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Hydrogeological Assessment

12519 & 12713 Humber Station Road, Bolton, Ontario

Palmer Project #
2008102

Prepared For
Prologis c/o Mainline Planning Services Inc.

July 31, 2025

871 Equestrian Court, Unit 1, Oakville, ON L6L 6L7
Tel: 647-795-8153 | www.pecg.ca

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Prologis
c/o
Mainline Planning Services Inc.
P.O. Bo 319 Kleinburg, ON
L0J 1C0

Re: Hydrogeological Assessment – 12519 & 12713 Humber Station Road, Bolton, ON
Project #: 2008102

Palmer (now part of SLR Consulting (Canada) Ltd) is pleased to submit the attached report presenting the results of our hydrogeological assessment for the proposed development located at 12519 & 12713 Humber Station Road, Bolton, ON. The hydrogeological assessment covers all the items provided in the proposal with adjustment based on site constraints and project requirement. Palmer conducted the required assessments and analyses as per applicable provincial guidelines and generally accepted practices.

This report has been updated to address the 1st Submission comments from the Town of Caledon, TRCA and Peel Region. A test pit investigation was completed by SLR in January 2025 to define the groundwater table. These findings are provided under a separate cover.

The major findings of the updated Hydrogeology Assessment Report include:

- The site is underlain with over 20 m thick overburden sediments that consist of silt to clay till and silt of the Halton Till formation within investigation depths. Significant aquifers are not identified below the site;

- Groundwater levels from monitoring wells range from 0.2 to 2.9 metres below ground surface (mbgs) with a predominant flow direction from northwest to southeast and to southwest, towards the tributary of West Humber River. The shallow groundwater levels measured are interpreted to be a reflection of the low permeability and poor drainage of the surficial soils. The recorded groundwater levels may result from interflows, localized or pocketed coarse-grain saturated soils or pathways, and may not be the real groundwater phreatic surface, which have been proved by the test pit investigation;

- Groundwater level and surface water level data from mini-piezometers do not show hydraulic connection between groundwater and surface water, indicating that groundwater does not support stream flow and associated wetlands and shallow ponds. Therefore, groundwater does not take part in forming the hydroperiod of these features and these feature can be considered surface water supported;

- Hydraulic conductivity values range from the orders of $6.0x10^{-10}$ to $6.6x10^{-7}$ m/s, generally increasing with depths and grain size of formations. The infiltration rate for native formations has an average value of 23 mm/hr. If infiltration facilities are sited on fill, the infiltration capacity of fill should be assessed;

- Groundwater quality is fresh and no visual or olfactory evidence of contamination such as visible petroleum hydrocarbon film or sheen as well as smell and odor were recorded during drilling or sampling. A number of exceedances were identified over ODWS and PWQO criteria, which is typical in raw groundwater, particularly in an agricultural setting;

- The construction dewatering analysis shows that the required dewatering rate for a typical construction working face for site servicing or shallow foundations could be up to 6,018 L/day, which is below the thresholder of 50,000 L/day for consideration of an EASR. Therefore, neither an EASR registration nor a PTTW application is expected to be required for this project. Potential possible stormwater accumulation is provided for client's reference only. The water taking for construction dewatering is of short term, limited quantity and limited influence zones. No impacts from construction dewatering to natural heritage features or private wells is expected;

- The site water balance analysis shows the proposed Phase 1 development will cause a reduction of infiltration of 25,476 m^3/year and an increase in runoff of 158,582 m^3/year. The proposed infiltration tank will fully compensate the infiltration deficit;

- FBWB conducted for Phase One development shows that the development will result in an increased runoff of 86,633 m^3/year and reduced infiltration of 1,012 m^3/year in the East Wetland catchment, and an increased runoff of 81,353 m^3/year and reduced infiltration of 678 m^3/year in the East Wetland catchment. As neither the East Wetland and West Wetland receive groundwater discharge contribution, the minor reduction of infiltration within the catchment of each wetland will not adversely impact the wetlands. Runoff should be properly managed through the proposed SWM Plan to prevent the increased runoff to end up in the both wetlands. Through the establishment of wetland setbacks and new compensation areas in the Eastern Wetland catchment, and the creation of a new, higher functioning drainage channel in the Western Wetland catchment, no impacts to wetland hydrology or hydrogeology is expected.

We trust that this report is complete within our terms of reference and suitable for your present requirements. If you have any questions or require further information, please do not hesitate to contact our office.

Yours truly,

_____

Jason Cole, M.Sc., P.Geo.
Technical Discipline Manager, Hydrology and Hydrogeology

Table of Contents

List of Figures

List of Tables

List of Appendices

1. Introduction

Palmer was retained by Prologis c/o Mainline Planning Services Inc. ("the client") to complete a Hydrogeological Assessment as part of the Draft Plan and Site Plan applications for the proposed industrial/ commercial development located at 12519 and 12713 Humber Station Road, Bolton, ON L7E 0Y1/0Z6 ("the site") (**Figure 1**). The site is approximately 78.46 ha in area and is located at the northwest quadrant of Mayfield Road and Humber Station Road. The site currently is vacant, and hosts cultivated lands, a small woodlot, a pond and hedgerows. The site has access to municipal servicing from Peel Region.

The purpose of the Hydrogeological Assessment is conducted as part of project design and permitting with the Town of Caledon, Region of Peel, and Toronto and Region Conservation Authority (TRCA). *This report has been updated to address the 1st Submission comments from the Town of Caledon, TRCA and Peel Region.*

1.1 Proposed Development

Based on site plans and design drawings provided by the client, the proposed development consists of following features (**Appendix A**):

- Proposed Phase One Building 1 with a footprint of 14.32 ha;
- Future Phase 2A and Phase 2B;
- Future Phase 3;
- Pavement for parking, loading areas, access driveways;
- Seven (7) storage tanks (Tank 1 to Tank 7) for Phase 1 Building 1;
- Three rainwater harvesting tanks (Tank A, B, D) for Phase 1 Building 1;
- Three infiltration tanks (Tank C, E, F) for Phase 1 Building 1;
- Shallow and deep servicing utilities such as storm sewers, sanitary sewers, gas and power lines; and
- Landscaped features.

An interim stormwater pond was proposed at the south end of the site to manage the stormwater during construction.

1.2 Scope of Work and Methodology

The Hydrogeological Report was produced in general accordance with Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications (2013) and covered items far beyond the original scope of services in the approved proposal for the project. The following sections provide the major methods used to complete the Hydrogeological Report.

1.2.1 Review of Records and Previous Studies

Detailed background and record review was conducted for the area surrounding the site to delineate the regional setting of the site, including physical setting and environmental setting. The regional setting will help delineate site conditions, help with data interpretation, and help with impact assessment.

The sources of data and records reviewed included, but are not limited to, Ontario Geological Survey database (physiography, geology and boreholes), MECP database (well record, natural heritage, hydrology, source protection and environmental instruments), data from Conservation Authorities (watershed plan, subwatershed studies, source protection plan, stormwater criteria and LID), and data from the municipalities (official plan, zoning plan, permit application, well head protection policies and sewer use bylaw).

Five previous study reports had been identified and extracted from the Comprehensive Environmental Impact Study and Management Plan (CEISMP), including:

1. Geotechnical Investigation Report by Soil Eng.in 2017;
2. Geotechnical Investigation Report by Pinchin in 2022;
3. Geotechnical Investigation Report by DS Consultants LTD.in 2023;
4. Supplemental Geotechnical Investigation – Proposed Industrial Development, Pinchin 2023; and
5. Hydrogeological Investigation Report by IBI Group in 2022.

The following presents the parts from these studies that will contribute to the site characterization and data analysis of the present study.

Soil Eng (2017) covered larger area containing the site. The investigation was based on eight monitoring wells on five locations (three nested wells). Only MW3-17 and MW4-17D/S are located within the site. All these monitoring wells within the site were enlisted for the present study.

Pinchin (2022) covered the same study area as the current study. The study was based on 18 boreholes (BH1 to BH18, depth range of 5.0 to 6.6 m, with six monitoring wells installed) and 14 test pits. The six monitoring wells installed were all enlisted for the current study. Grain size analysis results from this study were used by the present study to estimate hydraulic conductivity of formations (**Appendix D**).

DS (2023) covered larger area containing the site, but did not drill boreholes within the site.

Pinchin (2023) was based on the boreholes completed by the 2022 study and 82 more boreholes. Among the 82 boreholes, seven (7) monitoring wells were installed. The seven monitoring wells installed for this study were all enlisted for the current study. As this report was provided at later time, groundwater levels from only the recent rounds of monitoring were available.

The IBI Group (2022) Hydrogeological Study was completed as part of the Comprehensive Environmental Impact Assessment and Management Plan (CEISMP) for the overall Humber Station Landowners Group, and was based on eight (8) monitoring wells (three nested) (completed by Soil Engineers as introduced above) with depths ranging from 6.0 to 12.5 m, three (3) monitoring wells (completed Burnside) with depths ranging from 4.5 to 5.8 m, as well as nine (9) mini-piezometers, five groundwater samples (MW1-17, MW5-17S, MW3-17 and MW4-17D), and three (3) surface water samples (SF1-17, SF5-17 and SF6-17). The monitoring wells and mini-piezometers installed within the site, and the two (2) wells south of the site are enlisted for the current study.

1.2.2 Monitoring Point Inventory, Enlisting and Instrumentation

Following the review of previous studies, site reconnaissance was conducted several times by Palmer staff to examine landform, surficial features, monitoring wells, potential pathways, groundwater outcrops, water courses and potential natural hazards such as sinkholes, faults and karst features, and to inspect and confirm the conditions of monitoring wells and mini-piezometers.

All monitoring wells available on site were identified and enlisted for the current study.

The inspection of monitoring wells and mini-piezometers included such activities as grading surrounding ground surface to ensure surface water will not accumulate and infiltrate into wells and mini-piezometers, cleaning well structure (pit, pipe and cap), developing the wells and mini-piezometers, and measuring well depth and water levels in metres below ground surface (mbgs), and measuring stick-up height. Surface elevation of wells is presented in metres above sea level (masl). Four data loggers were installed in selected monitoring wells. **Table 1** lists the summary of the 21 monitoring wells (BH and MW) and five 95) mini-piezometers (SF and WL) that were confirmed to be in good condition and were selected to be monitored for the current study.

It should be noted that there are discrepancies between the elevations listed in **Table 1** and the elevations marked in borehole logs (**Appendix B**). The elevations in **Table 1** were provided by the client based on their survey, and will be used for calculating groundwater level elevations. **Figure 1** shows the location of the adopted monitoring wells. The well logs were attached as **Appendix B**.

Table 1. Monitoring Wells and Mini-piezometers from the CESMP and Utilized for the Current Study

Well ID	Surface Elevation (masl)	Stick-up (m)	Depth (mbgs)	Screened Interval (mbgs)	Screened Unit	Logger Installed	Consultant
BH1	239.28	0.97	6.02	3-6	Silt	Yes	Pinchin
BH9	235.57	0.95	6.09	3-6	Silt	Yes	Pinchin
BH12	237.15	0.89	4.3	3-6	Silt	-	Pinchin
BH12b	-	0.95	5.31	-	-	-	-
BH13	237.42	0.94	6.04	3-6	Silt	Yes	Pinchin
BH15	234.02	1	6.19	3-6	Silt	-	Pinchin
BH18	232.61	0.93	6.35	3-6	Silt	Yes	Pinchin
MW103	238.79	0.92	6.07	3-6	Clay till	-	Pinchin
MW108	236.89	1.05	6.1	3-6	Clay till	-	Pinchin
BHz	-	0.81	6.1	3-6	-	-	-
MW124	239.04	0.95	6.23	3-6	Clay till and sand	-	Pinchin
MW160	234.36	0.9	6.23	3-6	Clay till and sandy silt	-	Pinchin
MW161	232.84	1.0	6.29	3-6	Clay till	-	Pinchin
MW168	231.87	1.08	6.03	3-6	Clay till	-	Pinchin
MW3-17	234.79	0.7	6.01	3-6	Silt	-	Soil Eng.
MW4-17S	233.98	0.93	5.85	3-6	Silt	-	Soil Eng.
MW4-17D	233.98	0.72	12.18	9-12	Silt	-	Soil Eng.
MW8	231.86	0.86	15.11	3.5-5	Silt till	-	Burnside

MW9	235.59	0.84	5.4	3.7-5.2	Silty sand	-	Burnside
BHx	-	0.86	6.28	-	-	-	-
SF2-7S	-	0.24	0.97	-	-	-	IBI
SF2-17D	-	1.38	0.66	-	-	-	IBI
SF5-17S	-	0.42	0.8	-	-	-	IBI
SF5-17D	-	1.06	0.96	-	-	-	IBI
WL2-17	-	1.6	0.3	-	-	-	IBI

1.2.3 In-Situ Hydraulic Test

Single well response test (SWRT or slug test) was conducted on November 21 and 29, 2021 in selected monitoring wells enlisted for the study to estimate hydraulic conductivity (K-value). During slut test, a change in hydraulic head was created with a bailer to remove water (<1 L) or with a slug rod to dispel water. The hydraulic conductivity was estimated by measuring the rate of change in water levels after the water head was created. The water level recovery during each test was recorded with an automatic datalogger. The recovery was also gauged manually using a water level tape. SWRTs were terminated after either 80% recovery was achieved or 30 minutes had passed. The testing results are attached in **Appendix C**.

1.2.4 Groundwater Sampling

Groundwater sampling was conducted in general accordance with provincial practices and Palmer's standard operation procedure (SOP). Chemical analysis was conducted by ALS Environmental Laboratory, which has been accredited Canadian Association for Laboratory Accreditation (CALA). The groundwater sample was taken from BH13 on November 21, 2022 and was submitted to the lab at the same day. The groundwater sample was tested against Ontario Drinking Quality Standards parameters. Test results were attached in **Appendix E**.

In addition, the chemical analysis results for groundwater from the enlisted monitoring wells located within the site from Pinchin (2023) are adopted for this study, which include testing results for groundwater samples from MW3-17 and MW4-17D. The certificates of analysis are attached in **Appendix E**.

1.2.5 Groundwater Level and Surface Water Stage Monitoring

Groundwater level and surface water stage monitoring was conducted through manual measurement, visual observations and logger recording, and was meant to delineate water level trend and fluctuation magnitude, as well as the interaction between surface water and groundwater. Palmer completed eight (8) rounds of site visits for groundwater level and surface water stage monitoring, and the following is the activities completed during each site visit:

- Measure groundwater levels for monitoring wells and mini-piezometers;
- Measure and observe surface water stage for creek and wetlands;
- Download data from loggers, confirm the conditions of logger, and reset loggers as required; and
- Carry out maintenance for monitoring wells and mini-piezometers.

1.2.6 Guelph Permeameter Infiltration Tests

Guelph Permeameter Infiltration tests (GP tests) were carried out with a Guelph Permeameter on June 2, 2025 at six (6) locations at the site (GP1 to GP6) (**Figure 1**), with two test locations for each proposed

infiltration tank. The developer excavated soil close to the elevation of the infiltration tank bottom and then the infiltration test was conducted on the grade of the infiltration tank bottom.

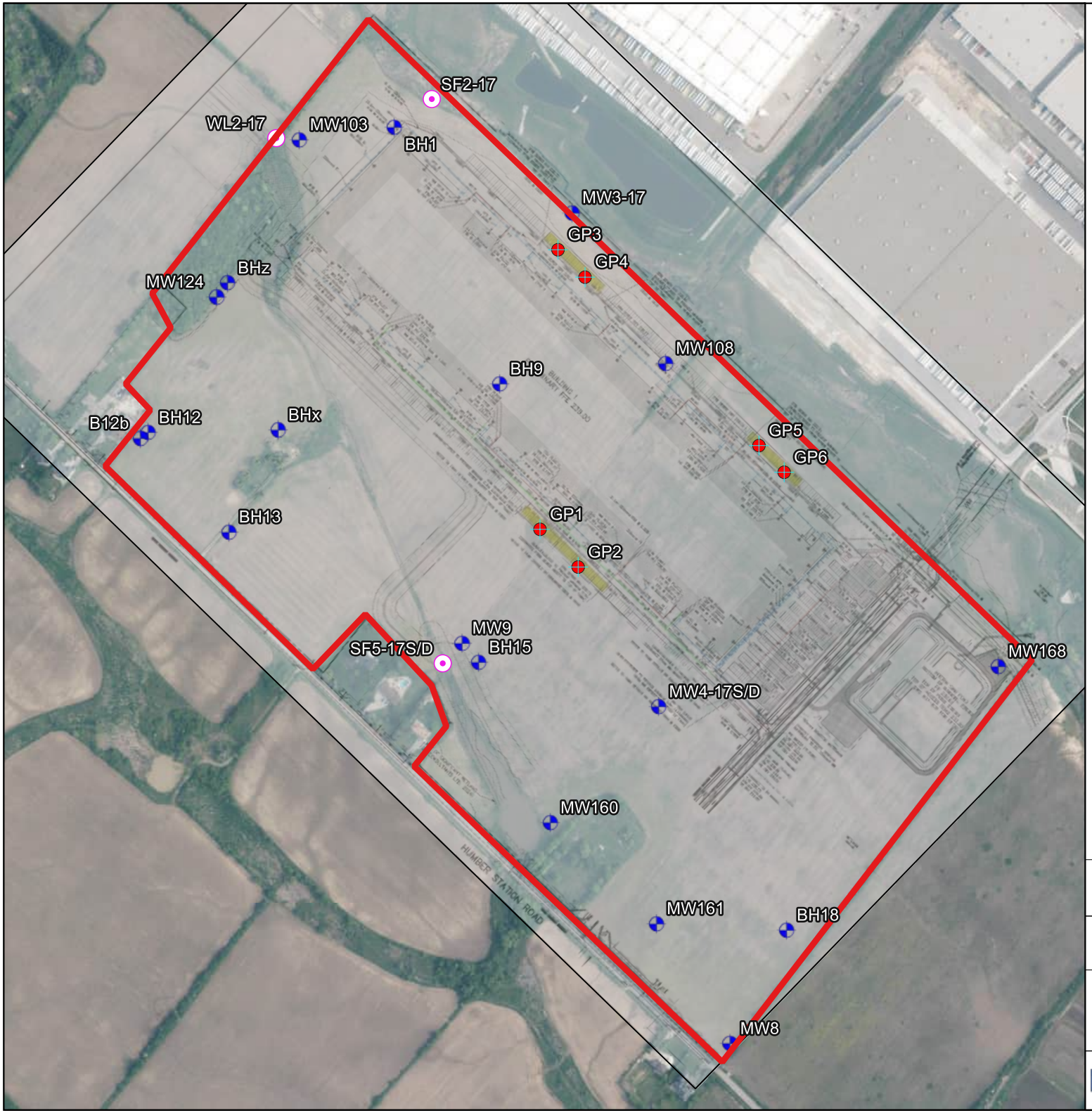
GP tests were conducted in a constant head condition with the GP pipes extended into pre-augered holes. Combined reservoir was used for all tests. Field saturated hydraulic conductivity (Kfs) values were calculated using the Guelph Permeameter K-sat Calculator (2012).

The manufacturer's operating instructions were followed to do the testing and the manufacturer's spreadsheet was used to analyze the data. The testing results are attached as **Appendix F**.

1.2.7 WWIS Well Record and PGMN Well Inventory

Well records within 500 m from the site boundary were queried from the database of the Water Well Information System (WWIS) of Ontario for fields of well ID, completion date, well depth, static groundwater levels, aquifer type (bedrock or overburden well), water quality and water use. A total 46 wells were identified. The results of well survey were attached in **Appendix G**.

The Provincial Groundwater Monitoring Network (PGMN) was also searched. The closest PGMN well was found located 4.0 km northwest of the site (W0000327-3). No water quality data is available for this well. Water level records show obvious seasonal trend, no yearly trend was observed, and fluctuations ranging from 0.6 to 0.8 m.



LEGEND

- Site Boundary
- Monitoring Well
- Mini-Piezometer
- Infiltration Test

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Basemap - Peel Imagery (2023)
Topo Contour - Peel Region (Spring 2021)

CLIENT

Prologis

PROJECT

12519 & 12713 Humber Station Road, Bolton, Ontario

TITLE

Site Investigation Plan

Palmer | PART OF SLR

REF. NO. 2008102

Figure 1

2. Site Characterization

2.1 Physiography and Natural Heritage

2.1.1 Geomorphology and Climate

The site is located in a Drumlinized Till Plain, part of an larger unit, South Slope (Chapman & Putnam, 1984 and OGS, **Figure 2**). The site is currently used as farmland, with flat to rolling ground surface. The ground elevations range from 239.0 to 232 masl, and dip gently from north to south.

The site is in a continental climate region with a warm, humid summer and a cold winter as well as wet spring, dry summer and moderate rainfall in autumn. The region is generally affected by warm, moist air masses from the south and cold, dry air masses from the north and experiences a wide range of weather conditions through the course of an average year. The following table lists the average and daily values of major climate parameters collected at the closest climate station (Toronto Lester B. Pearson International Airport) for the period between 1981 and 2010 (**Table 2**).

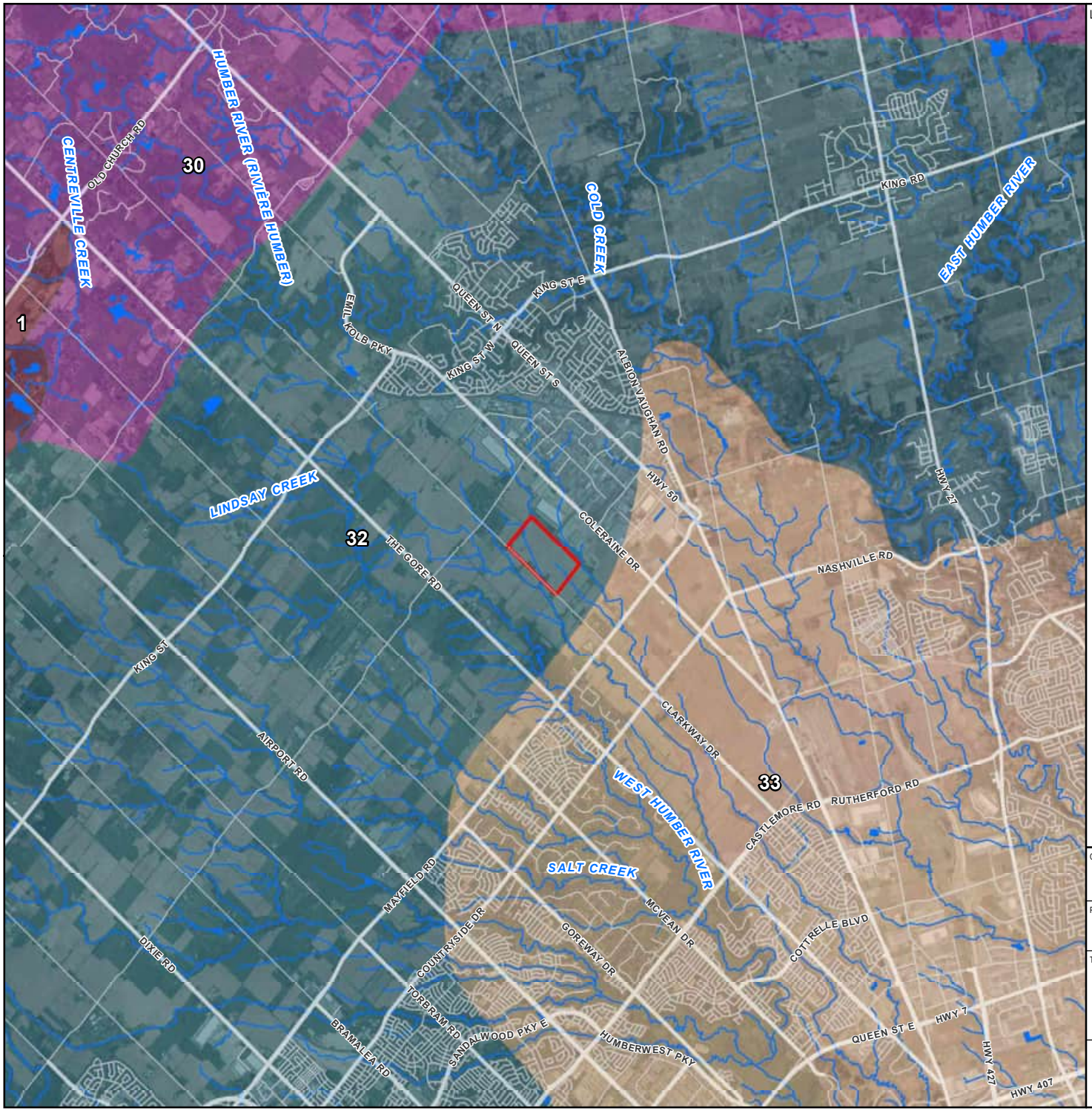
Table 2. Monthly Averaged Climate Data

Average Value	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Daily Air T (°C)	-5.5	-4.5	0.1	7.1	13.1	18.6	21.5	20.6	16.2	9.5	3.7	-2.2
Rainfall (mm)	25.1	24.3	32.6	63	74.3	71.5	75.7	78.1	74.5	60.6	68	34
Snowfall (cm)	29.5	24	17.7	4.5	0	0	0	0	0	0.4	7.5	24.9
Precipitation (mm)	51.8	47.7	49.8	68.5	74.3	71.5	75.7	78.1	74.5	61.1	75.1	57.9
Extreme Daily Value	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Extreme Daily Rainfall (mm)	58.7	31.8	41.7	55.8	92.7	53.8	118.5	80.8	108	121.4	86.1	40.9
Extreme Daily Snowfall (cm)	36.8	39.9	32.3	26.7	2.3	0	0	0	0	7.4	33.5	28.2

2.1.2 Natural Heritage Features

The site is in the West Humber subwatershed of Humber River watershed under the jurisdiction of Toronto and Region Conservation Authority (TRCA).

Goreway Drive Tributary to the West Humber River flows from northwest to southeast about 90 m to the west of the site, and a subtributary (an ephemeral creek) flows through the site and join the Goreway Drive Tributary to the west of the site. Clarkway Drive Tributary runs along the east boundary of the site flowing from northwest to southeast. An ephemeral subtributary of Clarkway Drive Tributary flows along the middle line of the site. This subtributrary is dry and has flow recoded only during or immediately following rainfall (**Figure 3**).



LEGEND

- Watercourse[1]
- Subject Site

Physiographic Region[2]

- 1: Niagara Escarpment
- 30: Oak Ridges Moraine
- 32: South Slope
- 33: Peel Plain

1. LIO/MNRF
2. Chapman, L.J. and Putnam, D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228.

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KM

North American Datum 1983
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NORTH

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Physiography

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Figure 2

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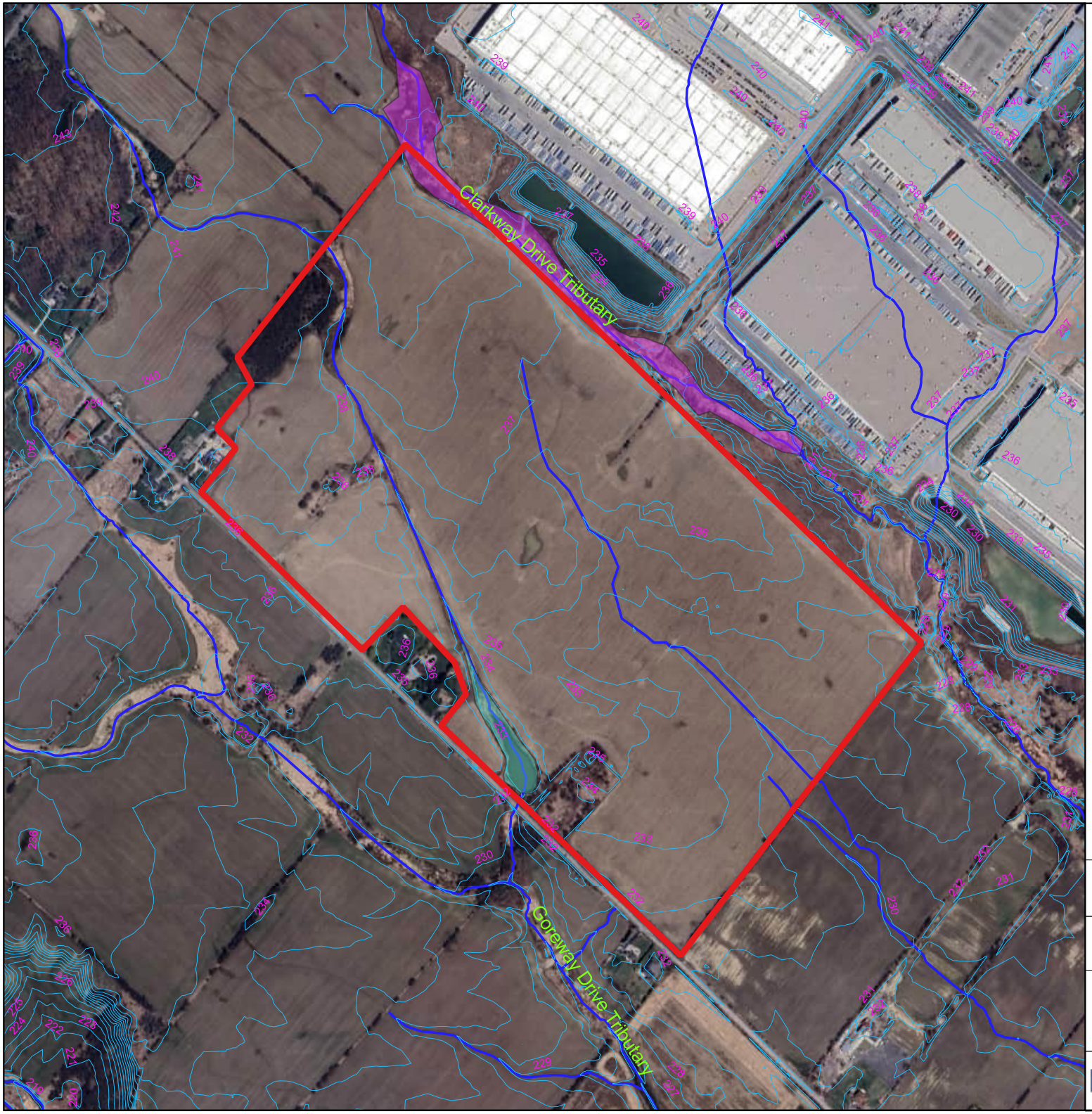

LEGEND

- Site Boundary
- Topo Contour
- Water Course
- East Wetland
- West Wetland

120 120 240 m

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Basemap - Google Satellite (2020)
Topo Contour - Peel Region (Spring 2021)

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PROJECT

12519 & 12713 Humber Station Road, Bolton, Ontario

TITLE

Terrain and Drainage

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REF. NO. 2008102

Figure 3

Based on the provincial natural heritage mapping and available site information, the site is located approximately 14 km east of the Niagara Escarpment, 6.0 km south of the Oak Ridges Moraine, 32.0 km to the north of Lake Ontario. Based on the Natural Heritage Feature map completed by GEI as part of the CEISMP Report (**Appendix G),** the natural heritage features identified near and within the site include:

- An ephemeral creek crossing the site. The creek is grown out with weed and shrubs;
- An in-line wetland on the north end of the site mapped by GEI as MAM2-11 and CUM1-1. This wetland was designated as unevaluated wetland in the provincial mapping;
- A woodland located bordering the in-line wetland on the north end of the site mapped by GEI as FOD8-3.
- An in-line pond on the south part of the site. The pond was mapped as Provincial Significant wetland (PSW) in the provincial natural heritage mapping, but mapped by GEI as SAS-1 and MAS2-1 and MAM2-2; and
- An in-line wetland along the east boundary of the site mapped by GEI as MAM2-11/2, MAS2-1 and CUM1-1. This wetland was designated as unevaluated wetland in the provincial mapping.

The ephemeral creek is proposed to be realigned to facilitate layout of the proposed development and is expected to maintain its function as a surface water supported, ephemeral feature.

2.2 Geology and Site Stratigraphy

Surficial geology of the Site was mapped by Ontario Geological Survey (OGS) as clay to silt-textured till (derived from glaciolacustrine deposits or shale), which is named regionally as Halton Till (**Figure 4**).

The site is located within the area of Oak Ridges Moraine Groundwater Program (ORMGP). ORMGP has developed three-dimensional overburden geological model within its area. Based on ORMGP model, the overburden geology under and surrounding the site is summarized in **Table 3**.

Table 3. Overburden Geology (ORMGP)

Division	Formation/Unit	Thickness (m)	Distribution within Site	Interpretation
Overburden	Halton Till	5-15	Whole area	
	ORM Complex	3-11	Whole area	Kame moraine
	Lower Newmarket Till	1-10	Whole area	-
Bedrock	Georgian Bay Formation	25-30 (depth)	-	-

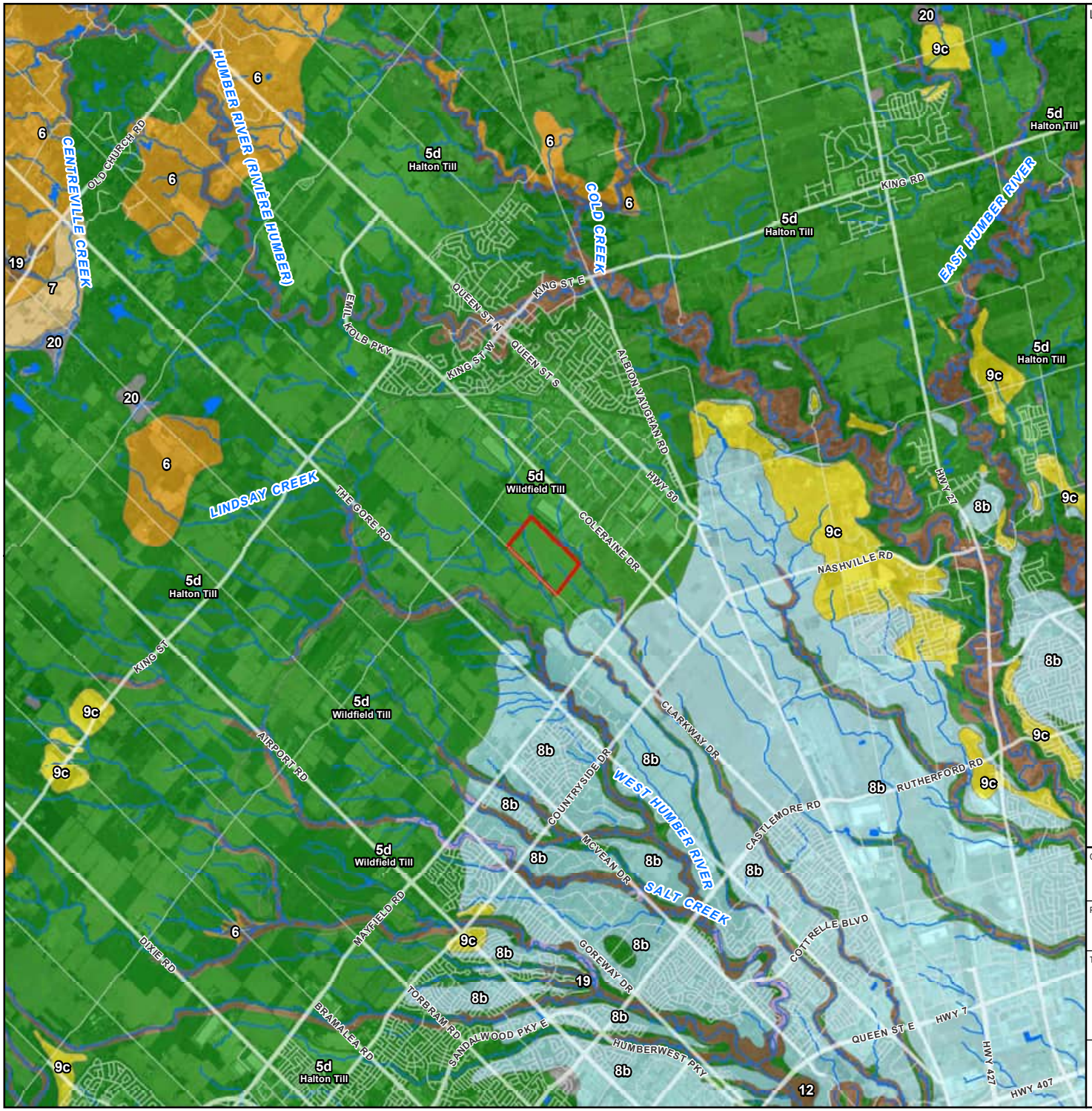
Bedrock underlays the overburden and was mapped as Georgian Bay Formation of Late Ordovician age and consists of shale, limestone, dolostone, siltstone. Georgian Bay Formation serves as regional aquitard in the area based on regional hydrogeology of Ontario (**Figure 5**).

The stratigraphy under the site was characterized based on the regional information and the findings from the borehole logs completed by Pinchin, Soil Eng. and Burnside (**Table 1** and **Appendix B**). **Table 4**. summarises the stratigraphy under the site including major lithological units, bottom depth ranges, natural water content and mechanical properties.

Table 4. Summary of Stratigraphy

Unit No	Unit Name	Lithology	Top Elvt (masl)	Bottom Elvt (masl)	Natural Water Content	N-Value	Hydro-stratigraphy
1	Topsoil	Silt, trace sand with organics, dark brown	239.28-232.61	239.13-232.46	Moist	-	Aquitard (Halton Till)
2	Brown Silt to silty clay till	Silt to clayey silt, trace sand and gravel, some oxidation.	239.13-232.46	234.73-229.19	Moist	8-30	
3	Grey Silt	Silt to sandy silt, or with trace sand and gravel, trace to some clay, trace oxidation locally.	234.73-229.19	222.1	Moist to wet	30-77	

As the summary of stratigraphy shows, the site is underlain with a suite of over-compacted clay till and silt deposited in glacial and proglacial environment. Both clay till and silt forms aquitards, and aquifer units were not encountered within the investigation depths.



LEGEND

Watercourse[1]

Subject Site

Surficial Geology[2]

Phanerozoic / Cenozoic / Quaternary / Recent

- 20: Organic deposits *(peat, muck, marl)*
- 19: Modern alluvial deposits *(clay, silt, sand, gravel, may contain organic remains)*

Phanerozoic / Cenozoic / Quaternary / Pleistocene

- 12: Older alluvial deposits *(clay, silt, sand, gravel, may contain organic remains)*
- 9c: Coarse-textured glaciolacustrine deposits *(Foreshore and basinal deposits)*
- 8b: Fine-textured glaciolacustrine deposits *(Interbedded silt and clay and gritty, pebbly flow till and rainout deposits)*
- 7: Glaciofluvial deposits *(river deposits and delta topset facies)*
- 6: Ice-contact stratified deposits *(sand and gravel, minor silt, clay and till)*
- 5d: Tilll *(Clay to silt-textured till [derived from glaciolacustrine deposits or shale])*

Phanerozoic / Paleozoic

- 3: Paleozoic bedrock

1. LIO/MNRF
2. Ontario Geological Survey 2010 (Mapped at 1:50,000). Surficial geology of southern Ontario; Ontario Geological Survey. Miscellaneous Release- Data 128 - Revised

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KM

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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Humber Station Road

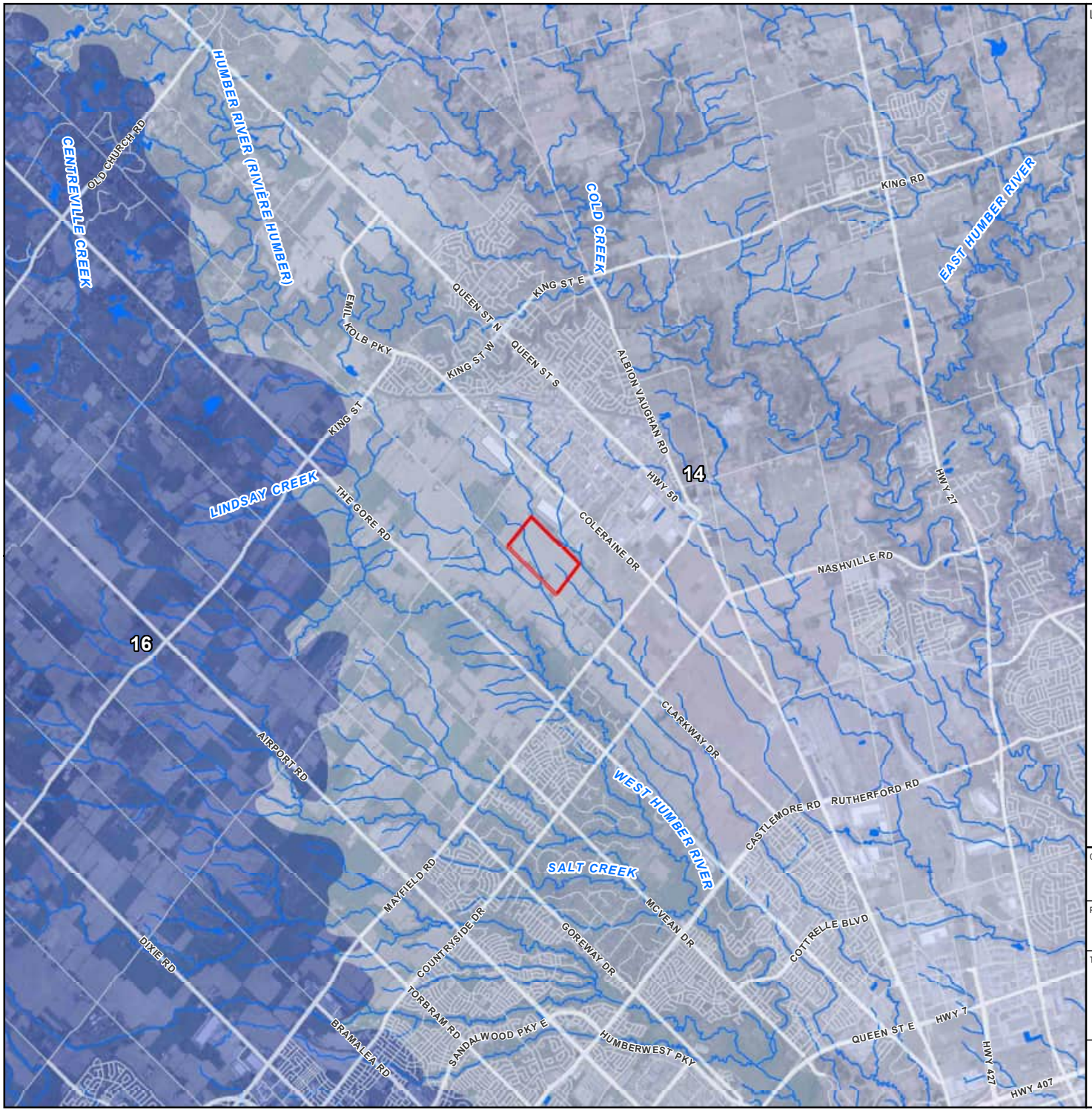
TITLE
Surficial Geology

Palmer

REF. NO. 2008102-2-1

Figure 4

Document Path: G:\Shared drives\Projects 2020\20081 - Prologis\2008102 - Humber Station Road\GIS\1_Workspace\Task 4 - HydroG Figures\2008102-2-1-Surficial Geology.mxd



LEGEND

Watercourse[1]

Subject Site

Paleozoic Bedrock Geology[2]

Upper Ordovician

16: Queenston *(shale, siltstone, minor limestone and sandstone)*

14: Georgian Bay *(shale and limestone)*

1. LIO/MNRF
2. Armstrong, D.K. and Dodge, J.E.P. Paleozoic Geology Map of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219

0 0.5 1 2 3 4 5
KM

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:100,000
Page Size: Letter (8.5 x 11 inches)

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Checked: FL
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NORTH

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PROJECT
Humber Station Road

TITLE
Bedrock Geology

Palmer

REF. NO. 2008102-3-1

Figure 5

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2.3 Site Groundwater Conditions

2.3.1 Source Protection, Water Supply and Sewerage System

The site is located within the Toronto and Region Source Protection Area under the Source Protection Plan of CTC Source Protection Region. The Source Protection Plan designated the following 10 types of vulnerable areas:

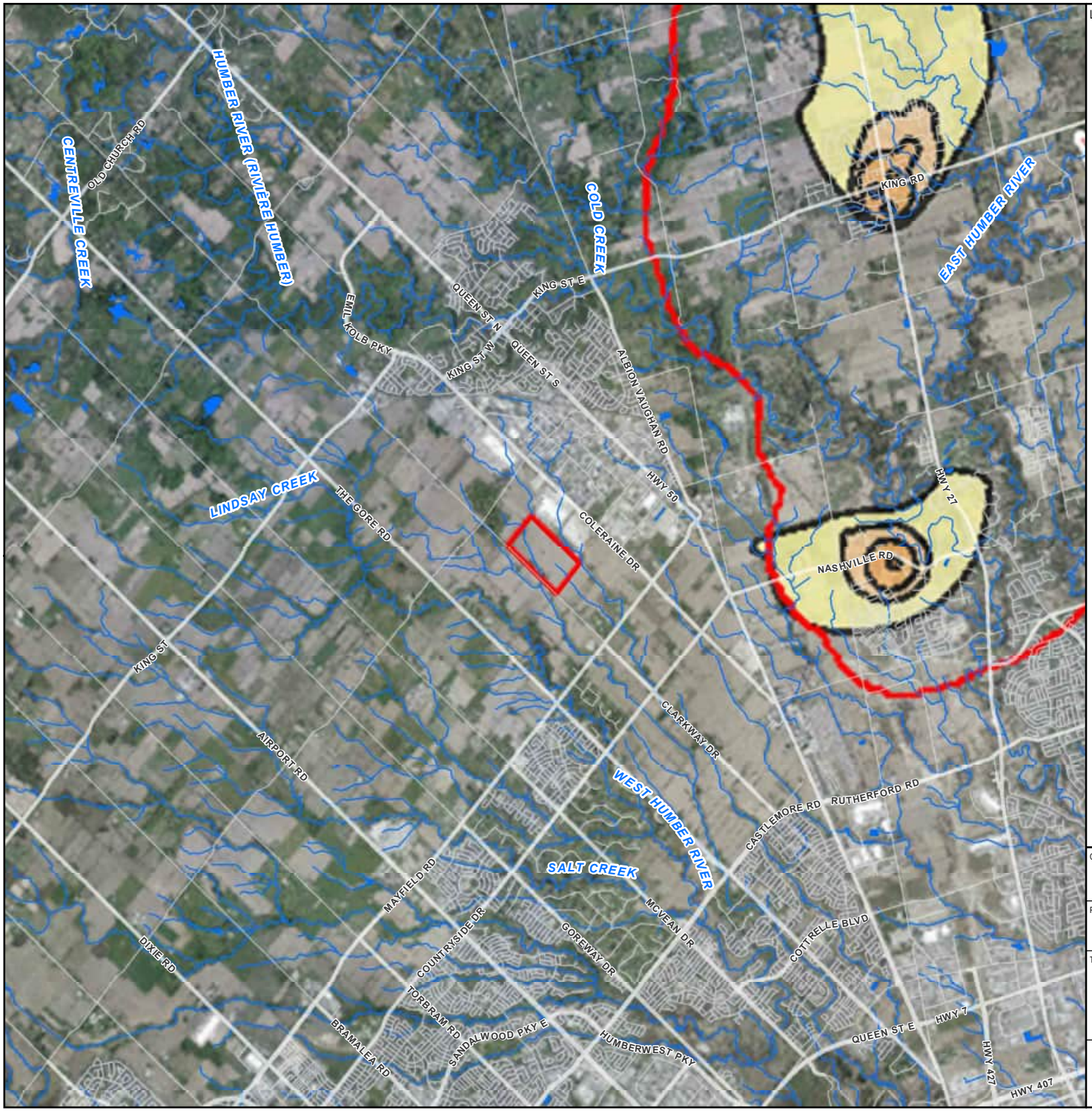
- Wellhead Protection Area-Quality
- Wellhead Protection Area E-(GUDI)
- Intake Protection Zone-Quality
- Intake Protection Zone-Quantity
- Issue Contributing Area
- Significant Groundwater Recharge Area
- Highly Vulnerable Aquifer
- Event Based Area
- Wellhead Protection Area Q1-Quantity
- Wellhead Protection Area Q2-Quantity

Based on the provincial source protection mapping and the above source protection plan (**Figure 6**), only two isolated areas within the site are located above the Highly Vulnerable Aquifer (HVA) with a vulnerable score of 6.

Based on well records queried from WWIS database (**Appendix F**), groundwater levels range from 0 to 14 mbgs. The groundwater levels have no apparent and even reverse correlation with well depths, indicating upward gradient may exists at certain depths within the well record searching area. All of the domestic wells were constructed before 1994, and about half of the domestic wells tapped water from bedrock aquifer and the other half tapped water from overburden aquifer. The well records within the site show that the shallow regional aquifers consisted of gravels and weathered shale (contact aquifer) may exist at depths greater than 17 mbgs.

Table 5. Summary of Well Records

Classification		Record Number
Water Use	Domestic/livestock	19
	Commercial	-
	Industrial	-
	Municipal	-
	Monitoring	-
	Monitoring and Test Hole	8
	Irrigation	-
	Decommissioned	-
	Unknow/Not used	19
Water Quality	Fresh	-
	Salty	-
	Untested	-
	Unknown	46
Aquifer	Overburden	21
	Bedrock	13
	Unknown	11



LEGEND

- Watercourse[1]
- Subject Site

Source Water Protection[2]

- Wellhead Protection Area - A
- Wellhead Protection Area - B
- Wellhead Protection Area - C
- Wellhead Protection Area - D
- Wellhead Protection Area Q1/Q2

1. LIO/MNRF
2. *Source Protection Information Atlas*, MECP © King's Printer for Ontario 2022

0 0.5 1 2 3 4 5
KM

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:100,000
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REF. NO. 2008102-4a-1

Figure 6a

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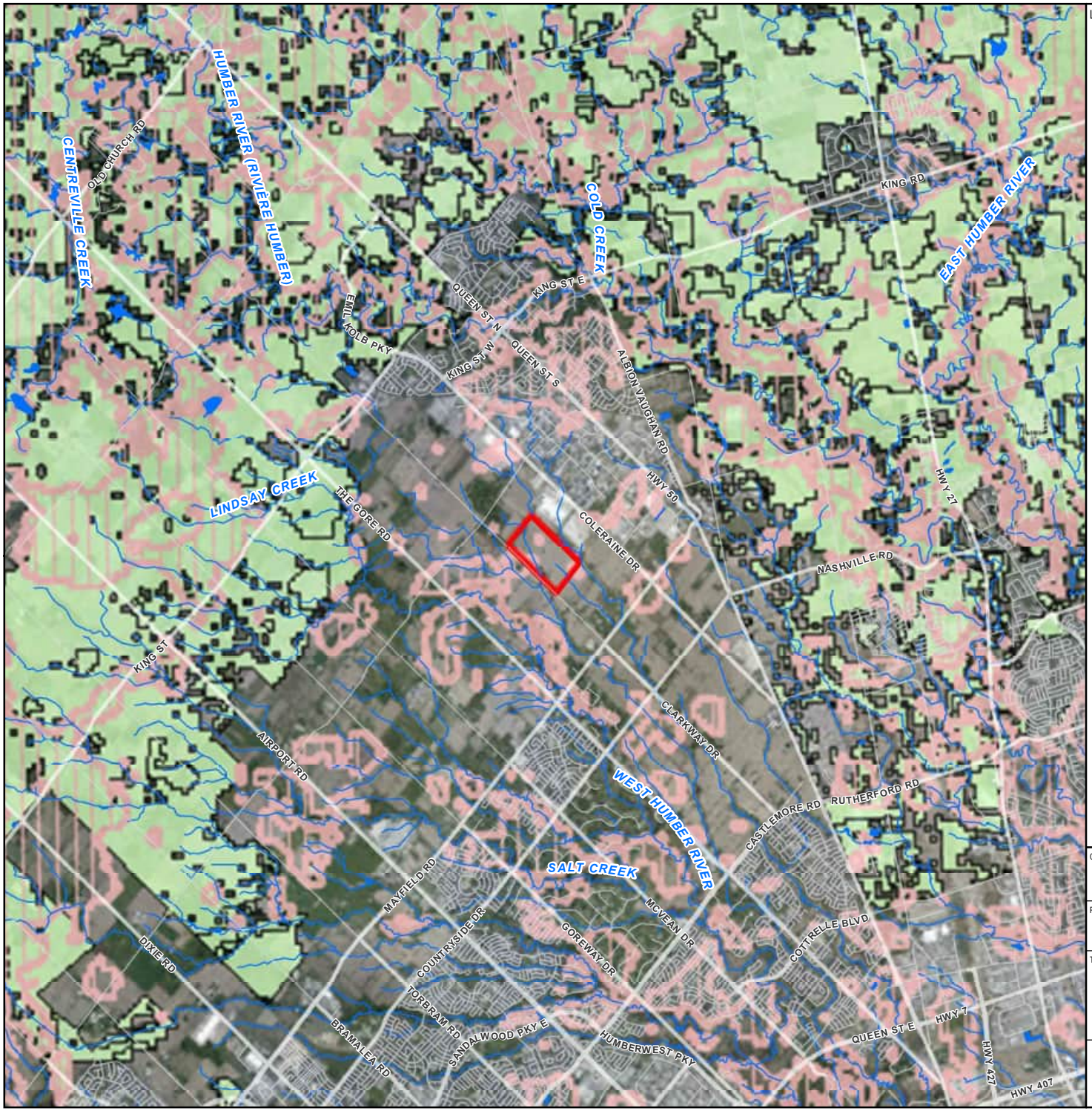

LEGEND

Watercourse[1]

Subject Site

Source Water Protection[2]

Highly Vulnerable Aquifer

Significant Groundwater Recharge Area

Score 0

1. LIO/MNRF
2. *Source Protection Information Atlas*, MECP © King's Printer for Ontario 2022

0 0.5 1 2 3 4 5
KM

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:100,000
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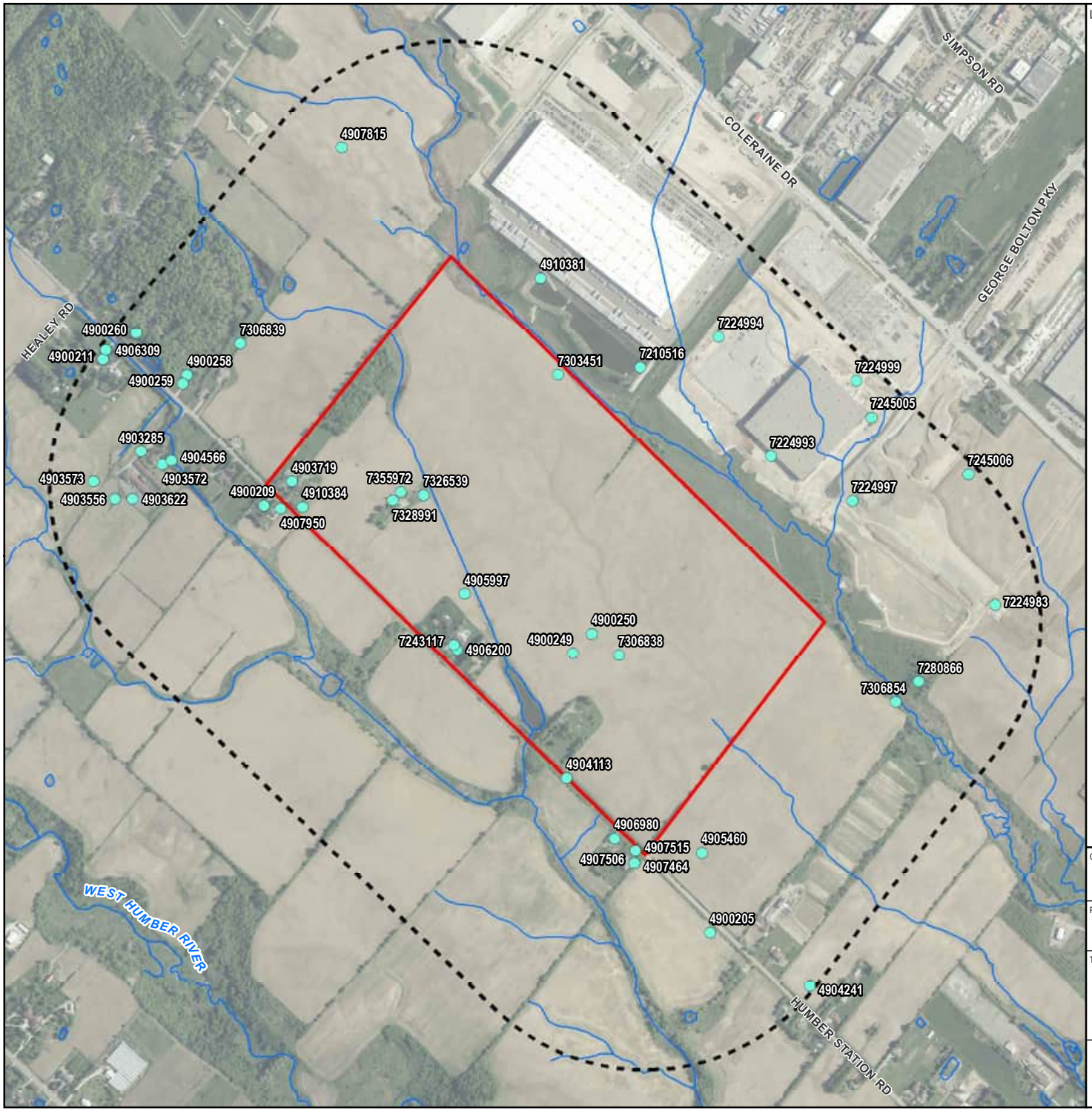
TITLE
Source Water Protection

Palmer

REF. NO. 2008102-4b-1

Figure 6b

Document Path: G:\Shared drives\Projects 2020\20081 - Prologis\2008102 - Humber Station Road\GIS\1_Workspace\Task 4 - HydroG Figures\2008102-4b-1-Source Water Protection.mxd



LEGEND

- Well Record within 500m[1]
- Watercourse[2]
- Subject Site
- 500m Site Buffer

1. MECP
2. LIO/MNRF

0 50 100 200 300 400 500
METERS

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:13,000
Page Size: Letter (8.5 x 11 inches)

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PROJECT
Humber Station Road

TITLE
MECP Well Records within 500 m of Site

Palmer

REF. NO. 2008102-5-1

Figure 7

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As shown above, majority of overburden soil were interpreted to be, from top down, Halton Till, ORM complex and Newmarket Till. Both Halton Till and Newmarket Till have limited capacity to store and transmit groundwater and act as regional aquitards. ORM complex is well recognized as a regional aquifer. Top weathered and fractured zone of bedrock has moderate capacity to store and transmit groundwater and may serve as regional aquifer.

The water supply and sanitary servicing are provided by the Region of Peel. The water supply for the area surrounding the site was provided by Peel Region through Palgrave - Caledon East Drinking Water System, which consists of three supply wells in Palgrave and four supply wells in Caledon East. The supply wells are located over ten (10) km to the north of the site.

2.4 Groundwater Levels, Flow Direction and Gradient

Several rounds of manual groundwater level measurement were conducted for the monitoring wells enlisted for this study. Data loggers were installed in four monitoring wells to monitor groundwater in a frequency of one recording per hour. The manual measurement results were summarized in **Table 6**.

Table 6. Groundwater Levels

Well ID	Surface Elevation (masl)	Depth (mbgs)	Water Level (m)							
			Nov 8/9, 22		Nov 21, 22		Nov 29, 22		Feb 8, 23	
			mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl
BH1	239.28	6.02	2.51	236.77	2.62	236.66	2.72	236.56	2.74	236.54
BH9	235.57	6.09	2.24	233.33	2.14	233.43	2.28	233.29	1.52	234.05
BH12	237.15	4.30	0.53	236.62	0.44	236.71	-	-	0.23	236.92
BH12b	-	5.31	0.85	-	-	-	-	-	0.40	-
BH13	237.42	6.04	2.18	235.24	-	-	2.26	235.16	1.13	236.29
BH15	234.02	6.19	2.87	231.15	2.76	231.26	-	-	1.50	232.52
BH18	232.61	6.35	1.83	230.78	-	-	1.85	230.76	0.79	231.82
MW103	238.79	6.07	-	-	-	-	-	-	-	-
MW108	236.89	6.10	-	-	-	-	-	-	-	-
BHz	-	6.10	-	-	-	-	-	-	-	-
MW124	239.04	6.23	-	-	-	-	-	-	-	-
MW160	234.36	6.23	-	-	-	-	-	-	-	-
MW161	232.84	6.29	-	-	-	-	-	-	-	-
MW168	231.87	6.03	-	-	-	-	-	-	-	-
MW3-17	234.79	6.01	0.30	234.49	0.52	234.27	-	-	0.22	234.57
MW4-17S	233.98	5.85	1.97	232.01	2.00	231.98	2.06	231.92	0.87	233.11
MW4-17D	233.98	12.18	2.18	231.80	2.07	231.91	2.12	231.86	0.97	233.01
MW8	231.86	15.11	1.81	230.05	-	-	1.84	230.02	0.52	231.34
MW9	235.59	5.40	3.04	232.55	2.93	232.66	-	-	1.96	233.63
BHx	-	6.28	-	-	-	-	-	-	-	-

Well ID	Surface Elevation (masl)	Depth (mbgs)	Water Level (m)							
			May 12, 23		July 31, 23		Feb 18, 24		May 20, 24	
			mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl
BH1	239.28	6.02	1.49	237.79	1.14	238.14	-	-	1.18	238.1
BH9	235.57	6.09	0.6	234.97	0.54	235.03	0.72	234.85	0.58	234.99
BH12	237.15	4.30	0.24	236.91	0.13	237.02	0.17	236.98	0.26	236.89
BH12b	-	5.31	0.27	-	0.27	-	0.21	-	0.35	-
BH13	237.42	6.04	0.33	237.09	0.305	237.115	0.43	236.99	0.4	237.02
BH15	234.02	6.19	0.93	233.09	-	-	1	233.02	0.98	233.04
BH18	232.61	6.35	0.45	232.16	0.42	232.19	0.49	232.12	0.45	232.16
MW103	238.79	6.07	-	-	-	-	1.04	237.75	0.37	238.42
MW108	236.89	6.10	-	-	-	-	0.82	236.07	0.63	236.26
BHz	-	6.10	-	-	-	-	1.69	-	-	-
MW124	239.04	6.23	-	-	-	-	1.5	237.54	0.62	238.42
MW160	234.36	6.23	-	-	-	-	1.01	233.35	1.05	233.31
MW161	232.84	6.29	-	-	-	-	0.45	232.39	0.53	232.31
MW168	231.87	6.03	-	-	-	-	-	-	0.67	231.2
MW3-17	234.79	6.01	0.16	234.63	-	-	1.94	232.85	0.19	234.6
MW4-17S	233.98	5.85	0.6	233.38	0.54	234.83	0.59	233.39	0.64	233.34
MW4-17D	233.98	12.18	0.53	233.45	0.54	233.44	0.55	233.43	0.52	233.46
MW8	231.86	15.11	0.59	231.27	0.66	233.44	0.52	231.34	0.66	231.2
MW9	235.59	5.4	1.61	233.98	1.55	231.2	1.6	233.99	1.62	233.97
BHx	-	6.28	-	-	-	-	0.96	-	0.81	-

Representative range of historical values of groundwater levels measured by previous studies of Soil Engineers and Palmer were listed in **Table 7**.

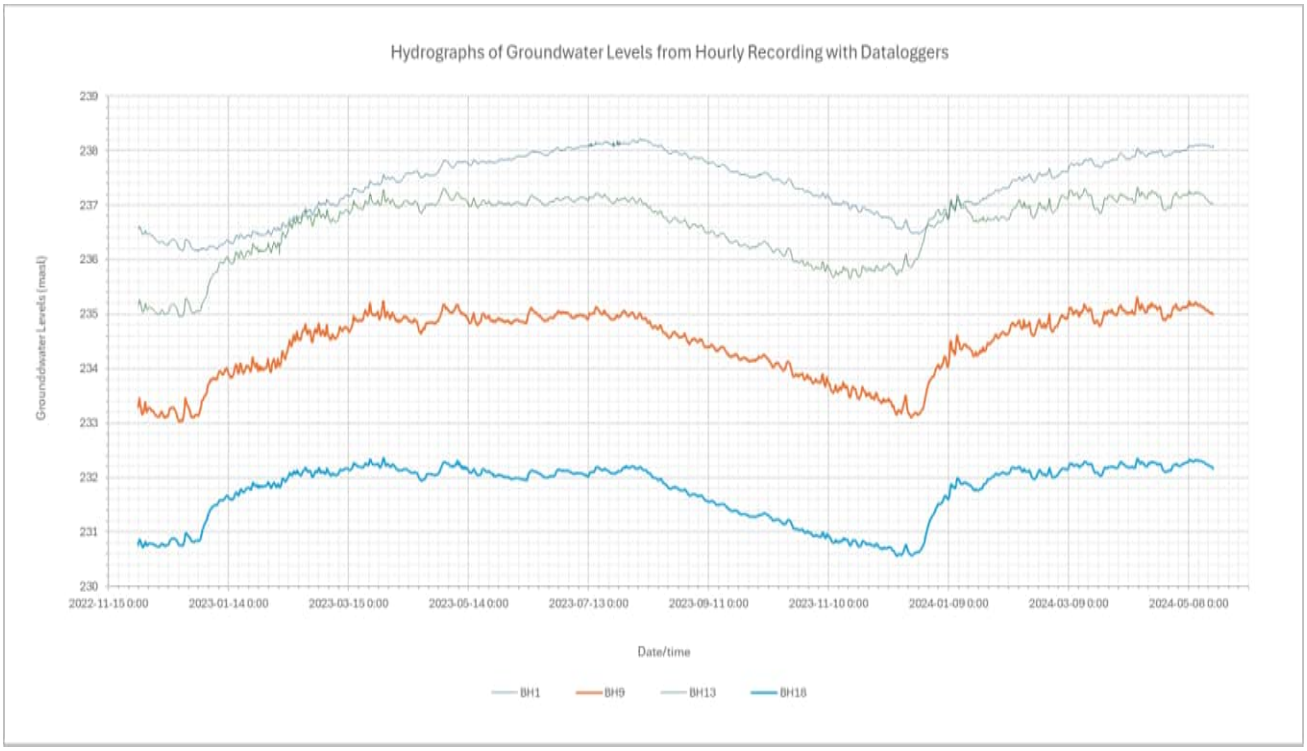
Table 7. Historical Groundwater Levels

Well ID	Surface Elevation (masl)	Depth (mbgs)	Water Level (m)													
			Aug 31, 17		Sep 22, 17		Nov 10, 17		Dec 5, 17		Feb 7, 18		Apr 23, 18		Apr 25, 22	
			mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl
BH1	239.28	6.15	-	-	-	-	-	-	-	-	-	-	-	-	5.5	233.78
BH9	235.57	6.13	-	-	-	-	-	-	-	-		-	-	-	1.8	233.77
BH12	237.15	4.22	-	-	-	-	-	-	-	-	-	-	-	-	1.2	235.95
BH12b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH13	237.42	6.00	-	-	-	-	-	-	-	-	-	-	-	-	1.4	236.02
BH15	234.02	6.30	-	-	-	-	-	-	-	-	-	-	-	-	2	232.02
BH18	232.61	6.40	-	-	-	-	-	-	-	-	-	-	-	-	1.5	231.11
MW3-17	234.79	7.04	2.61	232.18	0.45	234.34	0.3	234.49	0.14	234.65	-	-	0.1	234.69	-	-
MW4-17S	233.98	5.90	1.06	232.92	1.37	232.61	1.76	232.22	1.4	232.58	1.48	232.5	0.48	233.5	-	-
MW4-17D	233.98	12.20	0.95	233.03	1.27	232.71	1.67	232.31	1.44	232.54	1.44	232.54	0.61	233.37	-	-
MW8	231.86	5.15	0.39	231.47	1.85	230.01	1.76	230.1	1.12	230.74	0.97	230.89	0.31	231.55	-	-
MW9	235.59	5.15	1.89	233.7	2.1	233.49	2.24	233.35	1.92	233.67	2.11	233.48	1.38	234.21	-	-

Continuous recording of groundwater levels was acquired with dataloggers for BH1 BH9, BH13 and BH18. The hydrographs are presented in **Figure 8**. The hydrographs show the following characteristics of the groundwater regime at the site:

- The forms and trends of these hydrographs are highly synchronized, indicating that groundwater under different locations within the site responds to recharge similarly and the overburden soil at the site are hydraulically uniform;
- The hydrographs do not show typical spring-high and summer-low patterns of groundwater levels in Southern Ontario. The peak groundwater levels appear three to four months after spring, indicating that groundwater levels respond slowly to precipitation, which may be due to low permeability of soils; and
- Overall, the hydrographs show a semi-year pattern, with peak levels on August and lowest levels at late December.

Figure 8. Groundwater Level Hydrographs



Based on the elevation of groundwater levels, the groundwater table contours and flow direction were delineated and shown in **Figure 9**. The horizontal groundwater gradient is about 0.7% and the flow direction is from northwest to southeast and south toward the tributaries.

It should be noted that no aquifer units were encountered within the investigation depths, which means that all monitoring wells were completed in aquitard units. Recorded groundwater levels show drastic variation among different monitoring wells and over different monitoring events, indicating that the groundwater table and saturated zones are not continuous within the investigation depths at the site. The groundwater table contours were created through interpolation of groundwater level values recorded from shallow monitoring wells with aid GIS. As the monitoring wells were all installed in soil medium (aquitard) with low hydraulic

conductivity and without continuous saturated zone as shown in borehole logs (**Appendix B**), the recorded groundwater levels may result from interflows, localized or pocketed coarse-grain saturated soils or pathways, and may not be the real groundwater phreatic surface. The recorded groundwater levels from shallow monitoring wells are adequate for assessing shallow groundwater dynamics and quality conditions, interaction between shallow groundwater and surficial water bodies as well as for construction dewatering assessment. However, these groundwater levels should not be used to assess groundwater level separation from the invert of permanent structures such as basement slabs, LID features and stormwater pond bottom.

To assess groundwater level separation from the invert of LID structures, a test pit investigation was completed to expose large scale of groundwater medium, pathways and groundwater occurrence to confirm the real, regional groundwater phreatic tables. The test pit report will be submitted separately.

LEGEND

- Site Boundary
- Monitoring Well
- GW Table Ele Contour
- Predominant Groundwater Flow Direction

120 120 240 m

North American Datum 1983, UTM Zone 17N (EPSG: 26917)

Scale: 1:7,000
Page Size: Letter (11 x 8.5 inches)

Drawn: FL
Checked: JC
Date: Nov 2024
Source Notes:
Basemap - Google Satellite (2020)
Topo Contour - Peel Region (Spring 2021)

CLIENT

Prologis

PROJECT

12519 & 12713 Humber Station Road, Bolton, Ontario

TITLE

Groundwater Table Contour and Flow Direction

Palmer | PART OF SLR

REF. NO. 2008102

Figure 9

2.5 Hydraulic Conductivity

2.5.1 Hydraulic Conductivity from Single Well Response Tests

Hydraulic conductivity (K-value) of saturated zones was estimated through single well response tests (SWRTs) or slug tests, which has been introduced above. The results of the slug tests are summed up in **Table 8**.

Table 8 Hydraulic Conductivity from Slug Tests

Well ID	Surface Elevation (masl)	Depth (mbgs)	Screened Interval (mbgs)	Screened Unit	K-value (m/s)
BH9	235.57	6.13	3-6	Silt	$6.6x10^{-7}$
BH12	237.15	4.22	3-6	Silt	$5.7x10^{-9}$
BH15	234.02	6.3	3-6	Silt	$5.3x10^{-8}$
BH18	232.61	6.4	3-6	Silt	$7.7x10^{-8}$
MW3-17	235.5	5.9	3-6	Silt	$7.2x10^{-8}$
MW4-17S	234.8	5.9	3-6	Silt	$1.4x10^{-7}$
MW8	231.94	5.15	3.5-5	Silt till	$5.6x10^{-7}$
MW9	235.69	5.15	3.7-5.2	Silty sand	$7.1x10^{-7}$
MW4-17D	234.8	12.2	9-12	Silt	2.9x10-7

2.5.2 Hydraulic Conductivity from Grain Size Analysis

The K-values of sampled soils were estimated with the results of grain size analysis tests which was completed by Pinchin. Soil samples for grain size analysis were taken different depths, representing shallow to deep soil conditions. The results of grain size analysis were used to get K-values through the following empirical equation, and the estimation results are presented in **Table 9**. It should be noted that the K-values from grain size analysis is substantially lower than K-values from slug tests, which may be attributed to the lack of structures such as joints, fractures, burrows and rootholes, as well as the reconstitution of grain size analysis samples.

$$K\ (Sauerbrei, 1932) = \frac{\rho g}{\mu}[(3.75 \times 10^{-5}) \times \tau]\left[\frac{n^3}{(1-n)^2}\right] d_{17}^2\ \frac{cm}{s}$$

Where K = hydraulic conductivity (cm/s)
ρ = $3.1x10^{-8}T^3 - 7.0x10^{-6}T^2 + 4.19x10^{-5}T + 0.99985$
g = $980\ cms^{-2}$
μ = $-7.0x10^{-8}T^3 + 1.002x10^{-5}T^2 - 5.7x10^{-4}T + 0.0178$
τ = $1.093x10^{-4}T^2 + 2.102x10^{-2}T + 0.5889$
n = porosity as a fraction of aquifer volume
T = water temperature (°C)

Table 9 Hydraulic Conductivity from Grain Size Analysis

Well ID	Sample ID	Depth (mbgs)	Soil Classification	K-value (m/s)
BH4	SS4	3.0-3.5	Silt	$6.0x10^{-10}$
BH6	SS1	0.0-0.6	Silt	$7.0x10^{-10}$
BH14	SS5	4.5-4.7	Silt	$1.0x10^{-8}$
BH18	SS4	3.0-3.5	Silt	$1.7x10^{-9}$

2.5.3 Hydraulic Conductivity for Different Formations

Different methods of hydraulic conductivity tests were targeted to soil formations of different depths in different water content states. Based on above test results, the K-values for each formation were summarised and listed **Table 10**.

Table 10. Hydraulic Conductivity Summary

Unit Name	Investigation Point ID	Test	Depth Range (mbgs)	K-value (m/s)	Geometric Mean K-value (m/s)	90th Percentile K-value (m/s)
Clayey silt	BH6	Grain Size Analysis	0.0-0.6	$7.0x10^{-10}$	$8.9x10^{-10}$	$1.5x10^{-9}$
Silt and clay	BH4	Grain Size Analysis	3.0-3.5	$6.0x10^{-10}$		
Silt	BH18	Grain Size Analysis	3.0-3.5	$1.7x10^{-9}$		
Silt	BH14	Grain Size Analysis	4.5-4.7	$1.0x10^{-8}$	$5.5x10^{-8}$	$3.5x10^{-7}$
Silt	BH9	Slug Test	3-6	$6.6x10^{-7}$		
Silt	BH12	Slug Test	3-6	$5.7x10^{-9}$		
Silt	BH15	Slug Test	3-6	$5.3x10^{-8}$		
Silt	BH18	Slug Test	3-6	$7.7x10^{-8}$		
Silt	MW3-17	Slug Test	3-6	$7.2x10^{-8}$		
Silt	MW4-17S	Slug Test	3-6	$1.4x10^{-7}$		
Sandy silt till	MW8	Slug Test	3.5-5	$5.6x10^{-7}$	$4.9x10^{-7}$	$6.8x10^{-7}$
Silty sand	MW9	Slug Test	3.7-5.2	$7.1x10^{-7}$		
Silt	MW4-17D	Slug Test	9-12	2.9x10-7		

2.6 Infiltration Rate

Infiltration rates were estimated through the following empirical equation correlating K-values and infiltration rate provided in Ontario Ministry of Municipal Affairs and Housing (OMMAH) Supplementary Guidelines to the Ontario Building Code 1997, and in the Low Impact Development Stormwater Management Planning and Design Guide (TRCA/CVC, 2010). The estimated infiltrate rates are listed in **Table 11**.

$$K = (6 \times 10^{-11})I^{3.7363}$$

Where:

K = hydraulic conductivity (cm/s)

I = infiltration rate (mm/hr)

Rearranging for infiltration rate, we obtain the following relationship:

$$I = \left[\frac{K}{6 \times 10^{-11}}\right]^{\frac{1}{3.7363}}$$

Table 11 lists the infiltrate rates estimated from the hydraulic conductivities acquired through monitoring well slug tests and soil sample grain size analysis results and Table 12 lists the infiltration rates from the GP tests.

Table 11. Infiltration Rates from Slug Test and Grain Size Analysis Results

Unit Name	Investigation Point ID	Depth Range (mbgs)	K-value (m/s)	Infiltration Rate		Average	
				mm/hr	T(min/cm)	mm/hr	T(min/cm)
Clayey silt to silt	BH6	0.0-0.6	$7.0x10^{-10}$	7	91	7	85
	BH4	3.0-3.5	$6.0x10^{-10}$	6	94		
	BH18	3.0-3.5	$1.7x10^{-9}$	8	71		
Silt	BH14	4.5-4.7	$1.0x10^{-8}$	13	44	23	30
	BH9	3-6	$6.6x10^{-7}$	41	14		
	BH12	3-6	$5.7x10^{-9}$	12	52		
	BH15	3-6	$5.3x10^{-8}$	21	28		
	BH18	3-6	$7.7x10^{-8}$	23	26		
	MW3-17	3-6	$7.2x10^{-8}$	23	26		
	MW4-17S	3-6	$1.4x10^{-7}$	27	22		

Table 12. Infiltration Rates from GP Tests

Infiltration Tank	Test Hole ID	K-value (m/s)	Infiltration Rate (mm/hr)
1	GP1	$2.0x10^{-6}$	56
	GP2	$6.8x10^{-7}$	42
2	GP3	$1.4x10^{-6}$	51
	GP4	$1.4x10^{-6}$	51
3	GP5	$1.4x10^{-6}$	51
	GP6	$2.0x10^{-6}$	56

2.7 Groundwater Chemistry

Groundwater analytical results for the current study (BH13) were assessed against Ontario Drinking Water Standards (ODWS) and Ontario Provincial Water Quality Objectives (PWQO), the exceedance is shown in **Table 13**. In addition, groundwater chemistry data for the two samples (MW3-17 and MW4-17D) from the hydrogeological assessment by IBI were also assessed against ODWS and PWQO, and their exceedances are shown in **Table 13**.

Table 13. Exceedances Over ODWQS

Parameters	Unit	PWQO	ODWS	BH13	MW3-17	MW4-17D
Color	CU	-	5	40	-	-
Total Dissolved Solid (TDS)	mg/L	-	500	689	-	-
Turbidity	NTU	-	5	21.4	-	-
Total Manganese	mg/L	-	0.05	0.12	-	-
Field pH	-	6.5-8.5	-	-	8.17	8.58
Total Phosphorus	mg/L	0.01	-	-	1.4	3.3
Total Boron	ug/L	200	-	-	260	ND
Total Cobalt	ug/L	0.9	-	-	ND	2.5
Total Copper	ug/L	5	-	-	ND	5.5
Total Iron	ug/L	300	-	-	ND	5400
Total Uranium	ug/L	5	-	-	3.4	1.2
Total Vanadium	ug/L	6	-	-	2.1	7.4

These exceedances are associated with either agricultural operation or high concentration of particulate materials of raw groundwater. The exceedances associated with agriculture are expected to improve with the cessation of agricultural operation. The exceedances associated with groundwater turbidity can be easily eliminated through filtering and settling.

2.8 Water Levels from Mini-Piezometers

Monitoring data from the mini-piezometers installed along the creek beds and wetlands include groundwater levels within the mini-piezometer pipes and surface water levels outside the mini-piezometer pipes, both groundwater and surface water levels being measured manually as meters from top of the pipes and converted to meters from the ground surface. **Table 14** summarises the monitoring results. As the monitoring results show, surface water features are dry during most of monitoring events and groundwater levels are below ground surface during all monitoring events, indicating that groundwater does not support surface water features.

It should be noted that WL2-17 was installed only 20 cm into ground. Recordings from WL2-17 do not represent actual water conditions.

Table 14. Water Level Monitoring Results for MPs

MP ID		Water Levels (mbgs)				
		Nov 9, 22	Nov 29, 22	Feb 8, 23	May 12, 23	July 31, 23
SF2-17S	In	-		-	0.01	0.06
	Out	-		-	Dry	Dry
	Gradient				Downward	Downward
SF2-17D	In	0.14		0.1	0	-0.08
	Out	0		dry	-0.06	-0.11
	Gradient	Downward		Downward	Downward	Downward
SF5-17S	In	Dry		0.04	0.12	0.05
	Out	Dry		Dry	Dry	Dry
	Gradient	-		Downward	Downward	Downward
SF5-17D	In	Dry		0.03	0.08	0.07
	Out	Dry		Dry	Dry	Dry
	Gradient	-		Downward	Downward	Downward

MP ID		Water Levels (mbgs)				
		Nov 9, 22	Nov 29, 22	Feb 8, 23	May 12, 23	July 31, 23
WL2-17	In	-0.69	Dry	0.16	-0.07	-0.46
	Out	dry	Dry	Dry	Dry	Dry
	Gradient	Upward	-	Downward	Upward	Upward

In – groundwater levels within MP.
Out – surface water levels outside the MP.
Negative values for in/out measurements indicate water levels above ground surface.
Gradient: minus-downgradient, positive-upgradient.
***No measurement due to frozen.**

3. Construction Dewatering Assessment

Dewatering for construction is conducted to fulfil three purposes: provide a dry working condition, help maintain ground stability and help maintain healthy and safe working environment. Based on the above characterization of site conditions, the recorded groundwater levels range from 0.1 to 2.7 mbgs, and from 230.0 to 238.3 masl. As the proposed industrial buildings will be built on slab-on-grade foundations, the requirement for construction dewatering for the buildings is not anticipated. However, the trenches for storm and sanitary sewers and the interim stormwater pond will extend below groundwater levels, and construction dewatering should be assessed for trench and interim stormwater pond excavation. The following will discuss construction dewatering for trench excavation.

3.1 Dewatering Rate and Influence Zone

Dewatering rate (L/day) and influence zone are the key parameters for implementing construction dewatering and impact assessment. The dewatering rate incorporates three kinds of potential water flow or seepage into trench excavations, including static groundwater seepage, storage of groundwater that has to be depleted before groundwater flow reaches a static state, and storm water. The following calculations and estimation are based on the assumptions:

For trenches:

- Depth of trenches – 4.0 m;
- Typical length of trenches – 30 m; and
- Width of trenches – 2.0 m;
- Building grade at 238.78 masl

For interim stormwater pond:

- Bottom elevation – 229.1masl;
- Recorded groundwater level elevation from nearby monitoring well (BH168) – 231.2 masl;
- Excavation area – 17,500 m^2.

Static Groundwater Seepage and Influence Zone:
Based on the above delineation of excavation dimensions and stratigraphy, the excavation will penetrate through fill and silt to clay till unit. The major saturated soil body to be excavated is silt till. Therefore, the hydraulic conductivity value of silt to clay till (**Table 10**) will be used for calculation of dewatering rate and influence zone.

The static groundwater seepage for trench excavation for linear development features such as utilities and storm and sanitary sewers is estimated with the following Dupuit-Thiem equation, which include an item for two ends of the trench and the item for the trench length:

$$Q = K(H^2 – h_w^2) / [\log (R / r_w)]+xK(H^2-h^2)/L$$

Q = pumping rate
K = hydraulic conductivity (m/s)
K_v=K/10
H = original water level (m) above lower aquitard
h_w = targeted level (m) above the lower aquitard
R = influence radius (combined) (m)
r_w = well radius or equivalent radius (m)
x=length of trench (m)
w=width of trench (m)
L=line source distance (m) which is the greater of R_0/2 or 10 m

Radius of influence zone is estimated with Sichardt and Kryieleis formula:

$$R_0 = C(H-h_w)K^{1/2}$$

Storage of Groundwater:
The storage of groundwater was estimated based on porosity of excavated soil, the volume of excavated saturated soil and the volume of saturated soil enclosed by the drawdown cone and influence zone column. Based on the classification of soil encountered in the boreholes, no wet and saturated zones were identified under the site within the zone of excavation. The soil encountered in boreholes are mostly fine-grained. Free gravity flow of groundwater during construction is not anticipated. Consequently, storge of groundwater will be insignificant and should be ignored.

Stormwater:
25 mm/day rainfall intensity has been used to estimate potential stormwater that may accumulate in the excavations as this rainfall intensity represent 95% storm events in southern Ontario. The potential stormwater accumulation is meant to direct the client to make a contingency plan for the construction executed during wet season and will not be considered in assessing if a PTTW or EASR is required.

Dewatering Summary:
Table 15 lists the input parameters and output values for dewatering rate and influence zone calculation for trenches of linear development features such as utilities and storm and sanitary sewers and the interim stormwater pond. The maximal required pumping rate for trenches will be 6,018 L/day after applying an uncertainty factor of 1.5 to the static flow rate, corresponding 0.1 L/s. The maximal required pumping rate for the interim stormwater pond will be 30,358 L/day after applying an uncertainty factor of 1.5 to the static flow rate, corresponding 0.4 L/s.

Table 15. Summary of Dewatering Analysis for Typical Length of Trench and Interim Stormwater Pond

Parameters	Trench	Interim Stormwater Pond
Excavation Area (m)	30 x 2	17,500
Excavation Depth (mbgs)	4.0	-
GW Level (masl)	239.3	232.2
Groundwater Level Target (masl)	233.78	228.1
K (m/s)	3.5×10^{-7}	3.5×10^{-7}
H (m)	5.5	4.1
h (m)	0	0
x (m)	30	-
W (m)	2	-
Storm (mm/day)	25	25
R_0 (m)	8.0	8.0
Q_{static} (L/day)	4,012	20,239
$Q_{StaticFOU=1.5}$ (L/day)	6,018	30,358
$Q_{storm=25mm}$ (L/day)	1,500	43,7500

3.2 Location of Discharge and Dewatering Methods

MECP construction dewatering guides provided several options for discharging pumped water, including:

- Discharge to a sewage works that has the appropriate environmental compliance approval (ECA);
- Transfer to a waste management system that has the appropriate environmental compliance approval (ECA) or is registered under the non-hazardous waste transportation systems EASR;
- Discharge to a municipal sanitary sewer or storm sewer in accordance with any municipal requirements; and
- Discharge to land surface and managed on-site.

Based on the understanding of site conditions and the low dewatering rate, it is recommended that the pumped water be managed on site through an infiltration swale or pond. The contractor is responsible for design and construction of infiltration facilities. Best management practices should be exercised to prevent erosion, flooding and groundwater contamination. Based on the predicted pumping rate, Sump pumps should be adequate for controlling groundwater that may accumulate in the excavation pits or trenches.

3.3 PTTW, EASR and Municipal Permits

Water taking in Ontario is governed with Section 34 of Ontario Water Resources Act and its Regulation 387/04. The act and regulation require that no person shall take more than 50,000 litres of water on any day by any means except in accordance with a permit.

Construction dewatering is governed with Part II. 2 of Environmental Protection Act and its Regulation 63/16. Based on the act and regulation, construction dewatering with rates between 50,000 and 400,000 L/day can go through Environmental Activity and Sector Registry (EASR) and do not have to apply for a PTTW if the impact to natural resource and environment is not significant and no sensitive features are involved.

Based on the above analysis and understanding of the water taking legislations, construction dewatering for this project is expected to be below 50,000 L/day, and therefore neither an ESAR registration nor a PTTW application are required.

4. Site Water Balance Assessment

As presented above, the site is not located in WHPA-Q, and therefore, source protection water balance policies do not apply to the proposed development. The site water balance assessment was conducted to address concerns from agencies regarding stormwater management, and to provide inputs to stormwater management design. The water balance assessment was conducted in general accordance with the Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications (2013) and Stormwater Management Planning and Design Manual of MECP (2003), and consists of the following steps:

- Water surplus determination;
- Land use unit delineation and infiltration factor determination for pre- and post-development scenarios;
- Pre- and post-development water balance analysis; and
- Low Impact Development (LID) considerations.

4.1 Water Surplus

Water surplus for pervious vegetated areas is estimated with Thornthwaite and Mather water balance method (1957) or based on Water Balance Tool developed by Toronto and Region Source Protection Area (TRSPA). Thornthwaite and Mather method is an accounting procedure to quantify components of the hydrologic cycle as expressed in the following equation:

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

P= Precipitation (mm/year)
ET= Evapotranspiration (mm/year)
R= Runoff (mm/year)
I= Infiltration (mm/year)
R+I=Water surplus (mm/year)
ΔS= Change in groundwater storage (mm/year)

Palmer developed its own spreadsheet program to execute the analysis. The input data includes:

- Long term (30 years) monthly average precipitation and temperature collected from closest climate station (Toronto Lester B. Pearson International Airport) for the period between 1981 and 2010) (Section 3.1)
- Degrees of altitude = 44.51°.
- Soil moisture storage capacity for predominant land coverage = 100 mm.

Soil moisture storage capacity of 100 mm was selected based on shallow rooted bean and landscaping features in clayey silt soil. **Table 16** sums up the results of the analysis.

Table 16. Water Surplus for pervious Soil

Month	Mean Temperature (°C)	Total Precipitation (mm)	Actual Evapotranspiration (mm)	Water Surplus (mm)
January	-5.5	51.8	0.0	51.8
February	-4.5	47.7	0.0	47.7
March	0.1	49.8	0.3	49.5
April	7.1	68.5	34.7	33.8
May	13.1	74.3	97.3	-23.0
June	18.6	71.5	88.5	-17.0
July	21.5	75.7	81.7	-6.0
August	20.6	78.1	74.1	4.0
September	16.2	74.5	59.5	15.0
October	9.5	61.1	40.5	20.6
November	3.7	75.1	11.8	63.3
December	-2.2	57.9	0.0	57.9
YEAR		**786**	488	298

TRSPA provided the following water balance values for the site and nearby area:

- Total precipitation – 863 mm/year;
- Evapotranspiration – 575 mm/year;
- Runoff – 234 mm/year;
- Recharge – 54 mm/year; and
- Water surplus – 288 mm/year.

TRSPA water balance results (**Appendix I**) are fairly close to the results from the Thornthwaite and Mather method. Considering TRSPA used a higher and more recent precipitation value, TRSPA water balance values are uses for the water balance analysis.

Water surplus for impervious areas (building roof, impervious pavement etc.) was calculated based on the assumption that 10% of total precipitation will evaporate on impervious surface (acceptable range is 10% to 20%), or with a runoff rate of 90%, and no precipitation will infiltrate. Total precipitation from TRSPA is 863 mm/year, and the water surplus on impervious at the site is 777 mm/year.

4.2 Land Use Unit Delineation and Infiltration Factor

Delineation of land use units was based on topography, surficial soil and land cover at the site for current site conditions (pre-development) and the conditions after the completion of the proposed development (post-development). Infiltration factor for each catchment was calculated based on the scoring table presented in the Page 3-4 of the Stormwater Management Planning and Design Manual of MECP (2003) and in the Page 4-62 of MECP Hydrogeological Technical Information Requirements for Land Development Applications (1995). **Table 17** summarizes the results of land unit delineation and infiltration factors for pre- and post- development scenarios.

As the Site Plans (**Appendix A**) show, only Phase 1 will be developed, therefore the water balance will focus on the Phase 1 development area. The Phase 2 and 3 development areas are treated as farmland.

Table 17. Land Use Units and Infiltration Factor for Pre- and Post-Development

Pre-Development					
Land Use Unit	Area (ha)	Slope Gradient	Soil	Land Cover	Infiltration Factor
Farmland	71.79	0.2	0.1	0.1	0.4
Woodland	2.98	0.2	0.1	0.2	0.5
Wetland	1.42	0.2	0.1	0.2	0.5
Grassland	0.64	0.2	0.1	0.2	0.5
Grass Channel	0.84	0.1	0.1	0.2	0.4
Pond	0.79	0.2	0.1	0.2	0.5
Total	78.46	-	-	-	-
Post-Development					
Land Use Unit	Area (ha)	Slope Gradient	Soil	Land Cover	Infiltration Factor*
Phase 1 Building	14.23	-	-	-	0
Phase 1 Pavement	12.99	-	-	-	0
Phase 2 A	11.38	0.2	0.1	0.1	0.4
Phase 2 B	10.92	0.2	0.1	0.1	0.4
Phase 3	13.55	0.2	0.1	0.1	0.4
Woodland	2.32	0.2	0.1	0.2	0.5
Wetland	1.42	0.2	0.1	0.2	0.5
Wetland Buffer	3.19	0.2	0.2	0.2	0.6
NHS	4.08	0.2	0.2	0.2	0.6
Pond	0.79	0.2	0.1	0.2	0.5
Landscape	3.59	0.2	0.2	0.2	0.6
Total	78.46	-	-	-	-

***Applies only to pervious areas.**

4.3 Water Balance for Pre-Development and Post-Development

With water surplus, areas of land use units and infiltration factors being determined, water balance for pre- and post-development scenarios is a simple process of accounting.

It should be noted that the land use unit post-development includes buildings and paved areas with zero infiltration and landscaped areas usually with increased infiltration owing to grading, vegetation and topsoil application. Following generally accepted practices, the impervious factors adopted for the land use units are as follows:

- Low density residential – 0.41;
- Low-medium density residential – 0.42;
- Medium density residential – 0.43;
- High density residential – 0.44;
- Commercial – 1.0;
- School – 1.0;
- Parks – 0;
- Wetland – 0;
- Stormwater Management facilities – 0.5;
- Vistas – 0.5;
- Trails – 0.5;
- Roads – 1.0;
- Natural heritage – 0;
- Farmland – 0;
- Woodland – 0;

Table 18 lists the results, which shows that the proposed development will cause a reduction of infiltration of 25,476 m^3/year and an increase in runoff of 158,582 m^3/year.

Table 18. Site Water Balance for Pre- and Post-Development

Pre-Development					
Land Use Unit	Area (ha)	Water Surplus (mm/year)	Infiltration Factor	Runoff (m^3/year)	Infiltration (m^3/year)
Farmland	71.79	288	0.4	124,053	82,702
Woodland	2.98	288	0.5	4,291	4,291
Wetland	1.42	288	0.5	2,045	2,045
Grassland	0.64	288	0.5	922	922
Grass Channel	0.84	288	0.4	1,452	968
Pond	0.79	288	0.5	1,138	1,138
Total	**78.46**	**-**	**-**	**133,900**	**92,065**
Post-Development					
Land Use Unit	Area (ha)	Water Surplus (mm)	Infiltration Factor	Runoff (m^3/year)	Infiltration (m^3/year)
Phase 1 Building	14.23	777	0	110,567	0
Phase 1 Pavement	12.99	778	0	100,932	0
Phase 2 A	11.38	288	0.4	19,665	13,110
Phase 2 B	10.92	288	0.4	18,870	12,580

Pre-Development					
Phase 3	13.55	288	0.4	23,414	15,610
Woodland	2.32	288	0.5	3,341	3,341
Wetland	1.42	288	0.5	2,045	2,045
Wetland Buffer	3.19	288	0.6	3,675	5,512
NHS	4.08	288	0.6	4,700	7,050
Pond	0.79	288	0.5	1,138	1,138
Landscape	3.59	288	0.6	4,136	6,204
Total	**78.46**	**-**	**-**	**292,482**	**66,588**
Pre- to Post- Development Change				+158,582	-25,476
Pre- to Post- Development Change (%)				+118%	-28%

4.4 LID Design Considerations

As mentioned above, the site is not located in any designation area of source protection, to maintain pre-development water balance is not a mandatory condition for the proposed development under the source protection plan. However, considering the large increased runoff and reduces infiltration due to the proposed development, Low Impact Development (LID) features, as a best management practice, should be considered to control flooding and erosion at downstream areas and to maintain infiltration as far as reasonably practical.

Based on the Low Impact Development Stormwater Management Planning and Design Guide (CVC and TRCA), the major site constraints are low infiltration rate and shallow groundwater table. In general, the guide recommends that the soil suitable for LID should have an infiltration rate of more than 15 mm/hr unless other supportive structures are considered, and the groundwater table should separate from the invert of LID structures more than one (1) meter. Infiltration rates acquired through infiltration tests for the three infiltration tanks range from 42 to 56 mm/hr, indicating the native soils have decent capability to take in water.

As characterized above, all the monitoring wells were all installed in soil medium with low hydraulic conductivity and without continuous saturated zone as shown in borehole logs (**Appendix B**). Groundwater levels recorded from monitoring wells should be not used to assess groundwater level separation from the invert of permanent structures such as basement slab and stormwater pond bottom. Test Pit Investigation Report has proved that the real groundwater levels are much deeper than groundwater levels recorded from monitoring wells and can provide more than one (1) m separation from the invert of the proposed infiltration tanks.

To boost infiltration, the client proposed a three rainwater harvesting tanks (Tank A, B, D) and three infiltration tanks (Tank C, E, F). The three infiltration tanks have invert elevations ranging from 236.85 masl for Tank C, 236.03 masl for Tank E and 236.06 masl for Tank F. Based on the results of test pit investigation, the one meter of separation could be maintained.

Table 19 present the LID analysis results, which shows that the proposed infiltration tanks are enough to fully mitigate infiltration deficit on the conditions that the storage depth is over 0.44 m, corresponding a 48 hours drawdown.

Table 19. LID Analysis

Variable and Unit	Formula	Value	Note
Catchment Area (m^2)	Ac=	110,567.00	Roof area supplying clean water
Total Precipitation (mm/yr)	P=	786.00	-
Runoff Coefficient	c=	0.90	10% evaporation
Total Clean Roof Runoff (m^3/yr)	Ro=(AcxP/1000)xc	78,215.10	Must be greater than infiltration deficit
Infiltration Deficit (m^3/yr)	Id=	25,476.00	-
Ratio of Infiltration Deficit	Ra=Id/Ro	0.33	-
Storm Even to be Catched (mm/d)	S=	5.00	5 mm accounts for over 50% events in Southern Ontario
LID Water Volume (m^3)	Vw=AcxS/1000	552.84	Storage to be infiltrated, water exceeding storage will overflow
Infiltration Rate of Native Soil (mm/hr)	Ir=	9.20	Based hydraulic conductivity of soils
LID Water Depth (m)	Dw=Irx48/1000	0.44	48 hour drawdown. The LID feature designed should have water depth less than 0.44 m to ensure 48 hour drawdown
LID Water Area (m^2)	Aw=Vl/Dw	1,251.89	This value is less than the stormwater tank area of 1500 m2.

5. Feature-Based Water Balance Assessment

The CEISMP provided that: "The majority of the wetlands were evaluated as low risk. No surface water or ground water monitoring is required and a non-continuous hydrological model (i.e., Thornthwaite Mather) is suitable for completing pre to post (with and without mitigation) wetland water balance analysis". The CEISMP also provided that: "TRCA agreed that Feature-based Water Balance (FBWB) modeling is not required for the riparian wetlands. Instead, the consultant team will demonstrate that erosion thresholds are not exceeded, and flows are contained within the channel corridor".

Feature-Based Water Balance Assessment (FBWBA) was conducted in general accordance with the guidelines of Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications (2013) and the Overview of Water Balance Practices in the Greenbelt (Ryan Post and Devon Owens, 2020). Basically, the FBWBA for this study breaks into following steps:

- Water surplus estimation;

- Catchment area delineation and infiltration factor determination for pre- and post-development scenarios; and
- Pre- and post-development Water balance analysis.

The FBWBA will focus on Phase 1 development as no post-development drainage information is available for future Phase 2 and Phase 3 developments.

5.1 Water Surplus

Water surplus values used for FBWBA will be the same as what had been derived for site water balance analysis as presented above, which includes:

- 288 mm/year for pervious area.
- 777 mm/year for impervious area.

5.2 Catchment Delineation and Infiltration Factor

Delineation of units of catchment to each subject wetland was based on topography, surficial soil, land cover and storm sewers alignment at the site for current site conditions (pre-development) and the conditions after the completion of the proposed development (post-development). **Figure 10** and **Figure 11** shows the delineation of catchment areas for pre-development and post-development.

The area of catchment units was measured with the aid of GIS and available site plans (**Appendix A).** It should be noted that the roof of Building 1 accounts for substantial part of the catchment area post-development. It was assumed that half of the area of Building 1 roof discharges into East Wetland catchment and the other half discharges into West Wetland catchment.

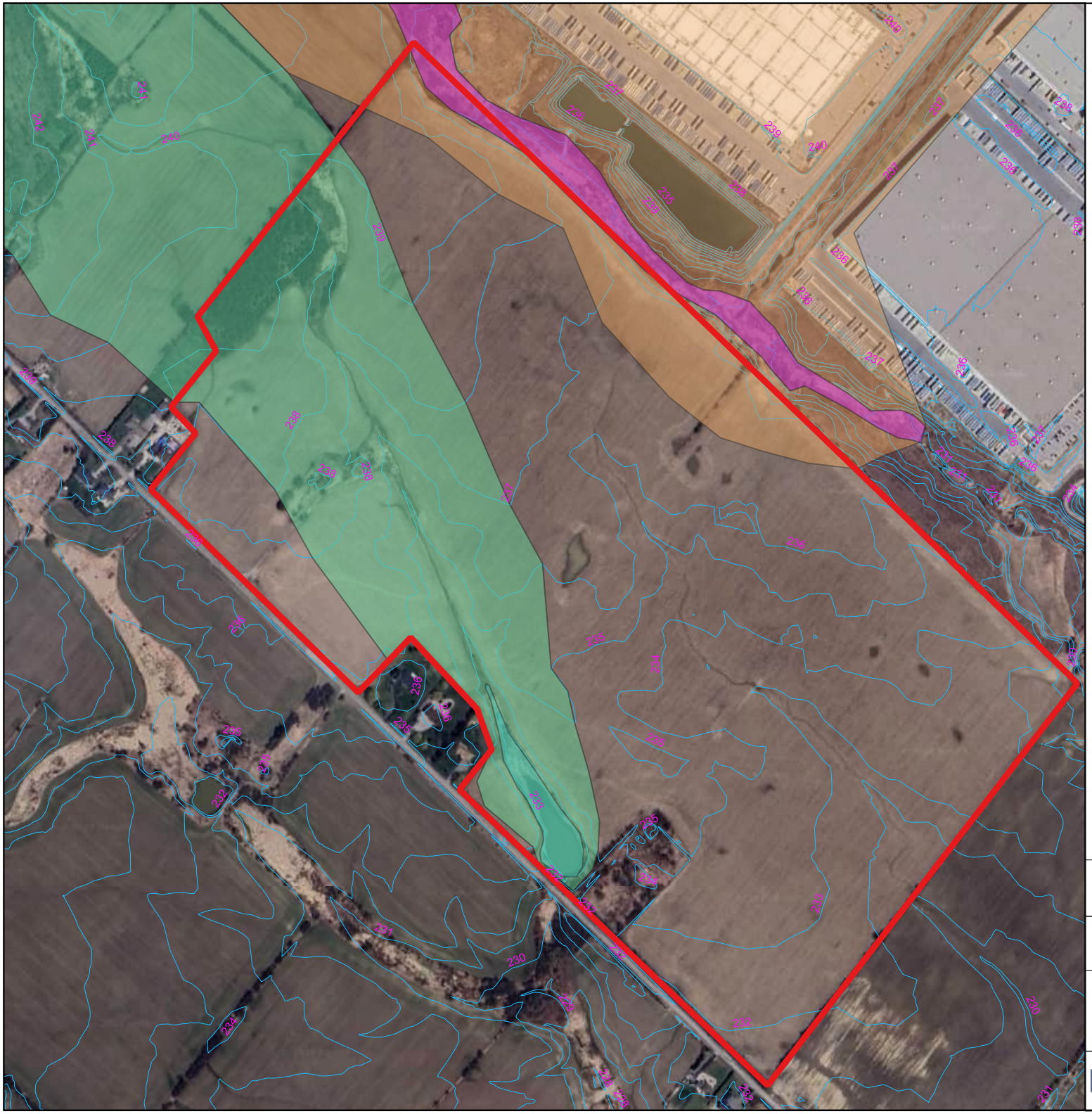
The Infiltration factor for each catchment units was calculated based on the scoring table presented in the Page 3-4 of the Stormwater Management Planning and Design Manual of MECP (2003) and in the Page 4-62 of MECP Hydrogeological Technical Information Requirements for Land Development Applications (1995). **Table 20** summarizes the results of catchment area delineation and infiltration factors for pre- and post- development scenarios for the East Wetland.

Table 20. Catchment Areas and Infiltration Factor for East Wetland

Pre-Development					
Catchment Unit	Area (ha)	Slope Gradient	Soil	Land Cover	Infiltration Factor
Wetland	0.46	0.2	0.1	0.2	0.5
Woodland/Shrub	0.07	0.2	0.1	0.2	0.5
Farmland	5.54	0.2	0.1	0.1	0.4
Total	6.08	-	-	-	-
Post-Development					
Catchment Unit	Area	Slope Gradient	Soil	Land Cover	Infiltration Factor*

Pre-Development					
	(ha)				
Roof of Building 1	7.16	-	-	-	0.0
Paved Area	3.98	-	-	-	0.0
Woodland/Shrub	0.07	0.2	0.1	0.2	0.5
Wetland	0.46	0.2	0.1	0.2	0.5
Landscaped Area	1.59	0.2	0.1	0.2	0.5
Wetland Buffer	3.08	0.2	0.1	0.1	0.4
Total	16.34	-	-	-	-

***Apply to pervious area only.**



LEGEND

- Site Boundary
- East Wetland
- West Wetland
- Topo Contour (1m)
- Catchment of East Wetland
- Catchment of West Wetland

120 120 240 m

North American Datum 1983, UTM Zone 17N (EPSG: 26917)

Scale: 1:7,000
Page Size: Letter (11 x 8.5 inches)

Drawn: FL
Checked: JC
Date: Aug 2024
Source Notes:
Basemap - Google Satellite (2020)
Topo Contour - Peel Region (Spring 2021)

CLIENT

Prologis

PROJECT

12519 & 12713 Humber Station Road, Bolton, Ontario

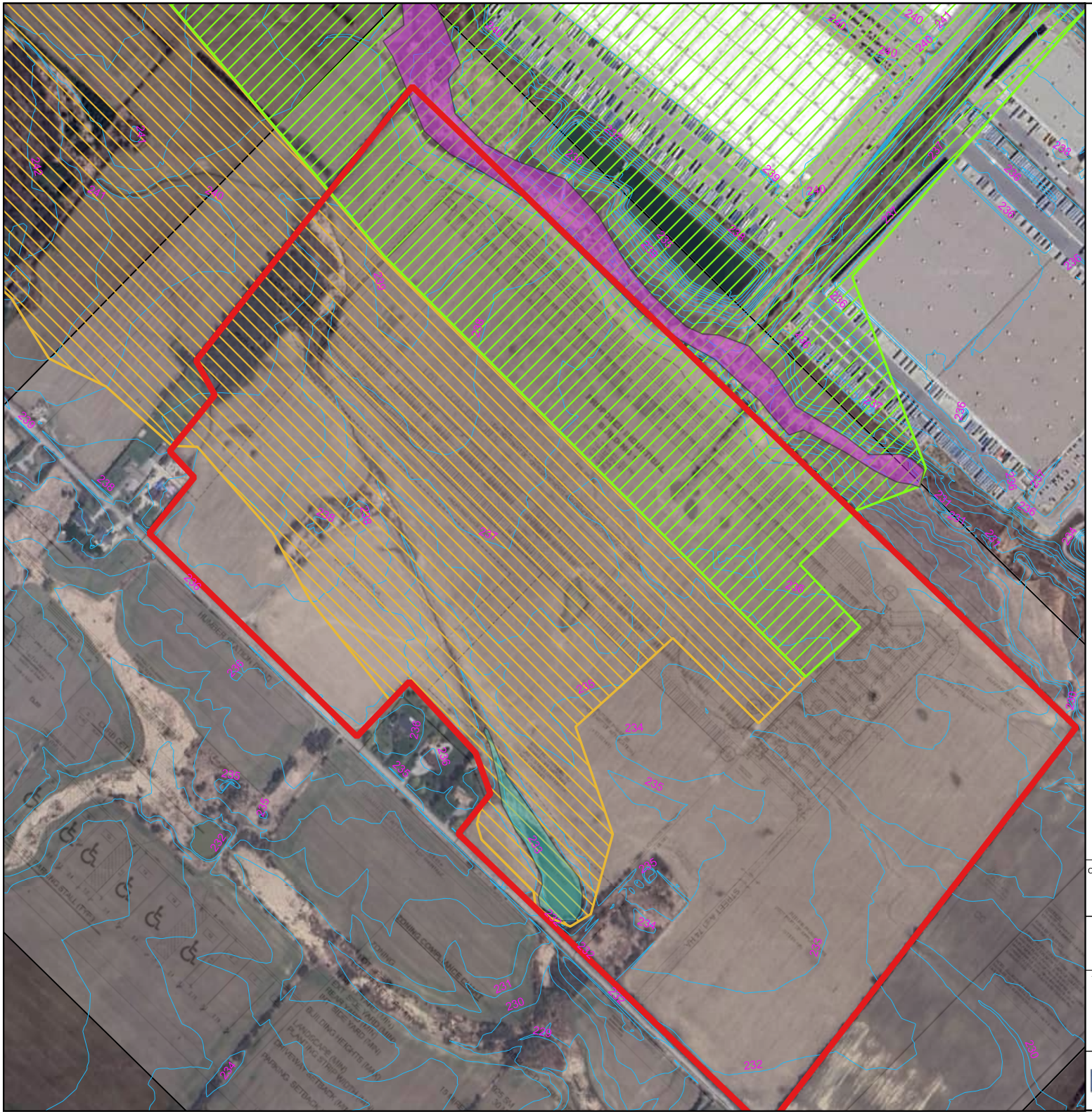
TITLE

Pre-Development Catchment Delineation

Palmer | PART OF SLR

REF. NO. 2008102

Figure 10



LEGEND

- Site Boundary
- East Wetland
- West Wetland
- Topo Contour (1m)
- Catchment of East Wetland
- Catchment of West Wetland

120 120 240 m

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:7,000
Page Size: Letter (11 x 8.5 inches)

Drawn: FL
Checked: JC
Date: Aug 2024
Source Notes:
Basemap - Google Satellite (2020)
Topo Contour - Peel Region (Spring 2021)

CLIENT

Prologis

PROJECT

12519 & 12713 Humber Station Road, Bolton, Ontario

TITLE

Post-Development Catchment Delineation

Palmer | PART OF SLR

REF. NO: 2008102

Figure 11

Table 21. Catchment Areas and Infiltration Factor for West Wetland

Pre-Development					
Catchment Unit	Area (ha)	Slope Gradient	Soil	Land Cover	Infiltration Factor
Grassland	0.94	0.2	0.1	0.1	0.4
Woodland/shrub	2.30	0.2	0.1	0.2	0.5
Wetland	0.78	0.2	0.1	0.2	0.5
Farmland	16.46	0.2	0.1	0.1	0.4
Total	20.48	-	-	-	-
Post-Development					
Catchment Unit	Area (ha)	Slope Gradient	Soil	Land Cover	Infiltration Factor*
Roof of Building 1	7.16	-	-	-	0.0
Paved Area	3.50	-	-	-	0.0
Grassland	0.94	0.2	0.1	0.2	0.5
Woodland/shrub	2.30	0.2	0.1	0.2	0.5
Wetland	0.78	0.2	0.1	0.2	0.5
Landscaped Area	0.19	0.2	0.1	0.2	0.5
Farmland	15.45	0.2	0.1	0.1	0.4
Total	30.32	-	-	-	-

5.3 Feature-Based Water Balance for Pre-Development and Post-Development

With water surplus, area of catchment units and infiltration factors being determined, water balance for pre- and post-development scenarios are a process of accounting. **Table 22** and **Table 23** list the water balance results for East and West Wetlands for pre- and post-development conditions. The water balance results show that the proposed Phase One development will result in an increased runoff of 86,633 m^3/year and reduced infiltration of 1,012 m^3/year in the East Wetland catchment, and an increased runoff of 81,353 m^3/year and reduced infiltration of 678 m^3/year in the East Wetland catchment.

Table 22. Feature Water Balance for East Wetland

Pre-Development					
Catchment Unit	Area (ha)	Water Surplus (mm/year)	Infiltration Factor	Runoff (m^3/year)	Infiltration (m^3/year)
Wetland	0.46	288	0.5	661	661
Woodland/Shrub	0.07	288	0.5	105	105
Farmland	5.54	288	0.4	9,581	6,387
Total	6.08			10,347	7,153
Post-Development					

Pre-Development					
Catchment Unit	Area (ha)	Water Surplus (mm)	Infiltration Factor	Runoff (m^3/year)	Infiltration (m^3/year)
Roof of Building 1	7.16	777	0.0	55,642	0
Paved Area	3.98	777	0.0	30,955	0
Woodland/Shrub	0.07	288	0.5	105	105
Wetland	0.46	288	0.5	661	661
Landscaped Area	1.59	288/777	0.5	4,302	1,831
Wetland Buffer	3.08	288	0.4	5,315	3,543
Total	16.34			96,980	6,141
Pre- to Post- Development Change				86,633	-1,012
Pre- to Post- Development Change (%)				837%	-14%

Table 23. Feature Water Balance for West Wetland

Pre-Development					
Catchment Unit	Area (ha)	Water Surplus (mm/year)	Infiltration Factor	Runoff (m^3/year)	Infiltration (m^3/year)
Grassland	0.94	288	0.40	1,630	1,086
Woodland/shrub	2.30	288	0.50	3,313	3,313
Wetland	0.78	288	0.50	1,122	1,122
Farmland	16.46	288	0.40	28,443	18,962
Total	20.48			34,508	24,484
Post-Development					
Catchment Unit	Area (ha)	Water Surplus (mm)	Infiltration Factor	Runoff (m^3/year)	Infiltration (m^3/year)
Roof of Building 1	7.16	777	0.00	55,642	0
Paved Area	3.50	777	0.00	27,223	0
Grassland	0.94	288	0.50	1,358	1,358
Woodland/shrub	2.30	288	0.50	3,313	3,313
Wetland	0.78	288	0.50	1,122	1,122
Landscaped Area	0.19	288/777	0.50	512	218
Farmland	15.45	288	0.40	26,691	17,794
Total	30.32			115,861	23,805
Pre- to Post- Development Change				81,353	-678
Pre- to Post- Development Change (%)				221%	-4%

5.4 Retained Natural Heritage Features Protection

The above FBWB shows that the proposed Phase One development will result in an increased runoff of 86,633 m^3/year and reduced infiltration of 1,012 m^3/year in the East Wetland catchment, and an increased runoff of 81,353 m^3/year and reduced infiltration of 678 m^3/year in the East Wetland catchment. Monitoring results, site observation and stratigraphy all proved that both wetlands do not receive groundwater discharge contribution. Therefore, the reduced infiltration will not have impact to the hydroperiod of both wetlands. Consequently, the minor reduction of infiltration within the catchment of each wetland will not adversely impact the wetlands. Runoff should be properly managed through the proposed SWM Plan to prevent the increased runoff to end up in both wetlands. Through the establishment of wetland setbacks and new compensation areas in the Eastern Wetland catchment, and the creation of a new, higher functioning drainage channel in the Western Wetland catchment, no impacts to wetland hydrology or hydrogeology is expected.

6. Assessment of Separation of Groundwater Table from Inverts of Permanent Structures

As presented above, all monitoring wells were completed in aquitard (aquitard well). Groundwater levels recorded in the aquitard wells may not reflect real phreatic water table conditions. To assess the real phreatic water table conditions, Palmer completed a test pit investigation, and a Test Pit Investigation report was submitted, which contains detailed rationale and analysis.

The test pit investigation concluded that the real phreatic groundwater table are deeper than the depth of the test pits, averaged at 6.0 mbgs. Consequently, the required separation of one (1) m of groundwater table from the inverts of LID features and building will be maintained.

7. Impact Assessment and Mitigation

The construction and operation of the proposed development both have the potential to cause quantity and quality impact of groundwater to natural heritage, municipal water sources and private water supply. Impact assessment is based on the understanding of the physical and environmental settings of the site, the knowledge of the site subsurface condition, results of dewatering assessment and water balance assessment, as well as the nature of construction and operation of the proposed development. The following presents the assessment of impact to each major resource and environmental features and ways of mitigation if the impact is negative.

7.1 Natural Heritage Features

The major heritage features identified within and nearby the site include Goreway Drive Tributary, Clarkway Drive Tributary and associated West Wetland and East Wetland.

The above FBWB shows that the proposed Phase One development will lead to an increased runoff of 86,633 m^3/year and reduced infiltration of 1,012 m^3/year in the East Wetland catchment, and an increased

runoff of 81,353 m^3/year and reduced infiltration of 678 m^3/year in the East Wetland catchment. If the stormwater is managed as recommended, the impact to the wetland and creeks will be insignificant,

The construction dewatering is of short term and will be discharged on site. The impact of construction dewatering to natural heritage features is not anticipated.

No impacts to groundwater supported natural heritage features is expected from the proposed development.

7.2 Source Water Protection

As presented above, the site is not located in WHPA-Q1 and WHPA-Q2, and to maintain site water balance post-development is not mandatory by source protection policies. The proposed infiltration tanks will fully compensate the infiltration deficit caused by the increased impervious area.

Two isolated areas within the site are located above a Highly Vulnerable Aquifer with a vulnerable score of 6. To prevent the potential impact to the HVA, a spill management plan generated and executed by the contractors should be enough to protect the HVA.

7.3 Private Water Wells

As presented above, the water supply for the area surrounding the site was provided by Peel Region through Palgrave - Caledon East Drinking Water System, and all domestic wells were constructed before 1994. Using private wells for drinking water supply is not anticipated within and surrounding the site. however, it can not be ruled out that certain wells are still being used for livestock and other purposes. Considering the low groundwater recharge, small dewatering rate and influence zone, the impact of reduced groundwater recharge and the short-term construction dewatering to the private water wells are not expected.

A private well survey and if needed, a monitoring program, can occur during the construction phase of the project.

7.4 Discharge Receiver

As presented above, the pumped water for the purpose of conduction dewatering is recommended to be discharged onto surface land. The major potential impact of the discharged water is flooding and erosion. Considering the limited dewatering rate and influence zones, flooding and erosion are not expected.

8. Conclusions and Recommendations

Based on the above site characterization, dewatering assessment and site and site water balance assessment, conclusions and recommendations are presented as follows:

- The site is underlain with over 20 m thick overburden sediments that consist of silt to clay till and silt of the Halton Till formation within investigation depths. Significant aquifers are not identified under the site;

- Groundwater levels from monitoring wells range from 0.2 to 2.9 mbgs at the site with a predominant horizontal groundwater flow direction from northwest to southeast, towards the tributary of West Humber River. Weak vertical gradients were identified in certain depths and certain area within and surrounding the site;

- Groundwater level and surface water level data from mini-piezometers do not show hydraulic connection between groundwater and surface water, indicating that groundwater does not support stream flow and associated wetlands and shallow ponds. Therefore, groundwater does not take part in forming the hydroperiod of these features;

- Hydraulic conductivity values range from the orders of $6.0x10^{-10}$ to $6.6x10^{-7}$ m/s, generally increasing with depths and grain size of formations. The infiltration rate for native formations has an average value of 23 mm/hr. If infiltration facilities are sited on fill, the infiltration capacity of fill should be assessed;

- Groundwater quality is fresh and no visual or olfactory evidence of contamination such as visible petroleum hydrocarbon film or sheen as well as smell and odor were recorded during drilling or sampling. A number of exceedances were identified over ODWS and PWQO. These exceedances are mostly associated with fine particle materials in natural groundwater caused by the sampling process or agricultural operation and will be easily removed through settling and filtration;

- The construction dewatering analysis shows that the required dewatering rate for a typical construction working face is 6,018 L/day, which is far under the thresholder of 50,000 L/day for consideration of EASR and PTTW. Therefore, neither an EASR registration nor a PTTW application is required. Potential possible stormwater accumulation is provided for client's reference only;

- The site water balance analysis shows the proposed Phase 1 development will cause a reduction of infiltration of 25,476 m^3/year and an increase in runoff of 158,582 m^3/year. The proposed infiltration tank will fully compensate the infiltration deficit.

- The CEISMP provided that: "The majority of the wetlands were evaluated as low risk. No surface water or ground water monitoring is required and a non-continuous hydrological model (i.e., Thornthwaite Mather) is suitable for completing pre to post (with and without mitigation) wetland water balance analysis";

- FBWB conducted for Phase One development shows that the development will result in an increased runoff of 86,633 m^3/year and reduced infiltration of 1,012 m^3/year in the East Wetland catchment, and an increased runoff of 81,353 m^3/year and reduced infiltration of 678 m^3/year in the East Wetland catchment. As neither the East Wetland and West Wetland receive groundwater discharge contribution, the minor reduction of infiltration within the catchment of each wetland will not adversely impact the wetlands. Runoff should be properly managed through the proposed SWM Plan to prevent the increased runoff to end up in the both wetlands. Through the establishment of wetland setbacks and new compensation areas in the Eastern Wetland catchment, and the creation of a new, higher functioning drainage channel in the Western Wetland catchment, no impacts to wetland hydrology or hydrogeology is expected;

- The water taking for construction dewatering is of short term, and of limited quantity and influence zones. The impacts of construction dewatering to natural heritage features and private wells are not expected.

The above hydrogeological assessment is based on the assumptions that the client and the contractors will undertake the execution and construction of the project following all applicable codes, regulations, guidelines and BPMs, and these assumptions will end up being realized through actual construction activities. This hydrogeological report should be considered preliminary until the final project design can assessed. Groundwater systems and other natural systems are highly complex and can have significant uncertainties between borehole locations. Additional hydrogeological testing is expected to be required as the project moves forward.

9. Signatures

This report was prepared, reviewed and approved by the undersigned.

Prepared By: _____

Frank C. Liu, P.Eng.
Senior Hydrogeologist

Reviewed By: _____

Jason Cole, M.Sc., P.Geo.
Technical Discipline Manager, Hydrology and Hydrogeology

10. Limitations of Report

The extent of this study was limited to the specific scope of work for which we were retained and that is described in this report. Palmer has assumed that the information provided by the client or any secondary sources of information are factual and accurate. Palmer accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or negligent acts from relied upon data. Judgment has been used by Palmer in the interpretation of the information provided but subsurface physical and chemical characteristics may differ from regional scale geology mapping and vary between or beyond well/borehole locations given the inherent variability in geological conditions.

Palmer is not a guarantor of the geological or groundwater conditions at the subject site, but warrants only that its work was undertaken and its report prepared in a manner consistent with the level of skill and diligence normally exercised by competent geoscience professionals practicing in the Province of Ontario. Our findings, conclusions and recommendations should be evaluated in light of the limited scope of our work.

The information and opinions expressed in the Report are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT PALMER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS PALMER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belongs to Palmer. Any use which a third party makes of the Report is the sole responsibility of such third party. Palmer accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Palmer's express written permission. Should the project design change following issuance of the Report, Palmer must be provided the opportunity to review and revise the Report in light of such alteration or variation.

11. References

Geotechnical Investigation Report by Pinchin in 2022

Supplemental Geotechnical Investigation – Proposed Industrial Development, Pinchin 2023

Hydrogeological Investigation Report by IBI Group in 2022

Armstrong D.K. and Dodge J.E.P. 2007:
Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release-Data 219.

Bedrock Geology, OGSEarth, Ministry of Energy, Northern Development and Mines, August 2019

Chapman, L.J. and Putnam, D.F.
The Physiography of Southern Ontario, 1984, Ontario Geological Survey.

MNDM. Ontario Geology Survey, Central Database

MECP. MAP Well Records of Ontario

MECP. Ontario Source Protection Atlas.

MECP. Provincial Groundwater Monitoring Network

Ontario Regulation 63/16, MECP

Ontario Geological Survey (OGS). 2007:
Paleozoic geology of Southern Ontario; Ontario Geological Survey, Map 2544

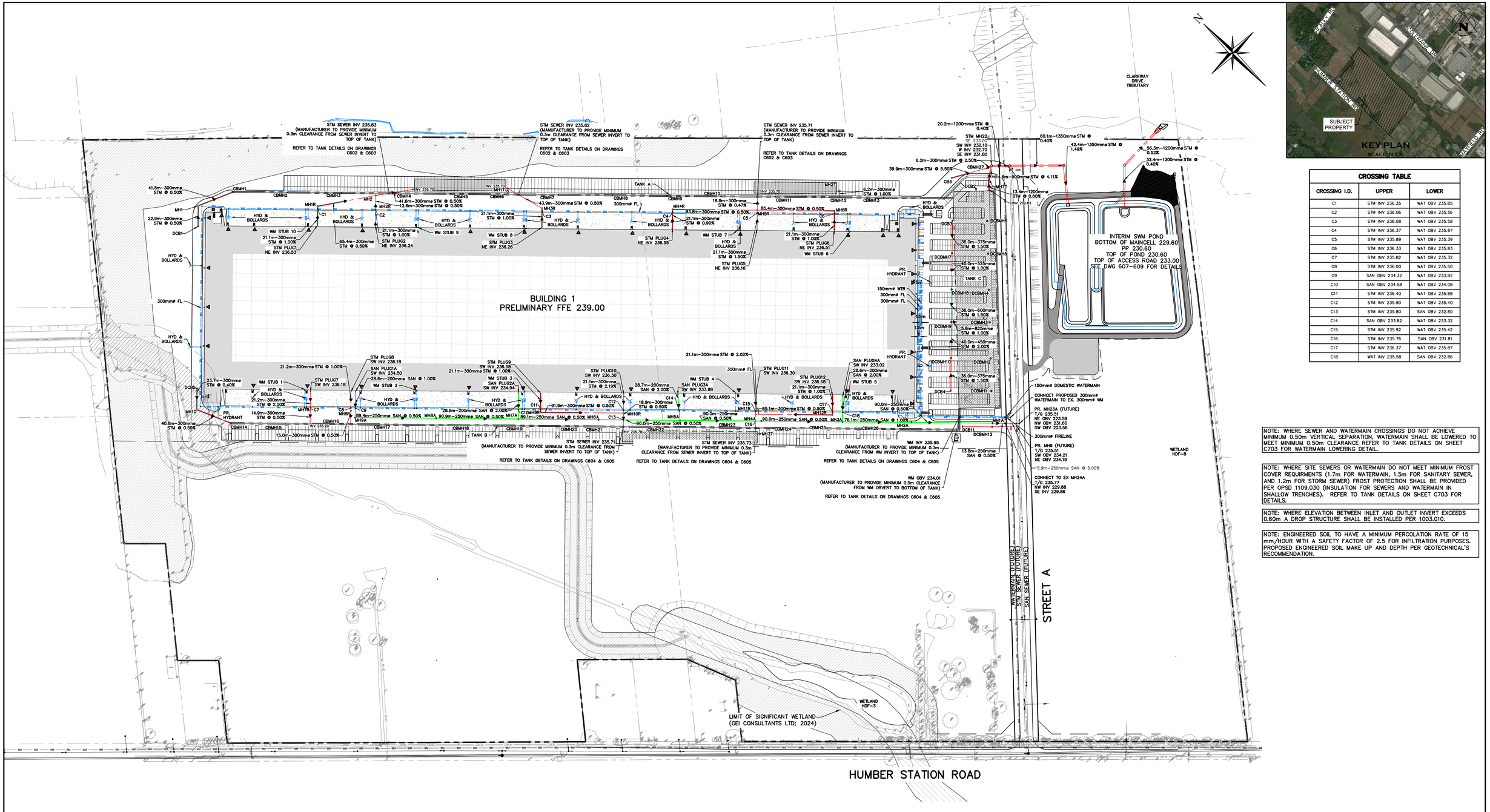
Surficial Geology, OGSEarth, Ministry of Energy, Northern Development and Mines, August 2019

Water Well Information System (WWIS) of Ontario, Dataset

Appendix A

Site Plans

(Crozier 2024)



CROSSING TABLE		
CROSSING I.D.	UPPER	LOWER
C1	STM INV 236.35	WAT OBV 235.85
C2	STM INV 236.06	WAT OBV 235.56
C3	STM INV 236.08	WAT OBV 235.58
C4	STM INV 236.37	WAT OBV 235.87
C5	STM INV 235.89	WAT OBV 235.39
C6	STM INV 236.33	WAT OBV 235.83
C7	STM INV 235.82	WAT OBV 235.32
C8	STM INV 236.00	WAT OBV 235.50
C9	SAN OBV 234.32	WAT OBV 233.82
C10	SAN OBV 234.58	WAT OBV 234.08
C11	STM INV 236.40	WAT OBV 235.88
C12	STM INV 235.90	WAT OBV 235.40
C13	STM INV 235.80	SAN OBV 232.80
C14	SAN OBV 233.82	WAT OBV 233.32
C15	STM INV 235.92	WAT OBV 235.42
C16	STM INV 235.76	SAN OBV 231.81
C17	STM INV 236.37	WAT OBV 235.87
C18	WAT INV 235.58	SAN OBV 232.86

NOTE: WHERE SEWER AND WATERMAIN CROSSINGS DO NOT ACHIEVE MINIMUM 0.50m VERTICAL SEPARATION, WATERMAIN SHALL BE LOWERED TO MEET MINIMUM 0.50m CLEARANCE REFER TO TANK DETAILS ON SHEET C703 FOR WATERMAIN LOWERING DETAIL.

NOTE: WHERE SITE SEWERS OR WATERMAIN DO NOT MEET MINIMUM FROST COVER REQUIRMENTS (1.7m FOR WATERMAIN, 1.5m FOR SANITARY SEWER, AND 1.2m FOR STORM SEWER) FROST PROTECTION SHALL BE PROVIDED PER OPSD 1109.030 (INSULATION FOR SEWERS AND WATERMAIN IN SHALLOW TRENCHES). REFER TO TANK DETAILS ON SHEET C703 FOR DETAILS.

NOTE: WHERE ELEVATION BETWEEN INLET AND OUTLET INVERT EXCEEDS 0.60m A DROP STRUCTURE SHALL BE INSTALLED PER 1003.010.

NOTE: ENGINEERED SOIL TO HAVE A MINIMUM PERCOLATION RATE OF 15 mm/HOUR WITH A SAFETY FACTOR OF 2.5 FOR INFILTRATION PURPOSES. PROPOSED ENGINEERED SOIL MAKE UP AND DEPTH PER GEOTECHNICAL'S RECOMMENDATION.

NOT FOR CONSTRUCTION

TEMPORARY BENCHMARKS:

ELEVATION ARE REFERRED TO THE REGION OF PEEL BENCHMARK No. 40 LOCATED ON THE SOUTH FACE AT THE WEST CORNER OF SOUTH END OF A CONCRETE BOX CULVERT ACROSS MAYFIELD ROAD APPROXIMATELY 0.56 km EAST OF CLARKWAY DRIVE, HAVING AN ELEVATION OF 222.165 m. VERTICAL DATUM: CANADIAN GEODETIC DATUM, 1928 (1978 SOUTHERN ONTARIO READJUSTMENT)

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON SITE PLAN PETROFF.
DRAWING No.: A100.0, DATED: 19/APR/2024
PROJECT No.: 22095.00

Town

No.	ISSUE	DATE: MMM/DD/YYYY
0	ISSUED FOR SPA SUBMISSION 1B	NOV/22/2024

Engineer

Engineer

Project
HUMBER STATION DISTRIBUTION CENTRE
TOWN OF CALEDON

Drawing
OVERALL SERVICING PLAN

CROZIER CONSULTING ENGINEERS

Drawn By	Design By	Project
S.C./D.G.	S.C./H.L.	624–6777
Check By	Check By	Drawing
M.I./R.A.	M.I./R.A.	C200

Appendix B

Well Logs

(Pinchin 2022, IBI 2022)

Log of Borehole: BH1

Project #: 308567.001 **Logged By:** KS

Project: Geotechnical Investigation

Client: Prologis

Location: 12519 & 12713 Humber Station Drive, Caledon, Ontario

Drill Date: April 16, 2022 **Project Manager:** SA

SUBSURFACE PROFILE

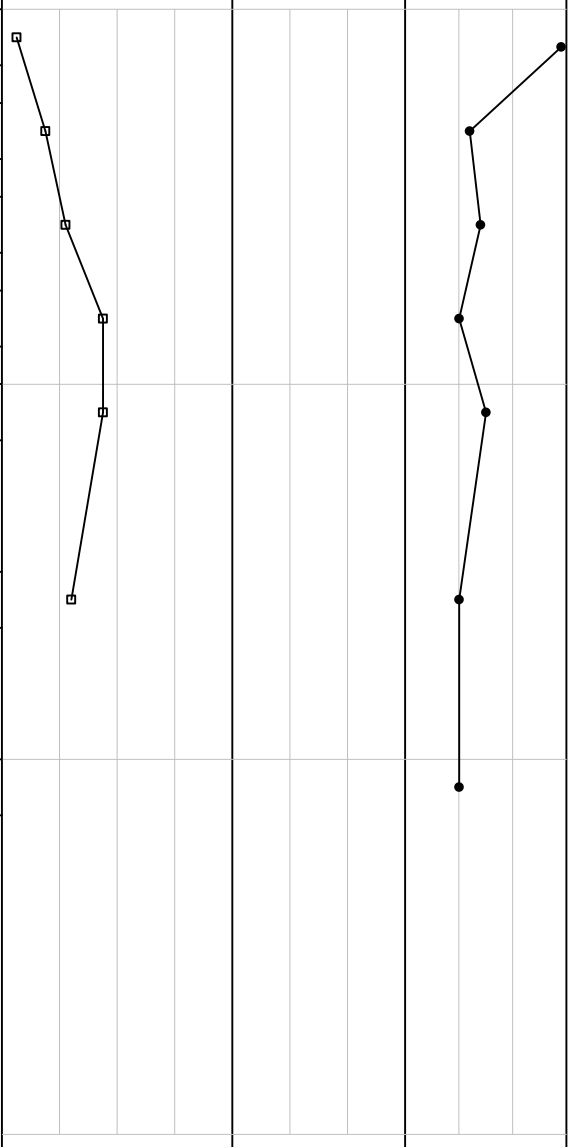
Depth (m)	Description	Elevation (m)
0	Ground Surface	239.28
	Topsoil Dark brown silt, trace sand, with organics - 150 mm	238.52
1	**Silt** Brown with some grey mottling clayey silt trace sand and gravel, with some oxidation, firm, WTPL	237.76
	Silt, some clay, trace sand and gravel, compact, moist	
2	Silt, trace sand, gravel and clay	237.00
	Brownish grey, dense	
3		236.24
	Grey, trace orange oxidation	
4		234.71
	compact	
5		
6		233.19
	Silt some sand and gravel, moist	232.73
	End of Borehole	
7	Borehole terminated at 6.6 mbgs.	
8		
9		

Monitoring Well Details: Bentonite, Riser, Silica sand, Screen

Water level = 5.47 mbgs, As measured on April 25, 2022

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	80	5
SS	2	100	15
SS	3	100	22
SS	4	100	35
SS	5	100	35
SS	6	100	24
SS	7	100	>50



Contractor: TEC

Grade Elevation: 239.28 masl

Drilling Method: Solid Stem Augers

Top of Casing Elevation: 240.36 masl

Well Casing Size: 51 mm

Sheet: 1 of 1

Log of Borehole: BH9

Project #: 308567.001 **Logged By:** KS

Project: Geotechnical Investigation

Client: Prologis

Location: 12519 & 12713 Humber Station Drive, Caledon, Ontario

Drill Date: April 16, 2022 **Project Manager:** SA

SUBSURFACE PROFILE

Depth (m)	Description	Elevation (m)
0	Ground Surface	235.57
	Topsoil Dark brown silt, trace sand, with organics - 150 mm	234.81
1	**Silt** Brown with some grey mottling silt, some clay, trace sand with some oxidation, loose, moist	234.05
	Compact	
2	Silt, some clay, trace sand and gravel	233.28
	Dense	
3	Brownish grey silt, trace sand, gravel and clay	232.52
4		
		231.00
5	Grey, very dense	
6		229.02
7	End of Borehole	
	Borehole terminated at 6.6 mbgs.	
8		
9		

Monitoring Well Details: Bentonite, Riser, Silica sand, Screen

Water level = 1.78 mbgs, As measured on April 25, 2022

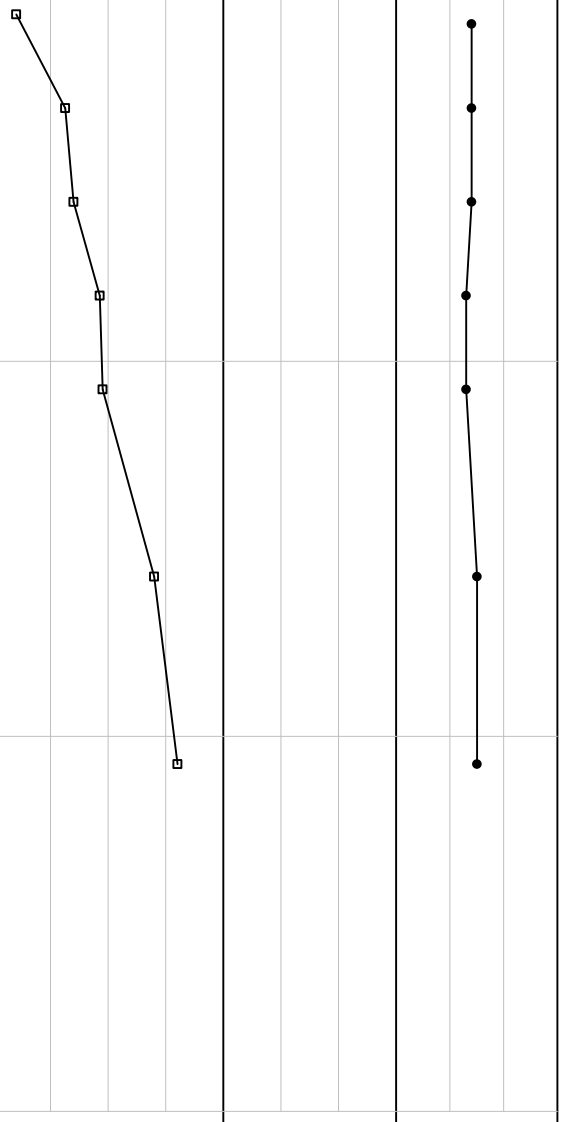
SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	100	8
SS	2	100	25
SS	3	100	28
SS	4	100	37
SS	5	100	38
SS	6	100	56
SS	7	100	64

Standard Penetration N-Value: 20, 40, 60

Shear Strength kPa: 100, 200

Water Content %: 10, 20



Contractor: TEC **Grade Elevation:** 235.57 masl

Drilling Method: Solid Stem Augers **Top of Casing Elevation:** 236.69 masl

Well Casing Size: 51 mm **Sheet:** 1 of 1

Log of Borehole: BH12

Project #: 308567.001 **Logged By:** KS

Project: Geotechnical Investigation

Client: Prologis

Location: 12519 & 12713 Humber Station Drive, Caledon, Ontario

Drill Date: April 16, 2022 **Project Manager:** SA

SUBSURFACE PROFILE

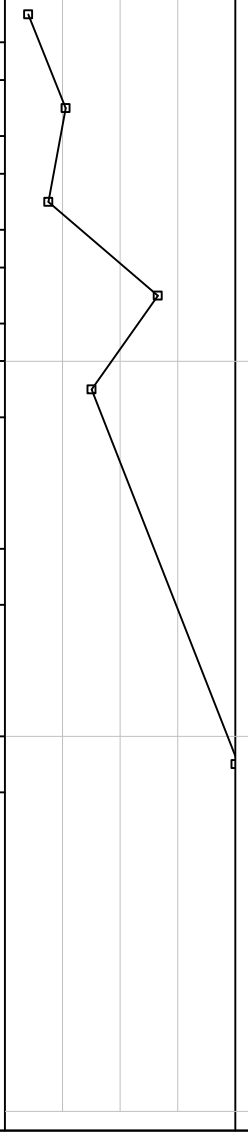
Depth (m)	Description	Elevation (m)
0	Ground Surface	237.15
	Topsoil Dark brown silt, trace sand, with organics - 150 mm	236.39
1	**Silt** Brown with some grey mottling silt, some clay, trace sand and gravel with some oxidation, loose, wet	235.63
	Reddish brown clayey silt, trace sand, very stiff, APL-WTPL	
2	Brown, silt some sand trace clay, compact, moist	234.86
	Greyish brown sandy silt, trace gravel, very dense	234.10
3	Silt some clay and sand, trace gravel, dense, moist	
4		232.58
	Wet, very dense	
5		
6		231.05
	Grey sandy silt some clay, trace gravel	230.60
	End of Borehole	
7	Borehole terminated at 6.6 mbgs.	
8		
9		

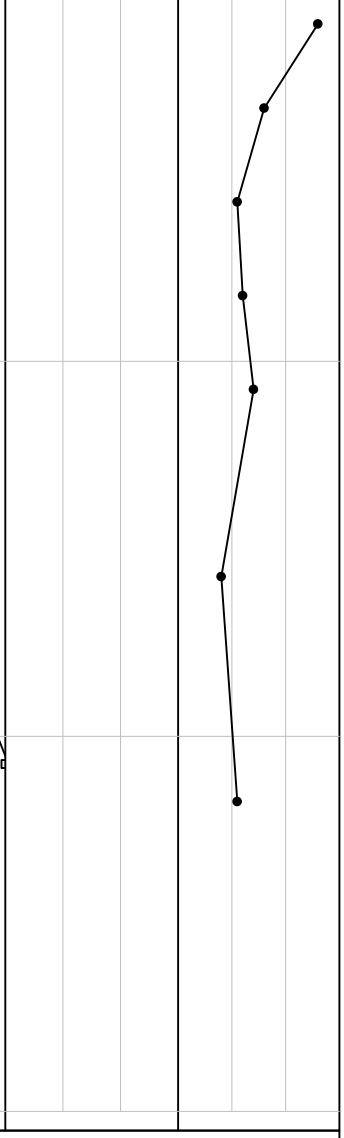
Monitoring Well Details: Bentonite, Riser, Silica sand, Screen

Water level = 1.15 mbgs, As measured on April 25, 2022

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	100	8
SS	2	100	21
SS	3	100	15
SS	4	100	53
SS	5	100	30
SS	6	100	>50
SS	7	100	81





Contractor: TEC

Grade Elevation: 237.15 masl

Drilling Method: Solid Stem Augers

Top of Casing Elevation: 238.17 masl

Well Casing Size: 51 mm

Sheet: 1 of 1

Log of Borehole: BH13

Project #: 308567.001 **Logged By:** KS

Project: Geotechnical Investigation

Client: Prologis

Location: 12519 & 12713 Humber Station Drive, Caledon, Ontario

Drill Date: April 16, 2022 **Project Manager:** SA

SUBSURFACE PROFILE

Depth (m)	Description	Elevation (m)
0	Ground Surface	237.42
	Topsoil Dark brown silt, trace sand, with organics - 150 mm	236.66
1	**Silt** Reddish brown with some grey mottling silt, some clay, trace sand, loose, wet	235.90
	Compact	
2	Silt, some clay, trace sand and gravel	234.37
3	Silt, trace sand, gravel and clay, dense, moist	232.85
4	Grey silt, trace sand and gravel	231.32
5	End of Borehole	
6	Borehole terminated at 6.1 mbgs.	
7		
8		
9		

Monitoring Well Details: Riser, Bentonite, Silica sand, Screen

Water level = 1.38 mbgs, As measured on April 25, 2022

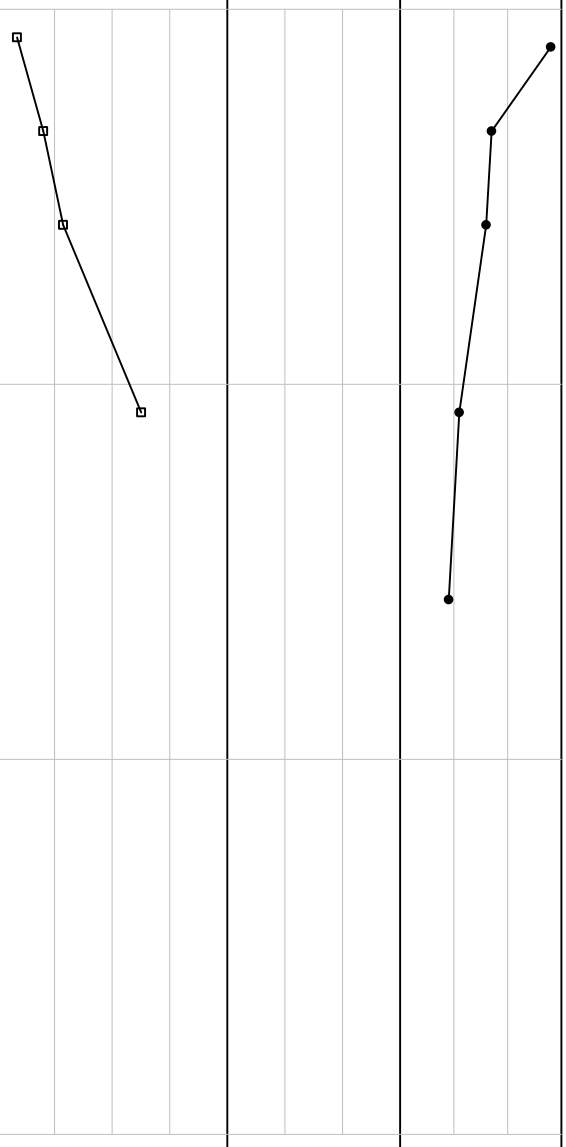
SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	80	7
SS	2	60	16
SS	3	50	23
SS	4	50	50
SS	5	10	>50

Standard Penetration N-Value (20, 40, 60)

Shear Strength kPa (100, 200)

Water Content % (10, 20)



Contractor: TEC **Grade Elevation:** 237.42 masl

Drilling Method: Solid Stem Augers **Top of Casing Elevation:** 238.49 masl

Well Casing Size: 51 mm **Sheet:** 1 of 1

Log of Borehole: BH15

Project #: 308567.001 **Logged By:** KS

Project: Geotechnical Investigation

Client: Prologis

Location: 12519 & 12713 Humber Station Drive, Caledon, Ontario

Drill Date: April 16, 2022 **Project Manager:** SA

SUBSURFACE PROFILE			SAMPLE						
Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (□ 20 40 60 □)	Shear Strength (△ kPa △ 100 200)	Water Content (● % ● 10 20)
0		Ground Surface	234.02								
		Topsoil Dark brown silt, trace sand, with organics - 150 mm	233.26	Bentonite	SS	1	100	11			
1		**Silt** Reddish brown clayey silt, trace sand and gravel, very stiff, APL	232.50		SS	2	100	21			
		brown silt, some clay, trace sand and gravel, compact, moist			SS	3	100	20			
2		Reddish brown		Screen							
3		Greyish brown, dense	230.97		SS	4	100	31			
4				Silica Sand							
5					SS	5	100	32			
				Riser							
6		Grey silt, trace sand, very dense, moist	227.92		SS	6	100	>50			
			227.47								
7		End of Borehole Borehole terminated at 6.6 mbgs.		Water level = 2.0 mbgs, as measured on April 25, 2022							
8											
9											

Contractor: TEC **Grade Elevation:** 234.02 masl

Drilling Method: Solid Stem Augers **Top of Casing Elevation:** 235.12 masl

Well Casing Size: 51 mm **Sheet:** 1 of 1

Log of Borehole: BH18

Project #: 308567.001 **Logged By:** KS

Project: Geotechnical Investigation

Client: Prologis

Location: 12519 & 12713 Humber Station Drive, Caledon, Ontario

Drill Date: April 16, 2022 **Project Manager:** SA

SUBSURFACE PROFILE

Depth (m)	Description	Elevation (m)
0	Ground Surface	232.61
	Topsoil Dark brown silt, trace sand, with organics - 150 mm	231.85
1	**Silt** Reddish brown with some grey mottling clayey silt, firm, WTPL	231.09
	Mottled grey/brownsilt some clay, trace sand and gravel, compact, moist	
2	Silt, some clay, trace sand and gravel	
3	Dense	229.56
4		228.04
	Grey sandy silt, some clay, trace gravel	
5		
6		226.06
	End of Borehole	
7	Borehole terminated at 6.6 mbgs.	
8		
9		

Monitoring Well Details: Bentonite, Riser, Silica sand, Screen

Water level = 1.52 mbgs, As measured on April 25, 2022

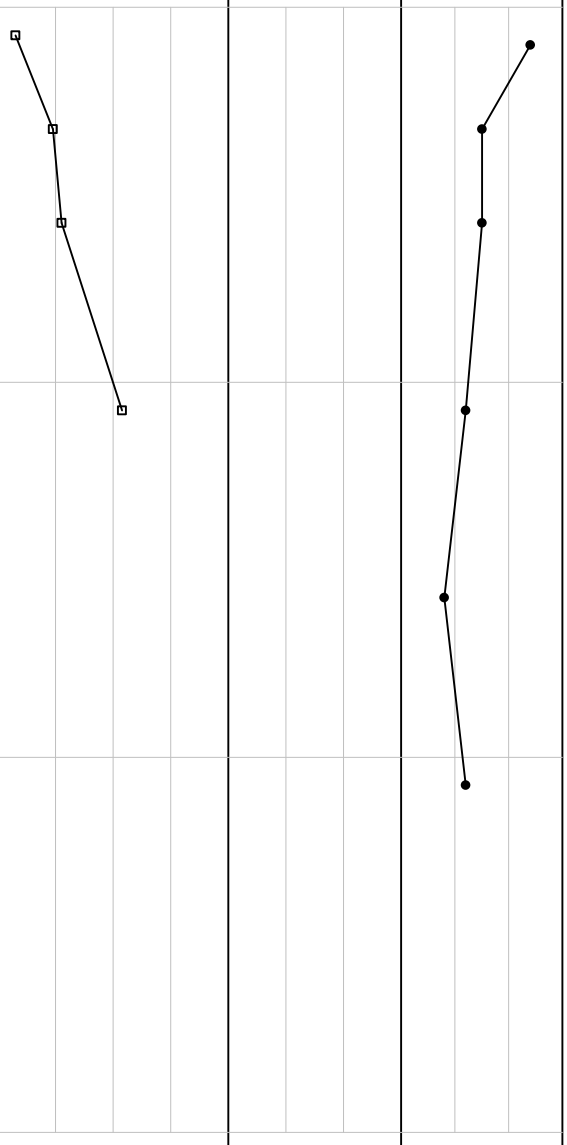
SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	75	6
SS	2	60	19
SS	3	80	22
SS	5	80	43
SS	6	20	>50
SS	7	10	>50

Standard Penetration N-Value (20, 40, 60)

Shear Strength kPa (100, 200)

Water Content % (10, 20)



Contractor: TEC **Grade Elevation:** 232.61 masl

Drilling Method: Solid Stem Augers **Top of Casing Elevation:** 233.66 masl

Well Casing Size: 51 mm **Sheet:** 1 of 1

Log of Borehole: BH103(MW)

Project #: 308567.002 **Logged By:** SL

Project: Geotechnical Investigation for Proposed Industrial Development

Client: Prologis

Location: 12519 & 12713 Humber Station Road, Caledon, Ontario

Drill Date: January 27, 2023 **Project Manager:** JD

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength (kPa) (100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	238.72											
		Topsoil Dark brown silt, trace sand, with organics - 150mm	0.00		SS	1	65	6			20.9			
1		**Silty Clay Till** Brown with some grey mottling silty clay, trace gravel, firm, DTPL	237.20 1.52		SS	2	95	19			14.8			
2		with black staining, trace oxidation, hard	236.44 2.29	Riser	SS	3	85	34			15.9			
		trace gravel and rock, hard, APL		Bentonite	SS	4	80	31			13.4			
3		trace orange oxidation, very stiff, DTPL	235.67 3.05		SS	5	100	27			13.1			
4		Grey	234.15 4.57	Silica Sand	SS	6	100	28			12.8			
5				Screen										
6		**Silty Sand** Grey silty sand, trace gravel, very dense, moist	232.63 6.10		SS	7	100	>50			6.9			
7		End of Borehole												
8		Borehole terminated at approximately 6.4 mbgs.												
9		Water Level Reading Date: May 26, 2023 Water Depth (mbgs): 0.6												
10														

Contractor: Geo-Environmental Drilling Inc.

Grade Elevation: 238.7 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: N/A

Well Casing Size: 51 mm

Sheet: 1 of 1

Log of Borehole: BH108(MW)

Project #: 308567.002 **Logged By:** SL

Project: Geotechnical Investigation for Proposed Industrial Development

Client: Prologis

Location: 12519 & 12713 Humber Station Road, Caledon, Ontario

Drill Date: January 31, 2023 **Project Manager:** JD

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Water Content (%)
0	Ground Surface	236.71					
	Topsoil Dark brown silt, trace sand, with organics - 150mm	0.00	SS	1	55	12	16.4
1	**Silty Clay Till** Brown with some grey mottling silty clay, trace gravel, very stiff, DTPL	235.49 1.22	SS	2	55	16	16.3
2	trace layer of sand		SS	3	75	19	15.4
	with black staining, trace orange oxidation		SS	4	80	16	15.4
3	trace grey mottling	233.66 3.05	SS	5	100	27	17.1
4							
5	trace rock	231.68 5.03	SS	6	100	26	15.1
6	Grey, hard, APL	230.62 6.10	SS	7	100	>50	11.1
	End of Borehole						
7	Borehole terminated at approximately 6.4 mbgs.						
	Water Level Reading Date: May 26, 2023 Water Depth (mbgs): 0.7						
8							
9							
10							

Monitoring Well Details: Riser, Bentonite, Silica Sand, Screen

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa, 100, 200

Sample ID | Soil Vapour Concentration (ppm) | Laboratory Analysis

Contractor: Geo-Environmental Drilling Inc.

Grade Elevation: 236.7 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: N/A

Well Casing Size: 51 mm

Sheet: 1 of 1

Log of Borehole: BH123

Project #: 308567.002 **Logged By:** SL

Project: Geotechnical Investigation for Proposed Industrial Development

Client: Prologis

Location: 12519 & 12713 Humber Station Road, Caledon, Ontario

Drill Date: January 20, 2023 **Project Manager:** JD

SUBSURFACE PROFILE					SAMPLE										
Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength (kPa, 100, 200)	Water Content (%)	Sample ID	Soil Vapour Concentration (ppm)	Laboratory Analysis
0		Ground Surface	238.09	No Monitoring Well Installed										
		Topsoil Dark brown silt, trace sand, with organics - 150mm	0.00 / 237.33		SS	1	50	7			19.2			
1		**Silty Clay Till** Brown silty clay with sand, trace gravel, firm, DTPL	0.76 / 236.57		SS	2	80	20			19.5			
2		with some grey mottling and black staining, trace orange oxidation, very stiff	1.52 / 235.80		SS	3	90	40			13.4			
		hard	2.29 / 235.04		SS	4	75	44			12.4			
3		trace black crystal Grey	3.05 / 234.43		SS	5	75	31			12.9			
		End of Borehole	3.66											
4		Borehole terminated at approximately 3.7 mbgs. At drilling completion, the borehole was open and dry.												
5														
6														
7														
8														
9														
10														

Contractor: Geo-Environmental Drilling Inc. **Grade Elevation:** 238.1 masl

Drilling Method: Split Spoon / Hollow Stem Auger **Top of Casing Elevation:** N/A

Well Casing Size: N/A **Sheet:** 1 of 1

Log of Borehole: BH124

Project #: 308567.002 **Logged By:** SL

Project: Geotechnical Investigation for Proposed Industrial Development

Client: Prologis

Location: 12519 & 12713 Humber Station Road, Caledon, Ontario

Drill Date: January 20, 2023 **Project Manager:** JD

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Water Content (%)
0	Ground Surface	239.14					
	Topsoil Dark brown silt, trace sand, with organics - 150mm	0.00 / 238.38	SS	1	50	7	23.5
1	**Silty Clay Till** Brown silty clay with sand, trace gravel, firm, DTPL	0.76 / 237.62	SS	2	75	24	16.6
2	with some grey mottling, trace rock, trace orange oxidation, very stiff	1.52 / 236.86	SS	3	100	28	16.0
	with black staining	2.29	SS	4	100	37	13.1
3	hard		SS	5	100	57	15.1
4		234.57					
	Sand Grey sand, trace silt, dense, moist	4.57	SS	6	15	40	12.7
5							
6		233.05					
	Sandy Silt Grey sandy silt, very dense, moist	6.10	SS	7	100	>50	6.3
7	End of Borehole						
8	Borehole terminated at approximately 6.4 mbgs.						
9	Water Level Reading Date: May 26, 2023 — Water Depth (mbgs): 1.5						
10							

Monitoring Well Details: Riser, Bentonite, Silica Sand, Screen

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa, 100, 200

Sample ID

Soil Vapour Concentration (ppm)

Laboratory Analysis

Contractor: Geo-Environmental Drilling Inc.

Grade Elevation: 239.1 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: N/A

Well Casing Size: 51 mm

Sheet: 1 of 1

Log of Borehole: BH160(MW)

Project #: 308567.002 **Logged By:** SL

Project: Geotechnical Investigation for Proposed Industrial Development

Client: Prologis

Location: 12519 & 12713 Humber Station Road, Caledon, Ontario

Drill Date: February 8, 2023 **Project Manager:** JD

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Water Content (%)
0	Ground Surface	234.19					
	Topsoil Dark brown silt, trace sand, with organics - 255mm	0.00 / 233.43	SS	1	50	4	20.2
1	**Silty Clay Till** Brown silty clay, some sand, soft, APL	0.76 / 232.67	SS	2	65	19	12.4
	trace gravel, very stiff	1.52 / 231.91	SS	3	80	28	13.3
2	with some grey mottling and black staining, trace orange oxidation						
	layer of sand	2.29 / 231.15	SS	4	100	28	12.0
3	hard	3.05	SS	5	100	40	9.8
4		229.62					
	Sandy Silt Grey sandy silt, trace gravel, very dense, moist	4.57	SS	6	75	>50	6.7
5							
6		228.10					
	Silt Grey silt, trace sand, very dense, moist	6.10	SS	7	100	>50	12.2
7	End of Borehole						
8	Borehole terminated at approximately 6.4 mbgs.						
9	Water Level Reading Date: May 26, 2023 — Water Depth (mbgs): 1.0						
10							

Monitoring Well Details: Riser; Bentonite; Silica Sand; Screen

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa, 100, 200

Sample ID | Soil Vapour Concentration (ppm) | Laboratory Analysis

Contractor: Geo-Environmental Drilling Inc.

Grade Elevation: 234.2 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: N/A

Well Casing Size: 51 mm

Sheet: 1 of 1

Log of Borehole: BH161(MW)

Project #: 308567.002 **Logged By:** SL

Project: Geotechnical Investigation for Proposed Industrial Development

Client: Prologis

Location: 12519 & 12713 Humber Station Road, Caledon, Ontario

Drill Date: February 8, 2023 **Project Manager:** JD

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Water Content (%)
0	Ground Surface	232.78					
	Topsoil Dark brown silt, trace sand, with organics - 255mm	0.00 / 232.02	SS	1	60	6	15.4
1	**Silty Clay Till** Brown silty clay, firm, APL	0.76 / 231.26	SS	2	80	17	15.1
	with some grey mottling, trace gravel, very stiff	1.52 / 230.50	SS	3	75	28	12.3
2	with black staining, trace orange oxidation	2.29	SS	4	40	31	11.4
	Brown, hard, DTPL	229.28	SS	5	65	49	9.3
3	trace rock	3.51 / 228.21					
4	Grey, very stiff	4.57	SS	6	70	20	8.4
5		226.69					
6	hard	6.10 / 226.08	SS	7	100	31	17.8
7	End of Borehole	6.71					

Monitoring Well Details: Riser, Bentonite, Silica Sand, Screen

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa, 100, 200

Sample ID | Soil Vapour Concentration (ppm) | Laboratory Analysis

Borehole terminated at approximately 6.7 mbgs.

Water Level Reading

Date	Water Depth (mbgs)
May 26, 2023	0.6

Contractor: Geo-Environmental Drilling Inc.

Grade Elevation: 232.8 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: N/A

Well Casing Size: 51 mm

Sheet: 1 of 1

Log of Borehole: BH168(MW)

Project #: 308567.002 **Logged By:** SL

Project: Geotechnical Investigation for Proposed Industrial Development

Client: Prologis

Location: 12519 & 12713 Humber Station Road, Caledon, Ontario

Drill Date: February 2, 2023 **Project Manager:** JD

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Water Content (%)
0	Ground Surface	231.95					
	Topsoil Dark brown silt, trace sand, with organics - 150mm	0.00	SS	1	50	5	17.2
1	**Silty Clay Till** Brown with some grey mottling silty clay with sand, trace gravel, firm, APL	230.43 1.52	SS	2	50	19	14.8
2	with black staining, trace orange oxidation, very stiff	229.67 2.29	SS	3	65	24	12.3
	Brown		SS	4	100	26	14.0
3	Grey	228.91 3.05	SS	5	65	27	13.4
4							
5			SS	6	65	24	15.4
6	No recovery	225.86 6.10	SS	7	0	47	N/A
		225.25 6.71					
7	End of Borehole						
	Borehole terminated at approximately 6.7 mbgs.						
8	Water Level Reading Date Water Depth (mbgs) May 26, 2023 0.8						
9							
10							

Monitoring Well Details: Riser, Bentonite, Silica Sand, Screen

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa 100 200

Sample ID | Soil Vapour Concentration (ppm) | Laboratory Analysis

Contractor: Geo-Environmental Drilling Inc.

Grade Elevation: 232.0 masl

Drilling Method: Split Spoon / Hollow Stem Auger

Top of Casing Elevation: N/A

Well Casing Size: 51 mm

Sheet: 1 of 1

JOB NO.: 1707-S200

LOG OF BOREHOLE NO.: MW3-17

FIGURE NO.: 4

PROJECT DESCRIPTION: Monitoring Wells Installation

METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: East side of Humber Station Road, south of Healey Road
Town of Caledon

DRILLING DATE: August 17, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
235.5	Ground Surface							
0.0	**20 cm TOPSOIL**	1A			0			
	Brown, firm to hard	1B	DO	5			15	
					1		13	
	weathered	2	AS	21				
	SILTY CLAY TILL						12	
		3	DO	32	2			
	some sand to sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	53			9	
	boulder	5	DO	55/15	3		10	
232.0								
3.5	Grey, very dense							
		6	DO	50/8	4		10	
	SILT							
		7	DO	50/15	5		11	
	some clay, a trace of sand occ. clay layers							
		8	DO	50/15			14	
229.1					6			
6.4	**END OF BOREHOLE**	9	DO	70/15			14	
	Installed 50 mm Ø monitoring well to 6.0 m completed with 3.0 m screen Sand backfill from 2.4 m to 6.0 m Bentonite seal from 0.0 m to 2.4 m Provided with a protective steel monument casing				7			
					8			
					9			
					10			
					11			
					12			
					13			
					14			
					15			

Dry on completion

JOB NO.: 1707-S200

LOG OF BOREHOLE NO.: MW4-17D

FIGURE NO.: 5

PROJECT DESCRIPTION: Monitoring Wells Installation

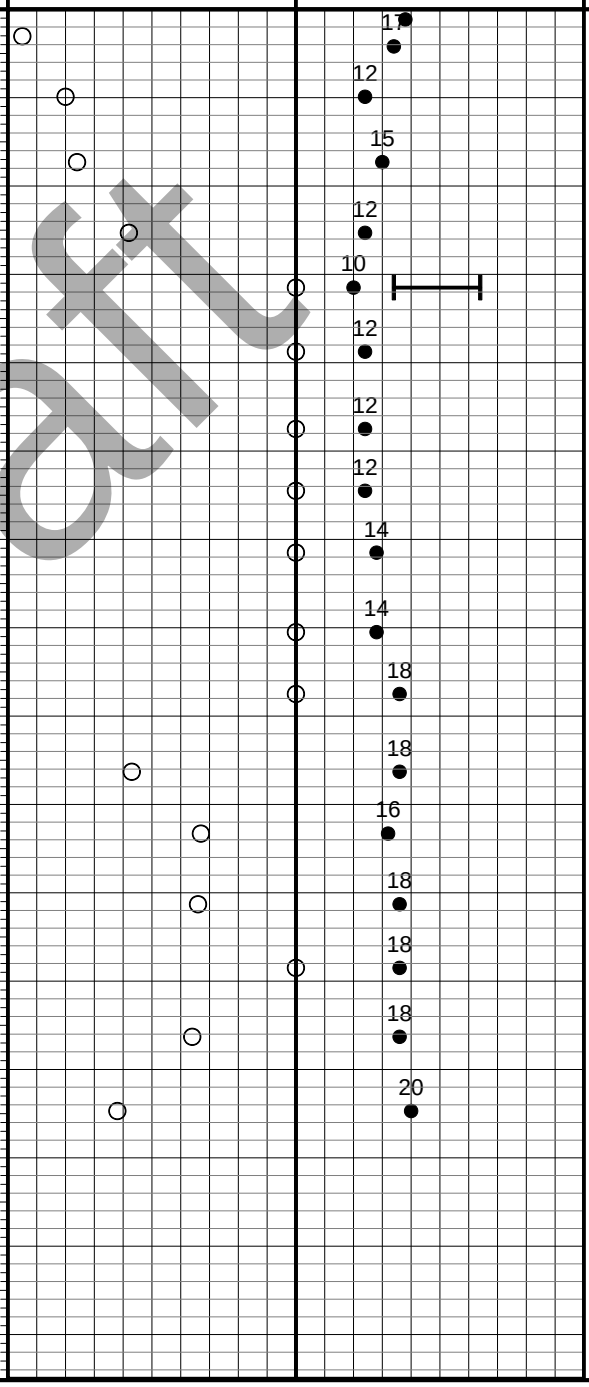
METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: East side of Humber Station Road, south of Healey Road
Town of Caledon

DRILLING DATE: August 16, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
234.8	Ground Surface			
0.0	**23 cm TOPSOIL**	1A	DO	5
	Brown, firm to hard	1B	AS	
	weathered	2	DO	20
	SILTY CLAY TILL	3	DO	24
	some sand to sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	4	DO	42
		5	DO	50/15
231.2				
3.6	Grey, dense to very dense	6	DO	50/15
	brown grey	7	DO	50/15
		8	DO	55/15
		9	DO	60/15
	SILT	10	DO	58/15
		11	DO	50/15
		12	DO	43
	some clay, a trace of sand occ. clay layers	13	DO	67
		14	DO	66
		15	DO	50/15
		16	DO	64
222.1		17	DO	38
12.7	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 12.2 m
completed with 3.0 m screen with filter sock
Sand backfill from 8.5 m to 12.2 m
Bentonite seal from 0.0 m to 8.5 m
Provided with a protective steel monument casing



WATER LEVEL

Dry on completion
W.L. @ El. 233.7 m on August 17, 2017

Soil Engineers Ltd.

JOB NO.: 1707-S200

LOG OF BOREHOLE NO.: MW4-17S

FIGURE NO.: 6

PROJECT DESCRIPTION: Monitoring Wells Installation

METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: East side of Humber Station Road, south of Healey Road
Town of Caledon

DRILLING DATE: August 16, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
234.8	Ground Surface							
0.0	**23 cm TOPSOIL**				0			
	Brown							
	weathered				1			
	SILTY CLAY TILL							
	some sand to sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders				2			
231.2					3			
3.6	Grey							
	brown grey				4			
	SILT							
	some clay, a trace of sand occ. clay layers				5			
228.8								
6.0	**END OF AUGER HOLE**				6			
	Installed 50 mm Ø monitoring well to 6.0 m completed with 3.0 m screen Sand backfill from 2.4 m to 6.0 m Bentonite seal from 0.0 m to 2.4 m Provided with a protective steel monument casing				7			
					8			
					9			
					10			
					11			
					12			
					13			
					14			
					15			

Dry on completion
W.L. @ El. 233.6 m on August 17, 2017

R.J. Burnside & Associates Limited
15 Townline, Orangeville, Ontario L9W 3R4
telephone (519) 941-5331 fax (519) 941-8120

LOG OF DRILLING OPERATIONS

MW8

Client: **Solmar Development Corp.**	Project Name: **Hydrogeological Investigation**	Logged by: **S. Goemans**
Project No.: **PTA 11575**	Location: **Caledon, Ontario**	Ground (m amsl): **231.94**
Drilling Co.: **Lantech Drilling Services Inc.**	Date Started: **11/2/2006**	Static Water Level (m amsl): **231.460**
Drilling Method: **Hollow Stem Auger**	Date Completed: **11/6/2006**	Sand Pack (m amsl): **229.81 - 225.98**

Depth Scale (ft)	Depth Scale (m)	Stratigraphic Description (Surface Elevation (m): **231.94**)	Strat. Plot	Depth (m)		SAMPLE Num.	Type	Int.	%Recov.	Depth Scale (ft)	Depth Scale (m)
		Dark brown TOPSOIL, moist. SS-1 (2, 3, 4, 4)		0.20		1	SS		100		
	1.0	Yellow-brown and grey sandy SILT TILL, with pebbles and stones. Pockets of sand. Many fractures, grey along fractures, iron staining. Damp. SS-2 (8, 13, 18, 23)			bentonite seal	2	SS		100		1.0
5.0				1.52						5.0	
	2.0	Yellow brown and grey silty CLAY TILL, some pebbles and sand pockets. Dark brown iron oxidation halos, fractures, moist. SS-3 (8, 13, 15, 18)				3	SS		90		2.0
		Yellow brown sandy SILT TILL, lots of pebbles, pockets of sand. Vertical fractures, iron staining on fractures, moist. SS-4 (11, 16, 32, 53)		2.29		4	SS		100		
10.0	3.0				silica sand pack					10.0	3.0
				3.35		5	SS		70		
		Silty SAND lense. Wet.		3.42							
	4.0	Yellow brown sandy SILT TILL, lots of pebbles, pockets of sand. Vertical fractures with iron staining, moist. SS-5 (35, 33, 50+), SS-6 (42, 100 +)				6	SS		80		4.0
15.0				4.57						15.0	
	5.0	Grey CLAY, compact, parts along bedding planes. Moist. SS-7 (24, 75)				7	SS		100		5.0
				5.18	5.08						

Prepared By: **S. Goemans** Checked By: **D. Gevaert** Date Prepared: **11/13/2006**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
- Water found @ time of drilling
- Static Water Level - 1/11/2007

MONITORING WELL DATA
- Pipe: **51 mm dia. PVC**
- Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

R.J. Burnside & Associates Limited
15 Townline, Orangeville, Ontario L9W 3R4
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LOG OF DRILLING OPERATIONS

MW9

Client: **Solmar Development Corp.**	Project Name: **Hydrogeological Investigation**	Logged by: **S. Goemans**
Project No.: **PTA 11575**	Location: **Caledon, Ontario**	Ground (m amsl): **235.69**
Drilling Co.: **Lantech Drilling Services Inc.**	Date Started: **11/6/2006**	Static Water Level (m amsl): **234.22**
Drilling Method: **Hollow Stem Auger**	Date Completed: **11/6/2006**	Sand Pack (m amsl): **232.53 - 229.46**

Depth Scale (ft)	Depth Scale (m)	Stratigraphic Description (Surface Elevation (m): **235.69**)	Strat. Plot	Depth (m)		SAMPLE Num.	Type	Int.	%Recov.	Depth Scale (ft)	Depth Scale (m)
		Dark brown TOPSOIL, moist. SS-1 (3, 3, 3, 8)		0.15		1	SS		40		
	1.0	Grey brown silty CLAY TILL, with pebbles and pockets of sand. Vertical fractures, iron staining, moist. SS-2 (6, 12, 18, 22)				2	SS		100		1.0
		SS-3 (6, 12, 23, 29)									
5.0		SS-4 (9, 22, 32, 40)			bentonite seal	3	SS		100	5.0	
	2.0	SS-5 (7, 19, 41, 50)									2.0
						4	SS		100		
10.0	3.0					5	SS		100	10.0	3.0
					silica sand pack						
	4.0	Brown silty SAND, coarse to medium sand, some gravel. Wet. SS-6 (30, 97)		3.81		6	SS		100		4.0
15.0		SS-7 (2, 7, 30, 40)				7	SS		100	15.0	
	5.0	Brown medium sand and gravel. Saturated. SS-8 (7, 18, 50)		5.18	5.45						5.0
		Grey CLAY, uniform, wet.		5.56		8	SS		100		
				5.86							

Prepared By: **S. Goemans** Checked By: **D. Gevaert** Date Prepared: **11/13/2006**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
- Water found @ time of drilling
- Static Water Level - 1/11/2007

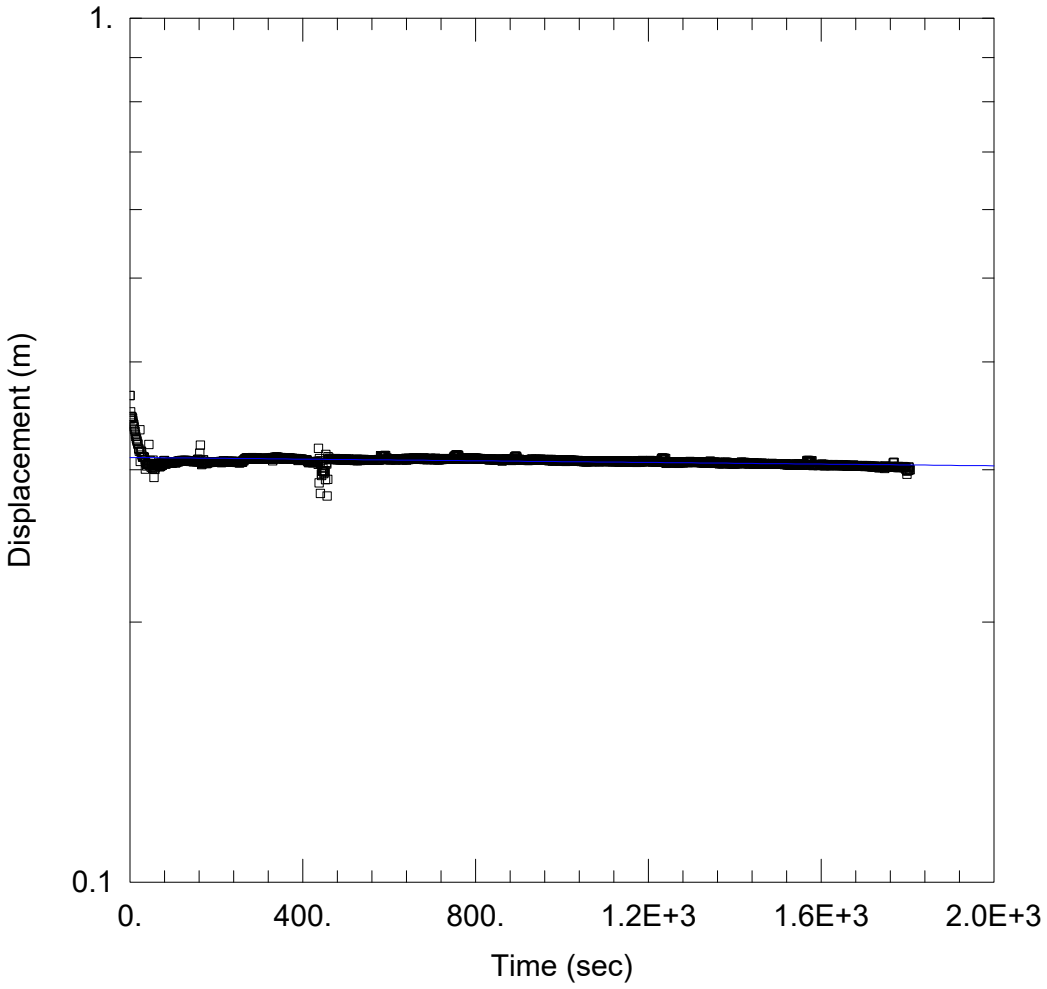
MONITORING WELL DATA
- Pipe: **51 mm dia. PVC**
- Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE
- AC Auger Cutting
- CS Continuous
- RC Rock Core
- SS Split Spoon
- AR Air Rotary
- WC Wash Cuttings

Appendix C

Single Well Response Tests

(Palmer 2022)



WELL TEST ANALYSIS

Data Set: G:\...\BH12_selfconfing.aqt
Date: 11/27/22 Time: 12:59:13

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: BH12
Test Date: Nov 21, 2022

AQUIFER DATA

Saturated Thickness: 6.16 m Anisotropy Ratio (Kz/Kr): 0.1

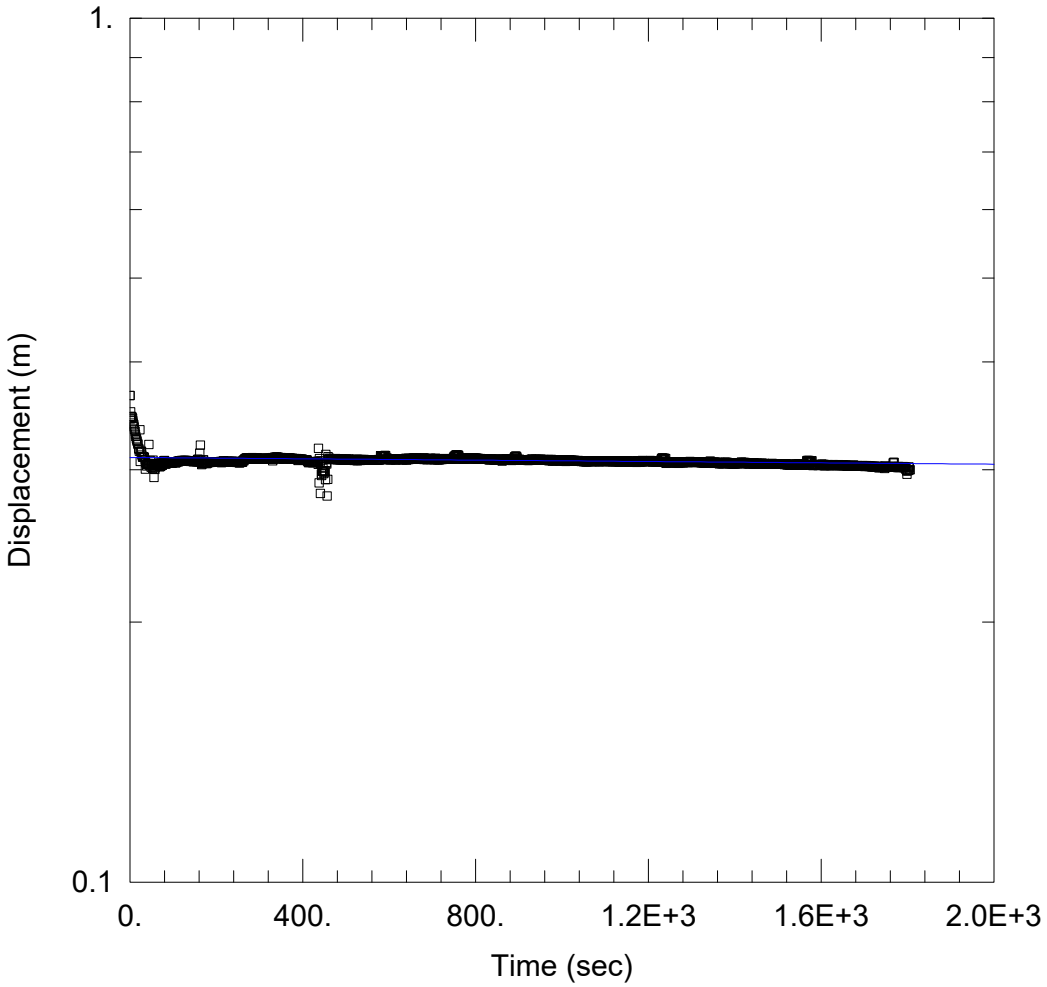
WELL DATA (BH12)

Initial Displacement: 0.3656 m
Total Well Penetration Depth: 5.56 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.16 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 5.706E-9 m/sec y0 = 0.3101 m



WELL TEST ANALYSIS

Data Set: G:\...\BH12_selfconfing.aqt
Date: 11/30/22 Time: 17:16:10

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: BH12
Test Date: Nov 21, 2022

AQUIFER DATA

Saturated Thickness: 6.16 m Anisotropy Ratio (Kz/Kr): 0.1

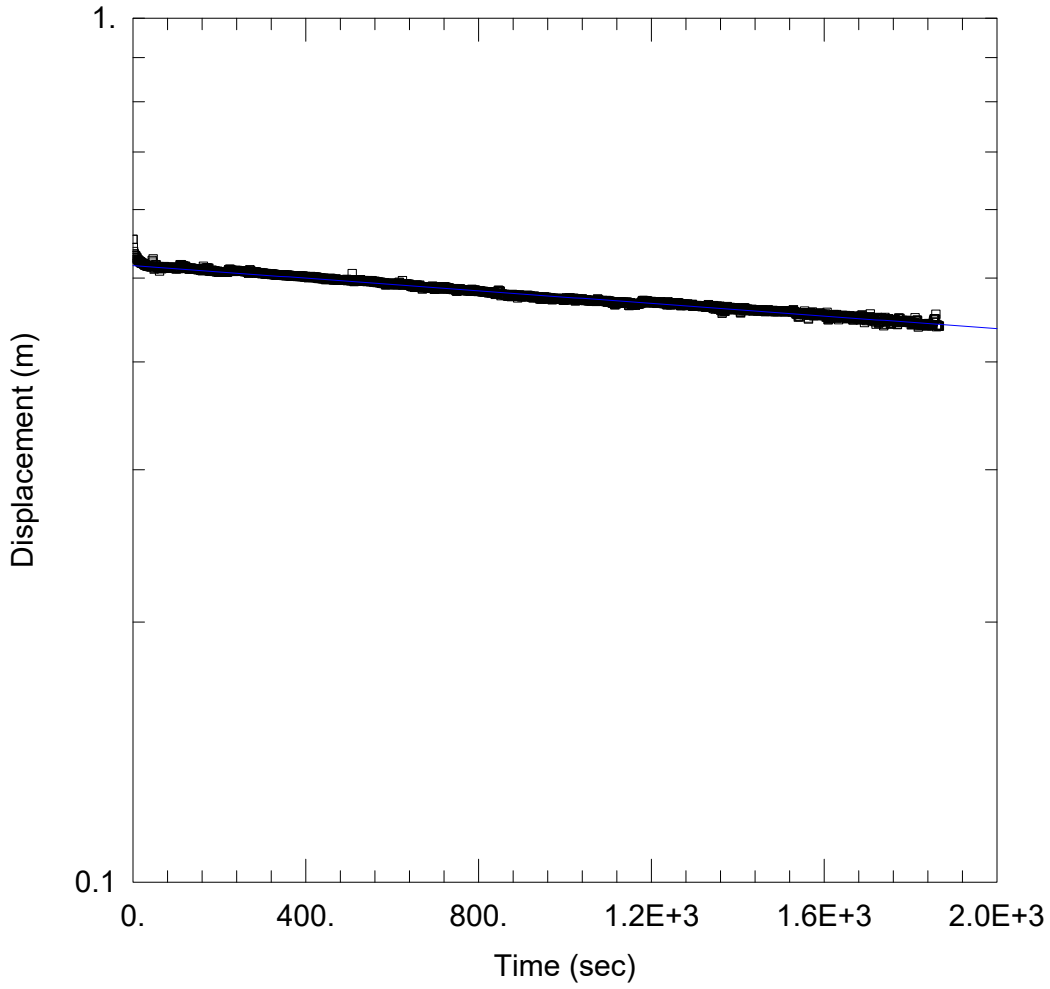
WELL DATA (BH12)

Initial Displacement: 0.3656 m
Total Well Penetration Depth: 5.66 m
Casing Radius: 0.0254 m
Static Water Column Height: 6.16 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 5.706E-9 m/sec y0 = 0.3101 m



WELL TEST ANALYSIS

Data Set: G:\...\BH15_selfconfining.aqt
Date: 11/30/22 Time: 17:29:11

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: BH15
Test Date: Nov 21, 2022

AQUIFER DATA

Saturated Thickness: 3.77 m Anisotropy Ratio (Kz/Kr): 0.1

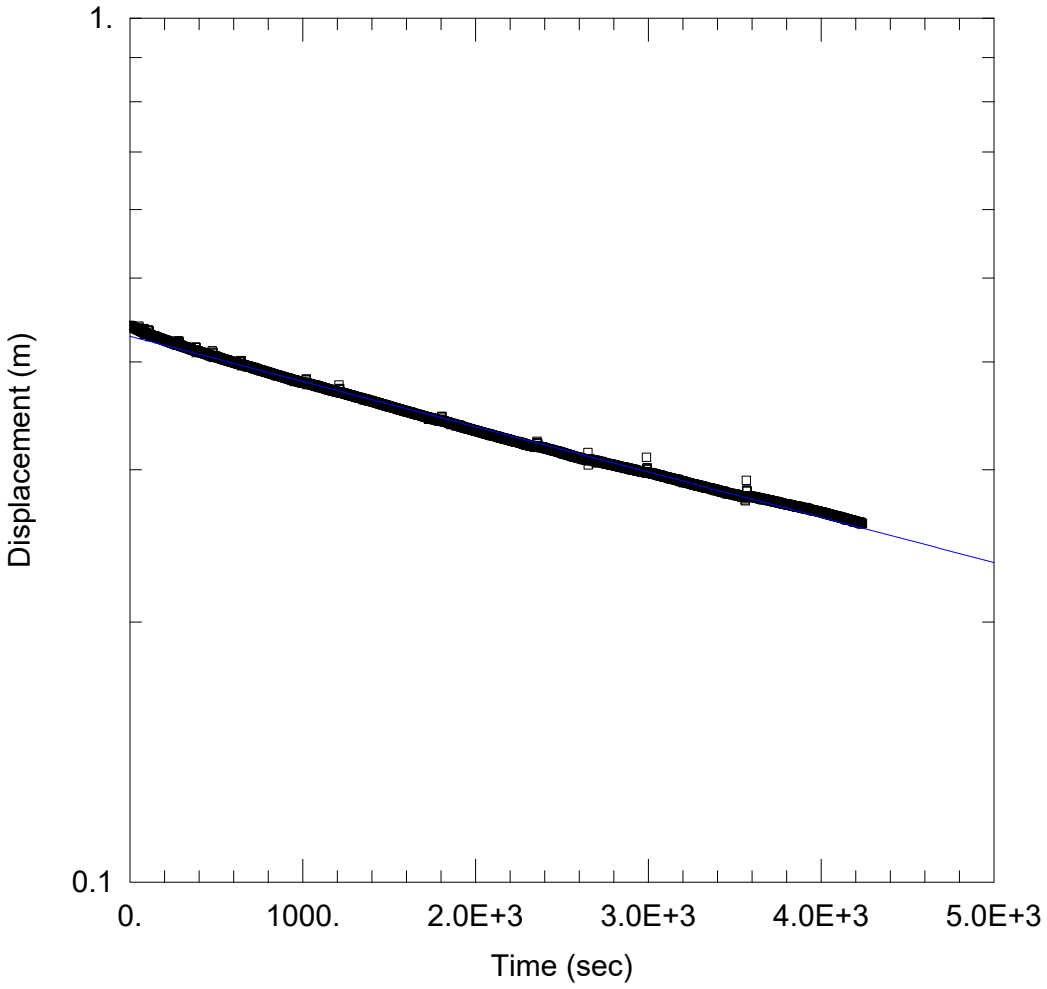
WELL DATA (bh15)

Initial Displacement: 0.5545 m
Total Well Penetration Depth: 3.41 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.41 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 5.353E-8 m/sec y0 = 0.517 m



WELL TEST ANALYSIS

Data Set: G:\...\BH18_Self Confining.aqt
Date: 11/30/22 Time: 14:59:34

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Date: Nov 29, 2022

AQUIFER DATA

Saturated Thickness: 4.78 m Anisotropy Ratio (Kz/Kr): 0.1

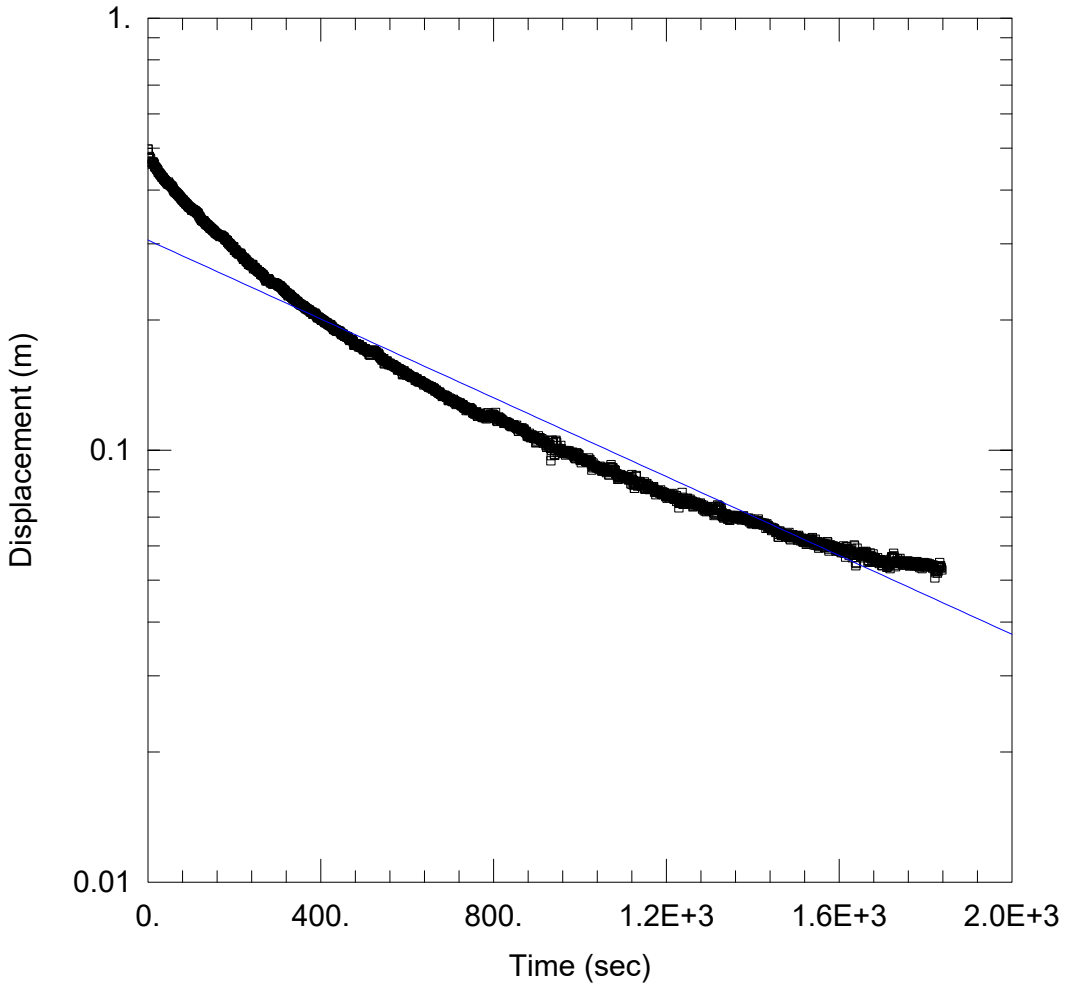
WELL DATA (BH18)

Initial Displacement: 0.4408 m
Total Well Penetration Depth: 4.52 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.52 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 7.683E-8 m/sec y0 = 0.4283 m



WELL TEST ANALYSIS

Data Set: G:\...\BH9_self-confing.aqt
Date: 11/30/22 Time: 17:00:09

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: BH9
Test Date: Nov 21, 2022

AQUIFER DATA

Saturated Thickness: 4.44 m Anisotropy Ratio (Kz/Kr): 0.1

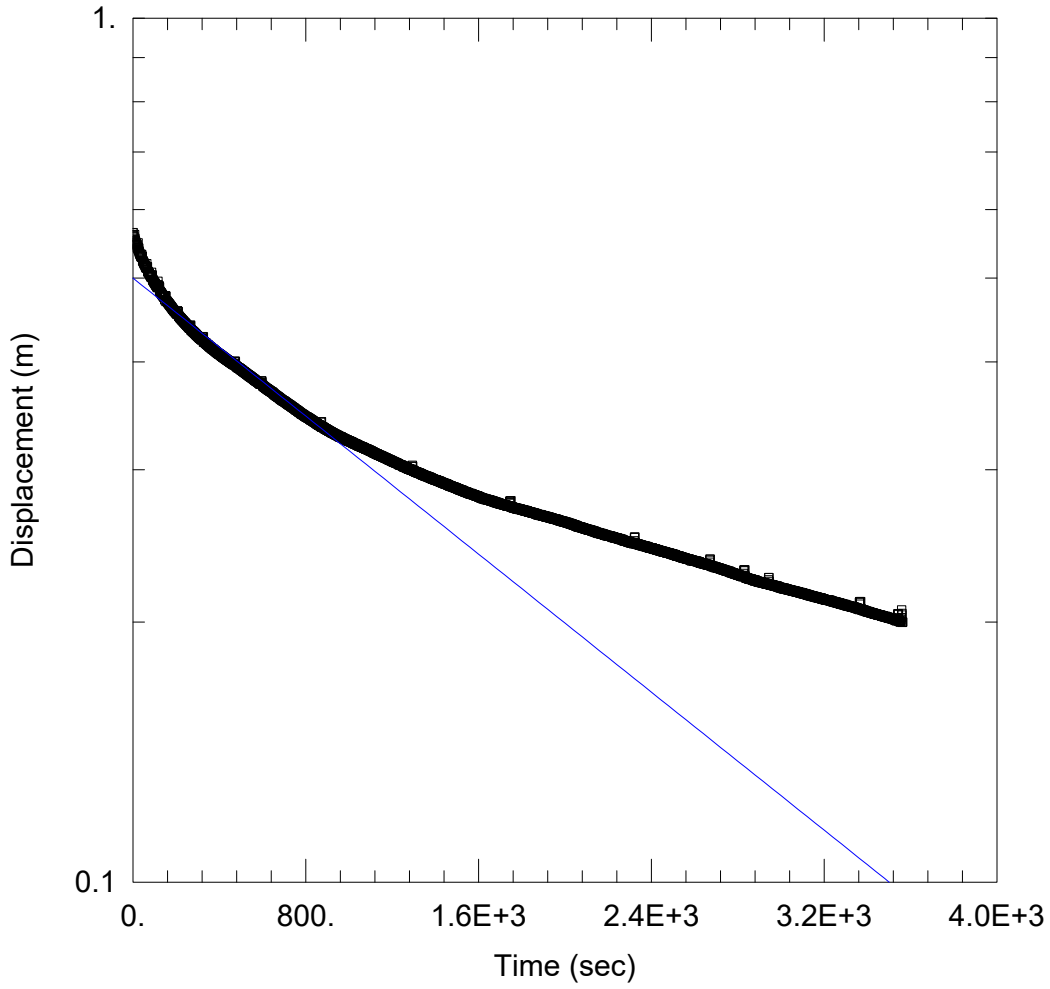
WELL DATA (BH9)

Initial Displacement: 0.4972 m
Total Well Penetration Depth: 3.96 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.96 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 6.692E-7 m/sec y0 = 0.3063 m



WELL TEST ANALYSIS

Data Set: G:\...\MW14-D_Confined_Beginning.aqt
Date: 11/30/22 Time: 20:17:41

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: MW4-17D
Test Date: Nov 29, 2022

AQUIFER DATA

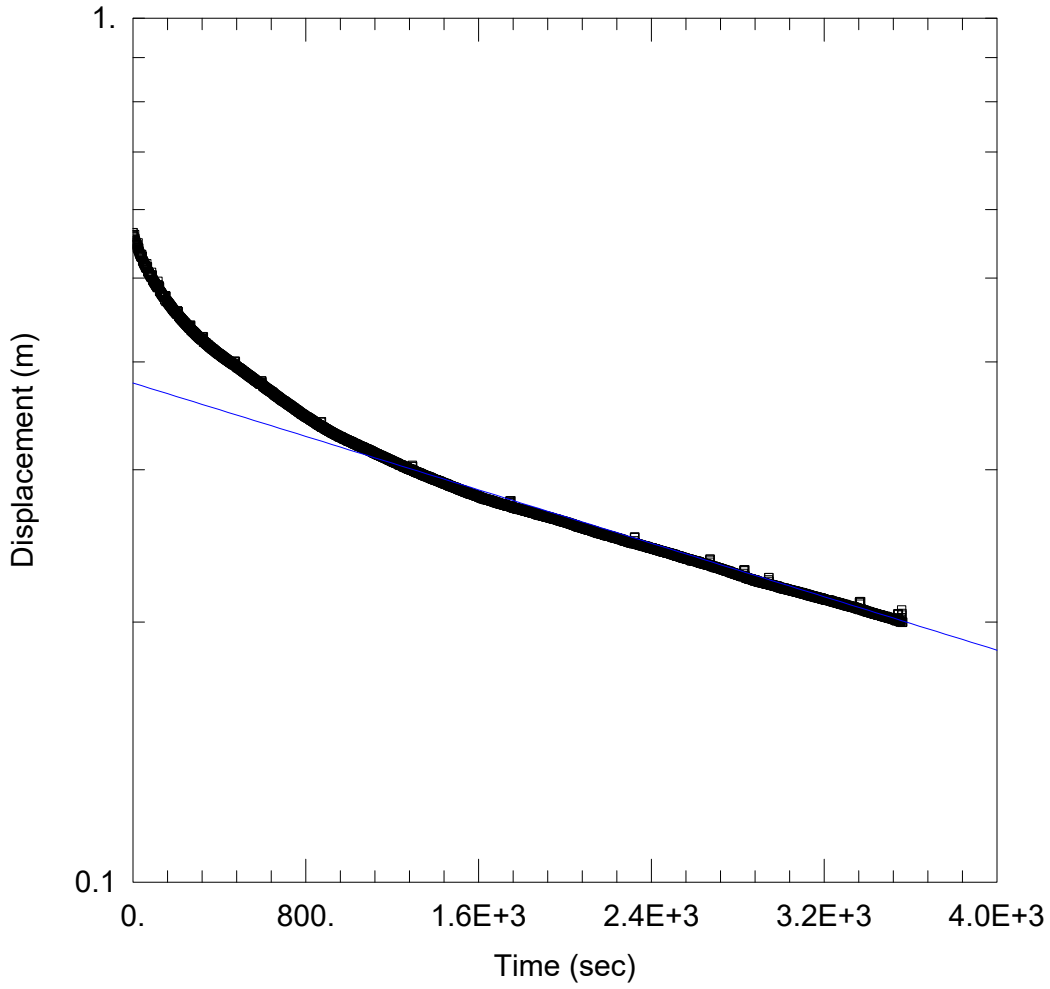
Saturated Thickness: 9.1 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW14-D)

Initial Displacement: 0.5646 m
Total Well Penetration Depth: 8.62 m
Casing Radius: 0.0254 m
Static Water Column Height: 10.1 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev
K = 2.928E-7 m/sec y0 = 0.5001 m



WELL TEST ANALYSIS

Data Set: G:\...\MW14-D_Confined_End.aqt
Date: 11/30/22 Time: 20:19:14

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: MW4-17D
Test Date: Nov 29, 2022

AQUIFER DATA

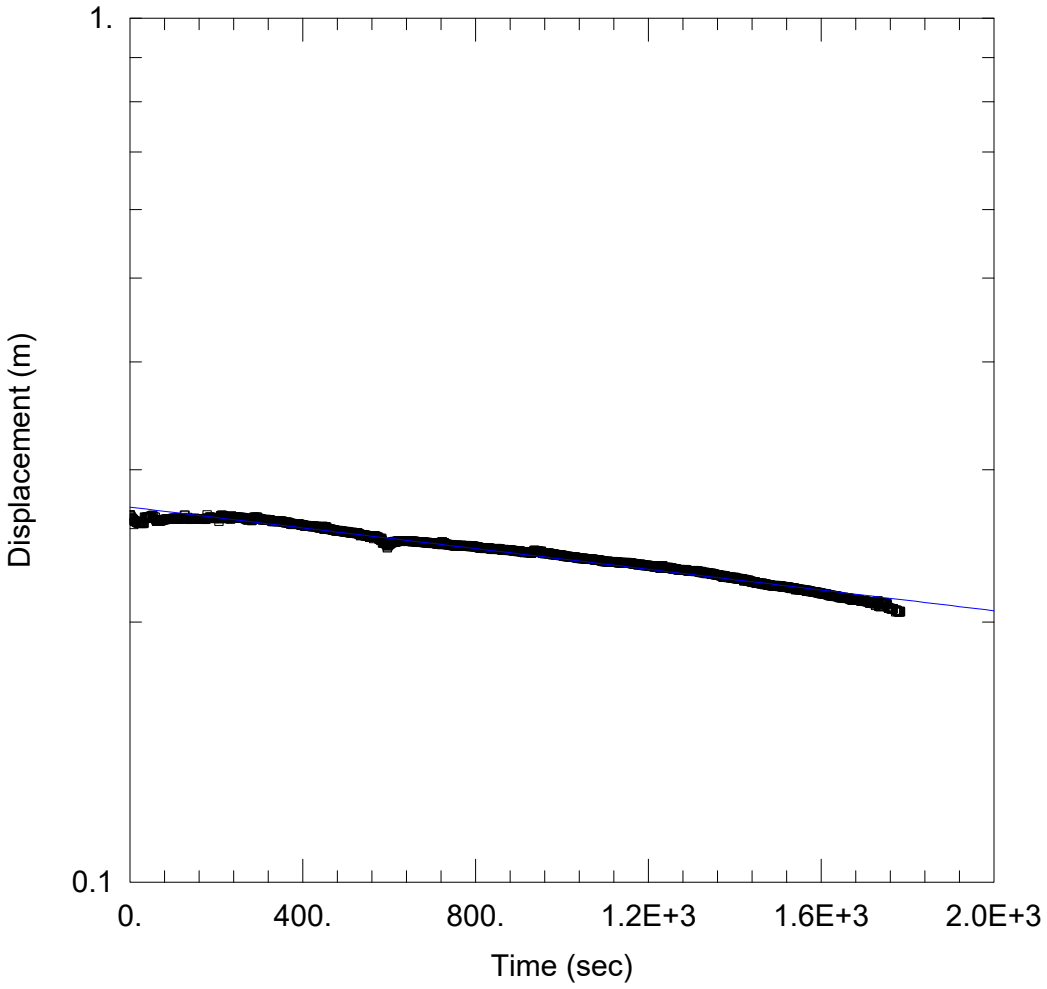
Saturated Thickness: 9.1 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW14-D)

Initial Displacement: 0.5646 m
Total Well Penetration Depth: 8.62 m
Casing Radius: 0.0254 m
Static Water Column Height: 10.1 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev
K = 1.134E-7 m/sec y0 = 0.3781 m



WELL TEST ANALYSIS

Data Set: G:\...\MW3-17_selfconfined.aqt
Date: 11/27/22 Time: 14:27:04

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: MW3-17
Test Date: Nov 21, 2022

AQUIFER DATA

Saturated Thickness: 5.99 m Anisotropy Ratio (Kz/Kr): 0.1

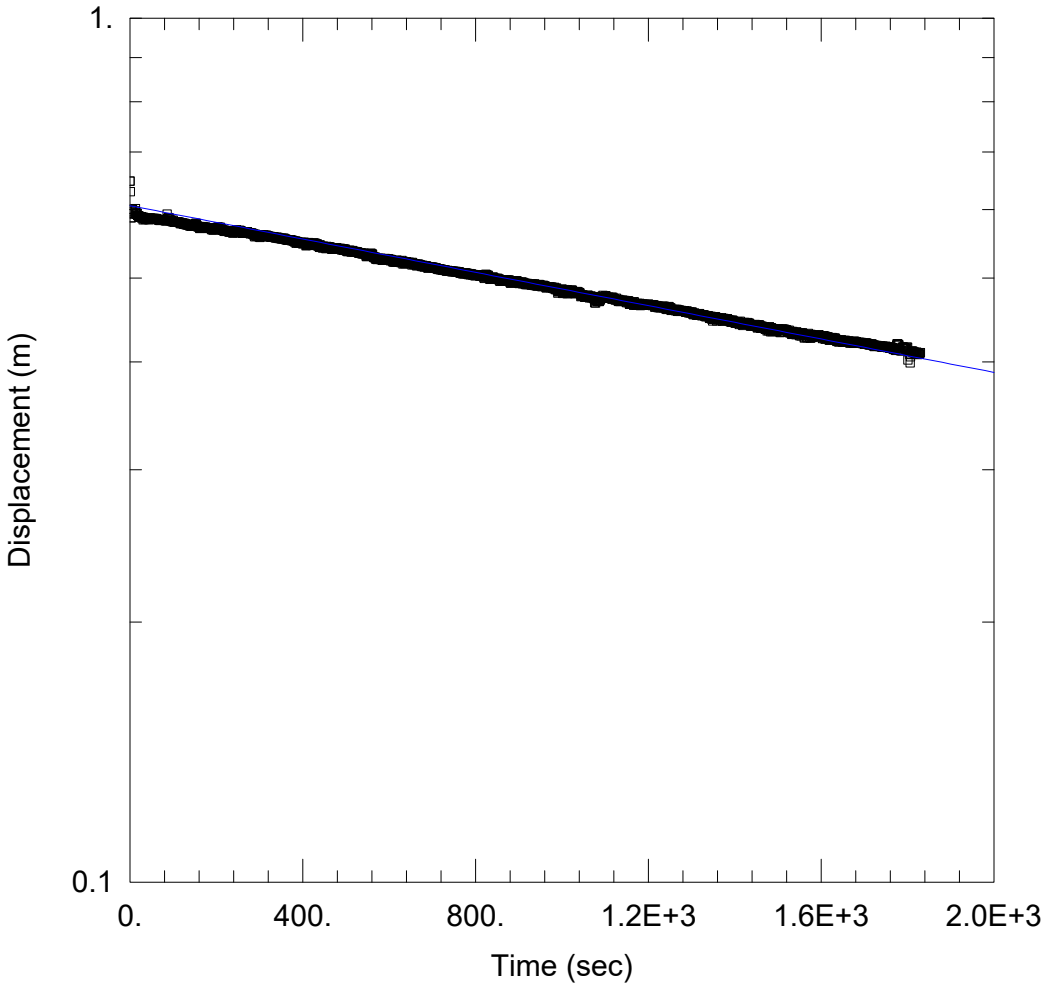
WELL DATA (MW3-17)

Initial Displacement: 0.266 m
Total Well Penetration Depth: 5.59 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.5 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 7.175E-8 m/sec y0 = 0.2716 m



WELL TEST ANALYSIS

Data Set: G:\...\MW4-17S_Selfconfining_Nov29.aqt
Date: 11/30/22 Time: 17:34:17

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: MW4-17S
Test Date: Nov 21, 2022

AQUIFER DATA

Saturated Thickness: 4. m Anisotropy Ratio (Kz/Kr): 0.1

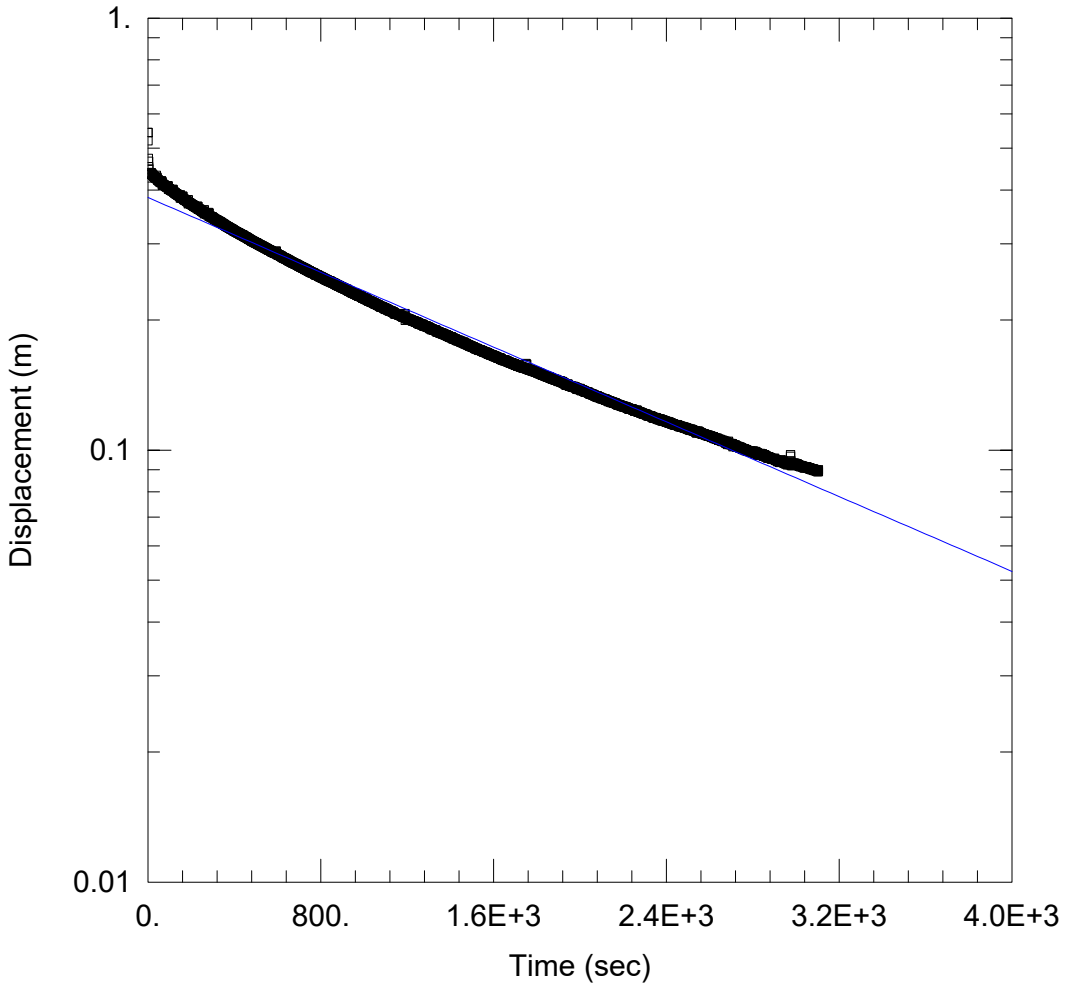
WELL DATA (MW4-17S)

Initial Displacement: 0.6475 m
Total Well Penetration Depth: 3.85 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.85 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 1.414E-7 m/sec y0 = 0.6065 m



WELL TEST ANALYSIS

Data Set: G:\...\MW8_self_confing.aqt
Date: 11/30/22 Time: 15:41:35

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Date: Nov 29, 2022

AQUIFER DATA

Saturated Thickness: 3.41 m Anisotropy Ratio (Kz/Kr): 0.1

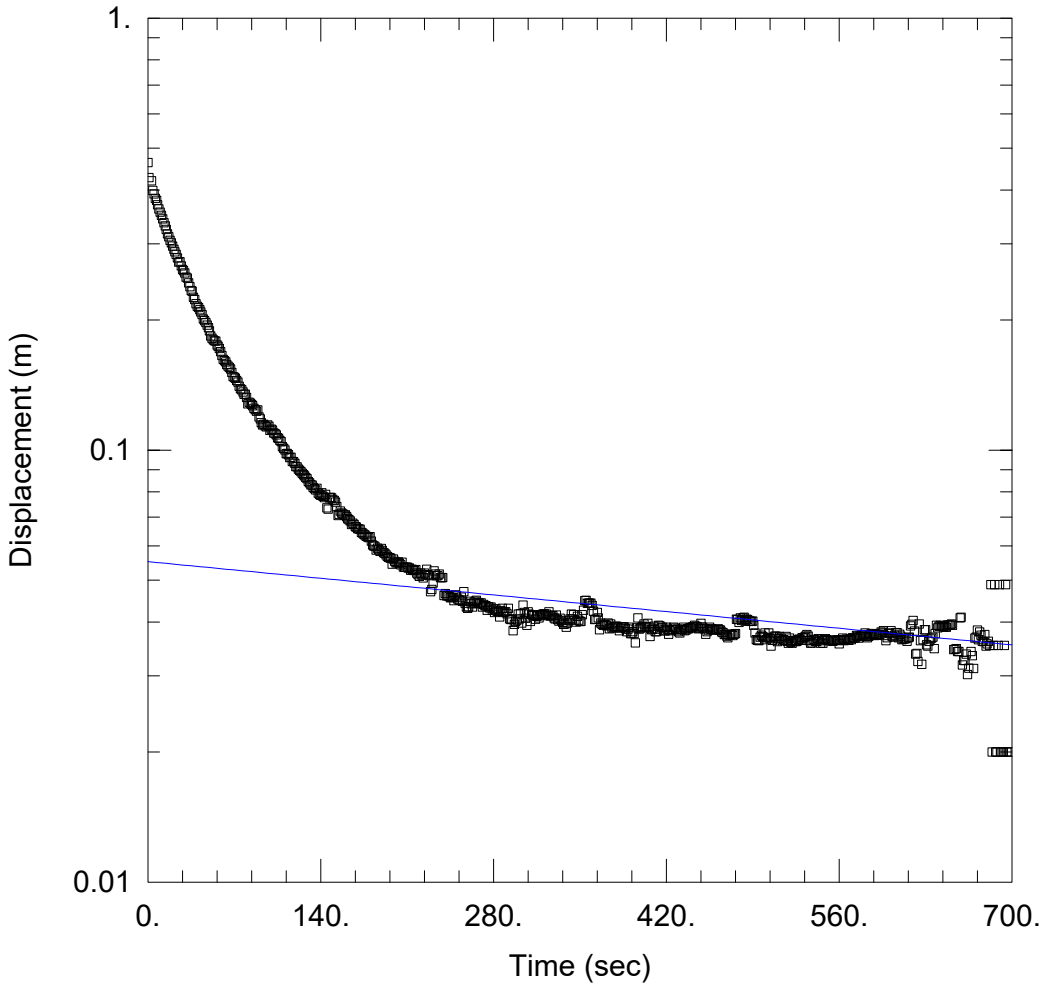
WELL DATA (MW8)

Initial Displacement: 0.5431 m
Total Well Penetration Depth: 3.32 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.32 m
Screen Length: 1.5 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 5.602E-7 m/sec y0 = 0.3842 m



WELL TEST ANALYSIS

Data Set: G:\...\MW9_attempt1.aqt
Date: 11/30/22 Time: 17:58:51

PROJECT INFORMATION

Company: Palmer
Client: Prologis
Project: 2008102
Location: Caledon, On
Test Well: MW9
Test Date: Nov 21, 2022

AQUIFER DATA

Saturated Thickness: 2.05 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW9)

Initial Displacement: 0.4632 m
Total Well Penetration Depth: 1.54 m
Casing Radius: 0.0254 m
Static Water Column Height: 2.48 m
Screen Length: 1.5 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

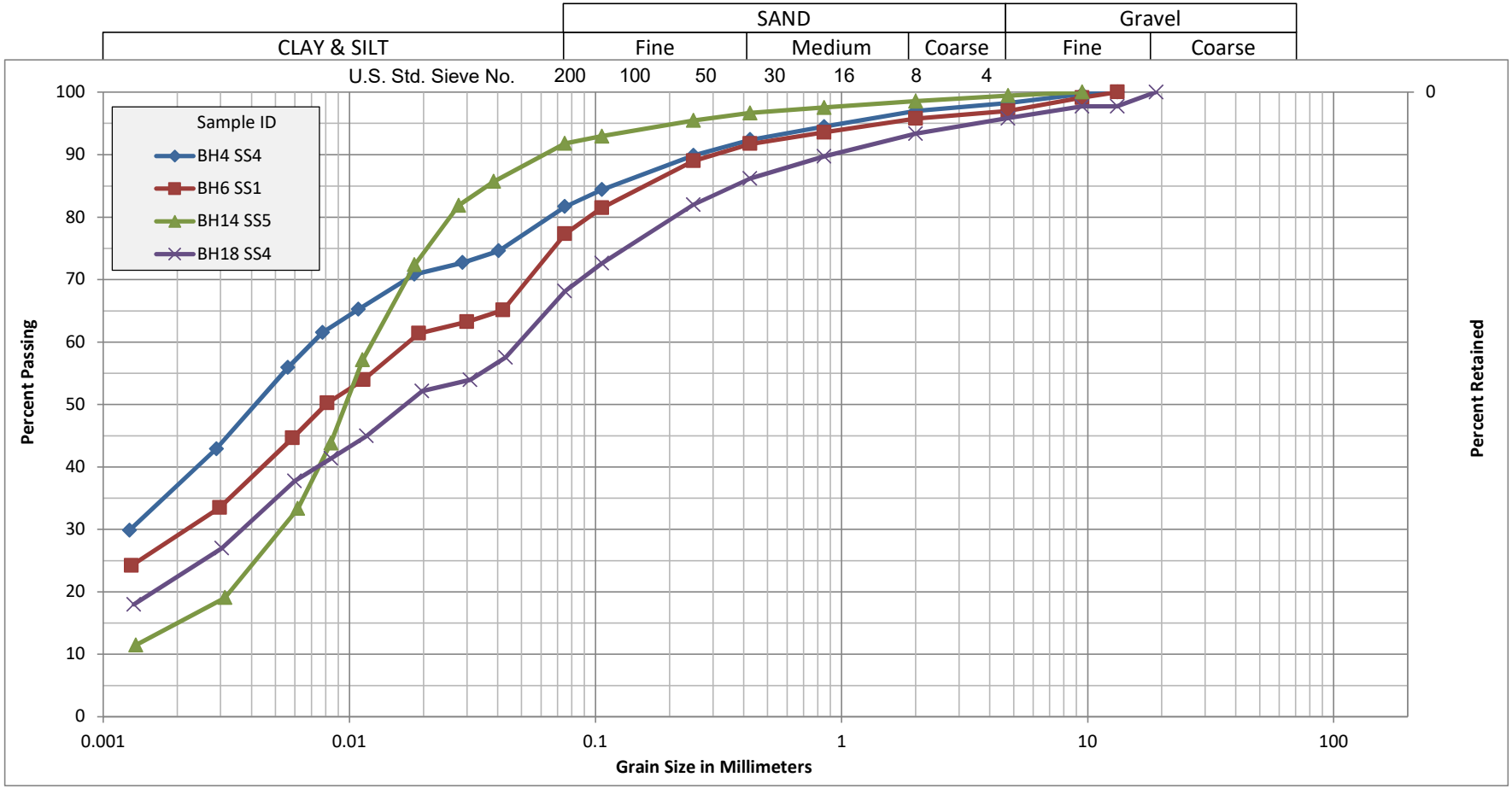
K = 7.129E-7 m/sec y0 = 0.05517 m

Appendix D

Grain Size Distributions and K-value Estimation

(Pinchin and Palmer 2022)

Unified Soil Classification System



Sample ID	Depth (ft)	% Gravel	% Sand	% Silt	% Clay
BH4 SS4	3.0-3.5	2.0	16.3	45.7	36.0
BH6 SS1	0.0-0.6	3.0	19.7	49.3	28.0
BH14 SS5	4.5-4.7	1.0	7.2	77.8	14.0
BH18 SS4	3.0-3.5	4.0	27.9	46.1	22.0

PINCHIN

Pinchin Waterloo - 225 Labrador Drive,
Unit 1, Waterloo, Ontario N2K 4M8

PARTICLE SIZE DISTRIBUTION ANALYSIS

Proposed Industrial Development - 12519 & 12713 Humber Station Dr, Caledon, ON
Prologis

Figure No. 1

308567.001

Reviewed By:

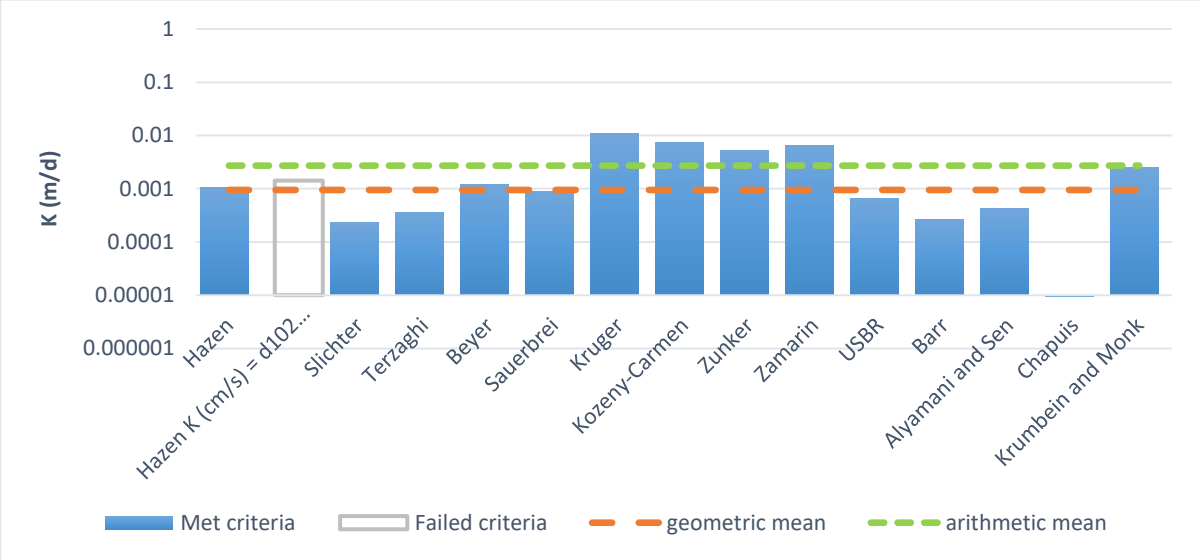
More information available upon request

Hydraulic Conductivity Report

Sample ID: BH14/SS5 Date: Feb 2023

Sample Mass (g): T (oC): 20

Poorly sorted clay low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.124E-05	.124E-07	0.00
Hazen K (cm/s) = d_{10} (mm)	.165E-05	.165E-07	0.00
Slichter	.267E-06	.267E-08	0.00
Terzaghi	.418E-06	.418E-08	0.00
Beyer	.140E-05	.140E-07	0.00
Sauerbrei	.103E-05	.103E-07	0.00
Kruger	.128E-04	.128E-06	0.01
Kozeny-Carmen	.868E-05	.868E-07	0.01
Zunker	.613E-05	.613E-07	0.01
Zamarin	.757E-05	.757E-07	0.01
USBR	.751E-06	.751E-08	0.00
Barr	.302E-06	.302E-08	0.00
Alyamani and Sen	.494E-06	.494E-08	0.00
Chapuis	.109E-07	.109E-09	0.00
Krumbein and Monk	.296E-05	.296E-07	0.00
geometric mean	.110E-05	.110E-07	0.00
arithmetic mean	.314E-05	.314E-07	0.00

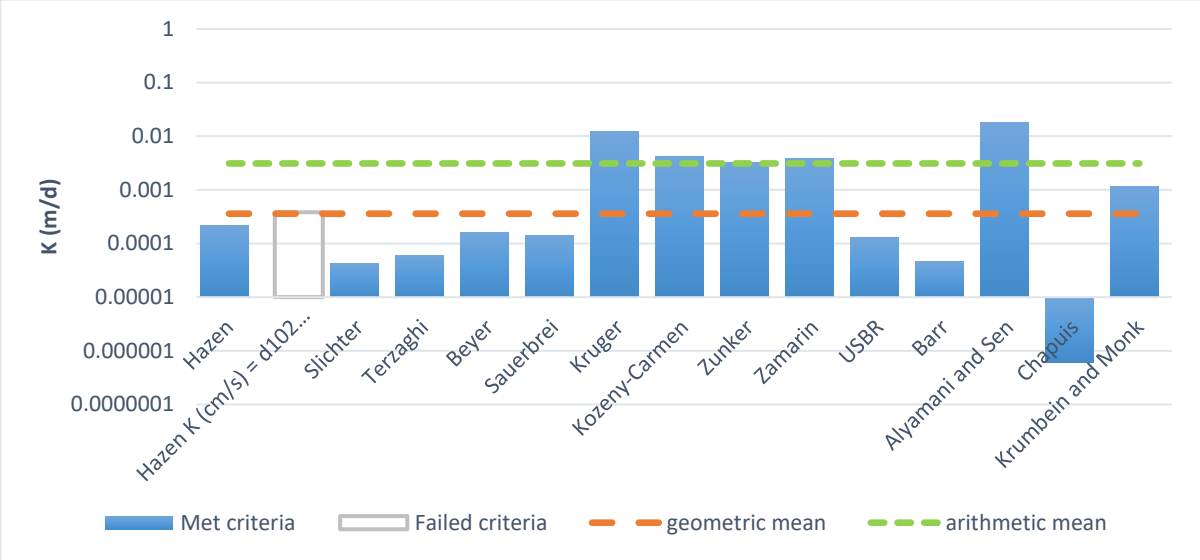
74 Berkeley Street, Toronto, ON M5A 2W7 Tel: 647-795-8153

Hydraulic Conductivity Report

Sample ID: BH18/SS4 Date: Feb 2023

Sample Mass (g): T (oC): 20

Poorly sorted silt low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.252E-06	.252E-08	0.00
Hazen K (cm/s) = d_{10} (mm)	.444E-06	.444E-08	0.00
Slichter	.495E-07	.495E-09	0.00
Terzaghi	.705E-07	.705E-09	0.00
Beyer	.185E-06	.185E-08	0.00
Sauerbrei	.166E-06	.166E-08	0.00
Kruger	.142E-04	.142E-06	0.01
Kozeny-Carmen	.482E-05	.482E-07	0.00
Zunker	.373E-05	.373E-07	0.00
Zamarin	.447E-05	.447E-07	0.00
USBR	.147E-06	.147E-08	0.00
Barr	.530E-07	.530E-09	0.00
Alyamani and Sen	.209E-04	.209E-06	0.02
Chapuis	.707E-09	.707E-11	0.00
Krumbein and Monk	.133E-05	.133E-07	0.00
geometric mean	.416E-06	.416E-08	0.00
arithmetic mean	.360E-05	.360E-07	0.00

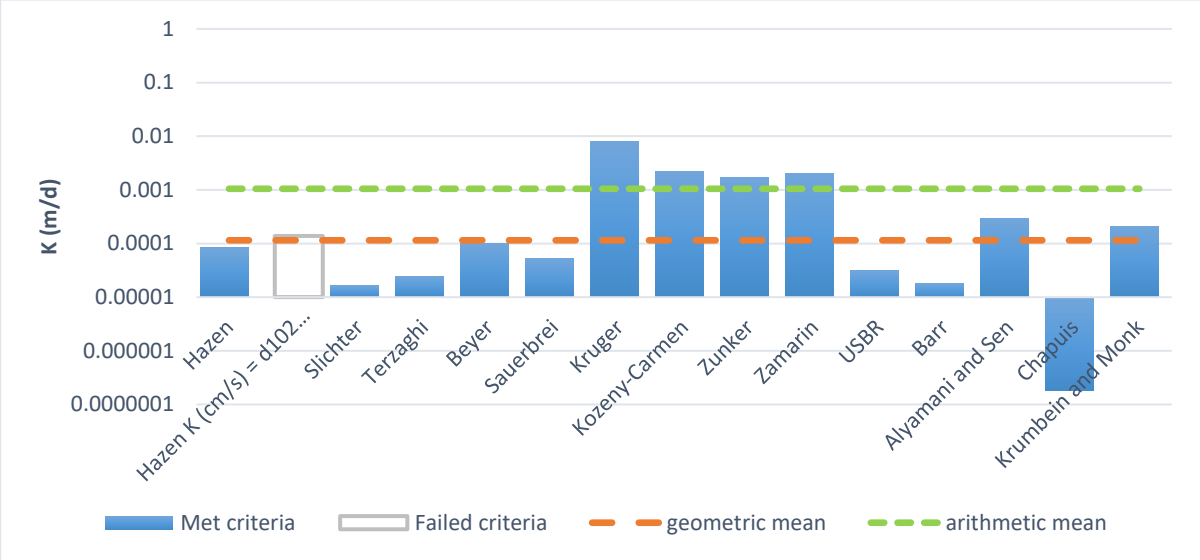
74 Berkeley Street, Toronto, ON M5A 2W7 Tel: 647-795-8153

Hydraulic Conductivity Report

Sample ID: BH4/SS4 Date: Feb 2023

Sample Mass (g): T (oC): 20

Poorly sorted clay low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.972E-07	.972E-09	0.00
Hazen K (cm/s) = d_{10} (mm)	.160E-06	.160E-08	0.00
Slichter	.195E-07	.195E-09	0.00
Terzaghi	.285E-07	.285E-09	0.00
Beyer	.117E-06	.117E-08	0.00
Sauerbrei	.599E-07	.599E-09	0.00
Kruger	.917E-05	.917E-07	0.01
Kozeny-Carmen	.259E-05	.259E-07	0.00
Zunker	.194E-05	.194E-07	0.00
Zamarin	.233E-05	.233E-07	0.00
USBR	.359E-07	.359E-09	0.00
Barr	.211E-07	.211E-09	0.00
Alyamani and Sen	.341E-06	.341E-08	0.00
Chapuis	.210E-09	.210E-11	0.00
Krumbein and Monk	.244E-06	.244E-08	0.00
geometric mean	.133E-06	.133E-08	0.00
arithmetic mean	.121E-05	.121E-07	0.00

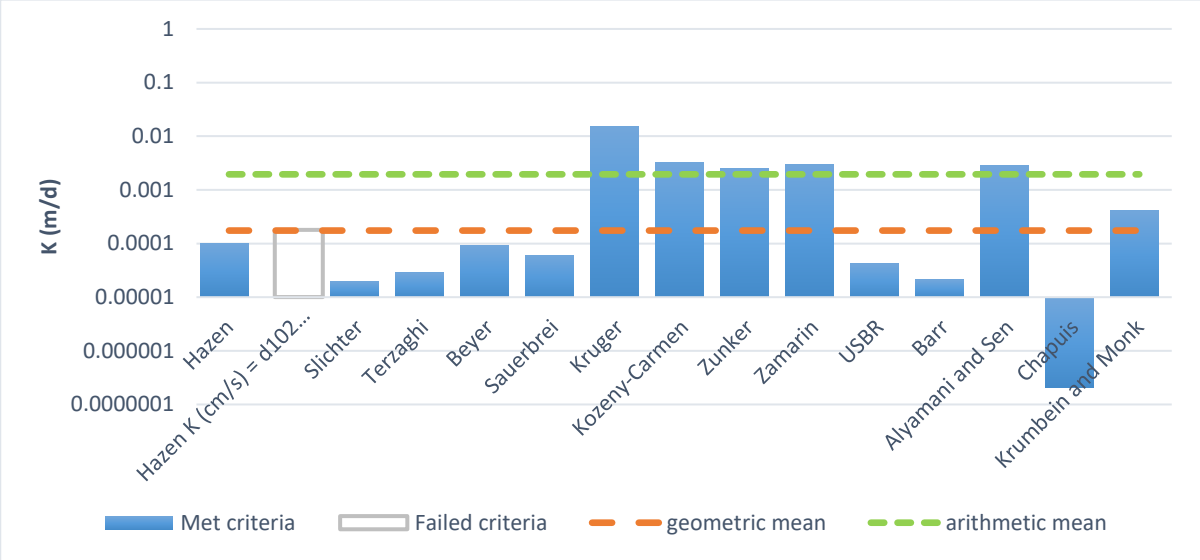
74 Berkeley Street, Toronto, ON M5A 2W7 Tel: 647-795-8153

Hydraulic Conductivity Report

Sample ID: BH6/SS1 Date: Feb 2023

Sample Mass (g): T (oC): 20

Poorly sorted clay low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.117E-06	.117E-08	0.00
Hazen K (cm/s) = d_{10} (mm)	.207E-06	.207E-08	0.00
Slichter	.230E-07	.230E-09	0.00
Terzaghi	.328E-07	.328E-09	0.00
Beyer	.108E-06	.108E-08	0.00
Sauerbrei	.700E-07	.700E-09	0.00
Kruger	.174E-04	.174E-06	0.02
Kozeny-Carmen	.375E-05	.375E-07	0.00
Zunker	.288E-05	.288E-07	0.00
Zamarin	.343E-05	.343E-07	0.00
USBR	.482E-07	.482E-09	0.00
Barr	.247E-07	.247E-09	0.00
Alyamani and Sen	.324E-05	.324E-07	0.00
Chapuis	.241E-09	.241E-11	0.00
Krumbein and Monk	.468E-06	.468E-08	0.00
geometric mean	.202E-06	.202E-08	0.00
arithmetic mean	.225E-05	.225E-07	0.00

74 Berkeley Street, Toronto, ON M5A 2W7 Tel: 647-795-8153

Appendix E

Groundwater Chemistry Analyses

(ALS 2022, Maxxam 2017)

ALS Canada Ltd.

right solutions. right partner.

CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2222750**	Page	: 1 of 9
Client	: **Palmer Environmental Consulting Group Inc.**	Laboratory	: Waterloo - Environmental
Contact	: Lauren Bourke	Account Manager	: Andrew Martin
Address	: 74 Berkeley Street Toronto ON Canada M5V 1E3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 2008162-HUMBER STATION RD	Date Samples Received	: 21-Nov-2022 16:10
PO	: ----	Date Analysis Commenced	: 23-Nov-2022
C-O-C number	: 17-792826	Issue Date	: 28-Nov-2022 17:34
Sampler	: ----		
Site	: ----		
Quote number	: (Q88296) PALMER 2022 STANDING OFFER		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Microbiology, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Inorganics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Metals, Waterloo, Ontario

Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
BH13	Water	colour, apparent	May interfere with disinfection; removal is important to ensure effective treatment.	ONDWS	AO/OG	40.0 CU	5 CU
	Water	solids, total dissolved [TDS]	Based on taste; TDS above 500 mg/L results in excessive scaling in water pipes, water heaters, boilers and appliances; TDS is composed of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate and nitrate.	ONDWS	AO/OG	689 mg/L	500 mg/L
	Water	turbidity	Filtration systems should be designed and operated to reduce turbidity levels as low as reasonably achievable and strive to achieve a treated water turbidity target from individual filters of less than 0.1 NTU. Particles can harbour microorganisms, protecting them from disinfection, and can entrap heavy metals and biocides; elevated or fluctuating turbidity in filtered water can indicate a problem with the water treatment process and a potential increased risk of pathogens in treated water.	ONDWS	AO/OG	21.4 NTU	5 NTU
	Water	manganese, total	Based on taste and staining of laundry and plumbing fixtures.	ONDWS	AO/OG	0.120 mg/L	0.05 mg/L
	Water	coliforms, total	Total coliforms are not used as indicators of potential health effects from pathogenic microorganisms; they are used as a tool to determine how well the drinking water treatment system is operating and to indicate water quality changes in the distribution system. Detection of total coliforms from consecutive samples from the same site or from more than 10% of the samples collected in a given sampling period should be investigated.	ONDWS	MAC	<10	1 CFU/100mL
	Water	sodium, total	Based on taste; where a sodium-based water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended.	ONDWS	MAC	58.4 mg/L	20 mg/L

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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. Guidelines 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.

Key : LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
CFU/100mL	colony forming units per hundred millilitres
CU	colour units (1 cu = 1 mg/l pt)
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units

>: greater than.
<: less than.
Red shading is applied where the result is greater than the Guideline Upper Limit or the result is lower than the Guideline Lower Limit.
For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit.

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
DLHC	*Detection Limit Raised: Dilution required due to high concentration of test analyte(s).*
DLM	*Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).*

Analytical Results Evaluation

Matrix: **Water**

Analyte	CAS Number	Unit	Client sample ID: BH13	----	----	----	----	----	----
			Sampling date/time: 21-Nov-2022 14:45	----	----	----	----	----	----
			Sub-Matrix: Water	----	----	----	----	----	----
			WT2222750-001	--------	--------	--------	--------	--------	--------
Physical Tests									
alkalinity, bicarbonate (as HCO3)	71-52-3	mg/L	608	----	----	----	----	----	----
alkalinity, carbonate (as CO3)	3812-32-6	mg/L	<1.0	----	----	----	----	----	----
alkalinity, hydroxide (as OH)	14280-30-9	mg/L	<1.0	----	----	----	----	----	----
alkalinity, total (as CaCO3)	----	mg/L	498	----	----	----	----	----	----
colour, apparent	----	CU	40.0	----	----	----	----	----	----
conductivity	----	µS/cm	1230	----	----	----	----	----	----
hardness (as CaCO3), from total Ca/Mg	----	mg/L	664	----	----	----	----	----	----
pH	----	pH units	7.94	----	----	----	----	----	----
solids, total dissolved [TDS]	----	mg/L	689 DLDS	----	----	----	----	----	----
solids, total dissolved [TDS], calculated	----	mg/L	800	----	----	----	----	----	----
turbidity	----	NTU	21.4	----	----	----	----	----	----
Langelier index (@ 20°C)	----	-	1.03	----	----	----	----	----	----
Langelier index (@ 4°C)	----	-	0.784	----	----	----	----	----	----
pH, saturation (@ 20°C)	----	pH units	6.91	----	----	----	----	----	----
pH, saturation (@ 4°C)	----	pH units	7.16	----	----	----	----	----	----
Anions and Nutrients									
ammonia, total (as N)	7664-41-7	mg/L	0.0642	----	----	----	----	----	----
bromide	24959-67-9	mg/L	<0.50 DLDS	----	----	----	----	----	----
chloride	16887-00-6	mg/L	9.33 DLDS	----	----	----	----	----	----
fluoride	16984-48-8	mg/L	0.228 DLDS	----	----	----	----	----	----
nitrate (as N)	14797-55-8	mg/L	<0.100 DLDS	----	----	----	----	----	----
nitrate + nitrite (as N)	----	mg/L	<0.112	----	----	----	----	----	----
nitrite (as N)	14797-65-0	mg/L	<0.050 DLDS	----	----	----	----	----	----
phosphate, ortho-, dissolved (as P)	14265-44-2	mg/L	<0.0030	----	----	----	----	----	----
sulfate (as SO4)	14808-79-8	mg/L	202 DLDS	----	----	----	----	----	----
Microbiological Tests									
coliforms, Escherichia coli [E. coli]	----	CFU/100mL	<1	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Water**

Analyte	CAS Number	Unit	Client sample ID: BH13	----	----	----	----	----	----
			Sampling date/time: 21-Nov-2022 14:45	----	----	----	----	----	----
			Sub-Matrix: Water	----	----	----	----	----	----
			WT2222750-001	--------	--------	--------	--------	--------	--------
Microbiological Tests									
coliforms, total	----	CFU/100mL	<10 DLM	----	----	----	----	----	----
coliforms, total background	----	CFU/100mL	10 DLM	----	----	----	----	----	----
Metals									
sodium adsorption ratio [SAR]	----	-	0.98	----	----	----	----	----	----
Ion Balance									
anion sum	----	meq/L	14.4	----	----	----	----	----	----
cation sum (total)	----	meq/L	16.0	----	----	----	----	----	----
ion balance (APHA)	----	%	5.26	----	----	----	----	----	----
ion balance (cations/anions)	----	%	111	----	----	----	----	----	----
Total Metals									
aluminum, total	7429-90-5	mg/L	<0.0300 DLHC	----	----	----	----	----	----
antimony, total	7440-36-0	mg/L	0.00161 DLHC	----	----	----	----	----	----
arsenic, total	7440-38-2	mg/L	0.00225 DLHC	----	----	----	----	----	----
barium, total	7440-39-3	mg/L	0.0776 DLHC	----	----	----	----	----	----
beryllium, total	7440-41-7	mg/L	<0.000200 DLHC	----	----	----	----	----	----
bismuth, total	7440-69-9	mg/L	<0.000500 DLHC	----	----	----	----	----	----
boron, total	7440-42-8	mg/L	0.102 DLHC	----	----	----	----	----	----
cadmium, total	7440-43-9	mg/L	<0.0000500 DLHC	----	----	----	----	----	----
calcium, total	7440-70-2	mg/L	79.8 DLHC	----	----	----	----	----	----
cesium, total	7440-46-2	mg/L	<0.000100 DLHC	----	----	----	----	----	----
chromium, total	7440-47-3	mg/L	<0.00500 DLHC	----	----	----	----	----	----
cobalt, total	7440-48-4	mg/L	<0.00100 DLHC	----	----	----	----	----	----
copper, total	7440-50-8	mg/L	<0.00500 DLHC	----	----	----	----	----	----
iron, total	7439-89-6	mg/L	<0.100 DLHC	----	----	----	----	----	----
lead, total	7439-92-1	mg/L	<0.000500 DLHC	----	----	----	----	----	----
lithium, total	7439-93-2	mg/L	0.0479 DLHC	----	----	----	----	----	----
magnesium, total	7439-95-4	mg/L	113 DLHC	----	----	----	----	----	----
manganese, total	7439-96-5	mg/L	0.120 DLHC	----	----	----	----	----	----
molybdenum, total	7439-98-7	mg/L	0.0457 DLHC	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Water**

Analyte	CAS Number	Unit	Client sample ID	----	----	----	----	----	----
			BH13	----	----	----	----	----	----
			Sampling date/time	21-Nov-2022 14:45	----	----	----	----	----	----
			Sub-Matrix	Water	----	----	----	----	----	----
			WT2222750-001	--------	--------	--------	--------	--------	--------
Total Metals									
nickel, total	7440-02-0	mg/L	<0.00500 DLHC	----	----	----	----	----	----
phosphorus, total	7723-14-0	mg/L	<0.500 DLHC	----	----	----	----	----	----
potassium, total	7440-09-7	mg/L	6.68 DLHC	----	----	----	----	----	----
rubidium, total	7440-17-7	mg/L	0.00227 DLHC	----	----	----	----	----	----
selenium, total	7782-49-2	mg/L	<0.000500 DLHC	----	----	----	----	----	----
silicon (as SiO2), total	7631-86-9	mg/L	20.7	----	----	----	----	----	----
silicon, total	7440-21-3	mg/L	9.70 DLHC	----	----	----	----	----	----
silver, total	7440-22-4	mg/L	<0.000100 DLHC	----	----	----	----	----	----
sodium, total	7440-23-5	mg/L	58.4 DLHC	----	----	----	----	----	----
strontium, total	7440-24-6	mg/L	0.886 DLHC	----	----	----	----	----	----
sulfur, total	7704-34-9	mg/L	72.9 DLHC	----	----	----	----	----	----
tellurium, total	13494-80-9	mg/L	<0.00200 DLHC	----	----	----	----	----	----
thallium, total	7440-28-0	mg/L	<0.000100 DLHC	----	----	----	----	----	----
thorium, total	7440-29-1	mg/L	<0.00100 DLHC	----	----	----	----	----	----
tin, total	7440-31-5	mg/L	<0.00100 DLHC	----	----	----	----	----	----
titanium, total	7440-32-6	mg/L	<0.00300 DLHC	----	----	----	----	----	----
tungsten, total	7440-33-7	mg/L	<0.00100 DLHC	----	----	----	----	----	----
uranium, total	7440-61-1	mg/L	0.00836 DLHC	----	----	----	----	----	----
vanadium, total	7440-62-2	mg/L	<0.00500 DLHC	----	----	----	----	----	----
zinc, total	7440-66-6	mg/L	<0.0300 DLHC	----	----	----	----	----	----
zirconium, total	7440-67-7	mg/L	<0.00200 DLHC	----	----	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

Summary of Guideline Limits

Analyte	CAS Number	Unit	ONDWS AO/OG	ONDWS MAC					
Physical Tests									
alkalinity, bicarbonate (as HCO3)	71-52-3	mg/L							
alkalinity, carbonate (as CO3)	3812-32-6	mg/L							
alkalinity, hydroxide (as OH)	14280-30-9	mg/L							
alkalinity, total (as CaCO3)	----	mg/L	**30 - 500 mg/L**						
colour, apparent	----	CU	**5 CU**						
conductivity	----	µS/cm							
hardness (as CaCO3), from total Ca/Mg	----	mg/L							
Langelier index (@ 20°C)	----	-							
Langelier index (@ 4°C)	----	-							
pH, saturation (@ 20°C)	----	pH units							
pH, saturation (@ 4°C)	----	pH units							
pH	----	pH units	**6.5 - 8.5 pH units**						
solids, total dissolved [TDS], calculated	----	mg/L							
solids, total dissolved [TDS]	----	mg/L	**500 mg/L**						
turbidity	----	NTU	**5 NTU**						
Anions and Nutrients									
ammonia, total (as N)	7664-41-7	mg/L							
bromide	24959-67-9	mg/L							
chloride	16887-00-6	mg/L	**250 mg/L**						
fluoride	16984-48-8	mg/L		**1.5 mg/L**					
nitrate (as N)	14797-55-8	mg/L		**10 mg/L**					
nitrate + nitrite (as N)	----	mg/L		**10 mg/L**					
nitrite (as N)	14797-65-0	mg/L		**1 mg/L**					
phosphate, ortho-, dissolved (as P)	14265-44-2	mg/L							
sulfate (as SO4)	14808-79-8	mg/L							
Microbiological Tests									
coliforms, Escherichia coli [E. coli]	----	CFU/100mL		**1 CFU/100mL**					
coliforms, total background	----	CFU/100mL							
coliforms, total	----	CFU/100mL		**1 CFU/100mL**					
Metals									
sodium adsorption ratio [SAR]	----	-							
Ion Balance									
anion sum	----	meq/L							
cation sum (total)	----	meq/L							
ion balance (APHA)	----	%							
ion balance (cations/anions)	----	%							

Analyte	CAS Number	Unit	ONDWS AO/OG	ONDWS MAC					
Total Metals									
aluminum, total	7429-90-5	mg/L	**0.1 mg/L**						
antimony, total	7440-36-0	mg/L		**0.006 mg/L**					
arsenic, total	7440-38-2	mg/L		**0.01 mg/L**					
barium, total	7440-39-3	mg/L		**1 mg/L**					
beryllium, total	7440-41-7	mg/L							
bismuth, total	7440-69-9	mg/L							
boron, total	7440-42-8	mg/L		**5 mg/L**					
cadmium, total	7440-43-9	mg/L		**0.005 mg/L**					
calcium, total	7440-70-2	mg/L							
cesium, total	7440-46-2	mg/L							
chromium, total	7440-47-3	mg/L		**0.05 mg/L**					
cobalt, total	7440-48-4	mg/L							
copper, total	7440-50-8	mg/L	**1 mg/L**						
iron, total	7439-89-6	mg/L	**0.3 mg/L**						
lead, total	7439-92-1	mg/L		**0.01 mg/L**					
lithium, total	7439-93-2	mg/L							
magnesium, total	7439-95-4	mg/L							
manganese, total	7439-96-5	mg/L	**0.05 mg/L**						
molybdenum, total	7439-98-7	mg/L							
nickel, total	7440-02-0	mg/L							
phosphorus, total	7723-14-0	mg/L							
potassium, total	7440-09-7	mg/L							
rubidium, total	7440-17-7	mg/L							
selenium, total	7782-49-2	mg/L		**0.05 mg/L**					
silicon (as SiO2), total	7631-86-9	mg/L							
silicon, total	7440-21-3	mg/L							
silver, total	7440-22-4	mg/L							
sodium, total	7440-23-5	mg/L	**200 mg/L**	**20 mg/L**					
strontium, total	7440-24-6	mg/L							
sulfur, total	7704-34-9	mg/L							
tellurium, total	13494-80-9	mg/L							
thallium, total	7440-28-0	mg/L							
thorium, total	7440-29-1	mg/L							
tin, total	7440-31-5	mg/L							
titanium, total	7440-32-6	mg/L							
tungsten, total	7440-33-7	mg/L							
uranium, total	7440-61-1	mg/L		**0.02 mg/L**					
vanadium, total	7440-62-2	mg/L							
zinc, total	7440-66-6	mg/L	**5 mg/L**						

Analyte	CAS Number	Unit	ONDWS AO/OG	ONDWS MAC					
Total Metals - Continued									
zirconium, total	7440-67-7	mg/L							

Please refer to the General Comments section for an explanation of any qualifiers detected.

Key:

ONDWS	Ontario Drinking Water Regulation (JAN, 2020)
AO/OG	Aesthetic Objective/Operational Guideline
MAC	Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)

ALS Canada Ltd.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2222750**	Page	: 1 of 10
Client	: **Palmer Environmental Consulting Group Inc.**	Laboratory	: Waterloo - Environmental
Contact	: Lauren Bourke	Account Manager	: Andrew Martin
Address	: 74 Berkeley Street Toronto ON Canada M5V 1E3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 2008162-HUMBER STATION RD	Date Samples Received	: 21-Nov-2022 16:10
PO	: ----	Issue Date	: 28-Nov-2022 17:34
C-O-C number	: 17-792826		
Sampler	: ----		
Site	: ----		
Quote number	: (Q88296) PALMER 2022 STANDING OFFER		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
BH13	E298	21-Nov-2022	24-Nov-2022	----	----		25-Nov-2022	28 days	4 days	✓
Anions and Nutrients : Bromide in Water by IC										
HDPE [ON MECP]										
BH13	E235.Br	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	28 days	3 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [ON MECP]										
BH13	E235.Cl	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	28 days	3 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (0.003 mg/L)										
HDPE [ON MECP]										
BH13	E378-T	21-Nov-2022	----	----	----		24-Nov-2022	7 days	3 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [ON MECP]										
BH13	E235.F	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	28 days	3 days	✓
Anions and Nutrients : Nitrate in Water by IC										
HDPE [ON MECP]										
BH13	E235.NO3	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	7 days	3 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE [ON MECP]										
BH13	E235.NO2	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	7 days	3 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Sulfate in Water by IC										
HDPE [ON MECP]										
BH13	E235.SO4	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	28 days	3 days	✓
Microbiological Tests : E. coli (MF-mFC-BCIG)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
BH13	E012A.EC	21-Nov-2022	----	----	----		23-Nov-2022	48 hrs	46 hrs	✓
Microbiological Tests : Total Coliforms (MF-mEndo)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
BH13	E012.TC	21-Nov-2022	----	----	----		23-Nov-2022	48 hrs	46 hrs	✓
Microbiological Tests : Total Coliforms Background (MF-mEndo)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
BH13	E012.BG.TC	21-Nov-2022	----	----	----		23-Nov-2022	48 hrs	46 hrs	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [ON MECP]										
BH13	E290	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	14 days	3 days	✓
Physical Tests : Colour (Apparent) by Spectrometer										
HDPE [ON MECP]										
BH13	E330	21-Nov-2022	----	----	----		28-Nov-2022	48 hrs	170 hrs	× EHT
Physical Tests : Conductivity in Water										
HDPE [ON MECP]										
BH13	E100	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	28 days	3 days	✓
Physical Tests : pH by Meter										
HDPE [ON MECP]										
BH13	E108	21-Nov-2022	23-Nov-2022	----	----		24-Nov-2022	14 days	3 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [ON MECP]										
BH13	E162	21-Nov-2022	----	----	----		24-Nov-2022	7 days	3 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Turbidity by Nephelometry										
HDPE [ON MECP]										
BH13	E121	21-Nov-2022	----	----	----		25-Nov-2022	3 days	4 days	× EHT
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
BH13	E420	21-Nov-2022	23-Nov-2022	----	----		23-Nov-2022	180 days	2 days	✓

Legend & Qualifier Definitions

EHT: Exceeded ALS recommended hold time prior to analysis.

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: ✘ = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Alkalinity Species by Titration	E290	754835	1	4	25.0	5.0	✓
Ammonia by Fluorescence	E298	756310	1	20	5.0	5.0	✓
Bromide in Water by IC	E235.Br	754832	1	2	50.0	5.0	✓
Chloride in Water by IC	E235.Cl	754829	1	9	11.1	5.0	✓
Colour (Apparent) by Spectrometer	E330	760306	1	20	5.0	5.0	✓
Conductivity in Water	E100	754834	1	4	25.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T	755801	1	18	5.5	5.0	✓
E. coli (MF-mFC-BCIG)	E012A.EC	754757	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	754827	1	10	10.0	5.0	✓
Nitrate in Water by IC	E235.NO3	754830	1	3	33.3	5.0	✓
Nitrite in Water by IC	E235.NO2	754831	1	3	33.3	5.0	✓
pH by Meter	E108	754833	1	18	5.5	5.0	✓
Sulfate in Water by IC	E235.SO4	754828	1	14	7.1	5.0	✓
TDS by Gravimetry	E162	756131	1	19	5.2	5.0	✓
Total Coliforms (MF-mEndo)	E012.TC	754762	0	8	0.0	5.0	✘
Total Coliforms Background (MF-mEndo)	E012.BG.TC	754763	0	6	0.0	5.0	✘
Total metals in Water by CRC ICPMS	E420	755030	1	6	16.6	5.0	✓
Turbidity by Nephelometry	E121	757299	1	20	5.0	5.0	✓
Laboratory Control Samples (LCS)							
Alkalinity Species by Titration	E290	754835	1	4	25.0	5.0	✓
Ammonia by Fluorescence	E298	756310	1	20	5.0	5.0	✓
Bromide in Water by IC	E235.Br	754832	1	2	50.0	5.0	✓
Chloride in Water by IC	E235.Cl	754829	1	9	11.1	5.0	✓
Colour (Apparent) by Spectrometer	E330	760306	1	20	5.0	5.0	✓
Conductivity in Water	E100	754834	1	4	25.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T	755801	1	18	5.5	5.0	✓
Fluoride in Water by IC	E235.F	754827	1	10	10.0	5.0	✓
Nitrate in Water by IC	E235.NO3	754830	1	3	33.3	5.0	✓
Nitrite in Water by IC	E235.NO2	754831	1	3	33.3	5.0	✓
pH by Meter	E108	754833	1	18	5.5	5.0	✓
Sulfate in Water by IC	E235.SO4	754828	1	14	7.1	5.0	✓
TDS by Gravimetry	E162	756131	1	19	5.2	5.0	✓
Total metals in Water by CRC ICPMS	E420	755030	1	6	16.6	5.0	✓
Turbidity by Nephelometry	E121	757299	1	20	5.0	5.0	✓
Method Blanks (MB)							

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Method Blanks (MB) - Continued							
Alkalinity Species by Titration	E290	754835	1	4	25.0	5.0	✓
Ammonia by Fluorescence	E298	756310	1	20	5.0	5.0	✓
Bromide in Water by IC	E235.Br	754832	1	2	50.0	5.0	✓
Chloride in Water by IC	E235.Cl	754829	1	9	11.1	5.0	✓
Colour (Apparent) by Spectrometer	E330	760306	1	20	5.0	5.0	✓
Conductivity in Water	E100	754834	1	4	25.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T	755801	1	18	5.5	5.0	✓
E. coli (MF-mFC-BCIG)	E012A.EC	754757	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	754827	1	10	10.0	5.0	✓
Nitrate in Water by IC	E235.NO3	754830	1	3	33.3	5.0	✓
Nitrite in Water by IC	E235.NO2	754831	1	3	33.3	5.0	✓
Sulfate in Water by IC	E235.SO4	754828	1	14	7.1	5.0	✓
TDS by Gravimetry	E162	756131	1	19	5.2	5.0	✓
Total Coliforms (MF-mEndo)	E012.TC	754762	1	8	12.5	5.0	✓
Total Coliforms Background (MF-mEndo)	E012.BG.TC	754763	1	6	16.6	5.0	✓
Total metals in Water by CRC ICPMS	E420	755030	1	6	16.6	5.0	✓
Turbidity by Nephelometry	E121	757299	1	20	5.0	5.0	✓
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	756310	1	20	5.0	5.0	✓
Bromide in Water by IC	E235.Br	754832	1	2	50.0	5.0	✓
Chloride in Water by IC	E235.Cl	754829	1	9	11.1	5.0	✓
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T	755801	1	18	5.5	5.0	✓
Fluoride in Water by IC	E235.F	754827	1	10	10.0	5.0	✓
Nitrate in Water by IC	E235.NO3	754830	1	3	33.3	5.0	✓
Nitrite in Water by IC	E235.NO2	754831	1	3	33.3	5.0	✓
Sulfate in Water by IC	E235.SO4	754828	1	14	7.1	5.0	✓
Total metals in Water by CRC ICPMS	E420	755030	1	6	16.6	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total Coliforms Background (MF-mEndo)	E012.BG.TC Waterloo - Environmental	Water	APHA 9222B (mod)	Noncoliform bacteria observed on Total Coliform plates are enumerated.
Total Coliforms (MF-mEndo)	E012.TC Waterloo - Environmental	Water	APHA 9222B (mod)	Following filtration (0.45 µm), and incubation at 35.0 ±0.5°C for 24 hours, colonies exhibiting characteristic morphology of the target organism are enumerated and confirmed.
E. coli (MF-mFC-BCIG)	E012A.EC Waterloo - Environmental	Water	ON E3433 (mod)	Following filtration (0.45 µm), and incubation at 44.5±0.2°C for 24 hours, colonies exhibiting characteristic morphology of the target organism are enumerated.
Conductivity in Water	E100 Waterloo - Environmental	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 Waterloo - Environmental	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Turbidity by Nephelometry	E121 Waterloo - Environmental	Water	APHA 2130 B (mod)	Turbidity is measured by the nephelometric method, by measuring the intensity of light scatter under defined conditions.
TDS by Gravimetry	E162 Waterloo - Environmental	Water	APHA 2540 C (mod)	Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, with evaporation of the filtrate at 180 ± 2°C for 16 hours or to constant weight, with gravimetric measurement of the residue.
Bromide in Water by IC	E235.Br Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Chloride in Water by IC	E235.Cl Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Nitrite in Water by IC	E235.NO2 Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC	E235.NO3 Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 Waterloo - Environmental	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 Waterloo - Environmental	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Colour (Apparent) by Spectrometer	E330 Waterloo - Environmental	Water	APHA 2120 C (mod)	Colour (Apparent) is measured in an unfiltered sample spectrophotometrically using the single wavelength method. The colour contribution of settleable solids are not included in the result. This method is intended for potable waters. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment.
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T Waterloo - Environmental	Water	APHA 4500-P E (mod)	Dissolved Orthophosphate is determined colourimetrically on a water sample that has been lab or field filtered through a 0.45 micron membrane filter. Field filtration is recommended to ensure test results represent conditions at time of sampling.
Total metals in Water by CRC ICPMS	E420 Waterloo - Environmental	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Hardness (Calculated) from Total Ca/Mg	EC100A Waterloo - Environmental	Water	APHA 2340B	“Hardness (as CaCO3), from total Ca/Mg” is calculated from the sum of total Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Ion Balance using Total Metals	EC101A Waterloo - Environmental	Water	APHA 1030E	Cation Sum (using total metals), Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
Sodium Adsorption Ratio [SAR] from Total Metals	EC102 Waterloo - Environmental	Water	CCME Sodium Adsorption Ratio (SAR)	The Sodium Adsorption Ratio (SAR) for a water sample is calculated from the Sodium, Calcium, and Magnesium concentrations of the water, using the same calculations as would be used for a sediment paste extract.
TDS calculated from conductivity	EC103A Waterloo - Environmental	Water	APHA 1030 E	Total dissolved solids (as mg/L) can be estimated by multiplying electrical conductance (in umhos/cm) by 0.65.
Langelier Index using Laboratory pH (Ca-T)	EC105A Waterloo - Environmental	Water	APHA 2330B	Langelier Index provides an indication of scale formation potential at a given pH and temperature, and is calculated as per APHA 2330B Saturation Index. Positive values indicate oversaturation with respect to CaCO3. Negative values indicate undersaturation of CaCO3. This calculation uses laboratory pH measurements and provides estimates of Langelier Index at temperatures of 4, 15, 20, 25, 66, and 77°C.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N Waterloo - Environmental	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).
Total Silicon as Silica (Calculation)	EC420.SiO2 Waterloo - Environmental	Water	N/A	Total Silicon (as SiO2) is a calculated parameter. Total Silicon (as SiO2 mg/L) = 2.139 x Total Silicon (mg/L).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 Waterloo - Environmental	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.

QUALITY CONTROL REPORT

Work Order	: **WT2222750**	Page	: 1 of 13
Client	: Palmer Environmental Consulting Group Inc.	Laboratory	: Waterloo - Environmental
Contact	: Lauren Bourke	Account Manager	: Andrew Martin
Address	: 74 Berkeley Street Toronto ON Canada M5V 1E3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: +1 519 886 6910
Project	: 2008162-HUMBER STATION RD	Date Samples Received	: 21-Nov-2022 16:10
PO	: ----	Date Analysis Commenced	: 23-Nov-2022
C-O-C number	: 17-792826	Issue Date	: 28-Nov-2022 17:34
Sampler	: ---- ----		
Site	: ----		
Quote number	: (Q88296) PALMER 2022 STANDING OFFER		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Waterloo Microbiology, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Waterloo Metals, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include 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 predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 754833)											
WT2222750-001	BH13	pH	----	E108	0.10	pH units	7.94	7.94	0.00%	4%	----
Physical Tests (QC Lot: 754834)											
WT2222750-001	BH13	conductivity	----	E100	1.0	µS/cm	1230	1220	0.981%	10%	----
Physical Tests (QC Lot: 754835)											
WT2222750-001	BH13	alkalinity, total (as CaCO3)	----	E290	1.0	mg/L	498	487	2.24%	20%	----
Physical Tests (QC Lot: 756131)											
HA2200039-003	Anonymous	solids, total dissolved [TDS]	----	E162	13	mg/L	80	89	9	Diff <2x LOR	----
Physical Tests (QC Lot: 757299)											
WT2222460-014	Anonymous	turbidity	----	E121	0.10	NTU	8.95	9.04	1.00%	15%	----
Anions and Nutrients (QC Lot: 754827)											
WT2222750-001	BH13	fluoride	16984-48-8	E235.F	0.100	mg/L	0.228	0.237	0.009	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 754828)											
WT2222750-001	BH13	sulfate (as SO4)	14808-79-8	E235.SO4	1.50	mg/L	202	203	0.391%	20%	----
Anions and Nutrients (QC Lot: 754829)											
WT2222750-001	BH13	chloride	16887-00-6	E235.Cl	2.50	mg/L	9.33	8.93	0.40	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 754830)											
WT2222750-001	BH13	nitrate (as N)	14797-55-8	E235.NO3	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 754831)											
WT2222750-001	BH13	nitrite (as N)	14797-65-0	E235.NO2	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 754832)											
WT2222750-001	BH13	bromide	24959-67-9	E235.Br	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 755801)											
WT2222604-001	Anonymous	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-T	0.300	mg/L	43.9	44.1	0.495%	20%	----
Anions and Nutrients (QC Lot: 756310)											
WT2222602-001	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	0.0507	0.0509	0.394%	20%	----
Microbiological Tests (QC Lot: 754757)											
WT2222619-001	Anonymous	coliforms, Escherichia coli [E. coli]	----	E012A.EC	1	CFU/100mL	2	1	1	Diff <2x LOR	----
Total Metals (QC Lot: 755030)											
TY2204274-001	Anonymous	aluminum, total	7429-90-5	E420	0.0030	mg/L	0.961	0.950	1.17%	20%	----
		antimony, total	7440-36-0	E420	0.00010	mg/L	0.00014	0.00015	0.000008	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 755030) - continued											
TY2204274-001	Anonymous	arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00119	0.00114	3.99%	20%	----
		barium, total	7440-39-3	E420	0.00010	mg/L	0.0215	0.0211	1.82%	20%	----
		beryllium, total	7440-41-7	E420	0.000020	mg/L	0.000026	0.000026	0.0000009	Diff <2x LOR	----
		bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		boron, total	7440-42-8	E420	0.010	mg/L	0.024	0.022	0.001	Diff <2x LOR	----
		cadmium, total	7440-43-9	E420	0.0000050	mg/L	0.0000218	0.0000210	0.0000008	Diff <2x LOR	----
		calcium, total	7440-70-2	E420	0.050	mg/L	39.0	37.0	5.19%	20%	----
		cesium, total	7440-46-2	E420	0.000010	mg/L	0.000219	0.000203	7.68%	20%	----
		chromium, total	7440-47-3	E420	0.00050	mg/L	0.00277	0.00303	0.00026	Diff <2x LOR	----
		cobalt, total	7440-48-4	E420	0.00010	mg/L	0.00129	0.00126	2.25%	20%	----
		copper, total	7440-50-8	E420	0.00050	mg/L	0.00759	0.00733	3.38%	20%	----
		iron, total	7439-89-6	E420	0.010	mg/L	1.24	1.22	1.60%	20%	----
		lead, total	7439-92-1	E420	0.000050	mg/L	0.000807	0.000764	5.41%	20%	----
		lithium, total	7439-93-2	E420	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
		magnesium, total	7439-95-4	E420	0.0050	mg/L	4.59	4.49	2.17%	20%	----
		manganese, total	7439-96-5	E420	0.00010	mg/L	0.0726	0.0706	2.89%	20%	----
		molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.000671	0.000654	2.50%	20%	----
		nickel, total	7440-02-0	E420	0.00050	mg/L	0.00292	0.00283	0.00009	Diff <2x LOR	----
		phosphorus, total	7723-14-0	E420	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		potassium, total	7440-09-7	E420	0.050	mg/L	2.87	2.78	3.12%	20%	----
		rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00636	0.00613	3.72%	20%	----
		selenium, total	7782-49-2	E420	0.000050	mg/L	0.000199	0.000204	0.000006	Diff <2x LOR	----
		silicon, total	7440-21-3	E420	0.10	mg/L	3.99	4.00	0.224%	20%	----
		silver, total	7440-22-4	E420	0.000010	mg/L	0.000014	0.000013	0.0000008	Diff <2x LOR	----
		sodium, total	7440-23-5	E420	0.050	mg/L	4.32	4.26	1.60%	20%	----
		strontium, total	7440-24-6	E420	0.00020	mg/L	0.122	0.116	5.28%	20%	----
		sulfur, total	7704-34-9	E420	0.50	mg/L	7.17	7.14	0.431%	20%	----
		tellurium, total	13494-80-9	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		thallium, total	7440-28-0	E420	0.000010	mg/L	0.000024	0.000018	0.000005	Diff <2x LOR	----
		thorium, total	7440-29-1	E420	0.00010	mg/L	0.00031	0.00030	0.00001	Diff <2x LOR	----
		tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		titanium, total	7440-32-6	E420	0.00030	mg/L	0.0371	0.0364	1.94%	20%	----
		tungsten, total	7440-33-7	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		uranium, total	7440-61-1	E420	0.000010	mg/L	0.000423	0.000401	5.34%	20%	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 755030) - continued											
TY2204274-001	Anonymous	vanadium, total	7440-62-2	E420	0.00050	mg/L	0.00280	0.00272	0.00007	Diff <2x LOR	----
		zinc, total	7440-66-6	E420	0.0030	mg/L	0.0064	0.0065	0.0001	Diff <2x LOR	----
		zirconium, total	7440-67-7	E420	0.00020	mg/L	0.00054	0.00049	0.00005	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 754834)						
conductivity	----	E100	1	µS/cm	<1.0	----
Physical Tests (QCLot: 754835)						
alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Physical Tests (QCLot: 756131)						
solids, total dissolved [TDS]	----	E162	10	mg/L	<10	----
Physical Tests (QCLot: 757299)						
turbidity	----	E121	0.1	NTU	<0.10	----
Physical Tests (QCLot: 760306)						
colour, apparent	----	E330	2	CU	<2.0	----
Anions and Nutrients (QCLot: 754827)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 754828)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 754829)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 754830)						
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 754831)						
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Anions and Nutrients (QCLot: 754832)						
bromide	24959-67-9	E235.Br	0.1	mg/L	<0.10	----
Anions and Nutrients (QCLot: 755801)						
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-T	0.003	mg/L	<0.0030	----
Anions and Nutrients (QCLot: 756310)						
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Microbiological Tests (QCLot: 754757)						
coliforms, Escherichia coli [E. coli]	----	E012A.EC	1	CFU/100mL	<1	----
Microbiological Tests (QCLot: 754762)						
coliforms, total	----	E012.TC	1	CFU/100mL	<1	----
Microbiological Tests (QCLot: 754763)						
coliforms, total background	----	E012.BG.TC	1	CFU/100mL	<1	----
Total Metals (QCLot: 755030)						

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 755030) - continued						
aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----
antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
barium, total	7440-39-3	E420	0.0001	mg/L	<0.00010	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
boron, total	7440-42-8	E420	0.01	mg/L	<0.010	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
calcium, total	7440-70-2	E420	0.05	mg/L	<0.050	----
cesium, total	7440-46-2	E420	0.00001	mg/L	<0.000010	----
chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----
iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
lithium, total	7439-93-2	E420	0.001	mg/L	<0.0010	----
magnesium, total	7439-95-4	E420	0.005	mg/L	<0.0050	----
manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	<0.050	----
potassium, total	7440-09-7	E420	0.05	mg/L	<0.050	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	<0.00020	----
selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
silicon, total	7440-21-3	E420	0.1	mg/L	<0.10	----
silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
sodium, total	7440-23-5	E420	0.05	mg/L	<0.050	----
strontium, total	7440-24-6	E420	0.0002	mg/L	<0.00020	----
sulfur, total	7704-34-9	E420	0.5	mg/L	<0.50	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	<0.00020	----
thallium, total	7440-28-0	E420	0.00001	mg/L	<0.000010	----
thorium, total	7440-29-1	E420	0.0001	mg/L	<0.00010	----
tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	<0.00010	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 755030) - continued						
uranium, total	7440-61-1	E420	0.00001	mg/L	<0.000010	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	----
zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	<0.00020	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 754833)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 754834)									
conductivity	----	E100	1	µS/cm	1409 µS/cm	102	90.0	110	----
Physical Tests (QCLot: 754835)									
alkalinity, total (as CaCO3)	----	E290	1	mg/L	150 mg/L	99.6	85.0	115	----
Physical Tests (QCLot: 756131)									
solids, total dissolved [TDS]	----	E162	10	mg/L	1000 mg/L	99.4	85.0	115	----
Physical Tests (QCLot: 757299)									
turbidity	----	E121	0.1	NTU	200 NTU	96.4	85.0	115	----
Physical Tests (QCLot: 760306)									
colour, apparent	----	E330	2	CU	25 CU	99.3	70.0	130	----
Anions and Nutrients (QCLot: 754827)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 754828)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	99.8	90.0	110	----
Anions and Nutrients (QCLot: 754829)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	99.8	90.0	110	----
Anions and Nutrients (QCLot: 754830)									
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	98.6	90.0	110	----
Anions and Nutrients (QCLot: 754831)									
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	98.5	90.0	110	----
Anions and Nutrients (QCLot: 754832)									
bromide	24959-67-9	E235.Br	0.1	mg/L	0.5 mg/L	103	85.0	115	----
Anions and Nutrients (QCLot: 755801)									
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-T	0.003	mg/L	0.0212 mg/L	106	80.0	120	----
Anions and Nutrients (QCLot: 756310)									
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	96.5	85.0	115	----
Total Metals (QCLot: 755030)									
aluminum, total	7429-90-5	E420	0.003	mg/L	0.1 mg/L	103	80.0	120	----
antimony, total	7440-36-0	E420	0.0001	mg/L	0.05 mg/L	103	80.0	120	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Total Metals (QCLot: 755030) - continued									
arsenic, total	7440-38-2	E420	0.0001	mg/L	0.05 mg/L	108	80.0	120	----
barium, total	7440-39-3	E420	0.0001	mg/L	0.0125 mg/L	101	80.0	120	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	0.005 mg/L	99.2	80.0	120	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	0.05 mg/L	103	80.0	120	----
boron, total	7440-42-8	E420	0.01	mg/L	0.05 mg/L	95.6	80.0	120	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	0.005 mg/L	104	80.0	120	----
calcium, total	7440-70-2	E420	0.05	mg/L	2.5 mg/L	101	80.0	120	----
cesium, total	7440-46-2	E420	0.00001	mg/L	0.0025 mg/L	104	80.0	120	----
chromium, total	7440-47-3	E420	0.0005	mg/L	0.0125 mg/L	104	80.0	120	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	0.0125 mg/L	105	80.0	120	----
copper, total	7440-50-8	E420	0.0005	mg/L	0.0125 mg/L	102	80.0	120	----
iron, total	7439-89-6	E420	0.01	mg/L	0.05 mg/L	107	80.0	120	----
lead, total	7439-92-1	E420	0.00005	mg/L	0.025 mg/L	104	80.0	120	----
lithium, total	7439-93-2	E420	0.001	mg/L	0.0125 mg/L	98.9	80.0	120	----
magnesium, total	7439-95-4	E420	0.005	mg/L	2.5 mg/L	108	80.0	120	----
manganese, total	7439-96-5	E420	0.0001	mg/L	0.0125 mg/L	104	80.0	120	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.0125 mg/L	101	80.0	120	----
nickel, total	7440-02-0	E420	0.0005	mg/L	0.025 mg/L	104	80.0	120	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	0.5 mg/L	104	80.0	120	----
potassium, total	7440-09-7	E420	0.05	mg/L	2.5 mg/L	104	80.0	120	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	0.005 mg/L	107	80.0	120	----
selenium, total	7782-49-2	E420	0.00005	mg/L	0.05 mg/L	103	80.0	120	----
silicon, total	7440-21-3	E420	0.1	mg/L	0.5 mg/L	106	80.0	120	----
silver, total	7440-22-4	E420	0.00001	mg/L	0.005 mg/L	92.6	80.0	120	----
sodium, total	7440-23-5	E420	0.05	mg/L	2.5 mg/L	108	80.0	120	----
strontium, total	7440-24-6	E420	0.0002	mg/L	0.0125 mg/L	103	80.0	120	----
sulfur, total	7704-34-9	E420	0.5	mg/L	2.5 mg/L	99.4	80.0	120	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	0.005 mg/L	94.6	80.0	120	----
thallium, total	7440-28-0	E420	0.00001	mg/L	0.05 mg/L	105	80.0	120	----
thorium, total	7440-29-1	E420	0.0001	mg/L	0.005 mg/L	99.3	80.0	120	----
tin, total	7440-31-5	E420	0.0001	mg/L	0.025 mg/L	100	80.0	120	----
titanium, total	7440-32-6	E420	0.0003	mg/L	0.0125 mg/L	100	80.0	120	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	0.005 mg/L	101	80.0	120	----
uranium, total	7440-61-1	E420	0.00001	mg/L	0.00025 mg/L	105	80.0	120	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	0.025 mg/L	106	80.0	120	----
zinc, total	7440-66-6	E420	0.003	mg/L	0.025 mg/L	103	80.0	120	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Total Metals (QCLot: 755030) - continued									
zirconium, total	7440-67-7	E420	0.0002	mg/L	0.005 mg/L	100	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 754827)										
WT2222750-001	BH13	fluoride	16984-48-8	E235.F	5.11 mg/L	5 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 754828)										
WT2222750-001	BH13	sulfate (as SO4)	14808-79-8	E235.SO4	508 mg/L	500 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 754829)										
WT2222750-001	BH13	chloride	16887-00-6	E235.Cl	507 mg/L	500 mg/L	101	75.0	125	----
Anions and Nutrients (QCLot: 754830)										
WT2222750-001	BH13	nitrate (as N)	14797-55-8	E235.NO3	12.4 mg/L	12.5 mg/L	98.9	75.0	125	----
Anions and Nutrients (QCLot: 754831)										
WT2222750-001	BH13	nitrite (as N)	14797-65-0	E235.NO2	2.44 mg/L	2.5 mg/L	97.8	75.0	125	----
Anions and Nutrients (QCLot: 754832)										
WT2222750-001	BH13	bromide	24959-67-9	E235.Br	2.49 mg/L	2.5 mg/L	99.5	75.0	125	----
Anions and Nutrients (QCLot: 755801)										
WT2222604-001	Anonymous	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-T	ND mg/L	0.0196 mg/L	ND	70.0	130	----
Anions and Nutrients (QCLot: 756310)										
WT2222602-001	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.104 mg/L	0.1 mg/L	104	75.0	125	----
Total Metals (QCLot: 755030)										
TY2204274-001	Anonymous	aluminum, total	7429-90-5	E420	ND mg/L	0.1 mg/L	ND	70.0	130	----
		antimony, total	7440-36-0	E420	0.0519 mg/L	0.05 mg/L	104	70.0	130	----
		arsenic, total	7440-38-2	E420	0.0537 mg/L	0.05 mg/L	107	70.0	130	----
		barium, total	7440-39-3	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		beryllium, total	7440-41-7	E420	0.00474 mg/L	0.005 mg/L	94.9	70.0	130	----
		bismuth, total	7440-69-9	E420	0.0499 mg/L	0.05 mg/L	99.8	70.0	130	----
		boron, total	7440-42-8	E420	0.045 mg/L	0.05 mg/L	89.3	70.0	130	----
		cadmium, total	7440-43-9	E420	0.00522 mg/L	0.005 mg/L	104	70.0	130	----
		calcium, total	7440-70-2	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		cesium, total	7440-46-2	E420	0.00260 mg/L	0.0025 mg/L	104	70.0	130	----
		chromium, total	7440-47-3	E420	0.0130 mg/L	0.0125 mg/L	104	70.0	130	----
		cobalt, total	7440-48-4	E420	0.0128 mg/L	0.0125 mg/L	102	70.0	130	----
		copper, total	7440-50-8	E420	0.0121 mg/L	0.0125 mg/L	97.0	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Total Metals (QCLot: 755030) - continued										
TY2204274-001	Anonymous	iron, total	7439-89-6	E420	ND mg/L	0.05 mg/L	ND	70.0	130	----
		lead, total	7439-92-1	E420	0.0250 mg/L	0.025 mg/L	99.9	70.0	130	----
		lithium, total	7439-93-2	E420	0.0115 mg/L	0.0125 mg/L	92.3	70.0	130	----
		magnesium, total	7439-95-4	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		manganese, total	7439-96-5	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		molybdenum, total	7439-98-7	E420	0.0124 mg/L	0.0125 mg/L	99.4	70.0	130	----
		nickel, total	7440-02-0	E420	0.0254 mg/L	0.025 mg/L	102	70.0	130	----
		phosphorus, total	7723-14-0	E420	0.526 mg/L	0.5 mg/L	105	70.0	130	----
		potassium, total	7440-09-7	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		rubidium, total	7440-17-7	E420	ND mg/L	0.005 mg/L	ND	70.0	130	----
		selenium, total	7782-49-2	E420	0.0527 mg/L	0.05 mg/L	105	70.0	130	----
		silicon, total	7440-21-3	E420	ND mg/L	0.5 mg/L	ND	70.0	130	----
		silver, total	7440-22-4	E420	0.00460 mg/L	0.005 mg/L	92.0	70.0	130	----
		sodium, total	7440-23-5	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		strontium, total	7440-24-6	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		sulfur, total	7704-34-9	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		tellurium, total	13494-80-9	E420	0.00460 mg/L	0.005 mg/L	92.0	70.0	130	----
		thallium, total	7440-28-0	E420	0.0511 mg/L	0.05 mg/L	102	70.0	130	----
		thorium, total	7440-29-1	E420	0.00472 mg/L	0.005 mg/L	94.4	70.0	130	----
		tin, total	7440-31-5	E420	0.0251 mg/L	0.025 mg/L	100	70.0	130	----
		titanium, total	7440-32-6	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		tungsten, total	7440-33-7	E420	0.00492 mg/L	0.005 mg/L	98.4	70.0	130	----
		uranium, total	7440-61-1	E420	ND mg/L	0.00025 mg/L	ND	70.0	130	----
		vanadium, total	7440-62-2	E420	0.0259 mg/L	0.025 mg/L	104	70.0	130	----
		zinc, total	7440-66-6	E420	0.0239 mg/L	0.025 mg/L	95.8	70.0	130	----
		zirconium, total	7440-67-7	E420	0.00410 mg/L	0.005 mg/L	82.1	70.0	130	----

ALS Environmental
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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 - 792826

Page of

Report To	Contact and company name below will appear on the final report
Company:	Palmer
Contact:	Lauren Bourke
Phone:	519-671-1345
Company address below will appear on the final report	
Street:	74 Berkeley St
City/Province:	Toronto, ON
Postal Code:	M5A 2W3
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	Palmer
Contact:	accountspayable@pgis.ca

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	Lauren.bourke@pgis.ca
Email 2	frank.ma@pgis.ca
Email 3	
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	accountspayable@pgis.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%] ☐	EMERGENCY 1 Business day [E - 100%] ☐
3 day [P3-25%] ☐	Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
2 day [P2-50%] ☐	
For tests that can not be performed according to the service level select	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Re: B008162-Humber Station Rd	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):	WT2222750	ALS Contact:	Sampler:

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	# of Containers	Analysis (Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below)	SUSPECTED HAZARD (see Special Instructions)
	BH13	2022-11-21	19:45	GW	1	Drinking water standard	

Environmental Division Waterloo
Work Order Reference
WT2222750

Telephone : +1 519 886 6910

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	Compare to drinking water standard criteria
Are samples for human consumption/ use? ☐ YES ☑ NO	

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
0.02	3.6

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Lauren Bourke	Date: 2022-11-21	Time: 16:00	Received by:	Date: 21-NOV-22	Time: 16:10	Received by:	Date: 22/11/22	Time: 3:15p

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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

GC123, N433, MH449

ALS Canada Ltd.

CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2222750**	Page	: 1 of 6
Client	: **Palmer Environmental Consulting Group Inc.**	Laboratory	: Waterloo - Environmental
Contact	: Lauren Bourke	Account Manager	: Andrew Martin
Address	: 74 Berkeley Street Toronto ON Canada M5V 1E3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 2008162-HUMBER STATION RD	Date Samples Received	: 21-Nov-2022 16:10
PO	: ----	Date Analysis Commenced	: 23-Nov-2022
C-O-C number	: 17-792826	Issue Date	: 28-Nov-2022 17:34
Sampler	: ----		
Site	: ----		
Quote number	: (Q88296) PALMER 2022 STANDING OFFER		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Amanda Ganouri-Lumsden	Department Manager - Microbiology and Prep	Microbiology, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Inorganics, Waterloo, Ontario
Greg Pokocky	Supervisor - Inorganic	Metals, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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. Guidelines 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.

Key : LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
CFU/100mL	colony forming units per hundred millilitres
CU	colour units (1 cu = 1 mg/l pt)
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units

>: greater than.
<: less than.
Red shading is applied where the result is greater than the Guideline Upper Limit or the result is lower than the Guideline Lower Limit.
For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit .

Qualifiers

Qualifier	*Description*
DLDS	*Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.*
DLHC	*Detection Limit Raised: Dilution required due to high concentration of test analyte(s).*
DLM	*Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).*

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	Method	LOR	Unit	Client sample ID: BH13 Sampling date/time: 21-Nov-2022 14:45 WT2222750-001	ONDWS AO/OG	ONDWS MAC				
Physical Tests										
alkalinity, bicarbonate (as HCO3)	E290	1.0	mg/L	608	--	--	--	--	--	--
alkalinity, carbonate (as CO3)	E290	1.0	mg/L	<1.0	--	--	--	--	--	--
alkalinity, hydroxide (as OH)	E290	1.0	mg/L	<1.0	--	--	--	--	--	--
alkalinity, total (as CaCO3)	E290	1.0	mg/L	498	30 - 500 mg/L	--	--	--	--	--
colour, apparent	E330	2.0	CU	40.0	5 CU	--	--	--	--	--
conductivity	E100	1.0	µS/cm	1230	--	--	--	--	--	--
hardness (as CaCO3), from total Ca/Mg	EC100A	0.50	mg/L	664	--	--	--	--	--	--
pH	E108	0.10	pH units	7.94	6.5 - 8.5 pH units	--	--	--	--	--
solids, total dissolved [TDS], calculated	EC103A	1.0	mg/L	800	--	--	--	--	--	--
solids, total dissolved [TDS]	E162	10	mg/L	689 DLDS	500 mg/L	--	--	--	--	--
turbidity	E121	0.10	NTU	21.4	5 NTU	--	--	--	--	--
Langelier index (@ 20°C)	EC105A	0.010	-	1.03	--	--	--	--	--	--
Langelier index (@ 4°C)	EC105A	0.010	-	0.784	--	--	--	--	--	--
pH, saturation (@ 20°C)	EC105A	0.010	pH units	6.91	--	--	--	--	--	--
pH, saturation (@ 4°C)	EC105A	0.010	pH units	7.16	--	--	--	--	--	--
Anions and Nutrients										
ammonia, total (as N)	E298	0.0050	mg/L	0.0642	--	--	--	--	--	--
bromide	E235.Br	0.10	mg/L	<0.50 DLDS	--	--	--	--	--	--
chloride	E235.Cl	0.50	mg/L	9.33 DLDS	250 mg/L	--	--	--	--	--
fluoride	E235.F	0.020	mg/L	0.228 DLDS	--	1.5 mg/L	--	--	--	--
nitrate (as N)	E235.NO3	0.020	mg/L	<0.100 DLDS	--	10 mg/L	--	--	--	--
nitrate + nitrite (as N)	EC235.N+N	0.0032	mg/L	<0.112	--	10 mg/L	--	--	--	--
nitrite (as N)	E235.NO2	0.010	mg/L	<0.050 DLDS	--	1 mg/L	--	--	--	--
phosphate, ortho-, dissolved (as P)	E378-T	0.0030	mg/L	<0.0030	--	--	--	--	--	--
sulfate (as SO4)	E235.SO4	0.30	mg/L	202 DLDS	--	--	--	--	--	--
Microbiological Tests										
coliforms, Escherichia coli [E. coli]	E012A.EC	1	CFU/100mL	<1	--	1 CFU/100mL	--	--	--	--

Analyte	Method	LOR	Unit	WT2222750-001 (Continued)	ONDWS AO/OG	ONDWS MAC				
Microbiological Tests - Continued										
coliforms, total background	E012.BG.TC	1	CFU/100mL	10 DLM	--	--	--	--	--	--
coliforms, total	E012.TC	1	CFU/100mL	<10 DLM	--	1 CFU/100mL	--	--	--	--
Metals										
sodium adsorption ratio [SAR]	EC102	0.10	-	0.98	--	--	--	--	--	--
Ion Balance										
anion sum	EC101A	0.10	meq/L	14.4	--	--	--	--	--	--
cation sum (total)	EC101A	0.10	meq/L	16.0	--	--	--	--	--	--
ion balance (APHA)	EC101A	0.010	%	5.26	--	--	--	--	--	--
ion balance (cations/anions)	EC101A	0.01	%	111	--	--	--	--	--	--
Total Metals										
aluminum, total	E420	0.0030	mg/L	<0.0300 DLHC	0.1 mg/L	--	--	--	--	--
antimony, total	E420	0.00010	mg/L	0.00161 DLHC	--	0.006 mg/L	--	--	--	--
arsenic, total	E420	0.00010	mg/L	0.00225 DLHC	--	0.01 mg/L	--	--	--	--
barium, total	E420	0.00010	mg/L	0.0776 DLHC	--	1 mg/L	--	--	--	--
beryllium, total	E420	0.000020	mg/L	<0.000200 DLHC	--	--	--	--	--	--
bismuth, total	E420	0.000050	mg/L	<0.000500 DLHC	--	--	--	--	--	--
boron, total	E420	0.010	mg/L	0.102 DLHC	--	5 mg/L	--	--	--	--
cadmium, total	E420	0.0000050	mg/L	<0.0000500 DLHC	--	0.005 mg/L	--	--	--	--
calcium, total	E420	0.050	mg/L	79.8 DLHC	--	--	--	--	--	--
cesium, total	E420	0.000010	mg/L	<0.000100 DLHC	--	--	--	--	--	--
chromium, total	E420	0.00050	mg/L	<0.00500 DLHC	--	0.05 mg/L	--	--	--	--
cobalt, total	E420	0.00010	mg/L	<0.00100 DLHC	--	--	--	--	--	--
copper, total	E420	0.00050	mg/L	<0.00500 DLHC	1 mg/L	--	--	--	--	--
iron, total	E420	0.010	mg/L	<0.100 DLHC	0.3 mg/L	--	--	--	--	--
lead, total	E420	0.000050	mg/L	<0.000500 DLHC	--	0.01 mg/L	--	--	--	--
lithium, total	E420	0.0010	mg/L	0.0479 DLHC	--	--	--	--	--	--
magnesium, total	E420	0.0050	mg/L	113 DLHC	--	--	--	--	--	--
manganese, total	E420	0.00010	mg/L	0.120 DLHC	0.05 mg/L	--	--	--	--	--
molybdenum, total	E420	0.000050	mg/L	0.0457 DLHC	--	--	--	--	--	--
nickel, total	E420	0.00050	mg/L	<0.00500 DLHC	--	--	--	--	--	--
phosphorus, total	E420	0.050	mg/L	<0.500 DLHC	--	--	--	--	--	--
potassium, total	E420	0.050	mg/L	6.68 DLHC	--	--	--	--	--	--
rubidium, total	E420	0.00020	mg/L	0.00227 DLHC	--	--	--	--	--	--
selenium, total	E420	0.000050	mg/L	<0.000500 DLHC	--	0.05 mg/L	--	--	--	--
silicon (as SiO2), total	EC420.SiO2	0.25	mg/L	20.7	--	--	--	--	--	--
silicon, total	E420	0.10	mg/L	9.70 DLHC	--	--	--	--	--	--

Analyte	Method	LOR	Unit	WT2222750-001 (Continued)		ONDWS AO/OG	ONDWS MAC				
Total Metals - Continued											
silver, total	E420	0.000010	mg/L	<0.000100	DLHC	--	--	--	--	--	--
sodium, total	E420	0.050	mg/L	58.4	DLHC	200 mg/L	20 mg/L	--	--	--	--
strontium, total	E420	0.00020	mg/L	0.886	DLHC	--	--	--	--	--	--
sulfur, total	E420	0.50	mg/L	72.9	DLHC	--	--	--	--	--	--
tellurium, total	E420	0.00020	mg/L	<0.00200	DLHC	--	--	--	--	--	--
thallium, total	E420	0.000010	mg/L	<0.000100	DLHC	--	--	--	--	--	--
thorium, total	E420	0.00010	mg/L	<0.00100	DLHC	--	--	--	--	--	--
tin, total	E420	0.00010	mg/L	<0.00100	DLHC	--	--	--	--	--	--
titanium, total	E420	0.00030	mg/L	<0.00300	DLHC	--	--	--	--	--	--
tungsten, total	E420	0.00010	mg/L	<0.00100	DLHC	--	--	--	--	--	--
uranium, total	E420	0.000010	mg/L	0.00836	DLHC	--	0.02 mg/L	--	--	--	--
vanadium, total	E420	0.00050	mg/L	<0.00500	DLHC	--	--	--	--	--	--
zinc, total	E420	0.0030	mg/L	<0.0300	DLHC	5 mg/L	--	--	--	--	--
zirconium, total	E420	0.00020	mg/L	<0.00200	DLHC	--	--	--	--	--	--

Please refer to the General Comments section for an explanation of any qualifiers detected.

Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
BH13	Water	colour, apparent	May interfere with disinfection; removal is important to ensure effective treatment.	ONDWS	AO/OG	40.0 CU	5 CU
	Water	solids, total dissolved [TDS]	Based on taste; TDS above 500 mg/L results in excessive scaling in water pipes, water heaters, boilers and appliances; TDS is composed of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate and nitrate.	ONDWS	AO/OG	689 mg/L	500 mg/L
	Water	turbidity	Filtration systems should be designed and operated to reduce turbidity levels as low as reasonably achievable and strive to achieve a treated water turbidity target from individual filters of less than 0.1 NTU. Particles can harbour microorganisms, protecting them from disinfection, and can entrap heavy metals and biocides; elevated or fluctuating turbidity in filtered water can indicate a problem with the water treatment process and a potential increased risk of pathogens in treated water.	ONDWS	AO/OG	21.4 NTU	5 NTU
	Water	manganese, total	Based on taste and staining of laundry and plumbing fixtures.	ONDWS	AO/OG	0.120 mg/L	0.05 mg/L
	Water	coliforms, total	Total coliforms are not used as indicators of potential health effects from pathogenic microorganisms; they are used as a tool to determine how well the drinking water treatment system is operating and to indicate water quality changes in the distribution system. Detection of total coliforms from consecutive samples from the same site or from more than 10% of the samples collected in a given sampling period should be investigated.	ONDWS	MAC	<10	1 CFU/100mL
	Water	sodium, total	Based on taste; where a sodium-based water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended.	ONDWS	MAC	58.4 mg/L	20 mg/L

Key:

ONDWS	Ontario Drinking Water Regulation (JAN, 2020)
AO/OG	Aesthetic Objective/Operational Guideline
MAC	Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)

Maxxam
A Bureau Veritas Group Company

Your Project #: 2017-0293
Site#: BOLTON
Site Location: SOLMAR
Your C.O.C. #: 629279-01-01

Attention:Alireza Hejazi

Cole Engineering Group Ltd
70 Valleywood Dr
Markham, ON
CANADA L3R 4T5

Report Date: 2017/09/29
Report #: R4745503
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7K8760
Received: 2017/09/22, 14:25

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Dissolved Aluminum (0.2 u, clay free)	1	N/A	2017/09/25	CAM SOP-00447	EPA 6020B m
Alkalinity	1	N/A	2017/09/26	CAM SOP-00448	SM 22 2320 B m
Chromium (VI) in Water	1	N/A	2017/09/28	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	1	N/A	2017/09/27	CAM SOP-00457	OMOE E3015 m
Dissolved Oxygen	1	2017/09/23	2017/09/23	CAM SOP-00427	SM 22 4500 O G m
Hardness (calculated as CaCO3)	1	N/A	2017/09/26	CAM SOP 00102/00408/00447	SM 2340 B
Mercury	1	2017/09/26	2017/09/27	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by ICPMS	1	N/A	2017/09/28	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	1	N/A	2017/09/28	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (1)	1	N/A	2017/09/28	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2017/09/26	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2017/09/26	CAM SOP-00444	OMOE E3179 m
Field pH (2)	1	N/A	2017/09/28		Field pH Meter
Sulphide	1	N/A	2017/09/26	CAM SOP-00455	SM 22 4500-S G m
Field Temperature (2)	1	N/A	2017/09/28		Field Thermometer
Total Phosphorus (Colourimetric)	1	2017/09/27	2017/09/27	CAM SOP-00407	SM 22 4500 P B H m
Turbidity	1	N/A	2017/09/24	CAM SOP-00417	SM 22 2130 B m
Un-ionized Ammonia	1	2017/09/23	2017/09/29		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Your Project #: 2017-0293
Site#: BOLTON
Site Location: SOLMAR
Your C.O.C. #: 629279-01-01

Attention:Alireza Hejazi

Cole Engineering Group Ltd
70 Valleywood Dr
Markham, ON
CANADA L3R 4T5

Report Date: 2017/09/29
Report #: R4745503
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7K8760
Received: 2017/09/22, 14:25
agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(2) This is a field test, therefore, the results relate to items that were not analysed at Maxxam Analytics Inc.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jolanta Goralczyk, Project Manager
Email: JGoralczyk@maxxam.ca
Phone# (905)817-5751
==========
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK658		
Sampling Date			2017/09/22 10:15		
COC Number			629279-01-01		
	UNITS	Criteria	MW3-17	RDL	QC Batch
Calculated Parameters					
Hardness (CaCO3)	mg/L	-	560	1.0	5179429
Total Un-ionized Ammonia	mg/L	-	0.019	0.0022	5179420
Field Measurements					
Field Temperature	Celcius	-	13.79	N/A	ONSITE
Field pH	pH	6.5:8.5	8.17		ONSITE
Inorganics					
Total Ammonia-N	mg/L	-	0.44	0.050	5182709
Dissolved Oxygen	mg/L	-	4.47		5179915
pH	pH	6.5:8.5	8.05		5179875
Phenols-4AAP	mg/L	0.001	ND	0.0010	5183116
Total Phosphorus	mg/L	0.01	**1.4**	0.2	5184483
Sulphide	mg/L	0.02	ND	0.020	5181226
Turbidity	NTU	-	12	0.1	5179395
WAD Cyanide (Free)	ug/L	5	ND	1	5182547
Alkalinity (Total as CaCO3)	mg/L	-	250	1.0	5179872
Metals					
Dissolved (0.2u) Aluminum (Al)	ug/L	15	7	5	5179909
Chromium (VI)	ug/L	1	ND	0.50	5184085
Mercury (Hg)	ug/L	0.2	ND	0.1	5183039
Total Antimony (Sb)	ug/L	20	ND	0.50	5186729
Total Arsenic (As)	ug/L	100	2.2	1.0	5186729
Total Beryllium (Be)	ug/L	11	ND	0.50	5186729
Total Boron (B)	ug/L	200	**260**	10	5186729
Total Cadmium (Cd)	ug/L	0.2	ND	0.10	5186729
Total Chromium (Cr)	ug/L	-	ND	5.0	5186729
Total Cobalt (Co)	ug/L	0.9	ND	0.50	5186729
Total Copper (Cu)	ug/L	5	ND	1.0	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK658		
Sampling Date			2017/09/22 10:15		
COC Number			629279-01-01		
	UNITS	Criteria	MW3-17	RDL	QC Batch
Total Iron (Fe)	ug/L	300	ND	100	5186729
Total Lead (Pb)	ug/L	5	ND	0.50	5186729
Total Molybdenum (Mo)	ug/L	40	11	0.50	5186729
Total Nickel (Ni)	ug/L	25	1.9	1.0	5186729
Total Selenium (Se)	ug/L	100	ND	2.0	5186729
Total Silver (Ag)	ug/L	0.1	ND	0.10	5186729
Total Thallium (Tl)	ug/L	0.3	ND	0.050	5186729
Total Tungsten (W)	ug/L	30	ND	1.0	5186729
Total Uranium (U)	ug/L	5	3.4	0.10	5186729
Total Vanadium (V)	ug/L	6	2.1	0.50	5186729
Total Zinc (Zn)	ug/L	30	ND	5.0	5186729
Total Zirconium (Zr)	ug/L	4	ND	1.0	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

RESULTS OF ANALYSES OF WATER

Maxxam ID		FEK658		
Sampling Date		2017/09/22 10:15		
COC Number		629279-01-01		
	UNITS	MW3-17	RDL	QC Batch
Inorganics				
Nitrite (N)	mg/L	ND	0.010	5185563
Nitrate (N)	mg/L	ND	0.10	5185563
Nitrate + Nitrite (N)	mg/L	ND	0.10	5185563

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK656
Sample ID: MW1-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK656 Dup
Sample ID: MW1-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya

Maxxam ID: FEK657
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/25	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/25	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK657
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK657 Dup
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5179872	N/A	2017/09/25	Surinder Rai
pH	AT	5179875	N/A	2017/09/25	Surinder Rai

Maxxam ID: FEK658
Sample ID: MW3-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/26	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5185563	N/A	2017/09/28	Chandra Nandlal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5183116	N/A	2017/09/26	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK659
Sample ID: MW4-17D
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK659
Sample ID: MW4-17D
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181239	N/A	2017/09/25	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	13.3°C

Results relate only to the items tested.

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
5179395	Turbidity	2017/09/24			101	85 - 115	ND, RDL=0.1	NTU	2.8	20		
5179872	Alkalinity (Total as CaCO3)	2017/09/25			97	85 - 115	ND, RDL=1.0	mg/L	0.70	20		
5179875	pH	2017/09/25			101	98 - 103			0.63	N/A		
5179909	Dissolved (0.2u) Aluminum (Al)	2017/09/25	110	80 - 120	102	80 - 120	ND,RDL=5	ug/L	NC	20		
5181226	Sulphide	2017/09/26	109	80 - 120	98	80 - 120	ND, RDL=0.020	mg/L	NC	20		
5181239	Sulphide	2017/09/25	96	80 - 120	105	80 - 120	ND, RDL=0.020	mg/L	3.8	20		
5181316	Nitrate (N)	2017/09/26	100	80 - 120	101	80 - 120	ND, RDL=0.10	mg/L	NC	20		
5181316	Nitrite (N)	2017/09/26	101	80 - 120	100	80 - 120	ND, RDL=0.010	mg/L				
5182547	WAD Cyanide (Free)	2017/09/27	103	80 - 120	101	80 - 120	ND,RDL=1	ug/L	NC	20		
5182709	Total Ammonia-N	2017/09/28	99	80 - 120	99	85 - 115	ND, RDL=0.050	mg/L	6.1	20		
5183039	Mercury (Hg)	2017/09/27	100	75 - 125	102	80 - 120	ND, RDL=0.1	ug/L	NC	20		
5183116	Phenols-4AAP	2017/09/26	94	80 - 120	96	85 - 115	ND, RDL=0.0010	mg/L	NC	20		
5184085	Chromium (VI)	2017/09/28	101	80 - 120	102	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5184483	Total Phosphorus	2017/09/27	96	80 - 120	92	80 - 120	ND, RDL=0.004	mg/L	NC	20	93	80 - 120
5185031	Phenols-4AAP	2017/09/27	97	80 - 120	99	85 - 115	ND, RDL=0.0010	mg/L	NC	20		
5185563	Nitrate (N)	2017/09/28	84	80 - 120	98	80 - 120	ND, RDL=0.10	mg/L	NC	20		
5185563	Nitrite (N)	2017/09/28	103	80 - 120	103	80 - 120	ND, RDL=0.010	mg/L				
5186729	Total Antimony (Sb)	2017/09/28	110	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5186729	Total Arsenic (As)	2017/09/28	104	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L	10	20		
5186729	Total Beryllium (Be)	2017/09/28	106	80 - 120	101	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5186729	Total Boron (B)	2017/09/28	102	80 - 120	98	80 - 120	ND, RDL=10	ug/L	5.1	20		
5186729	Total Cadmium (Cd)	2017/09/28	105	80 - 120	99	80 - 120	ND, RDL=0.10	ug/L	NC	20		
5186729	Total Chromium (Cr)	2017/09/28	104	80 - 120	100	80 - 120	ND, RDL=5.0	ug/L	NC	20		
5186729	Total Cobalt (Co)	2017/09/28	107	80 - 120	103	80 - 120	ND, RDL=0.50	ug/L	5.4	20		
5186729	Total Copper (Cu)	2017/09/28	108	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	9.7	20		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
5186729	Total Iron (Fe)	2017/09/28	105	80 - 120	101	80 - 120	ND, RDL=100	ug/L	2.3	20		
5186729	Total Lead (Pb)	2017/09/28	102	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	0.80	20		
5186729	Total Molybdenum (Mo)	2017/09/28	108	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	0.14	20		
5186729	Total Nickel (Ni)	2017/09/28	100	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	8.1	20		
5186729	Total Selenium (Se)	2017/09/28	103	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L	NC	20		
5186729	Total Silver (Ag)	2017/09/28	101	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20		
5186729	Total Thallium (Tl)	2017/09/28	101	80 - 120	102	80 - 120	ND, RDL=0.050	ug/L	NC	20		
5186729	Total Tungsten (W)	2017/09/28	112	80 - 120	108	80 - 120	ND, RDL=1.0	ug/L	NC	20		
5186729	Total Uranium (U)	2017/09/28	106	80 - 120	102	80 - 120	ND, RDL=0.10	ug/L	7.8	20		
5186729	Total Vanadium (V)	2017/09/28	101	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	0.15	20		
5186729	Total Zinc (Zn)	2017/09/28	105	80 - 120	102	80 - 120	ND, RDL=5.0	ug/L	NC	20		
5186729	Total Zirconium (Zr)	2017/09/28	106	80 - 120	95	80 - 120	ND, RDL=1.0	ug/L	NC	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Brad Newman, Scientific Service Specialist

Cristina Carriere, Scientific Service Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam
A Bureau Veritas Group Company

Your Project #: 2017-0293
Site#: BOLTON
Site Location: SOLMAR
Your C.O.C. #: 629279-01-01

Attention:Alireza Hejazi

Cole Engineering Group Ltd
70 Valleywood Dr
Markham, ON
CANADA L3R 4T5

Report Date: 2017/09/29
Report #: R4745503
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7K8760
Received: 2017/09/22, 14:25

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Dissolved Aluminum (0.2 u, clay free)	1	N/A	2017/09/25	CAM SOP-00447	EPA 6020B m
Alkalinity	1	N/A	2017/09/26	CAM SOP-00448	SM 22 2320 B m
Chromium (VI) in Water	1	N/A	2017/09/28	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	1	N/A	2017/09/27	CAM SOP-00457	OMOE E3015 m
Dissolved Oxygen	1	2017/09/23	2017/09/23	CAM SOP-00427	SM 22 4500 O G m
Hardness (calculated as CaCO3)	1	N/A	2017/09/27	CAM SOP 00102/00408/00447	SM 2340 B
Mercury	1	2017/09/26	2017/09/27	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by ICPMS	1	N/A	2017/09/28	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	1	N/A	2017/09/28	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (1)	1	N/A	2017/09/26	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2017/09/26	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2017/09/27	CAM SOP-00444	OMOE E3179 m
Field pH (2)	1	N/A	2017/09/28		Field pH Meter
Sulphide	1	N/A	2017/09/25	CAM SOP-00455	SM 22 4500-S G m
Field Temperature (2)	1	N/A	2017/09/28		Field Thermometer
Total Phosphorus (Colourimetric)	1	2017/09/27	2017/09/27	CAM SOP-00407	SM 22 4500 P B H m
Turbidity	1	N/A	2017/09/24	CAM SOP-00417	SM 22 2130 B m
Un-ionized Ammonia	1	2017/09/23	2017/09/29		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise

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Your Project #: 2017-0293
Site#: BOLTON
Site Location: SOLMAR
Your C.O.C. #: 629279-01-01

Attention:Alireza Hejazi

Cole Engineering Group Ltd
70 Valleywood Dr
Markham, ON
CANADA L3R 4T5

Report Date: 2017/09/29
Report #: R4745503
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7K8760
Received: 2017/09/22, 14:25
agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(2) This is a field test, therefore, the results relate to items that were not analysed at Maxxam Analytics Inc.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jolanta Goralczyk, Project Manager
Email: JGoralczyk@maxxam.ca
Phone# (905)817-5751
==========
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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK659		
Sampling Date			2017/09/22 10:50		
COC Number			629279-01-01		
	UNITS	Criteria	MW4-17D	RDL	QC Batch
Calculated Parameters					
Hardness (CaCO3)	mg/L	-	310	1.0	5179429
Total Un-ionized Ammonia	mg/L	-	0.067	0.005	5179420
Field Measurements					
Field Temperature	Celcius	-	13.15	N/A	ONSITE
Field pH	pH	6.5:8.5	**8.58**		ONSITE
Inorganics					
Total Ammonia-N	mg/L	-	0.67	0.050	5182709
Dissolved Oxygen	mg/L	-	2.84		5179915
pH	pH	6.5:8.5	8.36		5179875
Phenols-4AAP	mg/L	0.001	ND	0.0010	5185031
Total Phosphorus	mg/L	0.01	**3.3**	0.2	5184483
Sulphide	mg/L	0.02	ND	0.020	5181239
Turbidity	NTU	-	3000	0.5	5179395
WAD Cyanide (Free)	ug/L	5	ND	1	5182547
Alkalinity (Total as CaCO3)	mg/L	-	340	1.0	5179872
Metals					
Dissolved (0.2u) Aluminum (Al)	ug/L	15	ND	5	5179909
Chromium (VI)	ug/L	1	ND	0.50	5184085
Mercury (Hg)	ug/L	0.2	ND	0.1	5183039
Total Antimony (Sb)	ug/L	20	0.94	0.50	5186729
Total Arsenic (As)	ug/L	100	2.8	1.0	5186729
Total Beryllium (Be)	ug/L	11	ND	0.50	5186729
Total Boron (B)	ug/L	200	110	10	5186729
Total Cadmium (Cd)	ug/L	0.2	ND	0.10	5186729
Total Chromium (Cr)	ug/L	-	ND	5.0	5186729
Total Cobalt (Co)	ug/L	0.9	**2.5**	0.50	5186729
Total Copper (Cu)	ug/L	5	**5.5**	1.0	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected
N/A = Not Applicable

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK659		
Sampling Date			2017/09/22 10:50		
COC Number			629279-01-01		
	UNITS	Criteria	MW4-17D	RDL	QC Batch
Total Iron (Fe)	ug/L	300	**5400**	100	5186729
Total Lead (Pb)	ug/L	5	2.5	0.50	5186729
Total Molybdenum (Mo)	ug/L	40	8.4	0.50	5186729
Total Nickel (Ni)	ug/L	25	5.2	1.0	5186729
Total Selenium (Se)	ug/L	100	ND	2.0	5186729
Total Silver (Ag)	ug/L	0.1	ND	0.10	5186729
Total Thallium (Tl)	ug/L	0.3	ND	0.050	5186729
Total Tungsten (W)	ug/L	30	ND	1.0	5186729
Total Uranium (U)	ug/L	5	1.2	0.10	5186729
Total Vanadium (V)	ug/L	6	**7.4**	0.50	5186729
Total Zinc (Zn)	ug/L	30	21	5.0	5186729
Total Zirconium (Zr)	ug/L	4	1.1	1.0	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

RESULTS OF ANALYSES OF WATER

Maxxam ID		FEK659		
Sampling Date		2017/09/22 10:50		
COC Number		629279-01-01		
	UNITS	MW4-17D	RDL	QC Batch
Inorganics				
Nitrite (N)	mg/L	ND	0.010	5181316
Nitrate (N)	mg/L	ND	0.10	5181316
Nitrate + Nitrite (N)	mg/L	ND	0.10	5181316

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK656
Sample ID: MW1-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK656 Dup
Sample ID: MW1-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya

Maxxam ID: FEK657
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/25	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/25	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK657
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK657 Dup
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5179872	N/A	2017/09/25	Surinder Rai
pH	AT	5179875	N/A	2017/09/25	Surinder Rai

Maxxam ID: FEK658
Sample ID: MW3-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/26	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5185563	N/A	2017/09/28	Chandra Nandlal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5183116	N/A	2017/09/26	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK659
Sample ID: MW4-17D
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK659
Sample ID: MW4-17D
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181239	N/A	2017/09/25	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	13.3°C

Results relate only to the items tested.

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
5179395	Turbidity	2017/09/24			101	85 - 115	ND, RDL=0.1	NTU	2.8	20		
5179872	Alkalinity (Total as CaCO3)	2017/09/25			97	85 - 115	ND, RDL=1.0	mg/L	0.70	20		
5179875	pH	2017/09/25			101	98 - 103			0.63	N/A		
5179909	Dissolved (0.2u) Aluminum (Al)	2017/09/25	110	80 - 120	102	80 - 120	ND,RDL=5	ug/L	NC	20		
5181226	Sulphide	2017/09/26	109	80 - 120	98	80 - 120	ND, RDL=0.020	mg/L	NC	20		
5181239	Sulphide	2017/09/25	96	80 - 120	105	80 - 120	ND, RDL=0.020	mg/L	3.8	20		
5181316	Nitrate (N)	2017/09/26	100	80 - 120	101	80 - 120	ND, RDL=0.10	mg/L	NC	20		
5181316	Nitrite (N)	2017/09/26	101	80 - 120	100	80 - 120	ND, RDL=0.010	mg/L				
5182547	WAD Cyanide (Free)	2017/09/27	103	80 - 120	101	80 - 120	ND,RDL=1	ug/L	NC	20		
5182709	Total Ammonia-N	2017/09/28	99	80 - 120	99	85 - 115	ND, RDL=0.050	mg/L	6.1	20		
5183039	Mercury (Hg)	2017/09/27	100	75 - 125	102	80 - 120	ND, RDL=0.1	ug/L	NC	20		
5183116	Phenols-4AAP	2017/09/26	94	80 - 120	96	85 - 115	ND, RDL=0.0010	mg/L	NC	20		
5184085	Chromium (VI)	2017/09/28	101	80 - 120	102	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5184483	Total Phosphorus	2017/09/27	96	80 - 120	92	80 - 120	ND, RDL=0.004	mg/L	NC	20	93	80 - 120
5185031	Phenols-4AAP	2017/09/27	97	80 - 120	99	85 - 115	ND, RDL=0.0010	mg/L	NC	20		
5185563	Nitrate (N)	2017/09/28	84	80 - 120	98	80 - 120	ND, RDL=0.10	mg/L	NC	20		
5185563	Nitrite (N)	2017/09/28	103	80 - 120	103	80 - 120	ND, RDL=0.010	mg/L				
5186729	Total Antimony (Sb)	2017/09/28	110	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5186729	Total Arsenic (As)	2017/09/28	104	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L	10	20		
5186729	Total Beryllium (Be)	2017/09/28	106	80 - 120	101	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5186729	Total Boron (B)	2017/09/28	102	80 - 120	98	80 - 120	ND, RDL=10	ug/L	5.1	20		
5186729	Total Cadmium (Cd)	2017/09/28	105	80 - 120	99	80 - 120	ND, RDL=0.10	ug/L	NC	20		
5186729	Total Chromium (Cr)	2017/09/28	104	80 - 120	100	80 - 120	ND, RDL=5.0	ug/L	NC	20		
5186729	Total Cobalt (Co)	2017/09/28	107	80 - 120	103	80 - 120	ND, RDL=0.50	ug/L	5.4	20		
5186729	Total Copper (Cu)	2017/09/28	108	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	9.7	20		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
5186729	Total Iron (Fe)	2017/09/28	105	80 - 120	101	80 - 120	ND, RDL=100	ug/L	2.3	20		
5186729	Total Lead (Pb)	2017/09/28	102	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	0.80	20		
5186729	Total Molybdenum (Mo)	2017/09/28	108	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	0.14	20		
5186729	Total Nickel (Ni)	2017/09/28	100	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	8.1	20		
5186729	Total Selenium (Se)	2017/09/28	103	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L	NC	20		
5186729	Total Silver (Ag)	2017/09/28	101	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20		
5186729	Total Thallium (Tl)	2017/09/28	101	80 - 120	102	80 - 120	ND, RDL=0.050	ug/L	NC	20		
5186729	Total Tungsten (W)	2017/09/28	112	80 - 120	108	80 - 120	ND, RDL=1.0	ug/L	NC	20		
5186729	Total Uranium (U)	2017/09/28	106	80 - 120	102	80 - 120	ND, RDL=0.10	ug/L	7.8	20		
5186729	Total Vanadium (V)	2017/09/28	101	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	0.15	20		
5186729	Total Zinc (Zn)	2017/09/28	105	80 - 120	102	80 - 120	ND, RDL=5.0	ug/L	NC	20		
5186729	Total Zirconium (Zr)	2017/09/28	106	80 - 120	95	80 - 120	ND, RDL=1.0	ug/L	NC	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Brad Newman, Scientific Service Specialist

Cristina Carriere, Scientific Service Specialist

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Maxxam
A Bureau Veritas Group Company

Your Project #: 2017-0293
Site#: BOLTON
Site Location: SOLMAR
Your C.O.C. #: 629279-01-01

Attention:Alireza Hejazi

Cole Engineering Group Ltd
70 Valleywood Dr
Markham, ON
CANADA L3R 4T5

Report Date: 2017/09/29
Report #: R4745503
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7K8760
Received: 2017/09/22, 14:25

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Dissolved Aluminum (0.2 u, clay free)	4	N/A	2017/09/25	CAM SOP-00447	EPA 6020B m
Alkalinity	1	N/A	2017/09/25	CAM SOP-00448	SM 22 2320 B m
Alkalinity	3	N/A	2017/09/26	CAM SOP-00448	SM 22 2320 B m
Chromium (VI) in Water	4	N/A	2017/09/28	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	4	N/A	2017/09/27	CAM SOP-00457	OMOE E3015 m
Dissolved Oxygen	4	2017/09/23	2017/09/23	CAM SOP-00427	SM 22 4500 O G m
Hardness (calculated as CaCO3)	1	N/A	2017/09/26	CAM SOP 00102/00408/00447	SM 2340 B
Hardness (calculated as CaCO3)	3	N/A	2017/09/27	CAM SOP 00102/00408/00447	SM 2340 B
Mercury	4	2017/09/26	2017/09/27	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by ICPMS	4	N/A	2017/09/28	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	4	N/A	2017/09/28	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (1)	3	N/A	2017/09/26	CAM SOP-00440	SM 22 4500-NO3I/NO2B
Nitrate (NO3) and Nitrite (NO2) in Water (1)	1	N/A	2017/09/28	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2017/09/25	CAM SOP-00413	SM 4500H+ B m
pH	3	N/A	2017/09/26	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2017/09/26	CAM SOP-00444	OMOE E3179 m
Phenols (4AAP)	3	N/A	2017/09/27	CAM SOP-00444	OMOE E3179 m
Field pH (2)	4	N/A	2017/09/28		Field pH Meter
Sulphide	1	N/A	2017/09/25	CAM SOP-00455	SM 22 4500-S G m
Sulphide	3	N/A	2017/09/26	CAM SOP-00455	SM 22 4500-S G m
Field Temperature (2)	4	N/A	2017/09/28		Field Thermometer
Total Phosphorus (Colourimetric)	4	2017/09/27	2017/09/27	CAM SOP-00407	SM 22 4500 P B H m
Turbidity	4	N/A	2017/09/24	CAM SOP-00417	SM 22 2130 B m
Un-ionized Ammonia	4	2017/09/23	2017/09/29		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

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Your Project #: 2017-0293
Site#: BOLTON
Site Location: SOLMAR
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Attention:Alireza Hejazi

Cole Engineering Group Ltd
70 Valleywood Dr
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CANADA L3R 4T5

Report Date: 2017/09/29
Report #: R4745503
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CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7K8760
Received: 2017/09/22, 14:25

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(2) This is a field test, therefore, the results relate to items that were not analysed at Maxxam Analytics Inc.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jolanta Goralczyk, Project Manager
Email: JGoralczyk@maxxam.ca
Phone# (905)817-5751

==========

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK656	FEK656		FEK657	FEK657		
Sampling Date			2017/09/22 12:45	2017/09/22 12:45		2017/09/22 11:50	2017/09/22 11:50		
COC Number			629279-01-01	629279-01-01		629279-01-01	629279-01-01		
	UNITS	Criteria	MW1-17	MW1-17 Lab-Dup	RDL	MW5-17S	MW5-17S Lab-Dup	RDL	QC Batch
Calculated Parameters									
Hardness (CaCO3)	mg/L	-	590		1.0	230		1.0	5179429
Total Un-ionized Ammonia	mg/L	-	0.0037		0.0016	0.11		0.0054	5179420
Field Measurements									
Field Temperature	Celcius	-	15.7		N/A	14.7		N/A	ONSITE
Field pH	pH	6.5:8.5	7.98			**8.56**			ONSITE
Inorganics									
Total Ammonia-N	mg/L	-	0.11		0.050	1.0		0.050	5182709
Dissolved Oxygen	mg/L	-	5.77	5.82		3.94			5179915
pH	pH	6.5:8.5	8.02			8.06	8.12		5179875
Phenols-4AAP	mg/L	0.001	ND		0.0010	ND		0.0010	5185031
Total Phosphorus	mg/L	0.01	**0.36**		0.02	**0.8**		0.1	5184483
Sulphide	mg/L	0.02	ND		0.020	ND		0.020	5181226
Turbidity	NTU	-	6.1		0.1	28		0.1	5179395
WAD Cyanide (Free)	ug/L	5	ND		1	ND		1	5182547
Alkalinity (Total as CaCO3)	mg/L	-	520		1.0	110	110	1.0	5179872
Metals									
Dissolved (0.2u) Aluminum (Al)	ug/L	15	ND		5	6		5	5179909
Chromium (VI)	ug/L	1	ND	ND	0.50	ND		0.50	5184085
Mercury (Hg)	ug/L	0.2	ND		0.1	ND		0.1	5183039
Total Antimony (Sb)	ug/L	20	ND		0.50	0.58		0.50	5186729
Total Arsenic (As)	ug/L	100	ND		1.0	ND		1.0	5186729
Total Beryllium (Be)	ug/L	11	ND		0.50	ND		0.50	5186729
Total Boron (B)	ug/L	200	110		10	**420**		10	5186729
Total Cadmium (Cd)	ug/L	0.2	ND		0.10	ND		0.10	5186729
Total Chromium (Cr)	ug/L	-	ND		5.0	ND		5.0	5186729
Total Cobalt (Co)	ug/L	0.9	ND		0.50	ND		0.50	5186729
Total Copper (Cu)	ug/L	5	1.6		1.0	1.3		1.0	5186729
Total Iron (Fe)	ug/L	300	ND		100	ND		100	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK656	FEK656		FEK657	FEK657		
Sampling Date			2017/09/22 12:45	2017/09/22 12:45		2017/09/22 11:50	2017/09/22 11:50		
COC Number			629279-01-01	629279-01-01		629279-01-01	629279-01-01		
	UNITS	Criteria	MW1-17	MW1-17 Lab-Dup	RDL	MW5-17S	MW5-17S Lab-Dup	RDL	QC Batch
Total Lead (Pb)	ug/L	5	ND		0.50	ND		0.50	5186729
Total Molybdenum (Mo)	ug/L	40	6.9		0.50	5.9		0.50	5186729
Total Nickel (Ni)	ug/L	25	2.6		1.0	ND		1.0	5186729
Total Selenium (Se)	ug/L	100	ND		2.0	ND		2.0	5186729
Total Silver (Ag)	ug/L	0.1	ND		0.10	ND		0.10	5186729
Total Thallium (Tl)	ug/L	0.3	ND		0.050	ND		0.050	5186729
Total Tungsten (W)	ug/L	30	ND		1.0	ND		1.0	5186729
Total Uranium (U)	ug/L	5	**9.2**		0.10	1.2		0.10	5186729
Total Vanadium (V)	ug/L	6	ND		0.50	0.74		0.50	5186729
Total Zinc (Zn)	ug/L	30	ND		5.0	ND		5.0	5186729
Total Zirconium (Zr)	ug/L	4	ND		1.0	ND		1.0	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK658			FEK659		
Sampling Date			2017/09/22 10:15			2017/09/22 10:50		
COC Number			629279-01-01			629279-01-01		
	UNITS	Criteria	MW3-17	RDL	QC Batch	MW4-17D	RDL	QC Batch
Calculated Parameters								
Hardness (CaCO3)	mg/L	-	560	1.0	5179429	310	1.0	5179429
Total Un-ionized Ammonia	mg/L	-	0.019	0.0022	5179420	0.067	0.005	5179420
Field Measurements								
Field Temperature	Celcius	-	13.79	N/A	ONSITE	13.15	N/A	ONSITE
Field pH	pH	6.5:8.5	8.17		ONSITE	**8.58**		ONSITE
Inorganics								
Total Ammonia-N	mg/L	-	0.44	0.050	5182709	0.67	0.050	5182709
Dissolved Oxygen	mg/L	-	4.47		5179915	2.84		5179915
pH	pH	6.5:8.5	8.05		5179875	8.36		5179875
Phenols-4AAP	mg/L	0.001	ND	0.0010	5183116	ND	0.0010	5185031
Total Phosphorus	mg/L	0.01	**1.4**	0.2	5184483	**3.3**	0.2	5184483
Sulphide	mg/L	0.02	ND	0.020	5181226	ND	0.020	5181239
Turbidity	NTU	-	12	0.1	5179395	3000	0.5	5179395
WAD Cyanide (Free)	ug/L	5	ND	1	5182547	ND	1	5182547
Alkalinity (Total as CaCO3)	mg/L	-	250	1.0	5179872	340	1.0	5179872
Metals								
Dissolved (0.2u) Aluminum (Al)	ug/L	15	7	5	5179909	ND	5	5179909
Chromium (VI)	ug/L	1	ND	0.50	5184085	ND	0.50	5184085
Mercury (Hg)	ug/L	0.2	ND	0.1	5183039	ND	0.1	5183039
Total Antimony (Sb)	ug/L	20	ND	0.50	5186729	0.94	0.50	5186729
Total Arsenic (As)	ug/L	100	2.2	1.0	5186729	2.8	1.0	5186729
Total Beryllium (Be)	ug/L	11	ND	0.50	5186729	ND	0.50	5186729
Total Boron (B)	ug/L	200	**260**	10	5186729	110	10	5186729
Total Cadmium (Cd)	ug/L	0.2	ND	0.10	5186729	ND	0.10	5186729
Total Chromium (Cr)	ug/L	-	ND	5.0	5186729	ND	5.0	5186729
Total Cobalt (Co)	ug/L	0.9	ND	0.50	5186729	**2.5**	0.50	5186729
Total Copper (Cu)	ug/L	5	ND	1.0	5186729	**5.5**	1.0	5186729
Total Iron (Fe)	ug/L	300	ND	100	5186729	**5400**	100	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
N/A = Not Applicable
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK658			FEK659		
Sampling Date			2017/09/22 10:15			2017/09/22 10:50		
COC Number			629279-01-01			629279-01-01		
	UNITS	Criteria	MW3-17	RDL	QC Batch	MW4-17D	RDL	QC Batch
Total Lead (Pb)	ug/L	5	ND	0.50	5186729	2.5	0.50	5186729
Total Molybdenum (Mo)	ug/L	40	11	0.50	5186729	8.4	0.50	5186729
Total Nickel (Ni)	ug/L	25	1.9	1.0	5186729	5.2	1.0	5186729
Total Selenium (Se)	ug/L	100	ND	2.0	5186729	ND	2.0	5186729
Total Silver (Ag)	ug/L	0.1	ND	0.10	5186729	ND	0.10	5186729
Total Thallium (Tl)	ug/L	0.3	ND	0.050	5186729	ND	0.050	5186729
Total Tungsten (W)	ug/L	30	ND	1.0	5186729	ND	1.0	5186729
Total Uranium (U)	ug/L	5	3.4	0.10	5186729	1.2	0.10	5186729
Total Vanadium (V)	ug/L	6	2.1	0.50	5186729	**7.4**	0.50	5186729
Total Zinc (Zn)	ug/L	30	ND	5.0	5186729	21	5.0	5186729
Total Zirconium (Zr)	ug/L	4	ND	1.0	5186729	1.1	1.0	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

RESULTS OF ANALYSES OF WATER

Maxxam ID		FEK656	FEK657		FEK658		FEK659		
Sampling Date		2017/09/22 12:45	2017/09/22 11:50		2017/09/22 10:15		2017/09/22 10:50		
COC Number		629279-01-01	629279-01-01		629279-01-01		629279-01-01		
	UNITS	MW1-17	MW5-17S	QC Batch	MW3-17	QC Batch	MW4-17D	RDL	QC Batch
Inorganics									
Nitrite (N)	mg/L	ND	0.013	5181316	ND	5185563	ND	0.010	5181316
Nitrate (N)	mg/L	ND	ND	5181316	ND	5185563	ND	0.10	5181316
Nitrate + Nitrite (N)	mg/L	ND	ND	5181316	ND	5185563	ND	0.10	5181316

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK656
Sample ID: MW1-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK656 Dup
Sample ID: MW1-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya

Maxxam ID: FEK657
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/25	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/25	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK657
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK657 Dup
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5179872	N/A	2017/09/25	Surinder Rai
pH	AT	5179875	N/A	2017/09/25	Surinder Rai

Maxxam ID: FEK658
Sample ID: MW3-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/26	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5185563	N/A	2017/09/28	Chandra Nandlal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5183116	N/A	2017/09/26	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK659
Sample ID: MW4-17D
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK659
Sample ID: MW4-17D
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181239	N/A	2017/09/25	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	13.3°C

Results relate only to the items tested.

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
5179395	Turbidity	2017/09/24			101	85 - 115	ND, RDL=0.1	NTU	2.8	20		
5179872	Alkalinity (Total as CaCO3)	2017/09/25			97	85 - 115	ND, RDL=1.0	mg/L	0.70	20		
5179875	pH	2017/09/25			101	98 - 103			0.63	N/A		
5179909	Dissolved (0.2u) Aluminum (Al)	2017/09/25	110	80 - 120	102	80 - 120	ND,RDL=5	ug/L	NC	20		
5181226	Sulphide	2017/09/26	109	80 - 120	98	80 - 120	ND, RDL=0.020	mg/L	NC	20		
5181239	Sulphide	2017/09/25	96	80 - 120	105	80 - 120	ND, RDL=0.020	mg/L	3.8	20		
5181316	Nitrate (N)	2017/09/26	100	80 - 120	101	80 - 120	ND, RDL=0.10	mg/L	NC	20		
5181316	Nitrite (N)	2017/09/26	101	80 - 120	100	80 - 120	ND, RDL=0.010	mg/L				
5182547	WAD Cyanide (Free)	2017/09/27	103	80 - 120	101	80 - 120	ND,RDL=1	ug/L	NC	20		
5182709	Total Ammonia-N	2017/09/28	99	80 - 120	99	85 - 115	ND, RDL=0.050	mg/L	6.1	20		
5183039	Mercury (Hg)	2017/09/27	100	75 - 125	102	80 - 120	ND, RDL=0.1	ug/L	NC	20		
5183116	Phenols-4AAP	2017/09/26	94	80 - 120	96	85 - 115	ND, RDL=0.0010	mg/L	NC	20		
5184085	Chromium (VI)	2017/09/28	101	80 - 120	102	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5184483	Total Phosphorus	2017/09/27	96	80 - 120	92	80 - 120	ND, RDL=0.004	mg/L	NC	20	93	80 - 120
5185031	Phenols-4AAP	2017/09/27	97	80 - 120	99	85 - 115	ND, RDL=0.0010	mg/L	NC	20		
5185563	Nitrate (N)	2017/09/28	84	80 - 120	98	80 - 120	ND, RDL=0.10	mg/L	NC	20		
5185563	Nitrite (N)	2017/09/28	103	80 - 120	103	80 - 120	ND, RDL=0.010	mg/L				
5186729	Total Antimony (Sb)	2017/09/28	110	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5186729	Total Arsenic (As)	2017/09/28	104	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L	10	20		
5186729	Total Beryllium (Be)	2017/09/28	106	80 - 120	101	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5186729	Total Boron (B)	2017/09/28	102	80 - 120	98	80 - 120	ND, RDL=10	ug/L	5.1	20		
5186729	Total Cadmium (Cd)	2017/09/28	105	80 - 120	99	80 - 120	ND, RDL=0.10	ug/L	NC	20		
5186729	Total Chromium (Cr)	2017/09/28	104	80 - 120	100	80 - 120	ND, RDL=5.0	ug/L	NC	20		
5186729	Total Cobalt (Co)	2017/09/28	107	80 - 120	103	80 - 120	ND, RDL=0.50	ug/L	5.4	20		
5186729	Total Copper (Cu)	2017/09/28	108	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	9.7	20		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
5186729	Total Iron (Fe)	2017/09/28	105	80 - 120	101	80 - 120	ND, RDL=100	ug/L	2.3	20		
5186729	Total Lead (Pb)	2017/09/28	102	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	0.80	20		
5186729	Total Molybdenum (Mo)	2017/09/28	108	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	0.14	20		
5186729	Total Nickel (Ni)	2017/09/28	100	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	8.1	20		
5186729	Total Selenium (Se)	2017/09/28	103	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L	NC	20		
5186729	Total Silver (Ag)	2017/09/28	101	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20		
5186729	Total Thallium (Tl)	2017/09/28	101	80 - 120	102	80 - 120	ND, RDL=0.050	ug/L	NC	20		
5186729	Total Tungsten (W)	2017/09/28	112	80 - 120	108	80 - 120	ND, RDL=1.0	ug/L	NC	20		
5186729	Total Uranium (U)	2017/09/28	106	80 - 120	102	80 - 120	ND, RDL=0.10	ug/L	7.8	20		
5186729	Total Vanadium (V)	2017/09/28	101	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	0.15	20		
5186729	Total Zinc (Zn)	2017/09/28	105	80 - 120	102	80 - 120	ND, RDL=5.0	ug/L	NC	20		
5186729	Total Zirconium (Zr)	2017/09/28	106	80 - 120	95	80 - 120	ND, RDL=1.0	ug/L	NC	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Brad Newman, Scientific Service Specialist

Cristina Carriere, Scientific Service Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam
A Bureau Veritas Group Company

Your Project #: 2017-0293
Site#: BOLTON
Site Location: SOLMAR
Your C.O.C. #: 629279-01-01

Attention:Alireza Hejazi

Cole Engineering Group Ltd
70 Valleywood Dr
Markham, ON
CANADA L3R 4T5

Report Date: 2017/09/29
Report #: R4745503
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7K8760
Received: 2017/09/22, 14:25

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Dissolved Aluminum (0.2 u, clay free)	1	N/A	2017/09/25	CAM SOP-00447	EPA 6020B m
Alkalinity	1	N/A	2017/09/26	CAM SOP-00448	SM 22 2320 B m
Chromium (VI) in Water	1	N/A	2017/09/28	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	1	N/A	2017/09/27	CAM SOP-00457	OMOE E3015 m
Dissolved Oxygen	1	2017/09/23	2017/09/23	CAM SOP-00427	SM 22 4500 O G m
Hardness (calculated as CaCO3)	1	N/A	2017/09/27	CAM SOP 00102/00408/00447	SM 2340 B
Mercury	1	2017/09/26	2017/09/27	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by ICPMS	1	N/A	2017/09/28	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	1	N/A	2017/09/28	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (1)	1	N/A	2017/09/26	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH	1	N/A	2017/09/26	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2017/09/27	CAM SOP-00444	OMOE E3179 m
Field pH (2)	1	N/A	2017/09/28		Field pH Meter
Sulphide	1	N/A	2017/09/26	CAM SOP-00455	SM 22 4500-S G m
Field Temperature (2)	1	N/A	2017/09/28		Field Thermometer
Total Phosphorus (Colourimetric)	1	2017/09/27	2017/09/27	CAM SOP-00407	SM 22 4500 P B H m
Turbidity	1	N/A	2017/09/24	CAM SOP-00417	SM 22 2130 B m
Un-ionized Ammonia	1	2017/09/23	2017/09/29		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise

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Your Project #: 2017-0293
Site#: BOLTON
Site Location: SOLMAR
Your C.O.C. #: 629279-01-01

Attention:Alireza Hejazi

Cole Engineering Group Ltd
70 Valleywood Dr
Markham, ON
CANADA L3R 4T5

Report Date: 2017/09/29
Report #: R4745503
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7K8760
Received: 2017/09/22, 14:25
agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(2) This is a field test, therefore, the results relate to items that were not analysed at Maxxam Analytics Inc.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jolanta Goralczyk, Project Manager
Email: JGoralczyk@maxxam.ca
Phone# (905)817-5751
==========
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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK656		
Sampling Date			2017/09/22 12:45		
COC Number			629279-01-01		
	UNITS	Criteria	MW1-17	RDL	QC Batch
Calculated Parameters					
Hardness (CaCO3)	mg/L	-	590	1.0	5179429
Total Un-ionized Ammonia	mg/L	-	0.0037	0.0016	5179420
Field Measurements					
Field Temperature	Celcius	-	15.7	N/A	ONSITE
Field pH	pH	6.5:8.5	7.98		ONSITE
Inorganics					
Total Ammonia-N	mg/L	-	0.11	0.050	5182709
Dissolved Oxygen	mg/L	-	5.77		5179915
pH	pH	6.5:8.5	8.02		5179875
Phenols-4AAP	mg/L	0.001	ND	0.0010	5185031
Total Phosphorus	mg/L	0.01	**0.36**	0.02	5184483
Sulphide	mg/L	0.02	ND	0.020	5181226
Turbidity	NTU	-	6.1	0.1	5179395
WAD Cyanide (Free)	ug/L	5	ND	1	5182547
Alkalinity (Total as CaCO3)	mg/L	-	520	1.0	5179872
Metals					
Dissolved (0.2u) Aluminum (Al)	ug/L	15	ND	5	5179909
Chromium (VI)	ug/L	1	ND	0.50	5184085
Mercury (Hg)	ug/L	0.2	ND	0.1	5183039
Total Antimony (Sb)	ug/L	20	ND	0.50	5186729
Total Arsenic (As)	ug/L	100	ND	1.0	5186729
Total Beryllium (Be)	ug/L	11	ND	0.50	5186729
Total Boron (B)	ug/L	200	110	10	5186729
Total Cadmium (Cd)	ug/L	0.2	ND	0.10	5186729
Total Chromium (Cr)	ug/L	-	ND	5.0	5186729
Total Cobalt (Co)	ug/L	0.9	ND	0.50	5186729
Total Copper (Cu)	ug/L	5	1.6	1.0	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected
N/A = Not Applicable

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FEK656		
Sampling Date			2017/09/22 12:45		
COC Number			629279-01-01		
	UNITS	Criteria	MW1-17	RDL	QC Batch
Total Iron (Fe)	ug/L	300	ND	100	5186729
Total Lead (Pb)	ug/L	5	ND	0.50	5186729
Total Molybdenum (Mo)	ug/L	40	6.9	0.50	5186729
Total Nickel (Ni)	ug/L	25	2.6	1.0	5186729
Total Selenium (Se)	ug/L	100	ND	2.0	5186729
Total Silver (Ag)	ug/L	0.1	ND	0.10	5186729
Total Thallium (Tl)	ug/L	0.3	ND	0.050	5186729
Total Tungsten (W)	ug/L	30	ND	1.0	5186729
Total Uranium (U)	ug/L	5	**9.2**	0.10	5186729
Total Vanadium (V)	ug/L	6	ND	0.50	5186729
Total Zinc (Zn)	ug/L	30	ND	5.0	5186729
Total Zirconium (Zr)	ug/L	4	ND	1.0	5186729

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

RESULTS OF ANALYSES OF WATER

Maxxam ID		FEK656		
Sampling Date		2017/09/22 12:45		
COC Number		629279-01-01		
	UNITS	MW1-17	RDL	QC Batch
Inorganics				
Nitrite (N)	mg/L	ND	0.010	5181316
Nitrate (N)	mg/L	ND	0.10	5181316
Nitrate + Nitrite (N)	mg/L	ND	0.10	5181316

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK656
Sample ID: MW1-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK656 Dup
Sample ID: MW1-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya

Maxxam ID: FEK657
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/25	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/25	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK657
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK657 Dup
Sample ID: MW5-17S
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5179872	N/A	2017/09/25	Surinder Rai
pH	AT	5179875	N/A	2017/09/25	Surinder Rai

Maxxam ID: FEK658
Sample ID: MW3-17
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/26	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5185563	N/A	2017/09/28	Chandra Nandlal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5183116	N/A	2017/09/26	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181226	N/A	2017/09/26	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

Maxxam ID: FEK659
Sample ID: MW4-17D
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5179909	N/A	2017/09/25	Prempal Bhatti
Alkalinity	AT	5179872	N/A	2017/09/26	Surinder Rai

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

TEST SUMMARY

Maxxam ID: FEK659
Sample ID: MW4-17D
Matrix: Water

Collected: 2017/09/22
Shipped:
Received: 2017/09/22

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chromium (VI) in Water	IC	5184085	N/A	2017/09/28	Lang Le
Free (WAD) Cyanide	SKAL/CN	5182547	N/A	2017/09/27	Louise Harding
Dissolved Oxygen	DO	5179915	2017/09/23	2017/09/23	Prakash Piya
Hardness (calculated as CaCO3)		5179429	N/A	2017/09/27	Automated Statchk
Mercury	CV/AA	5183039	2017/09/26	2017/09/27	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5186729	N/A	2017/09/28	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5182709	N/A	2017/09/28	Sarabjit Raina
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5181316	N/A	2017/09/26	Amanpreet Sappal
pH	AT	5179875	N/A	2017/09/26	Surinder Rai
Phenols (4AAP)	TECH/PHEN	5185031	N/A	2017/09/27	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Sulphide	ISE/S	5181239	N/A	2017/09/25	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/09/23	Adriana Smith
Total Phosphorus (Colourimetric)	LACH/P	5184483	2017/09/27	2017/09/27	Amanpreet Sappal
Turbidity	AT	5179395	N/A	2017/09/24	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5179420	2017/09/29	2017/09/29	Automated Statchk

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	13.3°C

Results relate only to the items tested.

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
5179395	Turbidity	2017/09/24			101	85 - 115	ND, RDL=0.1	NTU	2.8	20		
5179872	Alkalinity (Total as CaCO3)	2017/09/25			97	85 - 115	ND, RDL=1.0	mg/L	0.70	20		
5179875	pH	2017/09/25			101	98 - 103			0.63	N/A		
5179909	Dissolved (0.2u) Aluminum (Al)	2017/09/25	110	80 - 120	102	80 - 120	ND,RDL=5	ug/L	NC	20		
5181226	Sulphide	2017/09/26	109	80 - 120	98	80 - 120	ND, RDL=0.020	mg/L	NC	20		
5181239	Sulphide	2017/09/25	96	80 - 120	105	80 - 120	ND, RDL=0.020	mg/L	3.8	20		
5181316	Nitrate (N)	2017/09/26	100	80 - 120	101	80 - 120	ND, RDL=0.10	mg/L	NC	20		
5181316	Nitrite (N)	2017/09/26	101	80 - 120	100	80 - 120	ND, RDL=0.010	mg/L				
5182547	WAD Cyanide (Free)	2017/09/27	103	80 - 120	101	80 - 120	ND,RDL=1	ug/L	NC	20		
5182709	Total Ammonia-N	2017/09/28	99	80 - 120	99	85 - 115	ND, RDL=0.050	mg/L	6.1	20		
5183039	Mercury (Hg)	2017/09/27	100	75 - 125	102	80 - 120	ND, RDL=0.1	ug/L	NC	20		
5183116	Phenols-4AAP	2017/09/26	94	80 - 120	96	85 - 115	ND, RDL=0.0010	mg/L	NC	20		
5184085	Chromium (VI)	2017/09/28	101	80 - 120	102	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5184483	Total Phosphorus	2017/09/27	96	80 - 120	92	80 - 120	ND, RDL=0.004	mg/L	NC	20	93	80 - 120
5185031	Phenols-4AAP	2017/09/27	97	80 - 120	99	85 - 115	ND, RDL=0.0010	mg/L	NC	20		
5185563	Nitrate (N)	2017/09/28	84	80 - 120	98	80 - 120	ND, RDL=0.10	mg/L	NC	20		
5185563	Nitrite (N)	2017/09/28	103	80 - 120	103	80 - 120	ND, RDL=0.010	mg/L				
5186729	Total Antimony (Sb)	2017/09/28	110	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5186729	Total Arsenic (As)	2017/09/28	104	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L	10	20		
5186729	Total Beryllium (Be)	2017/09/28	106	80 - 120	101	80 - 120	ND, RDL=0.50	ug/L	NC	20		
5186729	Total Boron (B)	2017/09/28	102	80 - 120	98	80 - 120	ND, RDL=10	ug/L	5.1	20		
5186729	Total Cadmium (Cd)	2017/09/28	105	80 - 120	99	80 - 120	ND, RDL=0.10	ug/L	NC	20		
5186729	Total Chromium (Cr)	2017/09/28	104	80 - 120	100	80 - 120	ND, RDL=5.0	ug/L	NC	20		
5186729	Total Cobalt (Co)	2017/09/28	107	80 - 120	103	80 - 120	ND, RDL=0.50	ug/L	5.4	20		
5186729	Total Copper (Cu)	2017/09/28	108	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	9.7	20		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
5186729	Total Iron (Fe)	2017/09/28	105	80 - 120	101	80 - 120	ND, RDL=100	ug/L	2.3	20		
5186729	Total Lead (Pb)	2017/09/28	102	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	0.80	20		
5186729	Total Molybdenum (Mo)	2017/09/28	108	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	0.14	20		
5186729	Total Nickel (Ni)	2017/09/28	100	80 - 120	97	80 - 120	ND, RDL=1.0	ug/L	8.1	20		
5186729	Total Selenium (Se)	2017/09/28	103	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L	NC	20		
5186729	Total Silver (Ag)	2017/09/28	101	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20		
5186729	Total Thallium (Tl)	2017/09/28	101	80 - 120	102	80 - 120	ND, RDL=0.050	ug/L	NC	20		
5186729	Total Tungsten (W)	2017/09/28	112	80 - 120	108	80 - 120	ND, RDL=1.0	ug/L	NC	20		
5186729	Total Uranium (U)	2017/09/28	106	80 - 120	102	80 - 120	ND, RDL=0.10	ug/L	7.8	20		
5186729	Total Vanadium (V)	2017/09/28	101	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	0.15	20		
5186729	Total Zinc (Zn)	2017/09/28	105	80 - 120	102	80 - 120	ND, RDL=5.0	ug/L	NC	20		
5186729	Total Zirconium (Zr)	2017/09/28	106	80 - 120	95	80 - 120	ND, RDL=1.0	ug/L	NC	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Maxxam Job #: B7K8760
Report Date: 2017/09/29

Cole Engineering Group Ltd
Client Project #: 2017-0293
Site Location: SOLMAR

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Brad Newman, Scientific Service Specialist

Cristina Carriere, Scientific Service Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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BOD

Maxxam Analytics International Corporation o/a Maxxam Analytics
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CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE TO:
Company Name: #24008 Cole Engineering Group Ltd
Attention: Accounts Payable
Address: 70 Valleywood Dr, Markham ON L3R 4T5
Tel: (416) 987-6161 x Fax: (905) 940-2064 x
Email: accountspayable@coleengineering.ca

REPORT TO:
Company Name:
Attention: Alireza Hejazi
Address:
Tel: (416) 987-6161 x243 Fax:
Email: AHejazi@coleengineering.ca

PROJECT INFORMATION:
Quotation #: B02064
P.O. #:
Project: 2017-0293
Project Name: [redacted] Solmar/Bolton
Site #:
Sampled By: AH, AG

Laboratory Use Only:
Maxxam Job #:
Bottle Order #: 629279
COC #: C#629279-01-01
Project Manager: Jolanta Goralczyk

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☐ Res/Park ☐ Medium/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ Reg 558 ☐ Storm Sewer Bylaw ☐ MISA Municipality ☐ ☒ PWQO ☐ Other

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)?

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects
Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.
Job Specific Rush TAT (if applies to entire submission)
Date Required: Time Required:
Rush Confirmation Number: (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	PWQO Metals and Inorganics	Nitrate	Nitrite	# of Bottles	Comments
1		MW1-17	22/09/17	12:45	GW	X	X	X	X		Temp 15.7°C, pH 7.98, Filtered
2		MW5-17s		11:50	GW	X	X	X	X		Temp 14.7°C, pH 8.56, Filtered
3		MW3-17		10:15	GW	X	X	X	X		Temp 13.79°C, pH 8.17, Filtered
4		MW4-17d		10:50	GW	X	X	X	X		Temp 13.15°C, pH 8.58, Filtered
5											
6											
7											
8											
9											
10											

22-Sep-17 14:25
Jolanta Goralczyk
B7K8760
GK1 ENV-1359

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Andrew O'Rourke Andrew O'Rourke	22/09/17	14:20	[illegible]	22/09/22	14:25	

Laboratory Use Only
Time Sensitive
Temperature (°C) on Receipt: 13/12/15
Custody Seal Present: Yes ☐ No ☐
Intact: ☐ ☑

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.MAXXAM.CA/TERMS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT HTTP://MAXXAM.CA/WP-CONTENT/UPLOADS/ONTARIO-COC.PDF.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

White: Maxxam Yellow: Client

Draft

Maxxam Analytics International Corporation o/a Maxxam Analytics

Appendix F

Infiltration Test Reports (SLR, 2025)

Guelph Permeameter In Field Measurements

Head 1

No	Time Elapsed	Time Interval (mins)	Water level (cm)	Water level change (cm)	Rate of Change (cm/min)
1	0	0			
2	0.5	0.5	11.1	11.1	22.2
3	1	0.5	11.5	0.4	0.8
4	1.5	0.5	11.7	0.2	0.4
5	2	0.5	12.1	0.4	0.8
6	2.5	0.5	12.3	0.2	0.4
7	3	0.5	12.4	0.1	0.2
8	3.5	0.5	12.6	0.2	0.4
9	4	0.5	12.8	0.2	0.4
10	4.5	0.5	13.1	0.3	0.6
11	5	0.5	13.4	0.3	0.6
12	5.5	0.5	13.6	0.2	0.4
13	6	0.5	13.7	0.1	0.2
14	6.5	0.5	14.1	0.4	0.8
15	7	0.5	14.3	0.2	0.4
16	7.5	0.5	14.5	0.2	0.4
17	8	0.5	14.7	0.2	0.4
18	8.5	0.5	15	0.3	0.6
19	9	0.5	15.2	0.2	0.4
20	9.5	0.5	15.5	0.3	0.6
21	10	0.5	15.7	0.2	0.4
22	10.5	0.5	15.9	0.2	0.4
23	11	0.5	16.2	0.3	0.6
24	11.5	0.5	16.4	0.2	0.4
25	12	0.5	16.7	0.3	0.6
26	12.5	0.5	16.9	0.2	0.4
27	13	0.5	17.2	0.3	0.6
28	13.5	0.5	17.4	0.2	0.4
29	14	0.5	17.7	0.3	0.6
30	14.5	0.5	18	0.3	0.6
30	14.5	0.5	18.3	0.3	0.6
30	14.5	0.5	18.6	0.3	0.6

Site Conditions and Metadata

Date:	2-Jun-25	Depth of Well (cm):	110
Location:	GP1	H1 (cm):	10
Operatiors:	Munjeong	H2 (cm):	
		Soil Type:	2
Weather Conditions	Sunny	Soil Description:	silt, some sand, some clay
		Reservoir Type:	Combined
		Date of last precipitation event:	29-May-25
		Amount of rain (mm):	10

Steady State Rate of Flow

R, the steady state of flow is achieved when the rate of change is the same in three consecutive time intervals.
These values will be used in the "GP Quick Calculator Tab"

R1 is the stready state rate of flow at H1 (cm/min)
R2 is the stready state rate of flow at H2 (cm/min)

R1 (cm/min)	0.6	Calculated Kfs Value (cm/sec)	2.03E-04
R2 (cm/min)		Infiltration Rate (mm/hr)	55.9369249
		K Value Method Selected from GP Calculator	

Guelph Permeameter Calculations - GP1

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.6000

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.04
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.29
R	0.600
Q	0.352
pi	3.142

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 1.290234
$Q =$ 0.3522

$K_{fs} =$	2.03E-04	cm/sec
	1.22E-02	cm/min
	2.03E-06	m/sec
	4.80E-03	inch/min
	8.00E-05	inch/sec
$\Phi_m =$	5.08E-03	(cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

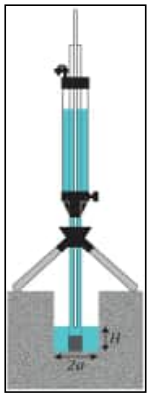
$C =$ 0
$Q =$ 0

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/ses
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
$\Phi_m =$	#DIV/0!	(cm^2/min)

Average

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/s
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$c_1 =$ 0

$c_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/sec
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
$\Phi_m =$	#DIV/0!	(cm^2/min)

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_1 C_1}{\pi(2H_1H_2(H_2-H_1)+a^2(H_1C_2-H_2C_1))}$ $G_2 = \frac{H_2 C_2}{\pi(2H_1H_2(H_2-H_1)+a^2(H_1C_2-H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2+a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1)+a^2(H_1C_2-H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2+a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1)+a^2(H_1C_2-H_2C_1))}$ $\Phi_m = G_1Q_1 - G_4Q_2$

Calculation formulas related to one-head and two-head methods. Where H is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2). Where H_1 is the first head of water established in borehole (cm), a is borehole radius (cm), R is steady-state rate of fall of water in reservoir (cm/s), α^* is Macroscopic capillary length parameter (from Table 2), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2). One-head method can be calculated while H_1 is established. Two-head method (G_1 and G_2) are calculated (Zhang et al., 1998)

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.632}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.632}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.704}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.704}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.704}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.704}$

Guelph Permeameter In Field Measurements

Head 1

No	Time Elapsed	Time Interval (mins)	Water level (cm)	Water level change (cm)	Rate of Change (cm/min)
1	0	0	10.8		
2	0.5	0.5	11	0.2	0.4
3	1	0.5	11.1	0.1	0.2
4	1.5	0.5	11.2	0.1	0.2
5	2	0.5	11.3	0.1	0.2
6	2.5	0.5	11.4	0.1	0.2
7	3	0.5	11.5	0.1	0.2
8	3.5	0.5	11.7	0.2	0.4
9	4	0.5	11.8	0.1	0.2
10	4.5	0.5	11.9	0.1	0.2
11	5	0.5	12	0.1	0.2
12	5.5	0.5	12.1	0.1	0.2
13	6	0.5	12.2	0.1	0.2
14	6.5	0.5	12.4	0.2	0.4
15	7	0.5	12.5	0.1	0.2
16	7.5	0.5	12.6	0.1	0.2
17	8	0.5	12.7	0.1	0.2
18	8.5	0.5	12.8	0.1	0.2
19	9	0.5	12.9	0.1	0.2
20	9.5	0.5	13	0.1	0.2
21	10	0.5	13.1	0.1	0.2
22	10.5	0.5	13.2	0.1	0.2
23	11	0.5	13.3	0.1	0.2
24	11.5	0.5	13.4	0.1	0.2
25	12	0.5	13.5	0.1	0.2

Site Conditions and Metadata

Date:	2-Jun-25	Depth of Well (cm):	120
Location:	GP2	H1 (cm):	10
Operatiors:	Munjeong	H2 (cm):	
		Soil Type:	2
Weather Conditions	Sunny	Soil Description:	silt, some sand, some clay
		Reservoir Type:	Combined
		Date of last precipitation event:	29-May-25
		Amount of rain (mm):	10

Steady State Rate of Flow

R, the steady state of flow is achieved when the rate of change is the same in three consecutive time intervals.
These values will be used in the "GP Quick Calculator Tab"

R1 is the stready state rate of flow at H1 (cm/min)
R2 is the stready state rate of flow at H2 (cm/min)

R1 (cm/min)	0.2	Calculated Kfs Value (cm/sec)	6.78E-05
R2 (cm/min)		Infiltration Rate (mm/hr)	41.6869121
		K Value Method Selected from GP Calculator	

Guelph Permeameter Calculations - GP2

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.2000

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.04
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.29
R	0.200
Q	0.117
pi	3.142

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 1.290234
$Q =$ 0.1174

$K_{fs} =$	6.78E-03	cm/sec
	4.07E-03	cm/min
	6.78E-07	m/sec
	1.60E-03	inch/min
	2.67E-05	inch/sec
$\Phi_m =$	1.69E-03	(cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

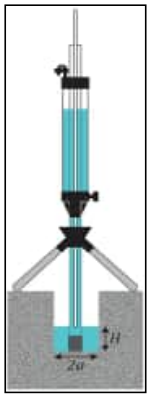
$\alpha^* =$ 0 (cm^{-1})

$C =$ 0
$Q =$ 0

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/ses
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
$\Phi_m =$	#DIV/0!	(cm^2/min)

Average

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
$\Phi_m =$	#DIV/0!	(cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/sec
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
$\Phi_m =$	#DIV/0!	(cm^2/min)

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_1 C_1}{\pi(2H_1H_2(H_2-H_1)+a^2(H_1C_2-H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2-H_1)+a^2(H_1C_2-H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2+a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1)+a^2(H_1C_2-H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2+a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1)+a^2(H_1C_2-H_2C_1))}$ $\Phi_m = G_1Q_1 - G_4Q_2$

Calculation formula related to one-head and two-head methods. Where H is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2). One-head method is calculated while H_1 is used and C_1 and G_1 are calculated (Zhang et al., 1998)

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.632}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.632}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Guelph Permeameter In Field Measurements

Head 1

No	Time Elapsed	Time Interval (mins)	Water level (cm)	Water level change (cm)	Rate of Change (cm/min)
1	0	0	12.8		
2	0.5	0.5	13	0.2	0.4
3	1	0.5	13.2	0.2	0.4
4	1.5	0.5	13.4	0.2	0.4
5	2	0.5	13.6	0.2	0.4
6	2.5	0.5	13.7	0.1	0.2
7	3	0.5	14.2	0.5	1
8	3.5	0.5	14.4	0.2	0.4
9	4	0.5	14.6	0.2	0.4
10	4.5	0.5	14.9	0.3	0.6
11	5	0.5	15.1	0.2	0.4
12	5.5	0.5	15.3	0.2	0.4
13	6	0.5	15.5	0.2	0.4
14	6.5	0.5	15.7	0.2	0.4
15	7	0.5	16	0.3	0.6
16	7.5	0.5	16.2	0.2	0.4
17	8	0.5	16.4	0.2	0.4
18	8.5	0.5	16.7	0.3	0.6
19	9	0.5	16.9	0.2	0.4
20	9.5	0.5	17.1	0.2	0.4
21	10	0.5	17.3	0.2	0.4
22	10.5	0.5	17.5	0.2	0.4
23	11	0.5	17.7	0.2	0.4
24	11.5	0.5	17.9	0.2	0.4

Site Conditions and Metadata

Date:	2-Jun-25	Depth of Well (cm):	110
Location:	GP3	H1 (cm):	10
Operatiors:	Munjeong	H2 (cm):	
		Soil Type:	2
Weather Conditions	Sunny	Soil Description:	silt, some sand, some clay
		Reservoir Type:	Combined
		Date of last precipitation event:	29-May-25
		Amount of rain (mm):	10

Steady State Rate of Flow

R, the steady state of flow is achieved when the rate of change is the same in three consecutive time intervals.
These values will be used in the "GP Quick Calculator Tab"

R1 is the stready state rate of flow at H1 (cm/min)
R2 is the stready state rate of flow at H2 (cm/min)

R1 (cm/min)	0.4	Calculated Kfs Value (cm/sec)	1.36E-04
R2 (cm/min)		Infiltration Rate (mm/hr)	50.18440015
		K Value Method Selected from GP Calculator	

Guelph Permeameter Calculations - GP3

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.4000

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.04
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.29
R	0.400
Q	0.235
pi	3.142

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 1.290234
$Q =$ 0.2348

$K_{fs} =$		
	1.36E-04	cm/sec
	8.13E-03	cm/min
	1.36E-06	m/sec
	3.20E-03	inch/min
	5.34E-05	inch/sec

$\Phi_m =$ 3.39E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0
$Q =$ 0

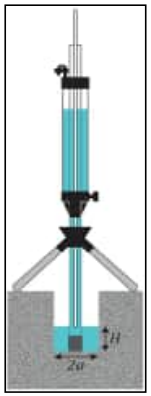
$K_{fs} =$		
	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/ses
	#DIV/0!	inch/min
	#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$		
	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$c_1 =$ 0

$c_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$		
	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/sec
	#DIV/0!	inch/min
	#DIV/0!	inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_1Q_1 - G_4Q_2$

Calculation formulas related to one-head and two-head methods. Where H is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2). Where H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm), a is borehole radius (cm), R is steady-state rate of fall of water in reservoir (cm/s), α^* is Macroscopic capillary length parameter (from Table 2), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), C is Shape factor (from Table 2). One-head and two-head methods are calculated (Zhang et al., 1998)

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.632}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.632}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Guelph Permeameter In Field Measurements

Head 1

No	Time Elapsed	Time Interval (mins)	Water level (cm)	Water level change (cm)	Rate of Change (cm/min)
1	0	0	7.9		
2	0.5	0.5	8	0.1	0.2
3	1	0.5	8.1	0.1	0.2
4	1.5	0.5	8.3	0.2	0.4
5	2	0.5	8.5	0.2	0.4
6	2.5	0.5	8.6	0.1	0.2
7	3	0.5	8.7	0.1	0.2
8	3.5	0.5	8.8	0.1	0.2
9	4	0.5	9	0.2	0.4
10	4.5	0.5	9.1	0.1	0.2
11	5	0.5	9.2	0.1	0.2
12	5.5	0.5	9.3	0.1	0.2
13	6	0.5	9.5	0.2	0.4
14	6.5	0.5	9.7	0.2	0.4
15	7	0.5	9.8	0.1	0.2
16	7.5	0.5	10	0.2	0.4
17	8	0.5	10.1	0.1	0.2
18	8.5	0.5	10.3	0.2	0.4
19	9	0.5	10.5	0.2	0.4
20	9.5	0.5	10.7	0.2	0.4
21	10	0.5	10.8	0.1	0.2
22	10.5	0.5	11	0.2	0.4
23	11	0.5	11.2	0.2	0.4
24	11.5	0.5	11.4	0.2	0.4
25	12	0.5	11.5	0.1	0.2
26	12.5	0.5	11.6	0.1	0.2
27	13	0.5	11.9	0.3	0.6
28	13.5	0.5	12	0.1	0.2
29	14	0.5	12.2	0.2	0.4
30	14.5	0.5	12.3	0.1	0.2
31	15	0.5	12.5	0.2	0.4
32	15.5	0.5	12.7	0.2	0.4
33	16	0.5	12.9	0.2	0.4
34	16.5	0.5	13.1	0.2	0.4
35	17	0.5	13.3	0.2	0.4
36	17.5	0.5	13.5	0.2	0.4
37	18	0.5	13.7	0.2	0.4
38	18.5	0.5	13.9	0.2	0.4
39	19	0.5	14.1	0.2	0.4

Site Conditions and Metadata

Date:	2-Jun-25	Depth of Well (cm):	110
Location:	GP4	H1 (cm):	10
Operatiors:	Munjeong	H2 (cm):	
		Soil Type:	2
Weather Conditions	Sunny	Soil Description:	silt, some sand, some clay
		Reservoir Type:	Combined
		Date of last precipitation event:	29-May-25
		Amount of rain (mm):	10

Steady State Rate of Flow

R, the steady state of flow is achieved when the rate of change is the same in three consecutive time intervals.
These values will be used in the "GP Quick Calculator Tab"

R1 is the stready state rate of flow at H1 (cm/min)
R2 is the stready state rate of flow at H2 (cm/min)

R1 (cm/min)	0.4	Calculated Kfs Value (cm/sec)	1.36E-04
R2 (cm/min)		Infiltration Rate (mm/hr)	50.18440015
		K Value Method Selected from GP Calculator	

Guelph Permeameter Calculations - GP4

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.4000

Res Type	35.22		
H	10		
a	3	$\alpha^* =$	0.04 (cm^{-1})
H/a	3.333		
a*	0.04	$C =$	1.290234
C0.01	1.218	$Q =$	0.2348
C0.04	1.29		
C0.12	1.288	$K_{fs} =$	1.36E-04 cm/sec
C0.36	1.288		8.13E-03 cm/min
C	1.29		1.36E-06 m/sec
R	0.400		3.20E-03 inch/min
Q	0.235		5.34E-05 inch/sec
pi	3.142		
		$\Phi_m =$	3.39E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

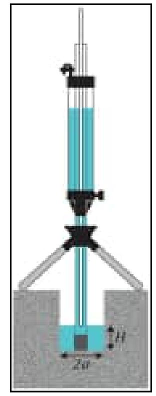
1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0		
H	0		
a	0	$\alpha^* =$	0 (cm^{-1})
H/a	#DIV/0!		
a*	0	$C =$	0
C0.01	#DIV/0!	$Q =$	0
C0.04	#DIV/0!		
C0.12	#DIV/0!	$K_{fs} =$	#DIV/0! cm/sec
C0.36	#DIV/0!		#DIV/0! cm/min
C	0		#DIV/0! m/ses
R	0.000		#DIV/0! inch/min
Q	0		#DIV/0! inch/sec
pi	3.1415		
		$\Phi_m =$	#DIV/0! (cm^2/min)

Average

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
$\Phi_m =$	#DIV/0!	(cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

		$Q_1 =$	0
		$Q_2 =$	0
		$C_1 =$	0
Res Type:	2.16	$C_2 =$	0
H1/a:	#DIV/0!		
H2/a:	#DIV/0!	$G_1 =$	#DIV/0!
C1-0.01:	#DIV/0!		
C2-0.01:	#DIV/0!	$G_2 =$	#DIV/0!
C1-0.04:	#DIV/0!		
C2-0.04:	#DIV/0!	$G_3 =$	#DIV/0!
C1-0.12:	#DIV/0!		
C2-0.12:	#DIV/0!	$G_4 =$	#DIV/0!
C1-0.36:	#DIV/0!		
C2-0.36:	#DIV/0!	$K_{fs} =$	#DIV/0! cm/sec
			#DIV/0! cm/min
			#DIV/0! m/sec
			#DIV/0! inch/min
			#DIV/0! inch/sec
		$\Phi_m =$	#DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is macroscopic capillary length factor which is decided according to the soil texture-structure category. For one head method, only C_1 needs to be calculated while for two head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	α^*(cm⁻¹)	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where $\bar{R}$ is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Guelph Permeameter In Field Measurements

Head 1

No	Time Elapsed	Time Interval (mins)	Water level (cm)	Water level change (cm)	Rate of Change (cm/min)
1	0	0	5.6		
2	0.5	0.5	5.8	0.2	0.4
3	1	0.5	6	0.2	0.4
4	1.5	0.5	6.2	0.2	0.4
5	2	0.5	6.4	0.2	0.4
6	2.5	0.5	6.6	0.2	0.4
7	3	0.5	6.7	0.1	0.2
8	3.5	0.5	6.9	0.2	0.4
9	4	0.5	7.1	0.2	0.4
10	4.5	0.5	7.3	0.2	0.4
11	5	0.5	7.5	0.2	0.4
12	5.5	0.5	7.6	0.1	0.2
13	6	0.5	7.8	0.2	0.4
14	6.5	0.5	7.9	0.1	0.2
15	7	0.5	8.1	0.2	0.4
16	7.5	0.5	8.3	0.2	0.4
17	8	0.5	8.4	0.1	0.2
18	8.5	0.5	8.6	0.2	0.4
19	9	0.5	8.7	0.1	0.2
20	9.5	0.5	8.9	0.2	0.4
21	10	0.5	9	0.1	0.2
22	10.5	0.5	9.2	0.2	0.4
23	11	0.5	9.3	0.1	0.2
24	11.5	0.5	9.5	0.2	0.4
25	12	0.5	9.7	0.2	0.4
26	12.5	0.5	9.9	0.2	0.4
27	13	0.5	10.1	0.2	0.4
28	13.5	0.5	10.2	0.1	0.2
29	14	0.5	10.4	0.2	0.4
30	14.5	0.5	10.5	0.1	0.2
31	15	0.5	10.6	0.1	0.2
32	15.5	0.5	10.8	0.2	0.4
33	16	0.5	11	0.2	0.4
34	16.5	0.5	11.2	0.2	0.4
35	17	0.5	11.3	0.1	0.2
36	17.5	0.5	11.5	0.2	0.4
37	18	0.5	11.7	0.2	0.4

Site Conditions and Metadata

Date:	2-Jun-25	Depth of Well (cm):	125
Location:	GP5	H1 (cm):	10
Operatiors:	Munjeong	H2 (cm):	
		Soil Type:	2
Weather Conditions	Sunny	Soil Description:	silt, some sand, some clay
		Reservoir Type:	Combined
		Date of last precipitation event:	29-May-25
		Amount of rain (mm):	10

Steady State Rate of Flow

R, the steady state of flow is achieved when the rate of change is the same in three consecutive time intervals.
These values will be used in the "GP Quick Calculator Tab"

R1 is the stready state rate of flow at H1 (cm/min)
R2 is the stready state rate of flow at H2 (cm/min)

R1 (cm/min)	0.4	Calculated Kfs Value (cm/sec)	1.36E-04
R2 (cm/min)		Infiltration Rate (mm/hr)	50.18440015
		K Value Method Selected from GP Calculator	

Guelph Permeameter Calculations - GP5

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.4000

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.04
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.29
R	0.400
Q	0.235
pi	3.142

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 1.290234
$Q =$ 0.2348

$K_{fs} =$ 1.36E-04 cm/sec; 8.13E-03 cm/min; 1.36E-06 m/sec; 3.20E-03 inch/min; 5.34E-05 inch/sec

$\Phi_m =$ 3.39E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0
H	0
a	0
H/a	#DIV/0!
a*	0
C0.01	#DIV/0!
C0.04	#DIV/0!
C0.12	#DIV/0!
C0.36	#DIV/0!
C	0
R	0.000
Q	0
pi	3.1415

$\alpha^* =$ 0 (cm^{-1})

$C =$ 0
$Q =$ 0

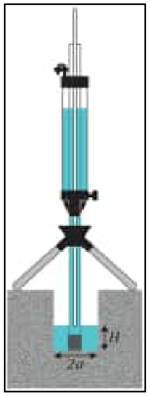
$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/ses; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Average

$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/s; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$K_{fs} =$ #DIV/0! cm/sec; #DIV/0! cm/min; #DIV/0! m/sec; #DIV/0! inch/min; #DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α* is macroscopic capillary length factor which is decided according to the soil texture-structure category. For one head method, only C_1 needs to be calculated while for two head method, C_1 and C_2 are calculated (Zhang et al., 1998).

Soil Texture-Structure Category	α*(cm⁻¹)	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where $\bar{R}$ is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), α* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter In Field Measurements

Head 1

No	Time Elapsed	Time Interval (mins)	Water level (cm)	Water level change (cm)	Rate of Change (cm/min)
1	0	0	15.9		
2	0.5	0.5	16.1	0.2	0.4
3	1	0.5	16.3	0.2	0.4
4	1.5	0.5	16.5	0.2	0.4
5	2	0.5	16.6	0.1	0.2
6	2.5	0.5	16.7	0.1	0.2
7	3	0.5	16.9	0.2	0.4
8	3.5	0.5	17.1	0.2	0.4
9	4	0.5	17.3	0.2	0.4
10	4.5	0.5	17.5	0.2	0.4
11	5	0.5	17.7	0.2	0.4
12	5.5	0.5	18.3	0.6	1.2
13	6	0.5	18.5	0.2	0.4
14	6.5	0.5	18.7	0.2	0.4
15	7	0.5	19	0.3	0.6
16	7.5	0.5	19.2	0.2	0.4
17	8	0.5	19.4	0.2	0.4
18	8.5	0.5	19.6	0.2	0.4
19	9	0.5	19.9	0.3	0.6
20	9.5	0.5	20.1	0.2	0.4
21	10	0.5	20.3	0.2	0.4
22	10.5	0.5	20.5	0.2	0.4
23	11	0.5	20.7	0.2	0.4
24	11.5	0.5	20.9	0.2	0.4
25	12	0.5	21.2	0.3	0.6
26	12.5	0.5	21.5	0.3	0.6
27	13	0.5	21.8	0.3	0.6
28	13.5	0.5	22.1	0.3	0.6
29	14	0.5	22.3	0.2	0.4
30	14.5	0.5	22.6	0.3	0.6
31	15	0.5	22.9	0.3	0.6
32	15.5	0.5	23.2	0.3	0.6
33	16	0.5	23.5	0.3	0.6
34	16.5	0.5	23.7	0.2	0.4
35	17	0.5	24	0.3	0.6
36	17.5	0.5	24.3	0.3	0.6
37	18	0.5	24.6	0.3	0.6
38	18.5	0.5	24.9	0.3	0.6
39	19	0.5	25.2	0.3	0.6

Site Conditions and Metadata

Date:	2-Jun-25	Depth of Well (cm):	120
Location:	GP6	H1 (cm):	10
Operatiors:	Munjeong	H2 (cm):	
		Soil Type:	2
Weather Conditions	Sunny	Soil Description:	silt, some sand, some clay
		Reservoir Type:	Combined
		Date of last precipitation event:	29-May-25
		Amount of rain (mm):	10

Steady State Rate of Flow

R, the steady state of flow is achieved when the rate of change is the same in three consecutive time intervals.
These values will be used in the "GP Quick Calculator Tab"

R1 is the stready state rate of flow at H1 (cm/min)
R2 is the stready state rate of flow at H2 (cm/min)

R1 (cm/min)	0.6	Calculated Kfs Value (cm/sec)	2.03E-04
R2 (cm/min)		Infiltration Rate (mm/hr)	55.9369249
		K Value Method Selected from GP Calculator	

Guelph Permeameter Calculations - GP6

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.6000

Res Type	35.22		
H	10		
a	3	$\alpha^* =$	0.04 (cm^{-1})
H/a	3.333		
a*	0.04	$C =$	1.290234
C0.01	1.218	$Q =$	0.3522
C0.04	1.29		
C0.12	1.288	$K_{fs} =$	2.03E-04 cm/sec
C0.36	1.288		1.22E-02 cm/min
C	1.29		2.03E-06 m/sec
R	0.600		4.80E-03 inch/min
Q	0.352		8.00E-05 inch/sec
pi	3.142		
		$\Phi_m =$	5.08E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):
Enter water Head Height ("H" in cm):
Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

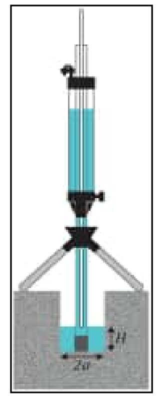
1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min):

Res Type	0		
H	0		
a	0	$\alpha^* =$	0 (cm^{-1})
H/a	#DIV/0!		
a*	0	$C =$	0
C0.01	#DIV/0!	$Q =$	0
C0.04	#DIV/0!		
C0.12	#DIV/0!	$K_{fs} =$	#DIV/0! cm/sec
C0.36	#DIV/0!		#DIV/0! cm/min
C	0		#DIV/0! m/ses
R	0.000		#DIV/0! inch/min
Q	0		#DIV/0! inch/sec
pi	3.1415		
		$\Phi_m =$	#DIV/0! (cm^2/min)

Average

$K_{fs} =$	#DIV/0!	cm/sec
	#DIV/0!	cm/min
	#DIV/0!	m/s
	#DIV/0!	inch/min
	#DIV/0!	inch/sec
$\Phi_m =$	#DIV/0!	(cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

Res Type:	2.16	$C_2 =$	0
H1/a:	#DIV/0!		
H2/a:	#DIV/0!	$G_1 =$	#DIV/0!
C1-0.01:	#DIV/0!		
C2-0.01:	#DIV/0!	$G_2 =$	#DIV/0!
C1-0.04:	#DIV/0!		
C2-0.04:	#DIV/0!	$G_3 =$	#DIV/0!
C1-0.12:	#DIV/0!		
C2-0.12:	#DIV/0!	$G_4 =$	#DIV/0!
C1-0.36:	#DIV/0!		
C2-0.36:	#DIV/0!	$K_{fs} =$	#DIV/0! cm/sec
			#DIV/0! cm/min
			#DIV/0! m/sec
			#DIV/0! inch/min
			#DIV/0! inch/sec
		$\Phi_m =$	#DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is macroscopic capillary length factor which is decided according to the soil texture-structure category. For one head method, only C_1 needs to be calculated while for two head method, C_1 and C_2 are calculated (Zhang et al., 1998)

Soil Texture-Structure Category	$\alpha^*(\text{cm}^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{[illegible]}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{[illegible]}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{[illegible]}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{[illegible]}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{[illegible]}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{[illegible]}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{[illegible]}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{[illegible]}$

Calculation formulas related to one-head and two-head methods. Where $\bar{R}$ is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Appendix G

Well Records (WWIS)

WELL_ID	COMPLETED	DEPTH TO BEDROCK	DEPTH	STATIC_LEV	WELL_USE	FORMATION
4900205	1958-10-28	0.00	7.6	3.7	DO	BRWN LOAM 0012 GREY CLAY STNS 0023 GREY MSND 0025
4900209	1967-01-24	0.00	10.4	4.9	DO	BRWN LOAM 0012 GREY CLAY MSND STNS 0032 MSND GRVL 0034
4900211	1961-08-05	0.00	16.8	4.6	DO	BRWN LOAM 0016 GREY CLAY STNS 0054 GRVL 0055
4900249	1961-10-02	Bedrock	36.6	0.0		PRDG 0030 BLDR CLAY 0035 BLUE CLAY 0055 BLUE CLAY MSND GRVL 0080 BLUE CLAY 0087 SHLE 0120
4900250	1961-10-17	Bedrock	23.2	3.4	DO	BRWN CLAY 0025 MSND CLAY 0032 BLUE CLAY 0052 HPAN 0075 GRVL 0076
4900258	1963-05-08	Bedrock	35.1	0.0		LOAM 0001 BRWN CLAY 0018 BLUE CLAY 0079 BLUE SHLE 0115
4900259	1963-05-31	Bedrock	24.4	13.7	DO	BRWN LOAM 0015 GREY CLAY 0066 GREY SHLE 0080
4900260	1965-05-15	0.00	15.8	9.8	DO	BRWN LOAM 0018 GREY CLAY 0049 CSND GRVL 0052
4903285	1969-07-07	Bedrock	27.4	3.7	ST DO	LOAM 0001 CLAY MSND STNS 0025 BLUE CLAY 0055 BLUE CLAY STNS 0058 BLUE SHLE 0090
4903556	1970-09-18	Bedrock	30.5	0.0		FILL 0001 BRWN CLAY 0015 BLUE CLAY GRVL 0060 BLUE SHLE 0100
4903572	1970-09-28	Bedrock	45.7	0.0		PRDG 0055 BLUE SHLE 0150
4903573	1970-10-08	Bedrock	38.1	0.0		BRWN CLAY 0010 BLUE CLAY STNS 0055 BLUE GRVL MSND 0070 BLUE CLAY GRVL 0077 BLUE SHLE 0125
4903622	1971-03-15	Bedrock	27.7	0.0		BRWN LOAM 0001 BRWN STNS CLAY 0022 GREY CLAY MSND GRVL 0065 BLUE CLAY SHLE 0070 BLUE SHLE 0091
4903719	1971-11-05	0.00	17.7	7.6	DO	BRWN CLAY 0014 GREY CLAY 0057 GRVL 0058
4904113	1973-06-21	0.00	18.6	3.4	ST DO	BRWN CLAY STNS 0015 SAND CLAY 0017 BRWN CLAY 0050 SAND GRVL CLAY 0061

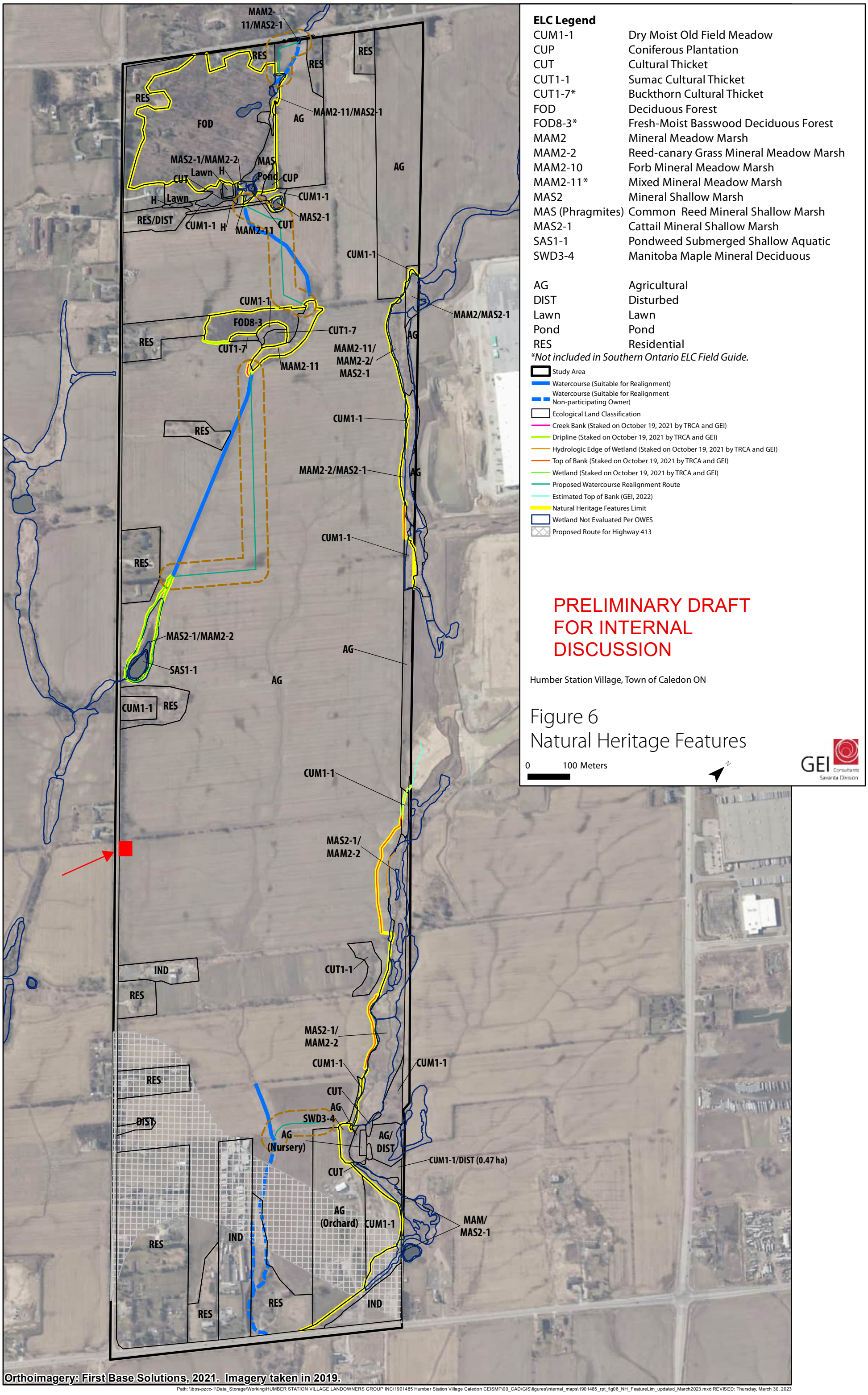
4904241	1973-09-25	0.00	66.1	0.0		BRWN CLAY 0016 BLUE CLAY 0112 GREY GRVL CLAY 0114 BLUE CLAY 0170 BLUE CLAY GRVL SILT 0205 BLUE SILT SAND 0217
4904566	1973-06-15	Bedrock	39.6	0.0		LOAM 0002 BLUE CLAY 0090 BLUE SHLE 0130
4905460	1978-09-15	0.00	9.8	7.6	DO	UNKN 0032
4905997	1982-09-01	0.00	15.8	3.0	DO	BLCK LOAM 0002 BRWN CLAY STNS 0017 BLUE CLAY STNS 0025 BLUE CLAY STNS SAND 0036 BLUE CLAY STNS 0045 BLUE CLAY CGVL 0048 BLUE CLAY STNS 0052
4906200	1984-05-11	Bedrock	16.5	3.7	DO ST	BLCK LOAM 0002 BRWN CLAY STNS 0015 GREY CLAY 0048 BRWN SAND GRVL 0053 BLUE SHLE 0054
4906309	1985-06-03	0.00	29.0	2.7	DO	BRWN SAND CLAY 0013 GREY SAND CLAY LYRD 0089 GREY SAND FSND SLTY 0094 GREY CLAY 0095
4906980	1988-11-20	0.00	18.9	6.1	DO	BRWN LOAM HARD 0001 BRWN CLAY HARD 0040 GREY CLAY LYRD PCKD 0062
4907464	1991-01-04	Bedrock	121.9	0.0	DO	BRWN CLAY 0040 GREY CGVL CMTD 0079 GREY FSND 0080 GREY CGVL CMTD 0092 GREY LMSN 0400
4907506	1991-02-01	0.00	0.0	2.4	DO	
4907515	1991-03-02	0.00	19.8	6.1	DO	BRWN LOAM HARD 0001 BRWN CLAY HARD 0030 GREY CLAY GRVL LYRD 0065
4907815	1993-09-03	0.00	18.3	3.0	DO	BRWN LOAM HARD 0001 BRWN CLAY HARD 0040 BRWN SAND LOOS 0060
4907950	1994-12-21	Bedrock	51.8	4.0	DO	BRWN CLAY STNS DNSE 0006 GREY CLAY STNS DNSE 0015 BLUE CLAY STNS DNSE 0059 BLUE SHLE HARD 0120 BLUE SHLE HARD 0170

4910381	2006-10-31	0.00	11.9	0.0		BRWN LOAM 0001 BRWN SILT TILL 0015 GREY SILT TILL 0020 GREY SILT TILL 0035 GREY SILT 0039
4910384	2006-11-06	0.00	53.3	0.0		BRWN LOAM 0001 BRWN SILT TILL 0010 GREY SILT TILL 0175
7210516	2013-10-11	0.00	6.1	0.0	MO	BRWN CLAY SAND PCKD 0005 GREY CLAY SAND SILT 0020
7224983	2014-06-09	0.00	7.6	0.0	MO	BRWN CLAY SILT LOOS 0015 GREY SILT CLAY PCKD 0025
7224993	2014-06-09	0.00	6.1	0.0	MO	BRWN CLAY SILT LOOS 0015 GREY SILT CLAY PCKD 0020
7224994	2014-06-09	0.00	7.6	0.0	MO	BRWN CLAY SILT LOOS 0015 GREY SILT CLAY PCKD 0025
7224997	2014-06-09	0.00	7.6	0.0	MO	BRWN CLAY SILT LOOS 0015 GREY SILT CLAY PCKD 0025
7224999	2014-06-09	0.00	6.1	0.0	MO	BRWN CLAY SILT LOOS 0015 GREY SILT CLAY PCKD 0020
7243117	2015-05-29	0.00	0.0	0.0		
7245005	2015-07-16	0.00	0.0	0.0		
7245006	2015-07-06	0.00	0.0	0.0		
7280866	2016-12-13	0.00	0.0	3.7		
7303451	2017-08-17	0.00	6.1	0.0	MO TH	BRWN SILT CLAY 0011 GREY SILT CLAY 0020
7306838	2017-08-16	0.00	0.0	0.0		
7306839	2017-08-16	0.00	0.0	0.0		
7306854	2017-08-18	0.00	0.0	0.0		
7326539	2018-12-07	0.00	0.0	0.0		
7328991	2018-04-05	0.00	0.0	0.0		
7355972	2019-04-02	0.00	6.1	0.0	TH	BRWN SILT CLAY 0012 GREY SILT CLAY 0020

Appendix H

Natural Heritage Features

(GEI 2022)



ELC Legend

CUM1-1	Dry Moist Old Field Meadow
CUP	Coniferous Plantation
CUT	Cultural Thicket
CUT1-1	Sumac Cultural Thicket
CUT1-7*	Buckthorn Cultural Thicket
FOD	Deciduous Forest
FOD8-3*	Fresh-Moist Basswood Deciduous Forest
MAM2	Mineral Meadow Marsh
MAM2-2	Reed-canary Grass Mineral Meadow Marsh
MAM2-10	Forb Mineral Meadow Marsh
MAM2-11*	Mixed Mineral Meadow Marsh
MAS2	Mineral Shallow Marsh
MAS (Phragmites)	Common Reed Mineral Shallow Marsh
MAS2-1	Cattail Mineral Shallow Marsh
SAS1-1	Pondweed Submerged Shallow Aquatic
SWD3-4	Manitoba Maple Mineral Deciduous

AG	Agricultural
DIST	Disturbed
Lawn	Lawn
Pond	Pond
RES	Residential

**Not included in Southern Ontario ELC Field Guide.*

- Study Area
- Watercourse (Suitable for Realignment)
- Watercourse (Suitable for Realignment Non-participating Owner)
- Ecological Land Classification
- Creek Bank (Staked on October 19, 2021 by TRCA and GEI)
- Dripline (Staked on October 19, 2021 by TRCA and GEI)
- Hydrologic Edge of Wetland (Staked on October 19, 2021 by TRCA and GEI)
- Top of Bank (Staked on October 19, 2021 by TRCA and GEI)
- Wetland (Staked on October 19, 2021 by TRCA and GEI)
- Proposed Watercourse Realignment Route
- Estimated Top of Bank (GEI, 2022)
- Natural Heritage Features Limit
- Wetland Not Evaluated Per OWES
- Proposed Route for Highway 413

PRELIMINARY DRAFT
FOR INTERNAL
DISCUSSION

Humber Station Village, Town of Caledon ON

Figure 6
Natural Heritage Features

0 100 Meters

GEI Consultants Saweta Division

Orthoimagery: First Base Solutions, 2021. Imagery taken in 2019.

Appendix I

TRSPA Water Balance Results

A WATER BALANCE TOOL