74 Berkeley Street, Toronto, ON M5A 2W7
Tel: 647-795-8153 | www.pecg.ca

Hydrogeological Investigation

1989 Appleby Line City of Burlington, Ontario

Palmer Project #
1901204

Prepared For
Latch Limited Partnership

May 30, 2022

74 Berkeley Street, Toronto, ON M5A 2W7
Tel: 647-795-8153 | www.pecg.ca

May 30, 2022

Marc Nufrio
1989 Appleby Latch Limited Partnership
2 Bloor St. W, Suite 700, Toronto, ON M4W 3R1
mnufrio@latch-developments.com

Dear: Mr. Nufrio

Re: Hydrogeological Investigation, 1989 Appleby Line City of Burlington, Ontario
Project #: 1901204

Palmer is pleased to submit the attached report describing the results of our Hydrogeological Investigation for the proposed development at 1989 Appleby Line, Burlington, Ontario ("the site"). It is understood that the proposed development will consist of medium-to-high density multi-unit residential buildings, with retail space and three levels of underground parking (P3). This report provides information on hydrogeological conditions to support design and permitting for the project based upon the results from our field investigations, laboratory testing, records reviews, and data analysis.

The site is underlain by a thin layer of silt to clay textured Halton Till, with shale bedrock below. The groundwater levels across the site are generally within the upper shale ranging from 2.62 to 5.60 meters below ground surface or 133.25 to 136.73 metres above sea level. Based upon the hydrogeological conditions encountered at the site and the proposed site plan, construction dewatering for three levels of basement is estimated to be 330,099 L/day, with a 1.5 x contingency factor applied and including direct precipitation. As this is above 50,000 L/day and below 400,000 L/day, an application on the Environmental Activity and Sector Registry (EASR) is recommended. As the proposed basement levels will be below the groundwater table, waterproofing is expected to be required as the City of Burlington is no longer permitting permanent discharge of groundwater to the storm or sanitary sewer systems.

We trust that this report will be satisfactory for your current needs. If you have any questions or require further information, please contact our office at your convenience. This report is subject to the Statement of Limitations provided at the end of this report.

Yours truly,
Palmer

Jason Cole, M.Sc., P.Geo.
VP, Principal Hydrogeologist

Table of Contents

1. Introduction 1
   1.1 Scope of Work 1
2. Hydrogeological Conditions 3
   2.1 Regional Conditions 3
      2.1.1 Physiography and Geology 3
      2.1.2 Hydrogeology 3
      2.1.3 Environmental Features and Drainage 7
      2.1.4 Source Water Protection 7
   2.2 Site Specific Conditions 7
      2.2.1 Borehole Drilling and Monitoring Well Installation 7
      2.2.2 Geology and Soil Profile 9
      2.2.3 Groundwater Levels 10
         2.2.3.1 Water Level Monitoring 10
      2.2.4 Hydraulic Conductivity 10
         2.2.4.1 In Situ- Single Well Response Tests 10
   2.3 Groundwater Chemistry 13
3. Dewatering Assessment 15
4. Hydrogeological Construction Considerations 16
   4.1 Short Term Construction Dewatering 16
   4.2 Long Term Foundation Dewatering 17
5. Impact Assessment 17
   5.1 Natural Environment 17
   5.2 Private Water Wells 17
   5.3 Ground Settlement 17
6. Discharge and Monitoring Plan 17
7. Conclusions and Recommendations 20
8. Signatures 21
9. Limitations of Report 22
10. References 23

List of Figures

Figure 1. Site Location 2

Figure 2. Surficial Geology 4
Figure 3. Bedrock Geology 5
Figure 4. Physiographic Region 6
Figure 5. Source Water Protection 8
Figure 6. Groundwater Flow 12
Figure 7. MECP Water Well Records 19

List of Tables

Table 1. Monitoring Well Installation Details 9
Table 2. Groundwater Monitoring Results 11
Table 3. Hydraulic Conductivity Summary Table 13
Table 4. Groundwater Chemistry Results 13
Table 5. Dewatering Rate Estimate Bedrock 16
Table 6. Discharge and Monitoring Plan 18

List of Appendices

Appendix A. Design Drawings (RAW, 2022)
Appendix B. Borehole Logs (Palmer, 2021/2022)
Appendix C. AQTESOLV Results (Palmer, 2022)
Appendix D. Certificate of Analysis

1. Introduction

Palmer Environmental Consulting Group Inc. (Palmer) was retained by Latch Limited Partnership to complete a Hydrogeological Investigation for a proposed mixed use development project located at 1989 Appleby Line, Burlington, Ontario (the "site"). The project site is situated on a 0.59-hectare (ha) plot of land in the east quadrant of the Appleby Line and Upper Middle Road intersection (**Figure 1**). The development area is currently occupied by a gas station and is bounded by Appleby Line to the southwest, Upper Middle road to the north-west, and by existing condominiums along the remaining sides. The proposed development consists of a medium-to-high density multi-unit residential buildings with retail space at ground-level and three levels of underground parking (P3). The site plan is provided in **Appendix A**.

This assessment is focused on characterizing hydrogeological conditions at the site to estimate dewatering rates and permitting requirements. Under the Ministry of the Environment, Conservation and Parks (MECP), registration on the Environmental Activity and Sector Registry (EASR) is required when dewatering is expected to be greater than 50,000 L/day but less than 400,000 L/day per non-overlapping water-taking area at a project site. If dewatering is expected to be greater than 400,000 L/day per non-overlapping water-taking area, a Category 3 Permit to Take Water (PTTW) from the MECP will be required.

1.1 Scope of Work

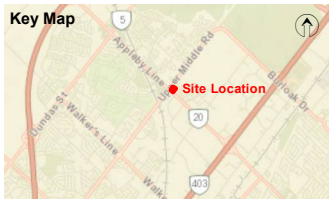
This hydrogeological assessment has been developed to utilize the boreholes and groundwater monitoring wells completed as part of the Phase Two ESA completed by Palmer and the geotechnical scope being completed by Grounded Engineering. The scope of work for this Hydrogeological Investigation included:

- Completion of a background review of hydrogeological data including watershed plans, MECP water well records, surficial and bedrock geology mapping, Source Water Protection mapping;
- Completion of groundwater monitoring to assess groundwater elevations and groundwater flow direction;
- Completion of well development of existing wells identified on site;
- Conduct single well response tests (i.e., slug tests and bail tests) in select monitoring wells to calculate the hydraulic conductivity of the shallow soils and bedrock at the site;
- Collect a groundwater chemistry sample form one (1) monitoring well, with the results compared against the Halton Region Storm and Sanitary Sewer Discharge criteria;
- Complete a dewatering assessment based on calculated hydraulic conductivity values and measured groundwater levels at the site; and
- Completion of a Hydrogeological Investigation report to summarize the hydrogeological conditions at the site and support design and permitting.



LEGEND

- Borehole
- Monitoring Well
- Subject Property



0 5 10 20 30

METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:750
Page Size: Letter (8.5 x 11 inches)

Drawn: CV
Checked: NA
Date: May 12, 2022

Source Notes:
Imagery (2021) provided by Esri basemap service

NORTH

CLIENT
1989 Appleby Latch Limited Partnership

PROJECT
1989 Appleby Line

TITLE
Site Location

Palmer

REF. NO. 1901204-MR-301-A

Figure 1

Document Path: G:\Shared drives\Projects 2019\19012 - Latch Developments Ltd\1901204 - 1989 Appleby Line\GIS\1_Workspace\Task 3 - HydroG Figures\1901204_1-1_Site Location.mxd

2. Hydrogeological Conditions

2.1 Regional Conditions

2.1.1 Physiography and Geology

Available surficial and quaternary geology mapping by the Ontario Geological Survey (OGS) indicates the native surficial geology is comprised of primarily of Halton Till (**Figure 2**). This deposit is primarily characterized as a clay to silt-textured till (Sharpe et al., 1999).

Bedrock underlying the site is characterized by the Queenston Formation which consists of shale, siltstone, and minor amounts of limestone and sandstone (**Figure 3**). Based on a review of nearby MECP water well records, bedrock is expected to be encountered at approximately 2 - 3 mbgs.

The site is located in the South Slope physiographic region (**Figure 4**) (Chapman and Putnam, 1984). This area is a sloping glaciolacustrine till plain that extends across the City of Toronto, as well as York, Peel, Halton and Durham Regions, and Northumberland County. The dominant soil texture of the region is clay and silt, with some interbedded deposits of sand. In the Halton Region the South Slope begins on the south side of the Niagara escarpment and slopes downward to the south. The topography in this region is gently rolling with numerous drumlins oriented up slope.

2.1.2 Hydrogeology

Hydrostratigraphic units can be subdivided into two distinct groups based on their ability to allow groundwater movement. An aquifer is classically defined as a layer of soil that is permeable enough to permit a usable supply of water to be extracted. An aquitard is a layer of soil that inhibits groundwater movement due to its low permeability. Shallow groundwater flow within the analysis area is influenced by two (2) key hydrostratigraphic units:

The ***Halton Till*** is a clayey silt to silty clay textured till unit representing the final advance of ice at the end of the Wisconsinan glaciations. It has a predominantly silty clay to silt matrix and contains isolated lenses of laminated sand, silt, and clay. Regionally the unit acts as a surficial aquitard, with hydraulic conductivities ranging from about 10^{-10} to 10^{-6} m/s (Gerber and Howard, 2002). The low bulk permeability acts to inhibit local groundwater recharge and reducing the exposure of underlying aquifers to contamination (Sharp et al., 1996). Groundwater flow within till soils is typically downwards towards more permeable, aquifer units. The water table is expected to be fairly shallow in the clay rich till soils, and perched water table conditions may form because of the poorly drained nature of the soil.

Queenston Shale Bedrock, which underlies the till, acts as an aquitard unit that inhibits deep groundwater flow. Despite acting as an aquitard, the Queenston Shale contains zones near the bedrock/overburden interface that has a relatively higher hydraulic conductivity and often functions as a thin bedrock aquifer. These zones are typically found within the upper 3 to 5 m of the shale as weathered and fracture-rich layers.



LEGEND

- Borehole
- Monitoring Well
- Watercourse[1]
- Groundwater Flow Direction
- Subject Property

Surficial Geology[2]

Phanerozoic / Cenozoic / Quaternary / Pleistocene

- 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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METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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Page Size: Letter (8.5 x 11 inches)

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Checked: NA
Date: May 12, 2022

NORTH

Source Notes:
Imagery (2021) provided by Esri basemap service.
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CLIENT
1989 Appleby Latch Limited Partnership

PROJECT
1989 Appleby Line

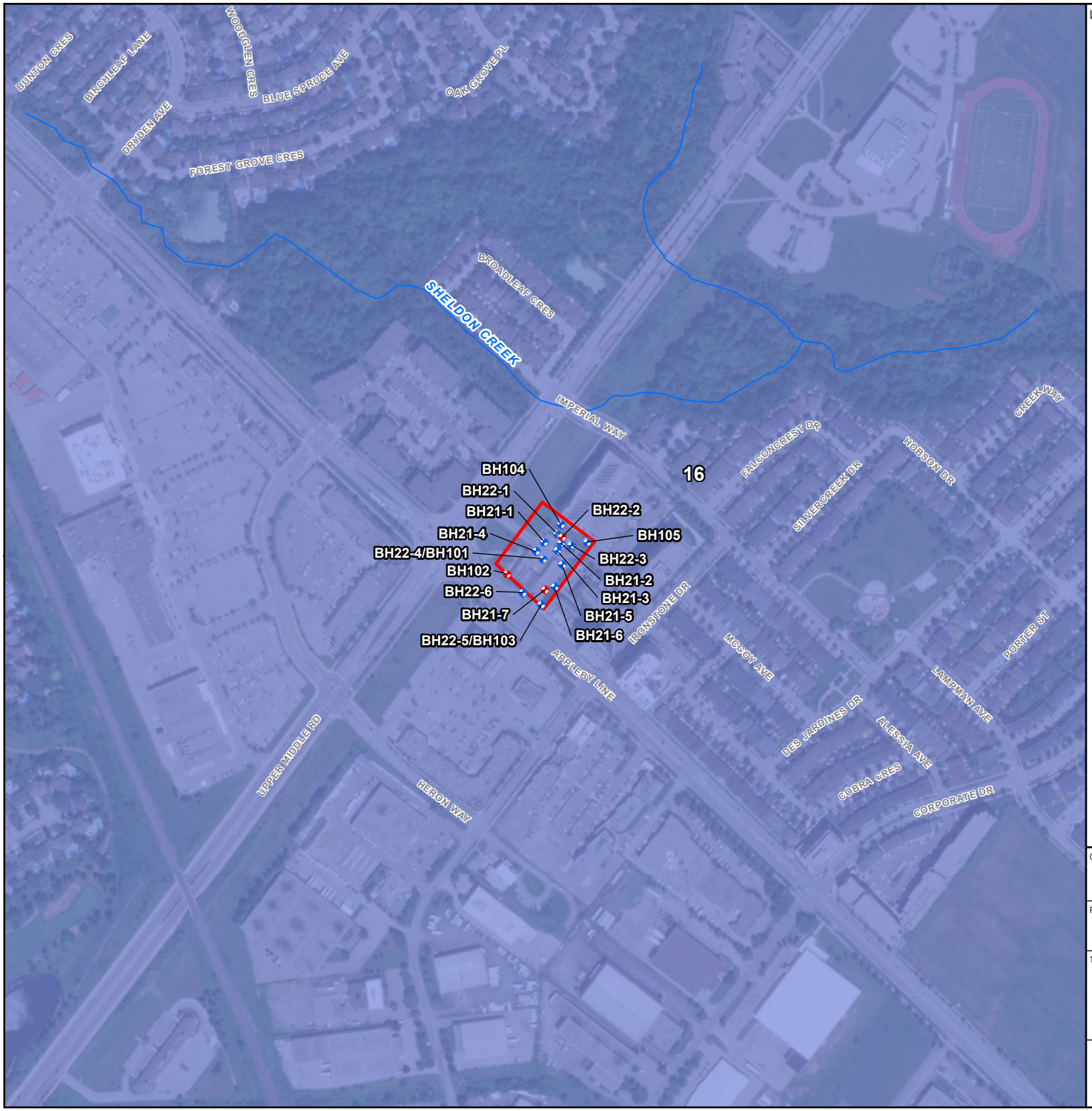
TITLE
Surficial Geology

Palmer

REF. NO. 1901204-MR-302-A

Figure 2

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LEGEND

- Borehole
- Monitoring Well
- Watercourse[1]
- Subject Property

Paleozoic Bedrock Geology[2]

Upper Ordovician

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

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

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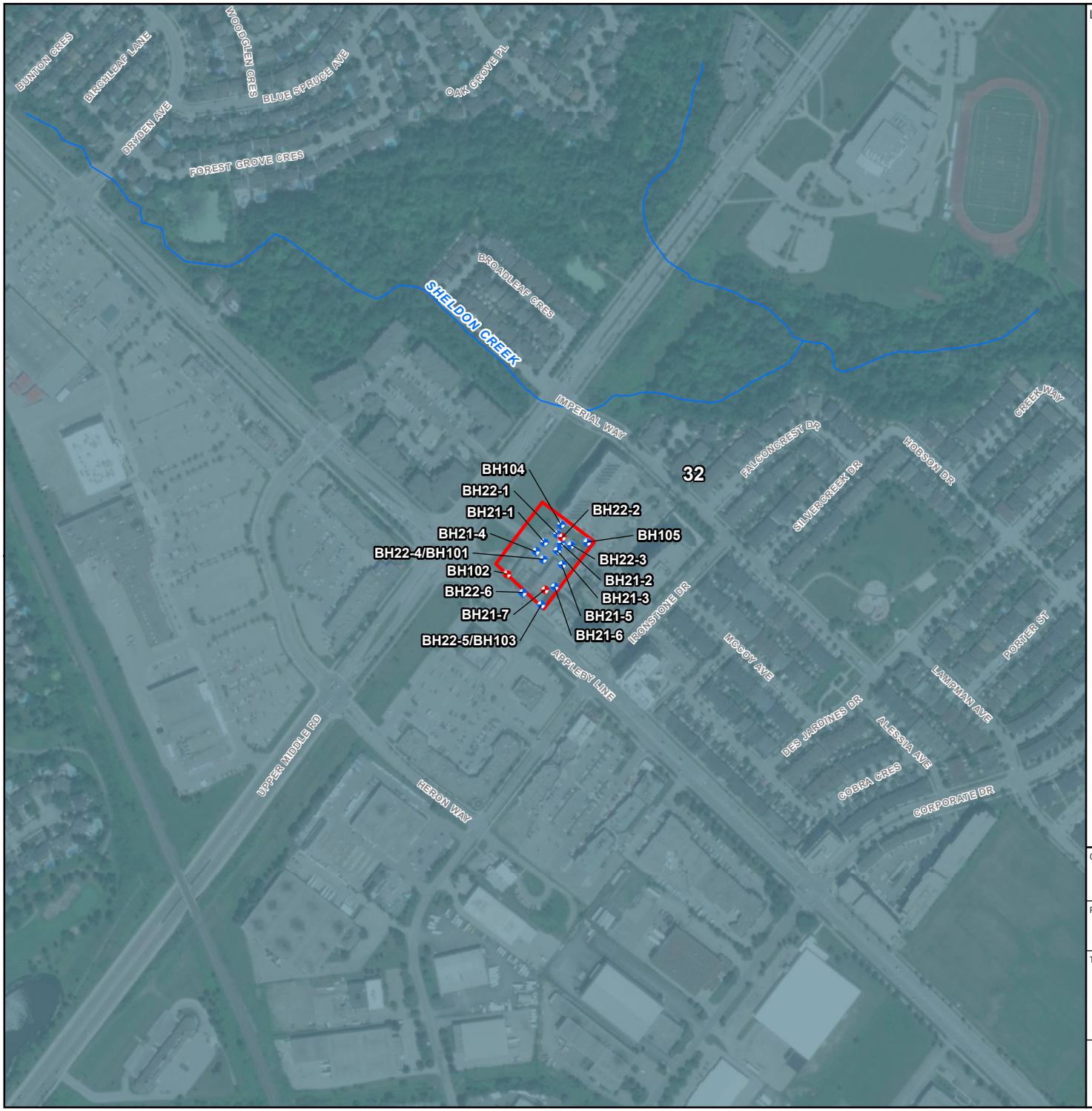
TITLE
Bedrock Geology

Palmer

REF. NO. 1901204-MR-303-A

Figure 3

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LEGEND

- Borehole
- Monitoring Well
- Watercourse[1]
- Subject Property

Physiographic Region[2]

- 32: South Slope

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

0 25 50 100 150 200 250
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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PROJECT
1989 Appleby Line

TITLE
Physiographic Region

Palmer™

REF. NO. 1901204-MR-304-A

Figure 4

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2.1.3 Environmental Features and Drainage

The site is located within the Appleby Creek subwatershed of the Burlington Urban Creeks watershed. The Appleby Creek subwatershed covers a total area of approximately 14.08 km^2, and ultimately drains into Lake Ontario (Conservation Halton, 2013). No natural features were identified within the site boundary.

Although the site is located in the Appleby Creek subwatershed, Sheldon Creek is the nearest natural feature to the site. It is located approximately 125 m north of the site (**Figure 2**).

2.1.4 Source Water Protection

The site is located within the Halton-Hamilton Source Protection Region. The Source Water Protection Plan identifies four main regulatory factors under the *Clean Water Act (2006)* relating to local hydrogeology to consider for site development: Significant Groundwater Recharge Areas (SGRAs), Highly Vulnerable Aquifers (HVAs), and Wellhead Protection Areas (WHPAs), and Intake Protection Zones (IPZs).

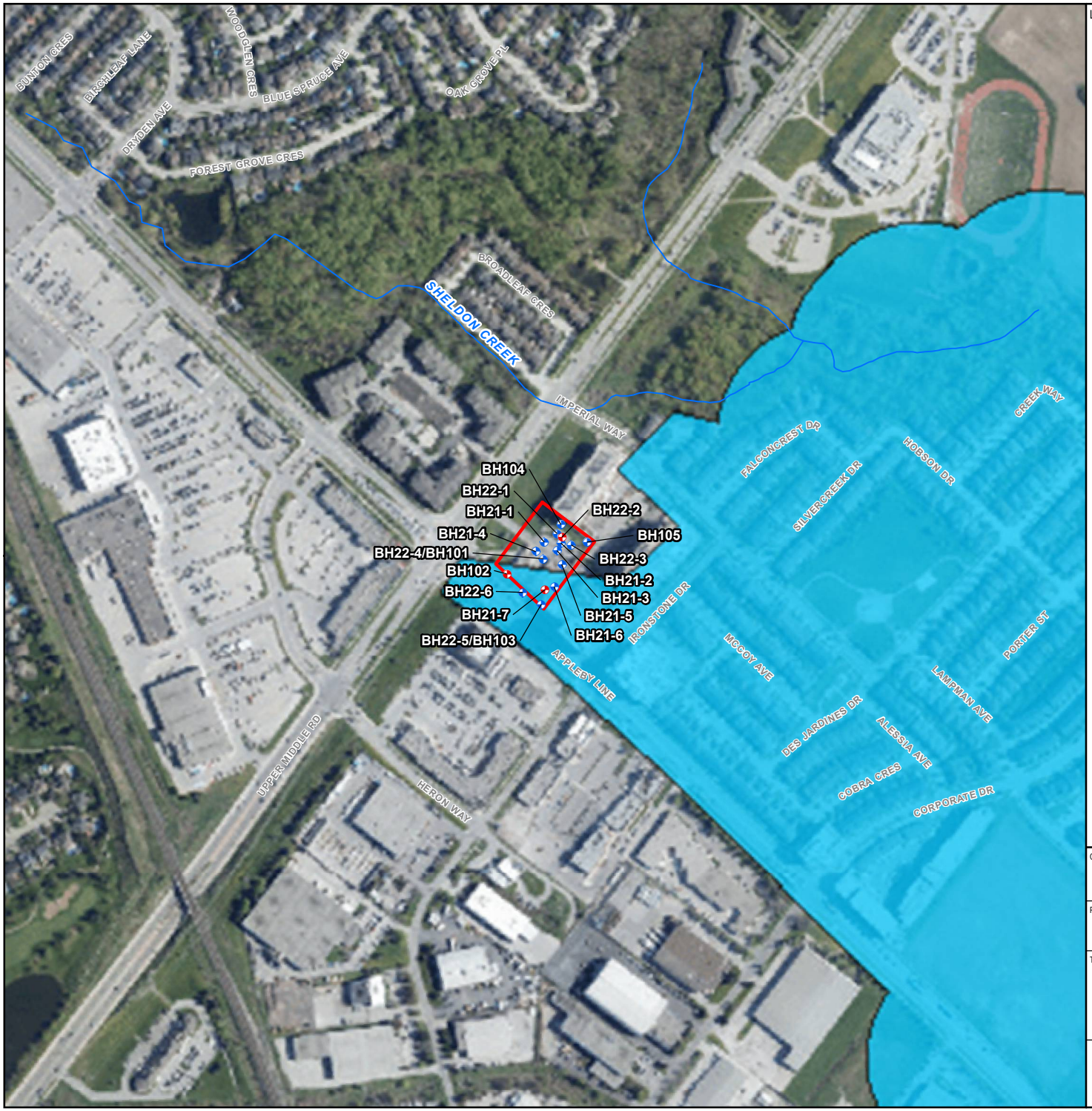
A Wellhead Protection Area (WHPA) is the area around the wellhead where land use activities have the potential to affect the quality or quantity of water that flows into the well. These areas are delineated into zones of vulnerability (A, B, C, and D) based on the time of travel of water into the well, and zones around a surface water body influencing a Groundwater Under Direct Influence (GUDI) (E, F). Other zones (Q1, and Q2) are defined as the areas where new water takings or reduced recharge could impact the quantity of water available to municipal supply wells. IPZs are the area on the water and land surrounding a municipal surface water intake. HVAs are aquifers that are susceptible to contamination as a result of the soil structure/material or due its location near the ground surface. Lastly, SGRAs are areas where recharge is important to maintain the water level in a community drinking water aquifer.

The site is not located within any WHPA, HVA or SGRA, but is located in an Intake Protection Zone (IPZ) (in the southwest corner), where it is evaluated as a level 2 score 4 IPZ (**Figure 5**). Based on the proposed development type, there are no development constraints related to Source Water Protection Plan or the presence of the IPZ-2.

2.2 Site Specific Conditions

2.2.1 Borehole Drilling and Monitoring Well Installation

Borehole drilling investigations were completed in October, 2021 and April, 2022 by Strata Drilling Group. In total, twelve (12) boreholes were advanced (BH21-1 to BH21-6, BH22-1 to BH22-6) with eleven (11) completed as 2-inch diameter monitoring wells (BH21-1 to BH21-6, BH22-1, BH22-3, BH22-4, BH22-5, BH22-6). Four (4) wells identified as BH101, BH102, BH104, and BH105 were also completed on site by 3D drilling as part of the Grounded Engineering geotechnical investigation (Grounded, 2022). The locations of the monitoring wells are shown on **Figure 1**. A summary of borehole and monitoring well installation details, including details of surface elevation, depth, and screened geology is provided in **Table 1**. The completed borehole logs by Palmer and a copy of the Grounded Engineering (2022) logs are provided in **Appendix B**.



LEGEND

- Borehole
- Monitoring Well
- Watercourse[1]
- Subject Property

Source Water Protection[2]

- Intake Protection Zone 2

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

0 25 50 100 150 200 250
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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1989 Appleby Latch Limited Partnership

PROJECT
1989 Appleby Line

TITLE
Source Water Protection

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REF. NO. 1901204-MR-305-A

Figure 5

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2.2.2 Geology and Soil Profile

The stratigraphy of the site area encountered during borehole drilling, as described by Palmer (2021, 2022) is summarized below:

Concrete/ asphalt: Concrete or asphalt was encountered in all completed boreholes except 104 and 105. The thickness of the layers was ~15 cm across the site.

Fill: The layer consisted of clayey silt, fill, trace gravel, trace sand and varied across the site with ranging coarseness. In boreholes 22-3, 22-5, 22-6 there was predominantly coarser fill with sand and trace gravel.

Clay Silt Till (Halton Till): Deposits of clayey silt till were found in all the wells below native soils. This unit represents a finer grained lithology of the Halton Till aquitard hydrostratigraphic unit.

Weathered Queenston Shale: Shale was encountered in all wells at depths ranging from 3.4 to 4.3 mbgs (135.2 to 136.4 masl) and ranges in thickness from 3.3 to 3.9 m in thickness. This unit is identified by elevated RQD values in the bedrock and the presence of rubble zones. The interface between the shale and overlying till consists of very weathered shale. This layer often resulted in refusal while drilling resulting in the need to auger to the total depths.

Competent Queenston Shale: Shale was encountered below depth ranging from 6.7 to 7.8 mbgs (131.8 to 133.1 masl). This unit is represented by RQD value over 80% and the high solid core recovery in the Grounded Engineering core logs (**Appendix B**).

Table 1. Monitoring Well Installation Details

Well ID	Surface Elevation (masl)	Depth (mbgs)	Screened Interval (mbgs)	Screened Unit
BH21-1 (MW)	137.11	4.68	3.18-4.68	Weathered Shale
BH21-2	138.20	6.23	3.23-6.23	Silty clay till - Weathered Shale
BH21-3	138.39	6.22	3.22-6.22	Silty clay till - Weathered Shale
BH21-4	137.52	4.73	3.23-4.73	Silty clay till - Weathered Shale
BH21-5	140.77	5.25	3.75-5.25	Clayey silt till - Weathered Shale
BH21-6	139.13	5.22	3.72-5.22	Silty clay - Clayey silt till - Weathered Shale
BH22-1	149.16	5.82	2.82-5.82	Clayey silt - Weathered Shale
BH22-3	141.19	5.88	2.88-5.88	Silty clay till - Weathered Shale
BH22-4/101	139.22	6.64	3.70-6.70	Weathered Shale
BH22-5/103	138.31	8.03	5.03-8.03	Weathered Shale
BH22-6	138.24	4.53	1.53-4.53	Clayey silt till - Weathered Shale
BH104	138.13	9.08	6.20-9.20	Weathered Shale / Competent Shale
BH105	138.14	7.85	4.90-7.90	Weathered Shale

2.2.3 Groundwater Levels

2.2.3.1 Water Level Monitoring

Water levels were measured at each well by Palmer personnel on April 19th, April 21st, and May 5th, 2022. Water levels were measured using a water level tape and recorded to the nearest centimeter. **Table 2** provides the measured water level elevations by Palmer. Water levels ranged from 2.62 to 5.60 mbgs or 133.25 to 136.72 masl. Groundwater levels collected in May and are expected to represent the seasonal high for the site.

A groundwater flow map was created based on groundwater levels collected on April 20/21, 2022 (**Figure 6**). Groundwater elevation is highest in the southeast/ central protion of the site, with groundwater flowing both south and northeast from this high point. Groundwater levels across the site were found within the upper fractured shale, or in the interface between overburden and upper fractured shale. Groundwater within the site area is anticipated to primarily move vertically through the upper Halton Till until reaching the upper fractured bedrock which acts as an unconfined aquifer at the site.

2.2.4 Hydraulic Conductivity

2.2.4.1 In Situ- Single Well Response Tests

Palmer conducted single well response tests to measure hydraulic conductivity (K) of the geological material in select monitoring wells on April 21, 2022. Tests were completed by lowering a 1 m long slug into each well (slug test) to create a change in hydraulic head or by removing a slug of water using a bailer (bail test). Hydraulic conductivity values were estimated by measuring the rate of change in recovery of the water level once the slug was inserted into the well (also known as a Falling Head (FH) Test). Once the Falling Head Test was terminated, the slug was removed and the subsequent rate of change in the water level was recorded (also known as a Rising Head (RH) Test). Bail tests were also conducted in which a volume of water (1 Litre) is removed from the well, after which recovery is also monitored.

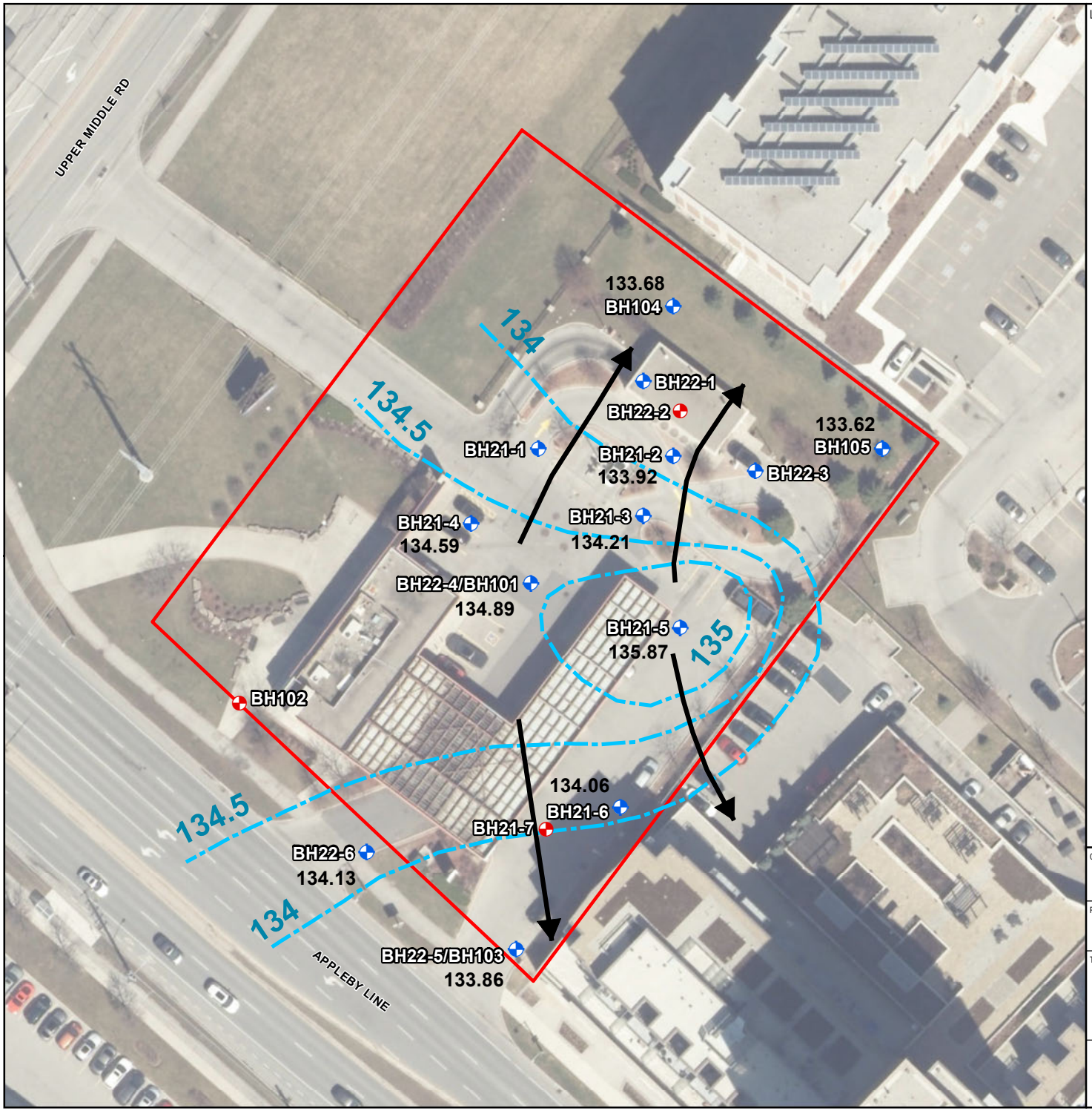
Water levels in each well were recorded using a datalogger set to record water levels at 1-second intervals. Manual water-level measurements were also collected during the tests in order to gauge recovery. Tests were terminated once either 80% recovery had been attained, or 30-minutes had elapsed, whichever occurred first.

Hydraulic conductivity values were calculated from the displacement-time data using the Bower and Rice (1976) method for both confined and unconfined aquifers, as modelled by Aqtesolv™ software. The analysis results are presented in **Appendix C**, and the range of calculated hydraulic conductivity values are summarized in **Table 3.**

The calculated hydraulic conductivity of the weathered Queenston Shale/ the saturated Till-Shale interface ranged from 1.6×10^{-6} m/s to 2.5×10^{-5} m/s with a geometric mean of 8.2×10^{-6} m/s and a 90th percentile of 2.4×10^{-5} m/s. No hydraulic conductivity values were collected from the competent shale found below 131.8 to 133.1 masl (6.7 to 7.8 mbgs), but it is expected to be on the order of 1×10^{-8} m/s unless an interconnected fracture is encountered.

Table 2. Groundwater Monitoring Results

Well Information		Groundwater Level and Elevation													
		October 20 2021		October 22 2021		April 19 2022		April 20 2022		April 21 2022		April 28 2022		May 5 2022	
MW ID	Elevation (mASL)	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl
BH21-1	137.12	2.86	134.26	2.92	134.20	2.88	134.24	2.93	134.19	2.89	134.23	2.95	134.17	2.62	134.50
BH21-2	138.20	4.2	134.00	4.27	133.93	4.30	133.90	4.28	133.92	4.28	133.92	4.13	134.07	Dry at 6.13	-
BH21-3	138.39	4.07	134.32	4.07	134.32	4.17	134.22	4.17	134.22	4.18	134.21	4.14	134.25	4.12	134.27
BH21-4	137.52	2.88	134.64	2.91	134.61	2.90	134.62	2.89	134.63	2.93	134.59	4.27	133.25	2.82	134.70
BH21-5	140.76	5.03	135.74	5.04	135.73	5.11	135.66	5.08	135.69	4.90	135.87	5.25	135.52	5.20	135.57
BH21-6	139.13	DRY	-	DRY	-	DRY	-	DRY	-	5.07	134.06	DRY	-	DRY	-
BH22-1	139.16	-	-	-	-	5.60	133.56	5.56	133.60	-	-	5.49	133.67	4.44	134.72
BH22-3	141.19	-	-	-	-	-	-	4.46	136.73	-	-	4.62	136.57	4.53	136.66
BH22-4/101	139.22	-	-	-	-	4.40	134.82	4.32	134.90	4.33	134.89	4.32	134.90	4.21	135.01
BH22-5/103	138.31	-	-	-	-	4.16	134.15	4.61	133.70	4.45	133.86	4.48	133.83	4.36	133.95
BH22-6	138.24	-	-	-	-	3.77	134.47	4.09	134.15	-	-	3.86	134.38	3.78	134.46
BH104	138.13	-	-	-	-	4.47	133.66	-	-	4.45	133.68	-	-	4.39	133.74
BH105	138.14	-	-	-	-	4.51	133.63	-	-	4.52	133.62	-	-	4.46	133.68



LEGEND

- Borehole
- Monitoring Well
- Groundwater Contour
- Subject Property

Notes:
1. Groundwater levels from April 20/21, 2022.
2. All elevations in metres above mean sea level.

0 5 10 20 30
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:750
Page Size: Letter (8.5 x 11 inches)

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Checked: NB
Date: May 30, 2022

Source Notes:
Imagery (2021) provided by Esri basemap service

NORTH

CLIENT
1989 Appleby Latch Limited Partnership

PROJECT
1989 Appleby Line

TITLE
Groundwater Flow

Palmer™

REF. NO. 1901204-MR-306-B

Figure 6

Document Path: G:\Shared drives\Projects 2019\19012 - Latch Developments Ltd\1901204 - 1989 Appleby Line\GIS\1_Workspace\Task 3 - HydroG Figures\1901204_6-2_Groundwater Flow.mxd

Table 3. Hydraulic Conductivity Summary Table

BH Name	Screened Geology	Hydrostratigraphic Unit	Aquifer Type	Tests	Hydraulic Conductivity [m/s]	Hydraulic Conductivity Geomean [m/s]	Hydraulic Conductivity 90th Percentile [m/s]
BH21-1	Weathered Shale	Queenston Shale	Unconfined	Bail	1.57×10^{-6}	8.26×10^{-6}	2.46×10^{-5}
BH21-2	Weathered Shale	Queenston Shale	Unconfined	FH	4.36×10^{-6}		
BH21-2	Weathered Shale / Silty Clay Till	Queenston Shale / Halton Till Interface	Unconfined	FH	4.59×10^{-6}		
BH21-4	Weathered Shale / Silty Clay Till	Queenston Shale / Halton Till Interface	Unconfined	FH	1.13×10^{-5}		
BH22-5	Weathered Shale	Queenston Shale	Unconfined	Bail	6.67×10^{-6}		
BH22-5	Weathered Shale	Queenston Shale	Unconfined	FH	9.00×10^{-6}		
BH22-5	Weathered Shale	Queenston Shale	Unconfined	RH	8.57×10^{-6}		
BH104	Weathered Shale	Queenston Shale	Confined	Bail	2.34×10^{-5}		
BH104	Weathered Shale	Queenston Shale	Confined	FH	2.27×10^{-5}		
BH104	Weathered Shale	Queenston Shale	Confined	RH	2.54×10^{-5}		
BH105	Weathered Shale	Queenston Shale	Unconfined	Bail	6.80×10^{-6}		
BH105	Weathered Shale	Queenston Shale	Unconfined	RH	6.62×10^{-6}		
BH105	Weathered Shale	Queenston Shale	Unconfined	RH	7.56×10^{-6}		

2.3 Groundwater Chemistry

Groundwater chemistry samples were collected on April 21, 2022 from BH104 and analyzed for a suite of water quality parameters including TSS, pH, metals, anions, and VOCs. A summary of the groundwater analysis results is presented in **Table 4** and the Certificate of Analysis is provided in **Appendix D**. Results were compared against the Halton Region Storm and Sanitary Sewer Discharge Criteria. The results indicate that water quality did not exceed Storm or Sanitary Sewer Discharge criteria for any parameters.

Table 4. Groundwater Chemistry Results

Parameter	Halton Region Guideline Limits		Lowest Detection Limit	Units	Water Sample
	Sanitary	Storm			BH 104
Physical Tests (Water)					
pH	6 -> 10	6.5 -> 8.5	0.10	pH units	7.56
Total Suspended Solids	350	25	3.0	mg/L	22.4
Anions and Nutrients (Water)					
Fluoride (F)	10	-	0.10	mg/L	0.14

Parameter	Halton Region Guideline Limits		Lowest Detection Limit	Units	Water Sample
Total Kjeldahl Nitrogen	100	-	0.050	mg/L	0.649
Phosphorus, Total	10	-	0.0030	mg/L	0.0155
Sulfate (SO4)	1500	-	1.5	mg/L	110
Cyanides (Water)					
Cyanide, Total	2	-	0.0020	mg/L	<0.0020
Bacteriological Tests (Water)					
E. Coli	-	200	-	CFU/100mL	0
Total Metals (Water)					
Aluminum (Al)-Total	50	-	0.050	mg/L	0.317
Antimony (Sb)-Total	5	-	0.0010	mg/L	<0.0010
Arsenic (As)-Total	1	-	0.0010	mg/L	0.0016
Beryllium (Be)-Total	5	-	0.0010	mg/L	<0.0010
Cadmium (Cd)-Total	1	-	0.000050	mg/L	<0.000050
Chromium (Cr)-Total	3	-	0.0050	mg/L	<0.0050
Cobalt (Co)-Total	5	-	0.0010	mg/L	<0.0010
Copper (Cu)-Total	3	-	0.0050	mg/L	<0.0050
Iron (Fe)-Total	50	-	0.10	mg/L	0.60
Lead (Pb)-Total	3	-	0.00050	mg/L	<0.00050
Manganese (Mn)-Total	5	-	0.0050	mg/L	0.161
Mercury (Hg)-Total	0.05	-	0.0000050	mg/L	<0.0000050
Molybdenum (Mo)-Total	5	-	0.00050	mg/L	0.00424
Nickel (Ni)-Total	3	-	0.0050	mg/L	<0.0050
Selenium (Se)-Total	5	-	0.00050	mg/L	<0.00050
Silver (Ag)-Total	5	-	0.00050	mg/L	<0.00050
Tin (Sn)-Total	5	-	0.0010	mg/L	0.0032
Titanium (Ti)-Total	5	-	0.0030	mg/L	0.0073
Zinc (Zn)-Total	3	-	0.030	mg/L	<0.030
Aggregate Organics (Water)					
BOD Carbonaceous	300	-	3.0	mg/L	<3.0
Oil and Grease, Total			5.0	mg/L	<5.0
Animal/Veg Oil & Grease	150	-	5.0	mg/L	<5.0
Mineral Oil and Grease	15	-	2.5	mg/L	<2.5
Phenols (4AAP)	1	-	0.0010	mg/L	<0.0010
Volatile Organic Compounds (Water)					
Benzene	10	-	0.50	ug/L	<0.50
Chloroform	40	-	1.0	ug/L	<1.0
1,4-Dichlorobenzene	80	-	0.50	ug/L	<0.50
Dichloromethane	2000	-	2.0	ug/L	<2.0
Ethylbenzene	160	-	0.50	ug/L	<0.50
Tetrachloroethylene	1000	-	0.50	ug/L	<0.50
Toluene	16	-	0.50	ug/L	<0.50
Trichloroethylene	400	-	0.50	ug/L	<0.50
4-Bromofluorobenzene	-	-	-	%	99.6
1,4-Difluorobenzene	-	-	-	%	100.8
Polycyclic Aromatic Hydrocarbons (Water)					

Parameter	Halton Region Guideline Limits		Lowest Detection Limit	Units	Water Sample
Naphthalene	140	-	0.020	ug/L	<0.020
d8-Naphthalene	-	-	-	%	83.8

3. Dewatering Assessment

Based on the design drawings provided in **Appendix A**, it is understood that three levels of underground parking (P3) are proposed with an approximate depth of 9.0 mbgs or to an elevation of 129.1 masl. Including one additional meter for elevator shaft construction and another one metre for the dewatering sump, the total depth of construction is estimated to be 11.0 mbgs or to an elevation of 127.1 masl. Dewatering estimates will be provided using the estimated depth of construction + 1 m to account for dry working conditions. The highest measured groundwater level taken on April 20, 2022 of 136.73 masl will be used to estimate the dewatering rates. It is assumed that the proposed building will have a footprint of approximately 65 x 90m.

The rounded 90th percentile measured hydraulic conductivity value of 2.5 x 10^{-5} m/s from the weathered shale (found in **Table 3**) has been used in the dewatering assessment. The weathered shale is expected to range in thickness from 3.4 to 4.3 m and range in elevation from 135.2 to 136.4 masl, meaning that it is considered to be fully saturated for the purposes of this assessment. The competent shale found below is expected to be found at depths ranging from 6.7 to 7.8 mbgs or 131.8 to 133.1 masl, extending the full depth of excavation, and has an estimated hydraulic conductivity of 1 x 10^{-8} m/s.

A dewatering rate estimate (Q) for the rectangular/near-square excavation was calculated using the following equation from Powers et. al (2007) for an equivalent well in an unconfined aquifer:

Unconfined Aquifer, $$Q_{unconfined} = \frac{\pi K(H^2 - h^2)}{ln\,(\frac{Ro}{r_e})} \quad m^3/s$$

Confined Aquifer, $$Q_{confined} = \frac{2\pi Kb(\mathrm{H}-\mathrm{h})}{ln\,(\frac{Ro}{r_e})} \quad m^3/s$$

Where

K = hydraulic conductivity (m/s)
H = saturated thickness (m)
h = saturated thickness after dewatering (m)
b = aquifer thickness (m)
R_O = radius of influence (only valid if $\ln[R_o/r_e] > 1.5$) estimated using (i) the Sichardt (1930) Approximation:
$R_O = 3000 * (H-h) * \sqrt{K}$ (m)
r_e = equivalent well radius estimated by:
$r_e = \sqrt{\frac{a^2}{\pi}}$ (m)

Where *a* = trench width (m)
X = trench length (m)

Table 5. Dewatering Rate Estimate Bedrock

Dewatering Parameter	Symbol	Unit	Weathered Queenston Shale	Competent Queenston Shale
Excavation length	X	[m]	90	90
Excavation width	A	[m]	65	65
Hydraulic Conductivity	K	[m/s]	2×10^{-5}	1×10^{-8}
Saturated thickness	H	[m]	4.93	4.7
Dewatered saturated thickness	h	[m]	0	0
Radius of influence	R_0	[m]	117.69	38.0
Equivalent Well Radius	R_e	[m]	43.2	36.7
Dewatering Rate	Q_{dw}	[L/day]	167,011	4,305
Total Dewatering Rate	Q_{dw}	[L/day]	171,316	
Total Dewatering Rate (Including 1.5x Safety Factor)	Q	[L/day]	256,974	

Based on the parameters provided in **Table 5**, the estimated dewatering rates for three (3) levels of basement and an elevator shaft is 171,316 L/day. Including a contingency factor of 1.5x to account for variability in the thickness of fractured shale, the total estimated dewatering rate is 256,974 L/day.

4. Hydrogeological Construction Considerations

4.1 Short Term Construction Dewatering

Short-term construction dewatering is required for the installation of the building foundation and the three levels of underground parking (P3) and elevator shafts. Under MECP requirements, registration on the Environmental and Site Activity Registry (EASR) is required when dewatering is greater than 50,000 L/day and less than 400,000 L/day. A Category 3 PTTW is required when dewatering is expected to be greater than 400,000 L/day. As the discharge does not exceed 400,000 L/day, only an application on the EASR is recommended.

To account for direct precipitation from large storm event, the volume from a 25 mm storm, dewatered over 1 day would add an additional 146,250 L/day of dewatering. If dewatered over 2-days, the rate would be 73,125 L/day for 2-days.

Therefore, taking into consideration groundwater seepage and direct precipitation, the total short-term construction dewatering that the client and their contractor should be prepared for is 330,099 L/day. A temporary discharge permit from Halton Region or the City of Burlington should be submitted for an amount of 330,099 L/day.

4.2 Long Term Foundation Dewatering

The groundwater table at the site is expected to range between approximately 133.25 and 136.72 masl. Based on the site plan to have 3 levels of underground parking and a foundation the underside foundation (UF) elevation of the proposed underground garage will be approximately 128.1 masl. As the building foundation will be located below the water table, long-term groundwater control or the use of water-tight foundations will be required. Assuming that non-watertight foundations are used, the long-term dewatering rate from the foundation drainage is estimated to be 64,055 L/day. This water would need to be directed to the storm or sanitary sewer and would be subject to approvals from Halton Region or the City of Burlington.

It is important to note that recent changes to City of Burlington engineering policies no longer allow long-term/ permanent drainage of *groundwater* into the sewer system. Therefore, as the building is below the groundwater table and long-term seepage of groundwater will occur, it is expected that the underground parking structure will need to be fully watertight.

5. Impact Assessment

5.1 Natural Environment

No adverse impacts on the natural environment are expected as a result of this project as there are no natural environmental features on the site or within the expected radius of influence of the construction dewatering.

5.2 Private Water Wells

All the surrounding areas are municipally served, and no users within the estimated Zone of Influence are expected to rely on domestic wells (**Figure 7**). No impacts to private well are therefore expected.

5.3 Ground Settlement

The evaluation of ground subsidence was not within the scope of work. Please refer to Grounded Engineering (2022) Geotechnical Report.

6. Discharge and Monitoring Plan

It is recommended that short-term dewatering discharge be directed to the storm or storm sewers on Appleby Line. Approval from the City of Burlington is required prior to discharging to municipal storm sewer and approval from Halton Region is required for discharge to the sanitary sewer. It is expected that TSS will need to be reduced to 25 mg/L to be directed to the storm sewer. In addition, the allowable capacity should be confirmed with the City Burlington / Halton Region prior to finalizing the discharge location.

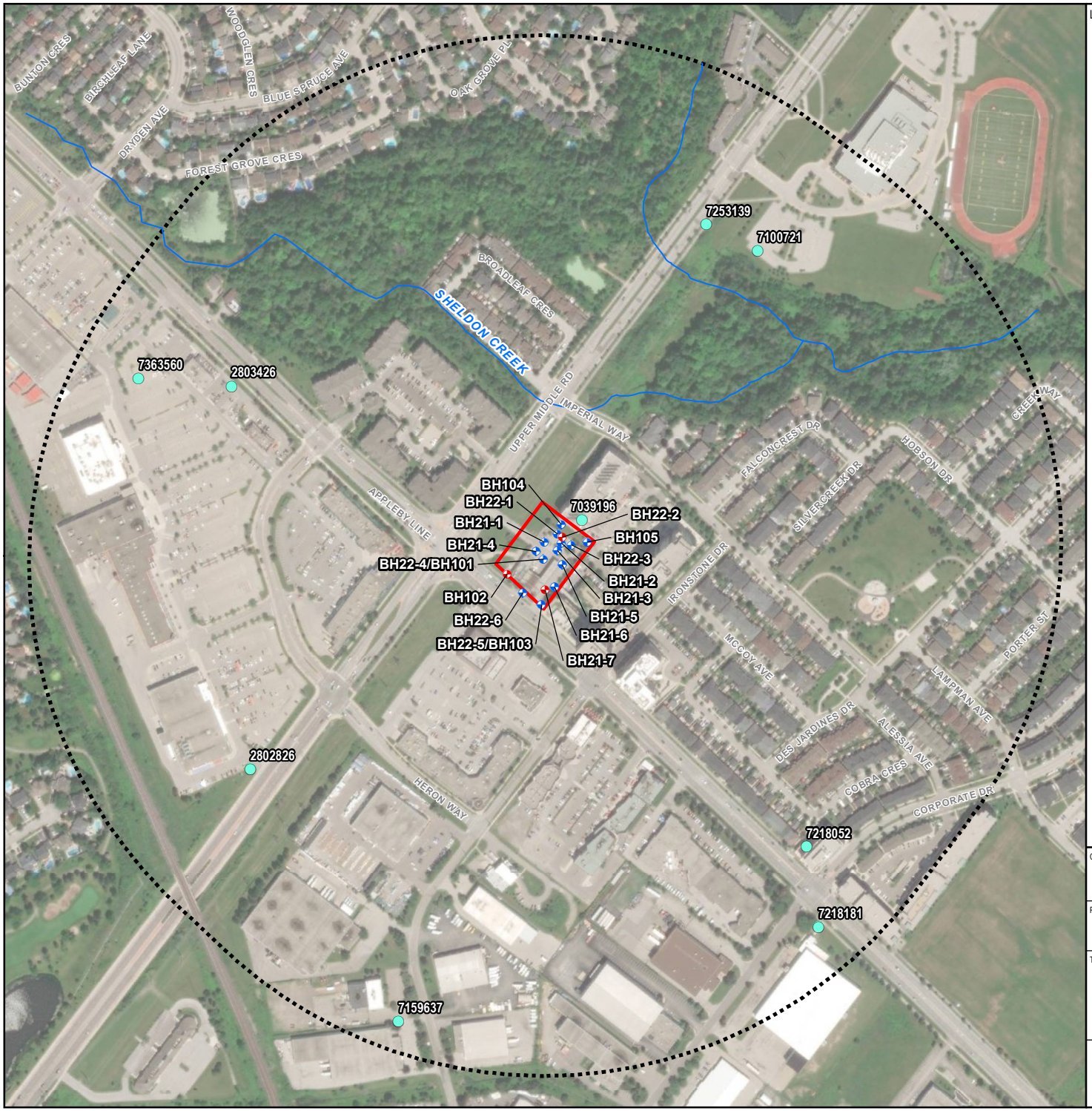
The contractor will be responsible for recording the daily water taking volumes and rates and reporting them to the MECP's online Water Taking and Reporting (WTRS) system. It is the responsibility of the Contractor

to ensure that the discharge water meets applicable standards for clarity or TSS for Halton Region and City of Burlington Sewer Discharge Criteria. The Contractor will conduct a daily visual inspection of the discharge and take daily TSS and turbidity measurements to ensure dewatering discharge meets the applicable discharge criteria.

The following monitoring program (**Table 6**) is provided to summarize the recommended discharge water quality monitoring prior to, during, and following construction.

Table 6. Discharge and Monitoring Plan

Period	Location	Parameters	Frequency	Trigger for Mitigation	Mitigation Measures	Contingency Plan
Groundwater Quality						
Pre-Construction	Existing Monitoring Well or sump	A complete screening for the Halton Region Sanitary/Storm Sewer Discharge Criteria, depending upon the sewer type selected for discharge.	Once to obtain a Halton Region Storm or Sanitary Discharge Permit	Exceedance of Storm Sewer or Sanitary Sewer Discharge Criteria (assuming 25 mg/L TSS for the storm sewer)	Install additional settling tanks or filtering/ treatment equipment to reduce groundwater chemical concentrations to within applicable limits.	If water does not meet Storm Sewer standards at the point of discharge, water shall be directed to the Sanitary Sewer (if approved) or the water will be trucked off-site for treatment and disposal
During Construction	Within excavation	Turbidity and TSS. Visual inspection for hydrocarbon sheen.	Daily measurements, or measurements immediately prior to discharge	Exceedance of Storm Sewer or Sanitary Sewer Discharge Criteria. Hydrocarbon sheen observed or exceedance for VOCs. Turbidity at 8 NTU or 25 mg/L TSS for Storm Sewer Discharge, and 350 mg/L for Sanitary Sewer Discharge.	Install additional settling tanks or filtering/ treatment equipment to reduce groundwater chemical concentrations to within applicable limits.	If water does not meet Storm Sewer standards at the point of discharge, water shall be directed to the Sanitary Sewer (if approved) or the water will be trucked off-site for treatment and disposal
Prior to Project Completion	Each discharge point	Confirmation that the sewer is free of construction related sediment.	Once following construction at each open cut section.	Accumulation of construction related sediment is observed.	Sediment will be removed to the satisfaction of the City of Toronto.	None.
Ground Settlement						
No ground settlement monitoring is recommended based on the results of the hydrogeological study. A geotechnical engineer should be retained to confirm ground settlement monitoring needs.						
Groundwater Level and Quality						
No groundwater level or groundwater quality monitoring is recommended for this project.						
Natural Environment						
No natural environmental monitoring is recommended.						



LEGEND

- Water Well Record within 500m[1]
- Borehole
- Monitoring Well
- Watercourse[2]
- Subject Property
- 500m Site Buffer

1. MECP
2. LIO/MNRF

0 25 50 100 150 200 250
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:6,000
Page Size: Letter (8.5 x 11 inches)

Drawn: CV
Checked: NA
Date: May 12, 2022

NORTH

Source Notes:
Imagery (2021) provided by Esri basemap service.
Contains information licensed under the Open Government Licence – Ontario.

CLIENT
1989 Appleby Latch Limited Partnership

PROJECT
1989 Appleby Line

TITLE
MECP Well Records within a 500m radius

Palmer

REF. NO. 1901204-MR-307-A

Figure 7

Document Path: G:\Shared drives\Projects 2019\19012 - Latch Developments Ltd\1901204 - 1989 Appleby Line\GIS\1_Workspace\Task 3 - HydroG Figures\1901204_7-1_MECP Well Records.mxd

7. Conclusions and Recommendations

The following conclusions are presented based on the hydrogeological investigation to assess the existing hydrogeological conditions and determine the dewatering requirements.

- The site lies within the South Slope physiographic region and consists of silty clay till and bedrock shale deposits. The unit of till is approximately 1.5 m thick, and bedrock is found from 3.4 to 4.3 mbgs.

- Borehole drilling and monitoring well installations were completed by Palmer and a total of twelve (12) borehole wee advanced with eleven (11) being completed as 2-inch monitoring wells. Grounded Engineering (2022) also installed four (4) wells as part of their geotechnical investigation.

- Water levels ranged from 2.62 to 5.60 mbgs and 133.25 to 136.72 masl. Groundwater level measurements confirm that groundwater flows both south and northeast radially from the site.

- Groundwater quality sampling indicates no exceedance of the Halton Region Storm Sewer Discharge Criteria for any parameters. Should any construction dewatering discharge be directed to local storm sewers, a permit from the City of Burlington will be required.

- Hydraulic conductivity was calculated using in-situ single well response tests performed at monitoring wells on April 21, 2022. The calculated hydraulic conductivity of the weathered shale ranged from 1.6 x 10^{-6} m/s to 2.5 x 10^{-5} m/s with a geometric mean of 8.3 x 10^{-6} m/s and a 90th percentile of 2.4 x 10^{-6} m/s.

- Dewatering rates calculated for the site construction assumed both a confined and unconfined square. Calculated dewatering rates assume dewatering for a total depth of dewatering of 11 mbgs. Total dewatering rates including a 1.5x contingency to account for variability in the thickness of the upper shale and precipitation is 330,099 L/day.

- Long-term discharge will be required for this site should non-watertight methods be considered. Long-term dewatering discharge is estimated to be 64,055 L/day. As the City of Burlington engineering policies no longer allow long-term/ permanent drainage of groundwater into the sewer system, it is expected that the underground parking structure will need to be fully watertight

- Under MECP requirements, registration on the Environmental and Site Activity Registry (EASR) is required when dewatering is greater than 50,000 L/day and less than 400,000 L/day. A Category 3 PTTW is required when dewatering is expected to be greater than 400,000 L/day. As the discharge does not exceed 400,000 L/day only a registration on the EASR is recommended.

8. Signatures

This report was prepared and reviewed by the undersigned:



Prepared By:

Nicole Anasis, M.EnvSc. G.I.T.
Environmental Scientist



Nolan Boyes, M.Sc., P.Geo.
Hydrogeologist



Reviewed By:

Jason Cole, M.Sc., P.Geo.
VP, Principal Hydrogeologist

9. Limitations of Report

This report was prepared by Palmer for Latch Limited Partnership in accordance with the scope of work described in the proposal. The conclusions and recommendations detailed in this report are based upon the information available at the time of preparation of the report. No investigative method eliminates the possibility of obtaining imprecise or incomplete information. Professional judgement was exercised in gathering and analyzing the information obtained and in the formulation of our conclusions and recommendations. The nature of the sampling works makes it possible that contrary conditions may be identified in locations which were not sampled. However, it does suggest that the conditions will be localized and not extensive. The soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations made during drilling and therefore should not be interpreted as exact planes of geological change.

The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects Palmer's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Palmer accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

Unless stated otherwise in this report, provided that the report is still reliable, and less than 18 months old, Palmer may issue a third-party reliance letter to parties client identifies in writing, upon payment of the then current fee for such letters. All third parties relying on Palmer's report, by such reliance agree to be bound by our proposal and Palmer's standard reliance letter. Palmer's standard reliance letter indicates that in no event shall Palmer be liable for any damages, howsoever arising, relating to third-party reliance on Palmer's report. No reliance by any party is permitted without such agreement. This report is not to be given over to any third party for any purpose whatsoever without the written permission of Palmer.

The original of this electronic document has been authenticated and will be retained by Palmer for a minimum of five years. Since the file transmitted is now out of Palmer's control and its integrity can no longer be ensured, no guarantee may be given with regards to any modifications made to this document.

10. References

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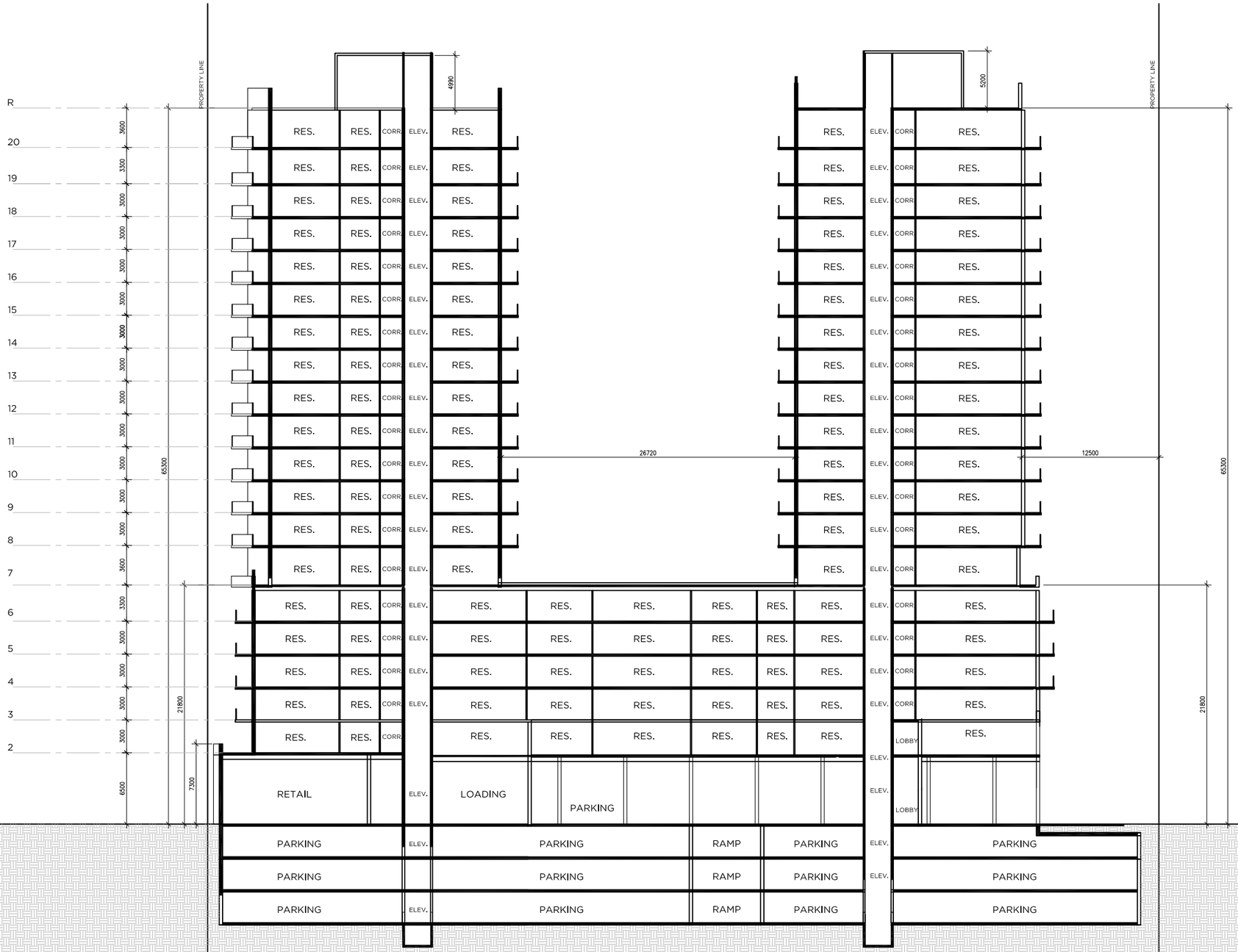
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Appendix A

Design Drawings (RAW, 2022)



This drawing is the property of the Architect and may not be reproduced or used without the express consent of the Architect. The Contractor is responsible for checking and verifying all levels and dimensions and shall report all discrepancies to the Architect and obtain clarification prior to commencing work.

ISSUED RECORD

REVISION RECORD

NORTH

405-317 ADELAIDE ST. W.
TORONTO CANADA M5V 1P9
+1 416 599 9729
WWW.RAWDESIGN.CA

21058

1989 Appleby Line
Burlington

Latch

CONCEPTUAL
TOWER
SECTION

1:400

A501

Appendix B

Borehole Logs (Palmer, 2021/2022, Grounded, 2022)

Palmer

LOG OF BOREHOLE BH21-1

PROJECT: Phase Two ESA
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: GeoProbe Dual Tube
ENCL NO.: 1
PROJECT LOCATION: 1989 Appleby Line, City of Burlington, ON
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Oct-12-2021
BH LOCATION: N 4805266.906 E 598068.864
CHECKED BY SO

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
139.4 Ground Surface						3 6 9 12 15			
139.2 0.2	**ASPHALT:** 100mm **FILL:** sand and gravel **FILL:** brown silty clay, trace gravel, trace sand		1	DT					Concrete
137.9 1.5	**SILTY CLAY TILL:** brown silty clay till, trace gravel, trace sand		2	DT	Analysis: ICPMS Metals				Bentonite
			3	DT	Analysis: PHCs/BTEX				
136.5 2.9	**SHALE:**brownish/red shale		4	DT					W. L. 136.5 m Oct 20, 2021
136.3 3.1	Refusal at 3.05 m. Augered to 4.7 m								Sand Screen
134.7 4.7	**END OF BOREHOLE** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings:Date: October 20, 2021 W. L. Depth: 2.86 mBGS"								

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

PALMER ENV_HWC 2017_0.0.0
PALMER ENVIRONMENTAL CONSULTANTS INC. - TEMPLATE LOGS.PRO\1901204\GPJ 21-10-1

Palmer

LOG OF BOREHOLE BH21-2

PROJECT: Phase Two ESA
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: GeoProbe Dual Tube
ENCL NO.: 2
PROJECT LOCATION: 1989 Appleby Line, City of Burlington, ON
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Oct-12-2021
BH LOCATION: N 4805262.684 E 598087.436
CHECKED BY SO

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
139.7	Ground Surface								
139.6 / 0.1	**ASPHALT:** 80mm								Concrete
139.5 / 0.2	**FILL:** sand and gravel								
	FILL: brown silty clay, trace gravel, trace sand, trace rootlets		1	DT	Analysis: PHCs/VOCs, Duplicate				
139.0 / 0.8	**FILL:** Brown clay, some silt, trace gravel		2	DT					
138.4 / 1.4	**FILL:** shale inclusions								
138.2 / 1.5	**SILTY CLAY TILL:** Brown silty clay till, trace gravel		3	DT					Bentonite
			4	DT					
136.5 / 3.2	**SHALE:** Redish/brown shale		5	DT	Analysis: Grainsize				
136.4 / 3.4	Refusal at 3.35 m. Augered to 6.25 m.								W. L. 135.5 m Oct 20, 2021
									Sand
									Screen
133.5 / 6.3	**END OF BOREHOLE**								

"Notes:
1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole.
2. Borehole was open upon completion of drilling.
3. Water Level Readings:Date: October 20, 2021W. L. Depth: 4.20 mBGS"

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

PALMER.ENV_LIVE.2017.GLB
PALMER.ENVSCI.ONJWOS1-18.RPM.2020 TEMPLATE LOGS.PH1913204GPJ 21-10-1

Palmer

LOG OF BOREHOLE BH21-3

PROJECT: Phase Two ESA
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: GeoProbe Dual Tube
ENCL NO.: 3
PROJECT LOCATION: 1989 Appleby Line, City of Burlington, ON
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Oct-13-2021
BH LOCATION: N 480258.134 E 598083.514
CHECKED BY SO

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
139.6 Ground Surface						3 6 9 12 15			
139.5 0.0	**ASPHALT:** 100mm								Concrete
0.1	**FILL:** brown silty clay, trace gravel, trace rootlets		1	DT	Analysis: pH, Duplicate				
138.8									
0.8	**FILL:** brown silty clay, trace gravel		2	DT	Analysis: Metals				
1									
			3	DT					Bentonite
2									
			4	DT					
136.7 2.9	**CLAY:** brown clay, trace silt, trace gravel								
3 136.5 3.1	**SILTY CLAY TILL :** brown silty clay till, trace gravel		5	DT	Analysis: PHC/BTEX, Duplicate				
136.4 3.2 136.2	**SHALE :** redish/brown shale								
3.4	Refusal at 3.35 m. Augered to 6.22 m.								
4									W. L. 135.5 m Oct 20, 2021
									Sand
									Screen
5									
6									
133.3 6.2	**END OF BOREHOLE** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2 Borehole was open upon completion of drilling. 3. Water Level Readings:Date: October 22, 2021W. L. Depth: 4.07 mBGS"								

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

PALMER.ENV_LIVE.2017.GLB
PALMER ENVIRONMENTAL LOGS.PH1901204.GPJ 21-10-1
TEMPLATE LOGS PHASE 2 ESA 2020

Palmer

LOG OF BOREHOLE BH21-4

PROJECT: Phase Two ESA
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: GeoProbe Dual Tube
ENCL NO.: 4
PROJECT LOCATION: 1989 Appleby Line, City of Burlington, ON
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Oct-13-2021
BH LOCATION: N 480526.802 E 598087.42
CHECKED BY SO

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
139.4 Ground Surface						3 6 9 12 15			
139.4 0.0	**ASPHALT:** 100mm								Concrete
139.3 0.1	**FILL:** sand and gravel								
139.1 0.3	**FILL:** brown clay, some cobble, trace gravel, trace rootlets		1	DT	Analysis: metals				
138.5									
1 0.9	**FILL:** brown silty clay, trace gravel		2	DT					
137.9									
1.5	**SILTY CLAY:** brown silty clay, trace gravel, trace sand, till gravel seam		3	DT					Bentonite
2 137.1									
2.3	**SILTY CLAY TILL:** brownish-red silty clay till, trace gravel		4	DT					
3 136.3									W. L. 136.5 m Oct 20, 2021
3.1	**SILTY CLAY TILL:** trace sand		5	DT	Analysis: PHC/BTEX				
135.7									
3.7	**SHALE :** redish/brown shale. Refusal at 3.35 m. Augered to 6.22 m.								Sand Screen
4 134.7									
4.7	**END OF BOREHOLE** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings:Date: October 20, 2021W. L. Depth: 2.88 mBGS"								

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH21-5

PROJECT: Phase Two ESA
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: GeoProbe Dual Tube
ENCL NO.: 5
PROJECT LOCATION: 1989 Appleby Line, City of Burlington, ON
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Oct-13-2021
BH LOCATION: N 4805221.856 E 598084.352
CHECKED BY SO

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
139.4	Ground Surface								
139.2 / 0.2	**ASPHALT:** 100mm **FILL:** sand and gravel **FILL:** brown clay, some silt, trace gravel		1	DT					Concrete
138.6 / 0.8	**FILL:** trace rootlets		2	DT					
137.9 / 1.5	**CLAYEY SILT:** brown clayey silt, trace gravel		3	DT	Analysis: metals				Bentonite
			4	DT					
136.3 / 3.1	**CLAYEY SILT TILL:** brownish red clayey silt till, trace gravel, with shale inclusions		5	DT	Analysis: PHCs/BTEX				
136.0 / 3.4	**SHALE :** redish/brown shale. Refusal at 3.35 m. Augered to 5.26 m.								Sand Screen
134.1 / 5.3	**END OF BOREHOLE** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings:Date: October 20, 2021W. L. Depth: 5.03 mBGS"								W. L. 134.4 m Oct 20, 2021

Head Space Combustible Vapor Reading (ppm): 3, 6, 9, 12, 15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

PALMER ENV_HWC 2017_GLB
PALMER ENVIRONMENTAL LOG STANDARD_TEMPLATE LOGS.PRO 01/12/2017 21:53:1

LOG OF BOREHOLE BH21-6

PROJECT: Phase Two ESA
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: GeoProbe Dual Tube
ENCL NO.: 6
PROJECT LOCATION: 1989 Appleby Line, City of Burlington, ON
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Oct-13-2021
BH LOCATION: N 4805257.29 E 598060.522
CHECKED BY SO

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
139.5 Ground Surface									
139.4 0.0	**ASPHALT:** 150mm								Concrete
139.2 0.2	**FILL:** brown sand and gravel, trace silt		1	DT					
	low recovery								
1 138.3 1.2	**FILL:** brown silty clay, trace gravel, trace rootlets		2	DT	Analysis: Metals				
138.0 1.5	**FILL:** brown clayey silt, trace gravel		3	DT	Analysis: PHC/BTEX				Bentonite
2 137.2	gravel seam								
2.3	**SILTY CLAY:** brownish-red silty clay, trace gravel		4	DT					
3			5	DT					
136.0 3.5	**CLAYEY SILT TILL:** brownish red clayey silt till, trace clay seams, trace gravel		6	DT					
135.5	gravel seam								
4 4.0	**SHALE :** redish/brown shale. Refusal at 3.96 m. Augered to 5.18 m.								Sand
									Screen
5 134.3 5.2	**END OF BOREHOLE** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings:Date: October 20, 2021W. L. Depth: DRY"								

Head Space Combustible Vapor Reading (ppm) scale: 3, 6, 9, 12, 15

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH21-7

PROJECT: Phase Two ESA
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: GeoProbe Dual Tube
ENCL NO.: 7
PROJECT LOCATION: 1989 Appleby Line, City of Burlington, ON
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Oct-13-2021
BH LOCATION: N 4805280.678 E 597958.897
CHECKED BY SO

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
140.8 Ground Surface						3 6 9 12 15			
140.7 0.0	**ASPHALT:** 100mm								
0.1	**FILL:** brown sand and gravel, trace silt		1	DT					
139.9									
1 0.9	**FILL:** brown silty clay, trace gravel		2	DT	Analysis: Metals				
139.3									
1.5	**SILTY CLAY:** brown silty clay, trace gravel		3	DT					
2 138.3									
2.4	**CLAY:** brown clay, some silt, trace gravel		4	DT					
3 137.7									
3.1	**SILTY CLAY:** brown silty clay, some sand, trace gravel, moist		5	DT	Analysis: PHC/BTEX				
137.1									
3.7	**SILTY CLAY TILL:** brownish-red silty clay till, some sand, trace gravel		6	DT					
136.8									
4.0	**END OF BOREHOLE** Refusal at 3.96 m on shale bedrock								

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

PALMER ENV_HWC 2017_02.0
PALMER ENVIRONMENTAL LOG W ACS - 18 FEB/2020 TEMPLATE LOGS 1901204 GPJ 21-10-1

Palmer

LOG OF BOREHOLE BH22-1

PROJECT: Phase Two ESA_1989 Appleby Line
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: Geoprobe Dual Tube
ENCL NO.: 1
PROJECT LOCATION: 1989 Appleby Line, City of Burlington
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Apr-11-2022
BH LOCATION: N 598080.71 E 4805266.32
CHECKED BY KN

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
149.2	Ground Surface					50 100 150 200 250			
149.0 0.0	**CONCRETE:**								Concrete
0.1	**SILTY SAND AND GRAVEL:** fill		1	DT	Analysis: PHC/VOC				
148.6									
0.6	**CLAYEY SILT FILL:** trace gravel, trace sand		2	DT					Bentonite
147.6									
1.5	**CLAYEY SILT TILL:** trace gravel		3	DT					
146.1			4	DT					
3.1	**CLAYEY SILT TILL/SHALE COMPLEX:**		5	DT					
145.4									
145.8 3.8	**WEATHERED SHALE:** Refusal at 3.82m, Augered to 6.1m		6	DT					Sand Screen
143.1									W. L. 143.7 m Apr 28, 2022
6.1	**END OF BOREHOLE** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: April 28, 2022 W. L. Depth: 5.49 mBGS"								

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH22-2

PROJECT: Phase Two ESA_1989 Appleby Line
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: Geoprobe Dual Tube
ENCL NO.: 2
PROJECT LOCATION: 1989 Appleby Line, City of Burlington
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Apr-11-2022
BH LOCATION: N 598090.45 E 4805270.57
CHECKED BY KN

SOIL PROFILE			SAMPLES						
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
148.3	Ground Surface								
148.2 / 0.0	**ASPHALT:**								
148.0 / 0.1	**SILTY SAND AND GRAVEL FILL:**								
0.3	**CLAYEY SILT FILL:** trace gravel, trace sand		1	DT					
1			2	DT	Analysis: PHC/VOC, duplicate				
146.8									
1.5	**CLAYEY SILT TILL:** trace gravel		3	DT					
2									
			4	DT					
145.3									
3.1	**END OF BOREHOLE**								

Head Space Combustible Vapor Reading (ppm): 5, 10, 15, 20, 25

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH22-3

PROJECT: Phase Two ESA_1989 Appleby Line
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: Geoprobe Dual Tube
ENCL NO.: 3
PROJECT LOCATION: 1989 Appleby Line, City of Burlington
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Apr-11-2022
BH LOCATION: N 598095.62 E 4805266.09
CHECKED BY KN

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
141.2	Ground Surface					50 100 150 200 250			
0.0 141.0	**CONCRETE:**								Concrete
140.9 0.3	**SAND AND GRAVEL:** sand and gravel fill **SILTY CLAY:**trace sand, trace gravel, fill		1	DT					
1			2	DT					Bentonite
139.7 1.5	**CLAYEY SILT:**trace sand, trace gravel, native		3	DT					
2			4	DT					
3			5	DT	Analysis: PHC/VOC				
137.8 3.4	**WEATHERED SHALE:**		6	DT					
137.4 3.8	Refusal at 3.81m. Augered to 6.1m								Sand Screen W. L. 136.6 m Apr 28, 2022
4									
5									
6 135.1									
6.1	**END OF BOREHOLE:** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: April 28, 2022 W. L. Depth: 4.62 mBGS"								

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ 8=3% Strain at Failure

Palmer

LOG OF BOREHOLE BH22-5

PROJECT: Phase Two ESA_1989 Appleby Line
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: Geoprobe Dual Tube
ENCL NO.: 5
PROJECT LOCATION: 1989 Appleby Line, City of Burlington
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Apr-11-2022
BH LOCATION: N 598067.61 E 4805203.37
CHECKED BY KN

SOIL PROFILE			SAMPLES					
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
138.3	Ground Surface								
138.2 / 0.0	**ASPHALT:**								Concrete
0.2	**SAND AND GRAVEL:** sand and gravel fill		1	DT					
137.7 / 0.6	**SILTY CLAY:**trace sand, trace gravel, fill		2	DT					
136.9 / 1.4	**CLAYEY SILT:**trace sand, trace gravel, native		3	DT					Bentonite
			4	DT	Analysis: PHC/BTEX, metals				
			5	DT					
			6	DT					
134.4									
134.0 / 4.0	**WEATHERED SHALE:** Refusal at 4m. Augered to 7.92m								W. L. 133.8 m Apr 28, 2022
130.4 / 7.9	**END OF BOREHOLE**								Sand, Screen

"Notes:

1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole.

2. Borehole was open upon completion of drilling.

3. Water Level Readings:

Date: April 28, 2022

W. L. Depth: 4.48 mBGS"

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH22-6

PROJECT: Phase Two ESA_1989 Appleby Line
REF. NO.: 1901204
CLIENT: 1989 Latch Limited Partnership
Method: Geoprobe Dual Tube
ENCL NO.: 6
PROJECT LOCATION: 1989 Appleby Line, City of Burlington
Diameter: 150 mm
ORIGINATED BY SB
DATUM: Geodetic
Date: Apr-11-2022
BH LOCATION: N 598048.34 E 4805213.98
CHECKED BY KN

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLE REMARKS	Head Space Combustible Vapor Reading (ppm)	LABORATORY ANALYSIS AND REMARKS	GROUND WATER CONDITIONS	WELL CONSTRUCTION DETAILS
138.2	Ground Surface					500 1000 1500 2000 2500			
138.0 / 0.0	**ASPHALT:**								Concrete
0.2 / 137.5	**SILTY SAND AND GRAVEL:** fill		1	DT					
0.8 / 136.7	**CLAYEY SILT:**trace sand, trace gravel, fill		2	DT					
1.5 / 135.2	**CLAYEY SILT:**trace sand, trace gravel, native		3	DT	Analysis: PCB, duplicate				Bentonite
			4	DT					
3.1 / 134.6	**SILTY CLAY/WEATHERED SHALE:**some gravel, native		5	DT	Analysis: PHC/BTEX, duplicate				
3.7 / 134.1	**WEATHERED SHALE:**		6	DT				▽	W. L. 134.4 m Apr 28, 2022
4.1 / 130.3	Refusal at 4.12m. Augered to 7.92m								Sand / Screen
7.9	**END OF BOREHOLE:** "Notes: 1. Upon completion of drilling, one 50mm diameter monitoring well was installed in the borehole. 2. Borehole was open upon completion of drilling. 3. Water Level Readings: Date: April 28, 2022 W. L. Depth: 3.86 mBGS"								

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

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

GROUNDED ENGINEERING

Date Started : Apr 4, 2022
Position : E: 598066, N: 4805252 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 101

File No. : 22-063 **Project** : 1989 Appleby Line, Burlington, Ontario **Client** : Latch Developments

drill method : CME 75

elev depth (m)	description	graphic log	number	type	SPT N-value
139.5	**GROUND SURFACE**				
	140mm **ASPHALT**				
	100mm **AGGREGATE**		1	GS	
	FILL, silty sand, some gravel, trace rock fragments, trace asphalt, brown and dark brown, moist				
138.0					
1.5	**CLAYEY SILT**, some sand, trace gravel, dark brown, moist (GLACIAL TILL)		2	GS	
136.7					
2.8	**SANDY SILT**, some gravel, some clay, trace rock fragments, very dense, reddish brown, moist (GLACIAL TILL)		3	SS	67
135.2					
4.3	**QUEENSTON FORMATION** (See rock core log for details)		1	RUN	
			2	RUN	
			3	RUN	
			4	RUN	
			5	RUN	
			6	RUN	
			7	RUN	
			8	RUN	
124.1					
15.4	**END OF BOREHOLE**				

hydro-vac OD=300 mm

hollow stem augers (mud) OD=175 mm

Rock coring (HQ) OD=96 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

well details

elevation (m): 139 138 137 136 135 134 133 132 131 130 129 128 127 126 125

undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
▣ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

30 23 34 13

3.5m: spoon bouncing, auger grinding

...at 7.6 m, top of sound bedrock

Borehole was filled with drill water upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
May 26, 2022	4.4	135.1

file: 22-063 gint.gpj

Tech : JAW | **PM** : KF | **Rev** : MD

ROCK CORE LOG 101

Date Started : Apr 4, 2022
Position : E: 598066, N: 4805252 (UTM 17T)
Elev. Datum : Geodetic

File No. : 22-063 **Project** : 1989 Appleby Line, Burlington, Ontario **Client** : Latch Developments

Rock coring started at 4.3m below grade — 135.2

QUEENSTON FORMATION
Shale, reddish brown, thinly bedded to medium bedded, weak, grey-green banding; joints are horizontal, closed to gapped, clean to sandy / silty filling

Run	elev depth (m)	recovery
R1	4.3 – 4.7	TCR = **100%** SCR = **44%** RQD = **31%**
R2	4.7 – 133.2	TCR = **100%** SCR = **95%** RQD = **83%**
R3	6.3 – 131.7	TCR = **100%** SCR = **91%** RQD = **80%**
R4	7.8 – 130.2	TCR = **100%** SCR = **100%** RQD = **100%**
R5	9.3 – 128.7	TCR = **100%** SCR = **100%** RQD = **100%**
R6	10.8 – 127.2	TCR = **100%** SCR = **100%** RQD = **100%**
R7	12.3 – 125.6	TCR = **100%** SCR = **100%** RQD = **100%**
R8	13.9 – 124.1	TCR = **100%** SCR = **98%** RQD = **98%**

... at 7.6 m (Elev. 131.9 m), transition to sound rock

END OF COREHOLE — **15.4m**

elevation (m)	natural fracture frequency
135	1+RZ
	2+SM
	2+SM
134	1
	0
	1+SM
	0
133	1
	2
	4
132	1+SM
	2
	0
131	1
	0
	0
130	1
	0
	0
	0
129	0
	1
	0
128	0
	0
	0
127	0
	0
	0
	0
126	0
	0
	0
125	2
	1
	0

laboratory testing

El. 133.2m:
UCS = 23.5 MPa
E = 3.80 GPa
γ = 25.9 kN/m^3

notes and comments

4.3 / 135.2 - 4.6 / 135.0m: Rubblized
5.1 / 134.5m: Clay seam (10 mm)
5.3 / 134.2m: Clay seam (25 mm)
6.1 / 133.4m: Clay seam (25 mm)
7.4 / 132.1 - 7.5 / 132.0m: Weathered zone
7.5 / 132.0m: Clay seam (50 mm)
14.7 / 124.9m: JT D PR GA VN

file: 22-063 gint.gpj

Tech : JAW | **PM** : KF | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Apr 5, 2022
Position : E: 598068, N: 4805203 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 103

File No. : 22-063 **Project** : 1989 Appleby Line, Burlington, Ontario **Client** : Latch Developments

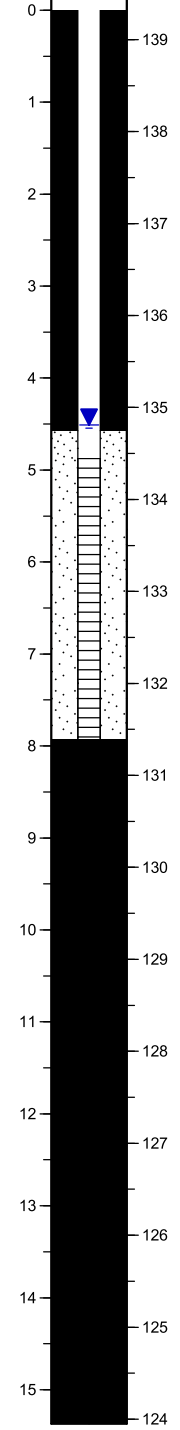
drill method : CME 75

elev depth (m)	description	graphic log	number	type	SPT N-value
139.3	**GROUND SURFACE**				
	140mm **ASPHALT**				
	FILL, sandy silt, some gravel, trace clay, trace asphalt, trace brick fragments, trace rock fragments, loose to compact, brown and dark brown, moist		1	SS	24
	...at 0.8 m, clayey silt, some sand, brown		2	SS	7
137.8					
1.5	**CLAYEY SILT**, some sand, trace gravel, trace rock fragments, very stiff, brown, moist (GLACIAL TILL)		3	SS	25
	...at 2.3 m, layered		4	SS	26
	...at 3.0 m, reddish brown, hard		5	SS	43
135.3	...at 3.8 m, sandy, some gravel, some clay, trace rock fragments (shale fragments), very dense		6	SS	60 / 25mm
4.0			1	RUN	
	QUEENSTON FORMATION (See rock core log for details)		2	RUN	
			3	RUN	
			4	RUN	
			5	RUN	
			6	RUN	
			7	RUN	
			8	RUN	
123.9					
15.4	**END OF BOREHOLE**				

hollow stem augers (med) OD=175 mm

Rock coring (HQ) OD=96 mm

depth scale (m) / well details / elevation (m)



undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
▣ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

...at 6.9 m, top of sound bedrock

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
May 26, 2022	4.5	134.8

Borehole was filled with drill water upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

file: 22-063 gint.gpj

Tech : JAW | **PM** : KF | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Apr 5, 2022
Position : E: 598068, N: 4805203 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 103

File No. : 22-063 **Project** : 1989 Appleby Line, Burlington, Ontario **Client** : Latch Developments

depth (m)	stratigraphy	Run elev. depth (m)	recovery	elevation (m)	notes and comments	elevation (m)
	Rock coring started at 4.0m below grade	**135.3**				
	QUEENSTON FORMATION **Shale**, reddish brown, thinly bedded to medium bedded, weak, grey-green banding; joints are horizontal, closed to gapped, clean to sandy / silty filling	4.0 R1 134.6	TCR = **100%** SCR = **46%** RQD = **21%**	135	**4.0 / 135.3 - 4.1 / 135.2m:** Rubblized **4.3 / 135.0m:** JT D UN R GA CT	135
5		4.7 R2 133.1	TCR = **100%** SCR = **83%** RQD = **67%**	134	**5.3 / 134.0 - 5.3 / 134.0m:** Rubblized **5.8 / 133.5m:** JT D PR GA CT	134
6		6.2 R3 131.6	TCR = **100%** SCR = **85%** RQD = **83%**	133	**6.1 / 133.2 - 6.1 / 133.2m:** Weathered zone **6.1 / 133.2m:** Clay seam (75 mm) **6.2 / 133.1 - 6.2 / 133.1m:** Weathered zone **6.2 / 133.1 - 6.4 / 133.0m:** Weathered zone **6.5 / 132.8m:** Clay seam (50 mm) **6.8 / 132.5 - 6.9 / 132.5m:** CS	133
7	**... at 6.9 m (Elev. 132.4 m), transition to sound rock**			132	**El. 132.1m:** UCS = 31.1 MPa E = 5.30 GPa γ = 26.1 kN/m^3	132
8		7.7 R4 130.0	TCR = **100%** SCR = **97%** RQD = **80%**	131	**7.8 / 131.5m:** Clay seam (10 mm)	131
9					**8.5 / 130.8m:** Clay seam (10 mm) **8.5 / 130.8m:** CS **8.7 / 130.6m:** CS	
10		9.3 R5 128.5	TCR = **100%** SCR = **100%** RQD = **88%**	130		130
11		10.8 R6 127.0	TCR = **100%** SCR = **100%** RQD = **100%**	129		129
12				128		128
13		12.3 R7 125.5	TCR = **100%** SCR = **100%** RQD = **100%**	127		127
14				126		126
15		13.8 R8 123.9	TCR = **100%** SCR = **100%** RQD = **100%**	125		125
		15.4m		124		124
	END OF COREHOLE					

shale weathering zones: Z1, Z2, Z3, Z4

UCS (MPa) / estimated strength: 5, 25, 50, 100, 250; R1, R2, R3, R4, R5, R6

natural fracture frequency: 3+RZ, 4, 1, 2+RZ, 1, 3, 1+SM, 2, 1+SM, 2, 0, 2, 3+SM, 1, 2+SM, 3, 0, 1, 1, 2, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0

laboratory testing

file: 22-063 gint.gpj

Tech : JAW | **PM** : KF | **Rev** : MD

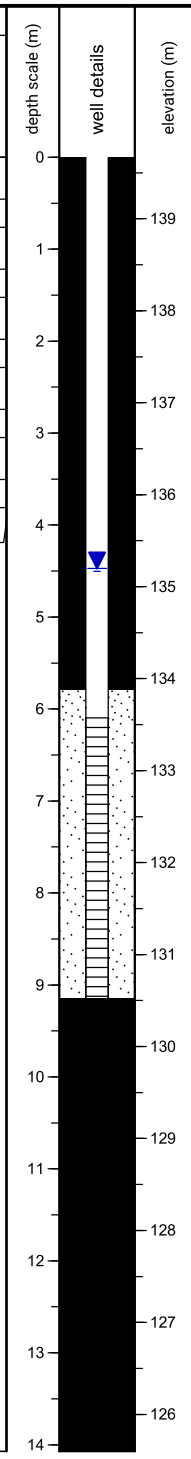
GROUNDED ENGINEERING

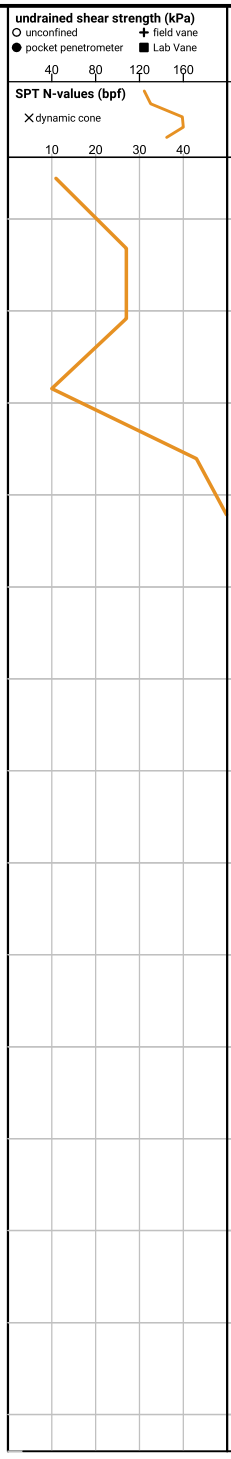
Date Started : Apr 7, 2022
Position : E: 598086, N: 4805289 (UTM 17T)
Elev. Datum : Geodetic

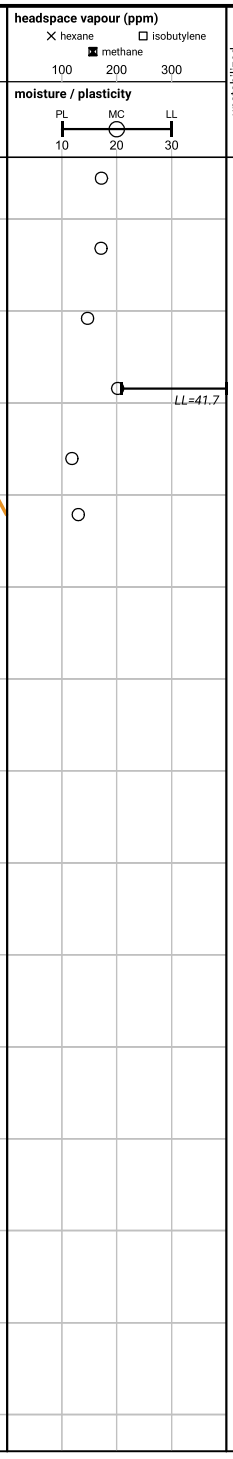
BOREHOLE LOG 104

File No. : 22-063 **Project** : 1989 Appleby Line, Burlington, Ontario **Client** : Latch Developments

drill method	elev / depth (m)	description	graphic log	sample number	sample type	SPT N-value
	139.7	**GROUND SURFACE**				
hollow stem augers (med) OD=175 mm		75mm **TOPSOIL**		1	SS	11
		FILL, clayey silt, some sand, trace gravel, trace rootlets, trace wood fragments, organic odour, stiff to very stiff, brown and dark brown, moist		2	SS	27
	138.2 / 1.5	...at 0.8 m, brown and reddish brown				
		CLAYEY SILT, some sand, trace gravel, very stiff, brown and reddish brown, moist (GLACIAL TILL)		3	SS	27
		...at 2.3 m, some gravel, stiff, layered		4	SS	10
	136.7 / 3.0					
		SANDY SILT, some gravel, some clay, trace rock fragments, (shale fragments), dense to very dense, reddish brown, moist (GLACIAL TILL)		5	SS	43
	135.7 / 4.0			6	SS	50 / 0mm
Rock coring (HQ) OD=96 mm		**QUEENSTON FORMATION** (See rock core log for details)		1	RUN	
				2	RUN	
				3	RUN	
				4	RUN	
				5	RUN	
				6	RUN	
				7	RUN	
	125.6 / 14.1					







unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

13 15 45 27

...at 7.8 m, top of sound bedrock

END OF BOREHOLE

Borehole was filled with drill water upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
May 26, 2022	4.5	135.2

file: 22-063 gint.gpj

Tech : JAW | **PM** : KF | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Apr 7, 2022
Position : E: 598086, N: 4805289 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 104

File No. : 22-063 **Project** : 1989 Appleby Line, Burlington, Ontario **Client** : Latch Developments

depth (m)	stratigraphy	Run elev depth (m)	recovery	elevation (m)	natural fracture frequency	laboratory testing	notes and comments	elevation (m)
	Rock coring started at 4.0m below grade	**135.7**						
	QUEENSTON FORMATION **Shale**, reddish brown, thinly bedded to medium bedded, weak, grey-green banding; joints are horizontal, closed to gapped, clean to sandy / silty filling	4.0 R1 134.8	TCR = **100%** SCR = **22%** RQD = **14%**		**1+RZ** **4+CS** **4+RZ**		**4.0 / 135.7 - 4.2 / 135.5m:** Clayey and Rubblized **4.3 / 135.4m:** Clay seam (25 mm) **4.5 / 135.2m:** Clay seam (10 mm) **4.5 / 135.1m:** Clay seam (15 mm)	135
5		4.9 R2 133.3	TCR = **100%** SCR = **72%** RQD = **20%**	134	**5+IS** **3** **2** **3+CS**		**4.7 / 135.0 - 4.7 / 134.9m:** Rubblized **5.0 / 134.7m:** IS clay; 10 mm **5.2 / 134.5 - 5.2 / 134.4m:** CS	134
6		6.4 R3 131.8	TCR = **100%** SCR = **95%** RQD = **73%**	133	**1** **2** **1** **1** **2**		**5.8 / 133.9 - 5.9 / 133.8m:** Rubblized wth clay seam, 75 mm **5.9 / 133.7 - 6.0 / 133.7m:** Weathered zone **7.3 / 132.4 - 7.3 / 132.4m:** CS	133
7				132	**3+IS**		**7.7 / 131.9m:** IS clay; 25 mm	132
8	**... at 7.8 m (Elev. 131.9 m), transition to sound rock**	7.9 R4 130.3	TCR = **100%** SCR = **100%** RQD = **100%**	131	**0** **1** **0** **0** **0**			131
9				130	**1** **1** **1**			130
10		9.4 R5 128.7	TCR = **100%** SCR = **100%** RQD = **100%**	129	**0** **0** **0** **0** **0**			129
11		11.0 R6 127.2	TCR = **100%** SCR = **100%** RQD = **100%**	128	**0** **1**	**El. 127.4m:** UCS = 44.1 MPa E = 10.10 GPa γ = 26.2 kN/m^3		128
12		12.5 R7 125.6	TCR = **100%** SCR = **100%** RQD = **100%**	127	**0** **0** **1**			127
13				126	**0** **0**			126
14		**14.1m**						
	END OF COREHOLE							

shale weathering zones: Z1, Z2, Z3, Z4

UCS (MPa): 5, 25, 50, 100, 250

estimated strength: R1, R2, R3, R4, R5, R6

file: 22-063 gint.gpj

Tech : JAW | **PM** : KF | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Apr 8, 2022
Position : E: 598115, N: 4805268 (UTM 17T)
Elev. Datum : Geodetic

BOREHOLE LOG 105

File No. : 22-063 **Project** : 1989 Appleby Line, Burlington, Ontario **Client** : Latch Developments

drill method : CME 55

elev depth (m)	description	graphic log	number	type	SPT N-value
139.4	**GROUND SURFACE**				
	75mm **TOPSOIL**		1	SS	7
	FILL, clayey silt, some sand, trace gravel, trace rootlets, trace wood fragments, organic odour, firm, brown and dark brown, moist		2	SS	8
137.9					
1.5	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		3	SS	15
	...at 2.3 m, trace rock fragments, brown and grey		4	SS	39
136.4					
3.0	**SANDY SILT**, some gravel, some clay, very dense, reddish brown, moist (GLACIAL TILL)		5A 5B	SS	94
135.7					
3.7	...at 3.2 m, trace rock fragments (shale fragments)		1	RUN	
	QUEENSTON FORMATION (See rock core log for details)		2	RUN	
			3	RUN	
			4	RUN	
			5	RUN	
			6	RUN	
			7	RUN	
125.3					
14.1	**END OF BOREHOLE**				

hollow stem augers (med) OD=175 mm

Rock coring (HQ) OD=96 mm

depth scale (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

well details

elevation (m): 139 138 137 136 135 134 133 132 131 130 129 128 127 126

undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
▣ methane
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL

24 29 35 12

...at 7.6 m, top of sound bedrock

GROUNDWATER LEVELS

date	depth (m)	elevation (m)
May 26, 2022	4.6	134.8

Borehole was filled with drill water upon completion of drilling.

50 mm dia. monitoring well installed.
No. 10 screen

file: 22-063 gint.gpj

Tech : JAW | **PM** : KF | **Rev** : MD

GROUNDED ENGINEERING

Date Started : Apr 8, 2022
Position : E: 598115, N: 4805268 (UTM 17T)
Elev. Datum : Geodetic

ROCK CORE LOG 105

File No. : 22-063 **Project** : 1989 Appleby Line, Burlington, Ontario **Client** : Latch Developments

Rock coring started at 3.7m below grade (135.7)

QUEENSTON FORMATION
Shale, reddish brown, thinly bedded to medium bedded, weak, grey-green banding; joints are horizontal, closed to gapped, clean to sandy / silty filling

Run	elev. depth (m)	recovery
	3.7	
R1	134.4	TCR = **100**% SCR = **60**% RQD = **42**%
	5.0	
R2	132.9	TCR = **100**% SCR = **78**% RQD = **70**%
	6.5	
R3	131.4	TCR = **100**% SCR = **88**% RQD = **65**%
	8.0	
R4	129.9	TCR = **100**% SCR = **100**% RQD = **100**%
	9.5	
R5	128.3	TCR = **100**% SCR = **100**% RQD = **100**%
	11.1	
R6	126.8	TCR = **100**% SCR = **100**% RQD = **100**%
	12.6	
R7	125.3	TCR = **100**% SCR = **100**% RQD = **100**%

... at 7.6 m (Elev. 131.8 m), transition to sound rock

14.1m

END OF COREHOLE

natural fracture frequency	notes and comments
2+RZ	**3.7 / 135.7 - 3.8 / 135.6m:** Rubblized
3+RZ	**3.9 / 135.5 - 4.0 / 135.5m:** Rubblized
3+SM	**4.0 / 135.4 - 4.1 / 135.4m:** Weathered zone
3+IS	**4.2 / 135.3 - 4.3 / 135.1m:** Weathered zone
2+RZ	**4.4 / 135.0m:** Clay seam (10 mm)
1	**4.7 / 134.7m:** JT PR GA CT
4+SM	**4.9 / 134.5m:** IS clay
2+SM	**5.1 / 134.3 - 5.1 / 134.3m:** Rubblized
1	**5.7 / 133.8 - 5.7 / 133.7m:** Weathered zone
4	**5.8 / 133.7 - 5.8 / 133.6m:** Rubblized
2	**5.8 / 133.6 - 5.9 / 133.5m:** Clay seam (100 mm)
1	**6.2 / 133.3m:** JT D UN GA CT
4+SM	**7.5 / 132.0 - 7.6 / 131.8m:** Clay seam (125 mm)
3	**7.7 / 131.8m:** JT UN GA CT
1	**7.8 / 131.6m:** JT UN GA CT
0	**7.8 / 131.6m:** JT UN GA CT
0	**7.9 / 131.6m:** JT UN GA CT
1	
1	
0	
1	
0	
0	
0	
0	
1	
0	
0	
0	
0	
0	
0	

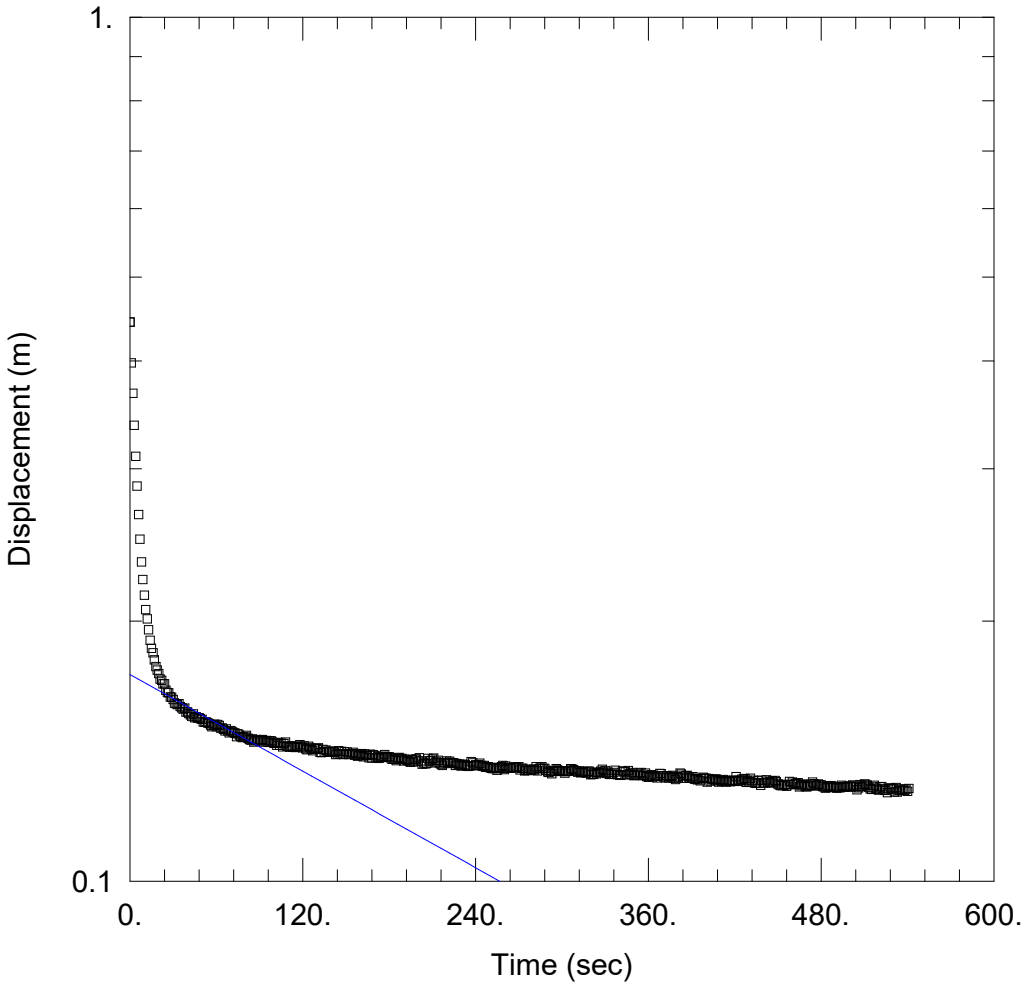
El. 128.7m:
UCS = 22.5 MPa
γ = 26.2 kN/m^3

file: 22-063 gint.gpj

Tech : JAW | **PM** : KF | **Rev** : MD

Appendix C

AQTESOLV Results (Palmer, 2022)



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Documents\BH21-1 BAIL 1.aqt
Date: 05/30/22 Time: 11:36:16

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 21-1
Test Date: April 21

AQUIFER DATA

Saturated Thickness: 6. m Anisotropy Ratio (Kz/Kr): 0.1

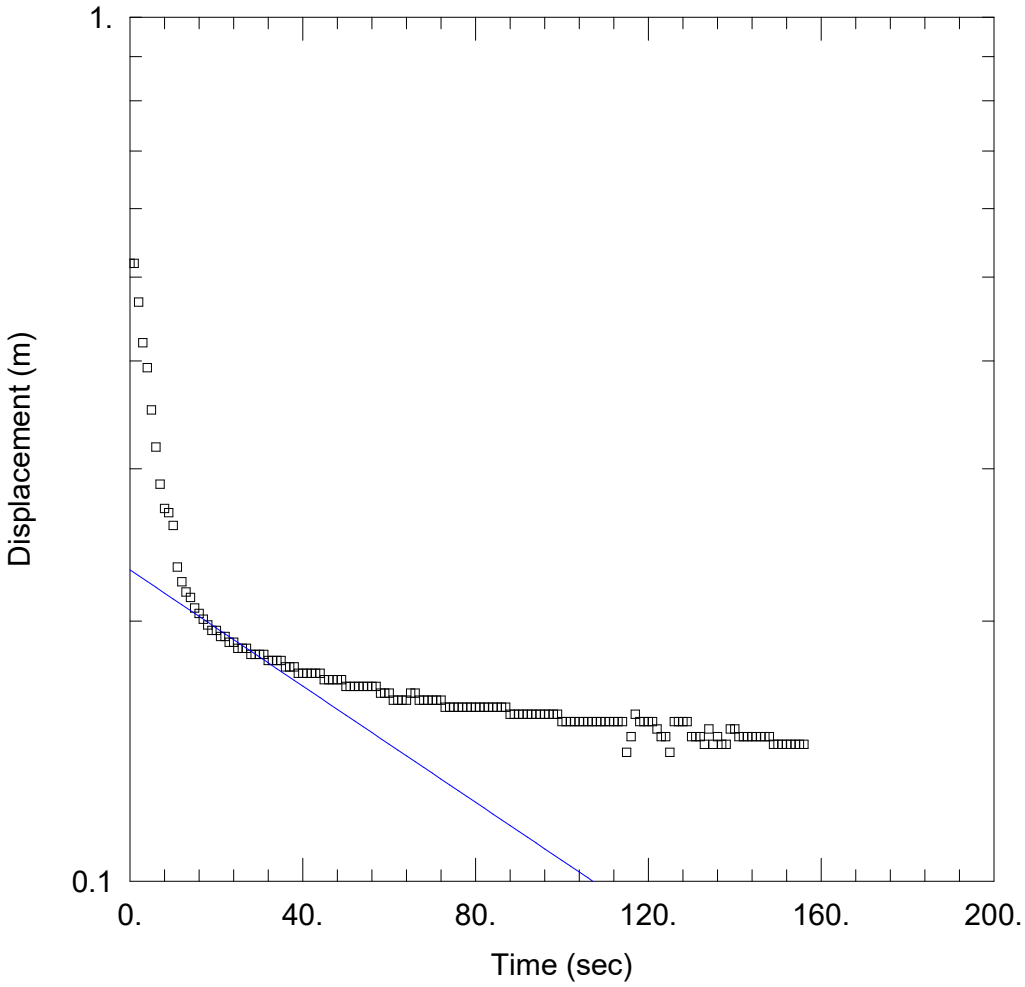
WELL DATA (BH21-1)

Initial Displacement: 0.444 m
Total Well Penetration Depth: 4.68 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.79 m
Screen Length: 1.5 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.57E-6 m/sec y0 = 0.1699 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Documents\BH21-2 Slug 1.aqt
Date: 05/30/22 Time: 11:32:36

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 21-2
Test Date: April 21

AQUIFER DATA

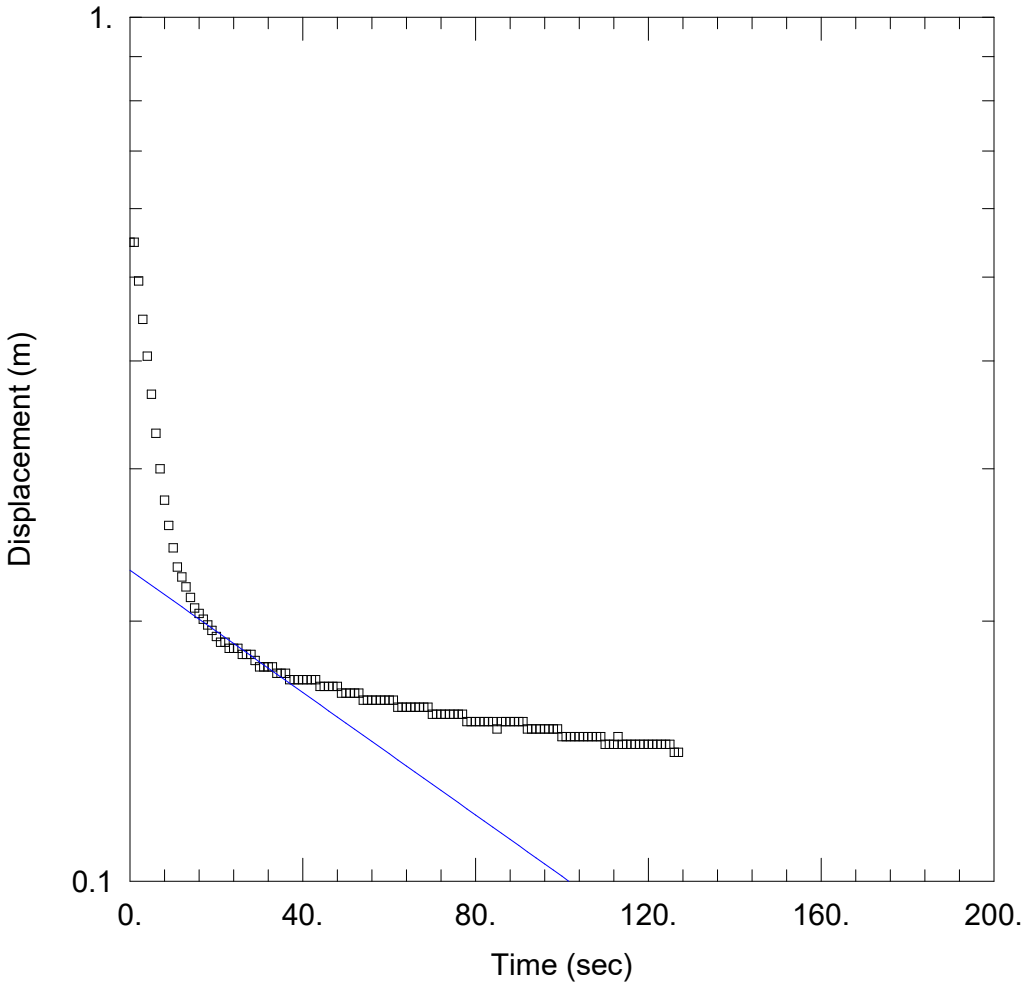
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW21-2)

Initial Displacement: 0.519 m
Total Well Penetration Depth: 6.2 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.95 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.362E-6 m/sec
y0 = 0.2292 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Documents\BH21-2 Slug 2.aqt
Date: 05/30/22 Time: 11:33:35

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 21-2
Test Date: April 21

AQUIFER DATA

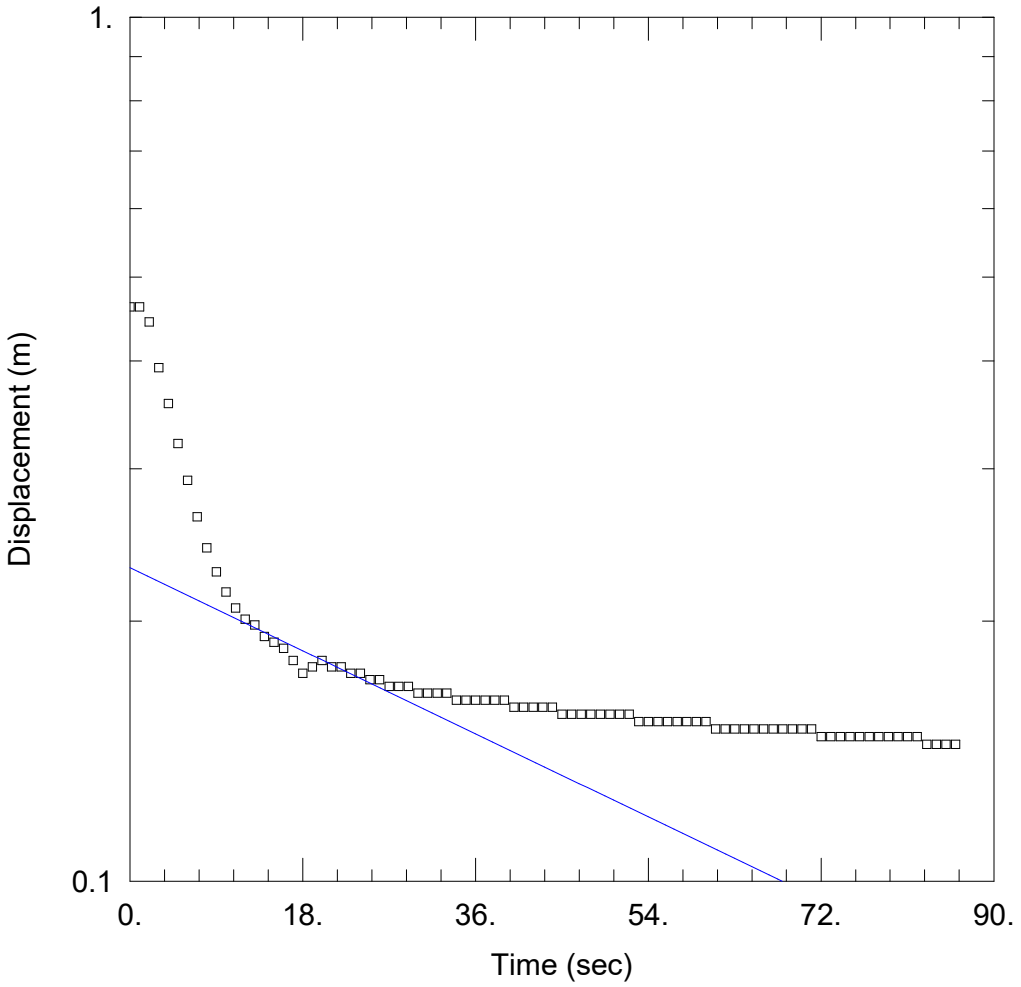
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW21-2)

Initial Displacement: 0.549 m
Total Well Penetration Depth: 6.2 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.95 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.595E-6 m/sec
y0 = 0.2291 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Downloads\BH21-4 Slug 1.aqt
Date: 05/30/22 Time: 11:39:07

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 21-4
Test Date: April 21

AQUIFER DATA

Saturated Thickness: 6. m Anisotropy Ratio (Kz/Kr): 0.1

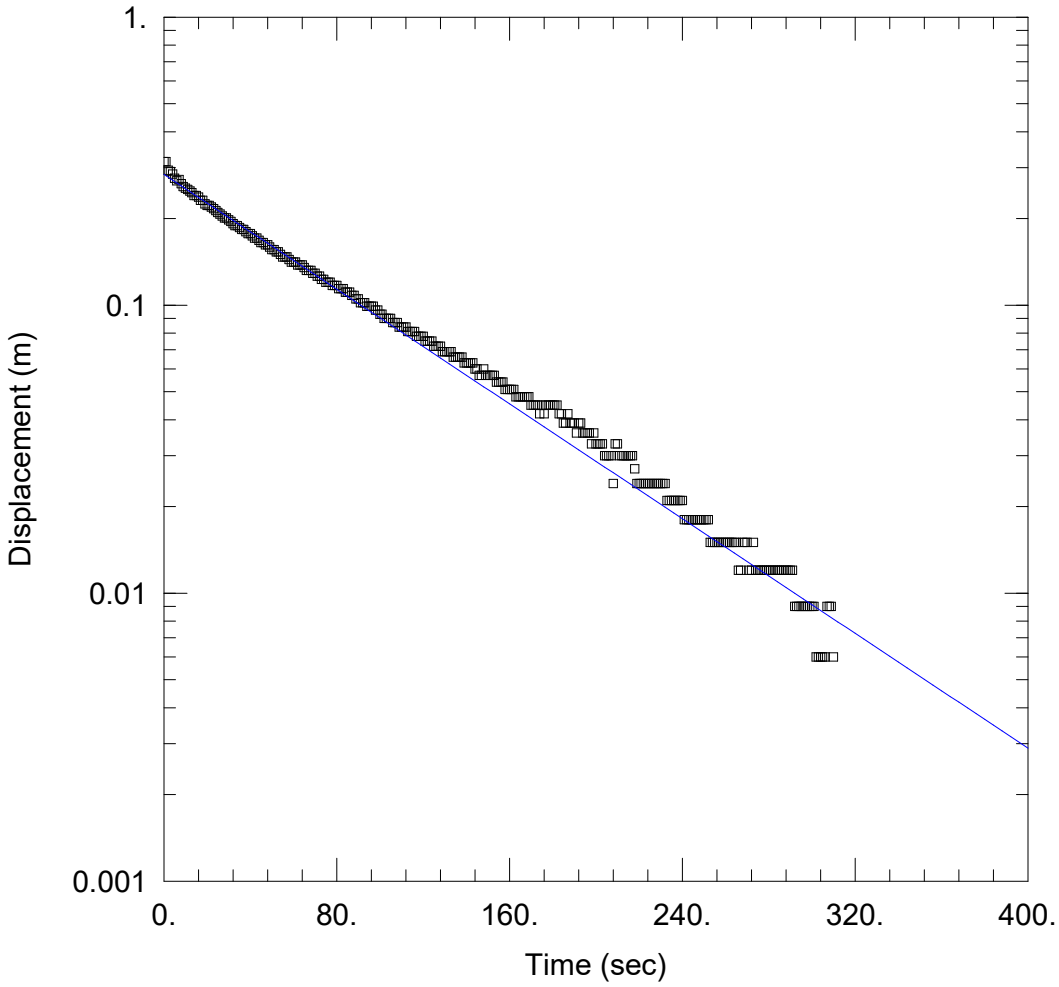
WELL DATA (BH21-4)

Initial Displacement: 0.462 m
Total Well Penetration Depth: 4.73 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.8 m
Screen Length: 1.5 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.129E-5 m/sec y0 = 0.2305 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Downloads\BH103-BH22-5 BAIL 1.aqt
Date: 05/30/22 Time: 11:43:06

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 103
Test Date: April 21

AQUIFER DATA

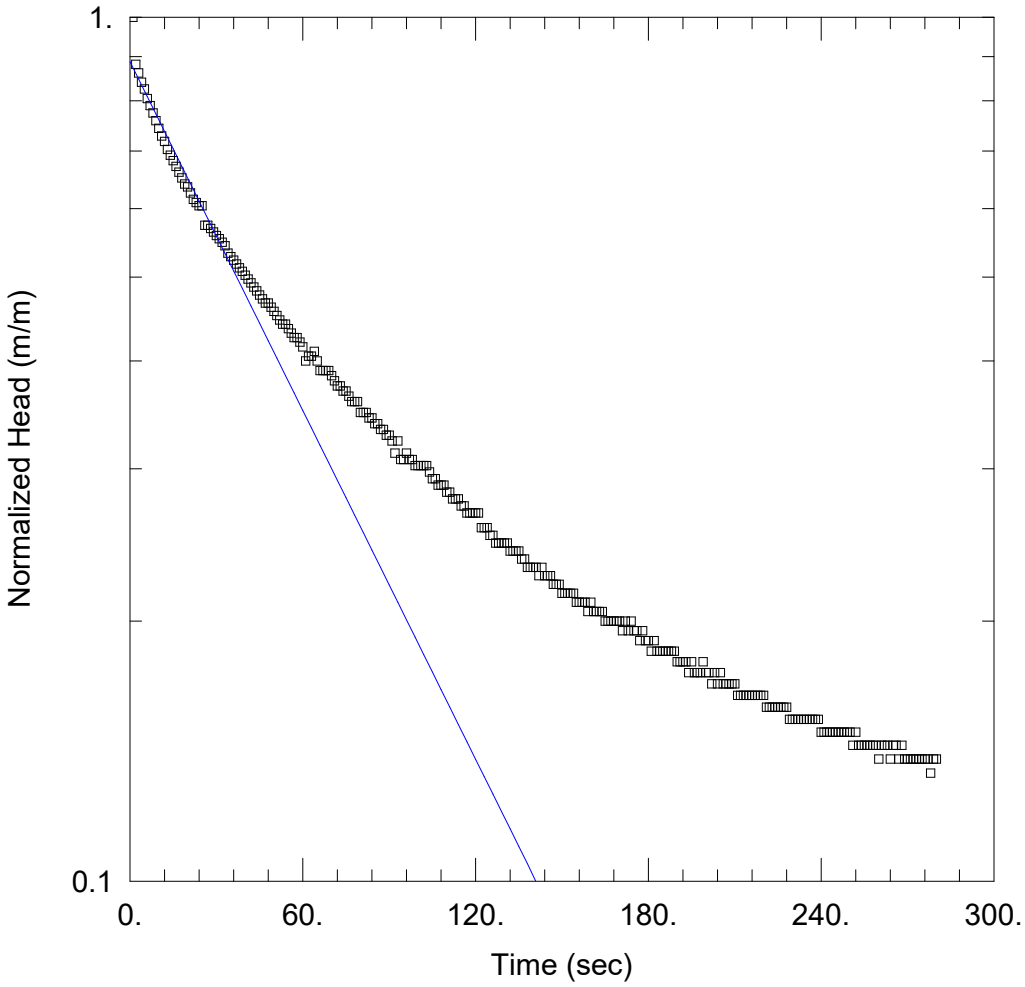
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH103-BH22-5)

Initial Displacement: 0.315 m
Total Well Penetration Depth: 8.03 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.58 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 6.675E-6 m/sec
y0 = 0.2842 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Desktop\Appleby AQTE\BH103-BH22-5 Slug 1 FH.aqt
Date: 05/30/22 Time: 11:41:34

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 103
Test Date: April 21

AQUIFER DATA

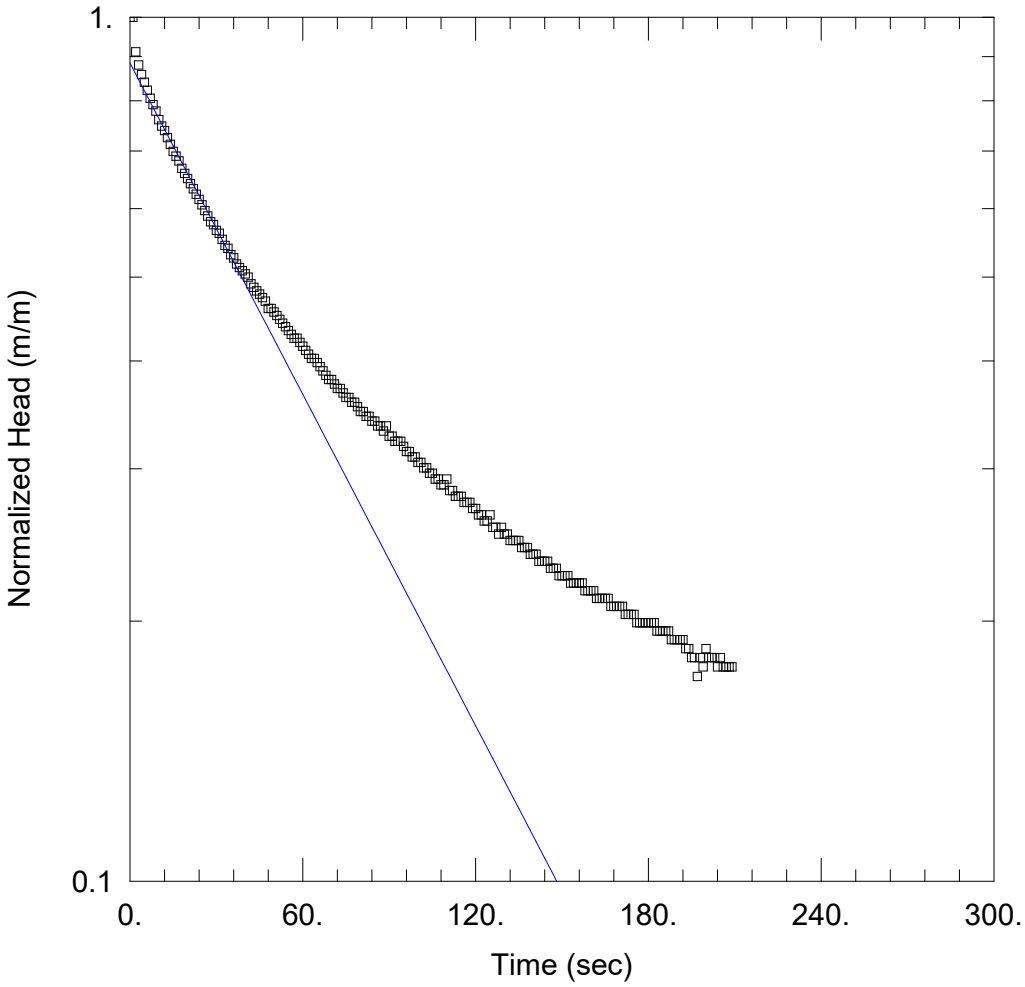
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH103-BH22-5)

Initial Displacement: -0.585 m
Total Well Penetration Depth: 8.03 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.58 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 9.019E-6 m/sec
y0 = -0.5195 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Desktop\Appleby AQTE\BH103-BH22-5 Slug 1 RH.aqt
Date: 05/30/22 Time: 11:42:12

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 103
Test Date: April 21

AQUIFER DATA

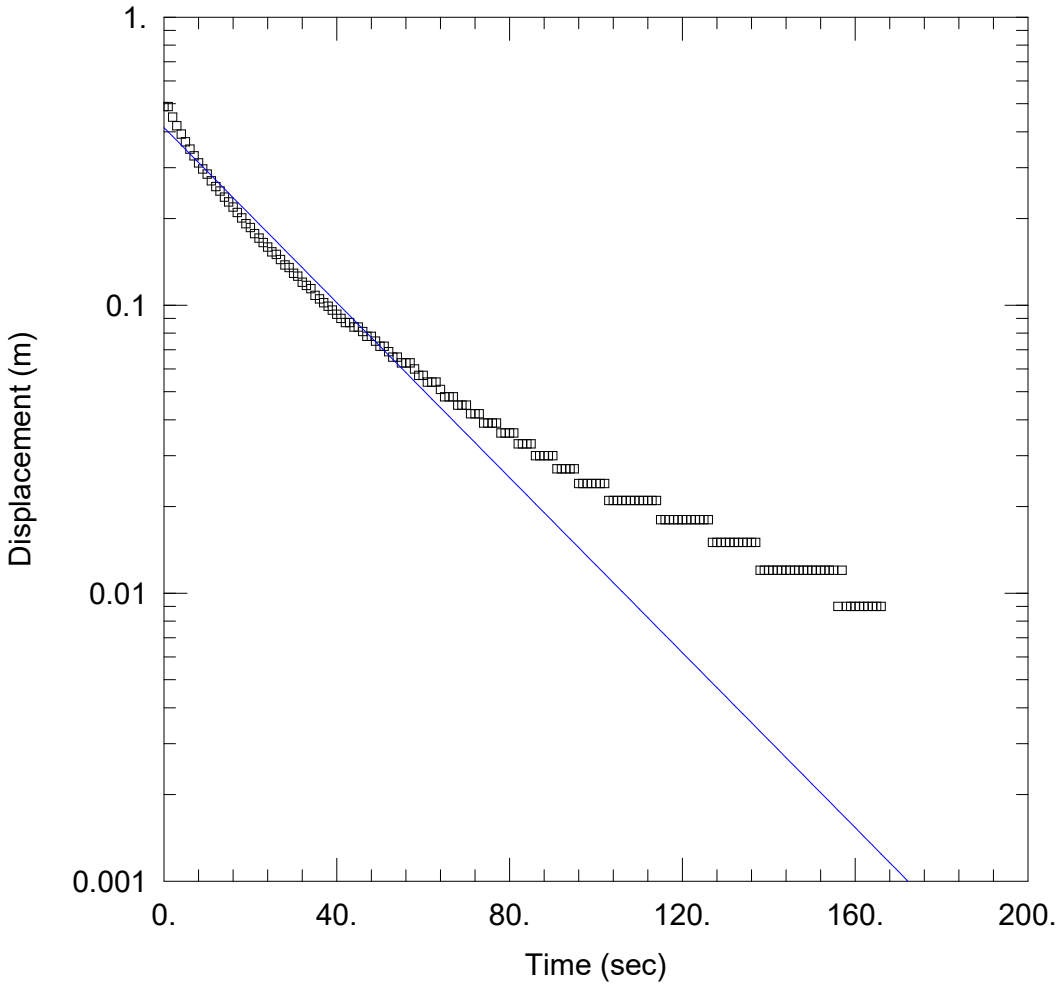
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH103-BH22-5)

Initial Displacement: 0.678 m
Total Well Penetration Depth: 8.03 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.58 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 8.566E-6 m/sec
y0 = 0.5998 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Downloads\BH104 B1.aqt
Date: 05/30/22 Time: 11:45:37

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 104
Test Date: April 21

AQUIFER DATA

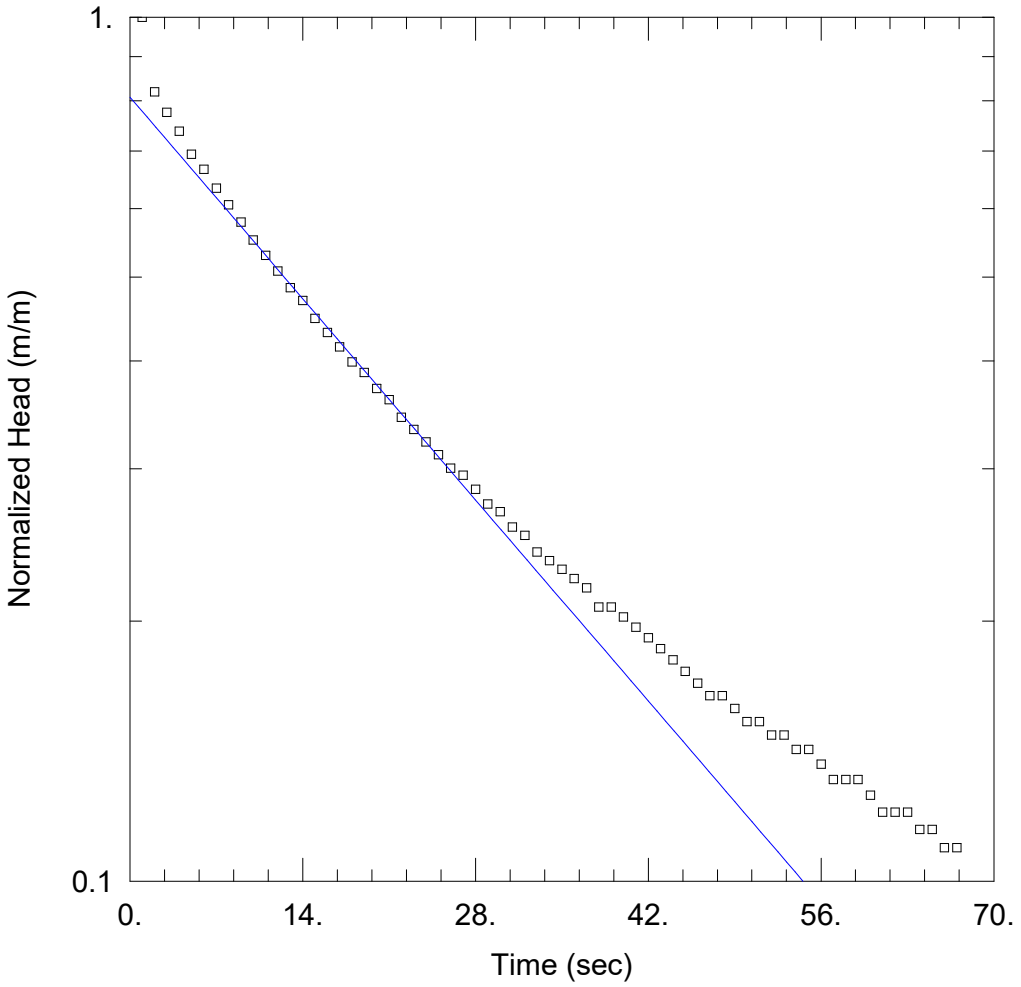
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH104)

Initial Displacement: 0.489 m
Total Well Penetration Depth: 9.08 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.61 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.343E-5 m/sec
y0 = 0.4114 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Desktop\Appleby AQTE\BH104 S3 FH.aqt
Date: 05/30/22 Time: 11:46:13

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 104
Test Date: April 21

AQUIFER DATA

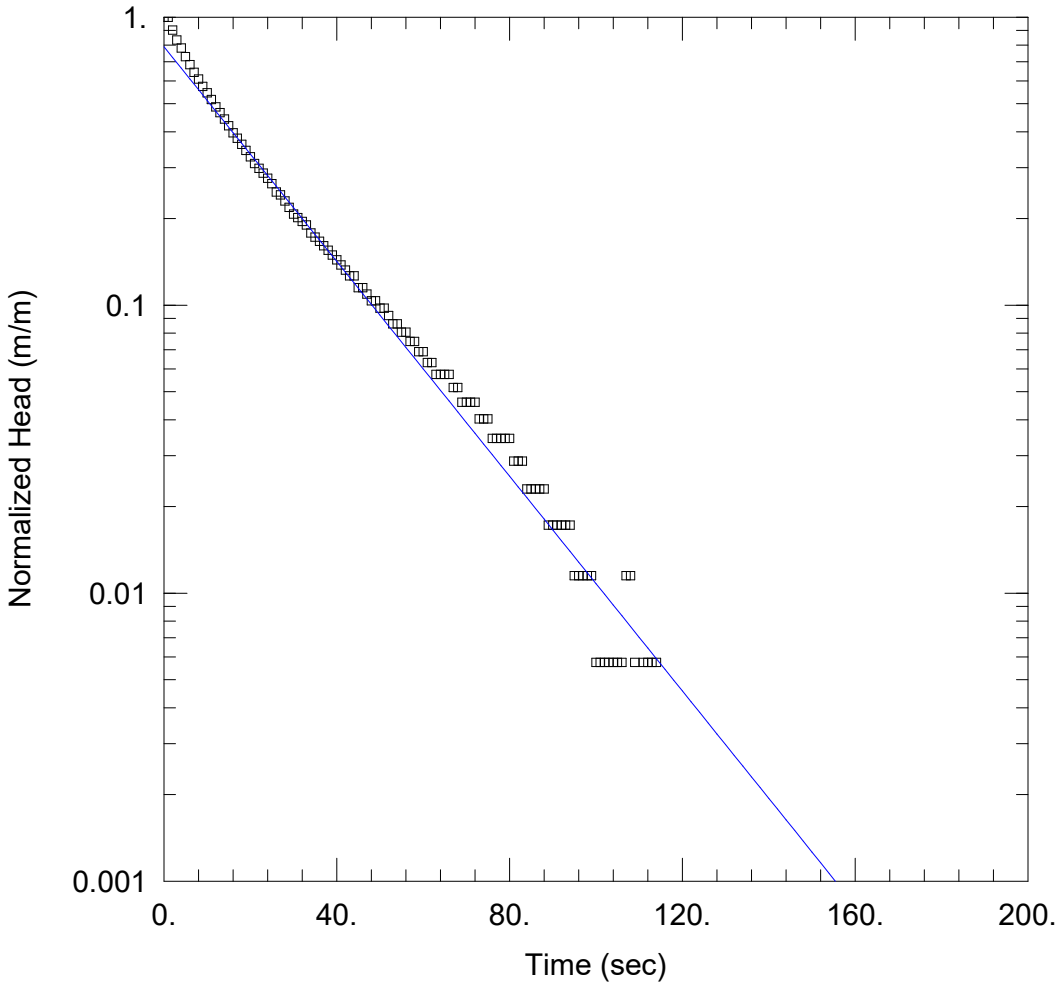
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH104)

Initial Displacement: -0.549 m
Total Well Penetration Depth: 9.08 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.61 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.265E-5 m/sec
y0 = -0.4436 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Desktop\Appleby AQTE\BH104 S3 RH.aqt
Date: 05/30/22 Time: 11:46:52

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 104
Test Date: April 21

AQUIFER DATA

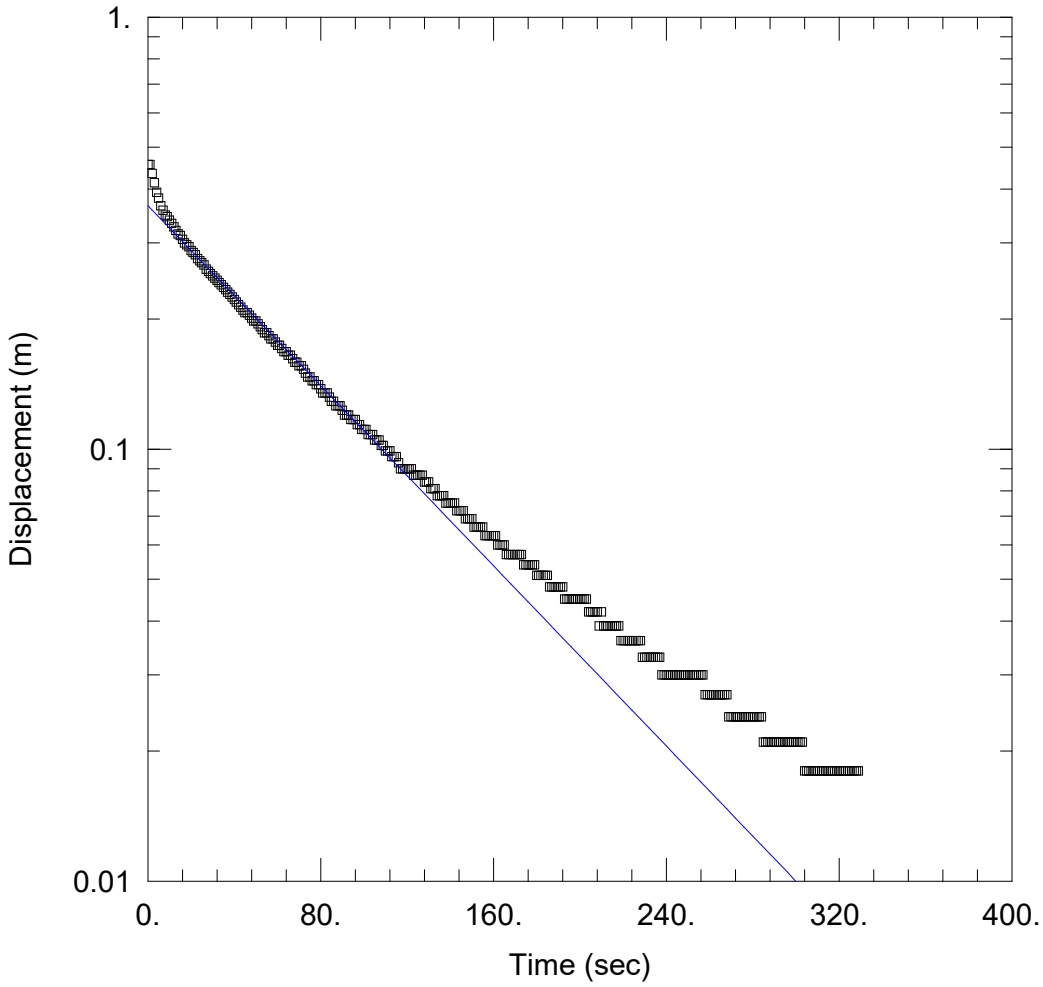
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH104)

Initial Displacement: 0.522 m
Total Well Penetration Depth: 9.08 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.61 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 2.537E-5 m/sec
y0 = 0.4118 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Downloads\BH105 B1.aqt
Date: 05/30/22 Time: 11:49:34

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 105
Test Date: April 21

AQUIFER DATA

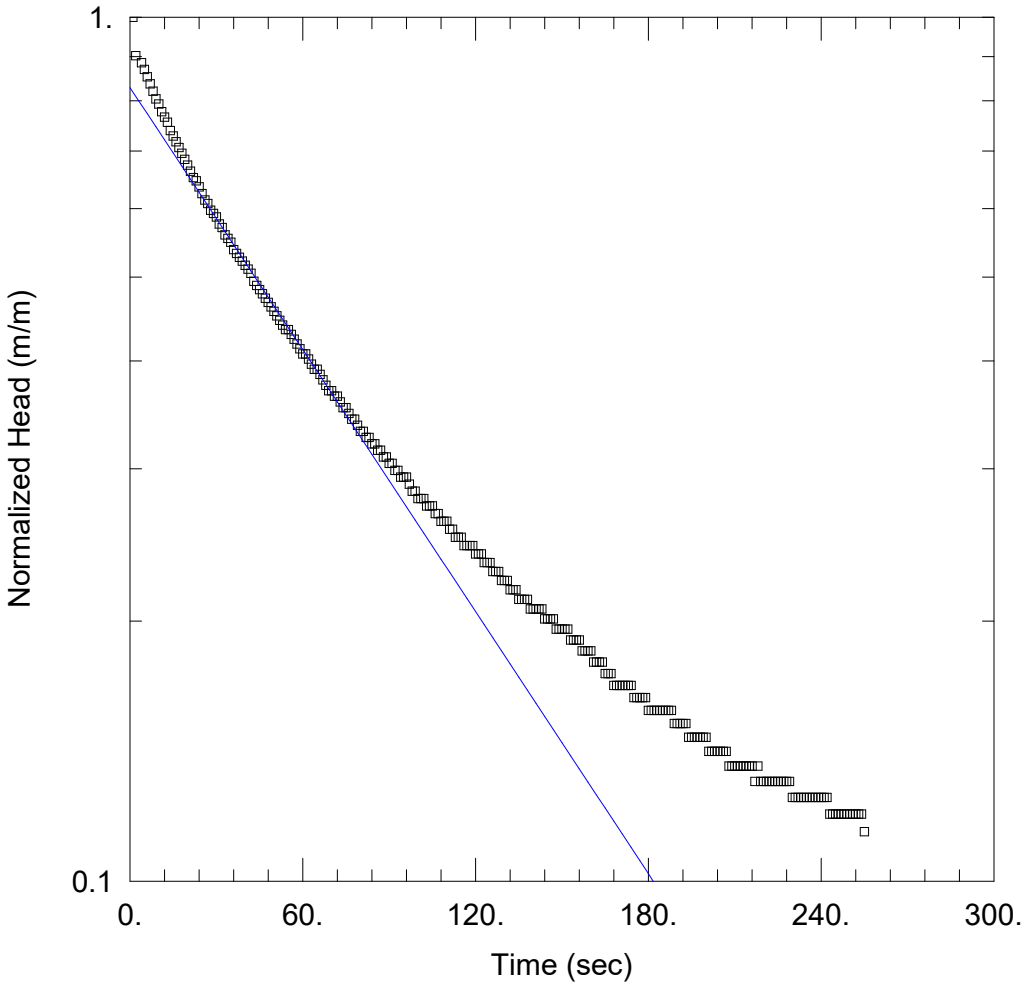
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH105)

Initial Displacement: 0.456 m
Total Well Penetration Depth: 6.64 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.33 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 6.821E-6 m/sec
y0 = 0.3661 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Desktop\Appleby AQTE\BH105 S3 FH.aqt
Date: 05/30/22 Time: 11:48:08

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 105
Test Date: April 21

AQUIFER DATA

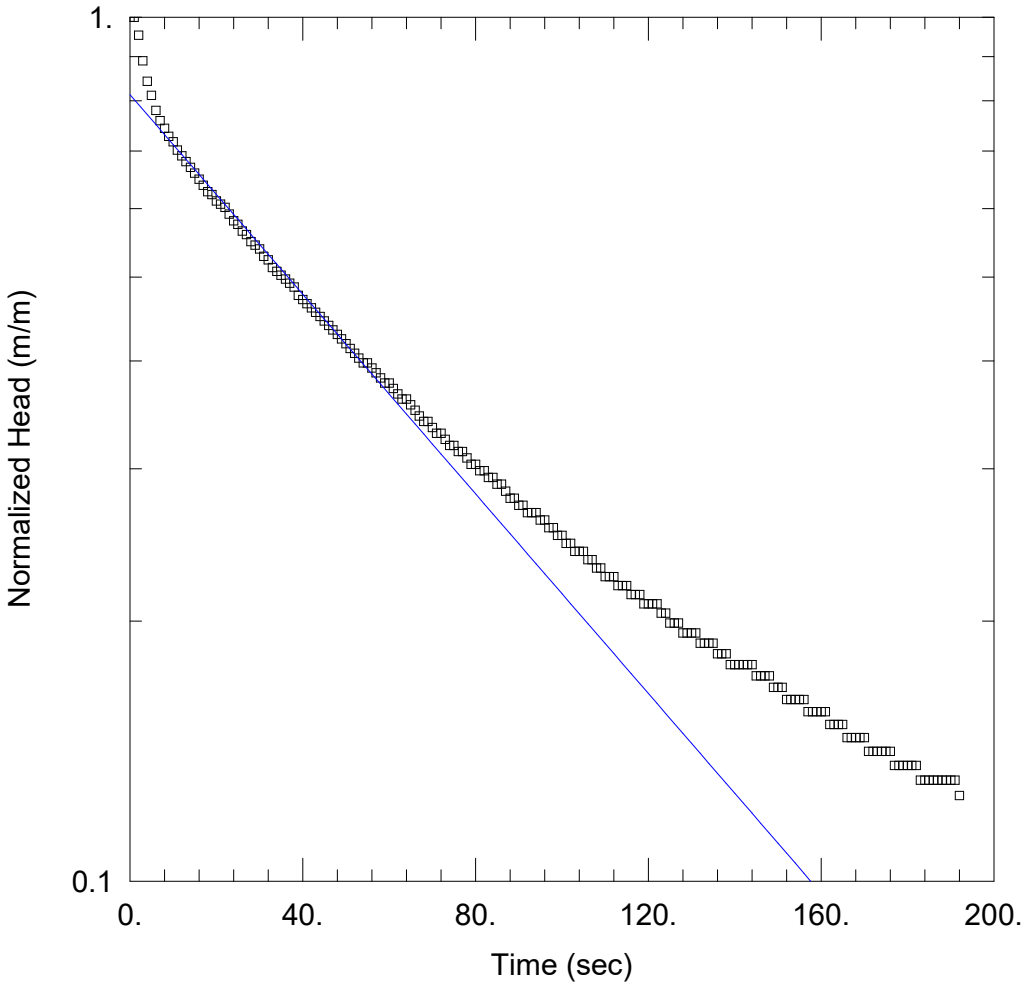
Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH105)

Initial Displacement: -0.552 m
Total Well Penetration Depth: 6.64 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.33 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 6.615E-6 m/sec
y0 = -0.4575 m



WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Desktop\Appleby AQTE\BH105 S3 RH.aqt
Date: 05/30/22 Time: 11:48:44

PROJECT INFORMATION

Company: Palmer
Client: Appleby
Project: 1901204
Test Well: MW 105
Test Date: April 21

AQUIFER DATA

Saturated Thickness: 6. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH105)

Initial Displacement: 0.573 m
Total Well Penetration Depth: 6.64 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.33 m
Screen Length: 3. m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 7.558E-6 m/sec
y0 = 0.466 m

Appendix D

Certificate of Analysis (ALS, 2022)

PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
ATTN: Bethany Gruber
74 Berkeley Street
Toronto ON M5V 1E3

Date Received: 21-APR-22
Report Date: 29-APR-22 11:53 (MT)
Version: FINAL

Client Phone: 647-795-8153

Certificate of Analysis

Lab Work Order #: L2700808

Project P.O. #: NOT SUBMITTED
Job Reference: 1901204
C of C Numbers:
Legal Site Desc:



KARANPARTAP SINGH
Account Manager

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

ANALYTICAL REPORT

Summary of Guideline Exceedances

ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit	Guideline

Ontario Halton Santitary Sewer By-law No. 02-03 (MAR, 2003) - Halton Sanitary Sewer By-Law No. 02-03

(No parameter exceedances)

Ontario Halton Santitary Sewer By-law No. 02-03 (MAR, 2003) - Halton Storm Sewer By-Law No, 02-03

(No parameter exceedances)

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

ANALYTICAL REPORT

Physical Tests - WATER

			Lab ID	L2700808-1
			Sample Date	21-APR-22
			Sample ID	MW104
Analyte	**Unit**	**Guide Limits #1**	**#2**	
pH	pH units	6.00-10.0	6.5-8.5	7.56 PEHT
Total Suspended Solids	mg/L	350	-	22.4

Guide Limit #1: Halton Sanitary Sewer By-Law No. 02-03
Guide Limit #2: Halton Storm Sewer By-Law No, 02-03

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

ANALYTICAL REPORT

Anions and Nutrients - WATER

			Lab ID	L2700808-1
			Sample Date	21-APR-22
			Sample ID	MW104
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Fluoride (F)	mg/L	10	-	0.14 DLDS
Total Kjeldahl Nitrogen	mg/L	100	-	0.649
Phosphorus, Total	mg/L	10.0	-	0.0155
Sulfate (SO4)	mg/L	1500	-	110 DLDS

Guide Limit #1: Halton Sanitary Sewer By-Law No. 02-03
Guide Limit #2: Halton Storm Sewer By-Law No, 02-03

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

ANALYTICAL REPORT

Cyanides - WATER

			Lab ID	L2700808-1
			Sample Date	21-APR-22
			Sample ID	MW104
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Cyanide, Total	mg/L	2	-	<0.0020

Guide Limit #1: Halton Sanitary Sewer By-Law No. 02-03
Guide Limit #2: Halton Storm Sewer By-Law No, 02-03

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

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

ANALYTICAL REPORT

Bacteriological Tests - WATER

		Guide Limits			
				Lab ID	L2700808-1
				Sample Date	21-APR-22
				Sample ID	MW104
Analyte	Unit	#1	#2		
E. Coli	CFU/100mL	-	200	0	

Guide Limit #1: Halton Sanitary Sewer By-Law No. 02-03
Guide Limit #2: Halton Storm Sewer By-Law No, 02-03

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

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

Total Metals - WATER

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2700808-1 Sample Date: 21-APR-22 Sample ID: MW104
Aluminum (Al)-Total	mg/L	50	-	0.317 DLHC
Antimony (Sb)-Total	mg/L	5	-	<0.0010 DLHC
Arsenic (As)-Total	mg/L	1	-	0.0016 DLHC
Beryllium (Be)-Total	mg/L	5	-	<0.0010 DLHC
Cadmium (Cd)-Total	mg/L	1	-	<0.000050 DLHC
Chromium (Cr)-Total	mg/L	3	-	<0.0050 DLHC
Cobalt (Co)-Total	mg/L	5	-	<0.0010 DLHC
Copper (Cu)-Total	mg/L	3	-	<0.0050 DLHC
Iron (Fe)-Total	mg/L	50	-	0.60 DLHC
Lead (Pb)-Total	mg/L	3	-	<0.00050 DLHC
Manganese (Mn)-Total	mg/L	5	-	0.161 DLHC
Mercury (Hg)-Total	mg/L	0.05	-	<0.0000050
Molybdenum (Mo)-Total	mg/L	5	-	0.00424 DLHC
Nickel (Ni)-Total	mg/L	3	-	<0.0050 DLHC
Selenium (Se)-Total	mg/L	5	-	<0.00050 DLHC
Silver (Ag)-Total	mg/L	5	-	<0.00050 DLHC
Tin (Sn)-Total	mg/L	5	-	0.0032 DLHC
Titanium (Ti)-Total	mg/L	5	-	0.0073 DLHC
Zinc (Zn)-Total	mg/L	3	-	<0.030 DLHC

Guide Limit #1: Halton Sanitary Sewer By-Law No. 02-03
Guide Limit #2: Halton Storm Sewer By-Law No, 02-03

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

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

ANALYTICAL REPORT

Aggregate Organics - WATER

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2700808-1 Sample Date: 21-APR-22 Sample ID: MW104
BOD Carbonaceous	mg/L	300	-	<3.0 BODL
Oil and Grease, Total	mg/L	-	-	<5.0
Animal/Veg Oil & Grease	mg/L	150	-	<5.0
Mineral Oil and Grease	mg/L	15	-	<2.5
Phenols (4AAP)	mg/L	1.0	-	<0.0010

Guide Limit #1: Halton Sanitary Sewer By-Law No. 02-03
Guide Limit #2: Halton Storm Sewer By-Law No, 02-03

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

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

ANALYTICAL REPORT

Volatile Organic Compounds - WATER

			Lab ID	L2700808-1
			Sample Date	21-APR-22
			Sample ID	MW104
		Guide Limits		
Analyte	Unit	#1	#2	
Benzene	ug/L	10	-	<0.50
Chloroform	ug/L	40	-	<1.0
1,4-Dichlorobenzene	ug/L	80	-	<0.50
Dichloromethane	ug/L	2000	-	<2.0
Ethylbenzene	ug/L	160	-	<0.50
Tetrachloroethylene	ug/L	1000	-	<0.50
Toluene	ug/L	16	-	<0.50
Trichloroethylene	ug/L	400	-	<0.50
Surrogate: 4-Bromofluorobenzene	%	-	-	99.6
Surrogate: 1,4-Difluorobenzene	%	-	-	100.8

Guide Limit #1: Halton Sanitary Sewer By-Law No. 02-03
Guide Limit #2: Halton Storm Sewer By-Law No, 02-03

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

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

ANALYTICAL REPORT

Polycyclic Aromatic Hydrocarbons - WATER

			Lab ID	L2700808-1
			Sample Date	21-APR-22
			Sample ID	MW104
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Naphthalene	ug/L	140	-	<0.020
Surrogate: d8-Naphthalene	%	-	-	83.8

Guide Limit #1: Halton Sanitary Sewer By-Law No. 02-03
Guide Limit #2: Halton Storm Sewer By-Law No, 02-03

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

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
PEHT	Parameter Exceeded Recommended Holding Time Prior to Analysis
BODL	Limit of Reporting for BOD was increased to account for the largest volume of sample tested.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
BOD-C-WT	Water	BOD Carbonaceous	APHA 5210 B (CBOD)

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

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

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

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

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

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

EC-WW-MF-WT	Water	E. Coli	SM 9222D

A 100 mL volume of sample is filtered through a membrane, the membrane is placed on mFC-BCIG agar and incubated at 44.5 –0 .2 °C for 24 – 2 h. Method ID: WT-TM-1200

F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

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

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

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

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

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

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

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

Sample is extracted with hexane, sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.

OGG-SPEC-WT	Water	Speciated Oil and Grease-Gravimetric	APHA 5520 B

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
		The procedure involves an extraction of the entire water sample with hexane. Sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.	
P-T-COL-WT	Water	Total P in Water by Colour	APHA 4500-P PHOSPHORUS
		This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is deteremined colourimetrically after persulphate digestion of the sample.	
PAH-NAPHTHALENE-WT	Water	Polyaromatic Hydrocarbons (PAHs)	SW846 8270
		Sample is extracted at neutral pH using separate aliquots of dichloromethane with a modified separatory funnel technique, extracts are then concentrated and analyzed by GC/MSD.	
PH-WT	Water	pH	APHA 4500 H-Electrode
		Water samples are analyzed directly by a calibrated pH meter.	
		Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days	
PHENOLS-4AAP-WT	Water	Phenol (4AAP)	EPA 9066
		An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.	
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
SOLIDS-TSS-WT	Water	Suspended solids	APHA 2540 D-Gravimetric
		A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1°C for a minimum of four hours or until a constant weight is achieved.	
TKN-F-WT	Water	TKN in Water by Fluorescence	J. ENVIRON. MONIT., 2005,7,37-42,RSC
		Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection	
VOC-ROU-HS-WT	Water	Volatile Organic Compounds	SW846 8260
		Aqueous samples are analyzed by headspace-GC/MS.	

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

Chain of Custody Numbers:

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

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

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

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

Quality Control Report

Workorder: L2700808 Report Date: 29-APR-22

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BOD-C-WT	**Water**							
Batch R5769488								
WG3719873-2 DUP		**L2700648-1**						
BOD Carbonaceous		4.7	5.0		mg/L	4.9	30	23-APR-22
WG3719873-3 LCS								
BOD Carbonaceous			97.5		%		85-115	23-APR-22
WG3719873-1 MB								
BOD Carbonaceous			<2.0		mg/L		2	23-APR-22
CN-TOT-WT	**Water**							
Batch R5768984								
WG3720610-3 DUP		**WG3720610-5**						
Cyanide, Total		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	26-APR-22
WG3720610-2 LCS								
Cyanide, Total			97.4		%		80-120	26-APR-22
WG3720610-1 MB								
Cyanide, Total			<0.0020		mg/L		0.002	26-APR-22
WG3720610-4 MS		**WG3720610-5**						
Cyanide, Total			104.9		%		70-130	26-APR-22
EC-WW-MF-WT	**Water**							
Batch R5768026								
WG3719830-1 MB								
E. Coli			0		CFU/100mL		1	23-APR-22
WG3719830-2 MB								
E. Coli			0		CFU/100mL		1	23-APR-22
F-IC-N-WT	**Water**							
Batch R5769321								
WG3721050-4 DUP		**WG3721050-3**						
Fluoride (F)		0.074	0.072		mg/L	3.1	20	27-APR-22
WG3721050-2 LCS								
Fluoride (F)			102.8		%		90-110	27-APR-22
WG3721050-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	27-APR-22
WG3721050-5 MS		**WG3721050-3**						
Fluoride (F)			104.0		%		75-125	27-APR-22
HG-T-CVAA-WT	**Water**							
Batch R5768253								
WG3720026-4 DUP		**WG3720026-3**						
Mercury (Hg)-Total		<0.0000050	<0.000005(	RPD-NA	mg/L	N/A	20	25-APR-22
WG3720026-2 LCS								

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-T-CVAA-WT	**Water**							
Batch R5768253								
WG3720026-2 LCS								
Mercury (Hg)-Total			101.0		%		80-120	25-APR-22
WG3720026-1 MB								
Mercury (Hg)-Total			<0.000005(		mg/L		0.000005	25-APR-22
WG3720026-6 MS		**WG3720026-5**						
Mercury (Hg)-Total			103.5		%		70-130	25-APR-22
MET-T-CCMS-WT	**Water**							
Batch R5768349								
WG3719890-4 DUP		**WG3719890-3**						
Aluminum (Al)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	25-APR-22
Antimony (Sb)-Total		0.00013	0.00013		mg/L	4.3	20	25-APR-22
Arsenic (As)-Total		0.00066	0.00063		mg/L	4.0	20	25-APR-22
Beryllium (Be)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	25-APR-22
Cadmium (Cd)-Total		0.0000301	0.0000330		mg/L	9.2	20	25-APR-22
Chromium (Cr)-Total		0.00066	0.00055		mg/L	18	20	25-APR-22
Cobalt (Co)-Total		0.00067	0.00066		mg/L	0.9	20	25-APR-22
Copper (Cu)-Total		0.0124	0.0121		mg/L	2.5	20	25-APR-22
Iron (Fe)-Total		0.014	0.013		mg/L	9.5	20	25-APR-22
Lead (Pb)-Total		0.000233	0.000206		mg/L	12	20	25-APR-22
Manganese (Mn)-Total		0.00340	0.00331		mg/L	2.7	20	25-APR-22
Molybdenum (Mo)-Total		0.000647	0.000635		mg/L	1.9	20	25-APR-22
Nickel (Ni)-Total		0.00358	0.00345		mg/L	3.6	20	25-APR-22
Selenium (Se)-Total		0.000115	0.000125		mg/L	8.4	20	25-APR-22
Silver (Ag)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	25-APR-22
Tin (Sn)-Total		0.00011	<0.00010	RPD-NA	mg/L	N/A	20	25-APR-22
Titanium (Ti)-Total		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	25-APR-22
Zinc (Zn)-Total		0.0098	0.0086		mg/L	13	20	25-APR-22
WG3719890-2 LCS								
Aluminum (Al)-Total			96.6		%		80-120	25-APR-22
Antimony (Sb)-Total			96.9		%		80-120	25-APR-22
Arsenic (As)-Total			97.3		%		80-120	25-APR-22
Beryllium (Be)-Total			96.6		%		80-120	25-APR-22
Cadmium (Cd)-Total			95.3		%		80-120	25-APR-22
Chromium (Cr)-Total			97.8		%		80-120	25-APR-22
Cobalt (Co)-Total			97.0		%		80-120	25-APR-22

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5768349								
WG3719890-2 LCS								
Copper (Cu)-Total			96.1		%		80-120	25-APR-22
Iron (Fe)-Total			100.2		%		80-120	25-APR-22
Lead (Pb)-Total			97.2		%		80-120	25-APR-22
Manganese (Mn)-Total			98.3		%		80-120	25-APR-22
Molybdenum (Mo)-Total			95.0		%		80-120	25-APR-22
Nickel (Ni)-Total			97.0		%		80-120	25-APR-22
Selenium (Se)-Total			97.5		%		80-120	25-APR-22
Silver (Ag)-Total			88.6		%		80-120	25-APR-22
Tin (Sn)-Total			96.8		%		80-120	25-APR-22
Titanium (Ti)-Total			94.9		%		80-120	25-APR-22
Zinc (Zn)-Total			94.3		%		80-120	25-APR-22
WG3719890-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	25-APR-22
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	25-APR-22
Arsenic (As)-Total			<0.00010		mg/L		0.0001	25-APR-22
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	25-APR-22
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	25-APR-22
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	25-APR-22
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	25-APR-22
Copper (Cu)-Total			<0.00050		mg/L		0.0005	25-APR-22
Iron (Fe)-Total			<0.010		mg/L		0.01	25-APR-22
Lead (Pb)-Total			<0.000050		mg/L		0.00005	25-APR-22
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	25-APR-22
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	25-APR-22
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	25-APR-22
Selenium (Se)-Total			<0.000050		mg/L		0.00005	25-APR-22
Silver (Ag)-Total			<0.000050		mg/L		0.00005	25-APR-22
Tin (Sn)-Total			<0.00010		mg/L		0.0001	25-APR-22
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	25-APR-22
Zinc (Zn)-Total			<0.0030		mg/L		0.003	25-APR-22
WG3719890-5 MS		**WG3719890-6**						
Aluminum (Al)-Total			N/A	MS-B	%		-	25-APR-22
Antimony (Sb)-Total			97.4		%		70-130	25-APR-22
Arsenic (As)-Total			102.5		%		70-130	25-APR-22

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5768349								
WG3719890-5 MS		**WG3719890-6**						
Beryllium (Be)-Total			96.9		%		70-130	25-APR-22
Cadmium (Cd)-Total			101.8		%		70-130	25-APR-22
Chromium (Cr)-Total			103.2		%		70-130	25-APR-22
Cobalt (Co)-Total			101.4		%		70-130	25-APR-22
Copper (Cu)-Total			94.6		%		70-130	25-APR-22
Iron (Fe)-Total			N/A	MS-B	%		-	25-APR-22
Lead (Pb)-Total			99.5		%		70-130	25-APR-22
Manganese (Mn)-Total			N/A	MS-B	%		-	25-APR-22
Molybdenum (Mo)-Total			97.0		%		70-130	25-APR-22
Nickel (Ni)-Total			98.6		%		70-130	25-APR-22
Selenium (Se)-Total			107.5		%		70-130	25-APR-22
Silver (Ag)-Total			86.8		%		70-130	25-APR-22
Tin (Sn)-Total			95.3		%		70-130	25-APR-22
Titanium (Ti)-Total			N/A	MS-B	%		-	25-APR-22
Zinc (Zn)-Total			96.4		%		70-130	25-APR-22
OGG-SPEC-WT	**Water**							
Batch R5769552								
WG3720352-2 LCS								
Oil and Grease, Total			88.0		%		70-130	26-APR-22
Mineral Oil and Grease			72.7		%		70-130	26-APR-22
WG3720352-1 MB								
Oil and Grease, Total			<5.0		mg/L		5	26-APR-22
Mineral Oil and Grease			<2.5		mg/L		2.5	26-APR-22
P-T-COL-WT	**Water**							
Batch R5768948								
WG3720377-3 DUP		**L2700666-1**						
Phosphorus, Total		0.0280	0.0268		mg/L	4.5	20	27-APR-22
WG3720377-2 LCS								
Phosphorus, Total			99.4		%		80-120	27-APR-22
WG3720377-1 MB								
Phosphorus, Total			<0.0030		mg/L		0.003	27-APR-22
WG3720377-4 MS		**L2700666-1**						
Phosphorus, Total			95.1		%		70-130	27-APR-22
PAH-NAPHTHALENE-WT	**Water**							

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-NAPHTHALENE-WT	**Water**							
Batch R5768290								
WG3719917-2 LCS								
Naphthalene			118.2		%		50-130	25-APR-22
WG3719917-1 MB								
Naphthalene			<0.020		ug/L		0.02	25-APR-22
Surrogate: d8-Naphthalene			71.9		%		60-140	25-APR-22
PH-WT	**Water**							
Batch R5769092								
WG3721098-4 DUP		**WG3721098-3**						
pH		7.91	7.93	J	pH units	0.02	0.2	27-APR-22
WG3721098-2 LCS								
pH			7.01		pH units		6.9-7.1	27-APR-22
PHENOLS-4AAP-WT	**Water**							
Batch R5768971								
WG3720378-3 DUP		**L2700595-7**						
Phenols (4AAP)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	26-APR-22
WG3720378-2 LCS								
Phenols (4AAP)			102.8		%		85-115	26-APR-22
WG3720378-1 MB								
Phenols (4AAP)			<0.0010		mg/L		0.001	26-APR-22
WG3720378-4 MS		**L2700595-7**						
Phenols (4AAP)			104.7		%		75-125	26-APR-22
SO4-IC-N-WT	**Water**							
Batch R5769321								
WG3721050-4 DUP		**WG3721050-3**						
Sulfate (SO4)		9.24	9.24		mg/L	0.0	20	27-APR-22
WG3721050-2 LCS								
Sulfate (SO4)			103.1		%		90-110	27-APR-22
WG3721050-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	27-APR-22
WG3721050-5 MS		**WG3721050-3**						
Sulfate (SO4)			105.1		%		75-125	27-APR-22
SOLIDS-TSS-WT	**Water**							
Batch R5768867								
WG3720430-3 DUP		**L2699687-4**						
Total Suspended Solids		289	258		mg/L	11	20	27-APR-22
WG3720430-2 LCS								
Total Suspended Solids			94.3		%		85-115	27-APR-22

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TSS-WT	**Water**							
Batch R5768867								
WG3720430-1 MB								
Total Suspended Solids			<3.0		mg/L		3	27-APR-22
TKN-F-WT	**Water**							
Batch R5769360								
WG3720376-3 DUP		**L2700650-2**						
Total Kjeldahl Nitrogen		0.284	0.261		mg/L	8.7	20	27-APR-22
WG3720376-2 LCS								
Total Kjeldahl Nitrogen			105.2		%		75-125	27-APR-22
WG3720376-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	27-APR-22
WG3720376-4 MS		**L2700650-2**						
Total Kjeldahl Nitrogen			119.5		%		70-130	27-APR-22
VOC-ROU-HS-WT	**Water**							
Batch R5768858								
WG3720477-4 DUP		**WG3720477-3**						
1,4-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	27-APR-22
Benzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	27-APR-22
Chloroform		<1.0	<1.0	RPD-NA	ug/L	N/A	30	27-APR-22
Dichloromethane		<2.0	<2.0	RPD-NA	ug/L	N/A	30	27-APR-22
Ethylbenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	27-APR-22
Tetrachloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	27-APR-22
Toluene		<0.40	<0.40	RPD-NA	ug/L	N/A	30	27-APR-22
Trichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	27-APR-22
WG3720477-1 LCS								
1,4-Dichlorobenzene			101.3		%		70-130	27-APR-22
Benzene			98.8		%		70-130	27-APR-22
Chloroform			105.0		%		70-130	27-APR-22
Dichloromethane			110.9		%		70-130	27-APR-22
Ethylbenzene			103.1		%		70-130	27-APR-22
Tetrachloroethylene			106.9		%		70-130	27-APR-22
Toluene			103.7		%		70-130	27-APR-22
Trichloroethylene			103.7		%		70-130	27-APR-22
WG3720477-2 MB								
1,4-Dichlorobenzene			<0.50		ug/L		0.5	27-APR-22
Benzene			<0.50		ug/L		0.5	27-APR-22

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5768858								
WG3720477-2 MB								
Chloroform			<1.0		ug/L		1	27-APR-22
Dichloromethane			<2.0		ug/L		2	27-APR-22
Ethylbenzene			<0.50		ug/L		0.5	27-APR-22
Tetrachloroethylene			<0.50		ug/L		0.5	27-APR-22
Toluene			<0.40		ug/L		0.4	27-APR-22
Trichloroethylene			<0.50		ug/L		0.5	27-APR-22
Surrogate: 1,4-Difluorobenzene			101.6		%		70-130	27-APR-22
Surrogate: 4-Bromofluorobenzene			102.2		%		70-130	27-APR-22
WG3720477-5 MS		**WG3720477-3**						
1,4-Dichlorobenzene			103.6		%		50-150	27-APR-22
Benzene			99.5		%		50-150	27-APR-22
Chloroform			105.7		%		50-150	27-APR-22
Dichloromethane			114.9		%		50-150	27-APR-22
Ethylbenzene			101.3		%		50-150	27-APR-22
Tetrachloroethylene			106.4		%		50-150	27-APR-22
Toluene			102.1		%		50-150	27-APR-22
Trichloroethylene			101.3		%		50-150	27-APR-22

Quality Control Report

Workorder: L2700808 Report Date: 29-APR-22

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Legend:

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

Sample Parameter Qualifier Definitions:

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

Quality Control Report

Workorder: L2700808 Report Date: 29-APR-22

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Bethany Gruber

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	21-APR-22 15:00	27-APR-22 00:00	4	5	days	EHT

Legend & Qualifier Definitions:

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

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2700808 were received on 21-APR-22 16:00.

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

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

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

Chain of Custody (COC) / Analytical

www.alsglobal.com

Canada Toll Free: 1 800 668 9

L2700808-COFC

20 - 955490

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	PALMER
Contact:	BETHANY GRUBER
Phone:	519 212 3092
	Company address below will appear on the final report
Street:	74 BERKELEY ST.
City/Province:	TORONTO / ONTARIO
Postal Code:	M5V 1E3
Invoice To	Same as Report To ☐ YES ☒ NO
	Copy of Invoice with Report ☐ YES ☒ NO
Company:	PALMER
Contact:	accounting@pecg.ca

Project Information

ALS Account # / Quote #:	24400
Job #:	1901204
PO / AFE:	
LSD:	
ALS Lab Work Order # (ALS use only):	L2700808 JD

Reports / Recipients

Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☒ YES ☐ NO ☐ N/A

☒ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: bethany.gruber@pecg.ca

Email 2: kalina.reydenova@pecg.ca

Email 3: nicole.anasis@pecg.ca

Invoice Recipients

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: accounting@pecg.ca

Email 2:

Oil and Gas Required Fields (client use)

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

ALS Contact: | Sampler:

☒ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please contact your AM to confirm availability.

Analysis Request

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	P	HALTON STORM + SANI	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	MW104	21-APR-22	15:00	WATER	1	X				

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

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

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

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

COMPARE TO HALTON STORM & SANITARY DISCHARGE CRITERIA

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☒ ICE PACKS ☐ FROZEN ☒ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
5.1°C				2.3			

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
Bethany Gruber	21-APR-22	16:00

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
TARA PUTAR	21-Apr-22	16:00

FINAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
	22APR-22	11:30

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

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

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