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HYDROGEOLOGY REPORT

Schedule B Municipal Class Environmental Assessment Albion Vaughan Road and King Street, Town of Caledon, Ontario

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Region of Peel Project
16-4390

REPORT

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by CIMA+ (CIMA) on behalf of The Regional Municipality of Peel to provide hydrogeological services in support of the Schedule B Class Environmental Assessment study for improvements to Albion Vaughan Road and King Street, Town of Caledon (see Figure 1).

The purpose of the investigation was determining the subsurface soil and groundwater conditions at the two stream crossing structures near the intersection, as well as, where the creek meanders and is in close proximity to Albion Vaughan Road. As part of the geotechnical investigation (provided under a separate cover), three boreholes were installed with monitoring wells. Data collected from these wells, along with review of any pre-existing existing borehole and monitoring well information was used to better understand the subsurface conditions. The information was used to provide an assessment of existing groundwater conditions including presence of aquifers/aquitards, depth to water table, hydraulic conductivity, and groundwater flow direction within the anticipated depth of construction activities.

The investigation and reporting were carried out in general accordance with the scope of work provided in our Proposal No. P1663783 dated September 16, 2016. The scope of work was developed based on the requirements of the Request for Proposal outlined in The Regional Municipality of Peel's Request for Proposal (RFP 16-4390) dated August 30, 2016.

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location.

This report should be read in conjunction with "Important Information and Limitations of This Report", following the text of this report. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Description

The study area is located at the intersection of Albion Vaughan Road and King Street East/King Road; east of the intersection King Road is within the Regional Municipality of York and south of King Road, Albion Vaughan Road is within the Town of Caledon and King Street West and Caledon-King Townline (north of the intersection) are within the Regional Municipality of Peel, Ontario. Relative to the intersection, the study limits extend approximately 80 m north and 90 m south along Albion Vaughn Road, and approximately 100 m west along King Street East and 80 m east along King Road (see Figure 1 for a site location plan).

The intersection is situated in a rural residential setting and is currently a two-lane road with one lane in each direction. Within the study area Cold Creek (which is a tributary of the Humber River) crosses the Caledon-King Townline approximately 80 north of the intersection and then it meanders in a southerly direction and crosses King Road East approximately 40 m east of the intersection. The study area is located within the Humber River Watershed where the Humber River runs from West to East along the south end of the study area. Cold Creek flows from North to South in this area and meets the Humber River immediately South-East of the study area. Cold Creek continues meandering to the south and at about 120 m south of the intersection along the Albion Vaughan Road the creek is about 8 m to east of the existing road. Cold Creek is classified as a cold-water stream

(TRCA, 2008a). In general, the topography in the site area slopes towards the intersection and within the study limits the ground surface of the various roads varies from about Elevation 215 m to 210 m.

2.2 Project Description

It is understood that as part of the Schedule B Class Environmental Assessment consideration is being given to intersection improvement works including widening at Albion Vaughan Road and King Street. Hydrogeological investigations and recommendations consist of an assessment of existing groundwater conditions (including shallow aquifers at proposed water crossings) and private wells within the study area, as well as assessing the need for a Permit to Take Water (PTTW) or Environmental Activity and Sector Registry (EASR) for the construction dewatering of the proposed water crossing excavations.

3.0 REGIONAL GEOLOGY

The site is located in the South Slope physiographic region as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984).

The South Slope physiographic region covers portions of the Regional Municipalities of Peel, York and Durham. A surficial till sheet, which generally follows the surface topography, is generally present throughout much of this area. The till is typically comprised of clayey silt to silty clay, with occasional silt to sand zones and is mapped in this area as the Halton Till.

4.0 REGIONAL HYDROGEOLOGY

Over all hydrostratigraphic units influencing groundwater flow in the study area include a shallow groundwater system (i.e., Halton Till and Oak Ridges Complex Aquifer) and a deeper groundwater system (i.e., Newmarket Till, Thorncliffe Aquifer, Sunnybrook Aquitard, Scarborough Aquifer and Weathered Bedrock) (TRCA 2008b). The characteristics of these hydrostratigraphic units that influence groundwater flow include the presence and configuration of bedrock valleys and tunnel channels, the thickness and lateral extent of the Newmarket Till, which separates the shallow and deep groundwater systems, and the thickness and lateral extent and nature of the sediments in the aquifer complexes (TRCA 2008b). Groundwater flow within all aquifer complexes is generally in a southerly direction from the Oak Ridges Moraine to Lake Ontario and shallow aquifer systems are locally influenced by topography (TRCA, 2008b). Significant groundwater discharge zones are associated with areas along the flanks of the ORM, particularly in the North West and North East portions of the Humber River watershed. It should also be noted that the study area is not located within any source water/wellhead protection areas (CTC, 2015).

4.1 Groundwater Use

Based on a review of the Ontario Ministry of the Environment and Climate Change’s (MOECC) Water Well Information System (WWIS) database, there are 44 water well records and no Permits to Take Water (PTTW) within a 500 m radius of the study area. Figure 3 indicates the locations of these water well records. Table A1 summarizes the well information (Appendix A).

The 44 listed wells were drilled between 1952 and 2016 to depths of 4.0 to 93.6 metres below ground surface (mbgs). Of the 44 records, 7 were identified as abandoned, 30 were identified as water supply wells (29 domestic and 1 unidentified), 5 were identified as monitoring/test holes/observation wells, 2 records were listed as "unfinished" and 1 record was unidentified. No municipal or public wells were identified. A door-to-door survey was required to identify if some of the domestic water supply wells remained active.

A door-to-door survey was completed by Golder on October 5, 2017 at selected properties within the study site boundaries (Figure 3). A total of ten (10) homes were identified within the study area and questionnaires were delivered to residents. The following is a list of identified domestic well residences that received surveys:

- 13456 Caledon King Townline South;
- 13055 Caledon King Townline South;
- 13418 Caledon King Townline South;
- 545 King Road;
- 550 King Road;
- 580 King Road;
- 590 King Road;
- 8000 King Road;
- 8020 King Road; and
- 525 King Road.

The well survey is to investigate the potential for interference to surrounding wells during the dewatering of excavations at the two river crossings. As of October 16, 2017, one completed private well survey was received and is summarized in Table A2 of Appendix A. Further results of this survey are still pending, and a revised summary of the results will be included in an update to this draft report.

4.2 Site Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes advanced as part of the geotechnical investigation are provided in the Record of Borehole sheets contained Appendix B. The results of geotechnical laboratory testing are also presented on Figures C1 to C7 contained in Appendix C. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the boreholes advanced encountered the pavement structure at ground surface, underlain by fill materials comprised of inter-layered deposits of loose to very dense sand and gravel to gravelly sand to silty sand, and silt and sand to stiff to hard clayey silt to sandy clayey silt. In Boreholes 17-03, 17-04, 17-06, 17-08 the fill material is underlain by a deposit of sand to sandy silt. In Boreholes 17-01, 17-06, 17-07, 17-09 and 17-10, advanced at the location of the proposed bridge extension and where the creek meanders close to Albion Vaughan Road, the fill material is underlain by a deposit of silt to clayey silt to silty clay.

A more detailed description of the subsurface conditions encountered in the boreholes are described in the geotechnical report provided under a separate cover (Golder, 2017).

5.0 FIELD INVESTIGATION

The field work for the geotechnical and pavement investigation at the intersection was carried out between May 23 and 29, 2017, during which time a total of eleven boreholes (designated as Borehole 17-01 to 17-11) were advanced at the locations shown on Figure 1. Monitoring wells were installed at three borehole locations (Boreholes 17-1, 17-7, and 17-10) as described in the geotechnical report, submitted under a separate cover. Borehole records and monitoring well installation details from this investigation are provided in Appendix B.

The hydrogeologic observations of the site were made on May 30, May 31, and July 17. Loggers were deployed beneath packers between May 31, 2017, and July 17, 2017. Static water levels were measured in each of the piezometers. Artesian conditions were encountered in boreholes 17-07 and 17-10 on May 30. To obtain static water levels additional riser pipes were attached to the top of the well casing and allowed to recover to steady state. Single well response tests were performed on each of the piezometers to estimate hydraulic conductivity as detailed in Section 5.3. Boreholes 17-07 and 17-10 were decommissioned due to artesian conditions, as detailed in the geotechnical report and indicated on Figure 1.

5.1 Groundwater Levels

The groundwater conditions in the open boreholes were observed during and upon completion of the drilling operations, and standpipe piezometers were installed in Boreholes 17-01, 17-07, and 17-10, to permit monitoring of the water level at those locations.

Following the development of BH17-07 and BH17-10, it was found that groundwater levels were flowing above ground surface. In order to measure a static groundwater level at these locations, these wells were instrumented with a standpipe riser to allow water levels to rise above ground surface and measurements were taken from the top of the standpipe riser.

Table 1: Groundwater Levels

Borehole ID	Ground Surface Elevation (masl)	Borehole Depth (m)	Date	Groundwater Level (mbtoc)	Groundwater Elevation (masl)
BH17-01*	210.00	6.7	24-May-17	2.66	207.34
			30-May-17	2.40	207.60
			31-May-17	2.40	207.60
BH17-07*	210.00	8.2	26-May-17	3.05	206.95
			30-May-17	-0.20	210.20
BH17-10*	211.10	9.8	24-May-17	7.82	203.28
			30-May-17	-0.92	212.02

*Indicates boreholes installed with piezometer
Note: Negative water level values indicate groundwater levels above top of casing

Data loggers were installed in monitoring wells 17-01, 17-07, and 17-10. Complete hydrographs for these monitoring wells can be found in Appendix D.

5.2 Grain Size Analysis

Hydraulic conductivities were derived from grain size samples collected from boreholes using the Hazen Method (Hazen, 1911). Table 2 below provides a summary of hydraulic conductivities derived from this analysis. Detailed grain size curves can be found in Appendix C.

Table 2: Hydraulic Conductivity Results Based on Grain Size Analysis

Borehole Identification	Sample Identification	Sample Depth (m)	Hazen Results (m/s)	Soil Description
17-05	2	0.76 – 1.37	3×10^{-9}	Fill - Sandy Clayey Silt to Silty Clay
17-04	2A	0.76 – 1.37	6×10^{-9}	Fill - Sandy Clayey Silt to Silty Clay
17-02	2	0.76 – 1.37	3×10^{-7}	Silt and Sand
17-01	4B	2.44 – 2.90	4×10^{-7}	Silt and Sand
17-03	1	0.15 – 0.76	4×10^{-5}	Fill - Sand and Gravel to Gravelly Sand
17-08	1A	0.15 – 0.76	4×10^{-5}	Fill - Sand and Gravel to Gravelly Sand
17-03	3	1.52 – 2.13	8×10^{-8}	Sandy Silt to Silt
17-07	7	6.10 – 6.71	3×10^{-8}	Sandy Silt to Silt
17-01	7	6.10 – 6.71	5×10^{-8}	Sandy Silt to Silt
17-09	5	3.05 – 3.66	9×10^{-9}	Silty Clay

Borehole Identification	Sample Identification	Sample Depth (m)	Hazen Results (m/s)	Soil Description
17-10	8	7.62 – 8.23	3 x 10^{-9}	Silty Clay
17-06	5	3.06 – 3.66	3 x 10^{-5}	Sandy Gravel

In summary, the results of the Hazen analysis showed a range of hydraulic conductivities from 3 x 10^{-9} m/s to 4 x 10^{-5} m/s with a geometric mean of 2 x 10^{-7} m/s. The geometric mean of hydraulic conductivities within the fill is 4 x 10^{-7} m/s.

5.3 Single Well Response Tests

A single well response tests (SWRT) were carried out on the three monitoring wells installed in boreholes 17-1, 17-7, and 17-10 on May 30, 2017. Two types of SWRT were employed: slug tests and constant head flow tests. The slug tests were performed by displacing a known volume of water rapidly from the well column, using a physical slug. Recovery of the water level in the well was subsequently monitored using a pressure transducer. Water levels were measured manually using a water level meter to 95% recovery. The recovery was analyzed using the Hvorslev method. The hydraulic conductivity of the screened material was interpreted from the water level displacement using the Hvorslev method (Hvorslev, 1951) as follows:

$$K = \frac{r^2 \ln\left(\frac{L}{R}\right) \ln\left(\frac{h_1}{h_2}\right)}{2L\,(t_2 - t_1)}$$

where, K = hydraulic conductivity of the tested material;

r = radius of the well riser pipe;

R = radius of the sand pack;

L = length of screen and sand pack; and,

h_1, h_2, t_1, and t_2 - represent the slope of the recovery plotted on the head ratio (log scale) versus elapsed time plot.

Constant rate flow tests were performed on artesian wells, BH17-07 and BH17-10, by pumping water from the well at constant head below the top of cap. The volume and duration were monitored to determine a flow rate. A stand pipe was then attached to the artesian wells to determine the static heads above the top of casing. Using the analytical solution for flow in a confined aquifer as presented in Powers et al. (2007) as follows:

$$K = \frac{Q\,ln({}^{R_0}/_{r_w})}{2\pi B(H - h_w)}$$

where, K = hydraulic conductivity of the tested material;

R_0 = radius of influence;

r_w = radius of the well riser pipe;

B = thickness of the confined aquifer (assumed to be equal to the well screen length);

H = static head; and

h_w = constant head during pumping

Table 3 summarizes the hydraulic conductivities from the SWRT and Appendix E presents the analyses of the SWRT.

Table 3: Single Well Response Tests

Well No.	Test Date	Screened Interval (mbgs)	Lithology along Screened Interval	Artesian Conditions	Test Type	Hydraulic Conductivity (m/s)
BH17-01	30-May-17	3.1 – 4.7	Sand and Gravel to Silt	No	Slug Test (Falling Head)	7×10^{-5}
BH17-01	30-May-17	3.1 – 4.7	Sand and Gravel to Silt	No	Slug Test (Rising Head)	8×10^{-5}
BH17-07	30-May-17	5.9 – 7.4	Silt	Yes	Slug Test (Rising Head)	1×10^{-7}
BH17-07	31-May-17	5.9 – 7.4	Silt	Yes	Constant Head Flow Test	6×10^{-7}
BH17-10	31-May-17	7.6 – 9.1	Silty Clay	Yes	Constant Head Flow Test	5×10^{-7}

In summary, the hydraulic conductivities calculated from single well response tests ranged from 1×10^{-7} m/s to 8×10^{-5} m/s. The geometric mean of hydraulic conductivities from SWRT is 3×10^{-6} m/s.

6.0 CONSTRUCTION DEWATERING

A total of two (2) structures requiring excavations were identified within the project boundaries. Structure A, located near BH17-7 along Caledon King Towline South, will be widened a total of two (2) lanes. The east end of the structure will be widened between 3.2 m to 3.5 m and the west end of the structure will be widened 0.5 m to 2.2 m, requiring the excavation at the abutments (4 excavations to the east and 4 excavations to the west of the crossing). Structure B, located near BH17-10 along King Road, will be widened 2.9 m to 3.2 m along the north side of the structure and 3.3 m to 3.8 m along the south side of the structure, requiring the excavation at the abutments (2 excavations to the north and 2 excavations to the south of the crossing). For the purposes of construction dewatering estimates and to take in to account the sloped walls of the proposed open cut excavations, a conservative excavation dimension estimate of 5 m by 5 m has been assumed. The table below summarizes the proposed structures that will require temporary dewatering.

Table 4: Proposed Structures

Structure	Single Excavation Length (m)	Single Excavation Width (m)	Single Excavation Invert Depth (mbgs)	Companion Borehole
Structure A (x8 excavations)	5	5	1.5	BH17-7
Structure B (x4 excavations)	5	5	1.5	BH17-10

The following assumptions have been made with respect to the dewatering calculation estimates:

- Dewatering of all excavations were estimated to 1m below the base of excavation;
- The excavations will be primarily in the shallow subsurface (fill) and dewatering depth is within the underlying native material (silt to silty clay). Therefore, hydraulic conductivity will be influenced by both the shallow material (fine and coarse-grained fill) and underlying native material (silt to silty clay). The geometric mean reported was 4 x 10^{-7} m/s and 3 x 10^{-6} m/s for the fill and native soil respectively. Therefore, a representative estimate of 1 x 10^{-6} m/s was used for both Structure A and Structure B.
- Porosity of subsoils assumed to be 0.1; and
- The aquifer base was assumed to be 2 m below the max dewatering depth.

The assumed parameters are summarized in the table below.

Table 5: Dewatering Parameters

Structure	Ground Surface Elevation (masl)	Dewatering Elevation (masl)	Static Groundwater Level (mbgs)	Base of Aquifer (masl)	H (m)	h (m)	K (m/s)	Aquifer Thickness B (m/s)
Structure A	210.0	207.5	-0.14	205.5	4.6	2	1 x 10^{-6}	4.6
Structure B	211.1	208.6	-0.87	206.6	5.4	2	1 x 10^{-6}	3.7

Details of the dewatering calculations and assumptions of various parameters (dimensions and hydraulic conductivity) for each of the proposed open cut excavation areas requiring dewatering are outlined below.

6.1 Dewatering Radius of Influence

The radius of influence, potential groundwater inflow to the excavation, and groundwater storage and precipitation removal was assessed. Based on Golder's geotechnical field investigation, the excavation will be primarily situated in the unconfined silt or silty clay unit, terminating at 1.5 m below ground surface. Therefore, a hydraulic conductivity of 1 x 10^{-6} m/s, was conservatively estimated. The water table was measured at 0.14 and 0.87 meters above the ground surface at BH17-7 and BH17-10 respectively, and a maximum drawdown of 1 metre below the base of the excavation was used in the dewatering calculations. Therefore, the maximum required water level drawdown would be 2.64 and 3.37 m for structures A and B respectively.

The dewatering radius of influence (ROI) represents the lateral extent of groundwater drawdown in response to dewatering. The dewatering ROI is governed by the transmissivity of the silt/ silty clay and the depth of dewatering required. Applying the Theis analytical solution, the lateral extend of groundwater level drawdown can be estimated as follows:

$$s(r,t) = \frac{Q}{4\pi T} W\left(\frac{r^2 S}{4Tt}\right)$$

Where s(r,t) = drawdown at distance (r) and time (t) after the start of pumping;
Q = pumping rate required to achieve maximum drawdown (m^3/day);
T = aquifer transmissivity (based on a hydraulic conductivity x aquifer thickness);
S = aquifer storativity (0.1 – assumed for specific yield of unconfined silt/ silty clay); and
W = Theis well function.

Based on the Theis analytical approach discussed above and assuming 14 days for the dewatering system to reach steady-state for the excavation, the dewatering ROI is interpreted to be 25 m for both Structures A and B at which distance the calculated groundwater level drawdown is less than 5 cm.

6.2 Estimated Groundwater Inflow

Based on the modified Jacob (Powers et al., 2007) non-equilibrium equation, the required dewatering rate to adequately lower the groundwater elevation was estimated as follows:

$$Q = \frac{\pi K (H^2 - h^2)}{ln\, R_o / r_w}$$

Where Q = dewatering rate (m^3/day)
K = assumed hydraulic conductivity (m/day);
H = average saturated thickness of the aquifer before pumping (m);
H = height of dewatering level above aquifer base (m);
R_o = radius of influence of the cone of depression estimated from Theis (m); and,
r_w = equivalent radius of dewatering area (m).

Based on this analysis, the steady state groundwater inflow rate to the proposed excavation is summarized in the table below.

Table 6: Summary of Steady-State Groundwater Inflow

Structure	K (m/day)	H-h (m)	ROI (m)	Rw	Single Excavation Q (m^3/day)	Number of Excavations	Total Q (All Excavations) (m^3/day)
Structure A	0.052	2.64	25	3.2	2.2	8	17
Structure B	0.043	3.37	25	3.2	3	4	12

6.2.1 Removal of Storage

At the start of dewatering, higher pumping rates will be required to remove water stored within the excavation and within the interconnected pore spaces in the overburden material. The volume of storage (Vs) can be estimated as follows:

$$V_s = sn\,[LW + (\frac{1}{3}\pi {R_o}^2) + LR_o]$$

Where V_s = volume of storage (m^3)
L = length of excavation (5 metres)
W = width of excavation (5 metres)
s = drawdown (2.64 to 3.37 metres)
n = porosity (0.1)
R_o = radius of influence (20 metres)

Assuming that aquifer storage can be removed over a 14-day period, the approximate daily discharge volume rate for the site is 148 m^3/day for Structure A and 94 m^3/day for Structure B.

6.2.2 Removal of Stormwater Inflows

In addition to groundwater inflows, the dewatering rate for the proposed excavation will also consider the removal of stormwater from direct precipitation inflow. It is assumed that the surrounding ground surface will be graded to direct any runoff away from the open excavation.

6.3 Summary of Temporary Groundwater Control

The various components of the estimated required water taking are summarized in the table below.

Table 7: Summary of Dewatering Rates

Location	Single Excavation Steady-State Groundwater Inflow (m^3/day)	Single Excavation Aquifer Storage (m^3/day)	Single Excavation Removal of Stormwater Inflows (m^3/day)	Number of Excavations	Total Water Taking (All Excavations) (m^3/day)	Total Water Taking (All Excavations) (L/day)
Structure A	2.2	18.5	0.8	8	171	171,000
Structure B	3	24	1	4	110	110,000

The estimated daily water taking requirement is given by the sum of the daily volumes for the steady-state groundwater inflow, aquifer storage, and removal of stormwater inflows. Based on the values presented above, it is recommended to apply for an EASR since the daily taking is between 50,000 and 400,000 L/day (50 and 400 m^3/day). The contractor is responsible for designing the dewatering program using the information stated in this report and any other relevant reports (e.g., geotechnical or environmental site assessment reports).

7.0 IMPACTS TO SURROUNDING AREAS

7.1 Surface Water and Natural Environment Effects

There are no areas of natural scientific interest or provincially significant wetland areas located within 500 m of the study area. The proposed construction does occur at two (2) crossings of Cold Creek, which is a cold-water stream. However, at this time there are no anticipated impacts to surrounding surface water and natural environment since the estimated dewatering rates are low and may be limited by groundwater control construction methods.

It is recommended that prior to construction, groundwater and surface water samples be obtained in order to assess baseline groundwater and surface water quality, options for discharge, and potential impacts to receptors. In addition, it would also be advantageous to collect surface water level and flow measurements at surface water features in order to establish a baseline for surrounding receptors.

7.2 Effects on Groundwater

Based on a review of the MOECC water well records, no groundwater users were identified within the estimated radius of influence of 25 m from either proposed structure (Figure 3). No impacts to groundwater users are therefore anticipated from the project. As previously mentioned, it is recommended that prior to construction, groundwater samples be collected to assess the potential presence and mobilization of contaminants and to establish a groundwater quality baseline.

7.3 Dewatering Considerations

Water takings in excess of 50,000 L/day are regulated by the MOECC. Certain takings of groundwater and storm water with a combined taking less than 400,000 L/day for construction site dewatering purposes qualify for registration on the MOECC's EASR. Registry on the EASR replaces the need to obtain a PTTW. A Category 3 PTTW is required where the proposed water taking is greater than 400,000 L/day.

Although individual excavations (5m x 5m x 1.5m) estimated inflows are low (<50,000 L/day), the total water taking for all excavations at each water crossing is anticipated to be between 50,000 to 400,000 L/day in order to lower groundwater levels at the proposed crossings. Therefore, an EASR will likely be required. Should construction methods or excavation dimensions change, or additional information be collected, this assessment should be reviewed and revised, as necessary, based on the updated information, including potential increases in takings exceeding 400,000 L/day, which would require and PTTW.

7.4 Monitoring Considerations

At this time the location of groundwater discharge is unknown. As part of the EASR application, a dewatering, discharge and monitoring plan is required in order to maintain compliance with the PTTW/EASR and should include the following:

- Water quantity (i.e., water taking rates) should be metered and recorded by the contractor at the water taking location(s);
- A discharge plan will need to be developed to meet EASR requirements. This will include monitoring pre-construction, during construction and post-construction for the following:
  - Stream base flow and elevation;
  - Grab samples of surface water quality sampling;
  - During construction, discharge water quality should be assessed on a daily to weekly basis, for turbidity and total suspended solids (TSS);
  - During construction, grab samples of discharge water should be submitted to laboratory for parameters regulated under discharge criteria (i.e. PQWO or sewer use by-law);

- It is recommended that groundwater levels and groundwater quality be monitored in select monitoring wells and/or private wells within the dewatering radius of influence. Monitoring should be done at pre-construction, during construction and post construction; and
- It is our understanding that all geotechnical monitoring wells will be decommissioned as per O. Reg. 903 prior to construction activities and therefore not available for groundwater level monitoring.

8.0 CLOSURE

We trust that this report provides sufficient information for the Schedule B Class Environmental Assessment study for improvements to Albion Vaughan Road and King Street, Town of Caledon. If you have any questions regarding the contents of this report or require additional information, please contact the undersigned.

Report Signature Page

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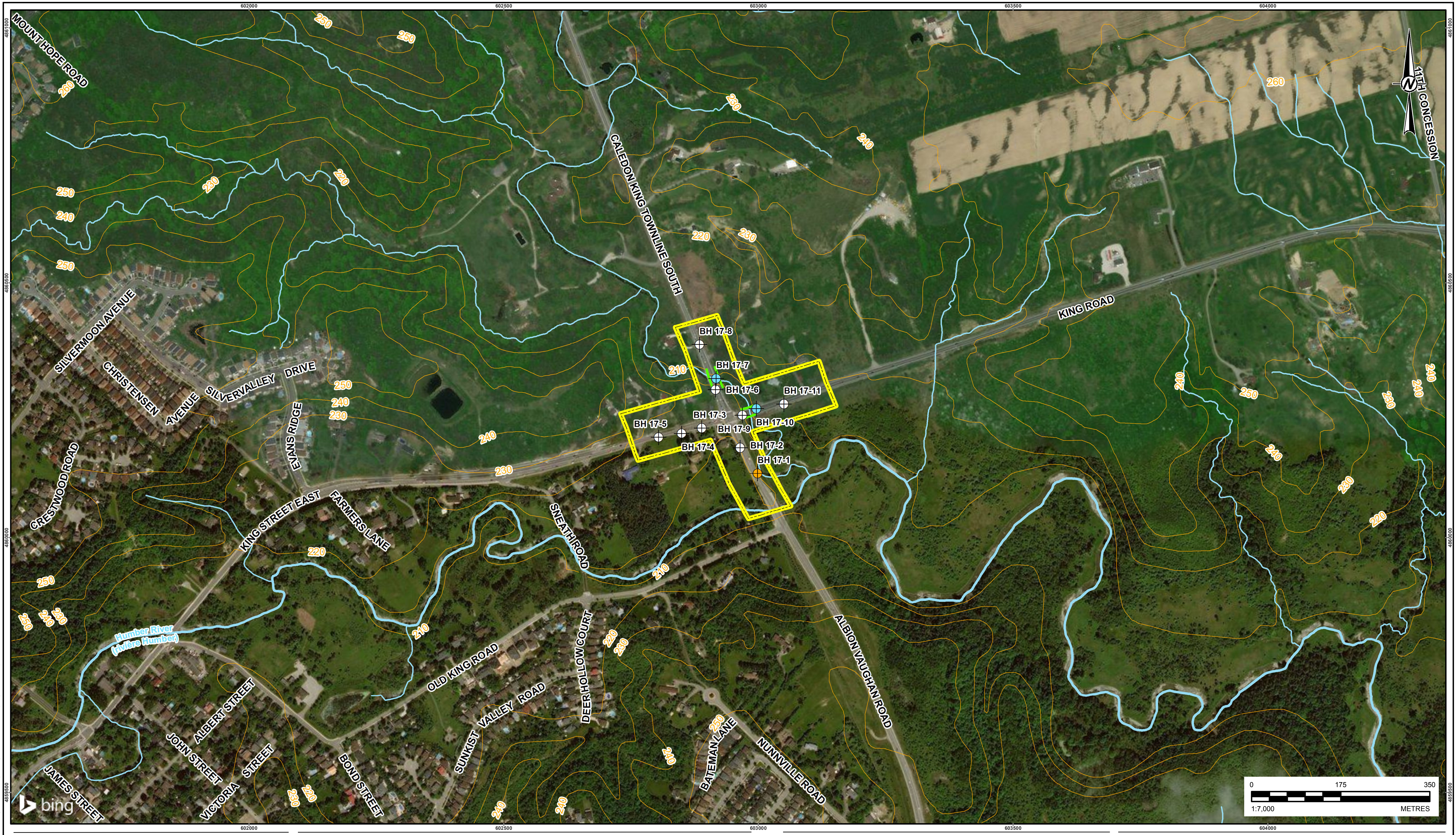
Toronto and Region Conservation Authority (TRCA), 2008a. Humber River State of the Watershed Report – Aquatic System

FIGURES



LEGEND

- ⊕ Monitoring Well
- ⊕ Monitoring Well - Decommissioned
- ⊕ Borehole
- — Watercourse
- — Contour
- — Water Crossings

REFERENCES

BASEDATA - MNRF LIO, OBTAINED 2017
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2016
IMAGERY - SERVICE LAYER CREDITS: © 2017 DIGITALGLOBE ©CNES (2017) DISTRIBUTION AIRBUS DS © 2017 MICROSOFT CORPORATION
COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1983

CLIENT
REGION OF PEEL

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-08-29
PREPARED	RA
DESIGN	RA
REVIEW	PM
APPROVED	XX

PROJECT
ENVIRONMENTAL ASSESSMENT ALBION-VAUGHAN ROAD AND KING STREET INTERSECTION

TITLE
SITE PLAN

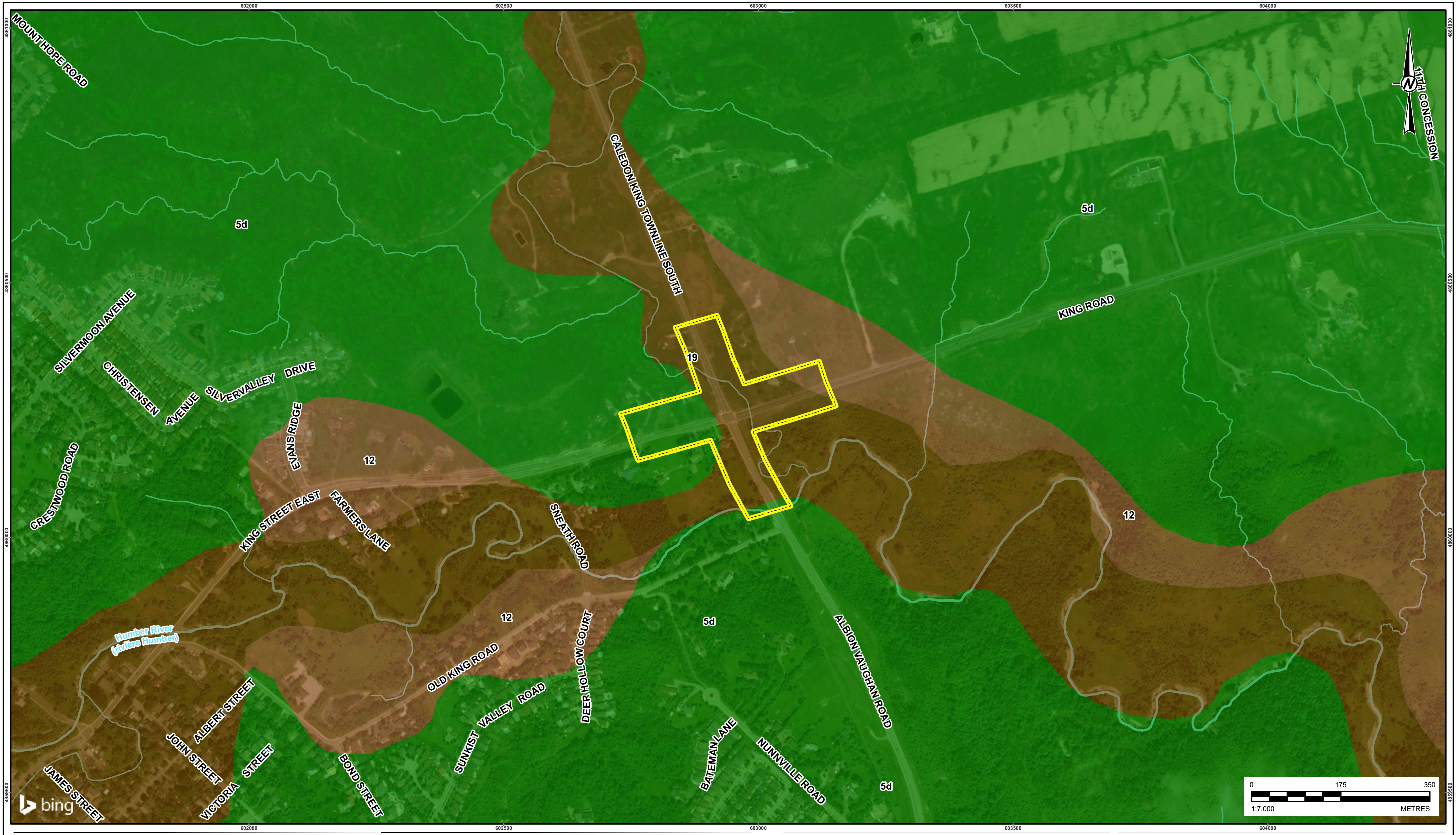
PROJECT NO.	PHASE	REV.	FIGURE
1664714	0.0	A	1

S:\Clients\Region_of_Peel\Caledon\99_PROJ\1664714_RegionofPeel_VaughanKingEA\40_PROD\0007_HydrogDesktopStudy\1664714-0007-CH-0001.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

0



LEGEND

- Watercourse
- [‐‐] Project Area
- 🟩 5d: Glaciolacustrine-derived silty to clayey till
- ▨ 12: Older alluvial deposits
- ▨ 19: Modern alluvial deposits

REFERENCES

BASEDATA - MNRF LIO, OBTAINED 2017
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COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1983

CLIENT
REGION OF PEEL

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-08-29
PREPARED	RA
DESIGN	RA
REVIEW	PM
APPROVED	XX

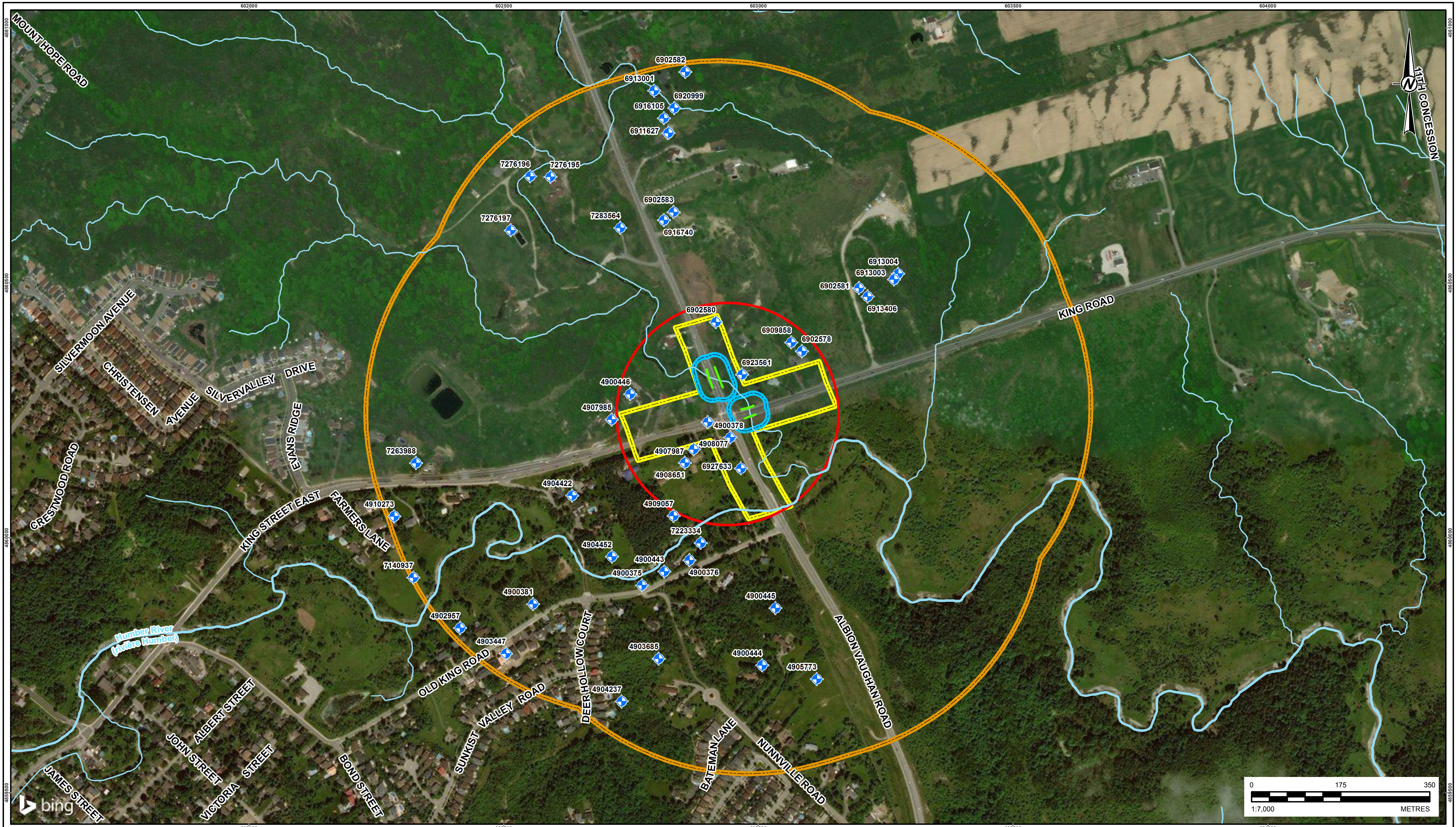
PROJECT
ENVIRONMENTAL ASSESSMENT ALBION-VAUGHAN ROAD AND KING STREET INTERSECTION

TITLE
SURFICIAL GEOLOGY

PROJECT NO.	PHASE	REV.	FIGURE
1664714	0.0	A	2

S:\Clients\Region_of_Peel\Caledon\99_PROJ\1664714_RegionofPeel_VaughanKingEA\40_PROD\0007_HydrogDesktopStudy\1664714-0007-CH-0002.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0



LEGEND

- ⊕ Waterwell Location
- — Watercourse
- 🟨 Project Area
- 🟧 500 Metre Project Area Buffer
- 🟥 Extent of Field Well Survey
- 🟦 Dewatering Radius of Influence

REFERENCES

BASEDATA - MNRF LIO, OBTAINED 2017
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MICROSOFT CORPORATION
COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1983

CLIENT
REGION OF PEEL

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-10-06
PREPARED	RA
DESIGN	RA
REVIEW	PM
APPROVED	XX

PROJECT
ENVIRONMENTAL ASSESSMENT ALBION-VAUGHAN ROAD AND KING STREET INTERSECTION

TITLE
MOECC WATER WELLS

PROJECT NO.	PHASE	REV.	FIGURE
1664714	0.0	A	3

S:\Clients\Region_of_Peel\Caledon\99_PROJ\1664714_RegionofPeel_VaughanKingEA\40_PROD\0007_HydrogDesktopStudy\1664714-0007-CH-0002.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

APPENDIX A

Water Well Records and Permits to Take Water

Table A1 - Summary of Water Well Records - Intersection of Albion Vaughan Road and King Road, Peel Region, Ontario

WELL ID	CON #	LOT #	COMPLETED	EASTING	NORTHING	ELEVATION (masl)	WATER FOUND (m bgs)	WATER KIND	CASING DIAM.(cm)	SCRN TOP (mbgs)	STATIC LEVEL (mbgs)	METHOD	STATUS	USE	DEPTH (mbgs)
4900375	7	7	1-Nov-1955	602771.6	4859907.0	212.7	7.3152	FRESH	24		5.8	Boring	Test Hole	Not Used	8.5
4900376	7	7	3-Nov-1955	602864.6	4859956.0	212.2	7.0104	FRESH	24		5.5	Boring	Test Hole	Not Used	7.9
4900378	7	8	20-May-1954	602900.6	4860227.0	211.5	40.8432	FRESH	5	130.0	18.3	Cable Tool	Unfinished	Not Used	41.5
4900381	7	8	24-Apr-1959	602557.6	4859870.0	212.9	13.4112	FRESH	20		9.1	Boring	Water Supply	Domestic	13.4
4900443	8	7	20-Aug-1952	602815.6	4859934.0	211.3			4			Cable Tool	Abandoned-Supply		48.8
4900444	8	7	11-May-1965	603007.6	4859750.0	246.0	76.8096	FRESH	5	256.0	36.6	Cable Tool	Water Supply	Domestic	79.2
4900445	8	7	12-Aug-1966	603033.6	4859862.0	233.2	53.9496	FRESH	5	181.0	41.1	Cable Tool	Water Supply	Domestic	56.4
4900446	8	8	6-Jan-1965	602748.6	4860282.0	229.0	62.484	SALTY	5	205.0	17.4	Cable Tool	Water Supply	Domestic	64
4902957	7	8	26-Feb-1968	602414.6	4859823.0	212.6	12.8016	FRESH	30		4.3	Boring	Water Supply	Domestic	16.8
4903447	7	7	24-Apr-1970	602504.6	4859773.0	216.2	3.9624	Not stated	30		2.4	Boring	Water Supply	Domestic	4
4903685	7	7	18-Sep-1971	602804.6	4859763.0	240.6	89.916	FRESH	5	296.0	41.1	Cable Tool	Water Supply	Domestic	91.4
4904237	7	7	23-Oct-1973	602731.6	4859678.9	228.9	94.7928	FRESH	5	311.0	4.5	Cable Tool	Water Supply	Domestic	12.4
4904422	8	8	15-Feb-1974	602634.6	4860083.0	218.0	60.6552	Not stated	7			Cable Tool	Unfinished	Domestic	73.8
4904452	8	8	13-Aug-1974	602712.6	4859963.1	211.2	13.716	FRESH	5	107.0	5.5	Rotary (Convent.)	Water Supply	Domestic	33.5
4905773	8	7	26-Sep-1980	603114.6	4859723.0	241.9	91.44	FRESH	5	297.0	39	Rotary (Convent.)	Water Supply	Domestic	93.6
4907985	8	7	29-Jul-1992	602712.0	4860232.0	233.3	62.1792	FRESH	6	205.0	31.1	Cable Tool	Water Supply	Domestic	64
4907987	8	7	31-Jul-1992	602873.0	4860173.9	211.6	46.3296	FRESH	6	155.0	8.2	Cable Tool	Water Supply	Domestic	49.4
4908077	8	7	5-Dec-1995	602945.0	4860197.0	210.1	41.4528	FRESH	6	130.0	7	Rotary (Convent.)	Water Supply	Domestic	41.5
4908651	8	7	5-Dec-2000	602856.0	4860147.0	211.6	38.7096	FRESH	8	129.0	14.9	Cable Tool	Water Supply	Domestic	41.5
6902578	11	6	15-Oct-1959	603085.6	4860366.0	220.1			7			Cable Tool	Abandoned-Supply		14.6
6902580	11	6	12-Oct-1966	602916.6	4860423.0	214.0	4.2672	FRESH	30		3.7	Boring	Water Supply	Domestic	13.7
6902581	11	6	10-Jun-1967	603197.6	4860490.0	233.9	14.0208	FRESH	36		12.2	Boring	Water Supply	Domestic	15.8
6902582	11	7	21-Jul-1964	602856.6	4860914.0	231.5	61.5696	FRESH	4	205.0	8.5	Cable Tool	Water Supply	Domestic	82.3
6902583	11	7	25-Jul-1965	602833.6	4860639.0	224.9	59.1312	FRESH	4	194.0	13.7	Cable Tool	Water Supply	Domestic	6.4
6909858	11	6	26-Feb-1970	603064.6	4860383.0	221.6	46.3296	FRESH	5	158.0	3.7	Cable Tool	Water Supply	Domestic	49.4
6911627	11	7	14-Aug-1973	602823.6	4860794.0	226.2	43.8912	FRESH	5	145.0	3	Cable Tool	Water Supply	Domestic	45.1
6913001	11	7	30-Sep-1975	602795.6	4860877.0	218.0	49.0728	Not stated	6	162.0		Cable Tool	Water Supply	Domestic	5.3
6913003	11	6	11-Sep-1975	603266.6	4860507.0	245.4			7			Cable Tool	Abandoned-Supply		47.2
6913004	11	6	17-Sep-1975	603274.6	4860518.0	246.1	48.1584	Not stated	6	160.0	4.9	Cable Tool	Water Supply	Domestic	5.6
6913406	11	6	21-May-1976	603214.6	4860473.0	236.1	66.7512	Not stated	7	219.0	14	Cable Tool	Water Supply	Domestic	67.7
6916105	11	7	2-Feb-1982	602814.6	4860823.1	221.6	49.3776	FRESH	6		6.4	Cable Tool	Water Supply	Domestic	49.4
6916740	11	7	9-Jun-1983	602814.6	4860623.0	224.2	59.7408	FRESH	6	202.0	6.4	Rotary (Convent.)	Water Supply	Domestic	62.8
6920999	11	6	12-Apr-1990	602835.0	4860843.0	220.4	48.1584	FRESH	6	163.0	4.6	Cable Tool	Water Supply	Domestic	51.2
6923561	11	6	12-Nov-1995	602968.0	4860320.0	213.4	60.0456	FRESH	6	197.0	9.4	Cable Tool	Water Supply	Domestic	61.3
4909057	8	7	8-Nov-2002	602833.8	4860043.0	210.0	38.7096	FRESH	6	133.0	-0.3	Cable Tool	Water Supply	Domestic	42.4
6927633	11	6	15-Sep-2003	602966.0	4860136.0	209.9						Other Method	Abandoned-Supply	Not Used	
4910273	7	8	11-Jul-2006	602285.0	4860042.0	225.0			0.9		1.9		Abandoned-Other		
7140937	7	8	30-Jul-2009	602323.0	4859922.0	213.0							Abandoned-Other	Not Used	
7223334	8	7	23-Jun-2014	602887.0	4859990.0	209.8			30		2.7	Boring	Water Supply		
7263988	7	8	12-May-2016	602328.0	4860147.0	227.5	1.8	Untested	90				Abandoned-Other		
7276195			14-Sep-2016	602592.0	4860708.0	213.8			2	30.0		Boring	Observation Wells	Monitoring	12.2
7276196			14-Sep-2016	602552.0	4860709.0	212.5			2	10.0		Boring	Observation Wells	Monitoring	4.6
7276197			14-Sep-2016	602514.0	4860603.0	214.5			2	15.0		Boring	Observation Wells	Monitoring	7.6
7283564			14-Oct-2016	602729.0	4860608.0	217.1									

Name	**590 King St. E**
Owner/Tenant	Lee Hendry
Address	590 King St. E, Bolton, ON, L7E 0V3
Telephone	905-951-0306
Date of Visit	5-Oct-17
How long have you lived here	22-Jan-00
Property used year round/seasonally	Year Round
Other wells on property	Yes, number not given
Cistern/other water supply	No
Municipal Water	No
Municipal Sewage	No
Septic System	Yes
Well Use	
Drinking	Yes
Washing	Yes
Cooking	Yes
Garden	Yes
Irrigation	Yes (garden)
Pool	No
Livestock	No
Industrial	No
Livestock	No
Other sources	
No. of persons using well	4
Water treatment?	
Softener	Yes
UV	No
RO	No
Filters	No
Chlorination	No
Well Description	
Pump type	Submersible
Well record available?	Yes, 4908077
Original owner?	Yes
Contractor?	King City Well Drilling
Date constructed?	1995
Age of well	22 years
Well completed in overburden/bedrock	Overburden
Type drilled/dug	Drilled
Aquifer	Sand
Stickup	
Depth	41.5 m
Diameter	6 inches
Casing	Steel
Well yield	
Present well problems	No
Screen/open hole?	Screen
Static water level	7 m
Ever gone dry?/ supply problems?	No
Water Quality	
Water Type	Iron Staining, Hard
Water quality problems	No
Description of water Quality (poor, good, excellent)	Excellent
Previous quality testing	Yes
Type of testing	Road Expansion tested monthly by Region
Pond(s)/surface water	
Pond/creek/other on property?	Yes, Humber River
Sewage Disposal System	
Type of sewage disposal system	Septic Tank and Leaching Bed
Year of Construction	1954
Contractor?	Unknown
Distance to well	40 m, Uphill
Frequency of pumping out of septic tank	every 5 years
Last pumping out	2013
Any problems with sewage disposal system?	No
Additional comments	
	N/A

APPENDIX B

Borehole Logs

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-01

SHEET 1 OF 1

LOCATION: N 4860127.01; E 602998.35

BORING DATE: May 24, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

BORING METHOD: Power Auger, 102 mm O.D. Solid 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

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	210.03
ASPHALT	0.00
FILL - (SW/GW) SAND and GRAVEL; brown, with asphalt fragments; non-cohesive, moist, very dense	209.85 0.18
FILL - (ML) CLAYEY SILT, some sand, trace gravel, trace organics; brown and grey mottled; cohesive, w<PL, stiff to very stiff	209.27 0.76
FILL - (SW/GW) SAND and GRAVEL, trace fines; brown; non-cohesive, moist to wet, very dense	208.51 1.52
FILL - (ML/SW) SILT and SAND, trace fines; grey; non-cohesive, wet, loose	207.59 2.44
FILL - (SW/GW) SAND and GRAVEL; grey; non-cohesive, wet, compact	207.06 2.97
(ML) SILT with slight plasticity, some clay; grey; non - cohesive, moist, dense	205.92 4.11
END OF BOREHOLE	203.32 6.71

SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	50/0		
2	SS	15		
3	SS	72		
4A	SS	4		
4B			MH	0 44 51 5
5	SS	11		
6	SS	36		
7	SS	35	MH	0 0 91 9

PIEZOMETER OR STANDPIPE INSTALLATION: Bentonite Seal; Screen and Sand Filter; Bentonite Seal

Notes:

1. Groundwater encountered at a depth of 2.7 m (Elev. 207.3 m) below ground surface upon completion of drilling.

2. Groundwater level measurements in piezometer:

Date	Depth (m)	Elev. (m)
05/30/17	2.5	207.5
07/17/17	2.6	207.4

DEPTH SCALE

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-02

SHEET 1 OF 1

LOCATION: N 4860177.53; E 602963.99

BORING DATE: May 23, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	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; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		GROUND SURFACE		209.05							
0	Power Auger 102 mm O.D. Solid Stem Augers	ASPHALT	■	0.00							
		FILL - (SW/GW) SAND and GRAVEL; brown; non-cohesive, moist, dense	▨	0.13	1	SS	30		○		
1		FILL - (SM) SILTY SAND of slight plasticity, trace plastic fines, trace gravel, some organics, sand pockets; dark grey; non-cohesive, moist, loose	▨	208.29 0.76	2	SS	6		⊢○	MH	2 57 36 5
2		FILL - (SW) gravelly SAND; grey; non-cohesive, wet, loose	▨	207.53 1.52	3	SS	9		○		
		END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling.		206.92 2.13							
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-03

SHEET 1 OF 1

LOCATION: N 4860215.85; E 602888.77

BORING DATE: May 23, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

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 GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		GROUND SURFACE		210.23							
0	Power Auger 102 mm O.D. Solid Stem Augers	ASPHALT	■	0.00							
		FILL - (SW) gravelly SAND, some fines, trace clay; brown; non-cohesive, moist, very dense	▨	0.13	1	SS	54		○	MH	30 57 11 2
					2A						
1		(ML) Sandy SILT, some plastic fines, trace gravel; dark grey; non-cohesive, moist, dense to compact		209.32 0.91	2B	SS	32				
					3	SS	11		○	MH	0 21 71 8
2		END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling.		208.10 2.13							
3											
4											
5											
6											
7											
8											
9											
10											

GTA-BHS 005 S:\CLIENTS\REGION_OF_PEEL\CALEDON\02_DATA\GINT\CALEDON.GPJ GAL-MIS.GDT 12/12/18

DEPTH SCALE

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-04

SHEET 1 OF 1

LOCATION: N 4860205.54; E 602849.09

BORING DATE: May 23, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

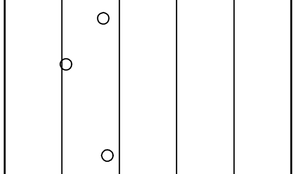
DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		GROUND SURFACE		212.04					
0	Power Auger 102 mm O.D. Solid Stem Augers	ASPHALT	■	0.00					
		FILL - (SW/GW) SAND and GRAVEL; brown; non-cohesive, moist, compact	▨	0.13	1A	SS	25		
		FILL - (ML) Sandy CLAYEY SILT, trace gravel, trace rootlets; dark brown; w<PL, hard	▨	211.41 0.63	1B				
1					2A	SS	32	MH	2 22 59 17
		(SW) SAND, some fines; brown; non-cohesive, moist to wet, dense to compact		210.97 1.07	2B				
2					3	SS	12		
		END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling		209.91 2.13					

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 1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-05

SHEET 1 OF 1

LOCATION: N 4860197.85; E 602804.16

BORING DATE: May 23, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

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 GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		GROUND SURFACE		214.83					
0	Power Auger 102 mm O.D. Solid Stem Augers	ASPHALT	■	0.00					
		FILL - (SW) gravelly SAND; brown; non-cohesive, moist, dense	▨	0.13	1	SS	32		
1		FILL - (CL) SILTY CLAY, some sand, trace gravel; mottled brown and grey; cohesive, w~PL, firm to stiff - Rootlets and wood fragments encountered at a depth of 1.5 m	▨	214.07 0.76	2	SS	8	MH	1 22 60 17
2					3	SS	10		
		END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling		212.70 2.13					
3									
4									
5									
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

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

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-06

SHEET 1 OF 1

LOCATION: N 4860291.35; E 602915.83

BORING DATE: May 23, 26 and 29, 2017

DATUM: Geodetic

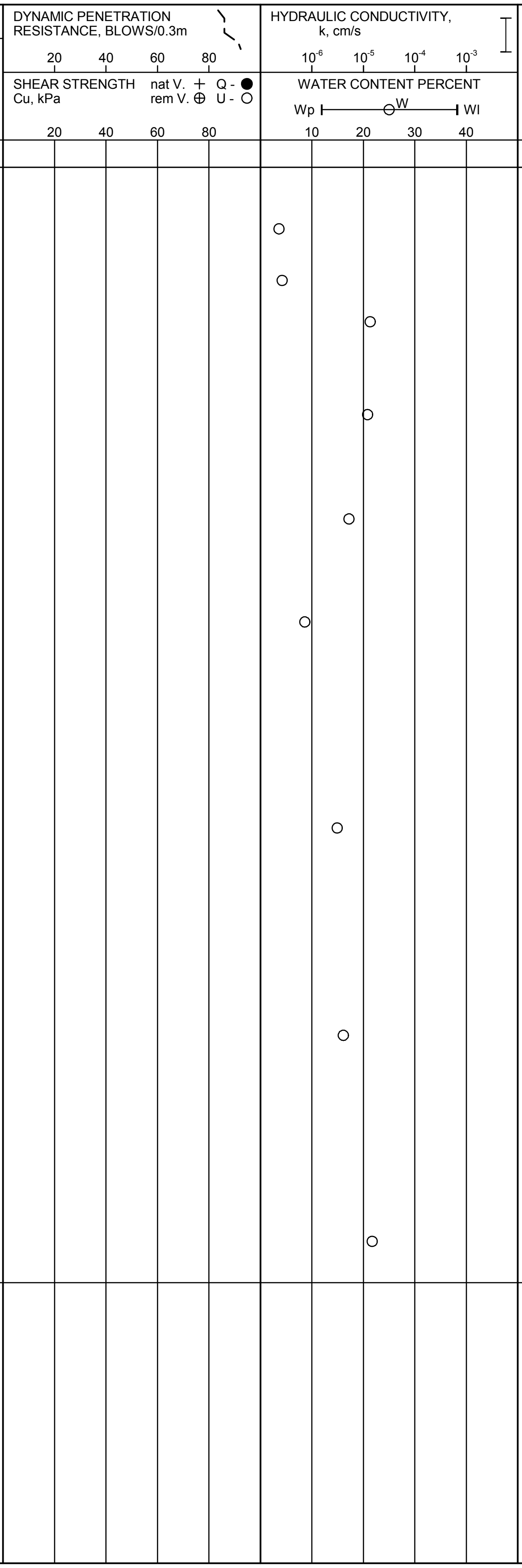
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: CME 55 Truck Mounted Drill Rig

BORING METHOD: Power Auger, 102 mm O.D. Solid Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	GROUND SURFACE	209.86					
0	ASPHALT	0.00					
	FILL - (SW/GW) SAND and GRAVEL, some fines; brown; non-cohesive, moist, very dense	0.15	1	SS	65		
		208.95	2A				
1	FILL - (ML) sandy CLAYEY SILT, plastic fines; grey; mottled; cohesive, w<PL, stiff	0.91	2B	SS	10		
		208.34					
	(SM) SILTY SAND, some plastic fines; brown; mottled; non-cohesive, wet, loose	1.52	3	SS	6		
2		207.57					
	(SW-GW) Sandy GRAVEL, some plastic fines, trace clay; brown to grey; non-cohesive, wet, loose to very dense	2.29	4	SS	5		
3			5	SS	77	MH	54 33 11 2
		206.05					
4	(ML) CLAYEY SILT, some to trace sand; grey; cohesive, w<PL to w>PL, hard	3.81					
5			6	SS	42		
6			7	SS	50		
8			8	SS	69		
		201.63					
	END OF BOREHOLE	8.23					

PIEZOMETER OR STANDPIPE INSTALLATION: ∇



Note:

1. Groundwater encountered at a depth of 2.5 m (Elev. 207.4 m) below ground surface upon completion of drilling.

DEPTH SCALE

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

GTA-BHS 005 S:\CLIENTS\REGION_OF_PEEL\CALEDON\02_DATA\GINT\CALEDON.GPJ GAL-MIS.GDT 12/12/18

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-07

SHEET 1 OF 1

LOCATION: N 4860313.30; E 602916.97

BORING DATE: May 26, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

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

BORING METHOD: Power Auger, 102 mm O.D. Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	210.00						
ASPHALT	0.00						
FILL - (SW/GW) SAND and GRAVEL; brown; non-cohesive, moist, compact	0.13	1	SS	29			Sand
FILL - (ML) CLAYEY SILT, some gravel, trace organics (rootlets and wood fragments); dark grey; cohesive, w<PL to w>PL, stiff to firm	209.24 0.76	2	SS	9			
		3	SS	4			Bentonite Seal
		4	SS	4			
(ML) SILT of slight plasticity, some clay, trace gravel; grey; non-cohesive, wet, compact	206.95 3.05	5	SS	13			
		6	SS	16			
		7	SS	21	MH	1 0 87 12	Screen and Sand Filter
		8	SS	13			
END OF BOREHOLE	201.77 8.23						

Notes:

1. Groundwater encountered at a depth of 3.1 m (Elev. 206.9 m) below ground surface upon completion of drilling.

2. Water level in standpipe piezometer measured 0.9 m above ground surface (Elev. 210.9 m) on July 17, 2017.

DEPTH SCALE
1 : 50

GOLDER

LOGGED: AJ
CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-08

SHEET 1 OF 1

LOCATION: N 4860379.79; E 602884.28

BORING DATE: May 23, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

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 / GRAIN SIZE DISTRIBUTION (%)
		GROUND SURFACE		210.02							GR SA SI CL
0	Power Auger 102 mm O.D. Solid Stem Augers	ASPHALT	■	0.00							
		FILL - (SW/GW) SAND and GRAVEL, some fines; brown; non-cohesive, moist, dense	▨	0.15	1A	SS	39		○	MH	48 41 9 2
				209.31	1B						
		FILL - (SM) SILTY SAND; brown; non-cohesive, moist, dense	▨								
1		FILL - (ML) sandy CLAYEY SILT, trace gravel; mottled brown; cohesive, w~PL, stiff	▨	0.76	2	SS	12				
				208.50							
		(SW) SAND, some fines, trace organics; mottled brown; non-cohesive, moist to wet, compact	░	1.52	3	SS	12		○		
2				207.89							
		END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling.		2.13							

DEPTH SCALE

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-09

SHEET 1 OF 2

LOCATION: N 4860241.29; E 602968.72

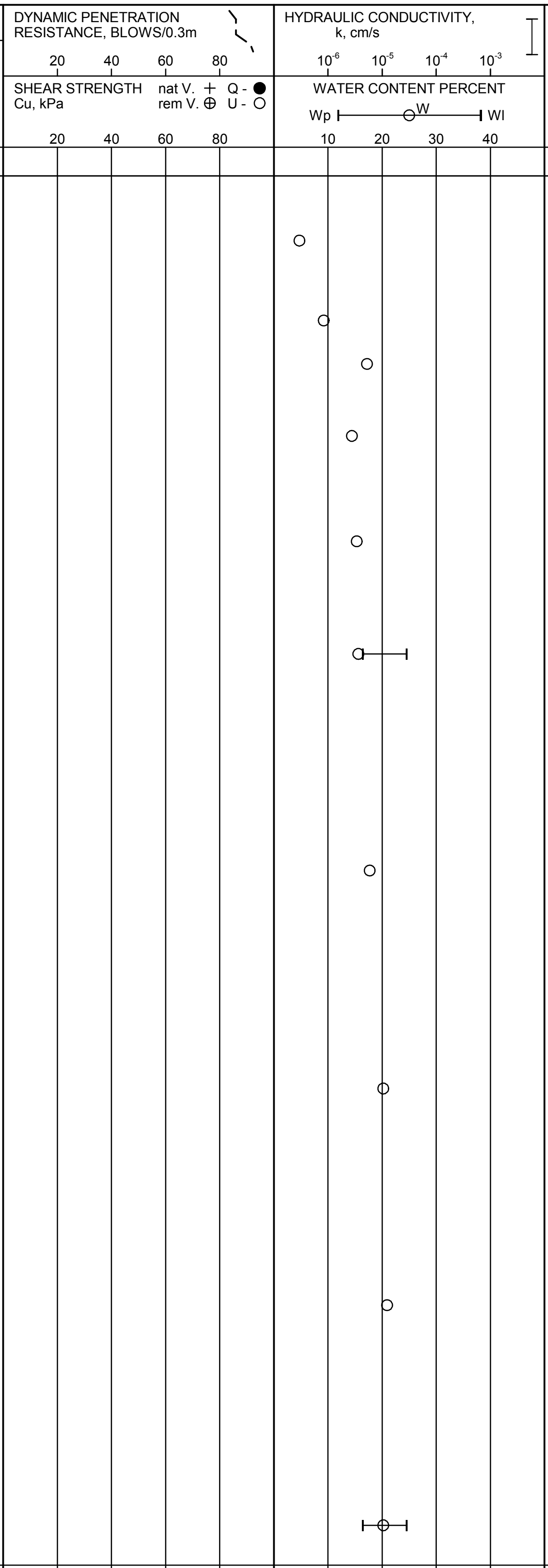
BORING DATE: May 26, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	210.03						
0	Power Auger 102 mm O.D. Solid Stem Augers	ASPHALT	0.00						
		FILL - (SW) gravelly SAND, some fines, trace rootlets; brown; non-cohesive, moist, very dense to compact	0.13	1	SS	53			
1				2A	SS	16			
		FILL - (ML) CLAYEY SILT, some sand, trace organics (rootlets and wood fragments); grey; cohesive, w<PL, hard	208.76 1.27	2B					
2				3	SS	32			
		(CL) SILTY CLAY, trace sand, trace gravel; brown to grey; cohesive, w<PL to w> PL at a depth of 7.6 m, hard	207.80 2.23	4	SS	37			
3				5	SS	32	MH	0 2 75 23	
4									
5				6	SS	44			
6				7	SS	21			
7									∇
8				8	SS	23			
9				9	SS	20			
		END OF BOREHOLE	200.28 9.75						
10		*CONTINUED NEXT PAGE*							



DEPTH SCALE

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-09

SHEET 2 OF 2

LOCATION: N 4860241.29; E 602968.72

BORING DATE: May 26, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

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 GRAIN SIZE DISTRIBUTION (%)
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				GR SA SI CL
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Note: 1. Groundwater encountered at a depth of 6.9 m (Elev. 203.1 m) below ground surface upon completion of drilling.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-10

SHEET 1 OF 2

LOCATION: N 4860254.14; E 602995.86

BORING DATE: May 24, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

BORING METHOD: Power Auger, 102 mm O.D. Solid Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	211.11
ASPHALT	0.00
FILL - (SW/GW) SAND and GRAVEL; brown; non-cohesive, moist, dense	210.93 0.18
FILL - (ML) CLAYEY SILT, some sand, trace gravel, trace organics; grey; cohesive, w<PL, stiff	210.32 0.79
(CL) SILTY CLAY, trace sand at 3.1 m; mottled brown and grey; cohesive, w<PL to w~PL, firm to hard	209.59 1.52
END OF BOREHOLE	201.36 9.75

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	37		
2	SS	12		
3	SS	6		
4	SS	22		
5	SS	35		
6	SS	29		
7	SS	33		
8	SS	23	MH	0 0 67 33
9	SS	17		

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: Bentonite Seal; Screen and Sand Filter

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

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-10

SHEET 2 OF 2

LOCATION: N 4860254.14; E 602995.86

BORING DATE: May 24, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

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 GRAIN SIZE DISTRIBUTION (%)
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									GR SA SI CL
10		Notes: 1. Groundwater encountered at a depth of 7.8 m (Elev. 203.3 m) below ground surface upon completion of drilling. 2. Water level in stand pipe piezometer measured at a depth of 0.1 m above ground surface (Elev. 211.2 m) on July 17, 2017.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

GOLDER

LOGGED: AJ
CHECKED: SMM

PROJECT: 1664714

RECORD OF BOREHOLE: BH17-11

SHEET 1 OF 1

LOCATION: N 4860263.16; E 603050.30

BORING DATE: May 23, 2017

DATUM: Geodetic

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

DRILL RIG: CME 55 Truck Mounted Drill Rig

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

GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE	214.19			
0	Power Auger 102 mm O.D. Solid Stem Augers	ASPHALT	0.00			
		FILL - (SW/GW) SAND and GRAVEL; brown; non-cohesive, moist, dense	0.13	1	SS	46
1		(CI) SILTY CLAY, sand pockets; brown; cohesive, w~PL to w<PL, stiff	213.43 0.76	2	SS	9
				3A	SS	13
2		(SW) SAND,some fines; brown; non-cohesive, wet, compact	212.11 2.13	3B		
		END OF BOREHOLE				

Note:

1. Borehole dry upon completion of drilling.

DEPTH SCALE 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

GOLDER

LOGGED: AJ

CHECKED: SMM

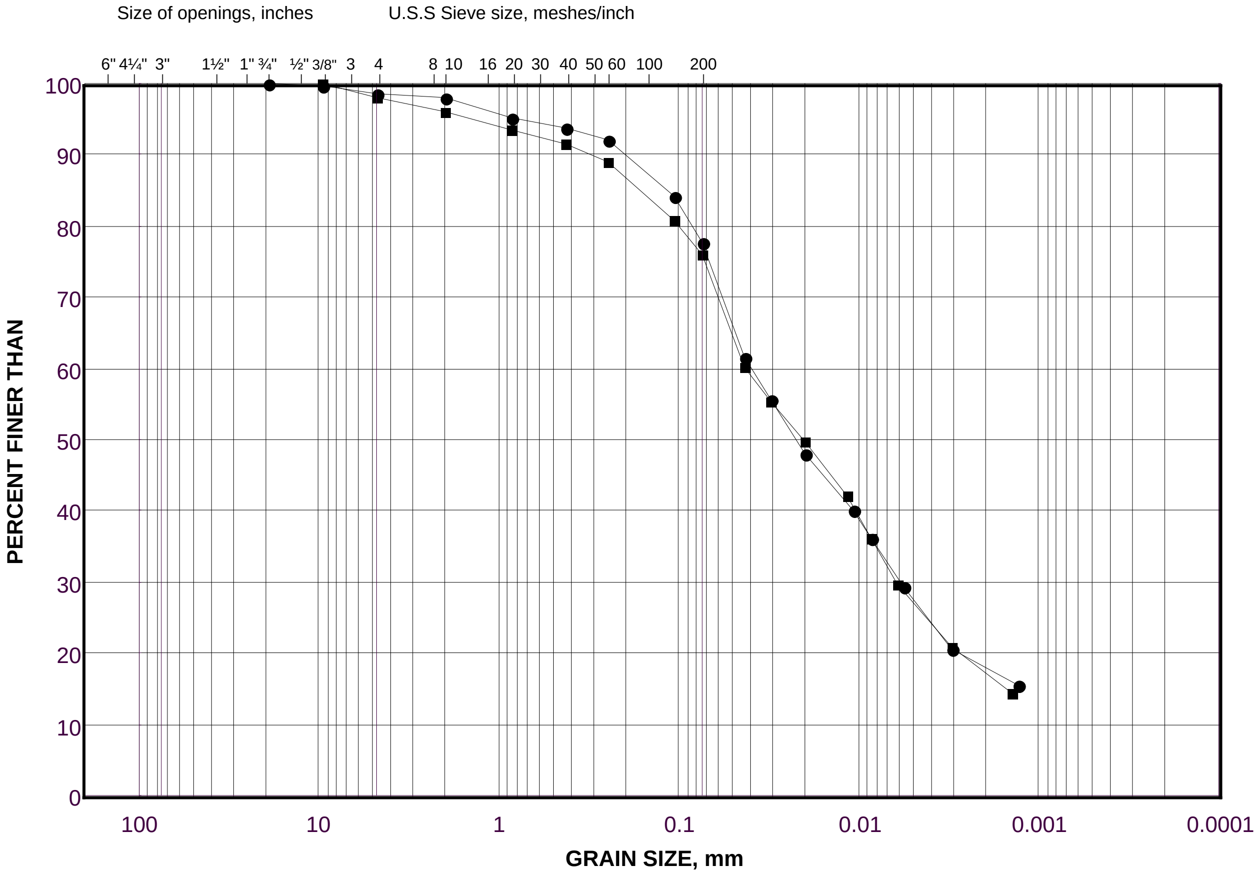
APPENDIX C

Geotechnical Laboratory Testing

GRAIN SIZE DISTRIBUTION

Fill - (ML) Sandy Clayey Silt to (CL) Silty Clay

FIGURE C1



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-05	2	213.7
■	17-04	2A	210.9

Project Number: 1664714

Checked By: ______________________

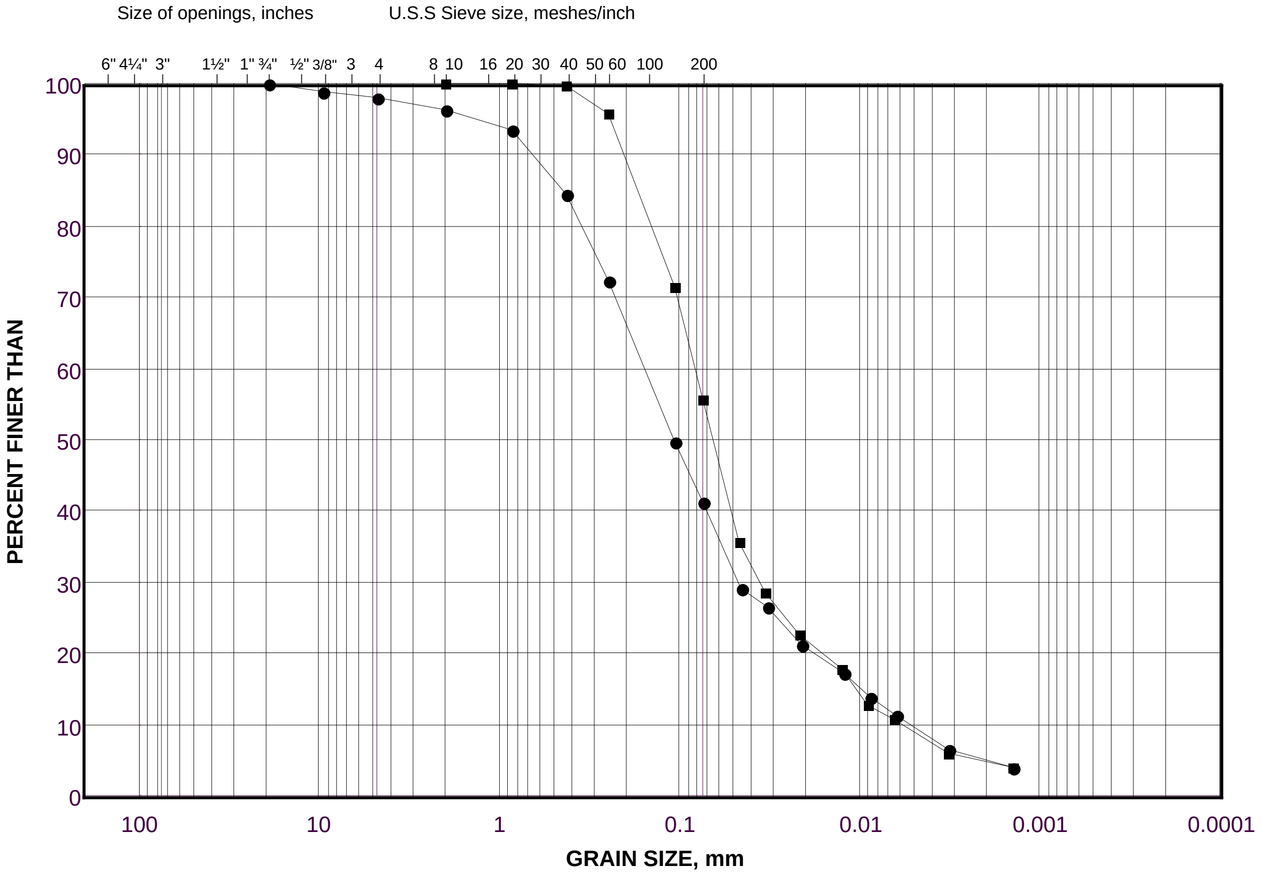
Golder Associates

Date: 16-Oct-17

GRAIN SIZE DISTRIBUTION

(ML/SW) Silt and Sand

FIGURE C2



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-02	2	207.9
■	17-01	4B	207.4

Project Number: 1664714

Checked By: ____________________

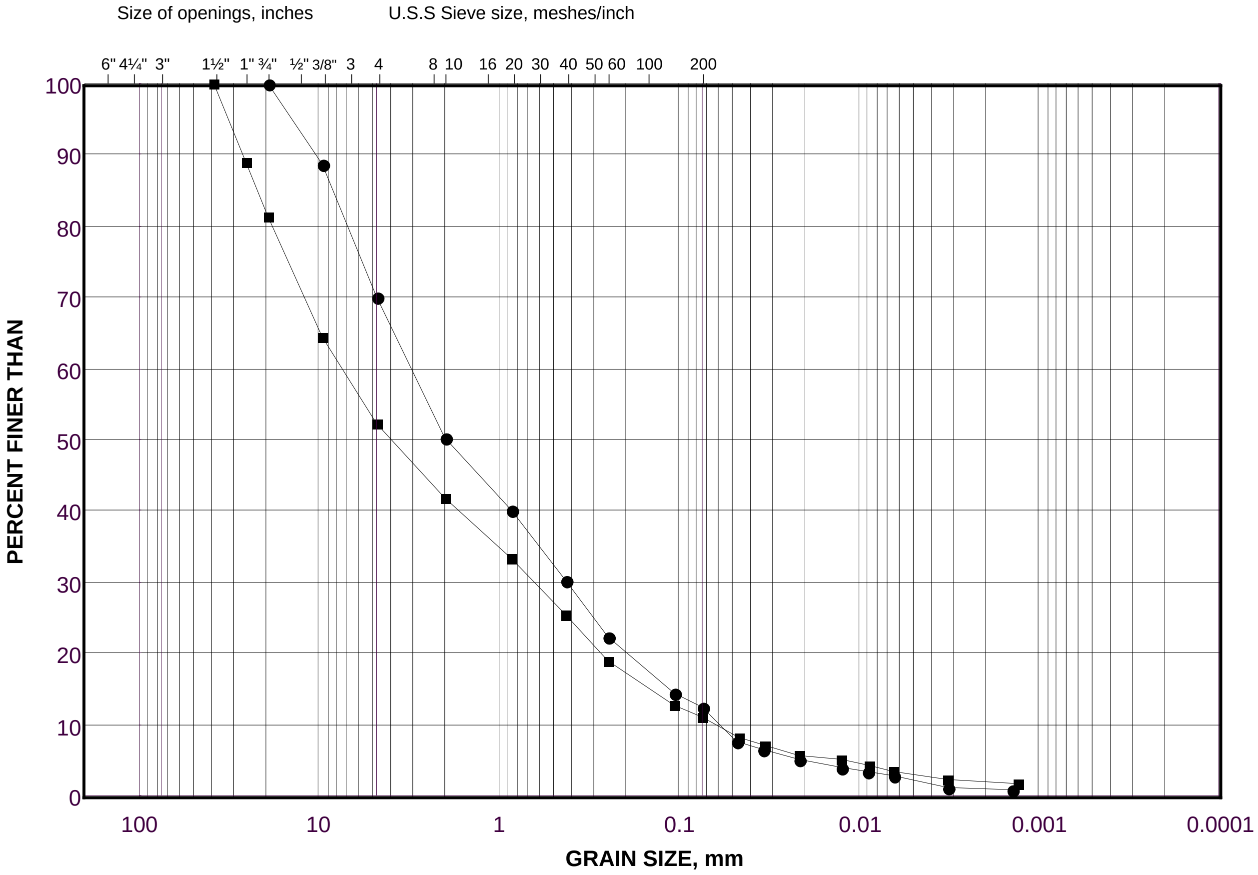
Golder Associates

Date: 16-Oct-17

GRAIN SIZE DISTRIBUTION

Fill - (SW/GW) Sand and Gravel to (SW) Gravelly Sand

FIGURE C3



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-03	1	209.7
■	17-08	1A	209.6

Project Number: 1664714

Checked By: ______________________

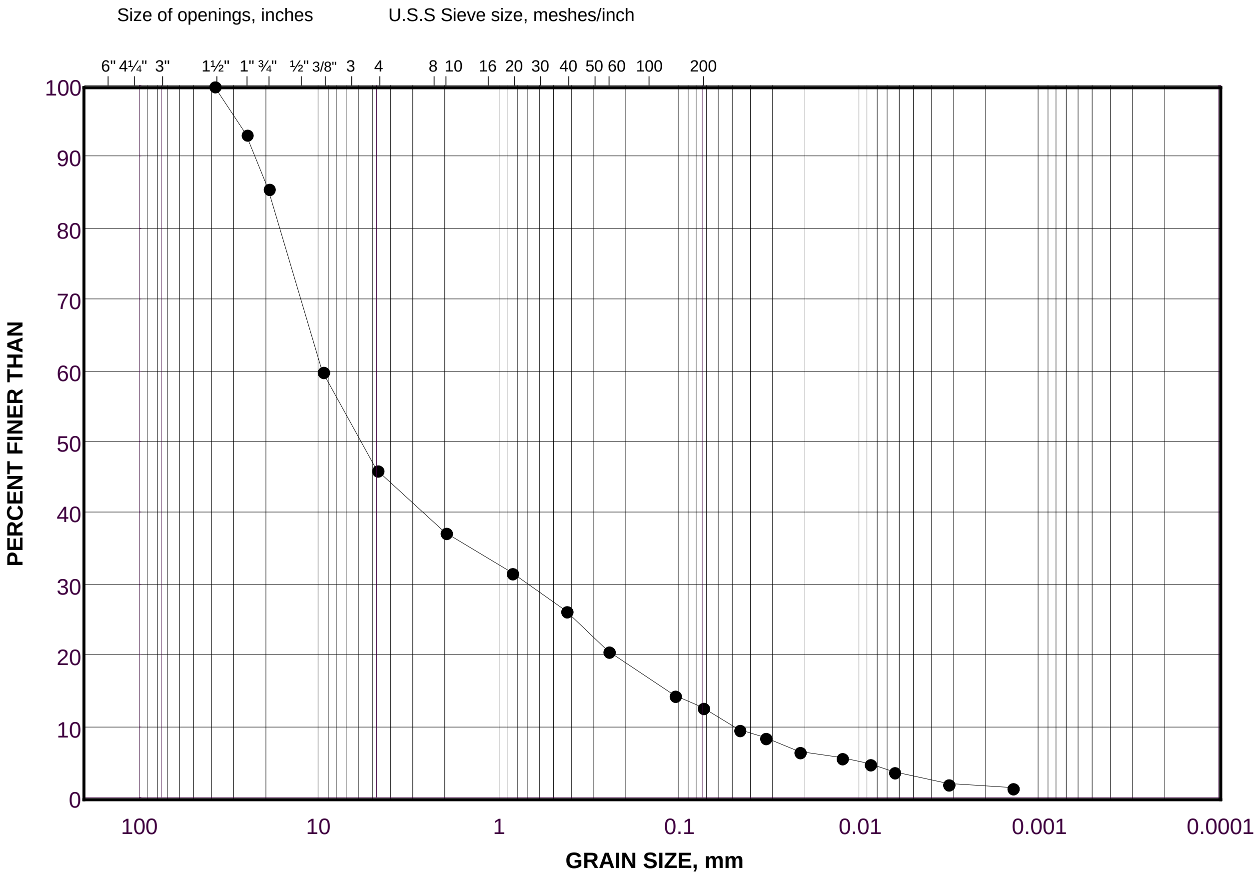
Golder Associates

Date: 16-Oct-17

GRAIN SIZE DISTRIBUTION

(SW-GW) Sandy Gravel

FIGURE C4



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-06	5	206.6

Project Number: 1664714

Checked By: ____________________________

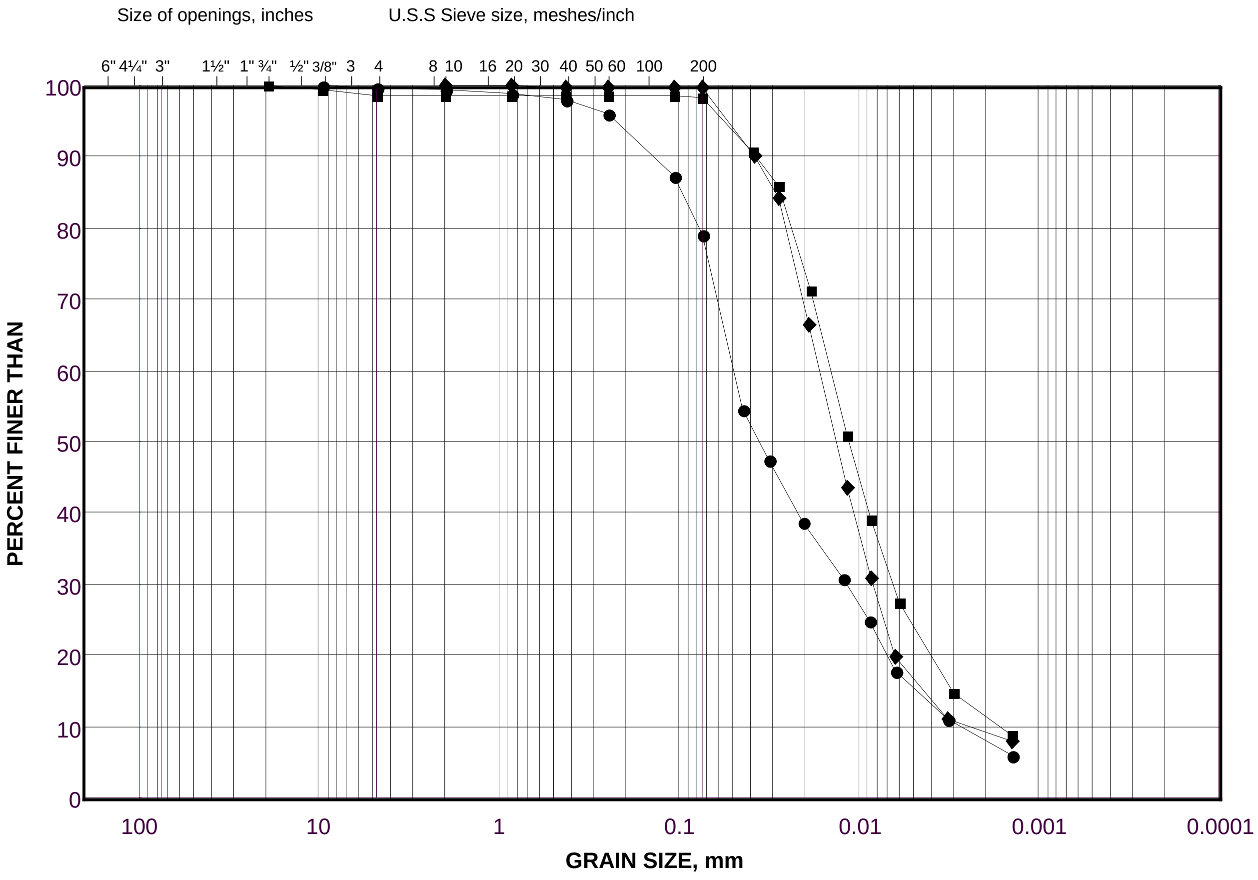
Golder Associates

Date: 16-Oct-17

GRAIN SIZE DISTRIBUTION

(ML) Sandy Silt to Silt

FIGURE C5



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-03	3	208.4
■	17-07	7	203.6
◆	17-01	7	203.6

Project Number: 1664714

Checked By: ________________________

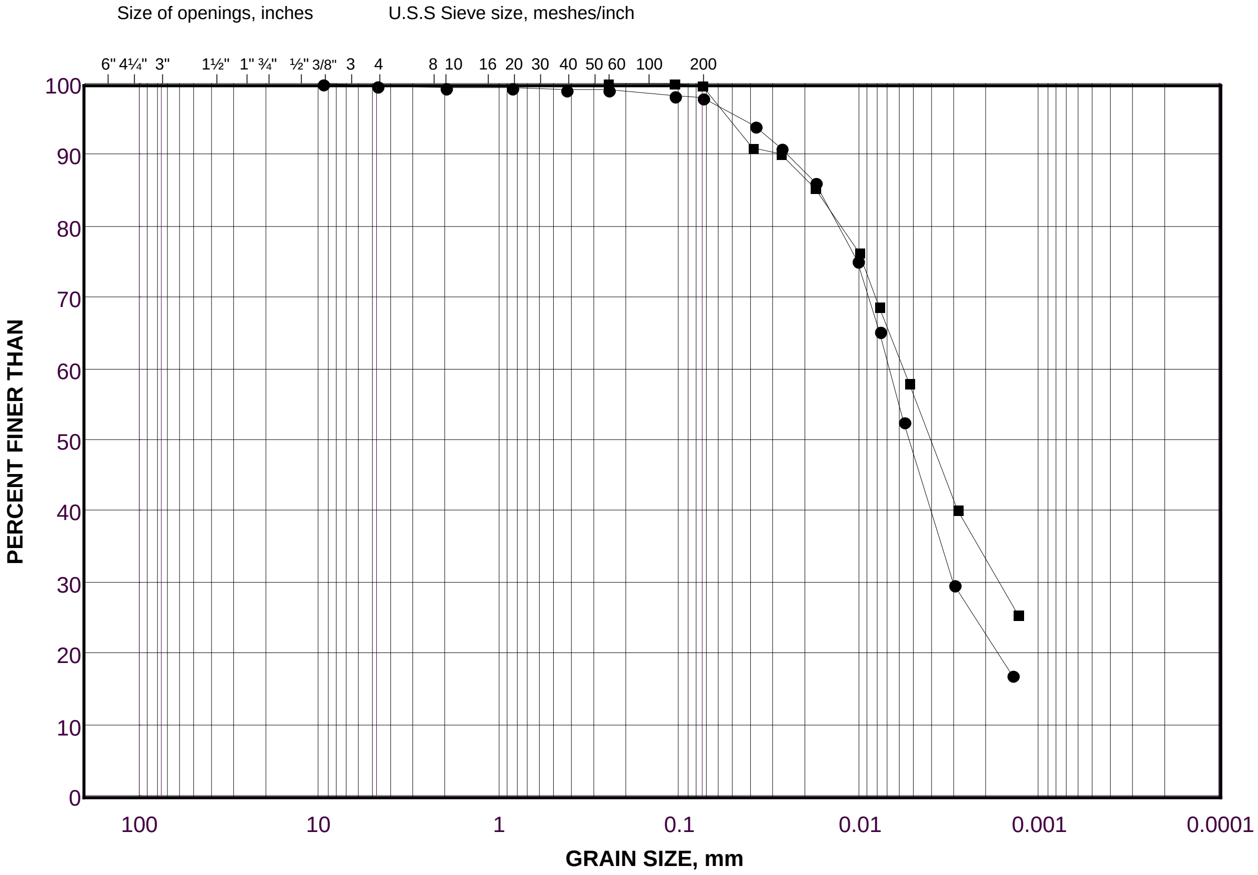
Golder Associates

Date: 16-Oct-17

GRAIN SIZE DISTRIBUTION

(CL/CI) Silty Clay

FIGURE C6



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	17-09	5	206.7
■	17-10	8	203.2

Project Number: 1664714

Checked By: ____________________

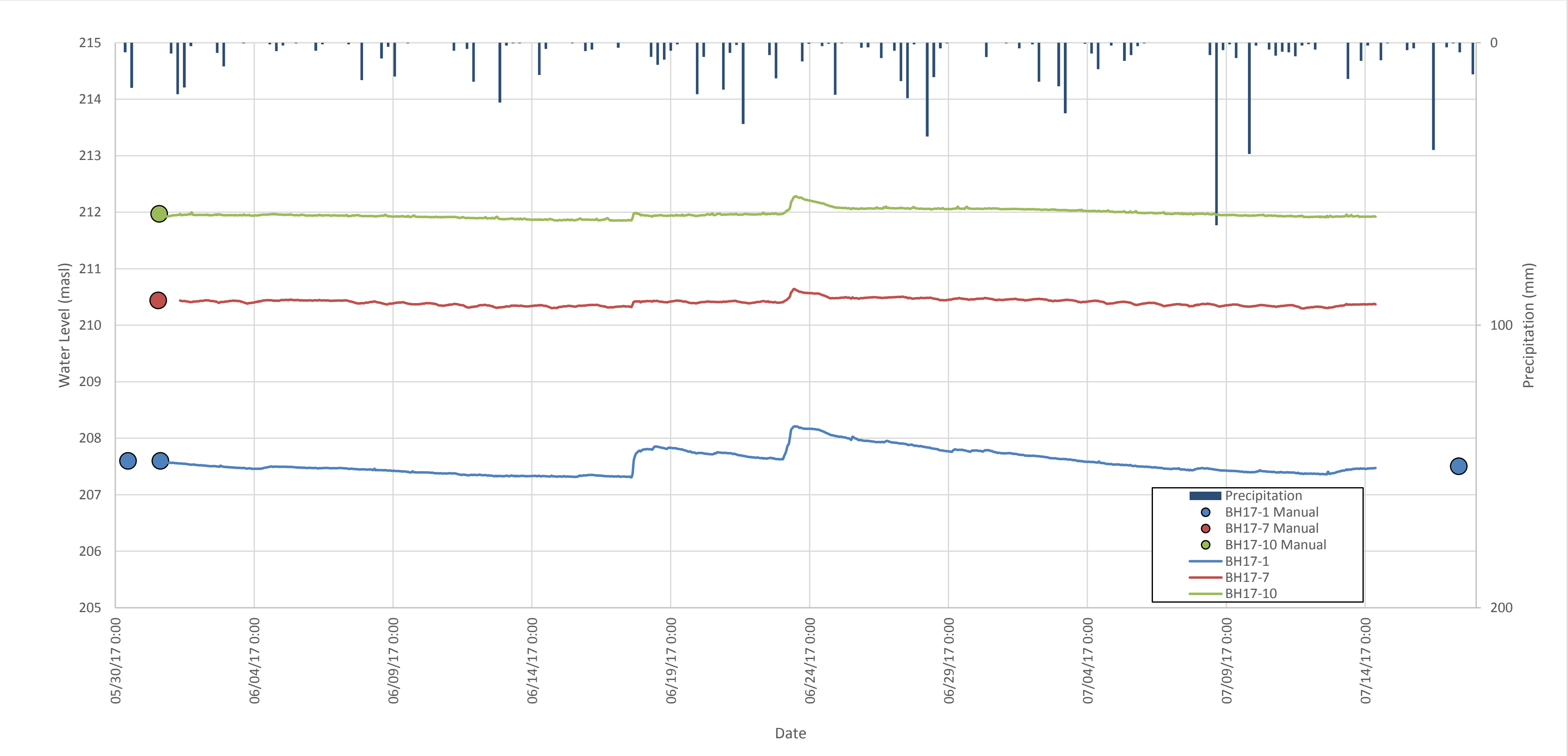
Golder Associates

Date: 16-Oct-17

APPENDIX D

Hydrographs

HYDROGRAPH OF
CALEDON KING VAUGHAN GROUNDWATER ELEVATIONS



DATE: September 2017

PROJECT: 1664714

CAD: AM

CHK: JP

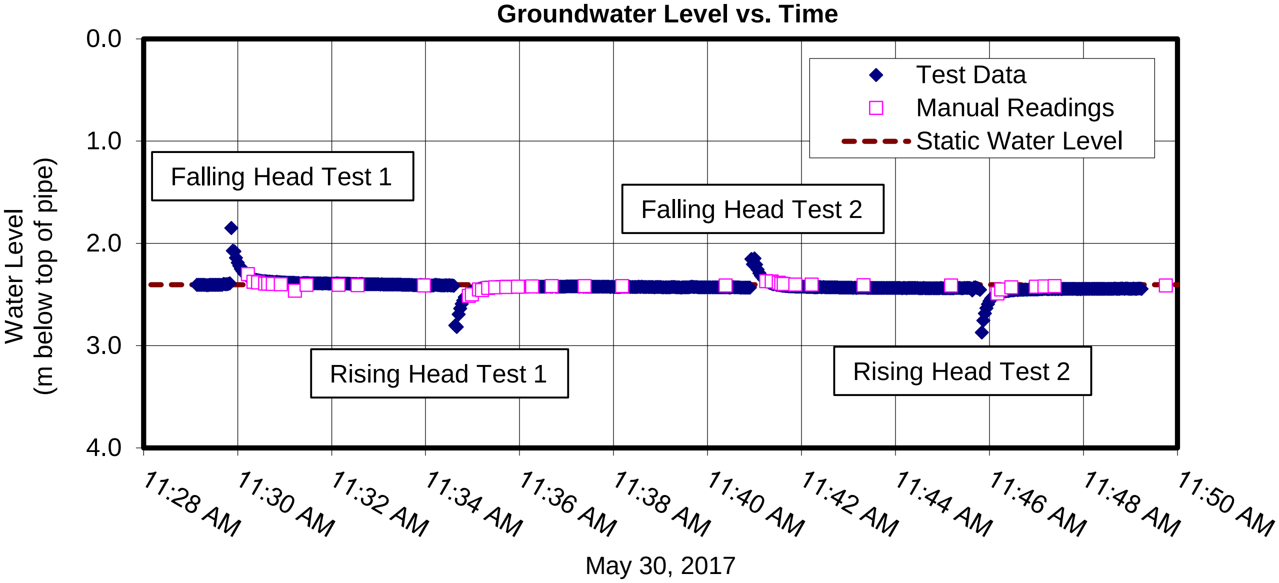
APPENDIX E

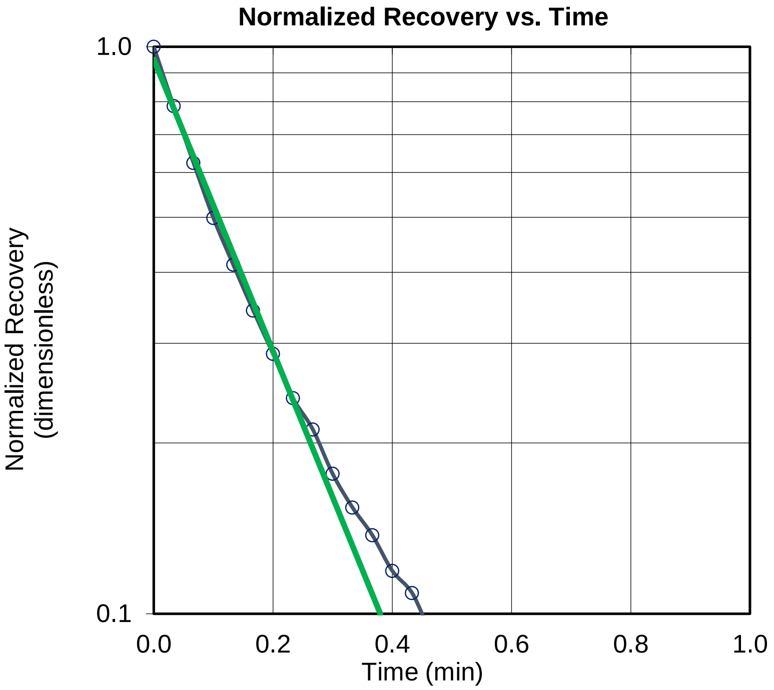
Single Well Response Tests

In-Situ Hydraulic Conductivity Test Report

Borehole BH-17-1 Falling Head Test 2

FIGURE E1





Test Interval (below top of pipe)

3.1 m to 4.7 m

Static Water Level (below top of pipe)

2.4 m

Test Interval (L) = 1.52 m

Well Radius (r) = 0.025 m

Hole Radius (R) = 0.057 m

Points Used for Match Line RHT

$h_1/H_0 =$ 0.95	$t_1 =$ 0 min
$h_2/H_0 =$ 0.10	$t_2 =$ 0.38 min

Hvorslev Analysis

RHT Hydraulic Conductivity (K) = $\frac{-(r^2) \bullet \ln({}^{L}/_{R})}{2 \bullet L} \bullet \frac{\ln(h_2/H_0) - \ln(h_1/H_0)}{t_2 - t_1}$ = **7E-5** **m/s**

DATE: August 2017

PROJECT: 1664714

Golder Associates

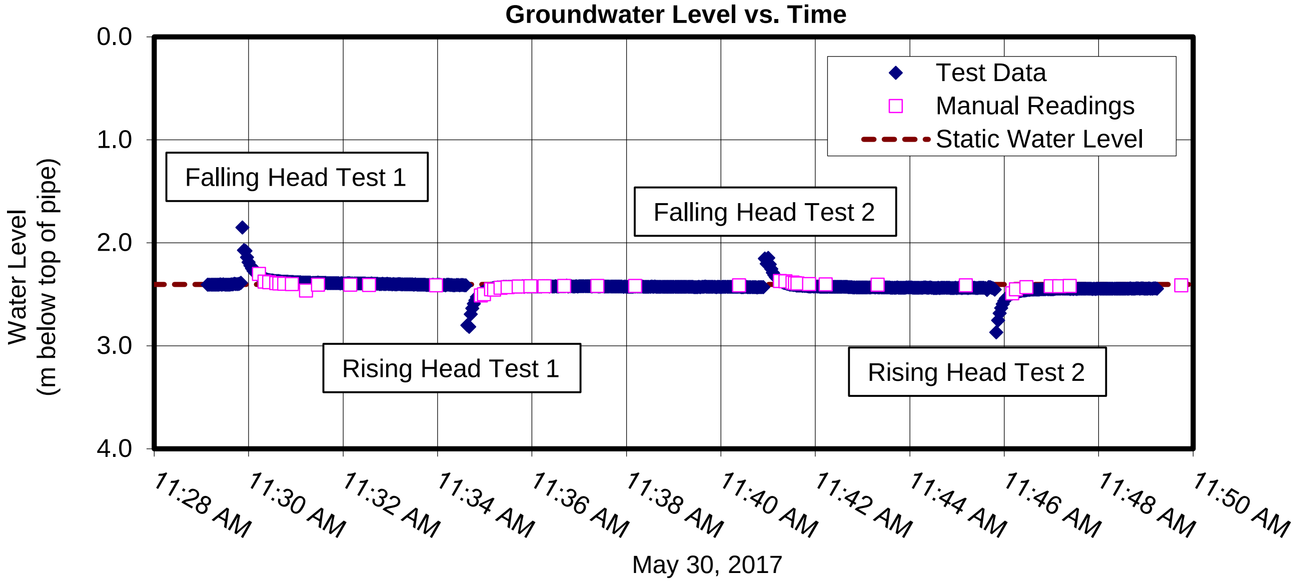
DESIGN: PGM

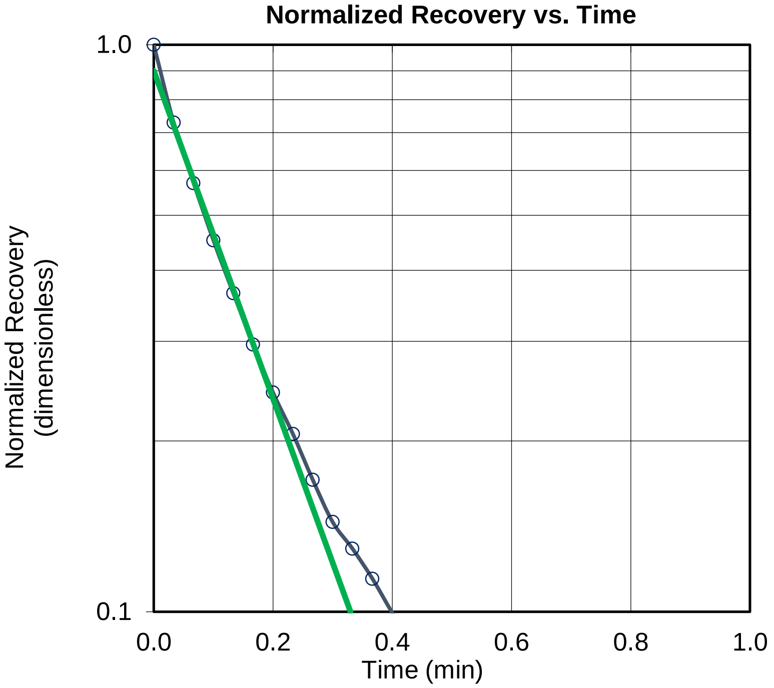
CHECK: MB

In-Situ Hydraulic Conductivity Test Report

Borehole BH-17-1 Rising Head Test 2

FIGURE E2





Test Interval (below top of pipe)

3.1 m to 4.7 m

Static Water Level (below top of pipe)

2.4 m

Test Interval (L) = 1.52 m

Well Radius (r) = 0.025 m

Hole Radius (R) = 0.057 m

Points Used for Match Line RHT

$h_1/H_0 = 0.90$	$t_1 = 0$ min
$h_2/H_0 = 0.10$	$t_2 = 0.33$ min

Hvorslev Analysis

RHT Hydraulic Conductivity (K) = $\frac{-(r^2) \cdot \ln(^L/_R)}{2 \cdot L} \cdot \frac{\ln(h_2/H_0) - \ln(h_1/H_0)}{t_2 - t_1}$ = **8E-5 m/s**

DATE: August 2017

PROJECT: 1664714

Golder Associates

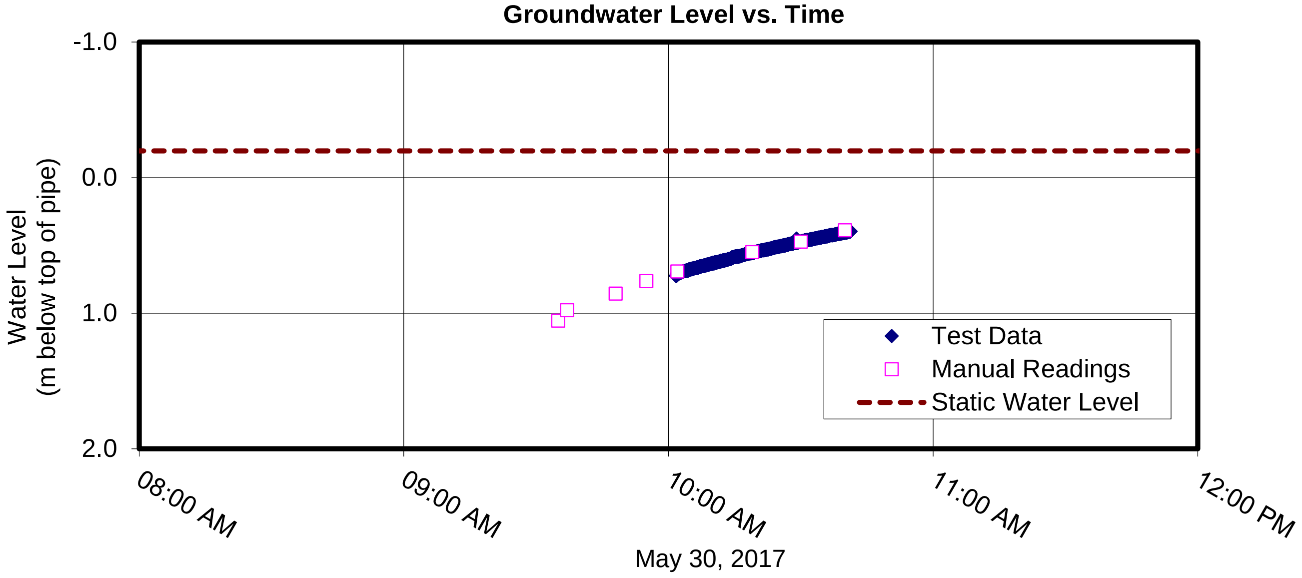
DESIGN: PGM

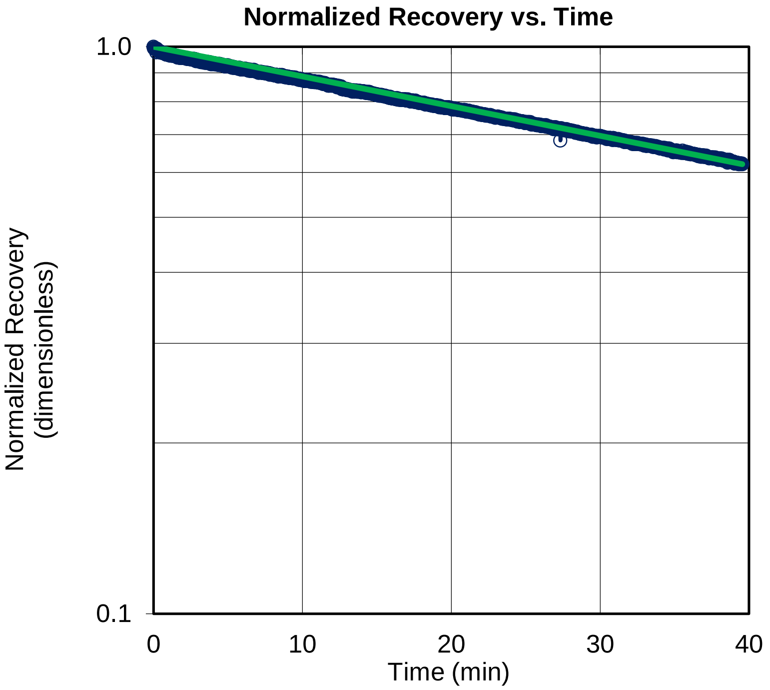
CHECK: MB

In-Situ Hydraulic Conductivity Test Report

Borehole BH-17-7 Rising Head Test

FIGURE E3





Test Interval (below top of pipe)

5.9 m to 7.4 m

Static Water Level (below top of pipe)

-0.2 m

Test Interval (L) = 1.52 m

Well Radius (r) = 0.025 m

Hole Radius (R) = 0.057 m

Points Used for Match Line RHT

$h_1/H_0 = 1.00$	$t_1 = 0$ min
$h_2/H_0 = 0.62$	$t_2 = 40$ min

Hvorslev Analysis

RHT Hydraulic Conductivity (K) =

$$\frac{-(r^2) \cdot \ln(^L/_R)}{2 \cdot L} \cdot \frac{\ln(h_2/H_0) - \ln(h_1/H_0)}{t_2 - t_1} = \mathbf{1E\text{-}7} \quad \mathbf{m/s}$$

DATE: August 2017

PROJECT: 1664714

DESIGN: PGM

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In-Situ Hydraulic Conductivity Test Report

FIGURE E4

Borehole BH-17-10 Constant Rate Test

Known Parameters

Rw	0.0254	m
H	-0.918	mbtoc
h	0.02	mbtoc
B	1.524	m
Volume Collected	400	mL
Time of Collection	7	min
Results		
Qw	9.5E-07	m^3/s
K	5E-07	m/s

Analytical Solution for Radial Flow to Well in a confined aquifer

$$Q = \frac{2\pi KB(H - h_w)}{\ln({}^{R_0}/_{r_w})}$$

Rearranged for hydraulic conductivity

$$K = \frac{Q\ln({}^{R_0}/_{r_w})}{2\pi B(H - h_w)}$$

Where: K = hydraulic conductivity of the tested material;

Rw = radius of the well riser pipe;

Ro = radius of influence;

B = thickness of the confined aquifer

(assumed to be equal to the well screen length);

H = static head; and

hw = constant head during pumping

Borehole BH-17-7 Rising Head Test 2

Known Parameters

Rw	0.0254	m
H	-0.197	mbtoc
h	0.02	mbtoc
B	1.524	m
Volume Collected	210	mL
Time of Collection	8	min
Results		
Qw	4.4E-07	m^3/s
K	6E-07	m/s

Analytical Solution for Radial Flow to Well in a confined aquifer

$$Q = \frac{2\pi KB(H - h_w)}{\ln({}^{R_0}/_{r_w})}$$

Rearranged for hydraulic conductivity

$$K = \frac{Q\ln({}^{R_0}/_{r_w})}{2\pi B(H - h_w)}$$

Where: K = hydraulic conductivity of the tested material;

Rw = radius of the well riser pipe;

Ro = radius of influence;

B = thickness of the confined aquifer

(assumed to be equal to the well screen length);

H = static head; and

hw = constant head during pumping

DATE: August 2017

PROJECT: 1664714

Golder Associates

DESIGN: PGM

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