Preliminary Hydrogeological Investigation

900 Mulock Drive
Newmarket, ON

Prepared For:

Denison Child Care Services-YRDSB

Project #: 19-190-100
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DS CONSULTANTS LTD.
6221 Highway 7, Unit 16
Vaughan, Ontario, L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

19-190-100 **April 15th, 2020**

Ms. Nancy Mosey- Executive Director
Denison Child Care Services- YRDSB
Dr. John M, Denison Child Care Centre
135 Bristol Road
Newmarket, ON
L3Y 8J7

Via email: pturner@counterpointeng.com

RE: Preliminary Hydrogeological Investigation – 900 Mulock Drive, Newmarket, ON

DS Consultants Limited (DS) was retained by Denison Child Care Services on behalf of York Region District School Board to complete a hydrogeological investigation for the proposed development at 900 Mulock Drive, Ontario (Site). The Site is an approximate 9,000 m^2 parcel of land currently occupied by two (2) residential dwelling situated within a mixed residential and commercial area. The Site is located on the north side of Mulock Drive, approximately 200 m east of the intersection of Mulock Dr and Fernbank Rd. It is understood that the proposed building will be a single storey structure, with slab-on-grade construction with no basement. The finished floor elevation of the proposed building was not available to DS at the time of writing this report. The Site location is shown in Figure 1.

This hydrogeological investigation includes an overview of the existing geological and hydrogeological conditions at the Study site and the surrounding area, provides an assessment of the hydrogeological constraints and impacts of the proposed development on the local groundwater and an estimation of construction dewatering requirements for site servicing trenches. If needed, the results of this investigation can be used in support of an application for a Category 3 Permit to Take Water (PTTW) or an Environmental Activity Sector Registry (EASR) for construction dewatering from the Ministry of the Environment, Conservation and Parks (MECP) and discharge permitting from the municipality of York.

The study includes a review of source water protection areas as the site is located within a well head protection area WHPA-D and a recharge management area WHPA-Q. To address the recharge management criteria, a site water balance assessment was completed which estimates the post-development infiltration deficit as a result of the proposed development. Post-development mitigation designs which include two 25m^2 soakaway pits with a combined storage of 20 m^3 were further investigated to determine to effectiveness of the design in removing the infiltration deficit.

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

1. Based on the MECP water well records search, there were thirteen (13) water wells within 500 m of the Site (Fig. 1.) Six (6) wells were noted for domestic use, one (1) well was noted for livestock and all wells were noted as test hole, monitoring well, dewatering, not in use or unknown.The study area is fully serviced with municipal water supply; therefore, it is not expected that there are any groundwater

users within a radius of 500 meters of the Site.

2. On October 17th, 2019, DS drilled three (3) boreholes as part of hydrogeological investigation concurrently with geotechnical and environmental investigations. Boreholes were advanced to depths ranging from 6.2 to 8.1 meters below ground surface (mbgs) (Elev. 258.6 to 259.5 masl). One (1) drilled borehole was converted into a monitoring well (BH19-3) and screened to a depth of 6.1 mbgs (Elev. 258.9 masl).
3. The surficial geology at the Site and study area is mapped as fine-textured glaciolacustrine deposits consisting of predominantly silt and clay with minor sand and gravel. The geology at the Site is dominated by native soils consists of clayey silt till with sandy silt till and cohesionless soil (silty sand, sand & gravel) extending to termination depth in BH19-1 and BH19-3 and extending to 7.6 mbgs in BH19-2.
4. Groundwater levels were measured on October 25th, October 28th, 2019 and April 15th, 2020 by DS. Groundwater levels were found in monitoring wells ranging from Groundwater was found in monitoring well at a depth ranging from 1.61 to 2.77 mbgs (262.20-263.39 masl), representing the groundwater elevation at the Site.
5. A Single Well Response Tests (SWRTs) was completed by DS at BH19-3 on October 28th, 2019. The resulting hydraulic conductivity was 7.08×10^{-7} m/s in the representative clayey silt till/ sandy silt till deposit and gravel deposits, which was used in the dewatering assessment. .
6. Site servicing trenches are expected to be dug through the clayey silt till and cohesionless soil deposits. No major problems due to groundwater seepage are anticipated during construction. The highest dewatering rate anticipated during construction of an assumed 30 m long 2 m wide trench would be approximately 23,000 L/day (23 m^3/day). This value incorporates a 100% safety factor and inflow that may occur from a major precipitation event.
7. The expected design dewatering rate for an unsealed excavation is below the MECP pumping limit of 50,000 L/day, as such, an Environmental Activity and Sector Registry (EASR) is not required to be submitted to the MECP for short-term dewatering.
8. One (1) unfiltered groundwater sample was collected from monitoring well BH19-3 on November 1st, 2019 and submitted for comparison of the Municipality of York Storm and Sanitary By-law #2011-56. The reported results indicate that all parameters meet guidelines for both storm and sanitary discharge with exception to Total Suspended Solids (TSS) which exceeded for both. Therefore, groundwater at the Site is not suitable for discharge into the Region's sewers without treatment which could include settling tanks and filtration techniques to reduce TSS concentrations to acceptable levels. A discharge permit will be required from York Region and/or the City of Newmarket if private water is to be discharged to the sewer system.

9. Discharge permits and agreements are required to be obtained from the York Region if private water is discharged to the City's sewers system for short-term (construction) and long-term (permanent drainage) period.
10. There are structures and utilities within the predicted zone of influence (ZOI) about 10 meters when considering an open-cut excavation. Since the trenches may extend into cohesionless soil deposits, there is always a possibility of a loss of fines during the dewatering activities depending on dewatering method. Therefore, settlement is may occur within the predicted zone of influence and settlement monitoring is recommended considering an unsealed excavation.
11. Once a groundwater dewatering system is set up at the Site, daily and weekly monitoring should be implemented to assess the groundwater conditions such as water levels, measurement of discharge flow, discharge water quality and any adverse impacts as a result of dewatering including settlement.
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.
13. The Site is within the South Georgian Bay Lake Simcoe (SGBLS) Source Protection Region and the Lake Simcoe Region Conservation Authority (LSRCA). The Site is not within the Oak Ridges Moraine (ORM) and is not in an area of High Aquifer Vulnerability (HVA) or in a Significant Groundwater Recharge Area (SGRA). The Site is in a Recharge Management Area (RMA) - WHPA-Q and is in a Wellhead Protection Area WHPA-D with a vulnerability score of 2. The proposed development is expected to improve the existing recharge condition at the Site by implementing Low Impact Development (LID) measures which encourage the storage and infiltration of clean sources of runoff. There are no significant chemical, pathogen or dense non-aqueous phase liquids (DNAPL) threats proposed for the Site and impacts to groundwater resources are not anticipated.

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

DS Consultants Ltd.

Prepared By:

Dorothy Garda, M.Sc.
Junior Hydrogeologist

Reviewed By:

Martin Gedeon, M.Sc., P.Geo.
Senior Hydrogeologist

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APPENDICES

1.0 INTRODUCTION

DS Consultants Limited (DS) was retained by Denison Child Care Services on behalf of York Region District School Board to complete a hydrogeological investigation for the proposed development at 900 Mulock Drive, Ontario (Site). The Site is an approximate 0.9 ha parcel of land currently occupied by two (2) residential dwelling situated within a mixed residential and commercial area. The Site is located on the north side of Mulock Drive, approximately 200 m east of the intersection of Mulock Dr and Fernbank Rd. It is understood that the proposed building will be a single storey structure, with slab-on-grade construction with no basement. The finished floor elevation of the proposed building was not available to DS at the time of writing this report. The Site location is shown in Figure 1.

This hydrogeological investigation includes an overview of the existing geological and hydrogeological conditions at the site and larger study area and provides an assessment of the hydrogeological constraints to development including potential impacts to local groundwater users and an estimation of construction dewatering requirements for site servicing trenches. If needed, the results of this investigation can be used in support of an application for a Category 3 Permit to Take Water (PTTW) or an Environmental Activity Sector Registry (EASR) for construction dewatering from the Ministry of the Environment, Conservation and Parks (MECP) and discharge permitting from the municipality of York.

The site is within a well head protection area WHPA-D and a recharge management area WHPA-Q. The proposed land use is within allowable uses prescribed by To address the recharge management criteria, a site water balance assessment was completed which estimates the post-development infiltration deficit as a result of the proposed development. Post-development mitigation designs which include two 25m^2 soakaway pits with a combined storage of 20 m^3 were further investigated to determine to effectiveness of the design in removing the infiltration deficit.

1.1 Purpose

The purpose of this investigation was to review and determine the need for dewatering, estimate dewatering rates, assess groundwater quality, conduct a feature based water balance (pre and post development), and determine the need for a Permit to Take Water (PTTW) or an Environmental Activity Sector Registry (EASR) from the Ministry of Environment and Conservation and Parks (MECP). Potential impacts related to construction dewatering and associated monitoring/mitigation measures were also to be investigated. The hydrogeological report may also be used to support Site Plan Approvals (SPA) and discharge permitting (short and long term) from the York Region.

1.2 Scope of Work

The scope of work for this investigation included:

(i) Site visits;

(ii) Collecting and interpreting available reports and data including the MECP Water Well Records (WWR), geotechnical, hydrogeological and environmental studies completed at the Site;

(iii) In-situ hydraulic conductivity testing of existing monitoring wells;

(iv) In-situ hydraulic infiltration testing in areas of proposed soak-a-way pits;

(v) Site water balance to compare existing and post-development hydrologic conditions and an evaluation of the effectiveness of proposed mitigation;

(vi) Estimation of temporary groundwater flow rate construction dewatering;

(vii) Assessing groundwater quality to evaluate discharge options; and,

(viii) Data analyses and report preparation.

2.0 FIELD INVESTIGATION

On October 17th, 2019, DS drilled three (3) boreholes as part of hydrogeological investigation concurrently with geotechnical and environmental investigations. Boreholes were advanced to depths ranging from 6.2 to 8.1 meters below ground surface (mbgs). One (1) drilled borehole was converted into a monitoring well (BH19-3) and screened to a depth of 6.1 mbgs. The monitoring well was constructed using 50 mm diameter PVC riser pipes and screens, which were installed in the borehole in accordance with O.Reg. 903. All wells were developed before use to allow for groundwater level monitoring, hydraulic conductivity testing, and assess groundwater quality.

One (1) single well response tests (SWRTs) was completed by performing a rising head test to estimate hydraulic conductivity values of formations/soils at the site. One (1) groundwater sample was collected from monitoring well BH19-3 on November 1st, 2019 and submitted for comparison of the Municipality of York Storm and Sanitary By-law #2011-56. The locations of the BHs/MWs are shown in Figure 3 and detailed subsurface conditions are presented on the geologic cross sections (Figure 4) and on the borehole Logs in Appendix A.

3.0 PHYSICAL SETTING

Available topographic maps, environmental, geotechnical, and hydrogeological reports were used to develop an understanding of the physical setting of the study area. The borehole logs as the Ministry of the Environment, Conservation and Parks Water Wells Records (MECP WWRs) were used to interpret the geological and hydrogeological conditions at the Site.

3.1 Physiography and Drainage

The Site is within the Schomberg Clay Plains Physiographic Region which is generally north of the Oak Ridges Moraine and south of the Simcoe Lowlands (Chapman and Putnam 1984). The Schomberg Clay Plains formed along the northern slopes of the Oak Ridges Moraine and contain deep deposits of stratified clay and silt. The thickness of clay is generally about 5 m however the depth can range to as much as 15 m as

encountered near the Holland Landing area. The Schomberg sediments are typically varved clays and are classified as well draining to poor draining silty clay and silt loams.

The Site is within the East Holland Subwatershed which generally drains North into the Lake Simcoe Basin via the Holland River East Branch. The topography at the Site has a downward slope to the west to northwest with surface elevations ranges between 265 and 275 metres above sea level (masl). Drainage is generally overland flow toward a ditch constructed along the west boundary of the Site. The ditch directs surface water toward the roadside ditch south of Mulock Dr. which flows west towards a swale in the southeast corner of the Fernbank Rd. and Mulock Dr. intersection. From there, drainage is toward a tributary of Bogart creek continuing about 2km in a northwest direction before discharging to the Holland River East Branch.

3.2 Geology

The following presents a brief description of regional and site geology based on the review of available information and site-specific soil investigations.

3.2.1 Quaternary Geology

The surficial geology of the Site and study area has been mapped as fine-textured glaciolacustrine deposits consisting of predominantly silt and clay with minor sand and gravel. The surficial geology map is shown in **Figure 2**.

3.2.2 Bedrock Geology

Available published mapping shows that bedrock in the area is predominantly a grey to black shale of the Georgian Bay Formation, (MNDM Map 2544 Bedrock Geology of Ontario). Based on the review of well record information, the depth to bedrock in the study area is estimated to be about 95 meters below the existing ground at an elevation of about 175 masl. Bedrock was not encountered during the site-specific soil investigation.

3.2.3 Site Geology

On-site subsurface soils were interpreted from the boreholes/monitoring wells (BHs/MWs) drilled by DS. The locations of the BHs/MWs are shown in Figure 3 and detailed subsurface conditions are presented on the borehole Logs in Appendix A. The subsurface conditions in the boreholes are summarized in the following paragraphs, and the geologic cross-section (A-A') are presented in Figure 4.

Topsoil/Fill Material:

A surficial topsoil layer of thickness varying from 100 to 125 mm was encountered in BH19-2 and BH19-3. BH19-1 encountered granular fill layer (125 mm of sand and gravel) at surface. Below the topsoil or granular, fill material consisting of silt, sandy silt and clayey silt to silt was encountered in the boreholes, extending to depths of 0.5 to 1.5 m. Fill material contained topsoil/organics and was in a very loose to compact state, based on the measured SPT 'N' values ranging from 3 to 16 blows per 300mm.

Upper Silt to Clayey Silt (Till-like):

Below the fill materials, upper native cohesive soils consisting of silt to clayey silt (till) were encountered in all boreholes, extending to depth varying from 1.5 to 4.6 m. The consistency of the silt to clayey silt was firm to stiff, as indicated by the measured SPT 'N' values of 8 to 14 blows per 300mm of penetration.

Sandy Silt Till:

Below the silt to clayey silt or till deposits, sandy silt till was encountered in borehole BH19-1 and BH19-2, extending to depths of 2.6 to 6.1m. The measured SPT 'N' values in sandy silt till deposit ranged from 19 to over 50 blows per 300 mm of penetration, indicating its compact to very dense state.

Cohesionless Soils (Silty Sand, Sand & Gravel) Deposits:

Below the clayey silt till or sandy silt till deposits, cohesionless deposits of silty sand and sand & gravel were encountered in boreholes, at depths varying from 4.6 to 6.1 m below the existing grade. The cohesionless soils were water bearing and present in a dense to very dense state, with the measured SPT 'N' values ranging from 34 to over 50 blows per 300 mm of penetration.

Lower Clayey Silt Till:

A lower clayey silt till deposit was encountered in borehole BH19-2 below the cohesionless deposits. This deposit was present in hard consistency, as indicated by SPT value of over 30 blows per 300 mm of penetration.

3.3 Hydrogeology

The hydrogeology at the Site was evaluated using the on-site monitoring wells installed by DS, local domestic wells and existing hydrogeological and environmental reports for the area.

3.3.1 Local Groundwater Use

As part of the hydrogeological study, DS completed a search of the Ministry of the Environment, Conservation and Parks (MECP) Water Well Record (WWR) database. Based on the MECP water well records search, there were thirteen (13) water wells within 500 m of the Site (Fig. 1.) Six (6) wells were noted for domestic use, one (1) well was noted for livestock and all wells were noted as test hole, monitoring well, dewatering, not in use or unknown. Figure 1 shows the MECP water well location plan. The study area is fully serviced with municipal water and therefore, no groundwater users are expected in the area.

3.3.2 Groundwater Conditions

One (1) boreholes/monitoring well1 (BHs/MWs) was installed into the clayey silt till/silty sand and was used for the current groundwater assessment (BH19-3). DS measured groundwater levels in all monitoring wells on October 25th and October 28th, 2019. Table 1 presents the groundwater levels in the monitoring well. The well was developed prior to any use. Groundwater was found in monitoring well at a depth ranging from 1.61 to 2.77 mbgs (262.20-263.39 masl), representing the groundwater elevation at the Site. The

groundwater flow direction within the Site area is inferred to be north and southwesterly towards tributary of Bogart Creek and the west branch of the Holland River, respectively.

Table 1: Groundwater Levels in Monitoring Wells

				October 25th, 2019		October 28th,2019		April 15th, 2020	
Well ID	Ground Elevation (masl)	Well Depth (mbgs)	Screened Interval (mbgs)	Depth to Water (mbgs)	Ground-water Elevation (masl)	Depth to Water (mbgs)	Ground-water Elevation (masl)	Depth to Water (mbgs)	Ground-water Elevation (masl)
BH19-3	265.0	6.1	3.1-601	2.77	262.20	2.46	262.54	1.61	263.39

3.3.3 Hydraulic Conductivity

A Single Well Response Tests (SWRTs) was completed by DS at BH19-3 on October 28th, 2019 to estimate hydraulic conductivity (k) for the representative geological units in which the well was completed. The SWRT was completed by performing a rising head test (slug test) with the use of Waterra® tubing and a foot valve to remove water from the well. A data logger was placed at the bottom of the wells to monitor recovery. Hydraulic conductivity (k) values were calculated using the Hvorslev method. The resulting hydraulic conductivity was 7.08 x 10^{-7} m/s, which was used in the dewatering assessment to represent the geological units in which site servicing trenches are expected to be built in. The hydraulic testing results are provided in Appendix B.

3.3.4 In-Situ Infiltration Testing

In-situ infiltration testing was conducted by DS field personnel on October 31st, 2019. The testing was completed to provide design infiltration rates for two proposed soakaway pits designed for mitigating post-development infiltration deficits. The locations of testing are shown in Figure 3. Testing was completed following the guidelines outlined in the Low Impact Development (LID) Stormwater Management Planning and Design Guide for Stormwater Infiltration, 2010 (Appendix C Site Evaluation and Soil Testing Protocol).

To estimate the infiltration rate of soils in the location of the two soakaway pits, DS completed in-situ infiltration testing at a depth of 1m and 2 m bgs. The testing included the use of a constant head infiltrometer which operates using the Marriott Bottle principal, whereby a shallow ponded head of water is maintained at a constant depth within an augured borehole. The steady-state flow of water into the subsurface soil following saturated conditions is regarded as the field saturated hydraulic conductivity (K_{fs}) rate respective of the depth of the head utilized. Using results from two different heads (0.05 and 0.10 m), the K_{fs} for the soil was estimated. The results of the infiltration testing is summarized below in Table 2.

Table 2: Summary of Test Pits and Measured and Estimated Soil Infiltration Rates

Test Location	Test Depth (mbgs)	Soil Type	Water Head	Steady State Rate of Water Level Change (cm/min)	K_{fs} (cm/sec)	Infiltration Rate (mm/hr)
TP 1	1.0	Clayey Silt (Structure Category 2)	H1 (0.05 m)	0.28	1.91×10^{-5}	29.7
			H2 (0.10 m)	0.49		
	2.0	Clayey Silt (Structure Category 2)	H1 (0.05 m)	0.21	7.03×10^{-6}	22.7
			H2 (0.10 m)	0.32		
TP 2	1.0	Clayey Silt (Structure Category 2)	H1 (0.05 m)	0.24	1.94×10^{-5}	29.8
			H2 (0.10 m)	0.44		
	2.0	Clayey Silt (Structure Category 2)	H1 (0.05 m)	0.20	1.36×10^{-5}	27.1
			H2 (0.10 m)	0.35		

Notes:
-mbgs– meters below ground surface
-Infiltration Rate approximated from Kfs using calculations provided in Figure C1 of Appendix C - Site Evaluation and Soil Testing Protocol (Low Impact Development (LID) Stormwater Management Planning and Design Guide for Stormwater Infiltration, 2010)

For the purpose of calculating design infiltration rates for on-site LID measures, Table C2 in the "Low Impact Development Stormwater Management Planning and Design Guide" (Appendix C), was used to determined safety correction factors for each of the test pit locations. The safety factors are applied to the measured infiltration rates of soils for each location to address heterogeneity of the soils. The calculated safety correction factors and the design infiltration rates for each location was determined to be 2.5. As a result of applying the safety correction factors, an infiltration rate of about 12 mm/hr can be considered for design purposes at the tested locations TP1 and TP2.

3.3.5 Groundwater Quality

To assess groundwater quality and evaluate options for discharging water collected during construction, one (1) groundwater sample was collected on October 28th, 2019 from MW19-3. The sample was submitted under chain of custody to ALS Environmental, a CALA certified laboratory, for chemical analysis of parameters listed in the York Region Sanitary and Storm Sewer use By-Law (No. 2011-56). The certificate of analysis is provided in Appendix C. The results indicate that all parameters meet guidelines for both storm and sanitary discharge with exception to Total Suspended Solids (TSS) which exceeded both guidelines. Therefore, groundwater at the Site is not suitable for discharge into the Region's sewers without treatment which could include settling tanks and filtration techniques to reduce TSS concentrations to acceptable levels. A discharge permit will be required from York Region and/or the City of Newmarket if private water is to be discharged to the sewer system.

4.0 SITE WATER BALANCE ASSESSMENT

4.1 EXISTING CONDITIONS

The Site is approximately 8,608 m^2 of land currently comprised of two residential dwelling, several storage sheds, two driveways with a parking area and a landscaped area of mainly lawn. Figure 2 of Appendix F provided by Counterpoint Engineering Inc. shows the Pre-development Imperviousness Plan which was used for establishing existing hydrologic conditions for the site water balance.

4.2 PROPOSED DEVELOPMENT

The area proposed for development includes the construction of a new building on the west boundary of the site and a new layout of paved surfaces as shown in the Post-Development Imperviousness Plan included in Figure 3 of Appendix F, provided by Counterpoint Engineering Inc. The plan also shows the removal of the building on the north boundary and several smaller utility building on the south boundary. Proposed development is shown to increase impervious surfaces from an existing impervious area of 1628 m^2, to a post-development impervious area of 1693 m^2, an increased impervious area of about 66 m^2.

4.3 THORNTHWAITE MONTHLY WATER BALANCE MODEL

The Thornthwaite water balance (Thornthwaite, 1948; Mather, 1978; 1979) is an accounting type method used to analyze the allocation of water among various components of the hydrologic cycle. Inputs to the model are monthly temperature, site latitude, precipitation and stormwater run-on. Outputs include monthly potential and actual evapotranspiration, evaporation, water surplus, total infiltration and total runoff. For ease of calculation, a spreadsheet model was used for the computation.

When precipitation (P) occurs, it can either runoff (R) through the surface water system, infiltrate (I) to the water table, or evaporate/evapotranspire (ET) from the earth's surface and vegetation. The sum of R and I is termed as the water surplus (S). When long-term averages of P, R, I and ET are used, there is no net change in groundwater storage (ST). Annually, however, there is a potential for small changes in ST.

The annual water budget can be stated as:

$$P = ET + R + I + ST$$

Based on the physiographic setting and proximity to climate stations, the King Smoke Tree WWTP Climate Station was chosen as the most representative database. The most recent 30-year normal (average weather data) available from Environment Canada covers the period from January 1981 to December 2010. Table E-1, Appendix E summarizes the monthly and annual averages for precipitation and daily temperature.

4.3.1 PRE-DEVELOPMENT WATER BALANCE

To predict outputs of the pre-development water balance, various inputs were entered into the Thornthwaite model including monthly precipitation and temperature, site latitude, water holding capacity

values for native soils and factors of infiltration. Various inputs and outputs of the model are described in detail below. The detailed calculations are presented in Appendix E.

PRECIPITATION (P)

Based on the 30-year average for the King Smoke Tree WWTP Climate Station, the average precipitation for the area is about 858 mm/year. The monthly distribution of precipitation is presented in Table E-1, Appendix E.

STORAGE (ST)

Groundwater storage (ST) of native soils for the existing site was estimated using values of Water Holding Capacity (mm) of respective land use and soil types identified in Table 3.1 of the Storm Water Management (SWM) Planning & Design Manual (MOE, March 2003). The land uses, soil types and respective water holding capacities chosen to represent existing conditions at the site include urban lawn with a silt loam soil. Using the procedures outlined in the SWM Planning & Design Manual for the above land use and soil type, the annul change in storage is 0. The monthly distribution of ST for each of the land us/soil types is presented in Table E-2, Appendix E.

EVAPORATION / EVAPOTRANSPIRATION (ET)

In the pre-development scenario it is assumed that evaporation will occur over existing impervious surfaces at approximately 15% of total precipitation. Considering a total annual precipitation of 858 mm, evaporation is estimated at 129 mm. With an impervious area totaling 1628 m^2, a total annual volume of evaporation is estimated at 209 m^3/yr. The detailed calculations for evaporation are included in Table E-2 Appendix E.

Evapotranspiration in the pre-development scenario occurs over each pervious land use. Monthly Potential Evapotranspiration (PET) is estimated using monthly temperature data and is defined as a water loss from a homogeneous vegetation-covered area that never lacks water (Thornthwaite, 1948; Mather, 1978). In the Thornthwaite water balance model, PET is calculated using the Hamon equation (Hamon, 1061);

$$PET\ (HAMON) = 13.97 * D * D2 * WT$$

Where:

d = the number of days in the month
D = the mean monthly hours of daylight in units of 12 hours
Wt = a saturated water vapour density term = 4.95 * e0.627/100
T = the monthly mean temperature in degrees Celcius

Considering a total annual precipitation of 858 mm, adjusted Potential Evapotranspiration (PET) is estimated at 580 mm.

A comparison between PET and Precipitation (P) produces a soil moisture deficit which begins in June and is as much as 94 mm in August. Actual Evapotranspiration (AET) is based on PET and changes in ST (Δ ST). Where there is not enough P to satisfy PET, a reduction in ST occurs. The total annual volume of AET across

the existing site is estimated at 3,801 m^3/yr. Detailed calculations and the monthly distribution of AET is presented in Table E-2, Appendix E.

PRECIPITATION SURPLUS (S)

For Impervious surfaces at the site, surplus is P-ET where ET is estimated at 15% of P. The resulting precipitation surplus is about 729 mm/yr. For pervious areas of the site, precipitation surplus is calculated as P –AET which produces a surplus of about 313 mm/yr. More detailed calculations are included in Table E-2, Appendix E.

INFILTRATION (I)

For pervious areas, precipitation surplus has two components in the Thornthwaite model: a runoff component (overland flow that occurs when soil moisture capacity is exceeded) and an infiltration component. The accumulation of infiltration factors for topography, soil types and cover as prescribed in Table 3.1 of the SWM Planning & Design Manual give infiltration factors for existing conditions on the site as shown below in Section Table 4.3.1.

Table 4.3.1: Existing Conditions – Infiltration Factor

LAND USES / SOIL TYPES	TOPOGRAPHY	SOIL	COVER	TOTAL INFILTRATION FACTOR
Urban Law	0.20	0.15	0.2	0.45

Considering the above infiltration factors, the total volume of Infiltration (I) estimated for existing conditions is about 1066 m^3/yr. The more detailed calculations are presented in Table E-2, Appendix E.

RUNOFF (R)

The runoff component calculated in the pre-development model is the remaining volume of precipitation surplus for both pervious and impervious areas. Considering the precipitation surpluses and the total Infiltration and evaporation volume over the site, the total runoff estimated for existing conditions is about 2,307 m^3/yr. The more detailed calculations are presented in Table E-2, Appendix E.

4.3.2 POST-DEVELOPMENT WATER BALANCE (NO MITIGATION)

To predict outputs of the post-development water balance, the same elements of the 30-year average weather data and site latitude inputs were used. Various inputs and outputs of the post-development model are described in detail below. The detailed calculations are presented in Table E-3 Appendix E.

PRECIPITATION (P)

Precipitation remains the same (ie. The 30-year climate normals (1981-2010) for the King Smoke Tree WWTP Climate Station Climate Station).

STORAGE (ST)

Groundwater storage (ST) of native soils for the post-development site changes to reflect the increased landscaped areas. These areas are given a soil moisture holding capacity of 125 mm for clay loam soils. Similar to the pre-development conditions, using the procedures outlined in the SWM Planning & Design Manual for each land use, the annual change in storage is 0. The monthly distribution of ST for each of the land use/soil types is presented in Table E-3 Appendix E.

EVAPORATION / EVAPOTRANSPIRATION (ET)

In the post construction scenario, changes in land use result in an about 66 m^2 of impervious surfaces. For these areas it is assumed that evaporation will occur and will amount to approximately 15% of total precipitation. Considering a total annual precipitation of 858 mm, evaporation is estimated at 129 mm. As a result, a total annual volume of evaporation is estimated at 218 m^3/yr. The detailed calculations for evaporation are included in Table E-3 Appendix E.

For post-development pervious areas, monthly PET is estimated using the same inputs and calculations described in the pre-development model respective of land use and soil moisture holding capacity. In the post-development scenario, annual AET is 3,766 m^3/yr. The monthly distribution of Post-development AET and detailed calculations are presented in Table E-3, Appendix E.

PRECIPITATION SURPLUS (S)

For post-development pervious surfaces at the site, precipitation surplus is calculated as P –AET which includes about 313 mm/yr. For Impervious surfaces at the site, surplus is P-ET where ET is estimated at 15% of P. The resulting precipitation surplus is about 729 mm/yr. The more detailed calculations are included in Table E-3, Appendix E.

INFILTRATION (I)

The same accumulation of infiltration factors for topography, soil types and cover as prescribed in Table 3.1 of the SWM Planning & Design Manual were used give infiltration factors for post-development conditions.

A 10% decrease in the infiltration factor was not applied to account for soil compaction activities which may occur in some areas during the demolition of existing structures. It is expected that fill materials brought in to reclaim the areas of these structures will be of a similar quality or better with regards to permeability.

Considering the infiltration factors used, the total volume of Infiltration (I) estimated for post-development conditions is about 1,056 m^3/yr. The more detailed calculations are presented in Table E-3, Appendix E.

RUNOFF (R)

The runoff component calculated in the post-development model is a combination of the remaining volume of precipitation surplus for both pervious and impervious areas. The total volume of runoff (R) estimated for post-development conditions is 2,344 m^3/yr. The more detailed calculations are presented in Table E-3, Appendix E.

4.3.3 POST-DEVELOPMENT WATER BALANCE (WITH MITIGATION)

Based on results of the pre-development and post-development water balance completed, the proposed development will produce a reduction in annual AET (36 m^3/yr), an increase in annual ET (8 m^3/yr), a reduction in annual infiltration (10 m^3/yr) and an increase in annual runoff (37 m^3/yr), as shown in Table E-4, Appendix E. The effects are mainly the result of increased impervious area, replacing pervious areas of the site.

To minimize the effects of increased impervious area, Low Impact Development (LID) measures which promote onsite infiltration were incorporated into development plan. Proposed LIDs include the construction of 2 soakaway pits which will receive runoff from a roof area of 530 m^2. The following details were provided by Counterpoint Enginering Inc.

- Assumed Infiltration Rate 10 mm/hr
- Drawdown Time 48 hours
- Max. Drawdown Depth 1.2 m
- Drawdown Design Depth 1.0 m
- Area of Soakway Pit 1 25 m^2
- Area of Soakway Pit 2 25 m^2
- Porosity 0.4
- Total Infiltration Volume 20 m^3

Based on the infiltration testing completed, the assumed infiltration rate of 10 mm/hr is under the design infiltration rate calculated (12 mm/hr). As a result, post-development infiltration is expected to be greater than the pre-development conditions by about 10 m^3/yr.

5.0 CONSTRUCTION DEWATERING

Site servicing trenches are expected to be excavated through the clayey silt till and silty sand deposits. No significant groundwater seepages are anticipated during construction. Construction dewatering will be required if excavations extend into underlying sandy silt and silty sand deposits. In this instance, groundwater may be controlled by pumping from sumps.

To estimate rates of dewatering for services, excavation dimensions of 30 m long and 2 m wide were assumed (open at any given time) with an approximate depth of 5 mbgs. The estimated dewatering values is based on the k-value obtained from the in-situ hydraulic testing (BH19-3) and highest groundwater elevation (263.39 masl). The Dupuit expression for an unconfined aquifer in steady-state conditions was used as follows:

$$Q = \pi K(H^2 - h^2)/Ln\,(R_0/R_S) + 2((XK(H^2 - h^2))/2L$$

Where,

K – Hydraulic conductivity = 7.08 x 10^{-7} m/s
H – Distance from water level to the bottom of an aquifer = 4.8 m
h – Depth of water in the well while pumping = 1.4 m
X – Length of trench = 30 m
R_s – equivalent radius, where a and b excavation dimensions = 4.37 m
R_o – cone of depression radius, where a and b excavation dimensions = 13 m
L- $R_0/2$

R_s- Equivalent radius:

$$R_s = \left(\frac{(a\,x\,b)}{\pi}\right)^{0.5}$$

R_0 – Radius of Influence:

$$R_0 = 3(H-h)(\sqrt{K})$$

From the values used in the above calculation, the estimated dewatering required for a 30 m linear trench to temporarily provide dry conditions would be approximately 10,000 L/day (10 m^3/day). The dewatering value with a safety factor of 100% would be approximately 20,000 L/day (20 m^3/day). In addition to groundwater seepage into the excavations, major precipitation events should be considered. With the assumed trench excavation dimensions (30 m long x 2 m wide) and a 50 mm precipitation event, the potential incidental rainfall would be 3,000 L/day (3 m^3/day), giving a total potential inflow of 23,000 L/day (23 m^3/day) which is considered a conservative estimate.

5.1 Permit Requirements

An Environmental Activity Sector Registration (EASR) is required to be submitted to the Ministry of the Environment, Conservation and Parks (MECP) if the taking of groundwater and stormwater for a temporary construction project is between 50,000 L/day and 400,000 L/ day. The EASR application is an online registry and should be submitted to the MECP before any construction dewatering. A PTTW is required to be submitted to the MECP if the taking of groundwater and stormwater for a temporary construction project is more than 400,000 L/ day. Since the expected design dewatering rate for the unsealed excavations is less than 50,000 L/day, an EASR application is not required to be submitted to the MECP for short-term dewatering.

5.2 Discharge Permits (Construction Dewatering and Permanent Drainage)

A discharge permit will be required from York Region if private water is to be sent to the sewer system. Based on the results of groundwater quality testing, discharge from construction dewatering will require

filtration or settling techniques to lower the TSS prior to discharge in either the storm or sanitary sewer system.

6.0 POTENTIAL IMPACTS

The following are the predicted potential impacts as a result of construction dewatering:

6.1 Local Groundwater Use

The area is fully serviced by municipal water supply and construction of the slab-on-grade building will not extend to significant depths. It is therefore highly unlikely that any well interference will occur within domestic or municipal wells in the area. Additionally, there are no groundwater users within predicted zones of influence for the minor dewatering expected for servicing. As a result, there is no short-term or long-term predicted impacts to groundwater users occurring from the proposed dewatering activities.

6.2 Point of Discharge and Groundwater Quality

Groundwater quality analysis indicates that TSS exceeded both the storm and sanitary discharge criteria listed in the York Region Sanitary and Storm Sewer use By-Law (No. 2011-56). The groundwater can not be discharged into the sewer systems without treatment. If groundwater is to be discharged into the sewer, treatment will be required for aforementioned parameters. Discharge permits and agreements are required from the Halton Region or the City of Milton for short-term and long-term discharge.

6.3 Settlement Due to Dewatering Activities

There are structures and utilities (buildings, sewers etc.) within the predicted zone of influence (ZOI) about 13 meters when considering an open-cut excavation. Since the proposed construction is anticipated to be constructed in clayey silt till/silty sand unit, there is always a possibility of a loss of fines during the dewatering activities depending on dewatering method. Therefore, settlement may occur within the predicted zone of influence and settlement monitoring is recommended considering an unsealed excavation.

6.4 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.

7.0 SOURCE WATER PROTECTION

The Site is within the South Georgian Bay Lake Simcoe (SGBLS) Source Protection Region and the Lake Simcoe Region Conservation Authority (LSRCA). A Source Water Protection Report provided by The Regional Municipality of York is shown in Figure 5. Based on a review of the report, the following was determined:

- The Site as not within the Oak Ridges Moraine (ORM);

- The Site is not in an area of High Aquifer Vulnerability (HVA);
- The Site is not in a Significant Groundwater Recharge Area (SGRA);
- The Site is in a Recharge Management Area (RMA) - WHPA-Q; and,
- The Site is in a Wellhead Protection Area WHPA-D with a vulnerability score of 2.

7.1 Recharge Management Area WHPA-Q2

The Site is within a WHPA-Q2 recharge management area regulated by the Lake Simcoe Protection Act which came into effect in 2008. Under the Act, The Lake Simcoe Protection Plan was released in 2009 including policies 4.8-DP and 6.40-DP. Under these policies, the effects of the development are to be minimized and a water budget offsetting plan is required to demonstrate that the quality and quantity of groundwater and the function of the recharge areas are protected, improved or restored. Based on the results of the pre and post-development water balance completed in this report, the proposed development will improve the existing recharge condition at the Site by implementing Low Impact Development (LID) measures which encourage the storage and infiltration of clean sources of runoff.

7.2 Wellhead Protection Area WHPA-D

The Site is located entirely within WHPA-D, which is the 25-year time of travel zone (Figure 5). Based on threat vulnerability mapping (CTC, 2015), the aquifer in this area is mapped with a vulnerability score of 2, meaning that there are no significant chemical, pathogen or dense non-aqueous phase liquids (DNAPL) threats that may be identified in this area. It is therefore unlikely that impacts will occur to groundwater resources as a result of proposed construction or end uses of the Site.

8.0 LIMITATIONS

This report was prepared for the sole use of the addressee to provide an assessment of the hydrogeological conditions on the property. The information presented in this report is based on information collected during the completion of the hydrogeological investigation. DS Consultants Limited was required to use and rely upon various information sources produced by other parties. The information provides in this report reflects DS' judgment in light of the information available at the time of report preparation. This report may not be relied upon by any other person or entity without the written authorization of DS Consultants Ltd. The scope of services performed in the execution of this investigation may not be appropriate to satisfy the needs of other users, and any use or reuse of this documents or findings, conclusions, and recommendations represented herein, is at the sole risk of said users. The conclusions drawn from the Hydrogeological report were based on information at selected observation and sampling locations. Different conditions between and beyond these locations may become apparent during future investigations or on-site work, which could not be detected or anticipated at the time of this investigation. DS Consultants Ltd. cannot be held responsible for hydrogeological conditions at the site that was not apparent from the available information.

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

DS Consultants Ltd.

Prepared By:

Dorothy Garda, M.Sc.
Junior Hydrogeologist

Reviewed By:

Martin Gedeon, M.Sc., P.Geo.
Senior Hydrogeologist

9.0 CONSULTANTS QUALIFICATIONS

Martin Gedeon, M.Sc., P.Geo., is a Professional Geoscientist (P.Geo.) with over 24 years of experience as an environmental/hydrogeological consultant in the areas of groundwater and soil monitoring, environmental Site assessments, environmental due diligence, and remediation. Martin has significant experience in physical and contaminant hydrogeology across Canada and overseas and has provided hydrogeological/environmental technical support on various projects. Martin has prepared hundreds of hydrogeological reports in support of permit applications for a private sector development application, municipal dewatering operations and provincial infrastructure projects across the province.

Dorothy Garda, M.Sc. is a junior hydrogeologist with DS Consultants Ltd. Dorothy holds a master's in Earth and Environmental Sciences (hydrogeology) and has 1 year of environmental consulting experience. Dorothy has experience with conducting Phase One and Phase Two Environmental Site Assessments, hydrogeological investigations in the Greater Toronto Area (GTA) for development, and has been involved with project coordination, field assessments, data interpretation and reporting. Dorothy has assisted with PTTW, EASRs and Discharge Permit applications in support of construction dewatering from the MECP and discharge permitting.

10.0 REFERENCES

Chapman, L.J., and D.F. Putnam; The Physiography of Southern Ontario, Third Edition, Ontario Geological Survey Special Volume 2; 1984, & 2007.

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Powers, J. Patrick, P.E. (1992); Construction Dewatering: New Methods and Applications - Second Edition, New York: John Wiley & Sons.

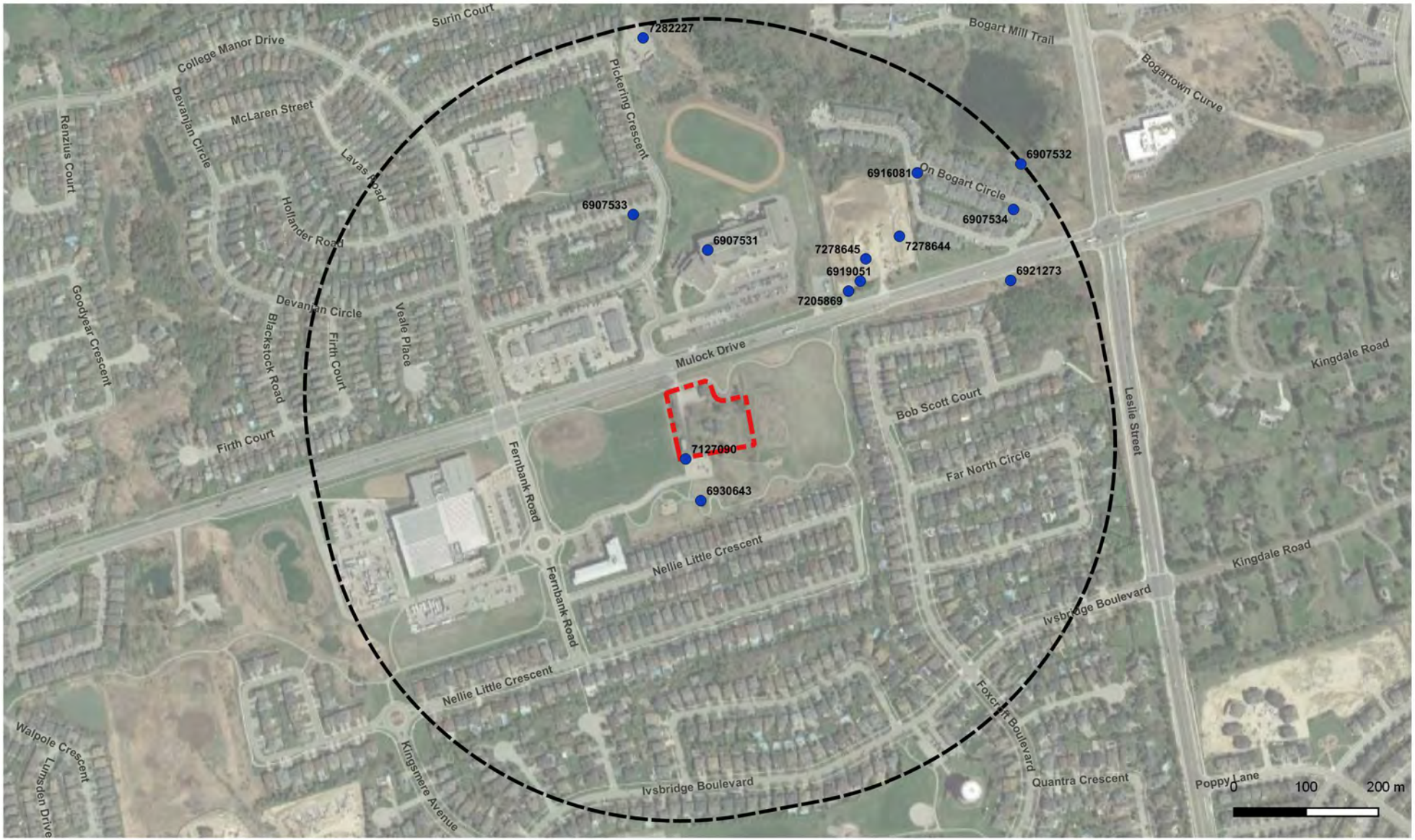
Pat M. Cashman and Martin Preene; Groundwater Lowering in Construction- Second Edition, CRC Press.

South Georgian Bay Lake Simcoe Source Protection Region (2015); Approved South Georgian Bay Lake Simcoe Source Protection Plan.

Regional Municipality of York (2014); Source Protection Guidance for Proposed Developments in Wellhead Protection Areas in the Regional Municipality of York.

Figures

J:\-GIS\19-190-100 Proposed Daycare Building\1-QGIS\Hydrogeology\Figure 1 - Site Location and MECP Well Records Map.qgs



Legend

- Approx Property Boundary
- 500m Buffer
- Registered Water Well (MECP WWR)

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6221 Highway 7, UNIT 16
Vaughan, Ontario L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

Project: PRELIMINARY HYDROGEOLOGICAL INVESTIGATION
900 Mulock Drive, Newmarket, ON

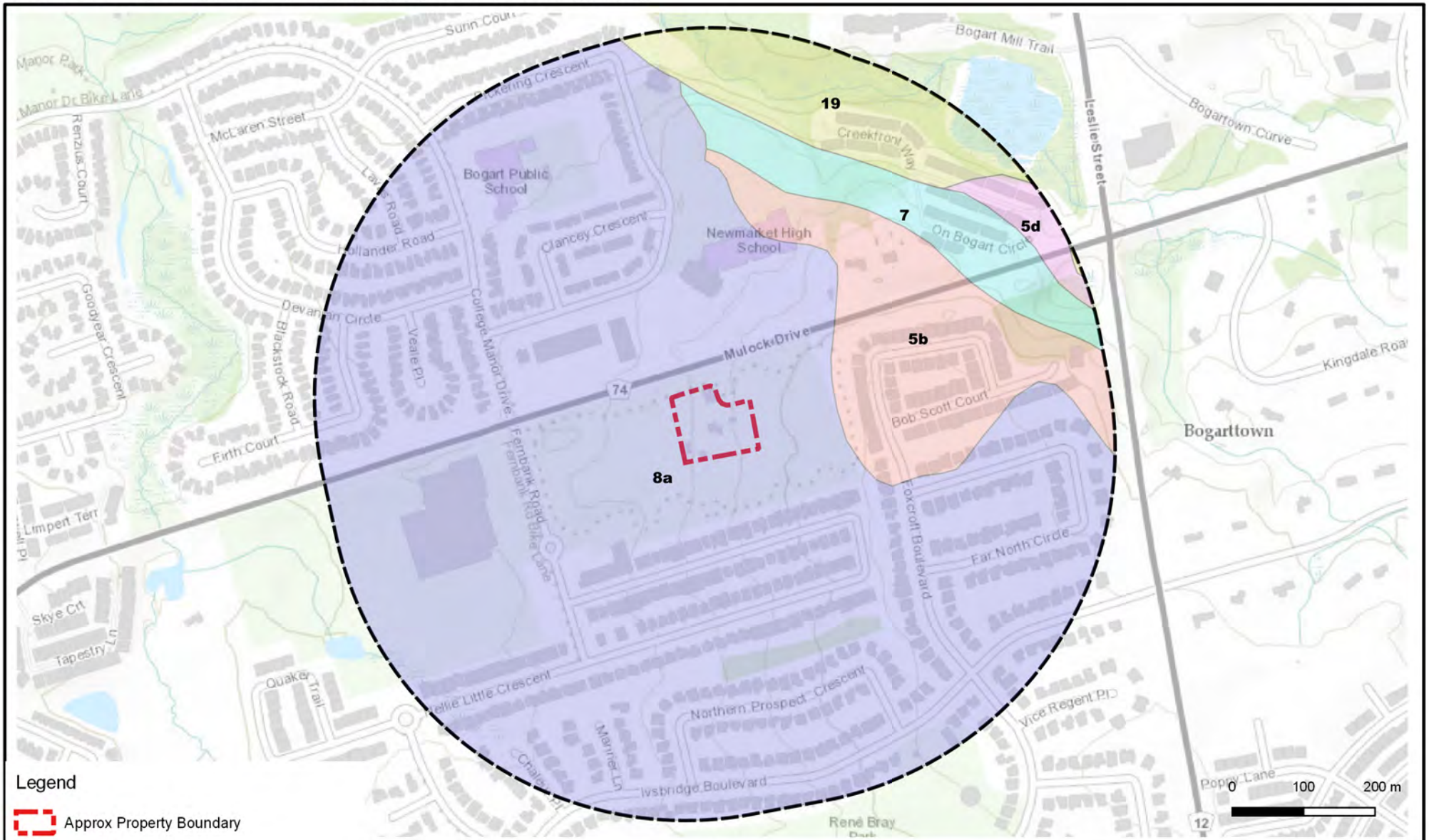
Title: **SITE LOCATION AND MECP WELL RECORDS MAP**

Client: COUNTERPOINT ENGINEERING
c/o DENISON CHILD CARE SERVICES – YRDSB

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	S.W	S.Y	November 2019
Rev:	Scale:	Project No.:	Figure No.:
0	As Shown	19-190-100	1

Image/Map Source: *Google Satellite Image*

J:\-GIS\19-190-100 Proposed Daycare Building\1-QGIS\Hydrogeology\Figure 2 - Surficial Geology Map.qgs



Legend

- Approx Property Boundary
- 500m Buffer
- 19 - Fluvial deposits
- 5b - Till
- 5d - Till
- 7-Glaciofluvial ice-contact stratified deposits
- 8a - Glaciolacustrine deposits

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www.dsconsultants.ca

Project: PRELIMINARY HYDROGEOLOGICAL INVESTIGATION
900 Mulock Drive, Newmarket, ON

Title: **SURFICIAL GEOLOGY MAP**

N

Client: COUNTERPOINT ENGINEERING
c/o DENISON CHILD CARE SERVICES – YRDSB

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	S.W	S.Y	November 2019
Rev: 0	Scale: As Shown	Project No.: 19-190-100	Figure No.: 2

Image/Map Source: *Google Satellite Image*

J:\-GIS\19-190-100 Proposed Daycare Building\1-QGIS\Hydrogeology\Figure 3 - BH-MW Location Plan.qgs

Legend

- Approx Property Boundary
- Borehole Location
- Monitoring Well Location
- Infiltration Test (IT) Location
- Cross Section

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6221 Highway 7, UNIT 16
Vaughan, Ontario L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

Client: COUNTERPOINT ENGINEERING
c/o DENISON CHILD CARE SERVICES – YRDSB

Project: PRELIMINARY HYDROGEOLOGICAL INVESTIGATION
900 Mulock Drive, Newmarket, ON

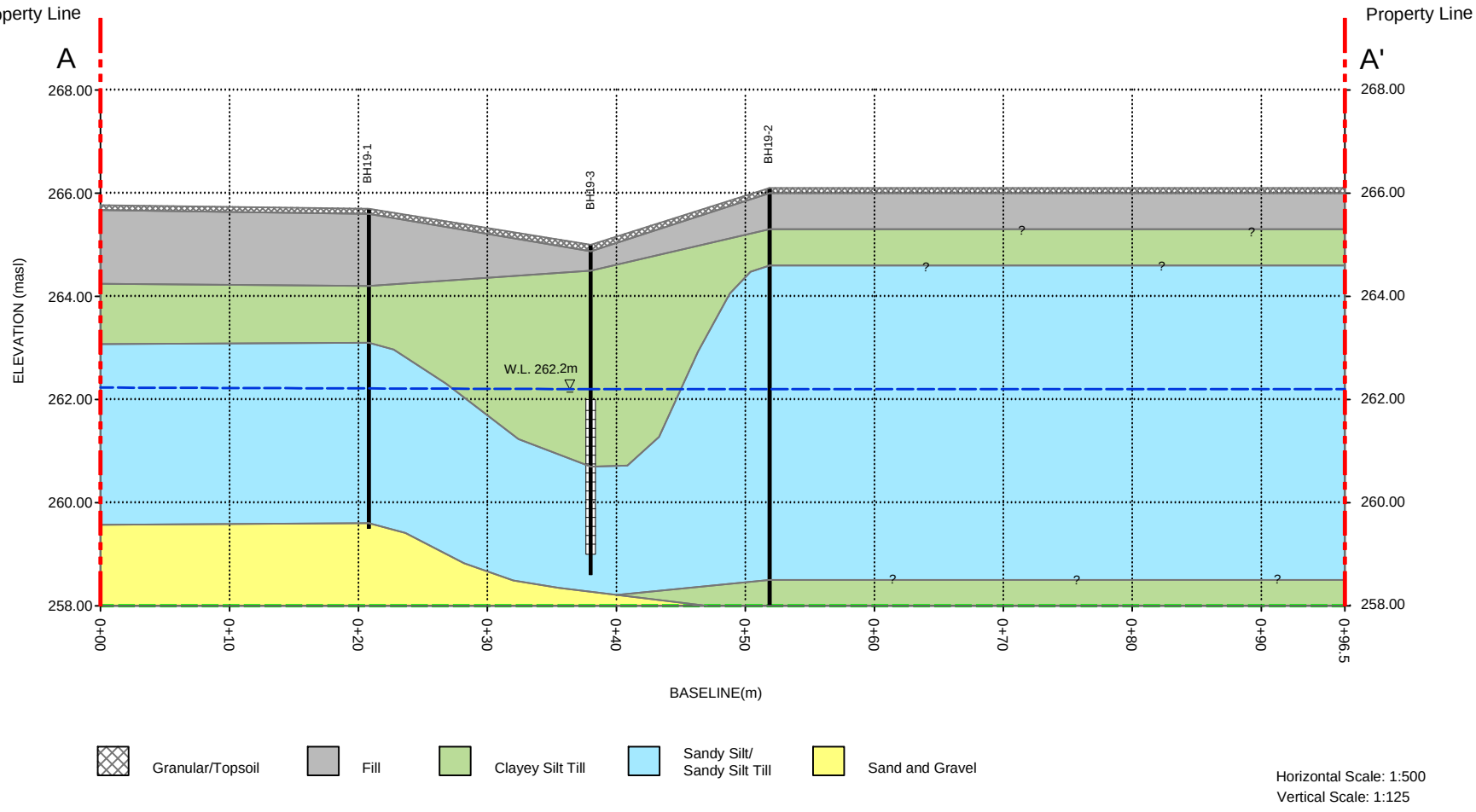
Title: **BOREHOLE AND MONITORING WELL LOCATIONS**

N

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	S.W	S.Y	November 2019
Rev: 0	Scale: As Shown	Project No.: 19-190-100	Figure No.: 3

Image/Map Source: *Google Satellite Image*

Path:j:\-gis\19-190-100 proposed daycare building\7-misc\cad\geological cross section -900 mulock.dwg



Horizontal Scale: 1:500
Vertical Scale: 1:125

Groundwater Elevation
(Oct 25, 2019)

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6221 Highway 7, UNIT 16
Vaughan, Ontario L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

Project: PRELIMINARY HYDROGEOLOGICAL INVESTIGATION
900 Mulock Drive, Newmarket, ON

Title: **GEOLOGICAL CROSS SECTION A-A'**

Client: COUNTERPOINT ENGINEERING
c/o DENISON CHILD CARE
SERVICES – YRDSB

Size:	Approved By:	Drawn By:	Date:
8.5 x 11	S.W	S.Y	November 2019
Rev.	**Scale:**	**Project No:**	**Figure No.**
	As Shown	19-190-100	**4**

Figure 5

Source Water Protection Report

Roll Number: 194804019780200
Parcel Id: 318537
Watershed: Lake Simcoe Region Conservation Authority (LSRCA)
Parcel Addresses: 605 Fernbank Road, Newmarket

Oak Ridges Moraine Conservation Plan

In the Oak Ridges Moraine?	No
Area of High Aquifer Vulnerability?	No

Clean Water Act

Source Protection Region: South Georgian Bay Lake Simcoe (SGBLS)

Recharge Management Area: Yes **In an Intake Protection Zone:** No **Significant Groundwater Recharge Area:** No **Highly Vulnerable Aquifers:** No

Wellhead Protection Area

Newmarket/Aurora WHPA-D

Vulnerability Score

Aurora and Newmarket Wells | Score: 2

Significant Groundwater Recharge Area

Highly Vulnerable Aquifers

For more information, email us at sourcewaterprotection@york.ca or call 1-877-464-9675 x75139
27/11/2019 4:13 PM

DS CONSULTANTS LTD.

Appendices

Appendix A:

Borehole Logs

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Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH19-1

PROJECT: Geotechnical Imvestigation-Proposed Daycare Building
CLIENT: Denison Child Care Services C/O YRDSB
PROJECT LOCATION: 900 Mulock Drive, Newmarket, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Oct/17/2019

REF. NO.: 19-190-100
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
265.7												
265.6	**GRANULAR:** sand and gravel, 125mm		1	SS	16		265		○			
265.3 0.4	**FILL:** clayey silt to silt, trace to some topsoil, dark brown to brown, moist, very stiff											
1	**FILL:** clayey silt, mixed with organics, grey, moist, soft		2	SS	3				○			
264.2 1.5	**SILT TO CLAYEY SILT TILL:** some sand, trace gravel, brown, very moist to wet, compact		3	SS	11		264		○			1 11 74 14
2												
263.1 2.6	**SANDY SILT TILL:** trace to some clay, trace gravel, brown, moist, dense		4	SS	14		263		○			
3			5	SS	33				○			
4							262					
261.1 4.6	**SILTY SAND:** trace clay, trace gravel, brown, wet, very dense		6	SS	88		261		○			
5												
259.6							260					
259.5 6.2	**SAND AND GRAVEL:** trace silt, grey, wet, very dense		7	SS	50/ 125mm				○			
	END OF BOREHOLE:											
	Notes: 1) Water level at depth of 4.6 mbgl during drilling											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG 19-190-100.GPJ DS.GDT 11/5/19

DS CONSULTANTS LTD.
Geotechnical ◆ Environmental ◆ Materials ◆ Hydrogeology

LOG OF BOREHOLE BH19-2

PROJECT: Geotechnical Imvestigation-Proposed Daycare Building
CLIENT: Denison Child Care Services C/O YRDSB
PROJECT LOCATION: 900 Mulock Drive, Newmarket, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Oct/17/2019

REF. NO.: 19-190-100
ENCL NO.: 3

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
266.1							
266.0 / 0.0	**TOPSOIL:** 100mm						266
265.9 / 0.1	**FILL:** sandy silt, trace topsoil/ rootlets, brown, moist, loose		1	SS	9		
265.3							
0.8	**SILT TO CLAYEY SILT:** trace sand, brown, very moist to wet, stiff		2	SS	11		265
264.6							
1.5	**SANDY SILT TILL:** trace gravel, trace to some clay, brown, wet, compact to very dense		3	SS	19		
			4	SS	38		264
			5	SS	49		263
	some gravel, moist below 4.6m		6	SS	50/ 125mm		262
260.0							261
6.1	**SILTY SAND:** trace clay, trace gravel, brown, wet, very dense		7	SS	50/ 125mm		260
258.5							259
7.6	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, grey, moist, hard		8	SS	88/ 250mm		
258.0							258
8.1	**END OF BOREHOLE:**						

Notes:
1) Water level at depth of 6.1 mbgl during drilling

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)
SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
METHANE AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG 19-190-100.GPJ DS.GDT 11/5/19

DS CONSULTANTS LTD.
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LOG OF BOREHOLE BH19-3

PROJECT: Geotechnical Imvestigation-Proposed Daycare Building
CLIENT: Denison Child Care Services C/O YRDSB
PROJECT LOCATION: 900 Mulock Drive, Newmarket, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: Oct/17/2019

REF. NO.: 19-190-100
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	METHANE AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
265.0												
264.9	**TOPSOIL:** 125mm											
0.1												
264.5	**FILL:** silt, trace topsoil, trace organics, brown, moist, loose		1	SS	5							
0.5	**CLAYEY SILT TILL:** some sand, trace gravel, brown, very moist, firm to stiff		2	SS	8		264					
								Bentonite				
			3	SS	14		263					
			4	SS	11							2 11 66 21
								W. L. 262.2 m Oct 25, 2019				
			5	SS	14		261					
260.7												
4.3	**SILTY SAND:** trace clay, trace gravel, brown, wet, dense to very dense							Filter Pack Slotted Pipe				
			6	SS	34		260					1 54 41 4
							259					
258.6	trace to some gravel below 6.1m		7	SS	50/ 100mm							
6.4	**END OF BOREHOLE:**											

Notes:
1) Water level at 4.6 mbgl during drilling.
2) 50mm dia. monitoring well installed upon completion.
3) Water level Reading:

Date:	Water Level (mbgl):
Oct 25, 2019	2.82

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

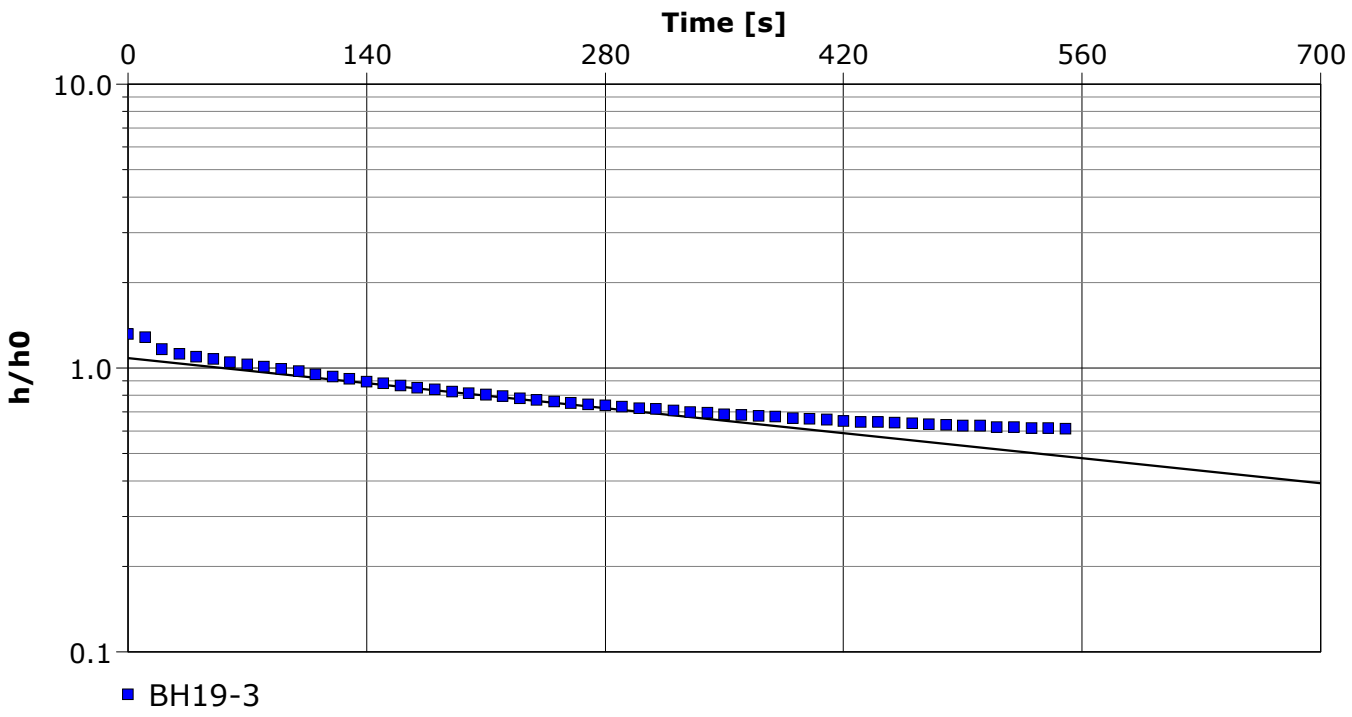
GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG 19-190-100.GPJ DS.GDT 11/5/19

Appendix B:
Hydraulic Conductivity Analysis

	Slug Test Analysis Report
	Project: Hydrogeological Investigation
	Number: 19-190-100
	Client: Denision Child Care Services

Location: 900 Mulock Drive, Newmarket	Slug Test: BH19-3	Test Well: BH19-3
Test Conducted by: TL		Test Date: 2019-10-25
Analysis Performed by: DG	BH19-3	Analysis Date: 2019-11-19
Aquifer Thickness: 6.40 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH19-3	7.08×10^{-7}	

Appendix C:
Groundwater Quality
Certificate of Analysis

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

Date Received: 01-NOV-19
Report Date: 13-NOV-19 10:11 (MT)
Version: FINAL

Client Phone: 647-237-5110

Certificate of Analysis

Lab Work Order #: L2376021

Project P.O. #: NOT SUBMITTED
Job Reference: 19-190-100
C of C Numbers: 17-731477
Legal Site Desc:

Amanda Overholster
Account Manager

ANALYTICAL REPORT

Summary of Guideline Exceedances

ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Guideline						
Ontario Mun.of York, Sanitary Bylaw #2011-56 - Ontario Mun.of York, Sanitary By-law #2011-56						
L2376021-1	BH19-3	Physical Tests	Total Suspended Solids	48400	350	mg/L
Ontario Mun.of York, Sanitary Bylaw #2011-56 - Ontario Mun. of York Storm and Land Drainage By-Law 2011-56						
L2376021-1	BH19-3	Physical Tests	Total Suspended Solids	48400	15	mg/L

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

ANALYTICAL REPORT

Physical Tests - WATER

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2376021-1 Sample Date: 28-OCT-19 Sample ID: BH19-3
pH	pH units	6.00-10.5	6-9	7.60 PEHT
Total Suspended Solids	mg/L	350	15	48400 DLHC

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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

Anions and Nutrients - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
		Guide Limits		
Analyte	Unit	#1	#2	
Fluoride (F)	mg/L	10	-	0.094
Total Kjeldahl Nitrogen	mg/L	100	1	0.88
Phosphorus, Total	mg/L	10	0.400	0.335
Sulfate (SO4)	mg/L	1500	-	49.5

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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

Cyanides - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Cyanide, Total	mg/L	2	0.020	0.0029

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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.

Total Metals - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Aluminum (Al)-Total	mg/L	50	-	2.63 DLHC
Antimony (Sb)-Total	mg/L	5	-	<0.0010 DLHC
Arsenic (As)-Total	mg/L	1	0.020	0.0015 DLHC
Cadmium (Cd)-Total	mg/L	1	0.008	<0.000050 DLHC
Chromium (Cr)-Total	mg/L	2	0.080	0.0083 DLHC
Cobalt (Co)-Total	mg/L	5	-	0.0013 DLHC
Copper (Cu)-Total	mg/L	3	0.050	0.011 DLHC
Lead (Pb)-Total	mg/L	5	0.120	0.00183 DLHC
Manganese (Mn)-Total	mg/L	5	0.150	0.0768 DLHC
Mercury (Hg)-Total	mg/L	0.1	0.0004	0.0000056
Molybdenum (Mo)-Total	mg/L	5	-	0.00318 DLHC
Nickel (Ni)-Total	mg/L	3	0.080	<0.0050 DLHC
Selenium (Se)-Total	mg/L	5	0.020	<0.00050 DLHC
Silver (Ag)-Total	mg/L	5	0.120	<0.00050 DLHC
Tin (Sn)-Total	mg/L	5	-	0.0023 DLHC
Titanium (Ti)-Total	mg/L	5	-	0.0807 DLHC
Zinc (Zn)-Total	mg/L	3	0.040	<0.030 DLHC

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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

Aggregate Organics - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
BOD Carbonaceous	mg/L	300	15	7.1
Oil and Grease, Total	mg/L	-	-	<5.0
Animal/Veg Oil & Grease	mg/L	150	-	<5.0
Mineral Oil and Grease	mg/L	15	-	<2.5
Phenols (4AAP)	mg/L	1	0.008	<0.0010

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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

Volatile Organic Compounds - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
		Guide Limits		
Analyte	Unit	#1	#2	
Benzene	ug/L	10	2.0	<0.50
Chloroform	ug/L	40	2.0	<1.0
1,2-Dichlorobenzene	ug/L	50	5.6	<0.50
1,4-Dichlorobenzene	ug/L	80	6.8	<0.50
cis-1,2-Dichloroethylene	ug/L	4000	5.6	<0.50
Dichloromethane	ug/L	2000	5.2	<2.0
trans-1,3-Dichloropropene	ug/L	140	5.6	<0.50
Ethylbenzene	ug/L	160	2.0	<0.50
Methyl Ethyl Ketone	ug/L	8000	-	<20
Styrene	ug/L	200	-	<0.50
1,1,2,2-Tetrachloroethane	ug/L	1400	17	<0.50
Tetrachloroethylene	ug/L	1000	4.4	<0.50
Toluene	ug/L	270	2.0	<0.50
Trichloroethylene	ug/L	400	8.0	<0.50
o-Xylene	ug/L	-	-	<0.50
m+p-Xylenes	ug/L	-	-	<1.0
Xylenes (Total)	ug/L	1400	4.4	<1.1
Surrogate: 4-Bromofluorobenzene	%	-	-	93.0
Surrogate: 1,4-Difluorobenzene	%	-	-	102.2

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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

Phthalate Esters - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Bis(2-ethylhexyl)phthalate	ug/L	12	8.8	<2.0
Surrogate: 2-fluorobiphenyl	%	-	-	76.8
Surrogate: p-Terphenyl d14	%	-	-	63.0

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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

Semi-Volatile Organics - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
		Guide Limits		
Analyte	Unit	#1	#2	
Di-n-butylphthalate	ug/L	80	15.0	<1.0
Surrogate: 2-Fluorobiphenyl	%	-	-	76.8
Surrogate: p-Terphenyl d14	%	-	-	63.0

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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

Polychlorinated Biphenyls - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
		Guide Limits		
Analyte	Unit	#1	#2	
Aroclor 1242	ug/L	-	-	<0.020
Aroclor 1248	ug/L	-	-	<0.020
Aroclor 1254	ug/L	-	-	<0.020
Aroclor 1260	ug/L	-	-	<0.020
Surrogate: Decachlorobiphenyl	%	-	-	93.4
Total PCBs	ug/L	1	0.4	<0.040
Surrogate: Tetrachloro-m-xylene	%	-	-	99.2

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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 Parameters - WATER

			Lab ID	L2376021-1
			Sample Date	28-OCT-19
			Sample ID	BH19-3
Analyte	**Unit**	**Guide Limits #1**	**#2**	
Bisphenol A	ug/L	-	-	<0.20
Nonylphenol	ug/L	20	-	<1.0
Nonylphenol Diethoxylates	ug/L	-	-	<0.10
Total Nonylphenol Ethoxylates	ug/L	200	-	<2.0
Nonylphenol Monoethoxylates	ug/L	-	-	<2.0
Octylphenol	ug/L	-	-	<1.0
Octylphenol Diethoxylates	ug/L	-	-	<0.10
Total Octylphenol Ethoxylates	ug/L	-	-	<2.0
Octylphenol Monoethoxylates	ug/L	-	-	<2.0

Guide Limit #1: Ontario Mun.of York, Sanitary By-law #2011-56
Guide Limit #2: Ontario Mun. of York Storm and Land Drainage By-Law 2011-56

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
PEHT	Parameter Exceeded Recommended Holding Time Prior to Analysis
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**
625-BIS-2-PHTH-WT	Water	Bis(2-ethylhexyl)phthalate	SW846 8270

Aqueous samples are extracted and extracts are analyzed on GC/MSD.

625-DNB-PHTH-WT	Water	Di-n-Butyl Phthalate	SW846 8270

Aqueous samples are extracted and extracts are analyzed on GC/MSD.

BOD-C-WT	Water	BOD Carbonaceous	APHA 5210 B (CBOD)

This analysis is carried out using procedures adapted from APHA Method 5210B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CN-TOT-WT	Water	Cyanide, Total	ISO 14403-2

Total cyanide is determined by the combination of UV digestion and distillation. Cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

When using this method, high levels of thiocyanate in samples can cause false positives at ~1-2% of the thiocyanate concentration. For samples with detectable cyanide analyzed by this method, ALS recommends analysis for thiocyanate to check for this potential interference

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

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.

HG-T-CVAA-WT	Water	Total Mercury in Water by CVAAS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

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

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

NP,NPE-LCMS-WT	Water	Nonylphenols and Ethoxylates by LC/MS-MS	J. Chrom A849 (1999) p.467-482

Water samples are filtered and analyzed on LCMS/MS by direct injection.

OGG-SPEC-CALC-WT	Water	Speciated Oil and Grease A/V Calc	CALCULATION

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
		Sample is extracted with hexane, sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.	
OGG-SPEC-WT	Water	Speciated Oil and Grease-Gravimetric	APHA 5520 B
		The procedure involves an extraction of the entire water sample with hexane. Sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.	
P-T-COL-WT	Water	Total P in Water by Colour	APHA 4500-P PHOSPHORUS
		This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is deteremined colourimetrically after persulphate digestion of the sample.	
PCB-WT	Water	Polychlorinated Biphenyls	EPA 8082
		PCBs are extracted from an aqueous sample at neutral pH with aliquots of dichloromethane using a modified separatory funnel technique. The extracts are analyzed by GC/MSD.	
PH-WT	Water	pH	APHA 4500 H-Electrode
		Water samples are analyzed directly by a calibrated pH meter.	
		Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days	
PHENOLS-4AAP-WT	Water	Phenol (4AAP)	EPA 9066
		An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.	
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
SOLIDS-TSS-WT	Water	Suspended solids	APHA 2540 D-Gravimetric
		A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1°C for a minimum of four hours or until a constant weight is achieved.	
TKN-WT	Water	Total Kjeldahl Nitrogen	APHA 4500-Norg D
		This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total Kjeldahl Nitrogen is determined by sample digestion at 380 Celsius with analysis using an automated colorimetric method.	
VOC-ROU-HS-WT	Water	Volatile Organic Compounds	SW846 8260
		Aqueous samples are analyzed by headspace-GC/MS.	
XYLENES-SUM-CALC-WT	Water	Sum of Xylene Isomer Concentrations	CALCULATION
		Total xylenes represents the sum of o-xylene and m&p-xylene.	

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

Chain of Custody Numbers:

Reference Information

17-731477

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

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

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: L2376021 Report Date: 28-NOV-19

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
625-BIS-2-PHTH-WT	**Water**							
Batch R4905059								
WG3215760-2 LCS								
Bis(2-ethylhexyl)phthalate			97.7		%		50-140	12-NOV-19
WG3215760-1 MB								
Bis(2-ethylhexyl)phthalate			<2.0		ug/L		2	12-NOV-19
Surrogate: 2-fluorobiphenyl			84.5		%		40-130	12-NOV-19
Surrogate: p-Terphenyl d14			87.8		%		40-130	12-NOV-19
625-DNB-PHTH-WT	**Water**							
Batch R4905059								
WG3215760-2 LCS								
Di-n-butylphthalate			98.2		%		50-150	12-NOV-19
WG3215760-1 MB								
Di-n-butylphthalate			<1.0		ug/L		1	12-NOV-19
Surrogate: 2-Fluorobiphenyl			84.5		%		40-130	12-NOV-19
Surrogate: p-Terphenyl d14			87.8		%		40-130	12-NOV-19
BOD-C-WT	**Water**							
Batch R4900814								
WG3208142-2 DUP		**L2374683-1**						
BOD Carbonaceous		<2.0	<2.0	RPD-NA	mg/L	N/A	20	06-NOV-19
WG3208142-3 LCS								
BOD Carbonaceous			98.5		%		85-115	06-NOV-19
WG3208142-1 MB								
BOD Carbonaceous			<2.0		mg/L		2	06-NOV-19
CN-TOT-WT	**Water**							
Batch R4900032								
WG3211062-11 DUP		**L2376023-1**						
Cyanide, Total		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	05-NOV-19
WG3211062-10 LCS								
Cyanide, Total			83.3		%		80-120	05-NOV-19
WG3211062-9 MB								
Cyanide, Total			<0.0020		mg/L		0.002	05-NOV-19
WG3211062-12 MS		**L2376023-1**						
Cyanide, Total			84.9		%		70-130	05-NOV-19
F-IC-N-WT	**Water**							
Batch R4899061								
WG3209798-20 DUP		**WG3209798-18**						
Fluoride (F)		0.116	0.115		mg/L	0.9	20	04-NOV-19
WG3209798-17 LCS								

Quality Control Report

Workorder: L2376021 Report Date: 28-NOV-19

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-IC-N-WT	**Water**							
Batch R4899061								
WG3209798-17 LCS								
Fluoride (F)			103.0		%		90-110	04-NOV-19
WG3209798-16 MB								
Fluoride (F)			<0.020		mg/L		0.02	04-NOV-19
WG3209798-19 MS		**WG3209798-18**						
Fluoride (F)			95.7		%		75-125	04-NOV-19
HG-T-CVAA-WT	**Water**							
Batch R4897218								
WG3209600-4 DUP		**WG3209600-3**						
Mercury (Hg)-Total		<0.0000050	<0.000005(	RPD-NA	mg/L	N/A	20	04-NOV-19
WG3209600-2 LCS								
Mercury (Hg)-Total			86.7		%		80-120	04-NOV-19
WG3209600-1 MB								
Mercury (Hg)-Total			<0.000005(		mg/L		0.000005	04-NOV-19
WG3209600-6 MS		**WG3209600-5**						
Mercury (Hg)-Total			81.5		%		70-130	04-NOV-19
MET-T-CCMS-WT	**Water**							
Batch R4897851								
WG3209437-4 DUP		**WG3209437-3**						
Aluminum (Al)-Total		0.097	0.091		mg/L	6.7	20	04-NOV-19
Antimony (Sb)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	04-NOV-19
Arsenic (As)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	04-NOV-19
Cadmium (Cd)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	04-NOV-19
Chromium (Cr)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	04-NOV-19
Cobalt (Co)-Total		0.0113	0.0114		mg/L	0.8	20	04-NOV-19
Copper (Cu)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	04-NOV-19
Lead (Pb)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	04-NOV-19
Manganese (Mn)-Total		4.85	4.93		mg/L	1.6	20	04-NOV-19
Molybdenum (Mo)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	04-NOV-19
Nickel (Ni)-Total		0.0976	0.0992		mg/L	1.7	20	04-NOV-19
Selenium (Se)-Total		0.00064	0.00064		mg/L	0.0	20	04-NOV-19
Silver (Ag)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	04-NOV-19
Tin (Sn)-Total		0.0048	0.0049		mg/L	1.7	20	04-NOV-19
Titanium (Ti)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	04-NOV-19
Zinc (Zn)-Total		<0.030	<0.030	RPD-NA	mg/L	N/A	20	04-NOV-19
WG3209437-2 LCS								

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4897851								
WG3209437-2 LCS								
Aluminum (Al)-Total			99.5		%		80-120	04-NOV-19
Antimony (Sb)-Total			99.2		%		80-120	04-NOV-19
Arsenic (As)-Total			97.4		%		80-120	04-NOV-19
Cadmium (Cd)-Total			98.9		%		80-120	04-NOV-19
Chromium (Cr)-Total			99.4		%		80-120	04-NOV-19
Cobalt (Co)-Total			97.9		%		80-120	04-NOV-19
Copper (Cu)-Total			98.4		%		80-120	04-NOV-19
Lead (Pb)-Total			99.99		%		80-120	04-NOV-19
Manganese (Mn)-Total			97.1		%		80-120	04-NOV-19
Molybdenum (Mo)-Total			98.2		%		80-120	04-NOV-19
Nickel (Ni)-Total			98.6		%		80-120	04-NOV-19
Selenium (Se)-Total			97.6		%		80-120	04-NOV-19
Silver (Ag)-Total			99.6		%		80-120	04-NOV-19
Tin (Sn)-Total			97.3		%		80-120	04-NOV-19
Titanium (Ti)-Total			96.9		%		80-120	04-NOV-19
Zinc (Zn)-Total			97.9		%		80-120	04-NOV-19
WG3209437-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	04-NOV-19
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	04-NOV-19
Arsenic (As)-Total			<0.00010		mg/L		0.0001	04-NOV-19
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	04-NOV-19
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	04-NOV-19
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	04-NOV-19
Copper (Cu)-Total			<0.0010		mg/L		0.001	04-NOV-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	04-NOV-19
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	04-NOV-19
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	04-NOV-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	04-NOV-19
Selenium (Se)-Total			<0.000050		mg/L		0.00005	04-NOV-19
Silver (Ag)-Total			<0.000050		mg/L		0.00005	04-NOV-19
Tin (Sn)-Total			<0.00010		mg/L		0.0001	04-NOV-19
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	04-NOV-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	04-NOV-19
WG3209437-5 MS		**WG3209437-6**						

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R4897851								
WG3209437-5 MS		**WG3209437-6**						
Aluminum (Al)-Total			108.0		%		70-130	04-NOV-19
Antimony (Sb)-Total			98.0		%		70-130	04-NOV-19
Arsenic (As)-Total			98.4		%		70-130	04-NOV-19
Cadmium (Cd)-Total			96.8		%		70-130	04-NOV-19
Chromium (Cr)-Total			98.2		%		70-130	04-NOV-19
Cobalt (Co)-Total			93.0		%		70-130	04-NOV-19
Copper (Cu)-Total			93.4		%		70-130	04-NOV-19
Lead (Pb)-Total			96.6		%		70-130	04-NOV-19
Manganese (Mn)-Total			N/A	MS-B	%		-	04-NOV-19
Molybdenum (Mo)-Total			96.7		%		70-130	04-NOV-19
Nickel (Ni)-Total			N/A	MS-B	%		-	04-NOV-19
Selenium (Se)-Total			101.6		%		70-130	04-NOV-19
Silver (Ag)-Total			98.0		%		70-130	04-NOV-19
Tin (Sn)-Total			95.7		%		70-130	04-NOV-19
Titanium (Ti)-Total			95.8		%		70-130	04-NOV-19
Zinc (Zn)-Total			88.2		%		70-130	04-NOV-19
NP,NPE-LCMS-WT	**Water**							
Batch R4898304								
WG3209390-7 DUP		**L2375920-1**						
Nonylphenol		<1.0	<1.0	RPD-NA	ug/L	N/A	30	04-NOV-19
Nonylphenol Monoethoxylates		<2.0	<2.0	RPD-NA	ug/L	N/A	30	04-NOV-19
Nonylphenol Diethoxylates		<0.10	<0.10	RPD-NA	ug/L	N/A	30	04-NOV-19
Octylphenol		<1.0	<1.0	RPD-NA	ug/L	N/A	30	04-NOV-19
Octylphenol Monoethoxylates		<2.0	<2.0	RPD-NA	ug/L	N/A	30	04-NOV-19
Octylphenol Diethoxylates		<0.10	<0.10	RPD-NA	ug/L	N/A	30	04-NOV-19
Bisphenol A		<0.20	<0.20	RPD-NA	ug/L	N/A	30	04-NOV-19
WG3209390-6 LCS								
Nonylphenol			85.3		%		75-125	04-NOV-19
Nonylphenol Monoethoxylates			93.5		%		75-125	04-NOV-19
Nonylphenol Diethoxylates			99.1		%		75-125	04-NOV-19
Octylphenol			102.0		%		75-125	04-NOV-19
Octylphenol Monoethoxylates			118.5		%		75-125	04-NOV-19
Octylphenol Diethoxylates			103.0		%		75-125	04-NOV-19
Bisphenol A			110.5		%		75-125	04-NOV-19

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NP,NPE-LCMS-WT	**Water**							
Batch R4898304								
WG3209390-5 MB								
Nonylphenol			<1.0		ug/L		1	04-NOV-19
Nonylphenol Monoethoxylates			<2.0		ug/L		2	04-NOV-19
Nonylphenol Diethoxylates			<0.10		ug/L		0.1	04-NOV-19
Octylphenol			<1.0		ug/L		1	04-NOV-19
Octylphenol Monoethoxylates			<2.0		ug/L		2	04-NOV-19
Octylphenol Diethoxylates			<0.10		ug/L		0.1	04-NOV-19
Bisphenol A			<0.20		ug/L		0.2	04-NOV-19
WG3209390-8 MS		**L2375920-1**						
Nonylphenol			101.6		%		50-150	04-NOV-19
Nonylphenol Monoethoxylates			111.7		%		50-150	04-NOV-19
Nonylphenol Diethoxylates			103.0		%		50-150	04-NOV-19
Octylphenol			111.0		%		50-150	04-NOV-19
Octylphenol Monoethoxylates			124.9		%		50-150	04-NOV-19
Octylphenol Diethoxylates			100.8		%		50-150	04-NOV-19
Bisphenol A			98.2		%		50-150	04-NOV-19
OGG-SPEC-WT	**Water**							
Batch R4898302								
WG3209402-2 LCS								
Oil and Grease, Total			95.3		%		70-130	03-NOV-19
Mineral Oil and Grease			91.4		%		70-130	03-NOV-19
WG3209402-1 MB								
Oil and Grease, Total			<5.0		mg/L		5	03-NOV-19
Mineral Oil and Grease			<2.5		mg/L		2.5	03-NOV-19
P-T-COL-WT	**Water**							
Batch R4904288								
WG3214795-3 DUP		**L2375905-5**						
Phosphorus, Total		0.0216	0.0234		mg/L	8.1	20	09-NOV-19
WG3214795-2 LCS								
Phosphorus, Total			90.7		%		80-120	09-NOV-19
WG3214795-1 MB								
Phosphorus, Total			<0.0030		mg/L		0.003	09-NOV-19
WG3214795-4 MS		**L2375905-5**						
Phosphorus, Total			98.1		%		70-130	09-NOV-19
PCB-WT	**Water**							

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PCB-WT	**Water**							
Batch R4898957								
WG3209585-2 LCS								
Aroclor 1242			110.0		%		65-130	05-NOV-19
Aroclor 1248			108.5		%		65-130	05-NOV-19
Aroclor 1254			113.8		%		65-130	05-NOV-19
Aroclor 1260			115.5		%		65-130	05-NOV-19
WG3209585-1 MB								
Aroclor 1242			<0.020		ug/L		0.02	05-NOV-19
Aroclor 1248			<0.020		ug/L		0.02	05-NOV-19
Aroclor 1254			<0.020		ug/L		0.02	05-NOV-19
Aroclor 1260			<0.020		ug/L		0.02	05-NOV-19
Surrogate: Decachlorobiphenyl			142.5		%		50-150	05-NOV-19
Surrogate: Tetrachloro-m-xylene			85.7		%		50-150	05-NOV-19
PH-WT	**Water**							
Batch R4896328								
WG3208923-4 DUP		**WG3208923-3**						
pH		7.20	7.18	J	pH units	0.02	0.2	02-NOV-19
WG3208923-2 LCS								
pH			7.03		pH units		6.9-7.1	02-NOV-19
PHENOLS-4AAP-WT	**Water**							
Batch R4901001								
WG3212127-7 DUP		**L2376570-1**						
Phenols (4AAP)		0.023	0.0227		mg/L	0.7	20	06-NOV-19
WG3212127-6 LCS								
Phenols (4AAP)			92.6		%		85-115	06-NOV-19
WG3212127-5 MB								
Phenols (4AAP)			<0.0010		mg/L		0.001	06-NOV-19
WG3212127-8 MS		**L2376570-1**						
Phenols (4AAP)			N/A	MS-B	%		-	06-NOV-19
SO4-IC-N-WT	**Water**							
Batch R4899061								
WG3209798-20 DUP		**WG3209798-18**						
Sulfate (SO4)		58.4	58.2		mg/L	0.4	20	04-NOV-19
WG3209798-17 LCS								
Sulfate (SO4)			103.7		%		90-110	04-NOV-19
WG3209798-16 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	04-NOV-19
WG3209798-19 MS		**WG3209798-18**						

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-IC-N-WT	**Water**							
Batch R4899061								
WG3209798-19 MS		**WG3209798-18**						
Sulfate (SO4)			98.7		%		75-125	04-NOV-19
SOLIDS-TSS-WT	**Water**							
Batch R4898418								
WG3209546-3 DUP		**L2374046-2**						
Total Suspended Solids		48.0	47.0		mg/L	2.1	20	05-NOV-19
WG3209546-2 LCS								
Total Suspended Solids			100.8		%		85-115	05-NOV-19
WG3209546-1 MB								
Total Suspended Solids			<2.0		mg/L		2	05-NOV-19
TKN-WT	**Water**							
Batch R4903365								
WG3213702-3 DUP		**L2375204-3**						
Total Kjeldahl Nitrogen		<0.15	<0.15	RPD-NA	mg/L	N/A	20	08-NOV-19
WG3213702-2 LCS								
Total Kjeldahl Nitrogen			100.2		%		75-125	08-NOV-19
WG3213702-1 MB								
Total Kjeldahl Nitrogen			<0.15		mg/L		0.15	08-NOV-19
WG3213702-4 MS		**L2375204-3**						
Total Kjeldahl Nitrogen			105.4		%		70-130	08-NOV-19
VOC-ROU-HS-WT	**Water**							
Batch R4902259								
WG3206019-4 DUP		**WG3206019-3**						
1,1,2,2-Tetrachloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
1,2-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
1,4-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
Benzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
Chloroform		<1.0	<1.0	RPD-NA	ug/L	N/A	30	07-NOV-19
cis-1,2-Dichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
Dichloromethane		<2.0	<2.0	RPD-NA	ug/L	N/A	30	07-NOV-19
Ethylbenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
m+p-Xylenes		<1.0	<1.0	RPD-NA	ug/L	N/A	30	07-NOV-19
Methyl Ethyl Ketone		<20	<20	RPD-NA	ug/L	N/A	30	07-NOV-19
o-Xylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
Styrene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R4902259								
WG3206019-4 DUP		**WG3206019-3**						
Tetrachloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
Toluene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
trans-1,3-Dichloropropene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
Trichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	07-NOV-19
WG3206019-1 LCS								
1,1,2,2-Tetrachloroethane			96.8		%		70-130	07-NOV-19
1,2-Dichlorobenzene			106.6		%		70-130	07-NOV-19
1,4-Dichlorobenzene			107.4		%		70-130	07-NOV-19
Benzene			116.5		%		70-130	07-NOV-19
Chloroform			110.4		%		70-130	07-NOV-19
cis-1,2-Dichloroethylene			105.7		%		70-130	07-NOV-19
Dichloromethane			105.3		%		70-130	07-NOV-19
Ethylbenzene			108.8		%		70-130	07-NOV-19
m+p-Xylenes			113.3		%		70-130	07-NOV-19
Methyl Ethyl Ketone			98.9		%		60-140	07-NOV-19
o-Xylene			105.2		%		70-130	07-NOV-19
Styrene			102.3		%		70-130	07-NOV-19
Tetrachloroethylene			99.6		%		70-130	07-NOV-19
Toluene			109.5		%		70-130	07-NOV-19
trans-1,3-Dichloropropene			110.4		%		70-130	07-NOV-19
Trichloroethylene			106.4		%		70-130	07-NOV-19
WG3206019-2 MB								
1,1,2,2-Tetrachloroethane			<0.50		ug/L		0.5	07-NOV-19
1,2-Dichlorobenzene			<0.50		ug/L		0.5	07-NOV-19
1,4-Dichlorobenzene			<0.50		ug/L		0.5	07-NOV-19
Benzene			<0.50		ug/L		0.5	07-NOV-19
Chloroform			<1.0		ug/L		1	07-NOV-19
cis-1,2-Dichloroethylene			<0.50		ug/L		0.5	07-NOV-19
Dichloromethane			<2.0		ug/L		2	07-NOV-19
Ethylbenzene			<0.50		ug/L		0.5	07-NOV-19
m+p-Xylenes			<1.0		ug/L		1	07-NOV-19
Methyl Ethyl Ketone			<20		ug/L		20	07-NOV-19
o-Xylene			<0.50		ug/L		0.5	07-NOV-19
Styrene			<0.50		ug/L		0.5	07-NOV-19

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R4902259								
WG3206019-2 MB								
Tetrachloroethylene			<0.50		ug/L		0.5	07-NOV-19
Toluene			<0.50		ug/L		0.5	07-NOV-19
trans-1,3-Dichloropropene			<0.50		ug/L		0.5	07-NOV-19
Trichloroethylene			<0.50		ug/L		0.5	07-NOV-19
Surrogate: 1,4-Difluorobenzene			102.1		%		70-130	07-NOV-19
Surrogate: 4-Bromofluorobenzene			96.8		%		70-130	07-NOV-19
WG3206019-5 MS		**WG3206019-3**						
1,1,2,2-Tetrachloroethane			99.2		%		50-150	07-NOV-19
1,2-Dichlorobenzene			108.8		%		50-150	07-NOV-19
1,4-Dichlorobenzene			109.3		%		50-150	07-NOV-19
Benzene			117.5		%		50-150	07-NOV-19
Chloroform			110.8		%		50-150	07-NOV-19
cis-1,2-Dichloroethylene			109.2		%		50-150	07-NOV-19
Dichloromethane			106.5		%		50-150	07-NOV-19
Ethylbenzene			108.4		%		50-150	07-NOV-19
m+p-Xylenes			113.2		%		50-150	07-NOV-19
Methyl Ethyl Ketone			91.8		%		50-150	07-NOV-19
o-Xylene			104.4		%		50-150	07-NOV-19
Styrene			101.0		%		50-150	07-NOV-19
Tetrachloroethylene			101.5		%		50-150	07-NOV-19
Toluene			109.0		%		50-150	07-NOV-19
trans-1,3-Dichloropropene			103.5		%		50-150	07-NOV-19
Trichloroethylene			108.2		%		50-150	07-NOV-19

Quality Control Report

Workorder: L2376021 Report Date: 28-NOV-19

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

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

Workorder: L2376021 Report Date: 28-NOV-19

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

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	28-OCT-19 12:00	02-NOV-19 08:00	4	5	days	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 L2376021 were received on 01-NOV-19 14:38.

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

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

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

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2376021-COFC

COC Number: 17 - 731477

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	DS Consultants
Contact:	Tanner Leonhardt
Phone:	
	Company address below will appear on the final report
Street:	6221 Hwy 7, Unit 16, Vaughan, ON
City/Province:	Vaughan, ON
Postal Code:	L4H 0K8
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	DS
Contact:	Paviola Derveni

Report Format / Distribution

Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☐ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: Scott.watson@dsconsultants.ca
Email 2: tanner.leonhardt@dsconsultants.ca
Email 3:

Invoice Distribution

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: accounting@dsconsultants.ca
Email 2:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E-100%] ☐ | Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	
Job #:	19-190-100
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only): L2376021 RD

ALS Contact: AF | Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	York Region Storm + San Package	SAMPLES ON HOLD	Sample is hazardous (please provide further details	NUMBER OF CONTAINERS
	BH19-3	08-10-19	12:00	GW	X			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☒ | Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				0.1			

SHIPMENT RELEASE (client use)

Released by: | Date: ~~01/10/2017~~ 01/11/19 | Time: 11:40

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: PK | Date: 11-01-19 | Time: 11:40

FINAL SHIPMENT RECEPTION (lab use only)

Received by: | Date: 01-NOV-19 | Time: 1436

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

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

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

Appendix D:
MECP Water Well
Record Summary

TOWNSHIP CON LOT	Eastings	Northing	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
NEWMARKET TOWN (WHIT	625331	4878602	7383	2	UT 0007		MO	0010 5	7282227	BRWN SAND GRVL SAND 0016
NEWMARKET TOWN (WHIT 02 090	625423	4877965	2006/07 4102						6930643	
NEWMARKET TOWN (WHIT CON 02 030	625401	4878022	2009/06 4102						7127090	
NEWMARKET TOWN (WHIT CON 02 031	625715	4878423	1981/08 2407	6	FR 0088	62/95//:	DO	0095 4	6916081	BLUE CLAY 0022 BRWN CLAY SNDY 0068 BLUE CLAY 0088 BLUE CSND 0099
NEWMARKET TOWN (WHIT CON 02 031	625645	4878303	2016/10 1663	6	UT	68///:		0107 6	7278645	
NEWMARKET TOWN (WHIT CON 02 031	625692	4878335	2016/11 1663	6	UT	62///:	NU	0095 4	7278644	
NEWMARKET TOWN (WHIT CON 02 031	625847	4878277	1990/09 3108	6	FR 0075	33//75/2:0	DO	0075 6	6921273	LOAM 0001 BRWN SAND GRVL 0008 BRWN SAND 0038 BLUE CLAY 0064 BLUE SAND 0081
NEWMARKET TOWN (WHIT CON 02 031	625322	4878358	1965/10 3414	4	FR 0093	50/80/4/2:0	ST DO	0089 4	6907533	PRDG 0014 SILT GRVL 0083 CLAY 0091 MSND 0093
NEWMARKET TOWN (WHIT CON 02 031	625426	4878311	1955/11 2801	8			NU		6907531	FSND 0019 CLAY MSND GRVL 0024 GREY CLAY MSND 0052 MSND GRVL 0060 GREY CLAY MSND 0122 GREY CLAY 0316 LMSN 0317
NEWMARKET TOWN (WHIT CON 02 031	625858	4878438	1963/11 2310	4	FR 0050	28/40/6/2:0	DO	0049 4	6907532	CLAY MSND 0025 CLAY STNS 0040 MSND 0050 CSND 0056
NEWMARKET TOWN (WHIT CON 02 031	625622	4878258	2013/07 7147						7205869	
NEWMARKET TOWN (WHIT CON 02 031	625849	4878375	1965/04 4102	30	FR 0015	13//4/:	DO		6907534	BRWN CLAY 0015 CSND 0027 BLUE CLAY 0035
WHITCHURCH-STOUFFVIL CON 02 031	625638	4878272	1987/09 1413	6	FR 0113	68/78/10/2:0	DO	0107 6	6919051	BRWN CLAY PCKD 0011 BRWN CLAY SAND PCKD 0073 BLUE CLAY DNSE 0098 GREY GRVL SLTY LYRD 0103 GREY SAND STNS MSND 0113

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour . Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

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

2. Core Color

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

3. Well Use

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

4. Water Detail

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

Appendix E:
Site Water Balance Calculations

TABLE E-1

CLIMATE NORMALS 1981-2010 (KING SMOKE TREE WWTP CLIMATE STATION)

900 Mulock Drive, Newmarket, ON.

	Thornthwaite (1948)					
Month	Mean Temperature (°C)	Heat Index	Unadjusted Potential Evapotranspiration (mm)	Daylight Correction Value	Adjusted Potential Evapotranspiration (mm)	Total Precipitation (mm)
January	-7.4	0.0	0.0	0.77	0.0	51.7
February	-6.1	0.0	0.0	0.87	0.0	46.0
March	-1.5	0.0	0.0	0.99	0.0	51.2
April	6.0	1.3	27.3	1.12	30.5	64.9
May	12.5	4.0	60.0	1.23	73.7	87.1
June	17.7	6.8	87.1	1.29	112.0	84.8
July	20.5	8.5	102.0	1.26	128.4	86.4
August	19.6	7.9	97.2	1.16	113.2	88.4
September	15.3	5.4	74.5	1.04	77.7	84.2
October	8.6	2.3	40.2	0.92	36.9	72.9
November	2.2	0.3	9.3	0.81	7.5	84.6
December	-3.7	0.0	0.0	0.75	0.0	55.5
TOTALS		**36.5**	**497.5**		**579.8**	**857.7**

Notes: Daylight Correction values obtained from Instruction and Tables For Computing Potential Evapotranspiration and The Water Balance (Thornthwaite & Mather, 1957)

TABLE E-2
PRE-DEVELOPMENT SITE WATER BALANCE
900 Mulock Drive, Newmarket, ON.

Hydrologic Components			Month												Total
			March	April	May	June	July	August	September	October	November	December	January	February	
PET - Adjusted Potential Evapotranspiration (mm)			0.00	30.53	73.69	111.99	128.35	113.20	77.70	36.88	7.50	0.00	0.00	0.00	**579.84**
P - Total Precipitation (mm)			51.20	64.90	87.10	84.80	86.40	88.40	84.20	72.90	84.60	55.50	51.70	46.00	**857.70**
P-PET (mm)			51.20	34.37	13.41	-27.19	-41.95	-24.80	6.50	36.02	77.10	55.50	51.70	46.00	**277.86**
Soil Moisture Deficit (mm)			0.00	0.00	0.00	-27.19	-69.15	-93.94	-87.45	-51.42	0.00	0.00	0.00	0.00	-
Total Site	Pervious Area (Silt Loam)	Soil Moisture Storage (mm)	125.00	125.00	125.00	97.81	55.85	31.06	37.55	73.58	125.00	125.00	125.00	125.00	-
		Actual Potential Evapotranspiration (mm)	0.00	30.53	73.69	109.03	112.19	97.02	77.70	36.88	7.50	0.00	0.00	0.00	**544.54**
		P-AET (mm)	51.20	34.37	13.41	-24.23	-25.79	-8.62	6.50	36.02	77.10	55.50	51.70	46.00	-
		Actual Soil Moisture Deficit (mm)	0.00	0.00	0.00	-24.23	-50.02	-58.64	-52.15	-16.12	0.00	0.00	0.00	0.00	-
		Change in Soil Moisture Deficit (mm)	0.00	0.00	0.00	24.23	25.79	8.62	-6.50	-36.02	-16.12	0.00	0.00	0.00	-
		Precipitation Surplus (mm)	51.20	34.37	13.41	0.00	0.00	0.00	0.00	0.00	60.98	55.50	51.70	46.00	**313.16**
		MOECC Infiltration Factor	0.45	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
		Run-Off Coefficient	0.55	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	-
		Infiltration (mm)	23.04	17.01	6.64	0.00	0.00	0.00	0.00	0.00	30.18	27.47	25.59	22.77	**152.71**
		Run-Off (mm)	28.16	17.36	6.77	0.00	0.00	0.00	0.00	0.00	30.79	28.03	26.11	23.23	**160.45**
		Catchment Area (m^2) = 6981	**Monthly Volumes (Pervious Area)**												
		AET (m^3)	0.00	213.10	514.42	761.11	783.12	677.25	542.42	257.42	52.35	0.00	0.00	0.00	**3801.18**
		Infiltration (m^3)	160.83	118.77	46.32	0.00	0.00	0.00	0.00	0.00	210.70	191.77	178.64	158.95	**1065.98**
		Run-Off (m^3)	196.57	121.17	47.26	0.00	0.00	0.00	0.00	0.00	214.96	195.65	182.25	162.16	**1120.01**
	Impervious Area (Roof and Paved)	Catchment Area (m^2) = 1628	**Monthly Volumes (Impervious Area)**												
		Evaporation from Imperv. (m^3), 15% of P.	12.50	15.84	21.26	20.70	21.09	21.58	20.56	17.80	20.65	13.55	12.62	11.23	**209.39**
		Run-Off from Imperv. (m^3), P - ET	70.83	89.78	120.49	117.31	119.52	122.29	116.48	100.85	117.03	76.78	71.52	63.64	**1186.52**
	Total Monthly Volumes (No Mitigation)														
	Total ET (m^3)		**12.50**	**15.84**	**21.26**	**20.70**	**21.09**	**21.58**	**20.56**	**17.80**	**20.65**	**13.55**	**12.62**	**11.23**	**209.39**
	Total AET (m^3)		**0.00**	**213.10**	**514.42**	**761.11**	**783.12**	**677.25**	**542.42**	**257.42**	**52.35**	**0.00**	**0.00**	**0.00**	**3801.18**
	Total Infiltration (m^3)		**160.83**	**118.77**	**46.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**210.70**	**191.77**	**178.64**	**158.95**	**1065.98**
	Total Runoff (m^3)		**267.40**	**210.95**	**167.75**	**117.31**	**119.52**	**122.29**	**116.48**	**100.85**	**331.99**	**272.42**	**253.77**	**225.79**	**2306.53**

NOTES:
1) PET and P Taken from Table 1
2) Soil Moisture Deficit (mm) is a function of P-Pet, once there is a shortage of P to satisfy PET
3) Water Holding Capacity (mm) of soils types taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003) and applied to March
4) Actual Evapotranspiration (AET) is a function of Adjusted Potential Evapotranspiration (PET) and change in Groundwater Storage (Δ ST) for a given soil type

TABLE E-3
POST-DEVELOPMENT SITE WATER BALANCE
900 Mulock Drive, Newmarket, ON.

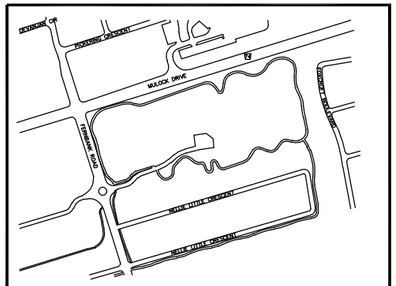
Hydrologic Components			Month												Total
			March	April	May	June	July	August	September	October	November	December	January	February	
PET - Adjusted Potential Evapotranspiration (mm)			0.00	30.53	73.69	111.99	128.35	113.20	77.70	36.88	7.50	0.00	0.00	0.00	**579.84**
P - Total Precipitation (mm)			51.20	64.90	87.10	84.80	86.40	88.40	84.20	72.90	84.60	55.50	51.70	46.00	**857.70**
P-PET (mm)			51.20	34.37	13.41	-27.19	-41.95	-24.80	6.50	36.02	77.10	55.50	51.70	46.00	**277.86**
Soil Moisture Deficit (mm)			0.00	0.00	0.00	-27.19	-69.15	-93.94	-87.45	-51.42	0.00	0.00	0.00	0.00	-
Total Site	Pervious Area (Silt Loam)	Soil Moisture Storage (mm)	125.00	125.00	125.00	97.81	55.85	31.06	37.55	73.58	125.00	125.00	125.00	125.00	-
		Actual Potential Evapotranspiration (mm)	0.00	30.53	73.69	109.03	112.19	97.02	77.70	36.88	7.50	0.00	0.00	0.00	**544.54**
		P-AET (mm)	51.20	34.37	13.41	-24.23	-25.79	-8.62	6.50	36.02	77.10	55.50	51.70	46.00	-
		Actual Soil Moisture Deficit (mm)	0.00	0.00	0.00	-24.23	-50.02	-58.64	-52.15	-16.12	0.00	0.00	0.00	0.00	-
		Change in Soil Moisture Deficit (mm)	0.00	0.00	0.00	24.23	25.79	8.62	-6.50	-36.02	-16.12	0.00	0.00	0.00	-
		Precipitation Surplus (mm)	51.20	34.37	13.41	0.00	0.00	0.00	0.00	0.00	60.98	55.50	51.70	46.00	**313.16**
		MOECC Infiltration Factor	0.45	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-
		Run-Off Coefficient	0.55	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	-
		Infiltration (mm)	23.04	17.01	6.64	0.00	0.00	0.00	0.00	0.00	30.18	27.47	25.59	22.77	**152.71**
		Run-Off (mm)	28.16	17.36	6.77	0.00	0.00	0.00	0.00	0.00	30.79	28.03	26.11	23.23	**160.45**
		Catchment Area (m^2) = 6915	**Monthly Volumes (Pervious Area)**												
		AET (m^3)	0.00	211.10	509.59	753.97	775.78	670.90	537.33	255.01	51.86	0.00	0.00	0.00	**3765.52**
		Infiltration (m^3)	159.32	117.66	45.89	0.00	0.00	0.00	0.00	0.00	208.72	189.97	176.97	157.45	**1055.98**
		Run-Off (m^3)	194.73	120.03	46.82	0.00	0.00	0.00	0.00	0.00	212.94	193.81	180.54	160.64	**1109.50**
	Impervious Area (Roof and Paved)	Catchment Area (m^2) = 1693	**Monthly Volumes (Impervious Area)**												
		Evaporation from Imperv. (m^3), 15% of P.	13.00	16.48	22.12	21.53	21.94	22.45	21.38	18.51	21.48	14.09	13.13	11.68	**217.81**
		Run-Off from Imperv. (m^3), P - ET	73.68	93.39	125.34	122.03	124.33	127.21	121.17	104.91	121.74	79.87	74.40	66.20	**1234.27**
	Total Monthly Volumes (No Mitigation)														
	Total ET (m^3)		**13.00**	**16.48**	**22.12**	**21.53**	**21.94**	**22.45**	**21.38**	**18.51**	**21.48**	**14.09**	**13.13**	**11.68**	217.81
	Total AET (m^3)		**0.00**	**211.10**	**509.59**	**753.97**	**775.78**	**670.90**	**537.33**	**255.01**	**51.86**	**0.00**	**0.00**	**0.00**	3765.52
	Total Infiltration (m^3)		**159.32**	**117.66**	**45.89**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**208.72**	**189.97**	**176.97**	**157.45**	1055.98
	Total Runoff (m^3)		**268.41**	**213.43**	**172.16**	**122.03**	**124.33**	**127.21**	**121.17**	**104.91**	**334.68**	**273.68**	**254.94**	**226.83**	2343.77

NOTES:
1) PET and P Taken from Table 1
2) Soil Moisture Deficit (mm) is a function of P-Pet, once there is a shortage of P to satisfy PET
3) Water Holding Capacity (mm) of soils types taken from Table 3.1, SWM Planning & Design Manual (MOE, March 2003) and applied to March
4) Actual Evapotranspiration (AET) is a function of Adjusted Potential Evapotranspiration (PET) and change in Groundwater Storage (Δ ST) for a given soil type

TABLE E-4
WATER BUDGET SUMMARY
900 Mulock Drive, Newmarket, ON.

Total Site	Month												Total
	March	April	May	June	July	August	September	October	November	December	January	February	
Pre-Development													
Total ET (m^3)	12	16	21	21	21	22	21	18	21	14	13	11	**209**
Total AET (m^3)	0	213	514	761	783	677	542	257	52	0	0	0	**3801**
Total Infiltration (m^3)	161	119	46	0	0	0	0	0	211	192	179	159	**1066**
Total Runoff (m^3)	267	211	168	117	120	122	116	101	332	272	254	226	**2307**
Post-Development without Mitigation													
Total ET (m^3)	13	16	22	22	22	22	21	19	21	14	13	12	**218**
Total AET (m^3)	0	211	510	754	776	671	537	255	52	0	0	0	**3766**
Total Infiltration (m^3)	159	118	46	0	0	0	0	0	209	190	177	157	**1056**
Total Runoff (m^3)	268	213	172	122	124	127	121	105	335	274	255	227	**2344**
Post-Development Deficit (-ve value implies a net gain)													
Total ET (m^3)	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	**-8**
Total AET (m^3)	0	2	5	7	7	6	5	2	0	0	0	0	**36**
Total Infiltration (m^3)	2	1	0	0	0	0	0	0	2	2	2	1	**10**
Total Runoff (m^3)	-1	-2	-4	-5	-5	-5	-5	-4	-3	-1	-1	-1	**-37**

Appendix F:
Pre and Post-Development Impervious Plan



KEY PLAN

LEGEND

	IMPERVIOUSNESS (%)	AREA (m²)
ROOF AREA	100%	553.5
ASPHALT AREA	100%	1,074.0
LANDSCAPED AREA	0%	6,980.5
TOTAL	19%	8,608.00

counterpoint ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

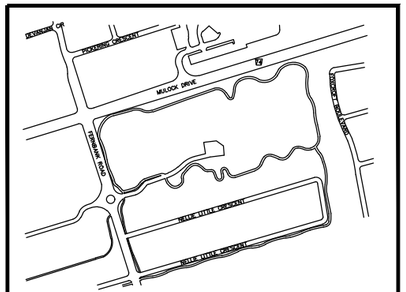
DENISON CHILD CARE CENTRE
605 FERNBANK (900 MULOCK DRIVE)
NEWMARKET, ONTARIO

PRE-DEVELOPMENT IMPERVIOUSNESS PLAN

DESIGNED BY: ES	DATE: OCT 2019
CHECKED BY: CB	PROJECT No. 18055
DRAWING BY: ES	
CHECKED BY: CB	FIGURE No. 2
SCALE: N.T.S.	

LEGEND

		IMPERVIOUSNESS (%)	AREA (m²)
	ROOF AREA	100%	839.00
	ASPHALT AREA	100%	854.0
	LANDSCAPED AREA	0%	6,915.0
	TOTAL	19%	8,608.00



KEY PLAN

counterpoint ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

DENISON CHILD CARE CENTRE
605 FERNBANK (900 MULOCK DRIVE)
NEWMARKET, ONTARIO

POST-DEVELOPMENT IMPERVIOUSNESS PLAN

DESIGNED BY: ES	DATE: OCT 2019
CHECKED BY: CB	PROJECT No. 18055
DRAWING BY: ES	
CHECKED BY: CB	FIGURE No. 3
SCALE: N.T.S	