



1 Dunbar Road North, Waterloo, ON

Hydrogeological Investigation

Project Location:

1 Dunbar Road North, Waterloo, ON

Prepared for:

2744668 Ontario Inc
1130 Sherbrooke West, Suite 700
Montreal, QC H3A 2M8

Prepared by:

MTE Consultants Inc.
520 Bingham's Centre Drive
Kitchener, ON N2B 3X9

August 30, 2024

Revised August 15, 2025

MTE File No.: 32375-800





Contents

1.0	INTRODUCTION & BACKGROUND	1
2.0	SCOPE OF WORK.....	1
2.1	Field Investigation	1
2.2	Assessment and Reporting	2
3.0	SITE DESCRIPTION & PROPOSED PLANS	2
4.0	INVESTIGATION METHODOLOGY	2
4.1	Monitoring Well Development	2
4.2	Groundwater Level Monitoring	2
4.3	Hydraulic Conductivity (K) Estimation	3
4.4	Groundwater Quality Analysis	3
5.0	LOCAL HYDROGEOLOGICAL CONDITIONS	4
5.1	Soil Stratigraphy.....	4
5.2	Groundwater Elevations and Flow Direction.....	4
5.3	Hydraulic Conductivity (K).....	5
5.4	Groundwater Quality	5
6.0	DEWATERING ASSESSMENT	5
6.1	Proposed Development and Constructability.....	6
6.2	Assessment Approach and Methodology	6
6.3	Construction Dewatering Volumes	7
6.4	Permitting/Approvals Requirements	7
6.5	Permanent Dewatering	8
7.0	IMPACT ASSESSMENT.....	8
7.1	Source Water Protection	8
7.1.1	Well Head Protection Area (WHPA) Vulnerability Assessment	8
7.1.2	Well Head Protection Area (WHPA-Q).....	9
7.1.3	Issue Contributing Area (ICAs)	10
7.1.4	Drinking Water Threats	10
7.2	Local Water Supply	11
7.3	Surface Water Features and Natural Environment.....	11
7.4	Groundwater Recharge Management	11
7.5	Discharge Plan.....	12
7.6	Settlement Considerations	12
8.0	PROPOSED MONITORING AND CONTINGENCY PLAN	13
9.0	CONCLUSIONS	13

10.0	RECOMMENDATIONS	14
11.0	LIMITATIONS.....	15
12.0	REFERENCES.....	16

Figures

Figure 1	Site Plan, Borehole and Monitoring Well Location Plan
Figure 2	Local Geological Cross-Section A-A'
Figure 3A	Well Head Protection Area (WHPA)
Figure 3B	WHPA – Vulnerability Score
Figure 4	Groundwater Flow Direction

Tables

Table 1	Summary of Groundwater Elevations
Table 2	Water Quality Summary

Appendices

Appendix A	Borehole Logs
Appendix B	Hydrographs
Appendix C	AquiferTest Reports
Appendix D	Laboratory Certificates of Analysis
Appendix E	Dewatering Calculations
Appendix F	Vulnerability Assessment
Appendix G	Monitoring and Contingency Plan

1.0 INTRODUCTION & BACKGROUND

MTE Consultants Inc. (MTE) was retained by 2744668 Ontario Inc. (Client) to conduct a hydrogeological investigation for a proposed residential building to be constructed at 142-154 Erb Street West and 5 Dunbar Road North (Site) in the City of Waterloo, Ontario. **Figure 1** illustrates the Site location.

The primary objective of the hydrogeological investigation is to provide an assessment of the dewatering requirements during construction and associated permitting requirements. This further includes identification of groundwater receptors and an assessment of the potential for hydrogeological impacts on these receptors as a result of the proposed groundwater taking.

This report should be read in context of the geotechnical investigation report completed for the Site by Chung & Vander Doelen (CVD) dated December 4, 2023. Geotechnical investigation drilling programs were completed in June 2018 and November 2023 and involved drilling a total of 10 boreholes (BH1 to BH10) to depths ranging from approximately 11.1 meters below ground surface (m BGS) to 21.8m BGS. Boreholes BH1 through BH6 were completed during the initial geotechnical investigation in June 2018, while BH7 through BH10 were completed during the supplementary investigation completed in November 2023. Upon completion of drilling, three boreholes (BH1, BH6 and BH8) were completed as groundwater monitoring wells. (CVD, December 2023). The locations of existing boreholes and monitoring wells completed by CVD are illustrated on **Figure 1**.

Relevant information from CVD's geotechnical report has been reviewed and included in the hydrogeological investigation, where appropriate. For the purpose of this assessment, MTE has utilized the existing on-Site monitoring wells to facilitate measurement of stabilized groundwater levels, groundwater sampling and/or hydraulic conductivity testing.

2.0 SCOPE OF WORK

For this investigation, the Study Area is defined as a buffer area of 500 m around the Site boundary. To meet the objectives of this assessment the following scope of work was implemented:

2.1 Field Investigation

- Collection of manual groundwater level measurements within accessible existing on-Site monitoring wells during eight monitoring events and installation of electronic pressure transducers (data loggers) within two of the existing on-Site monitoring wells (BH1 and BH6) to monitor groundwater levels on an hourly basis between June 2023 to June 2025.
- Completion of well development and in-situ single well hydraulic response testing within two existing on-Site monitoring wells (BH1 and BH6) to determine the hydraulic conductivity of the saturated native soils.
- Collection of two unfiltered groundwater samples from two existing on-Site monitoring wells (BH1 and BH6) for analysis of a general chemistry package and comparison to the Region of Waterloo Sanitary Sewer Use By-Law 21-036 and Provincial Water Quality Objectives (PWQOs) guidelines (where applicable), to assess discharge requirements during construction dewatering operations.

2.2 Assessment and Reporting

The report will address the following items:

- A hydrogeologic characterization of the Site including seasonal groundwater levels, hydraulic conductivity, flow direction and gradient.
- Assessment of construction dewatering volumes and required permitting/approvals.
- Assessment of groundwater quality for potential discharge of pumped groundwater.
- Assessment of potential hydrogeological impacts due to the groundwater taking operations.
- Recommendations for additional work and groundwater monitoring as appropriate.

3.0 SITE DESCRIPTION & PROPOSED PLANS

The Site encompasses an area of approximately 0.3 hectares (0.7 acres) and currently consists of seven 2-storey residential dwellings, each with its own driveway entrance. Of the seven residential dwellings, six front Erb Street West and one fronts Dunbar Road North. The Site is bounded to the north by existing residential developments, to the east by Dunbar Road North, to the south by Erb Street West, and to the west by Roslin Avenue North. **Figure 1** illustrates the Site location.

Based on the boreholes advanced at the Site by CVD, the ground surface elevation across the Site slopes down from the east to west with elevations ranging from approximately 331.42 metres above mean sea level (m AMSL) to 329.41m AMSL.

Based on the information provided, it is understood that the proposed redevelopment includes a 9-storey residential building with two levels of split parking structure (P2) along with construction of asphalt-surfaced parking and access driveways.

4.0 INVESTIGATION METHODOLOGY

4.1 Monitoring Well Development

Two of the existing on-Site monitoring wells (BH1 and BH6) were developed on June 20, 2023, using Waterra™ Surge Blocks to remove any accumulated sediments from the bottom of the well and to remove fine grained materials from the well screen and sand pack. Monitoring well development included the removal of 10 well volumes and/or until silt-free discharge.

4.2 Groundwater Level Monitoring

Manual groundwater levels were collected from the accessible existing on-Site monitoring wells on eight occasions between June 23, 2023, and June 10, 2025. As BH8 was not completed until November 2023 groundwater measurements are not available prior to the November 10, 2023, field visit. Dedicated pressure transducers (data loggers) were installed in two of the on-Site monitoring wells (BH1 and BH6) on June 30, 2023. Data loggers were programmed to record groundwater levels every hour. Furthermore, groundwater levels recorded by on-Site dataloggers were compensated for atmospheric pressure using a data logger located at MTE's Kitchener office (7 km east of the Site).

Table 1 summarizes the manually measured groundwater levels. Hydrographs illustrating the continuous groundwater elevations at select monitoring wells are provided in **Appendix B**.

4.3 Hydraulic Conductivity (K) Estimation

Single well hydraulic response tests (SWRTs) were conducted in two on-Site monitoring wells (BH1 and BH6) on August 17, 2023, to estimate the hydraulic conductivity of the screened native sediments in the vicinity of the tested monitoring wells. Testing methodology was chosen depending upon the local conditions at each well. The methods employed were as follows:

Method 1 (Slug Test) involved using a “slug” (a predetermined solid length of PVC with a known displacement) which was introduced into the well, causing a near instantaneous rise in the water level within the well. The water level rise was followed by a gradual decrease back to static conditions (the water level within the well prior to slug introduction), as a result of the natural flow of groundwater back out of the well. Once the water level returned to static conditions, the slug was removed quickly resulting in a near instantaneous drop in the water level within the well, followed by a rise in the water level back to the static conditions. Slug tests were used on wells screened in medium to high permeability sediments and/or when water levels were within the screened interval.

Method 2 (Recovery Test) involved using a pneumatic initiation system whereby air pressure was applied to depress (lower) the water column in the well by a known amount. To initiate the test, the air pressure was released and the water level recovery was measured using a data logger programmed to collect a water level every second. The response tests were carried out a minimum of three times using different initiation pressures to assess the viability of the assumptions underlying slug test analysis methods.

As a result of the course grained nature of the screened material in both BH1 and BH6, Method 2 was chosen as the preferred testing method. However, as a result of the water level at BH1 being within the screened interval Method 2 was not a viable option and as such Method 1 was attempted. Although Method 1 was attempted on BH1 the rapid response to slug introduction resulted in poor data quality which did not allow for accurate analysis.

Method 2 was able to be completed for BH6. The recovery of the well back to static conditions was monitored using a datalogger recording on half second intervals. Analysis was conducted using the Bouwer & Rice method in AquiferTest Pro (Waterloo Hydrogeologic, 2022). As results from BH1 were not analyzed only hydraulic conductivity testing results from BH6 were used when estimating the hydraulic conductivity of the underlying sand.

AquiferTest Pro reports are provided in **Appendix C**.

4.4 Groundwater Quality Analysis

Unfiltered groundwater samples were collected from monitoring wells BH1 and BH6 on June 30, 2023. Prior to sampling, each monitoring well was purged a minimum of three equivalent well volumes of groundwater. Groundwater samples were collected in appropriate bottles supplied by an analytical laboratory with the applicable preservatives added by the laboratory.

Upon collection, the samples were placed in coolers and submitted under chain of custody to the ALS Laboratories in Waterloo, Ontario for analysis of a general chemistry package including physical tests, anions and nutrients, total metals, volatile organic compounds (VOCs) and hydrocarbons (PHCs) and compared with Region of Waterloo Sanitary Sewer Use By-Law 21-036 and Provincial Water Quality Objectives (PWQOs) guidelines (where applicable) to assess discharge requirements during construction dewatering operations.

A summary of the water quality results can be found in **Table 2**. The laboratory certificates of analysis for samples collected are presented in **Appendix D**.

5.0 LOCAL HYDROGEOLOGICAL CONDITIONS

5.1 Soil Stratigraphy

Based on the findings of the CVD's geotechnical investigation report (CVD, December 2023), the soil conditions encountered at the Site typically include surficial topsoil and pavement structure underlain by fill materials followed by granular deposits of sand to sand and gravel, which were then underlain by clayey silt till summarized as below:

- i. **Earth Fill;** consists of silty sand to sandy silt with traces of gravel and clay extended to depths of 0.97 m BGS to 2.45 m BGS indicating moist moisture conditions.
- ii. **Native – Granular Deposits;** consists of sand to sand and gravel and extended to the underlying till deposits to depths of 10.05 m BGS to 13.10 m BGS. BH1, BH2, BH4 and BH5 were noted to be terminated within the granular deposit and did not extend into the underlying till.
- iii. **Native – Till Deposits;** were encountered in boreholes BH3, BH6 and BH7 through BH10 and were described as consisting of clayey silt till containing traces of sand and gravel with occasional to frequent silt seams. Native till deposits were noted to extend to borehole termination depth (11.13m BGS to 21.8 m BGS) in respective boreholes where encountered.

The simplified stratigraphy interpreted from the boreholes are shown on the cross-section provided on **Figure 2**. The cross-section location is depicted on **Figure 1**. Borehole logs indicating details related to encountered stratigraphy are provided in **Appendix B**.

For further details related to subsurface conditions, please refer to the geotechnical investigation report completed by CVD under separate cover (CVD, December 2023).

5.2 Groundwater Elevations and Flow Direction

Continuous groundwater elevations from monitoring wells BH1 and BH6 are shown on **Hydrograph 1** and **Hydrograph 2** and are provided in **Appendix B**. Manual groundwater levels collected by MTE are summarized in **Table 1**. For context local precipitation data have been shown on **Hydrograph 1** and **Hydrograph 2**.

Precipitation data obtained from Environment Canada's Historical Data online database for the Kitchener/Waterloo weather station (Climate ID No. 6144239) were also plotted with groundwater elevations to assess groundwater seasonal fluctuations in context to precipitation events.

Based on the groundwater monitoring data collected by MTE between June 23, 2023, and June 10, 2025, the groundwater elevation ranged between 324.11m AMSL (BH6) and 323.50m AMSL (BH1). Based on the groundwater elevations measured on Jan 8, 2024, the local groundwater flow is interpreted northwest with a horizontal hydraulic gradient of approximately 0.0075m/m as shown on **Figure 4**.

Groundwater conditions may subsequently differ from those described herein due to seasonal variations in response to significant precipitation events. The groundwater conditions at the time of construction should be confirmed by the contractor and their work plan modified as appropriate. Groundwater monitoring is currently on-going at the Site in order to assess seasonal groundwater fluctuations and to provide groundwater information for the detailed design stage if needed.

5.3 Hydraulic Conductivity (K)

As described in Section 4.3 Hydraulic conductivity analysis could not be completed for BH1 due to poor data quality; therefore, a representative test from BH6 was analyzed in AquiferTest Pro using the Bouwer and Rice (1976) methodology.

BH6 was screened within a sand interval and the resultant K value was estimated at 4.3×10^{-4} m/sec. The estimated K value is consistent with the average published values of order 10^{-1} to 10^{-5} m/sec for similar deposits (Freeze and Cherry, 1979). A copy of the AquiferTest data sheets is provided in **Appendix C**.

In addition to this, based on the grain size distribution analyses completed on soil samples collected from BH10 during the CVD's geotechnical investigation program (CVD, 2023), the hydraulic conductivity of 4×10^{-9} m/sec was determined for the native till deposits using Kozeny Carmen empirical relation (Freeze and Cherry 1979; Rosas et al. 2014). Please refer to the geotechnical investigation report completed by CVD under separate cover for details on grain size distribution results of analyzed soil samples (CVD, December 2023).

5.4 Groundwater Quality

Groundwater samples collected from monitoring wells BH1 and BH6 had exceedances for total metals when compared against PWQO guidelines. The exceedances for total metals may be related to the Total Suspended Solids (TSS) in the collected samples, rather than actual dissolved concentrations. A summary of the exceeded parameters is below:

- An exceedance against the PWQO for total copper was measured at BH6 (0.00731 mg/L) versus the PWQO guideline value of 0.005 mg/L;
- An exceedance against the PWQO for total iron was measured at BH1 (0.474 mg/L) and BH6 (5.58 mg/L) versus the PWQO guideline value of 0.3 mg/L; and
- An exceedance against the PWQO for total zinc was measured at BH6 (0.0396 mg/L) versus the PWQO guideline value of 0.03 mg/L.

Groundwater samples from BH1 and BH6 analyzed for Volatile Organic Compounds (VOC) were noted to have concentrations below the detection limit with the exception of chloroform. A chloroform value of 1.11 µg/L was measured in BH6. The presence of chloroform may be attributed to a nearby leaky water distribution pipe as there were no other VOC detections and chloroform is a by-product of the chlorine disinfection for drinking water.

No exceedances were reported for analyzed parameters when compared to Region of Waterloo Sanitary Sewer Use By-Law 21-036 guidelines.

A summary of the water quality results can be found in **Table 2**. The laboratory certificates of analysis for the groundwater samples collected are presented in **Appendix D**.

6.0 DEWATERING ASSESSMENT

This subsection provides an assessment of dewatering efforts and related permitting requirements for the project.

Notes:

- The following provides a preliminary assessment of the daily dewatering discharge for the purposes of initial design and planning. It is not intended to support dewatering approvals and dewatering contractor's system design.

- It is recommended that a licensed dewatering contractor be consulted to review the subsurface conditions and to design a site-specific dewatering system. It is the dewatering contractor's responsibility to assess the factual data and to provide the recommended Dewatering Plan.
- The assessment is based on the assumed excavation specifics and possible shoring design, therefore should there be changes in these items, a revised assessment will be required.

6.1 Proposed Development and Constructability

Based on the information provided, it is understood that the proposed redevelopment includes a 9-storey residential building with two levels of split parking structure (P2). The bottom of the slab of the lowest parking level will vary between 323.27m AMSL at Dunbar Rd N and 321.77m AMSL at Roslin Ave N. (ACDF Architects, Drawing P-351, August 2025).

The soil conditions encountered at the Site include surficial topsoil and pavement structure underlain by very loose to loose fill materials followed by granular deposits of sand to sand and gravel, which were then underlain by a clayey silt till. Construction dewatering is generally anticipated to be required for excavations that extend below approximately 324.11m AMSL, corresponding to the highest observed groundwater elevation during the monitoring period between June 23, 2023, and June 10, 2025.

For details related to foundation design and general geotechnical recommendations please refer to the geotechnical investigation report prepared by CVD (CVD, December 2023).

6.2 Assessment Approach and Methodology

For the purpose of this assessment, dewatering volumes were estimated based on groundwater control, considering exclusion an method which uses a physical low permeable cut-off wall installed around an excavation perimeter to exclude the horizontal flow of groundwater from the Site into the excavation while considering the upward flow of groundwater into the excavation.

The method of shoring should be left to the contractor's discretion. The dewatering volumes for 'groundwater control using exclusion' with consideration of groundwater cut-off were estimated using the semi-empirical relationship published by Kavvas et al 1992.

The design of the dewatering system should extend to at least 0.5m below the lowest foundation/bottom of slab elevation in order to provide a stable excavation base (dewatering target). The cut-off wall is assumed to extend 2m into the underlying low-permeable clay till deposits at an elevation of 318m AMSL, based on borehole data showing an average encountered elevation of 320m AMSL for these deposits.

The dewatering volume should account for the initial volume of stored groundwater (storage release) within the shored excavation area which will require removal. This volume can be estimated as a product of the area excavation, aquifer thickness, and the storage coefficient of the saturated deposits. The storage coefficient of an unconfined aquifer typically ranges from 0.02 to 0.26. As dewatering will occur in an unconfined aquifer interlayered with native granular deposits, a number at the high end of this scale i.e., 0.26 was selected as conservative approach (Fetter, 1994). The aquifer thickness for storage volume was considered to extend down to the top of lower till material (Elevation. 320m AMSL).

A 30-day drainage period was considered to handle this storage volume. A factor of safety of 1.5 was applied on the steady state dewatering volumes to account for any aquifer heterogeneities.

For the dewatering calculations, the hydraulic conductivity of 4.3×10^{-4} m/sec was used for the native granular deposits based on in-situ single well response testing completed on BH6, whereas the hydraulic conductivity of 4×10^{-9} m/sec was determined for the native till deposits based on the grain size distribution analyses completed on soil sample collected from BH10.

Furthermore, the dewatering operations should also consider stormwater management from rainfall events. Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. A value of 28.2 mm (rainfall) for a storm event with a 2-hour duration and a 2-year return period was used to determine the incidental precipitation volumes to the proposed excavations based on the review of Intensity-duration-frequency (IDF) curves (Ontario Ministry of Transportation, 2016), assuming this water is removed over a one-day period. The purpose of this calculation is to ensure that the contractor is prepared to handle a similar rainfall event during construction without impeding the construction progress.

The details of the methodology and calculations are provided in **Appendix D**. The following table summarize the input parameters related to constructability used in the dewatering calculations:

Proposed Structure	Bottom of Slab Elevation	Design Water Table Elevation	Dewatering Target Elevation	Cut-off Wall Embedment Elevation
	(m AMSL)	(m AMSL)	(m AMSL)	(m AMSL)
P2	323.27 – 321.77	324.11	321.27	318.00

6.3 Construction Dewatering Volumes

The table below provides a summary of construction dewatering volumes:

Groundwater Control Method	Groundwater Initial Storage Release (30-day Drainage Period)	Groundwater Steady State Dewatering (Safety Factor: 1.5)	Additional Stormwater Management (1-day Removal Period)
	(L/d)	(L/d)	(L/d)
Exclusion – Groundwater Cut-off	72,500	500	57,500

6.4 Permitting/Approvals Requirements

In accordance with the Ontario Water Resources Act, a simplified process is in place to register the 'construction site dewatering' as a prescribed activity on the Environmental Activity and Sector Registry (EASR) with the MECP for groundwater, stormwater or a combination of groundwater and stormwater takings greater than 50,000 L/day.

Effective July 1, 2025, construction site dewatering no longer requires a Permit to Take Water PTTW (regardless of threshold volume), and will now be governed by Ontario Regulation 63/16, Part III, as amended (O. Reg. 63/16), under the Environmental Protection Act, and will require an EASR submittal. A Water Taking and Discharge Plan signed by a Qualified Person (QP) will be required prior to registering on the EASR.

Given the excavation is supported by a groundwater cut-off wall embedded into the lower till deposits, groundwater taking volumes during construction (including initial storage and steady

state rate) are estimated to be greater than 50,000 L/day. As such, an EASR registration would be required.

Furthermore, construction dewatering discharge permits and/or agreements may also be required with the Region of Waterloo for discharging pumped groundwater to the municipal sewer system.

The requirements for the above permits should be reviewed during the detailed design.

6.5 Permanent Dewatering

It is our understanding that permanent dewatering is not permitted by the Region of Waterloo. As such, the proposed development is expected to be designed as a water tight/water proof structure. However, the structure must then be designed to resist hydrostatic pressure and uplift forces.

7.0 IMPACT ASSESSMENT

The following section provides a discussion of the potential hydrogeological impacts of the proposed dewatering on identified groundwater receptors:

7.1 Source Water Protection

7.1.1 Well Head Protection Area (WHPA) Vulnerability Assessment

MECP's online Source Protection Information Atlas (SPIA) mapping indicates that the Site is located in Region of Waterloo Wellhead Protection Area (WHPA) B with a Vulnerability Score of 8 associated with William Street Wellfield (Active Production Wells W1B, W1C, and W2) located approximately 875m east of the Site. The locations of Wellhead Protection Areas and Vulnerability Score are shown on **Figure 3A** and **Figure 3B** respectively. Additionally, based on a review of mapping the Region of Waterloo Official Plan (October 2024) the Site is located either in a Wellhead Protection Sensitivity Area (WPSA) 7 or WPSA 8.

The William Street production wells are screened within the deep overburden municipal aquifer known as the pre Catfish Creek aquifer (AFD1) which is overlain intermittently by the Maryhill and Catfish Creek Tills aquitard (ATB2) (MECP, 2023; Lake Erie Region Source Protection Committee, 2022).

For evaluating the risk for a Site in a WPSA where underground parking structure is proposed, Intrinsic susceptibility must be calculated for the existing soil profile based on borehole information and excavated soil profile to determine how the susceptibility may change.

The aquifer vulnerability was calculated using the methodology known as the Intrinsic Susceptibility Index (ISI) as per *Guidelines for Construction of Underground Parking in a Groundwater Protection Area, July 2011* (Guidelines of Underground Parking). The idea is that an aquifer's susceptibility decreases as the distance and travel time to the municipal aquifer increases.

To calculate the ISI, the thickness of each soil layer is multiplied by a coefficient (K factor) which is inversely proportional to the relative ease with which water and potential contaminants flows through the material. The lower the ISI value of an aquifer, the more at risk an aquifer is to contamination. As per the guidelines, ISI should be averaged for all available borehole information. The relation to estimate the ISI is represented as:

$$\text{Intrinsic Susceptibility Index (ISI)} = \text{Sum (layer thickness} \times \text{K factor)}$$

In order to evaluate the Intrinsic Susceptibility for existing soil profile, the type and thickness of the material over the municipal aquifer was considered based on encountered soil conditions during CVD drilling program. The soil profile encountered at the Site typically included fill materials underlain by granular deposits of sand to sand and gravel, underlain by clayey silt till. K-factor of 2 was used for granular deposits 'Soil Type – Sand' and K-factor of 6 was used for till deposits 'Soil Type – Clay' as per the *Guidelines of Underground Parking Appendix A – K factors based on Table 3.2 of the MOE Groundwater Vulnerability Guidance Module*.

In order to estimate an average ISI from the existing soil profile encountered, Boreholes BH7 – BH10 are considered as they indicate all soil types encountered and investigates the existing soil profile to a deeper depth of approximately 21m BGS. The soil profile encountered in these boreholes indicates an average thickness of Sand and Till material to be 9m to 9.3m respectively. Based on this, average ISI is estimated to be '**74**' and categorized as '**Medium**' based on the *Guidelines of Underground Parking Table 2. Intrinsic Susceptibility Categories*.

It is to be noted that boreholes advanced at the Site only extended to a maximum depth of 21m BGS indicating a maximum thickness of Till (aquitard) to be 10m. (Elevation. 309.37m AMSL). Therefore, in order to understand the regional hydrogeological setting underneath the maximum depth of investigation, MTE reviewed three-dimensional mapping of surficial deposits within the Regional Municipality of Waterloo (Bajc and Shiota, 2007). This is a regional scale three dimensional digital model that was developed to assist with understanding and protecting the groundwater resources in the Region of Waterloo.

Based on the review of Regional Geological Cross Section A-A' (Bajc and Shiota, 2007) across the Site as presented in **Appendix F**, it is understood that the municipal production aquifer (pre Catfish Creek aquifer - AFD1) is overlain by Middle Maryhill Till (ATB2) and Catfish Creek Till (ATC1) which hydraulically isolates the municipal production aquifer AFD1 from the Site.

To calculate the aquifer vulnerability, the Intrinsic Susceptibility was calculated for the existing and excavated soil profile based on regional setting as presented on Geological Cross Section A-A' by multiplying the thickness of each geological formation and appropriate K-factor. K-factor of 2 and 6 were used for regional aquifers and aquitards respectively.

Based on the information presented above, the ISI value for the existing soil profile was estimated to be '**160**' and categorized as '**Low**' Intrinsic Susceptibility. Considering the P2 bottom of slab will extend to approximately 321.77m AMSL, the ISI value for the excavated soil profile was estimated to '**138**' and also categorized as '**Low**' Intrinsic Susceptibility (*Guidelines of Underground Parking Table 2. Intrinsic Susceptibility Categories*). The calculations to estimate ISI based on regional setting are presented in **Appendix F**.

Furthermore, the lowest P2 bottom of slab is approximately set at 321.77m AMSL, while the caisson cut-off will extend to around 318m AMSL and are not expected to intersect with the municipal production aquifer, AFD1, which is found to be at an elevation of approximately 290m AMSL underneath the Site (Bajc and Shiota, 2007). Socketing the cut-off wall into less permeable lower till deposits will reduce the radius of influence laterally, thereby confining it within the excavation limits and will not extend to the William Street municipal production wells.

Based on above discussion, the municipal production wells of William Street Wellfield are not anticipated to be impacted by the proposed construction dewatering operations or the development.

7.1.2 Well Head Protection Area (WHPA-Q)

The Site is also located within Wellhead Water Quantity Zone with a low vulnerability. The vulnerability score relates to the aquifers susceptibility to water use and reduction in recharge

(GRCA, 2022). Based on the preliminary dewatering assessment, an EASR should be secured from the MECP for construction dewatering operations which will set pumping limits to ensure the dewatering operations do not exceed the sustainable yield of the aquifer or adversely affect the nearby local and regional groundwater resources. Monitoring and contingency plans should be implemented to establish monitoring programs and trigger limits to govern when the plans are implemented. This will ensure that the water taking 'risk' is managed effectively and does not result in an unacceptable impact on groundwater receptor(s) and will initiate contingency action if unforeseen unacceptable impacts do occur.

Based on the review of 'Land Use Infiltration Plan' of City of Waterloo Stormwater Management Master Plan: Stormwater Infiltration Policy Recommendations (2021), it is noted that for all sites within ICAs and/or WHPAs with vulnerability scores equal to or greater than 8, paved surfaces (roads, sidewalks and parking surfaces) should not be treated with stormwater infiltration practices due to salt-based deicers commonly used in the winter. The infiltration of runoff from landscape areas and relatively clean impervious surfaces such as roof tops should be considered a priority for infiltration. The water balance approach should be determined in consultation with the City of Waterloo Engineering Services prior to the design

7.1.3 Issue Contributing Area (ICAs)

The Site is also located within the Issue Contributing Area (ICA) for Sodium, Chloride and Trichloroethylene (TCE) associated with William Street Wellfield. This means that the raw water quality at production wells has been impacted by Sodium, Chloride and TCE. This not to be interpreted as representing that the Site is a source of Sodium, Chloride or TCE contamination in the production wells.

The widespread use of de-icing salt is the primary source of elevated chloride and sodium in groundwater at William Street Wellfield (Lake Erie Region Source Protection Committee, 2022). Best management practices for the use of salt during winter maintenance should be adopted to reduce the potential impacts to drinking water sources by following guidelines such as Syntheses of Best Practices – Road Salt Management to encourage best management practices for salt applications (Transportation Association of Canada, 2013).

Following a review of Chapter 8 of the Grand River Assessment Report, it is noted that TCE has been detected in water samples from the three production wells since 2001, with concentrations ranging from non-detect (<0.5µg/L) to 8µg/L, in comparison to the Ontario Drinking Water Standard of 5µg/L. While long-term TCE trends remain stable, short-term fluctuations in TCE concentrations at individual production wells are noted, which are attributed to variations in pumping rates from the three supply wells. However, the TCE concentrations in the collected groundwater samples from the Site were noted to be non-detect (< 0.5 ug/L) and therefore below the Ontario Drinking Water Standard (ODWS) of 5ug/L.

7.1.4 Drinking Water Threats

Based on a review of Grand River Source Protection Plan Chapter 10 and Significant Drinking Water Threats Table, the following 'Significant' drinking water threats were identified for sites located within Grand River Source Water Protection WHPA-B (8):

- i. Waste disposal site - landfilling (municipal waste);
- ii. Waste disposal site - landfilling (solid non hazardous industrial or commercial);
- iii. Waste disposal site - liquid industrial waste injection into a well;
- iv. Sewage system or sewage works - sewage storage - treatment or holding tanks;

- v. Handling of a Dense Non Aqueous Phase Liquid (DNAPL); and
- vi. Storage of a Dense Non Aqueous Phase Liquid (DNAPL).

It is understood that the proposed development will not be a future waste disposal site for the injection of liquid industrial waste, landfilling of municipal waste and/or solid non-hazardous waste. The development will be serviced municipally and will not have on-site sewage system holding tanks.

The handling or storage of DNAPLs is not anticipated at the Site. However, the proposed construction will require the use of heavy machinery and equipment and, as such, there is some localized potential of possible spills associated with petroleum hydrocarbons, such as fuel or lubricants. These risks can be minimized by implementing best management practices for all refueling and equipment maintenance activities and implementing a spill contingency plan.

Based on the above, no drinking water sources are anticipated to be impacted by the proposed development.

7.2 Local Water Supply

The MECP's online Water Well Information System (WWIS) was queried for data pertaining to well records located within an approximate 500 m radius of the Site. This query resulted in data for 190 wells records. The MECP WWIS identified four water supply well records constructed between the years 1954 to 1964 for industrial water supply use with depths ranging from 35.1m BGS to 55.5m BGS. Three of the wells are located approximately 375 to 470m to the east and one well is located approximately 425m to the northwest (MECP, 2014).

Although a door-to-door water well survey was not completed as part of the current scope of work, given the urban setting and that a piped municipal water supply services this area, it is unlikely that nearby properties currently rely on private groundwater supply as their primary water supply source. Therefore, no private water supply wells are anticipated to be impacted by the proposed dewatering.

Socketing the cut-off wall into the less permeable lower till deposits will essentially eliminate the radius of influence laterally, thereby confining it within the excavation limits and eliminating the potential impact to nearby wells.

7.3 Surface Water Features and Natural Environment

Socketing the cut-off wall into less permeable lower till deposits will reduce the radius of influence laterally, thereby confining it within the excavation limits. Therefore, no surface water or natural features are anticipated to be impacted by the proposed water takings.

7.4 Groundwater Recharge Management

As the Site is not considered to be a SGRA and given that the Site was previously developed with buildings and impervious parking areas, the proposed development is not expected to significantly reduce infiltration or groundwater recharge relative to the current conditions and is not expected to be considered as 'Significant' drinking water threat.

In addition to this, it is noted that the Region of Waterloo does not support the infiltration of runoff from parking lots and/or paved areas within Chloride Issue Contributing Areas. However, infiltration of clean roof runoff may be considered for appropriate recharge management.

7.5 Discharge Plan

The results of the unfiltered groundwater samples indicated exceedances for total metals when compared against PWQO guidelines. The exceedances for total metals may be related to the total suspended solids (TSS) in the collected samples, rather than actual dissolved concentrations. However, no exceedances were reported for analyzed parameters when compared to Region of Waterloo Sanitary Sewer Use By-Law 21-036 guidelines.

A groundwater treatment and discharge plan will be required for the Site that will include quality criteria and a proposed discharge location for the dewatering effluent. It is recommended to establish the TSS criteria of the discharged groundwater if the discharge is to be directed to a storm sewer. Based on our experience in administering the dewatering activities within jurisdiction of other municipalities, it is recommended to achieve a TSS concentration of 15 mg/L prior to discharge to the storm sewer.

It is understood that the Site is located within an Issue Contributing Area for TCE. As previously noted, this does not imply that the Site is a source of TCE contamination. It is recommended that TCE monitoring criteria for discharged groundwater be set below the ODWS of 5 µg/L.

Additionally, the use of a caisson cut-off wall around the excavation perimeter, embedded into the underlying till material, is expected to isolate the Site and should not alter existing groundwater flow patterns in the surrounding area. Anchoring the cut-off wall into less permeable lower till deposits will reduce the lateral radius of influence, thereby confining it within the excavation boundaries.

The final design for any dewatering effluent is the responsibility of the retained contractor undertaking construction and the team designing the pre-treatment system. Suitable treatment and performance criteria for the removal of suspended solids should be included as part of the tender specifications and monitored by the contract administrator, on behalf of the proponent, throughout construction dewatering.

The restrictions on the volume and flow rates may be imposed by the Region of Waterloo where warranted by conditions in the sewer systems. Any discharge agreements/permits should be obtained prior discharging groundwater to the municipal sewer system.

At the time of preparing this report, no additional information regarding the environmental condition of the Site is available for review.

7.6 Settlement Considerations

Dewatering activities within the granular sandy deposits may have the potential to reduce pore pressures within these sediments, potentially causing dewatering-induced settlement of adjacent structures and services. However, socketing the cut-off wall into less permeable lower till deposits may reduce the risk of dewatering-induced settlement of off-Site structures and services as a result of construction dewatering.

The Site conditions must be carefully assessed by a professional shoring designer/geotechnical engineer to select an appropriate type of shoring system considering the proximity of the existing buildings. The impacts due to dewatering-induced settlement should be further assessed by a professional geotechnical engineer once the shoring plans/drawings are available and finalized.

8.0 PROPOSED MONITORING AND CONTINGENCY PLAN

Based on the impact assessment above, MTE recommends a preliminary dewatering monitoring and contingency plan be implemented as described in **Table G.1 (Appendix G)** which includes monitoring requirements (groundwater levels and discharge quality), field protocols, and appropriate response actions.

The monitoring and contingency plan requirements should be reviewed and updated as needed before commencing dewatering activities, based on the final dewatering system design, shoring methodology, etc.

9.0 CONCLUSIONS

Based on the foregoing assessment, it is concluded that:

1. The soil conditions encountered at the Site typically include surficial topsoil and pavement structure underlain by fill materials underlain by granular deposits of sand to sand and gravel, which were then underlain by a clayey silt till.
2. The hydraulic conductivity for the native granular and till deposits was estimated to be in order of 10^{-4} m/sec and 10^{-9} m/sec respectively.
3. Based on the groundwater monitoring data collected from June 23, 2023, to June 10, 2025, the groundwater elevation ranged between 324.11m AMSL (BH6) and 323.50m AMSL (BH1).
4. Construction dewatering is anticipated to be required for excavations that extend below approximately 324.11m AMSL, corresponding to the highest observed groundwater elevation during the monitoring period.
5. The groundwater taking volume during construction (including initial storage and steady state rate) is estimated to be greater than 50,000L/day. Based on this an EASR registration is required with MECP to register construction dewatering activities.
6. Socketing the cut-off wall into less permeable lower till deposits will reduce the radius of influence laterally, thereby confining it within the excavation limits.
7. Unfiltered groundwater samples collected had exceedances for total metals when compared against PWQO guidelines. However, no exceedances were reported for analyzed parameters when compared to Region of Waterloo Sanitary Sewer Use By-Law 21-036 guideline.
8. No local and regional water supply wells are anticipated to be impacted by the proposed dewatering operations.
9. The proposed development is not expected to significantly reduce infiltration or groundwater recharge relative to the current conditions and is not expected to be considered as 'Significant' drinking water threat.

10.0 RECOMMENDATIONS

It is recommended that:

1. Continue the on-going groundwater monitoring program to assess seasonal groundwater fluctuations and to provide groundwater information for the detailed design stage if needed.
2. The water taking and discharge permitting requirements outlined in Section 6.4 be implemented.
3. The monitoring and contingency plan outlined in Table G.1 Appendix G be implemented
4. The dewatering and hydrogeological impact assessment be reviewed and updated if necessary to support permitting and tendering once final design details are available.
5. The impacts due to dewatering-induced settlement should be assessed by a professional geotechnical engineer once the shoring plans/drawings are available and finalized.
6. Special provisions for temporary construction dewatering be included in the tender documents.
7. The monitoring wells installed as part of this investigation should be maintained, to the extent feasible, for possible use to confirm groundwater levels closer to construction, after which they should be properly abandoned by a licensed well technician in accordance with O.Reg. 903, as amended.

11.0 LIMITATIONS

Services performed by **MTE Consultants Inc.** (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Environmental Engineering & Consulting profession. No other warranty or representation expressed or implied as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of MTE and the Client. The assignment was carried out in accordance with the Scope of Work described in Section 2.0 as reviewed with and agreed to by the Client. MTE makes no representation that the present report has dealt with all of the important environmental issues, except as provided in the Scope of Work. This report is not intended to be exhaustive in scope or to imply a risk-free facility. As such, this report may not deal with all issues potentially applicable to the Site and may omit aspects which are or may be of interest to the reader.

In addition, it should be recognized that a soil sample or groundwater level measurement represents one discrete portion of the Site at the time it is collected, and that the findings of this report are based on conditions as they existed during the time period of the investigation.

Any use which another party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by another party as a result of decisions made or actions taken, based upon this report. Others with interest in the Site should undertake their own investigations and studies to determine how or if the condition affects them or their plans.

It should be recognized that the passage of time may affect the views, conclusions, and recommendations (if any) provided in this report because environmental conditions of a property can change, along with regulatory requirements. Should additional or new information become available, MTE recommends that it be brought to our attention in order that we may determine whether it affects the contents of this report.

All of which is respectfully submitted,

MTE Consultants Inc.



Usman Arshad, M.Eng., P.Eng., PMP
Project Manager - Hydrogeology
905-639-2552
uarshad@mte85.com

A handwritten signature in black ink, appearing to read "Fraser Cummings".



Fraser Cummings, M.Sc., P.Geo.
Manager, Hydrogeology Division
519-743-6500
fcummings@mte85.com

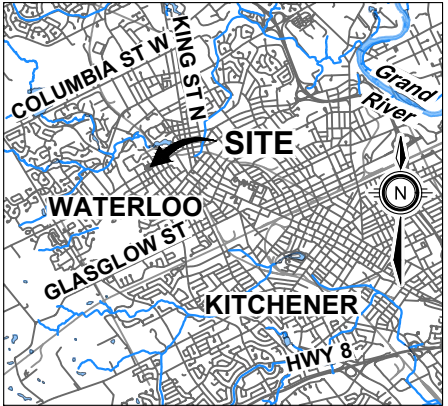
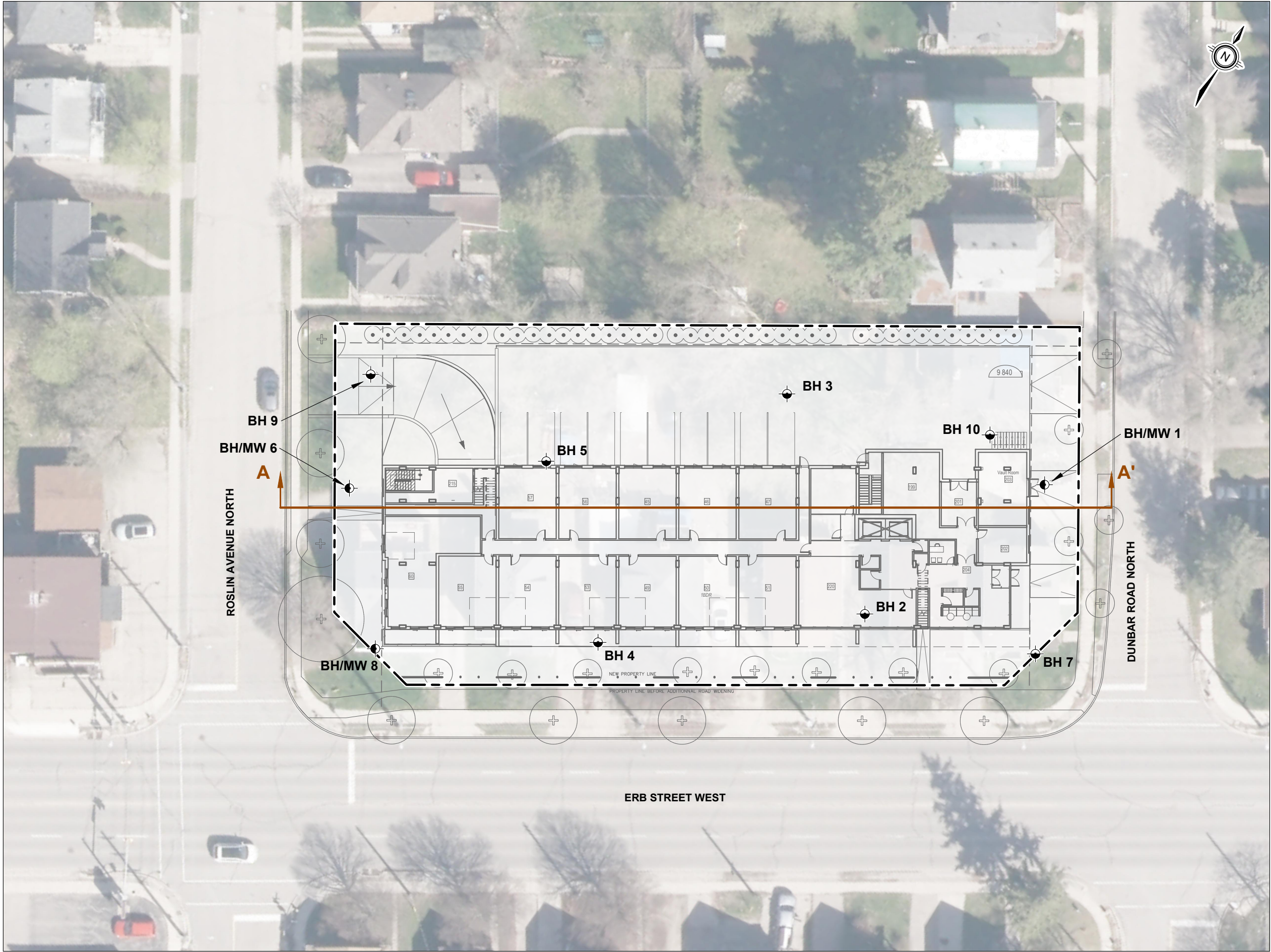
UMA/TFC: smk

https://mte85.sharepoint.com/sites/32375-800/Shared Documents/HydroG/32375-800_2025-08-15_rpt_Hydrog Investigation.docx

12.0 REFERENCES

- Bajc, A., & Shiota, J. (2007). Three-dimensional mapping of surficial deposits within the Regional Municipality of Waterloo, southwestern Ontario. Groundwater Resources Study 3, 41p. ISBN 978-1-4249-4393-7: Ontario Geological Survey.
- Bouwer, H. and Rice, R.C., 1976: A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. Water Resources Research 12:423-28.
- Chung & Vander Doelen Engineering Ltd. (CVD). (2020). Phase I Environmental Site Assessment, 142-154 Erb Street West & 5 Dunbar Road North, Waterloo, Ontario
- Chung & Vander Doelen Engineering Ltd. (CVD). (2023). Supplementary Geotechnical Investigation: Proposed 6-Storey Apartment Building, 142-154 Erb Street West, Waterloo, Ontario.
- City of Waterloo Stormwater Management Master Plan 2021: Stormwater Infiltration Policy Recommendations
- Freeze, R.A., and Cherry, J.A. (1979). Groundwater. Englewood Cliffs, New Jersey: Prentice-Hall Inc.
- Guidelines for Construction of Underground Parking in a Groundwater Protection Area July 2011
- Kavvas, M., Giolas, A., & Papacharalambous, G. (1992). Drainage of supported excavations. Geotechnical and Geological Engineering, 10(2), 141–157.
- Lake Erie Region Source Protection Committee. (2022). Grand River Source Protection Area Approved Assessment Report. Cambridge.
- Ministry of the Environment, Conservation and Parks (2014) Retrieved from <https://www.ontario.ca/page/map-well-records>
- Ministry of Environment, Conservation and Parks (2023) Source Protection Information Atlas Retrieved from <https://www.lioapplications.lrc.gov.on.ca/SourceWaterProtection/index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-CA>
- Ontario Ministry of Transportation (2016) Retrieved from http://www.eng.uwaterloo.ca/~dprincz/mto_site/terms.shtml
- Rosas, J., O. Lopez, T.M. Missimer, K.M. Coulibaly, A.H.A. Dehwah, K. Sesler, L.R. Lujan and D. Mantilla, 2014. Determination of hydraulic conductivity from grain-size distribution for different depositional environments, Ground Water, vol. 52, no. 3, pp. 399-413.
- Source Protection Information Atlas. (2022). Retrieved from: <https://www.lioapplications.lrc.gov.on.ca/>.
- The Regional Municipality of Waterloo (RMOW). (2021). By-Law Number 21-036. Retrieved from: <https://www.regionofwaterloo.ca/en/resources/Bylaws/By-law-21-036.PDF>.
- Waterloo Hydrogeologic Inc. (2022). AquiferTest Pro Software. Waterloo, Ontario. www.waterloohydrogeologic.com.

Figures



KEY PLAN (nts)

LEGEND

- SITE
- CHUNG & VANDER DOELEN SAMPLING:
 - BOREHOLE
 - BOREHOLE/MONITORING WELL
- A A' GEOLOGICAL CROSS-SECTION

REFERENCES

2019 AERIAL IMAGE, CITY OF WATERLOO;
ROAD AND WATER NETWORK, CITY OF
KITCHENER OPEN DATA SET; AND
ACDF ARCHITECTURE, UPDATED
PROPOSAL, AUGUST 5 - 2025.
CHUNG & VANDER DOELEN
ENGINEERING LTD. BOREHOLE
LOCATION PLAN, FILE No. 1548, DWG No.
1, AUGUST 2024.

NOTES

THIS FIGURE IS SCHEMATIC ONLY AND TO
BE READ IN CONJUNCTION WITH
ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

0 4 8 12 16 20m



Engineers, Scientists, Surveyors

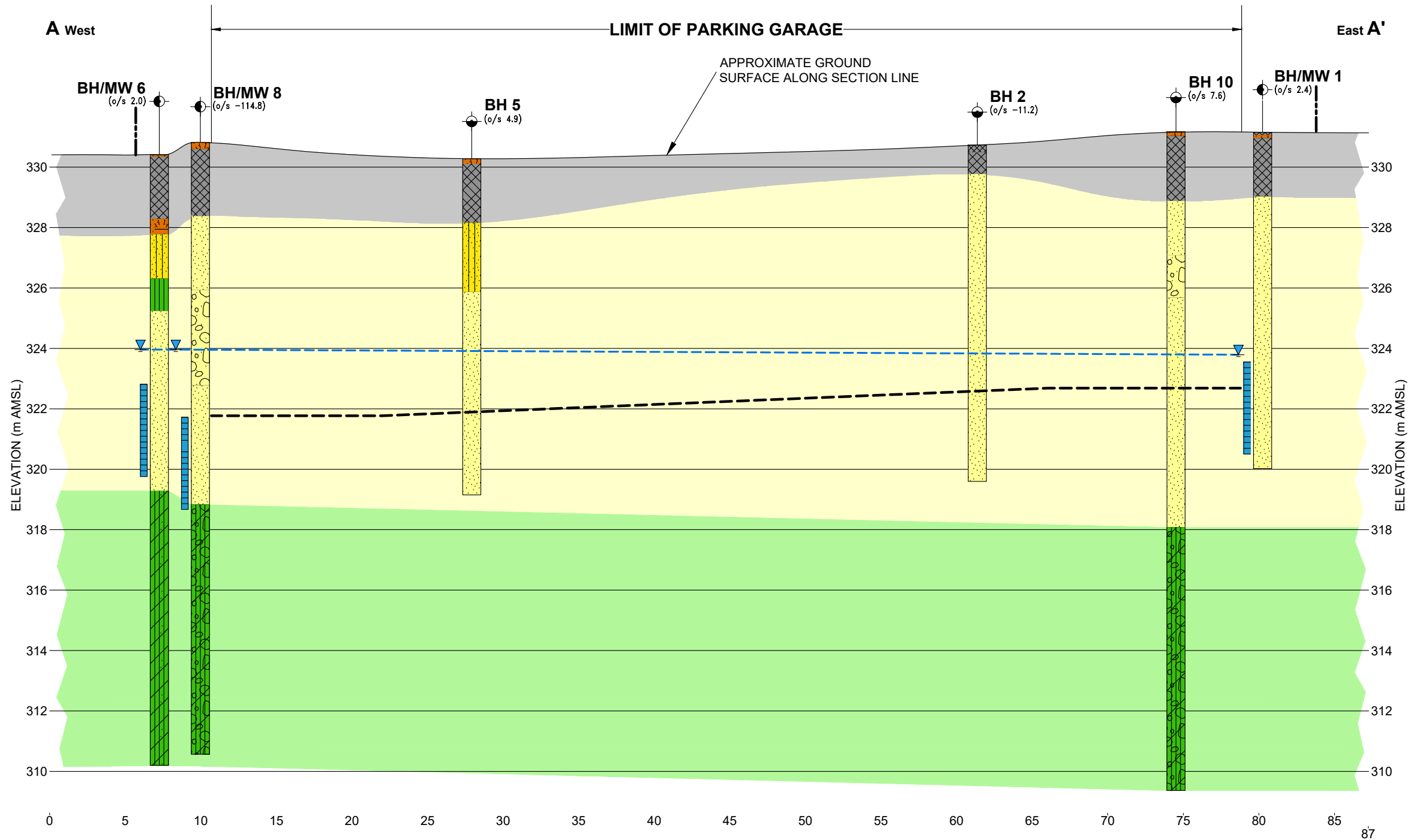
PROJECT

HYDROGEOLOGICAL INVESTIGATION
1 DUNBAR ROAD NORTH
WATERLOO, ONTARIO

TITLE

**SITE PLAN, BOREHOLE AND
MONITORING WELL LOCATION PLAN**

Drawn	DCH/SS	Scale	1:400	Figure 1
Checked		Project No.	32375-800	
Date	2025-08-15	Rev No.	0	



LEGEND

- SITE
- INTERPRETED GROUNDWATER TABLE
- BOTTOM OF SLAB

CHUNG & VANDER DOELEN SAMPLING:

- BOREHOLE
- BOREHOLE/MONITORING WELL

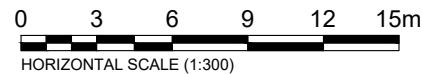
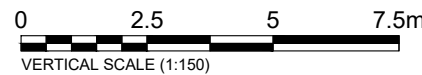
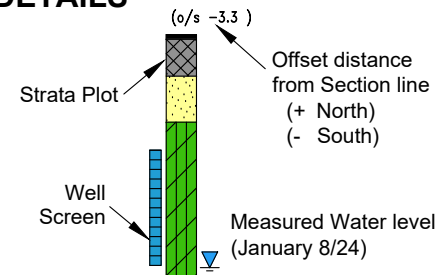
SIMPLIFIED STRATIGRAPHY

- ASPHALT
- TOPSOIL
- FILL (Granular)
- FILL
- SAND
- SILT
- SILTY SAND
- CLAYEY SILT
- GRAVELLY SAND to SAND A& GRAVEL
- CLAYEY SILT TILL

HYDROSTRATIGRAPHY

- FILL/TOPSOIL
- GRANULAR SOILS
- TILLS

TYPICAL INSTALLATION DETAILS



REFERENCES

CHUNG & VANDER DOELEN ENGINEERING LTD. BOREHOLE LOCATION PLAN, FILE No. 1548, DWG No. 1, AUGUST 2024.

NOTES

THIS FIGURE IS SCHEMATIC ONLY AND TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

WIDTH OF BOREHOLES FOR ILLUSTRATION PURPOSES ONLY AND DO NOT CORRESPOND TO ACTUAL SPATIAL EXTENT.

THE GEOLOGIC SEQUENCE PRESENTED HEREIN IS BASED ON PROFESSIONAL INTERPRETATION FROM THE OVERBURDEN SEDIMENTS RECORDED DURING DRILLING, ACTUAL GEOLOGICAL CONDITIONS MAY VARY BETWEEN AND BEYOND LOCATIONS.

ALL LOCATIONS ARE APPROXIMATE.



PROJECT
HYDROGEOLOGICAL INVESTIGATION
1 DUNBAR ROAD NORTH
WATERLOO, ONTARIO

TITLE
LOCAL GEOLOGICAL CROSS-SECTION A-A'

Drawn	DCH/SS	Scale	AS SHOWN	Figure
Checked		Project No.	32375-800	
Date	2024-08-29	Rev No.	0	

2



LEGEND

- SITE
- A- 100m Exclusion Zone
- B- 0 to 2 Year Time of Travel
- C- 2 to 5 Year Time of Travel
- D- 5 to 25 Year Time of Travel
- MUNICIPAL WELL (WILLIAM STREET WELLFIELD)

REFERENCES

BING IMAGERY AS OF JANUARY 14 - 2024;
AND
GRAND RIVER CONSERVATION
AUTHORITY, WHPA WELL HEAD
PROTECTION AREA DATA, OPEN DATA SET.

NOTES

THIS FIGURE IS SCHEMATIC ONLY AND TO
BE READ IN CONJUNCTION WITH
ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.
0 100 200 300 400 500m



Engineers, Scientists, Surveyors

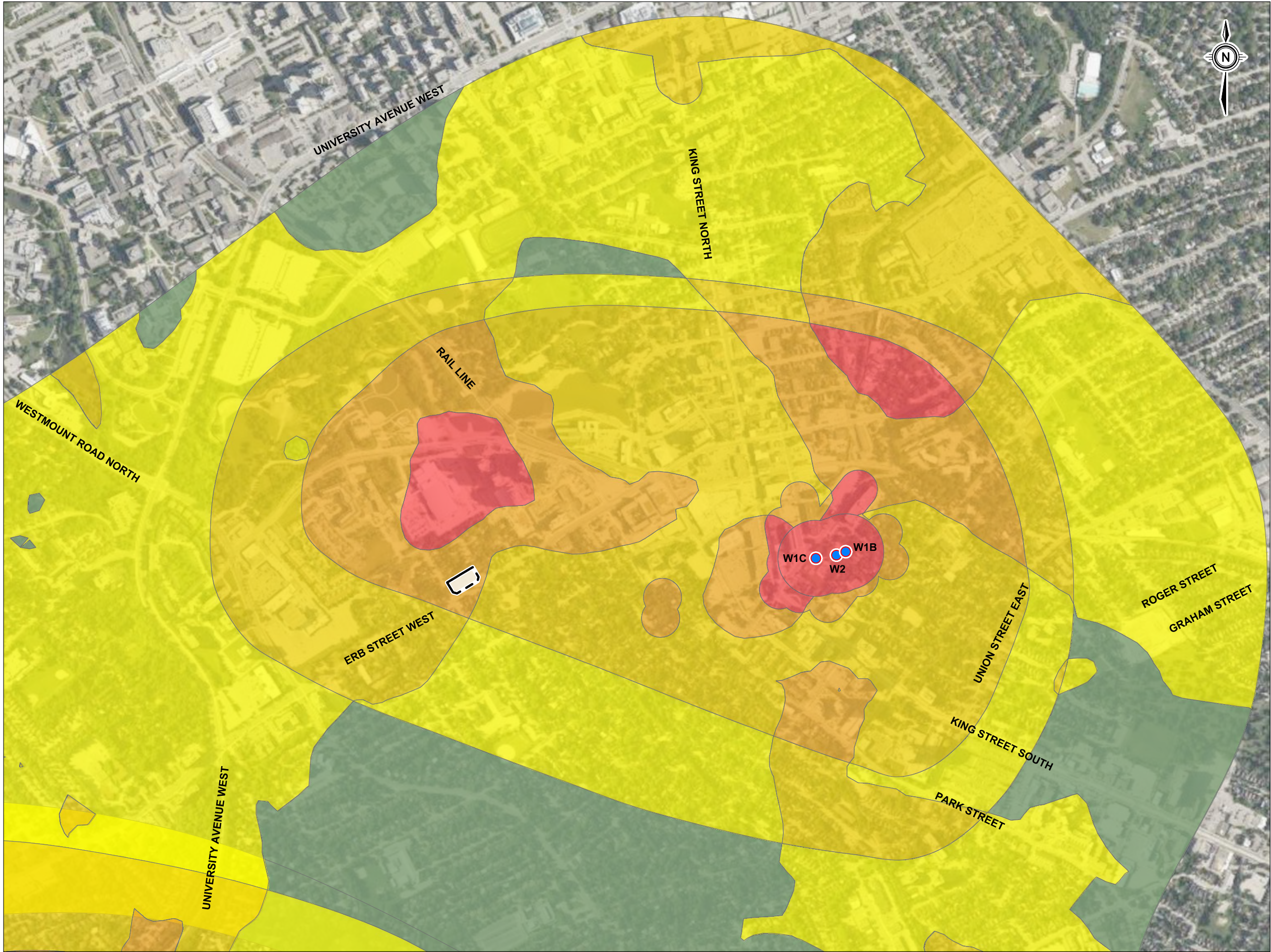
PROJECT

HYDROGEOLOGICAL INVESTIGATION
1 DUNBAR ROAD NORTH
WATERLOO, ONTARIO

TITLE

**WELL HEAD
PROTECTION AREA (WHPA)**

Drawn	DCH/SS	Scale	1:10,000	Figure 3A
Checked		Project No.	32375-800	
Date	2024-08-29	Rev No.	0	



LEGEND

--- SITE

SWP WHPA VULNERABILITY

- 2
- 4
- 6
- 8
- 10

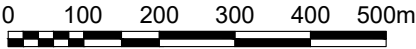
MUNICIPAL WELL
(WILLIAM STREET WELLFIELD)

REFERENCES

2019 AERIAL IMAGE, CITY OF WATERLOO;
ROAD AND WATER NETWORK, CITY OF
KITCHENER OPEN DATA SET; AND
GRAND RIVER CONSERVATION
AUTHORITY, WHPA VULNERABILITY SCORE
DATA, OPEN DATA SET.

NOTES

THIS FIGURE IS SCHEMATIC ONLY AND TO
BE READ IN CONJUNCTION WITH
ACCOMPANYING TEXT.
ALL LOCATIONS ARE APPROXIMATE.



PROJECT
HYDROGEOLOGICAL INVESTIGATION
1 DUNBAR ROAD NORTH
WATERLOO, ONTARIO

TITLE
**WHPA
VULNERABILITY SCORE**

Drawn	DCH/SS	Scale	1:10,000	Figure 3B
Checked		Project No.	32375-800	
Date	2024-08-29	Rev No.	0	



LEGEND

- SITE
- CHUNG & VANDER DOELEN SAMPLING:
- BOREHOLE
 - BOREHOLE/MONITORING WELL
- GROUNDWATER
- 323.62** MEASURED WATER LEVEL JANUARY 08, 2024 (m AMSL)
 - 323.60** INTERPRETED WATER TABLE ELEVATION (m AMSL)
 - ➔ INFERRED GROUNDWATER FLOW DIRECTION

REFERENCES

2019 AERIAL IMAGE, CITY OF WATERLOO;
ROAD AND WATER NETWORK, CITY OF KITCHENER OPEN DATA SET.

NOTES

THIS FIGURE IS SCHEMATIC ONLY AND TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

0 4 8 12 16 20m



Engineers, Scientists, Surveyors

PROJECT
HYDROGEOLOGICAL INVESTIGATION
1 DUNBAR ROAD NORTH
WATERLOO, ONTARIO

TITLE
GROUNDWATER FLOW DIRECTION

Drawn DCH/SS	Scale 1:400	Figure 4
Checked	Project No. 32375-800	
Date 2024-08-29	Rev No. 0	

Tables

Table 1: Summary of Groundwater Elevations



Monitoring Well ID	Ground surface Elevation	Top of Pipe Elevation	23-Jun-23			30-Jun-23			17-Aug-23			10-Nov-23			8-Jan-24			26-Aug-24			26-Nov-24			10-Jun-25		
			Water Level		Elevation	Water Level		Elevation	Water Level		Elevation	Water Level		Elevation	Water Level		Elevation	Water Level		Elevation	Water Level		Elevation	Water Level		Elevation
	(m AMSL)	(m AMSL)	(m BTOP)	(m BGS)	(m AMSL)	(m BTOP)	(m BGS)	(m AMSL)	(m BTOP)	(m BGS)	(m AMSL)	(m BTOP)	(m BGS)	(m AMSL)	(m BTOP)	(m BGS)	(m AMSL)	(m BTOP)	(m BGS)	(m AMSL)	(m BTOP)	(m BGS)	(m AMSL)	(m BTOP)	(m BGS)	(m AMSL)
BH1	331.15	331.07	7.44	7.52	323.63	7.43	7.51	323.64	7.40	7.48	323.67	7.46	7.54	323.61	7.45	7.53	323.62	7.31	7.39	323.76	7.45	7.53	323.62	7.32	7.40	323.75
BH6	330.41	330.34	6.52	6.59	323.82	6.52	6.59	323.82	6.47	6.54	323.87	6.55	6.62	323.79	6.55	6.62	323.79	6.38	6.45	323.96	6.53	6.60	323.81	6.37	6.44	323.97
BH8	330.82	330.71	-	-	-	-	-	-	-	-	-	6.91	7.02	323.80	6.91	7.02	323.80	6.75	6.86	323.96	6.89	7.00	323.82	6.73	6.84	323.98

Notes:
"m BGS" - meters below ground surface
"m AMSL" - meters above mean sea level
"m BTOP" - meters below top of pipe
"-": not measured or not applicable

Table 2
Water Quality Summary



Client Sample ID					BH1	BH6
Date Sampled					30-Jun-2023	30-Jun-2023
ALS Sample ID					WT2319506-001	WT2319506-002
Parameter	Detection Limit	PWQO	Waterloo Sanitary By-law	Units	Water	Water
Physical Tests						
Alkalinity	2	-	-	mg/L	324	351
Colour	2	-	-	CU	49.5	967
Electrical Conductivity	2	-	-	µS/cm	2020	2180
Hardness	0.5	-	-	mg/L	502	579
pH	0.1	6.5 - 8.5	10.5	pH units	7.6	7.73
Total Dissolved Solids (TDS)	10	-	-	mg/L	1210	1300
Total Suspended Solids (TSS)	3	-	350	mg/L	13	168
Turbidity	0.1	-	-	NTU	6.23	224
Anions and Nutrients						
Ammonia	0.005	-	-	mg/L	0.0054	<0.0050
Chloride	0.5	-	1500	mg/L	430	475
Fluoride	0.02	-	10	mg/L	<0.100	<0.100
Nitrate	0.02	-	-	mg/L	1.89	2.04
Nitrite	0.01	-	-	mg/L	<0.050	<0.050
Orthophosphate	0.001	-	-	mg/L	<0.0010	0.0028
Sulfate	0.3	-	1500	mg/L	42.5	42.4
Total Metals						
Aluminum (Al)	0.003	0.1	50	mg/L	0.196	3.31
Antimony (Sb)	0.0001		5	mg/L	<0.00010	<0.00100
Arsenic (As)	0.0001		1	mg/L	0.00062	0.00279
Barium (Ba)	0.0001	-	-	mg/L	0.137	0.161
Beryllium (Be)	0.00002	0.011	-	mg/L	<0.000020	<0.000200
Bismuth (Bi)	0.00005	-	5	mg/L	<0.000050	<0.000500
Boron (B)	0.01	-	-	mg/L	0.024	<0.100
Cadmium (Cd)	0.000005	0.0002	0.5	mg/L	0.0000297	0.000112
Calcium (Ca)	0.05	-	-	mg/L	134	159
Cesium (Cs)	0.00001	-	-	mg/L	0.000021	0.000378
Chromium (Cr)	0.0005	-	2.8	mg/L	0.00063	0.00515
Cobalt (Co)	0.0001	-	5	mg/L	0.00037	0.00238
Copper (Cu)	0.0005	0.005	-	mg/L	0.00182	0.00731
Iron (Fe)	0.01	0.3	50	mg/L	0.474	5.58
Lead (Pb)	0.00005	0.025	1	mg/L	0.00124	0.0064
Lithium (Li)	0.001	-	-	mg/L	0.0072	0.0125
Magnesium (Mg)	0.005	-	-	mg/L	40.6	44.3
Manganese (Mn)	0.0001	-	5	mg/L	0.021	0.161
Molybdenum (Mo)	0.00005	-	5	mg/L	0.000192	<0.000500
Nickel (Ni)	0.0005	0.025	2	mg/L	0.00065	0.00541
Phosphorous (P)	0.05	-	10	mg/L	<0.050	<0.500
Potassium (K)	0.05	-	-	mg/L	2.5	2.92
Rubidium (Rb)	0.0002	-	-	mg/L	0.00043	0.00619
Selenium (Se)	0.00005	0.1	1	mg/L	0.000408	0.000721
Silicon (Si)	0.1	-	-	mg/L	7.37	12.9
Silver (Ag)	0.00001	0.0001	5	mg/L	<0.000010	<0.000100
Sodium (Na)	0.05	-	-	mg/L	236	263
Strontium (Sr)	0.0002	-	-	mg/L	0.328	0.344
Sulfur (S)	0.5	-	-	mg/L	16.9	15.1
Tellurium (Te)	0.0002	-	-	mg/L	<0.00020	<0.00200
Thallium (Tl)	0.00001	-	-	mg/L	<0.000010	<0.000100
Thorium (Th)	0.0001	-	-	mg/L	<0.00010	<0.00100
Tin (Sn)	0.0001	-	5	mg/L	<0.00010	0.00138
Titanium (Ti)	0.0003	-	5	mg/L	0.00691	0.105
Tungsten (W)	0.0001	-	-	mg/L	<0.00010	<0.00100
Uranium (U)	0.00001	-	-	mg/L	0.00141	0.00136
Vanadium (V)	0.0005	-	5	mg/L	0.00058	0.00667
Zinc (Zn)	0.003	0.03	-	mg/L	0.0076	0.0396
Zirconium (Zr)	0.0002	-	3	mg/L	0.00023	<0.00200
Volatile Organic Compounds						
Acetone	20	-	-	µg/L	<20	<20
Benzene	0.5	-	0.00001	µg/L	<0.50	<0.50
Bromodichloromethane	0.5	-	-	µg/L	<0.50	<0.50
Bromoform	0.5	-	-	µg/L	<0.50	<0.50

Table 2
Water Quality Summary



Client Sample ID					BH1	BH6
Date Sampled					30-Jun-2023	30-Jun-2023
ALS Sample ID					WT2319506-001	WT2319506-002
Parameter	Detection Limit	PWQO	Waterloo Sanitary By-law	Units	Water	Water
Bromomethane	0.5	-	-	µg/L	<0.50	<0.50
BTEX, total	0.2	-	-	µg/L	<1.0	<1.0
Carbon tetrachloride	0.5	-	-	µg/L	<0.20	<0.20
Chlorobenzene	0.5	15	-	µg/L	<0.50	<0.50
Chloroform	0.5	-	0.00004	µg/L	<0.50	1.11
Dibromochloromethane	0.2	-	-	µg/L	<0.50	<0.50
Dibromoethane, 1,2-	0.5	-	-	µg/L	<0.20	<0.20
Dichlorobenzene, 1,2-	0.5	2.5	0.00005	µg/L	<0.50	<0.50
Dichlorobenzene, 1,3-	0.5	2.5	-	µg/L	<0.50	<0.50
Dichlorobenzene, 1,4-	0.5	4	0.00008	µg/L	<0.50	<0.50
Dichlorodifluoromethane	0.5	-	-	µg/L	<0.50	<0.50
Dichloroethane, 1,1-	0.5	-	-	µg/L	<0.50	<0.50
Dichloroethane, 1,2-	0.5	-	-	µg/L	<0.50	<0.50
Dichloroethylene, 1,1-	0.5	-	-	µg/L	<0.50	<0.50
Dichloroethylene, cis-1,2-	0.5	-	0.004	µg/L	<0.50	<0.50
Dichloroethylene, trans-1,2-	1	-	-	µg/L	<0.50	<0.50
Dichloromethane	0.5	-	0.002	µg/L	<1.0	<1.0
Dichloropropane, 1,2-	0.5	-	-	µg/L	<0.50	<0.50
Dichloropropylene, cis+trans-1,3-	0.3	-	-	µg/L	<0.50	<0.50
Dichloropropylene, cis-1,3-	0.3	-	-	µg/L	<0.30	<0.30
Dichloropropylene, trans-1,3-	0.5	-	0.0014	µg/L	<0.30	<0.30
Ethylbenzene	0.5	-	0.0016	µg/L	<0.50	<0.50
Hexane, n-	20	-	-	µg/L	<0.50	<0.50
Methyl ethyl ketone [MEK]	20	-	-	µg/L	<20	<20
Methyl isobutyl ketone [MIBK]	0.5	-	-	µg/L	<20	<20
Methyl-tert-butyl ether [MTBE]	0.5	-	-	µg/L	<0.50	<0.50
Styrene	0.5	-	-	µg/L	<0.50	<0.50
Tetrachloroethane, 1,1,1,2-	0.5	-	0.0014	µg/L	<0.50	<0.50
Tetrachloroethane, 1,1,2,2-	0.5	-	-	µg/L	<0.50	<0.50
Tetrachloroethylene	0.5	-	0.001	µg/L	<0.50	<0.50
Toluene	0.5	-	0.00027	µg/L	<0.50	<0.50
Trichloroethane, 1,1,1-	0.5	-	-	µg/L	<0.50	<0.50
Trichloroethane, 1,1,2-	0.5	-	-	µg/L	<0.50	<0.50
Trichloroethylene	0.5	-	0.0004	µg/L	<0.50	<0.50
Trichlorofluoromethane	0.5	-	-	µg/L	<0.50	<0.50
Vinyl chloride	0.4	-	-	µg/L	<0.50	<0.50
Xylene, m+p-	0.3	2	-	µg/L	<0.40	<0.40
Xylene, o-	0.5	40	-	µg/L	<0.30	<0.30
Xylenes, total	1	-	0.0014	µg/L	<0.50	<0.50
Hydrocarbons						
F1 (C6-C10)	25	-	-	µg/L	<25	<25
F1-BTEX	100	-	-	µg/L	<25	<25
F2 (C10-C16)	250	-	-	µg/L	<100	<100
F3 (C16-C34)	250	-	-	µg/L	<250	<250
F4 (C34-C50)	25	-	-	µg/L	<250	<250
Hydrocarbons, total (C6-C50)	240	-	0.000004	µg/L	<370	<370

Notes:

- Results highlighted **bold** exceed the Provincial Water Quality Objective (PWQO)

Appendix A

Borehole Logs

FILE No: G18555**BOREHOLE No. 1**Client: **1950512 Ontario Inc.**Project: **Proposed 6-Storey Apartment Building**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D-50T**Method: **Hollow Stem Auger**Size: **108 mm I.D.**Date: **Jun 05 - 18 TO Jun 05 - 18**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. ×				LAB TEST: Unc. ■ P.P. □					
							50 100 150 200				PENETRATION RESISTANCE					
							STANDARD ● DYN. CONE ○				20 40 60 80					
							W _p W W _L			10 20 30						
331.05 330.90	Ground Elevation: 331.15 m 100 mm GRANULAR BASE 100 mm TOPSOIL	0.5														steel flushmount casing set in concrete
329.02 2.13	very loose, dark brown FILL, sand and silt to silty sand trace clay, trace topsoil/organics moist	1.0		1	SS	3	●							○		
		1.5		2	SS	1	●							○		
		2.0														
		2.5		3	SS	24		●						○		
		3.0														
		3.5		4	SS	21		●						○		
		4.0														
		4.5														
		5.0		5	SS	17		●						○		bentonite seal/50 mm I.D. PVC riser
		5.5														
320.02 11.13	compact to dense brown SAND trace to some silt trace gravel occ. silty seams damp to saturated	6.0														
		6.5		6	SS	34		●						○		
		7.0														
		7.5														
		8.0		7	SS	28		●						○		water level in monitoring well at a depth of 7.72 m on June 5, 2018
		8.5														
		9.0														
		9.5		8	SS	28		●						○		3 m long, 50 mm I.D. PVC screen with sandpack
		10.0														
		10.5														
	11.0		9	SS	26		●						○			
	11.5															
	End of Borehole	11.5														

PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: G18555**BOREHOLE No. 2**Client: **1950512 Ontario Inc.**Project: **Proposed 6-Storey Apartment Building**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**

Machine: **Diedrich D-50T**
 Method: **Hollow Stem Auger**
 Size: **108 mm I.D.**
 Date: **Jun 04 - 18 TO Jun 04 - 18**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS			
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80						W _p W W _L ↗ — ○ ↖ 10 20 30		
329.76 0.97	250 mm GRANULAR BASE																		
	very loose, dark brown FILL, silty sand trace topsoil/organics moist	0.5																	
		1.0	1	SS	3														
		1.5																	
	very loose to dense brown SAND trace to some gravel trace to some silt damp to saturated	2.0	2	SS	8														
		2.5																	
		3.0	3	SS	10														
	3.5																		
	4.0	4	SS	11															
	4.5																		
319.60 11.13	gravelly layer	5.0	5	SS	20														
		5.5																	
		6.0	6	SS	24														
		6.5																	
		7.0																	
		7.5																	
		8.0	7	SS	35														
	gravelly layer	8.5																	
		9.0																	
		9.5	8	SS	22														
	10.0																		
	10.5																		
	11.0	9	SS	27															
	11.5																		
	End of Borehole	11.5																	

borehole cave-in and
water level at depth of
6.25 m bgs upon
completion of drilling

PROJECT MANAGER: **EYC**

**CHUNG & VANDER DOELEN
ENGINEERING LTD.**

311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: G18555**BOREHOLE No. 3**Client: **1950512 Ontario Inc.**Project: **Proposed 6-Storey Apartment Building**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D-50T**Method: **Hollow Stem Auger**Size: **108 mm I.D.**Date: **Jun 05 - 18 TO Jun 05 - 18**

SOIL LITHOLOGY			SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS	
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				W _p W W _L					
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80				10 20 30					
Ground Elevation: 329.41 m																
329.11 0.30	300 mm TOPSOIL															
	loose to dense	0.5														
	brown	1.0		1	SS	7	●					○				
	SAND	1.5														
	trace to some silt	2.0		2	SS	17	●					○				
	trace gravel	2.5														
	occ. silty seams	3.0														
	damp to saturated	3.5		3	SS	17	●					○				
		4.0														
	-----	4.5														
	gravelly layer	5.0		4	SS	26	●					○				
	-----	5.5														
		6.0														
		6.5		5	SS	32	●					○				
		7.0														
		7.5														
		8.0		6	SS	25	●						○			
		8.5														
	9.0															
	9.5		7	SS	28	●							○			
	10.0															
	10.5															
319.20 10.21	hard, grey CLAYEY SILT	10.5													borehole cave-in at water level at depth of 5.94 m bgs upon completion of drilling	
	trace sand	11.0		8	SS	24	●						○			
	moist	11.0														
318.28 11.13	End of Borehole	11.0		9	SS	46	●					□	○			
		11.5														

borehole cave-in at water level at depth of 5.94 m bgs upon completion of drilling

PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

BOREHOLE No. 4



Location: **142-154 Erb Street West, Waterloo,
Ontario**

Machine: **Diedrich D-50T**
Method: **Hollow Stem Auger**
Size: **108 mm I.D.**
Date: **Jun 04 - 18 TO Jun 04 - 1**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS		
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □				W _p W W _L							
							50 100 150 200				↗ ○ ↖							
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○				10 20 30							
328.64 2.13	50 mm ASPHALT 200 mm GRANULAR BASE	0.5																
	very loose, dark brown	1.0		1	SS	4	●											
	FILL, sandy silt to silt sand trace gravel, trace clay, trace topsoil/organics	1.5																
	moist	2.0		2	SS	3	●											
	loose to very dense, brown SAND trace to some silt trace gravel damp to saturated ----- gravelly layer -----		2.5	3	SS	8	●											
			3.0															
			3.5	4	SS	12	●											
			4.0	5	SS	36	●											
			4.5															
			5.0	6	SS	49	●											
			5.5															
			6.0															
			6.5	7	SS	53	●											
			7.0															
			7.5															
			8.0	8	SS	30	●											
			8.5															
			9.0															
			9.5	9	SS	33	●											
	10.0																	
	10.5																	
	11.0	10	SS	37	●													
319.64 11.13	End of Borehole	11.5																

10025 PL - STANDARD BORING WITH LOGGING CYLINDERLOG.DWG 23-JUL-2

borehole cave-in and water level at depth of 7.01 m bgs upon completion of drilling

CVD BOREHOLE (2017) G18555 142 - 154 ERB ST. W., WATERLOO.GPJ CVD ENG.GDT 23-12-2

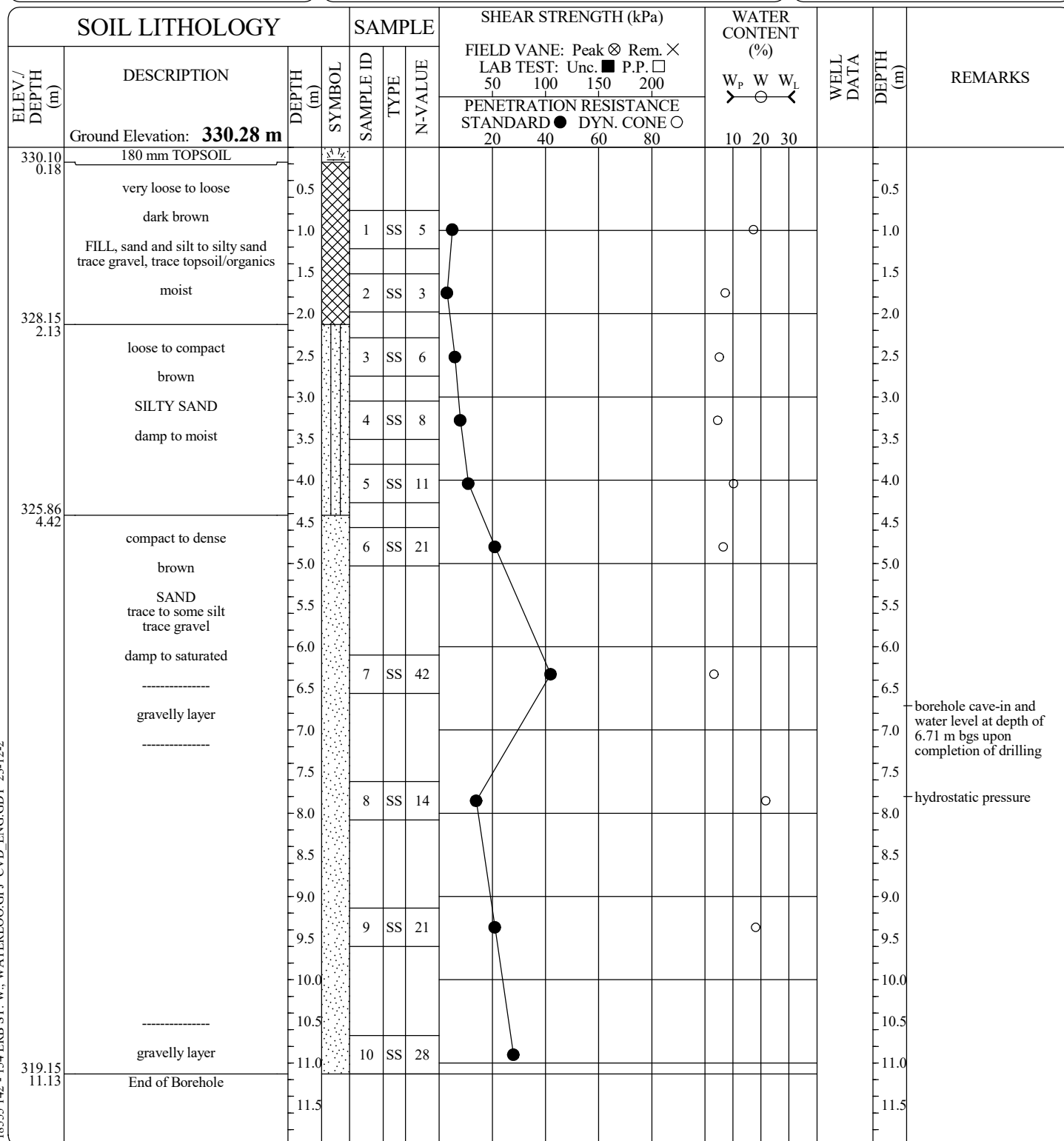
PROJECT MANAGER: EYC

CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: G18555**BOREHOLE No. 5**Client: **1950512 Ontario Inc.**Project: **Proposed 6-Storey Apartment Building**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**

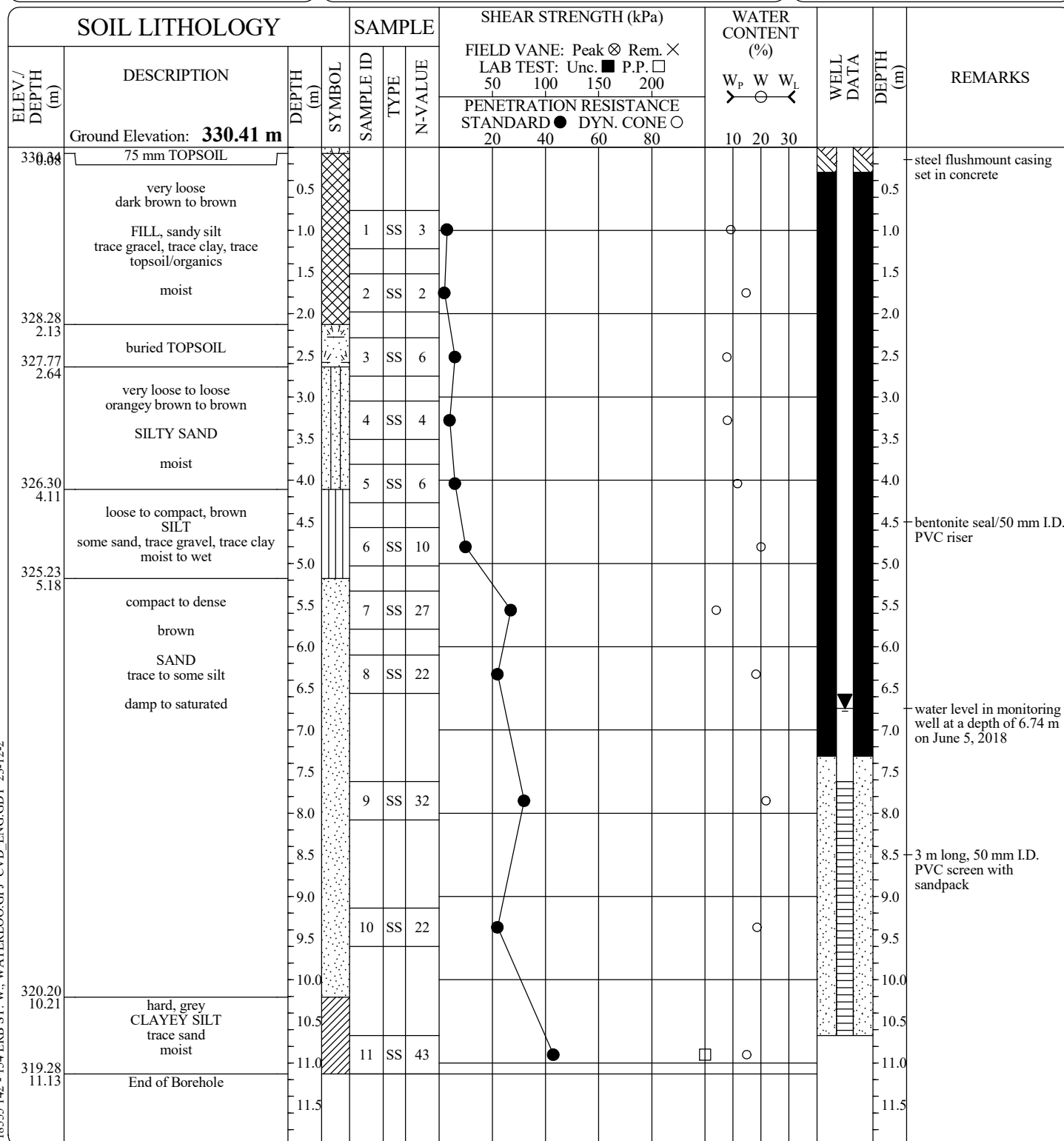
Machine: **Diedrich D-50T**
 Method: **Hollow Stem Auger**
 Size: **108 mm I.D.**
 Date: **Jun 04 - 18 TO Jun 04 - 18**

PROJECT MANAGER: **EYC**
**CHUNG & VANDER DOELEN
ENGINEERING LTD.**

311 Victoria Street North
 Kitchener, Ontario N2H 5E1
 ph. (519) 742-8979, fx. (519) 742-7739

FILE No: G18555**BOREHOLE No. 6**Client: **1950512 Ontario Inc.**Project: **Proposed 6-Storey Apartment Building**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**

Machine: **Diedrich D-50T**
 Method: **Hollow Stem Auger**
 Size: **108 mm I.D.**
 Date: **Jun 04 - 18 TO Jun 04 - 18**

PROJECT MANAGER: **EYC**
**CHUNG & VANDER DOELEN
ENGINEERING LTD.**

311 Victoria Street North
 Kitchener, Ontario N2H 5E1
 ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 1548

BOREHOLE No. 7



Client: **2744668 Ontario Inc.**

Project: **Supplementary Geotechnical Investigation**

Location: **142-154 Erb Street West, Waterloo, Ontario**

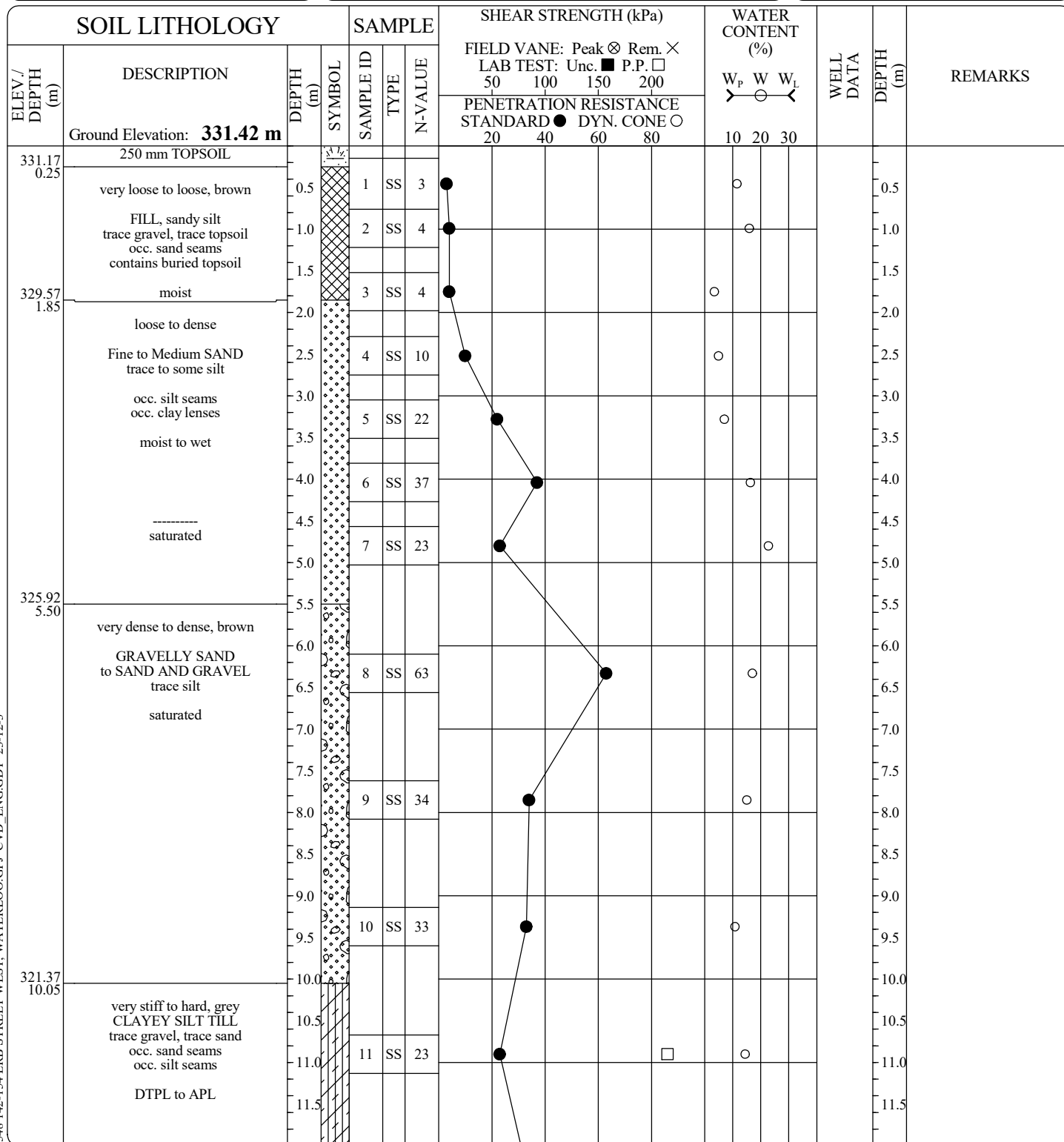
EQUIPMENT DATA

Machine: **Diedrich D70**

Method: **HSA/Mud Rotary**

Size: **108 mm I.D.**

Date: **Nov 06 - 23 TO Nov 06 - 23**

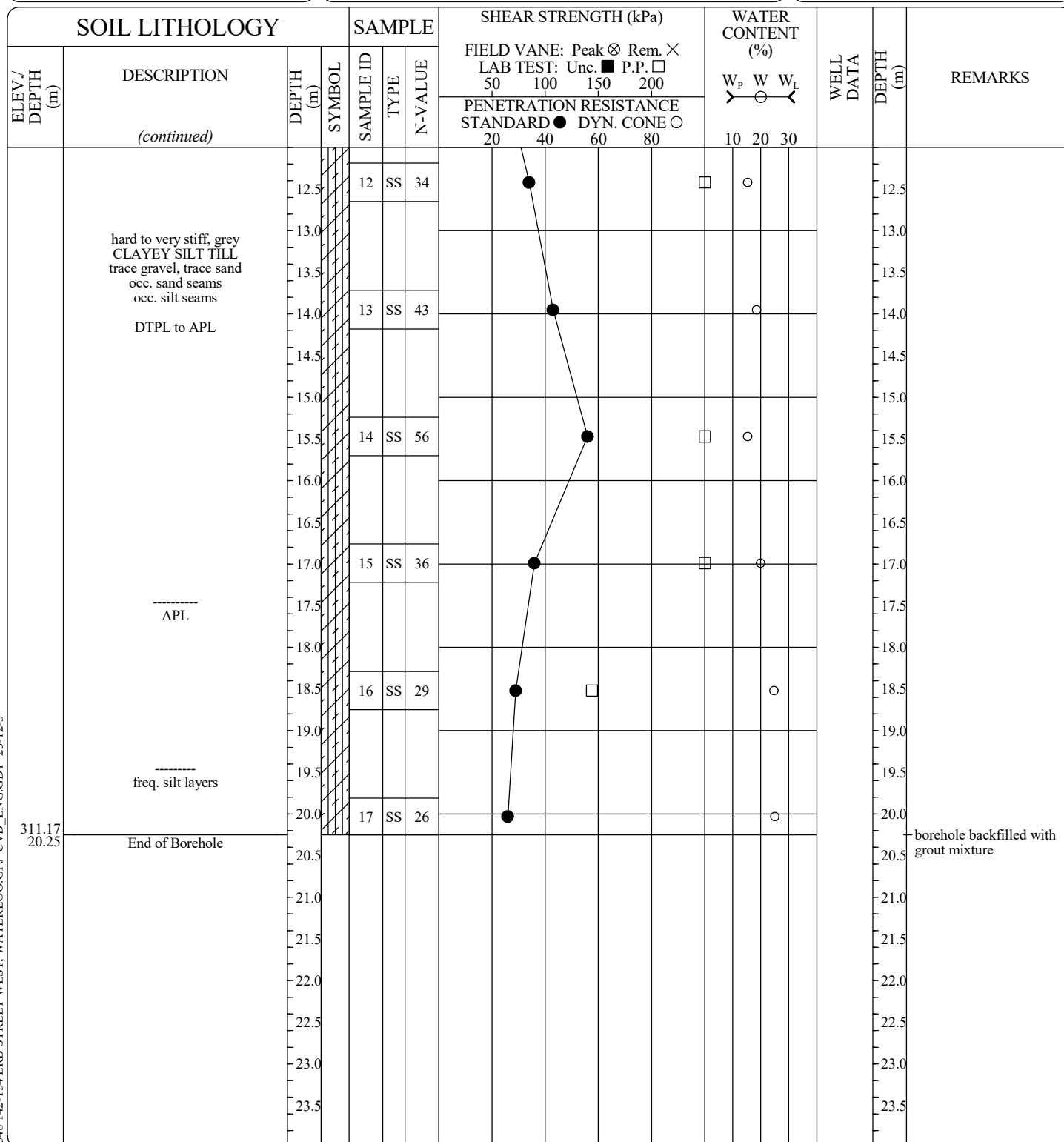


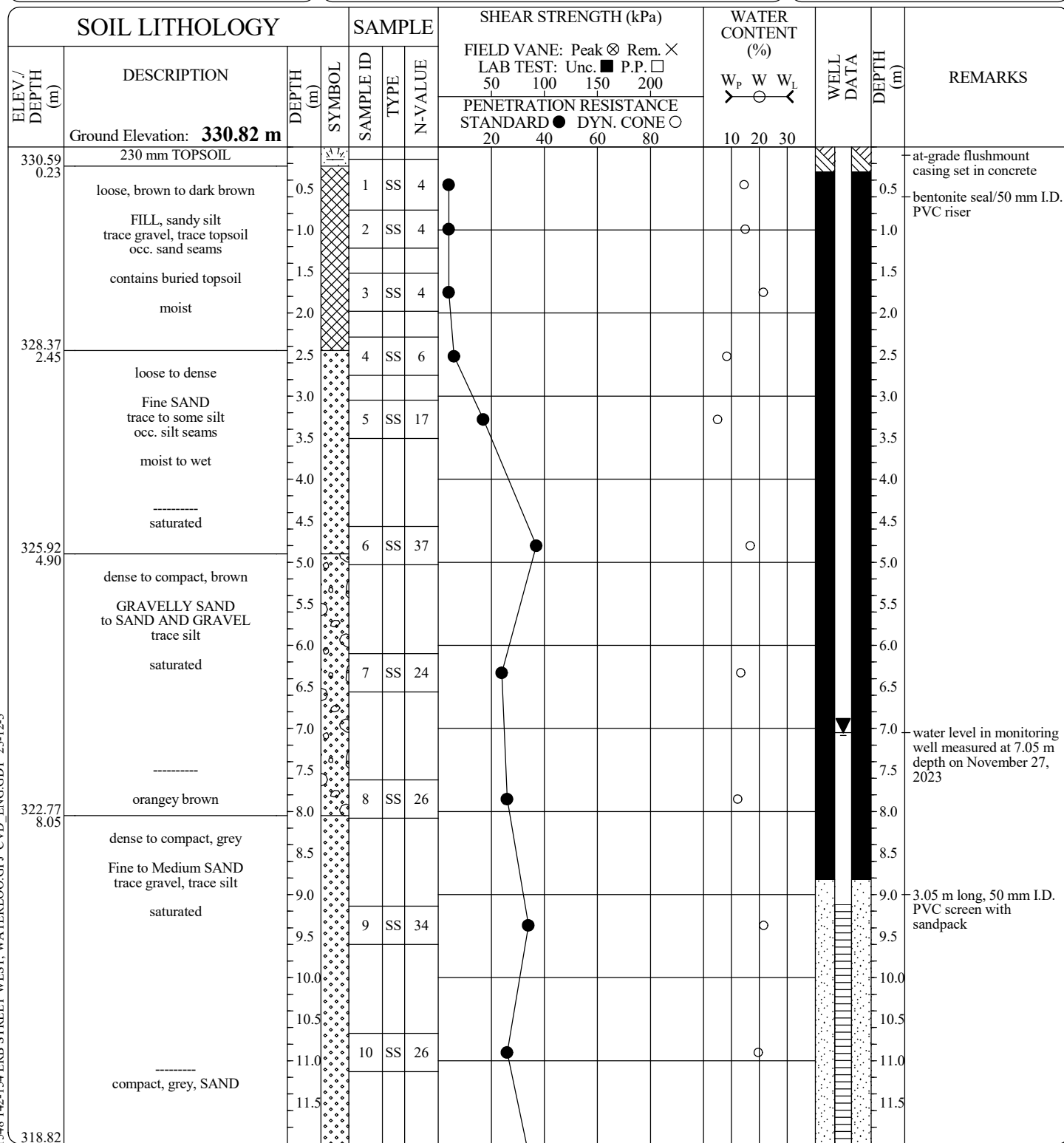
PROJECT MANAGER: **EYC**

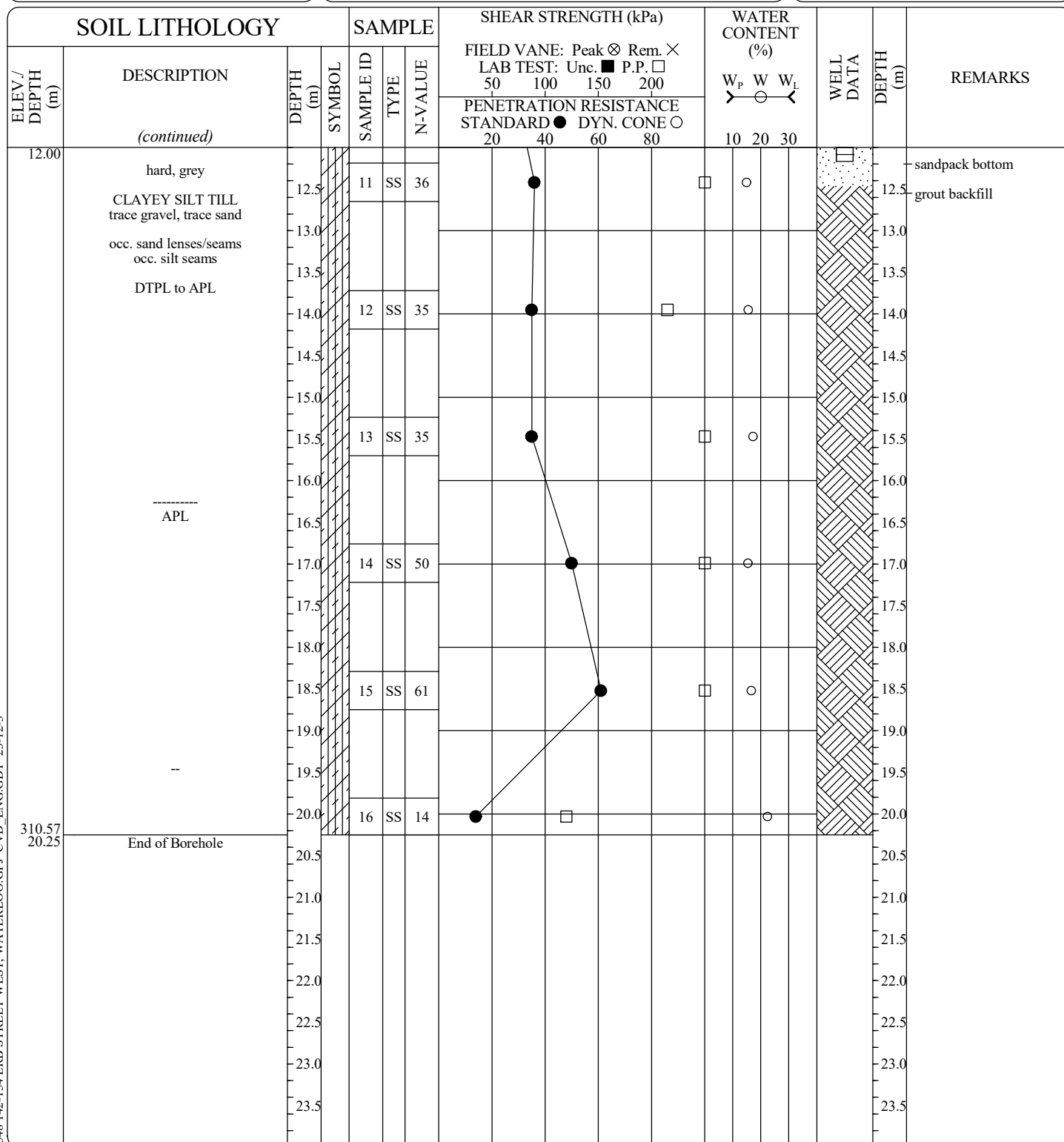
**CHUNG & VANDER DOELEN
ENGINEERING LTD.**

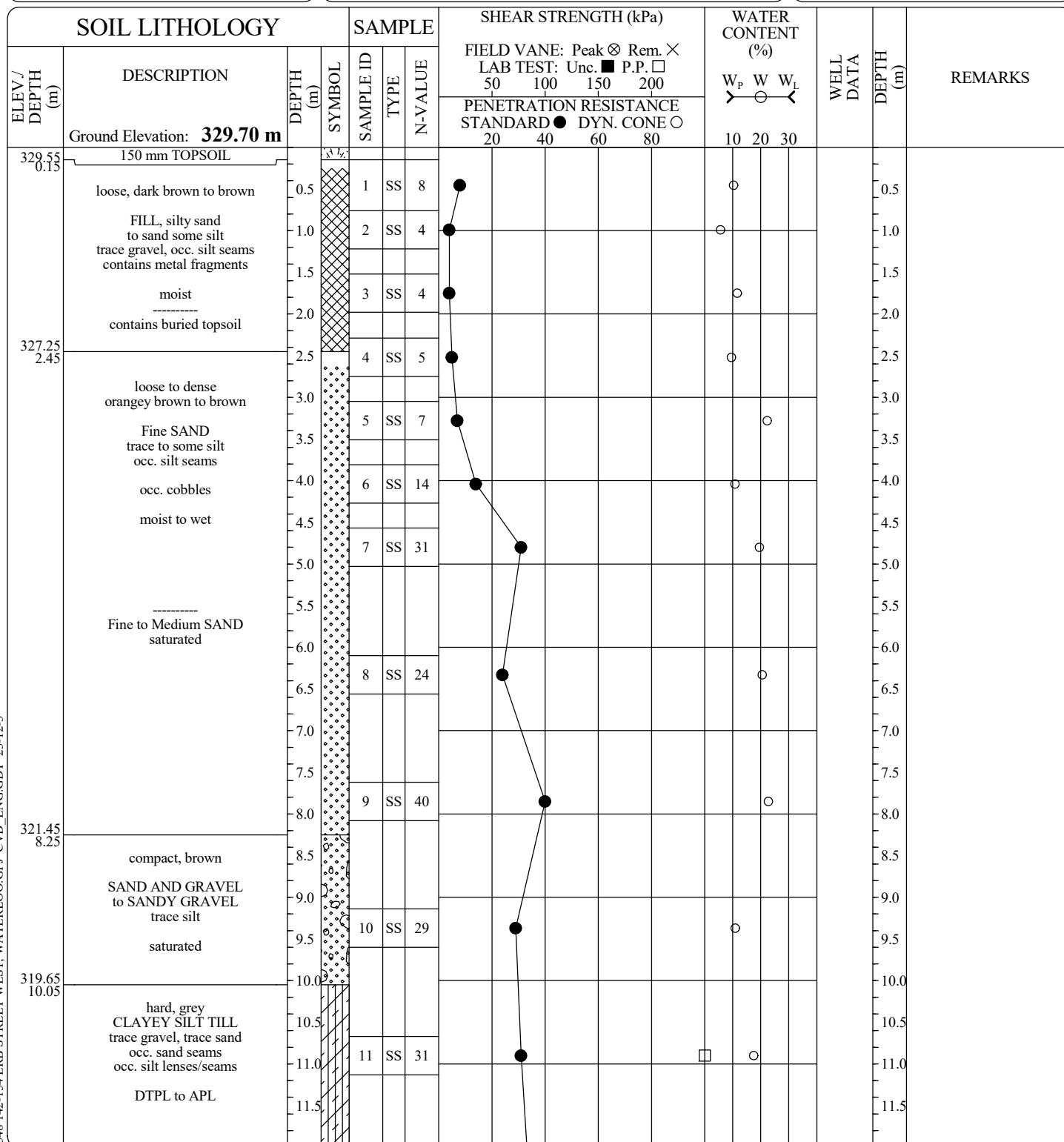
311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

CVD BOREHOLE (2017) 1548 142-154 ERB STREET WEST, WATERLOO.GPJ CVD_ENG.GDT 23-12-3

FILE No: 1548**BOREHOLE No. 7**Client: **2744668 Ontario Inc.**Project: **Supplementary Geotechnical Investigation**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D70**Method: **HSA/Mud Rotary**Size: **108 mm I.D.**Date: **Nov 06 - 23 TO Nov 06 - 23**PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**
 311 Victoria Street North
 Kitchener, Ontario N2H 5E1
 ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 1548**BOREHOLE No. 8**Client: **2744668 Ontario Inc.**Project: **Supplementary Geotechnical Investigation**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D70**Method: **HSA/Mud Rotary**Size: **108 mm I.D.**Date: **Nov 06 - 23 TO Nov 07 - 23**PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

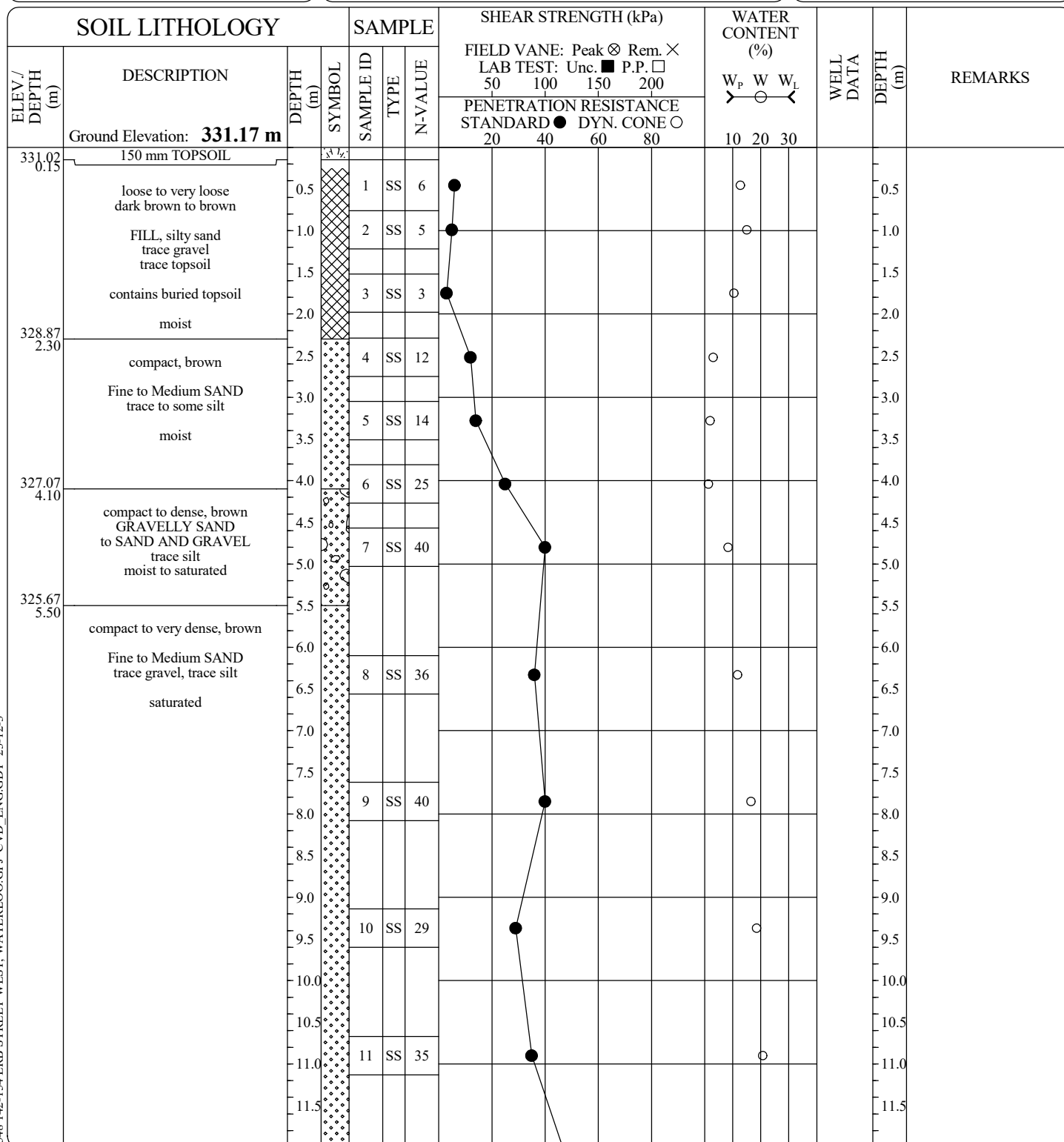
FILE No: 1548**BOREHOLE No. 8**Client: **2744668 Ontario Inc.**Project: **Supplementary Geotechnical Investigation**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D70**Method: **HSA/Mud Rotary**Size: **108 mm I.D.**Date: **Nov 06 - 23 TO Nov 07 - 23**PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

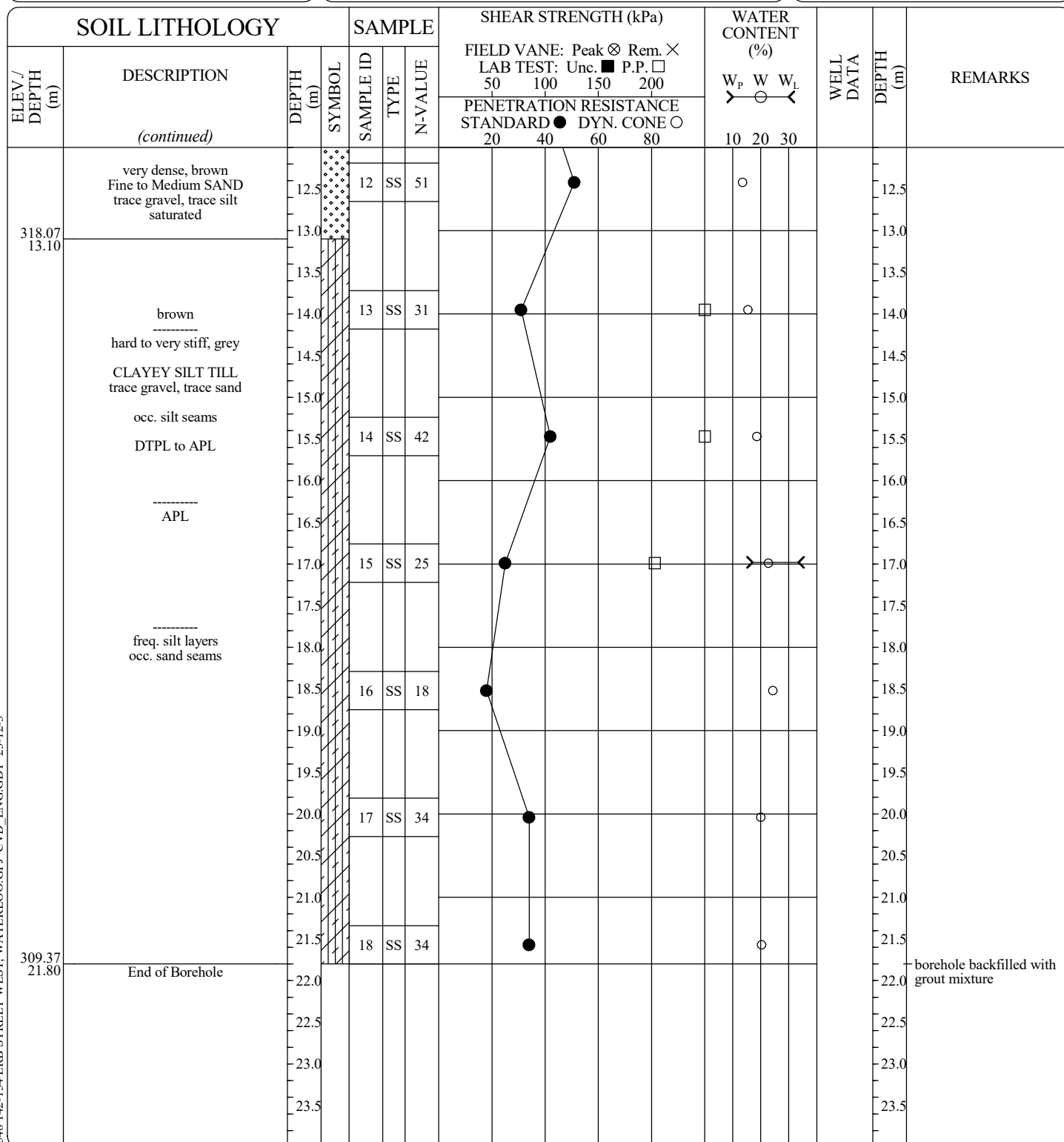
FILE No: 1548**BOREHOLE No. 9**Client: **2744668 Ontario Inc.**Project: **Supplementary Geotechnical Investigation**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D70**Method: **HSA/Mud Rotary**Size: **108 mm I.D.**Date: **Nov 07 - 23 TO Nov 08 - 23**PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 1548**BOREHOLE No. 9**Client: **2744668 Ontario Inc.**Project: **Supplementary Geotechnical Investigation**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D70**Method: **HSA/Mud Rotary**Size: **108 mm I.D.**Date: **Nov 07 - 23 TO Nov 08 - 23**

SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS		
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □				W _p W W _L							
							PENETRATION RESISTANCE STANDARD ● DYN. CONE ○				↗ ○ ↖							
							20	40	60	80	10	20	30					
309.45 20.25	hard, grey CLAYEY SILT TILL trace gravel, trace sand occ. sand seams occ. silt lenses/seams DTPL to APL ----- APL ----- freq. silt seams ----- freq. sand and silt layers	12.5		12	SS	34		●					□	○		12.5	borehole backfilled with grout mixture	
		13.0																13.0
		13.5																13.5
		14.0		13	SS	50		□	●						○			14.0
		14.5														14.5		
		15.0																15.0
		15.5		14	SS	47		■	●						○			15.5
		16.0														16.0		
		16.5																16.5
		17.0		15	SS	54			●						○			17.0
		17.5																17.5
		18.0																18.0
		18.5		16	SS	58			●						○			18.5
		19.0																19.0
		19.5																19.5
		20.0	End of Borehole		17	SS	54			●					○			20.0
		20.5																
	21.0																	21.0
			21.5													21.5		
			22.0													22.0		
		22.5													22.5			
		23.0													23.0			
		23.5													23.5			

PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

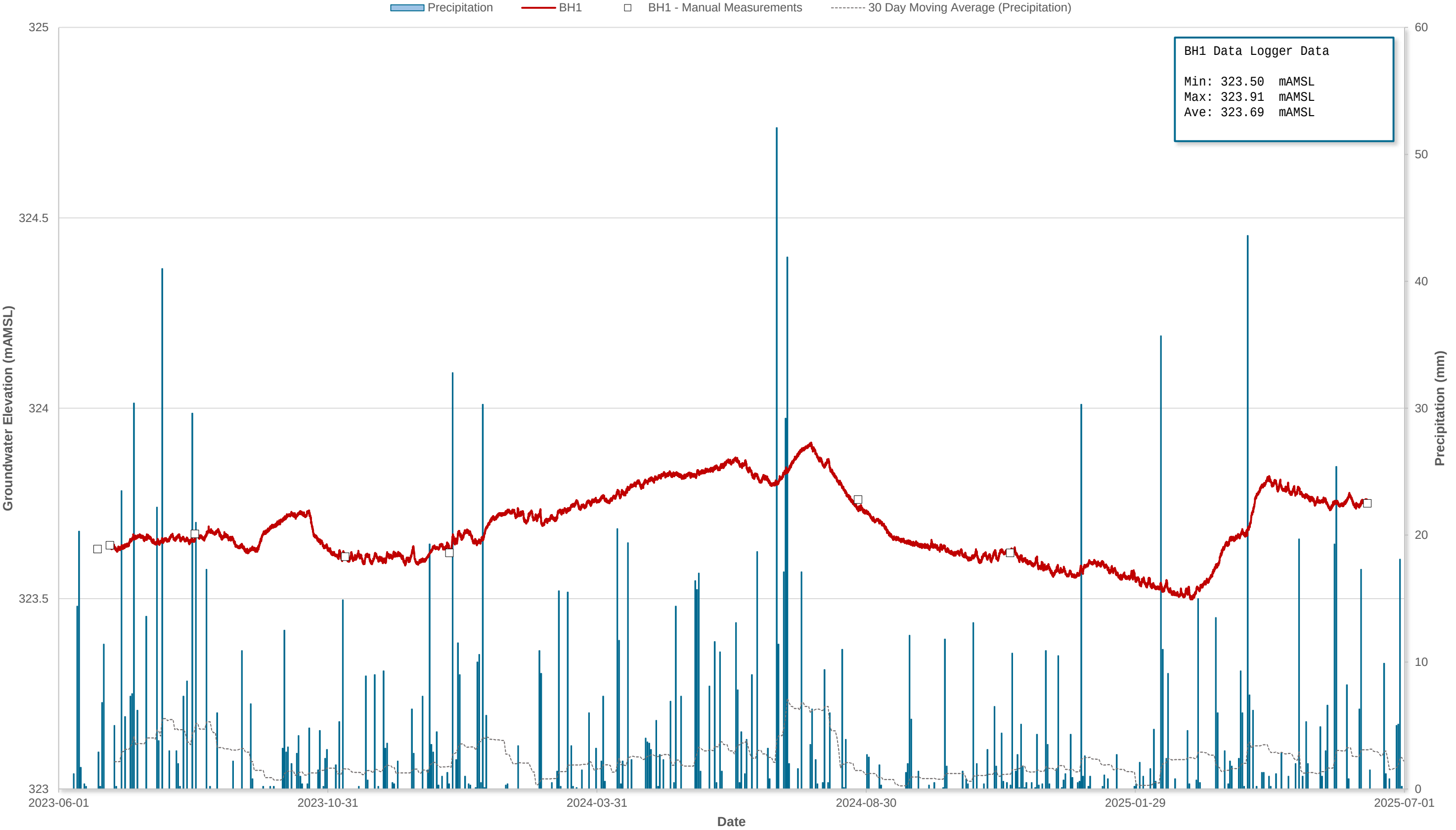
FILE No: 1548**BOREHOLE No. 10**Client: **2744668 Ontario Inc.**Project: **Supplementary Geotechnical Investigation**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D70**Method: **HSA/Mud Rotary**Size: **108 mm I.D.**Date: **Nov 03 - 23 TO Nov 03 - 23**PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 1548**BOREHOLE No. 10**Client: **2744668 Ontario Inc.**Project: **Supplementary Geotechnical Investigation**Location: **142-154 Erb Street West, Waterloo, Ontario****EQUIPMENT DATA**Machine: **Diedrich D70**Method: **HSA/Mud Rotary**Size: **108 mm I.D.**Date: **Nov 03 - 23 TO Nov 03 - 23**PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

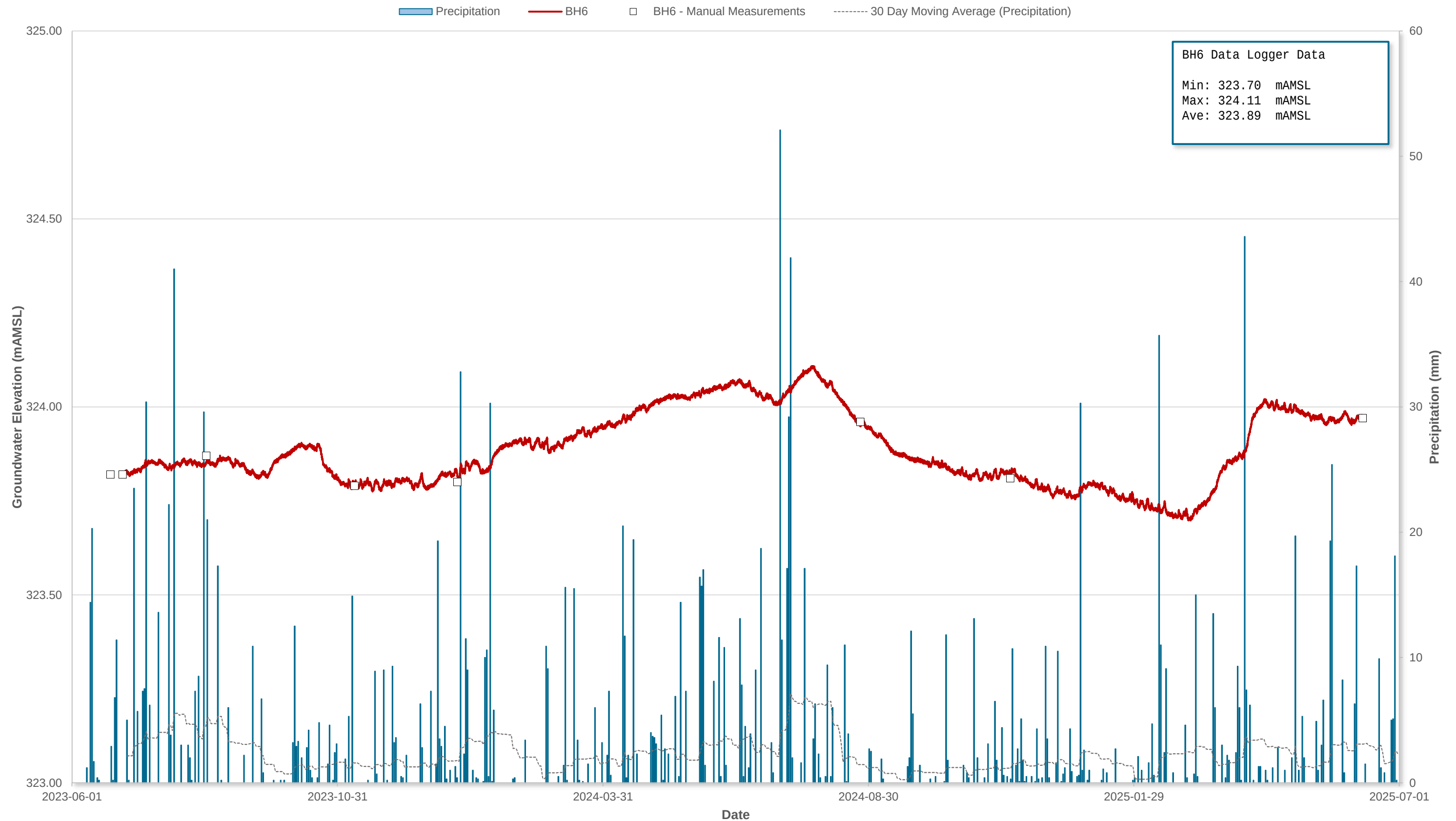
Appendix B

Hydrographs

Hydrograph 1: Groundwater Elevations (mAMSL) - BH1



Hydrograph 2: Groundwater Elevations (mAMSL) - BH6



Appendix C

AquiferTest Reports

**Slug Test - Water Level Data**

Page 1 of 1

Project: Hydrogeological Investigation

Number: 32375-800

Client: 2744668 Ontario Inc.

Location: 1 Dunbar Road N, Waterloo

Slug Test: BH6_Pneumatic 4

Test Well: BH6

Test Conducted by: ALC

Test Date: 8/17/2023

Water level at t=0 [m]: 6.72

Static Water Level [m]: 6.47

Water level change at t=0 [m]: 0.25

	Time [s]	Water Level [m]	WL Change [m]
1	0	6.718	0.248
2	0.5	6.638	0.168
3	1	6.579	0.109
4	1.5	6.538	0.068
5	2	6.514	0.044
6	2.5	6.498	0.028
7	3	6.488	0.018
8	3.5	6.482	0.012
9	4	6.477	0.007
10	4.5	6.475	0.005
11	5	6.475	0.005
12	5.5	6.472	0.002
13	6	6.472	0.002
14	6.5	6.472	0.002
15	7	6.472	0.002
16	7.5	6.47	0.00
17	8	6.47	0.00
18	8.5	6.47	0.00
19	9	6.47	0.00
20	9.5	6.47	0.00



Slug Test Analysis Report

Project: Hydrogeological Investigation

Number: 32375-800

Client: 2744668 Ontario Inc.

Location: 1 Dunbar Road N, Waterloo

Slug Test: BH6_Pneumatic 4

Test Well: BH6

Test Conducted by: ALC

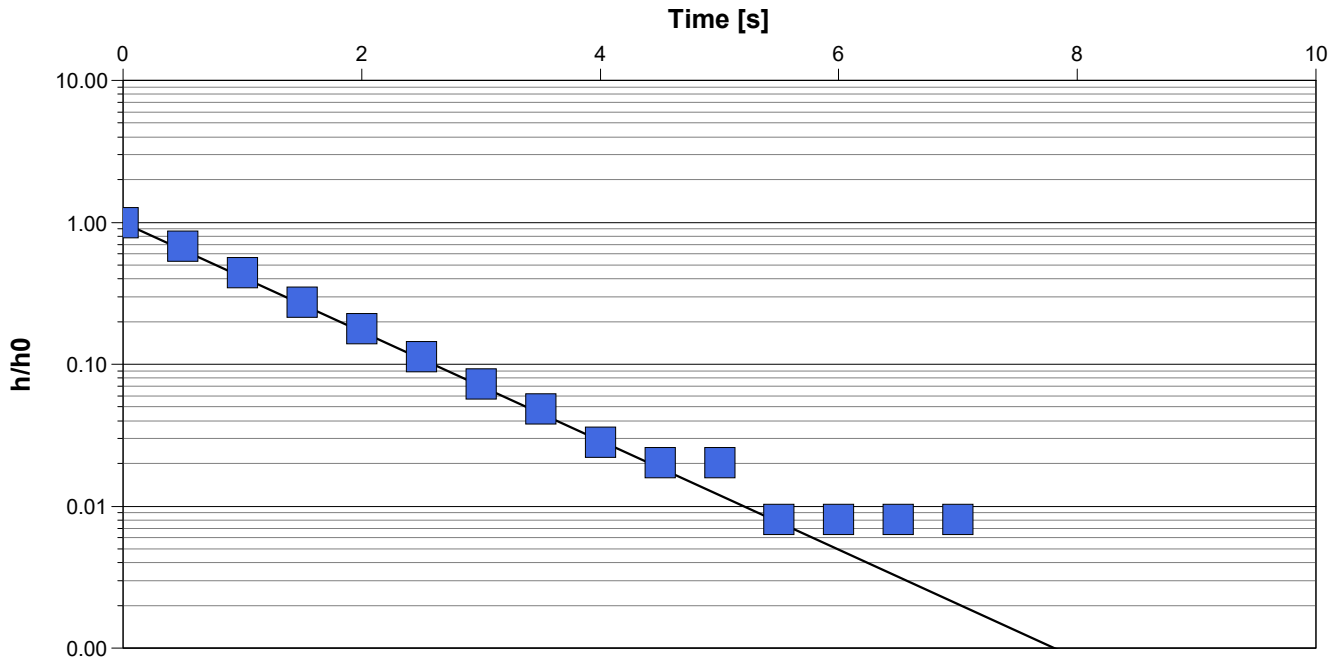
Test Date: 8/17/2023

Analysis Performed by: JDH

Bouwer & Rice

Analysis Date: 9/12/2023

Aquifer Thickness: 3.47 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH6

4.28×10^{-4}

**Slug Test - Analyses Report**

Project: Hydrogeological Investigation

Number: 32375-800

Client: 2744668 Ontario Inc.

Location: 1 Dunbar Road N, Waterloo

Slug Test: BH6_Pneumatic 4

Test Well: BH6

Test Conducted by: ALC

Test Date: 8/17/2023

Aquifer Thickness: 3.47 m

	Analysis Name	Analysis Performed by	Analysis Date	Method name	Well	T [m ² /s]	K [m/s]	S
1	Bouwer & Rice	JDH	9/12/2023	Bouwer & Rice	BH6		4.28×10^{-4}	

Appendix D

Laboratory Certificate of Analysis

CERTIFICATE OF ANALYSIS

Work Order	: WT2319506	Page	: 1 of 6
Client	: MTE Consultants Inc.	Laboratory	: ALS Environmental - Waterloo
Contact	: Fraser Cummings	Account Manager	: Emily Hansen
Address	: 520 Bingemans Centre Drive Kitchener ON Canada N2B 3X9	Address	: 60 Northland Road, Unit 1 Waterloo ON Canada N2V 2B8
Telephone	: 519 743 6500	Telephone	: +1 519 886 6910
Project	: 32375-700	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Date Analysis Commenced	: 30-Jun-2023
C-O-C number	: ----	Issue Date	: 10-Jul-2023 16:28
Sampler	: ----		
Site	: ----		
Quote number	: Standing Offer 2023		
No. of samples received	: 2		
No. of samples analysed	: 2		

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
- Surrogate Control Limits

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
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Jeremy Gingras	Team Leader - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Inorganics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Metals, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	VOC, Waterloo, Ontario
Wayne Smith	Client Services Specialist	Inorganics, Waterloo, Ontario



General Comments

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

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	Description
-	no units
µg/L	micrograms per litre
µS/cm	microsiemens per centimetre
CU	colour units (1 cu = 1 mg/l pt)
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
OWP	Organic water sample contained visible sediment (must be included as part of analysis). Measured concentrations of organic substances in water can be biased high due to presence of sediment.



Analytical Results

Sub-Matrix: Water			Client sample ID		BH1	BH6	----	----	----
(Matrix: Water)									
Client sampling date / time					30-Jun-2023 12:50	30-Jun-2023 14:10	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WT2319506-001	WT2319506-002	-----	-----	-----
					Result	Result	----	----	----
Physical Tests									
Colour, apparent	----	E330/WT	2.0	CU	49.5	967 ^{DLHC}	----	----	----
Conductivity	----	E100/WT	2.0	µS/cm	2020	2180	----	----	----
Hardness (as CaCO3), from total Ca/Mg	----	EC100A/WT	0.50	mg/L	502	579	----	----	----
pH	----	E108/WT	0.10	pH units	7.60	7.73	----	----	----
Solids, total dissolved [TDS]	----	E162/WT	10	mg/L	1210 ^{DLDS}	1300 ^{DLDS}	----	----	----
Solids, total suspended [TSS]	----	E160/WT	3.0	mg/L	13.0	168 ^{DLHC}	----	----	----
Turbidity	----	E121/WT	0.10	NTU	6.23	224	----	----	----
Alkalinity, total (as CaCO3)	----	E290/WT	2.0	mg/L	324	351	----	----	----
Anions and Nutrients									
Ammonia, total (as N)	7664-41-7	E298/WT	0.0050	mg/L	0.0054	<0.0050	----	----	----
Chloride	16887-00-6	E235.Cl/WT	0.50	mg/L	430 ^{DLDS}	475 ^{DLDS}	----	----	----
Fluoride	16984-48-8	E235.F/WT	0.020	mg/L	<0.100 ^{DLDS}	<0.100 ^{DLDS}	----	----	----
Nitrate (as N)	14797-55-8	E235.NO3/WT	0.020	mg/L	1.89 ^{DLDS}	2.04 ^{DLDS}	----	----	----
Nitrite (as N)	14797-65-0	E235.NO2/WT	0.010	mg/L	<0.050 ^{DLDS}	<0.050 ^{DLDS}	----	----	----
Phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U/WT	0.0010	mg/L	<0.0010	0.0028	----	----	----
Sulfate (as SO4)	14808-79-8	E235.SO4/WT	0.30	mg/L	42.5 ^{DLDS}	42.4 ^{DLDS}	----	----	----
Total Metals									
Aluminum, total	7429-90-5	E420/WT	0.0030	mg/L	0.196	3.31 ^{DLHC}	----	----	----
Antimony, total	7440-36-0	E420/WT	0.00010	mg/L	<0.00010	<0.00100 ^{DLHC}	----	----	----
Arsenic, total	7440-38-2	E420/WT	0.00010	mg/L	0.00062	0.00279 ^{DLHC}	----	----	----
Barium, total	7440-39-3	E420/WT	0.00010	mg/L	0.137	0.161 ^{DLHC}	----	----	----
Beryllium, total	7440-41-7	E420/WT	0.000020	mg/L	<0.000020	<0.000200 ^{DLHC}	----	----	----
Bismuth, total	7440-69-9	E420/WT	0.000050	mg/L	<0.000050	<0.000500 ^{DLHC}	----	----	----
Boron, total	7440-42-8	E420/WT	0.010	mg/L	0.024	<0.100 ^{DLHC}	----	----	----
Cadmium, total	7440-43-9	E420/WT	0.0000050	mg/L	0.0000297	0.000112 ^{DLHC}	----	----	----
Calcium, total	7440-70-2	E420/WT	0.050	mg/L	134	159 ^{DLHC}	----	----	----
Cesium, total	7440-46-2	E420/WT	0.000010	mg/L	0.000021	0.000378 ^{DLHC}	----	----	----
Chromium, total	7440-47-3	E420/WT	0.00050	mg/L	0.00063	0.00515 ^{DLHC}	----	----	----
Cobalt, total	7440-48-4	E420/WT	0.00010	mg/L	0.00037	0.00238 ^{DLHC}	----	----	----



Analytical Results

Sub-Matrix: Water					Client sample ID	BH1	BH6	----	----	----
(Matrix: Water)										
					Client sampling date / time	30-Jun-2023 12:50	30-Jun-2023 14:10	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WT2319506-001	WT2319506-002	-----	-----	-----	
					Result	Result	----	----	----	
Total Metals										
Copper, total	7440-50-8	E420/WT	0.00050	mg/L	0.00182	0.00731 ^{DLHC}	----	----	----	
Iron, total	7439-89-6	E420/WT	0.010	mg/L	0.474	5.58 ^{DLHC}	----	----	----	
Lead, total	7439-92-1	E420/WT	0.000050	mg/L	0.00124	0.00640 ^{DLHC}	----	----	----	
Lithium, total	7439-93-2	E420/WT	0.0010	mg/L	0.0072	0.0125 ^{DLHC}	----	----	----	
Magnesium, total	7439-95-4	E420/WT	0.0050	mg/L	40.6	44.3 ^{DLHC}	----	----	----	
Manganese, total	7439-96-5	E420/WT	0.00010	mg/L	0.0210	0.161 ^{DLHC}	----	----	----	
Molybdenum, total	7439-98-7	E420/WT	0.000050	mg/L	0.000192	<0.000500 ^{DLHC}	----	----	----	
Nickel, total	7440-02-0	E420/WT	0.00050	mg/L	0.00065	0.00541 ^{DLHC}	----	----	----	
Phosphorus, total	7723-14-0	E420/WT	0.050	mg/L	<0.050	<0.500 ^{DLHC}	----	----	----	
Potassium, total	7440-09-7	E420/WT	0.050	mg/L	2.50	2.92 ^{DLHC}	----	----	----	
Rubidium, total	7440-17-7	E420/WT	0.00020	mg/L	0.00043	0.00619 ^{DLHC}	----	----	----	
Selenium, total	7782-49-2	E420/WT	0.000050	mg/L	0.000408	0.000721 ^{DLHC}	----	----	----	
Silicon, total	7440-21-3	E420/WT	0.10	mg/L	7.37	12.9 ^{DLHC}	----	----	----	
Silver, total	7440-22-4	E420/WT	0.000010	mg/L	<0.000010	<0.000100 ^{DLHC}	----	----	----	
Sodium, total	7440-23-5	E420/WT	0.050	mg/L	236	263 ^{DLHC}	----	----	----	
Strontium, total	7440-24-6	E420/WT	0.00020	mg/L	0.328	0.344 ^{DLHC}	----	----	----	
Sulfur, total	7704-34-9	E420/WT	0.50	mg/L	16.9	15.1 ^{DLHC}	----	----	----	
Tellurium, total	13494-80-9	E420/WT	0.00020	mg/L	<0.00020	<0.00200 ^{DLHC}	----	----	----	
Thallium, total	7440-28-0	E420/WT	0.000010	mg/L	<0.000010	<0.000100 ^{DLHC}	----	----	----	
Thorium, total	7440-29-1	E420/WT	0.00010	mg/L	<0.00010	<0.00100 ^{DLHC}	----	----	----	
Tin, total	7440-31-5	E420/WT	0.00010	mg/L	<0.00010	0.00138 ^{DLHC}	----	----	----	
Titanium, total	7440-32-6	E420/WT	0.00030	mg/L	0.00691	0.105 ^{DLHC}	----	----	----	
Tungsten, total	7440-33-7	E420/WT	0.00010	mg/L	<0.00010	<0.00100 ^{DLHC}	----	----	----	
Uranium, total	7440-61-1	E420/WT	0.000010	mg/L	0.00141	0.00136 ^{DLHC}	----	----	----	
Vanadium, total	7440-62-2	E420/WT	0.00050	mg/L	0.00058	0.00667 ^{DLHC}	----	----	----	
Zinc, total	7440-66-6	E420/WT	0.0030	mg/L	0.0076	0.0396 ^{DLHC}	----	----	----	
Zirconium, total	7440-67-7	E420/WT	0.00020	mg/L	0.00023	<0.00200 ^{DLHC}	----	----	----	
Volatile Organic Compounds										
Acetone	67-64-1	E611D/WT	20	µg/L	<20	<20 ^{OWP}	----	----	----	
Benzene	71-43-2	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	



Analytical Results

Sub-Matrix: Water					Client sample ID	BH1	BH6	----	----	----
(Matrix: Water)					Client sampling date / time	30-Jun-2023 12:50	30-Jun-2023 14:10	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WT2319506-001	WT2319506-002	-----	-----	-----	-----
					Result	Result	----	----	----	----
Volatile Organic Compounds										
Bromodichloromethane	75-27-4	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Bromoform	75-25-2	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Bromomethane	74-83-9	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Carbon tetrachloride	56-23-5	E611D/WT	0.20	µg/L	<0.20	<0.20 ^{OWP}	----	----	----	----
Chlorobenzene	108-90-7	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Chloroform	67-66-3	E611D/WT	0.50	µg/L	<0.50	1.11	----	----	----	----
Dibromochloromethane	124-48-1	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dibromoethane, 1,2-	106-93-4	E611D/WT	0.20	µg/L	<0.20	<0.20 ^{OWP}	----	----	----	----
Dichlorobenzene, 1,2-	95-50-1	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichlorobenzene, 1,3-	541-73-1	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichlorobenzene, 1,4-	106-46-7	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichlorodifluoromethane	75-71-8	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichloroethane, 1,1-	75-34-3	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichloroethane, 1,2-	107-06-2	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichloroethylene, 1,1-	75-35-4	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichloroethylene, cis-1,2-	156-59-2	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichloroethylene, trans-1,2-	156-60-5	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichloromethane	75-09-2	E611D/WT	1.0	µg/L	<1.0	<1.0 ^{OWP}	----	----	----	----
Dichloropropane, 1,2-	78-87-5	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichloropropylene, cis+trans-1,3-	542-75-6	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Dichloropropylene, cis-1,3-	10061-01-5	E611D/WT	0.30	µg/L	<0.30	<0.30 ^{OWP}	----	----	----	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D/WT	0.30	µg/L	<0.30	<0.30 ^{OWP}	----	----	----	----
Ethylbenzene	100-41-4	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Hexane, n-	110-54-3	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Methyl ethyl ketone [MEK]	78-93-3	E611D/WT	20	µg/L	<20	<20 ^{OWP}	----	----	----	----
Methyl isobutyl ketone [MIBK]	108-10-1	E611D/WT	20	µg/L	<20	<20 ^{OWP}	----	----	----	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Styrene	100-42-5	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Tetrachloroethane, 1,1,1,2-	630-20-6	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----



Analytical Results

Sub-Matrix: Water					Client sample ID	BH1	BH6	----	----	----
(Matrix: Water)					Client sampling date / time	30-Jun-2023 12:50	30-Jun-2023 14:10	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WT2319506-001	WT2319506-002	-----	-----	-----	-----
					Result	Result	----	----	----	----
Volatile Organic Compounds										
Tetrachloroethylene	127-18-4	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Toluene	108-88-3	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Trichloroethane, 1,1,1-	71-55-6	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Trichloroethane, 1,1,2-	79-00-5	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Trichloroethylene	79-01-6	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Trichlorofluoromethane	75-69-4	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Vinyl chloride	75-01-4	E611D/WT	0.50	µg/L	<0.50	<0.50 ^{OWP}	----	----	----	----
Xylene, m+p-	179601-23-1	E611D/WT	0.40	µg/L	<0.40	<0.40 ^{OWP}	----	----	----	----
Xylene, o-	95-47-6	E611D/WT	0.30	µg/L	<0.30	<0.30 ^{OWP}	----	----	----	----
Xylenes, total	1330-20-7	E611D/WT	0.50	µg/L	<0.50	<0.50	----	----	----	----
BTEX, total	----	E611D/WT	1.0	µg/L	<1.0	<1.0	----	----	----	----
Hydrocarbons										
F1 (C6-C10)	---	E581.F1-L/WT	25	µg/L	<25	<25 ^{OWP}	----	----	----	----
F2 (C10-C16)	---	E601.SG/WT	100	µg/L	<100	<100	----	----	----	----
F3 (C16-C34)	---	E601.SG/WT	250	µg/L	<250	<250	----	----	----	----
F4 (C34-C50)	---	E601.SG/WT	250	µg/L	<250	<250	----	----	----	----
F1-BTEX	---	EC580/WT	25	µg/L	<25	<25	----	----	----	----
Hydrocarbons, total (C6-C50)	---	EC581SG/WT	240	µg/L	<370	<370	----	----	----	----
Chromatogram to baseline at nC50	n/a	E601.SG/WT	-	-	YES	YES	----	----	----	----
Hydrocarbons Surrogates										
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	E601.SG/WT	1.0	%	76.4	70.6	----	----	----	----
Dichlorotoluene, 3,4-	95-75-0	E581.F1-L/WT	1.0	%	99.6	93.3	----	----	----	----
Volatile Organic Compounds Surrogates										
Bromofluorobenzene, 4-	460-00-4	E611D/WT	1.0	%	108	108	----	----	----	----
Difluorobenzene, 1,4-	540-36-3	E611D/WT	1.0	%	102	102	----	----	----	----

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.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WT2319506	Page	: 1 of 13
Client	: MTE Consultants Inc.	Laboratory	: ALS Environmental - Waterloo
Contact	: Fraser Cummings	Account Manager	: Emily Hansen
Address	: 520 Bingemans Centre Drive Kitchener ON Canada N2B 3X9	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: 519 743 6500	Telephone	: +1 519 886 6910
Project	: 32375-700	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Issue Date	: 10-Jul-2023 16:29
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: Standing Offer 2023		
No. of samples received	: 2		
No. of samples analysed	: 2		

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 Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- Method Blank value outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Outliers : Quality Control Samples
Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: Water

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Method Blank (MB) Values								
Total Metals	QC-1020601-001	----	Magnesium, total	7439-95-4	E420	0.0076 ^B mg/L	0.005 mg/L	Blank result exceeds permitted value

Result Qualifiers

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.



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	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) [ON MECP] BH1	E298	30-Jun-2023	04-Jul-2023	----	----		05-Jul-2023	28 days	5 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) [ON MECP] BH6	E298	30-Jun-2023	04-Jul-2023	----	----		05-Jul-2023	28 days	5 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [ON MECP] BH1	E235.Cl	30-Jun-2023	04-Jul-2023	----	----		04-Jul-2023	28 days	4 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [ON MECP] BH6	E235.Cl	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	28 days	5 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [ON MECP] BH1	E378-U	30-Jun-2023	02-Jul-2023	----	----		05-Jul-2023	7 days	5 days	✓
Anions and Nutrients : Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001										
HDPE [ON MECP] BH6	E378-U	30-Jun-2023	02-Jul-2023	----	----		05-Jul-2023	7 days	5 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group	Method	Sampling Date	Extraction / Preparation				Analysis			
Container / Client Sample ID(s)			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Anions and Nutrients : Fluoride in Water by IC										
HDPE [ON MECP] BH1	E235.F	30-Jun-2023	04-Jul-2023	----	----		04-Jul-2023	28 days	4 days	✔
Anions and Nutrients : Fluoride in Water by IC										
HDPE [ON MECP] BH6	E235.F	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	28 days	5 days	✔
Anions and Nutrients : Nitrate in Water by IC										
HDPE [ON MECP] BH1	E235.NO3	30-Jun-2023	04-Jul-2023	----	----		04-Jul-2023	7 days	4 days	✔
Anions and Nutrients : Nitrate in Water by IC										
HDPE [ON MECP] BH6	E235.NO3	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	7 days	5 days	✔
Anions and Nutrients : Nitrite in Water by IC										
HDPE [ON MECP] BH1	E235.NO2	30-Jun-2023	04-Jul-2023	----	----		04-Jul-2023	7 days	4 days	✔
Anions and Nutrients : Nitrite in Water by IC										
HDPE [ON MECP] BH6	E235.NO2	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	7 days	5 days	✔
Anions and Nutrients : Sulfate in Water by IC										
HDPE [ON MECP] BH1	E235.SO4	30-Jun-2023	04-Jul-2023	----	----		04-Jul-2023	28 days	4 days	✔
Anions and Nutrients : Sulfate in Water by IC										
HDPE [ON MECP] BH6	E235.SO4	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	28 days	5 days	✔
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID (Low Level)										
Glass vial (sodium bisulfate) BH1	E581.F1-L	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	14 days	5 days	✔



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID (Low Level)										
Glass vial (sodium bisulfate) BH6	E581.F1-L	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	14 days	5 days	✓
Hydrocarbons : Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) BH1	E601.SG	30-Jun-2023	05-Jul-2023	14 days	5 days	✓	10-Jul-2023	40 days	5 days	✓
Hydrocarbons : Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID										
Amber glass/Teflon lined cap (sodium bisulfate) BH6	E601.SG	30-Jun-2023	05-Jul-2023	14 days	5 days	✓	10-Jul-2023	40 days	5 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [ON MECP] BH1	E290	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	14 days	6 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE [ON MECP] BH6	E290	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	14 days	6 days	✓
Physical Tests : Colour (Apparent) by Spectrometer										
HDPE [ON MECP] BH6	E330	30-Jun-2023	----	----	----		30-Jun-2023	48 hrs	3 hrs	✓
Physical Tests : Colour (Apparent) by Spectrometer										
HDPE [ON MECP] BH1	E330	30-Jun-2023	----	----	----		30-Jun-2023	48 hrs	4 hrs	✓
Physical Tests : Conductivity in Water										
HDPE [ON MECP] BH1	E100	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	28 days	6 days	✓
Physical Tests : Conductivity in Water										
HDPE [ON MECP] BH6	E100	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	28 days	6 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : pH by Meter										
HDPE [ON MECP] BH1	E108	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	14 days	6 days	✓
Physical Tests : pH by Meter										
HDPE [ON MECP] BH6	E108	30-Jun-2023	05-Jul-2023	----	----		06-Jul-2023	14 days	6 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [ON MECP] BH1	E162	30-Jun-2023	----	----	----		05-Jul-2023	7 days	5 days	✓
Physical Tests : TDS by Gravimetry										
HDPE [ON MECP] BH6	E162	30-Jun-2023	----	----	----		05-Jul-2023	7 days	5 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [ON MECP] BH1	E160	30-Jun-2023	----	----	----		05-Jul-2023	7 days	5 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [ON MECP] BH6	E160	30-Jun-2023	----	----	----		05-Jul-2023	7 days	5 days	✓
Physical Tests : Turbidity by Nephelometry										
HDPE [ON MECP] BH6	E121	30-Jun-2023	----	----	----		01-Jul-2023	48 hrs	18 hrs	✓
Physical Tests : Turbidity by Nephelometry										
HDPE [ON MECP] BH1	E121	30-Jun-2023	----	----	----		01-Jul-2023	48 hrs	19 hrs	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) BH1	E420	30-Jun-2023	03-Jul-2023	----	----		04-Jul-2023	180 days	4 days	✓



Matrix: **Water** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) BH6	E420	30-Jun-2023	03-Jul-2023	----	----		04-Jul-2023	180 days	4 days	✓
Volatile Organic Compounds : VOCs (Eastern Canada List) by Headspace GC-MS										
Glass vial (sodium bisulfate) BH1	E611D	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	14 days	5 days	✓
Volatile Organic Compounds : VOCs (Eastern Canada List) by Headspace GC-MS										
Glass vial (sodium bisulfate) BH6	E611D	30-Jun-2023	05-Jul-2023	----	----		05-Jul-2023	14 days	5 days	✓

Legend & Qualifier Definitions

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



Quality Control Parameter Frequency Compliance

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

Matrix: **Water** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Alkalinity Species by Titration	E290	1022613	2	12	16.6	5.0	✔
Ammonia by Fluorescence	E298	1021675	1	15	6.6	5.0	✔
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L	1022672	1	15	6.6	5.0	✔
Chloride in Water by IC	E235.Cl	1021996	2	15	13.3	5.0	✔
Colour (Apparent) by Spectrometer	E330	1018548	1	6	16.6	5.0	✔
Conductivity in Water	E100	1022612	2	17	11.7	5.0	✔
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	1019945	1	19	5.2	5.0	✔
Fluoride in Water by IC	E235.F	1021997	2	12	16.6	5.0	✔
Nitrate in Water by IC	E235.NO3	1021993	2	7	28.5	5.0	✔
Nitrite in Water by IC	E235.NO2	1021994	2	4	50.0	5.0	✔
pH by Meter	E108	1022611	2	40	5.0	5.0	✔
Sulfate in Water by IC	E235.SO4	1021995	2	13	15.3	5.0	✔
TDS by Gravimetry	E162	1023730	1	19	5.2	5.0	✔
Total metals in Water by CRC ICPMS	E420	1020601	1	20	5.0	5.0	✔
TSS by Gravimetry	E160	1023302	1	19	5.2	4.7	✔
Turbidity by Nephelometry	E121	1019231	1	4	25.0	5.0	✔
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	1022671	1	20	5.0	5.0	✔
Laboratory Control Samples (LCS)							
Alkalinity Species by Titration	E290	1022613	2	12	16.6	5.0	✔
Ammonia by Fluorescence	E298	1021675	1	15	6.6	5.0	✔
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L	1022672	1	15	6.6	5.0	✔
Chloride in Water by IC	E235.Cl	1021996	2	15	13.3	5.0	✔
Colour (Apparent) by Spectrometer	E330	1018548	1	6	16.6	5.0	✔
Conductivity in Water	E100	1022612	2	17	11.7	5.0	✔
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	1019945	1	19	5.2	5.0	✔
Fluoride in Water by IC	E235.F	1021997	2	12	16.6	5.0	✔
Nitrate in Water by IC	E235.NO3	1021993	2	7	28.5	5.0	✔
Nitrite in Water by IC	E235.NO2	1021994	2	4	50.0	5.0	✔
pH by Meter	E108	1022611	2	40	5.0	5.0	✔
Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID	E601.SG	1022653	1	20	5.0	5.0	✔
Sulfate in Water by IC	E235.SO4	1021995	2	13	15.3	5.0	✔
TDS by Gravimetry	E162	1023730	1	19	5.2	5.0	✔
Total metals in Water by CRC ICPMS	E420	1020601	1	20	5.0	5.0	✔
TSS by Gravimetry	E160	1023302	1	19	5.2	4.7	✔
Turbidity by Nephelometry	E121	1019231	1	4	25.0	5.0	✔
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	1022671	1	20	5.0	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
Method Blanks (MB)							
Alkalinity Species by Titration	E290	1022613	2	12	16.6	5.0	✔
Ammonia by Fluorescence	E298	1021675	1	15	6.6	5.0	✔
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L	1022672	1	15	6.6	5.0	✔
Chloride in Water by IC	E235.Cl	1021996	2	15	13.3	5.0	✔
Colour (Apparent) by Spectrometer	E330	1018548	1	6	16.6	5.0	✔
Conductivity in Water	E100	1022612	2	17	11.7	5.0	✔
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	1019945	1	19	5.2	5.0	✔
Fluoride in Water by IC	E235.F	1021997	2	12	16.6	5.0	✔
Nitrate in Water by IC	E235.NO3	1021993	2	7	28.5	5.0	✔
Nitrite in Water by IC	E235.NO2	1021994	2	4	50.0	5.0	✔
Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID	E601.SG	1022653	1	20	5.0	5.0	✔
Sulfate in Water by IC	E235.SO4	1021995	2	13	15.3	5.0	✔
TDS by Gravimetry	E162	1023730	1	19	5.2	5.0	✔
Total metals in Water by CRC ICPMS	E420	1020601	1	20	5.0	5.0	✔
TSS by Gravimetry	E160	1023302	1	19	5.2	4.7	✔
Turbidity by Nephelometry	E121	1019231	1	4	25.0	5.0	✔
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	1022671	1	20	5.0	5.0	✔
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	1021675	1	15	6.6	5.0	✔
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L	1022672	1	15	6.6	5.0	✔
Chloride in Water by IC	E235.Cl	1021996	2	15	13.3	5.0	✔
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U	1019945	1	19	5.2	5.0	✔
Fluoride in Water by IC	E235.F	1021997	2	12	16.6	5.0	✔
Nitrate in Water by IC	E235.NO3	1021993	2	7	28.5	5.0	✔
Nitrite in Water by IC	E235.NO2	1021994	2	4	50.0	5.0	✔
Sulfate in Water by IC	E235.SO4	1021995	2	13	15.3	5.0	✔
Total metals in Water by CRC ICPMS	E420	1020601	1	20	5.0	5.0	✔
VOCs (Eastern Canada List) by Headspace GC-MS	E611D	1022671	1	20	5.0	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
Conductivity in Water	E100 ALS Environmental - Waterloo	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 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 $20 \pm 5^\circ\text{C}$). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Turbidity by Nephelometry	E121 ALS Environmental - Waterloo	Water	APHA 2130 B (mod)	Turbidity is measured by the nephelometric method, by measuring the intensity of light scatter under defined conditions.
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 $104 \pm 1^\circ\text{C}$, 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.
TDS by Gravimetry	E162 ALS Environmental - Waterloo	Water	APHA 2540 C (mod)	Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, with evaporation of the filtrate at $180 \pm 2^\circ\text{C}$ for 16 hours or to constant weight, with gravimetric measurement of the residue.
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.
Nitrite in Water by IC	E235.NO2 ALS Environmental - Waterloo	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC	E235.NO3 ALS Environmental - Waterloo	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
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.
Alkalinity Species by Titration	E290 ALS Environmental - Waterloo	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 ALS Environmental - Waterloo	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Colour (Apparent) by Spectrometer	E330 ALS Environmental - Waterloo	Water	APHA 2120 C (mod)	Colour (Apparent) is measured in an unfiltered sample spectrophotometrically using the single wavelength method. The colour contribution of settleable solids are not included in the result. This method is intended for potable waters. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment.
Dissolved Orthophosphate by Colourimetry (Ultra Trace Level 0.001 mg/L)	E378-U ALS Environmental - Waterloo	Water	APHA 4500-P F (mod)	Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter. Field filtration is recommended to ensure test results represent conditions at time of sampling.
Total metals in Water by CRC ICPMS	E420 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.
CCME PHC - F1 by Headspace GC-FID (Low Level)	E581.F1-L ALS Environmental - Waterloo	Water	CCME PHC in Soil - Tier 1 (mod)	CCME Fraction 1 (F1) is analyzed by static headspace GC-FID. 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. Analytical methods for CCME Petroleum Hydrocarbons (PHCs) are validated to comply fully with the Reference Method for the Canada-Wide Standard for PHC. Unless qualified, all required quality control criteria of the CCME PHC method have been met, including response factor and linearity requirements.
Silica Gel Treated CCME PHCs - F2-F4sg by GC-FID	E601.SG ALS Environmental - Waterloo	Water	CCME PHC in Soil - Tier 1 (mod)	Sample extracts are subjected to in-situ silica gel treatment prior to analysis by GC-FID for CCME hydrocarbon fractions (F2-F4). Analytical methods for CCME Petroleum Hydrocarbons (PHCs) are validated to comply fully with the Reference Method for the Canada-Wide Standard for PHC. Unless qualified, all required quality control criteria of the CCME PHC method have been met, including response factor and linearity requirements.



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.
Hardness (Calculated) from Total Ca/Mg	EC100A ALS Environmental - Waterloo	Water	APHA 2340B	"Hardness (as CaCO ₃), from total Ca/Mg" is calculated from the sum of total Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters.
F1-BTEX	EC580 ALS Environmental - Waterloo	Water	CCME PHC in Soil - Tier 1	F1-BTEX is calculated as follows: F1-BTEX = F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).
SUM F1 to F4 where F2-F4 is SG treated	EC581SG ALS Environmental - Waterloo	Water	CCME PHC in Soil - Tier 1	Hydrocarbons, total (C6-C50) is the sum of CCME Fraction F1(C6-C10), F2(C10-C16), F3(C16-C34), and F4(C34-C50), where F2-F4 have been treated with silica gel. F4G-sg is not used within this calculation due to overlap with other fractions.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 ALS Environmental - Waterloo	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.
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 the GC/MS-FID system.
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.

QUALITY CONTROL REPORT

Work Order	: WT2319506	Page	: 1 of 18
Client	: MTE Consultants Inc.	Laboratory	: ALS Environmental - Waterloo
Contact	: Fraser Cummings	Account Manager	: Emily Hansen
Address	: 520 Bingemans Centre Drive Kitchener ON Canada N2B 3X9	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: +1 519 886 6910
Project	: 32375-700	Date Samples Received	: 30-Jun-2023 14:45
PO	: ----	Date Analysis Commenced	: 30-Jun-2023
C-O-C number	: ----	Issue Date	: 10-Jul-2023 16:28
Sampler	: ---- 519 743 6500		
Site	: ----		
Quote number	: Standing Offer 2023		
No. of samples received	: 2		
No. of samples analysed	: 2		

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.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Greg Pokocky	Manager - Inorganics	Waterloo Inorganics, Waterloo, Ontario
Jeremy Gingras	Team Leader - Semi-Volatile Instrumentation	Waterloo Organics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Waterloo Inorganics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Waterloo Metals, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	Waterloo VOC, Waterloo, Ontario
Wayne Smith	Client Services Specialist	Waterloo Inorganics, 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: 1018548)											
HA2300346-001	Anonymous	Colour, apparent	----	E330	2.0	CU	54.2	54.9	1.35%	20%	----
Physical Tests (QC Lot: 1019231)											
WT2318462-001	Anonymous	Turbidity	----	E121	0.10	NTU	<0.10	<0.10	0	Diff <2x LOR	----
Physical Tests (QC Lot: 1022611)											
WT2319506-001	BH1	pH	----	E108	0.10	pH units	7.60	7.63	0.394%	4%	----
Physical Tests (QC Lot: 1022612)											
WT2319506-001	BH1	Conductivity	----	E100	2.0	µS/cm	2020	2030	0.494%	10%	----
Physical Tests (QC Lot: 1022613)											
WT2319506-001	BH1	Alkalinity, total (as CaCO ₃)	----	E290	2.0	mg/L	324	331	2.01%	20%	----
Physical Tests (QC Lot: 1022633)											
WT2319506-002	BH6	pH	----	E108	0.10	pH units	7.73	7.69	0.519%	4%	----
Physical Tests (QC Lot: 1022634)											
WT2319506-002	BH6	Conductivity	----	E100	2.0	µS/cm	2180	2160	0.922%	10%	----
Physical Tests (QC Lot: 1022635)											
WT2319506-002	BH6	Alkalinity, total (as CaCO ₃)	----	E290	2.0	mg/L	351	361	2.95%	20%	----
Physical Tests (QC Lot: 1023302)											
WT2319471-001	Anonymous	Solids, total suspended [TSS]	----	E160	3.0	mg/L	9.8	10.4	0.6	Diff <2x LOR	----
Physical Tests (QC Lot: 1023730)											
WT2319360-010	Anonymous	Solids, total dissolved [TDS]	----	E162	20	mg/L	423	438	3.37%	20%	----
Anions and Nutrients (QC Lot: 1019945)											
HA2300346-001	Anonymous	Phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 1021675)											
WT2319487-001	Anonymous	Ammonia, total (as N)	7664-41-7	E298	0.0100	mg/L	0.711	0.607	15.8%	20%	----
Anions and Nutrients (QC Lot: 1021993)											
WT2319506-001	BH1	Nitrate (as N)	14797-55-8	E235.NO3	0.100	mg/L	1.89	1.85	1.92%	20%	----
Anions and Nutrients (QC Lot: 1021994)											
WT2319506-001	BH1	Nitrite (as N)	14797-65-0	E235.NO2	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 1021995)											
WT2319506-001	BH1	Sulfate (as SO ₄)	14808-79-8	E235.SO4	1.50	mg/L	42.5	42.1	0.869%	20%	----
Anions and Nutrients (QC Lot: 1021996)											

Page : 4 of 18
 Work Order : WT2319506
 Client : MTE Consultants Inc.
 Project : 32375-700



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
Anions and Nutrients (QC Lot: 1021996) - continued											
WT2319506-001	BH1	Chloride	16887-00-6	E235.Cl	2.50	mg/L	430	428	0.257%	20%	----
Anions and Nutrients (QC Lot: 1021997)											
WT2319506-001	BH1	Fluoride	16984-48-8	E235.F	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 1022628)											
WT2319506-002	BH6	Sulfate (as SO4)	14808-79-8	E235.SO4	1.50	mg/L	42.4	42.4	0.00501%	20%	----
Anions and Nutrients (QC Lot: 1022629)											
WT2319506-002	BH6	Chloride	16887-00-6	E235.Cl	2.50	mg/L	475	474	0.271%	20%	----
Anions and Nutrients (QC Lot: 1022630)											
WT2319506-002	BH6	Fluoride	16984-48-8	E235.F	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 1022631)											
WT2319506-002	BH6	Nitrate (as N)	14797-55-8	E235.NO3	0.100	mg/L	2.04	2.06	1.02%	20%	----
Anions and Nutrients (QC Lot: 1022632)											
WT2319506-002	BH6	Nitrite (as N)	14797-65-0	E235.NO2	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Total Metals (QC Lot: 1020601)											
WT2319308-001	Anonymous	Aluminum, total	7429-90-5	E420	0.0300	mg/L	0.996	1.02	2.32%	20%	----
		Antimony, total	7440-36-0	E420	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	----
		Arsenic, total	7440-38-2	E420	0.00100	mg/L	0.00134	0.00132	0.00002	Diff <2x LOR	----
		Barium, total	7440-39-3	E420	0.00100	mg/L	0.0534	0.0524	1.86%	20%	----
		Beryllium, total	7440-41-7	E420	0.000200	mg/L	<0.000200	<0.000200	0	Diff <2x LOR	----
		Bismuth, total	7440-69-9	E420	0.000500	mg/L	0.0156	0.0159	2.22%	20%	----
		Boron, total	7440-42-8	E420	0.100	mg/L	0.153	0.162	0.008	Diff <2x LOR	----
		Cadmium, total	7440-43-9	E420	0.0000500	mg/L	0.000354	0.000377	0.0000231	Diff <2x LOR	----
		Calcium, total	7440-70-2	E420	0.500	mg/L	30.9	31.9	2.99%	20%	----
		Cesium, total	7440-46-2	E420	0.000100	mg/L	<0.000100	<0.000100	0	Diff <2x LOR	----
		Chromium, total	7440-47-3	E420	0.00500	mg/L	0.00623	0.00619	0.00004	Diff <2x LOR	----
		Cobalt, total	7440-48-4	E420	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	----
		Copper, total	7440-50-8	E420	0.00500	mg/L	0.0721	0.0746	3.37%	20%	----
		Iron, total	7439-89-6	E420	0.100	mg/L	1.31	1.17	11.0%	20%	----
		Lead, total	7439-92-1	E420	0.000500	mg/L	0.00185	0.00190	0.000050	Diff <2x LOR	----
		Lithium, total	7439-93-2	E420	0.0100	mg/L	<0.0100	<0.0100	0	Diff <2x LOR	----
		Magnesium, total	7439-95-4	E420	0.0500	mg/L	8.70	8.86	1.81%	20%	----
		Manganese, total	7439-96-5	E420	0.00100	mg/L	0.0212	0.0204	3.91%	20%	----
		Molybdenum, total	7439-98-7	E420	0.000500	mg/L	0.00178	0.00175	0.000028	Diff <2x LOR	----
		Nickel, total	7440-02-0	E420	0.00500	mg/L	<0.00500	<0.00500	0	Diff <2x LOR	----



Sub-Matrix: Water					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Total Metals (QC Lot: 1020601) - continued											
WT2319308-001	Anonymous	Phosphorus, total	7723-14-0	E420	0.500	mg/L	3.51	3.36	0.153	Diff <2x LOR	----
		Potassium, total	7440-09-7	E420	0.500	mg/L	11.0	11.3	2.47%	20%	----
		Rubidium, total	7440-17-7	E420	0.00200	mg/L	0.00990	0.0104	0.00052	Diff <2x LOR	----
		Selenium, total	7782-49-2	E420	0.000500	mg/L	<0.000500	<0.000500	0	Diff <2x LOR	----
		Silicon, total	7440-21-3	E420	1.00	mg/L	389	415	6.49%	20%	----
		Silver, total	7440-22-4	E420	0.000100	mg/L	0.00140	0.00147	5.12%	20%	----
		Sodium, total	7440-23-5	E420	0.500	mg/L	392	404	3.00%	20%	----
		Strontium, total	7440-24-6	E420	0.00200	mg/L	0.157	0.162	2.92%	20%	----
		Sulfur, total	7704-34-9	E420	5.00	mg/L	61.3	64.8	5.50%	20%	----
		Tellurium, total	13494-80-9	E420	0.00200	mg/L	<0.00200	<0.00200	0	Diff <2x LOR	----
		Thallium, total	7440-28-0	E420	0.000100	mg/L	<0.000100	<0.000100	0	Diff <2x LOR	----
		Thorium, total	7440-29-1	E420	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	----
		Tin, total	7440-31-5	E420	0.00100	mg/L	0.00228	0.00238	0.00010	Diff <2x LOR	----
		Titanium, total	7440-32-6	E420	0.00300	mg/L	0.702	0.625	11.6%	20%	----
		Tungsten, total	7440-33-7	E420	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	----
		Uranium, total	7440-61-1	E420	0.000100	mg/L	0.000429	0.000413	0.000016	Diff <2x LOR	----
		Vanadium, total	7440-62-2	E420	0.00500	mg/L	<0.00500	<0.00500	0	Diff <2x LOR	----
		Zinc, total	7440-66-6	E420	0.0300	mg/L	2.88	2.94	2.06%	20%	----
		Zirconium, total	7440-67-7	E420	0.00200	mg/L	0.00970	0.00992	0.00022	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 1022671)											
WT2319512-001	Anonymous	Acetone	67-64-1	E611D	20	µg/L	<20	<20	0	Diff <2x LOR	----
		Benzene	71-43-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Bromodichloromethane	75-27-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Bromoform	75-25-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Bromomethane	74-83-9	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Carbon tetrachloride	56-23-5	E611D	0.20	µg/L	<0.20	<0.20	0	Diff <2x LOR	----
		Chlorobenzene	108-90-7	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	----
		Dibromochloromethane	124-48-1	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dibromoethane, 1,2-	106-93-4	E611D	0.20	µg/L	<0.20	<0.20	0	Diff <2x LOR	----
		Dichlorobenzene, 1,2-	95-50-1	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichlorobenzene, 1,3-	541-73-1	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	----
		Dichlorodifluoromethane	75-71-8	E611D	0.50	µg/L	<0.50	<0.50	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
Volatile Organic Compounds (QC Lot: 1022671) - continued											
WT2319512-001	Anonymous	Dichloroethane, 1,1-	75-34-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethane, 1,2-	107-06-2	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloroethylene, 1,1-	75-35-4	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	----
		Dichloroethylene, trans-1,2-	156-60-5	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	----
		Dichloropropane, 1,2-	78-87-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Dichloropropylene, cis-1,3-	10061-01-5	E611D	0.30	µg/L	<0.30	<0.30	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	----
		Hexane, n-	110-54-3	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Methyl ethyl ketone [MEK]	78-93-3	E611D	20	µg/L	<20	<20	0	Diff <2x LOR	----
		Methyl isobutyl ketone [MIBK]	108-10-1	E611D	20	µg/L	<20	<20	0	Diff <2x LOR	----
		Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Styrene	100-42-5	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Tetrachloroethane, 1,1,1,2-	630-20-6	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	----
		Trichloroethane, 1,1,1-	71-55-6	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Trichloroethane, 1,1,2-	79-00-5	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	----
		Trichlorofluoromethane	75-69-4	E611D	0.50	µg/L	<0.50	<0.50	0	Diff <2x LOR	----
		Vinyl chloride	75-01-4	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	----
Hydrocarbons (QC Lot: 1022672)											
WT2319512-001	Anonymous	F1 (C6-C10)	----	E581.F1-L	25	µg/L	<25	<25	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: 1018548)						
Colour, apparent	----	E330	2	CU	<2.0	----
Physical Tests (QCLot: 1019231)						
Turbidity	----	E121	0.1	NTU	<0.10	----
Physical Tests (QCLot: 1022612)						
Conductivity	----	E100	1	µS/cm	<1.0	----
Physical Tests (QCLot: 1022613)						
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	1.6	----
Physical Tests (QCLot: 1022634)						
Conductivity	----	E100	1	µS/cm	<1.0	----
Physical Tests (QCLot: 1022635)						
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	1.2	----
Physical Tests (QCLot: 1023302)						
Solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Physical Tests (QCLot: 1023730)						
Solids, total dissolved [TDS]	----	E162	10	mg/L	<10	----
Anions and Nutrients (QCLot: 1019945)						
Phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	<0.0010	----
Anions and Nutrients (QCLot: 1021675)						
Ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 1021993)						
Nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 1021994)						
Nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Anions and Nutrients (QCLot: 1021995)						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 1021996)						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 1021997)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 1022628)						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 1022629)						



Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Anions and Nutrients (QCLot: 1022629) - continued						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 1022630)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 1022631)						
Nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 1022632)						
Nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Total Metals (QCLot: 1020601)						
Aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----
Antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
Arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
Barium, total	7440-39-3	E420	0.0001	mg/L	<0.00010	----
Beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	----
Bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
Boron, total	7440-42-8	E420	0.01	mg/L	<0.010	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
Calcium, total	7440-70-2	E420	0.05	mg/L	<0.050	----
Cesium, total	7440-46-2	E420	0.00001	mg/L	<0.000010	----
Chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
Cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
Copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----
Iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
Lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
Lithium, total	7439-93-2	E420	0.001	mg/L	<0.0010	----
Magnesium, total	7439-95-4	E420	0.005	mg/L	# 0.0076	B
Manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
Molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
Nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
Phosphorus, total	7723-14-0	E420	0.05	mg/L	<0.050	----
Potassium, total	7440-09-7	E420	0.05	mg/L	<0.050	----
Rubidium, total	7440-17-7	E420	0.0002	mg/L	<0.00020	----
Selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
Silicon, total	7440-21-3	E420	0.1	mg/L	<0.10	----
Silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
Sodium, total	7440-23-5	E420	0.05	mg/L	<0.050	----



Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 1020601) - continued						
Strontium, total	7440-24-6	E420	0.0002	mg/L	<0.00020	----
Sulfur, total	7704-34-9	E420	0.5	mg/L	<0.50	----
Tellurium, total	13494-80-9	E420	0.0002	mg/L	<0.00020	----
Thallium, total	7440-28-0	E420	0.00001	mg/L	<0.000010	----
Thorium, total	7440-29-1	E420	0.0001	mg/L	<0.00010	----
Tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
Titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
Tungsten, total	7440-33-7	E420	0.0001	mg/L	<0.00010	----
Uranium, total	7440-61-1	E420	0.00001	mg/L	<0.000010	----
Vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	----
Zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
Zirconium, total	7440-67-7	E420	0.0002	mg/L	<0.00020	----
Volatile Organic Compounds (QCLot: 1022671)						
Acetone	67-64-1	E611D	20	µg/L	<20	----
Benzene	71-43-2	E611D	0.5	µg/L	<0.50	----
Bromodichloromethane	75-27-4	E611D	0.5	µg/L	<0.50	----
Bromoform	75-25-2	E611D	0.5	µg/L	<0.50	----
Bromomethane	74-83-9	E611D	0.5	µg/L	<0.50	----
Carbon tetrachloride	56-23-5	E611D	0.2	µg/L	<0.20	----
Chlorobenzene	108-90-7	E611D	0.5	µg/L	<0.50	----
Chloroform	67-66-3	E611D	0.5	µg/L	<0.50	----
Dibromochloromethane	124-48-1	E611D	0.5	µg/L	<0.50	----
Dibromoethane, 1,2-	106-93-4	E611D	0.2	µg/L	<0.20	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,3-	541-73-1	E611D	0.5	µg/L	<0.50	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	<0.50	----
Dichlorodifluoromethane	75-71-8	E611D	0.5	µg/L	<0.50	----
Dichloroethane, 1,1-	75-34-3	E611D	0.5	µg/L	<0.50	----
Dichloroethane, 1,2-	107-06-2	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, 1,1-	75-35-4	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	<0.50	----
Dichloroethylene, trans-1,2-	156-60-5	E611D	0.5	µg/L	<0.50	----
Dichloromethane	75-09-2	E611D	1	µg/L	<1.0	----
Dichloropropane, 1,2-	78-87-5	E611D	0.5	µg/L	<0.50	----
Dichloropropylene, cis-1,3-	10061-01-5	E611D	0.3	µg/L	<0.30	----



Sub-Matrix: Water

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Volatile Organic Compounds (QCLot: 1022671) - continued						
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	----
Hexane, n-	110-54-3	E611D	0.5	µg/L	<0.50	----
Methyl ethyl ketone [MEK]	78-93-3	E611D	20	µg/L	<20	----
Methyl isobutyl ketone [MIBK]	108-10-1	E611D	20	µg/L	<20	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D	0.5	µg/L	<0.50	----
Styrene	100-42-5	E611D	0.5	µg/L	<0.50	----
Tetrachloroethane, 1,1,1,2-	630-20-6	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	----
Trichloroethane, 1,1,1-	71-55-6	E611D	0.5	µg/L	<0.50	----
Trichloroethane, 1,1,2-	79-00-5	E611D	0.5	µg/L	<0.50	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	<0.50	----
Trichlorofluoromethane	75-69-4	E611D	0.5	µg/L	<0.50	----
Vinyl chloride	75-01-4	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	----
Hydrocarbons (QCLot: 1022653)						
F2 (C10-C16)	----	E601.SG	100	µg/L	<100	----
F3 (C16-C34)	----	E601.SG	250	µg/L	<250	----
F4 (C34-C50)	----	E601.SG	250	µg/L	<250	----
Hydrocarbons (QCLot: 1022672)						
F1 (C6-C10)	----	E581.F1-L	25	µg/L	<25	----

Qualifiers

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.



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 (%)		Qualifier
					Concentration	LCS	Low	High	
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1018548)									
Colour, apparent	----	E330	2	CU	25 CU	104	70.0	130	----
Physical Tests (QCLot: 1019231)									
Turbidity	----	E121	0.1	NTU	200 NTU	100.0	85.0	115	----
Physical Tests (QCLot: 1022611)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1022612)									
Conductivity	----	E100	1	µS/cm	1409 µS/cm	100	90.0	110	----
Physical Tests (QCLot: 1022613)									
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	150 mg/L	102	85.0	115	----
Physical Tests (QCLot: 1022633)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1022634)									
Conductivity	----	E100	1	µS/cm	1409 µS/cm	101	90.0	110	----
Physical Tests (QCLot: 1022635)									
Alkalinity, total (as CaCO3)	----	E290	1	mg/L	150 mg/L	102	85.0	115	----
Physical Tests (QCLot: 1023302)									
Solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	102	85.0	115	----
Physical Tests (QCLot: 1023730)									
Solids, total dissolved [TDS]	----	E162	10	mg/L	1000 mg/L	99.8	85.0	115	----
Anions and Nutrients (QCLot: 1019945)									
Phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.001	mg/L	0.0212 mg/L	109	80.0	120	----
Anions and Nutrients (QCLot: 1021675)									
Ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	100	85.0	115	----
Anions and Nutrients (QCLot: 1021993)									
Nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	98.7	90.0	110	----
Anions and Nutrients (QCLot: 1021994)									
Nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	96.8	90.0	110	----
Anions and Nutrients (QCLot: 1021995)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	99.9	90.0	110	----
Anions and Nutrients (QCLot: 1021996)									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	99.0	90.0	110	----



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
					Concentration	LCS	Low	High	
Analyte	CAS Number	Method	LOR	Unit					
Anions and Nutrients (QCLot: 1021997)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 1022628)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 1022629)									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	99.9	90.0	110	----
Anions and Nutrients (QCLot: 1022630)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 1022631)									
Nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	99.6	90.0	110	----
Anions and Nutrients (QCLot: 1022632)									
Nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	99.2	90.0	110	----
Total Metals (QCLot: 1020601)									
Aluminum, total	7429-90-5	E420	0.003	mg/L	0.1 mg/L	94.8	80.0	120	----
Antimony, total	7440-36-0	E420	0.0001	mg/L	0.05 mg/L	104	80.0	120	----
Arsenic, total	7440-38-2	E420	0.0001	mg/L	0.05 mg/L	105	80.0	120	----
Barium, total	7440-39-3	E420	0.0001	mg/L	0.0125 mg/L	100	80.0	120	----
Beryllium, total	7440-41-7	E420	0.00002	mg/L	0.005 mg/L	97.2	80.0	120	----
Bismuth, total	7440-69-9	E420	0.00005	mg/L	0.05 mg/L	96.5	80.0	120	----
Boron, total	7440-42-8	E420	0.01	mg/L	0.05 mg/L	96.3	80.0	120	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	0.005 mg/L	100	80.0	120	----
Calcium, total	7440-70-2	E420	0.05	mg/L	2.5 mg/L	100	80.0	120	----
Cesium, total	7440-46-2	E420	0.00001	mg/L	0.0025 mg/L	101	80.0	120	----
Chromium, total	7440-47-3	E420	0.0005	mg/L	0.0125 mg/L	98.8	80.0	120	----
Cobalt, total	7440-48-4	E420	0.0001	mg/L	0.0125 mg/L	98.1	80.0	120	----
Copper, total	7440-50-8	E420	0.0005	mg/L	0.0125 mg/L	98.1	80.0	120	----
Iron, total	7439-89-6	E420	0.01	mg/L	0.05 mg/L	98.1	80.0	120	----
Lead, total	7439-92-1	E420	0.00005	mg/L	0.025 mg/L	97.1	80.0	120	----
Lithium, total	7439-93-2	E420	0.001	mg/L	0.0125 mg/L	101	80.0	120	----
Magnesium, total	7439-95-4	E420	0.005	mg/L	2.5 mg/L	108	80.0	120	----
Manganese, total	7439-96-5	E420	0.0001	mg/L	0.0125 mg/L	99.6	80.0	120	----
Molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.0125 mg/L	101	80.0	120	----
Nickel, total	7440-02-0	E420	0.0005	mg/L	0.025 mg/L	98.3	80.0	120	----
Phosphorus, total	7723-14-0	E420	0.05	mg/L	0.5 mg/L	109	80.0	120	----
Potassium, total	7440-09-7	E420	0.05	mg/L	2.5 mg/L	96.0	80.0	120	----
Rubidium, total	7440-17-7	E420	0.0002	mg/L	0.005 mg/L	102	80.0	120	----



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
					Concentration	LCS	Low	High	
Analyte	CAS Number	Method	LOR	Unit					
Total Metals (QCLot: 1020601) - continued									
Selenium, total	7782-49-2	E420	0.00005	mg/L	0.05 mg/L	99.2	80.0	120	----
Silicon, total	7440-21-3	E420	0.1	mg/L	0.5 mg/L	119	80.0	120	----
Silver, total	7440-22-4	E420	0.00001	mg/L	0.005 mg/L	91.6	80.0	120	----
Sodium, total	7440-23-5	E420	0.05	mg/L	2.5 mg/L	102	80.0	120	----
Strontium, total	7440-24-6	E420	0.0002	mg/L	0.0125 mg/L	104	80.0	120	----
Sulfur, total	7704-34-9	E420	0.5	mg/L	2.5 mg/L	100	80.0	120	----
Tellurium, total	13494-80-9	E420	0.0002	mg/L	0.005 mg/L	99.8	80.0	120	----
Thallium, total	7440-28-0	E420	0.00001	mg/L	0.05 mg/L	96.0	80.0	120	----
Thorium, total	7440-29-1	E420	0.0001	mg/L	0.005 mg/L	92.0	80.0	120	----
Tin, total	7440-31-5	E420	0.0001	mg/L	0.025 mg/L	101	80.0	120	----
Titanium, total	7440-32-6	E420	0.0003	mg/L	0.0125 mg/L	98.2	80.0	120	----
Tungsten, total	7440-33-7	E420	0.0001	mg/L	0.005 mg/L	94.0	80.0	120	----
Uranium, total	7440-61-1	E420	0.00001	mg/L	0.00025 mg/L	95.0	80.0	120	----
Vanadium, total	7440-62-2	E420	0.0005	mg/L	0.025 mg/L	99.6	80.0	120	----
Zinc, total	7440-66-6	E420	0.003	mg/L	0.025 mg/L	97.6	80.0	120	----
Zirconium, total	7440-67-7	E420	0.0002	mg/L	0.005 mg/L	99.4	80.0	120	----
Volatile Organic Compounds (QCLot: 1022671)									
Acetone	67-64-1	E611D	20	µg/L	100 µg/L	110	70.0	130	----
Benzene	71-43-2	E611D	0.5	µg/L	100 µg/L	109	70.0	130	----
Bromodichloromethane	75-27-4	E611D	0.5	µg/L	100 µg/L	116	70.0	130	----
Bromoform	75-25-2	E611D	0.5	µg/L	100 µg/L	97.7	70.0	130	----
Bromomethane	74-83-9	E611D	0.5	µg/L	100 µg/L	120	60.0	140	----
Carbon tetrachloride	56-23-5	E611D	0.2	µg/L	100 µg/L	118	70.0	130	----
Chlorobenzene	108-90-7	E611D	0.5	µg/L	100 µg/L	108	70.0	130	----
Chloroform	67-66-3	E611D	0.5	µg/L	100 µg/L	115	70.0	130	----
Dibromochloromethane	124-48-1	E611D	0.5	µg/L	100 µg/L	112	70.0	130	----
Dibromoethane, 1,2-	106-93-4	E611D	0.2	µg/L	100 µg/L	108	70.0	130	----
Dichlorobenzene, 1,2-	95-50-1	E611D	0.5	µg/L	100 µg/L	107	70.0	130	----
Dichlorobenzene, 1,3-	541-73-1	E611D	0.5	µg/L	100 µg/L	107	70.0	130	----
Dichlorobenzene, 1,4-	106-46-7	E611D	0.5	µg/L	100 µg/L	109	70.0	130	----
Dichlorodifluoromethane	75-71-8	E611D	0.5	µg/L	100 µg/L	101	60.0	140	----
Dichloroethane, 1,1-	75-34-3	E611D	0.5	µg/L	100 µg/L	106	70.0	130	----
Dichloroethane, 1,2-	107-06-2	E611D	0.5	µg/L	100 µg/L	110	70.0	130	----
Dichloroethylene, 1,1-	75-35-4	E611D	0.5	µg/L	100 µg/L	106	70.0	130	----
Dichloroethylene, cis-1,2-	156-59-2	E611D	0.5	µg/L	100 µg/L	107	70.0	130	----



Sub-Matrix: Water					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
					Concentration	LCS	Low	High	
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Volatile Organic Compounds (QCLot: 1022671) - continued									
Dichloroethylene, trans-1,2-	156-60-5	E611D	0.5	µg/L	100 µg/L	108	70.0	130	----
Dichloromethane	75-09-2	E611D	1	µg/L	100 µg/L	116	70.0	130	----
Dichloropropane, 1,2-	78-87-5	E611D	0.5	µg/L	100 µg/L	104	70.0	130	----
Dichloropropylene, cis-1,3-	10061-01-5	E611D	0.3	µg/L	100 µg/L	101	70.0	130	----
Dichloropropylene, trans-1,3-	10061-02-6	E611D	0.3	µg/L	100 µg/L	93.2	70.0	130	----
Ethylbenzene	100-41-4	E611D	0.5	µg/L	100 µg/L	104	70.0	130	----
Hexane, n-	110-54-3	E611D	0.5	µg/L	100 µg/L	104	70.0	130	----
Methyl ethyl ketone [MEK]	78-93-3	E611D	20	µg/L	100 µg/L	110	70.0	130	----
Methyl isobutyl ketone [MIBK]	108-10-1	E611D	20	µg/L	100 µg/L	87.2	70.0	130	----
Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D	0.5	µg/L	100 µg/L	106	70.0	130	----
Styrene	100-42-5	E611D	0.5	µg/L	100 µg/L	104	70.0	130	----
Tetrachloroethane, 1,1,1,2-	630-20-6	E611D	0.5	µg/L	100 µg/L	111	70.0	130	----
Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	0.5	µg/L	100 µg/L	97.6	70.0	130	----
Tetrachloroethylene	127-18-4	E611D	0.5	µg/L	100 µg/L	115	70.0	130	----
Toluene	108-88-3	E611D	0.5	µg/L	100 µg/L	103	70.0	130	----
Trichloroethane, 1,1,1-	71-55-6	E611D	0.5	µg/L	100 µg/L	112	70.0	130	----
Trichloroethane, 1,1,2-	79-00-5	E611D	0.5	µg/L	100 µg/L	107	70.0	130	----
Trichloroethylene	79-01-6	E611D	0.5	µg/L	100 µg/L	124	70.0	130	----
Trichlorofluoromethane	75-69-4	E611D	0.5	µg/L	100 µg/L	119	60.0	140	----
Vinyl chloride	75-01-4	E611D	0.5	µg/L	100 µg/L	99.4	60.0	140	----
Xylene, m+p-	179601-23-1	E611D	0.4	µg/L	200 µg/L	110	70.0	130	----
Xylene, o-	95-47-6	E611D	0.3	µg/L	100 µg/L	104	70.0	130	----
Hydrocarbons (QCLot: 1022653)									
F2 (C10-C16)	----	E601.SG	100	µg/L	3879.32 µg/L	80.2	70.0	130	----
F3 (C16-C34)	----	E601.SG	250	µg/L	7754.95 µg/L	85.2	70.0	130	----
F4 (C34-C50)	----	E601.SG	250	µg/L	4176.89 µg/L	85.9	70.0	130	----
Hydrocarbons (QCLot: 1022672)									
F1 (C6-C10)	----	E581.F1-L	25	µg/L	2000 µg/L	102	80.0	120	----



Matrix Spike (MS) Report

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

Sub-Matrix: Water					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		Qualifier
					Concentration	Target	MS	Low	High	
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method						
Anions and Nutrients (QCLot: 1019945)										
HA2300346-001	Anonymous	Phosphate, ortho-, dissolved (as P)	14265-44-2	E378-U	0.0176 mg/L	0.0196 mg/L	89.9	70.0	130	----
Anions and Nutrients (QCLot: 1021675)										
WT2319487-001	Anonymous	Ammonia, total (as N)	7664-41-7	E298	ND mg/L	0.1 mg/L	ND	75.0	125	----
Anions and Nutrients (QCLot: 1021993)										
WT2319506-001	BH1	Nitrate (as N)	14797-55-8	E235.NO3	12.6 mg/L	12.5 mg/L	101	75.0	125	----
Anions and Nutrients (QCLot: 1021994)										
WT2319506-001	BH1	Nitrite (as N)	14797-65-0	E235.NO2	2.53 mg/L	2.5 mg/L	101	75.0	125	----
Anions and Nutrients (QCLot: 1021995)										
WT2319506-001	BH1	Sulfate (as SO4)	14808-79-8	E235.SO4	501 mg/L	500 mg/L	100	75.0	125	----
Anions and Nutrients (QCLot: 1021996)										
WT2319506-001	BH1	Chloride	16887-00-6	E235.Cl	510 mg/L	500 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 1021997)										
WT2319506-001	BH1	Fluoride	16984-48-8	E235.F	5.11 mg/L	5 mg/L	102	75.0	125	----
Anions and Nutrients (QCLot: 1022628)										
WT2319506-002	BH6	Sulfate (as SO4)	14808-79-8	E235.SO4	482 mg/L	500 mg/L	96.3	75.0	125	----
Anions and Nutrients (QCLot: 1022629)										
WT2319506-002	BH6	Chloride	16887-00-6	E235.Cl	484 mg/L	500 mg/L	96.8	75.0	125	----
Anions and Nutrients (QCLot: 1022630)										
WT2319506-002	BH6	Fluoride	16984-48-8	E235.F	4.95 mg/L	5 mg/L	99.0	75.0	125	----
Anions and Nutrients (QCLot: 1022631)										
WT2319506-002	BH6	Nitrate (as N)	14797-55-8	E235.NO3	12.2 mg/L	12.5 mg/L	97.8	75.0	125	----
Anions and Nutrients (QCLot: 1022632)										
WT2319506-002	BH6	Nitrite (as N)	14797-65-0	E235.NO2	2.41 mg/L	2.5 mg/L	96.6	75.0	125	----
Total Metals (QCLot: 1020601)										
WT2319454-001	Anonymous	Aluminum, total	7429-90-5	E420	0.102 mg/L	0.1 mg/L	102	70.0	130	----
		Antimony, total	7440-36-0	E420	0.0516 mg/L	0.05 mg/L	103	70.0	130	----
		Arsenic, total	7440-38-2	E420	0.0530 mg/L	0.05 mg/L	106	70.0	130	----
		Barium, total	7440-39-3	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----



Sub-Matrix: Water					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		Qualifier
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	
Total Metals (QCLot: 1020601) - continued										
WT2319454-001	Anonymous	Beryllium, total	7440-41-7	E420	0.00515 mg/L	0.005 mg/L	103	70.0	130	----
		Bismuth, total	7440-69-9	E420	0.0455 mg/L	0.05 mg/L	91.0	70.0	130	----
		Boron, total	7440-42-8	E420	ND mg/L	0.05 mg/L	ND	70.0	130	----
		Cadmium, total	7440-43-9	E420	0.00476 mg/L	0.005 mg/L	95.3	70.0	130	----
		Calcium, total	7440-70-2	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		Cesium, total	7440-46-2	E420	0.00255 mg/L	0.0025 mg/L	102	70.0	130	----
		Chromium, total	7440-47-3	E420	0.0126 mg/L	0.0125 mg/L	100	70.0	130	----
		Cobalt, total	7440-48-4	E420	0.0126 mg/L	0.0125 mg/L	100	70.0	130	----
		Copper, total	7440-50-8	E420	0.0118 mg/L	0.0125 mg/L	94.5	70.0	130	----
		Iron, total	7439-89-6	E420	ND mg/L	0.05 mg/L	ND	70.0	130	----
		Lead, total	7439-92-1	E420	0.0232 mg/L	0.025 mg/L	92.8	70.0	130	----
		Lithium, total	7439-93-2	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		Magnesium, total	7439-95-4	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		Manganese, total	7439-96-5	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		Molybdenum, total	7439-98-7	E420	0.0129 mg/L	0.0125 mg/L	103	70.0	130	----
		Nickel, total	7440-02-0	E420	0.0238 mg/L	0.025 mg/L	95.0	70.0	130	----
		Phosphorus, total	7723-14-0	E420	0.554 mg/L	0.5 mg/L	111	70.0	130	----
		Potassium, total	7440-09-7	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		Rubidium, total	7440-17-7	E420	0.00531 mg/L	0.005 mg/L	106	70.0	130	----
		Selenium, total	7782-49-2	E420	0.0477 mg/L	0.05 mg/L	95.4	70.0	130	----
		Silicon, total	7440-21-3	E420	ND mg/L	0.5 mg/L	ND	70.0	130	----
		Silver, total	7440-22-4	E420	0.00428 mg/L	0.005 mg/L	85.7	70.0	130	----
		Sodium, total	7440-23-5	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		Strontium, total	7440-24-6	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		Sulfur, total	7704-34-9	E420	ND mg/L	2.5 mg/L	ND	70.0	130	----
		Tellurium, total	13494-80-9	E420	0.00547 mg/L	0.005 mg/L	109	70.0	130	----
		Thallium, total	7440-28-0	E420	0.0459 mg/L	0.05 mg/L	91.9	70.0	130	----
		Thorium, total	7440-29-1	E420	0.00381 mg/L	0.005 mg/L	76.1	70.0	130	----
		Tin, total	7440-31-5	E420	0.0254 mg/L	0.025 mg/L	102	70.0	130	----
		Titanium, total	7440-32-6	E420	0.0142 mg/L	0.0125 mg/L	114	70.0	130	----
		Tungsten, total	7440-33-7	E420	0.00489 mg/L	0.005 mg/L	97.8	70.0	130	----
		Uranium, total	7440-61-1	E420	ND mg/L	0.00025 mg/L	ND	70.0	130	----
		Vanadium, total	7440-62-2	E420	0.0268 mg/L	0.025 mg/L	107	70.0	130	----
		Zinc, total	7440-66-6	E420	0.0208 mg/L	0.025 mg/L	83.2	70.0	130	----
		Zirconium, total	7440-67-7	E420	0.00467 mg/L	0.005 mg/L	93.4	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
Volatile Organic Compounds (QCLot: 1022671)										
WT2319512-001	Anonymous	Acetone	67-64-1	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Benzene	71-43-2	E611D	99.0 µg/L	100 µg/L	99.0	60.0	140	----
		Bromodichloromethane	75-27-4	E611D	106 µg/L	100 µg/L	106	60.0	140	----
		Bromoform	75-25-2	E611D	89.1 µg/L	100 µg/L	89.1	60.0	140	----
		Bromomethane	74-83-9	E611D	108 µg/L	100 µg/L	108	60.0	140	----
		Carbon tetrachloride	56-23-5	E611D	104 µg/L	100 µg/L	104	60.0	140	----
		Chlorobenzene	108-90-7	E611D	99.1 µg/L	100 µg/L	99.1	60.0	140	----
		Chloroform	67-66-3	E611D	104 µg/L	100 µg/L	104	60.0	140	----
		Dibromochloromethane	124-48-1	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Dibromoethane, 1,2-	106-93-4	E611D	99.9 µg/L	100 µg/L	99.9	60.0	140	----
		Dichlorobenzene, 1,2-	95-50-1	E611D	99.5 µg/L	100 µg/L	99.5	60.0	140	----
		Dichlorobenzene, 1,3-	541-73-1	E611D	97.8 µg/L	100 µg/L	97.8	60.0	140	----
		Dichlorobenzene, 1,4-	106-46-7	E611D	99.8 µg/L	100 µg/L	99.8	60.0	140	----
		Dichlorodifluoromethane	75-71-8	E611D	86.1 µg/L	100 µg/L	86.1	60.0	140	----
		Dichloroethane, 1,1-	75-34-3	E611D	96.4 µg/L	100 µg/L	96.4	60.0	140	----
		Dichloroethane, 1,2-	107-06-2	E611D	102 µg/L	100 µg/L	102	60.0	140	----
		Dichloroethylene, 1,1-	75-35-4	E611D	95.0 µg/L	100 µg/L	95.0	60.0	140	----
		Dichloroethylene, cis-1,2-	156-59-2	E611D	98.1 µg/L	100 µg/L	98.1	60.0	140	----
		Dichloroethylene, trans-1,2-	156-60-5	E611D	97.3 µg/L	100 µg/L	97.3	60.0	140	----
		Dichloromethane	75-09-2	E611D	106 µg/L	100 µg/L	106	60.0	140	----
		Dichloropropane, 1,2-	78-87-5	E611D	96.0 µg/L	100 µg/L	96.0	60.0	140	----
		Dichloropropylene, cis-1,3-	10061-01-5	E611D	92.7 µg/L	100 µg/L	92.7	60.0	140	----
		Dichloropropylene, trans-1,3-	10061-02-6	E611D	86.6 µg/L	100 µg/L	86.6	60.0	140	----
		Ethylbenzene	100-41-4	E611D	95.2 µg/L	100 µg/L	95.2	60.0	140	----
		Hexane, n-	110-54-3	E611D	93.1 µg/L	100 µg/L	93.1	60.0	140	----
		Methyl ethyl ketone [MEK]	78-93-3	E611D	105 µg/L	100 µg/L	105	60.0	140	----
		Methyl isobutyl ketone [MIBK]	108-10-1	E611D	82 µg/L	100 µg/L	82.3	60.0	140	----
		Methyl-tert-butyl ether [MTBE]	1634-04-4	E611D	99.4 µg/L	100 µg/L	99.4	60.0	140	----
		Styrene	100-42-5	E611D	95.2 µg/L	100 µg/L	95.2	60.0	140	----
		Tetrachloroethane, 1,1,1,2-	630-20-6	E611D	101 µg/L	100 µg/L	101	60.0	140	----
		Tetrachloroethane, 1,1,2,2-	79-34-5	E611D	94.7 µg/L	100 µg/L	94.7	60.0	140	----
		Tetrachloroethylene	127-18-4	E611D	101 µg/L	100 µg/L	101	60.0	140	----
		Toluene	108-88-3	E611D	93.6 µg/L	100 µg/L	93.6	60.0	140	----
		Trichloroethane, 1,1,1-	71-55-6	E611D	99.1 µg/L	100 µg/L	99.1	60.0	140	----
		Trichloroethane, 1,1,2-	79-00-5	E611D	99.5 µg/L	100 µg/L	99.5	60.0	140	----



Sub-Matrix: Water					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
					Concentration	Target	MS	Low	High	Qualifier
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method						
Volatile Organic Compounds (QCLot: 1022671) - continued										
WT2319512-001	Anonymous	Trichloroethylene	79-01-6	E611D	109 µg/L	100 µg/L	109	60.0	140	----
		Trichlorofluoromethane	75-69-4	E611D	104 µg/L	100 µg/L	104	60.0	140	----
		Vinyl chloride	75-01-4	E611D	88.9 µg/L	100 µg/L	88.9	60.0	140	----
		Xylene, m+p-	179601-23-1	E611D	200 µg/L	200 µg/L	100	60.0	140	----
		Xylene, o-	95-47-6	E611D	95.7 µg/L	100 µg/L	95.7	60.0	140	----
Hydrocarbons (QCLot: 1022672)										
WT2319512-001	Anonymous	F1 (C6-C10)	----	E581.F1-L	1630 µg/L	2000 µg/L	81.5	60.0	140	----



www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: 20-1007883

Page 1 of 1

Environmental Division
Waterloo
Work Order Reference
WT2319506



Telephone : +1 519 886 6910

Report To

Company: MTE
Contact: Fraser Cummings
Phone:

Street: K. Hether
City/Province:
Postal Code:

Company address below will appear on the final report

Invoice To: Same as Report To ☒ YES ☐ NO
Copy of Invoice with Report ☐ YES ☐ NO

Company:
Contact:

Project Information

ALS Account # / Quote #: 32375-700
Job #: 32375-700
PO / AFE:
LSD:

ALS Lab Work Order # (ALS use only): WT2319506

Sample Identification and/or Coordinates
(This description will appear on the report)

BH1
BH6

Oil and Gas Required Fields (client use)

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

ALS Contact: Emily H Sampler: ALC

Turnaround Time (TAT) Requested

☒ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Addic may apply to rush requests on weekends, statutory holidays and non-rout

Date and Time Required for all E&P TATs:

For all tests with rush TATs requested, please ct

Analysis Ret

Indicate Filtered (F), Preserved (P) or Filtered an

NUMBER OF CONTAINERS

Genchempy
total metals
VOCs
BTEX (F-F4)
TSS

SAMPLES ON HOLD

EXTENDED STORAGE REQU

SUSPECTED HAZARD (see r

Drinking Water (DW) Samples¹ (client use)

Are samples taken from a Regulated DW System? ☐ YES ☒ NO
Are samples for human consumption/ use? ☐ YES ☒ NO

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

SHIPMENT RELEASE (client use)

Released by: Date: Jun 30/23 Time: 1440

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by: Date: Time:

FINAL SHIPMENT RECEPTION (ALS use only)

Received by: Date: 06/30/23 Time: 1440

COOLING METHOD: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

SUBMISSION COMMENTS IDENTIFIED ON SAMPLE RECEIPT NOTIFICATION: ☐ YES ☐ NO

COOLER CUSTODY SEALS INTACT: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C: 21.3 FINAL COOLER TEMPERATURES °C: 21.3

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GC-218
MM-226
VW-2945

Appendix E

Dewatering Calculations

Methodology:

This assessment is based on semi-empirical relationship proposed by Kavvasdas et al 1992 which calculates the dewatering flow rates in case of supported excavation below the water table

Equations:

$$q = 0.85kH \left[1 - (0.2)^{\frac{s}{0.5B}} \right] \left(\frac{d}{0.5B} \right)^{-\frac{1}{2}} \left(\frac{d_1}{0.5B} \right)^{-\frac{1}{8}}$$

Equation 10 (Kavvasdas et al 1992)*

* modified for rectangular excavations

$$q_o = q \left[0.70 + 0.30 \left(1 - \frac{B}{L} \right) \right]$$

Equation 16a (Kavvasdas et al 1992)

$$q_r = q/\mu$$

Equation 15a (Kavvasdas et al 1992)**

** when low permeable layer is present to toe the support

$$\mu = 1 + 0.25 \left(\frac{t}{d} \right) \left(\frac{k}{k_r} - 1 \right)^{\frac{1}{8}}$$

Equation 15c (Kavvasdas et al 1992)**

Assumptions:

Steady state seepage flow conditions (no change in storage)

Soil is homogenous and isotropic

Uniform saturated thickness

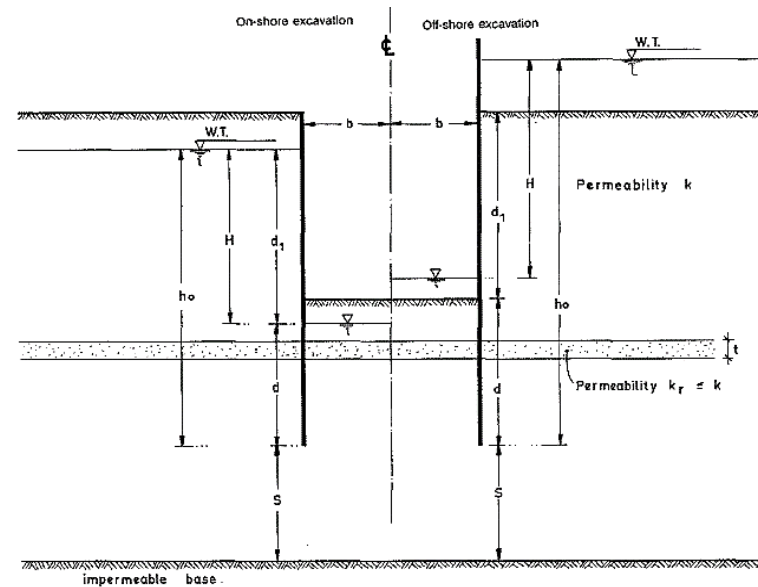
Terminology:

q	Total amount of seepage into the excavation per unit length of perimeter ¹	m ³ /sec
q _r	Total amount of seepage into the excavation per unit length of perimeter ²	m ³ /sec
q _o	Total amount of seepage into the excavation per unit length of perimeter ³	m ³ /sec
K	Hydraulic conductivity of high permeable layer	m/sec
H	Required drawdown to target water table	m
s	Distance of support from the impermeable base	m
B	Width of the excavation (where B < L)	m
L	Length of excavation	m
d	Penetration depth of support below the target water table	m
d ₁	Drawdown in the excavation	m
q _r	Total amount of seepage into the excavation per unit length ²	m ³ /sec
t	thickness of continuous horizontal low permeability layer	m
k _r	Hydraulic conductivity of low permeability layer	m/sec

¹ when low permeable layer is not present to toe the support

² when low permeable layer is present to toe the support

³ adjusted for excavations of finite length

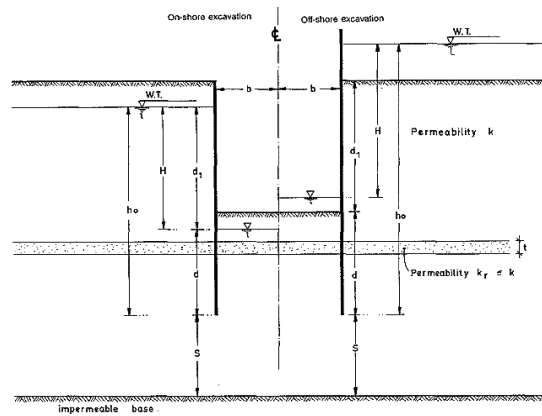


Applicable Geometry = Left (on-shore supported excavation below the water table)
(Kavvasdas et al 1992)

Lowest Underground Structure P2

Input Parameter	Units	Value
Excavation Length	m	67.5
Excavation Width	m	30.1
Excavation Perimeter	m	195.0
Design Water Table	m AMSL	324.11
Lowest Bottom of Slab	m AMSL	321.77
Dewatering Target	m AMSL	321.27
Top of Low Permeable Layer	m AMSL	320.00
Bottom of Low Permeable Layer	m AMSL	309.37
Bottom of Impermeable Base/ Aquifer	m AMSL	309.37
Toe of Support	m AMSL	318.00
Hydraulic conductivity of high permeable layer	m/sec	4.3E-04
Hydraulic conductivity of low permeable layer	m/sec	4.0E-09
Storage Coefficient/Storativity	-	0.26
Rainfall Depth	mm	28.2
Factor of Safety (SF)	-	1.5

m AMSL: meters above mean sea level



Applicable Geometry = Left (on-shore supported excavation below the water table)
(Kavvas et al 1992)

Steady State Dewatering Rate

H	s	B	d	d ₁	t	q	q _o	μ	q _r	Q	Q
Required Drawdown	Distance of Support from Impermeable Base	Excavation Width	Penetration Depth of Support	Drawdown in Excavation	Thickness of Low Permeability Layer	Seepage Per Unit Length	Seepage Per Unit Length	Adjustment Factor	Seepage Per Unit Length	Total Seepage	Total Seepage for Entire Section
(m)	(m)	(m)	(m)	(m)	(m)	(m ³ /sec)	(m ³ /sec)	-	(m ³ /sec)	(m ³ /sec)	(m ³ /day)
2.84	8.63	30.05	3.27	2.84	10.63	0.001653	0.001432	87364.5	0.000000	0.000003	0.28

Results Summary

Total Seepage Q	L/day	276
Total Seepage Q (SF:1.5)	L/day	500
Precipitation Control	L/day	57,500
assumed period of removal	days	1
Storage Release	L/day	72,500
assumed period of removal	days	30

$$q = 0.85kH \left[1 - (0.2)^{\frac{s}{0.5B}} \right] \left(\frac{d}{0.5B} \right)^{-\frac{1}{2}} \left(\frac{d_1}{0.5B} \right)^{-\frac{1}{8}}$$

Equation 10 (Kavvas et al 1992)*
* modified for rectangular excavations

$$q_r = q/\mu$$

Equation 15a (Kavvas et al 1992)**
** when low permeable layer is present to toe the support

$$q_o = q \left[0.70 + 0.30 \left(1 - \frac{B}{L} \right) \right]$$

Equation 16a (Kavvas et al 1992)

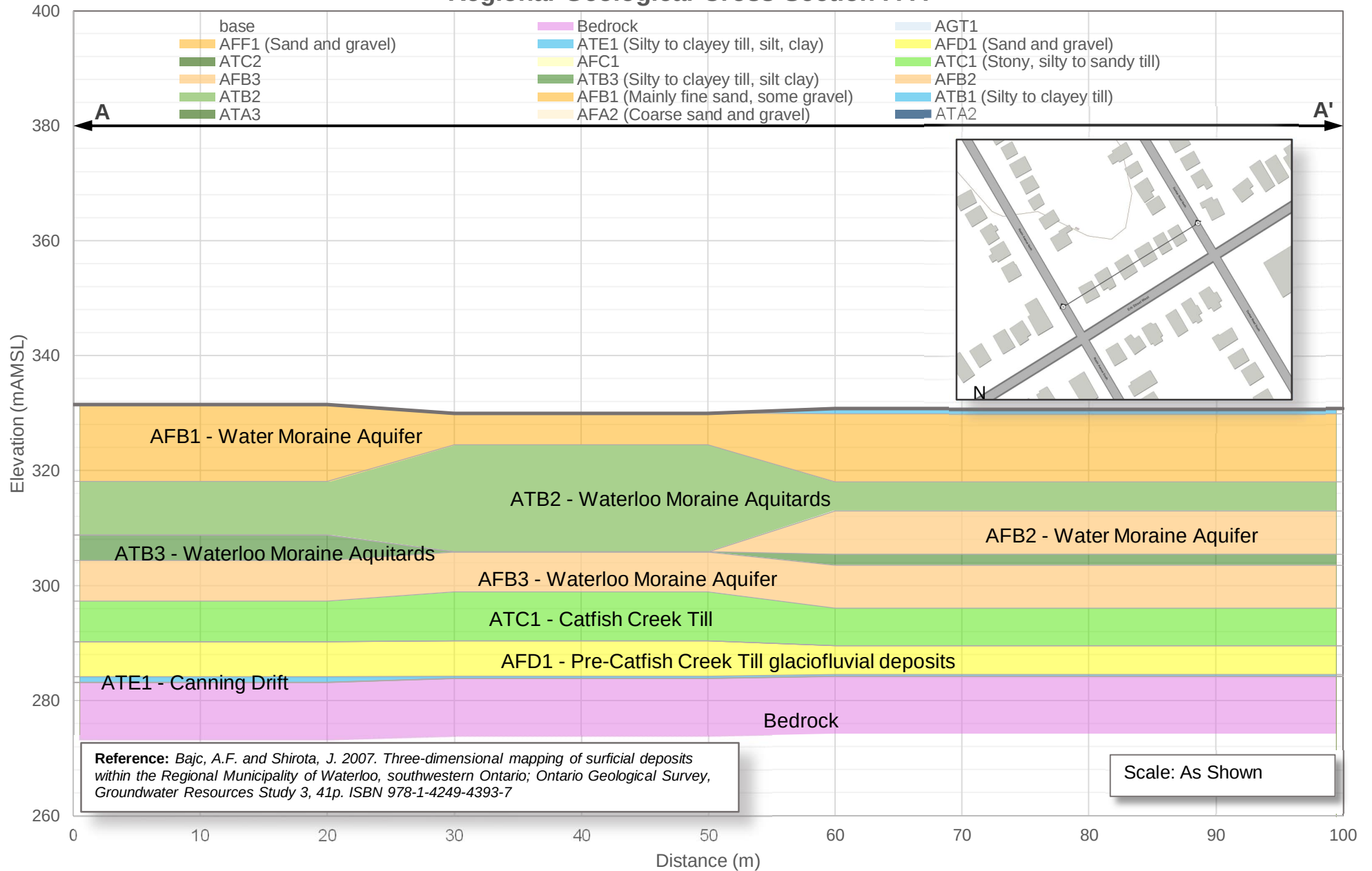
$$\mu = 1 + 0.25 \left(\frac{t}{d} \right) \left(\frac{k}{k_r} - 1 \right)^{-\frac{1}{8}}$$

Equation 15c (Kavvas et al 1992)**

Appendix F

Vulnerability Assessment

Regional Geological Cross-Section A-A'



Existing Soil Conditions - Regional Geological Cross Section A-A'

Distance along Section A'A' (m)	Thickness of Geological Formation (m)							Estimated ISI
	ATC1	AFB3	ATB3	AFB2	ATB2	AFB1	ATB1	
0	7.1	7.1	4.4	0.0	9.3	13.4	0.0	166
10	7.1	7.1	4.4	0.0	9.3	13.4	0.0	166
20	7.1	7.1	4.4	0.0	9.3	13.4	0.0	166
30	8.6	6.9	0.0	0.0	18.7	5.5	0.0	188
40	8.6	6.9	0.0	0.0	18.7	5.5	0.0	188
50	8.6	6.9	0.0	0.0	18.7	5.5	0.0	188
60	6.6	7.4	1.9	7.5	5.0	11.9	0.8	140
70	6.6	7.4	1.9	7.5	5.0	11.9	0.8	140
80	6.6	7.4	1.9	7.5	5.0	11.9	0.8	140
90	6.6	7.4	1.9	7.5	5.0	11.9	0.8	140
100	6.6	7.4	1.9	7.5	5.0	11.9	0.8	140
K-Factor	6	2	6	2	6	2	6	

$$\text{Intrinsic Susceptibility Index (ISI)} = \text{Sum (layer thickness} \times \text{K factor)} = \mathbf{160}$$

Excavated Conditions - Regional Geological Cross Section A-A'

Distance along Section A'A' (m)	Thickness of Geological Formation (m)							Estimated ISI
	ATC1	AFB3	ATB3	AFB2	ATB2	AFB1	ATB1	
0	7.1	7.1	4.4	0.0	9.3	3.9	0.0	147
10	7.1	7.1	4.4	0.0	9.3	3.9	0.0	147
20	7.1	7.1	4.4	0.0	9.3	3.9	0.0	147
30	8.6	6.9	0.0	0.0	16.1	0.0	0.0	162
40	8.6	6.9	0.0	0.0	16.1	0.0	0.0	162
50	8.6	6.9	0.0	0.0	16.1	0.0	0.0	162
60	6.6	7.4	1.9	7.5	5.0	4.0	0.0	119
70	6.6	7.4	1.9	7.5	5.0	4.0	0.0	119
80	6.6	7.4	1.9	7.5	5.0	4.0	0.0	119
90	6.6	7.4	1.9	7.5	5.0	4.0	0.0	119
100	6.6	7.4	1.9	7.5	5.0	4.0	0.0	119
K-Factor	6	2	6	2	6	2	6	

$$\text{Intrinsic Susceptibility Index (ISI)} = \text{Sum (layer thickness} \times \text{K factor)} = \mathbf{138}$$

References:

Guidelines for Construction of Underground Parking in a Groundwater Protection Area, July 2011
 Bajc, A., & Shirota, J. (2007).

Intrinsic Susceptibility Categories

Category	Intrinsic Susceptibility Value
Low	Greater than 80
Medium	30 - 80
High	Less than 30

Appendix G

Monitoring and Contingency Plan

Table G.1: Dewatering Monitoring and Contingency Plan

Monitoring Component	Monitoring Parameter	Monitoring Location	Monitoring Frequency	Trigger	Contingency/Corrective Action	Reporting/Documentation Requirements
Discharge	Quantity/Flow	Dewatering System	Flow rates from the dewatering system should be measured and recorded daily using a calibrated in-line flow meter installed at the discharge outlet. The selected flow meter should be capable of continuously logging flow rates and cumulative daily volumes. The daily water takings should be reviewed regularly to assess trends that may indicate increased groundwater inflow.	N/A	N/A	All flow records and maintenance logs will be kept onsite and made available for inspection upon request by MECP or municipal representatives. A summary of daily flow volumes should be included in the monitoring or dewatering completion report. The reported water takings under the EASR are required to be filed by March 31 of the following year under O. Reg. 387/04
	Quality	Dewatering System/Discharge Outlet	Discharge samples should also be analyzed for General Chemistry parameters including: Alkalinity, Ammonia, Colour, Conductivity, Hardness, pH, TDS, Total Metals, Cl, F, NO₂, NO₃, PO₄, SO₄, Total Chromium VI, Total Mercury, Total Phosphorus, Turbidity, TSS, and TCE During active dewatering, sampling should be conducted weekly for the first 3 weeks to confirm compliance with PWQOs, TSS and TCE criteria. If results remain within acceptable limits, the frequency can be reduced to biweekly. Additional sampling should be completed following changes to the dewatering setup, or if any visual changes in discharge quality are observed.	Discharge quality exceeds PWQO guidelines and/or TSS>15mg/L and/or TCE>5µg/L and/or visible water quality impact	Pumping should be suspended and discharge be diverted to on-site storage or holding tanks for treatment. The dewatering/treatment system will be inspected, and improvements will be implemented as necessary. Once corrective actions have been taken, re-sampling should be conducted and discharge may resume only when monitoring results confirm compliance with discharge criteria.	All water quality data and field observations, should be recorded in a site log. Any exceedances and associated response actions should be documented, and a summary of monitoring results should be provided upon request or at the conclusion of the dewatering activities.