Hydrogeological Investigation Report

Proposed Residential Development
280 Clair Road West
Guelph, Ontario

Client:
John Farley and Home Opportunities

Attention:
John Farley

Type of Document:
Final Report

Project Number:
G4836-24-3

Project Name:
Proposed Residential Development

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Date Submitted:
January 29, 2025

Version Control

	First Issue		Final Issue	
Project Number	G4836-24-3		G4836-24-3	
Report Title	Hydrogeological Investigation Report Proposed Residential Development, 280 Clair Road West, Guelph, Ontario		Hydrogeological Investigation Report Proposed Residential Development, 280 Clair Road West, Guelph, Ontario	
Version Number	1		2	
Remarks	Draft Report		Final Report	
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Initials	Draft Report			
Date	September 4, 2024		January 29, 2025	

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1. Introduction

1.1 Project Description

JLP Services Inc. (JLP) was retained by John Farley and Home Opportunities ("Client") to conduct a Hydrogeological Investigation for the proposed residential development located at 280 Clair Road West, Guelph, Ontario, herein referred to as the "Site" and "Subject Property".

The Site is currently vacant. The Site is an irregular-shaped parcel of land and is surrounded by parkland, an urban reserve, a high school, and industrial properties. Residential and industrial properties were noted within the near surrounding areas.

The Site location is shown in Figure 1.

As per the information presented in the drawings from Architecture Unfolded, JLP understands that the development includes approximately 960 residential units spread over thirty-one (31) cluster townhouse buildings with 318 units, two (2) apartment buildings with 16-storey and 14-storey towers and one six-storey parking structure. JLP understands that the two (2) apartment buildings will be completed with one-level of basement, the 6-storey parking structure with a partial basement and cluster townhouses will be of slab-on-grade construction. An on-grade parking lot is located on the northwestern portion of the site and associated driveway and greenspace areas are proposed throughout the site.

However, the site configuration is subject to change. Final details of the proposed development were not available for review during the preparation of this report.

JLP conducted a Geotechnical Investigation in conjunction with this study. Pertinent information gathered from the geotechnical investigation was utilized for the completion of this report.

Limitations and Use of Report (Report Terms and Conditions) are provided in Appendix A.

1.2 Project Objectives and Scope of Work

The main objectives of the proposed hydrogeological investigation are provided below:

- Characterize regional and site-specific hydrogeological conditions;
- Estimate construction and post-construction dewatering rates and evaluate potential dewatering related impacts;
- Evaluate permitting requirements for construction and post-construction dewatering (if applicable) activities; and,
- Preparation of a Hydrogeological Investigation report.

This hydrogeological investigation report was prepared to satisfy the Ministry of the Environment, Conservation and Parks (MECP), Grand River Conservation Authority (GRCA), and the City of Guelph.

To achieve the investigation objectives, JLP has completed the following scope of work:

Information Review

- Reviewed available geological and hydrogeological information for the Site including established maps and public reports;
- Reviewed the MECP and GRCA mapping on Wellhead Protection Areas (WHPA), Highly Vulnerable Aquifers (HVA), Significant Groundwater Recharge Areas (SGRA) and other hydrogeologically sensitive areas (e.g., karstic areas); and,
- Searched MECP water well records database for existing water wells within 500 m of the property boundary.

Field Program

- Drilled and installed seven (7) monitoring wells at selected locations on-site to a maximum depth of approximately 9 metres below ground surface (mbgs) with 3.1 m long and 50 mm diameter screens, as part of the combined drilling program;
- Developed and conducted Single Well Response Tests (SWRT) on five (5) monitoring wells installed on-site to evaluate hydraulic properties of the saturated stratigraphic units at the Site;

  Note: two (2) monitoring wells were dry at the time of SWRT testing
- Completed four (4) rounds of groundwater level measurements at all monitoring wells after well development;
- Completed elevation survey at all monitoring wells for geodetic elevations;
- Completed six (6) in-situ infiltration rate tests at three (3) selected locations using Guelph Permeameter at 0.5 m and 1.5 m below ground surface to provide infiltration rates across the Site;
- Collected one (1) groundwater sample from a selected monitoring well for laboratory analysis and screening against the City of Guelph Sanitary and Storm Sewer By-Law criteria; and,
- Conduct one-year seasonal groundwater level monitoring program including continual water level monitoring using data loggers at five (5) selected monitoring wells.

  Note: The seasonal groundwater level monitoring program is currently in progress. An addendum report will be issued when the full 12-month data has been collected.

Data Evaluation

- Evaluated the information collected during the field investigation program including, but not limited to; borehole geological information, SWRT results, groundwater level measurements, and groundwater water quality;
- Prepared site-specific surface and bedrock geological maps, Site plans, groundwater contours, and cross sections;
- Estimated construction dewatering flow rates (short-term), assessed potential impacts, and recommended mitigation measures; and,
- Evaluated requirement of MECP water taking permits (permit to take water / Environmental Activity and Sector Registry [EASR]) and discharge agreements with the relevant municipality/Region.

Reporting

- Prepared Hydrogeological Investigation Report which summarizes the work completed on the site to satisfy regulatory authorities having jurisdiction.
    - This report provides information on site setting, desktop review of geological and hydrogeological information, groundwater quality, results of field investigation program, and construction dewatering requirements and potential impacts on the surrounding environment.
- Preparation of technical memorandum detailing seasonal groundwater level monitoring results (manual and continual)- currently ongoing.

1.3 Review of Previous Reports

The following report was reviewed as part of this hydrogeological investigation:

- JLP Services Inc. (January 29, 2025). Geotechnical Investigation Report, Proposed Residential Development, 280 Clair Road West, Guelph, Ontario, prepared for John Farley and Home Opportunities.

2. Regional and Local Hydrogeology

2.1 Regional Setting

2.1.1 Regional Physiology

The Site is located within a physiographic region named the Horseshoe Moraines, and a physiographic landform named as the Till Moraines.

The Horseshoe Moraines occupies an area of approximately 5,590 km^2 lying to the west of the highest part of the Niagara Escarpment. The "toe" of the horseshoe-shaped region lies on the highest part of the upland south of Georgian Bay at about 518 m above sea level (masl), while the two "heels" are about 274 m lower (Chapman & Putman, 2007).

Associated meltwater stream deposits give the region two main landform types; (a) irregular, stony knobs and ridges, and (b) pitted sand and gravel terraces and swampy valley floors.

2.1.2 Regional Geology and Hydrogeology

The surficial geology of the subject property and surrounding area is mapped as glaciofluvial deposits (gravelly river deposits and delta topset facies) in the west to northwest, stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain in the south to southeast and ice-contact stratified deposits (sand and gravel, minor silt, clay and till) in the northeast (Ontario Geological Survey, 2010). Based on the surficial geology/mapping, the Site is an intersection of glaciofluvial, ice contact and stone poor deposits.

The dominant bedrock geology of the area is mapped as Lower Silurian sandstone, shale, dolostone, and siltstone belonging to the Guelph Formation. The bedrock in the area shows potential karstic conditions.

The surficial and bedrock geology of the Site and surrounding areas are shown in Figures 2 and 3, respectively.

The Site area is located within the Ellis Creek-Speed River watershed and Hanlon Creek sub-watershed which eventually joins the Speed River. Regional groundwater flow in the area is in a northwest direction, towards the Speed River. It is expected that groundwater flow directions may vary locally from the regional flow directions due to various natural factors including local topographic and stratigraphic variations, submerged riverbeds, and engineering structures such as buildings and infrastructure.

2.2 Vulnerable Areas Assessment

The site is located within the Grand River Source Protection Area. Published maps and websites for GRCA and the MECP were reviewed to identify if the Site footprint is included in any regulated areas.

It should be noted that the area of the proposed development does not fall within a GRCA regulated area.

The following regulated areas were considered during the above information search:

- Wellhead Protection Areas (WHPA) – The Site area is located within Wellhead Protection Area C (WHPA-C) with a low vulnerability score of 4. The Site is located outside WHPA under the direct influence of surface water (WHPA-E).

- WHPA – Q (Water Quantity) – The Site area is located outside of mapped WHPA Q1/Q2 (Water Quantity).
- Significant Groundwater Recharge Areas (SGRA) – The Site area is located within mapped SGRA, with an unspecified vulnerability score.
- Highly Vulnerable Aquifer Areas - The Site is located outside the mapped highly vulnerable aquifer areas.
- Intake Protection Zones (IPZ) - Intake Protection Zones are the area of water and land surrounding a municipal surface water intake. The closest Intake Protection Zone (IPZ3) is located approximately 200 m southeast of the Site.
- Paris-Galt Moraine – The southern part of the Site is located within the Paris-Galt Moraine area.
- Karst Areas – The Site is located within an area categorized as a potential karstic area.

The location of the Site in relation to vulnerable areas is shown in Figures 4-1 to 4-8.

2.3 Existing Water Wells

Water Well Records (WWRs) from the database maintained by the MECP were reviewed to determine the number of water wells within a 500 m buffer from the Site centroid. The locations of the MECP WWR are shown in Figure 5. A summary of the WWR is included in Appendix B.

The MECP WWR database indicates a total of 43 wells within 500 m distance from the site boundaries, including one domestic water supply well, one livestock water supply well and three observation wells located on-Site. The off-site wells are recorded as; domestic water supply wells (1), abandoned wells (6), observation/monitoring/ testing wells (24), dewatering and test wells (1), municipal test wells (1) and unidentified wells (5).

The recorded water found depths ranged from approximately 3.6 to 4.9 mbgs.

The closest water supply well (for domestic use) outside the Site is located approximately 100 m away from the Site boundary. Existing water supply wells within 500 m of the Site boundary were installed from 1963 to 1977.

The Site and surrounding areas are serviced by municipal water supply.

2.4 Site Setting

2.4.1 Site Topography and Surface Water Features

As per elevation survey results at borehole/monitoring well locations, the surface elevation of the Site area varies from approximately 333.21 to 342.15 masl, which indicates an approximate difference of about 8.94 m between the highest and lowest elevations at borehole/monitoring well locations. The topography of the site area can be considered sloped towards the northwest across the property.

The Site is zoned as parkland (P.1) and urban reserve (UR) under the City of Guelph Zoning By-law (2023)-20790.

The Site area is located within the Ellis Creek-Speed River watershed and Hanlon Creek sub-watershed. The nearest surface water feature is a tributary of Hanlon Creek, which runs approximately 700 m northwest of the Site boundary. Available area maps show that no streams or surface waterbodies exist on-Site.

2.4.2 Local Geology and Hydrogeology

A summary of subsurface soil stratigraphy at the Site is provided in the following paragraphs.

Appendix C provides geological logs for boreholes with detailed soil profiles. The borehole location plan and interpreted geological cross sections are presented in Figures 6, 7 and 8.

It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the hydrogeological investigation and shall not be interpreted as exact planes of geological change.

Refer to the geotechnical investigation report (JLP, January 2025) for a detailed description of the subsurface soil stratigraphy at the Site.

A layer of **topsoil**, about 175 to 400mm thick, was encountered at the surface of all boreholes. The topsoil consisted of dark brown to brown silty sand, some gravel with scattered organic inclusions. The topsoil was generally dark brown in colour.

Based on visual and tactile examination of the soil samples, the topsoil was in moist condition.

It should be noted that the thickness of topsoil may vary significantly between borehole locations and should not be used to estimate the quantity of topsoil removal.

Below the topsoil in BH/MW1, BH4, BH/MW5, BH/MW8, BH/MW9, BH/MW10, BH/MW11, BH12, BH13, BH14 and BH/MW15, a discontinuous deposit of fill was encountered to depths of about 0.8 to 1.3 mbgs. In BH/MW1, BH/MW8, BH/MW9, BH/MW10, BH13 and BH14, the fill consisted of dark brown to brown silty sand, some gravel, and occasional organic inclusions. In BH4, BH/MW5, BH/MW11, BH12 and BH/MW15, the fill consisted of brown sand and gravel, some silt. Standard Penetration tests in the fill gave N-values ranging from 5 to 35 blows/300mm. The natural moisture content was found to range from 7 to 35%. The relatively high moisture content in a portion of the fill material was due to the presence of organics.

Based on visual and tactile examination of the soil samples and the test results, the silty sand fill and sand and gravel fill are considered to be in a loose to dense state of compactness and in moist condition.

The silty sand and sand and gravel fill at BH/MW1, BH4, BH/MW5, BH/MW8, BH/MW9, BH/MW10, BH/MW11, BH12, BH13, BH14 and BH/MW15 and topsoil at BH2, BH3, BH6 and BH7 were underlain by a deposit of sand and gravel to the depth of 6.1 mbgs in BH14 and to the full depth of investigation in all other boreholes at about 2.3 to 9.0 mbgs. The sand and gravel was brown in colour and contained trace to some silt inclusions and scattered sandy silt seams. Standard Penetration tests in this material gave N-values ranging from 5 to greater than 100 blows/300mm, with typical values between 27 and 65 blows/300mm. The natural moisture content was found to range between 1 and 18%, with typical values between 3 and 13.

Based on visual and tactile examination of the soil samples and the test results, the sand and gravel was typically in a compact to very dense state of compactness and in moist to wet condition.

A discontinuous layer of silt till was found at BH12 between the sand and gravel ranging from 2.4 to 3.8 mbgs and to the full depth of investigation i.e. 7.6 mbgs in BH14. The silt till was brown or grey in colour and contained trace to some sand inclusions. Standard Penetration tests in this material gave N-values ranging from 5 to 69 blows/300mm. The natural moisture content was found to range between 7 and 10%.

Based on visual and tactile examination of the soil samples and the test results, the silt till is typically in a loose to very dense state of compactness and in moist condition.

It is noted that auger refusal on probable boulder was encountered at BH/MW1, BH2, BH3, BH6, BH7, BH/MW8 and BH/MW10 at depths of about 2.3 to 7.6 mbgs.

Two (2) cross sections (Cross Section A-A' and Cross Section B-B') were prepared to show the soil stratigraphy to a depth of approximately 9.0 mbgs within the Site boundaries. Cross Section A-A' and Cross Section B-B' are provided as Figures 7 and 8, respectively.

3. Field Investigation Results

3.1 Monitoring Well Network Details

As part of the combined drilling program for geotechnical and hydrogeological investigations, fifteen (15) boreholes (BH/MW1, BH2, BH3, BH4, BH/MW5, BH6, BH7, BH/MW8, BH/MW9, BH/MW10, BH/MW11, BH12, BH13, BH14 and BH/MW15) were advanced at the Site, of which seven (7) were completed as monitoring wells (BH/MW1, BH/MW5, BH/MW8, BH/MW9, BH/MW10, BH/MW11 and BH/MW15) by JLP, (Figure 6 and Appendix C).

All monitoring wells were equipped with a 50 mm diameter PVC pipe and 3.1 metre long well screens and completed with monument style well protectors.

Table 3.1 provides a summary of monitoring well construction details.

Table 3.1: Summary of Monitoring Well Installation Details

Monitoring Well ID	Northing (m±)	Easting (m±)	Ground Elevation (masl)	Well Depth (mbgs)	Screen Interval (masl)	Soil Formation Screened
BH/MW1	4815636.4	565116.9	341.39	7.54	336.9 to 333.85	Sand and Gravel
BH/MW5	4815554.4	564941.3	335.45	6.1	332.4 to 329.35	Sand and Gravel
BH/MW8	4815723.7	565062.3	341.21	4.28	339.98 to 336.93	Sand and Gravel
BH/MW9	4815661.0	564934.1	335.80	8.73	330.12 to 327.07	Sand and Gravel
BH/MW10	4815656.7	564860.1	335.44	6.03	332.46 to 329.41	Sand and Gravel
BH/MW11	4815746.8	564855.3	336.41	7.46	332.0 to 328.95	Sand and Gravel
BH/MW15	4815931.0	564864.3	333.21	5.37	330.89 to 327.84	Sand and Gravel

Ontario Regulation 903 of the Ontario Water Resources Act requires that all monitoring wells and dewatering wells (if available) be decommissioned when no longer required. Well decommissioning should be completed by a licenced well contractor.

3.2 Groundwater Level Monitoring

As part of the current hydrogeological investigation, groundwater levels have been monitored using all wells located on-site within the property boundary. All water levels in the monitoring wells have been measured with respect to masl.

Groundwater level monitoring was carried out at the Site in four (4) full monitoring rounds from April 16, 2024, to August 11, 2024. A summary of the groundwater level monitoring results is provided in Table 3.2.

Table 3.2: Summary of Groundwater Level Monitoring Results

Monitoring Well ID	Ground Surface Elevation (masl)	Monitoring Well Depth (mbgs)	Monitoring Well bottom Elevation (masl)	Units	April 16, 2024	July 9, 2024	July 22, 2024	August 13, 2024
BH/MW1	341.392	7.54	333.85	mbtoc	Dry	Dry	Dry	8.37
				mbgs	>7.54	>7.54	>7.54	7.43
				masl	<333.85	<333.85	<333.85	333.96
BH/MW5	335.445	6.1	329.35	mbtoc	Dry	6.72	6.2	6.36
				mbgs	>6.1	5.85	5.33	5.49
				masl	<329.35	329.60	330.12	329.96
BH/MW8	341.207	4.28	336.93	mbtoc	Dry	Dry	Dry	Dry
				mbgs	>4.28	>4.28	>4.28	>4.28
				masl	<336.93	<336.93	<336.93	<336.93
BH/MW9	335.795	8.73	327.07	mbtoc	7.17	7.03	6.51	6.68
				mbgs	6.35	6.21	5.69	5.86
				masl	329.45	329.59	330.11	329.94
BH/MW10	335.437	6.03	329.41	mbtoc	Dry	6.55	6.02	6.19
				mbgs	>6.03	5.83	5.30	5.47
				masl	<329.41	329.61	330.14	329.97
BH/MW11	336.406	7.46	328.95	mbtoc	7.46	7.37	6.82	7.03
				mbgs	6.90	6.81	6.26	6.47
				masl	329.51	329.60	330.15	329.94
BH/MW15	333.209	5.37	327.84	mbtoc	4.23	4.31	3.6	3.97
				mbgs	3.57	3.65	2.94	3.31
				masl	329.64	329.56	330.27	329.90

mbtoc means “meters below top of casing”

The highest groundwater elevations recorded at monitoring wells from April 16, 2023, to August 13, 2024, are provided in Table 3.3.

Table 3.3: Highest Recorded Groundwater Elevations

Monitoring Well ID	Date Measured	Highest Groundwater Elevation (masl)	Groundwater Level (mbgs)
BH/MW1	August 13, 2024	333.96	7.43

According to the results of the groundwater level (Static Water Level) monitoring, the shallow groundwater flow direction across the Site is interpreted to be varied from northwest to southwest, towards Hanlon Creek. The groundwater flow maps may need to be updated as groundwater monitoring progresses.

One (1) groundwater contour map for the water-bearing zone up to approximately 9 mbgs is shown in Figure 9.

It should be noted that groundwater levels are expected to show seasonal fluctuations and the groundwater flow directions across the Site may change. Thus, seasonal groundwater level monitoring will be pertinent to understand seasonal groundwater level and/or flow fluctuations.

A seasonal groundwater monitoring program at the Site is currently in progress.

3.3 Hydraulic Conductivity Testing

3.3.1 Single Well Response Testing

Single Well Response Tests (SWRT) were completed at five (5) monitoring wells (BH/MW1, BH/MW5, BH/MW10, BH/MW11, and BH/MW15) on June 8th and 9th of 2024, in order to estimate the saturated hydraulic conductivity (K) of the soil/bedrock surrounding the monitoring well screen.

All monitoring wells were developed prior to conducting SWRT testing and left for full recovery. Prior to starting SWRT testing, static groundwater level in each well was measured and the test was conducted by rapidly inserting a solid/water slug into the well. A digital data logger pre-programmed to record data at each 1 second interval was inserted in the well prior to inserting solid/water slug.

SWRT field data interpretation was completed using the Hvorslev solution provided in the AQTESOLV Pro. V.4.5 software package.

3.3.2 Summary of Hydraulic Conductivity Test Results

Table 3.4 provides a summary of SWRT results completed on monitoring wells BH/MW5, BH/MW9, BH/MW10, BH/MW11 and BH/MW15.

Appendix D provides SRWT test analytical results.

Table 3.4: Summary of Hydraulic Conductivity Test Results

Monitoring Well ID	Well Depth (mbgs)	Screen Interval (mbgs)		Screened Lithologic Unit	Test Type	Estimated Hydraulic Conductivity (m/s)
		From	To			
BH/MW5	6.10	3.05	6.10	Sand and Gravel	SWRT – Falling Head	4.65E-06
BH/MW9	8.73	5.68	8.73	Sand and Gravel	SWRT – Falling Head	1.08E-05
BH/MW10	6.03	2.98	6.03	Sand and Gravel	SWRT – Falling Head	5.86E-05
BH/MW11	7.46	4.41	7.46	Sand and Gravel	SWRT – Falling Head	7.92E-05
BH/MW15	5.37	2.32	5.37	Sand and Gravel	SWRT – Falling Head	5.91E-05
					Highest Estimated K Value	7.92E-05
					Geometric Mean of K Values	2.68E-05

The highest K value of the saturated overburden to a depth of approximately 9 mbgs is 7.92E-05 m/s and the geometric mean of the K values is 2.68E-05 m/s.

It should be noted that SWRT results provide the estimated saturated hydraulic conductivity (K) of the soil surrounding each monitoring well screen and therefore, may not represent the hydraulic conductivity of the total soil formation screened.

3.4 Infiltration Rate Testing Results

3.4.1 Infiltration Rate Testing

Using Guelph Permeameter, JLP completed six (6) infiltration rate tests at three (3) selected locations (INF5S/D, INF10S/D and INF11S/D) within the Site area close to existing boreholes / monitoring wells BH/MW5 (INF5S/D), BH/MW10 (INF10S/D) and BH/MW11 (INF11S/D), on August 8, 2024.

Infiltration rate testing was completed by constant head well permeameter method using Guelph Permeameter.

Infiltration tests were conducted at depths of 0.5 and 1.5 mbgs at each of the above noted locations and the infiltration tests were conducted in 7 cm diameter holes. The reported water levels at these monitoring wells adjacent to the infiltration holes on August 13, 2024, were approximately 5.49 mbgs (BH/MW5 – INF5S/D), 5.47 mbgs (BH/MW10 – INF10S/D) and 6.47 mbgs (BH/MW11 – INF11S/D).

The soil types encountered within the infiltration test holes are medium to coarse grained sand and gravel with some silt (Appendix C).

Table 3.5 below provides a summary of field saturated hydraulic conductivity (Kfs) testing and design infiltration rates, as per the LID Stormwater Management Planning and Design Guide, CVC – TRCA, 2010, Appendix G. The estimated field saturated hydraulic conductivities were correlated to infiltration rates based on the relationship provided in Appendix D of the guideline.

Infiltration rate testing locations are shown in Figure 6 and infiltration rate analysis is provided in Appendix E.

Table 3.5: Summary of Infiltration Testing Results

Infiltration Test Location/MW ID	Depth of Hole (mbgs)	Formation tested	Field Saturated Hydraulic Conductivity, Kfs (cm/s)	Infiltration Rate (mm/hr)
Shallow Soils				
INF5S – 0.5 mbgs	0.5	Sand and Gravel	8.10E-04	81
INF10S – 0.5 mbgs	0.5	Silty Sand	1.31E-03	92
INF11S – 0.5 mbgs	0.5	Sand and Gravel	1.80E-03	101
Deep Soils				
INF5D – 1.5 mbgs	1.5	Sand and Gravel	1.40E-02	173
INF10D – 1.5 mbgs	1.5	Sand and Gravel	5.70E-03	137
INF11D – 1.5 mbgs	1.5	Sand and Gravel	2.50E-02	202
Geometric Mean (Shallow Soils)			1.24E-03	91
Geometric Mean (Deep Soils)			1.25E-02	168
Design Infiltration Rate (Based on Infiltration Rate Testing) *				**36**

Notes:
*Safety Factor of 2.5 was used to calculate the design infiltration rate as per Low Impact Development Stormwater Management Planning and Design Guide, CVC – TRCA, 2010.

The estimated design infiltration rate based on infiltration rate testing for the Site is 36 mm/hr., which will be used to determine the area of Low Impact Development (LID) system to mitigate the pre- vs post-development infiltration rate deficit.

Please note that the City of Guelph requires completing a monthly water balance analysis for the Site to maintain pre-development recharge rate, volume and hydroperiods at post development conditions. LID best management practices (BMP) can be proposed to mitigate the development's impact on the water balance and mimic pre-development recharge when pre- vs post-development infiltration deficit is available from a Site water balance assessment. Based on the correspondences with the civil consultant, a water balance assessment was not undertaken at this point in time.

3.5 Groundwater Quality

It is JLP's understanding that the dewatering effluent during the construction will be directed into a municipal drain/existing surface water body during dewatering activities.

To assess the suitability for discharging pumped groundwater into a municipal drain / existing surface water body during dewatering activities, one (1) groundwater sample was collected from monitoring well BH/MW9 on September 4, 2024, using a bailer.

Prior to the collection of the above noted groundwater samples, approximately three (3) standing well volumes of groundwater were purged from the monitoring well. The noted sample was collected unfiltered and placed into pre-cleaned laboratory-supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample handling.

The groundwater samples were submitted for analysis to ALS Environmental, a CALA certified independent laboratory in Waterloo, Ontario. Analytical results are provided in Appendix G.

A summary of the pertinent results is provided in Table 5.1:

Table 5.1: Summary of Analytical Results

Parameter	Units	City of Guelph Storm Sewer Bylaw Limit	City of Guelph Sanitary Sewer Bylaw Limit	Analytical Results BH/MW 9 September 4, 2024
Total Suspended Solids (TSS)	mg/L	15	350	**1,310**
Total Phosphorus	mg/L	0.4	10	0.706
Total Cadmium	mg/L	0.001	0.7	0.00390
Total Copper	mg/L	0.01	2	0.191
Total Lead	mg/L	0.05	0.7	0.420
Total Zinc	mg/L	0.05	2	**2.42**

Notes:
underlined – concentration exceeds storm sewer use bylaw criteria.
Bolded – concentration exceeds sanitary sewer use bylaw criteria.

When compared to the City of Guelph Storm Sewer Bylaw, the laboratory Certificate of Analysis (CofA) indicated that the concentration of Total Suspended Solids (TSS), Total Phosphorus, Total Cadmium, Total Copper, Total Lead and Total Zinc were reported above criteria limits.

When compared to City of Guelph Sanitary Sewer Bylaw, the laboratory CofA indicated that the concentration of TSS and Total Zinc were reported above criteria limits.

Laboratory CofA is provided in Appendix G.

It will be pertinent to review an Environmental Site Assessment (Phase II) and/or any other groundwater quality data/report for the Site for more information on groundwater quality.

It is expected that the concentration of TSS, turbidity and some related parameters such as total metals may exceed City of Guelph Sewer Bylaw criteria during construction dewatering activities. Therefore, it is recommended to implement a suitable treatment method such as filtration and/or decantation or any other suitable treatment method recommended by the treatment specialist/process engineer, prior to discharging groundwater during construction activities.

Groundwater quality at the site is expected to be varied with time and may not be representative of long-term groundwater quality.

Discharge from dewatering (short-term) can be directed to a municipal sewer system. The City of Guelph should be contacted prior to releasing dewatering effluent (short-term) for required approvals (permit to discharge etc.), if any.

4. Dewatering Rate Assessment

As per the information presented in the drawings from Architecture Unfolded, JLP understands that the development includes approximately 960 residential units spread over thirty-one (31) cluster townhouse buildings with 318 units, two (2) apartment buildings with 16-storey and 14-storey towers and one six-storey parking structure. JLP understands that the two (2) apartment buildings will be completed with one-level full basements, the 6-storey parking structure with a partial basement and cluster townhouses will be of slab-on-grade construction. An on-grade parking lot is located on the northwestern portion of the site and associated driveway and greenspace areas are proposed throughout the site.

Based on the results of the groundwater level monitoring at the subject Site, and the assumed foundation elevation, it is expected that dewatering may be required during the construction phase of the development. Therefore, construction (short-term) dewatering rate assessment is included in this report.

An assessment of expected short-term and long-term dewatering rates was completed as described below.

4.1 Dewatering Rate Estimates

Apartment buildings with 16-storey and 14-storey towers (Apartment Buildings A and B): Two (2) apartment buildings are proposed with one (1) level of basement with a building footprint area of approximately 1,753.4 m^2 (approximately 79.7 m x 22.0 m). As per Geotechnical Report (JLP, January 29, 2025), assuming that the lowest basement floor slab will be at about 3.5 to 4.0 m below the existing grade, the lowest elevation of the basements for Apartment Buildings A and B are 331.8 and 337.0 masl, respectively. The estimated seasonal highest groundwater elevation within the footprint areas of Apartment Buildings A and B are 331.0 and 334.5 masl (0.5 m above the recorded highest groundwater elevation). Since the expected seasonal highest groundwater elevation is approximately 1.3 and 2.5 m lower than the lowest basement levels for Buildings A and B, respectively, construction dewatering will not be required.

Six (6) Story Parking Structure: One (1) parking structure is proposed with one (1) level of partial basement with a building footprint area of approximately 4,622.0 m^2 (approximately 122.6 m x 37.7 m). As suggested in the Geotechnical Report (JLP, January 29, 2025), assuming that the lowest basement floor slab will be at about 3.5 to 4.0 m below existing grade, the lowest elevation of the basement for the Parking Structure is 332.0 masl. The estimated seasonal highest groundwater elevation within the footprint areas of the Parking Structure is 331.5 masl (0.5 m above the recorded highest groundwater elevation) and it is expected that construction dewatering will not be required.

Town House Buildings: JLP understands that cluster townhouses will be of slab-on-grade construction. The reported water level for most of the Site ranges between 5.3 and 7.43 mbgs. As a result, construction dewatering will not be required in these areas.

Site Services: The inverts of the proposed site services are not available at the time of this report. However, it is expected that the on-site sanitary sewer, storm sewer and watermain inverts will be located at depths ranging between 2 and 4 metres below the finished grades (JLP, July 25, 2024). The reported groundwater levels at the Site varied from 2.94 to 7.43 mbgs. With the exception of the reported water level at BH/MW15, reported water levels at all other monitoring wells varied from 5.30 to 7.43 mbgs. As per the available information and reported

groundwater elevations, it is expected that at the area adjacent to BH/MW15, some dewatering will be required during the installation of site services.

Please note that to estimate the requirement of construction dewatering for the Site, existing ground elevation was considered. When the site regrading plan and the final elevation for the building basements (proposed construction designs) are available for review, construction and post-construction dewatering rates may need to be updated.

Dewatering rate estimates were carried out using the methodology provided in Sections 4.2 and 4.3.

Table 4.1: Summary of In-put Data – Construction Dewatering

Input Parameter	Unit	Site Servicing	Notes
Lowest ground surface elevation	masl	-	Approximate ground surface elevation, based on Site Plan (2024.01.31).
Highest groundwater elevation	masl	2.44	Highest groundwater level recorded at the Site plus 0.5 m for seasonal highest groundwater elevation.
Lowest basement footing elevation	masl	4.0	
Dewatered elevation target	masl	5.0	Short-term – Assumed 1.0 metre below site servicing invert elevation.
Excavation for site servicing	m^2 (m x m)	20 (2 x 10)	10 m of underground servicing
Hydraulic Conductivity (K)	m/s	2.68E-05	Geometric mean of K values estimated for overburden

4.2 Dewatering Flow Rate Assessment Methodology

a. Site Servicing

Linear flow to an excavation (linear source) at a distance of L_0 to a fully penetrating well can be expressed using the equation (Dupuit equation) given below. This equation was used to estimate short-term (construction) dewatering rates for the project.

$$Q_w = (x1 + x2) * K * (H^2 - h^2)/Lo$$

Where:

Qw = Rate of pumping (m^3/s)
x_1 = Length of excavation (m)
X_2 = Width of excavation (m)
K = Hydraulic conductivity (m/s)
H = Aquifer Thickness/Initial Water Column Thickness (m)
h = Final Water Column Thickness (m)
Lo = Distance of influence (m)

Rainfall Intake

The additional volume of water will need to be removed from the excavation during and after precipitation events. As a result, the daily dewatering volume should include the removal of anticipated rainwater from the excavation to determine the total dewatering rate.

To estimate the volume of rainwater collected within the footprint area of the excavation, an assumed 15 mm/day precipitation was considered. It is the responsibility of the dewatering contractor to manage the volume from direct precipitation safely without exceeding the permitted daily dewatering and discharging rates during and after rainfall events greater than 15 mm (e.g., 2-year/100-year storm event).

As provided in the Intensity Duration Frequency (IDF) Curves (Ontario Ministry of Transportation), the recorded 2-year and 100-year storm event in the Site area are 60.1 and 132.0 mm/24-hrs, respectively.

4.3 Dewatering Radius of Influence

Linear Flow

The radius of influence (ROI) for the construction dewatering was calculated based on Sichardt's equation. This equation is used to predict the distance at which the drawdown resulting from pumping is negligible. These empirical formulas were developed to provide flow rates assuming steady state flow, as stated below.

The estimated radius of influence (R_o) of pumping based on Sichardt's formula is described as follows:

$$R_o = C(H - h)\sqrt{(K)}$$

Where:
R_o = Estimated radius of influence (m)
H = Hydraulic head in aquifer (static water level or saturated depth (m)
h = Dynamic water level (m)
K = Hydraulic conductivity (m/sec)
C = Constant (3000) for radial flow

Based on Sichardt's formula and the highest K-value, the calculated maximum theoretical zone of influence for linear flow (L_0) is taken as $R_o/2$.

4.4 Results of Construction Dewatering Rate Estimate

For this assessment, a temporary shoring system, if required, was assumed to be included in the proposed construction plans. Should the proposed shoring system be revised, JLP should be retained to review the dewatering estimates.

Table 4.2 and Appendix F present the short term (construction) dewatering estimate. Please note that, the dewatering estimates provided in Table 4.2 will need to be revised, when the final grading plan for the proposed development and proposed basement levels for the buildings are available.

Table 4.2: Short Term (Construction) Dewatering Estimates

Description	Site Services L/day	Notes
Dewatering Flow Rate without SF	23,470	Assumed 10 m long service trench kept open at a time
Dewatering Flow Rate multiplied by FS of 1.5 (Qsf)	35,210	For MECP Permitting purposes
Volume from 15 mm/day rainfall event (p)	300	
Dewatering Flow Rate multiplied by FS of 1.5 + Precipitation of 15 mm/day (Qsf+p)	35,510	For Discharge Purposes / Agreement
Dewatering Zone of Influence from Excavation Boundary (metres)	10.0	

The estimated dewatering rates provided in Table 4.2 should be considered conservative, which accounts for initial high dewatering rates, seasonal high groundwater elevation and any other unforeseen conditions including variation of hydraulic properties and the effect of underground servicing.

Pits (if needed) are assumed to have equal excavation depth as the main excavation, and therefore the same dewatering target; deeper pits may require extra localized dewatering and revised dewatering estimates. High dewatering rates can be expected within local areas having highly conductive soils, deeper excavations for pits etc., and it is the dewatering contractor's responsibility to install additional dewatering systems to keep the excavation floor free from ponding water during the entire dewatering period.

As described in Section 4.1, basement elevations of Bldg. A, Bldg. B, cluster town homes and Parking Structure, are approximately 0.5 to 4.5 m above the estimated highest groundwater elevation at the Site. As a result, no groundwater removal is expected during the construction phase of the project. Based on the assumed precipitation of 15 mm/day, the expected rainwater collection into individual excavations varies from approximately 3,430 to 34,300 L/day.

4.5 MECP Water Taking Permit Requirements

4.5.1 Construction Dewatering

The Ontario Water Resources Act states that registration in the Environmental Activity and Sector Registry (EASR) with the MECP will be required for a rate of water taking between 50,000 and 400,000 L/day, during the construction period. If the rate of water taking exceeds 400,000 L/day, a Category 3 Permit to Take Water (PTTW) will be required from the MECP.

Based on the available hydrogeological information, and assuming approximately 10 long excavations for site servicing is kept open at any given time, the estimated maximum construction dewatering rate using the geometric mean of K values obtained for the overburden is 35,210 L/day (including safety factor of 1.5 and without intake from rainfall). Therefore, a permit from the MECP will not be required to facilitate the construction dewatering program for the Site.

It should be noted that the estimated dewatering rate is a conservative value, which may be higher than the dewatering rate during the later stage of dewatering.

5. Environmental Impact Assessment

5.1 Surface Water Features

The Site area is located within the Ellis Creek-Speed River watershed and Hanlon Creek sub-watershed. The nearest surface water feature is a tributary of Hanlon Creek, which runs approximately 700 m northwest of the Site boundary. Available area maps show that no streams exist on Site.

The estimated maximum construction dewatering zone of influence is approximately 40 m from the dewatering area. Given that a tributary of Hanlon Creek, which is the nearest surface water feature is approximately 700 m away from the Site boundary, no impacts to surface water features are expected during construction activities.

5.2 Potential Impacts on Groundwater Users in the Area

As per the results of the MECP WWR Database, there is one (1) water supply well (for domestic use) outside the Site and within 500m of the Site boundary. The closest water supply well outside the Site is located approximately 100 m away from the Site boundary.

Based on the locations of the proposed buildings and the limited dewatering zone of influence (maximum 10 m from the excavation boundary), dewatering related impacts are not expected during dewatering activities.

5.3 Other Potential Impact Considerations

5.3.1 Geotechnical Considerations

Geotechnical assessment of the potential ground settlement due to water taking (ex. settlement, soil loss, subsidence, etc.) is required to ensure that the required water taking would not have an unacceptable effect on soils and surrounding engineering structures. Since dewatering will not be required during building construction activities, no impacts are anticipated.

5.3.2 Groundwater Quality

It is JLP's understanding that the dewatering effluent during construction will be directed to a Storm or sanitary sewer system owned by the City of Guelph.

When compared to the City of Guelph Storm Sewer Bylaw, the laboratory Certificate of Analysis (CofA) indicated that the concentration of Total Suspended Solids (TSS), Total Phosphorus, Total Cadmium, Total Copper, Total Lead and Total Zinc were reported above criteria limits.

When compared to City of Guelph Sanitary Sewer Bylaw, the laboratory CofA indicated that the concentration of TSS and Total Zinc were reported above criteria limits.

It is expected that the reported total metal concentration exceedances are related to high total suspended solids in water samples. Therefore, it is recommended to implement a suitable treatment method such as filtration and/or decantation or any other suitable treatment method recommended by the project treatment specialist/process engineer, prior to discharging dewatering effluent during construction.

6. Conclusions and Recommendations

The conclusions and recommendations provided below should be reviewed in conjunction with the entirety of the report. Any changes to the design concept may result in a modification to the recommendations provided in this report.

Based on the findings of the hydrogeological investigation, the following conclusions and recommendations are provided:

- The Site is located within a physiographic region named the Horseshoe Moraines, and physiographic landform named the Till Moraines. The Horseshoe Moraines occupies an area of approximately 5,590 km^2 lying to the west of the highest part of the Niagara Escarpment. The "toe" of the horseshoe-shaped region lies on the highest part of the upland south of Georgian Bay at about 518 m above sea level (masl), while the two "heels" are about 274 m lower.

- As required by the City of Guelph it is recommended to complete a water balance analysis for the Site to maintain predevelopment recharge rate, volume and hydroperiods at post development conditions. Low Impact Development (LID) best management practices (BMP) can be proposed to mitigate the development's impact on the water balance and mimic pre-development recharge.

- The highest static groundwater level recorded at the Site is 333.96 masl (7.43 mbgs), which was measured on August 13, 2024. It is recommended to carry out a seasonal groundwater level monitoring program to determine the seasonal highest water level at the Site.

- The highest K value of the saturated overburden to a depth of approximately 8.7 mbgs is 7.92×10^{-5} m/s and geometric mean of the K values is 2.68×10^{-5} m/s.

- When compared to the City of Guelph Storm Sewer Bylaw, the laboratory CofA indicated that the concentration of TSS, Total Phosphorus, Total Cadmium, Total Copper, Total Lead and Total Zinc were reported above criteria limits.

- When compared to City of Guelph Sanitary Sewer Bylaw, the laboratory CofA indicated that the concentration of TSS and Total Zinc were reported above criteria limits.

- Based on the assumptions outlined in this report, the estimated maximum dewatering rate for the proposed construction activities will be 35,510 L/day (with SF of 1.5 and stormwater intake). This daily rate should be used for the discharge purposes and permitting, if required.

- Based on the available hydrogeological information, and assuming approximately 10 long excavation for site servicing is kept open at any given time, the estimated maximum construction dewatering rate using the geometric mean of K values obtained for the overburden is 35,210 L/day (including safety factor of 1.5 and without intake from rainfall). Therefore, an EASR permit from the MECP will not be required to facilitate the construction dewatering program for the Site.

- Discharge from dewatering (short-term) can be directed to the municipal sewer system. The City of Guelph should be contacted prior to releasing dewatering effluent (short-term) for required approvals, if any.

- It is anticipated that the concentration of TSS, turbidity and some related parameters such as total metals may fluctuate and/or exceed City of Guelph Sewer Bylaw criteria, during construction dewatering activities. Therefore, it is recommended to implement a suitable treatment method such as filtration and/or decantation or any other suitable treatment method recommended by the project treatment specialist/process engineer, prior to discharging dewatering effluent during construction.

- The geometric mean of the estimated design infiltration rates based on the results of infiltration rate testing using Guelph Permeameter for the Site is 36 mm/hr. This rate can be used to determine the area of LID system to mitigate pre- vs post-development infiltration rate deficit when results from Site water balance assessment are available.

- Seasonal groundwater level monitoring program is currently in progress. A memorandum will be issued when the full 12-month data has been collected detailing hydrographs and groundwater elevation data.

- Regulation 903 of the Ontario Water Resources Act requires that all monitoring wells and dewatering wells (if available) be decommissioned when no longer required. Well decommissioning should be completed by a licensed well contractor.

7. Closure

We trust this report is satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Sincerely,

JLP Services Inc.

Cindy Luu, B.Sc.
Environmental Scientist

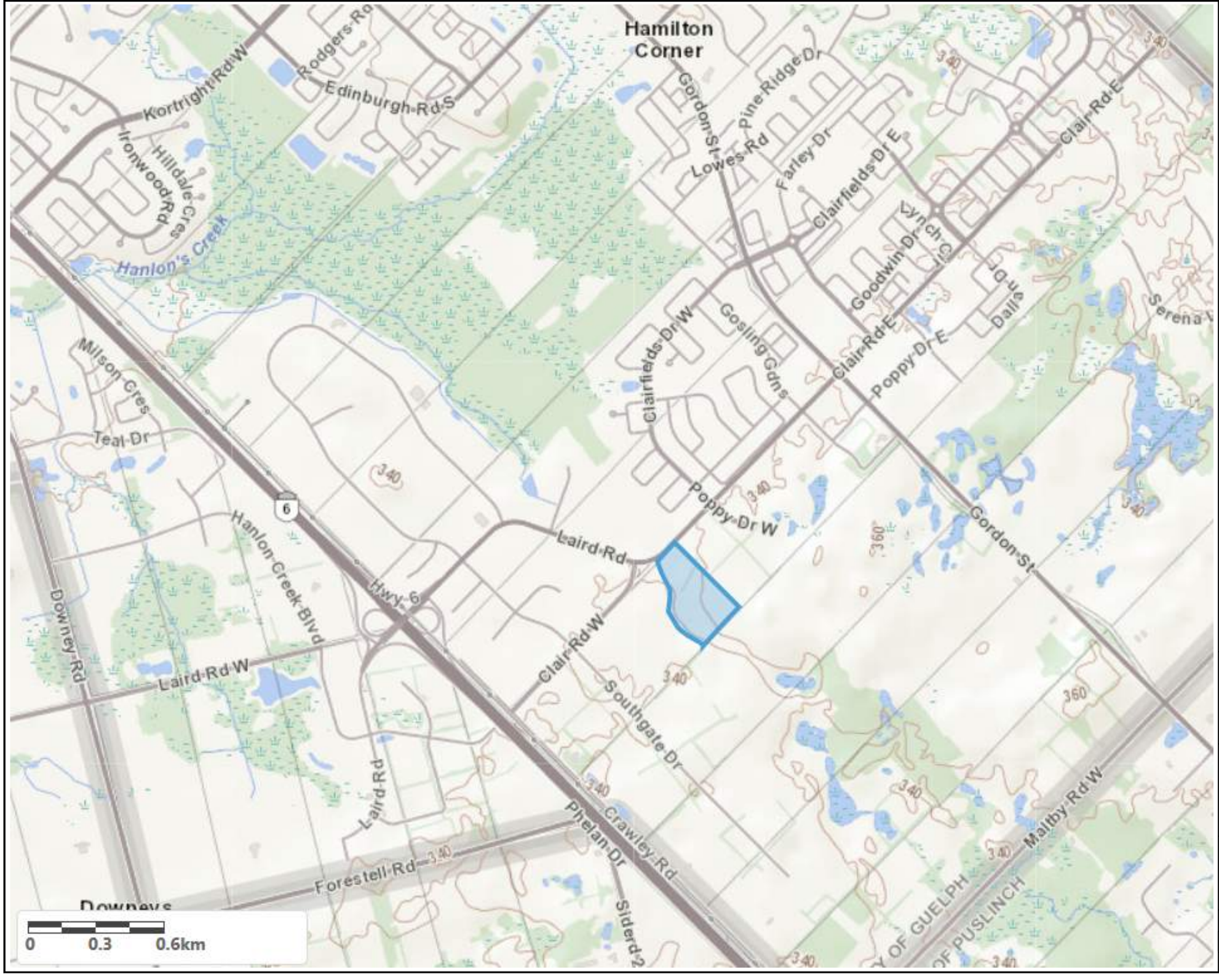
Jay Samarakkody, M.Sc., P.Geo.
Senior Hydrogeologist

Ajay Jayalath, MBA, P.Geo., QP.
Vice President, Environmental Services

8. References

- Cashman and Preene (2013). Groundwater Lowering in Construction, 2nd Edition.
- Chapman, L.J and D.F. Putnam (1984). The Physiography of Southern Ontario, Third Edition; Ontario Geological Survey, Special Volume 2.
- City of Guelph (October 2023). Development Engineering manual, Engineering and Transportation Services
- JLP Services Inc. (January 29, 2025). Geotechnical Investigation Report, Proposed Residential Development, 280 Clair Road West, Guelph, Ontario, prepared for John Farley and Home Opportunities.
- Ministry of Northern Development and Mines (May 2012). OGS Earth. Retrieved from https://www.geologyontario.mndm.gov.on.ca/ogsearth.html
- Percolation Test Methodology and Data Analysis, Toronto and Region Conservative Authorities (TRCA), assessed to the website (https://wiki.sustainabletechnologies.ca/wiki/Percolation_test) dated August 2022.
- Reynolds, W.D. (2016). A unified Per Test-Well Permeameter methodology for adsorption field investigations, Geoderma, V.264, Part A, 160-140 p.
- Reynolds, W.D., Galloway, K., and Radcliffe, D.E. (2015). “The relationship between perc time and field-saturated hydraulic conductivity for cylindrical test holes.”, National Onsite Wastewater Recycling Association (NOWRA) 2015 Onsite Wastewater Mega-Conference, Virginia Beach, VA, USA, November 3-6, 2015.

Figures



Legend:

Site Location

N

True North

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Locality Plan
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 20, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 1
Source: King's Printer for Ontario, 2023		

Legend:

Project Area

PLEISTOCENE

- **7** — **Glaciofluvial deposits:** river deposits and delta topset facies
  - 7a Sandy deposits
  - 7b Gravelly deposits
- **6** — **Ice-contact stratified deposits:** sand and gravel, minor silt, clay and till
  - 6a In moraines, eskers, kames and crevasse fills
  - 6b In subaquatic fans
- **5a** — **Till:** Silty sand to sand-textured till on Precambrian terrain
  - 5a Silty sand to sand-textured till on Precambrian terrain
- **5b** — 5b Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain

N
True North

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Surficial Geology
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 20, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 2
Source: Ontario Geological Survey, 2010	Scale: 10 20 40 80 metres	

Legend:

PHANEROZOIC[b] (Present to 542.0 Ma)

PALEOZOIC (251.0 Ma to 542.0 Ma)

DEVONIAN (359.2 Ma to 416.0 Ma)

MIDDLE DEVONIAN

59 **Limestone, dolostone, shale**

- 59a Hamilton Gp.
- 59b Marcellus Fm.
- 59c Dundee Fm.
- 59d Detroit River Gp.; Onondaga Fm.
- 59e Williams Island Fm.
- 59f Murray Island Fm.
- 59g Moose River Fm.
- 59h Kwataboahegan Fm.

LOWER DEVONIAN

58 **Sandstone, dolostone, limestone**

- 58a Bois Blanc Fm.; Oriskany Fm.
- 58b Stooping River Fm.
- 58c Sextant Fm.

SILURIAN (416.0 Ma to 443.7 Ma)

UPPER SILURIAN

57 **Limestone, dolostone, shale, sandstone, gypsum, salt**

- 57a Bass Islands Fm.
- 57b Bertie Fm.
- 57c Salina Fm.
- 57d Kenogami River Fm. (Upper Silurian to Lower Devonian)

LOWER SILURIAN

56 **Sandstone, shale, dolostone, siltstone**

- 56a Guelph Fm. (also present in the Upper Silurian)
- 56b Lockport Fm.
- 56c Amabel Fm.
- 56d Clinton Gp.; Cataract Gp.
- 56e Thornloe Fm.; Earlton Fm.
- 56f Wabi Gp.
- 56g Attawapiskat Fm. (also present in the Upper Silurian)
- 56h Ekwan River Fm.
- 56i Severn River Fm.

ORDOVICIAN (443.7 Ma to 488.3 Ma)

UPPER ORDOVICIAN

55 **Shale, limestone, dolostone, siltstone**

- 55a Queenston Fm.
- 55b Georgian Bay Fm.; Blue Mountain Fm.; Billings Fm.; Collingwood Mb.; Eastview Mb.
- 55c Liskeard Gp.
- 55d Red Head Rapids Fm.
- 55e Churchill River Gp.
- 55f Bad Cache Rapids Gp.

N
True North

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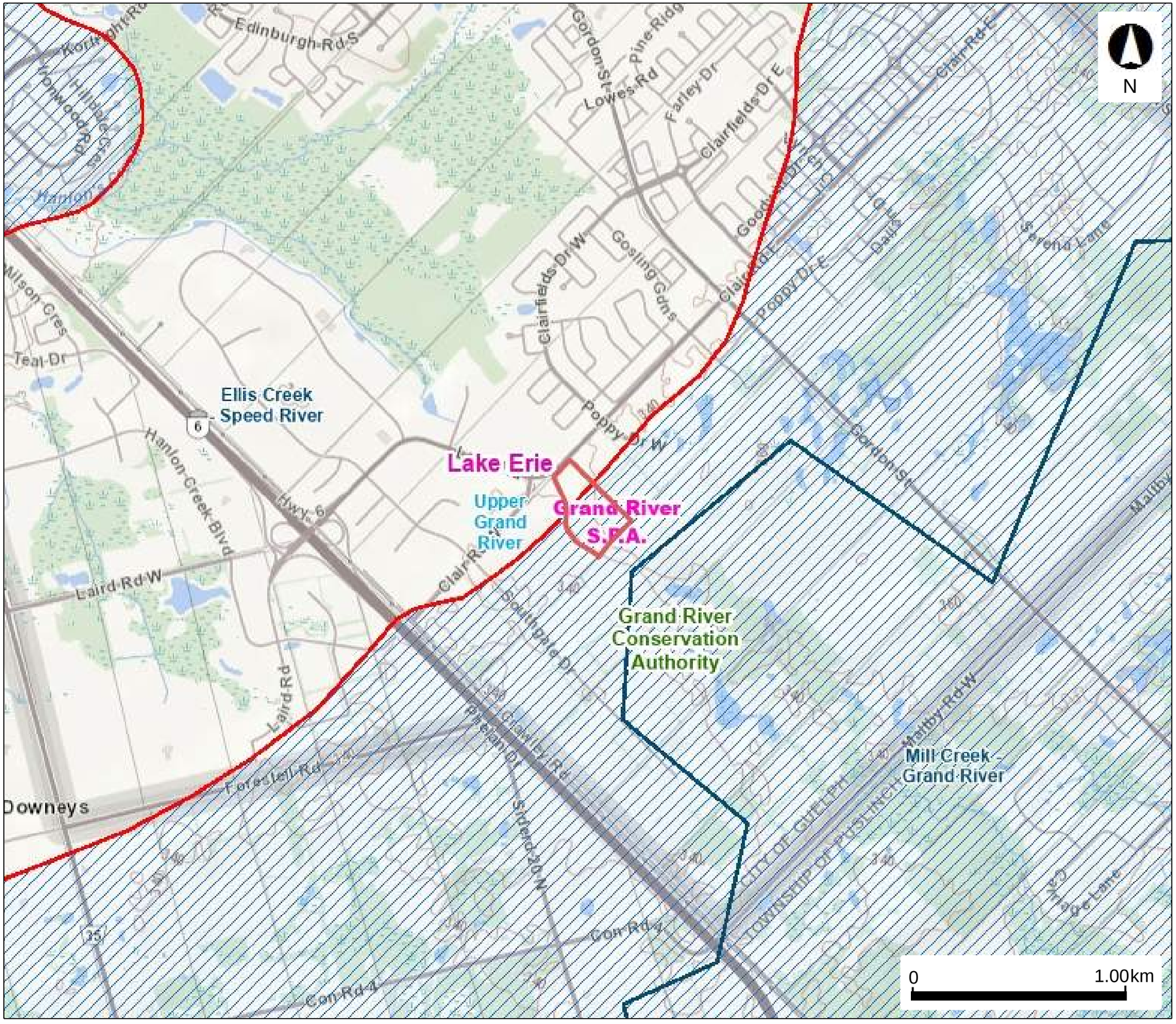
Bedrock Geology
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 20, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 3
Source: Ontario Geological Survey, 2011	Scale: 1.3 2.5 5.0 7.5 kilometres	



Legend:

- Project Area
- Niagara Escarpment Plan (NEP)
- Greenbelt
- Oak Ridges Moraine
- Source Protection Areas
- Source Protection Regions
- Conservation Authority
- Tertiary
- Quaternary
- Paris Galt Moraine

N
True North

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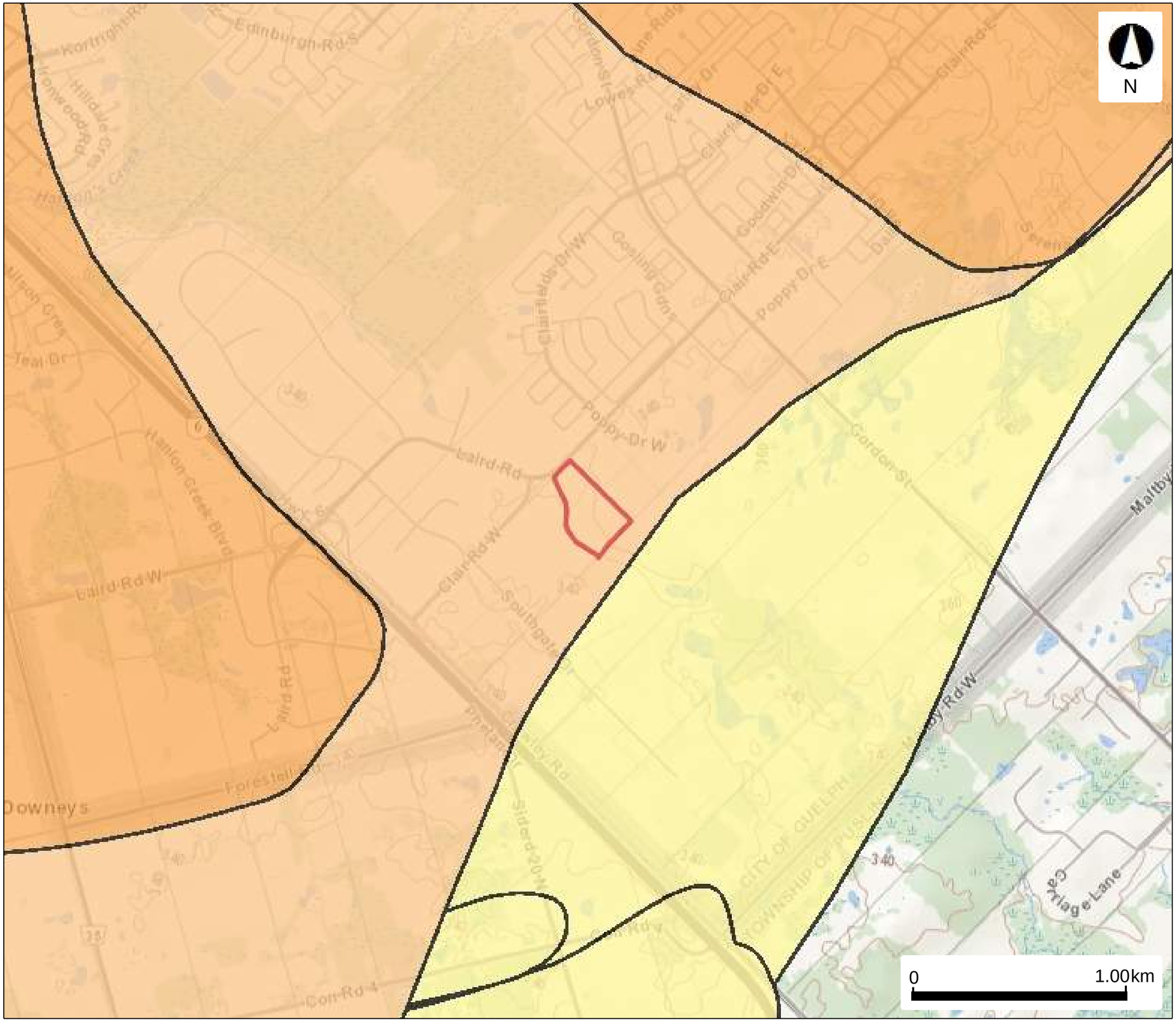
Vulnerability Mapping 1
Paris Galt Moraine Area
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 22, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 4-1
Source: King's Printer for Ontario, 2024		



Legend:

- Project Location
- Issue Contributing Areas
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F

N
True North

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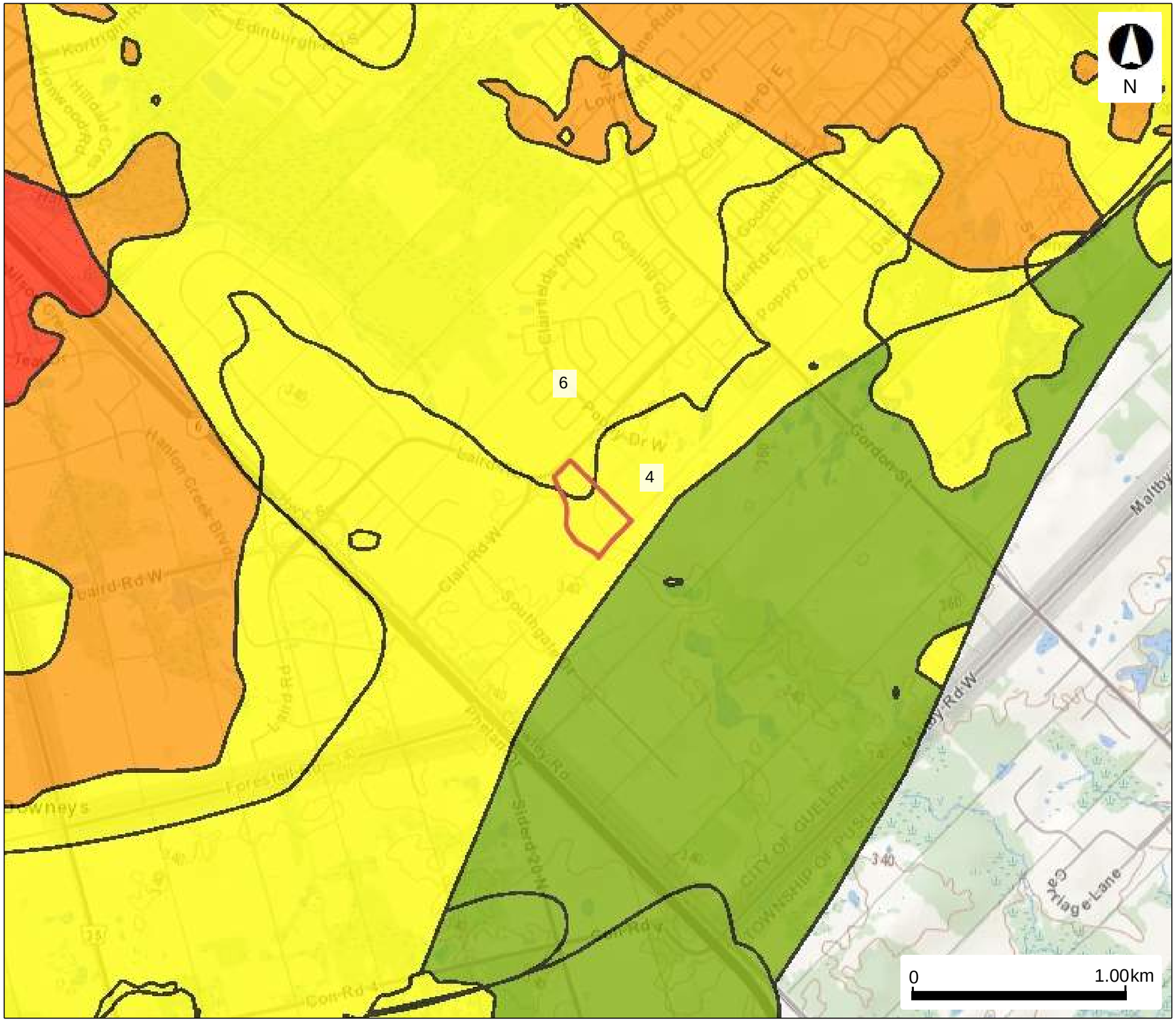
Vulnerability Mapping 2
WHPAs
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 22, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 4-2
Source: King's Printer for Ontario, 2024		



Legend:

Project Area

Vulnerable Scoring Area - Groundwater

- 2
- 4
- 6
- 8
- 10

N

True North

JLP

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Vulnerability Mapping 3
Wellhead Protection Areas
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 22, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 4-3
Source: King's Printer for Ontario, 2024		

Legend:

- Project Area
- Intake Protection Zone 1
- Intake Protection Zone 2
- Intake Protection Zone 3

N
True North

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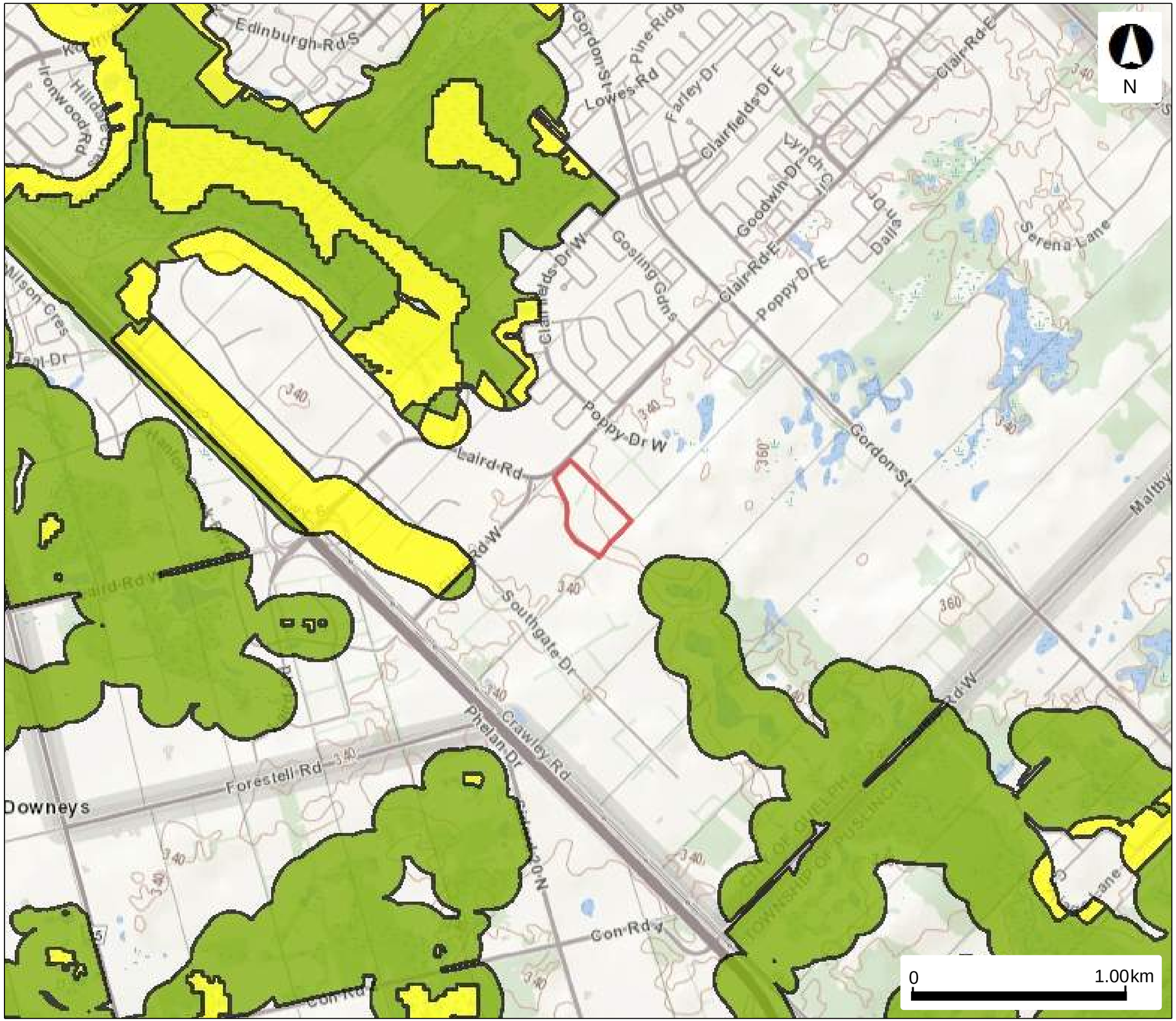
Vulnerability Mapping 4
Intake Protection Zone
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 22, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 4-4
Source: King's Printer for Ontario, 2024		



Legend:

- Project Area

Vulnerable Scoring Area - Surface Water

- 0 - 3.9
- 4 - 7.9
- 8 - 8.9
- 9 - 10

N
True North

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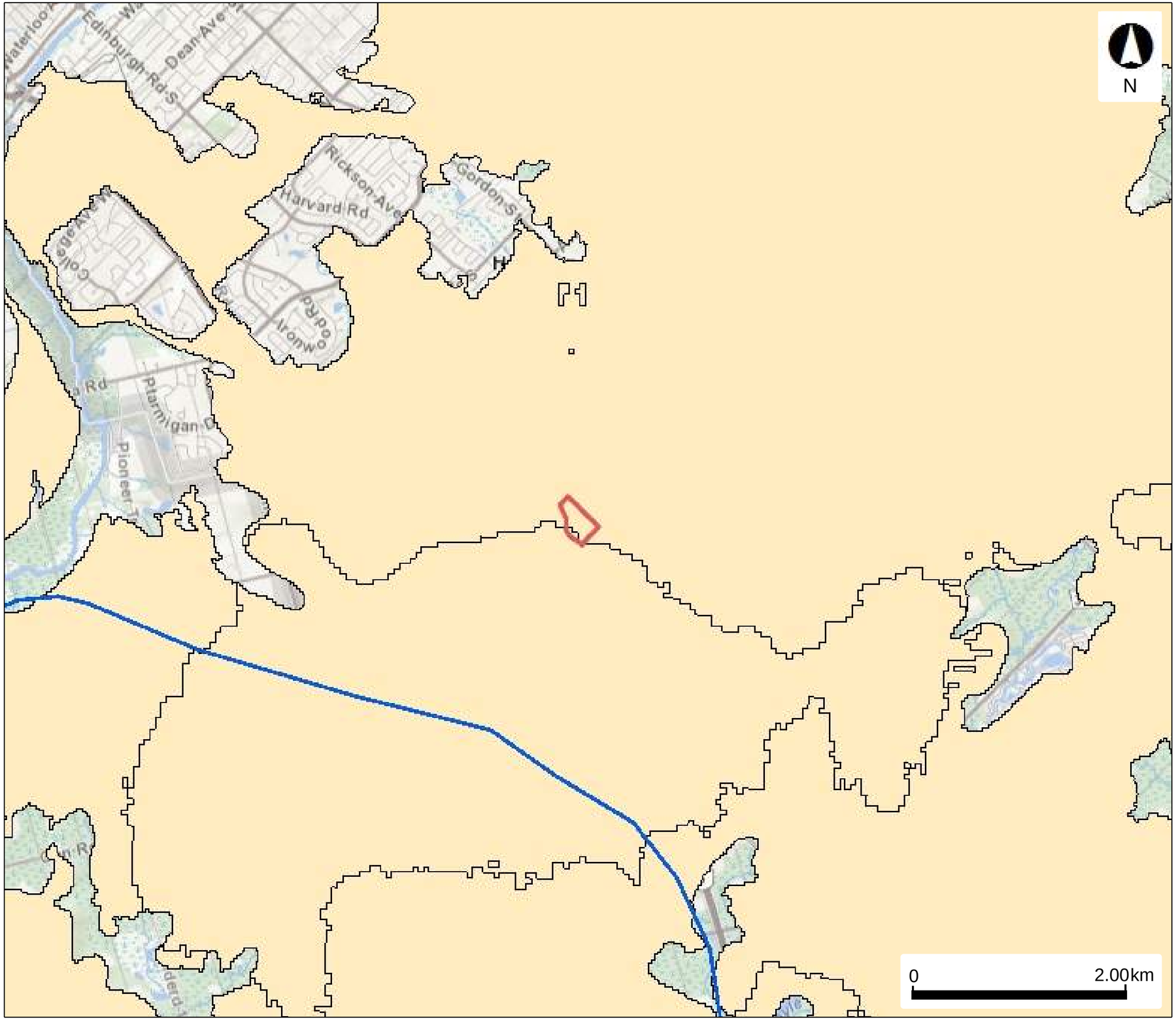
Vulnerability Mapping 5
Intake Protection Zones
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 22, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 4-5
Source: King's Printer for Ontario, 2024		



Legend:

- Project Area
- Intake Protection Zone Q
- Wellhead Protection Area Q2
- Significant Groundwater Recharge Area
  - N/A
  - 0
  - 2
  - 4
  - 6

N
True North

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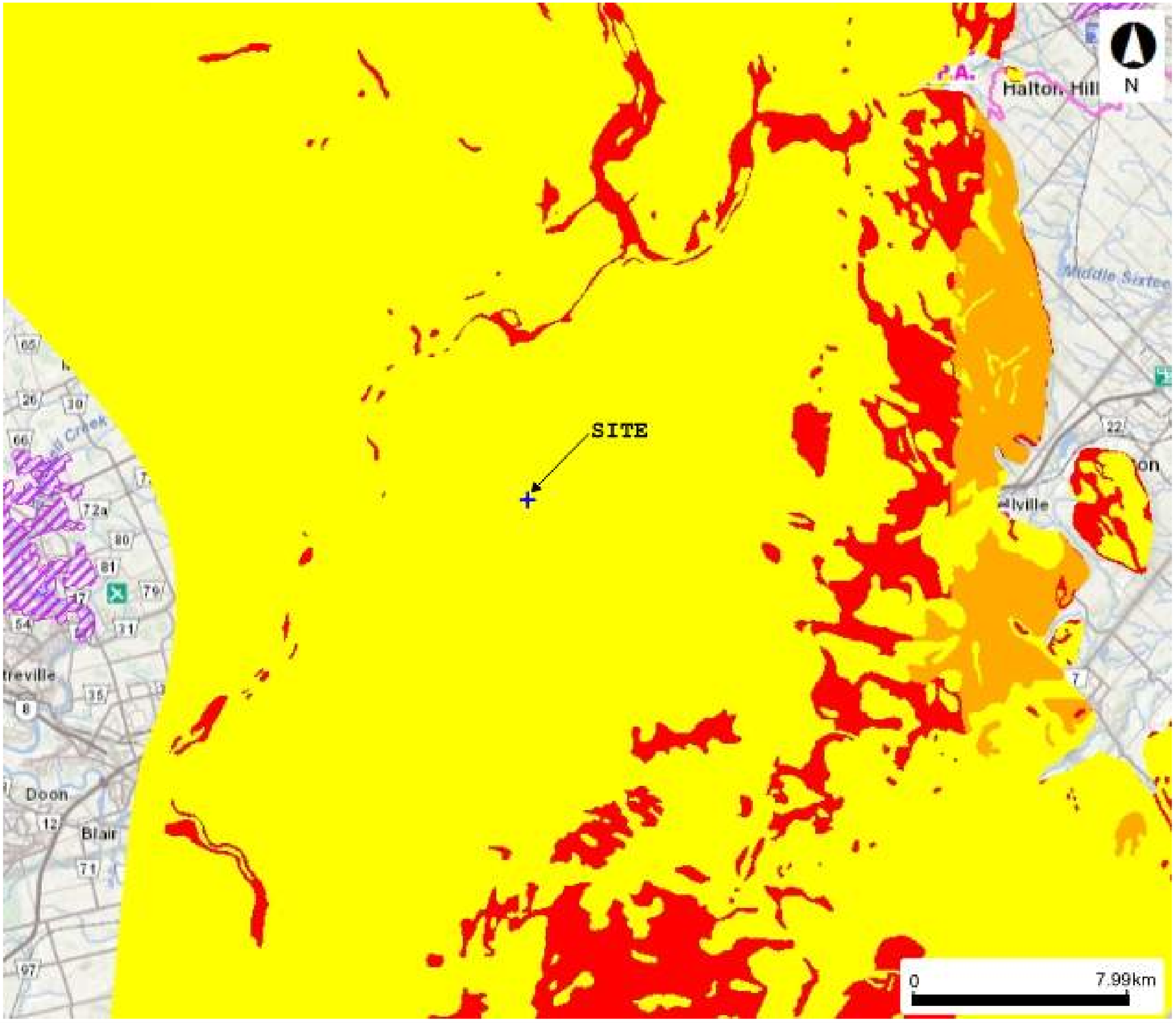
Vulnerability Mapping 6
Significant Groundwater Recharge Areas
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 22, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 4-6
Source: King's Printer for Ontario, 2024		



Legend:

- Project Area

Karst

- Known
- Inferred
- Potential

N
True North

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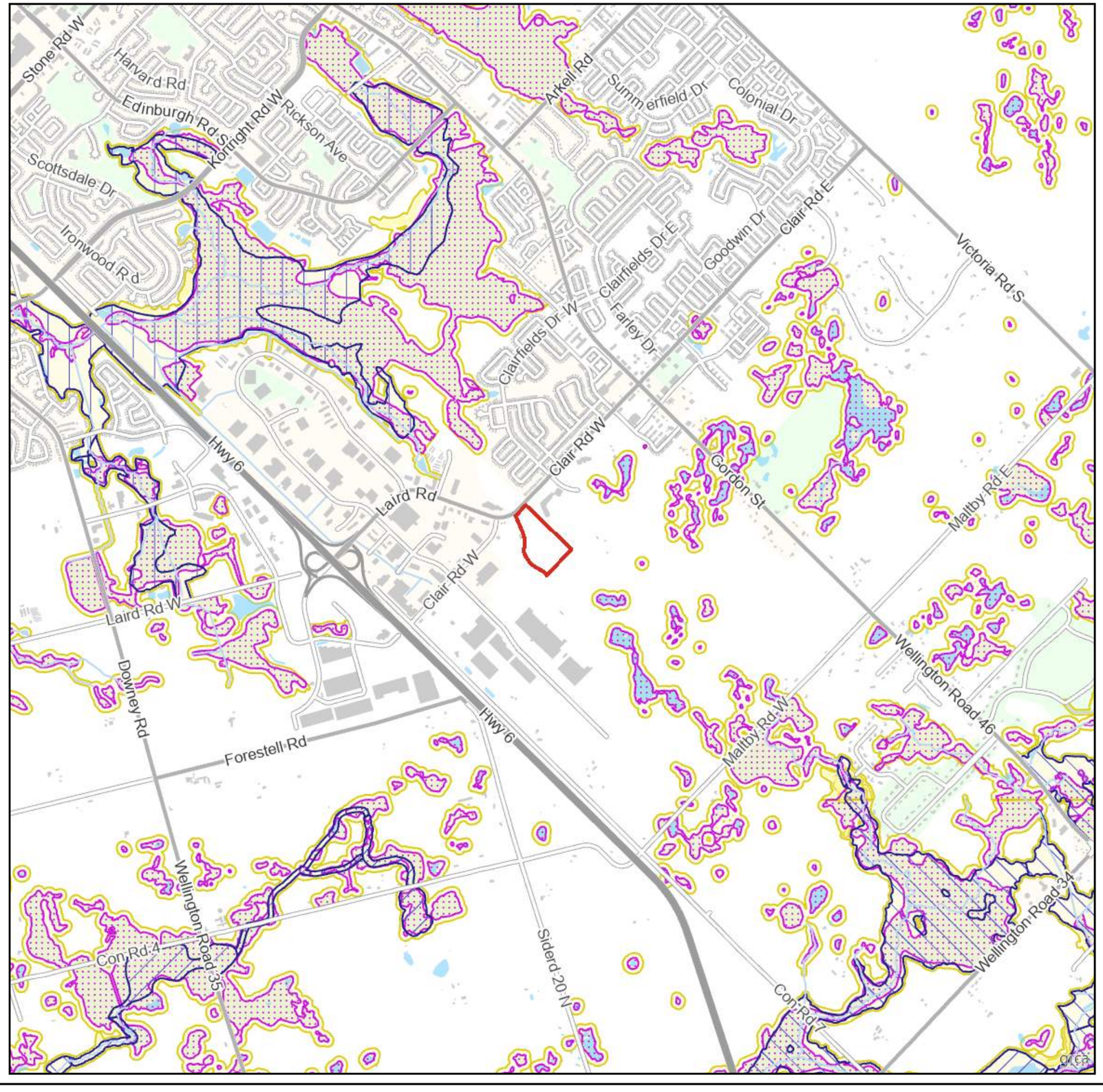
Vulnerability Mapping 7
Karst Area
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 22, 2024	Ref. No. G4836-24-3		
Prepared By: CL	Checked By: JS	FIG. No.	4-7
Source: King's Printer for Ontario, 2024			



Legend:

- Project Area
- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)

N
True North

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Vulnerability Mapping 8
GRCA Regulated Areas
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 22, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 4-8
Source: GRCA, 2024	Scale: 0 90 180 360 540 Meters	

Legend:

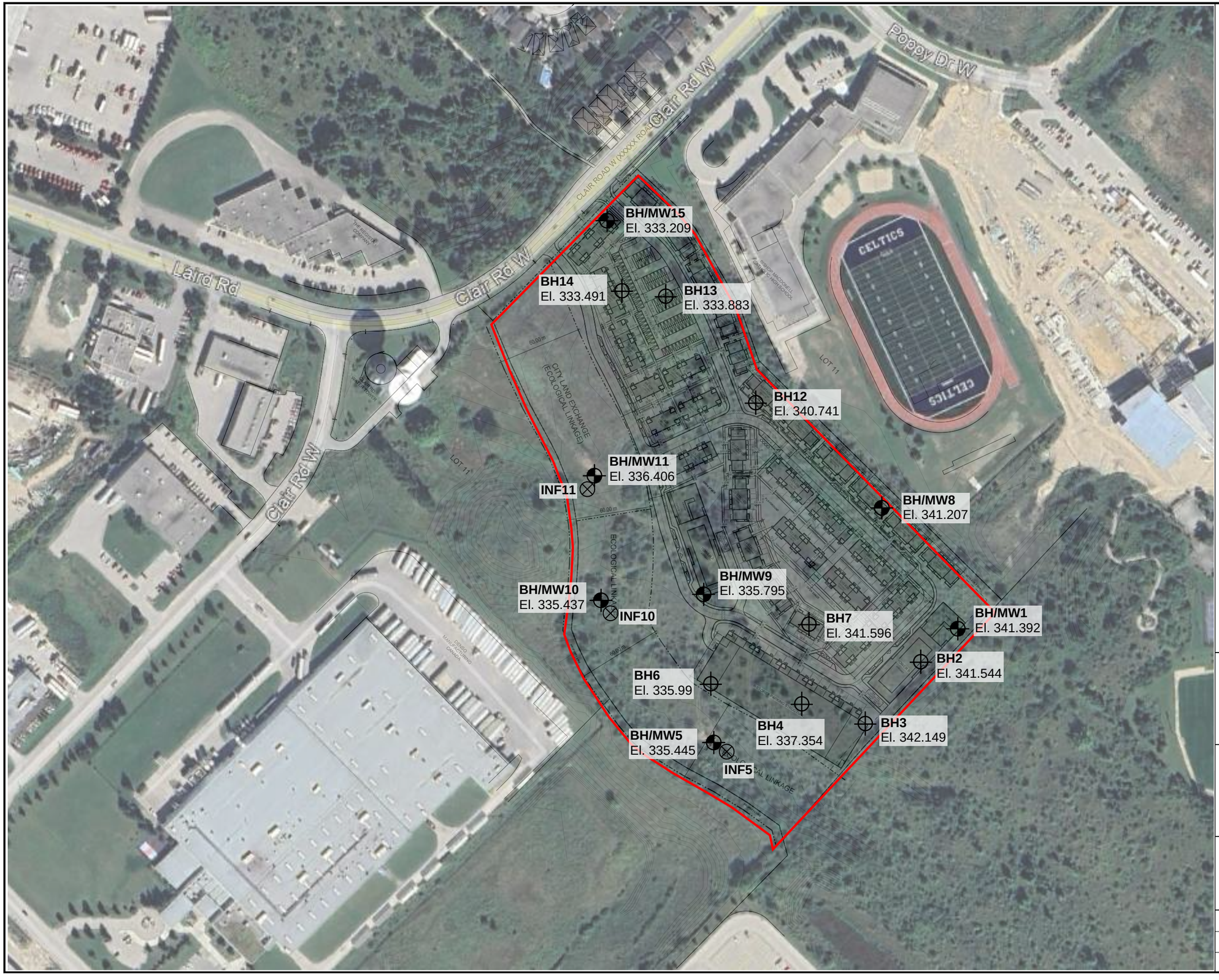
- Project Area
- 500m Radius from Site-Boundary
- Monitoring / Observation Well / Test Hole
- Unclassified / Unfinished Well
- Water Supply Well
- Dewatering Well
- Abandoned Well

N
True North

JLP
Geotechnical & Environmental Consultants

MECP Water Well Record Map
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: July 20, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: JS	FIG. No. 5
Source: MECP Well Records, 2024	Scale: 15 30 60 120 metres	



Legend

- Project Area
- Borehole (JLP, 2024)
- Borehole with Monitor (JLP, 2024)
- Infiltration Test Location

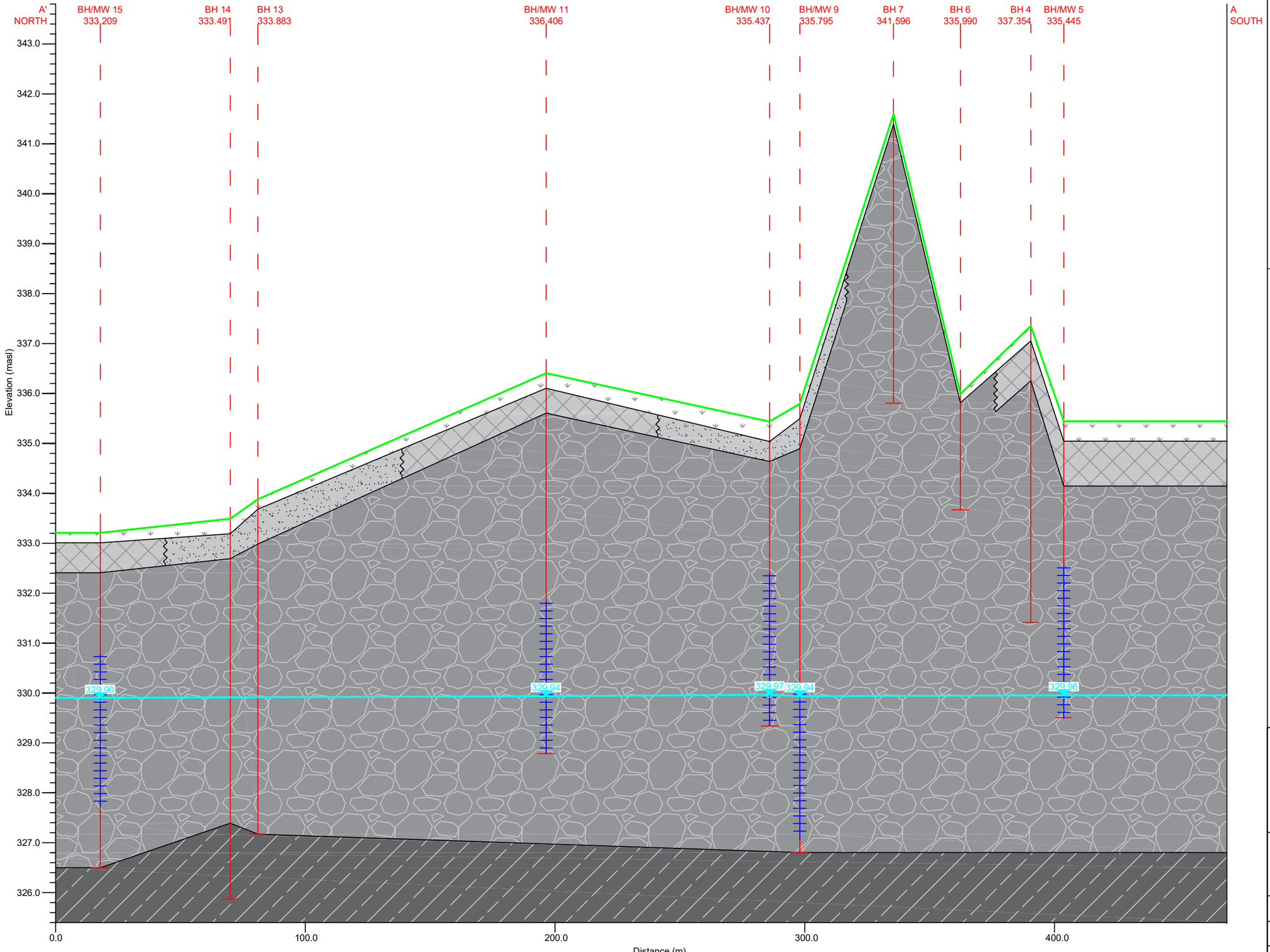
N
True North

- This drawing shall be read in conjunction with the associated technical report.
- El = Elevation
- The ground surface elevations were obtained using a Sokkia GcX3 global position system referenced to the coordinate system known as NAD83 no trans, which is the North American Datum of 1983 of the Canadian Spatial Reference System, and the Universal Transverse Mercator (UTM) Zone 17.
- The soil types and boundaries are applicable only at the location of the boreholes. Between boreholes, they are assumed and may change substantially. The topsoil thicknesses quoted in the report are used for discussion purposes only and should not be used for estimating purposes.
- The soil samples will be retained for three months from the date of issue of the final report and then discarded, unless the client has requested to extend the storage period with fees.

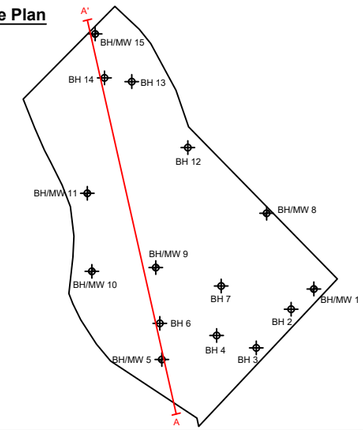
JLP
Geotechnical & Environmental Consultants

Borehole Location Plan
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: Jan. 24, 2025	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: AL	Encl. No. 6
Source: Google Earth, 2025; Architecture Unfolded, A101 Site Plan (2024.12.04)	Scale: 0 10 20 40 60 metres	



Site Plan



Legend

BH8 229.0 — *Borehole Number and Elevation*

Existing Ground Topography

223.0 — *Groundwater Elevation (August 13, 2024)*

Well Screen Location

Borehole with Monitoring Well (JLP, 2024)

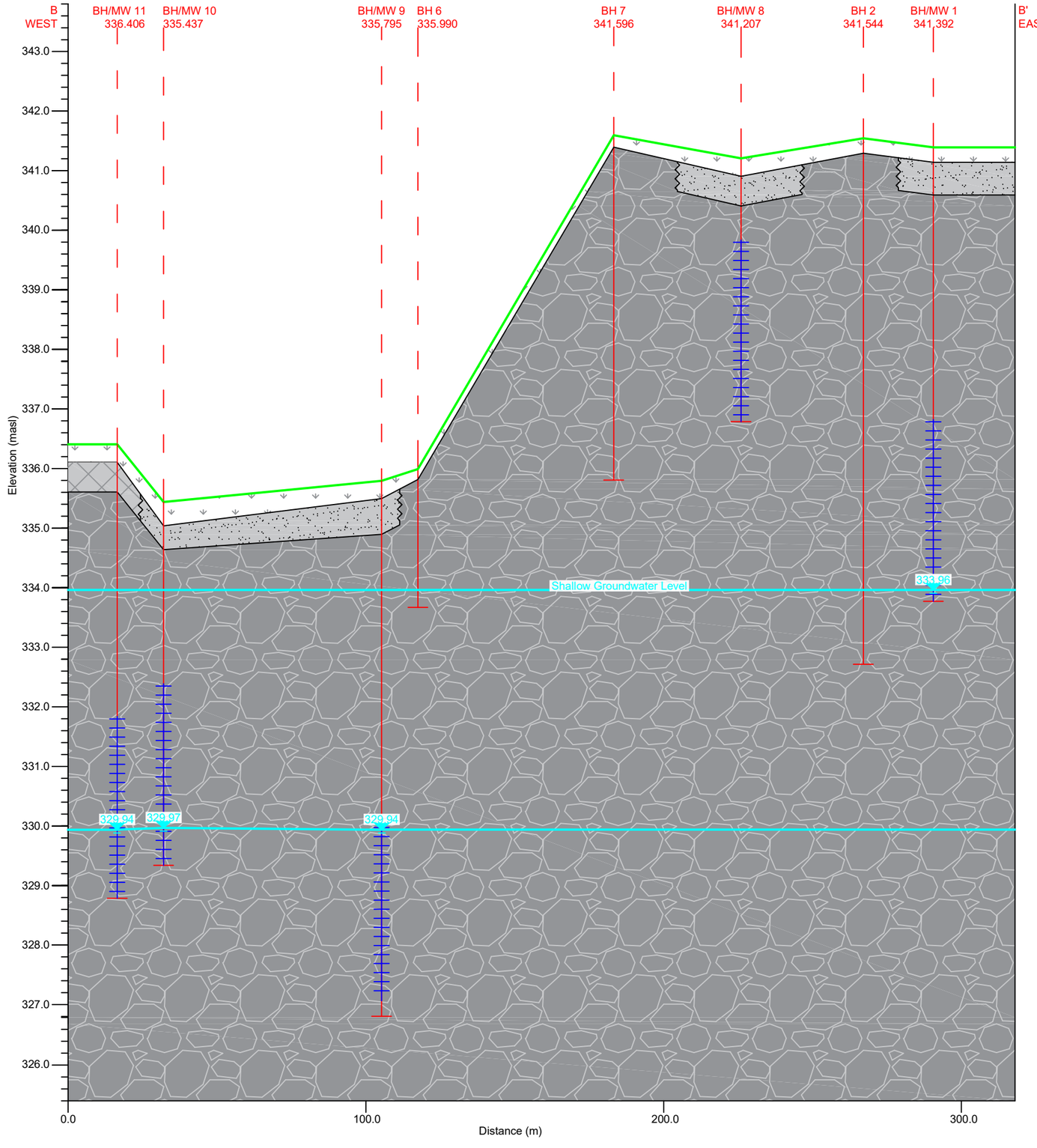
Borehole (JLP, 2024)

	TOPSOIL
	Sand and Gravel FILL
	Silty Sand FILL
	SAND AND GRAVEL
	SILT TILL

JLP
Geotechnical & Environmental Consultants

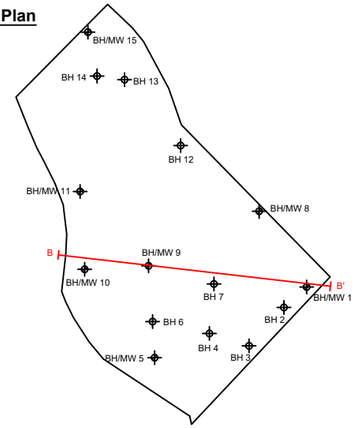
Cross Section A-A'
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: August 15, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: AJ	FIG. No. 7
Horizontal Scale: 1:1500	Vertical Scale: 1:75	



Vertical Exaggeration - 20x

Site Plan



Legend

BH8 229.0 — *Borehole Number and Elevation*

Existing Ground Topography

223.0 — *Groundwater Elevation (August 13, 2024)*

Well Screen Location

Borehole with Monitoring Well (JLP, 2024)

Borehole (JLP, 2024)

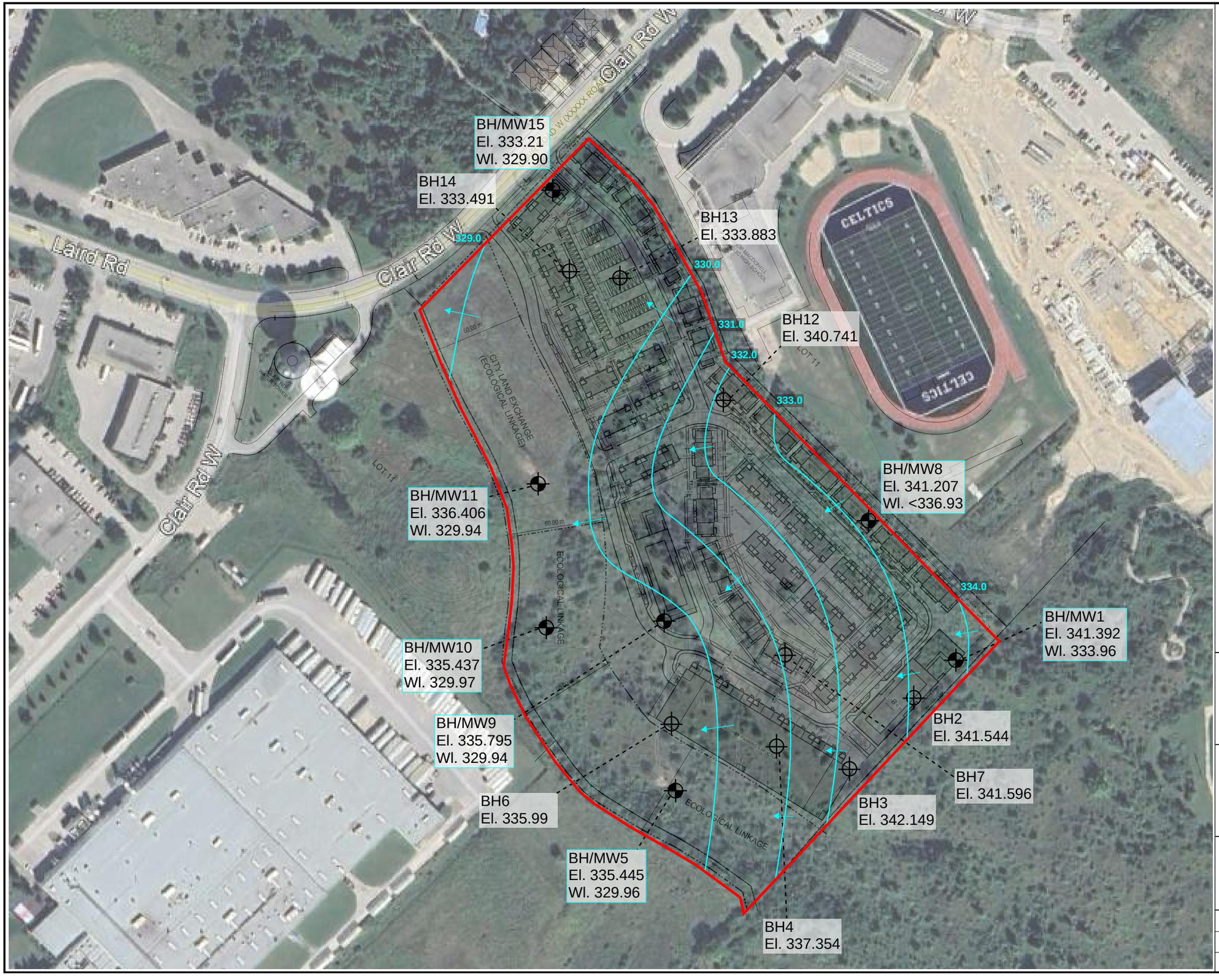
	TOPSOIL
	Sand and Gravel FILL
	Silty Sand FILL
	SAND AND GRAVEL
	SILT TILL

JLP

Geotechnical & Environmental Consultants

Cross Section B-B'
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: August 15, 2024	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: AJ	FIG. No. 8
Horizontal Scale: 1:1500	Vertical Scale: 1:75	



Legend

- Project Area
- Borehole (JLP, 2024)
- Borehole with Monitor (JLP, 2024)
- Groundwater Contour (water levels taken August 13, 2024)

N
True North

- This drawing shall be read in conjunction with the associated technical report.
- El = Elevation
- Wl = Water level elevation
- The ground surface elevations were obtained using a Sokkia GcX3 global position system referenced to the coordinate system known as NAD83 no trans, which is the North American Datum of 1983 of the Canadian Spatial Reference System, and the Universal Transverse Mercator (UTM) Zone 17.
- The soil types and boundaries are applicable only at the location of the boreholes. Between boreholes, they are assumed and may change substantially. The topsoil thicknesses quoted in the report are used for discussion purposes only and should not be used for estimating purposes.
- The soil samples will be retained for three months from the date of issue of the final report and then discarded, unless the client has requested to extend the storage period with fees.

JLP
Geotechnical & Environmental Consultants

Groundwater Contour Plan
Proposed Residential Development
280 Clair Road West,
Guelph, Ontario

Date: Jan. 24, 2025	Ref. No. G4836-24-3	
Prepared By: CL	Checked By: AL	Encl. No. 9
Source: Google Earth, 2025 Architecture Unfolded, A101 Site Plan (2024.12.04)	Scale: 7.5 15 30 45 metres	

Appendix A – Limitations and Use of Report

REPORT TERMS AND CONDITIONS

NOTICE: THE FOLLOWING PROVISIONS SET FORTH IMPORTANT QUALIFICATIONS AND LIMITATIONS ON THE FINDINGS AND RECOMMENDATIONS IN THE REPORT AS WELL AS THE USE OF, AND RELIANCE ON, THE REPORT.

1. **DEFINITIONS**. The following capitalized terms have the following meanings:

   (a) "**Additional Investigations**" means investigations that JLP has indicated to the Client should be undertaken to take into account any Out-of-Scope Requirements, but that are not otherwise specifically within the scope of investigations conducted for the purpose of the Report.

   (b) "**Applicable Laws**" means and includes without limitation all applicable provincial laws, regulations, guidelines, policies, standards, protocols, and objectives administered by the Ministry of the Environment and Climate Change or any other duly-constituted governmental authority, all as in force as of the date of the Report.

   (c) "**Client**" means the Client as referred to in the Report.

   (d) "**Client Information**" means the information, representations, and instructions provided by the Client, the Client's representatives, and/or others and upon which the Report is based, in whole or in part.

   (e) "**Findings**" means the evaluations and conclusions set forth in the Report.

   (f) "**JLP**" means JLP Services Inc.

   (g) "**Out-of-Scope Requirements**" means special concerns or requirements of the Client in respect of the subject matter of the Report.

   (h) "**Recommendations**" mean the findings and recommendations referred to in the Report, taking into account any Out-of-Scope Requirements that were disclosed to JLP prior to the date of the Report.

   (i) "**Report**" means the report to which these Terms and Conditions are attached and form part.

   (j) "**Report Documents**" means the underlying documents, records, data, and files, in any medium whatsoever, generated in connection with the preparation of the Report, including without limitation, the instructions and objectives communicated to JLP by the Client, communications between JLP and the Client, and other reports, proposals, or documents prepared by JLP for the Client in connection with the Site.

   (k) "**Site**" means the site in respect of which the Report was prepared.

   (l) "**Site Conditions**" means Site conditions known as a result of, or reasonably imputed by, the investigations that were undertaken as of the date of the Report.

2. **BASIS OF REPORT**. The Report is based on the Site Conditions. Any changes to the Site Conditions after the date of the Report that could or will affect the Site Conditions may or will have a corresponding effect on the Recommendations. The Report does not take into account any (a) Additional Investigations that were not undertaken, or (b) Out-of-Scope Requirements that were not communicated prior to completion of the investigations that were been undertaken as of the date of the Report. Where recommended field services are referred to, they are the minimum services necessary to determine compliance of construction with Applicable Laws, generally accepted industry-standard practices, and the Recommendations.

3. **RELIANCE & USE**. The Report has been prepared only for the Site and the related design, development, building, or building assessment objectives identified by the Client. The Findings and Recommendations are based on the Site Conditions and the Client Information. In preparing the Report, JLP has relied upon the Client Information and disclaims any responsibility for any inaccuracy, misstatement, omission, unintentional misrepresentation, or other deficiency contained in the Report as a result of such reliance. Unless specifically stated otherwise, the applicability and reliability of the Findings and the Recommendations expressed in the Report are only valid to the extent that (a) there has been no material change to or variation from any of the Client Information, (b) the Client Information contains no untrue statement of a material fact, or (c) the Client Information omits no statement of a material fact necessary in order to make the Client Information not misleading.

   The Report and the Findings and Recommendations are for the sole benefit of the Client. No other party may use or rely upon the Report in whole or in part without the prior written consent of JLP, which may be arbitrarily withheld or conditioned.

   RELIANCE UPON THE REPORT OR ANY OF THE DETERMINATIONS MADE HEREIN BY A THIRD PARTY WITHOUT JLP'S CONSENT IS PROHIBITED AND JLP MAKES NO REPRESENTATION, GUARANTEE, OR WARRANTY IN FAVOUR OF ANY

THIRD PARTY WITH RESPECT TO THE REPORT WHATSOEVER. JLP FULLY DISCLAIMS, AND WILL HAVE NO LIABILITY FOR, ANY LOSS, DAMAGES, OR EXPENSES WHICH ANY THIRD-PARTY MAY INCUR OR SUFFER AS A RESULT OF THE USE OF OR RELIANCE ON THIE REPORT WHERE JLP HAS NOT EXPRESSLY AUTHORIZED SAME. ANY THIRD PARTY WHO RELIES ON THE REPORT TO ANY EXTENT DOES SO AT SUCH PARTY'S OWN RISK AND COMPLETELY WAIVES ANY AND ALL CLAIMS AGAINST JLP IN CONNECTION WITH THE REPORT, REGARDLESS OF THE THEORY OF LAW (WHETHER IN CONTRACT, TORT, OR ANY THEORY OF LAW COMING INTO EXISTENCE HEREAFTER).

4. **STANDARD OF CARE**. The Report has been prepared in a manner consistent with the degree of care and skill exercised by engineering consultants currently practicing under similar circumstances. No other warranty, expressed or implied, is made or intended in the Report. It is intended that the Findings and Recommendations are meant to assist in reducing the Client's risk associated with environmental impairment at the Site. The Report should not be considered risk mitigation.

5. **ENTIRE REPORT**. The Report also includes the Report Documents. In order to properly understand the Findings and Recommendations, reference must be made to the Report in its entirety. JLP is not responsible for use by any party of a part of the Report only.

6. **GOVERNING FORMAT**. Notwithstanding that JLP may have submitted an electronic version of the Report or any document forming part of the Report, only the signed and sealed physical copy of the Report shall be deemed to be the original and in the event of any dispute or discrepancy, the physical copy shall govern. JLP makes no representation about the compatibility of its electronic or digital file format with the Client's current or future software and/or hardware systems. The documents described herein are JLP's instruments of professional service and shall not be altered without the written consent of JLP.

7. **GENERAL LIMITATIONS**.

   (a) Unless specifically stated otherwise, the Report does not contain environmental consulting advice.

   (b) The Report contains no opinion or determination as to any matters governed by laws other than the laws of the Province of Ontario and the federal laws of Canada applicable therein as of the date hereof.

   (c) During any future development of the Site, conditions not observed during JLP's investigations may become apparent. If this occurs, JLP should be contacted to assess the situation and whether there is a need for additional testing.

   (d) JLP's investigations were carried out to address the intent of Applicable Laws, which are subject to change, and such changes, when coming into legal force and effect, could alter the Findings and Recommendations in a material way.

   (e) Achieving the objectives stated in the Report has required JLP to arrive at conclusions based upon the best information presently known to JLP. Current investigative methodologies do not completely eliminate the possibility of imprecise or incomplete information. Rather, they merely reduce such possibility to acceptable levels. Professional judgment was exercised in gathering and analyzing information obtained and in the formulation of the Findings. JLP does not act as an absolute insurer of the Findings and will only be responsible for gross negligence with respect thereto.

   (f) The Report may not be reproduced in whole or in part by any party other than the Client without JLP's prior written consent. All intellectual property rights in the Report are reserved to JLP.

Appendix B – MECP WWR Summary Table

Appendix B: MECP Water Well Record Summary Table
(Water Wells located within 500 m of Site Boundary)

JLP Services Inc.
G4836-24-3
280 Clair Road West, Guelph, ON

# Well	Well ID	Distance From Site Centroid (m)	Zone	East 83	North 83	Location Accuracy	Date Received	Street	City	Final Status	1st Use	2nd Use	Depth Water Found (m)	Geology			
														Depth (m)	Material 1	Material 2	Material 3
1 (on-Site)	6702482	59	17	564980.3	4815700	margin of error : 100 m - 300 m	3/20/1963			Water Supply	Livestock	Domestic	42.06	6.1 10.7 13.7 21.3 25.0 27.4 37.5 38.7 42.1	BOULDERS BOULDERS STONES HARDPAN MEDIUM SAND HARDPAN LIMESTONE LIMESTONE LIMESTONE	CLAY HARDPAN GRAVEL	
2 (on-Site)	6706532	104	17	564834.3	4815663	margin of error : 30 m - 100 m	10/14/1977			Water Supply	Domestic		54.86	9.1 12.8 39.0 48.8 60.4 71.6 91.4 93.0	CLAY CLAY CLAY ROCK ROCK ROCK ROCK ROCK	STONES GRAVEL STONES LIGHT-COLOURED DARK-COLOURED COARSE-GRAINED	
3 (on-Site)	7044527	199	17	564876	4815909	margin of error : 10 - 30 m	6/7/2007	CLAIR RD W.	PUSLINCH	Observation Wells				17.5 42.0 45.0 82.3	SAND	SILTY	
4 (on-Site)	7044528	199	17	564876	4815909	margin of error : 10 - 30 m	6/7/2007	CLAIR RD W.	PUSLINCH	Observation Wells				17.5 42.0 45.0 64.1	SAND	SILTY	
5 (on-Site)	7044529	199	17	564876	4815909	margin of error : 10 - 30 m	6/7/2007	CLAIR RD WEST	PUSLINCH	Observation Wells				17.5 33.9	SAND	SILTY	
6	6700932	226	17	564704.3	4815768	margin of error : 100 m - 300 m	9/25/1967			Water Supply	Domestic		19.81	0.3 9.1 17.4 32.6 32.9 43.3 82.3	TOPSOIL GRAVEL CLAY ROCK SAND ROCK ROCK	 STONES GRAVEL	
7	6715028	653	17	564705	4815101	margin of error : 10 - 30 m	9/10/2004	CRAWLEY RD AND CLAIR RD WEST	GUELPH	Abandoned-Other	Not Used						
8	6715029	653	17	564705	4815101	margin of error : 10 - 30 m	9/10/2004	CRAWLEY RD AND CLAIR RD WEST	GUELPH	Abandoned-Other	Not Used						
9	6715030	587	17	565097	4815155	margin of error : 10 - 30 m	9/10/2004	CRAWLEY RD AND CLAIR RD WEST	GUELPH	Abandoned-Other	Not Used						
10	6715032	587	17	565097	4815155	margin of error : 10 - 30 m	9/10/2004	CRAWLEY	GUELPH	Abandoned-Other	Not Used						
11	7121100	524	17	565403	4815503	margin of error : 10 - 30 m	3/30/2009	1 GUELPH SOUTH BALL PARK	Guelph	Test Hole	Municipal		41.15	2.4 27.4 36.6 37.8 48.8 59.4 80.8 96.0 102.1	CLAY CLAY CLAY GRAVEL LIMESTONE LIMESTONE LIMESTONE LIMESTONE SHALE	SAND STONES STONES ROCK	FRACTURED

Appendix B: MECP Water Well Record Summary Table
(Water Wells located within 500 m of Site Boundary)

JLP Services Inc.
G4836-24-3
280 Clair Road West, Guelph, ON

# Well	Well ID	Distance From Site Centroid (m)	Zone	East 83	North 83	Location Accuracy	Date Received	Street	City	Final Status	1st Use	2nd Use	Depth Water Found (m)	Geology			
														Depth (m)	Material 1	Material 2	Material 3
12	7132490	638	17	564393	4816070	margin of error : 30 m - 100 m	10/23/2009	405 LAIRD RD	Guelph	Test Hole	Monitoring		3.60	0.1			
13	(cluster wells)	631	17	564397	4816063	margin of error : 10 - 30 m								0.6	SAND	GRAVEL	FILL
14		634	17	564395	4816066	margin of error : 10 - 30 m								1.6	SAND	GRAVEL	SILT
15		621	17	564433	4816096	margin of error : 10 - 30 m								2.1	SILT	SAND	GRAVEL
16		567	17	564452	4816030	margin of error : 10 - 30 m								5.8	SAND	GRAVEL	
17		550	17	564468	4816024	margin of error : 10 - 30 m											
18		544	17	564482	4816033	margin of error : 10 - 30 m											
19		566	17	564457	4816036	margin of error : 10 - 30 m											
20		683	17	564375	4816123	margin of error : 10 - 30 m											
21	7136046	582	17	564361	4815863	margin of error : 30 m - 100 m	12/16/2009	412 LAIRD RD.	Guelph	Observation Wells	Monitoring			5.5	SAND	MEDIUM GRAVEL	PACKED
														7.9	GRAVEL	SAND	PACKED
22	7178268	582	17	565415	4816029	margin of error : 30 m - 100 m	3/19/2012	CLAIR ROAD	Guelph	Test Hole	Dewatering			2.4	SAND	GRAVEL	DENSE
														15.2	GRAVEL	SAND	SILT
23	7216001	585	17	564357	4815859	margin of error : 30 m - 100 m	2/10/2014	412 LAIRD DR	GUELPJ	Monitoring and Test Hole	Monitoring and Test Hole			0.3	SAND	GRAVEL	LOOSE
														5.2	SAND	LOOSE	
														7.0	GRAVEL	DENSE	
24	7216002	547	17	564393	4815848	margin of error : 30 m - 100 m	2/10/2014	412 LAIRD DR	GUELPH	Monitoring and Test Hole	Monitoring and Test Hole			0.3	SAND	GRAVEL	LOOSE
														5.2	SAND	LOOSE	
														7.0	GRAVEL	DENSE	
25	7216003	588	17	564367	4815904	margin of error : 30 m - 100 m	2/10/2014	412 LAIRD ST	GUELPH	Monitoring and Test Hole	Monitoring and Test Hole			0.3	SAND	GRAVEL	LOOSE
														5.2	SAND	LOOSE	
														7.0	GRAVEL	DENSE	
26	7216004	546	17	564406	4815889	margin of error : 30 m - 100 m	2/10/2014	412 LAIRD DR	GUELPH	Monitoring and Test Hole	Monitoring and Test Hole			0.3	SAND	GRAVEL	LOOSE
														5.2	SAND	LOOSE	
														7.0	GRAVEL	DENSE	
27	7239559	566	17	564460	4816040	margin of error : 30 m - 100 m	4/8/2015										
28	7278485	591	17	565479	4815512	margin of error : 30 m - 100 m	1/6/2017	25 POPPY DR	GUELPH	Observation Wells	Monitoring		20.42	0.6	TOPSOIL		
														3.0	SAND	SILT	
														22.9	SAND	GRAVEL	
														24.4	SAND		FINE-GRAINED
														29.0	SAND		FINE-GRAINED
														33.5	SAND	CLAY	
														35.4	SAND	GRAVEL	COARSE-GRAINED
29	7284991	574	17	564368	4815573	margin of error : 30 m - 100 m	4/10/2017	836 SOUTHGATE DR	Guelph	Monitoring and Test Hole	Test Hole	Monitoring		0.9	FILL		
														10.7	SAND	GRAVEL	
30	7303640	693	17	564384	4816151	margin of error : 30 m - 100 m	1/19/2018										
31	7333798	601	17	564347	4815883	margin of error : 30 m - 100 m	4/15/2019	430 Laird	Guelph	Monitoring and Test Hole	Monitoring and Test Hole			1.2	OTHER		
														9.1	SAND	GRAVEL	
32	7333799	599	17	564355	4815903	margin of error : 30 m - 100 m	4/15/2019	430 Laird Guelph		Monitoring and Test Hole	Monitoring and Test Hole			0.1	OTHER		
														0.9	SAND	GRAVEL	
33	7350239	595	17	564359	4815901	margin of error : 30 m - 100 m	12/24/2019	LAIRD ROAD	Guelph	Observation Wells							
34	7350240	586	17	564374	4815918	margin of error : 30 m - 100 m	12/24/2019	LAIRD ROAD	Guelph	Observation Wells							
35	7353873	582	17	564509	4816124	margin of error : 30 m - 100 m	2/21/2020										
36	7359712	345	17	565212	4815906	margin of error : 30 m - 100 m	5/28/2020	25 Poppy St W	Guelph	Observation Wells	Monitoring		13.72	0.3	TOPSOIL		
														15.2	SILT	SAND	GRAVEL
37	7359713	394	17	565316	4815759	margin of error : 30 m - 100 m	5/28/2020	25 Poppy Dr W	Guelph	Observation Wells	Monitoring		15.24	0.3	TOPSOIL		
															SILT	SAND	GRAVEL
38	7370925	590	17	564365	4815905	margin of error : 30 m - 100 m	10/19/2020	412 Laird Road	Guelph	Abandoned-Other							
39	7370926	592	17	564365	4815910	margin of error : 30 m - 100 m	10/19/2020	412 Laird Road	Guelph	Abandoned-Other							
40	7379281	617	17	564349	4815492	margin of error : 30 m - 100 m	1/27/2021	489 Clair Rd West	Guelph	Observation Wells	Monitoring and Test Hole			0.3	TOPSOIL		LOOSE
														9.1	STONES	SAND	HARD
41	7416891	569	17	564534	4815302	margin of error : 30 m - 100 m	5/10/2022										
42	7437262	709	17	565600	4815503	margin of error : 30 m - 100 m	12/23/2022	2090 Gordon St.	Guelph	Observation Wells	Monitoring		21.70	22.8	SAND	GRAVEL	HARD
43	7445981	606	17	564331	4815841	margin of error : 30 m - 100 m	3/15/2023										

Appendix C – Borehole Logs

BORING NUMBER BH 1 (MW)

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/3/24 **COMPLETED** 4/3/24
GROUND ELEVATION 341.392 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR Arrow
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY MC **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE (20 40 60 80)	WELL CONSTRUCTION
341	0		**TOPSOIL** 250mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.3	SS 1	1-2-3-3 (5)	41	ND			
	1		**FILL** silty sand, trace gravel, trace organic inclusions; brown, moist, no odour, no staining	0.8	SS 2	2-5-7-9 (12)	36	ND			
340	2		**SAND AND GRAVEL** medium to coarse grained; brown, moist, compact to very dense, no odour, no staining		SS 3	9-8-19-31 (27)	30	ND			
339	3				SS 4	18-39-31-34 (70)	3	ND			
338	4				SS 5	19-23-20-27 (43)	43	ND			
					SS 6	50/0.08 50/75mm	0	ND		>>	
337	5				SS 7	10-7-9-6 (16)	25	ND			
336	6										
335	7										
334				7.6							

PL MC LL (20 40 60 80)

End of Borehole at 7.62 mbgs Due to Auger Refusal

BORING NUMBER BH 2

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/3/24 **COMPLETED** 4/3/24
GROUND ELEVATION 341.544 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR Arrow
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY MC **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80 / PL MC LL 20 40 60 80	WELL CONSTRUCTION
			TOPSOIL 250mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.3							
341	1		**SAND AND GRAVEL** medium to coarse grained; brown, moist, compact to very dense, no odour, no staining		SS 1	4-5-9-13 (14)	41	ND			
					SS 2	26-17-15-20 (32)	25	ND			
340	2				SS 3	14-15-14-20 (29)	36	ND			
339	3				SS 4	28-29-17-14 (46)	41	ND			
					SS 5	25-50/0.08 50/75mm	0	ND		>>	
338	4				SS 6	27-46-23-19 (69)	30	ND			
337	5				SS 7	25-50/0.13 50/125mm	33	ND		>>	
336	6				SS 8	50/0.10 50/100mm	15	ND		>>	
335	7										
334	8										
333				8.8							

End of Borehole at 8.83 mbgs Due to Auger Refusal

BORING NUMBER BH 3

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/3/24 **COMPLETED** 4/3/24
GROUND ELEVATION 342.149 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR Arrow
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY MC **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80 / PL MC LL 20 40 60 80	WELL CONSTRUCTION
342			**TOPSOIL** 300mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.3	SS 1	2-9-10-22 (19)	36	ND			
	1				SS 2	15-24-25-36 (49)	30	ND			
341			**SAND AND GRAVEL** brown, moist, dense to very dense, no odour, no staining		SS 3	27-40-24-21 (64)	30	ND			
	2										
340				2.4	SS 4	50/0.08 50/75mm	0	ND			

End of Borehole at 2.37 mbgs Due to Auger Refusal

BORING NUMBER BH 4

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/4/24 **COMPLETED** 4/4/24
GROUND ELEVATION 337.354 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR Arrow
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY MC **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80 / PL MC LL 20 40 60 80	WELL CONSTRUCTION
337	1		**TOPSOIL** 300mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.3	SS 1	2-2-3-3 (5)	41	ND			
			FILL sand and gravel, some silt; brown, moist, no odour, no staining	1.1	SS 2	4-6-13-20 (19)	28	ND			
336	2		**SAND AND GRAVEL** medium to coarse grained; brown, moist, compact to very dense, no odour, no staining		SS 3	18-27-50-47 (77)	41	ND			
335	3				SS 4	14-28-25-23 (53)	38	ND			
334	4				SS 5	23-23-31-43 (54)	41	ND			
333	5				SS 6	21-41-43-32 (84)	53	ND			
332					SS 7	15-13-10-25 (23)	38	ND			
				5.9	SS 8	22-17-28-50 (45)	38	ND			

End of Borehole at 5.94 mbgs

BORING NUMBER BH 5 (MW)

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/5/24 **COMPLETED** 4/5/24
GROUND ELEVATION 335.445 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR Arrow
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY MC **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 5.33 m / Elev 330.12 m

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	WELL CONSTRUCTION
335	1		**TOPSOIL** 400mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.4	SS 1	2-3-7-6 (10)	15	ND		
			FILL sand and gravel, some silt; brown, moist, no odour, no staining	1.3	SS 2	3-4-5-9 (9)	51	ND		
334	2		**SAND AND GRAVEL** trace silt; brown, moist, very dense, no odour, no staining		SS 3	50 50/100mm	0	ND		
333	3				SS 4	35-44-50 (94) 50/75mm	25	ND		
332	4				SS 5	40-33-50 (83) 50/50mm	28	ND		
					SS 6	50 50/50mm	0	ND		
331	5				SS 7	24-33-36-50 (69) 50/125mm	38	ND		
330			wet at 5.6 mbgs	5.9	SS 8	19-30-25-26 (55)	41	ND		

SPT N VALUE: 20 40 60 80
PL MC LL: 20 40 60 80

End of Borehole at 5.94 mbgs

BORING NUMBER BH 6

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/4/24 **COMPLETED** 4/4/24
GROUND ELEVATION 335.99 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR Arrow
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY MC **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80	WELL CONSTRUCTION
			TOPSOIL 175mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.2	SS 1	1-2-3-3 (5)	18	ND			
335	1		**SAND AND GRAVEL** trace silt; brown, moist, very dense, no odour, no staining		SS 2	17-29-30-44 (59)	38	ND			
334	2				SS 3	23-29-37-41 (66)	43	ND			
			End of Borehole at 2.32 mbgs Due to Auger Refusal	2.3	AU 4	50/0.03 50/25mm					

PL MC LL 20 40 60 80

BORING NUMBER BH 7

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/4/24 **COMPLETED** 4/4/24
GROUND ELEVATION 341.596 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR Arrow
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY MC **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80 / PL MC LL 20 40 60 80	WELL CONSTRUCTION
			TOPSOIL 200mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.2	SS 1	5-15-24-26 (39)	33	ND			
341	1		**SAND AND GRAVEL** trace silt, brown; moist, compact to very dense, no odour, no staining		SS 2	19-18-50/0.13 50/125mm	30	ND		>>	
340	2				SS 3	50/0.08 50/75mm	3	ND		>>	
339	3				SS 4	30-18-18-15 (36)	33	ND			
338	4				SS 5	10-21-23-26 (44)	33	ND			
337	5				SS 6	21-29-21-23 (50)	28	ND			
336					SS 7	14-13-11-22 (24)	38	ND			
				5.8	SS 8	40-39-50 (89) 50/150mm	43	ND			

End of Borehole at 5.79 mbgs Due to Auger Refusal

BORING NUMBER BH 8 (MW)

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/5/24 **COMPLETED** 4/5/24
GROUND ELEVATION 341.207 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR 3D Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY SJ **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80 / PL MC LL 20 40 60 80	WELL CONSTRUCTION
341			**TOPSOIL** 300mm of silty sand, some gravel; scattered organic inclusions, dark brown, moist, no odour, no staining	0.3	SS 1	1-2-4-17 (6)	36	ND			
	1		**FILL** silty sand, trace gravel, trace organic inclusions; brown, moist, no odour, no staining	0.8	SS 2	16-15-21-17 (36)	25	ND			
340					SS 3	18-30-32-43 (62)	33	ND			
	2		**SAND AND GRAVEL** medium to coarse grained; brown, moist, compact to very dense, no odour, no staining		SS 4	10-23-39-32 (62)	23	ND			
339											
	3				SS 5	15-33-44-50 (77)	36	ND			
338											
	4				SS 6	50/0.01 50/10mm				>>	
337				4.4							

End of Borehole at 4.42 mbgs Due to Auger Refusal

BORING NUMBER BH 9 (MW)

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/4/24 **COMPLETED** 4/4/24
GROUND ELEVATION 335.795 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR Arrow
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY MC **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 5.69 m / Elev 330.11 m

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80 / PL MC LL 20 40 60 80	WELL CONSTRUCTION
335	1		**TOPSOIL** 300mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.3	SS 1	1-1-2-3 (3)	25	ND			
			FILL silty sand, trace gravel; brown, moist, no odour, no staining	0.9	SS 2	13-30-37-38 (67)	41	ND			
334	2		**SAND AND GRAVEL** medium to coarse grained; brown, moist to wet, very dense, no odour, no staining		SS 3	20-34-48-50/0.08 50/125mm	36	ND		>>	
					SS 4	34-50/0.08 50/75mm	25	ND		>>	
333	3				SS 5	26-29-31-37 (60)	38	ND			
332	4				SS 6	15-36-37-46 (73)	38	ND			
331	5				SS 7	32-50-50/0.13 50/125mm	30	ND		>>	
330	6				SS 8	20-27-32-37 (59)	38	ND			
329	7				SS 9	13-12-23-16 (35)	50	ND			
328	8										
327				9.0	SS 10	5-13-16-10 (29)	35	ND			

End of Borehole at 8.99 mbgs

BORING NUMBER BH10 (MW)

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/5/24 **COMPLETED** 4/5/24
GROUND ELEVATION 335.437 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR 3D Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY SJ **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 5.30 m / Elev 330.14 m

ELEV. (m)	DEPTH (m)	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS
335	0	**TOPSOIL** 400mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.4	SS 1	1-2-2-3 (4)	51	ND	
	1	**FILL** silty sand, trace gravel; brown, moist, no odour, no staining	0.8	SS 2	29-12-18-22 (30)	51	ND	
334	2	**SAND AND GRAVEL** medium to coarse grained, some silt; brown, moist to wet, very dense, no odour, no staining		SS 3	15-26-25-50 (51)	41	ND	
333	3			SS 4	17-30-47-43 (77)	41	ND	
332	4			SS 5	27-49-50 (99)	25	ND	
				SS 6	49-50	25	ND	
331	5			SS 7	50	20	ND	
330	6		6.1					

SPT N VALUE: 20 40 60 80
PL MC LL: 20 40 60 80

WELL CONSTRUCTION

End of Borehole at 6.10 mbgs Due to Auger Refusal

BORING NUMBER BH11 (MW)

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/5/24 **COMPLETED** 4/5/24
GROUND ELEVATION 336.406 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR 3D Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY SJ **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 6.26 m / Elev 330.15 m

ELEV. (m)	DEPTH (m)	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80 / PL MC LL 20 40 60 80	WELL CONSTRUCTION
336		**TOPSOIL** 300mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.3	SS 1	6-12-23-27 (35)	41	ND			
	1	**FILL** sand and gravel, trace silt; brown, moist, no odour, no staining	0.8	SS 2	45-33-23-43 (56)	36	ND			
335	2	**SAND AND GRAVEL** medium to coarse grained, some silt; brown, moist to wet, very dense, no odour, no staining		SS 3	34-32-32-22 (64)	53	ND			
334	3			SS 4	14-30-23-19 (53)	36	ND			
333	4			SS 5	16-42-19-33 (61)	48	ND			
332	5			SS 6	18-22-41-49 (63)	46	ND			
331	6			SS 7	11-33-27-28 (60)	43	ND			
330	7			SS 8	20-17-18-14 (35)	43	ND			
329		sand seams at 7.2mbgs wet	7.6							
		End of Borehole at 7.62 mbgs								

BORING NUMBER BH12

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/5/24 **COMPLETED** 4/5/24
GROUND ELEVATION 340.741 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR 3D Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY SJ **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE (20 40 60 80) PL MC LL	WELL CONSTRUCTION
			TOPSOIL 225mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.2	SS 1	1-4-7-7 (11)	43	ND			
340	1		**FILL** sand and gravel, trace silt; brown, moist, no odour, no staining	0.8	SS 2	10-26-12-14 (38)	33	ND			
339	2		**SAND AND GRAVEL** some silt; brown, moist to wet, dense, no odour, no staining		SS 3	17-22-20-17 (42)	28	ND			
				2.4	SS 4	16-23-17-36 (40)	25	ND			
338	3		**SILT TILL** silt, trace gravel; brown, wet, no odour, no staining		SS 5	25-29-31-45 (60)	33	ND			
337	4		**SAND AND GRAVEL** medium to coarse grained, some silt; brown, wet, dense, no odour, no staining	3.8	SS 6	11-25-46-20 (71)	43	ND			
336	5				SS 7	17-31-34-46/-0.17	33	ND		>>	
			End of Borehole at 5.33 mbgs	5.3	SS 8	50/0.00				>>	

BORING NUMBER BH13

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/5/24 **COMPLETED** 4/5/24
GROUND ELEVATION 333.883 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR 3D Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY SJ **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE (20 40 60 80)	WELL CONSTRUCTION
333	1		**TOPSOIL** 200mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.2	SS 1	1-8-7-3 (15)	25	ND			
			FILL silty sand, trace gravel, scattered organics; brown, moist, no odour, no staining	0.9	SS 2	8-15-19-23 (34)	25	ND			
332	2		**SAND AND GRAVEL** medium to coarse grained, some silt; brown, moist, dense to very dense, no odour, no staining		SS 3	16-31-27-30 (58)	33	ND			
					SS 4	31-49-50 (99) 50/150mm	15	ND			
331	3				SS 5	38-35-50 (85) 50/150mm	28	ND			
330	4		cobbles and boulders at about 4.0mbgs								
329	5				SS 6	16-17-16-16 (33)	43	ND			
328	6		wet at 4.6mbgs	6.7	SS 7	4-4-4-11 (8)	43	ND			

End of Borehole at 6.71 mbgs

BORING NUMBER BH14

JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/5/24 **COMPLETED** 4/5/24
GROUND ELEVATION 333.491 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR 3D Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY SJ **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE 20 40 60 80 / PL MC LL 20 40 60 80	WELL CONSTRUCTION
333			**TOPSOIL** 300mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.3	SS 1	1-1-2-5 (3)	15	ND			
	1			0.8	SS 2	14-26-41-49 (67)	43	ND			
332			**FILL** silty sand, trace gravel; brown, moist, no odour, no staining		SS 3	50		ND			
	2		**SAND AND GRAVEL** medium to coarse grained, some silt, scattered cobbles; brown, moist, compact to very dense, no odour, no staining		SS 4	29-22-33-34 (55)	41	ND			
331	3		cobbles and boulder at about 3.2mbgs		SS 5	18-50	13	ND			
330	4				SS 6	15-19-16-12 (35)	41	ND			
329	5				SS 7	2-4-14-15 (18)	41	ND			
328	6			6.1							
327	7		**SILT TILL** some sand, trace gravel; grey, wet, loose to very dense, no odour, no staining		SS 8	1-2-3-3 (5)	25	ND			
326				7.6	SS 9	16-33-36-39 (69)	61	ND			

End of Borehole at 7.62 mbgs

BORING NUMBER BH15 (MW)

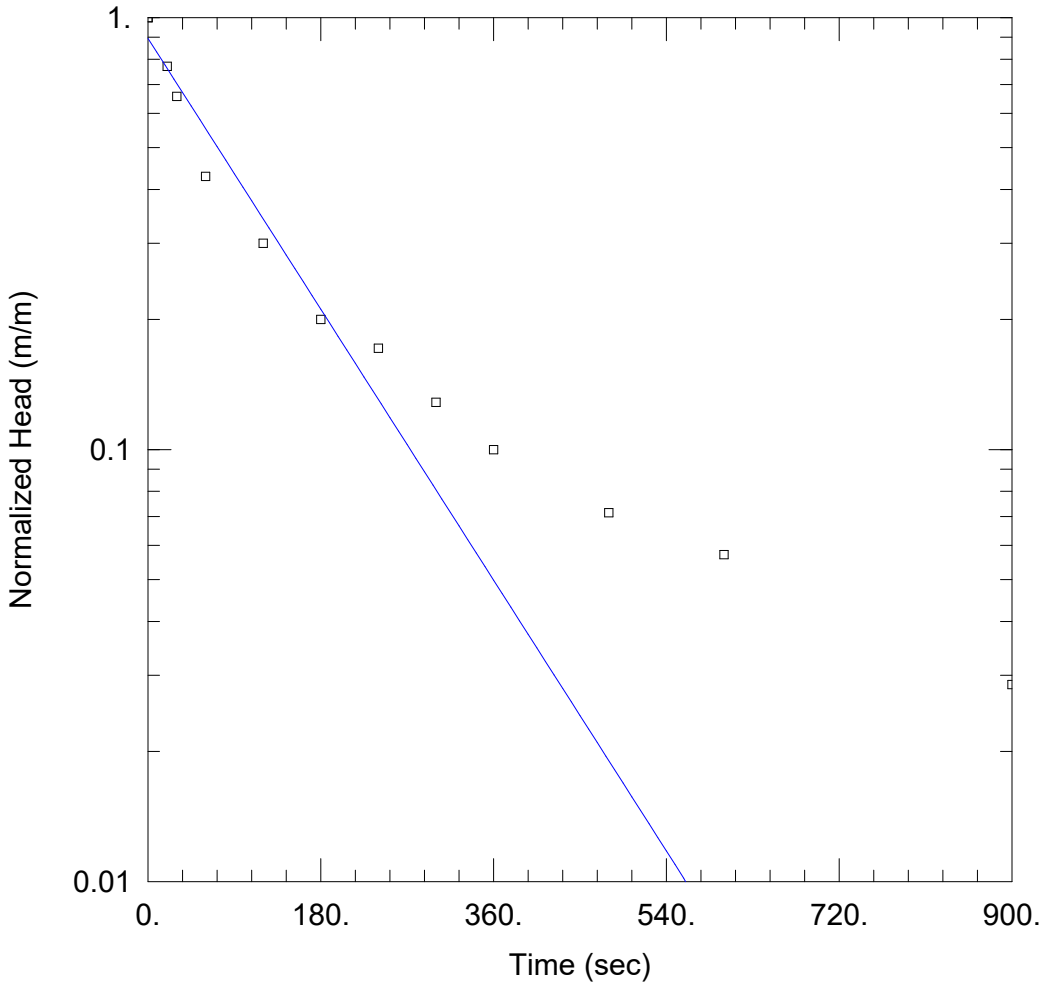
JLP
Geotechnical & Environmental Consultants

CLIENT John Farley and Home Opportunities
PROJECT NAME Proposed Residential Development
PROJECT NUMBER G4836-24-3
PROJECT LOCATION 280 Clair Road West, Guelph, ON
DATE STARTED 4/5/24 **COMPLETED** 4/5/24
GROUND ELEVATION 333.209 m Geodetic **HOLE SIZE** 150mm
DRILLING CONTRACTOR 3D Drilling
GROUND WATER LEVELS:
DRILLING METHOD CME-45 Truck
AT TIME OF DRILLING ---
LOGGED BY SJ **CHECKED BY** AL
AT END OF DRILLING ---
NOTES
AFTER DRILLING 2.94 m / Elev 330.27 m

ELEV. (m)	DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY (cm)	HEADSPACE VAPOUR (ppm)	ANALYSIS	SPT N VALUE / PL MC LL	WELL CONSTRUCTION
333			**TOPSOIL** 200mm of silty sand, some gravel, scattered organic inclusions; dark brown, moist, no odour, no staining	0.3	SS 1	1-4-6-12 (10)	15	ND			
	1		**FILL** sand and gravel, trace silt; brown, moist, no odour, no staining	0.8	SS 2	20-14-28-27 (42)	18	ND			
332					SS 3	44-50	15	ND			
	2		**SAND AND GRAVEL** medium to coarse grained, some silt; brown, moist, dense to very dense, no odour, no staining		SS 4	25-31-25-27 (56)	48	ND			
331											
	3				SS 5	36-37-39-27 (76)	48	ND			
330											
	4		wet at 3.8 mbgs		SS 6	7-15-11-13 (26)	30	ND			
329											
	5				SS 7	14-14-21-26 (35)	20	ND			
328											
	6										
327			sand seams at 6.10mbgs		SS 8	1-1-1-2 (2)		ND			
				6.7							

End of Borehole at 6.71 mbgs

Appendix D – Single Well Response Test (SWRT)



SWRT BH/MW 5

Data Set: C:\...\BHMW 5.aqt
Date: 07/30/24 Time: 12:34:47

PROJECT INFORMATION

Company: JLP Services Inc.
Client: John Farley & Home Opport.
Project: G4836-24-3
Location: 280 Clair Rd W, Guelph
Test Well: BH/MW 5
Test Date: July 8, 2024

AQUIFER DATA

Saturated Thickness: 2.95 m Anisotropy Ratio (Kz/Kr): 1.

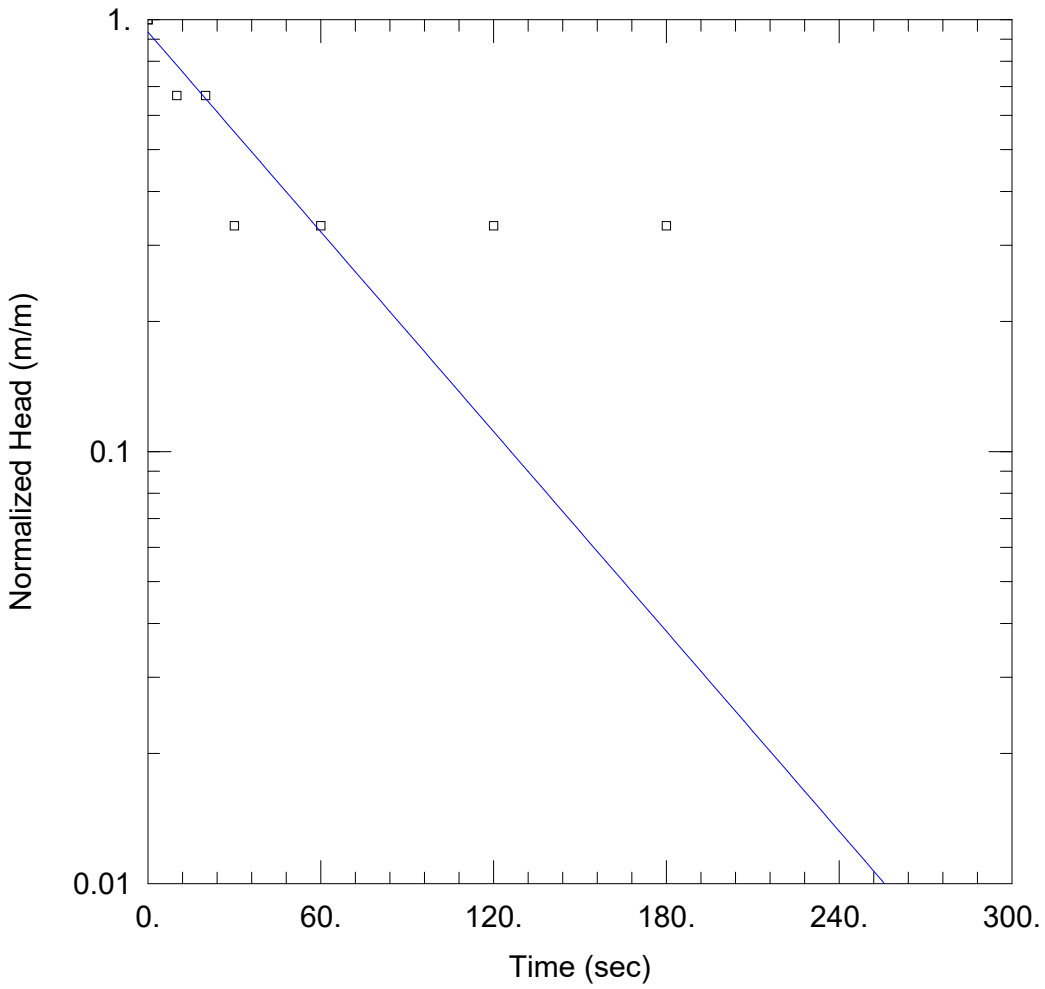
WELL DATA (BH/MW 5)

Initial Displacement: 0.7 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.95 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 4.647E-6 m/sec y0 = 0.6265 m



SWRT BH/MW 9

Data Set: C:\...\BHMW 9.aqt
Date: 07/30/24 Time: 12:28:16

PROJECT INFORMATION

Company: JLP Services Inc.
Client: John Farley & Home Opport.
Project: G4836-24-3
Location: 280 Clair Rd W, Guelph
Test Well: BH/MW 9
Test Date: July 8, 2024

AQUIFER DATA

Saturated Thickness: 2.82 m Anisotropy Ratio (Kz/Kr): 1.

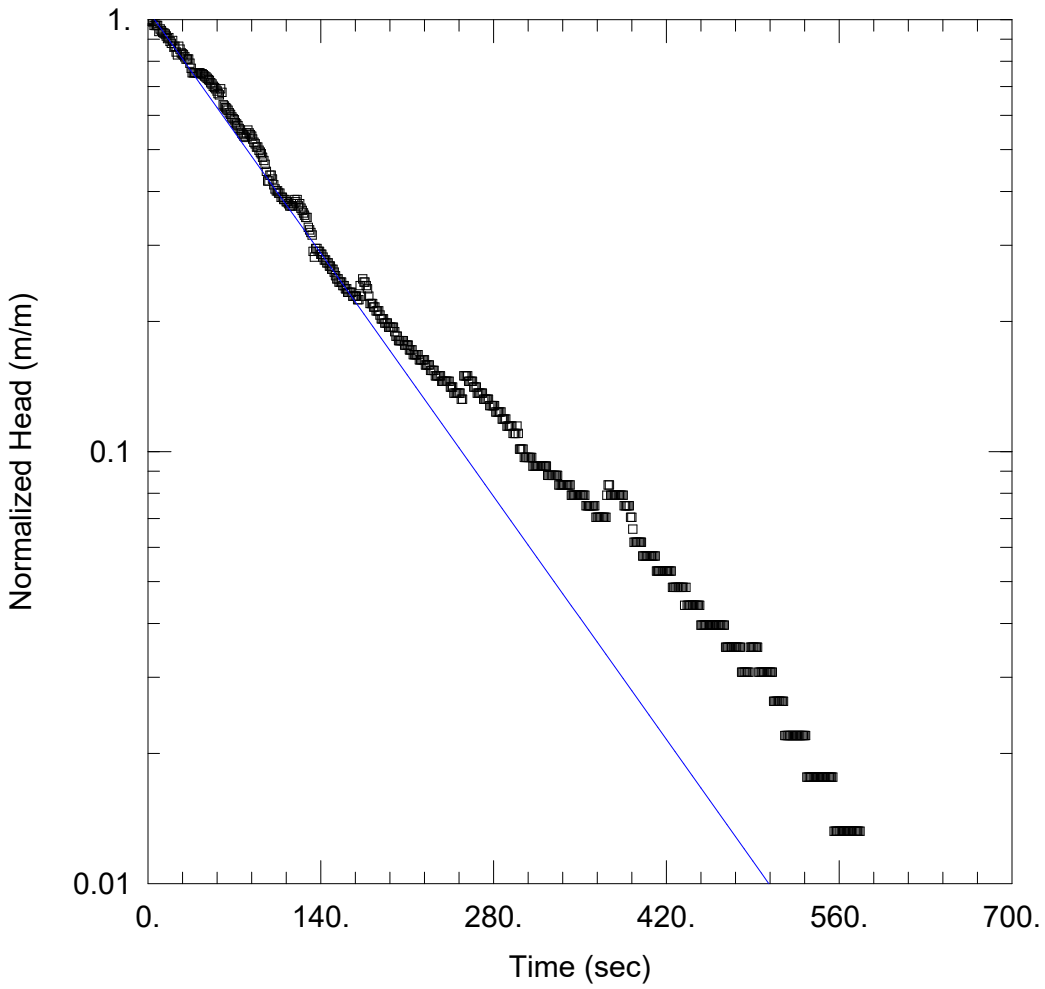
WELL DATA (BH/MW 9)

Initial Displacement: 0.03 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.82 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.076E-5 m/sec y0 = 0.02807 m



SWRT BH/MW 10

Data Set: C:\...\BHMW 10.aqt
Date: 07/30/24 Time: 12:20:30

PROJECT INFORMATION

Company: JLP Services Inc.
Client: John Farley & Home Opport.
Project: G4836-24-3
Location: 280 Clair Rd W, Guelph
Test Well: BH/MW 10
Test Date: July 8, 2024

AQUIFER DATA

Saturated Thickness: 0.27 m Anisotropy Ratio (Kz/Kr): 1.

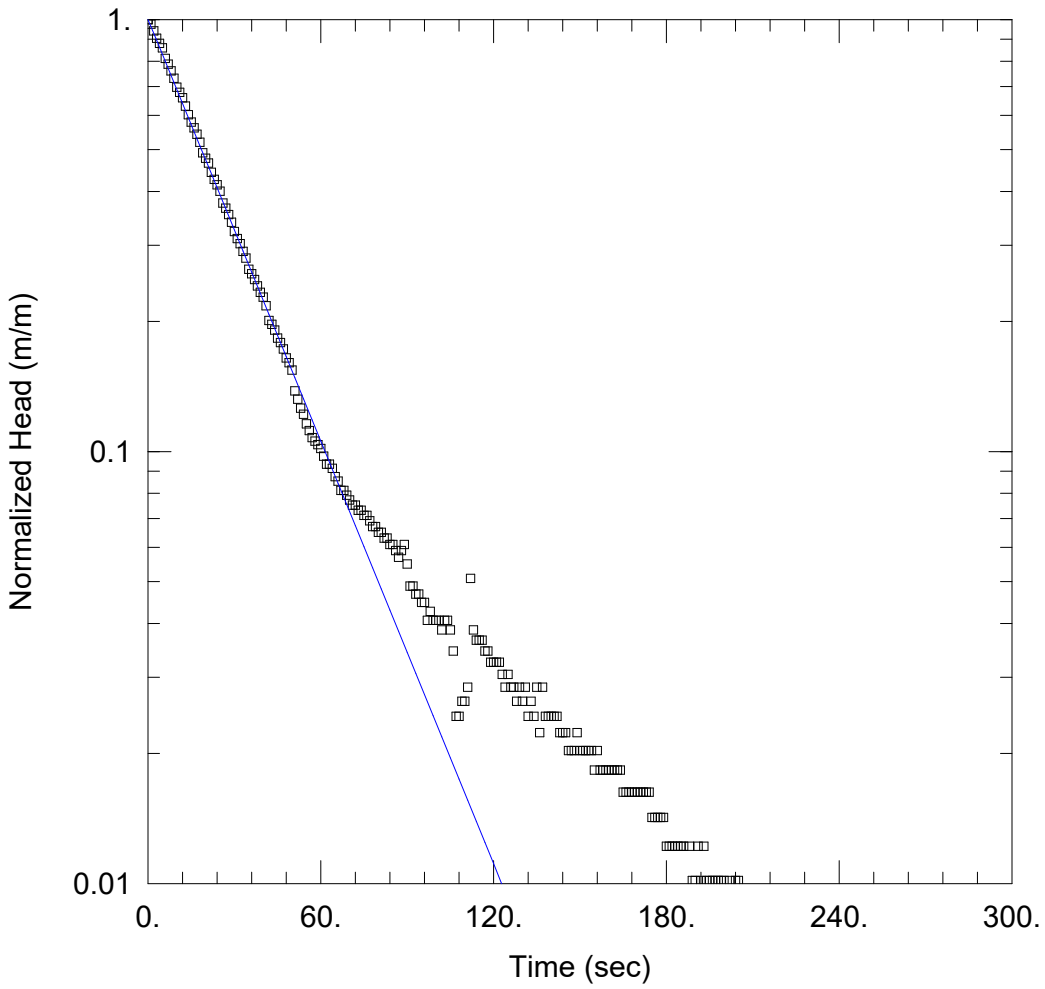
WELL DATA (BH/MW 10)

Initial Displacement: 0.681 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 0.27 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 5.856E-5 m/sec y0 = 0.7149 m



SWRT BH/MW 11

Data Set: C:\...\BHMW 11.aqt
Date: 07/30/24 Time: 12:14:35

PROJECT INFORMATION

Company: JLP Services Inc.
Client: John Farley & Home Opport.
Project: G4836-24-3
Location: 280 Clair Rd W, Guelph
Test Well: BH/MW 11
Test Date: July 8, 2024

AQUIFER DATA

Saturated Thickness: 0.81 m Anisotropy Ratio (Kz/Kr): 1.

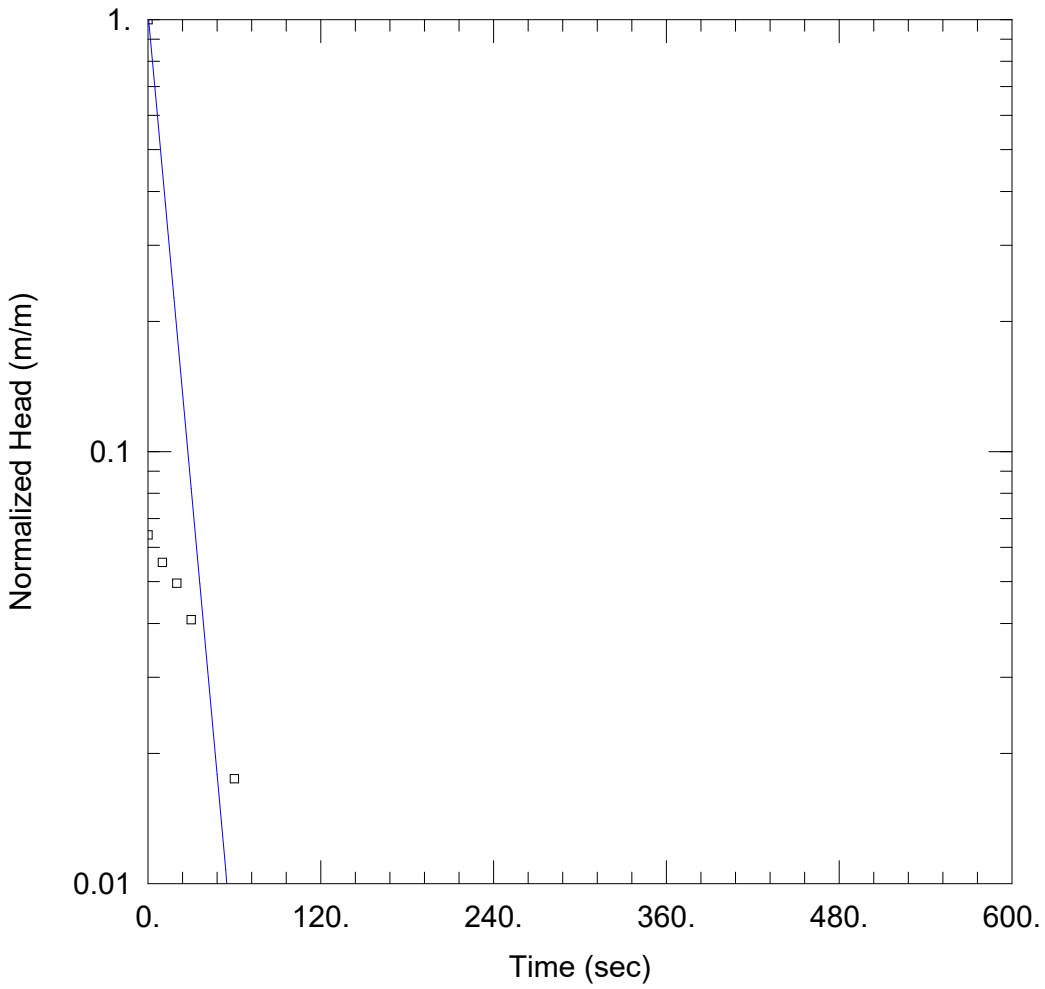
WELL DATA (BH/MW 11)

Initial Displacement: 1.476 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 0.81 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 7.915E-5 m/sec y0 = 1.481 m



SWRT BH/MW 15

Data Set: C:\...\BHMW 15.aqt
Date: 07/30/24 Time: 12:42:28

PROJECT INFORMATION

Company: JLP Services Inc.
Client: John Farley & Home Opport.
Project: G4836-24-3
Location: 280 Clair Rd W, Guelph
Test Well: BH/MW 15
Test Date: July 8, 2024

AQUIFER DATA

Saturated Thickness: 2.45 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH/MW 15)

Initial Displacement: 3.43 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0254 m
Static Water Column Height: 2.45 m
Screen Length: 3. m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 5.911E-5 m/sec y0 = 3.58 m

Appendix E – Infiltration Rates

Appendix E
Infiltration Test Data Analysis

Location: 280 Clair Road West, Guelph, Ontario
Project Number: G4836-24-3
Test Date: 8-Aug-24

Test Location	Co-efficient of Permeability (K_{fs}) (cm/s)	Infiltration Rate (IR) (mm/hr)	Discrete Design Infiltration Rate (mm/hr)	Percolation Time (T-Time) (min/cm)	Design Percolation (T) Time (min/cm)
Shallow Soils					
INF5S - 0.5 mbgs	8.1E-04	81	32.4	7.4	19
INF10S - 0.5 mbgs	1.31E-03	92	36.8	6.5	16
INF11S - 0.5 mbgs	1.8E-03	101	40.2	6.0	15
Deep Soils					
INF5D - 1.5 mbgs	1.4E-02	173	69.2		
INF10D - 1.5 mbgs	5.7E-03	137	54.6		
INF11D - 1.5 mbgs	2.5E-02	202	80.8		

Soil Unit	Geometric Mean of K (cm/s)	Geo-Mean Infiltration Rate (IR) (mm/hr)	Ratio - Geo-mean of Infiltration Rates	Safety Correction Factor (SCF)
Shallow Soils (0.5 mbgs)	1.24E-03	91	0.5	2.5
Deep Soils (1.5 mbgs)	1.25E-02	168		

Geo-Mean of Design Infiltration Rates (mm/hr)	Geo-mean of Design Percolation (T) Times (min/cm)
36	**17**

Note:

* Assumed approximately 1.5 m below the test elevation

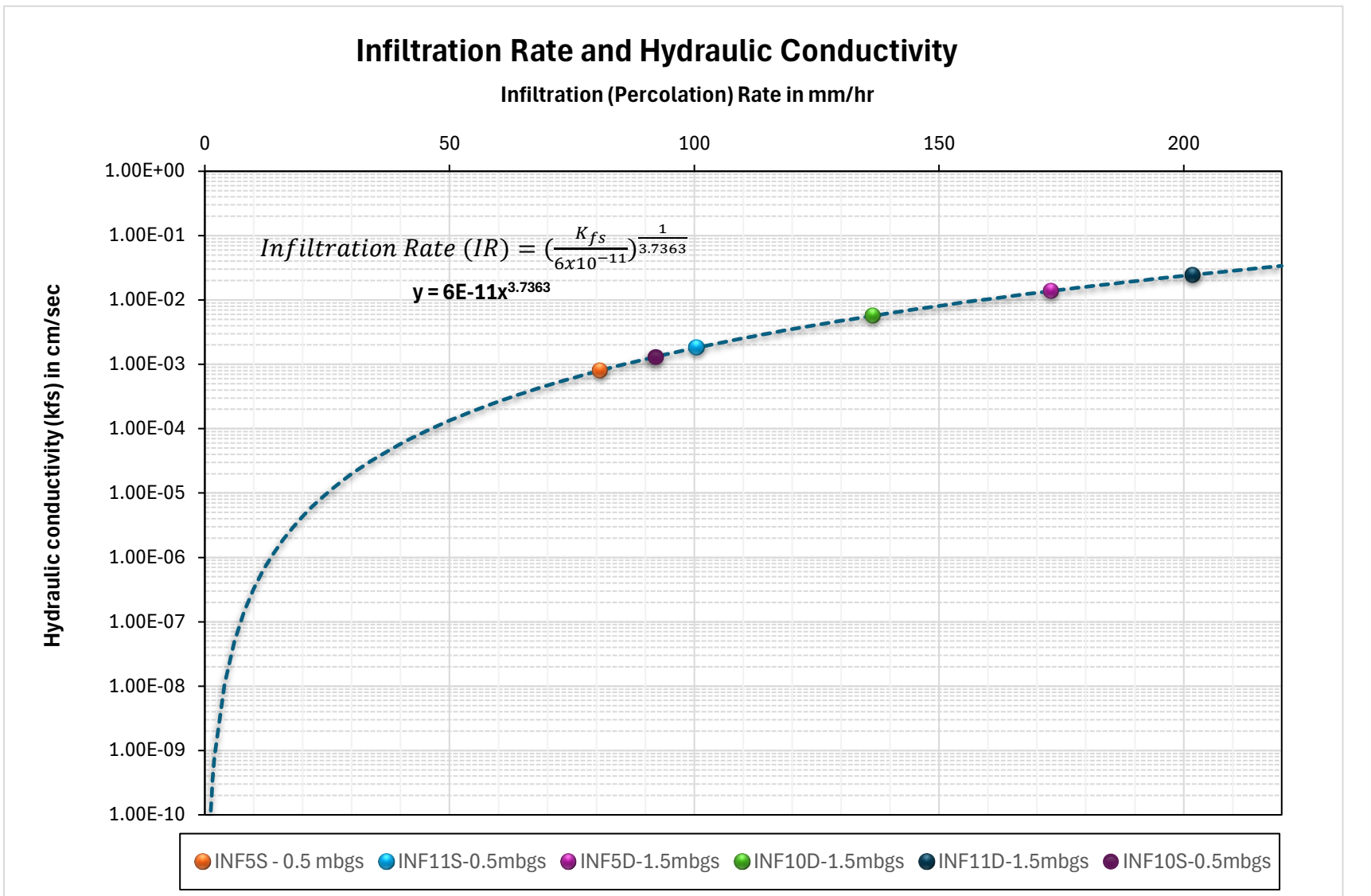
$$Infiltration\ Rate\ (IR) = \left(\frac{K_{\square}}{6x10^{-11}}\right)^{\frac{1}{3.7363}}$$

$$Design\ Infiltration\ Rate\ (DIR) = \frac{IR}{SCF}$$

Safety Correction Factors (SCF) for Design Infiltration Rate**	
Ratio of Mean Measured Infiltration	Safety Correction Factor
</=1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16	6.5
16.1 or greater	8.5

Kfs: field saturated hydraulic conductivity (cm/sec)
IR: infiltration rate (mm/hr)
DIR: design infiltration rate (mm/hr)

****SCF**: Safety Correction Factor (based on the chart recommended by CVC and TRCA, 2010)



Source: Ontario Ministry of Municipal Affairs and Housing. 1997. Supplementary Guidelines to the Ontario Building Code 1997. SG-6 Percolation Time and Soil Descriptions. Toronto, Ontario

Guelph Permeameter Calculations

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.8000

Res Type 35.22
H 5
a 3.5
H/a 1.429
a* 0.12
C0.01 0.736
C0.04 0.763
C0.12 0.72
C0.36 0.72
C 0.72
R 0.800
Q 0.47
pi 3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.720428
$Q =$ 0.4696

$K_{fs} =$ 7.58E-04 cm/sec
4.55E-02 cm/min
7.58E-06 m/sec
1.79E-02 inch/min
2.98E-04 inch/sec

$\Phi_m =$ 6.31E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 1.5000

Res Type 35.22
H 10
a 3.5
H/a 2.85714
a* 0.12
C0.01 1.11597
C0.04 1.17651
C0.12 1.16258
C0.36 1.16258
C 1.16258
R 1.500
Q 0.8805
pi 3.1415

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.162583
$Q =$ 0.8805

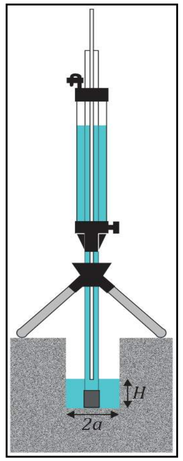
$K_{fs} =$ 8.55E-04 cm/sec
5.13E-02 cm/min
8.55E-06 m/ses
2.02E-02 inch/min
3.37E-04 inch/sec

$\Phi_m =$ 7.13E-03 (cm^2/min)

Average

$K_{fs} =$ 8.06E-04 cm/sec
4.84E-02 cm/min
8.06E-06 m/s
1.91E-02 inch/min
3.18E-04 inch/sec

$\Phi_m =$ 6.72E-03 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 5
Enter the second water Head Height ("H2" in cm): 10

Enter the Borehole Radius ("a" in cm): 3.8

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.36 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0
$Q_2 =$ 0
$C_1 =$ 0.679549
$C_2 =$ 1.100129
$G_1 =$ 0.004135
$G_2 =$ 0.003347
$G_3 =$ 0.048513
$G_4 =$ 0.02176

Res Type: 2.16
H1/a: 1.315789
H2/a: 2.631579
C1-0.01: 0.699357
C2-0.01: 1.06403
C1-0.04: 0.723895
C2-0.04: 1.119231
C1-0.12: 0.679549
C2-0.12: 1.100129
C1-0.36: 0.679549
C2-0.36: 1.100129

$K_{fs} =$ 0.00E+00 cm/sec
0.00E+00 cm/min
0.00E+00 m/sec
0.00E+00 inch/min
0.00E+00 inch/sec

$\Phi_m =$ 0.00E+00 (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.8000

Res Type	35.22
H	5
a	3.5
H/a	1.429
a*	0.36
C0.01	0.736
C0.04	0.763
C0.12	0.72
C0.36	0.72
C	0.72
R	0.800
Q	0.47
pi	3.142

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 0.72043
$Q =$ 0.4696

$K_{fs} =$ 1.24E-03 cm/sec
7.46E-02 cm/min
1.24E-05 m/sec
2.94E-02 inch/min
4.90E-04 inch/sec

$\Phi_m =$ 3.45E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 1.7000

Res Type	35.22
H	10
a	3.5
H/a	2.85714
a*	0.36
C0.01	1.11597
C0.04	1.17651
C0.12	1.16258
C0.36	1.16258
C	1.16258
R	1.700
Q	0.9979
pi	3.1415

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 1.16258
$Q =$ 0.9979

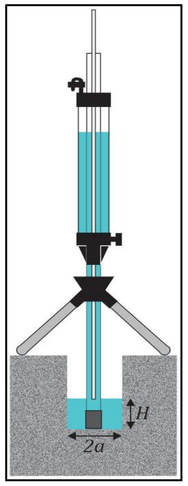
$K_{fs} =$ 1.37E-03 cm/sec
8.21E-02 cm/min
1.37E-05 m/ses
3.23E-02 inch/min
5.39E-04 inch/sec

$\Phi_m =$ 3.80E-03 (cm^2/min)

Average

$K_{fs} =$ 1.31E-03 cm/sec
7.84E-02 cm/min
1.31E-05 m/s
3.09E-02 inch/min
5.14E-04 inch/sec

$\Phi_m =$ 3.63E-03 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$c_1 =$ 0

$c_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! cm/sec
#DIV/0! cm/min
#DIV/0! m/sec
#DIV/0! inch/min
#DIV/0! inch/sec

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 1.3000

Res Type	35.22
H	5
a	3.5
H/a	1.429
a*	0.36
C0.01	0.736
C0.04	0.763
C0.12	0.72
C0.36	0.72
C	0.72
R	1.300
Q	0.763
pi	3.142

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 0.72043
$Q =$ 0.7631

$K_{fs} =$ 2.02E-03 *cm/sec*
1.21E-01 *cm/min*
2.02E-05 *m/sec*
4.77E-02 *inch/min*
7.96E-04 *inch/sec*

$\Phi_m =$ 5.61E-03 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 2.0000

Res Type	35.22
H	10
a	3.5
H/a	2.85714
a*	0.36
C0.01	1.11597
C0.04	1.17651
C0.12	1.16258
C0.36	1.16258
C	1.16258
R	2.000
Q	1.174
pi	3.1415

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 1.16258
$Q =$ 1.174

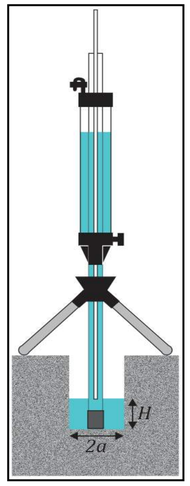
$K_{fs} =$ 1.61E-03 *cm/sec*
9.66E-02 *cm/min*
1.61E-05 *m/ses*
3.80E-02 *inch/min*
6.34E-04 *inch/sec*

$\Phi_m =$ 4.47E-03 (cm^2/min)

Average

$K_{fs} =$ 1.82E-03 *cm/sec*
1.09E-01 *cm/min*
1.82E-05 *m/s*
4.29E-02 *inch/min*
7.15E-04 *inch/sec*

$\Phi_m =$ 5.04E-03 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 0

Enter the first water Head Height ("H1" in cm): 0
Enter the second water Head Height ("H2" in cm): 0

Enter the Borehole Radius ("a" in cm): 0

Enter the soil texture-structure category (enter one of the below numbers): 0

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! *cm/sec*
#DIV/0! *cm/min*
#DIV/0! *m/sec*
#DIV/0! *inch/min*
#DIV/0! *inch/sec*

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3.5
Enter the soil texture-structure category (enter one of the below numbers):	4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 11.0000

Res Type	35.22
H	5
a	3.5
H/a	1.429
a*	0.36
C0.01	0.736
C0.04	0.763
C0.12	0.72
C0.36	0.72
C	0.72
R	#####
Q	6.457
pi	3.142

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 0.72043

$Q =$ 6.457

$K_{fs} =$ 1.71E-02 *cm/sec*
1.03E+00 *cm/min*
1.71E-04 *m/sec*
4.04E-01 *inch/min*
6.73E-03 *inch/sec*

$\Phi_m =$ 4.75E-02 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	10
Enter the Borehole Radius ("a" in cm):	3.5
Enter the soil texture-structure category (enter one of the below numbers):	4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 13.0000

Res Type	35.22
H	10
a	3.5
H/a	2.85714
a*	0.36
C0.01	1.11597
C0.04	1.17651
C0.12	1.16258
C0.36	1.16258
C	1.16258
R	13.000
Q	7.631
pi	3.1415

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 1.16258

$Q =$ 7.631

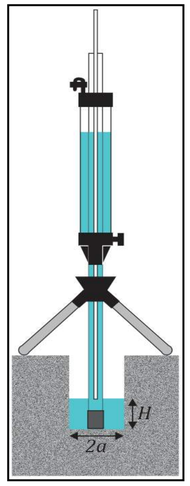
$K_{fs} =$ 1.05E-02 *cm/sec*
6.28E-01 *cm/min*
1.05E-04 *m/ses*
2.47E-01 *inch/min*
4.12E-03 *inch/sec*

$\Phi_m =$ 2.91E-02 (cm^2/min)

Average

$K_{fs} =$ 1.38E-02 *cm/sec*
8.27E-01 *cm/min*
1.38E-04 *m/s*
3.26E-01 *inch/min*
5.43E-03 *inch/sec*

$\Phi_m =$ 3.83E-02 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	0
Enter the first water Head Height ("H1" in cm):	0
Enter the second water Head Height ("H2" in cm):	0
Enter the Borehole Radius ("a" in cm):	0
Enter the soil texture-structure category (enter one of the below numbers):	0

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! *cm/sec*
#DIV/0! *cm/min*
#DIV/0! *m/sec*
#DIV/0! *inch/min*
#DIV/0! *inch/sec*

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 4.5000

Res Type	35.22
H	5
a	3.5
H/a	1.429
a*	0.36
C0.01	0.736
C0.04	0.763
C0.12	0.72
C0.36	0.72
C	0.72
R	4.500
Q	2.642
pi	3.142

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 0.72043
$Q =$ 2.6415

$K_{fs} =$ 6.99E-03 *cm/sec*
4.20E-01 *cm/min*
6.99E-05 *m/sec*
1.65E-01 *inch/min*
2.75E-03 *inch/sec*

$\Phi_m =$ 1.94E-02 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 5.5000

Res Type	35.22
H	10
a	3.5
H/a	2.85714
a*	0.36
C0.01	1.11597
C0.04	1.17651
C0.12	1.16258
C0.36	1.16258
C	1.16258
R	5.500
Q	3.2285
pi	3.1415

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 1.16258
$Q =$ 3.2285

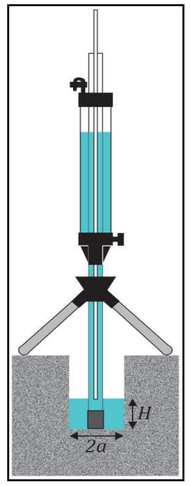
$K_{fs} =$ 4.43E-03 *cm/sec*
2.66E-01 *cm/min*
4.43E-05 *m/ses*
1.05E-01 *inch/min*
1.74E-03 *inch/sec*

$\Phi_m =$ 1.23E-02 (cm^2/min)

Average

$K_{fs} =$ 5.71E-03 *cm/sec*
3.43E-01 *cm/min*
5.71E-05 *m/s*
1.35E-01 *inch/min*
2.25E-03 *inch/sec*

$\Phi_m =$ 1.59E-02 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):

Enter the first water Head Height ("H1" in cm):
Enter the second water Head Height ("H2" in cm):

Enter the Borehole Radius ("a" in cm):

Enter the soil texture-structure category (enter one of the below numbers):

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$C_1 =$ 0

$C_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! *cm/sec*
#DIV/0! *cm/min*
#DIV/0! *m/sec*
#DIV/0! *inch/min*
#DIV/0! *inch/sec*

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 14.0000

Res Type	35.22
H	5
a	3.5
H/a	1.429
a*	0.36
C0.01	0.736
C0.04	0.763
C0.12	0.72
C0.36	0.72
C	0.72
R	#####
Q	8.218
pi	3.142

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 0.72043
$Q =$ 8.218

$K_{fs} =$ 2.18E-02 *cm/sec*
1.31E+00 *cm/min*
2.18E-04 *m/sec*
5.14E-01 *inch/min*
8.57E-03 *inch/sec*

$\Phi_m =$ 6.04E-02 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3.5

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 34.0000

Res Type	35.22
H	10
a	3.5
H/a	2.85714
a*	0.36
C0.01	1.11597
C0.04	1.17651
C0.12	1.16258
C0.36	1.16258
C	1.16258
R	34.000
Q	19.958
pi	3.1415

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 1.16258
$Q =$ 19.958

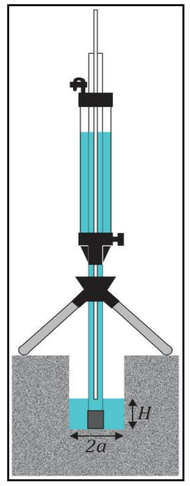
$K_{fs} =$ 2.74E-02 *cm/sec*
1.64E+00 *cm/min*
2.74E-04 *m/ses*
6.47E-01 *inch/min*
1.08E-02 *inch/sec*

$\Phi_m =$ 7.60E-02 (cm^2/min)

Average

$K_{fs} =$ 2.46E-02 *cm/sec*
1.47E+00 *cm/min*
2.46E-04 *m/s*
5.80E-01 *inch/min*
9.67E-03 *inch/sec*

$\Phi_m =$ 6.82E-02 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 0

Enter the first water Head Height ("H1" in cm): 0
Enter the second water Head Height ("H2" in cm): 0

Enter the Borehole Radius ("a" in cm): 0

Enter the soil texture-structure category (enter one of the below numbers): 0

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min):

Steady State Rate of Water Level Change ("R2" in cm/min):

$Q_1 =$ 0

$Q_2 =$ 0

$c_1 =$ 0

$c_2 =$ 0

Res Type:	2.16
H1/a:	#DIV/0!
H2/a:	#DIV/0!
C1-0.01:	#DIV/0!
C2-0.01:	#DIV/0!
C1-0.04:	#DIV/0!
C2-0.04:	#DIV/0!
C1-0.12:	#DIV/0!
C2-0.12:	#DIV/0!
C1-0.36:	#DIV/0!
C2-0.36:	#DIV/0!

$G_1 =$ #DIV/0!

$G_2 =$ #DIV/0!

$G_3 =$ #DIV/0!

$G_4 =$ #DIV/0!

$K_{fs} =$ #DIV/0! *cm/sec*
#DIV/0! *cm/min*
#DIV/0! *m/sec*
#DIV/0! *inch/min*
#DIV/0! *inch/sec*

$\Phi_m =$ #DIV/0! (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
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Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Appendix F – Construction Dewatering Rates

Appendix F
Dewatering Flow Rate Estimates - Short-Term
280 Clair Road W, Guelph, Ontario

Table F-2: Short-Term Dewatering Rates for Servicing

Parameters	Unit	Value
Ground Elevation / Lowest Finished Flow Elevation	masl	
Highest Groundwater Elevation (1.0 m above highest recorded)	mbgs	2.44
Lowest Invert Elevation	mbgs	4.00
Dewatered Elevation Target	mbgs	5.00
Top of the Water-Bearing Zone	mbgs	2.44
Base of the Water-Bearing Zone (assumed 3 m lowest invert)	mbgs	7.00
Height of Water Table Above the Base of Water-Bearing Zone (H)	m	4.56
Height of Dewatering Target Above the Base of Water-Bearing Zone (h)	m	2.00
Hydraulic Conductivity (K)	m/s	2.68E-05
Length of Excavation (x_1)	m	10.00
Width of Excavation (x_2)	m	2.00

Radius of Influence	Unit	Value
Method to Calculate Radius of Influence	-	**Sichardt**
Radius of Influence from Sides of Excavation	m	39.76
Distance to Linear Source from Sides of excavation (L_0)	m	19.88

Dewatering Rates	Unit	Value
Dewatering Flow Rate (unconfined linear) (Q)	L/day	**23,470**
Factor of Safety (F_s)	-	1.50
Dewatering Flow Rate (multiplied by factor of safety) Q_{FS}	L/day	**35,210**
Assumed Precipitation Event	L/day	15
Volume from Precipitation	L/day	300
Total Volume (GW Discharge Discharge withh SF + Precipitation)	L/day	**35,510**

Lamina Flow from an Unconfined Aquifer to a Fully-Penetrating Excavation

$$Q_w = xK(H^2 - h^2)/Lo$$ (Based on the Dupuit Equation)

$$R_s = C(H - h)\sqrt{(K)}$$

Where:

Qw = Rate of Pumping (m^3/s)

x_1 = Length of Excavation (m)

x_2 = Width of Excavation (m)

K = Hydraulic Conductivity (m/s)

L_0 = Distance to Line Source, assumed $R_0/2$ (m)

R = Radius of Influence (R_0)

H = Aquifer Thickness / Initial Water Column Thickness (m)

h = Final Water Column Thickness (m)

C = Constant (3000)

Appendix G – Laboratory Certificates of Analysis

ALS Canada Ltd.

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CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2426295**	Page	: 1 of 13
Client	: **JLP Services Inc.**	Laboratory	: ALS Environmental - Waterloo
Contact	: Ajay Jayalath	Account Manager	: Andrew Martin
Address	: 405 York Road Guelph ON Canada N1E 3H3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 519 763 3101	Telephone	: +1 519 886 6910
Project	: G4836	Date Samples Received	: 06-Sep-2024 17:35
PO	: ----	Date Analysis Commenced	: 07-Sep-2024
C-O-C number	: 23-1122592	Issue Date	: 16-Sep-2024 17:32
Sampler	: Client		
Site	: ----		
Quote number	: 2024 SOA		
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*
Amaninder Dhillon	Team Lead - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Andrea Armstrong	Department Manager - Air Quality and Volatiles	VOC, Waterloo, Ontario
Brooke Miller	Laboratory Analyst	Inorganics, Edmonton, Alberta
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Metals, Waterloo, Ontario
Hannah Lewis	Inorganics Analyst	Inorganics, Waterloo, Ontario
Jeremy Gingras	Supervisor - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Kim Jensen	Department Manager - Metals	Metals, Burnaby, British Columbia
Rachel Cameron	Supervisor - Semi-Volatile Extractions	Organics, Waterloo, Ontario
Stephanie Pinheiro	Team Leader - LCMS	LCMS, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Inorganics, Waterloo, Ontario
Zeba Patel	Analyst	Microbiology, Waterloo, Ontario

Summary of Guideline Breaches by Sample

SampleID/Client ID	Matrix	Analyte	Analyte Summary	Guideline	Category	Result	Limit
BH/MW9	Water	Solids, total suspended [TSS]		COGSUB	SAN	1310 mg/L	350 mg/L
	Water	Zinc, total		COGSUB	SAN	2.42 mg/L	2 mg/L
	Water	Solids, total suspended [TSS]		COGSUB	STM	1310 mg/L	15 mg/L
	Water	Phosphorus, total		COGSUB	STM	0.706 mg/L	0.4 mg/L
	Water	Cadmium, total		COGSUB	STM	0.00390 mg/L	0.001 mg/L
	Water	Copper, total		COGSUB	STM	0.191 mg/L	0.01 mg/L
	Water	Lead, total		COGSUB	STM	0.420 mg/L	0.05 mg/L
	Water	Zinc, total		COGSUB	STM	2.42 mg/L	0.05 mg/L

General Comments

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

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

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

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

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

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

Unit	*Description*
µg/L	micrograms per litre
CFU/100mL	colony forming units per hundred millilitres
mg/L	milligrams per litre
pH units	pH units

>: greater than.
<: less than.
Red shading is applied where the result or the LOR is greater than the Guideline Upper Limit (or lower than the Guideline Lower Limit, if applicable).
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
BODL	Limit of Reporting for BOD was increased to account for the largest volume of sample tested.
DLA	Detection Limit adjusted for required dilution.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
PEHT	Parameter exceeded recommended holding time prior to analysis.

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	BH/MW9	----	----	----	----	----	----
				Sampling date/time	04-Sep-2024 00:00	----	----	----	----	----	----
				Sub-Matrix	Groundwater	----	----	----	----	----	----
					WT2426295-001	--------	--------	--------	--------	--------	--------
Physical Tests											
pH	----	E108/WT	pH units		7.84	----	----	----	----	----	----
Solids, total suspended [TSS]	----	E160/WT	mg/L		1310 DLHC	----	----	----	----	----	----
Anions and Nutrients											
Chloride	16887-00-6	E235.Cl/WT	mg/L		17.4	----	----	----	----	----	----
Fluoride	16984-48-8	E235.F/WT	mg/L		0.056	----	----	----	----	----	----
Kjeldahl nitrogen, total [TKN]	----	E318/WT	mg/L		0.515	----	----	----	----	----	----
Phosphorus, total	7723-14-0	E372-U/WT	mg/L		0.706	----	----	----	----	----	----
Sulfate (as SO4)	14808-79-8	E235.SO4/WT	mg/L		12.7	----	----	----	----	----	----
Cyanides											
Cyanide, strong acid dissociable (Total)	----	E333/WT	mg/L		<0.0020	----	----	----	----	----	----
Total Sulfides											
Sulfide, total (as H2S)	7783-06-4	E396/WT	mg/L		<0.019	----	----	----	----	----	----
Sulfide, total (as S)	18496-25-8	E396/WT	mg/L		<0.018	----	----	----	----	----	----
Microbiological Tests											
Coliforms, thermotolerant [fecal]	----	E012.FC/WT	CFU/100 mL		Not Detected DLM, PEHT	----	----	----	----	----	----
Total Metals											
Aluminum, total	7429-90-5	E420/WT	mg/L		12.2 DLHC	----	----	----	----	----	----
Antimony, total	7440-36-0	E420/WT	mg/L		<0.00100 DLHC	----	----	----	----	----	----
Arsenic, total	7440-38-2	E420/WT	mg/L		0.0410 DLHC	----	----	----	----	----	----
Bismuth, total	7440-69-9	E420/WT	mg/L		<0.000500 DLHC	----	----	----	----	----	----
Cadmium, total	7440-43-9	E420/WT	mg/L		0.00390 DLHC	----	----	----	----	----	----
Chromium, total	7440-47-3	E420/WT	mg/L		0.0270 DLHC	----	----	----	----	----	----
Cobalt, total	7440-48-4	E420/WT	mg/L		0.0376 DLHC	----	----	----	----	----	----
Copper, total	7440-50-8	E420/WT	mg/L		0.191 DLHC	----	----	----	----	----	----
Gold, total	7440-57-5	E462.PM/VA	µg/L		<0.040 DLA	----	----	----	----	----	----
Iron, total	7439-89-6	E420/WT	mg/L		47.6 DLHC	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID: BH/MW9	----	----	----	----	----	----
				Sampling date/time: 04-Sep-2024 00:00	----	----	----	----	----	----
				Sub-Matrix: Groundwater	----	----	----	----	----	----
				WT2426295-001	--------	--------	--------	--------	--------	--------
Total Metals										
Lead, total	7439-92-1	E420/WT	mg/L	0.420 DLHC	----	----	----	----	----	----
Manganese, total	7439-96-5	E420/WT	mg/L	2.69 DLHC	----	----	----	----	----	----
Mercury, total	7439-97-6	E508/WT	mg/L	0.0000083	----	----	----	----	----	----
Molybdenum, total	7439-98-7	E420/WT	mg/L	0.00206 DLHC	----	----	----	----	----	----
Nickel, total	7440-02-0	E420/WT	mg/L	0.0382 DLHC	----	----	----	----	----	----
Selenium, total	7782-49-2	E420/WT	mg/L	<0.000500 DLHC	----	----	----	----	----	----
Silver, total	7440-22-4	E420/WT	mg/L	0.000745 DLHC	----	----	----	----	----	----
Tin, total	7440-31-5	E420/WT	mg/L	0.00170 DLHC	----	----	----	----	----	----
Titanium, total	7440-32-6	E420/WT	mg/L	0.458 DLHC	----	----	----	----	----	----
Vanadium, total	7440-62-2	E420/WT	mg/L	0.0340 DLHC	----	----	----	----	----	----
Zinc, total	7440-66-6	E420/WT	mg/L	2.42 DLHC	----	----	----	----	----	----
Platinum, total	7440-06-4	E462.PM/VA	µg/L	<0.040 DLA	----	----	----	----	----	----
Rhodium, total	7440-16-6	E462.PM/VA	µg/L	<0.0100 DLA	----	----	----	----	----	----
Speciated Metals										
Chromium, hexavalent [Cr VI], total	18540-29-9	E532/WT	mg/L	<0.00050	----	----	----	----	----	----
Aggregate Organics										
Biochemical oxygen demand [BOD]	----	E550/WT	mg/L	<3.0 BODL	----	----	----	----	----	----
Chemical oxygen demand [COD]	----	E559-L/WT	mg/L	38	----	----	----	----	----	----
Oil & grease (gravimetric)	----	E567/WT	mg/L	<5.0	----	----	----	----	----	----
Oil & grease, animal/vegetable (gravimetric)	----	EC567A.SG/WT	mg/L	<5.0	----	----	----	----	----	----
Oil & grease, mineral (gravimetric)	----	E567SG/WT	mg/L	<5.0	----	----	----	----	----	----
Phenols, total (4AAP)	----	E562/EO	mg/L	<0.0010	----	----	----	----	----	----
Volatile Organic Compounds										
Benzene	71-43-2	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Chloroform	67-66-3	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Dichlorobenzene, 1,2-	95-50-1	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Dichlorobenzene, 1,4-	106-46-7	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Dichloroethylene, cis-1,2-	156-59-2	E611D/WT	µg/L	<0.50	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID: BH/MW9	----	----	----	----	----	----
				Sampling date/time: 04-Sep-2024 00:00	----	----	----	----	----	----
				Sub-Matrix: Groundwater	----	----	----	----	----	----
				WT2426295-001	--------	--------	--------	--------	--------	--------
Volatile Organic Compounds										
Dichloromethane	75-09-2	E611D/WT	µg/L	<1.0	----	----	----	----	----	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D/WT	µg/L	<0.30	----	----	----	----	----	----
Ethylbenzene	100-41-4	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Tetrachloroethylene	127-18-4	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Toluene	108-88-3	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Trichloroethylene	79-01-6	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Xylene, m+p-	179601-23-1	E611D/WT	µg/L	<0.40	----	----	----	----	----	----
Xylene, o-	95-47-6	E611D/WT	µg/L	<0.30	----	----	----	----	----	----
Xylenes, total	1330-20-7	E611D/WT	µg/L	<0.50	----	----	----	----	----	----
Volatile Organic Compounds Surrogates										
Bromofluorobenzene, 4-	460-00-4	E611D/WT	%	101	----	----	----	----	----	----
Difluorobenzene, 1,4-	540-36-3	E611D/WT	%	96.8	----	----	----	----	----	----
Polycyclic Aromatic Hydrocarbons										
Anthracene	120-12-7	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Benz(a)anthracene	56-55-3	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Benzo(a)pyrene	50-32-8	E641A-L/WT	mg/L	<0.0000050	----	----	----	----	----	----
Benzo(b+j)fluoranthene	n/a	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Benzo(e)pyrene	192-97-2	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Benzo(g,h,i)perylene	191-24-2	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Benzo(k)fluoranthene	207-08-9	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Chrysene	218-01-9	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Dibenz(a,h)acridine	226-36-8	E642D/WT	mg/L	<0.000050	----	----	----	----	----	----
Dibenz(a,h)anthracene	53-70-3	E641A-L/WT	mg/L	<0.0000050	----	----	----	----	----	----
Dibenz(a,j)acridine	224-42-0	E642D/WT	mg/L	<0.000050	----	----	----	----	----	----
Dibenzo(a,i)pyrene	189-55-9	E642D/WT	mg/L	<0.000050	----	----	----	----	----	----
Dibenzo(c,g)carbazole, 7H-	194-59-2	E642D/WT	mg/L	<0.000050	----	----	----	----	----	----
Dinitropyrene, 1,3-	75321-20-9	E642D/WT	mg/L	<0.0010	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID: BH/MW9	----	----	----	----	----	----
				Sampling date/time: 04-Sep-2024 00:00	----	----	----	----	----	----
				Sub-Matrix: Groundwater	----	----	----	----	----	----
				WT2426295-001	--------	--------	--------	--------	--------	--------
Polycyclic Aromatic Hydrocarbons										
Dinitropyrene, 1,6-	42397-64-8	E642D/WT	mg/L	<0.0010	----	----	----	----	----	----
Dinitropyrene, 1,8-	42397-65-9	E642D/WT	mg/L	<0.0010	----	----	----	----	----	----
Fluoranthene	206-44-0	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Methylcholanthrene, 3-	56-49-5	E642D/WT	mg/L	<0.000050	----	----	----	----	----	----
Perylene	198-55-0	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Phenanthrene	85-01-8	E641A-L/WT	mg/L	<0.000010	----	----	----	----	----	----
Pyrene	129-00-0	E641A-L/WT	mg/L	0.000011	----	----	----	----	----	----
PAHs, total (ON Sewer Use)	n/a	EC640A/WT	mg/L	<0.00175	----	----	----	----	----	----
Polycyclic Aromatic Hydrocarbons Surrogates										
Chrysene-d12	1719-03-5	E641A-L/WT	%	133	----	----	----	----	----	----
Naphthalene-d8	1146-65-2	E641A-L/WT	%	100	----	----	----	----	----	----
Phenanthrene-d10	1517-22-2	E641A-L/WT	%	120	----	----	----	----	----	----
Terphenyl-d14, p-	1718-51-0	E642D/WT	%	48.7	----	----	----	----	----	----
Phthalate Esters										
bis(2-Ethylhexyl) phthalate [DEHP]	117-81-7	E625A/WT	µg/L	<0.60	----	----	----	----	----	----
Di-n-butyl phthalate	84-74-2	E625A/WT	µg/L	<1.0	----	----	----	----	----	----
Semi-Volatile Organics										
Dichlorobenzidine, 3,3'-	91-94-1	E625A/WT	µg/L	<0.40	----	----	----	----	----	----
Semi-Volatile Organics Surrogates										
Fluorobiphenyl, 2-	321-60-8	E625A/WT	%	82.2	----	----	----	----	----	----
Nitrobenzene-d5	4165-60-0	E625A/WT	%	101	----	----	----	----	----	----
Terphenyl-d14, p-	1718-51-0	E625A/WT	%	89.6	----	----	----	----	----	----
Chlorinated Phenolics										
Pentachlorophenol [PCP]	87-86-5	E625A/WT	µg/L	<0.50	----	----	----	----	----	----
Phenolics Surrogates										
Tribromophenol, 2,4,6-	118-79-6	E625A/WT	%	87.5	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Groundwater**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	BH/MW9	----	----	----	----	----	----
				Sampling date/time	04-Sep-2024 00:00	----	----	----	----	----	----
				Sub-Matrix	Groundwater	----	----	----	----	----	----
				WT2426295-001	--------	--------	--------	--------	--------	--------	
Nonylphenols											
Nonylphenol [NP]	84852-15-3	E749A/WT	µg/L	<0.40	----	----	----	----	----	----	
Nonylphenol diethoxylate [NP2EO]	20427-84-3	E749B/WT	µg/L	<0.10	----	----	----	----	----	----	
Nonylphenol ethoxylates, mono+di	n/a	E749B/WT	µg/L	<2.0	----	----	----	----	----	----	
Nonylphenol monoethoxylate [NP1EO]	27986-36-3	E749B/WT	µg/L	<0.40	----	----	----	----	----	----	
Organochlorine Pesticides											
Aldrin	309-00-2	E660F/WT	µg/L	<0.0080	----	----	----	----	----	----	
Chlordane, cis- (alpha)	5103-71-9	E660F/WT	µg/L	<0.0080	----	----	----	----	----	----	
Chlordane, total	57-74-9	E660F/WT	µg/L	<0.011	----	----	----	----	----	----	
Chlordane, trans- (gamma)	5103-74-2	E660F/WT	µg/L	<0.0080	----	----	----	----	----	----	
DDD, 2,4'-	53-19-0	E660F/WT	µg/L	<0.0040	----	----	----	----	----	----	
DDD, 4,4'-	72-54-8	E660F/WT	µg/L	<0.0040	----	----	----	----	----	----	
DDD, total	----	E660F/WT	µg/L	<0.0060	----	----	----	----	----	----	
DDE, 2,4'-	3424-82-6	E660F/WT	µg/L	<0.0040	----	----	----	----	----	----	
DDE, 4,4'-	72-55-9	E660F/WT	µg/L	<0.0040	----	----	----	----	----	----	
DDE, total	----	E660F/WT	µg/L	<0.0060	----	----	----	----	----	----	
DDT, 2,4'-	789-02-6	E660F/WT	µg/L	<0.0040	----	----	----	----	----	----	
DDT, 4,4'-	50-29-3	E660F/WT	µg/L	<0.0040	----	----	----	----	----	----	
DDT, total	----	E660F/WT	µg/L	<0.0060	----	----	----	----	----	----	
Dieldrin	60-57-1	E660F/WT	µg/L	<0.0080	----	----	----	----	----	----	
Hexachlorocyclohexane, gamma-	58-89-9	E660F/WT	µg/L	<0.0080	----	----	----	----	----	----	
Mirex	2385-85-5	E660F/WT	µg/L	<0.0080	----	----	----	----	----	----	
Aldrin + Dieldrin	----	E660F/WT	µg/L	<0.011	----	----	----	----	----	----	
DDT + metabolites, total	----	E660F/WT	µg/L	<0.010	----	----	----	----	----	----	
Organochlorine Pesticides Surrogates											
Decachlorobiphenyl	2051-24-3	E660F/WT	%	88.2	----	----	----	----	----	----	
Tetrachloro-m-xylene	877-09-8	E660F/WT	%	105	----	----	----	----	----	----	

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

Please refer to the Accreditation section for an explanation of analyte accreditations.

Summary of Guideline Limits

Analyte	CAS Number	Unit	COGSUB SAN	COGSUB STM
Physical Tests				
pH	----	pH units	6 - 9.5 pH units	6 - 9 pH units
Solids, total suspended [TSS]	----	mg/L	350 mg/L	15 mg/L
Anions and Nutrients				
Chloride	16887-00-6	mg/L	1500 mg/L	--
Fluoride	16984-48-8	mg/L	10 mg/L	--
Kjeldahl nitrogen, total [TKN]	----	mg/L	100 mg/L	--
Phosphorus, total	7723-14-0	mg/L	10 mg/L	0.4 mg/L
Sulfate (as SO4)	14808-79-8	mg/L	1500 mg/L	--
Cyanides				
Cyanide, strong acid dissociable (Total)	----	mg/L	1.2 mg/L	--
Total Sulfides				
Sulfide, total (as H2S)	7783-06-4	mg/L	0.5 mg/L	--
Sulfide, total (as S)	18496-25-8	mg/L	--	--
Microbiological Tests				
Coliforms, thermotolerant [fecal]	----	CFU/100mL	--	200 CFU/100mL
Total Metals				
Aluminum, total	7429-90-5	mg/L	50 mg/L	--
Antimony, total	7440-36-0	mg/L	5 mg/L	--
Arsenic, total	7440-38-2	mg/L	1 mg/L	--
Bismuth, total	7440-69-9	mg/L	5 mg/L	--
Cadmium, total	7440-43-9	mg/L	0.7 mg/L	0.001 mg/L
Chromium, total	7440-47-3	mg/L	2.8 mg/L	0.2 mg/L
Cobalt, total	7440-48-4	mg/L	5 mg/L	--
Copper, total	7440-50-8	mg/L	2 mg/L	0.01 mg/L
Gold, total	7440-57-5	µg/L	5000 µg/L	--
Iron, total	7439-89-6	mg/L	50 mg/L	--
Lead, total	7439-92-1	mg/L	0.7 mg/L	0.05 mg/L
Manganese, total	7439-96-5	mg/L	5 mg/L	--
Mercury, total	7439-97-6	mg/L	0.01 mg/L	0.001 mg/L
Molybdenum, total	7439-98-7	mg/L	5 mg/L	--
Nickel, total	7440-02-0	mg/L	2 mg/L	0.05 mg/L
Platinum, total	7440-06-4	µg/L	5000 µg/L	--
Rhodium, total	7440-16-6	µg/L	5000 µg/L	--
Selenium, total	7782-49-2	mg/L	0.8 mg/L	--
Silver, total	7440-22-4	mg/L	0.4 mg/L	--

Analyte	CAS Number	Unit	COGSUB SAN	COGSUB STM
Total Metals - Continued				
Tin, total	7440-31-5	mg/L	**5 mg/L**	--
Titanium, total	7440-32-6	mg/L	**5 mg/L**	--
Vanadium, total	7440-62-2	mg/L	**5 mg/L**	--
Zinc, total	7440-66-6	mg/L	**2 mg/L**	**0.05 mg/L**
Speciated Metals				
Chromium, hexavalent [Cr VI], total	18540-29-9	mg/L	**2 mg/L**	--
Aggregate Organics				
Biochemical oxygen demand [BOD]	----	mg/L	**300 mg/L**	**15 mg/L**
Chemical oxygen demand [COD]	----	mg/L	**600 mg/L**	--
Oil & grease (gravimetric)	----	mg/L	--	--
Oil & grease, animal/vegetable (gravimetric)	----	mg/L	**100 mg/L**	--
Oil & grease, mineral (gravimetric)	----	mg/L	**15 mg/L**	--
Phenols, total (4AAP)	----	mg/L	**0.1 mg/L**	**0.02 mg/L**
Volatile Organic Compounds				
Benzene	71-43-2	µg/L	**10 µg/L**	--
Chloroform	67-66-3	µg/L	**40 µg/L**	--
Dichlorobenzene, 1,2-	95-50-1	µg/L	**50 µg/L**	--
Dichlorobenzene, 1,4-	106-46-7	µg/L	**80 µg/L**	--
Dichloroethylene, cis-1,2-	156-59-2	µg/L	--	--
Dichloromethane	75-09-2	µg/L	**90 µg/L**	--
Dichloropropylene, trans-1,3-	10061-02-6	µg/L	**140 µg/L**	--
Ethylbenzene	100-41-4	µg/L	**60 µg/L**	--
Tetrachloroethane, 1,1,2,2-	79-34-5	µg/L	--	--
Tetrachloroethylene	127-18-4	µg/L	**60 µg/L**	--
Toluene	108-88-3	µg/L	**20 µg/L**	--
Trichloroethylene	79-01-6	µg/L	**50 µg/L**	--
Xylene, m+p-	179601-23-1	µg/L	--	--
Xylene, o-	95-47-6	µg/L	--	--
Xylenes, total	1330-20-7	µg/L	**300 µg/L**	--
Volatile Organic Compounds Surrogates				
Bromofluorobenzene, 4-	460-00-4	%	--	--
Difluorobenzene, 1,4-	540-36-3	%	--	--
Polycyclic Aromatic Hydrocarbons				
Anthracene	120-12-7	mg/L	--	--
Benz(a)anthracene	56-55-3	mg/L	--	--
Benzo(a)pyrene	50-32-8	mg/L	--	--
Benzo(b+j)fluoranthene	n/a	mg/L	--	--
Benzo(e)pyrene	192-97-2	mg/L	--	--
Benzo(g,h,i)perylene	191-24-2	mg/L	--	--

Analyte	CAS Number	Unit	COGSUB SAN	COGSUB STM
Polycyclic Aromatic Hydrocarbons - Continued				
Benzo(k)fluoranthene	207-08-9	mg/L	--	--
Chrysene	218-01-9	mg/L	--	--
Dibenz(a,h)acridine	226-36-8	mg/L	--	--
Dibenz(a,h)anthracene	53-70-3	mg/L	--	--
Dibenz(a,j)acridine	224-42-0	mg/L	--	--
Dibenzo(a,i)pyrene	189-55-9	mg/L	--	--
Dibenzo(c,g)carbazole, 7H-	194-59-2	mg/L	--	--
Dinitropyrene, 1,3-	75321-20-9	mg/L	--	--
Dinitropyrene, 1,6-	42397-64-8	mg/L	--	--
Dinitropyrene, 1,8-	42397-65-9	mg/L	--	--
Fluoranthene	206-44-0	mg/L	--	--
Indeno(1,2,3-c,d)pyrene	193-39-5	mg/L	--	--
Methylcholanthrene, 3-	56-49-5	mg/L	--	--
PAHs, total (ON Sewer Use)	n/a	mg/L	**0.005 mg/L**	--
Perylene	198-55-0	mg/L	--	--
Phenanthrene	85-01-8	mg/L	--	--
Pyrene	129-00-0	mg/L	--	--
Chrysene-d12	1719-03-5	%	--	--
Naphthalene-d8	1146-65-2	%	--	--
Phenanthrene-d10	1517-22-2	%	--	--
Terphenyl-d14, p-	1718-51-0	%	--	--
Phthalate Esters				
bis(2-Ethylhexyl) phthalate [DEHP]	117-81-7	µg/L	**12 µg/L**	--
Di-n-butyl phthalate	84-74-2	µg/L	**80 µg/L**	--
Semi-Volatile Organics				
Dichlorobenzidine, 3,3'-	91-94-1	µg/L	**2 µg/L**	--
Semi-Volatile Organics Surrogates				
Fluorobiphenyl, 2-	321-60-8	%	--	--
Nitrobenzene-d5	4165-60-0	%	--	--
Terphenyl-d14, p-	1718-51-0	%	--	--
Chlorinated Phenolics				
Pentachlorophenol [PCP]	87-86-5	µg/L	--	--
Tribromophenol, 2,4,6-	118-79-6	%	--	--
Nonylphenols				
Nonylphenol [NP]	84852-15-3	µg/L	**20 µg/L**	--
Nonylphenol diethoxylate [NP2EO]	20427-84-3	µg/L	--	--
Nonylphenol ethoxylates, mono+di	n/a	µg/L	**200 µg/L**	--
Nonylphenol monoethoxylate [NP1EO]	27986-36-3	µg/L	--	--
Organochlorine Pesticides				

Analyte	CAS Number	Unit	COGSUB SAN	COGSUB STM					
Organochlorine Pesticides - Continued									
Aldrin + Dieldrin	----	µg/L	**0.2 µg/L**	--					
Aldrin	309-00-2	µg/L	--	--					
Chlordane, cis- (alpha)	5103-71-9	µg/L	--	--					
Chlordane, total	57-74-9	µg/L	**100 µg/L**	--					
Chlordane, trans- (gamma)	5103-74-2	µg/L	--	--					
DDD, 2,4'-	53-19-0	µg/L	--	--					
DDD, 4,4'-	72-54-8	µg/L	--	--					
DDD, total	----	µg/L	--	--					
DDE, 2,4'-	3424-82-6	µg/L	--	--					
DDE, 4,4'-	72-55-9	µg/L	--	--					
DDE, total	----	µg/L	--	--					
DDT + metabolites, total	----	µg/L	**0.1 µg/L**	--					
DDT, 2,4'-	789-02-6	µg/L	--	--					
DDT, 4,4'-	50-29-3	µg/L	--	--					
DDT, total	----	µg/L	**0.1 µg/L**	--					
Dieldrin	60-57-1	µg/L	--	--					
Hexachlorocyclohexane, gamma-	58-89-9	µg/L	**100 µg/L**	--					
Mirex	2385-85-5	µg/L	**100 µg/L**	--					
Decachlorobiphenyl	2051-24-3	%	--	--					
Tetrachloro-m-xylene	877-09-8	%	--	--					

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

Key:

COGSUB — Ontario Guelph Sanitary and Storm Sewer By-Law (2024-20911)

SAN — Ontario City of Guelph Sanitary Sewer Use By-Law (2024-20911)

STM — Ontario City of Guelph Storm Sewer Use By-Law (2024-20911)

ALS Canada Ltd.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2426295**	Page	: 1 of 13
Client	: **JLP Services Inc.**	Laboratory	: ALS Environmental - Waterloo
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Telephone	: 519 763 3101	Telephone	: +1 519 886 6910
Project	: G4836	Date Samples Received	: 06-Sep-2024 17:35
PO	: ----	Issue Date	: 16-Sep-2024 17:32
C-O-C number	: 23-1122592		
Sampler	: Client		
Site	: ----		
Quote number	: 2024 SOA		
No. of samples received	: 1		
No. of samples analysed	: 1		

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

Key

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

Workorder Comments

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

Summary of Outliers

Outliers : Quality Control Samples

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

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

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

Outliers : Frequency of Quality Control Samples

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

Analysis Holding Time Compliance

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

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

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

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

Matrix: **Water**

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

Analyte Group : Analytical Method / 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
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT-4d]										
BH/MW9	E550	04-Sep-2024	----	----	----		07-Sep-2024	4 days	3 days	✓
Aggregate Organics : Chemical Oxygen Demand by Colourimetry (Low Level)										
Amber glass total (sulfuric acid) [ON MECP]										
BH/MW9	E559-L	04-Sep-2024	----	----	----		09-Sep-2024	28 days	5 days	✓
Aggregate Organics : Mineral Oil & Grease by Gravimetry										
Amber glass (hydrochloric acid)										
BH/MW9	E567SG	04-Sep-2024	12-Sep-2024	28 days	9 days	✓	12-Sep-2024	28 days	9 days	✓
Aggregate Organics : Oil & Grease by Gravimetry										
Amber glass (hydrochloric acid)										
BH/MW9	E567	04-Sep-2024	12-Sep-2024	28 days	9 days	✓	12-Sep-2024	28 days	9 days	✓
Aggregate Organics : Phenols (4AAP) in Water by Colorimetry										
Amber glass total (sulfuric acid) [ON MECP]										
BH/MW9	E562	04-Sep-2024	10-Sep-2024	28 days	7 days	✓	10-Sep-2024	28 days	7 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [ON MECP]										
BH/MW9	E235.Cl	04-Sep-2024	11-Sep-2024	28 days	8 days	✓	12-Sep-2024	28 days	8 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [ON MECP]										
BH/MW9	E235.F	04-Sep-2024	11-Sep-2024	28 days	8 days	✓	12-Sep-2024	28 days	8 days	✓

Matrix: **Water**

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

Analyte Group : Analytical Method / 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]										
BH/MW9	E235.SO4	04-Sep-2024	11-Sep-2024	28 days	8 days	✓	12-Sep-2024	28 days	8 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid) [ON MECP]										
BH/MW9	E318	04-Sep-2024	13-Sep-2024	28 days	9 days	✓	13-Sep-2024	28 days	10 days	✓
Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)										
Amber glass total (sulfuric acid) [ON MECP]										
BH/MW9	E372-U	04-Sep-2024	12-Sep-2024	28 days	9 days	✓	13-Sep-2024	28 days	9 days	✓
Chlorinated Phenolics : BNA (Routine List) by GC-MS-MS										
Amber glass/Teflon lined septa cap - SVOCs (sodium thiosulfate) [ON MECP]										
BH/MW9	E625A	04-Sep-2024	12-Sep-2024	14 days	8 days	✓	12-Sep-2024	40 days	0 days	✓
Cyanides : Total Cyanide										
UV-inhibited HDPE - total (sodium hydroxide)										
BH/MW9	E333	04-Sep-2024	11-Sep-2024	14 days	8 days	✓	11-Sep-2024	14 days	8 days	✓
Microbiological Tests : Thermotolerant (Fecal) Coliform (MF-mFC)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
BH/MW9	E012.FC	04-Sep-2024	----	----	----		07-Sep-2024	48 hrs	87 hrs	× EHTL
Nonylphenols : Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode										
Amber glass/Teflon lined cap - LCMS										
BH/MW9	E749B	04-Sep-2024	09-Sep-2024	7 days	5 days	✓	09-Sep-2024	7 days	0 days	✓
Nonylphenols : Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode										
Amber glass/Teflon lined cap - LCMS										
BH/MW9	E749A	04-Sep-2024	09-Sep-2024	7 days	5 days	✓	09-Sep-2024	7 days	0 days	✓
Organochlorine Pesticides : OCP Analysis by GC-MS-MS or GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH/MW9	E660F	04-Sep-2024	10-Sep-2024	14 days	7 days	✓	12-Sep-2024	40 days	2 days	✓

Matrix: **Water**

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

Analyte Group : Analytical Method / Container / Client Sample ID(s)	*Method*	*Sampling Date*	*Extraction / Preparation*				*Analysis*			
			Preparation Date	*Holding Times*		*Eval*	*Analysis Date*	*Holding Times*		*Eval*
				Rec	*Actual*			*Rec*	*Actual*	
Phthalate Esters : BNA (Routine List) by GC-MS-MS										
Amber glass/Teflon lined septa cap - SVOCs (sodium thiosulfate) [ON MECP]										
BH/MW9	E625A	04-Sep-2024	12-Sep-2024	14 days	8 days	✓	12-Sep-2024	40 days	0 days	✓
Physical Tests : pH by Meter										
HDPE [ON MECP]										
BH/MW9	E108	04-Sep-2024	11-Sep-2024	14 days	8 days	✓	12-Sep-2024	14 days	8 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [ON MECP]										
BH/MW9	E160	04-Sep-2024	----	----	----		07-Sep-2024	7 days	4 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs (ON Special List) by GC-MS										
Amber glass/Teflon lined cap [ON MECP]										
BH/MW9	E642D	04-Sep-2024	09-Sep-2024	14 days	6 days	✓	10-Sep-2024	40 days	1 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Water by Hexane LVI GC-MS (Low Level)										
Amber glass/Teflon lined cap (sodium bisulfate) [ON MECP]										
BH/MW9	E641A-L	04-Sep-2024	11-Sep-2024	14 days	8 days	✓	12-Sep-2024	40 days	1 days	✓
Semi-Volatile Organics : BNA (Routine List) by GC-MS-MS										
Amber glass/Teflon lined septa cap - SVOCs (sodium thiosulfate) [ON MECP]										
BH/MW9	E625A	04-Sep-2024	12-Sep-2024	14 days	8 days	✓	12-Sep-2024	40 days	0 days	✓
Speciated Metals : Total Hexavalent Chromium (Cr VI) by IC										
HDPE - total (NaOH+Buf) [ON MECP]										
BH/MW9	E532	04-Sep-2024	----	----	----		10-Sep-2024	28 days	6 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid) [ON MECP]										
BH/MW9	E508	04-Sep-2024	11-Sep-2024	28 days	7 days	✓	13-Sep-2024	28 days	9 days	✓
Total Metals : Total Metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
BH/MW9	E420	04-Sep-2024	09-Sep-2024	180 days	5 days	✓	09-Sep-2024	180 days	5 days	✓

Matrix: **Water**

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

Analyte Group : Analytical Method / Container / Client Sample ID(s)	*Method*	*Sampling Date*	*Extraction / Preparation*				*Analysis*			
			Preparation Date	*Holding Times*		*Eval*	*Analysis Date*	*Holding Times*		*Eval*
				Rec	*Actual*			*Rec*	*Actual*	
Total Metals : Total Precious Metals in Water by Triple Quad ICPMS										
HDPE total (nitric acid)										
BH/MW9	E462.PM	04-Sep-2024	11-Sep-2024	180 days	8 days	✓	13-Sep-2024	180 days	10 days	✓
Total Sulfides : Total Sulfide by Colourimetry (Manual)										
HDPE total (zinc acetate+sodium hydroxide)										
BH/MW9	E396	04-Sep-2024	----	----	----		10-Sep-2024	7 days	7 days	✓
Volatile Organic Compounds : VOCs (Eastern Canada List) by Headspace GC-MS										
Glass vial (sodium bisulfate)										
BH/MW9	E611D	04-Sep-2024	12-Sep-2024	14 days	8 days	✓	12-Sep-2024	14 days	8 days	✓

Legend & Qualifier Definitions

EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.

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)							
Biochemical Oxygen Demand - 5 day	E550	1638935	1	19	5.2	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	1640046	1	8	12.5	5.0	✓
Chloride in Water by IC	E235.Cl	1645824	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	1645826	1	11	9.0	5.0	✓
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B	1639975	1	20	5.0	5.0	✓
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A	1639974	1	20	5.0	5.0	✓
pH by Meter	E108	1645823	1	13	7.6	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	1642513	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1645825	1	10	10.0	5.0	✓
Thermotolerant (Fecal) Coliform (MF-mFC)	E012.FC	1639120	0	2	0.0	5.0	✖
Total Cyanide	E333	1646031	1	15	6.6	5.0	✓
Total Hexavalent Chromium (Cr VI) by IC	E532	1640808	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	1645796	1	12	8.3	5.0	✓
Total Mercury in Water by CVAAS	E508	1644198	1	18	5.5	5.0	✓
Total Metals in Water by CRC ICPMS	E420	1639779	1	14	7.1	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	1645797	1	20	5.0	5.0	✓
Total Precious Metals in Water by Triple Quad ICPMS	E462.PM	1644725	1	6	16.6	5.0	✓
Total Sulfide by Colourimetry (Manual)	E396	1642657	1	13	7.6	5.0	✓
TSS by Gravimetry	E160	1638709	1	16	6.2	4.7	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	1646710	1	31	3.2	5.0	✖
Laboratory Control Samples (LCS)							
Biochemical Oxygen Demand - 5 day	E550	1638935	1	19	5.2	5.0	✓
BNA (Routine List) by GC-MS-MS	E625A	1646309	1	20	5.0	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	1640046	1	8	12.5	5.0	✓
Chloride in Water by IC	E235.Cl	1645824	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	1645826	1	11	9.0	5.0	✓
Mineral Oil & Grease by Gravimetry	E567SG	1643753	1	10	10.0	5.0	✓
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B	1639975	1	20	5.0	5.0	✓
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A	1639974	1	20	5.0	5.0	✓
OCP Analysis by GC-MS-MS or GC-MS	E660F	1642795	1	9	11.1	5.0	✓
Oil & Grease by Gravimetry	E567	1643752	1	18	5.5	5.0	✓
PAHs (ON Special List) by GC-MS	E642D	1640717	1	5	20.0	5.0	✓
PAHs in Water by Hexane LVI GC-MS (Low Level)	E641A-L	1644150	1	1	100.0	5.0	✓
pH by Meter	E108	1645823	1	13	7.6	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	1642513	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1645825	1	10	10.0	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*
Laboratory Control Samples (LCS) - Continued							
Total Cyanide	E333	1646031	1	15	6.6	5.0	✓
Total Hexavalent Chromium (Cr VI) by IC	E532	1640808	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	1645796	1	12	8.3	5.0	✓
Total Mercury in Water by CVAAS	E508	1644198	1	18	5.5	5.0	✓
Total Metals in Water by CRC ICPMS	E420	1639779	1	14	7.1	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	1645797	1	20	5.0	5.0	✓
Total Precious Metals in Water by Triple Quad ICPMS	E462.PM	1644725	1	6	16.6	5.0	✓
Total Sulfide by Colourimetry (Manual)	E396	1642657	1	13	7.6	5.0	✓
TSS by Gravimetry	E160	1638709	1	16	6.2	4.7	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	1646710	2	31	6.4	5.0	✓
Method Blanks (MB)							
Biochemical Oxygen Demand - 5 day	E550	1638935	1	19	5.2	5.0	✓
BNA (Routine List) by GC-MS-MS	E625A	1646309	1	20	5.0	5.0	✓
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	1640046	1	8	12.5	5.0	✓
Chloride in Water by IC	E235.Cl	1645824	1	11	9.0	5.0	✓
Fluoride in Water by IC	E235.F	1645826	1	11	9.0	5.0	✓
Mineral Oil & Grease by Gravimetry	E567SG	1643753	1	10	10.0	5.0	✓
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B	1639975	1	20	5.0	5.0	✓
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A	1639974	1	20	5.0	5.0	✓
OCP Analysis by GC-MS-MS or GC-MS	E660F	1642795	1	9	11.1	5.0	✓
Oil & Grease by Gravimetry	E567	1643752	1	18	5.5	5.0	✓
PAHs (ON Special List) by GC-MS	E642D	1640717	1	5	20.0	5.0	✓
PAHs in Water by Hexane LVI GC-MS (Low Level)	E641A-L	1644150	1	1	100.0	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	1642513	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1645825	1	10	10.0	5.0	✓
Thermotolerant (Fecal) Coliform (MF-mFC)	E012.FC	1639120	1	2	50.0	5.0	✓
Total Cyanide	E333	1646031	1	15	6.6	5.0	✓
Total Hexavalent Chromium (Cr VI) by IC	E532	1640808	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	1645796	1	12	8.3	5.0	✓
Total Mercury in Water by CVAAS	E508	1644198	1	18	5.5	5.0	✓
Total Metals in Water by CRC ICPMS	E420	1639779	1	14	7.1	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	1645797	1	20	5.0	5.0	✓
Total Precious Metals in Water by Triple Quad ICPMS	E462.PM	1644725	1	6	16.6	5.0	✓
Total Sulfide by Colourimetry (Manual)	E396	1642657	1	13	7.6	5.0	✓
TSS by Gravimetry	E160	1638709	1	16	6.2	4.7	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	1646710	2	31	6.4	5.0	✓
Matrix Spikes (MS)							
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L	1640046	1	8	12.5	5.0	✓
Chloride in Water by IC	E235.Cl	1645824	1	11	9.0	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*
Matrix Spikes (MS) - Continued							
Fluoride in Water by IC	E235.F	1645826	1	11	9.0	5.0	✓
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B	1639975	1	20	5.0	5.0	✓
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A	1639974	1	20	5.0	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	1642513	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1645825	1	10	10.0	5.0	✓
Total Cyanide	E333	1646031	1	15	6.6	5.0	✓
Total Hexavalent Chromium (Cr VI) by IC	E532	1640808	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	1645796	1	12	8.3	5.0	✓
Total Mercury in Water by CVAAS	E508	1644198	1	18	5.5	5.0	✓
Total Metals in Water by CRC ICPMS	E420	1639779	1	14	7.1	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	1645797	1	20	5.0	5.0	✓
Total Precious Metals in Water by Triple Quad ICPMS	E462.PM	1644725	1	6	16.6	5.0	✓
Total Sulfide by Colourimetry (Manual)	E396	1642657	1	13	7.6	5.0	✓
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	1646710	1	31	3.2	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
Thermotolerant (Fecal) Coliform (MF-mFC)	E012.FC ALS Environmental - Waterloo	Water	APHA 9222 D (mod)	Following filtration (0.45 µm), and incubation at 44.5 ±0.2°C for 22-26 hours, colonies exhibiting characteristic morphology of the target organism are enumerated and confirmed.
pH by Meter	E108 ALS Environmental - Waterloo	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.
TSS by Gravimetry	E160 ALS Environmental - Waterloo	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
Chloride in Water by IC	E235.Cl ALS Environmental - Waterloo	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 ALS Environmental - Waterloo	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 ALS Environmental - Waterloo	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318 ALS Environmental - Waterloo	Water	Method Fialab 100, 2018	TKN 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).
Total Cyanide	E333 ALS Environmental - Waterloo	Water	ISO 14403 (mod)	Total or Strong Acid Dissociable (SAD) Cyanide is determined by Continuous Flow Analyzer (CFA) with in-line UV digestion followed by colourmetric analysis. Method Limitation: High levels of thiocyanate (SCN) may cause positive interference (up to 0.5% of SCN concentration).
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U ALS Environmental - Waterloo	Water	APHA 4500-P E (mod).	Total Phosphorus is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total Sulfide by Colourimetry (Manual)	E396 ALS Environmental - Waterloo	Water	APHA 4500-S2 D (mod)	Total Sulfide is determined by spectrophotometer using the methlyene blue colourimetric method. Results expressed "as H2S" if reported represent the maximum possible H2S concentration based on the total sulfide concentration in the sample. The H2S calculation converts Total Sulphide as (S2-) and reports it as Total Sulphide as (H2S).
Total Metals in Water by CRC ICPMS	E420 ALS Environmental - Waterloo	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.
Total Precious Metals in Water by Triple Quad ICPMS	E462.PM ALS Environmental - Vancouver	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Triple Quadrupole ICPMS.
Total Mercury in Water by CVAAS	E508 ALS Environmental - Waterloo	Water	EPA 1631E (mod)	Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS
Total Hexavalent Chromium (Cr VI) by IC	E532 ALS Environmental - Waterloo	Water	APHA 3500-Cr C (Ion Chromatography)	Hexavalent Chromium is measured by Ion chromatography-Post column reaction and UV detection. Results are based on an un-filtered, field-preserved sample.
Biochemical Oxygen Demand - 5 day	E550 ALS Environmental - Waterloo	Water	APHA 5210 B (mod)	Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter. Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples.
Chemical Oxygen Demand by Colourimetry (Low Level)	E559-L ALS Environmental - Waterloo	Water	APHA 5220 D (mod)	Samples are analyzed using the closed reflux colourimetric method.
Phenols (4AAP) in Water by Colorimetry	E562 ALS Environmental - Edmonton	Water	EPA 9066	This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide (K3Fe(CN)6) and 4-amino-antipyrine (4-AAP) to form a red complex which is measured colorimetrically.
Oil & Grease by Gravimetry	E567 ALS Environmental - Waterloo	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane and the extract is evaporated to dryness. The residue is then weighed to determine Oil and Grease.
Mineral Oil & Grease by Gravimetry	E567SG ALS Environmental - Waterloo	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane, followed by silica gel treatment after which the extract is evaporated to dryness. The residue is then weighed to determine Mineral Oil and Grease.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
VOCs (Eastern Canada List) by Headspace GC-MS	E611D ALS Environmental - Waterloo	Water	EPA 8260D (mod)	Volatile Organic Compounds (VOCs) are analyzed by static headspace GC-MS. Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler, causing VOCs to partition between the aqueous phase and the headspace in accordance with Henry's law.
BNA (Routine List) by GC-MS-MS	E625A ALS Environmental - Waterloo	Water	EPA 8270E (mod)	BNA are analyzed by GC-MS-MS.
PAHs in Water by Hexane LVI GC-MS (Low Level)	E641A-L ALS Environmental - Waterloo	Water	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by large volume injection (LVI) GC-MS.
PAHs (ON Special List) by GC-MS	E642D ALS Environmental - Waterloo	Water	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by GC-MS.
OCP Analysis by GC-MS-MS or GC-MS	E660F ALS Environmental - Waterloo	Water	EPA 8270E (mod)	Pesticides are analyzed by GC-MS-MS or GC-MS
Nonylphenol, Octylphenol and BPA in Water by LC-MS-MS Negative Mode	E749A ALS Environmental - Waterloo	Water	ASTM D7485-16 (mod)	An aliquot of 5.0 mL of sample is spiked with internal standards and analyzed by Direct Aqueous Injection and LC-MS-MS-Negative mode.
Nonylphenol Ethoxylates in Water by LC-MS-MS Positive Mode	E749B ALS Environmental - Waterloo	Water	ASTM D7485-16 (mod)	An aliquot of 5.0 mL of sample is spiked with internal standards and analyzed by Direct Aqueous Injection and LC-MS-MS.
Animal & Vegetable Oil & Grease by Gravimetry	EC567A.SG ALS Environmental - Waterloo	Water	APHA 5520 (mod)	Animal & vegetable oil and grease is calculated as follows: Oil & Grease (gravimetric) minus Mineral Oil & Grease (gravimetric)
Total PAH (Ontario Sewer Use Extended List)	EC640A ALS Environmental - Waterloo	Water	Calculation (Sum of the Squares)	Total PAH (Ontario Sewer Use) is the sum of the following PAHs: anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b+j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, pyrene, benzo(e)pyrene, perylene, 3-methylcholanthrene, 1,3-dinitropyrene, 1,6-dinitropyrene, 1,8-dinitropyrene, 7H-dibenzo(c,g)carbazole, dibenzo(a,i)pyrene, dibenz(a,j)acridine, and dibenz(a,h)acridine. When the PAH is less than LOR, zero is used for calculation.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Digestion for TKN in water	EP318 ALS Environmental - Waterloo	Water	APHA 4500-Norg D (mod)	Samples are digested at high temperature using Sulfuric Acid with Copper catalyst, which converts organic nitrogen sources to Ammonia, which is then quantified by the analytical method as TKN. This method is unsuitable for samples containing high levels of nitrate. If nitrate exceeds TKN concentration by ten times or more, results may be biased low.
Digestion for Total Phosphorus in water	EP372 ALS Environmental - Waterloo	Water	APHA 4500-P E (mod).	Samples are heated with a persulfate digestion reagent.
Oil & Grease Extraction for Gravimetry	EP567 ALS Environmental - Waterloo	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane by liquid-liquid extraction.
VOCs Preparation for Headspace Analysis	EP581 ALS Environmental - Waterloo	Water	EPA 5021A (mod)	Samples are prepared in headspace vials and are heated and agitated on the headspace autosampler. An aliquot of the headspace is then injected into a GC-MS-FID.
PHCs and PAHs Hexane Extraction	EP601 ALS Environmental - Waterloo	Water	EPA 3511 (mod)	Petroleum Hydrocarbons (PHCs) and Polycyclic Aromatic Hydrocarbons (PAHs) are extracted using a hexane liquid-liquid extraction.
BNA Extraction	EP625 ALS Environmental - Waterloo	Water	EPA 3510C (mod)	SVOCs are extracted from aqueous sample using DCM liquid-liquid extraction.
PAHs DCM Extraction	EP642 ALS Environmental - Waterloo	Water	EPA 3510C (mod)	PAH are extracted from aqueous sample using DCM liquid-liquid extraction.
Pesticides, PCB, and Neutral Extractable Chlorinated Hydrocarbons Extraction	EP660 ALS Environmental - Waterloo	Water	EPA 3511 (mod)	Samples are extracted from aqueous sample using an organic solvent liquid-liquid extraction.
Preparation of Nonylphenol and Nonylphenol Ethoxylates	EP749 ALS Environmental - Waterloo	Water	ASTM D7485-16 (mod)	An aliquot of 5.0 mL of sample is spiked with internal standards and analyzed by Direct Aqueous Injection and LC-MS/MS.

QUALITY CONTROL REPORT

Work Order	: **WT2426295**	Page	: 1 of 17
Client	: JLP Services Inc.	Laboratory	: ALS Environmental - Waterloo
Contact	: Ajay Jayalath	Account Manager	: Andrew Martin
Address	: 405 York Road Guelph ON Canada N1E 3H3	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 519 763 3101	Telephone	: +1 519 886 6910
Project	: G4836	Date Samples Received	: 06-Sep-2024 17:35
PO	: ----	Date Analysis Commenced	: 07-Sep-2024
C-O-C number	: 23-1122592	Issue Date	: 16-Sep-2024 17:31
Sampler	: Client		
Site	: ----		
Quote number	: 2024 SOA		
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*
Amaninder Dhillon	Team Lead - Semi-Volatile Instrumentation	Waterloo Organics, Waterloo, Ontario
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Walt Kippenhuck	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario
Zeba Patel	Analyst	Waterloo Microbiology, 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: 1638709)											
WT2426034-001	Anonymous	Solids, total suspended [TSS]	----	E160	3.0	mg/L	<3.0	<3.0	0	Diff <2x LOR	----
Physical Tests (QC Lot: 1645823)											
HA2402138-001	Anonymous	pH	----	E108	0.10	pH units	5.75	5.70	0.873%	4%	----
Anions and Nutrients (QC Lot: 1645797)											
WT2426129-001	Anonymous	Phosphorus, total	7723-14-0	E372-U	0.0200	mg/L	2.41	2.40	0.744%	20%	----
Anions and Nutrients (QC Lot: 1645824)											
WT2426544-002	Anonymous	Chloride	16887-00-6	E235.Cl	0.50	mg/L	18.4	18.7	1.26%	20%	----
Anions and Nutrients (QC Lot: 1645825)											
WT2426544-002	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	29.7	30.2	1.86%	20%	----
Anions and Nutrients (QC Lot: 1645826)											
WT2426544-002	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.621	0.642	3.36%	20%	----
Cyanides (QC Lot: 1646031)											
TY2409732-001	Anonymous	Cyanide, strong acid dissociable (Total)	----	E333	0.0020	mg/L	<0.0020	<0.0020	0	Diff <2x LOR	----
Total Sulfides (QC Lot: 1642657)											
WT2425894-001	Anonymous	Sulfide, total (as S)	18496-25-8	E396	0.018	mg/L	<0.018	<0.018	0	Diff <2x LOR	----
Total Metals (QC Lot: 1639779)											
WP2421461-002	Anonymous	Aluminum, total	7429-90-5	E420	0.0030	mg/L	0.484	0.491	1.29%	20%	----
		Antimony, total	7440-36-0	E420	0.00010	mg/L	0.00019	0.00019	0.0000001	Diff <2x LOR	----
		Arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00117	0.00121	2.91%	20%	----
		Bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Cadmium, total	7440-43-9	E420	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
		Chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	0.00143	0.00093	Diff <2x LOR	----
		Cobalt, total	7440-48-4	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Copper, total	7440-50-8	E420	0.00050	mg/L	0.00256	0.00263	0.00006	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	0.000063	0.000062	0.0000009	Diff <2x LOR	----
		Manganese, total	7439-96-5	E420	0.00010	mg/L	0.00101	0.00092	0.00009	Diff <2x LOR	----
		Molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.00233	0.00242	3.89%	20%	----
		Nickel, total	7440-02-0	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Selenium, total	7782-49-2	E420	0.000050	mg/L	0.000080	0.000064	0.000017	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: 1639779) - continued											
WP2421461-002	Anonymous	Silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Titanium, total	7440-32-6	E420	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		Vanadium, total	7440-62-2	E420	0.00050	mg/L	0.00101	0.00105	0.00004	Diff <2x LOR	----
		Zinc, total	7440-66-6	E420	0.0030	mg/L	<0.0030	<0.0030	0	Diff <2x LOR	----
Total Metals (QC Lot: 1644198)											
BF2400302-001	Anonymous	Mercury, total	7439-97-6	E508	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
Total Metals (QC Lot: 1644725)											
TY2409914-001	Anonymous	Gold, total	7440-57-5	E462.PM	0.020	µg/L	<0.020	<0.020	0	Diff <2x LOR	----
		Platinum, total	7440-06-4	E462.PM	0.020	µg/L	<0.020	<0.020	0	Diff <2x LOR	----
		Rhodium, total	7440-16-6	E462.PM	0.0050	µg/L	<0.0050	<0.0050	0	Diff <2x LOR	----
Speciated Metals (QC Lot: 1640808)											
VA24C2332-001	Anonymous	Chromium, hexavalent [Cr VI], total	18540-29-9	E532	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
Aggregate Organics (QC Lot: 1638935)											
WT2426024-002	Anonymous	Biochemical oxygen demand [BOD]	----	E550	2.0	mg/L	<2.0	<2.0	0.0%	30%	----
Aggregate Organics (QC Lot: 1640046)											
WT2426110-001	Anonymous	Chemical oxygen demand [COD]	----	E559-L	10	mg/L	495	496	0.383%	20%	----
Aggregate Organics (QC Lot: 1642513)											
EO2407797-015	Anonymous	Phenols, total (4AAP)	----	E562	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 1646710)											
TY2409850-001	Anonymous	Benzene	71-43-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Chloroform	67-66-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,2-	95-50-1	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,4-	106-46-7	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, cis-1,2-	156-59-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloromethane	75-09-2	E611D	1.0	µg/L	<1.0	<1.0	0	Diff <2x LOR	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.30	µg/L	<0.30	<0.30	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethylene	127-18-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Toluene	108-88-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichloroethylene	79-01-6	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Xylene, m+p-	179601-23-1	E611D	0.40	µg/L	<0.40	<0.40	0	Diff <2x LOR	----
		Xylene, o-	95-47-6	E611D	0.30	µg/L	<0.30	<0.30	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*
Nonylphenols (QC Lot: 1639974)											
VA24C3191-001	Anonymous	Nonylphenol [NP]	84852-15-3	E749A	0.44	µg/L	<0.44	<0.44	0	Diff <2x LOR	----
Nonylphenols (QC Lot: 1639975)											
VA24C3191-001	Anonymous	Nonylphenol diethoxylate [NP2EO]	20427-84-3	E749B	0.12	µg/L	<0.12	<0.12	0	Diff <2x LOR	----
		Nonylphenol monoethoxylate [NP1EO]	27986-36-3	E749B	0.40	µg/L	<0.40	<0.40	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: 1638709)						
Solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Anions and Nutrients (QCLot: 1645796)						
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 1645797)						
Phosphorus, total	7723-14-0	E372-U	0.002	mg/L	<0.0020	----
Anions and Nutrients (QCLot: 1645824)						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 1645825)						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 1645826)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Cyanides (QCLot: 1646031)						
Cyanide, strong acid dissociable (Total)	----	E333	0.002	mg/L	<0.0020	----
Total Sulfides (QCLot: 1642657)						
Sulfide, total (as S)	18496-25-8	E396	0.018	mg/L	<0.018	----
Microbiological Tests (QCLot: 1639120)						
Coliforms, thermotolerant [fecal]	----	E012.FC	1	CFU/100mL	<1	----
Total Metals (QCLot: 1639779)						
Aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----
Antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
Arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
Bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
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	----
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	----
Selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 1639779) - continued						
Silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
Tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
Titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
Vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	----
Zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
Total Metals (QCLot: 1644198)						
Mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	----
Total Metals (QCLot: 1644725)						
Gold, total	7440-57-5	E462.PM	0.02	µg/L	<0.020	----
Platinum, total	7440-06-4	E462.PM	0.02	µg/L	<0.020	----
Rhodium, total	7440-16-6	E462.PM	0.005	µg/L	<0.0050	----
Speciated Metals (QCLot: 1640808)						
Chromium, hexavalent [Cr VI], total	18540-29-9	E532	0.0005	mg/L	<0.00050	----
Aggregate Organics (QCLot: 1638935)						
Biochemical oxygen demand [BOD]	----	E550	2	mg/L	<2.0	----
Aggregate Organics (QCLot: 1640046)						
Chemical oxygen demand [COD]	----	E559-L	10	mg/L	<10	----
Aggregate Organics (QCLot: 1642513)						
Phenols, total (4AAP)	----	E562	0.001	mg/L	<0.0010	----
Aggregate Organics (QCLot: 1643752)						
Oil & grease (gravimetric)	----	E567	5	mg/L	<5.0	----
Aggregate Organics (QCLot: 1643753)						
Oil & grease, mineral (gravimetric)	----	E567SG	5	mg/L	<5.0	----
Volatile Organic Compounds (QCLot: 1646710)						
Benzene	71-43-2	E611D	0.5	µg/L	<0.50	----
Chloroform	67-66-3	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	<0.50	----
Dichloromethane	75-09-2	E611D	1	µg/L	<1.0	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	<0.30	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	<0.50	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	<0.50	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	<0.50	----
Toluene	108-88-3	E611D	0.5	µg/L	<0.50	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Volatile Organic Compounds (QCLot: 1646710) - continued						
Trichloroethylene	79-01-6	E611D	0.5	µg/L	<0.50	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	<0.40	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	<0.30	----
Volatile Organic Compounds (QCLot: 1649419)						
Benzene	71-43-2	E611D	0.5	µg/L	<0.50	----
Chloroform	67-66-3	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	<0.50	----
Dichloromethane	75-09-2	E611D	1	µg/L	<1.0	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	<0.30	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	<0.50	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	<0.50	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	<0.50	----
Toluene	108-88-3	E611D	0.5	µg/L	<0.50	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	<0.50	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	<0.40	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	<0.30	----
Polycyclic Aromatic Hydrocarbons (QCLot: 1640717)						
Dibenz(a,h)acridine	226-36-8	E642D	0.05	µg/L	<0.050	----
Dibenz(a,j)acridine	224-42-0	E642D	0.05	µg/L	<0.050	----
Dibenzo(a,i)pyrene	189-55-9	E642D	0.05	µg/L	<0.050	----
Dibenzo(c,g)carbazole, 7H-	194-59-2	E642D	0.05	µg/L	<0.050	----
Dinitropyrene, 1,3-	75321-20-9	E642D	1	µg/L	<1.0	----
Dinitropyrene, 1,6-	42397-64-8	E642D	1	µg/L	<1.0	----
Dinitropyrene, 1,8-	42397-65-9	E642D	1	µg/L	<1.0	----
Methylcholanthrene, 3-	56-49-5	E642D	0.05	µg/L	<0.050	----
Polycyclic Aromatic Hydrocarbons (QCLot: 1644150)						
Anthracene	120-12-7	E641A-L	0.01	µg/L	<0.010	----
Benz(a)anthracene	56-55-3	E641A-L	0.01	µg/L	<0.010	----
Benzo(a)pyrene	50-32-8	E641A-L	0.005	µg/L	<0.0050	----
Benzo(b+j)fluoranthene	n/a	E641A-L	0.01	µg/L	<0.010	----
Benzo(e)pyrene	192-97-2	E641A-L	0.01	µg/L	<0.010	----
Benzo(g,h,i)perylene	191-24-2	E641A-L	0.01	µg/L	<0.010	----
Benzo(k)fluoranthene	207-08-9	E641A-L	0.01	µg/L	<0.010	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 1644150) - continued						
Chrysene	218-01-9	E641A-L	0.01	µg/L	<0.010	----
Dibenz(a,h)anthracene	53-70-3	E641A-L	0.005	µg/L	<0.0050	----
Fluoranthene	206-44-0	E641A-L	0.01	µg/L	<0.010	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.01	µg/L	<0.010	----
Perylene	198-55-0	E641A-L	0.01	µg/L	<0.010	----
Phenanthrene	85-01-8	E641A-L	0.01	µg/L	<0.010	----
Pyrene	129-00-0	E641A-L	0.01	µg/L	<0.010	----
Phthalate Esters (QCLot: 1646309)						
bis(2-Ethylhexyl) phthalate [DEHP]	117-81-7	E625A	0.6	µg/L	<0.60	----
Di-n-butyl phthalate	84-74-2	E625A	1	µg/L	<1.0	----
Semi-Volatile Organics (QCLot: 1646309)						
Dichlorobenzidine, 3,3'-	91-94-1	E625A	0.4	µg/L	<0.40	----
Chlorinated Phenolics (QCLot: 1646309)						
Pentachlorophenol [PCP]	87-86-5	E625A	0.5	µg/L	<0.50	----
Nonylphenols (QCLot: 1639974)						
Nonylphenol [NP]	84852-15-3	E749A	0.4	µg/L	<0.40	----
Nonylphenols (QCLot: 1639975)						
Nonylphenol diethoxylate [NP2EO]	20427-84-3	E749B	0.1	µg/L	<0.10	----
Nonylphenol monoethoxylate [NP1EO]	27986-36-3	E749B	0.4	µg/L	<0.40	----
Organochlorine Pesticides (QCLot: 1642795)						
Aldrin	309-00-2	E660F	0.008	µg/L	<0.0080	----
Chlordane, cis- (alpha)	5103-71-9	E660F	0.008	µg/L	<0.0080	----
Chlordane, trans- (gamma)	5103-74-2	E660F	0.008	µg/L	<0.0080	----
DDD, 2,4'-	53-19-0	E660F	0.004	µg/L	<0.0040	----
DDD, 4,4'-	72-54-8	E660F	0.004	µg/L	<0.0040	----
DDE, 2,4'-	3424-82-6	E660F	0.004	µg/L	<0.0040	----
DDE, 4,4'-	72-55-9	E660F	0.004	µg/L	<0.0040	----
DDT, 2,4'-	789-02-6	E660F	0.004	µg/L	<0.0040	----
DDT, 4,4'-	50-29-3	E660F	0.004	µg/L	<0.0040	----
Dieldrin	60-57-1	E660F	0.008	µg/L	<0.0080	----
Hexachlorocyclohexane, gamma-	58-89-9	E660F	0.008	µg/L	<0.0080	----
Mirex	2385-85-5	E660F	0.008	µg/L	<0.0080	----

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	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1638709)									
Solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	107	85.0	115	----
Physical Tests (QCLot: 1645823)									
pH	----	E108	----	pH units	7 pH units	101	98.0	102	----
Anions and Nutrients (QCLot: 1645796)									
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	4 mg/L	116	75.0	125	----
Anions and Nutrients (QCLot: 1645797)									
Phosphorus, total	7723-14-0	E372-U	0.002	mg/L	0.333 mg/L	97.6	80.0	120	----
Anions and Nutrients (QCLot: 1645824)									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 1645825)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 1645826)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	102	90.0	110	----
Cyanides (QCLot: 1646031)									
Cyanide, strong acid dissociable (Total)	----	E333	0.002	mg/L	0.25 mg/L	94.5	80.0	120	----
Total Sulfides (QCLot: 1642657)									
Sulfide, total (as S)	18496-25-8	E396	0.018	mg/L	0.1 mg/L	91.0	75.0	125	----
Total Metals (QCLot: 1639779)									
Aluminum, total	7429-90-5	E420	0.003	mg/L	0.1 mg/L	95.4	80.0	120	----
Antimony, total	7440-36-0	E420	0.0001	mg/L	0.05 mg/L	103	80.0	120	----
Arsenic, total	7440-38-2	E420	0.0001	mg/L	0.05 mg/L	106	80.0	120	----
Bismuth, total	7440-69-9	E420	0.00005	mg/L	0.05 mg/L	101	80.0	120	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	0.005 mg/L	100	80.0	120	----
Chromium, total	7440-47-3	E420	0.0005	mg/L	0.012 mg/L	103	80.0	120	----
Cobalt, total	7440-48-4	E420	0.0001	mg/L	0.012 mg/L	102	80.0	120	----
Copper, total	7440-50-8	E420	0.0005	mg/L	0.012 mg/L	102	80.0	120	----
Iron, total	7439-89-6	E420	0.01	mg/L	0.05 mg/L	101	80.0	120	----
Lead, total	7439-92-1	E420	0.00005	mg/L	0.025 mg/L	104	80.0	120	----
Manganese, total	7439-96-5	E420	0.0001	mg/L	0.012 mg/L	99.6	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Target Concentration	LCS	Low	High	Qualifier
Total Metals (QCLot: 1639779) - continued									
Molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.012 mg/L	99.7	80.0	120	----
Nickel, total	7440-02-0	E420	0.0005	mg/L	0.025 mg/L	101	80.0	120	----
Selenium, total	7782-49-2	E420	0.00005	mg/L	0.05 mg/L	102	80.0	120	----
Silver, total	7440-22-4	E420	0.00001	mg/L	0.005 mg/L	94.2	80.0	120	----
Tin, total	7440-31-5	E420	0.0001	mg/L	0.025 mg/L	102	80.0	120	----
Titanium, total	7440-32-6	E420	0.0003	mg/L	0.012 mg/L	100	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	100	80.0	120	----
Total Metals (QCLot: 1644198)									
Mercury, total	7439-97-6	E508	0.000005	mg/L	0 mg/L	99.0	80.0	120	----
Total Metals (QCLot: 1644725)									
Gold, total	7440-57-5	E462.PM	0.02	µg/L	10 µg/L	93.9	80.0	120	----
Platinum, total	7440-06-4	E462.PM	0.02	µg/L	10 µg/L	99.9	80.0	120	----
Rhodium, total	7440-16-6	E462.PM	0.005	µg/L	10 µg/L	98.1	80.0	120	----
Speciated Metals (QCLot: 1640808)									
Chromium, hexavalent [Cr VI], total	18540-29-9	E532	0.0005	mg/L	0.025 mg/L	99.9	80.0	120	----
Aggregate Organics (QCLot: 1638935)									
Biochemical oxygen demand [BOD]	----	E550	2	mg/L	198 mg/L	100	85.0	115	----
Aggregate Organics (QCLot: 1640046)									
Chemical oxygen demand [COD]	----	E559-L	10	mg/L	100 mg/L	110	85.0	115	----
Aggregate Organics (QCLot: 1642513)									
Phenols, total (4AAP)	----	E562	0.001	mg/L	0.02 mg/L	101	85.0	115	----
Aggregate Organics (QCLot: 1643752)									
Oil & grease (gravimetric)	----	E567	5	mg/L	200 mg/L	90.6	70.0	130	----
Aggregate Organics (QCLot: 1643753)									
Oil & grease, mineral (gravimetric)	----	E567SG	5	mg/L	100 mg/L	80.4	70.0	130	----
Volatile Organic Compounds (QCLot: 1646710)									
Benzene	71-43-2	E611D	0.5	µg/L	100 µg/L	101	70.0	130	----
Chloroform	67-66-3	E611D	0.5	µg/L	100 µg/L	111	70.0	130	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	100 µg/L	104	70.0	130	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	100 µg/L	103	70.0	130	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	100 µg/L	108	70.0	130	----
Dichloromethane	75-09-2	E611D	1	µg/L	100 µg/L	111	70.0	130	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 1646710) - continued									
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	100 µg/L	107	70.0	130	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	100 µg/L	98.0	70.0	130	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	100 µg/L	114	70.0	130	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	100 µg/L	106	70.0	130	----
Toluene	108-88-3	E611D	0.5	µg/L	100 µg/L	98.3	70.0	130	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	100 µg/L	109	70.0	130	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	200 µg/L	101	70.0	130	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	100 µg/L	99.6	70.0	130	----
Volatile Organic Compounds (QCLot: 1649419)									
Benzene	71-43-2	E611D	0.5	µg/L	100 µg/L	92.7	70.0	130	----
Chloroform	67-66-3	E611D	0.5	µg/L	100 µg/L	93.6	70.0	130	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	100 µg/L	97.4	70.0	130	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	100 µg/L	96.5	70.0	130	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	100 µg/L	88.1	70.0	130	----
Dichloromethane	75-09-2	E611D	1	µg/L	100 µg/L	88.9	70.0	130	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	100 µg/L	89.7	70.0	130	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	100 µg/L	95.2	70.0	130	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	100 µg/L	84.4	70.0	130	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	100 µg/L	110	70.0	130	----
Toluene	108-88-3	E611D	0.5	µg/L	100 µg/L	94.5	70.0	130	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	100 µg/L	106	70.0	130	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	200 µg/L	95.6	70.0	130	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	100 µg/L	95.1	70.0	130	----
Polycyclic Aromatic Hydrocarbons (QCLot: 1640717)									
Dibenz(a,h)acridine	226-36-8	E642D	0.05	µg/L	1.6 µg/L	87.7	60.0	130	----
Dibenz(a,j)acridine	224-42-0	E642D	0.05	µg/L	1.6 µg/L	90.3	60.0	130	----
Dibenzo(a,i)pyrene	189-55-9	E642D	0.05	µg/L	1.6 µg/L	67.0	60.0	130	----
Dibenzo(c,g)carbazole, 7H-	194-59-2	E642D	0.05	µg/L	1.6 µg/L	91.8	60.0	130	----
Dinitropyrene, 1,3-	75321-20-9	E642D	1	µg/L	1.6 µg/L	102	60.0	130	----
Dinitropyrene, 1,6-	42397-64-8	E642D	1	µg/L	1.6 µg/L	89.3	60.0	130	----
Dinitropyrene, 1,8-	42397-65-9	E642D	1	µg/L	1.6 µg/L	85.0	60.0	130	----
Methylcholanthrene, 3-	56-49-5	E642D	0.05	µg/L	1.6 µg/L	121	60.0	130	----
Polycyclic Aromatic Hydrocarbons (QCLot: 1644150)									
Anthracene	120-12-7	E641A-L	0.01	µg/L	0.526 µg/L	91.4	50.0	140	----
Benz(a)anthracene	56-55-3	E641A-L	0.01	µg/L	0.526 µg/L	103	50.0	140	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report: Spike: Target Concentration	Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 1644150) - continued									
Benzo(a)pyrene	50-32-8	E641A-L	0.005	µg/L	0.526 µg/L	98.6	50.0	140	----
Benzo(b+j)fluoranthene	n/a	E641A-L	0.01	µg/L	0.526 µg/L	95.1	50.0	140	----
Benzo(e)pyrene	192-97-2	E641A-L	0.01	µg/L	0.526 µg/L	91.9	50.0	140	----
Benzo(g,h,i)perylene	191-24-2	E641A-L	0.01	µg/L	0.526 µg/L	93.0	50.0	140	----
Benzo(k)fluoranthene	207-08-9	E641A-L	0.01	µg/L	0.526 µg/L	80.4	50.0	140	----
Chrysene	218-01-9	E641A-L	0.01	µg/L	0.526 µg/L	102	50.0	140	----
Dibenz(a,h)anthracene	53-70-3	E641A-L	0.005	µg/L	0.526 µg/L	88.0	50.0	140	----
Fluoranthene	206-44-0	E641A-L	0.01	µg/L	0.526 µg/L	105	50.0	140	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.01	µg/L	0.526 µg/L	112	50.0	140	----
Perylene	198-55-0	E641A-L	0.01	µg/L	0.526 µg/L	103	50.0	140	----
Phenanthrene	85-01-8	E641A-L	0.01	µg/L	0.526 µg/L	101	50.0	140	----
Pyrene	129-00-0	E641A-L	0.01	µg/L	0.526 µg/L	106	50.0	140	----
Phthalate Esters (QCLot: 1646309)									
bis(2-Ethylhexyl) phthalate [DEHP]	117-81-7	E625A	0.6	µg/L	33.7 µg/L	103	50.0	140	----
Di-n-butyl phthalate	84-74-2	E625A	1	µg/L	33.7 µg/L	93.2	50.0	140	----
Semi-Volatile Organics (QCLot: 1646309)									
Dichlorobenzidine, 3,3'-	91-94-1	E625A	0.4	µg/L	8.42 µg/L	88.7	50.0	140	----
Chlorinated Phenolics (QCLot: 1646309)									
Pentachlorophenol [PCP]	87-86-5	E625A	0.5	µg/L	25.3 µg/L	87.9	65.0	130	----
Nonylphenols (QCLot: 1639974)									
Nonylphenol [NP]	84852-15-3	E749A	0.4	µg/L	10 µg/L	103	60.0	140	----
Nonylphenols (QCLot: 1639975)									
Nonylphenol diethoxylate [NP2EO]	20427-84-3	E749B	0.1	µg/L	2 µg/L	96.9	60.0	140	----
Nonylphenol monoethoxylate [NP1EO]	27986-36-3	E749B	0.4	µg/L	10 µg/L	99.7	60.0	140	----
Organochlorine Pesticides (QCLot: 1642795)									
Aldrin	309-00-2	E660F	0.008	µg/L	0.2 µg/L	73.8	50.0	150	----
Chlordane, cis- (alpha)	5103-71-9	E660F	0.008	µg/L	0.2 µg/L	114	50.0	150	----
Chlordane, trans- (gamma)	5103-74-2	E660F	0.008	µg/L	0.2 µg/L	104	50.0	150	----
DDD, 2,4'-	53-19-0	E660F	0.004	µg/L	0.2 µg/L	89.6	50.0	150	----
DDD, 4,4'-	72-54-8	E660F	0.004	µg/L	0.2 µg/L	146	50.0	150	----
DDE, 2,4'-	3424-82-6	E660F	0.004	µg/L	0.2 µg/L	109	50.0	150	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Organochlorine Pesticides (QCLot: 1642795) - continued									
DDE, 4,4'-	72-55-9	E660F	0.004	µg/L	0.2 µg/L	96.5	50.0	150	----
DDT, 2,4'-	789-02-6	E660F	0.004	µg/L	0.2 µg/L	97.5	50.0	150	----
DDT, 4,4'-	50-29-3	E660F	0.004	µg/L	0.2 µg/L	110	50.0	150	----
Dieldrin	60-57-1	E660F	0.008	µg/L	0.2 µg/L	96.2	50.0	150	----
Hexachlorocyclohexane, gamma-	58-89-9	E660F	0.008	µg/L	0.2 µg/L	105	50.0	150	----
Mirex	2385-85-5	E660F	0.008	µg/L	0.2 µg/L	89.2	50.0	150	----

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: 1645796)										
WT2426129-002	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	----	----		70.0	130	----
Anions and Nutrients (QCLot: 1645797)										
WT2426129-001	Anonymous	Phosphorus, total	7723-14-0	E372-U	ND mg/L	----	ND	70.0	130	----
Anions and Nutrients (QCLot: 1645824)										
WT2426544-002	Anonymous	Chloride	16887-00-6	E235.Cl	107 mg/L	100 mg/L	107	75.0	125	----
Anions and Nutrients (QCLot: 1645825)										
WT2426544-002	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	106 mg/L	100 mg/L	106	75.0	125	----
Anions and Nutrients (QCLot: 1645826)										
WT2426544-002	Anonymous	Fluoride	16984-48-8	E235.F	1.10 mg/L	1 mg/L	110	75.0	125	----
Cyanides (QCLot: 1646031)										
TY2409732-001	Anonymous	Cyanide, strong acid dissociable (Total)	----	E333	0.219 mg/L	0.25 mg/L	87.6	75.0	125	----
Total Sulfides (QCLot: 1642657)										
WT2425894-001	Anonymous	Sulfide, total (as S)	18496-25-8	E396	0.070 mg/L	0.1 mg/L	70.0	65.0	135	----
Total Metals (QCLot: 1639779)										
WP2421461-003	Anonymous	Aluminum, total	7429-90-5	E420	ND mg/L	----	ND	70.0	130	----
		Antimony, total	7440-36-0	E420	0.0532 mg/L	0.05 mg/L	106	70.0	130	----
		Arsenic, total	7440-38-2	E420	0.0533 mg/L	0.05 mg/L	106	70.0	130	----
		Bismuth, total	7440-69-9	E420	0.0467 mg/L	0.05 mg/L	93.4	70.0	130	----
		Cadmium, total	7440-43-9	E420	0.00485 mg/L	0.005 mg/L	97.1	70.0	130	----
		Chromium, total	7440-47-3	E420	0.0129 mg/L	0.012 mg/L	103	70.0	130	----
		Cobalt, total	7440-48-4	E420	0.0127 mg/L	0.012 mg/L	102	70.0	130	----
		Copper, total	7440-50-8	E420	ND mg/L	----	ND	70.0	130	----
		Iron, total	7439-89-6	E420	0.050 mg/L	0.05 mg/L	99.3	70.0	130	----
		Lead, total	7439-92-1	E420	0.0239 mg/L	0.025 mg/L	95.7	70.0	130	----
		Manganese, total	7439-96-5	E420	0.0125 mg/L	0.012 mg/L	100	70.0	130	----
		Molybdenum, total	7439-98-7	E420	0.0134 mg/L	0.012 mg/L	107	70.0	130	----
		Nickel, total	7440-02-0	E420	0.0245 mg/L	0.025 mg/L	98.1	70.0	130	----
		Selenium, total	7782-49-2	E420	0.0501 mg/L	0.05 mg/L	100	70.0	130	----
		Silver, total	7440-22-4	E420	0.00445 mg/L	0.005 mg/L	89.0	70.0	130	----
		Tin, total	7440-31-5	E420	0.0256 mg/L	0.025 mg/L	103	70.0	130	----
		Titanium, total	7440-32-6	E420	0.0132 mg/L	0.012 mg/L	106	70.0	130	----
		Vanadium, total	7440-62-2	E420	0.0268 mg/L	0.025 mg/L	107	70.0	130	----
		Zinc, total	7440-66-6	E420	0.0228 mg/L	0.025 mg/L	91.4	70.0	130	----
Total Metals (QCLot: 1644198)										
BF2400302-002	Anonymous	Mercury, total	7439-97-6	E508	0.0000871 mg/L	0 mg/L	87.1	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: 1644725)										
TY2409914-002	Anonymous	Gold, total	7440-57-5	E462.PM	0.903 µg/L	1 µg/L	90.3	70.0	130	----
		Platinum, total	7440-06-4	E462.PM	1.02 µg/L	1 µg/L	102	70.0	130	----
		Rhodium, total	7440-16-6	E462.PM	0.994 µg/L	1 µg/L	99.4	70.0	130	----
Speciated Metals (QCLot: 1640808)										
VA24C2332-001	Anonymous	Chromium, hexavalent [Cr VI], total	18540-29-9	E532	0.0401 mg/L	0.04 mg/L	100	70.0	130	----
Aggregate Organics (QCLot: 1640046)										
WT2426110-001	Anonymous	Chemical oxygen demand [COD]	----	E559-L	ND mg/L	----	ND	75.0	125	----
Aggregate Organics (QCLot: 1642513)										
EO2407797-016	Anonymous	Phenols, total (4AAP)	----	E562	0.0200 mg/L	0.02 mg/L	100.0	75.0	125	----
Volatile Organic Compounds (QCLot: 1646710)										
TY2409850-001	Anonymous	Benzene	71-43-2	E611D	101 µg/L	100 µg/L	101	60.0	140	----
		Chloroform	67-66-3	E611D	110 µg/L	100 µg/L	110	60.0	140	----
		Dichlorobenzene, 1,2-	95-50-1	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Dichlorobenzene, 1,4-	106-46-7	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Dichloroethylene, cis-1,2-	156-59-2	E611D	106 µg/L	100 µg/L	106	60.0	140	----
		Dichloromethane	75-09-2	E611D	108 µg/L	100 µg/L	108	60.0	140	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611D	105 µg/L	100 µg/L	105	60.0	140	----
		Ethylbenzene	100-41-4	E611D	97.8 µg/L	100 µg/L	97.8	60.0	140	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	109 µg/L	100 µg/L	109	60.0	140	----
		Tetrachloroethylene	127-18-4	E611D	108 µg/L	100 µg/L	108	60.0	140	----
		Toluene	108-88-3	E611D	97.4 µg/L	100 µg/L	97.4	60.0	140	----
		Trichloroethylene	79-01-6	E611D	110 µg/L	100 µg/L	110	60.0	140	----
		Xylene, m+p-	179601-23-1	E611D	203 µg/L	200 µg/L	101	60.0	140	----
		Xylene, o-	95-47-6	E611D	99.0 µg/L	100 µg/L	99.0	60.0	140	----
Nonylphenols (QCLot: 1639974)										
VA24C3191-001	Anonymous	Nonylphenol [NP]	84852-15-3	E749A	8.95 µg/L	10 µg/L	89.5	50.0	140	----
Nonylphenols (QCLot: 1639975)										
VA24C3191-001	Anonymous	Nonylphenol diethoxylate [NP2EO]	20427-84-3	E749B	1.86 µg/L	2 µg/L	93.0	50.0	140	----
		Nonylphenol monoethoxylate [NP1EO]	27986-36-3	E749B	9.97 µg/L	10 µg/L	99.7	50.0	140	----

Chain of Custody (COC) / Analytical Request Form

COC Number: 23 - 1122592

Page of

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Canada Toll Free: 1 800 668 9878

Environmental Division Waterloo

Work Order Reference WT2426295

Telephone : +1 519 886 6910

Report To	Contact and company name below will appear on the final report	Reports / Recipients	Turnaround Time (TAT) Requested
Company:	JLP Services Inc.	Select Report Format: ☑ PDF ☐ EXCEL ☑ EDD (DIGITAL)	☑ Routine [R] if received by 3pm M-F - no surcharges apply
Contact:	Ajay Jayalath	Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A	☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimu
Phone:	519 763 3101	☑ Compare Results to Criteria on Report - provide details below if box checked	☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minim
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minim
Street:	405 York Rd.	Email 1 or Fax ajay.jayalath@JLPservices.ca	☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minim
City/Province:	Guelph / ON	Email 2 morgan.chronoboy@jlpservices.ca	☐ Same day [E2] if received by 10am M-S - 200% rush surcharge.
Postal Code:	N1E 3H3	Email 3 Cindy.Luu@jlpservices.ca	Additional fees may apply to rush requests on weeke
Invoice To	Same as Report To ☐ YES ☐ NO	**Invoice Recipients**	Date and Time Required for all E&P TATs:
	Copy of Invoice with Report ☐ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	For all tests with rush TATs requested, please
Company:		Email 1 or Fax accounting@jlpservices.ca	Analysis R
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Client Code / QUOTE #:	JLP Mun	AFE/Cost Center:	PO#
Job / Project #:	G4836	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (ALS use only):	WT2426295 FA	ALS Contact: Andrew Martin	Sampler:

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	City of Guelph Sanitary and Storm Sewer By-Law	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BHMW9	Sep. 4	AM	GW	25	X			

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

Drinking Water (DW) Samples[1] (client use)	Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)
Are samples taken from a Regulated DW System? ☐ YES ☒ NO	
Are samples for human consumption/ use? ☐ YES ☒ NO	

SAMPLE RECEIPT DETAILS (ALS use only)

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

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

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				9.2			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by: Saiith Kumara	Date: Sep 6 2024	Time: 5:15 PM	Received by:	Date:	Time:	Received by: VM	Date: 9-6-24	Time: 17:35

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JAN 2023 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**.

OS-715 OGG-835 OR-706 B-916 GC-729 N-202 L-714 MM-070 CN-100 SC-930 VW-006

Appendix H – Qualifications of Assessors

Cindy Luu, B.Sc.

Cindy has a Bachelor of Science in Biomedical Sciences from the University of Waterloo. She then completed a graduate certificate program in Environmental Engineering Applications from Conestoga College.

Cindy is responsible for environmental reporting, including Phase I and II Environmental Site Assessments, due diligence reports, excess soil management, environmental monitoring and investigations, regulatory compliance and regulations.

Ajay Jayalath, MBA, P.Geo., QP

Mr. Jayalath graduated from University of Toronto with a Bachelor of Science in Environmental Geoscience, specializing in Urban Geoscience and Hydrogeology. He then obtained a Master's of Science degree from the University of Toronto in Environmental Science and a MBA from the DeGroote School of Business, McMaster University.

Mr. Jayalath has over fifteen years of environmental investigations experience in the geo-environmental field. Mr. Jayalath has worked on numerous remediation projects including the design and application of in-situ and ex-situ remediation projects. In addition, he has been involved in over fifty Phase l and ll Environmental Site Assessments, from conducting field work to the reporting and project management phases.

His current responsibilities include the management of the environmental groups, including the site assessment, hydrogeological, air quality, hazardous materials, and risk assessment teams. As part of his responsibilities, Mr. Jayalath's role is to ensure the environmental operations are completed in a timely manner to client satisfaction. Mr. Jayalath oversees various contracts for nationwide clients and routinely coordinates with the regional offices to ensure project and contract performance.

Jay Samarakkody, B.Sc., M.Phil., P. Geo.

Mr. Samarakkody is a Senior Hydrogeologist graduated from the University of Peradeniya, Sri Lanka with a Bachelor of Science in Geology, and a Master of Philosophy in Hydrogeology. He completed a Post Graduate diploma in Environmental Engineering Applications at Conestoga College in Kitchener, Ontario.

Mr. Samarakkody has over forty years of overall experience including over twenty years in Canada, completing numerous hydrogeology related projects for public and private sector clients, mainly in the province of Ontario.

His core expertise includes overall management of variety of hydrogeology related projects, well developed hydrogeological technical expertise, water balance studies, numerical groundwater modelling, client engagement and management, project team management, staff development in technical fields, report writing and peer reviewing. He has a thorough knowledge of applicable federal, provincial and municipal Acts and Regulations.