Hydrogeological Assessment and Water Balance
4134 16th Avenue, Markham

Sixteenth Land Holdings Inc.

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1.0 Introduction

Sixteenth Land Holdings Inc. has retained R.J. Burnside & Associates Limited (Burnside) to prepare this Hydrogeological Assessment and Water Balance report in support of an Official Plan Amendment (OPA) application to permit the development of a residential community on the Subject Property municipally known as 4134 16th Avenue, in the City of Markham, Region of York. The property is located in Part Lots 16, 17 and 18, Concession 5. The Subject Property is a total of 168.64 hectares (416.72 acres), and is located on the north side of 16th Avenue, on the west side of Kennedy Road, and has a small amount of frontage onto the east side of Warden Avenue as well (Figure 1). There is existing urban development surrounding the property on all sides.

Except for an area adjacent to Kennedy Road, the balance of the property is currently used by its former owner York Downs Golf & Country Club for a golf course. The golf course has been in operation since York Downs Golf & Country Club opened in the early 1970s. The current Official Plan designation of ‘Private Open Space’ for the areas outside of the valleylands reflects this historic golf course use.

Sixteenth Land Holdings Inc. intends to develop the property for a residential community and is submitting an OPA to re-designate the developable portion of the property from ‘Private Open Space’ to appropriate urban residential designations to permit the development of residential uses.

This report has been prepared in conjunction with the OPA application in support of the re-designation as proposed in the draft OPA and in the Planning Report (Gatzios Planning, October 2017). Please refer to the draft OPA and to the Planning Report for a description of the proposed Official Plan land use designations for the property.

The proposed residential development is detailed in the two Draft Plan of Subdivision applications that accompany the OPA application. There is one Draft Plan of Subdivision for the east portion of the property and one for the west portion of the property. The west Draft Plan of Subdivision also contains the valleylands associated with both the Berczy Creek and the Bruce Creek. References in this report to the two draft plans or to specific lots/blocks will include ‘East’ or ‘West’ to denote the appropriate area.

The purpose of the hydrogeological study is to characterize the geological and hydrogeological conditions on the property, identify potential development impacts on the local groundwater and surface water conditions, and to complete water balance calculations. The water balance calculations provide input to the stormwater management plans to be developed for the property by Stantec and provide recharge targets for the design of Low Impact Development (LID) measures to maintain, where possible, key hydrogeological functions.

1.1 Scope of Work

A comprehensive Terms of Reference (TOR) was developed in consultation with the City and TRCA for the MESP for the Subject Property (July 12, 2016). The scope of work for this study was specifically designed to fulfill the hydrogeological and water balance requirements as per the TOR and included completion of the following tasks:

1. Review of published geological and hydrogeological information: A review of existing mapping for the area was completed, including topography (Figure 2), surficial geology (Figure 3) and bedrock geology.

2. Review of the Ministry of the Environment and Climate Change (MOECC) well records: The MOECC maintains a database that provides geological records of water supply wells drilled in the province. A list of the available records for local wells is provided in Appendix A and the well locations are shown on Figure 5. It is noted that the well locations listed in the MOECC records are approximations only and may not be representative of the precise well locations in the field.

3. Review of the geotechnical report and liaison with the project geotechnical engineers (Golder Associates) for the installation of groundwater monitoring wells across the Subject Property: In 2014, Golder drilled 34 boreholes and installed 10 monitoring wells to investigate the soil and groundwater conditions for a preliminary geotechnical investigation. In 2016, Golder drilled an additional 20 boreholes and installed 18 monitoring wells to investigate the soil and groundwater conditions for a geotechnical investigation and the hydrogeological assessment. Lastly, Golder drilled an additional 63 boreholes and installed 9 monitoring wells in 2017 to further assess the geotechnical and hydrogeological setting. The locations of the monitoring wells and boreholes are shown on Figure 5 and copies of the borehole logs are provided in Appendix B.

4. Piezometer installations: Fifteen piezometers (three single piezometers and six nests of two piezometers installed at different depths) were installed in 2016 along Bruce Creek, Berczy Creek, golf course ponds and within wetlands to investigate the shallow groundwater conditions. An additional six piezometers (three nests of two piezometers installed at different depths) were installed in 2017 to provide additional shallow groundwater information in the vicinity of the Unit 18 wetland area. The locations of the piezometers are shown on Figure 4.

5. Review of grainsize analyses: Analyses were completed by the geotechnical consultants on representative soil samples obtained during the geotechnical

investigation. These data were reviewed to characterize the surficial sediments and estimate the hydraulic conductivity of the soils encountered. Copies of the soil grainsize analyses are provided in Appendix C.

6. Hydraulic conductivity testing: Single well response tests were completed in seven groundwater monitoring wells (BH16-5, BH16-6, BH16-9, BH16-12s, BH16-13d, BH16-14 and BH16-15) to assess the in situ hydraulic conductivity of the shallow soils. The hydraulic conductivity field testing results are provided in Appendix D.

7. Monitoring of groundwater levels: Monitoring is currently on-going to measure the depth to the water table and assess seasonal groundwater flow conditions. Groundwater level measurements have been obtained in the site monitoring wells and piezometers monthly from March 2016 to May 2017 and on a quarterly basis to date. Automatic water level recorders (dataloggers) were installed in six of the on-site monitoring wells (BH16-5, BH16-7, BH16-12d, BH16-13d, BH16-15d and BH16-16) and in 14 of the piezometers (PZ4s/d, PZ5s/d, PZ8s/d, PZ9s/d, PZ10s/d, PZ11s/d, and PZ12s/d) in order to record continuous water level fluctuations. The groundwater monitoring data and hydrographs are provided in Appendix E.

8. Monitoring of surface water: Surface water observations and spot-flow measurements have been obtained monthly from April 2016 to May 2017 and on a quarterly basis to date at three locations along Bruce Creek and two locations along Berczy Creek (Figure 4). Three additional flow monitoring stations were added in the spring of 2017 to further assess surface water flows associated with the Unit 18 and Unit 23/33 features (Figure 4). Flow was estimated using a stream area-velocity method. Automatic water level recorders (dataloggers) were installed at staff gauges SG4, SG5, SG8 and SG9 as well as at culverts SG C-1 and SG C-2. The surface water monitoring data are summarized in Appendix F.

9. Water quality testing: Groundwater samples were collected from two monitoring wells (BH16-5 and BH16-15s) and one surface water sample was collected from both the Bruce Creek and Berczy Creek monitoring stations (SS1 and SG7, respectively) to characterize the baseline water quality across the Subject Property. The water samples were submitted to a qualified laboratory for analysis of general quality indicators (e.g., pH, hardness, and conductivity), basic ions (including chloride and nitrate) and selected metals. The testing results are provided in Appendix G.

10. Water balance calculations: A spreadsheet model has been used to calculate the pre-development water balance (based on existing land use conditions) and

post-development water balance (based on the proposed development concept) to assess the potential impacts of land development on the local groundwater recharge conditions. Separate calculations were completed for the East Draft Plan and West Draft Plan areas for the overall Subject Property as requested by the TRCA. A feature based water balance was also completed specifically for the catchment area of the Woodlot/Wetland feature located within the East Draft Plan area as requested by the TRCA. The detailed water balance calculations are provided in Appendix H.

2.0 Physical Setting

2.1 Physiography and Topography

The study area is located within a physiographic region known as the Peel Plain (Chapman and Putnam, 1984). The Peel Plain consists of a thin veneer of lacustrine silt and clay deposited over glacial till which has a flat to rolling topography with generally more incised slopes in the vicinity of the watercourses (Figure 2). The land surface regionally slopes to the south, with a maximum relief amplitude across the Subject Property of about 22 m. The highest elevations within the Subject Property are about 198 masl in the north sloping downwards to 174 masl in the southeast (Figure 2).

2.2 Drainage

The Subject Property is located in the Rouge River watershed within the jurisdiction of the Toronto and Region Conservation Authority (TRCA). The Subject Property is traversed by both Bruce Creek and Berczy Creek (Figure 2) which bisect the Subject Property and flow southeast. Bruce Creek enters the northern boundary of the property approximately 750 m east of Warden Avenue and 825 m south of Major Mackenzie Drive, meandering close to 2.2 km before exiting the property at 16th Avenue, approximately 400 m west of Kennedy Road. Berczy Creek enters the western property boundary at Warden Avenue and immediately exits the Subject Property flowing southeast through the existing residential area. Berczy Creek re-enters the Subject Property approximately 550 m east of Warden Avenue and 325 m north of 16th Avenue, flowing approximately 500 m before exiting the property at 16th Avenue, approximately 700 m east of Warden Avenue. The southwest corner of the Subject Property drains to the southwest, towards Berczy Creek, and the remainder of the property drains to Bruce Creek (Figure 2).

2.2.1 Bruce Creek

Flow monitoring has been conducted monthly in Bruce Creek from April 2016 to May 2017 and quarterly to date at three monitoring locations: SS1 at the northern boundary of the Subject Property, SS2 located midway along the Creek in vicinity of the centre of the Subject Property, and SS3 at the southern boundary of the Subject Property as shown on Figure 4. Monitoring of flows on this watercourse indicate that Bruce Creek is perennial. Flow rates observed along the Creek ranged between a low of 42 L/s at SS2 on August 31, 2016 six days following a rainfall event and a high of 1,005 L/s at SS3 on February 27, 2017 two days following a rainfall event (Table F-1, Appendix F).

The flow in Bruce Creek was generally found to decrease from SS1 to SS2 then increase from SS2 to SS3. The loss in flow between SS1 and SS2 was found to range from 7 L/s to 132 L/s and may be attributed to flows from Bruce Creek diverted to a series of golf course ponds via culverts located along the Creek valley (Figure 2). Ponds C and D are connected to the flows of Bruce Creek via a culvert system; Bruce Creek contributes flow to Pond C; Pond C flows to Pond D; and Pond D drains back to Bruce Creek. The gain in flow between SS2 and SS3 was found to range from 9 L/s on October 28, 2016, one day following a rainfall event to 109 L/s on May 16, 2017 during spring runoff and unusually high precipitation conditions. As will be discussed in Section 2.3.3 of this report, the Bruce Creek valley appears to intersect a sand layer found beneath the Subject Property. Groundwater levels observed in the monitoring wells (discussed below in Sections 2.4.3 and 2.4.6), suggests that groundwater is discharging to Bruce Creek from the sand layer (refer to Section 2.3.3) and contributes baseflow to the watercourse.

It is noted that data collected on May 20, 2016 does not reflect the pattern observed during the other events reported above and measurement inaccuracy is suspected. Flow was observed to increase from SS1 to SS2 by approximately 10 L/s, and then decrease from SS2 to SS3 by approximately 32 L/s during the May 20, 2016 monitoring event.

2.2.2 Berczy Creek

Monthly flow monitoring was also conducted in Berczy Creek from April 2016 to May 2017 and quarterly to date at SS5 located along Warden Avenue, south of Major Mackenzie and SS4 located in the southwest corner of the Subject Property as shown on Figure 4. There are two tributaries between SS5 and SS4 that also contribute flow to Berczy Creek. Flow rates observed along Berczy Creek ranged between a low of 18 L/s on August 31, 2016, six days following a rainfall event and a high of 729 L/s on February 27, 2017, two days following a rainfall event (Table F-1, Appendix F). Flow in Berczy Creek was generally found to increase from SS5 (upstream) to SS4 (downstream). The gain in flow was found to range from 10 L/s on June 29, 2016 to 108 L/s on May 16, 2017. It should also be noted that the surface flow monitoring stations along the Bruce and Berczv Creeks were observed to be frozen or partially frozen in December 2016. Furthermore, flow measurements could not be conducted safely due to the dangerously high water levels observed on several site visits made in the winter and spring of 2017, as a result of the spring freshet and abnormally high precipitation levels.

2.2.3 Wetland Hydroperiod Monitoring

Monitoring of select wetland features was completed during the spring and summer of 2017 to determine the hydroperiod of these features. Five monitoring locations were selected and are indicated as W-YD1, W-YD2, W-YD3, W-YD4 and W-YD5 on Figure 4. The monitoring consisted of weekly visits through the spring to photograph the features, observe the depth and extent of surface water at each feature, and where present, obtain groundwater level measurements in piezometers and surface water flow measurements. The results of the wetland monitoring are provided in Tables F-3A to F-3E in Appendix F, and illustrate the following:

- Wetland W-YD1 is located in a mineral meadow marsh in a low-lying area near the western limits of the West Draft Plan area (refer to Figure 4). Observations at W-YD1 found this area to generally have saturated soils; however, no standing water was observed (Table F-3A, Appendix F). The saturated area continued to decrease through the spring and was found to go dry in late-May. Piezometer nest PZ9s/d is located within the mineral meadow marsh. Groundwater levels were observed to be dry in PZ9s until January 2017, rising to about 0.1 m below ground surface (mbgs) in May 2017 and declining into the summer months of 2017. Groundwater levels in PZ9d ranged from dry in October and November of 2016 to about 0.2 m above ground surface (mags) in January 2017 (Figure E-44, Appendix E). Groundwater levels in the shallow piezometer are noted to be consistently above those in the deep piezometer, suggesting a downward gradient (i.e., recharge conditions) beneath the feature. The exception to this is in January 2017 when the deep piezometer water level was observed to be approximately 0.2 mags while the shallow was 0.2 mbgs.

- Location W-YD2 is located at staff gauge SG4 within a meadow marsh community (Unit 18) in the East Draft Plan area (Figure 4). Surface water draining to the wetland from a number of outlets converge to a defined channel and flow southwest through the feature where it outlets through a culvert. Flow rates observed at SG4 during hydroperiod monitoring ranged from standing water to 17 L/s during a precipitation event (Table F-3B, Appendix F). When surface water was not flowing, the standing water levels measured in SG4 indicated the channel to be up to 0.37 m deep (Figure E-39, Appendix E). The saturated area continued to decrease through the spring and into the summer. Piezometer nest PZ4s/d is located within the northern portion of the feature where the hydroperiod monitoring was completed. The groundwater level in the shallow piezometer has been seasonally variable, ranging between approximately 0.2 m mbgs in May 2016 to about 0.9 mbgs in October 2016 (Figure E-39, Appendix E). The datalogger in the deeper piezometer has groundwater levels ranging between approximately 1.5 mbgs in March 2016 to about 0.15 mbgs in July of 2017. Generally the hydraulic gradient is downwards indicative of recharge conditions. It is interpreted that when standing water occurs in the feature during spring runoff or heavy rainfall periods that the feature has a recharge function. Upward gradients were observed on occasion in 2016 during the very dry summer and fall periods. This apparent reversal in gradient is likely a result of increased evapotranspiration and a quicker response of the shallower monitor to the dry conditions than the deeper piezometer in such tight soils.

- Location W-YD3 is located within the reed canary grass mineral meadow marsh in the East Draft Plan area as identified on Figure 4. The ground in vicinity of SG5 and PZ5s/d is observed to be saturated and have numerous small pools of standing water measured to be as deep as 0.11 m (Figure E-40, Appendix E). The saturated area continued to decrease through the spring and standing water was no longer observed in mid-June; however, the ground was still observed to be slightly saturated in early-July (Table F-3C, Appendix F). Groundwater levels measured in PZ5s/d were below ground surface at the beginning of monitoring and have steadily risen to near or above ground surface into the summer of 2017. Groundwater levels in PZ5s have ranged from about 0.9 mbgs to 0.1 mbgs and from 1.4 mbgs to 0.1 mags in PZ5d. The groundwater levels in the deeper piezometer are observed to be higher than in the shallow piezometer from fall of 2016 through to the summer of 2017 showing an upward gradient. Groundwater levels were above ground surface from April 2017 through to August 2017 and may be discharging to the feature (Figure E-40, Appendix E).

- Location W-YD4 is located within a cultural woodland in the East Draft Plan area (Figure 4). The ground is observed to be saturated and have numerous small pools of standing water measured to be as deep as 0.06 m (Table F-3D, Appendix F). Surface water from within the woodlands flows in a southwesterly direction toward the reed canary grass mineral meadow marsh described above at W-YD3. Flow was measured to be up to 3 L/s during a precipitation event. The depth of standing water and flows to the mineral meadow marsh continued to decrease through the spring and into the summer; however, the ground remained saturated into July.

- Location W-YD5 is a cultural plantation/cultural woodland located on the west side of the York Downs laneway (Figure 4). A large pool of standing water up to 0.16 m deep was present in April of 2017. The pool of water continued to decrease in size through the spring, leaving several smaller pools and saturated ground in between, before drying up in mid-May (Table F-3E, Appendix F).

2.3 Geology

2.3.1 Surficial Geology

Surficial geology mapping published by the Ontario Geological Survey (1999) shows that the majority of the Subject Property is covered by glaciolacustrine silt and clay deposits (Figure 3). The north and northeastern portions of the East Draft Plan area have been mapped as glaciolacustrine sand and gravel deposits and a small area in the northwest corner of the West Draft Plan area is mapped as silty to sandy till. Alluvial deposits comprised of sand, silt, clay and organics are mapped along the Bruce and Berczy Creek valleys (Figure 3).

The geotechnical drilling records generally confirm that the Subject Property is covered by glaciolacustrine silt and clay deposits, though they did not encounter glaciolacustrine sand and gravel at surface as widely shown on the published mapping. The borehole logs, provided in Appendix B, show that sand and gravel deposits were found at surface or underlying fill material at boreholes BH14-18 and BH16-12 in isolated areas mapped as glaciolacustrine sand and gravel; however, sand and silt deposits were found at depths ranging from about 1 mbgs to 4 mbgs underlying fill, silty clay, sandy silty clay, silty clay till and/or silty sand till at nine boreholes (BH17-132, BH17-133, BH17-134, BH17-135, BH17-141, BH17-142, BH17-146, BH17-148 and BH17-149) located within the area mapped as glaciolacustrine sand and gravel at surface. Sand was also found at the surface in isolated boreholes mapped as glaciolacustrine silt and clay at 11 boreholes (BH14-5, BH14-14, BH14-20, BH16-14, BH17-01, BH17-05, BH17-06, BH17-07, BH17-08, BH17-129 and BH17-136; refer to Figure 4 for locations). Silty to sandy till was not encountered at the surface during the drilling program in the northwest corner of the West Draft Plan area, but was found to be approximately 1 m to 2 m below ground surface underlying silty clay to clayey silt at boreholes BH14-29 and BH14-30.

2.3.2 Bedrock Geology

Bedrock in the study area consists of layered grey shale bedrock of the Blue Mountain Formation (OGS, 1991). Of the 44 MOECC well records within the Subject Property, six extend to the bedrock (Appendix A). The reported depth to bedrock ranges from approximately 35 m to 57 m and the reported bedrock elevations ranges between 128 masl and 150 masl. Published bedrock topography mapping suggests the bedrock generally slopes to the southwest in this area and the elevation ranges from approximately 134 masl in the southwest corner to 150 masl at the northeast corner of the property.

2.3.3 Hydrostratigraphy

The local MOECC well records (Appendix A) provide geology data that have been used along with all of the site-specific geological information obtained from the geotechnical boreholes and groundwater monitoring wells drilled on the property (Appendix B) to assess the local stratigraphy.

To illustrate the local geological conditions, six schematic cross-sections through the Subject Property have been prepared. The cross-section locations are shown on Figure 5 and the cross-sections are shown on Figures 6 through 11**.** On the cross-sections, an interpretation of the major hydrostratigraphic units has been made based on the overall sediment characteristics. The interpretation has also been informed by modelling work completed by the TRCA for the Rouge River Watershed (2008) that outlined the hydrostratigraphic framework in the Markham area. Cross-sections through the Rouge River Watershed prepared by the TRCA (2008) identified three major overburden aquifer systems described in order of increasing depth as the:

1. Oak Ridges Aquifer Complex (ORAC), formed within the ORM sediments and sometimes referred to as the Upper Aquifer.
2. Thorncliffe Aquifer (or Middle Aquifer), formed by the sandy sediments of the Thorncliffe Formation and generally separated from the overlying ORAC by the Newmarket till aquitard.
3. Scarborough Aquifer (Lower Aquifer), formed by sandy sediments of the Scarborough Formation overlying the bedrock, and separated from the Thorncliffe Aquifer by the Sunnybrook aquitard.

The cross-sections through the Subject Property (Figures 6 through 11) generally show a thick layer of finer-grained soils (glaciolacustrine silt and clay and glacial till deposits) overlying the bedrock, interspersed with lenses and layers of sand of variable thickness and extent. These silt, clay and till deposits typically restrict groundwater movement and are considered to form aquitard layers and the sandier deposits are considered as aquifers. The overburden sequence ranges in thickness from about 35 m to more than 60 m to bedrock (Figures 6 through 11).

The sand lenses and layers encountered between elevations of about 165 masl and 190 masl across the Subject Property are interpreted to be part of the Oak Ridges Aquifer Complex (ORAC) or equivalent deposits. The ORAC thins and pinches out on the south slope of the Oak Ridges Moraine, and in the Markham area, the aquifer may be thin and discontinuous or absent. These sand layers are interpreted to intersect the Bruce Creek valley and may locally provide contributions to baseflow (Figures 6, 8, and 10).

A deeper sand layer is found beneath the Subject Property between elevations of about 145 masl and 165 mas (Figures 6 through 11). This layer appears to be continuous from north to south beneath the west side of the Subject Property (Figure 9), but the well data suggest the aquifer may thin and pinch out to the east (Figures 6, 7 and 8). This deeper sand layer is interpreted to be the Thorncliffe Aquifer.

There is no evidence of the deeper Sunnybrook aquifer beneath the Subject Property.

2.3.4 Soil Hydraulic Conductivity and Infiltration Rates

There are various methods that can be used to assess soil hydraulic conductivity, i.e., the ability of the soil to transmit groundwater. Grain-size data and soil characteristics can be used to provide a general estimate of hydraulic conductivity. Single well bail-down tests and constant-head tests 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 in the Subject Property as discussed below.

2.3.4.1 Estimates from Soil Grain-Size

During the 2014 and 2016 drilling programs, 27 representative soil samples were collected and analysed for grain-size distribution by Golder (Appendix C). The grain-size analyses were conducted on various soil types found across the property. A summary of the hydraulic conductivity values estimated from the individual grain-size analyses using the Hazen approximation method is provided in Table C-1 (Appendix C) and ranges of hydraulic conductivities for each soil type are presented below in Table 1a. The Hazen method is designed to approximate the hydraulic conductivity of more permeable sediments; however, it is still considered useful in finer grained sediments to provide a general indication of the low range of the hydraulic conductivity values.

2.3.4.2 In-situ Well Tests

To assess the in-situ hydraulic conductivity of the screened intervals, single well response tests were completed at BH16-5, BH16-6, BH16-9, BH16-12s, BH16-13d, BH16-14s and BH16-15s (refer to Figure 4 for monitoring well locations and Appendix B for borehole logs). A constant-head test was completed in BH16-5 using a Waterra foot valves and tubing assembly to pump the well at different rates and measuring the (quasi) stead-state drawdown at each flow rate, using the field technique described by Rannie and Nadon (1988). Bail-down tests were completed at BH16-6, BH16-9, BH16-12s, BH16-13d, BH16-14s and BH16-15s as steady-state drawdown would not be achieved within a reasonable time frame under continuous, low-flow pumping. The test results are provided in Appendix D and the calculated hydraulic conductivity values are summarized below and in Table 1a.

- BH16-5 is screened in sand. The recovery in this well was rapid, and the results of the constant-head test at this location suggest a relatively high hydraulic conductivity of 8.3 x 10^{-4} cm/sec.

- BH16-6 is screened in silty sand to sandy silt. The results of the bail-down test at this location suggest a low-moderate hydraulic conductivity of 5.8 x 10^{-5} cm/sec.

- BH16-9 is screened in silty clay, sandy to trace sand. The results of the bail-down test at this location suggest a low-moderate hydraulic conductivity of 1.2 x 10^{-5} cm/sec.

- BH16-12s is screened in sand and silt to sandy silt till. The results of the bail-down test at this location suggest a low-moderate hydraulic conductivity of 1.6 x 10^{-5} cm/sec.

- BH16-13d is screened in sand and silt to sandy silt. The results of the bail-down test at this location suggest a low hydraulic conductivity of 8.8 x 10^{-6} cm/sec.

- BH16-14s is screened in silty sand. The results of the bail-down test at this location suggest a moderate hydraulic conductivity of 2.7 x 10^{-4} cm/sec.

- BH16-15s is screened in sand and silt. The results of the hydraulic conductivity testing at this location indicate a low-moderate hydraulic conductivity of 4.1 x 10^{-5} cm/sec.

Table 1a: Summary of Hydraulic Conductivity Test Results

Soil Type	**Hydraulic Conductivity (cm/sec) Hazen Estimation**	**Hydraulic Conductivity (cm/sec) In-Situ Test**
Silty Clay	<1.0 x 10^{-6}	-
Sandy Clayey Silt to Clayey Sand Till	<1.0 x 10^{-6} to 2.3 x 10^{-6}	1.2 x 10^{-5}
Sandy Silt to Silty Sand Till	1.0 x 10^{-6} to 2.2 x 10^{-5}	1.6 x 10^{-5}
Silty Sand to Sand	2.6 x 10^{-4} to 8.3 x 10^{-3}	8.8 x 10^{-6} to 8.3 x 10^{-4}

2.3.4.3 Infiltration Tests

To assess surficial infiltration potential, a series of tests using a Turf-Tec double ring infiltrometer were completed at selected locations across the site (Figure 4). The test results are provided in Figures D8 to D14, in Appendix D. The tests were completed by removing the topsoil in the test area and installing the infiltrometer in the underlying soil.

Both rings of the infiltrometer were then filled with water and the time for the water level in the inner ring to fall 10 mm was recorded. This was repeated until consistent readings were recorded for at least three consecutive intervals. The test results are discussed below and are summarized in Table 1b. Graphs of the test results are provided in Appendix D.

Seven infiltration tests were completed across the Subject Property on May 30 and June 3, 2016 (IT1, IT2, IT3, IT4, IT5, IT6 and IT7 on Figure 4). Tests IT1, IT2 and IT3 were completed across the southern extent of the West Draft Plan area. Test IT1 was conducted at a depth of 0.35 m in sandy silt till with some gravel. The results of the test show that the soil has an infiltration rate of approximately 200 mm/hour (Figure D-8, Appendix D). Test IT2 was completed at a depth of 0.4 m in silty sand till and gravel. The results of the test show that the soil has an infiltration rate of approximately 1,000 mm/hour (Figure D-9, Appendix D). Test IT3 was completed at a depth of 0.40 m in sandy silt till with some clay. The results of the test show that the soil has an infiltration rate of approximately 200 mm/hour (Figure D-10, Appendix D).

Test IT4 was conducted approximately in the centre of the West Draft Plan area (Figure 4) at a depth of 0.45 m in clayey silt with trace sand. The results of the test show that the soil has an infiltration rate of approximately 135 mm/hour (Figure D-11, Appendix D).

Tests IT5 and IT6 were completed in the northeast corner of the East Draft Plan area (Figure 4). Test IT5 was conducted at a depth of 0.35 m in clayey silt till and had an infiltration rate of approximately 50 mm/hour (Figure D-12, Appendix D). Test IT6 was completed at a depth of 0.4 m in sandy silt with trace clay. The results of the test show that the soil has an infiltration rate of approximately 360 mm/hour (Figure D-13, Appendix D).

Test IT7 was conducted at the northern extent of the West Draft Plan area (Figure 4) at a depth of 0.45 m in silty sand and gravel. The results of the test show that the soil has an infiltration rate of approximately 360 mm/hour (Figure D-14, Appendix D).

Table 1b: Summary of Infiltration Rates

Soil Type	Measured Field Infiltration (mm/hour)
Clayey Silt to Clayey Sand Till	50 to 135
Sandy Silt to Silty Sand	200 to 360

2.3.4.4 Discussion of Hydraulic Conductivity Results

The observed infiltration rates of 200 mm/hour to 360 mm/hour at test locations IT1, IT3 and IT7 (Table 1b) are higher than expected based on the nature of the material, i.e., silty sand to sandy silt deposits that would be expected to have a hydraulic conductivity of about 1 x 10^{-5} cm/sec (Table 1a). A hydraulic conductivity value of 10^{-5} cm/sec would be equivalent to about 30 mm/hour (Ontario Ministry of Municipal Affairs & Housing OMAH), 1997 – Site Evaluation and Soil Testing Protocol for Stormwater Infiltration). Tests IT4 and IT5 were completed in clayey silt soils and had infiltration rates of approximately 50 mm/hour and 135 mm/hour, respectively (Table 1b). Again, these infiltration rates are higher than expected for clayey silt soils, as the hydraulic conductivity of the clayey silt soils of 10^{-6} cm/sec or less would be equivalent to about 12 mm/hour or less).

Test IT6 was completed in sandy silt with trace clay with and had an infiltration rate of approximately 360 mm/hour. Test IT2 was completed in silty sand and gravel with an infiltration rate of 1,000 mm/hour. All of the field IT test rates show higher values than the other methods. This is likely because the upper sediments are fractured, weathered and disturbed leading to higher 'secondary' permeability, and the tests simulate saturated conditions. This is an important consideration for the success of lot level and shallow infiltration LID measures for stormwater management. Weathering and fracturing is expected to decrease with depth, so the overall infiltration potential across the Subject Property that will contribute groundwater recharge to depth will be more limited.

It is concluded that the hydraulic conductivity of the surficial soils is generally suitable for the use of LID measures to promote shallow infiltration. It is noted that all test locations were completed in areas where 0.5 m to 3.5 m of fill material will be added as part of the proposed grading plan. Site-specific testing of the soils proposed for fill material and at the depths of the proposed infiltration LID measures should be completed during detailed design to confirm actual infiltration rates.

2.4 Hydrogeology

2.4.1 Local Groundwater Use

The Subject Property is situated within a developed community. All lands surrounding the Subject Property are residential subdivisions that are municipally serviced with lake-based supplies. The proposed development will also be municipally serviced and there is no proposed on-site groundwater use for the development.

The York Downs Golf & Country Club has a Permit to Take Water (PTTW) No. 4201-8DEPTU that allows the golf club to draw water from five groundwater wells and Bruce Creek to supplement irrigation water stored in a large off-line storage reservoir. Groundwater supply wells at the Subject Property are separated into two clusters: the north cluster consisting of PW3 (TW1-69), PW4 (TW3-69) and PW6 (currently not used) and the south cluster consisting of PW1 (TW3-68) and PW2B (Figure 5) (Burnside, 2015).

TW1-69 and TW3-69 are completed to depths of 28.3 m and 26.2 m, respectively. TW3-68 is completed to a depth of 31.4 m. Groundwater taking at the site predominantly relies on pumping wells PW1 and PW4 to refill the irrigation storage pond. The total average daily irrigation volume for the golf course is 1,804,700 L (Burnside, 2015).

The golf course reports their annual groundwater use to the MOECC in accordance with their permits. It is anticipated that the golf course will continue this water use until such time as the Subject Property is developed. At that time, all pumping wells will be decommissioned in accordance with provincial regulations and, as noted above, there is no proposed future groundwater use for the development.

Well Head Protection Areas (WHPAs) are zones around municipal water supply wells where land uses must be carefully planned and restricted to protect the quality of the water supply. Based on our review of WHPA mapping available from the Region of York, the Subject Property is not located within a WHPA, and as such, the development is not considered to pose a significant threat to drinking water supplies.

2.4.2 Aquifer Vulnerability

Aquifer vulnerability refers to the susceptibility of an aquifer to potential contamination. Some degree of protection for groundwater quality from natural and human impacts is provided by the soil above the water table. The degree of protection is dependent upon the depth to the water table (for unconfined aquifers) or the depth of the aquifer (for confined aquifers) and the type of soil above the water table or aquifer. As these two properties vary over any given area, the degree of protection or vulnerability of the groundwater to contamination also varies. Some land use restrictions may apply to areas of high aquifer vulnerability, which pose a risk of contaminating the underlying aquifers. Residential land uses are not considered ‘high risk’ in terms of potential aquifer contamination.

Review of the Aquifer Vulnerability mapping available from the Region of York shows that a large area within the central Subject Property and smaller areas around the perimeter have been mapped as an area of high aquifer vulnerability (Figure 12). While there are some areas where aquifer layers are close to surface over most of the Subject Property, the interpreted stratigraphy suggests that the ORAC is discontinuous and ‘patchy’ in this area (refer to Section 2.3.3). The deeper Thorncliffe Aquifer is well protected by more than 20 m of low hydraulic conductivity sediments and would not be considered to have high vulnerability to contamination.

2.4.3 Groundwater Levels

Groundwater levels have been monitored in monitoring wells and piezometers across the Subject Property since March 2016, and the data are summarized in Tables E-1 and E-2 in Appendix E. Hydrographs for each monitoring location are also provided as Figures E-1 through E-47 in Appendix E to illustrate the water level variations. In addition to the manual water level measurements recorded at each location, an automatic water level recorder (datalogger) was installed in six monitoring wells (BH16-5, BH16-7, BH16-12d, BH16-13d, BH16-15d and BH16-6) and in 14 piezometers (PZ4s/d, PZ5s/d, PZ8s/d,PZ9s/d, PZ10s/d, PZ11s/d, and PZ12s/d) to record continuous water levels.

The groundwater monitoring data show the following (refer to Figure 4 for the monitoring locations and the data tables and hydrographs in Appendix E):

- The shallow monitoring wells installed in the shallow till and shallow sand layers across the Subject Property (BH17-104, BH17-110, BH17-127, BH17-131, BH17-139s, BH17-140, BH16-3, BH16-4, BH16-6, BH16-7, BH16-8, BH16-9, BH16-10, BH16-11, BH14-1, BH14-2, BH14-8, BH14-12, BH14-15, BH14-17, BH14-29 and BH14-33) were found to have groundwater levels fluctuating between approximately 0.2 m (BH16-10, Figure E-8 in Appendix-E) to 6.0 m (BH14-17, Figure E-21 in Appendix E) below ground surface. The seasonal variation in groundwater levels in these wells ranged from 0.5 m (BH16-4, Figure E-2 in Appendix E) to 3.8 m (BH14-17, Figure E-21 in Appendix E).

- Monitoring wells BH16-5 and BH17-104 are the only shallow wells that had groundwater levels above ground surface. BH16-5 is located in a topographically low area in the north central portion of the property (Figure 4). Groundwater levels at this well ranged between approximately 0.3 m above ground surface (April 2017) to 1.2 m below ground surface (November 2017; refer to Figure E-3 in Appendix E). BH17-104 is located in the west central area of the Subject Lands and was observed to have groundwater levels above ground surface on one occasion in March 2017 shortly after the well was installed (Figure 4). It is our understanding that water was pumped into the borehole during drilling to aid in the installation of the monitoring well and the initial water level measured may not reflect natural conditions.

- Nested monitoring wells (e.g., wells located adjacent to each other but completed at different depths) were installed in BH17-139s/d, BH16-12s/d, BH16-13s/d, BH16-14s/d and BH16-15s/d. Monitoring wells BH14-3 (shallow) and BH16-16 (deep) is also interpreted as a nest, though they are located approximately 25 m apart.

- Monitoring well nest BH17-139s/d was constructed in March 2017 and is located at the western edge of the woodlot/wetland (Feature 1). The shallow well is installed in a silty till layer and the deep well is installed in the underlying sandy silt to silty sand layer. The groundwater levels in BH17-139s showed an increase of 0.09 m from April to May followed by a decrease of 0.27 m from May to August 2017. The water level in BH17-139d showed a decrease of 0.43 m from April to August 2017. The groundwater levels in BH17-139s are generally 0.4 to 0.8 m higher than those observed in the deep well, suggesting a downward gradient ranging between approximately 0.07 m/m to 0.12 m/m (Figure E-32, Appendix E).

- Monitoring well nest BH16-12s/d is located within a small valley feature in the northeast corner of the Subject Property in the vicinity of the existing stormwater management pond ‘Pond H’ (Figure 4). The shallow well is installed in a sand layer and the deep well is installed in the underlying silty clay till (Figure 9). The groundwater levels in BH16-12s show a seasonal decline in the water levels with groundwater in the sand layer ranging from about 0.2 m to 2.6 m below grade (Figure E-10, Appendix E). The water levels recorded in BH16-12d have primarily been above ground surface for the duration of the monitoring. The groundwater levels in BH16-12d are approximately 0.5 m to 2.6 m higher than the groundwater levels in the shallow well showing a strong upward gradient at this location ranging between approximately -0.03 m/m to -0.18 m/m (Figure E-10, Appendix E).

- Monitoring well nests BH16-13s/d, BH16-14s/d and BH14-3/BH16-16 are located in low-lying elevations in the southeast quadrant of the Subject Property and are within approximately 100 m of Bruce Creek (refer to Figure 4 for well locations). The shallow and deep wells are installed in the upper sand layers with the exception of BH16-14d; this well is installed in sandy clayey silt till (Figures 8, 10 and 11). The groundwater levels in BH16-13d are 1 m to 2 m or more higher than the groundwater levels in the shallow well, showing a strong upward gradient (Figure E-11, Appendix E). The water levels in both the shallow and deep wells decline through the spring and summer months of 2016 before recovering in the fall. Water levels in 2017 have been measured to be within 0.5 m of ground surface between and January and August. The water levels in the BH16-14s/d nest show a relatively small decline into and during the summer months of 2016 before recovering in the fall. Groundwater levels in BH16-14d have consistently been approximately 0.2 m higher than the groundwater levels in the shallow well (BH16-14s), showing an upward gradient (Figure E-12, Appendix E). The groundwater levels in BH16-16 were above ground surface in March and April 2016 showing spring discharge conditions before gently declining over the dry summer months to about 0.6 m below grade (Figure E-14,

Appendix E). Water levels in 2017 have consistently stayed above ground level into the summer months. The groundwater levels in BH16-16 have also been higher than the groundwater levels in BH14-3 (shallow well) showing a strong upward gradient (Figures E-14 and E-17, Appendix E). Cross-sections C-C' (Figure 8) and F-F' (Figure 11) show that shallow sand deposits are present along the Bruce Creek Valley, and the upward gradients observed in BH16-13d, BH16-14d and BH16-16 suggest groundwater discharge conditions in these sands. Upward gradients in these well nests ranged between -0.01 m/m at BH16-14s/d to -0.26 m/m at BH14-3/BH16-16. It is interpreted that discharge from these sand layers contributes baseflow to Bruce Creek. The Bruce Creek flow monitoring indicates the creek gains flow as it traverses across the Subject Property.

  - Monitoring well nest BH16-15s/d is located at the south end of the Subject Property in the vicinity of the site entrance (Figure 4). The shallow and deep wells are installed in silty sand layers that are isolated from each other by a clayey silt till layer (Figure 8). The water levels in the shallow well are more than 3 m below grade and have declined from March to November 2016 (Figure E-13, Appendix E). Groundwater levels rose in the winter and spring and have then declined through the warmer summer months. The groundwater levels in the shallow well are approximately 0.1 m to 1.1 m higher than the deep groundwater levels showing a downward gradient ranging between approximately 0.01 m/m to 0.1 m/m and suggesting recharge conditions in this location (Figure E-13, Appendix E).

- Piezometers were installed adjacent to a number of the golf course ponds that are located along the Bruce Creek (PZ1, PZ2 and PZ6; refer to Figure 4 for locations). Groundwater levels in PZ1 and PZ6 were consistently lower than the surface water levels measured in adjacent ponds at SG1 (Pond C) and SG6 (Pond A), respectively (Figures E-36 and E-41, Appendix E). These data suggest that the ponds will have a recharge function when they fill up with runoff and precipitation, particularly in the spring.

- Groundwater levels at PZ2 were below the surface water levels measured in the adjacent pond at SG2 (Pond D) during the spring and early summer of 2016 (first four monitoring events), but during the summer months were measured to be above the surface water level in the pond (Figure E-37, Appendix E). Water levels in PZ2 returned to below SG2 levels into the fall of 2016 and remained there until spring 2017. A gradient reversal was seen again in the summer of 2017. The steady rise and fall in the water level in the piezometer suggests that this pipe is located in very low hydraulic conductivity soils that have restricted the inflow and stabilization to a static water elevation. This low hydraulic conductivity will also result in a lag of response between the pond levels and the local groundwater levels. Based on the closeness of the water elevations, it is interpreted that Pond D is excavated into the local water table and will function as described above for Ponds A and C, i.e., when the surface water levels are high in the ponds, they will have a recharge function. When surface water inputs are low, the local water table will sustain the pond features.

- Nested piezometers were installed along Bruce Creek (PZ3s/d) and along Berczy Creek (PZ7s/d; refer to Figure 4 for locations). As shown on Figure E-38 in Appendix E, the groundwater levels in the shallow and deeper piezometer in the PZ3s/d nest are similar, showing a slight downward gradient (i.e., recharge conditions). The groundwater level in these piezometers was found to range between 0.16 mbgs to 0.69 mbgs. The groundwater levels in the shallow piezometer are very close to or slightly higher than the surface water levels measured at staff gauge SG3 suggesting groundwater discharge conditions to Bruce Creek. Groundwater levels in the deep piezometer were also higher than the surface water level measured at staff gauge SG3 on two occasions (Figure E-38, Appendix E).

- Groundwater levels in the shallow piezometer (PZ7s) reflect the surface water levels at SG7, illustrating the groundwater/surface water interaction in this location. The shallow groundwater levels at PZ7s were, however, consistently higher than the groundwater levels in the deeper PZ7d, showing a downward gradient (i.e. recharge conditions) in this location along Berczy Creek (Figure E-42, Appendix E). These data suggest that the watercourse may recharge the local groundwater in this area.

- Piezometer nests PZ4s/d, PZ10s/d, PZ11s/d and PZ12s/d are located within or adjacent to the Unit 18 wetland area (reed/canary grass mineral marsh meadow as described by Beacon, 2017) within the East Draft Plan area that receives runoff from the driving range area (Figure 4).

- Piezometer nest PZ4s/d was installed in March 2016 and is located in the northern portion of the feature. The groundwater level in the shallow piezometer has been seasonally variable, ranging between approximately 0.2 mbgs in May 2016 to about 0.9 mbgs in October 2016 (Figure E-39, Appendix E). The datalogger in the deeper piezometer has groundwater levels ranging between approximately 1.5 mbgs in March 2016 to about 0.15 mbgs in July of 2017. Generally the hydraulic gradient is downwards indicative of recharge conditions. It is interpreted that when standing water occurs in the feature during spring runoff or heavy rainfall periods that the feature has a recharge function. Upward gradients were observed on occasion in 2016 during the very dry summer and fall periods.

- Piezometer nests PZ10s/d, PZ11s/d and PZ12s/d were installed in April 2017. PZ10s/d is located in the southern portion of Unit 18 adjacent to the drainage outlet from the feature. This location is at the base of a relatively steep bank and is an area where some iron staining and minor groundwater seepage has been observed. The groundwater levels in the shallow piezometer have generally ranged between approximately 0.1 mags to about 0.3 mags during the spring monitoring period (Figure E-45, Appendix E). The deeper piezometer has groundwater levels ranging between 0.1 mags to about 0.4 mags, with the highest levels following a period of very heavy rainfall. While groundwater levels have been observed to be above ground surface during all measurements to date, the hydraulic gradient has generally been flat or downwards (recharge), until upward gradients were observed in summer 2017 (i.e., discharge conditions).

- PZ11s/d is located immediately adjacent to the feature on the northwest side (Figure 4). The groundwater levels in the shallow piezometer have generally ranged between approximately 0.46 mbgs in April 2017 and 0.81 mbgs in August 2017 (Figure E-46, Appendix E). The deep piezometer has groundwater levels ranging between 1.4 mbgs in April 2017 to about 0.77 mbgs in May 2017 (Figure E-46, Appendix E). The hydraulic gradient at this location is quite strongly downwards showing recharge conditions.

- PZ12s/d is located immediately upgradient of Unit 18 on the north side (Figure 4). The groundwater levels in the shallow piezometer have generally ranged between about 0.7 mbgs in May 2017 to dry (i.e., greater than 1.3 mbgs) in August 2017 (Figure E-47, Appendix E). The deep piezometer has similar groundwater levels ranging between 0.74 mbgs in April 2017 to 0.85 mbgs in July 2017 (Figure E-47, Appendix E). There is a very minor vertical hydraulic gradient evident at this location, but through the spring it has been generally downwards, again showing recharge conditions in the area around the Unit 18 wetland.

- Piezometer nests PZ5s/d and PZ8s/d were installed in a woodlot/wetland feature within the East Draft Plan area. This area is referred to as the ‘Feature 1 Woodlot/Wetland’ in the Natural Environment Report/Environmental Impact Study by Beacon, 2017 (Figure 4). PZ5s/d is located within the wetland portion of the feature and has been monitored since March 2016 (Figure E-40, Appendix E). PZ8s/d is located within the woodlot portion of the feature and has been monitored since June 2016 (Figure E-43, Appendix E). Groundwater levels measured in PZ5s/d were below ground surface at the beginning of monitoring and have steadily risen to near or above ground surface into summer 2017. Groundwater levels in PZ5s have ranged from about 0.9 mbgs to 0.1 mbgs and from1.4 mbgs to 0.1 mags in PZ5d. The deep groundwater levels are observed higher than the shallow groundwater levels from the fall of 2016 through the 2017 summer showing an upward gradient and discharge conditions since April 2017 (Figure E-40, Appendix E). Similar to PZ4s/d, the datalogger in PZ5d has shown a slow recovery of water levels illustrating low hydraulic conductivity soils,

- Groundwater levels measured in PZ8s/d were also below ground surface at the beginning of monitoring and have steadily risen to or above ground surface into the summer of 2017. Groundwater levels in PZ8s have ranged from about 1.0 mbgs to at or slightly above ground surface and from about 1.6 mbgs to just below ground surface in PZ5d. The shallow groundwater levels are observed higher than the deep groundwater levels throughout the duration of monitoring suggesting a downward gradient and recharge conditions; however, the shallow water table has been observed above ground surface on occasion and possibly discharging to Feature 1 (Figure E-43, Appendix E).

- PZ9s/d was installed within a small wetland near the western limits of the West Draft Plan area in August 2016 (refer to Figure 4 for piezometer nest location). Groundwater levels were observed to be dry in PZ9s until January 2017, rising to about 0.1 mbgs in May 2017 and declining into the summer months of 2017. Groundwater levels in PZ9d ranged from dry in October and November of 2016 to about 0.2 mags in January 2017 (Figure E-44, Appendix E). Groundwater levels in the shallow piezometer are noted to be consistently above those in the deep piezometer, suggesting a downward gradient (i.e., recharge conditions). The exception to this is in January 2017 when the deep piezometer water level was observed to be approximately 0.2 mags while the shallow was 0.2 mbgs.

2.4.4 Interpreted Groundwater Flow Conditions

Spring groundwater elevation data from April 2017 are shown on Figure 13, along with the interpreted groundwater elevation contours for the Subject Property. The contours shown on Figure 13 represent the interpreted shallow groundwater in the shallow surficial soils across the Subject Property.

The groundwater elevation data suggest that the water table in the upper till soils reflects the general surface topography and that the shallow groundwater flow patterns will mimic the surface water flow patterns (Figure 2), with flow moving from higher elevations towards lower elevations. A groundwater divide is interpreted to be roughly coincident with the surface water divide between the Bruce Creek and the Berczy Creek (compare Figure 2 and Figure 13). The shallow groundwater is interpreted to move across the Subject Property towards Bruce Creek, with the exception of the west half of the West Draft Plan area; shallow groundwater within the west half of the West Draft Plan Area is interpreted to flow towards Berczy Creek (Figure 13).

2.4.5 Groundwater Flow Systems

Areas where water from precipitation percolates or infiltrates into the ground and moves downward from the water table are known as recharge areas. These areas are generally in areas of relatively higher topographic elevation. Areas where groundwater moves upward are discharge areas and these generally occur in areas of relatively lower topographic elevation, such as along watercourses. Recharge and discharge may occur in local, intermediate and more regional flow systems. Infiltrating water at any given location may follow a shallow flow path and discharge a short distance away from the recharge area along the nearest slopes or in small watercourses, swales, agricultural ditches, wetlands, etc. This is referred to as a local groundwater flow system (i.e., flows that closely follow the existing topography with relatively short flow distances, e.g., up to a few hundred metres). Some water may follow much deeper and longer flow paths (hundreds to thousands of metres) to recharge underlying aquifers and discharge to features and watercourses possibly a very long way from the area of recharge. Such conditions may be referred to as intermediate and/or regional groundwater flow systems depending on the scale of analysis.

In the study area, the groundwater flow conditions are interpreted to involve: 1) a local shallow system involving groundwater flow in the upper surficial portions of the till and glaciolacustrine sediments, and 2) deeper more regional groundwater flow systems involving the ORAC and Thorncliffe aquifers. The shallow local flow system is superimposed over the regional flow systems and more closely follows the local topography and surface water drainage patterns (Figure 12). Water infiltrating on the Subject Property will move laterally through the shallow soils to recharge the underlying shallow sands and discharge locally in Bruce Creek.

The deeper regional systems are driven by recharge originating in the topographically higher Oak Ridges Moraine to the north of the study area. Flow moves through the aquifers to the south, and as the aquifer layers dip, thin and eventually pinch out, groundwater discharge conditions are evident. Artesian pressures are evident in MOECC well records for wells in the western portion of the Subject Property completed in the sand layer that has been interpreted as the Thorncliffe aquifer (refer to Section 2.3.3 and refer to Figures 8 and 9).

As discussed in Section 2.3.3, on the Subject Property, there are only isolated layers and lenses of sand that may be interpreted as possible ORAC deposits and the Thorncliffe aquifer may not be present in all locations. However, where present, the sandy layers of the ORAC may provide a means for shallow groundwater originating north of the Subject Property to locally contribute baseflow to Bruce Creek and the artesian heads in the Thorncliffe will act to support local high water table conditions. Local infiltration that seeps into the surficial soils is not able to move to depth to recharge the underlying Thorncliffe aquifer due to the upward hydraulic pressures.

2.4.6 Recharge and Discharge Conditions

Groundwater conditions across the Subject Property generally show recharge conditions; however, monitoring well nests indicate both downward and upward hydraulic gradients (Section 2.4.3). Monitoring well nests within approximately 100 m of Bruce Creek (BH16-13s/d, BH16-14s/d and BH14-3/BH16-16) show upward hydraulic gradients. Upward gradients ranged between -0.01 m/m at BH16-14s/d to -0.26 m/m at BH14-3/BH16-16. The interpreted cross-sections C-C’ (Figure 8) and F-F’ (Figure 11) through the Bruce Creek valley show shallow sand deposits are present along the Bruce Creek valley. The upward gradients observed in BH16-13d, BH16-14d and BH16-16 may reflect groundwater discharge from the sandy layers to Bruce Creek. The flow monitoring indicates that Bruce Creek gains flow as it traverses across the Subject Property, supporting the interpretation that the watercourse receives groundwater inputs (Section 2.2 and Table F-2 in Appendix F).

Monitoring well nest BH16-12s/d showed an upward gradient ranging between approximately -0.03 m/m to -0.18 m/m from a silty clay to a sand and silt unit, indicating a discharge area. The upward gradients observed at BH16-12s/d are interpreted to be influenced by the location of the well nest on the side of a hill sloping toward a topographic low where stormwater management pond ‘Pond H’ is located (Figure 4). The hydraulic head in the deep well is thought to be driven by a local flow system from the topographically higher recharge area in the northeast corner of the Subject Property.

Shallow groundwater levels in monitoring well BH16-5, located to the west of Pond H, were observed above ground surface in March and April 2016 and again from March to July 2017. This well is screened in a confined sand deposit (refer to Figure E-3 in Appendix E). Similar to BH16-12s/d, this well is located in a topographically low area and the groundwater levels observed in the well are interpreted to be influenced by the local flow system from the topographically higher area to the northeast.

The hydraulic gradients measured in and around the Unit 18 wetland are generally downwards indicative of recharge conditions. It is interpreted that when standing water occurs in the feature during spring runoff or heavy rainfall periods that the feature has a recharge function.As discussed above in 2.4.5, minor groundwater seepage and some iron staining was observed at the base of a relatively steep bank; however, the hydraulic gradient has generally been flat or downwards (recharge). These data are interpreted to show that groundwater locally recharges to the shallow sand layer then discharges along the steep bank, particularly during very high water table conditions.

The hydraulic gradients measured within the higher elevated woodlot portion of the Feature 1 suggest a downward gradient and recharge conditions. The groundwater levels within the reed canary grass mineral meadow marsh, located at the lower elevation portion of Feature 1 and downgradient of the woodlot, generally show an upward gradient and discharge conditions through 2017.

Groundwater levels in PZ9s/d, located within a small wetland near the western limits of the West Draft Plan, were observed to have downward gradients indicating this feature provides recharge to the underlying soils. Recharge at this location is limited as a result of the underlying low hydraulic conductivity soils.

2.5 Significant Groundwater Recharge Areas

Significant Groundwater Recharge Areas (SGRAs) and Ecologically Significant Groundwater Recharge Areas (ESGRAs) have been mapped for the Rouge River Watershed (TRCA, 2016). Review of this mapping shows that two small areas situated within the western extent of the Subject Property are located within areas mapped as SGRA. The TRCA recharge mapping is provided on Figure 14. The areas identified as SGRAs are shown to have surficial silts and clays on the provincial surficial geology map (OGS, 2003). The findings of this report do not support the TRCA mapping as our investigation identified low rates of infiltration across the tableland, limited by the fine grained surficial sediments and till, as well as discharge conditions along the Berczy Creek and Bruce Creek valleys.

There are no ESGRA mapped on the Subject Property.

2.6 Water Quality

2.6.1 Groundwater Quality

To characterize the background groundwater quality on the property, groundwater samples were collected in April 2016 from MW16-5 and MW16-15s. The groundwater samples were analysed for pH, conductivity, basic ions and selected metals.

The laboratory results are summarized in Table G-1 in Appendix G, and show the following:

- When compared to the Ontario Drinking Water Standards (ODWS), the groundwater is relatively hard (512 mg/L and 491 mg/L at MW16-5 and MW16-15s, respectively), exceeding the ODWS criteria of 100 mg/L. This is common for groundwater in southern Ontario.

- The sodium and chloride concentrations were higher at MW16-5 (68.8 mg/L and 150 mg/L, respectively) than MW16-15s (9.57 mg/L and 16 mg/L, respectively). The higher concentrations observed in MW16-5 may be more affected by inputs from surface activities (i.e., recharge of water impacted by road salt) than the shallow groundwater in MW16-15s. The chloride concentrations are below the ODWS of

250 mg/L in both wells. The sodium concentration in MW16-5 (68.8 mg/L) is above the ODWS of 20 mg/L.

- The concentration of total dissolved solids (TDS) in MW16-5 (760 mg/L) and MW16-15s (697 mg/L) exceed the ODWS criteria of 500 mg/L.

- The iron concentration in MW16-15s (1.22 mg/L) exceeds the ODWS of 0.3 mg/L.

- The manganese concentration in MW16-5 (486 µg/L) and MW16-15s (78.1 µg/L) both exceed the ODWS of 50 µg/L.

- Nitrate levels in both wells were very low, with reported concentrations of 0.22 mg/L and <0.06 mg/L for MW16-5 and MW16-15s, respectively, and well below the ODWS of 10 mg/L for nitrate.

- The colour of the water collected from MW16-5 has a value of 7 TCU exceeding the ODWS aesthetic value of 5 TCU.

- All other concentrations were reported below the ODWS for parameters tested.

2.6.2 Surface Water Quality

Surface water samples were collected at SS1 and SG7 in April 2016 to characterize the water quality in Bruce Creek and Berczy Creek, respectively. The surface water samples were analysed for pH, conductivity, basic ions and selected metals and the laboratory results are summarized in Table G-2 in Appendix G. In addition to the laboratory analyses, field monitoring of pH, temperature, dissolved oxygen, conductivity, salinity, total dissolved solids (TDS) and total suspended solids (TSS) was completed at the surface water stations when flow was present during the flow monitoring program. The results of the field quality monitoring are summarized in Table G-3 in Appendix G.

The surface water quality data (Tables G-2 and G-3, Appendix G) show the following:

- The reported chloride concentrations are 380 mg/L and 120 mg/L at SS1 and SG7, respectively. The sodium concentrations are reported at 241 mg/L and 69.6 mg/L for SS1 and SG7, respectively.

- The total phosphorus concentrations were reported below the Provincial Water Quality Objective (PWQO) for phosphorus of 30 µg/L.

- Nitrate levels in both samples were very low, with reported concentrations of 1.99 mg/L and 1.70 mg/L for SS1 and SG7, respectively.

- The field chemistry data show that the TSS concentrations in Bruce Creek ranged from 8 mg/L to 28 mg/L and 10 mg/L to 18 mg/L in Berczy Creek. The pH level measurements in Bruce Creek and Berczy Creek ranged from 8.6 to 9.1. Conductivity measurements in Bruce Creek ranged from 701 mS/cm to 927 mS/cm and 727 mS/cm to 1445 mS/cm in Berczy Creek.

The results of the surface water sampling show that the water quality in Bruce Creek and Berczy Creek meet the PWQO for the parameters tested, and show little impact from the surrounding land uses.

3.0 Water Balance

In order to assess potential land development impacts on the local groundwater conditions, a detailed water balance analysis has been completed for the East and West draft plans to determine the pre-development infiltration volumes (based on existing land use conditions) and the post-development infiltration volumes that would be expected based on the proposed land use plan. The water balance calculations are provided in Appendix H and discussed below.

3.1 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 study area. 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 Property are discussed below:

Precipitation (P)

The long-term average annual precipitation for the area is 853 mm based on data from the Environment Canada Toronto Buttonville climate station (Station 615HMAK - 43° 51.440' N, 79° 22.120' W, elevation 198.1 masl) for the period between 1981 and 2010. Average monthly records of precipitation and temperature from this station have been used for the water balance component calculations in this study (Tables H-1 and H-2, Appendix H).

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) / Evaporation (E)

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 often less than the PET under dry conditions (i.e., during the summer when there is a soil moisture deficit). In this report, the monthly PET and AET have been calculated using a soil-moisture balance approach, using average temperature data and climate information adjusted to the local latitude (refer to Tables H-1 and H-2 in Appendix H).

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 and the remainder infiltrates the surficial soil.

The infiltration is comprised of two end member components: one component that moves vertically downward to the groundwater table (typically referred to as percolation, deep infiltration or net recharge) and a second component that moves laterally through the 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 overland during precipitation or snowmelt events, shallow interflow becomes an “indirect” component of runoff. The interflow component of surface water 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, but both interflow and direct runoff contribute to the overall surface water runoff component from the property.

3.2 Approach and Methodology

The analytical approach to calculate a water balance for the Subject Property involved monthly soil-moisture balance calculations to determine the pre-development (based on existing land use conditions) and post-development (based on the proposed development concept plan) infiltration volumes. A soil-moisture balance approach assumes that soils do not release water as "potential infiltration" 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).

Considering the nature of the silt soils in the area, a soil moisture storage capacity of 125 mm was used for the predominantly short to moderate-rooted fairways throughout the golf course. A soil moisture storage capacity of 400 mm was used for longer-rooted vegetation, i.e., the wooded areas. Table H-1 (for 125 mm retention) and Table H-2 (for 400 mm retention) in Appendix H detail the monthly potential evapotranspiration calculations accounting for latitude and climate, and the actual evapotranspiration (AET) and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions.

The MOECC 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 two soil moisture storage conditions (i.e., for 125 mm and 400 mm storage as presented on Tables H-1 and H-2 in Appendix H).

The calculated water balance components from these tables are used to assess the pre-development infiltration volumes on a draft plan basis (i.e., for the portions of the Subject Property within the East Draft Plan area and the West Draft Plan area) based on the existing land use characteristics (open space, buildings, wooded areas, etc.). The West Draft Plan area has been further divided into Berczy Creek and Bruce Creek catchment areas to assess conditions for each of these features. A post-development water balance scenario is then calculated for each draft plan area based on the proposed land development plan. The pre- and post-development calculations are provided in Tables H-4 (East Draft Plan), H-5a (West Draft Plan – Berczy Creek Catchment area) and H-5b (West Draft Plan – Bruce Creek Catchment area) in Appendix H.

3.3 Component Values

The detailed monthly calculations show that a water surplus is generally available from December to May. As shown on the calculation tables, infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. In winter climates, frozen conditions affect when the actual infiltration will occur, however, the monthly balance calculations show the potential volumes available for these water balance components.

The monthly calculations are summed to provide estimates of the annual water balance component values (Tables H-1 and H-2, Appendix H). A summary of these values is provided in Table 2.

Table 2: Water Balance Component Values

Water Balance Component	Golf Course/Open Space	Woodlot
Average Precipitation	853 mm/year	853 mm/year
Actual Evapotranspiration	599 mm/year	607 mm/year
Water Surplus	254 mm/year	246 mm/year
Infiltration	114 mm/year	135 mm/year
Runoff	140 mm/year	111 mm/year

3.4 Pre-Development Water Balance (Existing Conditions)

The pre-development water balance calculations for the portions of the Subject Property within the East Draft Plan and West Draft Plan areas are presented in Tables H-4 (East Draft Plan), H-5a (West Draft Plan – Berczy Creek Catchment area) and H-5b (West Draft Plan – Bruce Creek Catchment area) in Appendix H. As summarized on Tables H-4, H-5a and H-5b, the total areas of the Subject Property that are proposed for development within the East Draft Plan area, West Draft Plan Berczy Creek area and West Draft Plan Bruce Creek area are about 76.17 ha, 38.06 ha and 54.31 ha, respectively. Land use is predominantly the golf course or open space land and wooded lands. The total areas for these two land cover types have been estimated and assigned appropriate water balance component values for either short-rooted vegetation for the golf course and open space (125 mm soil moisture storage) or longer-rooted vegetation for the wooded areas (400 mm soil moisture storage). The total calculated pre-development infiltration, runoff and evapotranspiration volumes are summarized in Table 3.

Table 3: Summary of Pre-Development Infiltration, Runoff and Evapotranspiration

Draft Plan	**Estimated Pre-Development Infiltration Volume (m^3/year)***	**Estimated Pre-Development Runoff Volume (m^3/year)**	**Estimated Pre-Development Evapotranspiration (m^3/year)**
East Draft Plan	81,200	137,900	423,700
West Draft Plan – Berczy Creek	42,500	58,400	222,600
West Draft Plan – Bruce Creek	59,100	94,700	305,000
Total	**182,800**	**291,000**	**951,300**

*It is acknowledged that infiltration rates are directly dependent upon the hydraulic conductivity of soils that may naturally vary over several orders of magnitude. Recognizing the wide margins of error associated with this analysis, the infiltration volumes presented in this report are considered simply as reasonable estimates for water balance comparisons and not firm values of actual infiltration.

3.5 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 70% of precipitation in the study area). So 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.

Water balance calculations of the potential water surplus for impervious areas are shown at the bottom of Table H-1 in Appendix H. 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 725 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. There are some existing groundwater supply wells within the Subject Property used for golf course irrigation (refer to Section 2.4.1). Further discussion on interim monitoring and decommissioning of any active water supply wells in the study area is provided in Sections 5.5 and 5.6.

3.6 Post-Development Water Balance With No Mitigation

In order to assess the potential development impact on infiltration, the post-development infiltration volumes have been calculated for the East Draft Plan and West Draft Plan areas on Tables H-4 (East Draft Plan), H-5a (West Draft Plan – Berczy Creek Catchment area) and H-5b (West Draft Plan – Bruce Creek Catchment area) in Appendix H. These calculations assume no mitigation is in place and allow for the quantification of an infiltration target for the design of a low impact development (LID) strategy for stormwater management. The total areas for the proposed land uses in each subcatchment area have been estimated by Stantec based on the proposed development concept and 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 H-1 and H-2 in Appendix H. The infiltration and runoff factors for the post-development calculations reflect the proposed grading across the Subject Property as shown on Table H-3. The total calculated post-development infiltration, runoff, and evapotranspiration volumes (without mitigation) are summarized in Table 4.

Table 4: Summary of Post-Development Infiltration, Runoff and Evapotranspiration (no LID measures)

Draft Plan	Estimated Post-Development Infiltration Volume ($m^{3/}$year)	Estimated Post-Development Runoff Volume (m^3/year)	Estimated Post-Development Evapotranspiration (m^3/year)
East Draft Plan	43,700	346,200	206,500
West Draft Plan – Berczy Creek	24,900	158,400	117,700
West Draft Plan – Bruce Creek	49,500	161,500	232,300
Total	**118,100**	**666,100**	**556,500**

Comparing the values in Tables 3 and 4, the water balance calculations show that development has the potential to reduce the natural infiltration by 46% (37,500 m^3/a) in the East Draft Plan area, 41% (17,500 m^3/a) in the West Draft Plan – Berczy Creek Catchment area and 16% (9,600 m^3/a) in the West Draft Plan – Bruce Creek Catchment area, with an overall site reduction of 35%. LID measures for stormwater management are recommended to try to make up the difference between the pre- and post-development infiltration conditions, i.e., the overall infiltration deficit volume of about 64,900 m^3/year. As noted above, with the wide margins of error associated with this type of analysis, the infiltration deficit volume is considered as a reasonable estimate that is suitable as a target or guide for LID strategy design.

Comparisons of the pre-development and post-development runoff volumes show that there is an increase in runoff within the catchment areas by 150% in the East Draft Plan area, 170% in the West Draft Plan – Berczy Creek Catchment area and 70% in the West Draft Plan – Bruce Creek Catchment area, with an overall site increase of 130%. Further discussion of the stormwater management strategies to address the surface water runoff are provided in the FSR (Stantec, 2017).

As discussed in Section 2.2, the East Draft Plan area and the eastern portion of the West Draft Plan area are within the Bruce Creek catchment. Comparing the pre-development infiltration and runoff to the post-development infiltration and runoff within the Bruce Creek Catchment area, the water balance calculations show that development has the potential to reduce the natural infiltration by 34% (47,100 m^3/a) and increase the runoff by approximately 120% (275,100 m^3/a).

Comparisons of the pre-development and post-development evapotranspiration rates show that there is a significant decrease in evapotranspiration within the East and West Draft Plan areas as is typical of urban development due to the increase of impervious areas. Measures to promote and enhance vegetation in the urbanized areas can be used to improve the post-development evapotranspiration. On the Subject Property, it is intended that rates of evapotranspiration will improve as a result of enhanced plantings in Area E and within the Bruce Creek valley; specifically, in vicinity of the existing ponds as the majority are proposed to be filled in. Further discussion of the enhanced planting areas is provided in the Natural Environment Report (Beacon, 2017).

3.7 Water Capture Requirements for LID Measures

The total depth of precipitation required to meet the infiltration targets presented in Tables H-4, H-5a and H-5b (Appendix H) range from 106 mm/year per impervious hectare for Residential – Single Detached/Laneway Homes to 113 mm/year per impervious hectare for Mixed Use & Residential – Medium Density. To quantify these volumes of precipitation required to meet the infiltration targets within the East and West Draft Plan areas, an analysis was completed using the long-term average annual precipitation for the area (853 mm) based on data from the Environment Canada Toronto Buttonville climate station. The rates of 106 mm/year and 113 mm/year per impervious/ha required to meet the infiltration targets is equivalent to approximately 12% and 13%, respectively, of the total precipitation received in the area.

The City of Toronto Wet Weather Flow Management Guidelines (November, 2006) were then used to correlate annual rainfall volumes to storm events. Since the Wet Weather Flow Management Guidelines reference the annual rainfall amounts, the annual rainfall data from the Buttonville Airport climate station of 717 mm, as opposed to the total annual precipitation, has been used for these calculations. This is a conservative estimate, as it assumes that no runoff from snow accumulation will be infiltrated. Again assuming 15% of the rainfall on impervious areas is lost to evaporation, the rate of rainfall available for infiltration is calculated to be 609 mm/year. And as such, the rates of 106 mm/year and 113 mm/year per impervious/ha required to meet the infiltration targets is equivalent to about 17% and 19%, respectively, of total rainfall received.

It is reported in these Guidelines, based on the review of rainfall data from 16 rainfall stations across Toronto, that both 17% and 19% of the annual rainfall is approximately equivalent to the 2 mm storm. Therefore, infiltration measures proposed for the Subject Property would need to be designed to capture storm events equivalent to 2 mm/impervious ha.

The stormwater management plan presented in the FSR (Stantec, 2017) proposes to use runoff collected primarily from roof areas into the LID strategy (i.e., for bio-retention enclaves and infiltration facility 1, some runoff from roads or driveways will be directed to the LID with pre-treatment provided through filtration). The required depth of rain to be captured from roof tops throughout the year and infiltrated to maintain water balance per land use is summarized below in Table 5.

Table 5: Summary of Post-Development Infiltration Targets

Land Use	Estimated Post-Development Infiltration Volume (mm/Imp ha/year)	Estimated Post-Development Infiltration Volume (mm/Imp ha/event)	Estimated Post-Development Infiltration per Available LID Roof Area (mm/Imp ha/event)
East Draft Plan			
Residential - Single Detached/Laneway Homes	106	2	9
Residential - Town Homes	110	2	25
Residential - Medium Density	113	2	4
School	110	2	6

Land Use	**Estimated Post-Development Infiltration Volume (mm/Imp ha/year)**	**Estimated Post-Development Infiltration Volume (mm/Imp ha/event)**	**Estimated Post-Development Infiltration per Available LID Roof Area (mm/Imp ha/event)**
West Draft Plan – Berczy Creek			
Residential - Single Detached/Laneway Homes	106	2	3
Residential - Town Homes or Laneway Homes	110	2	3
Mixed Use & Residential - Medium Density	113	2	2
West Draft Plan – Bruce Creek			
Residential - Single Detached/Laneway Homes	106	2	4
Residential - Town Homes or Laneway Homes	110	2	9
Mixed Use & Residential - Medium Density	113	2	3

3.8 Water Balance Mitigation Strategies

The basic premise for low impact development is to try to manage stormwater to minimize the runoff of rainfall and increase the potential for infiltration. As outlined in the MOECC SWMP Design Manual (2003) and Low Impact Development Stormwater Management Planning and Design Guide published by the CVC and TRCA (2010), there are a wide variety of mitigation techniques that can be used to try to reduce the increases in direct runoff that occur with land development and increase the potential for post-development infiltration.

Techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards lawns, side and rear yard swales, and other pervious areas throughout the development where possible can considerably reduce the volume of runoff and increase the volume of infiltration in developed areas. These types of surface LID techniques promote natural infiltration simply by providing additional water volumes in the pervious areas (i.e., these areas would receive precipitation as well as extra water from roof runoff). Increasing the topsoil thickness by about two times the normal thickness is also considered as beneficial to enhance storage of water in the topsoil and increase the potential for infiltration. 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 mitigation techniques that can be considered to mitigate increases in runoff and reductions in infiltration include such measures as: permeable pavements, rain gardens, bioswales, subsurface infiltration trenches, galleries and pervious pipe systems. Subsurface methods should only be considered in areas where there is sufficient depth to water table to accommodate the systems within the unsaturated zone and sufficient soil hydraulic conductivity to function effectively. The MOECC manual recommends that subsurface galleries or trenches should be about 1 m above the high water table.

The water balance calculations suggest that, without mitigation, the developed area will receive about 65% of the current amount of average annual groundwater infiltration. In addition, runoff will increase 129% and evapotranspiration will decrease 42%. To minimize the potential development impacts, the FSR (Stantec, 2017) proposes the incorporation of amended soils, downspout disconnection, bioretention and infiltration facilities into the development plan to increase infiltration and reduce runoff (refer to Stantec Figure 2.17 in Appendix H).

East Draft Plan Area

Amended soils are proposed for select areas within the East Draft Plan area using infiltration rates shown in Table H-6 in Appendix H. The amended soils will aid in the infiltration of runoff from roof downspout disconnection to rear yard lawns. A volumetric runoff reduction of 25% was applied as the surficial soils across the site are generally characterized as hydrologic soil groups (HSG) C and D. The estimated volume of precipitation that will be infiltrated across the East Draft Plan area as a result of downspout disconnection from 36,500 m^2 of roof area is approximately 6,600 m^3/a (~18% of target) (refer to Table H-7).

Stantec also proposes to direct precipitation from 11,800 m^2 of roof area within the East Draft Plan to perforated roof leader collector pipes (RLC), bioretention or infiltration facilities designed to infiltrate a 25 mm storm event. The Buttonville Airport precipitation data was used to correlate storm events to annual precipitation volumes in Table H-7 in Appendix H. The 25 mm storm event accounts for approximately 93% of precipitation. The annual precipitation data from the Buttonville climate station of 853 mm has been used for these calculations. Assuming 15% of the precipitation is lost to evaporation, the rate of precipitation directed to the infiltration trenches is calculated to be 725 mm/year. Using a total impervious area of 11,800 m^2 from which roof runoff will be directed to RLC, a bioretention enclave or infiltration facilities, the total annual volume of runoff directed to these facilities was then calculated. The calculations in Table H-7 (Appendix H) show that, assuming 93% of the precipitation (i.e., the 25 mm storm) is infiltrated in the bioretention and infiltration facilities, approximately 21% of the target can be met (~8,000 m^3/a).

Stantec has advised that approximately 12,400 m^3/a of precipitation collected from roof tops will be directed to enhancement Area E to replicate similar conditions observed in the mineral marsh meadow that is proposed to be removed. Approximately 25% of the precipitation collected from these roof tops is estimated to infiltrate with the remainder contributing to runoff.

The calculations suggest that natural infiltration that occurs on pervious surfaces, along with the mitigative measures proposed to address the groundwater infiltration deficit, do not meet the pre-development infiltration volume for the East Draft Plan area leaving a deficit of approximately 19,200 m^3/a (~24% of pre-development infiltration volumes). It is noted that due to the high water table and the amount of cut proposed in the west-central portion of the East Draft Plan area, infiltration trenches or RLCs are not proposed as they could intersect the water table.

The calculations also indicate that the typical increases in runoff that may occur with development can also be reduced (i.e., an increase in runoff of 1.4 times as compared to 1.5 times without LID measures). It should be noted that the development of the proposed East Draft Plan concept will reduce evapotranspiration by ~51% (216,500 m^3/a).

West Draft Plan Area

Similar to the East Draft Plan area, amended soils are proposed for select areas within the West Draft Plan area using infiltration rates shown in Table H-6 in Appendix H. The amended soils aid in the infiltration of runoff from roof downspout disconnection from 41,800 m^2 of roof area to rear yard lawns; 28,800 m^2 of roof area in the West Draft Plan Berczy Creek Catchment area infiltrating approximately 5,200 m^3/a (~30% of West Berczy Creek target) and 13,000 m^2 of roof area in the West Draft Plan Bruce Creek Catchment area infiltrating approximately 2,400 m^3/a (~25% of West Bruce Creek target).

Stantec also proposes to direct precipitation from 79,700 m^2 of roof area (37,200 m^2 from West Draft Plan Berczy Creek Catchment area and 42,500 m^2 from West Draft Plan Bruce Creek Catchment area) to the RLC, bioretention enclaves or infiltration facilities designed to infiltrate a 25 mm storm event. Using the same methodology described above for the East Draft Plan area, the calculations in Tables H-8a and H-8b (Appendix H) show that, assuming 93% of the precipitation (i.e., the 25 mm storm) is infiltrated in the RLC, bioretention and infiltration facilities, the targets will be exceeded by approximately 27% in the West Draft Plan Berczy Catchment area (~22,300 m^3/a) and by 199% in the West Draft Plan Bruce Creek Catchment area (~28,700 m^3/a). Together, this results in an overall increase of 88% over target for the overall West Draft Plan area.

Natural infiltration that occurs on pervious surfaces along with the proposed mitigative measures for the West Draft Plan exceed the pre-development infiltration volume by approximately 13,100 m^3/a (~31% increase in infiltration) for the West Draft Plan Berczy Creek Catchment area and approximately 21,600 m^3/a (~36% increase in infiltration) for the West Draft Plan Bruce Creek Catchment area, with a total increase of approximately 34,600 m^3/a (~34% increase in infiltration) to the West Draft Plan area. The overall site-wide water balance for 4134 16th Avenue, incorporating low impact development techniques into the proposed development, will infiltrate 108% of the pre-development infiltration volume, amounting to an increase of ~12,100 m^3/a.

The typical increases in runoff that may occur with development can also be reduced; an increase in runoff of 2.2 times as compared to 2.7 times without LID measures in the West Draft Plan area – Berczy Catchment, and an increase in runoff of 1.4 times as compared to 1.7 times without LID measures in the West Draft Plan area – Bruce Catchment. In addition, the development of the proposed West Draft Plan concept will reduce evapotranspiration within the Berczy Catchment by ~47% (104,900 m^3/a) and within the Bruce Catchment by ~24% (72,800 m^3/a), with a total reduction of approximately 34% (~177,000 m^3/a) to the West Draft Plan area.

Comparing the pre-development infiltration of the Bruce Creek Catchment area (East Draft Plan Area and West Draft Plan Area – Bruce Creek Catchment) to the post-development infiltration, the calculations show that water balance will be maintained in post-development by implementing the proposed comprehensive LID strategy. A summary of the infiltration, runoff and evapotranspiration volumes for the Subject Property in post-development with LID measures is presented below in Table 6.

Table 6: Summary of Post-Development Infiltration, Runoff and Evapotranspiration (with LID measures)

Draft Plan	**Estimated Post-Development Infiltration Volume (m$^{3/}$year) and % Change from Pre to Post**		**Estimated Post-Development Runoff Volume (m^3/year) and % Change from Pre to Post**		**Estimated Post-Development Evapotranspiration (m^3/year) and % Change from Pre to Post**	
East Draft Plan	61,900 m^3	-24%	327,300 m^3	+140%	207,200 m^3	-51%
West Draft Plan – Berczy Creek	55,500 m^3	+31%	127,900 m^3	+120%	117,700 m^3	-47%
West Draft Plan – Bruce Creek	80,700 m^3	+36%	130,400 m^3	+40%	232,200 m^3	-24%
Total	**198,100 m^3**	**+8%**	**585,600 m^3**	**+101%**	**557,100 m^3**	**-41%**

4.0 Woodlot/Wetland Feature Based Water Balance

The woodlot/wetland (Feature 1) is located within the East Draft Plan area (Figure 2) and is approximately 36,400 m^2 in size; comprising 19,000 m^2 of woodlot and 17,400 m^2 of wetland. There is an external catchment area of approximately 30,200 m^2 that also drains to the feature (refer to Stantec Figure 2.15 in Appendix H). Monitoring well BH16-4 and piezometer nest PZ5s/d are located within the wetland portion of the feature and have been monitored since March 2016. Piezometer nest PZ8s/d is located within the woodlot portion of the feature and has been monitored since June 2016. As discussed in Section 2.4.3 and 2.4.6, groundwater levels measured in BH16-4 have been below ground surface throughout the duration of the monitoring period, indicating groundwater from an underlying deep aquifer does not discharge to this feature; however, some of the precipitation that infiltrates within the upgradient area of the Feature 1 catchment discharges to the surface within the downgradient area of the catchment as interflow (groundwater). Discharge gradients at PZ5s/d have been measured to range between about -0.02 m/m to -0.1 m/m. The shallow groundwater levels at PZ8s/d are consistently higher than the levels in the deep piezometer suggesting recharge conditions.

Dataloggers have been installed in both piezometers at PZ5s/d and PZ8s/d, at staff gauges SG4 and SG8 to measure surface water elevations and at SG C-1 to monitor surface water flows leaving the woodlot/wetland feature to confirm the groundwater/surface water interactions in this feature (refer to Figure 4).

A detailed water balance analysis has been completed for this feature to determine the pre-development infiltration and runoff volumes (based on existing land use conditions) and the post-development infiltration and runoff volumes that would be expected based on the proposed land use plan. The water balance calculations are provided in Appendix H and discussed below.

4.1 Pre-Development Water Balance (Existing Conditions)

The pre-development water balance calculations for the woodlot/wetland feature and external drainage area are presented in Table H-9 in Appendix H. Similar to the site-wide water balance methodology discussed in Section 3, a soil moisture storage capacity of 125 mm was used for the predominantly short to moderate-rooted wetland area and a soil moisture storage capacity of 400 mm was used for longer-rooted vegetation, i.e., the wooded areas (refer to Table H-1 (for 125 mm retention) and Table H-2 (for 400 mm retention) in Appendix H). In summary from these appendix tables, the total calculated pre-development infiltration and runoff volumes are summarized in Table 7.

Table 7: Summary of Pre-Development Runoff to Woodlot/Wetland Feature

Land Use Area	Estimated Pre-Development Infiltration Volume (m^3/year)	Estimated Pre-Development Runoff Volume (m^3/year)	Estimated Pre-Development Evapotranspiration (m^3/year)
Wetland	2,000	2,400	10,400
Woodlot	2,600	2,100	11,500
External Drainage Area	3,400	4,200	18,100
Total	**8,000**	**8,700**	**40,000**

4.2 Post-Development Water Balance and Mitigation Strategies

The development of the East Draft Plan area proposes to build houses and roads within the external drainage area to the feature, essentially eliminating infiltration and surface water contributions from the upland area, and creating infiltration and runoff deficits of approximately 3,400 m^3/a (~43% of pre-development infiltration) and 4,200 m^3/a (~48% of pre-development runoff), respectively. The wetland and woodlot areas will remain the same in post-development.

The FSR (Stantec, 2017) proposes to create a buffer area around the woodlot/wetland feature to allow for groundwater to infiltrate and to direct runoff toward the woodlot/wetland feature. The buffer area of approximately 13,700 m^2 will be left to naturalize and provide about 1,900 m^3/a of infiltration (~55% of target) and 1,500 m^3/a of runoff (~36% of target) to the woodlot/wetland feature in post-development. The FSR also proposes downspout disconnection into the development plan to maintain the surface water runoff contribution to the woodlot/wetland feature. Similar to the methods discussed above in Section 3.8, amended soils are proposed for the rear yards backing onto the woodlot/wetland feature using the infiltration and runoff rates shown in Table H-6 in Appendix H. The volume of precipitation that will infiltrate within the catchment as a result of downspout disconnection from approximately 5,400 m^2 of roof area is approximately 1,000 m^3/a (~29% of target). The volume of precipitation that will runoff and be directed as sheet flow to the woodlot/wetland feature as a result of runoff from rear yard lawns and downspout disconnection from approximately 5,400 m^2 of roof area is approximately 2,900 m^3/a (~69% of target). In summary from the appendix tables, the total calculated pre-development infiltration, runoff and evapotranspiration volumes are summarized in Table 8.

Table 8: Summary of Post-Development Infiltration, Runoff and Evapotranspiration to Woodlot/Wetland Feature With Mitigation

Land Use Area		**Estimated Post-Development Infiltration Volume (m^3/year)**	**Estimated Post-Development Runoff Volume (m^3/year)**	**Estimated Post-Development Evapotranspiration (m^3/year)**
Wetland		2,000	2,400	10,400
Woodlot		2,600	2,100	11,500
Open Space/Buffer Area		1,800	1,500	8,300
External Drainage Area	Natural Infiltration/Runoff from Rear Yard Lawns	400	300	1,700
	Roof Downspout Disconnection	1,000	3,000	0
	Total	**7,800**	**9,300**	**31,900**

Natural infiltration that occurs within Feature 1 and the proposed buffer area, along with the proposed mitigative measures, provide enough infiltration to maintain the pre-development infiltration volume for Feature 1 and its existing catchment area. The runoff that occurs within Feature 1 and the proposed buffer area along with the proposed mitigative measures exceed the pre-development runoff volume by approximately 500 m^3/a (~6% increase in runoff). There is also an overall reduction in evapotranspiration of about 20% (~8,000 m^3/a).

5.0 Construction Considerations

5.1 Water Quality

Depending on land use, runoff from urban developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, bacteria and viruses. Generally, with the exception of the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater transport through the soils. As such, the potential for effects on groundwater quality from infiltration in the urban areas is therefore expected to be limited. Any potential changes to the shallow groundwater quality are not expected to influence conditions in the surface water features given the limited discharge volumes. The deeper aquifer zones in the study area are well protected by thick layers of low hydraulic conductivity sediments and upward gradients and no effect on the groundwater quality in these aquifers is expected from the proposed development.

5.2 Construction Below Water Table

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 excavated trenches. Over the long-term, these impacts can lower the local groundwater table. 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.

5.3 Dewatering/Depressurization Requirements

The water table can be seasonally close to the existing ground surface in some areas, particularly along the watercourse valleys and in the west-central portion of the East Draft Plan area. Much of the upland area will be above the water table, however, subsurface excavations may encounter wet soil conditions, particularly in the spring and fall. The construction dewatering requirements may vary significantly depending on the local soils, the climate conditions, the construction season and the depth and size of the excavations. Over most of proposed development area, the surficial soils encountered during servicing will predominantly be relatively low hydraulic conductivity silt, clay and till sediments that would not be expected to produce much water. Minor seepage into excavations within the silty clayey soils can likely be handled, as required, by pumping from sumps within the trench excavations.

There are areas where coarser-grained sand or gravel layers and/or heavily weathered and fractured till deposits may be encountered that may produce more significant volumes of groundwater flow. The shallow sand layers encountered across the Subject Property appear to be relatively discontinuous (refer to Section 5.3.2) and may not sustain significant flow of groundwater; however, for excavations and servicing, such areas may require more active dewatering or groundwater control systems involving networks of well points or groundwater control wells.

Regional artesian conditions are evident in the western portion of the Subject Property, that are interpreted to be related to the presence of the Thorncliffe Aquifer (refer to Section 2.4.4). It is not anticipated that the regional aquifer will be directly encountered during servicing of the Subject Property; however, deeper excavations may require depressurization for construction.

Dewatering and/or depressurization requirements and anticipated water flow volumes will be confirmed by geotechnical and hydrogeological investigations completed in support of detailed servicing design. The studies will build on the current knowledge of the existing hydrogeological conditions (i.e., areas where saturated sand and gravel layers are present) and determine the most effective method to control groundwater during construction. A groundwater management plan and sediment control system will be established such that the dewatering discharge water is returned to the local environment in a clear (non-turbid) condition.

Recently the MOECC has introduced new regulations that allow for construction related dewatering to proceed under the Environmental Activity Sector Registry (EASR) process if dewatering volumes are below 400,000 L/d. Based on our knowledge of the regulations, the dewatering will either be allowed by a Category 3 Permit to Take Water (PTTW) or under the EASR process depending on the expected volume of water taking. Both the EASR process and the Category 3 PTTW application allow for the uncertainties of the construction process in relation to the duration of the dewatering period. The determination of which process should be followed (PTTW or EASR) is based on the expected volume of taking during dewatering; takings between 50,000 L/d and 400,000 L/d are required to register for the EASR while takings above 400,000 L/d are regulated by the PTTW process.

5.4 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 the active and inactive irrigation supply wells for the golf course and the groundwater monitoring wells installed for this study unless they are maintained throughout the construction for monitoring purposes.

6.0 Monitoring

Groundwater and surface water monitoring at all monitoring wells, drive-point piezometers, staff gauges and surface water stations will be completed on a monthly basis for a period of one year to establish seasonal fluctuations, confirm stable water elevations and assess the water table response to precipitation. Following one year of monthly monitoring, the monitoring frequency will change to quarterly for a period of one to two years, depending on the type and sensitivity of the features (wetlands, woodlots, etc.) in accordance with the ToR. Automatic water level recorders (dataloggers) were installed in six of the on-site monitoring wells (BH16-5, BH16-7, BH16-12d, BH16-13d, BH16-15d and BH16-16) and in 14 of the piezometers (PZ4s/d, PZ5s/d, PZ8s/d, PZ9s/d, PZ10s/d, PZ11s/d, and PZ12s/d) in order to record continuous water level fluctuations. Dataloggers were also installed at staff gauges SG4, SG5, SG8 and SG9 as well as at culverts SG C-1 and SG C-2.

Monitoring of the groundwater elevation and surface water flow conditions will continue during and post-construction activities following the LID implementation. New monitoring wells may be installed where necessary to replace existing monitoring wells that may be decommissioned to accommodate construction activities. The proposed monitoring locations and frequency will be determined based on the final LID strategy at detailed design.

7.0 Bibliography and References

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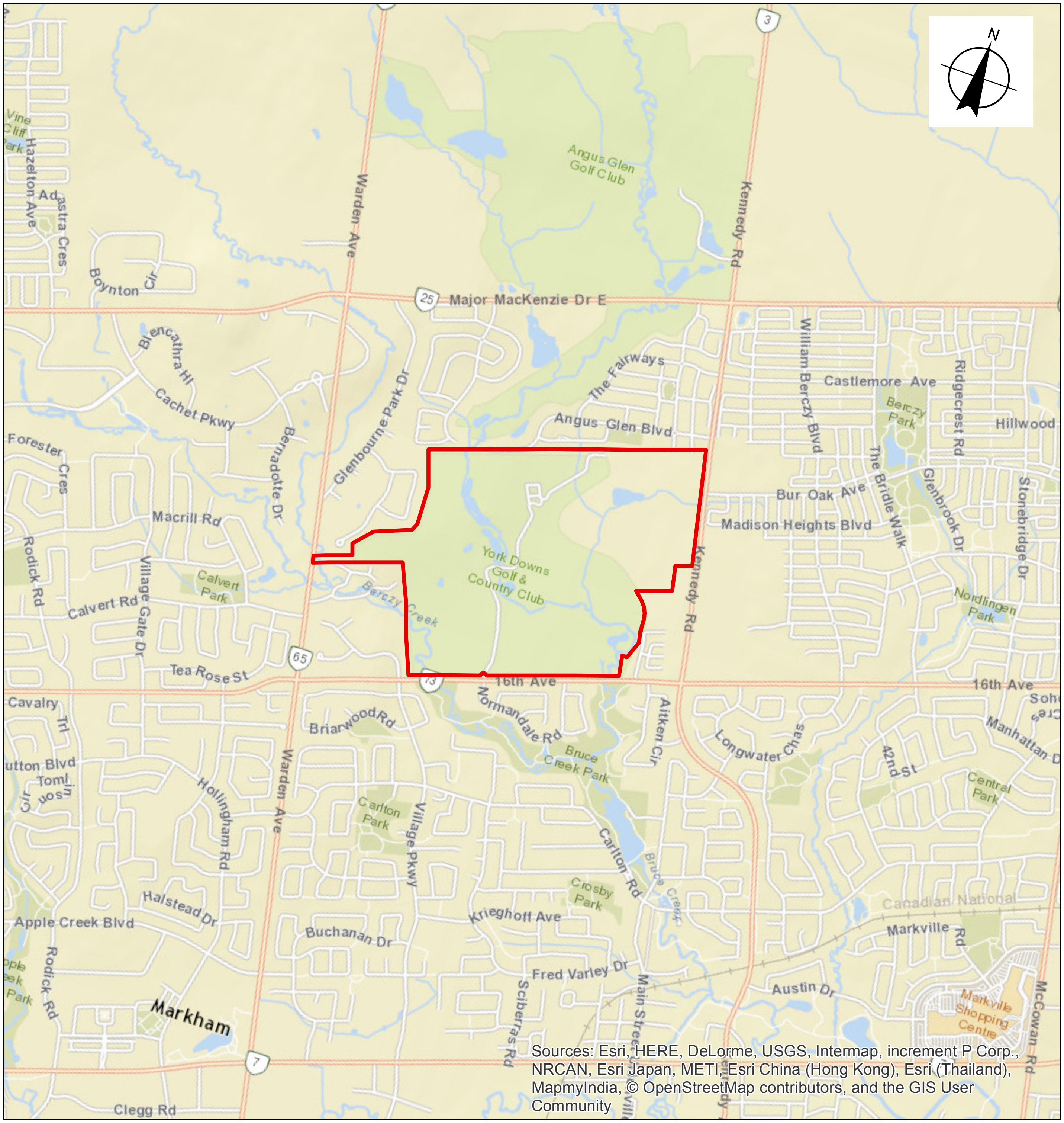
BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Figures



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 500 1,000 1,500

Metres

LEGEND

▭ SUBJECT LANDS

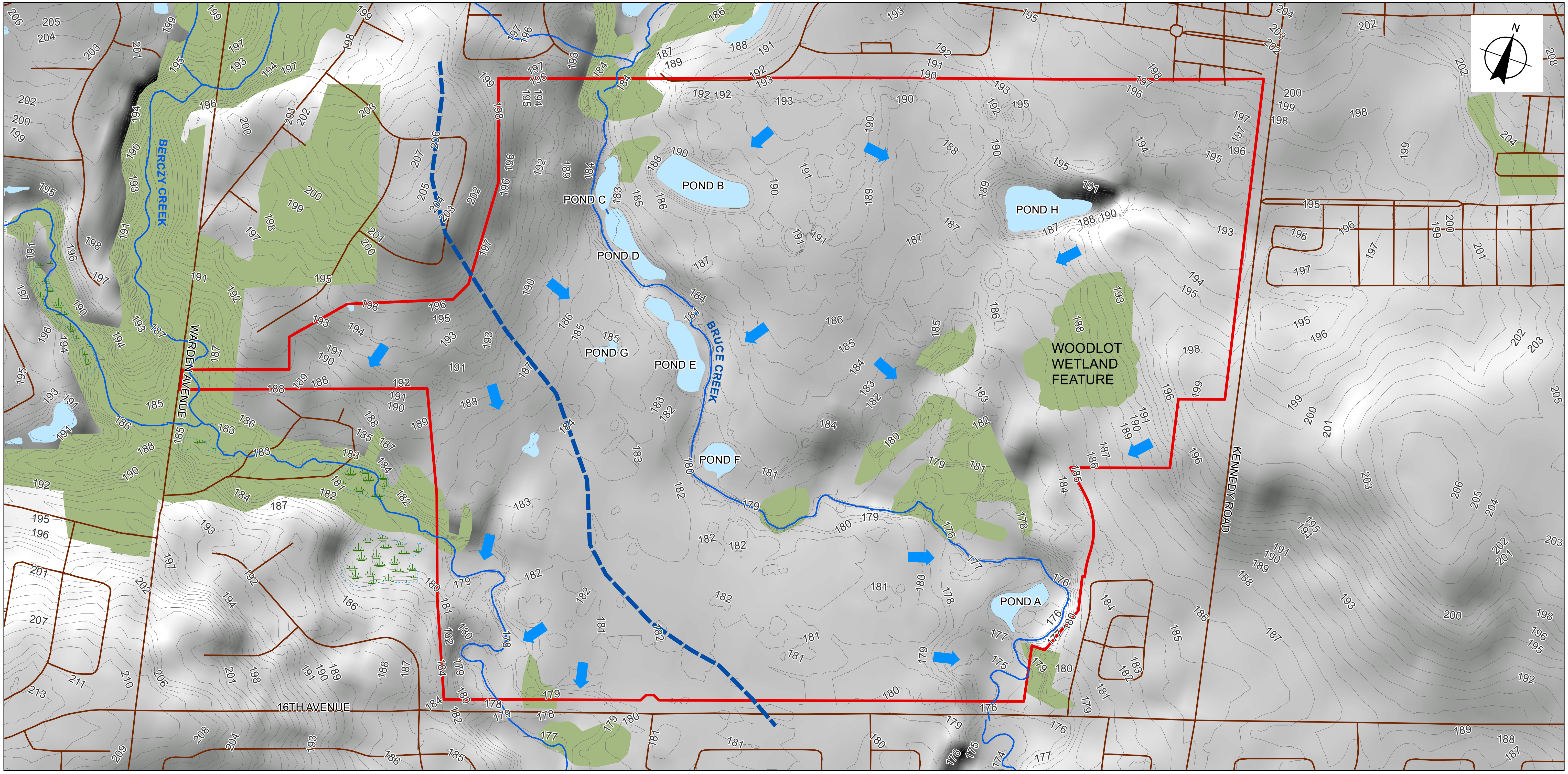
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE 4134 16TH AVENUE

FIGURE 1

SITE LOCATION

OCTOBER 2017

File Path:Nigel/Shared Work Areas/038247 York Downs D:\Burnside work\038247 York Downs\038247 York Downs SL.mxd Print Date: 2017/10/23 Time: 09:32 AM



Stantec
BEACON ENVIRONMENTAL
BURNSIDE

0 100 200 300 400 500 600
Metres

LEGEND

🟥 SUBJECT LANDS
WATERCOURSE
ROADWAY
🟩 WOODED
CONTOUR (1m intervals - masl)
OPEN WATER
WETLAND
DRAINAGE DIVIDE
➡ SURFACE WATER FLOW DIRECTION

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 2

TOPOGRAPHY AND DRAINAGE

OCTOBER 2017

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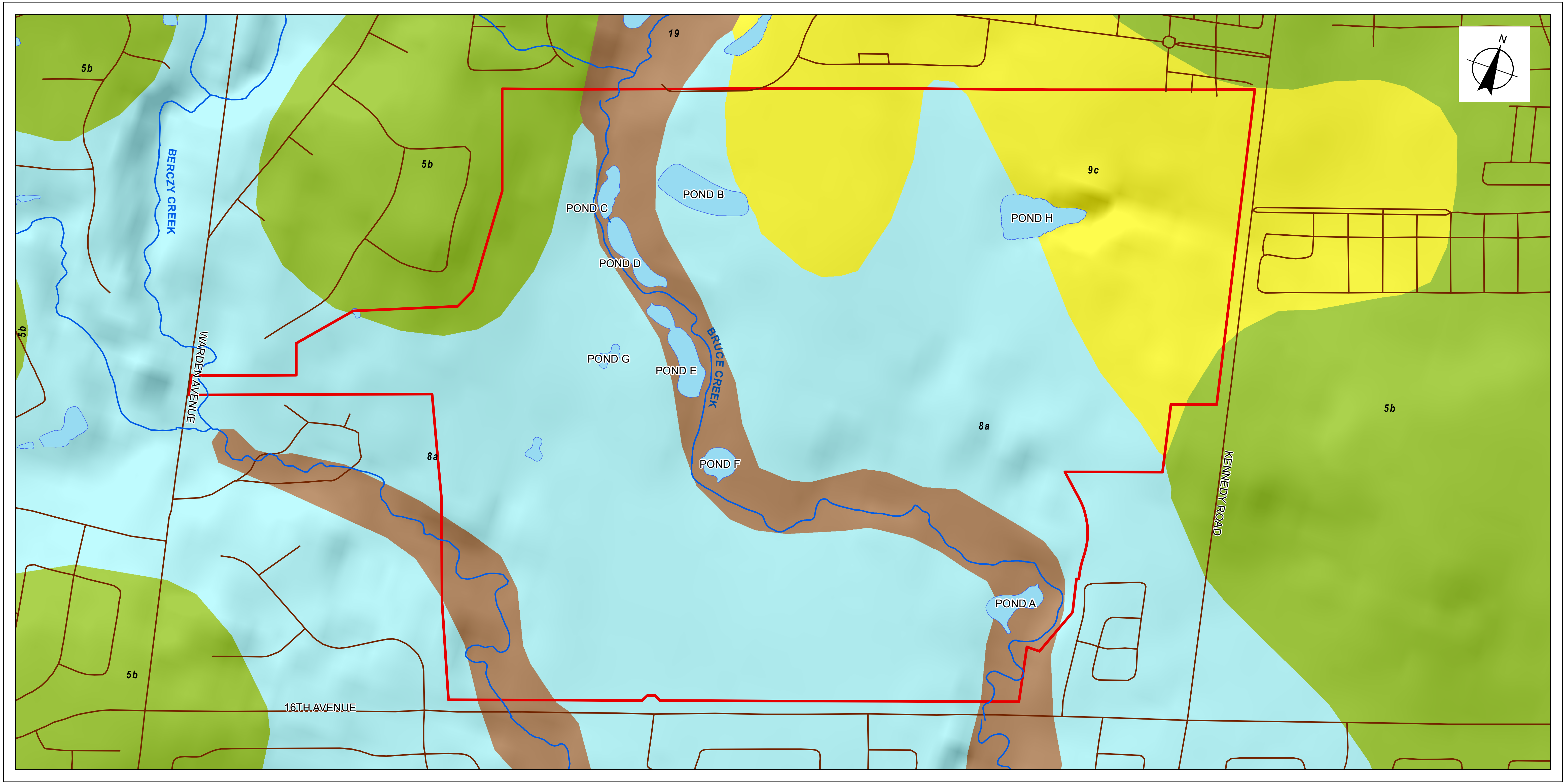


Stantec
BEACON ENVIRONMENTAL
BURNSIDE

0 100 200 300 400 500 600
Metres

LEGEND

🟥	SUBJECT LANDS
—	WATERCOURSE
—	ROADWAY
🟦	OPEN WATER
🟩	5b: Stone-poor, carbonate-derived silty to sandy till
🟦	8a: Fine-textured glaciolacustrine deposits: Massive-well laminated
🟨	9c: Coarse-textured glaciolacustrine deposits: Foreshore-basinal deposits
🟫	19: Modern alluvial deposits

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 3

SURFICIAL GEOLOGY

OCTOBER 2017

File Path:Nigel/Shared Work Areas/038247 York Downs D:\Burnside work\038247 York Downs\038247 York Downs SG.mxd Print Date: 2017/10/23 Time: 09:42 AM

Stantec
BEACON ENVIRONMENTAL
BURNSIDE

0 100 200 300 400 500 600
Metres

LEGEND

- WATERCOURSE
- MONITORING WELL (GOLDER, 2017)
- MONITORING WELL (GOLDER 2014)
- MONITORING WELL (GOLDER 2016)
- ● DRIVE POINT PIEZOMETER
- 🟩 STAFF GAUGE
- ▲ SURFACE WATER MONITORING LOCATION
- ▮ CULVERT
- ☒ INFILTRATION TEST LOCATION
- ⊗ HYDROPERIOD MONITORING LOCATION

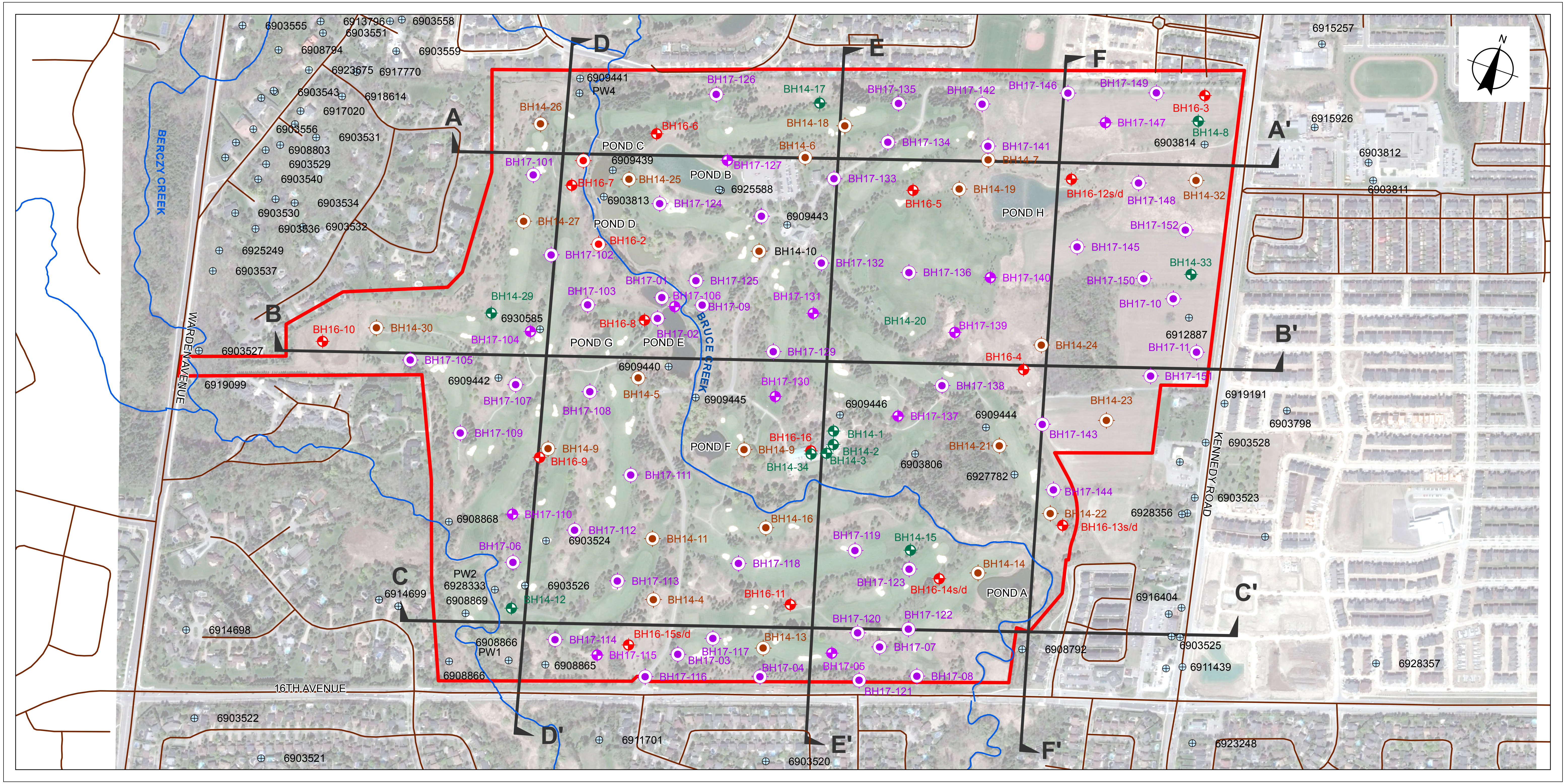
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 4

MONITORING LOCATIONS

OCTOBER 2017

File Path: D:\Burnside work\038247 York Downs\038247 Monitoring Locations.mxd Print Date: 2017/10/30 Time: 01:39 PM



0 100 200 300 400 500 600
Metres

LEGEND

🟥	SUBJECT LANDS
—	WATERCOURSE
●	MONITORING WELL (GOLDER, 2017)
●	MONITORING WELL (GOLDER 2014)
●	MONITORING WELL (GOLDER 2016)
●	BOREHOLE (GOLDER, 2017)
●	BOREHOLE (GOLDER 2016)
●	BOREHOLE (GOLDER, 2014)
⊕	MOECC WELL RECORD LOCATION
⌴	CROSS SECTION LOCATION KEY

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 5

CROSS SECTION LOCATION KEY

OCTOBER 2017

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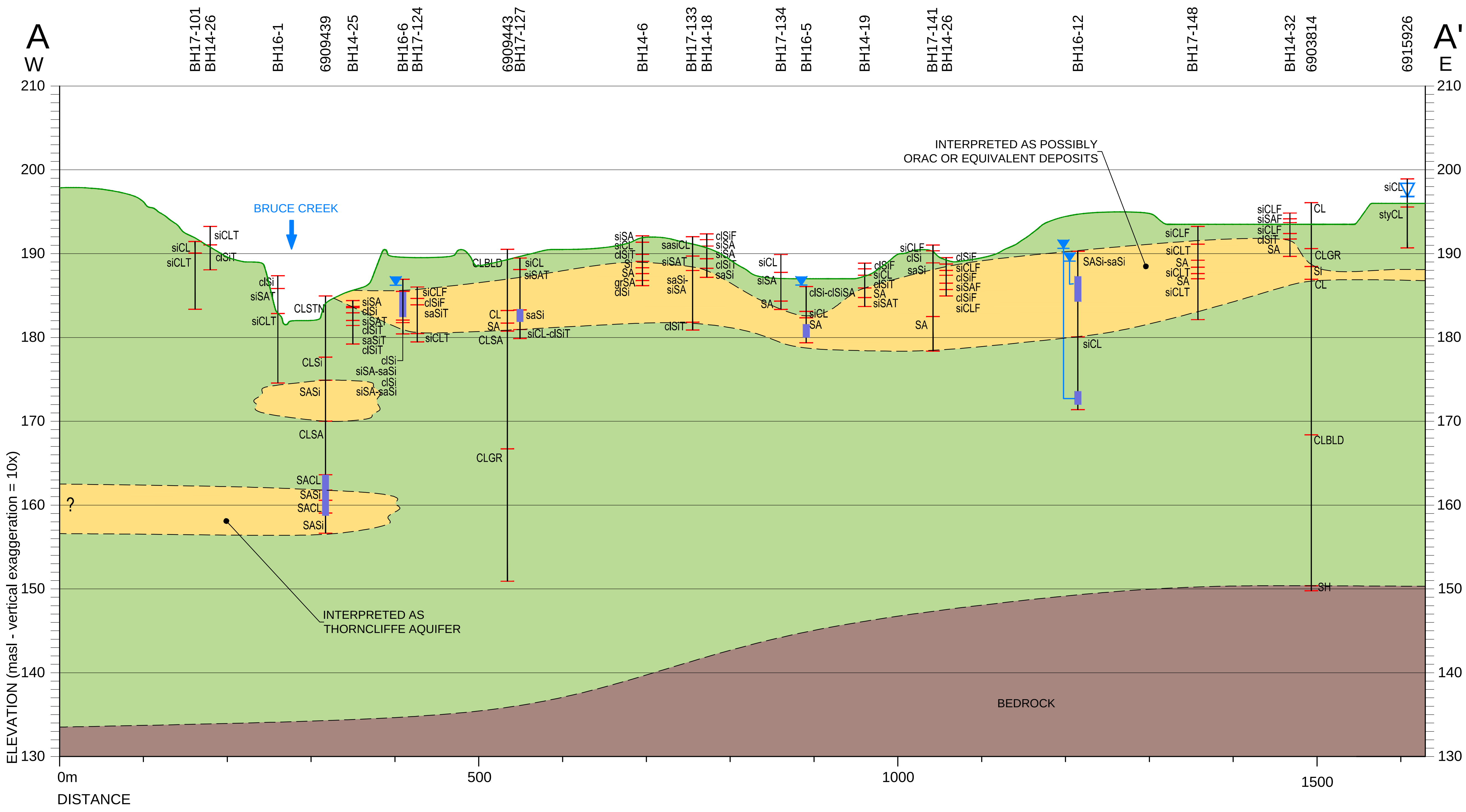
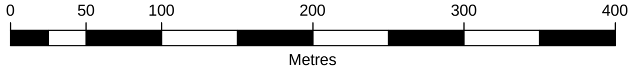




Stantec

BEACON ENVIRONMENTAL

BURNSIDE

Legend

MW9 WELL IDENTIFICATION

EXISTING GROUNDLINE

GEOLOGICAL STRATIGRAPHY CONTACT

▽ STATIC WATER LEVEL (MOECC WELL RECORD)

▼ MEASURED WATER LEVEL (APRIL 22, 2016)

▮ WELL SCREEN

🟩 CLAYEY SILT TILL

🟨 SANDY SILT

🟫 SHALE

- - - - - INTERPRETED GEOLOGICAL CONTACT

↓ WATERCOURSE CROSSING

cl	clayey
si	silty
sa	sandy
gr	gravelly
TS	Topsoil

CL	Clay
Si	Silt
SA	Sand
GR	Gravel
STN	Stones
BLD	Boulder
LMSN	Limestone

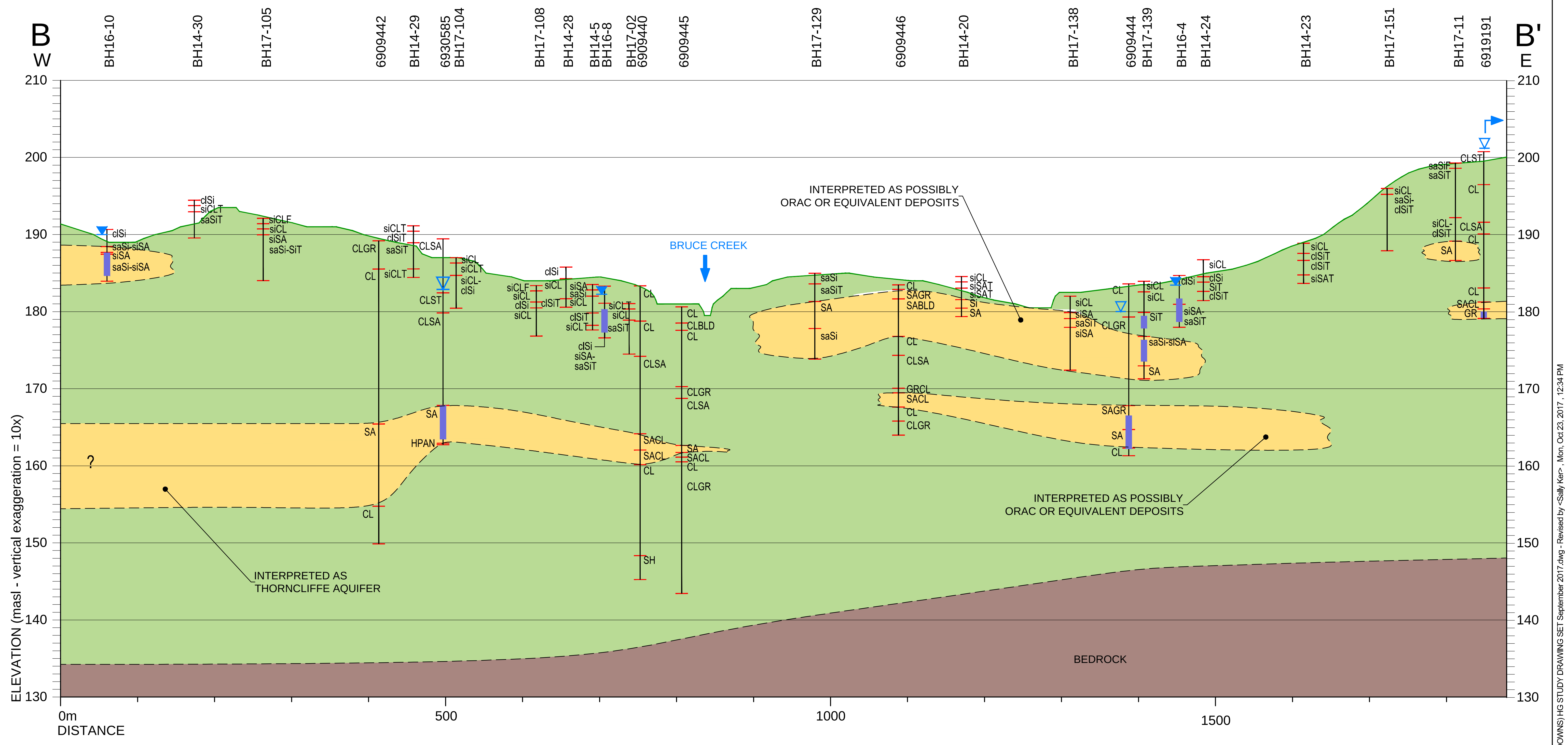
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 6

INTERPRETED GEOLOGICAL
CROSS SECTION A-A'

OCTOBER 2017

File:Nigel/Shared Work Areas/038247 (YORK DOWNS) HG STUDY DRAWING SET September 2017.dwg - Revised by <Sally Ker> , Mon, Oct 23, 2017 , 12:31 PM



Stantec	BEACON ENVIRONMENTAL	BURNSIDE

Legend

MW9
WELL IDENTIFICATION
EXISTING GROUNDLINE
GEOLOGICAL STRATIGRAPHY CONTACT
▽ STATIC WATER LEVEL (MOECC WELL RECORD)
▼ MEASURED WATER LEVEL (APRIL 22, 2016)
▮ WELL SCREEN

🟩 CLAYEY SILT TILL
🟨 SANDY SILT
🟫 SHALE
- - - - - INTERPRETED GEOLOGICAL CONTACT

cl	clayey
si	silty
sa	sandy
gr	gravelly
TS	Topsoil

CL	Clay
Si	Silt
SA	Sand
GR	Gravel
STN	Stones
BLD	Boulder
LMSN	Limestone

↓ WATERCOURSE CROSSING

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 7

INTERPRETED GEOLOGICAL
CROSS SECTION B-B'

OCTOBER 2017

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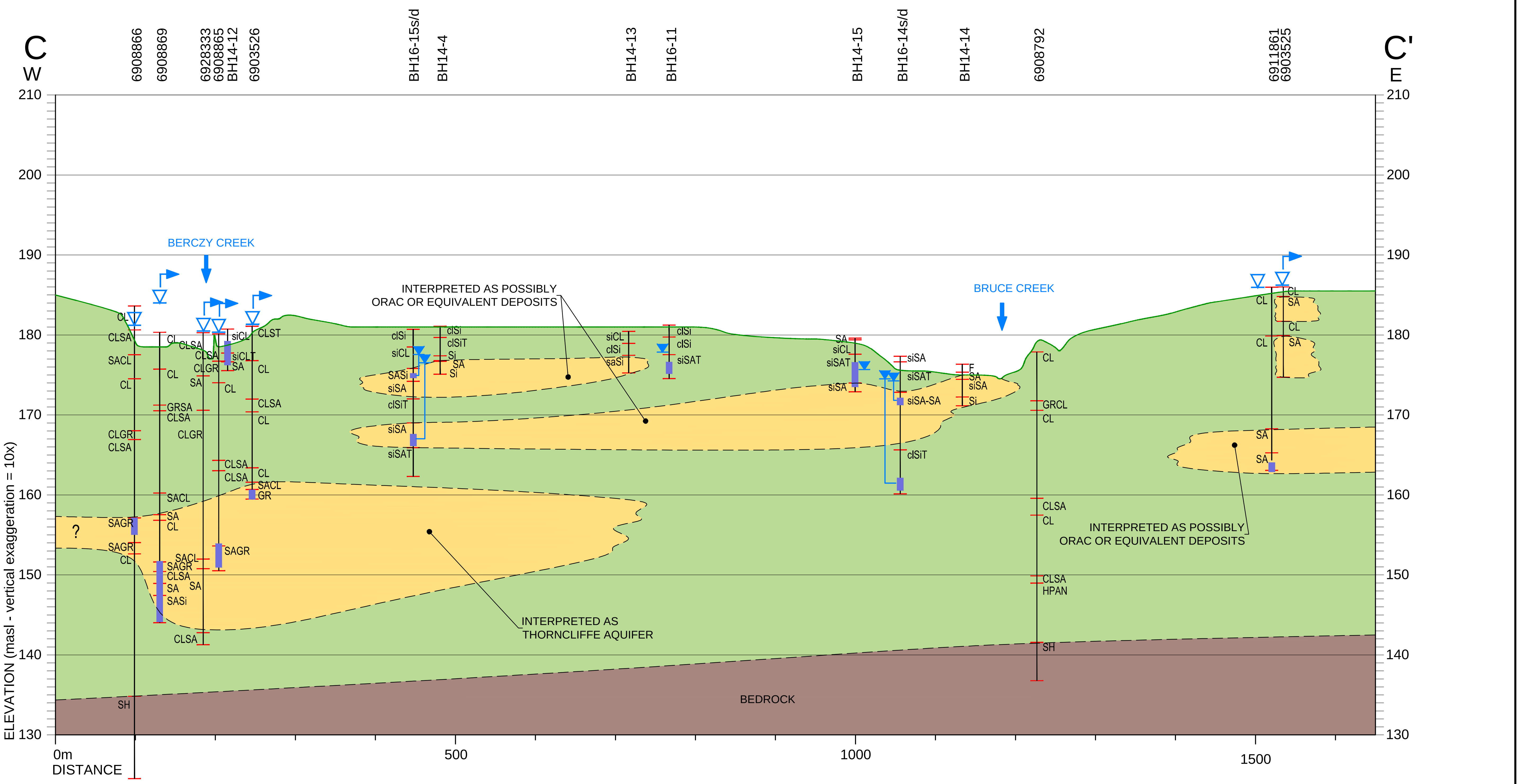


Legend

MW9 — WELL IDENTIFICATION

EXISTING GROUNDLINE

GEOLOGICAL STRATIGRAPHY CONTACT

▽ STATIC WATER LEVEL (MOECC WELL RECORD)

▼ MEASURED WATER LEVEL (APRIL 22, 2016)

WELL SCREEN

🟩 CLAYEY SILT TILL

🟨 SANDY SILT

🟫 SHALE

----- INTERPRETED GEOLOGICAL CONTACT

cl	clayey
si	silty
sa	sandy
gr	gravelly
TS	Topsoil

CL	Clay
Si	Silt
SA	Sand
GR	Gravel
STN	Stones
BLD	Boulder
LMSN	Limestone

↓ WATERCOURSE CROSSING

0 50 100 150 200 250
1:5000

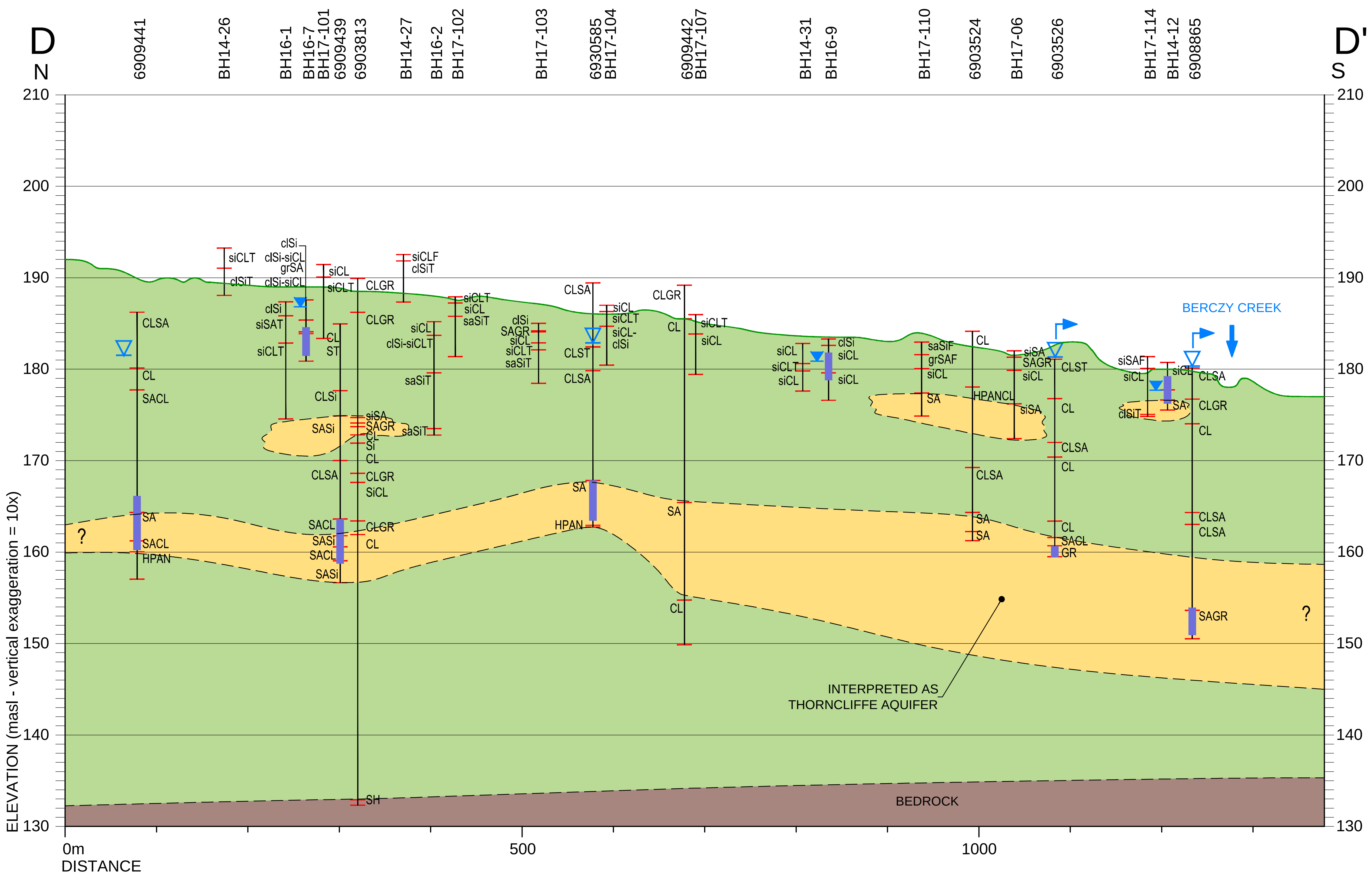
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 8

INTERPRETED GEOLOGICAL CROSS SECTION C-C'

SEPTEMBER 2016

File: 032847 (YORK DOWNS) HG STUDY CROSS SECTIONS.dwg



Stantec

BEACON
ENVIRONMENTAL

BURNSIDE

0 50 100 200 300 400
Metres

Legend

MW9 WELL IDENTIFICATION

EXISTING GROUNDLINE

GEOLOGICAL STRATIGRAPHY CONTACT

▽ STATIC WATER LEVEL (MOECC WELL RECORD)

▼ MEASURED WATER LEVEL (APRIL 22, 2016)

WELL SCREEN

🟩 CLAYEY SILT TILL

🟨 SANDY SILT

🟫 SHALE

- - - - - INTERPRETED GEOLOGICAL CONTACT

cl	clayey
si	silty
sa	sandy
gr	gravelly
TS	Topsoil

CL	Clay
Si	Silt
SA	Sand
GR	Gravel
STN	Stones
BLD	Boulder
LMSN	Limestone

⬇ WATERCOURSE CROSSING

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 9

INTERPRETED GEOLOGICAL
CROSS SECTION D-D'

OCTOBER 2017

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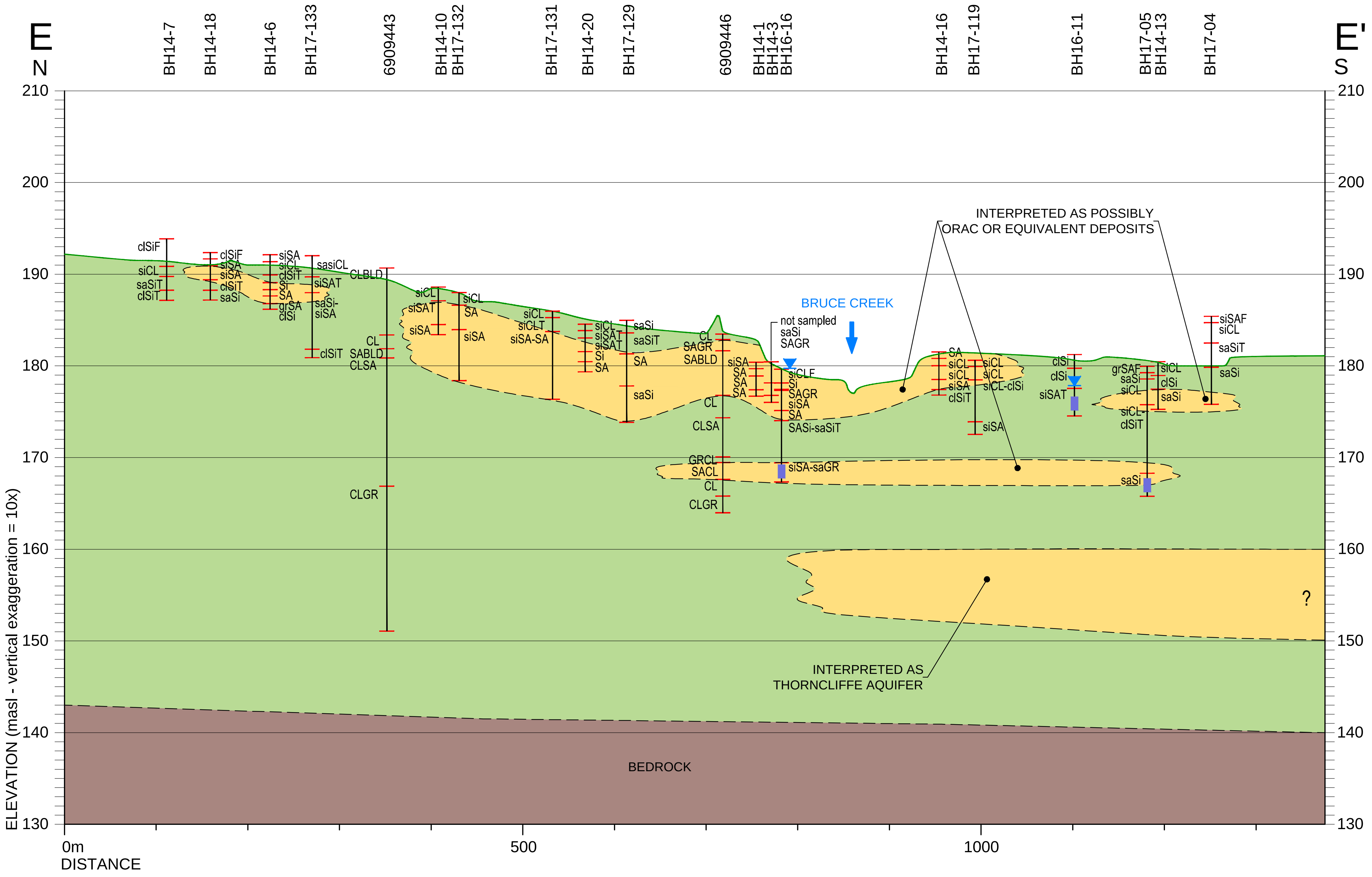

Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 50 100 200 300 400
Metres

Legend

MW9 WELL IDENTIFICATION

EXISTING GROUNDLINE

GEOLOGICAL STRATIGRAPHY CONTACT

▽ STATIC WATER LEVEL (MOECC WELL RECORD)

▼ MEASURED WATER LEVEL (APRIL 22, 2016)

▮ WELL SCREEN

🟩 CLAYEY SILT TILL

🟨 SANDY SILT

🟫 SHALE

----- INTERPRETED GEOLOGICAL CONTACT

cl	clayey
si	silty
sa	sandy
gr	gravelly
TS	Topsoil

CL	Clay
Si	Silt
SA	Sand
GR	Gravel
STN	Stones
BLD	Boulder
LMSN	Limestone

⬇ WATERCOURSE CROSSING

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 10

INTERPRETED GEOLOGICAL
CROSS SECTION E-E'

OCTOBER 2017

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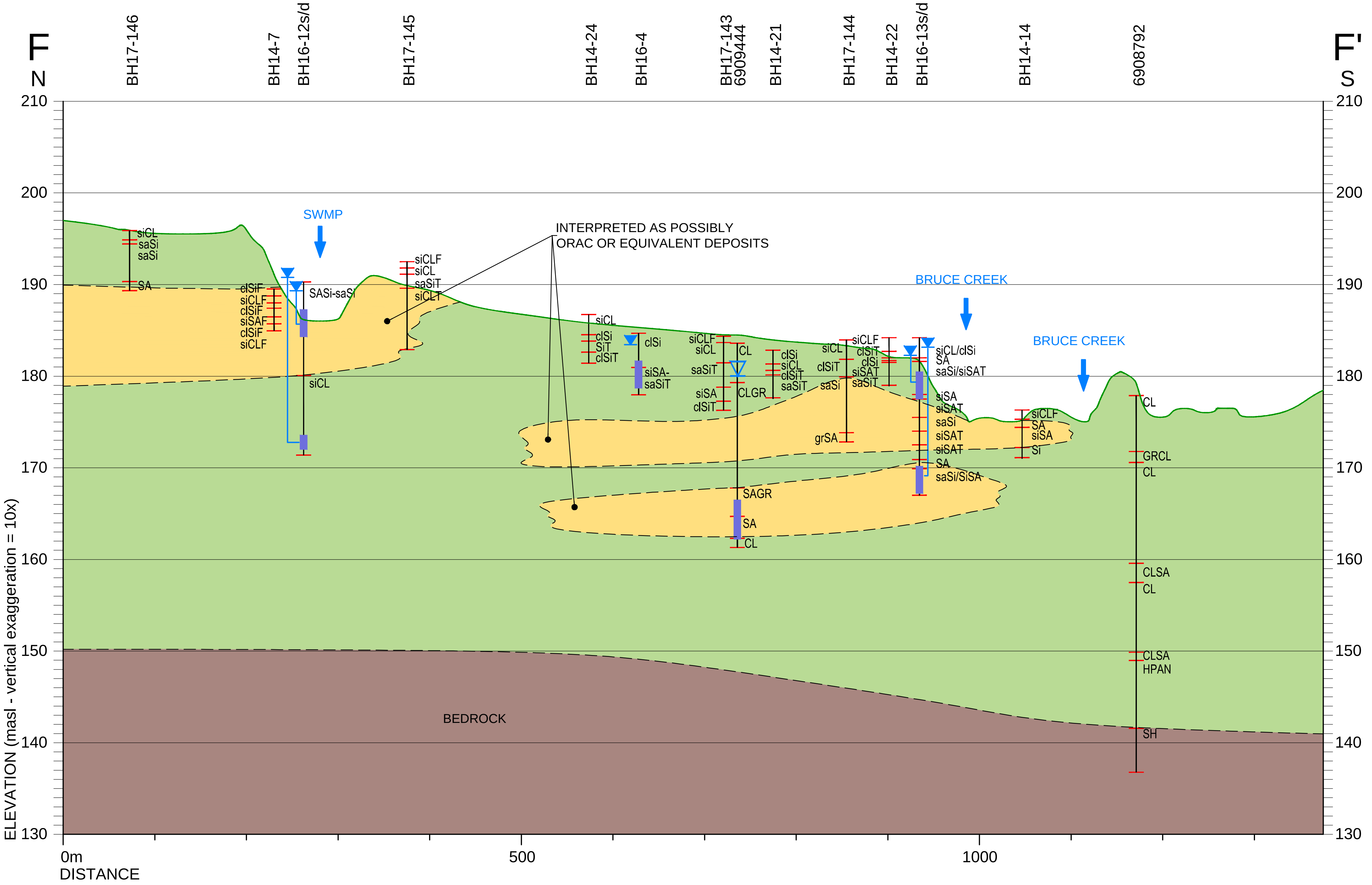


Legend

MW9

WELL IDENTIFICATION

EXISTING GROUNDLINE

GEOLOGICAL STRATIGRAPHY CONTACT

▽ STATIC WATER LEVEL (MOECC WELL RECORD)

▼ MEASURED WATER LEVEL (APRIL 22, 2016)

▮ WELL SCREEN

🟩 CLAYEY SILT TILL

🟨 SANDY SILT

🟫 SHALE

- - - - - INTERPRETED GEOLOGICAL CONTACT

↓ WATERCOURSE CROSSING

cl	clayey
si	silty
sa	sandy
gr	gravelly
TS	Topsoil

CL	Clay
Si	Silt
SA	Sand
GR	Gravel
STN	Stones
BLD	Boulder
LMSN	Limestone

0 50 100 200 300 400
Metres

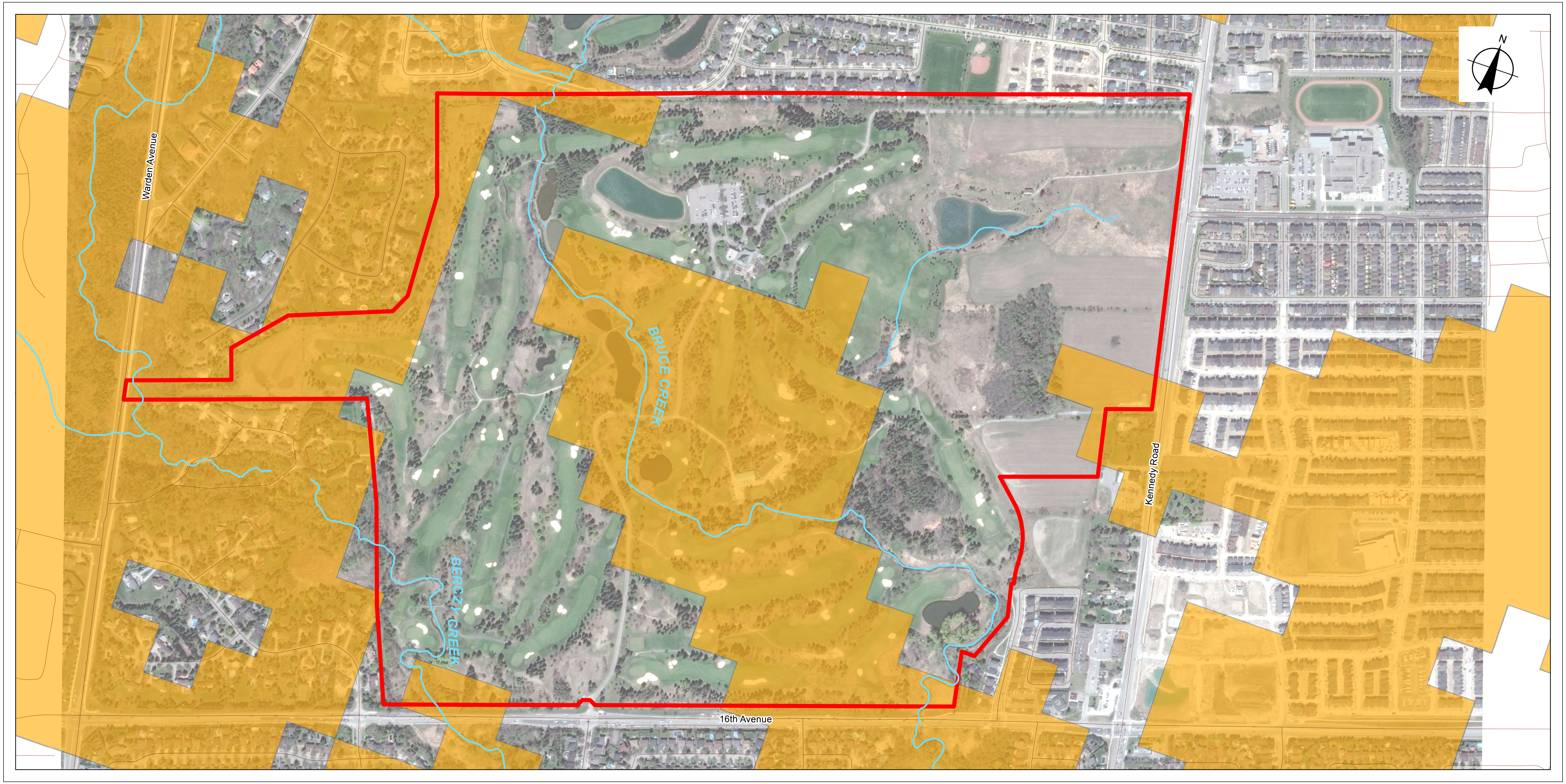
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 11

INTERPRETED GEOLOGICAL
CROSS SECTION F-F'

OCTOBER 2017

File:Nigel/Shared Work Areas/038247 York Downs/038247 (YORK DOWNS) HG STUDY DRAWING SET September 2017.dwg - Revised by <Sally Ker> , Mon, Oct 23, 2017 , 12:36 PM



Stantec

BEACON ENVIRONMENTAL

BURNSIDE

0 100 200 300 400 500 600

Metres

LEGEND

▭ SUBJECT LANDS

― WATERCOURSE

🟧 Highly Vulnerable Aquifers TRCA

HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE
4134 16TH AVENUE

FIGURE 12

HIGHLY VULNERABLE AQUIFER AREAS

OCTOBER 2017

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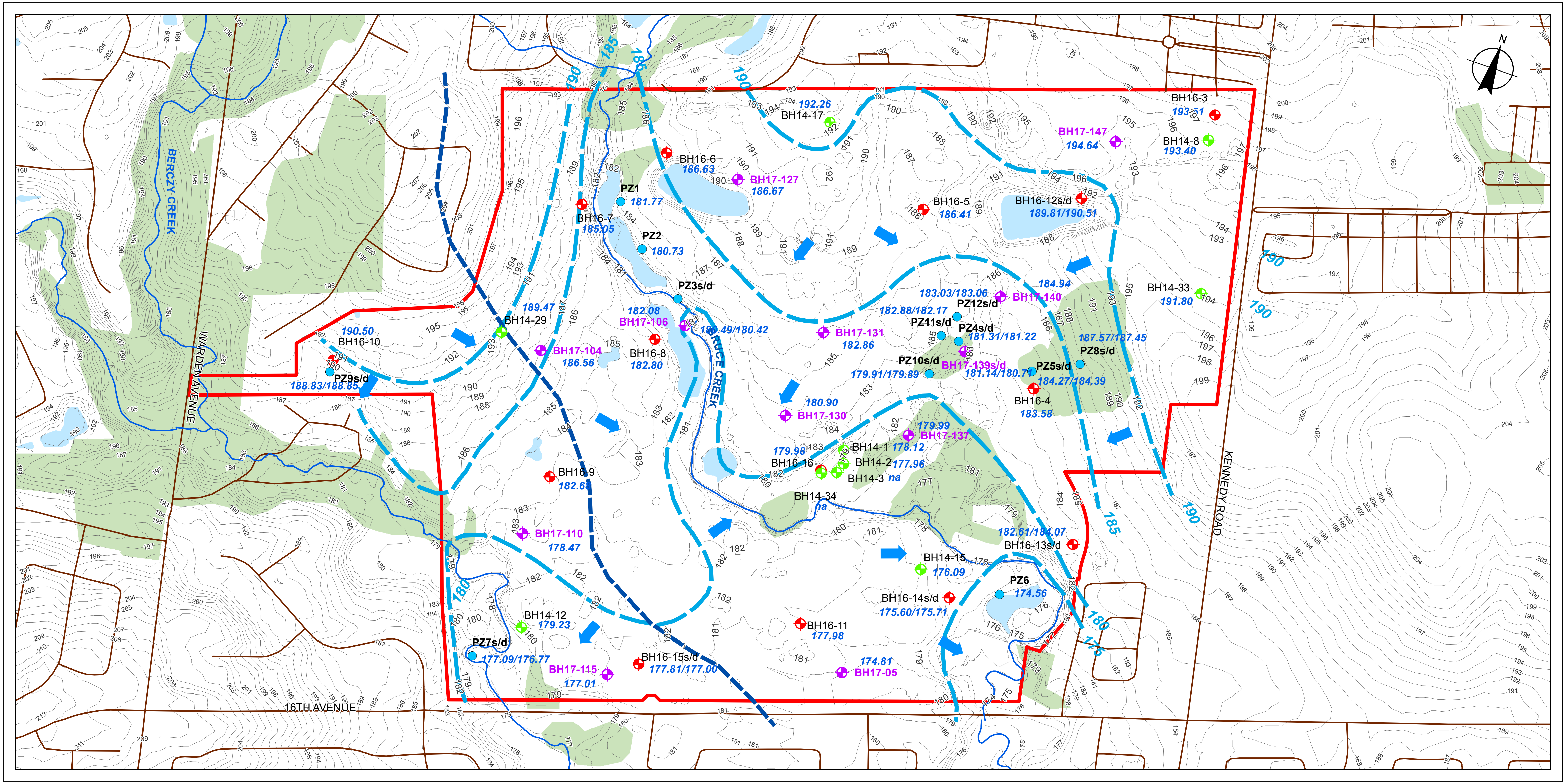

LEGEND

🟥	SUBJECT LANDS
—	ROADWAY
—	CONTOUR (1m intervals - masl)
▬ ▬	DRAINAGE DIVIDE
—	WATERCOURSE
▭	OPEN WATER
🟩	WOODED
⊕	MONITORING WELL (GOLDER, 2017)
⊕	MONITORING WELL (GOLDER 2014)
⊕	MONITORING WELL (BURNSIDE 2016)
●	DRIVE POINT PIEZOMETER
▬ ▬	INTERPRETED GROUNDWATER CONTOUR (masl)
➡	INTERPRETED GROUNDWATER FLOW DIRECTION
177.95	MEASURED WATER LEVEL (APRIL 21, 2017)

Stantec
BEACON ENVIRONMENTAL
BURNSIDE

0 100 200 300 400 500 600
Metres

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 13

INTERPRETED SHALLOW GROUNDWATER FLOW

OCTOBER 2017

File Path: D:\Burnside work\038247 York Downs\038247 York Downs GW.mxd Print Date: 2017/10/23 Time: 11:52 AM

Stantec
BEACON ENVIRONMENTAL
BURNSIDE

0 100 200 300 400 500 600
Metres

LEGEND

🟥 SUBJECT LANDS

WATERCOURSE

▨ Significant Groundwater Recharge Areas TRCA

HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE
4134 16TH AVENUE

FIGURE 14

RECHARGE AREAS

OCTOBER 2017

File Path: D:\Burnside work\038247 York Downs\038247 York Downs SGRA Areas.mxd Print Date: 2017/10/23 Time: 11:55 AM

BURNSIDE

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Appendix A

MOECC Well Records

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(014)	17 634591 4858911[W]	1955/08 2801	06					6903478 () BRWN CLAY 0003 BLUE CLAY 0007 BLDR CLAY MSND 0013 FSND 0024 BLUE CLAY 0030 BLUE CLAY MSND 0039 MSND SILT CLAY 0069 BLUE CLAY 0075 MSND SILT CLAY 0088 BLUE CLAY SILT 0123 BLUE CLAY MSND GRVL 0163 BLUE CLAY MSND BLDR 0164 BLUE CLAY MSND 0177 BLUE CLAY MSND GRVL 0181 BLDR CLAY MSND 0182 BLUE CLAY MSND 0185 BLUE CLAY GRVL 0208 BLUE SHLE 0212
MARKHAM TOWN (MARKHA CON 05(014)	17 635035 4859203[W]	1972/07 4610	08 16 10	SA 0108	-008 / 080 200 / 24:0	MN	0110 07 0117 07	6910992 () BLCK LOAM 0002 BLCK MUCK SAND GRVL 0015 GREY GRVL BLDR 0020 GREY SAND GRVL CLAY 0028 GREY GRVL CLAY 0035 GREY CLAY SAND 0051 GREY CLAY SAND GRVL 0076 GREY CLAY 0096 GREY CLAY SILT 0104 GREY CLAY SILT FSND 0108 GREY SAND GRVL CLAY 0111 GREY SAND GRVL 0125 GREY SHLE 0141
MARKHAM TOWN (MARKHA CON 05(014)	17 635045 4858842[W]	1965/11 2105	02	FR 0040	005 / 006 / 3:0	DO	0039 05	6903518 () PRDG 0020 FSND 0022 BLUE CLAY 0040 GRVL 0044
MARKHAM TOWN (MARKHA CON 05(014)	17 633735 4858434[W]	1953/01 4623	05 05	FR 0225	060 / 090 006 / 3:0	DO		6903507 () LOAM 0005 HPAN 0055 GRVL 0060 HPAN 0095 WHIT MSND 0210 SHLE 0232
MARKHAM TOWN (MARKHA CON 05(014)	17 635210 4858844[W]	1959/02 2105	02	FR 0038	013 / 006 / 3:30	DO	0037 05	6903509 () LOAM 0004 BRWN CLAY MSND 0013 BLUE CLAY STNS 0038 GRVL 0042
MARKHAM TOWN (MARKHA CON 05(014)	17 635536 4859189[W]	1964/08 5420	34	FR 0034	016 / / :0	DO		6903516 () LOAM 0001 YLLW CLAY 0010 BLUE CLAY 0030 BLUE CLAY MSND 0040
MARKHAM TOWN (MARKHA CON 05(014)	17 635077 4858972[W]	1958/07 3414	04	FR 0036	/ 026 010 / 2:0	DO	0032 04	6903508 () PRDG 0013 BLUE CLAY 0032 BRWN CSND 0036
MARKHAM TOWN (MARKHA CON 05(015)	17 633793 4859064[W]	1984/11 2517	06	FR 0185	005 / 004 / :0	DO		6917518 () GREY CLAY GRVL BLDR 0128 GREY GRNT 0204
MARKHAM TOWN (MARKHA CON 05(015)	17 635419 4859701[W]	1974/12 2610	06 06					6912497 () BRWN CLAY SAND 0018 GREY CLAY SAND 0065 GREY CLAY 0075 GREY CLAY SAND 0085 GREY CLAY 0160 GREY CLAY SAND 0170 GREY CLAY 0200 GREY CLAY SAND 0220 GREY SHLE 0330
MARKHAM TOWN (MARKHA CON 05(015)	17 633630 4858828[W]	1958/05 4508	04 04	FR 0185	020 / 230 002 / 5:0	DO		6903519 () BRWN CLAY 0040 BRWN CLAY MSND 0047 BRWN MSND 0070 GREY FSND 0185 GREY SHLE 0241
MARKHAM TOWN (MARKHA CON 05(015)	17 633607 4859204[W]	1966/03 4610	07	FR 0208 FR 0159	070 / 072 012 / 5:0	DO	0204 09	6903522 () LOAM 0001 BRWN CLAY 0010 HPAN BLDR 0063 BLUE CLAY GRVL 0110 BLUE CLAY 0159 MSND 0161 BLUE CLAY 0171 CLAY MSND 0185 BLUE CLAY 0208 FSND 0212 CSND GRVL 0213

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(015)	17 633755 4859063^{W}	1976/11 2651	06	FR	033 / 141 004 / 4:0	DO	0128 08	6913795 () FILL 0003 BRWN CLAY 0012 GREY CLAY GRVL 0083 GREY CLAY SAND 0111 FSND 0122 GREY CLAY SAND 0131 CSND 0141 GREY CLAY SAND 0141
MARKHAM TOWN (MARKHA CON 05(015)	17 634375 4859423^{W}	1973/07 1663	05	FR 0069 FR 0110	013 / 072 005 / 2:30	DO	0075 04	6911701 () BRWN LOAM 0001 YLLW CLAY BLDR 0016 BLUE CLAY SAND 0047 BLUE CLAY 0069 GREY SAND GRVL 0098 BLUE CLAY GRVL 0110 GREY SAND GRVL 0127
MARKHAM TOWN (MARKHA CON 05(015)	17 633757 4859172^{W}	1962/07 1413	05	FR 0132	012 / 095 002 / 3:0	DO	0128 04	6903521 () HPAN 0125 FSND 0132
MARKHAM TOWN (MARKHA CON 05(015)	17 634699 4859490^{W}	1961/08 4813	05	FR 0097	-001 / 006 / :0	DO	0095 05	6903520 () FILL 0003 BRWN CLAY 0018 BLUE CLAY 0036 CLAY QSND 0050 HPAN 0072 CLAY 0091 MSND 0101
MARKHAM TOWN (MARKHA CON 05(016)	17 635105 4859863^{W}	1968/08 4610	06					6908792 () BRWN CLAY 0020 GRVL CLAY BLDR 0024 BLUE CLAY 0060 BLUE CLAY MSND 0067 BLUE CLAY 0092 CLAY MSND 0095 HPAN 0119 BLUE SHLE 0135
MARKHAM TOWN (MARKHA CON 05(016)	17 635325 4860223^{W}	1970/06 5459	34	FR 0018	/ / :0	DO		6910172 () BLCK LOAM 0002 BRWN CLAY MSND 0009 BLUE CLAY 0018 GREY MSND 0020 BLUE CLAY STNS 0022
MARKHAM TOWN (MARKHA CON 05(016)	17 635391 4859987^{W}	1954/10 4619	04	FR 0037	/ / :0	DO		6903525 () BRWN CLAY 0004 MSND 0014 BLUE MSND 0020 FSND 0037
MARKHAM TOWN (MARKHA CON 05(016)	17 635329 4860256^{W}	1955/02 1413	06	FR 0017	/ / :0	DO		6903523 () PRDG 0009 BLUE CLAY 0017
MARKHAM TOWN (MARKHA CON 05(016)	17 633369 4859817^{W}	1987/09 1413	06	FR 0079	004 / 060 005 / 4:10	DO	0073 06	6919047 (13698) BRWN CLAY STNS HARD 0006 BRWN SAND STNS LOOS 0014 GREY CLAY SLTY 0069 BRWN SAND GRVL CLN 0079 GREY CLAY DNSE 0088
MARKHAM TOWN (MARKHA CON 05(016)	17 637355 4860778^{W}	1989/06 5459	06	FR 0062	/ 050 030 / 1:0	DO	0064 03	6920491 (58314) BRWN CLAY 0007 BLUE CLAY SOFT 0016 BLUE CLAY GRVL 0019 BLUE CLAY SAND 0040 GREY SAND FSND 0054 GREY CLAY STNS 0062 GREY GRVL 0067
MARKHAM TOWN (MARKHA CON 05(016)	17 635385 4859920^{W}	1990/11 1413	06	FR 0118	/ 100 030 / 1:0	DO	0115 03	6921321 (91655) BRWN CLAY DNSE 0017 GREY CLAY DNSE 0037 GREY CLAY SILT LYRD 0078 BLCK SAND GRVL CGVL 0118 BLCK SHLE HARD 0119
MARKHAM TOWN (MARKHA CON 05(016)	17 633915 4859543^{W}	1978/08 4816	06	FR 0190	011 / 185 002 / 3:0		0195 03	6914701 () CLAY GRVL BLDR 0019 SAND 0031 CLAY GRVL SAND 0053 SAND SHLE 0061 CLAY 0076 SAND CLAY 0153 CLAY SILT 0183 SAND GRVL CLAY 0197 SAND 0204 GRVL SHLE 0209 BRWN SHLE 0210

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(016)	17 634148 4859760^{W}	1953/06 4619	04	FR 0065	/ / :0	DO		6903524 () BRWN CLAY 0020 HPAN CLAY STNS 0049 BLUE CLAY MSND 0065 FSND 0072 FSND CSND 0075
MARKHAM TOWN (MARKHA CON 05(016)	17 634138 4859663^{W}	1962/10 5420	34	FR 0030	012 / / :0	ST DO		6903526 () LOAM 0001 YLLW CLAY MSND 0010 BLUE CLAY 0030 GRVL 0032
MARKHAM TOWN (MARKHA CON 05(016)	17 634084 4859636^{W}	2004/08 1663	07	FR 0095	-003 / 070 / 1:0	IR		6928333 (Z19436) A013022 BLCK LOAM 0001 BRWN CLAY SAND 0018 BRWN MSND 0032 BLUE CLAY GRVL LYRD 0093 GREY SAND CLAY DRTY 0097 GREY MSND FSND 0123 BLUE CLAY FSND LYRD 0128
MARKHAM TOWN (MARKHA CON 05(016)	17 635316 4860217^{W}	1974/08 5459	06	FR 0069	012 / 055 020 / 1:0	DO	0071 04	6912452 () LOAM 0002 BRWN CLAY 0018 BLUE CLAY 0060 BLUE CLAY SAND 0069 BLUE CSND 0075
MARKHAM TOWN (MARKHA CON 05(016)	17 631639 4858619^{W}	1999/08 1663				NU		6925042 (206290) BRWN CLAY SNDY 0000 YLLW UNKN 0007 BRWN CLAY SNDY GRVL 0021 YLLW UNKN 0063
MARKHAM TOWN (MARKHA CON 05(016)	17 635375 4860043^{W}	1981/08 5459	06	FR 0038	001 / 035 010 / :0	DO	0044 03	6916014 () PRDG 0015 BLUE CLAY STNS 0031 BLUE CLAY SOFT 0038 BLUE SAND 0047
MARKHAM TOWN (MARKHA CON 05(016)	17 633875 4859543^{W}	1978/07 4816	06	FR 0189 FR 0035	019 / 004 / 2:0			6914699 () CLAY SAND STNS 0025 SAND GRVL BLDR 0050 GRVL SAND CLAY 0065 SAND CLAY SILT 0189 MSND 0206 CLAY SAND STNS 0211 BRWN SHLE 0215
MARKHAM TOWN (MARKHA CON 05(016)	17 634045 4859573^{W}	1968/12 4610	06	FR 0108	-012 / 077 030 / :0	 NU	0094 25	6908869 () LOAM 0001 BRWN CLAY 0015 BLUE CLAY 0030 GRVL MSND 0032 CLAY MSND 0066 MSND CLAY 0075 MSND 0077 BLUE CLAY 0094 MSND GRVL 0098 CLAY MSND 0103 MSND 0108 MSND SILT 0119
MARKHAM TOWN (MARKHA CON 05(016)	17 635355 4860023^{W}	1982/08 5459	06	FR 0050	003 / 045 010 / :0	DO	0051 03	6916404 () BRWN CLAY 0019 BLUE CLAY STNS 0038 BLUE CLAY SAND SOFT 0046 BLUE SAND CLAY SOFT 0050 BLUE SAND 0054
MARKHAM TOWN (MARKHA CON 05(016)	17 633915 4859543^{W}	1978/12 4816	06	UK 0033	002 / 018 004 / 2:0	MN	0038 05	6914947 () SAND CLAY LYRD 0009 CLAY HARD 0015 SAND SILT CMTD 0033 FSND MSND SILT 0043 CLAY GRVL STNS 0062
MARKHAM TOWN (MARKHA CON 05(016)	17 634155 4859513^{W}	1968/09 4610	07	FR 0087	-003 / 016 / 2:0	NU	0086 10	6908865 () LOAM 0008 CLAY MSND GRVL 0011 CLAY GRVL 0020 BLUE CLAY 0052 CLAY MSND GRVL 0056 CLAY MSND 0087 MSND GRVL 0097
MARKHAM TOWN (MARKHA CON 05(016)	17 633535 4859363^{W}	1978/07 4816	06	FR 0194	069 / 010 / 2:0	DO	0197 03	6914698 () SAND CLAY STNS 0062 CLAY HARD 0090 CLAY SOFT 0142 CLAY SAND LYRD 0245
MARKHAM TOWN (MARKHA CON 05(016)	17 633875 4859543^{W}	1978/08 4816	06	FR 0189	023 / / :0			6914700 () PRDG 0197

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(016)	17 635375 4859983[W]	1973/09 5459	06	FR 0070	/ 060 008 / 2:30	DO	0072 03	6911861 () LOAM 0002 BLUE CLAY 0020 BLUE CLAY SILT 0058 FSND 0068 CSND 0075
MARKHAM TOWN (MARKHA CON 05(016)	17 635415 4859933[W]	1973/05 5459	30		010 / / :0	 DO		6911439 () BRWN CLAY 0008 BLUE CLAY 0015 BLUE CLAY 0020
MARKHAM TOWN (MARKHA CON 05(016)	17 633369 4859817[W]	1987/10 1413	06	FR 0136	012 / 030 024 / 2:30	DO ST	0129 06	6919099 () BRWN CLAY SAND PCKD 0016 BLUE CLAY DNSE 0079 GREY SAND SILT CLAY 0122 GREY SAND CLN 0136
MARKHAM TOWN (MARKHA CON 05(016)	17 635324 4860451[W]	1987/08 5459	06	FR 0067	-004 / 030 020 / 1:0	DO	0068 03	6919191 () BRWN CLAY STNS 0014 BLUE CLAY 0030 BLUE CLAY SAND 0035 BLUE CLAY 0058 BLUE CLAY SOFT 0064 BLUE SAND CLAY 0067 BLUE GRVL 0071
MARKHAM TOWN (MARKHA CON 05(016)	17 634045 4859473[W]	1968/10 4610	07	FR 0087	008 / 075 075 / 9:0	IR	0087 07	6908866 () BRWN CLAY 0010 CLAY MSND STNS 0020 MSND CLAY 0030 BLUE CLAY 0051 CLAY GRVL 0055 CLAY MSND GRVL 0087 MSND GRVL 0097 MSND GRVL CLAY 0102 CLAY MSND GRVL 0160 BLUE SHLE 0194
MARKHAM TOWN (MARKHA CON 05(016)	17 633955 4859733[W]	1968/11 4610		UK 0044		NU		6908868 () LOAM 0001 BRWN CLAY 0020 BLUE CLAY 0044 MSND 0048 MSND 0084 BLUE CLAY MSND 0094
MARKHAM TOWN (MARKHA CON 05(017)	17 635278 4860313[W]	1986/06 5459	06	FR 0118	020 / 118 015 / 2:0	DO	0118 06	6918617 (01193) BRWN CLAY SAND 0009 GREY CLAY STNS 0023 GREY CLAY SILT 0044 GREY CLAY STNS 0053 GREY SAND STNS SILT 0058 GREY CLAY SAND STNS 0097 GREY SILT SAND 0107 GREY CLAY STNS 0111 GREY SAND STNS 0125
MARKHAM TOWN (MARKHA CON 05(017)	17 634780 4860158[W]	1965/08 2801	06					6903806 () LOAM 0004 CLAY GRVL BLDR 0009 MSND 0017 BLUE CLAY 0033 MSND SILT 0040 CLAY BLDR 0043 SILT FSND 0053 MSND GRVL 0064 CLAY GRVL 0069 CLAY GRVL BLDR 0070 CLAY GRVL SHLE 0128
MARKHAM TOWN (MARKHA CON 05(017)	17 634615 4860183[W]	1969/06 4610	07	FR 0046		NU		6909446 () CLAY 0002 MSND GRVL BLDR 0006 MSND BLDR 0022 BLUE CLAY 0030 CLAY MSND 0044 GRVL CLAY 0046 FSND CLAY 0052 FSND 0058 CLAY 0064 BLUE CLAY GRVL 0083
MARKHAM TOWN (MARKHA CON 05(017)	17 634335 4860123[W]	1969/06 4610	07	FR 0059		 NU		6909445 () BRWN CLAY 0007 CLAY BLDR 0010 CLAY 0034 CLAY GRVL 0039 CLAY MSND 0059 MSND 0062 MSND CLAY 0064 CLAY 0066 CLAY GRVL 0122
MARKHAM TOWN (MARKHA CON 05(017)	17 633380 4859891[W]	1961/07 2204	02	FR 0064	-014 / 020 / :0	 DO		6903527 () BLCK LOAM 0002 GRVL 0004 BLUE CLAY 0064 CSND 0065

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(017)	17 633955 4860033^{W}	1969/04 4610						6909442 () CLAY GRVL BLDR 0012 BLUE CLAY 0078 FSND CLAY 0113 BLUE CLAY 0129
MARKHAM TOWN (MARKHA CON 05(017)	17 634265 4860163^{W}	1969/03 4610	07	FR 0072		NU		6909440 () BRWN CLAY 0015 BLUE CLAY 0030 CLAY MSND 0063 MSND CLAY 0076 CLAY 0115 SHLE CLAY 0125
MARKHAM TOWN (MARKHA CON 05(017)	17 635203 4860588^{W}	1975/08 5459	06	FR 0070	028 / 070 020 / 2:0	DO	0070 04	6912887 () BRWN CLAY 0015 BLUE CLAY 0035 GREY SAND 0080
MARKHAM TOWN (MARKHA CON 05(017)	17 635314 4860366^{W}	1961/09 5420	34	FR 0019	004 / / :0	DO		6903528 () LOAM 0001 YLLW CLAY 0009 BLUE CLAY GRVL STNS 0015 MSND CLAY 0021
MARKHAM TOWN (MARKHA CON 05(017)	17 634895 4860253^{W}	1969/06 4610	07	FR 0052	012 / 043 018 / 5:0	NU	0056 14	6909444 () LOAM 0002 BRWN CLAY 0014 CLAY GRVL 0052 MSND GRVL 0062 MSND FSND 0070 CLAY 0073
MARKHAM TOWN (MARKHA CON 05(018)	17 633353 4860091^{W}	1999/06 1663	06	FR 0129	035 / 056 018 / 1:0	DO	0133 03	6925249 (213471) BLUE LOAM 0001 BRWN GRVL SAND 0009 BLUE CLAY SLTY SILT 0041 BLUE CLAY 0064 GREY SAND 0066 BLUE CLAY SAND 0129 GREY MSND 0137 GREY FSND 0148
MARKHAM TOWN (MARKHA CON 05(018)	17 634249 4860525^{L}	1996/08 1413	06	FR 0117	040 / 114 020 / 1:0	DO	0114 03	6923678 (166608) BRWN CLAY HARD 0017 GREY CLAY HARD 0109 GREY CGVL 0117
MARKHAM TOWN (MARKHA CON 05(018)	17 633407 4860155^{W}	1966/08 4305	04	FR 0105	032 / 095 015 / 13:0	DO	0105 07	6903536 () LOAM 0002 CSND 0035 FSND 0068 GREY CLAY 0105 MSND CLAY 0112
MARKHAM TOWN (MARKHA CON 05(018)	17 634395 4860503^{W}	1969/05 4610	06					6909443 () LOAM 0002 BRWN CLAY BLDR 0024 BLUE CLAY 0029 MSND BLDR 0032 CLAY MSND 0078 CLAY GRVL 0130
MARKHAM TOWN (MARKHA CON 05(018)	17 633483 4860457^{W}	1986/10 3903	06	FR 0134	031 / 087 015 / 3:0	DO	0129 04	6918614 () BRWN CLAY STNS DNSE 0017 GREY CLAY SILT LYRD 0034 GREY CLAY STNS HARD 0097 GREY CLAY SILT LYRD 0129 GREY CLAY SAND LOOS 0134
MARKHAM TOWN (MARKHA CON 05(018)	17 634035 4860438^{W}	1965/08 2801	02	FR 0050	/ 020 027 / 8:0	 NU	0066 22	6903813 () LOAM 0001 BLDR CLAY 0003 CLAY GRVL BLDR 0012 CLAY GRVL 0050 SILT FSND 0052 MSND GRVL 0053 CLAY 0056 SILT 0059 CLAY 0070 CLAY GRVL 0073 SILT CLAY 0087 CLAY GRVL BLDR 0092 CLAY 0187 SHLE 0189
MARKHAM TOWN (MARKHA CON 05(018)	17 633359 4860171^{W}	1963/08 1515	04	FR 0107	016 / 106 007 / 8:0	DO	0108 06	6903530 () LOAM 0001 MSND GRVL 0080 BLUE CLAY 0107 MSND 0114
MARKHAM TOWN (MARKHA CON 05(018)	17 633413 4860375^{W}	1964/04 3108	04	FR 0139	038 / 065 005 / 2:30	DO	0141 03	6903533 () LOAM 0001 BRWN CLAY STNS 0012 BLUE CLAY STNS 0025 BLUE CLAY MSND 0052 BLUE CLAY 0120 BLUE CLAY STNS 0139 MSND 0144

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(018)	17 634249 4860525[L]	1965/05 3108	04	FR 0154	045 / 050 010 / 4:0	DO	0155 04	6903535 () LOAM 0001 YLLW CLAY 0052 BLUE CLAY 0126 MSND 0135 CLAY MSND 0142 MSND 0149 BLUE MSND CLAY 0154 MSND 0159
MARKHAM TOWN (MARKHA CON 05(018)	17 633334 4860402[W]	1975/08 5459	06	FR 0114	050 / 060 030 / 3:0	DO	0115 03	6912788 () LOAM 0002 BRWN CLAY 0019 BLUE CLAY 0040 BLUE CLAY GRVL 0080 BLUE CLAY 0114 BLUE CSND 0118
MARKHAM TOWN (MARKHA CON 05(018)	17 634245 4860525[L]	2000/09 5459	06	FR 0090	015 / 040 025 / 1:0		0090 09	6925588 (221537) BRWN CLAY SOFT 0018 GREY CLAY 0032 GREY CLAY SNDY 0070 GREY CLAY SAND SOFT 0081 GREY CLAY SNDY 0084 GREY MSND 0088 GREY CLAY SNDY 0090 GREY MSND 0094 GREY MSND 0100
MARKHAM TOWN (MARKHA CON 05(018)	17 634245 4860525[L]	2000/09 5459	06 02				0127 05	6925590 (221536) BLCK LOAM 0001 BRWN CLAY 0013 GREY CLAY STNS SOFT 0028 GREY CLAY SAND 0070 GREY CLAY SAND SOFT 0079 GREY CSND 0081 GREY CLAY SILT 0083 GREY MSND 0094 GREY FSND 0099 GREY CLAY GRVL 0102 GREY CLAY GRVL 0126 GREY SAND CLAY SOFT 0134 GREY CLAY STNS 0142
MARKHAM TOWN (MARKHA CON 05(018)	17 633404 4860485[W]	1996/08 1413	06	FR 0117	060 / 100 040 / 1:0	DO	0114 03	6923675 (166603) BRWN CLAY HARD 0017 GREY CLAY STNS HARD 0050 GREY CLAY DNSE 0105 GREY CSND 0110 GREY CGVL 0117
MARKHAM TOWN (MARKHA CON 05(018)	17 633385 4860282[W]	1958/05 2527	02	FR 0104	034 / 003 / 8:0	DO	0103 05	6903529 () CLAY 0041 CLAY MSND 0052 BLUE CLAY 0078 MSND 0089 QSND 0093 WHIT CLAY 0103 MSND 0108
MARKHAM TOWN (MARKHA CON 05(018)	17 633461 4860364[W]	1963/09 5420	34	FR 0012	012 / 004 / :0	DO		6903531 () LOAM 0001 YLLW CLAY 0010 MSND GRVL 0014 BLUE CLAY 0034
MARKHAM TOWN (MARKHA CON 05(018)	17 633494 4860189[W]	1963/10 5420	34	FR 0025	022 / 002 / :0	DO		6903532 () LOAM 0001 YLLW CLAY 0010 BLUE CLAY 0025 MSND 0026 BLUE CLAY 0046
MARKHAM TOWN (MARKHA CON 05(018)	17 633463 4860228[W]	1964/06 5420	05	FR 0146	031 / 045 020 / 7:0	DO	0146 04	6903534 () PRDG 0047 CLAY GRVL 0060 BLUE CLAY 0120 CLAY MSND 0141 MSND 0150
MARKHAM TOWN (MARKHA CON 05(018)	17 634035 4860493[W]	1969/02 4610	06	FR 0049 FR 0070	/ 036 050 / 24:0	IR	0070 16	6909439 () LOAM 0002 BRWN CLAY STNS 0024 BLUE CLAY SILT 0033 MSND SILT GRVL 0049 CLAY MSND SILT 0070 CSND FSND CLAY 0076 FSND SILT 0080 FSND CSND CLAY 0085 FSND SILT CLAY 0093
MARKHAM TOWN (MARKHA CON 05(018)	17 633915 4860643[W]	1969/04 4610	07	FR 0072	016 / 050 100 / 6:0	IR	0066 19	6909441 () CLAY MSND 0020 BLUE CLAY 0028 FSND CLAY 0072 CSND 0082 MSND CLAY 0086 HPAN 0096

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(018)	17 633315 4860303^{W}	1980/04 5459	06	FR 0113	050 / 110 015 / :0	DO	0113 03	6915725 () BLCK LOAM 0002 BRWN CLAY SOFT 0019 BLUE CLAY SOFT 0031 BLUE CLAY STNS 0079 BLUE CLAY SOFT 0113 BLUE SAND 0116
MARKHAM TOWN (MARKHA CON 05(018)	17 633494 4860512^{W}	1985/10 3903	06 06	FR 0130	046 / 120 020 / 5:0	DO	0130 03	6917770 () BRWN CLAY SAND LYRD 0011 GREY CLAY STNS HARD 0031 GREY CLAY DNSE 0060 GREY CLAY STNS HARD 0116 BRWN CLAY SAND LYRD 0119 GREY CLAY DNSE 0129 BRWN CLAY SAND LYRD 0134 GREY CLAY DNSE 0144 GREY CLAY STNS HARD 0185 GREY CLAY SHLE HARD 0196 GREY SHLE DNSE 0207
MARKHAM TOWN (MARKHA CON 05(018)	17 633425 4860223^{W}	1970/07 4813	05	FR 0159	055 / 060 010 / 2:50	DO	0155 04	6909881 () BLCK LOAM 0002 BLUE CLAY STNS 0100 SILT 0111 GREY CLAY 0142 GRVL 0150 MSND 0159
MARKHAM TOWN (MARKHA CON 05(018)	17 633375 4860308^{W}	1968/08 5420	05	FR 0140	034 / 080 009 / 6:0	DO	0159 04	6908803 () BRWN CLAY STNS 0008 GRVL CLAY 0010 BRWN CLAY BLDR 0045 BLUE CLAY 0140 GRVL SILT CLAY 0155 GREY MSND 0163
MARKHAM TOWN (MARKHA CON 05(018)	17 633354 4860049^{W}	1965/09 2801	06	FR 0092				6903537 () LOAM 0002 GRVL 0006 CLAY 0025 CLAY SILT 0029 CLAY 0069 SILT 0073 CLAY SILT 0080 CLAY 0092 GRVL MSND 0096 SILT 0108 SILT FSND 0119 CLAY 0178 CLAY BLDR 0192 SHLE 0194
MARKHAM TOWN (MARKHA CON 05(018)	17 633305 4860268^{W}	1967/01 3519	05	FR 0125	040 / 080 010 / 6:0	DO	0126 04	6903538 () LOAM 0002 CLAY STNS 0050 HPAN 0110 WHIT CLAY 0125 BLCK CSND 0130
MARKHAM TOWN (MARKHA CON 05(018)	17 633399 4860327^{W}	1968/01 1104	06	FR 0105 FR 0134	039 / 136 004 / 48:0	DO	0138 04	6903539 () LOAM 0006 GRVL 0033 HPAN 0044 CLAY 0049 CLAY GRVL 0064 SILT CLAY 0105 MSND SILT 0112 SILT 0134 MSND 0144
MARKHAM TOWN (MARKHA CON 05(018)	17 633380 4860249^{W}	1967/11 5420	05	FR 0148	040 / 080 008 / 3:0	DO	0151 04	6903540 () LOAM 0001 BLDR CLAY 0035 CLAY MSND STNS 0148 MSND 0155
MARKHAM TOWN (MARKHA CON 05(018)	17 635121 4860921^{W}	1965/08 2801	06					6903814 () LOAM 0001 CLAY 0018 CLAY GRVL 0025 SILT 0030 CLAY 0091 CLAY BLDR 0150 SHLE 0152
MARKHAM TOWN (MARKHA CON 05(019)	17 635015 4861470^{W}	1996/09 3108						6923713 (166663)
MARKHAM TOWN (MARKHA CON 05(019)	17 633555 4860576^{W}	1966/09 5420	05	FR 0121	040 / 065 010 / 10:0	DO	0121 04	6903559 () PRDG 0005 BRWN CLAY STNS 0040 BLUE CLAY 0100 HPAN 0115 BLUE CLAY 0121 MSND GRVL 0125
MARKHAM TOWN (MARKHA CON 05(019)	17 633407 4860563^{W}	1965/07 5420	05	FR 0098	020 / 030 010 / 3:0	DO	0096 04	6903551 () CLAY BLDR 0060 BLUE CLAY MSND 0098 GRVL MSND 0100

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(019)	17 633215 4860643[W]	1968/09 2104	06	FR 0115	040 / 130 004 / 72:0	 DO		6908692 () LOAM 0001 BRWN CLAY MSND 0020 GREY CLAY MSND STNS 0115 GRVL MSND CLAY 0137
MARKHAM TOWN (MARKHA CON 05(019)	17 633265 4860803[W]	1968/06 5420	05	FR 0120	031 / 110 004 / 8:0	DO	0120 08	6908769 () PRDG 0023 BLUE CLAY STNS 0038 BLUE CLAY 0110 BLUE CLAY BLDR 0120 MSND SILT GRVL 0130
MARKHAM TOWN (MARKHA CON 05(019)	17 633235 4860783[W]	1968/05 5420	34	FR 0030	/ / :0	DO		6908789 () LOAM 0001 BRWN CLAY 0011 BLUE CLAY BLDR 0034
MARKHAM TOWN (MARKHA CON 05(019)	17 634167 4860935[L]	1994/10 5459	06	FR 0148	050 / 080 025 / 1:0	DO	0153 03	6922923 (141542) BLCK LOAM 0002 BRWN CLAY STNS 0018 GREY CLAY STNS 0065 GREY CLAY SLTY 0115 GREY SAND GRVL CLAY 0127 GREY CLAY STNS 0148 GREY SAND MUCK 0156 GREY CLAY STNS
MARKHAM TOWN (MARKHA CON 05(019)	17 634166 4860935[L]	2000/04 5459	06	FR 0071	025 / 060 008 / 1:30	DO	0072 03	6925321 (211663) BLCK LOAM 0002 BRWN CLAY SAND STNS 0014 GREY CLAY SNDY 0058 GREY CLAY SAND SILT 0071 GREY MSND 0075 GREY CLAY SNDY 0075
MARKHAM TOWN (MARKHA CON 05(019)	17 635038 4861179[W]	1996/09 3108						6923714 (166662) CLAY 0010 FILL CLAY CMTD 0010
MARKHAM TOWN (MARKHA CON 05(019)	17 633545 4860638[W]	1974/08 5459	06	FR 0105	042 / 116 008 / 3:0	DO	0113 03	6912307 () BRWN CLAY 0020 BLUE CLAY STNS 0080 GREY SAND CLAY 0105 GREY SAND 0116
MARKHAM TOWN (MARKHA CON 05(019)	17 633395 4860583[W]	1976/11 2651	06	FR	028 / 114 002 / 4:0	DO	0107 04	6913796 () LOAM 0002 BRWN CLAY GRVL 0008 GREY CLAY GRVL 0104 SAND 0114 SAND CLAY 0114
MARKHAM TOWN (MARKHA CON 05(019)	17 633455 4860688[W]	1971/07 5459	06	FR 0118	041 / 075 006 / 5:0	DO	0120 05	6910650 () BLUE CLAY STNS MSND 0035 BLUE CLAY STNS 0118 MSND GRVL 0125
MARKHAM TOWN (MARKHA CON 05(019)	17 633855 4860943[W]	1977/07 3109	30	FR 0044	025 / / :0	DO		6914159 () LOAM 0002 BRWN CLAY STNY 0025 BLUE CLAY STNY 0043 SAND 0045 BLUE CLAY STNY 0052
MARKHAM TOWN (MARKHA CON 05(019)	17 633516 4860903[W]	1975/11 5459	06	UK 0145	070 / 150 012 / 3:0	 DO	0147 06	6912994 () BRWN CLAY 0012 BRWN GRVL SAND 0027 BLUE CLAY STNS 0121 BLUE FSND 0124 BLUE CLAY 0145 BLUE CSND 0153
MARKHAM TOWN (MARKHA CON 05(019)	17 633785 4860963[W]	1969/07 4610	06	FR 0059	/ 039 007 / 11:0	DO	0056 04	6909421 () BRWN CLAY 0004 BRWN CLAY MSND GRVL 0007 BLUE CLAY MSND 0024 BLUE CLAY 0057 GREY MSND SILT 0059 GREY MSND GRVL 0063
MARKHAM TOWN (MARKHA CON 05(019)	17 633335 4860503[W]	1968/05 5420		FR 0109 FR 0145	028 / 150 002 / 6:0	NU		6908794 () BRWN CLAY 0008 YLLW CLAY MSND 0024 HPAN 0042 BLUE CLAY 0109 BLUE CLAY SILT 0113 BLUE CLAY 0145 GREY FSND SILT 0153 BLUE CLAY SILT 0167 SHLE 0180

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(019)	17 634818 4861336W	1959/12 5420	30	FR 0014	010 / 002 / :0	ST		6903541 () YLLW CLAY 0007 BLUE CLAY 0012 GRVL STNS 0015 BLUE CLAY STNS 0027
MARKHAM TOWN (MARKHA CON 05(019)	17 633452 4860852W	1960/09 5420	34	FR 0018	009 / 004 / :0	DO		6903542 () YLLW CLAY MSND 0006 YLLW CLAY 0012 BLUE CLAY 0034
MARKHAM TOWN (MARKHA CON 05(019)	17 633355 4860422W	1960/12 2527	02					6903543 () PRDG 0004 BRWN CLAY STNS 0027
MARKHAM TOWN (MARKHA CON 05(019)	17 633352 4860424W	1961/02 1622	04	FR 0156	100 / 156 006 / 8:0	DO	0156 04	6903544 () PRDG 0005 BLUE CLAY BLDR 0030 BLUE CLAY 0115 CSND 0155 FSND 0160
MARKHAM TOWN (MARKHA CON 05(019)	17 633292 4860941W	1962/05 3414	04	FR 0047	012 / 044 005 / 8:0	DO		6903545 () CLAY MSND STNS 0001 GREY CLAY BLDR 0047 GRVL 0048
MARKHAM TOWN (MARKHA CON 05(019)	17 635038 4861317W	1963/12 5420	34	FR 0014	014 / / :0	DO		6903546 () LOAM 0001 YLLW CLAY 0009 BLUE CLAY MSND 0036
MARKHAM TOWN (MARKHA CON 05(019)	17 633586 4860912W	1964/01 5420	05	FR 0166	042 / 050 006 / 4:0	DO	0167 05	6903547 () PRDG 0034 BRWN CLAY MSND 0045 BRWN CLAY BLDR 0070 BLUE CLAY MSND 0110 GREY MSND 0135 BLUE CLAY MSND 0166 GREY MSND 0172
MARKHAM TOWN (MARKHA CON 05(019)	17 633407 4860681W	1964/05 5420	05	FR 0118	025 / 115 006 / 24:0	DO	0118 04	6903548 () CLAY STNS MSND 0050 BLUE CLAY 0105 GRVL CLAY 0118 CSND 0122
MARKHAM TOWN (MARKHA CON 05(019)	17 633421 4860774W	1965/06 5420	34	FR 0035	018 / / :0	DO		6903549 () LOAM 0001 YLLW CLAY 0012 BLUE CLAY STNS 0035 CLAY MSND STNS 0040
MARKHAM TOWN (MARKHA CON 05(019)	17 633240 4860635W	1965/06 5420	05	FR 0105	039 / 100 006 / 5:0	DO	0105 04	6903550 () PRDG 0035 BLUE CLAY 0105 MSND CSND 0107 CLAY 0109
MARKHAM TOWN (MARKHA CON 05(019)	17 633482 4860995W	1965/10 5420	05	FR 0094	022 / 090 012 / 4:0	DO	0092 04	6903552 () CLAY BLDR 0055 CLAY MSND STNS 0092 GRVL MSND 0096
MARKHAM TOWN (MARKHA CON 05(019)	17 633205 4860797W	1966/02 5420	05	FR 0102	030 / 055 014 / 15:0	DO	0098 04	6903553 () CLAY BLDR 0045 CLAY STNS 0102 MSND 0104
MARKHAM TOWN (MARKHA CON 05(019)	17 633472 4860820W	1966/04 5420	05	FR 0115	045 / 115 008 / 4:0	DO	0115 04	6903554 () LOAM 0002 YLLW CLAY MSND 0008 BRWN CLAY BLDR 0045 BLUE CLAY BLDR 0115 GREY FSND 0120
MARKHAM TOWN (MARKHA CON 05(019)	17 633252 4860525W	1966/05 4305	04	FR 0103	031 / 085 008 / 8:0	DO	0100 06	6903555 () LOAM 0002 CSND STNS 0020 GREY CLAY 0100 GRVL CLAY 0102 FSND CLAY 0103 CSND 0106
MARKHAM TOWN (MARKHA CON 05(019)	17 633339 4860339W	1966/07 5420	05	FR 0102	028 / 038 012 / 5:0	DO	0101 04	6903556 () BRWN MSND 0006 BLDR CLAY 0022 CLAY MSND 0040 BLUE CLAY 0102 GREY MSND 0105

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 05(019)	17 633241 4860735^{W}	1966/08 5420	05	FR 0111	045 / 105 007 / 20:0	DO	0109 04	6903557 () BRWN CLAY 0007 YLLW CLAY STNS 0028 BRWN CLAY STNS 0040 BLUE CLAY 0106 MSND CLAY 0111 GREY MSND 0113
MARKHAM TOWN (MARKHA CON 05(019)	17 633524 4860628^{W}	1966/09 5420	05	FR 0106	035 / 043 010 / 10:0	DO	0108 04	6903558 () PRDG 0046 CLAY 0106 MSND 0112
MARKHAM TOWN (MARKHA CON 05(019)	17 634979 4861462^{W}	1996/09 3108						6923715 (166661)
MARKHAM TOWN (MARKHA CON 05(020)	17 633315 4861213^{W}	1970/11 3903	06	UK 0138	030 / 090 008 / 4:0	DO	0138 04	6910100 () BLCK CLAY MSND STNS 0006 YLLW CLAY STNS 0021 BLUE CLAY STNS 0065 STNS MSND 0067 BLUE CLAY SILT STNS 0115 GREY MSND GRVL 0142
MARKHAM TOWN (MARKHA CON 05(020)	17 633195 4861023^{W}	1983/05 5459	06	FR 0217	035 / 217 010 / 2:0	DO	0217 03	6917027 () BRWN CLAY 0005 BLUE CLAY STNS 0093 BLUE CLAY SILT 0111 GREY SAND STNS SILT 0137 BLUE CLAY SILT 0184 GREY SAND SILT 0205 WHIT CLAY STNS 0209 GREY SAND STNS CLN 0221
MARKHAM TOWN (MARKHA CON 05(020)	17 634085 4861342^{L}	1991/03 5459	06	FR 0158	/ / 3:0	DO	0158 06	6921420 (85054) BRWN CLAY SNDY 0014 GREY CLAY SAND STNS 0067 GREY CLAY SILT 0113 GREY SAND STNS 0119 GREY CLAY SILT 0147 GREY CLAY SAND STNS 0158 GREY SAND FSND 0164 GREY CLAY SAND STNS 0168 GREY CLAY SILT 0175
MARKHAM TOWN (MARKHA CON 05(020)	17 633217 4860916^{W}	1974/05 5459	06	FR 0127	032 / 125 005 / 2:0	DO	0128 04	6912318 () BRWN CLAY 0018 BLUE CLAY SAND STNS 0122 SAND 0127 SAND 0132
MARKHAM TOWN (MARKHA CON 05(020)	17 633135 4861123^{W}	1976/04 5459	06	FR 0125	040 / 125 012 / :0	DO	0127 06	6913631 () BRWN CLAY 0016 BLUE CLAY STNS 0114 BLUE CLAY FSND 0125 BLUE MSND 0134
MARKHAM TOWN (MARKHA CON 05(020)	17 633175 4860843^{W}	1982/06 2407	06	FR 0051	006 / 030 004 / 10:0	DO		6916470 () BLUE HPAN STNS SAND 0051
MARKHAM TOWN (MARKHA CON 05(020)	17 634995 4861743^{W}	1977/07 3109	30 30	FR 0016	012 / / :0	DO		6914160 () LOAM 0002 BRWN CLAY STNY 0016 SAND GRVL 0036
MARKHAM TOWN (MARKHA CON 05(020)	17 633195 4861223^{W}	1973/09 5459	06	FR 0074	015 / 070 008 / 4:0	DO		6911860 () CLAY SAND 0020 CLAY STNS 0028 GRVL 0035 BLUE CLAY 0070 CLAY 0077
MARKHAM TOWN (MARKHA CON 05(020)	17 634935 4861823^{W}	1979/11 1350	06	FR 0065	005 / 035 010 / 2:0	DO		6915314 () GREY CLAY 0018 GREY SILT CLAY STNS 0065 GREY GRVL HPAN 0080
MARKHAM TOWN (MARKHA CON 05(020)	17 633995 4861293^{W}	1969/07 4610	06	FR 0093	-001 / 072 003 / 5:0	DO	0094 04	6909425 () PRDG 0036 BLUE CLAY MSND 0077 BLUE CLAY 0093 BLUE MSND 0097 BLUE CLAY GRVL MSND 0104
MARKHAM TOWN (MARKHA CON 05(020)	17 633235 4860823^{W}	1973/07 5459	06	FR 0154	020 / 135 010 / 2:30	DO	0155 08	6911526 () BRWN CLAY 0022 BLUE CLAY 0154 FSND 0163

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 06(014)	17 635965 4859378^{W}	1960/06 4610	01	FR 0050 FR 0043	006 / 012 020 / 6:0	NU	0127 10	6903791 () LOAM 0002 BRWN CLAY 0012 BLUE CLAY STNS 0042 MSND 0043 BLUE CLAY 0050 FSND 0100 MSND CLAY SILT 0110 FSND 0128 GRVL 0137 CLAY GRVL 0139 CLAY 0145 CLAY STNS 0205 SHLE 0215
MARKHAM TOWN (MARKHA CON 06(014)	17 635695 4859273^{W}	1960/07 4610	06	FR 0025	/ / :0	NU		6903792 () LOAM 0002 BLUE CLAY STNS 0025 FSND CLAY 0087 CLAY STNS 0175 CLAY BLDR 0177 CLAY STNS 0198 SHLE 0200
MARKHAM TOWN (MARKHA CON 06(014)	17 637546 4860054^{W}	1962/12 5420	05	FR 0105	016 / 020 007 / 12:0	DO		6903794 () PRDG 0030 BRWN MSND 0065 CLAY STNS MSND 0100 CLAY MSND 0108
MARKHAM TOWN (MARKHA CON 06(014)	17 635582 4859182^{W}	1966/07 2610	30	FR 0021	002 / 019 / :0	DO		6903796 () BRWN CLAY 0011 GREY CLAY 0021 GRVL 0026
MARKHAM TOWN (MARKHA CON 06(014)	17 636930 4859802^{W}	1962/03 1622	04	FR 0180	003 / 030 012 / 5:0	ST DO	0191 04	6903795 () BRWN CLAY 0018 GRVL BLDR 0050 GRVL CLAY 0180 CSND 0195
MARKHAM TOWN (MARKHA CON 06(014)	17 637555 4860003^{W}	1979/11 5206	06	FR 0105	020 / 100 005 / 4:30	DO	0114 03	6915260 () BRWN LOAM 0001 BRWN SAND CLAY 0048 GRVL CLAY HARD 0096 CLAY 0108 GREY SAND 0117
MARKHAM TOWN (MARKHA CON 06(014)	17 636160 4859483^{W}	1960/06 4610	05	FR 0032 FR 0003	-004 / 010 060 / 4:0	NU	0052 12	6903790 () LOAM 0002 BLUE CLAY 0005 GRVL 0006 BLUE CLAY 0032 MSND STNS 0050 MSND 0054 MSND STNS 0060 MSND CLAY 0061 FSND 0070 MSND CLAY 0074 GRVL HPAN 0086
MARKHAM TOWN (MARKHA CON 06(014)	17 635995 4859423^{W}	1960/07 4610	04	FR 0047	006 / 027 040 / 48:0	NU	0111 20	6903793 () LOAM 0001 BRWN CLAY 0002 BLUE CLAY 0047 MSND 0117 GRVL BLDR 0131 CLAY STNS 0175 GRVL CLAY 0177 CLAY MSND STNS 0201 SHLE 0205
MARKHAM TOWN (MARKHA CON 06(014)	17 636240 4859523^{W}	1960/06 4610	02	FR 0024 FR 0193	/ 020 006 / 10:0	IR	0193 13	6903789 () LOAM 0002 BLUE CLAY 0018 BLUE CLAY STNS 0024 GRVL CLAY 0036 CLAY STNS MSND 0040 CLAY BLDR 0043 BLUE CLAY 0100 GRVL CLAY 0137 BLDR 0139 GRVL CLAY 0170 GRVL CLAY BLDR 0193 GRVL CLAY 0206 CLAY STNS 0214 SHLE 0220
MARKHAM TOWN (MARKHA CON 06(015)	17 636471 4860003^{L}	2002/02 3903	12 10	FR 0112	/ 024 300 / 70:0	CO	0067 50	6926271 (227712) BRWN CLAY STNS HARD 0026 GREY CLAY SILT LYRD 0070 BRWN SAND CLAY LYRD 0112
MARKHAM TOWN (MARKHA CON 06(015)	17 635482 4859797^{W}	1995/05 3903	04 06		004 / / :0	DO		6923248 (26721) PRDG 0034
MARKHAM TOWN (MARKHA CON 06(016)	17 638041 4856420^{W}	2003/07 1663				NU		6927316 (253165)

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 06(016)	17 637355 4860943[W]	1980/10 5459	06	FR 0121	025 / 121 030 / 2:0	DO	0121 03	6915749 () BRWN CLAY STNS 0039 BRWN SAND SILT 0059 GREY SAND STNS 0078 BLUE CLAY STNS 0092 BLUE CLAY SILT 0108 GREY SAND STNS 0127
MARKHAM TOWN (MARKHA CON 06(016)	17 637306 4861118[W]	1998/11 3903				NU		6924751 (165712)
MARKHAM TOWN (MARKHA CON 06(016)	17 637232 4860506[W]	1997/10 1663						6924242 (186409)
MARKHAM TOWN (MARKHA CON 06(016)	17 634978 4860184[W]	 5459				NU		6927782 (Z05066) A004654
MARKHAM TOWN (MARKHA CON 06(016)	17 635445 4860478[W]	1963/08 5420	05	FR 0058	016 / 025 008 / 4:0	DO ST	0058 04	6903798 () LOAM 0002 CLAY MSND 0055 MSND 0062
MARKHAM TOWN (MARKHA CON 06(016)	17 637347 4860927[W]	1953/02 2419	02	FR 0038	033 / 033 003 / :0	 DO	0038 05	6903800 () GREY CLAY 0038 MSND 0043
MARKHAM TOWN (MARKHA CON 06(016)	17 636472 4860317[W]	1964/04 5420	34	FR 0014	005 / / :0	DO		6903802 () LOAM 0001 YLLW CLAY 0008 BLUE CLAY 0014 CLAY MSND 0016
MARKHAM TOWN (MARKHA CON 06(016)	17 636783 4860448[W]	1964/05 5420	34	FR 0021	021 / 002 / :0	 DO		6903803 () LOAM 0001 CLAY SILT 0012 FSND 0035
MARKHAM TOWN (MARKHA CON 06(016)	17 636443 4860402[W]	1967/03 5420	34	FR 0025	014 / / :0	DO		6903805 () LOAM 0001 BRWN CLAY 0010 BLUE CLAY 0025 BLDR CLAY 0029
MARKHAM TOWN (MARKHA CON 06(016)	17 636445 4860373[W]	1971/05 2407	05	FR 0082	008 / 090 005 / 2:0	DO	0088 03	6910688 () LOAM 0001 FILL 0009 BRWN MSND 0021 BLUE CLAY 0082 BLUE MSND 0091
MARKHAM TOWN (MARKHA CON 06(016)	17 637035 4860453[W]	1968/08 5420	34	FR 0025	010 / / :0	 DO		6908810 () LOAM 0001 BRWN CLAY 0012 BLUE CLAY STNS 0023 BLUE CLAY MSND BLDR 0031
MARKHAM TOWN (MARKHA CON 06(016)	17 637404 4860612[W]	1997/08 6926	01	FR 0010			0020 03	6924311 (174629) BRWN SILT CLAY SAND 0013 BRWN CLAY FSND DNSE 0023
MARKHAM TOWN (MARKHA CON 06(016)	17 636485 4860303[W]	1969/06 2407	05	FR 0064	/ 088 030 / 12:0	ST	0092 04	6909188 () LOAM 0001 BRWN MSND 0024 BLUE CLAY MSND 0064 BLUE MSND 0096
MARKHAM TOWN (MARKHA CON 06(016)	17 637304 4861123[W]	1998/11 3903				NU		6924750 (165713)
MARKHAM TOWN (MARKHA CON 06(016)	17 637220 4860500[W]	1997/10 1663						6924241 (186408)
MARKHAM TOWN (MARKHA CON 06(016)	17 635485 4860229[W]	2004/09 1413	06	FR 0197	072 / 164 007 / 1:0	DO ST		6928356 (Z19210) A006686 BRWN CLAY STNS HARD 0050 BRWN SAND PCKD 0097 GREY SAND MSND 0125 GREY CLAY STNS HARD 0164 GREY SHLE SOFT 0198

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 06(016)	17 635773 4860064^{W}	2004/09 1413	06	FR 0197	085 / 174 016 / 1:0	DO ST		6928357 (Z19211) A006687 BRWN CLAY STNS HARD 0040 GREY CLAY STNS HARD 0075 BRWN SAND LOOS 0137 GREY CLAY SILT GRVL 0177 GREY SHLE HARD 0198
MARKHAM TOWN (MARKHA CON 06(016)	17 637267 4860540^{W}	1960/12 1413	05	FR 0046	020 / 038 009 / 2:0	ST DO	0038 08	6903797 () CLAY STNS 0020 FSND 0046
MARKHAM TOWN (MARKHA CON 06(016)	17 637217 4860534^{W}	1960/10 5420	34	FR 0024	024 / 002 / :0	ST		6903799 () YLLW CLAY 0006 MSND 0032
MARKHAM TOWN (MARKHA CON 06(016)	17 636977 4860482^{W}	1964/01 5420	05	FR 0103	014 / 022 030 / 2:0	 DO	0114 04	6903801 () CLAY 0008 MSND SILT 0058 GREY CSND 0063 HPAN 0103 GREY MSND 0118
MARKHAM TOWN (MARKHA CON 06(016)	17 635859 4860281^{W}	1964/12 5420	05					6903804 () PRDG 0030 BLUE CLAY STNS 0075 BLUE FSND 0164 BLUE FSND CLAY 0192
MARKHAM TOWN (MARKHA CON 06(016)	17 635808 4860277^{W}	1990/04 4738	06	FR 0075	022 / 020 / 1:0	DO	0094 03	6920991 (78254) BRWN CLAY STNS 0027 GREY CLAY STNS 0075 GREY SAND VERY FSND 0090 GREY SAND MSND 0097
MARKHAM TOWN (MARKHA CON 06(018)	17 635268 4861523^{W}	1997/11 1663						6924245 (186425)
MARKHAM TOWN (MARKHA CON 06(018)	17 636234 4861213^{L}	2001/12 6418						6926232 (213180)
MARKHAM TOWN (MARKHA CON 06(018)	17 635267 4861523^{W}	1997/11 1663						6924236 (186427)
MARKHAM TOWN (MARKHA CON 06(018)	17 635267 4861523^{W}	1997/11 1663						6924243 (186426)
MARKHAM TOWN (MARKHA CON 06(018)	17 635846 4861104^{W}	1962/05 2113	06	FR 0060	018 / 040 012 / 8:0	DO	0059 05	6903808 () LOAM 0001 BRWN CLAY STNS 0030 GREY CLAY STNS 0060 GREY CLAY GRVL 0064
MARKHAM TOWN (MARKHA CON 06(018)	17 635690 4861041^{W}	1964/04 2113	06	FR 0041	/ 020 020 / 3:0	DO		6903810 () LOAM 0001 BRWN CLAY STNS 0012 GREY CLAY 0041 BRWN GRVL 0042
MARKHAM TOWN (MARKHA CON 06(018)	17 638185 4856899^{W}	1999/12 1663				NU		6925248 (213428)
MARKHAM TOWN (MARKHA CON 06(018)	17 635268 4861523^{W}	1997/11 1663						6924244 (186424)
MARKHAM TOWN (MARKHA CON 06(018)	17 637150 4861680^{W}	1962/03 5420	34	FR 0048	015 / / :0	 DO		6903807 () LOAM 0001 YLLW CLAY 0014 BLUE CLAY STNS 0048 CSND 0050
MARKHAM TOWN (MARKHA CON 06(018)	17 637031 4861480^{W}	1962/08 5420	34	FR 0028	030 / / :0	 DO		6903809 () LOAM 0001 YLLW CLAY 0017 CLAY MSND 0028 CSND 0042

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
MARKHAM TOWN (MARKHA CON 06(018)	17 635458 4860962^{W}	1964/06 2113	06	FR 0045	/ 024 005 / 2:0	DO	0045 04	6903811 () LOAM 0001 BRWN CLAY 0009 BRWN GRVL MSND 0024 GREY CLAY STNS 0034 BRWN FSND 0040 BRWN FSND STNS 0045 BRWN FSND 0049
MARKHAM TOWN (MARKHA CON 06(018)	17 635438 4860992^{W}	1965/07 5420	34	FR 0020	/ 010 / :0	DO		6903812 () LOAM 0001 BRWN CLAY 0008 BLUE CLAY 0020 FSND 0024
MARKHAM TOWN (MARKHA CON 06(018)	17 635315 4861023^{W}	1981/06 3109	30	FR 0011	007 / / 12:0	DO		6915926 () LOAM 0001 BRWN CLAY SLTY 0011 BLUE CLAY STNY 0027
MARKHAM TOWN (MARKHA CON 06(019)	17 635275 4861183^{W}	1979/11 3109	30	FR 0027	012 / / 8:0	DO		6915257 () LOAM 0002 BRWN CLAY SLTY 0016 BLUE CLAY SLTY 0027 CSND 0030
MARKHAM TOWN (MARKHA CON 06(019)	17 636154 4861608^{L}	2001/01 1663				NU		6925824 (227400)
MARKHAM TOWN (MARKHA CON 06(019)	17 637175 4861743^{W}	1978/07 2651	06	FR 0112	043 / 020 / 2:0	DO	0116 04	6914959 () BRWN CLAY SAND 0017 GREN CLAY SAND GRVL 0111 GREN MSND 0124
MARKHAM TOWN (MARKHA CON 06(020)	17 636317 4862285^{W}	1962/10 5420	34	FR 0030 FR 0050	026 / / :0	DO ST		6903816 () LOAM 0001 YLLW CLAY 0012 BLUE CLAY STNS 0050 MSND CLAY 0051
MARKHAM TOWN (MARKHA CON 06(020)	17 635555 4861663^{W}	1979/12 3108	06	UK 0108	038 / 110 060 / 0:30	DO	0113 06	6915377 () YLLW CLAY 0015 CLAY GRVL 0061 BLUE CLAY SNDY 0081 BLUE CLAY GVLY 0108 BLUE SAND 0119
MARKHAM TOWN (MARKHA CON 06(020)	17 637003 4862529^{W}	1974/08 1413	05			NU		6912293 () BRWN SILT HPAN 0003 GREY SILT CLAY HPAN 0022 GREY SILT SAND STNS 0076 GREY SILT CLAY 0100 GREY FSND STNS 0187 GREY SAND SILT 0205 GREY SHLE 0210
MARKHAM TOWN (MARKHA CON 06(020)	17 635385 4861780^{W}	1962/09 5420	34	FR 0020	018 / / :0	ST DO		6903815 () LOAM 0001 YLLW CLAY STNS 0012 CLAY MSND 0020 GRVL 0029
MARKHAM TOWN (MARKHA CON 06(020)	17 635593 4861687^{W}	1998/06 1663				NU		6924562 (190437)
MARKHAM TOWN (MARKHA CON 06(020)	17 636494 4862297^{W}	1998/11 1663				NU		6924791 (198163) BRWN SAND CLAY 0000 YLLW SAND 0008 BRWN SAND CLAY 0009 YLLW SAND 0050
MARKHAM TOWN (MARKHA CON 06(020)	17 638274 4862986^{W}	2002/05 1663				NU		6926475 (240051)
MARKHAM TOWN (MARKHA CON 06(020)	17 638278 4862992^{W}	2002/05 1663				NU		6926474 (240050)
MARKHAM TOWN (MARKHA CON 06(020)	17 636075 4862011^{L}	2003/07 5459	36			NU		6927158 (264104)

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Borehole and Monitoring Well Logs

Appendix B

PROJECT: 1413472

RECORD OF BOREHOLE: 14-1

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: November 19, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		178.59							
0	CME 85 Truck Mount 203 mm O.D. Hollow Stem Augers	ASPHALT (100 mm)		0.00							Sand
		FILL - (SM) SILTY SAND, some clay, trace gravel; grey, trace organics, moist, loose		0.10	1	SS	9				
		(SP) SAND with clay, trace gravel, trace silt; brown with red iron mottling; non-cohesive, moist, compact		177.90 0.69	2	SS	11				Bentonite
1											Sand Nov. 19, 2014 ▽
		(SW) SAND, some silt; brown; wet, loose to compact		177.14 1.45	3	SS	7				
2					4	SS	14				Screen
3		(SW) SAND, some silt, some gravel; brown; wet, compact		175.62 2.97	5	SS	12				
		END OF BOREHOLE		174.93 3.66							1. Water level in piezometer measured at a depth of 1.30 m below ground surface (Elev. 177.29 m) on November 19, 2014.
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-2

SHEET 1 OF 1

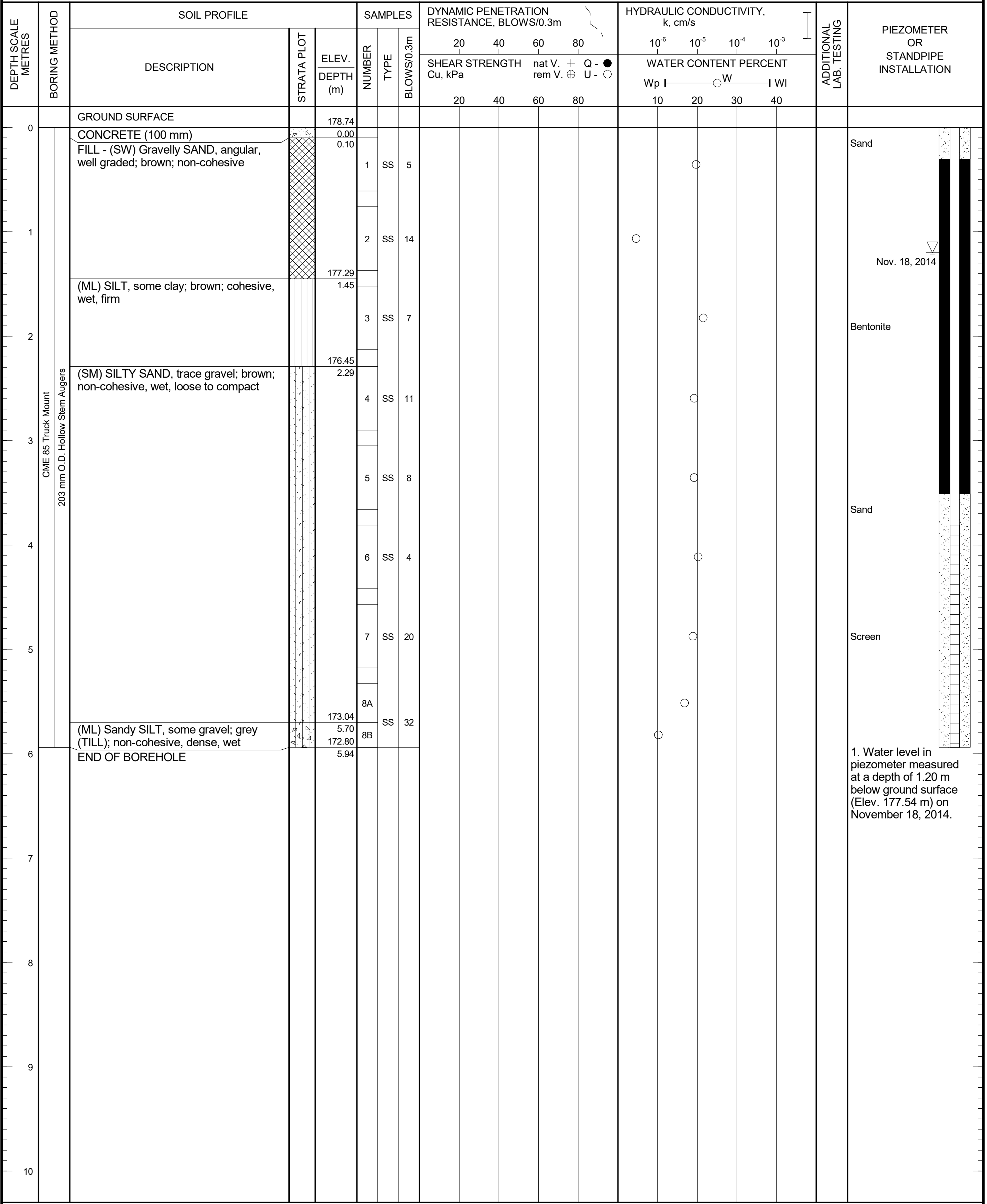
LOCATION: SEE FIGURE 2

BORING DATE: November 18, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	178.74
CONCRETE (100 mm)	0.00
FILL - (SW) Gravelly SAND, angular, well graded; brown; non-cohesive	0.10
(ML) SILT, some clay; brown; cohesive, wet, firm	177.29 1.45
(SM) SILTY SAND, trace gravel; brown; non-cohesive, wet, loose to compact	176.45 2.29
(ML) Sandy SILT, some gravel; grey (TILL); non-cohesive, dense, wet	173.04 5.70
END OF BOREHOLE	172.80 5.94

NUMBER	TYPE	BLOWS/0.3m
1	SS	5
2	SS	14
3	SS	7
4	SS	11
5	SS	8
6	SS	4
7	SS	20
8A 8B	SS	32

1. Water level in piezometer measured at a depth of 1.20 m below ground surface (Elev. 177.54 m) on November 18, 2014.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-3

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

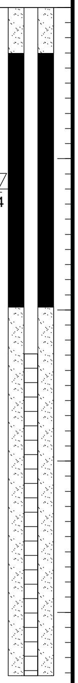
BORING DATE: November 18, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	178.67							
0	CME 85 Truck Mount 203 mm O.D. Hollow Stem Augers	CONCRETE (100 mm)	0.00							Sand
		Hydro-vacuumed and unsampled	0.10							
1										Bentonite ▽ Nov. 18, 2014
2										Sand
		(ML) Sandy SILT, trace gravel; brown; non-cohesive, loose, wet	176.38 2.29	1	SS	7				
3				2	SS	5				Screen
		(SW) SAND, some gravel, brown; non-cohesive, wet, compact	175.01 3.66							
4				3	SS	16				
		END OF BOREHOLE	174.25 4.42							
5										
6										
7										
8										
9										
10										



1. Water level in piezometer measured at a depth of 1.20 m below ground surface (Elev. 177.47 m) on November 18, 2014.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-4

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: November 19, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

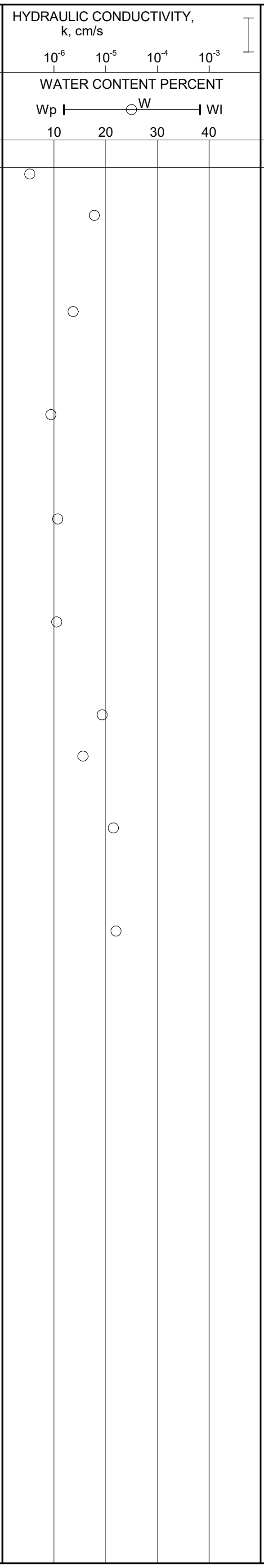
BORING METHOD: CME 85 Truck Mount
203 mm O.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	181.30			
FILL - SAND and GRAVEL; grey; non-cohesive, dry	0.00	1A	SS	
(ML) CLAYEY SILT; brown; cohesive, w<PL, stiff	0.10	1B	SS	11
(ML) CLAYEY SILT, some sand, some gravel; brown, (TILL-LIKE); cohesive, w~PL, firm	180.69 0.61	2	SS	6
(ML) CLAYEY SILT, some sand, some gravel; brown (TILL); cohesive, w~PL, stiff to very stiff	179.90 1.40	3	SS	11
		4	SS	24
		5	SS	25
(ML) SILT, some sand; brown; non-cohesive, wet, dense	177.57 3.73	6A	SS	45
(SW) SAND, well graded, some silt; brown with orange mottling, stratified; non-cohesive, wet, dense	177.03 4.27	6B	SS	
(ML) SILT, some sand; brown, zones of silty fine sand; non-cohesive, wet, dense	4.42	7	SS	30
		8	SS	22
END OF BOREHOLE	175.36 5.94			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

PROJECT: 1413472

RECORD OF BOREHOLE: 14-5

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: November 19, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: CME 85 Truck Mount, 102 mm Solid Stem Augers

DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	183.50			
(SM) SILTY SAND, trace clay, trace organics; dark brown; non-cohesive, dry, loose	0.00	1	SS	6
(ML) Sandy SILT, trace clay; brown; non-cohesive, wet, compact	182.81 0.69	2	SS	11
(CI) SILTY CLAY; brown to grey; cohesive, w~PL, stiff to firm	181.98 1.52	3A 3B	SS	11
		4	SS	6
		5	SS	8
(ML) CLAYEY SILT, some gravel trace sand; grey (TILL); cohesive, w<PL, stiff to very stiff	179.77 3.73	6	SS	11
		7	SS	26
(CI) SILTY CLAY, trace to some gravel, trace sand; grey (TILL); w<PL, very stiff	178.17 5.33	8	SS	26
END OF BOREHOLE	177.56 5.94			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

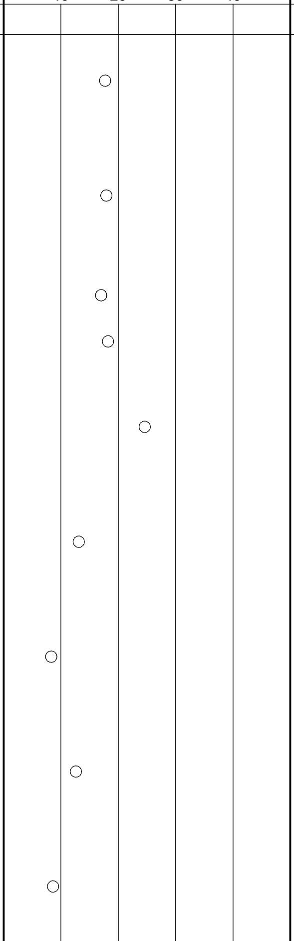
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-6

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

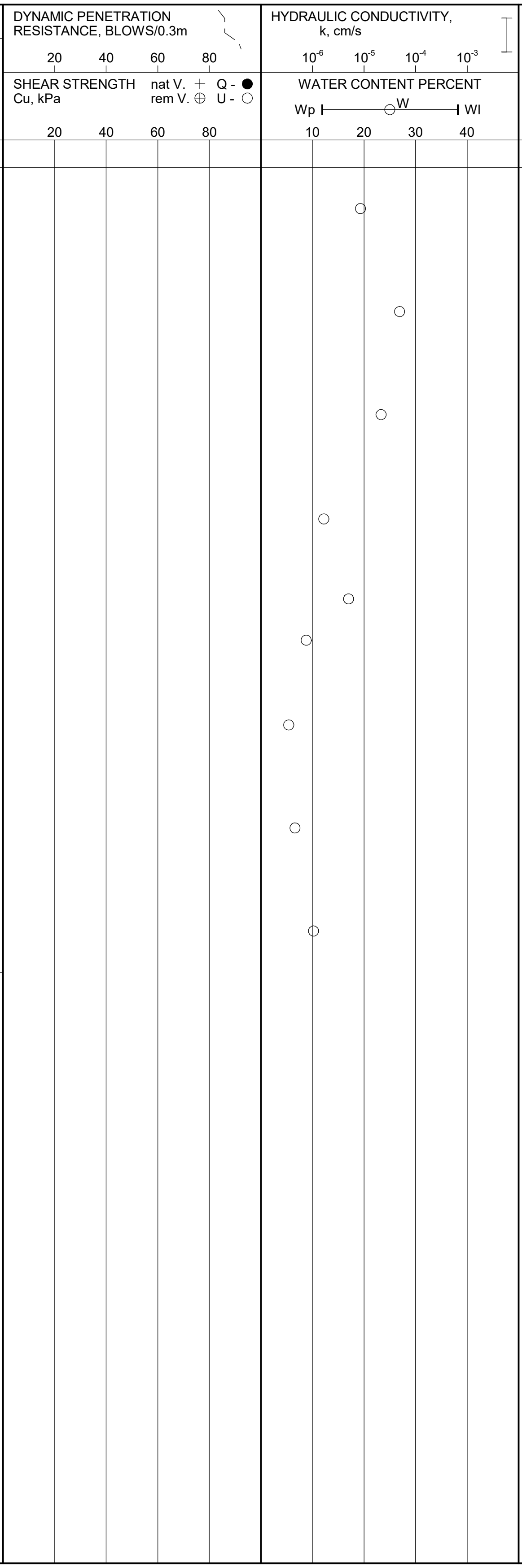
BORING DATE: November 19, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		192.10			
0	CME 85 Truck Mount 102 mm Solid Stem Augers	(SM) SILTY SAND, trace to some gravel; mottled brown and orange; non-cohesive, loose		0.00	1	SS	4
		(CL) SILTY CLAY; light brown to grey; cohesive, w>PL, soft to stiff		191.34 0.76	2	SS	4
					3	SS	8
		(ML) CLAYEY SILT, some gravel; grey, with layers of silty clay (TILL-LIKE); cohesive, w<PL, stiff		189.89 2.21	4	SS	8
		(ML) SILT, trace sand, trace gravel; grey; non-cohesive, wet, compact		189.05 3.05	5A 5B	SS	14
		(SP) SAND, angular to sub-angular, poorly graded, trace gravel; grey; non-cohesive, dense, moist		188.29 3.81	6	SS	25
		(SW) Gravelly SAND, trace silt; grey; non-cohesive, compact		187.60 4.50	7	SS	17
		(ML) CLAYEY SILT; grey, stratified; cohesive, w<PL, hard		186.77 5.33	8	SS	36
6		END OF BOREHOLE		186.16 5.94			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-7

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

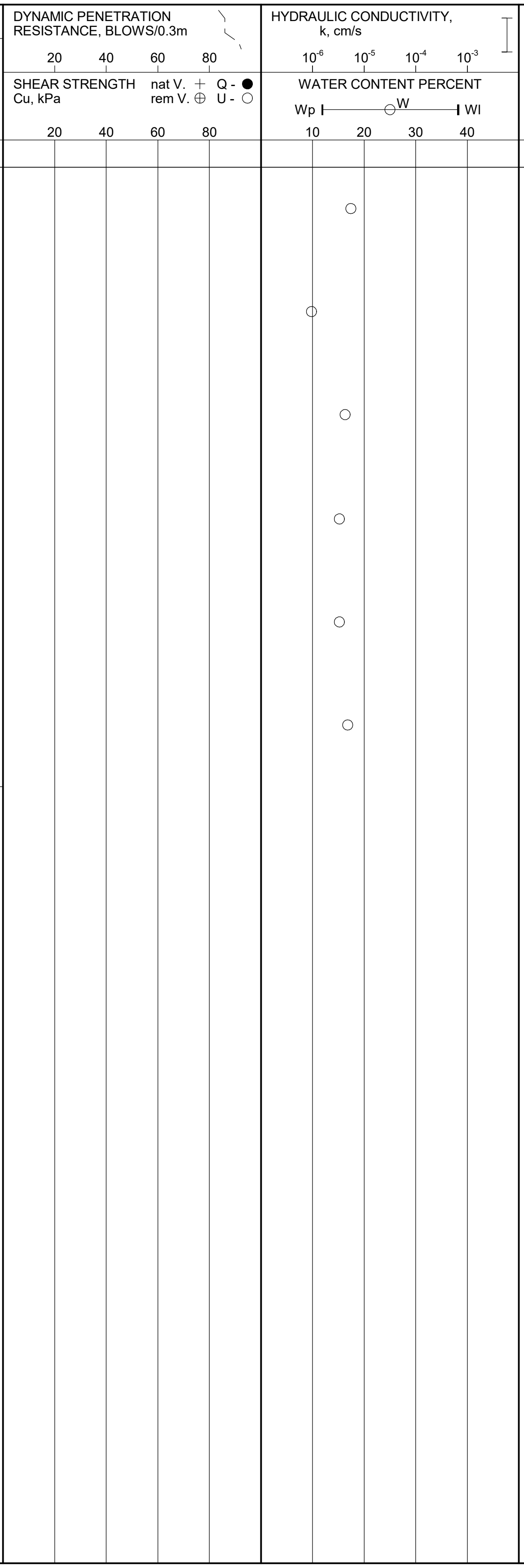
BORING DATE: November 20, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		189.60			
0	Boomer Track Mount 102 mm Solid Stem Augers	FILL - (ML) CLAYEY SILT, some organics, trace gravel; brown; cohesive, w<PL, firm	▨	0.00	1	SS	8
1		FILL - (CL) SILTY CLAY; grey-brown; cohesive, w~PL, stiff	▨	188.84 0.76	2	SS	9
2		FILL - (ML) CLAYEY SILT, some sand, trace gravel; brown; cohesive, w<PL, stiff	▨	188.08 1.52	3	SS	12
		FILL - (SM) SILTY SAND, trace gravel; mottled brown; non-cohesive, moist, loose	▨	187.39 2.21	4	SS	9
3		FILL - (ML) CLAYEY SILT, trace gravel; brown; cohesive, w<PL, firm	▨	186.55 3.05	5	SS	7
4		FILL - (CL) SILTY CLAY; grey-brown; cohesive, w~PL, stiff	▨	185.79 3.81	6	SS	11
5		END OF BOREHOLE ON CONCRETE PIPE		185.03 4.57			
6							
7							
8							
9							
10							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-8

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

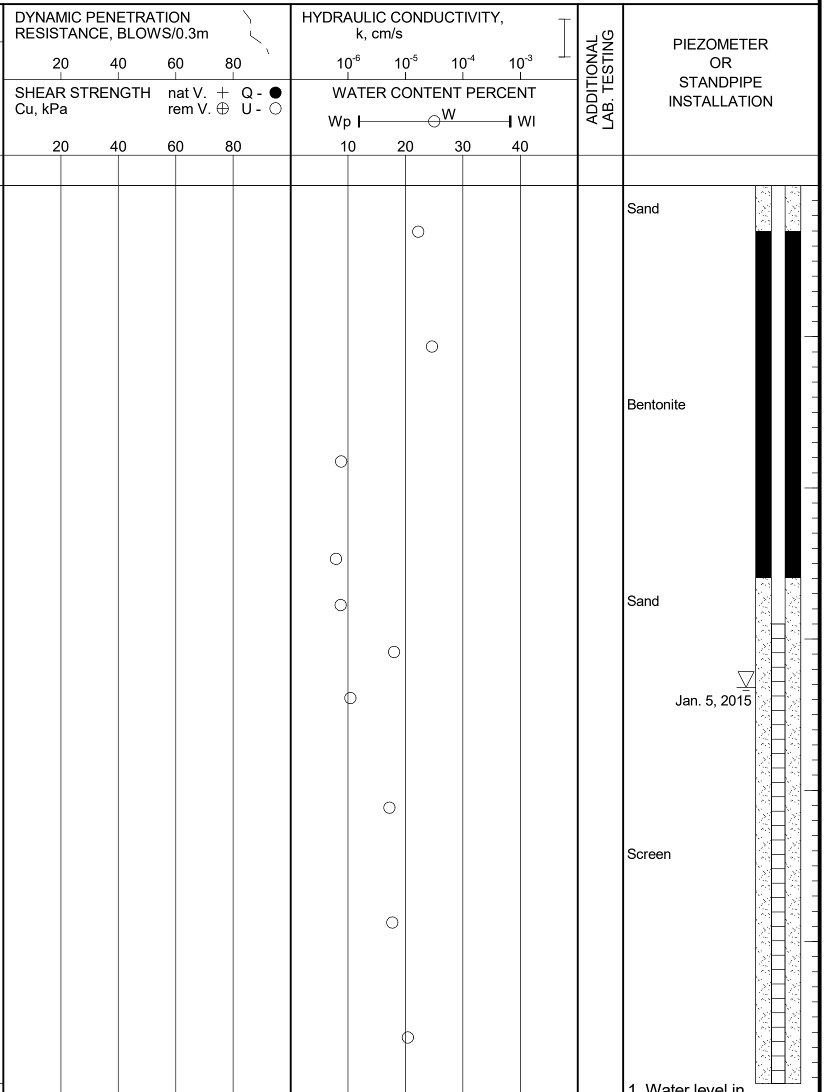
BORING DATE: November 20, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE	196.19			
0	Boomer Track Mount 102 mm Solid Stem Augers	(CL) SILTY CLAY, trace sand, trace gravel; mottled grey-brown, organic inclusions in upper 0.3 m, layers of sandy silt below a depth of 1.0 m; cohesive, w~PL, firm to stiff	0.00	1	SS	7
1				2	SS	13
		(SM) SILTY SAND, trace clay, trace gravel; brown to grey (TILL); non-cohesive, moist, compact	194.74 1.45	3	SS	13
2				4A 4B	SS	16
3		(SW) SAND; grey; non-cohesive, moist, dense	193.22 2.97	5A	SS	
		(ML) SILT, some clay, trace sand, trace gravel; grey (TILL); cohesive, moist, very stiff	3.12	5B		27
		(SW) SAND; brown; non-cohesive, wet, compact	192.53 3.66			
4				6	SS	19
5				7	SS	23
		(SM) SILTY SAND; brown; non-cohesive, compact, wet	190.93 5.26	8	SS	13
6		END OF BOREHOLE	190.25 5.94			
7						
8						
9						
10						



1. Water level in piezometer measured at a depth of 3.32 m below ground surface (Elev. 192.87 m) on January 5, 2015.

DEPTH SCALE

1 : 50

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-9

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

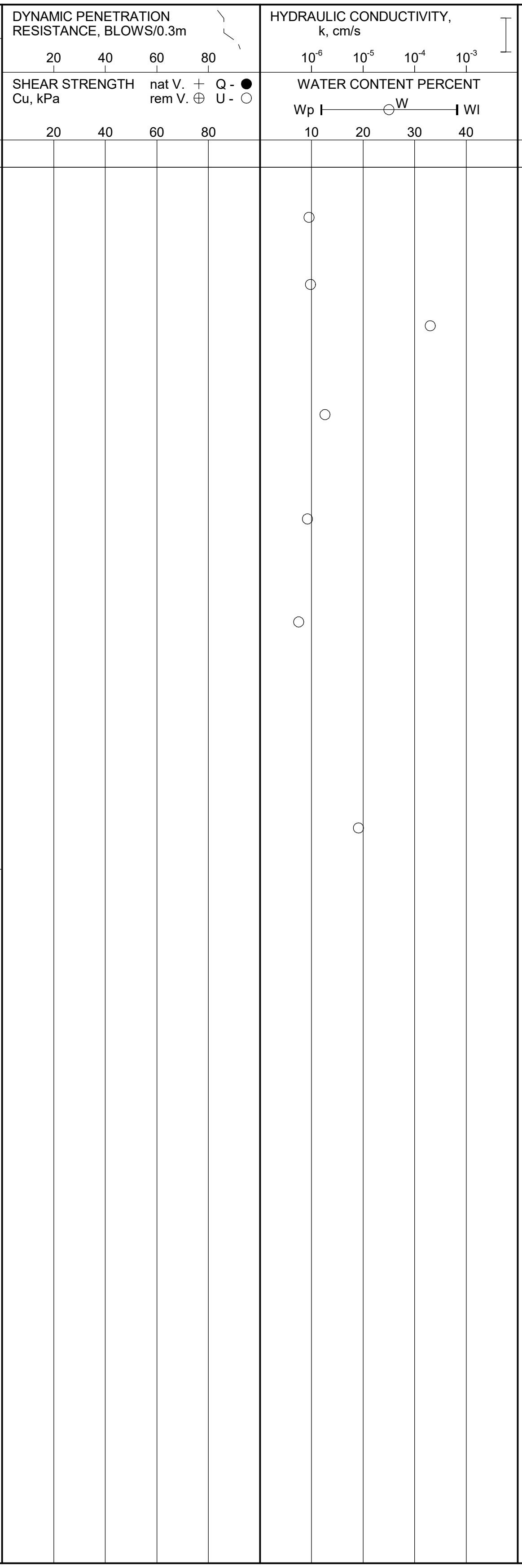
BORING DATE: December 10, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	181.70					
0	Mini Mole 102 mm Solid Stem Augers	FILL-Topsoil (130 mm)	0.00	1A	SS			
		FILL - (SM) SILT SAND, trace clay, trace to some gravel; trace organics; brown to grey, moist, compact	0.13	1B		23		
1		TOPSOIL	180.73 0.97	2A 2B	SS	9		
		(ML) CLAYEY SILT, some sand, some gravel; brown, zones of fine sand and gravel (TILL); w<PL, very stiff	180.33 1.37	3	SS	26		
2		(ML) CLAYEY SILT and SAND, some gravel, some silt, brown to grey (TILL); cohesive, moist, very stiff to hard	179.34 2.36	4	SS	29	MH	
3				5	SS	34		∇ Dec. 10, 2014
4		(CI) SILTY CLAY, trace sand, trace gravel; grey, zones of silt; cohesive, w<PL, very stiff	177.59 4.11	6	SS	28	MH	
5		END OF BOREHOLE	176.52 5.18					1. Water level in open borehole measured at a depth of 3.7 m below ground surface (Elev. 177.70 m) on December 10, 2014.
6								
7								
8								
9								
10								



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-10

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

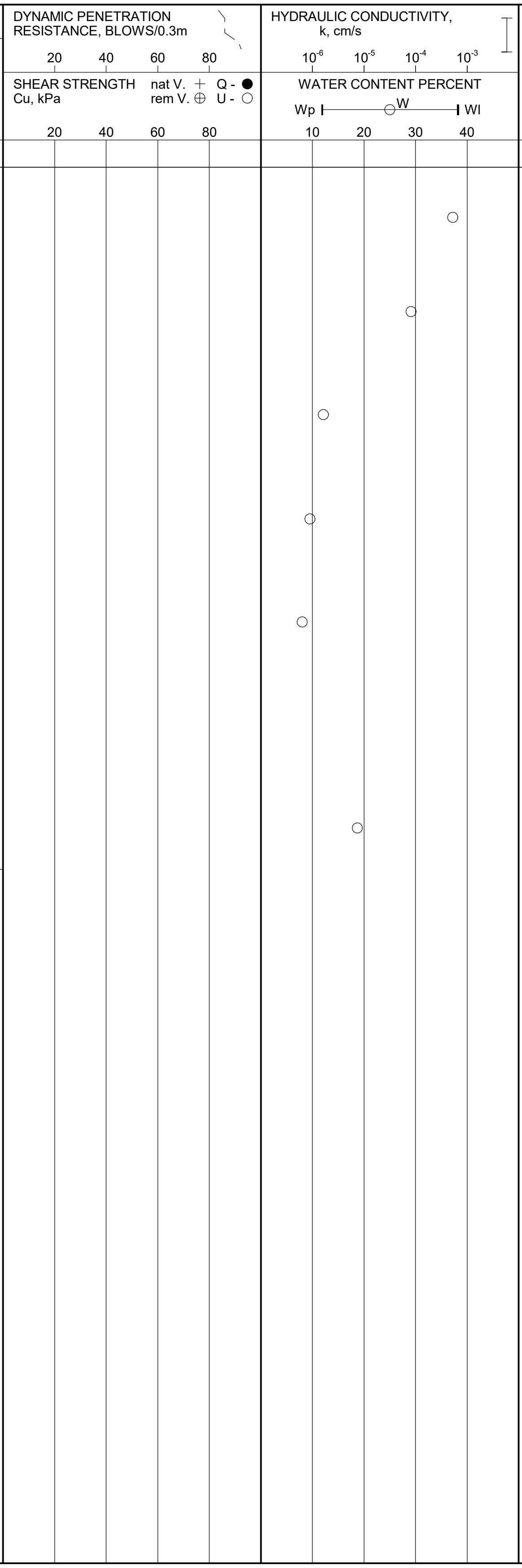
BORING DATE: December 10, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		188.60					
0	Mini Mole 102 mm Solid Stem Augers	TOPSOIL (130 mm)		0.00	1A				
		(CI) SILTY CLAY; brown, stratified; cohesive, moist, stiff		0.13	1B	SS	11		
1					2	SS	11		
		(SM) SILTY SAND, some gravel, trace clay; brown, containing fissures with oxidation, containing cobbles and boulders (TILL); non-cohesive, moist to dry, compact to very dense		187.15 1.45	3	SS	12	MH	
2					4	SS	73		
3					5	SS	76		
4		(SM) SILTY SAND, trace clay, trace gravel; brown; non-cohesive, moist, compact		184.49 4.11					∇ Dec. 10, 2014
5					6	SS	29		
		END OF BOREHOLE		183.42 5.18					1. Water level in open borehole measured at a depth of 4.6 m below ground surface (Elev. 184.61 m) on December 10, 2014.
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

LOGGED: AVR

CHECKED: SDK

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

PROJECT: 1413472

RECORD OF BOREHOLE: 14-11

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 10, 2014

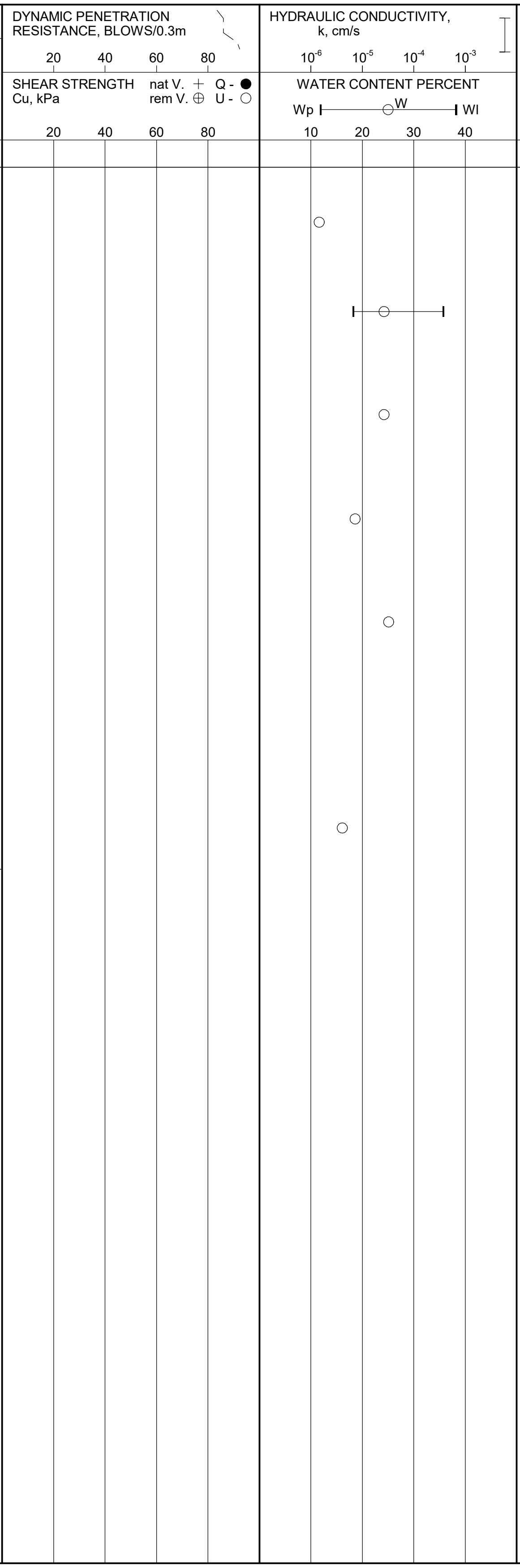
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: Mini Mole, 102 mm Solid Stem Augers

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	182.20					
0	TOPSOIL	0.00 182.00	1A				
	(SM) SILTY SAND, trace gravel; brown, organic staining; non-cohesive, dry, compact	0.20	1B	SS	13		
1	(CI) SILTY CLAY, trace sand, trace to some gravel; brown to grey, some layering; cohesive, w<PL, stiff to very stiff	181.44 0.76	2	SS	17		
2	0.08 m sand seam at a depth of 1.83 m		3	SS	21		
			4	SS	22		
3			5	SS	22		
4	(SM) gravelly SILTY SAND, some clay; grey; non-cohesive, wet, compact	178.09 4.11					
5			6	SS	16	MH	
	END OF BOREHOLE	177.02 5.18					



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-12

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

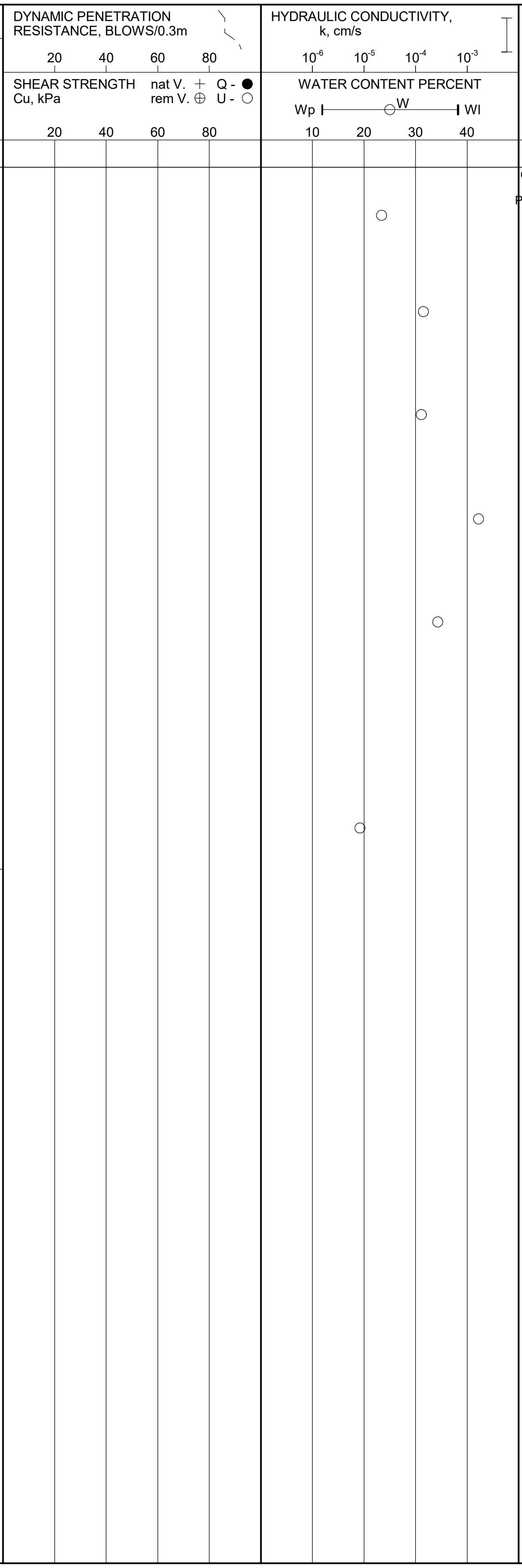
BORING DATE: December 16, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		179.48					
0	Mini Mole 102 mm Solid Stem Augers	TOPSOIL		0.00	1A			OP OC Nitrate Phospate	Cement
		(CI) SILTY CLAY; brown to grey, stratified; cohesive, w>PL, firm to soft		0.10	1B	SS	7		Sand
									Bentonite
1					2	SS	8	M&I	
									Sand Jan. 5, 2015
					3	SS	4		
2									
					4	SS	3		
3		(CI) SILTY CLAY, trace sand, trace gravel; (TILL-LIKE); cohesive, w>PL, soft		176.51 2.97					Screen
					5	SS	4		
4		(SW) SAND, some silt; grey; non-cohesive, wet, loose		175.37 4.11					
					6	SS	N/R		
5		END OF BOREHOLE *N/R - Not Recorded		174.30 5.18					1. Water level in piezometer measured at a depth of 1.49 m below ground surface (Elev. 177.99 m) on January 5, 2015.
6									
7									
8									
9									
10									



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

PROJECT: 1413472

RECORD OF BOREHOLE: 14-13

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

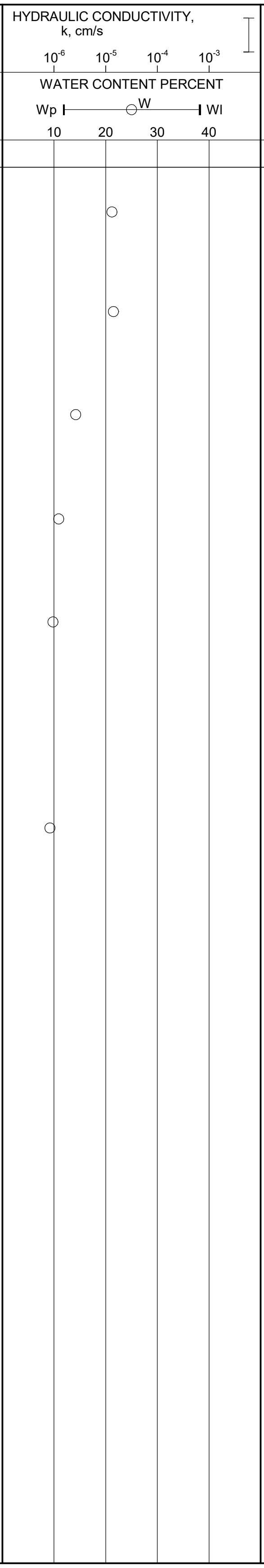
BORING DATE: December 16, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES – NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	180.90			
0	TOPSOIL	0.00	1A	SS	
	(CI) SILTY CLAY; mottled grey-brown; cohesive, w~PL, soft to firm	0.05	1B		3
1			2	SS	8
	(ML) CLAYEY SILT, some sand, some gravel; grey; cohesive, w<PL, stiff	179.45 1.45			
2			3	SS	18
			4	SS	11
3	(ML) Sandy SILT, some clay; grey; non-cohesive, moist, dense	177.93 2.97	5	SS	46
4					
5			6	SS	38
	END OF BOREHOLE	175.72 5.18			
6					
7					
8					
9					
10					



DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○; 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-14

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

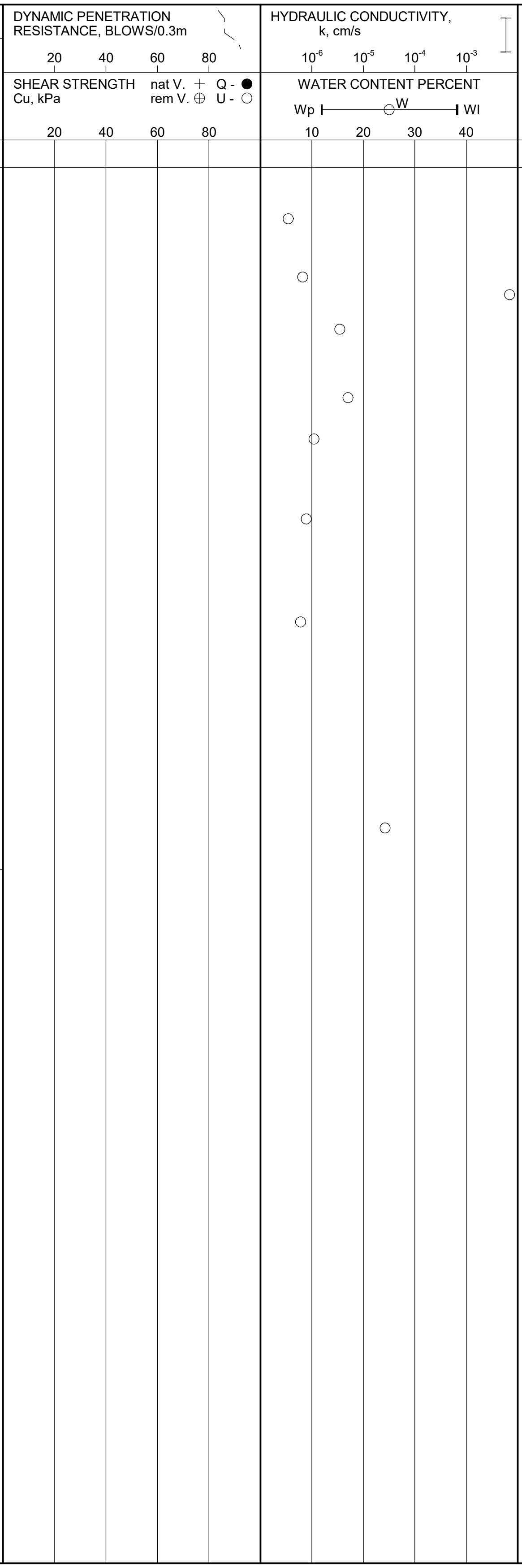
BORING DATE: December 9, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	176.30					
Mini Mole 102 mm Solid Stem Augers	FILL - TOPSOIL (150 mm)	0.00	1A				
	FILL - (SM) SILTY SAND, some gravel, trace clay; mottled brown and grey; non-cohesive, moist, compact	0.15	1B	SS	22		
	TOPSOIL	175.44 0.86	2A 2B	SS	12		
	(SW) SAND, some gravel; brown; non-cohesive, wet, compact	1.02	2C				
			3A	SS	28		
	(SM) SILTY SAND, some gravel, trace to some clay; brown to grey (TILL); moist, compact to dense	174.42 1.88	3B				
			4	SS	20		
			5	SS	40		
	(ML) SILT, some sand, trace clay; grey; non-cohesive, w>PL, very stiff	172.19 4.11	6	SS	21	MH	
	END OF BOREHOLE	171.12 5.18					



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

DEPTH SCALE

1 : 50

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-15

SHEET 1 OF 1

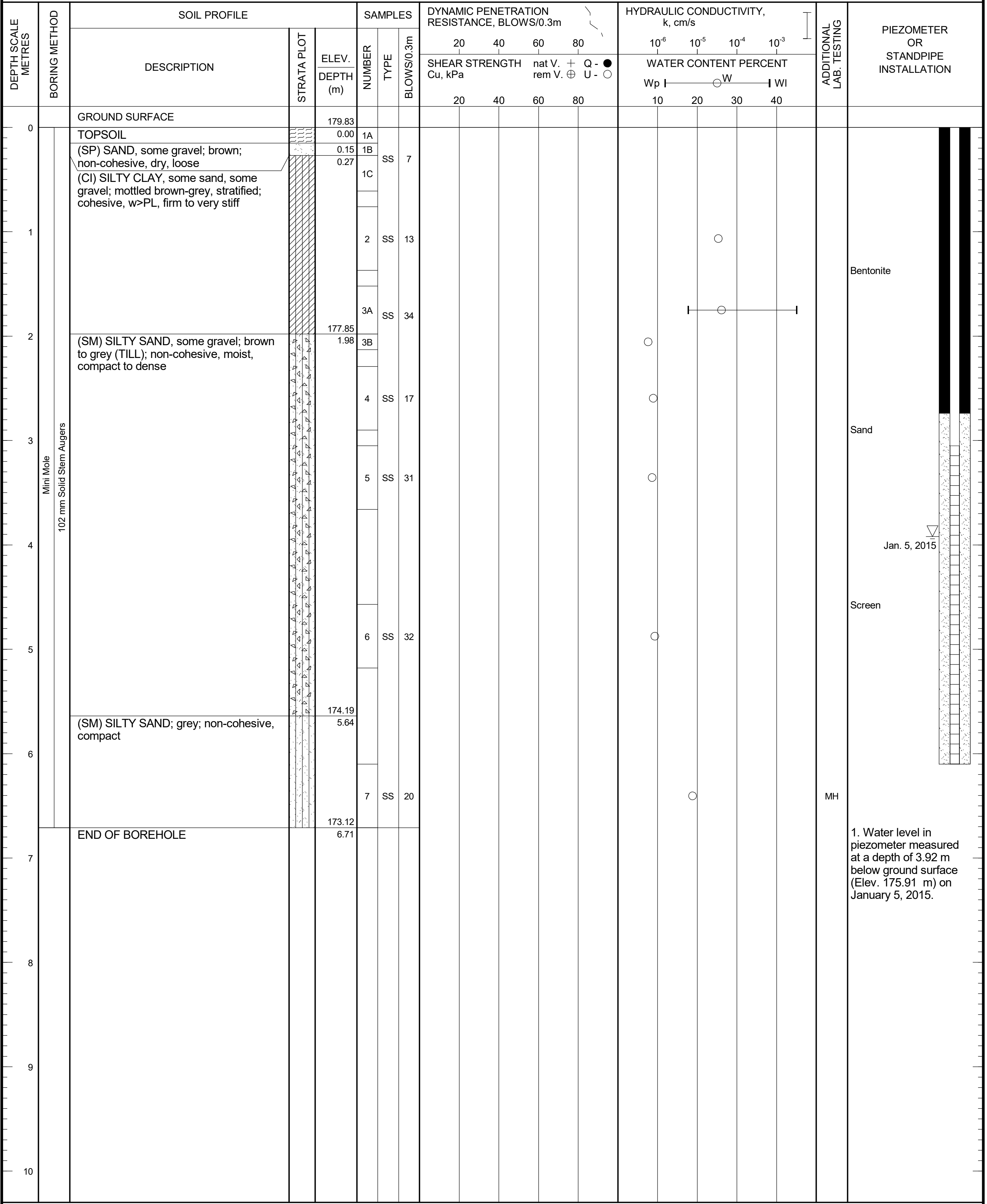
LOCATION: SEE FIGURE 2

BORING DATE: December 9, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm



ELEV. DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
179.83	GROUND SURFACE				
0.00	TOPSOIL	1A			
0.15	(SP) SAND, some gravel; brown; non-cohesive, dry, loose	1B	SS	7	
0.27	(CI) SILTY CLAY, some sand, some gravel; mottled brown-grey, stratified; cohesive, w>PL, firm to very stiff	1C			
		2	SS	13	
		3A	SS	34	
177.85 1.98	(SM) SILTY SAND, some gravel; brown to grey (TILL); non-cohesive, moist, compact to dense	3B			
		4	SS	17	
		5	SS	31	
		6	SS	32	
174.19 5.64	(SM) SILTY SAND; grey; non-cohesive, compact				
		7	SS	20	MH
173.12 6.71	END OF BOREHOLE				

1. Water level in piezometer measured at a depth of 3.92 m below ground surface (Elev. 175.91 m) on January 5, 2015.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-16

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 9, 2014

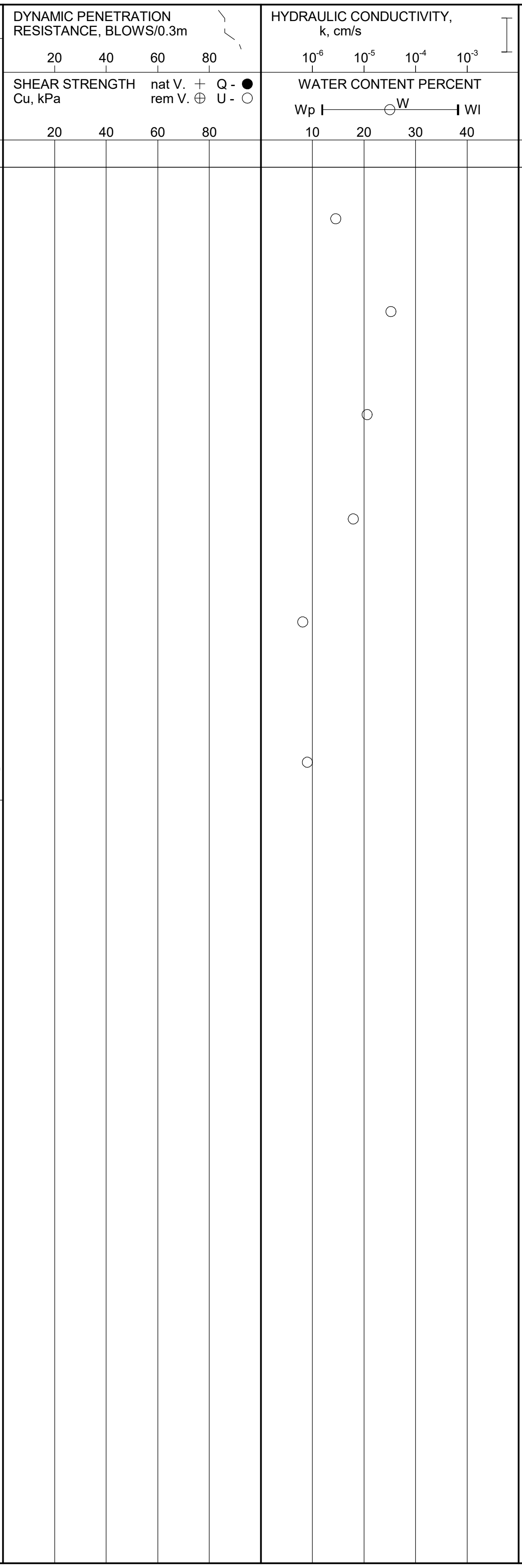
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: Mini Mole, 102 mm Solid Stem Augers

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE		181.30			
TOPSOIL		0.00	1A		
(SP) SAND, trace gravel; brown; non-cohesive, dry, compact		0.15	1B	SS	11
(CI) SILTY CLAY; brown, varved, containing sand seams at a depth of 1.07 m; cohesive, w>PL, stiff		180.61 0.69	2	SS	12
(CL) SILTY CLAY, trace sand, trace gravel; brown, stratified; cohesive, w~PL, very stiff		179.85 1.45	3 4	SS SS	24 23
(SM) SILTY SAND, some gravel; grey (TILL); non-cohesive, moist, compact		178.33 2.97	5	SS	17
(ML) CLAYEY SILT, some sand, some gravel; grey (TILL); cohesive, w<PL, hard		177.19 4.11	6	SS	50/ 0.10
END OF BOREHOLE		176.63 4.67			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

DEPTH SCALE

1 : 50

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-17

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

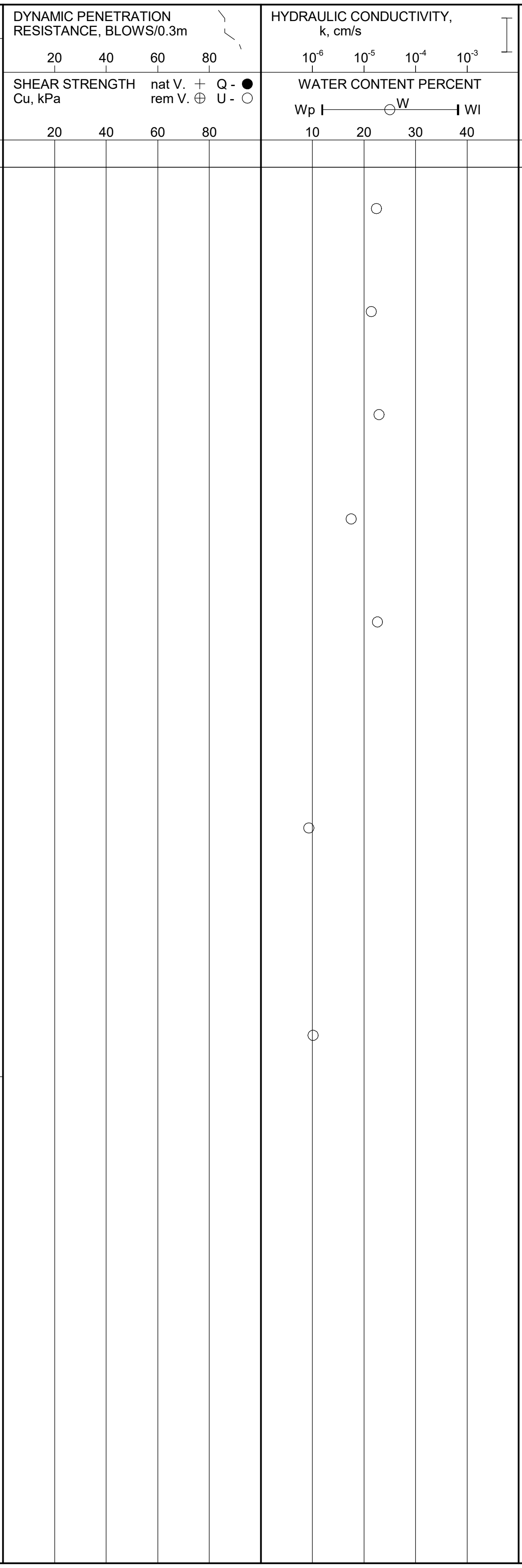
BORING DATE: December 15, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

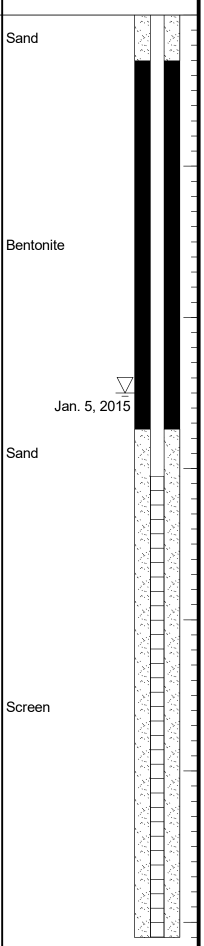
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	194.43			
0	FILL - (ML) CLAYEY SILT, trace sand, trace gravel, some organics; dark brown; cohesive, firm to very stiff	0.00	1	SS	6
1			2	SS	12
2			3	SS	22
			4	SS	22
3	(CI) SILTY CLAY; mottled brown-grey; cohesive, w>PL, very stiff	191.46 2.97	5	SS	24
4	(ML) Sandy SILT, some clay, some gravel; mottled grey-brown (TILL); non-cohesive, moist, very dense	190.32 4.11			
5			6	SS	50
6	(ML) CLAYEY SILT, some sand, some gravel; grey (TILL); cohesive, w<PL, very stiff	188.79 5.64	7	SS	26
7	END OF BOREHOLE	187.72 6.71			
8					
9					
10					



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



1. Water level in piezometer measured at a depth of 2.50 m below ground surface (Elev. 191.93 m) on January 5, 2015.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-18

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 15, 2014

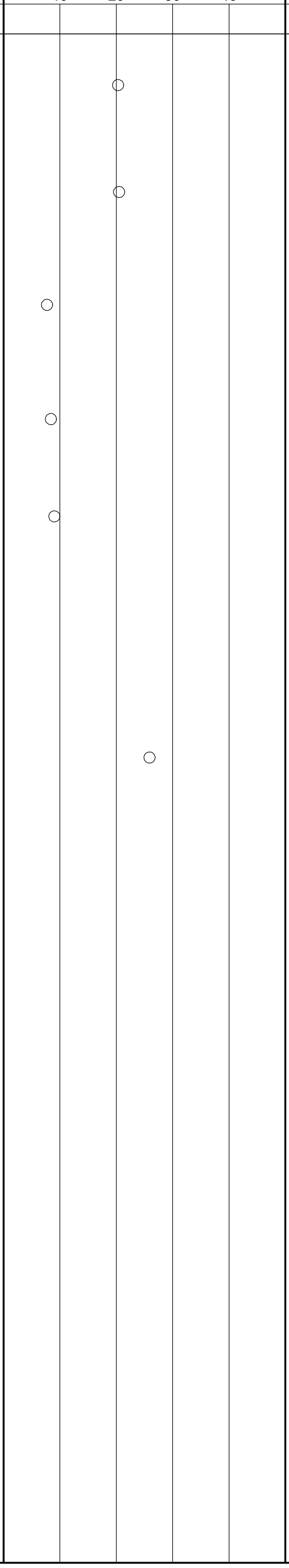
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	192.30					
0		TOPSOIL	0.00	1A				
		FILL - (ML) CLAYEY SILT, some sand, trace gravel, trace organics; brown; cohesive, w~PL, stiff	0.08	1B	SS	9		
		(SM) SILTY SAND, fine grained; brown, stratified; non-cohesive, moist, compact	191.61 0.69	2	SS	14		
1								
		(SM) SILTY SAND, some gravel, trace clay; brown, with oxidation staining (TILL); non-cohesive, moist, dense to very dense	190.85 1.45	3	SS	48		
2				4	SS	65		
3		(ML) CLAYEY SILT, some gravel, trace sand; grey (TILL); cohesive, hard	189.33 2.97	5	SS	83/ 0.25		
4		(ML) Sandy SILT; brown; non-cohesive, wet, dense	188.19 4.11	6	SS	45		
5		END OF BOREHOLE	187.12 5.18					
6								
7								
8								
9								
10								

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
20 40 60 80
SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○
20 40 60 80



GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

DEPTH SCALE
1 : 50

LOGGED: EWB
CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-19

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 15, 2014

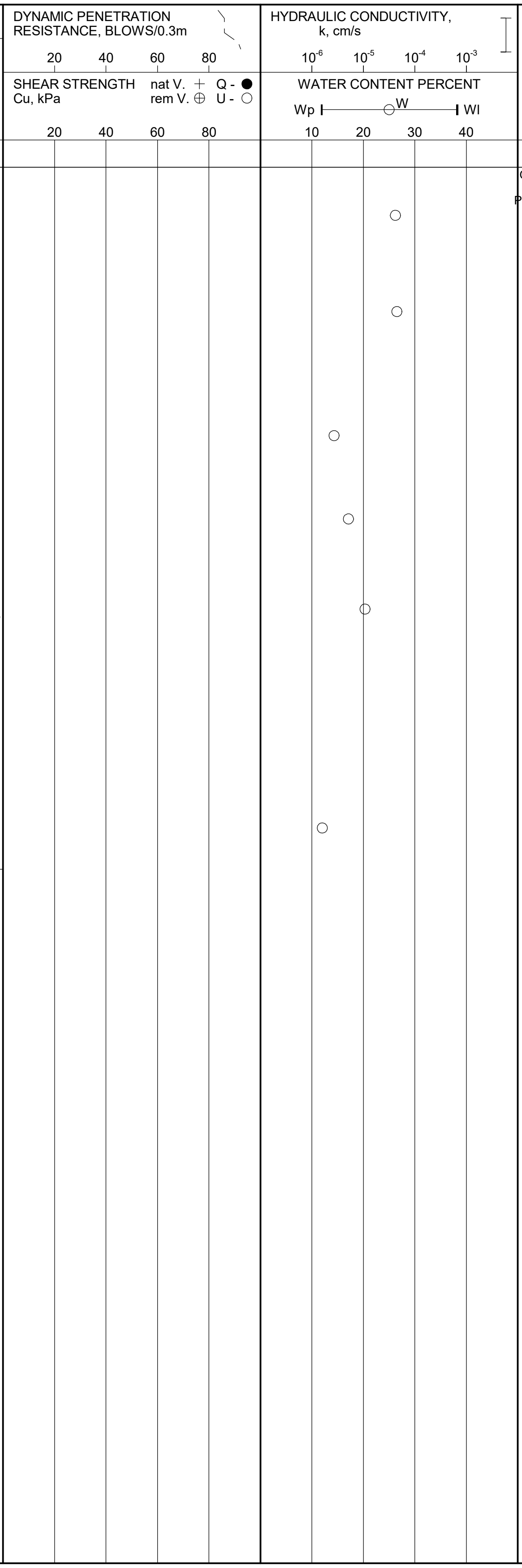
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	188.80
TOPSOIL	0.00
FILL - (ML) CLAYEY SILT, some sand, trace gravel, trace organics; brown to dark brown; cohesive, w>PL, firm	0.10
(CI) SILTY CLAY; brown, stratified; cohesive, w>PL, stiff	188.11 0.69
(ML) CLAYEY SILT, some sand, some gravel; brown (TILL); cohesive, w<PL, stiff to very stiff	187.35 1.45
(SW) SAND, some silt, trace clay; brown; wet, compact	185.83 2.97
(SM) SILTY SAND, some gravel, trace clay; brown (TILL); non-cohesive, very dense, wet	184.69 4.11
END OF BOREHOLE	183.62 5.18

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A			OP OC Nitrate Phospate
1B	SS	5	
2	SS	9	M&I
3A			
3B	SS	16	
4	SS	14	
5	SS	83/ 0.25	
6	SS	45	



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-20

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

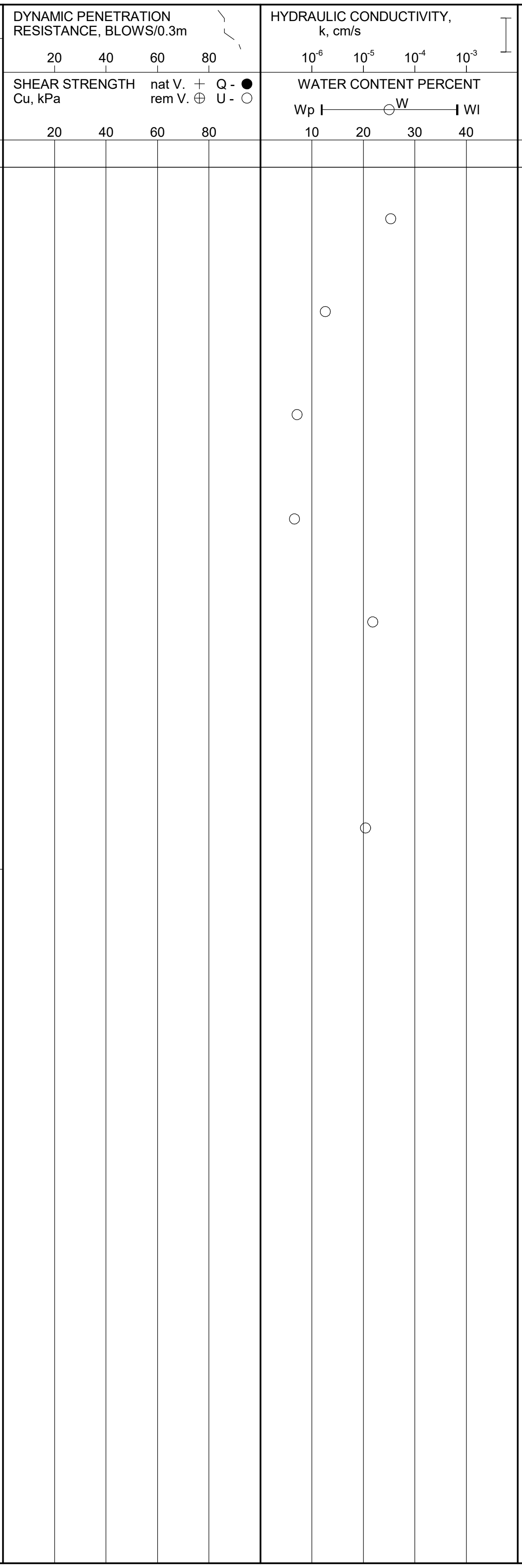
BORING DATE: December 15, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		184.60			
0	Geoprobe 7822 DT Track Mount 83 mm Direct Push SVT	TOPSOIL (150 mm)		0.00	1A	SS	6
		(CI) SILTY CLAY; mottled grey-brown, some layering; cohesive, w>PL, firm		0.15	1B		
1		(SM) SILTY SAND, trace clay, trace gravel; brown (TILL-LIKE); non-cohesive, loose		183.91 0.69	2	SS	9
2		(SM) SILTY SAND, some gravel, trace clay; brown to grey (TILL); non-cohesive, dry to moist, very dense to dense		183.15 1.45	3 4	SS SS	67 46
3		(ML) SILT, trace to some clay; grey, containing seams of silty clay; non-cohesive, wet, dense		181.63 2.97	5	SS	32
4		(SW) SAND, fine grained, trace silt, trace gravel; grey, stratified; non-cohesive, wet, compact		180.49 4.11	6	SS	16
5		END OF BOREHOLE		179.42 5.18			
6							
7							
8							
9							
10							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ Dec. 15, 2014

1. Water level in open borehole measured at a depth of 3.7 m below ground surface (Elev. 180.90 m) on December 15, 2014.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AVR
CHECKED: SDK

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

PROJECT: 1413472

RECORD OF BOREHOLE: 14-21

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 15, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

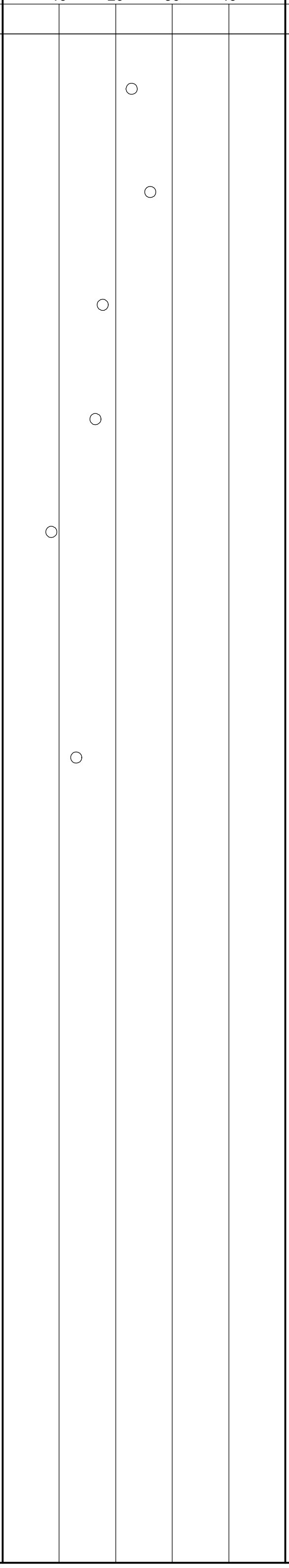
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE	182.80			
0	Geoprobe 7822 DT Track Mount 83 mm Direct Push SVT	TOPSOIL (130 mm)	0.00	1A		
		(ML) CLAYEY SILT, trace gravel; mottled grey-brown, containing rootlets; cohesive, w>PL, firm to stiff	0.13	1B	SS	4
1				2	SS	9
		(CI) SILTY CLAY; mottled brown to grey, some varves; cohesive, w<PL, very stiff	181.35 1.45	3	SS	17
2		(ML) CLAYEY SILT, some gravel, trace sand; brown (TILL); cohesive, w>PL, stiff	180.59 2.21	4	SS	14
3		(ML) Sandy SILT, some gravel, trace clay; grey, with zones of clayey silt (TILL); non-cohesive, moist, compact	180.06 2.74	5	SS	16
4						
5				6	SS	11
		END OF BOREHOLE	177.62 5.18			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl — 10 20 30 40



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

1. Open borehole dry upon completion of drilling on Dec. 15, 2014.

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-22

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 15, 2014

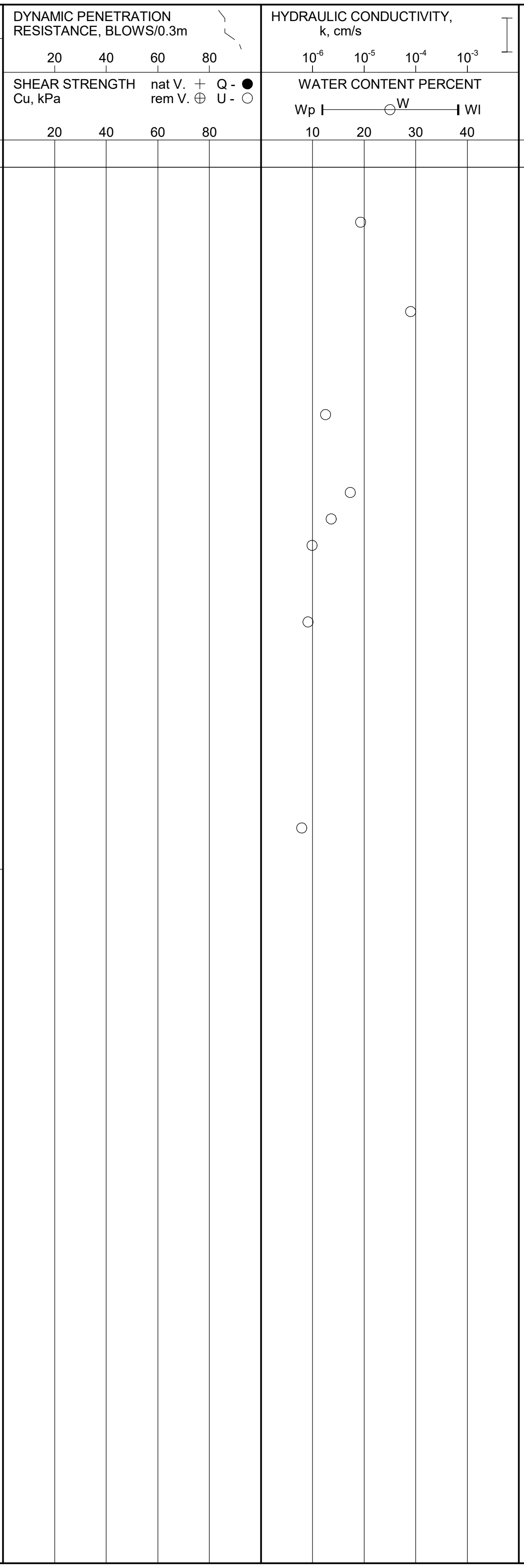
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: Geoprobe 7822 DT Track Mount, 83 mm Direct Push SVT

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	184.20			
TOPSOIL (200 mm)	0.00	1A		
FILL - (CI) SILTY CLAY, some gravel, trace organics; brown to grey, containing rootlets; cohesive, w>PL, firm to soft	184.00 0.20	1B	SS	6
		2	SS	3
(ML) CLAYEY SILT, trace sand, trace gravel; brown, with oxidation staining, fissured (TILL); cohesive, w>PL, stiff	182.75 1.45	3	SS	11
(ML) CLAYEY SILT; brown, layered; cohesive, w>PL, stiff	181.99 2.21	4A		
(SM) SILTY SAND, some gravel, trace clay; (TILL); wet, dense	181.69 2.51	4B	SS	34
(ML) Sandy SILT, some gravel, trace to some clay; brown to grey (TILL); non-cohesive, moist, dense to compact	2.68	4C		
		5	SS	20
		6	SS	27
END OF BOREHOLE	179.02 5.18			



PIEZOMETER OR STANDPIPE INSTALLATION

1. Open borehole dry upon completion of drilling on Dec. 15, 2014.

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-23

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 8, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: B-45HD Track Mount; 203 mm O.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	189.10	0.00
TOPSOIL (200 mm)	188.90	0.20
(CI) SILTY CLAY, trace sand, trace gravel; brown, varved; cohesive, w>PL, firm to stiff	187.80	1.30
(ML) CLAYEY SILT, some sand, some gravel; grey, with zones of fine sand (TILL); cohesive, w<PL, stiff	186.89	2.21
(ML) CLAYEY SILT and SAND, some sand, some gravel (TILL-LIKE); grey, with zones of fine sand; cohesive, w<PL, firm	184.99	4.11
(SM) SILTY SAND, some gravel, trace clay; grey (TILL); non-cohesive, moist, compact	183.92	5.18
END OF BOREHOLE		

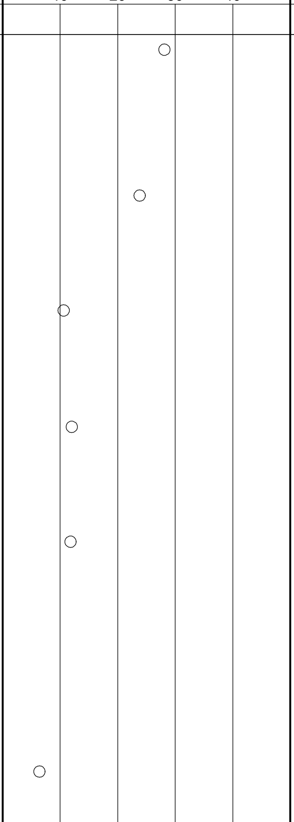
NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A			
1B	SS	6	
2	SS	11	
3	SS	14	
4	SS	6	MH
5	SS	8	
6	SS	27	MH

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40



PIEZOMETER OR STANDPIPE INSTALLATION

1. Open borehole dry upon completion of drilling on Dec. 8, 2014.

DEPTH SCALE 1 : 50

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-24

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

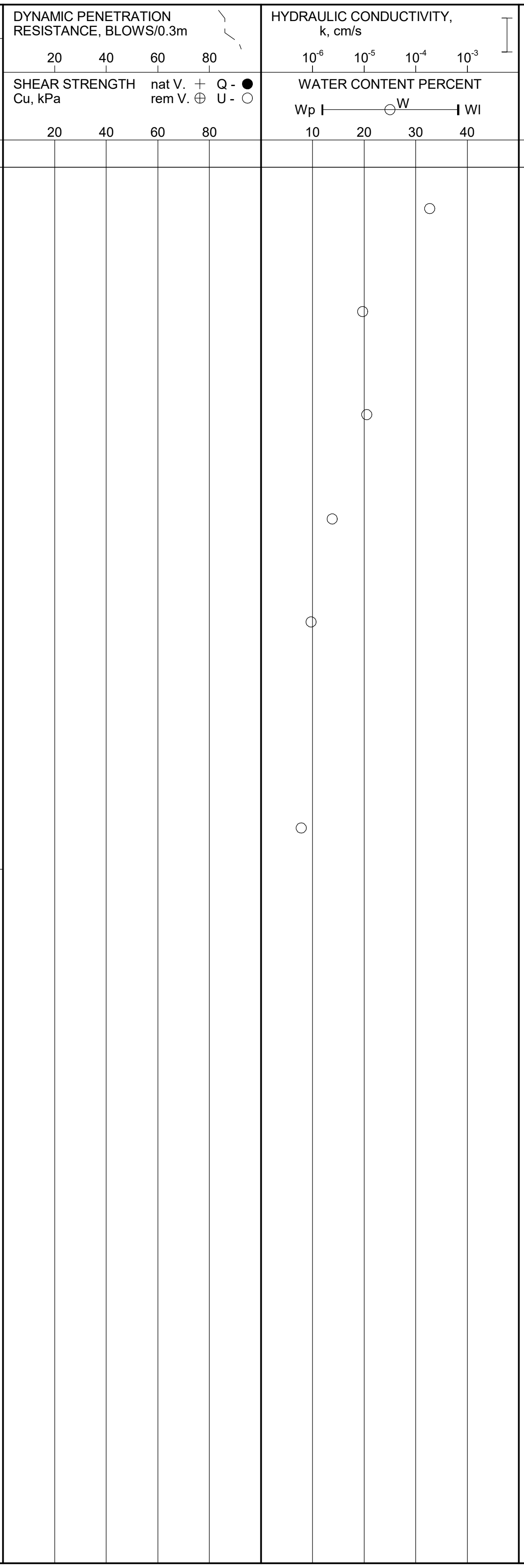
BORING DATE: December 8, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	186.70			
B-45HD Track Mount 203 mm O.D. Hollow Stem Augers	FILL - TOPSOIL	0.00	1	SS	3
	(CI) SILTY CLAY, trace sand, trace gravel; mottled brown-grey, block structure; cohesive, w~PL, firm to stiff	186.01 0.69	2 3	SS SS	7 15
	(ML) CLAYEY SILT, some sand, some gravel; grey; cohesive, w<PL, stiff	184.49 2.21	4	SS	10
	(ML) SILT, some sand, some gravel; grey, with zones of medium sand (TILL); non-cohesive, moist, compact	183.73 2.97	5	SS	15
	(ML) CLAYEY SILT, some sand, some gravel; grey (TILL); cohesive, w<PL, stiff	182.59 4.11	6	SS	16
	END OF BOREHOLE	181.52 5.18			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ Dec 8, 2014

1. Water level in open borehole measured at a depth of 3.7 m below ground surface (Elev. 182.00 m) on December 8, 2014.

DEPTH SCALE

1 : 50

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-25

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 15, 2014

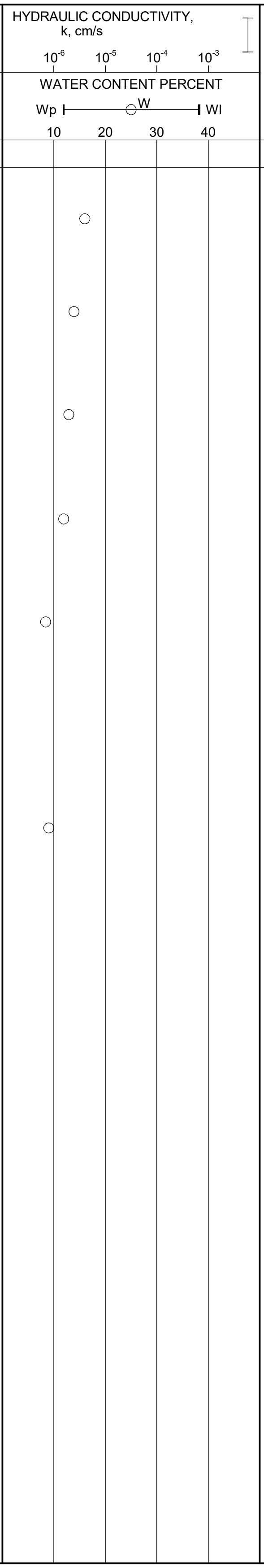
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: Geoprobe 7822 DT Track Mount; 83 mm Direct Push SVT

ELEV. / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m
184.70	GROUND SURFACE			
0.00	TOPSOIL (150 mm)	1A	SS	
0.15	FILL - (SM) SILTY SAND, trace gravel, trace rootlets; dark brown; non-cohesive, moist, loose	1B		5
184.01 0.69	(ML) CLAYEY SILT; mottled grey-brown; cohesive, w<PL, firm			
0.84	(SM) SILTY SAND, some gravel, trace clay; brown (TILL); moist, compact	2	SS	13
183.25 1.45	(ML) CLAYEY SILT, some sand, some gravel; brown to grey (TILL-LIKE); cohesive, w>PL, soft	3	SS	2
182.34 2.36	(ML) Sandy SILT, some gravel, some clay; grey (TILL); non-cohesive, wet, compact	4	SS	18
181.73 2.97	(ML) CLAYEY SILT, some sand, some gravel; grey, with zones of silt, layered (TILL); cohesive, dry to moist, very stiff	5 6	SS SS	27 27
179.52 5.18	END OF BOREHOLE			



DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇ Dec. 15, 2014

1. Water level in open borehole measured at a depth of 4.7 m below ground surface (Elev. 180.80 m) on December 15, 2014.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-26

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

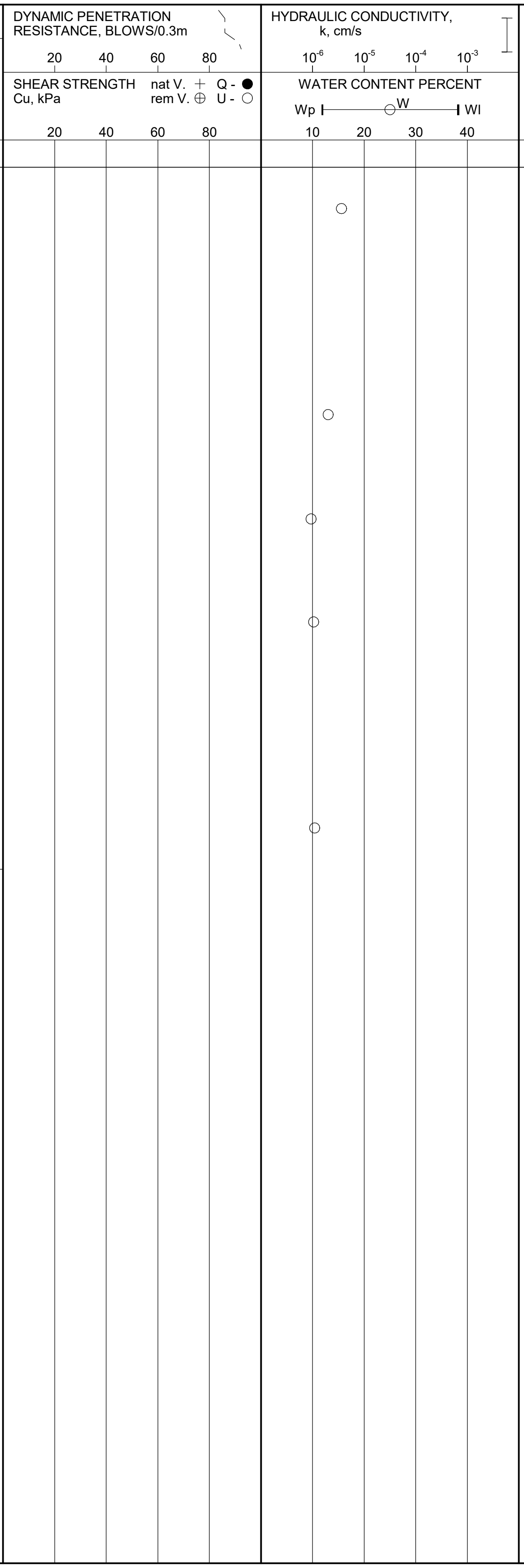
BORING DATE: December 16, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	193.10			
0	TOPSOIL (50 mm)	0.00			
	(CI) SILTY CLAY, some gravel, trace sand; brown (TILL); cohesive, w<PL, stiff to very stiff	0.05	1	SS	8
1			2	SS	21
			3	SS	21
2	(ML) CLAYEY SILT, trace sand, some gravel; brown to grey (TILL); cohesive, w<PL, hard to very stiff	190.89 2.21	4	SS	34
3			5	SS	32
4					
5			6	SS	29
	END OF BOREHOLE	187.92 5.18			
6					
7					
8					
9					
10					



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

BORING METHOD

STRATA PLOT

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-27

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

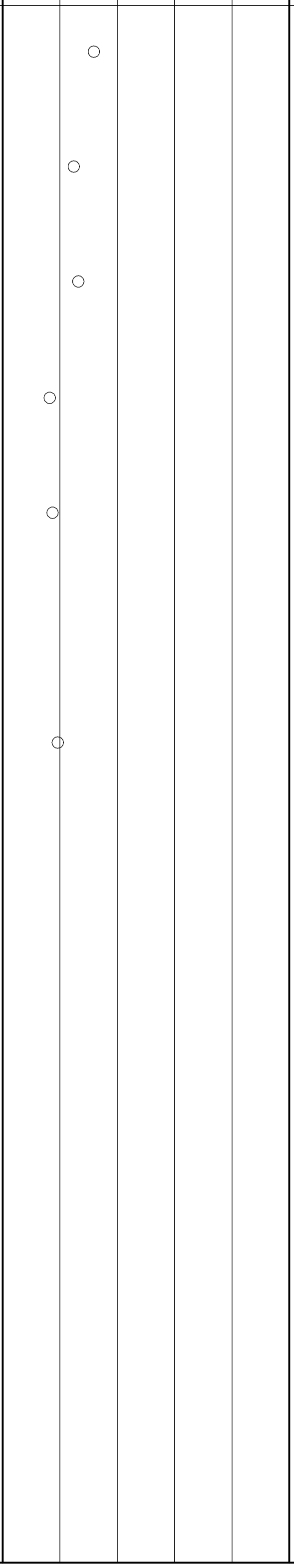
BORING DATE: December 17, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ├──○W──┤ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		192.50							
0		TOPSOIL (25 mm)		0.00 0.03							
		FILL - (CI) SILTY CLAY, trace sand, trace gravel; cohesive, w<PL, firm			1	SS	5				
		(ML) CLAYEY SILT, some gravel, trace sand; grey (TILL); w<PL, stiff to hard		191.81 0.69							
1					2	SS	13				
2					3	SS	27				
					4	SS	72				
3					5	SS	65				
4											
5				187.32	6	SS	84				
		END OF BOREHOLE		5.18							
6											
7											
8											
9											
10											



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

PROJECT: 1413472

RECORD OF BOREHOLE: 14-28

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 16, 2014

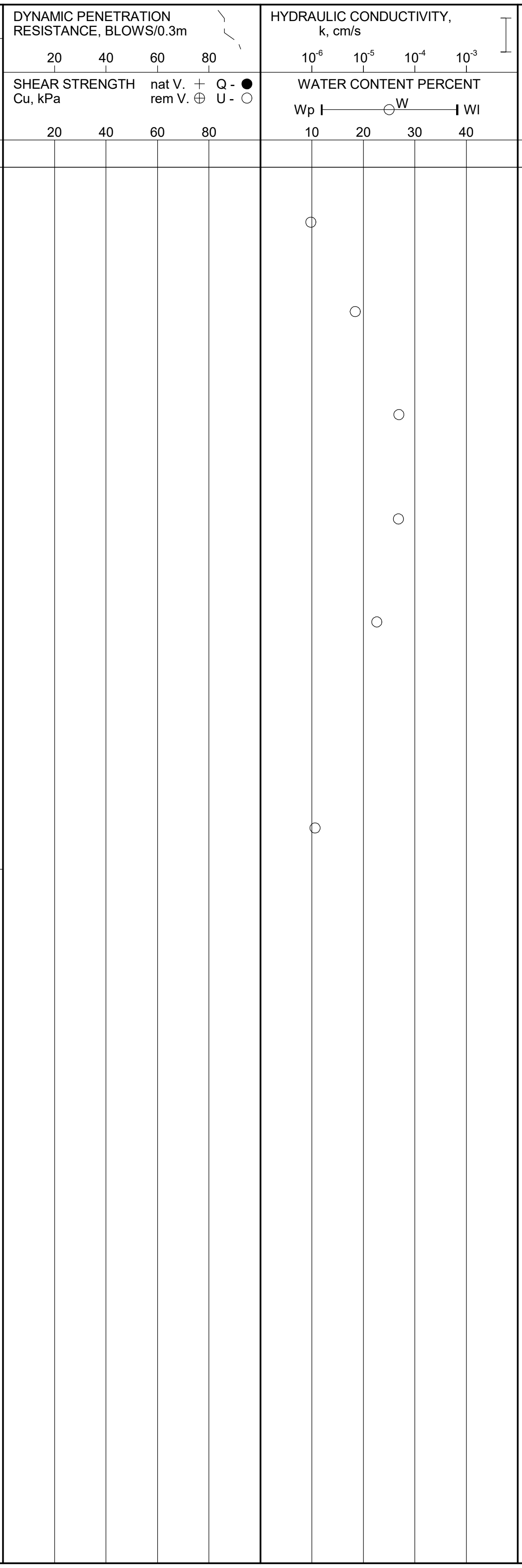
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	185.70
0	TOPSOIL (200 mm)	0.00 185.50
	FILL - (ML) CLAYEY SILT, some gravel, trace sand, trace organics; brown; cohesive, moist, stiff to very stiff	0.20
	(CI) SILTY CLAY, trace sand; brown to grey, varved; cohesive, w>PL, stiff to very stiff	184.25 1.45
	(ML) CLAYEY SILT, some gravel, trace sand; grey (TILL); cohesive, w<PL, very stiff	181.59 4.11
	END OF BOREHOLE	180.52 5.18

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1A		
1B	SS	9
2	SS	26
3	SS	13
4	SS	21
5	SS	19
6	SS	20



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

PROJECT: 1413472

RECORD OF BOREHOLE: 14-29

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

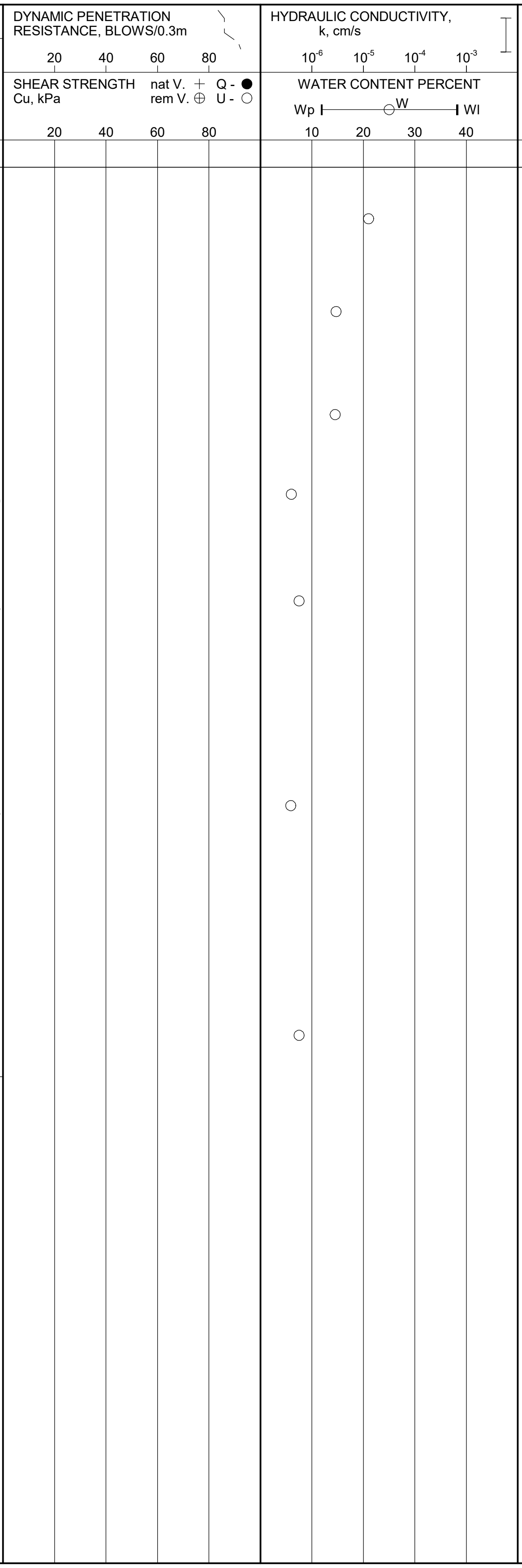
BORING DATE: December 16, 2014

DATUM: Geodetic

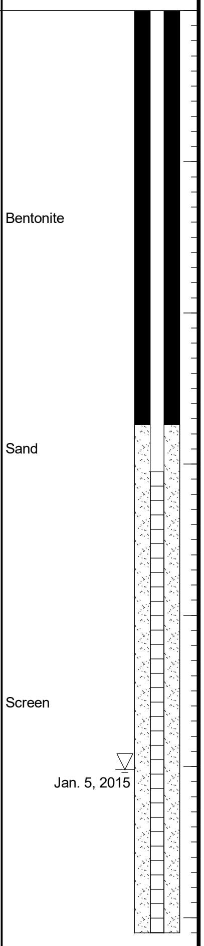
HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	190.39			
Geoprobe 7822 DT Track Mount 83 mm Direct Push SVT	TOPSOIL (150 mm)	0.00	1A		
	(CI) SILTY CLAY, trace sand, trace gravel; mottled grey-brown (TILL-Like); cohesive, w~PL, firm	0.15	1B	SS	8
	(ML) CLAYEY SILT, some gravel, trace sand; mottled grey-brown (TILL); cohesive, w<PL, very stiff to hard	189.70 0.69	2	SS	18
			3	SS	32
Geoprobe 7822 DT Track Mount 150 mm Hollow Stem Augers	(ML) Sandy SILT, some gravel, trace clay; brown to grey (TILL); dry to moist, very dense	188.18 2.21	4	SS	50/ 0.10
			5	SS	50/ 0.15
			6	SS	50/ .125
	(CI) SILTY CLAY, trace sand, trace gravel; grey (TILL); cohesive, w<PL, hard	184.75 5.64	7	SS	73
	END OF BOREHOLE	183.68 6.71			



PIEZOMETER OR STANDPIPE INSTALLATION



1. Water level in open borehole measured at a depth of 5.0 m below ground surface (Elev. 185.39 m) on January 5, 2015.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-30

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

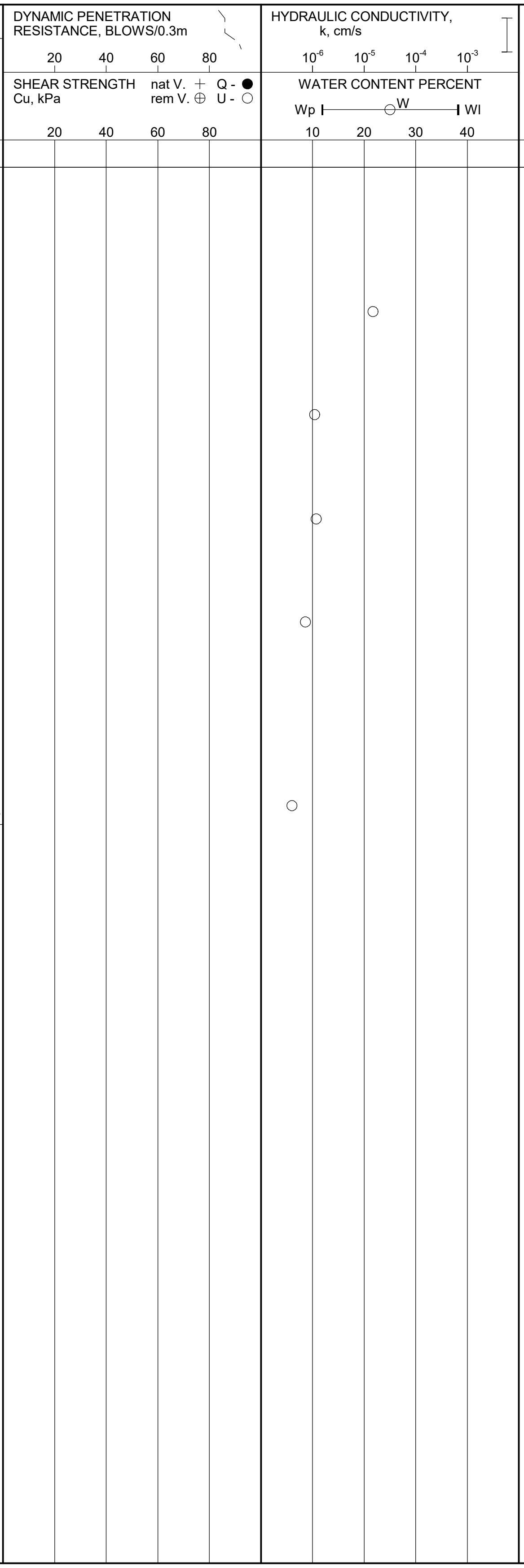
BORING DATE: December 16, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m
		GROUND SURFACE		194.40			
0	Geoprobe 7822 DT Track Mount 83 mm Direct Push SVT	TOPSOIL (250 mm)		0.00	1A		
		(ML) CLAYEY SILT, some gravel, trace sand; brown (TILL-LIKE); cohesive, w>PL, soft		194.15 0.25	1B	SS	3
1		(ML) CLAYEY SILT, some gravel, trace to some sand; (TILL); cohesive, w<PL, stiff		193.71 0.69	2	SS	12
2		(ML) Sandy SILT, some clay, some gravel; brown to grey (TILL); non-cohesive, moist to dry, dense to very dense		192.95 1.45	3	SS	17
					4	SS	28
3					5	SS	26
4					6	SS	50/ .125
5		END OF BOREHOLE		189.55 4.85			
6							
7							
8							
9							
10							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-31

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

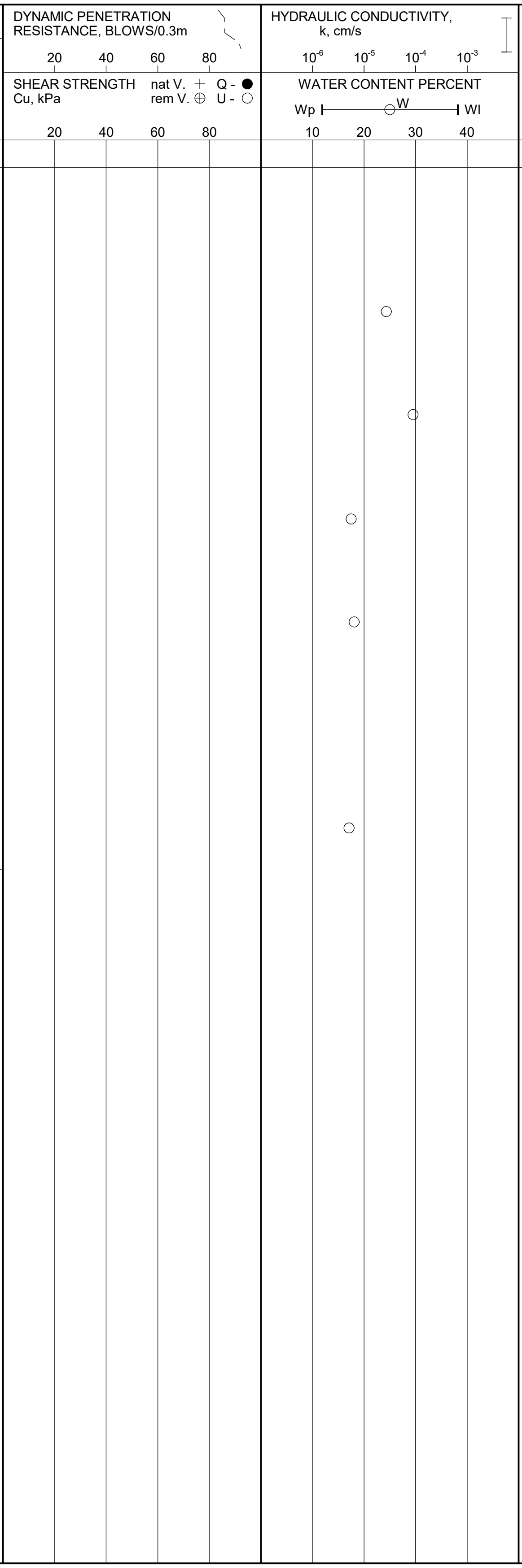
BORING DATE: December 16, 2014

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		182.70					
0		(CL) SILTY CLAY; brown to grey, varved; cohesive, w<PL, firm to stiff	▨	0.00	1	SS	6		
1					2	SS	11		
2					3	SS	11		
		(CI) SILTY CLAY, trace sand, trace gravel; grey (TILL-LIKE); cohesive, w>PL, firm		180.49 2.21	4	SS	8		
3		(CI) SILTY CLAY; grey, massive; cohesive, w>PL to a depth of 4.27 m, w<PL below a depth of 4.27 m, very stiff to hard	▨	179.73 2.97	5	SS	26		
4									
5					6	SS	N/R		
		END OF BOREHOLE *N/R - Not Recorded		177.52 5.18					
6									
7									
8									
9									
10									



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: EWB
CHECKED: SDK

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

PROJECT: 1413472

RECORD OF BOREHOLE: 14-32

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 5, 2014

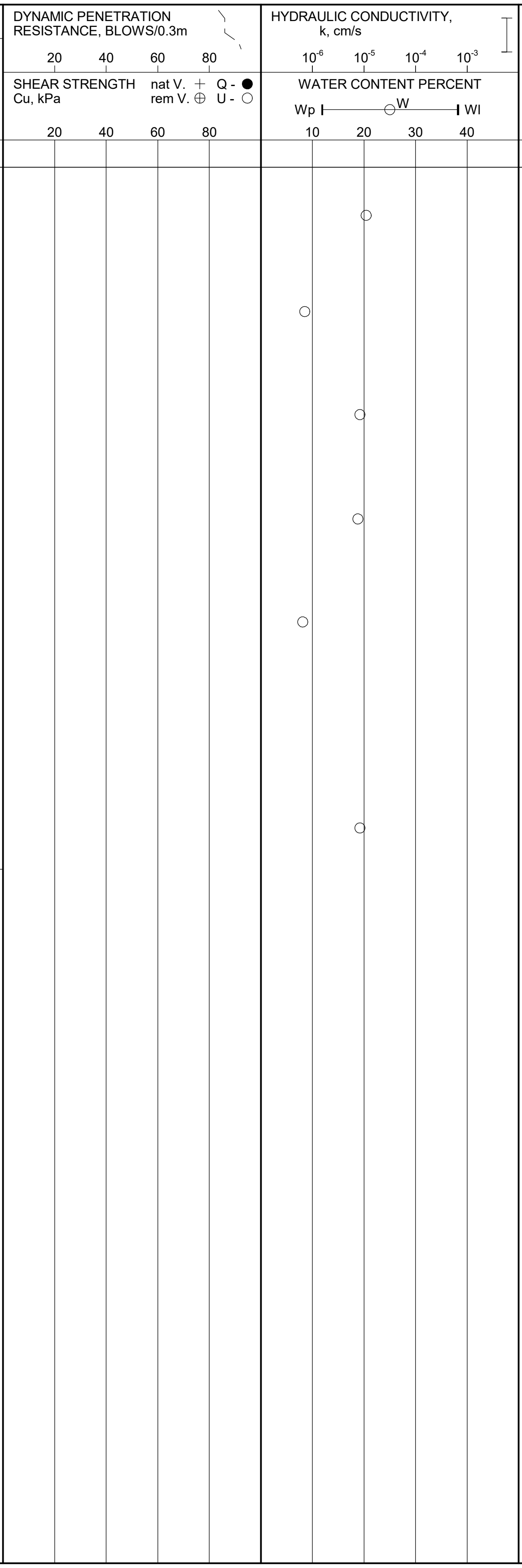
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: B-45HD Track Mount, 102 mm Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	194.90				
TOPSOIL (100 mm)	0.00	1A			
FILL - (CI) SILTY CLAY, trace sand, trace gravel; brown, containing organics; cohesive, w>PL, stiff	0.10	1B	SS	12	
FILL - (SM) SILTY SAND, trace gravel, trace silt; brown/grey; non-cohesive, moist, loose	194.21 0.69	2	SS	7	
FILL - (CL) SILTY CLAY, some sand, trace gravel; mixed brown and grey, containing organics; cohesive, w<PL, firm	193.76 1.14	3	SS	6	
(ML) CLAYEY SILT, some sand, some gravel; grey (TILL-LIKE); cohesive, firm	192.46 2.44	4	SS	6	
(SM) SILTY SAND, trace gravel; grey; non-cohesive, moist, compact	191.80 3.10	5	SS	16	
		6	SS	19	MH
END OF BOREHOLE	189.72 5.18				



PIEZOMETER OR STANDPIPE INSTALLATION

1. Open borehole dry upon completion of drilling on Dec. 5, 2014.

DEPTH SCALE
1 : 50

LOGGED: AVR
CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-33

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 5, 2014

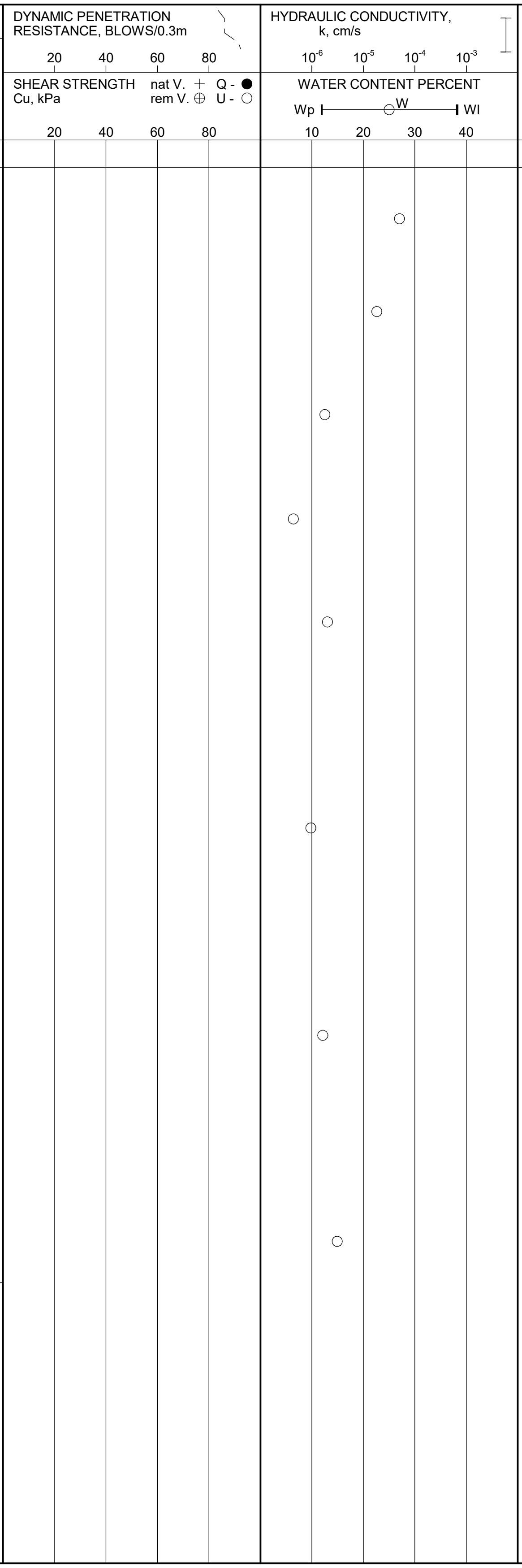
DATUM: Geodetic

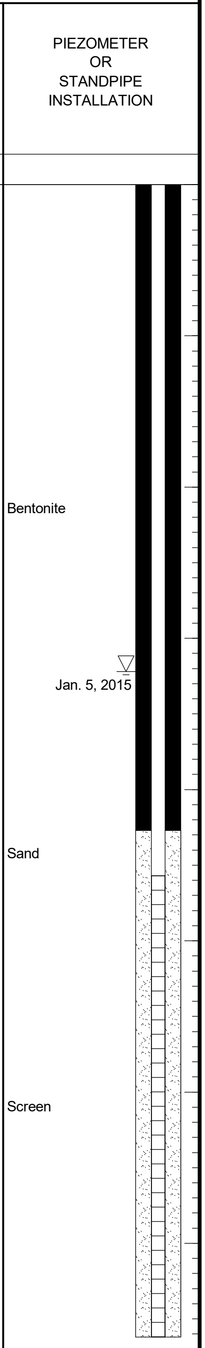
HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: B-45HD Track Mount; 203 mm O.D. Hollow Stem Augers

DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	194.67				
TOPSOIL (150 mm)	0.00	1A			
(CL) SILTY CLAY, trace gravel; mottled grey-brown;, containing rootlets in upper zones; cohesive, w>PL, stiff	0.15	1B	SS	10	
		2	SS	12	
(SM) SILTY SAND, some clay, some gravel; mottled grey-brown to grey; non-cohesive, moist to wet, compact	193.22 1.45	3	SS	12	
		4	SS	21	
(CL) sandy SILTY CLAY, trace to some gravel; grey (TILL); cohesive, moist, stiff to hard	191.70 2.97	5	SS	12	
		6	SS	16	MH
		7	SS	66	
(SP) SAND, fine grained, trace silt; grey, with layers of clayey silt; moist, compact	187.51 7.16	8	SS	21	
END OF BOREHOLE	186.44 8.23				





1. Water level in piezometer measured at a depth of 3.22 m below ground surface (Elev. 191.45 m) on January 5, 2015.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-34

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 8, 2014

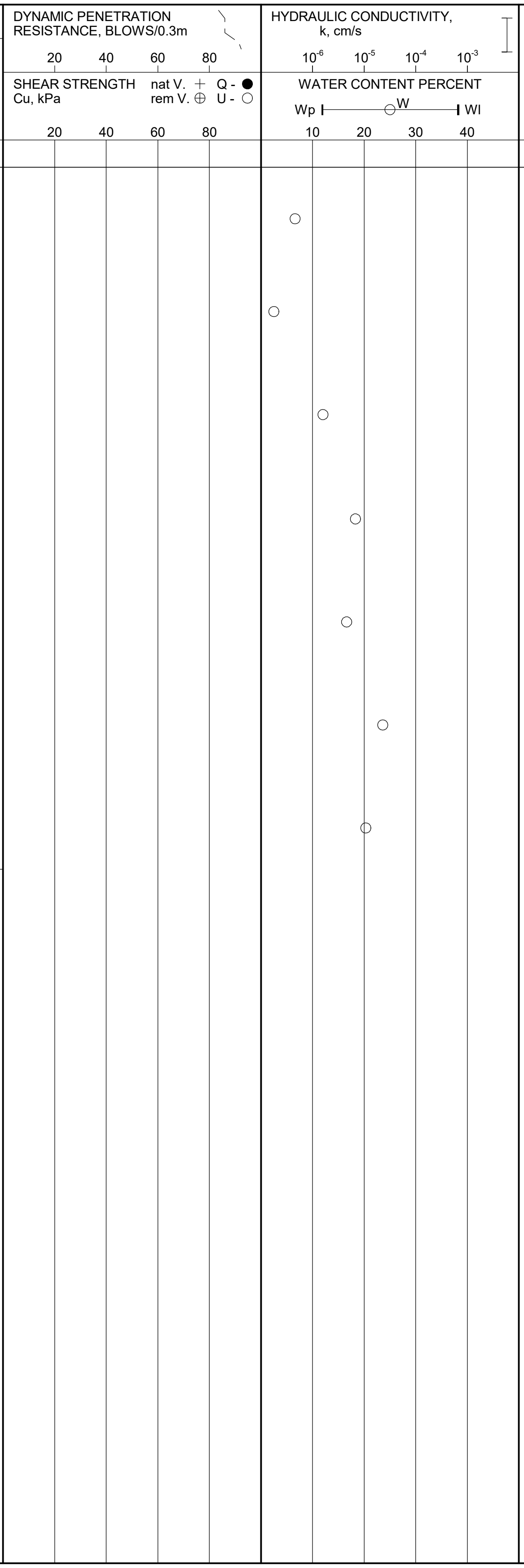
DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

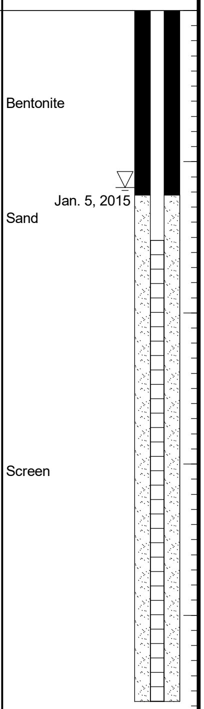
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

BORING METHOD: B-45HD Track Mount, 203 mm O.D. Hollow Stem Augers (0 to 5.18 m)

DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	180.40				
ASPHALT	0.00	1A			
GRANULAR FILL	0.15	1B	SS	10	
(SW) Gravelly SAND, trace silt; brown; non-cohesive, moist to wet, compact	179.56 0.84	2	SS	11	
		3	SS	25	
(SM) SILTY SAND, fine grained, some gravel, trace clay; grey; non-cohesive, wet, compact to very loose	178.04 2.36	4	SS	12	
		5	SS	WR	
(SM) SILTY SAND, fine grained, trace clay; grey; non-cohesive, wet, compact	176.67 3.73	6	SS	17	MH
		7	SS	14	
END OF BOREHOLE	175.22 5.18				



PIEZOMETER OR STANDPIPE INSTALLATION



1. Water level in piezometer measured at a depth of 1.17 m below ground surface (Elev. 179.23 m) on January 5, 2015.

DEPTH SCALE

1 : 50

LOGGED: AVR

CHECKED: SDK

GTA-BHS 001 1413472.GPJ GAL-MIS.GDT 9/12/17 MK Sept. 12/17

PROJECT: 1413472

LOCATION: N 4860422.01; E 633976.14

RECORD OF BOREHOLE: 16-1

BORING DATE: February 29 to March 1, 2016

SHEET 1 OF 2

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

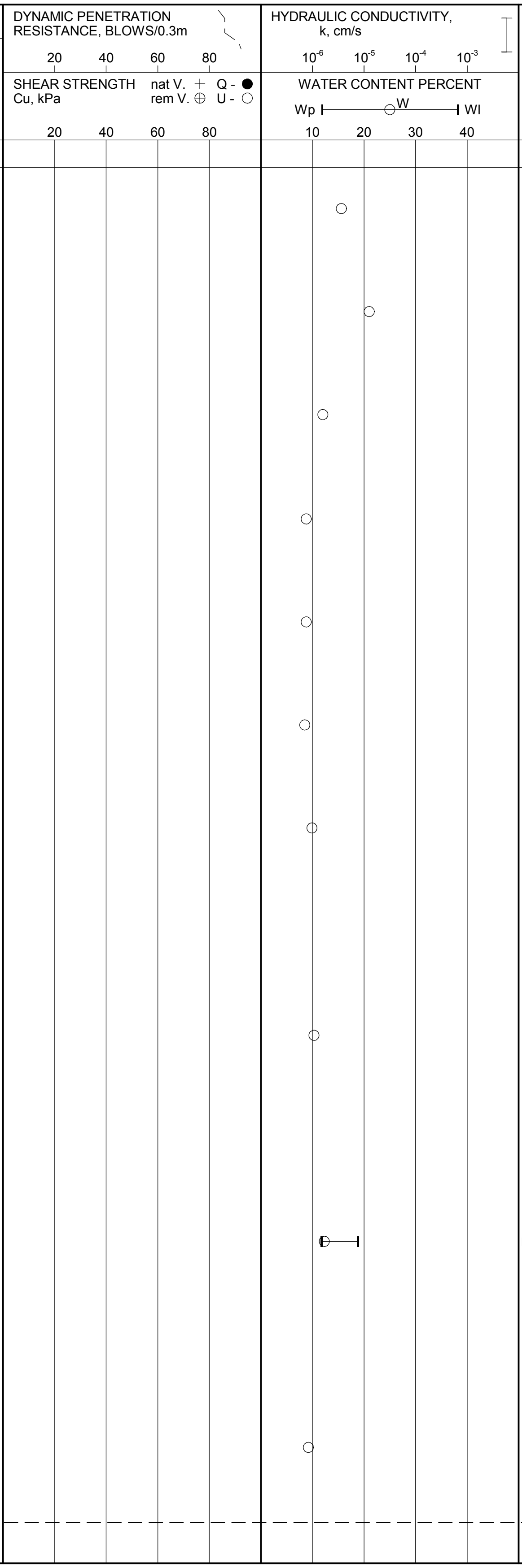
HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER

100 mm O.D. Solid Stem Augers

ELEV. DEPTH (m)	SOIL PROFILE DESCRIPTION
187.38	GROUND SURFACE
0.00	TOPSOIL
187.00 0.38	(CL-ML) Sandy CLAYEY SILT, trace gravel; brown to dark brown to grey; cohesive, w>PL, stiff to very stiff
185.86 1.52	(SM) SILTY SAND, trace gravel, some cohesive fines; brown to grey, oxidation staining to a depth of 3.8 m (TILL); moist, non-cohesive, very dense - Fibrous organics noted to a depth of 2.1 m -Becoming grey below a depth of 3.8 m
182.88 4.50	(CL-ML) Sandy SILTY CLAY to Sandy CLAYEY SILT, trace to some gravel; grey (TILL); cohesive, w<PL to w~PL, very stiff to hard

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	8	
2	SS	17	
3	SS	49	
4	SS	62	
5	SS	69	
6	SS	53	
7	SS	24	
8	SS	25	
9	SS	23	MH/AL
10	SS	57	



PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

RECORD OF BOREHOLE: 16-1

SHEET 2 OF 2

LOCATION: N 4860422.01; E 633976.14

BORING DATE: February 29 to March 1, 2016

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ├──○W──┤ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	CME-85 TRUCK MOUNTED - POWER AUGER 100 mm O.D. Solid Stem Augers	(CL-ML) Sandy SILTY CLAY to Sandy CLAYEY SILT, trace to some gravel; grey (TILL); cohesive, w<PL to w~PL, very stiff to hard	▨								
11					11	SS	48		○		▽ March 1, 2016
12					12	SS	37		○		
				174.58 12.80							
13		END OF BOREHOLE NOTES: 1. Water level measured in open borehole at a depth of 11.2 m upon completion of drilling.									
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860347.14; E 634037.23

RECORD OF BOREHOLE: 16-2

BORING DATE: March 1, 2016

SHEET 1 OF 2

DATUM: Geodetic

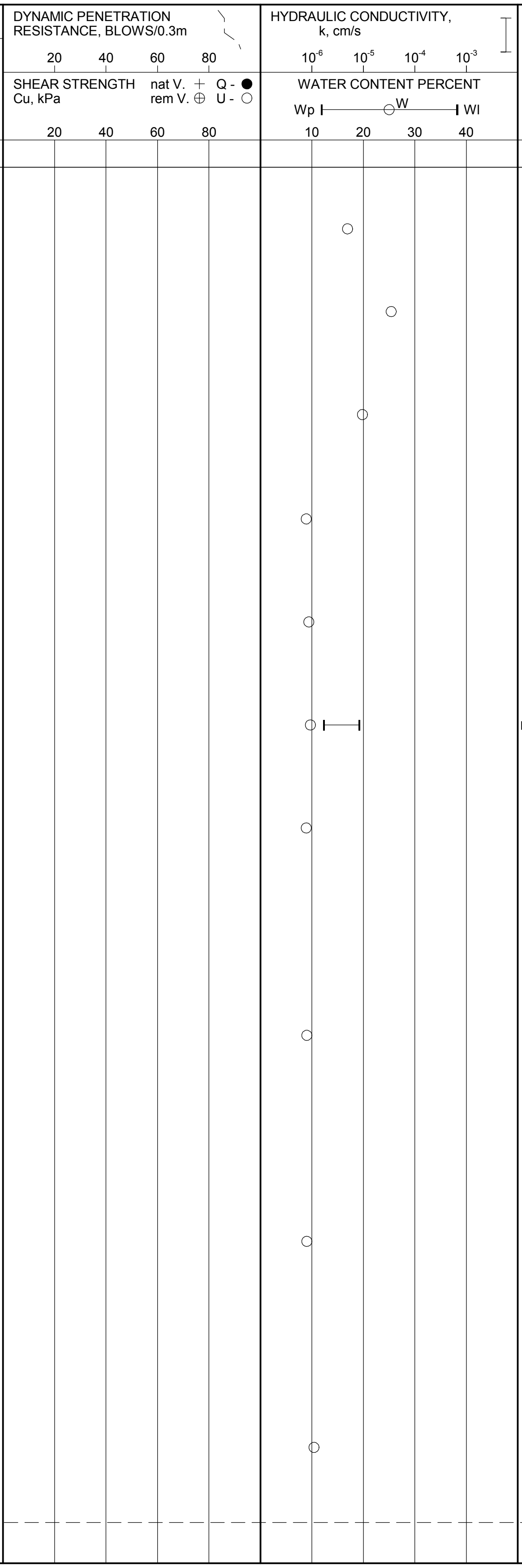
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER; 100 mm O.D. Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	185.36					
TOPSOIL	0.00	1A	SS	3		
(CL) Sandy SILTY CLAY, trace gravel; brown to dark brown, trace fibrous organics; cohesive, w>PL, soft to firm	185.06 0.30	1B				
		2	SS	7		
(CL-ML) Sandy CLAYEY SILT to Sandy SILTY CLAY, trace to some gravel; brown to grey (TILL); cohesive, w<PL, stiff to very stiff	183.91 1.45	3	SS	15		▽ March 1, 2016
- Becoming grey below a depth of 2.6 m		4	SS	24		
		5	SS	21		
		6	SS	28	MH/AL	
		7	SS	24		
- Auger grinding on probable cobbles/boulders at a depth of 5.6 m (ML) Sandy SILT, some cohesive fines, trace gravel; grey (TILL); non-cohesive, moist, dense to very dense	179.72 5.64	8	SS	59		
		9	SS	46		
		10	SS	60		

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10



CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860347.14; E 634037.23

RECORD OF BOREHOLE: 16-2

BORING DATE: March 1, 2016

SHEET 2 OF 2

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	CME-85 TRUCK MOUNTED - POWER AUGER 100 mm O.D. Solid Stem Augers	(ML) Sandy SILT, some cohesive fines, trace gravel; grey (TILL); non-cohesive, moist, dense to very dense									
11					11	SS	54		○		
12				172.94	12	SS	50/ 0.08		○		
		END OF BOREHOLE NOTES: 1. Water level measured in open borehole at a depth of 2.0 m upon completion of drilling, March 1, 2016		12.42							
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

RECORD OF BOREHOLE: 16-3

SHEET 1 OF 1

LOCATION: N 4861018.31; E 635094.77

BORING DATE: February 24, 2016

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
110 mm I.D. 200 mm O.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	197.56
TOPSOIL	0.00
(CL) SILTY CLAY, some sand to sandy, trace to some gravel; light brown to light brown mottled grey, oxidation staining, fibrous organics; cohesive, w~PL, stiff	197.36 0.20
(SM) SILTY SAND, some gravel, trace to some cohesive fines; brown to grey, oxidation staining (TILL); non-cohesive, moist, compact to dense - Auger grinding on probable cobbles/boulders from depths of 1.5 m to 2.1 m	196.11 1.45
(ML/SM) Sandy SILT to SILTY SAND; grey; non-cohesive, moist to wet, dense - 50 mm thick sand seam at a depth of 4.3 m	193.83 3.73
(SP) SAND, fine, some fines; grey; non-cohesive, wet, dense	192.68 4.88
(SM) SILTY SAND, some gravel, some cohesive fines; grey (TILL); non-cohesive, moist, compact	191.46 6.10
END OF BOREHOLE	190.85 6.71

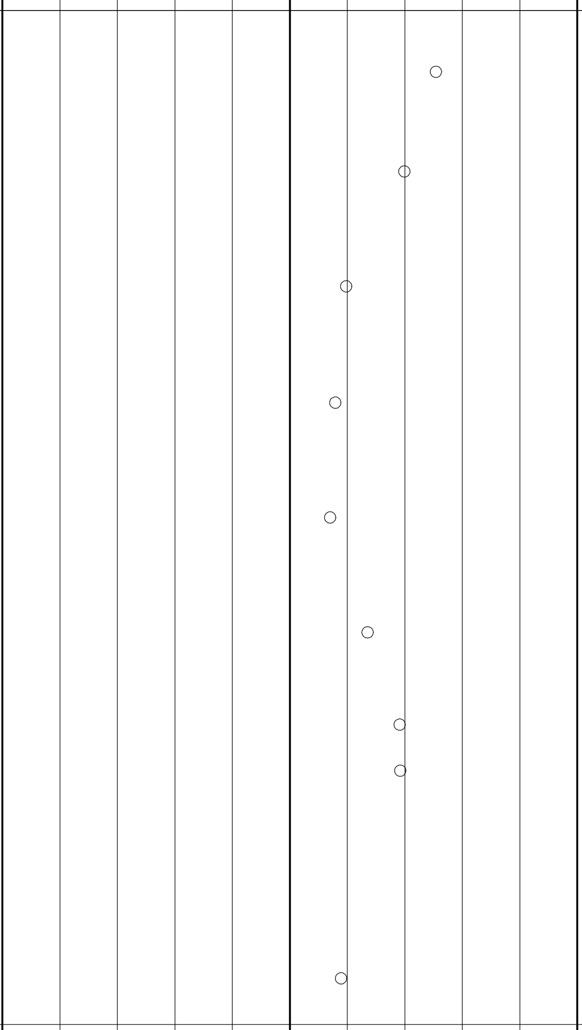
SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A			
1B	SS	9	
2	SS	9	
3	SS	28	
4	SS	48	
5	SS	30	
6	SS	33	
7A	SS	36	
7B			M
8	SS	25	

NOTE:

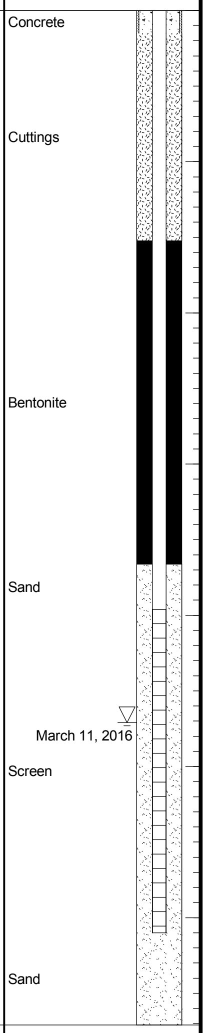
1. Water level measured in open borehole at a depth of 5.9 m upon completion of drilling, February 24, 2016.

2. Water level measured in monitoring well at a depth of 4.71 m, March 11, 2016.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80
SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT Wp W Wl 10 20 30 40



PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860382.52; E 634929.27

RECORD OF BOREHOLE: 16-4

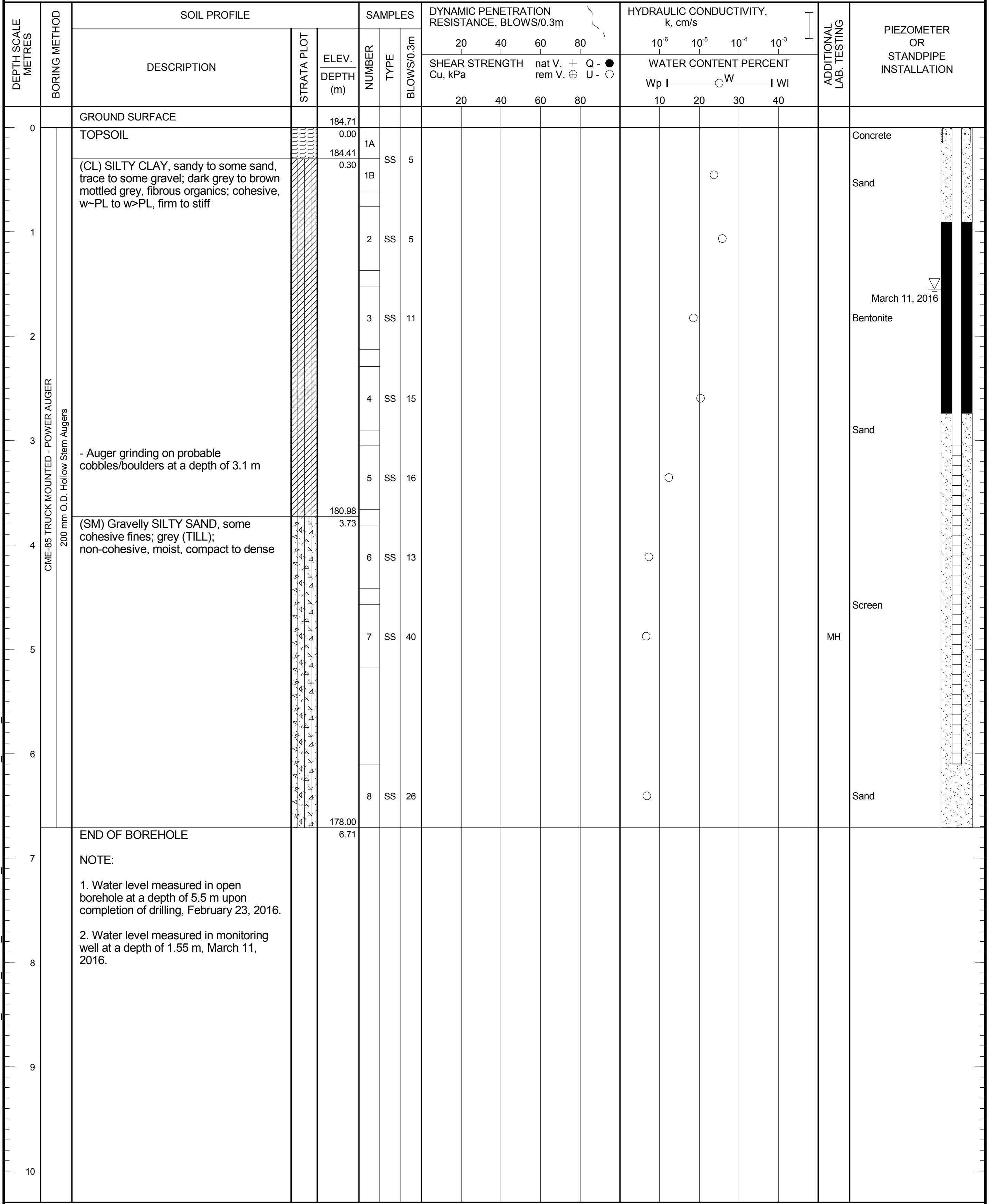
BORING DATE: February 23, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	184.71
TOPSOIL	0.00
(CL) SILTY CLAY, sandy to some sand, trace to some gravel; dark grey to brown mottled grey, fibrous organics; cohesive, w~PL to w>PL, firm to stiff - Auger grinding on probable cobbles/boulders at a depth of 3.1 m	184.41 0.30
(SM) Gravelly SILTY SAND, some cohesive fines; grey (TILL); non-cohesive, moist, compact to dense	180.98 3.73
END OF BOREHOLE	178.00 6.71

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A 1B	SS	5	
2	SS	5	
3	SS	11	
4	SS	15	
5	SS	16	
6	SS	13	
7	SS	40	MH
8	SS	26	

NOTE:

1. Water level measured in open borehole at a depth of 5.5 m upon completion of drilling, February 23, 2016.

2. Water level measured in monitoring well at a depth of 1.55 m, March 11, 2016.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860647.72; E 634606.69

RECORD OF BOREHOLE: 16-5

BORING DATE: February 24, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

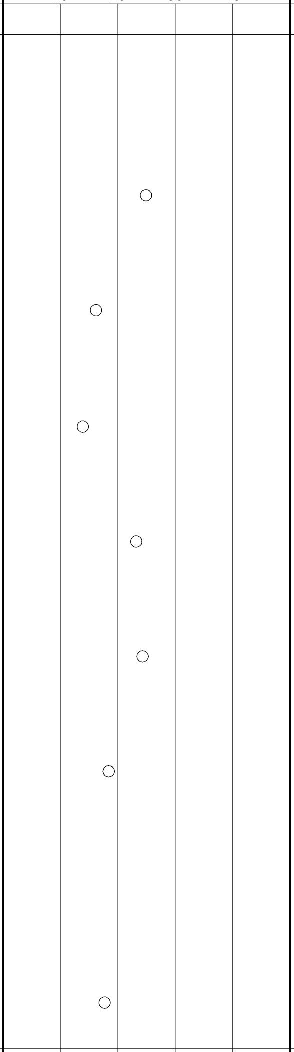
BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER, 200 mm O.D. Hollow Stem Augers

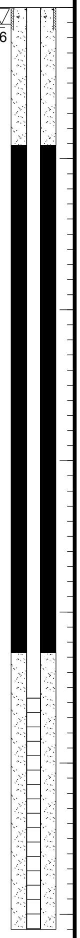
SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	186.08					
TOPSOIL	0.00	1	SS	6		Concrete March 11, 2016 Sand
(CL-ML) CLAYEY SILT to CLAYEY SILT and SAND, trace to some gravel; brown mottled grey, becoming grey below a depth of 2.3 m, trace fibrous organics; cohesive, w~PL to w>PL, soft to stiff	185.47 0.61	2	SS	12		
		3	SS	13		
		4	SS	4		Bentonite Seal
(CL) SILTY CLAY, trace sand; light brown; cohesive, w>PL, firm	183.11 2.97	5	SS	6		
(SW) SAND, trace to some gravel, trace fines; brown; non-cohesive, wet, very loose to dense	182.35 3.73	6	SS	6		
		7	SS	4	M	Sand Screen
		8	SS	35		
END OF BOREHOLE	179.37 6.71					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}





NOTE:

1. Water level measured in monitoring well at a depth of 0.5 m, February 25, 2016.

2. Water level measured in monitoring well at a depth of 0.11 m, March 11, 2016.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472
LOCATION: N 4860589.30; E 634092.95

RECORD OF BOREHOLE: 16-6

BORING DATE: March 2, 2016

SHEET 1 OF 1
DATUM: Geodetic

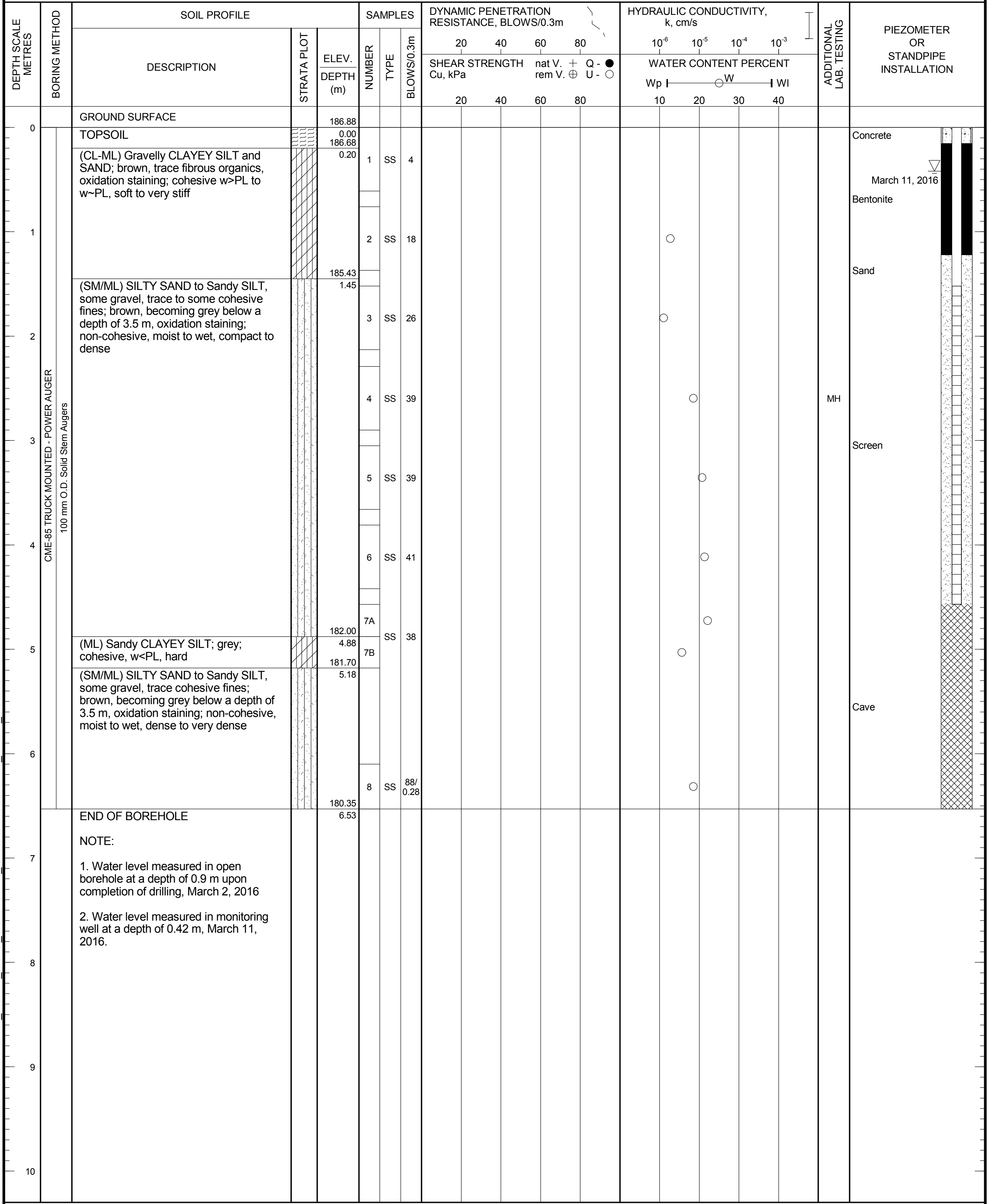
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
100 mm O.D. Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	186.88
TOPSOIL	0.00
(CL-ML) Gravelly CLAYEY SILT and SAND; brown, trace fibrous organics, oxidation staining; cohesive w>PL to w~PL, soft to very stiff	186.68 0.20
(SM/ML) SILTY SAND to Sandy SILT, some gravel, trace to some cohesive fines; brown, becoming grey below a depth of 3.5 m, oxidation staining; non-cohesive, moist to wet, compact to dense	185.43 1.45
(ML) Sandy CLAYEY SILT; grey; cohesive, w<PL, hard	182.00 4.88
(SM/ML) SILTY SAND to Sandy SILT, some gravel, trace cohesive fines; brown, becoming grey below a depth of 3.5 m, oxidation staining; non-cohesive, moist to wet, dense to very dense	181.70 5.18
END OF BOREHOLE	180.35 6.53

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	4	
2	SS	18	
3	SS	26	
4	SS	39	MH
5	SS	39	
6	SS	41	
7A 7B	SS	38	
8	SS	88/ 0.28	



NOTE:

1. Water level measured in open borehole at a depth of 0.9 m upon completion of drilling, March 2, 2016

2. Water level measured in monitoring well at a depth of 0.42 m, March 11, 2016.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860439.38; E 633967.65

RECORD OF BOREHOLE: 16-7

BORING DATE: February 29, 2016

SHEET 1 OF 1

DATUM: Geodetic

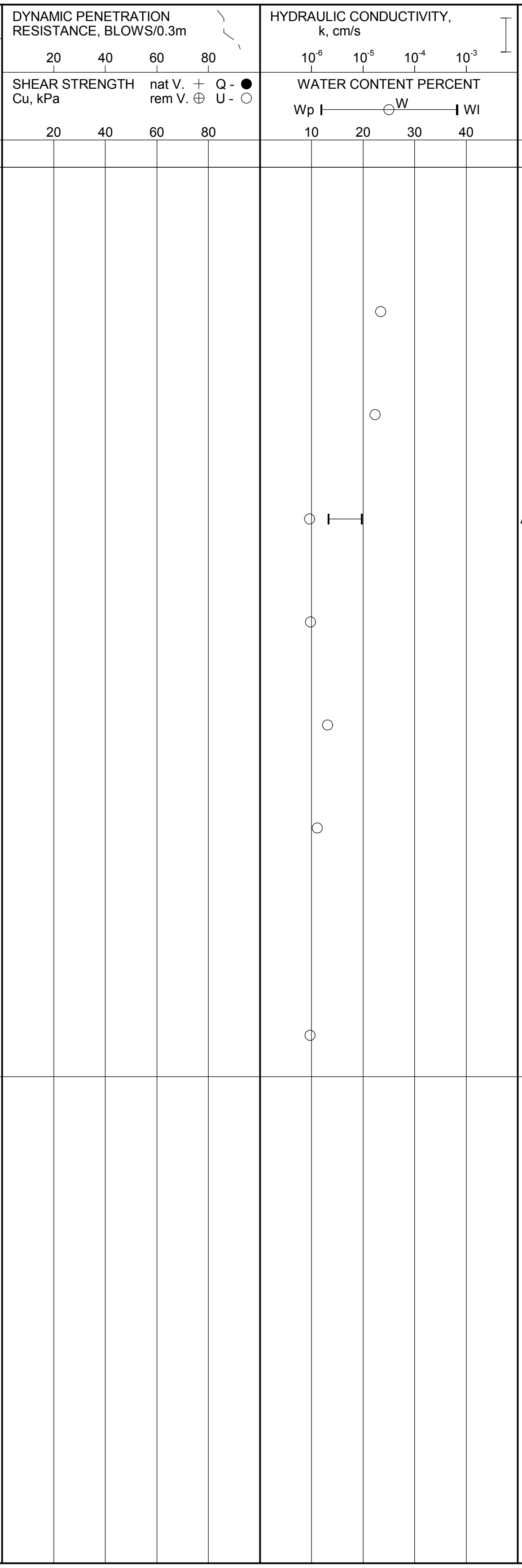
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

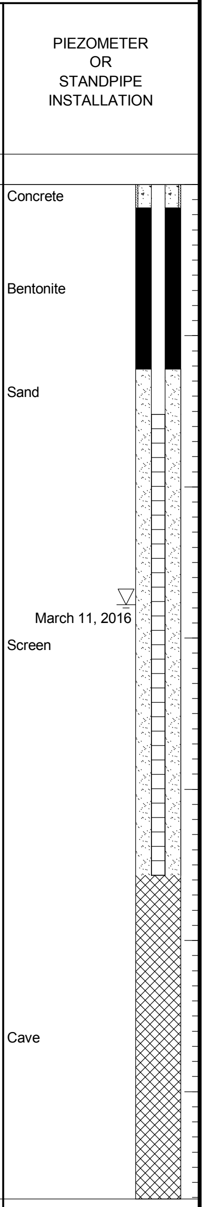
HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
100 mm O.D. Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	187.59	
TOPSOIL		0.00
(CL-ML) Sandy CLAYEY SILT, trace gravel; brown, trace fibrous organics; cohesive, w<PL to w~PL, soft to very stiff	187.18	0.41
(ML-CL) Sandy CLAYEY SILT to Sandy SILTY CLAY, trace to some gravel; light brown, oxidation staining (TILL); cohesive, w<PL, hard	185.38	2.21
(SW) Gravelly SAND, some fines; brown; non-cohesive, moist, dense	184.08	3.51
(ML/CL) Sandy CLAYEY SILT to SILTY CLAY, trace to some gravel; grey, oxidation staining (TILL); cohesive, w<PL to w~PL, stiff to very stiff		3.66
END OF BOREHOLE	180.88	6.71

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	4	
2	SS	12	
3	SS	19	
4	SS	41	AL/MH
5	SS	41	
6	SS	14	
7	SS	17	
8	SS	22	





NOTE:

1. Water level measured in open borehole at a depth of 4.3 m upon completion of drilling, February 29, 2016.

2. Water level measured in monitoring well at a depth of 2.78 m, March 11, 2016.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860234.20; E 634189.57

RECORD OF BOREHOLE: 16-8

BORING DATE: February 29, 2016

SHEET 1 OF 1

DATUM: Geodetic

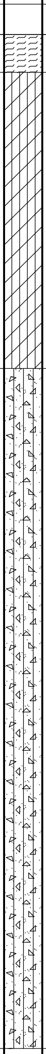
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

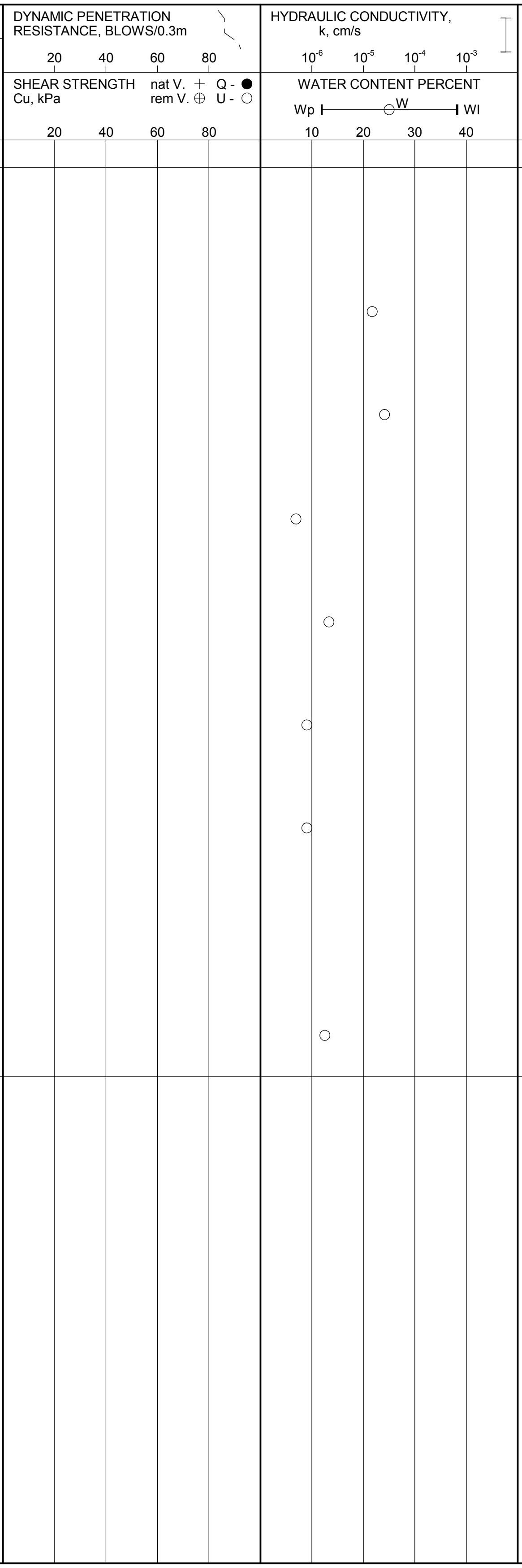
HAMMER TYPE: AUTOMATIC

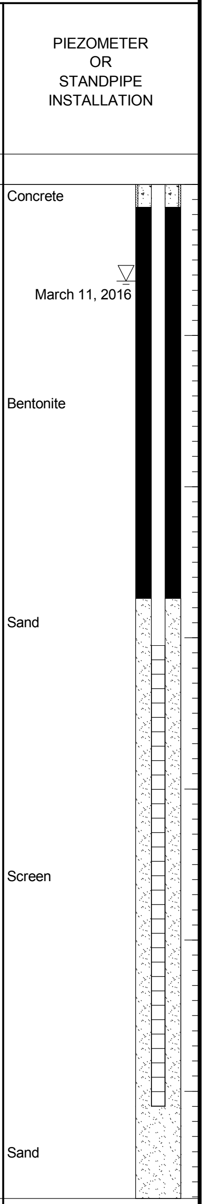
BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER, 100 mm O.D. Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	183.22
TOPSOIL	0.00
(CL-ML) Sandy CLAYEY SILT, trace gravel; light brown to brown, oxidation staining; cohesive, w~PL to w>PL, stiff to very stiff	182.97 0.25
(SM/ML) SILTY SAND to Sandy SILT, some gravel, some cohesive fines; grey (TILL); non-cohesive, moist, compact to very dense	181.01 2.21
END OF BOREHOLE	176.51 6.71

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	12	
2	SS	13	
3	SS	22	
4	SS	24	
5	SS	33	
6	SS	64	MH
7	SS	52	
8	SS	63	







NOTE:

1. Water level measured in open borehole at a depth of 6.0 m upon drilling completion, February 29, 2016.

2. Water level measured in monitoring well at a depth of 0.64 m, March 11, 2016.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: N 4859910.90; E 634082.19

RECORD OF BOREHOLE: 16-9

BORING DATE: February 29, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER; 100 mm O.D. Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	183.30				
TOPSOIL	0.00	1A	SS	9	
(CL-ML) Sandy CLAYEY SILT; brown, some fibrous organics; cohesive, w~PL, stiff	183.00 0.30	1B			
(CL) SILTY CLAY, sandy to trace sand, varved; brown to light brown, becoming grey below a depth of 1.8 m; cohesive, w~PL to w<PL, firm to very stiff	182.61 0.69	2	SS	5	
		3	SS	21	
		4	SS	15	
		5	SS	21	
(CI) SILTY CLAY, trace sand; grey; cohesive, w~PL, very stiff to hard	179.57 3.73	6	SS	19	MH
		7	SS	40	
		8	SS	43	
END OF BOREHOLE	176.59 6.71				

NOTE:

1. Borehole dry upon completion of drilling, February 29, 2016.

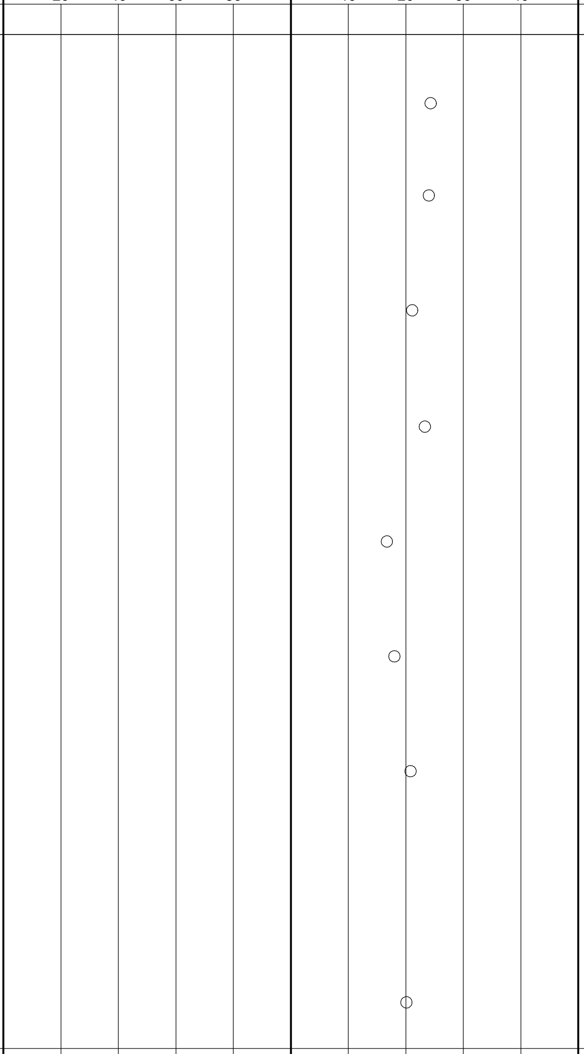
2. Water level measured in monitoring well at a depth of 0.86 m, March 11, 2016.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

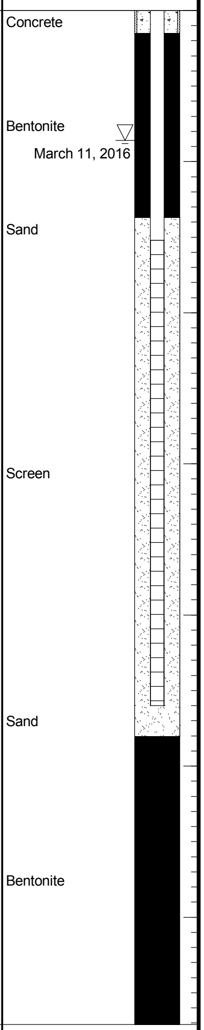
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40



PIEZOMETER OR STANDPIPE INSTALLATION



DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: N 4859988.01; E 633603.68

RECORD OF BOREHOLE: 16-10

BORING DATE: February 29, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER; 100 mm O.D. Solid Stem Augers

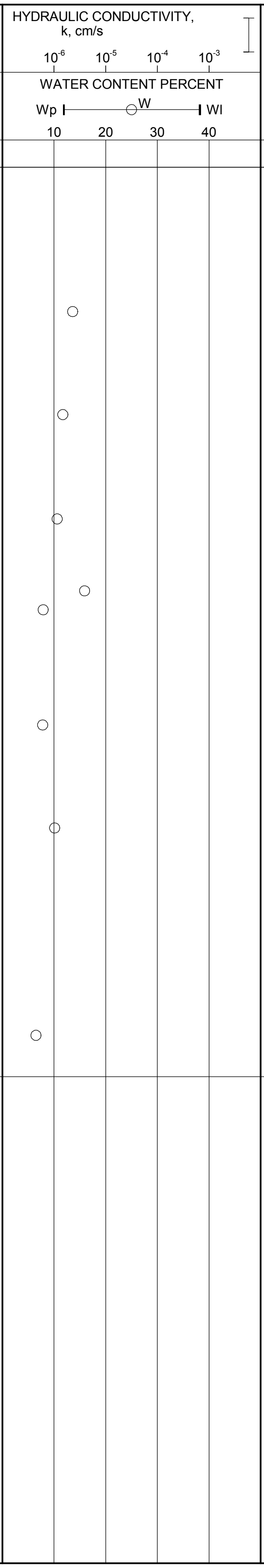
SOIL PROFILE – DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	190.66	
TOPSOIL		0.00
(CL-ML) Sandy CLAYEY SILT, trace gravel; light brown; cohesive, w~PL, firm to very stiff	190.41	0.25
(ML) Sandy SILT to SILT and SAND, some gravel, trace to some cohesive, fines; brown, oxidation staining (TILL); non-cohesive, moist, compact	188.45	2.21
(SM) SILTY SAND, trace gravel; brown; non-cohesive, wet, very dense	187.69	2.97
(ML) Sandy SILT to SILT and SAND, some gravel, trace to some cohesive, fines; brown, becoming grey below a depth of 4.1 m, oxidation staining (TILL); non-cohesive, moist, compact to very dense - Auger grinding on probable cobbles and boulders at a depth of about 5.5 m	187.46	3.20
END OF BOREHOLE	183.95	6.71

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	6	
2	SS	7	
3	SS	19	
4	SS	23	
5A 5B	SS	50/ 0.13	
6	SS	40	MH
7	SS	28	
8	SS	51	

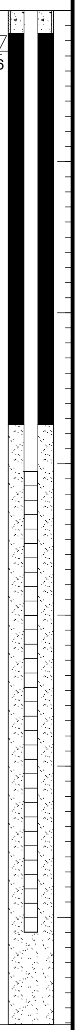
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}



PIEZOMETER OR STANDPIPE INSTALLATION



NOTE:

1. Water level measured in open borehole at a depth of 2.0 m upon drilling completion, February 29, 2016.

2. Water level measured in monitoring well at a depth of 0.27 m, March 11, 2016.

DEPTH SCALE

1 : 50

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: N 4859797.82; E 634643.69

RECORD OF BOREHOLE: 16-11

BORING DATE: February 25, 2016

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

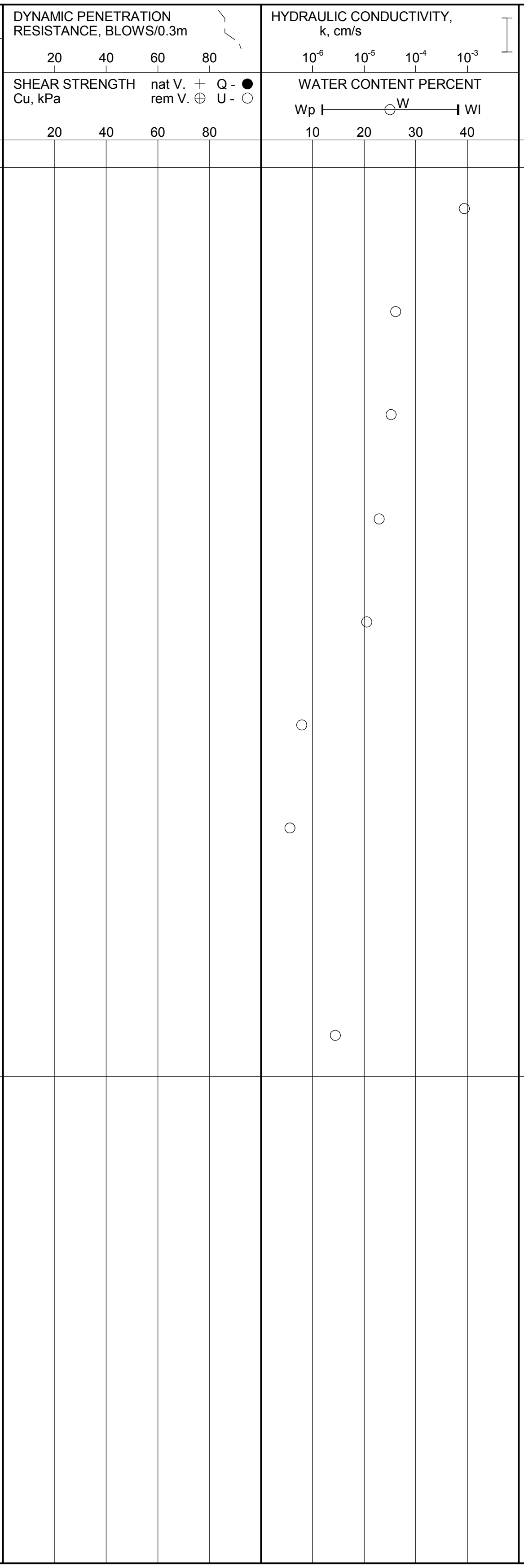
BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER; 100 mm O.D. Solid Stem Augers

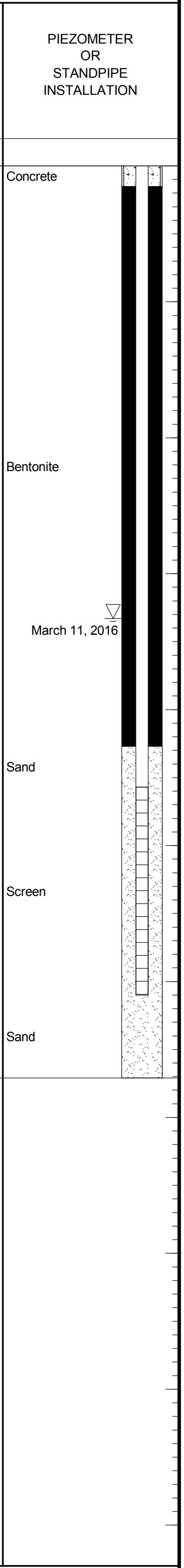
DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	181.20
TOPSOIL	0.00
(CL-ML) Sandy CLAYEY SILT; light brown, mottled grey, trace fibrous organics; cohesive, w>PL, firm to stiff	0.10
(CL-ML) CLAYEY SILT, some sand; brown to grey; cohesive, w<PL, stiff - 80 mm sand seam at a depth of 1.8 m	179.75 1.45
(SM) SILTY SAND, gravelly to some gravel, trace to some cohesive fines; grey, contains crushed rock fragments (TILL); non-cohesive, moist, compact to dense	177.47 3.73
END OF BOREHOLE	174.49 6.71

NOTE:

1. Water level measured in monitoring well at a depth of 3.33 m, March 11, 2016.

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	6	
2	SS	13	
3	SS	15	
4	SS	13	
5	SS	10	
6	SS	30	
7	SS	43	MH
8	SS	36	





DEPTH SCALE

1 : 50

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860771.27; E 634894.00

RECORD OF BOREHOLE: 16-12

BORING DATE: February 25, 2016

SHEET 1 OF 3

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
200 mm O.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	190.11			
TOPSOIL	0.00			
(SM/ML) SAND and SILT to Sandy SILT, some gravel, trace to some cohesive fines; grey (TILL); non-cohesive, moist, dense to very dense	189.88 0.23	1	SS	4
		2	SS	45
- Auger grinding on probable cobbles/boulders at a depth of 1.2 m				
		3	SS	48
		4	SS	49
		5	SS	32
		6	SS	38
		7	SS	40
		8	SS	35
		9	SS	46
		10	SS	63

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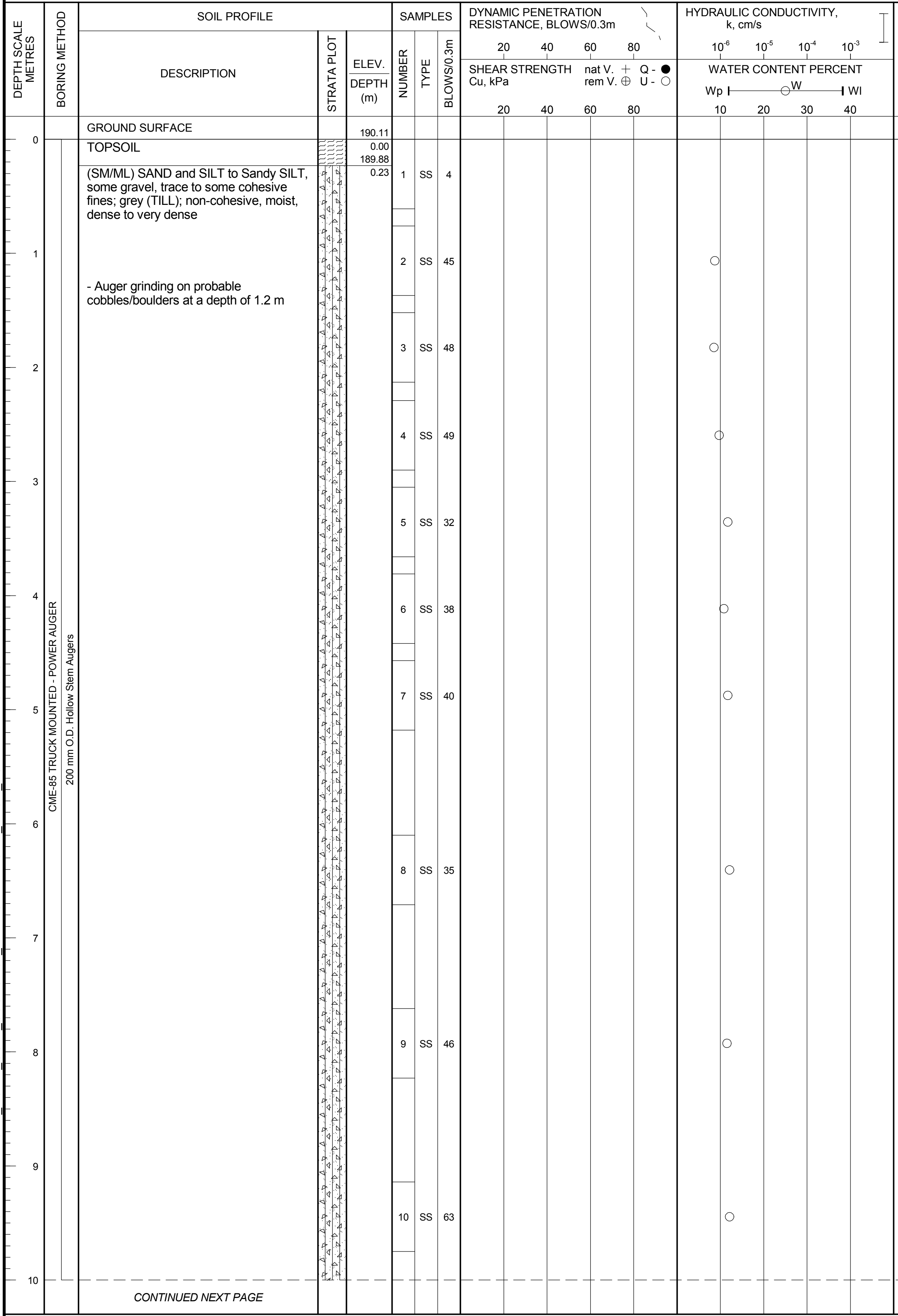
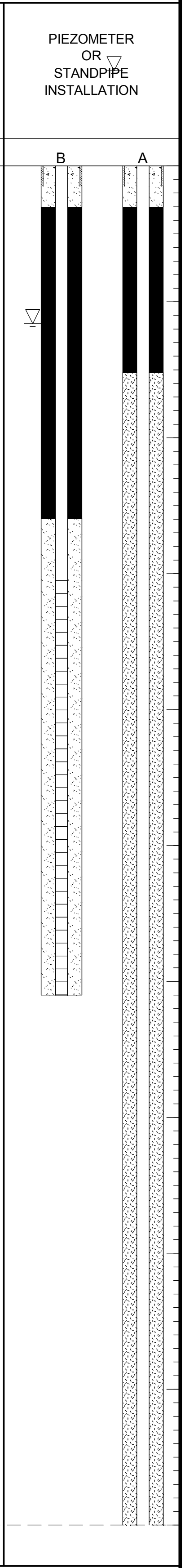




DEPTH SCALE
1 : 50

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860771.27; E 634894.00

RECORD OF BOREHOLE: 16-12

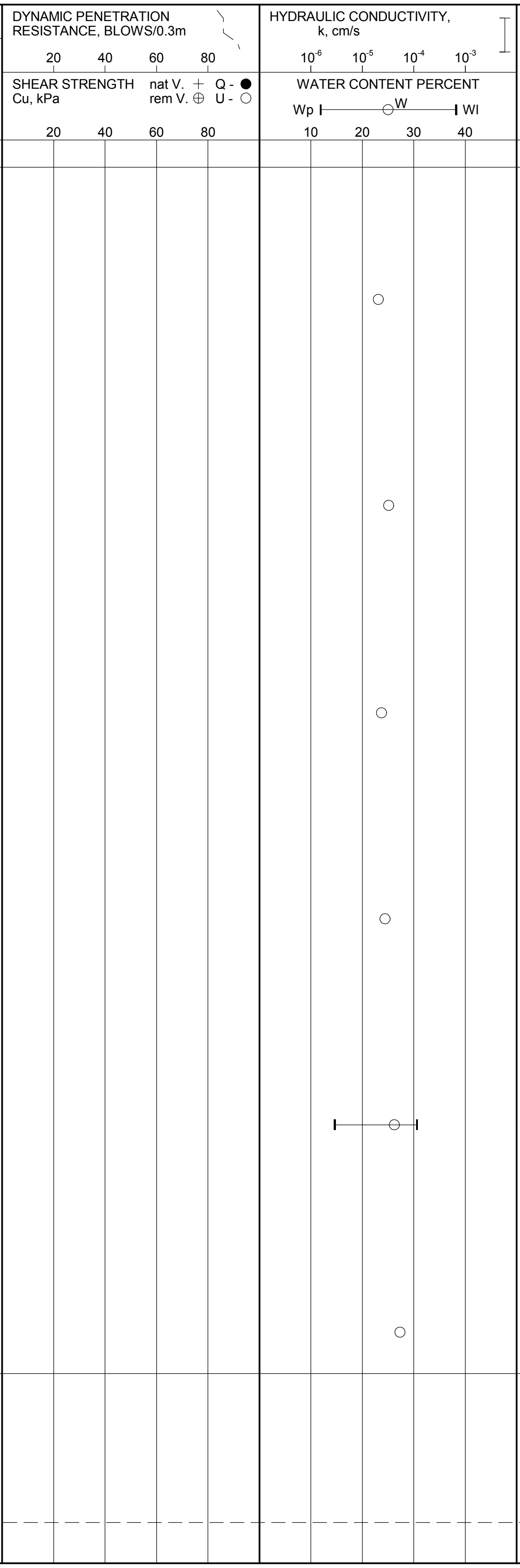
BORING DATE: February 25, 2016

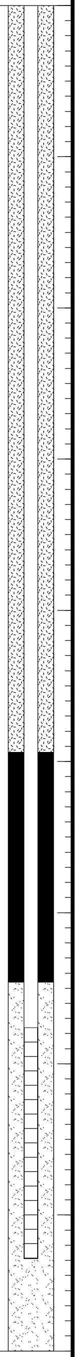
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---							
10	CME-85 TRUCK MOUNTED - POWER AUGER 200 mm O.D. Hollow Stem Augers	(CI) SILTY CLAY, trace to some sand, varved; grey; cohesive, w>PL, stiff to hard		179.90 10.21					
11					11	SS	37		
12					12	SS	45		
13									
14					13	SS	27		
15					14	SS	12		Bentonite Seal
16									Sand
17		- 50 mm sand seam at a depth of 16.9 m			15	SS	32	MH/AL	Silica Sand Filter
18					16	SS	22		Sand
19		END OF BOREHOLE NOTE: 1. Water level measured in monitoring well A at a depth of -0.70 m (above ground surface), March 11, 2016. 2. Water level measured in monitoring		171.21 18.90					
20		*CONTINUED NEXT PAGE*							





DEPTH SCALE

1 : 50

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860771.27; E 634894.00

RECORD OF BOREHOLE: 16-12

BORING DATE: February 25, 2016

SHEET 3 OF 3

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
20		well B at a depth of 0.41 m, March 11, 2016.									
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860121.00; E 635100.28

RECORD OF BOREHOLE: 16-13

BORING DATE: February 22, 2016

SHEET 1 OF 2

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

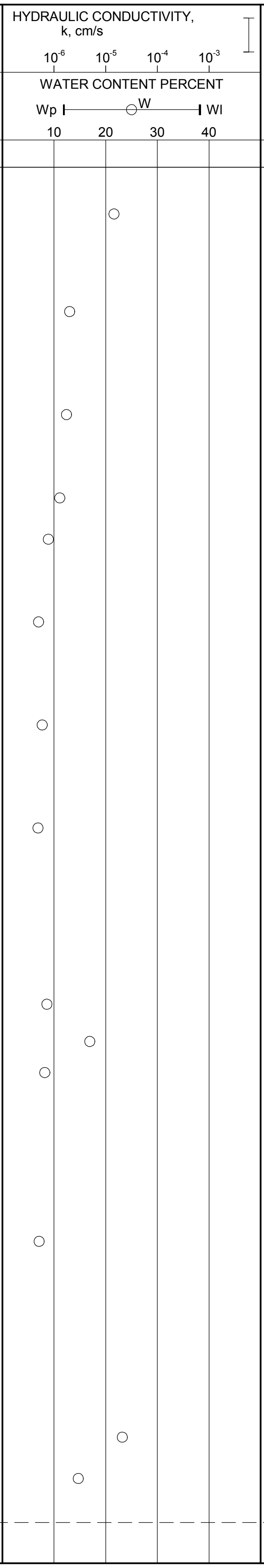
BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
110 mm I.D. 200 mm O.D. Hollow Stem Augers

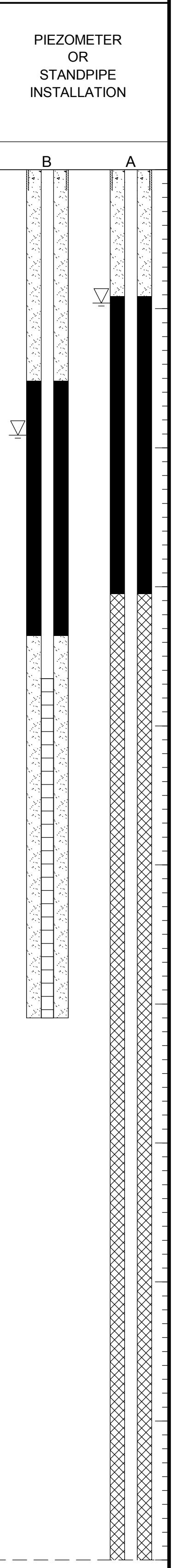
SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	184.14
TOPSOIL	0.00
(CL-ML) Sandy SILTY CLAY to CLAYEY SILT, trace gravel; brown to brown mottled grey, fibrous organics, oxidation staining; cohesive, w~PL, firm to very stiff	0.08
(SP) SAND, trace fines; grey; non-cohesive, moist to wet, compact	181.93 2.21
(ML/SM) Sandy SILT to SILTY SAND, gravelly to some gravel, trace to some cohesive fines; grey (TILL); non-cohesive, moist to wet, compact - Auger grinding on probable cobbles/boulders at a depth of 3.8 m - Auger grinding on probable cobbles/boulders at a depth of 4.6 m	181.55 2.59
(SM) SILTY SAND; grey; non-cohesive, wet, compact	177.89 6.25
(SM) SILTY SAND, trace to some gravel, trace cohesive fines; grey (TILL); moist to wet, compact to dense - Auger grinding on probable cobbles/boulders from depths of 6.9 m to 7.5 m	177.49 6.65
(ML) Sandy SILT; grey; non-cohesive, wet, loose	175.45 8.69

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A			
1B	SS	6	
2	SS	16	
3	SS	21	
4A	SS	15	
4B			
5	SS	22	
6	SS	18	
7	SS	22	MH
8A	SS	17	
8B			
8C			
9	SS	32	
10A	SS	9	
10B			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80





DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472
LOCATION: N 4860121.00; E 635100.28

RECORD OF BOREHOLE: 16-13

BORING DATE: February 22, 2016

SHEET 2 OF 2
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

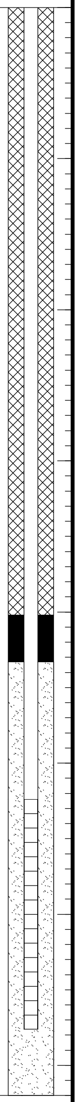
HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
110 mm I.D. 200 mm O.D. Hollow Stem Augers

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl: 10 20 30 40

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	(SM) SILTY SAND trace to some gravel, trace cohesive fines; grey (TILL); non-cohesive, moist, dense	173.93 10.21					
11			11	SS	38		
	(SM) SILTY SAND, some gravel; grey; non-cohesive, wet, loose	172.41 11.73					
12			12	SS	5		
13	(SW) SAND, trace gravel; grey; non-cohesive, wet, very dense - Auger grinding on probable cobbles/boulders at a depth of 13.6 m	170.88 13.26					
14			13	SS	56		Bentonite Seal
	(ML) Sandy SILT to SILT and SAND; grey; non-cohesive, moist to wet, very dense	169.81 14.33					Sand
15			14	SS	80		
16							Silica Sand Filter
17			15	SS	94/ 0.28		Sand
	END OF BOREHOLE	166.94 17.20					
18							
19							
20							



NOTE:

1. Water level measured in hollow stems at a depth of 3.9 m after advance augers to a depth of 3.8 m.

2. Water level measured in open borehole at a depth of 7.5 m upon completion of drilling, February 22, 2016.

3. Water level measured in monitoring well A at a depth of 0.96 m, March 11, 2016.

4. Water level measured in monitoring well B at a depth of 1.91 m, March 11, 2016.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

LOCATION: N 4859941.64; E 634905.52

RECORD OF BOREHOLE: 16-14

BORING DATE: February 26, 2016

SHEET 1 OF 2

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
110 mm I.D. 200 mm O.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	177.45
TOPSOIL	0.00
(SM) SILTY SAND, some gravel, trace cohesive fines; brown to light brown, fibrous organics, oxidation staining; non-cohesive, moist, loose	177.15 0.30
(SM) SILTY SAND, some gravel, trace cohesive fines; light brown to brown, becoming grey below a depth of 2.3 m, oxidation staining (TILL); non-cohesive, moist, compact to dense - Auger grinding on probable cobbles/boulders at a depth of 1.4 m - Auger grinding on probable cobbles/boulders at a depth of 2.0 m	176.76 0.69
(SM/SW) SILTY SAND to SAND, trace to some gravel, trace clay; grey; non-cohesive, wet, loose to compact	172.95 4.50

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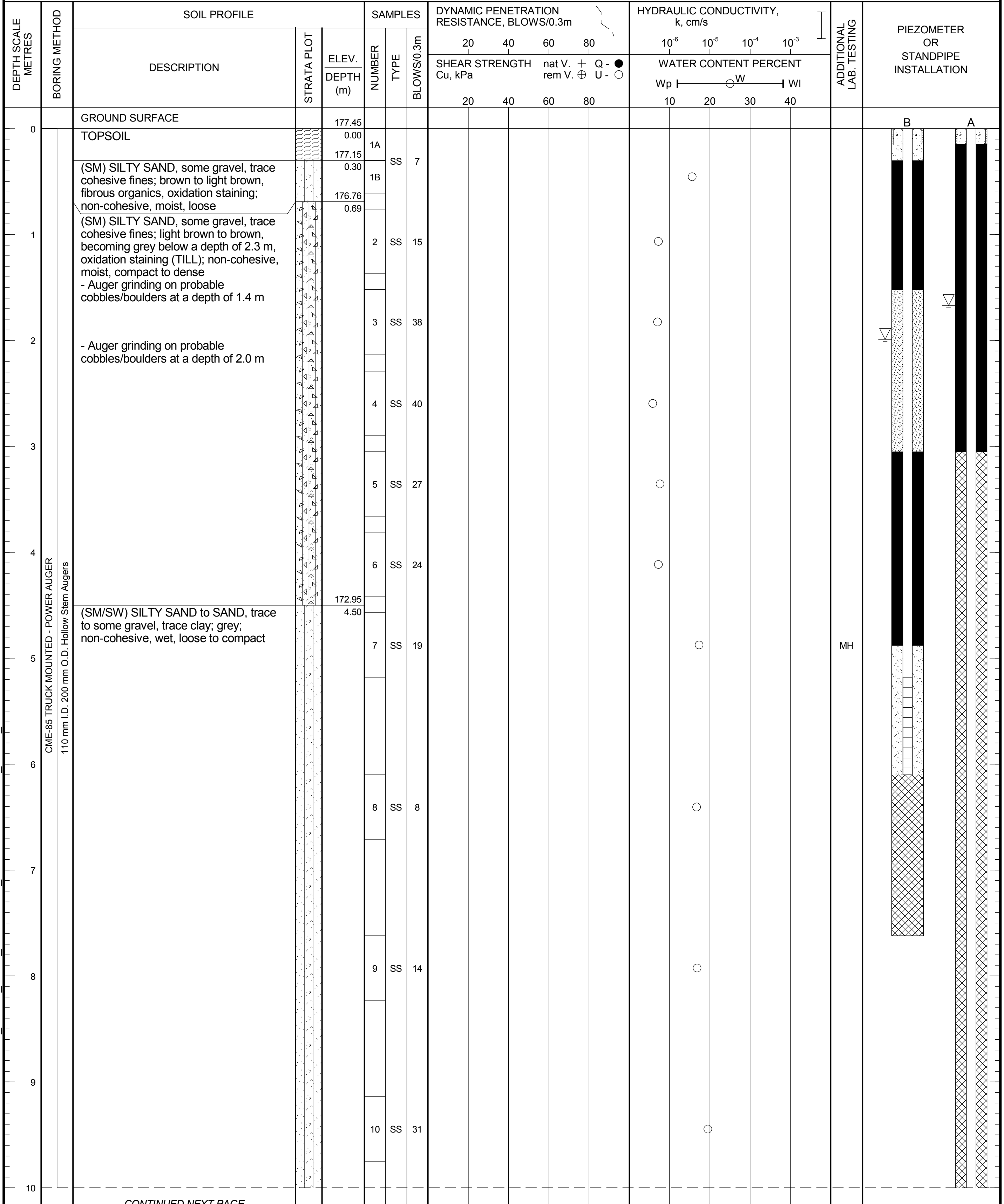
SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1A	SS	7	
1B			
2	SS	15	
3	SS	38	
4	SS	40	
5	SS	27	
6	SS	24	
7	SS	19	MH
8	SS	8	
9	SS	14	
10	SS	31	



DEPTH SCALE
1 : 50

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

RECORD OF BOREHOLE: 16-14

SHEET 2 OF 2

LOCATION: N 4859941.64; E 634905.52

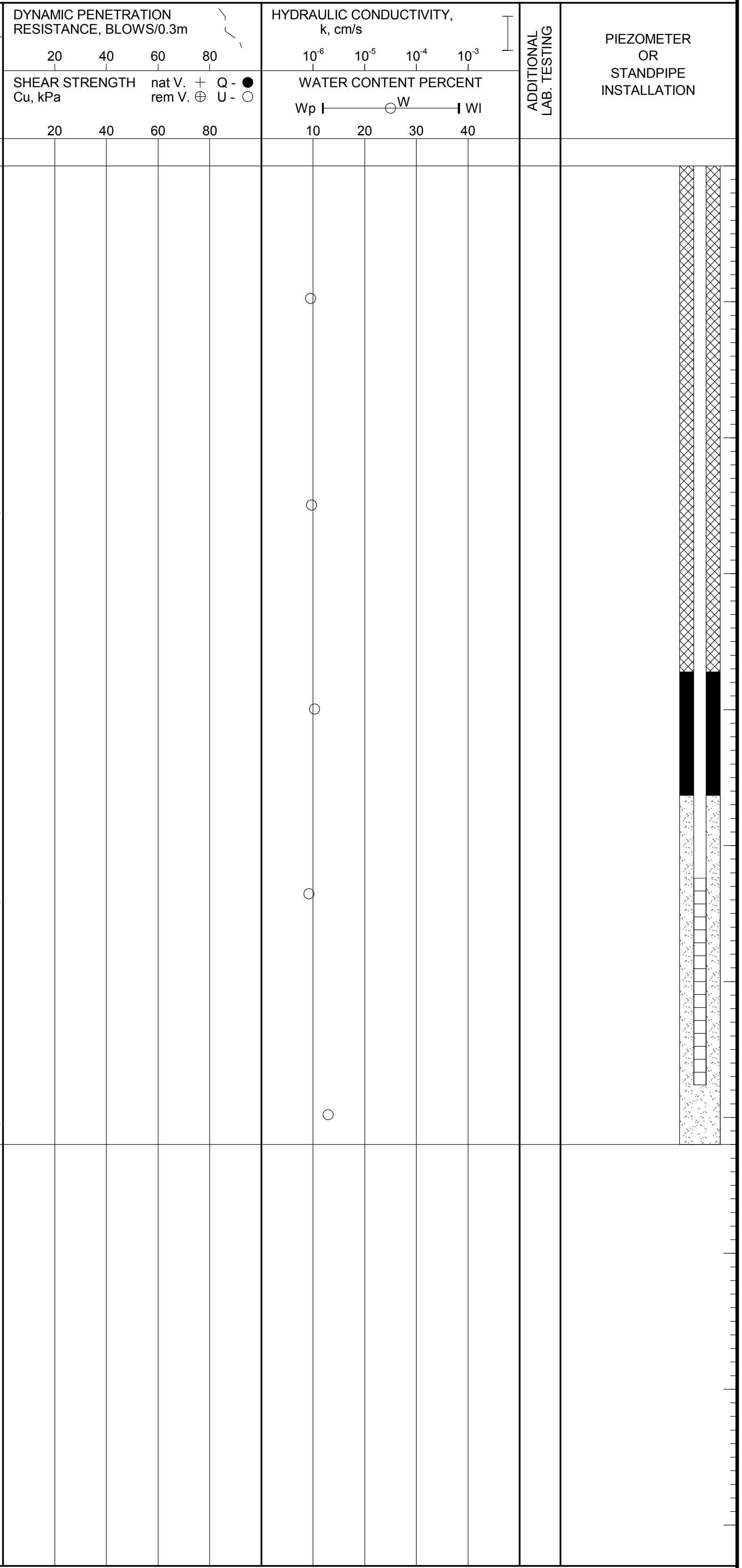
BORING DATE: February 26, 2016

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m
		--- CONTINUED FROM PREVIOUS PAGE ---				
10	CME-85 TRUCK MOUNTED - POWER AUGER 110 mm I.D. 200 mm O.D. Hollow Stem Augers	(SM/SW) SILTY SAND to SAND, trace to some gravel, trace clay; grey; non-cohesive, wet, loose to compact				
11				11	SS	29
		(CL-ML) Sandy CLAYEY SILT, trace gravel; grey (TILL); cohesive, w<PL, hard	165.72 11.73			
12				12	SS	92/ 0.25
13						
14				13	SS	69
15	TRICONE 100 mm Diameter			14	SS	50/ 0.08
16						
17				15	SS	95/ 0.28
		END OF BOREHOLE: NOTE: 1. Water level measured in monitoring well A at a depth of 1.67 m, March 11, 2016. 3. Water level measured in monitoring well B at a depth of 1.99 m, March 11, 2016.	160.25 17.20			
18						
19						
20						



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

RECORD OF BOREHOLE: 16-15

SHEET 1 OF 2

LOCATION: N 4859619.51; E 634368.01

BORING DATE: March 4, 2016

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
200 mm O.D. Hollow Stem Augers

SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES – NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	180.87			
TOPSOIL	0.00			
(CL-ML) CLAYEY SILT, trace to some sand; grey, oxidation staining; cohesive, w<PL to w~PL, firm to stiff	0.15	1	SS	4
		2	SS	10
		3	SS	12
(CL-ML) SILTY CLAY, trace sand, trace gravel; grey; cohesive, w>PL, stiff to very soft	178.66 2.21	4	SS	11
		5	SS	5
		6	SS	WH
		7A	SS	6
(SM/SW) SAND and SILT to SAND, some gravel; grey; non-cohesive, wet, loose to compact	175.99 4.88	7B		
- Auger grinding on probable cobbles/boulders at a depth of 6.1 m		8A	SS	10
(SM) SILTY SAND, trace to some gravel, some cohesive fines; grey; non-cohesive, wet, compact to dense	174.39 6.48	8B		
		9	SS	38
- 150 mm sand and silt seam at a depth of 8.1 m				
(ML-CL) Sandy CLAYEY SILT, trace gravel; grey (TILL); cohesive, w<PL, hard	172.18 8.69	10	SS	92/ 0.28

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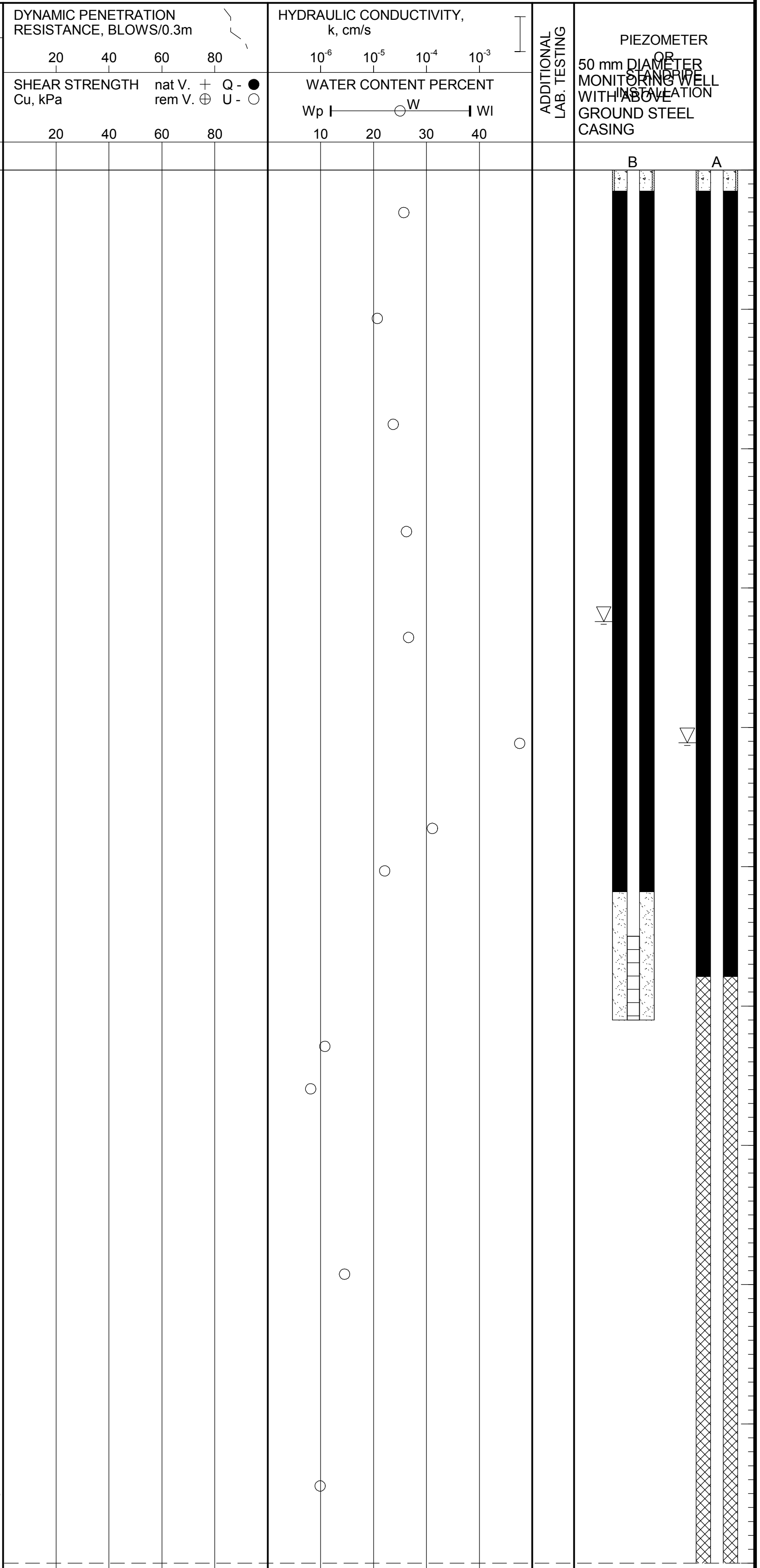


DEPTH SCALE

1 : 50

LOGGED: DM

CHECKED: OS

PROJECT: 1413472
LOCATION: N 4859619.51; E 634368.01

RECORD OF BOREHOLE: 16-15

BORING DATE: March 4, 2016

SHEET 2 OF 2
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

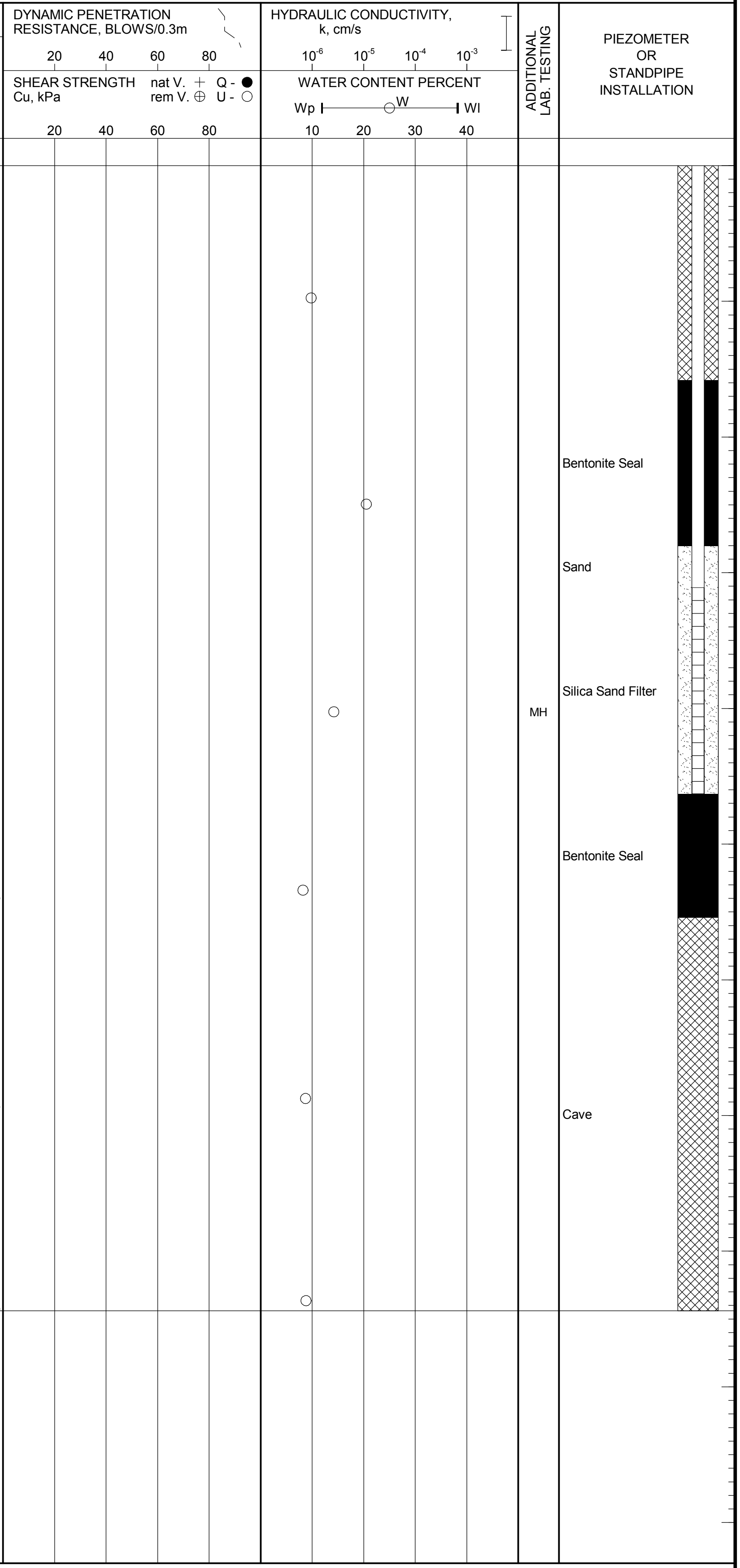
HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER; 200 mm O.D. Hollow Stem Augers

--- CONTINUED FROM PREVIOUS PAGE ---

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
(ML-CL) Sandy CLAYEY SILT, trace gravel; grey (TILL); cohesive, w<PL, hard	169.14 11.73
(SM) Gravelly SILTY SAND, some cohesive fines; grey; non-cohesive, wet, compact	166.09 14.78
(SM) SILTY SAND, some gravel, trace cohesive fines; grey (TILL); non-cohesive, moist to wet, very dense	162.43 18.44
END OF BOREHOLE	

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
11	SS	41	
12	SS	28	
13	SS	31	MH
14	SS	50/ 0.05	
15	SS	50/ 0.08	
16	SS	50/ 0.15	



NOTE:

1. Water level measured in monitoring well A at a depth of 4.11 m, March 11, 2016.

2. Water level measured in monitoring well B at a depth of 3.24 m, March 11, 2016.

DEPTH SCALE
1 : 50

LOGGED: DM
CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860097.78; E 634583.69

RECORD OF BOREHOLE: 16-16

BORING DATE: February 22, 2016

SHEET 1 OF 2

DATUM: Geodetic

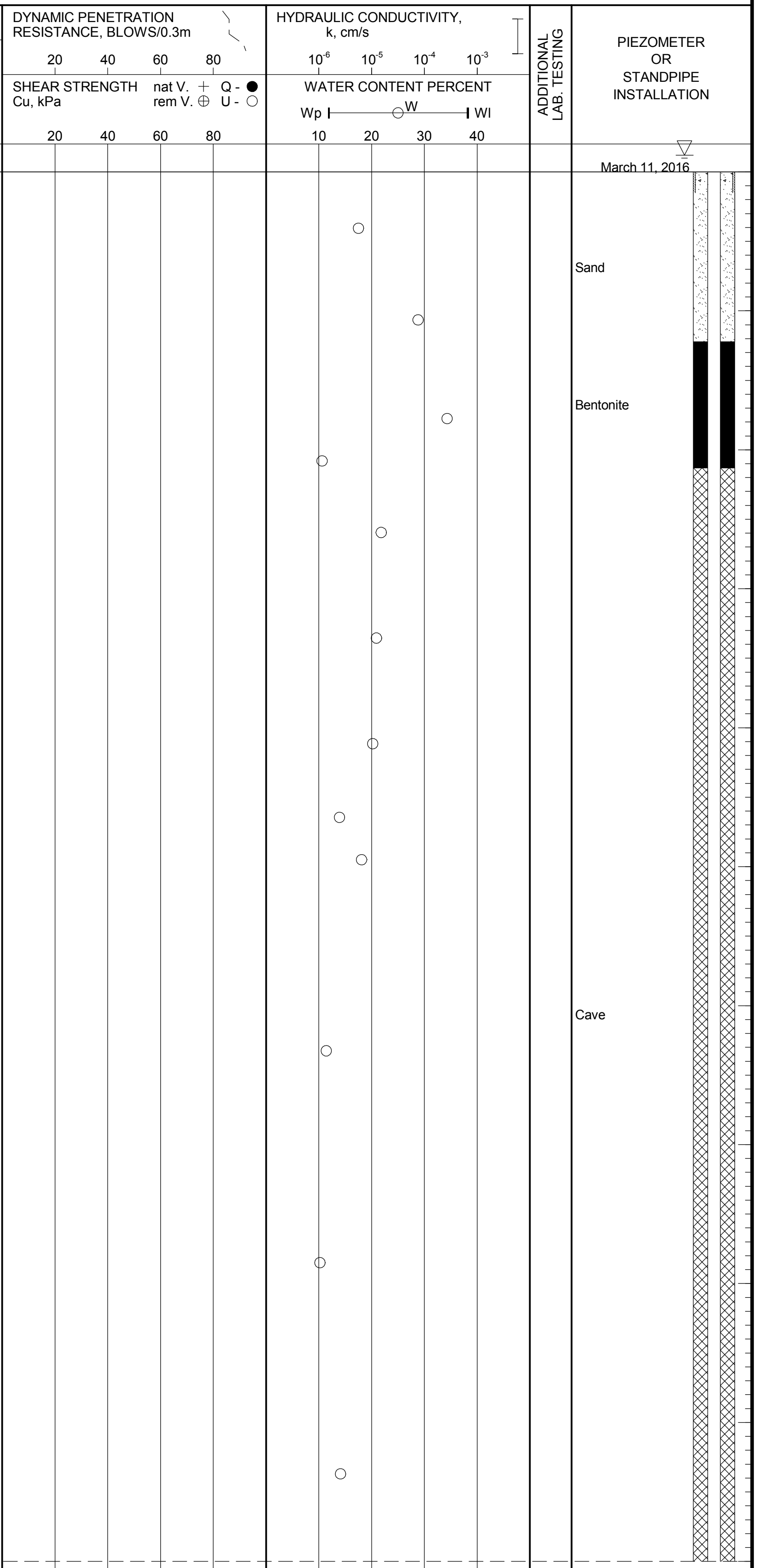
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME-85 TRUCK MOUNTED - POWER AUGER
200 mm O.D. Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	GROUND SURFACE	179.60
0	TOPSOIL	0.00 179.40
	FILL - (CL) Sandy SILTY CLAY, some gravel; dark brown to brown; cohesive, w<PL, soft to firm	0.20
1		178.15
	(OL) ORGANIC SILT, some sand; black	1.45
2		177.57
	(SW) SAND and GRAVEL, trace fines, trace gravel; brown; non-cohesive, moist, compact	2.03 177.39
	(SM) SILTY SAND; grey; non-cohesive, wet, loose to compact	2.21
3		
4	- 80 mm thick gravelly sand seam noted at a depth of 4.0 m	175.10
	(SW) SAND, trace silt, trace gravel; grey; non-cohesive, wet, compact	4.50
5		173.96
	(SM/ML) SAND and SILT to Sandy SILT, trace gravel, trace to some cohesive fines; grey (TILL); non-cohesive, wet to moist, very dense	5.64
6		
7		
8		
9		
10	*CONTINUED NEXT PAGE*	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1A 1B	SS	8
2	SS	4
3A 3B	SS	13
4	SS	24
5	SS	6
6	SS	6
7A 7B	SS	19
8	SS	63
9	SS	100
10	SS	76



DEPTH SCALE

1 : 50

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: N 4860097.78; E 634583.69

RECORD OF BOREHOLE: 16-16

BORING DATE: February 22, 2016

SHEET 2 OF 2

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---						
10	CME-85 TRUCK MOUNTED - POWER AUGER 200 mm O.D. Hollow Stem Augers	- Auger grinding on probable cobbles/boulders at a depth of 9.9 m and at a depth of 10.2 m	169.39 10.21					Bentonite
11		(SM/GW) SILTY SAND to Sandy GRAVEL, some fines; grey; non-cohesive, wet, compact to very dense		11	SS	16	M	Sand Screen
12			167.26 12.34	12	SS	50		Sand
		- Auger grinding on probable cobbles/boulders at a depth of 12.3 m						
		END OF BOREHOLE:						

NOTE:

1. Water level measured in hollow stem augers at a depth of 3.10 m after advancing to a depth of 3.8 m.

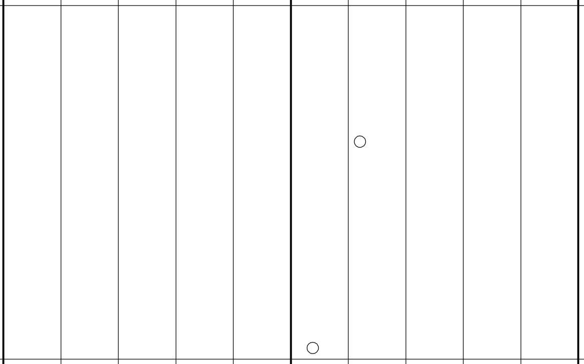
2. Water level measured monitoring well at a depth of -0.12 m (above ground surface), March 11, 2016.

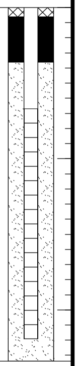
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40





Depth scale: 10 11 12 13 14 15 16 17 18 19 20

DEPTH SCALE

1 : 50

LOGGED: DM

CHECKED: OS

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-1

BORING DATE: March 16, 2017

SHEET 1 OF 2

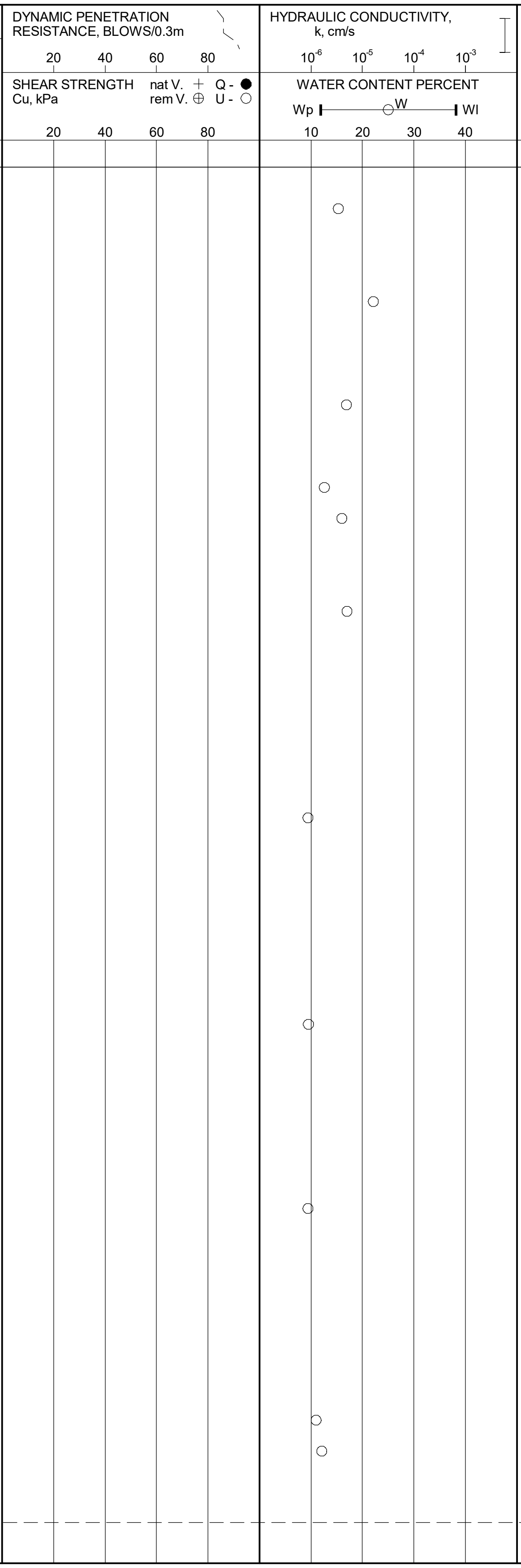
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	181.56
TOPSOIL	0.00
(SC) CLAYEY SAND, trace gravel; dark brown, organic matter, rootlets; non-cohesive, moist, loose	181.32 0.24
(SP/GP) SAND and GRAVEL, trace silt; brown to grey; non-cohesive, wet, loose to compact	180.19 1.37
(CL-ML) SILTY CLAY to CLAYEY SILT, trace sand, trace gravel; grey, (TILL); cohesive, w~PL to w<PL, stiff to hard	179.13 2.44
(SM) SILTY SAND; grey; non-cohesive, wet, very dense	173.10 8.46
(CL-ML) SILTY CLAY to CLAYEY SILT, trace sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	172.22 9.35

CONTINUED NEXT PAGE

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	10
2	SS	6
3	SS	5
4A 4B	SS	14
5	SS	17
6	SS	38
7	SS	78
8	SS	50/ 0.13
9A 9B	SS	50/ 0.08



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇ 16-MAR-17

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

GTA-BHS 001 \\GOLDER.GDS\GAL\SUDBURY\CAD-GIS\SIM\CLIENTS\SIXTEENTH_LAND_HOLDINGS_INC\YORK_DOWNS_GOLF_COURSE\02_DATA\GINT\1413472_2017.GPJ GAL-MIS.GDT 10/17/17 JJL/TB

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-1

BORING DATE: March 16, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ├──○W──┤ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(CL-ML) SILTY CLAY to CLAYEY SILT, trace sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	▨	170.76 10.81	10	SS	50/ 0.13		○		
11 12 13 14 15 16 17 18 19 20		END OF BOREHOLE Notes: 1. Groundwater encountered during drilling at a depth of 1.5 m below ground surface. 2. Borehole open upon completion of drilling. 3. Groundwater measured at a depth of 1.89 m below ground surface upon completion of drilling.									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

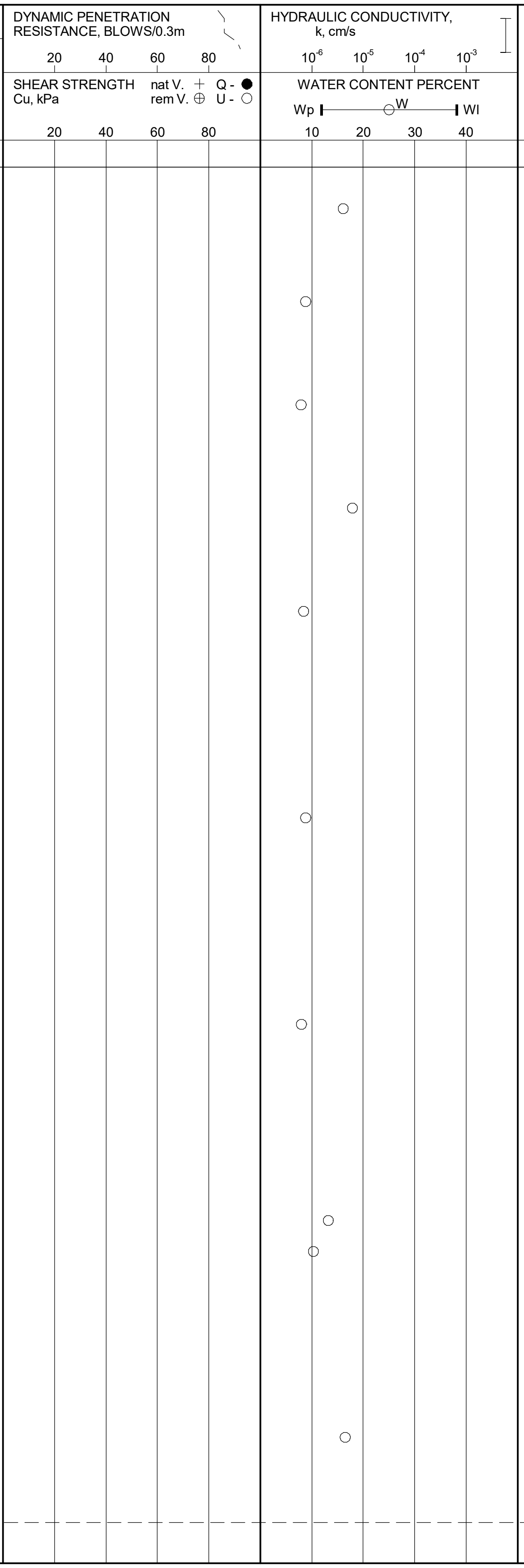
PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-2

BORING DATE: March 16, 2017

SHEET 1 OF 2
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE	180.53			
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	TOPSOIL	0.00			
		(CL) sandy SILTY CLAY, some gravel; brown, organic matter, rootlets; cohesive, w~PL, firm	180.32 0.21	1	SS	5
1		(CL-ML) sandy SILTY CLAY to sandy CLAYEY SILT, some to trace gravel; brown to grey, (TILL); cohesive, w~PL to w<PL, stiff to hard	179.85 0.69	2	SS	12
		-becoming grey at 1.5 m depth		3	SS	17
2				4	SS	14
3				5	SS	34
4–5				6	SS	66
6				7	SS	38
7–8		-0.3 m grey sandy silt seam at 7.6 m depth		8A 8B	SS	42
		(CL) SILTY CLAY, layered with thin sand seams; grey; cohesive, w<PL, hard	172.00 8.53			
9				9	SS	42
10						



PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: PT
CHECKED: SEMP

PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-2

BORING DATE: March 16, 2017

SHEET 2 OF 2
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3}	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40		
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(CL) SILTY CLAY, layered with thin sand seams; grey; cohesive, w<PL, hard	▨								▽ 16-MAR-17
11			▨		10	SS	37		○		
		END OF BOREHOLE Notes: 1. Groundwater encountered during drilling at a depth of 7.9 m below ground surface. 2. Groundwater measured at a depth of 10.6 m below ground surface upon completion of drilling.		169.41 11.13							
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PT
CHECKED: SEMP

GTA-BHS 001 \\GOLDER.GDS\GAL\SUDBURY\CAD-GIS\SIM\CLIENTS\SIXTEENTH_LAND_HOLDINGS_INC\YORK_DOWNS_GOLF_COURSE\02_DATA\GINT\1413472_2017.GPJ GAL-MIS.GDT 10/17/17 JJL/TB

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-3

BORING DATE: March 14, 2017

SHEET 1 OF 2

DATUM: Geodetic

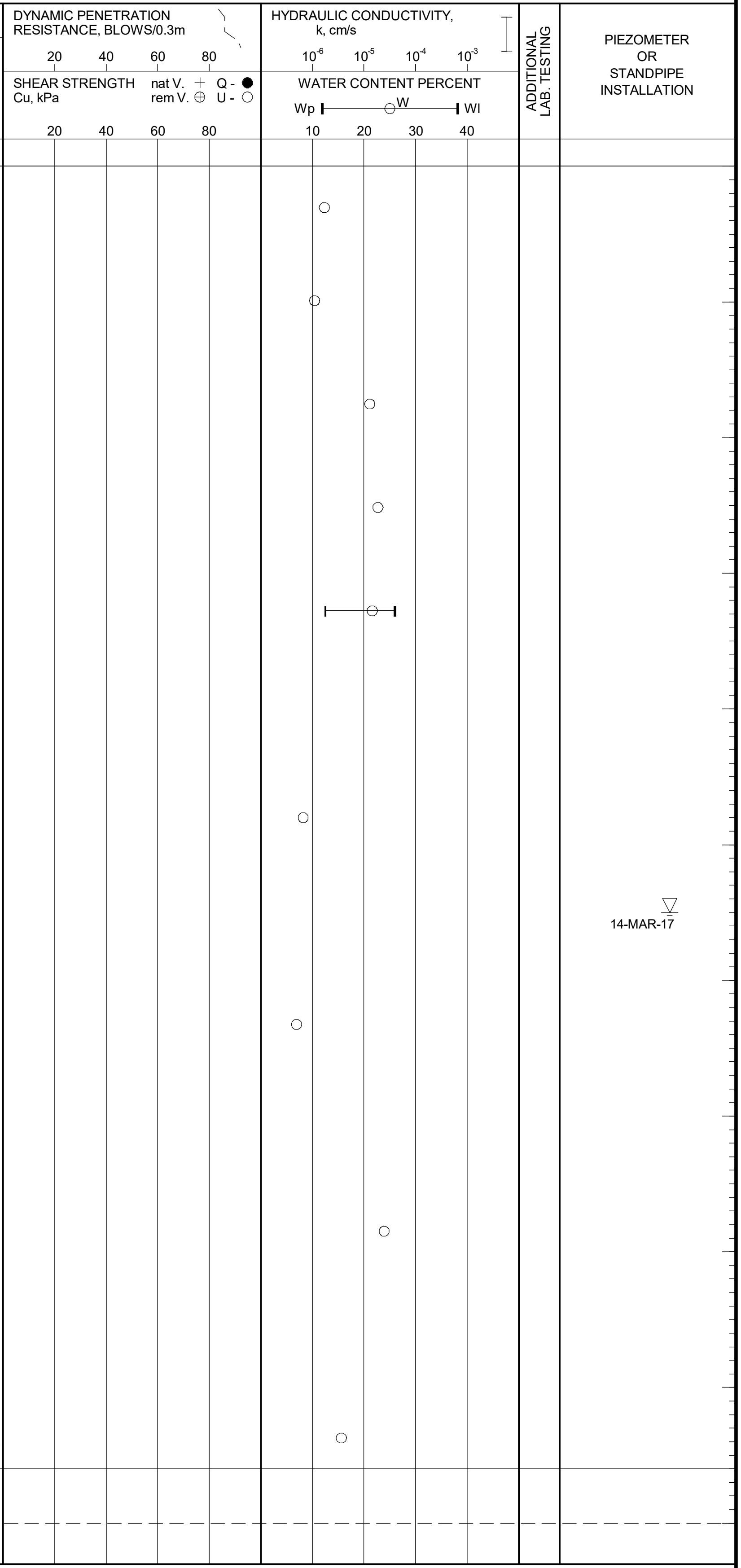
BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	181.34
FILL - TOPSOIL	0.00
FILL - (ML) sandy CLAYEY SILT; brown, organic matter, rootlets; cohesive, w<PL, frozen	0.09
FILL - (SP) gravelly SAND; brown, oxidation staining, silty clay pockets; non-cohesive, moist, compact	180.66 0.69
(CL) SILTY CLAY; bown; cohesive, w>PL, stiff to very stiff -becoming grey at 2.1 m depth	179.97 1.37
(ML) sandy CLAYEY SILT, some gravel; grey, (TILL); cohesive, w<PL, stiff to hard -gravel seam between 4.7 m and 4.9 m depth	177.30 4.04
(ML-SM) sandy SILT to SILTY SAND; grey; non-cohesive, wet, compact to very dense	174.26 7.09
END OF BOREHOLE	171.74 9.60

SAMPLES

NUMBER	TYPE	BLOWS/0.3m
1	SS	10
2	SS	18
3	SS	9
4	SS	18
5	SS	13
6	SS	13
7	SS	36
8	SS	18
9	SS	89/ 0.23



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DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-3

BORING DATE: March 14, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ├──○W──┤ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface. 2. Groundwater measured at a depth of 5.5 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-4

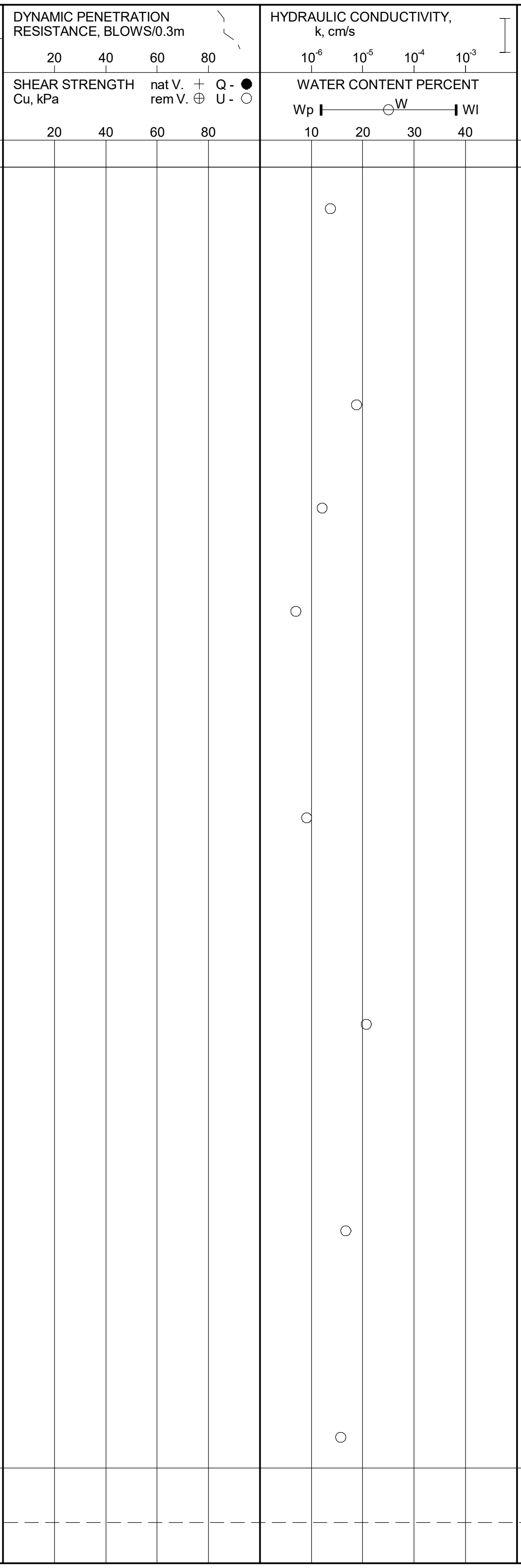
BORING DATE: March 14, 2017

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	180.55				
0	FILL - TOPSOIL	0.00				
	FILL - (SM) SILTY SAND, some gravel; brown, oxidation staining; non-cohesive, moist, loose	0.15	1	SS	3	
	(CL) SILTY CLAY; brown, oxidation staining; cohesive, w~PL to w<PL, stiff	179.87 0.69	2	SS	12	
1–2			3	SS	15	
2	-becoming grey at 2.1 m depth		4	SS	13	
3	(ML) sandy CLAYEY SILT, some gravel (TILL); grey; cohesive, w<PL, very stiff to hard	177.66 2.90	5	SS	24	
4–5			6	SS	31	
5–6	(ML) sandy SILT; grey; non-cohesive, grey, dense to very dense	174.99 5.56				
6			7	SS	37	▽ 14-MAR-17
7–8			8	SS	44	
9			9	SS	76	
	END OF BOREHOLE	170.95 9.60				
10						



ADDITIONAL LAB. TESTING

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-4

BORING DATE: March 14, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface. 2. Borehole caved to a depth of 6.1 m below ground surface upon completion of drilling. 3. Groundwater measured at a depth of 6.1 m below ground surface upon completion of drilling.									
11											
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13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472
LOCATION: SEE FIGURE 1

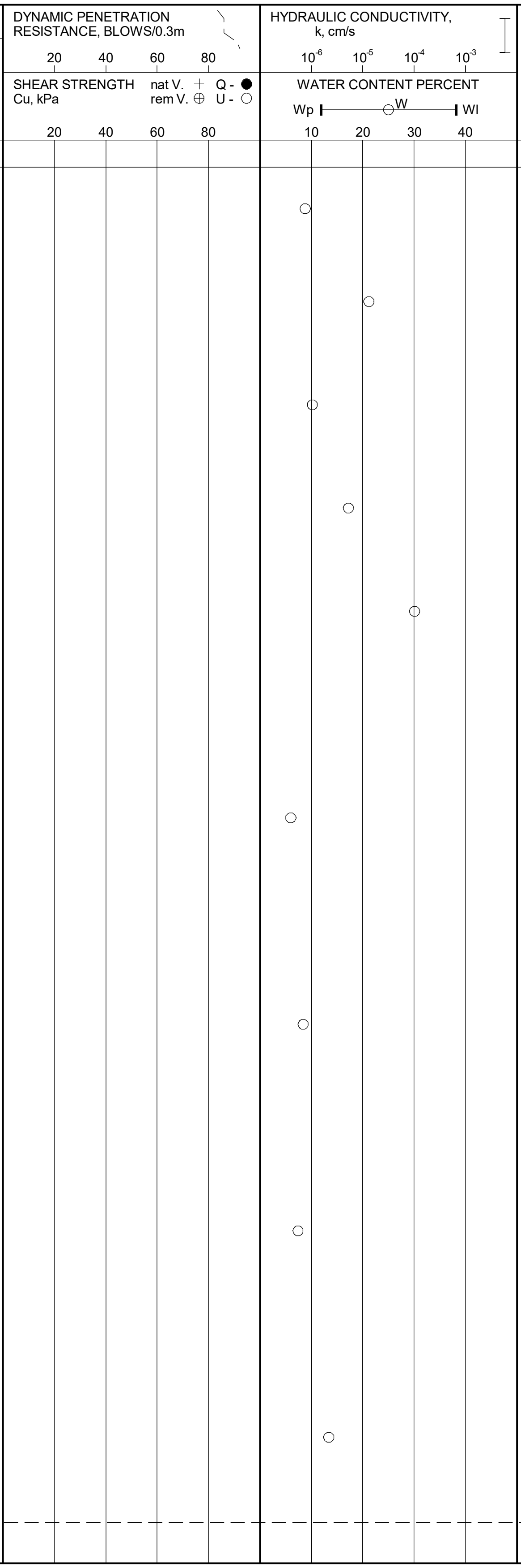
RECORD OF BOREHOLE: 17-5

BORING DATE: March 15, 2017

SHEET 1 OF 2
DATUM: Geodetic

DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE		179.67				
FILL - TOPSOIL		0.00				
FILL - (SP) gravelly SAND, trace silt; brown, organic matter; non-cohesive, moist, compact		0.12	1	SS	10	50 mm Diameter Monitoring Well
(ML) sandy SILT; brown; non-cohesive, wet, compact		178.99 0.69	2	SS	12	
(CL) SILTY CLAY, trace sand; grey; cohesive, w<PL to w>PL, firm to stiff		178.30 1.37	3	SS	12	
			4	SS	8	
			5	SS	7	
(ML-CL) SILTY CLAY to CLAYEY SILT, some sand; grey, (TILL); cohesive, w<PL, stiff to hard		175.51 4.17	6	SS	19	Bentonite
						15-MAR-17
			7	SS	15	
			8	SS	32	
			9	SS	12	

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger



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DEPTH SCALE
1 : 50

LOGGED: MB
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-5

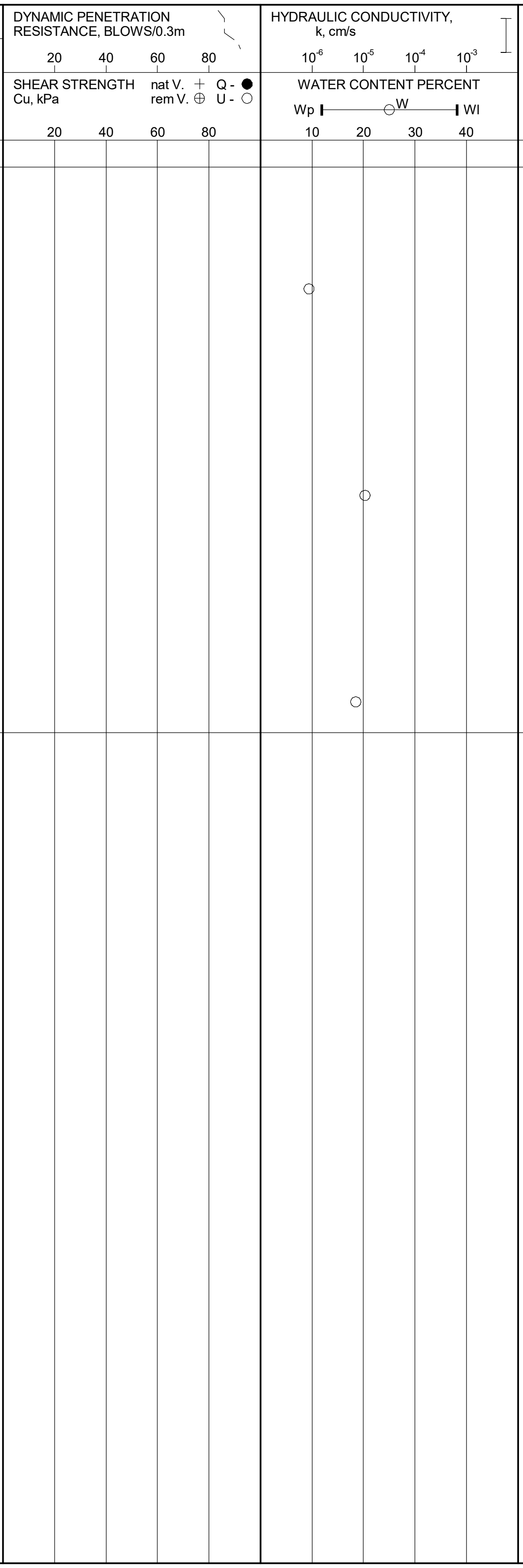
BORING DATE: March 15, 2017

SHEET 2 OF 2

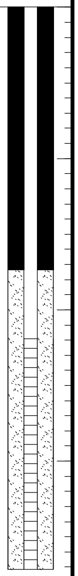
DATUM: Geodetic

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	(ML-CL) SILTY CLAY to CLAYEY SILT, some sand; grey, (TILL); cohesive, w<PL, stiff to hard					
11				10	SS	12	Bentonite
			168.02 11.66				
12		(ML) sandy SILT; grey; non-cohesive, wet, compact to very dense		11	SS	17	
13							Silica Sand and Screen
14				12	SS	72	
			165.50 14.17				
		END OF BOREHOLE					
15							
16							
17							
18							
19							
20							



ADDITIONAL LAB. TESTING



Notes:

1. Groundwater encountered during drilling at a depth of 7.6 m below ground surface.

2. Groundwater measured at a depth of 5.6 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-6

BORING DATE: March 13, 2017

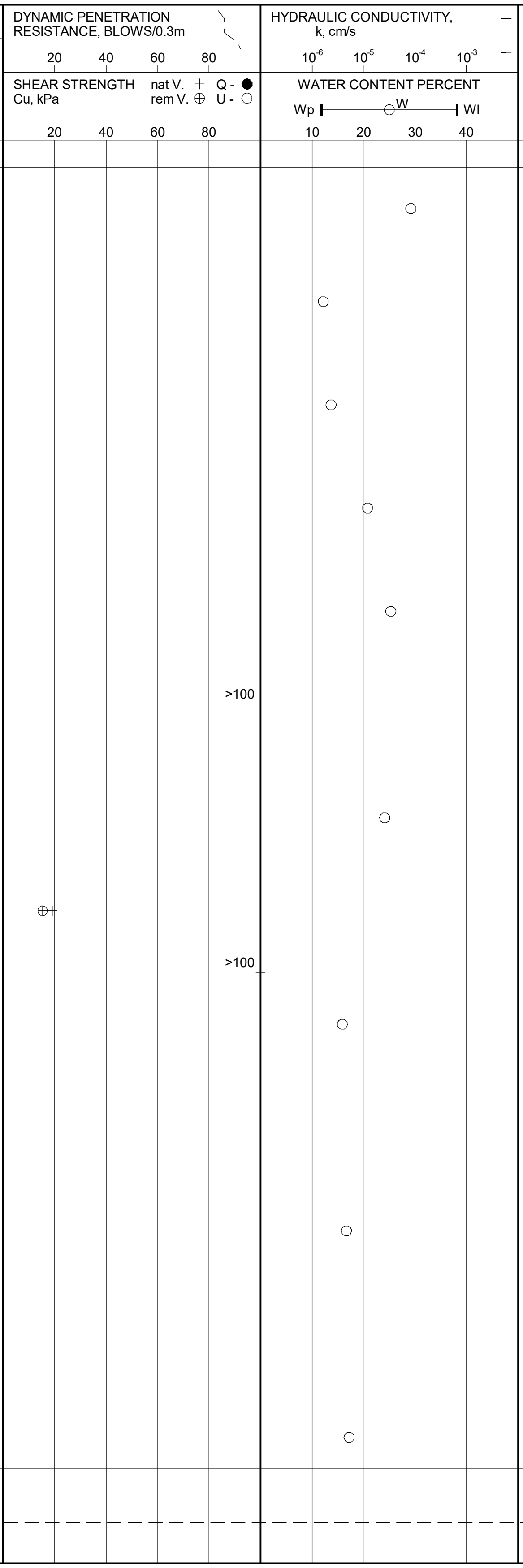
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		182.34
FILL - TOPSOIL	▨	0.00
FILL - (SM) SILTY SAND; dark brown, organic matter, rottlets; cohesive, moist, loose	▨	181.99 0.35
FILL - (SP/GP) SAND and GRAVEL, trace fines; brown; non-cohesive, wet, compact to dense	▨	181.66 0.69
(CL) SILTY CLAY, trace sand, trace gravel; grey; cohesive, w~PL to w>PL, stiff to very soft	▨	180.21 2.13
(SM) SILTY SAND; grey; non-cohesive, wet, compact to very dense	▨	176.40 5.94
END OF BOREHOLE		172.74 9.60

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	8
2	SS	21
3	SS	30
4	SS	11
5	SS	8
6	SS	1
7	SS	17
8	SS	88
9	SS	83



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 13-MAR-17

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-6

BORING DATE: March 13, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 1.5 m below ground surface. 2. Groundwater measured at a depth of 1.5 m below ground surface upon completion of drilling.									
11											
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16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-7

BORING DATE: March 16, 2017

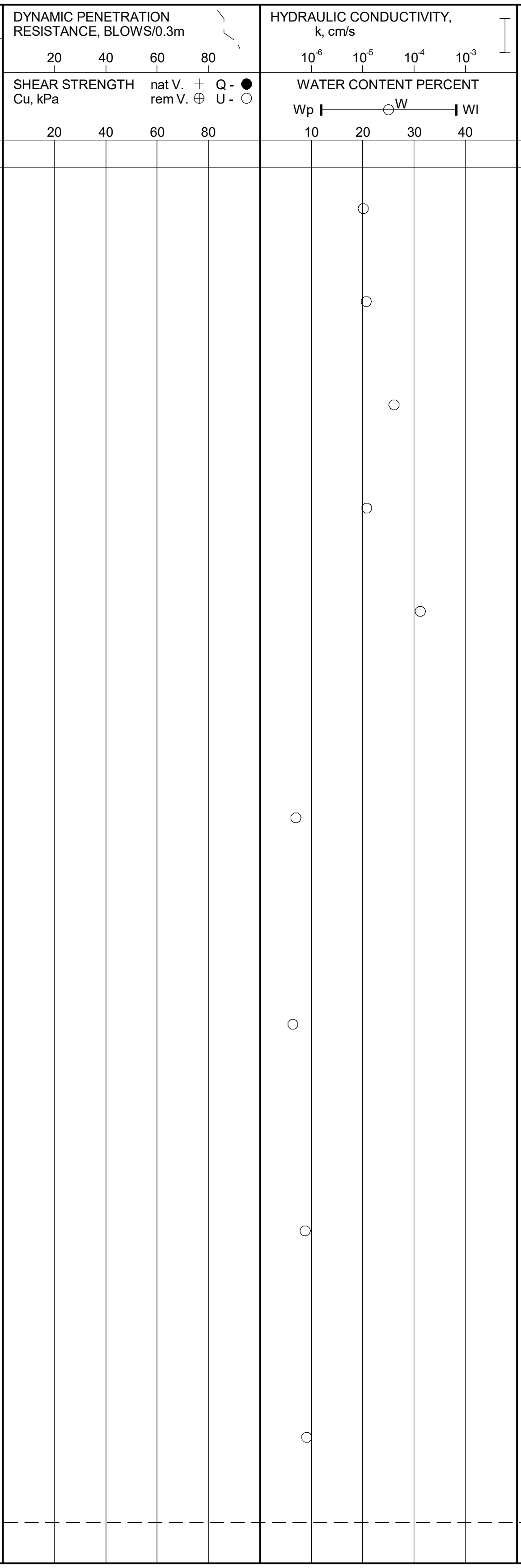
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger, 108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.08
TOPSOIL	0.00
(SM) SILTY SAND to gravelly SAND, silty clay pockets; brown, oxidation staining; non-cohesive, moist to wet, loose	0.15
(CL) SILTY CLAY, trace sand; grey, layered; cohesive, w~PL to w>PL, stiff	178.71 1.37
(CL-ML) sandy CLAYEY SILT to sandy SILTY CLAY, trace to some gravel; grey, (TILL); cohesive, w~PL to w>PL, very stiff to hard	176.05 4.04

NUMBER	TYPE	BLOWS/0.3m
1	SS	7
2	SS	9
3	SS	12
4	SS	15
5	SS	10
6	SS	46
7	SS	63
8	SS	15
9	SS	13



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 16-MAR-17

DEPTH SCALE METRES: 0 – 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

GTA-BHS 001 \\GOLDER.GDS\GAL\SUDBURY\CAD-GIS\SIM\CLIENTS\SIXTEENTH_LAND_HOLDINGS_INC\YORK_DOWNS_GOLF_COURSE\02_DATA\GINT\1413472_2017.GPJ GAL-MIS.GDT 10/17/17 JJL/TB

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-7

BORING DATE: March 16, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	(SM) SILTY SAND; grey; non-cohesive, wet, very loose		169.95 10.13	10	SS	1		○		
11 12		(SP) SAND, some fines, trace gravel; grey; non-cohesive, wet, compact		169.03 11.05	11	SS	19		○		
13 14 15 16 17 18 19 20		END OF BOREHOLE Notes: 1. Groundwater encountered during drilling at a depth of 1.5 m below ground surface. 2. Groundwater measured at a depth of 9.0 m below ground surface upon completion of drilling.		167.43 12.65							

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-8

BORING DATE: March 16, 2017

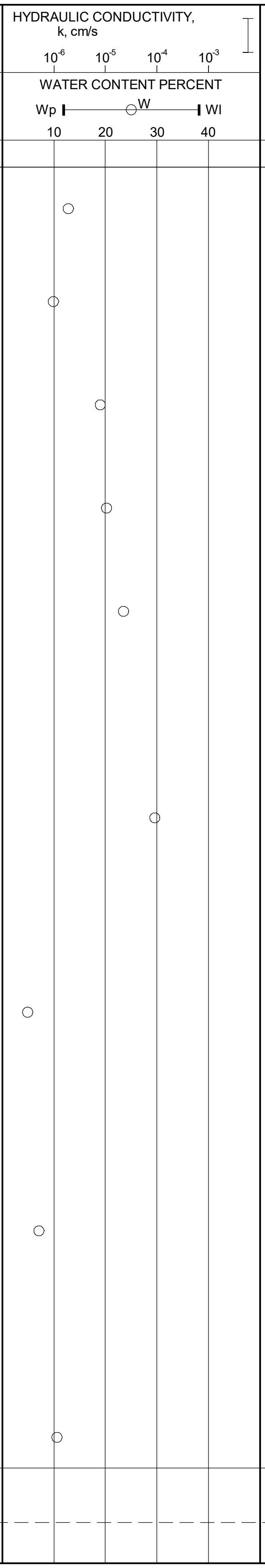
SHEET 1 OF 2
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	180.90
FILL - TOPSOIL	0.00
FILL - (SM) SILTY SAND, trace gravel; brown, organic matter, rootlets; non-cohesive, mosit, compact	0.09
(SM) SILTY SAND, some gravel to gravelly; brown, oxidation staining, silty clay pockets; non-cohesive, moist, compact	180.22 0.69
(CL) SILTY CLAY; grey; cohesive, w>PL, firm to very stiff	178.77 2.13
(CL-ML) sandy CLAYEY SILT to sandy SILTY CLAY, some gravel; grey, (TILL); cohesive, w~PL to w>PL, hard	175.34 5.56
END OF BOREHOLE	171.30 9.60

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	16	
2	SS	10	MH
3	SS	16	
4	SS	10	
5	SS	17	
6	SS	6	
7	SS	50/ 0.13	
8	SS	38	
9	SS	45	

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}



PIEZOMETER OR STANDPIPE INSTALLATION: ∇ 16-MAR-17

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DEPTH SCALE
1 : 50

LOGGED: MB
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-8

BORING DATE: March 16, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}) / WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10, 20, 30, 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Note: 1. Groundwater measured at a depth of 8.1 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-9

BORING DATE: March 17, 2017

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	GROUND SURFACE	183.31					
	FILL - TOPSOIL	0.00					
	FILL - (CL) sandy SILTY CLAY; dark brown, organic matter, rootletsl cohesive, w>PL, firm	183.10 0.21	1	SS	9		
	(ML) sandy CLAYEY SILT, some gravel; brown, (TILL); cohesive, w<PL, stiff to very stiff	182.63 0.69	2	SS	14		
			3	SS	25		
	-becoming grey at 2.1 m depth		4	SS	18	MH	▽ 17-MAR-17
	(SM) SILTY SAND; grey; non-cohesive, wet, loose to compact	180.42 2.90	5	SS	6		
			6A	SS	21		
	(CL) SILTY CLAY; grey; cohesive, w<PL to w~PL, very stiff to hard	178.44 4.88	6B				
			7	SS	17		
			8	SS	80		
			9	SS	50/ 0.15		

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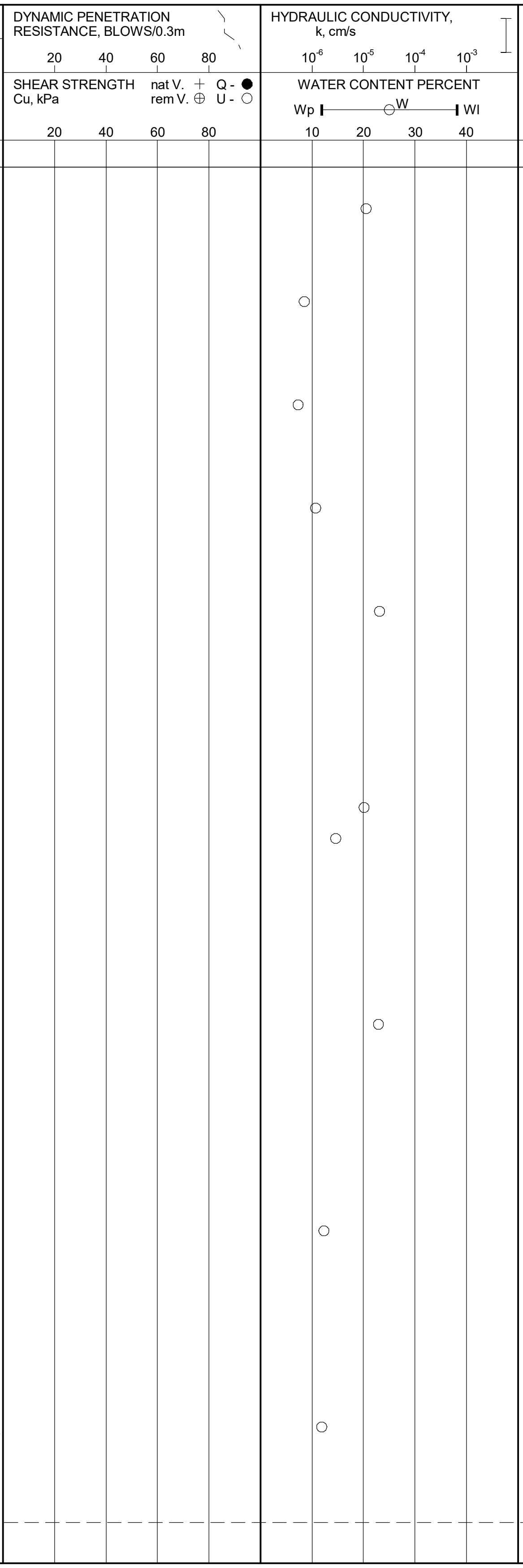


DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: EW

PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-9

BORING DATE: March 17, 2017

SHEET 2 OF 2
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger, 108 mm I.D. Hollow Stem Auger

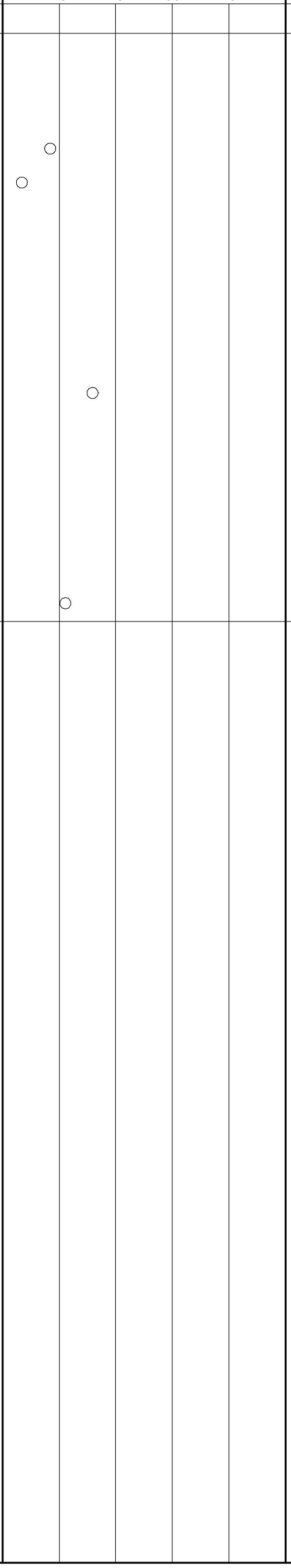
--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
10	(CL) SILTY CLAY; grey; cohesive, w<PL to w~PL, very stiff to hard				
		172.43 10.88	10A	SS	82/ 0.28
11	(SM) SILTY SAND, some gravel to gravelly; grey; non-cohesive, wet, very dense		10B		
12			11	SS	90/ 0.25
13					
		169.35 13.96	12	SS	50/ 0.10
14	END OF BOREHOLE				

Notes:

1. Groundwater encountered during drilling at a depth of 3.0 m below ground surface.

2. Groundwater measured at a depth of 2.6 m below ground surface upon completion of drilling.



DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

LOGGED: PT
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-10

BORING DATE: March 23, 2017

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE	195.72			
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	(CL) sandy SILTY CLAY; brown, rootlets; cohesive, w<PL, firm	0.00	1	SS	7
		(CL) sandy SILTY CLAY, some gravel; brown (TILL); cohesive, w<PL, stiff to hard	195.24 0.48			
1				2	SS	12
				3	SS	21
2				4	SS	50/ 0.10
3		-oxidation staining above 2.9 m depth		5	SS	50/ 0.08
4		-becoming grey below 4.0 m depth				
5				6	SS	56
6				7	SS	44
7						
8				8	SS	67/ 0.20
		(SM) SILTY SAND, fine; grey; non-cohesive, moist, very dense	187.11 8.61			
9				9	SS	92
		END OF BOREHOLE	186.12 9.60			
10						

CONTINUED NEXT PAGE

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

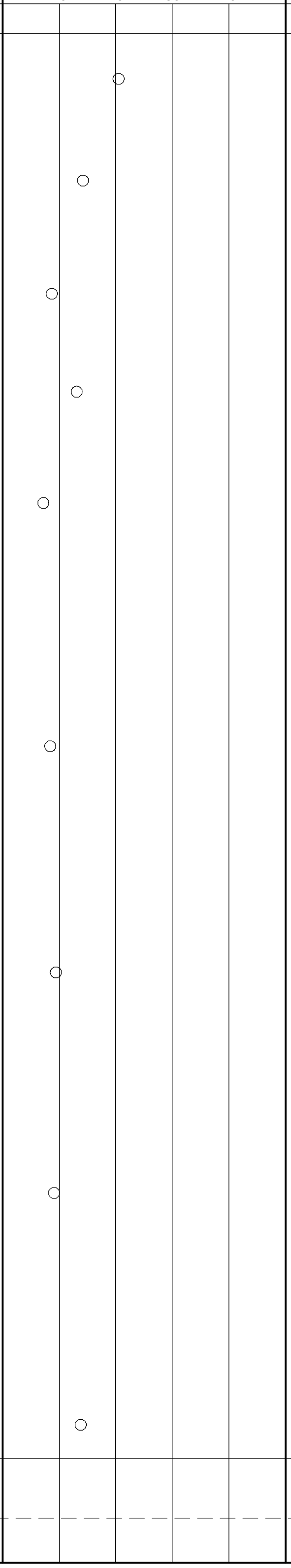
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



∇ 23-MAR-17

DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-10

BORING DATE: March 23, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Note: 1. Borehole caved to a depth of 8.8 m below ground surface upon completion of drilling. 2. Groundwater measured at a depth of 8.5 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

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PROJECT: 1413472
LOCATION: SEE FIGURE 1

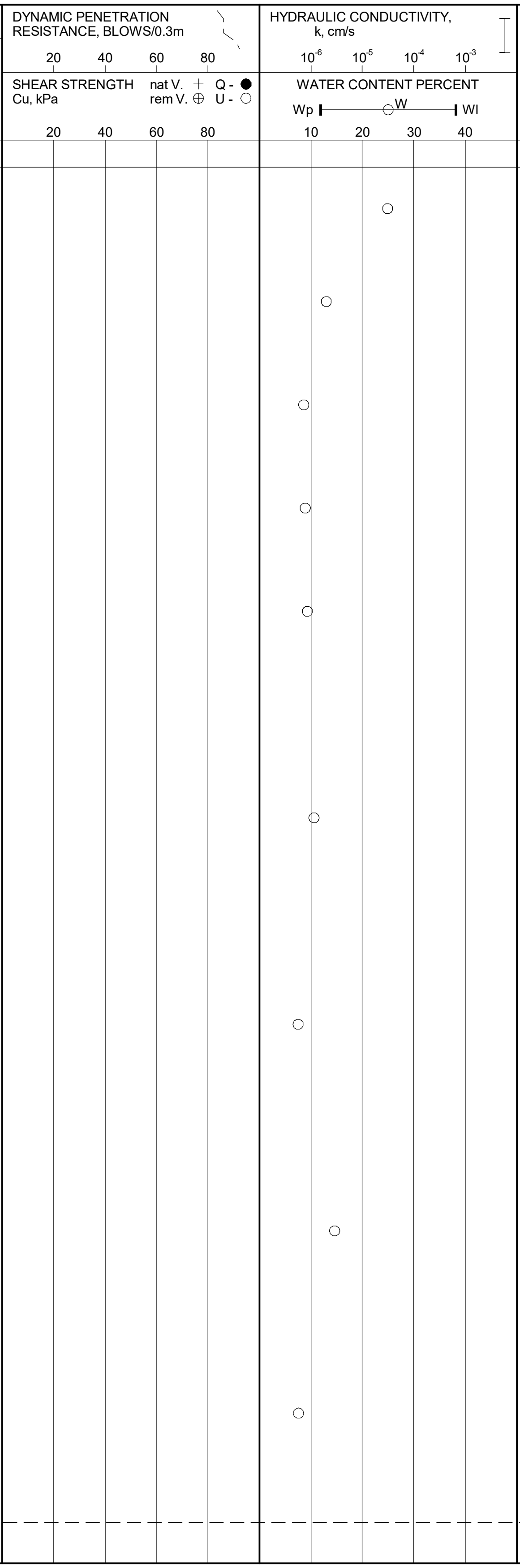
RECORD OF BOREHOLE: 17-11

BORING DATE: March 23, 2017

SHEET 1 OF 2
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	198.38				
0	FILL - (CL) sandy SILTY CLAY; dark brown, rootlets; cohesive, w<PL, firm	0.00	1	SS	6	
	(CL) sandy SILTY CLAY; brown to grey, (TILL); cohesive, w~PL, stiff to hard	197.69 0.69				
1			2	SS	8	
2			3	SS	16	
			4	SS	29	
3			5	SS	58	
5			6	SS	32	
6	-becoming grey at 6.1 m depth		7	SS	32	
7	(CL-ML) SILTY CLAY to sandy CLAYEY SILT; grey, (TILL); cohesive, w~PL, stiff to hard	191.29 7.09				▽ 23-MAR-17
8			8	SS	9	
9	-auger grinding at 8.8 m depth on cobble or boulder		9	SS	50/ 0.10	
10						



ADDITIONAL LAB. TESTING

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: MB
CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-11

BORING DATE: March 23, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10⁻⁶ 10⁻⁵ 10⁻⁴ 10⁻³); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Augers	(SP) SAND, some fines; grey; non-cohesive, wet, loose to dense		188.24 10.13							
11					10	SS	8		○		
12				185.73	11	SS	35		○		
		END OF BOREHOLE		12.65							

Notes:

1. Groundwater encountered during drilling at a depth of 7.6 m below ground surface.

2. Groundwater measured at a depth of 7.0 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-101

BORING DATE: March 16, 2017

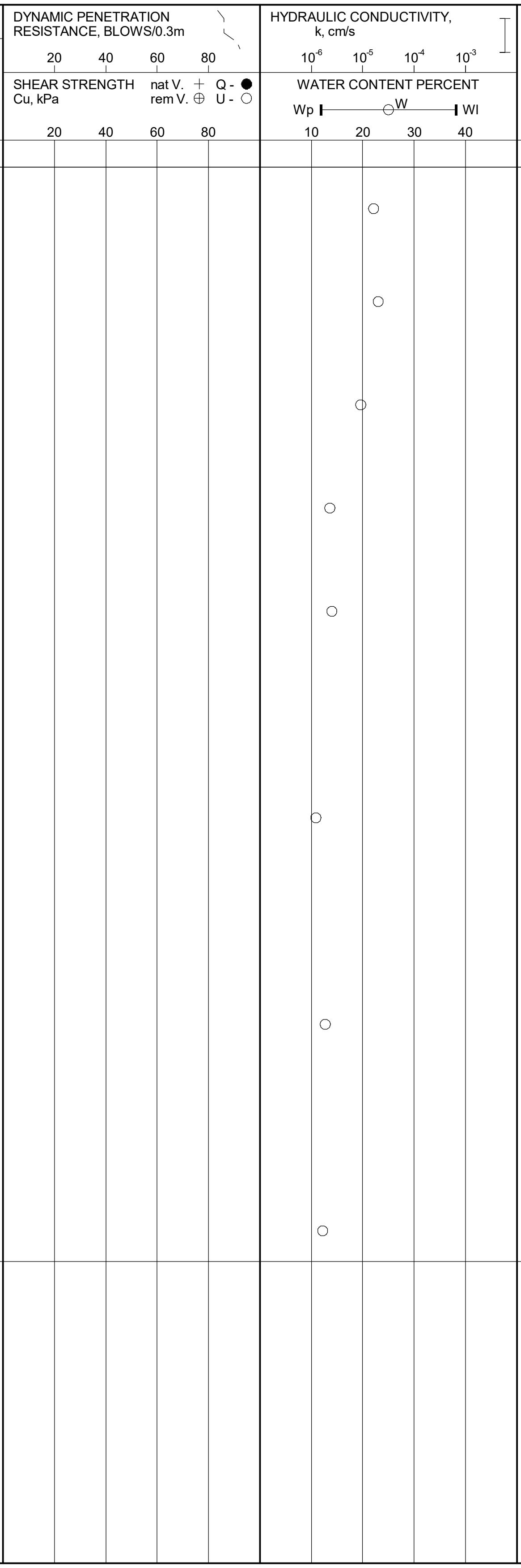
SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES: 0 to 10

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	191.27			
TOPSOIL	0.00			
(CL) sandy SILTY CLAY, trace gravel; brown, organic matter, rootlets; cohesive, w>PL, firm to stiff	0.15	1 2	SS SS	6 10
(CL) SILTY CLAY, some sand, trace gravel; light brown to grey, (TILL); w<PL to w~PL, very stiff	189.90 1.37	3 4	SS SS	22 15
-oxidation staining above 3.0 m depth		5	SS	18
- auger grinding between 4.6 m and 4.9 m depth on cobble or boulder.		6	SS	16
- becoming grey at 4.9 m depth		7 8	SS SS	15 22
END OF BOREHOLE	183.19 8.08			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 16-MAR-17

Notes:

1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface.

2. Groundwater measured at a depth of 7.3 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: AP

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PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-102

BORING DATE: March 15, 2017

SHEET 1 OF 1

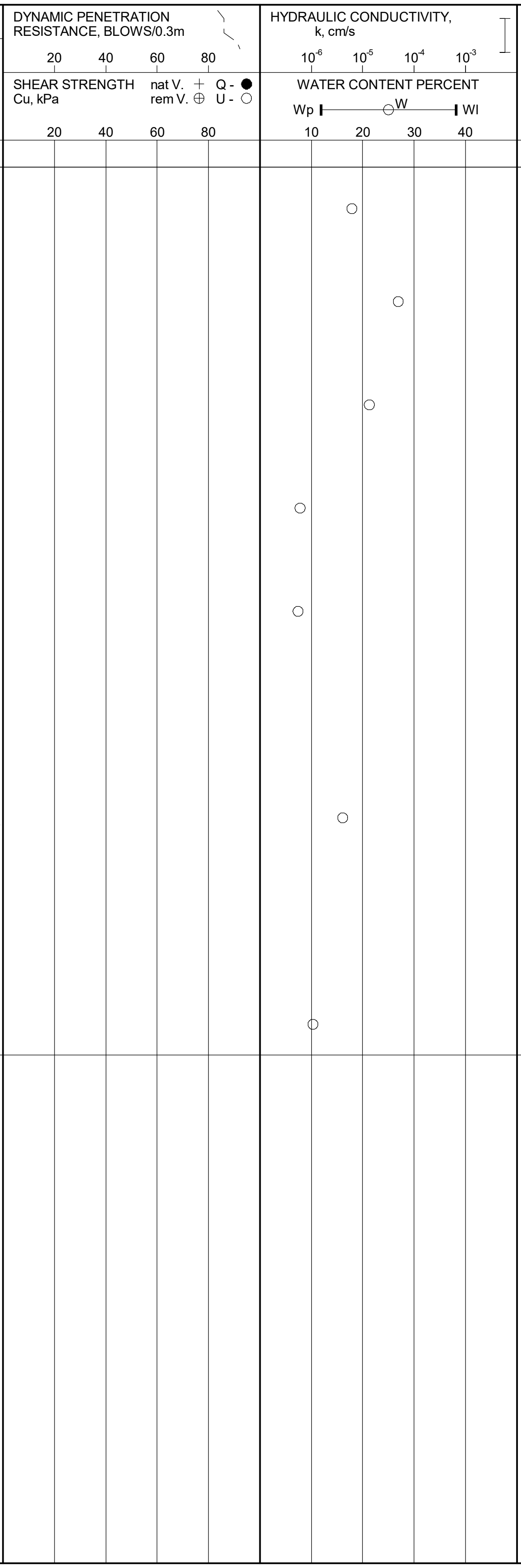
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	187.66			
FILL - TOPSOIL	0.00			
FILL - (CL) SILTY CLAY, some sand, trace gravel; dark brown, organic matter, rootlets; cohesive, w~PL, firm	187.45 0.21	1	SS	8
(CL) SILTY CLAY, some sand, some gravel; brown, oxidation staining; cohesive, w>PL to w~PL, firm to hard	186.98 0.69	2	SS	5
		3	SS	54/ 0.25
(ML) Sandy CLAYEY SILT, some to trace gravel; brown to grey, (TILL); cohesive, w<PL to w~PL, hard - becoming grey at 2.4 m depth	185.53 2.13	4	SS	105
		5	SS	85
		6	SS	90/ 0.25
		7	SS	44
END OF BOREHOLE	181.11 6.55			

Note:

1. Borehole dry upon completion of drilling.



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: AP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-103

BORING DATE: March 16, 2017

SHEET 1 OF 1

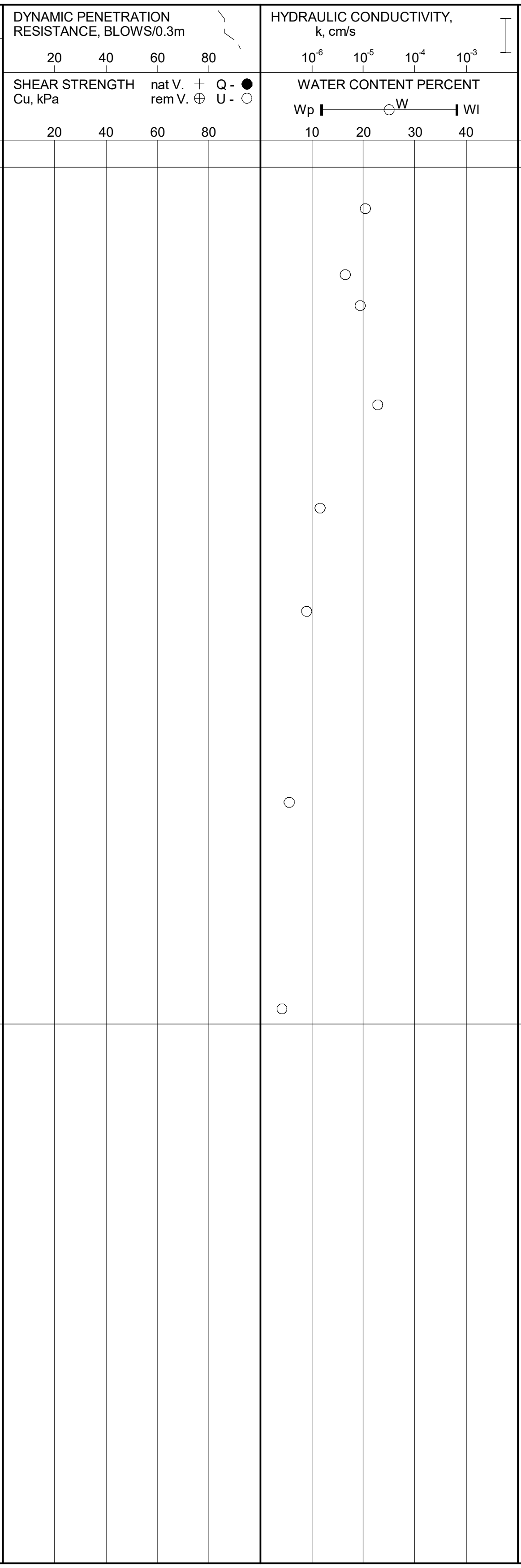
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH Cu, kPa	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		184.75							
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	TOPSOIL		0.00	1	SS	4				
		(CL) sandy CLAYEY SILT; dark brown, organic matter, rootlets; cohesive, w~PL, soft		184.37 0.38							
		(SP/GP) SAND and GRAVEL, trace fines; brown; non-cohesive, wet, loose		183.93 0.82	2A						
1		(CL) SILTY CLAY, some sand, trace gravel; brown to grey, oxidation staining; cohesive, w~PL, firmt to stiff		0.94	2B	SS	7				
					3	SS	14				
2		(CL) SILTY CLAY, some sand, trace gravel; grey, (TILL); cohesive, w>PL, stiff		182.62 2.13	4	SS	11				
3		(CL) sandy SILTY CLAY, trace gravel; grey, (TILL); cohesive, w<PL, hard		181.86 2.90	5	SS	55				
4		- auger grinding between depths of 4.6 m to 5.2 m on cobble or boulder			6	SS	50/ 0.08			MH	
5											
6				178.43	7	SS	50/ 0.08				
		END OF BOREHOLE		6.32							
7											
8											
9											
10											

Notes:

1. Groundwater encountered during drilling at a depth of 0.8 m below ground surface.

2. Borehole dry upon completion of drilling.



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: AP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-104

BORING DATE: March 15, 2017

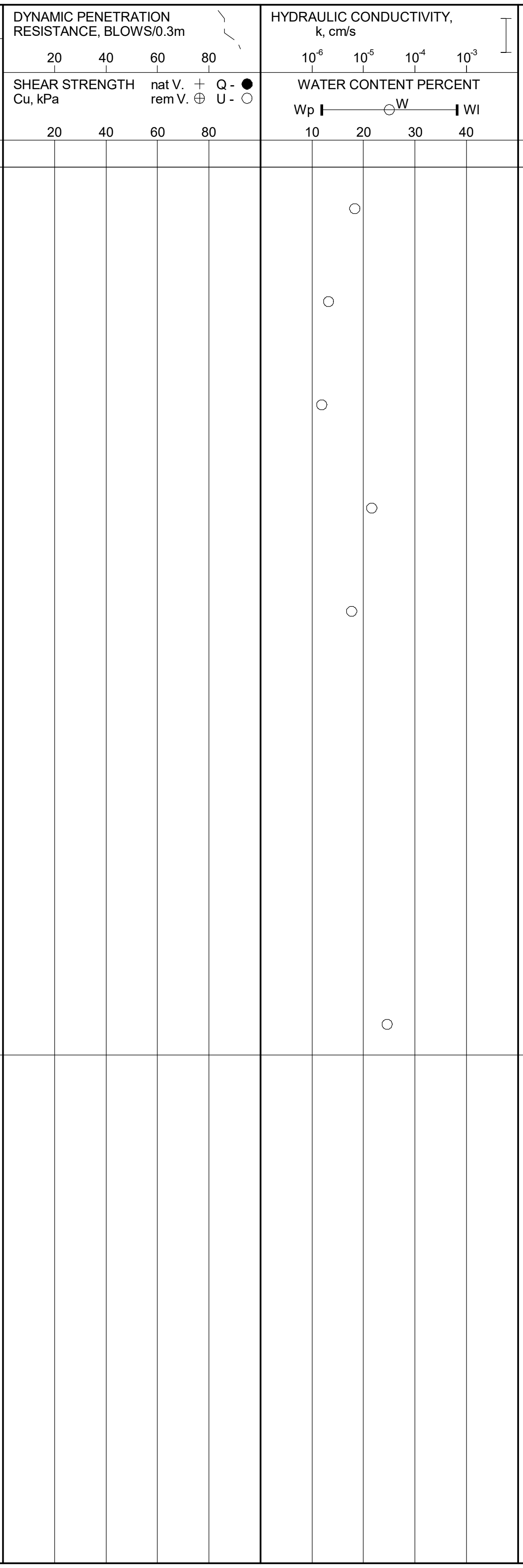
SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		186.69					
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	TOPSOIL		0.00					
		(CL) sandy SILTY CLAY, trace gravel; light brown; cohesive, w~PL, firm		186.48 0.21	1	SS	9		50 mm Diameter Monitoring Well
1		(CL) sandy SILTY CLAY, trace to some gravel; light brown to grey, (TILL), crushed rock fragments, oxidation staining; cohesive, w<PL, stiff to very stiff		186.01 0.69	2	SS	13		
2		-auger grinding between 1.5 m and 4.6 m depth on cobble or boulder			3	SS	19		Bentonite
		(CL-ML) SILTY CLAY to CLAYEY SILT, some to trace sand; grey; cohesive, w~PL, stiff to very stiff		184.41 2.29	4	SS	19		
3					5	SS	20		
5					6	SS	12		Silica Sand and Screen
6		-layered at 6.1 m depth			7	SS	13		
		END OF BOREHOLE		180.14 6.55					

Note:

1. Borehole dry upon completion of drilling.



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: AP

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PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-105

BORING DATE: March 15, 2017

SHEET 1 OF 1

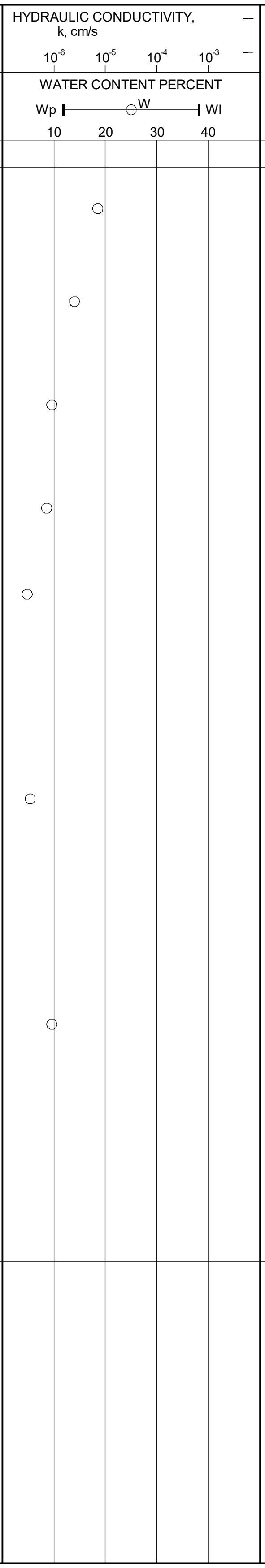
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger, 108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	191.96			
FILL - TOPSOIL	0.00			
FILL - (CL) sandy SILTY CLAY, trace gravel; brown, rootlets, organic matter; cohesive, w~PL, firm	191.75 0.21	1	SS	8
(CL) sandy SILTY CLAY, trace gravel; light brown, oxidation staining; cohesive, w~PL, very stiff	191.28 0.69	2	SS	18
(SM) SILTY SAND, some gravel; light brown, (TILL), oxidation staining; non-cohesive, moist, compact	190.59 1.37	3	SS	20
(ML) Sandy SILT, some gravel; brown to grey, (TILL), oxidation staining; non-cohesive, moist, dense to very dense	189.83 2.13	4	SS	79/ 0.20
-auger grinding between 3.0 m and 4.6 m depth on cobble o boulder		5	SS	50/ 0.05
		6	SS	50/ 0.02
-becoming grey at 6.1 m depth		7	SS	49
		8	SS	61
END OF BOREHOLE	183.88 8.08			

Note:

1. Borehole dry upon completion of drilling.



DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE 1 : 50

LOGGED: PT

CHECKED: AP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-106

BORING DATE: March 17, 2017

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	181.71					
0	FILL - TOPSOIL	0.00	1A	SS	7		50 mm Diameter Monitoring Well
	FILL - (CL) sandy SILTY CLAY, trace gravel; brown, organic matter, rootlets; cohesive, w~PL, firm	181.38 0.34	1B				
1	(CL) SILTY CLAY, some sand; brown, organic staining, rootlets; cohesive, w>PL, firm to stiff	181.03 0.69	2 3A	SS SS	9 5		
2	(SM) SILTY SAND; brown; non-cohesive, wet, loose to compact	179.79 1.92	3B 4	 SS	 25		
3	(CL) SILTY CLAY, trace sand; grey; cohesive, w~PL, stiff	178.82 2.90	5	SS	12		
4	(CL) SILTY CLAY, some sand, some gravel; grey, (TILL); cohesive, w<PL, hard	177.67 4.04	6 7 8	SS SS SS	32 50/ 0.10 53		Bentonite
9	(SM) SILTY SAND, trace gravel; grey, non-cohesive, wet, very dense	173.10 8.61	9A	SS	78	MH	Silica Sand and Screen
10	(CL) SILTY CLAY, some sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	172.14 9.57	9B				

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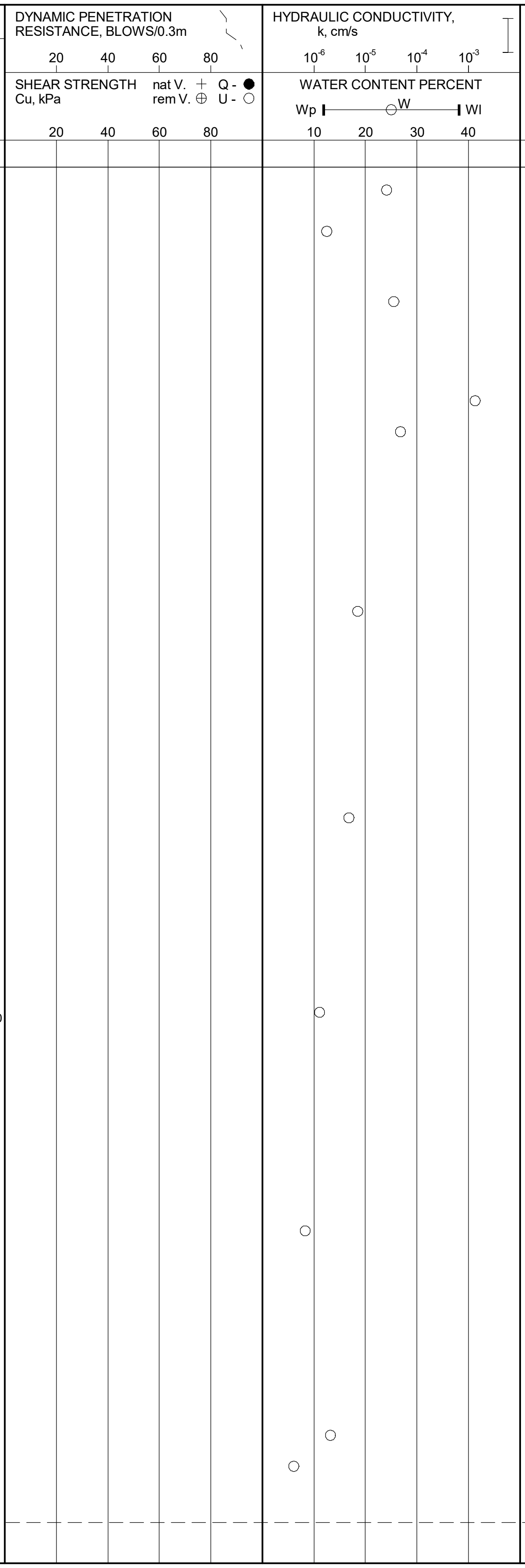


DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-106

BORING DATE: March 17, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- *CONTINUED FROM PREVIOUS PAGE* ---									
10		(CL) SILTY CLAY, some sand, trace gravel; grey, (TILL); cohesive, w<PL, hard									
11				170.59	10	SS	50/ 0.10		○		
		END OF BOREHOLE Note: 1. Groundwater encountered during drilling at a depth of 2.3 m below ground surface.		11.13							
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-107

BORING DATE: March 14, 2017

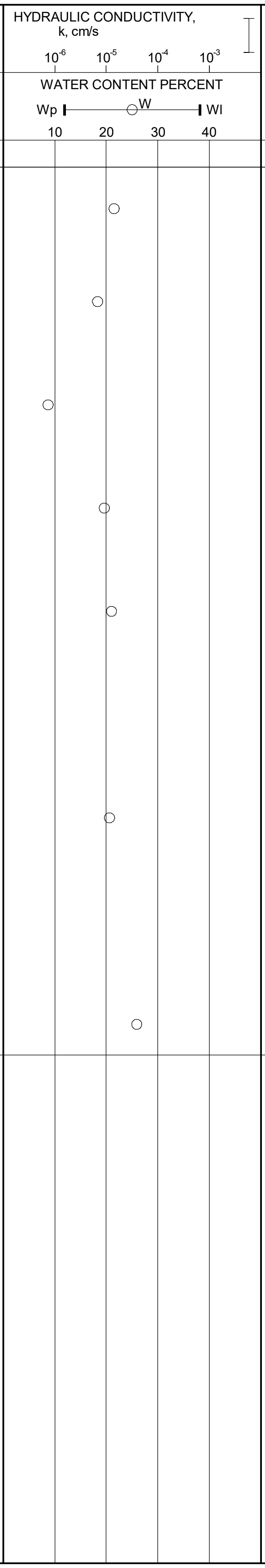
SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		186.03			
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Augers	TOPSOIL		0.00			
		(CL) sandy SILTY CLAY, trace gravel; light brown, oxidation staining; cohesive, w~PL to w<PL, firm to very stiff		185.82 0.21	1	SS	4
1					2	SS	16
					3	SS	16
2		(CL-ML) SILTY CLAY; grey, layered; cohesive, w<PL to w~PL, stiff to very stiff -becoming grey at 2.1 m depth		183.90 2.13	4	SS	16
3					5	SS	15
4							
5					6	SS	13
6					7	SS	17
		END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling.		179.48 6.55			
7							
8							
9							
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80

SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

GTA-BHS 001 \\GOLDER.GDS\GAL\SUDBURY\CAD-GIS\SIM\CLIENTS\SIXTEENTH_LAND_HOLDINGS_INC\YORK_DOWNS_GOLF_COURSE\02_DATA\GINT\1413472_2017.GPJ GAL-MIS.GDT 10/17/17 JJL/TB

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-108

BORING DATE: March 14, 2017

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Augers

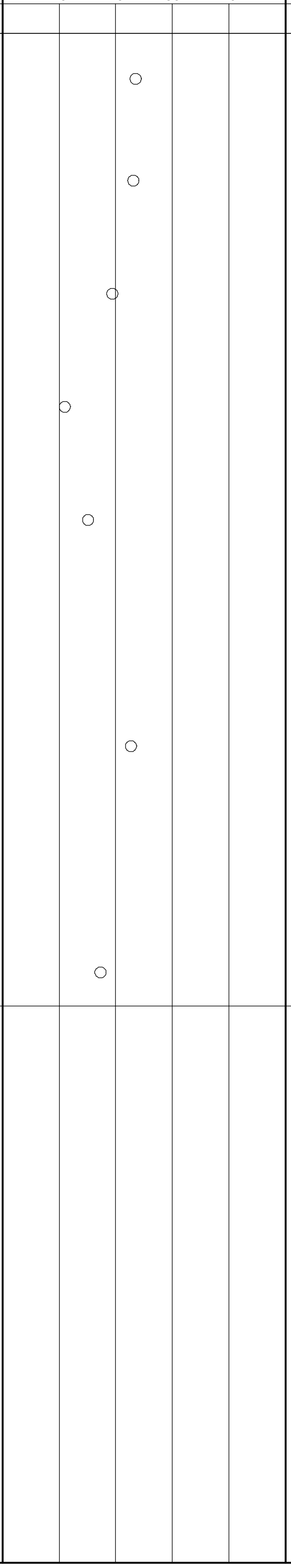
DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		183.46
FILL - TOPSOIL	▨	0.00
FILL - (CL) SILTY CLAY, some sand, trace gravel; dark brown, organic matter, rootlets; cohesive, w>PL, firm	▨	183.25 0.21
(CL) SILTY CLAY, some sand; light brown, oxidation staining; cohesive, w>PL, stiff - becoming grey at 1.4 m depth	▨	182.78 0.69
(ML) sandy CLAYEY SILT, some gravel; grey, cohesive, w<PL, stiff	▨	181.33 2.13
(CL) SILTY CLAY; grey, layered; cohesive, w>PL, very stiff to hard	▨	180.57 2.90
END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling.		176.91 6.55

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	7
2	SS	12
3	SS	11
4	SS	14
5	SS	15
6	SS	33
7	SS	37

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

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PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-109

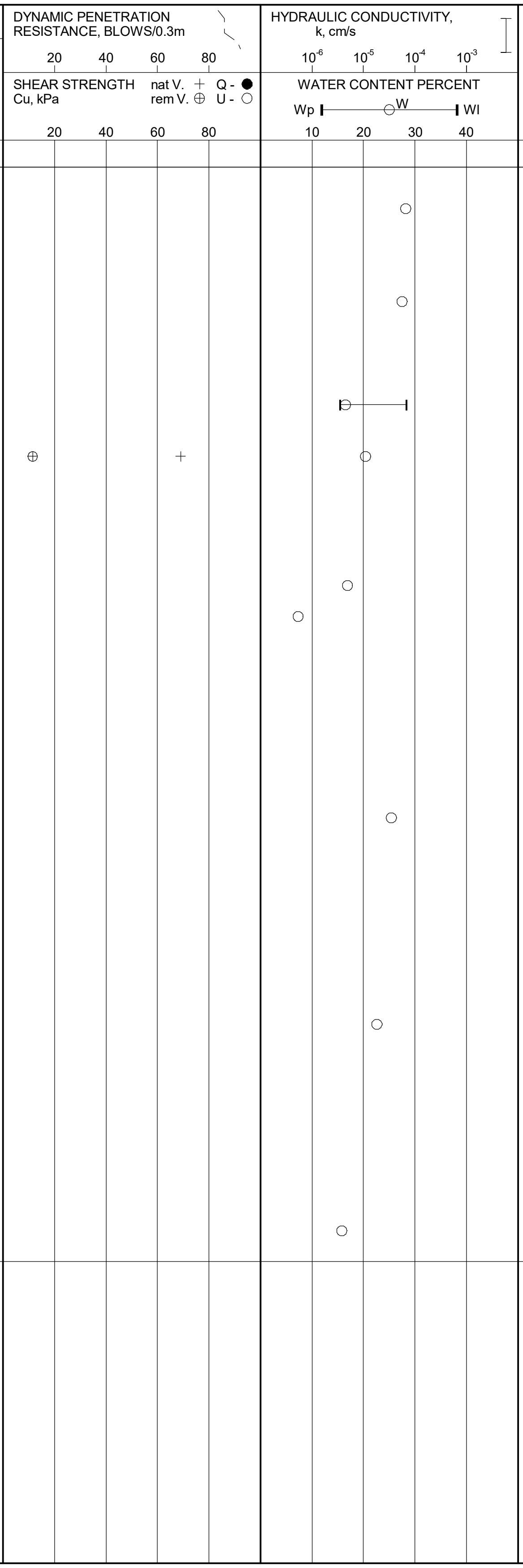
BORING DATE: March 15, 2017

SHEET 1 OF 1
DATUM: Geodetic

DEPTH SCALE METRES: 0 – 10

BORING METHOD: CME 55 Trackmount Power Auger, 108 mm I.D. Hollow Stem Augers

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLES – NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	185.77			
FILL - TOPSOIL	0.00			
FILL - (CL) sandy SILTY CLAY; brown, organic matter, rootlets; cohesive, w>PL, stiff	185.56 0.21	1	SS	9
(CL) SILTY CLAY, trace sand; brown, layered; cohesive, w>PL, soft to firm	185.09 0.69	2	SS	6
		3	SS	4
(SM) SILTY SAND; brown; non-cohesive, wet, compact	183.49 2.29	4	SS	27
(CI) SILTY CLAY; grey; cohesive, w<PL, hard to very stiff	182.65 3.12	5A 5B	SS	50/ 0.13
		6	SS	33
		7	SS	32
		8	SS	23
END OF BOREHOLE	177.70 8.08			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇ 15-MAR-17

Notes:

1. Groundwater encountered during drilling at a depth of 2.3 m below ground surface.

2. Groundwater measured at a depth of 2.1 m below ground surface upon completion of drilling.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PT
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

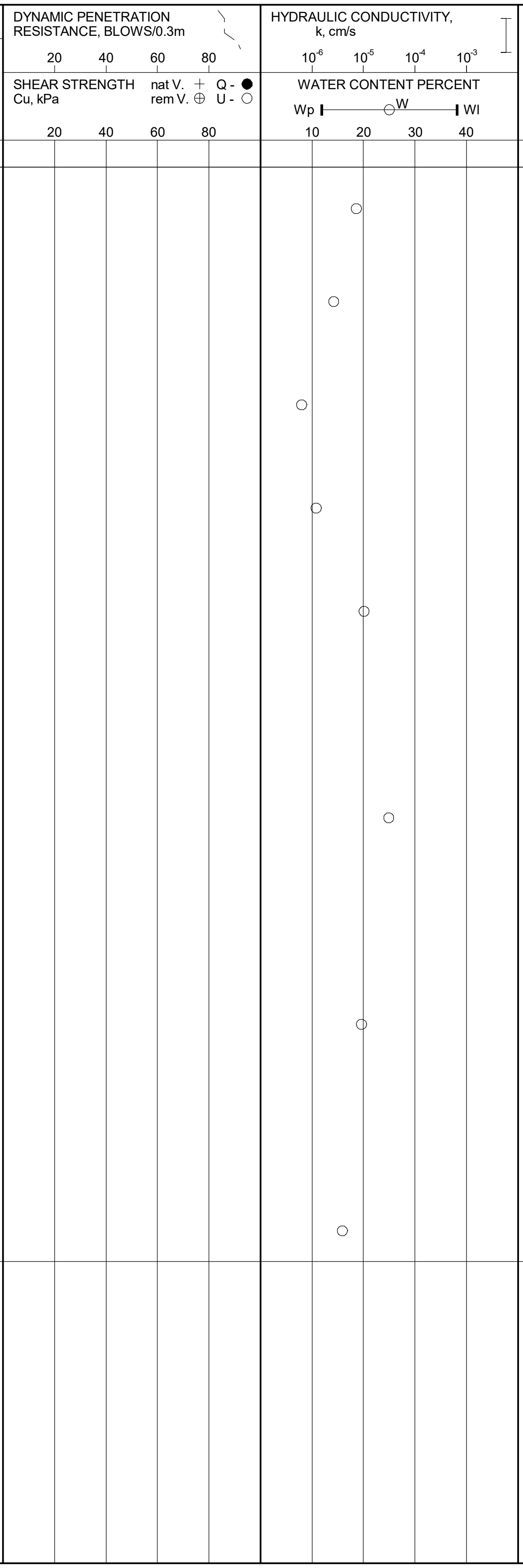
RECORD OF BOREHOLE: 17-110

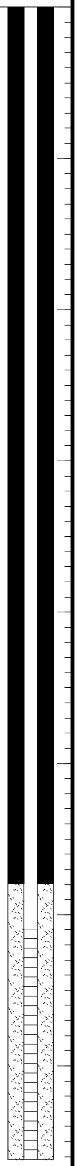
BORING DATE: March 13, 2017

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		183.95					
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	FILL - TOPSOIL	▨	0.00					
		FILL - (ML) sandy CLAYEY SILT, trace gravel; dark brown, organic matter, rootlets; non-cohesive, moist, compact to loose	▨	183.70 0.25	1	SS	11		50 mm Diameter Monitoring Well
1					2	SS	6		
		FILL - (SP) gravelly SAND; brown to grey; non-cohesive, moist to wet, compact -auger grinding at 1.7 m depth on cobble or boulder	▨	182.58 1.37	3	SS	24		
2					4	SS	27		
3		(CL) SILTY CLAY, trace sand, trace gravel; brown to grey; cohesive, w>PL, stiff		181.06 2.90	5	SS	11		Bentonite
4		-becoming grey at 4.6 m depth			6	SS	11		
5									
6		(ML) sandy SILT, trace gravel; grey; non-cohesive, wet, compact to very dense		178.39 5.56	7	SS	13		Silica Sand and Screen
7									
8					8	SS	50	MH	
		END OF BOREHOLE Note: 1. Groundwater encountered during drilling at a depth of 2.3 m below ground surface.		175.88 8.08					
9									
10									





DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: AP

PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-111

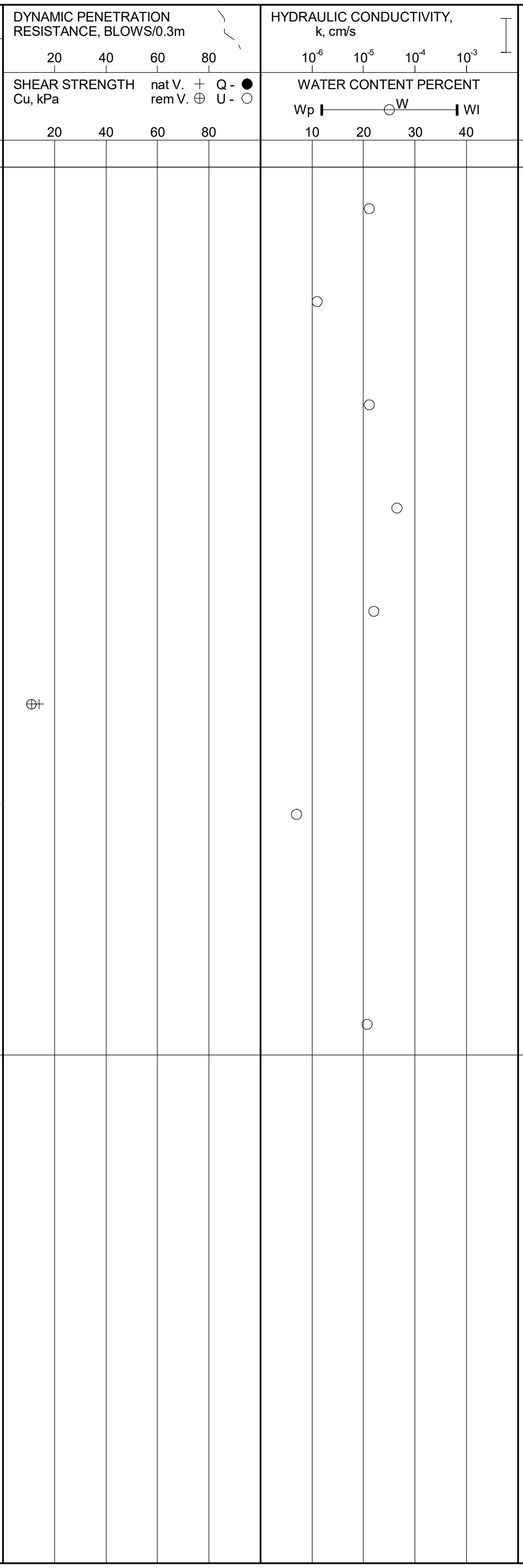
BORING DATE: March 14, 2017

SHEET 1 OF 1
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	182.86
FILL - TOPSOIL	0.00
FILL - (ML) sandy CLAYEY SILT; dark brown, organic matter, rootlets; non-cohesive, moist, loose	182.51 0.36
FILL - (SP) gravelly SAND, trace fines; brown; non-cohesive, wet, loose	182.13 0.73
(CL) SILTY CLAY, some sand, trace gravel; brown; cohesive, w~PL to w>PL, stiff to firm -becoming grey at 1.2 m depth	0.85
(SM) SILTY SAND, trace gravel; grey, (TILL); non-cohesive, moist, very dense	178.75 4.11
(ML-CL) SILTY CLAY to CLAYEY SILT; grey; cohesive, w~PL, hard	177.30 5.56
END OF BOREHOLE	176.31 6.55

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	5
2	SS	9
3	SS	9
4	SS	9
5	SS	6
6	SS	100/ 0.25
7	SS	31



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION
14-MAR-17

Notes:

1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface.

2. Borehole caved to a depth of 5.8 m below ground surface upon completion of drilling.

3. Groundwater measured at a depth of 3.7 m below ground surface upon completion of drilling.

DEPTH SCALE
1 : 50

LOGGED: PT
CHECKED: AP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-112

BORING DATE: March 13, 2017

SHEET 1 OF 1

DATUM: Geodetic

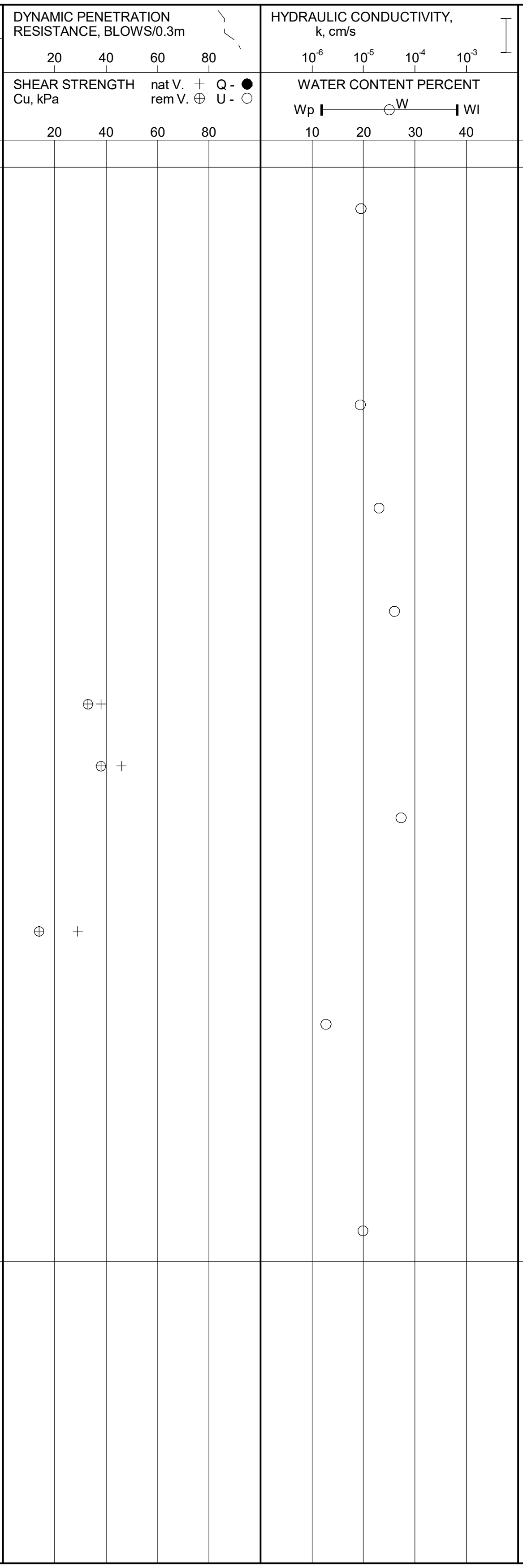
BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	182.03			
CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	FILL - TOPSOIL	0.00			
	FILL - (ML) sandy CLAYEY SILT; light brown, organic matter, rootlets; non-cohesive, moist, loose	0.15	1	SS	4
	(CL) SILTY CLAY to SILTY CLAY, trace sand to sandy, trace gravel; light brown to grey; cohesive, w~PL, firm to stiff	181.35 0.69	2	SS	4
			3	SS	12
	-becoming grey at 2.3 m depth		4	SS	12
			5	SS	6
			6	SS	4
	(SM) SILTY SAND, trace gravel; grey; non-cohesive, wet, very dense	176.24 5.79	7	SS	77/ 0.25
	(CL) SILTY CLAY, some sand; grey, layered; cohesive, w~PL, hard	174.95 7.09	8	SS	45
	END OF BOREHOLE	173.96 8.08			

Notes:

1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface.

2. Borehole caved to a depth of 5.8 m below ground surface upon completion of drilling.

3. Groundwater measured at a depth of 5.3 m below ground surface upon completion of drilling.



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇ 13-MAR-17

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: PT

CHECKED: AP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-113

BORING DATE: March 14, 2017

SHEET 1 OF 1

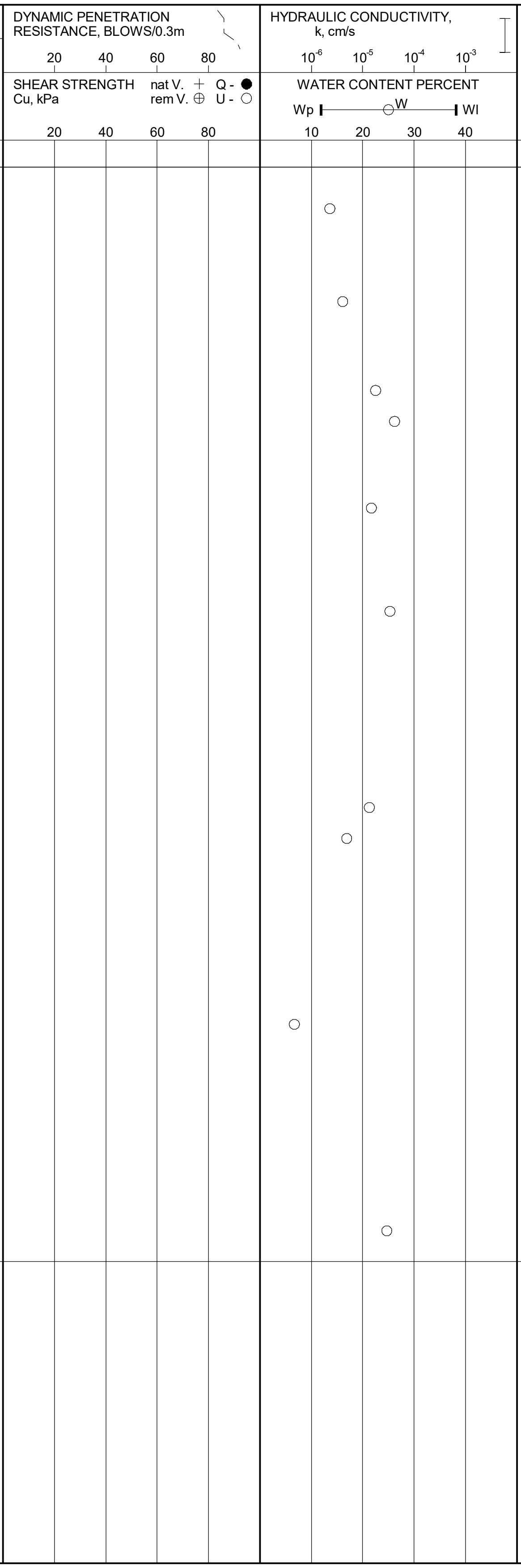
DATUM: Geodetic

BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE		181.97					
CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	FILL - TOPSOIL	▨	0.00					
	FILL - (SM) SILTY SAND, trace gravel; brown, organic matter, rootlets; non-cohesive, moist, loose	▨	181.73 0.24	1	SS	5		
	FILL - (CL) sandy SILTY CLAY; brown, oxidation staining; brown; cohesive, w~PL, compact	▨	181.29 0.69	2	SS	11		▽ 14-MAR-17
	(CL) SILTY CLAY, trace sand, trace gravel; grey; cohesive, w<PL to W~PL, stiff - sand and gravel seam at 1.7 m depth	▨	180.60 1.37	3A 3B	SS	9		
				4	SS	15		
				5	SS	10		
				6A	SS	10		
	(SP) gravelly SAND, some fines; grey; non-cohesive, wet, dense	▨	177.10 4.88	6B				
				7	SS	48	M	
	(ML) SILT and SAND, trace gravel; grey, (TILL); non-cohesive, moist, very dense	▨	174.89 7.09	8	SS	59		
	END OF BOREHOLE		173.90 8.08					

Notes:

1. Groundwater encountered during drilling at a depth of 1.5 m below ground surface.

2. Groundwater measured at a depth of 1.0 m below ground surface upon completion of drilling.



DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: AP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-114

BORING DATE: March 10, 2017

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE

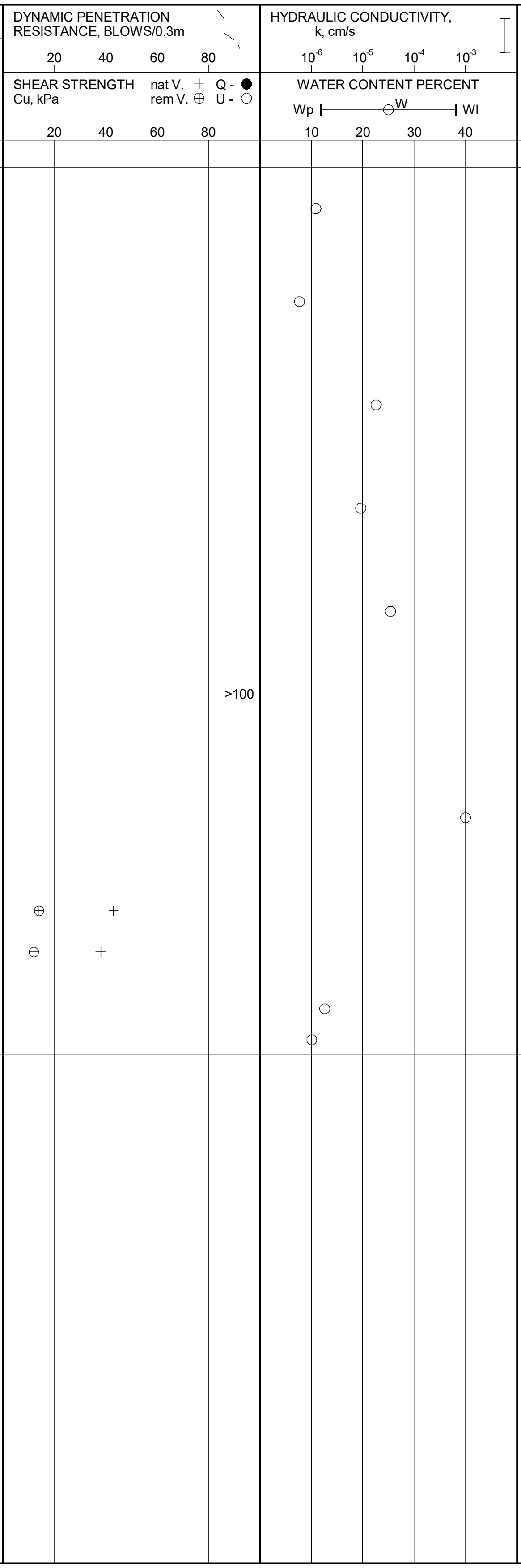
DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)
GROUND SURFACE		181.41
FILL - TOPSOIL	▨	0.00
FILL - (SM/GP) SILTY SAND, some gravel to sandy GRAVEL, trace fines; brown; non-cohesive, moist, loose to compact	▨	181.11 0.30
(CL) SILTY CLAY, trace sand, trace gravel; grey; cohesive, w<PL to w>PL, soft to very stiff	▨	180.12 1.30
(ML) sandy CLAYEY SILT, some gravel; grey, (TILL); cohesive, w<PL, very stiff		175.09 6.32
END OF BOREHOLE		174.86 6.55

Notes:

1. Groundwater measured at a depth of 2.7 m below ground surface upon completion of drilling.

SAMPLES

NUMBER	TYPE	BLOWS/0.3m
1	SS	9
2	SS	18
3	SS	9
4	SS	12
5	SS	8
6	SS	3
7A 7B	SS	22



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇ 10-MAR-17

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AK

CHECKED: AP

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PROJECT: 1413472
LOCATION: SEE FIGURE 1

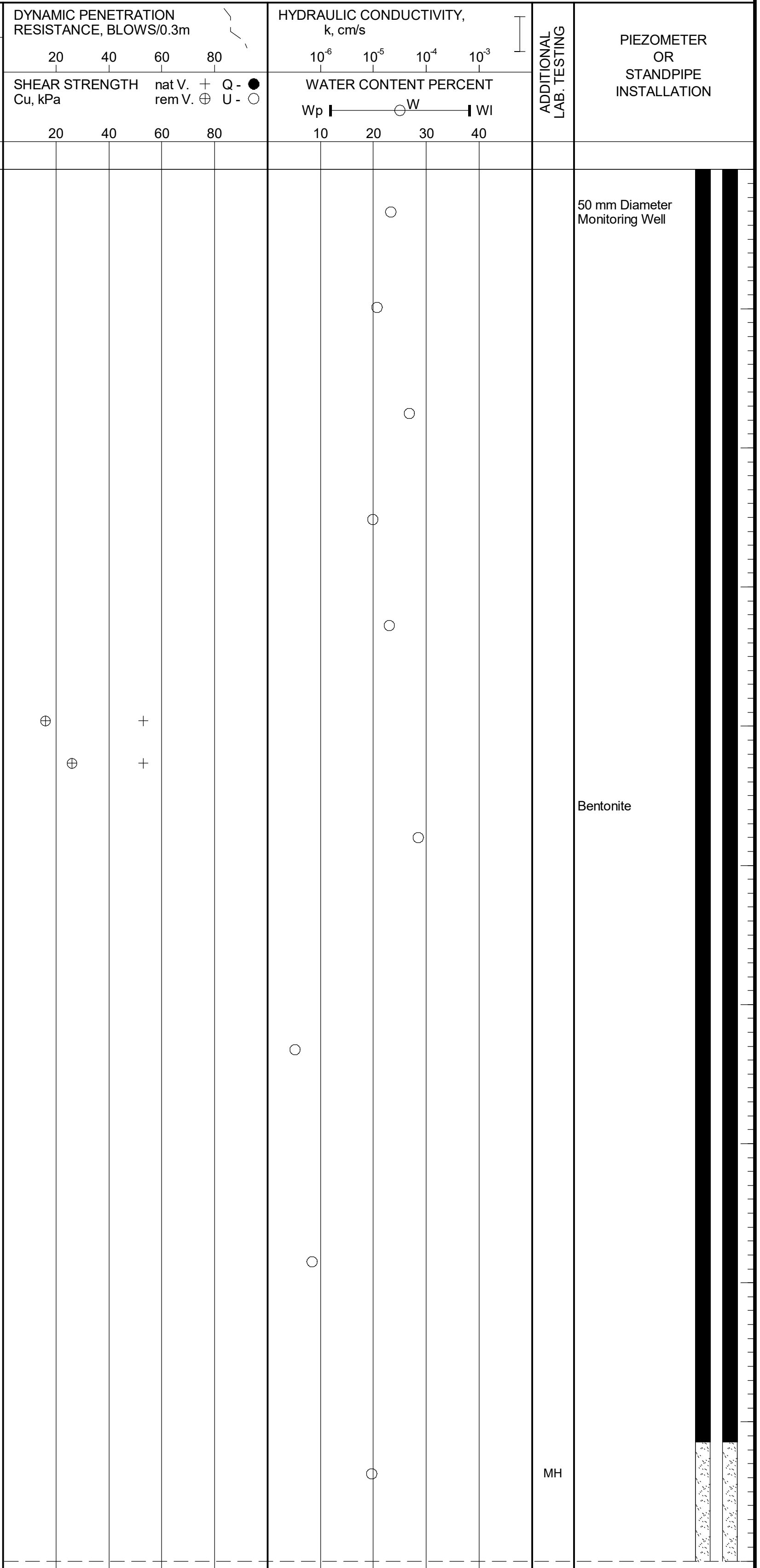
RECORD OF BOREHOLE: 17-115

BORING DATE: March 10, 2017

SHEET 1 OF 2
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	180.69					
FILL - TOPSOIL	0.00					
FILL - (CL) SILTY CLAY, trace sand, trace gravel; brown; cohesive, w<PL, firm	180.51 0.18	1	SS	7		50 mm Diameter Monitoring Well
(CL) SILTY CLAY, trace to some sand, trace gravel; brown; cohesive, w<PL to w>PL, firm to stiff -sand and silt seams between 0.8 m and 1.2 m depth -becoming grey at 2.1 m depth	179.88 0.81	2	SS	11		
		3	SS	15		
		4	SS	7		
		5	SS	3		
		6	SS	WH		Bentonite
(ML) SILT and SAND, some gravel to gravelly; grey, (TILL); non-cohesive, moist, dense	175.66 5.03	7	SS	34		
		8	SS	33		
(CL) sandy SILTY CLAY, trace gravel; grey, (TILL); cohesive, w<PL, very stiff	172.08 8.61	9	SS	20	MH	



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PT
CHECKED: AP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-115

BORING DATE: March 10, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- *CONTINUED FROM PREVIOUS PAGE* ---									
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger			170.56							
		(SP) SAND, some fines; grey; non-cohesive, wet, loose to very dense - Sample 10 disturbed due to heaving sand		10.13							
11					10	SS	6		○		Silica Sand and Screen
12					11	SS	58		○		
				168.04							
		END OF BOREHOLE		12.65							
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: AP

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PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-116

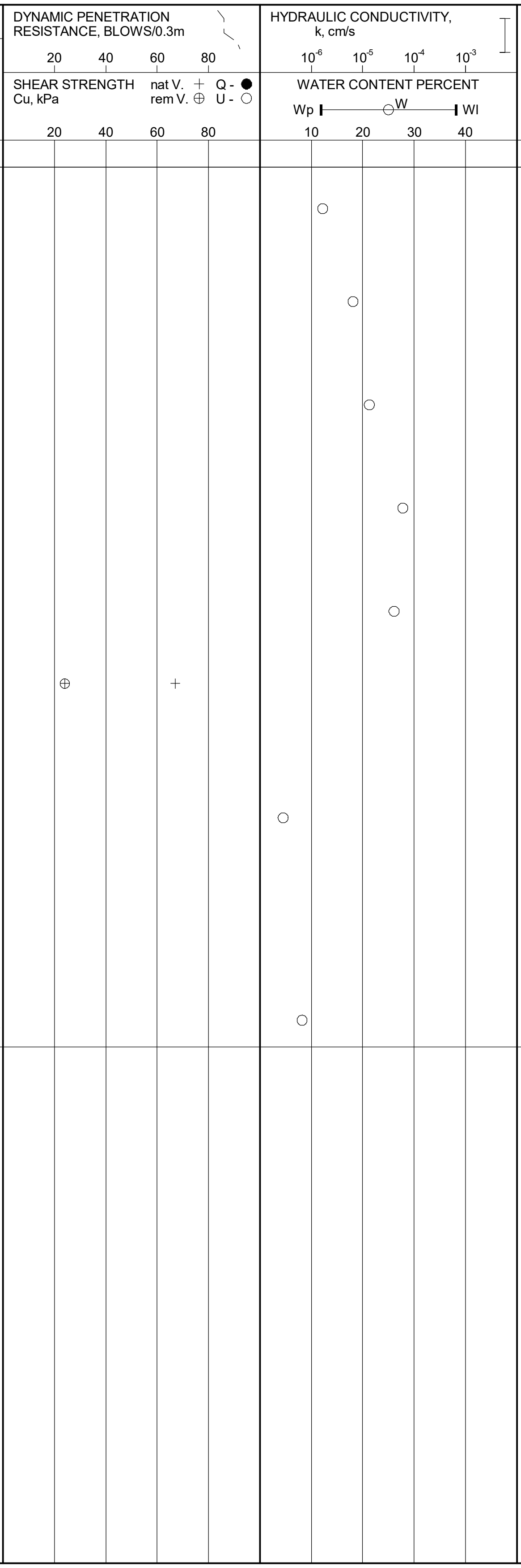
BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	180.52			
FILL - TOPSOIL	0.00			
FILL - (CL) sandy SILTY CLAY; brown, brick fragments; cohesive, w<PL, very stiff	0.08	1	SS	22
FILL - (SP) gravelly SAND; brown; non-cohesive, wet, loose	179.84 0.69	2	SS	6
(CL/CI) SILTY CLAY, some sand, trace gravel; grey; cohesive, w~PL to w>PL, stiff	179.15 1.37	3	SS	11
		4	SS	13
		5	SS	5
(GP) sandy GRAVEL; grey; non-cohesive, wet, compact	176.49 4.04	6	SS	19
(ML) sandy SILT; grey; non-cohesive, moist, very dense	174.96 5.56	7	SS	87/ 0.23
END OF BOREHOLE	174.03 6.49			



PIEZOMETER OR STANDPIPE INSTALLATION: ∇ 20-MAR-17

Notes:

1. Borehole caved to a depth of 4.9 m below ground surface upon completion of drilling.

2. Groundwater measured at a depth of 4.6 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: SEMP

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PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-117

BORING DATE: March 14, 2017

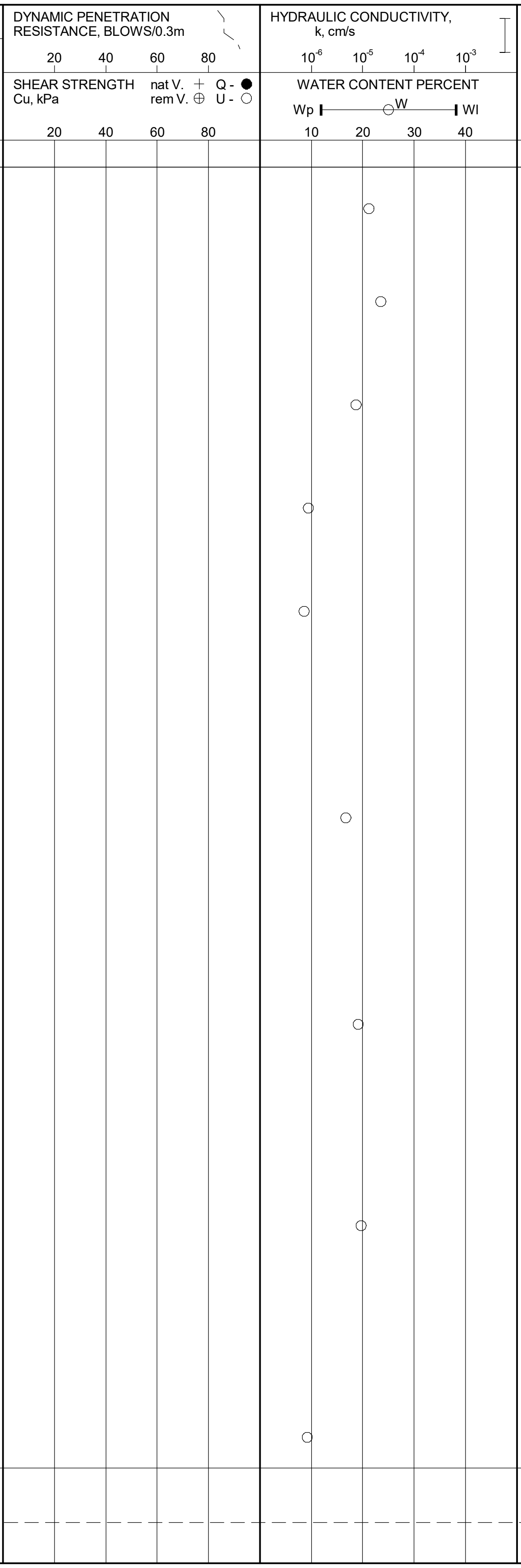
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.71
FILL - TOPSOIL	0.00
FILL - (CL) sandy SILTY CLAY; brown, organic matter; cohesive, w>PL, firm	0.15
(CL) SILTY CLAY, some sand; brown, oxidation staining; cohesive, w>PL, stiff	180.10 0.61
(ML) sandy CLAYEY SILT, some gravel; grey, (TILL); cohesive, w<PL, stiff to very stiff	178.58 2.13
(ML) sandy SILT; grey; non-cohesive, wet, compact to very dense	176.68 4.04
END OF BOREHOLE	171.11 9.60

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	7
2	SS	12
3	SS	10
4	SS	14
5	SS	22
6	SS	13
7	SS	40
8	SS	86/ 0.23
9	SS	49



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: ▽ 14-MAR-17

DEPTH SCALE METRES: 0 – 10

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-117

BORING DATE: March 14, 2017

SHEET 2 OF 2
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	SOIL PROFILE STRATA PLOT	SOIL PROFILE ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 3.0 m below ground surface. 2. Borehole caved to a depth of 8.5 m below ground surface upon completion of drilling. 3. Groundwater measured at a depth of 5.0 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MB
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-118

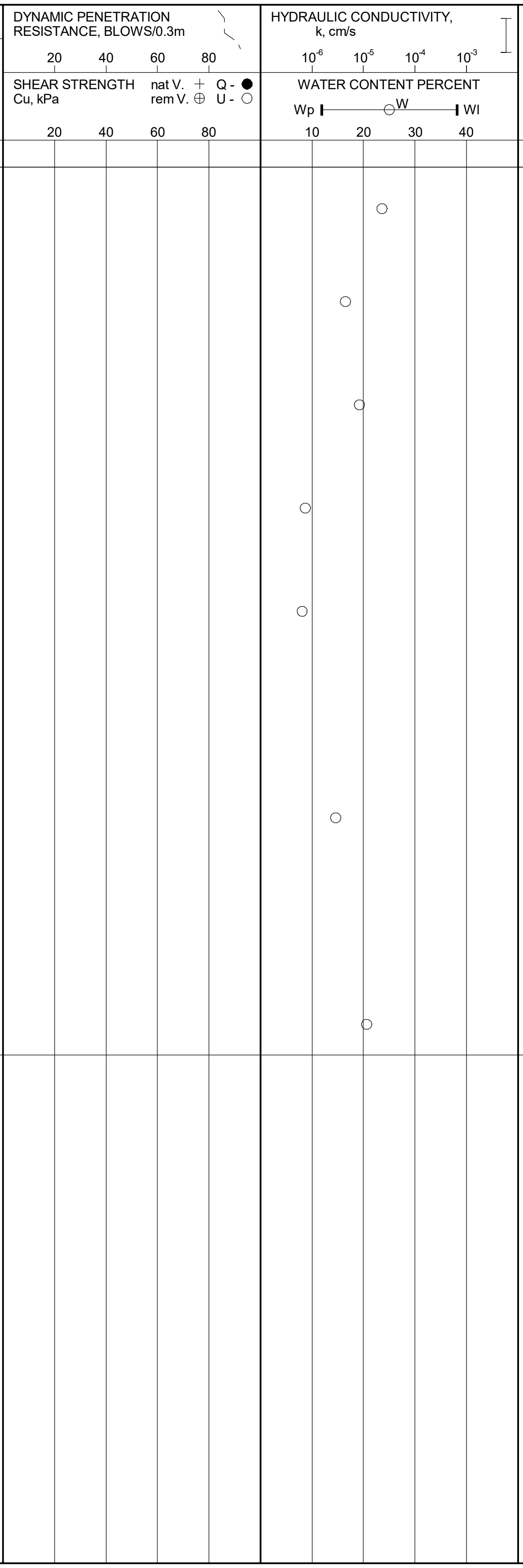
BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	181.09			
0	TOPSOIL	0.00			
	(CL) SILTY CLAY, trace to some sand; brown, oxidation staining; cohesive, w<PL to w~PL, firm to very stiff	0.12	1	SS	6
1			2	SS	13
			3	SS	17
2	(ML) sandy CLAYEY SILT to sandy SILT; grey, (TILL); cohesive, w<PL, stiff	178.96 2.13	4	SS	9
3			5	SS	14
4	(SM) SILTY SAND; grey; non-cohesive, wet, dense	176.93 4.17	6	SS	36
6			7	SS	43
	END OF BOREHOLE	174.54 6.55			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: ∇ 20-MAR-17

Notes:

1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface.

2. Borehole caved to a depth of 5.8 m below ground surface upon completion of drilling.

3. Groundwater measured at a depth of 5.5 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-119

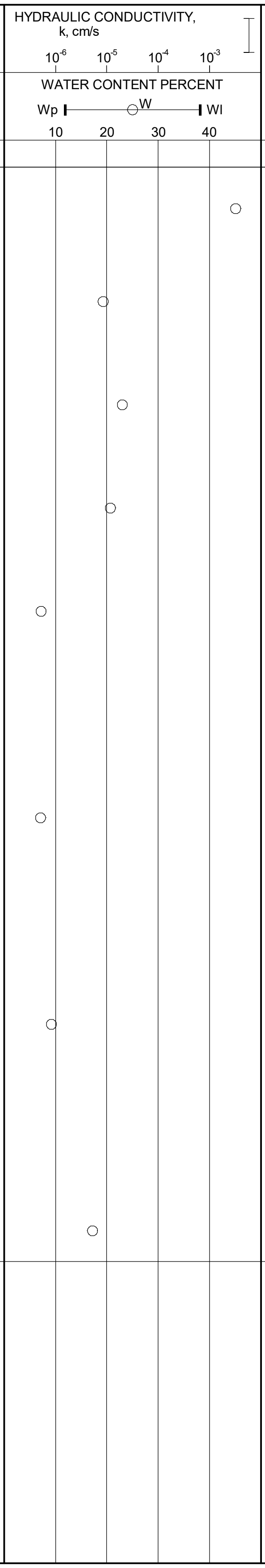
BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	180.74				
TOPSOIL	0.00				
(CL) SILTY CLAY, some sand; dark brown, organic matter; cohesive, w>PL, firm	0.12	1	SS	5	
(CL) SILTY CLAY, trace to some sand; brown, mottled; cohesive, w~PL, stiff	180.06 0.69	2	SS	12	
		3	SS	15	
(CL-ML) SILTY CLAY to CLAYEY SILT, some sand, some gravel; grey, (TILL); cohesive, w~PL to w<PL, very stiff to hard	178.61 2.13	4	SS	16	
		5	SS	19	
		6	SS	38	
					▽ 20-MAR-17
		7	SS	57	
(SM) SILTY SAND; grey; non-cohesive, wet, compact	174.04 6.71	8	SS	22	
END OF BOREHOLE	172.67 8.08				



DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80

ADDITIONAL LAB. TESTING

Notes:

1. Groundwater encountered during drilling at a depth of 7.6 m below ground surface.

2. Borehole caved to a depth of 6.1 m below ground surface upon completion of drilling.

3. Groundwater measured at a depth of 5.5 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-120

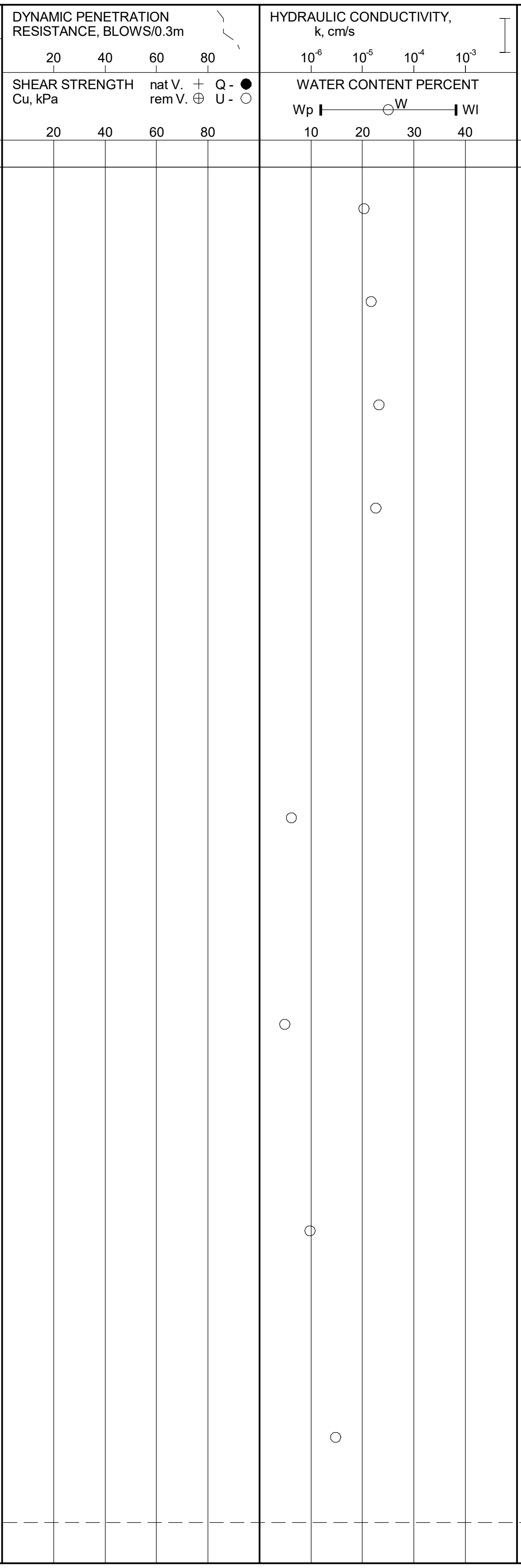
BORING DATE: March 17, 2017

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE		179.67				
0	TOPSOIL		0.00				
	(CL) SILTY CLAY, trace sand; brown to grey; cohesive, w~PL, soft to very stiff		0.15	1	SS	3	
1				2	SS	16	
	-becoming grey below 1.5 m depth			3	SS	15	
2				4	SS	10	
3				5	SS	7	
4	(CL-ML) sandy CLAYEY SILT to sandy SILTY CLAY, some sand, some gravel; grey, (TILL); cohesive, w~PL, very stiff to hard		175.64 4.04				
5				6	SS	62	∇ 17-MAR-17
6				7	SS	18	
7							
8				8	SS	23	
9				9	SS	20	
10	*CONTINUED NEXT PAGE*						



DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-120

BORING DATE: March 17, 2017

SHEET 2 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

--- CONTINUED FROM PREVIOUS PAGE ---

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
(CL) SILTY CLAY, trace sand; grey; cohesive, w>PL, very stiff	169.54 10.13	10	SS	23
(ML) sandy SILT; grey; non-cohesive, wet, very dense	168.02 11.66	11	SS	50/ 0.15
(CL) SILTY CLAY, some sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	166.49 13.18	12	SS	58
(SM) SILTY SAND, fine; grey; non-cohesive, wet, very dense	165.04 14.63	13	SS	50/ 0.15
END OF BOREHOLE	164.16 15.51			

Notes:

1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface.

2. Borehole caved to a depth of 12.5 m below ground surface upon completion of drilling.

3. Groundwater measured at a depth of 5.5 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-121

BORING DATE: May 15, 2017

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	180.00
FILL - TOPSOIL	0.00
FILL - (SM) SILTY SAND; brown, oxidation staining; non-coheisve, moist, loose to compact	0.15
(CL) SILTY CLAY; brown; cohesive, w>PL, firm to stiff - oxidation staining above 2.1 m depth - becoming grey at 2.1 m depth	178.63 1.37
(ML) CLAYEY SILT and SAND, some gravel; grey, (TILL); cohesive, w<PL, stiff to hard - auger grinding at 4.3 m depth on cobble or boulder - auger grinding at 8.5 m depth on cobble or boulder	175.97 4.04
(CL) SILTY CLAY, some sand, some gravel; grey, (TILL); compact, w<PL, very stiff to hard	171.39 8.61

SAMPLE NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION	ADDITIONAL LAB. TESTING
1	SS	6		
2	SS	14		
3	SS	10		
4	SS	9		
5	SS	6		
			>100	
6	SS	13		
7	SS	40		MH
8	SS	22		
9	SS	18		

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-121

BORING DATE: May 15, 2017

SHEET 2 OF 2

DATUM: Geodetic

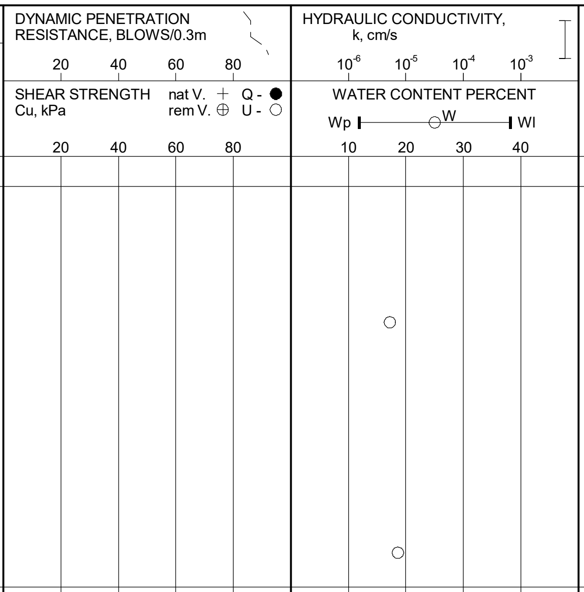
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---							
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	(CL) SILTY CLAY, some sand, some gravel; grey, (TILL); compact, w<PL, very stiff to hard	▨						▽ 15-MAY-17
11					10	SS	35		
		(ML) sandy SILT; grey; non-cohesive, wet, dense		168.35 11.66					
12					11	SS	35		
		END OF BOREHOLE		167.35 12.65					
13									
14									
15									
16									
17									
18									
19									
20									

Notes:

1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface.

2. Borehole caved to a depth of 11.6 m below ground surface upon completion of drilling.

3. Groundwater measured at a depth of 10.4 m below ground surface upon completion of drilling.



DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-122

BORING DATE: March 17, 2017

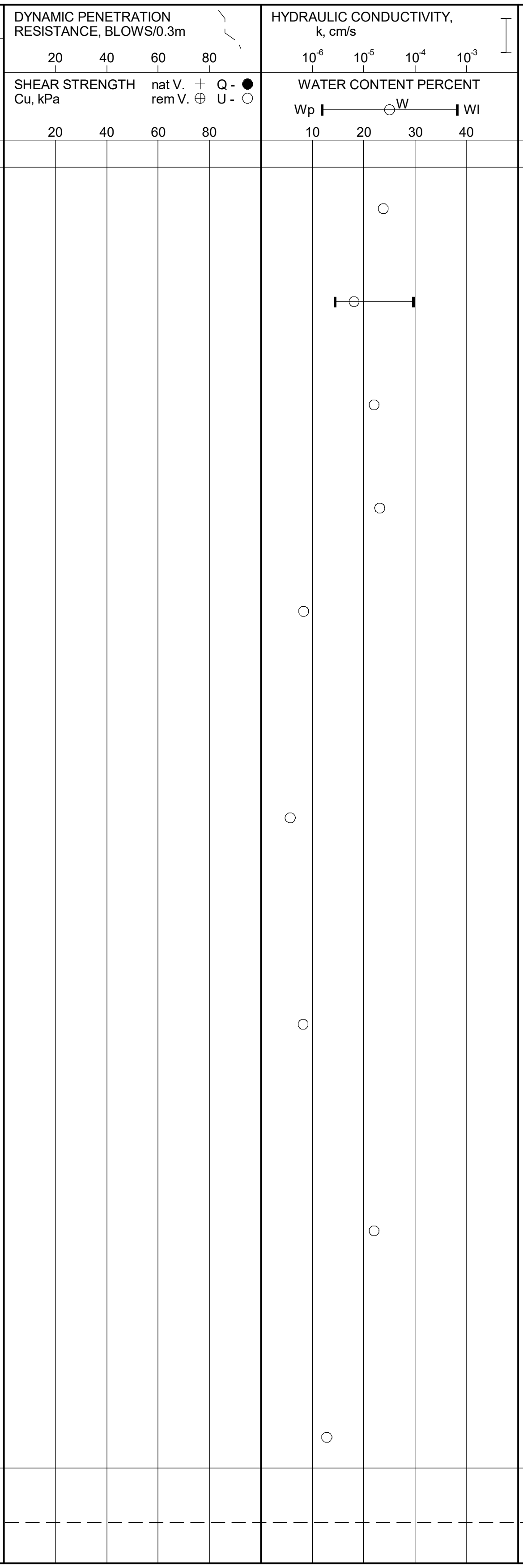
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV.	DEPTH (m)
GROUND SURFACE		179.47	
TOPSOIL			0.00
(CL) SILTY CLAY, trace sand; brown; cohesive, w>PL, stiff to very stiff -becoming grey at 1.4 m depth - oxidation staining above 1.5 m depth			0.15
(ML) sandy SILT, some gravel; grey, (TILL); non-cohesive, compact to very dense - auger grinding at 4.3 m depth on cobble or boulder		176.58	2.90
(SM) SILTY SAND; grey; non-cohesive, wet, compact		172.39	7.09
END OF BOREHOLE		169.87	9.60

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	8
2	SS	14
3	SS	20
4	SS	17
5	SS	31
6	SS	65
7	SS	13
8	SS	18
9	SS	29



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇ 17-MAR-17

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-122

BORING DATE: March 17, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 2.3 m below ground surface. 2. Borehole caved to a depth of 7.2 m below ground surface upon completion of drilling. 3. Groundwater measured at a depth of 5.3 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-123

BORING DATE: March 17, 2017

SHEET 1 OF 2

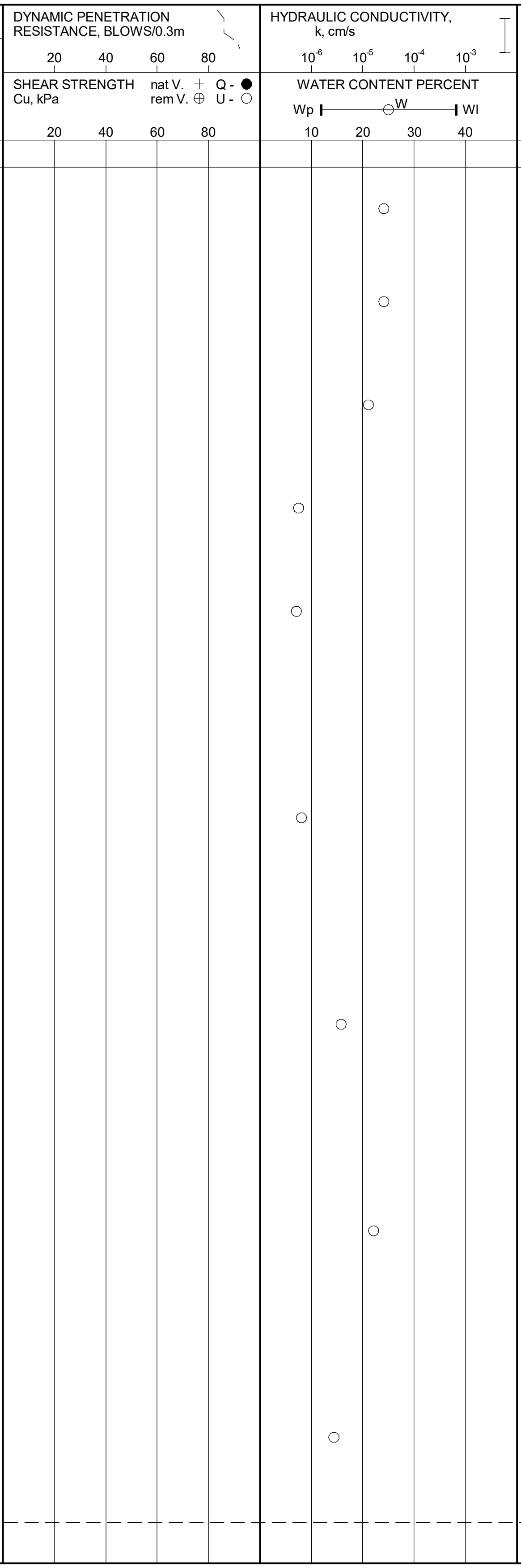
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Augers

DEPTH SCALE METRES: 0 – 10

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	179.75
TOPSOIL	0.00
(CL) sandy SILTY CLAY, some gravel; brown, oxidation staining; cohesive, w<PL, firm to stiff	179.60 0.15
(ML) sandy CLAYEY SILT; brown, (TILL); cohesive, w<PL, stiff to very stiff - oxidation staining above 2.7 m depth - becoming grey at 3.4 m depth	177.62 2.13
(SM) SILTY SAND; grey; brown; non-cohesive, wet, very loose to compact	174.19 5.56
(SP) SAND, trace fines; grey; non-cohesive, wet, very dense	171.14 8.61

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	6
2	SS	13
3	SS	14
4	SS	22
5	SS	20
6	SS	10
7	SS	3
8	SS	18
9	SS	51



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 17-MAR-17

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-123

BORING DATE: March 17, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} / WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Augers	(CL) SILTY CLAY, trace sand, trace gravel; grey; cohesive, w~PL, very stiff		169.62 10.13							
11					10	SS	25		○		
		(CL) SILTY CLAY, some sand, trace gravel; grey, (TILL); cohesive, w<PL, hard		168.17 11.58							
12					11	SS	53		○		
		END OF BOREHOLE		167.10 12.65							
13											
14											
15											
16											
17											
18											
19											
20											

Notes:

1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface.

2. Borehole caved to a depth of 8.2 m below ground surface upon completion of drilling.

3. Groundwater measured at a depth of 4.6 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-124

BORING DATE: March 20, 2017

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger, 108 mm I.D. Hollow Stem Augers

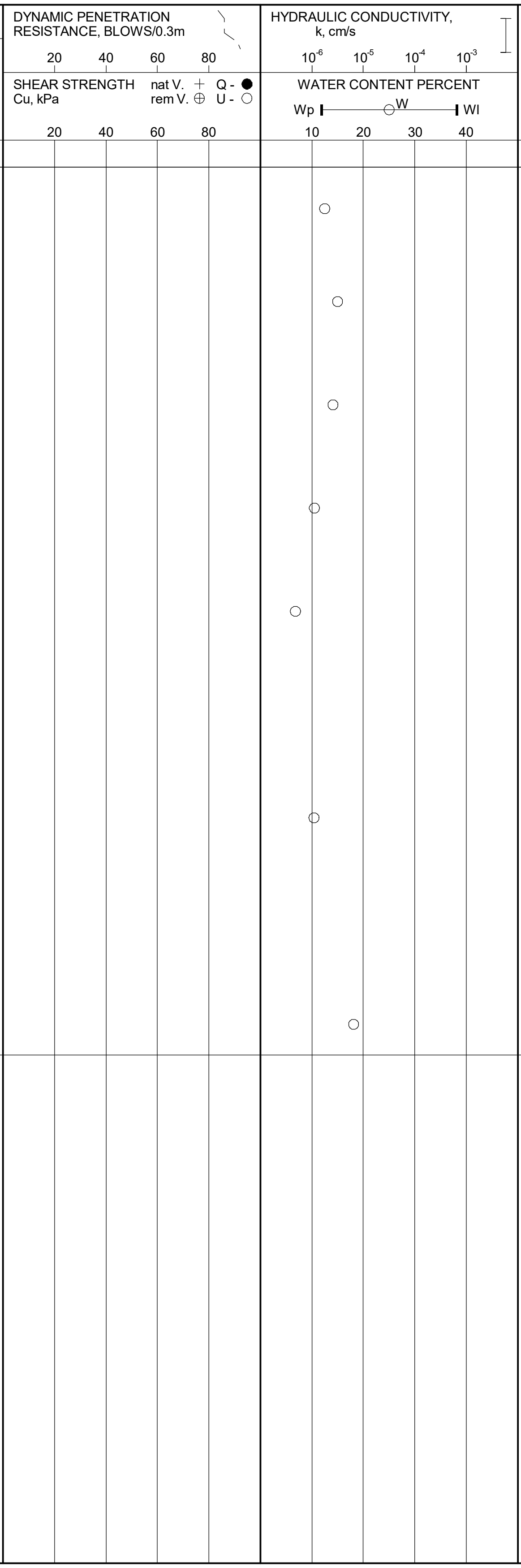
SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	186.73				
FILL - TOPSOIL	0.00				
FILL - (CL) sandy SILTY CLAY, trace gravel; dark brown, organic matter, rootlets; cohesive, w~PL, firm to stiff	0.15	1	SS	6	
		2	SS	9	
FILL - (ML) sandy CLAYEY SILT, trace cobbles; grey and brown; cohesive, w~PL, stiff	185.36 1.37	3	SS	10	
(ML) sandy SILT, some gravel; brown to grey, (TILL), oxidation staining; non-cohesive, wet - moist, compact to dense	184.60 2.13	4	SS	11	▽ 20-MAR-17
-becoming grey at 3.0 m depth		5	SS	32	
		6	SS	27	
(CL) SILTY CLAY, trace sand, trace gravel; grey, (TILL); cohesive, w~PL, very stiff	181.17 5.56	7	SS	22	
END OF BOREHOLE	180.18 6.55				

Notes:

1. Groundwater encountered during drilling at a depth of 2.3 m below ground surface.

2. Borehole open upon completion of drilling.

3. Groundwater measured at a depth of 2.4 m below ground surface upon completion of drilling.



ADDITIONAL LAB. TESTING

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-125

BORING DATE: March 20, 2017

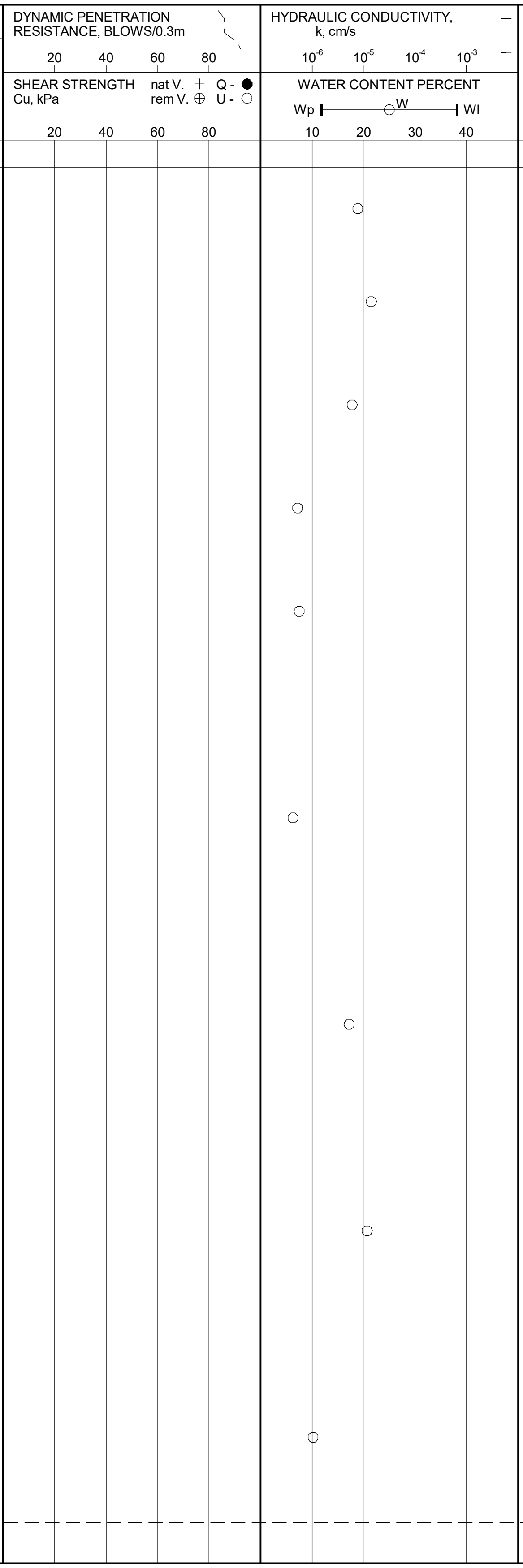
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	190.41
TOPSOIL	0.00
(CL) SILTY CLAY, some sand; dark brown, organic matter, rootlets; cohesive, w~PL, firm	0.15
(CL-ML) sandy SILTY CLAY to sandy CLAYEY SILT, trace gravel; light brown, (TILL), oxidation staining; cohesive, w<PL to w~PL, stiff to hard	189.73 0.69
(SP) SAND, trace fines; grey; non-cohesive, wet, very loose	184.85 5.56
(CL) SILTY CLAY, trace sand, some gravel; grey, (TILL); cohesive, w~PL, very stiff to hard	183.32 7.09

NUMBER	TYPE	BLOWS/0.3m
1	SS	9
2	SS	12
3	SS	13
4	SS	27
5	SS	45
6	SS	40
7	SS	WH
8	SS	16
9	SS	56



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 20-MAR-17 (at approx. 8 m depth)

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-125

BORING DATE: March 20, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(CL) SILTY CLAY, trace sand, some gravel; grey, (TILL); cohesive, w~PL, very stiff to hard	▨	179.65	10	SS	50/ 0.10		○		
11		END OF BOREHOLE SPLIT SPOON BOUNCING AUGER REFUSAL		10.76							

Notes:

1. Borehole caved to a depth of 10.4 m below ground surface upon completion of drilling.

2. Groundwater measured at a depth of 7.9 m below ground surface upon completion of drilling.

12

13

14

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18

19

20

GTA-BHS 001 \\GOLDER.GDS\GAL\SUDBURY\CAD-GIS\SIM\CLIENTS\SIXTEENTH_LAND_HOLDINGS_INC\YORK_DOWNS_GOLF_COURSE\02_DATA\GINT\1413472_2017.GPJ GAL-MIS.GDT 10/17/17 JJL/TB

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-126

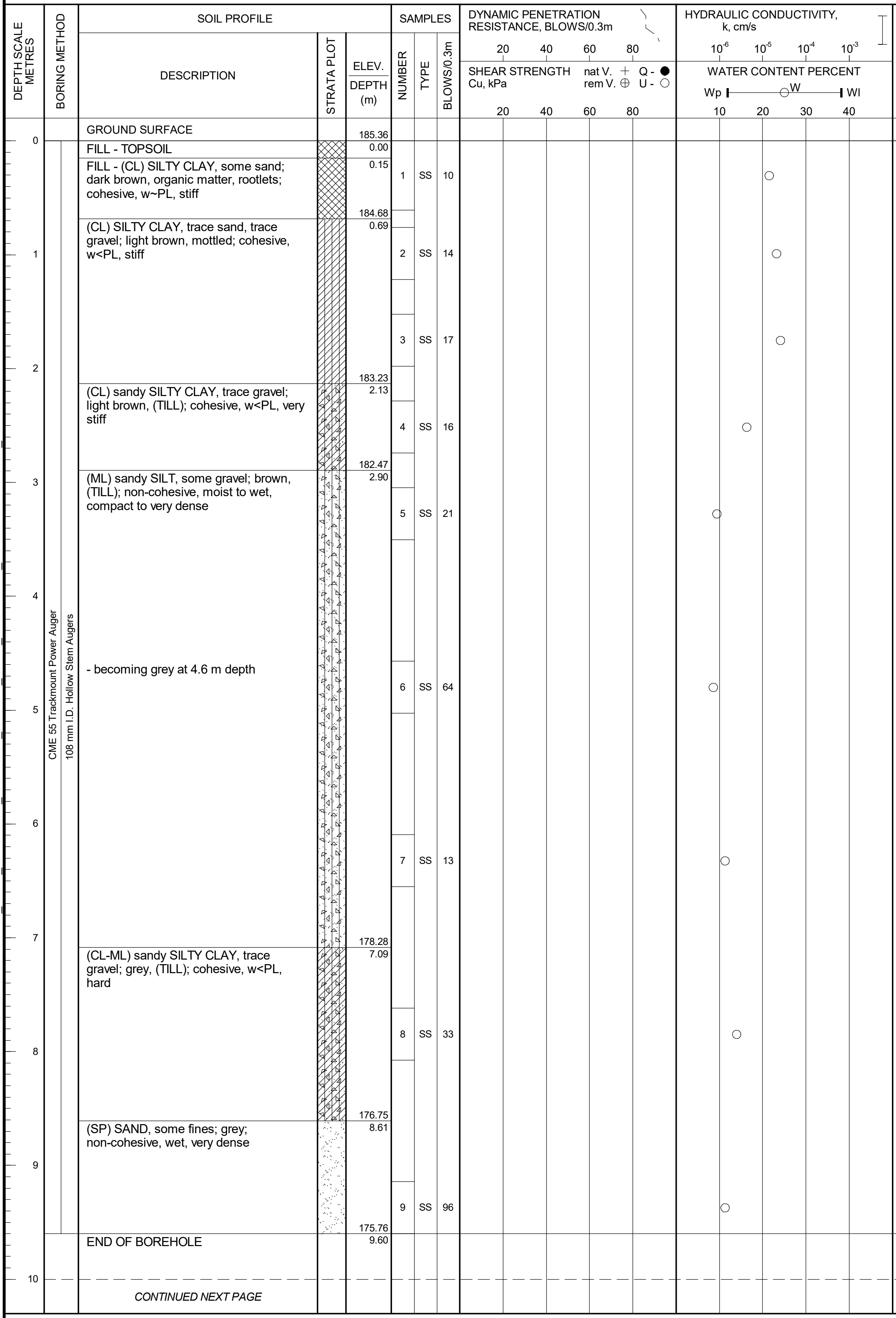
BORING DATE: March 21, 2017

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	185.36				
FILL - TOPSOIL	0.00				
FILL - (CL) SILTY CLAY, some sand; dark brown, organic matter, rootlets; cohesive, w~PL, stiff	0.15	1	SS	10	
(CL) SILTY CLAY, trace sand, trace gravel; light brown, mottled; cohesive, w<PL, stiff	184.68 0.69	2	SS	14	
		3	SS	17	
(CL) sandy SILTY CLAY, trace gravel; light brown, (TILL); cohesive, w<PL, very stiff	183.23 2.13	4	SS	16	
(ML) sandy SILT, some gravel; brown, (TILL); non-cohesive, moist to wet, compact to very dense	182.47 2.90	5	SS	21	
- becoming grey at 4.6 m depth		6	SS	64	
					∇ 21-MAR-17
		7	SS	13	
(CL-ML) sandy SILTY CLAY, trace gravel; grey, (TILL); cohesive, w<PL, hard	178.28 7.09	8	SS	33	
(SP) SAND, some fines; grey; non-cohesive, wet, very dense	176.75 8.61	9	SS	96	
END OF BOREHOLE	175.76 9.60				



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DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-126

BORING DATE: March 21, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface. 2. Borehole caved to a depth of 6.1 m below ground surface upon completion of drilling. 3. Groundwater measured at a depth of 5.5 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-127

BORING DATE: March 21, 2017

SHEET 1 OF 2

DATUM: Geodetic

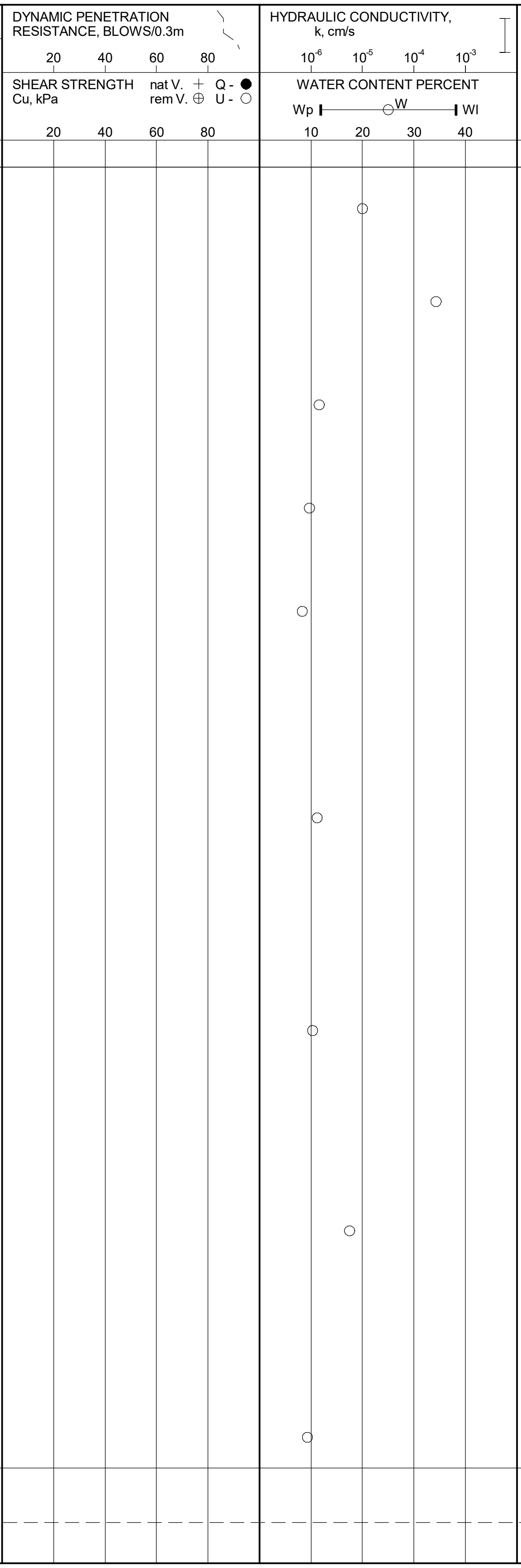
BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DEPTH SCALE METRES: 0 to 10

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	189.51
TOPSOIL	0.00
(CL) SILTY CLAY, some sand, trace gravel; brown, organic matter to 0.7 m depth; cohesive, w>PL, firm to stiff	0.15
(SM/ML) SILTY SAND to sandy SILT, trace to some gravel; brown, oxidation staining, (TILL); non-cohesive, moist, compact to dense -becoming grey at 5.6 m depth -sand seams between 5.6 m and 6.2 m depth	188.14 1.37
(ML) sandy SILT; grey; non-cohesive, wet, dense	183.32 6.19
(CL-ML) SILTY CLAY to CLAYEY SILT, some sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	180.98 8.53
END OF BOREHOLE	179.91 9.60

CONTINUED NEXT PAGE

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	7
2	SS	10
3	SS	16
4	SS	17
5	SS	21
6	SS	42
7A 7B	SS	42
8	SS	28
9	SS	88



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

50 mm Diameter Monitoring Well

▽ 21-MAR-17

Bentonite

Silica Sand and Screen

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-127

BORING DATE: March 21, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface. 2. Groundwater measured at a depth of 6.1 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

GTA-BHS 001 \\GOLDER.GDS\GAL\SUDBURY\CAD-GIS\SIM\CLIENTS\SIXTEENTH_LAND_HOLDINGS_INC\YORK_DOWNS_GOLF_COURSE\02_DATA\GINT\1413472_2017.GPJ GAL-MIS.GDT 10/17/17 JJL/TB

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-128

BORING DATE: March 20, 2017

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	190.01				
FILL - TOPSOIL	0.00				
FILL - (CL) SILTY CLAY, trace gravel, trace sand; brown, oganic matter, rootlets; cohesive, w~PL, firm	0.15	1	SS	8	
(CL) SILTY CLAY, trace gravel, trace sand; light brown, mottled; cohesive, w~PL, stiff	189.33 0.69	2	SS	9	
(CL) sandy SILTY CLAY, trace gravel; brown, (TILL), oxidation staining; cohesive, w~PL, stiff	188.64 1.37	3	SS	13	
(ML) sandy SILT, some gravel; brown, (TILL), oxidation staining; non-cohesive, moist, compact to dense	187.88 2.13	4 5	SS SS	16 43	
-auger grinding between 4.9 m and 5.2 m depth on cobble or boulder		6	SS	41	▽ 20-MAR-17
(SP) SAND, some fines; brown; non-cohesive, wet, compact	184.45 5.56	7 8	SS SS	13 16	
(CL) SILTY CLAY, some sand, trace gravel; grey, (TILL); cohesive, w>PL to w<PL, very stiff	181.40 8.61	9	SS	29	

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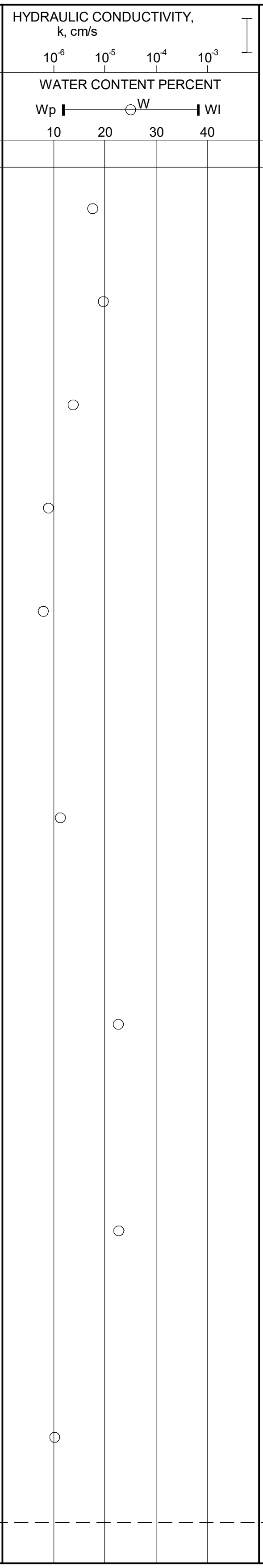


DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

ADDITIONAL LAB. TESTING

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-128

BORING DATE: March 20, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} / WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10				179.88 10.13							
		(SM) SILTY SAND; grey; non-cohesive, wet, dense			10	SS	38		○		
11				178.89 11.13							
		END OF BOREHOLE Notes: 1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface. 2. Borehole caved to a depth of 5.8 m below ground surface upon completion of drilling. 3. Groundwater measured at a depth of 5.4 m below ground surface upon completion of drilling.									
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-129

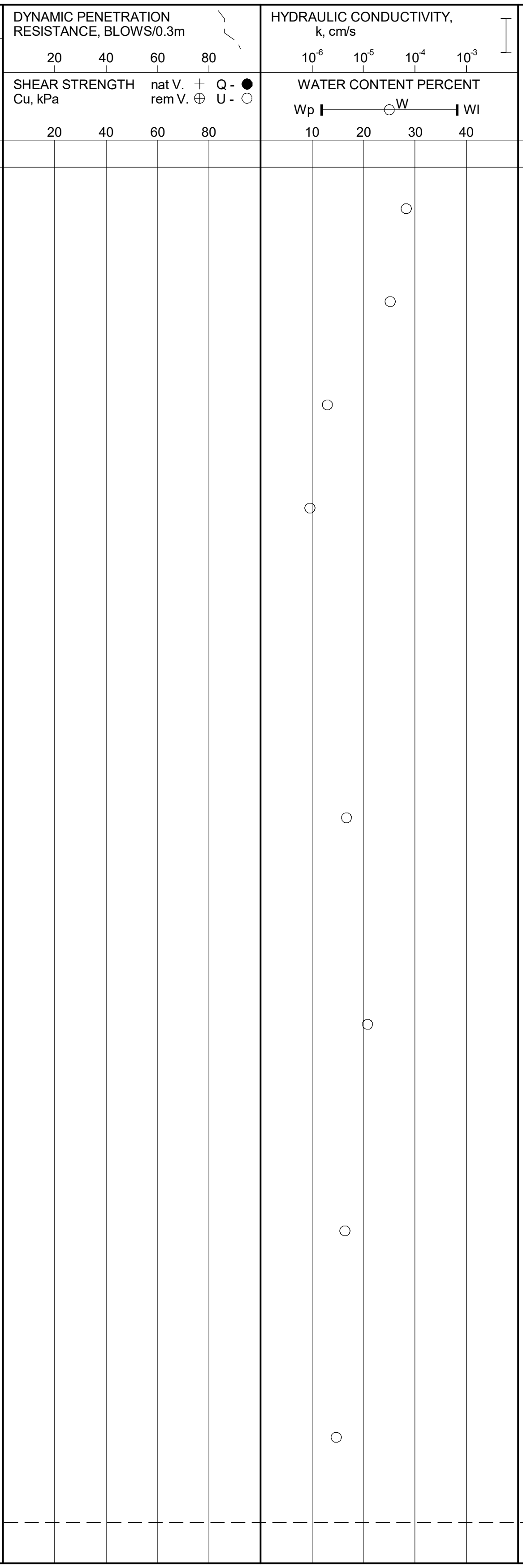
BORING DATE: March 20, 2017

SHEET 1 OF 2
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	185.12
TOPSOIL	0.00
(CL) sandy SILTY CLAY, some gravel; dark brown to brown, mottled, oxidation staining; cohesive, w<PL, firm to stiff	0.09
(ML) sandy SILT; brown, (TILL), oxidation staining; non-cohesive, moist, compact to very dense	183.75 1.37
(SP) SAND, some fines; brown, oxidation staining; non-cohesive, wet, dense	181.46 3.66
(CL) sandy SILTY CLAY; grey; cohesive, w<PL, hard -430 mm grey, wet, silty sand seam at 8.6 m depth	177.96 7.16
CONTINUED NEXT PAGE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	4
2	SS	14
3	SS	18
4	SS	22
5	SS	57
6	SS	36
7	SS	37
8	SS	35
9	SS	54



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE
1 : 50

LOGGED: MB
CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-129

BORING DATE: March 20, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ├──○W──┤ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(CL) sandy SILTY CLAY; grey; cohesive, w<PL, hard	▨								
11					10	SS	73		○		
		END OF BOREHOLE Notes: 1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface. 2. Borehole caved to a depth of 8.2 m below ground surface upon completion of drilling.		174.00 11.13							
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: SEMP

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-130

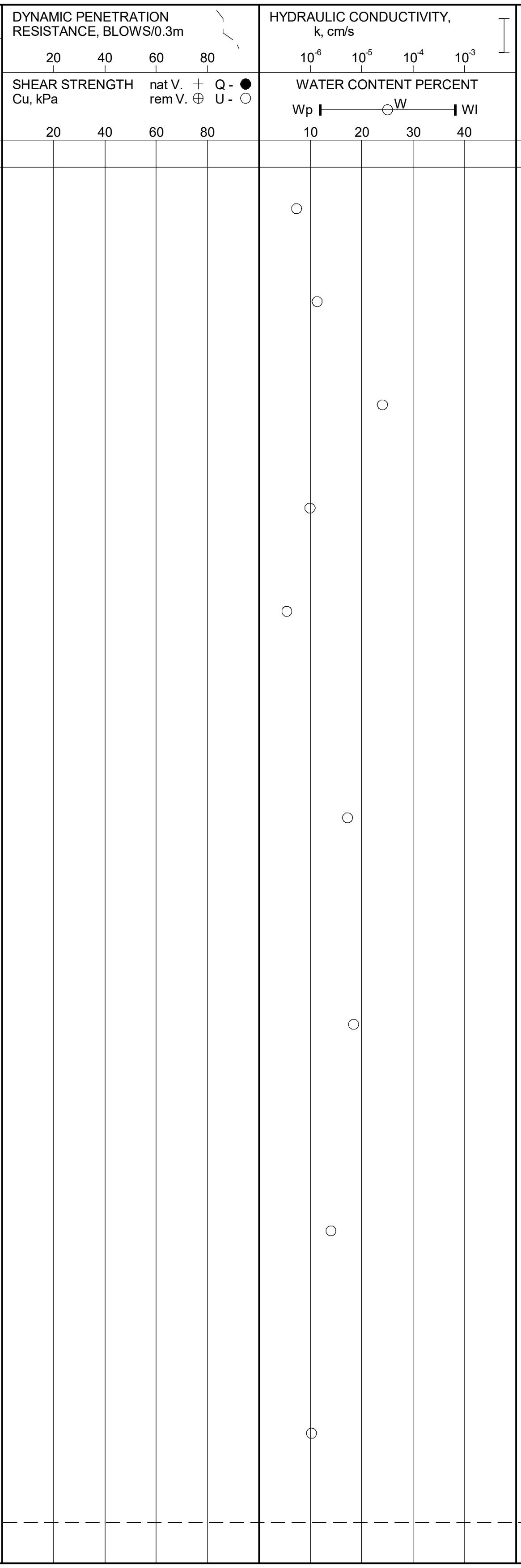
BORING DATE: March 21, 2017

SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	183.90				
0	FILL - TOPSOIL	0.00				
	FILL - (SP) gravelly SAND, some plastic fines; brown, oxidation staining; non-cohesive, wet, loose to compact	0.15	1	SS	5	50 mm Diameter Monitoring Well
1			2	SS	15	
	(CL) SILTY CLAY; brown; cohesive, w>PL, very stiff	182.53 1.37	3	SS	19	
2	(ML) sandy SILT; brown to grey, (TILL), oxidation staining; non-cohesive, moist, dense to very dense	181.77 2.13	4	SS	34	
3			5	SS	70	
4	- auger grinding at 4.0 m depth on cobble or boulder (SM) SILTY SAND; brown, oxidation staining; non-cohesive, wet, compact to dense	179.86 4.04	6	SS	29	
5						Bentonite
6			7	SS	39	
7	(ML) sandy SILT; grey; non-cohesive, wet, dense to very dense - auger grinding at 7.3 m depth on cobble or boulder	176.82 7.09	8	SS	41	
8						
9			9	SS	80/ 0.25	
	- auger grinding at 9.8 m depth on cobble or boulder					
10						
	CONTINUED NEXT PAGE					



ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-130

BORING DATE: March 21, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---					
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Augers	(ML) sandy CLAYEY SILT, some gravel; grey, (TILL); cohesive, w<PL, hard	173.77 10.13				Bentonite
				10	SS	50/ 0.08	
11							Silica Sand and Screen
12			171.58 12.32	11	SS	50/ 0.13	
		END OF BOREHOLE					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

Note:

1. Groundwater encountered during drilling at a depth of 2.9 m below ground surface.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-131

BORING DATE: March 22, 2017

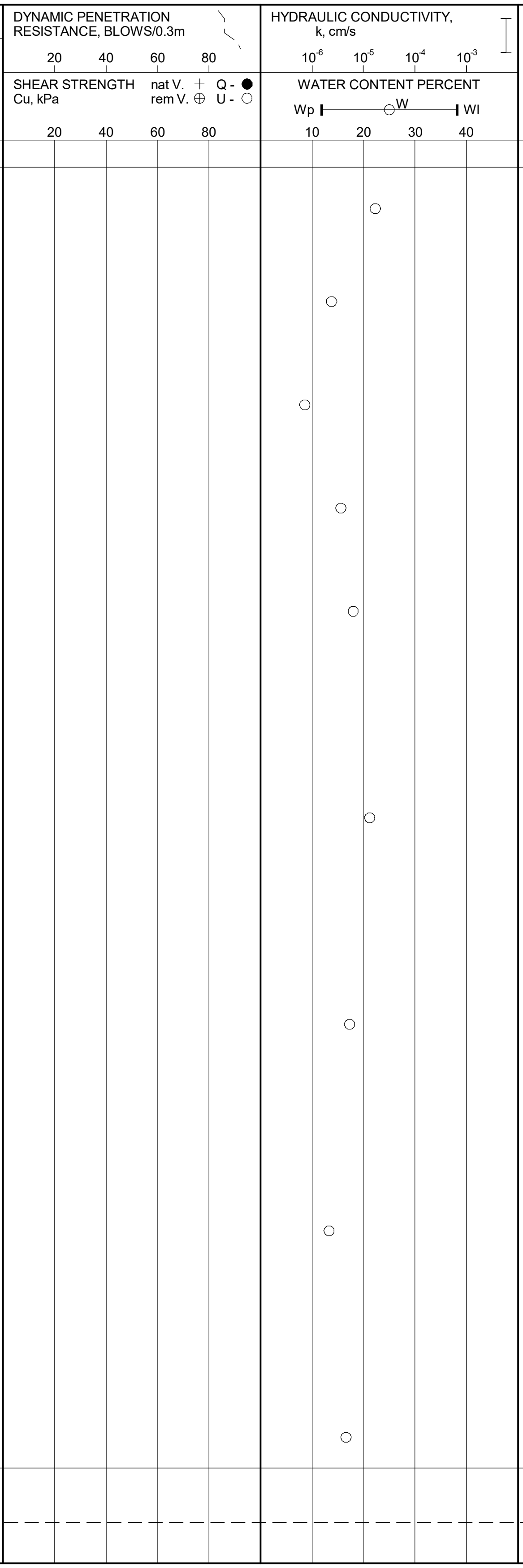
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	185.91
TOPSOIL	0.00
(CL) SILTY CLAY, trace sand, trace gravel; brown, rootlets; cohesive, w~PL, firm	0.15
(CL) sandy SILTY CLAY, some gravel; brown, (TILL), sand seams; cohesive, w~PL, stiff	185.23 0.69
(SM/SP) SILTY SAND to SAND, trace fines, trace to some gravel; brown; non-cohesive, dry to wet, compact to dense - dry pockets above 2.7 m depth - becoming wet at 4.6 m depth - oxidation staining above 6.1 m depth - becoming grey below 7.6 m depth	183.70 2.21
END OF BOREHOLE	176.31 9.60

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	6
2	SS	12
3	SS	14
4	SS	30
5	SS	24
6	SS	36
7	SS	43
8	SS	22
9	SS	18



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

50 mm Diameter Monitoring Well

Bentonite

Silica Sand and Screen

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: EW

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PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-131

BORING DATE: March 22, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	SOIL PROFILE STRATA PLOT	SOIL PROFILE ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ├──○W──┤ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Note: 1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

GTA-BHS 001 \\GOLDER.GDS\GAL\SUDBURY\CAD-GIS\SIM\CLIENTS\SIXTEENTH_LAND_HOLDINGS_INC\YORK_DOWNS_GOLF_COURSE\02_DATA\GINT\1413472_2017.GPJ GAL-MIS.GDT 10/17/17 JJL/TB

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-132

BORING DATE: March 21, 2017

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH Cu, kPa	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		187.75							
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	TOPSOIL		0.00							
		(CL) SILTY CLAY, trace gravel; brown, organic matter to 0.7 m depth; cohesive, w>PL, firm to stiff		0.12	1	SS	9				
1					2	SS	11				
		(SP-SM) SAND, fine to medium, some fines; brown; non-cohesive, dry to moist, compact		186.38 1.37	3	SS	21				
2					4	SS	28			M	
3					5	SS	22				
4		(SM) SILTY SAND; brown; non-cohesive, dense to very dense		183.71 4.04	6	SS	40				
5											
6					7	SS	56				▽ 21-MAR-17
7		-becoming grey at 7.1 m depth									
8					8	SS	34				
9					9	SS	43				
		END OF BOREHOLE		178.15 9.60							
10											

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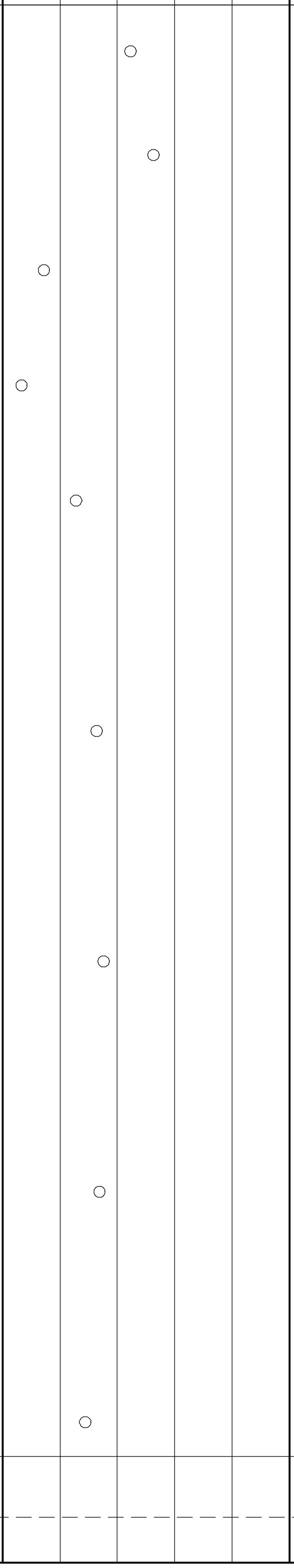


DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-132

BORING DATE: March 21, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 7.6 m below ground surface. 2. Borehole caved to a depth of 4.3 m below ground surface upon completion of drilling. 3. Groundwater measured at a depth of 6.8 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-133

BORING DATE: March 9, 2017

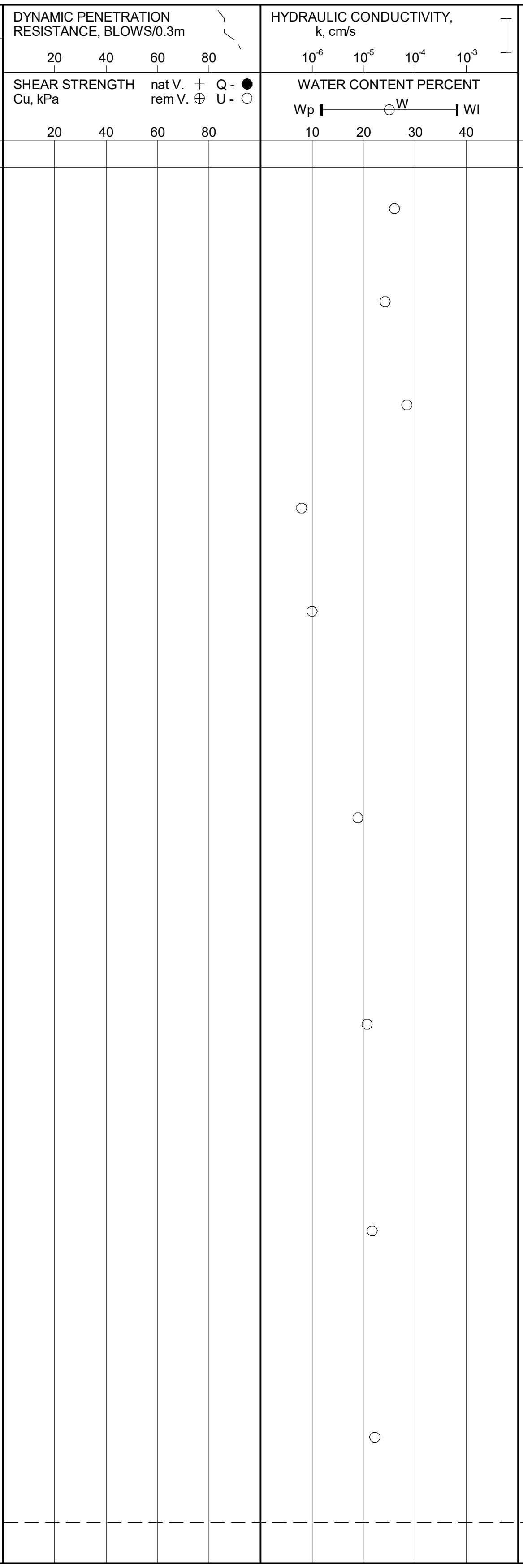
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Auger

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	191.12
TOPSOIL	0.00
(CL) sandy SILTY CLAY, trace to some gravel; brown; cohesive, w>PL, firm -organic matter between 0.1 m to 0.7 m depth	0.15
(SM) SILTY SAND, some gravel; brown, oxidation staining, (TILL); non-cohesive, moist, compact	188.80 2.32
(ML/SM) sandy SILT to SILTY SAND; brown; non-cohesive, moist, compact to dense -oxidation staining above 4.9 m depth - becoming grey at 9.1 m depth	187.08 4.04

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	8
2	SS	7
3	SS	7
4	SS	23
5	SS	27
6	SS	45
7	SS	29
8	SS	35
9	SS	31



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇ 09-MAR-17

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AK

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-133

BORING DATE: March 9, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ├──○W──┤ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10				180.91 10.21							
		(ML) CLAYEY SILT, some sand, trace gravel; grey, (TILL); cohesive, w<PL, hard			10	SS	51		○		
11				180.00 11.13							
		END OF BOREHOLE									

Notes:

1. Borehole caved to a depth of 2.1 m below ground surface upon completion of drilling.

2. Groundwater measured at a depth of 0.6 m below ground surface upon completion of drilling.

12

13

14

15

16

17

18

19

20

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AK

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-134

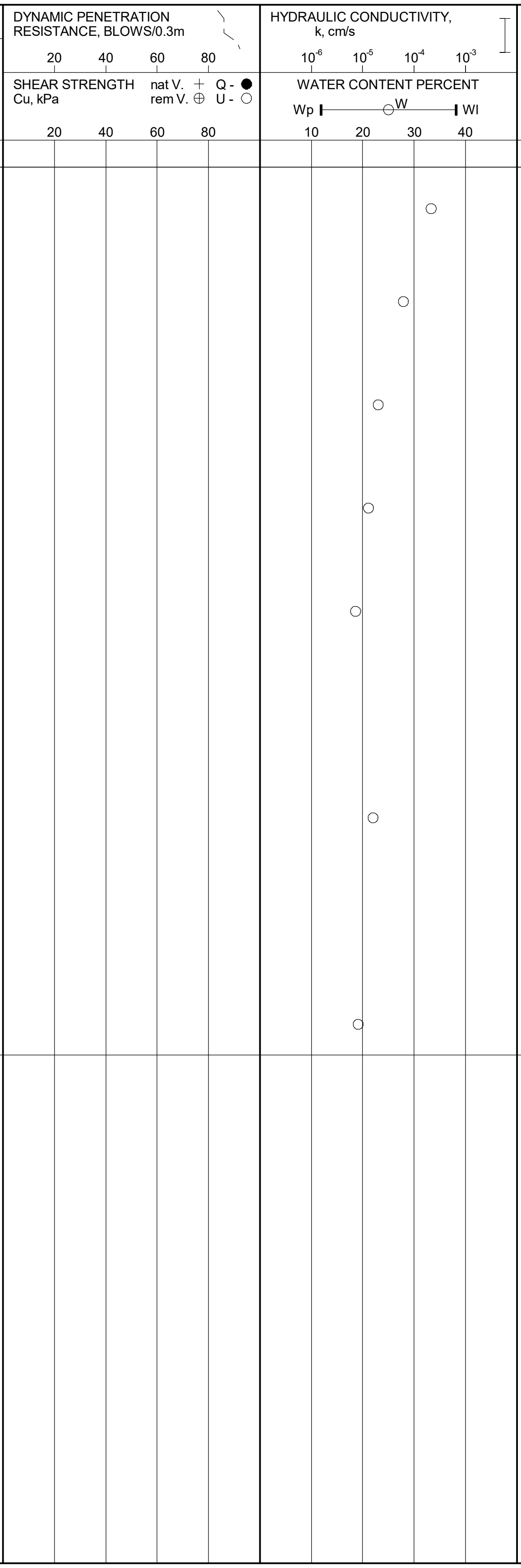
BORING DATE: March 8, 2017

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	186.92			
FILL - TOPSOIL	0.00			
FILL - (CL) SILTY CLAY, trace sand, trace to some gravel; brown, organic matter, rootlets; cohesive, w<PL, firm	0.15	1	SS	5
(CL) SILTY CLAY, some sand, trace to some gravel; brown, oxidation staining; cohesive, w>PL, stiff	186.24 0.69	2	SS	10
		3	SS	12
(SM) SILTY SAND; brown; non-cohesive, wet, loose to compact	184.79 2.13	4	SS	6
		5	SS	7
		6	SS	10
(SP) gravelly SAND, trace fines; brown, non-cohesive, wet, dense	181.36 5.56	7	SS	37
END OF BOREHOLE	180.37 6.55			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 08-MAR-17

Notes:

1. Borehole caved to a depth of 2.1 m below ground surface upon completion of drilling.

2. Groundwater measured at ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

LOGGED: AK

CHECKED: EW

GTA-BHS 001 \\GOLDER.GDS\GAL\SUDBURY\CAD-GIS\SIM\CLIENTS\SIXTEENTH_LAND_HOLDINGS_INC\YORK_DOWNS_GOLF_COURSE\02_DATA\GINT\1413472_2017.GPJ GAL-MIS.GDT 10/17/17 JJL/TB

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-135

BORING DATE: March 9, 2017

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES: 0 – 10

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Auger

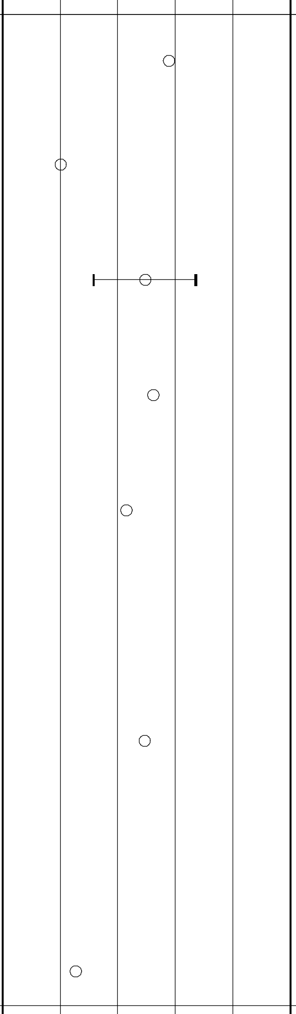
SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	187.58			
FILL - TOPSOIL	0.00			
FILL - (CL) SILTY CLAY, some sand, trace gravel; brown, organic matter; cohesive, w>PL, firm	187.28 0.30	1	SS	5
(CI) sandy SILTY CLAY, trace gravel; brown, oxidation staining; cohesive, w<PL to w>PL, firm to stiff	186.90 0.69	2	SS	10
		3	SS	8
		4	SS	13
(SP) SAND, some silt, trace gravel to SAND and GRAVEL; brown; non-cohesive, wet, loose to dense	184.69 2.90	5	SS	6
		6	SS	13
		7	SS	30
END OF BOREHOLE	181.03 6.55			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: ∇ 09-MAR-17

Notes:

1. Borehole caved to a depth of 2.1 m below ground surface upon completion of drilling.

2. Groundwater measured at a depth of 0.6 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

LOGGED: AK

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

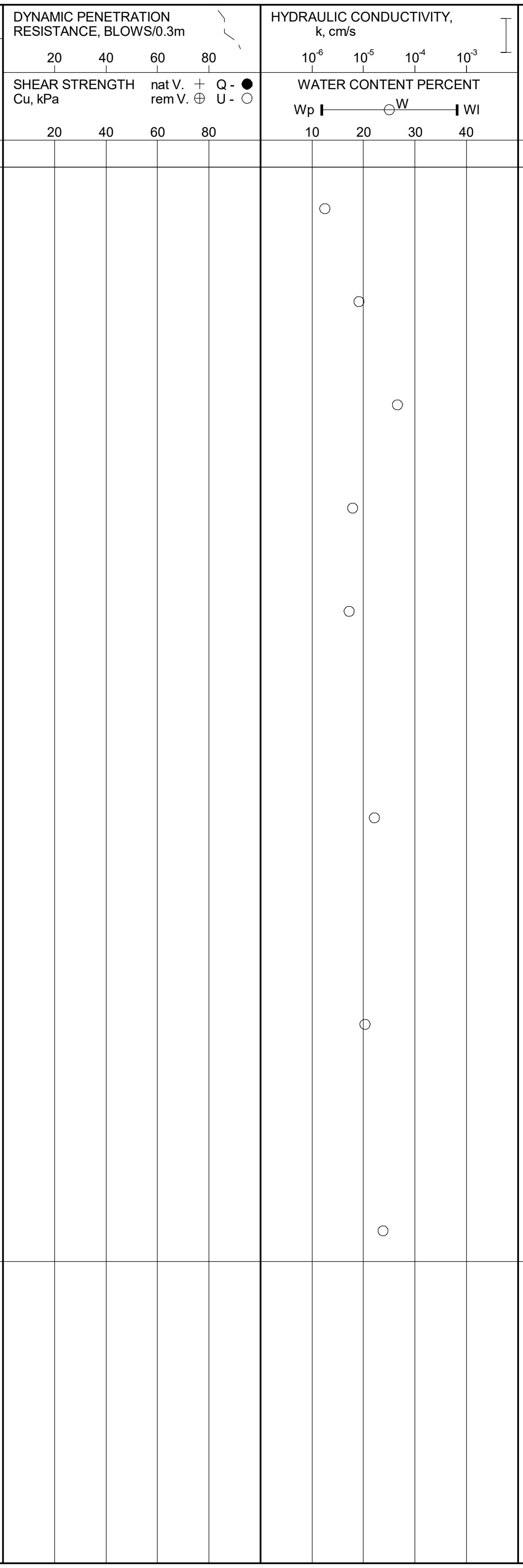
RECORD OF BOREHOLE: 17-136

BORING DATE: March 22, 2017

SHEET 1 OF 1

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		185.89					
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Augers	TOPSOIL		0.00					
		(ML) sandy SILT, trace gravel, trace clay; brown; non-cohesive, moist, loose		0.15	1	SS	9		
1		(CL) sandy SILTY CLAY, trace gravel; brown, mottled, organic staining; cohesive, w~PL, stiff to very stiff		185.21 0.69	2 3	SS SS	10 18		
2, 3		(CL) sandy SILTY CLAY, some gravel; brown, (TILL), sand seams; cohesive, w~PL, very stiff		183.76 2.13	4 5	SS SS	16 15		▽ 22-MAR-17
4, 5, 6, 7		(SP) SAND, some fines; brown to grey; non-cohesive, wet, compact -becoming grey at 6.1 m depth		181.85 4.04	6 7 8	SS SS SS	27 12 25		
8		END OF BOREHOLE		177.82 8.08					



Notes:

1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface.

2. Groundwater measured at a depth of 3.8 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: SEMP

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PROJECT: 1413472

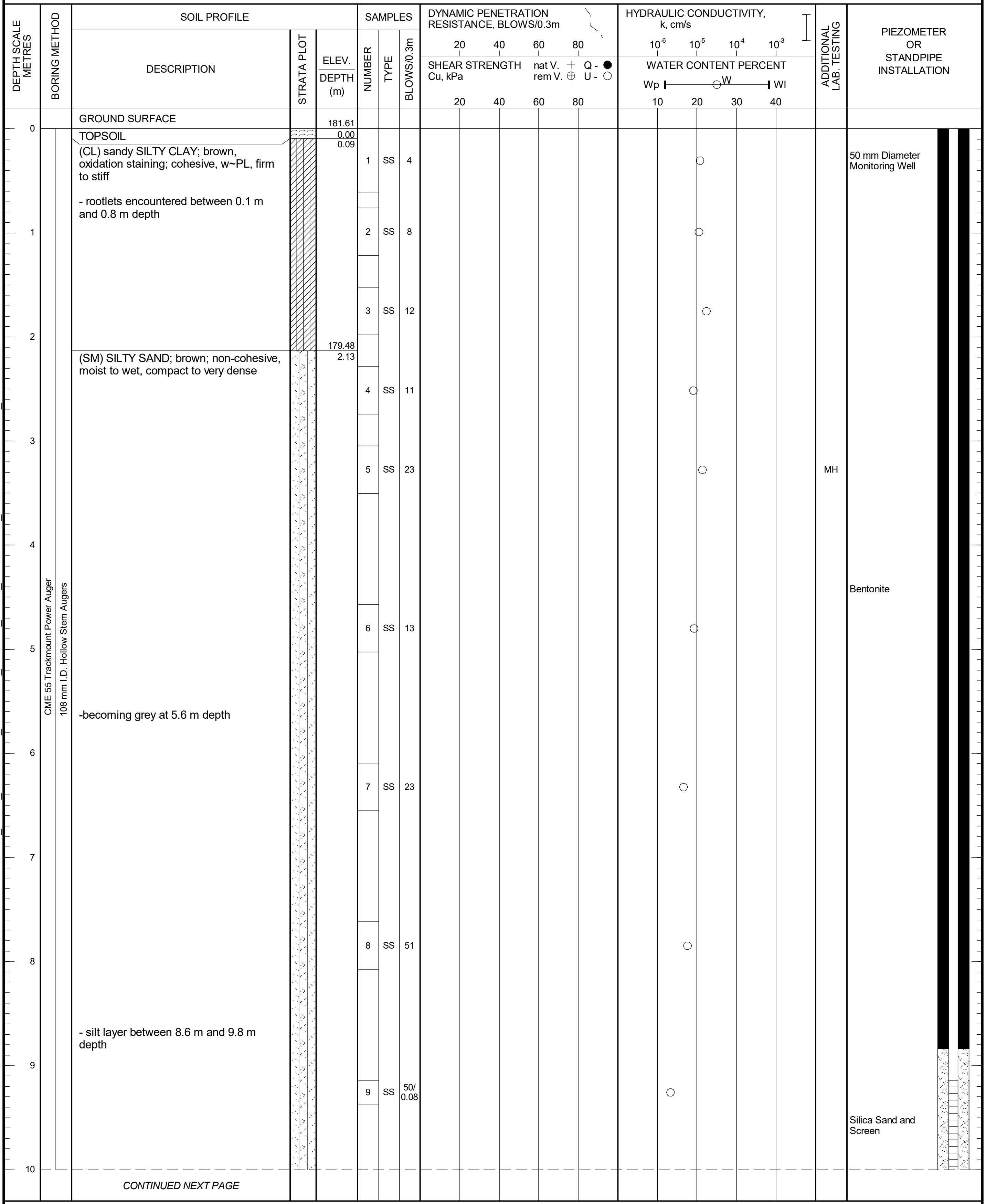
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-137

BORING DATE: March 22, 2017

SHEET 1 OF 2

DATUM: Geodetic



DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
		GROUND SURFACE	181.61				
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Augers	TOPSOIL	0.00				
		(CL) sandy SILTY CLAY; brown, oxidation staining; cohesive, w~PL, firm to stiff - rootlets encountered between 0.1 m and 0.8 m depth	0.09	1	SS	4	
1				2	SS	8	
				3	SS	12	
2		(SM) SILTY SAND; brown; non-cohesive, moist to wet, compact to very dense	179.48 2.13				
				4	SS	11	
3				5	SS	23	MH
4							
5				6	SS	13	
		-becoming grey at 5.6 m depth					
6				7	SS	23	
7							
8				8	SS	51	
		- silt layer between 8.6 m and 9.8 m depth					
9				9	SS	50/ 0.08	
10							

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-137

BORING DATE: March 22, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(SM) SILTY SAND; brown; non-cohesive, moist to wet, compact to very dense									Silica Sand and Screen
11				170.49	10	SS	84		○		
		END OF BOREHOLE		11.13							
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-138

BORING DATE: March 22, 2017

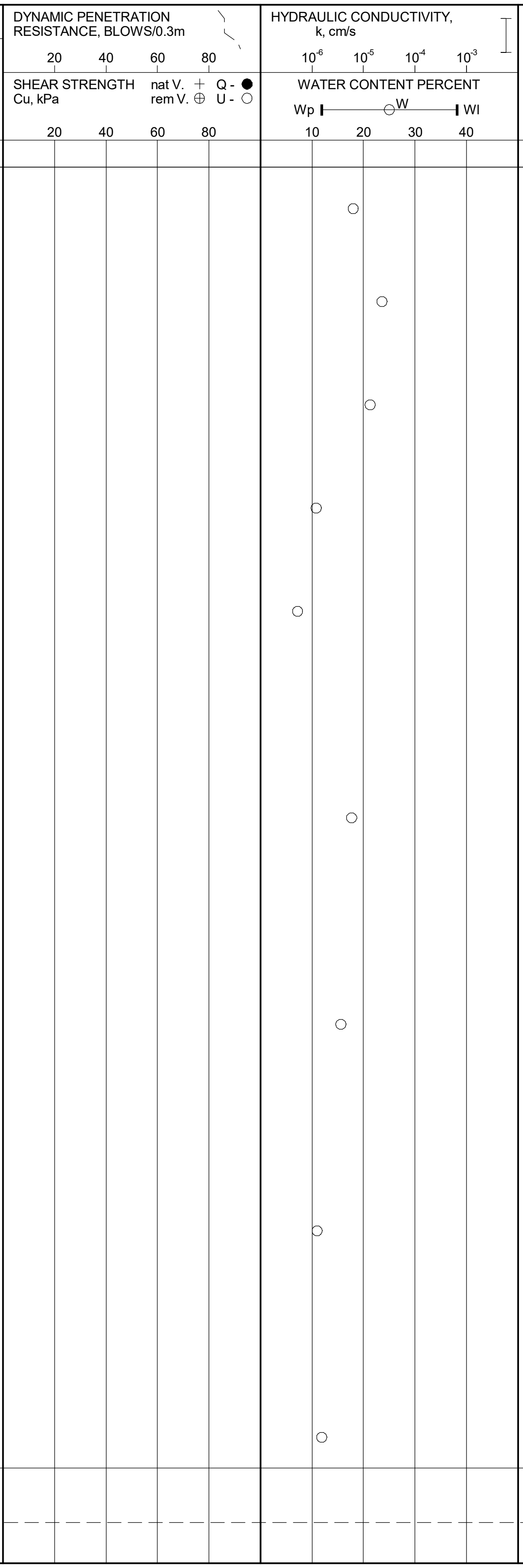
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

DESCRIPTION	ELEV.	DEPTH (m)
GROUND SURFACE	182.33	
TOPSOIL		0.00
(CL) sandy SILTY CLAY, some gravel; brown, oxidation staining; compact, w~PL to w>PL, firm to stiff -rootlets encounterd between 0.7 m and 0.9 m depth		0.15
(SM) SILTY SAND, some gravel; brown; non-cohesive, wet, compact	180.20	2.13
(ML) sandy SILT, some gravel; brown, (TILL); non-cohesive, moist, compact - auger grinding at 3.7 m depth on cobble or boulder	179.44	2.90
(SM) SILTY SAND; grey; non-cohesive, wet, compact to dense -becoming coarser with depth	178.29	4.04
END OF BOREHOLE	172.73	9.60

NUMBER	TYPE	BLOWS/0.3m
1	SS	6
2	SS	11
3	SS	15
4	SS	16
5	SS	21
6	SS	11
7	SS	17
8	SS	37
9	SS	25



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

∇ 22-MAR-17

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-138

BORING DATE: March 22, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 6.1 m below ground surface. 2. Borehole caved to a depth of 5.5 m below ground surface upon completion of drilling. 3. Groundwater measured at a depth of 4.6 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-139

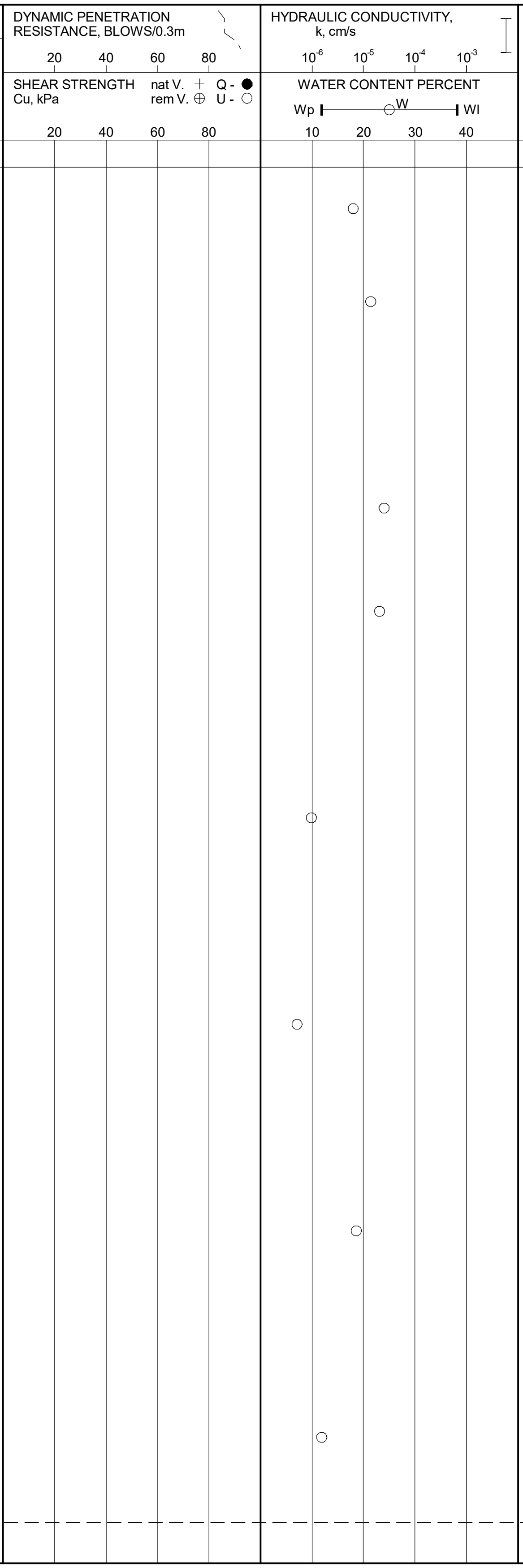
BORING DATE: March 23, 2017

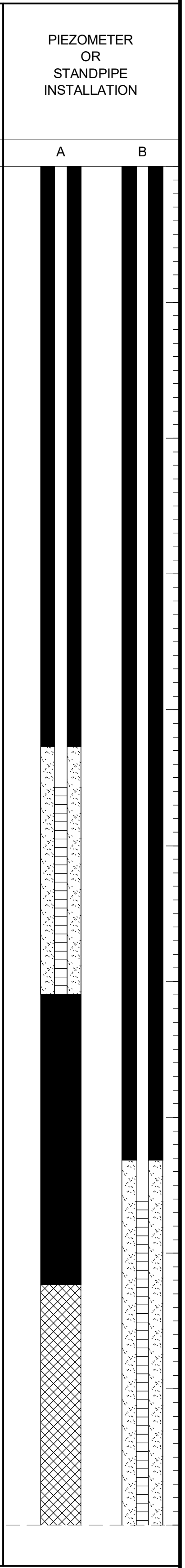
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	183.95			
0	TOPSOIL	0.00			
	(CL) SILTY CLAY, trace gravel; brown, organic matter, rootlets; w>PL, firm	0.14	1	SS	5
1			2	SS	7
	(CI) SILTY CLAY; brown; cohesive, w>PL, stiff	182.58 1.37	3	SS	10
2	- oxidation staining above 2.1 m depth. - becoming grey at of 2.1 m depth.		4	SS	8
3			5	SS	9
4	(ML) SILT, some sand, some gravel; grey, (TILL); non-cohesive, moist, compact	179.91 4.04			
5			6	SS	18
6			7	SS	30
7	(ML/SM) sandy SILT to SILTY SAND; grey; non-cohesive, wet, loose to compact - Samples 8 and 9 distured due to heaving sand	176.79 7.16			
8			8	SS	4
9			9	SS	7
10	*CONTINUED NEXT PAGE*				





DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: EW

PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-139

BORING DATE: March 23, 2017

SHEET 2 OF 2
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH Cu, kPa	WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---								A B
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Augers	(ML/SM) sandy SILT to SILTY SAND; grey; non-cohesive, wet, loose to compact								
11				10	SS	10		20		
			172.37 11.58							
12		(SP) gravelly SAND, some fines; grey; non-cohesive, wet, dense		11	SS	31		5	M	
			171.30 12.65							
13		END OF BOREHOLE								

Notes:

1. Groundwater encountered during drilling at a depth of 7.6 m below ground surface.

2. Groundwater measured at a depth of 5.2 m below ground surface upon completion of drilling.

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PT
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-140

BORING DATE: March 22 and 23, 2017

SHEET 1 OF 1

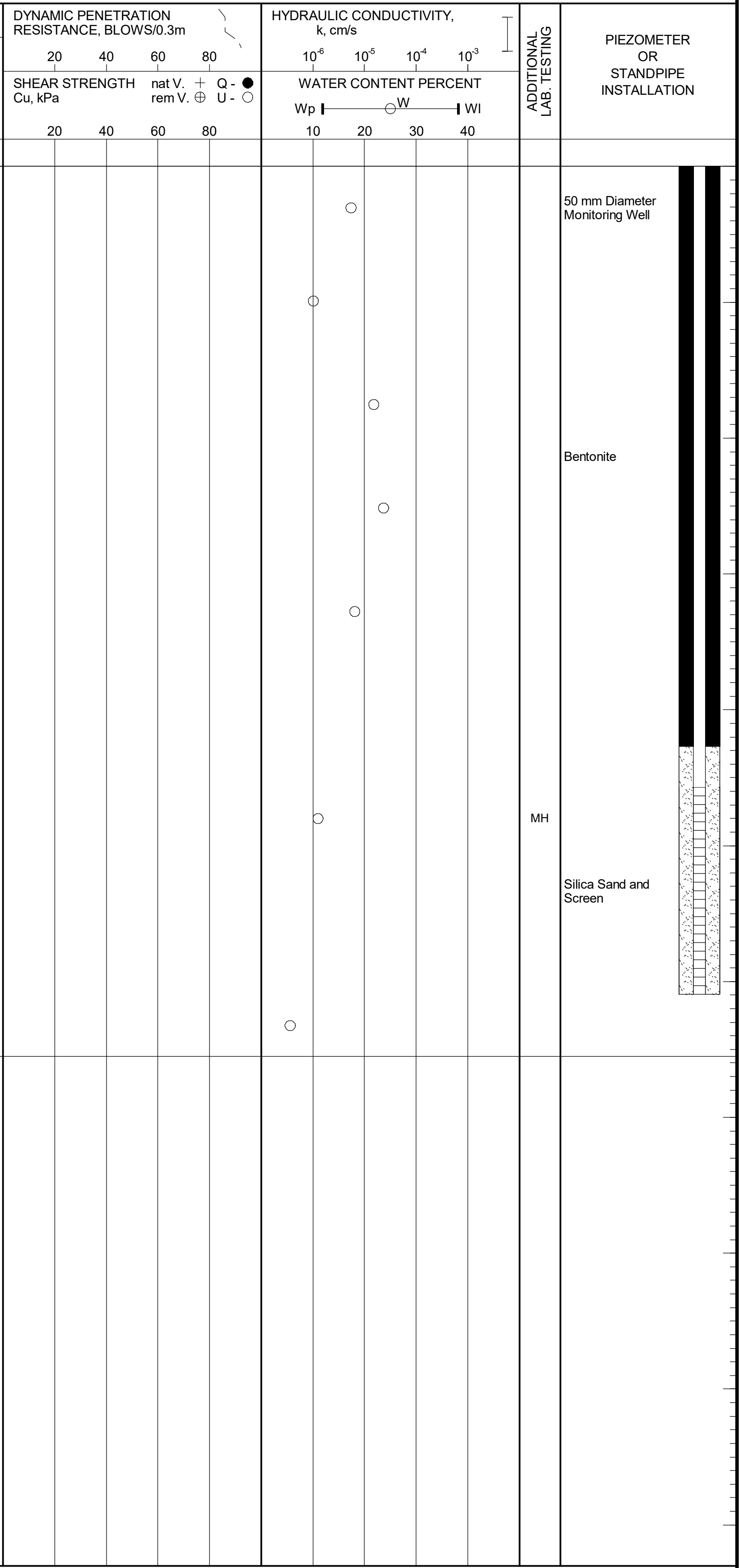
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	GROUND SURFACE		186.84				
0	TOPSOIL		0.00				
	(CL) SILTY CLAY to sandy SILTY CLAY; brown; cohesive, w~PL to w>PL, firm to very stiff		0.15	1	SS	4	
1				2	SS	11	
				3	SS	10	
2				4	SS	17	
3				5	SS	15	
4	(SM) gravelly SILTY SAND; grey, (TILL); non-cohesive, moist, compact to dense		182.80 4.04				
				6	SS	12	MH
5							
6				7	SS	35	
	END OF BOREHOLE		180.29 6.55				

Note:

1. Borehole open and dry upon completion of drilling.



DEPTH SCALE

1 : 50

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-141

BORING DATE: March 7, 2017

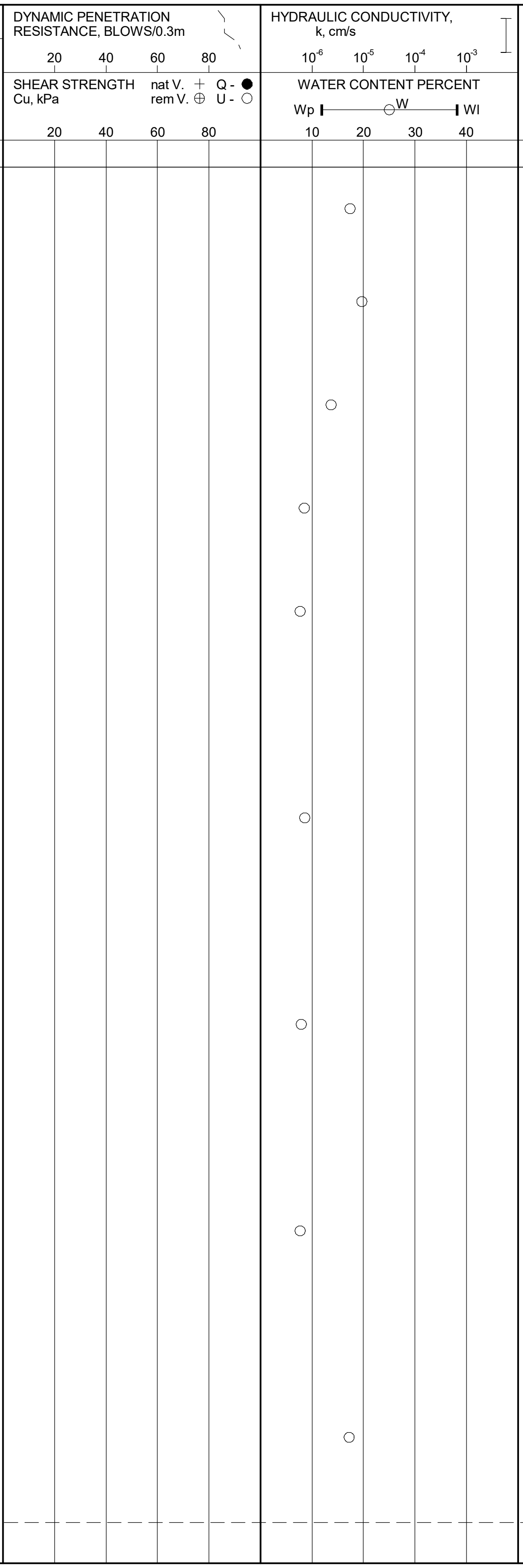
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger, 108 mm I.D. Hollow Stem Auger

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	190.16
TOPSOIL becoming (CL) SILTY CLAY; brown, rootlets; cohesive, w<PL, firm	0.00
(ML) sandy CLAYEY SILT, some gravel; brown, rootlets and organic matter to 1.4 m depth; cohesive, w~PL t w<PL, firm	189.48 0.69
(ML) sandy SILT, some gravel; grey; non-cohesive, moist, compact to dense - auger grinding at 2.7 m depth on cobble or boulder - becoming grey at 3.4 m depth - auger grinding at 5.2 m depth on cobble or boulder	188.03 2.13
(SP) SAND, some fines, trace gravel; grey; non-cohesive, wet, very loose to dense - Samples 9 and 11 disturbed due to heaving sand	181.63 8.53

NUMBER	TYPE	BLOWS/0.3m
1	SS	6
2	SS	7
3	SS	7
4	SS	28
5	SS	22
6	SS	13
7	SS	32
8	SS	17
9	SS	WH



PIEZOMETER OR STANDPIPE INSTALLATION: ∇ 08-MAR-17

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DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AP

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

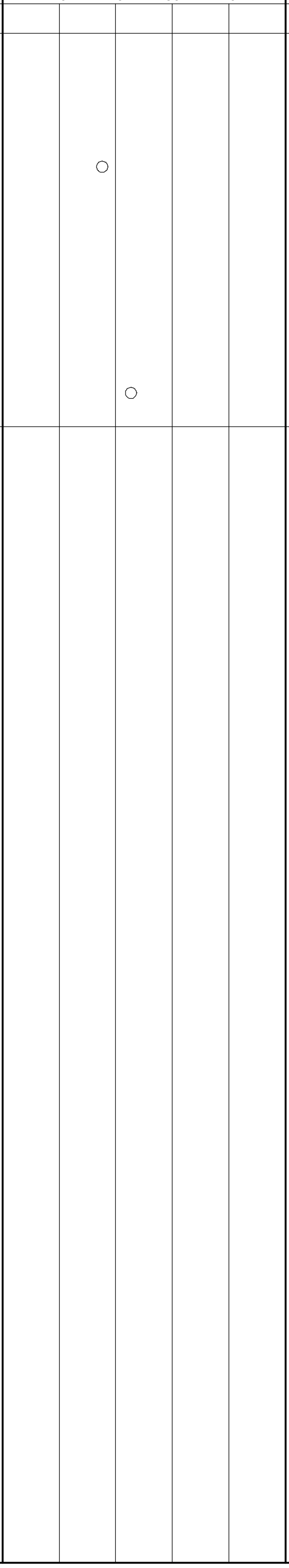
RECORD OF BOREHOLE: 17-141

BORING DATE: March 7, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ├──○W──┤ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	(SP) SAND, some fines, trace gravel; grey; non-cohesive, wet, very loose to dense									
11					10	SS	26		○		
12		- becoming coarser at 11.7 m depth									
					11	SS	-		○		
		END OF BOREHOLE		177.51 12.65							
13		Notes: 1. Groundwater encountered during drilling at a depth of 9.1 m below ground surface. 2. Borehole caved to a depth of 9.3 m below ground surface upon completion of drilling.									
14											
15											
16											
17											
18											
19											
20											



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AP

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-142

BORING DATE: March 8, 2017

SHEET 1 OF 2

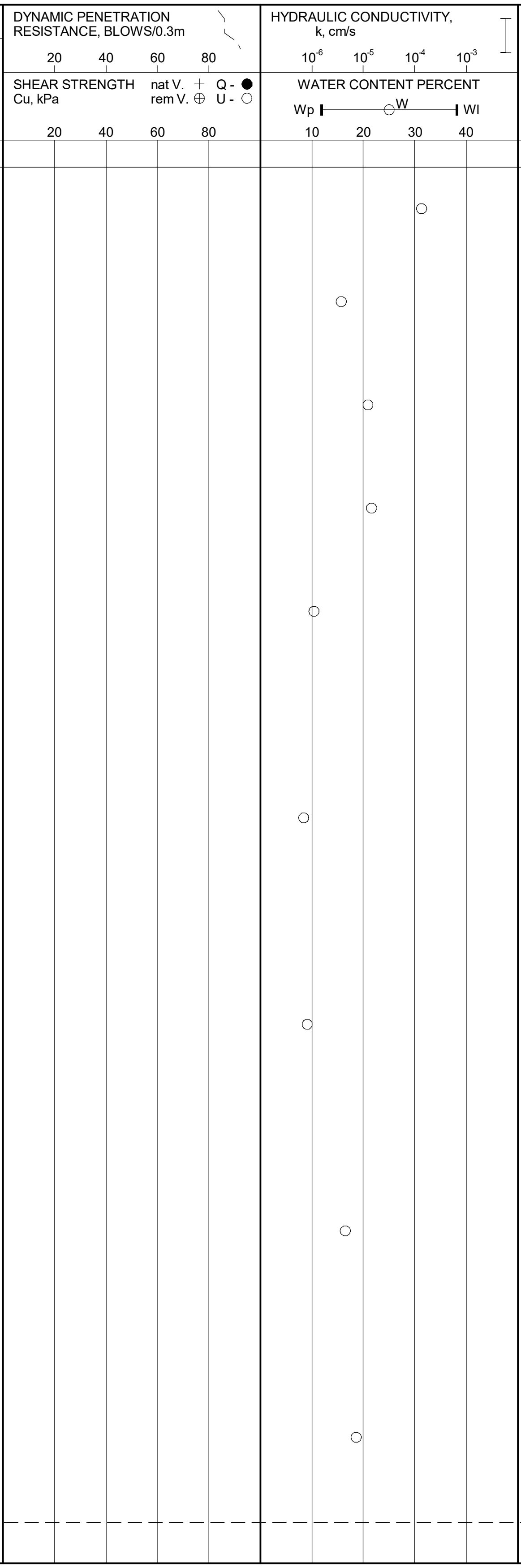
DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	191.71
TOPSOIL	0.00
(CL) sandy SILTY CLAY, trace gravel; brown, organic matter, rootlets; cohesive, w>PL to w<PL, stiff	191.53 0.18
(ML) sandy SILT; brown, oxidation staining; non-cohesive, wet, compact - 2 mm sand seam encountered at 1.8 m depth	190.34 1.37
(ML) sandy SILT, some gravel; brown, (TILL); non-cohesive, moist, compact to dense - becoming grey at 4.0 m depth	188.82 2.90
(SM) SILTY SAND, trace gravel; grey; non-cohesive, wet, compact to dense - Sample 8 disturbed due to heaving sand	184.62 7.09

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	SS	8	
2	SS	11	
3	SS	10	
4	SS	13	
5	SS	19	
6	SS	15	
7	SS	31	
8	SS	10	MH
9	SS	22	

PIEZOMETER OR STANDPIPE INSTALLATION: ▽ 08-MAR-17



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DEPTH SCALE

1 : 50

LOGGED: AK

CHECKED: EW

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PROJECT: 1414472

RECORD OF BOREHOLE: 17-142

LOCATION: SEE FIGURE 1

BORING DATE: March 8, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ├─○W─┤ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	(SM) SILTY SAND, trace gravel; grey; non-cohesive, wet, compact to dense									
11					10	SS	33		○		
12					11	SS	53		○		
				179.06 12.65							
		END OF BOREHOLE									
13		Notes:									
		1. Borehole caved to a depth of 9.8 m below ground surface upon completion of drilling.									
		2. Groundwater measured at a depth of 5.8 m below ground surface upon completion of drilling.									
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AK

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-143

BORING DATE: March 22, 2017

SHEET 1 OF 1

DATUM: Geodetic

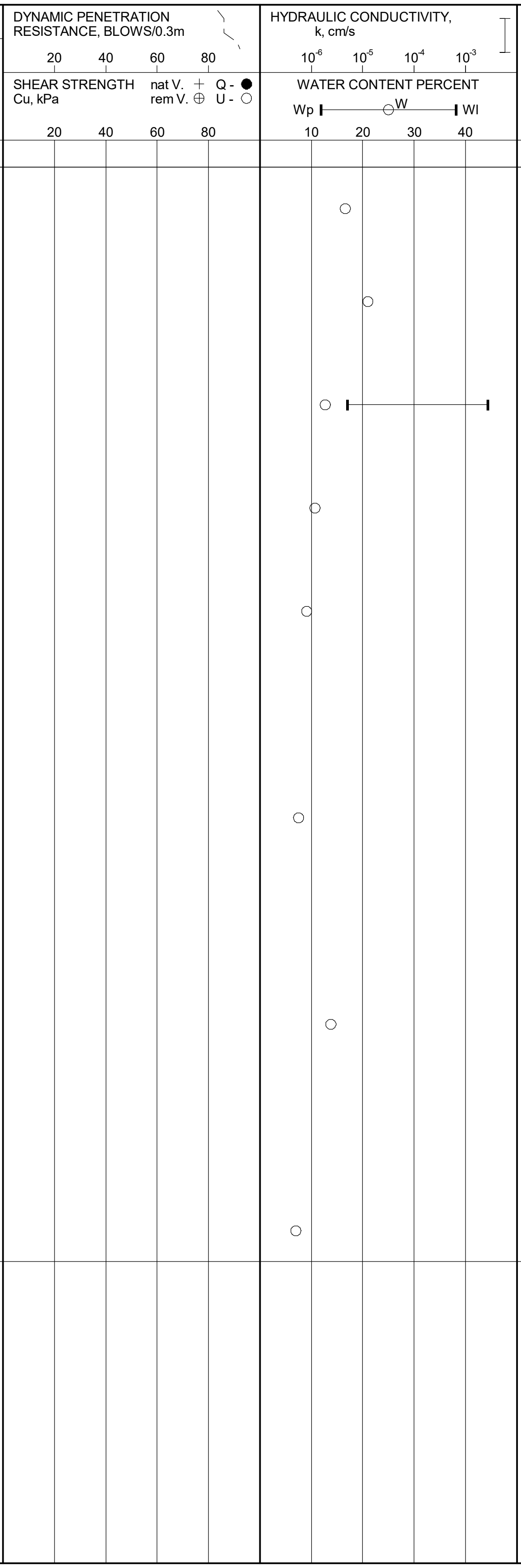
BORING METHOD: CME 55 Trackmount Power Auger, 108 mm I.D. Hollow Stem Augers

SOIL PROFILE

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	184.50
FILL - (CL) SILTY CLAY, some sand; brown, organic matter, rootlets; cohesive, w>PL, firm	0.00
(CI) SILTY CLAY, some sand; brown, oxidation staining; cohesive, w<PL, stiff to firm	183.82 0.69
(ML) sandy SILT, some gravel; grey, (TILL); non-cohesive, moist, compact	181.61 2.90
(SM) SILTY SAND; grey; non-cohesive, wet, dense	178.94 5.56
(ML) sandy CLAYEY SILT, some gravel; grey, (TILL); cohesive, w<PL, hard	177.42 7.09
END OF BOREHOLE	176.43 8.08

SAMPLES

NUMBER	TYPE	BLOWS/0.3m
1	SS	7
2	SS	10
3	SS	14
4	SS	7
5	SS	15
6	SS	17
7	SS	32
8	SS	39



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: ▽ 22-MAR-17

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

Notes:

1. Borehole caved to a depth of 7.0 m below ground surface upon completion of drilling.

2. Groundwater measured at a depth of 6.1 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

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PROJECT: 1413472
LOCATION: SEE FIGURE 1

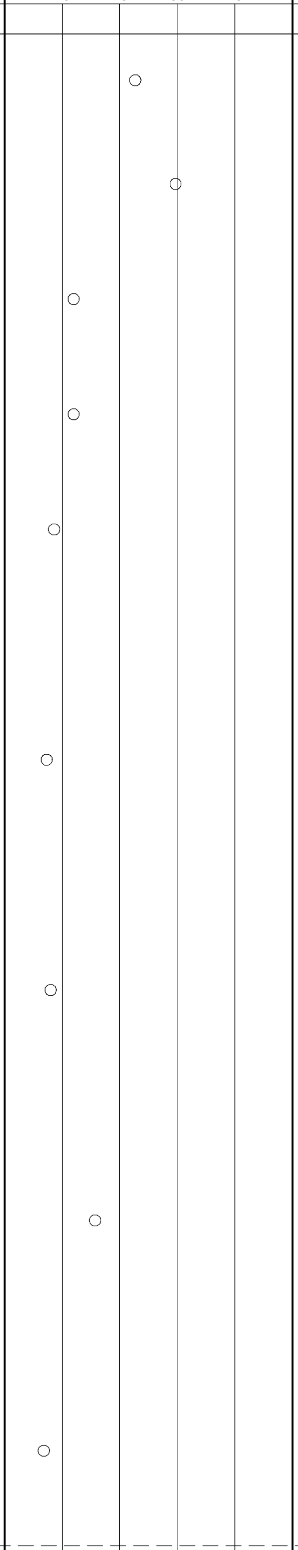
RECORD OF BOREHOLE: 17-144

BORING DATE: March 22, 2017

SHEET 1 OF 2
DATUM: Geodetic

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl 10 20 30 40

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	184.17				
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Augers	TOPSOIL	0.00				
		(CI) SILTY CLAY, trace to some sand; brown, mottled, oxidation staining; cohesive, w~PL to w>PL, firm to very stiff	0.14	1	SS	6	
1				2	SS	10	
				3	SS	18	
2		(ML) sandy CLAYEY SILT, some gravel; brown to grey, (TILL); cohesive, w<PL, very stiff - auger grinding at 2.2 m depth on cobble or boulder	182.04 2.13	4	SS	18	
3				5	SS	15	
4		(ML) sandy SILT, some gravel; grey, (TILL); non-cohesive, moist, compact to dense	180.13 4.04				
5				6	SS	21	
6				7	SS	28	
7		- 0.45 m grey, wet, silty sand layer at 7.6 m depth		8	SS	16	
8		- auger grinding at 8.5 m depth on cobble or boulder					▽ 22-MAR-17
9				9	SS	38	
10		*CONTINUED NEXT PAGE*					



DEPTH SCALE
1 : 50

LOGGED: MB
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-144

BORING DATE: March 22, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10				174.04 10.13							
		(SP) gravelly SAND; grey; non-cohesive, wet, dense			10	SS	36		○		
11				173.05 11.13							
		END OF BOREHOLE									
12											
13											
14											
15											
16											
17											
18											
19											
20											

Notes:

1. Borehole caved to a depth of 9.8 m below ground surface upon completion of drilling.

2. Groundwater measured at a depth of 8.5 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

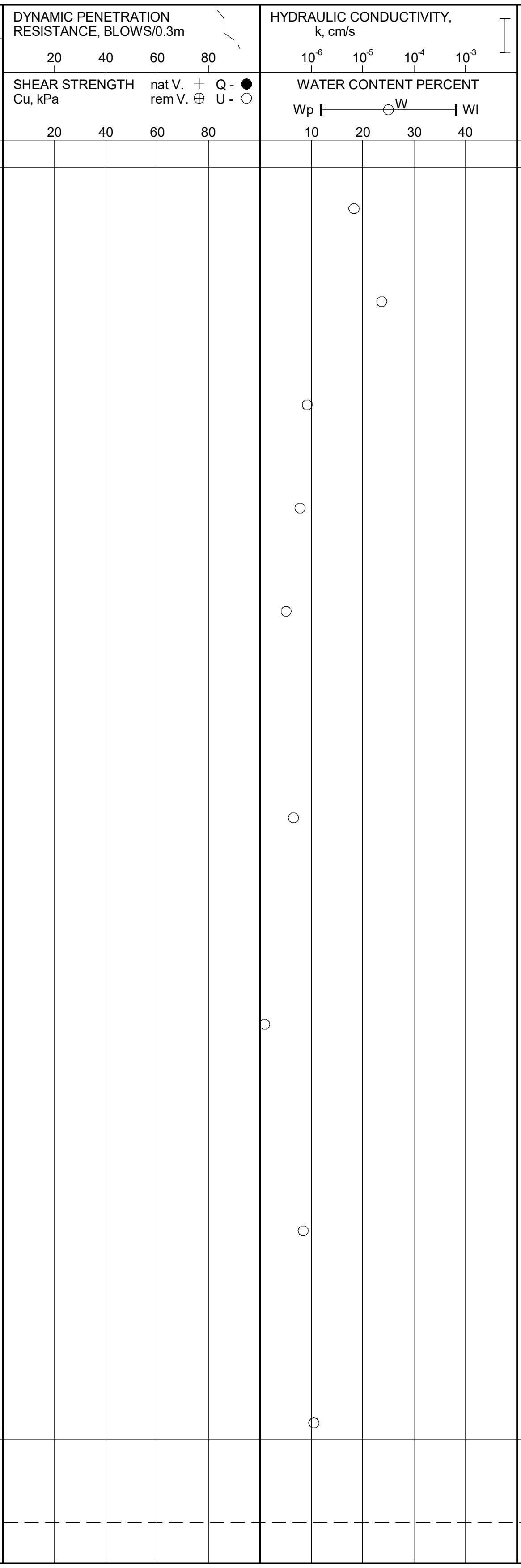
PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-145

BORING DATE: March 23, 2017

SHEET 1 OF 2
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		192.75					
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	FILL - OPSOIL		0.00					
		FILL - (CL) sandy SILTY CLAY; brown, rootlets; cohesive, w~PL, firm		192.57 0.18	1	SS	7		
1		(CL) SILTY CLAY, some sand; brown, rootlets; cohesive, w>PL, firm		192.06 0.69	2	SS	4		
2		(ML) sandy SILT, some gravel; brown, oxidation staining, (TILL); non-cohesive, moist, compact		191.38 1.37	3	SS	10		
					4	SS	17		
3		(CL) SILTY CLAY, some sand, some gravel; grey, (TILL); cohesive, w<PL, hard		189.86 2.90	5	SS	62		
4		- auger grinding between 4.3 m and 4.6 m on boulder							
5		- auger grinding between 4.6 m and 5.5 m on boulder			6	SS	49		
6					7	SS	54		
7									
8					8	SS	65/ 0.28		
		- SPT hammer bouncing at 8.1 m depth							
9					9	SS	50/ 0.10		
		END OF BOREHOLE		183.36 9.39					
10									



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DEPTH SCALE
1 : 50

LOGGED: PT
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-145

BORING DATE: March 23, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Borehole caved to a depth of 7.9 m below ground surface upon completion of drilling. 2. Borehole dry upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-146

BORING DATE: March 7, 2017

SHEET 1 OF 1

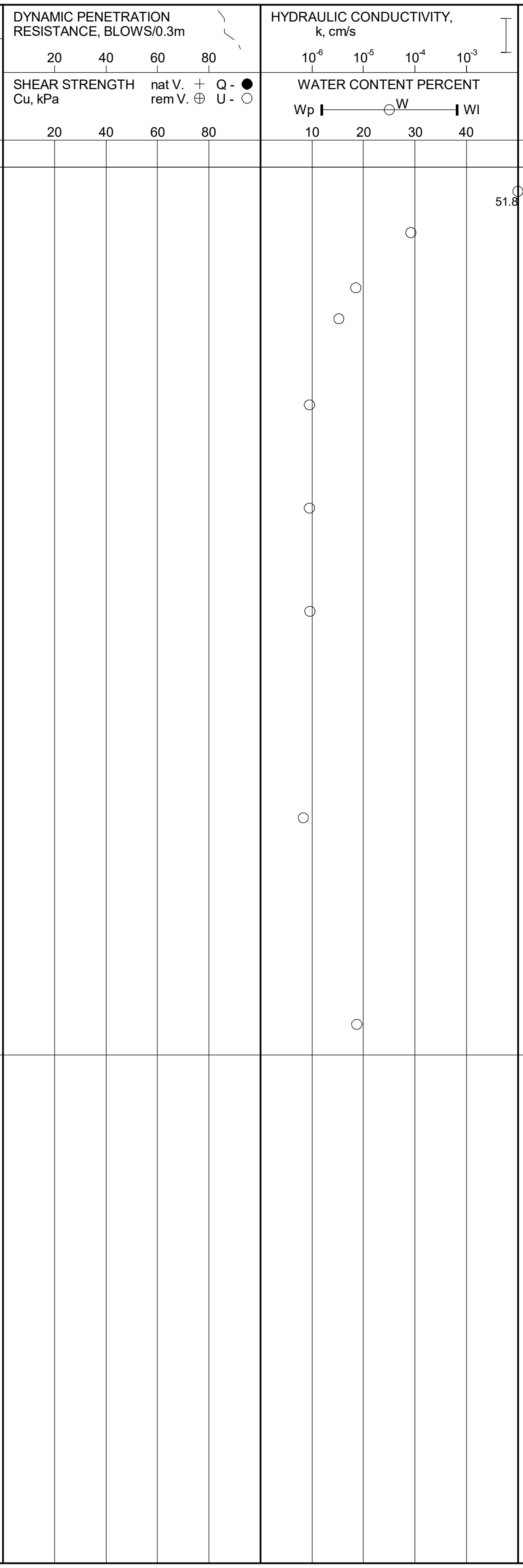
DATUM: Geodetic

DEPTH SCALE METRES: 0 – 10

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	195.79
TOPSOIL	0.00
(CL) SILTY CLAY, trace sand, trace gravel; brown; cohesive, w>PL to w~PL, firm to stiff	195.44 0.35
(ML) sandy SILT, trace gravel; brown; non-cohesive, moist, compact - becoming grey at 2.4 m depth - sand and gravel seam at 3.4 m depth	194.77 1.01
(SM) SAND; grey; non-cohesive, wet, dense	190.23 5.56
END OF BOREHOLE	189.24 6.55

NUMBER	TYPE	BLOWS/0.3m
1A	SS	6
1B		
2A	SS	13
2B		
3	SS	19
4	SS	21
5	SS	21
6	SS	24
7	SS	32



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 07-MAR-17

Notes:

1. Groundwater encountered during drilling at a depth of 3.4 m below ground surface.

2. Borehole caved to a depth of 4.1 m below ground surface upon completion of drilling.

3. Groundwater measured at a depth of 2.3 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AP

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-147

BORING DATE: March 24, 2017

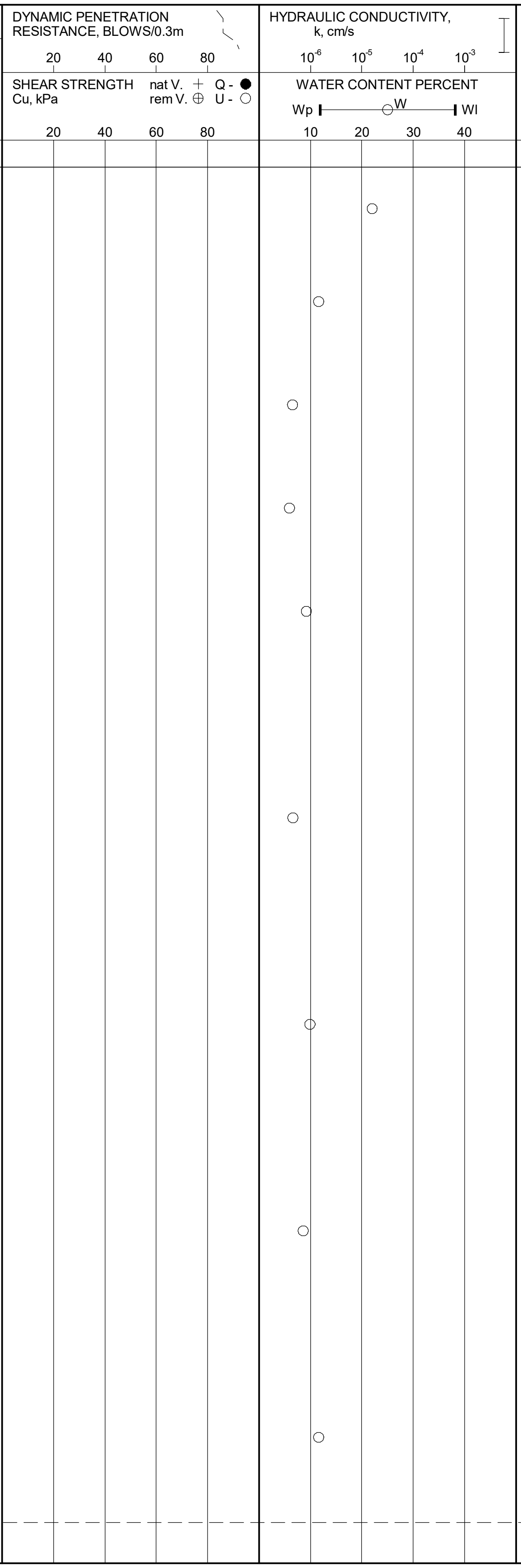
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger, 108 mm I.D. Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	194.62
FILL - TOPSOIL	0.00
FILL - (CL) SILTY CLAY, some sand, trace gravel; brown, rootlets, organic matter; cohesive, firm	0.15
(CL) sandy SILTY CLAY, trace gravel; light brown; non-cohesive, wet, dense	193.93 0.69
(CL-ML) SILTY CLAY to CLAYEY SILT, some sand, trace to some gravel; brown, (TILL); cohesive, w<PL, very stiff to hard - oxidation staining above 2.0 m depth - becoming grey at 2.3 m depth	193.27 1.35

NUMBER	TYPE	BLOWS/0.3m
1	SS	6
2	SS	48
3	SS	41
4	SS	62
5	SS	26
6	SS	46
7	SS	65
8	SS	34
9	SS	46



PIEZOMETER OR STANDPIPE INSTALLATION:
50 mm Diameter Monitoring Well
Bentonite
Silica Sand and Screen

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

LOGGED: MB
CHECKED: EW

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PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-147

BORING DATE: March 24, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(CL-ML) SILTY CLAY to CLAYEY SILT, some sand, trace to some gravel; brown, (TILL); cohesive, w<PL, very stiff to hard									Silica Sand and Screen
11					10	SS	66		○		
				183.49 11.13							
		END OF BOREHOLE Note: 1. Groundwater encountered during drilling at a depth of 0.8 m below ground surface.									
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-148

BORING DATE: March 24, 2017

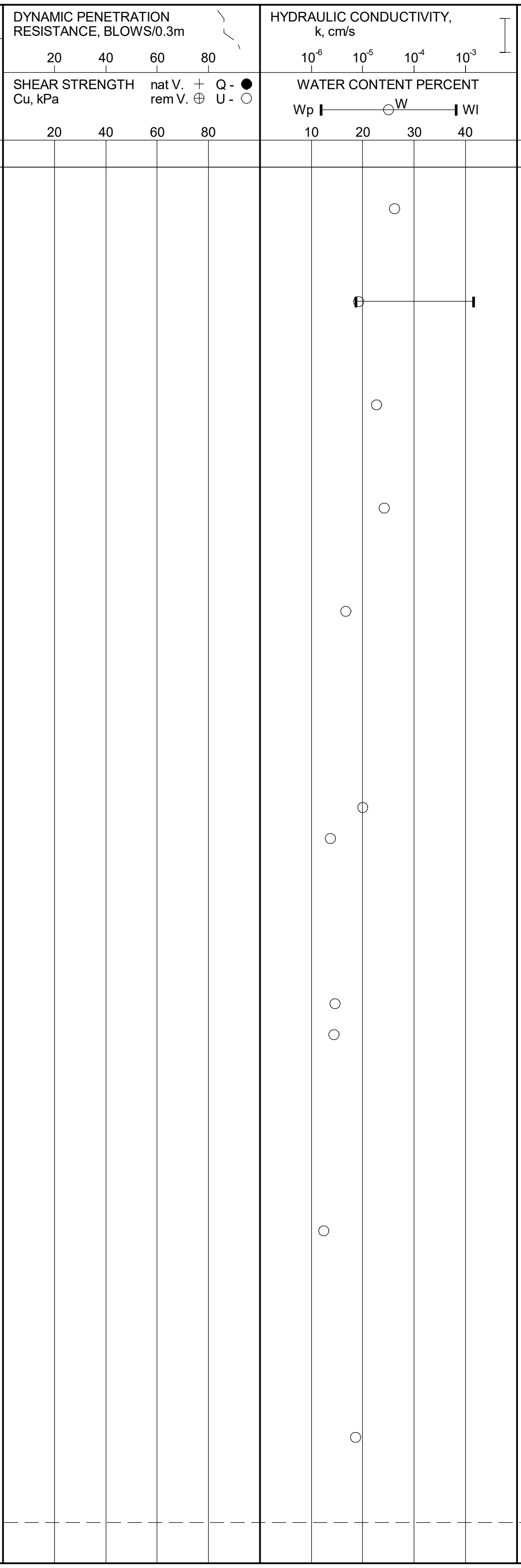
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Augers

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	193.20
FILL - TOPSOIL	0.00
FILL - (CI) SILTY CLAY; brown, organic matter, oxidation staining; cohesive, w>PL to w~PL, firm	0.09
(CL) SILTY CLAY, trace sand, trace gravel; brown, (TILL), oxidation staining; cohesive, w>PL to w<PL, stiff	191.07 2.13
(SP) SAND, trace fines; grey; non-cohesive, wet, dense	189.16 4.04
(CL) SILTY CLAY, trace sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	188.32 4.88
(SP) SAND, trace fines; grey; non-cohesive, wet, very dense	187.56 5.64
(CL) SILTY CLAY, trace sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	186.95 6.25

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	SS	7
2	SS	6
3	SS	6
4	SS	12
5	SS	9
6A 6B	SS	45
7A 7B	SS	73
8	SS	86
9	SS	62



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-148

BORING DATE: March 24, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80; SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3}; WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		(CL) SILTY CLAY, trace sand, trace gravel; grey, (TILL); cohesive, w<PL, hard	▨								
11					10	SS	61		○		
				182.08 11.13							
		END OF BOREHOLE									
12											
13											
14											
15											
16											
17											
18											
19											
20											

Notes:

1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface.

2. Borehole caved to a depth of 4.6 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PT

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-149

BORING DATE: March 7, 2017

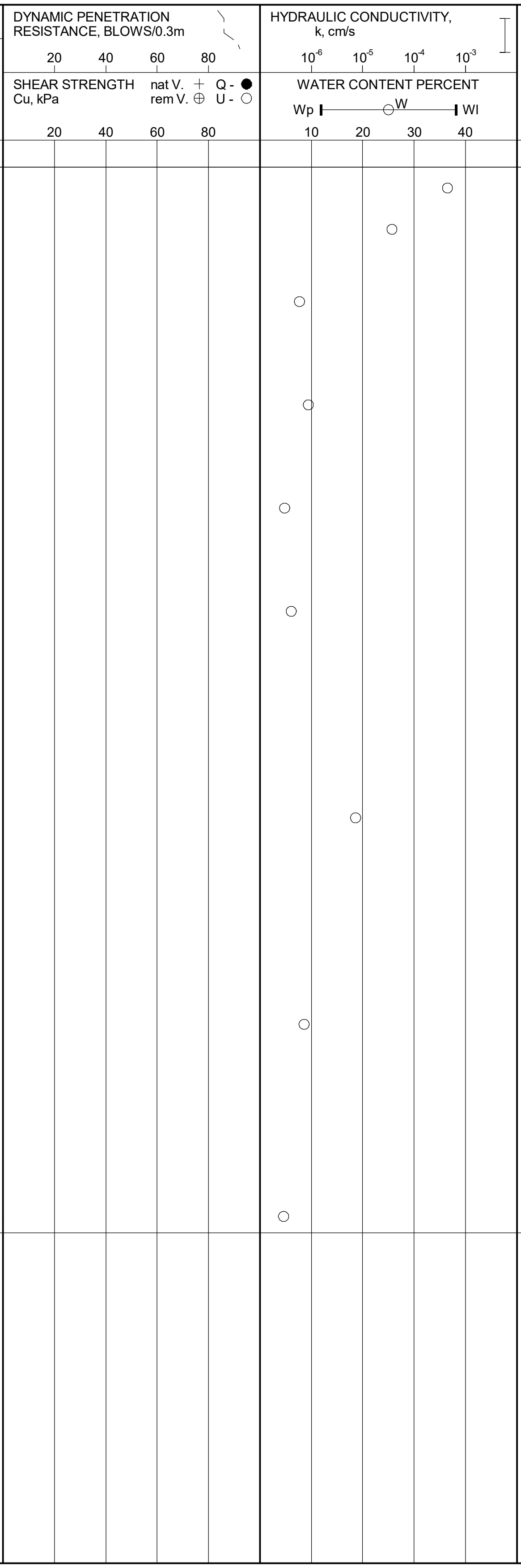
SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger; 108 mm I.D. Hollow Stem Auger

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	196.63
TOPSOIL	0.00
(CL) SILTY CLAY, some sand, some gravel; brown, rootlets; cohesive, w~PL, firm	196.32 0.30
(ML) sandy SILT, some gravel, some to trace plastic fines; brown, (TILL); non-cohesive, moist, compact to very dense - becoming grey at 1.8 m depth -auger grinding at 2.0 m depth on cobble or boulder -auger grinding at 3.7 m depth on cobble or boulder	195.94 0.69
(ML) SILT, some sand; grey; non-cohesive, moist, dense	192.59 4.04
(ML) sandy SILT, some gravel; grey, (TILL); non-cohesive, moist, dense to very dense - auger grinding at 6.7 m depth on cobble or boulder	191.07 5.56
END OF BOREHOLE	188.77 7.86

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1A	SS	7
1B		
2	SS	21
3	SS	11
4	SS	26
5	SS	34
6	SS	45
7	SS	45
8	SS	50/ 0.10



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: ▽ 07-MAR-17

Notes:

1. Borehole caved to a depth of 5.2 m below ground surface upon completion of drilling.

2. Groundwater measured at a depth of 3.4 m below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AP

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

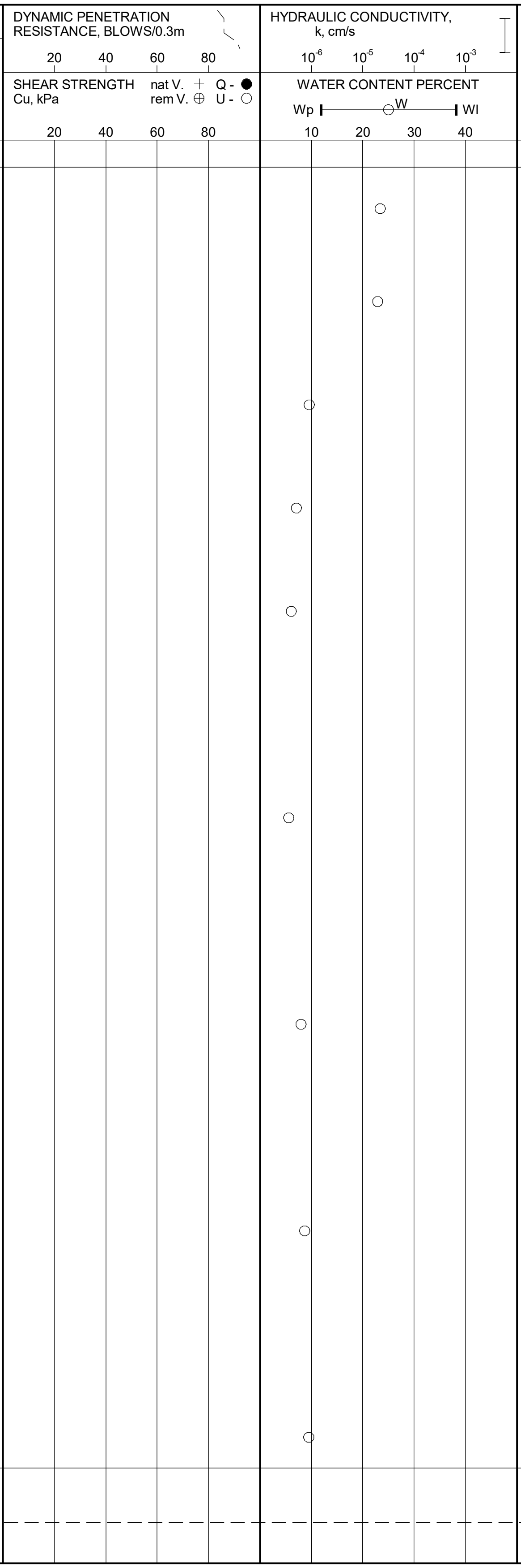
RECORD OF BOREHOLE: 17-150

BORING DATE: March 24, 2017

SHEET 1 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		195.80			
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	FILL - (CL) SILTY CLAY, some sand; brown; cohesive, w>PL, firm	▨	0.00	1	SS	4
		(CL) SILTY CLAY, some sand; brown, oxidation staining; cohesive, w>PL, stiff	▨	195.11 0.69	2	SS	14
		(ML) sandy SILT, some gravel; brown, (TILL); moist, compact to very dense	▨	194.43 1.37	3	SS	25
		- oxidation staining abve 2.1 m depth					
		- becoming grey at 2.1 m depth			4	SS	56
3					5	SS	50/ 0.10
4–5					6	SS	50/ 0.13
6					7	SS	46
8					8	SS	77
9					9	SS	74
		END OF BOREHOLE		186.20 9.60			
10							



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

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DEPTH SCALE

1 : 50

LOGGED: MB

CHECKED: EW

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PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-150

BORING DATE: March 24, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ├──○W──┤ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Borehole caved to a depth of 8.2 m below ground surface upon completion of drilling. 2. Borehole dry upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472
LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-151

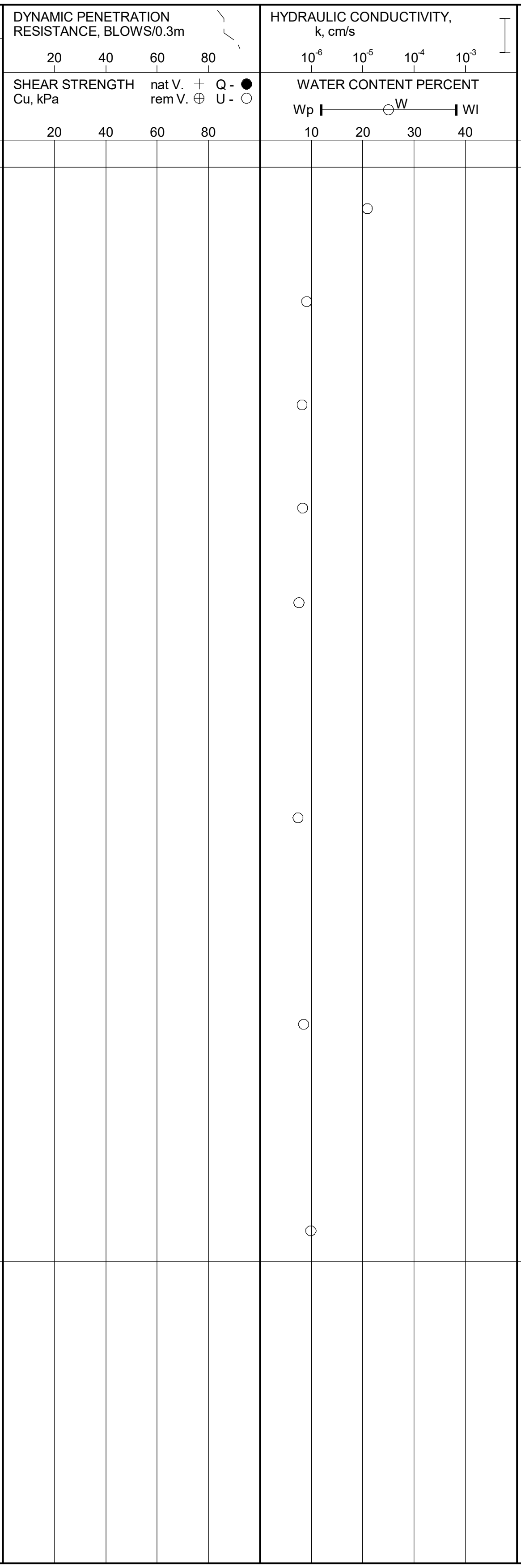
BORING DATE: March 23, 2017

SHEET 1 OF 1
DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		196.11			
0	CME 55 Trackmount Power Auger 108 mm I.D. Hollow Stem Auger	(CL) sandy SILTY CLAY; dark brown, organic matter, rootlets; cohesive, w~PL, firm		0.00	1	SS	5
		(CL-ML) sandy SILTY CLAY to sandy CLAYEY SILT; brown, (TILL); cohesive, w<PL, very stiff to hard		195.42 0.69	2	SS	16
1					3	SS	22
2					4	SS	32
3					5	SS	75/ 0.18
4		- becoming grey at 4.0 m depth			6	SS	57
6					7	SS	60
7		- sand seams below 7.6 m depth			8	SS	50
8		END OF BOREHOLE		188.03 8.08			

Note:

1. Borehole open and dry upon completion of drilling.



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

LOGGED: MB
CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-152

BORING DATE: March 24, 2017

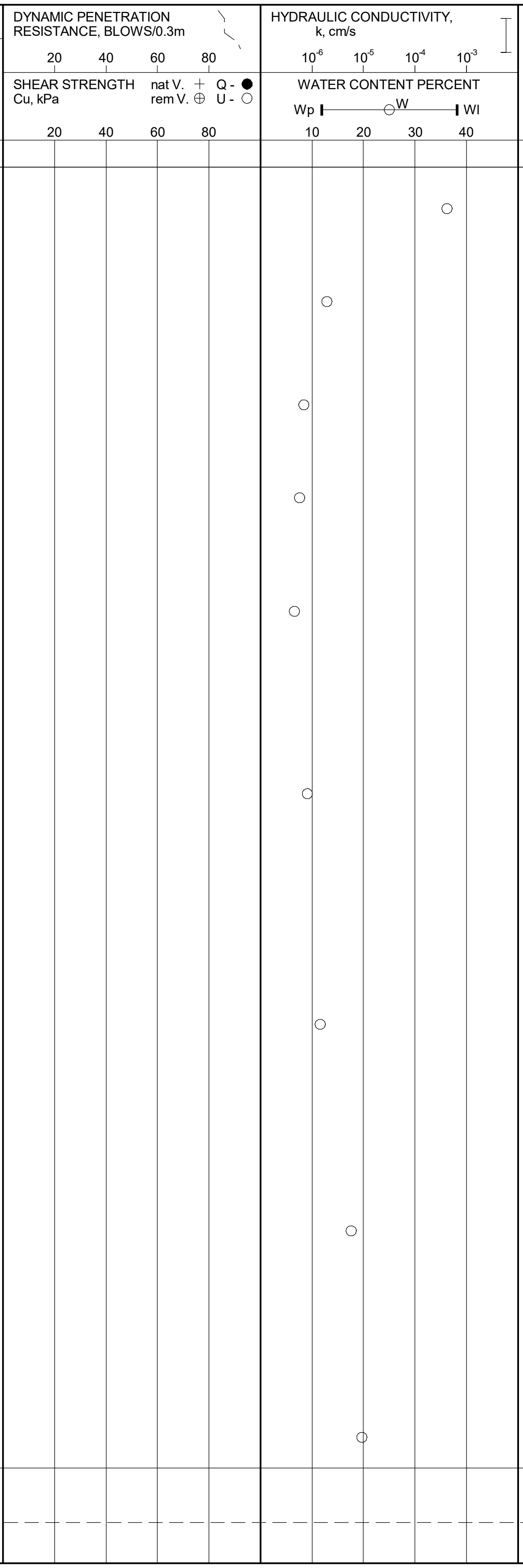
SHEET 1 OF 2

DATUM: Geodetic

BORING METHOD: CME 55 Trackmount Power Auger
108 mm I.D. Hollow Stem Auger

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	192.26
FILL - (CL) sandy SILTY CLAY; brown, rootlets, organic matter; cohesive, w>PL, firm	0.00
(CL-ML) SILTY CLAY to SILTY CLAYEY SILT, some sand, some gravel; brown, oxidation staining; cohesive, w<PL, stiff	191.57 0.69
(ML) Sandy SILT, some gravel, (TILL); non-cohesive, moist, very dense - auger grinding at 2.7 m depth on cobble or boulder	190.13 2.13
(SM) SILTY SAND, trace gravel; (TILL); non-cohesive, moist, dense to very dense	189.52 2.74
END OF BOREHOLE	182.66 9.60

NUMBER	TYPE	BLOWS/0.3m
1	SS	4
2	SS	9
3	SS	8
4	SS	50/ 0.13
5	SS	65
6	SS	50/ 0.10
7	SS	39
8	SS	56
9	SS	35



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

▽ 24-MAR-17

DEPTH SCALE METRES: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

PROJECT: 1413472

LOCATION: SEE FIGURE 1

RECORD OF BOREHOLE: 17-152

BORING DATE: March 24, 2017

SHEET 2 OF 2

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Notes: 1. Groundwater encountered during drilling at a depth of 4.6 m below ground surface. 2. Borehole caved to a depth of 7.3 m below ground surface upon completion of drilling. 3. Groundwater measured at a depth of 4.6 m below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: MB

CHECKED: EW

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix C

Grain-Size Analysis

Appendix C

TABLE C-1:
4134 16th Avenue, Markham
Summary of Grain-size Analyses

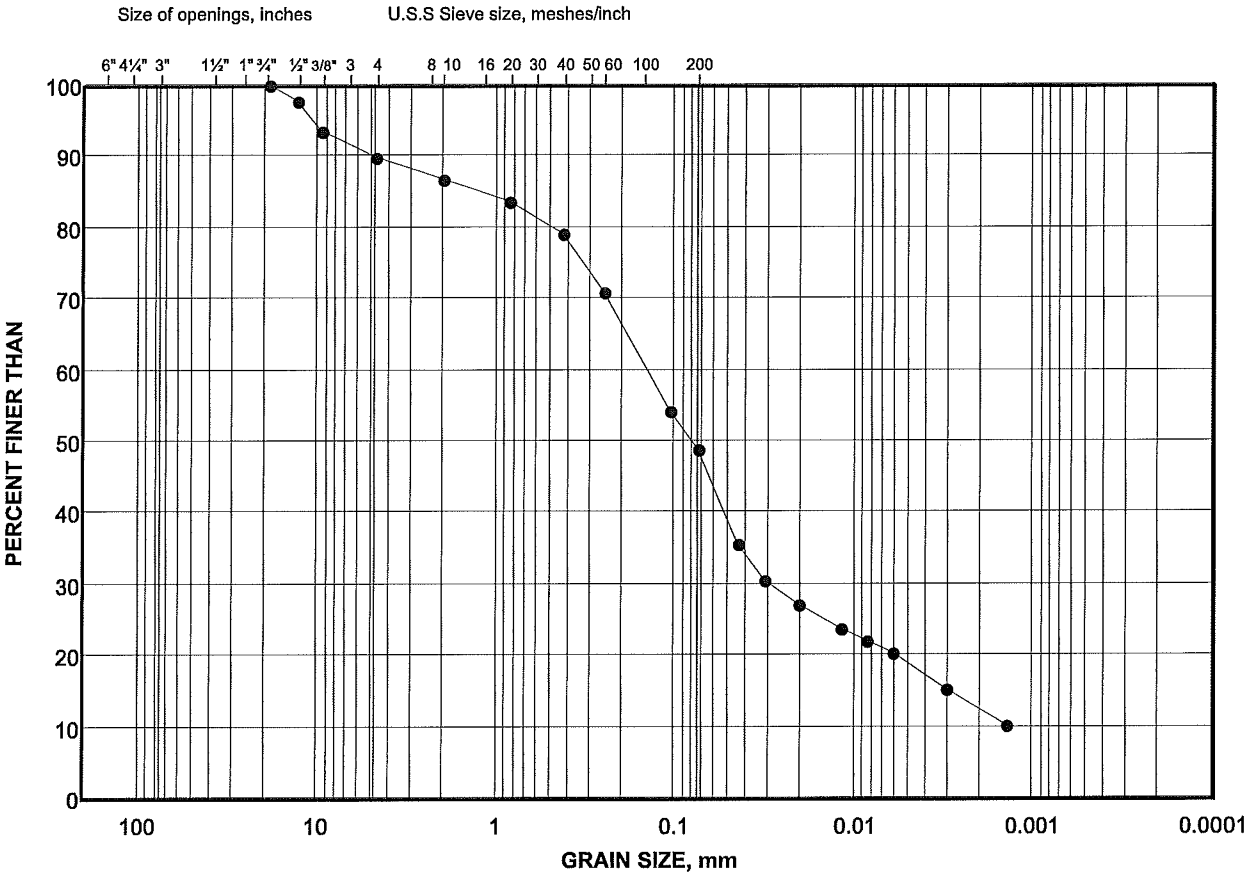
Borehole	Sediment Sample				Sample Description	Estimated K (cm/s)	
	No.	Depth (m)	Elevation (masl)	d_{10} (mm)		Sample	Geometric Mean
14-09	6	4.6-5.2	176.8	<0.001	Silty Clay	<0.001	<0.001
16-12	15	16.8-17.4	173.04	<0.001	Silty Clay	<0.001	
16-9	6	3.7-4.3	178.42	<0.001	Silty Clay	<0.001	
14-33	6	4.6-5.2	187.7	<0.001	Sandy, Clayey Silt, trace sand (Till)	<0.001	2.1E-06
16-7	4	2.2-2.8	185	<0.001	sandy Silty Clay to sandy Clayey Silt (Till)	<0.001	
16-2	6	4-4.6	181.24	<0.001	sandy Silty Clay to sandy Clayey Silt (Till)	<0.001	
16-1	9	8-8.6	179.45	<0.001	sandy Silty Clay to sandy Clayey Silt (Till)	<0.001	
14-23	4	2.3-2.9	186.5	0.001	Clayey Silt, some sand, trace gravel (Till-like)	2.0E-06	
14-09	4	2.3-2.9	179.3	0.002	Clayey Sand Till	2.3E-06	
14-14	6	4.6-5.2	171.5	0.005	Silt, trace clay, some sand	2.2E-05	3.2E-06
14-23	6	4.6-5.2	184.2	0.002	Silty Sand, some sand, trace clay (Till)	2.3E-06	
14-10	3	1.5-2.1	186.7	0.003	Silty Sand Till	6.3E-06	
14-11	6	4.6-5.2	177.5	0.005	Silty Sand Till	2.5E-05	
16-11	7	4.6-5.2	177.08	0.001	Silty Sand (Till)	2.0E-06	
16-13	7	4.6-5.2	179.26	0.001	Silty Sand (Till)	1.0E-06	
16-4	7	5-5.6	174.96	0.002	Silty Sand (Till)	4.0E-06	
16-10	6	3.8-4.4	186.54	0.001	sandy Silt (Till)	1.0E-06	
16-8	6	4.4.6	179.10	0.001	sandy Silt (Till)	1.0E-06	
16-6	4	2.5-3.1	184.29	0.001	sandy Silt	2.0E-06	
14-34	6	3.8-4.4	176.4	0.016	Silty Sand, fine grained sand, trace clay	2.6E-04	2.1E-03
16-16	11	10.7-11.1	168.7	0.045	Silty Sand	2.0E-03	
16-15	13	13.7-14.3	166.84	0.035	Silty Sand	1.2E-03	
16-14	7	4.6-5.2	172.57	0.043	Silty Sand	1.8E-03	
14-15	7	6.1-6.7	173.5	0.058	Silty Sand	3.4E-03	
16-5	7	5-5.6	176.33	0.091	Sand	8.3E-03	
16-3	7B	4.9-5.5	192.56	0.078	Sand	6.1E-03	
14-32	6	4.6-5.2	189.4	0.046	Sand	2.1E-03	

Notes:
m - metres
masl - metres above sea level
NA - Not applicable
Borehole locations are shown in ***Figure 4*** .
K values estimated using the Hazen correlation
Grain-size distributions are based on the Unified Soil Classification.
D_{10} values are from Grain-size analyses or estimated by Burnside
Geometric mean values do not include <0.001 values

GRAIN SIZE DISTRIBUTION

CLAYEY SAND TILL

FIGURE 3



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-09	4	

Project Number: 14-13472

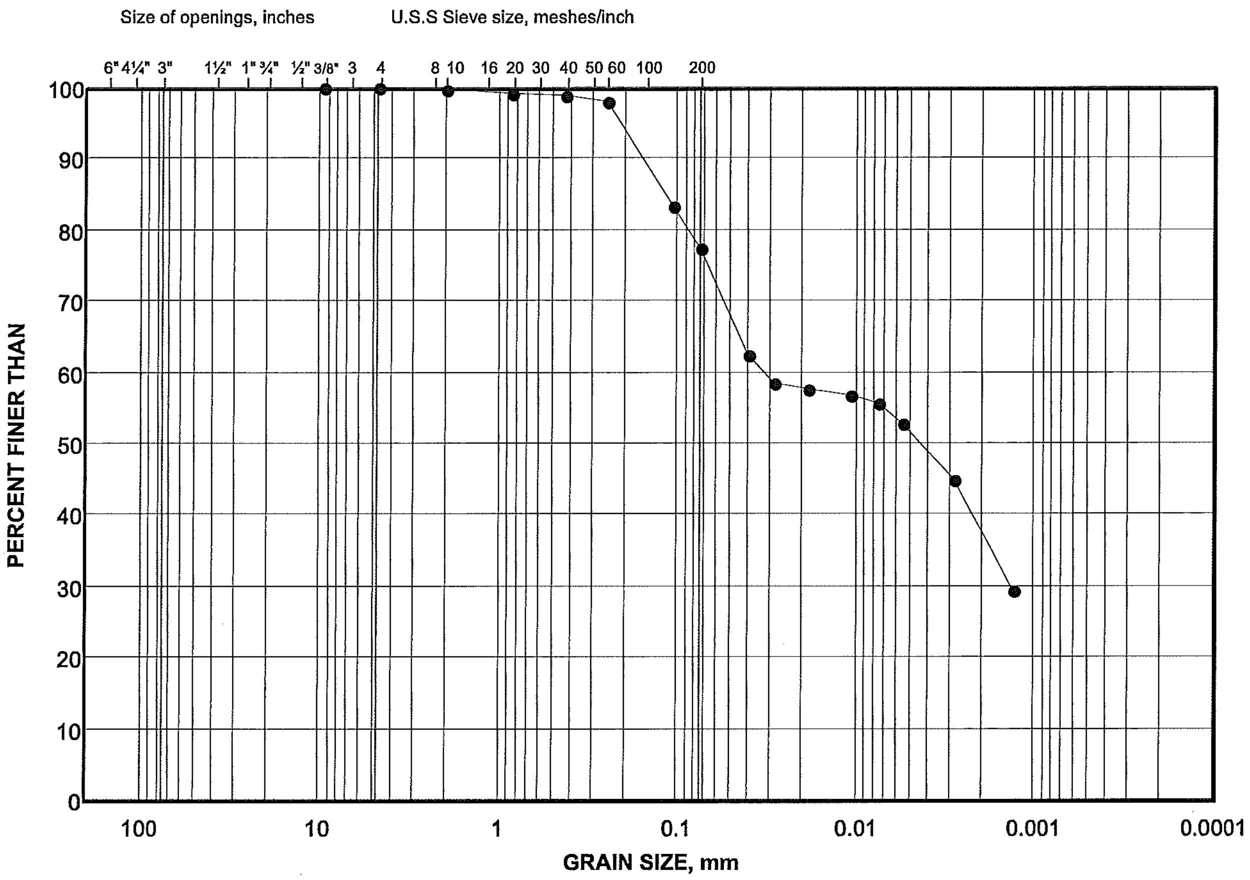
Checked By: SDK

Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION
SILTY CLAY

FIGURE 4



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-09	6	

Project Number: 14-13472

Checked By: SDK

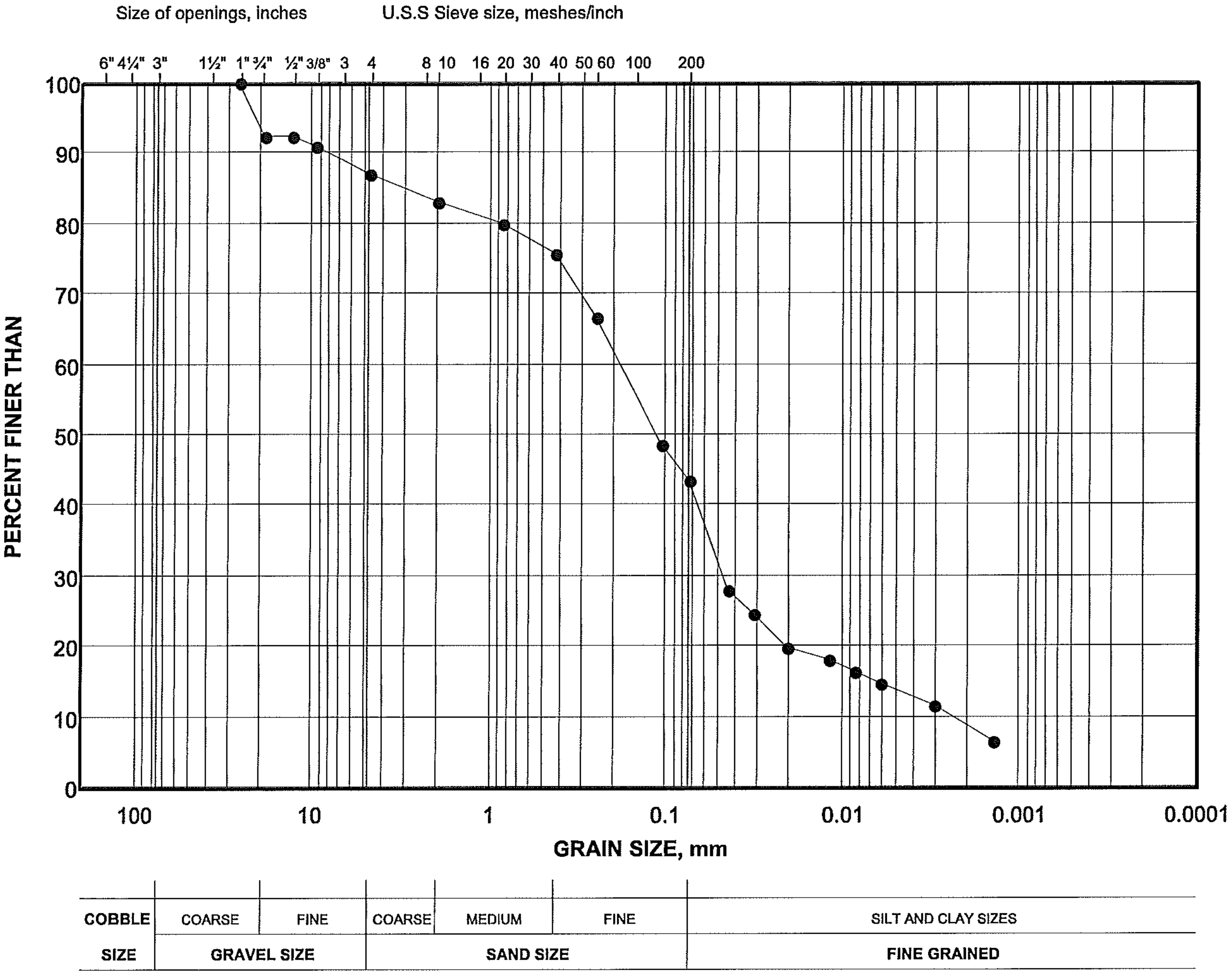
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(SM) SILTY SAND TILL

FIGURE 5



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-10	3	

Project Number: 14-13472

Checked By: SDK

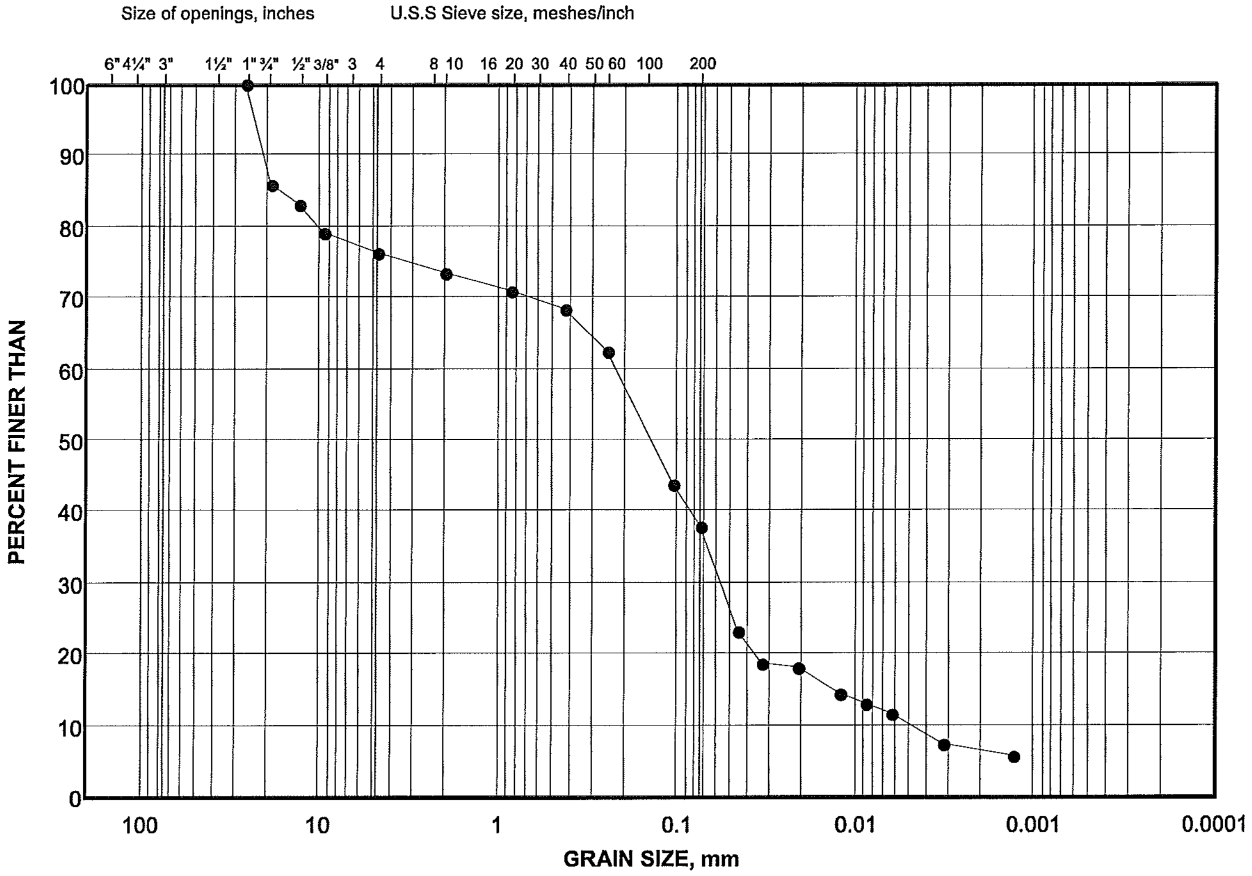
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(SM) SILTY SAND TILL

FIGURE 6



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-11	6	

Project Number: 14-13472

Checked By: SDK

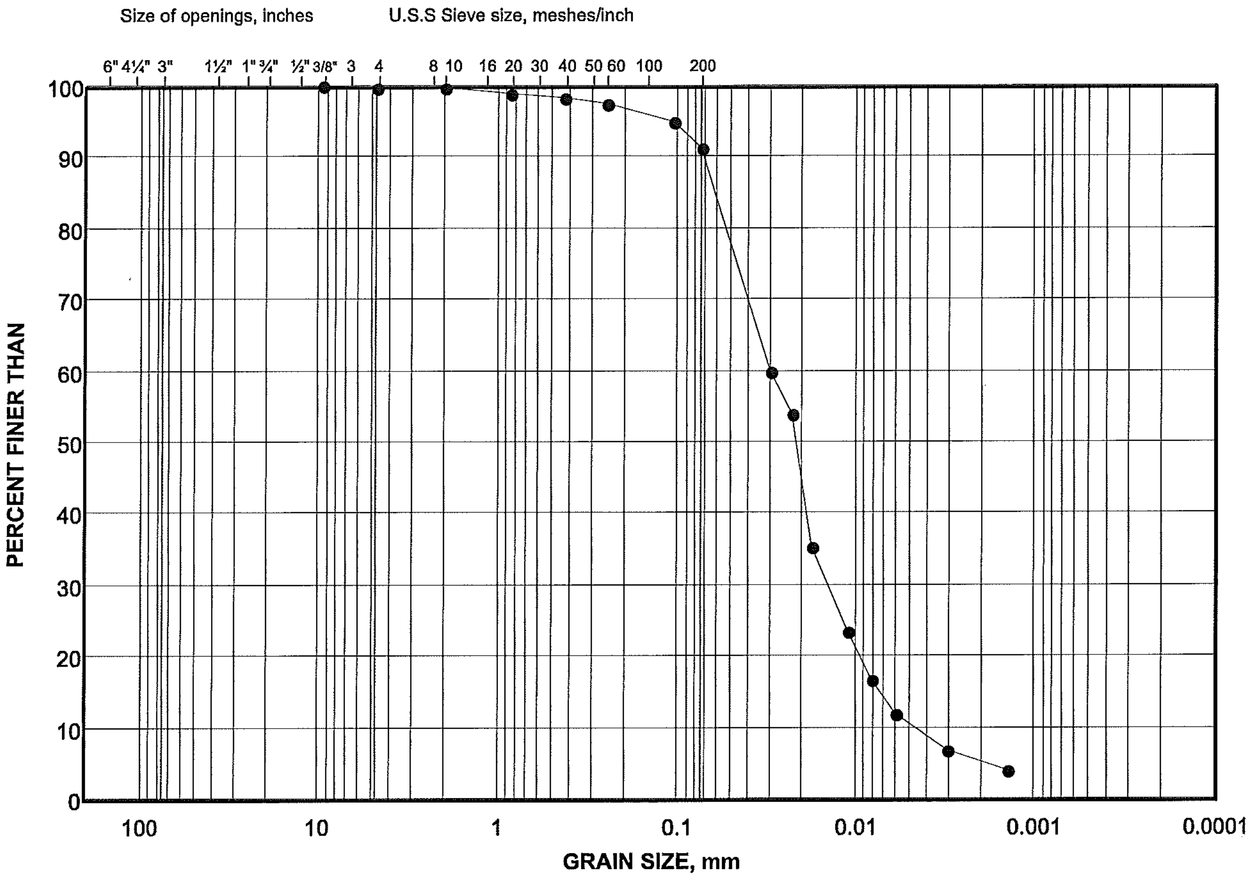
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(ML) SILT, trace clay, some sand

FIGURE 7



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-14	6	

Project Number: 14-13472

Checked By: SDK

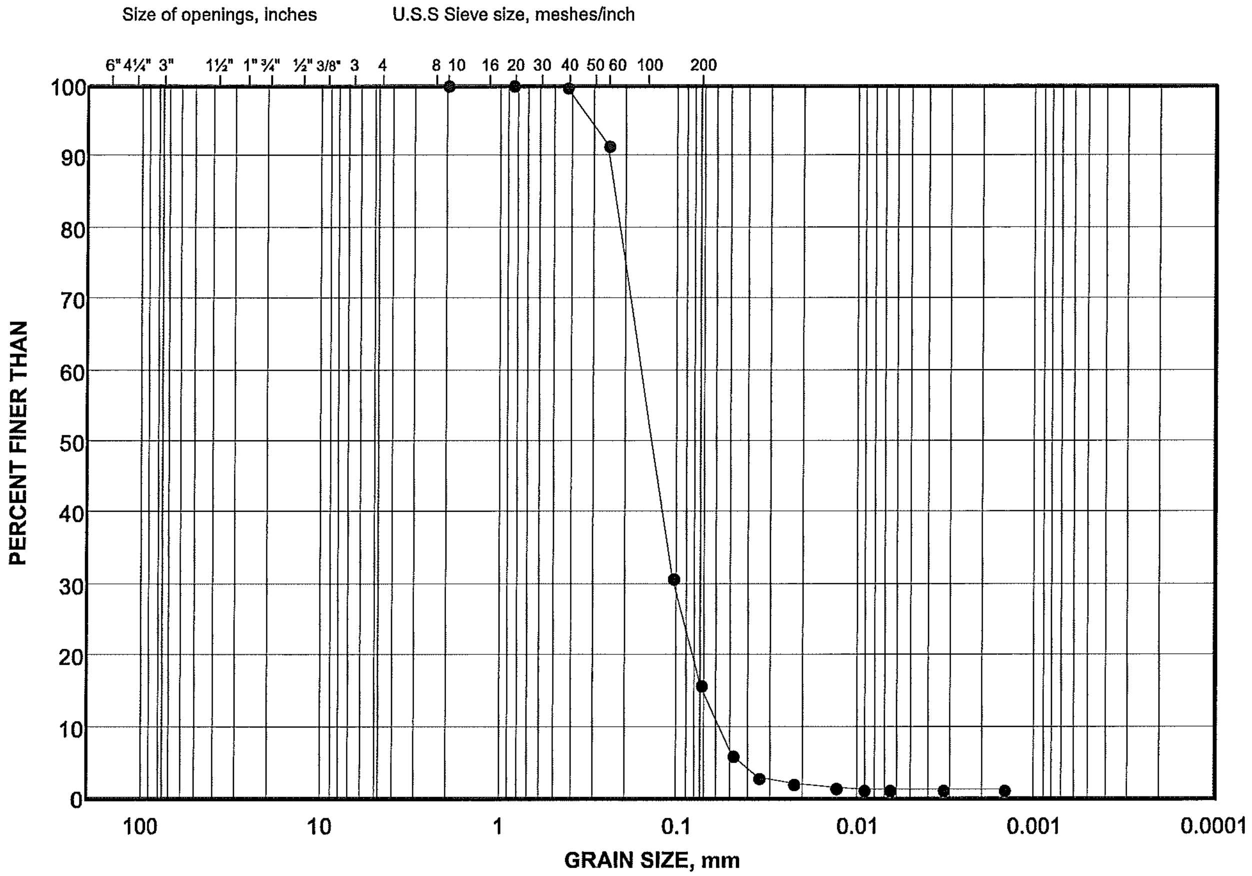
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(SM) SILTY SAND

FIGURE 8



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-15	7	

Project Number: 14-13472

Checked By: SDK

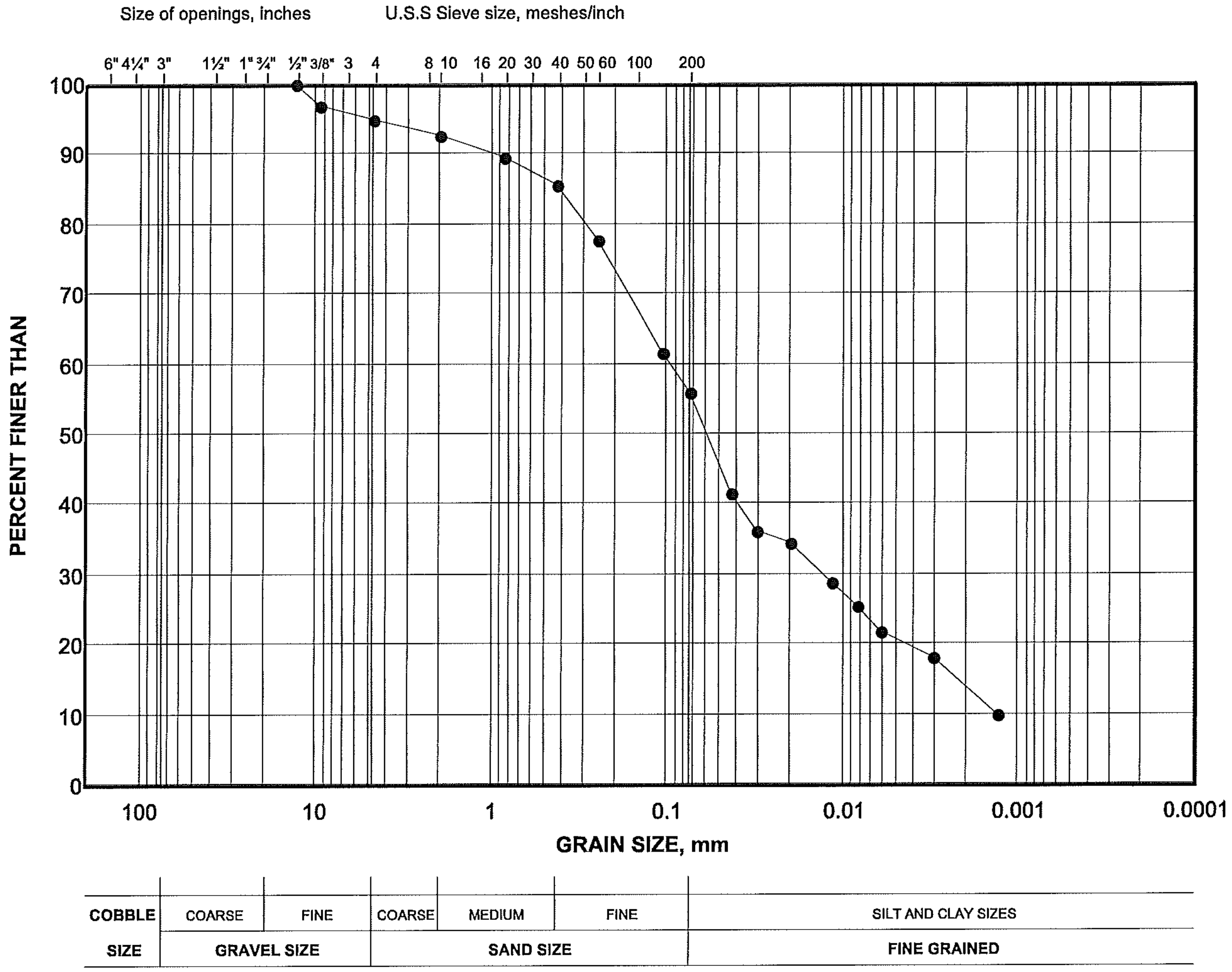
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(ML) CLAYEY SILT, some sand, trace gravel (Till-like)

FIGURE 9



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-23	4	

Project Number: 14-13472

Checked By: SDK

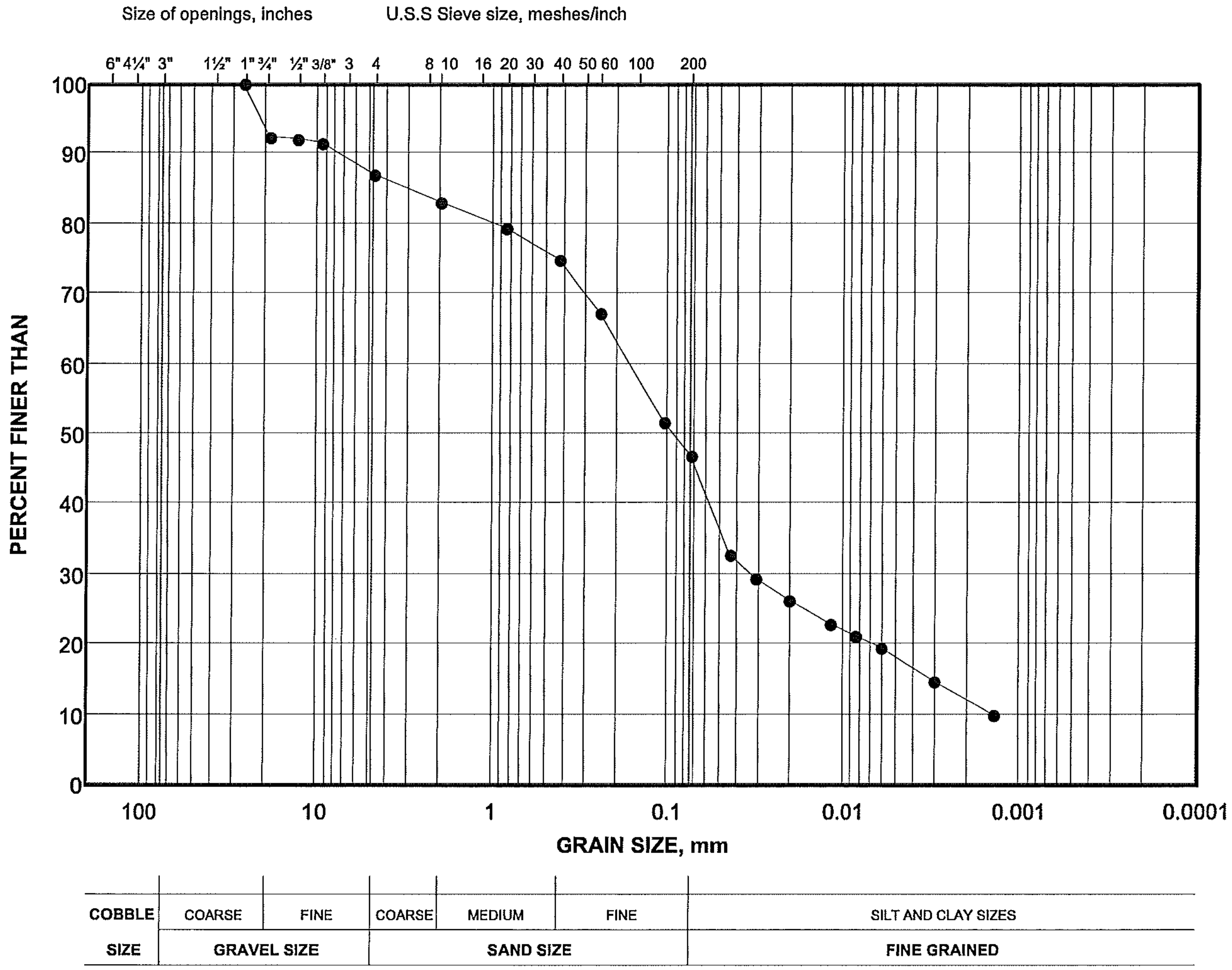
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(SM) SILTY SAND, some sand, trace clay (Till)

FIGURE 10



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-23	6	

Project Number: 14-13472

Checked By: SDK

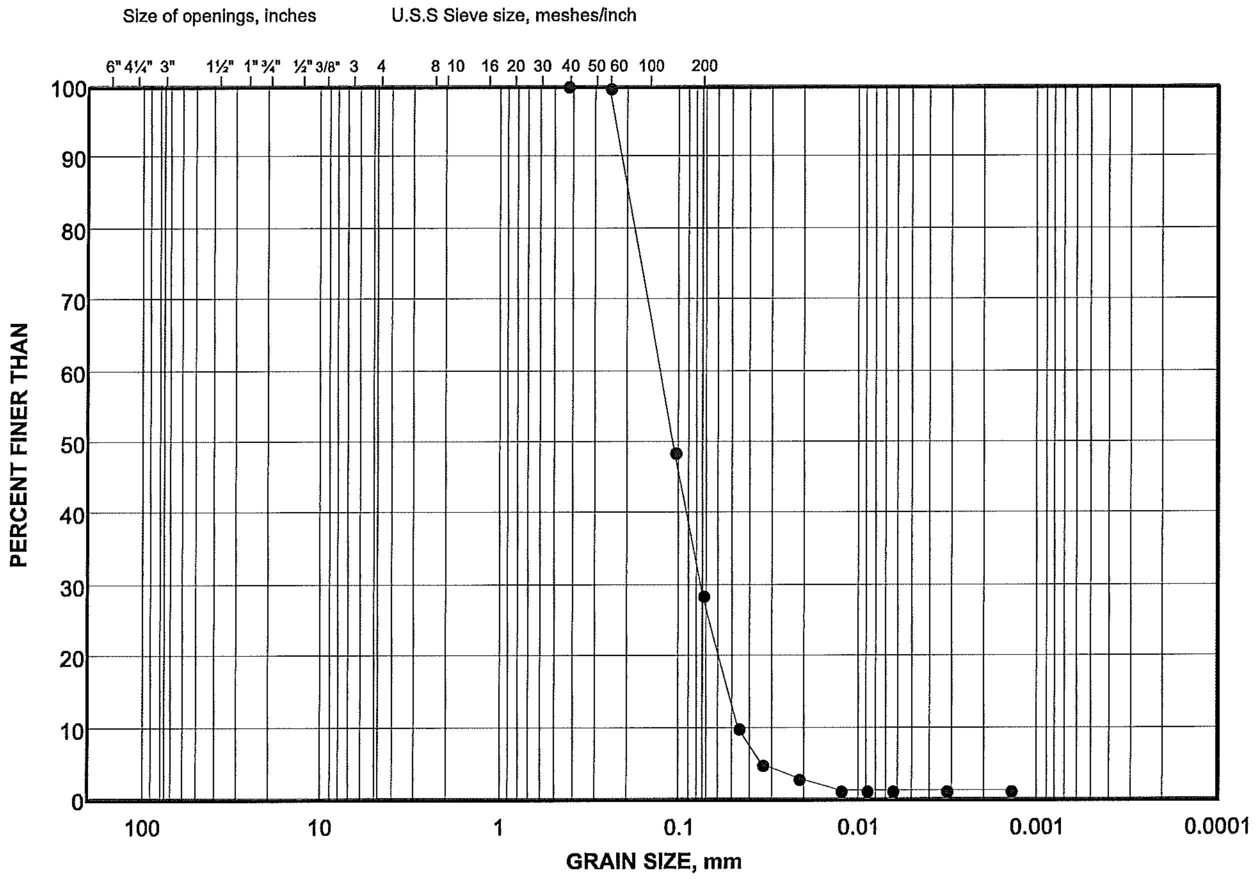
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(SP) SAND

FIGURE 11



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-32	6	

Project Number: 14-13472

Checked By: SDK

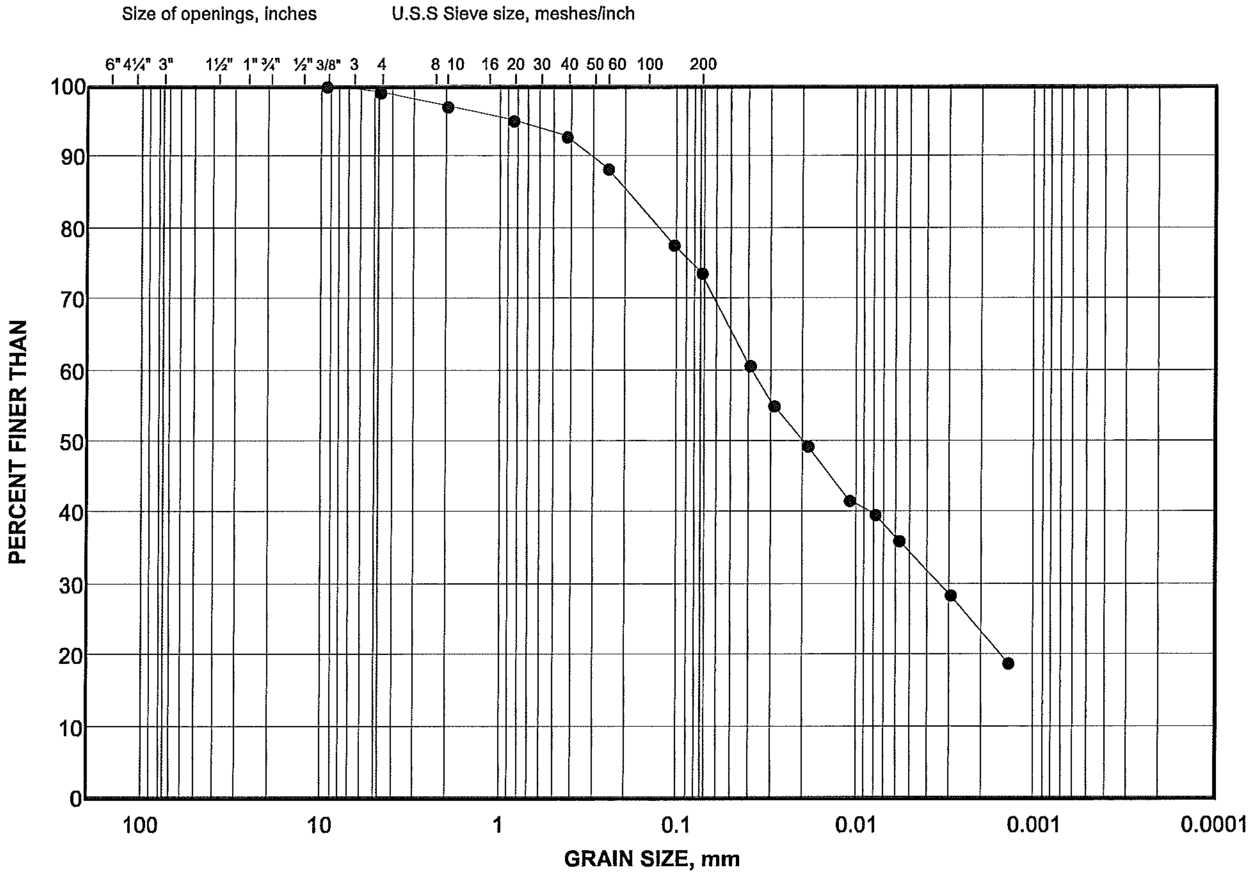
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(ML) Sandy, CLAYEY SILT, trace sand (Till)

FIGURE 12



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-33	6	

Project Number: 14-13472

Checked By: SDK

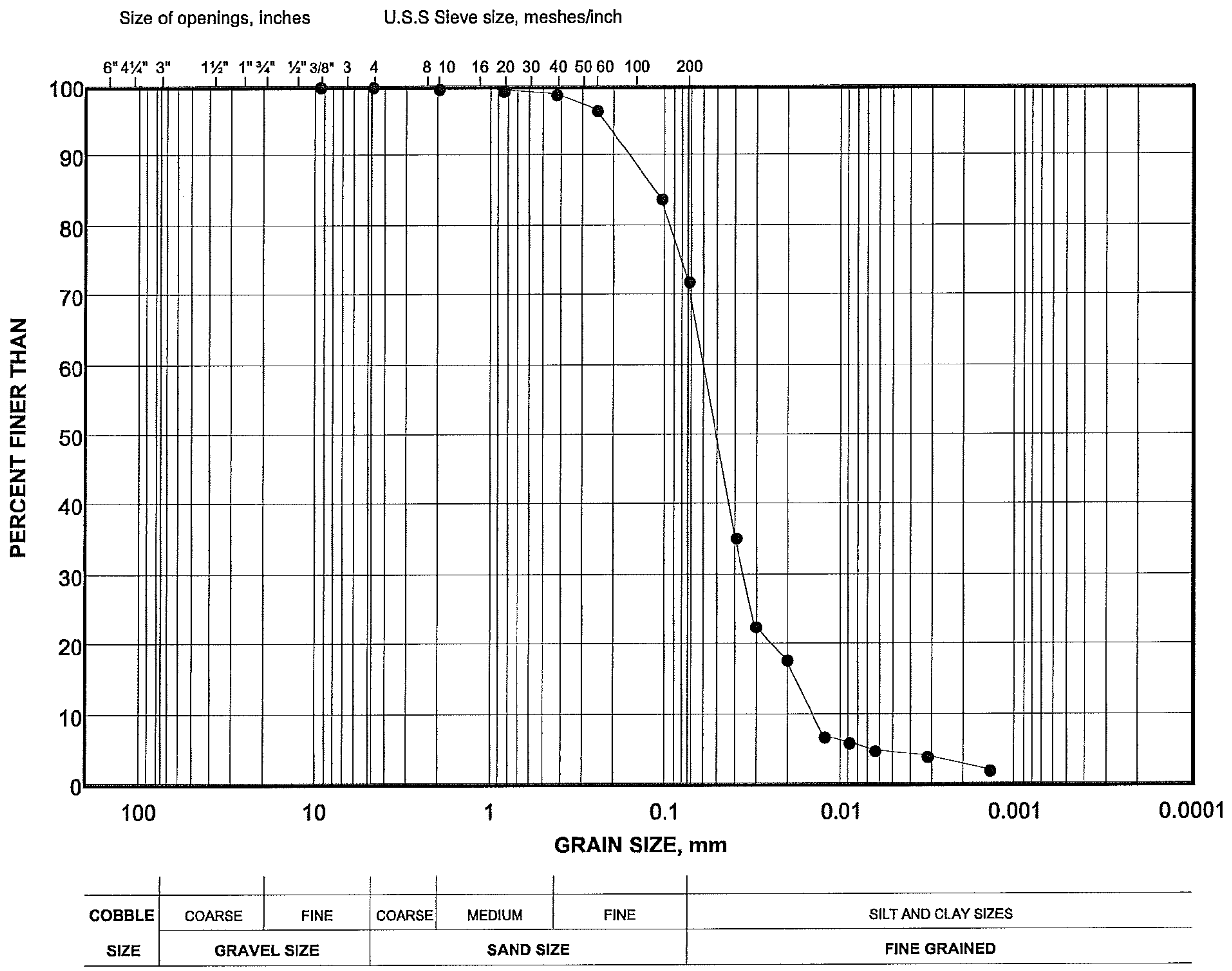
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(SM) SILTY SAND, fine grained sand, trace clay

FIGURE 13



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-34	6	

Project Number: 14-13472

Checked By: SDK

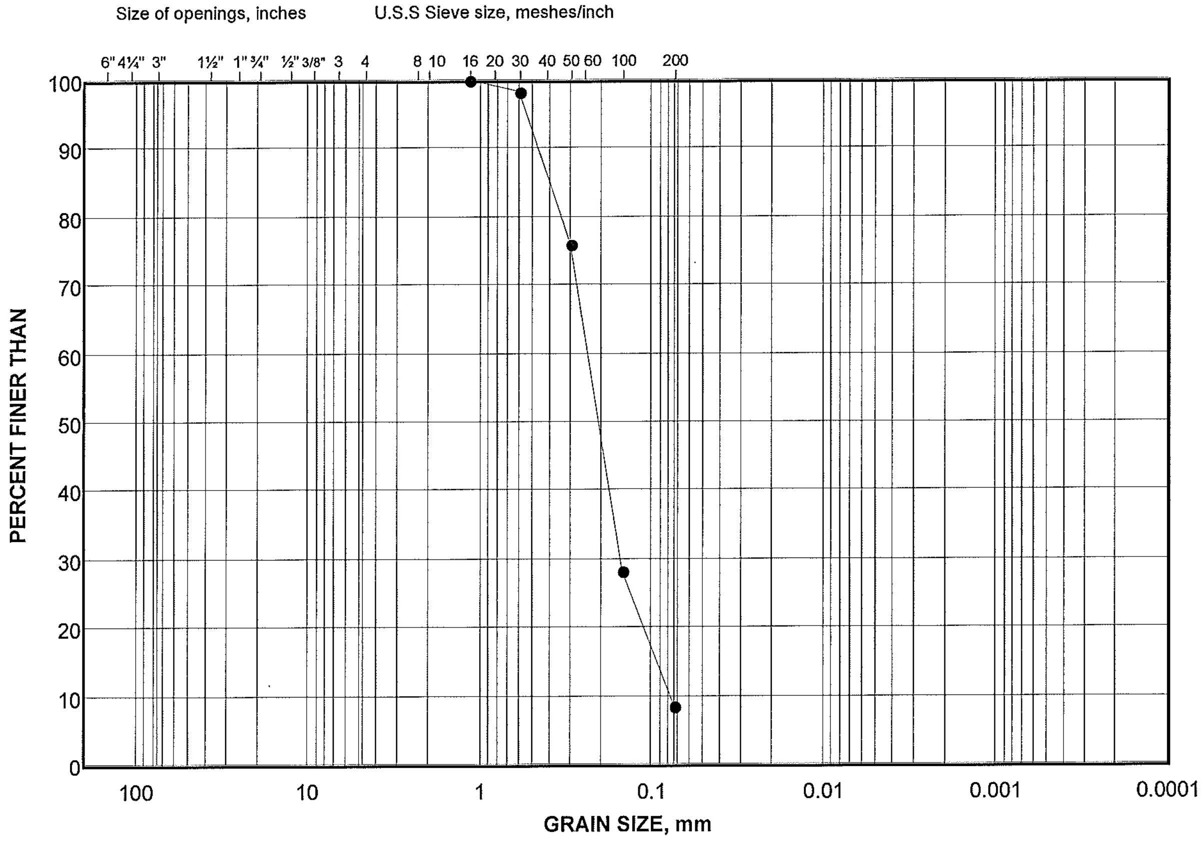
Golder Associates

Date: 05-Jan-15

GRAIN SIZE DISTRIBUTION

(SP) SAND

FIGURE 10



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	16-3	7B	192.56

Project Number: 1413472 (8000)

Checked By: OS

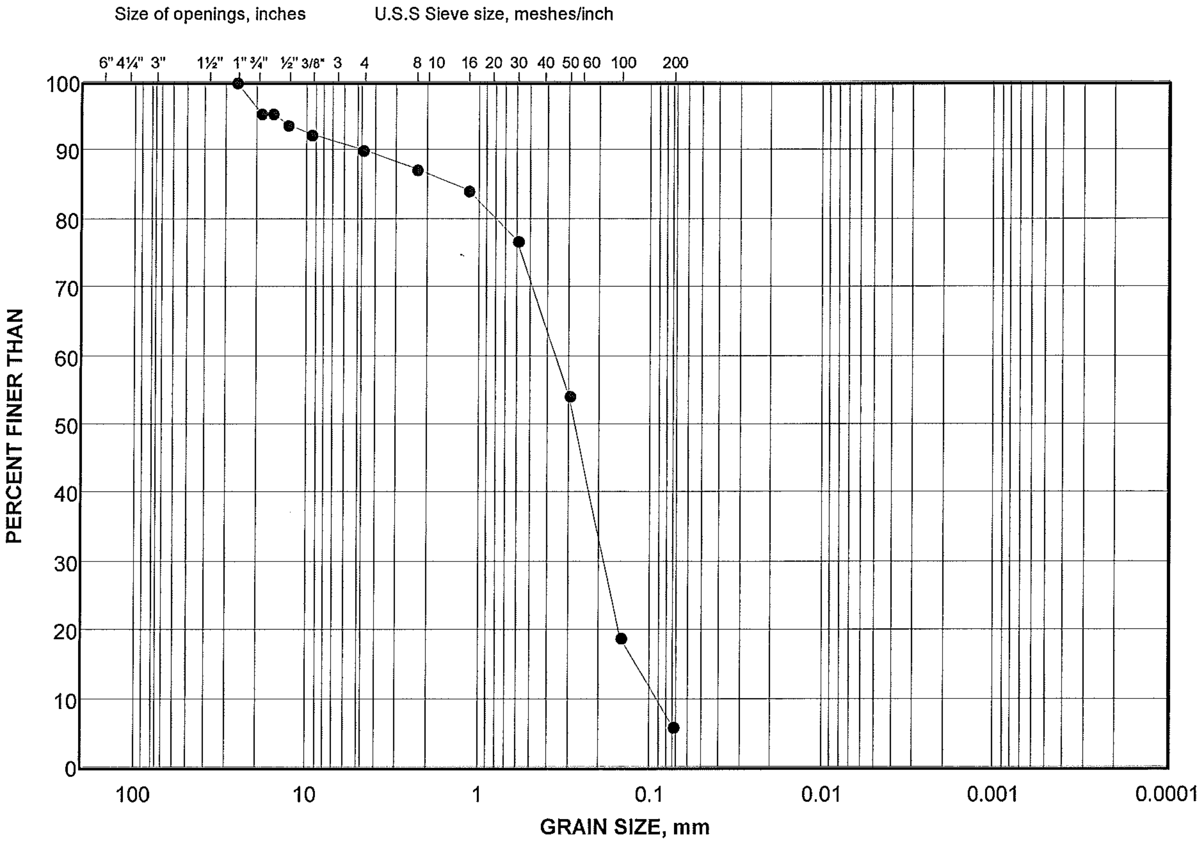
Golder Associates

Date: 24-Mar-16

GRAIN SIZE DISTRIBUTION

(SW) SAND

FIGURE 9



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	16-5	7	176.33

Project Number: 1413472 (8000)

Checked By: OS

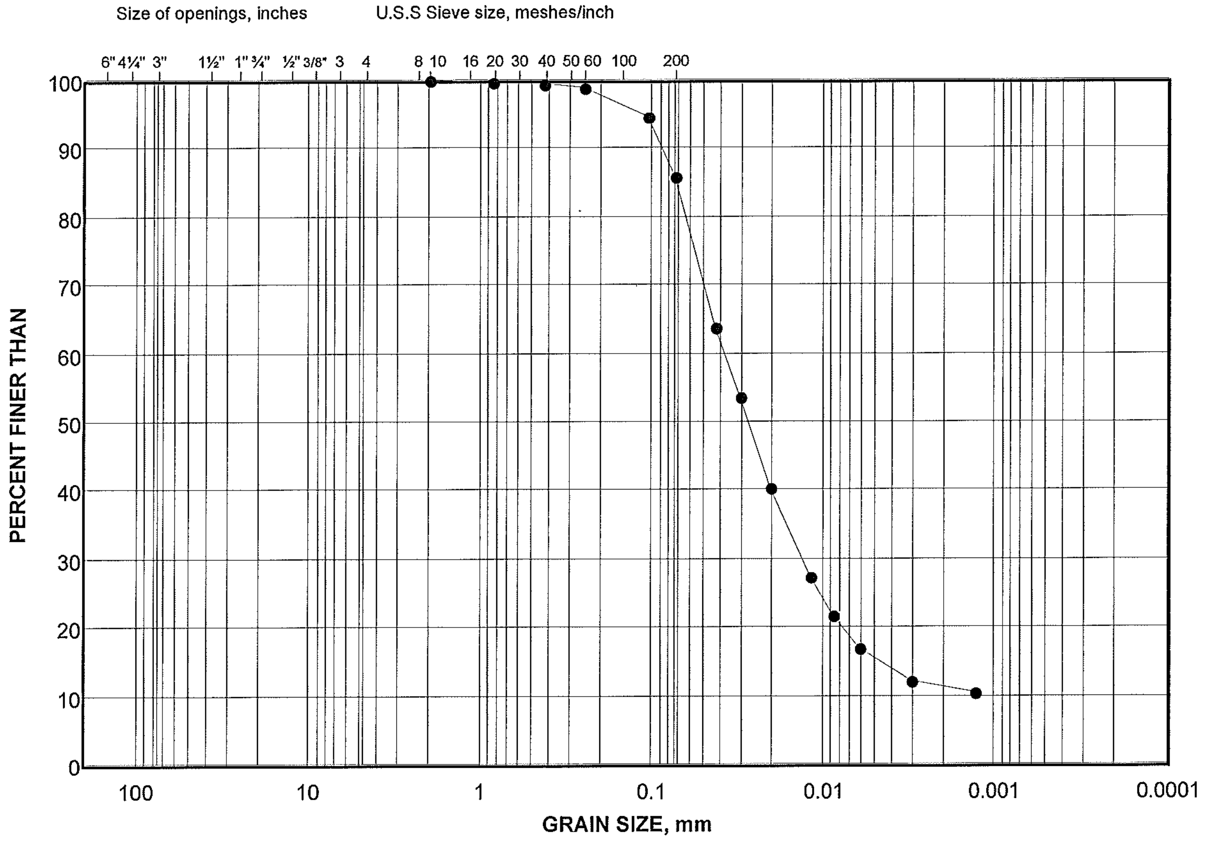
Golder Associates

Date: 24-Mar-16

GRAIN SIZE DISTRIBUTION

(ML) sandy SILT

FIGURE 8



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	16-6	4	184.29

Project Number: 1413472 (8000)

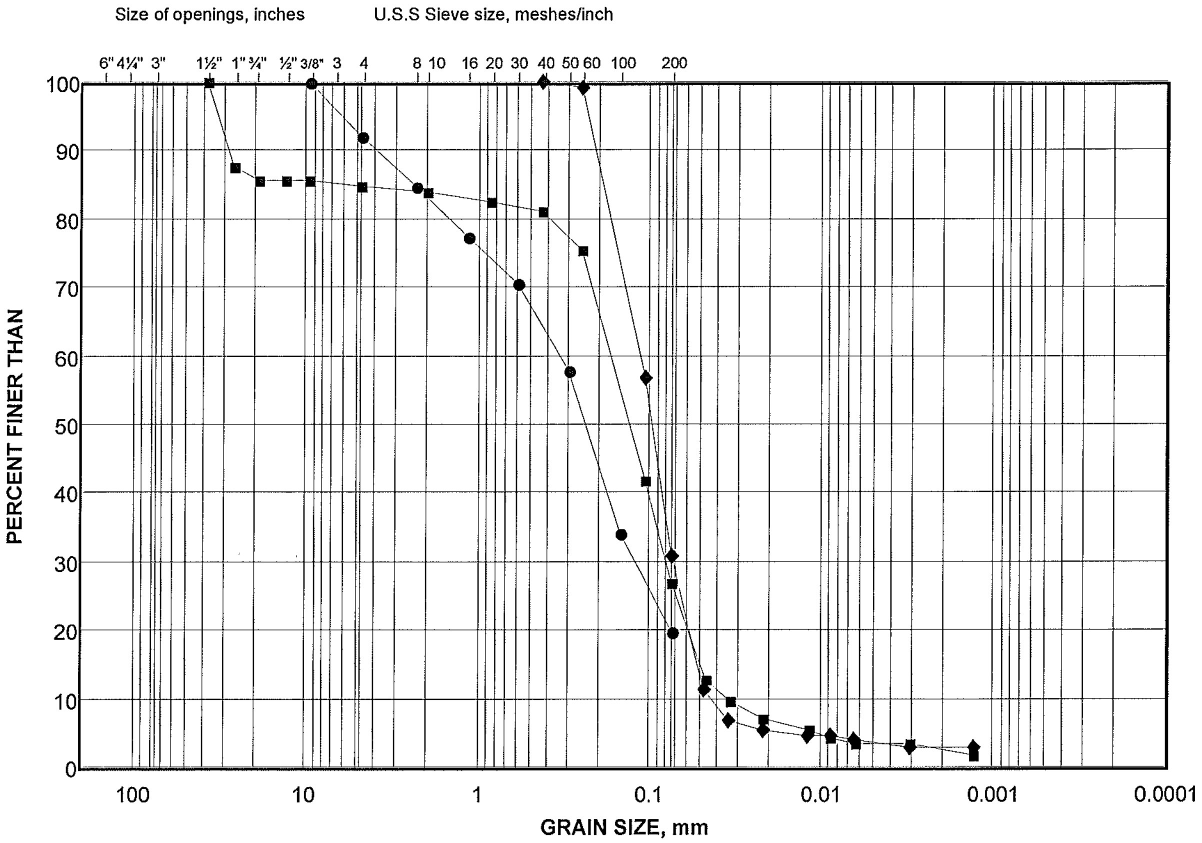
Checked By: OS

Golder Associates

Date: 24-Mar-16

GRAIN SIZE DISTRIBUTION
(SM) SILTY SAND

FIGURE 7



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	16-16	11	168.70
■	16-15	13	166.84
◆	16-14	7	172.57

Project Number: 1413472 (8000)

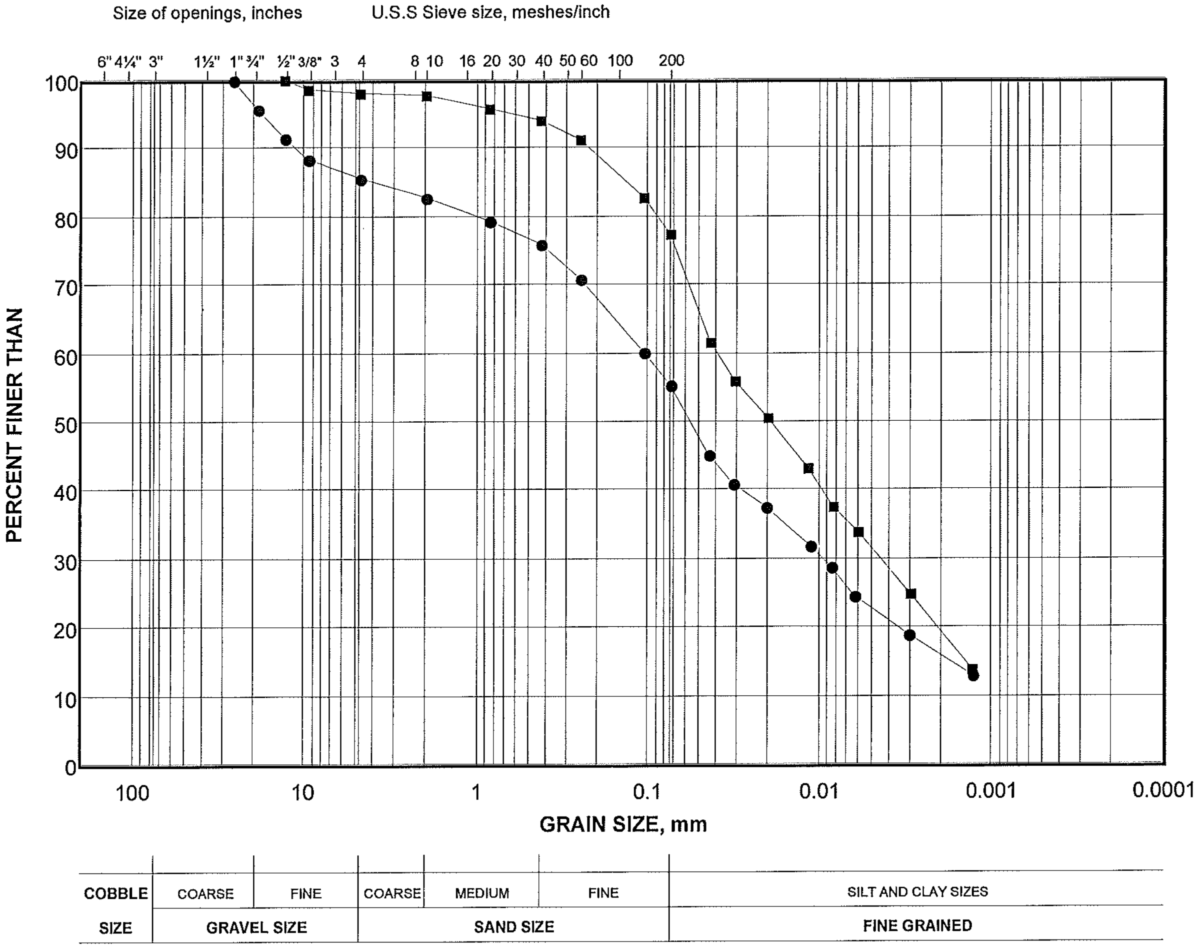
Checked By: OS

Golder Associates

Date: 24-Mar-16

GRAIN SIZE DISTRIBUTION
(ML) sandy SILT (TILL)

FIGURE 6



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	16-10	6	186.54
■	16-8	6	179.10

Project Number: 1413472 (8000)

Checked By: OS

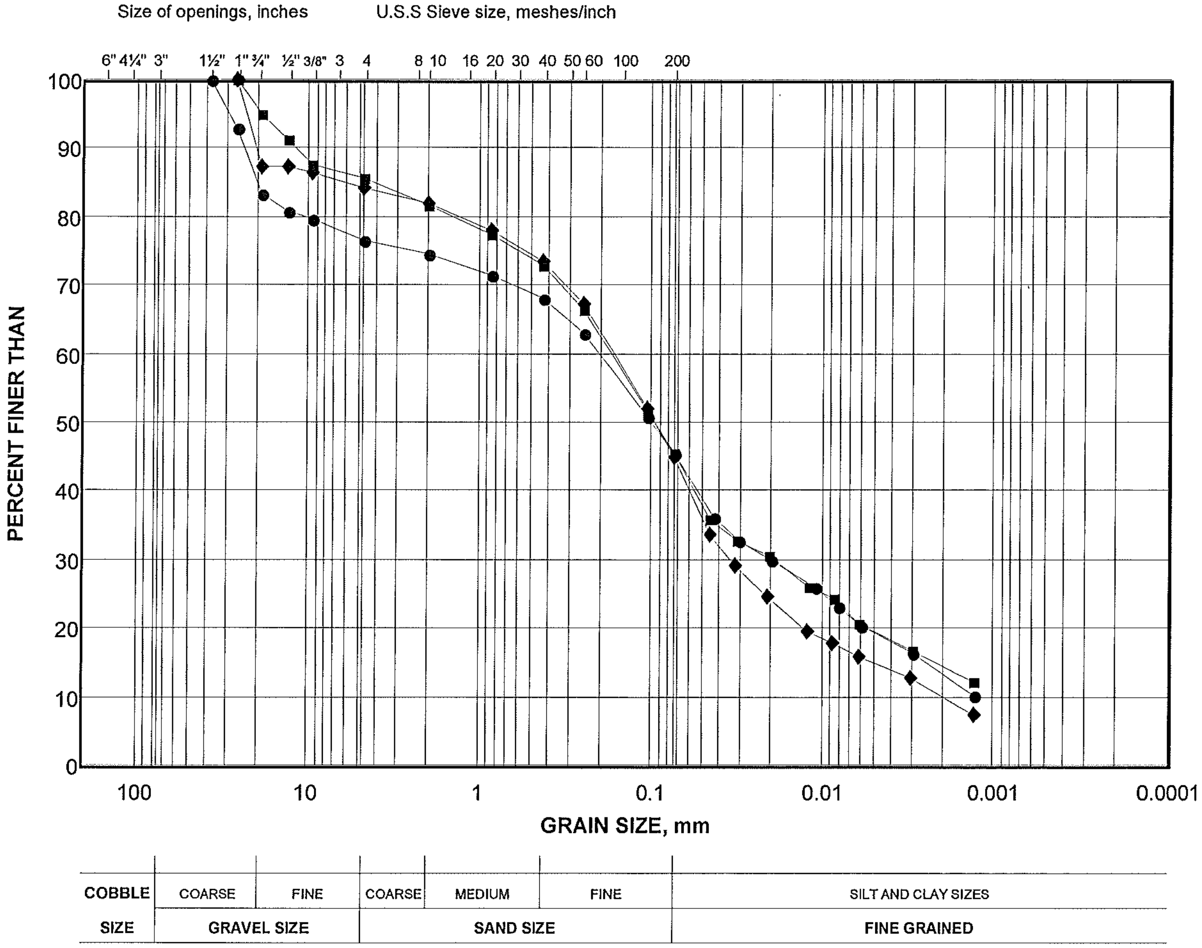
Golder Associates

Date: 24-Mar-16

GRAIN SIZE DISTRIBUTION

(SM) SILTY SAND (TILL)

FIGURE 5



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	16-11	7	177.08
■	16-13	7	179.26
◆	16-4	7	174.96

Project Number: 1413472 (8000)

Checked By: OS

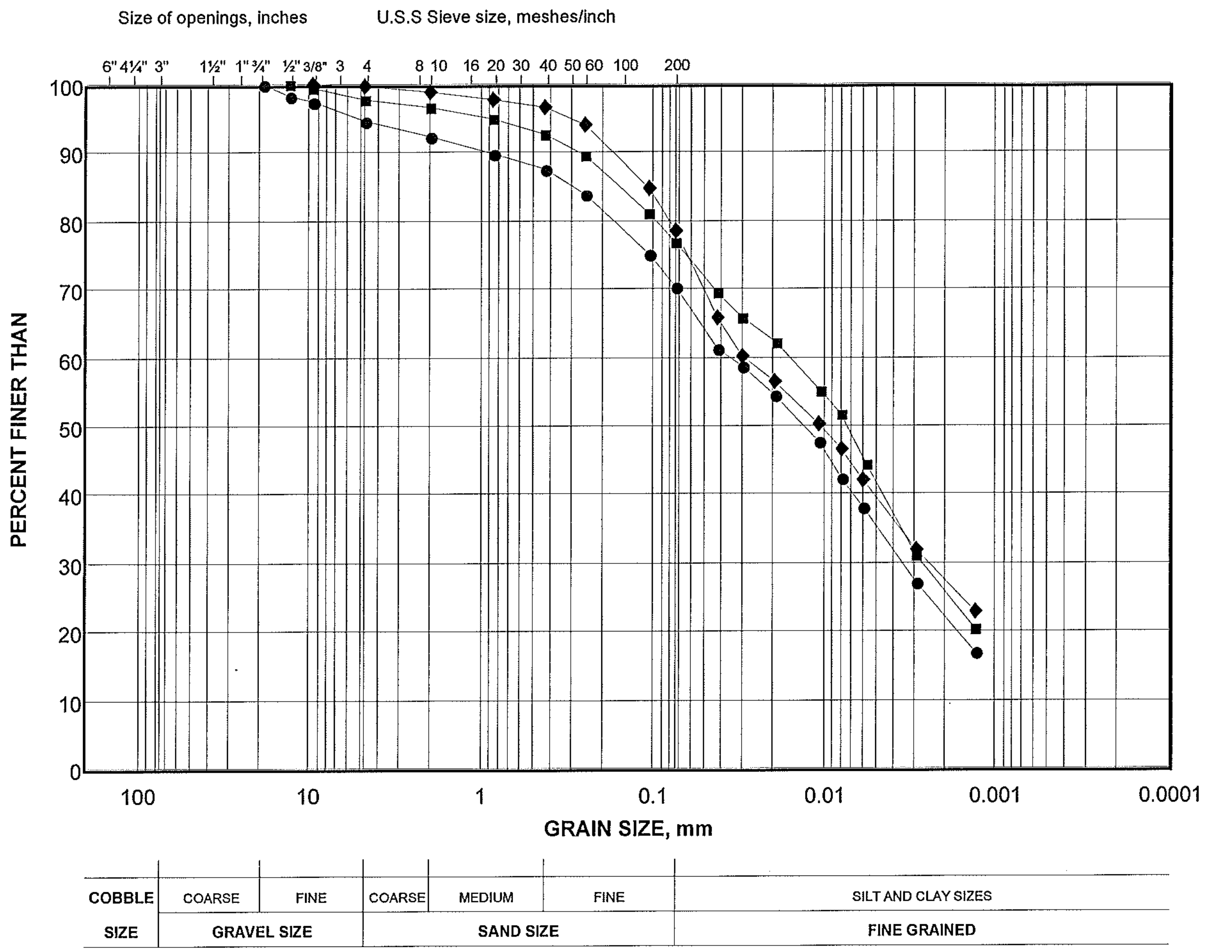
Golder Associates

Date: 24-Mar-16

GRAIN SIZE DISTRIBUTION

(CL-ML) sandy SILTY CLAY to sandy CLAYEY SILT (TILL)

FIGURE 4



LEGEND

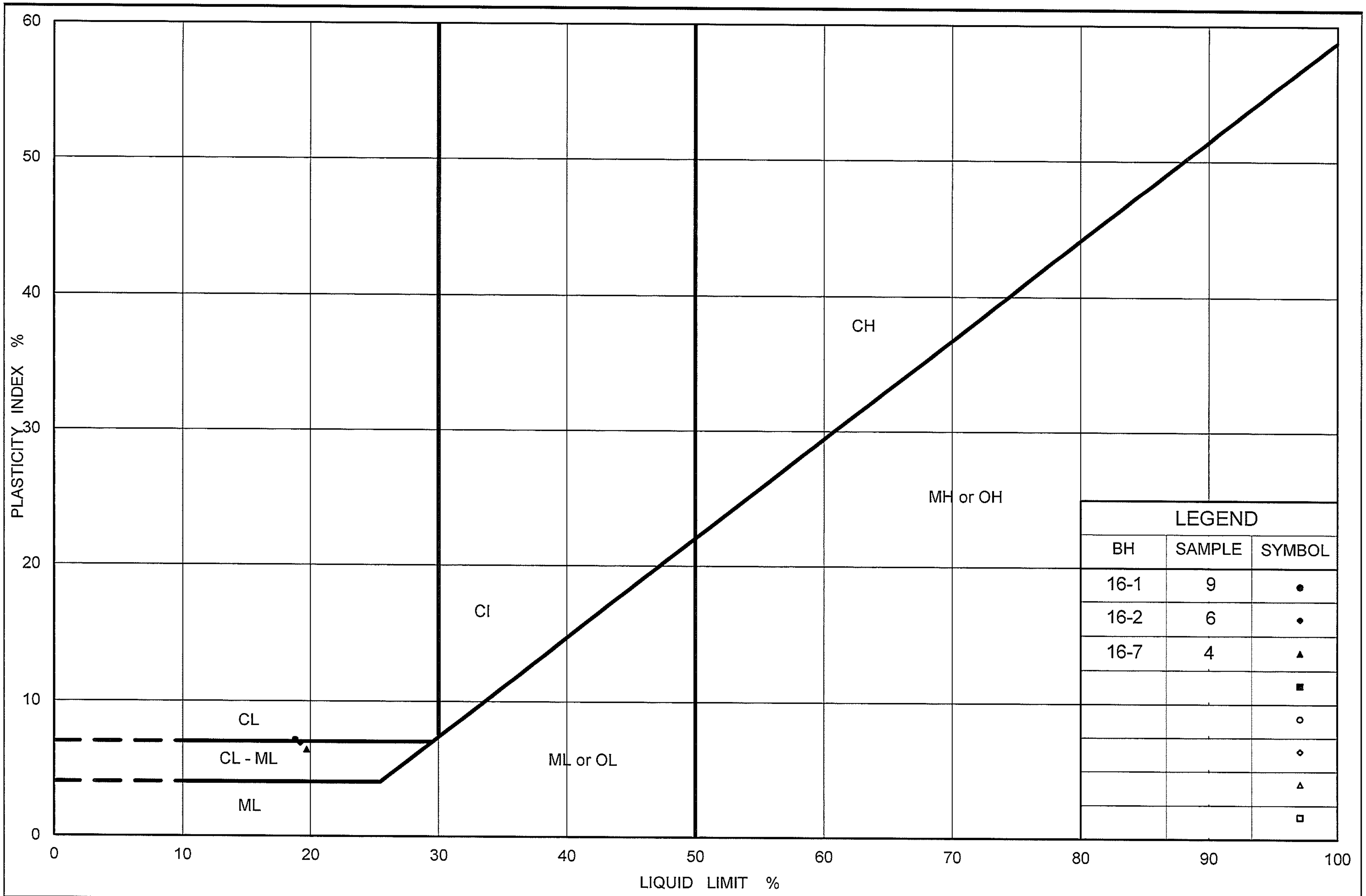
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	16-7	4	185.00
■	16-2	6	181.24
◆	16-1	9	179.45

Project Number: 1413472 (8000)

Checked By: OS

Golder Associates

Date: 24-Mar-16



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PLASTICITY CHART
(CL-ML) SILTY CLAY TO CLAYEY SILT (TILL)

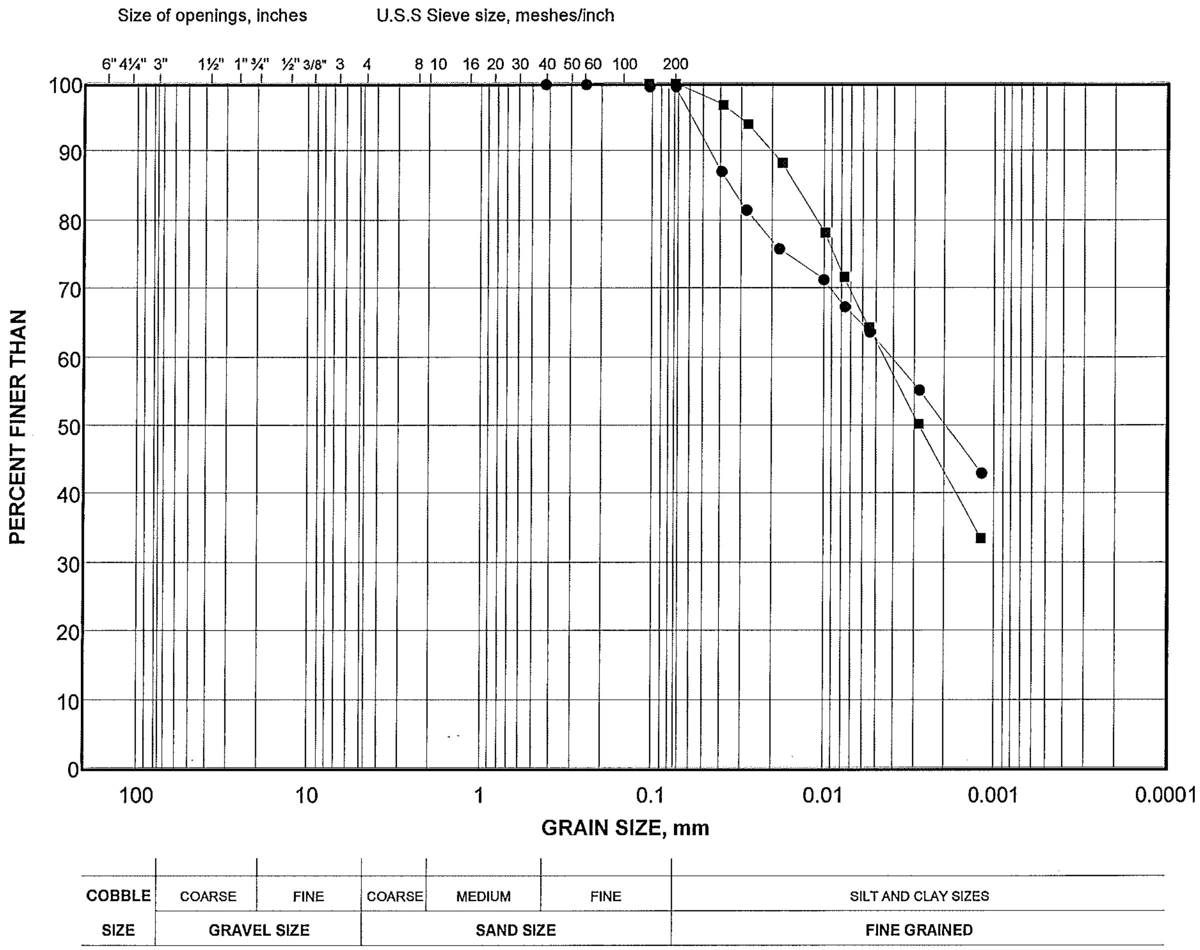
Figure No. 3

Project No. 1413472 (8000)

Checked By: OS

GRAIN SIZE DISTRIBUTION
(CI) SILTY CLAY

FIGURE 2



LEGEND

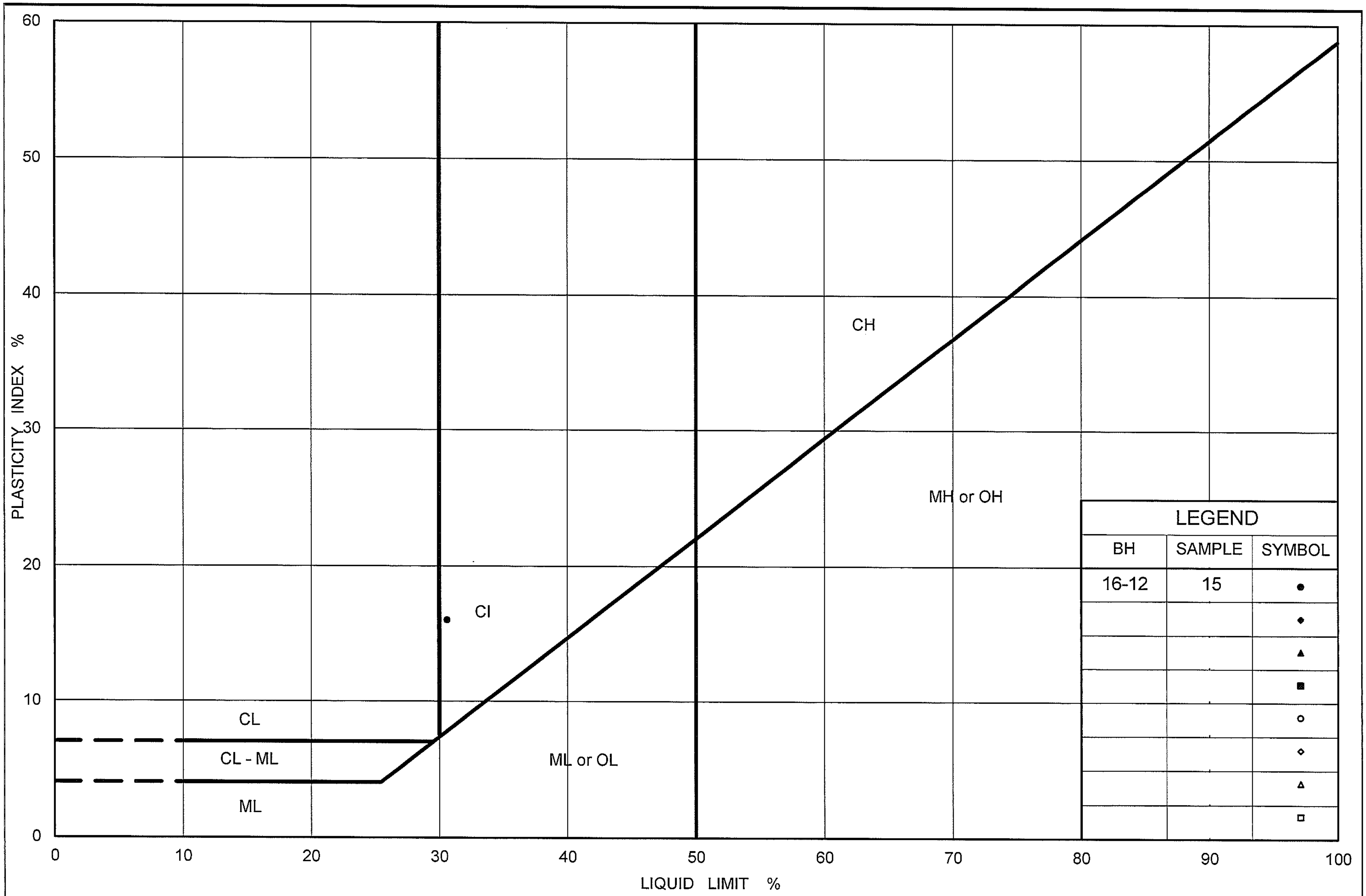
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	16-12	15	173.04
■	16-9	6	178.42

Project Number: 1413472 (8000)

Checked By: OS

Golder Associates

Date: 28-Mar-16



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PLASTICITY CHART
(CI) SILTY CLAY

Figure No. 1

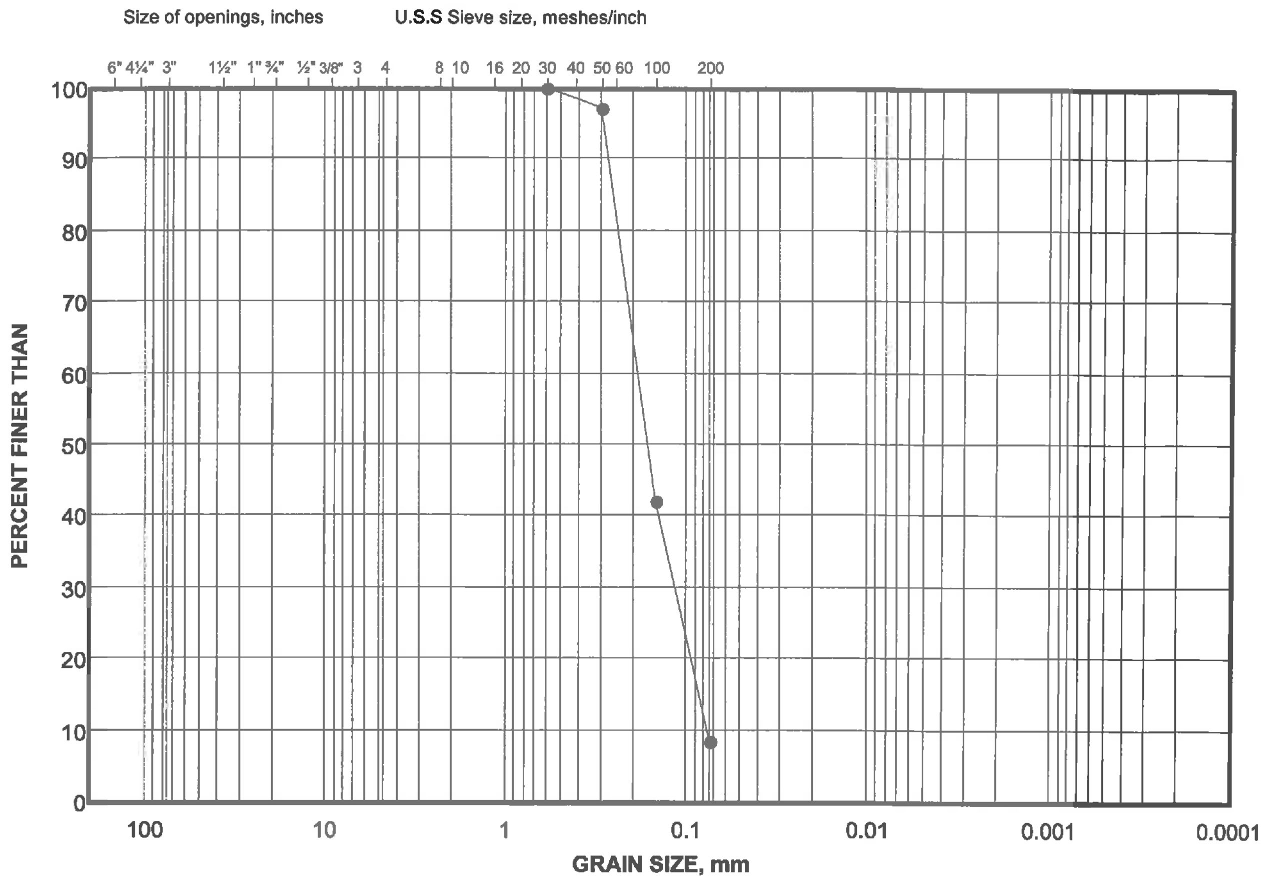
Project No. 1413472 (8000)

Checked By: OS

GRAIN SIZE DISTRIBUTION

MTO LS-602

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	**GRAVEL SIZE**		**SAND SIZE**			**FINE GRAINED**

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	132	4	

Project Number: 1413472

Checked By: ______________

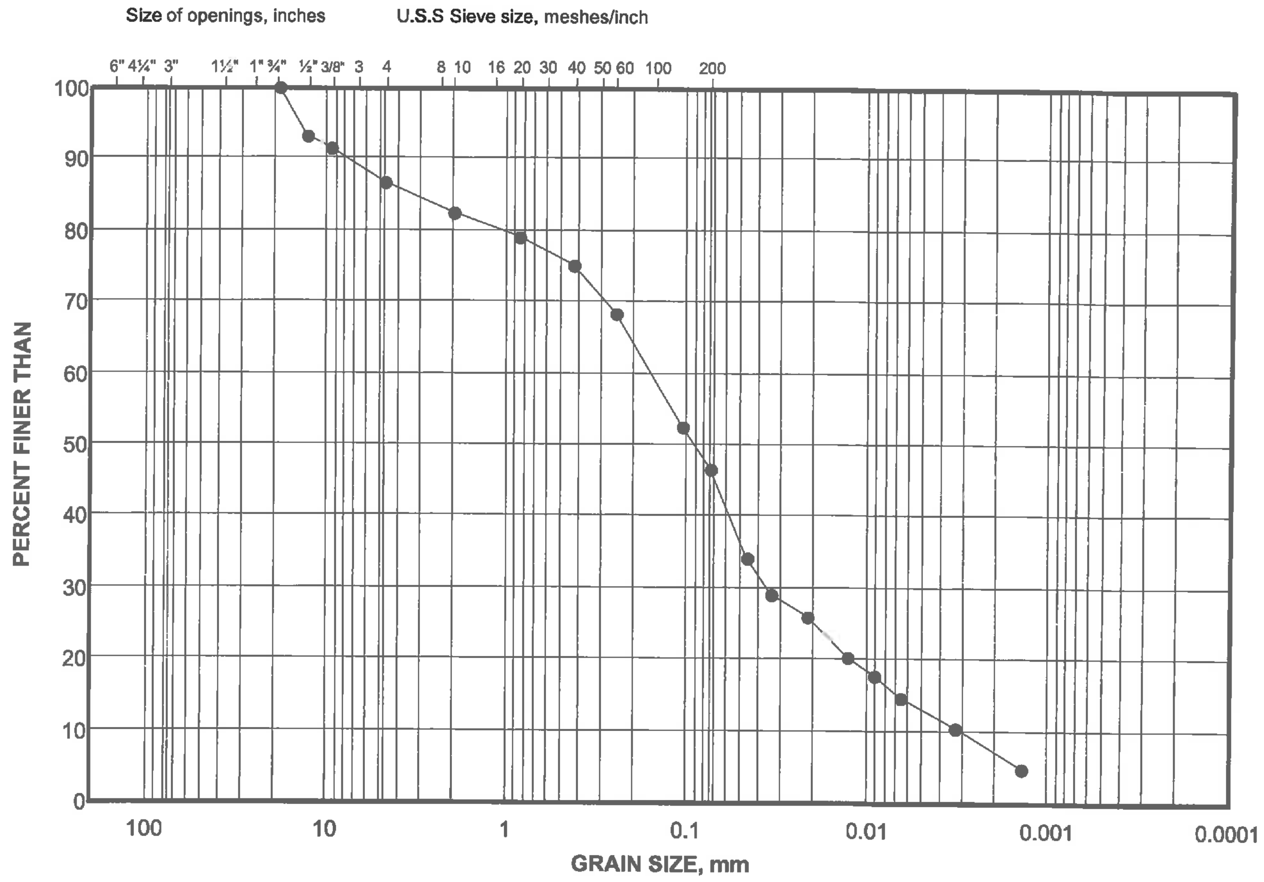
Golder Associates

Date: 09-May-17

GRAIN SIZE DISTRIBUTION

MTO LS-702

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	140	6	

Project Number: 1413472

Checked By: ______________________

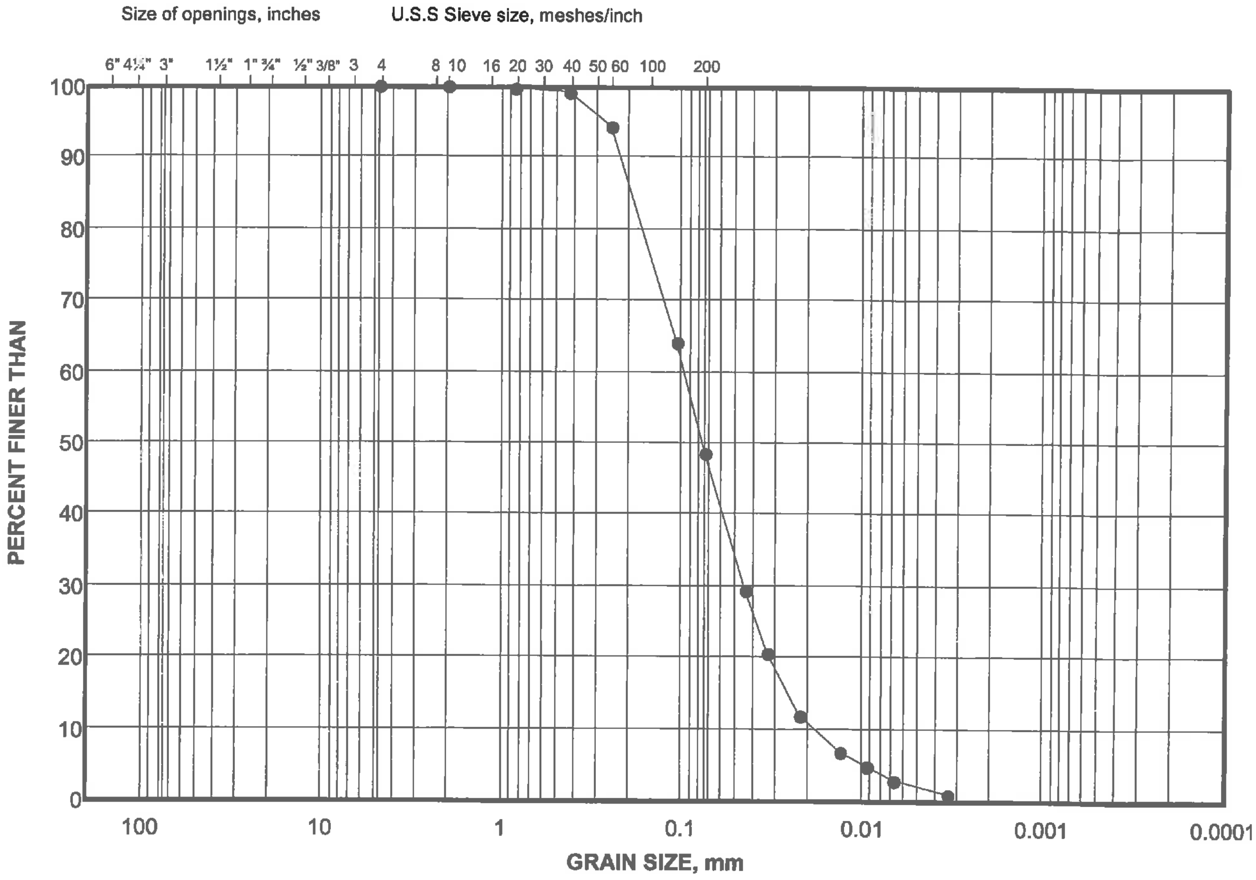
Golder Associates

Date: 09-May-17

GRAIN SIZE DISTRIBUTION

MTO LS-702

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	142	8	

Project Number: 1413472

Checked By: ________________

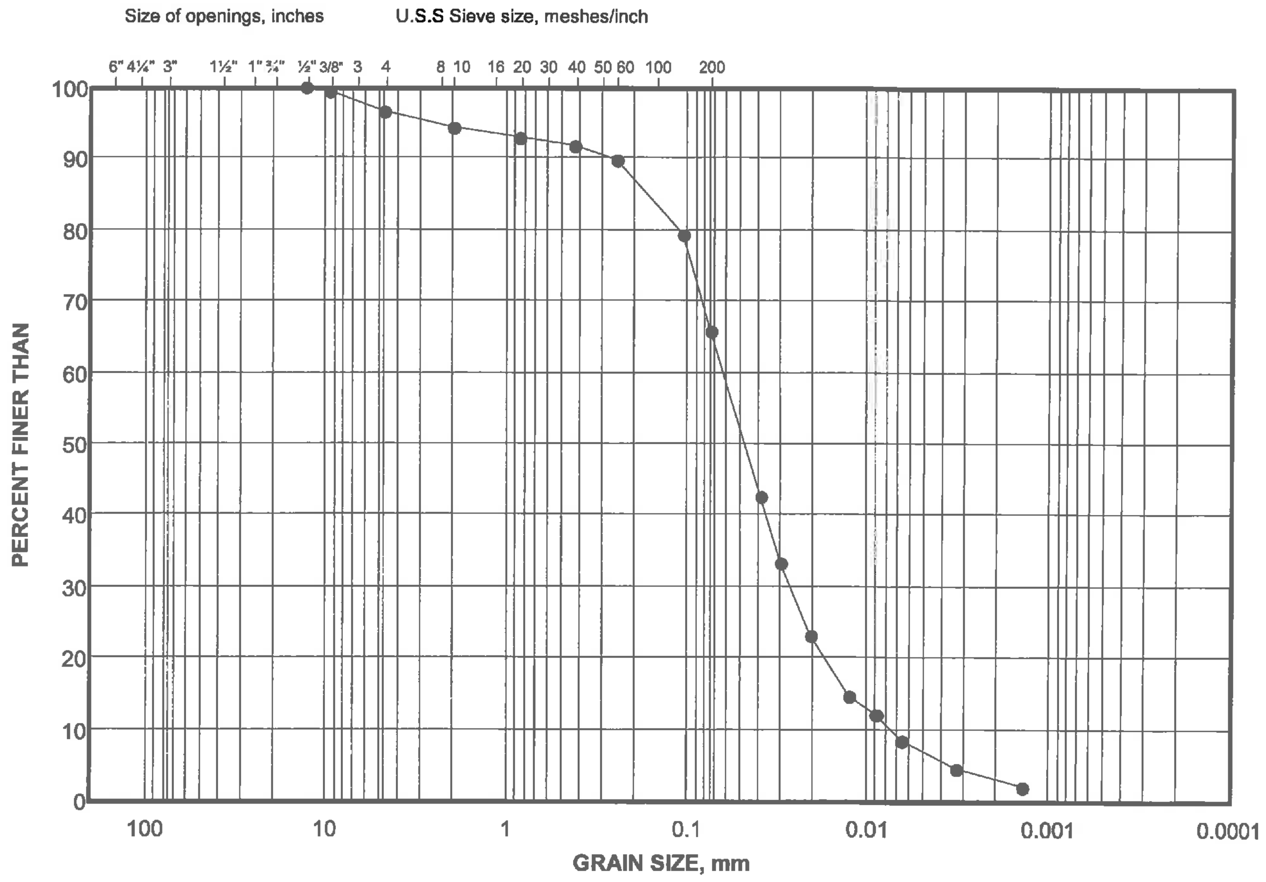
Golder Associates

Date: 09-May-17

GRAIN SIZE DISTRIBUTION

MTO LS-702

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	17-110	8	

Project Number: 1413472

Checked By: ____________

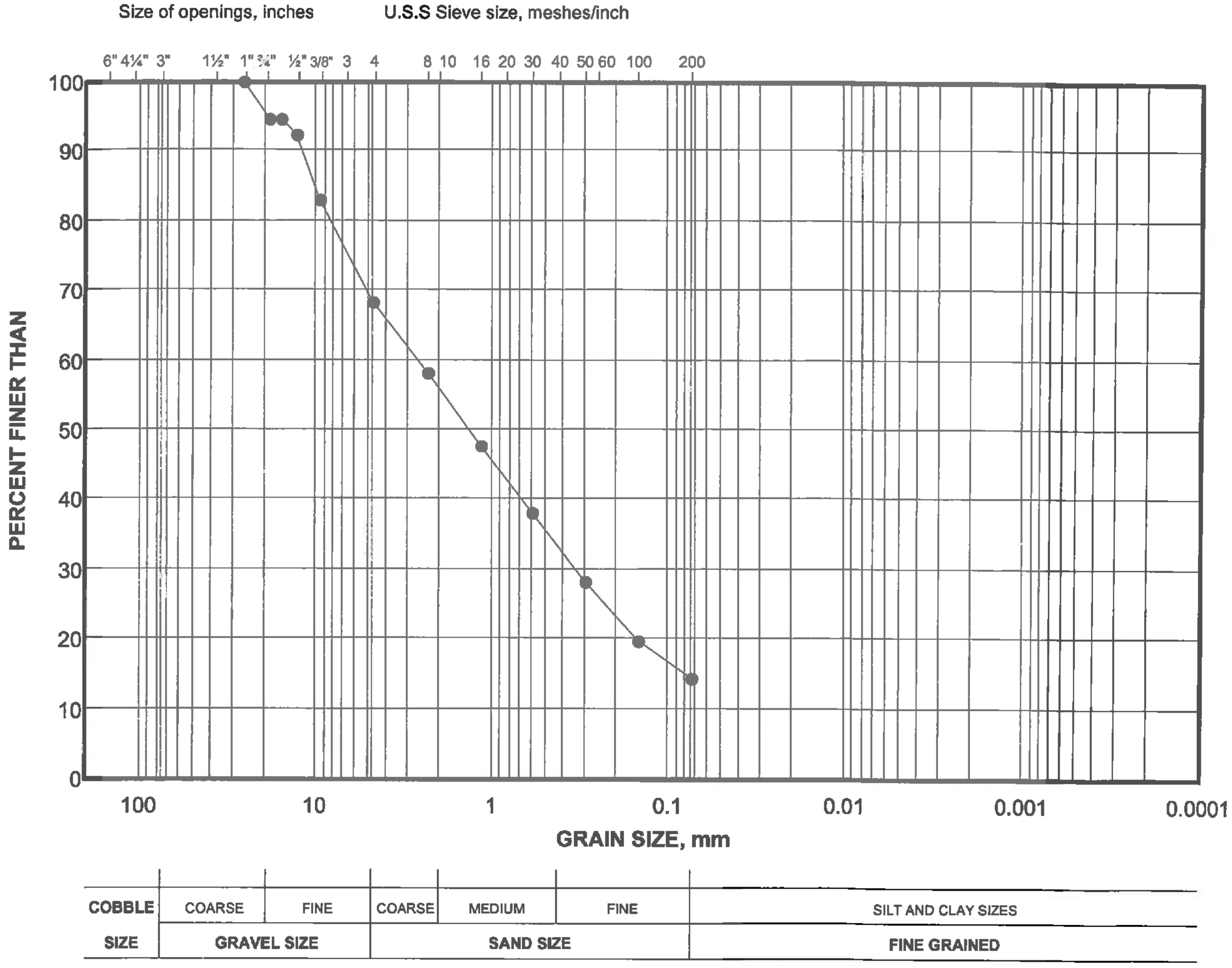
Golder Associates

Date: 09-May-17

GRAIN SIZE DISTRIBUTION

MTO LS-602

FIGURE



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	17-113	7	

Project Number: 1413472

Checked By:

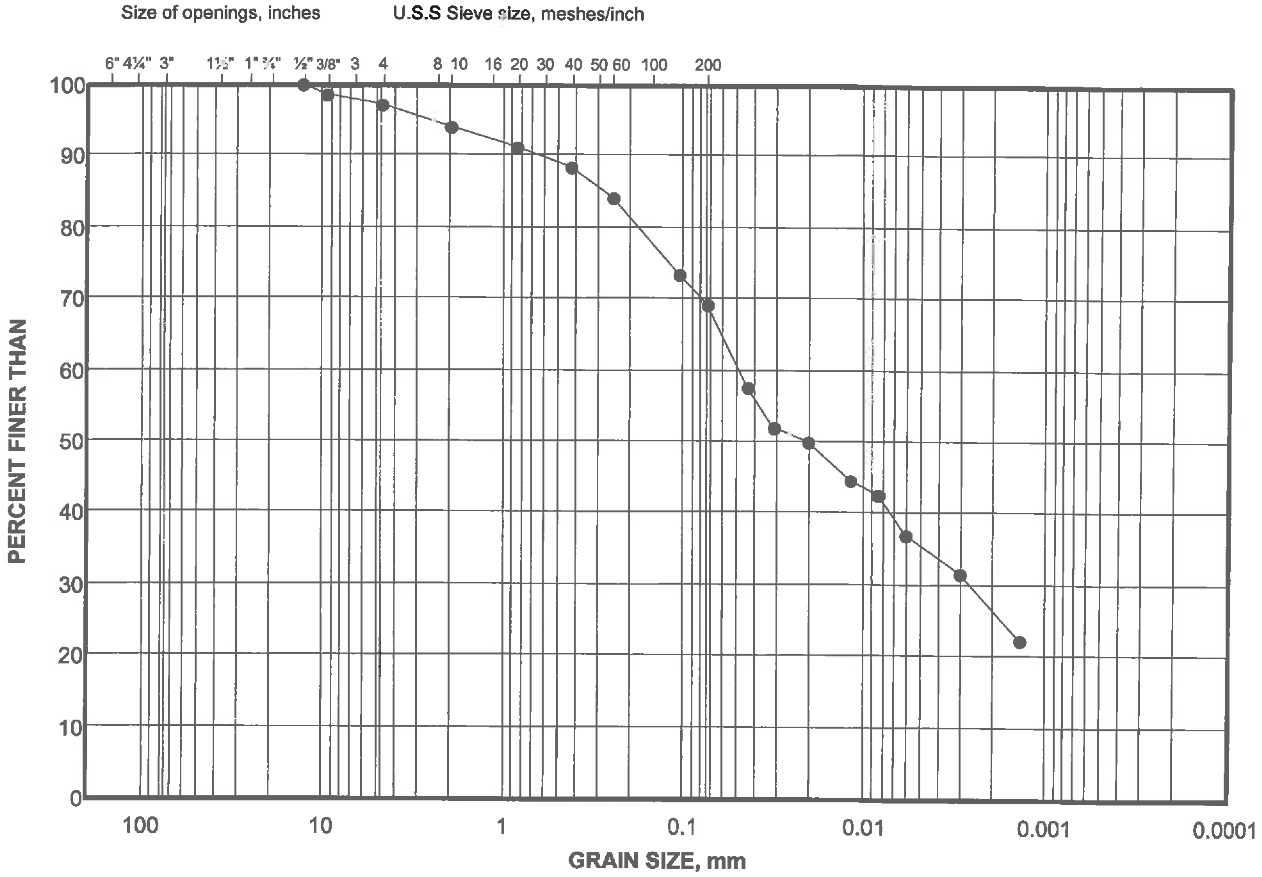
Golder Associates

Date: 09-May-17

GRAIN SIZE DISTRIBUTION

MTO LS-702

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	17-115	9	

Project Number: 1413472

Checked By: ______________

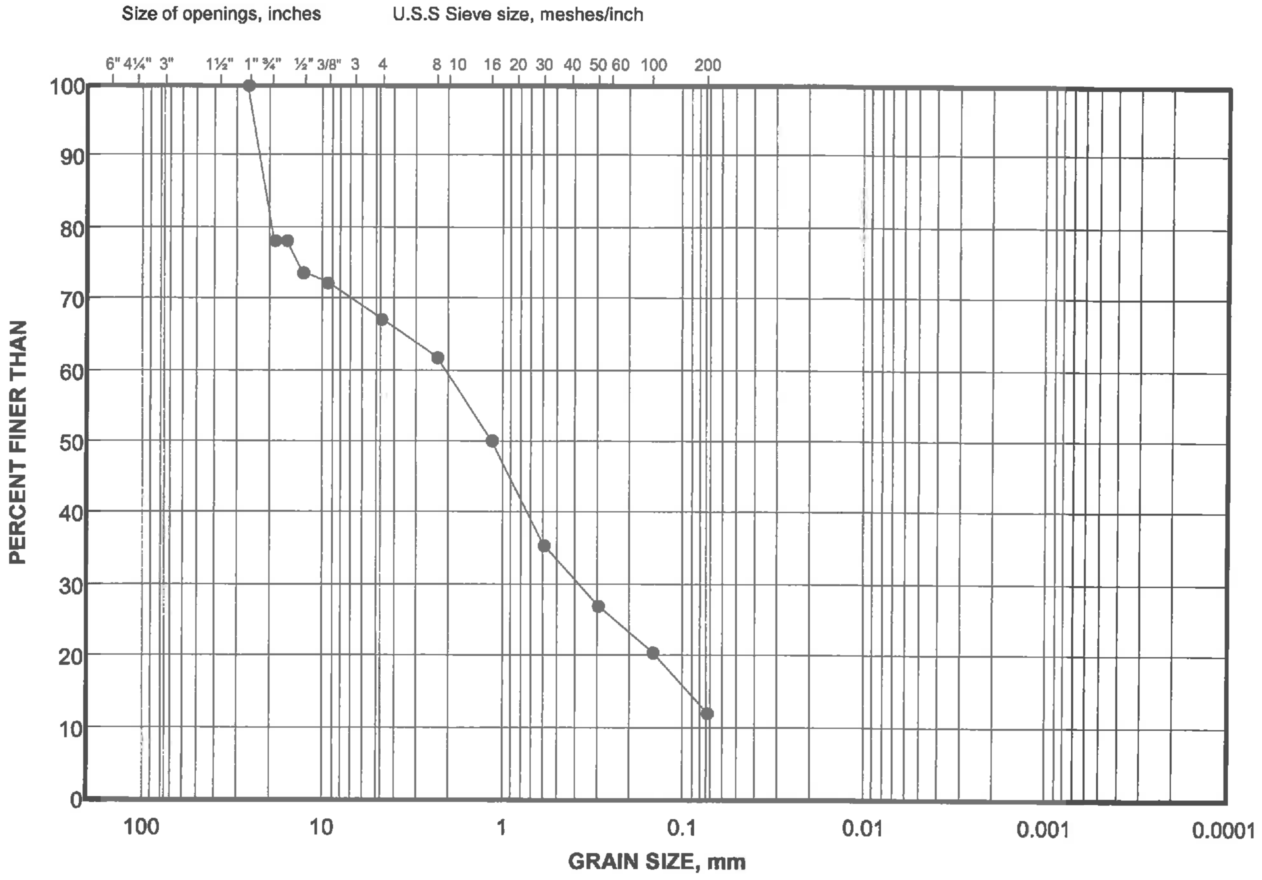
Golder Associates

Date: 09-May-17

GRAIN SIZE DISTRIBUTION

MTO LS-602

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	139	11	

Project Number: 1413472

Checked By: ______________________

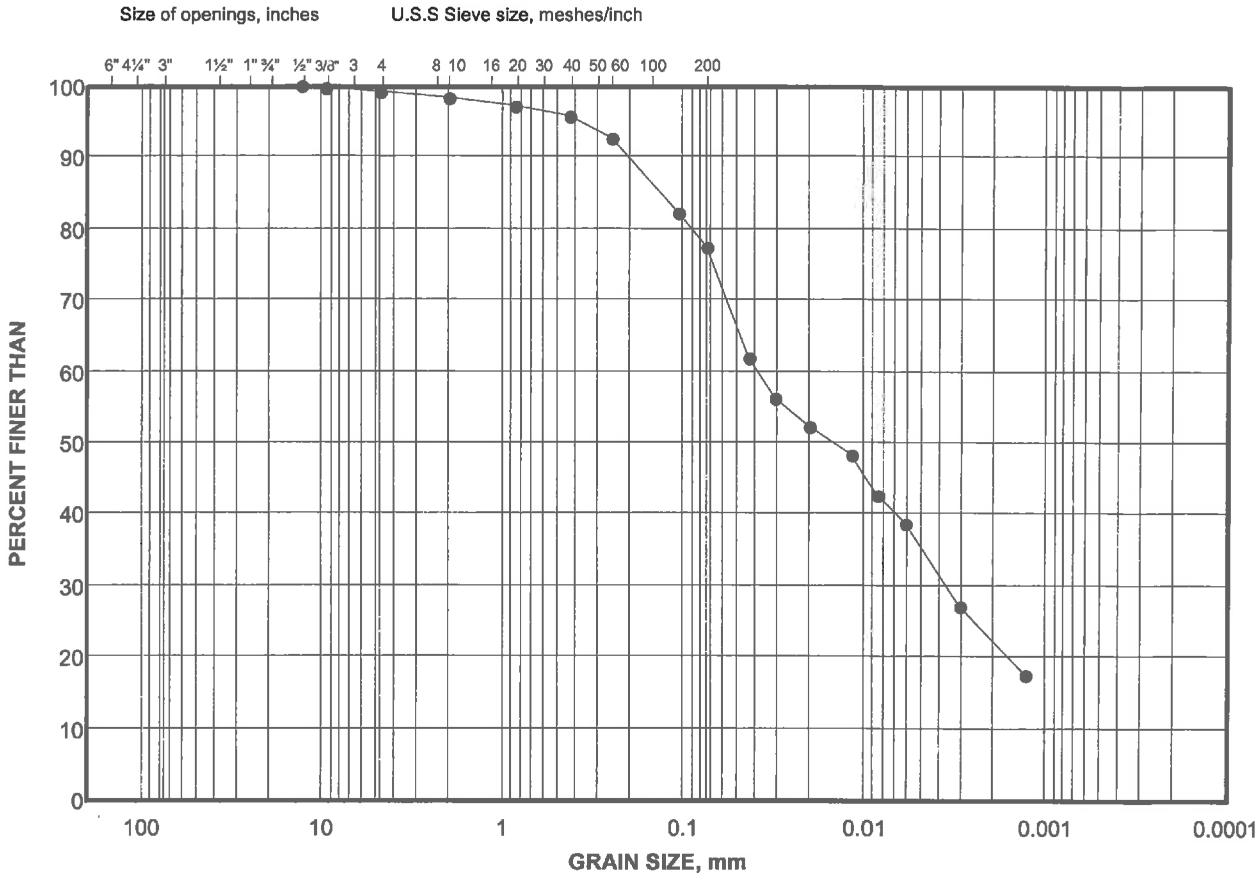
Golder Associates

Date: 19-May-17

GRAIN SIZE DISTRIBUTION

MTO LS-702

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	17-103	6	

Project Number: 1413472

Checked By: ____________

Golder Associates

Date: 19-May-17

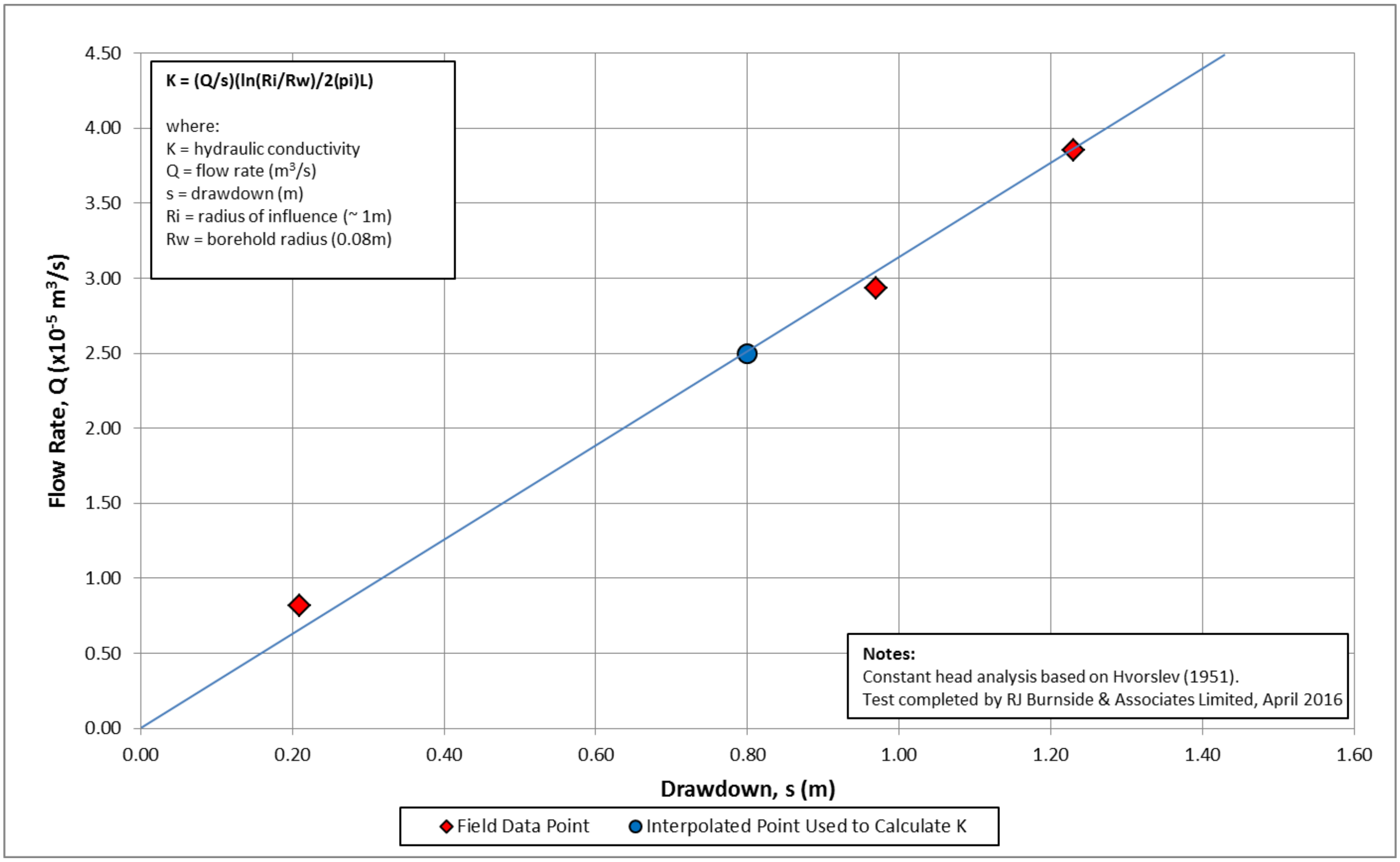
BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix D

Hydraulic Conductivity and Infiltration Tests

Appendix D



K = (Q/s)(ln(Ri/Rw)/2(pi)L)

where:
K = hydraulic conductivity
Q = flow rate (m^3/s)
s = drawdown (m)
Ri = radius of influence (~ 1m)
Rw = borehold radius (0.08m)

Notes:
Constant head analysis based on Hvorslev (1951).
Test completed by RJ Burnside & Associates Limited, April 2016

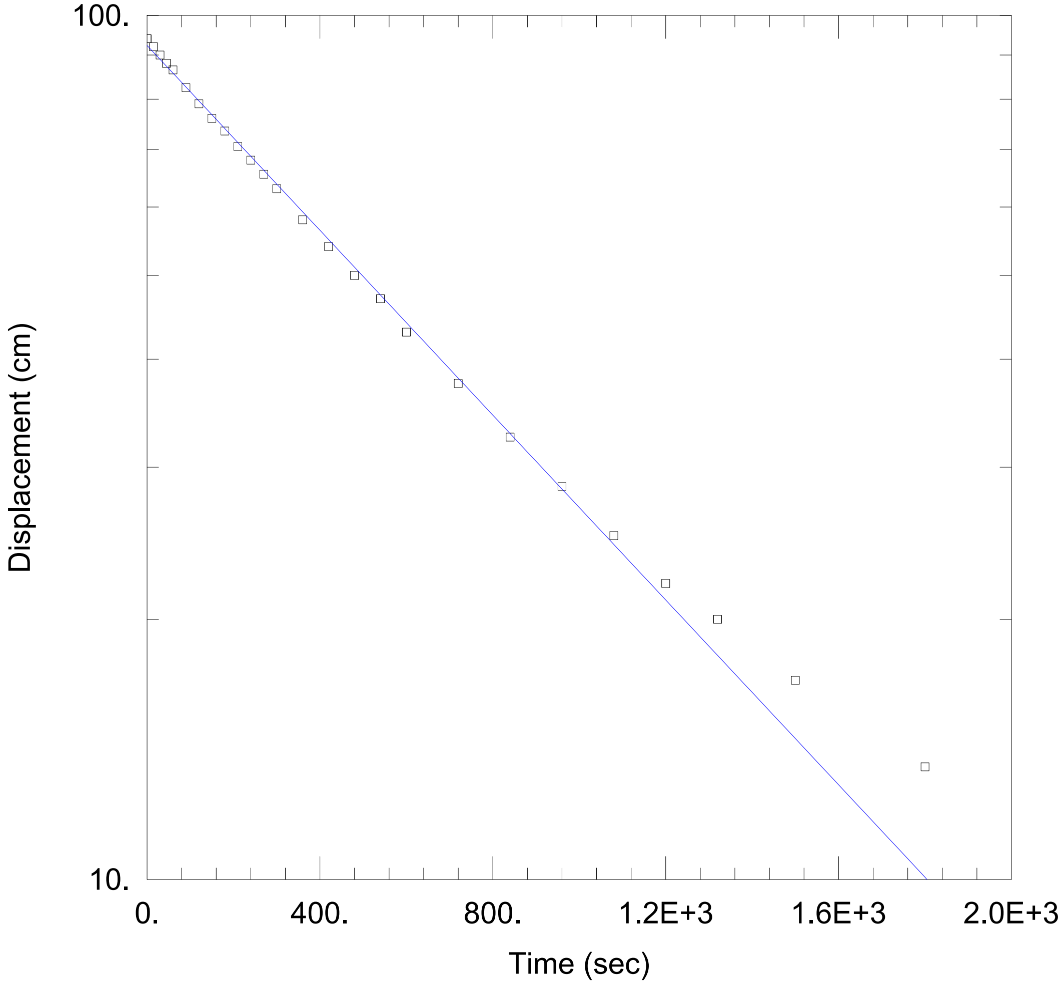
HYDRAULIC CONDUCTIVITY ANALYSIS OF CONSTANT HEAD TEST AT

BH16-5 – SCREENED IN SAND

Well	Test Type	Test Date	Test Time	SWL Depth (mbtoc)	Flow Rate, Q		PWL Depth (mbtoc)	Drawdown (m)
					(L/min)	(x10^{-5} m^3/s)		
BH16-5	Constant Head	6-Apr-16	9:00 AM	0.53	0.49	0.82	0.74	0.21
					1.76	2.93	1.50	0.97
					2.31	3.85	1.76	1.23

Selected Data Point for K Calculation (Constant Head Tests)						Geological Material	In-Situ K (m/sec)	In-Situ K (cm/sec)
Flow Rate (m^3/s)	Drawdown (m)	Saturated Interval Length, L (m)						
		SWL Elev. (masl)	PWL Elev. (masl)	Well Bottom Elev. (masl)	L (m)			
2.50E-05	0.8	186.37	185.57	180.20	1.52	Sand	8.3E-06	8.3E-04

Figure D-2



HYDRAULIC CONDUCTIVITY TEST AT BH16-6 - SCREENED IN SILTY SAND TO SANDY SILT

PROJECT INFORMATION

Company: R.J. Burnside and Associates
Client: York Downs
Project: 300038247
Location: Markham, ON
Test Well: BH16-6
Test Date: April 7, 2016

AQUIFER DATA

Saturated Thickness: 423. cm

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH16-6)

Initial Displacement: 94. cm
Total Well Penetration Depth: 423. cm
Casing Radius: 2.54 cm

Static Water Column Height: 423. cm
Screen Length: 300. cm
Well Radius: 7.62 cm

SOLUTION

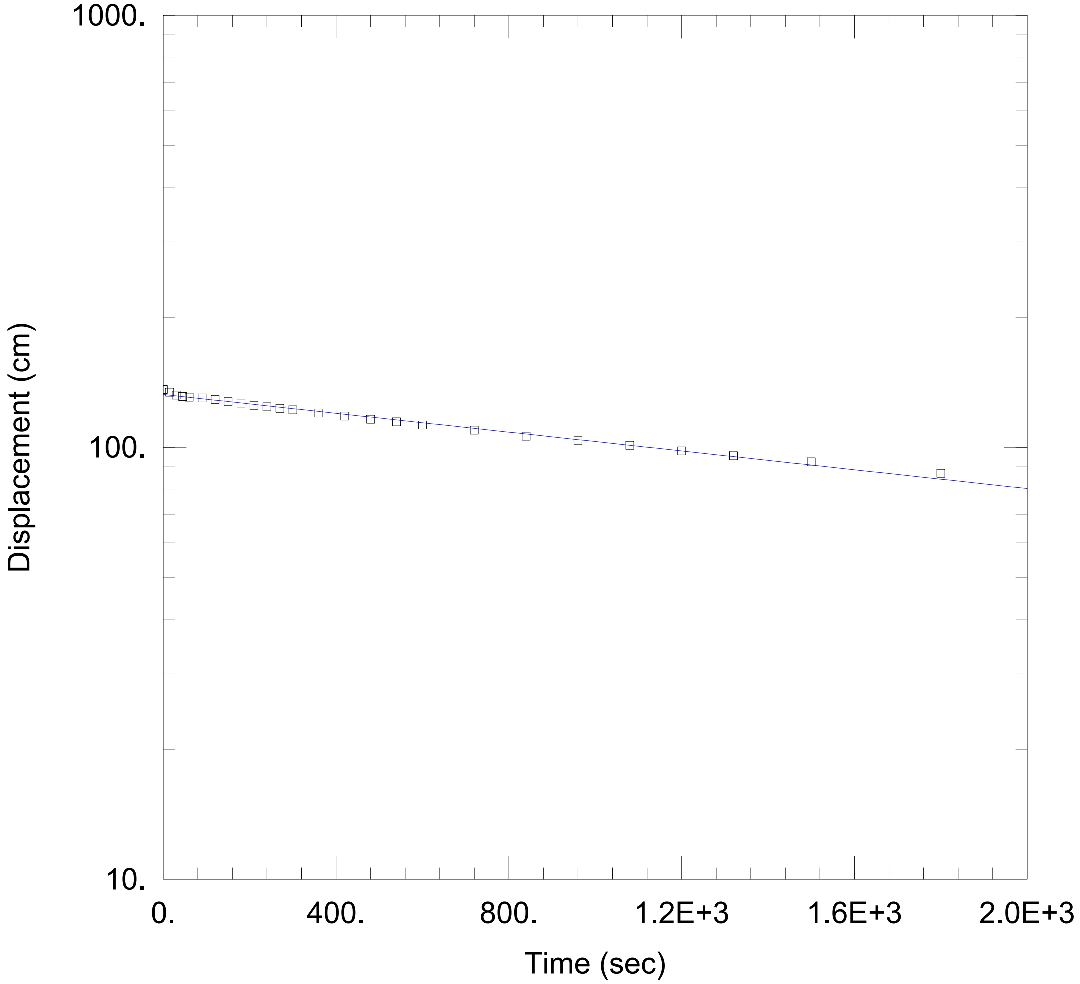
Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 5.782E-5 cm/sec

y0 = 92.31 cm

Figure D-3



HYDRAULIC CONDUCTIVITY TEST AT BH16-9 - SCREENED IN SILTY CLAY

PROJECT INFORMATION

Company: R.J. Burnside and Associates
Client: York Downs
Project: 300038247
Location: Markham, ON
Test Well: BH16-9
Test Date: April 7, 2016

AQUIFER DATA

Saturated Thickness: 429. cm
Anisotropy Ratio (Kz/Kr): 1.

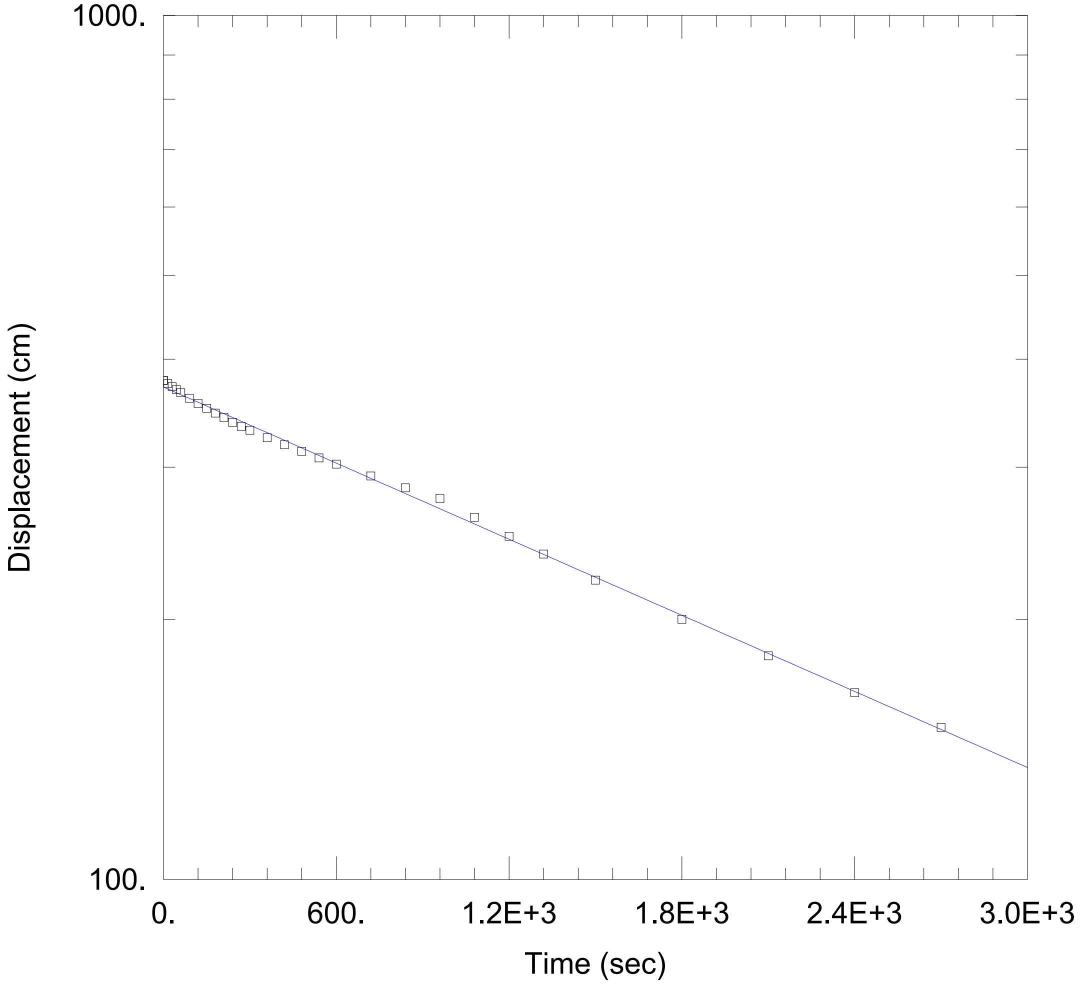
WELL DATA (BH16-9)

Initial Displacement: 136. cm
Total Well Penetration Depth: 429. cm
Casing Radius: 2.54 cm
Static Water Column Height: 429. cm
Screen Length: 300. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 1.177E-5 cm/sec
y0 = 132.4 cm



HYDRAULIC CONDUCTIVITY TEST AT BH16-12S - SCREENED IN SANDY SILT

PROJECT INFORMATION

Company: R.J. Burnside and Associates
Client: York Downs
Project: 300038247
Location: Markham, ON
Test Well: BH16-12s
Test Date: April 6, 2016

AQUIFER DATA

Saturated Thickness: 560. cm

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH16-12s)

Initial Displacement: 378. cm
Total Well Penetration Depth: 560. cm
Casing Radius: 2.54 cm

Static Water Column Height: 560. cm
Screen Length: 300. cm
Well Radius: 7.62 cm

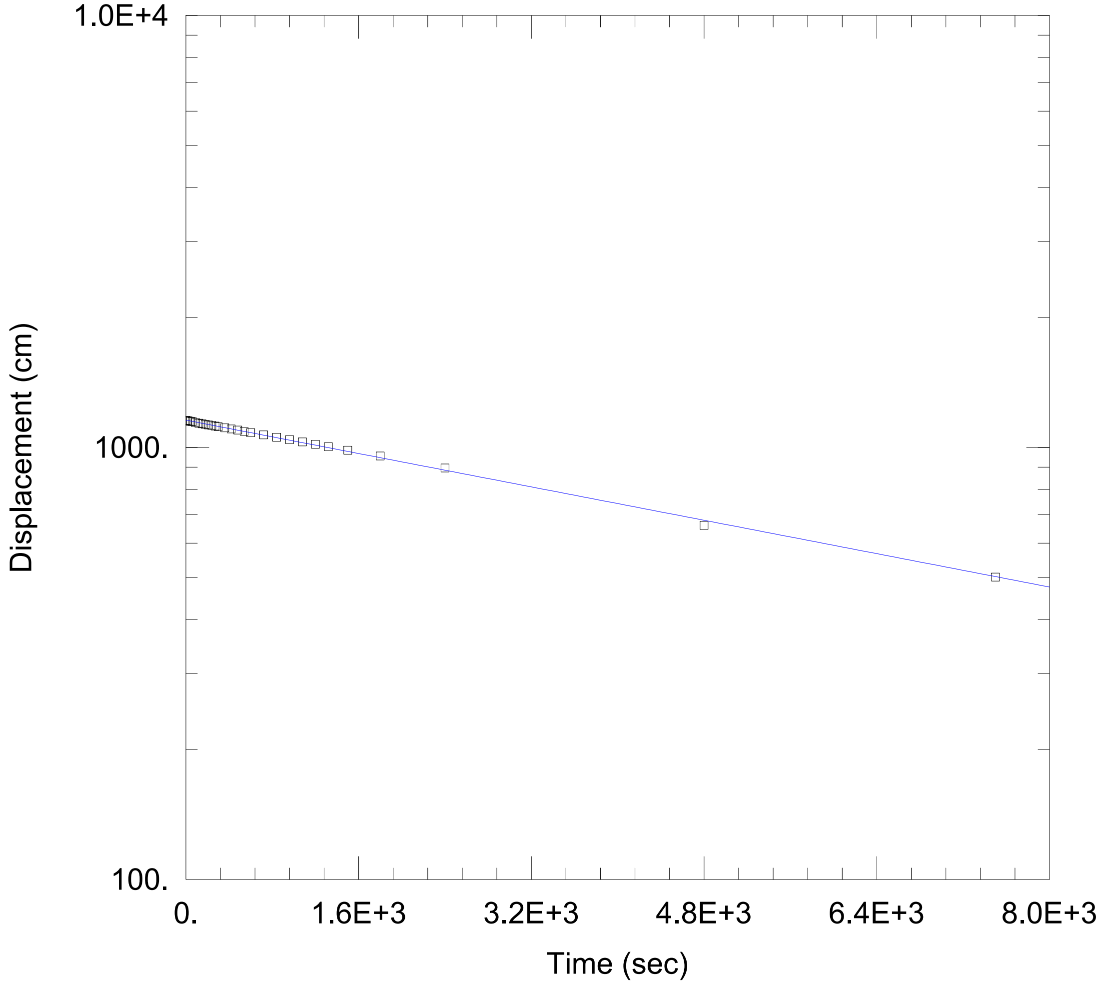
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 1.587E-5 cm/sec

y0 = 371.4 cm



HYDRAULIC CONDUCTIVITY TEST AT BH16-13D - SCREENED IN SANDY SILT TO SILT/SAND

PROJECT INFORMATION

Company: R.J. Burnside and Associates
Client: York Downs
Project: 300038247
Location: Markham, ON
Test Well: BH16-13d
Test Date: April 7, 2016

AQUIFER DATA

Saturated Thickness: 1572. cm

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH16-13d)

Initial Displacement: 1156. cm
Total Well Penetration Depth: 1572. cm
Casing Radius: 2.54 cm

Static Water Column Height: 1572. cm
Screen Length: 150. cm
Well Radius: 7.62 cm

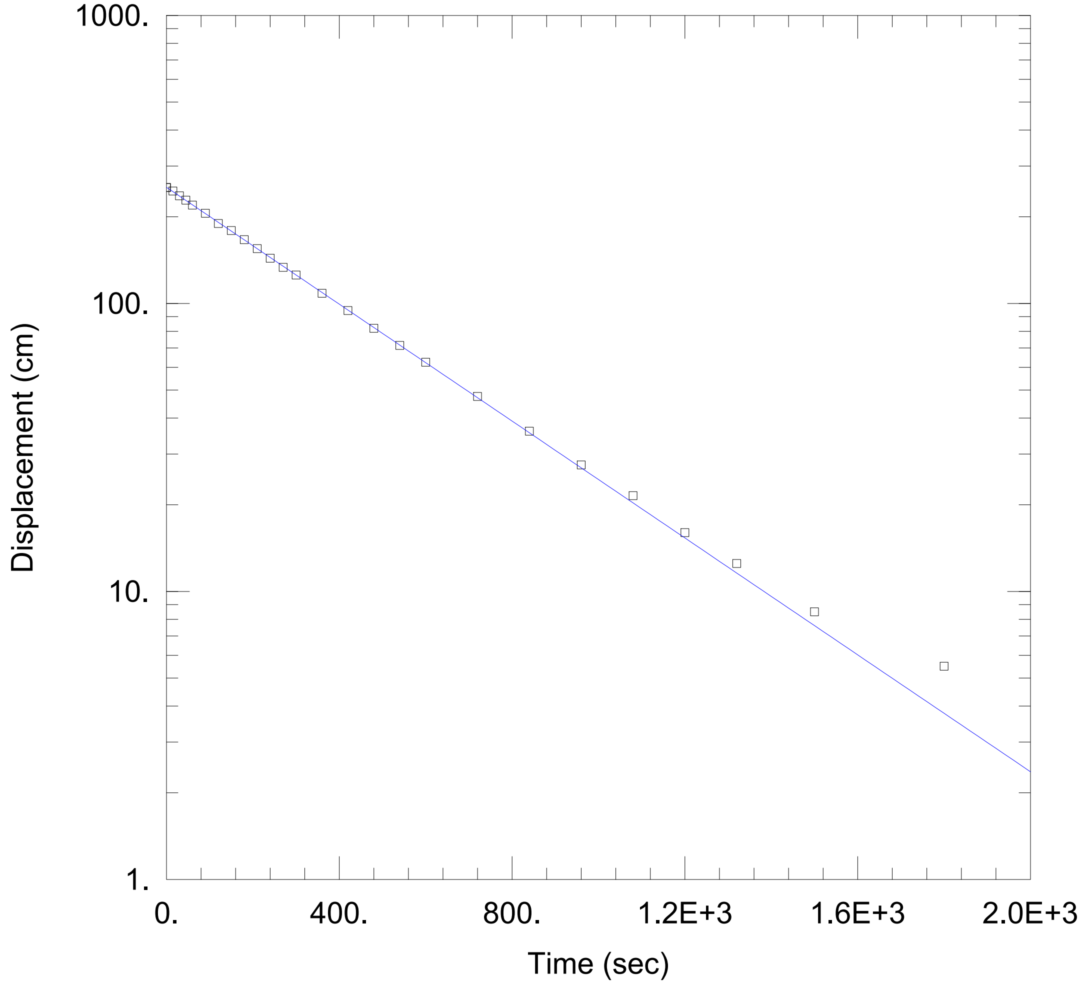
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 8.784E-6 cm/sec

y0 = 1156.6 cm



HYDRAULIC CONDUCTIVITY TEST AT BH16-14S - SCREENED IN SILTY SAND TO SAND

PROJECT INFORMATION

Company: R.J. Burnside and Associates
Client: York Downs
Project: 300038247
Location: Markham, ON
Test Well: BH16-14s
Test Date: April 7, 2016

AQUIFER DATA

Saturated Thickness: 396.5 cm

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH16-14s)

Initial Displacement: 252.5 cm
Total Well Penetration Depth: 396.5 cm
Casing Radius: 2.54 cm

Static Water Column Height: 396.5 cm
Screen Length: 90. cm
Well Radius: 7.62 cm

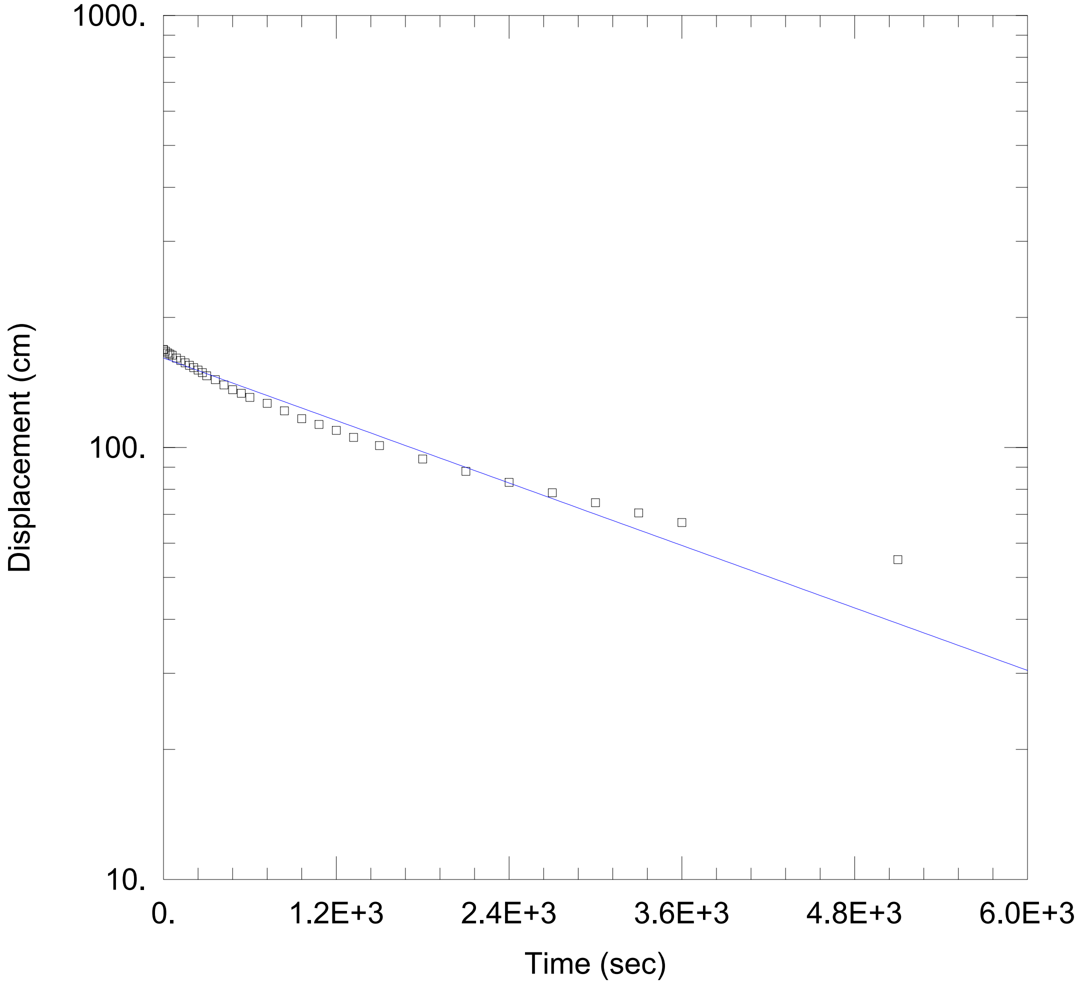
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 0.000265 cm/sec

y0 = 253. cm



HYDRAULIC CONDUCTIVITY TEST AT BH16-15S - SCREENED IN SAND/SILT TO SAND

PROJECT INFORMATION

Company: R.J. Burnside and Associates
Client: York Downs
Project: 300038247
Location: Markham, ON
Test Well: BH16-15s
Test Date: April 6, 2016

AQUIFER DATA

Saturated Thickness: 233.5 cm
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH16-15s)

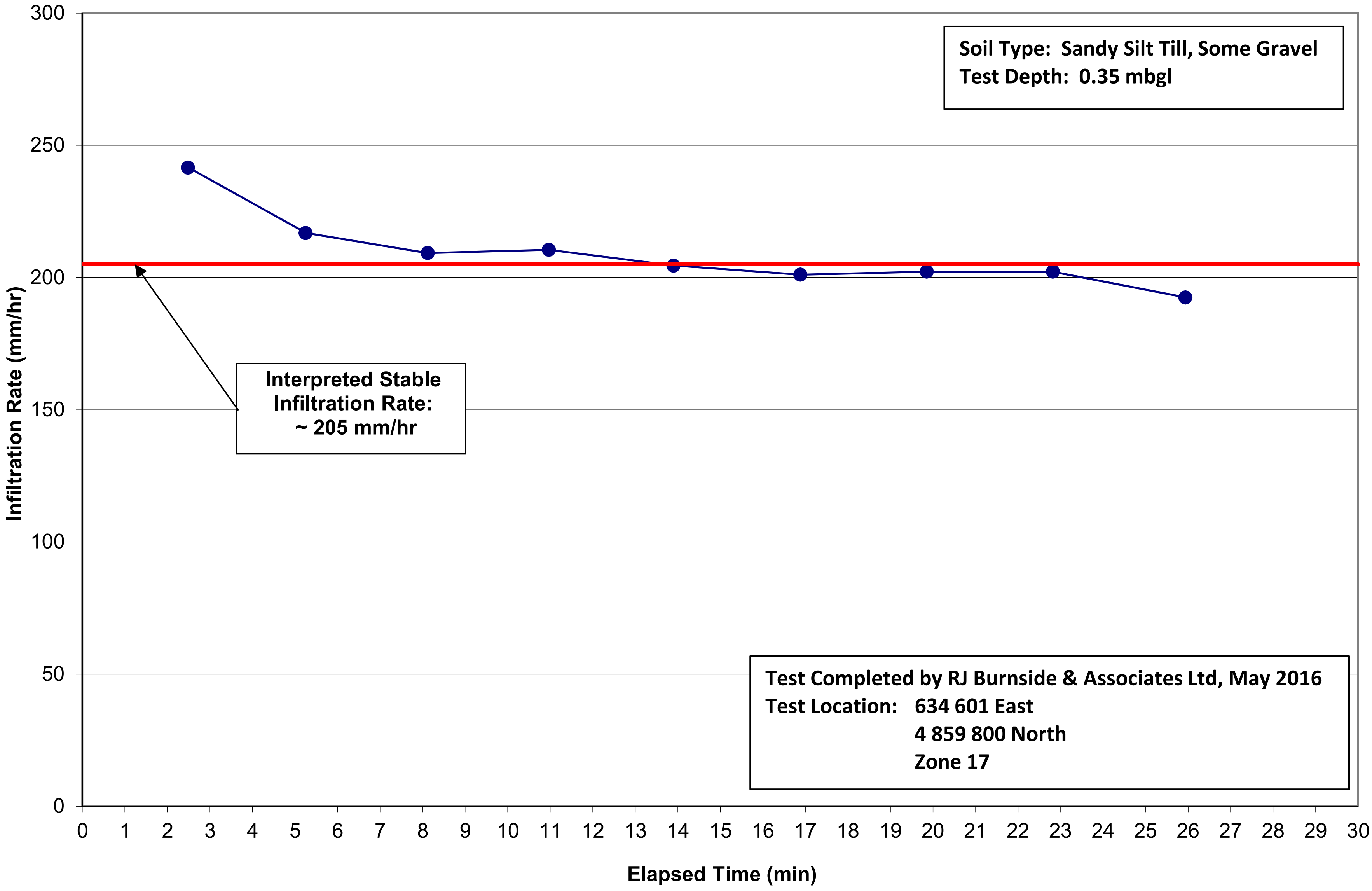
Initial Displacement: 168.5 cm
Total Well Penetration Depth: 233.5 cm
Casing Radius: 2.54 cm
Static Water Column Height: 233.5 cm
Screen Length: 60. cm
Well Radius: 7.62 cm

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 4.118E-5 cm/sec
y0 = 161. cm

Infiltration Rate at IT1



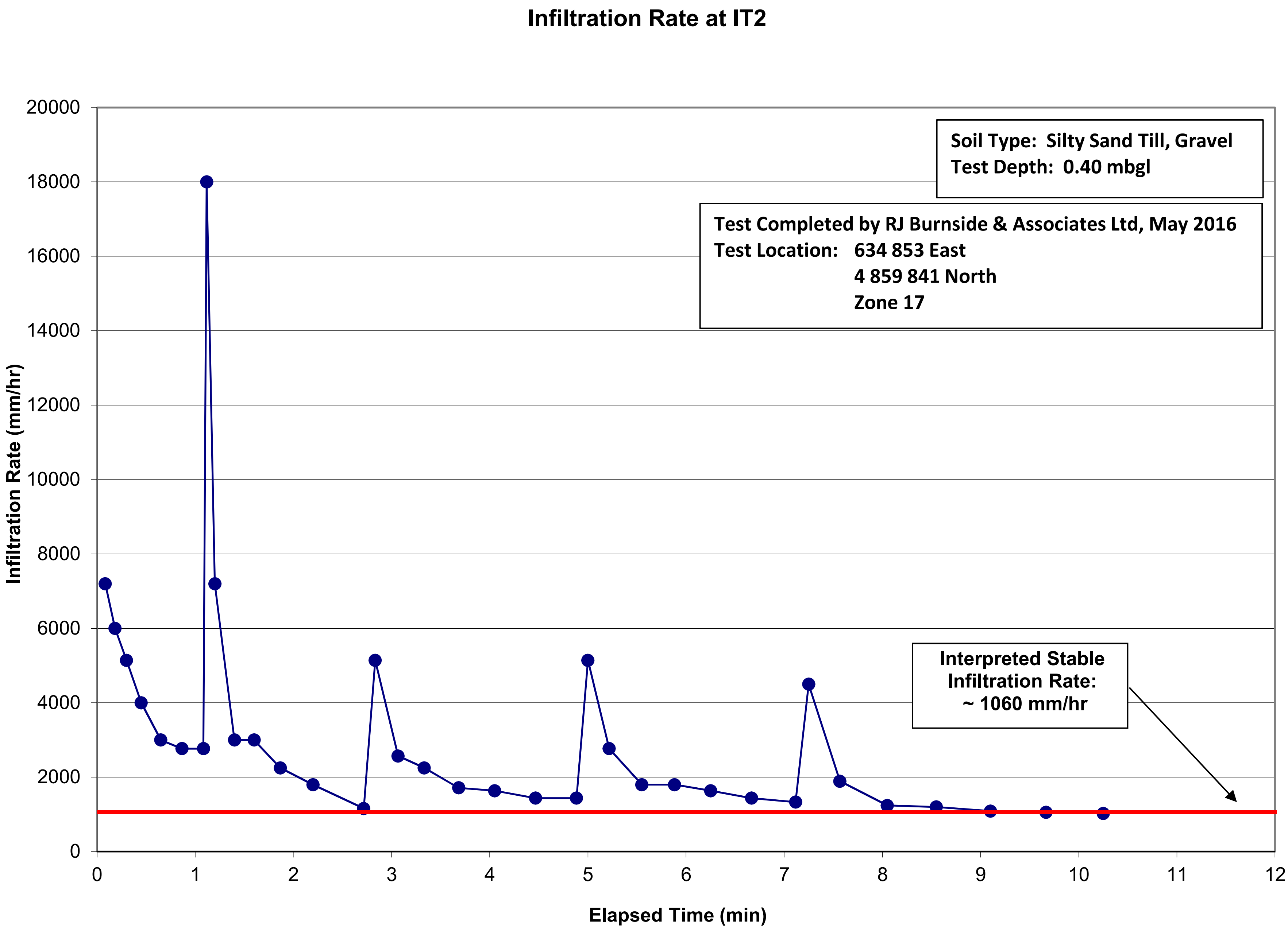
Soil Type: Sandy Silt Till, Some Gravel
Test Depth: 0.35 mbgl

Interpreted Stable Infiltration Rate: ~ 205 mm/hr

Test Completed by RJ Burnside & Associates Ltd, May 2016
Test Location: 634 601 East
4 859 800 North
Zone 17

R.J. Burnside & Associates Limited
York Downs
300038247

Figure D-8



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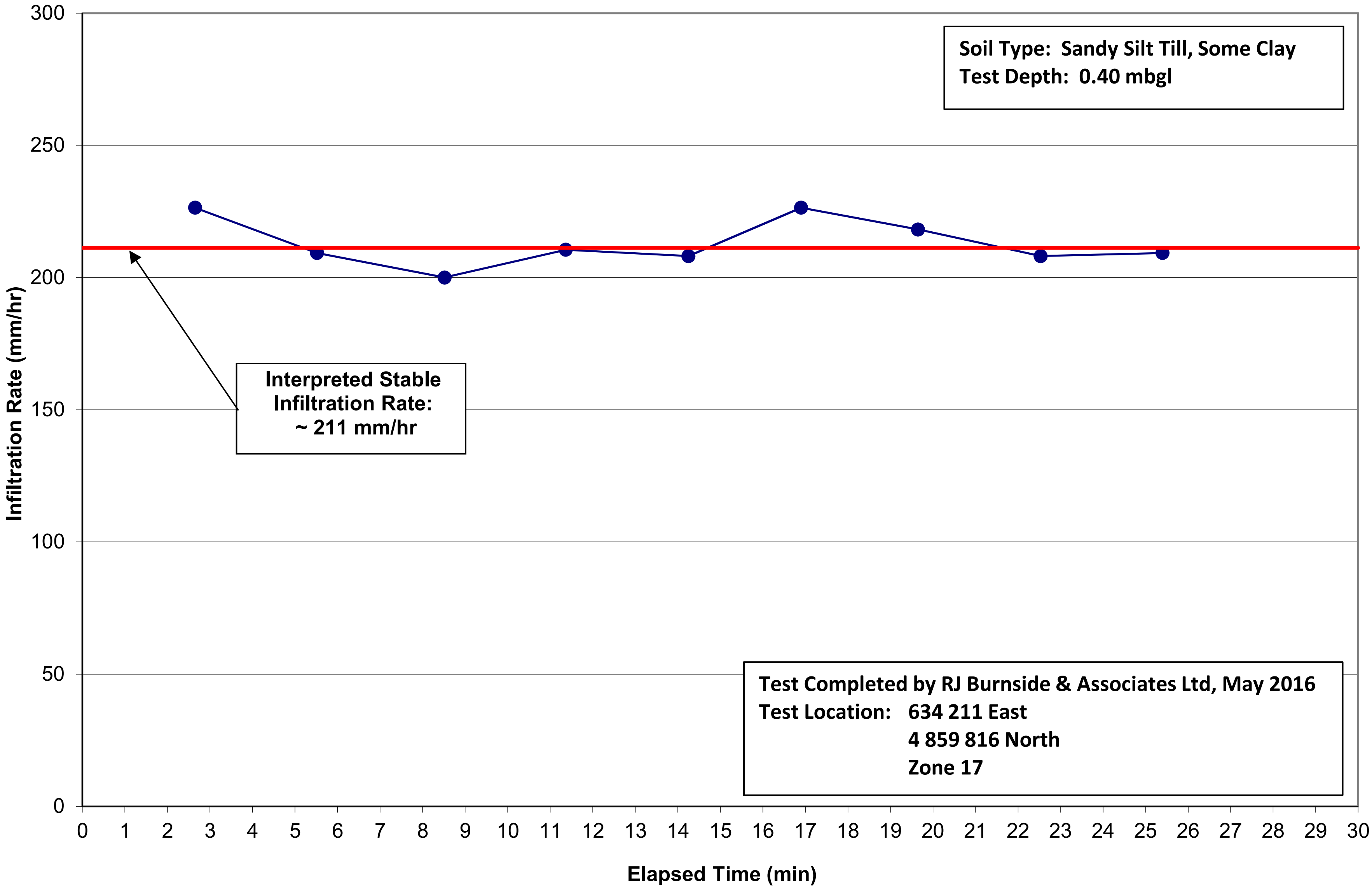
York Downs
300038247

Figure D-9

Infiltration Rate at IT3



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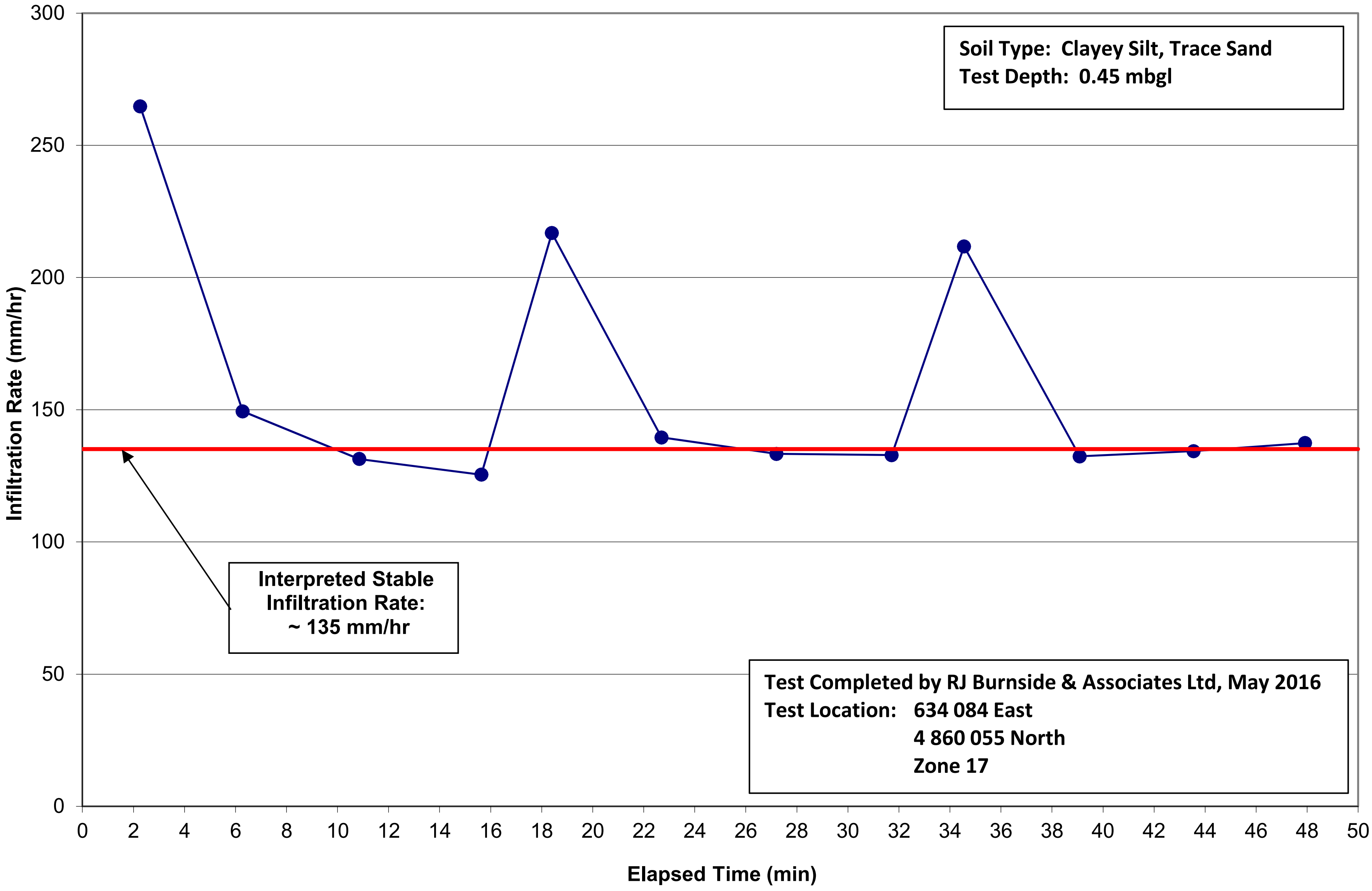
York Downs
300038247

Figure D-10

Infiltration Rate at IT4



Soil Type: Clayey Silt, Trace Sand
Test Depth: 0.45 mbgl

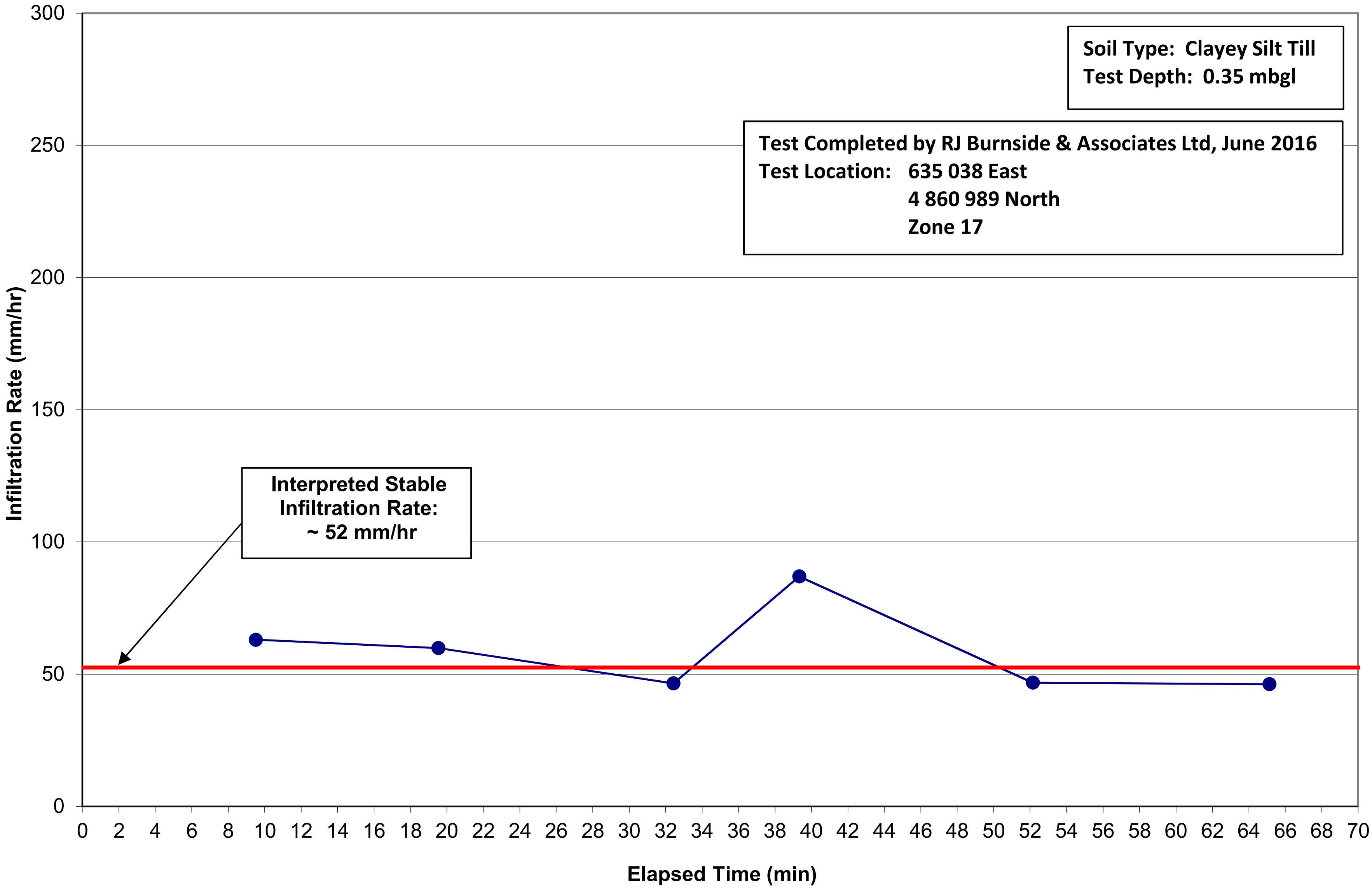
Interpreted Stable
Infiltration Rate:
~ 135 mm/hr

Test Completed by RJ Burnside & Associates Ltd, May 2016
Test Location: 634 084 East
4 860 055 North
Zone 17

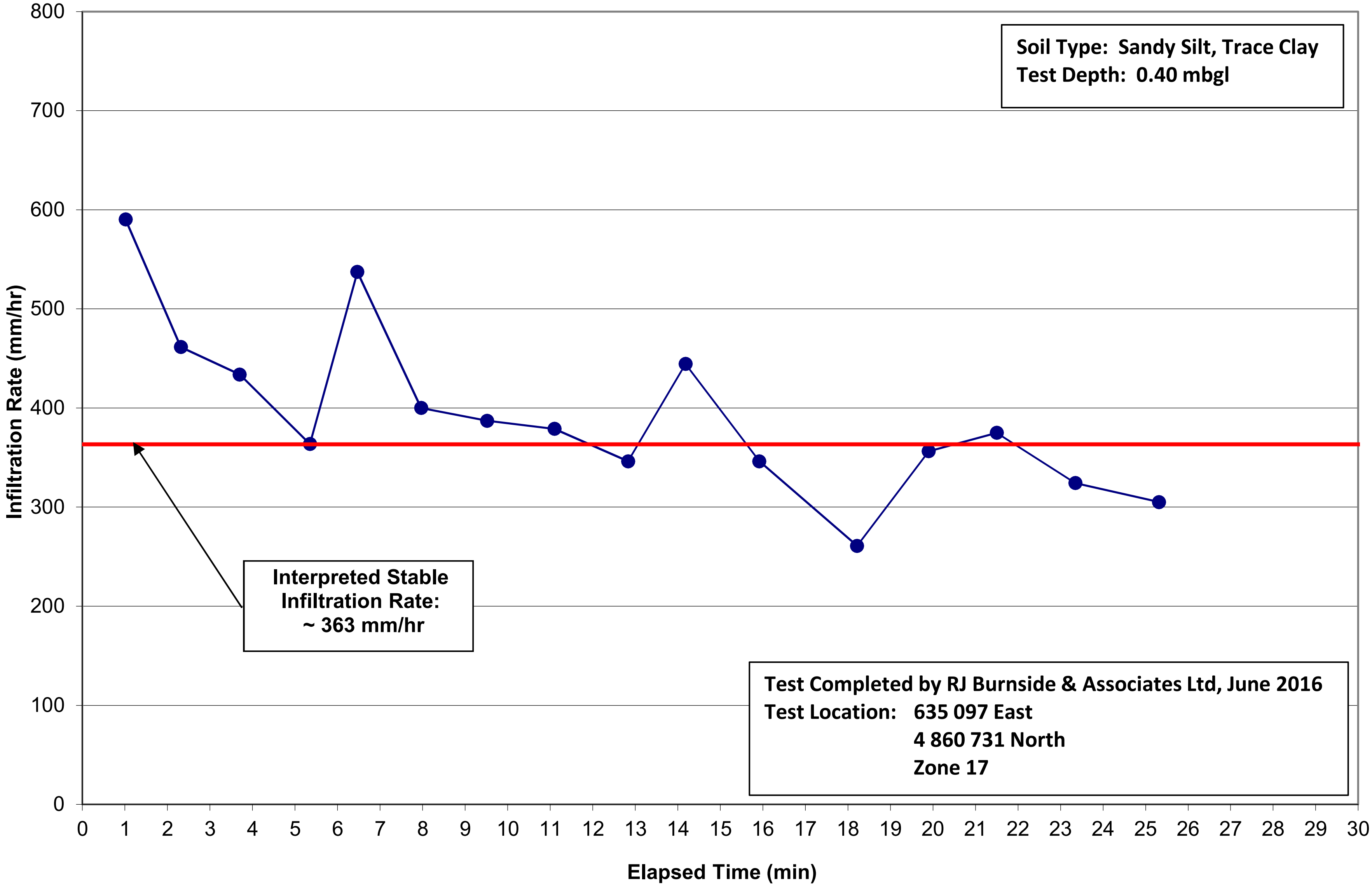
R.J. Burnside & Associates Limited
York Downs
300038247

Figure D-11

Infiltration Rate at IT5



Infiltration Rate at IT6



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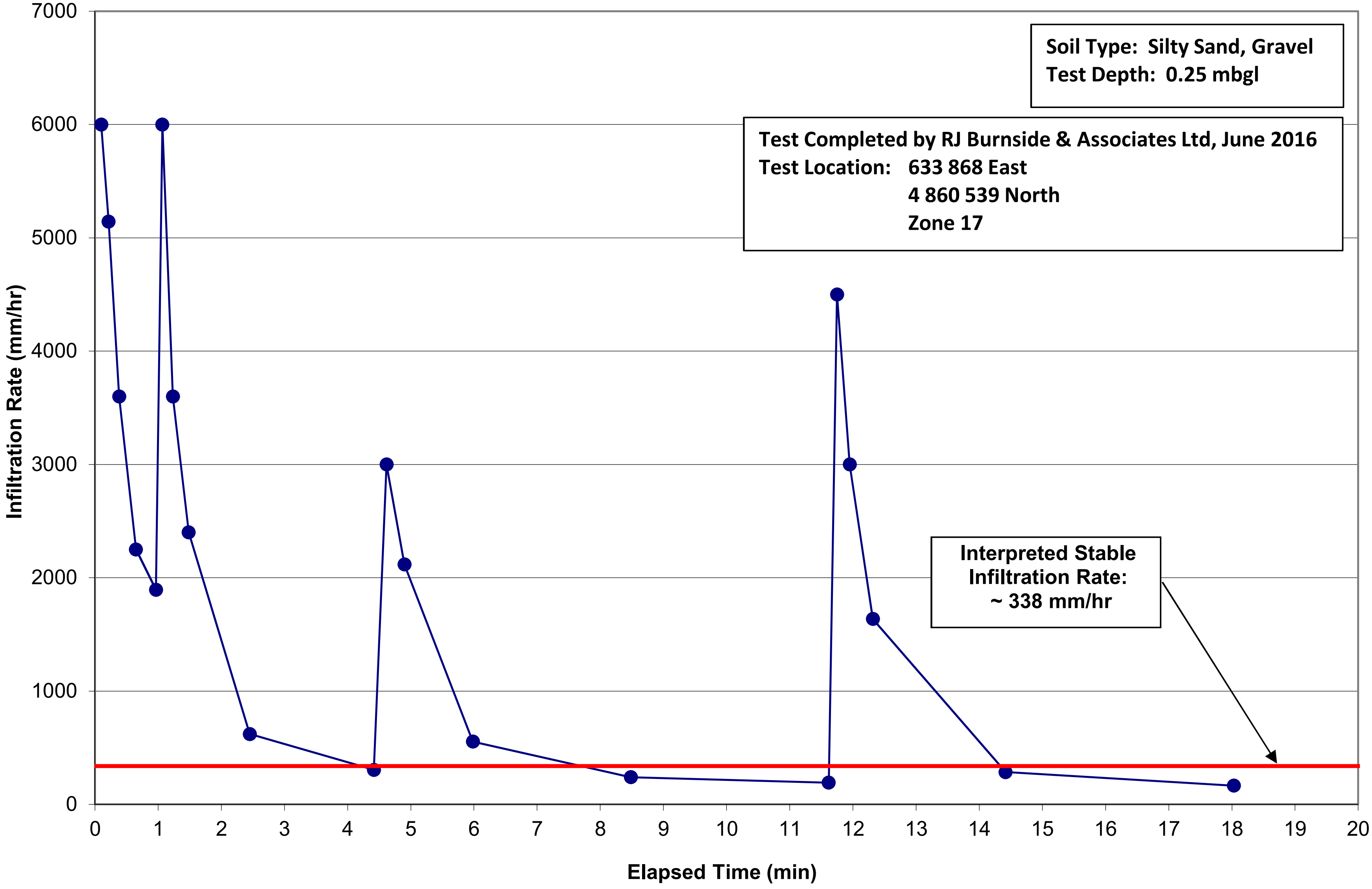
300038247

Figure D-13

Infiltration Rate at IT7



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300038247

Figure D-14

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix E

Groundwater Elevation Data

Table E-1
Monitoring Well Groundwater Elevations

Well	Well Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	29-Mar-16		22-Apr-16		20-May-16		29-Jun-16	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
BH16-3	**5.87**	**0.88**	**197.56**	4.54	193.02	4.36	193.20	4.55	193.01	4.75	192.81
BH16-4	**6.02**	**0.83**	**184.71**	1.39	183.32	1.17	183.54	1.35	183.36	1.52	183.19
BH16-5	**5.88**	**0.82**	**186.08**	-0.29	186.37	-0.25	186.33	0.31	185.78	0.69	185.39
BH16-6	**4.39**	**0.72**	**186.88**	0.38	186.50	0.59	186.29	0.87	186.02	1.47	185.42
BH16-7	**4.33**	**0.74**	**187.59**	2.72	184.88	2.88	184.72	2.95	184.64	3.00	184.60
BH16-8	**6.03**	**0.81**	**183.22**	0.52	182.70	1.17	182.06	1.49	181.74	1.78	181.45
BH16-9	**4.76**	**0.84**	**183.30**	0.61	182.69	0.72	182.58	0.92	182.39	1.10	182.20
BH16-10	**5.78**	**0.78**	**190.66**	0.15	190.51	0.67	190.00	0.81	189.85	1.47	189.19
BH16-11	**5.91**	**0.74**	**181.20**	3.17	178.03	3.25	177.95	3.44	177.77	3.64	177.56
BH16-12s	**5.82**	**0.75**	**190.11**	0.39	189.72	0.97	189.14	1.40	188.71	1.78	188.33
BH16-12d	**15.72**	**0.73**	**190.08**	-0.70	190.78	-0.65	190.73	-0.53	190.61	-0.31	190.39
BH16-13s	**6.20**	**0.83**	**184.14**	1.68	182.47	1.79	182.35	2.32	181.83	2.63	181.51
BH16-13d	**16.10**	**0.93**	**184.07**	0.54	183.54	0.78	183.30	1.21	182.87	1.34	182.74
BH16-14s	**5.73**	**0.77**	**177.45**	1.86	175.59	2.07	175.39	2.17	175.28	2.33	175.12
BH16-14d	**15.51**	**0.74**	**177.45**	1.71	175.74	1.85	175.60	1.94	175.51	2.11	175.35
BH16-15s	**5.07**	**0.78**	**180.87**	2.91	177.96	3.22	177.65	3.47	177.40	3.80	177.07
BH16-15d	**14.29**	**0.73**	**180.87**	3.99	176.88	4.00	176.87	4.26	176.61	4.49	176.39
BH16-16	**12.43**	**0.81**	**179.60**	-0.32	179.92	-0.32	179.92	0.17	179.43	0.48	179.13
BH14-1	**3.50**	**0.00**	**178.59**	-	-	0.70	177.89	-	-	1.01	177.58
BH14-2	**3.60**	**0.00**	**178.74**	-	-	1.19	177.55	-	-	1.49	177.25
BH14-3	**3.70**	**0.00**	**178.67**	-	-	1.12	177.55	-	-	1.40	177.27
BH14-8	**5.01**	**0.81**	**196.19**	2.87	193.32	3.18	193.01	3.68	192.51	3.97	192.22
BH14-12	**4.55**	**0.00**	**179.48**	-	-	1.66	177.83	1.87	177.61	2.42	177.06
BH14-15	**5.80**	**1.06**	**179.83**	3.79	176.04	3.96	175.88	4.06	175.77	4.30	175.54
BH14-17	**6.13**	**1.02**	**194.43**	2.17	192.26	2.57	191.87	2.79	191.65	3.99	190.44
BH14-29	**6.14**	**0.68**	**190.39**	0.71	189.69	0.55	189.85	0.64	189.75	0.95	189.45
BH14-33	**7.46**	**0.93**	**194.67**	3.17	191.50	2.89	191.78	3.21	191.47	3.33	191.35
BH17-104	**7.05**	**0.00**	**186.74**	-	-	-	-	-	-	-	-
BH17-106	**10.26**	**0.00**	**181.76**	-	-	-	-	-	-	-	-
BH17-110	**8.15**	**0.00**	**184.00**	-	-	-	-	-	-	-	-
BH17-115	**11.88**	**0.98**	**180.74**	-	-	-	-	-	-	-	-
BH17-127	**7.87**	**0.96**	**189.56**	-	-	-	-	-	-	-	-
BH17-130	**12.00**	**0.00**	**183.95**	-	-	-	-	-	-	-	-
BH17-131	**8.88**	**0.00**	**185.96**	-	-	-	-	-	-	-	-
BH17-137	**10.68**	**0.90**	**181.66**	-	-	-	-	-	-	-	-
BH17-139s	**6.08**	**0.89**	**184.00**	-	-	-	-	-	-	-	-
BH17-139d	**11.13**	**0.91**	**184.00**	-	-	-	-	-	-	-	-
BH17-140	**6.05**	**0.99**	**186.89**	-	-	-	-	-	-	-	-
BH17-147	**10.25**	**0.85**	**194.67**	-	-	-	-	-	-	-	-
BH17-05	**14.13**	**0.00**	**179.72**	-	-	-	-	-	-	-	-

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round or unavailable data

Table E-1
Monitoring Well Groundwater Elevations

Well	Well Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	29-Jul-16		31-Aug-16		06-Oct-16		28-Oct-16	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
BH16-3	**5.87**	**0.88**	**197.56**	4.92	192.64	5.04	192.52	5.18	192.38	5.23	192.33
BH16-4	**6.02**	**0.83**	**184.71**	1.61	183.10	1.60	183.11	1.66	183.05	1.64	183.07
BH16-5	**5.88**	**0.82**	**186.08**	0.70	185.38	0.90	185.18	1.07	185.01	1.09	184.99
BH16-6	**4.39**	**0.72**	**186.88**	1.31	185.57	1.33	185.55	2.06	184.82	2.18	184.70
BH16-7	**4.33**	**0.74**	**187.59**	2.92	184.68	3.00	184.60	3.04	184.56	2.98	184.62
BH16-8	**6.03**	**0.81**	**183.22**	1.79	181.44	1.73	181.50	1.74	181.49	1.80	181.43
BH16-9	**4.76**	**0.84**	**183.30**	1.17	182.13	1.24	182.06	1.73	181.57	1.78	181.52
BH16-10	**5.78**	**0.78**	**190.66**	1.97	188.69	2.28	188.38	2.67	188.00	2.55	188.11
BH16-11	**5.91**	**0.74**	**181.20**	3.84	177.37	3.88	177.33	4.05	177.16	4.11	177.10
BH16-12s	**5.82**	**0.75**	**190.11**	2.00	188.12	2.11	188.00	2.45	187.66	2.58	187.53
BH16-12d	**15.72**	**0.73**	**190.08**	-0.21	190.29	-0.08	190.16	0.01	190.07	-0.02	190.10
BH16-13s	**6.20**	**0.83**	**184.14**	3.20	180.94	3.43	180.72	3.64	180.50	3.69	180.45
BH16-13d	**16.10**	**0.93**	**184.07**	1.04	183.04	1.15	182.92	1.50	182.58	1.48	182.60
BH16-14s	**5.73**	**0.77**	**177.45**	2.33	175.12	2.39	175.07	2.35	175.10	2.30	175.15
BH16-14d	**15.51**	**0.74**	**177.45**	2.11	175.34	2.15	175.30	2.11	175.34	2.07	175.38
BH16-15s	**5.07**	**0.78**	**180.87**	4.12	176.75	4.32	176.55	4.50	176.37	4.50	176.37
BH16-15d	**14.29**	**0.73**	**180.87**	4.58	176.29	4.60	176.27	4.65	176.22	4.61	176.26
BH16-16	**12.43**	**0.81**	**179.60**	0.51	179.09	0.49	179.12	0.46	179.14	0.38	179.22
BH14-1	**3.50**	**0.00**	**178.59**	1.02	177.57	1.15	177.44	-	-	0.66	177.93
BH14-2	**3.60**	**0.00**	**178.74**	1.72	177.02	1.80	176.94	-	-	1.28	177.46
BH14-3	**3.70**	**0.00**	**178.67**	1.50	177.17	1.81	176.86	-	-	1.37	177.30
BH14-8	**5.01**	**0.81**	**196.19**	4.23	191.97	4.41	191.78	4.59	191.60	4.67	191.52
BH14-12	**4.55**	**0.00**	**179.48**	2.45	177.03	2.57	176.91	2.58	176.90	2.55	176.93
BH14-15	**5.80**	**1.06**	**179.83**	4.34	175.50	4.40	175.44	4.41	175.43	4.39	175.45
BH14-17	**6.13**	**1.02**	**194.43**	4.65	189.79	5.18	189.25	5.67	188.76	5.96	188.47
BH14-29	**6.14**	**0.68**	**190.39**	1.43	188.97	1.95	188.45	2.56	187.84	2.98	187.42
BH14-33	**7.46**	**0.93**	**194.67**	3.49	191.18	3.57	191.10	3.75	190.92	3.77	190.90
BH17-104	**7.05**	**0.00**	**186.74**	-	-	-	-	-	-	-	-
BH17-106	**10.26**	**0.00**	**181.76**	-	-	-	-	-	-	-	-
BH17-110	**8.15**	**0.00**	**184.00**	-	-	-	-	-	-	-	-
BH17-115	**11.88**	**0.98**	**180.74**	-	-	-	-	-	-	-	-
BH17-127	**7.87**	**0.96**	**189.56**	-	-	-	-	-	-	-	-
BH17-130	**12.00**	**0.00**	**183.95**	-	-	-	-	-	-	-	-
BH17-131	**8.88**	**0.00**	**185.96**	-	-	-	-	-	-	-	-
BH17-137	**10.68**	**0.90**	**181.66**	-	-	-	-	-	-	-	-
BH17-139s	**6.08**	**0.89**	**184.00**	-	-	-	-	-	-	-	-
BH17-139d	**11.13**	**0.91**	**184.00**	-	-	-	-	-	-	-	-
BH17-140	**6.05**	**0.99**	**186.89**	-	-	-	-	-	-	-	-
BH17-147	**10.25**	**0.85**	**194.67**	-	-	-	-	-	-	-	-
BH17-05	**14.13**	**0.00**	**179.72**	-	-	-	-	-	-	-	-

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round or unavailable data

Table E-1
Monitoring Well Groundwater Elevations

Well	Well Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	23-Nov-16		14-Dec-16		20-Jan-17		27-Feb-17	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
BH16-3	**5.87**	**0.88**	**197.56**	5.24	192.32	5.24	192.32	5.05	192.51	4.89	192.67
BH16-4	**6.02**	**0.83**	**184.71**	1.71	183.00	1.57	183.14	1.43	183.29	1.50	183.21
BH16-5	**5.88**	**0.82**	**186.08**	1.16	184.92	1.10	184.98	0.50	185.58	0.17	185.91
BH16-6	**4.39**	**0.72**	**186.88**	2.19	184.69	2.02	184.86	0.74	186.14	0.70	186.18
BH16-7	**4.33**	**0.74**	**187.59**	2.98	184.61	2.96	184.64	2.85	184.74	2.81	184.79
BH16-8	**6.03**	**0.81**	**183.22**	2.00	181.23	1.78	181.45	1.04	182.19	0.58	182.65
BH16-9	**4.76**	**0.84**	**183.30**	1.65	181.65	1.31	181.99	1.05	182.25	0.92	182.38
BH16-10	**5.78**	**0.78**	**190.66**	2.33	188.33	2.09	188.57	0.23	190.43	0.30	190.36
BH16-11	**5.91**	**0.74**	**181.20**	4.08	177.13	3.93	177.28	3.57	177.64	3.39	177.82
BH16-12s	**5.82**	**0.75**	**190.11**	2.72	187.39	1.99	188.12	0.60	189.51	0.47	189.64
BH16-12d	**15.72**	**0.73**	**190.08**	0.00	190.08	-	-	0.09	189.99	-0.58	190.66
BH16-13s	**6.20**	**0.83**	**184.14**	3.56	180.58	3.31	180.83	2.45	181.69	1.91	182.23
BH16-13d	**16.10**	**0.93**	**184.07**	1.41	182.67	1.11	182.97	0.34	183.73	0.25	183.83
BH16-14s	**5.73**	**0.77**	**177.45**	2.29	175.16	2.26	175.19	2.04	175.41	1.98	175.47
BH16-14d	**15.51**	**0.74**	**177.45**	2.06	175.39	2.04	175.41	1.84	175.61	1.78	175.67
BH16-15s	**5.07**	**0.78**	**180.87**	4.57	176.30	4.39	176.48	3.49	177.38	3.49	177.38
BH16-15d	**14.29**	**0.73**	**180.87**	4.64	176.23	-	-	4.17	176.70	4.12	176.75
BH16-16	**12.43**	**0.81**	**179.60**	0.30	179.30	0.26	179.34	0.05	179.55	-0.19	179.79
BH14-1	**3.50**	**0.00**	**178.59**	0.62	177.97	-	-	-	-	-	-
BH14-2	**3.60**	**0.00**	**178.74**	1.25	177.49	-	-	-	-	-	-
BH14-3	**3.70**	**0.00**	**178.67**	-	-	-	-	-	-	-	-
BH14-8	**5.01**	**0.81**	**196.19**	4.70	191.49	4.72	191.47	4.40	191.79	3.59	192.60
BH14-12	**4.55**	**0.00**	**179.48**	2.34	177.14	-	-	1.42	178.06	0.54	178.94
BH14-15	**5.80**	**1.06**	**179.83**	4.40	175.44	-	-	4.05	175.79	3.96	175.88
BH14-17	**6.13**	**1.02**	**194.43**	5.95	188.48	5.96	188.47	5.23	189.20	2.49	191.94
BH14-29	**6.14**	**0.68**	**190.39**	3.16	187.24	3.22	187.18	2.47	187.93	1.69	188.71
BH14-33	**7.46**	**0.93**	**194.67**	3.79	190.88	3.81	190.86	3.35	191.32	3.24	191.43
BH17-104	**7.05**	**0.00**	**186.74**	-	-	-	-	-	-	-	-
BH17-106	**10.26**	**0.00**	**181.76**	-	-	-	-	-	-	-	-
BH17-110	**8.15**	**0.00**	**184.00**	-	-	-	-	-	-	-	-
BH17-115	**11.88**	**0.98**	**180.74**	-	-	-	-	-	-	-	-
BH17-127	**7.87**	**0.96**	**189.56**	-	-	-	-	-	-	-	-
BH17-130	**12.00**	**0.00**	**183.95**	-	-	-	-	-	-	-	-
BH17-131	**8.88**	**0.00**	**185.96**	-	-	-	-	-	-	-	-
BH17-137	**10.68**	**0.90**	**181.66**	-	-	-	-	-	-	-	-
BH17-139s	**6.08**	**0.89**	**184.00**	-	-	-	-	-	-	-	-
BH17-139d	**11.13**	**0.91**	**184.00**	-	-	-	-	-	-	-	-
BH17-140	**6.05**	**0.99**	**186.89**	-	-	-	-	-	-	-	-
BH17-147	**10.25**	**0.85**	**194.67**	-	-	-	-	-	-	-	-
BH17-05	**14.13**	**0.00**	**179.72**	-	-	-	-	-	-	-	-

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round or unavailable data

Table E-1
Monitoring Well Groundwater Elevations

Well	Well Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	21-Mar-17		21-Apr-17		16-May-17		02-Aug-17	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
BH16-3	**5.87**	**0.88**	**197.56**	4.66	192.90	4.05	193.51	4.29	193.27	4.51	193.05
BH16-4	**6.02**	**0.83**	**184.71**	1.32	183.39	1.13	183.58	1.21	183.50	1.41	183.30
BH16-5	**5.88**	**0.82**	**186.08**	0.33	185.75	-0.33	186.41	-0.14	186.22	0.15	185.93
BH16-6	**4.39**	**0.72**	**186.88**	0.89	185.99	0.25	186.63	0.54	186.34	0.67	186.21
BH16-7	**4.33**	**0.74**	**187.59**	2.95	184.65	2.55	185.05	2.91	184.69	2.93	184.67
BH16-8	**6.03**	**0.81**	**183.22**	1.15	182.08	0.43	182.80	1.20	182.03	1.46	181.77
BH16-9	**4.76**	**0.84**	**183.30**	0.92	182.38	0.62	182.68	0.77	182.53	0.79	182.51
BH16-10	**5.78**	**0.78**	**190.66**	0.73	189.93	0.16	190.50	0.74	189.92	1.06	189.60
BH16-11	**5.91**	**0.74**	**181.20**	3.45	177.76	3.23	177.98	3.22	177.99	3.35	177.86
BH16-12s	**5.82**	**0.75**	**190.11**	0.71	189.40	0.30	189.81	0.92	189.19	1.28	188.83
BH16-12d	**15.72**	**0.73**	**190.08**	-0.57	190.65	-0.43	190.51	-0.60	190.68	-0.31	190.39
BH16-13s	**6.20**	**0.83**	**184.14**	2.02	182.12	1.53	182.61	1.81	182.33	2.28	181.86
BH16-13d	**16.10**	**0.93**	**184.07**	0.20	183.88	0.01	184.07	0.10	183.98	0.14	183.94
BH16-14s	**5.73**	**0.77**	**177.45**	2.10	175.35	1.85	175.60	2.07	175.38	2.18	175.27
BH16-14d	**15.51**	**0.74**	**177.45**	1.95	175.50	1.74	175.71	1.93	175.52	2.03	175.42
BH16-15s	**5.07**	**0.78**	**180.87**	3.38	177.49	3.06	177.81	3.19	177.69	3.52	177.35
BH16-15d	**14.29**	**0.73**	**180.87**	4.14	176.73	3.87	177.00	4.00	176.87	4.21	176.66
BH16-16	**12.43**	**0.81**	**179.60**	-0.29	179.89	-0.38	179.98	-0.29	179.89	-0.26	179.86
BH14-1	**3.50**	**0.00**	**178.59**	1.28	177.31	0.47	178.12	1.39	177.20	-	-
BH14-2	**3.60**	**0.00**	**178.74**	1.01	177.73	0.78	177.96	0.98	177.76	-	-
BH14-3	**3.70**	**0.00**	**178.67**	0.97	177.70	-	-	1.19	177.48	-	-
BH14-8	**5.01**	**0.81**	**196.19**	3.63	192.56	2.79	193.40	3.16	193.03	3.63	192.56
BH14-12	**4.55**	**0.00**	**179.48**	1.26	178.22	0.25	179.23	1.44	178.04	2.03	177.45
BH14-15	**5.80**	**1.06**	**179.83**	4.06	175.78	3.75	176.09	3.98	175.86	4.08	175.76
BH14-17	**6.13**	**1.02**	**194.43**	2.46	191.97	2.17	192.26	2.47	191.96	2.97	191.46
BH14-29	**6.14**	**0.68**	**190.39**	1.34	189.06	0.93	189.47	0.78	189.62	0.83	189.57
BH14-33	**7.46**	**0.93**	**194.67**	3.10	191.58	2.87	191.80	2.45	192.22	3.05	191.62
BH17-104	**7.05**	**0.00**	**186.74**	-0.54	187.28	0.18	186.56	0.38	186.36	0.30	186.44
BH17-106	**10.26**	**0.00**	**181.76**	-0.19	181.95	-0.32	182.08	-0.22	181.98	0.13	181.63
BH17-110	**8.15**	**0.00**	**184.00**	5.91	178.09	5.53	178.47	5.69	178.31	5.78	178.22
BH17-115	**11.88**	**0.98**	**180.74**	3.96	176.78	3.74	177.01	3.75	177.00	3.98	176.77
BH17-127	**7.87**	**0.96**	**189.56**	-	-	2.90	186.67	2.67	186.90	2.97	186.60
BH17-130	**12.00**	**0.00**	**183.95**	-	-	3.05	180.90	2.77	181.18	2.83	181.12
BH17-131	**8.88**	**0.00**	**185.96**	-	-	3.10	182.86	2.59	183.37	2.84	183.12
BH17-137	**10.68**	**0.90**	**181.66**	-	-	1.67	179.99	1.79	179.87	-	-
BH17-139s	**6.08**	**0.89**	**184.00**	-	-	2.86	181.14	2.77	181.23	3.04	180.96
BH17-139d	**11.13**	**0.91**	**184.00**	-	-	3.29	180.71	3.53	180.47	3.72	180.28
BH17-140	**6.05**	**0.99**	**186.89**	-	-	1.95	184.94	2.60	184.29	2.92	183.97
BH17-147	**10.25**	**0.85**	**194.67**	-	-	0.21	194.46	0.39	194.28	0.48	194.19
BH17-05	**14.13**	**0.00**	**179.72**	5.17	174.55	4.91	174.81	5.09	174.63	5.21	174.51

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of monitoring round or unavailable data

Table E-2
Piezometer Groundwater Elevations

Piezometer	Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	22-Mar-16		29-Mar-16		22-Apr-16		20-May-16		29-Jun-16	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
PZ1	**0.99**	**0.61**	**182.24**	0.97	181.27	0.86	181.38	0.93	181.32	0.85	181.39	0.74	181.50
PZ2	**1.67**	**1.15**	**181.53**	1.13	180.40	0.98	180.55	0.84	180.70	0.70	180.83	0.58	180.96
PZ3s	**1.34**	**0.57**	**180.83**	1.16	179.67	0.29	180.54	0.54	180.29	0.62	180.21	0.68	180.15
PZ3d	**1.78**	**1.04**	**180.75**	0.62	180.13	0.16	180.59	0.50	180.25	0.59	180.16	0.65	180.10
PZ4s	**1.11**	**0.80**	**181.43**	1.10	180.33	0.85	180.58	0.44	180.99	0.19	181.24	0.57	180.86
PZ4d	**1.63**	**1.19**	**181.46**	1.26	180.20	1.47	179.99	1.10	180.36	0.78	180.68	0.57	180.89
PZ5s	**1.22**	**0.69**	**184.39**	0.89	183.50	0.66	183.73	0.65	183.74	0.51	183.88	0.42	183.97
PZ5d	**1.73**	**1.09**	**184.38**	1.36	183.02	1.43	182.95	0.84	183.54	0.58	183.81	0.39	184.00
PZ6	**1.19**	**0.72**	**175.35**	1.18	174.17	0.95	174.40	0.81	174.55	0.68	174.67	0.61	174.75
PZ7s	**1.24**	**0.67**	**177.30**	0.92	176.38	0.24	177.06	0.49	176.81	0.54	176.76	0.63	176.68
PZ7d	**1.71**	**1.11**	**177.41**	1.34	176.07	1.26	176.15	1.13	176.28	1.01	176.40	0.89	176.52
PZ8s	**1.35**	**0.56**	**187.59**	-	-	-	-	-	-	-	-	0.97	186.62
PZ8d	**1.88**	**0.94**	**187.57**	-	-	-	-	-	-	-	-	1.57	186.01
PZ9s	**0.96**	**0.95**	**188.95**	-	-	-	-	-	-	-	-	-	-
PZ9d	**1.57**	**1.25**	**188.86**	-	-	-	-	-	-	-	-	-	-
PZ10s	**1.24**	**0.68**	**179.61**	-	-	-	-	-	-	-	-	-	-
PZ10d	**1.75**	**0.87**	**179.56**	-	-	-	-	-	-	-	-	-	-
PZ11s	**1.30**	**0.60**	**183.34**	-	-	-	-	-	-	-	-	-	-
PZ11d	**1.89**	**0.95**	**183.30**	-	-	-	-	-	-	-	-	-	-
PZ12s	**1.30**	**0.61**	**183.77**	-	-	-	-	-	-	-	-	-	-
PZ12d	**1.88**	**0.96**	**183.80**	-	-	-	-	-	-	-	-	-	-

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of round or unavailable data

Table E-2
Piezometer Groundwater Elevations

Piezometer	Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	29-Jul-16		05-Aug-16		31-Aug-16		06-Oct-16		28-Oct-16	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
PZ1	**0.99**	**0.61**	**182.24**	0.69	181.55	-	-	0.64	181.60	0.62	181.62	0.60	181.64
PZ2	**1.67**	**1.15**	**181.53**	0.62	180.91	-	-	0.79	180.74	1.05	180.48	1.15	180.38
PZ3s	**1.34**	**0.57**	**180.83**	0.64	180.19	-	-	0.69	180.14	0.65	180.18	0.58	180.25
PZ3d	**1.78**	**1.04**	**180.75**	0.62	180.13	-	-	0.67	180.08	0.64	180.11	0.58	180.17
PZ4s	**1.11**	**0.80**	**181.43**	0.50	180.93	-	-	0.47	180.96	0.93	180.50	0.80	180.63
PZ4d	**1.63**	**1.19**	**181.46**	0.59	180.87	-	-	0.51	180.95	0.67	180.79	0.73	180.73
PZ5s	**1.22**	**0.69**	**184.39**	0.50	183.89	-	-	0.46	183.93	0.46	183.94	0.41	183.98
PZ5d	**1.73**	**1.09**	**184.38**	0.44	183.95	-	-	0.42	183.96	0.40	183.98	0.33	184.05
PZ6	**1.19**	**0.72**	**175.35**	0.78	174.57	-	-	1.01	174.34	1.14	174.21	1.12	174.23
PZ7s	**1.24**	**0.67**	**177.30**	0.51	176.79	-	-	0.64	176.66	0.61	176.70	0.55	176.75
PZ7d	**1.71**	**1.11**	**177.41**	0.86	176.55	-	-	0.80	176.61	0.80	176.61	0.80	176.61
PZ8s	**1.35**	**0.56**	**187.59**	0.69	186.90	-	-	0.50	187.09	0.45	187.14	0.38	187.21
PZ8d	**1.88**	**0.94**	**187.57**	1.27	186.30	-	-	0.95	186.62	0.76	186.81	0.64	186.93
PZ9s	**0.96**	**0.95**	**188.95**	-	-	dry	dry	dry	dry	-	-	dry	dry
PZ9d	**1.57**	**1.25**	**188.86**	-	-	1.51	187.35	1.50	187.36	-	-	dry	dry
PZ10s	**1.24**	**0.68**	**179.61**	-	-	-	-	-	-	-	-	-	-
PZ10d	**1.75**	**0.87**	**179.56**	-	-	-	-	-	-	-	-	-	-
PZ11s	**1.30**	**0.60**	**183.34**	-	-	-	-	-	-	-	-	-	-
PZ11d	**1.89**	**0.95**	**183.30**	-	-	-	-	-	-	-	-	-	-
PZ12s	**1.30**	**0.61**	**183.77**	-	-	-	-	-	-	-	-	-	-
PZ12d	**1.88**	**0.96**	**183.80**	-	-	-	-	-	-	-	-	-	-

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of round or unavailable data

Table E-2
Piezometer Groundwater Elevations

Piezometer	Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	23-Nov-16		14-Dec-16		20-Jan-17		27-Feb-17		21-Mar-17	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
PZ1	**0.99**	**0.61**	**182.24**	0.59	181.65	0.58	181.66	0.55	181.69	0.54	181.70	0.51	181.73
PZ2	**1.67**	**1.15**	**181.53**	1.15	180.38	1.18	180.35	1.12	180.41	1.01	180.52	0.92	180.61
PZ3s	**1.34**	**0.57**	**180.83**	0.60	180.23	0.50	180.33	0.49	180.34	0.45	180.38	0.56	180.27
PZ3d	**1.78**	**1.04**	**180.75**	0.60	180.15	0.50	180.25	0.48	180.27	0.44	180.31	0.56	180.20
PZ4s	**1.11**	**0.80**	**181.43**	0.55	180.88	0.48	180.95	0.22	181.21	0.19	181.24	0.18	181.25
PZ4d	**1.63**	**1.19**	**181.46**	0.67	180.79	0.67	180.79	0.53	180.93	0.42	181.04	0.38	181.08
PZ5s	**1.22**	**0.69**	**184.39**	0.37	184.02	0.39	184.00	0.32	184.07	0.23	184.16	0.21	184.18
PZ5d	**1.73**	**1.09**	**184.38**	0.25	184.13	0.38	184.00	0.19	184.19	0.13	184.25	0.11	184.27
PZ6	**1.19**	**0.72**	**175.35**	1.02	174.33	-	-	0.78	174.57	0.64	174.71	0.61	174.74
PZ7s	**1.24**	**0.67**	**177.30**	0.58	176.72	0.58	176.72	0.40	176.90	0.40	176.90	0.51	176.79
PZ7d	**1.71**	**1.11**	**177.41**	0.80	176.61	0.78	176.63	0.73	176.68	0.70	176.71	0.67	176.74
PZ8s	**1.35**	**0.56**	**187.59**	0.31	187.28	0.34	187.25	0.29	187.30	0.16	187.43	0.12	187.47
PZ8d	**1.88**	**0.94**	**187.57**	0.54	187.03	0.53	187.04	0.42	187.15	0.32	187.25	0.25	187.32
PZ9s	**0.96**	**0.95**	**188.95**	dry	dry	dry	dry	0.37	188.58	0.13	188.82	0.23	188.72
PZ9d	**1.57**	**1.25**	**188.86**	dry	dry	1.12	187.74	-0.21	189.07	0.12	188.74	0.18	188.68
PZ10s	**1.24**	**0.68**	**179.61**	-	-	-	-	-	-	-	-	-	-
PZ10d	**1.75**	**0.87**	**179.56**	-	-	-	-	-	-	-	-	-	-
PZ11s	**1.30**	**0.60**	**183.34**	-	-	-	-	-	-	-	-	-	-
PZ11d	**1.89**	**0.95**	**183.30**	-	-	-	-	-	-	-	-	-	-
PZ12s	**1.30**	**0.61**	**183.77**	-	-	-	-	-	-	-	-	-	-
PZ12d	**1.88**	**0.96**	**183.80**	-	-	-	-	-	-	-	-	-	-

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of round or unavailable data

Table E-2
Piezometer Groundwater Elevations

Piezometer	Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	17-Apr-17		21-Apr-17		16-May-17		19-May-17		24-May-17	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
PZ1	**0.99**	**0.61**	**182.24**	-	-	0.47	181.77	0.44	181.80	-	-	-	-
PZ2	**1.67**	**1.15**	**181.53**	-	-	0.80	180.73	0.70	180.83	-	-	-	-
PZ3s	**1.34**	**0.57**	**180.83**	-	-	0.34	180.49	0.52	180.31	-	-	-	-
PZ3d	**1.78**	**1.04**	**180.75**	-	-	0.33	180.42	0.53	180.22	-	-	-	-
PZ4s	**1.11**	**0.80**	**181.43**	-	-	0.12	181.31	0.12	181.31	-	-	0.13	181.30
PZ4d	**1.63**	**1.19**	**181.46**	-	-	0.24	181.22	0.19	181.27	-	-	0.19	181.27
PZ5s	**1.22**	**0.69**	**184.39**	-	-	0.12	184.27	0.10	184.29	-	-	-	-
PZ5d	**1.73**	**1.09**	**184.38**	-	-	-0.01	184.39	-0.03	184.41	-	-	-	-
PZ6	**1.19**	**0.72**	**175.35**	-	-	0.55	174.80	0.45	174.90	-	-	-	-
PZ7s	**1.24**	**0.67**	**177.30**	-	-	0.21	177.09	0.47	176.83	-	-	-	-
PZ7d	**1.71**	**1.11**	**177.41**	-	-	0.64	176.77	0.61	176.80	-	-	-	-
PZ8s	**1.35**	**0.56**	**187.59**	-	-	0.02	187.57	-0.01	187.60	-	-	-	-
PZ8d	**1.88**	**0.94**	**187.57**	-	-	0.12	187.45	0.09	187.48	-	-	-	-
PZ9s	**0.96**	**0.95**	**188.95**	-	-	0.12	188.83	0.24	188.71	-	-	-	-
PZ9d	**1.57**	**1.25**	**188.86**	-	-	0.01	188.85	0.22	188.64	-	-	-	-
PZ10s	**1.24**	**0.68**	**179.61**	-0.21	179.82	-0.30	179.91	-0.18	179.79	-0.19	179.80	-0.19	179.80
PZ10d	**1.75**	**0.87**	**179.56**	-0.26	179.82	-0.33	179.89	-0.18	179.74	-0.14	179.70	-0.18	179.74
PZ11s	**1.30**	**0.60**	**183.34**	dry	dry	0.46	182.88	0.54	182.80	0.60	182.74	0.62	182.72
PZ11d	**1.89**	**0.95**	**183.30**	1.40	181.90	1.13	182.17	0.80	182.50	0.82	182.48	0.78	182.52
PZ12s	**1.30**	**0.61**	**183.77**	dry	dry	0.74	183.03	0.75	183.02	-	-	0.71	183.06
PZ12d	**1.88**	**0.96**	**183.80**	dry	dry	0.74	183.06	0.79	183.01	-	-	0.77	183.03

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of round or unavailable data

Table E-2
Piezometer Groundwater Elevations

Piezometer	Depth (mbgl)	Casing Stick up (m)	Ground Elevation (masl)	29-May-17		14-Jun-17		07-Jul-17		20-Jul-17		02-Aug-17	
				Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)	Water Level Depth (mbgl)	Estimated Elevation (masl)
PZ1	**0.99**	**0.61**	**182.24**	-	-	-	-	-	-	-	-	0.42	181.82
PZ2	**1.67**	**1.15**	**181.53**	-	-	-	-	-	-	-	-	0.55	180.98
PZ3s	**1.34**	**0.57**	**180.83**	-	-	-	-	-	-	-	-	0.64	180.19
PZ3d	**1.78**	**1.04**	**180.75**	-	-	-	-	-	-	-	-	0.62	180.13
PZ4s	**1.11**	**0.80**	**181.43**	0.11	181.32	0.13	181.30	0.12	181.31	0.12	181.31	0.12	181.31
PZ4d	**1.63**	**1.19**	**181.46**	0.18	181.28	0.19	181.27	0.14	181.32	0.14	181.32	0.13	181.33
PZ5s	**1.22**	**0.69**	**184.39**	-	-	-	-	-	-	-	-	0.06	184.33
PZ5d	**1.73**	**1.09**	**184.38**	-	-	-	-	-	-	-	-	-0.07	184.45
PZ6	**1.19**	**0.72**	**175.35**	-	-	-	-	-	-	-	-	0.34	175.01
PZ7s	**1.24**	**0.67**	**177.30**	-	-	-	-	-	-	-	-	0.56	176.74
PZ7d	**1.71**	**1.11**	**177.41**	-	-	-	-	-	-	-	-	0.57	176.84
PZ8s	**1.35**	**0.56**	**187.59**	-	-	-	-	-	-	-	-	0.00	187.59
PZ8d	**1.88**	**0.94**	**187.57**	-	-	-	-	-	-	-	-	0.02	187.55
PZ9s	**0.96**	**0.95**	**188.95**	-	-	-	-	-	-	-	-	0.45	188.50
PZ9d	**1.57**	**1.25**	**188.86**	-	-	-	-	-	-	-	-	0.40	188.46
PZ10s	**1.24**	**0.68**	**179.61**	-0.22	179.83	-0.13	179.74	-0.14	179.75	-0.19	179.80	-0.10	179.71
PZ10d	**1.75**	**0.87**	**179.56**	-0.29	179.85	-0.17	179.73	-0.50	180.06	-0.39	179.95	-0.10	179.66
PZ11s	**1.30**	**0.60**	**183.34**	0.59	182.75	0.69	182.65	0.71	182.63	0.69	182.65	0.81	182.53
PZ11d	**1.89**	**0.95**	**183.30**	0.77	182.53	0.86	182.44	0.87	182.43	0.90	182.40	0.98	182.32
PZ12s	**1.30**	**0.61**	**183.77**	0.73	183.04	0.78	182.99	0.83	182.94	0.86	182.91	dry	dry
PZ12d	**1.88**	**0.96**	**183.80**	0.80	183.00	0.85	182.95	0.85	182.95	0.80	183.00	0.84	182.96

mbgl - metres below ground level
masl - metres above sea level
"-" denotes not part of round or unavailable data

Groundwater Elevations
BH16-3

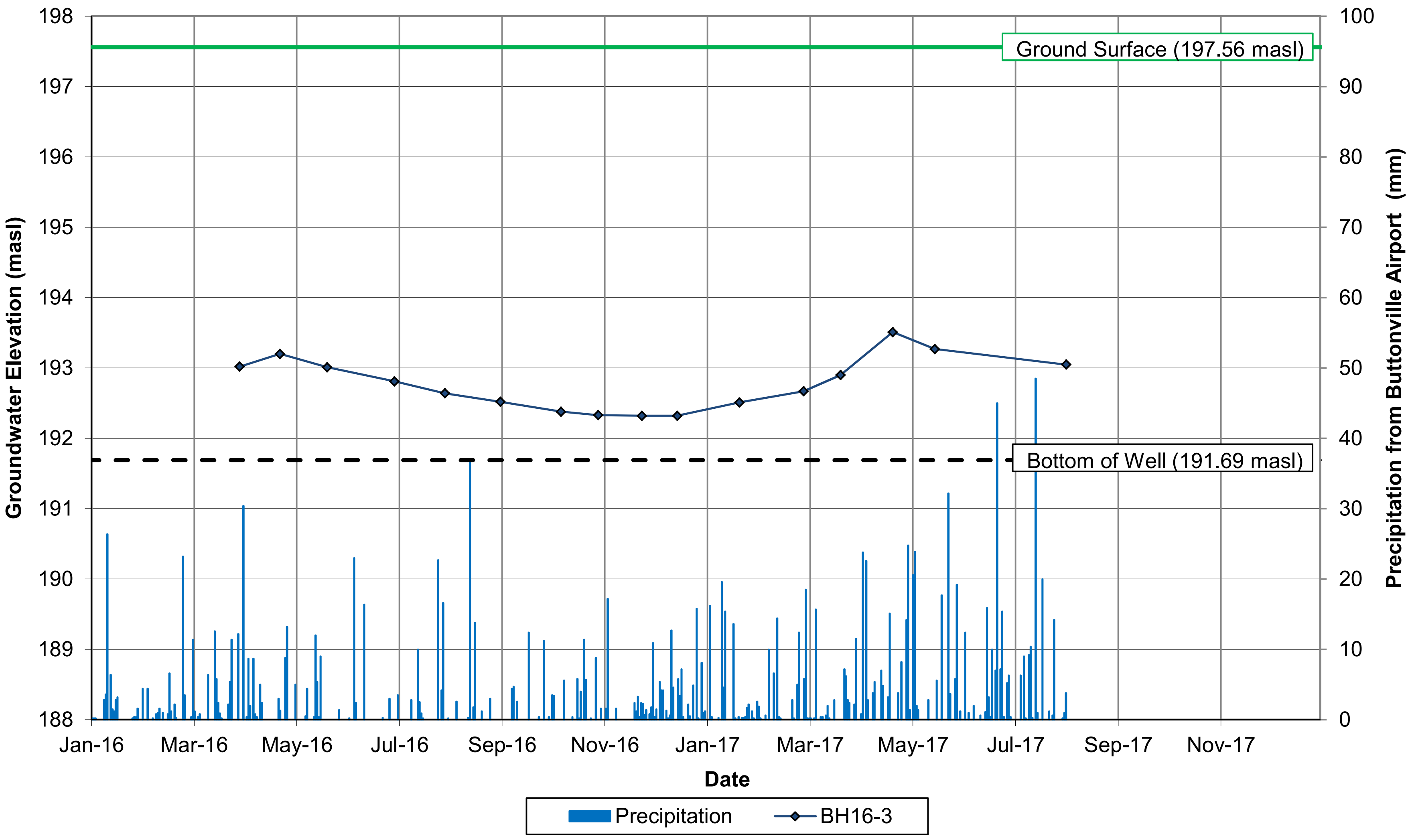

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Figure E-1

Groundwater Elevations
BH16-4

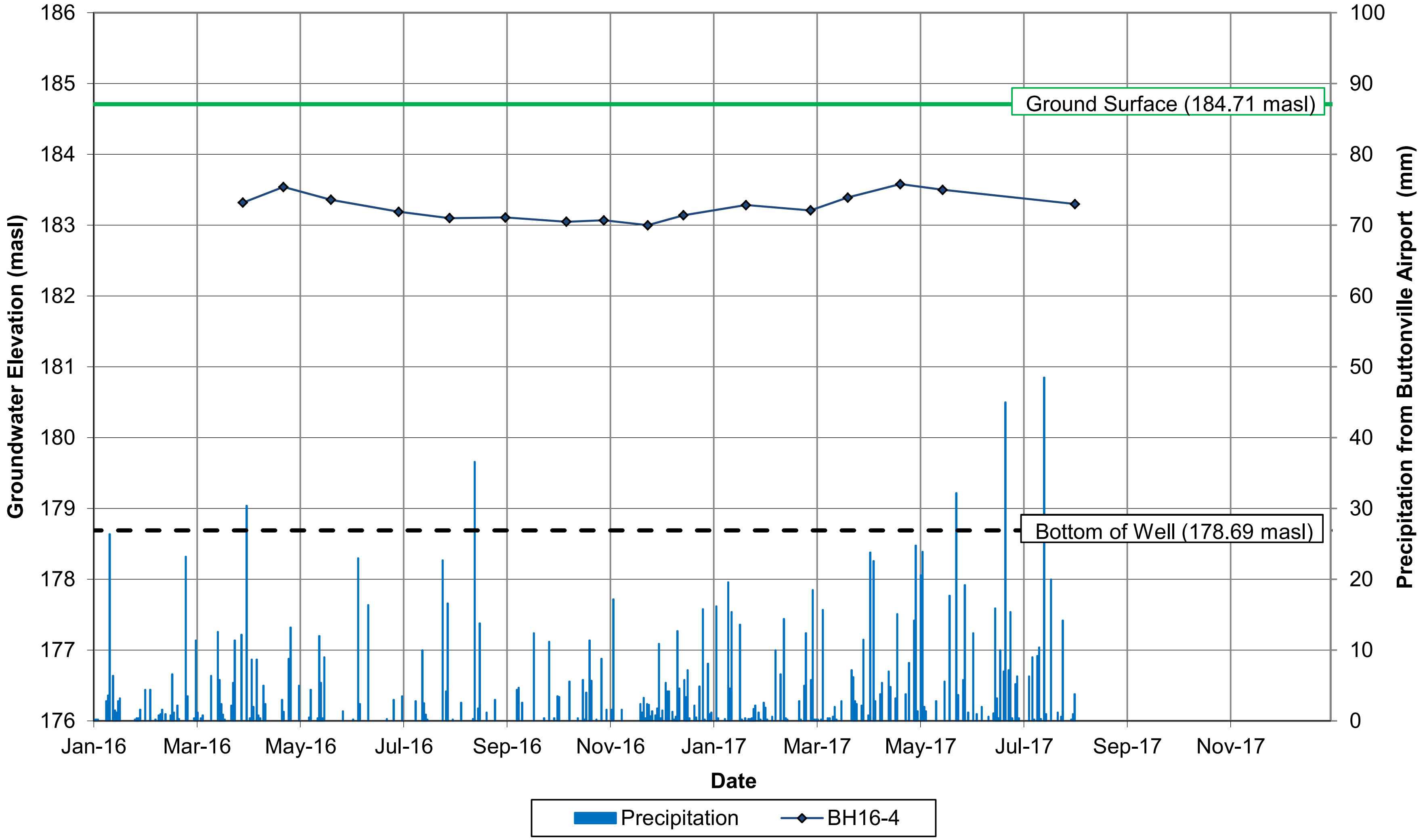

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Figure E-2

Groundwater Elevations
BH16-5

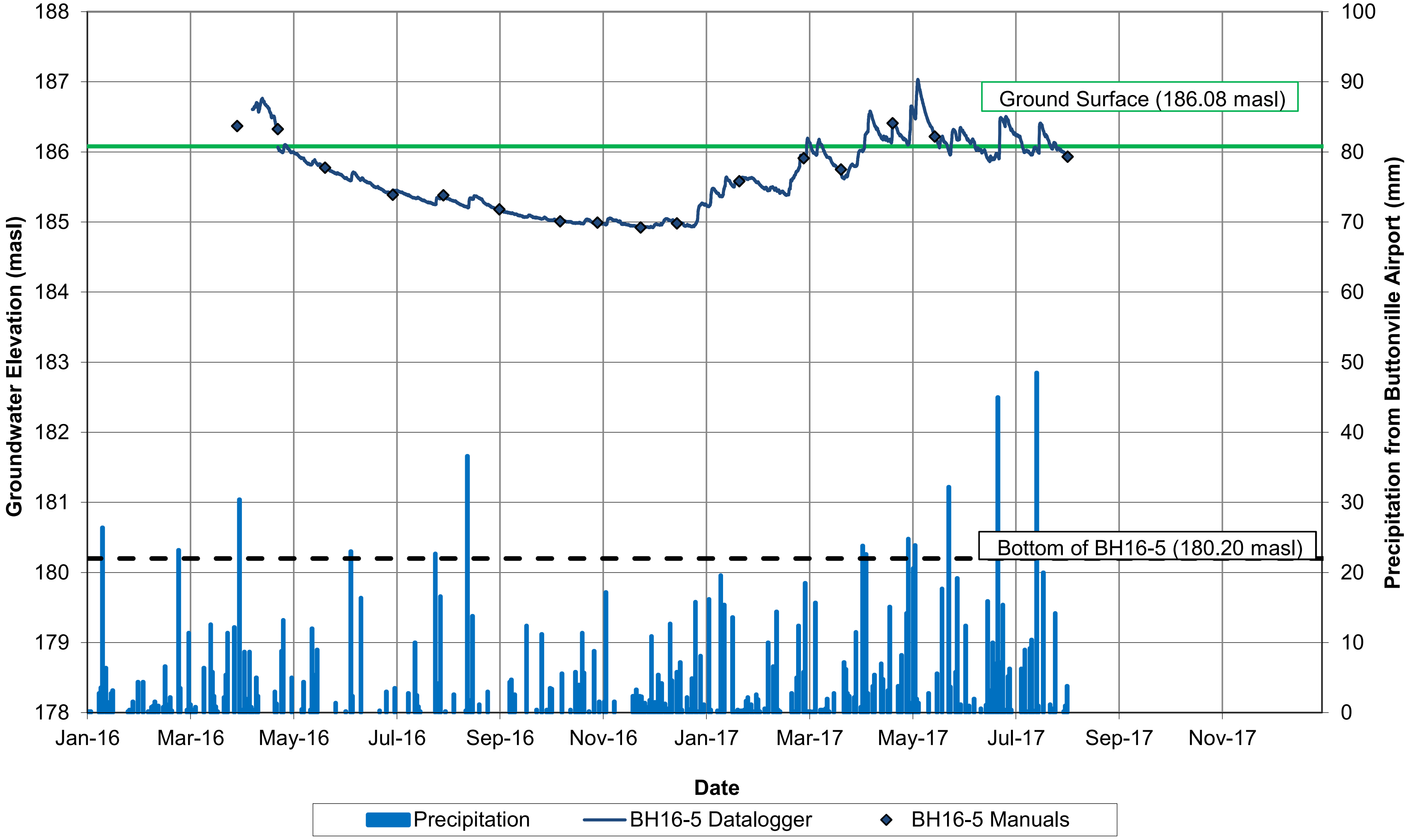

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Figure E-3

Groundwater Elevations
BH16-6

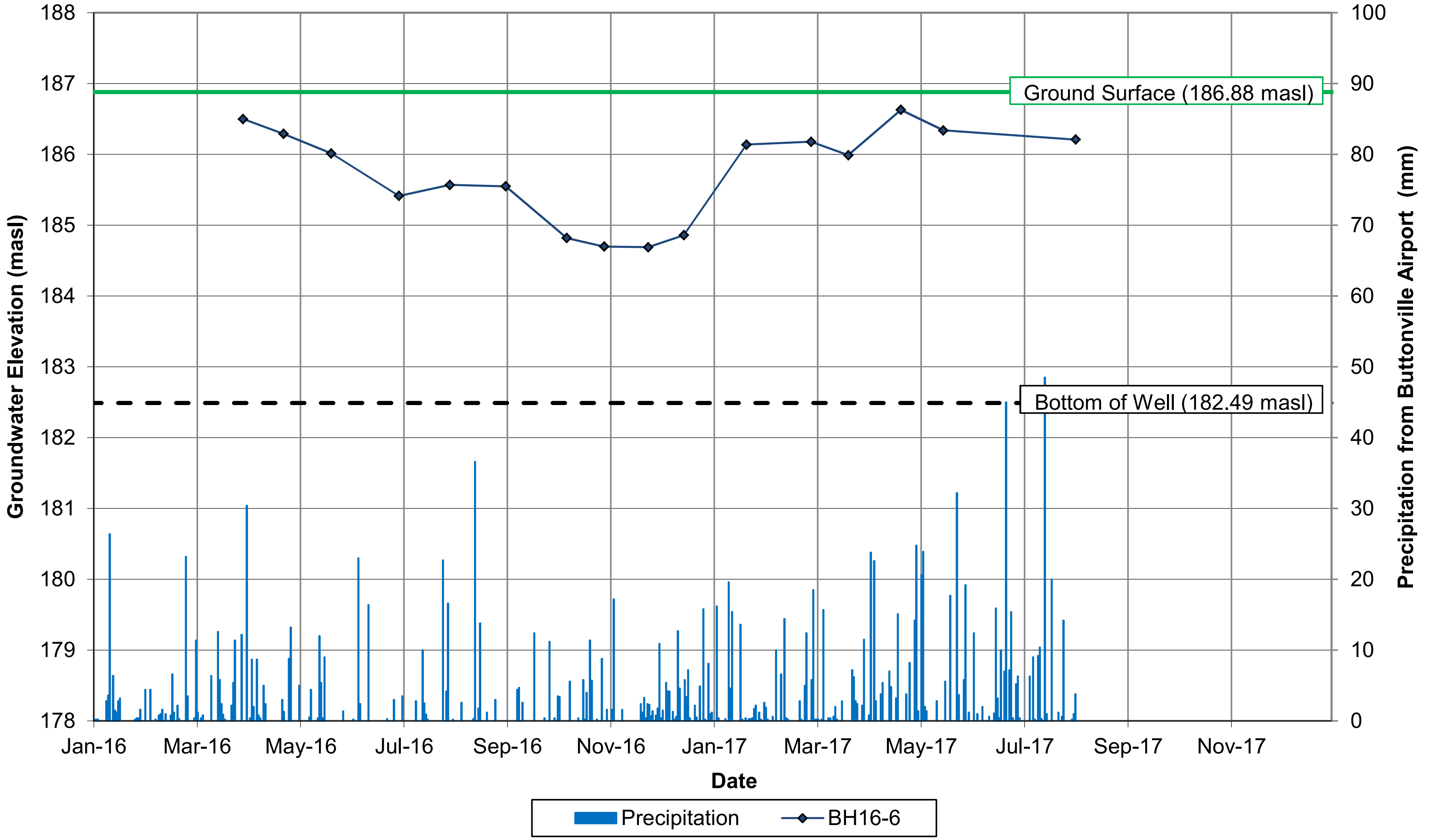

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Figure E-4

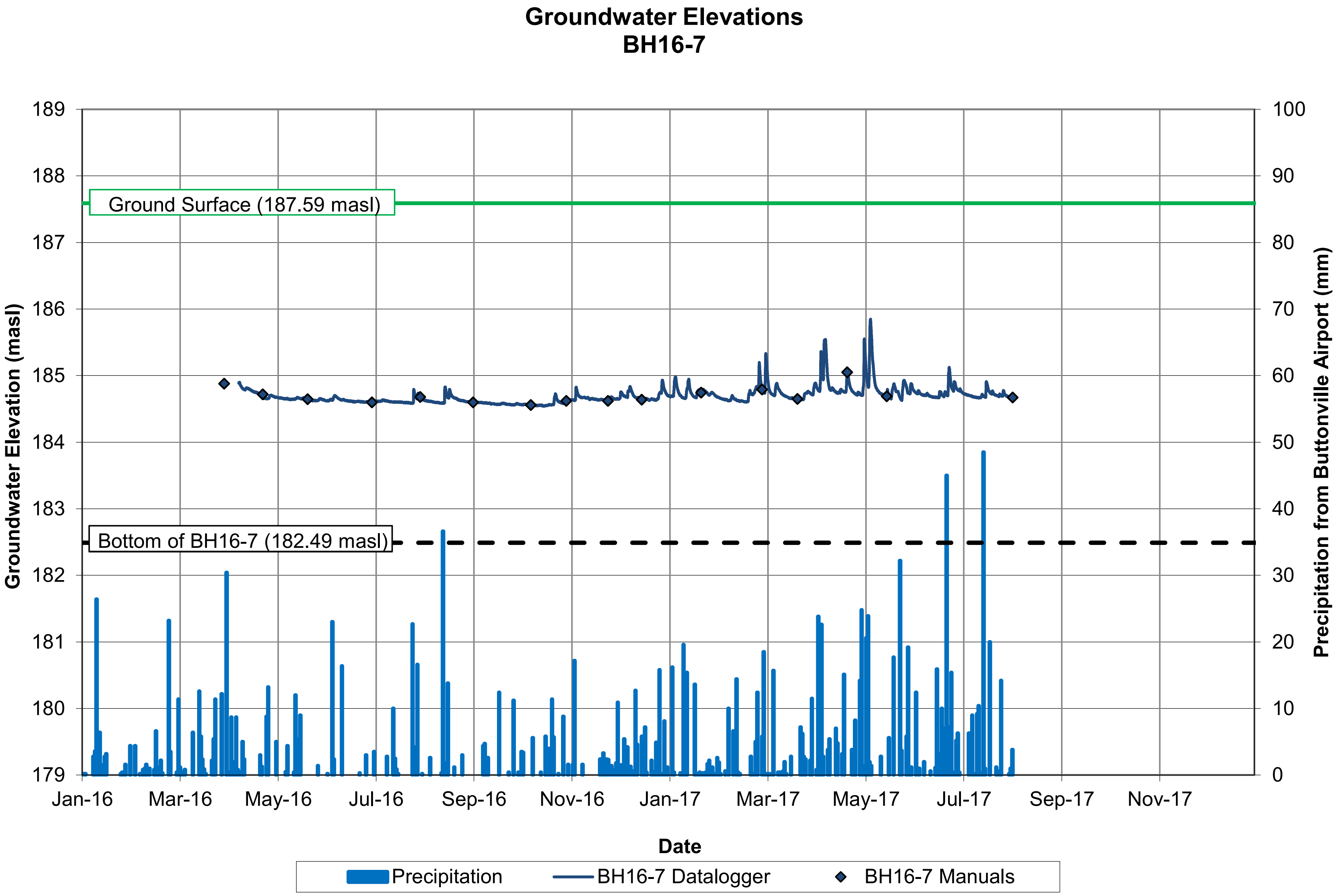

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Figure E-5

Groundwater Elevations
BH16-8

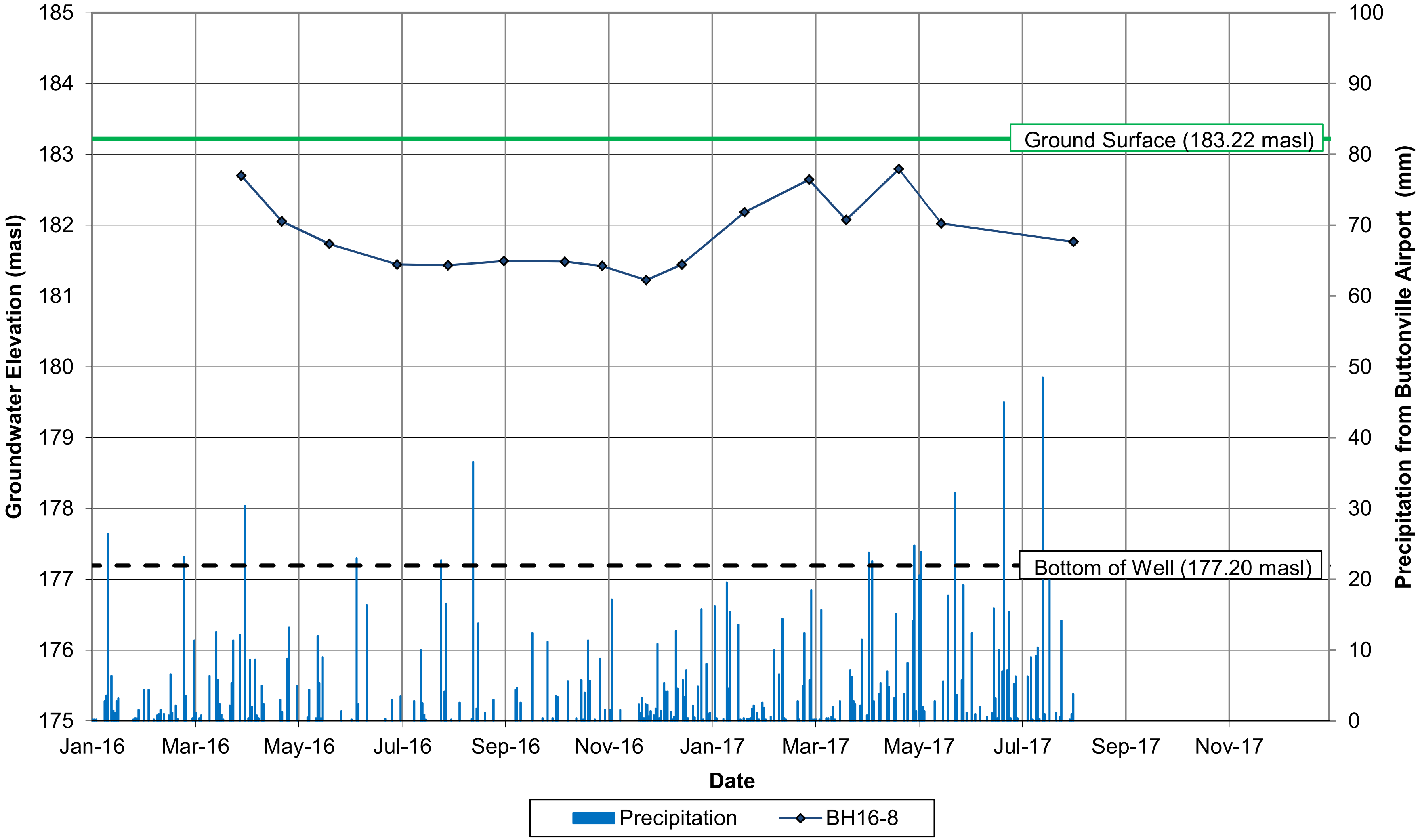

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Figure E-6

Groundwater Elevations
BH16-9

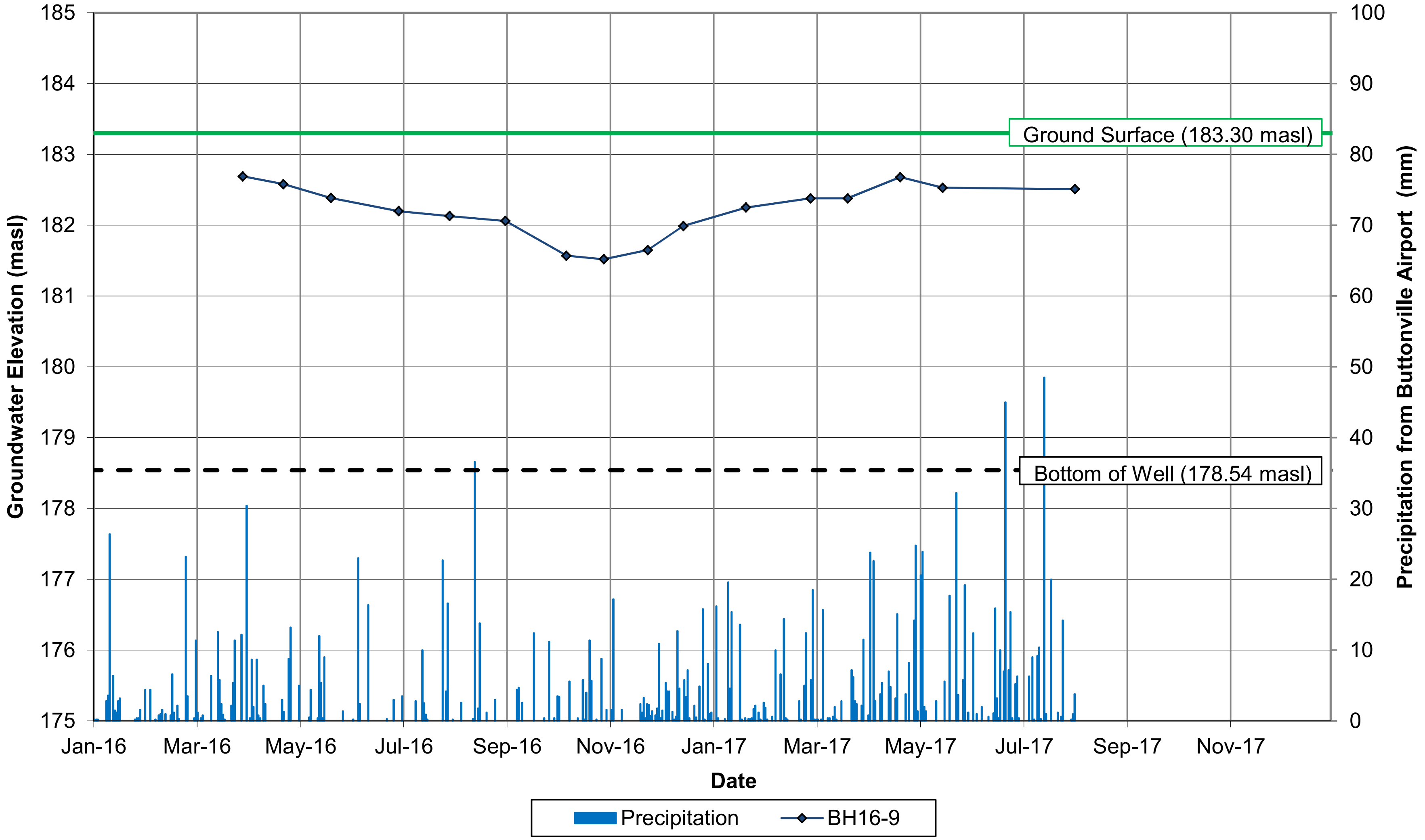

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Figure E-7

Groundwater Elevations
BH16-10

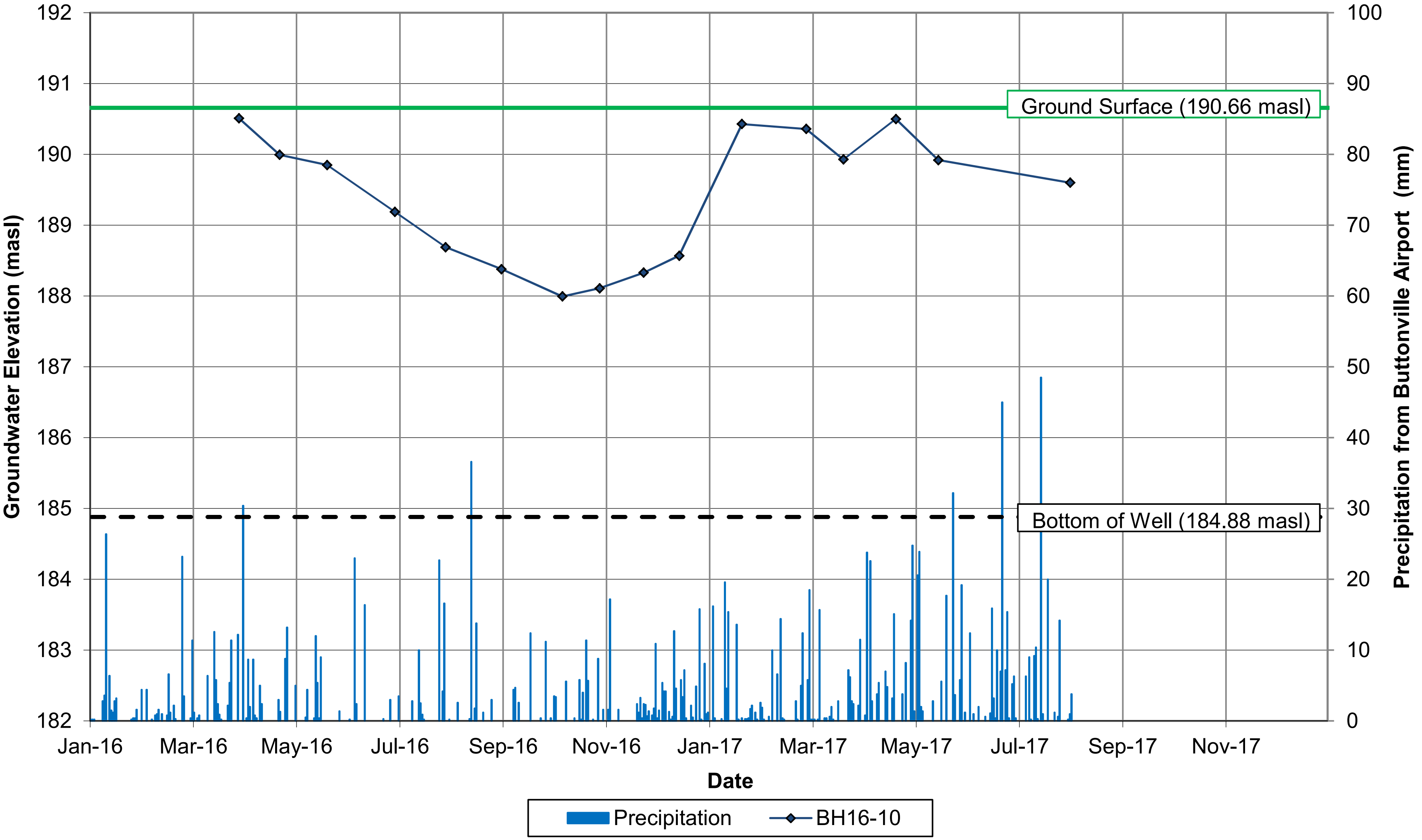

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Figure E-8

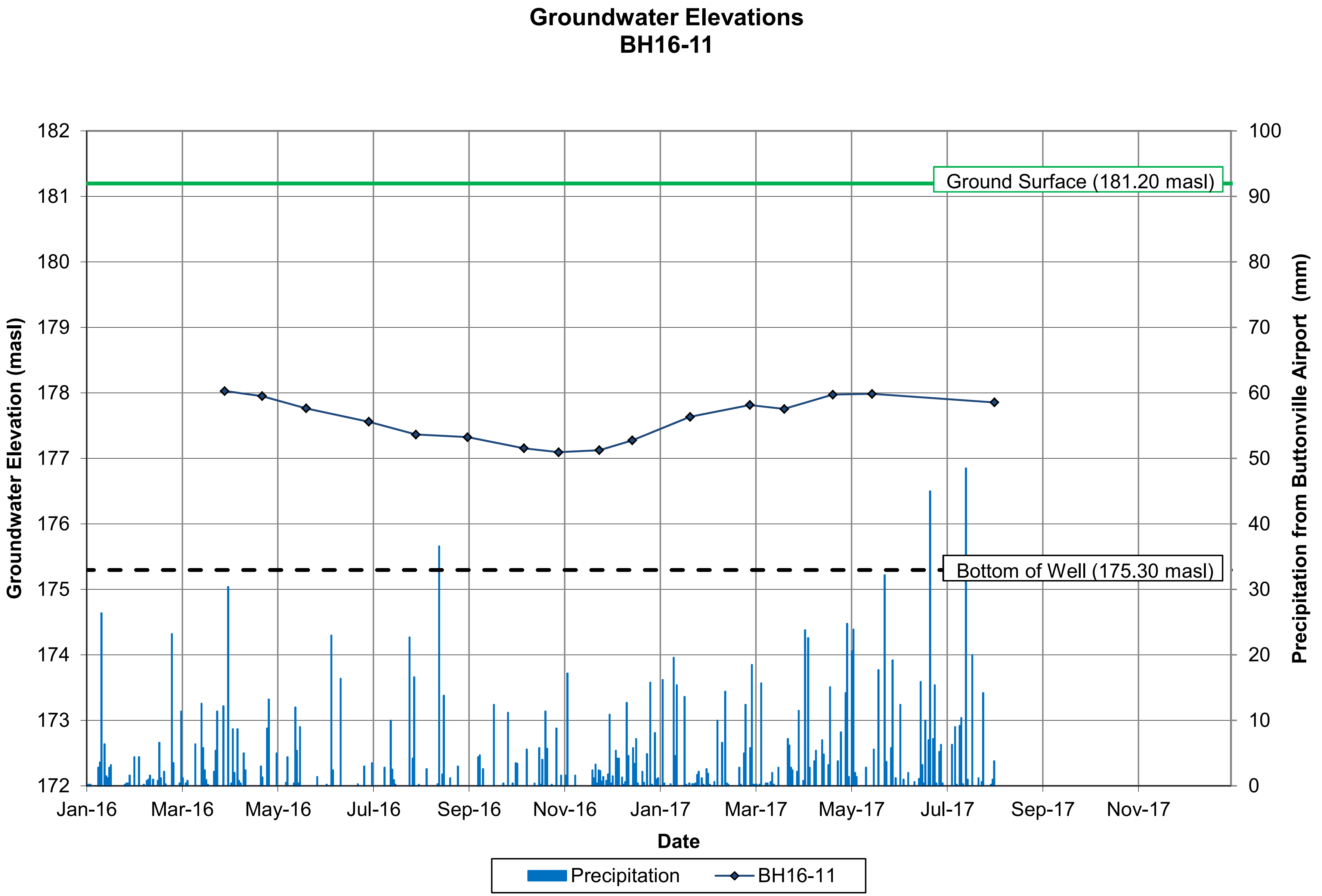

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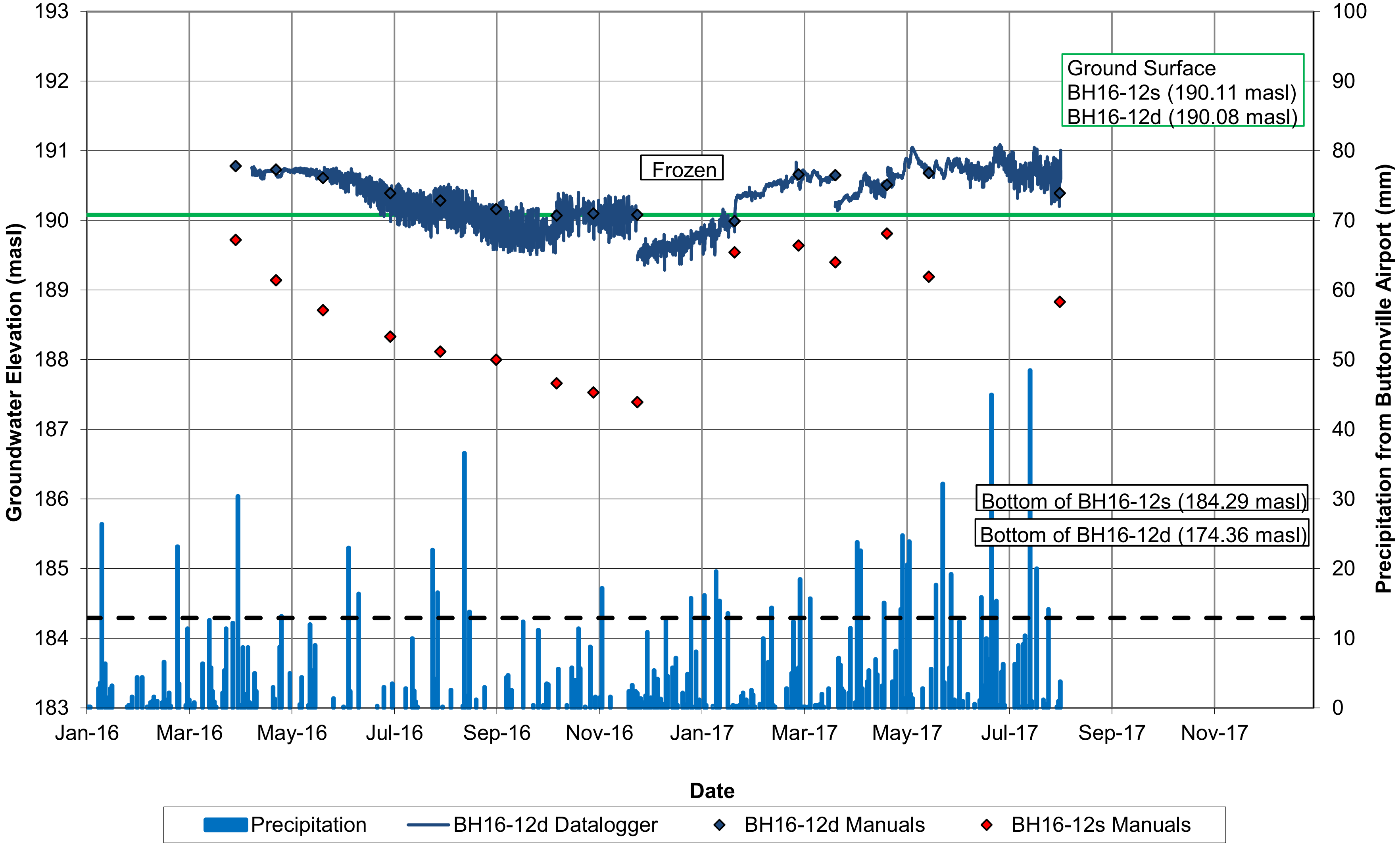
Figure E-9

Groundwater Elevations
BH16-12s/d



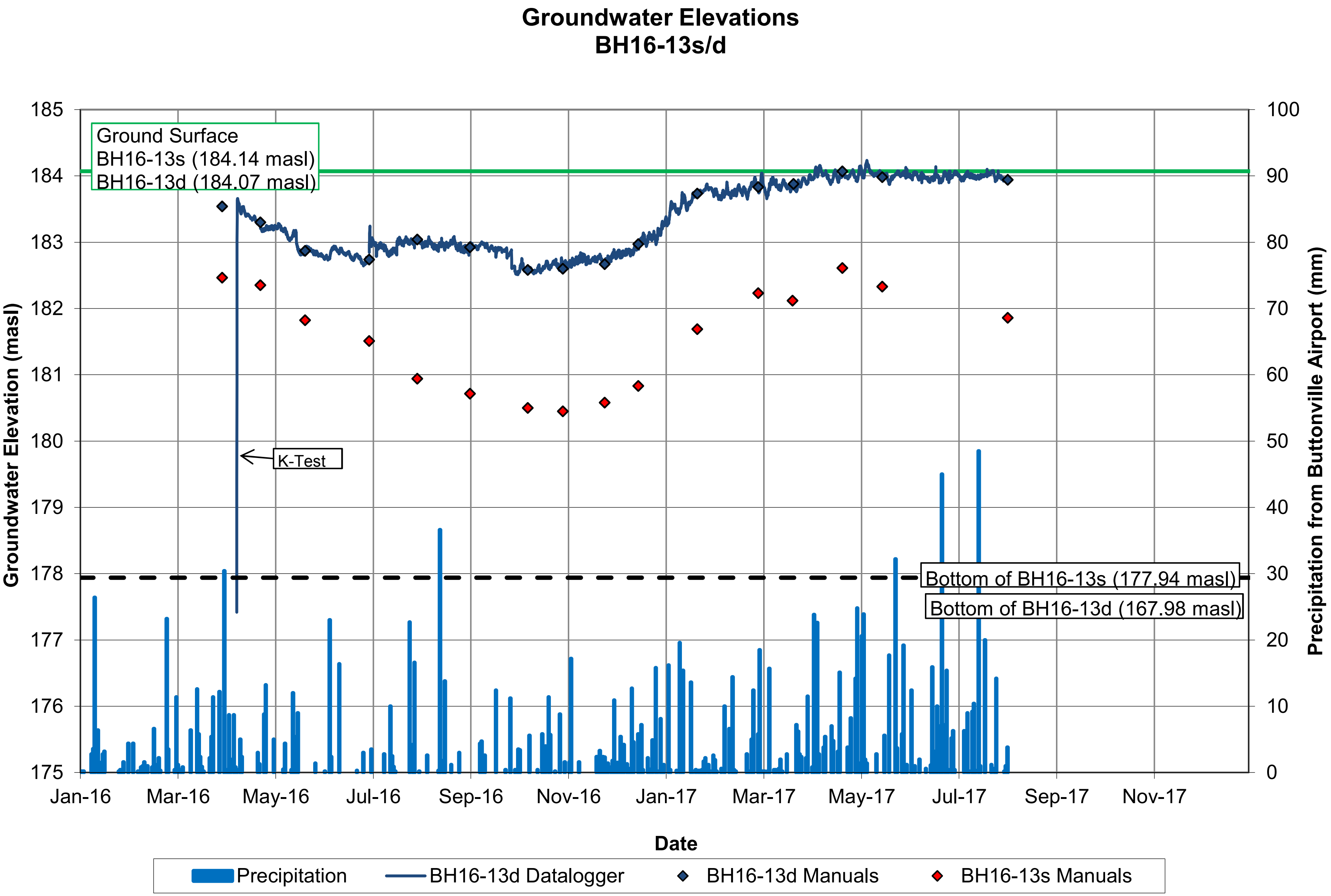


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Figure E-11

Groundwater Elevations
BH16-14s/d

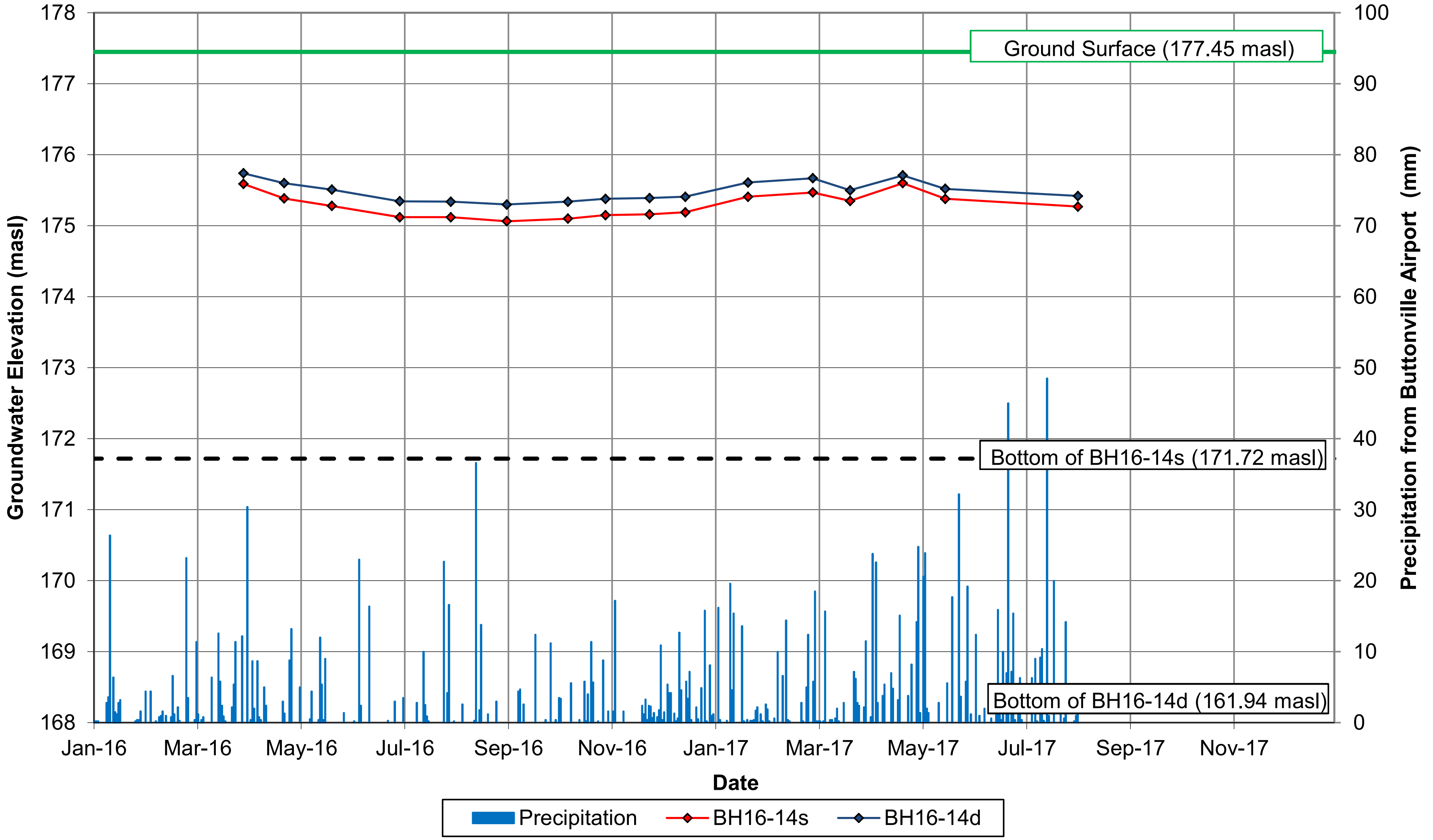

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Figure E-12

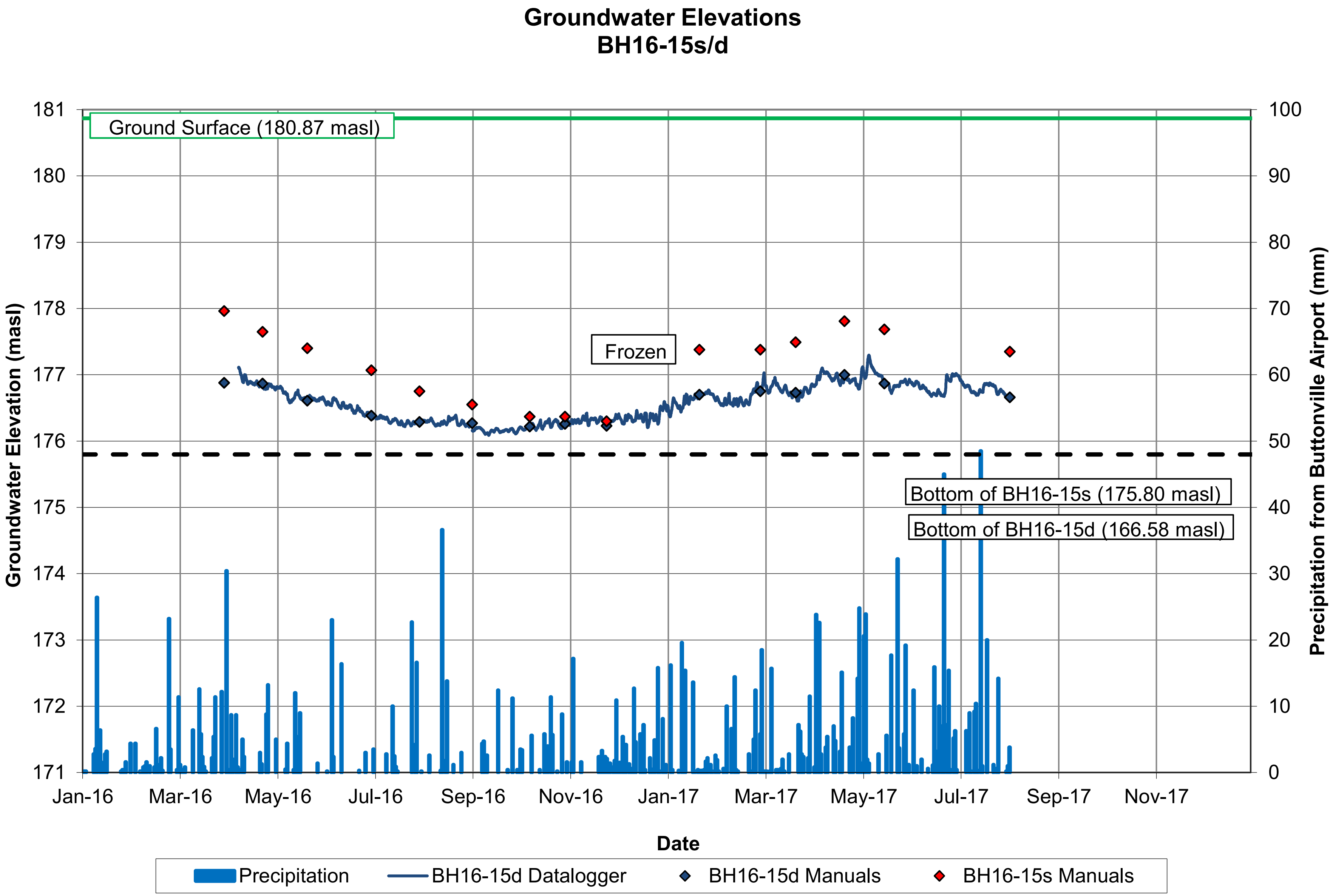

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Figure E-13

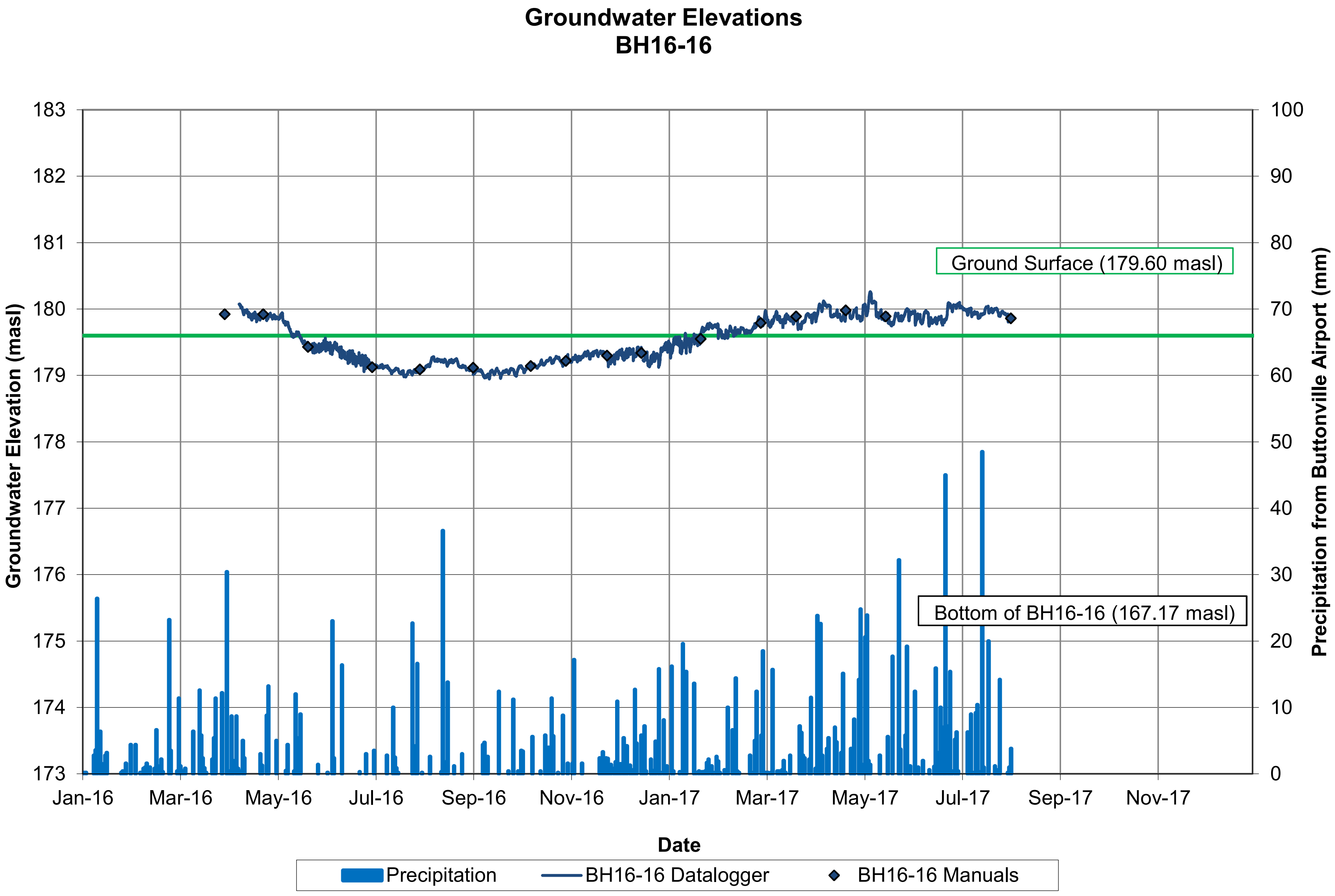

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Figure E-14

Groundwater Elevations
BH14-1

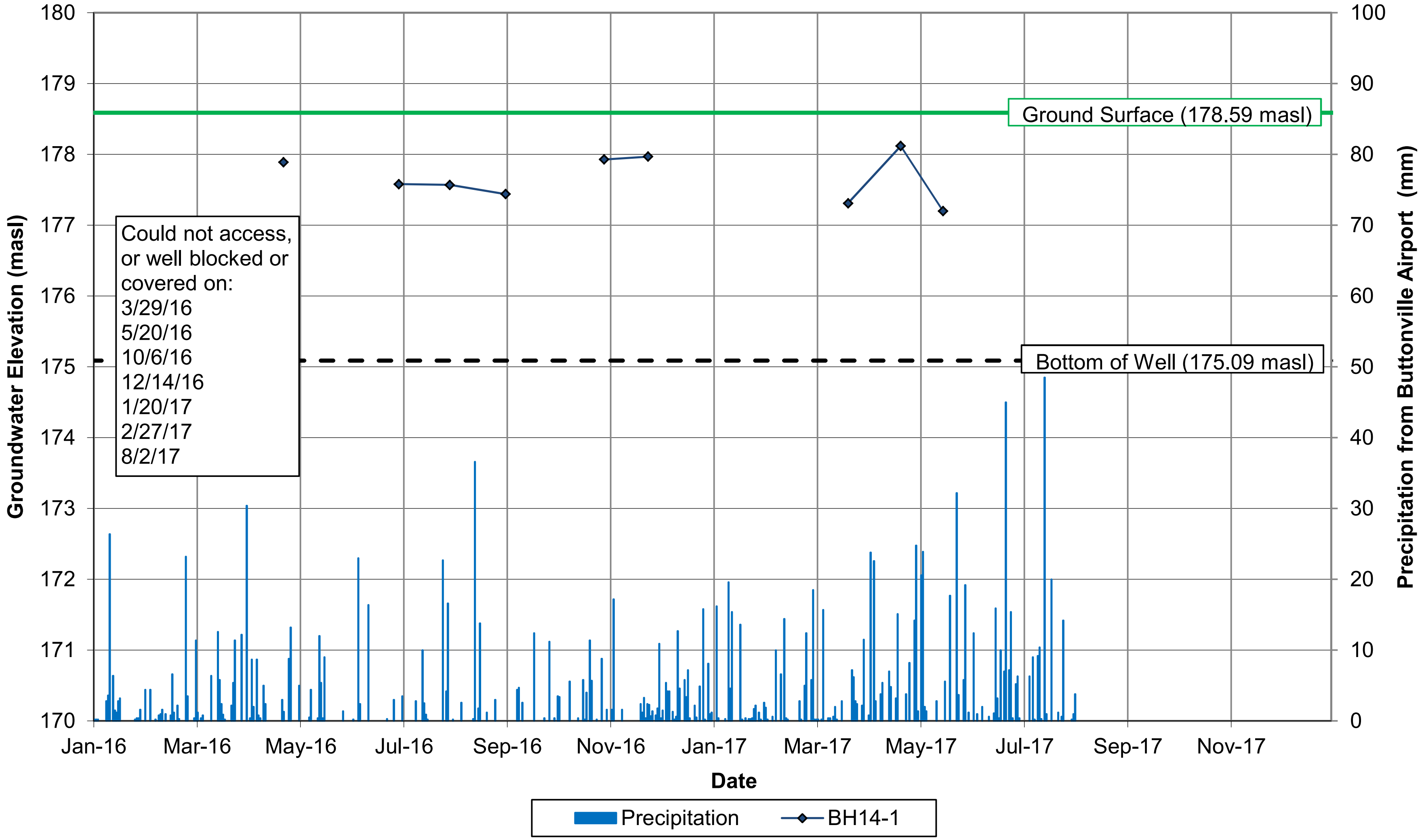

Figure E-15

Groundwater Elevations
BH14-2

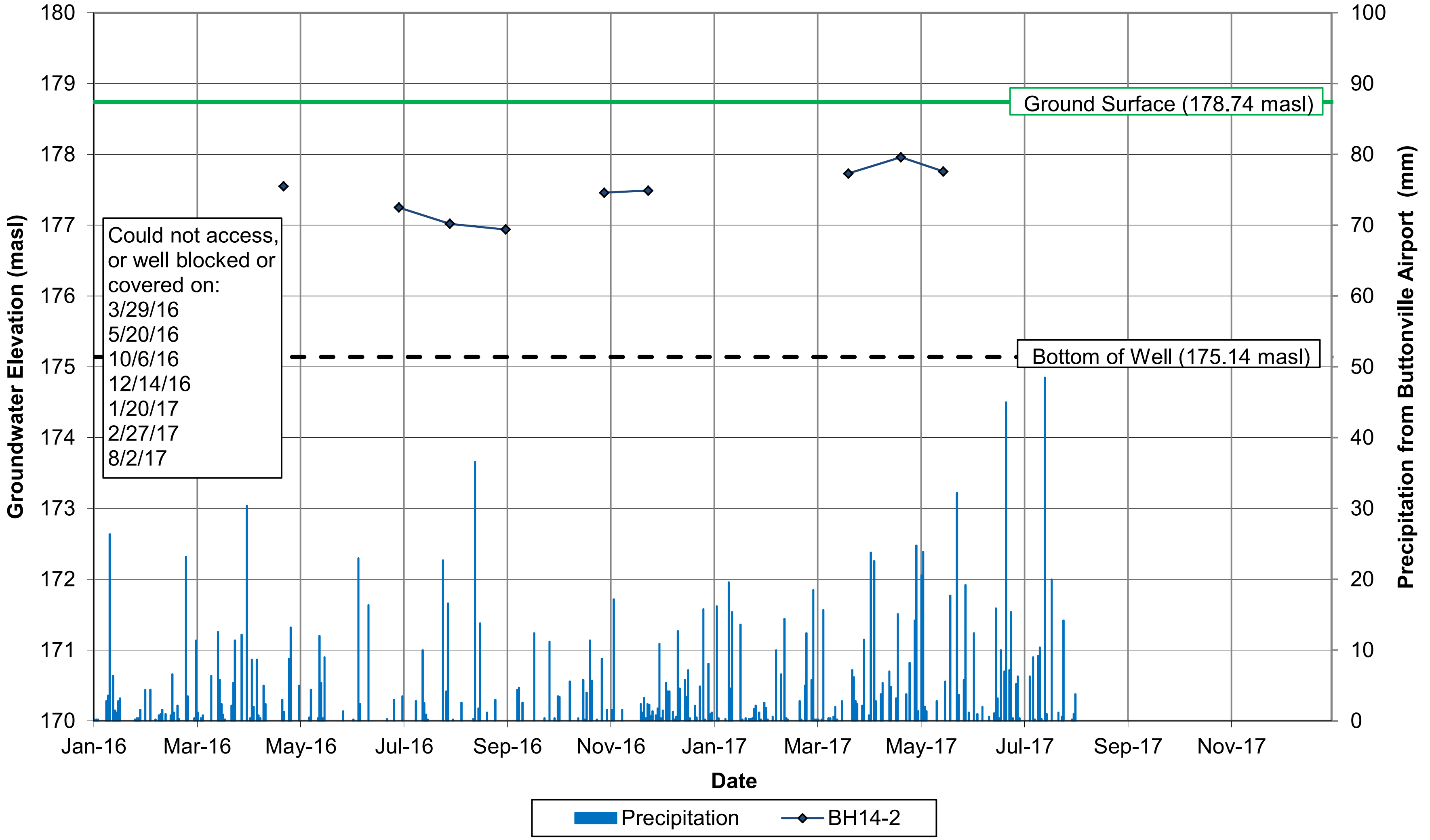

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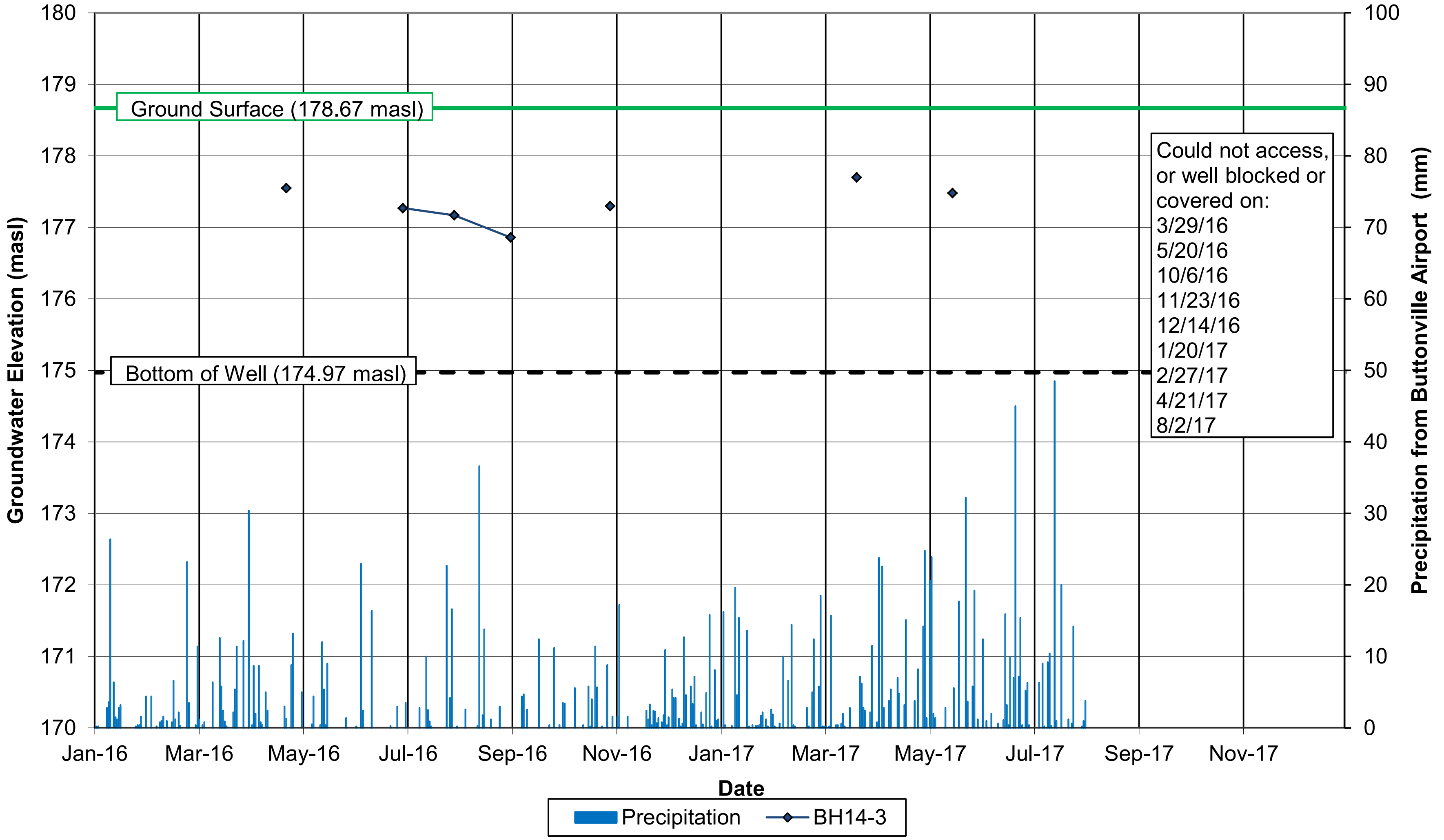
Figure E-16

Groundwater Elevations
BH14-3



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1/20/17
2/27/17
4/21/17
8/2/17

R.J. Burnside & Associates Limited
File: 038247_York Downs GW Monitoring Data
Date: 9/26/2017
Prepared By: JJM

Figure E-17

Groundwater Elevations
BH14-8

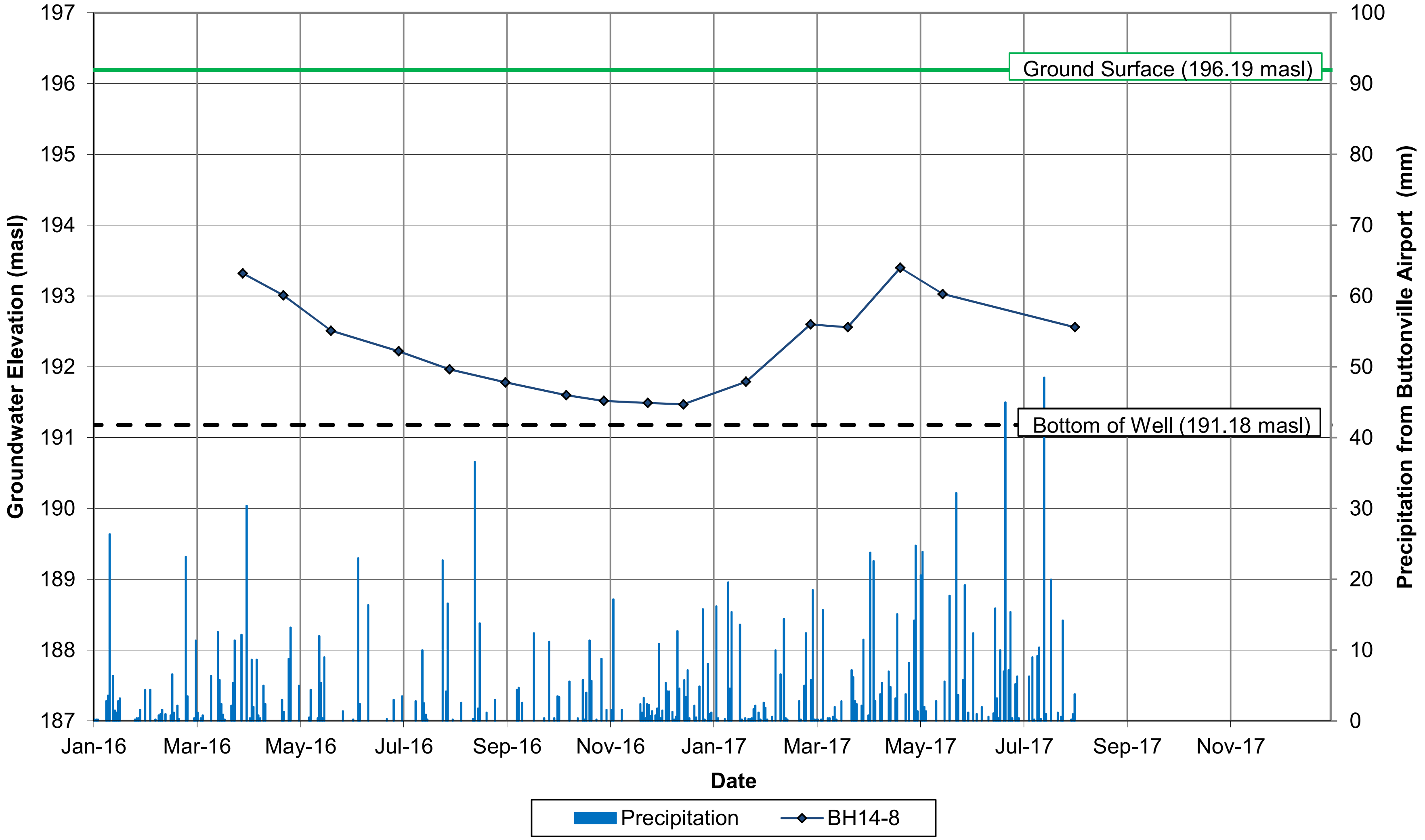

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Figure E-18

Groundwater Elevations
BH14-12

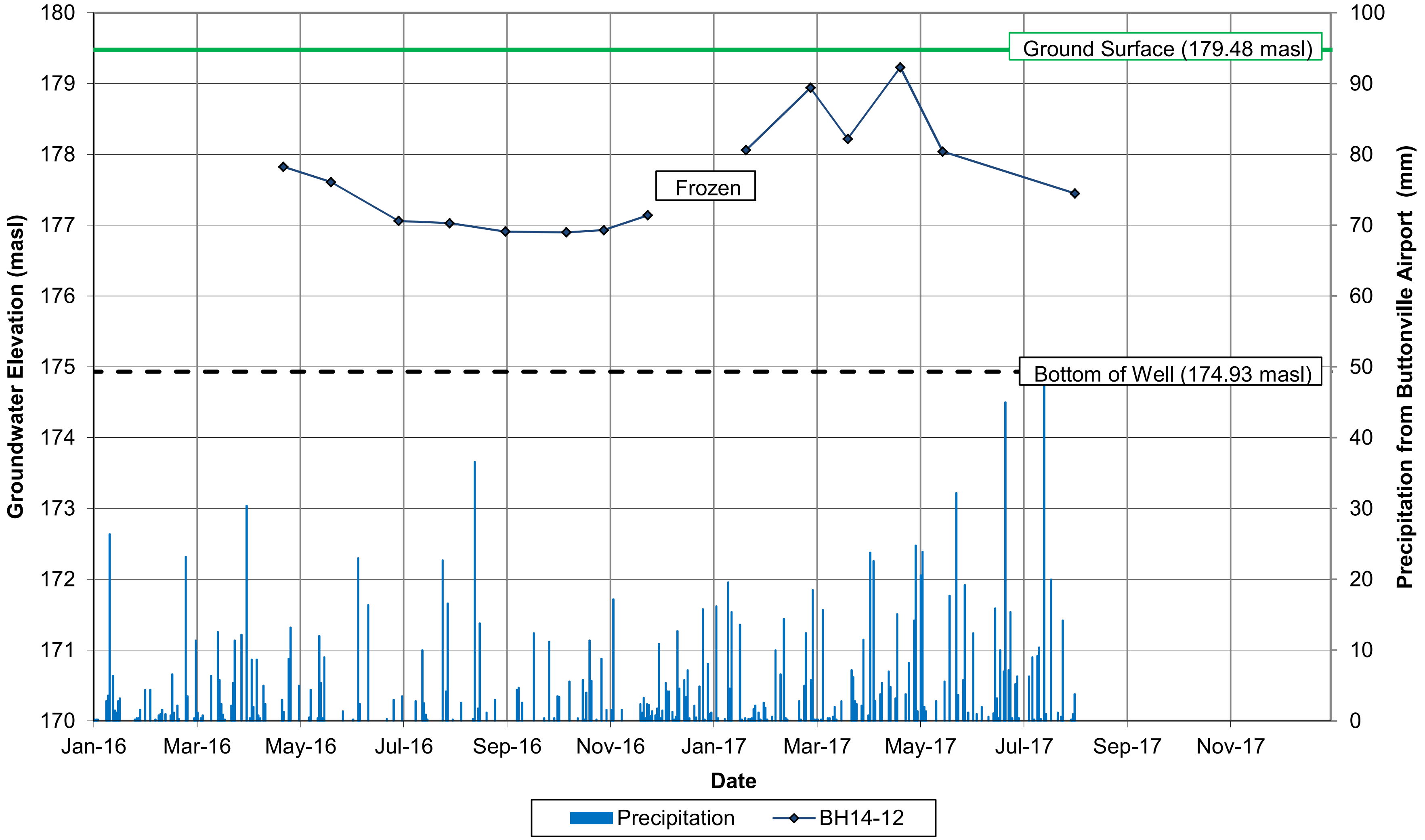

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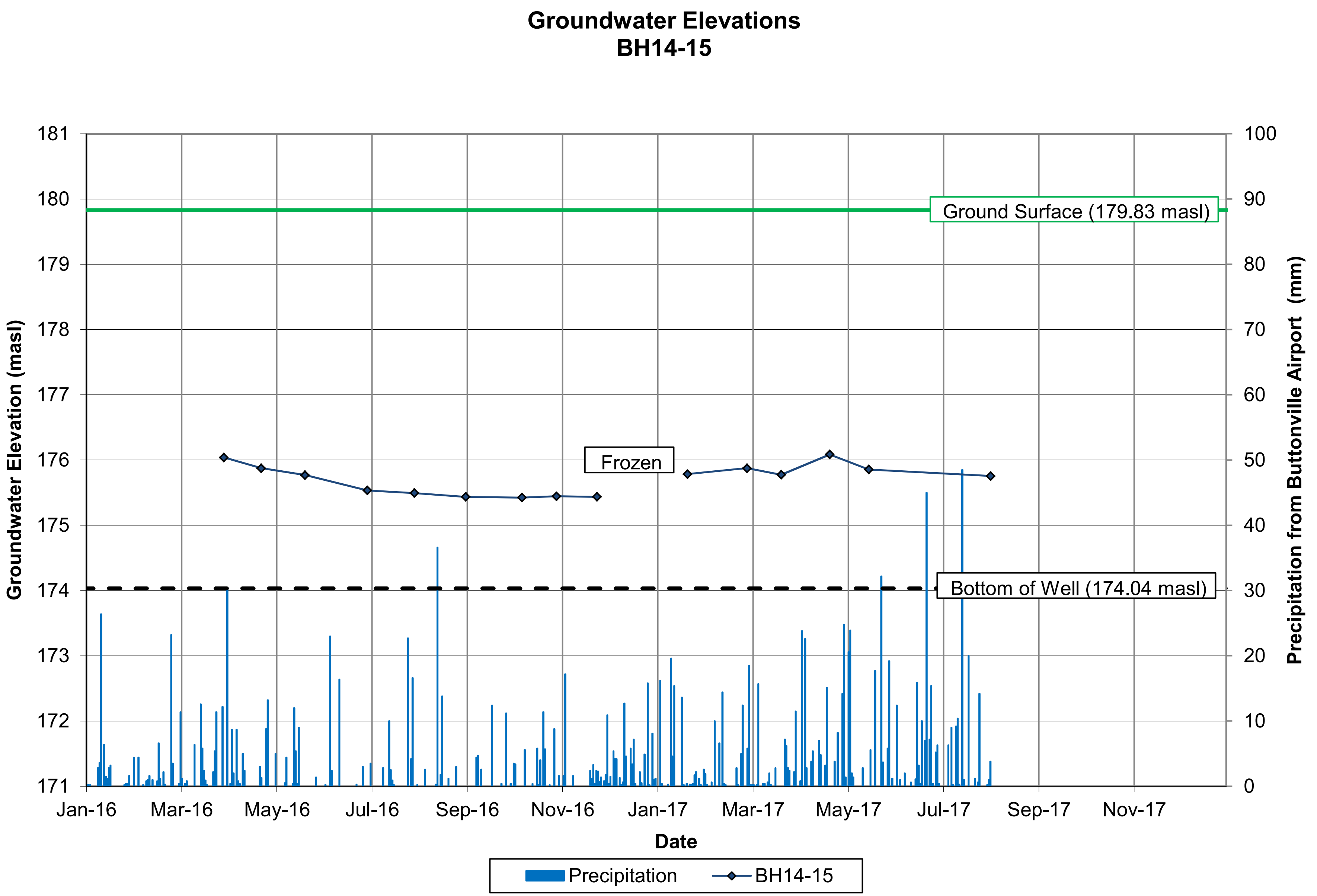
Figure E-19


Groundwater Elevations
BH14-15
Groundwater Elevation (masl)
181
180
179
178
177
176
175
174
173
172
171
Precipitation from Buttonville Airport (mm)
100
90
80
70
60
50
40
30
20
10
0
Ground Surface (179.83 masl)
Frozen
Bottom of Well (174.04 masl)
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Date
Precipitation
BH14-15

Groundwater Elevations
BH14-17

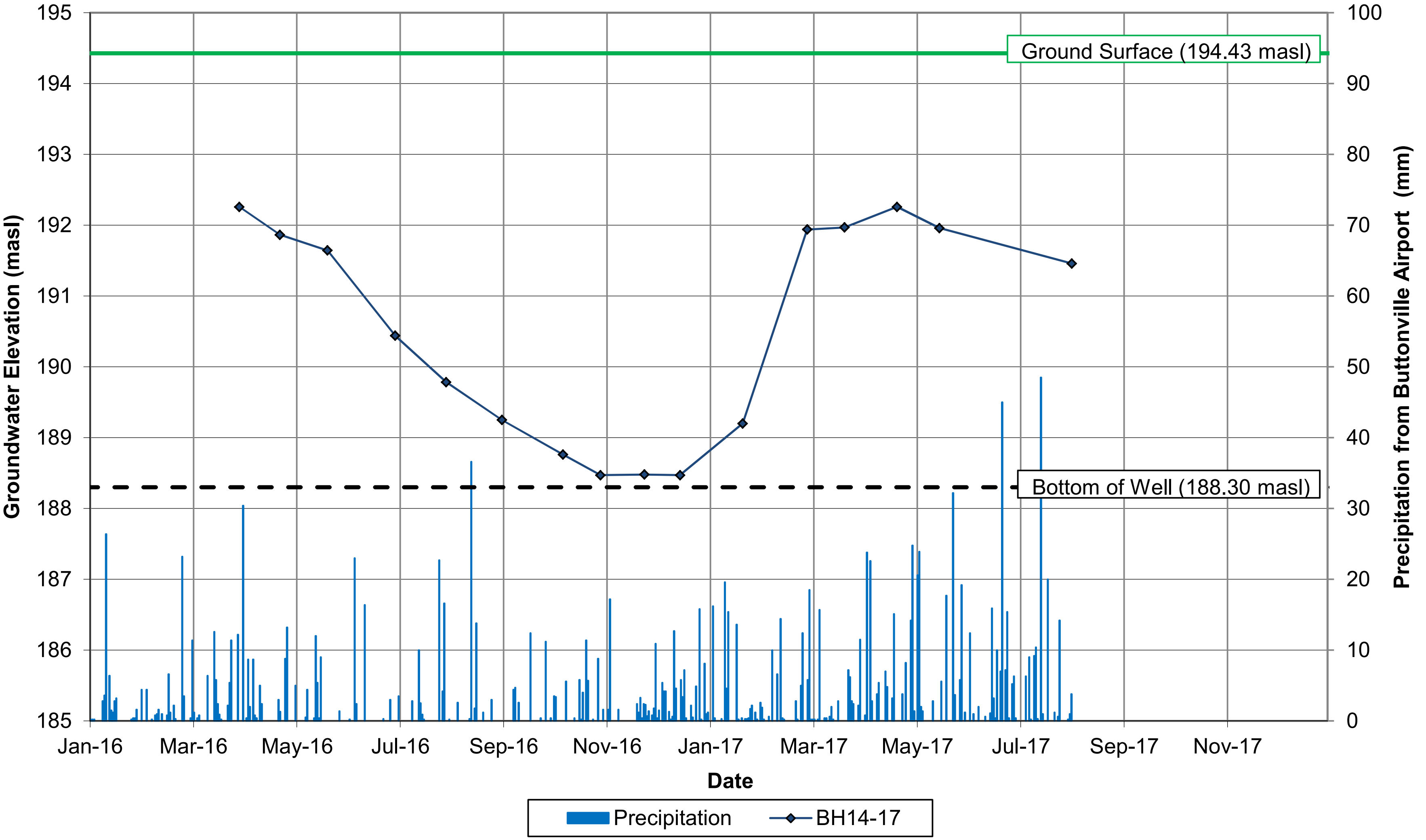


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Figure E-21

Groundwater Elevations
BH14-29

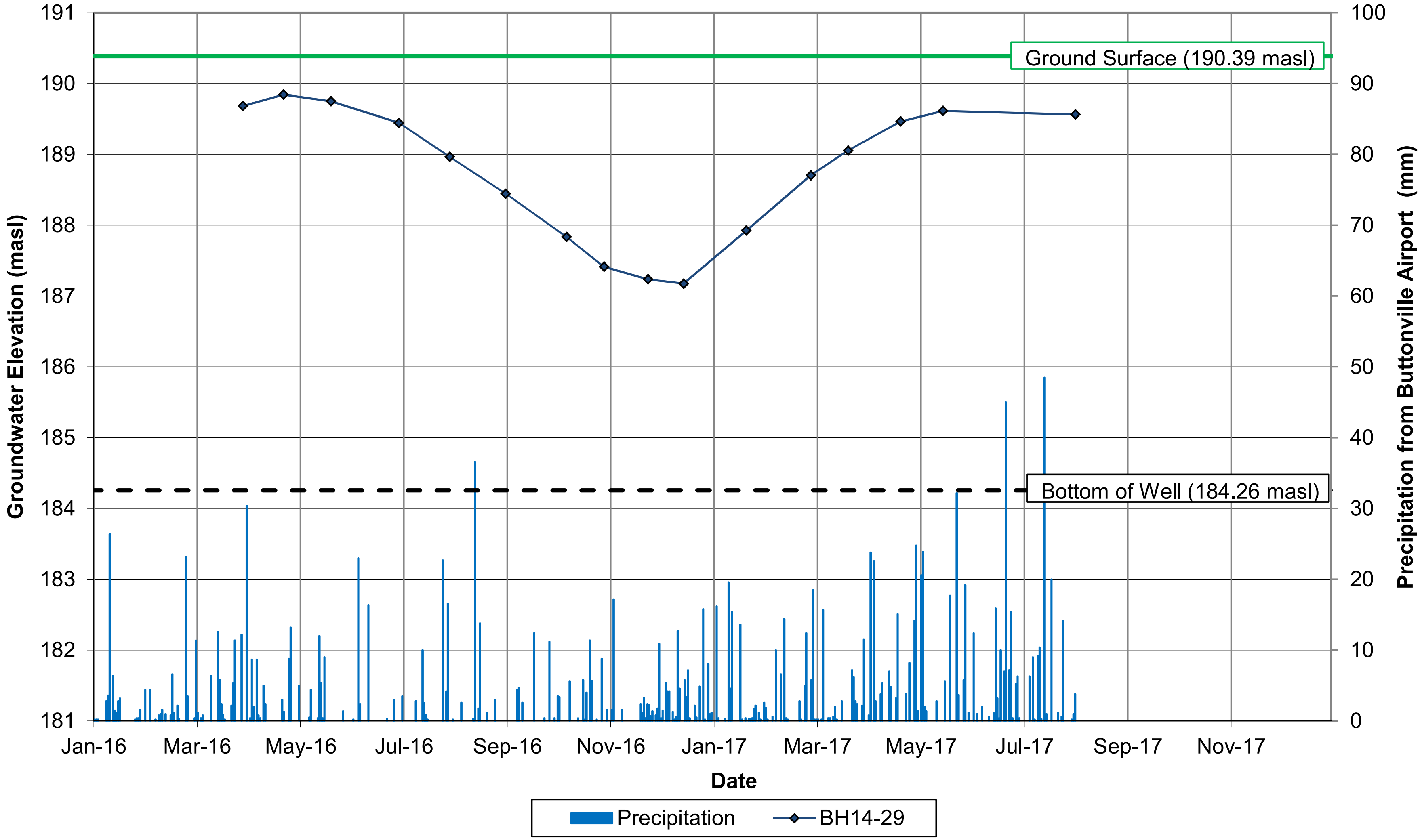

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Figure E-22

Groundwater Elevations
BH14-33

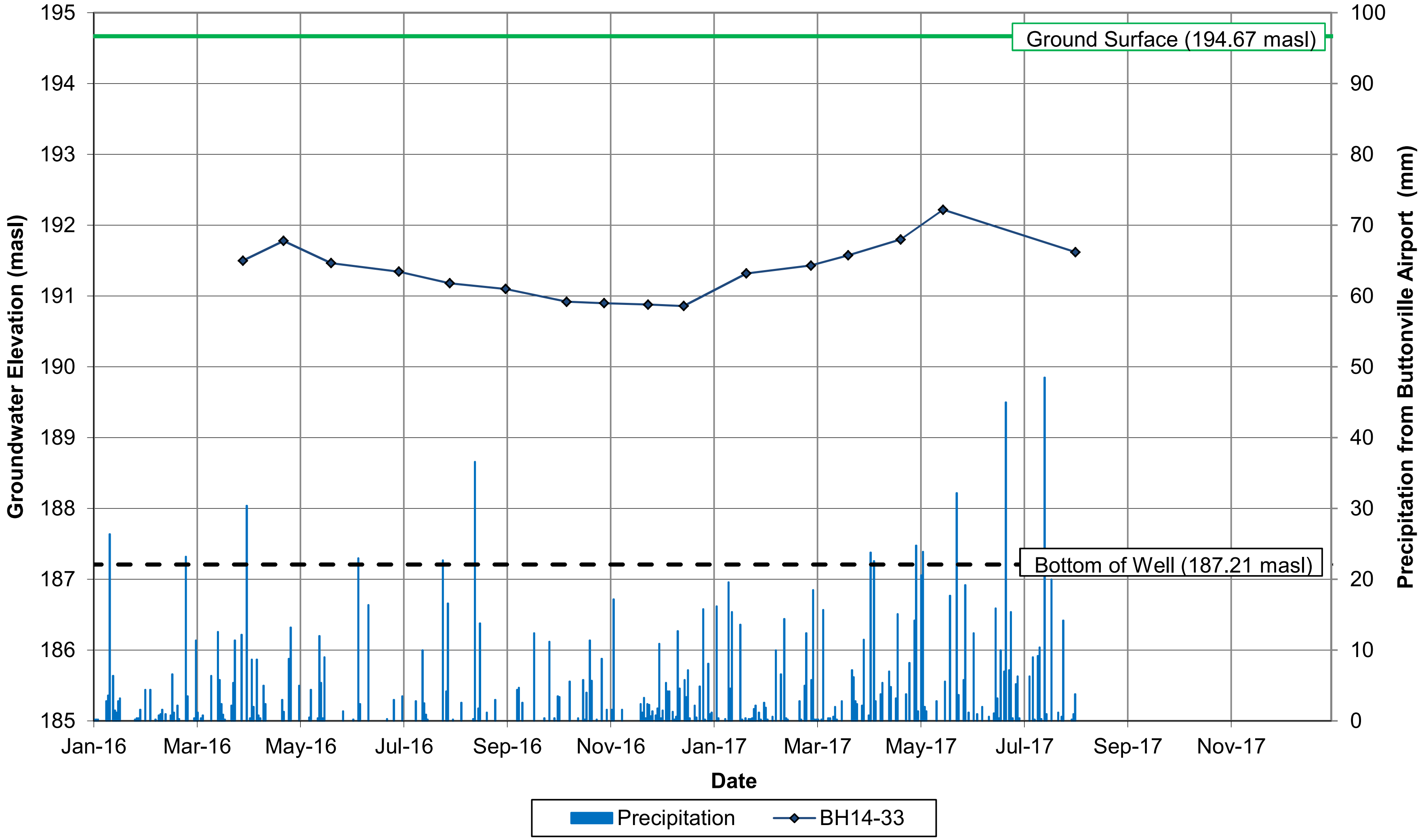

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Figure E-23

Groundwater Elevations
BH17-104

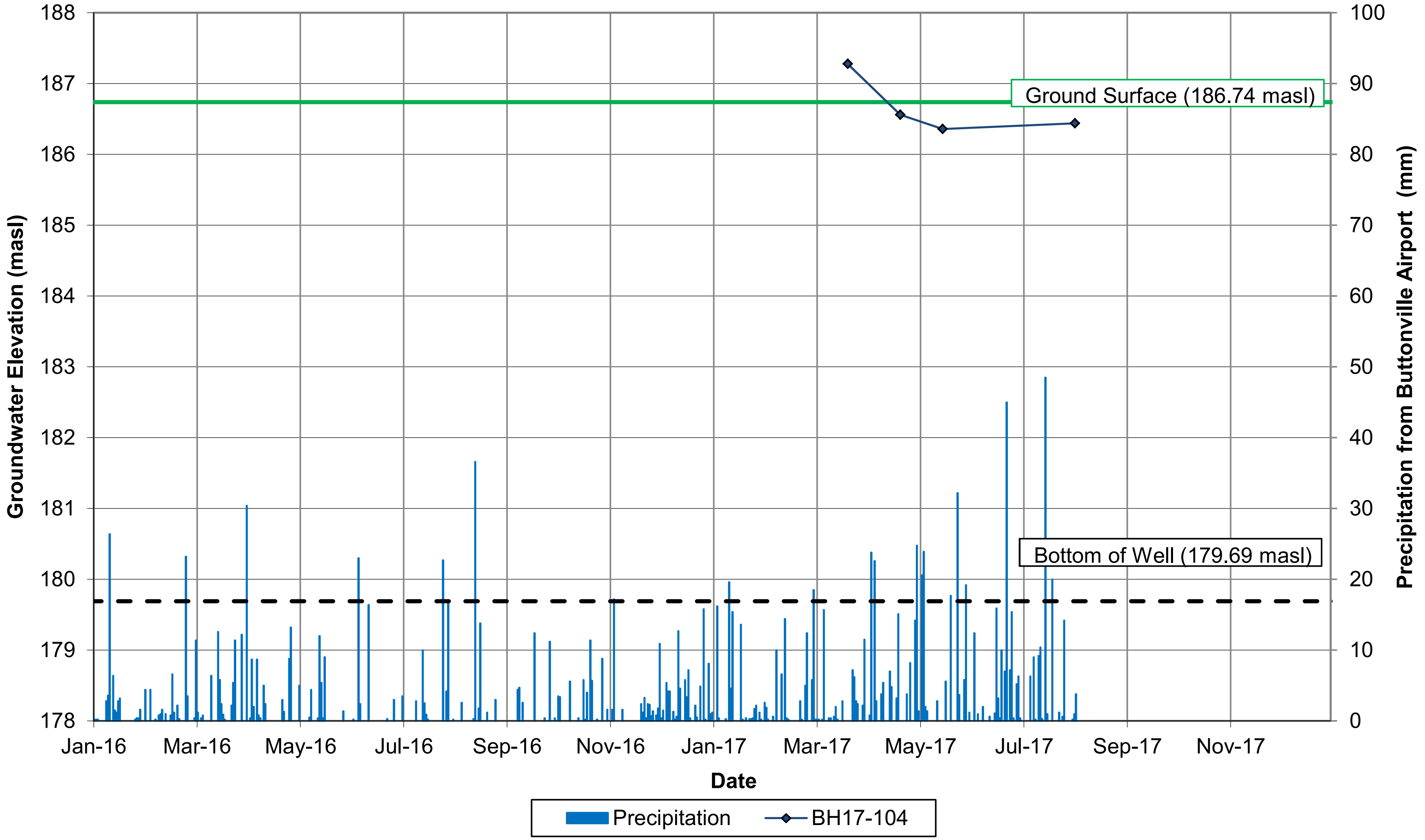

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Figure E-24

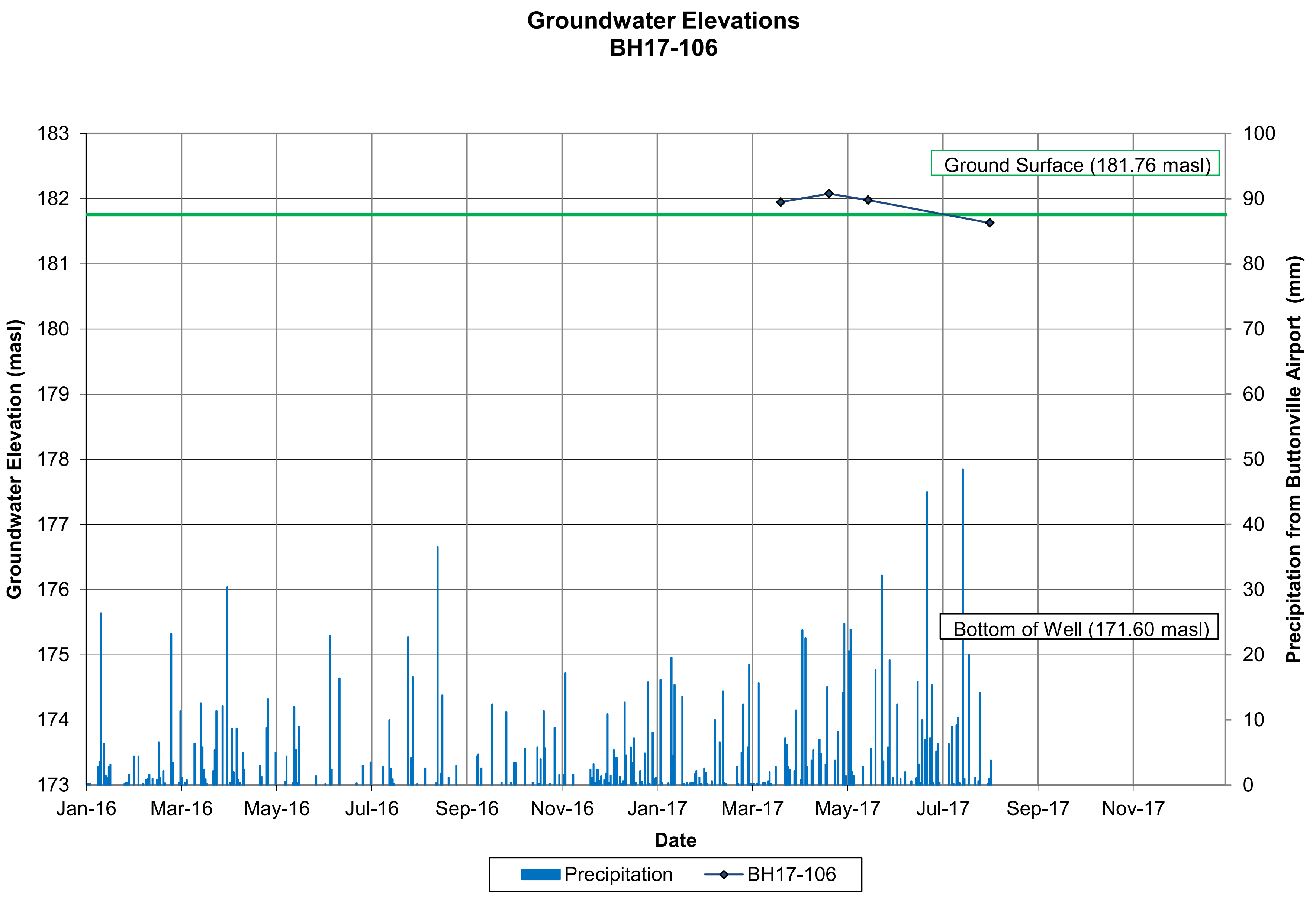

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Figure E-25

Groundwater Elevations
BH17-110

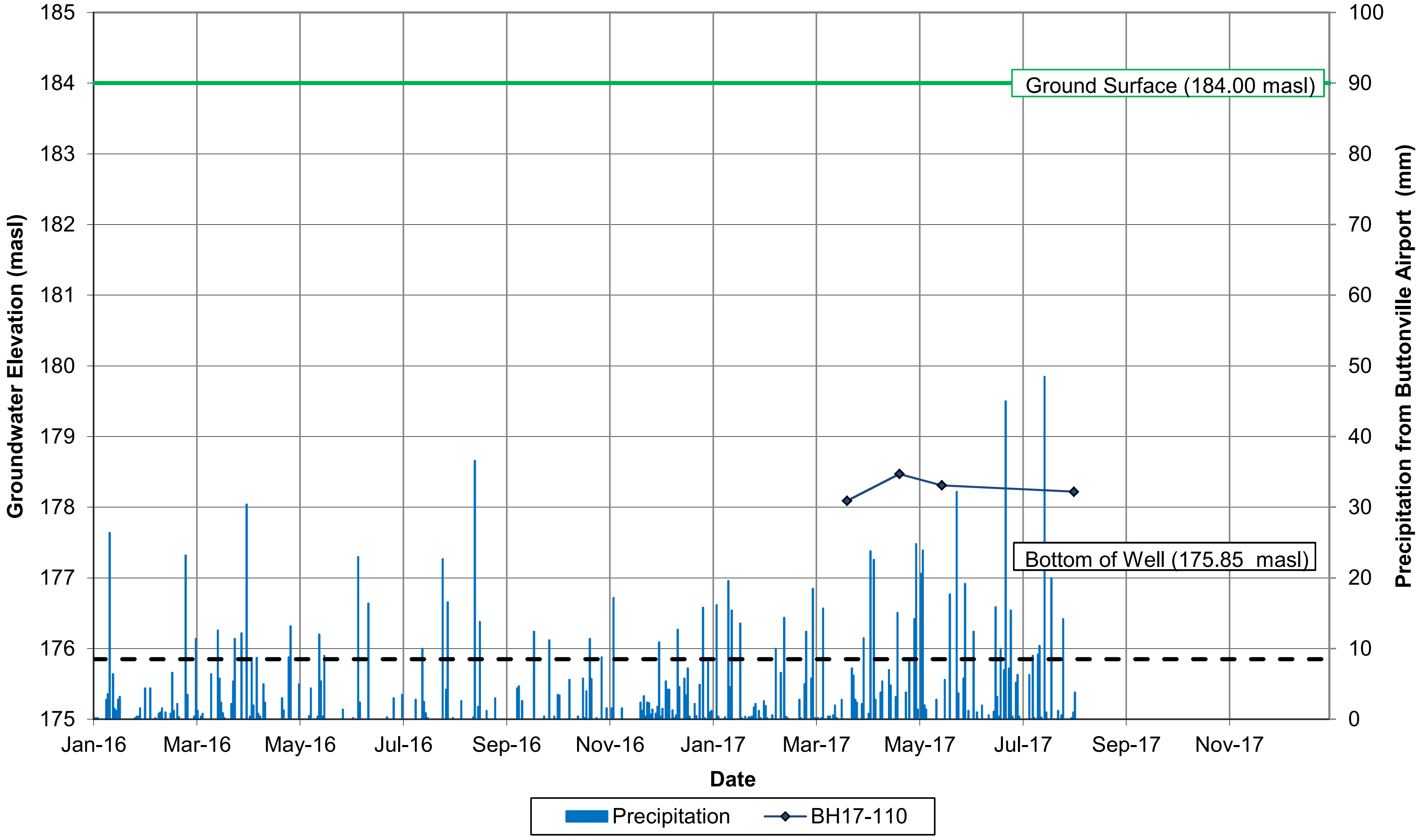

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Figure E-26

Groundwater Elevations
BH115

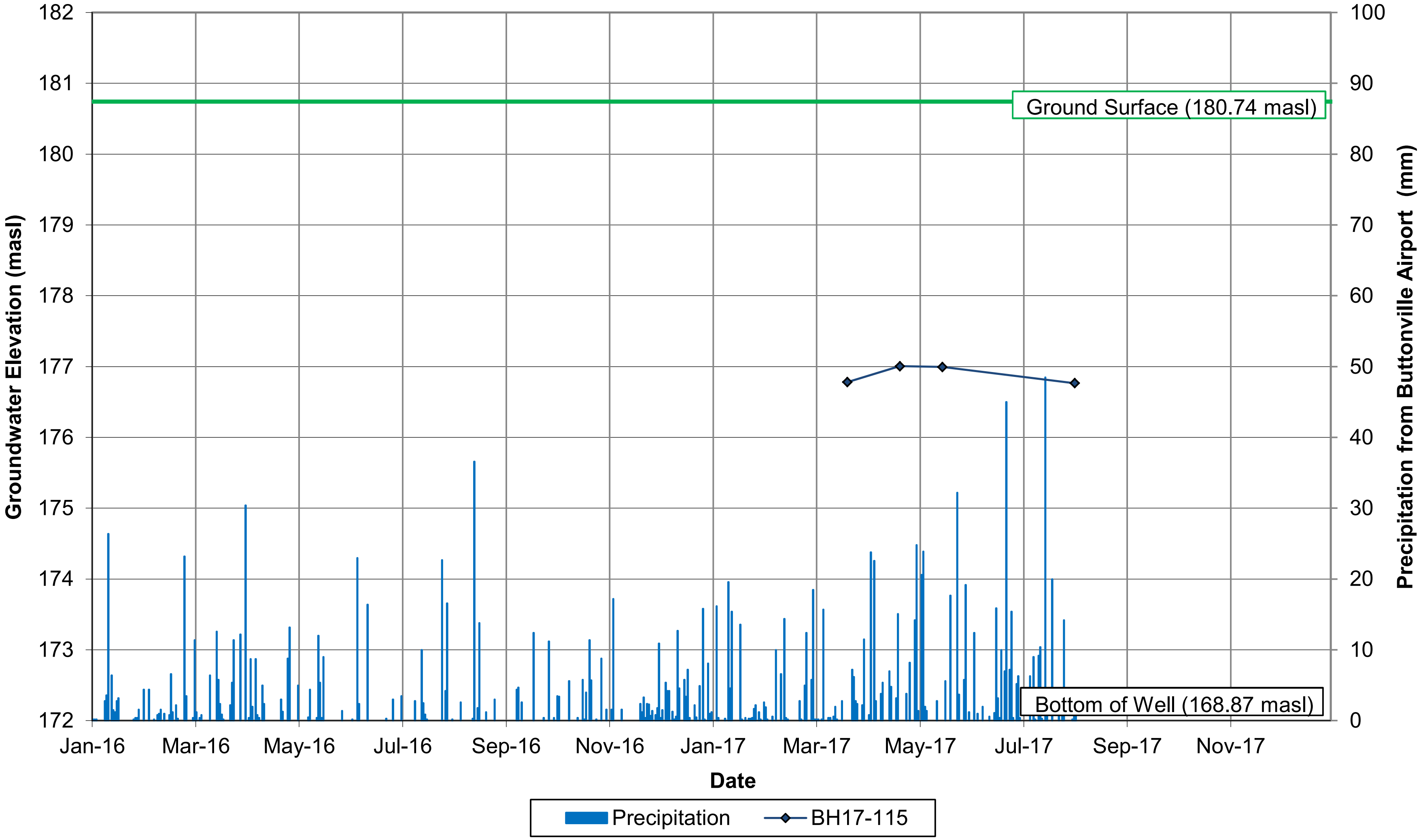

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Figure E-27

Groundwater Elevations
BH17-127

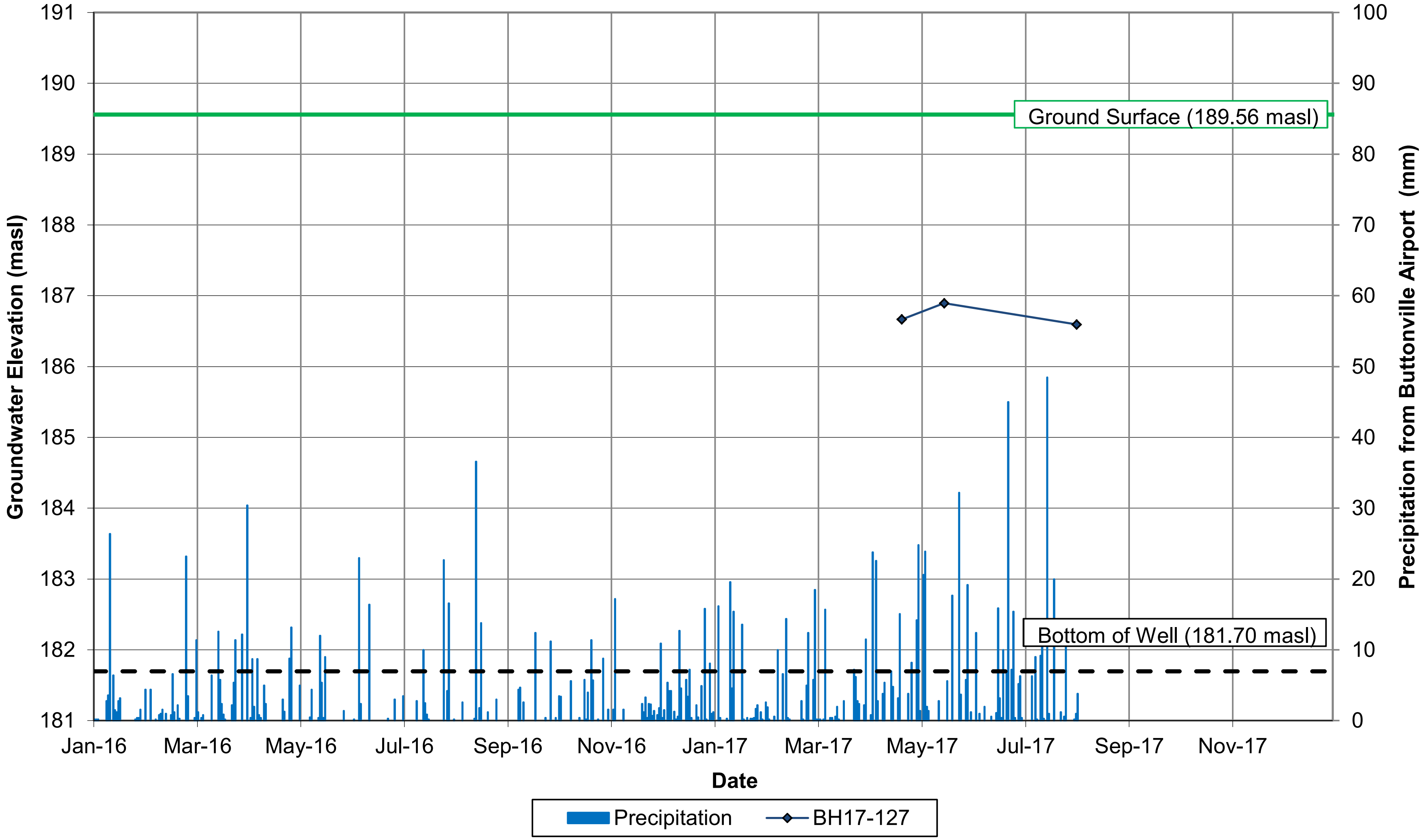

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Figure E-28

Groundwater Elevations
BH17-130

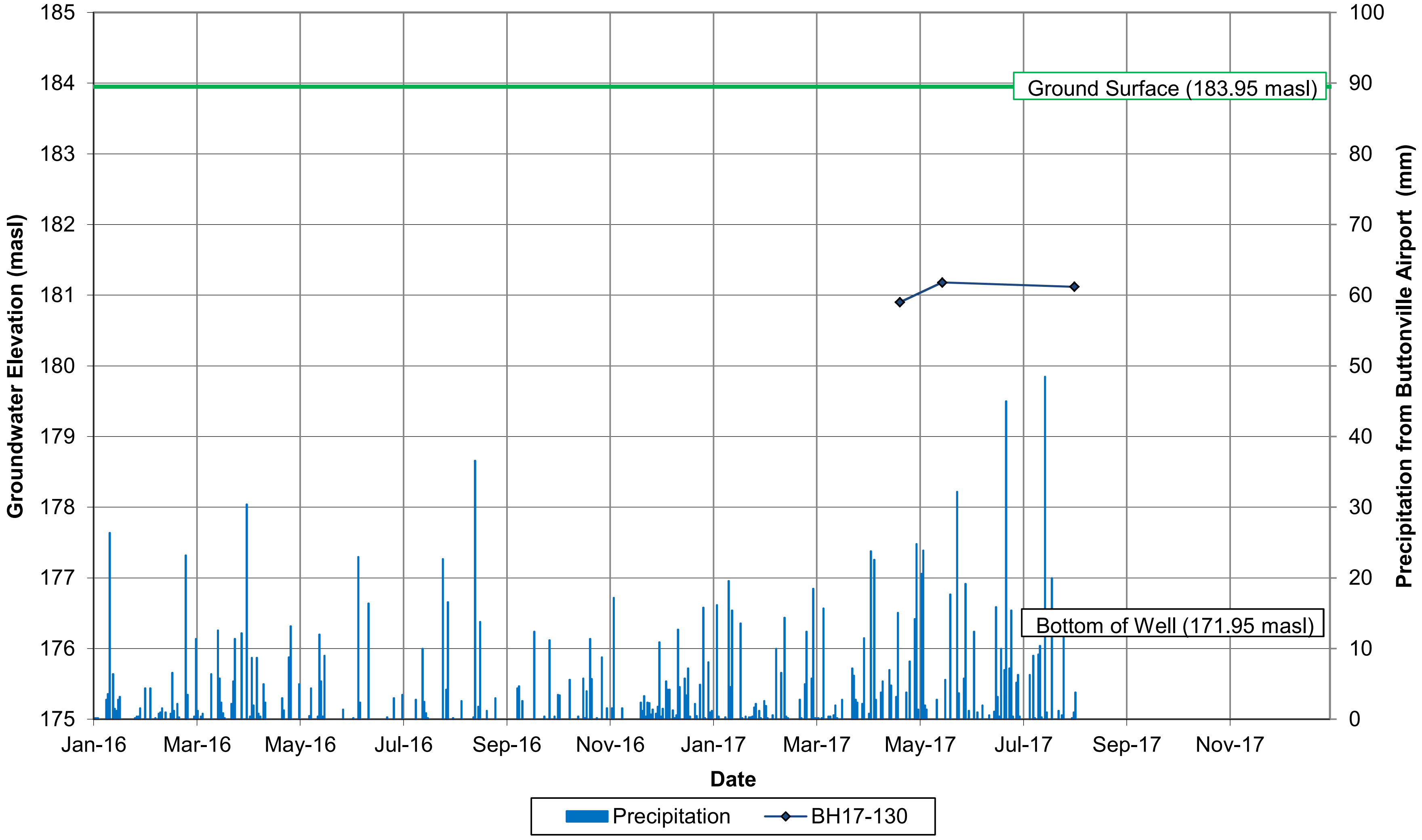

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Figure E-29

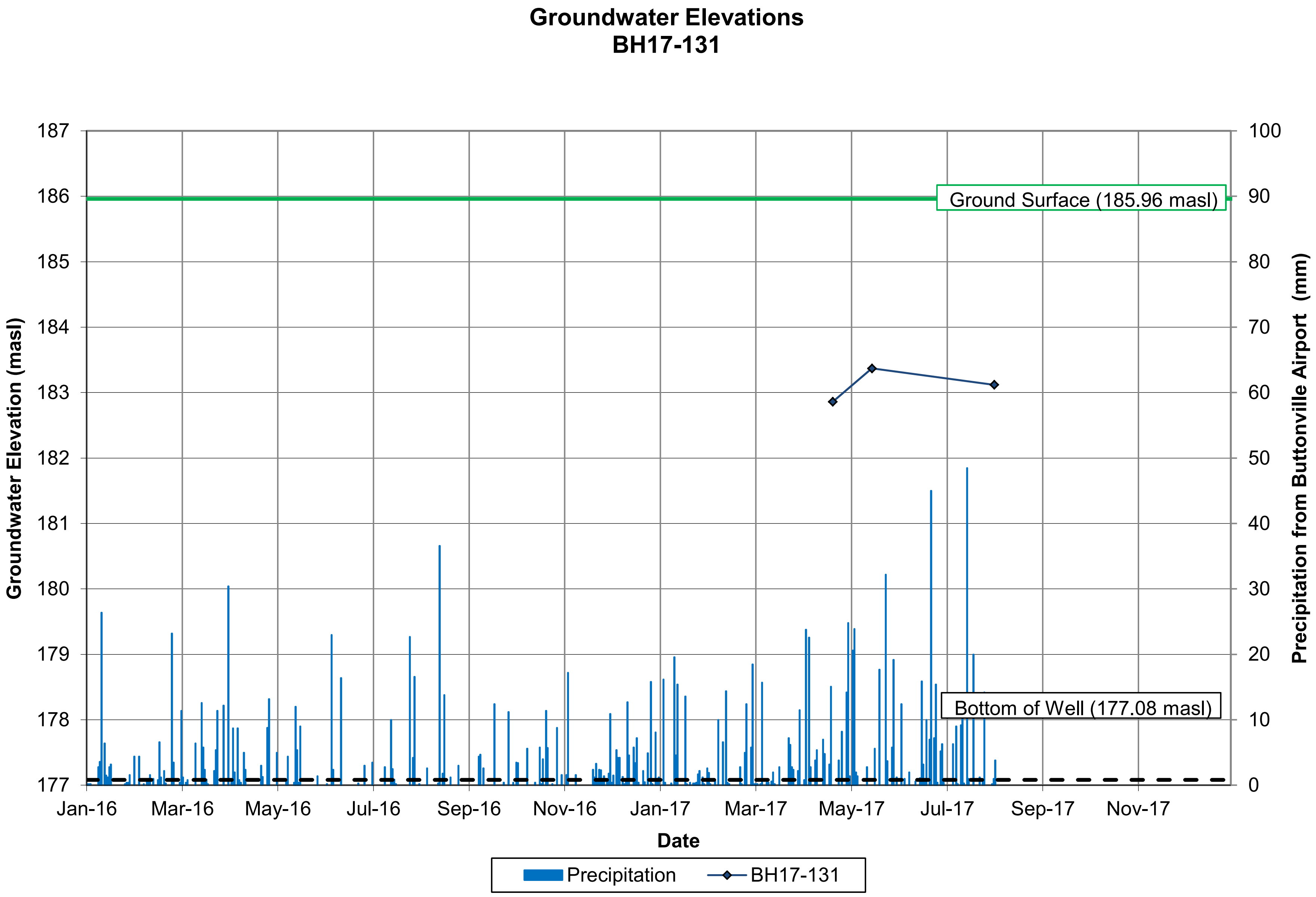

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Figure E-30

Groundwater Elevations
BH17-137

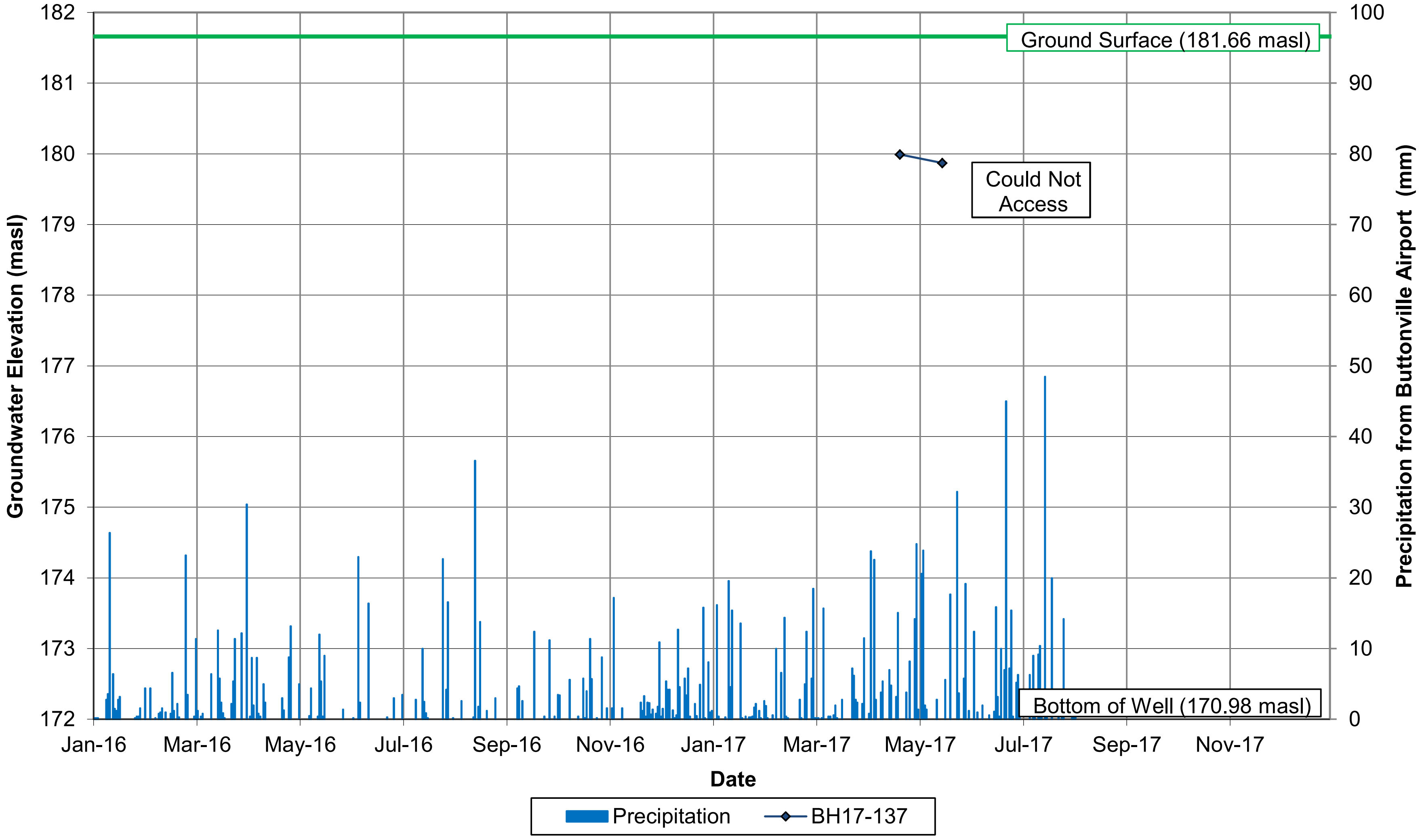

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Figure E-31

Groundwater Elevations
BH17-139s/d

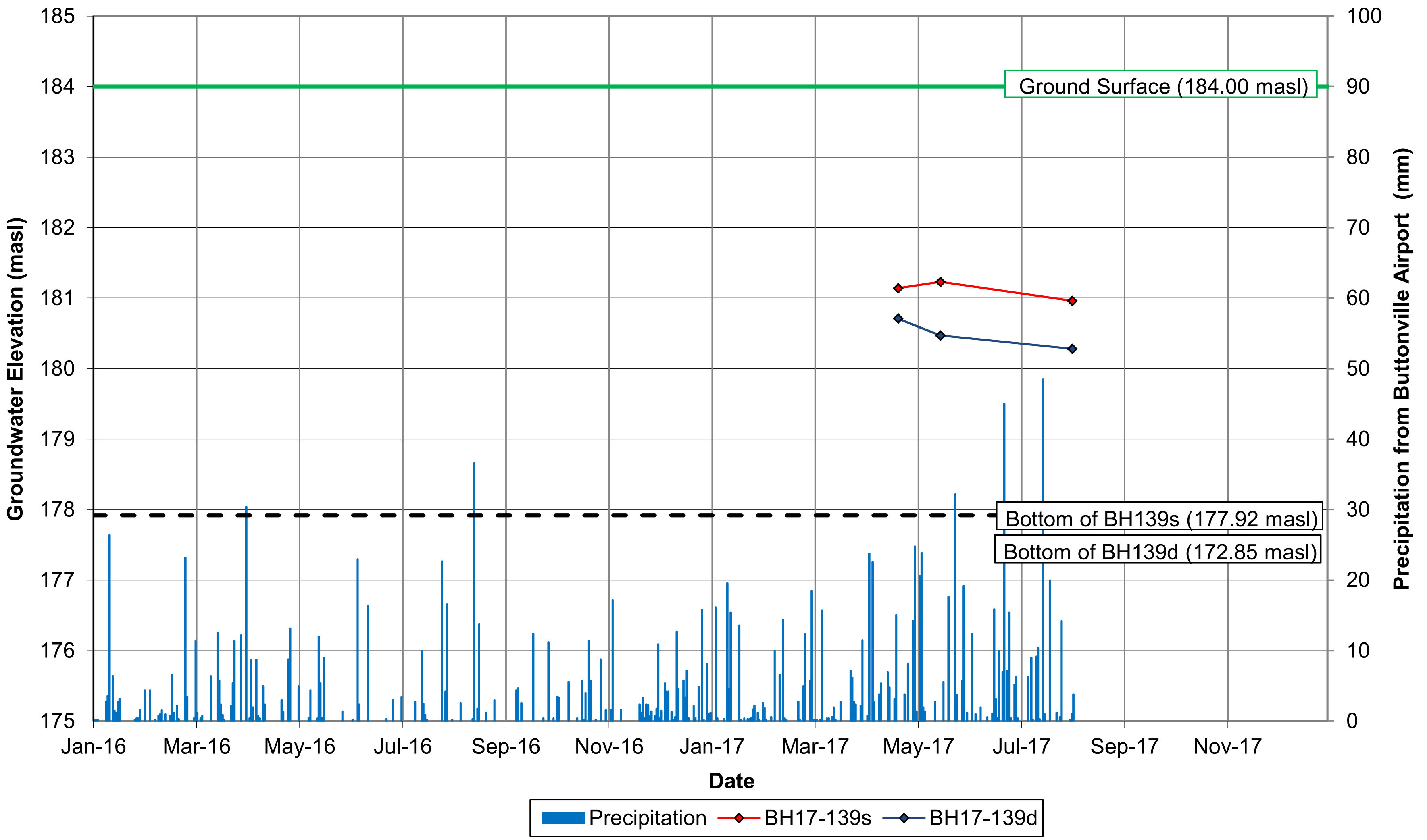

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Figure E-32

Groundwater Elevations
BH17-140

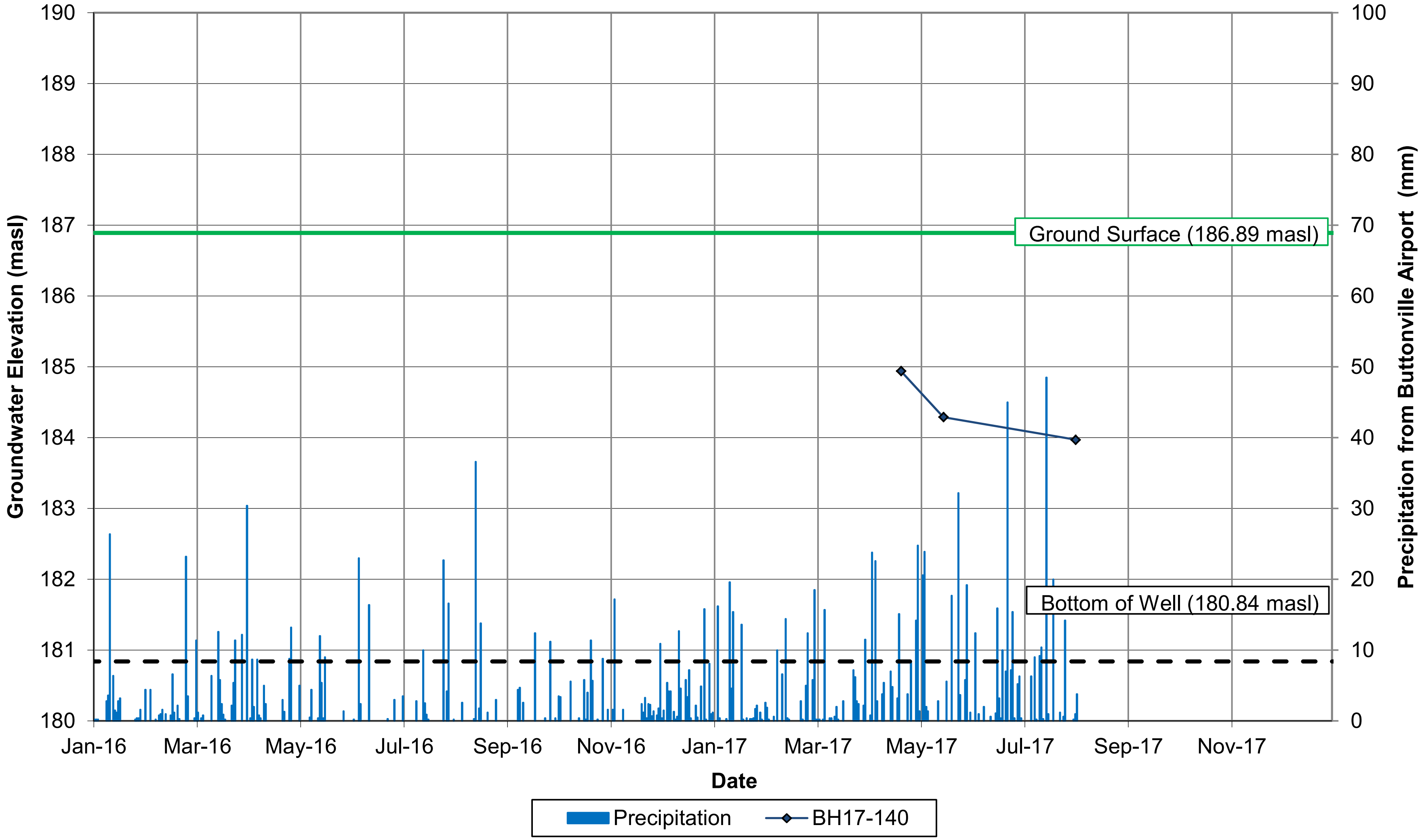

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Figure E-33

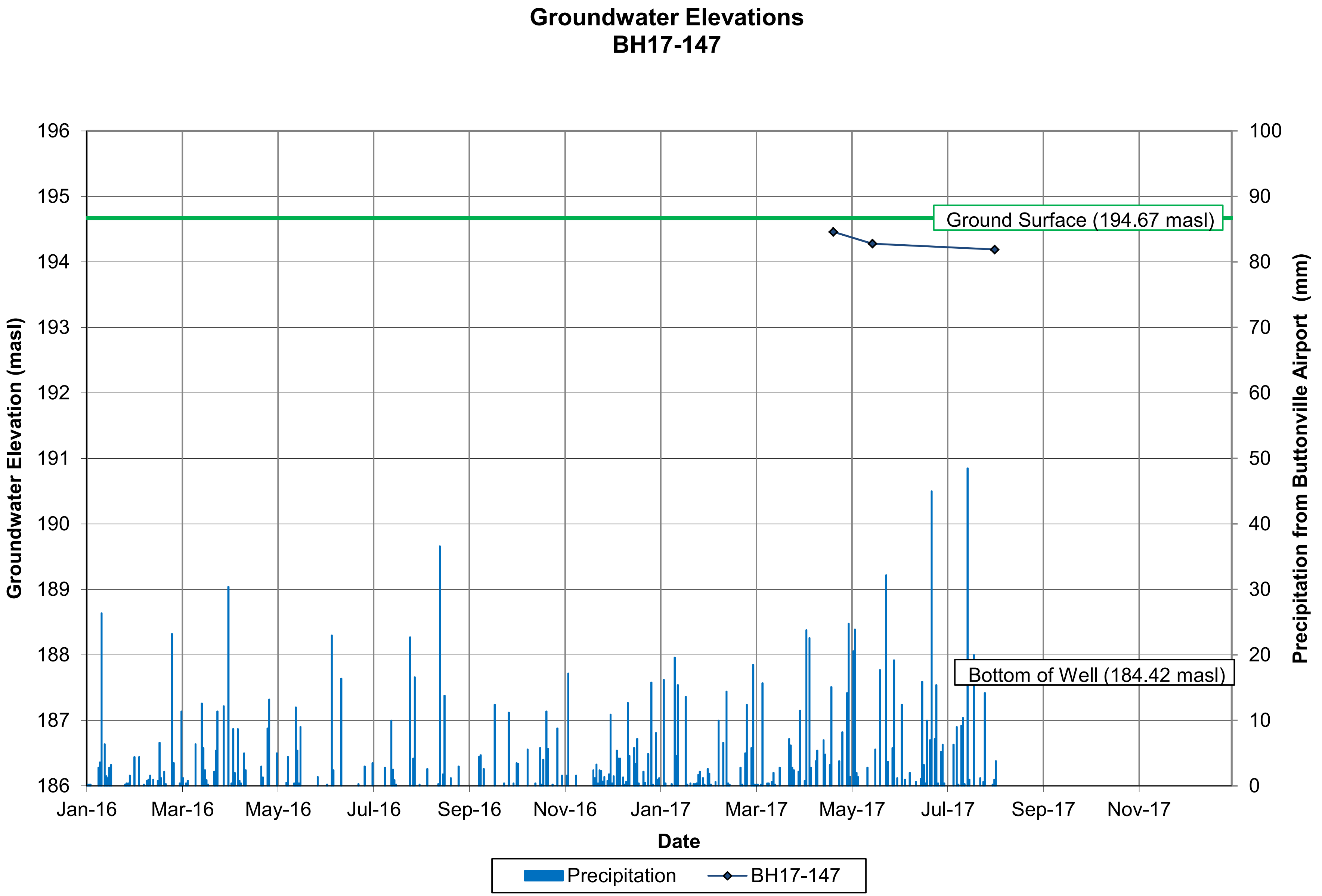

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Figure E-34

Groundwater Elevations
BH17-05

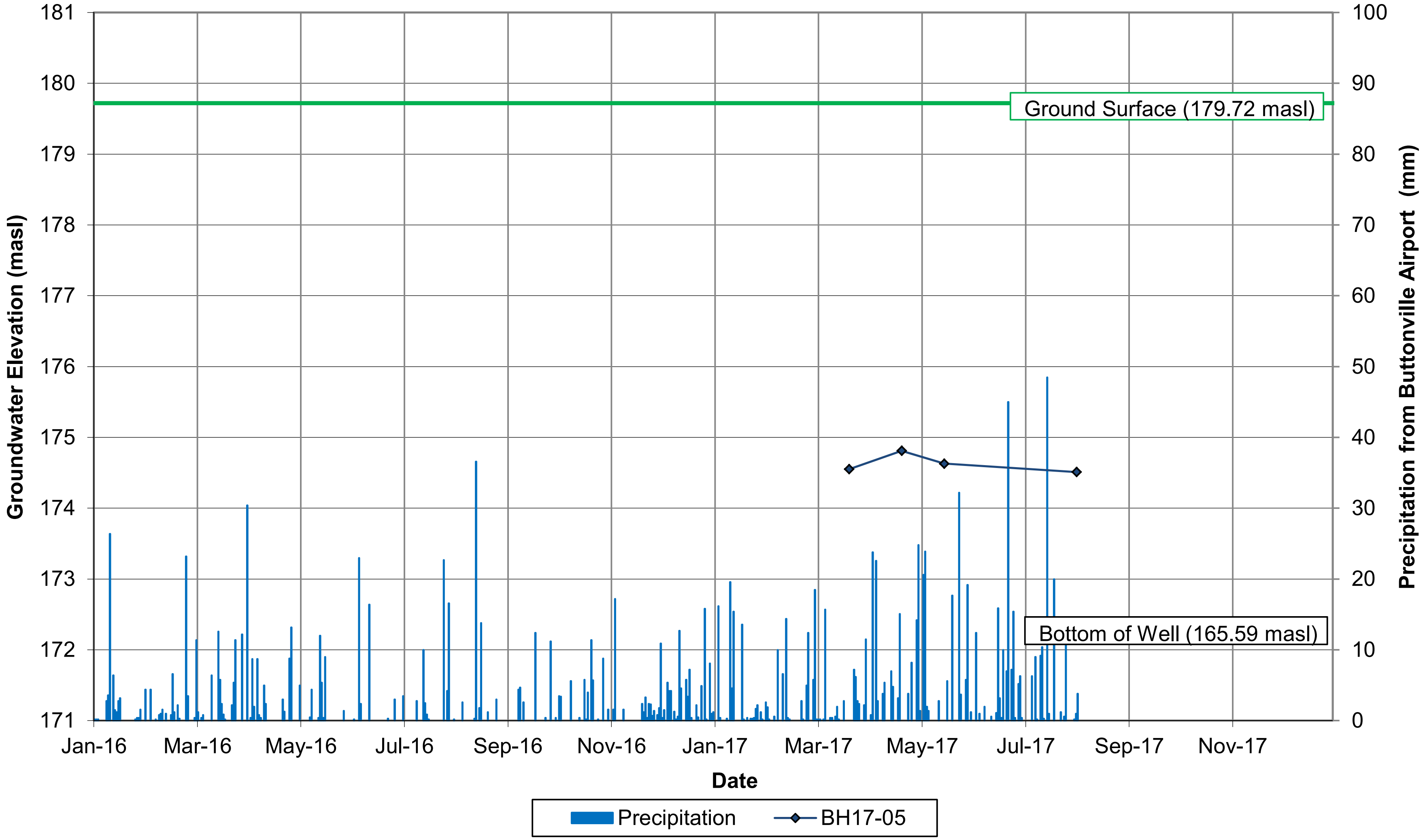

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Figure E-35

Groundwater Elevations
PZ1 + SG1

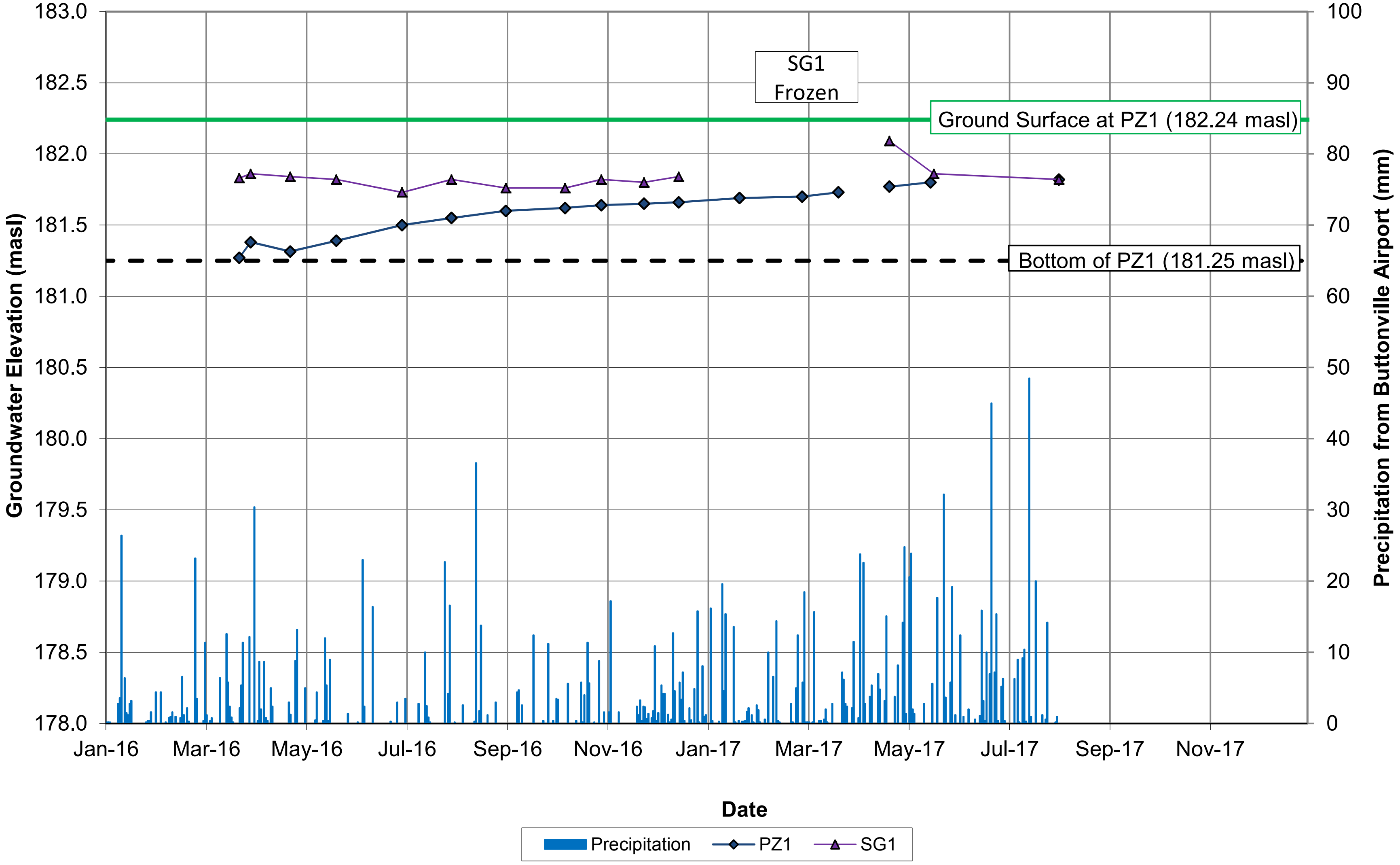

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Figure E-36

Groundwater Elevations
PZ2 + SG2

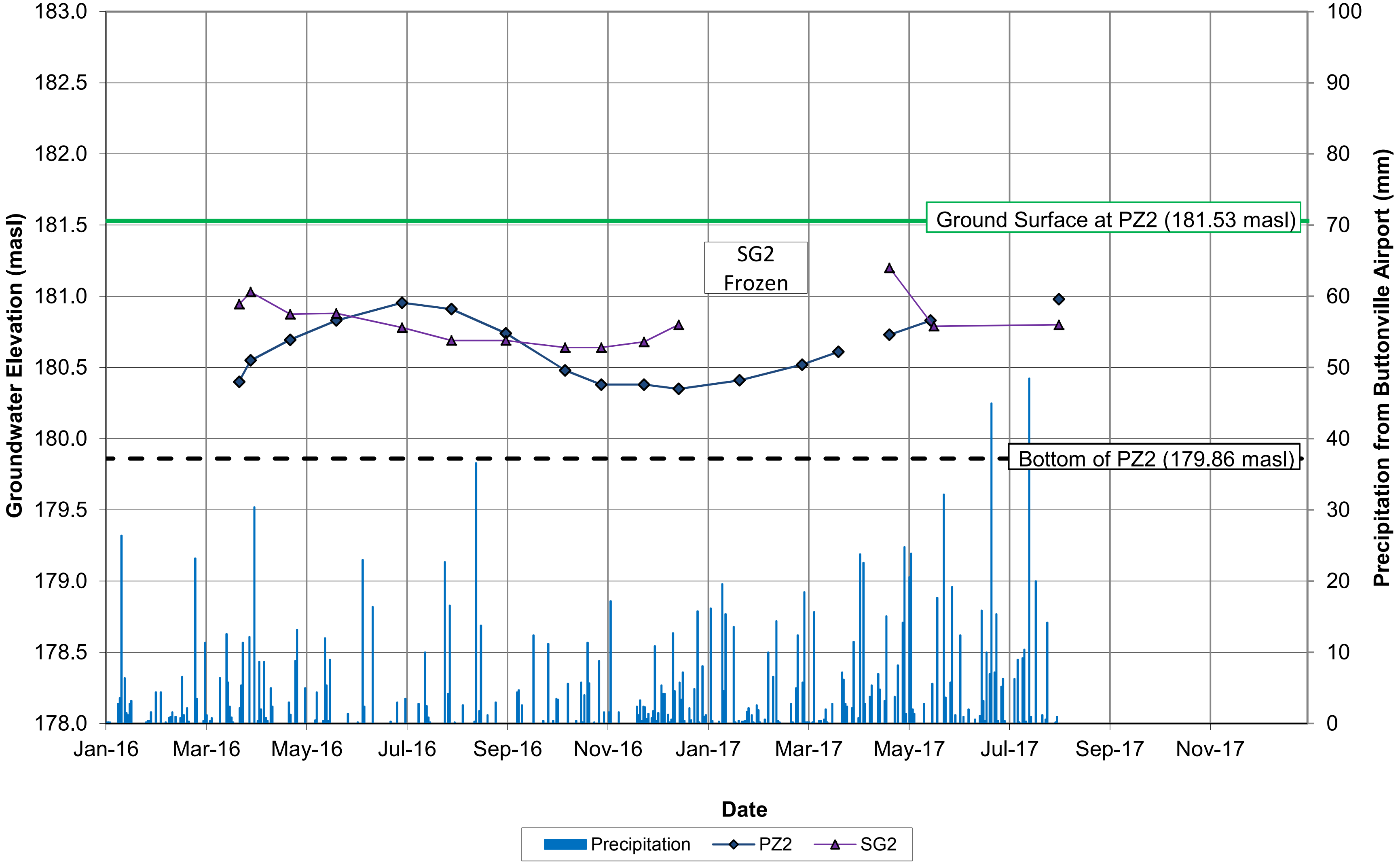

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Figure E-37

Groundwater Elevations
PZ3s/d + SG3

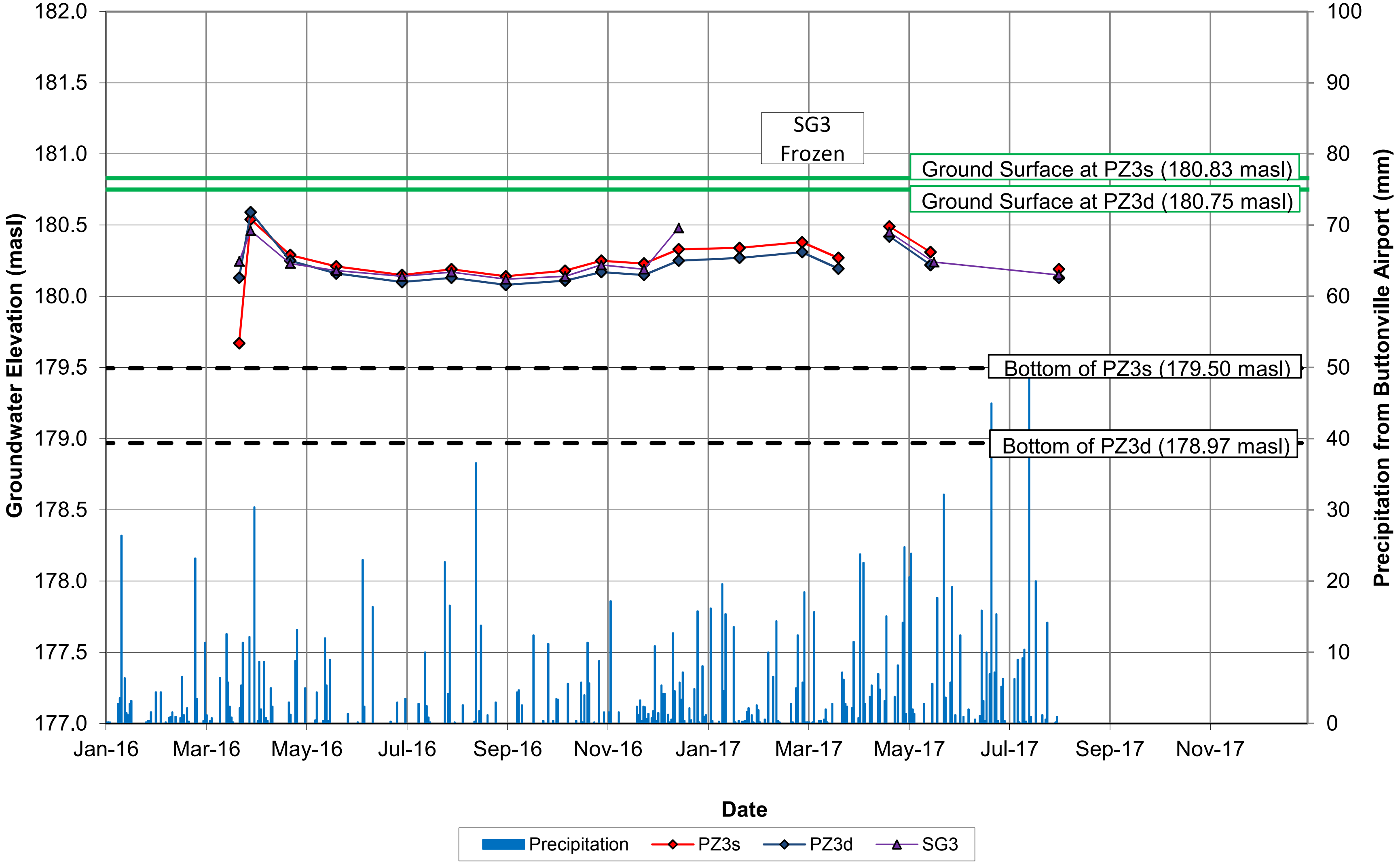

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Figure E-38

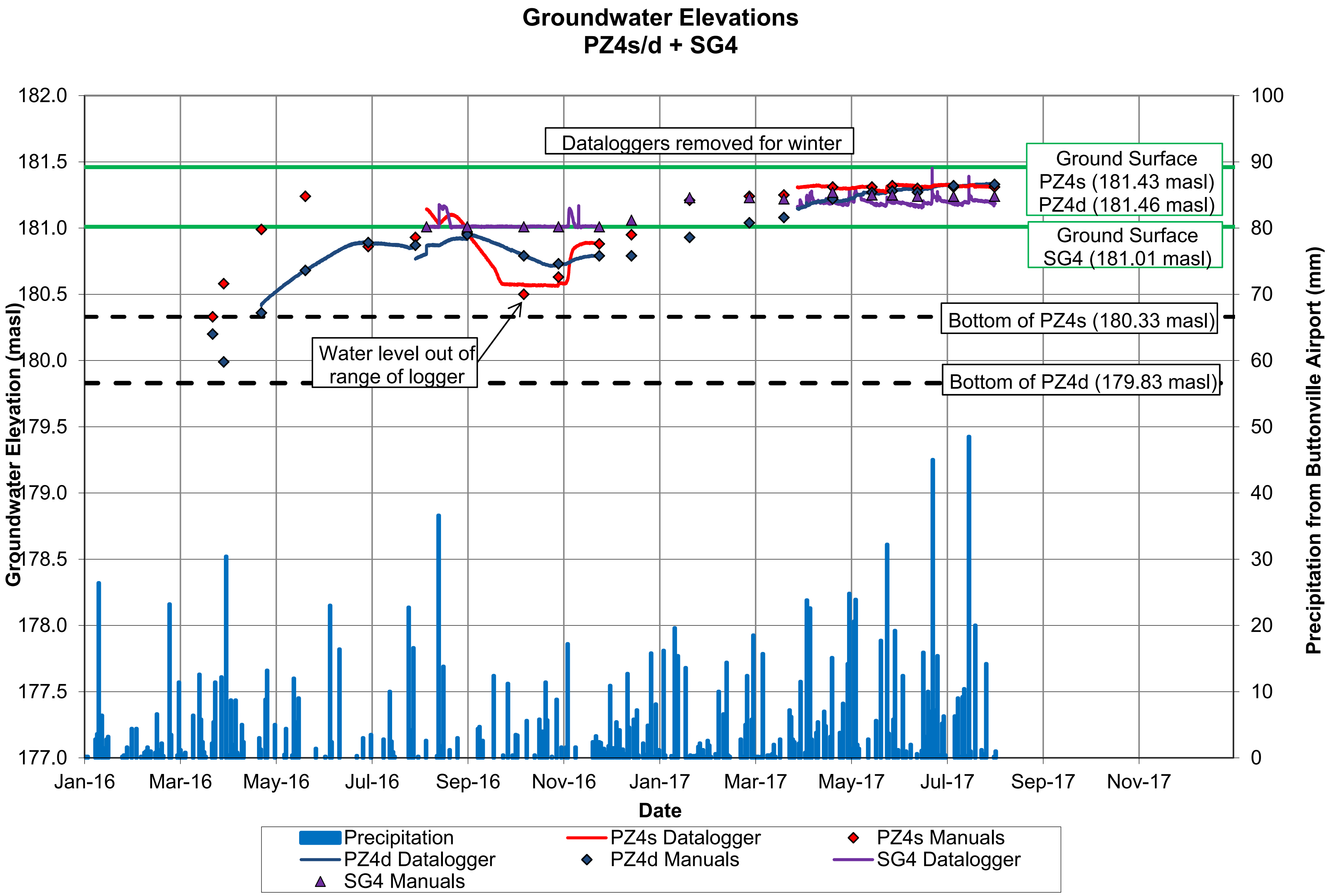

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Figure E-39

Groundwater Elevations
PZ5s/d + SG5

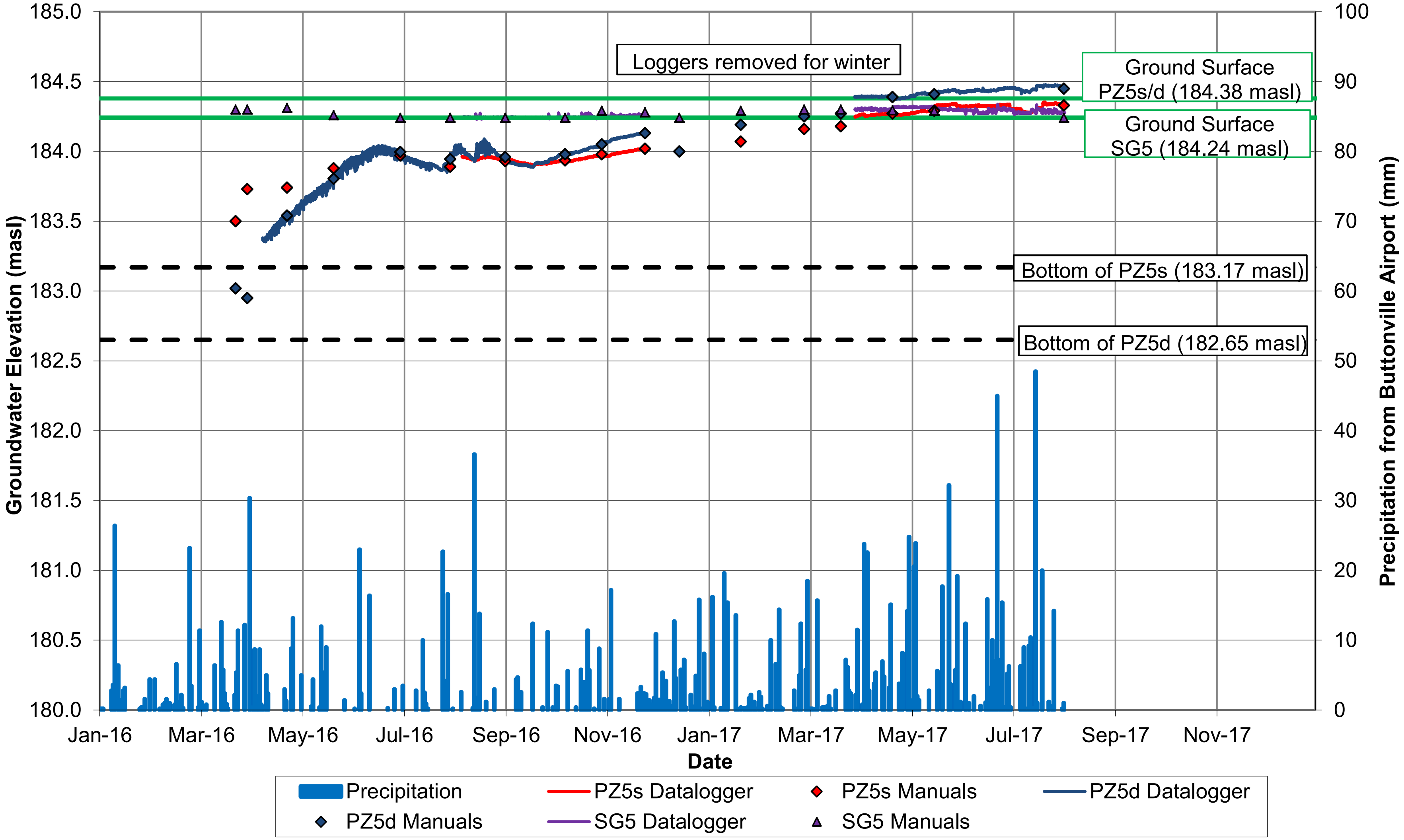

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Figure E-40

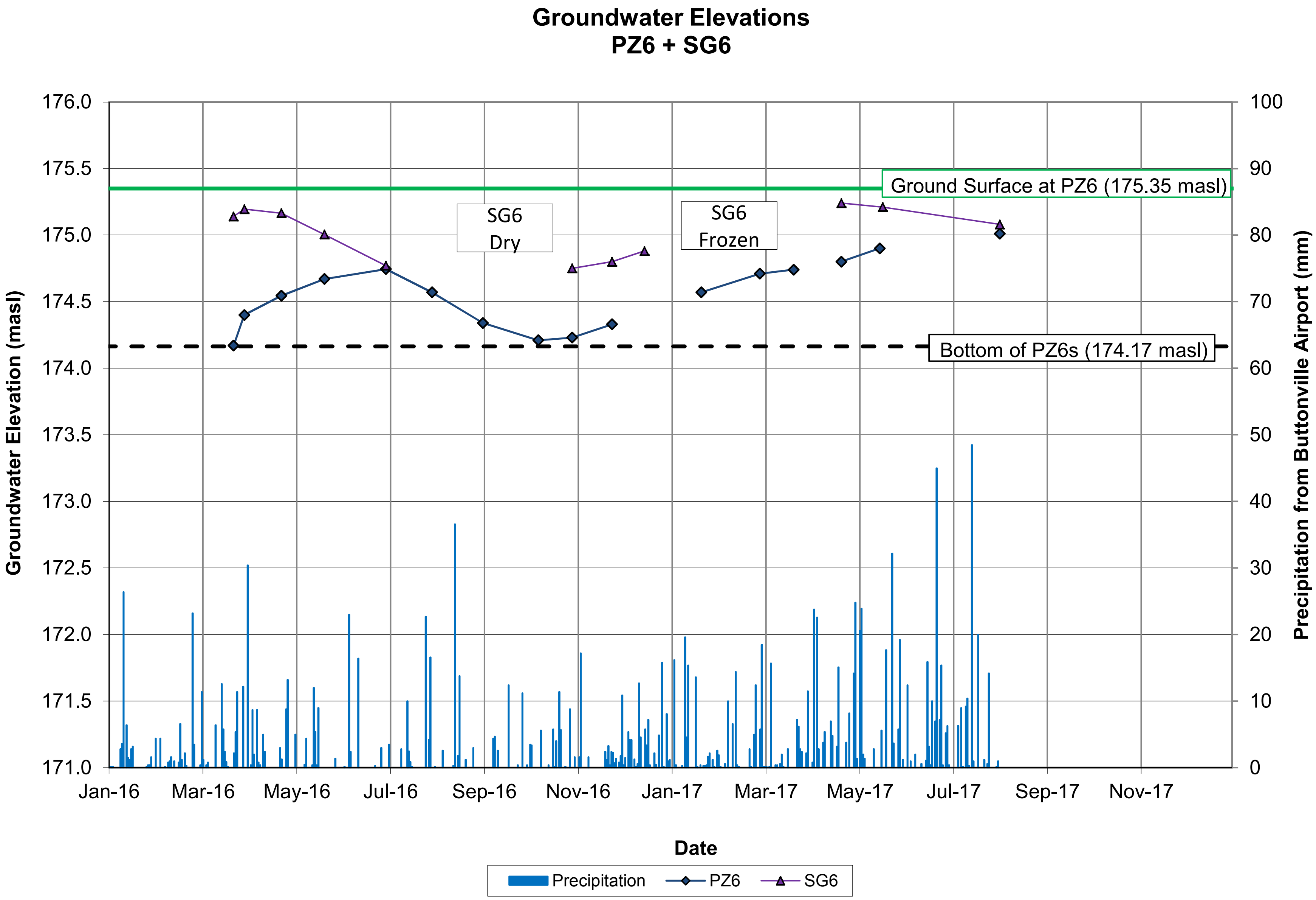

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Figure E-41

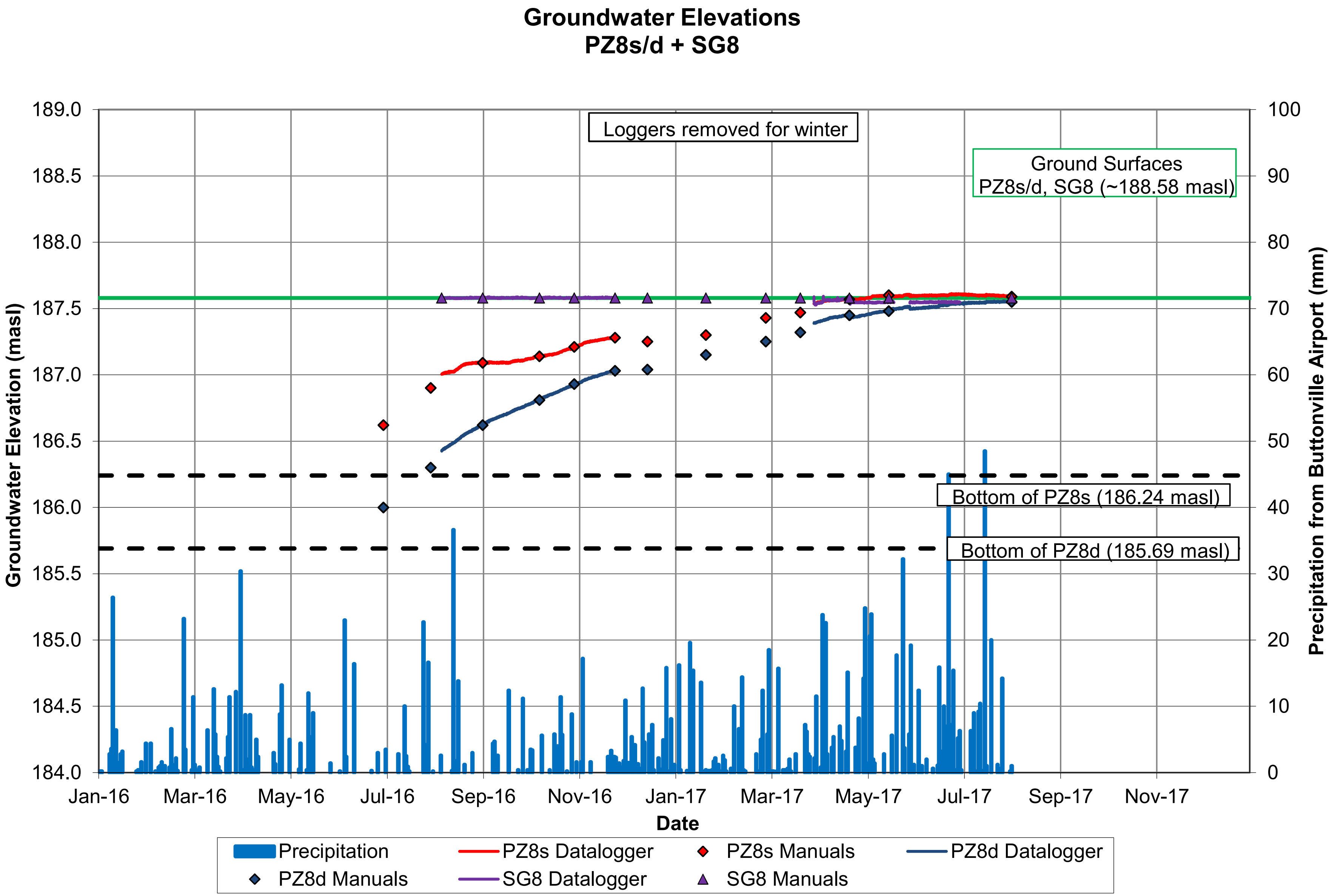

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Figure E-43

Groundwater Elevations
PZ9s/d + SG9

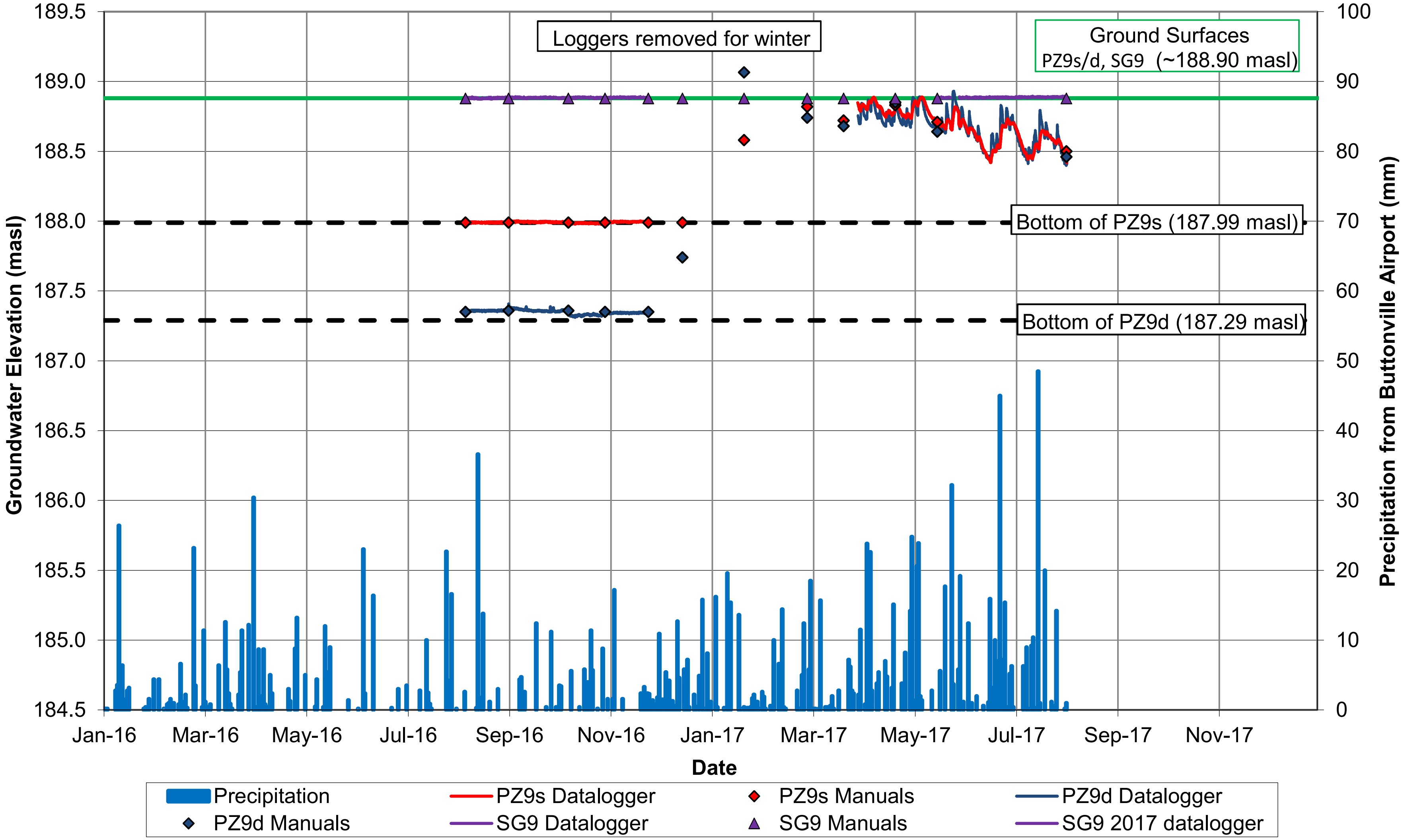

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Figure E-44

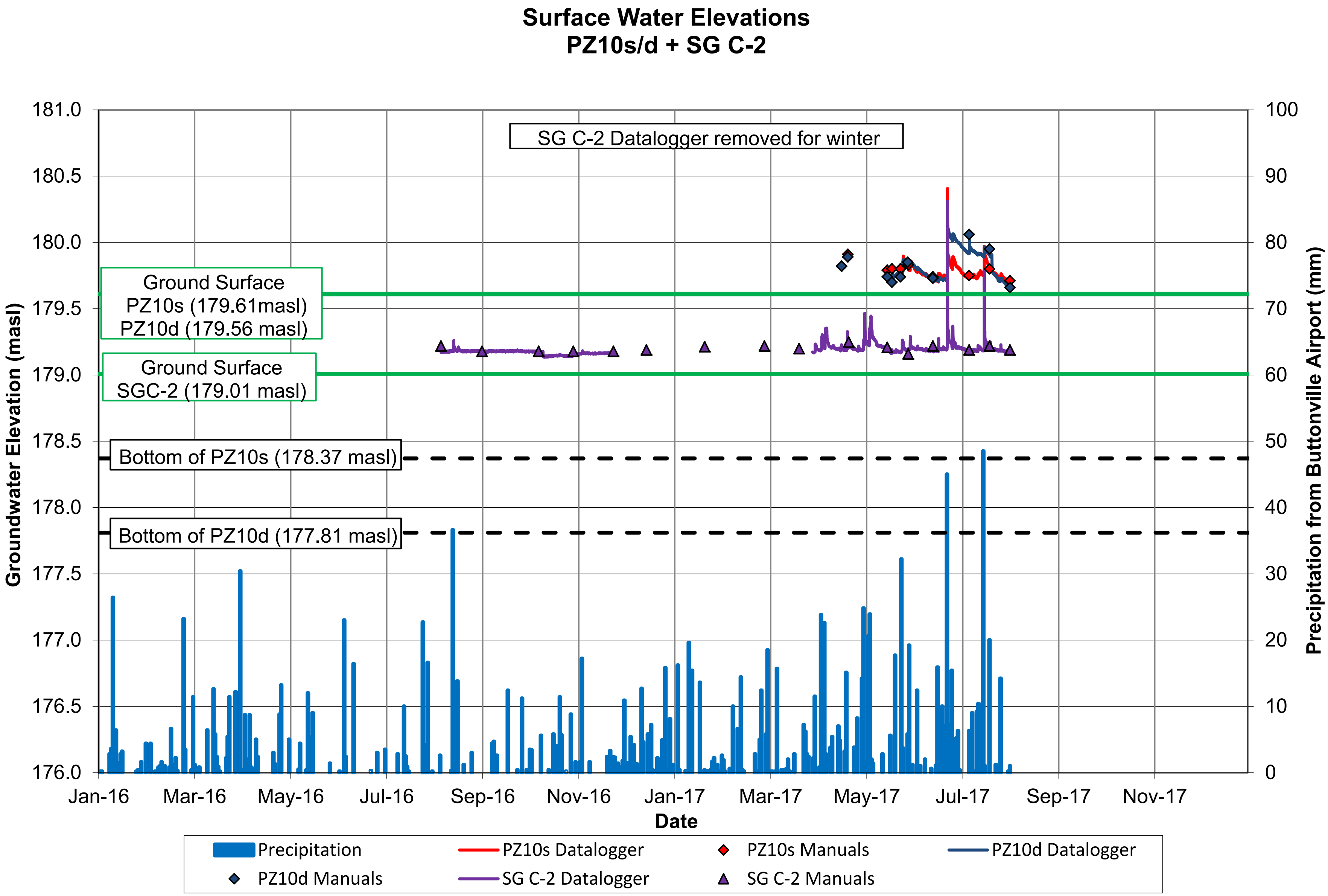

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Figure E-45

Groundwater Elevations
PZ11s/d

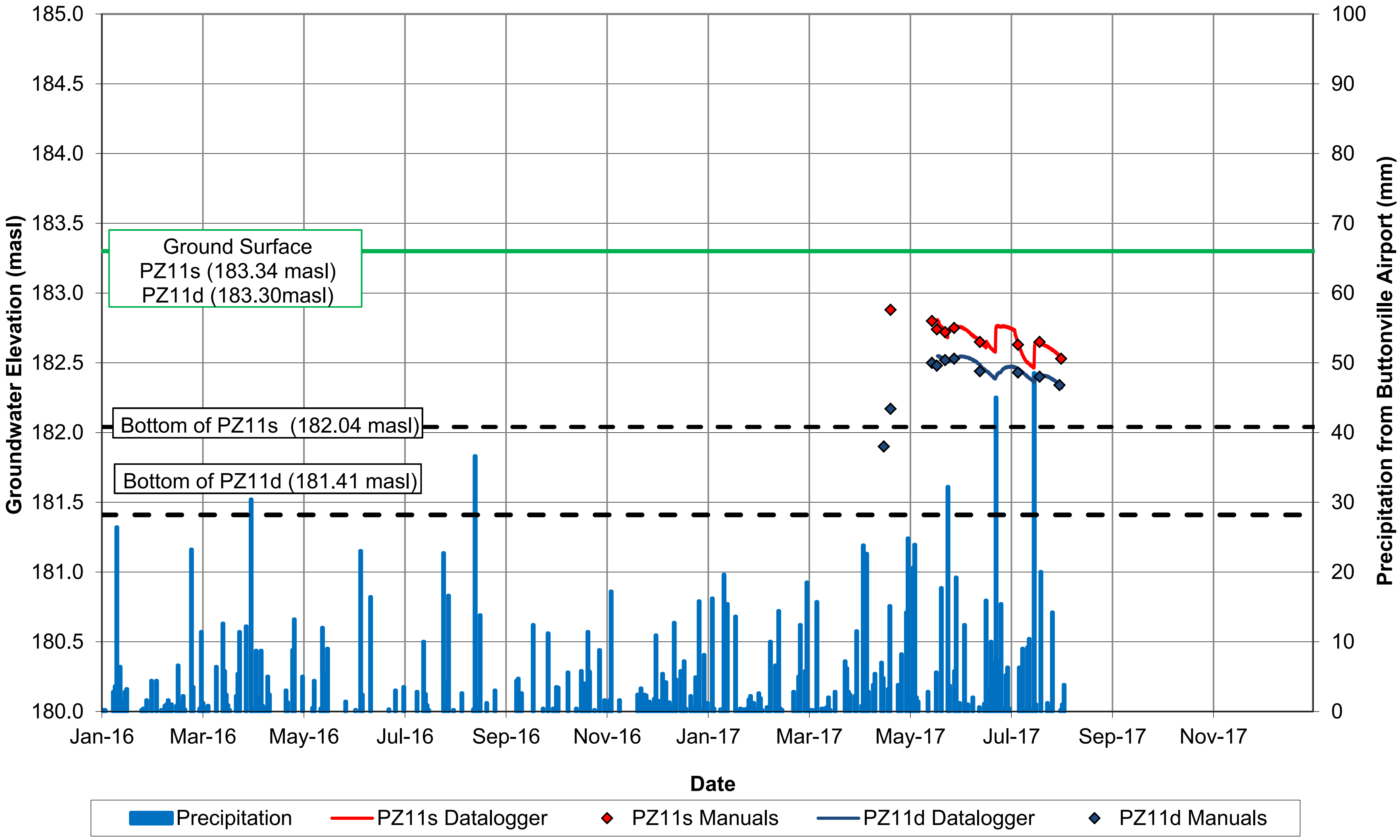

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Figure E-46

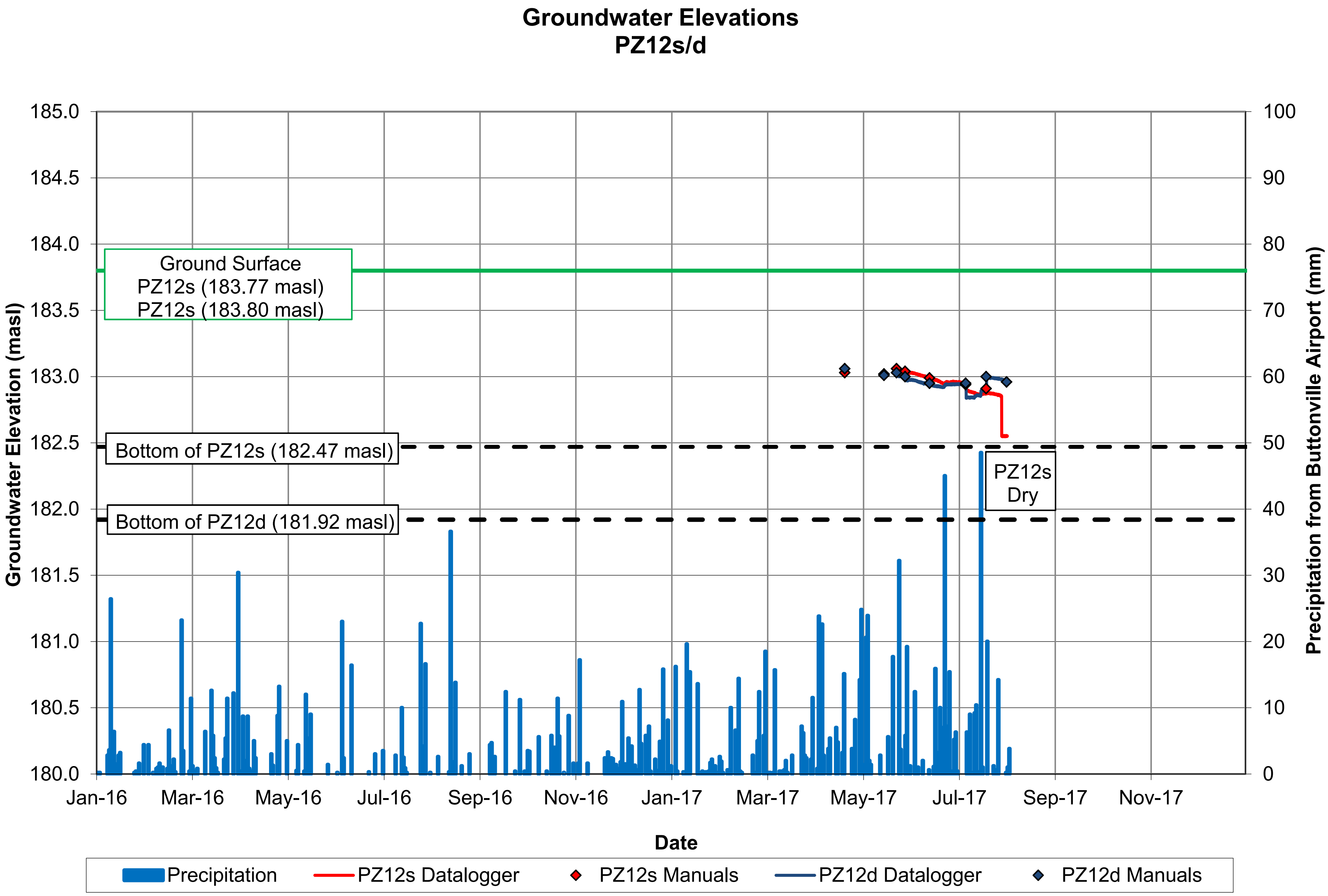

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Figure E-47

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix F

Surface Water Data

Table F-1
Surface Water Elevations

Staff Gauge Number	SG1	SG2	SG3	SG4	SG5	SG6
Ground Elev. (masl)	**181.42**	**180.55**	**180.00**	**181.01**	**184.24**	**174.71**
Date	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**
23-Mar-16	181.83	180.95	180.25	-	184.35	175.14
29-Mar-16	181.86	181.03	180.46	-	184.35	175.20
22-Apr-16	181.84	180.88	180.23	-	184.36	175.17
20-May-16	181.82	180.88	180.18	-	184.31	175.01
29-Jun-16	181.73	180.78	180.14	-	dry	174.77
29-Jul-16	181.82	180.69	180.17	-	dry	dry
5-Aug-16	-	-	-	dry	-	-
31-Aug-16	181.76	180.69	180.12	dry	dry	dry
6-Oct-16	181.76	180.64	180.14	dry	dry	dry
28-Oct-16	181.82	180.64	180.22	dry	184.34	174.75
23-Nov-16	181.80	180.68	180.19	dry	184.33	174.80
14-Dec-16	181.84	180.80	180.48	181.06	dry	174.88
20-Jan-17	frozen	frozen	frozen	181.23	184.34	frozen
27-Feb-17	frozen	frozen	frozen	181.23	184.35	frozen
21-Mar-17	frozen	frozen	frozen	181.22	184.35	frozen
21-Apr-17	182.09	181.20	180.45	181.27	184.35	175.24
16-May-17	181.86	180.79	180.24	181.25	184.34	175.21
2-Aug-17	181.82	180.80	180.15	181.24	dry	175.08

Table F-1
Surface Water Elevations

Staff Gauge Number	SG7	SG8	SG9	SG C-1	SG C-2
Ground Elev. (masl)	**176.51**	**187.58**	**188.88**	**180.39**	**179.06**
Date	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**	**Water Level Elev. (masl)**
23-Mar-16	176.81	-	-	-	-
29-Mar-16	177.05	-	-	-	-
22-Apr-16	176.81	-	-	-	-
20-May-16	176.76	-	-	-	-
29-Jun-16	176.68	-	-	-	-
29-Jul-16	176.81	-	-	-	-
5-Aug-16	-	dry	dry	180.65	179.27
31-Aug-16	176.66	dry	dry	180.66	179.23
6-Oct-16	176.68	dry	dry	180.67	179.23
28-Oct-16	176.74	dry	dry	180.68	179.23
23-Nov-16	176.73	dry	dry	180.68	179.23
14-Dec-16	176.91	dry	dry	180.70	179.24
20-Jan-17	176.93	dry	dry	180.69	179.27
27-Feb-17	176.94	dry	dry	180.69	179.27
21-Mar-17	176.80	187.63	dry	180.70	179.25
21-Apr-17	177.11	dry	dry	180.69	179.30
16-May-17	176.87	187.63	dry	180.68	179.26
2-Aug-17	176.80	187.59	dry	180.69	179.24

Table F-2
Surface Water Flows

Date	Days Since Precipitiation:	Surface Water Station							
		SS1	**SS2**	**SS3**	**SS4**	**SS5**	**SS6**	**SS7**	**SS8**
22-Apr-16	**1**	387	375	437	271	234	-	-	-
20-May-16	**4**	228	238	216	131	C.N.A	-	-	-
29-Jun-16	**3**	89	82	92	43	33	-	-	-
29-Jul-16	**1**	168	132	174	181	111	-	-	-
31-Aug-16	**6**	64	42	64	30	18	-	-	-
6-Oct-16	**4**	95	83	76	40	19	-	-	-
28-Oct-16	**1**	155	147	156	65	83	-	-	-
23-Nov-16	**1**	106	142	132	60	67	-	-	-
14-Dec-16	**2**	Frozen	Frozen	Partially Frozen	Partially Frozen	Partially Frozen	-	-	-
20-Jan-17	**2**	C.N.A	C.N.A	529	C.N.A	337	-	-	-
27-Feb-17	**2**	C.N.A	C.N.A	1005	C.N.A	729	-	-	-
21-Mar-17	**3**	351	238	346	231	186	-	-	-
17-Apr-17	**0**	-	-	-	-	-	3.3		
21-Apr-17	**1**	C.N.A	C.N.A	C.N.A	C.N.A	C.N.A	3.1	14	13
16-May-17	**3**	366	234	343	307	199	No Flow	2	2
2-Aug-17	**1**	119	93	166	81	23	No Flow	1	4

Flow measurements are in L/s
"C.N.A." - Could Not Access

Table F-3A
W-YD1 Hydroperiod Monitoring

2017			29-Mar-17		4-Apr-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 2		Days since previous precipitation event: 0	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD1	**PZs**	**PZ9s (masl)**	0.14	188.81	0.15	188.80
		PZ9d (masl)	0.09	188.77	0.07	188.79
	SG	**SG9 (m)**	Dry		Dry	
	Wetland	**Approximate Length (m)**	10		10	
		Approximate Width (m)	10		10	
		Approximate Area (m^2)	100		100	
		Approximate Maximum Depth (m)	0		0	
	Time		1:00 PM		8:30 AM	
	Comments		Ground is slightly saturated and damp under dense vegetation, otherwise it is relatively dry.		Ground saturation has increased between monitoring rounds.	
	Representative Picture					

Table F-3A
W-YD1 Hydroperiod Monitoring

2017			13-Apr-17		21-Apr-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 2		Days since previous precipitation event: 1	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD1	**PZs**	**PZ9s (masl)**	0.16	188.79	0.12	188.83
		PZ9d (masl)	0.15	188.71	0.01	188.85
	SG	**SG9 (m)**	Dry		Dry	
	Wetland	**Approximate Length (m)**	7		7	
		Approximate Width (m)	7		7	
		Approximate Area (m^2)	49		49	
		Approximate Maximum Depth (m)	0		0	
	Time		12:05 PM		10:05 AM	
	Comments		Area of saturation has decreased, ground remains damp under vegetation.		Ground saturation increased between monitoring rounds.	
	Representative Picture					

Table F-3A
W-YD1 Hydroperiod Monitoring

2017			10-May-17		16-May-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 3		Days since previous precipitation event: 3	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD1	**PZs**	**PZ9s (masl)**	-	-	0.24	188.71
		PZ9d (masl)	-	-	0.22	188.64
	SG	**SG9 (m)**	Dry		Dry	
	Wetland	**Approximate Length (m)**	1.5		1.5	
		Approximate Width (m)	2.0		2.0	
		Approximate Area (m^2)	3		3	
		Approximate Maximum Depth (m)	0		0	
	Time		11:47 AM		8:55 AM	
	Comments		Ground saturation decreased between monitoring rounds.		No significant change since previous monitoring round.	
	Representative Picture					

Table F-3A
W-YD1 Hydroperiod Monitoring

2017			**24-May-17**	
			Monitored By: MM	
			Days since previous precipitation event: 3	
			Water Level Depth	**Estimated Elevation (masl)**
W-YD1	**PZs**	**PZ9s (masl)**	0.26	188.69
		PZ9d (masl)	0.24	188.62
	SG	**SG9 (m)**	Dry	
	Wetland	**Approximate Length (m)**	1	
		Approximate Width (m)	1.0	
		Approximate Area (m^2)	1	
		Approximate Maximum Depth (m)	0	
	Time		10:35 AM	
	Comments		Saturation decreased and the ground has dried. No further monitoring required.	
	Representative Picture			

Table F-3B
W-YD2 Hydroperiod Monitoring

2017			29-Mar-17		4-Apr-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 2		Days since previous precipitation event: 0	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD2	**PZs**	**PZ4s (masl)**	0.18	181.25	0.12	181.31
		PZ4d (masl)	0.37	181.09	0.29	181.17
	SG	**SG4 (m)**	0.20	181.21	0.28	181.29
	Wetland	**Approximate Length (m)**	25		25	
		Approximate Width (m)	25		25	
		Approximate Area (m^2)	625		625	
		Approximate Maximum Depth (m)	0.25		0.28	
	Flow	**Observed Flow**	Standing Water		Flowing	
		Creek Width (m)	1.8		1.15	
		Creek Depth (m)	0.25		0.28	
		Estimated Velocity (m/s)	0		-	
		Estimated Flow (L/s)	0		-	
		Measured Flow (L/s)	-		17	
	Water Quality	**Salinity (g/L or ppt)**	-		420	
		Dissolved Oxygen	-		N/A	
		Temperature (°C)	-		6.2	
		pH	-		8.2	
		Conductivity (μs/cm)	-		906	
		Total Dissolved Solids (mg/L)	-		694	
		Total Suspended Solids (mg/L)	-		N/A	
	Time		1:45 PM		9:45 AM	
	Comments		Standing water pooled in defined channel that crosses the wetland, connecting drainage input from the north east and west, and outflowing at the south west. The standing water has algae growth, as well as an oily sheet located at the staff gage. Ground surrounding the channel is saturated.		Ground saturation, and volume of water increased between monitoring rounds. Standing water pools are scattered across vegetation layer.	
	Representative Picture					

Table F-3B
W-YD2 Hydroperiod Monitoring

2017			13-Apr-17		21-Apr-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 2		Days since previous precipitation event: 1	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD2	**PZs**	**PZ4s (masl)**	0.12	181.31	0.12	181.31
		PZ4d (masl)	0.25	181.21	0.24	181.22
	SG	**SG4 (m)**	0.24	181.25	0.26	181.27
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	15		15	
		Approximate Area (m^2)	300		300	
		Approximate Maximum Depth (m)	0.33		0.27	
	Flow	**Observed Flow**	Minimal Flow		Minimal Flow	
		Creek Width (m)	2.2		2.5	
		Creek Depth (m)	0.33		0.27	
		Estimated Velocity (m/s)	0.05		0.05	
		Estimated Flow (L/s)	0.04		0.03	
		Measured Flow (L/s)	-		-	
	Water Quality	**Salinity (g/L or ppt)**	-		-	
		Dissolved Oxygen	-		-	
		Temperature (°C)	-		-	
		pH	-		-	
		Conductivity (µs/cm)	-		-	
		Total Dissolved Solids (mg/L)	-		-	
		Total Suspended Solids (mg/L)	-		-	
	Time		12:20 PM		12:20 PM	
	Comments		Wetland saturation has decreased between monitoring rounds. Pools of standing water on top of vegetation has dried. The banks on either side of the creek remain saturated up to 2m. The creek is minimal flow to standing water, with algae growth on the surface.		No significant change since previous monitoring round.	
	Representative Picture					

Table F-3B
W-YD2 Hydroperiod Monitoring

2017			10-May-17		16-May-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 3		Days since previous precipitation event: 3	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD2	**PZs**	**PZ4s (masl)**	0.11	181.32	0.12	181.31
		PZ4d (masl)	0.19	181.27	0.19	181.27
	SG	**SG4 (m)**	0.28	181.29	0.24	181.25
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	15		15	
		Approximate Area (m^2)	300		300	
		Approximate Maximum Depth (m)	0.27		0.26	
	Flow	**Observed Flow**	Minimal Flow		Minimal Flow	
		Creek Width (m)	2.38		0.87	
		Creek Depth (m)	0.31		0.26	
		Estimated Velocity (m/s)	0.05		0.05	
		Estimated Flow (L/s)	0.04		0.01	
		Measured Flow (L/s)	-		-	
	Water Quality	**Salinity (g/L or ppt)**	-		-	
		Dissolved Oxygen	-		-	
		Temperature (°C)	-		-	
		pH	-		-	
		Conductivity (µs/cm)	-		-	
		Total Dissolved Solids (mg/L)	-		-	
		Total Suspended Solids (mg/L)	-		-	
	Time		12:10 PM		11:25 AM	
	Comments		Volume of water increased between monitoring rounds. Banks remain saturated and algae growth is developing in the channel.		Channel width and volume decreased between monitoring rounds. Ground saturation under vegetation is slightly drier.	
	Representative Picture					

Table F-3B
W-YD2 Hydroperiod Monitoring

2017			**24-May-17**		**31-May-17**	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 3		Days since previous precipitation event: 1	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD2	**PZs**	**PZ4s (masl)**	0.13	181.30	0.11	181.32
		PZ4d (masl)	0.19	181.27	0.18	181.28
	SG	**SG4 (m)**	0.21	181.22	0.24	181.25
	Wetland	**Approximate Length (m)**	15		15	
		Approximate Width (m)	15		15	
		Approximate Area (m^2)	225		225	
		Approximate Maximum Depth (m)	0.21		0.28	
	Flow	**Observed Flow**	Standing Water		Standing Water	
		Creek Width (m)	1.32		1.14	
		Creek Depth (m)	0.21		0.28	
		Estimated Velocity (m/s)	-		-	
		Estimated Flow (L/s)	-		-	
		Measured Flow (L/s)	-		-	
	Water Quality	**Salinity (g/L or ppt)**	-		-	
		Dissolved Oxygen	-		-	
		Temperature (°C)	-		-	
		pH	-		-	
		Conductivity (µs/cm)	-		-	
		Total Dissolved Solids (mg/L)	-		-	
		Total Suspended Solids (mg/L)	-		-	
	Time		9:55 AM		9:50 AM	
	Comments		Volume of water decreased between monitoring rounds. Ground saturation along the banks, and center of the feature has decreased.		Ground saturation and volume of water in channel increased between monitoring rounds.	
	Representative Picture					

Table F-3B
W-YD2 Hydroperiod Monitoring

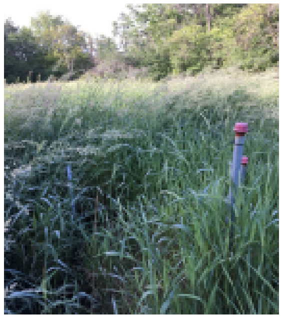
2017			14-Jun-17		7-Jul-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 1		Days since previous precipitation event: 6	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD2	**PZs**	**PZ4s (masl)**	0.13	181.30	0.12	181.31
		PZ4d (masl)	0.19	181.27	0.14	181.32
	SG	**SG4 (m)**	0.23	181.24	0.23	181.24
	Wetland	**Approximate Length (m)**	15		15	
		Approximate Width (m)	15		10	
		Approximate Area (m^2)	225		150	
		Approximate Maximum Depth (m)	0.26		0.25	
	Flow	**Observed Flow**	Standing Water		Standing Water	
		Creek Width (m)	0.98		0.62	
		Creek Depth (m)	0.26		0.25	
		Estimated Velocity (m/s)	-		-	
		Estimated Flow (L/s)	-		-	
		Measured Flow (L/s)	-		-	
	Water Quality	**Salinity (g/L or ppt)**	-		-	
		Dissolved Oxygen	-		-	
		Temperature (°C)	-		-	
		pH	-		-	
		Conductivity (µs/cm)	-		-	
		Total Dissolved Solids (mg/L)	-		-	
		Total Suspended Solids (mg/L)	-		-	
	Time		8:15 AM		8:00 AM	
	Comments		Volume of water decreased between monitoring rounds. Ground saturation along the banks, and center of the feature has decreased. Oil sheen along the streambanks.		Volume of water decreased between monitoring rounds.	
	Representative Picture					

Table F-3B
W-YD2 Hydroperiod Monitoring

2017			**20-Jul-17**	
			Monitored By: MM	
			Days since previous precipitation event: 3	
			Water Level Depth	**Estimated Elevation (masl)**
W-YD2	**PZs**	**PZ4s (masl)**	0.12	181.31
		PZ4d (masl)	0.14	181.32
	SG	**SG4 (m)**	0.24	181.25
	Wetland	**Approximate Length (m)**	10	
		Approximate Width (m)	10	
		Approximate Area (m^2)	100	
		Approximate Maximum Depth (m)	0.37	
	Flow	**Observed Flow**	Minimal Flow	
		Creek Width (m)	1.27	
		Creek Depth (m)	0.37	
		Estimated Velocity (m/s)	-	
		Estimated Flow (L/s)	-	
		Measured Flow (L/s)	-	
	Water Quality	**Salinity (g/L or ppt)**	-	
		Dissolved Oxygen	-	
		Temperature (°C)	-	
		pH	-	
		Conductivity (μs/cm)	-	
		Total Dissolved Solids (mg/L)	-	
		Total Suspended Solids (mg/L)	-	
	Time		7:30 AM	
	Comments		Channel width and volume increased. Surrounding ground and banks are less saturated.	
	Representative Picture			

Table F-3C
W-YD3 Hydroperiod Monitoring

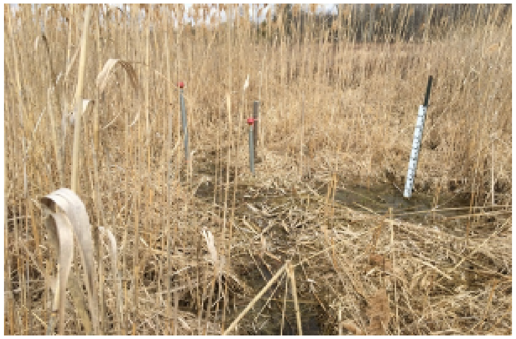
2017			29-Mar-17		4-Apr-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 2		Days since previous precipitation event: 0	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD3	**PZs**	**PZ5s (masl)**	0.22	184.17	0.14	184.25
		PZ5d (masl)	0.82	183.56	0.01	184.37
	SG	**SG5 (m)**	0.10	184.34	0.11	184.35
	Wetland	**Approximate Length (m)**	30		30	
		Approximate Width (m)	30		30	
		Approximate Area (m^2)	900		900	
		Approximate Maximum Depth (m)	0.08		0.12	
	Time		1:30 PM		11:35 AM	
	Comments		The ground surrounding the PZ and SG is heavily saturated, with small pools of standing water throughout (1m^2 and 0.04m deep). Water is clear, with some algae growth.		Ground saturation, quantity and volume of standing water pools increased between monitoring rounds. The pooled area encompasses PZ's and SG. Difficult to estimate the approximate length of the entire wetland as the vegetation is dense.	
	Representative Picture					

Table F-3C
W-YD3 Hydroperiod Monitoring

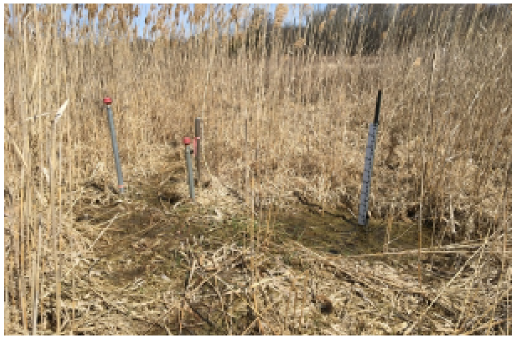
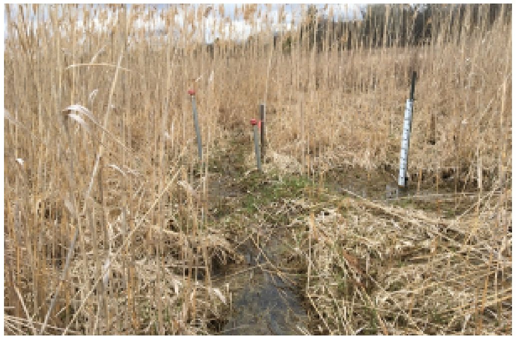
2017			13-Apr-17		21-Apr-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 2		Days since previous precipitation event: 1	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD3	**PZs**	**PZ5s (masl)**	0.18	184.21	0.12	184.27
		PZ5d (masl)	-0.04	184.42	-0.01	184.39
	SG	**SG5 (m)**	0.10	184.34	0.11	184.35
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	30		30	
		Approximate Area (m^2)	600		600	
		Approximate Maximum Depth (m)	0.1		0.11	
	Time		12:25 PM		12:35 PM	
	Comments		Standing water pools decreased monitoring rounds. Clear standing water is pooled in the walking path/ ground that has been depressed. Average size of pools are 1m^2 and 0.1m deep.		Saturation and volume of standing water has increased between monitoring rounds. One large pool encompasses the PZ's, SG and path, and is approximately 6m^2 and 0.11m deep.	
	Representative Picture					

Table F-3C
W-YD3 Hydroperiod Monitoring

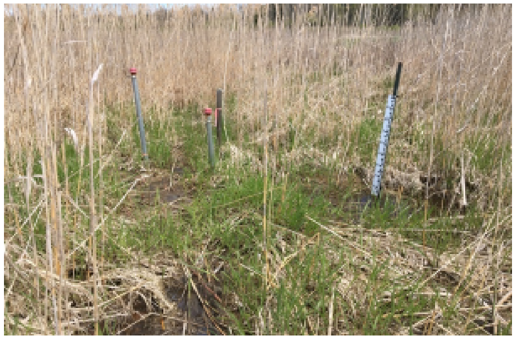
2017			10-May-17		16-May-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 3		Days since previous precipitation event: 3	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD3	**PZs**	**PZ5s (masl)**	0.09	184.30	0.10	184.29
		PZ5d (masl)	-0.07	184.45	-0.03	184.41
	SG	**SG5 (m)**	0.10	184.34	0.10	184.34
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	30		30	
		Approximate Area (m^2)	600		600	
		Approximate Maximum Depth (m)	0.11		0.11	
	Time		12:20 PM		11:45 AM	
	Comments		No significant change between monitoring rounds. Standing water pools are clear, with an oily sheen.		No significant change between monitoring rounds. One large standing water pool surround the SG is approximately 1.5m^2 and 0.1m deep.	
	Representative Picture					

Table F-3C
W-YD3 Hydroperiod Monitoring

2017			24-May-17		31-May-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 3		Days since previous precipitation event: 1	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD3	**PZs**	**PZ5s (masl)**	0.10	184.29	0.09	184.30
		PZ5d (masl)	-0.03	184.41	-0.08	184.46
	SG	**SG5 (m)**	0.10	184.34	0.11	184.35
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	30		30	
		Approximate Area (m^2)	600		600	
		Approximate Maximum Depth (m)	0.1		0.11	
	Time		10:05 AM		12:20 PM	
	Comments		No significant change between monitoring rounds. Standing water pools are clear, with an oily sheen.		Ground saturation and quantity and volume of standing water pools increased between monitoring rounds.	
	Representative Picture					

Table F-3C
W-YD3 Hydroperiod Monitoring

2017			14-Jun-17		7-Jul-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 1		Days since previous precipitation event: 6	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD3	**PZs**	**PZ5s (masl)**	0.09	184.30	0.10	184.29
		PZ5d (masl)	-0.05	184.43	0.31	184.07
	SG	**SG5 (m)**	Dry		Dry	
	Wetland	**Approximate Length (m)**	10		10	
		Approximate Width (m)	10		5	
		Approximate Area (m^2)	100		50	
		Approximate Maximum Depth (m)	0		0	
	Time		8:25 AM		8:15 AM	
	Comments		Standing water pools have dried, ground remains heavily saturated.		Ground is dry to slightly saturated. No further monitoring is required.	
	Representative Picture					

Table F-3D
W-YD4 Hydroperiod Monitoring

2017			29-Mar-17		4-Apr-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 2		Days since previous precipitation event: 0	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD4	**Flow**	**Observed Flow**	Flowing		Flowing	
		Creek Width (m)	0.29		0.34	
		Creek Depth (m)	0.06		0.06	
		Estimated Velocity (m/s)	-		-	
		Estimated Flow (L/s)	-		-	
		Measured Flow (L/s)	2		3	
	Water Quality	**Salinity (g/L or ppt)**	500		486	
		Dissolved Oxygen	-		-	
		Temperature (°C)	9.78		7.3	
		pH	8.46		8.35	
		Conductivity (µs/cm)	1045		1053	
		Total Dissolved Solids (mg/L)	744		727	
		Total Suspended Solids (mg/L)	8		-	
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	20		20	
		Approximate Area (m^2)	400		400	
		Approximate Maximum Depth (m)	0.06		0.06	
	Time		2:05 PM		11:40 AM	
	Comments		Ground is significantly saturated, with small pools of standing water throughout. Water in pools and channel have a oil sheen and iron staining. The water flows minimally from wooded area from the north, into a defined channel, flowing south into a larger marsh wetland.		Ground saturation, flow velocity, and quantity and volume of standing water pools increased between monitoring rounds. Water remains oily and iron stained. Approximate size of wetland remains the same, however pools are deeper and more frequent.	
	Representative Picture					

Table F-3D
W-YD4 Hydroperiod Monitoring

2017			13-Apr-17		21-Apr-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 2		Days since previous precipitation event: 1	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD4	**Flow**	**Observed Flow**	Flowing		Flowing	
		Creek Width (m)	0.22		0.27	
		Creek Depth (m)	0.04		0.06	
		Estimated Velocity (m/s)	-		-	
		Estimated Flow (L/s)	-		-	
		Measured Flow (L/s)	1		2	
	Water Quality	**Salinity (g/L or ppt)**	476		0.502	
		Dissolved Oxygen	-		-	
		Temperature (°C)	11.7		9.7	
		pH	8.48		8.52	
		Conductivity (μs/cm)	990		1046	
		Total Dissolved Solids (mg/L)	691		0.739	
		Total Suspended Solids (mg/L)	-		-	
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	20		20	
		Approximate Area (m^2)	400		400	
		Approximate Maximum Depth (m)	0.04		0.04	
	Time		12:30 PM		12:45 PM	
	Comments		Ground saturation, number of pools, water depth, and flow have all decreased from previous monitoring round. Water remains oily and iron stained. Approximate size of wetland remains the same, however pools are shallower and less frequent.		Increase in ground saturation, volume of standing water pools, and stream flow.	
	Representative Picture					

Table F-3D
W-YD4 Hydroperiod Monitoring

2017			10-May-17		16-May-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 3		Days since previous precipitation event: 3	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD4	**Flow**	**Observed Flow**	Flowing		Flowing	
		Creek Width (m)	0.24		0.22	
		Creek Depth (m)	0.04		0.08	
		Estimated Velocity (m/s)	-		-	
		Estimated Flow (L/s)	-		-	
		Measured Flow (L/s)	1		1	
	Water Quality	**Salinity (g/L or ppt)**	0.514		0.519	
		Dissolved Oxygen	0.23		0.45	
		Temperature (°C)	10.6		11	
		pH	8.32		8.17	
		Conductivity (μs/cm)	931		932	
		Total Dissolved Solids (mg/L)	0.655		0.663	
		Total Suspended Solids (mg/L)	23		62	
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	20		20	
		Approximate Area (m^2)	400		400	
		Approximate Maximum Depth (m)	0.04		0.04	
	Time		12:25 PM		11:55 AM	
	Comments		Standing water pools have dried, but site remains highly saturated, with iron stains and oil sheen on top of surface.		No significant change since between monitoring rounds.	
	Representative Picture					

Table F-3D
W-YD4 Hydroperiod Monitoring

2017			24-May-17		31-May-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 3		Days since previous precipitation event: 1	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD4	**Flow**	**Observed Flow**	Minimal Flow		Minimal Flow	
		Creek Width (m)	0.21		0.39	
		Creek Depth (m)	0.05		0.06	
		Estimated Velocity (m/s)	0.05		0.05	
		Estimated Flow (L/s)	0.001		0.001	
		Measured Flow (L/s)	-		-	
	Water Quality	**Salinity (g/L or ppt)**	-		-	
		Dissolved Oxygen	-		-	
		Temperature (°C)	-		-	
		pH	-		-	
		Conductivity (µs/cm)	-		-	
		Total Dissolved Solids (mg/L)	-		-	
		Total Suspended Solids (mg/L)	-		-	
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	20		20	
		Approximate Area (m^2)	400		400	
		Approximate Maximum Depth (m)	0.04		0.04	
	Time		11:10 AM		11:10 AM	
	Comments		No significant change between monitoring rounds. Observed flow has decreased to minimal.		Ground saturation and volume of water in channel increased between monitoring rounds.	
	Representative Picture					

Table F-3D
W-YD4 Hydroperiod Monitoring

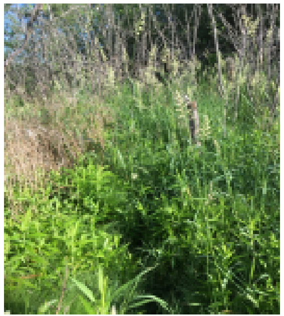
2017			14-Jun-17		7-Jul-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 1		Days since previous precipitation event: 6	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD4	**Flow**	**Observed Flow**	Minimal Flow		Minimal Flow	
		Creek Width (m)	0.37		0.23	
		Creek Depth (m)	0.05		0.06	
		Estimated Velocity (m/s)	0.05		0.05	
		Estimated Flow (L/s)	0.001		0.001	
		Measured Flow (L/s)	-		-	
	Water Quality	**Salinity (g/L or ppt)**	-		-	
		Dissolved Oxygen	-		-	
		Temperature (°C)	-		-	
		pH	-		-	
		Conductivity (μs/cm)	-		-	
		Total Dissolved Solids (mg/L)	-		-	
		Total Suspended Solids (mg/L)	-		-	
	Wetland	**Approximate Length (m)**	20		20	
		Approximate Width (m)	20		20	
		Approximate Area (m^2)	400		400	
		Approximate Maximum Depth (m)	0.04		0.06	
	Time		8:30 AM		8:20 AM	
	Comments		No significant change between monitoring rounds.		Ground saturation increased between monitoring rounds. Small pools of standing water formed in footprints (>0.5m^2 and 0.03m deep).	
	Representative Picture					

Table F-3D
W-YD4 Hydroperiod Monitoring

<table>
<tr><td colspan="3" rowspan="4">2017</td><td colspan="2">20-Jul-17</td></tr>
<tr><td colspan="2">Monitored By: MM</td></tr>
<tr><td colspan="2">Days since previous precipitation event: 3</td></tr>
<tr><td>Water Level Depth</td><td>Estimated Elevation (masl)</td></tr>
<tr><td rowspan="22">W-YD4</td><td rowspan="6">Flow</td><td>Observed Flow</td><td colspan="2">Flowing</td></tr>
<tr><td>Creek Width (m)</td><td colspan="2">0.35</td></tr>
<tr><td>Creek Depth (m)</td><td colspan="2">0.06</td></tr>
<tr><td>Estimated Velocity (m/s)</td><td colspan="2">-</td></tr>
<tr><td>Estimated Flow (L/s)</td><td colspan="2">-</td></tr>
<tr><td>Measured Flow (L/s)</td><td colspan="2">1</td></tr>
<tr><td rowspan="7">Water Quality</td><td>Salinity (g/L or ppt)</td><td colspan="2">0.433</td></tr>
<tr><td>Dissolved Oxygen</td><td colspan="2">5.81</td></tr>
<tr><td>Temperature (°C)</td><td colspan="2">12.8</td></tr>
<tr><td>pH</td><td colspan="2">8.26</td></tr>
<tr><td>Conductivity (μs/cm)</td><td colspan="2">898</td></tr>
<tr><td>Total Dissolved Solids (mg/L)</td><td colspan="2">0.679</td></tr>
<tr><td>Total Suspended Solids (mg/L)</td><td colspan="2">7</td></tr>
<tr><td rowspan="4">Wetland</td><td>Approximate Length (m)</td><td colspan="2">20</td></tr>
<tr><td>Approximate Width (m)</td><td colspan="2">20</td></tr>
<tr><td>Approximate Area (m^2)</td><td colspan="2">400</td></tr>
<tr><td>Approximate Maximum Depth (m)</td><td colspan="2">0.05</td></tr>
<tr><td colspan="2">Time</td><td colspan="2">7:50 AM</td></tr>
<tr><td colspan="2">Comments</td><td colspan="2">Ground saturation increased between monitoring rounds. Small pools of standing water formed in footprints (>0.7m^2 and 0.05m deep).</td></tr>
<tr><td colspan="2">Representative Picture</td><td colspan="2"></td></tr>
</table>

Table F-3E
W-YD5 Hydroperiod Monitoring

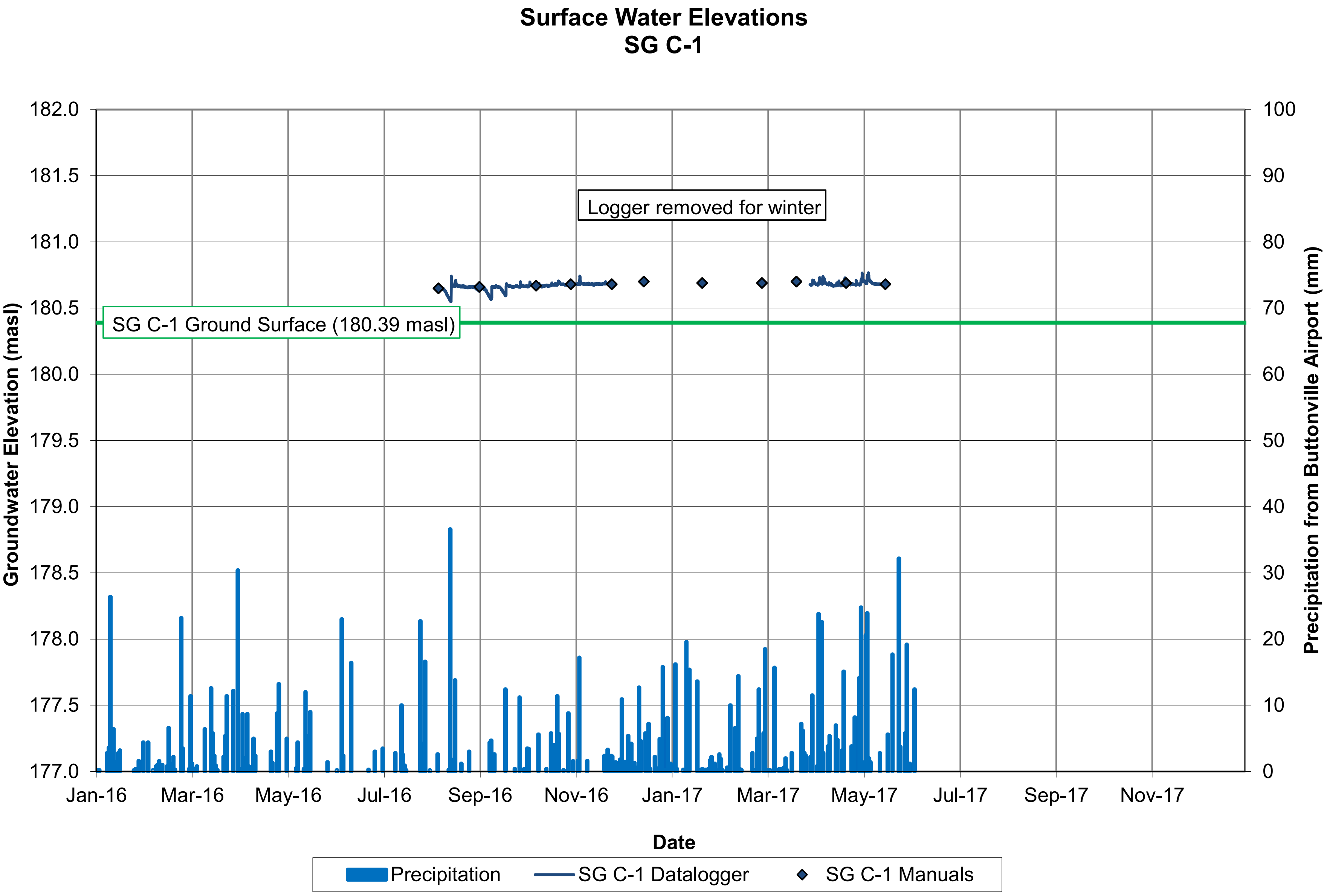
<table>
<tr><td colspan="3" rowspan="4">2017</td><td colspan="2">4-Apr-17</td><td colspan="2">13-Apr-17</td></tr>
<tr><td colspan="2">Monitored By: MM</td><td colspan="2">Monitored By: MM</td></tr>
<tr><td colspan="2">Days since previous precipitation event: 0</td><td colspan="2">Days since previous precipitation event: 2</td></tr>
<tr><td>Water Level Depth</td><td>Estimated Elevation (masl)</td><td>Water Level Depth</td><td>Estimated Elevation (masl)</td></tr>
<tr><td rowspan="7">W-YD5</td><td rowspan="4">Wetland</td><td>Approximate Length (m)</td><td colspan="2">30</td><td colspan="2">10</td></tr>
<tr><td>Approximate Width (m)</td><td colspan="2">30</td><td colspan="2">10</td></tr>
<tr><td>Approximate Area (m^2)</td><td colspan="2">900</td><td colspan="2">100</td></tr>
<tr><td>Approximate Maximum Depth (m)</td><td colspan="2">0.16</td><td colspan="2">0</td></tr>
<tr><td colspan="2">Time</td><td colspan="2">12:05 PM</td><td colspan="2">12:50 PM</td></tr>
<tr><td colspan="2">Comments</td><td colspan="2">Standing water pooled throughout the open field area. One large pool in the center of the site (45m^2 and 0.16m deep). Water has also pooled in cart tracks.</td><td colspan="2">Standing water pools have dried, however ground remains very saturated.</td></tr>
<tr><td colspan="2">Representative Picture</td><td colspan="2"></td><td colspan="2"></td></tr>
</table>

Table F-3E
W-YD5 Hydroperiod Monitoring

2017			21-Apr-17		10-May-17	
			Monitored By: MM		Monitored By: MM	
			Days since previous precipitation event: 1		Days since previous precipitation event: 3	
			Water Level Depth	**Estimated Elevation (masl)**	**Water Level Depth**	**Estimated Elevation (masl)**
W-YD5	**Wetland**	**Approximate Length (m)**	10		5	
		Approximate Width (m)	10.0		5.0	
		Approximate Area (m^2)	100		25	
		Approximate Maximum Depth (m)	0.12		0	
	Time		10:40 AM		12:00 PM	
	Comments		Increase in saturation, and quantity and volume of standing water pools. Largest pool is approximately $5m^2$ and 0.12m deep.		Standing water pools have dried, ground remains saturated.	
	Representative Picture					

Table F-3E
W-YD5 Hydroperiod Monitoring

2017			**16-May-17**	
			Monitored By: MM	
			Days since previous precipitation event: 3	
			Water Level Depth	**Estimated Elevation (masl)**
W-YD5	**Wetland**	**Approximate Length (m)**	0	
		Approximate Width (m)	0.0	
		Approximate Area (m^2)	0	
		Approximate Maximum Depth (m)	0	
	Time		9:45 AM	
	Comments		Ground is dry to slightly saturated/ muddy. No further monitoring required.	
	Representative Picture			



R.J. Burnside & Associates Limited
York Downs
300038247

Figure F-1

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix G

Water Quality Data

Table G-1
Groundwater Quality

Sample Description					**MW16-5**	**MW16-15**
				Date Sampled	**06-Apr-16**	**06-Apr-16**
Parameter	**Unit**	**ODWS**	**A/O**	**RDL**		
Electrical Conductivity	uS/cm			2	1120	824
pH	pH Units		6.5-8.5	0.05	7.88	8.05
Total Suspended Solids	mg/L			2	355	2580
Total Hardness (as CaCO3)	mg/L		80-100	2	512	491
Total Dissolved Solids	mg/L	500		30	**760**	**697**
Alkalinity (as CaCO3)	mg/L		30-500	2	342	271
Chloride	mg/L	250		1	150	16
Nitrate as N	mg/L	10		0.06	0.22	< 0.06
Nitrite as N	mg/L	1		0.03	< 0.03	< 0.03
Ammonia+Ammonium (N)	mg/L			0.1	< 0.1	0.2
Sulphate	mg/L	500		1	72	210
Calcium	mg/L			0.01	176	160
Magnesium	mg/L			0.001	17.8	22.0
Sodium	mg/L	20	200	0.01	68.8	9.57
Potassium	mg/L			0.003	1.66	1.05
Aluminum	µg/L		100	1	< 1	< 1
Antimony	µg/L	6		0.2	< 0.2	< 0.2
Arsenic	µg/L	25		0.2	0.2	0.9
Barium	µg/L	1000		0.02	81.3	69.0
Beryllium	µg/L	---		0.007	< 0.007	< 0.007
Boron	µg/L	5000		2	29	11
Cadmium	µg/L	5		0.003	0.009	0.008
Chromium	µg/L	50		0.03	0.35	0.22
Cobalt	µg/L			0.004	1.70	0.110
Copper	µg/L		1000	0.02	0.33	0.08
Iron	µg/L		300	7	42	1220
Lead	µg/L	10		0.01	< 0.01	0.02
Manganese	µg/L		50	0.01	486	70.1
Mercury	µg/L	0.001		0.01	< 0.01	< 0.01
Molybdenum	µg/L			0.01	0.80	0.59
Nickel	µg/L			0.1	4.8	0.4
Selenium	µg/L	10		0.04	0.04	< 0.04
Silver	µg/L			0.002	< 0.002	< 0.002
Strontium	µg/L			0.02	421	288
Thallium	µg/L			0.005	0.030	< 0.005
Tin	µg/L			0.01	0.04	0.06
Titanium	µg/L			0.05	< 0.05	< 0.05
Uranium	µg/L	20		0.002	2.02	0.063
Vanadium	µg/L			0.01	0.09	0.10
Zinc	µg/L		5000	2	2	3
Anion Sum	meq/L			NA	12.6	10.2
Cation Sum	meq/L			NA	13.3	10.2
% Difference/ Ion Balance	%			NA	2.80	0.01

RDL- Reported Detection Limit
ODWS- Ontario Drinking Water Standard Maximum Acceptable Concentration
Chemical/Physical Objectives [A/O]- Not Health Related
NA- Not Applicatble
Bold results indicate exceedances in ODWS criteria
Shaded results indicate exceedances in aesthetic objectives (A/O)

Table G-2
Surface Water Quality

Sample Description			**Berczy (SG7)**	**Bruce (SS1)**
		Date Sampled	**06-Apr-16**	**06-Apr-16**
Parameter	**Units**	**PWQO**		
Temperature Upon Receipt	°C		6.0	6.0
Total Suspended Solids	mg/L		3	2
Total Dissolved Solids	mg/L		500	946
pH	no unit	6.5-8.5	8.15	8.23
Alkalinity	mg/L as CaCO3		238	218
Conductivity	uS/cm		858	1680
Colour	TCU		8	10
Fluoride	mg/L		0.10	0.12
Chloride	mg/L		120	380
Sulphate	mg/L		35	48
Nitrite (as N)	as N mg/L		< 0.03	< 0.03
Nitrate (as N)	as N mg/L		1.70	1.99
Ammonia+Ammonium (N)	as N mg/L		< 0.1	< 0.1
Total Kjeldahl Nitrogen	as N mg/L		< 0.5	< 0.5
Total Organic Carbon	mg/L		4.3	3.4
Dissolved Organic Carbon	mg/L		3.5	3.4
Mercury (total)	µg/L	0.2	0.00003	< 0.00001
Hardness	mg/L as CaCO3		324	346
Silver (total)	µg/L	0.1	< 0.002	0.004
Aluminum (total)	µg/L		116	71
Aluminum (dissolved)	µg/L	75	1	2
Arsenic (total)	µg/L	5	0.3	0.3
Barium (total)	µg/L		64.3	54.8
Beryllium (total)	µg/L	1100	0.019	< 0.007
Boron (total)	µg/L	200	18	23
Bismuth (total)	µg/L		0.018	0.027
Calcium (total)	mg/L		108	115
Cadmium (total)	µg/L	0.5	0.006	0.008
Cobalt (total)	µg/L	0.9	0.123	0.146
Chromium (total)	µg/L		0.54	0.67
Copper (total)	µg/L	5	0.80	1.55
Iron (total)	µg/L	300	260	148
Potassium (total)	mg/L		2.71	2.81
Lithium (total)	µg/L		2.17	2.31
Magnesium (total)	mg/L		13.3	14.1
Manganese (total)	µg/L		28.4	29.8
Molybdenum (total)	µg/L	40	0.50	0.66
Sodium (total)	mg/L		69.6	241
Nickel (total)	µg/L	25	0.6	0.8
Phosphorus (total)	µg/L		32	16
Lead (total)	µg/L	5	0.12	0.16
Antimony (total)	µg/L	20	< 0.2	0.2
Selenium (total)	µg/L	100	0.14	0.14
Silicon (total)	µg/L		4510	3530
Tin (total)	µg/L		0.19	0.19
Strontium (total)	µg/L		266	384
Titanium (total)	µg/L		4.07	2.94
Thallium (total)	µg/L	0.3	0.019	< 0.005
Uranium (total)	µg/L	5	0.793	0.824
Vanadium (total)	µg/L	6	0.49	0.46
Zinc (total)	µg/L	20	< 2	4
Anion Sum	meq/L		8.87	16.1
Cation sum	meq/L		9.58	17.4
Anion-Cation Balance	% difference		3.84	4.10

PWQO- Provincial Water Quality Objective
Bold results indicate exceedances in criteria

Table G-3
Surface Water Field Chemistry

Surface Water Station	Time	Salinity (ppm)	Dissolved Oxygen (mg/L)	Temperature (^{o}C)	pH	Conductivity (µS/cm)	TDS (g/L)	TSS (mg/L)
SS1								
22-Apr-16	10:15 AM	426	N/A	12.9	9.1	927	0.655	8
20-May-16	8:45 AM	401	N/A	12.3	8.9	872	0.62	11
29-Jun-16	9:00 AM	339	N/A	18	8.8	730	0.52	20
29-Jul-16	10:30 AM	330	N/A	22.6	8.6	701	0.50	28
8/312016	8:45 AM	356	N/A	20.5	8.5	763	0.54	22
6-Oct-16	9:20 AM	347	N/A	15	8.5	751	0.53	20
28-Oct-16	9:25 AM	379	N/A	5.1	8.9	858	0.61	N/A
23-Nov-16	9:00 AM	378	N/A	0.3	9.0	852	0.61	N/A
21-Mar-17	9:50 AM	422	14.8*	4	8.9	919	0.66	15
16-May-17	8:10 AM	438	0.3	10.8	8.9	805	0.56	N/A
2-Aug-17	7:30 AM	377	3.9	18.5	8.8	788	0.55	11
SS2								
22-Apr-16	1:15 PM	397	N/A	16.4	9.1	849	0.61	10
20-May-16	8:30 AM	397	N/A	11.3	9.0	863	0.62	11
29-Jun-16	8:45 AM	338	N/A	17.9	8.9	731	0.52	18
29-Jul-16	8:45 AM	329	N/A	21.1	8.6	705	0.50	19
31-Aug-16	8:30 AM	355	N/A	20.5	8.8	760	0.54	21
6-Oct-16	9:05 AM	344	N/A	14.9	8.9	747	0.53	18
28-Oct-16	11:15 AM	388	N/A	4.6	8.8	884	0.63	N/A
23-Nov-16	8:40 AM	382	N/A	0.3	8.9	871	0.61	N/A
21-Mar-17	9:25 AM	430	17.3*	2.9	9.2	934	0.66	4
16-May-17	1:05 PM	434	N/A	13	8.9	771	0.54	43
2-Aug-17	1:00 PM	369	7.9	23.7	9.1	750	0.54	19
SS3								
22-Apr-16	2:30 PM	420	N/A	17.9	9.2	900	0.64	11
20-May-16	10:45 AM	424	N/A	14.5	8.9	917	0.65	11
29-Jun-16	11:30 AM	340	N/A	20.3	8.8	727	0.52	18
29-Jul-16	11:45 AM	327	N/A	23.9	8.7	700	0.50	16
31-Aug-16	11:00 AM	374	N/A	22.5	8.5	796	0.57	13
6-Oct-16	10:45 AM	367	N/A	17.8	8.4	787	0.56	17
28-Oct-16	11:40 AM	398	N/A	5.9	8.8	896	0.64	N/A
23-Nov-16	11:33 AM	379	N/A	1.2	8.8	898	0.64	N/A
20-Jan-17	10:15 AM	532	13.9	2.4	9.0	1212	0.86	8
27-Feb-17	10:30 AM	481	13.8	3.1	9.1	1039	0.75	N/A
21-Mar-17	11:45 AM	468	16.5	6.6	9.1	1000	0.71	11
16-May-17	10:05 AM	447	0.3	11.6	8.8	814	0.57	43
2-Aug-17	9:45 AM	390	5.2	20.1	8.8	781	0.57	10
SS4								
22-Apr-16	3:00 PM	668	N/A	17.1	9.0	1409	1.00	10
20-May-16	9:30 AM	684	N/A	14.1	8.7	1445	1.00	10
29-Jun-16	10:30 AM	602	N/A	18.7	8.6	1278	0.90	14
29-Jul-16	11:00 AM	389	N/A	22.8	8.7	827	0.59	18
31-Aug-16	10:00 AM	570	N/A	20.9	8.4	1198	0.85	12
6-Oct-16	10:20 AM	533	N/A	16	8.5	1125	0.80	17
28-Oct-16	10:40 AM	542	N/A	4.8	8.7	1218	0.87	N/A
23-Nov-16	10:30 AM	663	N/A	0.7	8.7	1476	1.04	N/A
21-Mar-17	11:52 AM	936	16.0	4.4	9.0	1988	1.41	17
16-May-17	9:15 AM	610	0.3	11.5	8.7	1087	0.74	36
2-Aug-17	9:00 AM	561	6.4	19.4	8.7	1125	0.80	18

Table G-3
Surface Water Field Chemistry

Surface Water Station	Time	Salinity (ppm)	Dissolved Oxygen (mg/L)	Temperature (°C)	pH	Conductivity (µS/cm)	TDS (g/L)	TSS (mg/L)
SS5								
22-Apr-16	3:30 PM	595	N/A	11.1	8.9	1261	0.86	7
20-May-16	-	-	-	-	-	-	-	-
29-Jun-16	1:00 PM	577	N/A	23.1	8.5	1101	0.79	13
29-Jul-16	1:00 PM	398	N/A	21.1	8.8	845	0.60	14
8/312016	2:00 PM	568	N/A	24.1	8.3	1193	0.85	24
6-Oct-16	3:00 PM	967	N/A	19.2	8.4	1184	0.84	18
28-Oct-16	1:30 PM	590	N/A	6.5	8.6	1318	0.71	N/A
23-Nov-16	3:00 PM	676	N/A	1.7	8.9	1433	0.98	N/A
20-Jan-17	3:00PM	817	13.5	2.1	8.7	1764	1.25	7
27-Feb-27	1:00 PM	678	15.0	5.9	8.8	1432	1.00	13
21-Mar-17	2:05 PM	826	17.2	7.7	8.9	1699	1.21	13
16-May-17	11:32 AM	570	N/A	12.3	8.8	1025	0.72	44
2-Aug-17	1:30 PM	545	6.4	23.0	8.8	1104	0.78	13
SS6								
17-Apr-17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21-Apr-17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SS7								
21-Apr-17	12:08 PM	446	N/A	10	8.6	930	0.67	N/A
16-May-17	10:50 AM	554	0.3	10.2	8.0	1001	0.71	43
2-Aug-17	10:20 AM	527	5.0	17.5	8.3	1070	0.75	50
SS8								
21-Apr-17	12:15 PM	426	N/A	9.5	8.5	893	0.64	N/A
16-May-17	11:00 AM	509	0.3	10.3	8.4	912	0.64	48
2-Aug-17	10:35 AM	502	5.8	17.0	8.5	1017	0.73	15

N/A- Data not available

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix H

Water Balance Calculations

Appendix H

WATER BALANCE CALCULATIONS
4134 16th Avenue, Markham

PROJECT No.300038247

TABLE H-1

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 125 mm (urban lawns in silt soils)

Precipitation data from Toronto Buttonville Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-5.80	-5.60	-0.40	6.70	13.00	18.60	21.20	20.20	15.70	8.90	3.10	-2.90	**7.7**	<--From Environment Canada
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.56	4.25	7.31	8.91	8.28	5.65	2.39	0.48	0.00	**38.8**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	29.28	61.03	90.77	104.93	99.46	75.23	40.11	12.46	0.00	**513**	
Adjusting Factor for U (Latitude 43° 52' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	62	51	53	74	80	83	79	76	82	68	80	66	**853**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
P - PET	62	51	53	41	3	-33	-56	-43	4	30	70	66	**246**	
Change in Soil Moisture Storage	0	0	0	0	0	-33	-56	-35	4	30	70	22	**0**	
Soil Moisture Storage max 125 mm	125	125	125	125	125	92	35	0	4	33	103	125		
Actual Evapotranspiration (AET)	0	0	0	33	77	116	135	111	78	38	10	0	**599**	
Soil Moisture Deficit max 125 mm	0	0	0	0	0	33	90	125	121	92	22	0		
Water Surplus - available for infiltration or runoff	62	51	53	41	3	0	0	0	0	0	0	44	**254**	
Potential Infiltration (based on MOECC metholodogy*; independent of temperature)	28	23	24	19	1	0	0	0	0	0	0	20	**114**	
Potential Direct Surface Water Runoff (independent of temperature)	34	28	29	23	1	0	0	0	0	0	0	24	**140**	
IMPERVIOUS AREA WATER SURPLUS														
Precipitation (P)	853	mm/year												
15%)	128	mm/year												
P-PE (surplus available for runoff from impervious areas)	725	mm/year												

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage	125 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOECC SWM infiltration calculations

topography - hilly land	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt soils	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - lawns	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.45**	

Latitude of site (or climate station) 43 ^{O} N.

WATER BALANCE CALCULATIONS
4134 16th Avenue, Markham

PROJECT No.300038247

TABLE H-2

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 400 mm (mature forest in silt soils)

Precipitation data from Toronto Buttonville Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-5.80	-5.60	-0.40	6.70	13.00	18.60	21.20	20.20	15.70	8.90	3.10	-2.90	**7.7**	<--From Environment Canada
Heat index: i = $(t/5)^{1.514}$	0.00	0.00	0.00	1.56	4.25	7.31	8.91	8.28	5.65	2.39	0.48	0.00	**38.8**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	29.28	61.03	90.77	104.93	99.46	75.23	40.11	12.46	0.00	**513**	
Adjusting Factor for U (Latitude 43° 52' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	62	51	53	74	80	83	79	76	82	68	80	66	**853**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
P - PET	62	51	53	41	3	-33	-56	-43	4	30	70	66	**246**	
Change in Soil Moisture Storage	0	0	0	0	0	-33	-56	-43	4	30	70	30	**0**	
Soil Moisture Storage max 400 mm	400	400	400	400	400	367	310	267	271	301	370	400		
Actual Evapotranspiration (AET)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
Soil Moisture Deficit max 400 mm	0	0	0	0	0	33	90	133	129	99	30	0		
Water Surplus - available for infiltration or runoff	62	51	53	41	3	0	0	0	0	0	0	36	**246**	
Potential Infiltration (based on MOECC methodology*; independent of temperature)	34	28	29	23	1	0	0	0	0	0	0	20	**135**	
Potential Direct Surface Water Runoff (independent of temperature)	28	23	24	19	1	0	0	0	0	0	0	16	**111**	
IMPERVIOUS AREA WATER SURPLUS														
Precipitation (P)	853	mm/year												
15%)	128	mm/year												
P-PE (surplus available for runoff from impervious areas)	725	mm/year												

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage	400 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOECC SWM infiltration calculations

topography - hilly land	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt soils	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - wooded lands	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.55**	

Latitude of site (or climate station) 43 ° N.

WATER BALANCE CALCULATIONS
4134 16th Avenue, Markham

PROJECT No.300038247

TABLE H-3

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 125 mm (urban lawns in silt soils) with Grading

Precipitation data from Toronto Buttonville Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-5.80	-5.60	-0.40	6.70	13.00	18.60	21.20	20.20	15.70	8.90	3.10	-2.90	**7.7**	<--From Environment Canada
Heat index: i = (t/5)$^{1.514}$	0.00	0.00	0.00	1.56	4.25	7.31	8.91	8.28	5.65	2.39	0.48	0.00	**38.8**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	29.28	61.03	90.77	104.93	99.46	75.23	40.11	12.46	0.00	**513**	
Adjusting Factor for U (Latitude 43^{o} 52' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	62	51	53	74	80	83	79	76	82	68	80	66	**853**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
P - PET	62	51	53	41	3	-33	-56	-43	4	30	70	66	**246**	
Change in Soil Moisture Storage	0	0	0	0	0	-33	-56	-35	4	30	70	22	**0**	
Soil Moisture Storage max 125 mm	125	125	125	125	125	92	35	0	4	33	103	125		
Actual Evapotranspiration (AET)	0	0	0	33	77	116	135	111	78	38	10	0	**599**	
Soil Moisture Deficit max 125 mm	0	0	0	0	0	33	90	125	121	92	22	0		
Water Surplus - available for infiltration or runoff	62	51	53	41	3	0	0	0	0	0	0	44	**254**	
Potential Infiltration (based on MOECC metholodogy*; independent of temperature)	31	25	27	21	1	0	0	0	0	0	0	22	**127**	
Potential Direct Surface Water Runoff (independent of temperature)	31	25	27	21	1	0	0	0	0	0	0	22	**127**	
IMPERVIOUS AREA WATER SURPLUS														
Precipitation (P)	853	mm/year												
15%)	128	mm/year												
P-PE (surplus available for runoff from impervious areas)	725	mm/year												

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage	125 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOECC SWM infiltration calculations

topography - graded land	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt soils	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawns	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.5**	

Latitude of site (or climate station) 43 ^{O} N.

TABLE H-4

Water Balance - EAST DRAFT PLAN AREA- Existing Conditions and Post-Development (no mitigation)
4134 16th Avenue, Markham

Catchment Area		**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)**
East Draft Plan - Existing Land Use													
Grass Area		668,400	0.00	0	0.725	0	668,400	0.140	93,329	0.114	76,360	93,329	76,360
Solid Path		27,000	1.00	27,000	0.725	19,576	0	0.140	0	0.114	0	19,576	0
Building		3,700	1.00	3,700	0.725	2,683	0	0.140	0	0.114	0	2,683	0
Gravel Area		4,300	0.50	2,150	0.725	1,559	2,150	0.140	300	0.114	246	1,859	246
Ponds		21,900	1.00	21,900	0.725	15,879	0	0.140	0	0.114	0	15,879	0
Woodlot Wetland Feature	Wetland	17,400	0.00	0	0.725	0	17,400	0.140	2,430	0.114	1,988	2,430	1,988
	Woodlot	19,000	0.00	0	0.725	0	19,000	0.111	2,103	0.135	2,570	2,103	2,570
TOTAL PRE-DEVELOPMENT		**761,700**		**54,750**		**39,696**	**706,950**		**98,162**		**81,164**	**137,858**	**81,164**
East Draft Plan - Post-Development Land Use													
Residential - Single Detached/Laneway Homes		246,000	0.62	151,290	0.725	109,693	94,710	0.127	12,022	0.127	12,022	121,715	12,022
Residential - Town Homes		85,000	0.77	65,365	0.725	47,393	19,635	0.127	2,492	0.127	2,492	49,885	2,492
Residential - Medium Density		19,100	0.92	17,629	0.725	12,782	1,471	0.127	187	0.127	187	12,969	187
School		24,600	0.77	18,917	0.725	13,716	5,683	0.127	721	0.127	721	14,437	721
Stormwater Management Pond Blocks		68,000	0.54	36,584	0.725	26,525	31,416	0.127	3,988	0.127	3,988	30,513	3,988
ROW		175,600	0.62	107,994	0.725	78,301	67,606	0.127	8,582	0.127	8,582	86,883	8,582
Parks		42,700	0.00	0	0.725	0	42,700	0.127	5,420	0.127	5,420	5,420	5,420
Open Space		44,800	0.00	0	0.725	0	44,800	0.127	5,687	0.127	5,687	5,687	5,687
Laneway		19,500	1.00	19,500	0.725	14,138	0	0.127	0	0.127	0	14,138	0
Woodlot Wetland Feature	Wetland	17,400	0.00	0	0.725	0	17,400	0.140	2,430	0.114	1,988	2,430	1,988
	Woodlot	19,000	0.00	0	0.725	0	19,000	0.111	2,103	0.135	2,570	2,103	2,570
TOTAL POST-DEVELOPMENT		**761,700**		**417,280**		**302,549**	**344,420**		**43,632**		**43,657**	**346,180**	**43,657**
% Change from Pre to Post												251	46
Effect of development (with no mitigation)												2.5 times increase in runoff	46% reduction in infiltration

* data provided by the mbtw group

** data provided by Stantec

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

To balance pre- to post-,
the infiltration target (m^3/a)= **37,507**

TABLE H-5a

Water Balance - WEST DRAFT PLAN BERCZY CATCHMENT AREA - Existing Conditions and Post-Development (no mitigation)
4134 16th Avenue, Markham

Catchment Area	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)
West Draft Plan Berczy Catchment Area - Existing Land Use												
Grass Area	371,200	0.00	0	0.725	0	371,200	0.140	51,831	0.114	42,407	51,831	42,407
Solid Path	7,500	1.00	7,500	0.725	5,438	0	0.140	0	0.114	0	5,438	0
Gravel Area	800	0.50	400	0.725	290	400	0.140	56	0.114	46	346	46
Ponds	1,100	1.00	1,100	0.725	798	0	0.140	0	0.114	0	798	0
TOTAL PRE-DEVELOPMENT	**380,600**		**9,000**		**6,525**	**371,600**		**51,887**		**42,453**	**58,412**	**42,453**
West Draft Plan Berczy Catchment Area - Post-Development Land Use												
Residential - Single Detached/Laneway Homes	138,100	0.62	84,932	0.725	61,580	53,169	0.127	6,749	0.127	6,749	68,329	6,749
Residential - Town Homes or Laneway Homes	20,400	0.77	15,688	0.725	11,374	4,712	0.127	598	0.127	598	11,972	598
Mixed Use & Residential - Medium Density	23,300	0.92	21,506	0.725	15,593	1,794	0.127	228	0.127	228	15,821	228
Stormwater Management Pond Blocks	11,200	0.54	6,026	0.725	4,369	5,174	0.127	657	0.127	657	5,026	657
ROW	77,000	0.62	47,355	0.725	34,335	29,645	0.127	3,763	0.127	3,763	38,098	3,763
Laneway	8,600	1.00	8,600	0.725	6,235	0	0.127	0	0.127	0	6,235	0
Parks	36,600	0.00	0	0.725	0	36,600	0.127	4,646	0.127	4,646	4,646	4,646
Open Space	65,400	0.00	0	0.725	0	65,400	0.127	8,302	0.127	8,302	8,302	8,302
TOTAL POST-DEVELOPMENT	**380,600**		**184,106**		**133,486**	**196,494**		**24,942**		**24,942**	**158,428**	**24,942**
% Change from Pre to Post											271	41
Effect of development (with no mitigation)											2.7 times increase in runoff	41% reduction in infiltration

* data provided by the mbtw group

** data provided by Stantec

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

To balance pre- to post-,
the infiltration target (m^3/a)= **17,510**

WATER BALANCE CALCULATIONS
4134 16th Avenue, Markham

PROJECT No.300038247

TABLE H-5b

Water Balance - WEST DRAFT PLAN BRUCE CATCHMENT AREA - Existing Conditions and Post-Development (no mitigation)
4134 16th Avenue, Markham

Catchment Area	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)
West Draft Plan Bruce Catchment Area - Existing Land Use												
Grass Area	460,080	0.00	0	0.725	0	460,080	0.140	64,241	0.114	52,561	64,241	52,561
Solid Path	10,500	1.00	10,500	0.725	7,613	0	0.140	0	0.114	0	7,613	0
Buildings	120	1.00	120	0.725	87	0	0.140	0	0.114	0	87	0
Gravel Area	800	0.50	400	0.725	290	400	0.140	56	0.114	46	346	46
Ponds	23,600	1.00	23,600	0.725	17,111	0	0.140	0	0.114	0	17,111	0
Woodlot	48,000	0.00	0	0.725	0	48,000	0.111	5,313	0.135	6,493	5,313	6,493
TOTAL PRE-DEVELOPMENT	**543,100**		**34,620**		**25,101**	**508,480**		**69,610**		**59,100**	**94,711**	**59,100**
West Draft Plan Bruce Catchment Area - Post-Development Land Use												
Residential - Single Detached/Laneway Homes	70,800	0.62	43,542	0.725	31,570	27,258	0.127	3,460	0.127	3,460	35,030	3,460
Residential - Town Homes or Laneway Homes	25,000	0.77	19,225	0.725	13,939	5,775	0.127	733	0.127	733	14,672	733
Residential - Stacked Towns Block	44,900	0.92	41,443	0.725	30,048	3,457	0.127	439	0.127	439	30,487	439
Stormwater Management Pond Blocks	13,800	0.54	7,424	0.725	5,383	6,376	0.127	809	0.127	809	6,192	809
ROW	53,400	0.62	32,841	0.725	23,811	20,559	0.127	2,610	0.127	2,610	26,421	2,610
Laneway	7,000	1.00	7,000	0.725	5,075	0	0.127	0	0.127	0	5,075	0
Parks	5,400	0.00	0	0.725	0	5,400	0.127	685	0.127	685	685	685
Open Space	270,200	0.00	0	0.725	0	270,200	0.127	34,298	0.127	34,298	34,298	34,298
Ponds	4,600	1.00	4,600	0.725	3,335	0	0.127	0	0.127	0	3,335	0
Woodlot	48,000	0.00	0	0.725	0	48,000	0.111	5,313	0.135	6,493	5,313	6,493
TOTAL POST-DEVELOPMENT	**543,100**		**156,075**		**113,162**	**387,025**		**48,348**		**49,528**	**161,510**	**49,528**
										% Change from Pre to Post	171	16
										Effect of development (with no mitigation)	1.7 times increase in runoff	16% reduction in infiltration

* data provided by the mbtw group

** data provided by Stantec

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

To balance pre- to post-,
the infiltration target (m^3/a)= **9,572**

WATER BALANCE CALCULATIONS
4134 16th Avenue, Markham

PROJECT No.300038247

TABLE H-6

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 125 mm (urban lawns in silt soils) with Amended Soils

Precipitation data from Toronto Buttonville Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-5.80	-5.60	-0.40	6.70	13.00	18.60	21.20	20.20	15.70	8.90	3.10	-2.90	**7.7**	<--From Environment Canada
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.56	4.25	7.31	8.91	8.28	5.65	2.39	0.48	0.00	**38.8**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	29.28	61.03	90.77	104.93	99.46	75.23	40.11	12.46	0.00	**513**	
Adjusting Factor for U (Latitude 43° 52' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	62	51	53	74	80	83	79	76	82	68	80	66	**853**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	0	33	77	116	135	119	78	38	10	0	**607**	
P - PET	62	51	53	41	3	-33	-56	-43	4	30	70	66	**246**	
Change in Soil Moisture Storage	0	0	0	0	0	-33	-56	-35	4	30	70	22	**0**	
Soil Moisture Storage max 125 mm	125	125	125	125	125	92	35	0	4	33	103	125		
Actual Evapotranspiration (AET)	0	0	0	33	77	116	135	111	78	38	10	0	**599**	
Soil Moisture Deficit max 125 mm	0	0	0	0	0	33	90	125	121	92	22	0		
Water Surplus - available for infiltration or runoff	62	51	53	41	3	0	0	0	0	0	0	44	**254**	
Potential Infiltration (based on MOECC metholodogy*; independent of temperature)	34	28	29	23	1	0	0	0	0	0	0	24	**140**	
Potential Direct Surface Water Runoff (independent of temperature)	28	23	24	19	1	0	0	0	0	0	0	20	**114**	
IMPERVIOUS AREA WATER SURPLUS														
Precipitation (P)	853	mm/year												
15%)	128	mm/year												
P-PE (surplus available for runoff from impervious areas)	725	mm/year												

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage	125 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOECC SWM infiltration calculations

topography - graded land	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt soils + additional topsoil depth	0.25	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawns	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.55**	

Latitude of site (or climate station) 43 ° N.

TABLE H-7

Water Balance - EAST DRAFT PLAN AREA - Existing Conditions and Post-Development with Mitigation (LIDs)
4134 16th Avenue, Markham

Catchment Area		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)
East Draft Plan - Existing Land Use													
Grass Area		668,400	0.00	0	0.725	0	668,400	0.140	93,329	0.114	76,360	93,329	76,360
Solid Path		27,000	1.00	27,000	0.725	19,576	0	0.140	0	0.114	0	19,576	0
Building		3,700	1.00	3,700	0.725	2,683	0	0.140	0	0.114	0	2,683	0
Gravel Area		4,300	0.50	2,150	0.725	1,559	2,150	0.140	300	0.114	246	1,859	246
Ponds		21,900	1.00	21,900	0.725	15,879	0	0.140	0	0.114	0	15,879	0
Woodlot Wetland Feature	Wetland	17,400	0.00	0	0.725	0	17,400	0.140	2,430	0.114	1,988	2,430	1,988
	Woodlot	19,000	0.00	0	0.725	0	19,000	0.111	2,103	0.135	2,570	2,103	2,570
TOTAL PRE-DEVELOPMENT		**761,700**		**54,750**		**39,696**	**706,950**		**98,162**		**81,164**	**137,858**	**81,164**
East Draft Plan - Post-Development Land Use													
Residential - Single Detached or Laneway Homes	Less Rear Yards and Roof Areas (described below)	178,600	0.64	114,838	0.725	83,263	63,762	0.127	8,094	0.127	8,094	91,357	8,094
	Rear Yard Amended Soils	31,000	0.00	0	0.725	0	31,000	0.114	3,542	0.140	4,329	3,542	4,329
	Roof to Grass - 25% infiltration	29,100	1.00	29,100	0.725	21,099	NA	NA	NA	NA	NA	15,824	5,275
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total rainfall)	5,200	1.00	5,200	0.725	3,770	NA	NA	NA	NA	NA	264	3,506
	Roof to Area E	2,100	1.00	2,100	0.725	1,523	NA	NA	NA	NA	NA	1,142	381
Residential - Town Homes	Less Rear Yards and Roof Areas (described below)	70,300	0.77	54,187	0.725	39,288	16,113	0.127	2,045	0.127	2,045	41,334	2,045
	Rear Yard Amended Soils	4,600	0.00	0	0.725	0	4,600	0.114	526	0.140	642	526	642
	Roof to Grass - 25% infiltration	7,400	1.00	7,400	0.725	5,365	NA	NA	NA	NA	NA	4,024	1,341
	Roof to Area E	1,000	1.00	1,000	0.725	725	NA	NA	NA	NA	NA	544	181
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total	1,700	1.00	1,700	0.725	1,233	NA	NA	NA	NA	NA	86	1,146
Residential - Stacked Towns Block	Less Roof Areas (described below)	6,300	0.76	4,773	0.725	3,461	1,527	0.127	194	0.127	194	3,654	194
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total rainfall)	4,900	1.00	4,900	0.725	3,553	NA	NA	NA	NA	NA	249	3,304
	Roof to Area E	7,900	1.00	7,900	0.725	5,728	NA	NA	NA	NA	NA	4,296	1,432
School	Less Roof Areas (described below)	18,450	0.69	12,767	0.725	9,257	5,683	0.127	721	0.127	721	9,978	721
	Roof to Area E	6,150	1.00	6,150	0.725	4,459	NA	NA	NA	NA	NA	3,344	1,115
Stormwater Management		68,000	0.54	36,584	0.725	26,525	31,416	0.127	3,988	0.127	3,988	30,513	3,988
ROW		175,600	0.62	107,994	0.725	78,301	67,606	0.127	8,582	0.127	8,582	86,883	8,582
Parks		42,700	0.00	0	0.725	0	42,700	0.127	5,420	0.127	5,420	5,420	5,420
Open Space		44,800	0.00	0	0.725	0	44,800	0.127	5,687	0.127	5,687	5,687	5,687
Laneway		19,500	1.00	19,500	0.725	14,138	0	0.140	0	0.114	0	14,138	0
Woodlot Wetland Feature	Wetland	17,400	0.00	0	0.725	0	17,400	0.140	2,430	0.114	1,988	2,430	1,988
	Woodlot	19,000	0.00	0	0.725	0	19,000	0.111	2,103	0.135	2,570	2,103	2,570
TOTAL POST-DEVELOPMENT		**761,700**		**416,093**		**301,688**	**345,607**		**43,330**		**44,260**	**327,337**	**61,941**
											% Change from Pre to Post	237	24
											Effect of development (with mitigation)	2.4 times increase in runoff	24% reduction in infiltration

* data provided by the mbtw group

** data provided by Stantec

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

To balance pre- to post-,
the infiltration target (m^3/a)= **19,223**

TABLE H-8a

Water Balance - WEST DRAFT PLAN BERCZY CATCHMENT AREA - Existing Conditions and Post-Development with Mitigation (LIDs)
4134 16th Avenue, Markham

Catchment Area		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)
West Draft Plan Berczy Catchment Area - Exising Land Use													
Grass Area		371,200	0.00	0	0.725	0	371,200	0.140	51,831	0.114	42,407	51,831	42,407
Solid Path		7,500	1.00	7,500	0.725	5,438	0	0.140	0	0.114	0	5,438	0
Gravel Area		800	0.50	400	0.725	290	400	0.140	56	0.114	46	346	46
Ponds		1,100	1.00	1,100	0.725	798	0	0.140	0	0.114	0	798	0
TOTAL PRE-DEVELOPMENT		**380,600**		**9,000**		**6,525**	**371,600**		**51,887**		**42,453**	**58,412**	**42,453**
West Draft Plan Berczy Catchment Area - Post-Development Land Use													
Residential - Single Detached or Laneway Homes	Less Rear Yards and Roof Areas (described below)	79,100	0.57	44,964	0.725	32,601	34,136	0.127	4,333	0.127	4,333	36,934	4,333
	Rear Yard Amended Soils	19,000	0.00	0	0.725	0	19,000	0.114	2,171	0.140	2,653	2,171	2,653
	Roof to Grass - 25% infiltration	21,000	1.00	21,000	0.725	15,226	NA	NA	NA	NA	NA	11,420	3,807
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total rainfall)	13,600	1.00	13,600	0.725	9,861	NA	NA	NA	NA	NA	690	9,170
	Roof to Enclave - designed for 25 mm storm (~ 93% of total rainfall)	5,400	1.00	5,400	0.725	3,915	NA	NA	NA	NA	NA	274	3,641
Residential - Town Homes or Laneway Homes	Less Rear Yards and Roof Areas (described below)	8,100	0.78	6,316	0.725	4,580	1,784	0.127	226	0.127	226	4,806	226
	Rear Yard Amended Soils	2,900	0.00	0	0.725	0	2,900	0.114	331	0.140	405	331	405
	Roof to Grass - 25% infiltration	5,200	1.00	5,200	0.725	3,770	NA	NA	NA	NA	NA	2,828	943
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total rainfall)	4,200	1.00	4,200	0.725	3,045	NA	NA	NA	NA	NA	213	2,832
Mixed Use & Residential - Medium Density	Less Roof Areas (described below)	6,700	0.73	4,905	0.725	3,556	1,795	0.127	228	0.127	228	3,784	228
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total rainfall)	14,000	1.00	14,000	0.725	10,151	NA	NA	NA	NA	NA	711	9,440
	Roof to Park (accounted for below)	2,600	1.00	2,600	0.725	1,885	NA	NA	NA	NA	NA	NA	NA
Stormwater Management Pond Blocks		11,200	0.54	6,026	0.725	4,369	5,174	0.127	657	0.127	657	5,026	657
ROW		77,000	0.62	47,355	0.725	34,335	29,645	0.127	3,763	0.127	3,763	38,098	3,763
Laneway		8,600	1.00	8,600	0.725	6,235	0	0.127	0	0.127	0	6,235	0
Parks	Park Blocks	36,600	0.00	0	0.725	0	36,600	0.127	4,646	0.127	4,646	4,646	4,646
	Roof to Park from Mixed Use Area above- 25% infiltration	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1,414	471
Open Space		65,400	0.00	0	0.725	0	65,400	0.127	8,302	0.127	8,302	8,302	8,302
TOTAL POST-DEVELOPMENT		**380,600**		**184,166**		**133,529**	**196,434**		**24,657**		**25,213**	**127,882**	**55,517**
											% Change from Pre to Post	219	-31
											Effect of development (with mitigation)	2.2 times increase in runoff	31% increase in infiltration

* data provided by the mbtw group

** data provided by Stantec

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

To balance pre- to post-,
the infiltration target (m^3/a)= **-13,064**

TABLE H-8b

Water Balance - WEST DRAFT PLAN BRUCE CATCHMENT AREA - Existing Conditions and Post-Development with Mitigation (LIDs)
4134 16th Avenue, Markham

Catchment Area		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)
West Draft Plan Bruce Catchment Area - Exising Land Use													
Grass Area		460,080	0.00	0	0.725	0	460,080	0.140	64,241	0.114	52,561	64,241	52,561
Solid Path		10,500	1.00	10,500	0.725	7,613	0	0.140	0	0.114	0	7,613	0
Buildings		120	1.00	120	0.725	87	0	0.140	0	0.114	0	87	0
Gravel Area		800	0.50	400	0.725	290	400	0.140	56	0.114	46	346	46
Ponds		23,600	1.00	23,600	0.725	17,111	0	0.140	0	0.114	0	17,111	0
Woodlot		48,000	0.00	0	0.725	0	48,000	0.111	5,313	0.135	6,493	5,313	6,493
TOTAL PRE-DEVELOPMENT		**543,100**		**34,620**		**25,101**	**508,480**		**69,610**		**59,100**	**94,711**	**59,100**
West Draft Plan Bruce Catchment Area - Post-Development Land Use													
Residential - Single Detached or Laneway Homes	Less Rear Yards and Roof Areas (described below)	39,700	0.53	21,189	0.725	15,363	18,511	0.127	2,350	0.127	2,350	17,713	2,350
	Rear Yard Amended Soils	8,700	0.00	0	0.725	0	8,700	0.114	994	0.140	1,215	994	1,215
	Roof to Grass - 25% infiltration	9,600	1.00	9,600	0.725	6,960	NA	NA	NA	NA	NA	5,220	1,740
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total rainfall)	10,300	1.00	10,300	0.725	7,468	NA	NA	NA	NA	NA	523	6,945
	Roof to Enclave - designed for 25 mm storm (~ 93% of total rainfall)	2,500	1.00	2,500	0.725	1,813	NA	NA	NA	NA	NA	127	1,686
Residential - Town Homes or Laneway Homes	Less Rear Yards and Roof Areas (described below)	18,400	0.76	14,044	0.725	10,183	4,356	0.127	553	0.127	553	10,736	553
	Rear Yard Amended Soils	1,400	0.00	0	0.725	0	1,400	0.114	160	0.140	195	160	195
	Roof to Grass - 25% infiltration	2,600	1.00	2,600	0.725	1,885	NA	NA	NA	NA	NA	1,414	471
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total rainfall)	2,600	1.00	2,600	0.725	1,885	NA	NA	NA	NA	NA	132	1,753
Residential - Stacked Towns Block	Less Roof Areas (described below)	17,000	0.80	13,542	0.725	9,819	3,458	0.127	439	0.127	439	10,258	439
	Roof to Infiltration - designed for 25 mm storm (~ 93% of total rainfall)	27,100	1.00	27,100	0.725	19,649	NA	NA	NA	NA	NA	1,375	18,273
	Roof to Park (accounted for below)	800	1.00	800	0.725	580	NA	NA	NA	NA	NA	NA	NA
Stormwater Management Pond Blocks		13,800	0.54	7,424	0.725	5,383	6,376	0.127	809	0.127	809	6,192	809
ROW		53,400	0.62	32,841	0.725	23,811	20,559	0.127	2,610	0.127	2,610	26,421	2,610
Laneway		7,000	1.00	7,000	0.725	5,075	0	0.127	0	0.127	0	5,075	0
Parks	Park Blocks	5,400	0.00	0	0.725	0	5,400	0.127	685	0.127	685	685	685
	Roof to Park from Mixed Use Area above-25% infiltration	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	435	145
Open Space	West Draft Plan	270,200	0.00	0	0.725	0	270,200	0.127	34,298	0.127	34,298	34,298	34,298
Ponds		4,600	1.00	4,600	0.725	3,335	0	0.127	0	0.127	0	3,335	0
Woodlot		48,000	0.00	0	0.725	0	48,000	0.111	5,313	0.135	6,493	5,313	6,493
TOTAL POST-DEVELOPMENT		**543,100**		**156,141**		**113,210**	**386,959**		**48,211**		**49,648**	**130,407**	**80,662**
											% Change from Pre to Post	138	-36
											Effect of development (with mitigation)	1.4 times increase in runoff	36% increase in infiltration

* data provided by the mbtw group

** data provided by Stantec

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

To balance pre- to post-,
the infiltration target (m^3/a)= **-21,562**

TABLE H-9

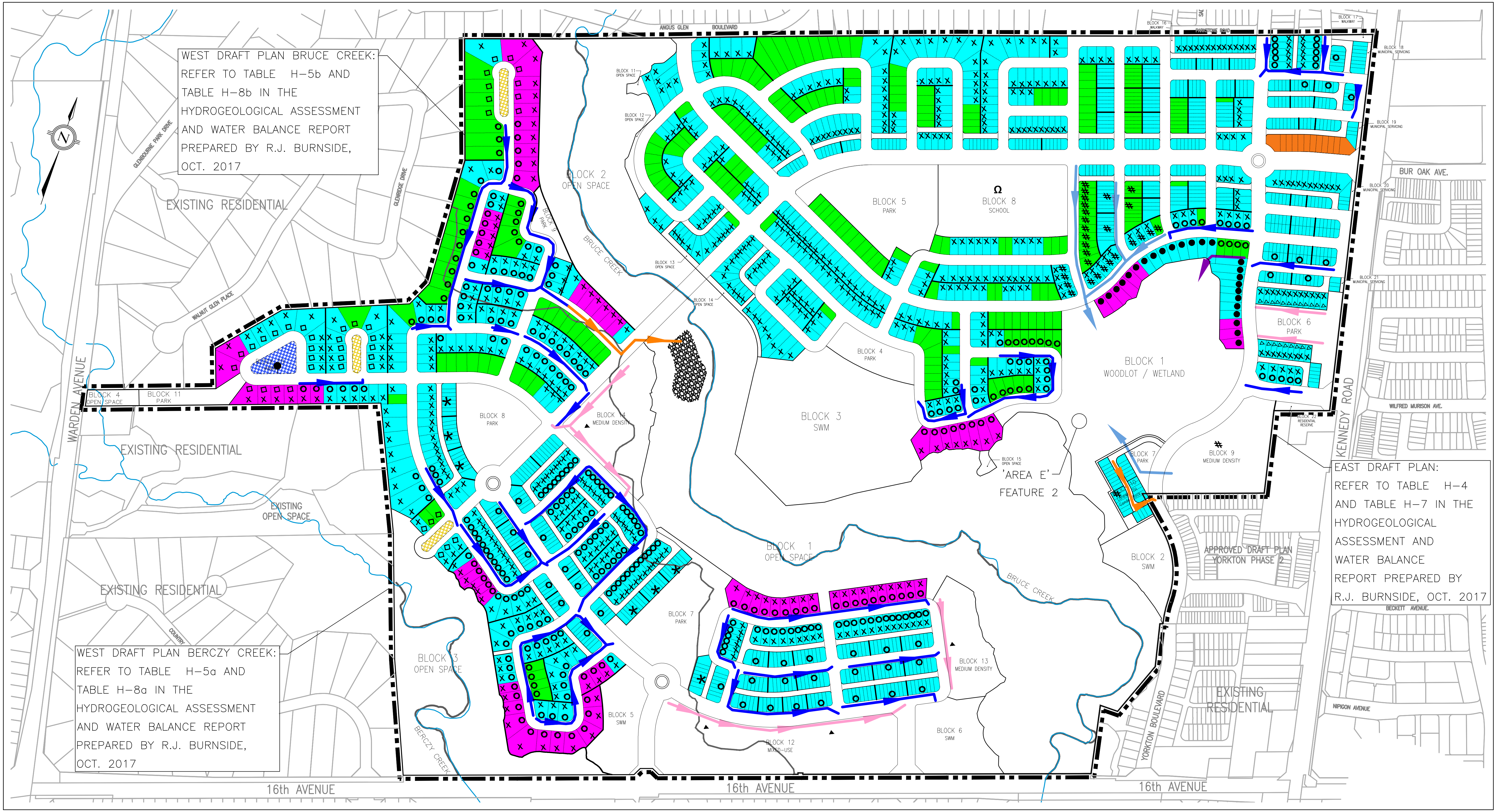
Feature Based Water Balance - WOODLOT/WETLAND FEATURE - Existing Conditions and Post-Development with LIDs
4134 16th Avenue, Markham

Catchment Area		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 to Feature (m^3/a)	Total Infiltration Volume (m^3/a)
Woodlot/Wetland Feature - Existing Land Use													
Woodlot Wetland Feature	Wetland	17,400	0.00	0	0.725	0	17,400	0.140	2,430	0.114	1,988	2,430	1,988
	Woodlot	19,000	0.00	0	0.725	0	19,000	0.111	2,103	0.135	2,570	2,103	2,570
Existing External Drainage Area to Feature		30,200	0.00	0	0.725	0	30,200	0.140	4,217	0.114	3,450	4,217	3,450
TOTAL PRE-DEVELOPMENT		**66,600**		**0**		**0**	**66,600**		**8,749**		**8,008**	**8,749**	**8,008**
Woodlot/Wetland Feature - Post-Development Land Use													
Woodlot Wetland Feature	Wetland	17,400	0.00	0	0.725	0	17,400	0.140	2,430	0.114	1,988	2,430	1,988
	Woodlot	19,000	0.00	0	0.725	0	19,000	0.111	2,103	0.135	2,570	2,103	2,570
Open Space/Buffer Draning to Feature		13,700	0.00	0	0.725	0	13,700	0.111	1,516	0.135	1,853	1,516	1,853
Type B Lots	Rear Yard Amended Soils	2,100	0.00	0	0.725	0	2,100	0.114	240	0.140	293	240	293
	Roof to Grass - 25% infiltrates & 75% runoff	4,000	1.00	4,000	0.725	2,900	NA	NA	NA	NA	NA	2,175	725
Type C Lots	Rear Yard Amended Soils	500	0.00	0	0.725	0	500	0.114	57	0.140	70	57	70
	Roof to Grass - 25% infiltrates & 75% runoff	900	1.00	900	0.725	653	NA	NA	NA	NA	NA	489	163
Type E Lots	Rear Yard Amended Soils	250	0.00	0	0.725	0	250	0.114	29	0.140	35	29	35
	Roof to Grass - 25% infiltrates & 75% runoff	500	1.00	500	0.725	363	NA	NA	NA	NA	NA	272	91
TOTAL POST-DEVELOPMENT		**58,350**		**5,400**		**3,915**	**52,950**		**6,375**		**6,809**	**9,311**	**7,788**
% Change from Pre to Post												-6	3
Effect of development (with no mitigation)												6% increase in runoff	maintains infiltration

* data provided by the mbtw group

** data provided by Stantec

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



WEST DRAFT PLAN BRUCE CREEK:
REFER TO TABLE H-5b AND
TABLE H-8b IN THE
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE REPORT
PREPARED BY R.J. BURNSIDE,
OCT. 2017

WEST DRAFT PLAN BERCZY CREEK:
REFER TO TABLE H-5a AND
TABLE H-8a IN THE
HYDROGEOLOGICAL ASSESSMENT
AND WATER BALANCE REPORT
PREPARED BY R.J. BURNSIDE,
OCT. 2017

EAST DRAFT PLAN:
REFER TO TABLE H-4
AND TABLE H-7 IN THE
HYDROGEOLOGICAL
ASSESSMENT AND
WATER BALANCE
REPORT PREPARED BY
R.J. BURNSIDE, OCT. 2017

Stantec
BEACON ENVIRONMENTAL
BURNSIDE

0 60 120 180 240 300
1:6000

Legend

- — · — SUBJECT PROPERTY
- → PROPOSED SOLID RLC
- → PROPOSED PERFORATED RLC
- → PROPOSED RLC TO WOODLOT/ WETLAND FEATURE
- → PROPOSED INFILTRATION GALLERY
- → PROPOSED FDRLC
- ⬬ WETLAND STONE RESERVOIR FOR FDRLC OUTLET
- — DRAINAGE DIVIDE BRUCE CREEK AND BERCZY CREEK
- 🟦 BACK SPLIT
- 🟩 FRONT DRAIN
- 🟧 FRONT WALK
- 🟪 WALKOUT
- ▦ ENCLAVE BIORETENTION
- ▦ INFILTRATION FACILITY
- * HALF ROOF TO SURFACE
- Ω FULL ROOF TO 'AREA E'
- # HALF ROOF TO 'AREA E'
- O HALF ROOF TO PERFORATED RLC
- □ HALF ROOF TO ENCLAVE BIORETENTION
- △ HALF ROOF TO INFILTRATION GALLERY
- ▲ FULL ROOF TO INFILTRATION GALLERY
- X HALF ROOF TO AMENDED SOILS
- ● FULL ROOF TO WOODLOT/WETLAND FEATURE

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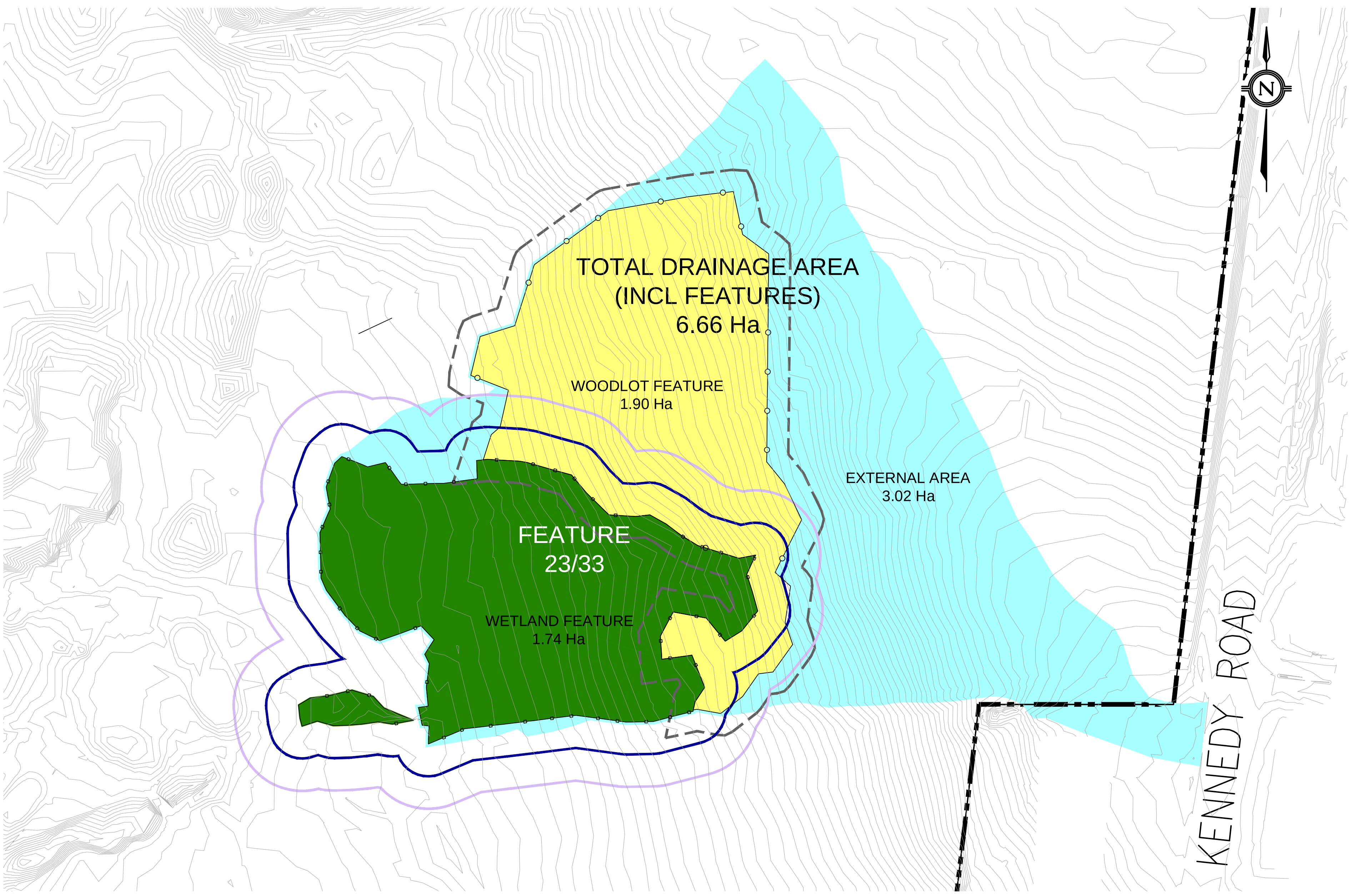
FIGURE 2.17

POST DEVELOPMENT WATER BALANCE MITIGATION PLAN

October 2017

File: V:\01606\Active\160622264\Drawing\sheet_files [MESP]\Figure 2.17 - Post Development Water Balance Mitigation Plan.dwg - Revised by <Overholt, Alysse> , Fri, Oct 27, 2017 , 1:38 PM



EXISTING DRAINAGE PLAN

PROPOSED DRAINAGE PLAN

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BEACON ENVIRONMENTAL
BURNSIDE

1:2000 0 20 40 60 80 100

Legend

- SUBJECT PROPERTY
- STAKED DRIPLINE
- STAKED WETLAND
- STAKED DRIPLINE +10.0m
- STAKED WETLAND +15.0m
- STAKED WETLAND +30.0m
- RLC TO WOODLOT/WETLAND FEATURE
- 🟩 WETLAND AREA
- 🟦 EXISTING DRAINAGE AREA TO FEATURE
- 🟨 WOODLOT AREA
- 🟧 PROPOSED REAR LOT AREA TO FEATURE
- 🟩 PROPOSED OPEN SPACE/ BUFFER TO FEATURE
- ● FULL ROOF TO WOODLOT/WETLAND FEATURE

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FIGURE 2.15

WOODLOT / WETLAND
FEATURE 1 DRAINAGE PLAN

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File: V:\01606\Active\160622264\Drawing\sheet_files [MESP]\Figure 2.15 – Woodlot–Wetland Drainage Plan.dwg – Revised by <Overholt, Alysse> , Thu, Oct 19, 2017 , 2:05 PM