



BURNSIDE

Hydrogeological Study in Support of Draft Plan

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Barrie, Ontario**

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**December 2018
300041886.0000**

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Record of Revisions

Revision	Date	Description
-	December 18, 2018	Final Submission to Di Poce Management Inc.

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) has been retained by Di Poce Management Inc. (Di Poce) to complete a hydrogeological assessment for lands located within the OPA 39 Salem Secondary Plan Area (SPA) in Barrie. The lands associated with the assessment, herein referred to as the subject lands are located at the east side of County Road 27, west side of Essa Road and north side of Salem Road in the City of Barrie, Ontario (Figure 1). The subject lands are located within the Barrie Annexed Lands and the OPA 39 Salem Secondary Plan Area (SPA) located on the southern boundary of the City of Barrie. In 2016, a Subwatershed Impact Study (SIS) for the Salem SPA was completed for the Salem Secondary Plan Landowners Group that included an assessment of regional hydrogeology (Burnside, 2016). The current assessment is aimed at updating information contained in the regional hydrogeological assessment and providing more detailed site-specific information for the subject lands in support of an application for draft plan approval.

1.1 Scope of Work

The scope of work completed for the hydrogeological study was developed to build upon the regional work completed for the Salem SIS (Burnside, 2016) and to address requirements for hydrogeological studies in support of draft plan approval. The scope of work for the hydrogeological assessment included the review of available regional information as well as the completion of the following site-specific tasks:

1. Review of published geological and hydrogeological information: A review of background material for the area, including topography, surficial geology and bedrock geology mapping and existing geotechnical and hydrogeological reports was completed to assess the regional hydrogeological setting.
2. Review of the Ministry of the Environment, Conservation and Parks (MECP) water well records: The MECP maintains a database that provides geological records of water supply wells drilled in the province. A list of the available MECP water well records for local wells is provided in Appendix A and the well locations are plotted on Figure 5. It is noted that the well locations listed in the MECP records are approximations only and may not be representative of the precise well locations in the field. These well data were compiled and mapped to characterize the local groundwater resources.
3. Establish groundwater monitoring network: Groundwater monitoring wells were constructed to characterize seasonal variations in the water table. In addition to the new monitoring wells, existing wells from previous studies were selected for inclusion in the monitoring program. One drive-point piezometer nest (one shallow and one deep piezometer driven into the ground at the same location)

was installed near a watercourse on the subject lands to determine the nature of potential groundwater/surface water interactions. The locations of the monitoring wells and piezometers are shown on Figure 2. The monitoring well construction details are provided on the borehole logs in Appendix B.

4. Hydraulic conductivity testing: Burnside conducted single well response tests in order to determine hydraulic conductivity. Single well response tests were completed at four groundwater monitoring wells (DP-BH7, DP-BH23, DP-BH120 and DP-BH129) in 2018. The hydraulic conductivity field testing results are provided in Appendix C.
5. Monitoring of groundwater levels: Groundwater monitoring has been completed to measure the depth to the water table and assess the horizontal and vertical groundwater flow conditions. Groundwater level monitoring was completed monthly since May 2018 in monitoring wells and piezometers. The groundwater monitoring data and hydrographs are provided in Appendix D.
6. Surface water monitoring: Surface water monitoring was completed along the tributary to Bear Creek that flows across the subject lands. The surface water monitoring locations were inspected monthly for water depth and flow from May 2018 to October 2018. The surface water monitoring data are summarized in Appendix E.
7. Water quality testing: Water quality data was collected from selected monitoring locations to typify the groundwater and surface water quality in the vicinity of the subject lands. Samples were collected in 2018 from two monitoring wells (MW3d and DP-BH120). The water samples were submitted to a certified laboratory for analyses of general water quality indicators (e.g., pH, hardness, and conductivity), basic ions (including chloride and nitrate) and selected metals to characterize the background water quality at the property. The laboratory water quality data are provided in Appendix F.
8. Water balance calculations: Pre and post-development water balance calculations have been completed to assess the groundwater infiltration volumes for the subject lands. The local climate data and detailed water balance calculations are provided in Appendix G.
9. Data compilation, assessment of site conditions and reporting: The above data were all compiled reviewed and assessed to develop an understanding of the site-specific hydrogeological conditions. The results of the assessment are presented in the current report.

2.0 Physical Setting

2.1 Topography and Drainage

The topography of the subject lands slopes regionally in a north-northwest direction with elevations ranging from 310 metres above sea level (masl) in the southeast corner to 287 masl, along the tributary of Bear Creek where it crosses County Road 27 (Figure 3). The topography can be described as gently rolling to flat with topographic low areas found along watercourses. The topography along the northeastern edge of the subject lands shows a sharp drop off to the main valley of the Bear Creek which is approximately 15 m below the elevation at the northeast corner of the subject lands.

The subject lands are located within the jurisdiction of the Nottawasaga Valley Conservation Authority (NVCA) and the Bear Creek subwatershed. A tributary of Bear Creek originates on lands to the south of the subject lands and flows in a north to northwest direction across the western portion of the subject lands (Figure 3). Within the subject lands there is an area of provincially significant wetland that is associated with this watercourse (see Figure 3).

2.2 Geology

The subject lands are located in the physiographic region known as the Peterborough Drumlin Field. The region is characterized as a rolling drumlinized till plain. The drumlins through the region are comprised of highly calcareous till (Chapman & Putnam, 1984).

The overburden within the Peterborough Drumlin Field was deposited as a series of advances and retreats of the Simcoe glacial ice lobe. This has resulted in drumlinized sheets of glacial till (Newmarket till), stratified glaciolacustrine deposits of sand and gravel, littoral-foreshore deposits and massive-well laminated deposits of sand and gravel being common in this area. A review of the quaternary geology mapping for the area (OGS, 2003) indicates that the overburden sediments of the subject lands consist primarily of silty to sandy glacial till and ice contact stratified deposits (Figure 4).

The bedrock in the area is mapped as consisting primarily of Paleozoic limestone of the Middle Ordovician Simcoe Group. Underlying the subject lands is the Lindsay Formation which consists mainly of fine to coarse grained, fossiliferous, commonly nodular, argillaceous limestone (OGS, 2007).

2.3 Regional Hydrostratigraphy

The overburden deposits of the subject lands influence groundwater occurrence and flow. The overburden has been interpreted by regional studies such as the Tier 3 Water Balance (AquaResource, 2011) and Source Water Protection Assessment Report (LSRCA, 2012) to consist of alternating sequences of coarser-grained permeable layers

(aquifers) and finer-grained less permeable areas (aquitards) of varying thicknesses. The basic hydrostratigraphic sequence that was modelled in the regional studies (AquaResource, 2011) consists of four main aquifer areas (A1-A4) and four main aquitards (C1 to C4) with a confining layer (UC) over the uppermost aquifer (A1).

A description of the interpreted regional hydrostratigraphic framework is provided below (LSRCA, 2012):

- Surficial Geology Layer – This layer represents coarse grained sediments in stream beds and at surface surficial geology areas that overly the UC. The thickness ranges from 0.1 m to 3 m.
- UC – Upper Confining Layer – Represents smaller areas of less permeable surficial material. The upper confining layer has been mapped as coarse-grained lacustrine deposits which are part of a regionally extensive sand plain (LSRCA, 2012). Regional studies such as the AquaResource (2011) report indicate that the confining layer (UC) is patchy in the area of the study area.
- A1 – Represents the uppermost aquifer. Frequently exists as a surficial unconfined aquifer and is stratigraphically equivalent to the Oak Ridges Moraine. It is generally associated with coarse grained glacial and interglacial sediments mapped as ice contact stratified drift. The majority of the local domestic wells are completed within this area. The upper aquifer A1 is reported to be present throughout the larger Barrie area, and has been interpreted to occur extensively in the study area.
- C1 – Upper aquitard. Described as varved clay and silt (LRSCA, 2012).
- A2 – Intermediate aquifer which is stratigraphically equivalent to areas within the Northern Till. The aquifer is generally described as being composed of sand with some clast rich portions (LRSCA, 2012). This area is used for the Innisfil Heights water supply.
- C2 – Intermediate aquitard.
- A3 – This area constitutes the main Barrie municipal aquifer and is the source of the Stroud water supply; it is stratigraphically equivalent to the Thorncliffe deposits in the Upland regions.
- C3 – Lower aquitard.
- A4 – Lower aquifer, thin and sometimes combined with A3 where C3 is thin or absent.

- C4 – Lower aquitard but may also represent weathered bedrock.

The above regional hydrostratigraphic sequence was supported by the work completed by Burnside in the SIS and is thought to represent the sequences encountered in the vicinity of the subject lands.

2.4 Local Stratigraphy

Boreholes were drilled across the subject lands as part of geotechnical investigations conducted by Terraprobe and GeoPro Consulting in 2018. A total of 32 boreholes were completed with 15 of the boreholes being completed as monitoring wells. The locations of the boreholes and monitoring wells are shown on Figure 5 and the borehole logs are provided in Appendix B.

The geological information from the boreholes indicated that the overburden is generally composed of layers of glacial till and sand. The till deposits were generally composed of sandy silt to silty sand with varying amounts of clay and gravel. Some lenses of finer grained sediments were encountered in the boreholes and these lenses were interpreted to be discontinuous. Surficial sand, corresponding to the mapped ice-contact stratified deposits (Figure 4) was encountered with thicknesses up to 8 m. The information provided by the borehole logs confirms the surficial geology mapping for the area.

To illustrate the shallow hydrostratigraphic sequence of the subject lands, schematic geologic cross-sections have been prepared (Figures 6 and 7) using the MECP well records (Appendix A) and the soils information collected during drilling of boreholes (Appendix B). The locations of the cross-sections are illustrated on Figure 5 along with the locations of water wells and boreholes used in the construction of the cross-sections.

The cross-sections update the information contained in the SIS and illustrate that the subject lands are underlain by surficial sand and silt with thickness ranging from 2 to 14 m. Underlying the surficial sand is a clay silt till layer with thickness ranging from 8 to 25 m. The clay silt till is interpreted to be exposed at surface to the east of the subject lands and has occasional layers of sand and gravel. Underlying the clay silt till layer is a deeper layer of sand. The deeper sand layer is interpreted to form the local aquifer where most private supply wells are completed (Figures 6 and 7). Based on cross-sections produced in the Salem SIS (Burnside, 2016), the sand layer extends from an elevation of approximately 275 masl to below 230 masl. The deeper sand aquifer is separated from the surface by the silty clay till which is interpreted to act as an aquitard and is up to 25 m thick.

3.0 Hydrogeology

The hydrogeology of the subject lands was investigated in order to determine site specific conditions and occurrences that impact the occurrence and movement of

groundwater at the local scale. Various parameters were evaluated in order to develop a full understanding and interpretation of hydrogeological conditions on the subject lands. Conceptually, the information was all combined to create an understanding of the hydrogeological conditions of the subject lands that is referred to as the conceptual model. The following sections provides additional information on the interpreted conceptual model for the subject lands.

3.1 Hydraulic Conductivity

There are various methods that can be used to assess soil hydraulic conductivity, i.e., the ability of the soil to transmit groundwater. Grainsize data and soil characteristics can be used to provide a general estimate of hydraulic conductivity. In situ bail-down or slug-testing methods are used in groundwater monitoring wells to assess site-specific hydraulic conductivity. These methods have been used to estimate the hydraulic conductivity of the soils encountered on the subject lands as discussed below.

3.1.1 Grainsize Analysis

Grainsize analysis from geotechnical investigations on the subject lands (GeoPro, 2018 and Terraprobe, 2011) were reviewed (data provided in Appendix C).

Grainsize analyses results indicate that the sediments within the overburden range in composition from sand (9% fines) to silt and clay (82% fines). The amount of fines within a deposit impacts the ability of the material to transmit water and generally a greater amount of fines lowers the overall hydraulic conductivity. Groundwater flow is therefore generally limited by fine grained sediments with lower hydraulic conductivity.

To estimate hydraulic conductivity based on grainsize analysis, an empirical formula known as the Hazen estimation is used. This method is an approximation of hydraulic conductivity based on grainsize curves for sandy soils. The approximation does not strictly apply to finer grained materials, however, it is still considered useful to provide a general indication of the range of the hydraulic conductivity values.

Hydraulic conductivity values were derived empirically using the Hazen method for twelve of the samples collected on the subject lands. The grainsize distribution graphs are provided in Appendix C and the calculated hydraulic conductivity values are provided in Table 1.

Table 1: Summary of Grainsize Analyses and Hydraulic Conductivity

Sample ID	Depth of Sample (mbgs)	% Fines	Hydraulic Conductivity (cm/s)
BH2-SS5	3.05	26.2	1.96E ⁻⁰⁴
BH3-SS2	0.61	56.6	4.00E ⁻⁰⁶
BH4-SS3	1.22	23.1	1.00E ⁻⁰⁴

Sample ID	Depth of Sample (mbgs)	% Fines	Hydraulic Conductivity (cm/s)
BH6-SS3	1.22	42.9	4.00E ⁻⁰⁶
BH7-SS4	2.29	35.5	3.60E ⁻⁰⁵
BH7-SS8	7.62	12.2	4.90E ⁻⁰³
BH8-SS5	3.05	22.6	6.40E ⁻⁰⁵
BH9-SS5b	3.2	11.6	4.90E ⁻⁰³
BH11-SS3	1.22	30.8	6.40E ⁻⁰⁵
BH12-SS3	1.22	11.2	4.90E ⁻⁰³
BH20-SS4	2.29	39.9	1.00E ⁻⁰⁶
BH25-SS3	1.22	9	5.93E ⁻⁰³

The hydraulic conductivities based on grainsize analyses are estimated in the range of 10⁻³ to 10⁻⁶ cm/sec.

3.1.2 Single Well Response Tests

To assess the in situ hydraulic conductivity of the sediments, single well response tests (bail-down tests) were conducted at four monitoring wells. The results from the tests were plotted (Appendix C) and analyzed to calculate hydraulic conductivity of the sediments screened. A summary the calculated hydraulic conductivities is provided below in Table 2.

Table 2: Single Well Response Testing Results

Monitoring Well	Screen Interval (mbgs)*	Formation Screened	Hydraulic Conductivity (cm/sec)
DP-BH7	14.8	Sand and Silt to Silty Sand	6.8 x 10 ⁻³
DP-BH23	6.1	Sand and Silt to Silty Sand	4.4 x 10 ⁻²
DP-BH120	7.5	Silty Sand	1.2 x 10 ⁻⁵
DP-BH129	4.5	Silty Sand	6.5 x 10 ⁻³

*metres below ground surface

The single well response test analyses resulted in hydraulic conductivities ranging from 10⁻² to 10⁻⁵ cm/sec. The wells tested were screened across sand and in the surficial silty sand till which forms the area to be impacted by development. Overall, the hydraulic conductivity of the overburden sediments on the subject lands consisting of sand and silt till is interpreted to range from 10⁻² cm/sec (high) to 10⁻⁵ cm/sec (moderate).

3.2 Local Groundwater Use

The City of Barrie obtains its water from a combination of groundwater and surface water based supplies. Municipal servicing is assumed to be available for lands within the municipal city boundary which includes lands north of the subject lands (Figure 1). Homes along Country Road 27 and Salem Road outside of the previous municipal limits however are likely to have private water supply wells.

A review of the MECP water well records indicated that there are approximately 17 water supply well records within 500 m of the subject lands. The locations of the MECP water well records are shown on Figure 5. The wells are located in the overburden at depths ranging from 5.2 to 72.5 m. Based on our interpretation of local stratigraphy and the interpreted geological cross-sections it is interpreted that most of the water supply wells are in the regional sand aquifer that occurs at elevations approximately between 210 masl and 275 masl (Figures 6 and 7). These wells would be separated from activities on the subject lands by a layer of low hydraulic conductivity silty clay till.

The City of Barrie groundwater supply wells are located in deep aquifers (A3 and A4 in the regional hydrostratigraphy). These aquifers are interpreted to be found at elevations of 150 masl to 195 masl and 115 masl to 160 masl respectively and are therefore significantly below the surficial layer found on the subject lands and separated from any potential impact due to the proposed development (AquaResource et al., 2011). There are no municipal water supply wells located close to the subject lands; the municipal water supply wells are located on the west and northern sides of the City more than 5 km from the subject lands. The subject lands do not fall within any wellhead protection areas or intake protection zones associated with the City of Barrie water supply systems (LSRCA, 2012).

3.3 Water Level Monitoring Results

Groundwater levels were monitored at the on-site monitoring wells on a monthly basis between May 2018 and October 2018. Groundwater level data is provided in tables and hydrographs in Appendix D. Groundwater elevations are plotted with daily precipitation data obtained from a nearby climate station – Barrie-Oro (Climate Station ID# 6117700) which is the closest station with daily precipitation values for 2018. Automatic water level meters were installed in September 2018 in monitoring wells DP-BH23 and DP-BH120 to collect continuous hourly water level data.

The groundwater monitoring data show the following (refer to Figure 2 for the monitoring locations and the data tables and hydrographs in Appendix D):

- Typically, in shallow wells in southern Ontario, a seasonal groundwater level pattern is apparent with highest levels occurring in the spring, declining throughout the summer and early fall and then rising again in the late fall/early winter. A portion of

this pattern was observed in the on-site wells with most wells showing a gradual decline over the summer followed by a slight increase in October. The range of water levels observed during this period was from 0.4 m to 2.4 m (Figures D-1 to D-10).

- It is interpreted that a perched groundwater table exists within the surficial sands at DP-BH18, DP-BH23, DP-BH120, DP-BH129 and MW3 with water levels ranging from 0.8 m to 5.3 meters below ground surface. At DP-BH14, a perched water table was encountered during drilling but the well was eventually screened below the surficial sand layer and therefore the well is dry.
- Due to topographic considerations, the perched water table was encountered at around 14.3 m bgs at DP-BH7 (Figure D-1). During the low water table conditions in September DP-BH7 was dry.
- DP-BH14 and DP-BH21 were consistently dry during the period of monitoring (Figure D-2 and D-4). These wells may have been screened below the productive zones in the shallow sand.
- Water levels in DP-BH123 are consistently 0.08 m above the bottom of the well (Figure D-8). This is interpreted to be water trapped in the bottom of the well cap and not a reflection of the water table. DP-BH123 is screened below the perched water table that adjacent wells MW3s/d are screened in.
- Water levels in piezometer nest DP-PZ1s/d ranged from ground surface to 0.4 m below ground surface. Water levels in the deep piezometer were lower than the shallow well indicating recharge conditions except during July where discharge conditions are observed (Figure D-11, Appendix D).

3.4 Interpreted Groundwater Flow Pattern

Groundwater flow within the shallow overburden (perched water table) is interpreted to be influenced by the surface topography with groundwater flow from the topographically higher areas towards topographically lower areas and surface water features.

Groundwater elevation data (June 2018) obtained from the monitoring wells are shown on Figure 8, along with the interpreted groundwater elevation contours for the area.

Arrows perpendicular to the groundwater elevation contours shown on Figure 8 illustrate the interpreted direction of the groundwater movement. Groundwater is interpreted to move in a northwest direction towards Bear Creek.

3.5 Recharge and Discharge Conditions

Areas where water from precipitation infiltrates into the ground and moves downward (i.e., areas of downward hydraulic gradients) are known as recharge areas. These areas are generally found at relatively higher topographic elevation. Areas where groundwater moves upward (i.e., areas of upward hydraulic gradients) are discharge areas and these generally occur in areas of relatively lower topographic elevation, such as along watercourses. When evaluating groundwater recharge or discharge conditions, nested wells (two wells screened at different depths at the same location) can be used to determine vertical hydraulic gradients in the subsurface.

At monitoring well nest MW3s/d, the shallow well is screened from 0.9 m to 6 m in sand and the deep well is screened from 5.1 m to 7.5 m in sand and sand and silt. Since the screens overlap a gradient cannot be calculated for the wells. DP-BH123 is also located beside the wells. DP-BH123 is screened from 10.6 m to 13.6 m and as discussed in Section 3.2, shows groundwater to below its screen. The water table exhibited at MW3 is interpreted to be a perched water table. Underlying unsaturated sediments screened by DP-BH123 would create a downward gradient and is interpreted to form recharge conditions at this location.

Piezometer nest DP-PZ1s/d is located along the tributary of Bear Creek. The hydrograph of DP-PZ1s/d (Figure D-11) indicates recharge conditions with water levels in the deep piezometer lower than the shallow piezometer. A reversal of gradient and groundwater discharge conditions was observed in July 2018 during the seasonal groundwater low.

There were no other nested wells on the subject property however, several wells that were dry or seasonally dry wells (DP-BH7, DP-BH14, DP-BH21 and DP-BH123) support the interpretation that recharge conditions are present on the subject lands.

3.6 Significant Groundwater Recharge Areas and Ecologically Significant Groundwater Recharge Areas

Significant Groundwater Recharge Areas (SGRAs) can be described as areas that can effectively move water from the surface through the unsaturated soil zone to replenish available groundwater resources (LSRCA, 2012). SGRAs were mapped by the Source Water Protection Assessment Report (LSRCA, 2012) as a requirement of the Clean Water Act, 2006 and based on guidance provided by the MECP. The delineation of these areas was completed using numerical models and analyses that included the evaluations of numerous factors including precipitation, temperature and other climate data along with land use, soil type, topography and vegetation to predict groundwater recharge, runoff and evapotranspiration.

SGRAs represent areas where the annual recharge rate is greater than 115% of the average recharge of 164 mm/year across the Lake Simcoe watershed (or greater than the threshold recharge rate of 189 mm/year) (LSRCA, 2012). SGRAs are mapped along the southern portion of the subject lands (Figure 9). The mapping corresponds to where the regional surficial geology mapping for ice contact stratified deposits (Figure 4). Monitoring data and borehole logs support this classification.

Ecologically Significant Groundwater Recharge Areas (ESGRAs) were delineated for the Barrie Creek, Lover's Creek and Hewitt's Creek subwatersheds by Earthfx (2012) using the groundwater model developed by AquaResources for the Source Protection studies. ESGRAs were identified as areas of land that are assumed to support groundwater systems or environmentally sensitive features like lakes, cold water streams and wetlands (Earthfx, 2012). ESGRAs were delineated by identifying pathways in which recharge, if it occurred, would reach an ecologically significant feature. Ecologically significant features used for the delineation of the ESGRAs included headwater streams, cold water fisheries, wetlands, and brook trout and sculpin capture sites. There are no ESGRAs mapped on the subject lands (Figure 9).

4.0 Surface Water Monitoring

Surface water monitoring was completed along the tributary of Bear Creek that flows through the subject lands at two monitoring locations (Figure 3). Flow was measured at SSF-8 where the tributary flows north under Salem Road towards the subject lands. Within the subject lands the tributary flows north through a forested wetland then through a vegetated channel that borders agricultural fields. Flow was also measured at SSF-7 where the tributary leaves the subject lands under County Road 27.

Flow monitoring as part of this study was completed from May 2018 to October 2018 (Table E-1, Appendix E). Minimal flow (<0.5 L/s to 1 L/s) was observed at the monitoring stations in May 2018 and October 2018. The stations were dry during monitoring events from June to September 2018. Surface water monitoring was also completed at SSF-7 and SSF-8 as part of the Salem SIS report (Burnside, 2016) from December 2014 to December 2017 (Table E-2, Appendix E). The monitoring concluded that the drainage feature is intermittent with the potential for some seasonal contributions of groundwater. Groundwater monitoring at DP-PZ1s/d showing seasonal discharge conditions would support this conclusion (Figure D-11).

5.0 Water Quality

5.1 Groundwater Quality

Water quality data was collected from selected monitoring wells to typify the groundwater quality on the subject lands. Groundwater sampling was completed on September 27 and 28, 2018 at two groundwater monitoring wells (MW3d and

DP-BH120). The water samples were submitted to a certified laboratory for analyses of general water quality indicators (e.g., pH, hardness, and conductivity), basic ions (including chloride and nitrate) and selected metals to characterize the background water quality. The groundwater testing results from the analytical laboratory are provided in Table F-1, Appendix F and discussed below.

- The results showed that the water generally met the Ontario Drinking Water Quality Standards (ODWQS).
- Both samples exceeded the ODWQS for total hardness (100 mg/L) with values ranging of 136 mg/L (MW3d) and 447 mg/L (DP-BH120). Hardness in groundwater is caused by dissolved calcium and magnesium and is typically related to the geologic material of the subsurface.
- Samples exceeded the ODWQS for turbidity (5 NTU) with values of 213 NTU (MW3d) and 384 NTU (DP-BH120). This is likely a result of high silt content in the samples caused by a lack of well development. Groundwater is not intended for potable uses as part of the development and hence this exceedance is not regarded as an issue of concern.
- At DP-BH120, high concentrations of sodium and chloride were detected. Sodium at DP-BH120 was 298 mg/L compared to a ODWQS of 200 mg/L. Chloride was 654 mg/L compared to an ODWQS of 250 mg/L. In contrast, MW3d had very low concentrations of sodium and chloride, 1.2 mg/L and 1.0 mg/L respectively. DP-BH120 is located close to Country Road 27. The elevated concentrations are likely a result of road salt runoff.

5.2 Surface Water Quality

A surface water sample was not collected since the watercourse was dry during the sampling event. A sample will be collected in the spring and provided in an updated report.

6.0 Water Balance

In order to assess potential land development impacts on the local groundwater conditions, a detailed water balance analysis has been completed to determine the pre-development recharge volumes (based on existing land use conditions). The detailed water balance calculations are provided in Appendix G.

6.1 Water Balance Components

A water balance is an accounting of the water resources within a given area. As a concept, the water balance is relatively simple and may be estimated from the following equation:

$$P = S + ET + R + I$$

Where:

P	=	precipitation
S	=	change in groundwater storage
ET	=	evapotranspiration/evaporation
R	=	surface water runoff
I	=	infiltration

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). Runoff, for example, occurs particularly during periods of snowmelt when the ground is frozen, or during intense rainfall events. Precise measurement of the water balance components is difficult and as such, approximations and simplifications are made to characterize the water balance of a property. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important input considerations for the water balance calculations.

The groundwater balance components for the subject area are discussed below:

Precipitation (P)

The long-term average annual precipitation for the area is 933 mm based on data from the Environment Canada Barrie WPCC (Station 6110557, 44°22'33.012" N, 79°41'23.010" W, elevation 221.0 masl) for the period between 1981 and 2010. The climate station is located 7.5 km northeast of the subject lands. Average monthly records of precipitation and temperature from this station have been used for the water balance calculations in this study (Appendix G).

Storage (S)

Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero so this term is dropped from the equation.

Evapotranspiration (ET)

Evapotranspiration and evaporation components vary based on the characteristics of the land surface cover (i.e., type of vegetation, soil moisture conditions, perviousness of

surfaces, etc.). Potential evapotranspiration (PET) refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than the PET under dry conditions (i.e., during the summer when there is a soil moisture deficit). In this report, the PET and AET have been calculated using a soil-moisture balance approach.

Water Surplus (R + I)

The difference between the mean annual P and the mean annual ET is referred to as the water surplus. Part of the water surplus travels across the surface of the soil as surface or overland runoff (R) and the remainder infiltrates the surficial soil (I). The infiltration is comprised of two end member components: one component that moves vertically downward to the groundwater table (referred to as recharge) and a second component that moves laterally through the topsoil profile or shallow soils as interflow that re-emerges locally to surface (i.e., as runoff) at some short time following cessation of precipitation. As opposed to the “direct” component of surface runoff that occurs during precipitation or snowmelt events, interflow becomes an “indirect” component of runoff. The interflow component of surface runoff is not accounted for in the water balance equation cited above since it is often difficult to distinguish between interflow and direct (overland) runoff, however both interflow and direct runoff together form the total surface water runoff component.

6.2 Approach and Methodology

The analytical approach to calculate the water balance involves monthly soil-moisture balance calculations to determine the pre-development (based on existing land use) infiltration volumes. A soil-moisture balance approach assumes that soils do not release water as potential recharge while a soil moisture deficit exists. During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

A soil moisture storage capacity of 150 mm was used for the agricultural lands with predominantly short to moderate-rooted vegetation (Table G-1, Appendix G). A soil moisture storage capacity of 300 mm was used for wooded areas within the subject lands (Table G-2, Appendix G). Tables G-1 and G-2 in Appendix G detail the monthly potential evapotranspiration calculations accounting for latitude and climate, and then calculate the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions.

The MECP SWM Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used and a corresponding runoff component was calculated for the soil moisture storage conditions. The

calculated water balance components from this table are then used to assess the pre-development and post development volumes for runoff and infiltration as presented on Table G-3 in Appendix G.

6.3 Water Balance Component Values

The detailed monthly calculations of the water balance components are provided in Tables G-1 and G-2 in Appendix G. For these calculations, it has been assumed that sandy loam soils are representative for the subject lands for estimating the soil infiltration factor. The calculations show that a water surplus is generally available from November to May. The monthly water balance calculations illustrate how infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. The monthly calculations are summed to provide estimates of the annual water balance component values (Tables G-1 and G-2, Appendix G). A summary of these values is provided in Table 3.

Table 3: Water Balance Component Values

Water Balance Component	Agricultural Lands	Wooded Areas
Average Precipitation	933 mm/year	933 mm/year
Actual Evapotranspiration	593 mm/year	593 mm/year
Water Surplus	340 mm/year	340 mm/year
Infiltration	238 mm/year	272 mm/year
Runoff	102 mm/year	68 mm/year

6.4 Pre-Development Water Balance (Existing Conditions)

The pre-development water balance calculations are presented in Table G-3 in Appendix G. As summarized on Table G-3, the total area of the subject lands is about 25.8 ha. The water balance component values from Table G-1 and Table G-2 were used to calculate the average annual volume of infiltration across the subject lands. Based on these component values, the pre-development infiltration volume for the subject lands is calculated to be about 53,000 m³/year (Table G-3, Appendix G).

6.5 Potential Urban Development Impacts to Water Balance

Development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (i.e., roads, parking lots, driveways, and rooftops). Impervious surfaces prevent infiltration of water into the soils and the removal of the vegetation removes the evapotranspiration component of the natural water balance. The evaporation component from impervious surfaces is relatively minor (estimated to be 10% to 20% of precipitation) compared to the evapotranspiration component that occurs with vegetation in this area (about 64% of

precipitation across the subject lands). The net effect of the construction of impervious surfaces is that most of the precipitation that falls onto impervious surfaces becomes surplus water and direct runoff. The natural infiltration components (interflow and deep recharge) are reduced.

A water balance calculation of the potential water surplus for impervious areas is shown at the bottom of Table G-1 in Appendix G. There is an evaporation component from impervious surfaces and this is typically estimated to be between about 10% and 20% of the total precipitation. For the purposes of the calculations in this study, the evaporation has been estimated to be 15% of precipitation. The remaining 85% of the precipitation that falls on impervious surfaces is assumed to become runoff. Therefore, assuming an evaporation/loss from impervious surfaces of 15% of the precipitation, there is a potential water surplus from impervious areas of 793 mm/year.

It is noted that the proposed development will be serviced by municipal water supply and waste water services. Therefore, there will be no impact on the water balance and local groundwater or surface water quantity and quality conditions related to any on-site groundwater supply pumping or disposal of septic effluent.

6.6 Post-Development Water Balance with No Mitigation

To assess potential development impacts on infiltration, the post-development infiltration volumes have been calculated for the subject lands on Table G-3 in Appendix G. The total areas for the proposed land uses and the associated percentage impervious factors were provided by Schaeffers Consulting Engineers.

The infiltration and runoff components for the post-development land uses have been calculated using the MOECC SWM Planning and Design Manual (2003) methodology based on topography, soil type and land cover as shown on Tables G-1 and G-2 in Appendix G. In summary from these appendix tables, the average calculated post-development infiltration volume (without mitigation) is about 27,000 m³/year.

Comparing the pre- and post-development infiltration volumes, shows that development has the potential to reduce the average infiltration on the subject lands from 53,000 m³/year to 27,000 m³/year, i.e., a reduction of about 26,000 m³/year or 50%. These calculations assume no low impact development (LID) measures for stormwater management are in place.

6.7 Recommended Mitigation Strategies for Infiltration

The water balance calculations suggest that, without mitigation, the subject lands will receive about 50% of the current amount of average annual groundwater infiltration after development. It is recommended to minimize the potential development impacts to infiltration through the use of 'low impact development' (LID) measures for stormwater

management to ensure the post-development groundwater infiltration volume is maintained as close to the pre-development infiltration volume as possible.

Where feasible, measures to promote infiltration and minimize development impacts on the water balance should be incorporated into the development design. There, as outlined in the MOE SWM Design Manual (2003), a number of mitigation techniques that can be used to increase the potential for post-development infiltration and mitigate the reductions in infiltration that occur with land development. Techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards lawns, side and rear yard swales, boulevards, parks, and other open space areas throughout the development where possible and increasing the topsoil thickness (i.e., from typical thicknesses of about 15 cm up to 20 cm or 30 cm) can increase the potential for infiltration in developed areas. These types of surface LID techniques promote natural infiltration by providing additional water volumes in the pervious areas. This may be particularly effective in the summer months, when natural infiltration would not generally occur because the additional water overcomes the natural soil moisture deficit. Other LID measures that may be considered to reduce runoff volumes include bioswales, rain gardens, perforated pipe systems, infiltration trenches and facilities, permeable pavements, tree boxes, and rainwater harvesting techniques, such as cisterns and rain barrels.

The Functional Servicing Report (FSR) for the subject lands (Schaeffers, 2018) discusses potential LID measures to mitigate the infiltration deficit which includes an infiltration area within a stormwater management pond. The FSR provides that the proposed measures will provide adequate water to offset the infiltration deficit, however the impact of LID measures on infiltration should be confirmed at detailed design.

7.0 Development Considerations

7.1 Construction Below the Water Table

Based on groundwater level data collected as part of this study water table on the subject lands ranges from 0.8 m to 14 m below ground surface. Should excavations during construction of servicing extend below the water table the local soils may need to be dewatered. Significant groundwater flows may be encountered in areas where high permeability sand and gravel layers are encountered.

The construction of buried services below the water table has the potential to capture and redirect groundwater flow through more permeable fill materials typically placed in the base of excavations. Groundwater may also infiltrate into joints in storm sewers and manholes. Over the long-term, these impacts can lower the groundwater table across the development area. To mitigate this effect, services to be installed below the water table should be constructed to prevent redirection of groundwater flow. This will involve the use of anti-seepage collars or clay plugs surrounding the pipes to provide barriers to

flow and prevent groundwater flow along granular bedding material and erosion of the backfill materials.

Due to the potential for encountering the water table during construction, the dewatering of local aquifers may be required in order for services to be installed below the water table. The undertaking of dewatering according to industry standards and in accordance with a MECP processes will ensure that adequate attention is paid to potential adverse impacts to the environment. Currently the MECP allows for construction dewatering of less than 400,000 L/d to proceed under the Environmental Activity Sector Registry (EASR) process. If dewatering is to be above this threshold, then the standard Permit to Take Water (PTTW) process applies. In both cases, a scientific study is required in support of EASR registration or PTTW application. This scientific study must review the potential for environmental impacts and provide mitigation and monitoring measures to the satisfaction of the MECP or other review agency. The requirements for construction dewatering will be confirmed by geotechnical/hydrogeological investigations completed in support of detailed design.

7.2 Local Groundwater Supply Wells

The area surrounding the subject lands is not currently serviced and residences are supplied by private wells. Based on the MECP well records, the majority of wells located in the vicinity of the subject lands are drilled wells more than 13 m deep (Table A-1, Appendix A). There are three dug wells with depths less than 13 m and screened in the surficial sand layer. These wells would be more vulnerable to impacts during construction as they are completed in the shallow subsurface for which is most likely to be impacted by construction dewatering activities. It should however be noted that the potential impact to the shallow aquifers and water supply wells would be of limited spatial extent and duration. No long-term adverse impacts are expected. Although no long-term impacts are not anticipated, a targeted monitoring and mitigation program is recommended as part of due diligence and a conservative approach to implementation. This monitoring and mitigation program would include targeting the three dug wells for monitoring during the construction process.

7.3 Well Decommissioning

Prior to or during construction, it is necessary to ensure that all inactive wells within the development footprint have been located and properly decommissioned by a licensed water well contractor according to Ontario Regulation 903. This regulation applies to private domestic wells and to the groundwater observation wells installed for this study unless they are maintained throughout the construction for monitoring purposes.

8.0 Monitoring and Mitigation

Dewatering, if required, will be of limited duration (less than one week) per section of pipe to be installed. In this context, the duration of the impact due to dewatering is expected to be short and of limited extent. On the completion of dewatering, conditions within the aquifer are expected to return to pre-dewatering conditions. Notwithstanding the short duration and minimal nature of the impact expected, the following monitoring program has been developed to show due diligence and allow for the implementation of a mitigation plan should it be required.

8.1 Pre-Construction Monitoring

Baseline monitoring has been ongoing in the area of the subject lands since 2014 as part of the SIS and then as part of this current study in support of draft plan. These data provide a sufficient baseline against which future impacts can be analyzed.

Our initial review of the MECP database has identified three dug wells in the vicinity of the subject lands. It is recommended that a water well survey be completed to identify confirm the status of these wells and also to locate any other potential vulnerable private water supply wells within 300 m of the subject lands. The survey would seek to confirm the location of any water supply wells in the vicinity of the subject lands and would also seek to collect information that can be used to identify potential monitoring locations. Contingent on property owner approval, select wells would be equipped with automatic water level recorders that would be used during construction.

It is recommended that, prior to the completion of any dewatering activities, local residents be advised of the activity and that an interference response procedure be established. The interference response procedure will include a contact information that a resident can use to report an impact at their well. Impacts should also be reported to the MECP and replacement water supplied until the impact has dissipated.

8.2 During Construction Monitoring

During construction groundwater monitoring should continue at piezometers within the wetland and monitoring wells outside of the area of construction.

If an interference complaint is received from a private water supply owner, an investigation will be initiated. An automatic water level meter will be immediately installed in the well and a review of well performance will be undertaken. Should it be determined that a water supply has been adversely affected by dewatering, the dewatering contractor will arrange for provision of alternative drinking water supplies until such time as construction activities have been completed and monitoring confirms that the water level in the well has returned to static conditions.

8.3 Post Construction Monitoring

Following completion of construction activities, monitoring of the piezometers and any remaining groundwater monitoring wells should continue until water levels in the wells have recovered and stabilized or at least for a period of three months.

9.0 References

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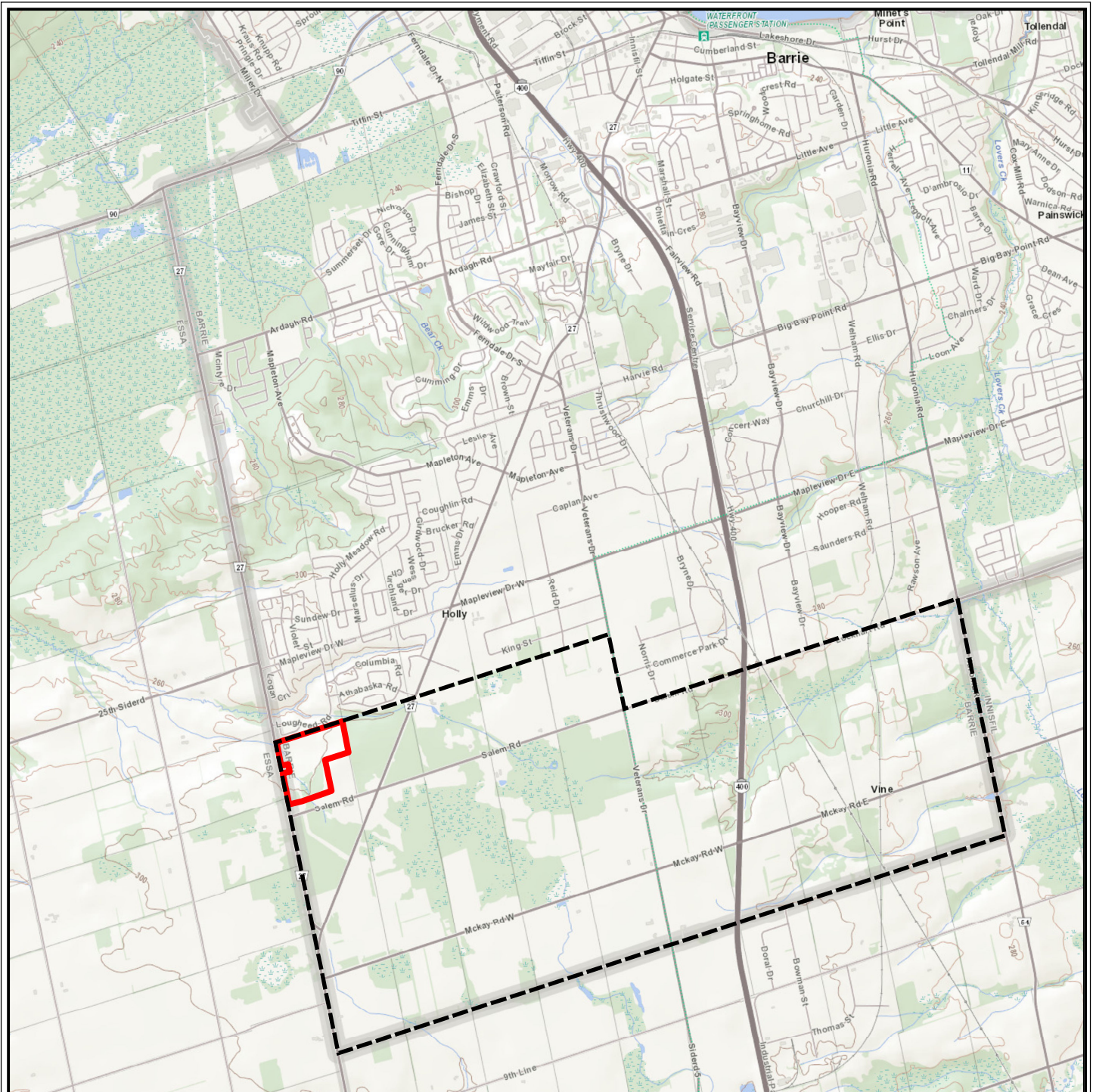
BURNSIDE

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Figures

Figures



LEGEND



SUBJECT LANDS



SETTLEMENT AREA BOUNDARY



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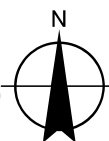
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IN SUPPORT OF DRAFT PLAN**

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SITE LOCATION

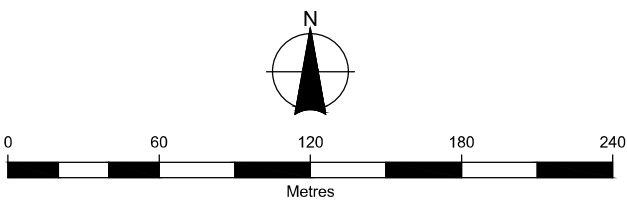
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Meters





- LEGEND**
- SUBJECT LANDS
 - WATERCOURSE
 - MONITORING WELL (GEOPRO CONSULTING, 2018)
 - MONITORING WELL (TERRAPROBE, 2011)
 - MONITORING WELL (TERRAPROBE, 2018)
 - DRIVE POINT PIEZOMETER (RJB 2018)



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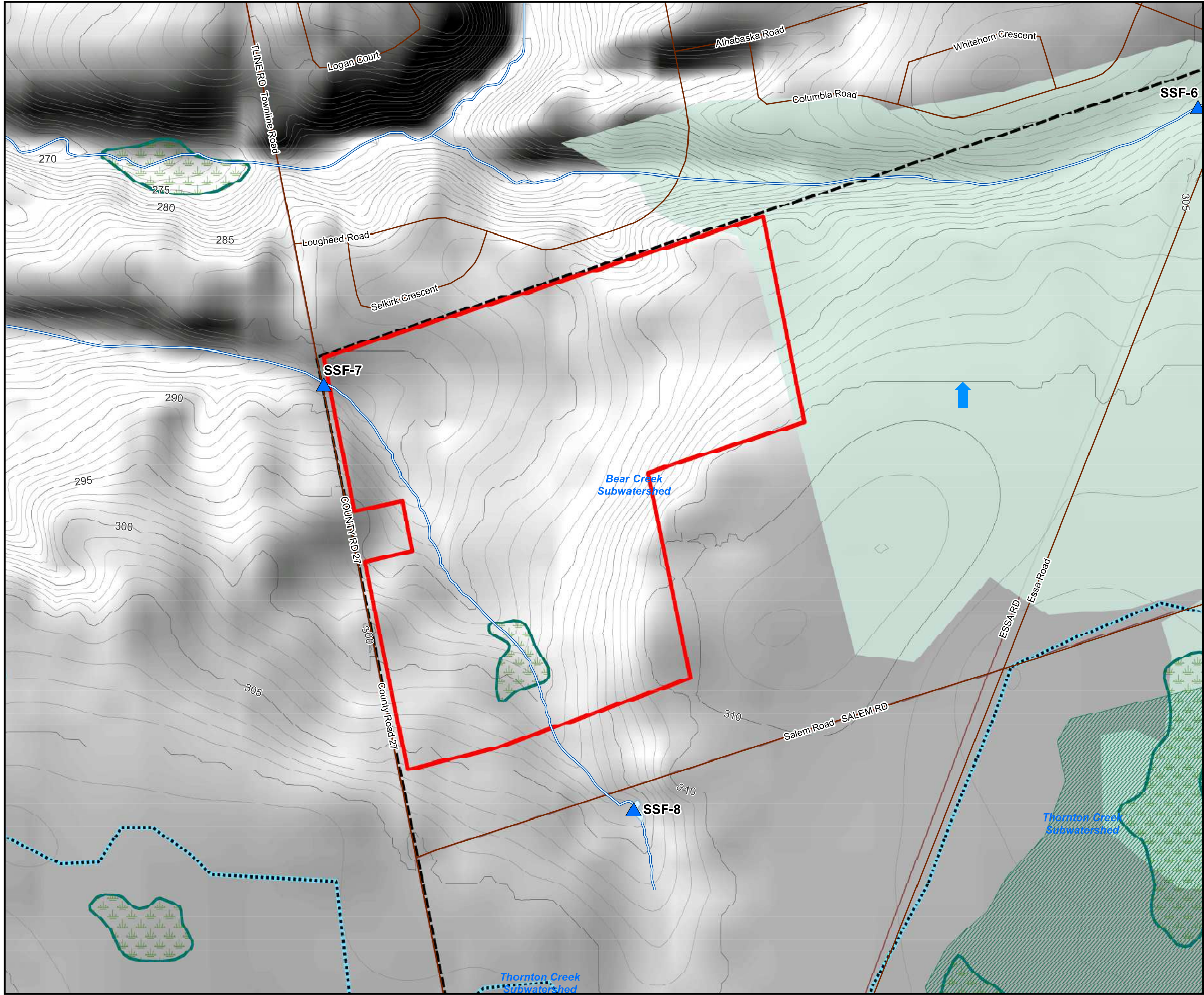
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BARRIE, ONTARIO

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Figure Title

MONITORING LOCATIONS

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LEGEND

- SUBJECT LANDS
- SETTLEMENT AREA
- WATERCOURSE
- ROADWAY
- WETLAND
- PROvincially SIGNIFICANT WETLAND
- ROADWAY
- WATERSHED BOUNDARY
- SUBWATERSHED BOUNDARY
- NATURAL HERITAGE SYSTEM BOUNDARY
- CONTOUR (5m intervals - masl)
- CONTOUR (1m intervals)
- WATERBODY
- WOODED
- SURFACE WATER MONITORING LOCATION
- SURFACE WATER FLOW DIRECTION

Sources:

- 1. Ministry of Natural Resources, © Queen's Printer for Ontario
- 2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

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Metres

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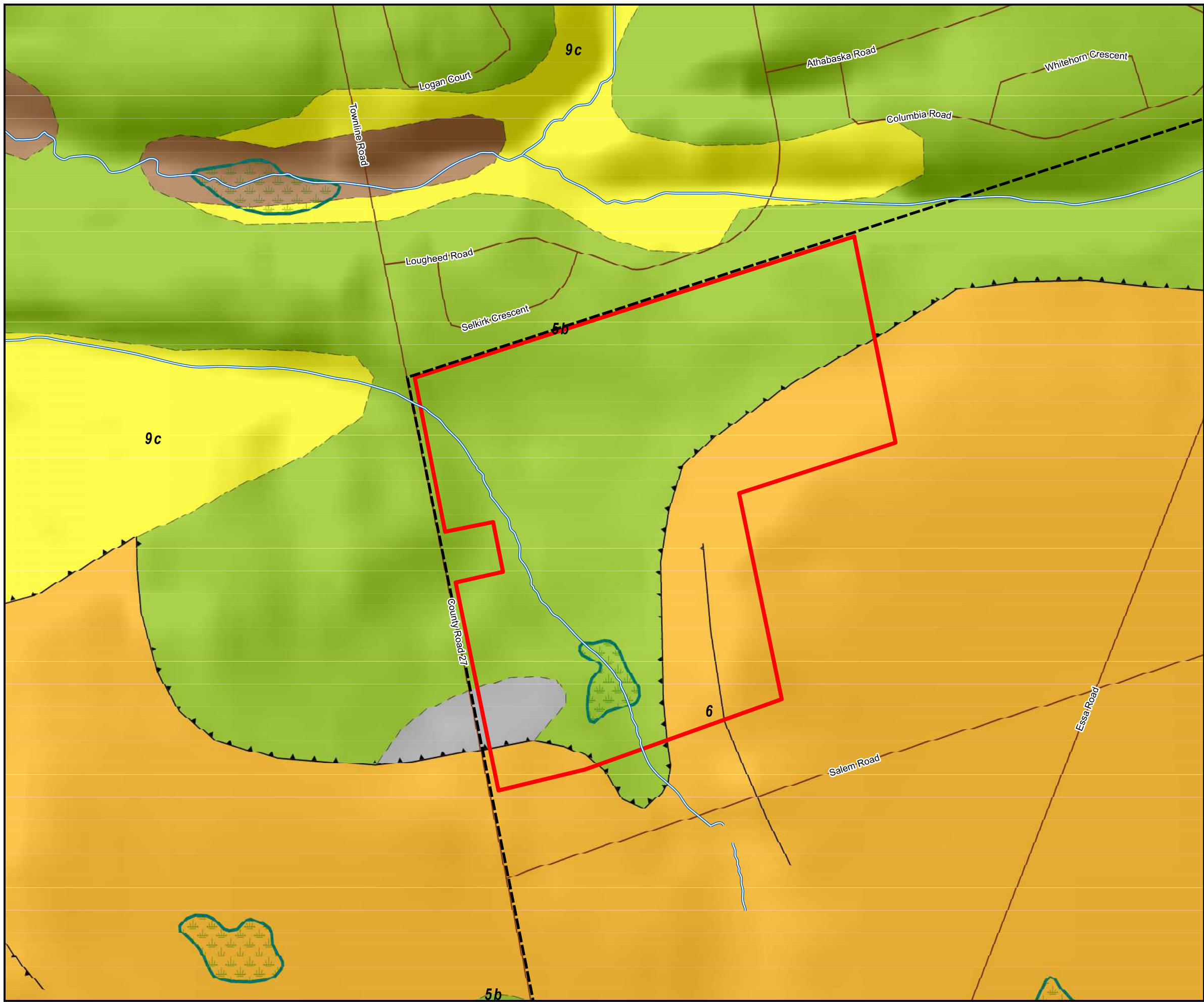
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Figure Title

TOPOGRAPHY AND DRAINAGE

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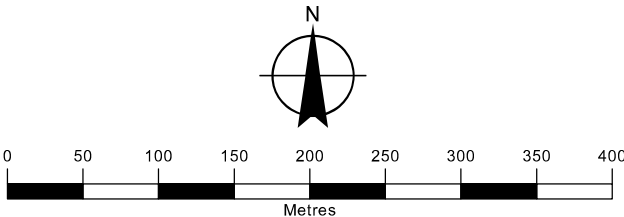


LEGEND

- SUBJECT LANDS
- SETTLEMENT AREA BOUNDARY
- ROADWAY
- WATERCOURSE
- Ice-Contact Slope
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 6: Ice-contact stratified deposits
- 9c: Coarse-textured glaciolacustrine deposits: Foreshore-basinal deposits
- 12: Older alluvial deposits
- 20: Organic deposits

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.
3. Ontario Geological Survey 2003. Surficial Geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128.



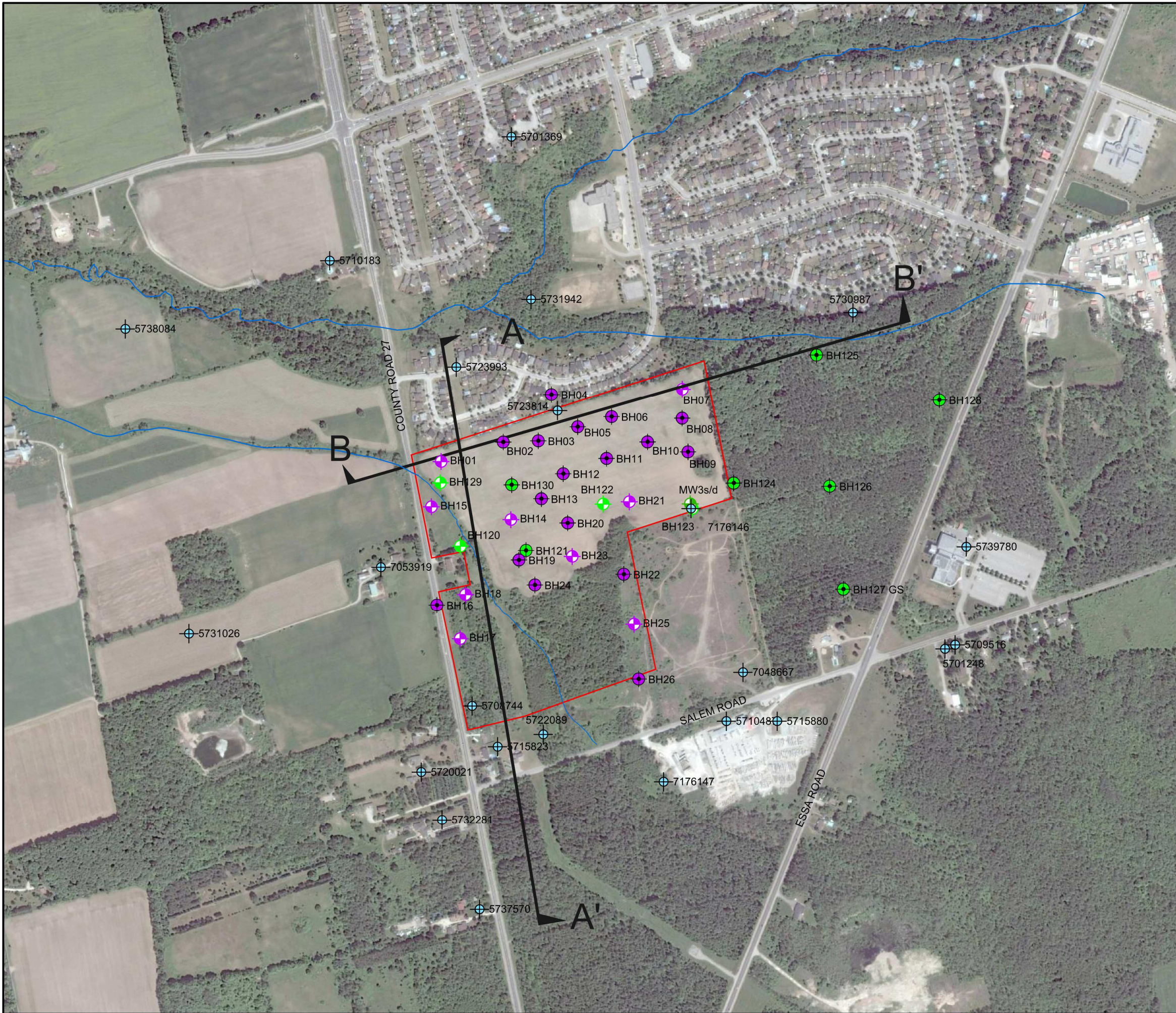
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Figure Title

SURFICIAL GEOLOGY

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LEGEND

SUBJECT LANDS

WATERCOURSE

MONITORING WELL
(GEOPRO CONSULTING, 2018)

MONITORING WELL
(TERRAPROBE, 2011)

MONITORING WELL
(TERRAPROBE, 2018)

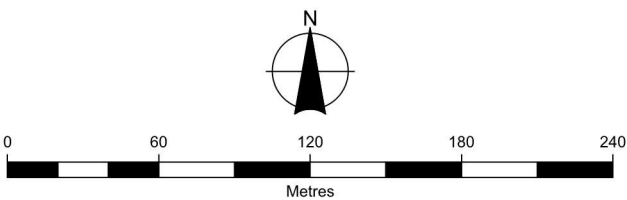
BOREHOLE
(GEOPRO CONSULTING, 2018)

BOREHOLE
(TERRAPROBE, 2018)

MECP WELL RECORD LOCATION

A A'

CROSS-SECTION LOCATION KEY



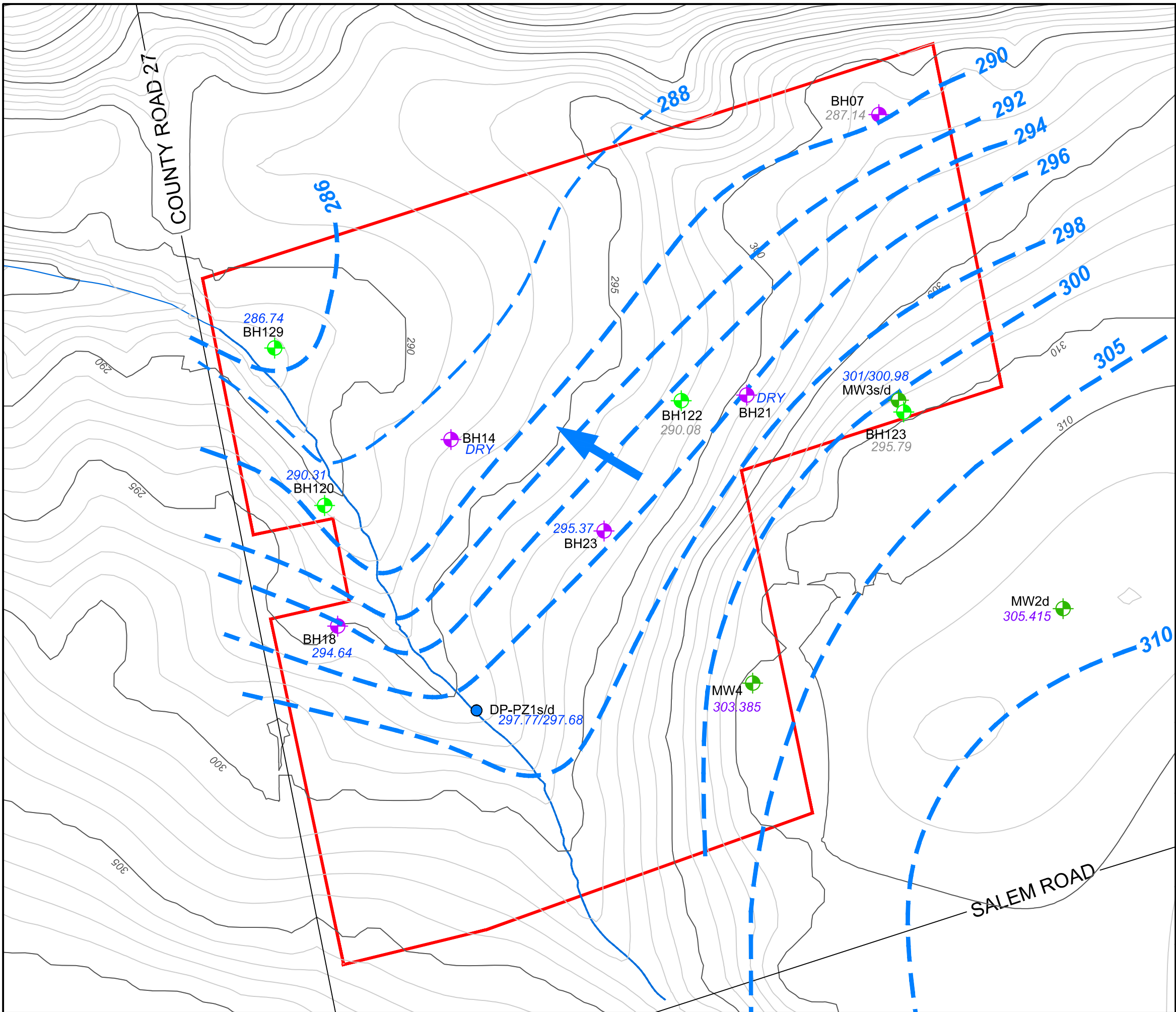
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Figure Title

**BOREHOLE AND WELL
LOCATION PLAN**

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LEGEND

SUBJECT LANDS

WATERCOURSE

MONITORING WELL
(GEOPRO CONSULTING, 2018)

MONITORING WELL
(TERRAPROBE, 2011)

MONITORING WELL
(TERRAPROBE, 2018)

DRIVE POINT PIEZOMETER

INTERPRETED GROUNDWATER
CONTOUR (masl)

267.45

MEASURED WATER LEVEL
(June, 2018)

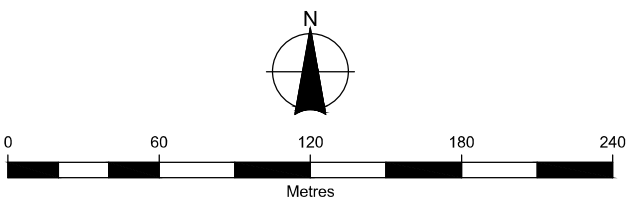
267.45

MEASURED WATER LEVEL
(May 14, 2015)

267.45

MEASURED WATER LEVEL
(Interpreted not to reflect shallow
groundwater table))

INTERPRETED GROUNDWATER FLOW



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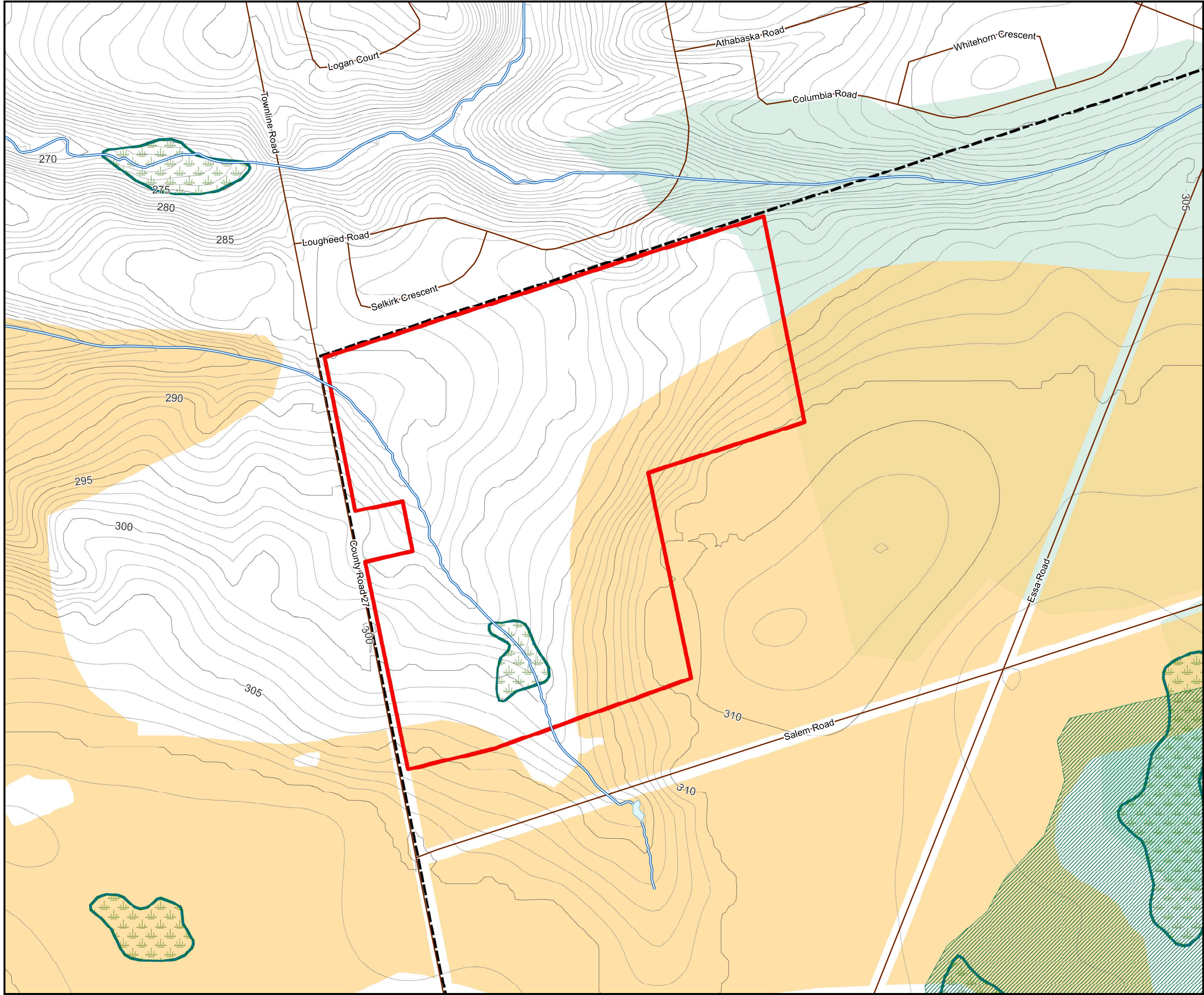
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Figure Title

INTERPRETED GROUNDWATER FLOW

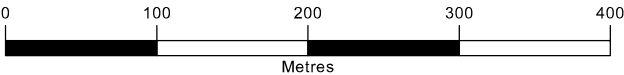
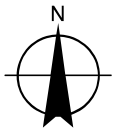
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- LEGEND**
- SUBJECT LANDS
 - SETTLEMENT AREA
 - WATERCOURSE
 - ROADWAY
 - SIGNIFICANT GROUNDWATER RECHARGE AREAS (SGRA, LSRCA)
 - WETLAND
 - PROvincially SIGNIFICANT WETLAND
 - WATERSHED BOUNDARY
 - NATURAL HERITAGE SYSTEM BOUNDARY
 - CONTOUR (5m intervals - masl)
 - CONTOUR (1m intervals)
 - WATERBODY
 - WOODED

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.
3. SGRA mapping obtained for Lake Simcoe Conservation Authority, 2018



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Figure Title

RECHARGE AREAS

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Appendix A

MECP Water Well Records

Table A-1: MECP Water Well Record Summary

MECP WELL #	Well Use	Well Depth (m)	Well Construction	Date Completed
5701248	Well: Supply	12.2	Dug Well	8/12/1964
5701369	Well: Abandoned	29.0	N/A	8/2/1966
5708744	Well: Supply	14.9	Drilled Well	1/28/1972
5709516	Well: Supply	50.9	Drilled Well	8/14/1972
5710183	Well: Supply	27.1	Drilled Well	8/15/1973
5710487	Well: Supply	8.5	Dug Well	10/7/1973
5715823	Well: Supply	5.2	Dug Well	5/6/1978
5715880	Well: Supply	47.2	Drilled Well	1/31/1979
5720021	Well: Supply	46.0	Drilled Well	5/17/1985
5722089	Well: Supply	54.9	Drilled Well	4/14/1987
5723814	Well: Supply	72.5	Drilled Well	8/30/1988
5723993	Well: Supply	45.7	Drilled Well	9/7/1988
5723994	Well: Supply	72.8	Drilled Well	9/1/1988
5730987	Well: Abandoned	71.3	N/A	7/28/1994
5731026	Well: Supply	21.3	Drilled Well	7/28/1994
5731942	Well: Supply	37.8	Drilled Well	6/12/1995
5732281	Well: Supply	48.8	Drilled Well	5/18/1995
5737570	Well: Supply	48.5	Drilled Well	1/5/2003
5738084	Well: Abandoned	0.0	N/A	8/4/2003
5739780	Well: Supply	48.8	Drilled Well	1/4/2005
7048667	Well: Monitoring	25.6	Drilled Well	8/2/2007
7053919	Well: Abandoned	5.4	N/A	11/14/2007
7176146	Well: Monitoring	7.6	Drilled Well	10/19/2011
7176147	Well: Monitoring	4.6	Drilled Well	10/18/2011

Water Well Records

Thursday, October 25, 2018

2:10:12 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
ESSA TOWNSHIP 11 024	17 600885 4907776 W	2007/11 5528	35.4			NU		7053919 (Z48268) A	
ESSA TOWNSHIP CON 11	17 601079 4907103 W	2003/01 2513	6	FR 0159	120/140/20/1:30	DO	0156 3	5737570 (254052)	LOAM 0001 YLLW SAND SILT STNS 0025 GREY CLAY SAND 0094 BRWN CLAY SAND BLDR 0123 YLLW FSND 0156 YLLW MSND 0159
ESSA TOWNSHIP CON 11 023	17 601005 4907279 W	1995/05 2431	6	FR 0143	122//15/2:30	DO	0143 4	5732281 (160505)	BRWN FSND 0007 GREY CLAY SLTY GRVL 0031 GREY CLAY TILL 0136 BRWN FSND MSND 0147 BRWN FSND 0160
ESSA TOWNSHIP CON 11 023	17 600964 4907373 W	1985/05 3660	5	FR 0144	122/125/10/2:0	DO	0147 3	5720021 ()	BLCK LOAM 0001 BRWN SAND 0010 GREY CLAY SAND 0055 BLUE CLAY 0096 BRWN SAND 0144 MSND WBRG 0151
ESSA TOWNSHIP CON 11 024	17 600507 4907645 L	1994/07 4919	30	UK 0040 UK 0050 UK 0060	30/50/10/1:0	DO		5731026 (125652)	BRWN LOAM HARD 0001 BRWN CLAY HARD 0020 GREY CLAY SAND PCKD 0070
ESSA TOWNSHIP CON 11 025	17 600382 4908244 L	2003/08 7088				NU		5738084 (265253) A	
ESSA TOWNSHIP CON 11 025	17 600784 4908378 W	1973/08 1204	5	FR 0024 FR 0066 FR 0078	51/59/7/1:40	DO	0083 3	5710183 ()	BLCK CLAY 0024 GREY GRVL 0025 GREY SILT CLAY 0066 GREY SAND 0068 GREY SAND SILT CLAY 0078 BLCK SAND 0089
INNISFIL TOWNSHIP	17 601597 4907569 W	2007/08 6809	2		///:	MO		7048667 (Z63332) A059618	BRWN SAND GRVL 0045 GREY SAND SILT DNSE 0080 GREY SILT CLAY 0084
INNISFIL TOWNSHIP	17 601441 4907354 W	2011/10 7190	2	UT 0002		MO	0015 10	7176147 (Z133800) A076132	BRWN SAND GRVL DNSE 0015
INNISFIL TOWNSHIP CON 10 001	17 601564 4907473 W	1973/10 4608	30	FR 0015	13///0:30	DO		5710487 ()	LOAM 0001 SAND 0005 GREY CLAY 0028
INNISFIL TOWNSHIP CON 10 002	17 601664 4907473 W	1979/01 4816	6	FR 0130	109//5/3:0	IN	0131 5	5715880 ()	SAND GRVL 0004 MSND 0015 CLAY GRVL SAND 0052 GREY CLAY 0099 FSND 0139 FSND SILT 0155
INNISFIL TOWNSHIP CON 10 002	17 601994 4907615 W	1964/08 1631	30	FR 0028	12//2/:	DO		5701248 ()	LOAM MSND 0010 GREY CLAY 0040
INNISFIL TOWNSHIP CON 10 002	17 602014 4907623 W	1972/08 3203	4	FR 0140	20/140/6/1:15	DO	0164 3	5709516 ()	YLLW CLAY SAND 0014 GREY SAND CLAY 0022 GREY CLAY 0060 GREY SAND CLAY 0066 GREY CLAY 0120 BRWN SAND 0155 GREY SAND 0167
INNISFIL TOWNSHIP CON 11 001	17 601064 4907503 W	1972/01 1204	5	FR 0049	12/36/2/6:0	DO		5708744 ()	BRWN FILL 0004 GREY SILT SAND 0030 GREY CLAY 0049
INNISFIL TOWNSHIP CON 11 001	17 601232 4908083 L	1988/09 2662	6	UK 0235	107/225/10/3:15	DO	0236 3	5723994 (29976)	BRWN SAND 0018 GREY CLAY SNDY 0120 BRWN SAND DRY 0190 GREY CLAY SNDY WBRG 0235 GREY SAND 0239
INNISFIL TOWNSHIP CON 11 001	17 601141 4908622 W	1966/08 4608						5701369 () A	GRVL 0060 MSND 0095

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
INNISFIL TOWNSHIP CON 11 001	17 601114 4907423 W	1978/05 4608	30	FR 0008	9///:	DO		5715823 ()	SAND 0017
INNISFIL TOWNSHIP CON 11 001	17 601232 4908083 L	1988/08 2662	6	UK 0234	108/225/10/4:0	DO	0235 4	5723814 (29977)	BRWN SAND 0014 GREY CLAY SNDY 0090 BRWN SAND DRY 0170 GREY CLAY SNDY 0238
INNISFIL TOWNSHIP CON 11 001	17 601033 4908169 W	1988/09 2662	6	UK 0145	60/140/10/3:20	DO	0146 4	5723993 (29982)	BRWN CLAY 0049 BRWN SAND 0091 GREY CLAY SNDY 0145 GREY SAND 0150
INNISFIL TOWNSHIP CON 11 001	17 601495 4907891 W	2011/10 7190	2	UT 0013		MO	0025 10	7176146 (Z133895) A076094	BRWN FSND 0015 GREY FSND 0025
INNISFIL TOWNSHIP CON 11 002	17 601180 4908302 W	1995/06 1583	6 5	FR 0123	72/85/12/2:0	DO	0099 4	5731942 (140621)	FILL CLAY 0006 BRWN CLAY 0012 BRWN SAND CLAY SOFT 0049 FSND 0100 BRWN FSND CGRD 0124
INNISFIL TOWNSHIP CON 11 002	17 602036 4907816 W	2005/01 2513	6.25	FR 0144	115/138/20/1:0	DO	0150 10	5739780 (Z14907) A014858	GREY SAND GRVL 0022 GREY CLAY BLDR 0078 GREY SAND CLAY 0093 YLLW SAND 0139 BRWN CLAY SAND 0142 YLLW SAND 0160
INNISFIL TOWNSHIP CON 11 002	17 601813 4908276 L	1994/07 6782		GS 0234	20/230/1/4:0	DO	0230 4	5730987 (144587) A	BLCK LOAM 0001 GREY CLAY STNS 0048 GREY SAND STNS 0050 GREY SAND GRVL 0075 GREY CLAY GRVL 0080 BRWN SAND CLAY 0115 GREY CLAY SAND 0140 GREY SAND 0147 GREY SAND WDFR SLTY 0220 BRWN CSND WDFR 0234

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
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Notes:

UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid

DATE CNTR: Date Work Completedand Well Contractor Licence Number

CASING DIA: .Casing diameter in inches

WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes

WELL USE: See Table 3 for Meaning of Code

SCREEN: Screen Depth and Length in feet

WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only

FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPG	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		



BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Borehole Logs

PROJECT: Geotechnical Investigation for Proposed Residential Developments

DRILLING DATA

CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI

METHOD: Continuous Flight Auger - Auto Hammer

DIAMETER: 155 mm

PROJECT LOCATION: County Road 27, Barrie, Ontario

FIELD ENGINEER: HR

DATE: 2018-04-30

DATUM: Geodetic

SAMPLE REVIEW: DX

REF. NO.: 17-2099GE

BH LOCATION: See Borehole Location Plan

CHECKED: DL

ENCL. NO.: 2

SOIL PROFILE			SAMPLES		GROUND WATER	DYNAMIC PENETRATION TEST				Plastic Limit			Natural Moisture Content	Liquid Limit	UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE		20	40	60	80	W _p	W	W _L				
289.7																
0.0	TOPSOIL: (300 mm)															
289.4																
0.3	REWORKED SILTY SAND TO SAND AND SILT: trace organics, trace rootlets, dark brown to brown, moist, loose		1	SS	4											
289.0																
0.6	SILTY SAND TO SAND AND SILT: trace clay, trace gravel, organic stain, brown, wet, loose to compact		2	SS	8											
288.1			3A	SS	18											
1.5	SAND AND SILT: trace clay, trace gravel, brown, moist to wet, compact		3B	SS												
287.6																
2.1	SAND: some silt, trace gravel, containing cobbles and boulders, brown, moist, dense		4A	SS	36											
287.1	--- auger grinding															
2.5	FINE SAND TO SILTY FINE SAND: brown, moist to wet, dense to very dense		4B	SS												
	--- layers of clayey silt till															
285.6			5	SS	69 / 280 mm											
4.0	SILTY SAND: trace to some gravel, trace clay, containing cobbles and boulders, brown, wet, very dense															
	--- containing cobbles and boulders															
283.4			6	SS	50 / 100 mm											
6.2	END OF BOREHOLE		7	SS	50 / 140 mm											
	Notes: 1) Water was encountered at a depth of 4.6 m below ground surface (mBGS) during drilling. 2) Borehole caved at a depth of 3.0 mBGS upon completion of drilling. 3) 51 mm dia. monitoring well was installed in borehole upon completion of drilling. Water Level Reading Date May 11, 2018 W. L. Depth (mBGS) 3.23															

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: RR						DATE: 2018-04-24																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
SOIL PROFILE			SAMPLES			GROUND WATER		DYNAMIC PENETRATION TEST								REMARKS AND GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m			ELEVATION	SHEAR STRENGTH (kPa)				WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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292.7	0.0	TOPSOIL: (310 mm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA													
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm							
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: RR						DATE: 2018-04-26							
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE							
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 4							
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Natural Moisture Content				UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				Plastic Limit w _p	Natural Moisture Content w	Liquid Limit w _L						
							○ SPT	≧ Cone	blows/0.3m										
						20	40	60	80										
294.3	TOPSOIL: (280 mm)																		
0.0																			
294.1			1	SS	4														
0.3	REWORKED SAND AND SILT: trace clay, trace gravel, trace organics, trace rootlets, pockets of topsoil, brown, moist, loose																		
293.7			2	SS	10														
0.6	SAND AND SILT: trace to some gravel, trace clay, organic stain, containing cobbles and boulders, brown, moist to wet, loose to very dense ---layers of sand																		
1			3	SS	50 / 150 mm														
292.4																			
1.9	SAND AND SILT TO SILTY SAND: trace gravel, containing cobbles and boulders, brown, moist, very dense																		
2			4	SS	93 / 230 mm														
291.5																			
2.8	SAND: some silt, trace gravel, layers of sandy silt, brown, moist, very dense																		
3			5	SS	50 / 80 mm														
290.4																			
3.9	GRAVELLY SAND: some silt to silty, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense																		
4			6	SS	50 / 50 mm														
289.0																			
5.4	SAND: some silt, trace to some gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense																		
6																			
288.2	auger grinding		7	SS	50 / 80 mm														
6.2	END OF BOREHOLE																		
	Note: 1) Borehole was open and dry upon completion of drilling.																		

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, X 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments					DRILLING DATA										
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI					METHOD: Continuous Flight Auger - Auto Hammer					DIAMETER: 155 mm					
PROJECT LOCATION: County Road 27, Barrie, Ontario					FIELD ENGINEER: HR					DATE: 2018-04-30					
DATUM: Geodetic					SAMPLE REVIEW: DX					REF. NO.: 17-2099GE					
BH LOCATION: See Borehole Location Plan					CHECKED: DL					ENCL. NO.: 5					
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Natural Moisture Content			UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				Plastic Limit w _p	Natural Moisture Content w	Liquid Limit w _L		
							SPT Cone blows/0.3m								
							● Unconfined ✕ Field Vane & Sensitivity								
							▲ Quick Triaxial ☒ Penetrometer + Lab Vane								
							20 40 60 80								
WATER CONTENT (%)										GR SA SI CL					
295.0	TOPSOIL: (230 mm)														
294.7	FILL: sand and silt to silty sand, trace clay, trace gravel, containing red brick fragments, brown, moist, compact SILTY SAND TO SAND: trace to some gravel, containing cobbles and boulders, brown, moist, compact to very dense --- auger grinding --- auger grinding --- auger grinding		1	SS	16										
294.4															
0.6															

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, ✕ 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments					DRILLING DATA													
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI					METHOD: Continuous Flight Auger - Auto Hammer					DIAMETER: 155 mm								
PROJECT LOCATION: County Road 27, Barrie, Ontario					FIELD ENGINEER: RR					DATE: 2018-04-26								
DATUM: Geodetic					SAMPLE REVIEW: DX					REF. NO.: 17-2099GE								
BH LOCATION: See Borehole Location Plan					CHECKED: DL					ENCL. NO.: 6								
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST								UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				WATER CONTENT (%)							
							SPT Cone blows/0.3m 20 40 60 80				Plastic Limit Natural Moisture Content Liquid Limit W _p W W _L							
						● Unconfined X Field Vane & Sensitivity ▲ Quick Triaxial ▣ Penetrometer + Lab Vane												
296.3	0.0	TOPSOIL: (330 mm)																
295.9	0.3	REWORKED FINE SAND AND SILT TO SILTY FINE SAND: trace organics, trace rootlets, pockets of sandy silt, brown, moist, very loose	1	SS	3													
295.7	0.6		2A	SS	4													
295.4	0.9	REWORKED SAND AND SILT TO SANDY SILT: trace to some clay, trace gravel, trace organics, trace rootlets, dark brown to brown, moist, loose	2B	SS														
295.0	1.2	SAND AND SILT: trace clay, trace gravel, containing cobbles and boulders, brown, moist, loose	3	SS	35													
294.2	2.1	SAND: trace to some gravel, layers/zones of sandy silt, containing cobbles and boulders, brown, moist, dense	4	SS	61													
		SILTY SAND: trace to some gravel, layers/zones of sandy silt, seams of silt, layers of sand, containing cobbles and boulders, brown, moist, very dense	5	SS	75													
		--- auger grinding																
292.2	4.0	SAND: some gravel, trace to some silt, brown, moist, very dense																
		--- auger grinding	6	SS	50 / 130 mm													
290.8	5.5	SAND AND SILT TO SILTY SAND: trace gravel, containing cobbles and boulders, brown, moist, very dense																
289.9	6.4	END OF BOREHOLE	7	SS	50 / 100 mm													
		Note: 1) Borehole was open and dry upon completion of drilling.																

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA												
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm						
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: RR						DATE: 2018-04-26						
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE						
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 7						
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Natural Moisture Content			UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				Plastic Limit W _p	Natural Moisture Content W	Liquid Limit W _L					
							SPT Cone blows/0.3m											
							SPT Cone blows/0.3m											
						● Unconfined X Field Vane & Sensitivity ▲ Quick Triaxial ☒ Penetrometer + Lab Vane				WATER CONTENT (%)								
						20 40 60 80				10 20 30 40								
298.6	TOPSOIL: (245 mm)																	
298.3																		
0.2	REWORKED SAND AND SILT: trace clay, trace gravel, trace organics, trace rootlets, dark brown to brown, moist to wet, very loose to compact		1	SS	2													
297.7			2A	SS														
0.8	SAND AND SILT TO SILTY SAND: trace to some clay, trace gravel, organic stain, containing cobbles and boulders, brown, moist, compact		2B	SS	11													
			3	SS	11													
296.5																		
2.1	SILTY SAND: trace gravel, layers/zones of sand and silt, containing cobbles and boulders, brown, moist, very dense		4	SS	67													
	--- auger grinding		5	SS	82													
294.5																		
4.0	CLAYEY SILT: some sand to sandy, trace gravel, zones/layers of silty sand, containing cobbles and boulders, brown, moist, hard --- auger grinding		6	SS	49													
293.0																		
5.6	SAND TO SILTY SAND: trace to some gravel, containing cobbles and boulders, brown, moist, very dense --- auger grinding		7	SS	50 / 130 mm													
290.9																		
7.7	END OF BOREHOLE Note: 1) Borehole was open and dry upon completion of drilling.		8	SS	60 / 80 mm													

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, ✕ 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA											
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 205 mm					
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: RR						DATE: 2018-04-25					
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE					
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 8					
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Natural Moisture Content				UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SPT				Plastic Limit w _p	Natural Moisture Content w	Liquid Limit w _L				
							SHEAR STRENGTH (kPa)										
							○ SPT ≥ Cone blows/0.3m 20 40 60 80										
						● Unconfined X Field Vane & Sensitivity ▲ Quick Triaxial ▣ Penetrometer + Lab Vane				WATER CONTENT (%)							
301.4	0.0	TOPSOIL: (360 mm)															
301.0	0.4	REWORKED SANDY SILT TO SAND AND SILT: trace to some clay, trace gravel, trace organics, trace rootlets, layers of clayey silt, dark brown to brown, moist, loose	1	SS	5												
300.8	0.6	CLAYEY SILT: some sand, trace organics, brown, moist, stiff	2	SS	11												
300.2	1.2	SAND AND SILT: trace clay, trace gravel, pockets of organics, brown, moist, loose	3	SS	6												
299.3	2.1	SILTY SAND: trace clay, trace gravel, layers of sand, containing cobbles and boulders, brown, moist, dense	4	SS	40												
298.5	2.9	FINE SAND AND SILT TO SILTY FINE SAND: trace gravel, layers/zones of silt, brown, moist, dense to very dense	5	SS	34												
297		--- auger grinding ---layers of clayey silt	6	SS	85 / 260 mm												
295.8	5.6	SILTY SAND: trace to some gravel, layers of sand and silt, containing cobbles and boulders, brown, moist, very dense	7	SS	50 / 150 mm												
294.4	6.9	SAND: some silt, some gravel, containing cobbles and boulders, brown, moist, very dense	8	SS	50 / 130 mm												
292.9	8.5	FINE SAND: trace to some silt, trace gravel, brown, moist, very dense	9	SS	50 / 80 mm												

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Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

[illegible]

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA														
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm								
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: RR						DATE: 2018-04-23								
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE								
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 9								
SOIL PROFILE			SAMPLES			GROUND WATER	ELEVATION	DYNAMIC PENETRATION TEST				Natural Moisture Content				UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m			SHEAR STRENGTH (kPa)				Plastic Limit w _p	Natural Moisture Content w	Liquid Limit w _L	WATER CONTENT (%)					
								○ SPT 20	≧ Cone 40	blows/0.3m 60	80									
301.8																				
0.0	TOPSOIL: (330 mm)																			
301.5			1	SS	11															
0.3	REWORKED SILTY SAND: trace gravel, trace organics, trace rootlets, pockets of organic silt, brown, moist to wet, compact																			
301.2			2	SS	6															
0.6	SILTY SAND: trace gravel, organic stain, dark brown to brown, wet, loose to compact																			
1			3	SS	4															
2																				
299.4			4A	SS																
2.4	SAND AND SILT TO SILTY SAND: trace clay, trace gravel, brown, moist to wet, compact																			
298.9			4B	SS	29															
2.9	SAND: trace to some silt, trace to some gravel, containing cobbles and boulders, brown, moist, compact to very dense																			
3			5	SS	43															
4																				
5	--- auger grinding		6	SS	97 / 260 mm															
6																				
6	---zones of silty sand																			
7			7	SS	24															
8																				
294.0			8	SS	50 / 80 mm															
7.9	END OF BOREHOLE																			
Notes: 1) Borehole was dry upon completion of drilling. 2) Borehole caved at depth of 7.3 m below ground surface (mBGS) upon completion of drilling.																				

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, X 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA													
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm							
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: RR						DATE: 2018-04-23							
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE							
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 10							
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Natural Moisture Content				UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				Plastic Limit w _p	Natural Moisture Content w	Liquid Limit w _L	WATER CONTENT (%)					
							○ SPT 20	≧ Cone 40	blows/0.3m 60	80									
						● Unconfined ✕ Field Vane & Sensitivity ▲ Quick Triaxial ⓧ Penetrometer + Lab Vane													
302.9	0.0	TOPSOIL: (330 mm)																	
302.6	0.3	REWORKED SILTY FINE SAND: trace organics, trace rootlets, dark brown to brown, moist, loose		1	SS	4													
302.3	0.6	SILTY SAND TO SANDY SILT: trace organics, organic stain, brown, moist to wet, loose		2	SS	5													
301.7	1.2	SILTY SAND: trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, compact to very dense		3	SS	20													
				4	SS	48													
299.7	3.2	SAND AND GRAVEL: trace silt, containing cobbles and boulders, brown, moist, very dense		5A	SS	50 / 100 mm													
				5B	SS														
298.9	4.0	SAND AND SILT TO SILTY SAND: trace to some gravel, containing cobbles and boulders, brown, moist, very dense																	
				6	SS	50 / 80 mm													
296.7	6.2	END OF BOREHOLE		7	SS	50 / 100 mm													
		Note: 1) Borehole caved at a depth of 5.0 m below ground surface (mBGS) upon completion of drilling.																	

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments

DRILLING DATA

CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI

METHOD: Continuous Flight Auger - Auto Hammer

DIAMETER: 155 mm

PROJECT LOCATION: County Road 27, Barrie, Ontario

FIELD ENGINEER: RR

DATE: 2018-04-23

DATUM: Geodetic

SAMPLE REVIEW: DX

REF. NO.: 17-2099GE

BH LOCATION: See Borehole Location Plan

CHECKED: DL

ENCL. NO.: 11

SOIL PROFILE			SAMPLES		GROUND WATER	DYNAMIC PENETRATION TEST				Plastic Limit			Natural Moisture Content	Liquid Limit	UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE		blows/0.3m	blows/0.3m	blows/0.3m	blows/0.3m	W _p	W	W _L				
300.8																
0.0	TOPSOIL: (310 mm)															
300.5																
0.3	REWORKED SAND AND SILT TO SILTY SAND: trace organics, trace rootlets, dark brown to brown, moist to wet, very loose		1	SS	3											
300.2																
0.6	SAND AND SILT TO SILTY SAND: trace clay, trace gravel, organic stain, dark brown to brown, moist to wet, very loose to compact		2	SS	2											
299.3			3A	SS	11											
1.5	SAND AND SILT TO SILTY SAND: trace clay, trace gravel, pockets of sand, containing cobbles and boulders, brown, moist, compact		3B	SS												
298.8																
2.1	SAND: some silt, trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense		4	SS	53											
297.9																
2.9	SILTY SAND: trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense		5	SS	80 / 280 mm											
3																
4																
5																
6			6	SS	50 / 100 mm											
295.5																
5.4	SILTY FINE SAND: trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense															
294.5			7	SS	50 / 100 mm											
6.4	END OF BOREHOLE															
Notes: 1) Borehole was dry upon completion of drilling. 2) Borehole caved at a depth of 5.9 m below ground surface (mBGS) upon completion of drilling.																

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments

DRILLING DATA

CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI

METHOD: Continuous Flight Auger - Auto Hammer

DIAMETER: 155 mm

PROJECT LOCATION: County Road 27, Barrie, Ontario

FIELD ENGINEER: RR

DATE: 2018-04-23

DATUM: Geodetic

SAMPLE REVIEW: DX

REF. NO.: 17-2099GE

BH LOCATION: See Borehole Location Plan

CHECKED: DL

ENCL. NO.: 12

SOIL PROFILE			SAMPLES		GROUND WATER	DYNAMIC PENETRATION TEST				Plastic Limit Natural Moisture Content Liquid Limit			UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE		20	40	60	80	W _p	W	W _L		
298.9														
0.0	TOPSOIL: (310 mm)													
298.6			1	SS	2									
0.3	REWORKED SAND AND SILT: trace clay, trace organics, trace rootlets, brown, moist, very loose													
298.3			2A	SS	9									
0.6	SAND AND SILT: trace to some clay, trace gravel, containing cobbles and boulders, brown, moist, loose													
297.8			2B	SS										
297.7														
1.2	SAND: trace to some silt, trace gravel, layers of sandy silt, brown, moist, loose		3	SS	51									
	SAND AND SILT TO SILTY SAND: trace clay, trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense													
2			4	SS	69									
3														
5			5	SS	82 / 280 mm									
4														
294.2	--- auger grinding		6A	SS	50 / 80 mm									
4.7	SAND: trace to some silt, trace gravel, brown, moist, very dense		6B	SS										
5														
6														
292.5			7	SS	50 / 130 mm									
6.4	END OF BOREHOLE Note: 1) Borehole caved at a depth of 5.2 m below ground surface (mBGS) upon completion of drilling.													

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments				DRILLING DATA																
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI				METHOD: Continuous Flight Auger - Auto Hammer				DIAMETER: 155 mm												
PROJECT LOCATION: County Road 27, Barrie, Ontario				FIELD ENGINEER: RR				DATE: 2018-04-23												
DATUM: Geodetic				SAMPLE REVIEW: DX				REF. NO.: 17-2099GE												
BH LOCATION: See Borehole Location Plan				CHECKED: DL				ENCL. NO.: 13												
SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION TEST				Natural Moisture Content				Liquid Limit		REMARKS AND GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m	GROUND WATER	ELEVATION	SHEAR STRENGTH (kPa)				WATER CONTENT (%)				UNIT WT (kN/m³)	GR	SA	SI	CL
295.3	TOPSOIL: (290 mm)							○ SPT ≥ Cone blows/0.3m 20 40 60 80				Plastic Limit Natural Moisture Content Liquid Limit W _p W W _L								
295.0								● Unconfined ✕ Field Vane & Sensitivity ▲ Quick Triaxial ☒ Penetrometer + Lab Vane				20 40 60 80								
0.0												10 20 30 40								
0.3	REWORKED SANDY SILT TO SAND AND SILT: trace clay, trace gravel, trace organics, trace rootlets, dark brown to brown, moist, loose		1	SS	4		295	○						○						
0.6								○						○						
294.7			2A	SS	4									○						
294.2	SAND AND SILT: trace clay, trace gravel, organic stain, brown, moist to wet, loose		2B	SS			294							○						
294.1														○						
1.2	SAND AND SILT: trace clay, trace gravel, containing cobbles and boulders, brown, moist, loose		3	SS	47					○				○				15	74 11	
293.2	SAND: some gravel, some silt, containing cobbles and boulders, brown, moist, dense																			
2.1	SILTY SAND: trace gravel, layers/zones of sand and silt, brown, moist, very dense		4	SS	72		293				○			○						
292.4																				
2.9	SILTY FINE SAND: seams/pockets of silt, brown, moist, very dense		5	SS	60		292				○			○						
291.3																				
4.0	SAND AND SILT TO SILTY SAND: trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense		6	SS	77 / 260 mm		291													
5	--- auger grinding													> >100 ○	○					
6							290													
7			7	SS	50 / 140 mm		289							> >100 ○	○					
287.6	--- containing cobbles and boulders		8	SS	50 / 130 mm		288							> >100 ○	○					
7.8	END OF BOREHOLE																			
Note: 1) Borehole caved at a depth of 6.3 m below ground surface (mBGS) upon completion of drilling.																				

PROJECT: Geotechnical Investigation for Proposed Residential Developments

DRILLING DATA

CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI

METHOD: Continuous Flight Auger - Auto Hammer

DIAMETER: 155 mm

PROJECT LOCATION: County Road 27, Barrie, Ontario

FIELD ENGINEER: RR

DATE: 2018-04-24

DATUM: Geodetic

SAMPLE REVIEW: DX

REF. NO.: 17-2099GE

BH LOCATION: See Borehole Location Plan

CHECKED: DL

ENCL. NO.: 14

SOIL PROFILE			SAMPLES		GROUND WATER	DYNAMIC PENETRATION TEST				Plastic Limit Natural Moisture Content Liquid Limit			UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE		ELEVATION	SPT 20	Cone 40	blows/0.3m 60 80	W _p	W	W _L		
294.6	TOPSOIL: (170 mm)													
294.5	REWORKED SANDY SILT: trace to some clay, trace gravel, trace organics, trace rootlets, dark brown to brown, moist, very loose		1	SS	3	294								
294.0	SAND AND SILT TO SANDY SILT: some clay, trace gravel, sand pockets, containing cobbles and boulders, brown, moist, compact		2	SS	11	294								1 39 42 18
293.6			3	SS	17	293								
292.6	SAND AND SILT TO SILTY SAND: trace gravel, containing cobbles and boulders, brown, moist, very dense		4	SS	64	292								
291.7	FINE SAND: trace to some silt, trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense --- auger grinding		5	SS	59	291								
290.6	SILTY FINE SAND: trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense		6A	SS	69	290								
289.8	SAND AND SILT: trace clay, trace gravel, containing cobbles and boulders, brown, moist, very dense		6B	SS		289								
289.1	SILTY SAND: trace gravel, layers of sandy silt, containing cobbles and boulders, brown, moist, very dense		7	SS	50 /	289								
288.4	END OF BOREHOLE Note: 1) Borehole caved at a depth of 5.4 m below ground surface (mBGS) upon completion of drilling.				140 mm									

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments										DRILLING DATA																			
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI										METHOD: Continuous Flight Auger - Auto Hammer										DIAMETER: 155 mm									
PROJECT LOCATION: County Road 27, Barrie, Ontario										FIELD ENGINEER: RR										DATE: 2018-04-24									
DATUM: Geodetic										SAMPLE REVIEW: DX										REF. NO.: 17-2099GE									
BH LOCATION: See Borehole Location Plan										CHECKED: DL										ENCL. NO.: 15									
SOIL PROFILE			SAMPLES			GROUND WATER			DYNAMIC PENETRATION TEST				Plastic Limit				Natural Moisture Content				Liquid Limit				REMARKS AND GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m	ELEVATION	SPT	Cone	blows/0.3m	SHEAR STRENGTH (kPa)				WATER CONTENT (%)				UNIT WT (kN/m³)				GR SA SI CL							
293.3							20	40	60	80	● Unconfined X Field Vane & Sensitivity ▲ Quick Triaxial Penetrometer + Lab Vane				w _p w w _L														
0.0	TOPSOIL: (340 mm)		1	SS	3	293																							
0.3	REWOKED SANDY SILT TO SAND AND SILT: trace to some clay, trace gravel, trace organics, trace rootlets, dark brown, moist, very loose		2	SS	5																								
0.6	SAND AND SILT: trace to some clay, trace gravel, trace rootlets, pockets of organics, organic stain, brown, wet, loose		3	SS	14	292																							
1.2	SAND AND SILT TO SILTY SAND: trace to some clay, trace gravel, pockets of sand, containing cobbles and boulders, moist to wet, compact to very dense		4	SS	14	291																							
			5	SS	12	290																							
			6	SS	70	289																							

PROJECT: Geotechnical Investigation for Proposed Residential Developments							DRILLING DATA													
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI							METHOD: Continuous Flight Auger - Auto Hammer							DIAMETER: 155 mm						
PROJECT LOCATION: County Road 27, Barrie, Ontario							FIELD ENGINEER: HR							DATE: 2018-04-30						
DATUM: Geodetic							SAMPLE REVIEW: DX							REF. NO.: 17-2099GE						
BH LOCATION: See Borehole Location Plan							CHECKED: DL							ENCL. NO.: 16						
SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION TEST								REMARKS AND GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m	GROUND WATER	ELEVATION	SHEAR STRENGTH (kPa)				WATER CONTENT (%)				UNIT WT (kN/m³)	GR	SA	SI	CL
								○ SPT 20	≧ Cone 40	blows/0.3m 60	80	Plastic Limit w _p	Natural Moisture Content w	Liquid Limit w _L						
291.3																				
0.0	TOPSOIL: (330 mm)		1	SS	2		291.0													
0.3	REWOKED SAND AND SILT: trace clay, trace gravel, trace organics, trace rootlets, dark brown, wet, very loose		2	SS	9		290.7													
0.6	SAND AND SILT: trace clay, trace gravel, organic stain, brown, wet, loose		3	SS	7		290.1													
1.2	SAND AND SILT TO SILTY SAND: trace to some clay, trace gravel, layers of silty sand, pockets of sand, brown, moist to wet, loose to very dense		4	SS	9		289.8/May 11													
			5	SS	11		289.0													
			6	SS	10		288.0													
			7	SS	50 / 100 mm		287.0													
-285.0	END OF BOREHOLE						286.0													
6.4	Notes: 1) Water was encountered at a depth of 2.1 m below ground surface (mBGS) during drilling. 2) Borehole caved at a depth of 5.5 mBGS upon completion of drilling. 3) 51 mm dia. monitoring well was installed upon completion of drilling. Water Level Reading Date May 11, 2018 W. L Depth (mBGS) 1.51																			

PROJECT: Geotechnical Investigation for Proposed Residential Developments					DRILLING DATA																
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI					METHOD: Continuous Flight Auger - Auto Hammer					DIAMETER: 155 mm											
PROJECT LOCATION: County Road 27, Barrie, Ontario					FIELD ENGINEER: HR					DATE: 2018-04-30											
DATUM: Geodetic					SAMPLE REVIEW: DX					REF. NO.: 17-2099GE											
BH LOCATION: See Borehole Location Plan					CHECKED: DL					ENCL. NO.: 17											
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Plastic Limit			Natural Moisture Content		Liquid Limit		UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				W _p	W	W _L								
							○ SPT	≧ Cone	blows/0.3m												
							20	40	60	80								GR	SA	SI	CL
299.0	ASPHALT: (60 mm)		1	AS																	
298.9	GRANULAR BASE/SUBBASE: (780 mm)																				
298.1			2	SS	15																
0.8	FILL: gravelly sand, trace silt, containing rock fragments, brown, moist, compact																				
297.7																					
1.2	FILL: organic sandy silt to organic silt, trace clay, trace gravel, dark brown, wet, loose																				
297.2		3A	SS	6																	
1.8	FILL: sandy silt to sand and silt, trace to some clay, trace organics, brown, wet, loose	3B	SS																		
296.8																					
2.1	SAND AND SILT: trace clay, trace gravel, brown to grey, wet, loose to compact																				
			4	SS	7																
																					
			5	SS	11																
																					
			6	SS	29																
	---grey																				
																					
																					
			7	SS	11																
292.4	END OF BOREHOLE																				
6.6	Notes: 1) Water was encountered at a depth of 4.6 m below ground surface (mBGS) during drilling. 2) Water was at a depth of 5.5 mBGS upon completion of drilling. 3) Borehole caved at a depth of 6.0 mBGS upon completion of drilling.																				

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments					DRILLING DATA									
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI					METHOD: Continuous Split Spoon					DIAMETER: 51 mm				
PROJECT LOCATION: County Road 27, Barrie, Ontario					FIELD ENGINEER: HR					DATE: 2018-05-02				
DATUM: Geodetic					SAMPLE REVIEW: DX					REF. NO.: 17-2099GE				
BH LOCATION: See Borehole Location Plan					CHECKED: DL					ENCL. NO.: 18				

SOIL PROFILE			SAMPLES		GROUND WATER	DYNAMIC PENETRATION TEST				SHEAR STRENGTH (kPa)			WATER CONTENT (%)			UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE		"N" BLOWS/0.3m	ELEVATION	blows/0.3m				WATER CONTENT (%)					
								SPT	Cone	blows/0.3m	Plastic Limit	Natural Moisture Content	Liquid Limit				
298.4	TOPSOIL: (320 mm)																
298.1	REWORKED SANDY SILT: some clay, trace to some organics, trace rootlets, brown, wet, very loose		1	SS	1	298.2/May 11											
297.6	SILTY CLAY: sandy, trace gravel, trace organics, organic stain, sand pockets, brown, wet, very soft to soft		2	SS	2	Bentonite										1 29 27 43	
296.9	SANDY SILT: some clay, trace gravel, layers/seams of clayey silt, brown, wet, loose to compact		3	SS	10												
296.3	CLAYEY SILT TO SILTY CLAY: trace to some sand, trace gravel, seams of silty sand, layers of sandy silt, brown, wet, stiff		4	SS	9	Sand											
295.3	SAND AND SILT: trace clay, trace gravel, containing cobbles and boulders, brown to grey, moist to wet, compact		5	SS	27	Screen											
294.7	END OF BOREHOLE																
Notes: 1) Water was encountered at a depth of 0.8 m below ground surface (mBGS) during drilling. 2) Water was at a depth of 0.2 mBGS upon completion of drilling. 3) 38 mm dia. monitoring was installed in borehole upon completion of drilling. Water Level Reading Date May 11, 2018 W. L. Depth (mBGS) 0.23																	

01 - GEOPRO SOIL LOG GEOPRO 17-2099 BH LOG PROJECT DATA 20180523-DC-DX-GPJ 2018-05-23 18:40

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments

DRILLING DATA

CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI

METHOD: Continuous Split Spoon

DIAMETER: 51 mm

PROJECT LOCATION: County Road 27, Barrie, Ontario

FIELD ENGINEER: RR

DATE: 2018-05-01

DATUM: Geodetic

SAMPLE REVIEW: DX

REF. NO.: 17-2099GE

BH LOCATION: See Borehole Location Plan

CHECKED: DL

ENCL. NO.: 19

SOIL PROFILE			SAMPLES		GROUND WATER	ELEVATION	DYNAMIC PENETRATION TEST				Plastic Limit			UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			○ SPT	≥ Cone	blows/0.3m		W _p	Natural Moisture Content	Liquid Limit		
296.6							20	40	60	80					
0.0	TOPSOIL: (300 mm)														
296.3															
0.3	REWORKED SAND AND SILT: trace clay, trace gravel, brown, moist to wet, very loose		1	SS	2										
295.8															
0.8	SAND AND SILT: trace clay, trace gravel, trace rootlets, layers/seams/pockets of sand, containing cobbles and boulders, brown, moist to wet, loose to compact		2	SS	6	295.4/May 11									
			3	SS	8										
			4	SS	9	294									
			5	SS	17										
			6	SS	13										
			7	SS	10	292									
291.4															
5.2	NO SAMPLE RECOVERY: likely silty sand		8	NR	19	291									
290.7															
5.9	END OF BOREHOLE:														
Notes: 1) Water was encountered at a depth of 2.3 m below ground surface (mBGS) during drilling. 2) Water was at a depth of 3.5 mBGS upon completion of drilling. 3) Borehole caved at a depth of 5.3 mBGS upon completion. 4) 38 mm dia. monitoring was installed in borehole upon completion of drilling. Water Level Reading Date W. L. Depth (mBGS) May 11, 2018 1.20															

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA											
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm					
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: RR						DATE: 2018-04-24					
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE					
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 20					
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Natural Moisture Content			UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				Plastic Limit w _p	w	Liquid Limit w _L				
							○ SPT 20 40 60 80	≧ Cone blows/0.3m 20 40 60 80	● Unconfined ▲ Quick Triaxial	✕ Field Vane & Sensitivity ⊠ Penetrometer + Lab Vane							
295.3 0.0	TOPSOIL: (290 mm)																
295.0 0.3	REWORKED FINE SAND AND SILT: trace organics, trace rootlets, pockets of organics, dark brown to brown, moist, loose		1	SS	4												
294.7 0.6	CLAYEY SILT: trace to some sand, trace organics, trace rootlets, zones of silty fine sand, organic stain, dark brown to brown, moist, soft to firm		2A	SS	4												
294.4 0.9	SAND AND SILT: trace to some clay, trace gravel, brown, moist to wet, loose		2B	SS													
294.1 1.2	SANDY SILT TO SAND AND SILT: trace to some clay, trace gravel, layers of clayey silt, containing cobbles and boulders, brown, moist to wet, loose		3	SS	9												
293.3 2.1	SAND AND SILT TILL: trace clay, trace gravel, layers of sand and silt, containing cobbles and boulders, brown, moist, compact																
292.4 2.9	SAND AND SILT: trace clay, trace gravel, containing cobbles and boulders, brown, moist, compact to very dense		4	SS	17												
292.4 3.0	---		5	SS	16												
291.0 4.0	---																
290.0 5.0	---		6	SS	87 / 260 mm												
289.8 5.6	SILTY SAND: trace gravel, containing cobbles and boulders, brown, moist, very dense																
288.9 6.4	END OF BOREHOLE		7	SS	50 / 150 mm												
Note: 1) Borehole caved at a depth of 5.3 m below ground surface (mBGS) upon completion of drilling.																	

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

[illegible]

GROUNDWATER ELEVATIONS

	1st	2nd	3rd	4th
Measurement				

GRAPH
NOTES

+ 3, × 3: Numbers refer to Sensitivity

▲ $\epsilon=3\%$ Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA											
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm					
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: RR						DATE: 2018-04-23					
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE					
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 22					
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Natural Moisture Content				REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				Plastic Limit W _p	Natural Moisture Content W	Liquid Limit W _L				
						● Unconfined X Field Vane & Sensitivity				WATER CONTENT (%)							
						▲ Quick Triaxial ⓧ Penetrometer + Lab Vane											
						20 40 60 80				10 20 30 40							
302.0	TOPSOIL: (240 mm)																
301.8	REWORKED FINE SAND AND SILT TO SILTY FINE SAND: trace clay, trace gravel, trace organics, trace rootlets, dark brown, wet, very loose SAND AND SILT: trace clay, trace gravel, trace rootlets, organic stain, dark brown to brown, moist to wet, loose SAND AND SILT TO SILTY SAND: trace clay, trace gravel, pockets of sand, containing cobbles and boulders, brown, moist, very dense		1	SS	2												
301.4			2	SS	5												
300.8			3	SS	61												
300.2			4	SS	89												
299.1	FINE SAND: trace to some silt, trace gravel, brown, moist, very dense																
298.6	SANDY SILT: trace clay, trace gravel, layers of silt, brown, moist, very dense		5A	SS	87 / 280 mm												
298.0			5B	SS													
297.5	SAND AND SILT TO SILTY SAND: trace gravel, containing cobbles and boulders, brown, moist, very dense --- auger grinding		6	SS	50 / 100 mm												
296.5			7	SS	50 / 80 mm												
295.1	SAND AND SILT TO SILTY SAND: trace gravel, pockets of sand, containing cobbles and boulders, brown, moist, very dense		8	SS	50 / 50 mm												
293.6																	
292.7	SILTY FINE SAND: brown, moist, very dense																
292.7	END OF BOREHOLE		9	SS	50 / 140 mm												
Notes: 1) Borehole caved at a depth of 7.9 m below ground surface (mBGS)																	

Notes:
 1) Borehole caved at a depth of 7.9 m below ground surface (mBGS)

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

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PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: HR						DATE: 2018-04-30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 23																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
SOIL PROFILE			SAMPLES			GROUND WATER			DYNAMIC PENETRATION TEST				Natural Moisture Content				UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m				ELEVATION	SHEAR STRENGTH (kPa)				WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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305.1	TOPSOIL: (230 mm)		1	SS	8			305	○								○																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									</

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

PROJECT: Geotechnical Investigation for Proposed Residential Developments

DRILLING DATA

CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI

METHOD: Continuous Flight Auger - Auto Hammer

DIAMETER: 155 mm

PROJECT LOCATION: County Road 27, Barrie, Ontario

FIELD ENGINEER: RR

DATE: 2018-04-24

DATUM: Geodetic

SAMPLE REVIEW: DX

REF. NO.: 17-2099GE

BH LOCATION: See Borehole Location Plan

CHECKED: DL

ENCL. NO.: 24

SOIL PROFILE			SAMPLES		GROUND WATER	DYNAMIC PENETRATION TEST				Plastic Limit			UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE		20	40	60	80	W _p	W	W _L		
299.2														
0.0	TOPSOIL: (240 mm)													
298.9			1A	SS	4									
0.2	REWORKED FINE SAND AND SILT: trace organics, trace rootlets, dark brown, moist, loose		1B	SS										
298.7														
298.6	REWORKED SANDY SILT: some clay, trace gravel, trace organics, trace rootlets, dark brown to brown, moist, loose		2	SS	4									
0.6														
1	SANDY SILT: some clay, trace organics, trace rootlets, organic stain, layers of sand, dark brown to brown, moist, loose		3	SS	17									
298.0														
1.2	SAND AND SILT: trace clay, trace gravel, organic stain, brown, moist to wet, compact													
297.1														
2.1	SAND AND SILT TO SILTY SAND: trace to some clay, trace gravel, sand pockets, containing cobbles and boulders, brown, moist to wet, dense to very dense		4	SS	44									
3			5	SS	53									
4														
	---auger grinding		6	SS	50 / 150 mm									4 64 21 11
5														
293.7	FINE SAND AND SILT TO SILTY FINE SAND: trace gravel, containing cobbles and boulders, brown, wet, very dense													
5.5														
293.0			7	SS	50 / 120 mm									
6.2	END OF BOREHOLE													
	Notes: 1) Water encountered at a depth of 3.1 m below ground surface (mBGS) during drilling. 2) Water was at a depth of 3.7 mBGS upon completion of drilling. 3) Borehole caved at a depth of 5.9 mBGS upon completion of drilling. 4) 51 mm dia. monitoring was installed in borehole upon completion of drilling. Water Level Reading Date May 11, 2018 W. L. Depth (mBGS) 2.20													

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, X 3: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

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[illegible]

PROJECT: Geotechnical Investigation for Proposed Residential Developments						DRILLING DATA														
CLIENT: Di Poce Management Inc. c/o Oksana Vialykh, BBA, AACI						METHOD: Continuous Flight Auger - Auto Hammer						DIAMETER: 155 mm								
PROJECT LOCATION: County Road 27, Barrie, Ontario						FIELD ENGINEER: HR						DATE: 2018-04-30								
DATUM: Geodetic						SAMPLE REVIEW: DX						REF. NO.: 17-2099GE								
BH LOCATION: See Borehole Location Plan						CHECKED: DL						ENCL. NO.: 27								
SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION TEST				Natural Moisture Content				UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3m		SHEAR STRENGTH (kPa)				Plastic Limit w _p	Natural Moisture Content w	Liquid Limit w _L							
							SPT Cone blows/0.3m 20 40 60 80													
							● Unconfined ✕ Field Vane & Sensitivity ▲ Quick Triaxial ☒ Penetrometer + Lab Vane				WATER CONTENT (%)									
306.5	0.0	TOPSOIL: (300 mm)																		
306.2	0.3	SAND AND SILT TO SILTY SAND: trace clay, trace gravel, trace to some organics, trace rootlets, layers of peats, dark brown, moist, compact FINE SAND: trace to some silt, trace gravel, brown, wet, compact to very dense	1	SS	14															
305.9	0.6		2	SS	33															
1			3	SS	18															
2			4	SS	37															
3			5	SS	54															
4																				
5																				
6																				
7																				
301.8	4.7	SILTY SAND TILL TO SAND AND SILT TILL: some clay to clayey, trace gravel, layers of clayey silt, zones/layers of sand and silt, containing cobbles and boulders, brown, moist to wet, dense to very dense	6A	SS																
5			6B	SS	47															
6																				
8																				
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GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

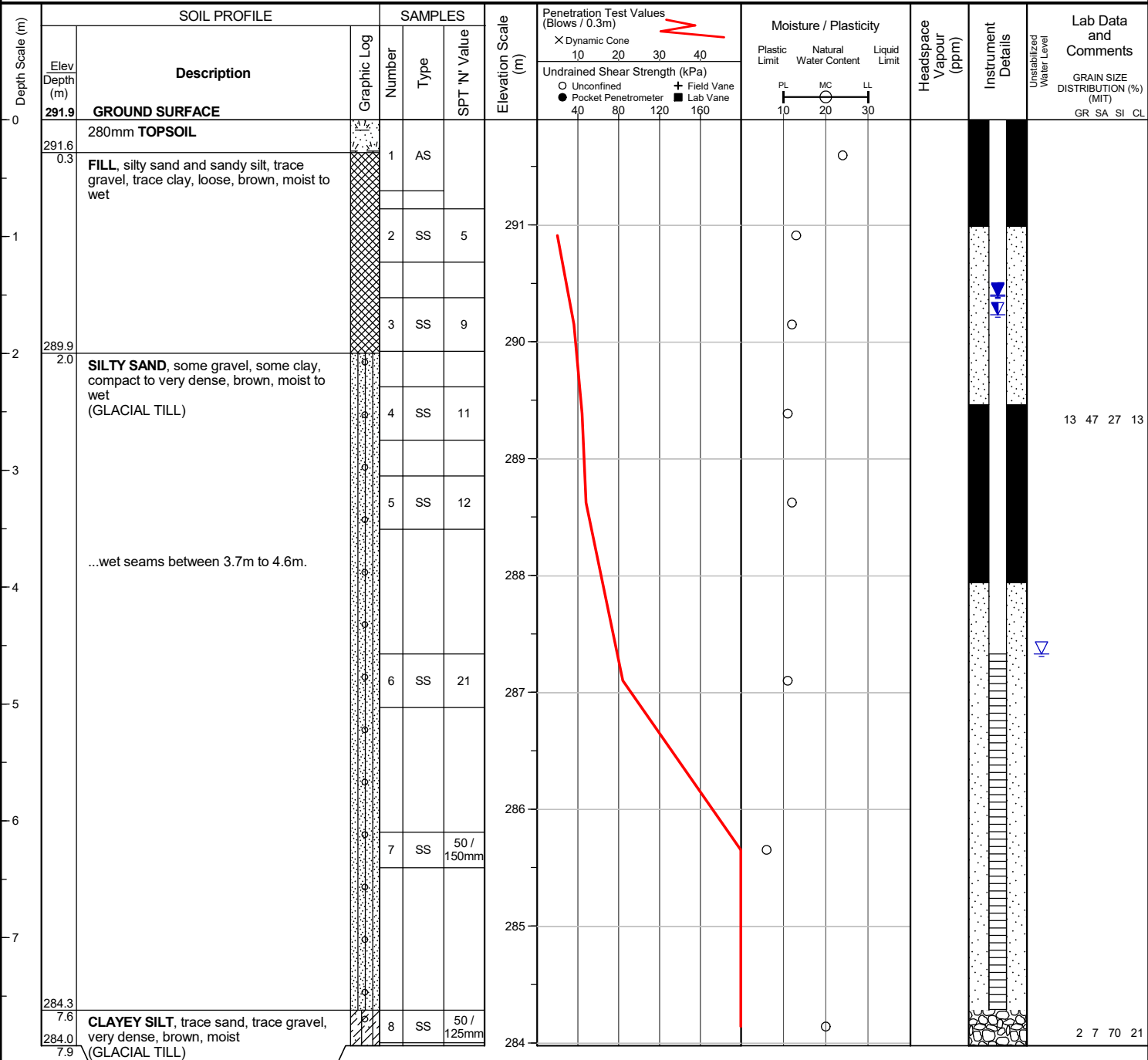
GRAPH NOTES

 +³, ×³: Numbers refer to Sensitivity

▲ s=3% Strain at Failure

Project No. : 3-17-0047-03	Client : PRATT DEVELOPMENT INC.	Originated by : BH
Date started : January 24, 2018	Project : BEAR CREEK RIDGE	Compiled by : BH
Sheet No. : 1 of 1	Location : Barrie	Checked by : SO

Position : <i>Dipoc Property</i>	Elevation Datum : Geodetic	
Rig type : CME 55, track-mounted	Drilling Method : Hollow stem augers	



END OF BOREHOLE

Unstabilized water level measured at 4.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed. 3.0m screen installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 15, 2018	1.7	290.2
Feb 20, 2018	1.5	290.4
Feb 22, 2018	1.5	290.4

Project No. : 3-17-0047-03

Client : PRATT DEVELOPMENT INC.

Originated by : BH

Date started : January 29, 2018

Project : BEAR CREEK RIDGE

Compiled by : BH

Sheet No. : 1 of 1

Location : Barrie

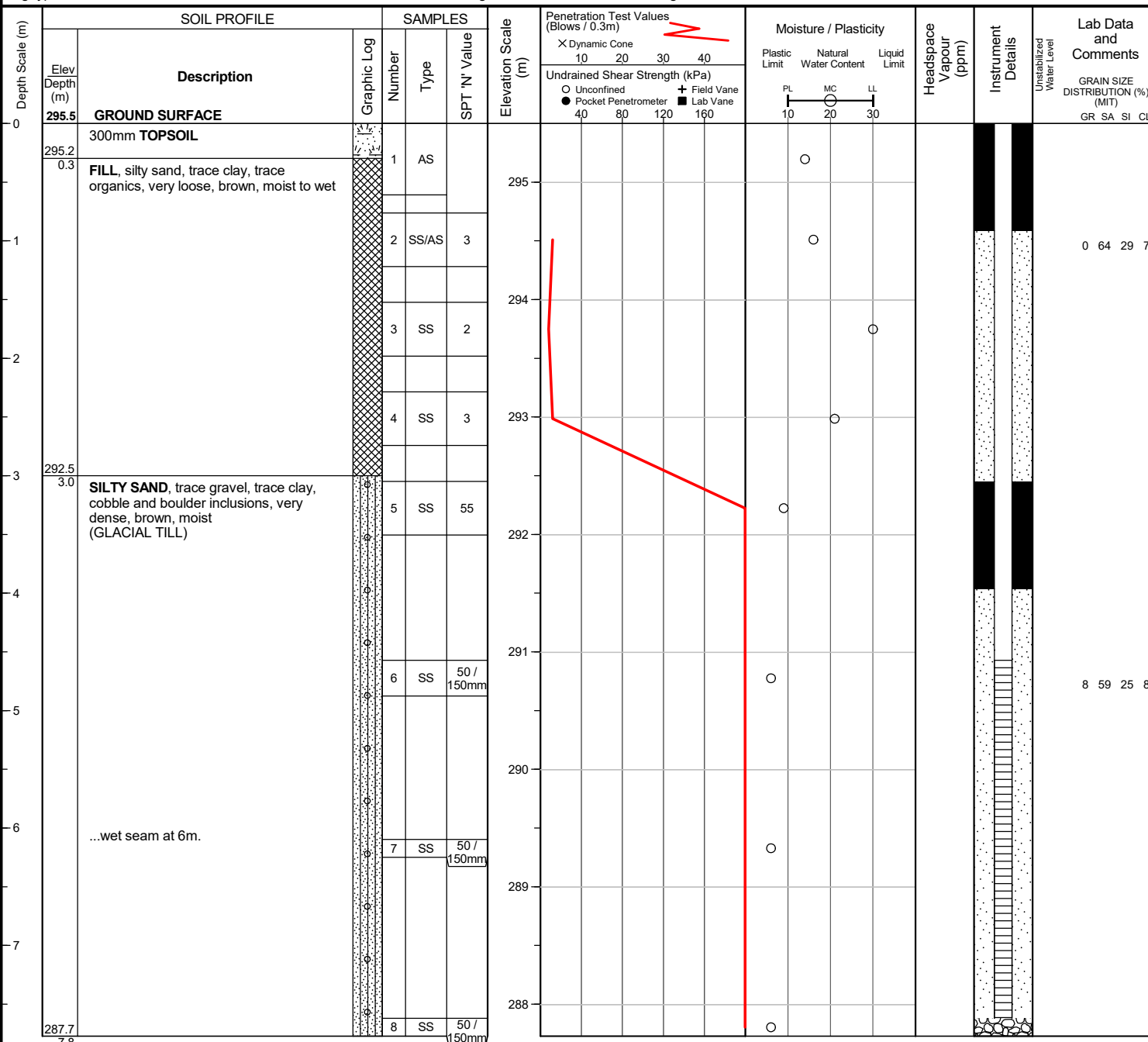
Checked by : SO

Position : Dipoce Property

Elevation Datum : Geodetic

Rig type : CME 55, track-mounted

Drilling Method : Hollow stem augers



END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.
3.0m screen installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 15, 2018	dry	n/a
Feb 20, 2018	dry	n/a
Feb 22, 2018	dry	n/a



Project No. : 3-17-0047-03

Client : PRATT DEVELOPMENT INC.

Originated by : BH

Date started : January 29, 2018

Project : BEAR CREEK RIDGE

Compiled by : BH

Sheet No. : 1 of 1

Location : Barrie

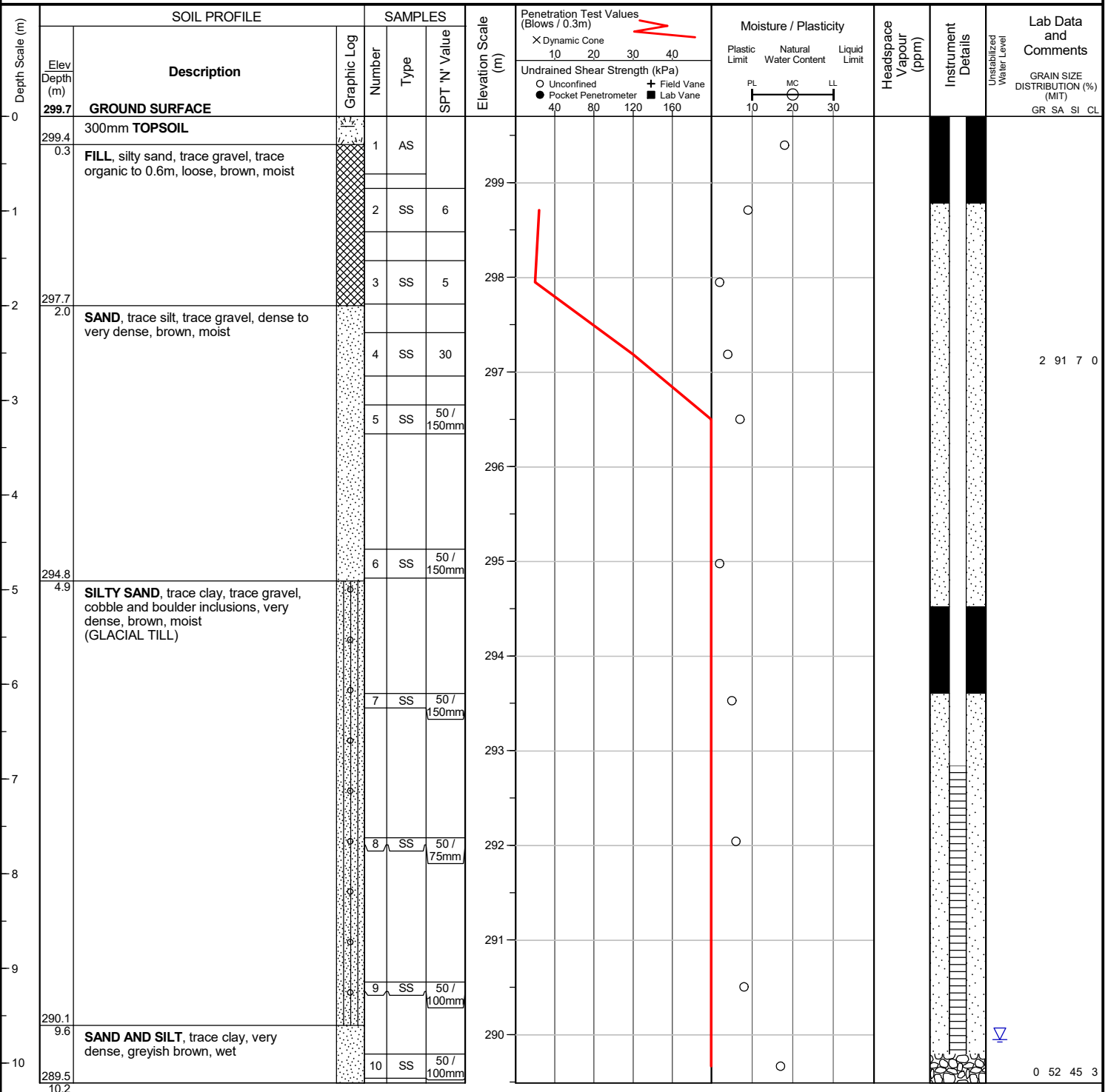
Checked by : SO

Position : Dipoc Property

Elevation Datum : Geodetic

Rig type : CME 55, track-mounted

Drilling Method : Hollow stem augers





Project No. : 3-17-0047-03

Client : PRATT DEVELOPMENT INC.

Originated by : BH

Date started : January 30, 2018

Project : BEAR CREEK RIDGE

Compiled by : BH

Sheet No. : 1 of 1

Location : Barrie

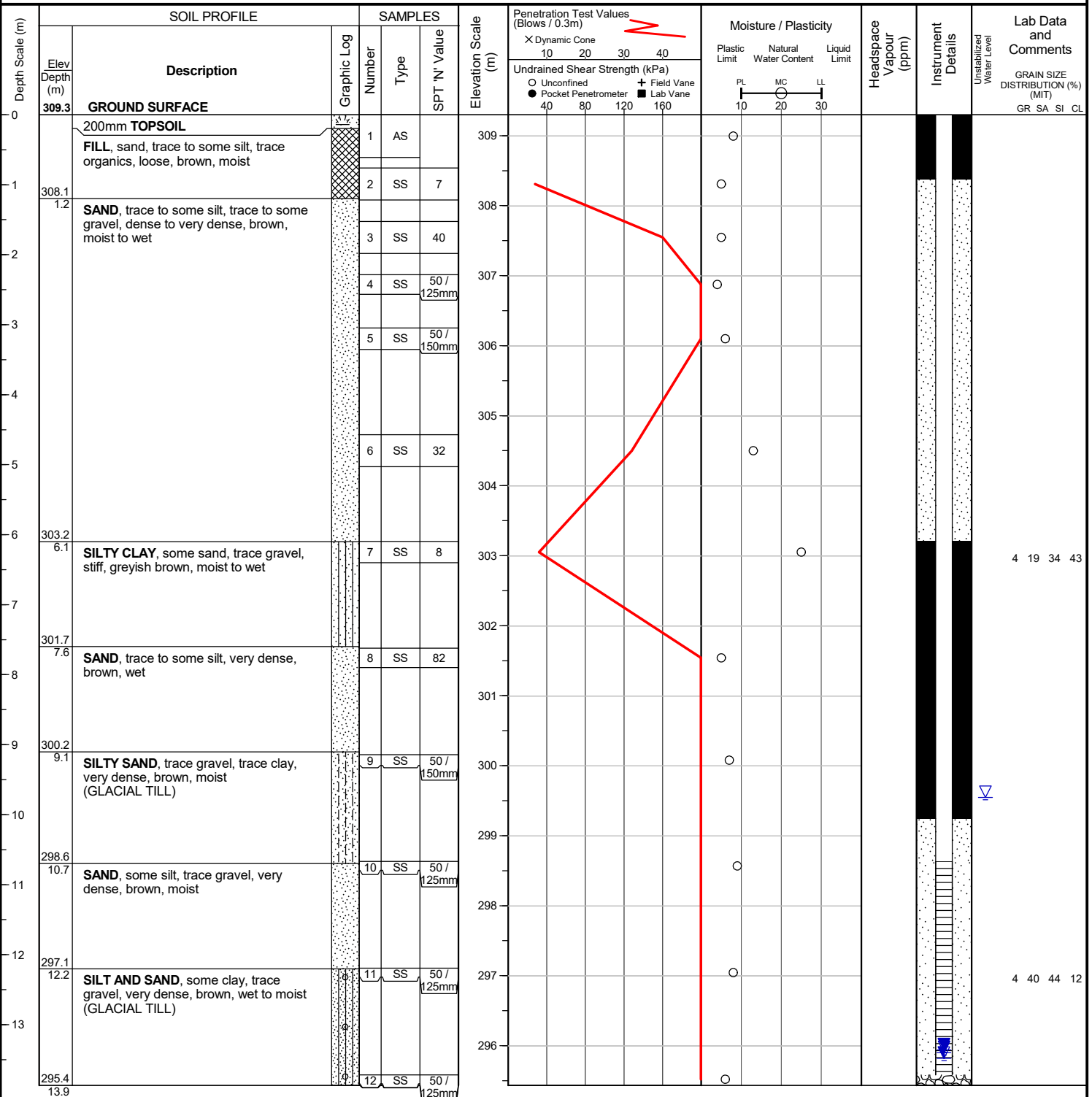
Checked by : SO

Position : Dipoce Property

Elevation Datum : Geodetic

Rig type : CME 55, track-mounted

Drilling Method : Hollow stem augers





Project No. : 3-17-0047-03

Client : PRATT DEVELOPMENT INC.

Originated by : BH

Date started : January 31, 2018

Project : BEAR CREEK RIDGE

Compiled by : BH

Sheet No. : 1 of 1

Location : Barrie

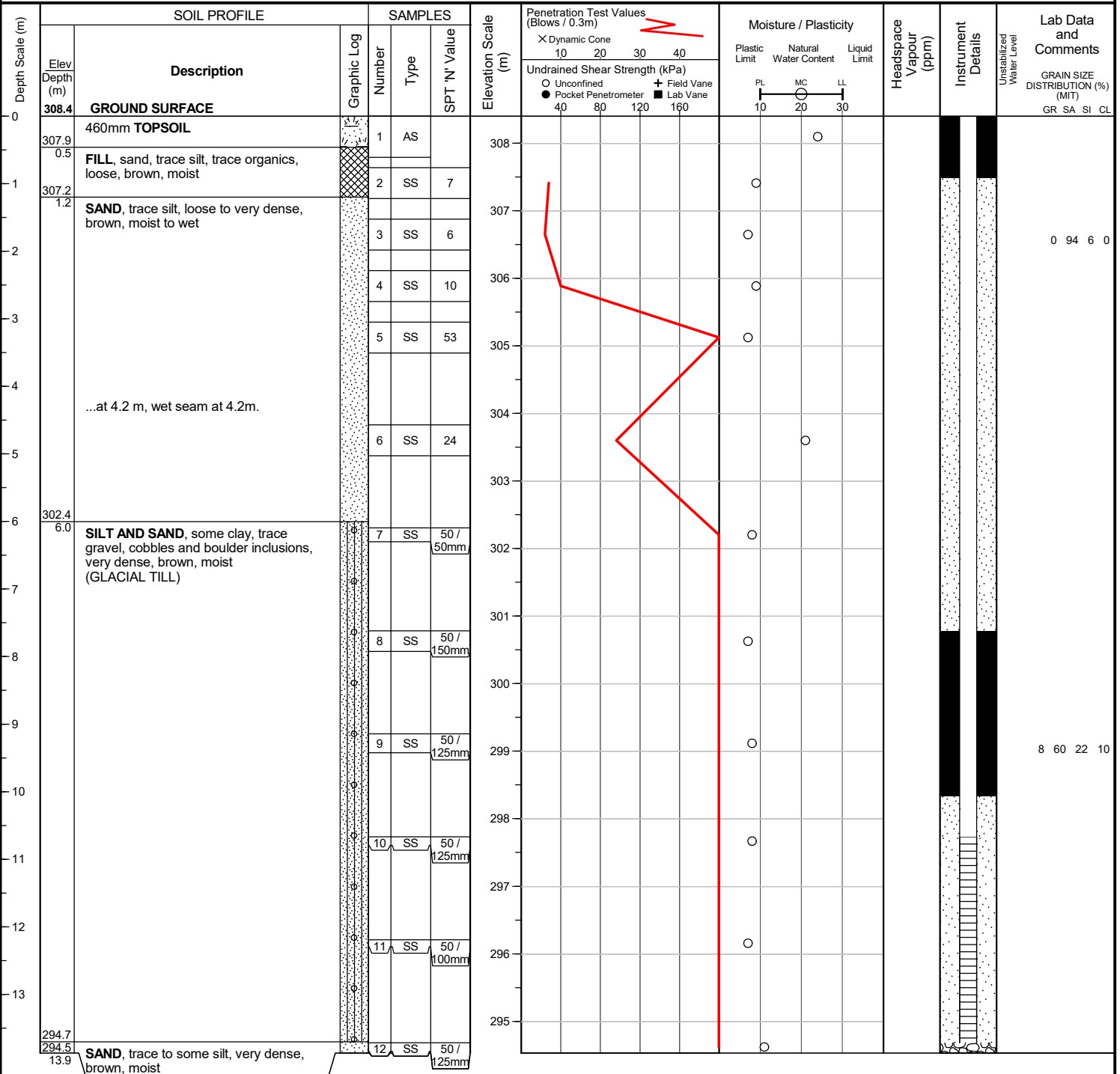
Checked by : SO

Position : 851 Essa Road

Elevation Datum : Geodetic

Rig type : CME 55, track-mounted

Drilling Method : Hollow stem augers



END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.
3.0m screen installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 15, 2018	dry	n/a
Feb 20, 2018	dry	n/a
Feb 22, 2018	dry	n/a



Project No. : 3-17-0047-03

Client : PRATT DEVELOPMENT INC.

Originated by : BH

Date started : February 6, 2018

Project : BEAR CREEK RIDGE

Compiled by : BH

Sheet No. : 1 of 1

Location : Barrie

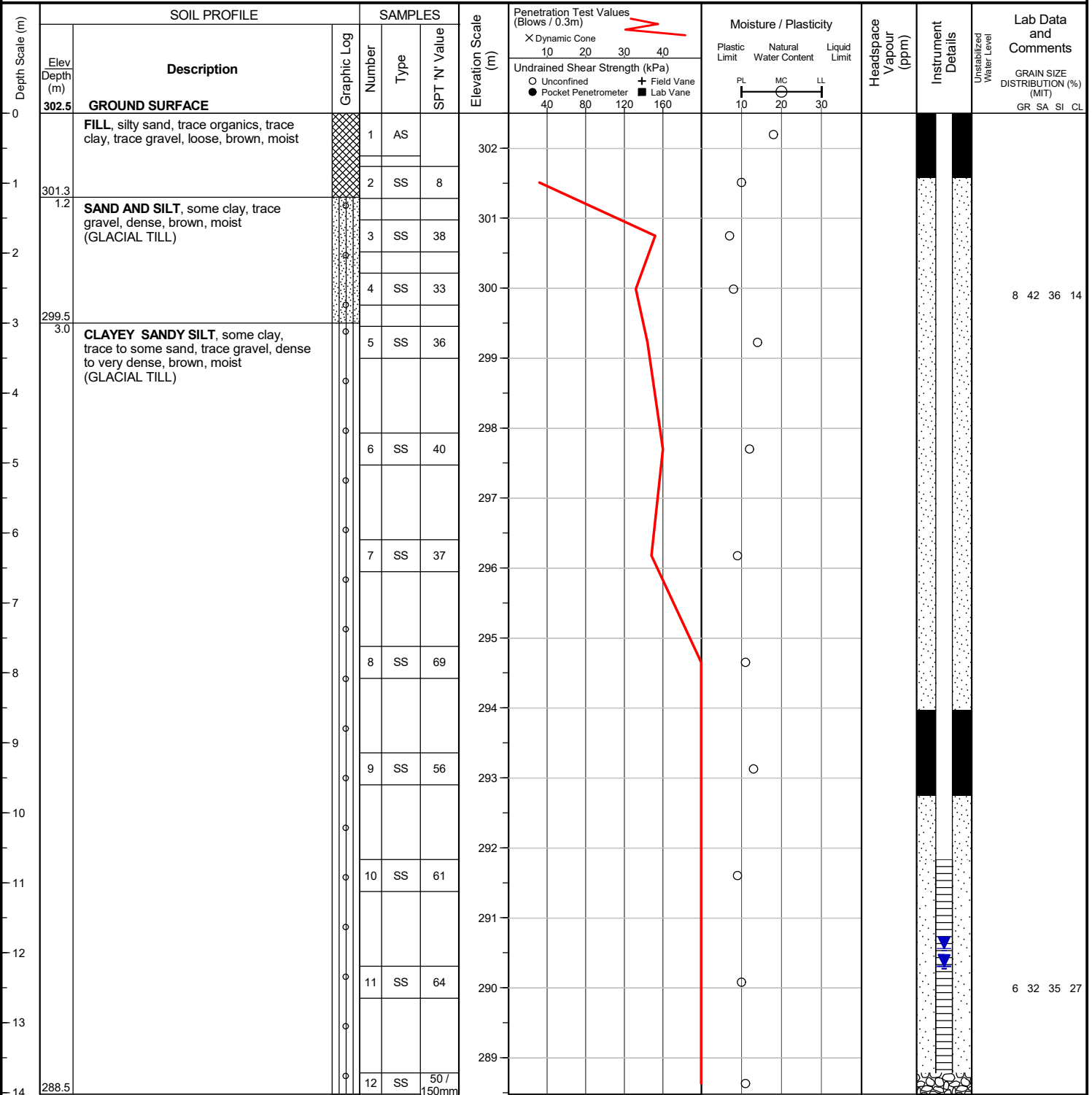
Checked by : SO

Position : 851 Essa Road

Elevation Datum : Geodetic

Rig type : CME 55, track-mounted

Drilling Method : Hollow stem augers



END OF BOREHOLE

Borehole was dry upon completion of drilling.

50 mm dia. monitoring well installed.
3.0m screen installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 15, 2018	12.2	290.3
Feb 20, 2018	12.2	290.3
Feb 22, 2018	11.9	290.6

Project No. : 3-17-0047-03

Client : PRATT DEVELOPMENT INC.

Originated by : BH

Date started : February 6, 2018

Project : BEAR CREEK RIDGE

Compiled by : BH

Sheet No. : 1 of 1

Location : Barrie

Checked by : SO

Position : 851 Essa Road

Elevation Datum : Geodetic

Rig type : CME 55, track-mounted

Drilling Method : Hollow stem augers

Depth Scale (m)	SOIL PROFILE			SAMPLES			Elevation Scale (m)	Penetration Test Values (Blows / 0.3m)		Moisture / Plasticity			Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value		Dynamic Cone	Undrained Shear Strength (kPa)	Plastic Limit	Natural Water Content	Liquid Limit			
0	309.1	GROUND SURFACE													
0.2	308.9	200mm TOPSOIL		1	AS		309								
		SAND, trace silt, trace gravel, trace organic to 0.6m, loose and compact, brown, moist		2	SS	5	308								1 97 2 0
				3	SS	13	307								
				4	SS	14	306								
				5	SS	7	305								
4.6	304.5	SILTY SAND, some gravel, trace silt, cobble and boulder inclusions, loose to very dense, brown, moist (GLACIAL TILL)		6	SS	9	304								
				7	SS	50 / 150mm	303								19 43 28 10
7.0	302.1	END OF BOREHOLE													

END OF BOREHOLE

Auger refusal on inferred bedrock and/or boulders

Borehole was dry upon completion of drilling.

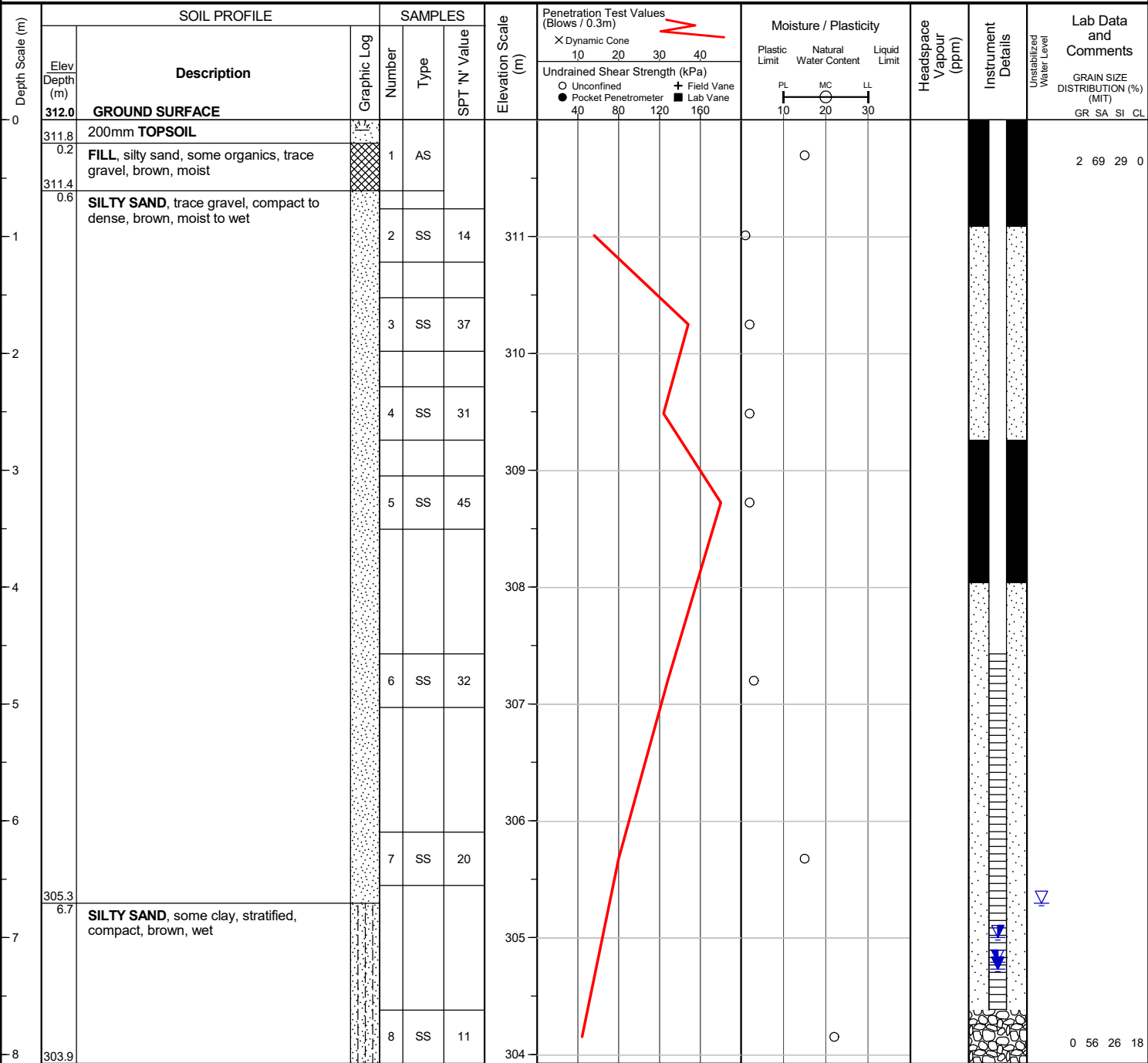
50 mm dia. monitoring well installed.
3.0m screen installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 15, 2018	dry	n/a
Feb 20, 2018	dry	n/a
Feb 22, 2018	dry	n/a

Project No. : 3-17-0047-03	Client : PRATT DEVELOPMENT INC.	Originated by : BH
Date started : February 7, 2018	Project : BEAR CREEK RIDGE	Compiled by : BH
Sheet No. : 1 of 1	Location : Barrie	Checked by : SO

Position : 851 Essa Road	Elevation Datum : Geodetic	
Rig type : CME 55, track-mounted	Drilling Method : Hollow stem augers	



END OF BOREHOLE

Unstabilized water level measured at 6.7 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed. 3.0m screen installed.

WATER LEVEL READINGS		
Date	Water Depth (m)	Elevation (m)
Feb 15, 2018	7.2	304.8
Feb 20, 2018	7.0	305.0
Feb 22, 2018	7.3	304.7



Project No. : 3-17-0047-03

Client : PRATT DEVELOPMENT INC.

Originated by : BH

Date started : February 5, 2018

Project : BEAR CREEK RIDGE

Compiled by : BH

Sheet No. : 1 of 1

Location : Barrie

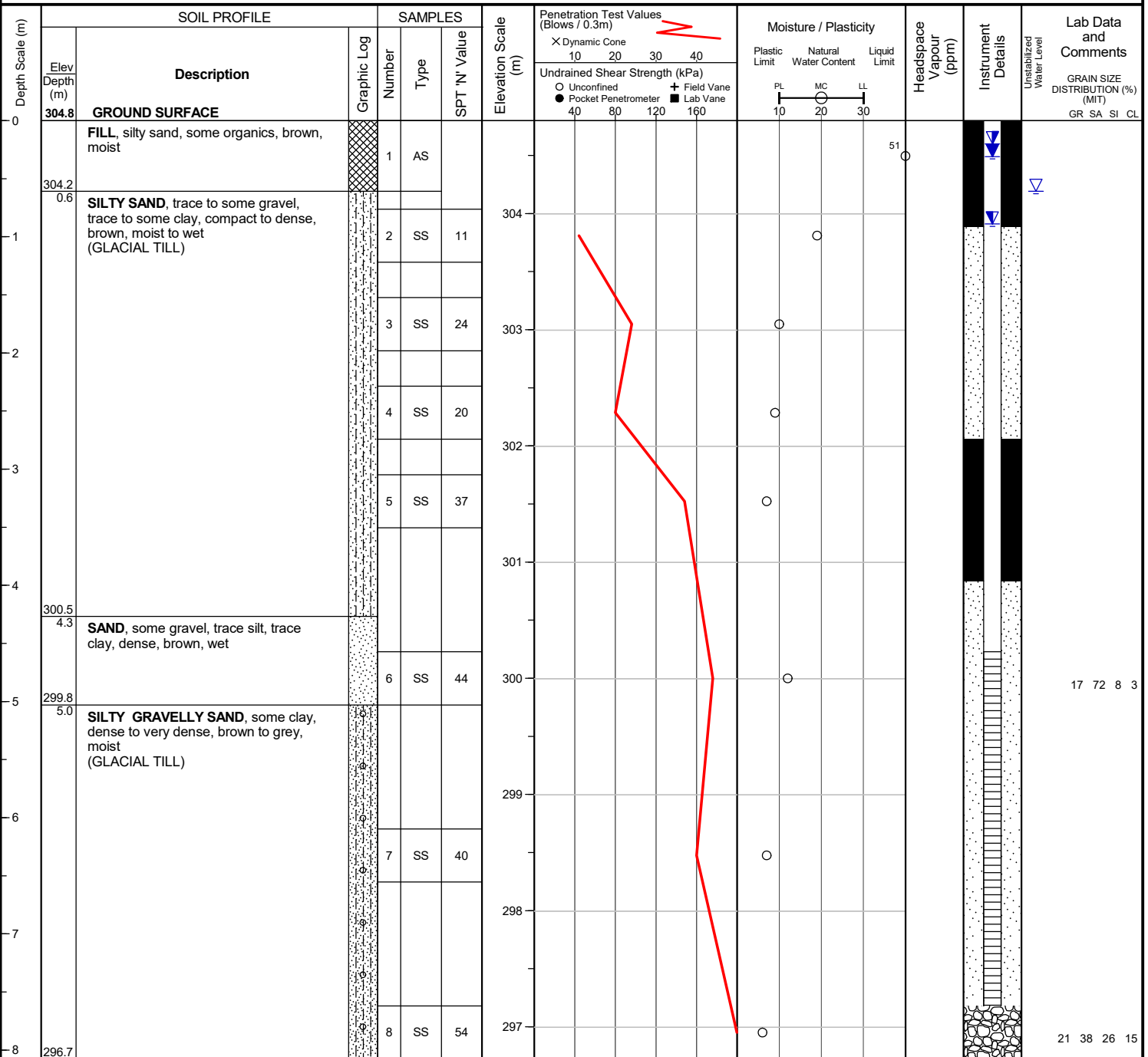
Checked by : SO

Position : 851 Essa Road

Elevation Datum : Geodetic

Rig type : CME 55, track-mounted

Drilling Method : Hollow stem augers





Project No. : 3-17-0047-03

Client : PRATT DEVELOPMENT INC.

Originated by : BH

Date started : January 24, 2018

Project : BEAR CREEK RIDGE

Compiled by : BH

Sheet No. : 1 of 1

Location : Barrie

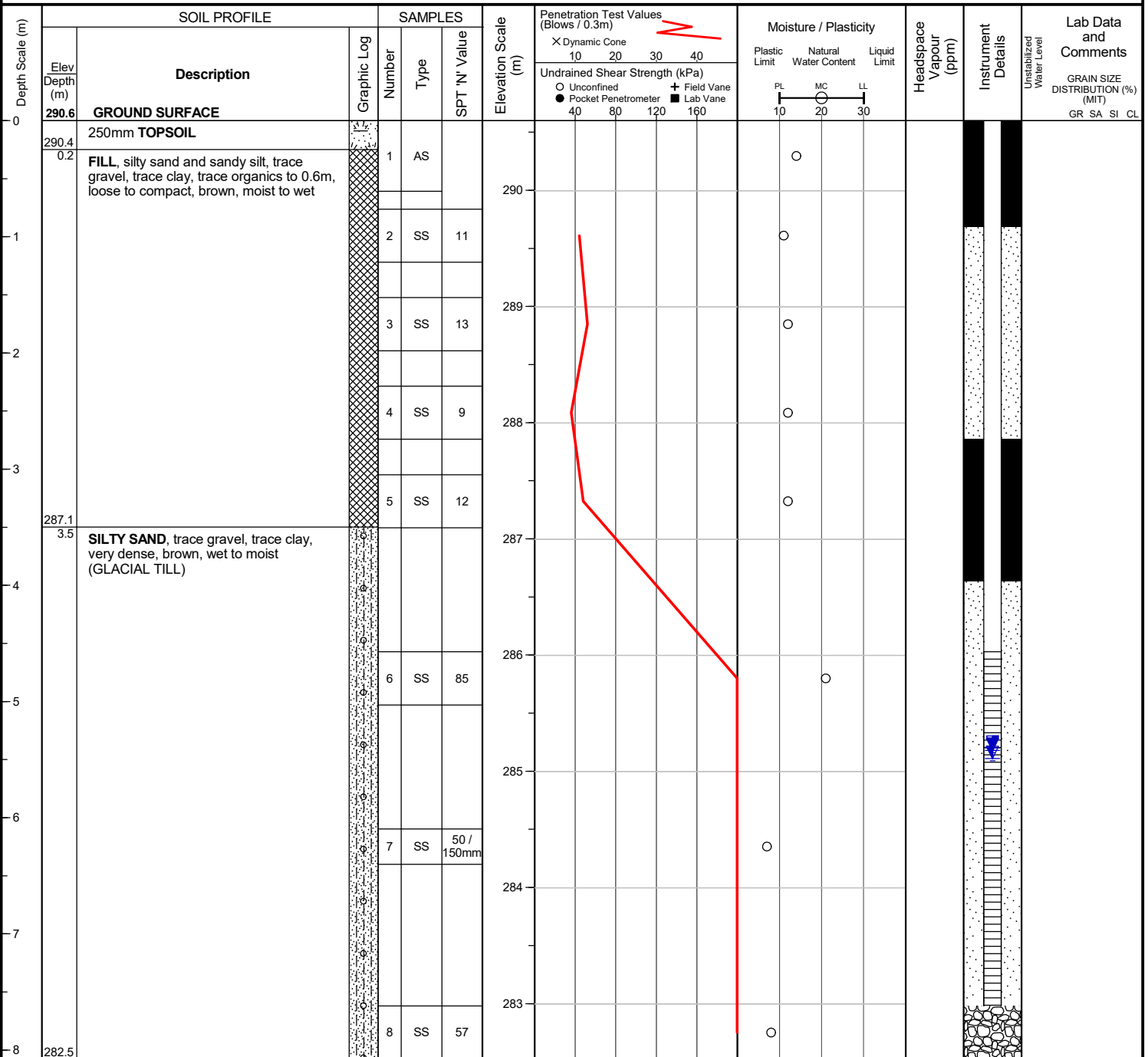
Checked by : SO

Position : Dipoce Property

Elevation Datum : Geodetic

Rig type : CME 55, track-mounted

Drilling Method : Hollow stem augers



END OF BOREHOLE

Borehole was dry upon completion of drilling.

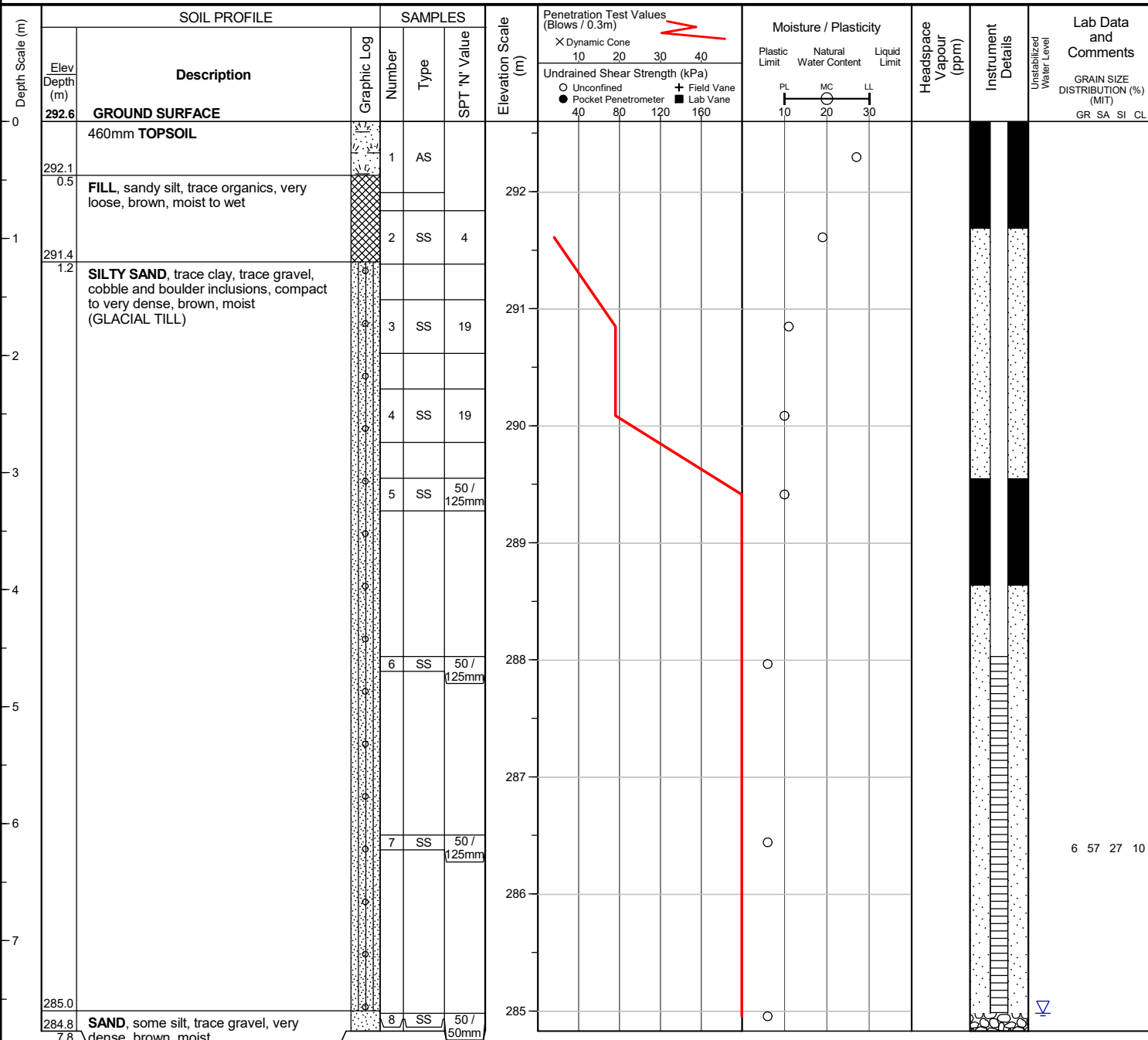
50 mm dia. monitoring well installed.
3.0m screen installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 15, 2018	5.5	285.1
Feb 20, 2018	5.4	285.2
Feb 22, 2018	5.4	285.2

Project No. : 3-17-0047-03	Client : PRATT DEVELOPMENT INC.	Originated by : BH
Date started : January 26, 2018	Project : BEAR CREEK RIDGE	Compiled by : BH
Sheet No. : 1 of 1	Location : Barrie	Checked by : SO

Position : <i>Dipoco Property</i>	Elevation Datum : Geodetic
Rig type : CME 55, track-mounted	Drilling Method : Hollow stem augers



END OF BOREHOLE

Unstabilized water level measured at 7.6 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed. 3.0m screen installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Feb 15, 2018	dry	n/a
Feb 20, 2018	dry	n/a
Feb 22, 2018	dry	n/a



Terraprobe

PROJECT NAME: Annex Lands, Barrie

CLIENT: Pratt Development

LOCATION: Barrie, Ontario

LOG OF BOREHOLE ..MW3..

PROJECT No.: 33-11-7130

BORING DATE: October 19, 2011

ELEVATION DATUM:

BORING METHOD	DEPTH SCALE IN METRES	SOIL PROFILE			SAMPLES			PENETRATION RESISTANCE PLOT X_x				WATER CONTENT (%)	INSTALLATION INFORMATION		
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	"N" VALUE	SHEAR STRENGTH kPa							
								20	40	60	80				
								nat.V - +	Q - ●	rem.V - ⊕	U - ○				
								20	40	60	80				
D-50T Crawler-mounted Drill Rig / Hollow Stem Augers															
	0	GROUND SURFACE													
		150mm - Topsoil			0.0	1	AS								
		Orange to Brown	Compact to Dense	Moist to Wet											
	1	SAND, fine to medium, trace to some gravel, trace to some silt			2	SS	5 x								
					3	SS	12 x								
	2						4	SS	55			x			
	3				5	SS	50/150mm								
	4														
	5				6	SS	61								
	6														
	7	Grey	Compact	Wet	6.4	7	SS	25							
		SAND & SILT													
		Brown	Very Dense	Wet	7.1										
		SAND, fine, some silt													
	8					8	SS	50/150mm							
		End of Borehole			8.1										
	9														

Bentonite Seal

Concrete

Bentonite Seal

Bentonite Seal

5.0m

6.6m

5. gas probe well depth to 6.9m with 5m screen. - 6. No detectable gas measured on October 24, 2011.

1. Borehole caved at 5.5m during drilling. - 2. Water level noted at 5.0m upon completion of drilling.
3. Schedule 40, 50mm diameter monitoring well installed with 3m screen tip at 8.1m. - 4. Water level measured on October 24, 2011 at 6.6m.

SHEET 1 OF 1

Bentonite Seal

Concrete

Bentonite Seal

Bentonite Seal

5.0m

6.6m

5. gas probe well depth to 6.9m with 5m screen. - 6. No detectable gas measured on October 24, 2011.

1. Borehole caved at 5.5m during drilling. - 2. Water level noted at 5.0m upon completion of drilling.

3. Schedule 40, 50mm diameter monitoring well installed with 3m screen tip at 8.1m. - 4. Water level measured on October 24, 2011 at 6.6m.

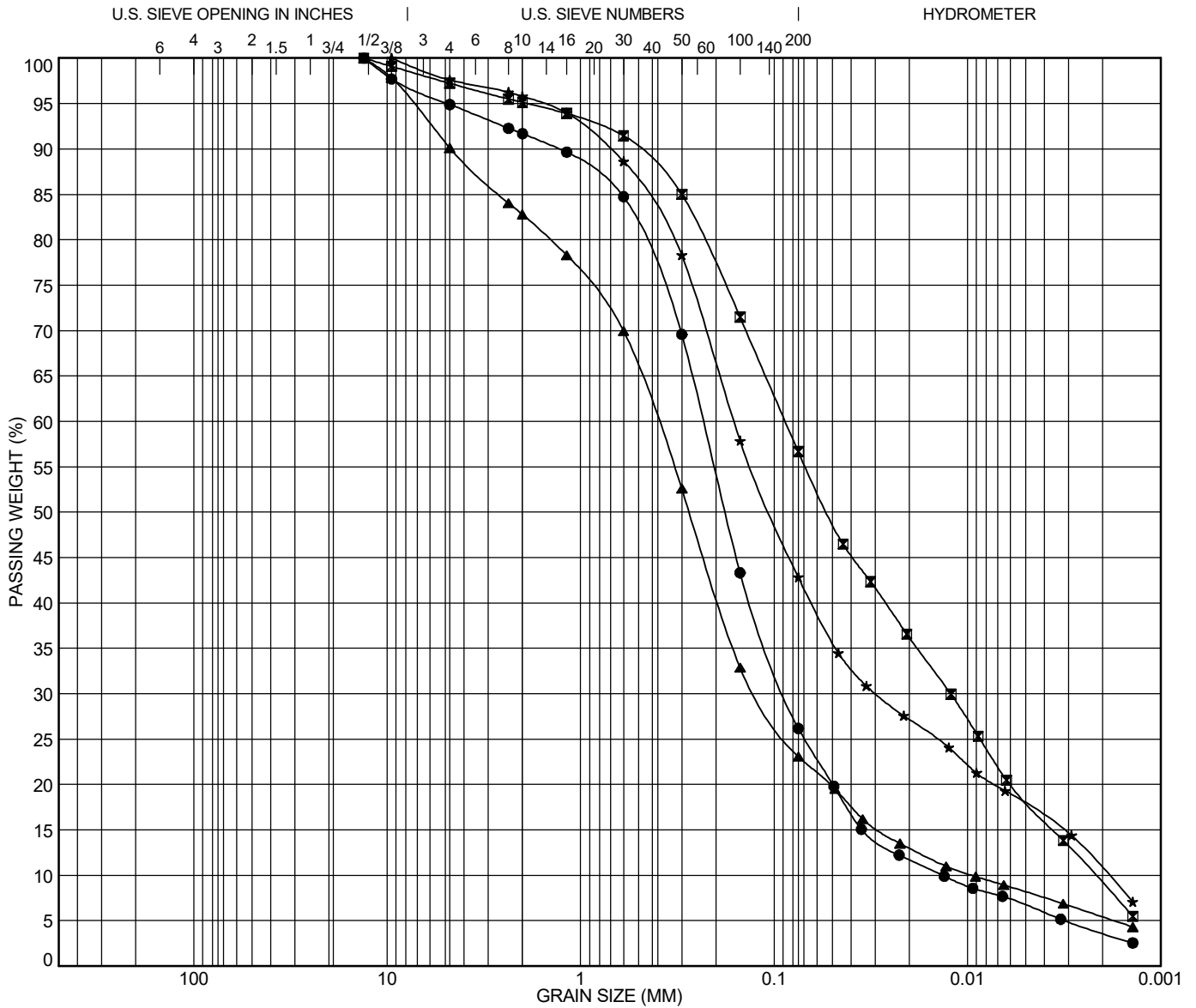


BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix C

Hydraulic Conductivity Data



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification				Classification				LL	PL	PI	Cc	Cu
●	BH02	SS5	3.05								2.43	17.20
■	BH03	SS2	0.61								0.78	40.03
▲	BH04	SS3	1.22								3.91	42.36
★	BH06	SS3	1.22								2.93	86.12
Specimen Identification				D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	
●	BH02	SS5	3.05	13.2	0.233	0.088	0.014	5.1	68.7	22.5	3.6	
■	BH03	SS2	0.61	13.2	0.088	0.012	0.002	2.8	40.6	47.6	9.1	
▲	BH04	SS3	1.22	13.2	0.403	0.122	0.01	9.9	67.0	17.7	5.4	
★	BH06	SS3	1.22	9.5	0.161	0.03	0.002	2.4	54.8	32.2	10.7	



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GRAIN SIZE DISTRIBUTION

PROJECT: Proposed Phase One Environmental Site Assessment (ESA) and Geotechnical Investigation

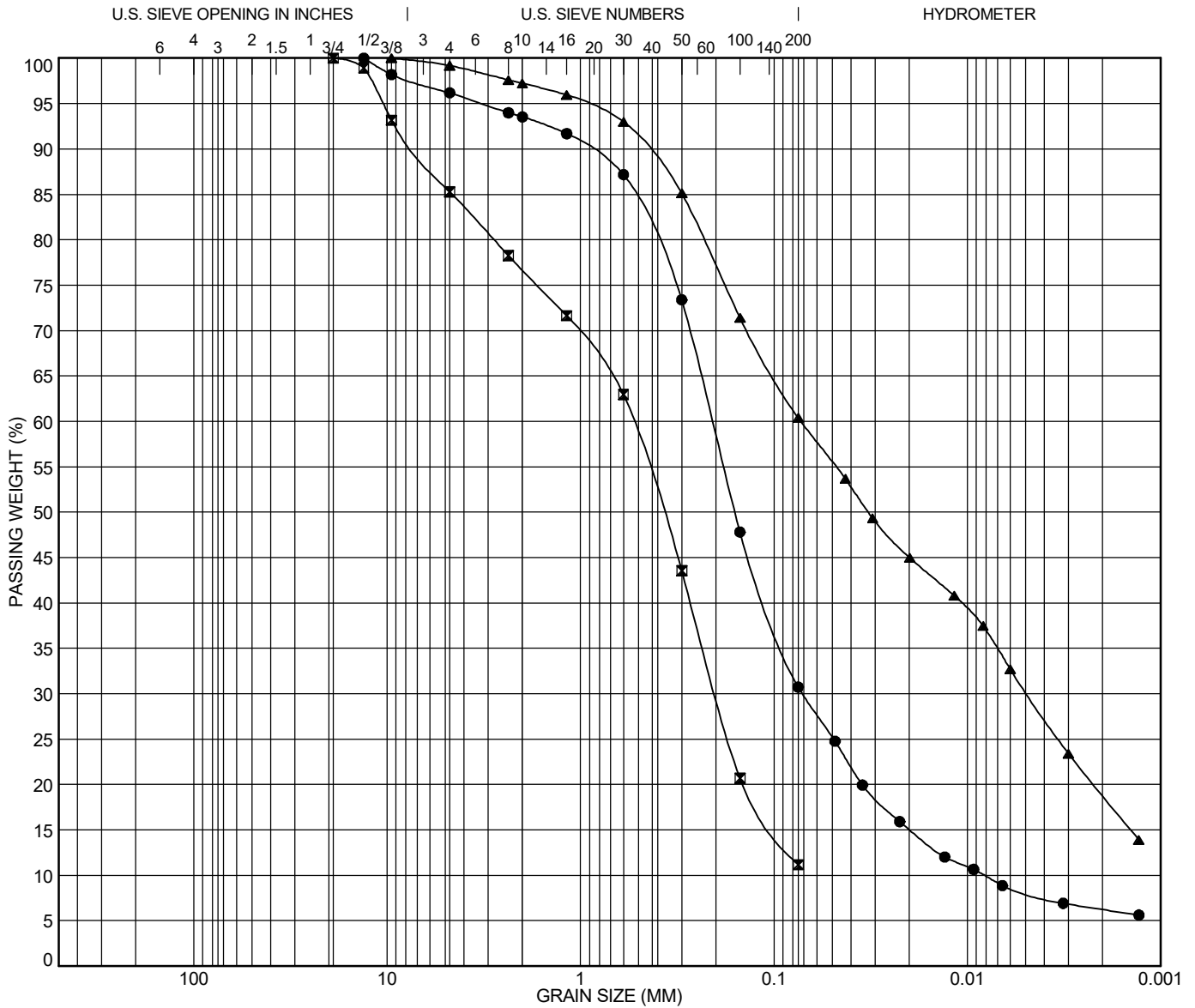
LOCATION: County Road 27, Barrie

PROJECT NO.: 17-2099GE

SAMPLED ON: 2018-04-26

FIGURE NO.: 1

TESTED ON: 2018-05-15



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification			Classification				LL	PL	PI	Cc	Cu
●	BH11	SS3	1.22							2.94	25.41
■	BH12	SS3	1.22							1.06	7.84
▲	BH13	SS2	0.61								
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	
●	BH11	SS3	1.22	13.2	0.209	0.071	0.008	3.8	65.4	24.5	6.2
■	BH12	SS3	1.22	19	0.54	0.199		14.7	74.1	11.2	
▲	BH13	SS2	0.61	9.5	0.073	0.005		0.8	38.8	41.6	18.8



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GRAIN SIZE DISTRIBUTION

PROJECT: Proposed Phase One Environmental Site Assessment (ESA) and Geotechnical Investigation

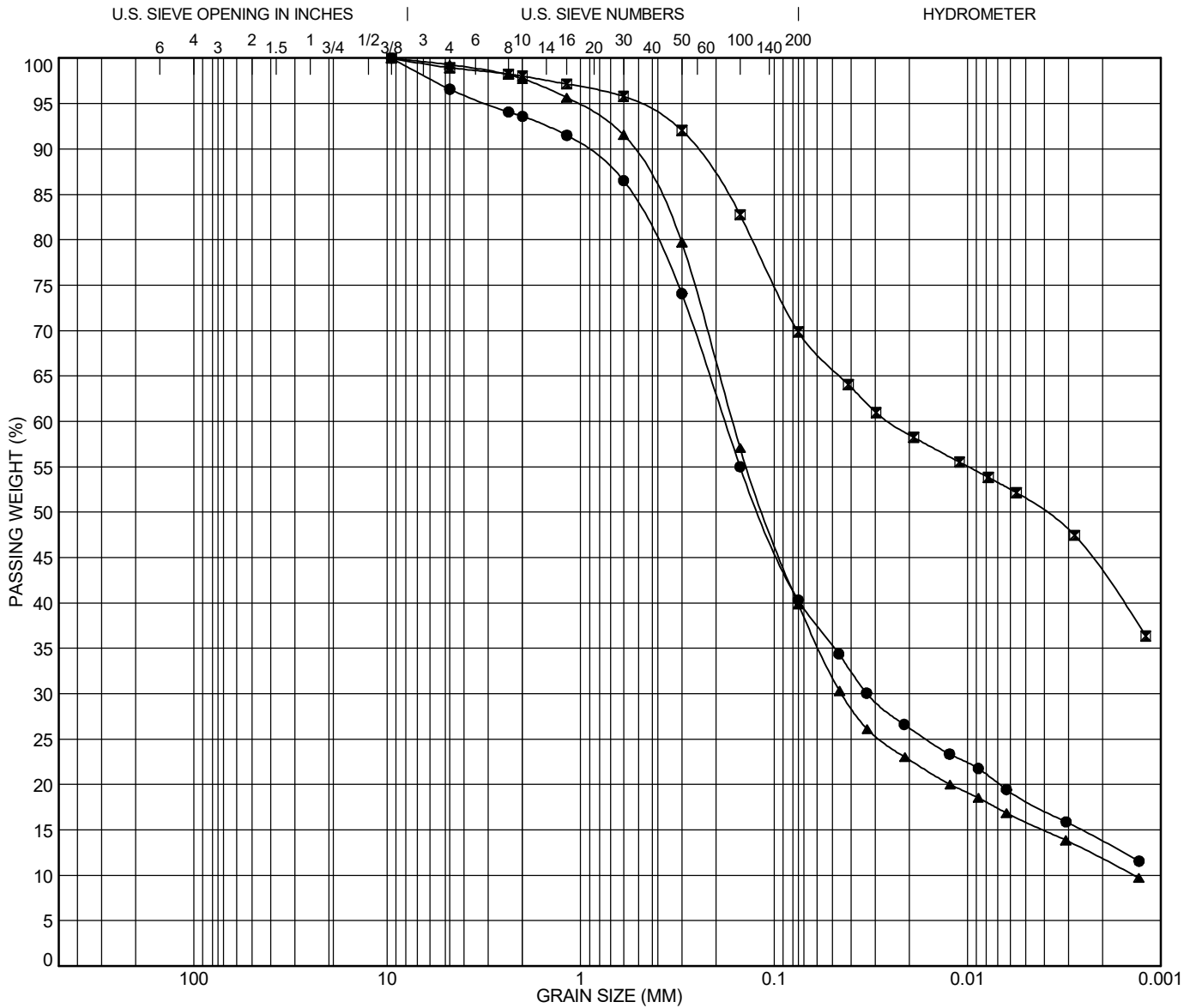
LOCATION: County Road 27, Barrie

PROJECT NO.: 17-2099GE

SAMPLED ON: 2018-04-24

FIGURE NO.: 3

TESTED ON: 2018-05-15



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification			Classification				LL	PL	PI	Cc	Cu
●	BH15	SS4	2.29								
■	BH17	SS2	0.76								
▲	BH20	SS4	2.29							8.85	118.54
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	
●	BH15	SS4	2.29	9.5	0.18	0.033	3.4	56.3	26.6	13.7	
■	BH17	SS2	0.76	9.5	0.025		1.0	29.1	26.8	43.0	
▲	BH20	SS4	2.29	9.5	0.164	0.045	0.001	59.4	28.1	11.8	



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GRAIN SIZE DISTRIBUTION

PROJECT: Proposed Phase One Environmental Site Assessment (ESA) and Geotechnical Investigation

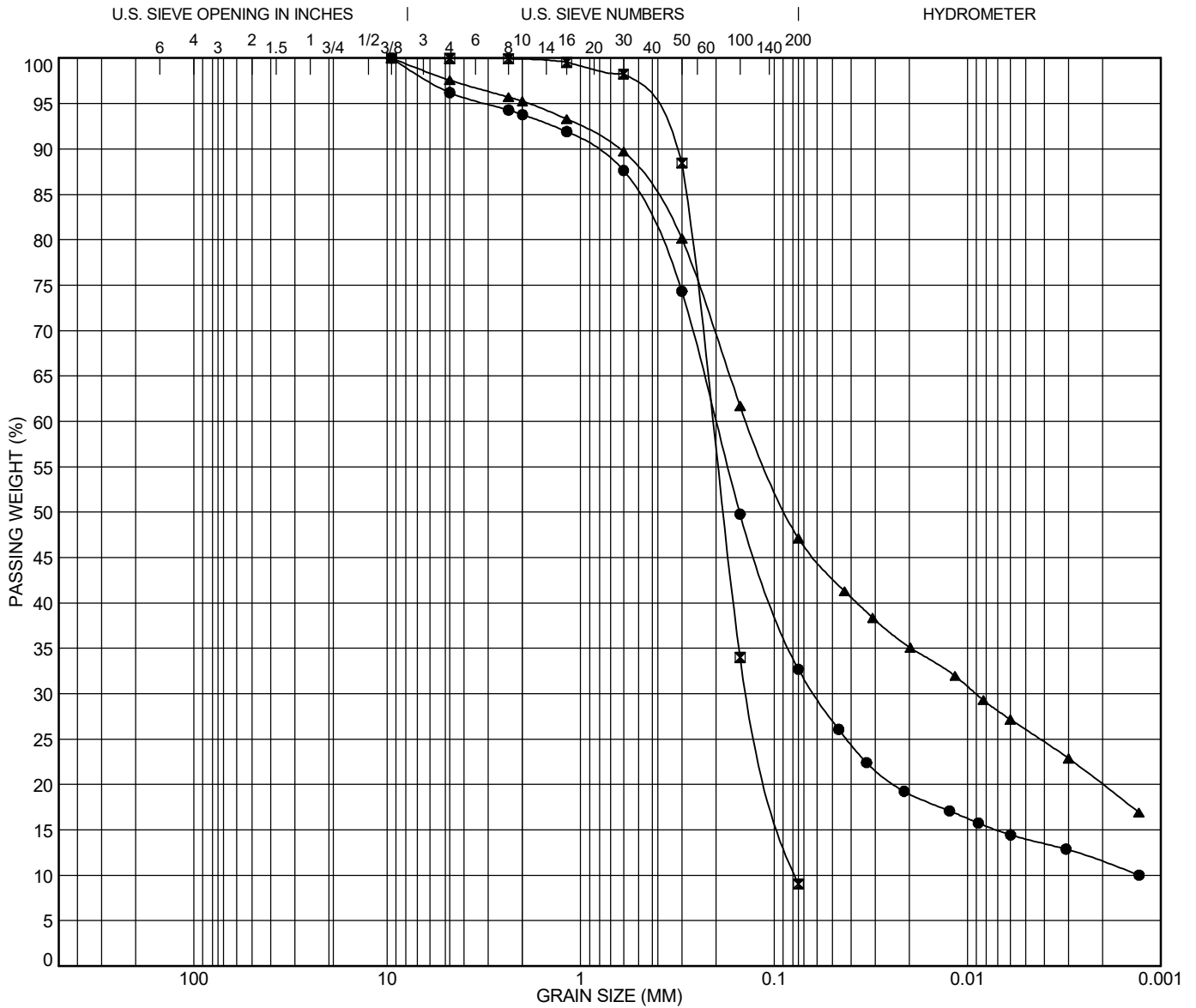
LOCATION: County Road 27, Barrie

PROJECT NO.: 17-2099GE

SAMPLED ON: 2018-04-24

FIGURE NO.: 4

TESTED ON: 2018-05-15



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification				Classification				LL	PL	PI	Cc	Cu
●	BH23	SS6	4.57									
■	BH25	SS3	1.22								1.12	2.71
▲	BH26	SS6B	4.70									
Specimen Identification				D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	
●	BH23	SS6	4.57	9.5	0.2	0.062		3.8	63.5	21.3	11.4	
■	BH25	SS3	1.22	9.5	0.209	0.134	0.077	0.0	90.9	9.0		
▲	BH26	SS6B	4.70	9.5	0.138	0.009		2.4	50.5	27.2	20.0	



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office@geoproconsulting.ca www.geoproconsulting.ca

GRAIN SIZE DISTRIBUTION

PROJECT: Proposed Phase One Environmental Site Assessment (ESA) and Geotechnical Investigation

LOCATION: County Road 27, Barrie

PROJECT NO.: 17-2099GE

SAMPLED ON: 2018-04-30

FIGURE NO.: 5

TESTED ON: 2018-05-15



Terraprobe

WASH SIEVE ANALYSIS TEST REPORT

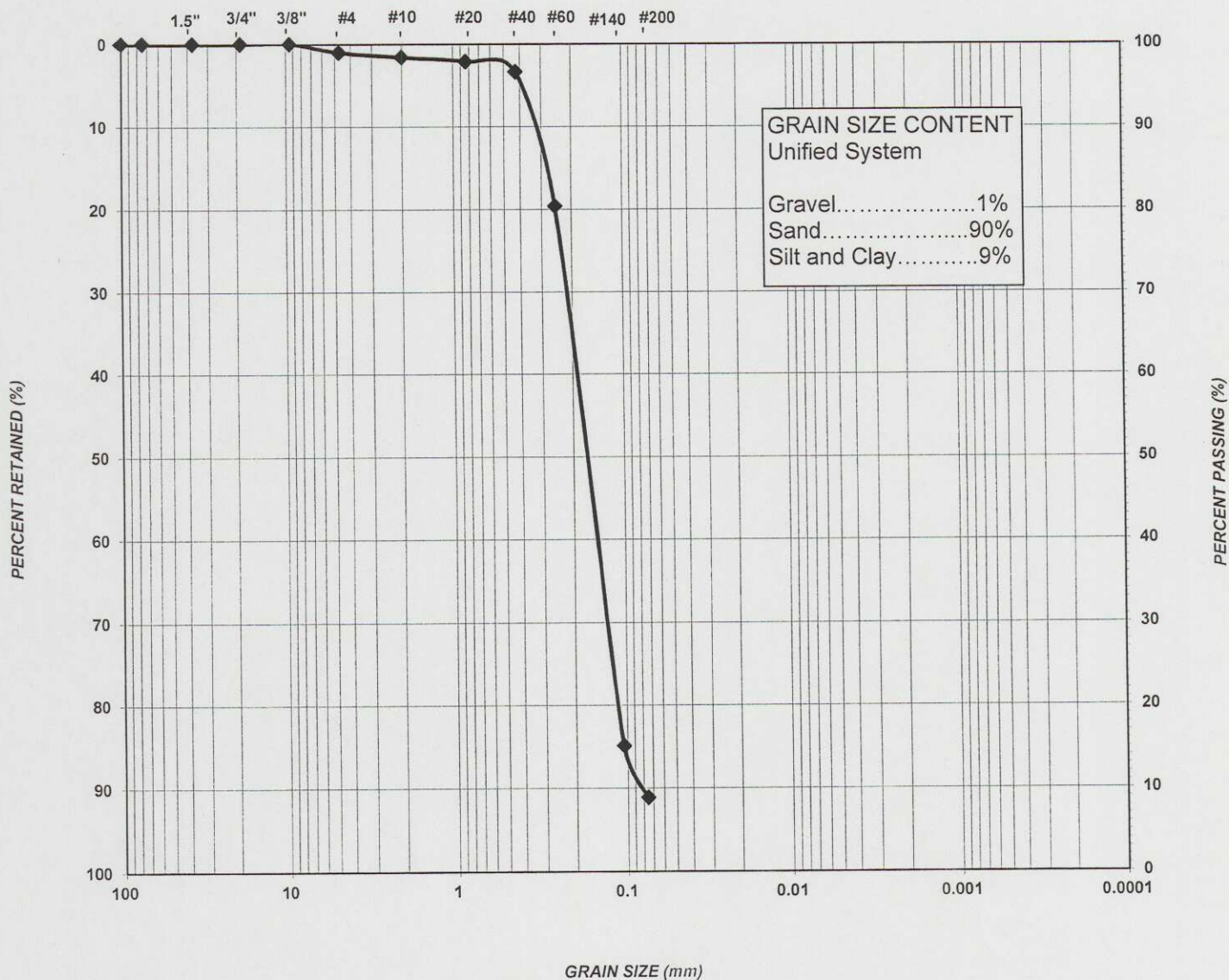
PROJECT: Annex Lands
LOCATION: Barrie, ON
CLIENT: Pratt Development

FILE NO.: 33-11-7130
LAB NO.: 1126a
SAMPLE DATE: Oct-19-11
SAMPLED BY: B.H.

TEST HOLE NUMBER: 2
SAMPLE NUMBER: 8
SAMPLE LOCATION: as above
SAMPLE DESCRIPTION: Sand, trace silt, trace gravel

GRAIN SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZES



MIT SYSTEM	GRAVEL			COARSE	MEDIUM	FINE	SILT	CLAY
				SAND				
UNIFIED SYSTEM	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY		
	GRAVEL		SAND					



Terraprobe

SIEVE AND HYDROMETER ANALYSIS

TEST REPORT

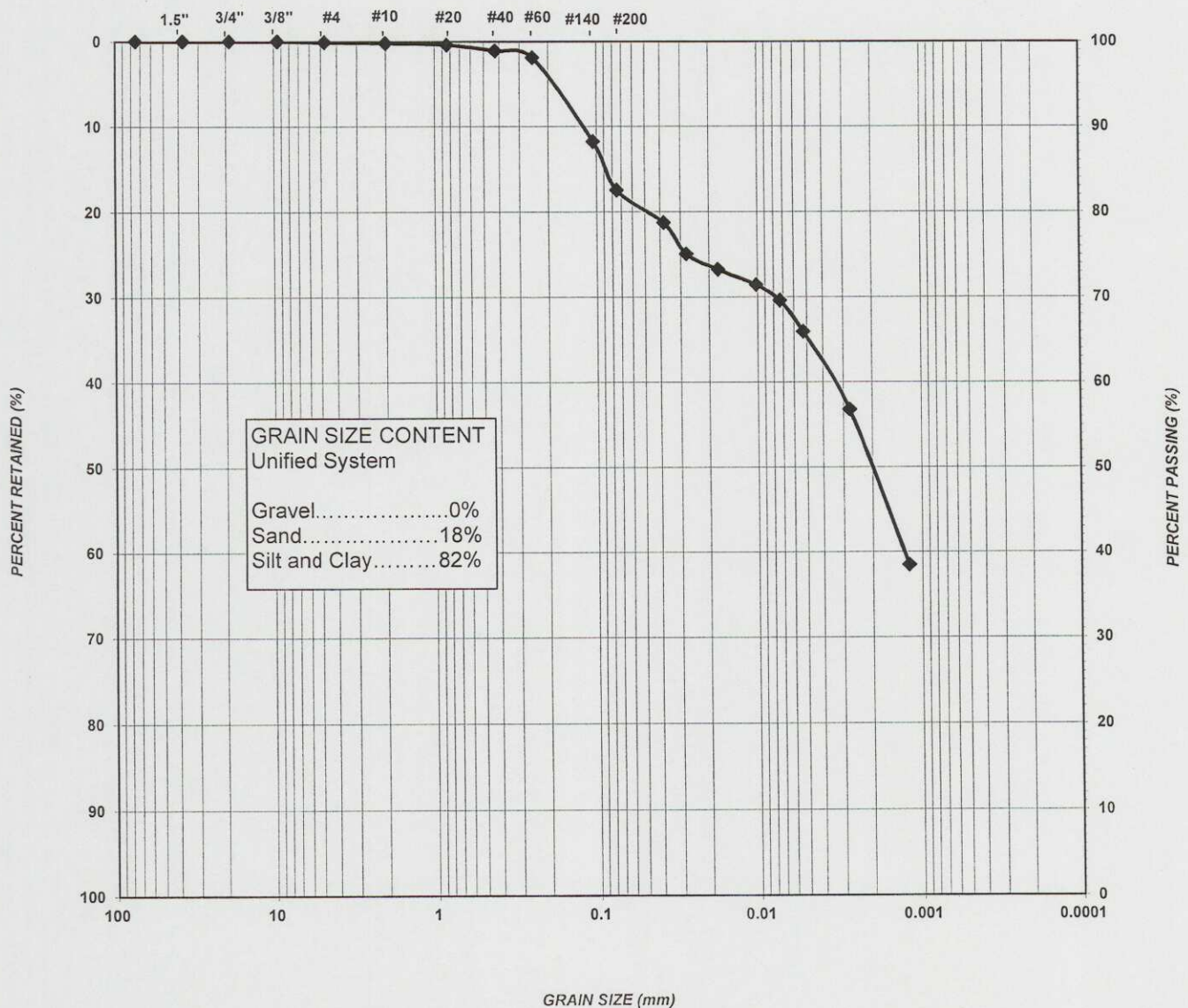
PROJECT: Annex Lands
LOCATION: Barrie, ON
CLIENT: Pratt Development

FILE NO.: 33-11-7130
LAB NO.: 1126b
SAMPLE DATE: Oct-19-11
SAMPLED BY: B.H.

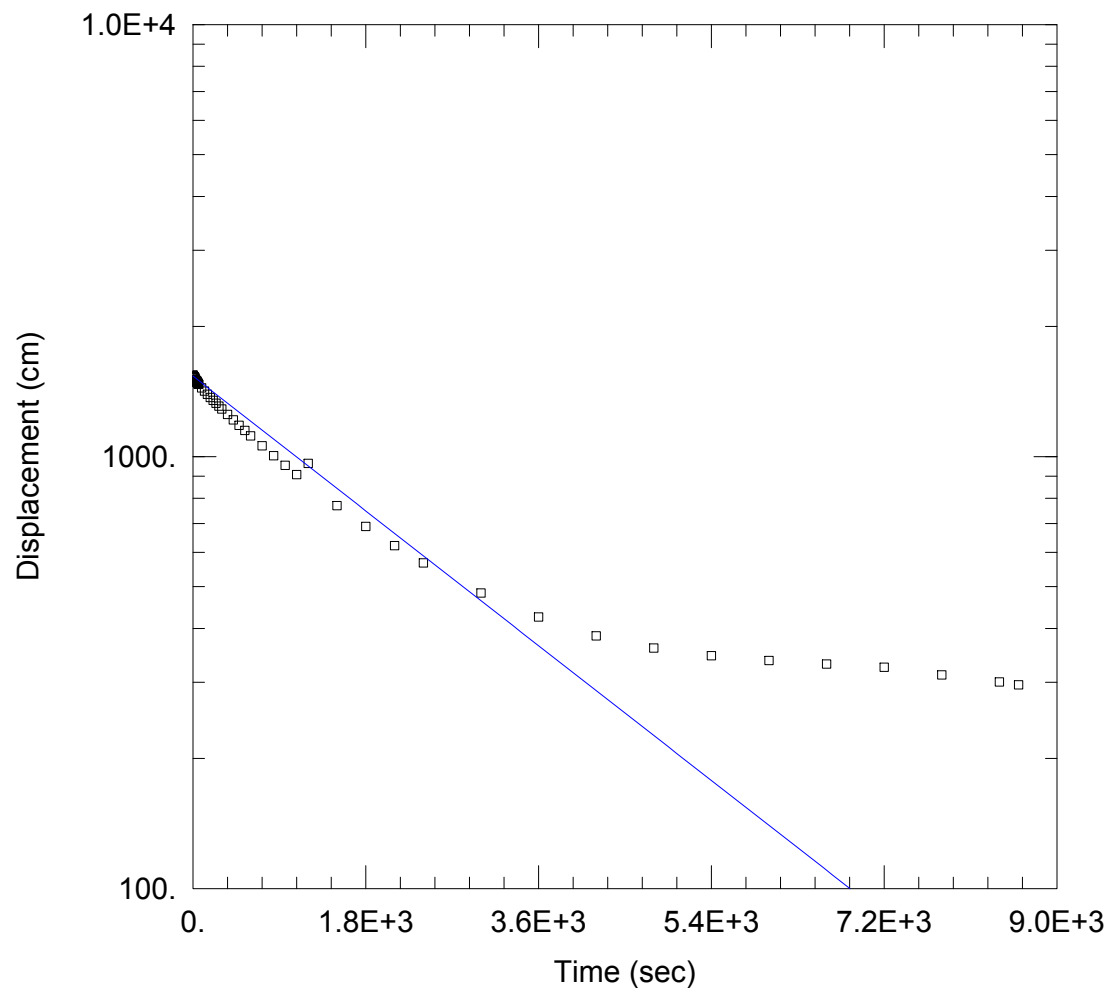
BOREHOLE NUMBER: 4
SAMPLE NUMBER: 6
SAMPLE LOCATION: as above
SAMPLE DESCRIPTION: Silt and clay, some sand

GRAIN SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZES



MIT SYSTEM	GRAVEL		COARSE	MEDIUM	FINE	SILT	CLAY
			SAND				
UNIFIED SYSTEM	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY	
	GRAVEL		SAND				



HYDRAULIC CONDUCTIVITY TEST AT BH7 "SCREENED IN SAND AND SILTY TO SILTY SAND"

PROJECT INFORMATION

Company: R.J Burnside
 Client: Di Poce
 Project: 300041886
 Location: Barrie
 Test Well: BH7
 Test Date: Sept 27, 2018

AQUIFER DATA

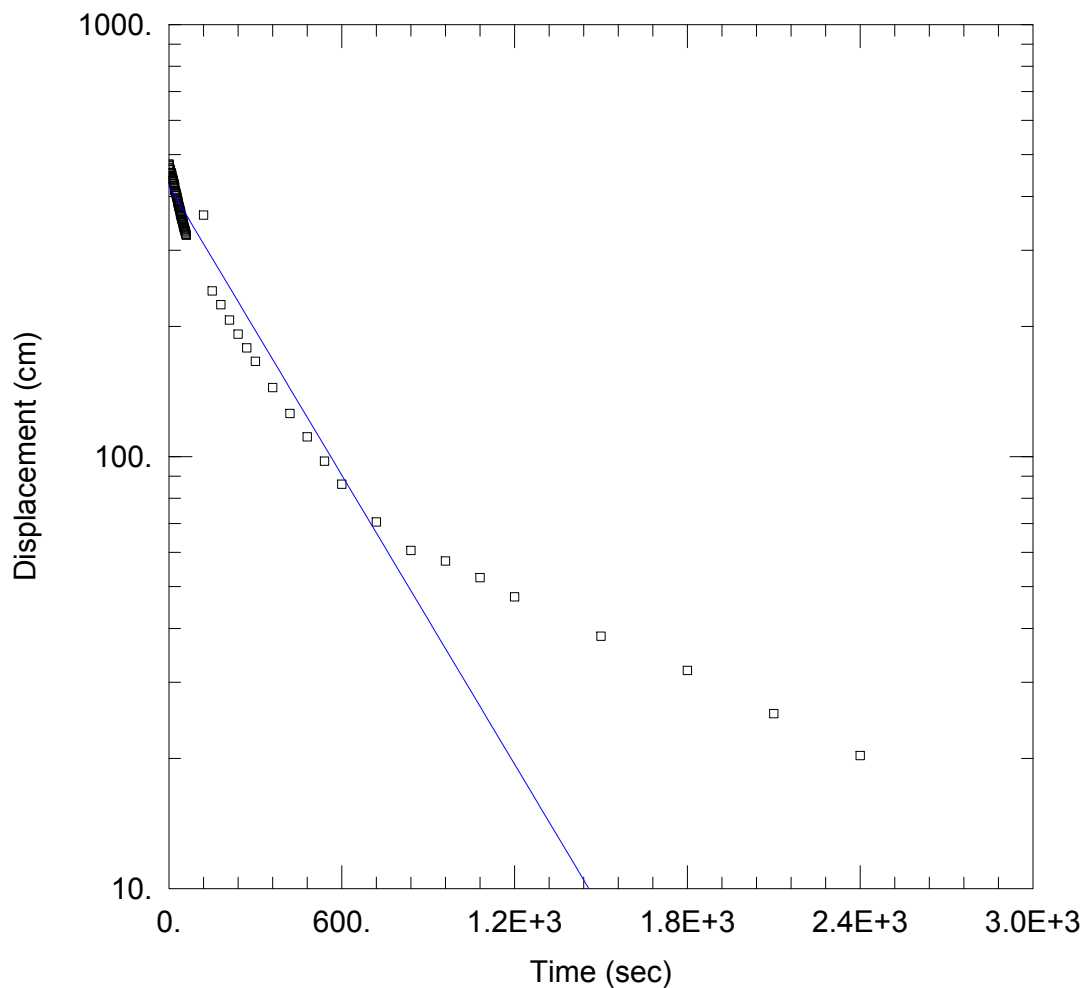
Saturated Thickness: 1. cm Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (DP-BH7)

Initial Displacement: 1544.5 cm Static Water Column Height: 0. cm
 Total Well Penetration Depth: 152. cm Screen Length: 152. cm
 Casing Radius: 2.54 cm Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 0.00682$ cm/sec $y_0 = 1534.6$ cm



HYDRAULIC CONDUCTIVITY TEST AT BH23 "SCREENED IN SAND AND SILT TO SILTY SAND"

PROJECT INFORMATION

Company: R.J Burnside
 Client: Di Poce
 Project: 300041886
 Location: Barrie
 Test Well: BH23
 Test Date: Sept 27, 2018

AQUIFER DATA

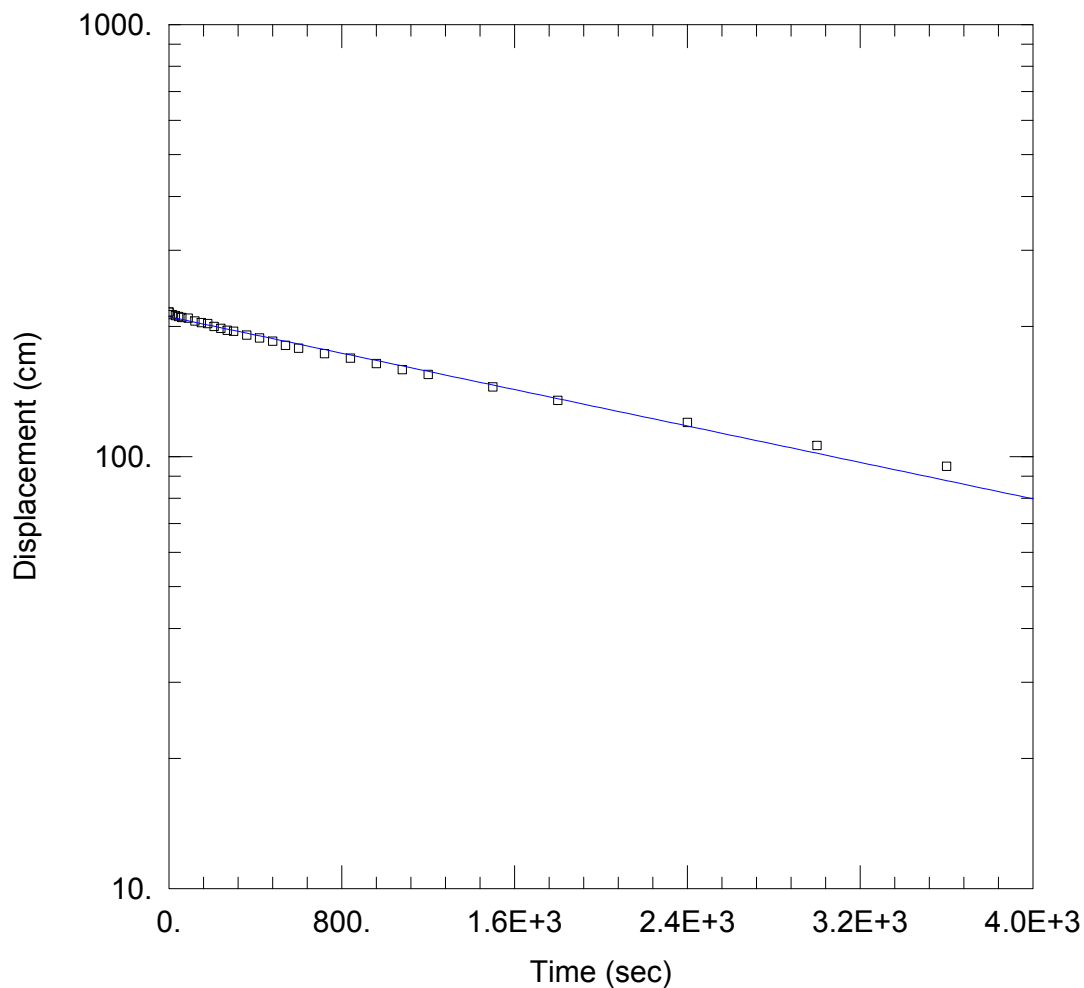
Saturated Thickness: 1. cm Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH23)

Initial Displacement: 475.1 cm Static Water Column Height: 0. cm
 Total Well Penetration Depth: 152. cm Screen Length: 152. cm
 Casing Radius: 2.54 cm Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 0.0439$ cm/sec $y_0 = 422.9$ cm



HYDRAULIC CONDUCTIVITY TEST AT BH120 "SCREENED IN SILTY SAND"

PROJECT INFORMATION

Company: R.J Burnside
 Client: Di Poce
 Project: 300041886
 Location: Barrie
 Test Well: BH120
 Test Date: Sept 27, 2018

AQUIFER DATA

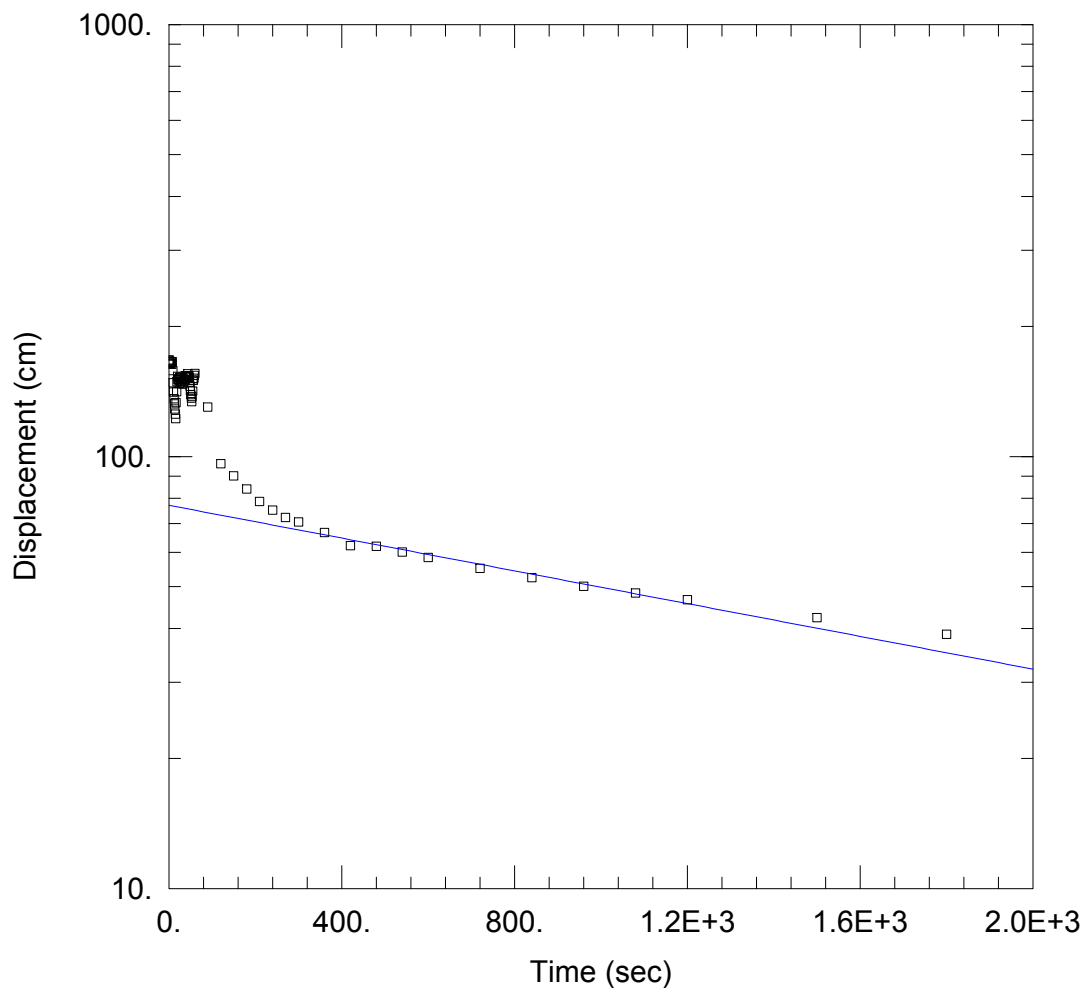
Saturated Thickness: 480. cm Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (DP-BH120)

Initial Displacement: 216. cm Static Water Column Height: 480. cm
 Total Well Penetration Depth: 628. cm Screen Length: 300. cm
 Casing Radius: 2.57 cm Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 1.166E-5$ cm/sec $y_0 = 210.6$ cm



HYDRAULIC CONDUCTIVITY TEST AT BH129 "SCREENED IN SILTY SAND"

PROJECT INFORMATION

Company: R.J Burnside
 Client: Di Poce
 Project: 300041886
 Location: Barrie
 Test Well: BH129
 Test Date: Sept 27, 2018

AQUIFER DATA

Saturated Thickness: 1. cm

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH129)

Initial Displacement: 167.3 cm
 Total Well Penetration Depth: 300. cm
 Casing Radius: 2.54 cm

Static Water Column Height: 0. cm
 Screen Length: 300. cm
 Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
 $K = 0.007461$ cm/sec

Solution Method: Hvorslev
 $y_0 = 77.08$ cm



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Appendix D

Groundwater Level Data

Table D-1
Groundwater Elevations

Well Name	Well Depth (mbgs)	Ground Surface Elevation (masl)*	17-May-2018		28-Jun-2018		27-Jul-2018		14-Aug-2018	
			Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)
DP-BH7	14.79	301.40	14.42	286.98	14.26	287.14	14.47	286.93	14.63	286.77
DP-BH14	6.05	293.30	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
DP-BH18	4.10	296.60	1.26	295.34	1.96	294.64	2.51	294.09	2.56	294.04
DP-BH121	8.94	302.00	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
DP-BH23	6.08	299.20	2.35	296.85	3.83	295.37	4.42	294.78	4.60	294.60
DP-BH120	7.50	291.90	0.78	291.12	1.59	290.31	2.46	289.44	2.58	289.32
DP-BH122	9.81	299.70	9.39	290.31	9.62	290.08	9.71	289.99	9.73	289.98
DP-BH123	13.59	305.50	13.50	292.00	13.51	291.99	13.51	291.99	13.51	291.99
DP-BH129	4.51	290.60	3.32	287.28	3.86	286.74	4.33	286.27	4.33	286.27
MW3s	6.04	305.50	Dry	Dry	5.00	300.50	5.18	300.32	5.29	300.21
MW3d	7.47	305.50	4.73	300.77	5.02	300.48	5.19	300.31	5.30	300.20
DP-PZ1s	1.24	297.50	-0.03	297.53	0.23	297.27	0.54	296.96	0.29	297.21
DP-PZ1d	1.85	297.50	0.02	297.48	0.32	297.18	0.33	297.17	0.36	297.14

Notes

"-" denotes data unavailable

mbgs - meters below ground surface

masl - metres above sea level

* Ground elevations from geotechnical reports
(GeoPro 2018, Terraprobe 2018)

Table D-1
Groundwater Elevations

Well Name	Well Depth (mbgs)	Ground Surface Elevation (masl)*	27-Sep-2018		24-Oct-2018	
			Water Level (mbgs)	Water Elevation (masl)	Water Level (mbgs)	Water Elevation (masl)
DP-BH7	14.79	301.40	Dry	Dry	Dry	Dry
DP-BH14	6.05	293.30	Dry	Dry	Dry	Dry
DP-BH18	4.10	296.60	2.49	294.11	1.78	294.82
DP-BH121	8.94	302.00	Dry	Dry	Dry	Dry
DP-BH23	6.08	299.20	4.74	294.46	4.67	294.53
DP-BH120	7.50	291.90	2.68	289.22	2.54	289.36
DP-BH122	9.81	299.70	9.75	289.95	9.76	289.94
DP-BH123	13.59	305.50	13.51	291.99	13.52	291.98
DP-BH129	4.51	290.60	4.34	286.26	4.34	286.26
MW3s	6.04	305.50	5.47	300.03	Dry	Dry
MW3d	7.47	305.50	5.54	299.96	5.78	299.72
DP-PZ1s	1.24	297.50	0.25	297.25	0.03	297.47
DP-PZ1d	1.85	297.50	0.25	297.25	0.12	297.38

Notes

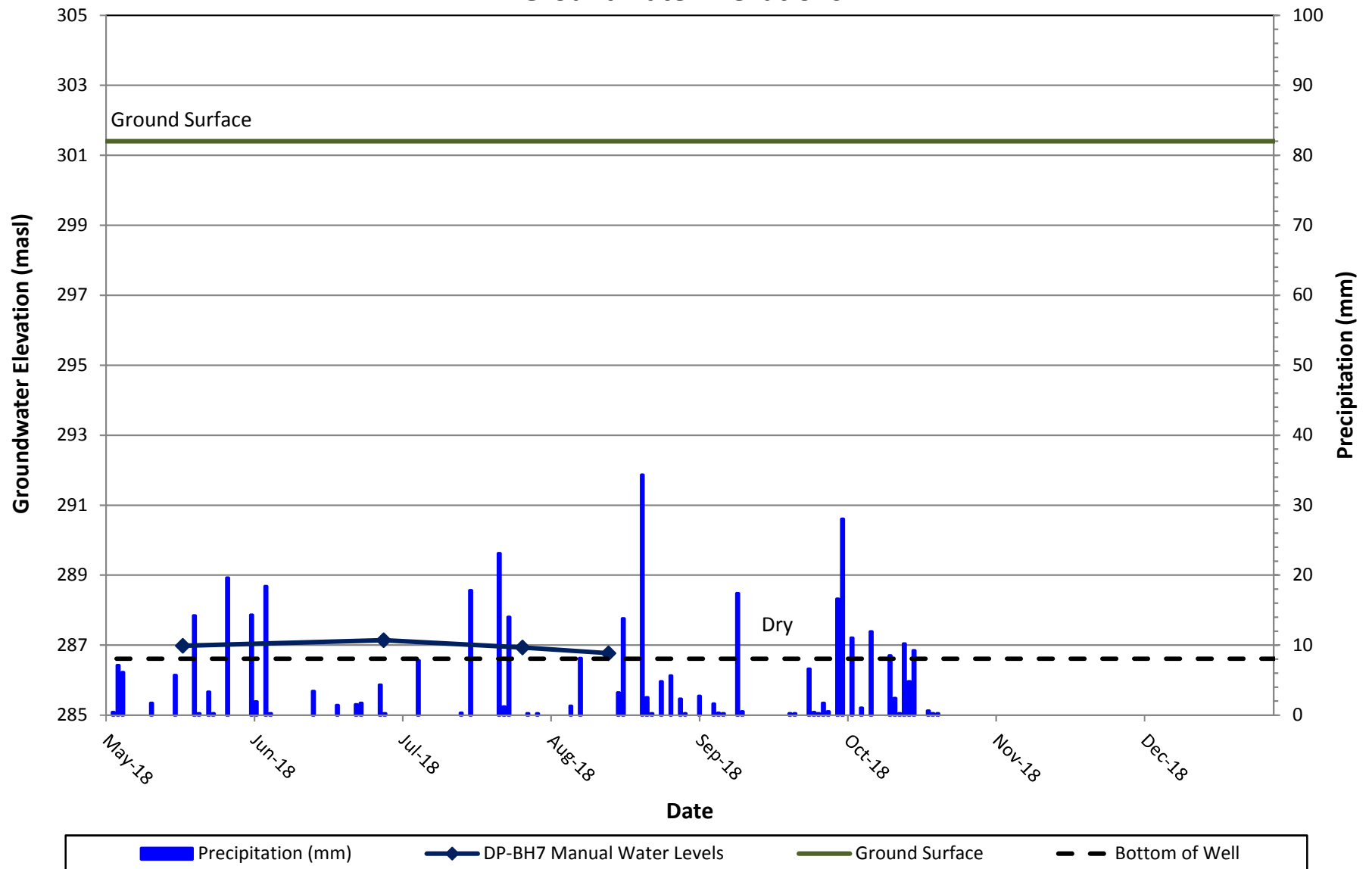
"-" denotes data unavailable

mbgs - meters below ground surface

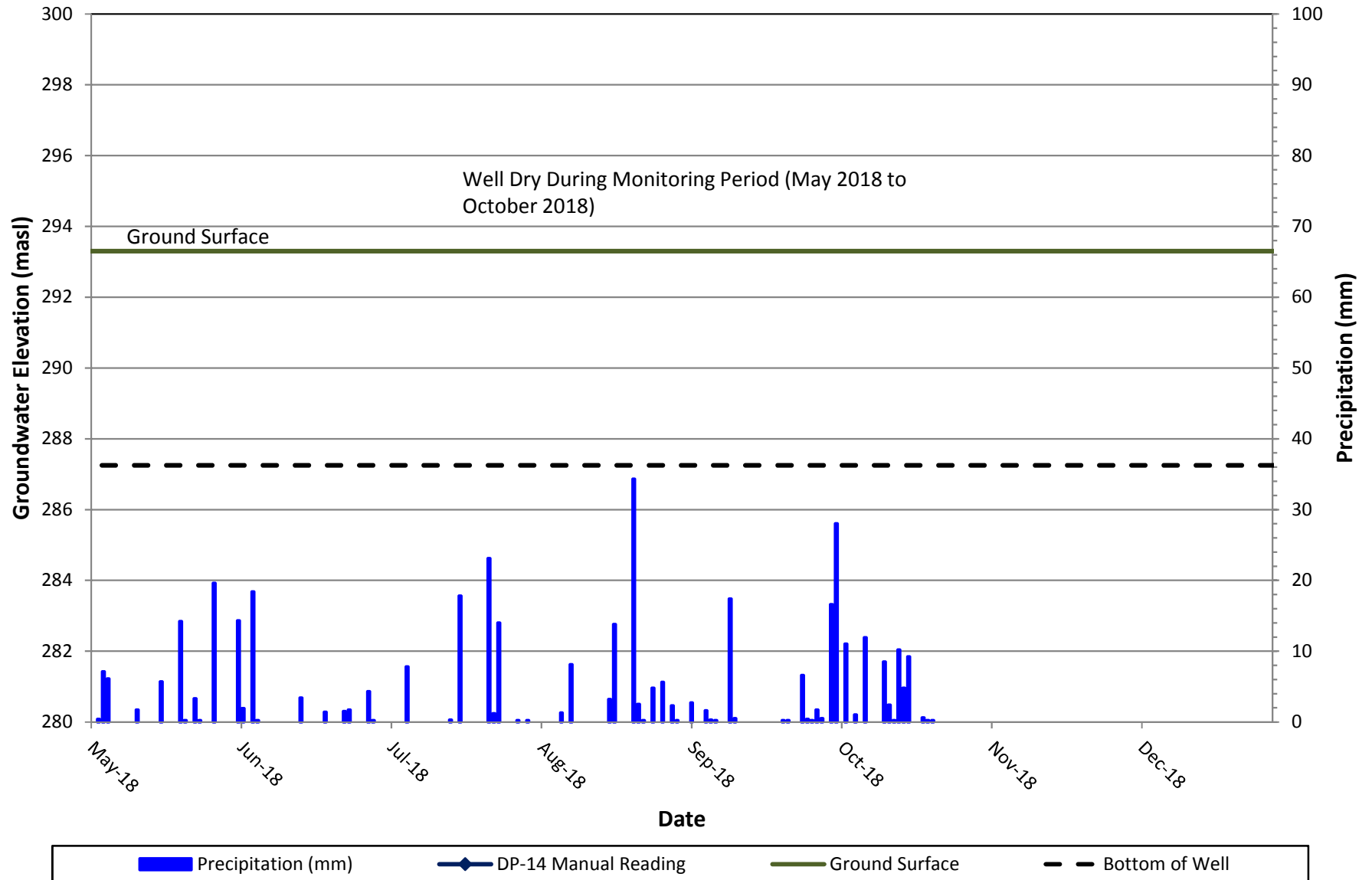
masl - metres above sea level

* Ground elevations from geotechnical reports
(GeoPro 2018, Terraprobe 2018)

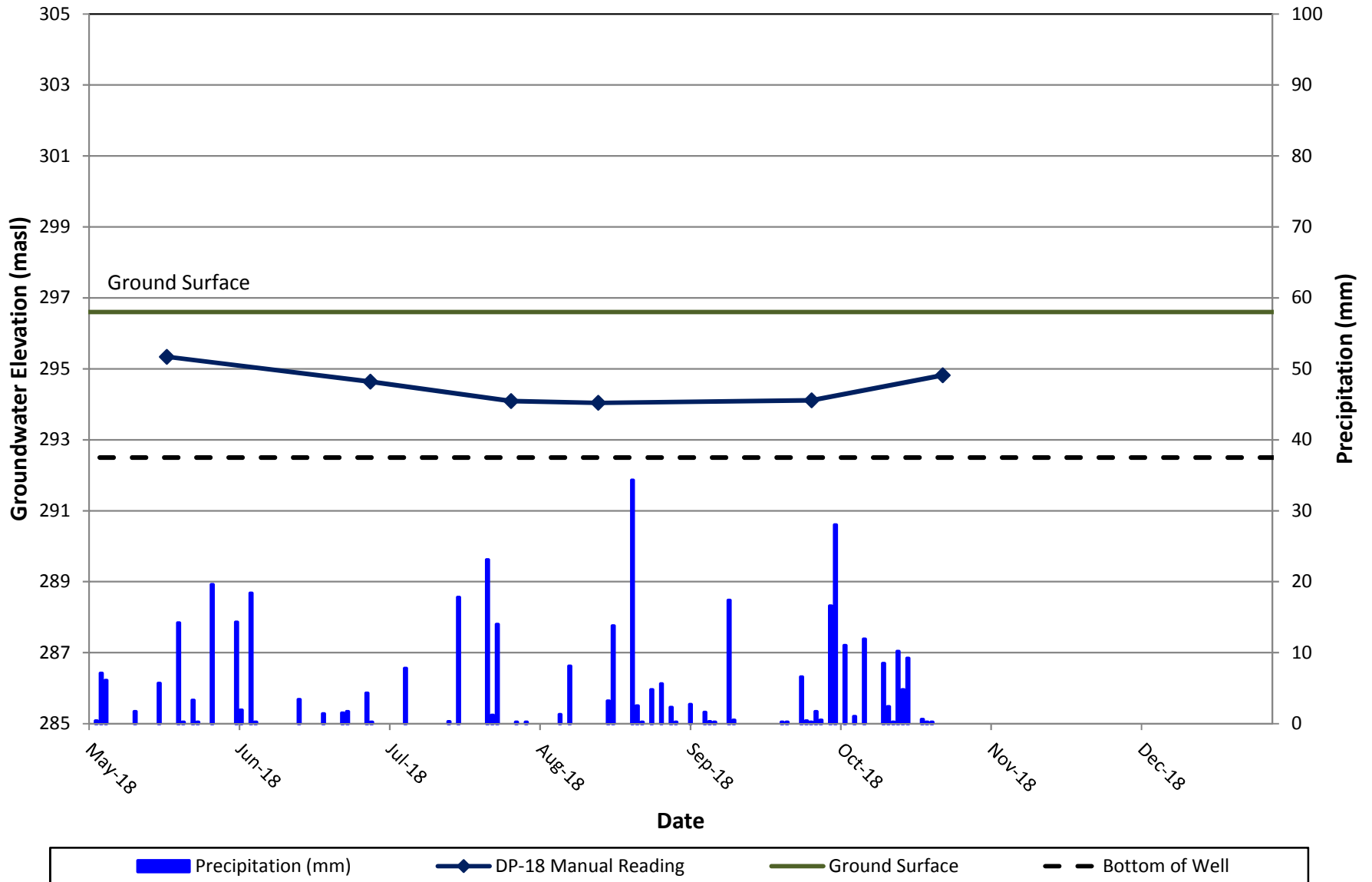
DP-BH7 (Well Depth: 14.8 m, Screened in Sand and Silt to Silty Sand) **Groundwater Elevations**



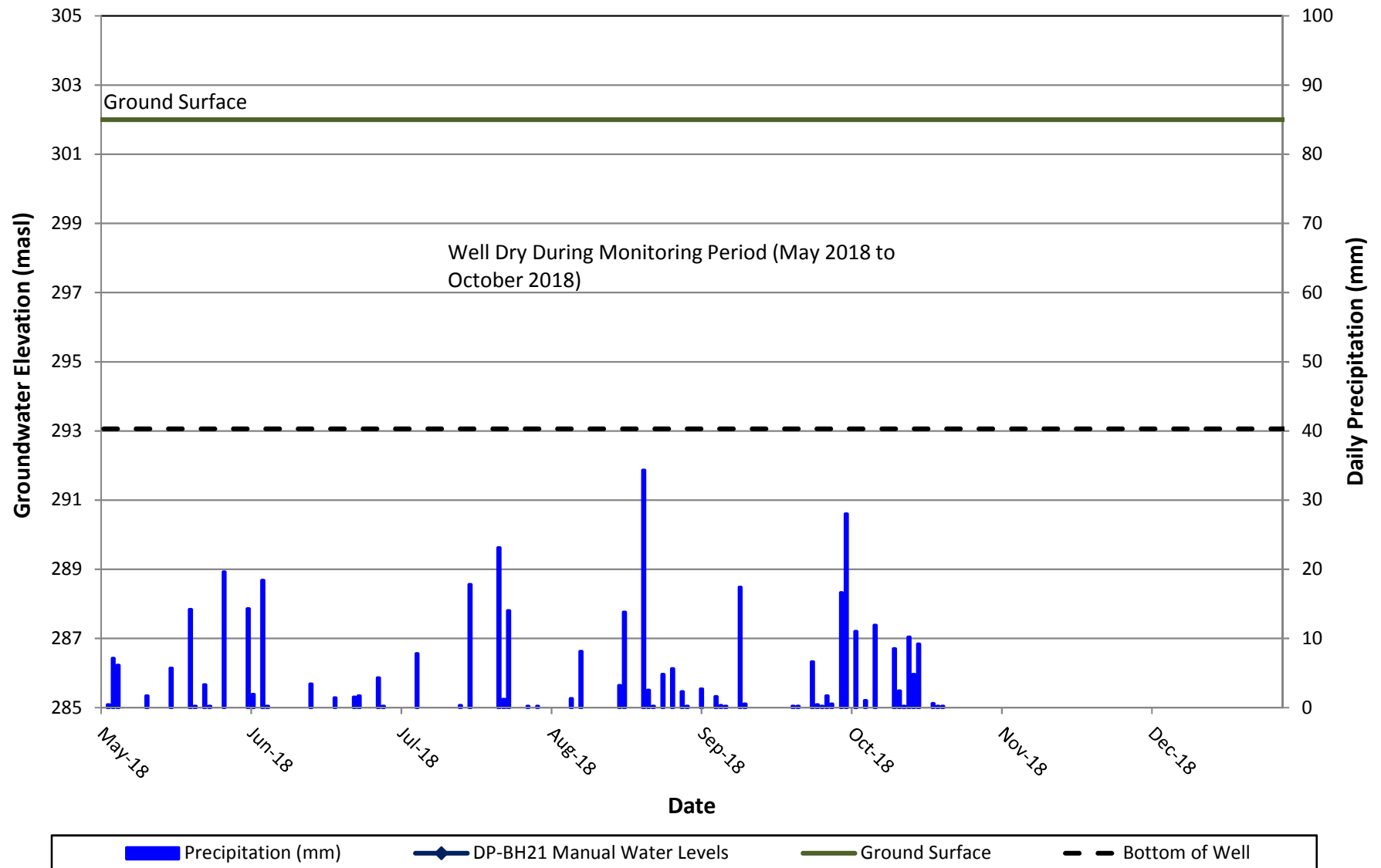
DP-BH14 (Well Depth: 6.1 m, Screened in Sand and Silt to Silty Sand)
Groundwater Elevations



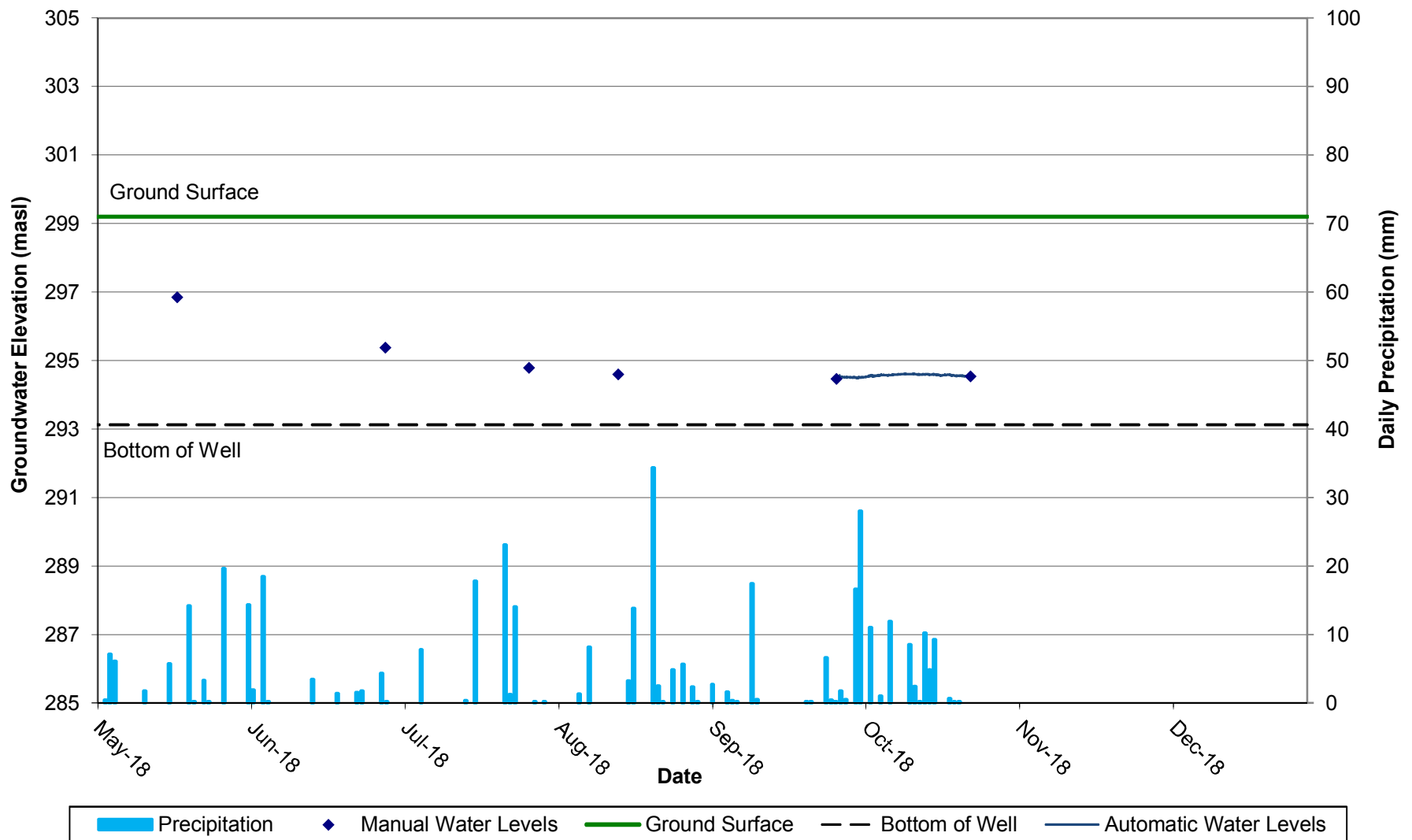
DP-BH18 (Well Depth: 4.1 m, Screened in Sand and Silt)
Groundwater Elevations



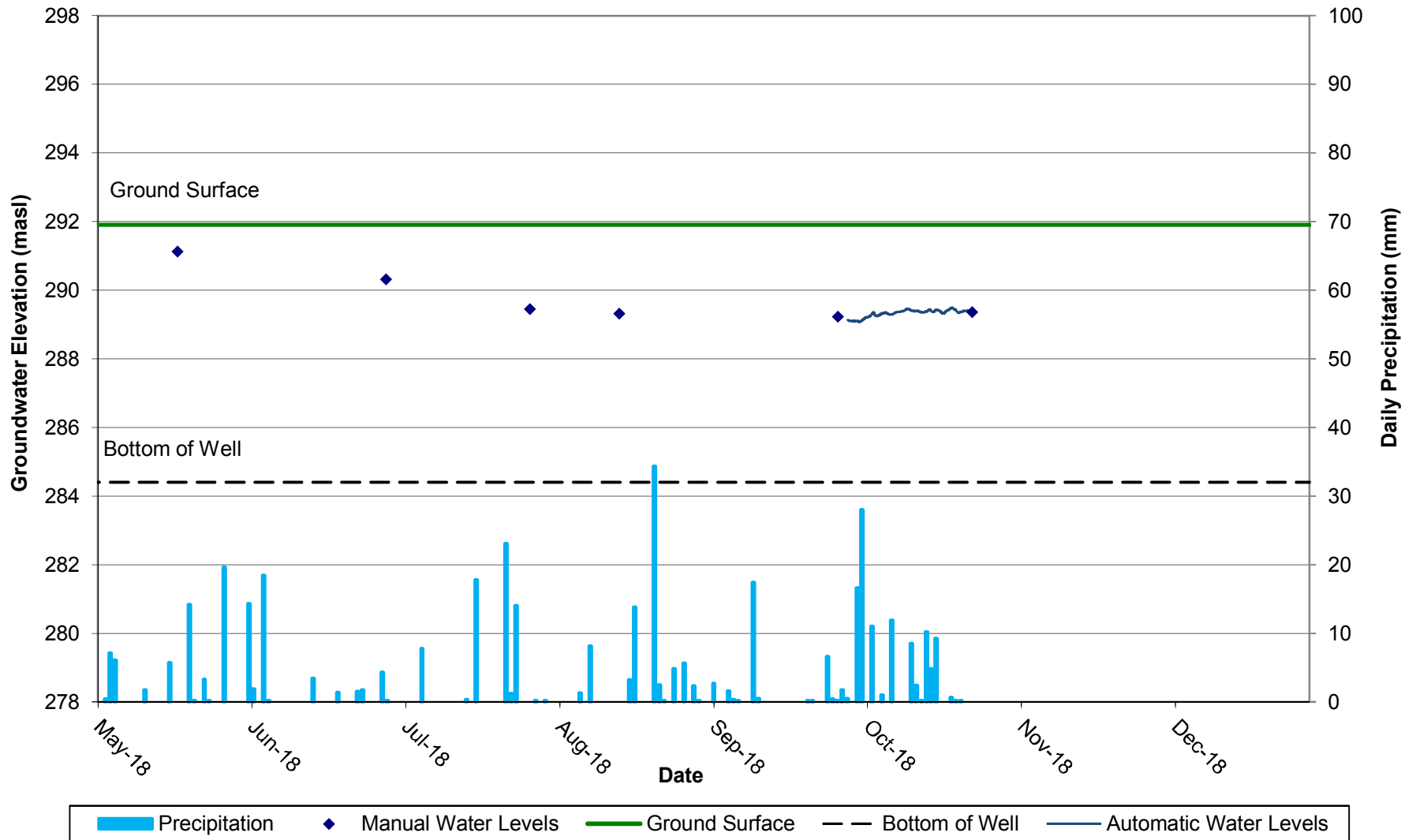
DP-BH21 (Well Depth: 8.9 m, Screened in Sand and Silt to Silty Sand)
Groundwater Elevations



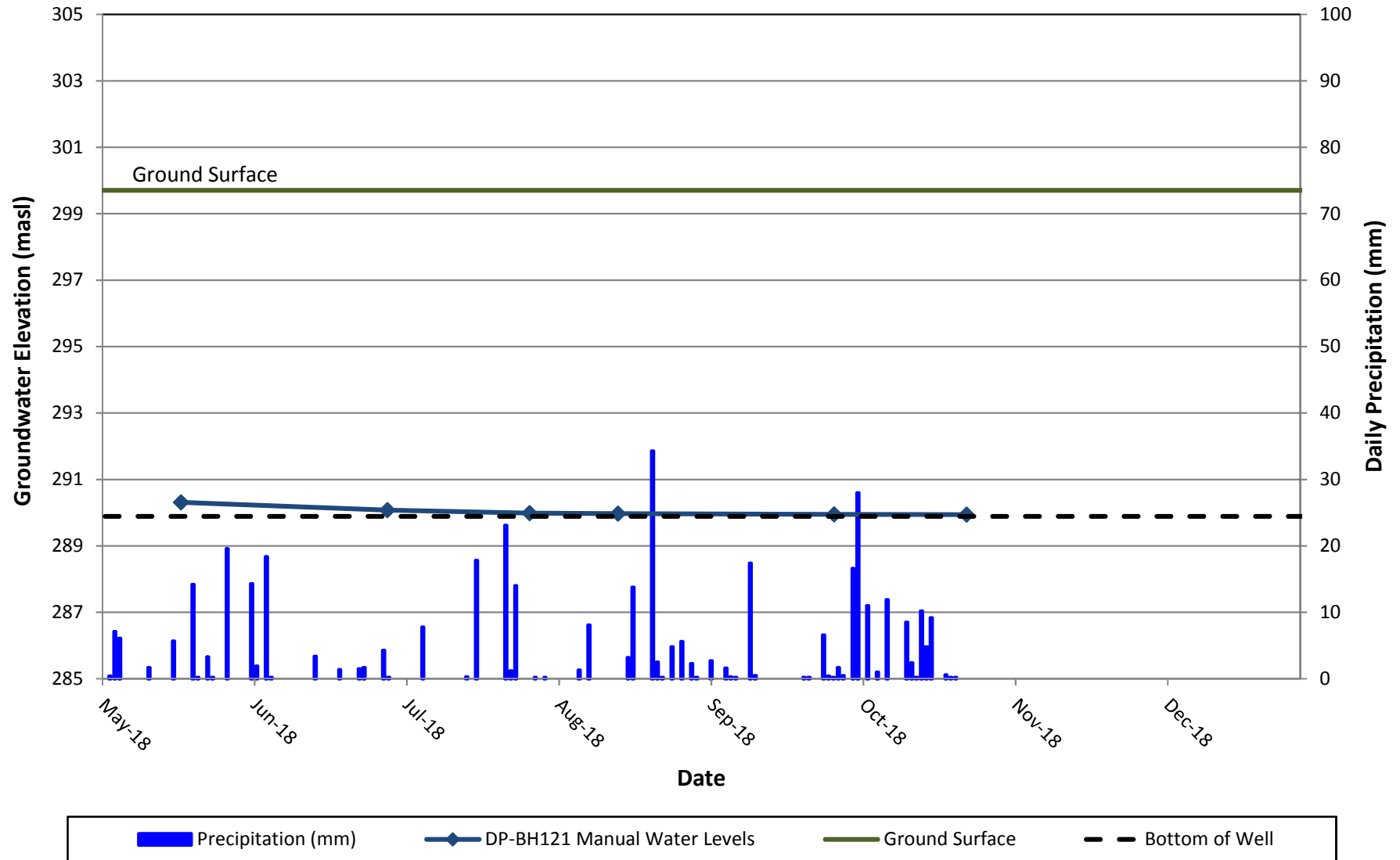
Groundwater Elevations



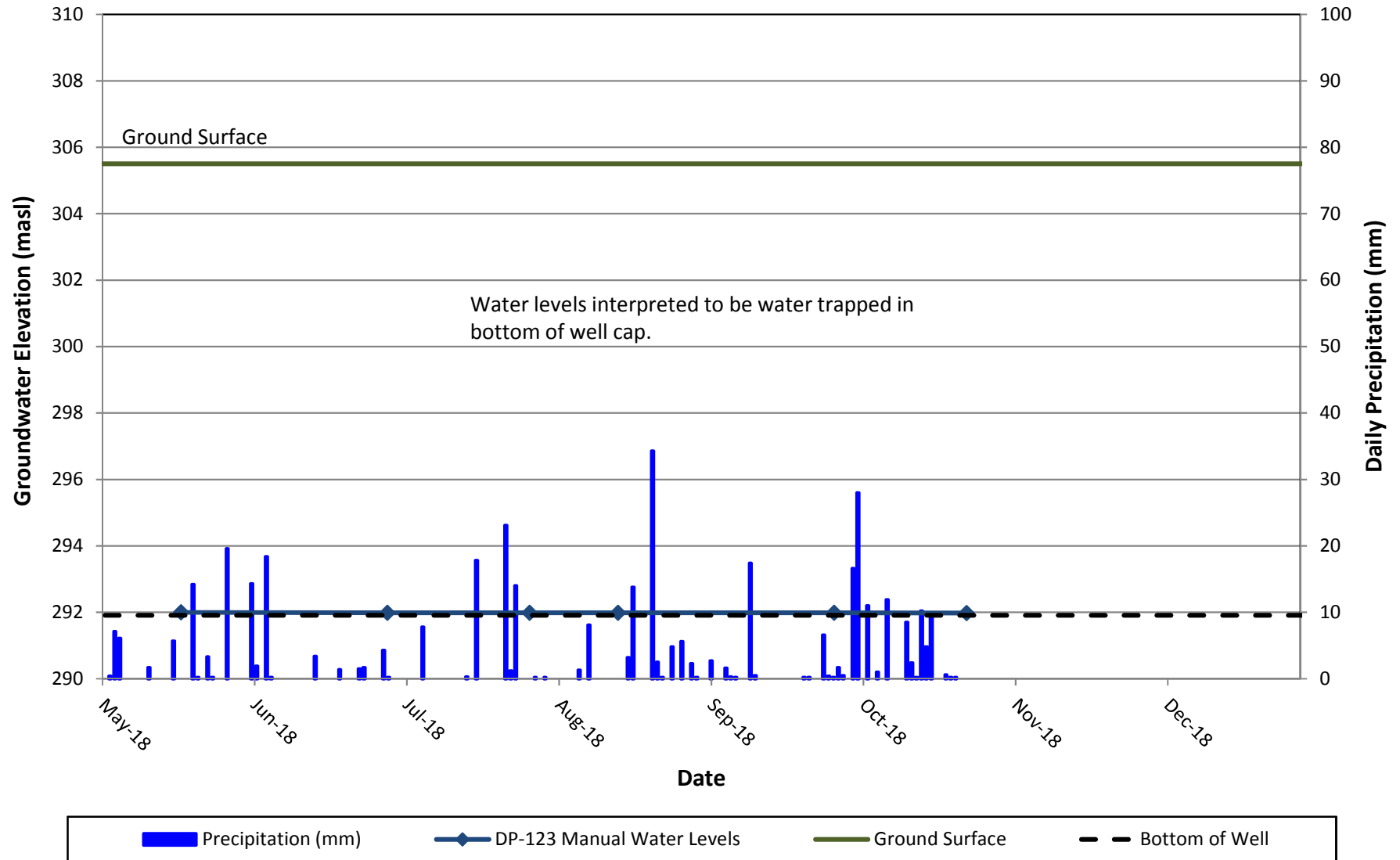
**DP-BH120 (Well Depth: 7.5 m, Screened in Silty Sand)
Groundwater Elevations**



DP-BH122 (Well Depth: 9.8 m, Screened in Silty Sand)
Groundwater Elevations



DP-BH123 (Well Depth: 13.6 m, Screened in Silty Sand, Sand)
Groundwater Elevations



DP-BH129 (Well Depth: 4.5 m, Screened in Silty Sand)
Groundwater Elevations

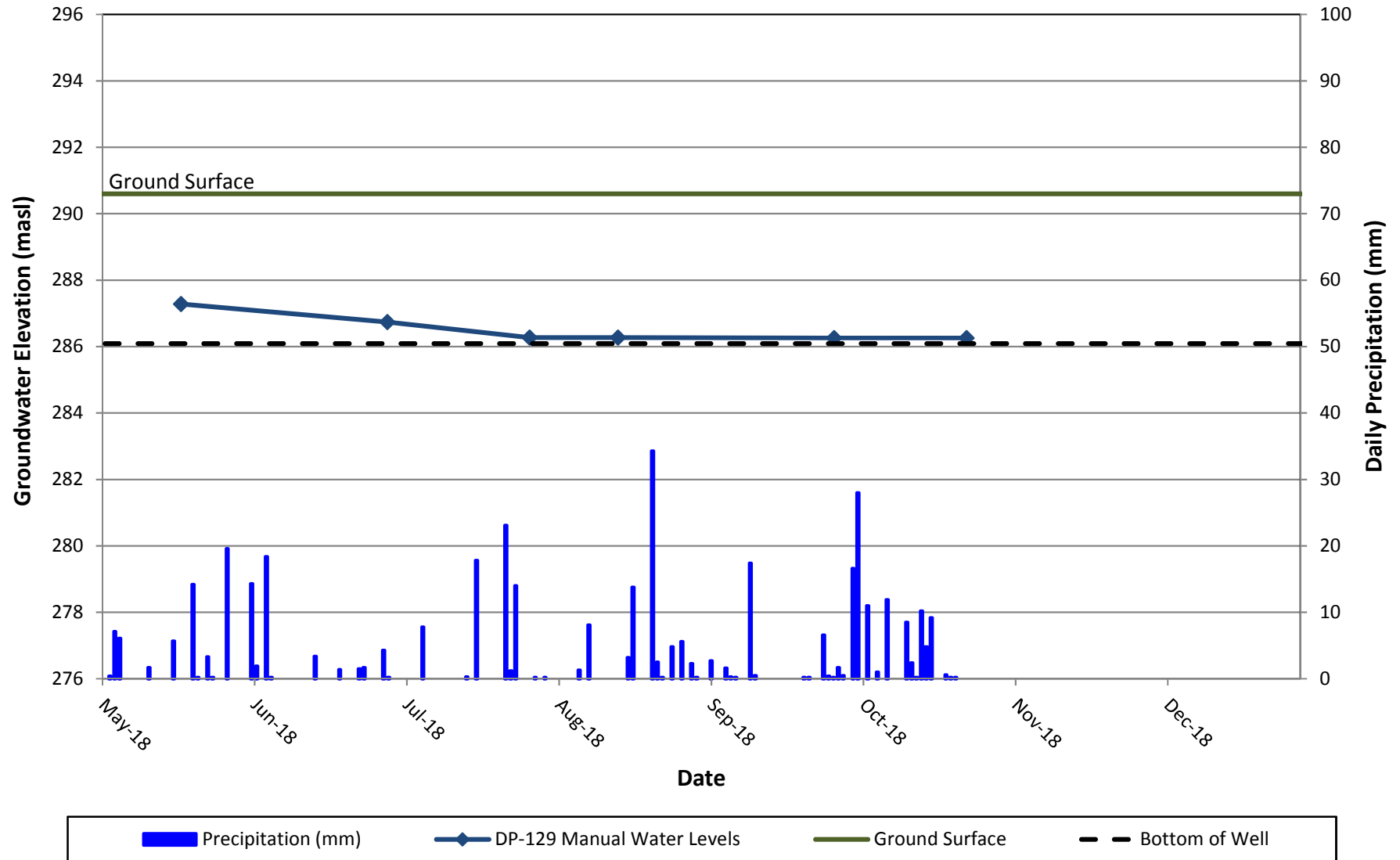
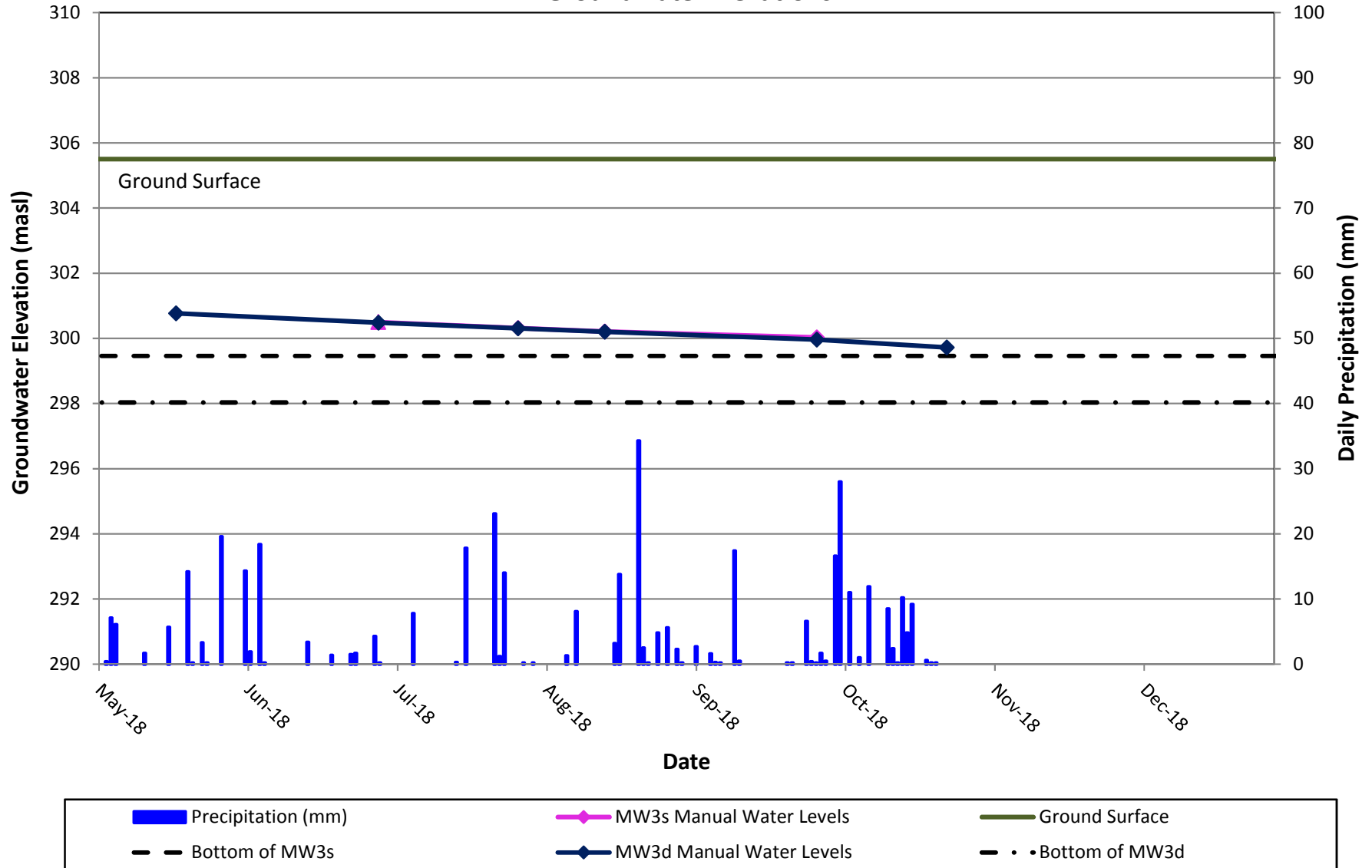
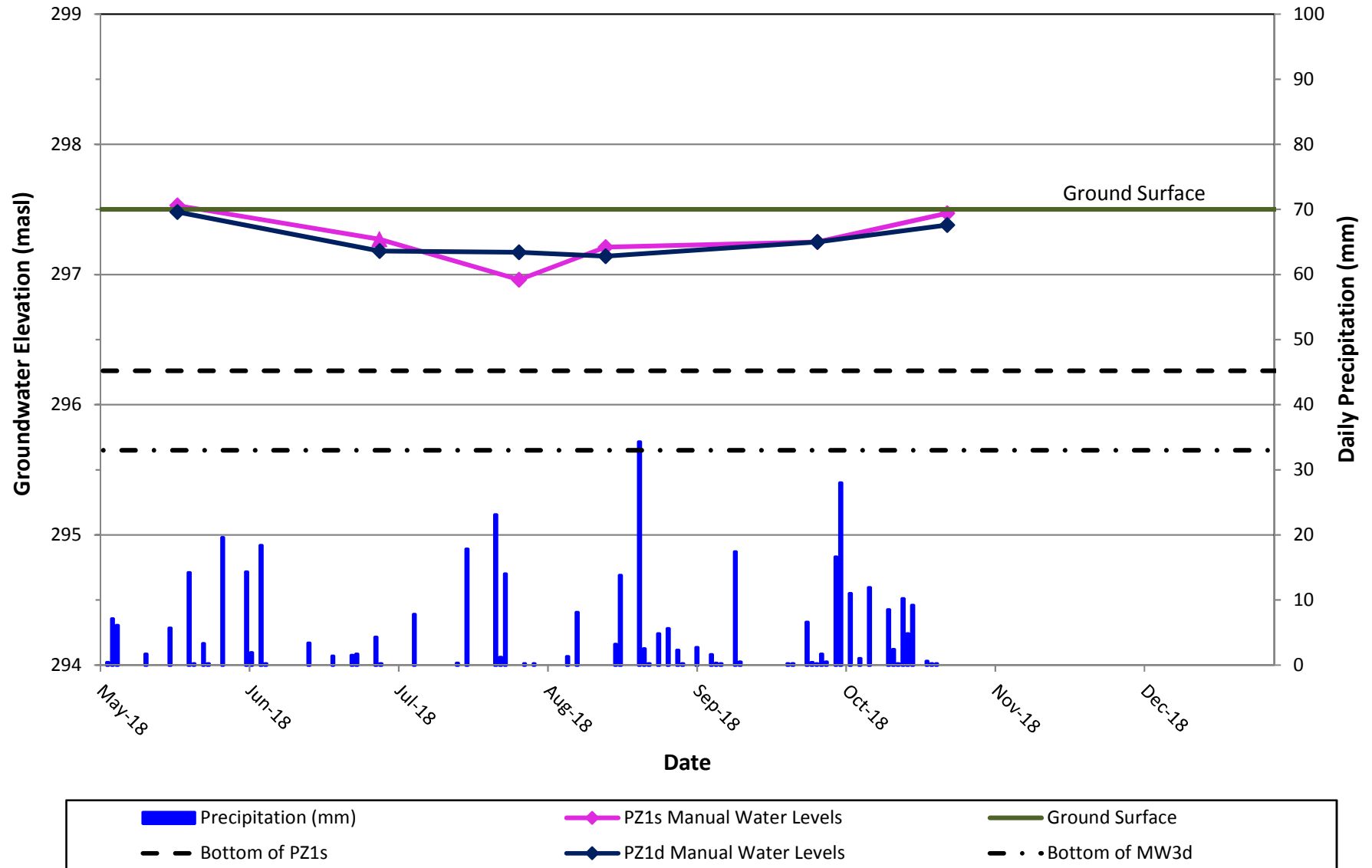


Figure D-9

MW3s (Well Depth: 6.0 m, Screened in Sand)
MW3d (Well Depth: 7.5 m, Screened in Sand & Silt)
Groundwater Elevations



DP-PZ1s/d Groundwater Elevations





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Appendix E

Surface Water Monitoring Data

Table E-1
Surface Water Flow

Date	Days since rain:	Flow Rate (L/s)	
		SSF-7	SSF-8
17-May-18	2	<0.5	<0.5
28-Jun-18	0	Dry	Dry
27-Jul-18	3	Dry	Dry
14-Aug-18	6	Dry	Dry
27-Sep-18	0	Dry	Dry
24-Oct-18	1	<0.5	1

Notes:

"<0.5" minimal flow not measurable with equipment (estimated)

"-" not measured

Table E-2
Historical Surface Water Flow

Date	Days since rain:	SSF-7	SSF-8
12-Dec-14	0	Snow Covered	Snow Covered
19-Jan-15	0	Snow Covered	Snow Covered
20-Feb-15	4	Snow Covered	Snow Covered
16-Mar-15	9	Frozen	No defined channel
15-Apr-15	2	9.7	2.2
14-May-15	1	0.4	0.1
25-Jun-15	0	0.3	0.1
16-Jul-15	8	Dry	Standing Water
24-Aug-15	4	Dry	<0.5
17-Sep-15	4	Dry	Standing Water
15-Oct-15	1	Dry	Dry
17-Nov-15	3	1.3	<0.5
22-Jan-16	1	Snow Covered	Snow Covered
29-Mar-16	0	5.3	1.4
30-May-16	4	0.3	0.8
19-Jul-16	4	Dry	Dry
20-Sep-16	2	Standing Water	Dry
14-Nov-16	1	Standing Water	<0.5
30-Mar-17	2	1.3	8.2
14-Jun-17	0	0.4	4.9
6-Oct-17	0	Dry	Dry
20-Dec-17	0	Frozen and Snow Covered	Frozen and Snow Covered

Notes:

"<0.5" minimal flow not measurable with equipment (estimated)

"-" not measured



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Appendix F

Water Quality Data

Table F-1
Groundwater Quality

Monitoring Well				MW3d	BH120
Date Sampled				27-Sep-18	28-Sep-18
Parameter	Unit	RDL	ODWQS		
Electrical Conductivity	µS/cm	2		269	2280
pH	pH Units	NA	(6.5-8.5)	7.85	7.68
Saturation pH				7.53	6.65
Langelier Index				0.32	1.03
Total Hardness (as CaCO ₃)	mg/L	0.5	(80-100)	136	447
Total Dissolved Solids	mg/L	20	500	156	1320
Alkalinity (as CaCO ₃)	mg/L	5	(30-500)	148	402
Bicarbonate (as CaCO ₃)	mg/L	5		148	402
Carbonate (as CaCO ₃)	mg/L	5		<5	<5
Hydroxide (as CaCO ₃)	mg/L	5		<5	<5
Fluoride	mg/L	0.05	1.5	<0.05	<0.5
Chloride	mg/L	0.10	250	1.00	654
Nitrate as N	mg/L	0.05	10.0	1.41	1.5
Nitrite as N	mg/L	0.05	1.0	<0.05	<0.5
Bromide	mg/L	0.05		<0.05	<0.5
Sulphate	mg/L	0.10	500	2.28	34.9
Ortho Phosphate as P	mg/L	0.10		<0.10	<1.0
Reactive Silica	mg/L	0.05		4.88	14.4
Ammonia as N	mg/L	0.02		<0.02	<0.02
Total Phosphorus	mg/L	0.02		<0.02	<0.02
Total Organic Carbon	mg/L	0.5		1.7	2.4
Colour	TCU	5	5	<5	<5
Turbidity	NTU	0.5	5	213	384
Calcium	mg/L	0.05		49.4	150
Magnesium	mg/L	0.05		3.09	17.7
Sodium	mg/L	0.05	20 (200)	1.20	298
Potassium	mg/L	0.05		0.60	2.05
Aluminum	mg/L	0.004	0.1	0.007	0.013
Antimony	mg/L	0.003	0.006	<0.003	<0.003
Arsenic	mg/L	0.003	0.025	<0.003	<0.003
Barium	mg/L	0.002	1	0.010	0.091
Beryllium	mg/L	0.001		<0.001	<0.001
Boron	mg/L	0.010	5	<0.010	0.025
Cadmium	mg/L	0.001	0.005	<0.001	<0.001
Chromium	mg/L	0.003	0.05	<0.003	<0.003
Cobalt	mg/L	0.001		<0.001	<0.001
Copper	mg/L	0.003	1	<0.003	0.004
Iron	mg/L	0.010	0.3	<0.010	<0.010
Lead	mg/L	0.001	0.01	<0.001	<0.001
Manganese	mg/L	0.002	0.05	<0.002	0.017
Mercury	mg/L	0.0001	0.001	<0.0001	<0.0001
Molybdenum	mg/L	0.002		<0.002	<0.002
Nickel	mg/L	0.003		<0.003	<0.003
Selenium	mg/L	0.004	0.01	<0.004	<0.004
Silver	mg/L	0.002		<0.002	<0.002
Strontium	mg/L	0.005		0.082	0.422
Thallium	mg/L	0.006		<0.006	<0.006
Tin	mg/L	0.002		<0.002	<0.002
Titanium	mg/L	0.002		<0.002	<0.002
Tungsten	mg/L	0.010		<0.010	<0.010
Uranium	mg/L	0.002	0.02	<0.002	<0.002
Vanadium	mg/L	0.002	3	<0.002	<0.002
Zinc	mg/L	0.005	5	0.005	0.020
Zirconium	mg/L	0.004		<0.004	<0.004
% Difference/ Ion Balance	%	NA		5.83	10.9

ODWQS - Ontario Drinking Water Quality Standards

RDL - Reported Detection Limit

Bold indicates an exceedence of the ODWQS



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Appendix G

Water Balance Calculations

WATER BALANCE CALCULATIONS

DiPoce Management Inc.
Barrie, ON

PROJECT No.300041886



TABLE G-1

Water Balance Components													
Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 150 mm (moderate rooted crops in sandy loam soils)													
Precipitation data from Barrie WPCC Climate Station (1981 - 2010)													

Potential Evapotranspiration Calculation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Average Temperature (Degree C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	6.9
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	36.8
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	25.18	58.76	88.02	103.48	97.59	74.33	40.47	11.47	0.00	499
Adjusting Factor for U (Latitude 44° 20' N)	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	28	75	114	135	117	77	38	9	0	593
WATER BALANCE COMPONENTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Precipitation (P)	83	62	58	62	82	85	77	90	94	78	89	74	933
Potential Evapotranspiration (PET)	0	0	0	28	75	114	135	117	77	38	9	0	593
P - PET	83	62	58	34	8	-29	-57	-27	17	39	80	74	340
Change in Soil Moisture Storage	0	0	0	0	0	-29	-57	-27	17	39	58	0	0
Soil Moisture Storage max 150 mm	150	150	150	150	150	121	64	37	53	92	150	150	
Actual Evapotranspiration (AET)	0	0	0	28	75	114	135	117	77	38	9	0	593
Soil Moisture Deficit max 150 mm	0	0	0	0	0	29	86	113	97	58	0	0	
Water Surplus - available for infiltration or runoff	83	62	58	34	8	0	0	0	0	0	22	74	340
Potential Infiltration (based on MOE methodology*; independent of temperature)	58	43	41	24	5	0	0	0	0	0	16	52	238
Potential Direct Surface Water Runoff (independent of temperature)	25	19	17	10	2	0	0	0	0	0	7	22	102
IMPERVIOUS AREA WATER SURPLUS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Precipitation (P)	933	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	140	mm/year											
P-PE (surplus available for runoff from impervious areas)	793	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage

150 mm

-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - rolling to hilly land

soils - sandy loam

cover - predominantly cultivated land

Infiltration factor

0.2

0.4

0.1

0.7

-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003

-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003

-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003

Latitude of site (or climate station)

44 ° N.

WATER BALANCE CALCULATIONS

DiPoce Management Inc.
Barrie, ON

PROJECT No.300041886



TABLE G-2

Water Balance Components													
Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 300 mm (wooded areas in sandy loam soils)													
Precipitation data from Barrie WPCC Climate Station (1981 - 2010)													

Potential Evapotranspiration Calculation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Average Temperature (Degree C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	6.9
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	36.8
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	25.18	58.76	88.02	103.48	97.59	74.33	40.47	11.47	0.00	499
Adjusting Factor for U (Latitude 44° 20' N)	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	28	75	114	135	117	77	38	9	0	593
WATER BALANCE COMPONENTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Precipitation (P)	83	62	58	62	82	85	77	90	94	78	89	74	933
Potential Evapotranspiration (PET)	0	0	0	28	75	114	135	117	77	38	9	0	593
P - PET	83	62	58	34	8	-29	-57	-27	17	39	80	74	340
Change in Soil Moisture Storage	0	0	0	0	0	-29	-57	-27	17	39	58	0	0
Soil Moisture Storage max 300 mm	300	300	300	300	300	271	214	187	203	242	300	300	
Actual Evapotranspiration (AET)	0	0	0	28	75	114	135	117	77	38	9	0	593
Soil Moisture Deficit max 300 mm	0	0	0	0	0	29	86	113	97	58	0	0	
Water Surplus - available for infiltration or runoff	83	62	58	34	8	0	0	0	0	0	22	74	340
Potential Infiltration (based on MOE methodology*; independent of temperature)	66	49	46	27	6	0	0	0	0	0	18	59	272
Potential Direct Surface Water Runoff (independent of temperature)	17	12	12	7	2	0	0	0	0	0	4	15	68
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	933	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	140	mm/year											
P-PE (surplus available for runoff from impervious areas)	793	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage

300 mm

-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - rolling to hilly land

soils - sandy loam

cover - woodlands

Infiltration factor

0.2

0.4

0.2

0.8

-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003

-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003

-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003

Latitude of site (or climate station)

44 ° N.

WATER BALANCE CALCULATIONS

DiPoce Management Inc.
Barrie, ON

PROJECT No.300041886



TABLE G-3

Water Balance for Pre- and Post-Development Land Use Conditions (with no SWM/LID measures in place)												
Land Use Description	Approx. Land Area* (m ²)	Estimated Impervious Fraction for Land Use*	Estimated Impervious Area (m ²)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m ³ /a)	Estimated Pervious Area (m ²)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m ³ /a)	Infiltration from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m ³ /a)	Total Runoff Volume (m ³ /a)	Total Infiltration Volume (m ³ /a)
Exisging Land Use												
Mixed Forest	33,700	0.00	0	0.793	0	33,700	0.068	2,290	0.272	9,159	2,290	9,159
Wetlands	40,500	1.00	40,500	0.793	32,115	0	0.068	0	0.272	0	32,115	0
Agricultural	184,000	0.00	0	0.793	0	184,000	0.102	18,752	0.238	43,755	18,752	43,755
TOTAL PRE-DEVELOPMENT	258,200		40,500		32,115	217,700		21,042		52,914	53,157	52,914
Post-Development Land Use (with no LID measures in place)												
Residential (Medium Density)	34,600	0.75	25,950	0.793	20,577	8,650	0.102	882	0.238	2,057	21,459	2,057
Residential (Townhouse)	50,700	0.69	34,983	0.793	27,740	15,717	0.102	1,602	0.238	3,738	29,342	3,738
Commercial	2,800	0.71	1,988	0.793	1,576	812	0.102	83	0.238	193	1,659	193
School	22,100	0.71	15,691	0.793	12,442	6,409	0.102	653	0.238	1,524	13,096	1,524
Stormwater Management Area	12,500	0.50	6,250	0.793	4,956	6,250	0.102	637	0.238	1,486	5,593	1,486
Park	24,800	0.07	1,736	0.793	1,377	23,064	0.102	2,351	0.238	5,485	3,727	5,485
Pipeline	9,000	0.00	0	0.793	0	9,000	0.102	917	0.238	2,140	917	2,140
Open Space	29,628	0.00	0	0.793	0	29,628	0.068	2,013	0.272	8,052	2,013	8,052
Wetlands	37,672	1.00	37,672	0.793	29,873	0	0.068	0	0.272	0	29,873	0
Paths/Walkways	900	1.00	900	0.793	714	0	0.102	0	0.238	0	714	0
Right of Way	33,500	0.75	25,125	0.793	19,923	8,375	0.102	854	0.238	1,992	20,777	1,992
TOTAL POST-DEVELOPMENT	258,200		150,295		119,179	107,905		9,991		26,666	129,169	26,666
% Change from Pre to Post											243	50
Effect of development (with no mitigation)											2.4 times increase in runoff	50% reduction of infiltration

* data provided by Schaeffers & Associates Ltd.

** figures from Tables G-1 and G-2

To balance pre- to post-,
the infiltration target (m³/a)= **26,248**