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Hydrogeology Investigation Report and Water Balance Assessment

115 Watson Parkway North, Guelph, ON

Palmer Project #
1510449

Prepared For
Guelph Watson Holdings Inc.

November 7, 2023

November 7, 2023
Trina Sillano
Guelph Watson Holdings Inc.
405-46 The Esplanade
Toronto, ON, M5E1A7

Re: Hydrogeology Investigation Report and Water Balance Assessment
Project #: 1510449

Palmer is pleased to submit the attached report describing the results of our Hydrogeological Investigation and Water Balance Assessment for the proposed development at 115 Watson Parkway North, Guelph, ON. This report provides information on hydrogeological conditions to support design and permitting for based upon the results from our reviews, laboratory testing, and data analysis.

The site is located within a Well Head Protection Area (WHPA), with an A and B designation, as well as in Significant Groundwater Recharge Area (SGRA). This is due to the proximity of the Municipal Supply Well: Clythe Well, and Booster Pumping Station. It is understood that Clythe Well is not currently being used for municipal water supply, but the Booster Pumping Station is in use. The majority of the site is located within the WHPA-B, with a small portion to the east being located in the WHPA-A. It should be noted that no development is proposed in the WHPA-A. As the site is within SGRA, groundwater recharge (infiltration) associated with the site should be maintained post development. A pre-to-post development water balance has been completed to identify infiltration targets. Based on the coarse surficial soils and moderately deep groundwater levels, the site is suitable for infiltration-based LIDs. This report details LID recommendations that will assist in meeting the infiltration targets.

Clythe Creek is located to the east of the site boundary, along with an associated wetland complex. Palmer installed a series of mini-piezometers to monitor these surface water features and characterize the surface water/groundwater interactions. It was determined that Clythe Creek and the wetland complex are primarily supported by surface water, with minor groundwater inputs to Clythe Creek. A feature based water balance has been completed for the site to determine how much infiltration and, more importantly, surface runoff from the site contributes to Clythe Creek and the wetland complex. Recommendations for LID measures to meet the pre-development runoff values are provided.

Two-levels of underground parking has been assumed for the proposed development. A watertight and non-watertight dewatering scenario have been provided. Based on the high dewatering estimate from the non-watertight scenario, it is recommended that watertight construction methods be utilized. With a watertight structure, the dewatering estimate is 387,072 L/day. This will require a registration on the Environmental Activity and Sector and Registry (EASR).

We trust this report will be satisfactory to your current needs. This report is subject to the Statement of Limitations found at the back of the report.

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

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1. Introduction

Palmer was retained by Guelph Watson Holdings Inc. to conduct a Hydrogeological Investigation for the proposed residential development at 115 Watson Parkway North, Guelph, ON (the "site") (**Figure 1**). The proposed development will be mixed-use residential with four buildings (Building A, B, C and D), townhouses, a park area, and two underground parking structures each with two-levels (**Appendix A**). A focus of this report is the assessment of the hydrogeological connection and function of the surface water features located to the east of the site boundary, through completion of a site water balance and feature based water balance assessment. A construction dewatering assessment was also completed and recommendations made for permitting with the Ministry of the Environment, Conservations and Parks (MECP).

The site is located within Well Head Protection Areas (WHPA-A and WHPA-B) associated with Clythe Well, a Municipal supply well, and a Booster Pumping Station. Although this well is currently not being used for municipal supply, the WHPA area remains. The site is also located in a Significant Groundwater Recharge Area (SGRA). As this site is located within this SGRA, groundwater recharge associated with the site should be maintained post-development to ensure groundwater quantity and quality are protected. The site is also located adjacent to Clythe Creek, and an associated wetland complex. A feature based water balance assessment has been completed to determine how site infiltration and runoff support the nearby feature.

1.1 Scope of Work

The scope of work for the Hydrogeological Investigation included:

- Provide guidance on the siting and installation of twelve (12) groundwater monitoring wells including shallow and deep nested wells;
- Complete groundwater monitoring at all monitoring wells to determine the groundwater table across the site;
- Install four (4) small diameter mini-piezometer in Clythe Creek and wetlands features adjacent to the site to determine surface water/groundwater interactions;
- Complete surface water monitoring at the mini-piezometer locations to determine surface water and shallow groundwater levels;
- Compete a groundwater flow assessment using measured groundwater levels;
- Collect one (1) groundwater quality sample and compare against ODWS criteria;
- Complete hydraulic testing at each monitoring well to determine the hydraulic conductivity of the surficial soils;
- Complete infiltration tests across the site to determine percolation rates of the upper soils;
- Complete a dewatering assessment based on preliminary understanding of the proposed development, and assuming 2-levels of underground parking for the higher density structures;
- Complete a pre-to-post development site wide water balance to delineate the infiltration and runoff associated with the site;
- Complete a feature based pre-to-post development water balance to delineate the infiltration and runoff from the site that is associated with Clythe Creek and the nearby wetland complex; and,
- Complete a Hydrogeological Investigation and Water Balance Report.

LEGEND

- Monitoring Well
- Mini Piezometer
- Watercourse[1]
- Subject Site

1. LIO/MNRF

0 10 20 40 60 80 100
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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CLIENT
Guelph Watson Holdings Inc.

PROJECT
115 Watson Parkway North - Guelph

TITLE
Site Location

Palmer™

REF. NO. 1510449-1-1

Figure 1

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2. Hydrogeological Conditions

2.1 Regional Conditions

2.1.1 Physiography and Surficial Geology

The site is located within the Guelph Drumlin Field physiographic region (Chapman and Putnum, 1984). The Guelph Drumlin Field occupies 800 km^2 and spans across the City of Guelph and parts of Wellington County and Waterloo Region. This region is characterized by approximately 300 northwest-southeast trending drumlins, which are broad oval shaped hills with low slopes. These drumlins typically consist of sandy till soils, fringed by glaciofluvial sand and gravel deposits.

The surficial geology of the site as described by the Ontario Geological Survey (OGS) consists primarily of glaciofluvial deposits characterized by sandy and gravelly soils (**Figure 2**). These soils tend to facilitate vertical groundwater recharge in vadose zone towards deeper units. Horizontal flow in saturated zone is expected and the soils can be considered well drained. Modern alluvial deposits associated with the nearby Clythe Creek are also present on the eastern edges of the site boundary. These soils tend to be comprised of clay, silt and sand with minor gravels and organics.

Bedrock geology was mapped by OGS as sandstone, shale, dolostone, siltstone of Armabel Formation, which was deposited during Early Silurian (S1) in a shallow high energy shoal to deep basinal environment.

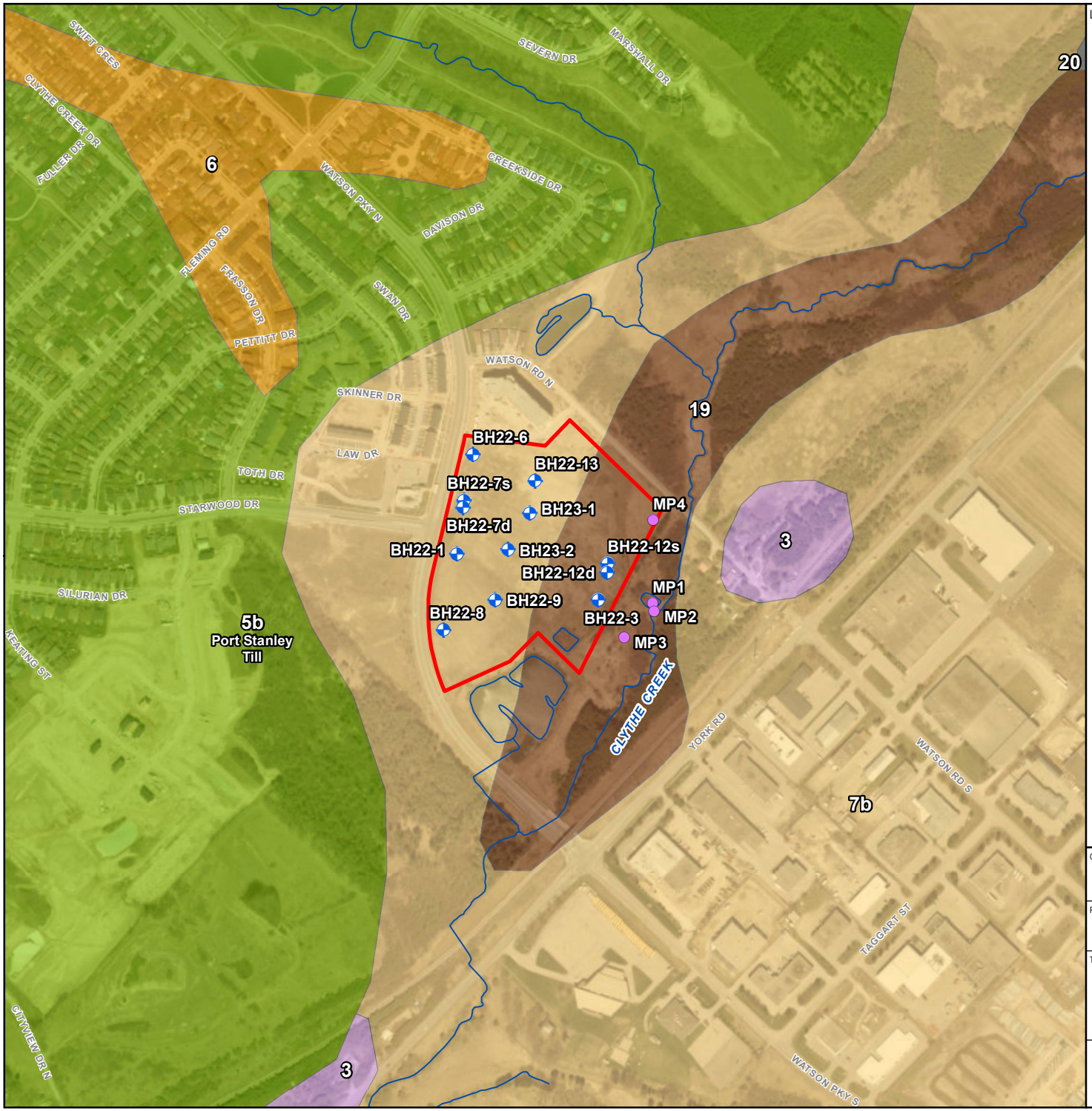
2.1.2 Hydrogeology

Hydrostratigraphic units can be subdivided into two distinct groups based on their ability to allow groundwater movement: an aquifer and an aquitard. An aquifer is 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. The major regional hydrostratigraphic unit that controls groundwater at the site is described below:

Modern alluvial deposits: This unit cuts through the spillway deposits and consist of clay, silt, sand, gravel, and possibly organic remains. Most of this unit was deposited during ancient channel stage, and modern Clythe Creek meanders off-regime within the boundary of this unit. The unit usually serves as a linear aquifer with abundant groundwater owing to its low position, high porosity and interaction with stream flow.

Coarse-Textured Glaciofluvial Deposits: These deposits are primarily made up of sands and gravels and are associated with glacial meltwater spillways (Karrow, 1968). These spillways tend to facilitate modern streams such as the Eramosa River and Clythe Creek. This unit acts as a shallow unconfined aquifer in the area and is generally drained as shallow groundwater flow within this unit is typically vertical towards less permeable units.

Wentworth Till: This till unit makes up the majority of the drumlins found in the Guelph area, and acts as a regional aquitard (GRCA, 2008). This unit is a stony till, primarily made up of sand and silts. Occasional



LEGEND

- Monitoring Well
- Mini Piezometer
- Watercourse[1]
- Subject Site

Surficial Geology[2]

Phanerozoic / Cenozoic / Quaternary / Recent

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

Phanerozoic / Cenozoic / Quaternary / Pleistocene

- 7b: Glaciofluvial deposits *(Gravelly deposits)*
- 6: Ice-contact stratified deposits *(sand and gravel, minor silt, clay and till)*
- 5b: Tilll *(Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain)*

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

0 25 50 100 150 200 250
METRE SCALE

North American Datum 1983
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TITLE
Surficial Geology

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REF. NO. 1510449-2-1

Figure 2

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seams of gravel and sand can be found in the unit which permit some groundwater flow. This unit is interpreted to be identified beneath the glaciofluvial deposits, and acts as a confining aquitard.

2.1.3 Environmental Features and Drainage

The site is located within the Grand River watershed which drains approximately 6,800 km^2 starting near Dundalk and emptying into Lake Erie near Port Maitland. The site is within the Eramosa River subwatershed, which is one of the four major contributing tributaries to the Grand River. The Eramosa River valley follows a spillway channel trending southwest with headwaters originating in Brisbane. Eramosa River flows southwest and meets Speed River in Guelph, which ultimately contributes to the Grand River. Clythe Creek, a tributary to the Eramosa River, is present about 40 m south of the site boundary. This creek flows southwest and is associated with a wetland complex south of the site. Overland flow from the site is expected to contribute to the function of Clythe Creek and the associated wetland complex.

2.1.4 Source Water Protection

The site is located in the Grand River Source Protection Area. 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). The source water protection designations for this site are provided in **Appendix B**.

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.

According to the Ministry of Environment, Conservation, and Parks (MECP) source protection information atlas, the site is within a SGRA and WHPA-B due to the Clythe Well and Booster Pumping Station located at 24 Watson Road North. A small portion of the site on the eastern boundary is in a WHPA-A. It should be noted currently Clythe Well is not in use and the station is only utilized as a Booster Pumping Station. Based on the Source Water Protection policies, infiltration must be maintained post-development as to not impact the supply well located approximately 50 m south of the site boundary.

2.2 Site Specific Conditions

2.2.1 Borehole Drilling and Monitoring Well Installations

A borehole drilling investigation was completed by Toronto Inspections Ltd. in May 2022, February 2022, and August 22, 2023. A summary of the well installation details is provided in **Table 1**, and the borehole logs are provided in **Appendix C.** A total of 18 boreholes were completed at the site with depths ranging

from 4.7 to 15.7 meters below ground surface (mbgs). Twelve (12) of the boreholes were completed as 2-inch monitoring wells with two nested wells at BH22-7s/d, and BH22-12s/d.

Table 1. Well Installation Details

Well ID	Surface Elevation (mASL)	Depth (mbgs)	Screened Interval (mbgs)	Screened Unit
BH22-1	327.20	15.7	12.7 - 15.7	Silty Sand / Sandy Silt Till
BH22-3	325.26	6.6	3.6 - 6.6	Sand and Gravel
BH22-6	328.20	15.7	12.7 - 15.7	Sandy Silt Till
BH22-7s	327.80	6.1	3.1 - 6.1	Sand and Gravel
BH22-7d	327.80	15.7	12.7 - 15.7	Sandy Silt Till
BH22-8	326.75	15.7	12.7 - 15.7	Sandy Silt Till
BH22-9	326.48	6.6	3.6 - 6.6	Sand and Gravel / Sandy Silt Till
BH22-12s	325.55	6.1	3.1 - 6.1	Sand and Gravel
BH22-12d	325.55	10.7	6.9 – 9.9	-
BH22-13	327.30	6.6	3.6 - 6.6	Sand and Gravel / Sandy Silt Till
BH23-1	327.30	7.6	4.6 – 7.6	Sand and Gravel / Sandy Silt Till
BH23-2	326.80	7.9	4.9 – 7.9	Sand and Gravel / Sandy Silt Till / Silty Sand

2.2.2 Geology and Soil Profile

The stratigraphy of the site area encountered during the borehole drilling program is summarized below.

Topsoil / Fill: It is understood that the site was raised/graded with the placement of fill in the past. This unit was encountered at all borehole locations and extended from 0.6 to 3.5 mbgs. This unit was generally comprised of sandy silt with some gravel and contained occasional rootlets.

Sand and Gravel: This unit was encountered at all borehole locations below the fill and extended to depths ranging from 0.6 to 7.8 mbgs. This unit contained some silty sand, with occasional cobbles. The thickness of this unit ranged from approximately 2 to 6 m. This unit was described as compact to very dense, and dry to wet.

Sandy Silt Till: This unit was encountered at boreholes BH22-1, BH22-2, BH22-5, BH22-6, BH22-7s/d, BH22-8, BH22-9, BH22-10, BH22-11, BH22-13, BH23-1, and BH23-2. This unit was encountered below the sand and gravel deposit at depths ranging from 4.0 to 7.8 m. This thickness of this unit ranged from approximately 1 m to >11 m. This unit is described as compact to very dense, and moist to wet.

2.2.3 Groundwater Levels and Flow

The groundwater level at each monitoring well was measured by Palmer personnel between June 2022 and April 2023. One round of groundwater level monitoring was completed by Toronto Inspections Ltd on May 26, 2022. One round of water levels was collected on September 12, 2023, by Palmer on newly installed wells. Water levels were measured using a water level tape and recorded to the nearest centimetre. **Table 2** provides a summary of the measured water levels. It should be noted that groundwater levels can vary and are subject to seasonal fluctuations in response to weather events.

The manually measured groundwater table ranges from 2.09 to 5.72 mbgs and 321.93 to 324.01 masl. Continuous groundwater level data is provided in **Figure 3** In general, groundwater levels are deeper on the west side of the site, and shallower on the east side of the site near Clythe Creek. The shallow and deep groundwater flow directions within the site boundary was interpreted using water levels date from August 10, 2022, and is estimated to flow southeast (**Figure 4A/B**).

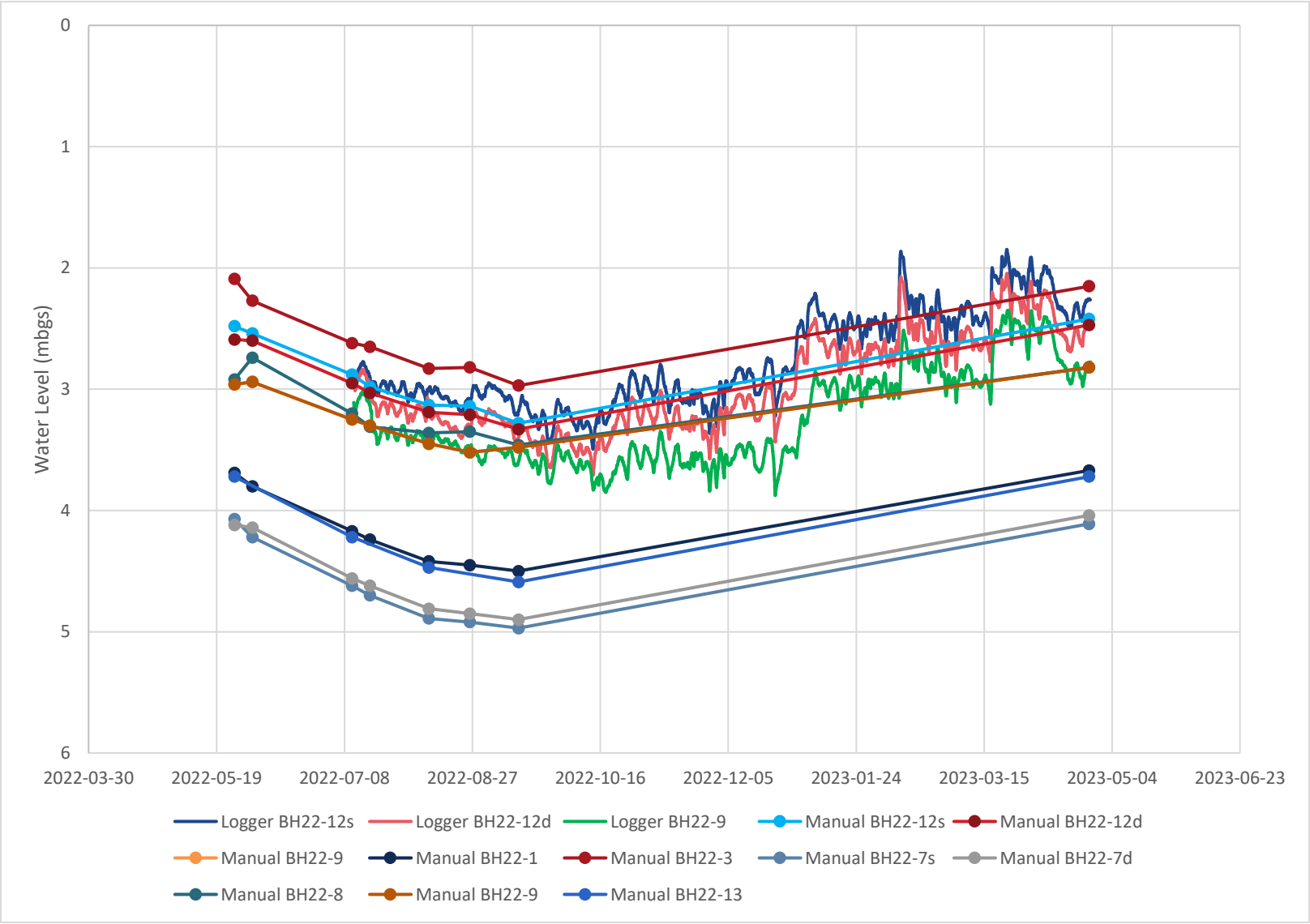
Table 2. Groundwater Monitoring

Well ID	Water Level																	
	May 26, 2022		June 2, 2022		July 11, 2022		July 18, 2022		August 10, 2022		August 26, 2022		September 14, 2022		April 25, 2023		September 12, 2023	
	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl
BH22-1	3.69	323.51	3.80	323.40	4.17	323.03	4.24	322.96	4.42	322.78	4.45	322.75	4.50	322.70	3.67	323.53	-	-
BH22-3	2.09	323.17	2.27	322.99	2.62	322.64	2.65	322.61	2.83	322.43	2.82	322.44	2.97	322.29	2.15	323.11	-	-
BH22-6	5.26	322.94	5.02	323.18	5.05	323.15	7.72	320.48	5.42	322.78	5.42	322.78	5.40	322.80	4.49	323.71	-	-
BH22-7s	4.07	323.73	4.22	323.58	4.62	323.18	4.70	323.10	4.89	322.91	4.92	322.88	4.97	322.83	4.11	323.69	-	-
BH22-7d	4.12	323.68	4.14	323.66	4.56	323.24	4.62	323.18	4.81	322.99	4.85	322.95	4.90	322.90	4.04	323.76	-	-
BH22-8	2.92	323.83	2.74	324.01	3.20	323.55	3.31	323.44	3.36	323.39	3.35	323.40	3.46	323.29	2.82	323.93	-	-
BH22-9	2.96	323.52	2.94	323.54	3.25	323.23	3.30	323.18	3.45	323.03	3.52	322.96	3.48	323.00	2.82	323.66	-	-
BH22-12s	2.48	323.07	2.54	323.01	2.88	322.67	2.98	322.57	3.13	322.42	3.14	322.41	3.28	322.27	2.42	323.13	-	-
BH22-12d	2.59	322.96	2.60	322.95	2.95	322.60	3.03	322.52	3.19	322.36	3.21	322.34	3.33	322.22	2.47	323.08	-	-
BH22-13	3.72	323.58	-	-	4.22	323.08	-	-	4.47	322.83	4.47	322.83	5.37	321.93	3.72	323.58	-	-
BH23-1	Installed August, 2023																3.88	323.45
BH23-2	Installed August, 2023																3.58	323.25

2.2.4 Surface Water Features

A large wetland complex is located to the east of the site area. To determine the function of the wetland complex, four mini-piezometers (MPs) were installed in the complex and on an adjacent wetland feature on the tablelands (**Figure 1**) (**Table 3**). Three (3) MPs (MP1, MP3, MP4) were installed in the wetland areas, and one (1) MP (MP2) was installed in Clythe Creek. Clythe Creek is located along the southeast boundary of the site and flows towards Eramosa River. The MPs were hand augured and post driven to approximately 1m below surface.

Figure 3. Continuous Groundwater Level Data



Water levels collected in MP1 show a neutral/negative gradient during the majority of monitoring events, and positive in April 2023. This suggests that this area of the wetland complex is supplied in majority by surface water with minor groundwater inputs in the spring. Monitoring data from MP2 in Clythe Creek show slightly negative and neutral gradients indicating the creek is primarily supported by surface water inputs. However, this creek is known to flow when groundwater levels are high, suggesting partial groundwater inputs in the spring. Finally, MP3 and MP4 were generally dry, indicating these areas of the wetland are surface water supported.

Table 3. Surface Water Monitoring

MP ID	Stick Up (m)	Depth (m)	Measure-ment	Water Level (mbgs)						Water Supply
				July 11, 2022	July 18, 2022	August 10, 2022	August 27, 2022	September 14, 2022	April 25, 2023	
MP1	1.13	1.27	**in**	0.95	0.03	-0.01	-0.05	0.00	-0.41	Neutral Surface Water/ Seasonal Groundwater
			out	Dry	0.00	-0.01	-0.09	Dry	-0.23	
			gradient	-	-0.02	0.00	-0.03	-	0.14	
MP2 (In Creek)	1.25	1.15	**in**	0.71	-0.08	-0.03	-0.16	0.25	-0.28	Surface Water
			out	-0.11	-0.11	-0.05	-0.18	Dry	-0.28	
			gradient	-0.71	-0.03	-0.02	-0.02	-	0	
MP3	1.01	1.39	**in**	Dry	Dry	0.61	0.55	0.61	Dry	Surface Water
			out	Dry	Dry	Dry	Dry	Dry	Dry	
			gradient	-	-	-	-	-	-	
MP4	1.16	1.24	**in**	Installed on August 10, 2022		0.84	-	Dry	Dry	Surface Water
			out			Dry	-	Dry	Dry	
			gradient			-	-	-	-	

2.2.5 MECP Water Wells

Based on a review of the MECP Water Well Records (WWR) database 48 wells were found within a 500 m radius of the site. A summary of these well records are presented in **Table 4** and are identified on **Figure 5**. Of these wells, 28 are stated to be for domestic use but were completed in the 1960's and are now within an area serviced with municipal water, as such it is assumed that they are no longer in use. Two (2) wells are for municipal water use, with one labelled as not in use. These are in reference to the Clythe Wells located south of the site. It is understood that neither of these wells are currently being used for municipal supply. The remaining nine (9) are for monitoring, seven (7) are unknown, and two (2) are not in use. The average depth of these wells is 29 mbgs, with static water levels ranging from 0.9 to 31.4 mbgs. As most of the wells are no longer in use, or are very deep, they are not likely to be impacted by the development.

LEGEND

- Monitoring Well
- Mini Piezometer
- Watercourse[1]
- Shallow Groundwater Elevation Contour *(masl)*
- Shallow Groundwater Flow Direction
- Subject Site

1. LIO/MNRF

0 10 20 40 60 80 100
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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PROJECT
115 Watson Parkway North - Guelph

TITLE
Shallow Groundwater Flow

Palmer™

REF. NO. 1510449-4a-1

Figure 4a

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LEGEND

- Monitoring Well
- Mini Piezometer
- Watercourse[1]
- Deep Groundwater Elevation Contour *(masl)*
- Deep Groundwater Flow Direction
- Subject Site

1. LIO/MNRF

0 10 20 40 60 80 100
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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PROJECT
115 Watson Parkway North - Guelph

TITLE
Deep Groundwater Flow

Palmer™

REF. NO. 1510449-4b-1

Figure 4b

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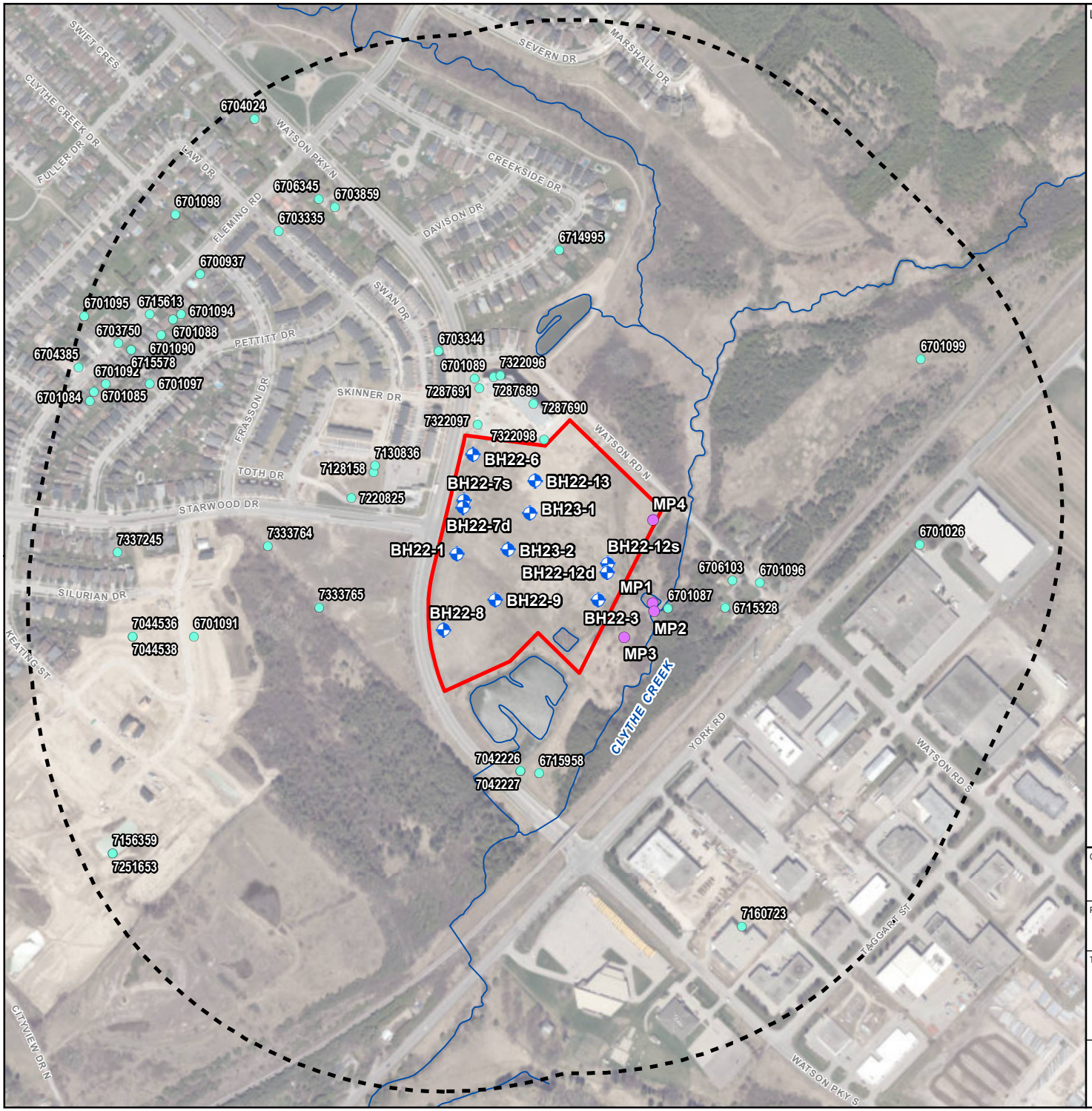

LEGEND

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

1. MECP
2. LIO/MNRF

0 25 50 100 150 200 250
METRE SCALE

North American Datum 1983
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115 Watson Parkway North - Guelph

TITLE
MECP Water Wells within 500m of Site

Palmer

REF. NO. 1510449-5-1

Figure 5

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Table 4. MECP Water Well Records

Well ID	Date Completed	Depth	Static Water Level	Use
6700937	1967-08-29	37.5	17.4	Domestic
6701026	1959-12-02	27.7	9.1	Domestic
6701084	1963-06-05	47.2	7.3	Domestic
6701085	1963-06-13	46.6	31.4	Domestic
6701087	1953-06-11	27.4	6.1	Domestic
6701088	1961-05-08	27.4	3.7	Domestic
6701089	1957-05-22	41.1	22.9	Domestic
6701090	1961-05-12	17.7	0.9	Domestic
6701091	1957-08-11	31.7	6.7	Domestic
6701092	1959-11-11	30.5	12.2	Domestic
6701094	1961-06-30	24.4	4.0	Domestic
6701095	1961-07-31	25.0	5.2	Domestic
6701096	1962-04-16	34.1	12.2	Domestic
6701097	1962-08-28	30.5	8.5	Domestic
6701098	1964-10-03	25.0	7.0	Domestic
6701099	1946-07-03	21.3	7.9	Domestic
6703859	1970-11-24	36.6	20.7	Commercial/Domestic
6703335	1969-04-15	31.4	15.2	Domestic
6703344	1969-04-22	38.1	15.2	Domestic
6703750	1970-09-07	32.6	7.9	Domestic
6704024	1971-08-03	35.1	24.4	Domestic
6704385	1972-09-09	38.1	12.2	Domestic
6706103	1976-05-05	64.0	2.1	Not Used/Monitoring
6706345	1977-03-14	47.5	22.9	Domestic
6714995	2004-04-29	-	-	-
6715328	1999-04-07	-	-	Monitoring
6715578	2005-10-11	-	-	Domestic
6715613	2005-12-16	-	4.9	Domestic
6715958	2006-10-25	-	-	-
7042226	2006-06-21	12.5	-	Not Used
7042227	2006-06-20	57.9	-	Not Used
7044536	2007-04-19	80.8	-	-
7044538	2007-04-19	27.5	-	-
7128158	2009-08-05	-	-	-
7130836	2009-06-01	6.0	-	Monitoring
7156359	2010-01-20	76.5	-	Monitoring
7160723	2010-09-13	-	-	-
7220825	2014-04-15	7.6	-	Monitoring
7251653	2015-10-26	-	-	-

Well ID	Date Completed	Depth	Static Water Level	Use
7287689	2017-05-09	6.1	4.3	Monitoring
7287690	2017-05-09	6.1	4.6	Monitoring
7287691	2017-05-09	6.1	3.0	Monitoring
7322096	2018-10-09	-	-	Domestic
7322097	2018-10-09	-	-	Domestic
7322098	2018-10-09	-	-	Domestic
7333764	2019-04-18	4.9	-	Monitoring
7333765	2019-04-18	3.0	-	Monitoring
7337245	2019-06-07	7.0	4.9	Monitoring
Note: "-" Refers to no data available				

2.2.6 Hydraulic Conductivity

Palmer personnel conducted single well response tests at select wells on site to determine the hydraulic conductivity of the screened soils. A summary of the hydraulic conductivity analysis is provided in **Table 5** and presented in **Appendix D**. Conductivity tests were completed by lowering a 1 m long slug into each well to create a change in hydraulic head. 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 completed where water was removed from the water column, and the rate of recovery was monitored. Water levels in each well were recorded using a datalogger set to record water levels at 1 and 2 second intervals. Tests were terminated once 80% recovery had been attained.

Hydraulic conductivity values were calculated form the displacement-time data using the Bouwer and Rice (1976) method for confined and unconfined aquifers, as modelled by Aqtesolv™ software. The hydraulic conductivity of the soils on site ranged from 7.36×10^{-8} to 1.31×10^{-4} m/s. The geomean hydraulic conductivity of the sandy silt till unit was 3.91×10^{-7} m/s, and the geomean of the sand and gravel unit was 3.15×10^{-5} m/s.

Table 5. Hydraulic Conductivity Summary

Well ID	Screened Geology	Analysis Method	Hydraulic Conductivity (K) (m/s)	Geomean (m/s)
BH22-1	Sandy Silt Till / Silty Sand	FH	3.16×10^{-7}	**Sandy Silt Till 3.91×10^{-7}**
		RH	5.03×10^{-7}	
BH22-3	Sand and Gravel	Bail	1.31×10^{-4}	
BH22-6	Sandy Silt Till / Silty Sand	FH	1.03×10^{-7}	
BH22-7s	Sand and Gravel / Sandy Silt Till	FH	5.93×10^{-7}	
		RH	4.70×10^{-7}	
BH22-7d	Sandy Silt Till / Silty Sand	FH	9.43×10^{-7}	
		RH	1.72×10^{-6}	**Sand and Gravel 2.39×10^{-5}**
BH22-8	Sandy Silt Till / Silty Sand	Bail	7.36×10^{-8}	
BH22-9	Sand and Gravel / Sandy Silt Till	Bail	1.18×10^{-5}	

Well ID	Screened Geology	Analysis Method	Hydraulic Conductivity (K) (m/s)	Geomean (m/s)
BH22-12s	Sand and Gravel	Bail	5.16×10^{-6}	
BH22-12d	-	Bail	4.10×10^{-5}	
BH23-2	Sand and Gravel / Sandy Silt Till	RH	9.50×10^{-5}	

2.2.7 Infiltration Rate

Infiltration rate is used to describe the perviousness of soil in vadose zone, which has a unit of cm/min or min/cm (T-time). A summary of the infiltration rates is provided in **Table 6**. Several methods exist for estimating infiltration rate, including hydraulic conductivity (Kfs), pit or hole percolation testing and Guelph Permeameter testing. The Guelph Permeameter testing was used to calculate the following infiltration rates for shallow soils and hydraulic conductivity values from slug test were used to estimate infiltration rate for deeper soil.

Based on the completed infiltration tests at the site, the infiltration rates ranged from 34.1 to 126.6 mm/hr with an average of 70.8 mm/hr. Including a 2.5x factor for uncertainty, the average infiltration rate is 28.3 mm/hr. These tests were completed at a variety of soil types found at the site; however, the majority of the site is overlaid by sand and gravel. Therefore, the higher infiltration rates are interpreted to be more representative of the site.

Table 6. Infiltration Rates for Shallow Soils

Infiltration Test ID	Depth (m)	Soil Type	Hydraulic Conductivity K_{fs} (m/s)	Infiltration Rate (mm/hr)	Average Infiltration Rate (mm/hr)	Average Infiltration Rate Including 2.5x Uncertainty (mm/hr)
IT1	0.52	Silty clay	3.2×10^{-7}	34.1	70.8	28.3
IT2	0.28	Topsoil/ Clay with organics	1.5×10^{-5}	95.5		
IT3	0.43	Sand and silt	4.3×10^{-5}	126.6		
IT4	0.60	Silty clay	1.0×10^{-6}	46.3		
IT5	0.59	Silt with gravel	1.5×10^{-6}	51.6		

2.2.8 Groundwater Chemistry

A groundwater chemistry sample was collected on August 9, 2022, from BH22-12s and analysed for a suite of water quality parameters including physical parameters, nutrients, metals, and bacteria. A summary of the groundwater analysis results is presented in **Table 7**, and the certificate of analysis is provided in **Appendix E**. Results were compared to both the aesthetic and microbiological/chemical Ontario Drinking Water Standards (ODWS).

The water sample exceeded the aesthetic ODWS for colour, total dissolved solids, turbidity, aluminium and iron. The sample exceeded the microbiological/chemical ODWS for sodium and total coliforms. The

aesthetic exceedances are expected to be related to turbidity in the sample and will likely be reduced using settling tanks. The microbiological/chemical exceedances are likely related to salting of nearby roadways and infiltration through the coarse soils into the water table.

Table 7. Groundwater Chemistry

Parameter	ODWS Aesthetic	ODWS Chemical/ Microbiological	Lowest Detection Limit	Units	BH22-12s
Physical Tests					
conductivity	-	-	1.0	µS/cm	1040
Langelier index (@ 4°C)	-	-	0.010	-	0.377
alkalinity, bicarbonate (as HCO3)	-	-	1.0	mg/L	378
alkalinity, carbonate (as CO3)	-	-	1.0	mg/L	<1.0
alkalinity, hydroxide (as OH)	-	-	1.0	mg/L	<1.0
alkalinity, total (as CaCO3)	30 -> 500	-	1.0	mg/L	310
colour, apparent	5	-	2.0	CU	**67.2**
hardness (as CaCO3), from total Ca/Mg		-	0.50	mg/L	371
pH	6.5 -> 8.5	-	0.10	pH units	7.62
solids, total dissolved [TDS]	500	-	10	mg/L	**562**
solids, total dissolved [TDS], calculated	-	-	1.0	mg/L	676
turbidity	5	-	0.10	NTU	**32.5**
Langelier index (@ 20°C)	-	-	0.010	-	0.624
pH, saturation (@ 4°C)	-	-	0.010	pH units	7.24
pH, saturation (@ 20°C)	-	-	0.010	pH units	7.00
Anions and Nutrients					
ammonia, total (as N)	-	-	0.0050	mg/L	0.0317
bromide	-	-	0.10	mg/L	<0.10
chloride	250	-	0.50	mg/L	146
fluoride	-	1.5	0.020	mg/L	0.072
nitrate (as N)	-	10	0.020	mg/L	<0.020
nitrate + nitrite (as N)	-	10	0.0032	mg/L	<0.0224
nitrite (as N)	-	1	0.010	mg/L	<0.010
phosphate, ortho-, dissolved (as P)	-	-	0.0030	mg/L	<0.0030
sulfate (as SO4)	-	-	0.30	mg/L	17.3
Microbiological Tests					
coliforms, Escherichia coli [E. coli]	-	1	1	CFU/100mL	<1

Parameter	ODWS Aesthetic	ODWS Chemical/ Microbiological	Lowest Detection Limit	Units	BH22-12s
coliforms, total	-	1	1	CFU/100mL	130
coliforms, total background	-	-	1	CFU/100mL	>2000
Metals					
sodium adsorption ratio [SAR]	-	-	0.10	-	1.98
Ion Balance					
anion sum	-	-	0.10	meq/L	10.7
cation sum (total)	-	-	0.10	meq/L	11.3
ion balance (cations/anions)	-	-	0.010	%	106
ion balance (APHA)	-	-	0.010	%	2.73
Total Metals					
aluminum, total	0.1	-	0.0030	mg/L	**0.489**
antimony, total	-	0.006	0.00010	mg/L	0.00012
arsenic, total	-	0.01	0.00010	mg/L	0.00036
barium, total	-	1	0.00010	mg/L	0.0390
beryllium, total	-	-	0.000020	mg/L	0.000021
bismuth, total	-	-	0.000050	mg/L	<0.000050
boron, total	-	5	0.010	mg/L	0.027
cadmium, total	-	0.005	0.0000050	mg/L	0.000232
calcium, total	-	-	0.050	mg/L	99.2
cesium, total	-	-	0.000010	mg/L	0.000053
chromium, total	-	0.05	0.00050	mg/L	0.00102
cobalt, total	-	-	0.00010	mg/L	0.00032
copper, total	1	-	0.00050	mg/L	0.00242
iron, total	0.3	-	0.010	mg/L	**0.634**
lead, total	-	0.01	0.000050	mg/L	0.00381
lithium, total	-	-	0.0010	mg/L	0.0018
magnesium, total	-	-	0.0050	mg/L	29.9
manganese, total	0.05	-	0.00010	mg/L	0.0391
molybdenum, total	-	-	0.000050	mg/L	0.000246
nickel, total	-	-	0.00050	mg/L	0.00134
phosphorus, total	-	-	0.050	mg/L	<0.050
potassium, total	-	-	0.050	mg/L	1.82
rubidium, total	-	-	0.00020	mg/L	0.00162
selenium, total	-	0.05	0.000050	mg/L	0.000050

Parameter	ODWS Aesthetic	ODWS Chemical/ Microbiological	Lowest Detection Limit	Units	BH22-12s
silicon (as SiO2), total	-	-	0.25	mg/L	10.7
silicon, total	-	-	0.10	mg/L	5.02
silver, total	-	-	0.000010	mg/L	<0.000010
sodium, total	200	20	0.050	mg/L	87.6
strontium, total	-	-	0.00020	mg/L	0.195
sulfur, total	-	-	0.50	mg/L	6.60
tellurium, total	-	-	0.00020	mg/L	<0.00020
thallium, total	-	-	0.000010	mg/L	0.000019
thorium, total	-	-	0.00010	mg/L	<0.00010
tin, total	-	-	0.00010	mg/L	0.00018
titanium, total	-	-	0.00030	mg/L	0.0167
tungsten, total	-	-	0.00010	mg/L	<0.00010
uranium, total	-	0.02	0.000010	mg/L	0.000487
vanadium, total	-	-	0.00050	mg/L	0.00099
zinc, total	5	-	0.0030	mg/L	0.0610
zirconium, total	-	-	0.00020	mg/L	0.00027

Exceedances in Aesthetic ODWS in **BOLD**
Exceedances in Chemical/Microbiological ODWS in GREY
Note "-" indicates no data/guideline available

3. Dewatering Assessment

The focus of the dewatering assessment is the proposed mixed use development consisting of four buildings (Building A, B, C and D) with two-levels (P2) of underground parking. The proposed townhomes and other residential structures will be built above the groundwater table and therefore would not require a dewatering assessment.

Two separate two-level parking structures are proposed for the buildings; Structure 1 for building A and B, and Structure 2 for building C and D. The dimensions for each underground structure have been estimated based on the design drawings (**Appendix A**). Based on the magnitude of dewatering likely to be required from the presence of saturated sand and gravel soils between approximately 4.0 to 7.8 mbgs, two dewatering scenarios will be provided. These scenarios include: (1) non-watertight shoring (i.e., pile and lagging) scenario, and (2) watertight shoring (i.e., caisson walls) scenario. Each dewatering scenario is presented below.

3.1 Non-Watertight Dewatering Scenario

In this dewatering scenario, no watertight methods are deployed to construct the underground structures. The water level used for the calculation is the highest water level recorded on the west side of the site. The depth of construction is estimated to be 7.5 m for two-levels of underground parking. The calculation assumes dewatering 1 m below the base of the excavation to ensure a dry working area for a total

excavation depth of 8.5 m. The dewatering rate is calculated using the Jacob's modified non-equilibrium equation for an unconfined aquifer (Powers et al., 2007).

$$Q_{Rectangle} = \frac{\pi K(H^2 - h^2)}{\ln(\frac{R_0}{r_e})} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right] \quad m^3/s$$

Where

K	=	hydraulic conductivity – 3.2 x 10^{-5} m/s (90^{th} Percentile)
H	=	saturated thickness before dewatering – 5.76 m
h	=	saturated thickness after dewatering – 0 m
R_e	=	equivalent radius of influence estimated by $\sqrt{\frac{a*x}{\pi}}$
a	=	width (m) – Structure 1 - 72 m, Structure 2 – 72 m
x	=	length (m) – Structure 1 - 120 m, Structure 2 – 110 m
R_o	=	radius of influence estimated using $3000(H - h)\sqrt{K}$

Given the above equations and assumptions, the total dewatering rate is calculated to be 688,000 L/day for Structure 1 and 639,010 L/day for Structure 2. Including a uncertainty factor of 50%, the total dewatering rate for Structure 1 and Structure 2 is 1,032,000 L/day and 958,516 L/day respectively. A maximum radius of influence for this level of dewatering is calculated to be 89 m. This amount of dewatering will require active dewatering methods (i.e., well points, eductors) to control seepage and for stability in the loose glaciofluvial soils, with sump pumps at the bottom of the excavation for additional groundwater control. Dewatering rates may be higher than those predicted during the initial phase of dewatering until an equilibrium is met.

3.1.1 Direct Precipitation

Storm based direct precipitation inputs must also be removed from each excavation. Assuming a 10 mm-storm event, this could add 86 m^3 of water to Structure 1, and 79 m^3 to Structure 2 that would need to be removed. If this volume was to be removed in 1-day, an additional 86,400 L/day would need to be removed from Structure 1, and 79,200 L/day from Structure 2. This assessment assumes that the area outside the excavation is sloped away from the excavation and that no runoff enters.

3.2 Watertight Dewatering Scenario

Due to the high dewatering rates presented in Section 3.1, a watertight construction scenario has been presented. In this dewatering scenario, watertight caisson walls installed into the deep till unit are assumed to reduce the overall dewatering requirements. This dewatering scenario assumes caisson walls are installed at least 1 m into the till unit identified below the surficial sand and gravel unit. Dewatering in this scenario has three components including: (1) removal of porewater, (2) vertical groundwater flow prior to pouring the concrete base, and (3) stormwater contribution. These components are assumed to be completed separately.

3.2.1 Porewater Storage

Porewater storage refers to the volume of water contained in the pore space of the overburden soil deposits. Coarse grained soils (i.e., sands) that rapidly drain under gravity must be dewatered before they can be effectively managed/ removed from an excavation. Fine grained soils (i.e., silt and clay) slowly drain under gravity and are often manageable without prior dewatering. Unless required for stability reasons, complete removal of porewater from fine grained soils is generally not practical or required for an excavation. Most of the porewater will be removed along with the soil through excavation.

The site primarily contains coarse grained soils in the fill and in the surficial aquifer. The thickness of the surficial aquifer saturated material requiring porewater drainage is approximately 5.76 m. The following equation was used to calculate the volume of water stored in the porewater of the surficial aquifer unit:

$$V_s = (n) * (xy) * (b)$$

Where:

x = excavation length (m) – Structure 1: 72 m, Structure 2: 72 m
y = excavation width (m) – Structure 1: 120 m, Structure 2: 110 m
b = unit thickness (m) – 5.76 m
n = effective porosity – 0.35

The total volume of porewater to be drained is calculated at 17,418,240 L for Structure 1, and 15,966,720 L for Structure 2. No additional porewater will be added to the drained units as the caisson wall seals them, and effectively creates a “bathtub”. Also, this volume of water does not need to be removed all at once and can be managed over the course of each excavation. In addition, much of the water that is held in the pore space of the soil will be removed through excavation and removal of the soil. Assuming that all water within this unit is dewatered over the first 45-days of excavation, a daily rate of 387,072 L/day or 268 L/min would be required for Structure 1, and 354,816 L/day or 246 L/min for Structure 2. Active dewatering methods such as a series of sump pits in the base of the excavations and/ or well points /eductors within the watertight shoring will be required to remove the porewater.

3.2.2 Vertical Groundwater Flow

Before the base slab is poured to seal the bottom of each excavation, there will be a difference in head between the outside and the inside of the caisson wall, leading to upwards groundwater flow. In order to effectively seal off the surficial aquifer, the caisson wall must be installed at least 1 m into sandy silt till unit located between approximately 6 – 8 mbgs. Failure to effectively install and seal the caisson wall into this unit will result in significantly higher dewatering rates presented herein.

Based on the above assumptions of the caisson wall installation, the volume of vertical groundwater flow (Q_v) through the sandy silt till unit can be calculated. This vertical seepage is calculated using the darcy equation:

$$Q_v = KiA$$

Where:

A = area of excavation (m^2) – Structure 1: 8640 m^2, Structure 2: 7920 m^2

i = hydraulic gradient – 0.58 (m/m) (estimated from the head difference inside and outside caisson wall)

K = hydraulic conductivity (m/s) – 3.9 x 10^{-7} m/s (geomean of the sandy silt till unit)

The total estimated vertical groundwater flow into Structure 1 and Structure 2 is 168,123 L/day or 117 L/min, and 154,113 or 107 L/min respectively. This level of dewatering can be managed by sump pumping but may require well points/ eductors. It is important to note that this level of dewatering is short term and will become 0 L/day once the base of the excavation is sealed.

3.2.3 Direct Precipitation

Similar to the non-watertight scenario, direct precipitation must be considered for dewatering estimates. Assuming a 10 mm-storm event, this could add 86 m^3 of water to Structure 1, and 79 m^3 to Structure 2 that would need to be removed. If this volume was to be removed in 1-day, an additional 86,400 L/day would need to be removed from Structure 1, and 79,200 L/day from Structure 2.

3.3 Dewatering Summary

Both watertight, and non-watertight dewatering scenarios have been presented for the construction of the underground structures. A summary of these scenarios is provided in **Table 8.** The non-watertight dewatering scenario includes uncertainty to account for heterogeneity in the soils and has a maximum dewatering rate of 1,032,000 L/day. The watertight dewatering scenario has three components that are assumed to be completed separately and will therefore have a maximum dewatering rate of 387,072 L/day. It is important to note that in the watertight scenario, once pore water is removed, no further dewatering will be required for that component, and once the base of the excavation is poured, no further dewatering will be required for the vertical groundwater flow component either.

Table 8. Dewatering Summary

Underground Structure ID	Non-Watertight Construction (L/day)	Watertight Construction (L/day)		
		Pore Water	Vertical Groundwater Flow	Precipitation
Structure 1	1,032,000	387,072	168,123	86,400
Structure 2	958,516	354,816	154,113	79,200

4. Water Balance Assessment

4.1 Pre-Development Water Balance

A pre-development water balance was completed for the site to determine the existing runoff and groundwater recharge (infiltration) conditions of the site. The pre-development water budget was calculated over the site area using a monthly soil-moisture balance approach as described in Thornthwaite and Mather (1957). The water balance calculation estimates average annual evapotranspiration (evaporation and plant transpiration) using factors such as monthly precipitation, temperature, and latitude. Long term climate data were obtained from the nearest meteorological station

to the study area with long term data. Data was obtained over the 30-year duration from 1981 to 2010 from the Region of Waterloo International Airport Weather Station which is approximately 20 km from the site.

The average available water surplus, which is the water available for infiltration and runoff, was calculated by subtracting the average annual evapotranspiration from the average annual precipitation. A soil moisture retention value of 150 mm was utilized to represent the fine to coarse textured deposits, as described by Thornthwaite and Mather (1957). The resulting annual water surplus for the area was then partitioned using MOEE (1995) infiltration factors (**Table 9**). The overall infiltration factor was based off the soil, vegetation cover, and topography encountered at the site and calculated to be 0.7.

Table 9. Infiltration Factor

Components of Infiltration Factor	Contribution to Overall Infiltration Factor
TOPOGRAPHY -Average slope factor of 0.5%	0.25
SOIL -Coarse-textured glaciofluvial deposits	0.3
COVER -Open Meadow	0.15
Overall Infiltration Factor	**0.7**

Monthly PET is estimated using monthly temperature data and is defined as a water loss from a homogeneous vegetation covered area that never lacks water (Thornthwaite, 1948; Mather, 1978). The calculated PET for the study area is 592 mm/year, or about 65% of the total precipitation. The actual evapotranspiration is calculated based on a potential ET (or PET) and soil-moisture storage withdrawal. The calculated actual evapotranspiration (or AET) based on the Thornthwaite and Mather monthly water balance model is approximately 517 mm/year, or approximately 56% of the total annual precipitation. Based on pre-development conditions with no impervious area, the calculated runoff from the site is 7,718 m^3/year and the calculated infiltration is 18,008 m^3/year (**Table 10**).

4.2 Pre-Development Feature Based Water Balance

A wetland complex/environmental area consisting of a variety of wetland communities has been identified to the east and south of the site boundary. The size of the wetland/environmental area within the site boundary is 0.46 ha. This area is associated with Clythe Creek, a seasonally flowing creek that is supported primarily by surface water with minor groundwater inputs and flows south along the site boundary. Surface water monitoring data concluded that most of the wetland complex is supported by surface water runoff. Based on the topographic profile and interpreted flow path of runoff from the site (**Appendix F**), it is estimated that 40% of surface runoff from the site contributes to the wetland complex. Including the wetland complex itself and the environmental area, this creates a total catchment area of 2.87 ha. A feature based water balance using the same method as the overall water balance has been completed to estimate the amount of infiltration and runoff that the site contributes to this area (**Table 11**). Based on pre-development conditions, the site contributes approximately 3,439 m^3/year of runoff and 8,025 m^3/year of infiltration to regional groundwater system.

4.3 Post-Development Water Balance

4.3.1 Post-Development Water Balance

The proposed development consists of four mixed-use buildings, townhouses and a parkland area (**Appendix A**). To determine the post-development water balance, the same method as the pre-development water balance was used, including an impervious factor applied for the development area. A summary of the post-development water balance is provided on **Table 12**. The post-development infiltration is calculated to be 8,955 m^3/year and the runoff is 30,537 m^3/year.

4.3.2 Post-Development Feature Based Water Balance

The wetland complex/environmental area is intended to be maintained post-development. The catchment area is reduced from the development to only include the complex and environmental area itself, with an area of 0.46 ha, or a reduction of 83%. As this area is primarily surface water supported, a discussion on the changes to surface runoff will be to focus of the feature based water balance. Based on the reduction in catchment area, it is estimated that post-development, approximately 551 m^3/year of precipitation will run off, and 1,286 m^3/year will infiltrate (**Table 13**). This represents a decrease in runoff by 2,888 m^3/year (-84%), and a decrease in infiltration of 6,739 m^3/year (-84%). The reduction in infiltration and runoff correlates to the reduction in catchment area.

Table 10. Pre-Development Water Balance

Land Use	Total (ha)	Impervious Factor	Impervious area (ha)	Run off from Impervious Area (m^3/year)	Estimated Pervious Area (ha)	Runoff Coefficient	Runoff Volume From Pervious Area (m^3/year)	Infiltration Coefficient	Infiltration Volume from Pervious Area (m^3/year)	Total Runoff Volume (m3/year)	Total Infiltration Volume (m^3/year)
Vacant / Wetland	6.44	0.00	0.00	0.00	6.44	0.30	7,718	0.70	18,008	7,718	18,008

Table 11. Post-Development Water Balance

Land Use	Total (ha)	Impervious Factor	Impervious area (ha)	Run off from Impervious Area (m^3/year)	Estimated Pervious Area (ha)	Runoff Coefficient	Runoff Volume From Pervious Area (m^3/year)	Infiltration Coefficient	Infiltration Volume from Pervious Area (m^3/year)	Total Runoff Volume (m3/year)	Total Infiltration Volume (m^3/year)	
High Density Residential	4.15	0.44	1.83	15,058	2.32	0.30	2,785	0.70	6,499	17,844	6,499	
Wetland / Environmental Area	0.46	0.00	0.00	0	0.46	0.30	551	0.70	1,286	551	1,286	
Road	1.38	1.00	1.38	11,380	0.00	0.30	0	0.70	0	11,380	0	
Park	0.45	0.07	0.03	260	0.42	0.30	502	0.70	1,170	761	1,170	
Total	**6.44**	**-**	**3.24**	**26,699**	**3.20**	**-**	**3,838**	**-**	**8,955**	**30,537**	**8,955**	
Pre-to-Post Development Change (m3/year)											**+22,819**	**-9,053**
Pre-to-Post Development Change (%)											**+396**	**-50**

Table 12. Pre-Development Feature Based Water Balance

Land Use	Total (ha)	Impervious Factor	Impervious area (ha)	Run off from Impervious Area (m^3/year)	Estimated Pervious Area (ha)	Runoff Coefficient	Runoff Volume From Pervious Area (m^3/year)	Infiltration Coefficient	Infiltration Volume from Pervious Area (m^3/year)	Total Runoff Volume (m^3/year)	Total Infiltration Volume (m^3/year)
Vacant / Wetland	2.87	0.00	0.00	0.00	2.87	0.30	3,439	0.70	8,025	3,439	8,025

Table 13. Post-Development Feature Based Water Balance

Land Use	Total (ha)	Impervious Factor	Impervious area (ha)	Run off from Impervious Area (m^3/year)	Estimated Pervious Area (ha)	Runoff Coefficient	Runoff Volume From Pervious Area (m^3/year)	Infiltration Coefficient	Infiltration Volume from Pervious Area (m^3/year)	Total Runoff Volume (m^3/year)	Total Infiltration Volume (m^3/year)
Wetland / Environmental Area	0.46	0.00	0.00	0.00	0.46	0.30	551	0.70	1,286	551	1,286
									Pre-to-Post Development Chane (m3/year)	-2,888	-6,739
									Pre-to-Post Development Change (%)	-84	-84

5. Hydrogeological Considerations and Impact Assessment

5.1 Source Water Protection

The site is located within a SGRA. The site is also in a WHPA-B due to the Clythe Well and Booster Pumping Station located at 24 Watson Road North. A small portion of the site on the eastern boundary is in a WHPA-A, however no development is proposed for this area. It should be noted that currently Clythe Well is not in use and the station is only utilized as a Booster Pumping Station. Based on the Source Water Protection Policies, site infiltration must be maintained post development to ensure no impacts to the nearby municipal well and groundwater quantity. The infiltration should be realized through utilizing clean water to maintain the groundwater quality in the area.

5.2 Natural Environment

A wetland complex associated with Clythe Creek has been identified to the east and south of the site boundary. Palmer installed four MPs in the wetland complex to determine the groundwater/surface water interactions. Surface water monitoring conducted between July 2022 and April 2023 found that negative surface water gradients were recorded for the majority of the monitoring period, with minimal standing water. This suggests most of the wetland complex is mainly surface water supported. Clythe Creek was determined to be primarily supported by surface water runoff and from upstream inputs, however it is expected that baseflow in the creek is partially supported by groundwater in the spring.

Shallow groundwater flow within the site boundary is controlled by a unit of coarse-textured glaciofluvial sand and gravel. Groundwater flow within the site boundary is expected to flow southeast towards Clythe Creek. Based on the current topographic profile of the site, it was estimated that 40% of runoff from the site contributes to the wetland complex and Clythe Creek. To maintain the wetland function and baseflow of Clythe Creek, it is important that clean runoff from the site is directed to the wetland complex. As infiltration across the site is expected to be maintained post-development, no adverse impacts to the wetlands or Clythe Creek are anticipated from development.

5.3 Water Balance

5.3.1 Site Pre-to-Post Water Balance

A pre-to-post development water balance was completed for the site area. Based on current conditions, the pre-development runoff for the site was calculated to be 7,718 m^3/year and the calculated infiltration is 18,008 m^3/year. The proposed development consists of mixed-use residential buildings, townhouses, and parkland. The wetland complex to the south will be maintained post-development. Based on the current site plan, the post-development runoff is 30,537 m^3/year and infiltration is 8,955 m^3/year. This represents a 22,819 m^3/year increase in runoff (+396%), and a 9,053 m^3/year decrease in infiltration (-50%).

5.3.2 Feature Based Pre-to-Post Water Balance

A feature based pre-to-post development water balance was completed for the large wetland complex and environmental area associated with Clythe Creek located south of the development. Surface water and shallow groundwater monitoring at this feature determined that it is generally surface water supported. To maintain the function of this feature, runoff must be maintained post-development. Based on the pre-development topographic profile and estimated runoff flow, it was determined that 3,439 m^3/year of runoff contributes to the area. To calculate the post-development water balance, it is assumed that the wetland will not receive any runoff from the development area. The post-development calculated runoff is 551 m^3/year, a reduction of 2,888 m^3/year (-84%).

5.4 LID Considerations

The site is overlaid by a thick layer of coarse-textured deposits, with a moderately deep groundwater table in some areas. Groundwater table elevations range from 321.93 to 324.01 masl, with deeper water levels being observed on the west side of the site. These conditions are ideal for infiltration-based LIDs that can increase the post-development infiltration and groundwater recharge. To maintain groundwater quality, it is recommended that only clean water is used to meet infiltration targets. Rooftop leaders directed towards shallow infiltration trenches, soak pits, or grassed swales can be effective at maintaining infiltration rates.

To maintain function of the wetland complex and environmental area associated with Clythe Creek, pre-development runoff values must be maintained post-development. To achieve the runoff targets, rooftop leaders from the southern townhomes that back onto the wetland may be directed to the complex. Rear yards from these homes may also be graded to ensure runoff reaches the wetland.

Based on the hydrogeological conditions, the use of infiltration-based LIDs is expected sufficiently maintain the water balance for this development. This will also ensure any groundwater contributions to Clythe Creek are maintained post-development. Additional design details will be provided as part of detailed design submissions.

5.4.1 Hydrogeological Conditions of the Tableland Wetland at MP4

A wetland was identified within the site boundary and was instrumented with MP4 to determine the surface water/groundwater interactions. MP4 was monitored in August 2022, September 2022, and April 2023, and on all occasions no surface water was present, and little to no groundwater was measured. This indicates that the wetland is surface water supported.

The lowest elevation in the identified wetland area was approximately 323.54 masl. The highest groundwater elevation measured at the nearest shallow monitoring well (BH22-12s) was 323.07 masl, or 0.47 m below the wetland elevation. These results suggest that the wetland on site is above the water table and does not receive any groundwater. This wetland is interpreted to not be hydraulically connected to the wetland complex.

5.5 Aquifer and Groundwater Users

Based on MECP water well records, 48 wells were found within a 500 m radius of the site. Of these wells 28 are stated to be for domestic use. However, these wells were completed in the 1960's and are mainly located in a serviced area, and therefore assumed to be no longer in use. Clythe Well and Booster Pumping Station are located east of the site. Although currently Clythe Well is not in use, groundwater quantity and quality should be maintained as the site is within a WHPA-A/B and SGRA. As infiltration is expected to be maintained post-development, no impact to the aquifer or existing groundwater users are anticipated.

5.6 Dewatering and Discharge

Under the MECP requirements, registration on the Environmental Activity and Sector Registry (EASR) is required when dewatering is greater than 50,000 L/day and less than 400,000 L/day. A PTTW is required when dewatering is expected to be greater than 400,000 L/day.

Based on the design drawings, two separate two-level underground parking structures are proposed for the development. The non-watertight dewatering rate estimate including uncertainty is 1,032,000 L/day. The estimated radius of influence for this construction method is 89 m. This would be above 400,000 L/day and would require an application for a Category 3 PTTW from the MECP. The watertight scenario has three dewatering components, with the largest dewatering component between the two structures having a dewatering rate estimate of 387,072 L/day. This would require registration on the EASR.

Dewatering discharge may be directed towards local storm/sanitary sewers pending approval from the City of Guelph. Any construction dewatering must meet the storm and sanitary discharge criteria prior to being discharged into the sewers, and it is recommended that an updated water sample is collected prior to discharge.

6. Conclusions and Recommendations

Based on the results of the Hydrogeological Investigation, the following summary of conclusions and recommendations are presented:

- The proposed site plan is understood to be a mixed-use residential with four buildings (Building A, B, C and D), townhouses, a park area, and two underground parking structures each with two-levels.

- The surficial geology of the site as encountered through borehole drilling investigation consists of sand and gravel at surface over a sandy silt till unit.

- The groundwater table at the site is interpreted to be located between 321.93 to 324.01 masl, or 2.09 to 5.72 mbgs, and shallow groundwater flow is interpreted to move southeast.

- Based on the MECPs Source Water Protection mapping, the site is within a SGRA with a vulnerability score of 0, and a WHPA-B. A small portion of the eastern edge of the site is within a

WHPA-A. This is due to the proximity of Clythe Well and Booster Pumping Station. Based on these Source Water Protection Policies, infiltration must be maintained post-development at the site.

- A wetland complex associated with Clythe Creek was identified to the east and south of the site. Four (4) mini piezometers were installed in this wetland complex to delineate the surface water/groundwater interactions. It was determined that the majority of the wetland complex is surface water supported, with minor groundwater inputs to Clythe Creek.

- The hydraulic conductivity values were determined using falling and rising head tests, and bail tests. The hydraulic conductivity of the sand and gravel unit ranges from 5.2×10^{-6} to 1.3×10^{-4} m/s. The hydraulic conductivity of the sandy silt till ranges from 7.4×10^{-8} to 1.7×10^{-6} m/s.

- A groundwater sample was collected from BH22-12s and analyzed for a suite of water quality parameters including physical parameters, nutrients, and metals. The sample exceeded the aesthetic ODWS for colour, total dissolved solids, turbidity, aluminium and iron. The sample exceeded the microbiological/chemical ODWS for sodium and total coliforms. The majority of these exceedances are anticipated to be reduced through settling tanks. Should any groundwater discharge be directed to nearby storm/sanitary sewers, additional water sampling to confirm the water meets storm and sanitary discharge criteria is required.

- Based on a review of the MECP Water Well Records (WWR) 48 wells were found within 500 m of the site, with 28 being for domestic use. The majority of these wells however were constructed in the 1960s and are in serviced areas and therefore interpreted to no longer be in use. The Clythe Well and Booster Pumping Station were identified to the east of the site boundary. Although this well is considered a municipal supply well, it is currently not in use. No impact to any nearby wells is anticipated from development.

- Two separate two-level underground parking structures are proposed for the development. A non-watertight and watertight dewatering scenario is provided. Based on the high dewatering rate estimate from the non-watertight scenario, watertight methods are recommended. The dewatering estimate for a watertight construction scenario is 387,072 L/day.

- A pre-to-post development water balance was completed for the site. Pre-development runoff from the site was calculated to be 7,718 m^3/year, and infiltration was 18,008 m^3/year. Post-development runoff from the site was calculated to be 30,537 m^3/year (+396%), and infiltration was 8,955 m^3/year (-50%).

- A feature based pre-to-post development water balance was also completed for the wetland complex and environmental area to the southeast of the site boundary. As the complex is primarily surface water supported, the focus of the feature based water balance is maintaining runoff. The calculated runoff from the site is 3,439 m^3/year. Post-development, assuming no runoff from the site contributes to the wetland, the runoff value is 551 m^3/year (-84%). To maintain function of this wetland, LID strategies such as roof leaders from the southern townhouses that back onto the wetland should be directed to the wetland.

- As the site is located within a WHPA and a SGRA, the pre-development infiltration should be maintained post-development. The site is ideal for the use of infiltration based LIDs due to the coarse surficial soils, and moderately deep groundwater table. LID methods such as rooftop leaders towards shallow infiltration trenches, soak pits, or grassed swales can assist in meeting infiltration targets. To maintain groundwater quality, only clean water is recommended to be directed to the LIDs. Should infiltration be maintained, no impacts to the nearby supply well are anticipated.

- Since infiltration is anticipated to be maintained post-development, groundwater inputs that may supply baseflow to Clythe Creek will also be maintained. No impact to the wetland complex or Clythe Creek is anticipated.

7. Certification

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

Prepared By:

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

Approved By:

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

8. Limitations of the Report

This report was prepared by Palmer for Tercot Management Inc. 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

9. References

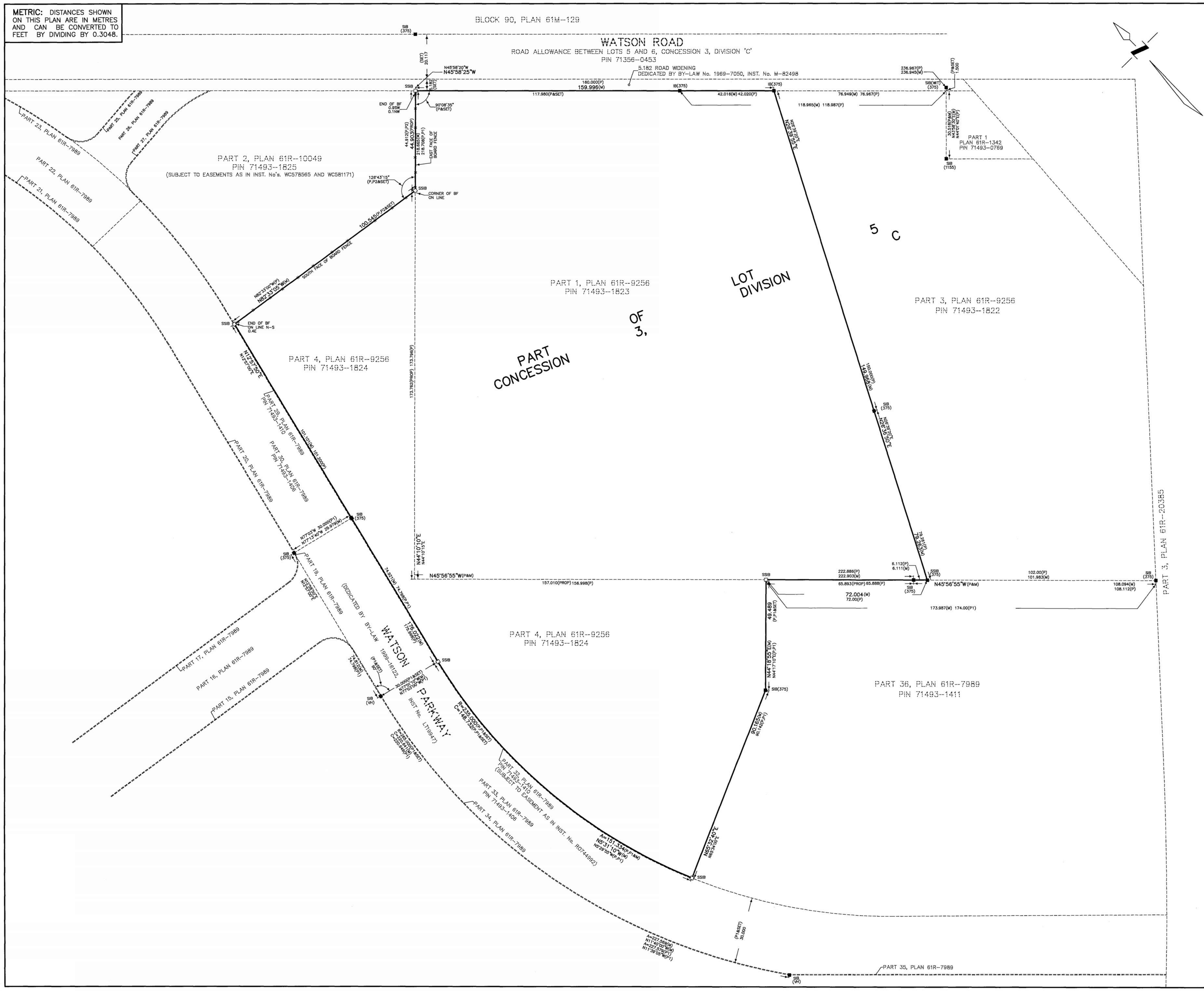
Chapman, L.J. and Putnam, D.F. 1984:
Physiography of southern Ontario; Ontario Geological Survey.

Grand River Conservation Authority, 2008.
Grand River Watershed Characterization Report

Karrow, 1968:
Pleistocene Geology of the Guelph Area Southern Ontario

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

Appendix A – Design Drawings (Turner Fleischer Architects, 2023)



PLAN OF SURVEY OF
PART OF LOT 5,
CONCESSION 3, DIVISION 'C'
(GEOGRAPHIC TOWNSHIP OF GUELPH)
CITY OF GUELPH
COUNTY OF WELLINGTON
SCALE 1:750

20 10 0 20 40 60 80 METRES

NOTES

■	DENOTES	FOUND MONUMENT
□	"	PLANTED MONUMENT
SSIB	"	SHORT STANDARD IRON BAR
SIB	"	STANDARD IRON BAR
IB	"	IRON BAR
P	"	PLAN 61R-9256
P1	"	PLAN 61R-7989 (PLAN 61R-7944)
P2	"	PLAN 61R-10049
M	"	MEASURED
PROP	"	PROPORTIONED
375	"	BLACK, SHOEMALER, ROBINSON & DONALDSON LIMITED, O.L.S.'s
VH	"	M.P. VAN HARTEN, O.L.S.
WIT	"	WITNESS
BF	"	BOARD FENCE

BEARINGS ARE GRID DERIVED FROM THE 6° UTM CO-ORDINATE SYSTEM ZONE 17, NAD 83 (ORIGINAL).

SURVEYOR'S CERTIFICATE

I CERTIFY THAT:

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON THE 9TH DAY OF MARCH, 2022.

DATE : MARCH 14, 2022

DAN DZALDOV
ONTARIO LAND SURVEYOR

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
2144873
THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR In accordance with Regulation 1026, Section 29(3).

SCHAEFFER DZALDOV BENNETT LTD.
ONTARIO LAND SURVEYORS
64 JARDIN DRIVE CONCORD, ONTARIO L4K 3P3 TEL.(416)987-0101

CALC. JZ	DRAWN ACAD/LW	CHECKED JZ	SCALE 1:750	JOB NO. 22-006-00

MARCH 14, 2022

TURNER FLEISCHER

Turner Fleischer Architects Inc.

67 Lesmill Road
Toronto, ON, M3B 2T8
T 416 425 2222
turnerfleischer.com

#	DATE	DESCRIPTION	BY
1	Date 1	Revision 1	

TERCOT COMMUNITIES

PROJECT
Guelph Watson Holdings Inc.
115 WATSON PARKWAY, GUELPH, ON

DRAWING
SURVEY

PROJECT NO. 22.028FS
PROJECT DATE 2023-10-04
DRAWN BY AAF
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SCALE

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REV. 1

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1	Date 1	Revision 1	

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PROJECT
Guelph Watson Holdings Inc.
115 WATSON PARKWAY, GUELPH, ON

DRAWING
SITE PLAN / ROOF PLAN

PROJECT NO. 22.028FS
PROJECT DATE 2023-10-04
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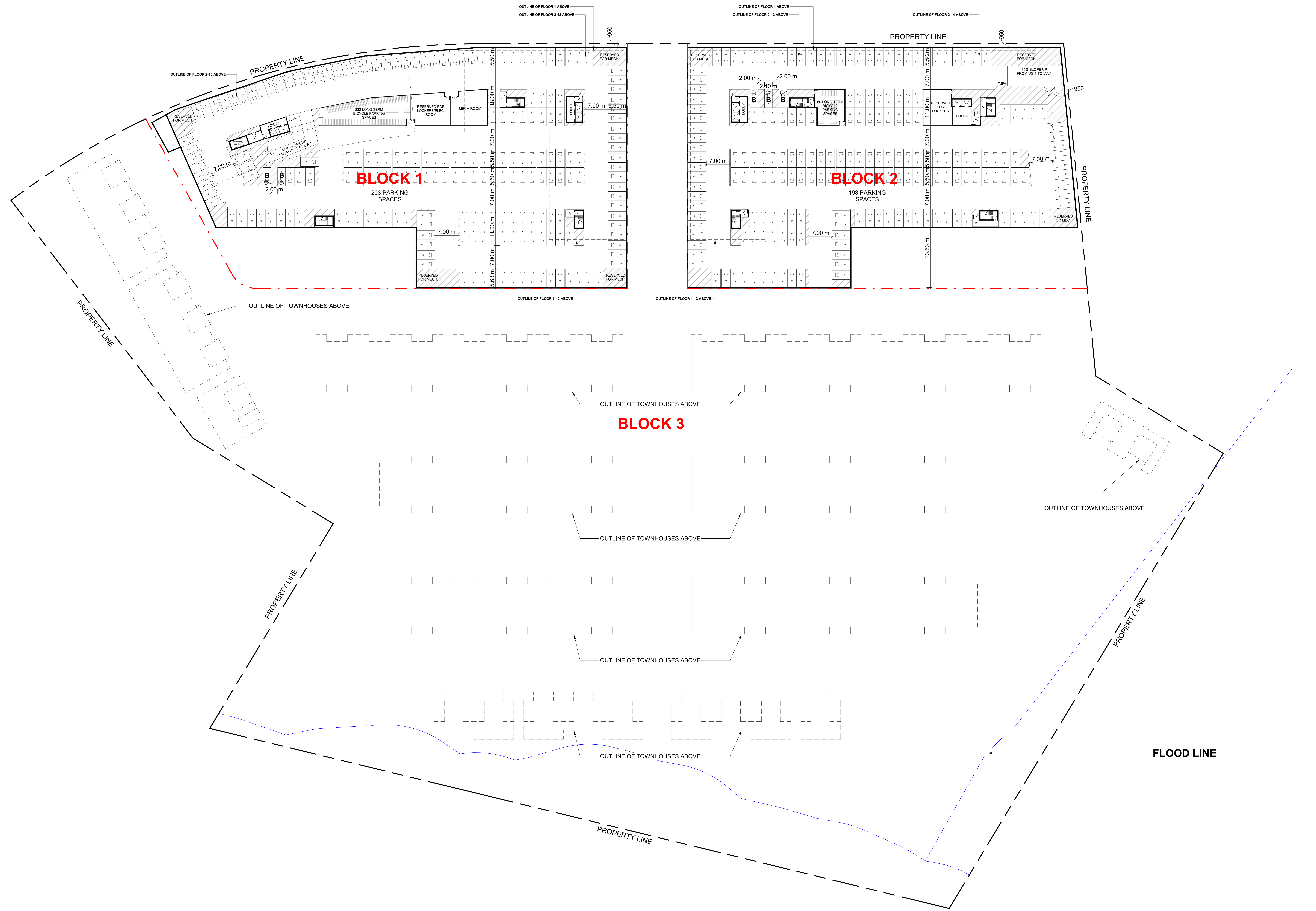

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Guelph Watson Holdings Inc.
115 WATSON PARKWAY, GUELPH, ON

DRAWING
UNDERGROUND LEVEL 02

PROJECT NO. 22.028FS
PROJECT DATE 2023-10-04
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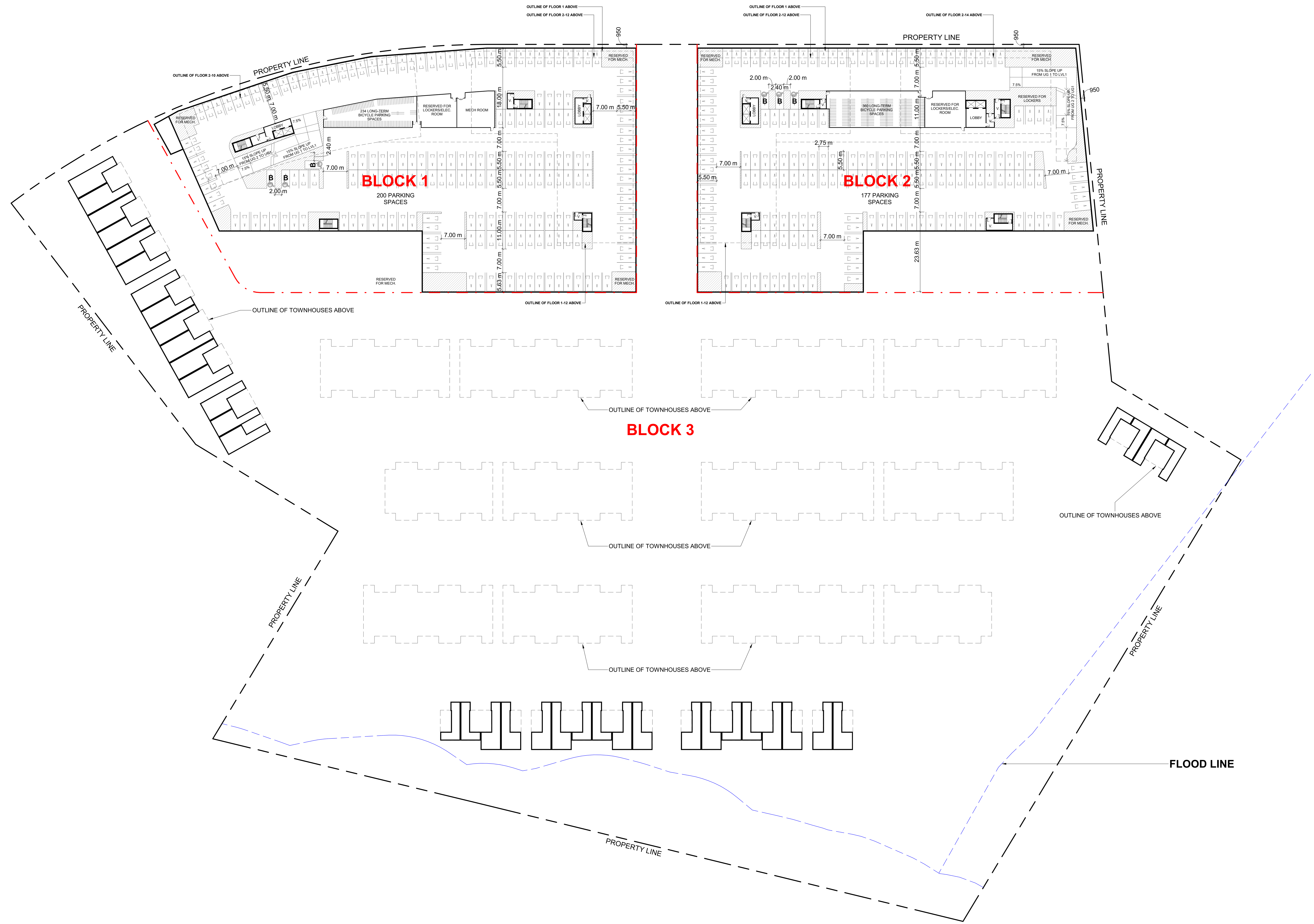

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PROJECT
Guelph Watson Holdings Inc.
115 WATSON PARKWAY, GUELPH, ON

DRAWING
UNDERGROUND LEVEL 01

PROJECT NO.	22.028FS
PROJECT DATE	2023-10-04
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DRAWING
FLOOR 01

PROJECT NO. 22.028FS
PROJECT DATE 2023-10-04
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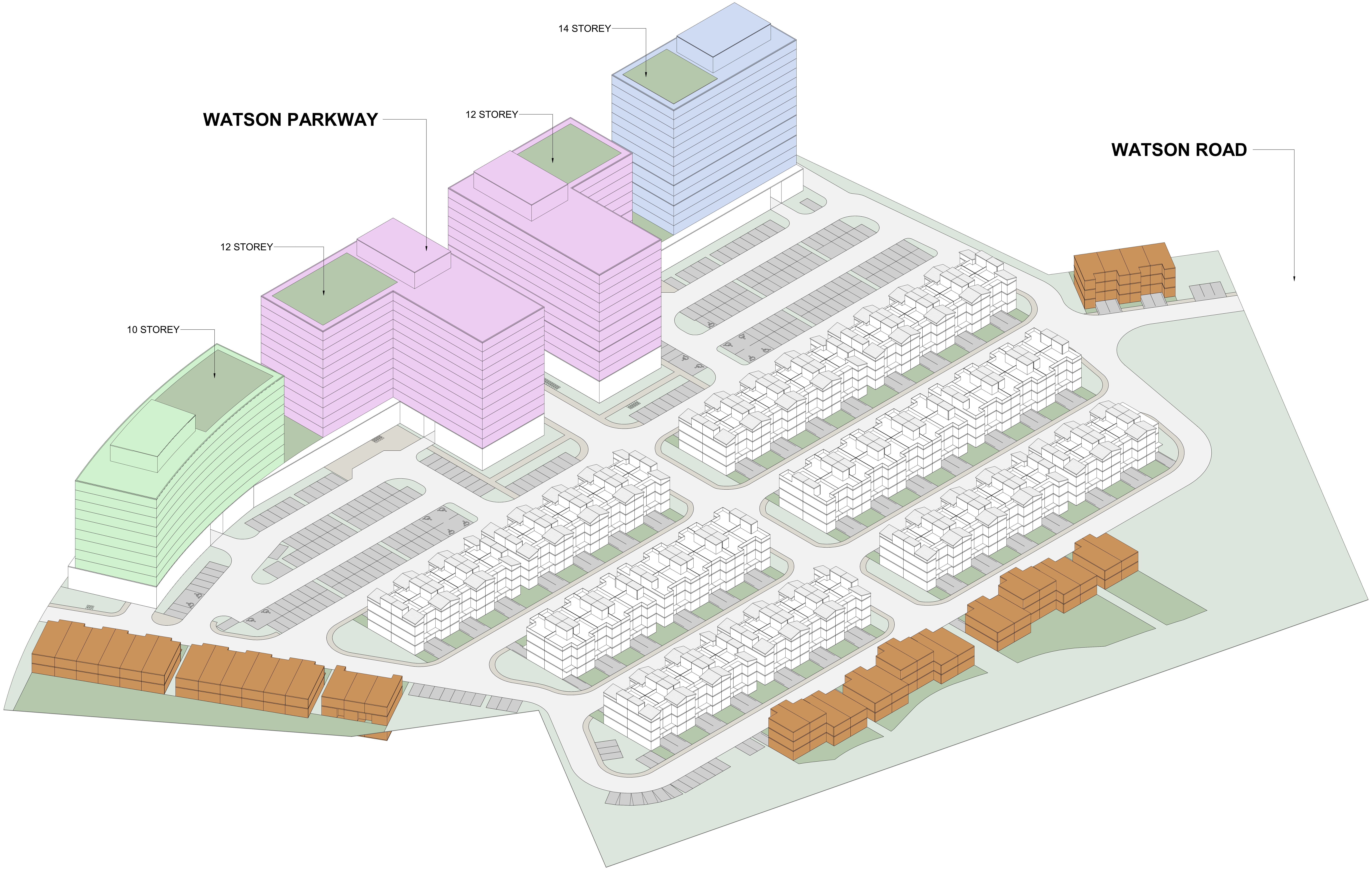

1 3D IMAGE VIEW TO NORTH
RZ801

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Guelph Watson Holdings Inc.
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DRAWING
3D PERSPECTIVES

PROJECT NO. 22.028FS
PROJECT DATE 2023-10-04
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SCALE

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REV. 1

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Appendix B – Source Water Protection Mapping (2022)

Significant Groundwater Recharge Area

Legend

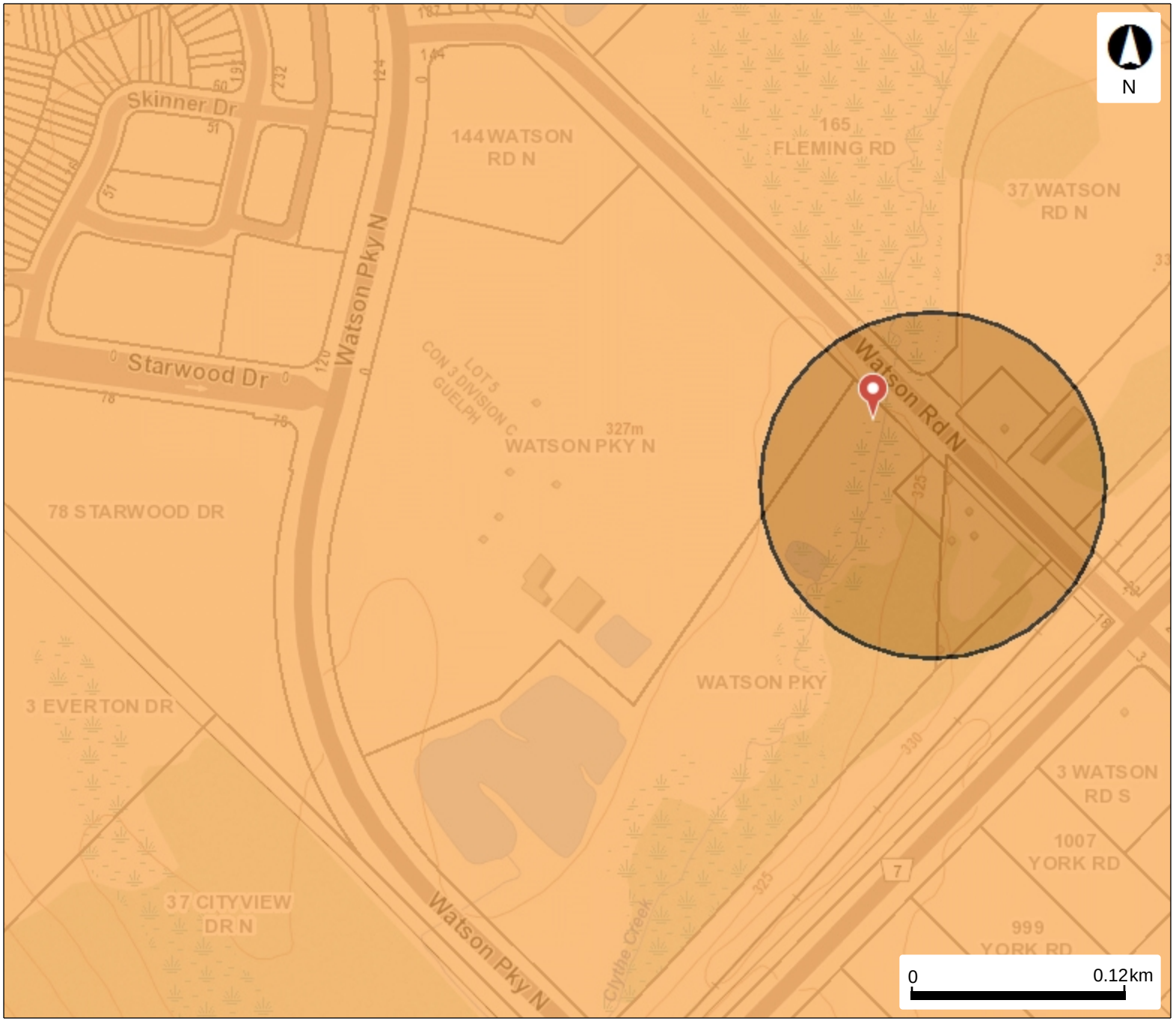
- Wellhead Protection Area Q1
- Wellhead Protection Area Q2
- Highly Vulnerable Aquifers
- Significant Groundwater Recharge Area
  - 0
  - 2
  - 4
  - 6
- WHPA Groundwater Under Direct Influence (WHPA-E)
- Assessment Parcel with Addre

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 10/6/2022
Map Center: 43.56558 N, -80.20995 W

Wellhead Protection Area



Legend

- Wellhead Protection Area Q1
- Wellhead Protection Area Q2
- Highly Vulnerable Aquifers
- WHPA Groundwater Under Direct Influence (WHPA-E)
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Assessment Parcel with Addre

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Ontario

Map Created: 10/6/2022
Map Center: 43.56558 N, -80.20995 W

Appendix C – Borehole Logs (Toronto Inspection, 2023)

Project No. 4515-22-GC

Log of Borehole 22BH-01 (MW)

Dwg No. 2

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

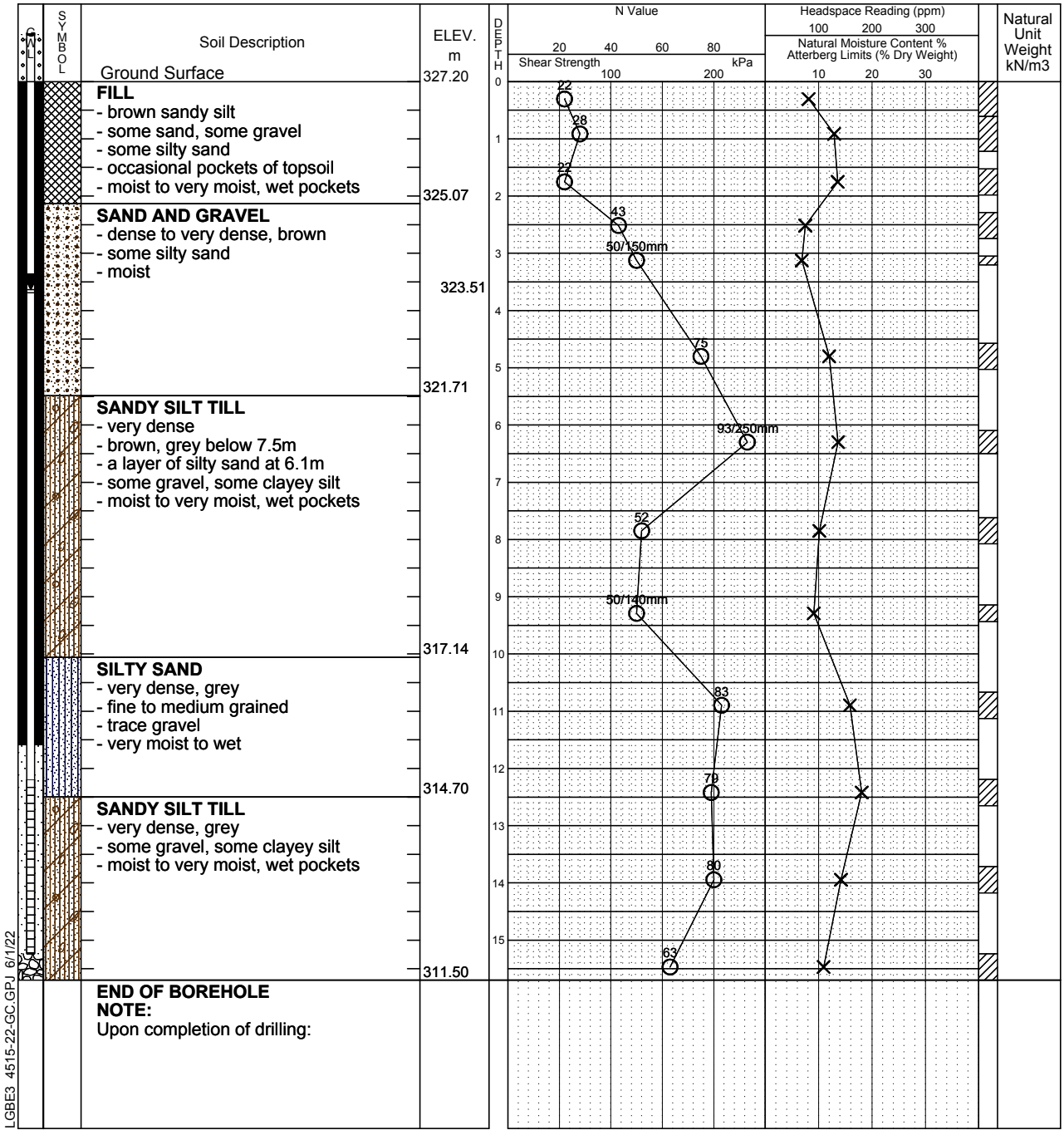
Date Drilled: 2/17/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Mar. 1, 2022	3.56m	
May 26, 2022	3.69m	

Project No. 4515-22-GC

Log of Borehole 22BH-02

Dwg No. 3

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 2/17/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m
		Ground Surface	325.71
		FILL - brown silty sand - some gravel - wet	325.10
		SAND AND GRAVEL - very dense, brown - some silt - very moist to wet	321.75
		SANDY SILT TILL - dense to very dense - brown, grey below 7.5m - some gravel, some clayey silt - occasional layers of sandy silt - moist to very moist, wet pockets	316.11
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 2.4m - cave-in at 2.9m	

DEPTH 0 1 2 3 4 5 6 7 8 9

N Value: 20 40 60 80
Shear Strength: 100 200 kPa

17
53
50/140mm
50
58
40
57
55
42

Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3

LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4515-22-GC

Log of Borehole 22BH-03 (MW)

Dwg No. 4

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 2/18/22

Drill Type: Track Mounted Drill Rig

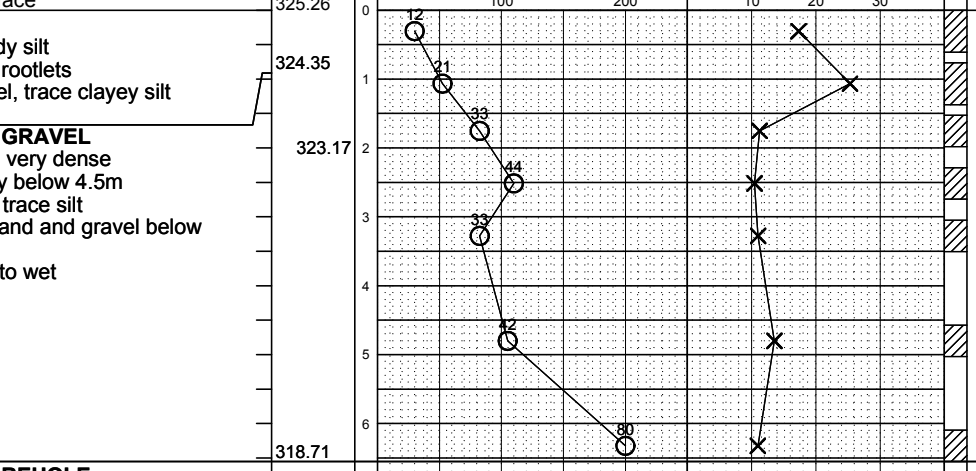
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

SYMBOL	Soil Description	ELEV. m	DEPTH
	Ground Surface	325.26	0
	FILL - brown sandy silt - very minor rootlets - some gravel, trace clayey silt - wet	324.35	
	SAND AND GRAVEL - compact to very dense - brown, grey below 4.5m - occasional trace silt - with river sand and gravel below 4.5m - very moist to wet	323.17	2
		318.71	6
	END OF BOREHOLE **NOTE:** Upon completion of drilling:		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Natural Unit Weight kN/m3



LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Mar. 1, 2022	2.16m	
May 26, 2022	2.09m	

Project No. 4515-22-GC

Log of Borehole 22BH-04

Dwg No. 5

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

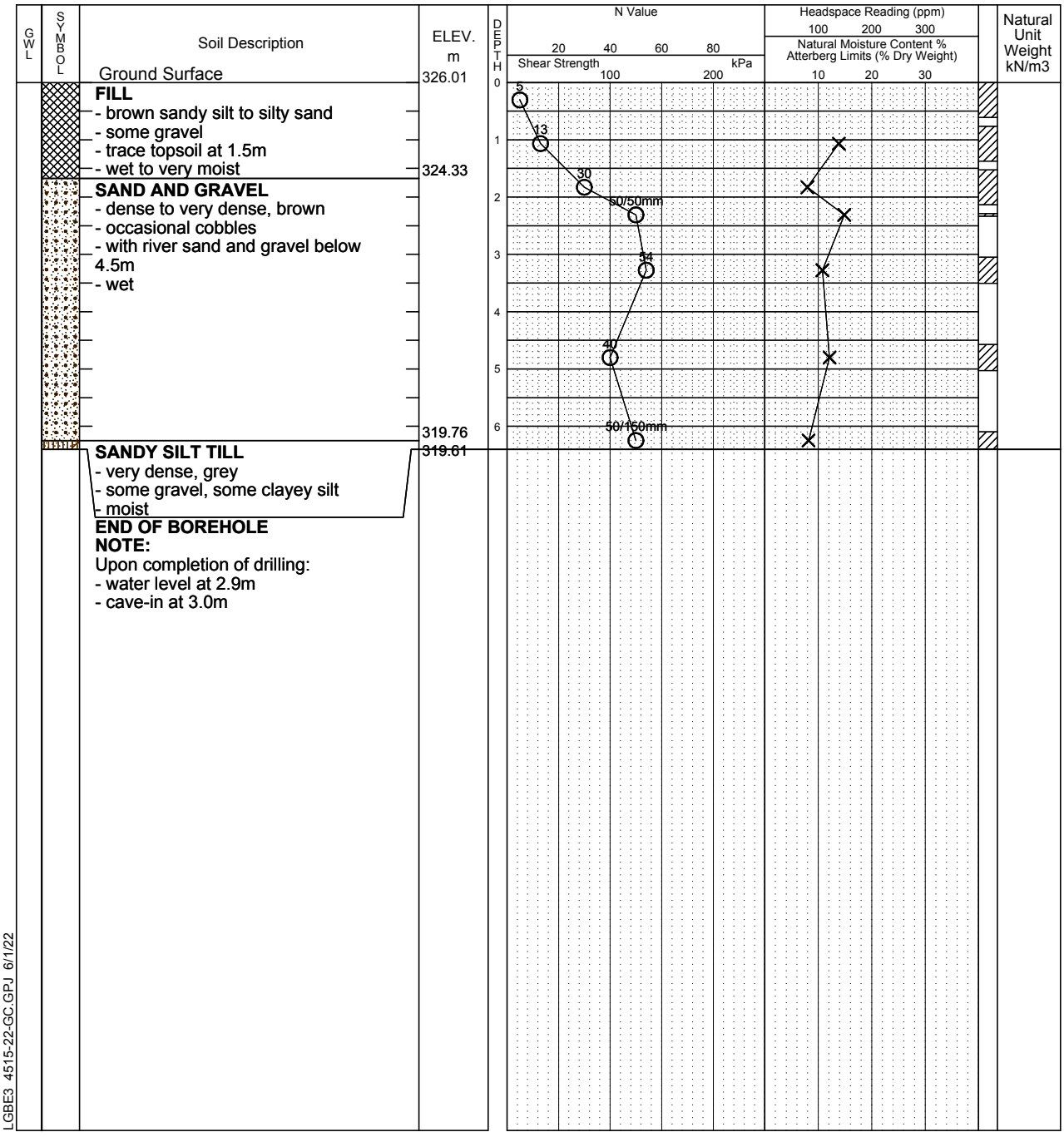
Date Drilled: 2/18/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4515-22-GC

Log of Borehole 22BH-05

Dwg No. 6

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 2/17/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH
		Ground Surface	324.52	0
		FILL - brown sandy silt - some gravel, some sand - minor topsoil at 1.8m - very moist to wet		1
			322.54	2
		SAND AND GRAVEL - very dense to dense, brown - some silty sand - occasional cobbles - moist to very moist		3
				4
			319.03	5
		SANDY SILT TILL - compact, grey - some gravel, some clayey silt - very moist	317.96	6
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 2.7m - cave-in at 3.0m		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa

16
10
14
70/250mm
50
40
24

Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3

LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4515-22-GC

Log of Borehole 22BH-06 (MW)

Dwg No. 7

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 5/11/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

Soil Description	ELEV. m	DEPTH
Ground Surface	328.20	0
TOPSOIL	328.12	
FILL - brown sandy silt - trace to some gravel - some silty sand - occasional pockets of topsoil or rootlets - moist to very moist	324.69	3
SAND AND GRAVEL - compact, brown - some silty sand - wet	322.96	5
	320.43	8
SANDY SILT TILL - very dense to dense, grey - trace to some gravel - trace to some clayey silt - thin layers of clayey silt till - seams of fine sand - moist, very moist pockets	312.50	15
END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 6.1m - cave-in at 14.0m		

N Value: 20 40 60 80
Shear Strength: 100 200 kPa

Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3

N Value: 19, 13, 19, 19, 8, 29, 28, 67, 74, 62, 42, 41, 73

LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
May 26, 2022	5.26m	

Project No. 4515-22-GC

Log of Borehole 22BH-07 (MW)

Dwg No. 8

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 5/10/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test ✚ S

Headspace Reading (ppm) •
Natural Moisture ×
Plastic and Liquid Limit |—|
Unconfined Compression % Strain at Failure ⊗
Penetrometer ▲

SOIL SYMBOL	Soil Description	ELEV. m	DEPTH
	Ground Surface	327.80	0
	TOPSOIL	327.75	
	FILL - brown sandy silt - trace to some gravel - some silty sand - very minor rootlets to 0.6m - minor pockets of topsoil at 2.5m - moist to very moist	324.90	1
	SAND AND GRAVEL - compact to very dense, brown - some silty sand - moist, wet at 4.5m	323.68	3
	SANDY SILT TILL - compact to dense, grey - trace to some gravel, some clayey silt - occasional layers of clayey silt till - seams of fine sand - moist to very moist	322.31	6
	END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 6.1m - cave-in at	312.10	15

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
Natural Unit Weight kN/m3

12, 15, 9, 10, 27, 69/230mm, 20, 27, 26, 23, 23, 32, 48

LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
May 26, 2022	4.12m	

Project No. 4515-22-GC

Log of Borehole 22BH-07S (MW)

Dwg No. 9

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 5/10/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (kPa)	Headspace Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	Natural Unit Weight kN/m3
	Ground Surface	327.80	0			
	NO SAMPLING - straight drill to 6.12m		1 2 3			
		323.75	4 5			
		321.70	6			
	END OF BOREHOLE **NOTE:** Upon completion of drilling:					

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
May 26, 2022	4.07m	

Project No. 4515-22-GC

Log of Borehole 22BH-08 (MW)

Dwg No. 10

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 5/10/22

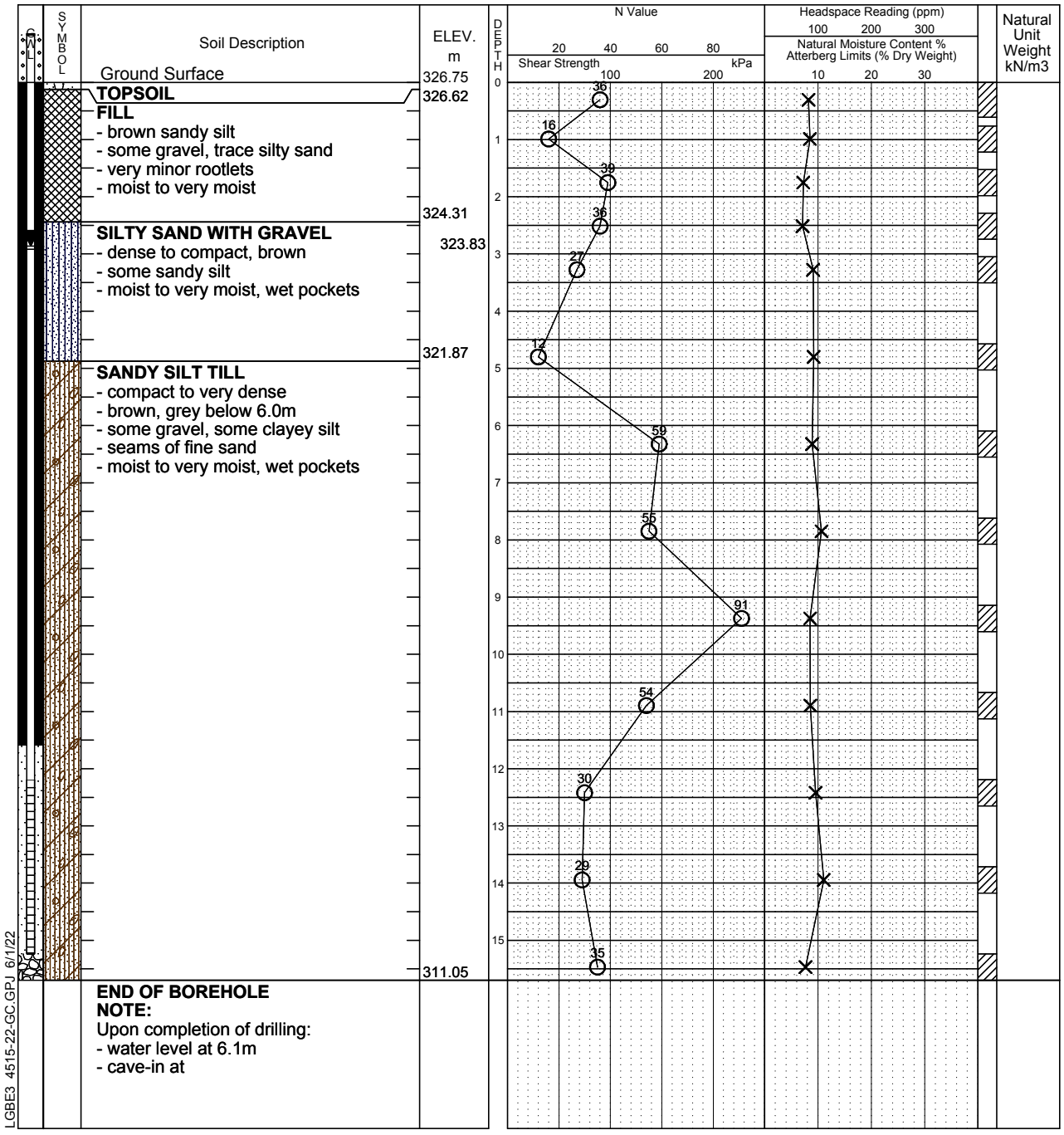
Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer

SOIL SYMBOL	Soil Description	ELEV. m	DEPTH
	Ground Surface	326.75	0
	TOPSOIL	326.62	
	FILL - brown sandy silt - some gravel, trace silty sand - very minor rootlets - moist to very moist		
		324.31	
	SILTY SAND WITH GRAVEL - dense to compact, brown - some sandy silt - moist to very moist, wet pockets	323.83	
		321.87	
	SANDY SILT TILL - compact to very dense - brown, grey below 6.0m - some gravel, some clayey silt - seams of fine sand - moist to very moist, wet pockets		
		311.05	
	END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 6.1m - cave-in at		



LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
May 26, 2022	2.92m	

Project No. 4515-22-GC

Log of Borehole 22BH-09 (MW)

Dwg No. 11

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

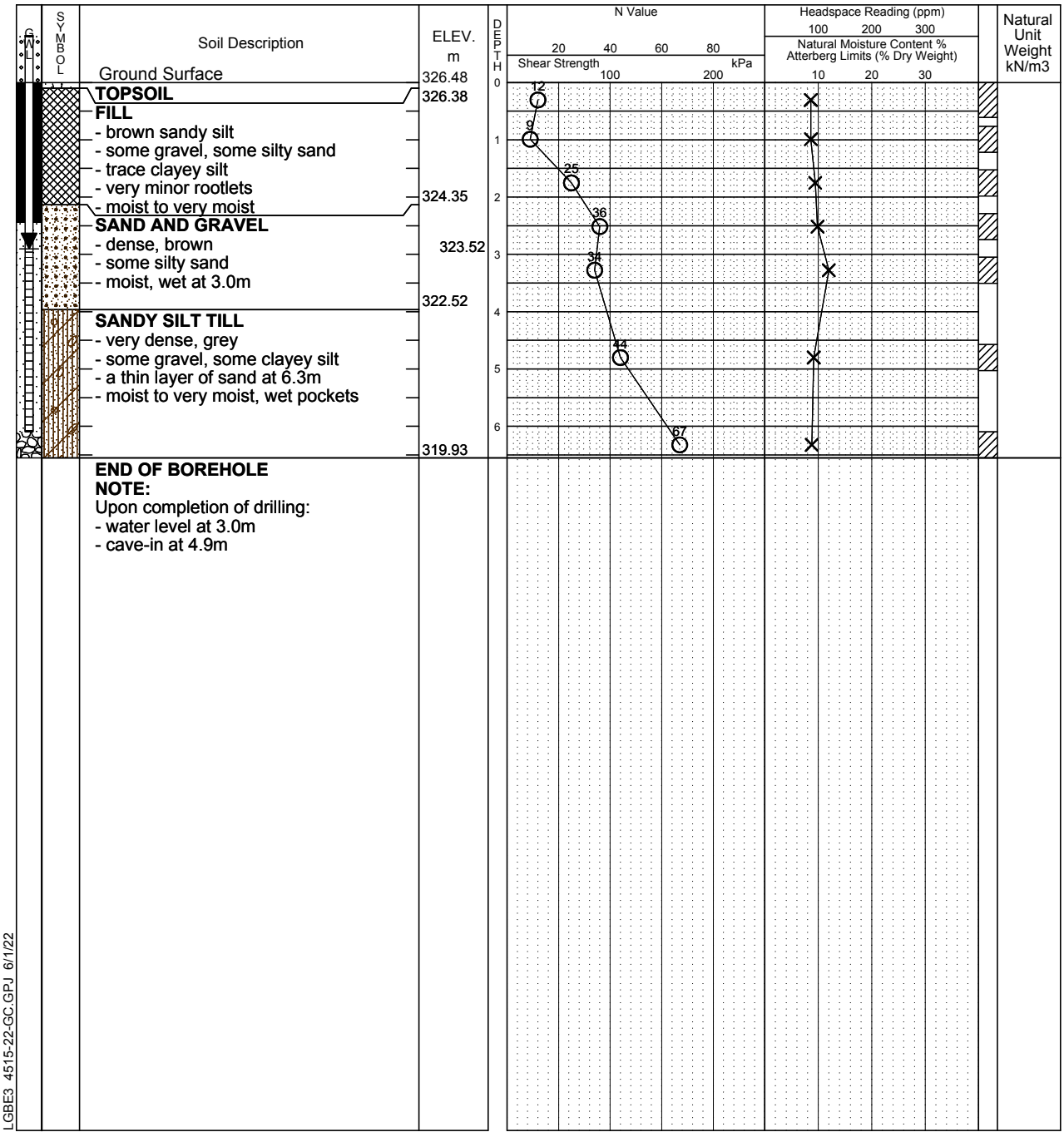
Date Drilled: 5/12/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
May 26, 2022	2.96m	

Project No. 4515-22-GC

Log of Borehole 22BH-10

Dwg No. 12

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 5/12/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m
		Ground Surface	325.60
		TOPSOIL	325.50
		FILL - brown silty sand - some gravel, some sandy silt - trace rootlets, some rootlets at 0.8m	323.92
		- moist **SAND AND GRAVEL** - compact to very dense, brown - river sand and gravel at 4.6m - occasional cobbles - trace silty sand - very moist, wet below 3.0m	319.35
		SANDY SILT TILL - dense, grey - some gravel, some clayey silt - moist, wet pockets	319.05
		END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 2.1m - cave-in at 3.0m	

DEPTH 0 1 2 3 4 5 6

N Value: 20 40 60 80
Shear Strength: 100 200 kPa
Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

N Value: 15, 9, 55, 71, 26, 55, 35

Natural Unit Weight kN/m3

LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4515-22-GC

Log of Borehole 22BH-11

Dwg No. 13

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 5/11/22

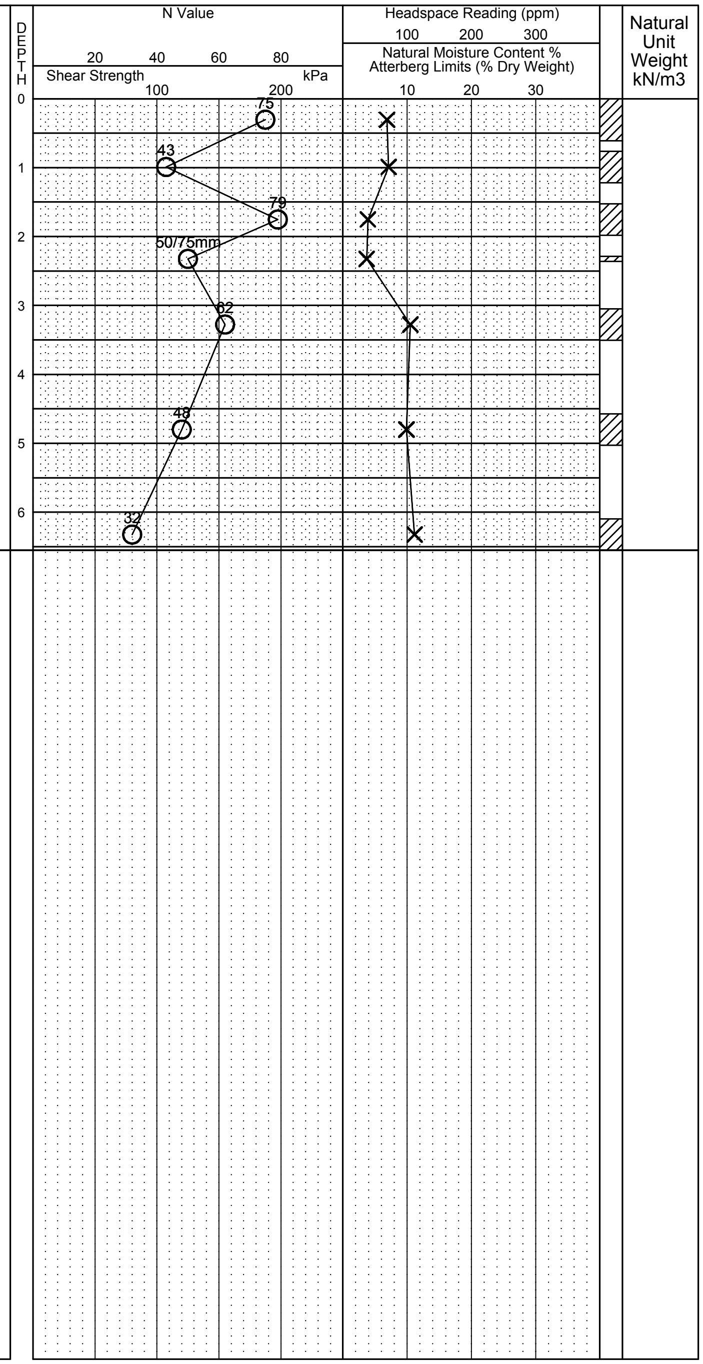
Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample	⊠	Headspace Reading (ppm)	●
SPT (N) Value	○ ▨	Natural Moisture	×
Dynamic Cone Test	—	Plastic and Liquid Limit	├─┤
Shelby Tube	■	Unconfined Compression % Strain at Failure	⊗
Field Vane Test	✚ S	Penetrometer	▲

Soil Description	ELEV. m
Ground Surface	326.80
TOPSOIL	326.75
FILL - dark brown to brown silty sand to sandy silt - gravelly to 0.6m - very minor rootlets or topsoil to 0.8m - some gravel - moist	325.58
SAND AND GRAVEL - very dense, brown - occasional cobbles - trace silty sand - moist, wet below 3.0m	322.84
SANDY SILT TILL - dense, grey - some gravel, some clayey silt - moist to very moist	320.25

END OF BOREHOLE
NOTE:
Upon completion of drilling:
- water level at 4.0m
- cave-in at 5.5m



LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Log of Borehole 22BH-12 (MW)

Project No. 4515-22-GC

Dwg No. 14

Sheet No. 1 of 1

Project: Geotechnical Investigation

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

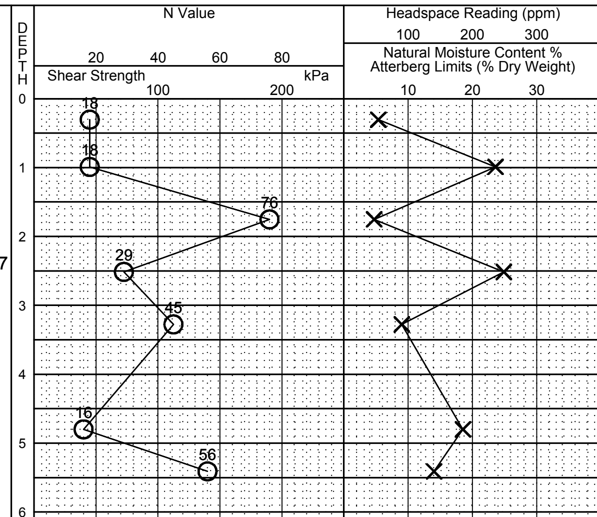
Date Drilled: 5/12/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Legend	
Auger Sample	☒
SPT (N) Value	○ ▨
Dynamic Cone Test	—
Shelby Tube	■
Field Vane Test	✚ S
Headspace Reading (ppm)	●
Natural Moisture	×
Plastic and Liquid Limit	⊢⊣
Unconfined Compression % Strain at Failure	⊗
Penetrometer	▲

Soil Description	ELEV. m
Ground Surface	325.55
TOPSOIL	325.53
FILL - brown silty sand to sandy silt - very minor rootlets and topsoil - some gravel - moist	324.33
SAND AND GRAVEL - compact to very dense, brown - medium to coarse grained sand - river sand with gravel at 4.5m - moist to very moist, wet below 3.0m	323.07 (water level) 319.45



Natural Unit Weight kN/m3

END OF BOREHOLE
NOTE:
Upon completion of drilling:
- water level at 3.0m
- cave-in at 5.2m

LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
May 26, 2022	2.48m	

Project No. 4515-22-GC

Log of Borehole 22BH-12D (MW)

Dwg No. 15

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 5/12/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ▨
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test ✚ S

Headspace Reading (ppm) •
Natural Moisture ×
Plastic and Liquid Limit ⊢—⊣
Unconfined Compression % Strain at Failure ⊗
Penetrometer ▲

Soil Profile	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength kPa (20 40 60 80 / 100 200)	Headspace Reading (ppm) 100 200 300 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30	Natural Unit Weight kN/m3
		Ground Surface	325.55	0			
		NO SAMPLING - straight drill to 9.9m		1			
			322.96	2			
				3			
				4			
				5			
				6			
				7			
				8			
				9			
			314.88	10			
		END OF BOREHOLE **NOTE:** Upon completion of drilling:					

LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
May 26, 2022	2.59m	

Project No. 4515-22-GC

Log of Borehole 22BH-13 (MW)

Dwg No. 16

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

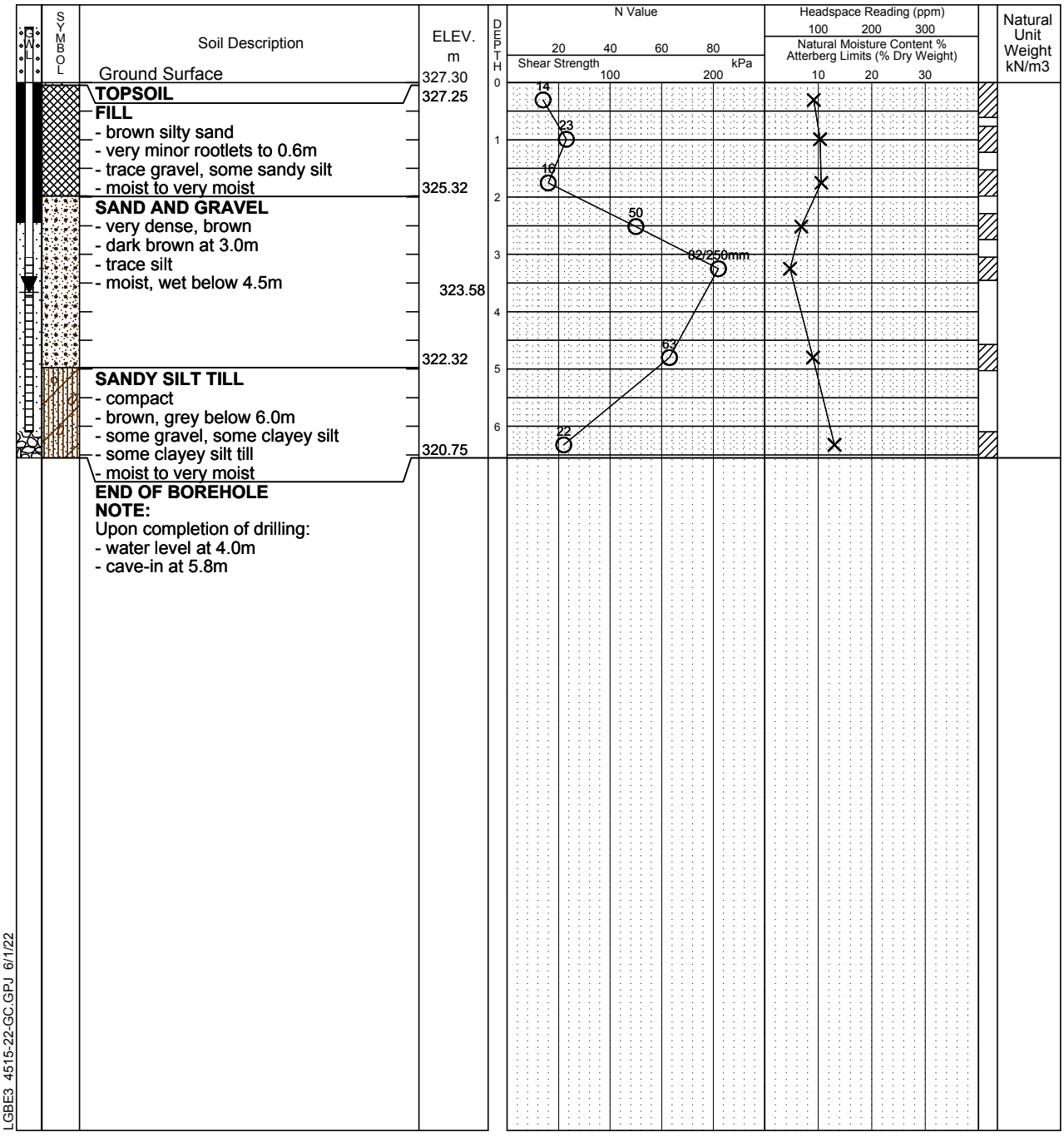
Date Drilled: 5/11/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer



LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
May 26, 2022	3.72m	

Project No. 4515-22-GC

Log of Borehole 22BH-14

Dwg No. 17

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 5/10/22

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

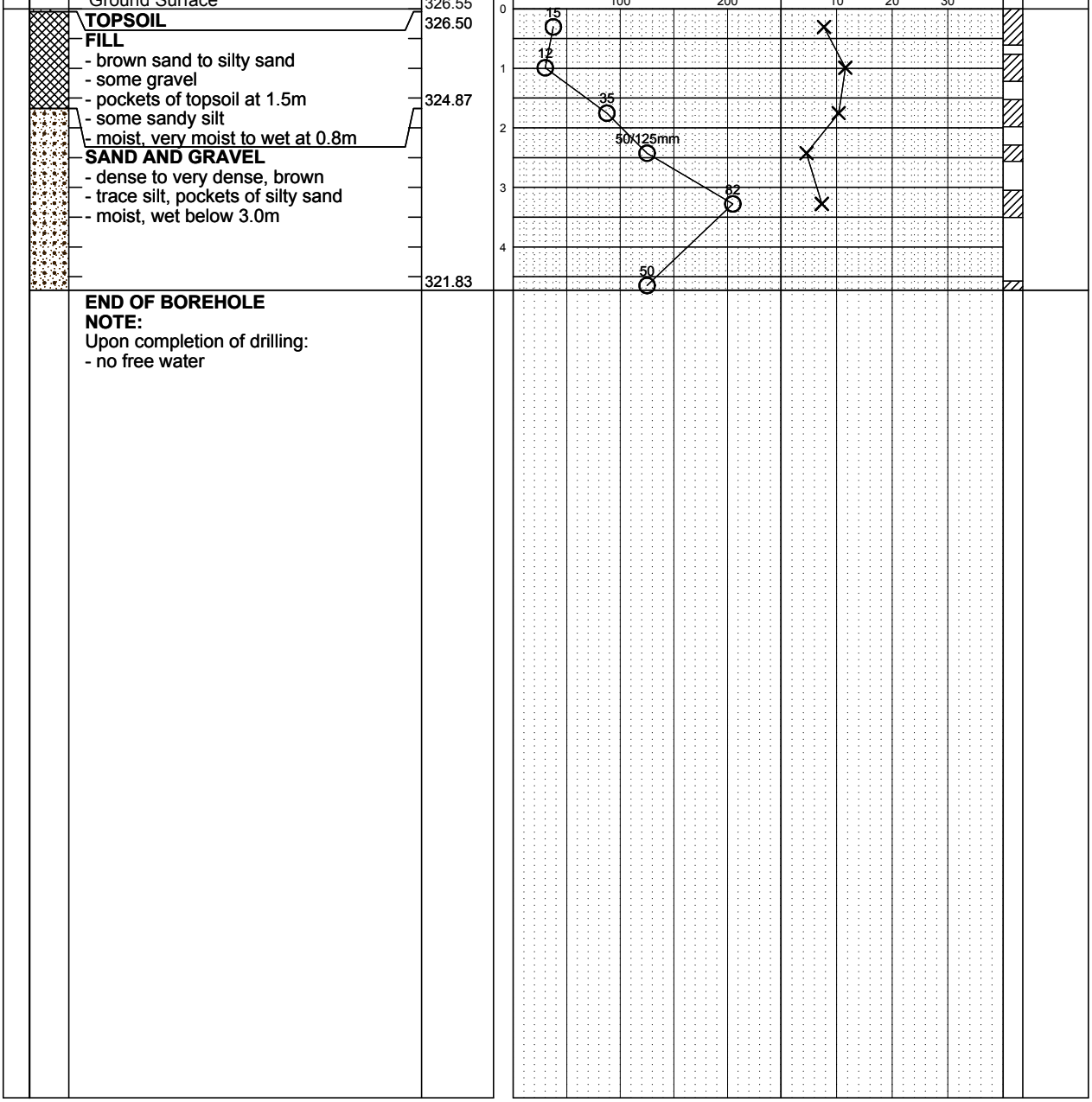
GWL	SYMBOL	Soil Description	ELEV. m
		Ground Surface	326.55
		TOPSOIL	326.50
		FILL	
		- brown sand to silty sand	
		- some gravel	
		- pockets of topsoil at 1.5m	324.87
		- some sandy silt	
		- moist, very moist to wet at 0.8m	
		SAND AND GRAVEL	
		- dense to very dense, brown	
		- trace silt, pockets of silty sand	
		- moist, wet below 3.0m	
			321.83
		END OF BOREHOLE	
		NOTE:	
		Upon completion of drilling:	
		- no free water	

DEPTH 0 1 2 3 4

N Value: 20 40 60 80
Shear Strength: 100 200 kPa

Headspace Reading (ppm): 100 200 300
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30

Natural Unit Weight kN/m3



LGBE3 4515-22-GC.GPJ 6/1/22

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 4515-22-GC

Log of Borehole 23BH-01 (MW)

Dwg No. 22

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

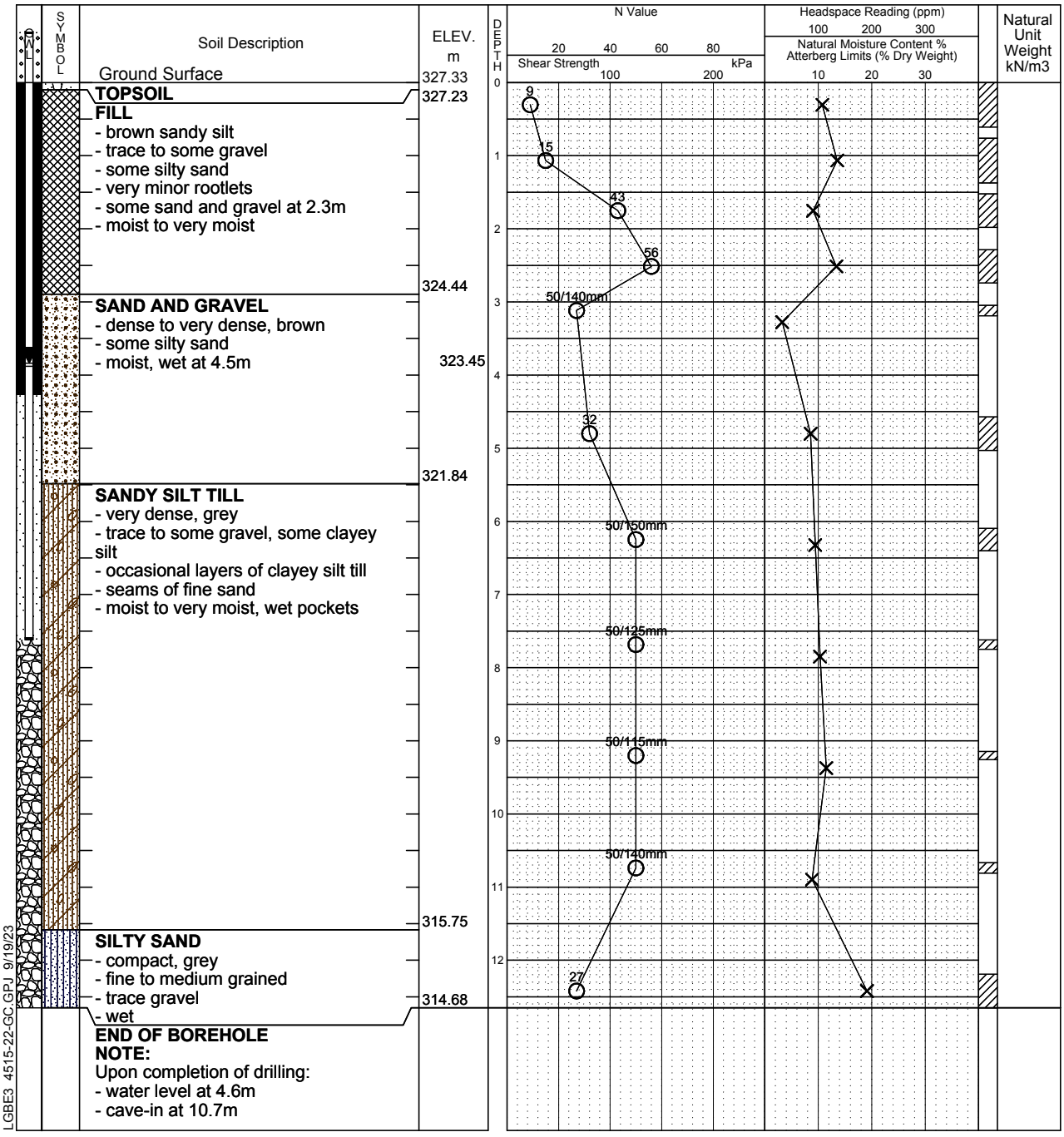
Date Drilled: 8/22/23

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test (S)

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression % Strain at Failure
Penetrometer



LGBE3 4515-22-GC.GPJ 9/19/23

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Sept. 12, 2023	3.88m	

Project No. 4515-22-GC

Log of Borehole 23BH-02 (MW)

Dwg No. 23

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 115 Watson Parkway North (& Starwood Drive), Guelph, Ontario

Date Drilled: 8/23/23

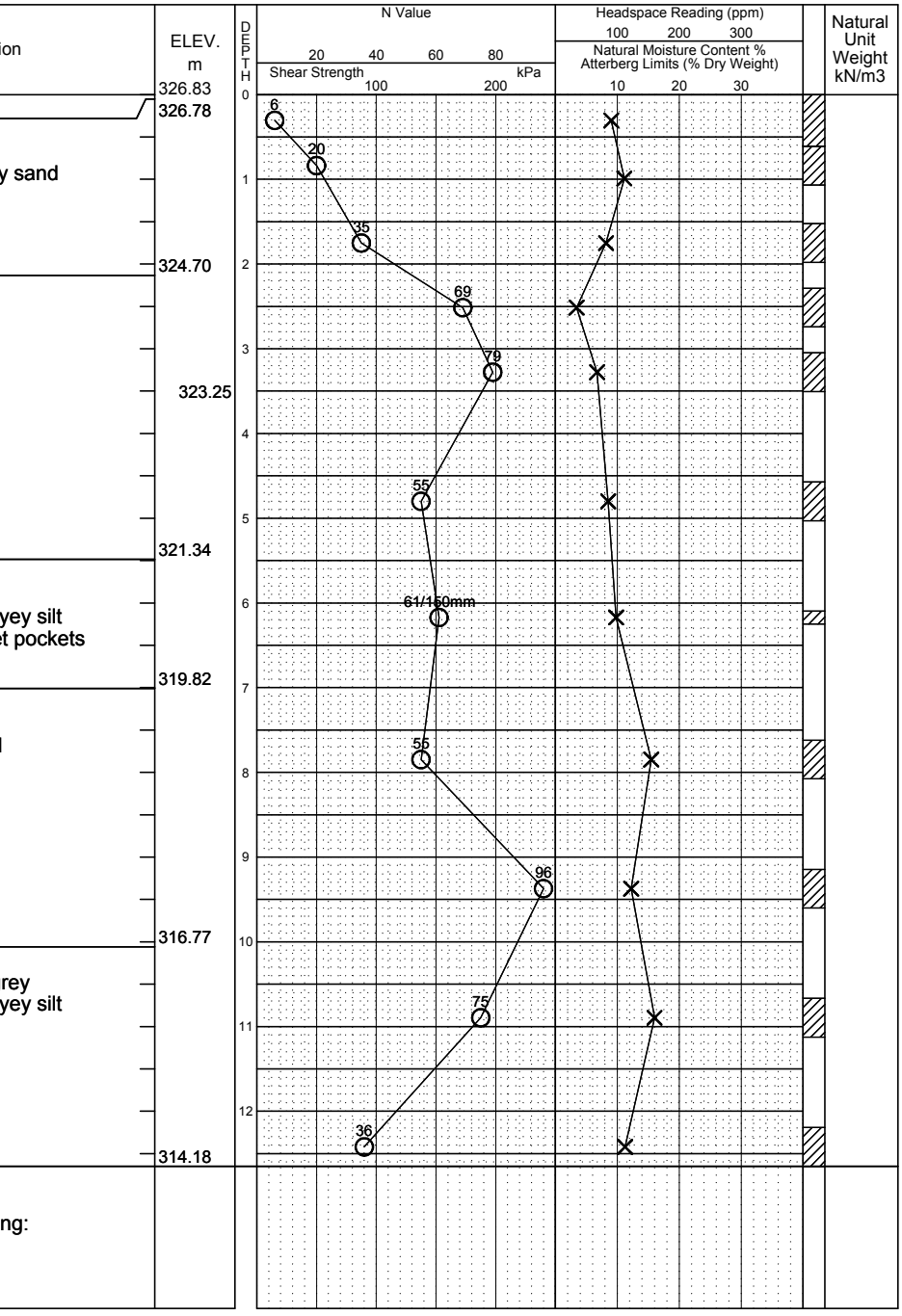
Drill Type: Track Mounted Drill Rig

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Headspace Reading (ppm)
Natural Moisture
Plastic and Liquid Limit
Unconfined Compression
% Strain at Failure
Penetrometer

SOIL SYMBOL	Soil Description	ELEV. m	DEPTH
	Ground Surface	326.83	0
	TOPSOIL	326.78	
	FILL - brown sandy silt - some gravel, some silty sand - trace clayey silt - very minor rootlets - moist to very moist	324.70	1
	SAND AND GRAVEL - very dense, brown - some silty sand - moist, wet below 4.5m	323.25	2
	SANDY SILT TILL - very dense, grey - some gravel, some clayey silt - moist to very moist, wet pockets	321.34	3
	SILTY SAND - very dense, grey - fine to medium grained - trace gravel - wet	319.82	4
	SANDY SILT TILL - dense to very dense, grey - some gravel, some clayey silt - moist to very moist	316.77	5
	END OF BOREHOLE **NOTE:** Upon completion of drilling: - water level at 3.4m - cave-in at 7.9m	314.18	6



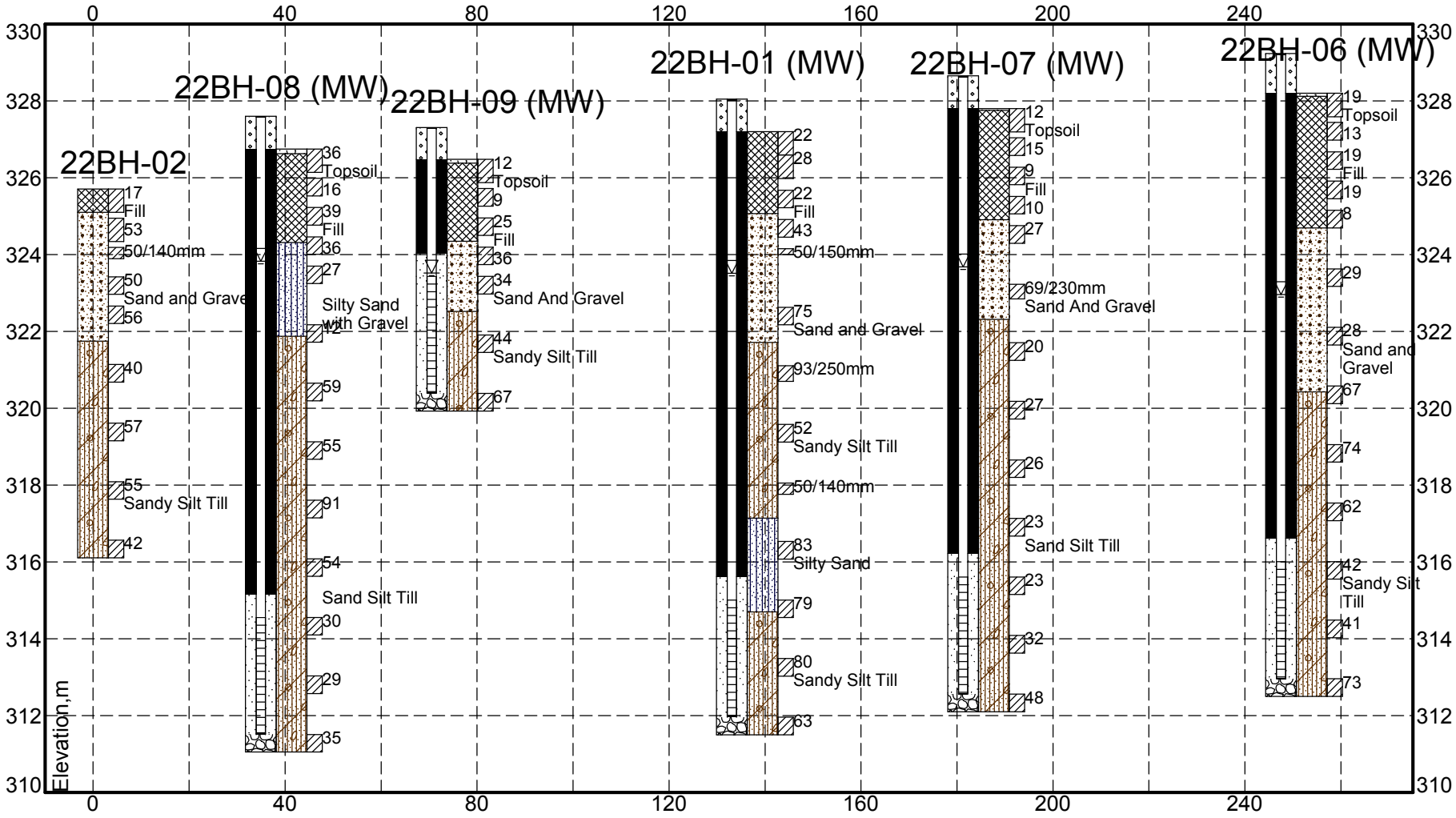
Natural Unit Weight kN/m3

LGBE3 4515-22-GC.GPJ 9/19/23

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
Sept. 12, 2023	3.58m	



Borehole No	Elev.	Depth
22BH-01 (MW)	327.2	15.7
22BH-02	325.7	9.6
22BH-06 (MW)	328.2	15.7
22BH-07 (MW)	327.8	15.7
22BH-08 (MW)	326.7	15.7
22BH-09 (MW)	326.5	6.6

Toronto Inspection Ltd.

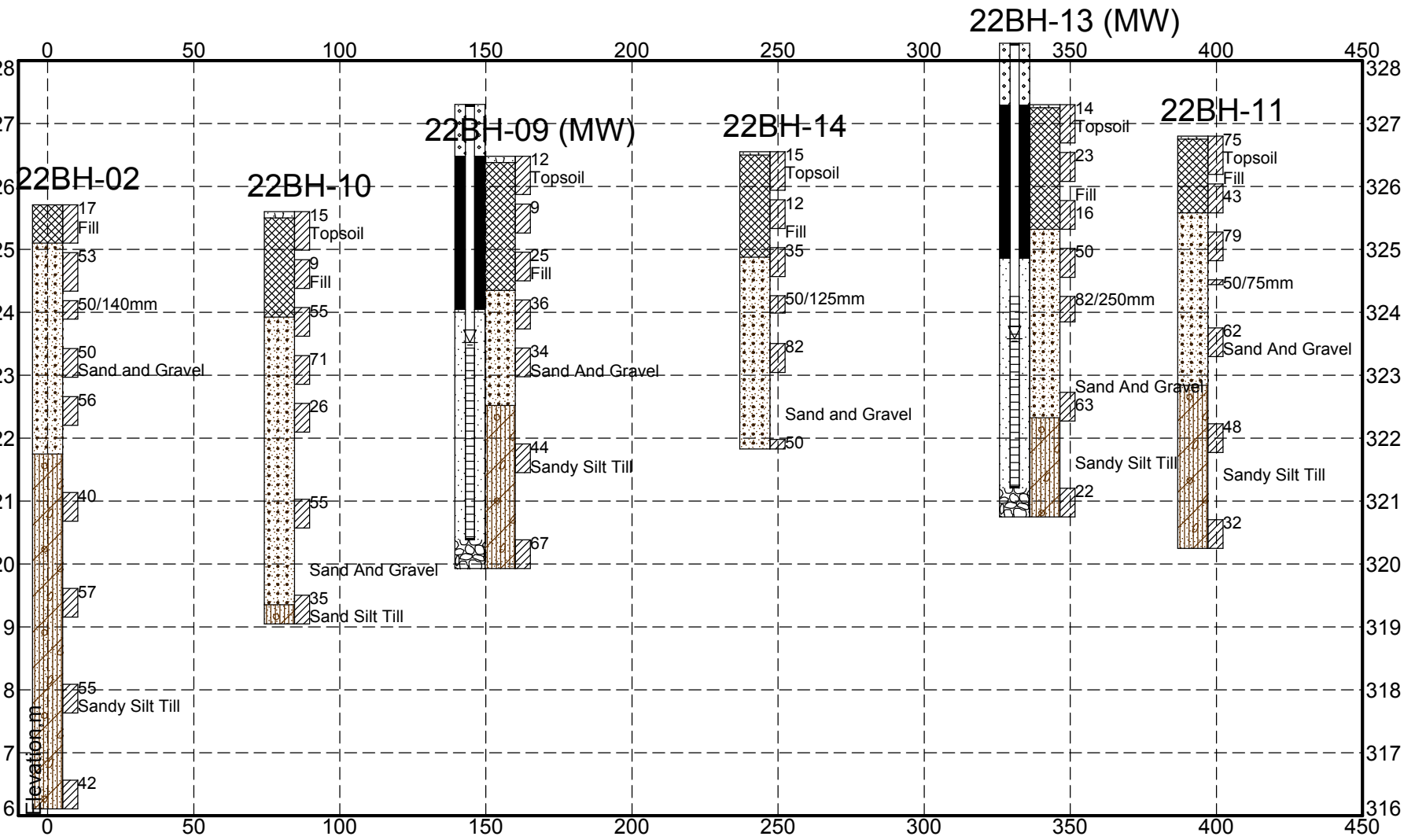
SUBSURFACE STRATIGRAPHY

Section 1

Geotechnical Investigation

115 Watson Parkway North
(& Starwood Drive), Guelph, Ontario

PROJECT #	DATE	DRAWING
4515-22-GC	Jun 22	18



Borehole No	Elev.	Depth
22BH-02	325.7	9.6
22BH-09 (MW)	326.5	6.6
22BH-10	325.6	6.6
22BH-11	326.8	6.6
22BH-13 (MW)	327.3	6.6
22BH-14	326.6	4.7

Toronto Inspection Ltd.

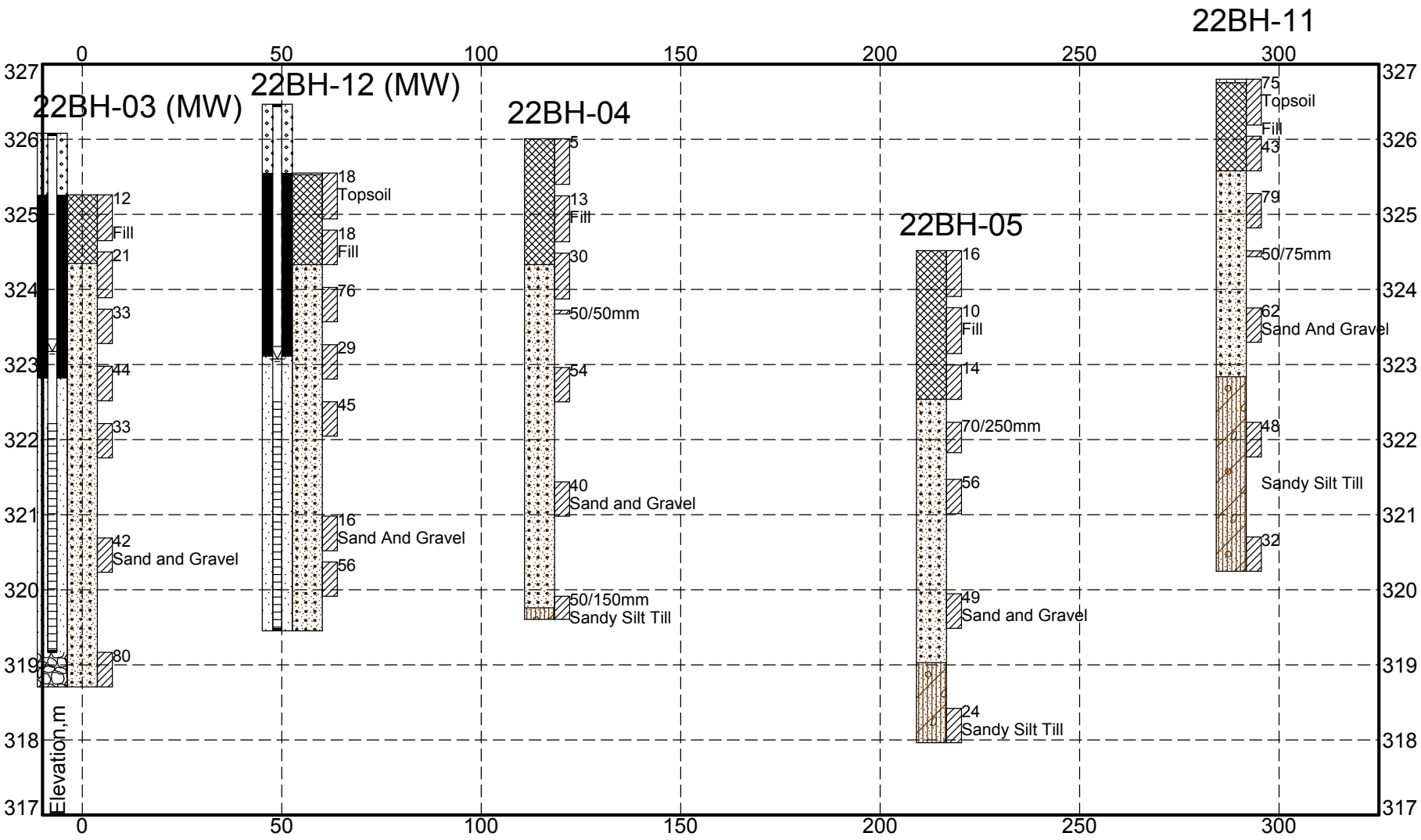
SUBSURFACE STRATIGRAPHY

Section 2

Geotechnical Investigation

115 Watson Parkway North
(& Starwood Drive), Guelph, Ontario

PROJECT #	DATE	DRAWING
4515-22-GC	Jun 22	19



Borehole No	Elev.	Depth
22BH-03 (MW)	325.3	6.6
22BH-04	326.0	6.4
22BH-05	324.5	6.6
22BH-11	326.8	6.6
22BH-12 (MW)	325.6	6.1

Toronto Inspection Ltd.

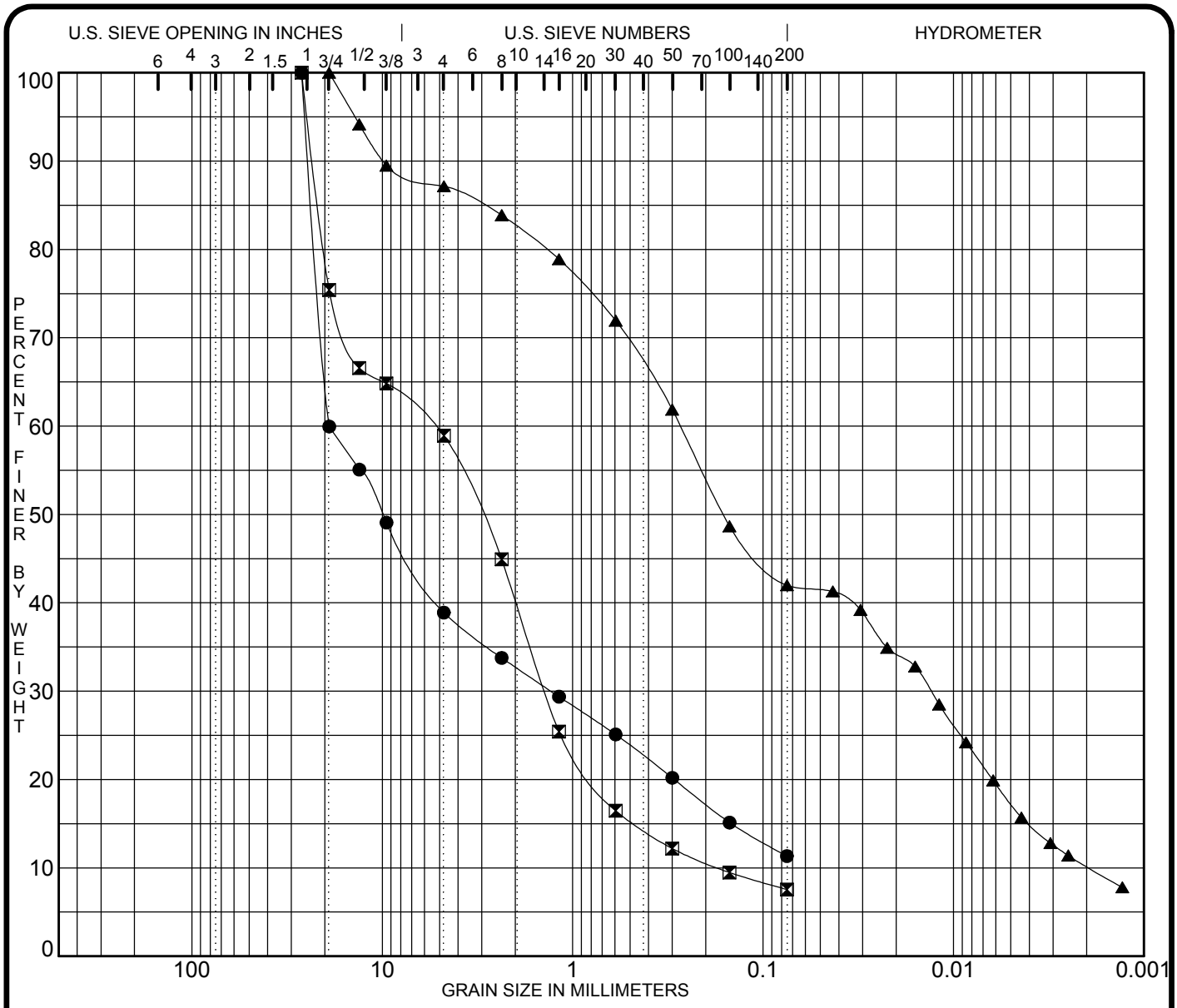
SUBSURFACE STRATIGRAPHY

Section 3

Geotechnical Investigation

115 Watson Parkway North
(& Starwood Drive), Guelph, Ontario

PROJECT #	DATE	DRAWING
4515-22-GC	Jun 22	20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**22BH-12 (MW)3.0**						**1.52**	**323.6**
⧓	**22BH-4 4.6**						**2.08**	**31.4**
▲	**22BH-8 (MW)12.2**						**0.33**	**140.2**

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**22BH-12 (MW)3.0**	**26.50**	**19.01**	**1.303**		**61.1**	**27.6**	**11.3**	
⧓	**22BH-4 4.6**	**26.50**	**5.39**	**1.389**	**0.1716**	**41.1**	**51.4**	**7.5**	
▲	**22BH-8 (MW)12.2**	**19.00**	**0.27**	**0.013**	**0.0019**	**12.8**	**45.2**	**24.7**	**17.3**

PROJECT **Geotechnical Investigation - Starwood Drive & Watson Parkway North, Guelph, Ontario**

JOB NO. **4515-22-GC**

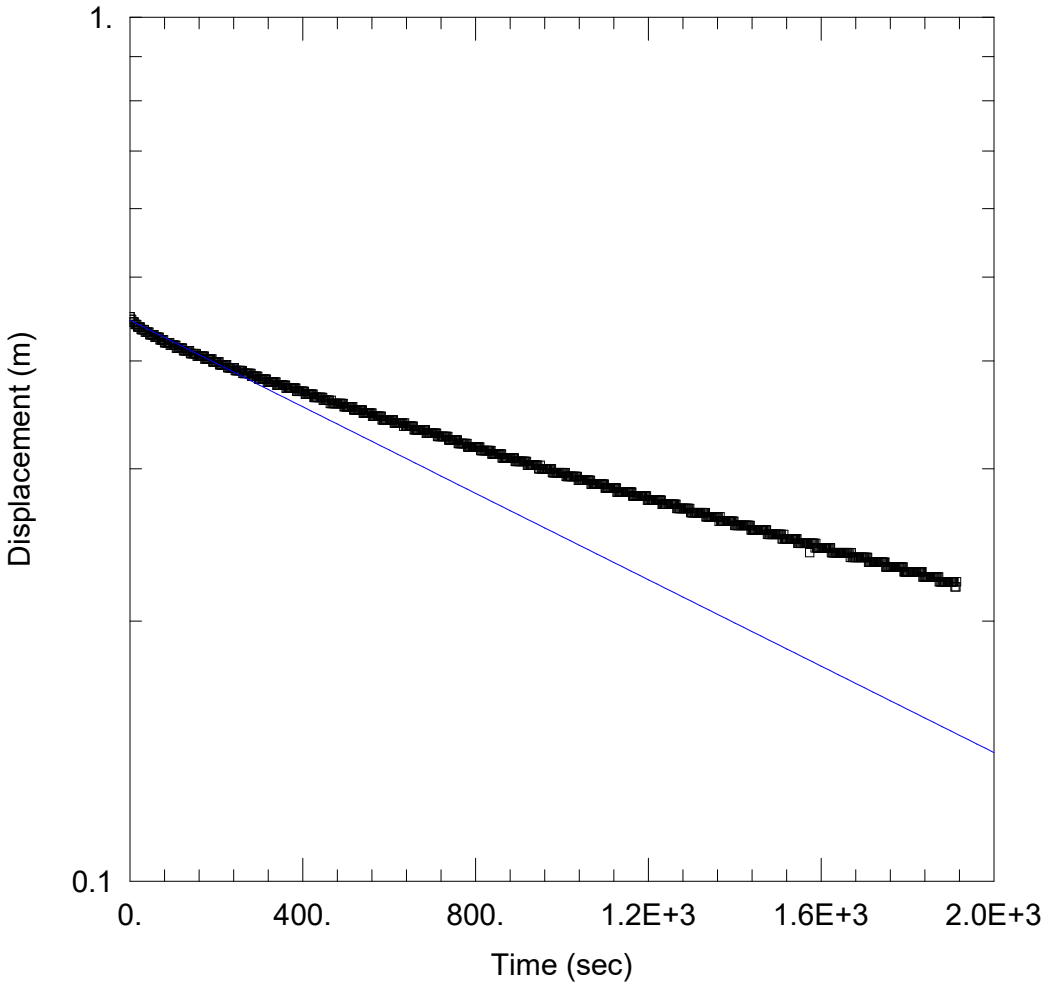
DATE **6/6/22**

GRADATION CURVES

Toronto Inspection Ltd.

FIGURE NO. 1

Appendix D – AQTESOLV Analysis (Palmer, 2023)



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH1 RH.aqt
Date: 10/19/22 Time: 16:31:16

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH1

AQUIFER DATA

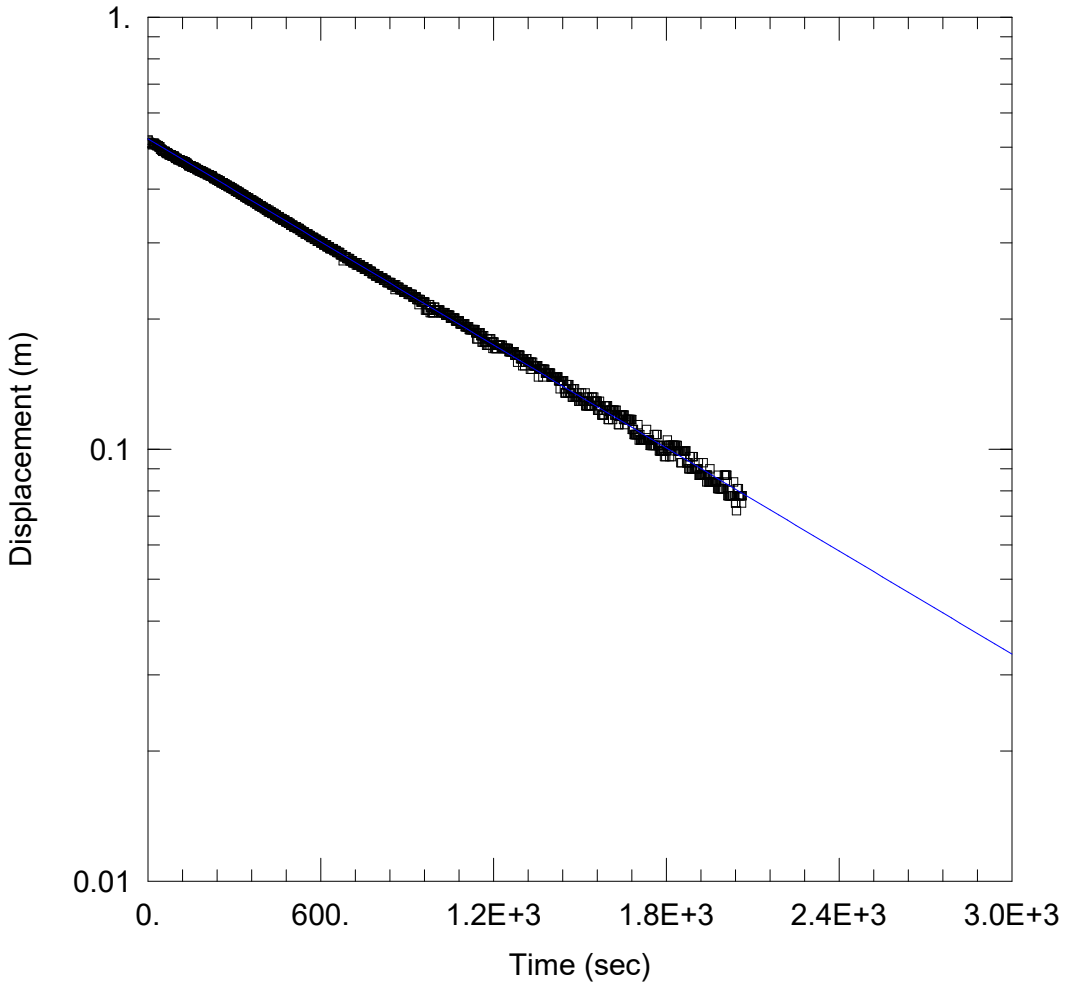
Saturated Thickness: 10.2 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.45 m
Total Well Penetration Depth: 9.6 m
Casing Radius: 0.0254 m
Static Water Column Height: 12.01 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.16E-7 m/sec
y0 = 0.4456 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH1 FH.aqt
Date: 10/19/22 Time: 16:30:58

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH1

AQUIFER DATA

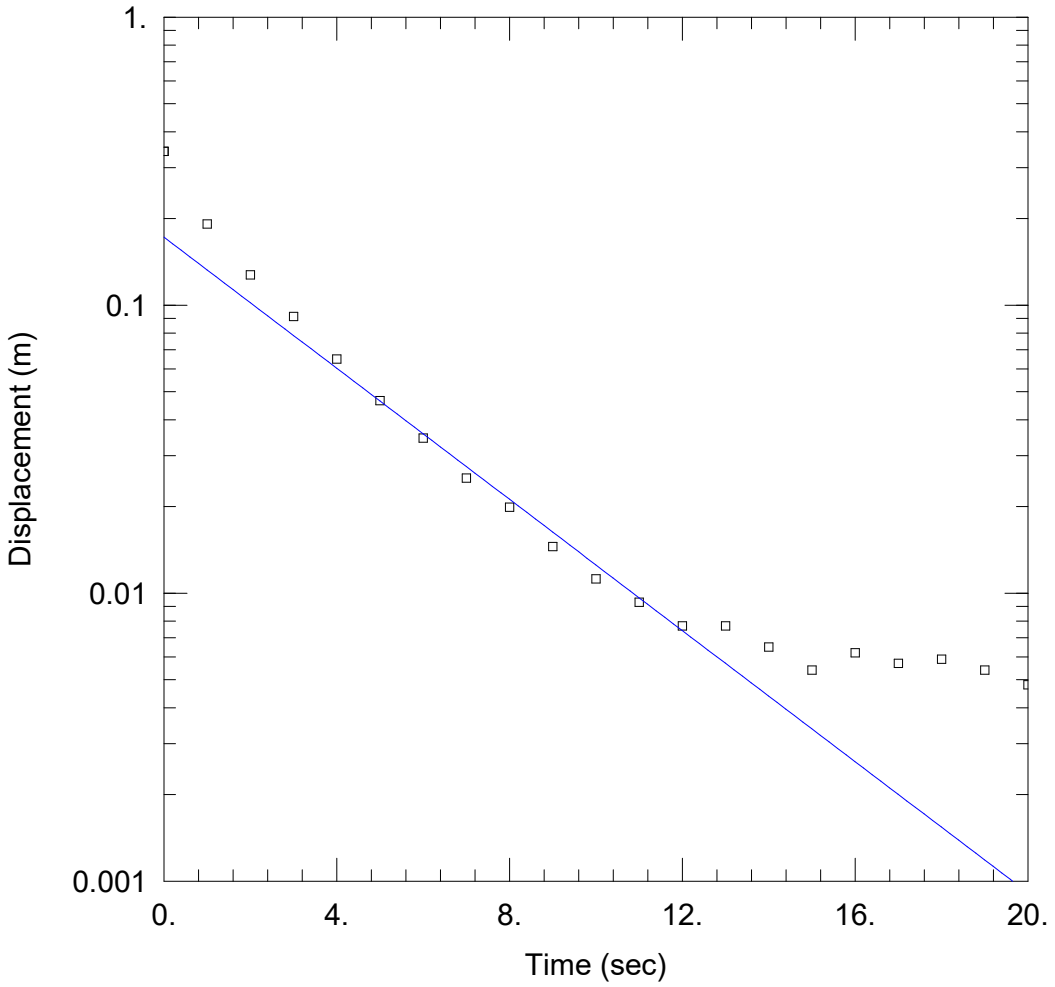
Saturated Thickness: 10.2 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.519 m
Total Well Penetration Depth: 9.6 m
Casing Radius: 0.0254 m
Static Water Column Height: 12.01 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 5.026E-7 m/sec
y0 = 0.523 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH3 BAIL.aqt
Date: 10/19/22 Time: 16:32:07

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH3

AQUIFER DATA

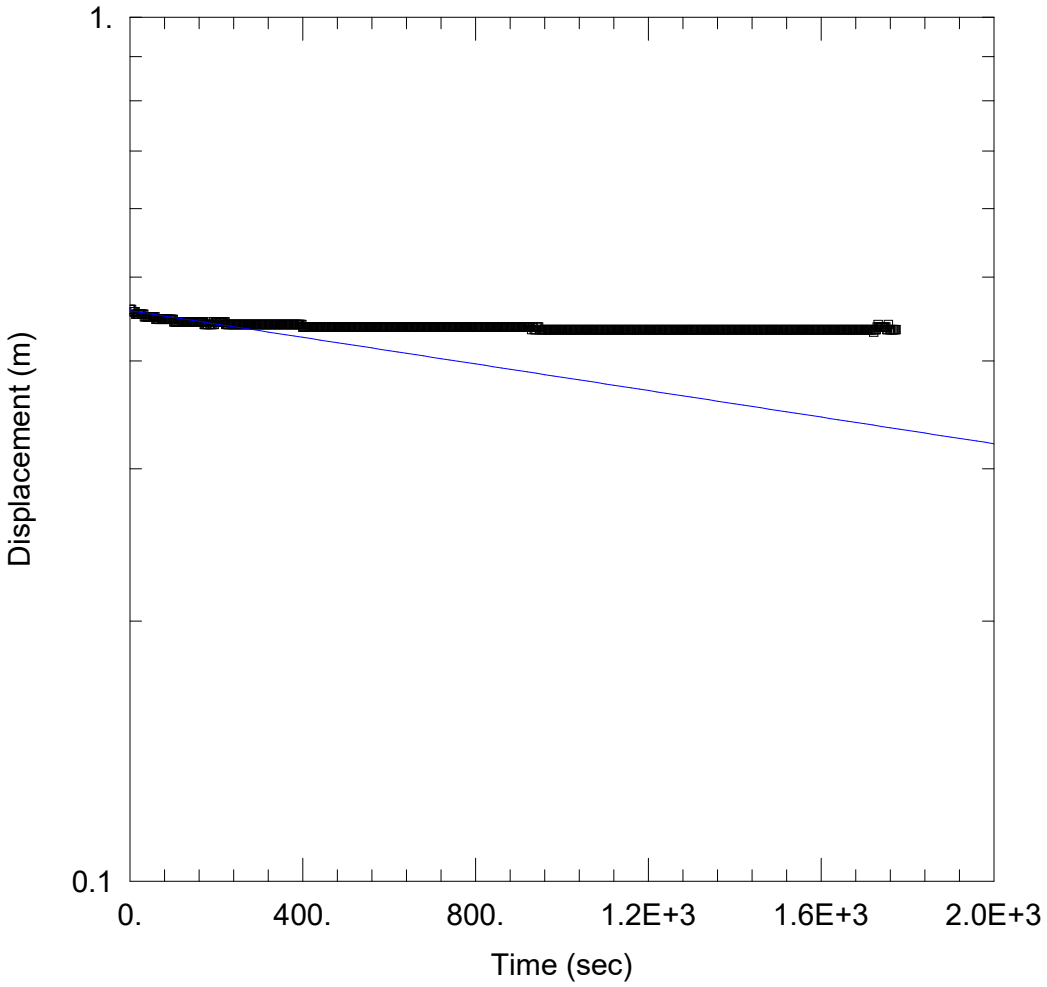
Saturated Thickness: 4.51 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.3418 m
Total Well Penetration Depth: 4.1 m
Casing Radius: 0.0254 m
Static Water Column Height: 4.51 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0001308 m/sec
y0 = 0.1721 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH6 FH.aqt
Date: 10/19/22 Time: 16:32:21

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH6

AQUIFER DATA

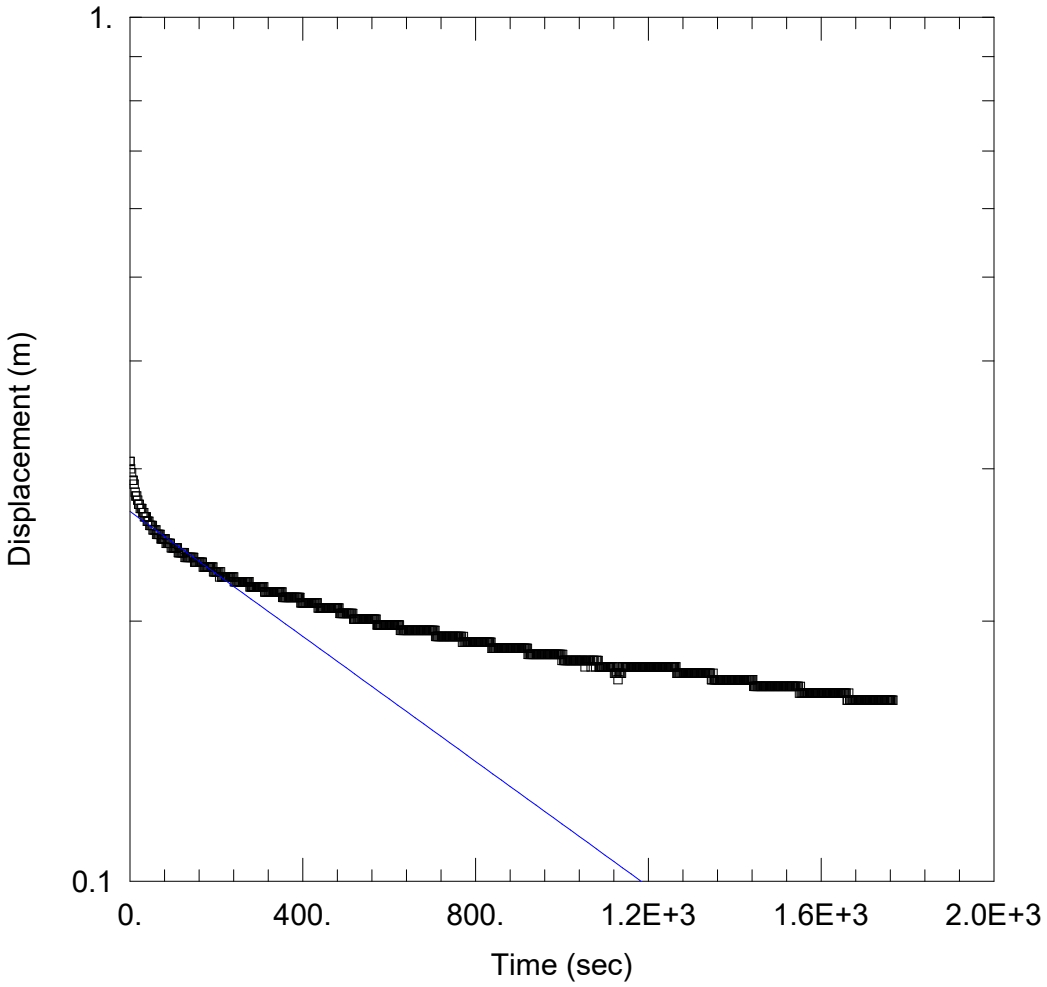
Saturated Thickness: 7.9 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.459 m
Total Well Penetration Depth: 7.9 m
Casing Radius: 0.0254 m
Static Water Column Height: 10.44 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 1.029E-7 m/sec
y0 = 0.4572 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH7s RH.aqt
Date: 10/19/22 Time: 16:38:11

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH7s

AQUIFER DATA

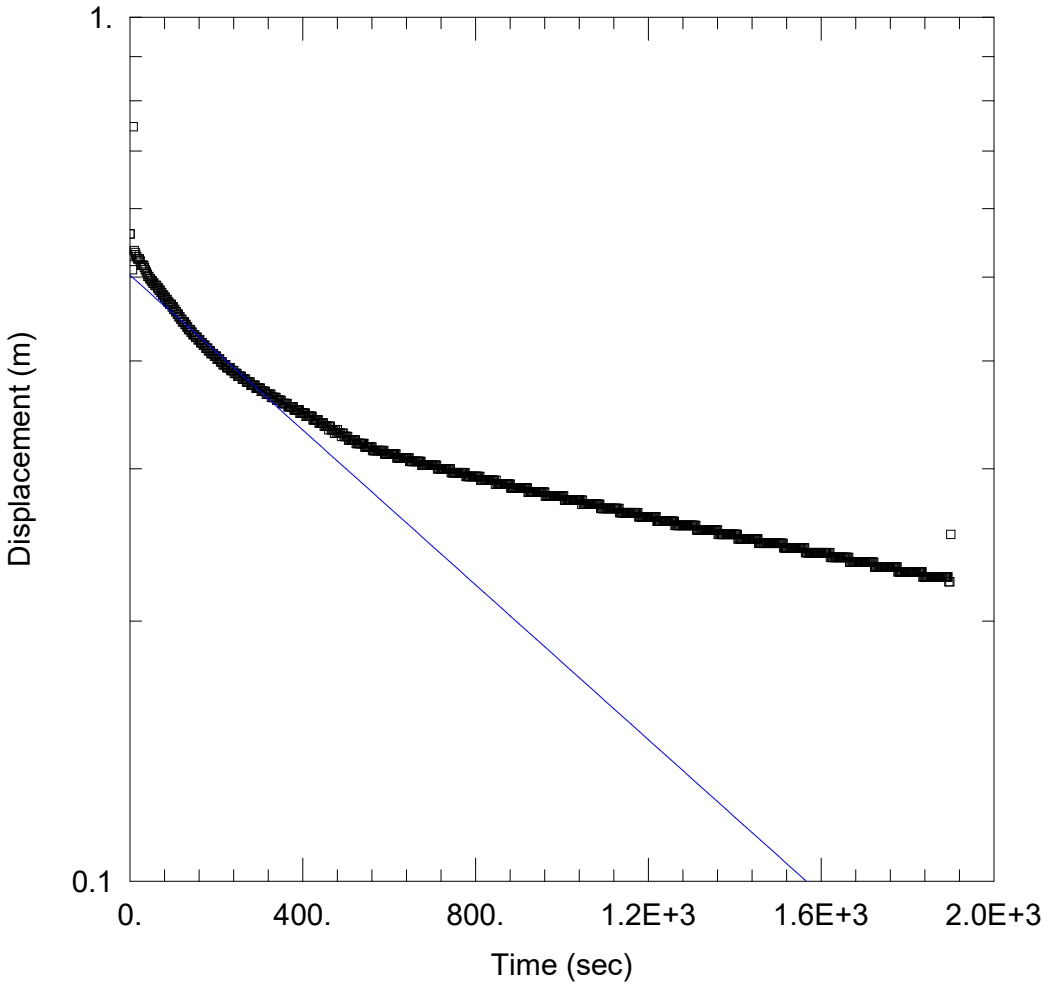
Saturated Thickness: 2.03 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.306 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.03 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.787E-7 m/sec
y0 = 0.2679 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH7s FH.aqt
Date: 10/19/22 Time: 16:37:54

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH7s

AQUIFER DATA

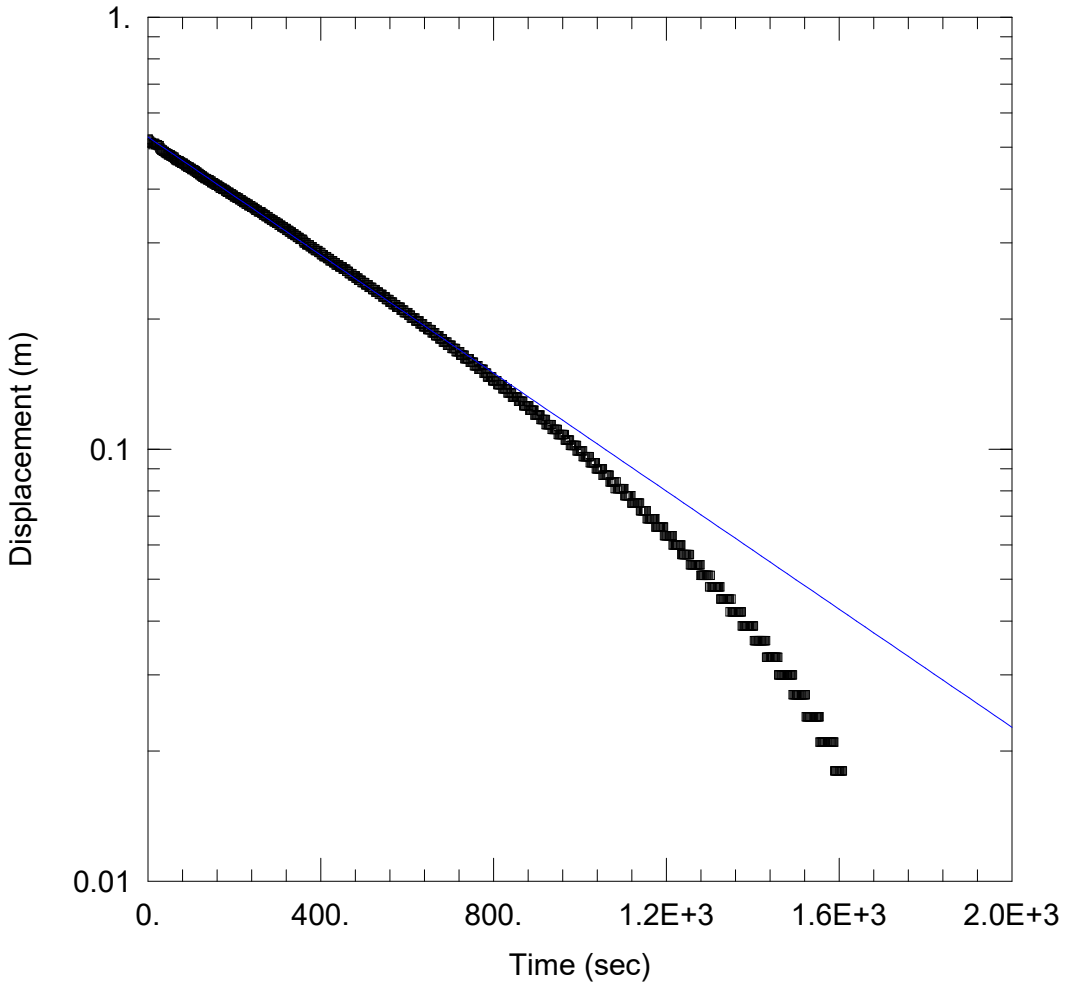
Saturated Thickness: 2.03 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.561 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.03 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 5.928E-7 m/sec
y0 = 0.5026 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH7d FH.aqt
Date: 10/19/22 Time: 16:32:33

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH7d

AQUIFER DATA

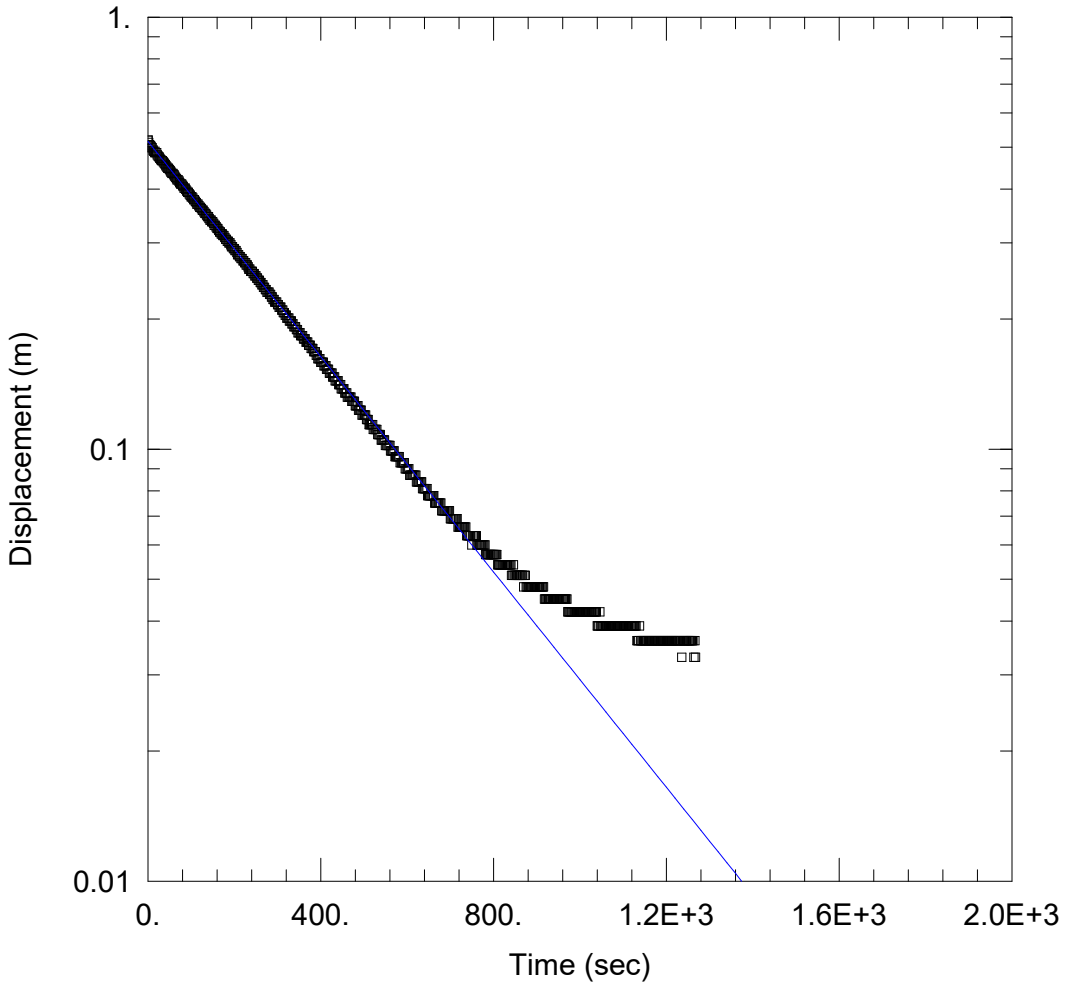
Saturated Thickness: 10.2 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.522 m
Total Well Penetration Depth: 10.2 m
Casing Radius: 0.0254 m
Static Water Column Height: 11.58 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 9.431E-7 m/sec
y0 = 0.5279 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH7d RH.aqt
Date: 10/19/22 Time: 16:32:48

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH7d

AQUIFER DATA

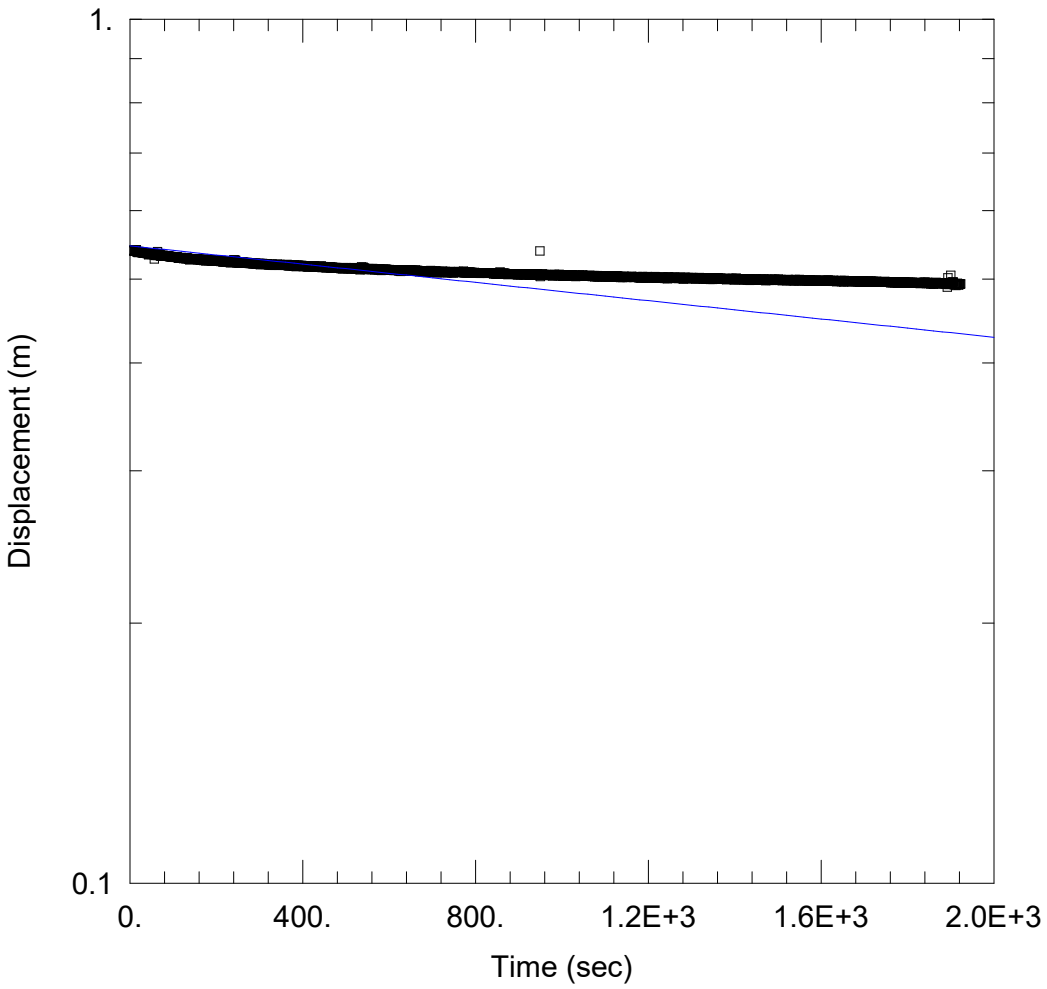
Saturated Thickness: 10.2 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.519 m
Total Well Penetration Depth: 10.2 m
Casing Radius: 0.0254 m
Static Water Column Height: 11.58 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 1.72E-6 m/sec
y0 = 0.5154 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH8 BAIL.aqt
Date: 10/19/22 Time: 16:38:27

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH8

AQUIFER DATA

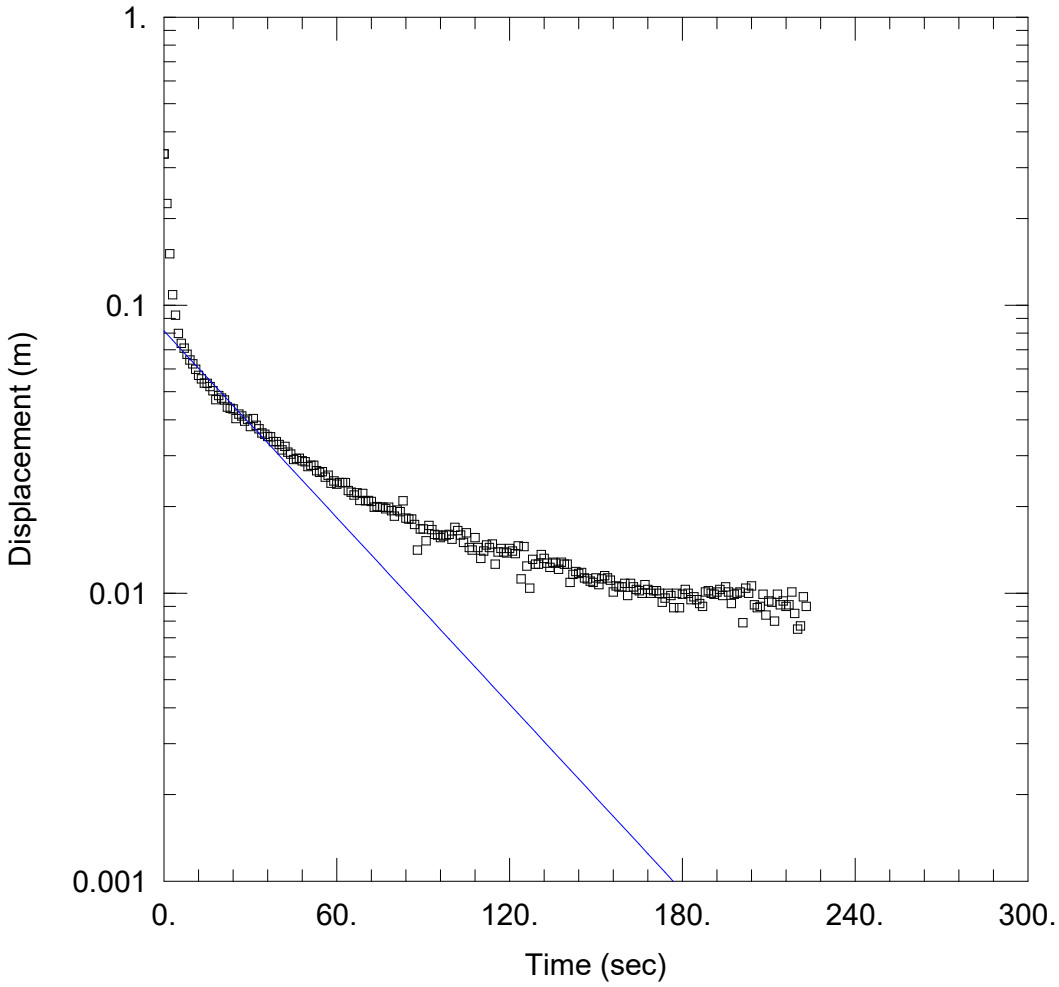
Saturated Thickness: 10.8 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.5401 m
Total Well Penetration Depth: 10.9 m
Casing Radius: 0.0254 m
Static Water Column Height: 12.78 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 7.362E-8 m/sec
y0 = 0.5465 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH9 BAIL.aqt
Date: 10/19/22 Time: 16:38:57

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH9

AQUIFER DATA

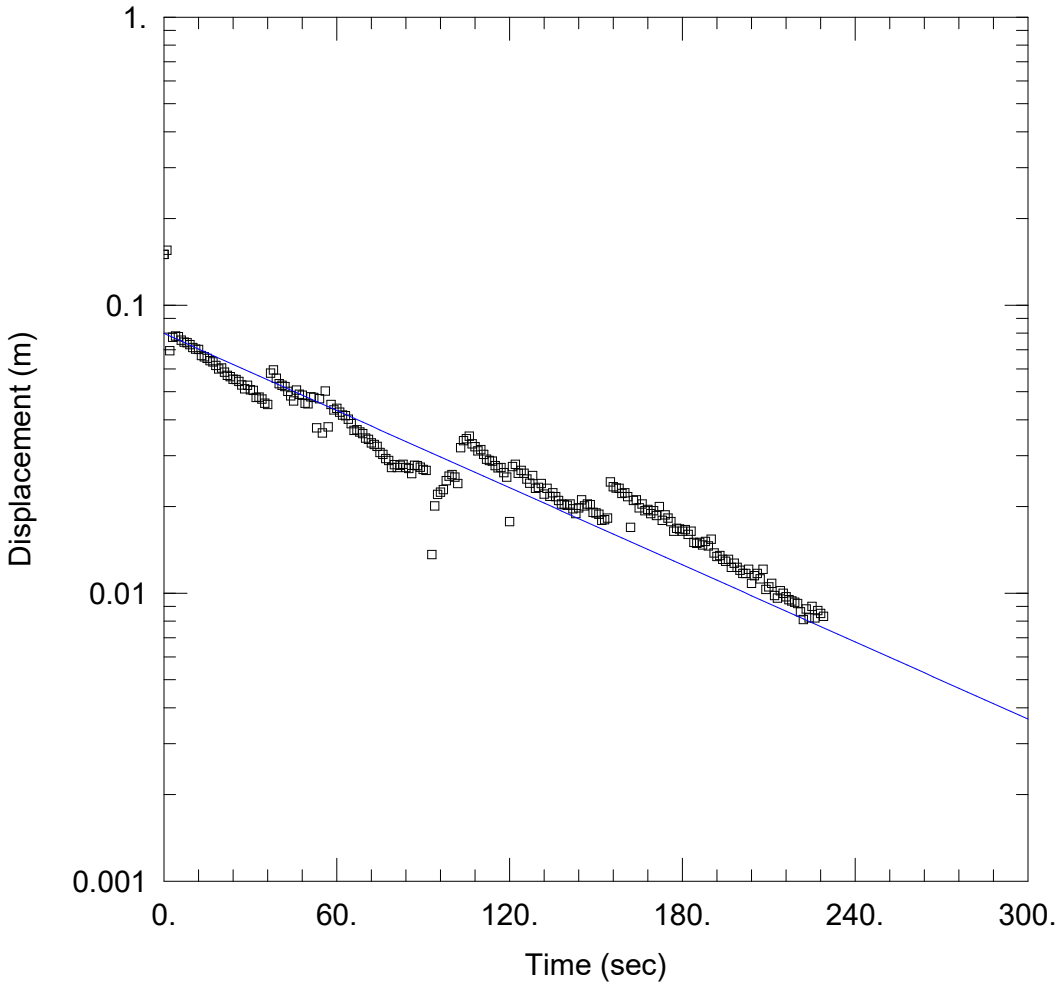
Saturated Thickness: 3.64 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.335 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 3.64 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.18E-5 m/sec
y0 = 0.08132 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH12s BAIL.aqt
Date: 10/19/22 Time: 16:39:09

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH12s

AQUIFER DATA

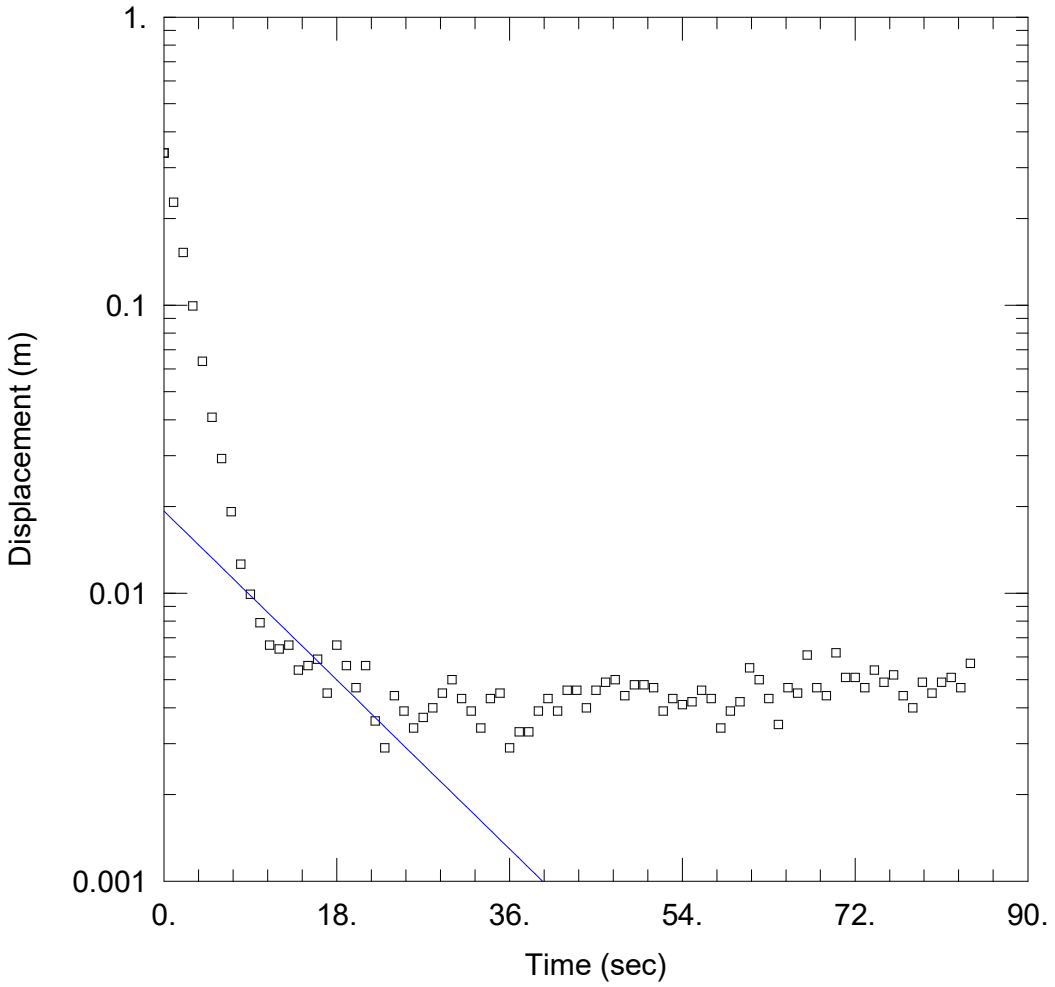
Saturated Thickness: 3.62 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (New Well)

Initial Displacement: 0.15 m
Total Well Penetration Depth: 3.5 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.62 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 5.161E-6 m/sec
y0 = 0.07966 m



WELL TEST ANALYSIS

Data Set: C:\Users\NolanBoyes\Documents\115 Watson BH12d BAIL.aqt
Date: 10/19/22 Time: 16:39:23

PROJECT INFORMATION

Company: Palmer
Client: Tercot
Project: 1510449
Location: 115 Watson
Test Well: BH12d

AQUIFER DATA

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

WELL DATA (New Well)

Initial Displacement: 0.3377 m
Total Well Penetration Depth: 5. m
Casing Radius: 0.0254 m
Static Water Column Height: 8.11 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 4.104E-5 m/sec
y0 = 0.01927 m

Appendix E – Certificate of Analysis (ALS, 2022)

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2210181**	Page	: 1 of 10
Amendment	: 1		
Client	: **Palmer Environmental Consulting Group Inc.**	Laboratory	: Waterloo - Environmental
Contact	: Nolan Boyes	Account Manager	: Karanpartap Singh
Address	: 74 Berkeley Street Toronto ON Canada M5V 1E3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: 19055076910
Project	: 1510449	Date Samples Received	: 09-Aug-2022 16:55
PO	: ----	Issue Date	: 01-Sep-2022 10:06
C-O-C number	: 20-955470		
Sampler	: CLIENT		
Site	: ----		
Quote number	: (Q88296) PALMER 2022 STANDING OFFER		
No. of samples received	: 1		
No. of samples analysed	: 1		

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

Key

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

Workorder Comments

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

Summary of Outliers

Outliers : Quality Control Samples

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

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

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

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

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

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

Matrix: **Water**

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

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) [ON MECP]										
12S	E298	09-Aug-2022	11-Aug-2022	----	----		12-Aug-2022	28 days	3 days	✓
Anions and Nutrients : Bromide in Water by IC										
HDPE [ON MECP]										
12S	E235.Br	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [ON MECP]										
12S	E235.Cl	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	28 days	2 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (0.003 mg/L)										
HDPE [ON MECP]										
12S	E378-T	09-Aug-2022	----	----	----		14-Aug-2022	7 days	5 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [ON MECP]										
12S	E235.F	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	28 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC										
HDPE [ON MECP]										
12S	E235.NO3	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	7 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE [ON MECP]										
12S	E235.NO2	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	7 days	2 days	✓

Matrix: **Water**

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

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Sulfate in Water by IC										
HDPE [ON MECP]										
12S	E235.SO4	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	28 days	2 days	✓
Microbiological Tests : E. coli (MF-mFC-BCIG)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
12S	E012A.EC	09-Aug-2022	----	----	----		11-Aug-2022	48 hrs	47 hrs	✓
Microbiological Tests : Total Coliforms (MF-mEndo)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
12S	E012.TC	09-Aug-2022	----	----	----		11-Aug-2022	48 hrs	47 hrs	✓
Microbiological Tests : Total Coliforms Background (MF-mEndo)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
12S	E012.BG.TC	09-Aug-2022	----	----	----		11-Aug-2022	48 hrs	47 hrs	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [ON MECP]										
12S	E290	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	14 days	2 days	✓
Physical Tests : Colour (Apparent) by Spectrometer										
HDPE [ON MECP]										
12S	E330	09-Aug-2022	----	----	----		11-Aug-2022	48 hrs	47 hrs	✓
Physical Tests : Conductivity in Water										
HDPE [ON MECP]										
12S	E100	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	28 days	2 days	✓
Physical Tests : pH by Meter										
HDPE [ON MECP]										
12S	E108	09-Aug-2022	11-Aug-2022	----	----		11-Aug-2022	14 days	2 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [ON MECP]										
12S	E162	09-Aug-2022	----	----	----		11-Aug-2022	7 days	2 days	✓

Matrix: **Water**

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

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Turbidity by Nephelometry										
HDPE [ON MECP]										
12S	E121	09-Aug-2022	----	----	----		11-Aug-2022	3 days	2 days	✓
Total Metals : Total Metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
12S	E420	09-Aug-2022	10-Aug-2022	----	----		11-Aug-2022	180 days	1 days	✓

Legend & Qualifier Definitions

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

Quality Control Parameter Frequency Compliance

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

Matrix: **Water**

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

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Alkalinity Species by Titration	E290	597460	1	3	33.3	5.0	✓
Ammonia by Fluorescence	E298	598859	1	12	8.3	5.0	✓
Bromide in Water by IC	E235.Br	597464	1	2	50.0	5.0	✓
Chloride in Water by IC	E235.Cl	597466	1	18	5.5	5.0	✓
Colour (Apparent) by Spectrometer	E330	597964	1	2	50.0	5.0	✓
Conductivity in Water	E100	597461	1	10	10.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T	602284	1	7	14.2	5.0	✓
E. coli (MF-mFC-BCIG)	E012A.EC	598242	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	597465	1	3	33.3	5.0	✓
Nitrate in Water by IC	E235.NO3	597462	1	5	20.0	5.0	✓
Nitrite in Water by IC	E235.NO2	597463	1	4	25.0	5.0	✓
pH by Meter	E108	597459	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	597467	1	11	9.0	5.0	✓
TDS by Gravimetry	E162	598494	1	18	5.5	5.0	✓
Total Coliforms (MF-mEndo)	E012.TC	598203	1	10	10.0	5.0	✓
Total Coliforms Background (MF-mEndo)	E012.BG.TC	598204	1	10	10.0	5.0	✓
Total Metals in Water by CRC ICPMS	E420	597155	1	17	5.8	5.0	✓
Turbidity by Nephelometry	E121	598018	1	8	12.5	5.0	✓
Laboratory Control Samples (LCS)							
Alkalinity Species by Titration	E290	597460	1	3	33.3	5.0	✓
Ammonia by Fluorescence	E298	598859	1	12	8.3	5.0	✓
Bromide in Water by IC	E235.Br	597464	1	2	50.0	5.0	✓
Chloride in Water by IC	E235.Cl	597466	1	18	5.5	5.0	✓
Colour (Apparent) by Spectrometer	E330	597964	1	2	50.0	5.0	✓
Conductivity in Water	E100	597461	1	10	10.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T	602284	1	7	14.2	5.0	✓
Fluoride in Water by IC	E235.F	597465	1	3	33.3	5.0	✓
Nitrate in Water by IC	E235.NO3	597462	1	5	20.0	5.0	✓
Nitrite in Water by IC	E235.NO2	597463	1	4	25.0	5.0	✓
pH by Meter	E108	597459	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	597467	1	11	9.0	5.0	✓
TDS by Gravimetry	E162	598494	1	18	5.5	5.0	✓
Total Metals in Water by CRC ICPMS	E420	597155	1	17	5.8	5.0	✓
Turbidity by Nephelometry	E121	598018	1	8	12.5	5.0	✓
Method Blanks (MB)							
Alkalinity Species by Titration	E290	597460	1	3	33.3	5.0	✓
Ammonia by Fluorescence	E298	598859	1	12	8.3	5.0	✓

Matrix: **Water**

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

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Method Blanks (MB) - Continued							
Bromide in Water by IC	E235.Br	597464	1	2	50.0	5.0	✓
Chloride in Water by IC	E235.Cl	597466	1	18	5.5	5.0	✓
Colour (Apparent) by Spectrometer	E330	597964	1	2	50.0	5.0	✓
Conductivity in Water	E100	597461	1	10	10.0	5.0	✓
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T	602284	1	7	14.2	5.0	✓
E. coli (MF-mFC-BCIG)	E012A.EC	598242	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	597465	1	3	33.3	5.0	✓
Nitrate in Water by IC	E235.NO3	597462	1	5	20.0	5.0	✓
Nitrite in Water by IC	E235.NO2	597463	1	4	25.0	5.0	✓
Sulfate in Water by IC	E235.SO4	597467	1	11	9.0	5.0	✓
TDS by Gravimetry	E162	598494	1	18	5.5	5.0	✓
Total Coliforms (MF-mEndo)	E012.TC	598203	1	10	10.0	5.0	✓
Total Coliforms Background (MF-mEndo)	E012.BG.TC	598204	1	10	10.0	5.0	✓
Total Metals in Water by CRC ICPMS	E420	597155	1	17	5.8	5.0	✓
Turbidity by Nephelometry	E121	598018	1	8	12.5	5.0	✓
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	598859	1	12	8.3	5.0	✓
Bromide in Water by IC	E235.Br	597464	1	2	50.0	5.0	✓
Chloride in Water by IC	E235.Cl	597466	1	18	5.5	5.0	✓
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T	602284	1	7	14.2	5.0	✓
Fluoride in Water by IC	E235.F	597465	1	3	33.3	5.0	✓
Nitrate in Water by IC	E235.NO3	597462	1	5	20.0	5.0	✓
Nitrite in Water by IC	E235.NO2	597463	1	4	25.0	5.0	✓
Sulfate in Water by IC	E235.SO4	597467	1	11	9.0	5.0	✓
Total Metals in Water by CRC ICPMS	E420	597155	1	17	5.8	5.0	✓

Methodology References and Summaries

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

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

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Nitrite in Water by IC	E235.NO2 Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC	E235.NO3 Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 Waterloo - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 Waterloo - Environmental	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 Waterloo - Environmental	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Colour (Apparent) by Spectrometer	E330 Waterloo - Environmental	Water	APHA 2120 C (mod)	Colour (Apparent) is measured in an unfiltered sample spectrophotometrically using the single wavelength method. The colour contribution of settleable solids are not included in the result. This method is intended for potable waters. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment.
Dissolved Orthophosphate by Colourimetry (0.003 mg/L)	E378-T Waterloo - Environmental	Water	APHA 4500-P E (mod)	Dissolved Orthophosphate is determined colourimetrically on a water sample that has been lab or field filtered through a 0.45 micron membrane filter. Field filtration is recommended to ensure test results represent conditions at time of sampling.
Total Metals in Water by CRC ICPMS	E420 Waterloo - Environmental	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Hardness (Calculated) from Total Ca/Mg	EC100A Waterloo - Environmental	Water	APHA 2340B	"Hardness (as CaCO3), from total Ca/Mg" is calculated from the sum of total Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters.
Ion Balance using Total Metals	EC101A Waterloo - Environmental	Water	APHA 1030E	Cation Sum (using total metals), Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Sodium Adsorption Ratio [SAR] from Total Metals	EC102 Waterloo - Environmental	Water	CCME Sodium Adsorption Ratio (SAR)	The Sodium Adsorption Ratio (SAR) for a water sample is calculated from the Sodium, Calcium, and Magnesium concentrations of the water, using the same calculations as would be used for a sediment paste extract.
TDS calculated from conductivity	EC103A Waterloo - Environmental	Water	APHA 1030 E	Total dissolved solids (as mg/L) can be estimated by multiplying electrical conductance (in umhos/cm) by 0.65.
Langelier Index using Laboratory pH (Ca-T)	EC105A Waterloo - Environmental	Water	APHA 2330B	Langelier Index provides an indication of scale formation potential at a given pH and temperature, and is calculated as per APHA 2330B Saturation Index. Positive values indicate oversaturation with respect to CaCO3. Negative values indicate undersaturation of CaCO3. This calculation uses laboratory pH measurements and provides estimates of Langelier Index at temperatures of 4, 15, 20, 25, 66, and 77°C.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N Waterloo - Environmental	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).
Total Silicon as Silica (Calculation)	EC420.SiO2 Waterloo - Environmental	Water	N/A	Total Silicon (as SiO2) is a calculated parameter. Total Silicon (as SiO2 mg/L) = 2.139 x Total Silicon (mg/L).

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

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **WT2210181**	Page	: 1 of 13
Amendment	: **1**		
Client	: Palmer Environmental Consulting Group Inc.	Laboratory	: Waterloo - Environmental
Contact	: Nolan Boyes	Account Manager	: Karanpartap Singh
Address	: 74 Berkeley Street Toronto ON Canada M5V 1E3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: 19055076910
Project	: 1510449	Date Samples Received	: 09-Aug-2022 16:55
PO	: ----	Date Analysis Commenced	: 10-Aug-2022
C-O-C number	: 20-955470	Issue Date	: 01-Sep-2022 10:06
Sampler	: CLIENT		
Site	: ----		
Quote number	: (Q88296) PALMER 2022 STANDING OFFER		
No. of samples received	: 1		
No. of samples analysed	: 1		

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

This Quality Control Report contains the following information:

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

Signatories

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

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

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

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

Workorder Comments

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

Laboratory Duplicate (DUP) Report

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

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 597459)											
WT2210129-001	Anonymous	pH	----	E108	0.10	pH units	6.67	6.61	0.904%	4%	----
Physical Tests (QC Lot: 597460)											
WT2210129-001	Anonymous	alkalinity, total (as CaCO3)	----	E290	1.0	mg/L	4.5	3.9	0.6	Diff <2x LOR	----
Physical Tests (QC Lot: 597461)											
WT2210129-001	Anonymous	conductivity	----	E100	1.0	µS/cm	20.8	20.4	1.94%	10%	----
Physical Tests (QC Lot: 597964)											
WT2210098-001	Anonymous	colour, apparent	----	E330	2.0	CU	4.8	<2.0	2.8	Diff <2x LOR	----
Physical Tests (QC Lot: 598018)											
WT2210098-001	Anonymous	turbidity	----	E121	0.10	NTU	<0.10	<0.10	0	Diff <2x LOR	----
Physical Tests (QC Lot: 598494)											
WT2210129-001	Anonymous	solids, total dissolved [TDS]	----	E162	10	mg/L	<10	<10	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 597462)											
WT2210129-001	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L	0.542	0.555	2.50%	20%	----
Anions and Nutrients (QC Lot: 597463)											
WT2210129-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L	0.028	0.028	0.0002	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 597464)											
WT2210129-001	Anonymous	bromide	24959-67-9	E235.Br	0.10	mg/L	<0.10	<0.10	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 597465)											
WT2210129-001	Anonymous	fluoride	16984-48-8	E235.F	0.020	mg/L	<0.020	<0.020	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 597466)											
WT2210129-001	Anonymous	chloride	16887-00-6	E235.Cl	0.50	mg/L	1.51	1.50	0.009	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 597467)											
WT2210129-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	0.57	0.57	0.002	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 598859)											
WT2210050-001	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	0.0987	0.100	1.41%	20%	----
Anions and Nutrients (QC Lot: 602284)											
WT2210181-001	12S	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-T	0.0030	mg/L	<0.0030	<0.0030	0	Diff <2x LOR	----
Microbiological Tests (QC Lot: 598203)											
WT2210206-002	Anonymous	coliforms, total	----	E012.TC	1	CFU/100mL	<1	<1	0	Diff <2x LOR	----
Microbiological Tests (QC Lot: 598204)											
WT2210206-002	Anonymous	coliforms, total background	----	E012.BG.TC	1	CFU/100mL	<1	<1	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Microbiological Tests (QC Lot: 598242)											
WT2210206-003	Anonymous	coliforms, Escherichia coli [E. coli]	----	E012A.EC	1	CFU/100mL	<1	<1	0	Diff <2x LOR	----
Total Metals (QC Lot: 597155)											
WT2210160-001	Anonymous	aluminum, total	7429-90-5	E420	0.0030	mg/L	<0.0030	<0.0030	0	Diff <2x LOR	----
		antimony, total	7440-36-0	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00033	0.00038	0.00004	Diff <2x LOR	----
		barium, total	7440-39-3	E420	0.00010	mg/L	0.164	0.164	0.0268%	20%	----
		beryllium, total	7440-41-7	E420	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		boron, total	7440-42-8	E420	0.010	mg/L	0.018	0.018	0.0002	Diff <2x LOR	----
		cadmium, total	7440-43-9	E420	0.0000050	mg/L	0.0000531	0.0000523	1.52%	20%	----
		calcium, total	7440-70-2	E420	0.050	mg/L	92.3	93.6	1.39%	20%	----
		cesium, total	7440-46-2	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, total	7440-48-4	E420	0.00010	mg/L	0.00054	0.00055	0.000002	Diff <2x LOR	----
		copper, total	7440-50-8	E420	0.00050	mg/L	0.00069	0.00072	0.00003	Diff <2x LOR	----
		iron, total	7439-89-6	E420	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		lead, total	7439-92-1	E420	0.000050	mg/L	0.00584	0.00597	2.09%	20%	----
		lithium, total	7439-93-2	E420	0.0010	mg/L	0.0028	0.0027	0.00005	Diff <2x LOR	----
		magnesium, total	7439-95-4	E420	0.0050	mg/L	26.1	26.6	1.68%	20%	----
		manganese, total	7439-96-5	E420	0.00010	mg/L	0.271	0.277	2.32%	20%	----
		molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.000526	0.000563	6.88%	20%	----
		nickel, total	7440-02-0	E420	0.00050	mg/L	0.00142	0.00139	0.00002	Diff <2x LOR	----
		phosphorus, total	7723-14-0	E420	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		potassium, total	7440-09-7	E420	0.050	mg/L	1.36	1.37	0.835%	20%	----
		rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00069	0.00066	0.00003	Diff <2x LOR	----
		selenium, total	7782-49-2	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		silicon, total	7440-21-3	E420	0.10	mg/L	6.98	7.01	0.514%	20%	----
		silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		sodium, total	7440-23-5	E420	0.050	mg/L	38.8	38.9	0.267%	20%	----
		strontium, total	7440-24-6	E420	0.00020	mg/L	0.173	0.180	3.53%	20%	----
		sulfur, total	7704-34-9	E420	0.50	mg/L	3.49	3.45	0.04	Diff <2x LOR	----
		tellurium, total	13494-80-9	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		thallium, total	7440-28-0	E420	0.000010	mg/L	0.000048	0.000049	0.0000007	Diff <2x LOR	----
		thorium, total	7440-29-1	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 597155) - continued											
WT2210160-001	Anonymous	titanium, total	7440-32-6	E420	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		tungsten, total	7440-33-7	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		uranium, total	7440-61-1	E420	0.000010	mg/L	0.000619	0.000629	1.54%	20%	----
		vanadium, total	7440-62-2	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		zinc, total	7440-66-6	E420	0.0030	mg/L	0.0196	0.0198	0.0002	Diff <2x LOR	----
		zirconium, total	7440-67-7	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----

Method Blank (MB) Report

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

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 597460)						
alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Physical Tests (QCLot: 597461)						
conductivity	----	E100	1	µS/cm	<1.0	----
Physical Tests (QCLot: 597964)						
colour, apparent	----	E330	2	CU	<2.0	----
Physical Tests (QCLot: 598018)						
turbidity	----	E121	0.1	NTU	<0.10	----
Physical Tests (QCLot: 598494)						
solids, total dissolved [TDS]	----	E162	10	mg/L	<10	----
Anions and Nutrients (QCLot: 597462)						
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 597463)						
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Anions and Nutrients (QCLot: 597464)						
bromide	24959-67-9	E235.Br	0.1	mg/L	<0.10	----
Anions and Nutrients (QCLot: 597465)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 597466)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 597467)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 598859)						
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 602284)						
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-T	0.003	mg/L	<0.0030	----
Microbiological Tests (QCLot: 598203)						
coliforms, total	----	E012.TC	1	CFU/100mL	<1	----
Microbiological Tests (QCLot: 598204)						
coliforms, total background	----	E012.BG.TC	1	CFU/100mL	<1	----
Microbiological Tests (QCLot: 598242)						
coliforms, Escherichia coli [E. coli]	----	E012A.EC	1	CFU/100mL	<1	----
Total Metals (QCLot: 597155)						
aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 597155) - continued						
antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
barium, total	7440-39-3	E420	0.0001	mg/L	<0.00010	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
boron, total	7440-42-8	E420	0.01	mg/L	<0.010	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
calcium, total	7440-70-2	E420	0.05	mg/L	<0.050	----
cesium, total	7440-46-2	E420	0.00001	mg/L	<0.000010	----
chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----
iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
lithium, total	7439-93-2	E420	0.001	mg/L	<0.0010	----
magnesium, total	7439-95-4	E420	0.005	mg/L	<0.0050	----
manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	<0.050	----
potassium, total	7440-09-7	E420	0.05	mg/L	<0.050	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	<0.00020	----
selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
silicon, total	7440-21-3	E420	0.1	mg/L	<0.10	----
silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
sodium, total	7440-23-5	E420	0.05	mg/L	<0.050	----
strontium, total	7440-24-6	E420	0.0002	mg/L	<0.00020	----
sulfur, total	7704-34-9	E420	0.5	mg/L	<0.50	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	<0.00020	----
thallium, total	7440-28-0	E420	0.00001	mg/L	<0.000010	----
thorium, total	7440-29-1	E420	0.0001	mg/L	<0.00010	----
tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	<0.00010	----
uranium, total	7440-61-1	E420	0.00001	mg/L	<0.000010	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 597155) - continued						
zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	<0.00020	----

Laboratory Control Sample (LCS) Report

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

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 597459)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 597460)									
alkalinity, total (as CaCO3)	----	E290	1	mg/L	150 mg/L	100	85.0	115	----
Physical Tests (QCLot: 597461)									
conductivity	----	E100	1	µS/cm	1409 µS/cm	99.1	90.0	110	----
Physical Tests (QCLot: 597964)									
colour, apparent	----	E330	2	CU	25 CU	99.7	70.0	130	----
Physical Tests (QCLot: 598018)									
turbidity	----	E121	0.1	NTU	200 NTU	98.0	85.0	115	----
Physical Tests (QCLot: 598494)									
solids, total dissolved [TDS]	----	E162	10	mg/L	1000 mg/L	98.0	85.0	115	----
Anions and Nutrients (QCLot: 597462)									
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	99.3	90.0	110	----
Anions and Nutrients (QCLot: 597463)									
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 597464)									
bromide	24959-67-9	E235.Br	0.1	mg/L	0.5 mg/L	103	85.0	115	----
Anions and Nutrients (QCLot: 597465)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 597466)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 597467)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 598859)									
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	96.8	85.0	115	----
Anions and Nutrients (QCLot: 602284)									
phosphate, ortho-, dissolved (as P)	14265-44-2	E378-T	0.003	mg/L	0.0196 mg/L	107	80.0	120	----
Total Metals (QCLot: 597155)									
aluminum, total	7429-90-5	E420	0.003	mg/L	0.1 mg/L	104	80.0	120	----
antimony, total	7440-36-0	E420	0.0001	mg/L	0.05 mg/L	101	80.0	120	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	0.05 mg/L	101	80.0	120	----
barium, total	7440-39-3	E420	0.0001	mg/L	0.0125 mg/L	101	80.0	120	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Total Metals (QCLot: 597155) - continued									
beryllium, total	7440-41-7	E420	0.00002	mg/L	0.005 mg/L	102	80.0	120	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	0.05 mg/L	98.1	80.0	120	----
boron, total	7440-42-8	E420	0.01	mg/L	0.05 mg/L	96.7	80.0	120	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	0.005 mg/L	101	80.0	120	----
calcium, total	7440-70-2	E420	0.05	mg/L	2.5 mg/L	99.3	80.0	120	----
cesium, total	7440-46-2	E420	0.00001	mg/L	0.0025 mg/L	99.1	80.0	120	----
chromium, total	7440-47-3	E420	0.0005	mg/L	0.0125 mg/L	99.4	80.0	120	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	0.0125 mg/L	98.5	80.0	120	----
copper, total	7440-50-8	E420	0.0005	mg/L	0.0125 mg/L	98.5	80.0	120	----
iron, total	7439-89-6	E420	0.01	mg/L	0.05 mg/L	98.6	80.0	120	----
lead, total	7439-92-1	E420	0.00005	mg/L	0.025 mg/L	102	80.0	120	----
lithium, total	7439-93-2	E420	0.001	mg/L	0.0125 mg/L	103	80.0	120	----
magnesium, total	7439-95-4	E420	0.005	mg/L	2.5 mg/L	107	80.0	120	----
manganese, total	7439-96-5	E420	0.0001	mg/L	0.0125 mg/L	103	80.0	120	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.0125 mg/L	98.8	80.0	120	----
nickel, total	7440-02-0	E420	0.0005	mg/L	0.025 mg/L	99.3	80.0	120	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	0.5 mg/L	106	80.0	120	----
potassium, total	7440-09-7	E420	0.05	mg/L	2.5 mg/L	101	80.0	120	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	0.005 mg/L	101	80.0	120	----
selenium, total	7782-49-2	E420	0.00005	mg/L	0.05 mg/L	99.3	80.0	120	----
silicon, total	7440-21-3	E420	0.1	mg/L	0.5 mg/L	108	80.0	120	----
silver, total	7440-22-4	E420	0.00001	mg/L	0.005 mg/L	91.2	80.0	120	----
sodium, total	7440-23-5	E420	0.05	mg/L	2.5 mg/L	108	80.0	120	----
strontium, total	7440-24-6	E420	0.0002	mg/L	0.0125 mg/L	98.6	80.0	120	----
sulfur, total	7704-34-9	E420	0.5	mg/L	2.5 mg/L	105	80.0	120	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	0.005 mg/L	97.6	80.0	120	----
thallium, total	7440-28-0	E420	0.00001	mg/L	0.05 mg/L	103	80.0	120	----
thorium, total	7440-29-1	E420	0.0001	mg/L	0.005 mg/L	103	80.0	120	----
tin, total	7440-31-5	E420	0.0001	mg/L	0.025 mg/L	97.8	80.0	120	----
titanium, total	7440-32-6	E420	0.0003	mg/L	0.0125 mg/L	99.5	80.0	120	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	0.005 mg/L	98.0	80.0	120	----
uranium, total	7440-61-1	E420	0.00001	mg/L	0.00025 mg/L	104	80.0	120	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	0.025 mg/L	102	80.0	120	----
zinc, total	7440-66-6	E420	0.003	mg/L	0.025 mg/L	101	80.0	120	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	0.005 mg/L	97.2	80.0	120	----

Matrix Spike (MS) Report

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

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 597462)										
WT2210129-001	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	2.51 mg/L	2.5 mg/L	100	75.0	125	----
Anions and Nutrients (QCLot: 597463)										
WT2210129-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.513 mg/L	0.5 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 597464)										
WT2210129-001	Anonymous	bromide	24959-67-9	E235.Br	0.50 mg/L	0.5 mg/L	101	75.0	125	----
Anions and Nutrients (QCLot: 597465)										
WT2210129-001	Anonymous	fluoride	16984-48-8	E235.F	1.02 mg/L	1 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 597466)										
WT2210129-001	Anonymous	chloride	16887-00-6	E235.Cl	101 mg/L	100 mg/L	101	75.0	125	----
Anions and Nutrients (QCLot: 597467)										
WT2210129-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	101 mg/L	100 mg/L	101	75.0	125	----
Anions and Nutrients (QCLot: 598859)										
WT2210050-001	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.100 mg/L	0.1 mg/L	100	75.0	125	----
Anions and Nutrients (QCLot: 602284)										
WT2210181-001	12S	phosphate, ortho-, dissolved (as P)	14265-44-2	E378-T	0.0164 mg/L	0.0196 mg/L	83.8	70.0	130	----
Total Metals (QCLot: 597155)										
WT2210160-002	Anonymous	aluminum, total	7429-90-5	E420	0.103 mg/L	0.1 mg/L	103	70.0	130	----
		antimony, total	7440-36-0	E420	0.0531 mg/L	0.05 mg/L	106	70.0	130	----
		arsenic, total	7440-38-2	E420	0.0506 mg/L	0.05 mg/L	101	70.0	130	----
		barium, total	7440-39-3	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		beryllium, total	7440-41-7	E420	0.00511 mg/L	0.005 mg/L	102	70.0	130	----
		bismuth, total	7440-69-9	E420	0.0473 mg/L	0.05 mg/L	94.6	70.0	130	----
		boron, total	7440-42-8	E420	0.048 mg/L	0.05 mg/L	97.1	70.0	130	----
		cadmium, total	7440-43-9	E420	0.00502 mg/L	0.005 mg/L	100	70.0	130	----
		calcium, total	7440-70-2	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		cesium, total	7440-46-2	E420	0.00258 mg/L	0.0025 mg/L	103	70.0	130	----
		chromium, total	7440-47-3	E420	0.0124 mg/L	0.0125 mg/L	99.6	70.0	130	----
		cobalt, total	7440-48-4	E420	0.0121 mg/L	0.0125 mg/L	97.0	70.0	130	----
		copper, total	7440-50-8	E420	0.0118 mg/L	0.0125 mg/L	94.6	70.0	130	----
		iron, total	7439-89-6	E420	ND mg/L	0.05 mg/L	ND	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Total Metals (QCLot: 597155) - continued										
WT2210160-002	Anonymous	lead, total	7439-92-1	E420	0.0241 mg/L	0.025 mg/L	96.2	70.0	130	----
		lithium, total	7439-93-2	E420	0.0125 mg/L	0.0125 mg/L	99.7	70.0	130	----
		magnesium, total	7439-95-4	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		manganese, total	7439-96-5	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		molybdenum, total	7439-98-7	E420	0.0130 mg/L	0.0125 mg/L	104	70.0	130	----
		nickel, total	7440-02-0	E420	0.0240 mg/L	0.025 mg/L	95.8	70.0	130	----
		phosphorus, total	7723-14-0	E420	0.534 mg/L	0.5 mg/L	107	70.0	130	----
		potassium, total	7440-09-7	E420	2.45 mg/L	2.5 mg/L	98.0	70.0	130	----
		rubidium, total	7440-17-7	E420	0.00528 mg/L	0.005 mg/L	106	70.0	130	----
		selenium, total	7782-49-2	E420	0.0506 mg/L	0.05 mg/L	101	70.0	130	----
		silicon, total	7440-21-3	E420	ND mg/L	0.5 mg/L	ND	70.0	130	----
		silver, total	7440-22-4	E420	0.00456 mg/L	0.005 mg/L	91.2	70.0	130	----
		sodium, total	7440-23-5	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		strontium, total	7440-24-6	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		sulfur, total	7704-34-9	E420	2.65 mg/L	2.5 mg/L	106	70.0	130	----
		tellurium, total	13494-80-9	E420	0.00501 mg/L	0.005 mg/L	100	70.0	130	----
		thallium, total	7440-28-0	E420	0.0492 mg/L	0.05 mg/L	98.3	70.0	130	----
		thorium, total	7440-29-1	E420	0.00511 mg/L	0.005 mg/L	102	70.0	130	----
		tin, total	7440-31-5	E420	0.0253 mg/L	0.025 mg/L	101	70.0	130	----
		titanium, total	7440-32-6	E420	0.0126 mg/L	0.0125 mg/L	101	70.0	130	----
		tungsten, total	7440-33-7	E420	0.00488 mg/L	0.005 mg/L	97.7	70.0	130	----
		uranium, total	7440-61-1	E420	0.000249 mg/L	0.00025 mg/L	99.7	70.0	130	----
		vanadium, total	7440-62-2	E420	0.0260 mg/L	0.025 mg/L	104	70.0	130	----
		zinc, total	7440-66-6	E420	0.0234 mg/L	0.025 mg/L	93.7	70.0	130	----
		zirconium, total	7440-67-7	E420	0.00520 mg/L	0.005 mg/L	104	70.0	130	----

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 955470

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Report To	Contact and company name below will appear on the final report
Company:	Palmer Environmental Consulting Group Inc.
Contact:	
Phone:	
	Company address below will appear on the final report
Street:	74 Berkeley Street
City/Province:	Toronto, ON
Postal Code:	M5A 2W7
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	Palmer
Contact:	Accounting

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: nolan.boyes@peeg.ca

Email 2:

Email 3:

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: accounting@peeg.ca

Email 2: sarah.sipak@peeg.ca

Turnaround Time (TAT) Requested

☑ 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.

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

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

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Project Information

ALS Account # / Quote #:

Job #: 1510494 Phase: Groundwater Monitoring

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (ALS use only): WT2210181

ALS Contact: Sampler:

Analysis Request

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

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	Potability	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	125	09-Aug-22	1:00	W		✓			

Environmental Division
Waterloo
Work Order Reference
WT2210181

Telephone : +1 519 886 6910

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 ODWS

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			
1.0°C				9.3			

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
	Aug 9/22	14:00

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
AARAV BUTA	9-Aug-2022	16:55

FINAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
JS	08/10/22	4:30

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**.

CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2210181**	Page	: 1 of 6
Amendment	: **1**		
Client	: **Palmer Environmental Consulting Group Inc.**	Laboratory	: Waterloo - Environmental
Contact	: Nolan Boyes	Account Manager	: Karanpartap Singh
Address	: 74 Berkeley Street Toronto ON Canada M5V 1E3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: 19055076910
Project	: 1510449	Date Samples Received	: 09-Aug-2022 16:55
PO	: ----	Date Analysis Commenced	: 10-Aug-2022
C-O-C number	: 20-955470	Issue Date	: 01-Sep-2022 10:06
Sampler	: CLIENT		
Site	: ----		
Quote number	: (Q88296) PALMER 2022 STANDING OFFER		
No. of samples received	: 1		
No. of samples analysed	: 1		

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

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

Signatories

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

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

General Comments

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

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

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

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

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

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

Unit	*Description*
-	No Unit
%	percent
µS/cm	Microsiemens per centimetre
CFU/100mL	colony forming units per 100 mL
CU	colour units (1 CU = 1 mg/L Pt)
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units

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

Qualifiers

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

Analytical Results

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

Analyte	Method	LOR	Unit	Client sample ID: 12S Sampling date/time: 09-Aug-2022 13:00 WT2210181-001	ONDWS AO/OG	ONDWS MAC				
Physical Tests										
alkalinity, bicarbonate (as HCO3)	E290	1.0	mg/L	378						
alkalinity, carbonate (as CO3)	E290	1.0	mg/L	<1.0						
alkalinity, hydroxide (as OH)	E290	1.0	mg/L	<1.0						
alkalinity, total (as CaCO3)	E290	1.0	mg/L	310	30 - 500 mg/L					
colour, apparent	E330	2.0	CU	67.2	5 CU					
conductivity	E100	1.0	µS/cm	1040						
hardness (as CaCO3), from total Ca/Mg	EC100A	0.50	mg/L	371						
pH	E108	0.10	pH units	7.62	6.5 - 8.5 pH units					
solids, total dissolved [TDS], calculated	EC103A	1.0	mg/L	676						
solids, total dissolved [TDS]	E162	10	mg/L	562 DLDS	500 mg/L					
turbidity	E121	0.10	NTU	32.5	5 NTU					
Langelier index (@ 20°C)	EC105A	0.010	-	0.624						
Langelier index (@ 4°C)	EC105A	0.010	-	0.377						
pH, saturation (@ 20°C)	EC105A	0.010	pH units	7.00						
pH, saturation (@ 4°C)	EC105A	0.010	pH units	7.24						
Anions and Nutrients										
ammonia, total (as N)	E298	0.0050	mg/L	0.0317						
bromide	E235.Br	0.10	mg/L	<0.10						
chloride	E235.Cl	0.50	mg/L	146	250 mg/L					
fluoride	E235.F	0.020	mg/L	0.072		1.5 mg/L				
nitrate (as N)	E235.NO3	0.020	mg/L	<0.020		10 mg/L				
nitrate + nitrite (as N)	EC235.N+N	0.0032	mg/L	<0.0224		10 mg/L				
nitrite (as N)	E235.NO2	0.010	mg/L	<0.010		1 mg/L				
phosphate, ortho-, dissolved (as P)	E378-T	0.0030	mg/L	<0.0030						
sulfate (as SO4)	E235.SO4	0.30	mg/L	17.3						
Microbiological Tests										
coliforms, Escherichia coli [E. coli]	E012A.EC	1	CFU/100mL	<1		1 CFU/100mL				
coliforms, total background	E012.BG.TC	1	CFU/100mL	>2000 DLM						

Analyte	Method	LOR	Unit	WT2210181-001 (Continued)	ONDWS AO/OG	ONDWS MAC				
Microbiological Tests - Continued										
coliforms, total	E012.TC	1	CFU/100mL	130 DLM		1 CFU/100mL				
Metals										
sodium adsorption ratio [SAR]	EC102	0.10	-	1.98						
Ion Balance										
anion sum	EC101A	0.10	meq/L	10.7						
cation sum (total)	EC101A	0.10	meq/L	11.3						
ion balance (APHA)	EC101A	0.010	%	2.73						
ion balance (cations/anions)	EC101A	0.010	%	106						
Total Metals										
aluminum, total	E420	0.0030	mg/L	0.489	0.1 mg/L					
antimony, total	E420	0.00010	mg/L	0.00012		0.006 mg/L				
arsenic, total	E420	0.00010	mg/L	0.00036		0.01 mg/L				
barium, total	E420	0.00010	mg/L	0.0390		1 mg/L				
beryllium, total	E420	0.000020	mg/L	0.000021						
bismuth, total	E420	0.000050	mg/L	<0.000050						
boron, total	E420	0.010	mg/L	0.027		5 mg/L				
cadmium, total	E420	0.0000050	mg/L	0.000232		0.005 mg/L				
calcium, total	E420	0.050	mg/L	99.2						
cesium, total	E420	0.000010	mg/L	0.000053						
chromium, total	E420	0.00050	mg/L	0.00102		0.05 mg/L				
cobalt, total	E420	0.00010	mg/L	0.00032						
copper, total	E420	0.00050	mg/L	0.00242	1 mg/L					
iron, total	E420	0.010	mg/L	0.634	0.3 mg/L					
lead, total	E420	0.000050	mg/L	0.00381		0.01 mg/L				
lithium, total	E420	0.0010	mg/L	0.0018						
magnesium, total	E420	0.0050	mg/L	29.9						
manganese, total	E420	0.00010	mg/L	0.0391	0.05 mg/L					
molybdenum, total	E420	0.000050	mg/L	0.000246						
nickel, total	E420	0.00050	mg/L	0.00134						
phosphorus, total	E420	0.050	mg/L	<0.050						
potassium, total	E420	0.050	mg/L	1.82						
rubidium, total	E420	0.00020	mg/L	0.00162						
selenium, total	E420	0.000050	mg/L	0.000050		0.05 mg/L				
silicon (as SiO2), total	EC420.SiO2	0.25	mg/L	10.7						
silicon, total	E420	0.10	mg/L	5.02						
silver, total	E420	0.000010	mg/L	<0.000010						
sodium, total	E420	0.050	mg/L	87.6	200 mg/L	20 mg/L				

Analyte	Method	LOR	Unit	WT2210181-001 (Continued)	ONDWS AO/OG	ONDWS MAC				
Total Metals - Continued										
strontium, total	E420	0.00020	mg/L	0.195						
sulfur, total	E420	0.50	mg/L	6.60						
tellurium, total	E420	0.00020	mg/L	<0.00020						
thallium, total	E420	0.000010	mg/L	0.000019						
thorium, total	E420	0.00010	mg/L	<0.00010						
tin, total	E420	0.00010	mg/L	0.00018						
titanium, total	E420	0.00030	mg/L	0.0167						
tungsten, total	E420	0.00010	mg/L	<0.00010						
uranium, total	E420	0.000010	mg/L	0.000487		0.02 mg/L				
vanadium, total	E420	0.00050	mg/L	0.00099						
zinc, total	E420	0.0030	mg/L	0.0610	5 mg/L					
zirconium, total	E420	0.00020	mg/L	0.00027						

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

Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
12S	Water	colour, apparent	May interfere with disinfection; removal is important to ensure effective treatment.	ONDWS	AO/OG	67.2 CU	5 CU
	Water	solids, total dissolved [TDS]	Based on taste; TDS above 500 mg/L results in excessive scaling in water pipes, water heaters, boilers and appliances; TDS is composed of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate and nitrate.	ONDWS	AO/OG	562 mg/L	500 mg/L
	Water	turbidity	Filtration systems should be designed and operated to reduce turbidity levels as low as reasonably achievable and strive to achieve a treated water turbidity target from individual filters of less than 0.1 NTU. Particles can harbour microorganisms, protecting them from disinfection, and can entrap heavy metals and biocides; elevated or fluctuating turbidity in filtered water can indicate a problem with the water treatment process and a potential increased risk of pathogens in treated water.	ONDWS	AO/OG	32.5 NTU	5 NTU
	Water	aluminum, total	There is no consistent, convincing evidence that aluminum in drinking water causes adverse health effects in humans. The operational guideline applies to treatment plants using aluminum-based coagulants; it does not apply to naturally occurring aluminum found in groundwater. For treatment plants using aluminum-based coagulants, monthly samples should be taken of the water leaving the plant; the OGs are based on a running annual average of monthly samples.	ONDWS	AO/OG	0.489 mg/L	0.1 mg/L
	Water	iron, total	Based on taste and staining of laundry and plumbing fixtures; no evidence exists of dietary iron toxicity in the general population.	ONDWS	AO/OG	0.634 mg/L	0.3 mg/L
	Water	coliforms, total	Total coliforms are not used as indicators of potential health effects from pathogenic microorganisms; they are used as a tool to determine how well the drinking water treatment system is operating and to indicate water quality changes in the distribution system. Detection of total coliforms from consecutive samples from the same site or from more than 10% of the samples collected in a given sampling period should be investigated.	ONDWS	MAC	130 CFU/100mL	1 CFU/100mL
	Water	sodium, total	Based on taste; where a sodium-based water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended.	ONDWS	MAC	87.6 mg/L	20 mg/L

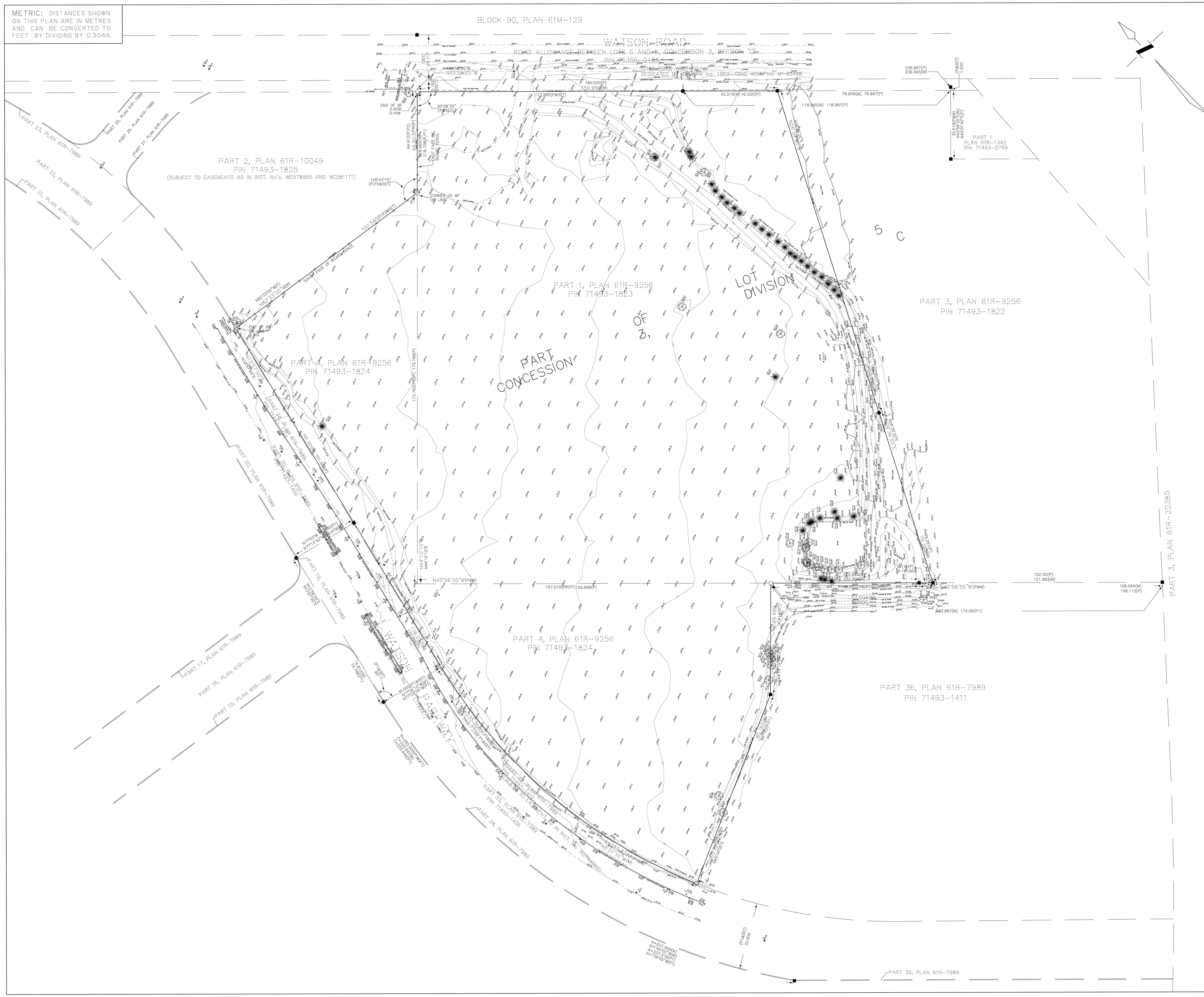
Key:

ONDWS — Ontario Drinking Water Regulation (JAN, 2020)

AO/OG — Aesthetic Objective/Operational Guideline

MAC — Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2018)

Appendix F – Topographic Profile (Schaeffer, 2022, Odan/DeTech, 2022)



PLAN OF SURVEY OF

PART OF LOT 5, CONCESSION 3, DIVISION 'C'

(GEOGRAPHIC TOWNSHIP OF GUELPH)

CITY OF GUELPH

COUNTY OF WELLINGTON

SCALE 1:750

20 10 0 20 40 60 80 METRES

TOPOGRAPHIC NOTES

CB	DENOTES	CATCH BASIN
MH	DENOTES	MANHOLE
WV	DENOTES	WATER VALVE
UP	DENOTES	UTILITY POLE
OW	DENOTES	OVERHEAD WIRES
D/T 0.10	DENOTES	DECIDUOUS TREE 0.10m dia.
C/T 0.10	DENOTES	CONIFEROUS TREE 0.10m dia.
L	DENOTES	LIGHT
H	DENOTES	HYDRO
FH	DENOTES	FIRE HYDRANT
CSP (500)	DENOTES	CORRUGATED STEEL PIPE (500mm DIA.)
G/MARK	DENOTES	BURIED GAS MARKER
GUY	DENOTES	GUY WIRE/POLE
INV	DENOTES	CULVERT INVERT

BENCHMARK

ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE REFERRED TO CITY OF GUELPH BENCHMARK No. 413 HAVING A PUBLISHED ELEVATION OF 330.034 METRES

CONTOUR INTERVAL 0.50m

DURING THE SURVEY WE ATTEMPTED TO UNCOVER ALL SURFACE FEATURES, HOWEVER, WE ARE NOT LIABLE FOR ANY SUCH FEATURES THAT WERE COVERED BY SNOW OR ICE AT THE TIME OF THE SURVEY.

NOTES

■	DENOTES	FOUND MONUMENT
□	"	PLANTED MONUMENT
SSIB	"	SHORT STANDARD IRON BAR
SIB	"	STANDARD IRON BAR
IB	"	IRON BAR
P	"	PLAN 61R-9256
P1	"	PLAN 61R-7989 (PLAN 61R-7944)
P2	"	PLAN 61R-10049
M	"	MEASURED
PROP	"	PROPORTIONED
375	"	BLACK, SHOEMALER, ROBINSON & DONALDSON LIMITED, O.L.S.'s
VH	"	M.P. VAN HARTEN, O.L.S.
WIT	"	WITNESS
BF	"	BOARD FENCE

BEARINGS ARE GRID DERIVED FROM THE 6° UTM CO-ORDINATE SYSTEM ZONE 17, NAD 83 (ORIGINAL).

SURVEYOR'S CERTIFICATE

I CERTIFY THAT:

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON THE DAY OF , 2022.

DATE :

DAN DZALDOV
ONTARIO LAND SURVEYOR

SCHAEFFER DZALDOV BENNETT LTD.
ONTARIO LAND SURVEYORS
64 JARDIN DRIVE CONCORD, ONTARIO L4K 3P3 TEL.(416)987-0101

CALC. JZ	DRAWN ACAD/LW	CHECKED	SCALE 1:750	JOB NO. 22-006-00

FEBRUARY 28, 2022