towards Lover's Creek located approximately 140 m north of the Site;
- Illustrates the shallow subsurface to generally be comprised of topsoil overlying fill comprised of silty sand to sand, underlain by native coarse-grained sediments (sand);
- Illustrates the fill unit to be present across the majority of the Site to a maximum depth of approximately 1.5 mbgs; and
- Illustrates the groundwater table at the Site ranges between 299.6 to 300.2 mamsl, indicating a potential connection to Lover's Creek.

5.1 Hydraulic Conductivity

Based on the results of the in-situ hydraulic response tests, hydraulic conductivity values were calculated to range from 1.2×10^{-5} m/sec (1.0 m/day) to 3.2×10^{-5} m/sec (2.8 m/day) with a geometric mean of 2.2×10^{-5} m/sec (1.9 m/day), which is consistent with average published values for sand (Freeze and Cherry, 1979). **Table 5.1** summarizes the K-value estimates for each analyzed data set. A summary of the analyses carried out in AquiferTest© Pro are provided in **Appendix E**.

Table 5.1: Summary of Hydraulic Conductivity Estimates

Well ID	Estimated Hydraulic Conductivity (m/sec)
BH-1	1.2×10^{-5}
BH-13	3.2×10^{-5}
BH-15	2.6×10^{-6}
Geometric Mean	2.2×10^{-5}

5.2 Groundwater Flow and Average Linear Groundwater Velocity

Groundwater flow mapping was conducted for the Site using the May 12, 2020, groundwater elevation data. Shallow groundwater contours and flow patterns are illustrated in **Figure 9**. The shallow groundwater flow direction is inferred to be northeasterly. The horizontal hydraulic gradient, based on the May 12, 2020, groundwater elevations, was calculated to be 0.008 m/m.

The average linear groundwater velocity can be calculated using Darcy's Law, as follows:

$$q = (-Ki)/n_e$$

Where:

q = groundwater flux ($\text{m}^3/\text{m}^2/\text{time}$)

K = hydraulic conductivity (2.2×10^{-5} m/s (geometric mean))

i = horizontal hydraulic gradient (0.008 m/m)

n_e = effective soil porosity (0.3 typical for sand, Freeze and Cherry, 1979)

Using the above values, the average linear groundwater velocity at the Site is estimated to be approximately 18.5 m/year (5.9×10^{-7} m/sec).

5.3 On-Site Infiltration

5.3.1 Seasonal Groundwater High Determination

Monitoring well location BH-13 was used to determine the seasonal high groundwater elevation at the proposed infiltration trench. As shown on **Figure 3**, BH-13 is located approximately 16 m hydraulically up-gradient from the proposed infiltration trench.

The continuous groundwater level data collected at BH-13 (provided in the appended hydrographs) shows the highest groundwater elevation measured to date at BH-13 is 300.30 mamsl. In addition, a review of the hydrographs for monitoring well locations BH-1 and BH-15 indicate that the seasonal groundwater high may have occurred prior to the commencement of the continuous water level monitoring. Therefore, in determining the seasonal groundwater elevation high for design purposes, an additional 0.50 m was added to the maximum recorded groundwater elevation measured to date at monitoring well location BH-13.

The addition of 0.50 m is considered conservative as it is anticipated that the maximum groundwater elevation would not exceed the maximum elevation measured to date in excess of 0.50 m, and includes a factor of safety to account for the limited monitoring period (less than 1 year). Therefore, the seasonal high groundwater elevation at BH-13 was estimated to be 300.80 mamsl.

5.3.2 Infiltration Testing

MTE completed test pit and in-situ infiltration testing at the Site on May 12, 2020. One test pit (TP101-20) was advanced at the Site for infiltration testing purposes using a 420 backhoe, operated by John Eek & Son Ltd., which was observed by MTE. The test pit location is illustrated on **Figure 3**.

Based on the seasonal high groundwater elevation in the vicinity of the proposed infiltration gallery of 300.60 mamsl and the minimum required separation distance between the base of the trench the water table of 1 m (Chapter 4, Section 4.10 – Perforated Pipe Systems of the Low Impact Development Stormwater Management Planning and Design Guide), the proposed base elevation of the infiltration trench is recommended to be located at 301.60 mamsl.

Infiltration tests were completed using a Soil Moisture 2800 K1 Guelph Permeameter. Water levels within the combined reservoir of the Guelph Permeameter were recorded at regular time intervals to obtain time varying infiltration rates of the sediment layer. The tests were completed at an elevation of approximately 301.28 mamsl. Given the homogeneity of the sand unit described in the geotechnical borehole log for BH-13, the results from the infiltration test completed at an elevation of 301.28 mamsl are considered to be representative of the sediments located to a depth of at least 1.5 m beneath this elevation.

The field saturated hydraulic conductivity (Kfs) of 1.52×10^{-2} was calculated using the Guelph Permeameter K-sat calculator, available for download on the soil moisture website (soilmoisture.com).

Design Infiltration Rate

Calculating the Design Infiltration Rate was based on the methodology outlined by the Sustainable Technologies Evaluation Program (STEP) updated guidance on Low Impact Development Stormwater Management Planning and Design. As outlined on the STEP website, the water component of STEP is a partnership between the Toronto and Region Conservation Authority, Credit Valley Conservation, and Lake Simcoe Region Conservation Authority. Additional information about STEP is provided on their website at sustainabletechnologies.ca.

STEP has reviewed the Low Impact Development Stormwater Management Planning and Design Guide first completed in 2010 and provided updated guidance to the 2010 Guide using a wiki website (wiki.sustainabletechnologies.ca). STEP recommends using the online wiki page as the primary resource for LID planning and design.

The STEP wiki-page pertaining to Design Infiltration Rates recommends that a safety correction factor between 2 to 3 be applied to the measured infiltration rate (i.e. the calculated Kfs value) from the in-Situ testing to apply conservatism. The following table is provided on the wiki-page which outlines factors that should be taken into consideration when determining an appropriate safety factor:

Selecting a Safety Factor

Lower Value (closer to 2)	Higher Value (closer to 3)
Catchment <100 m ²	Catchment >100 m²
Permeameter or Percolation Test on Site	Double Ring infiltrometer on Site, or grain size analysis is used
Loamy or Sandy Soil Texture	Clayey Soil Texture
No variation in geologic formation, soil texture or bulk density within 1.5 meters below the proposed bottom of the practice.	Variation in geologic formation, soil texture or bulk density within 1.5 meters below the proposed bottom of the practice.
No nearby sensitive receptors	Sensitive receptors in near proximity (e.g. septic systems, building foundations).

Notes:

Bolded items indicate the post-development parameters applicable to the site used to select an appropriate safety factor.

Based on the above, a safety factor of 2.5 has been applied to the calculated Kfs to determine the Design Infiltration Rate. The Design Infiltration Rate, as determined by the in-situ infiltration testing, is provided in **Table 5.3.2**.

Table 5.3.2: Design Infiltration Rate (mm/hr)

Test Pit	Test No.	Depth (mbgs)	Soil Type	Kfs ¹ (cm/sec)	Geo-Mean Kfs (cm/sec)	Safety Factor	Design Infiltration Rate (mm/hr)
TP101-20	1	2.5	Sand	1.56x10 ⁻²	1.52x10 ⁻²	2.5	219
	2			1.48x10 ⁻²			

Any soils brought to the Site for grading are required to have the same or better infiltration rates as current conditions.

5.4 Groundwater Chemistry

Groundwater samples were submitted and analyzed for general chemistry parameters in order to document the groundwater chemistry prior to development. The analytical results are summarized in **Table 2**. Laboratory Certificates of Analysis are provided in **Appendix F**.

Anions and Nutrients

As shown, concentrations of Ammonia and Nitrate were reported as below their detectable limits. Nitrate concentrations were reported to be 3.34 mg/L at BH-1 and 2.73 mg/L at BH-13, which are interpreted to be located hydraulically up-gradient at the Site. The nitrate concentration at BH-15, interpreted to be located hydraulically down-gradient, was 1.73 mg/L which indicates the Site is serving to attenuate nitrate concentrations.

Total Metals

The following parameters were detected in at least one of the groundwater samples collected from the Site:

- | | | | |
|-------------|------------|--------------|-------------|
| • Aluminum | • Cesium | • Magnesium | • Rubidium |
| • Arsenic | • Chromium | • Manganese | • Selenium |
| • Barium | • Cobalt | • Molybdenum | • Silicon |
| • Beryllium | • Copper | • Nickel | • Sodium |
| • Cadmium | • Iron | • Phosphorus | • Strontium |
| • Calcium | • Lead | • Potassium | Sulfur |
| • Cesium | | | |
| • Chromium | | | |

The maximum Sodium and Chloride concentrations were reported at monitoring location BH-13 with concentrations of 1,420 mg/L and 2,650 mg/L, respectively. These concentrations are interpreted to result from road salt application on the municipal roadway adjacently south of the Site (approximately 8 m from BH-13). Sodium and Chloride concentrations at the remaining monitoring locations were 421 mg/L and 638 mg/L (BH-1) and 61.9 mg/L and 5.1 mg/L (BH-15). These results indicate sodium and chloride concentrations reduce across the Site from south to north.

6.0 Source Water Protection

The source water protection assessment was conducted using the online Source Protection Information Atlas (SPIA) provided by the Ministry of Environment, Conservation and Parks. Information provided by the SPIA was used to assess whether the Site is within a vulnerable area i.e. close to a municipal drinking water well or other drinking water intake. The SPIA also provides information pertaining to aquifer vulnerability and significant groundwater recharge areas. The Lakes Simcoe and Couchiching-Black River SPA Part 1 Approved Assessment Report (AAR, 2015) was also reviewed as part of the assessment for information pertaining to groundwater vulnerability, described below.

6.1 Wellhead Protection Area (WHPA) Vulnerability Assessment

Based on the SPIA, the Site is not located within a WHPA. The closest municipal well is located approximately 3.8 km northwest of the Site (Well 19, Barrie Water Supply 220001192).

6.2 Groundwater Vulnerability & Issue Contributing Areas

Factors taken into consideration when determining the vulnerability of a municipal aquifer include (AAR, 2015):

- Municipal aquifer thickness and depth;
- Travel time of water moving through the ground; and
- Types of man-made transport pathways which can create a direct pathway between water at the surface and the underlying aquifer that is a source of drinking water (i.e. quarries, pipelines, etc.).

Based on a review of Figure 1.1-1: Lake Simcoe Watershed Groundwater Vulnerability provided in the AAR, the Site appears to be located in either a low or medium groundwater vulnerability

area; however, due to the scale of the image, the exact classification could not be discerned. A review of the SPIA confirmed that the Site is not located within a Highly Vulnerable Aquifer area.

The SPIA defines Issue Contributing Areas (ICA) as:

“An area where land based activities contribute to the presence of an unwanted substance in the water source. Activities producing the substance may be prohibited or need to be managed more effectively.”

As the Site is not located within a source area for a municipal supply, and based on a review of the SPIA, the Site is not located within an ICA.

6.3 Significant Groundwater Recharge Areas (SGRA)

The Lakes Simcoe and Couchiching-Black River SPA Part 1 Approved Assessment Report (AAR, 2015) describes SGRAs as:

“area[s] where rain or snow seep into the ground and flows to an aquifer.”

As described in the AAR, SGRAs are generally in areas where permeable soils are present (i.e. sand or gravel) which allows the water to easily infiltrate to the subsurface. Areas deemed ‘significant’ are those which help “maintain the water level in an aquifer that supplies a community with drinking water, or supplies groundwater recharge to a cold water ecosystem that is dependent on this recharge to maintain its ecological function” (AAR, 2015).

SGRAs are assigned a vulnerability scoring which provide an indication of the level of vulnerability. The SGRA vulnerability scores are determined by overlaying the groundwater vulnerability score (outlined above) with the SGRA (AAR, 2015). There are three vulnerability scores that can be applied to SGRAs:

- Vulnerability Score of 6 = High Vulnerability
- Vulnerability Score of 4 = Medium Vulnerability
- Vulnerability Score of 2 = Low Vulnerability

Based on a review of the SPIA, several areas of the Site are located within a SGRA with a vulnerability score of 2.

6.4 Groundwater Quality Threats

Based on the groundwater vulnerable areas presented on the SPIA, no activities on the Site can be considered significant groundwater quality threats. The South Georgian Bay Lake Simcoe Source Protection Region Source Protection Plan (SPP, 2015) does not include any policies that are related to any anticipated Site activities. Note that the City of Barrie Official Plan and other policies may contain policies that are relevant to the proposed Site use.

7.0 Impact Assessment

The following impact assessment pertains only to Phase 1 of the development since the design documents for Phase 2 of the development were not available at the time of this report. An additional impact assessment is required once the design of the second phase of development is available.

7.1 Potential Private Well Interference

As stated in Section 3.2, 11 the MECP well records online database identified 11 wells within 500 m of the Site with six wells listed as being industrial, livestock or domestic water supply wells. The locations of the MECP wells as provided by the MECP are shown on **Figure 10**. A summary of the MECP Well Records and Impact Assessment is provided in **Table 3**.

As shown in **Table 3**, there are no wells anticipated to be impacted by the proposed development. This is based on the approximate distances of the MECP wells from the Site and the location of the wells (as provided by the MECP) in relation to the Site as hydraulically up- or cross-gradient.

It is noted that MECP Well ID 5720702 is shown in the MECP database to be located approximately 3 m north (hydraulically down-gradient) of the Site. The MECP Well record for Well ID 5720702 states that the well was installed in the Town of Innisfil. The location sketch provided in the well record illustrates the well to be located in an area outside of the Study Area for the Site, therefore, the location of the well in the MECP online database is considered to be inaccurate and the well will not be impacted by the proposed development.

MECP Well ID 5720702 is shown on Figure 10 for illustration purposes; however, the well ID has been stricken, indicating the location is considered inaccurate.

7.2 Impact of Stormwater Management

7.2.1 Water Balance

A water balance using the Thornthwaite-Mather method has been completed for the Site as part of the Stormwater Management (SWM) Report completed by MTE, dated December 12, 2019 (revised March 31, 2020). As outlined in the SWM report, post-development infiltration measures at the Site include passive infiltration across the Site in pervious areas and infiltration of runoff from the proposed building rooftop via an infiltration gallery since this is considered a clean source. Infiltration of water from paved surfaces is not permitted.

Since the infiltration gallery will only be used to infiltration rooftop water, and infiltration of water from paved surfaces is not permitted, it is anticipated that the post-development infiltration measures proposed at the Site will not have a negative impact on the groundwater or surface water quality beneath or near the Site.

The water balance provided in the SWM report indicates that the proposed development will result in an overall net decrease in infiltration across the Site of approximately 32% (1,512 cubic meters). As the Lover's Creek tributary in the vicinity of the Site is not a significant discharge feature (Section 4.3), this deficit is not expected to impact the form or function of the creek.

7.2.2 High Groundwater Separation

Based on the design documents (available in Appendix A) the proposed base elevation of the infiltration gallery is 301.8 mamsl. The composite high groundwater elevation beneath the infiltration gallery is approximately 300.6 mamsl. Therefore, the required minimum separation distance of one meter is satisfied.

8.0 Dewatering Considerations

The following discussion pertains only to Phase 1 of the proposed development since the design documents for Phase 2 of the development were not available at the time of this report. An additional evaluation of dewatering considerations is required once the design of the second phase of development is available.

Groundwater elevations at the Site were recorded to range between 300.34 mamsl (BH-1) and 299.46 mamsl (BH-15) during the monitoring period. To determine the seasonal high groundwater elevations across the Site, 0.50 m was added to the highest groundwater elevation recorded at each of the monitoring wells, as outlined in Section 5.3.1. The composite high groundwater elevation contours are provided in **Figure 11**.

The Site Servicing Plan (provided in Appendix A) shows a proposed finished floor elevation (FFE) of 304.15 mamsl and the lowest sanitary sewer invert elevation of 301.00 mamsl (located along the southern property boundary). A comparison of the composite high groundwater elevations to the proposed FFE indicates that the building footings (assumed to be approximately 1 m below the proposed FFE) and excavation base required for the footing construction are above the calculated seasonal high groundwater elevation.

A comparison of the composite high groundwater elevation in the vicinity of the proposed lowest sanitary sewer invert (approximately 300.75 mamsl) to the proposed lowest sanitary sewer invert elevation (301.00 mamsl) indicates that the lowest sanitary sewer invert elevation is above the water table with a separation distance of approximately 0.25 m. Therefore, the water table may be encountered during advancement of the trench to install the sanitary sewer in this area of the Site. If groundwater is encountered, the dewatering volumes are expected to small since the excavation into the water table would be minimal.

If, upon final confirmation of building and servicing design, it is anticipated that the water table may be intercepted during construction activities, the need for construction dewatering should be assessed through a Dewatering Assessment, which is outside the scope of this Hydrogeological Investigation. The Dewatering Assessment would estimate the required daily volume of water to be removed from the Site and determine whether a Permit to Take Water or registration in the Environmental Activity Sector Registry is required. In addition, the Dewatering Assessment would include an impact assessment of the dewatering activities on the area surrounding the Site.

9.0 Conclusions and Recommendations

Based on this hydrogeological investigation, MTE offers the following findings:

Geology

- Soils reportedly encountered at the Site were described to consist of topsoil and fill (silty sand to sand) underlain by native silty sand, sandy silt and sand deposits. Soils encountered at the Site during this hydrogeological investigation were generally consistent with those described in the geotechnical report completed by Toronto Inspection Ltd.
- Bedrock has not been encountered at the Site and, based on drift thickness mapping, is anticipated to be located approximately 250 mbgs.

Shallow Aquifer Characteristics - Groundwater Flow & Infiltration

- Groundwater elevations at the Site were recorded to range between 300.34 mamsl (BH-1) and 299.46 mamsl (BH-15) during the monitoring period.
- The shallow groundwater flow direction beneath the Site is inferred to be north-easterly, towards Lover's Creek.
- Based on the shallow groundwater flow direction and water levels measured to date, it is likely that groundwater beneath the Site contributes to Lover's Creek.
- The horizontal hydraulic gradient of the groundwater table beneath the Site was calculated to be 0.008 m/m which is based on the manual groundwater level measurements collected on May 12, 2020.
- Hydraulic conductivity values were calculated to range from 1.2×10^{-5} m/sec (1.0 m/day) to 3.2×10^{-5} m/sec (2.8 m/day) with a geometric mean of 2.2×10^{-5} m/sec (1.9 m/day).
- The average linear groundwater velocity of the shallow groundwater aquifer beneath the Site was calculated to be 18.0 m/year.
- The Design Infiltration Rate, as determined by the in-situ infiltration testing, is 219 mm/hr.

Shallow Aquifer Characteristics - Groundwater Chemistry

- Concentrations of Ammonia and Nitrate were reported as below their detectable limits. Nitrate concentrations reported for the monitoring wells within the Site indicate the Site is serving to attenuate nitrate concentrations.
- Various total metals parameters were detected in one or more groundwater samples collected from the monitoring wells at the Site to document pre-development groundwater chemistry.
- The maximum concentrations of sodium (1,420 mg/L) and chloride (2,650 mg/L) were reported at monitoring location BH-13, located approximately 8 m north of the municipal roadway adjacently south of the Site. The reported sodium and chloride concentrations for the remaining monitoring wells at the Site indicate the concentrations of these parameters reduce across the Site from south to north.

Source Water Protection

- The Site is not located within a WHPA and the closest municipal well is located approximately 3.8 km northwest of the Site.
- The Site appears to be located in either a low or medium groundwater vulnerability area.
- The Site is not located within an ICA.
- Several areas of the Site are located within a SGRA with a vulnerability score of 2.
- There were no significant groundwater quality threats listed for the Site based on the review of the SPIA.

Impact Assessment

- There are no wells anticipated to be impacted by the proposed development based on a review of the MECP well records within 500 m of the Site.
- It is anticipated that the post-development infiltration measures proposed at the Site will not have a negative impact on the groundwater or surface water quality beneath or near the Site.
- As the Lover's Creek tributary in the vicinity of the Site is not a significant discharge feature, the pre- to post-development infiltration deficit is not expected to impact the form or function of the creek.

Dewatering Considerations

- A comparison of the composite high groundwater elevations to the proposed FFE indicates that the building footings (assumed to be approximately 1 m below the proposed FFE) and excavation base required for the footing construction are above the calculated seasonal high groundwater elevation.
- A comparison of the composite high groundwater elevations to the proposed lowest sanitary sewer invert elevation indicates that the water table may be encountered during excavation and installation of the sanitary sewer, particularly in the south portion of the Site where the lowest sanitary sewer invert elevation coincides with the area of the Site where the groundwater elevation is highest (i.e. the hydraulically up-gradient area of the Site).

9.1 Recommendations and Monitoring

Based on findings of this hydrogeological investigation, MTE offers the following recommendations:

- Continuous groundwater monitoring should be ongoing, updated, and utilized during the Site plan approval process, as well as updated information utilized during the final design of the site plan.
- During the development application process, existing on-site groundwater monitoring wells be maintained in accordance with Ontario Regulation 903 (as amended).
- Upon monitoring well decommissioning, monitoring wells will need to be decommissioned in accordance with Ontario Regulation 903 (as amended).
- Soils brought to the Site for grading must have the same or better infiltration rates as the current conditions.
- The City of Barrie Official Plan and related documents should be reviewed by a Professional Planner for relevant policies, particularly related to salt management.
- If, upon final confirmation of building and servicing design for Phase 1 of the development, it is anticipated that the water table may be intercepted during construction activities, the need for construction dewatering will need to be assessed through a Dewatering Assessment.
- An impact assessment and review of dewatering considerations is required for the second phase of the development once the design of the second phase is available.

10.0 Limitations

Services performed by **MTE Consultants Inc.** (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Environmental Engineering & Consulting profession. No other warranty or representation expressed or implied as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of MTE and Crescent Homes. The assignment was carried out in accordance with the Scope of Work described in Section 1.1 as reviewed with and agreed to by the Client. MTE makes no representation that the present report has dealt with all of the important environmental issues, except as provided in the Scope of Work. This report is not intended to be exhaustive in scope or to imply a risk-free facility. As such, this report may not deal with all issues potentially applicable to the Site and may omit aspects which are or may be of interest to the reader.

In addition, it should be recognized that a soil sample or groundwater level measurement represents one discrete portion of the Site at the time it is collected, and that the findings of this report are based on conditions as they existed during the time period of the investigation.

Any use which another party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by another party as a result of decisions made or actions taken, based upon this report. Others with interest in the Site should undertake their own investigations and studies to determine how or if the condition affects them or their plans.

It should be recognized that the passage of time may affect the views, conclusions and recommendations (if any) provided in this report because environmental conditions of a property can change, along with regulatory requirements. Should additional or new information become available, MTE recommends that it be brought to our attention in order that we may determine whether it affects the contents of this report.

All of which is respectfully submitted,

MTE Consultants Inc.

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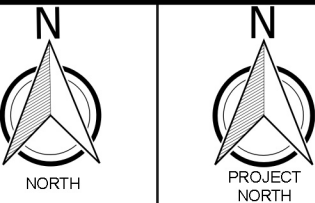
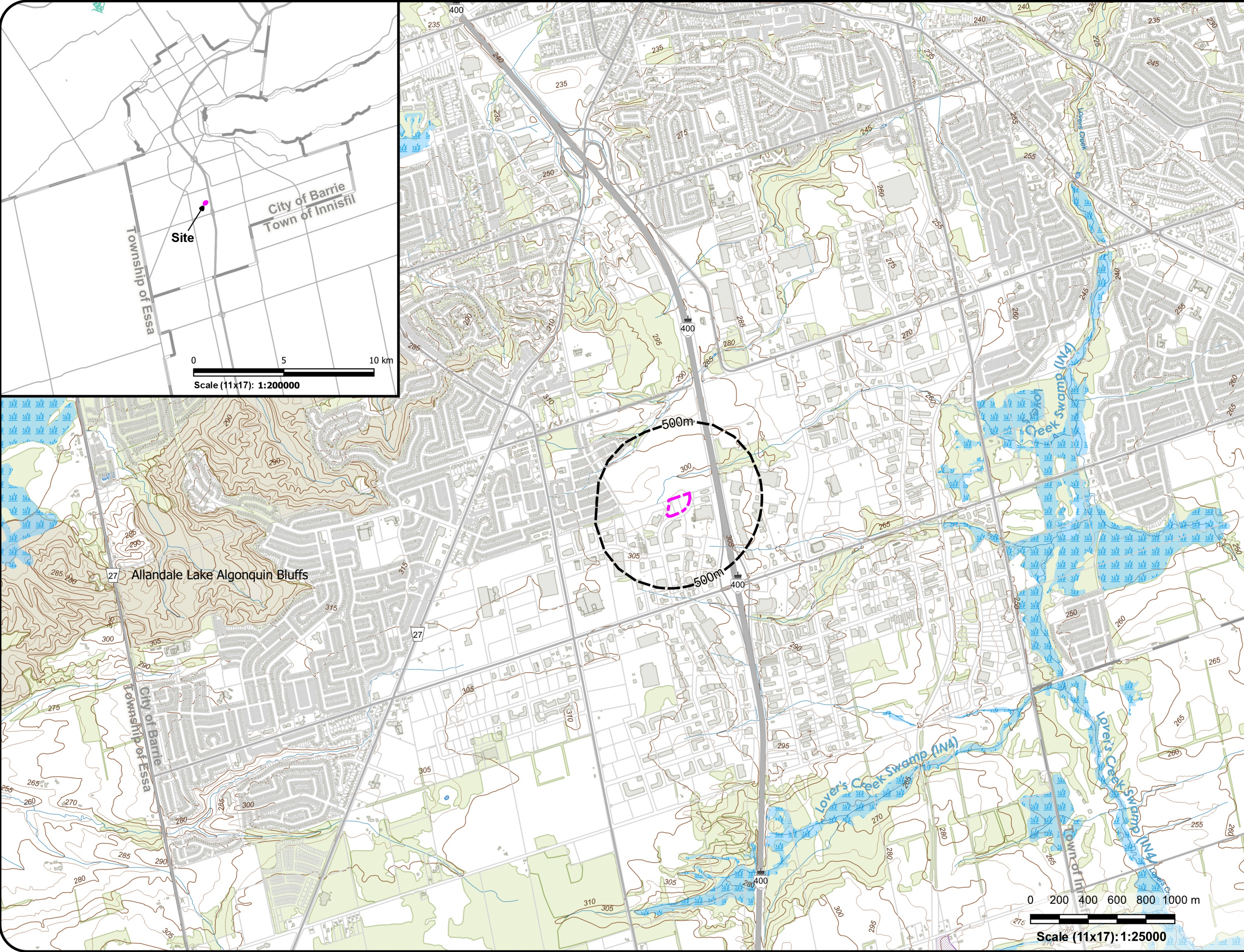
KLW: apm

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<https://www.ontario.ca/environment-and-energy/map-well-records>
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https://www.google.ca/search?q=moecc+source+water+protection+information+atlas&rlz=1C1GGRV_enCA751CA751&oq=moecc+source&ags=chrome.1.69i57j35i39j0l4.3688j0i4&sourceid=chrome&ie=UTF-8&safe=active&ssui=on
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- Sustainable Technologies Evaluation Program (STEP). (2020). Design Infiltration Rate. Retrieved from Low Impact Development Stormwater Planning and Design Guide:
https://wiki.sustainabletechnologies.ca/wiki/Design_infiltration_rate
- Toronto Inspection Ltd. (2019). *Report on Geotechnical Investigation 316, 326 and 336 Bryne Drive Barrie, Ontario* prepared for Meridian Credit Union.
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Figures



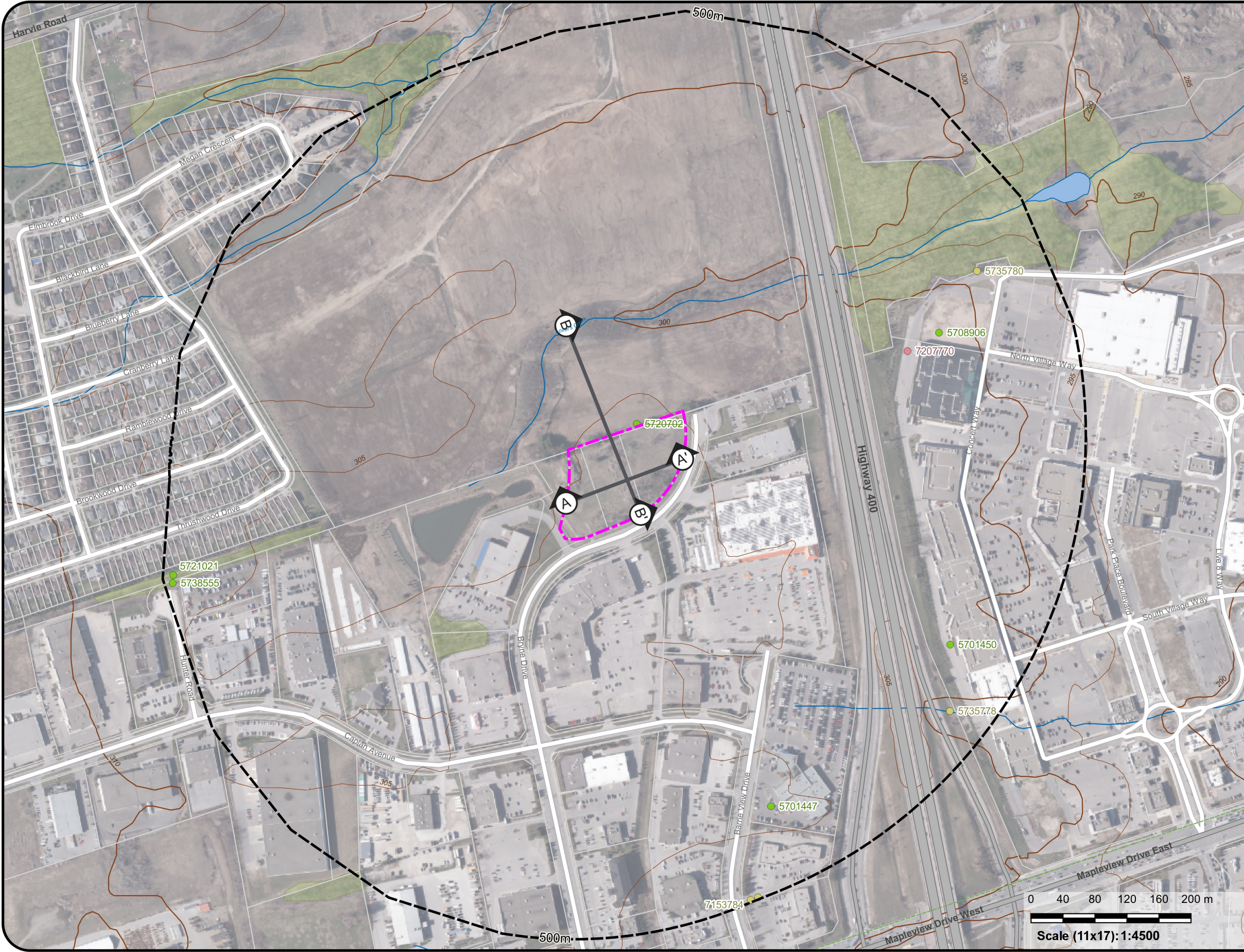
Legend

Property Boundary
Study Area (500m)
Base Map
Road
Municipal Boundary
Buildings
Surface Water
Surface Waterbody
Watercourse
Provincially Significant Wetland
Ground Surface
Ground Surface Elevation Contour
Land Use
Provincial ANSI - Life Science
Wooded Area

Data Sources:
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Project CRS: NAD83 / UTM zone 17N



Client	Mataj Architects Inc.	
Project	Hydrogeological Investigation	
Site	326 Bryne Drive, Barrie	
Title	Key Map	
Reviewed By	ATD	
Prepared By	KLW	Project No. 45303-200
Drawn By	KLW	Figure No.
Date	July 2020	1



Legend

- Property Boundary
- Study Area (500m)
- Geological Cross Section Location

MECP Wells within Study Area

- Abandoned-Other
- Monitoring and Test Hole
- Water Supply

Base Map

- Road

Surface Water

- Surface Waterbody
- Watercourse

Groundsurface

- Ground Surface Elevation Contour (10m)
- Ground Surface Elevation Contour (5m)

Landuse

- Wooded Area

Data Sources:

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Engineers, Scientists, Surveyors
Ph. (519) 743-6500

Client

Mataj Architects Inc.

Project

Hydrogeological Investigation

Site

326 Byrne Drive, Barrie

Title

Study Area

Reviewed By

ATD

Prepared By

KLW

Drawn By

KLW

Date

July 2020

Project No

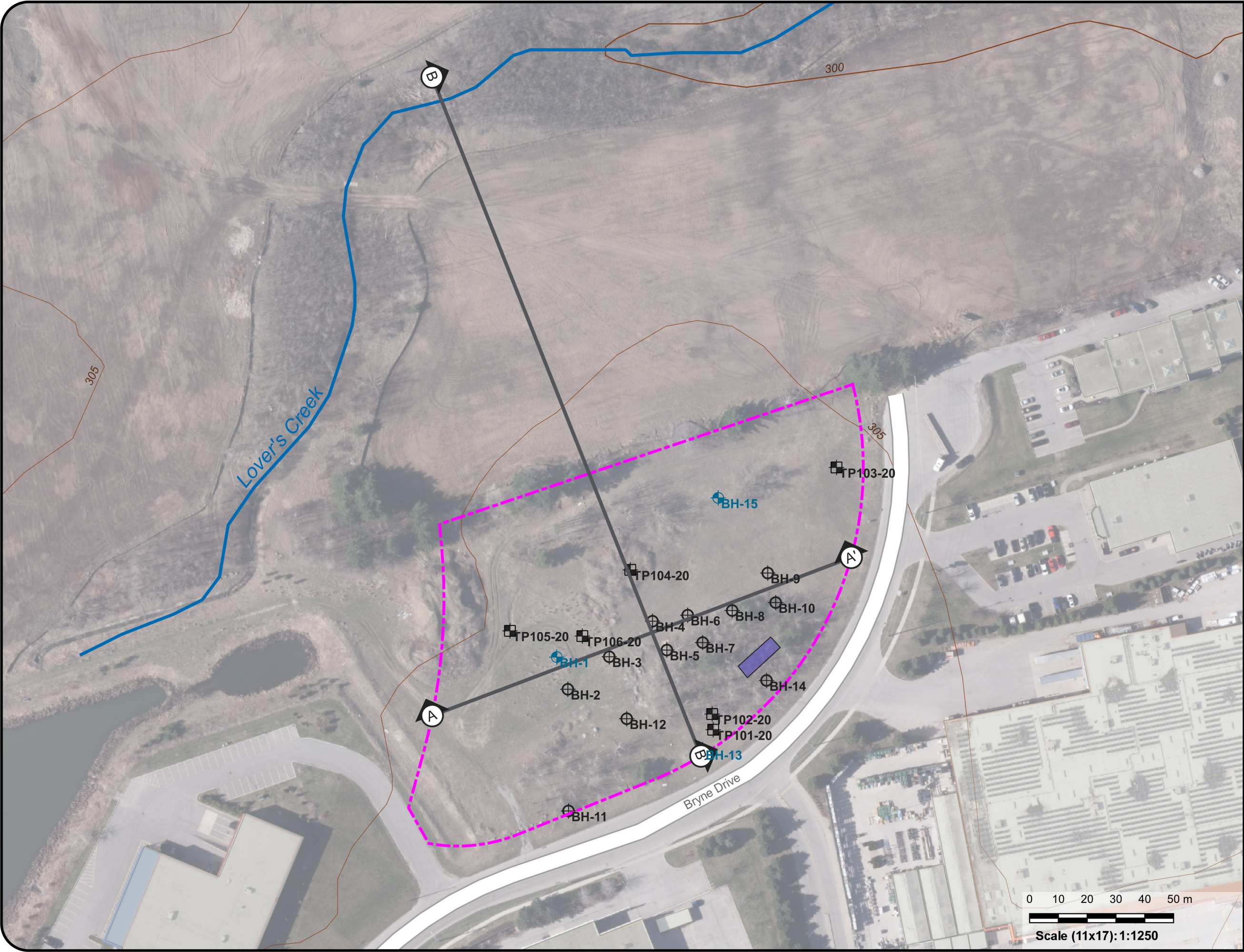
45303-200

Figure No

2

0 40 80 120 160 200 m

Scale (11x17): 1:4500



Legend

- Property Boundary
- Proposed Infiltration Trench Location
- Geological Cross Section Location
- Surface Water**
 - Watercourse
- Groundsurface**
 - Ground Surface Elevation Contour (10m)
 - Ground Surface Elevation Contour (5m)
- Investigative Locations**
 - Monitoring Well
 - Borehole (Approximate)
 - Test Pit

Notes:
Borehole locations approximated from Site Map provided in Geotechnical Report completed by Toronto Inspection Ltd.

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Project CRS: NAD83 / UTM zone 17N



Client
Mataj Architects Inc.

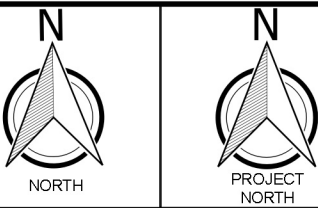
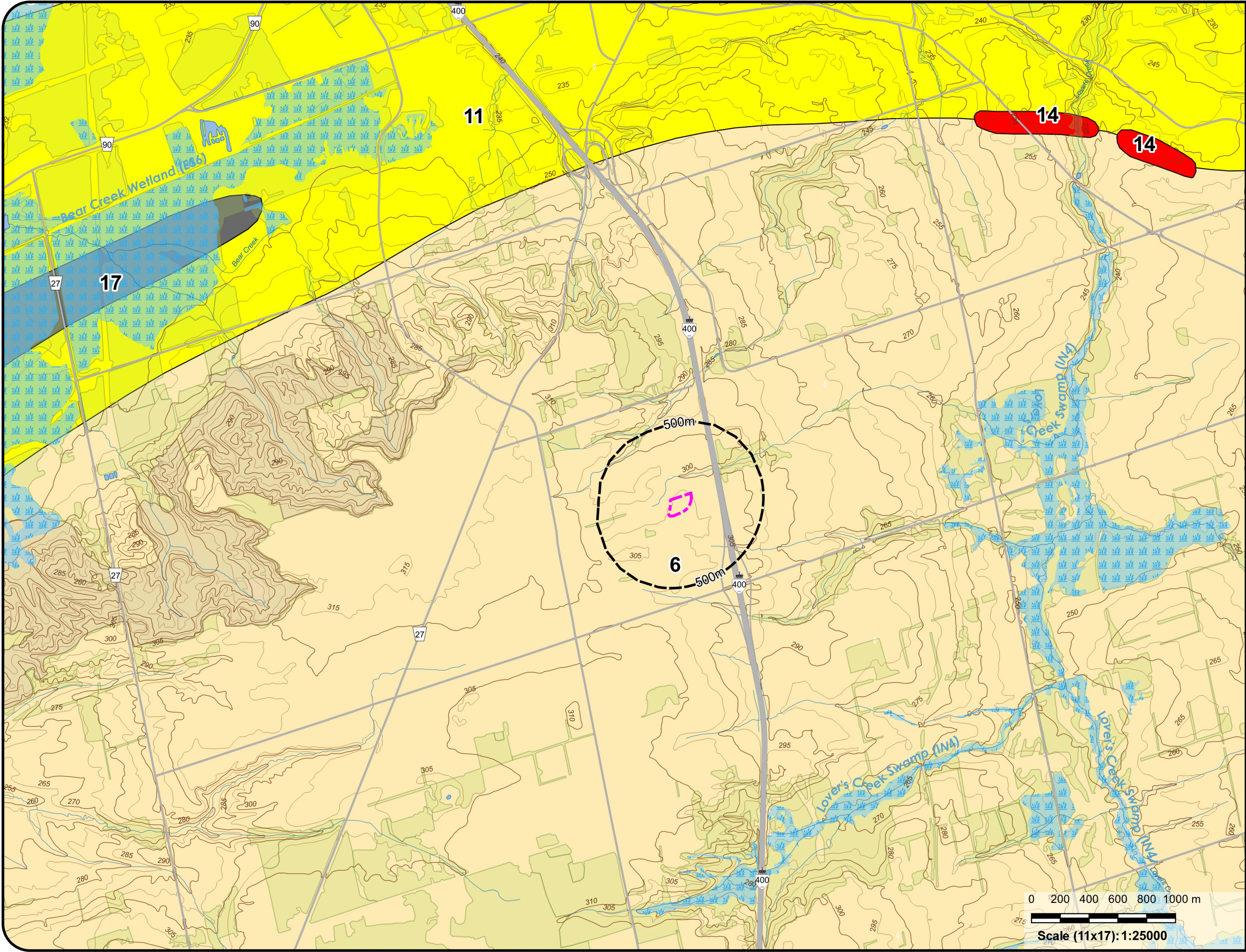
Project
Hydrogeological Investigation

Site
326 Bryne Drive, Barrie

Title
Existing Features

Reviewed By	ATD	Project No	45303-200
Prepared By	KLW	Figure No	3
Drawn By	KLW		
Date	July 2020		

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Scale (11x17): 1:1250

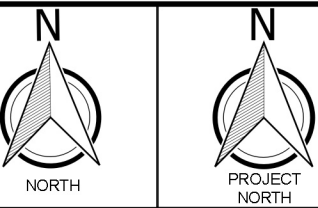
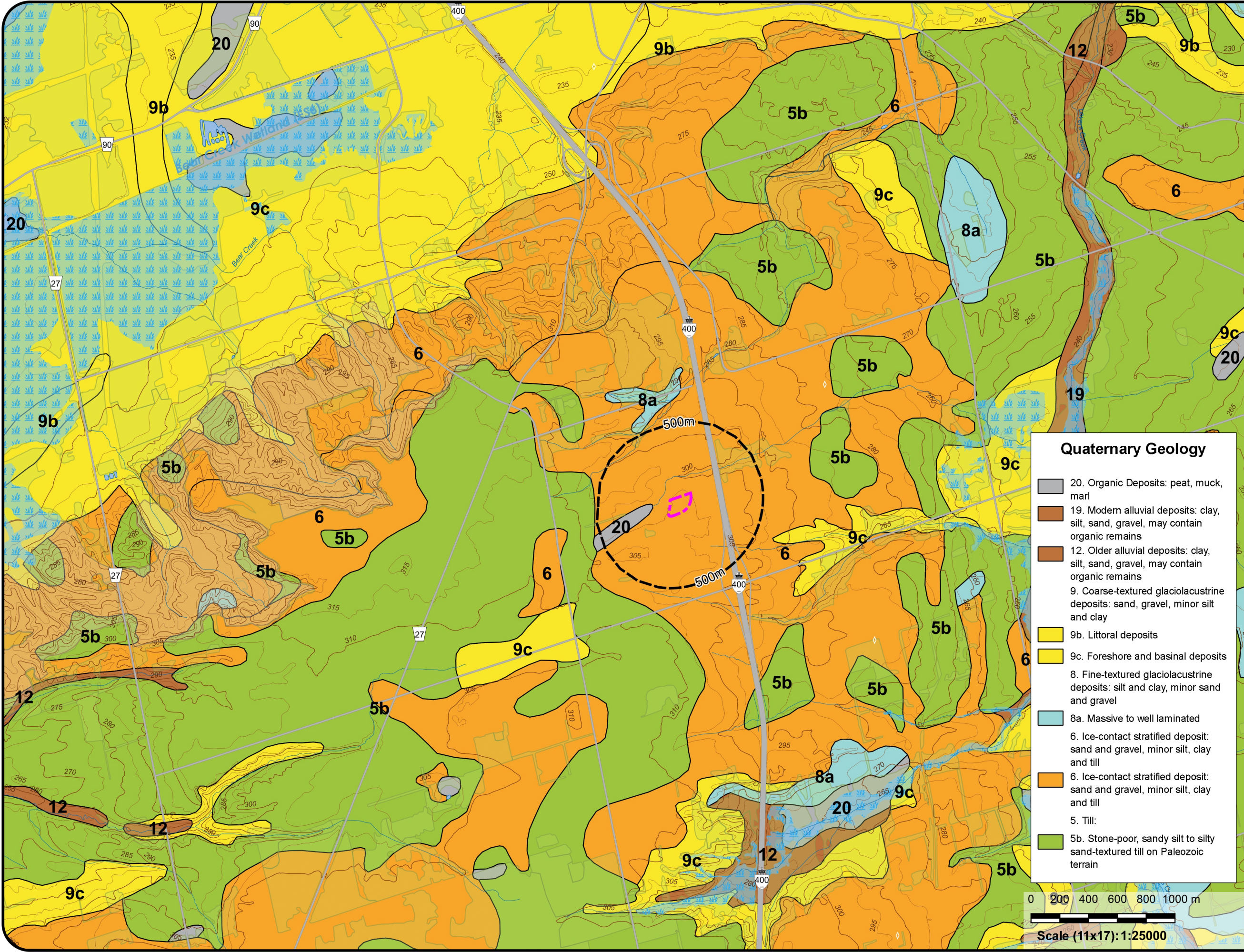


- Legend**
- Property Boundary
Study Area (500m)
Base Map
— Road
- Surface Water**
Surface Waterbody
Watercourse
Provincially Significant Wetland
- Ground Surface**
— Ground Surface Elevation Contour
- Land Use**
Provincial ANSI - Life Science
Wooded Area
- Physiographic Landforms**
6. Till Plains (Drumlinized)
11. Sand Plains
14. Beaches
17. Peat and Muck

Data Sources:
Contains information licensed under the Open Government License Ontario.
Chapman L.J. and Putnam D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey Miscellaneous Release—Data 228.
Project CRS: NAD83 / UTM zone 17N

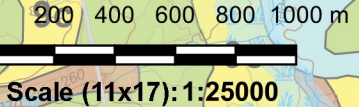


Client	Mataj Architects Inc.	
Project	Hydrogeological Investigation	
Site	326 Bryne Drive, Barrie	
Title	Physiographic Landforms	
Reviewed By	ATD	
Prepared By	KLW	Project No 45303-200
Drawn By	KLW	Figure No
Date	July 2020	4



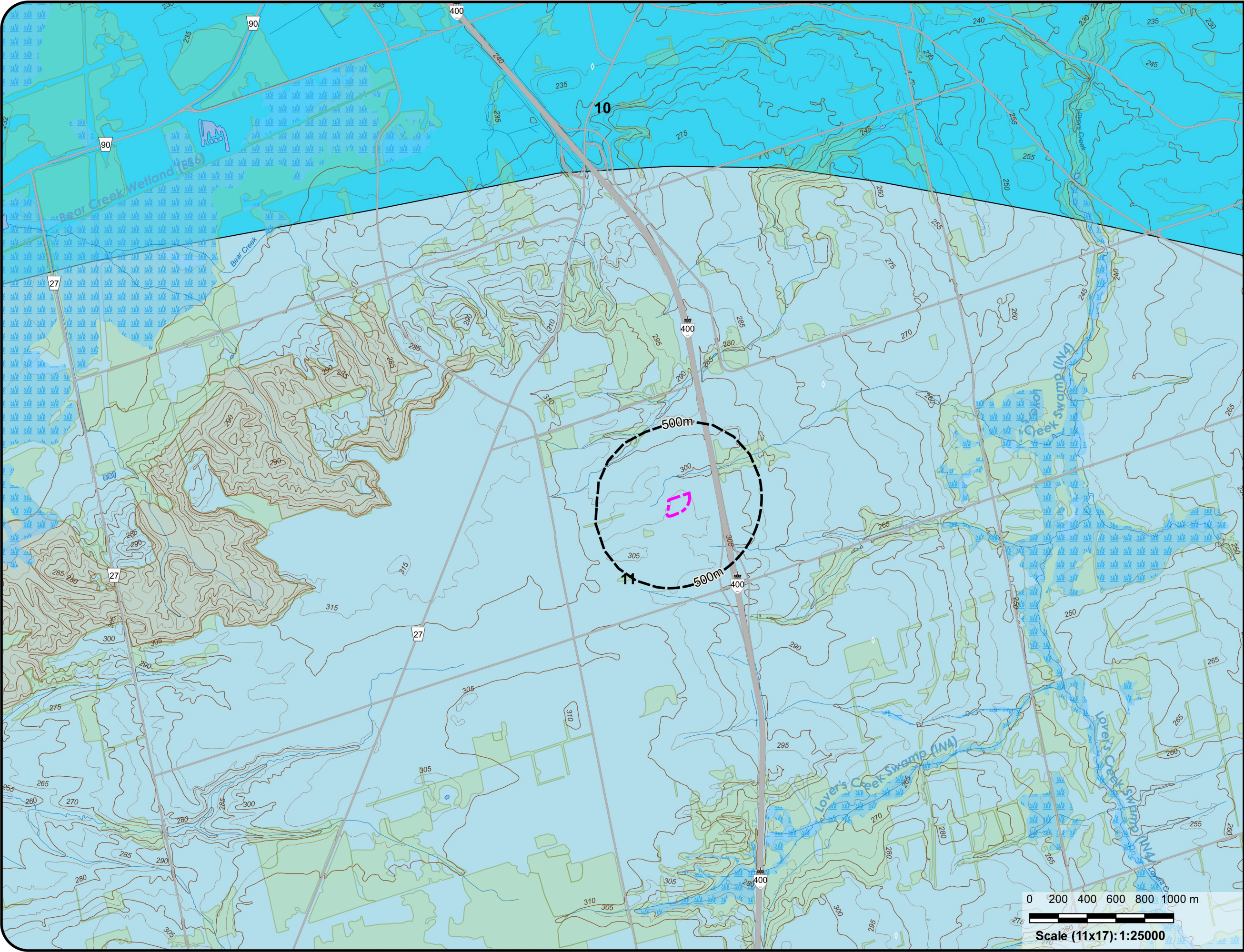
- Legend**
- Property Boundary
Study Area (500m)
Base Map
Road
Surface Water
Surface Waterbody
Watercourse
Provincially Significant Wetland
Ground Surface
Ground Surface Elevation Contour
Land Use
Provincial ANSI - Life Science
Wooded Area

- Quaternary Geology**
- 20. Organic Deposits: peat, muck, marl
 - 19. Modern alluvial deposits: clay, silt, sand, gravel, may contain organic remains
 - 12. Older alluvial deposits: clay, silt, sand, gravel, may contain organic remains
 - 9. Coarse-textured glaciolacustrine deposits: sand, gravel, minor silt and clay
 - 9b. Littoral deposits
 - 9c. Foreshore and basal deposits
 - 8. Fine-textured glaciolacustrine deposits: silt and clay, minor sand and gravel
 - 8a. Massive to well laminated
 - 6. Ice-contact stratified deposit: sand and gravel, minor silt, clay and till
 - 6. Ice-contact stratified deposit: sand and gravel, minor silt, clay and till
 - 5. Till:
 - 5b. Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain



Data Sources:
Contains information licensed under the Open Government License Ontario.
Ontario Geological Survey 2010. Surficial geology of southern Ontario; Ontario Geological Survey Miscellaneous Release-128 - Revised.
Project CRS: NAD83 / UTM zone 17N

 Engineers, Scientists, Surveyors Ph. (519) 743-6500	
Client	Mataj Architects Inc.
Project	Hydrogeological Investigation
Site	326 Bryne Drive, Barrie
Title	Quaternary Geology
Reviewed By	ATD
Prepared By	KLW
Drawn By	KLW
Date	July 2020
Project No.	45303-200
Figure No.	5



Legend

Property Boundary

Study Area (500m)

Base Map

— Road

Surface Water

Surface Waterbody

Watercourse

Provincially Significant Wetland

Ground Surface

Ground Surface Elevation Contour

Land Use

Provincial ANSI - Life Science

Wooded Area

Paleozoic Geology

Middle Ordovician

Simcoe Group

11. Lindsay Formation: limestone;
nodular to black laminated
(=Collingwood Member or Eastview
Member in eastern Ontario)

10. Verulam Formation: limestone and
shale

Data Sources:

Contains information licensed under the Open
Government License Ontario.

Armstrong D.K. and Dodge J.E.P. 2007. Paleozoic
geology of southern Ontario; Ontario Geological Survey
Miscellaneous Release—Data 219.

Project CRS: NAD83 / UTM zone 17N



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Client

Mataj Architects Inc.

Project

Hydrogeological Investigation

Site

326 Bryne Drive, Barrie

Title

Paleozoic Geology

Reviewed By

ATD

Prepared By

KLW

Drawn By

KLW

Date

July 2020

Project No.

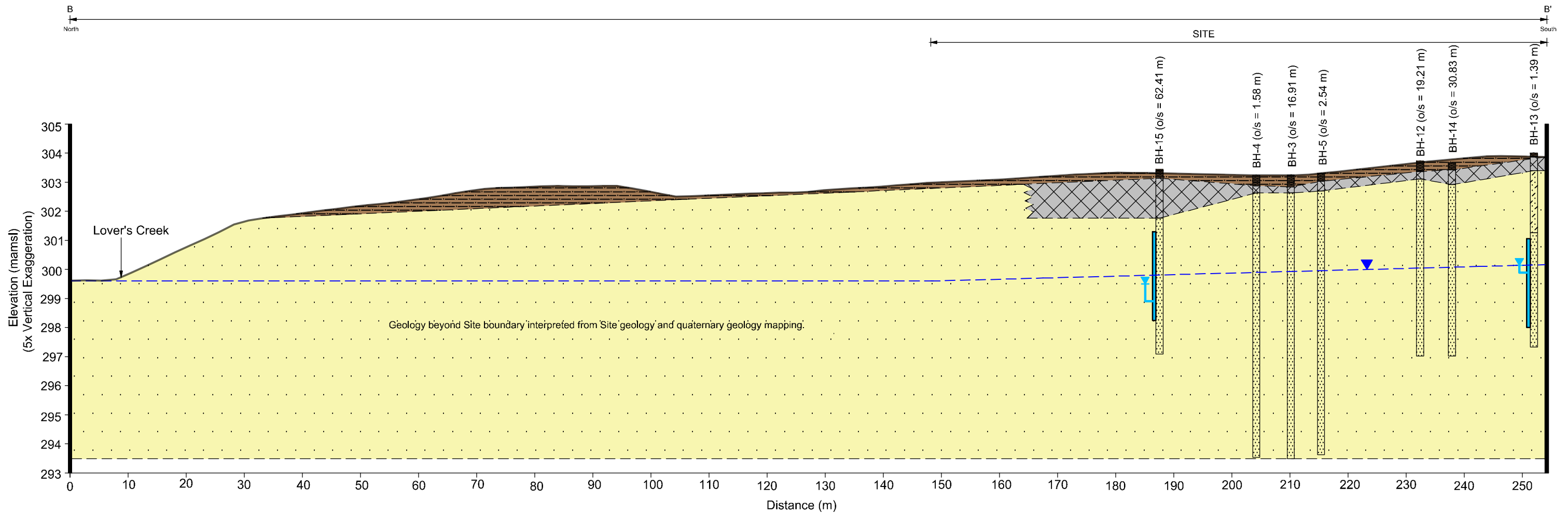
45303-200

Figure No.

3

0 200 400 600 800 1000 m

Scale (11x17): 1:25000



Legend

- Ground Surface
- Interpreted Water Table

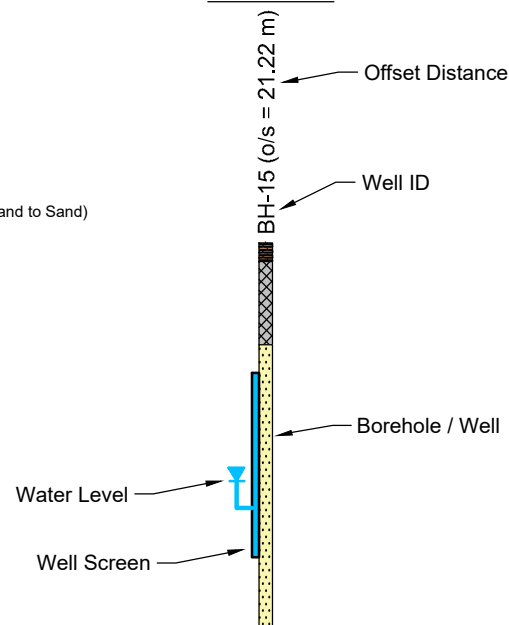
Borehole Lithology

- Topsoil
- Fill (Silty Sand to Sand)
- Silty Sand
- Sand

Interpreted Geology

- Topsoil
- Fill
- Sand

Well Detail

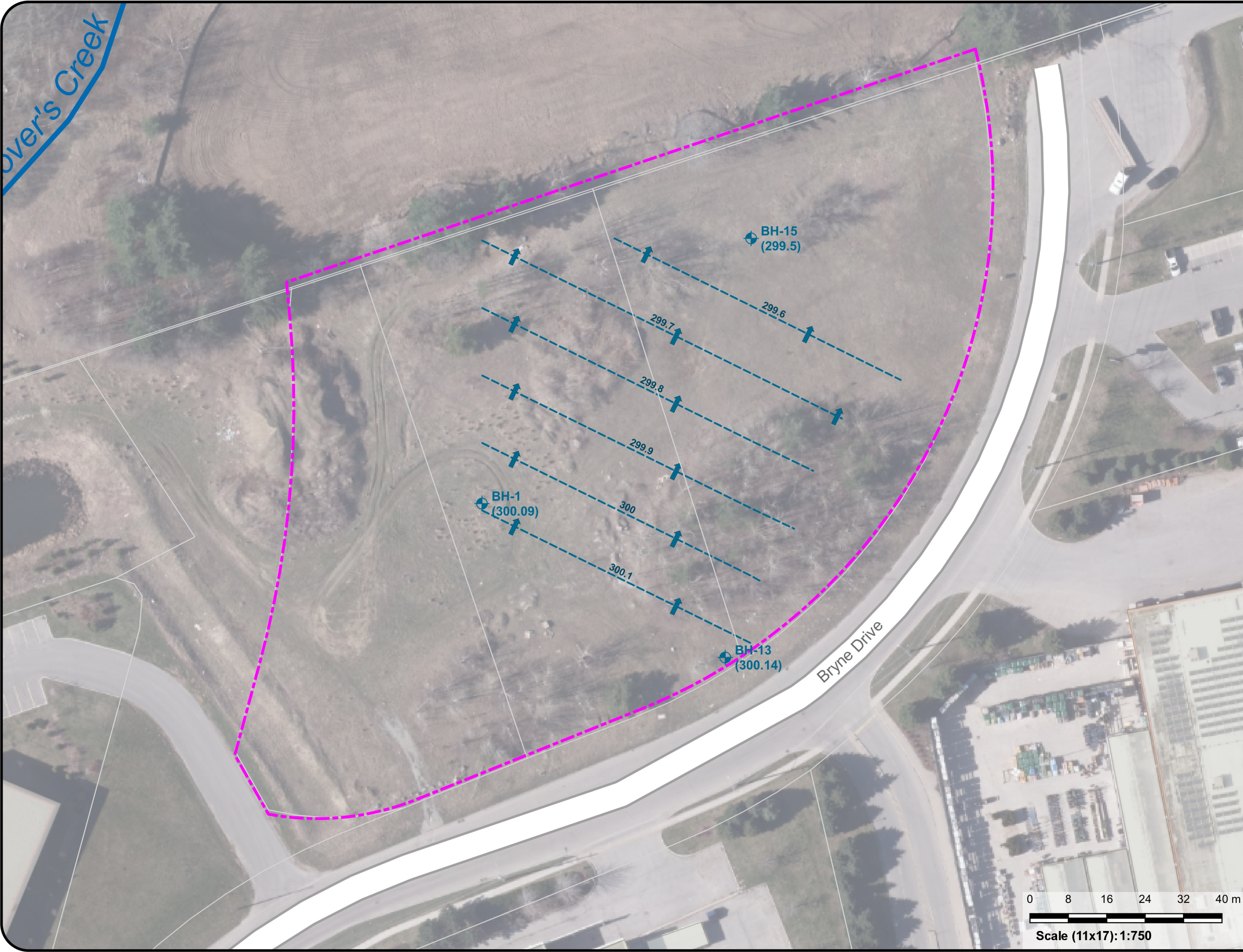


Notes:

- Geological sequence is based on professional interpretation from sediments encountered during field activities and geological descriptions provided in borehole logs completed by others. Actual geological conditions may vary between the tested locations.
- The ground surface and interpreted water table surface have been projected on the geological cross-section. Differences between the ground surface and boreholes/wells presented on the cross-section are a result of offset distances.
- Water levels for the on-Site monitoring wells were measured May 12, 2020.



CLIENT		Mataj Architects Inc.
PROJECT		Hydrogeological Investigation
SITE		326 Bryne Drive, Barrie
TITLE		Geological Cross-Section B-B'
Reviewed By		ATD
Prepared By	KLW	Project No. 43070-300
Drawn By	KLW	Figure No. 8
Date	July 2020	



Legend

- Property Boundary
- Watercourse
- Shallow Groundwater Elevation Contour (mamsl)

Investigative Locations

- Monitoring Well (Groundwater Elevation (mamsl))

Notes:
Based on groundwater level measurements collected May 12, 2020.

Data Sources:

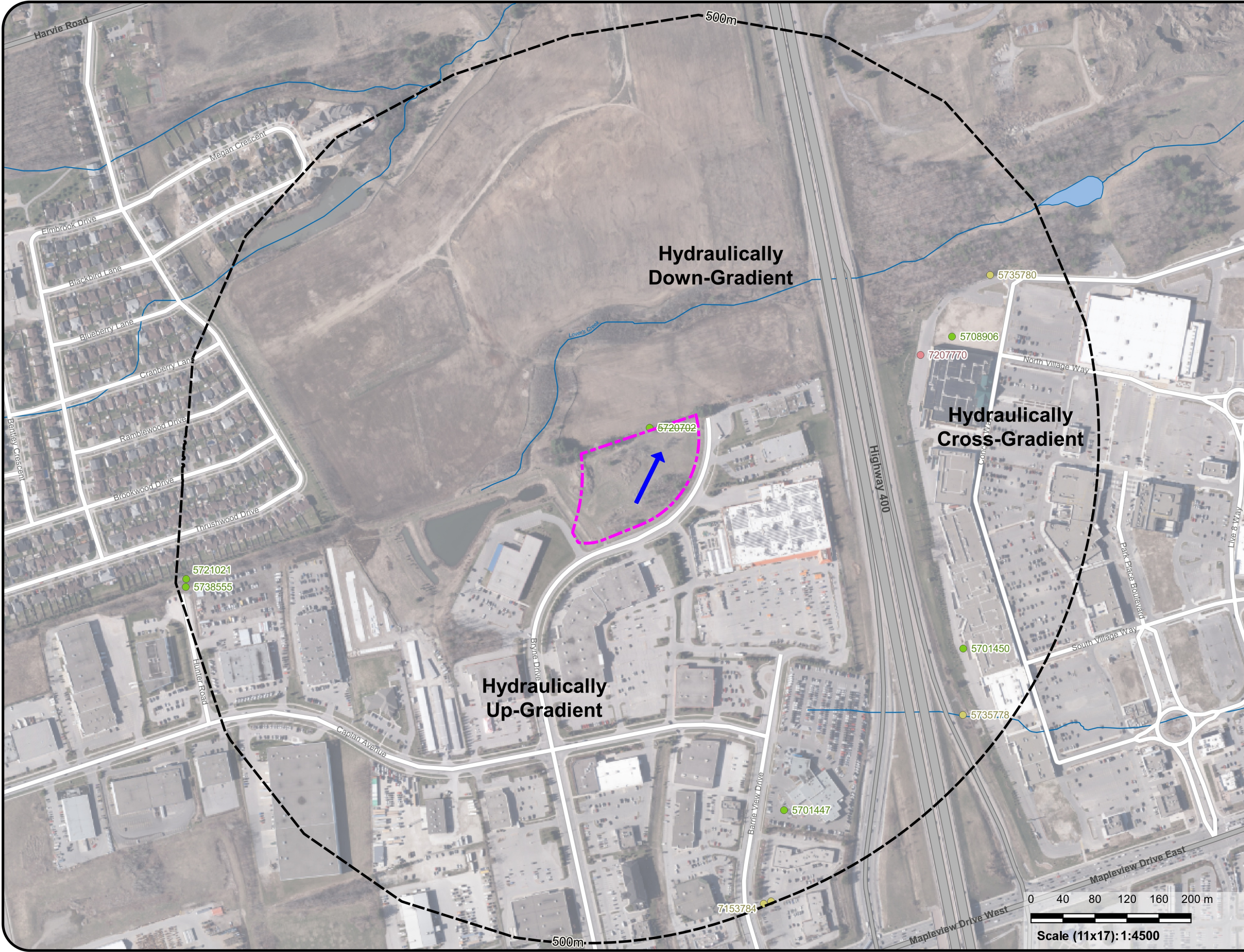
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Project CRS: NAD83 / UTM zone 17N



Client	Mataj Architects Inc.	
Project	Hydrogeological Investigation	
Site	326 Bryne Drive, Barrie	
Title	Inferred Local Shallow Groundwater Flow	
Reviewed By	ATD	
Prepared By	KLW	Project No 45303-200
Drawn By	KLW	Figure No
Date	July 2020	9



Legend

- Property Boundary
- Study Area (500m)
- Inferred Shallow Groundwater Flow Direction
- Surface Water Body
- Watercourse

MECP Wells within Study Area & Final Status

- Abandoned-Other
- Monitoring and Test Hole
- Water Supply

Notes:
Based on information provided in the MECP Well Record for Well ID No. 5720702, the location of this well as provided by the MECP is considered to be inaccurate (refer to Table 4 for additional details).

Data Sources:

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Project CRS: NAD83 / UTM zone 17N



Engineers, Scientists, Surveyors
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Client

Mataj Architects Inc.

Project

Hydrogeological Investigation

Site

326 Bryne Drive, Barrie

Title

MECP Wells within Study Area

Reviewed By

ATD

Prepared By

KLW

Drawn By

KLW

Date

July 2020

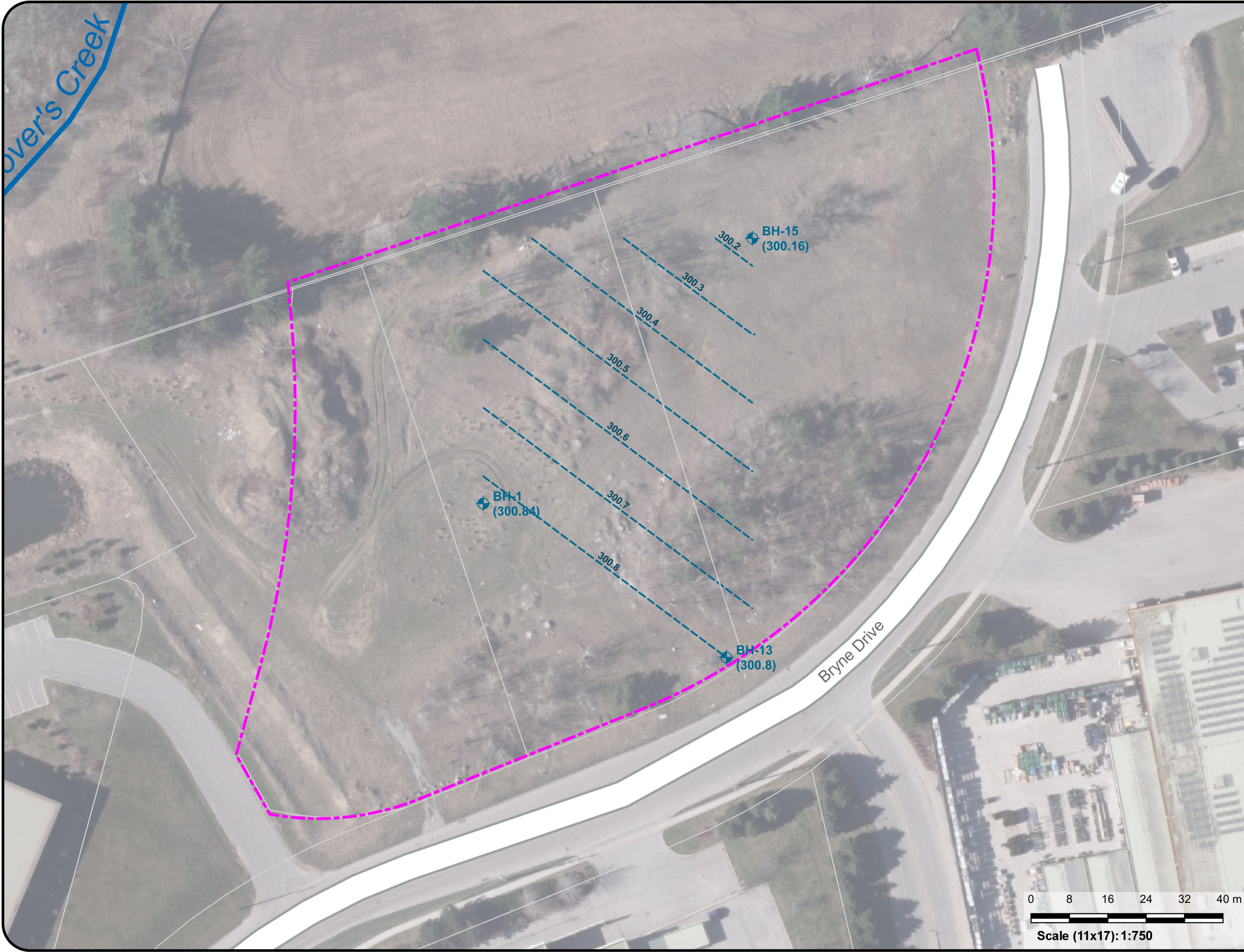
Project No

45303-200

Figure No

10

Scale (11x17): 1:4500



Legend

- Property Boundary
- Watercourse
- Composite High Groundwater Elevation Contour (mamsl)

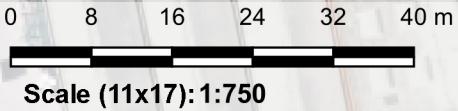
Investigative Locations

- Monitoring Well (Max. Groundwater Elevation (mamsl))

Data Sources:
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Project CRS: NAD83 / UTM zone 17N



Client	Mataj Architects Inc.		
Project	Hydrogeological Investigation		
Site	326 Bryne Drive, Barrie		
Title	Composite High Groundwater Contours		
Reviewed By	ATD	Project No	45303-200
Prepared By	KLW	Figure No	11
Drawn By	KLW		
Date	July 2020		



Tables

Table 1. Manual Groundwater Measurements Elevations (mamsl)

ID	BH-1			BH-13			BH-15		
TOC Elevation (mAMSL)	304.03			304.86			304.08		
GS Elevation	303.33			304.01			303.14		
Stickup (m)	0.71			0.86			0.94		
Date	mbtoc	mbgs	mamsl	mbtoc	mbgs	mamsl	mbtoc	mbgs	mamsl
18-Mar-20	3.69	2.98	300.34	4.61	3.75	300.25	4.45	3.51	299.63
12-May-20	3.94	3.23	300.09	4.72	3.86	300.14	4.58	3.64	299.50

Notes:

mbtoc = meters below top of casing

mbgs = meters below ground surface

mamsl = metres above mean sea level

Table 2. Groundwater Chemistry Summary

Parameter	Units	DL	BH-1	BH-13	BH-15
			18-Mar-20		
			L2429519-1	L2429519-2	L2429519-3
Physical Tests					
Colour, Apparent	CU	2	17.7	20.3	17.7
Conductivity	umhos/cm	3	2550	6560	488
Hardness (as CaCO3)	mg/L	10	809	566	238
pH	pH units	0.1	7.53	7.78	7.97
Total Dissolved Solids	mg/L	20	1350	3580	292
Turbidity	NTU	0.1	588	132	224
Anions and Nutrients					
Alkalinity, Total (as CaCO3)	mg/L	10	462	386	261
Ammonia, Total (as N)	mg/L	0.01	<0.010	<0.010	<0.010
Chloride (Cl)	mg/L	0.5	638	2650	5.1
Fluoride (F)	mg/L	0.02	<0.10	<0.40	0.05
Nitrate (as N)	mg/L	0.02	3.34	2.73	1.73
Nitrite (as N)	mg/L	0.01	<0.050	<0.20	<0.010
Orthophosphate-Dissolved (as P)	mg/L	0.003	<0.0030	<0.0030	<0.0030
Sulfate (SO4)	mg/L	0.3	17.6	77.1	4.81
Total Metals					
Aluminum (Al)-Total	mg/L	0.01	9.04	3.98	2.69
Antimony (Sb)-Total	mg/L	0.0001	<0.0010	<0.0010	<0.00010
Arsenic (As)-Total	mg/L	0.0001	0.0026	0.0012	0.00084
Barium (Ba)-Total	mg/L	0.0002	0.143	0.146	0.0292
Beryllium (Be)-Total	mg/L	0.0001	<0.0010	<0.0010	0.00011
Bismuth (Bi)-Total	mg/L	0.00005	<0.00050	<0.00050	<0.000050
Boron (B)-Total	mg/L	0.01	<0.10	<0.10	<0.010
Cadmium (Cd)-Total	mg/L	0.00001	0.00007	<0.000050	0.000018
Calcium (Ca)-Total	mg/L	0.5	290	201	88.5
Cesium (Cs)-Total	mg/L	0.00001	0.00052	0.00023	0.000161
Chromium (Cr)-Total	mg/L	0.0005	0.0124	0.008	0.00643
Cobalt (Co)-Total	mg/L	0.0001	0.009	0.004	0.00283
Copper (Cu)-Total	mg/L	0.001	0.0203	0.0101	0.0083
Iron (Fe)-Total	mg/L	0.05	11.9	5.14	3.45
Lead (Pb)-Total	mg/L	0.0001	0.00592	0.00276	0.00294
Magnesium (Mg)-Total	mg/L	0.05	20.6	15.3	4.25
Manganese (Mn)-Total	mg/L	0.0005	0.579	0.221	0.179
Molybdenum (Mo)-Total	mg/L	0.00005	0.00051	0.00079	0.000323
Nickel (Ni)-Total	mg/L	0.0005	0.0128	0.0053	0.00549
Phosphorus (P)-Total	mg/L	0.05	0.57	0.52	0.15
Potassium (K)-Total	mg/L	0.05	2.68	2.43	0.981
Rubidium (Rb)-Total	mg/L	0.0002	0.012	0.0054	0.00339
Selenium (Se)-Total	mg/L	0.00005	<0.00050	<0.00050	0.000255
Silicon (Si)-Total	mg/L	0.1	18.7	10.3	8.11
Silver (Ag)-Total	mg/L	0.00005	<0.00050	<0.00050	<0.000050
Sodium (Na)-Total	mg/L	0.5	421	1420	61.9
Strontium (Sr)-Total	mg/L	0.001	0.589	2.49	0.178
Sulfur (S)-Total	mg/L	0.5	5.4	22.2	1.95
Tellurium (Te)-Total	mg/L	0.0002	<0.0020	<0.0020	<0.00020
Thallium (Tl)-Total	mg/L	0.00001	<0.00010	<0.00010	0.000029
Thorium (Th)-Total	mg/L	0.0001	0.0051	0.0026	0.00168
Tin (Sn)-Total	mg/L	0.0001	0.0011	<0.0010	0.00114
Titanium (Ti)-Total	mg/L	0.0003	0.539	0.219	0.106
Tungsten (W)-Total	mg/L	0.0001	<0.0010	<0.0010	<0.00010
Uranium (U)-Total	mg/L	0.00001	0.00048	0.0005	0.000169
Vanadium (V)-Total	mg/L	0.0005	0.0183	0.0084	0.00584
Zinc (Zn)-Total	mg/L	0.003	0.038	<0.030	0.011
Zirconium (Zr)-Total	mg/L	0.0003	0.002	<0.0020	0.00064

Table 3. MECP Well Summary and Impact Assessment

Well Details								Impact Assessment		
Well ID	Date Completed	Easting	Northing	Final Status	Primary Use	Secondary Use	Well Depth (m)	Distance from Site (m)	Location in Reference to the Site	Anticipated Impact from Proposed Development
5735778	8-Dec-2000	604858	4910230	Abandoned-Other	N.A.	N.A.	0	Not Required		
5735780	5-Dec-2000	604892	4910780	Abandoned-Other	N.A.	N.A.	0			
7153784	27-Aug-2010	604609	4909994	Abandoned-Other	Monitoring and Test Hole	N.A.	20			
7153784	27-Aug-2010	604618	4909992	Abandoned-Other	Monitoring and Test Hole	N.A.	20			
7207770	4-Jul-2013	604805	4910680	Monitoring and Test Hole	Monitoring and Test Hole	N.A.	6.1	291	Hydraulically Cross-Gradient	None
5721021	23-Jun-1986	603888.4	4910395	Water Supply	Domestic	N.A.	42.67	487	Hydraulically Up-Gradient	None
5720702	10-Dec-1985	604466.4	4910589	Water Supply	Domestic	N.A.	16.46	REFER TO NOTES		
5701450	6-Jul-1965	604858.4	4910313	Water Supply	Livestock	Domestic	44.2	402	Hydraulically Cross-Gradient	None
5738555	18-Nov-2003	603885.3	4910395	Water Supply	Domestic	N.A.	66.45	489	Hydraulically Up-Gradient	None
5701447	3-Oct-1966	604634.4	4910111	Water Supply	Livestock	Domestic	6.1	399	Hydraulically Up-Gradient	None
5708906	28-Mar-1972	604844.4	4910703	Water Supply	Industrial	N.A.	45.72	335	Hydraulically Cross-Gradient	None

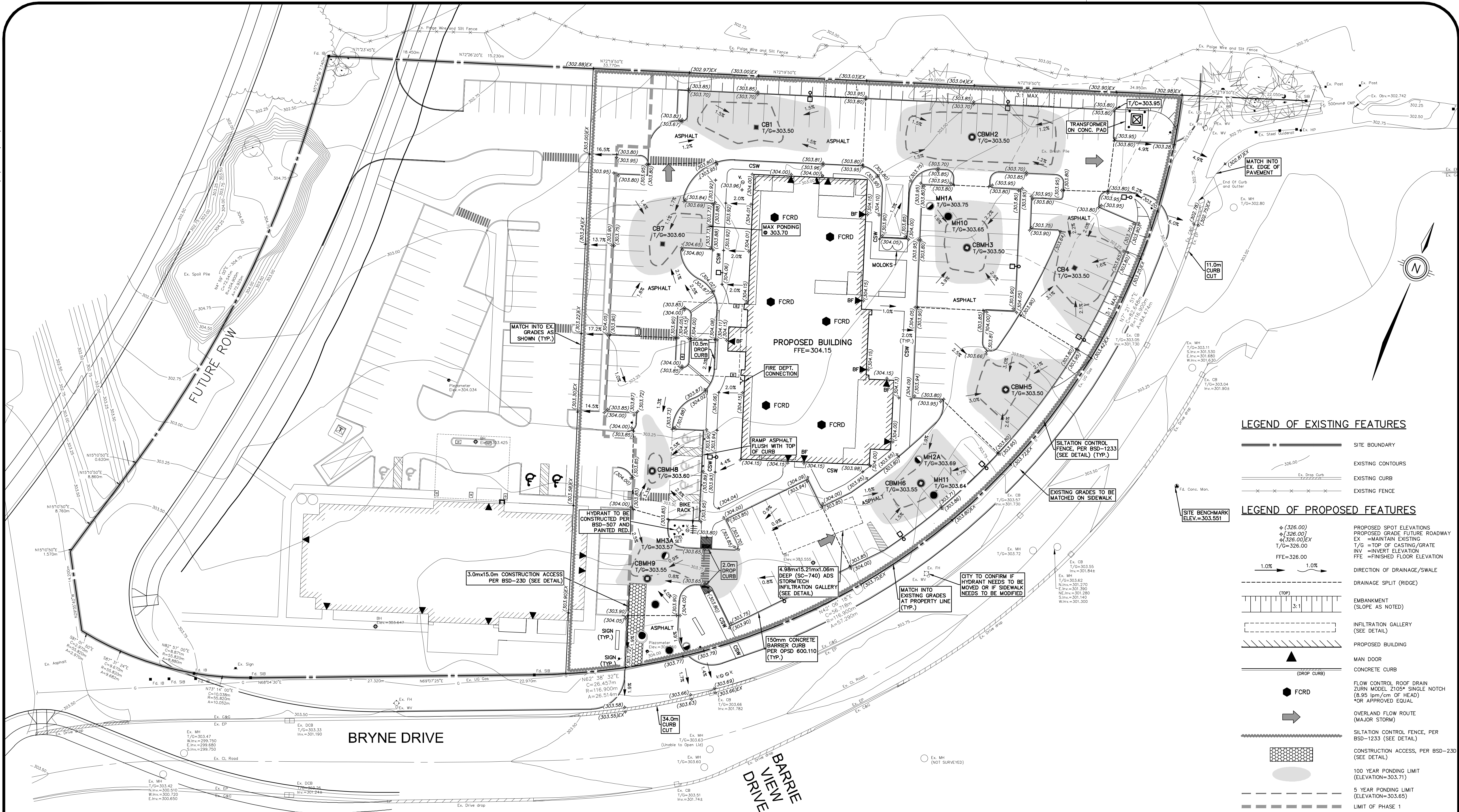
Notes:

The MECP Well record for Well ID 5720702 states that the well was installed in the Town of Innisfil. The location sketch provided in the well record illustrates the well to be located in an area outside of the Study Area for the Site, therefore, the location of the well in the MECP online database is considered to be inaccurate and the well will not be impacted by the proposed development.

N.A. = Information Not Available

Appendix A

Design Documents



NOTE:

1. PROPERTY—LINE IS APPROXIMATE ONLY AND IS TAKEN FROM PLAN PREPARED BY EPLETT & WOROBEC SURVEYING LTD. DATED OCTOBER 23, 1995 AND FEBRUARY 24, 2010.
2. INVERTS DENOTED WITH "±" ARE TAKEN FROM AS—RECORDED PLAN AND PROFILE DRAWINGS COMPLETED BY SKELTON BRUMWELL & ASSOCIATES INC. DATED OCTOBER, 1995 AND ARE CONSIDERED APPROXIMATE ONLY. CONTRACTOR TO FIELD VERIFY AND REPORT ANY DISCREPANCIES TO ENGINEER.
4. THIS PLAN IS PART OF A SET OF PLANS WHICH COMPRISE OF THE FOLLOWING: C1.1, C2.1, C2.2, C2.3, C2.4 AND THE SWM REPORT.

CITY OF BARRIE CONTROL MONUMENTS:

- (1) MONUMENT # 03120080046
TYPE: BRASS TABLET
ELEVATION: 303.551
- (2) MONUMENT # 03120080048
TYPE: BRASS TABLET
ELEVATION: 302.523

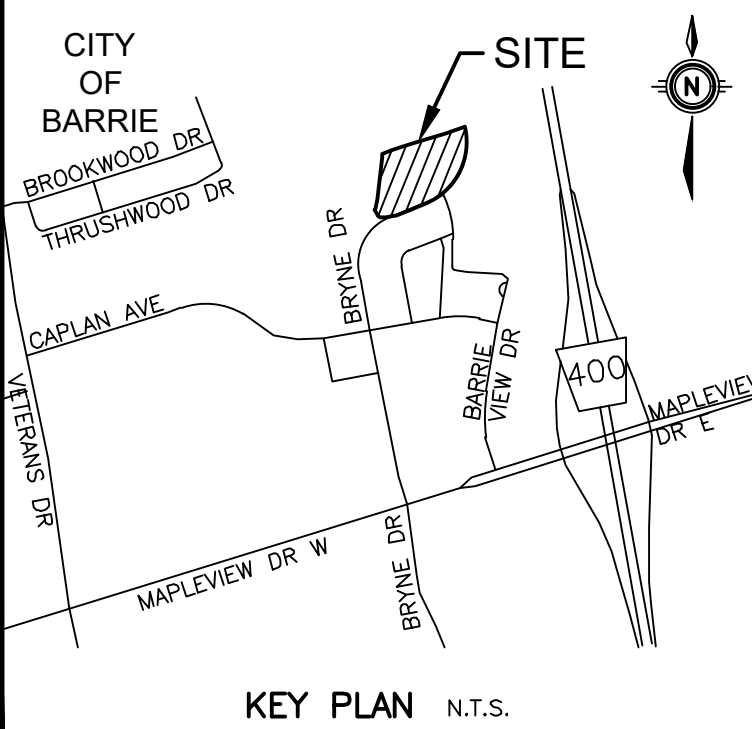
NOTE TO CONTRACTOR :

DO NOT SCALE DRAWINGS

CONTRACTORS MUST CHECK AND VERIFY ALL DIMENSIONS AND REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.

ALL DRAWINGS REMAIN THE PROPERTY OF THE ENGINEER
AND SHALL NOT BE REPRODUCED OR REUSED WITHOUT THE
ENGINEER'S WRITTEN PERMISSION.

THE OWNER/ARCHITECT/CONTRACTOR IS ADVISED THAT
M.T.E. CONSULTANTS INC. CANNOT CERTIFY ANY COMPONENT
OF THE SITE WORKS NOT INSPECTED DURING CONSTRUCTION
IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO
NOTIFY M.T.E. CONSULTANTS INC. PRIOR TO COMMENCEMENT
OF CONSTRUCTION TO ARRANGE FOR INSPECTION.



8.			
7.			
6.			
5.			
4.			
3.	Revised per City comments	jPL	JUL.23/20
2.	Revised per City comments	jPL	MAR.31/20
1.	ISSUED FOR APPROVAL	jPL	DEC.12/19
No.	REVISION	BY	DATE

GEODETIC BM

BRASS TABLET LOCATED ON EAST LIMIT OF BRYNE DRIVE (SOUTH SIDE OF ENTRANCE TO #311 BRYNE DRIVE. NOTE: PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.

SITE BENCHMARK

SEE ABOVE

ELEV

CLIENT

2599974 ONTARIO INC.

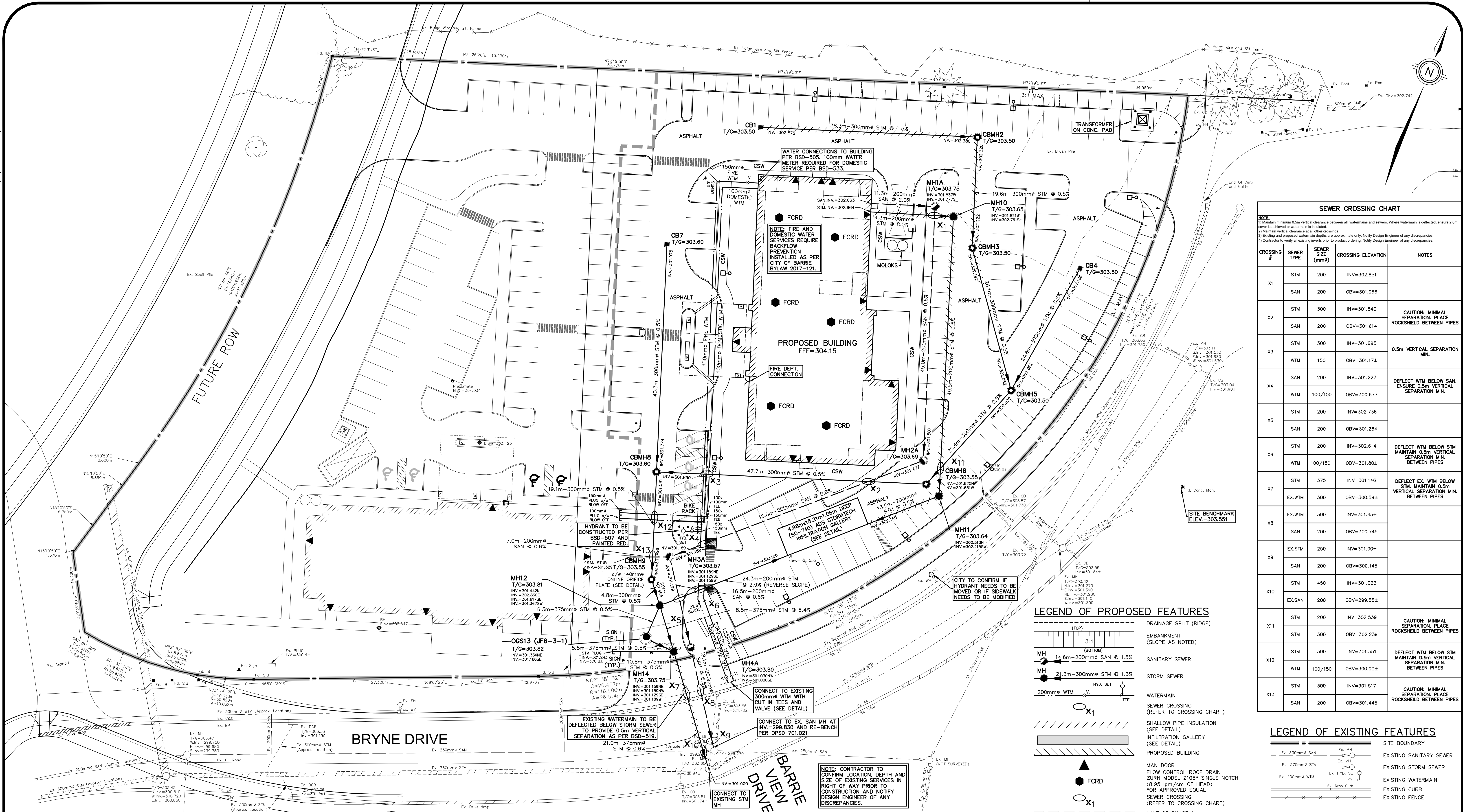
204 COOKS MILL CRESCENT

VAUGHAN

HOLIDAY INN EXPRESS

326 BRYNE DRIVE
DRAWING

		Engineers, Scientists, Surveyors	
		(519) 743-6500	
Project Manager		Project No. 45303-100	
Design By CAH		Checked By JPL	
Drawn By DDK		Checked By CAH	
Surveyed By MTE		Drawing No. C2.1	
Date Jan.25/19			
Scale 1:300		Sheet 2 of 5	



SEWER CROSSING CHART				
NOTE:				
1) Maintain minimum 0.5m vertical clearance between all watermain and sewers. Where watermain is deflected, ensure 2.0m cover is achieved or watermain is installed.				
2) Maintain vertical clearance at all other crossings.				
3) Existing and proposed watermain depths are approximate only. Notify Design Engineer of any discrepancies.				
4) Contractor to verify all existing inverts prior to product ordering. Notify Design Engineer of any discrepancies.				
CROSSING #	SEWER TYPE	SEWER SIZE (mm)	CROSSING ELEVATION	NOTES
X1	STM	200	INV=302.851	
	SAN	200	OBV=301.966	
X2	STM	300	INV=301.840	CAUTION: MINIMAL SEPARATION. PLACE ROCKSHIELD BETWEEN PIPES
	SAN	200	OBV=301.614	
X3	STM	300	INV=301.695	0.5m VERTICAL SEPARATION MIN.
	WTM	150	OBV=301.17±	
X4	SAN	200	INV=301.227	DEFLECT WTM BELOW SAN. ENSURE 0.5m VERTICAL SEPARATION MIN.
	WTM	100/150	OBV=300.677	
X5	STM	200	INV=302.736	
	SAN	200	OBV=301.284	
X6	STM	200	INV=302.614	DEFLECT WTM BELOW STM. MAINTAIN 0.5m VERTICAL SEPARATION MIN. BETWEEN PIPES
	WTM	100/150	OBV=301.80±	
X7	STM	375	INV=301.146	DEFLECT EX. WTM BELOW STM. MAINTAIN 0.5m VERTICAL SEPARATION MIN. BETWEEN PIPES
	EX.WTM	300	OBV=300.59±	
X8	EX.WTM	300	INV=301.45±	
	SAN	200	OBV=300.745	
X9	EX.STM	250	INV=301.00±	
	SAN	200	OBV=300.145	
X10	STM	450	INV=301.023	
	EX.SAN	200	OBV=299.55±	
X11	STM	200	INV=302.539	CAUTION: MINIMAL SEPARATION. PLACE ROCKSHIELD BETWEEN PIPES
	STM	300	OBV=302.239	
X12	STM	300	INV=301.551	DEFLECT WTM BELOW STM. MAINTAIN 0.5m VERTICAL SEPARATION MIN. BETWEEN PIPES
	WTM	100/150	OBV=300.00±	
X13	STM	300	INV=301.517	CAUTION: MINIMAL SEPARATION. PLACE ROCKSHIELD BETWEEN PIPES
	SAN	200	OBV=301.445	

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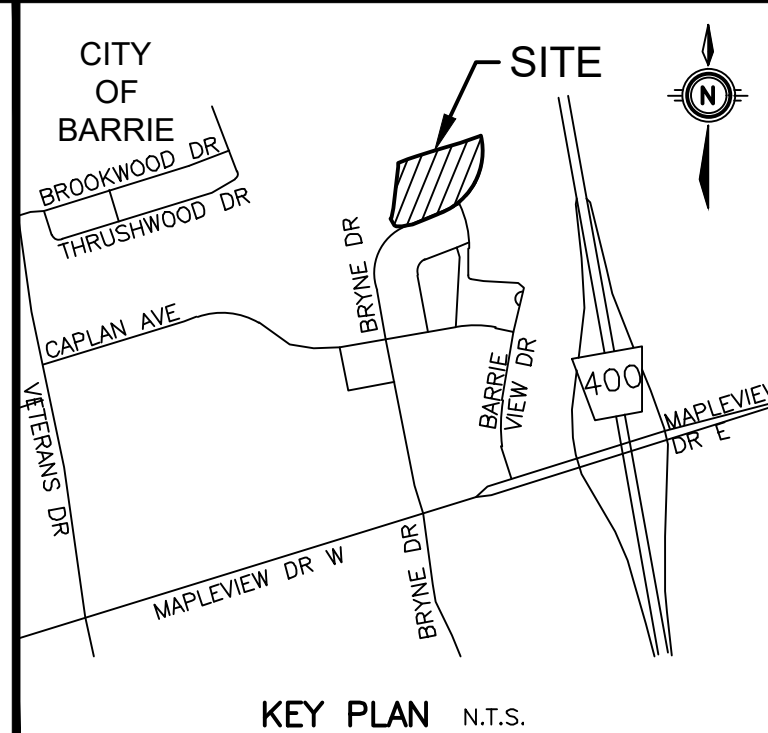
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CITY OF BARRIE



KEY PLAN N.T.S.

GEODETIC BM

BRASS TABLET LOCATED ON EAST LIMIT OF BRYNE DRIVE ON SOUTH SIDE OF ENTRANCE TO #311 BRYNE DRIVE. NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.

SITE BENCHMARK

SEE ABOVE.

ELEV. = 303.551 m

CLIENT

2599974 ONTARIO INC.

204 COOKS MILL CRESCENT

VAUGHAN

PROJECT

HOLIDAY INN EXPRESS

326 BRYNE DRIVE

DRAWING

BARRIE

SITE SERVICING PLAN



Engineers, Scientists, Surveyors

(519) 743-6500

www.mte85.com

Project Manager

J. LERCH

Design By

CAH

Drawn By

DDK

Surveyed By

MTE

Date

Jan.25/19

Scale

1:300

Project No.

45303-100

Checked By

JPL

Checked By

CAH

Drawing No.

C2.2

Sheet

3 of 5

Appendix B

Geotechnical Report



**REPORT ON
GEOTECHNICAL INVESTIGATION
316, 326 AND 336 BRYNE DRIVE
BARRIE, ONTARIO**

**REPORT NO.: 4649-18-GB
REPORT DATE: MARCH 8, 2019**

**PREPARED FOR
MERIDIAN CREDIT UNION
592 YONGE STREET
BARRIE, ONTARIO
L4N 4E4**



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DRAWINGS & FIGURE

Borehole Location Plan
Borehole Logs (BH-1 to BH-15)
Sections
Gradation Curves

Drawing No. 1
Drawing Nos. 2-16
Drawing Nos. 17 & 18
Figure No. 1

1.0 INTRODUCTION

Toronto Inspection Ltd. was retained by Mr. Jay Panchal on behalf of Meridian Credit Union to conduct a geotechnical investigation for the property, located at 316, 326 and 336 Bryne Drive in Aurora, Ontario (hereafter described as “the Site”).

It is our understanding that the development at the Site will consist of two six storey hotel buildings. The purpose of the investigation was to determine the subsoil and groundwater conditions at the Site and provide our recommendations for the design and construction of the buildings. In particular, geotechnical data was to be provided for:

- General founding conditions
- Foundation design bearing pressures
- Construction recommendations
- Excavation recommendations

This report is provided on the basis of the above terms of reference and on an assumption that the design of the structure will be in accordance with the applicable guidelines, building codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, our office should be consulted to review the design and to confirm the recommendations and comments provided in the report.

2.0 SITE CONDITION

The Site, approximately 1.6 ha in area and irregular in shape, is located at the northwest side of Bryne Drive in Barrie, Ontario.

At the time of investigation, the Site was a vacant parcel with some trees, vegetation and snow at the ground surface. The site gradient was fairly flat, close to the street level, with slightly sloping down to the north.

3.0 INVESTIGATION PROCEDURE

The field work for the investigation was carried out on January 21 to 23 and 29, 2019. A total of fifteen sampled boreholes (BH-1 to BH-15), extending to depths of 6.4m to 9.8m from grade, were conducted in the property, at the locations as shown in the appended Borehole Location Plan, Drawing No. 1.

The boreholes were advanced using a track mounted drill rig, equipped with continuous flight solid stem augers, sampling rods and a drop hammer, supplied by a specialist

drilling contractor. Soil samples were taken at 0.76m intervals to depths of 3.0m below the existing ground level. Below the depth, the sampling frequency was increased to 1.5m. The samples were obtained using a split spoon sampler in conjunction with Standard Penetration Tests using a driving energy of 475 joules (350 ft-lbs). The soil samples were identified and logged in the field and were carefully bagged for later visual identification and the determination of moisture content.

Groundwater observations were made in the boreholes during and upon the completion of drilling. Boreholes BH-1, BH-13 and BH-15 were completed as observation wells to determine the static groundwater condition.

The locations of boreholes, established in the field by our field personnel, are shown on the appended Borehole Location Plan (Drawing No. 1). The ground elevations at the borehole locations were determined using the “TOP OF FIRE HYDRANT”, located at the southeast boundary of the Site, approximately 40m northeast of Barrie View Drive, on the west side of Bryne Drive, as a temporary bench mark (TBM).

The assumed elevation of 304.50m for the TBM does not represent the geodetic elevation.

4.0 SUMMARIZED SITE AND SUBSURFACE CONDITIONS

Reference is made to the appended Borehole Location Plan (Drawing No. 1), Logs of Boreholes (Drawing Nos. 2 to 16), for details of field work, including soil classification, inferred stratigraphy, and groundwater observations carried out during and on completion of borehole drilling.

The boreholes revealed that the subsoil, below the topsoil at the ground surface and fill, consisted of native silty sand, sandy silt and sand deposits. Brief descriptions of the sub soils, encountered at the borehole locations, were as follows:

4.1 Topsoil

Topsoil, approximately 125mm to 400mm in thickness, was contacted at the ground surface at all borehole locations.

4.2 Fill

A layer of fill was contacted below the surficial topsoil at all borehole locations, at depths of 0.125m to 0.4m from grade.

The fill consisted of silty sand to sand, trace to some gravel and pockets of clayey silt or sandy silt, with minor to some topsoil or rootlets. The fill extended to depths of 0.6m to 1.4m from grade. It is our opinion that this material probably represents the material disturbed during the farming process. For identification purpose, this layer has been identified as fill in the borehole logs.

4.3 Silty Sand

A silty sand deposit was contacted below the fill, at BH-8 and BH-13 locations, at depths of 1.1m and 0.6m from grade, respectively. The silty sand deposit contained some sandy silt and gravel.

Based on the Standard Penetration N-values of 10 to 59 blows per 0.3m penetration, the relative density of the silty sand deposit was compact to very dense.

The silty sand deposit, at BH-8 and BH-13 locations, extended to depths of 2.7m from grade.

The insitu moisture content of the soil samples retrieved from this deposit ranged from 8% to 10%, indicating moist to very moist conditions.

4.4 Sandy Silt

A sandy silt deposit was contacted below the fill at BH-9 location, at a depth of 1.2m from grade. The sandy silt deposit contained some silty sand, trace gravel, trace to some clayey silt and an isolated sand layer.

Based on the Standard Penetration N-values of 8 to 11 blows per 0.3m penetration, the relative density of the sandy silt deposit was loose to compact.

The sandy silt deposit, at BH-9 location, extended to a depth of 3.0m from grade.

The insitu moisture content of the soil samples retrieved from this deposit ranged from 12% to 22%, indicating very moist conditions with wet pockets.

4.5 Sand

A sand deposit was contacted below the fill, silty sand and sandy silt deposit, at all borehole locations, at depths of 0.6m to 3.0m from grade. The sand deposit, generally fine to medium grained with occasional coarse grained, contained some or layers of silty sand or sandy silt, and trace to gravel.

Based on the Standard Penetration N-values of 4 to more than 100 blows per 0.3m penetration, the relative density of the sand deposit was generally compact to very dense, with loose condition at the upper portion, at BH-2, BH-4, BH-6, BH-10 and BH-15 locations.

Materials of lower relative density, N-values in the range of 4 to 20 blows for a penetration of 0.3m penetration, were encountered at a number of boreholes, below the groundwater table. It is our opinion that the lower N-values are due to disturbance of the non-cohesive deposit by an excessive groundwater pressure in the sand deposit.

All the boreholes were terminated in the sand deposit, at depths of 6.4m to 9.8m from grade.

The insitu moisture content of the soil samples retrieved from this deposit ranged from 3% to 22%, indicating moist to wet conditions.

Grain size analyses were carried out on two selected soil samples from this deposit, obtained from Boreholes BH-2 (SS2 – at a depth of 0.9m) and BH-7 (SS3 – at a depth of 1.5m) using mechanical sieves. The grain size distributions are shown on the appended Figure No. 1.

4.6 Groundwater

Free water (cave-in) was recorded at the borehole locations, at depths of 2.7m to 5.8m (2.4m to 6.3m) from grade, during and upon completion of drilling and sampling.

On January 23 and 29, 2019, water levels were recorded in the observation wells at BH-1, BH-13 and BH-15 locations, at depths of 3.4m to 4.1m from grade.

Based on the moisture content profile of the soil samples retrieved from the boreholes and our field observations at the Site, during and upon completion of the drilling process, it is our opinion that there is a continuous groundwater within the sand deposit, at depths of 3.4m to 4.1m from grade. However, perched water may exist within the silty sand and sandy silt deposits or in the fill.

5.0 RECOMMENDATIONS

We understand that the development at the Site will consist of two six storey hotel building without basements, with driveway and parking lot. The slab-on-grade of the proposed buildings were not known at the time of preparation of this report. For the purpose of this report, we have assumed the finished floor elevations of the buildings will be at or above to the street level or the existing ground level.

Based on the subsoil and groundwater conditions encountered at the borehole locations, our comments and recommendations for the design and construction of the proposed structure are as follows:

5.1 Site Preparation

The soil description and the depths of topsoil and fill, as shown on the Borehole Logs, are specific depths at the borehole locations only. The thickness of topsoil, and the depth of fill at locations beyond the boreholes may be thicker or deeper. We recommend that the contractor bidding for the job should determine the depths of fill and any deleterious material by test pits and allow for the removal of the materials, including materials with high moisture and organic content, during the site preparation for site grading.

Any new fill, to be placed within the proposed building and pavement areas, should consist of organics free soil and compacted in 200mm lifts to at least 98% of its Standard Proctor maximum dry density.

Compressible topsoil and the fill material, containing relatively high organic content, will not be suitable for reuse in areas where future settlement cannot be tolerated. This material will have to be disposed off-site or reused in landscaped areas, subject to approval by the landscape architect.

5.2 Foundation Design

The proposed building can be supported on conventional spread/strip footings, founded on the native sand to silty sand deposits. However, the design bearing pressures will vary due to the varying relative density of the subsoils, below the fill at the Site.

The recommended design bearing pressures for conventional spread/strip footings, founded on the sand deposit, at different depths below the existing ground surface, are shown on the following charts:

Phase I Building at West Portion of the Site

Borehole ID	Founding Depth	Design Bearing Pressures		Founding Depth (m)	Design Bearing Pressures	
		SLS (kPa)	ULS (kPa)		SLS (kPa)	ULS (kPa)
BH-1	1.5m	150	220	3.5m	400	600
BH-2	1.5m	75	110	3.5m	400	600
BH-3	1.5m	150	220	2.5m	400	600
BH-4	1.5m	75	110	3.0m	400	600
BH-5	1.5m	200	300	2.5m	400	600

Phase II Building at East Portion of the Site

Borehole ID	Founding Depth	Design Bearing Pressures		Founding Depth (m)	Design Bearing Pressures	
		SLS (kPa)	ULS (kPa)		SLS (kPa)	ULS (kPa)
BH-6	1.5m	150	220	3.5m	400	600
BH-7	1.5m	150	220	2.5m	400	600
BH-8	1.5m	150	220	3.5m	400	600
BH-9	1.5m	100	200	3.5m	400	600
BH-10	1.5m	200	300	3.0m	400	600

The total and differential settlement of footings, designed for the above Serviceability Limit State, will not exceed 25mm and 20mm, respectively.

All perimeter footings or any footings, which may be exposed to freezing conditions, should be placed below the frost penetration depth of 1.5m below the outside grade or provided with an equivalent thermal protection.

It should be noted that the above recommendations for foundations have been analysed by **Toronto Inspection Ltd.** from the subsoil information obtained at the borehole locations. The bearing material, the interpretation between the boreholes and the recommendations of this report must be checked through field inspection provided by **Toronto Inspection Ltd.** to validate the information for use during the construction stage.

5.3 Floor Slab Construction

The floor slab can be designed and constructed as a conventional slab-on-grade method, on the sand deposit, below the fill. The subgrade should be thoroughly proof-rolled under the supervision of a geotechnical technician from **Toronto Inspection Ltd.** Any compressible, loose, or weak spots encountered during the proof rolling process, should be sub-excavated to a firm ground. Any backfill of the sub-excavated areas or new fill, below the slab-on-grade, should consist of organic free soils, compacted to at least 98% of its Standard Proctor maximum dry density (SPMDD).

A bedding consisting of at least 150 mm of granular A (OPSS Form 1010) or its approved equivalent, is recommended as a moisture barrier under a light to medium loaded floor slab. The bedding should be compacted to at least 100% SPMDD.

5.4 Earthquake Consideration

The Ontario Building Code requires that all buildings be designed to resist earthquake forces. In accordance with Table 4.1.8.4.A of the Ontario Building Code, the site classification for the Seismic Site Response is Class D (stiff soil).

The acceleration and velocity based site coefficients, F_a and F_v , should conform to Tables 4.1.8.4.B and 4.1.8.4.C. These values should be reviewed by the Structural Engineer.

5.5 Excavation and Backfilling

All excavations should comply with the Ontario Occupational Health and Safety Act. Any excavation should be sloped back to a safe angle of 45° or flatter. A flatter slope will be required for excavation in saturated soils.

The insitu moisture content of the fill is apparently higher than its optimum moisture content. This material may not be suitable for backfilling in its current

state. Selected on-site excavated soils can be reused for backfilling, provided they are free of organics and allowed to air dry to the dry side of its optimum, prior to placement. The use of the compressible fill should be limited to backfilling of locations where future settlement will be of little consequence.

Topsoil and other compressible fill removed from the Site may be reused in landscape areas, subject to the approval of the landscape architect.

Bedding for the underground services, including catch basins and manholes, should consist of OPSS Granular A, 20mm crusher run limestone, or equivalent.

No significant groundwater conditions are anticipated in excavations to depths of 3.5m from grade. However, the perched water may be encountered in the saturated fill or native deposit. Therefore, provision should be made to use filtered sumps to remove any groundwater seepage from the overburden or saturated soils, if encountered.

5.6 Pavement Construction

The existing on-site material consists of sandy silt to silty sand with trace of clayey silt. These materials are normally susceptible to medium frost.

The following minimum pavement design thicknesses are recommended based on the assumption that perforated sub-drains will be installed to prevent build-up of water in the granular bases of the pavement:

		Light Duty Parking	Heavy Duty Fire Routes
Asphaltic Concrete	OPSS HL3 or equivalent	65mm	40mm
	OPSS HL8 or equivalent	-	60mm
Base:	OPSS Granular A or 20mm crusher-run	150mm	150mm
Sub-base:	OPSS Granular B or 50mm crusher-run	200mm	300mm

The granular base and sub-base should be compacted to a minimum of 100% SPMDD. Asphaltic concrete should be compacted to at least 96% Marshall density.

The above pavement thicknesses are based on the favourable site conditions and the construction being carried out during the drier period of the year and that the subgrade is stable, not heaving under construction traffic. If the subgrade is wet and unstable, additional thickness of sub-base material may be required.



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Following site grading, the subgrade of the entire pavement should be proof-rolled using a heavy vibratory roller. Any soft spots revealed by the proof-rolling should be sub-excavated and replaced with an approved dry material and compacted to at least 98% of its SPMDD. If the subgrade is wet and unstable, the wet material should be removed from the subgrade and additional thickness of sub-base be used for road construction.

6.0 GENERAL STATEMENT OF LIMITATION

The comments and recommendations presented in this report are based on the subsoil and ground water conditions encountered at the borehole locations, indicated in the borehole location plan, and are intended for the guidance of the design engineer. Although we consider this report to be representative of the subsurface conditions at the subject property, the soil and the ground water conditions between and beyond the borehole locations may differ from those encountered at the time of our investigation and may become apparent during construction. Any contractor bidding on, or undertaking the works, should decide on their own investigation and interpretations of the groundwater and the soil conditions between the borehole locations.

Any use and/or the interpretation of the data presented in this report, and any decisions made on it by the third party are responsibility of the third parties. The responsibility of **Toronto Inspection Ltd.** is limited to the accurate interpretation of the soil and ground water conditions prevailing in the locations investigated and accepts no responsibility for the loss of time and damages, if any, suffered by the third party as a result of decisions or actions based on this report.

Any legal actions arising directly or indirectly from this work and/or **Toronto Inspection Ltd.**'s performance of the services shall be filed no longer than two years from the date of **Toronto Inspection Ltd.**'s substantial completion of the services. **Toronto Inspection Ltd.** shall not be responsible to the client for lost revenues, loss of profits, cost of content, claims of customers, or other special indirect, consequential, or punitive damages.

To the fullest extent permitted by law, the client's maximum aggregate recovery against **Toronto Inspection Ltd.**, its directors, employees, sub-contractors, and representatives, for any and all claims by clients for all causes including, but not limited to, claims of breach of contract, breach of warranty and/or negligence, shall be the amount of the fee paid to **Toronto Inspection Ltd.** for its professional services rendered under the agreement with respect to the particular site which is the subject of the claim by the client.

TORONTO INSPECTION LTD.



David S. Wang, P.Eng.
Senior Engineer



Upkar S. Sappal, P.Eng.
Principal Engineer



Toronto Inspection Ltd.

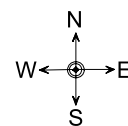
Drawings & Figure

Borehole Location Plan

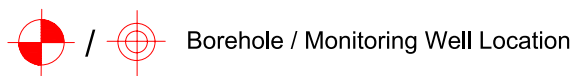
Borehole Logs (BH-1 to BH-15)

Sections

Gradation Curves



LEGEND



NOT TO SCALE

TorontoInspection
GEO-ENVIRONMENTAL CONSULTANTS

110 Konrad Crescent, Unit 16, Markham, Ontario L3R 9X2

Tel: 905-940 8509 Fax: 905-940 8192

Email : TIL@torontoinspection.com

TITLE:

Borehole / Monitoring Well Location Plan

LOCATION:

316, 326 and 336 Bryne Drive, Barrie, Ontario

PROJECT NO.

4649-18-GB

DATE :

January 2019

DRAWING NO :

1

Project No. 4649-18-GB

Log of Borehole **BH-1**

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/22/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

Natural Moisture

Plastic and Liquid Limit

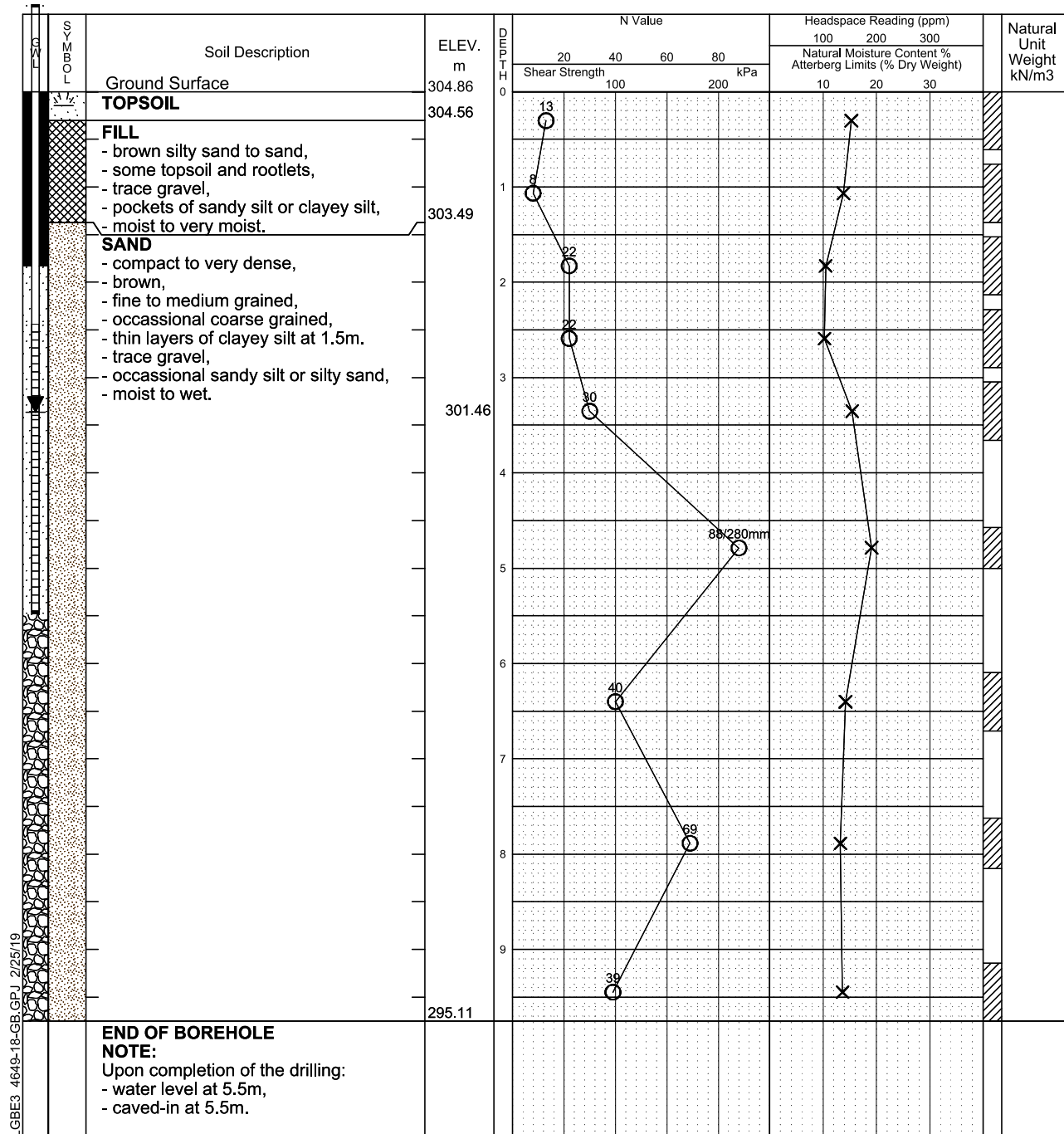
Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill Rig

Datum: Temporary



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

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Time	Water Level (m)	Depth to Cave (m)
Jan 23, 2019	3.5m	
Jan 29, 2019	3.4m	

Log of Borehole BH-2

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/22/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

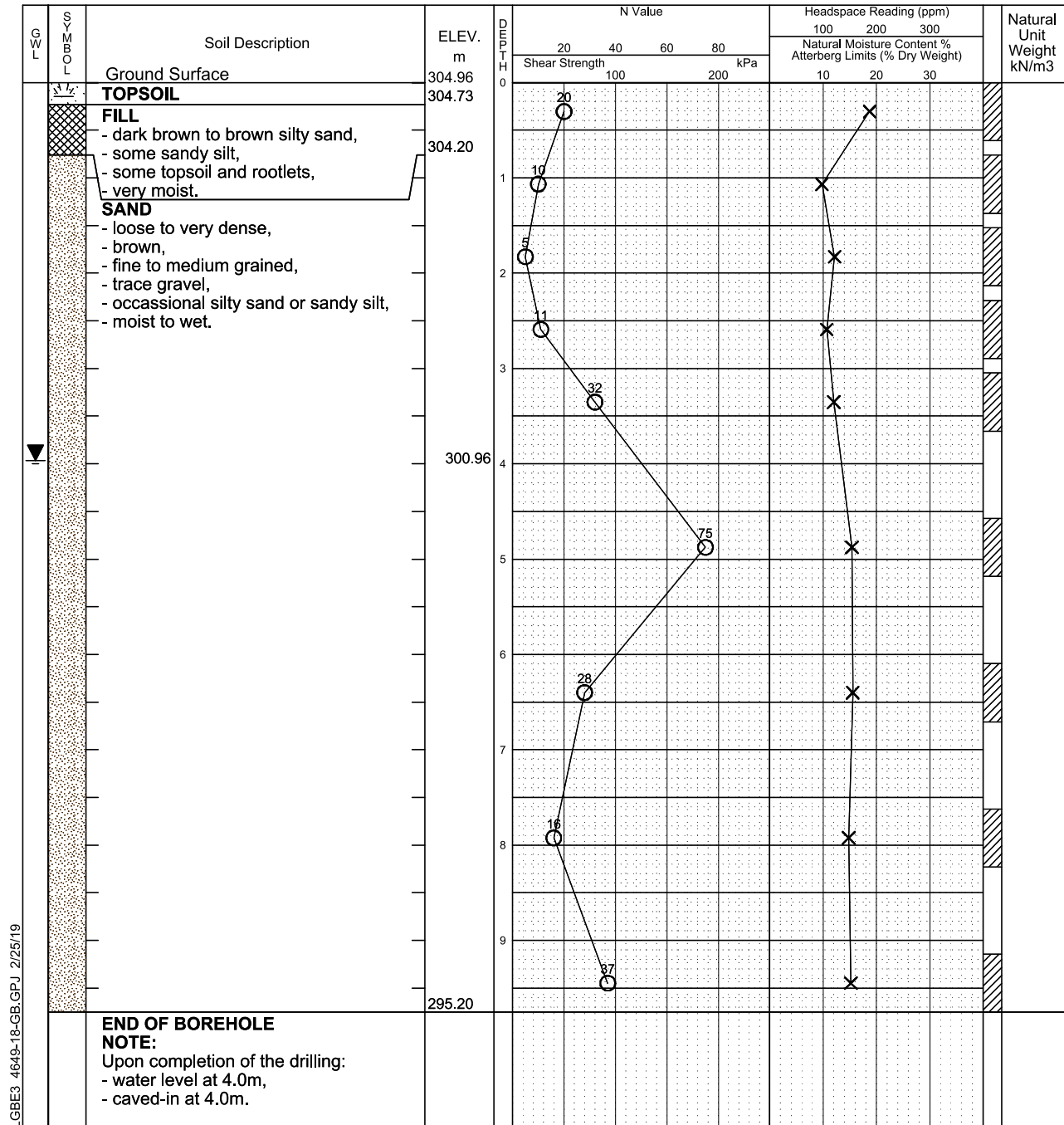
Natural Moisture

Plastic and Liquid Limit

Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill RigDatum: Temporary

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4649-18-GB

Log of Borehole **BH-3**

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/22/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

Natural Moisture

Plastic and Liquid Limit

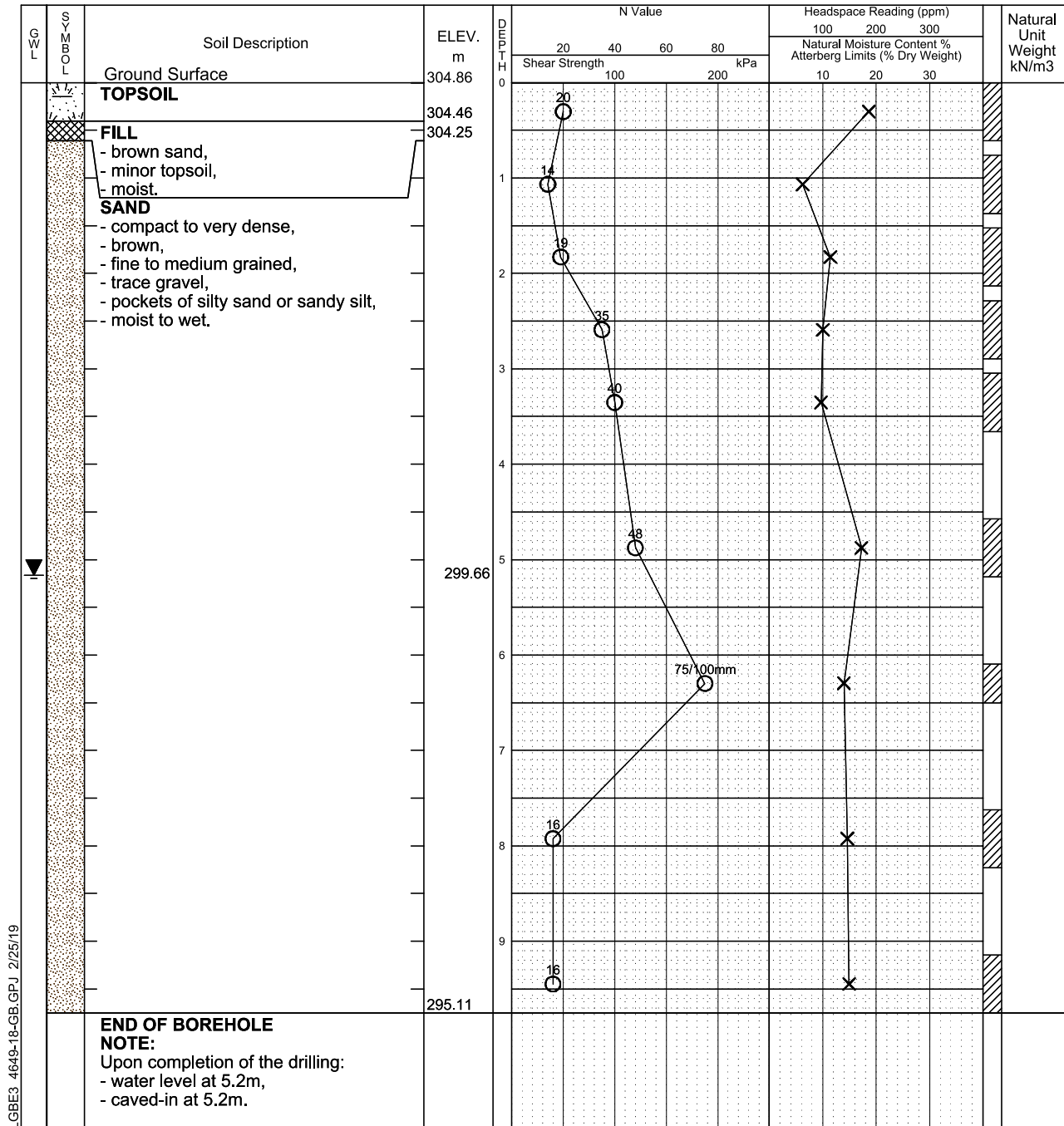
Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill Rig

Datum: Temporary



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Log of Borehole BH-4

Dwg No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

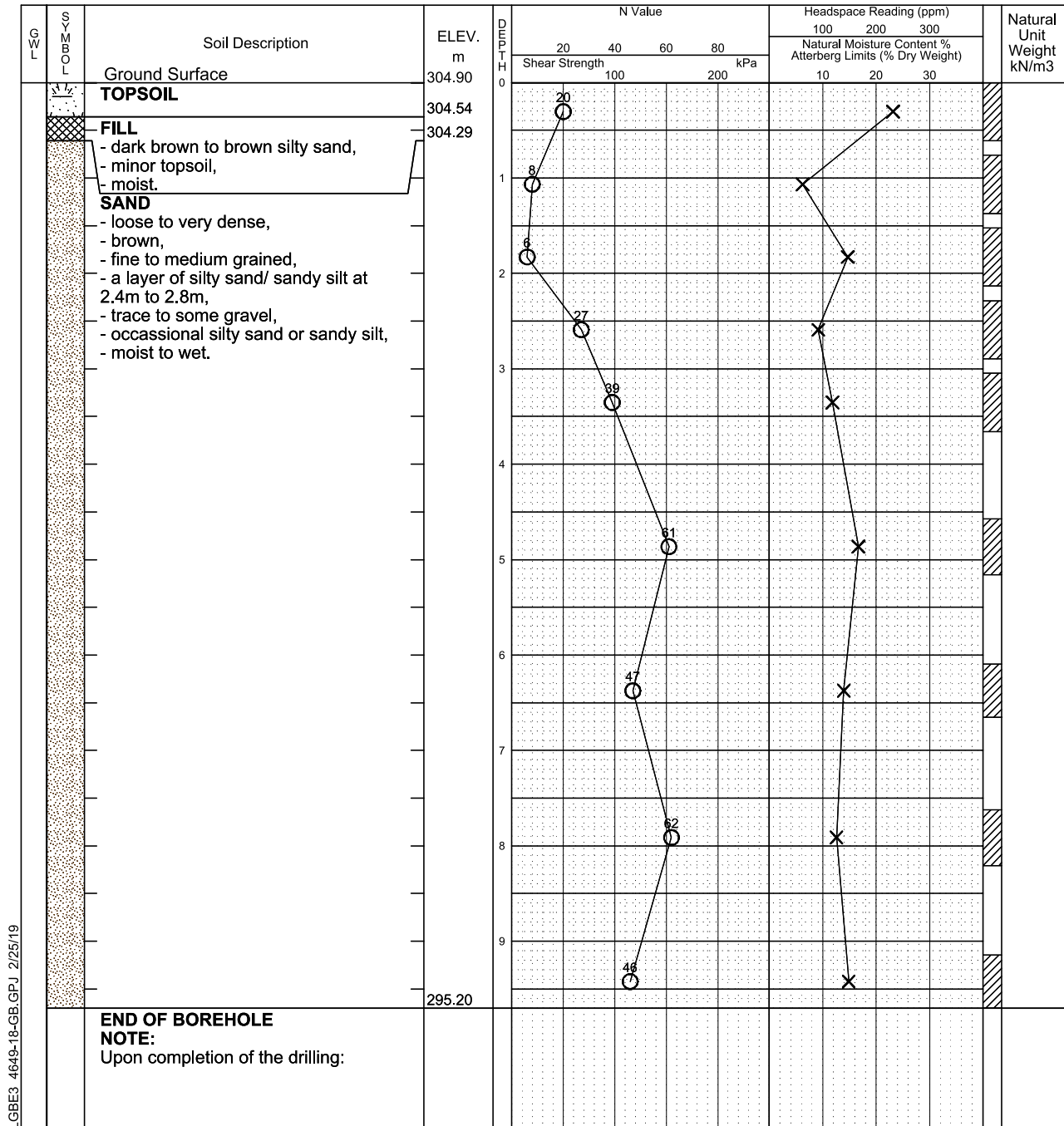
Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/23/19

Drill Type: Track Mounted Drill RigDatum: Temporary

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Log of Borehole BH-5

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/23/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

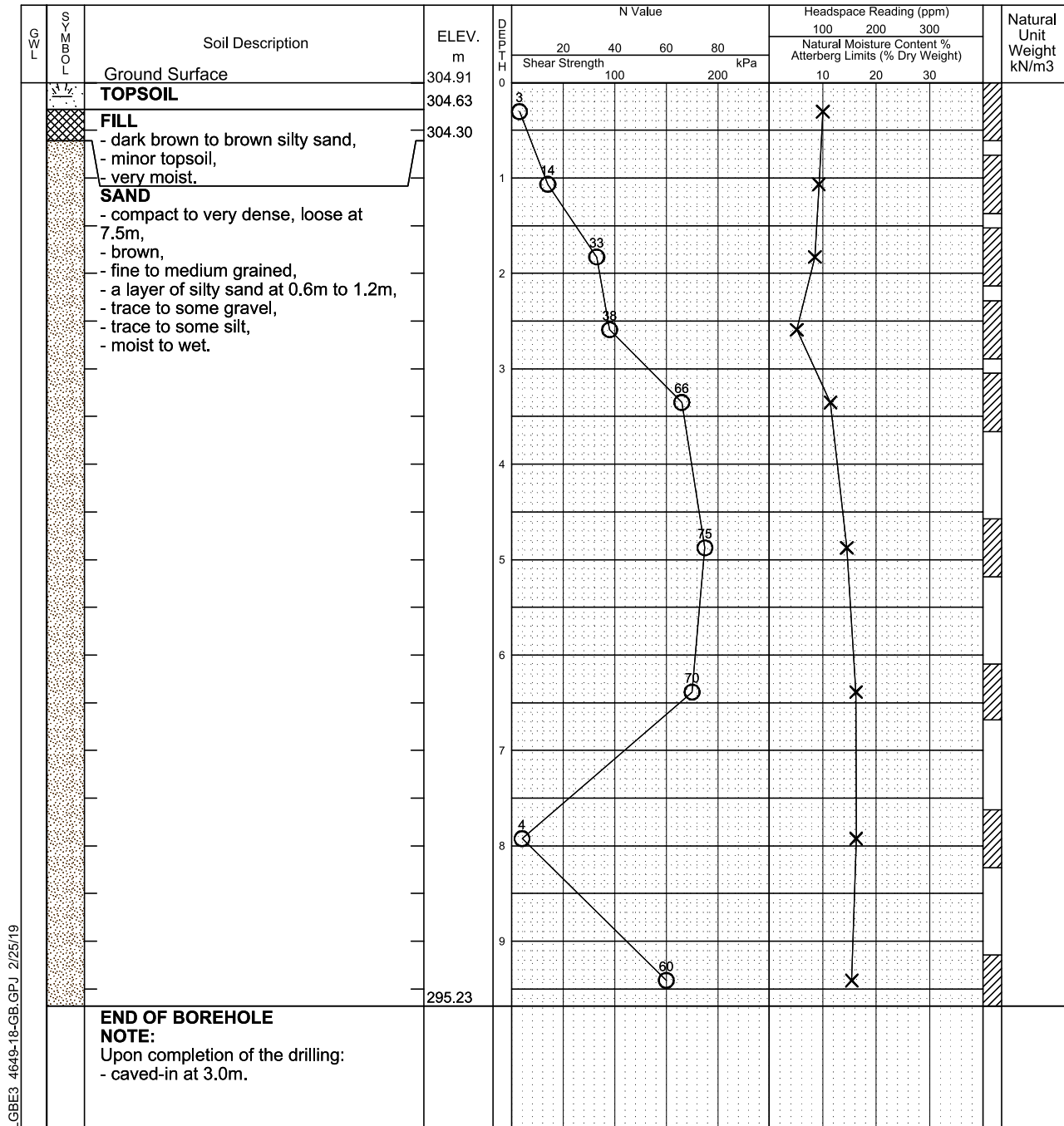
Natural Moisture

Plastic and Liquid Limit

Unconfined Compression

% Strain at Failure

Penetrometer



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Log of Borehole BH-6

Dwg No. 7

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/23/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

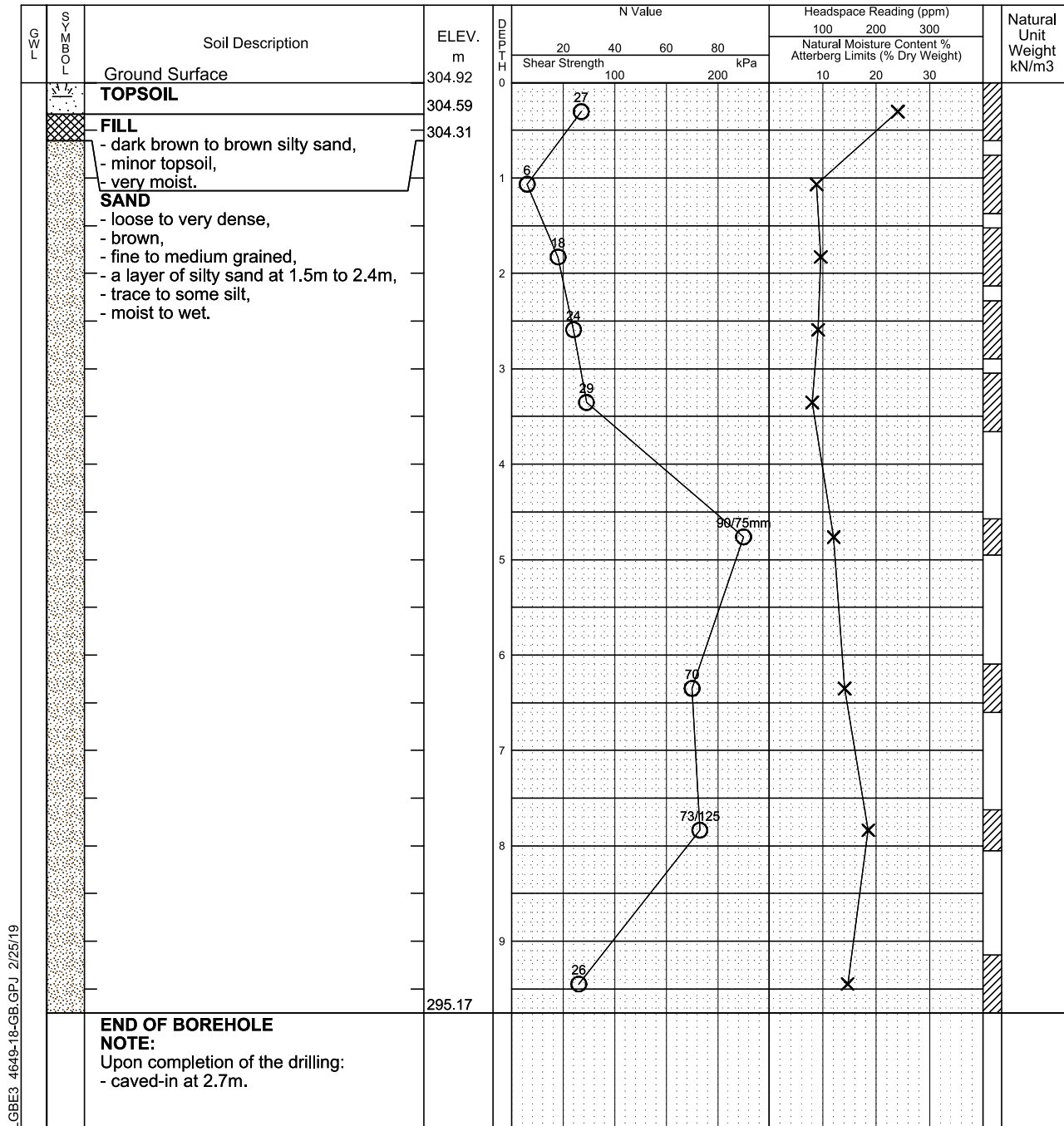
Natural Moisture

Plastic and Liquid Limit

Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill RigDatum: Temporary

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

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Time	Water Level (m)	Depth to Cave (m)

Log of Borehole BH-7

Dwg No. 8

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/23/19Drill Type: Track Mounted Drill RigDatum: Temporary

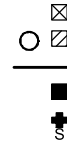
Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test



Headspace Reading (ppm)

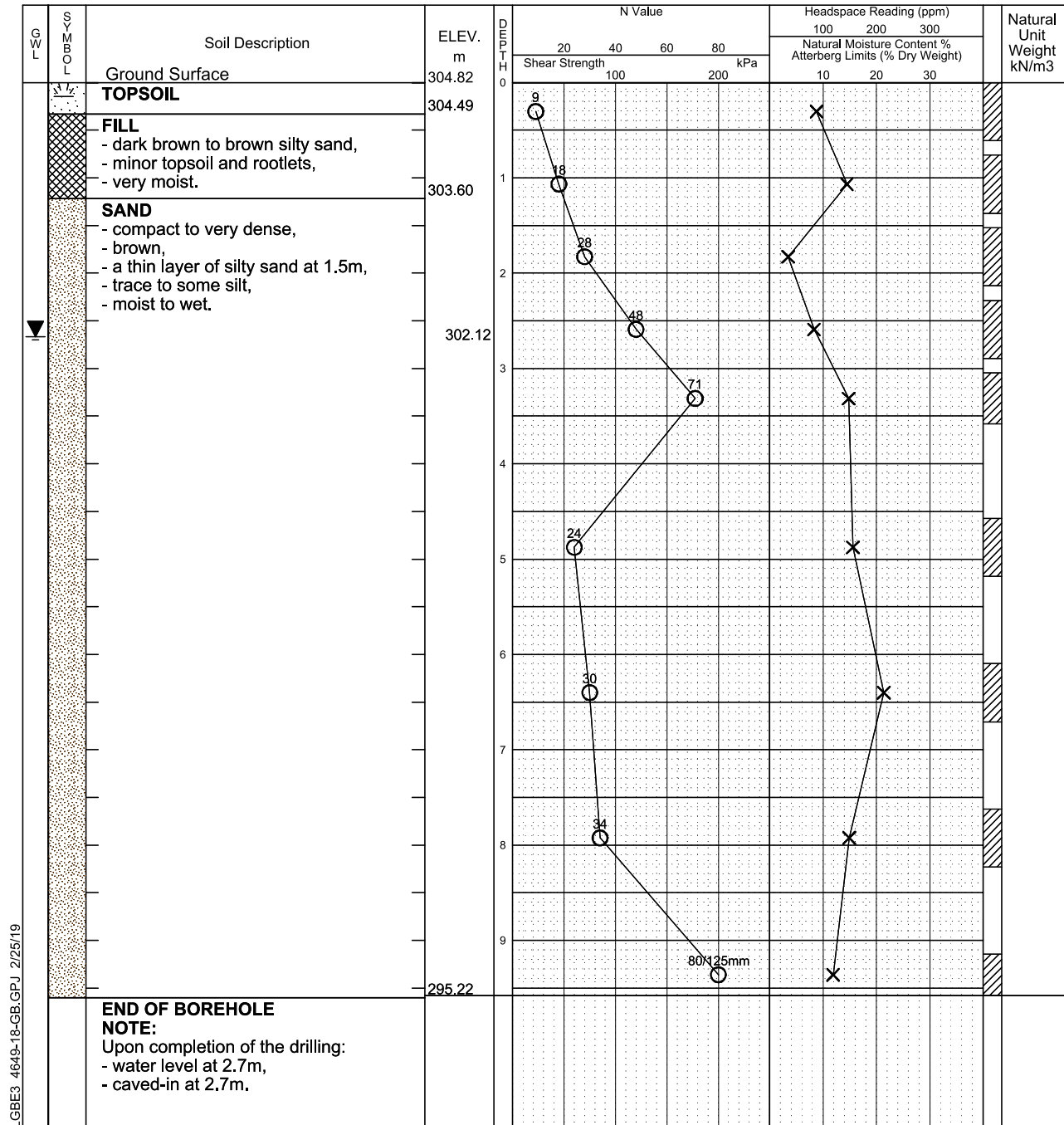
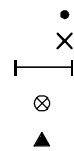
Natural Moisture

Plastic and Liquid Limit

Unconfined Compression

% Strain at Failure

Penetrometer



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4649-18-GB

Log of Borehole **BH-8**

Dwg No. 9

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/29/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

Natural Moisture

Plastic and Liquid Limit

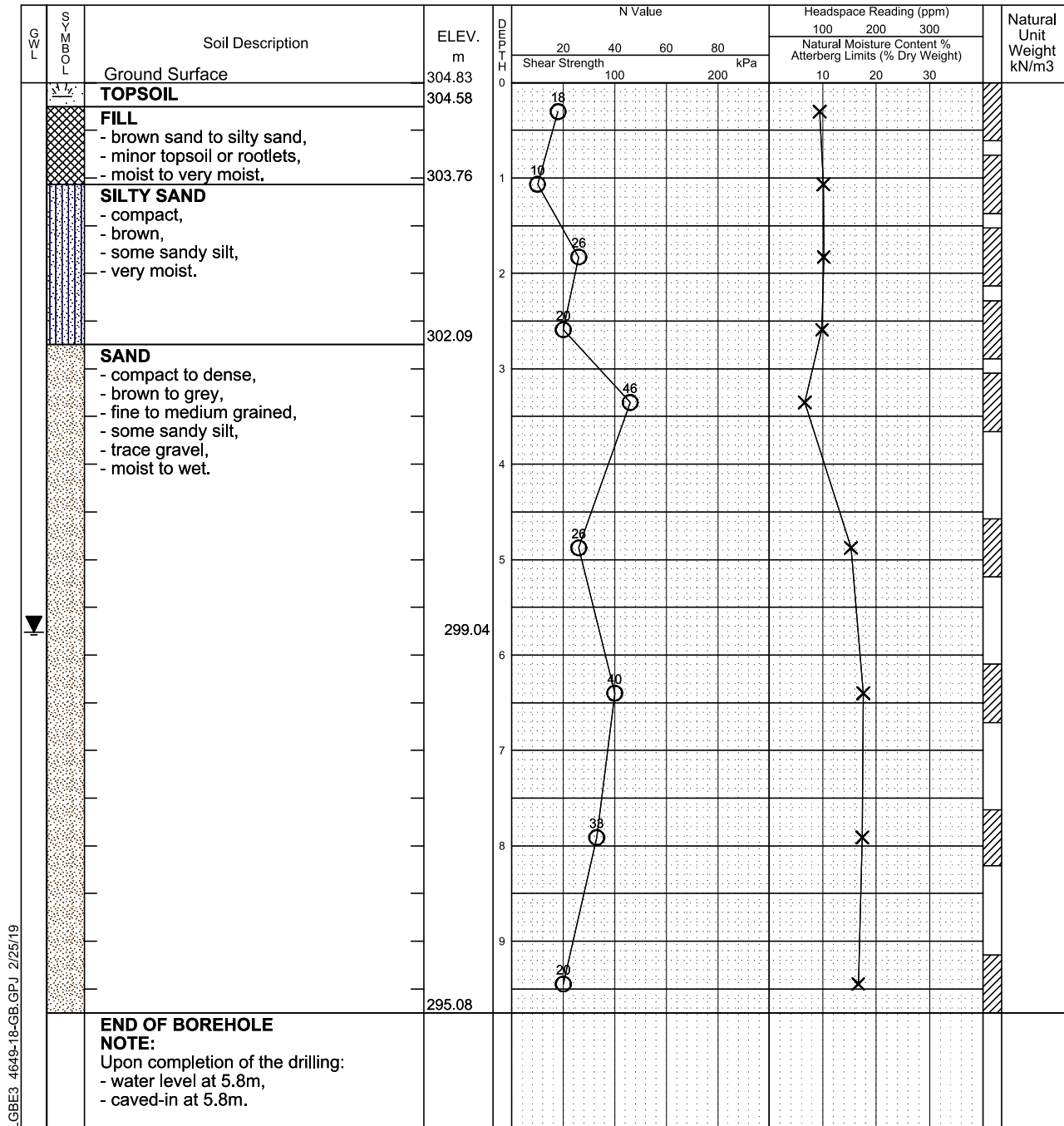
Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill Rig

Datum: Temporary



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

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Time	Water Level (m)	Depth to Cave (m)

Project No. 4649-18-GB

Log of Borehole **BH-9**

Dwg No. 10

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/29/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

Natural Moisture

Plastic and Liquid Limit

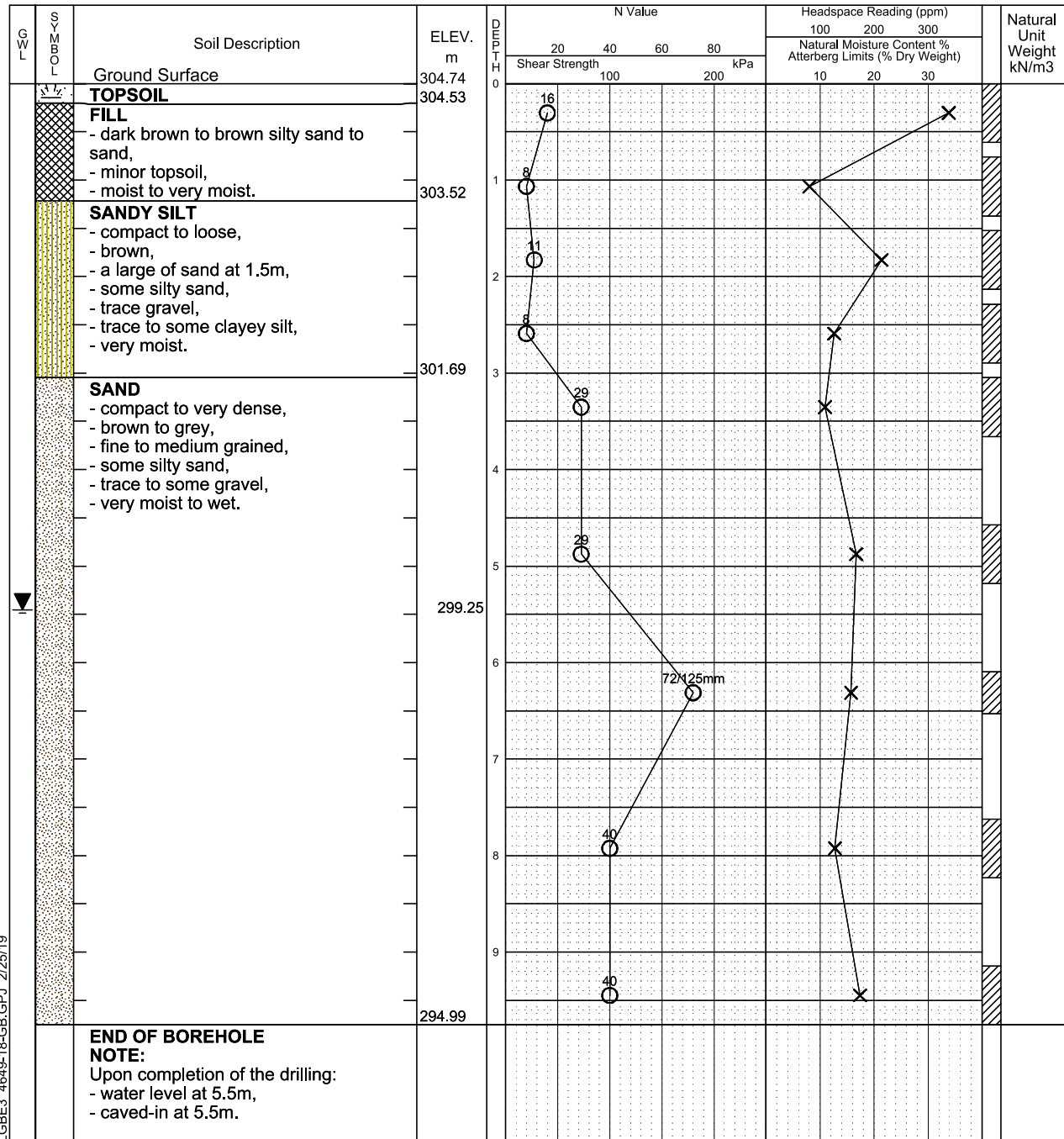
Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill Rig

Datum: Temporary



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

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Time	Water Level (m)	Depth to Cave (m)

Project No. 4649-18-GB

Log of Borehole **BH-10**

Dwg No. 11

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/29/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

Natural Moisture

Plastic and Liquid Limit

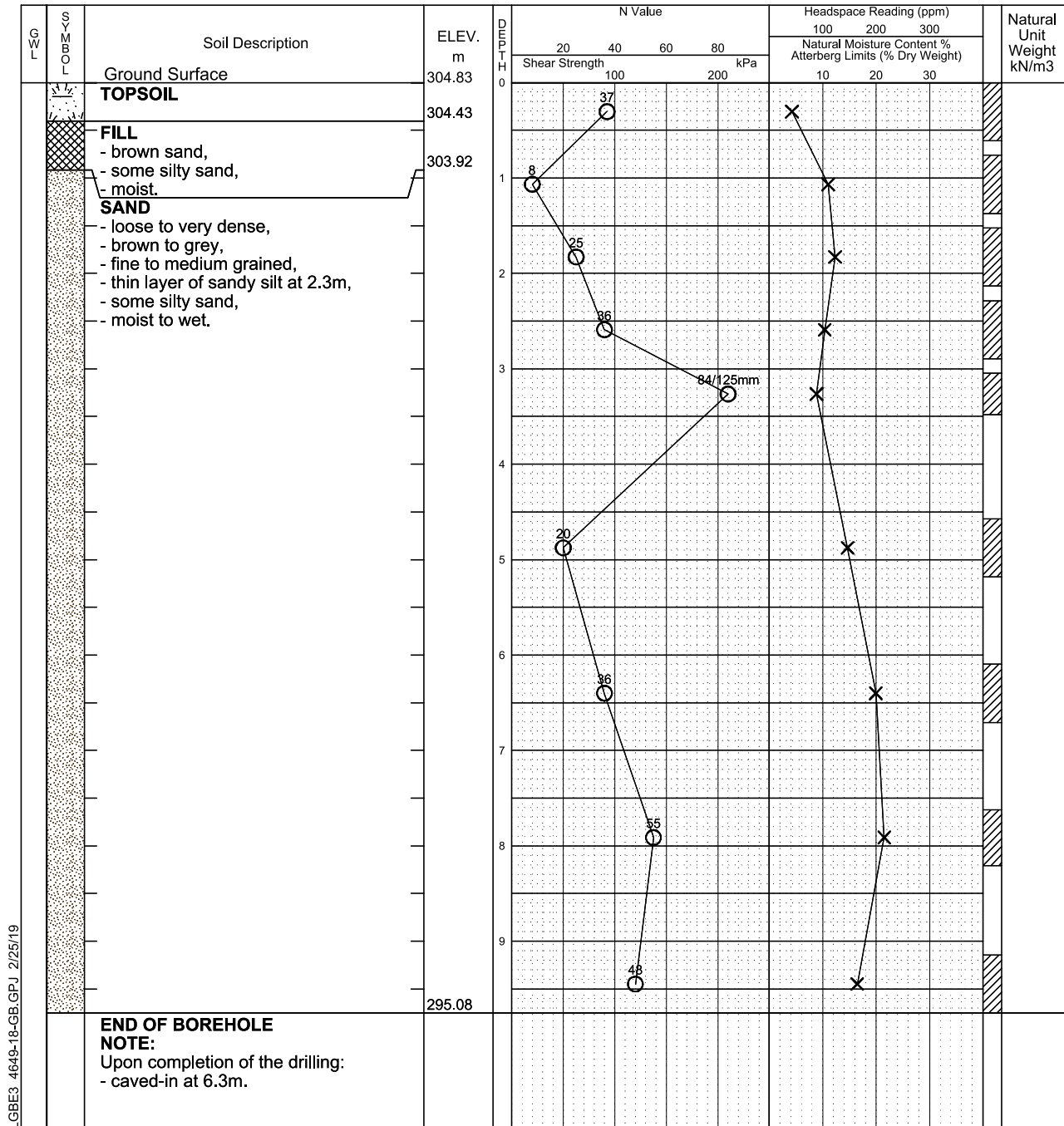
Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill Rig

Datum: Temporary



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

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Time	Water Level (m)	Depth to Cave (m)

Log of Borehole BH-11

Dwg No. 12

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/21/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

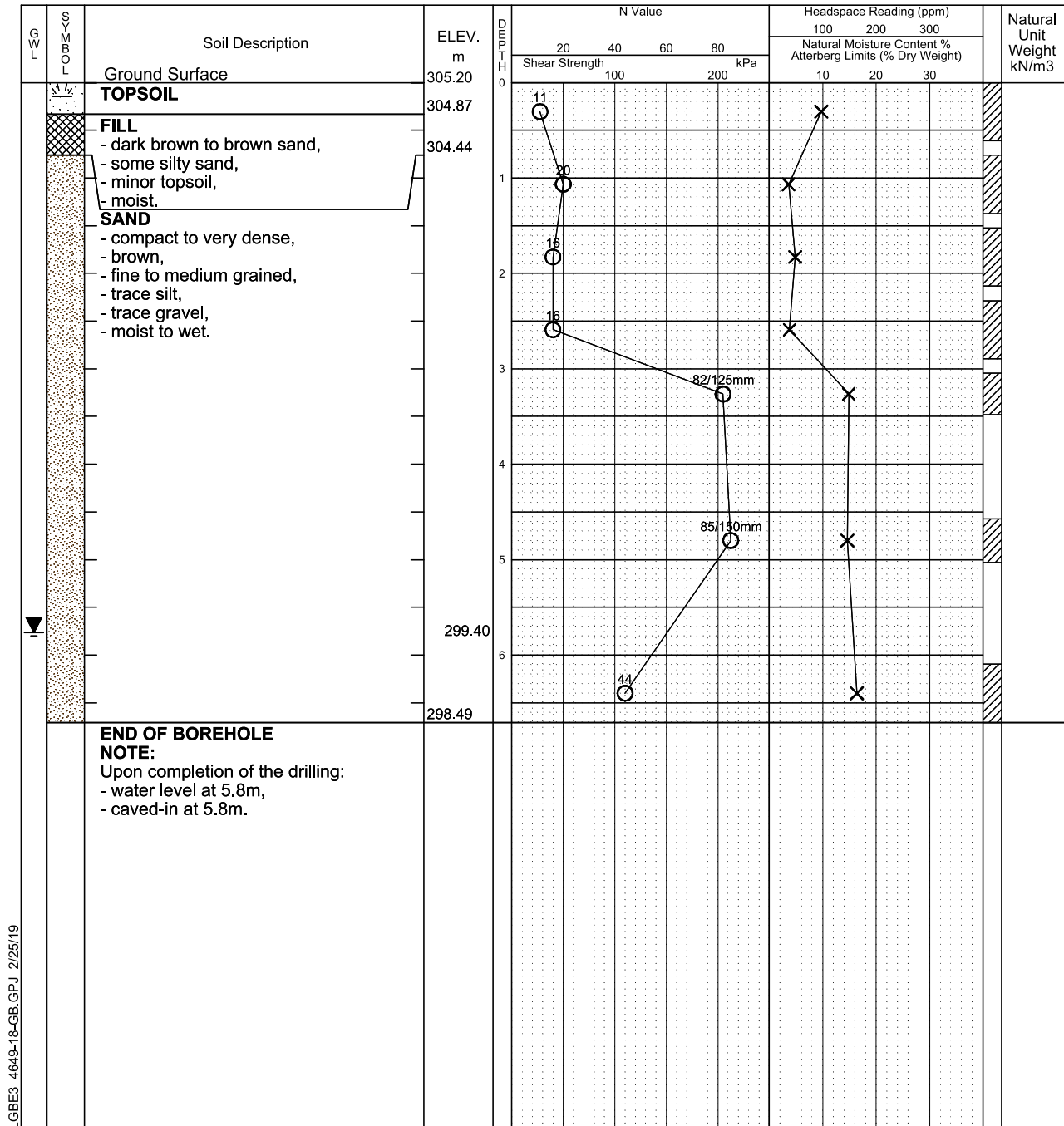
Natural Moisture

Plastic and Liquid Limit

Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill RigDatum: Temporary

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

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Time	Water Level (m)	Depth to Cave (m)

Log of Borehole BH-12

Dwg No. 13

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/22/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

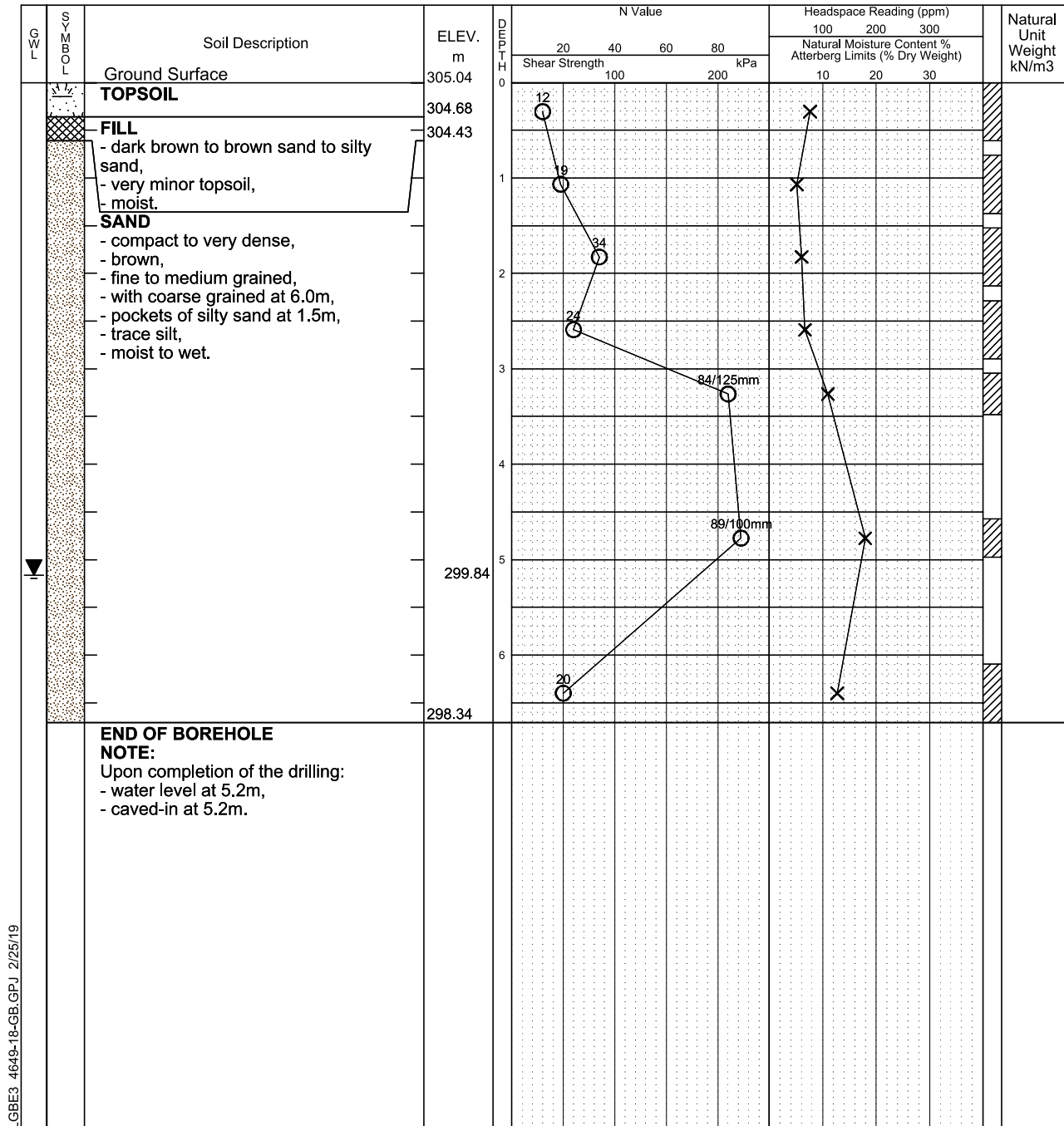
Natural Moisture

Plastic and Liquid Limit

Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill RigDatum: Temporary

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

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Time	Water Level (m)	Depth to Cave (m)

Project No. 4649-18-GB

Log of Borehole **BH-13**

Dwg No. 14

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/21/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

Natural Moisture

Plastic and Liquid Limit

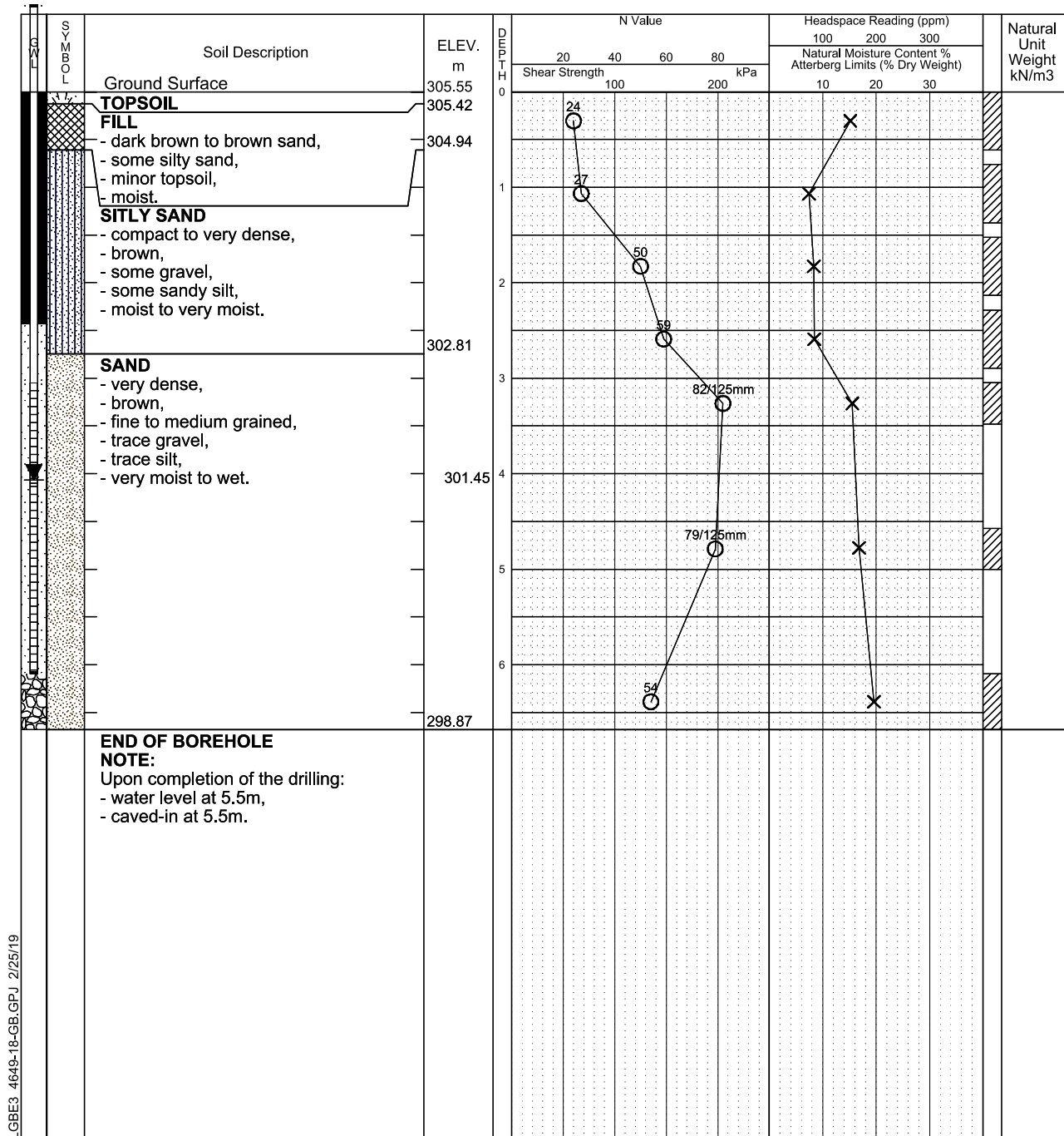
Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill Rig

Datum: Temporary



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Time	Water Level (m)	Depth to Cave (m)
Jan 23, 2019	4.1m	
Jan 29, 2019	4.1m	

Project No. 4649-18-GB

Log of Borehole **BH-14**

Dwg No. 15

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 316, 326 and 336 Bryne Drive, Barrie, Ontario

Date Drilled: 1/21/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

Natural Moisture

Plastic and Liquid Limit

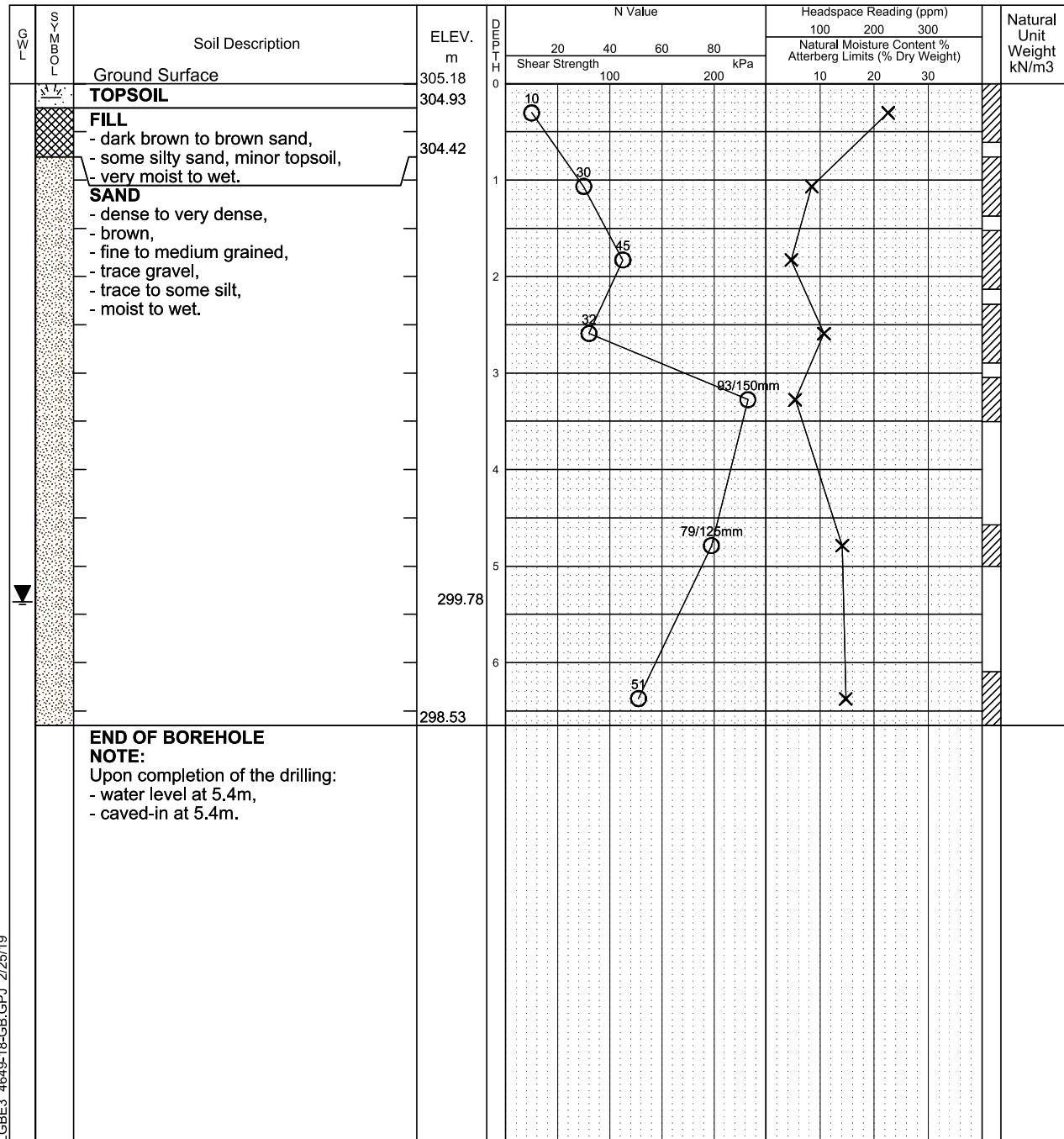
Unconfined Compression

% Strain at Failure

Penetrometer

Drill Type: Track Mounted Drill Rig

Datum: Temporary



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

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Time	Water Level (m)	Depth to Cave (m)

Project: Geotechnical InvestigationSheet No. 1 of 1Location: 316, 326 and 336 Bryne Drive, Barrie, OntarioDate Drilled: 1/22/19

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Headspace Reading (ppm)

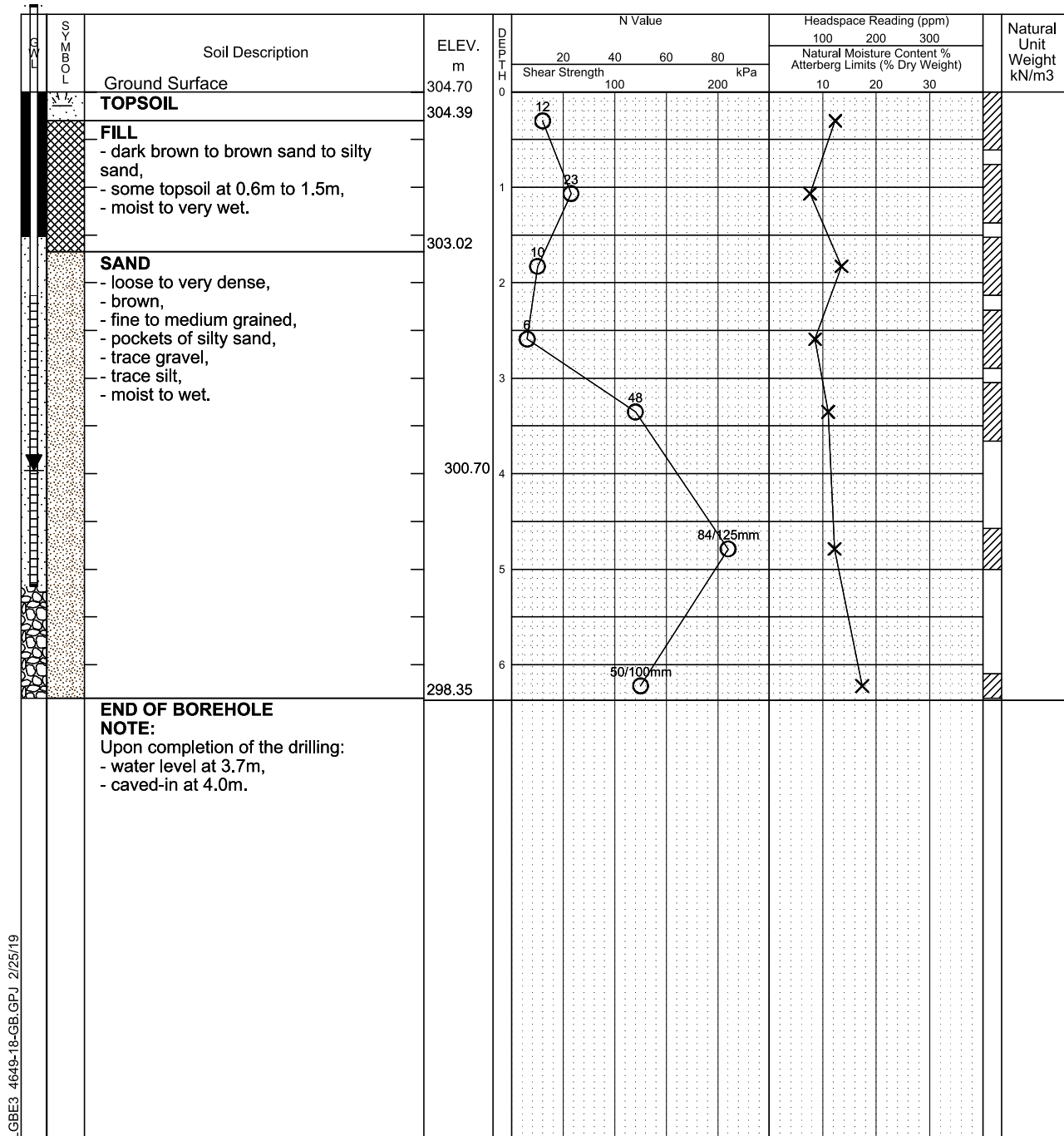
Natural Moisture

Plastic and Liquid Limit

Unconfined Compression

% Strain at Failure

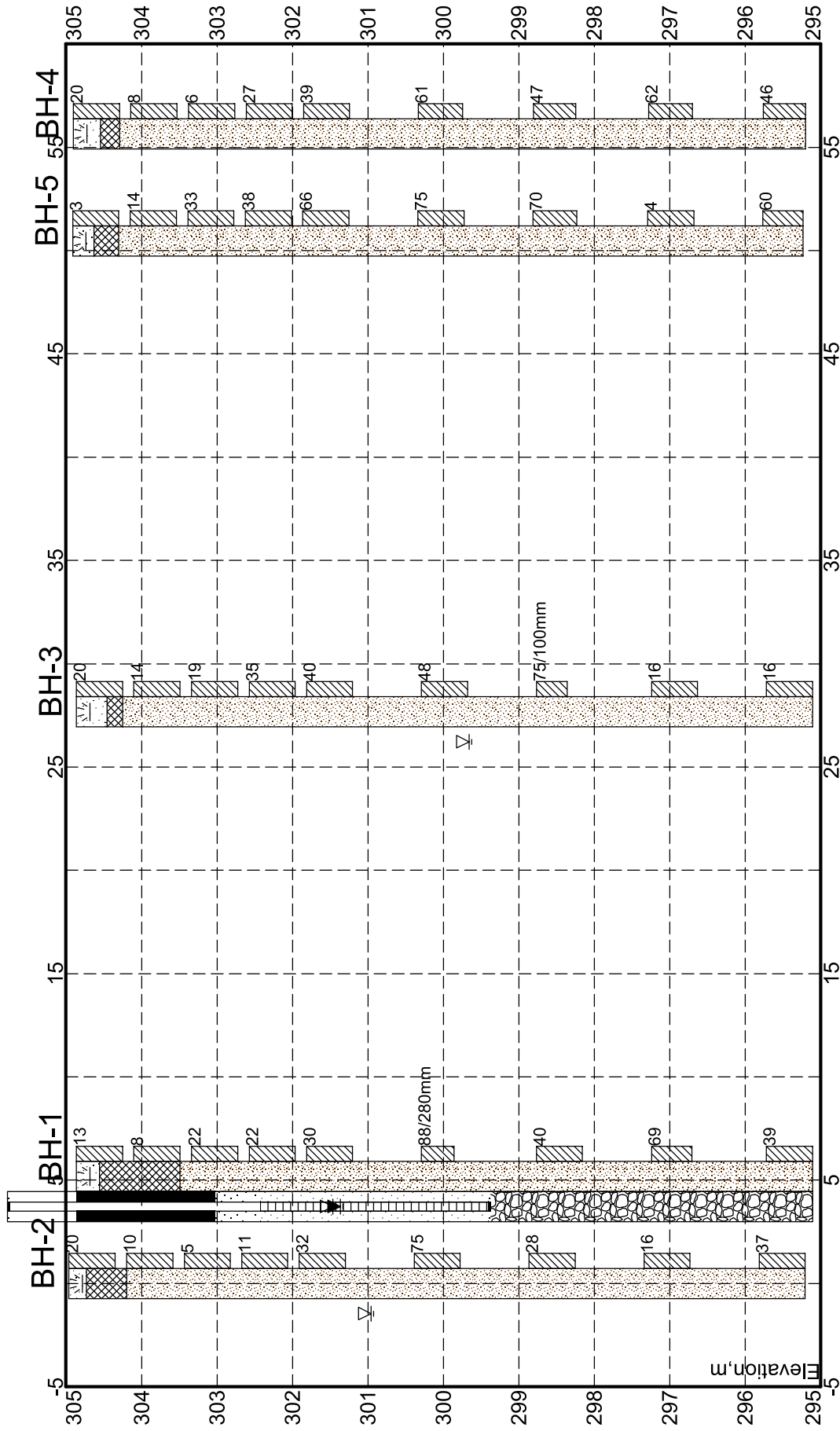
Penetrometer

Drill Type: Track Mounted Drill RigDatum: Temporary

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

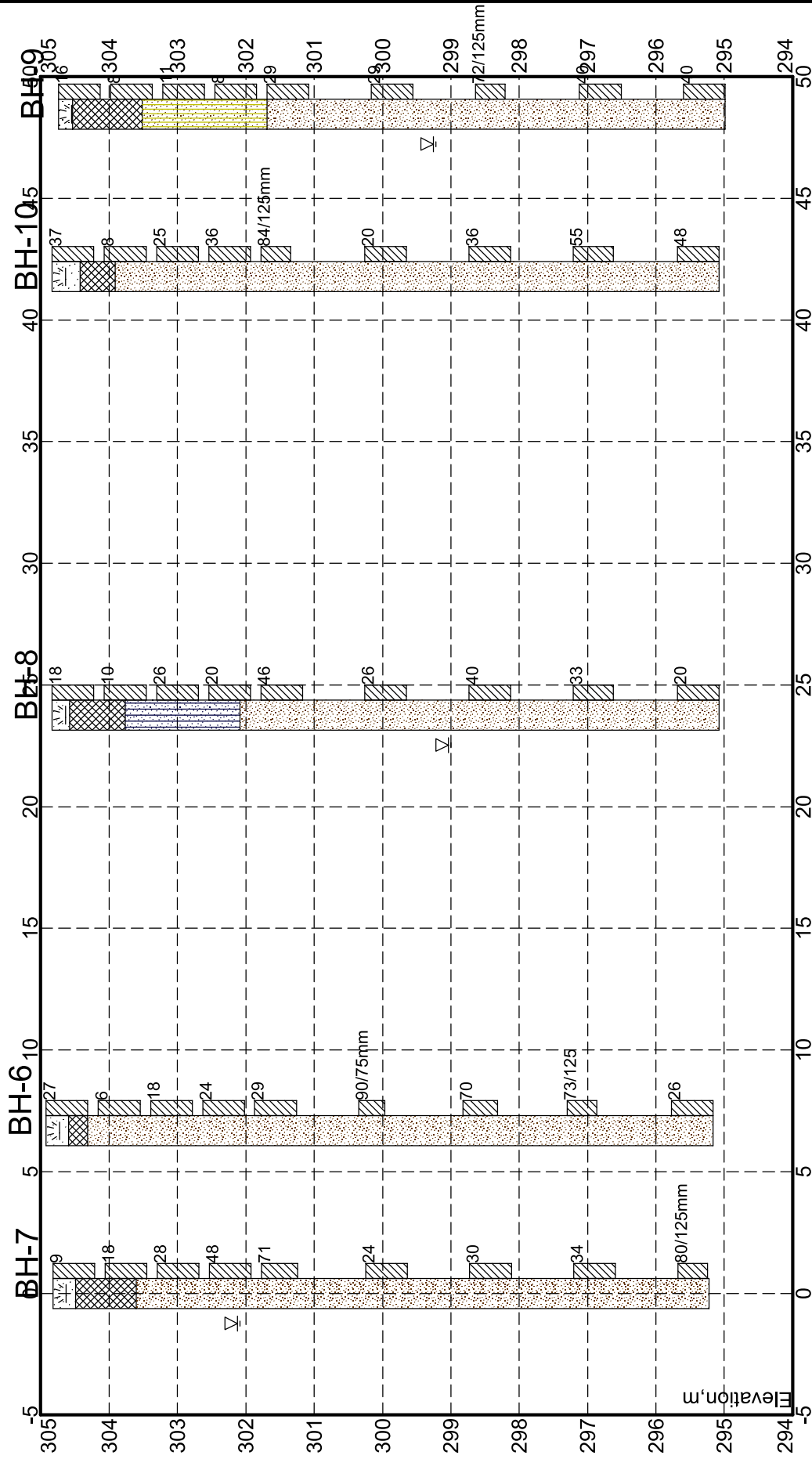
Time	Water Level (m)	Depth to Cave (m)
Jan 23, 2019	4.1m	
Jan 29, 2019	4.0m	



Borehole No	Elev.	Depth
BH-1	304.9	9.8
BH-2	305.0	9.8
BH-3	304.9	9.8
BH-4	304.9	9.7
BH-5	304.9	9.7

SUBSURFACE STRATIGRAPHY		
Section (BH-1 to BH-5)		
Geotechnical Investigation		
316, 326 and 336 Bryne Drive, Barrie, Ontario		
PROJECT #	DATE	DRAWING
4649-18-GB	Mar 19	17

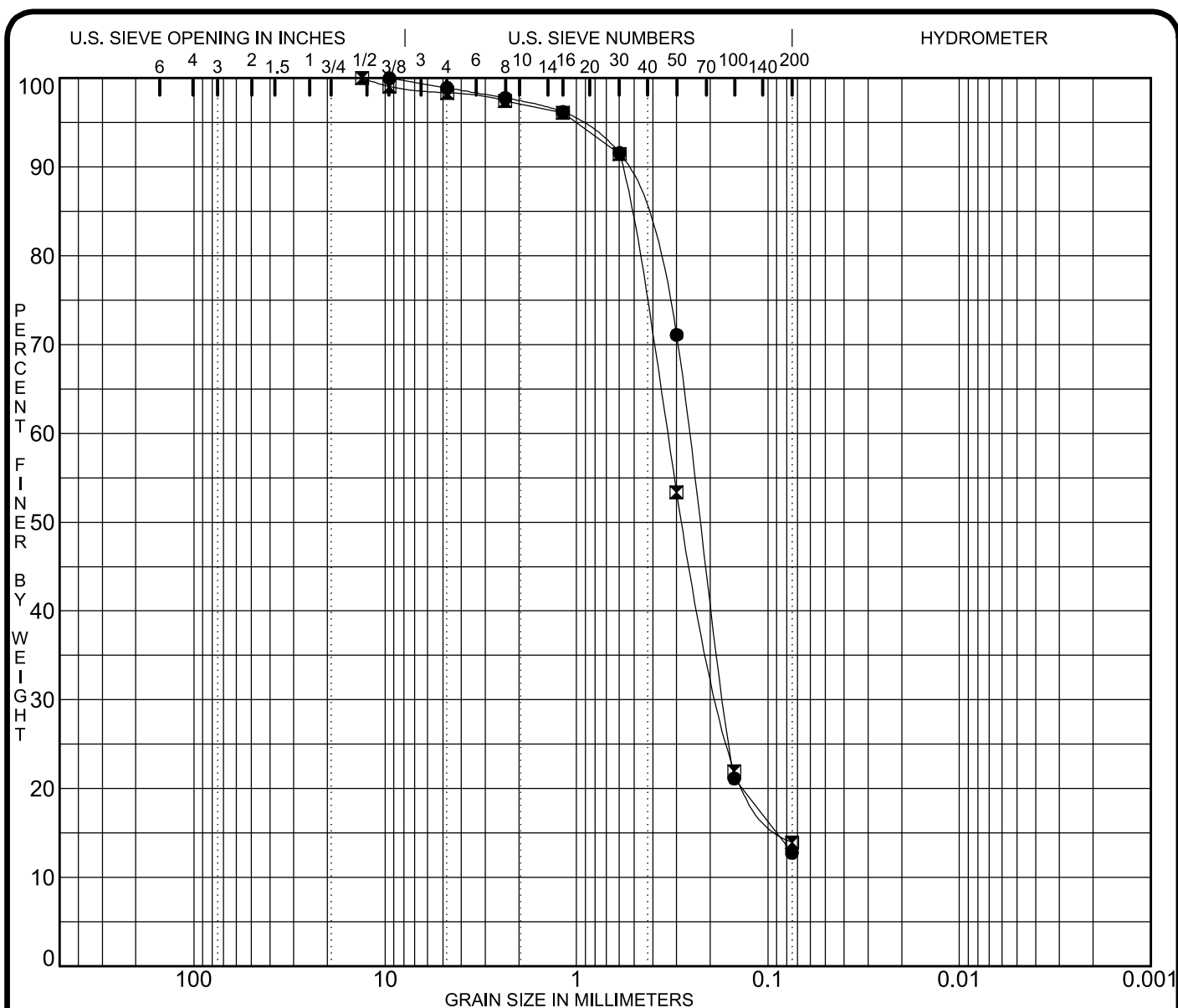
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Borehole No	Elev.	Depth
BH-10	304.8	9.8
BH-6	304.9	9.8
BH-7	304.8	9.6
BH-8	304.8	9.8
BH-9	304.7	9.8

SUBSURFACE STRATIGRAPHY		
Section (BH-6 to BH-10)		
Geotechnical Investigation		
316, 326 and 336 Bryne Drive, Barrie, Ontario		
PROJECT #	DATE	DRAWING
4649-18-GB	Mar 19	18

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Appendix C

Test Pit Logs

ID Number: TP101-20**Project:** Hydrogeological Investigation**Project No:** 45303-200**Client:** Mataj Architects Inc.**Site Location:** 326 Bryne Drive, Barrie**Date:** 5/12/2020**Contractor:** John Eek & Son Ltd.**Excavation Method:** 430 Backhoe

Subsurface Profile				Soil Sample Depth (m)	Moisture Content (%)	Groundwater Observations and Remarks
Depth	Symbol	Soil Description	Elevation (masl) Depth (m)			
0		Ground Surface	0.0			
0		TOPSOIL Sandy topsoil	0.0			
			-0.5			
2		SAND Reddish-brown fine to medium-grained sand	0.5			
			-1.2			
4		grey below 1.2m	1.2			
			-2.3			
8		Excavation Terminated	2.3			
10						
12						
14						
16						
18						
20						

Field Technician: ALB / PAG**Drafted by:** K LW**Reviewed by:** ATD

Sheet: 1 of 1

ID Number: TP102-20**Project:** Hydrogeological Investigation**Project No:** 45303-200**Client:** Mataj Architects Inc.**Site Location:** 326 Bryne Drive, Barrie**Date:** 5/12/2020**Contractor:** John Eek & Son Ltd.**Excavation Method:** 430 Backhoe

Subsurface Profile				Soil Sample Depth (m)	Moisture Content (%)	Groundwater Observations and Remarks
Depth	Symbol	Soil Description	Elevation (masl) Depth (m)			
0		Ground Surface	0.0			
0		TOPSOIL Sandy topsoil	0.0			
			-0.5			
2		SAND Reddish-brown fine to medium-grained sand	0.5			
			-1.1			
4			1.1			
6						
8						
10						
12						
14						
16						
18						
20						
		Excavation Terminated				

Test pit dry upon completion.

Field Technician: ALB / PAG**Drafted by:** KLW**Reviewed by:** ATD

Sheet: 1 of 1

ID Number: TP103-20**Project:** Hydrogeological Investigation**Project No:** 45303-200**Client:** Mataj Architects Inc.**Site Location:** 326 Bryne Drive, Barrie**Date:** 5/12/2020**Contractor:** John Eek & Son Ltd.**Excavation Method:** 430 Backhoe

Subsurface Profile				Soil Sample Depth (m)	Moisture Content (%)	Groundwater Observations and Remarks
Depth	Symbol	Soil Description	Elevation (masl) Depth (m)			
0		Ground Surface	0.0			
0		TOPSOIL Sandy topsoil	0.0			
			-0.5			
2		FILL Sandy fill, some gravel and asphalt	0.5			
			-0.9			
4		SAND grey sand	0.9			
			-1.5			
6		stoney, silty	1.5			
2			-2.1			
8		Excavation Terminated	2.1			
10						
12						
4						
14						
16						
18						
6						
20						

Field Technician: ALB / PAG**Drafted by:** K LW**Reviewed by:** ATD

Sheet: 1 of 1

ID Number: TP104-20**Project:** Hydrogeological Investigation**Project No:** 45303-200**Client:** Mataj Architects Inc.**Site Location:** 326 Bryne Drive, Barrie**Date:** 5/12/2020**Contractor:** John Eek & Son Ltd.**Excavation Method:** 430 Backhoe

Subsurface Profile				Soil Sample Depth (m)	Moisture Content (%)	Groundwater Observations and Remarks
Depth	Symbol	Soil Description	Elevation (masl) Depth (m)			
ft m		Ground Surface	0.0			
0			0.0			
		FILL Sandy, some stones, wood, asphalt, concrete fragments				
2			-0.6			
		SAND Reddish-brown fine to medium-grained sand	0.6			
4						
			-1.5			
6		grey below 1.5m	1.5			
2			-2.1			
		Excavation Terminated	2.1			
8						
10						
12						
4						
14						
16						
18						
6						
20						

Field Technician: ALB / PAG**Drafted by:** K LW**Reviewed by:** ATD

Sheet: 1 of 1

ID Number: TP105-20**Project:** Hydrogeological Investigation**Project No:** 45303-200**Client:** Mataj Architects Inc.**Site Location:** 326 Bryne Drive, Barrie**Date:** 5/12/2020**Contractor:** John Eek & Son Ltd.**Excavation Method:** 430 Backhoe

Subsurface Profile				Soil Sample Depth (m)	Moisture Content (%)	Groundwater Observations and Remarks
Depth	Symbol	Soil Description	Elevation (masl) Depth (m)			
0		Ground Surface	0.0			
0		TOPSOIL Dark brown sandy topsoil	0.0			
2			-0.6			
2		SAND Reddish-brown fine to medium-grained sand	0.6			
4			-1.4			
4		grey below 1.4m	1.4			
6			-2.1			
2		Excavation Terminated	2.1			
8						
10						
12						
14						
16						
18						
20						

Field Technician: ALB / PAG**Drafted by:** K LW**Reviewed by:** ATD

Sheet: 1 of 1

ID Number: TP106-20**Project:** Hydrogeological Investigation**Project No:** 45303-200**Client:** Mataj Architects Inc.**Site Location:** 326 Bryne Drive, Barrie**Date:** 5/12/2020**Contractor:** John Eek & Son Ltd.**Excavation Method:** 430 Backhoe

Subsurface Profile				Soil Sample Depth (m)	Moisture Content (%)	Groundwater Observations and Remarks
Depth	Symbol	Soil Description	Elevation (masl) Depth (m)			
0		Ground Surface	0.0			
0		TOPSOIL Dark brown sandy topsoil	0.0			
2		SAND Reddish-brown fine to medium-grained sand	-0.5 0.5			
4		grey below 1.4m	-1.4 1.4			
6						
2			-2.1 2.1			
8		Excavation Terminated				
10						
12						
4						
14						
16						
18						
6						
20						

Field Technician: ALB / PAG**Drafted by:** KLW**Reviewed by:** ATD

Sheet: 1 of 1

Appendix D

Hydrographs

Hydrograph 1: Groundwater Elevations (mAMSL) - BH-1



Hydrograph 2: Groundwater Elevations (mAMSL) - BH-13



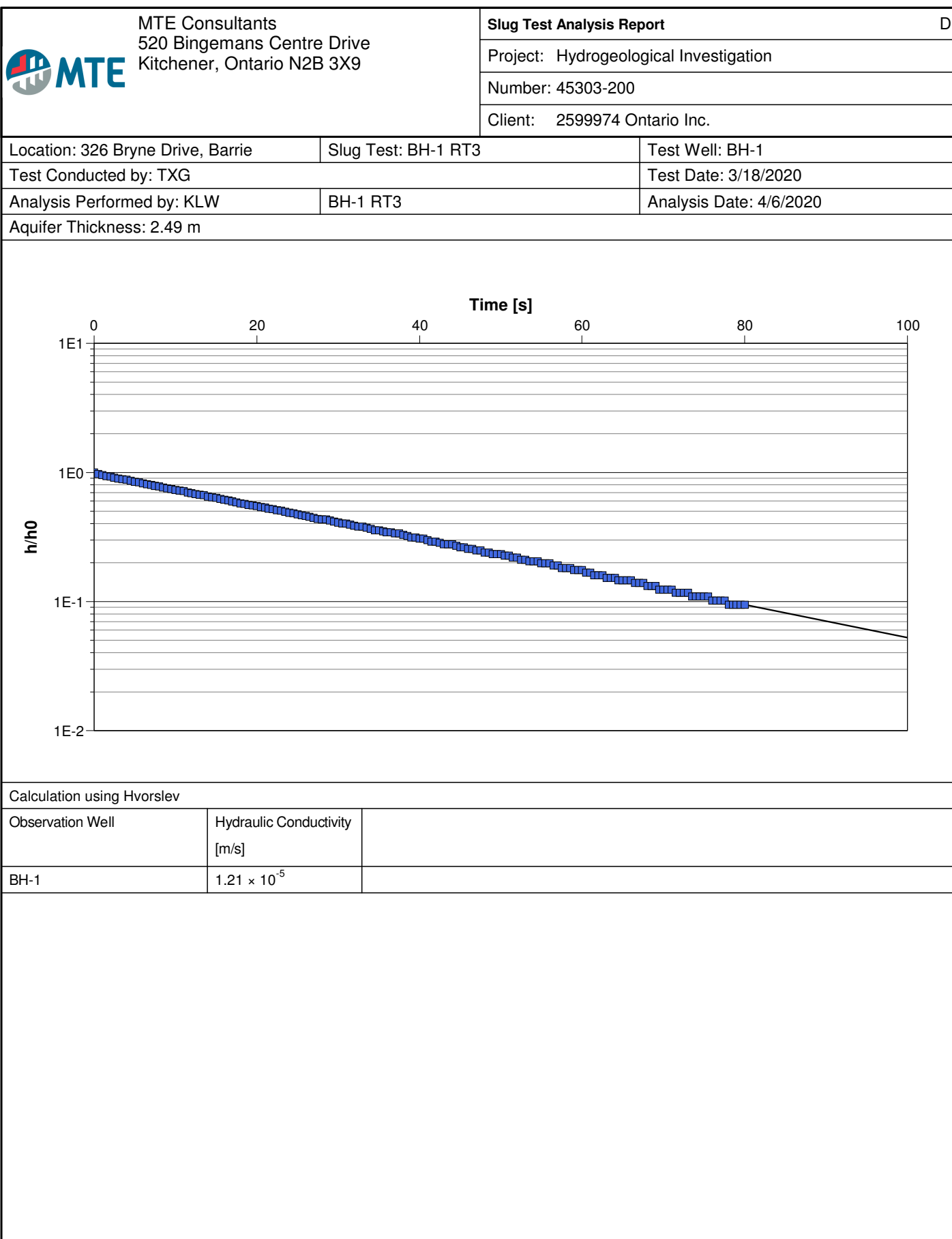
Hydrograph 3: Groundwater Elevations (mAMSL) - BH-15

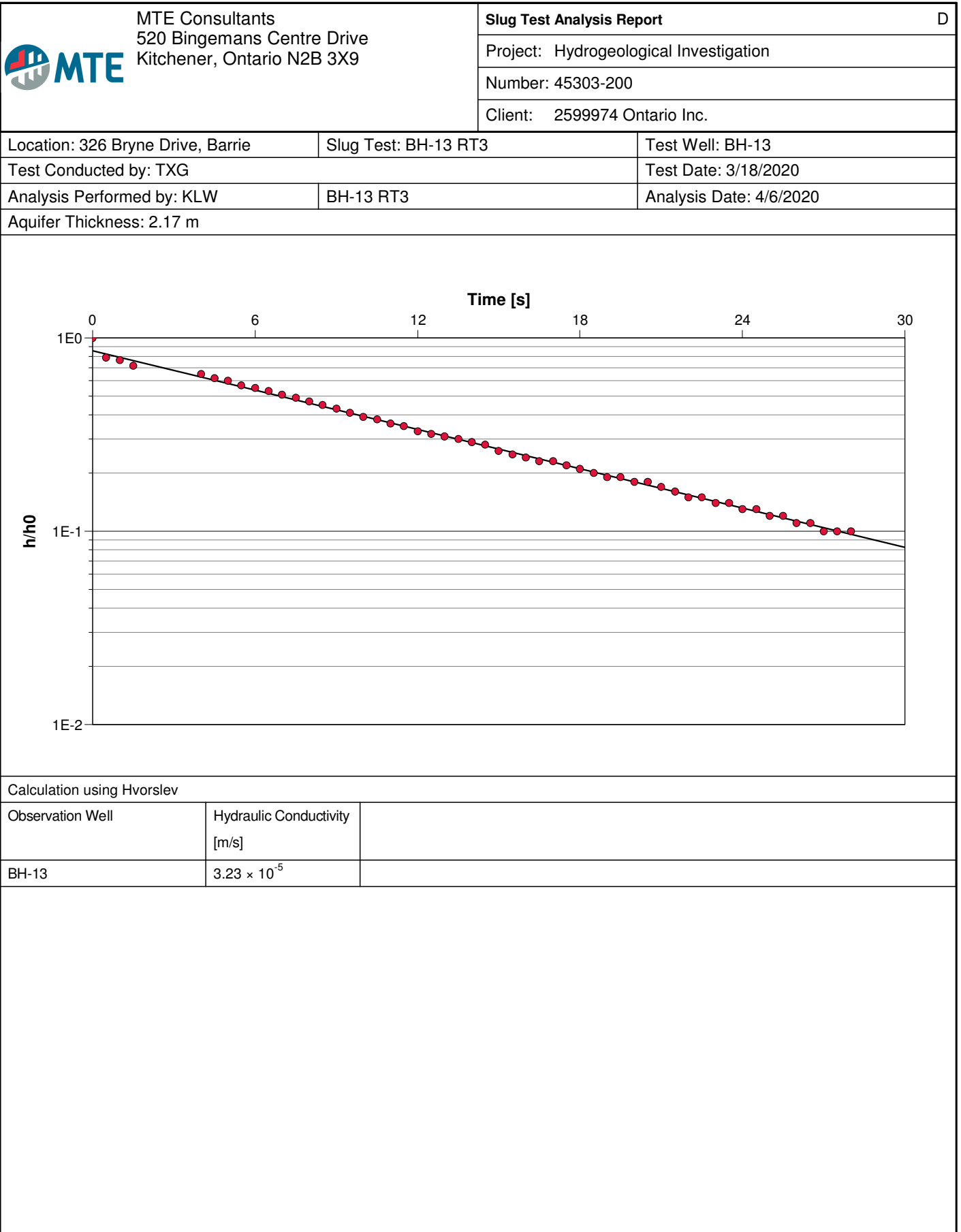


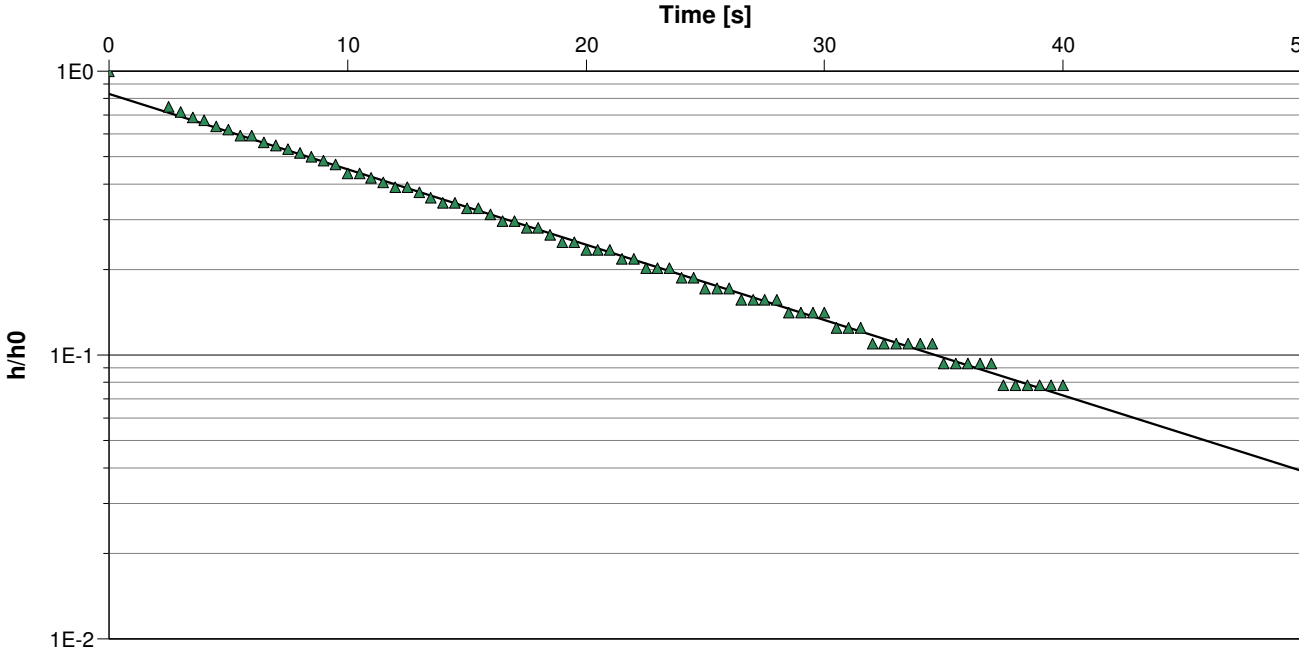
Appendix E

AquiferTest[®] Data Sheet







MTE Consultants 520 Bingemans Centre Drive Kitchener, Ontario N2B 3X9		Slug Test Analysis Report		D
		Project: Hydrogeological Investigation		
		Number: 45303-200		
		Client: 2599974 Ontario Inc.		
Location: 326 Bryne Drive, Barrie		Slug Test: BH-15 RT2		Test Well: Well 3
Test Conducted by: TXG			Test Date: 3/18/2020	
Analysis Performed by: K LW		BH-15 RT2		Analysis Date: 4/6/2020
Aquifer Thickness: 1.53 m				
Time [s] 				
Calculation using Hvorslev				
Observation Well		Hydraulic Conductivity		
		[m/s]		
Well 3		2.58×10^{-5}		

Appendix F

Laboratory Certificate of Analysis



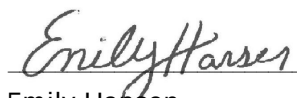
MTE CONSULTANTS INC. (Kitchener)
ATTN: Tim Greer
520 BINGEMANS CENTRE DRIVE
KITCHENER ON N2B 3X9

Date Received: 18-MAR-20
Report Date: 24-MAR-20 12:16 (MT)
Version: FINAL

Client Phone: 519-743-6500

Certificate of Analysis

Lab Work Order #: L2429519
Project P.O. #: NOT SUBMITTED
Job Reference: 45303-200
C of C Numbers: 17-622571
Legal Site Desc:


Emily Hansen
Account Manager

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ADDRESS: 60 Northland Road, Unit 1, Waterloo, ON N2V 2B8 Canada | Phone: +1 519 886 6910 | Fax: +1 519 886 9047
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2429519-1 BH-1								
Sampled By: TG on 18-MAR-20 @ 10:15								
Matrix: WATER								
Physical Tests								
Colour, Apparent		17.7		2.0	CU		19-MAR-20	R5032808
Conductivity		2550		3.0	umhos/cm		19-MAR-20	R5033090
Hardness (as CaCO3)		809	HTC	1.3	mg/L		19-MAR-20	
pH		7.53		0.10	pH units		19-MAR-20	R5033090
Total Dissolved Solids		1350	DLDS	20	mg/L		20-MAR-20	R5033648
Turbidity		588		0.10	NTU		19-MAR-20	R5031309
Anions and Nutrients								
Alkalinity, Total (as CaCO3)		462		10	mg/L		19-MAR-20	R5033090
Ammonia, Total (as N)		<0.010		0.010	mg/L		19-MAR-20	R5032874
Chloride (Cl)		638	DLDS	2.5	mg/L		20-MAR-20	R5034454
Fluoride (F)		<0.10	DLDS	0.10	mg/L		20-MAR-20	R5034454
Nitrate (as N)		3.34	DLDS	0.10	mg/L		20-MAR-20	R5034454
Nitrite (as N)		<0.050	DLDS	0.050	mg/L		20-MAR-20	R5034454
Orthophosphate-Dissolved (as P)		<0.0030		0.0030	mg/L		19-MAR-20	R5031289
Sulfate (SO4)		17.6	DLDS	1.5	mg/L		20-MAR-20	R5034454
Total Metals								
Aluminum (Al)-Total		9.04	DLHC	0.050	mg/L	19-MAR-20	19-MAR-20	R5031467
Antimony (Sb)-Total		<0.0010	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Arsenic (As)-Total		0.0026	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Barium (Ba)-Total		0.143	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Beryllium (Be)-Total		<0.0010	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Bismuth (Bi)-Total		<0.00050	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Boron (B)-Total		<0.10	DLHC	0.10	mg/L	19-MAR-20	19-MAR-20	R5031467
Cadmium (Cd)-Total		0.000070	DLHC	0.000050	mg/L	19-MAR-20	19-MAR-20	R5031467
Calcium (Ca)-Total		290	DLHC	0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Cesium (Cs)-Total		0.00052	DLHC	0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Chromium (Cr)-Total		0.0124	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Cobalt (Co)-Total		0.0090	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Copper (Cu)-Total		0.0203	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Iron (Fe)-Total		11.9	DLHC	0.10	mg/L	19-MAR-20	19-MAR-20	R5031467
Lead (Pb)-Total		0.00592	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Magnesium (Mg)-Total		20.6	DLHC	0.050	mg/L	19-MAR-20	19-MAR-20	R5031467
Manganese (Mn)-Total		0.579	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Molybdenum (Mo)-Total		0.00051	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Nickel (Ni)-Total		0.0128	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Phosphorus (P)-Total		0.57	DLHC	0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Potassium (K)-Total		2.68	DLHC	0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Rubidium (Rb)-Total		0.0120	DLHC	0.0020	mg/L	19-MAR-20	19-MAR-20	R5031467
Selenium (Se)-Total		<0.00050	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Silicon (Si)-Total		18.7	DLHC	1.0	mg/L	19-MAR-20	19-MAR-20	R5031467
Silver (Ag)-Total		<0.00050	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2429519-1 BH-1 Sampled By: TG on 18-MAR-20 @ 10:15 Matrix: WATER								
Total Metals								
Sodium (Na)-Total		421	DLHC	0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Strontium (Sr)-Total		0.589	DLHC	0.010	mg/L	19-MAR-20	19-MAR-20	R5031467
Sulfur (S)-Total		5.4	DLHC	5.0	mg/L	19-MAR-20	19-MAR-20	R5031467
Tellurium (Te)-Total		<0.0020	DLHC	0.0020	mg/L	19-MAR-20	19-MAR-20	R5031467
Thallium (Tl)-Total		<0.00010	DLHC	0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Thorium (Th)-Total		0.0051	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Tin (Sn)-Total		0.0011	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Titanium (Ti)-Total		0.539	DLHC	0.0030	mg/L	19-MAR-20	19-MAR-20	R5031467
Tungsten (W)-Total		<0.0010	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Uranium (U)-Total		0.00048	DLHC	0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Vanadium (V)-Total		0.0183	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Zinc (Zn)-Total		0.038	DLHC	0.030	mg/L	19-MAR-20	19-MAR-20	R5031467
Zirconium (Zr)-Total		0.0020	DLHC	0.0020	mg/L	19-MAR-20	19-MAR-20	R5031467
L2429519-2 BH-13 Sampled By: TG on 18-MAR-20 @ 10:40 Matrix: WATER								
Physical Tests								
Colour, Apparent		20.3		2.0	CU		19-MAR-20	R5032808
Conductivity		6560		3.0	umhos/cm		19-MAR-20	R5033090
Hardness (as CaCO3)		566	HTC	1.3	mg/L		19-MAR-20	
pH		7.78		0.10	pH units		19-MAR-20	R5033090
Total Dissolved Solids		3580	DLDS	20	mg/L		20-MAR-20	R5033648
Turbidity		132		0.10	NTU		19-MAR-20	R5031309
Anions and Nutrients								
Alkalinity, Total (as CaCO3)		386		10	mg/L		19-MAR-20	R5033090
Ammonia, Total (as N)		<0.010		0.010	mg/L		19-MAR-20	R5032874
Chloride (Cl)		2650	DLDS	10	mg/L		20-MAR-20	R5034454
Fluoride (F)		<0.40	DLDS	0.40	mg/L		20-MAR-20	R5034454
Nitrate (as N)		2.73	DLDS	0.40	mg/L		20-MAR-20	R5034454
Nitrite (as N)		<0.20	DLDS	0.20	mg/L		20-MAR-20	R5034454
Orthophosphate-Dissolved (as P)		<0.0030		0.0030	mg/L		19-MAR-20	R5031289
Sulfate (SO4)		77.1	DLDS	6.0	mg/L		20-MAR-20	R5034454
Total Metals								
Aluminum (Al)-Total		3.98	DLHC	0.050	mg/L	19-MAR-20	19-MAR-20	R5031467
Antimony (Sb)-Total		<0.0010	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Arsenic (As)-Total		0.0012	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Barium (Ba)-Total		0.146	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Beryllium (Be)-Total		<0.0010	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Bismuth (Bi)-Total		<0.00050	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Boron (B)-Total		<0.10	DLHC	0.10	mg/L	19-MAR-20	19-MAR-20	R5031467
Cadmium (Cd)-Total		<0.000050	DLHC	0.000050	mg/L	19-MAR-20	19-MAR-20	R5031467
Calcium (Ca)-Total		201	DLHC	0.50	mg/L	19-MAR-20	19-MAR-20	R5031467

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2429519-2 BH-13 Sampled By: TG on 18-MAR-20 @ 10:40 Matrix: WATER								
Total Metals								
Cesium (Cs)-Total		0.00023	DLHC	0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Chromium (Cr)-Total		0.0080	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Cobalt (Co)-Total		0.0040	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Copper (Cu)-Total		0.0101	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Iron (Fe)-Total		5.14	DLHC	0.10	mg/L	19-MAR-20	19-MAR-20	R5031467
Lead (Pb)-Total		0.00276	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Magnesium (Mg)-Total		15.3	DLHC	0.050	mg/L	19-MAR-20	19-MAR-20	R5031467
Manganese (Mn)-Total		0.221	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Molybdenum (Mo)-Total		0.00079	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Nickel (Ni)-Total		0.0053	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Phosphorus (P)-Total		0.52	DLHC	0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Potassium (K)-Total		2.43	DLHC	0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Rubidium (Rb)-Total		0.0054	DLHC	0.0020	mg/L	19-MAR-20	19-MAR-20	R5031467
Selenium (Se)-Total		<0.00050	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Silicon (Si)-Total		10.3	DLHC	1.0	mg/L	19-MAR-20	19-MAR-20	R5031467
Silver (Ag)-Total		<0.00050	DLHC	0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Sodium (Na)-Total		1420	DLHC	5.0	mg/L	19-MAR-20	19-MAR-20	R5031467
Strontium (Sr)-Total		2.49	DLHC	0.010	mg/L	19-MAR-20	19-MAR-20	R5031467
Sulfur (S)-Total		22.2	DLHC	5.0	mg/L	19-MAR-20	19-MAR-20	R5031467
Tellurium (Te)-Total		<0.0020	DLHC	0.0020	mg/L	19-MAR-20	19-MAR-20	R5031467
Thallium (Tl)-Total		<0.00010	DLHC	0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Thorium (Th)-Total		0.0026	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Tin (Sn)-Total		<0.0010	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Titanium (Ti)-Total		0.219	DLHC	0.0030	mg/L	19-MAR-20	19-MAR-20	R5031467
Tungsten (W)-Total		<0.0010	DLHC	0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Uranium (U)-Total		0.00050	DLHC	0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Vanadium (V)-Total		0.0084	DLHC	0.0050	mg/L	19-MAR-20	19-MAR-20	R5031467
Zinc (Zn)-Total		<0.030	DLHC	0.030	mg/L	19-MAR-20	19-MAR-20	R5031467
Zirconium (Zr)-Total		<0.0020	DLHC	0.0020	mg/L	19-MAR-20	19-MAR-20	R5031467
L2429519-3 BH-15 Sampled By: TG on 18-MAR-20 @ 09:40 Matrix: WATER								
Physical Tests								
Colour, Apparent		17.7		2.0	CU		19-MAR-20	R5032808
Conductivity		488		3.0	umhos/cm		19-MAR-20	R5033090
Hardness (as CaCO3)		238	HTC	1.3	mg/L		19-MAR-20	
pH		7.97		0.10	pH units		19-MAR-20	R5033090
Total Dissolved Solids		292	DLDS	20	mg/L		20-MAR-20	R5033648
Turbidity		224		0.10	NTU		19-MAR-20	R5031309
Anions and Nutrients								
Alkalinity, Total (as CaCO3)		261		10	mg/L		19-MAR-20	R5033090
Ammonia, Total (as N)		<0.010		0.010	mg/L		19-MAR-20	R5032874

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2429519-3 BH-15								
Sampled By: TG on 18-MAR-20 @ 09:40								
Matrix: WATER								
Anions and Nutrients								
Chloride (Cl)		5.10		0.50	mg/L		20-MAR-20	R5034454
Fluoride (F)		0.050		0.020	mg/L		20-MAR-20	R5034454
Nitrate (as N)		1.73		0.020	mg/L		20-MAR-20	R5034454
Nitrite (as N)		<0.010		0.010	mg/L		20-MAR-20	R5034454
Orthophosphate-Dissolved (as P)		<0.0030		0.0030	mg/L		19-MAR-20	R5031289
Sulfate (SO4)		4.81		0.30	mg/L		20-MAR-20	R5034454
Total Metals								
Aluminum (Al)-Total		2.69		0.010	mg/L	19-MAR-20	19-MAR-20	R5031467
Antimony (Sb)-Total		<0.00010		0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Arsenic (As)-Total		0.00084		0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Barium (Ba)-Total		0.0292		0.00020	mg/L	19-MAR-20	19-MAR-20	R5031467
Beryllium (Be)-Total		0.00011		0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Bismuth (Bi)-Total		<0.000050		0.000050	mg/L	19-MAR-20	19-MAR-20	R5031467
Boron (B)-Total		<0.010		0.010	mg/L	19-MAR-20	19-MAR-20	R5031467
Cadmium (Cd)-Total		0.000018		0.000010	mg/L	19-MAR-20	19-MAR-20	R5031467
Calcium (Ca)-Total		88.5		0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Cesium (Cs)-Total		0.000161		0.000010	mg/L	19-MAR-20	19-MAR-20	R5031467
Chromium (Cr)-Total		0.00643		0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Cobalt (Co)-Total		0.00283		0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Copper (Cu)-Total		0.0083		0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Iron (Fe)-Total		3.45		0.050	mg/L	19-MAR-20	19-MAR-20	R5031467
Lead (Pb)-Total		0.00294		0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Magnesium (Mg)-Total		4.25		0.050	mg/L	19-MAR-20	19-MAR-20	R5031467
Manganese (Mn)-Total		0.179		0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Molybdenum (Mo)-Total		0.000323		0.000050	mg/L	19-MAR-20	19-MAR-20	R5031467
Nickel (Ni)-Total		0.00549		0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Phosphorus (P)-Total		0.150		0.050	mg/L	19-MAR-20	19-MAR-20	R5031467
Potassium (K)-Total		0.981		0.050	mg/L	19-MAR-20	19-MAR-20	R5031467
Rubidium (Rb)-Total		0.00339		0.00020	mg/L	19-MAR-20	19-MAR-20	R5031467
Selenium (Se)-Total		0.000255		0.000050	mg/L	19-MAR-20	19-MAR-20	R5031467
Silicon (Si)-Total		8.11		0.10	mg/L	19-MAR-20	19-MAR-20	R5031467
Silver (Ag)-Total		<0.000050		0.000050	mg/L	19-MAR-20	19-MAR-20	R5031467
Sodium (Na)-Total		61.9		0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Strontium (Sr)-Total		0.178		0.0010	mg/L	19-MAR-20	19-MAR-20	R5031467
Sulfur (S)-Total		1.95		0.50	mg/L	19-MAR-20	19-MAR-20	R5031467
Tellurium (Te)-Total		<0.00020		0.00020	mg/L	19-MAR-20	19-MAR-20	R5031467
Thallium (Tl)-Total		0.000029		0.000010	mg/L	19-MAR-20	19-MAR-20	R5031467
Thorium (Th)-Total		0.00168		0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Tin (Sn)-Total		0.00114		0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467
Titanium (Ti)-Total		0.106		0.00030	mg/L	19-MAR-20	19-MAR-20	R5031467
Tungsten (W)-Total		<0.00010		0.00010	mg/L	19-MAR-20	19-MAR-20	R5031467

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2429519-3	BH-15							
Sampled By:	TG on 18-MAR-20 @ 09:40							
Matrix:	WATER							
Total Metals								
Uranium (U)-Total		0.000169		0.000010	mg/L	19-MAR-20	19-MAR-20	R5031467
Vanadium (V)-Total		0.00584		0.00050	mg/L	19-MAR-20	19-MAR-20	R5031467
Zinc (Zn)-Total		0.0110		0.0030	mg/L	19-MAR-20	19-MAR-20	R5031467
Zirconium (Zr)-Total		0.00064		0.00030	mg/L	19-MAR-20	19-MAR-20	R5031467

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Iron (Fe)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Manganese (Mn)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Silicon (Si)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Sulfur (S)-Total	MS-B	L2429519-1, -2, -3
Matrix Spike	Ammonia, Total (as N)	MS-B	L2429519-1, -2, -3

Sample Parameter Qualifier key listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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ALK-WT	Water	Alkalinity, Total (as CaCO3)	APHA 2320B
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This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)
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Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

COLOUR-APPARENT-WT	Water	Colour	APHA 2120
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Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510
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Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-WT	Water	Conductivity	APHA 2510 B
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Water samples can be measured directly by immersing the conductivity cell into the sample.

F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)
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Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT	Water	Hardness	APHA 2340 B
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Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
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Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NH3-F-WT	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
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This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-WT	Water	pH	APHA 4500 H-Electrode
Water samples are analyzed directly by a calibrated pH meter.			

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days

PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS
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This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			

SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.			

TURBIDITY-WT	Water	Turbidity	APHA 2130 B
Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-622571

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid weight of sample

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2429519

Report Date: 24-MAR-20

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Client: MTE CONSULTANTS INC. (Kitchener)
520 BINGEMANS CENTRE DRIVE
KITCHENER ON N2B 3X9

Contact: Tim Greer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-WT		Water						
Batch	R5033090							
WG3295471-2	LCS							
Alkalinity, Total (as CaCO ₃)			103.6		%		85-115	19-MAR-20
WG3295471-1	MB							
Alkalinity, Total (as CaCO ₃)			<10		mg/L		10	19-MAR-20
CL-IC-N-WT		Water						
Batch	R5034454							
WG3295966-2	LCS							
Chloride (Cl)			104.2		%		90-110	20-MAR-20
WG3295966-1	MB							
Chloride (Cl)			<0.50		mg/L		0.5	20-MAR-20
COLOUR-APPARENT-WT		Water						
Batch	R5032808							
WG3295717-2	LCS							
Colour, Apparent			100.6		%		85-115	19-MAR-20
WG3295717-1	MB							
Colour, Apparent			<2.0		CU		2	19-MAR-20
EC-WT		Water						
Batch	R5033090							
WG3295471-2	LCS							
Conductivity			101.0		%		90-110	19-MAR-20
WG3295471-1	MB							
Conductivity			<3.0		umhos/cm		3	19-MAR-20
F-IC-N-WT		Water						
Batch	R5034454							
WG3295966-2	LCS							
Fluoride (F)			102.8		%		90-110	20-MAR-20
WG3295966-1	MB							
Fluoride (F)			<0.020		mg/L		0.02	20-MAR-20
MET-T-CCMS-WT		Water						
Batch	R5031467							
WG3294964-2	LCS							
Aluminum (Al)-Total			109.6		%		80-120	19-MAR-20
Antimony (Sb)-Total			104.3		%		80-120	19-MAR-20
Arsenic (As)-Total			104.5		%		80-120	19-MAR-20
Barium (Ba)-Total			109.2		%		80-120	19-MAR-20
Beryllium (Be)-Total			102.4		%		80-120	19-MAR-20
Bismuth (Bi)-Total			103.5		%		80-120	19-MAR-20

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT		Water						
Batch	R5031467							
WG3294964-2	LCS							
Boron (B)-Total			104.9		%		80-120	19-MAR-20
Cadmium (Cd)-Total			103.4		%		80-120	19-MAR-20
Calcium (Ca)-Total			100.4		%		80-120	19-MAR-20
Chromium (Cr)-Total			105.4		%		80-120	19-MAR-20
Cesium (Cs)-Total			100.9		%		80-120	19-MAR-20
Cobalt (Co)-Total			103.1		%		80-120	19-MAR-20
Copper (Cu)-Total			101.6		%		80-120	19-MAR-20
Iron (Fe)-Total			99.4		%		80-120	19-MAR-20
Lead (Pb)-Total			105.9		%		80-120	19-MAR-20
Magnesium (Mg)-Total			110.9		%		80-120	19-MAR-20
Manganese (Mn)-Total			107.6		%		80-120	19-MAR-20
Molybdenum (Mo)-Total			99.8		%		80-120	19-MAR-20
Nickel (Ni)-Total			102.2		%		80-120	19-MAR-20
Phosphorus (P)-Total			107.8		%		70-130	19-MAR-20
Potassium (K)-Total			107.9		%		80-120	19-MAR-20
Rubidium (Rb)-Total			107.7		%		80-120	19-MAR-20
Selenium (Se)-Total			99.7		%		80-120	19-MAR-20
Silicon (Si)-Total			104.0		%		60-140	19-MAR-20
Silver (Ag)-Total			103.2		%		80-120	19-MAR-20
Sodium (Na)-Total			105.4		%		80-120	19-MAR-20
Strontium (Sr)-Total			107.4		%		80-120	19-MAR-20
Sulfur (S)-Total			99.0		%		80-120	19-MAR-20
Thallium (Tl)-Total			103.2		%		80-120	19-MAR-20
Tellurium (Te)-Total			99.1		%		80-120	19-MAR-20
Thorium (Th)-Total			106.0		%		70-130	19-MAR-20
Tin (Sn)-Total			100.4		%		80-120	19-MAR-20
Titanium (Ti)-Total			103.3		%		80-120	19-MAR-20
Tungsten (W)-Total			101.1		%		80-120	19-MAR-20
Uranium (U)-Total			100.8		%		80-120	19-MAR-20
Vanadium (V)-Total			107.3		%		80-120	19-MAR-20
Zinc (Zn)-Total			105.3		%		80-120	19-MAR-20
Zirconium (Zr)-Total			100.7		%		80-120	19-MAR-20
WG3294964-1	MB							
Aluminum (Al)-Total			<0.0050		mg/L		0.005	19-MAR-20

Quality Control Report

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT		Water						
Batch	R5031467							
WG3294964-1 MB								
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	19-MAR-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	19-MAR-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	19-MAR-20
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	19-MAR-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	19-MAR-20
Boron (B)-Total			<0.010		mg/L		0.01	19-MAR-20
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	19-MAR-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	19-MAR-20
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	19-MAR-20
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	19-MAR-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	19-MAR-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	19-MAR-20
Iron (Fe)-Total			<0.010		mg/L		0.01	19-MAR-20
Lead (Pb)-Total			<0.000050		mg/L		0.00005	19-MAR-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	19-MAR-20
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	19-MAR-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	19-MAR-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	19-MAR-20
Phosphorus (P)-Total			<0.050		mg/L		0.05	19-MAR-20
Potassium (K)-Total			<0.050		mg/L		0.05	19-MAR-20
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	19-MAR-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	19-MAR-20
Silicon (Si)-Total			<0.10		mg/L		0.1	19-MAR-20
Silver (Ag)-Total			<0.000050		mg/L		0.00005	19-MAR-20
Sodium (Na)-Total			<0.050		mg/L		0.05	19-MAR-20
Strontium (Sr)-Total			<0.0010		mg/L		0.001	19-MAR-20
Sulfur (S)-Total			<0.50		mg/L		0.5	19-MAR-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	19-MAR-20
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	19-MAR-20
Thorium (Th)-Total			<0.00010		mg/L		0.0001	19-MAR-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	19-MAR-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	19-MAR-20
Tungsten (W)-Total			<0.00010		mg/L		0.0001	19-MAR-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	19-MAR-20

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	Water							
Batch	R5031467							
WG3294964-1 MB								
Vanadium (V)-Total			<0.00050		mg/L		0.0005	19-MAR-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	19-MAR-20
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	19-MAR-20
NH3-F-WT	Water							
Batch	R5032874							
WG3295127-2 LCS								
Ammonia, Total (as N)			109.1		%		85-115	19-MAR-20
WG3295127-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	19-MAR-20
NO2-IC-WT	Water							
Batch	R5034454							
WG3295966-2 LCS								
Nitrite (as N)			103.1		%		90-110	20-MAR-20
WG3295966-1 MB								
Nitrite (as N)			<0.010		mg/L		0.01	20-MAR-20
NO3-IC-WT	Water							
Batch	R5034454							
WG3295966-2 LCS								
Nitrate (as N)			102.5		%		90-110	20-MAR-20
WG3295966-1 MB								
Nitrate (as N)			<0.020		mg/L		0.02	20-MAR-20
PH-WT	Water							
Batch	R5033090							
WG3295471-2 LCS								
pH			7.03		pH units		6.9-7.1	19-MAR-20
PO4-DO-COL-WT	Water							
Batch	R5031289							
WG3295228-2 LCS								
Orthophosphate-Dissolved (as P)			104.6		%		80-120	19-MAR-20
WG3295228-1 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	19-MAR-20
SO4-IC-N-WT	Water							

Quality Control Report

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-IC-N-WT	Water							
Batch	R5034454							
WG3295966-2	LCS							
Sulfate (SO4)			105.0		%		90-110	20-MAR-20
WG3295966-1	MB							
Sulfate (SO4)			<0.30		mg/L		0.3	20-MAR-20
SOLIDS-TDS-WT	Water							
Batch	R5033648							
WG3296080-2	LCS							
Total Dissolved Solids			97.2		%		85-115	20-MAR-20
WG3296080-1	MB							
Total Dissolved Solids			<10		mg/L		10	20-MAR-20
TURBIDITY-WT	Water							
Batch	R5031309							
WG3295320-3	DUP	L2429519-1						
Turbidity		588	625		NTU	6.1	15	19-MAR-20
WG3295320-2	LCS							
Turbidity			101.0		%		85-115	19-MAR-20
WG3295320-1	MB							
Turbidity			<0.10		NTU		0.1	19-MAR-20

Quality Control Report

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2429519-COFC

COC Number: 17 - 622571

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[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FROM