

Hydrogeological Investigation
Proposed AquaVil Development
Town of The Blue Mountains, Ontario

Prepared For:

Royalton Homes Inc.

Prepared By:

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August 14, 2019

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Attention: Mr. Samer Chaaya

**RE: Hydrogeological Investigation
AquaVil Development
Town of The Blue Mountains, Ontario**

DS Consultants Limited (DSCL) was retained by Royalton Homes Inc. to undertake a hydrogeological investigation for the proposed AquaVil Development located north of Highway 26, west of Longpoint Road and east of Blue Mountain Drive in the Town of The Blue Mountains, Ontario. This investigation includes an overview of the existing geological and hydrogeological conditions at the Site and the surrounding area, provides an assessment of the hydrogeological constraints and impacts of the proposed development on the local groundwater and provides an estimation of construction dewatering requirements during the proposed development. The results of this investigation can be used in support of an Environmental Activity Sector Registry (EASR) for construction dewatering from the Ministry of the Environment, Conservation and Parks (MECP).

Based on the results of our investigation, the following summary of conclusions and recommendations are presented:

1. Based on MECP water well records search, there are records for one hundred twenty-eight (128) water wells within 500 m of the site. One hundred fourteen (114) are listed as domestic wells, nine (9) are listed as unknown, three (3) are listed as commercial, and two (2) are listed as public. The depths of these wells range from 3.1 m to 45.1 m below ground surface. A door-to-door survey was carried out to verify the location, existence, or status of domestic supply wells. No domestic wells were identified, letters and surveys were left with residents.
2. There were ten (10) boreholes drilled as part of this investigation at the Site from October 31 – November 6, 2018. Four (4) boreholes were converted into monitoring wells for monitoring groundwater levels, hydraulic conductivity testing and assessing representative groundwater quality at the site. In addition, twenty-four (24) boreholes were drilled (BH1 through BH24) during a previous investigation titled; “Preliminary Geotechnical Investigation, Proposed Residential and Commercial Development, Craighleith, Ontario” in 2008 by Shaheen & Peaker (S&P). The depths of these boreholes ranged from 2.3 m to 6.7 mbgs. All boreholes were used to interpret the subsurface soils on-site.
3. Surficial geology in the study area generally consists of glaciolacustrine deposits of sand and silty sand overlaying glacial till and/or bedrock mapped as the Simcoe group including limestone, dolostone, shale, arkose, and sandstone. The soils at the Site consisted of topsoil and disturbed native materials, followed by native silty sand/sandy silt, sand and gravel, and sand layers. Assumed bedrock was found to range between 4.6 and 6.7 m below ground surface.

4. Shallow groundwater conditions at the site are generally characterized as being between 0.2 m and 1.4 metres below ground surface between elevations of about 177.3 and 180.7 masl. Groundwater flow is in a northwest direction with a horizontal gradient of about 0.005 m/m and a vertical gradient of about 0.006 m/m downward.
5. Hydraulic conductivity (K) testing was completed at four (4) monitoring wells. The K for each overburden monitoring well was calculated using the Hvorslev method and the results were used to estimate dewatering rates where proposed excavations intersect the water table. Based on the results of the testing, the calculated K of the sandy silt till to the sand varies between 5.91×10^{-6} m/sec to 3.27×10^{-5} m/sec, respectively.
6. Groundwater quality testing as part of the hydrogeological investigation indicated that the concentrations of Aluminum, Copper, and Iron exceed the Provincial Water Quality Objectives (PWQO) guidelines in one or more samples from tested onsite monitoring wells. All other parameters tested met the standards with the exception of phosphorus, cobalt and silver where detection limits were slightly over the guideline.
7. Based on available information, temporary dewatering is anticipated for the construction of the townhouses and condominiums, sewers/utilities installation, and the SWM facility. The calculated maximum dewatering rate for the construction of the townhouse/condominium footings (assumed 100m open trench) is 69,000 L/day. The calculated maximum dewatering rate anticipated for the liner infrastructure construction (per 30 m open trench) is 94,500 L/day. The calculated maximum dewatering rate during the construction of the SWM facility (assumed 1000m² at any given time) is 39,000 L/day. Should these activities be occurring simultaneously, the total dewatering rate is 202,500 L/day.
8. Since the expected dewatering rates exceed 50,000 L/day limit, an Environmental Activity and Sector Registry (EASR) application may be required. The calculated dewatering rates do not exceed 400,000 L/day. As a result, a Permit to Take Water (PTTW) application will not be required.
9. Based on groundwater quality testing, if groundwater is to be discharged to a surface water body during construction, a treatment system would have to be set up and implemented by the contractor. Water quality should be monitored during the construction phase to ensure that water quality meets the discharge criteria.
10. Temporary reductions in groundwater contributions to the wetlands may occur during construction dewatering activities in areas where the ZOI extend into the wetland. As a result, it is recommended that the construction of SWM facilities adjacent to the SCWC occur following the seasonally high groundwater levels which temporarily flood the wetland. No long-term reduction in groundwater levels or reductions in groundwater contributions to the SCWC is anticipated as a result of the proposed development.
11. Predicted ZOIs are minimal and not expected to interfere with structures, utilities or downgradient groundwater supply wells.

12. In conformance with Regulation 903 of the Ontario Water Resources Act, the decommissioning of any dewatering system and monitoring wells should be carried out by a licensed contractor under the supervision of a licensed water well technician.

Should you have any questions regarding these findings, please do not hesitate to contact the undersigned.

DS Consultants Ltd

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1. INTRODUCTION

DS Consultants Ltd. (DSCL) was retained by Royalton Homes Inc. to complete a hydrogeological investigation for the proposed AquaVil Development in the Town of The Blue Mountains, Ontario (Site). The Site is located north of Highway 26, west of Long Point Road and east of Blue Mountain Drive as shown in **Figure 1** and currently comprises approximately 26 ha of partially forested and reworked land. The subject property is divided by Brophy's Lane, with approximately 16 ha of land west of Brophy's Lane (West Lands) and 10 ha of land east of Brophy's Lane (East Lands).

Conceptual plan drawings were provided to DSCL including water servicing, sanitary servicing, existing and proposed road configurations and post-development drainage plans (Crozier & Associates; Project 305-2815, 04/06/2008). The proposed development plan within the West Lands will consist of 151 residential units, tennis courts, parking areas, a clubhouse and a stormwater management (SWM) facility. The development plans for the East Lands consist of a series of commercial blocks, an institutional block and 8 single family residential lots. The development structures for both the West and East Lands will be slab-on-grade construction and will be fully serviced.

1.1 Purpose

The purpose of this investigation was to characterize the hydrogeological conditions over the entire Site and determine the need for construction dewatering based on preliminary designs. This includes providing estimates of dewatering pumping rates to determine the need for a Permit to Take Water (PTTW) or registration requirements on the Environmental Activity and Sector Registry (EASR) from the Ministry of the Environment, Conservation and Parks (MECP). Potential impacts related to construction dewatering and long-term dewatering/drainage control requirements were also investigated.

1.2 Scope of Work

The scope of work for this investigation included:

- (i) Background information review of relevant information to assess local conditions, available through past geotechnical, geological, and environmental studies along with the Ministry of the Environment and Climate Change Water Well Record database for the area;
- (ii) Water Well Record Search and supplementary door-to-door water well survey;
- (iii) Groundwater and surface water level monitoring including seasonal manual measurements at all available monitoring wells and continuous level monitoring using data loggers in select monitoring locations (4 total);
- (iv) In-situ hydraulic conductivity testing of (6) monitoring wells;
- (v) Water quality monitoring at two (2) monitoring wells to evaluate discharge options;
- (vi) Assessment of dewatering requirements and the need for a Permit to Take Water (PTTW) during construction; and
- (vii) Data analyses and preparation of a hydrogeological report suitable for submission in support of a Category 3 PTTW application, if required.

2. PHYSICAL SETTING

Available topographic, environmental, geotechnical and hydrogeological reports and maps were used to develop an understanding of the physical setting of the study area. Results from a preliminary geotechnical study completed in 2008 (S&P, 2008) and a drilling program completed as part of this investigation were used to interpret the geological and hydrogeological conditions at the Site. A review of MECP Water Well Records (WWR) was also completed. The following presents a brief description of regional geological and hydrogeological conditions based on the review of available information.

2.1 Regional Physiography and Drainage

The Site is situated within Nottawasaga Basin section of the Simcoe Lowlands physiographic region of Southern Ontario (Chapman and Putnam, 1984) bordering the Niagara Escarpment to the southwest and Georgian Bay to the north. Physiographic landforms in the area include clay plains and the escarpment to the southwest and a variety of glacial overburden deposits including bevelled till plains and sand plains. The Site lies within an area mapped as sand plains and beaches. The sites terrain is dominated by sandy beach ridges which are a result of ancient beach dune deposition from Georgian Bay and run in a roughly northeast to southwest direction through the property.

Drainage at the Site generally flows in a northward direction from the Highway 26 towards Georgian Bay. The southeast corner along Highway 26 represents the highest elevations at the Site at about 181 metres above sea level (masl). Topography is generally flat and gradually decreases to an elevation of approximately 178 masl at the Georgian Bay shoreline. The Site is described as having imperfect drainage conditions and poorly defined drainage features. There are a series of linear wetland features formed in troughs between recessional beach ridges between the east and west development areas. These features are Provincially Significant Wetland (PSW) and reportedly flood in the spring and become dry in the summer and fall. The site lies within the limits of four Grey Sauble Conservation Area (GSCA) subwatersheds.

2.2 Site Geology

Major glacial advances and retreats shaped the land surrounding the general area. Surficial geology in the area is mapped as Lacustrine Sand consisting of sand, gravel, and minor silt and clay littoral deposits. The site is mainly characterized by surficial deposits of sand and silty sand which overlay glacial till. The glacial till consists of silty till of the Halton series. The Surficial Geology Map is show in **Figure 4**.

Based on local MECP water well records (Well IDs 2507551 and 2506099), overburden thickness in the area of the Site ranges from approximately 4.0 - 6.5 m, increasing in thickness with further away from the Georgian Bay shoreline, and comprised of continuous sand with some gravel and clay. Bedrock mapping suggests that the site is underlain by the Shadow Lake Formation including limestone, dolostone, shale, arkose, and sandstone.

As part of this investigation, ten (10) boreholes (MW18-1 through MW18-10) were completed by DSCL from October 31, 2018 to November 6, 2018. In addition, twenty-four (24) boreholes were drilled (BH1 through BH24) during a previous investigation titled; "Preliminary Geotechnical Investigation, Proposed

Residential and Commercial Development, Craigeleith, Ontario” in 2008 by Shaheen & Peaker (S&P). The depths of these boreholes ranged from 2.3 m to 6.7 m below existing ground surface (mbgs). All boreholes were used to interpret the subsurface soils on-site. The locations of the boreholes are shown in **Figure 1**, and detailed subsurface conditions are presented on the Borehole Logs in **Appendix A**. Subsurface conditions are summarized as follows:

Topsoil/Fill: A surficial topsoil layer was encountered at all borehole locations. The measured topsoil thickness at the borehole locations ranged from 50 mm to 250 mm (average 170 mm). Localized thick topsoil deposits and soils rich in organic content may likely be encountered, especially in depressed areas and/or near water courses. Topsoil quantities should not be calculated from the borehole information, as large variations in depth may exist between boreholes.

Disturbed silty sand to sand soil (possible fill) was encountered below the surficial topsoil layer. The disturbed silty sand to sand soil contained varied amounts of organics within its matrix (mixed soil). This disturbed soil layer generally extended to a depth of 0.6 mbgs. The disturbed soil layer extended to a depth of 1.2 mbgs at borehole BH18-08.

The 2008 Preliminary Geotechnical Investigation as completed by S&P identified fill soils (disturbed soil) at eight (8) borehole locations across the property. The identified fill soil consisted of sand with some gravel, trace to some silt mixed with organics. The fill soils identified during the S&P investigation extended from surface levels, ranging in thickness from between 0.8 m to 1.5 m.

Sand to Silty Sand: Native deposits of sand to silty sand (at depth) were encountered below the topsoil and disturbed organic rich soils. The sand deposits contained thin gravel rich seams (layers). Cobble sizes were also encountered at various depths within the sand deposit. Moisture content of the tested samples from the sand to silty sand deposits varied between 11% to 27% by weight, indicating moist to wet conditions (average 23%, wet). The sand to silty sand deposits extended to depths of 2.3 mbgs (BH18-10) to 5.0 mbgs (BH18-2).

Silt to Silty Clay: Native sandy silt to clayey silt deposits were identified below the upper level native sand deposits at borehole locations BH18-1, BH18-2, BH18-6, BH18-7 and BH18-8. These deposits were layered (stratified). Moisture content of the tested samples from the sandy silt to clayey silt deposits varied between 19% to 29% by weight, indicating wet conditions (average 22%, wet). The sandy silt to clayey silt deposits were found to be dilatant. The sandy silt to clayey silt deposits were identified below depths of +/- 3.8 mbgs (BH18-6 and BH18-7) to +/-5.0 mbgs. These silt deposits extended to the borehole termination depth or underlying glacial till deposits. In general, the silt deposits were found to have a thickness of +/- 0.3 m to +/-2.0 m.

Glacial Till: Glacial till deposits at depth were encountered at borehole locations BH18-04, BH18-05, BH18-07 to BH18-10. The glacial till deposit had a varied matrix of sandy silt to silty sand with varied amounts of gravel and traces of clay. Clayey Silt matrix till was noted at BH18-07, BH18-08 at depth. The till deposit contained cobble of varying sizes. Moisture content of the tested samples from the glacial till deposits varied between 7% to 26% by weight, indicating moist to wet conditions (average 14%, moisture). The glacial till deposits were identified below depths of +/- 2.3 mbgs to +/-6.0 mbgs. The glacial till deposits extended to the borehole termination depths.

Boulders or Inferred Bedrock: Auger refusal due to boulders or Inferred bedrock was noted at most of the borehole locations. **Table 1** summarizes the depths to auger refusal at the borehole locations.

Table 1: Depth to Auger Refusal on Boulders or Inferred Bedrock

BH No.	Ground Surface Elev. (masl)	Depth to Auger Refusal (m)	Elevation of Auger Refusal (masl)
BH18-01	178.6	4.9	173.7
BH18-02	178.4	5.7	172.7
BH18-03	178.0	4.6	173.4
BH18-05	179.7	6.5	173.2
BH18-06	179.4	5.6	173.8
BH18-07	180.2	6.6	173.6
BH18-08	181.2	6.7	174.5
BH18-09	181.2	5.2	176.0
BH18-10	181.2	5.8	175.4

Based on the above table, auger refusal on boulders or inferred bedrock was encountered at 4.6 to 6.7 mbgs (172.7 to 176.0 masl).

Auger cuttings and/or split spoon samples from the auger refusal levels were obtained from some borehole locations (where possible). The retrieved samples were classified as being grey shale material. Bedrock was not proven by rock coring.

2.3 Hydrogeology

The hydrogeological conditions at the site were evaluated using the data collected from the MECP water well records, the on-site monitoring wells installed as part of this investigation, and existing reports for the area.

2.3.1 Groundwater Resources and Supply

As part of the hydrogeological study, DSCL completed a search of the Ministry of Environment Water Well Record (WWR) database. A summary of the search is presented in **Appendix D** and **Figure 3** shows the location of all MECP-registered water well records within a 500-metre radius of the site. A review of the water well records indicated that there are one hundred twenty-eight (128) water wells within the 500 m radius of the site. Of the one hundred twenty-eight (128) well records, one hundred fourteen (114) are listed as domestic, nine (9) are listed as unknown, three (3) are listed as commercial, and two (2) are listed as public. The depths of these wells range from 3.1 m to 45.1 m below ground surface.

To verify the findings from the MECP WWR database search, a door to door well condition survey was conducted on November 23, 2018. To begin the survey, a letter of introduction regarding the water well survey was prepared and delivered to residences in the study area. The letter explained the purpose of

the study and requested the participation of the residents. During the survey, DS staff visited houses within the 500 m radius of the site and, if a resident was home, DS interviewed the resident and completed the well survey to document the current condition and use of their well(s) with home owner's consent.

The survey included questions about the wells (e.g. type of well, location, age, depth, etc.) the quantity of water (water levels, usage) and quality of water (clarity, odour, treatment types, etc.). If no one was home or residents declined to be interviewed, a copy of the letter and a blank survey form was left at each location and the resident was requested to complete and return the form and to arrange a site visit by DS at the resident's convenience at a later date.

Approximately 60 properties were visited during the door-to-door survey, resulting in twelve (12) properties completing surveys/interviews. Of the twelve (12) residents interviewed, eight (8) were unaware of wells on their property and indicated they are provided with municipal water. The remaining Four (4) residents indicated that a domestic well is located on their property but was not currently in use, and that they are also supplied with municipal water. It was noted during interviews of residents that municipal water was provided to the area approximately 30 to 40 years ago, and all residents have been switched over from domestic wells to municipal water supply. Based on review of available information, the Thornbury Water Treatment Plant (WTP) supplies water to The Blue Mountains and was originally constructed in 1977 with the plant put into service in 1978, corresponding with information provided by the residents.

2.3.2 Groundwater Conditions

For the AquaVil Development property, groundwater conditions were assessed using the four (4) monitoring wells (MW18-1, MW18-4S, MW18-4D, and MW18-9) and one (1) piezometer (PZ18-1), strategically installed across the site by DSCL, as well as the nine (9) monitoring wells (BH1, BH4, BH10, BH12, BH14, BH16, BH19, BH22, BH23) installed by S&P. All fourteen (14) of these monitoring wells/piezometers are screened in overburden at the site. Five (5) of the monitoring wells are screened in the upper sand formation (PZ18-1, MW18-1, MW18-4S, MW18-9, BH4, and BH10), and the remaining eight (8) are screened in the lower sandy silt till formation (MW18-4D, BH1, BH12, BH14, BH19, BH22, BH23). The most recent groundwater level monitoring was conducted on July 15, 2019 at all available monitoring wells. **Table 2** presents a summary of the measured groundwater level in all wells, **Figure 1** shows the monitoring well locations, and **Figure 5** shows continuous groundwater level hydrographs for monitoring locations MW18-4D, MW18-4S, MW18-9, and PZ18-1. On July 15, 2019 water level elevations ranged from 177.2 – 180.1 masl. Based on measured water levels, the localized groundwater flow in the vicinity of the site is interpreted to be in a northwest direction with a horizontal gradient of about 0.005 m/m and a vertical gradient of about 0.006 m/m downward. **Figure 2** shows the groundwater flow direction.

Table 2: **Groundwater Levels in Monitoring Wells**

Monitoring Well	Ground Elevation (masl)	MP Elevation (masl)	Well Depth (mbgs)	Screened Interval (mbgs)	Ground Water Elevation (masl)					
					20-Aug-18	15-Nov-18	14-Dec-18	06-Mar-19	09-May-19	15-Jul-19
MW18-1	178.59	179.39	4.1	2.6 – 4.1	-	177.2	177.3	177.18	177.96	177.25
MW18-4S	179.79	180.74	2.7	1.2 – 2.7	-	178.6	178.8	178.74	178.92	178.43
MW18-4D	179.79	180.85	5.7	4.2 – 5.7	-	178.5	178.7	178.65	178.83	178.44
MW18-9	181.16	181.87	4.6	3.1 – 4.6	-	180.3	180.4	180.12	179.76	179.84
PZ18-1	178.959	180.079	0.5	0.2 – 0.5	-	dry	dry	178.98	179.11	178.64
BH1	179.37	180.13	4	2.5 – 4.0	178.6	178.7	178.7	-	178.7	178.3
BH4	179.99	180.84	4.3	2.8 – 4.3	178.6	178.6	178.9	-	178.91	178.42
BH10	178.3	178.94	4.2	2.7 – 4.2	177.8	178	178.1	-	177.99	177.51
BH12	178.34	179.14	4.3	2.8 – 4.3	177.3	177.5	177.7	-	177.64	177.16
BH14	180.98	181.58	5.8	4.3 – 5.8	179.3	179.5	179.8	-	179.68	179.21
BH16	180.92	181.66	4.5	3.0 – 4.5	179.4	179.6	179.7	-	179.72	179.43
BH19	181.35	182.26	5.2	3.7 – 5.2	180	180	180.1	-	180.17	180.11
BH22	181.26	182.14	4.6	3.1 – 4.6	180	180.3	180.7	-	180.78	-
BH23	180.96	181.85	3.1	1.6 – 3.1	180	180.1	180.3	-	180.32	-

2.3.3 Hydraulic Conductivity

Single Well Response Tests (SWRTs) to assess in-situ hydraulic conductivity (K) were completed by DSCL on August 15, 2018 at all four (4) DSCL installed monitoring wells (MW18-1, MW18-4S, MW18-4D, and MW18-9). The testing was completed using data loggers placed in the wells to accurately measure the change in hydraulic head versus time. Manual water level measurements were also collected to confirm datalogger readings. K values were calculated using the Hvorslev method. The K values ranged from as low as 5.91×10^{-6} m/sec to as high as 3.27×10^{-5} m/sec. **Table 3** presents a summary of the Hydraulic Conductivity (K) results. The test results are provided in **Appendix B**.

Table 3: **Summary of Single Well Response Tests (SWRTs) Hydraulic Conductivity Results**

Monitoring Well	Depth (mbgs)	Screened Interval (masl)	Screen Formation	Hydraulic Conductivity (K) (m/sec)
MW18-1	4.1	174.5 - 176.0	Sand	1.09×10^{-5}
MW18-4S	2.7	177.1 – 178.6	Sand	3.27×10^{-5}
MW18-4D	5.7	174.1 – 175.6	Sandy Silt Till	5.91×10^{-6}
MW18-9	4.6	176.6 – 178.1	Sand	1.01×10^{-5}

2.3.4 Water Quality

Groundwater samples were collected on November 15, 2018 from MW18-1 and MW18-9, representing the upper sand formation. The samples were submitted under chain of custody to ALS Environmental, a CALA certified laboratory, for chemical analysis of concentrations of metals and general water quality

characteristics. The laboratory results were compared to the Provincial Water Quality Objectives (PWQO). The certificate of analysis is provided in **Appendix C**. The PWQO exceedances in each location are summarized in **Table 4** below.

Table 4: Parameters in Groundwater Exceeding Provincial Water Quality Objectives (PWQO)

Monitoring Well	Stratigraphic Unit	Criteria Exceeded	PWQO Guideline (mg/L)	Lab Result (mg/L)
MW18-3	Sand	Aluminum	0.015	0.105
		Copper	0.001	0.00124
		Iron	0.3	4.38
		Phosphorus*	0.01	<0.050
MW18-6	Sand	Aluminum	0.015	0.170
		Cobalt*	0.0009	<0.0010
		Copper*	0.001	<0.0020
		Iron	0.3	0.97
		Phosphorus*	0.01	<0.50
		Silver*	0.0001	<0.00050

Note; ‘*’ Detection Limit exceeds the Guideline Limit, assessment against the Guideline Limit cannot be made.

To address water quality issues noted above, a treatment plan must be developed and implemented by the contractor prior to any discharge. Treatment may include, but not limited to, sedimentation and/or filtration to lower TSS. Since many metals are associated with sediments, it is expected that elevated metals will also be reduced with reductions in TSS. Additional treatment (e.g. Coagulation) may be needed to further reduce metals concentrations prior to discharge.

2.3.5 Surface Water Conditions

The definable surface water features identified on the property include a relatively short portion of an ephemeral ditch on the north side of the West Lands, a municipal ditch between the West and East Lands, a permanent watercourse west of Long Point Road, the Georgian Bay shoreline area to the north of the West Lands and the Provincially Significant Silver Creek Wetland Complex (SCWC).

A major portion of the AquaVil Development property is comprised of the SCWC as shown in the Development Plan provided in Appendix E. The Natural Heritage Information Centre describes it as a 166.5 ha fen, swamp and marsh complex made up of four individual wetlands. The MNR evaluated this wetland complex in 1986 as a Provincially Significant Wetland (PSW). Much of the natural vegetation on both the East and West Lands are part of the wetland complex. The wetland on-site consists of a series of linear troughs interspersed with narrow ridges of upland forest.

According to the Provincial Policy Statement, development shall not take place within provincially significant wetlands, and any development proposal within 120 m of a provincially significant wetland must be accompanied by an Environmental Impact Statement (EIS) demonstrating that the development will not negatively impact the wetland’s functions. An EIS was prepared by Hensel Design Group Inc.

(HDG) in 2009 which assessed the potential impacts to the PSW and provided recommended mitigation measures. The details of this assessment are summarized in **Table 5** below.

Table 5: Summary of Potential Impacts and Recommended Mitigations to PSW’s

Development Area	Potential Impacts	Recommended Mitigations
<p>West Lands</p>	<p>Approximately 338 m² of PSW will be removed as a result of construction of the entrance off Highway 26. Potential impacts to the PSW complex include changes to groundwater and surface water regimes.</p> <p>Community trails have been discussed as a potential feature within the development. Trails within and adjacent to the PSW(s) may create significant impacts without careful placement, effective design to control pedestrian and pet traffic, and development of an education program for users.</p> <p>Several proposed lots within the proposed development plan encroach within the proposed minimum 10m setback buffer from the PSW(s). Areas of the proposed constructed wetland SWM facility are also located with the proposed 10m setback buffer</p>	<p>The intrusion into the PSW will not compromise the overall integrity of the wetland complex. The creation of the SWM facility proposed along the PSW edge will maintain the overall feature and functions of the PSW complex.</p> <p>Proposed pedestrian trails within the development will require on-site review and location by qualified biologists and concerned agencies. Individual water balance calculations for each PSW area will be completed and post development stormwater volumes contributing to each area will be designed to match predevelopment hydrologic conditions.</p> <p>A minimum buffer setback of 10m has been proposed from all PSW(s). This placement allows the buffer to also serve as an extension of the wetland feature and through careful design will also provide added habitat diversity along the existing PSW edge.</p>
<p>East Lands</p>	<p>The development proposal will not result in the removal of any of the PSW. HDG recommends the exclusion of one wetland small unit that does not merit inclusion.</p>	<p>Careful evaluation of one 0.2 ha historically mapped PSW has led to the conclusion by a qualified wetland expert (Ms. Dale Leadbeater) that when applying the guidelines in the Wetland Evaluation System for inclusion of small wetland areas in complexes, this particular area does not merit inclusion. This area will be removed as a part of the development plan.</p> <p>Transplanting of viable plants from the PSW area to be removed will be relocated within the SWM facility.</p>

As part of this hydrogeological investigation, DSCL strategically installed one (1) surface water monitoring station (PZ18-1) within the PSW area located in the West Lands (**See Figure 1**). The Surface water station consists of a piezometer and a staff gauge to measure surface water and shallow groundwater levels. To provide seasonal characterization of the wetlands, continuous level monitoring using a data logger placed in PZ18-1 was completed November 2018 to July 2019. **Figure 5** shows the continuous groundwater level hydrographs for PZ18-1 in comparison to water levels recorded at MW18-4D, MW18-4S and MW18-9.

Based on the observed and recorded water levels, surface water levels in the wetland appear to be a

subdued reflection of the groundwater levels in the area as observed at monitoring well MW18-4S. Water levels in the wetland were observed as frozen at ground surface throughout the 2018/2019 winter season. Sustained surface water levels begin to accumulate in mid March 2019 and raise to a maximum recorded level of 179.2 masl, a depth of about 0.25m above the wetland ground surface. The surface water level begins to fall back below the wetland ground surface in mid June 2019 corresponding to a falling groundwater level also recorded at this time.

3. CONSTRUCTION DEWATERING

The West Lands development includes a combination of residential units (Townhomes and Condominiums), tennis courts, parking areas, a clubhouse, and a stormwater management (SWM) facility to be designed as a constructed wetland feature. The East Lands development includes a series of commercial blocks, an institutional block and eight (8) single family residential lots. The Development structures for both areas are proposed to be slab-on-grade construction, serviced by a network of private and municipal roadways, watermains and storm and sanitary sewers.

Conceptual plan drawings provided to DSCL included routes of water servicing, sanitary servicing, and existing and proposed road configurations. Detailed servicing plans were not available at the time of writing this report and so dewatering estimates were completed based on approximated depths of services. Additionally, a grading plan was not available for review. It is however understood that existing grades will be maintained for the most part, with some increases in grade for northern sections of the West Lands particularly development areas adjacent to Georgian Bay.

The need for temporary construction dewatering is assumed where excavations including trenching for utility works and excavations for the temporary SWM pond are anticipated to intersect with groundwater. Temporary or permanent dewatering for the construction and design of all proposed buildings and structures were also examined. Details and estimated dewatering volumes can be found in the following sections below.

3.1 Dewatering Requirements – Townhomes and Condominiums

Based on current conceptual designs, basements and crawl spaces are not proposed for any of the building structures. Slab on grade construction is anticipated to be more or less at existing grade with footings extending approximately 2 m into the native sandy soils. Considering the current groundwater table ranges across the site between 0.2 and 1.4 mbgs (December 2018), it is expected that footings will be constructed within saturated soils. As a result, some dewatering will likely be required to provide reasonably dry conditions during the construction. For the purposes of estimating dewatering rates, seasonal high water levels are estimated to be at ground surface.

To estimate the amount of dewatering needed to drain the excavation for the construction of the footings and foundation walls, the Dupuit expression for an “unconfined aquifer in steady-state conditions to a well” was used:

$$Q = K * (H^2 - h^2) / 0.733 * \text{Log} (R/r_e) = \sim 46 \text{ m}^3/\text{day}$$

Where,

K – Hydraulic conductivity [m/day] = 3.27×10^{-5} m/sec

H – Distance from static water level to the bottom of an aquifer = 3m

h – Depth of water in the well while pumping = 0.5m

r_e – equivalent radius [m] = $((a*b) / \pi)^{0.5}$ where a and b excavation dimensions (3 x 100 m) = 9.77 m

R – Radius of the cone of depression = $r_e + 3000 * (H - h) * K^{0.5}$, (k [m/s]) = 52.66 m

To temporarily provide dry conditions for the construction of footings and foundation walls, buildings requiring 100m of open trench should anticipate a dewatering rate of about 46, 000 L per day. Though conservative measurements were used in estimating the dewatering rate, a safety factor of 1.5 should be included to account for possible variations in K and weather events such as precipitation and snow melt. Including the factor, a dewatering rate of about **69, 000 L per day** should be anticipated. Groundwater control through sumps may be possible in areas where groundwater levels are over 1 m below finished grade. Positive dewatering through wells or eductors should be considered in areas with saturated surface conditions. Permanent dewatering is not anticipated for the buildings however under slab groundwater control should be included in designs given the potential for high groundwater conditions.

3.2 Dewatering Requirements- Sewers/Utilities Installation

The proposed development will include a watermain, storm and sanitary sewer installation. The proposed water main for the West Lands includes a proposed connection to the existing 200mm watermain along Hwy 26 across from Hope Street and a connection to the existing 150 mm watermain along Blue Mountain Drive. For the East Lands, the proposed watermain will include a connection to the existing 150mm watermain along Brophy's Lane and Long Point Road. Upgrades to the existing watermain in the East Lands may be required. To complete the watermain connection to the existing 200mm watermain (Hwy 26), a Jack & Bore method of construction under Highway 26 is proposed. The entire development will require approximately 1200 m of watermain within the West Lands and about 500 m of watermain within the East Lands.

The proposed sanitary sewers for the West Lands includes a proposed connection to the existing 300mm sanitary sewer along Hwy 26 south of Blue Mountain Drive. The invert at the connection is at an elevation of approximately 175.86 masl. Invert elevations for the proposed sanitary manholes rise to the north with the highest invert elevation being 178.15 masl in the northeast corner of the West Lands. The proposed sanitary sewers for the East Lands includes a proposed connection to the existing 300mm sanitary sewer along Hwy 26 south of Brophy's Lane and between Timmons Street and Long Point Road. The invert at the connection is at an elevation of approximately 177.26 and 178.63 masl, respectively. Invert elevations for the proposed sanitary manholes include a maximum 179.10 masl for the southeast corner of the East Lands and about 178.40 masl for the northwest corner of the East Lands. To complete the watermain connection to the existing 300mm sanitary sewer (Hwy 26) between Timmons Street and Long Point Road, a Jack & Bore method of construction under Highway 26 is proposed. The entire

development will require approximately 1000 m of sanitary lines within the West Lands and about 500 m of sanitary line within the East Lands.

The proposed storm sewer servicing plan was not available for review at the time of writing this report. Based on the configuration of the proposed development, it is anticipated that the entire development will require approximately 1500 m of storm sewers within the West Lands and about 800 m of storm sewers within the East Lands. Proposed invert elevations are not known at this time.

It is understood that installations and service connections will be completed open cut with the exception of service connections across Hwy 26 which will be completed using a Jack & Bore methodology. Watermain and sewer profiles were not provided and so trench depths required for service installs were estimated to be a maximum of 4 m below existing grade. The maximum depth was chosen using the sanitary sewer invert elevation at the existing 300mm sanitary sewer connection along Hwy 26 south of Blue Mountain Drive as the worst-case scenario. Excavated soils can be expected to consist of sand to silty sand. It is expected that only 30 meters of trench would be open at any given time. Given the worst-case scenario, the anticipated pumping rate that is needed to achieve the required drawdown for a 30 m open cut trench to a depth of 4 mbgs was estimated using the Dupuit expression for an unconfined aquifer in steady-state conditions:

$$Q = K * (H^2 - h^2) / 0.733 * \text{Log} (R/r_e) = \sim 63 \text{ m}^3/\text{day}$$

Where,

K – Hydraulic conductivity [m/day] = 3.27×10^{-5} m/sec

H – Distance from static water level to the bottom of an aquifer = 4.5m

h – Depth of water in the well while pumping = 0.5m

r_e – equivalent radius [m] = $((a*b) / \pi)^{0.5}$ where a and b excavation dimensions (2 x 30 m) = 4.37 m

R – Radius of the cone of depression = $r_e + 3000 * (H - h) * K^{0.5}$, (k [m/s]) = 72.99 m

To temporarily provide dry conditions for the installation of linear infrastructure including watermains, storm and sanitary services, a 30 m section of open cut trench given the worst-case scenario may require a dewatering rate of upto 63, 000 L per day. Though conservative measurements were used in estimating the dewatering rate, a safety factor of 1.5 should be included to account for possible variations in K and weather events such as precipitation and snow melt. Including the factor, a dewatering rate of about **94, 500 L per day** should be anticipated. Groundwater control through sumps may be possible in areas where groundwater levels are over 1 m below finished grade. Positive dewatering through wells or eductors should be considered in areas with saturated surface conditions.

3.3 Dewatering Requirements- SWM Facility

The proposed development will be serviced with a SWM pond located along the south and west perimeter of the PSW complex. A detailed design drawing for the pond was not available at the time of writing this report however it is understood that the pond will be a constructed wetland SWM facility approximately 1.4 ha in size. The facility is mainly a conveyance corridor with water quality control

capability. Do to the direct outlet to Georgian Bay, peak flow management is not a requirement. As a result, the facility is expected to be relatively shallow. The facility will be hydrologically and hydrogeologically isolated from the existing water regime that supports the existing PSW features. This isolation will be achieved using impermeable liners along the entire course of the facility. To anticipate the rate of dewatering required to construct the facility, an excavation of approximately 1m is assumed to remove topsoil and install the liner material. Due to the size of the facility, it is anticipated that only small sections (1000 m²) will be constructed at any given time. For the purposes of estimating dewatering rates, seasonal high water levels are estimated to be at ground surface.

To estimate the amount of dewatering needed to drain the excavation for the construction of the SWM facility, the Dupuit expression for an “unconfined aquifer in steady-state conditions to a well” was used:

$$Q = K * (H^2 - h^2) / 0.733 * \text{Log} (R/r_e) = \sim 26 \text{ m}^3/\text{day}$$

Where,

K – Hydraulic conductivity [m/day] = 3.27×10^{-5} m/sec

H – Distance from static water level to the bottom of an aquifer = 1.5m

h – Depth of water in the well while pumping = 0.5m

r_e – equivalent radius [m] = $((a*b) / \pi)^{0.5}$ where a and b excavation dimensions (20 x 50 m) = 17.84 m

R – Radius of the cone of depression = $r_e + 3000 * (H - h) * K^{0.5}$, (k [m/s]) = 35.00 m

To temporarily provide dry conditions for the construction of the SWM facility (1000 m² at a time), a dewatering rate of about 26, 000 L per day should be anticipated. Though conservative measurements were used in estimating the dewatering rate, a safety factor of 1.5 should be included to account for possible variations in K and weather events such as precipitation and snow melt. Including the factor, a dewatering rate of about **39, 000 L per day** should be anticipated. Groundwater control through overland flow and sumps is likely acceptable. Positive dewatering using wells or eductors is not anticipated.

3.4 Permit to Take Water (PTTW) / Environmental Activity and Sector Registry (EASR) Application

The highest dewatering rate anticipated during the construction of any 30 m length of open trench for the installation of linear infrastructure is **94, 500 L per day**. The highest dewatering rate anticipated during the construction of buildings / footings (assumed 100 m open trench) is **69, 000 L per day**. For the construction of the SWM facility (assumed 1000 m² at any given time), a dewatering rate of about **39, 000 L per day** is anticipated. Should these activities be occurring simultaneously, the total dewatering rate is **202,500 L per day**. Since the expected dewatering rates exceed a limit 50,000 L/day, an Environmental Activity and Sector Registry (EASR) application will be required from the MECP. Maximum combined dewatering rates from concurrent dewatering activities are not anticipated to reach the Limit for a PTTW permit requirement at 400,000 L/day. As such, a PTTW is not considered a requirement at this time. If concurrent dewatering activities are planned, including open cut trenching in excess of what has been described in this report, DSCL should be notified to provide a reassessment of predicted

dewatering rates.

3.5 Point of Discharge

A discharge plan will be required for the discharge of pumped groundwater from the construction dewatering. The plan must identify the discharge location and ensure the discharge will not result in any adverse impacts by identifying the discharge measures to be installed and control measures to limit the turbidity of the discharge water. If the water is to be discharge to local surface water, approvals may be required from the GSCA. As such, the quality of groundwater discharge will have to conform to the applicable standards. These include the Provincial Water Quality Objectives (PWQO). **Table 6** provides a recommended monitoring program, triggers for mitigation and recommended mitigation measures for groundwater levels and the discharge of water during construction.

Table 6: Monitoring and Mitigation Plan

Period	Monitoring Location	Monitoring Frequency	Method	Triggers for Mitigation	Comments and Recommendations
Water Levels					
Pre-Construction	Groundwater level monitoring (available on-site monitoring wells)	Bi-monthly	Dataloggers within the existing wells (recording daily)	None	Complete hydrographs to document baseline water levels
	Surface water level monitoring (on-site staff gauges / piezometers)	Bi-monthly	Dataloggers within piezometers/staff gauges (recording daily)	None	Complete hydrographs to document baseline water levels
During Construction	Existing monitoring wells or replacements adjacent to dewatering area	Weekly	Dataloggers within the existing wells (recording daily)	Target drawdown not reached or exceeded	Increased/reduced pumping
	Existing on-site piezometers/staff gauges	Weekly	Dataloggers within piezometers/staff gauges (daily)	Adverse impacts observed	Increased/reduced pumping
	Discharge Volume	Daily at discharge location	Manual with totalizing flow meter in-line	Flow exceeds predicted volumes	If pumping is approaching 400 m ³ /day, a PTTW will be required; Reduce to maximum

Period	Monitoring Location	Monitoring Frequency	Method	Triggers for Mitigation	Comments and Recommendations
					allowed or obtain a PTTW
Post-Construction	Existing monitoring wells or replacements adjacent to dewatering area	Daily until water level reaches 90% of static level; bi-monthly after static is reached	Dataloggers within wells (recording daily measurements)	N/A	N/A
	Existing on-site piezometer/staff gauge located within wetland complex)	Bi-monthly	Dataloggers within piezometers/staff gauges (recording daily measurements)	N/A	N/A
Water Quality					
During Construction	Groundwater Discharge from dewatering	Once at the start of dewatering at the point of discharge Weekly from the dewatering system for the first month of active dewatering Assuming water quality is compliant, monthly for the remainder of the dewatering period.	Sample for metals and general water quality characteristics for comparison to PWQO criteria	Discharge quality exceeds the PWQO criteria	More frequent monitoring will be considered Enhanced treatment of the discharge water will be considered if needed

4. PREDICTED IMPACTS

The following are the predicted potential impacts as a result of the proposed development and construction dewatering, if required:

4.1 Water Quality

For water quality impacts to arise from dewatering activities, groundwater impacts must already be present within the zone of influence (ZOI). Considering the radius of influence anticipated and the relatively short duration of dewatering expected, impacts migrating onsite as a result of dewatering is highly unlikely.

Groundwater quality analysis indicated that one or more parameters listed in PWQO criteria exceeded the guideline concentrations. Therefore, the groundwater at the site is not suitable for direct discharge to surface water or drainage features. To address water quality prior to discharge, a treatment plan must be developed and implemented by the contractor. Treatment may include, but not limited to, sedimentation and/or filtration to lower TSS. Since many metals are associated with sediments, it is expected that elevated metals will also be reduced with reductions in TSS. If needed, additional treatment (e.g. Coagulation) may be needed to further reduce metals concentrations prior to discharge.

4.2 Settlement Due to Dewatering Activities

The predicted zone of influence (ZOI) is minimal for proposed open-cut excavations for services and is not anticipated to induce settlement for nearby structures. In the area of the temporary SWM pond, there are no structures within the predicted 85m ZOI.

4.3 Drainage

Post development stormwater conveyance and improvement to surface drainage details are outlined in the Post Development Drainage Plan carried out by C.F. Crozier & Associates. Post development drainage conditions for the two (2) development areas are summarized below:

West Lands:

The entire development across the West Lands will drain to the proposed SWM facility via storm sewers and overland flow routes, with the exception of the rear lots of the lakefront units. Runoff from the improved Blue Mountain Road corridor and extension of the Brophy's Lane cul-de-sac will also drain to the SWM facility. The SWM facility is to be constructed as a linear stormwater wetland with water quality control capability, consistent with industry standard SWM practices. It is noted that Peak flow control is unnecessary due to the direct outlet to Georgian Bay. The constructed wetland SWM facility will extend from the East Lands and will discharge into Georgian Bay via a constructed outfall.

Overall, the drainage area contributing to the culvert at Blue Mountain Drive is reduced when compared to existing conditions. This is due to the redirection of drainage from the majority of the development

lands to the proposed SWM facility. Drainage from the Highway 26 corridor will remain independent from the internal drainage network and continue to discharge to approximately 300 m west of the site. Drainage from the Provincially Significant Wetland (PSW) areas within the West Lands will remain unchanged as a result of the development. The constructed wetland SWM facility, will be hydrologically and hydrogeologically isolated from the existing water regime that supports the existing PSW features which will be adjacent the facility. This isolation will be achieved through use of impermeable barriers between the natural and constructed wetlands.

East Lands:

The proposed SWM facilities in the East Lands will consist of roof and parking lot storage. However, portions of the development within the East Lands will also utilize the constructed wetland SWM facility to the extent possible subject to site grading constraints. The redirection of runoff from areas of imperfect drainage characteristics will be implemented where feasible in order to improve existing drainage conditions. Drainage from the Highway 26 corridor would also remain independent from the internal drainage in the East Lands.

Based on site grading constraints, the commercial blocks adjacent to the Eastern Drain and watercourse will be directed to their respective outlets, (See Appendix E). For commercial blocks less than 5 ha, typical SWM practices include rooftop, parking lot and subsurface storage for water quantity control, and end-of-pipe treatment (i.e. oil/grit separator) for water quality control. This is the case for two of the commercial blocks within the East Lands. Since Georgian Bay is not the direct receiver of runoff from these blocks, water quantity (i.e. peak flow) control will be required in addition to water quality controls. Drainage from each catchment will be controlled through the above-noted treatment methods prior to discharge to their respective outlets. The direct discharge of treated runoff to the suitable outlets will reduce the volume of runoff which currently enters the area and doesn't drain. Overall, the proposed stormwater management measures will improve the local drainage conditions. All proposed SWM works will also be isolated from the existing PSW features in the East Lands, such that pre-development water budgets remain unchanged post development.

4.4 Groundwater Contribution to SCWC

An Environmental impact Study was prepared by HDG in 2009 which assessed the potential impacts to the SCWC and provided recommended mitigation measures. The details of this assessment are summarized in **Table 5** in Section 2.3.5. of this report. In addition to the potential impacts provided, temporary reductions in groundwater contributions to the wetlands may occur during construction dewatering activities in areas where the ZOI extend into the wetland. Considering water levels in the wetland appears to be a reflection of the water table, reductions in groundwater levels would result in a lowering of water levels within the SCWC. As a result, it is recommended that the construction of SWM facilities adjacent to the SCWC occur following the seasonally high groundwater levels which temporarily flood the wetland. No long term reduction in groundwater levels or reductions in groundwater contributions to the SCWC is anticipated as a result of the proposed development.

4.5 Well Decommissioning

Following the completion of construction activities, all dewatering wells, well points, eductors, and monitoring wells installed at various stages of this project must be decommissioned. The installation and eventual decommissioning of the wells and the dewatering system must be carried out by a licenced water well contractor in accordance with Regulation 903 of the Ontario Water Resources Act.

5. GENERAL COMMENTS AND LIMITATIONS OF REPORT

DS Consultants Limited (DSCL) should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, DSCL will assume no responsibility for interpretation of the recommendations in the report.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to DSCL at the time of preparation. Unless otherwise agreed in writing by DSCL, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

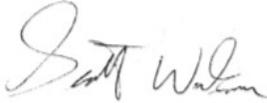
The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted hydrogeological practices.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. DSCL accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

Very truly yours,
DS CONSULTANTS LTD



Scott Watson, B.A.T.
Project Manager



Martin Gedeon, M.Sc. P.Geo.,
Vice President

6. REFERENCES

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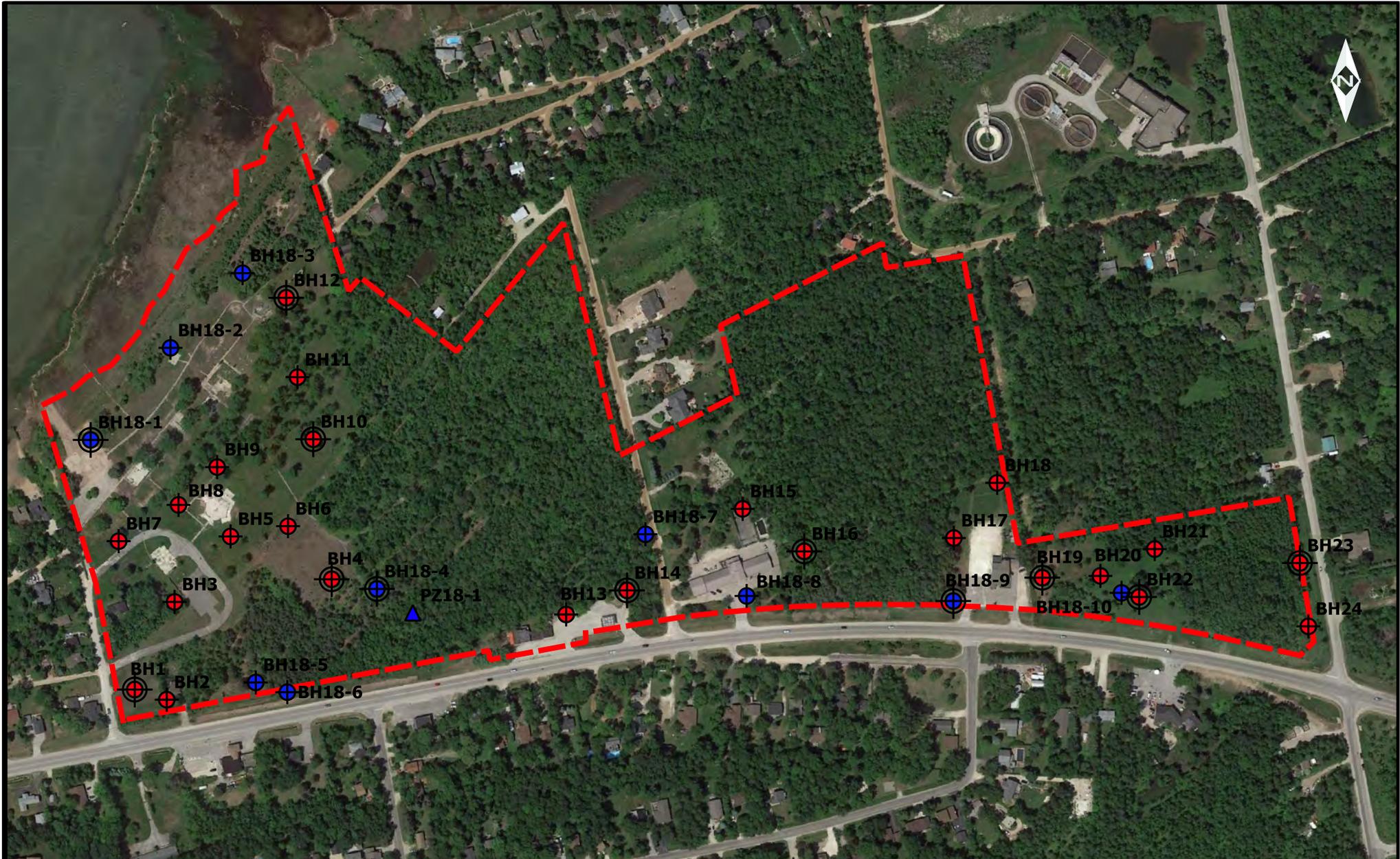
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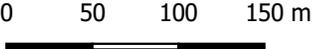
Hensel Design Group Inc.; An Environmental Impact Statement for the Proposed Terrasan Development on Part of Lot 20 and Lot 21, Concession 1, Town of The Blue Mountains; February 2009

FIGURES



Legend

-  Site Boundary
-  Borehole Location (DS Consultants Ltd., 2018)
-  Monitoring Well Location (DS Consultants Ltd., 2018)
-  Borehole Location (Shaheen & Peaker, 2008)
-  Monitoring Well Location (Shaheen & Peaker, 2008)
-  Surface Water Monitoring Station

Date: August 2019	Drawing By: WG	Approved By: SW	Client: Royalton Homes	Figure 1
Original: Tabloid			Project # 18-736-10	
 DS CONSULTANTS LTD. Geotechnical ♦ Environmental ♦ Materials ♦ Hydrogeology			Figure Name: Borehole Location Map	
			Project: Hydrogeological Investigation	



Legend

- Site Boundary
- ▲ Piezometer
- Borehole Locations 2018
- Borehole Location 2008
- Groundwater Elevation Contour (0.25 m)

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 Vaughan, Ontario L4H 0K8
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 www.dsconsultants.ca

Client: Royalton Homes

Project: Aquavil Development, Craigeith, Ontario			
Title: Groundwater Flow Map			
Size: 11x17	Approved By: SW	Drawn By: WG	Date: August 2019
Rev: 0	Scale: As Shown	Project No.: 18-736-10	Figure No.: 2
Image/Map Source: Google Satellite Image			



Legend

-  Site Boundary
-  500m Buffer
-  Registered Water Wells (MOECP WWR)

Date: November 2018	Drawing By: SE	Approved By: SW	Client: Royalton Homes	Figure # 3
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Original: Tabloid	0 100 200 300 m	Project # 18-736-10
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 DS CONSULTANTS LTD. Geotechnical ♦ Environmental ♦ Materials ♦ Hydrogeology	Figure Name: MOECP Water Well Record Map
	Project: Hydrogeological Investigation



Legend

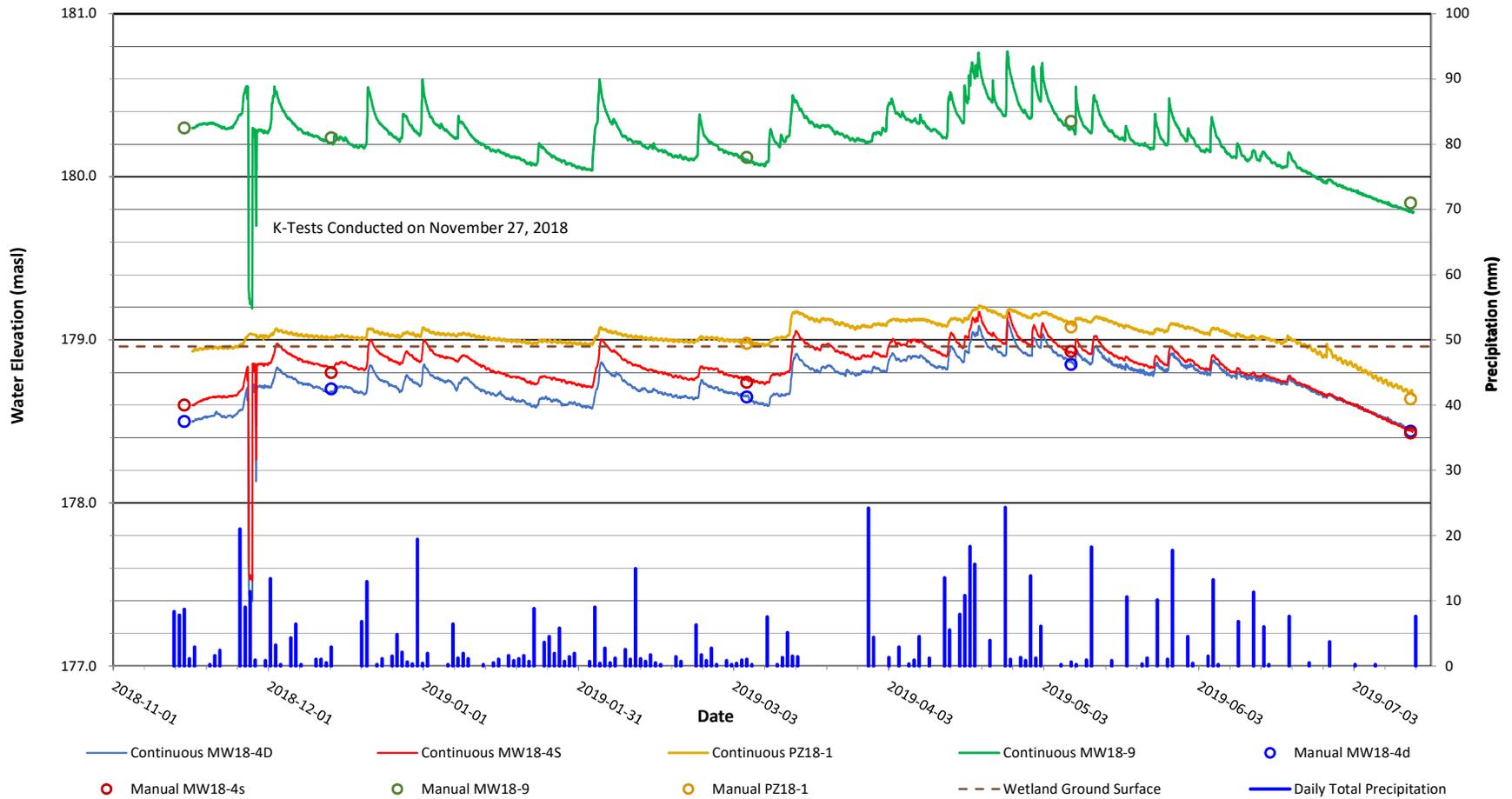
- Site Boundary
- 3 - Paleozoic Bedrock
- 14b - lacustrine sand - littoral
- 5b - glacial diamicton
- 9b - glaciolacustrine gravel - littoral
- 5d - glacial diamicton
- 9c - glaciolacustrine sand - foreshore
- 20 - wetland organic deposits
- 6 - glaciofluvial sand, gravel - ice-contact
- 21 - anthropogenic fill

Date: January 2019	Drawing By: SE	Approved By: SW	Client: Royalton Homes	Figure # 4
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Original: Tabloid	0 500 1000 1500 m	Project # 18-736-10
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	<p>DS CONSULTANTS LTD.</p> <p>Geotechnical ♦ Environmental ♦ Materials ♦ Hydrogeology</p>	<p>Figure Name: Surficial Geology Map</p> <p>Project: Hydrogeological Investigation</p>
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Groundwater Level Hydrograph



AquaVil Development, Craigeith, ON

Hydrogeological Investigation

Project #: 18-736-400

November 2018 to July 2019

Figure 5



DS CONSULTANTS LTD.
Geotechnical - Environmental - Materials - Hydrogeology

APPENDICES

Appendix A: Borehole Logs

PROJECT: AquaVil Development
 CLIENT: Royalton Homes
 PROJECT LOCATION: Craigeleith, ON
 DATUM: Geodetic
 BOREHOLE LOCATION: See Drawing 1 N 4930371 E 555263.7

DRILLING DATA
 Method: Hollow Stem Auger
 Diameter: 150mm
 Date: Oct-31-2018
 REF. NO.: 18-736-10
 ENCL NO.: 1

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			20 40 60 80 100	20 40 60 80 100						
178.6	TOPSOIL: 210 mm													
178.4	SILTY SAND: some organics, black to brown, moist, loose. Disturbed soil zone.	1	SS	5										
178.0	SAND: trace gravel, cobble sizes, trace silt, moist, compact	2	SS	15										
177.4	wet, loose	3	SS	9										
176.8		4	SS	7										
176.2		5	SS	8										
174.0	grey	6	SS	50/ 25mm										
173.7	CLAYEY SILT: grey, soft to stiff, wet													
4.9	END OF BOREHOLE Notes: 1) Borehole terminated due to auger refusal on boulders or inferred bedrock at 4.9 mbgs 2) 51 mm diameter monitoring well installed upon completion 3) Water level measured at 1.5 mbgs upon completion 4) Water level measured at 1.4 mbgs (177.2 masl) on Nov.15, 2018													

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigeleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930448.8 E 555331.2	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Oct-31-2018 REF. NO.: 18-736-10 ENCL NO.: 2
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)							
178.4	TOPSOIL: 190 mm													
178.0	SAND: with silt, trace to some organics, black to brown, moist, loose. Disturbed soil zone.	1	SS	5		178								
177.8	SAND: trace to gravelly layers, cobble sizes, trace silt, brown to grey, moist to wet, compact	2	SS	17		177								
177.0		3	SS	19		176								
176.0		4	SS	19		175								
175.0		5	SS	23		174								
173.8						173								
173.4	SILTY SAND: some gravel, grey, wet, loose	6	SS	7		173								
173.0	CLAYEY SILT: grey, wet, compact													
172.9	SHALE: grey, wet, very dense.	7	SS	50/										
172.7	boulders or assumed bedrock.			25 mm										
172.5	END OF BOREHOLE Notes: 1) Auger grinding at 5.5 m mbgs 2) Borehole terminated due to auger refusal at 5.7 mbgs on boulders or assumed bedrock 3) Water level at 1.70 mbgs upon completion													

W. L. 176.7 m
Oct 31, 2018

6 86 (6)

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930511.9 E 555392.2	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Oct-31-2018 REF. NO.: 18-736-10 ENCL NO.: 3
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)						
178.0														
177.8	TOPSOIL: 180 mm	X	1	SS	3									
0.2	SAND: trace silt, trace organics, black to brown, moist, loose.	X												
177.4	Disturbed soil zone.	X												
0.6	SAND: trace to gravelly layers, cobble sizes, trace silt, brown to grey, moist to wet, compact	X	2	SS	15									
1		X												
2		X	3	SS	18									
3		X												
4	grey	X	4	SS	16									
5		X												
6		X	5	SS	12									
174.8	SHALE: grey, wet, very dense. Boulders or assumed bedrock.	X	6	SS	50/25mm									
4.6	END OF BOREHOLE Notes: 1) Borehole terminated due to auger refusal at 4.6 mbgs on boulders or assumed bedrock 2) Water level at 0.9 mbgs upon completion	X												

W. L. 177.1 m
Oct 31, 2018

wet spoon

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: AquaVil Development
 CLIENT: Royalton Homes
 PROJECT LOCATION: Craigeleith, ON
 DATUM: Geodetic
 BOREHOLE LOCATION: See Drawing 1 N 4930245.1 E 555505.8

DRILLING DATA
 Method: Hollow Stem Auger
 Diameter: 150mm
 Date: Nov-01-2018
 REF. NO.: 18-736-10
 ENCL NO.: 4

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)						
179.8	TOPSOIL: 110 mm												
179.0	SAND: trace silt, trace organics, black to brown, moist, loose.	1	SS	4									
179.2	Disturbed soil zone.												
0.6	SAND: trace to gravelly layers, cobble sizes, trace silt, brown to grey, moist to wet, loose to dense	2	SS	8									
1	wet												
2		3	SS	20									
3	grey												
4		4	SS	27									92 (8)
5		5	SS	30									
175.1	SANDY SILT TILL: some gravel, trace clay, moist, very dense	6	SS	65									11 31 52 6
4.8													
6													
173.2	END OF BOREHOLE Notes: 1) 51 mm diameter monitoring well installed upon completion 2) Water level at 1.5 mbgs upon completion 3) Water level measured at 1.3 mbgs (178.5 masl) on Nov.15, 2018	7	SS	33									
6.6													

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigeleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930245.1 E 555505.8	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Nov-01-2018 REF. NO.: 18-736-10 ENCL NO.: 5
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			20 40 60 80 100	20 40 60 80 100						
179.8	TOPSOIL: 110 mm													
179.0	SAND: trace silt, trace organics, black to brown, moist, loose.	1	SS	4					o					
179.2	Disturbed soil zone.													
179.0	SAND: trace to gravelly layers, cobble sizes, trace silt, brown to grey, moist to wet, loose to dense	2	SS	8					o					
178.6	wet													
178.4		3	SS	20					o					
178.2														
178.0	grey													
177.8		4	SS	22					o					92 (8)

3.1	END OF BOREHOLE Notes: 1) 51 mm diameter monitoring well installed upon completion 2) Water level at 1.4 mbgs upon completion 3) Water level measured at 1.2 mbgs (178.6 masl) on Nov.15, 2018													
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DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930166.1 E 555403.3	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Nov-01-2018 REF. NO.: 18-736-10 ENCL NO.: 6
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)								WATER CONTENT (%)	
179.7	TOPSOIL: 250 mm															
0.0 179.5	SAND: trace silt, trace organics, black to brown, moist, loose. Disturbed soil zone. SAND: trace to gravelly layers, cobble sizes, trace to some silt layers, brown to grey, moist to wet, loose to compact	1	SS	4	▽	W. L. 178.5 m Nov 01, 2018										
0.3 179.1		2	SS	8												
0.6 178.9		3	SS	16												
1 178.7		4	SS	21												
1.2 178.5		5	SS	23												
1.4 178.3																
1.6 178.1																
1.8 177.9																
2.0 177.7																
2.2 177.5																
2.4 177.3																
2.6 177.1																
2.8 176.9																
3.0 176.7																
3.2 176.5																
3.4 176.3																
3.6 176.1																
3.8 175.9																
4.0 175.7																
4.2 175.5																
4.4 175.3																
4.6 175.1	SANDY SILT TILL: some clay, some gravel, wet, very dense	6	SS	4												
4.8 174.9																
5.0 174.7																
5.2 174.5																
5.4 174.3																
5.6 174.1																
5.8 173.9																
6.0 173.7																
6.2 173.5																
6.4 173.3																
6.5 173.2	END OF BOREHOLE Notes: 1) Borehole terminated due to auger refusal on boulders or inferred bedrock at 6.5 mbgs 2) Water level measured at 1.2 mbgs upon completion	7	SS	50/ 50mm												

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigeleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930157.8 E 555430	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Nov-05-2018 REF. NO.: 18-736-10 ENCL NO.: 7
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)							
179.4	TOPSOIL: 100 mm													
178.9	SAND: trace silt, trace organics, black to brown, moist, loose.	1	SS	4	▽	179								
178.8	Disturbed soil zone.					178.9 m								
1	SAND: trace gravel, cobble sizes, trace silt, brown to grey, wet, loose to compact	2	SS	9		178								
2		3	SS	8		177								
3	compact	4	SS	28		176								
4		5	SS	12		175								
175.6	SANDY SILT: to clayey silt, trace sand, grey, wet, loose	6	SS	5		174								
175.1	SILTY CLAY: trace to some sand, grey, wet, soft	7	SS	3				7.0						
174.2	SILT: some clayey, trace sand, grey, wet, loose	8	SS	50/ 27mm										

END OF BOREHOLE
 Notes:
 1) Borehole terminated due to auger refusal on boulders or inferred bedrock at 5.6 mbgs
 2) Water level measured at 0.5 mbgs upon completion

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930291.3 E 555732.9	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Nov-05-2018 REF. NO.: 18-736-10 ENCL NO.: 8
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SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)						
180.2	TOPSOIL: 50 mm		1	SS	6	W. L. 179.6 m Nov 06, 2018							GR SA SI CL	
180.4	SAND: trace silt, trace organics, brown, moist, loose. Disturbed soil zone.													
179.6	SAND: trace to gravelly layers, trace to some silt layers, brown, wet, loose to compact		2	SS	8									
179.0			3	SS	14									
177.9	SILTY SAND: grey, wet, compact		4	SS	18									
177.3			5	SS	17									
176.4	SILT: trace sand, trace gravel, trace clay, grey, wet, loose		6	SS	7									1 7 84 8
175.4	SILTY CLAY: trace sand, grey, soft, wet		7	SS	4									
174.1				VANE										
173.6	CLAYEY SILT TILL: trace to some sand, trace gravel, grey, wet, stiff		8	SS	8									
173.0				VANE										
174.1			9	SS	7									
6.6	END OF BOREHOLE Notes: 1) Borehole terminated due to auger refusal on boulders or inferred bedrock at 6.6 mbgs													

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigeleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930239.1 E 555818.5	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Nov-06-2018 REF. NO.: 18-736-10 ENCL NO.: 9
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)						
181.2	TOPSOIL: 250 mm												
181.0	SAND: some silt, some organics, trace to some gravel, cobble sizes, black to brown, moist, loose to compact. Disturbed soil zone.	1	SS	7									
180.0		2	SS	14									
180.0		SAND: trace to gravelly layers, trace to some silt layers, brown, moist to wet, compact to dense.	3	SS	19								
179.0			4	SS	25								
178.0			5	SS	37								
176.5	SILTY CLAY: trace sand, trace gravel, grey, firm, wet	6	SS	7									
175.2			VANE										
174.5	CLAYEY SILT TILL: trace to some sand, trace gravel, grey, wet, stiff	7		50/127mm									
6.7	END OF BOREHOLE Notes: 1) Borehole terminated due to auger refusal on boulders or inferred bedrock at 6.7 mbgs												

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES: + 3, x 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigeleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930234.8 E 55993.3	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Nov-06-2018 REF. NO.: 18-736-10 ENCL NO.: 10
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%)				
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L
181.2	TOPSOIL: 210 mm																
180.0	SAND: some organics, trace silt, black to brown, moist, loose.	1	SS	5													
180.6	Disturbed soil zone.																
0.6	SAND: trace to gravelly layers, trace to some silt layers, brown to grey, wet, compact to dense.	2	SS	17													
1	grey	3	SS	10													
2	dense	4	SS	30													
3		5	SS	19													
4																	
176.6	SANDY SILT TILL: some gravel, cobble sizes, trace clay, grey, wet, very dense	6	SS	73													
176.0																	
5.2	END OF BOREHOLE Notes: 1) 51 mm diameter monitoring well installed upon completion 2) Water level at 1.1 mbgs upon completion 3) Borehole terminated due to auger refusal on boulders or inferred bedrock at 5.2 mbgs 4) Water level measured at 0.9 mbgs (180.3 masl) on Nov.15, 2018																

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS.GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: AquaVil Development CLIENT: Royalton Homes PROJECT LOCATION: Craigeleith, ON DATUM: Geodetic BOREHOLE LOCATION: See Drawing 1 N 4930241.7 E 556135.6	DRILLING DATA Method: Hollow Stem Auger Diameter: 150mm Date: Nov-06-2018 REF. NO.: 18-736-10 ENCL NO.: 11
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	METHANE AND GRAIN SIZE DISTRIBUTION (%)				
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80				100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L
181.2	TOPSOIL: 130 mm																
180.9 0.1	SAND: some organics, trace silt, black to brown, moist, loose.	1	SS	4													
180.6 0.6	Disturbed soil zone.																
	SAND: trace gravel, trace silt, brown to grey, wet, loose.	2	SS	9													
1	grey																
2		3	SS	8													
178.9 2.3	SANDY SILT TILL: gravelly some gravel, cobble sizes, some clay, grey, wet, compact to dense	4	SS	43													
3	compact																
4		5	SS	16													
5	dense																
6		6	SS	47													
175.4 5.8	SHALE: grey, wet, very dense. Boulders or assumed bedrock. END OF BOREHOLE Notes: 1) Borehole terminated due to auger refusal at 5.8 mbgs on boulders or assumed bedrock 2) Water level at 1.2 mbgs upon completion	7	SS	50 for 25mm													

W. L. 180.0 m
Nov 06, 2018

39 41 19 1

DS SOIL LOG - 17-736-10, CRAIGLEITH, ON, GPJ DS, GDT 18-11-29

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ●=3% Strain at Failure

Log of Borehole BH1

Project No. SPN1235

Drawing No. 2

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigleith, Ontario

(N4930201 ; E444703)

Date Drilled: August 11, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

DEPTH (m)	Soil Description	ELEV. (m)	N Value				Combustible Vapour Reading (ppm)			SPT (N)	Natural Unit Weight (kN/m ³)
			Shear Strength (MPa)				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
			20	40	60	80	250	500	750		
0	50MM TOPSOIL	195.00									
	SAND trace silt, brown, moist, loose	194.95	0.1 0.2				10 20 30				
1	grey wet	194.20									
2											
3											
4	SANDY SILT TILL grey, wet	191.49									
	END OF BOREHOLE	190.43									
	- no detectable gases - 50mm well installed - borehole backfilled upon completion										



Shaheen & Peaker
Consulting Engineers
A Division of Coffey Geotechnics, Inc.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion August 20, 2008	WET CAVE 0.8	1.1 N/A

Log of Borehole BH2

Project No. SPN1235

Drawing No. 3

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario

(N4930182 ; E444676)

Date Drilled: August 11, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

G W L	S O I L	Soil Description	ELEV. m	D E P T H m	N Value				Combustible Vapour Reading (ppm)			S A M P L E	Natural Unit Weight kN/m ³
					Shear Strength				Natural Moisture Content %				
					MPa				Atterberg Limits (% Dry Weight)				
		FILL sand and gravel, some silt, greyish brown, moist, compact	195.00	0	0.1	0.2			10	20	30		
		SAND trace gravel, trace silt, brown, wet, compact to dense	194.24	1									
		grey		2									
				3									
				4									
			189.97	5									
		END OF BOREHOLE - no detectable gases - borehole backfilled upon completion											



**Shaheen & Peaker
Consulting Engineers**
A Division of Coffey Geotechnics, Inc.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	WET CAVE	0.5

Log of Borehole BH4

Project No. SPN1235

Drawing No. 5

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930254 ; E444534)

Date Drilled: August 12, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
				Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
				20	40	60	80	250	500	750	
	FILL sand, some mixed organics, brown, moist, loose	181.00	0	0.1	0.2	10	20	30	X		
		179.60	1						X		
		179.48	2						X		
	grey		3						X		
		176.10	4						X		
		175.97	5						X		
	SANDY SILT TILL grey, very moist, dense END OF BOREHOLE - no detectable gases - 50mm well installed - borehole backfilled upon completion										



Shaheen & Peaker
Consulting Engineers
A Division of Coffey Geotechnics, Inc.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion August 20, 2008	DRY 1.4	OPEN N/A

Log of Borehole BH6

Project No. SPN1235

Drawing No. 7

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930308 ; E444565)

Date Drilled: August 12, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SOIL	Soil Description	ELEV. m	DEPTH	N Value				Combustible Vapour Reading (ppm)			SATURATED	Natural Unit Weight kN/m ³
					Shear Strength MPa				Natural Moisture Content %				
					20	40	60	80	250	500	750		
		SAND trace surface topsoil, trace silt, brown, wet, compact grey	175.00	0	0.1	0.2			10	20	30		
		SANDY SILT TILL grey, wet, dense END OF BOREHOLE - no detectable gases - borehole backfilled upon completion	170.10 169.97	5									



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.2	4.0

Log of Borehole BH7

Project No. SPN1235

Drawing No. 8

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario
(N4930279 ; E444727)

Date Drilled: August 13, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- | | | | |
|-------------------------|-------------------------------------|---|-------------------------------------|
| Auger Sample | <input checked="" type="checkbox"/> | Combustible Vapour Reading | <input type="checkbox"/> |
| SPT (N) Value | <input type="checkbox"/> | Natural Moisture | <input checked="" type="checkbox"/> |
| Dynamic Cone Test | <input type="checkbox"/> | Plastic and Liquid Limit | <input type="checkbox"/> |
| Shelby Tube | <input checked="" type="checkbox"/> | Undrained Triaxial at % Strain at Failure | <input type="checkbox"/> |
| Field Vane Test | <input checked="" type="checkbox"/> | Penetrometer | <input checked="" type="checkbox"/> |
| Sensitivity | <input type="checkbox"/> | | |
| Piezometric Water Level | <input type="checkbox"/> | | |

G W L	L O a m e s	Soil Description	ELEV. m	D E P T H	N Value				Combustible Vapour Reading (ppm)			S A M P L 	Natural Unit Weight kN/m ³
					Shear Strength				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
					20	40	60	80	250	500	750		
		152MM TOPSOIL	179.00	0									
		FILL sand and gravel, trace silt, mixed organics, brown, moist, compact	178.85										
		SAND trace organics to 2.0m, trace shells, brown, wet, compact	178.24	1									
				2									
		grey											
				3									
				4									
		SANDY SILT TILL grey, moist, compact	174.30										
		END OF BOREHOLE - no detectable gases - borehole backfilled upon completion	173.97	5									



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.6	4.1

Log of Borehole BH8

Project No. SPN1235

Drawing No. 9

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario

(N4930302 ; E444680)

Date Drilled: August 13, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- | | | | |
|-------------------------|-------------------------------------|---|-------------------------------------|
| Auger Sample | <input checked="" type="checkbox"/> | Combustible Vapour Reading | <input type="checkbox"/> |
| SPT (N) Value | <input checked="" type="checkbox"/> | Natural Moisture | <input checked="" type="checkbox"/> |
| Dynamic Cone Test | <input type="checkbox"/> | Plastic and Liquid Limit | <input type="checkbox"/> |
| Shelby Tube | <input checked="" type="checkbox"/> | Undrained Triaxial at % Strain at Failure | <input type="checkbox"/> |
| Field Vane Test | <input checked="" type="checkbox"/> | Penetrometer | <input checked="" type="checkbox"/> |
| Sensitivity | <input type="checkbox"/> | | |
| Piezometric Water Level | <input type="checkbox"/> | | |

LOG	CORRECTION	Soil Description	ELEV. m	DEPTH (m)	N Value				Combustible Vapour Reading (ppm)			SAMPLES	Natural Unit Weight KN/m ³			
					Shear Strength MPa				250	500	750			Natural Moisture Content %		
					0.1 0.2				10	20	30			Atterberg Limits (% Dry Weight)		
		203MM TOPSOIL	175.00	0												
		SAND trace silt, trace shells, brown, wet, compact	174.80	0												
				1												
		grey		2												
				3												
			170.15	4												
		SANDY SILT TILL grey, moist, compact	169.97	5												
		END OF BOREHOLE														
		- no detectable gases - borehole backfilled upon completion														



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.3	4.1

Log of Borehole BH9

Project No. SPN1235

Drawing No. 10

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario

(N4930335 ; E444644)

Date Drilled: August 13, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	L	Soil Description	ELEV. m	D	N Value				Combustible Vapour Reading (ppm)			S	Natural Unit Weight kN/m ³	
					Shear Strength MPa				Natural Moisture Content %					
					20	40	60	80	250	500	750			
		102MM TOPSOIL	177.00	0										
		SAND trace silt, trace organics to 0.6m, trace shells, greyish brown, moist to very moist, loose to compact	176.90											
	 grey		1										
				2										
				3										
				4										
		SANDY SILT TILL grey, moist, very dense	172.43											
		END OF BOREHOLE - no detectable gases - borehole backfilled upon completion	172.30											



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.2	3.9

Log of Borehole BH10

Project No. SPN1235

Drawing No. 11

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930370 ; E444543)

Date Drilled: August 12, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

SOIL	Soil Description	ELEV. m	N Value				Combustible Vapour Reading (ppm)			SAMP	Natural Unit Weight kN/m ³
			Shear Strength				250	500	750		
			20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)				
0	76MM TOPSOIL	176.00									
	SAND trace silt, trace organics to 0.6m, brown, wet, loose to compact	175.92									
1		175.50									
2											
3	grey										
4											
	SANDY SILT TILL grey, moist, very dense END OF BOREHOLE	171.43 171.28									



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion August 20, 2008	3.5 0.5	OPEN N/A

Log of Borehole BH11

Project No. SPN1235

Drawing No. 12

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario
(N4930397 ; E444575)

Date Drilled: August 12, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- | | | | |
|-------------------------|-------------------------------------|---|-------------------------------------|
| Auger Sample | <input checked="" type="checkbox"/> | Combustible Vapour Reading | <input type="checkbox"/> |
| SPT (N) Value | <input type="checkbox"/> | Natural Moisture | <input checked="" type="checkbox"/> |
| Dynamic Cone Test | <input type="checkbox"/> | Plastic and Liquid Limit | <input type="checkbox"/> |
| Shelby Tube | <input type="checkbox"/> | Undrained Triaxial at % Strain at Failure | <input type="checkbox"/> |
| Field Vane Test | <input type="checkbox"/> | Penetrometer | <input type="checkbox"/> |
| Sensitivity | <input type="checkbox"/> | | |
| Piezometric Water Level | <input type="checkbox"/> | | |

GWL	SOIL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			SAMPLING	Natural Unit Weight kN/m ³
					Shear Strength MPa				250	500	750		
					20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		51MM TOPSOIL	183.00	0									
		SAND trace silt, trace organics to 0.8m, brown, wet, loose	182.95										
		grey, wet, compact		1									
				2									
				3									
				4									
		SANDY SILT TILL grey, wet, very dense	178.43										
		END OF BOREHOLE - no detectable gases - borehole backfilled upon completion	178.28										



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.5	3.2

Log of Borehole BH12

Project No. SPN1235

Drawing No. 13

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930494 ; E444578)

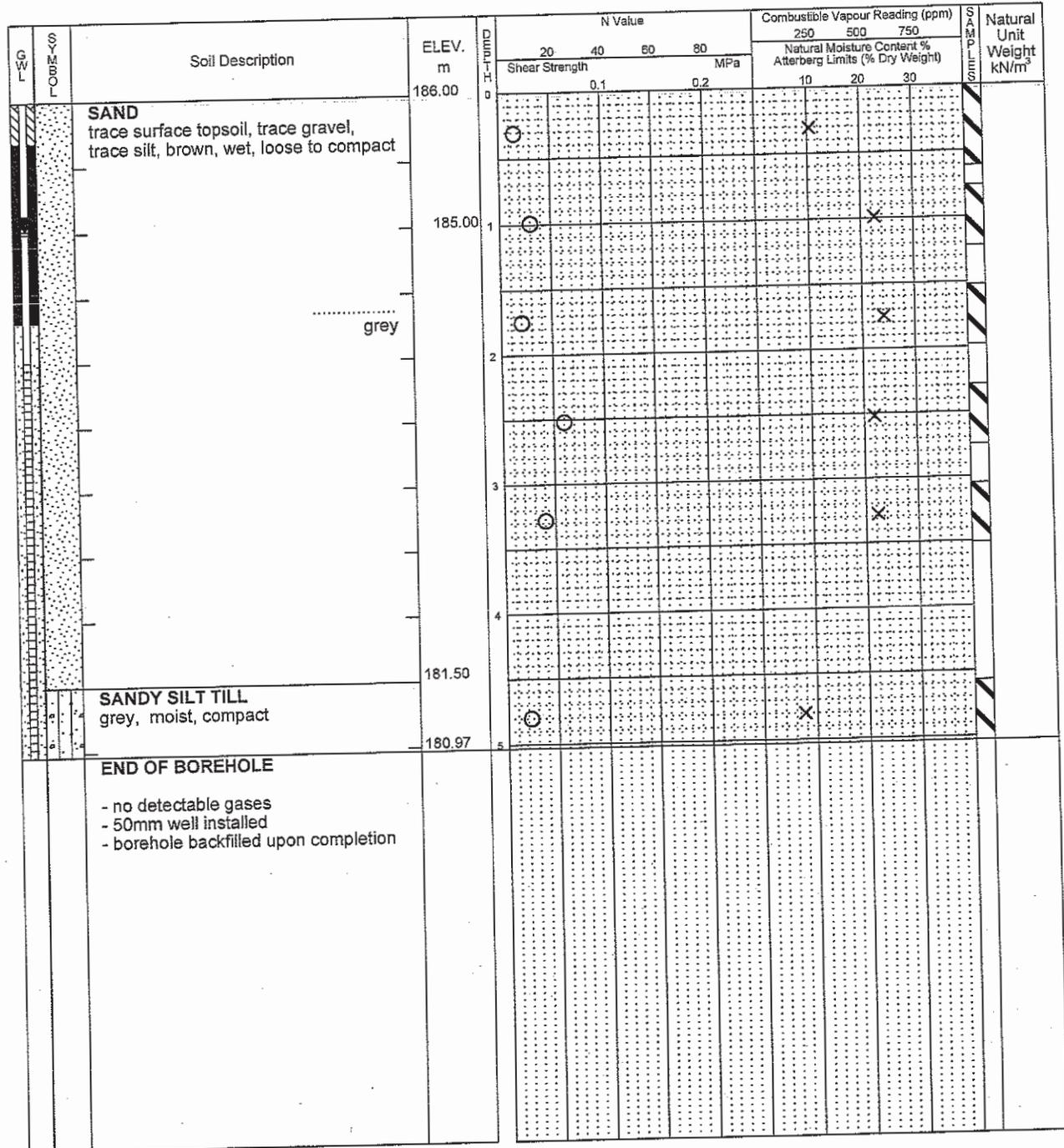
Date Drilled: August 12, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample ☒
- SPT (N) Value ○ ☒
- Dynamic Cone Test —
- Shelby Tube ■
- Field Vane Test +
- Sensitivity S
- Piezometric Water Level ▽

- Combustible Vapour Reading ☐
- Natural Moisture X
- Plastic and Liquid Limit —○
- Undrained Triaxial at % Strain at Failure ⊕
- Penetrometer ▲



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.0	OPEN
August 20, 2008	1.0	N/A

Log of Borehole BH13

Project No. SPN1235

Drawing No. 14

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930211 ; E444343)

Date Drilled: August 13, 2008

Auger Sample

Combustible Vapour Reading

SPT (N) Value

Natural Moisture

Dynamic Cone Test

Plastic and Liquid Limit

Shelby Tube

Undrained Triaxial at % Strain at Failure

Field Vane Test

Sensitivity

Penetrometer

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

Piezometric Water Level

G W L	L O B E S	Soil Description	ELEV. m	D I V I S I O N	N Value				Combustible Vapour Reading (ppm)			S A M P L E S	Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750		
					Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		760MM TOPSOIL	191.00	0									
		SAND trace silt, trace shells, trace gravel, brown, wet, compact to dense	190.24	1									
		grey		2									
		SANDY SILT TILL grey, moist, very dense	187.95	3									
		END OF BOREHOLE - auger refusal at 4.1m on assumed bedrock - no detectable gases - borehole backfilled upon completion	186.89	4									



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.9	2.7

Log of Borehole BH14

Project No. SPN1235

Drawing No. 15

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario

(N4930236 ; E444292)

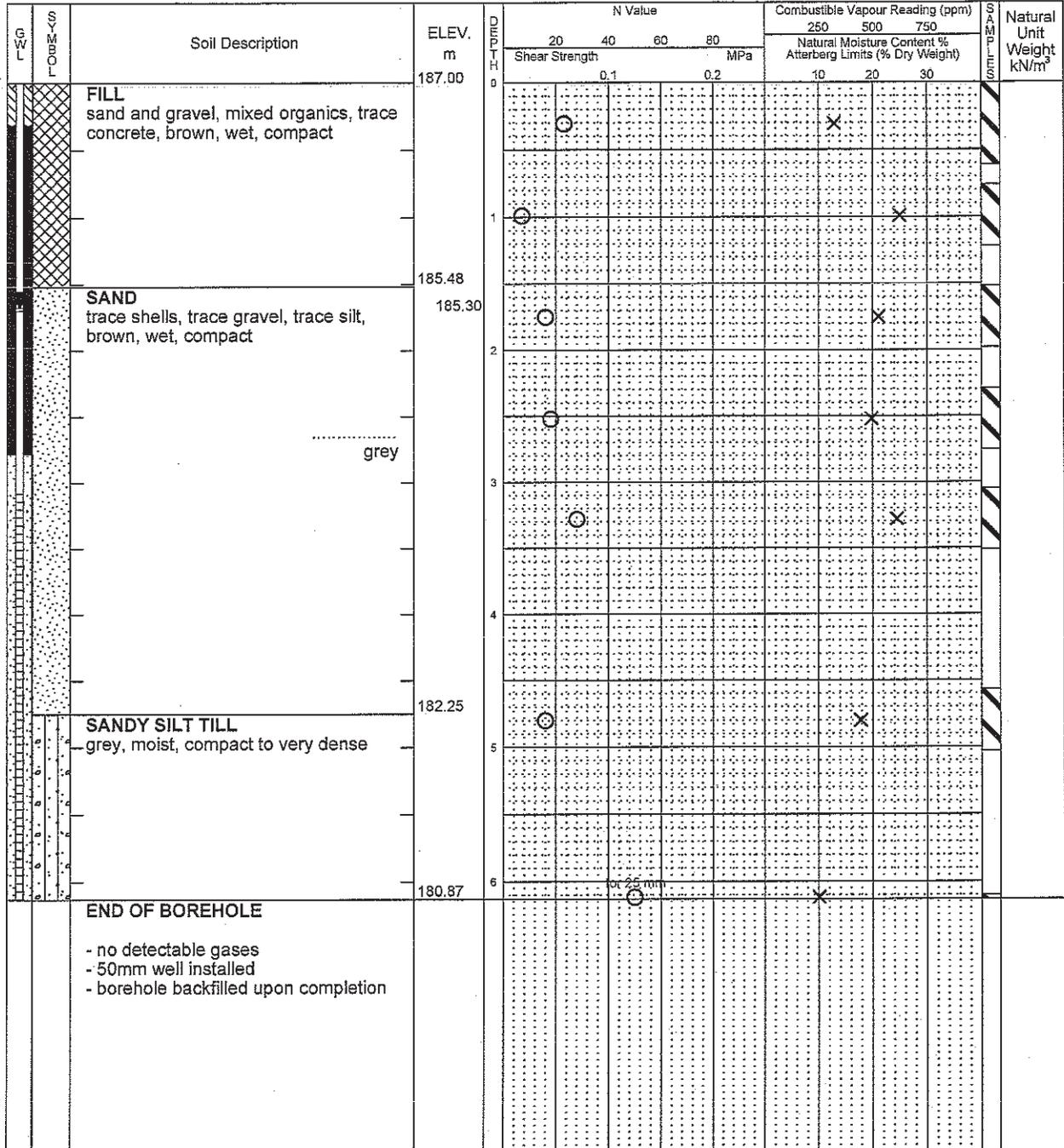
Date Drilled: August 13, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	4.0	OPEN
August 20, 2008	1.7	N/A

Log of Borehole BH15

Project No. SPN1235

Drawing No. 16

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigleith, Ontario

(N4930281 ; E444224)

Date Drilled: August 13, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- | | | | |
|-------------------------|-------------------------------------|---|-------------------------------------|
| Auger Sample | <input checked="" type="checkbox"/> | Combustible Vapour Reading | <input type="checkbox"/> |
| SPT (N) Value | <input type="checkbox"/> | Natural Moisture | <input checked="" type="checkbox"/> |
| Dynamic Cone Test | <input type="checkbox"/> | Plastic and Liquid Limit | <input type="checkbox"/> |
| Shelby Tube | <input checked="" type="checkbox"/> | Undrained Triaxial at % Strain at Failure | <input checked="" type="checkbox"/> |
| Field Vane Test | <input checked="" type="checkbox"/> | Penetrometer | <input checked="" type="checkbox"/> |
| Sensitivity | <input type="checkbox"/> | | |
| Piezometric Water Level | <input checked="" type="checkbox"/> | | |

LWG	Soil Description	ELEV. m	DEPTH (m)	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
				Shear Strength MPa				Natural Moisture Content %			
				20	40	60	80	250	500	750	
	FILL sandy silt, some gravel, mixed organics, dark brown, wet, compact	185.00	0	0.1	0.2	10	20	30			
			1								
	SAND trace silt, trace shells, trace gravel, brown, wet, compact	183.48	2								
			3								
	grey		4								
	SANDY SILT TILL grey, moist, compact	180.43	5								
	END OF BOREHOLE - no detectable gases - borehole backfilled upon completion	179.97	5								



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	WET CAVE	3.4

Log of Borehole BH16

Project No. SPN1235

Drawing No. 17

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario

(N4930270 ; E444137)

Date Drilled: August 14, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

DEPTH m	Soil Description	ELEV. m	N Value				Combustible Vapour Reading (ppm)			S A M P L E S	Natural Unit Weight kN/m ³
			Shear Strength				250	500	750		
			MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
0	102MM TOPSOIL	187.00	20	40	60	80	10	20	30		
	FILL sand and gravel, some silt, some concrete, brown, wet, compact	186.90									
1											
2	SAND trace to some gravel, trace silt, trace shells, brown, wet, compact to very dense	183.50									
3											
4											
5	SANDY SILT TILL grey, moist, compact	182.43									
	END OF BOREHOLE - no detectable gases - 50mm well installed - borehole backfilled upon completion	181.97									



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion August 20, 2008	4.0 1.5	OPEN N/A

Log of Borehole BH17

Project No. SPN1235

Drawing No. 18

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigleith, Ontario

(N4930283 ; E443998)

Date Drilled: August 14, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					Shear Strength MPa				Natural Moisture Content %			
					20	40	60	80	250	500	750	
		610MM TOPSOIL	188.00	0	0.1	0.2			10	20	30	
		SAND trace gravel, trace silt, trace shells, brown, wet, compact	187.39	1					X			
				2					X			
		grey		3					X			
		SANDY SILT TILL grey, moist, very dense	184.95	4					X			
				5					X			
				6					X			
		END OF BOREHOLE - no detectable gases - borehole backfilled upon completion	181.65						X			



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	DRY	4.9

Log of Borehole BH18

Project No. SPN1235

Drawing No. 19

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930314 ; E443973)

Date Drilled: August 14, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- | | | | |
|-------------------------|-------------------------------------|---|-------------------------------------|
| Auger Sample | <input checked="" type="checkbox"/> | Combustible Vapour Reading | <input type="checkbox"/> |
| SPT (N) Value | <input type="checkbox"/> | Natural Moisture | <input checked="" type="checkbox"/> |
| Dynamic Cone Test | <input type="checkbox"/> | Plastic and Liquid Limit | <input type="checkbox"/> |
| Shelby Tube | <input checked="" type="checkbox"/> | Undrained Triaxial at % Strain at Failure | <input type="checkbox"/> |
| Field Vane Test | <input checked="" type="checkbox"/> | Penetrometer | <input checked="" type="checkbox"/> |
| Sensitivity | <input type="checkbox"/> | | |
| Piezometric Water Level | <input type="checkbox"/> | | |

G L W	Soil Description	ELEV. m	D I P T H	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
				Shear Strength				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
				20	40	60	80	250	500	750	
	FILL silty sand, some gravel, mixed organics, moist, compact	184.00		0.1	0.2			10	20	30	
	SAND trace gravel, trace silt, brown, wet, compact to very dense	183.24	1								
	grey		2								
			3								
	END OF BOREHOLE - auger refusal at 4.0m on assumed bedrock - no detectable gases - borehole backfilled upon completion	180.01									



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.4	2.2

Log of Borehole BH19

Project No. SPN1235

Drawing No. 20

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario

(N4930252 ; E443932)

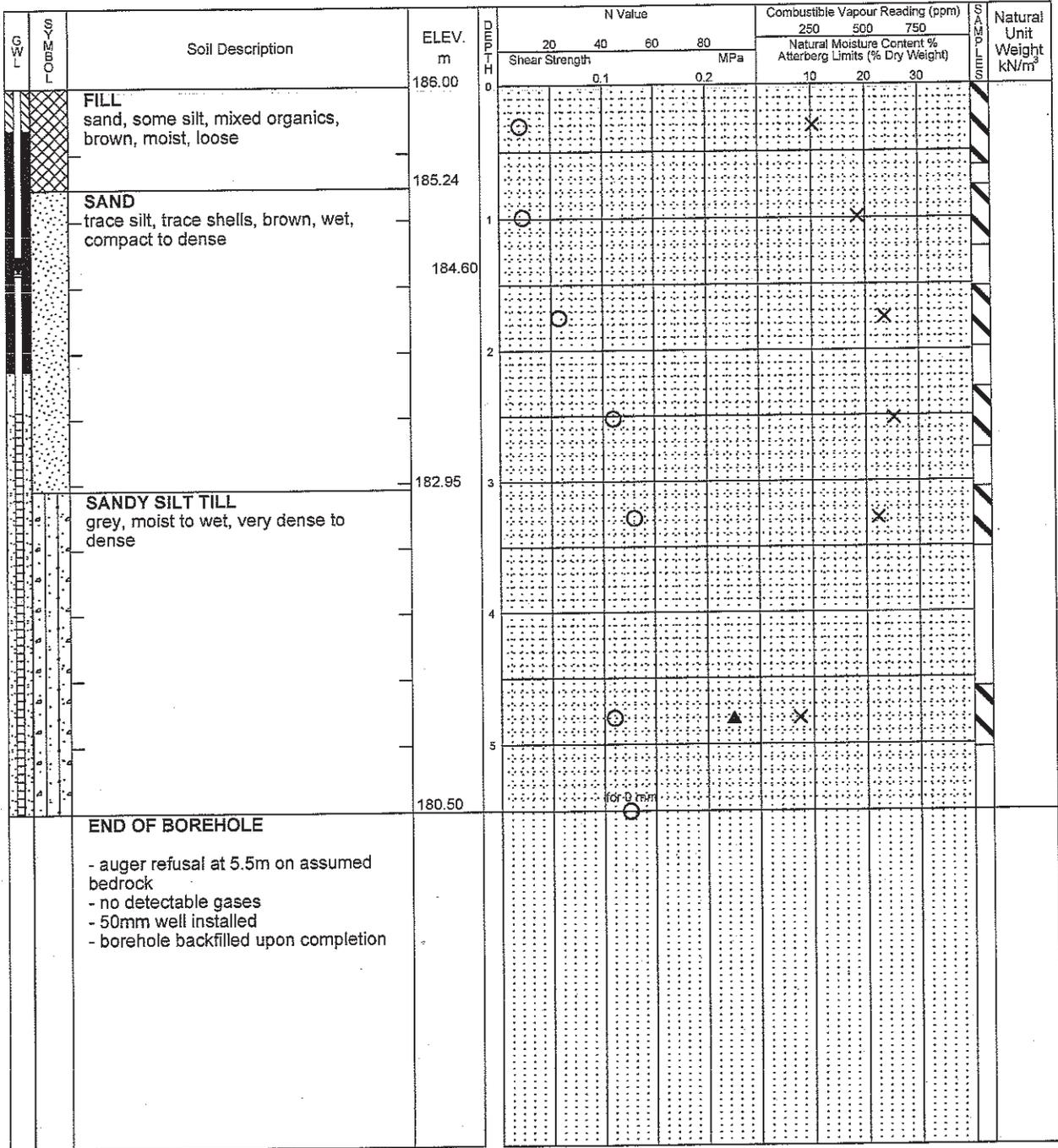
Date Drilled: August 14, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Ungrained Triaxial at % Strain at Failure
- Penetrometer



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion August 20, 2008	4.0 1.4	OPEN N/A

Log of Borehole BH20

Project No. SPN1235

Drawing No. 21

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930250 ; E443897)

Date Drilled: August 14, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

GWL	SOIL OBSERV L	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					Shear Strength MPa				Natural Moisture Content %			
					20	40	60	80	250	500	750	
		SAND trace surface topsoil, trace shells, trace silt, brown, moist to wet, loose to very dense	178.00	0								
		grey, trace gravel		1								
				2								
				3								
				4								
			174.95	5								
		SANDY SILT TILL grey, moist, very dense		6								
				7								
				8								
			173.15	9								
		END OF BOREHOLE - no detectable gases - borehole backfilled upon completion		10								



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	WET CAVE	3.4

Log of Borehole BH21

Project No. SPN1235

Drawing No. 22

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario

(N4930276 ; E443839)

Date Drilled: August 14, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- | | | | |
|-------------------------|-------------------------------------|---|-------------------------------------|
| Auger Sample | <input checked="" type="checkbox"/> | Combustible Vapour Reading | <input type="checkbox"/> |
| SPT (N) Value | <input type="checkbox"/> | Natural Moisture | <input checked="" type="checkbox"/> |
| Dynamic Cone Test | <input type="checkbox"/> | Plastic and Liquid Limit | <input type="checkbox"/> |
| Shelby Tube | <input checked="" type="checkbox"/> | Undrained Triaxial at % Strain at Failure | <input type="checkbox"/> |
| Field Vane Test | <input checked="" type="checkbox"/> | Penetrometer | <input checked="" type="checkbox"/> |
| Sensitivity | <input type="checkbox"/> | | |
| Piezometric Water Level | <input type="checkbox"/> | | |

GWL	Soil Description	ELEV. m	D	N Value				Combustible Vapour Reading (ppm)			SPT	Natural Unit Weight kN/m ³
				Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
				20	40	60	80	250	500	750		
	127MM TOPSOIL	180.00 179.87	0									
	SAND some organics, trace gravel, trace silt, trace shells to 0.6m, brown, wet, loose to dense		1									
			2									
	SANDY SILT TILL grey, moist, very dense	177.71	3									
			4									
	END OF BOREHOLE - no detectable gases - borehole backfilled upon completion	175.28	5									



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Time	Water Level (m)	Depth to Cave (m)
Upon Completion	3.0	OPEN

Log of Borehole BH22

Project No. SPN1235

Drawing No. 23

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930237 ; E443845)

Date Drilled: August 15, 2008

Auger Sample

Combustible Vapour Reading

SPT (N) Value

Natural Moisture

Dynamic Cone Test

Plastic and Liquid Limit

Drill Type: Skidder Mounted CME 55

Shelby Tube

Undrained Triaxial at % Strain at Failure

Field Vane Test

Sensitivity

Penetrometer

Datum: Geodetic (Derived by GPS)

Piezometric Water Level

	Soil Description	ELEV. m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
							250	500	750	
							Natural Moisture Content % Atterberg Limits (% Dry Weight)			
0	76MM TOPSOIL	183.00								
0	SAND trace to some organics, trace gravel, trace silt, trace shells, brown, wet, very loose to compact	182.92								
1	grey, mixed organics	181.70								
2	SANDY SILT TILL grey, moist, very dense	180.71								
3										
4										
4	END OF BOREHOLE	178.40								
	- no detectable gases - 50mm well installed - borehole backfilled upon completion									



**Shaheen & Peaker
Consulting Engineers**
A Division of Coffey Geotechnics, Inc.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.5	OPEN
August 20, 2008	1.3	N/A

Log of Borehole BH23

Project No. SPN1235

Drawing No. 24

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeith, Ontario

(N4930265 ; E443712)

Date Drilled: August 15, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Field Vane Test
- Sensitivity
- Piezometric Water Level

- Combustible Vapour Reading
- Natural Moisture
- Plastic and Liquid Limit
- Undrained Triaxial at % Strain at Failure
- Penetrometer

DEPTH m	Soil Description	ELEV. m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
			Shear Strength MPa				250	500	750	
			20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)			
0	127MM TOPSOIL SILTY SAND some gravel, trace silt, brown, wet, loose	181.00 180.87	0.1	0.2						
1		180.00								
2	SANDY SILT TILL grey, moist, very dense	179.48			for 292 mm					
3		177.95			for 0 mm					
END OF BOREHOLE - auger refusal at 3.1 m on assumed bedrock - borehole moved 1m south , auger refusal at 3.1 m on assumed bedrock - 50mm well installed - no detectable gases - borehole backfilled upon completion										



**Shaheen & Peaker
Consulting Engineers**
A Division of Coffey Geotechnics, Inc.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	2.0	OPEN
August 20, 2008	1.0	N/A

Log of Borehole BH24

Project No. SPN1235

Drawing No. 25

Project: Preliminary Geotechnical Investigation

Sheet No. 1 of 1

Location: Residential and Commercial Development - Craigeleith, Ontario

(N4930228 ; E443704)

Date Drilled: August 15, 2008

Drill Type: Skidder Mounted CME 55

Datum: Geodetic (Derived by GPS)

- | | | | |
|-------------------------|-------------------------------------|---|-------------------------------------|
| Auger Sample | <input checked="" type="checkbox"/> | Combustible Vapour Reading | <input type="checkbox"/> |
| SPT (N) Value | <input checked="" type="checkbox"/> | Natural Moisture | <input checked="" type="checkbox"/> |
| Dynamic Cone Test | <input type="checkbox"/> | Plastic and Liquid Limit | <input type="checkbox"/> |
| Shelby Tube | <input checked="" type="checkbox"/> | Undrained Triaxial at % Strain at Failure | <input type="checkbox"/> |
| Field Vane Test | <input checked="" type="checkbox"/> | Penetrometer | <input checked="" type="checkbox"/> |
| Sensitivity | <input type="checkbox"/> | | |
| Piezometric Water Level | <input type="checkbox"/> | | |

GWL	SOIL LOG	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			SAMPLES	Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750		
					Shear Strength MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		254MM TOPSOIL	182.00	0									
		SILTY SAND some gravel, trace silt, trace shells to 1.5m, brown, wet to moist, loose	181.75										
		grey		1									
		SANDY SILT TILL grey, moist, compact to very dense	180.32										
		END OF BOREHOLE	179.79	2									
		- auger refusal at 2.2 m on assumed bedrock - borehole moved 5m south, auger refusal at 2.2 m on assumed bedrock - no detectable gases - borehole backfilled upon completion											



**Shaheen & Peaker
Consulting Engineers**
A Division of Coffey Geotechnics, Inc.

Time	Water Level (m)	Depth to Cave (m)
Upon Completion	1.3	1.0

Appendix B: Hydraulic Conductivity Analysis

Slug Test Analysis Report

Project: AquaVil Development

Number: 18-736-10

Client: Royalton Homes Inc.

Location: Craigeith Village

Slug Test: MW18-1

Test Well: MW18-1

Test Conducted by: Sean Ellison

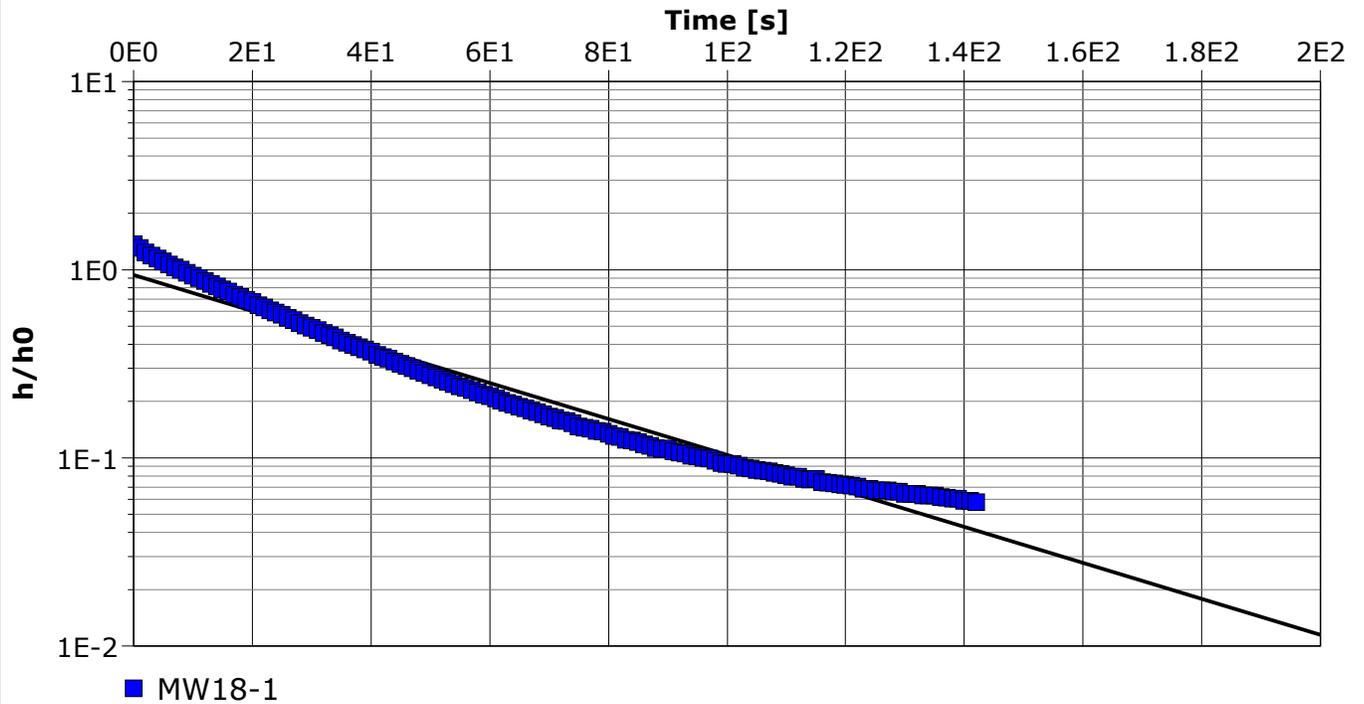
Test Date: 2018-11-15

Analysis Performed by: Dorothy Garda

MW18-1

Analysis Date: 2018-11-20

Aquifer Thickness:



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
MW18-1	1.09×10^{-5}

Slug Test Analysis Report

Project: AquaVil Development

Number: 18-736-10

Client: Royalton Homes Inc.

Location: Craigeith Village

Slug Test: MW18-4D

Test Well: MW18-4D

Test Conducted by: Sean Ellison

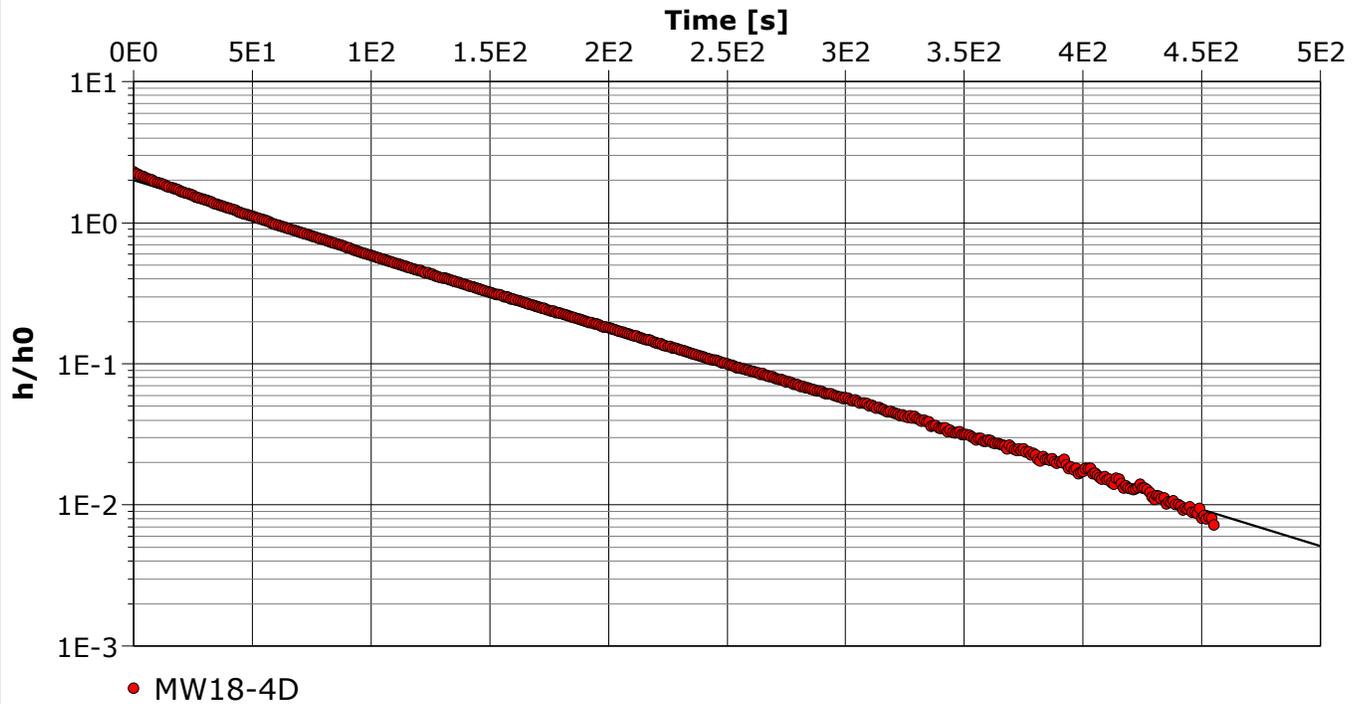
Test Date: 2018-11-15

Analysis Performed by: Dorothy Garda

MW18-4D

Analysis Date: 2018-11-20

Aquifer Thickness:



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
MW18-4D	5.91×10^{-6}

Slug Test Analysis Report

Project: AquaVil Development

Number: 18-736-10

Client: Royalton Homes Inc.

Location: Craigeleith Village

Slug Test: MW18-4S

Test Well: MW18-4S

Test Conducted by: Sean Ellison

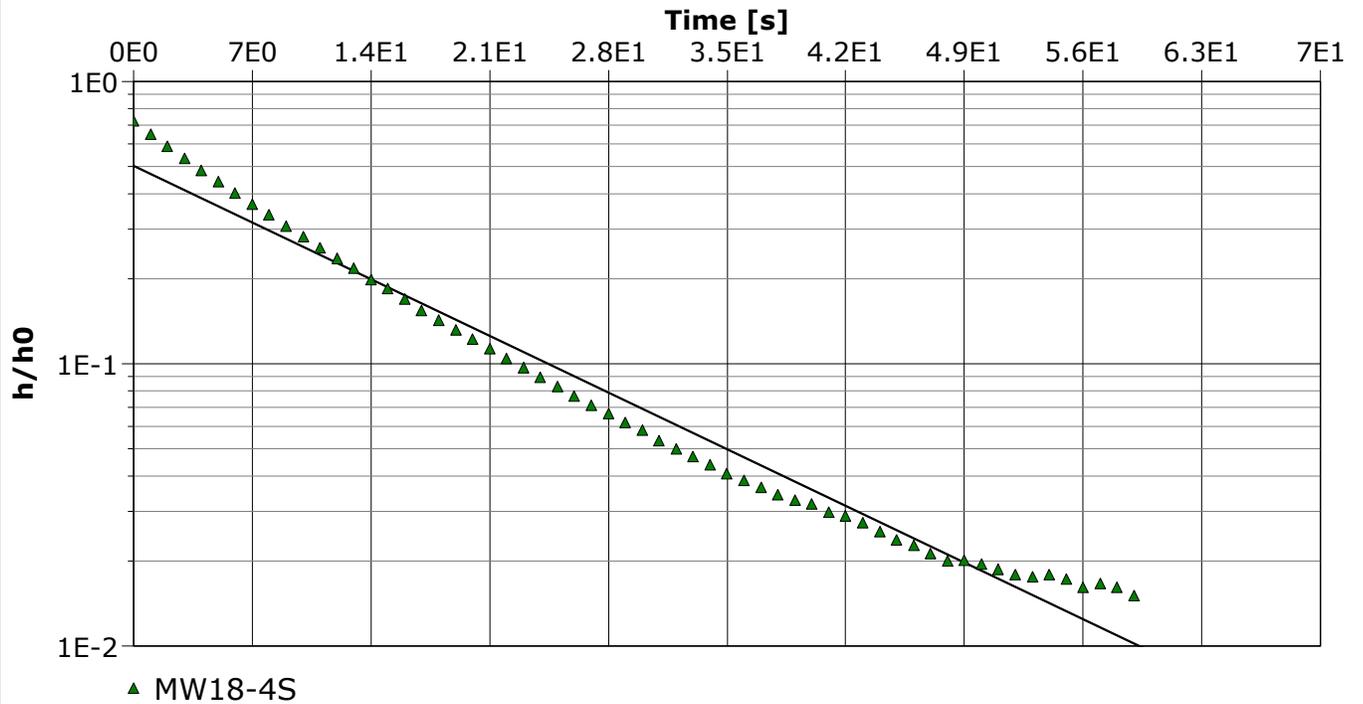
Test Date: 2018-11-15

Analysis Performed by: Dorothy Garda

MW18-4S

Analysis Date: 2018-11-20

Aquifer Thickness:



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
MW18-4S	3.27×10^{-5}

Slug Test Analysis Report

Project: AquaVil Development

Number: 18-736-10

Client: Royalton Homes Inc.

Location: Craigeith Village

Slug Test: MW18-9

Test Well: MW18-9

Test Conducted by: Sean Ellison

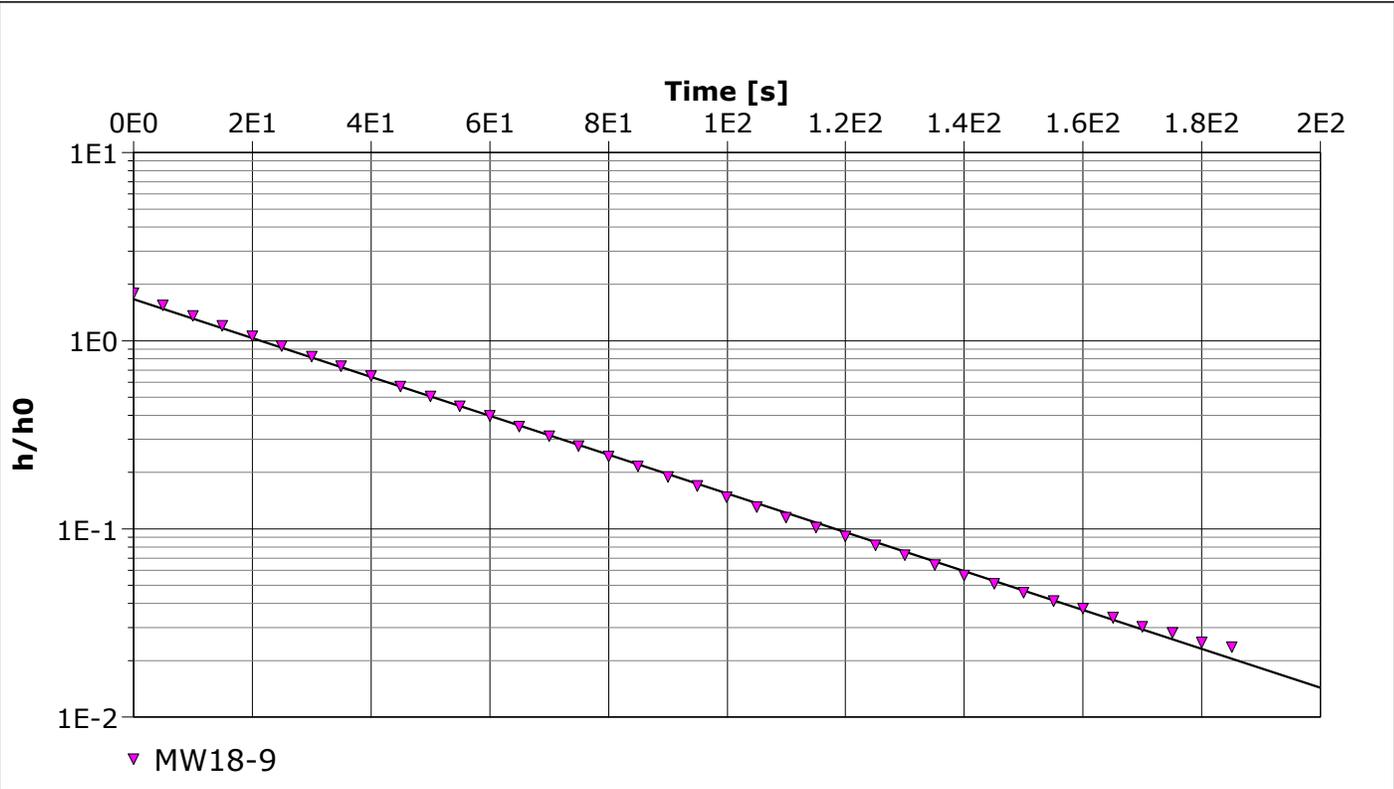
Test Date: 2018-11-15

Analysis Performed by: Dorothy Garda

MW18-9

Analysis Date: 2018-11-20

Aquifer Thickness:



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
MW18-9	1.01×10^{-5}

**Appendix C: Groundwater Quality
Certificate of Analysis**



DS Consultants (Vaughan)
ATTN: Sean Ellison
6221 Highway 7
Unit 16
Vaughan ON L4H 0K8

Date Received: 19-NOV-18
Report Date: 26-NOV-18 10:35 (MT)
Version: FINAL

Client Phone: 647-237-5110

Certificate of Analysis

Lab Work Order #: L2198556
Project P.O. #: NOT SUBMITTED
Job Reference: 18-736-10
C of C Numbers: 17-732134
Legal Site Desc:



Amanda Fazekas
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 5730 Coopers Avenue, Unit #26, Mississauga, ON L4Z 2E9 Canada | Phone: +1 905 507 6910 | Fax: +1 905 507 6927
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Summary of Guideline Exceedances

Guideline		Grouping	Analyte	Result	Guideline Limit	Unit
ALS ID	Client ID					
Ontario Provincial Water Quality Objectives (JULY, 1994) - Surface Water PWQO						
L2198556-1	MW18-1	Dissolved Metals	Aluminum (Al)-Dissolved	0.105	0.015	mg/L
			Copper (Cu)-Dissolved	0.00124	0.001	mg/L
			Iron (Fe)-Dissolved	4.38	0.3	mg/L
			Phosphorus (P)-Dissolved	<0.050	0.01	mg/L
L2198556-2	MW18-9	Dissolved Metals	Aluminum (Al)-Dissolved	0.170	0.015	mg/L
			Cobalt (Co)-Dissolved	<0.0010	0.0009	mg/L
			Copper (Cu)-Dissolved	<0.0020	0.001	mg/L
			Iron (Fe)-Dissolved	0.97	0.3	mg/L
			Phosphorus (P)-Dissolved	<0.50	0.01	mg/L
		Silver (Ag)-Dissolved	<0.00050	0.0001	mg/L	

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Physical Tests - WATER

Analyte	Unit	Guide Limits			
		#1	#2	#1	#2
Colour, Apparent	CU	-	-	26.0	13.2
Conductivity	umhos/cm	-	-	789	3220
pH	pH units	6.5-8.5	-	7.26	7.43
Total Dissolved Solids	mg/L	-	-	483 ^{DLDS}	1840 ^{DLDS}
Turbidity	NTU	-	-	47.0	51.3

Lab ID	L2198556-1	L2198556-2
Sample Date	16-NOV-18	16-NOV-18
Sample ID	MW18-1	MW18-9

Guide Limit #1: Surface Water PWQO

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Anions and Nutrients - WATER

Analyte	Unit	Guide Limits			
		#1	#2		
		Lab ID	L2198556-1	L2198556-2	
		Sample Date	16-NOV-18	16-NOV-18	
		Sample ID	MW18-1	MW18-9	
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	365	379
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<10	<10
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<10	<10
Alkalinity, Total (as CaCO3)	mg/L	-	-	365	379
Ammonia, Total (as N)	mg/L	-	-	2.97 ^{DLHC}	0.308
Bromide (Br)	mg/L	-	-	<0.10	0.11
Chloride (Cl)	mg/L	-	-	67.1	907
Computed Conductivity	uS/cm	-	-	757	2830
Conductivity % Difference	%	-	-	-4.1	-13.1
Fluoride (F)	mg/L	-	-	0.150	0.120
Hardness (as CaCO3)	mg/L	-	-	307	414
Ion Balance	%	-	-	117	101
Langelier Index		-	-	0.4	0.5
Nitrate and Nitrite as N	mg/L	-	-	<0.022	<0.022
Nitrate (as N)	mg/L	-	-	<0.020	<0.020
Nitrite (as N)	mg/L	-	-	<0.010	<0.010
Saturation pH	pH	-	-	6.88	6.89
Orthophosphate-Dissolved (as P)	mg/L	-	-	<0.0030	<0.0030
TDS (Calculated)	mg/L	-	-	475	1890
Sulfate (SO4)	mg/L	-	-	3.08	38.1
Anion Sum	me/L	-	-	7.95	32.6
Cation Sum	me/L	-	-	9.33	32.8
Cation - Anion Balance	%	-	-	8.0	0.3

Guide Limit #1: Surface Water PWQO

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Organic / Inorganic Carbon - WATER

Analyte	Unit	Guide Limits			
		#1	#2		
Dissolved Carbon Filtration Location		-	-	LAB	LAB
Dissolved Organic Carbon	mg/L	-	-	10.7	7.28

Lab ID	L2198556-1	L2198556-2
Sample Date	16-NOV-18	16-NOV-18
Sample ID	MW18-1	MW18-9

Guide Limit #1: Surface Water PWQO

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Inorganic Parameters - WATER

Analyte	Unit	Guide Limits			
		#1	#2	24.1	11.7
Silica	mg/L	-	-	24.1	11.7

Lab ID	L2198556-1	L2198556-2
Sample Date	16-NOV-18	16-NOV-18
Sample ID	MW18-1	MW18-9

Guide Limit #1: Surface Water PWQO

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.



ANALYTICAL REPORT

Dissolved Metals - WATER

Analyte	Unit	Guide Limits		Sample Data	
		#1	#2	Lab ID Sample Date Sample ID	Lab ID Sample Date Sample ID
Dissolved Metals Filtration Location	-	-	FIELD	FIELD	
Aluminum (Al)-Dissolved	mg/L	0.015	-	0.105	0.170 ^{DLHC}
Antimony (Sb)-Dissolved	mg/L	0.02	-	0.00046	0.0016 ^{DLHC}
Arsenic (As)-Dissolved	mg/L	0.005	-	0.00458	0.0010 ^{DLHC}
Barium (Ba)-Dissolved	mg/L	-	-	0.0830	0.101 ^{DLHC}
Beryllium (Be)-Dissolved	mg/L	0.011	-	<0.00010	<0.0010 ^{DLHC}
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.000050	<0.00050 ^{DLHC}
Boron (B)-Dissolved	mg/L	0.2	-	0.043	<0.10 ^{DLHC}
Cadmium (Cd)-Dissolved	mg/L	0.0001	-	<0.000010	<0.000050 ^{DLHC}
Calcium (Ca)-Dissolved	mg/L	-	-	105	138 ^{DLHC}
Chromium (Cr)-Dissolved	mg/L	-	-	<0.00050	<0.0050 ^{DLHC}
Cobalt (Co)-Dissolved	mg/L	0.0009	-	0.00040	<0.0010 ^{DLHC}
Copper (Cu)-Dissolved	mg/L	0.001	-	0.00124	<0.0020 ^{DLHC}
Iron (Fe)-Dissolved	mg/L	0.3	-	4.38	0.97 ^{DLHC}
Lead (Pb)-Dissolved	mg/L	0.001	-	0.000203	<0.00050 ^{DLHC}
Magnesium (Mg)-Dissolved	mg/L	-	-	10.8	16.6 ^{DLHC}
Manganese (Mn)-Dissolved	mg/L	-	-	0.506	0.0960 ^{DLHC}
Molybdenum (Mo)-Dissolved	mg/L	0.04	-	0.00880	0.0240 ^{DLHC}
Nickel (Ni)-Dissolved	mg/L	0.025	-	0.00109	<0.0050 ^{DLHC}
Phosphorus (P)-Dissolved	mg/L	0.01	-	<0.050	<0.50 ^{DLHC}
Potassium (K)-Dissolved	mg/L	-	-	2.51	6.15 ^{DLHC}
Selenium (Se)-Dissolved	mg/L	0.1	-	0.000171	<0.00050 ^{DLHC}
Silicon (Si)-Dissolved	mg/L	-	-	11.3	5.48 ^{DLHC}
Silver (Ag)-Dissolved	mg/L	0.0001	-	<0.000050	<0.00050 ^{DLHC}
Sodium (Na)-Dissolved	mg/L	-	-	67.0	560 ^{DLHC}
Strontium (Sr)-Dissolved	mg/L	-	-	0.280	0.490 ^{DLHC}
Sulfur (S)-Dissolved	mg/L	-	-	<5.0	12.2 ^{DLHC}
Thallium (Tl)-Dissolved	mg/L	0.0003	-	<0.000010	<0.00010 ^{DLHC}
Tin (Sn)-Dissolved	mg/L	-	-	0.00042	0.0011 ^{DLHC}
Titanium (Ti)-Dissolved	mg/L	-	-	<0.0040 ^{DLUI}	<0.0075 ^{DLUI}

Guide Limit #1: Surface Water PWQO

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Dissolved Metals - WATER

Lab ID	L2198556-1	L2198556-2
Sample Date	16-NOV-18	16-NOV-18
Sample ID	MW18-1	MW18-9

Analyte	Unit	Guide Limits			
		#1	#2	#3	#4
Tungsten (W)-Dissolved	mg/L	0.03	-	<0.00010	<0.0010 ^{DLHC}
Uranium (U)-Dissolved	mg/L	0.005	-	0.00211	0.00019 ^{DLHC}
Vanadium (V)-Dissolved	mg/L	0.006	-	<0.00050	<0.0050 ^{DLHC}
Zinc (Zn)-Dissolved	mg/L	0.02	-	0.0026	<0.010 ^{DLHC}
Zirconium (Zr)-Dissolved	mg/L	0.004	-	0.00034	<0.0030 ^{DLHC}

Guide Limit #1: Surface Water PWQO

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLUI	Detection Limit Raised: Unknown Interference generated an apparent false positive test result.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-AUTO-WT	Water	Automated Speciated Alkalinity	EPA 310.2
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.			
ALK-SPECIATED-WT	Water	pH Measurement for Spec. Alk	APHA 4500 H-Electrode
Water samples are analyzed directly by a calibrated pH meter.			
BR-IC-N-WT	Water	Bromide in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
COLOUR-APPARENT-WT	Water	Colour	APHA 2120
Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
DOC-WT	Water	Dissolved Organic Carbon	APHA 5310B
Sample is filtered through a 0.45um filter, then injected into a heated reaction chamber which is packed with an oxidative catalyst. The water is vaporized and the organic carbon is oxidized to carbon dioxide. The carbon dioxide is transported in a carrier gas and is measured by a non-dispersive infrared detector.			
EC-WT	Water	Conductivity	APHA 2510 B
Water samples can be measured directly by immersing the conductivity cell into the sample.			
ETL-N2N3-WT	Water	Calculate from NO2 + NO3	APHA 4110 B
ETL-SILICA-CALC-WT	Water	Calculate from SI-TOT-WT	EPA 200.8
F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
IONBALANCE-OP03-WT	Water	Detailed Ion Balance Calculation	APHA 1030E, 2330B, 2510A
MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
<p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
NH3-WT	Water	Ammonia, Total as N	EPA 350.1
<p>Sample is measured colorimetrically. When sample is turbid a distillation step is required, sample is distilled into a solution of boric acid and measured colorimetrically.</p>			
NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)
<p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p>			
NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)
<p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p>			
PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS
<p>This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.</p>			
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
<p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p>			
SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C
<p>This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.</p>			
TURBIDITY-WT	Water	Turbidity	APHA 2130 B
<p>Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.</p>			
<p>**ALS test methods may incorporate modifications from specified reference methods to improve performance.</p>			
<p>Chain of Custody Numbers:</p>			
<p>17-732134</p>			
<p><i>The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:</i></p>			
Laboratory Definition Code	Laboratory Location		
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

Reference Information

GLOSSARY OF REPORT TERMS

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

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

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

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

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

< - Less than.

D.L. - The reporting limit.

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

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

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

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

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.



Quality Control Report

Workorder: L2198556

Report Date: 26-NOV-18

Page 1 of 11

Client: DS Consultants (Vaughan)
6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-AUTO-WT								
	Water							
Batch	R4351789							
WG2936690-3	CRM	WT-ALK-CRM						
Alkalinity, Total (as CaCO3)			90.3		%		80-120	22-NOV-18
WG2936690-4	DUP	L2198808-1						
Alkalinity, Total (as CaCO3)		229	226		mg/L	1.3	20	22-NOV-18
WG2936690-2	LCS							
Alkalinity, Total (as CaCO3)			98.4		%		85-115	22-NOV-18
WG2936690-1	MB							
Alkalinity, Total (as CaCO3)			<10		mg/L		10	22-NOV-18
ALK-SPECIATED-WT								
	Water							
Batch	R4347430							
WG2934316-4	DUP	WG2934316-3						
pH		7.70	7.67	J	pH units	0.03	0.2	20-NOV-18
WG2934316-2	LCS							
pH			7.02		pH units		6.9-7.1	20-NOV-18
BR-IC-N-WT								
	Water							
Batch	R4352701							
WG2935867-15	DUP	WG2935867-13						
Bromide (Br)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	21-NOV-18
WG2935867-12	LCS							
Bromide (Br)			103.7		%		85-115	21-NOV-18
WG2935867-11	MB							
Bromide (Br)			<0.10		mg/L		0.1	21-NOV-18
WG2935867-14	MS	WG2935867-13						
Bromide (Br)			88.0		%		75-125	21-NOV-18
CL-IC-N-WT								
	Water							
Batch	R4352701							
WG2935867-15	DUP	WG2935867-13						
Chloride (Cl)		67.0	67.1		mg/L	0.1	20	21-NOV-18
WG2935867-12	LCS							
Chloride (Cl)			101.0		%		90-110	21-NOV-18
WG2935867-11	MB							
Chloride (Cl)			<0.50		mg/L		0.5	21-NOV-18
WG2935867-14	MS	WG2935867-13						
Chloride (Cl)			100.8		%		75-125	21-NOV-18
COLOUR-APPARENT-WT								
	Water							



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Client: DS Consultants (Vaughan)
6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
COLOUR-APPARENT-WT								
	Water							
Batch	R4344711							
WG2934391-3	DUP	L2198556-1						
Colour, Apparent		26.0	24.7		CU	4.9	20	20-NOV-18
WG2934391-2	LCS							
Colour, Apparent			99.5		%		85-115	20-NOV-18
WG2934391-1	MB							
Colour, Apparent			<2.0		CU		2	20-NOV-18
DOC-WT								
	Water							
Batch	R4353631							
WG2933645-3	DUP	L2197611-1						
Dissolved Organic Carbon		2.37	2.54		mg/L	7.0	25	22-NOV-18
WG2933645-2	LCS							
Dissolved Organic Carbon			117.6		%		70-130	22-NOV-18
WG2933645-1	MB							
Dissolved Organic Carbon			<0.50		mg/L		0.5	22-NOV-18
WG2933645-4	MS	L2197611-1						
Dissolved Organic Carbon			107.4		%		70-130	22-NOV-18
EC-WT								
	Water							
Batch	R4347430							
WG2934316-4	DUP	WG2934316-3						
Conductivity		408	410		umhos/cm	0.5	10	20-NOV-18
WG2934316-2	LCS							
Conductivity			97.2		%		90-110	20-NOV-18
WG2934316-1	MB							
Conductivity			<3.0		umhos/cm		3	20-NOV-18
F-IC-N-WT								
	Water							
Batch	R4352701							
WG2935867-15	DUP	WG2935867-13						
Fluoride (F)		0.148	0.146		mg/L	1.4	20	21-NOV-18
WG2935867-12	LCS							
Fluoride (F)			101.6		%		90-110	21-NOV-18
WG2935867-11	MB							
Fluoride (F)			<0.020		mg/L		0.02	21-NOV-18
WG2935867-14	MS	WG2935867-13						
Fluoride (F)			97.9		%		75-125	21-NOV-18
MET-D-CCMS-WT								
	Water							



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Client: DS Consultants (Vaughan)
6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT								
	Water							
Batch	R4345976							
WG2934247-4	DUP	WG2934247-3						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	20-NOV-18
Antimony (Sb)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	20-NOV-18
Arsenic (As)-Dissolved		0.00024	0.00024		mg/L	2.0	20	20-NOV-18
Barium (Ba)-Dissolved		0.0187	0.0185		mg/L	1.0	20	20-NOV-18
Beryllium (Be)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	20-NOV-18
Bismuth (Bi)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	20-NOV-18
Boron (B)-Dissolved		0.017	0.016		mg/L	3.8	20	20-NOV-18
Cadmium (Cd)-Dissolved		0.0000109	0.0000088	J	mg/L	0.0000021	0.00001	20-NOV-18
Calcium (Ca)-Dissolved		79.3	78.1		mg/L	1.6	20	20-NOV-18
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	20-NOV-18
Cobalt (Co)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	20-NOV-18
Copper (Cu)-Dissolved		0.00201	0.00199		mg/L	1.3	20	20-NOV-18
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	20-NOV-18
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	20-NOV-18
Magnesium (Mg)-Dissolved		15.1	15.2		mg/L	1.1	20	20-NOV-18
Manganese (Mn)-Dissolved		0.00071	0.00068		mg/L	5.2	20	20-NOV-18
Molybdenum (Mo)-Dissolved		0.000216	0.000215		mg/L	0.4	20	20-NOV-18
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	20-NOV-18
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	20-NOV-18
Potassium (K)-Dissolved		7.03	7.21		mg/L	2.5	20	20-NOV-18
Selenium (Se)-Dissolved		0.000126	0.000148		mg/L	16	20	20-NOV-18
Silicon (Si)-Dissolved		3.25	3.29		mg/L	1.2	20	20-NOV-18
Silver (Ag)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	20-NOV-18
Sodium (Na)-Dissolved		19.2	18.7		mg/L	2.3	20	20-NOV-18
Strontium (Sr)-Dissolved		0.158	0.156		mg/L	1.3	20	20-NOV-18
Sulfur (S)-Dissolved		3.24	3.26		mg/L	0.6	20	20-NOV-18
Thallium (Tl)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	20-NOV-18
Tin (Sn)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	20-NOV-18
Titanium (Ti)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	20-NOV-18
Tungsten (W)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	20-NOV-18
Uranium (U)-Dissolved		0.000301	0.000292		mg/L	2.8	20	20-NOV-18
Vanadium (V)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	20-NOV-18
Zinc (Zn)-Dissolved		<0.0010	<0.0010		mg/L			20-NOV-18



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6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT								
	Water							
Batch	R4345976							
WG2934247-4	DUP	WG2934247-3						
Zinc (Zn)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	20-NOV-18
Zirconium (Zr)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	20-NOV-18
WG2934247-2	LCS							
Aluminum (Al)-Dissolved			103.0		%		80-120	20-NOV-18
Antimony (Sb)-Dissolved			104.0		%		80-120	20-NOV-18
Arsenic (As)-Dissolved			100.7		%		80-120	20-NOV-18
Barium (Ba)-Dissolved			101.4		%		80-120	20-NOV-18
Beryllium (Be)-Dissolved			100.1		%		80-120	20-NOV-18
Bismuth (Bi)-Dissolved			96.3		%		80-120	20-NOV-18
Boron (B)-Dissolved			99.5		%		80-120	20-NOV-18
Cadmium (Cd)-Dissolved			98.5		%		80-120	20-NOV-18
Calcium (Ca)-Dissolved			103.5		%		80-120	20-NOV-18
Chromium (Cr)-Dissolved			101.8		%		80-120	20-NOV-18
Cobalt (Co)-Dissolved			98.9		%		80-120	20-NOV-18
Copper (Cu)-Dissolved			100.0		%		80-120	20-NOV-18
Iron (Fe)-Dissolved			101.4		%		80-120	20-NOV-18
Lead (Pb)-Dissolved			98.0		%		80-120	20-NOV-18
Magnesium (Mg)-Dissolved			102.4		%		80-120	20-NOV-18
Manganese (Mn)-Dissolved			101.7		%		80-120	20-NOV-18
Molybdenum (Mo)-Dissolved			101.6		%		80-120	20-NOV-18
Nickel (Ni)-Dissolved			100.2		%		80-120	20-NOV-18
Phosphorus (P)-Dissolved			101.1		%		80-120	20-NOV-18
Potassium (K)-Dissolved			101.8		%		80-120	20-NOV-18
Selenium (Se)-Dissolved			102.1		%		80-120	20-NOV-18
Silicon (Si)-Dissolved			104.5		%		60-140	20-NOV-18
Silver (Ag)-Dissolved			106.0		%		80-120	20-NOV-18
Sodium (Na)-Dissolved			100.0		%		80-120	20-NOV-18
Strontium (Sr)-Dissolved			104.6		%		80-120	20-NOV-18
Sulfur (S)-Dissolved			96.4		%		80-120	20-NOV-18
Thallium (Tl)-Dissolved			91.9		%		80-120	20-NOV-18
Tin (Sn)-Dissolved			97.8		%		80-120	20-NOV-18
Titanium (Ti)-Dissolved			98.0		%		80-120	20-NOV-18
Tungsten (W)-Dissolved			99.5		%		80-120	20-NOV-18
Uranium (U)-Dissolved			103.4		%		80-120	20-NOV-18



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Client: DS Consultants (Vaughan)
6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT		Water						
Batch	R4345976							
WG2934247-2 LCS								
	Vanadium (V)-Dissolved		103.3		%		80-120	20-NOV-18
	Zinc (Zn)-Dissolved		98.4		%		80-120	20-NOV-18
	Zirconium (Zr)-Dissolved		99.5		%		80-120	20-NOV-18
WG2934247-1 MB								
	Aluminum (Al)-Dissolved		<0.0050		mg/L		0.005	20-NOV-18
	Antimony (Sb)-Dissolved		<0.00010		mg/L		0.0001	20-NOV-18
	Arsenic (As)-Dissolved		<0.00010		mg/L		0.0001	20-NOV-18
	Barium (Ba)-Dissolved		<0.00010		mg/L		0.0001	20-NOV-18
	Beryllium (Be)-Dissolved		<0.00010		mg/L		0.0001	20-NOV-18
	Bismuth (Bi)-Dissolved		<0.000050		mg/L		0.00005	20-NOV-18
	Boron (B)-Dissolved		<0.010		mg/L		0.01	20-NOV-18
	Cadmium (Cd)-Dissolved		<0.0000050		mg/L		0.000005	20-NOV-18
	Calcium (Ca)-Dissolved		<0.050		mg/L		0.05	20-NOV-18
	Chromium (Cr)-Dissolved		<0.00050		mg/L		0.0005	20-NOV-18
	Cobalt (Co)-Dissolved		<0.00010		mg/L		0.0001	20-NOV-18
	Copper (Cu)-Dissolved		<0.00020		mg/L		0.0002	20-NOV-18
	Iron (Fe)-Dissolved		<0.010		mg/L		0.01	20-NOV-18
	Lead (Pb)-Dissolved		<0.000050		mg/L		0.00005	20-NOV-18
	Magnesium (Mg)-Dissolved		<0.0050		mg/L		0.005	20-NOV-18
	Manganese (Mn)-Dissolved		<0.00050		mg/L		0.0005	20-NOV-18
	Molybdenum (Mo)-Dissolved		<0.000050		mg/L		0.00005	20-NOV-18
	Nickel (Ni)-Dissolved		<0.00050		mg/L		0.0005	20-NOV-18
	Phosphorus (P)-Dissolved		<0.050		mg/L		0.05	20-NOV-18
	Potassium (K)-Dissolved		<0.050		mg/L		0.05	20-NOV-18
	Selenium (Se)-Dissolved		<0.000050		mg/L		0.00005	20-NOV-18
	Silicon (Si)-Dissolved		<0.050		mg/L		0.05	20-NOV-18
	Silver (Ag)-Dissolved		<0.000050		mg/L		0.00005	20-NOV-18
	Sodium (Na)-Dissolved		<0.050		mg/L		0.05	20-NOV-18
	Strontium (Sr)-Dissolved		<0.0010		mg/L		0.001	20-NOV-18
	Sulfur (S)-Dissolved		<0.50		mg/L		0.5	20-NOV-18
	Thallium (Tl)-Dissolved		<0.000010		mg/L		0.00001	20-NOV-18
	Tin (Sn)-Dissolved		<0.00010		mg/L		0.0001	20-NOV-18
	Titanium (Ti)-Dissolved		<0.00030		mg/L		0.0003	20-NOV-18
	Tungsten (W)-Dissolved		<0.00010		mg/L		0.0001	20-NOV-18



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Client: DS Consultants (Vaughan)
6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT								
	Water							
Batch	R4345976							
WG2934247-1	MB							
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	20-NOV-18
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	20-NOV-18
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	20-NOV-18
Zirconium (Zr)-Dissolved			<0.00030		mg/L		0.0003	20-NOV-18
WG2934247-5	MS	WG2934247-6						
Aluminum (Al)-Dissolved			98.6		%		70-130	20-NOV-18
Antimony (Sb)-Dissolved			103.2		%		70-130	20-NOV-18
Arsenic (As)-Dissolved			103.0		%		70-130	20-NOV-18
Barium (Ba)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Beryllium (Be)-Dissolved			102.4		%		70-130	20-NOV-18
Bismuth (Bi)-Dissolved			84.5		%		70-130	20-NOV-18
Boron (B)-Dissolved			98.1		%		70-130	20-NOV-18
Cadmium (Cd)-Dissolved			103.8		%		70-130	20-NOV-18
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Chromium (Cr)-Dissolved			98.4		%		70-130	20-NOV-18
Cobalt (Co)-Dissolved			95.6		%		70-130	20-NOV-18
Copper (Cu)-Dissolved			92.8		%		70-130	20-NOV-18
Iron (Fe)-Dissolved			96.4		%		70-130	20-NOV-18
Lead (Pb)-Dissolved			97.4		%		70-130	20-NOV-18
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Manganese (Mn)-Dissolved			99.3		%		70-130	20-NOV-18
Molybdenum (Mo)-Dissolved			99.7		%		70-130	20-NOV-18
Nickel (Ni)-Dissolved			94.5		%		70-130	20-NOV-18
Phosphorus (P)-Dissolved			105.9		%		70-130	20-NOV-18
Potassium (K)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Selenium (Se)-Dissolved			108.6		%		70-130	20-NOV-18
Silicon (Si)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Silver (Ag)-Dissolved			103.0		%		70-130	20-NOV-18
Sodium (Na)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Sulfur (S)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Thallium (Tl)-Dissolved			92.2		%		70-130	20-NOV-18
Tin (Sn)-Dissolved			102.3		%		70-130	20-NOV-18
Titanium (Ti)-Dissolved			99.1		%		70-130	20-NOV-18



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Client: DS Consultants (Vaughan)
6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT								
	Water							
Batch	R4345976							
WG2934247-5 MS		WG2934247-6						
Tungsten (W)-Dissolved			98.4		%		70-130	20-NOV-18
Uranium (U)-Dissolved			N/A	MS-B	%		-	20-NOV-18
Vanadium (V)-Dissolved			101.6		%		70-130	20-NOV-18
Zinc (Zn)-Dissolved			92.3		%		70-130	20-NOV-18
Zirconium (Zr)-Dissolved			99.8		%		70-130	20-NOV-18
NH3-WT								
	Water							
Batch	R4348487							
WG2935467-11 DUP		L2198808-1						
Ammonia, Total (as N)		0.105	0.114		mg/L	8.5	20	21-NOV-18
WG2935467-10 LCS								
Ammonia, Total (as N)			102.3		%		85-115	21-NOV-18
WG2935467-9 MB								
Ammonia, Total (as N)			<0.020		mg/L		0.02	21-NOV-18
WG2935467-12 MS		L2198808-1						
Ammonia, Total (as N)			98.2		%		75-125	21-NOV-18
NO2-IC-WT								
	Water							
Batch	R4352701							
WG2935867-15 DUP		WG2935867-13						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	25	21-NOV-18
WG2935867-12 LCS								
Nitrite (as N)			98.2		%		70-130	21-NOV-18
WG2935867-11 MB								
Nitrite (as N)			<0.010		mg/L		0.01	21-NOV-18
WG2935867-14 MS		WG2935867-13						
Nitrite (as N)			94.2		%		70-130	21-NOV-18
NO3-IC-WT								
	Water							
Batch	R4352701							
WG2935867-15 DUP		WG2935867-13						
Nitrate (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	25	21-NOV-18
WG2935867-12 LCS								
Nitrate (as N)			100.6		%		70-130	21-NOV-18
WG2935867-11 MB								
Nitrate (as N)			<0.020		mg/L		0.02	21-NOV-18
WG2935867-14 MS		WG2935867-13						
Nitrate (as N)			99.0		%		70-130	21-NOV-18
PO4-DO-COL-WT								
	Water							



Quality Control Report

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Client: DS Consultants (Vaughan)
6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT								
	Water							
Batch	R4349571							
WG2936099-3	DUP	L2198904-1						
Orthophosphate-Dissolved (as P)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	30	21-NOV-18
WG2936099-2	LCS							
Orthophosphate-Dissolved (as P)			105.3		%		80-120	21-NOV-18
WG2936099-1	MB							
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	21-NOV-18
WG2936099-4	MS	L2198904-1						
Orthophosphate-Dissolved (as P)			102.7		%		70-130	21-NOV-18
SO4-IC-N-WT								
	Water							
Batch	R4352701							
WG2935867-15	DUP	WG2935867-13						
Sulfate (SO4)		3.08	3.06		mg/L	0.6	20	21-NOV-18
WG2935867-12	LCS							
Sulfate (SO4)			101.4		%		90-110	21-NOV-18
WG2935867-11	MB							
Sulfate (SO4)			<0.30		mg/L		0.3	21-NOV-18
WG2935867-14	MS	WG2935867-13						
Sulfate (SO4)			103.1		%		75-125	21-NOV-18
SOLIDS-TDS-WT								
	Water							
Batch	R4348228							
WG2934565-3	DUP	L2196040-1						
Total Dissolved Solids		90	81		mg/L	11	20	20-NOV-18
WG2934565-2	LCS							
Total Dissolved Solids			95.1		%		85-115	20-NOV-18
WG2934565-1	MB							
Total Dissolved Solids			<10		mg/L		10	20-NOV-18
TURBIDITY-WT								
	Water							
Batch	R4345331							
WG2934357-3	DUP	L2198556-2						
Turbidity		51.3	49.1		NTU	4.4	15	20-NOV-18
WG2934357-6	DUP	L2198335-1						
Turbidity		11.4	10.7		NTU	6.3	15	20-NOV-18
WG2934357-2	LCS							
Turbidity			107.0		%		85-115	20-NOV-18
WG2934357-5	LCS							
Turbidity			107.0		%		85-115	20-NOV-18
WG2934357-1	MB							



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Client: DS Consultants (Vaughan)
6221 Highway 7 Unit 16
Vaughan ON L4H 0K8

Contact: Sean Ellison

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-WT	Water							
Batch	R4345331							
WG2934357-1	MB							
Turbidity			<0.10		NTU		0.1	20-NOV-18
WG2934357-4	MB							
Turbidity			<0.10		NTU		0.1	20-NOV-18

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Legend:

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

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Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Colour	1	16-NOV-18	20-NOV-18 08:00	48	92	hours	EHTR
	2	16-NOV-18	20-NOV-18 08:00	48	92	hours	EHTR
Turbidity	1	16-NOV-18	20-NOV-18 00:00	48	84	hours	EHTR
	2	16-NOV-18	20-NOV-18 00:00	48	84	hours	EHTR

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2198556 were received on 19-NOV-18 17:30.

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

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

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

**Appendix D: MECP Water Well Record
Summary**

MECP Water Well Records located within 500 m of Study Area

Well ID	Township	UTM(co-ordinates)	Construction Date	Water Kind & Found at (ft)	SWL(ft)	Well Use	Formation(Depth in ft)
2500366	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555074.30 Northing: 4930023.00	1950-08-08	FR (Fresh) 42	8	DO (Domestic)	SND 6 LMSN 42
2500367	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555369.30 Northing: 4930118.00	1953-09-29	FR	8	DO	SND 24 LMSN 40
2500368	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555039.30 Northing: 4930033.00	1955-05-16	FR 32	32	DO	CLAY 22 LMSN 33
2500369	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555377.30 Northing: 4930093.00	1956-06-08	FR 33	5	CO (Commercial)	SND 22 LMSN 34
2500370	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556152.30 Northing: 4930152.00	1958-09-02	FR 26	19	DO	SND 17 LMSN 37
2500371	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555554.30 Northing: 4930019.00	1959-07-01	FR 27	14	DO	SND 10 CLAY 27 LMSN 31
2500372	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555549.30 Northing: 4930034.00	1959-09-14	FR 38	14	DO	SND 16 CLAY 20 LMSN 41
2500373	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555161.30 Northing: 4930037.00	1963-06-20	FR 27	6	DO	CLAY 15 ROCK 27
2500374	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555589.30 Northing: 4930139.00	1965-05-22	FR 33	12	DO	FILL 5 SND 15 HPAN 25 LMSN 33
2500375	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555308.30 Northing: 4930036.00	1967-08-24	FR 40	13	CO	SND 15 CLAY 33 LMSN
2500376	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555154.30 Northing: 4930048.00	1967-07-11	FR 28	5	DO	SND 6 CLAY 17 SHLE 23 LMSN 39
2500377	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555564.30 Northing: 4929999.00	1967-10-31	SU (Sulphur) 38	18	DO	SND 9 CLAY 28 SHLE 28
2500378	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555258.30 Northing: 4930203.00	1954-08-18	FR 30	8	DO	SND 25 LMSN 32

2500379	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 554954.30 Northing: 4930173.00	1954-09-07	FR 25	2	DO	SND 5 SHLE 25
2500380	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555034.30 Northing: 4930231.00	1955-07-04	FR 20	4	DO	SND 16 LMSN 28
2500381	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555154.30 Northing: 4930293.00	1955-07-09	FR 20	4	DO	SND 16 LMSN 28
2500382	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555461.30 Northing: 4930334.00	1955-07-15	FR 20	4	DO	SND 16 LMSN 28
2500383	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555894.30 Northing: 4930887.00	1957-06-25	SU 25	4	DO	LOAM 5 LMSN 34
2500384	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555364.30 Northing: 4930433.00	1958-06-10	FR 28	6	DO	SND 14 LMSN 53
2500386	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555566.30 Northing: 4930614.00	1959-07-21	FR 30	6	DO	SND 20 ROCK 32
2500387	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555529.30 Northing: 4930534.00	1959-07-28	FR 30	6	DO	SND 22 LMSN 30
2500388	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555394.30 Northing: 4930227.00	1960-05-27	FR 40	8	DO	LOAM 1 CLAY 17 SHLE 22 LMSN 40
2500389	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555688.30 Northing: 4930740.00	1961-02-06	-	-	-	SND 19 ROCK 41
2500390	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556132.30 Northing: 4930204.00	1961-11-18	FR 35	8	DO	SND 17 LMSN 38
2500391	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555644.30 Northing: 4930744.00	1962-05-15	FR 39	8	DO	SND 8 LMSN 40
2500392	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555489.30 Northing: 4930677.00	1962-06-07	FR 26	6	DO	SND 26 GRVL 28
2500393	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555766.30 Northing: 4930789.00	1962-07-12	FR 20	5	DO	SND 15 CLAY 35 LMSN 60

2500394	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555157.30 Northing: 4930168.00	1962-10-24	FR 34	8	CO	SND 15 CLAY 23 LMSN 40
2500395	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555164.30 Northing: 4930293.00	1963-04-27	FR 28	9	DO	LOAM 1 SND 5 CLAY 19 SHLE 20 LMSN 28
2500396	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555746.30 Northing: 4930787.00	1963-04-15	FR 45	3	DO	CLAY 15 ROCK 45
2500397	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555749.30 Northing: 4930694.00	1963-08-06	FR 36	31	DO	SND 15 ROCK 36
2500398	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555299.30 Northing: 4930323.00	1964-08-19	FR 40	10	PU (Public)	SND 18 HPAN 19 LMSN 46
2500399	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555324.30 Northing: 4930333.00	1964-09-05	FR 40	10	PU	SND 18 HPAN 19 LMSN 51
2500400	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555257.30 Northing: 4930233.00	1966-08-13	FR 22	7	DO	SND 10 CLAY 18 GRVL 22 ROCK 24
2500401	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555259.30 Northing: 4930283.00	1966-08-16	FR 10	7	DO	SND 10 CLAY 18 GRVL 21 ROCK 24
2500402	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555094.30 Northing: 4930193.00	1966-09-13	SU 31	4	DO	SND 5 SHLE 11 LMSN 31
2500403	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555239.30 Northing: 4930293.00	1966-08-18	FR 46	2	DO	LOAM 2 CLAY 10 LMSN 46
2500404	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 554964.30 Northing: 4930143.00	1967-04-08	SU 32	2	DO	GRVL 7 LMSN 32
2500405	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555124.30 Northing: 4930286.00	1967-12-04	FR 37	3	DO	LOAM 1 CLAY 14 SHLE 21 ROCK 37
2500406	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555121.30 Northing: 4930278.00	1967-12-10	FR 37	6	DO	LOAM 1 CLAY 14 SHLE 21 ROCK37
2500435	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 554959.30 Northing: 4930070.00	1966-08-22	FR 20	2	DO	LOAM 2 CLAY 7 SND 9 HPAN 10 LMSN 60

2502644	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555664.30 Northing: 4930744.00	1968-12-18	FR 13	2	DO	SND 4 CLAY 11 LMSN 26
2502679	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555134.30 Northing: 4930033.00	1968-06-22	FR 26	5	DO	SND 14 LMSN 29
2502974	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556114.30 Northing: 4930224.00	1969-06-23	FR 28	4	DO	CLAY 14 SHLE 23 LMSN 28
2503057	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555664.30 Northing: 4930204.00	1969-01-20	IR (Iron)	28	DO	SND 7 CLAY 17 SHLE 21 ROCK 28
2503058	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555714.30 Northing: 4930074.00	1969-08-23	FR 31	12	DO	SND 5 CLAY 18 SHLE 24 LMSN 31
2503059	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555684.30 Northing: 4930674.00	1969-08-28	FR 20	7	DO	SND 11 SHLE 17 ROCK 20
2503060	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555714.30 Northing: 4930704.00	1969-08-26	FR 30	7	DO	SND 13 SHLE 24 ROCK 30
2503061	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555764.30 Northing: 4930174.00	1969-08-15	FR 31	9	DO	SND 14 CLAY 19 SHLE 22 LMSN 31
2503062	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556094.30 Northing: 4930174.00	1969-08-20	FR 24	4	DO	SND 7 SHLE 10 LMSN 24
2503081	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555584.30 Northing: 4930164.00	1969-11-04	-	9	DO	SND 10 CLAY 18 LMSN 35
2503082	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555924.30 Northing: 4930064.00	1969-11-06	FR 14	5	DO	SND 8 CLAY 14 LMSN 21
2503225	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556214.30 Northing: 4930154.00	1970-07-10	SU 34	6	DO	SND 2 CLAY 9 SHLE 39
2503249	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555774.30 Northing: 4930774.00	1970-04-29	MI (Mineral) 33	4	DO	SND 7 CLAY 17 SHLE 22 LMSN 33
2503251	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556164.30 Northing: 4930514.00	1970-01-02	FR 33	-1	DO	LOAM 1 SND 7 CLAY 17 SHLE 23 ROCK 34

2503252	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555744.30 Northing: 4930764.00	1970-04-20	NS (Not Stated)	6	DO	SND 4 CLAY 16 SHLE 18 ROCK 19 GRVL 20 ROCK 30
2503253	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555914.30 Northing: 4930154.00	1970-04-21	NS	1	DO	SND 9 CLAY 12 ROCK 20
2503254	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555874.30 Northing: 4930854.00	1970-04-25	NS	5	DO	SND 6 CLAY 14 SHLE 17 ROCK 34
2503279	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555534.30 Northing: 4930114.00	1970-08-25	FR 24	14	DO	SND 20 SHLE 32
2503299	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555714.30 Northing: 4930004.00	1970-10-02	FR 50	14	DO	SND 10 CLAY 20 SHLE 26 LMSN 50
2503300	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555334.30 Northing: 4930173.00	1970-10-07	FR 33	9	DO	LOAM 1 SND 20 SHLE 23 LMSN 33
2503301	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555654.30 Northing: 4930094.00	1970-10-08	FR 44	12	DO	SND 15 CLAY 22 SHLE 26 LMSN 44
2503359	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 554974.30 Northing: 4930193.00	1970-11-11	SU 21	6	DO	SND 8 SHLE 36
2503398	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555714.30 Northing: 4930174.00	1969-02-24	FR 25	5	DO	PRDG 7 SND 13 SHLE 28
2503474	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555794.30 Northing: 4930244.00	1971-07-16	FR 38	9	DO	SAND 10 CLAY 20 SHLE 22 LMSN 44
2503566	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555594.30 Northing: 4930074.00	1971-10-17	FR 30	12	DO	FILL 4 SND 20 CLAY 26 LMSN 46
2503567	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555904.30 Northing: 4930124.00	1971-10-27	FR 28	8	DO	SAND 10 CLAY 15 LMSN 34
2503694	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555514.30 Northing: 4930024.00	1971-12-11	FR 39	13	DO	SND 3 CLAY 20 SHLE 32 LMSN 42
2503787	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555839.30 Northing: 4929999.00	1971-10-20	FR 30	8	DO	SND 15 GRVL 16 SND 24 SNDS 46

2503804	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555864.30 Northing: 4930724.00	1972-06-06	FR 28	4	DO	CLAY 17 LMSN 30
2503805	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555644.30 Northing: 4930624.00	1972-05-30	NS 29	4	DO	SND 14 CLAY 16 LMSN 30
2503807	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555864.30 Northing: 4930794.00	1972-06-07	-	4	-	PRDR 65 LMSN 105
2503809	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555664.30 Northing: 4930664.00	1972-06-06	FR 28	4	DO	CLAY 17 LMSN 30
2503814	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555614.30 Northing: 4930674.00	1972-06-07	FR 29	4	DO	SND 2 CLAY 15 LMSN 30
2503815	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555714.30 Northing: 4930664.00	1972-05-30	FR 29	4	DO	SND 14 CLAY 16 LMSN 30
2503816	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555764.30 Northing: 4930724.00	1972-05-30	FR 28	4	DO	SND 15 CLAY 17 LMSN 30
2503817	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555614.30 Northing: 4930714.00	1972-06-14	FR 29	4	DO	SND 13 CLAY 17 LMSN 30
2503867	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555914.30 Northing: 4930014.00	1972-07-25	FR 22	3	DO	SND 12 SHLE 17 LMSN 40
2504024	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555664.30 Northing: 4930124.00	1972-10-03	FR 43	9	DO	LOAM 2 SND 12 CLAY 26 LMSN 43
2504093	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555894.30 Northing: 4930784.00	1972-01-08	FR 25	4	DO	GRVL 14 SHLE 17 LMSN 26
2504195	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555364.30 Northing: 4929942.00	1973-06-21	FR 45	8	DO	FILL 1 SND 26 ROCK 27 SND 28 ROCK 66
2504230	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555814.30 Northing: 4930794.00	1971-07-31	SU 30	1	DO	FILL 2 SND 11 CLAY 19 LMSN 30
2504308	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555464.30 Northing: 4929974.00	1973-09-08	FR 40	14	DO	SND 20 CLAY 25 SHLE 28 LMSN 43

2504485	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556178.30 Northing: 4930576.00	1973-12-06	-	-	-	SND 6 CLAY 12 SHLE 18 LMSN 55
2504867	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556185.30 Northing: 4930576.00	1974-10-24	-	-	-	LOAM 1 SND 6 CLAY 28 SHLE 63
2505106	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555841.30 Northing: 4930127.00	1975-06-18	FR 42	40	DO	SND 10 CLAY 20 SHLE 50
2505395	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555718.30 Northing: 4930120.00	1975-11-06	FR 26	10	DO	LOAM 1 SND 21 CLAY 22 LMSN 29
2505412	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555840.30 Northing: 4930240.00	1975-11-20	FR 26	12	DO	SND 12 CLAY 26 SHLE 32
2505494	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555868.30 Northing: 4930249.00	1975-11-12	SU 41	10	DO	LOAM 1 SND 21 LMSN 41
2505741	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555864.30 Northing: 4930874.00	1976-07-09	FR 40	2	DO	FILL 1 CLAY 12 SHLE 43
2505743	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555784.30 Northing: 4930794.00	1976-06-10	FR 38	2	DO	SND 1 CLAY 9 SHLE 12 ROCK 45
2505749	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555664.30 Northing: 4929994.00	1976-07-26	FR 44	14	DO	LOAM 1 SND 10 CLAY 24 LMSN 50
2506099	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555314.30 Northing: 4930373.00	1977-06-30	SU 33	4	DO	SND 3 CLAY 12 SHLE 38
2506122	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555364.30 Northing: 4930073.00	1977-07-05	FR	-	DO	PRDR 50 LMSN 79
2506127	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555114.30 Northing: 4930323.00	1977-07-13	FR 40	3	DO	LOAM 1 SND 11 LMSN 43
2506229	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555064.30 Northing: 4930273.00	1977-09-02	FR 35	5	DO	CLAY 14 LMSN 36
2506456	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556164.30 Northing: 4930174.00	1978-06-28	FR 50	15	-	SND 16 LMSN 103

2506467	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556014.30 Northing: 4930074.00	1978-06-15	FR 30	11	DO	SND 5 CLAY 26 SHLE 45
2506572	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555964.30 Northing: 4930124.00	1978-06-23	FR 24	11	DO	LOAM 1 SND 19 CLAY 23 LMSN 26
2506581	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556114.30 Northing: 4930074.00	1978-08-01	FR 46	17	DO	FILL 1 CLAY 25 LMSN 49
2506585	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556164.30 Northing: 4930074.00	1978-09-08	FR 40	8	DO	SND 23 SHLE 52
2506832	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555314.30 Northing: 4930323.00	1979-05-12	FR 30	4	DO	LOAM 1 CLAY 14 SHLE 58
2507058	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555314.30 Northing: 4930073.00	1979-09-29	FR 35	11	DO	SND 23 LMSN 38
2507379	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 554964.30 Northing: 4930173.00	1980-11-07	FR 30	9	DO	LOAM 1 CLAY 20 SHLE 23 LMSN 41
2507449	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555564.30 Northing: 4930424.00	1981-03-24	SU 22	8	DO	SND 2 CLAY 19 SHLE 20
2507551	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555514.30 Northing: 4930224.00	1981-09-17	SU 37	10	DO	CLAY 21 SHLE 42
2507556	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555864.30 Northing: 4930174.00	1981-09-07	SU 78	6	DO	CLAY 10 SHLE 15 LMSN 80
2507592	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555264.30 Northing: 4930273.00	1981-12-17	FR 35	6	DO	SND 8 CLAY 15 SHLE 43
2507593	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555864.30 Northing: 4930174.00	1981-12-23	SU 22	7	DO	SND 6 CLAY 10 SHLE 22
2507761	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556214.30 Northing: 4930624.00	1982-08-04	SU 24	4	DO	LOAM 2 CLAY 22 SND 24 LMSN 30
2507942	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555714.30 Northing: 4930574.00	1983-08-15	FR 25	3	DO	SND 6 CLAY 12 SHLE 35

2508384	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555364.30 Northing: 4930073.00	1985-06-13	FR 38	14	DO	LOAM 1 SND 13 CLAY 19 SHLE 21 LMSN 38
2508416	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555264.30 Northing: 4930323.00	1985-08-22	FR 48	6	DO	LOAM 1 CLAY 21 SHLE 23 LMSN 62
2508432	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555264.30 Northing: 4930023.00	1985-04-25	FR 39	8	DO	LOAM 1 SND 8 CLAY 26 SHLE 41
2508700	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555425.30 Northing: 4929998.00	1986-12-11	FR 48	13	DO	PRDR 38 SHLE 48
2509121	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555989.30 Northing: 4930524.00	1987-11-02	-	-	DO	FILL 1 CLAY 3 SHLE 100
2509221	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555469.30 Northing: 4930574.00	1987-12-12	FR 35	6	DO	SND 9 SHLE 40
2509391	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555523.30 Northing: 4930657.00	1988-05-25	FR 34	4	DO	SND 1 CLAY 6 SHLE 40
2509514	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555777.30 Northing: 4930799.00	1988-07-14	FR 20	6	DO	CLAY 10 SHLE 45
2509519	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555484.30 Northing: 4929838.00	1988-09-15	FR 147	44	DO	LOAM 1 CLAY 33 GRVL 42 CLAY 103 SND 145 GRVL 148
2509997	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555624.30 Northing: 4930679.00	1989-06-17	FR 24	3	DO	LOAM 1 CLAY 8 SHLE 26
2510343	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555762.30 Northing: 4930684.00	1989-12-07	FR 36	6	DO	CLAY 6 SHLE 41
2516794	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555352.00 Northing: 4930108.00	2006-04-24	-	-	-	SND 10
5707686	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556564.30 Northing: 4929984.00	1970-11-07	SU 38	12	DO	PRDG 8 SND 10 SHLE 40
5709982	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 556491.30 Northing: 4930035.00	1973-07-17	SU 12	3	DO	LOAM 1 CLAY 5 SHLE 35

7041618	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555697.00 Northing: 4930226.00	2006-03-03	-	10	-	-
7108393	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555907.00 Northing: 4930837.00	2008-05-21	NS 4	4	-	LOAM 1 SND 10 CLAY 15 SILT 20
7128380	COLLINGWOOD TOWNSHIP	NAD83 — Zone 17 Easting: 555372.00 Northing: 4930113.00	2007-12-14	-	-	-	SND 10

Appendix E: Development Plan



DRAFT PLAN OF SUBDIVISION OF LOTS 59, 110, 111 AND 112 PART OF LOTS 86, 87, 88, 89, 113 AND 114 PART OF BLOCK D (CLOSED BY BY-LAW) REGISTERED PLAN 529 (FORMERLY TOWNSHIP OF COLLINGWOOD) TOWN OF THE BLUE MOUNTAINS COUNTY OF GREY

SCALE 1:1000
 20 10 0 20 40 60 Metres
 LLOYD & PURCELL A DIVISION OF SCHAEFFER OZALDOV BENNETT LTD.

PLANNING ACT, SECTION 51(7)

- (a) AS SHOWN ON DRAFT PLAN
- (b) AS SHOWN ON DRAFT PLAN
- (c) AS SHOWN ON DRAFT PLAN
- (d) SEE SCHEDULE OF LAND USE
- (e) AS SHOWN ON DRAFT PLAN
- (f) AS SHOWN ON DRAFT PLAN
- (g) AS SHOWN ON DRAFT PLAN
- (h) MUNICIPAL PIPED WATER AT THE TIME OF DEVELOPMENT
- (i) SANDY LOAM
- (j) AS SHOWN ON DRAFT PLAN
- (k) AVAILABLE
- (l) AS SHOWN ON DRAFT PLAN

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN ON THIS PLAN.

____ DAY OF _____, 2019.

T. M. PURCELL
ONTARIO LAND SURVEYOR

OWNER'S CERTIFICATE

AS OF THE DATE ON THIS PLAN THE UNDERSIGNED BEING THE REGISTERED OWNERS OF THE SUBJECT LANDS HEREBY AUTHORIZE LLOYD & PURCELL A DIVISION OF SCHAEFFER OZALDOV BENNETT LTD., HENSHEL DESIGN GROUP INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION AND TO MAKE APPLICATION TO THE COUNTY OF GREY FOR APPROVAL THEREOF.

DATED THE DAY OF _____, 2019. 2590019 ONTARIO INC.

PERSON: TITLE
 I HAVE THE AUTHORITY TO SIGN THE CORPORATION

LLOYD & PURCELL
 A DIVISION OF SCHAEFFER OZALDOV BENNETT LTD.
 ONTARIO LAND SURVEYORS

1228 CORHAM STREET, UNIT 28, NEWMARKET, ONTARIO, L3Y 8Z1
 (905) 895-6416 Fax (905) 853-8837 EMAIL: l.purcell@lloydandpurcell.com
 TORONTO LINE (905) 478-6500 Fax (905) 478-6515
 WWW.LLOYDANDPURCELL.COM

CAD: B/C/D/L P.C.: F L.S.R.: 12-176
 CALC: BI CHK'D: TMP FILE: PLAN 529

LLOYD & PURCELL

LAND USE STATISTICS

LAND USE	AREA
TOWNHOMES (BLOCK 1)	1.24 ha.
SINGLE FAMILY DWELLINGS (BLOCKS 17 AND 18)	0.41 ha.
SEMI DETACHED HOMES (BLOCKS 3 AND 4)	0.97 ha.
CONDOMINIUMS (BLOCKS 5 AND 11)	2.78 ha.
MIX-USE RESIDENTIAL/COMMERCIAL (BLOCKS 19 AND 24)	1.15 ha.
COMMERCIAL (BLOCKS 21 AND 25)	3.15 ha.
PRIVATE RECREATION (BLOCK 12)	0.23 ha.
INSTITUTIONAL (BLOCKS 15 AND 23)	0.65 ha.
OPEN SPACE/ ENVIRONMENTAL PROTECTION (BLOCKS 2, 6, 16, 20 AND 22)	10.79 ha.
STORM WATER MANAGEMENT (BLOCKS 7, 10 AND 13)	1.01 ha.
ROAD SYSTEM TOTAL	223,808.1 m ² (22.38 ha.)
STREETS A AND B	1.75 ha.
ROADS/ ROAD WIDENING/ DAY LIGHT TRIANGLE (BLOCKS 8, 9, 14, 26, 28, 29 AND 32 TO 35)	1.27 ha.
MTO SETBACK (BLOCK 27 AND 31)	0.40 ha.
ROAD SYSTEM TOTAL	34,198.5 m ² (3.42 ha.)
TOTAL SITE	258,006.6 m ² (25.80 ha.)
TOTAL OPEN SPACE	121,880.0 m ² (12.19 ha.)

REVISIONS

No.	Date	Description
12	Aug 16 2019	Revised Land Use Statistics, Streets and Block Layout
11	Apr 29 2014	Revised Land Use Statistics, Streets, Remove F, added E
10	Oct 31 2013	Block 22 removed, block 28 removed, block 22, block 21 area increase by 0.2ha
9	19/08/12	Revised alignment street c, d & remove block 25, add wave upturn line
8	28/06/12	Removed Wet Land Area Between Blocks 21 and 22 Extending into Street B.
7	26/05/12	Added Land Use Statistics and Areas to Face of Plot.
6	30/05/12	Add Dimensions to Proposed Block Fabric.
5	29/05/12	Add contours and spot elevations
4	01/05/12	revised storm water blocks, added wetland/topo, change some lots to blocks etc.
3	04/04/12	RESCALED DRAWING FROM 1:2000 TO 1:1000
2	02/04/12	REVISED AS PER CLIENTS
1	30/03/12	ISSUED FOR CLIENT REVIEW.