



CHUNG & VANDER DOELEN
ENGINEERING LTD.

**GEOTECHNICAL INVESTIGATION
PROPOSED APARTMENT BUILDINGS
36 WESTHILL DRIVE
Waterloo, Ontario**

SUBMITTED TO:

Blackdoor DC
75 Sheffield Street
North York, ON
M6M 3E9

ATTENTION:

Mr. Rob Gazzola



CHUNG & VANDER DOELEN
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September 3, 2025
File No.: 2297 Rev.2

Blackdoor DC
75 Sheffield Street
North York, ON
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Attention: Mr. Rob Gazzola

RE: Geotechnical Investigation
Proposed Apartment Buildings
36 Westhill Drive, Waterloo, Ontario

We take pleasure in enclosing one (1) copy of our Geotechnical Investigation Report carried out at the above-referenced Site. Soil samples will be retained for a period of three (3) months and will thereafter be disposed of unless we are otherwise instructed.

If you have any questions or clarifications are required, please contact the undersigned at your convenience.

We thank you for giving us this opportunity to be of service to you.

Yours truly,

CHUNG & VANDER DOELEN ENGINEERING LTD.

Eric Y. Chung, M.Eng., P.Eng.
Principal Engineer

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1.0 INTRODUCTION

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) was retained by Blackdoor DC to carry out a geotechnical investigation for the proposed apartment buildings at 36 Westhill Drive, Waterloo, Ontario.

The site has an area of $0.7\pm$ ha and is presently occupied by a single-family residential dwelling, a detached residential garage, and a shed structure. The remainder of the site consists of grassed/landscaped areas. It is understood that the existing residential dwelling/structures will be demolished for the proposed redevelopment.

Based on the latest design drawings, the site will be redeveloped with one (1) 6-storey building (Building A) and one (1) 8-storey building (Building B), each has a plan area of $18.4\pm$ by $49.9\pm$ m. Building A is located at the southern portion of the site, with an east-west orientation, while Building B is located to the north in a north-south orientation fronting Westhill Drive, with finished grades at 386.150 m and 386.550 m respectively. Basement is not proposed at either building.

At grade paved parking will be provided on the east side of the proposed buildings and a “Lower Parking” level will be located at the northeast corner of the site with finished grade proposed at elevation 384.425 m.

The purpose of this investigation was to determine the subsurface conditions at the site and, based on the findings, to make geotechnical recommendations for:

- Foundation recommendations;
- Preliminary hydrogeological assessment;
- Foundation soil classification for seismic design per OBC 2024;
- Excavation and groundwater control;
- Shoring Design;
- Pavement design and construction; and
- Discussion of analytical chemistry results of soils.

2.0 FIELD WORK

Nine (9) boreholes were drilled and sampled to a depth of 9.76 m below existing grade to investigate the subsurface conditions at the site. The borehole locations are illustrated on the appended Borehole Location Plan, Drawing No. 1.

The field work for this project was carried out on January 14 to 16, 2025, under the supervision of a member of our engineering team, who logged the boreholes in the field, effected the subsurface sampling and monitored the groundwater conditions. Underground utilities were located prior to commencing the field work program, by contacting Ontario-One-Call and a private locator.

The boreholes were advanced using a track-mounted CME 55 drill rig, supplied, and operated by a specialist drilling contractor. The drill rig was equipped with continuous flight hollow stem augers and standard soil sampling equipment. Standard penetration tests (SPTs) in accordance with ASTM



Specification D1586, were carried out at frequent intervals of depth, and the results are shown on the Borehole Logs as Penetration Resistance or “N”-values. Dynamic cone penetration testing was conducted where low “N”-values were recorded to confirm the compactness of the soil deposit.

The undrained shear strength of the cohesive soil deposits was determined on the slightly disturbed SPT samples using a field pocket penetrometer. The compactness condition and the consistency of the soil strata has been inferred from the test results.

The boreholes were surveyed by CVD with reference to a local temporary benchmark (TBM). The temporary benchmark elevation was surveyed by CVD for the purpose of this report using a Network RTK Global Navigation Satellite System (GNSS) Receiver. The survey data was collected using the UTM Zone 17N Projection, NAD83(CSRS)v7-2010 datum and Canada Geoid Model HT2_2010v70 (CGVD28).

3.0 LABORATORY TESTING

Soil samples obtained from the in-situ tests were examined in the field and subsequently brought to our laboratory for visual and tactile examination to confirm field classification. Moisture content of all retrieved samples was determined.

Two (2) grain size distribution analyses and two (2) Atterberg Limits tests were carried out on representative soil samples of the major soil deposits to confirm field identification and to provide information on the soil hydraulic conductivity and engineering characteristics.

Four (4) soil samples were submitted to ALS Laboratories of Waterloo for analysis of Metals and Inorganics, Petroleum Hydrocarbons (PHCs) fractions F1-F4, and Benzene-Toluene-Ethylbenzene-Xylene (BTEX). The chemical testing was conducted to provide a preliminary assessment of the environmental quality of potential excess soil which may be generated and removed off-site during construction.

4.0 EXISTING SITE CONDITIONS

The site is located on the east side of Westhill Drive and has an area of 0.7± ha. It is presently occupied by a single-family residential dwelling, a detached residential garage, and a shed structure. The remainder of the site consists of grassed/landscaped areas.

The site is bound by Westhill Drive on west which connects to Ira Needles Boulevard and by residential properties to the north, east and south. There is a 4.0± m grade difference between the boreholes with elevations ranging between 387.12 and 383.06 m and a 5.0± m grade difference between the highest point on the northwest portion of the site to the lowest point on the northeast corner of the site.



5.0 SUBSURFACE CONDITIONS

5.1 General

The subsurface conditions encountered at the boreholes are detailed on the respective log sheets, Enclosures 1 to 9. The following sections provide descriptions of the major deposits encountered at the boreholes. Enclosure A provides explanations of the various soil abbreviations and terms used on the borehole log sheets.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling conducted during advancement of the borehole drilling procedures and, therefore, represent transitions between soil types rather than exact planes of geologic change. The subsurface conditions will vary between and beyond the borehole locations.

5.2 Topsoil and Fill

The boreholes penetrated topsoil at the ground surface with measured thicknesses between 200 and 500 mm.

Below the surficial topsoil, Boreholes 1, 2, 3 and 5 encountered fill materials, consisting of dark brown to brown sandy silt with some gravel and trace clay. The fill materials extended to depths between 0.76 and 1.52 m below ground surface. Occasional rootlets and trace to some organics (topsoil-like) were also observed within the fill layers.

Standard penetration testing within the fill yielded “N”-values of 4 to 10 blows per 300 mm, thus indicating variable loose to compact state of compactness. The moisture content determinations from this layer revealed moisture to be between 10 and 17%, indicative of moist moisture conditions.

5.3 Clayey Silt

Clayey silt deposit was encountered below the fill in Boreholes 1, 2, 3, 5 and below the topsoil in the remaining boreholes. The brown to grey clayey silt deposit was interlayered with occasional sand and silt seams/layers in all boreholes and extended to at least the borehole termination depths of 9.76 m below existing grade. The sand/silt seams/layers were often saturated.

Results of two (2) grain size distribution analyses from Boreholes 1 and 9 are shown graphically on Enclosures 10 and 11.

The SPT “N”-values measured within the clayey silt deposit ranged from 3 to 20 blows per 300 mm of penetration, indicating a soft to very stiff condition. Natural moisture contents were measured between 11 and 23%, indicating drier than plastic limit (DTPL) to about plastic limit (APL) condition within the upper clayey silt deposit and moist to wet moisture conditions in the occasional sand and silt seams and the lower clayey silt stratum. Pocket penetrometer testing on the retrieved split-spoon samples indicated undrained shear strength values ranging from 50 to greater than 225 kPa.



5.4 Soil Chemistry

Four (4) soil samples were submitted to ALS Laboratories of Waterloo for analysis of Metals and Inorganics, Petroleum Hydrocarbons (PHCs) fractions F1-F4, and Benzene-Toluene-Ethylbenzene-Xylene (BTEX). The chemical testing was conducted to initially assess the environmental quality of potential excess soil which may be generated and removed off-site during construction activities.

The following table presents the location, depth, description, and parameters analysed for each soil sample collected and submitted.

Sample I.D.	Sample Depth (mbgs)	Sample Description	Parameters Analysed
BH3 SS1	0.0 to 0.6	Topsoil and FILL – sandy silt	Metals and Inorganics, PHCs F1-F4, BTEX
BH4 SS1	0.0 to 0.6	Topsoil and NATIVE – clayey silt	Metals and Inorganics, PHCs F1-F4, BTEX
BH6 SS1	0.0 to 0.6	Topsoil and NATIVE – clayey silt	Metals and Inorganics, PHCs F1-F4, BTEX
BH7 SS1	0.0 to 0.6	Topsoil and NATIVE – clayey silt	Metals and Inorganics, PHCs F1-F4, BTEX

mbgs– denotes metres below ground surface

The laboratory certificates of chemical analysis and results provided by ALS Laboratories of Waterloo are enclosed in Appendix B.

5.5 Groundwater Condition

Groundwater conditions were monitored during and immediately following the withdrawal of the drilling augers at each borehole location. Upon auger withdrawal, all the boreholes remained open and observed to be dry.

Three (3) monitoring wells were installed across the site to determine the groundwater level/elevation and to provide hydrogeological information. One (1) monitoring well was installed at shallow depth to determine the upper “perched” groundwater level and two (2) monitoring wells were installed at the bottom of the borehole to capture the groundwater level at the lower soil stratum.



The groundwater depths and corresponding elevations are shown in the following table:

Borehole No.	Existing Ground Elevation (m)	Date	Groundwater Depth (m)	Groundwater Elevation (m)
1	387.12	January 29, 2025	3.73	383.39
		February 21, 2025	3.94	383.18
6	384.20	January 29, 2025	2.06	382.14
		February 21, 2025	2.25	381.95
7	386.68	January 29, 2025	4.57	382.11
		February 21, 2025	4.60	382.08

Based on the observed groundwater levels in the monitoring wells, moisture contents, the conditions observed in the boreholes upon withdrawal of the drilling augers and the response test performed in the monitoring wells, the perched groundwater table observed within the clayey silt deposit was found at elevations ranging between 381.95± and 383.18± m (Boreholes 1, 6 and 7). Appendix D provides the summary of water levels, elevations and fluctuations.

Typically, the long-term groundwater table is expected to lie where the clayey silt deposit changes in colour from brown to grey at depths between 3.5± and 6.0± m. The shallow groundwater flow direction is expected to follow topography and generally flow in a northeasterly direction beneath the site.

It should be noted that the observed groundwater table will likely be higher in the spring following snow melt and will fluctuate seasonally and in response to major weather events.

5.6 Preliminary Hydrogeological Assessment and Dewatering

Well response recovery test (slug test) was conducted at monitoring well locations 1 and 6 on February 21, 2025. The monitoring wells were purged by hand using polyethylene tubing and check valves. The water in the test well was lowered by pumping and the subsequent water level recovery was measured over time. The data collected were analyzed using AquiferTest software and the results are presented in Appendix D. The hydraulic conductivity (permeability) of the clayey silt deposit at the monitoring well locations was in the range of 2×10^{-8} to 3×10^{-8} m/sec. These low hydraulic conductivity values imply that the sand/silt seams/layers are of minimal thickness and occurrence.

Considering the slow rate of groundwater ingress and the small quantity (less than 50,000 L/day) of water produced from the perched water table due to the low hydraulic conductivity of the sand/ silt seams/layers encountered within the clayey silt deposit (2.5×10^{-8} m/sec), conventional pumping from filter sump pits should be sufficient to control perched water ingress during foundation and basement construction.



6.0 DISCUSSION AND RECOMMENDATIONS

6.1 General

Based on the latest design drawings, the site will be redeveloped with one (1) 6-storey building (Building A) and one (1) 8-storey building (Building B), each has a plan area of $18.4\pm$ by $49.9\pm$ m. Building A is located at the southern portion of the site, with an east-west orientation, while Building B is located to the north in a north-south orientation fronting Westhill Drive, with finished grades at 386.150 m and 386.550 m respectively. Basement is not proposed at either building.

At grade paved parking will be provided on the east side of the proposed buildings and a “Lower Parking” level will be located at the northeast corner of the site with finished grade proposed at elevation 384.425 m.

Typically, the long-term groundwater table is expected to lie where the clayey silt deposit changes in colour from brown to grey at depths between $3.5\pm$ and $6.0\pm$ m. The shallow groundwater flow direction is expected to follow topography and generally flow in a northeasterly direction beneath the site. Minor seasonally springs were observed on this sloping site at its northeastern portion and the slope east of the property boundary.

The hydraulic conductivity (permeability) of the clayey silt deposit at the monitoring well locations was in the range of 2×10^{-8} to 3×10^{-8} m/sec.

6.2 Lower Parking Level

The lower parking structure has a proposed finished grade of 384.425 m, which is essentially near existing grade along the west side and above existing grade on the east side. This below grade parking structure will be located above the measured groundwater table, and therefore conventional weeping tile will suffice in controlling surface water that could inadvertently infiltrate adjacent to the foundation wall.

6.3 Footing Foundation

Conventional strip and spread footing foundations can be used to support the proposed apartment buildings and the lower parking structure. Footings cast on firm to stiff, grey clayey silt which can be designed using a net Geotechnical Reaction at SLS of 150 kPa. The SLS value given above is based on a maximum settlement of 25 mm under the footing foundations. The Factored net Geotechnical Resistance at ULS is 225 kPa.

These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. The maximum total and differential settlements of footings designed to the above recommended soil bearing pressures are expected to be less than 25 and 20 mm, respectively, and these are considered tolerable for the structure being contemplated.



The majority of the settlements will take place during construction and the first loading cycle of the building. Footings should be founded below any existing fill, building foundations and utility trenches, on competent native undisturbed soil. Spacing between adjacent footing steps should not be steeper than 10H to 7V.

The following table provides the depth and elevation at each borehole location where non-suitable soil conditions were encountered:

Borehole No.	Existing Ground Elevation (m)	Highest Founding Depth (m)	Highest Founding Elevation (m)
1	387.12	1.62	385.50
2	385.01	1.41	383.60
3	383.06	1.26	381.80
4	386.40	0.60	385.80
5	387.00	1.50	385.50
6	384.20	1.20	383.00
7	386.68	1.08	385.60
8	386.93	1.13	385.80
9	385.53	1.43	384.10

Exterior footings and footings in unheated portions of the building should be provided with a soil cover of not less than 1.2 m or equivalent synthetic thermal insulation for adequate frost protection. The founding subgrade soils must be protected from frost penetration during winter construction.

It is recommended that a lean concrete mat be placed over approved footing subgrade in wet or saturated areas to prevent further disturbance to the bearing soils resulting from construction activities.

It is also recommended that the footing excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation.

6.4 Engineered Fill Construction

The finished floor elevation of 384.425 m will be above the existing grade of the eastern portion of the lower parking structure, and therefore engineered fill can be constructed to raise the grade to support the footings and floor slab.

The existing topsoil, fill materials and foundations are to be removed and replaced with properly placed and compacted engineered fill. Approved imported sand and gravel containing less than 8% silt sized



particles (OPSS Granular “B” Type I) should be used to construct the engineered fill under controlled and supervised conditions. The moisture content of the soil requires to be within 3% dry of its optimum moisture condition to achieve the specified degree of compaction.

Engineered fill is to be constructed in accordance with the following procedures in order to support the future foundations and floor slabs, if adopted:

1. All existing topsoil, fill materials, existing foundations and otherwise deleterious materials are to be excavated/removed to expose the underlying competent native subgrade;
2. The exposed subgrade surface is to be thoroughly recompacted by large heavy compaction equipment (10 tonne recommended) and inspected by qualified geotechnical personnel. Any loose or soft areas identified should be excavated to the level of competent soil;
3. The required grades can then be achieved by placing approved sand and gravel (OPSS Granular B, Type I) in maximum 300 mm thick lifts and compacted to no less than 100% Standard Proctor maximum dry density (SPMDD) to the underside of the proposed footings and to at least 95% SPMDD for floor slab support. The moisture content of the soil requires to be within 3% dry of its optimum moisture condition to achieve the specified degree of compaction;
4. Engineered fill must be placed such that the fill pad extends horizontally outwards from all footings/foundation at least the same distance as how thick the engineered fill pad will exist between the underside of future footings and the approved native subgrade; and
5. All fill placement and compaction operations must be supervised on a full-time basis by qualified geotechnical personnel to approve fill material and ensure the specified degree of compaction has been achieved.

Foundations supported on approved engineered fill constructed in accordance with the procedures outlined above can be designed for net bearing capacities up to a maximum of 150 kPa at SLS and 225 kPa at ULS, as specified in *Section 6.2*.

6.5 Raft Foundation

A raft foundation (or combined large footings) may be required to locally support heavily-loaded areas such as the elevator and stair cores of the building. The raft should be founded on competent native clayey silt at or below the elevations given in the table in *Section 6.2*.

The following preliminary design and construction criteria are recommended for raft foundation. A detail settlement analysis will be required when the loads and size of the raft foundation are available.

- Modulus of vertical subgrade reaction of 10 MPa/m can be used for preliminary structural design of the raft foundation.
- Remove any loose or soft soils exposed at the raft founding subgrade and replace such materials with lean concrete.



- Place a 50 to 100 mm thick lean concrete working pad to facilitate placement of reinforcement steel.
- Groundwater must be properly controlled during the raft slab construction.
- The Factored net geotechnical bearing resistance at Ultimate Limit State (ULS) is 300 kPa.

A refined settlement analysis can be completed once the actual pressure distribution under the raft is established by the structural engineer. CVD can update the preliminary settlement model and provide a refined modulus of subgrade reaction and settlement estimate for the final raft design.

It is recommended that the foundation excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation.

6.6 Earthquake Consideration

In accordance with The Ontario Building Code 2024 (OBC), the proposed structure should be designed to resist earthquake load and effects as per Subsection 4.1.8.

Based on the average Vs30 obtained from the MASW sounding, the site can be classified as **Site Class C** ($360 < V_s \leq 760$) in accordance with Table 4.1.8.4.-B of the 2024 Ontario Building Code (OBC 2024). The site designation is X439 in accordance with clause 4.1.8.4-(2b) of OBC 2024.

For detailed information on the site-specific shear wave velocity survey, refer to the Shear Wave Velocity Sounding report dated August 22, 2025 in Appendix F.

6.7 Open Cut Excavation and Groundwater Control

Excavations are expected to range from 1± m to 3± m across the site for foundations, site servicing, and elevator pits. The excavations will typically penetrate topsoil, loose to compact fill over very stiff to firm clayey silt deposit with occasional sand and silt seams/layers.

These materials are considered to be Type 3 Soils in accordance with the latest Occupational Health and Safety Act. Excavations in the Type 3 Soils are expected to remain stable during the construction period provided that side slopes are cut to 1H : 1V from the bottom of the excavation. Where excessively loose/soft soils and/or seepage zones or groundwater are intersected, side slopes should be cut to more stable angles of 3H : 1V. The side slopes should be suitably protected from erosion processes.

It is noted that the perched groundwater table caused due to the sand and silt seams/layers encountered within the clayey silt deposit lies at depths between 2.3± and 3.9± m, corresponding to elevations 382.0± and 383.2± m.

Considering the low hydraulic conductivity of the silt and sand seams/layers encountered within the clayey silt deposit (2.5×10^{-8} m/sec), the rate of groundwater ingress will be slow, and the quantity will



be less than 50,000 L/day. It is anticipated that no significant amount of groundwater ingress into the excavations would be encountered. Storm water runoff and local perched groundwater conditions at site can be controlled by pumping from filtered sump pits as and where required.

It is recommended that excavation for the future development be done during the typically drier summer months when groundwater conditions would be expected to lie at lower elevations. It should be noted that the observed groundwater table will likely be higher in the spring following snow melt and will fluctuate seasonally and in response to major weather events.

In wet to saturated subgrade condition, it will be necessary to excavate below founding level and pour a 75 mm thick mud slab of lean concrete to protect the founding soil from disturbance during the installation of reinforcing steel bars and form work.

6.8 Slab on Grade

The floor slab for the apartment building and lower parking structure can be constructed as slab-on-grade. At the time of floor slab construction, the exposed subgrade should be proof-rolled with a heavy roller in conjunction with an inspection by the geotechnical engineer. Any soft and/or unstable areas detected should be replaced with imported granular fill which should be compacted to at least 95% SPMDD.

Following the proof-rolling of the subgrade, it is recommended that a minimum 150 mm thick layer of OPSS Granular "A" be placed and compacted to at least 100% SPMDD beneath the concrete floor slabs to provide uniform support.

A modulus of subgrade reaction (k_s) of 30 MN/m³ may be used for the design of the floor slabs, considering the floor subgrade will consist of predominantly clayey silt soils.

Care should be taken to ensure that the backfill against foundation walls, interior piers/columns and concrete pits are placed in thin layers and each layer compacted to at least 95% SPMDD. These types of confined areas should be backfilled with OPSS Granular B Type I.

The floor slabs should be separated structurally from the columns and foundation walls. Sawcut control joints should be provided at regular spacing (less than 30 times the concrete slab thickness) and to depths between one-third and one-quarter of the slab thickness.

Moisture migration from the underlying soils through the concrete slab-on-grade will take place via "capillary action" and "diffusion" (due to vapour pressure differential). Although the Granular "A" layer will provide a capillary break, the low permeance of the concrete slab and floor coverings will result in 100% humidity under the concrete slab and, consequently, the moisture in the concrete will increase over time. The potential effect of the soil moisture should be considered in selecting the floor coverings.



A vapour retarder material (such as a 15-mil poly meeting ASTM E-1745) may be installed to reduce soil moisture migration in areas where moisture-sensitive floor coverings are planned. Reference is made to ACI 302. For this project, a vapour retarder shall be provided beneath the basement floor slab in all living areas and enclosed spaces, including storage rooms, utility rooms, and similar areas.

6.9 Lateral Earth Pressure

Unbalanced foundation walls and any other soil retaining structures should be designed to resist the lateral earth pressure acting against these walls. The following formula may be used to calculate the unfactored earth pressure distribution. The factored resistance can be calculated by using a factor of 0.8.

$$P = K (\gamma H + q)$$

where:

P =	lateral earth pressure	kPa
K =	earth pressure coefficient, 0.5 for non-yielding foundation wall earth pressure coefficient, 0.3 for yielding retaining wall	
γ =	unit weight of granular backfill, compacted to 95% SPMDD	21 kN/m ³
H =	unbalanced height of wall	m
q =	surcharge load at ground surface	kPa

The backfill for the foundation walls and retaining walls should be free-draining granular materials which should have less than 8% silt particles (OPSS Granular "B" Type I). The backfill should be placed in thin layers and compacted to 95% SPMDD. Over-compaction adjacent to the foundation/retaining walls should be avoided. Compaction should be carried out with hand operated equipment within 1 m of the foundation wall or retaining wall. Weeping tiles leading to a frost-free outlet or weep holes should be installed to effect drainage behind the retaining wall.

The sliding resistance of the retaining wall footings should be checked. The unfactored horizontal resistance against sliding between cast-in-place concrete and the various soils can be calculated using the following unit weight and friction coefficient:

Soil	Unit Weight (kN/m ³)	Friction Coefficient
Firm to very stiff cohesive deposits	20	0.40
Well-compacted granular backfill	21	0.45



6.10 Pavement Design and Construction

6.10.1 Access Driveways and Parking Areas on Ground

Based on the results of the field work, the subgrade soil at the site will consist predominantly of clayey silt materials. The following flexible pavement structures are recommended based on an assumed CBR value, the observed groundwater conditions, and the frost susceptibility of subgrade soils:

Component	Light Duty Pavement (mm)	Heavy Duty Pavement (mm)
Asphaltic Concrete HL3	40	40
Asphaltic Concrete HL8	50	50
Granular "A" Base	150	150
Granular "B" Sub-base	300	450

A light-duty pavement structure is recommended for all car parking areas, while a heavy-duty pavement structure should be implemented for access driveways and zones subjected to heavier loads, such as fire trucks, garbage trucks, and delivery vehicles.

The pavement design considers that pavement construction will be carried out during the drier time of the year and that the subgrade is stable, not heaving under construction equipment traffic. If the subgrade is wet or unstable following proof-rolling, additional granular sub-base and/or placement of a geogrid/geotextile material may be required.

Prior to placement of the granular subbase materials, all topsoil and other deleterious materials must be stripped from the proposed pavement areas to expose inorganic subgrade soils. The exposed subgrade surface must be thoroughly proof-rolled and recompact with a heavy vibratory compactor and inspected by qualified geotechnical personnel. Any soft spots encountered during the process should be excavated to the level of competent soil.

Bulk fill placed to raise site grades in pavement areas should consist of select approved inorganic fill or imported sand and gravel (OPSS Granular "B" Type I), placed in maximum 300 mm thick lifts, and compacted to no less than 95% Standard Proctor maximum dry density (SPMDD). The moisture content of the soil requires to be within 3% dry of its optimum moisture condition to achieve the specified degree of compaction.

The Granular "A" and Granular "B" Type II materials should be produced in accordance with the current OPSS specifications and placed and uniformly compacted to at least 100% SPMDD. The placing and rolling of the asphalt mixture should conform to OPSS.MUNI 310 Table 10 and should be compacted to no less than 92% of the Marshall density (MRD). Frequent in situ density testing by this office should be carried out to verify that the specified degree of compaction is being achieved and maintained.



SS-1 or SS-1HH tack coat should be applied to all binder course surfaces and vertical surfaces (i.e., curbs, pavement joints, etc.) prior to placement of asphalt. Refer to OPSS 310 and OPSS 1101 for additional details.

It should be noted that even well compacted trench backfill could settle for a period of time after construction. In this regard, the surface course of the asphaltic concrete should be placed at least one (1) year after trench backfill is completed to allow any minor settlements to occur within the trench backfill. The incomplete pavement structure may not be capable of supporting construction traffic. Consequently, minor repairs of the sub-base, base and asphaltic concrete may be required prior to paving with the base course and/or the surface course asphaltic concrete.

The prepared earth subgrade and final pavement surfaces should be graded to direct water runoff away from buildings, sidewalks, and other similar pertinent structures. Positive drainage outlets should be provided at all low points of the prepared earth subgrade, such as stub drains and/or longitudinal subdrains extended from the catch-basins. Systematic drainage of the granular base materials will promote the longevity of the pavement structures.

6.10.2 Pavement Above Lower Parking Structure on Concrete Slab

It is understood that asphalt pavement may be constructed above the lower parking structure on concrete slab and the following pavement structure is recommended:

Component	Component Thickness (mm)
Superpave 12.5 Surface Course	45
Asphaltic Concrete HL4 Base Course	45
Granular "A" Base (less than 5% silt)	Variable

A water-proofing membrane should be installed above the concrete slab to prevent moisture migration into the underground parking level, protect the concrete slab and reinforcing steel rebar, and aid the drainage of infiltrated water from the Granular "A" base layer to area drains. The structural concrete slab should be sloped to direct water runoff to area drains.

Protection board should be installed above the waterproofing membrane in order protect it from damage and improve the durability and performance of the pavement structure.

The granular base thickness above the underground parking structure will be variable. The granular base materials should contain less than 5% silt and be uniformly compacted to at least 100% SPMDD. The prepared earth subgrade and final pavement surfaces should be graded to direct water runoff to area drains.



7.0 GEOENVIRONMENTAL CONSIDERATIONS

Excess soil may be generated and removed off-site during the construction activities associated with the proposed site works. The management of excess soil is now governed by Ontario Regulation 406/19 (O. Reg. 406/19), MECP document titled “On-Site and Excess Soil Management Regulation”. In accordance with the regulation, the Project Leader is responsible for the handling, storage, reuse, transportation, and removal of all soil. Furthermore, the analytical results must be disclosed with and approved by the owner(s) of the receiving site before exporting the soil.

The following planning documents may be required for on-site and excess soil management:

- Planning Documentation
 - Assessment of Past Uses
 - Sampling and Analysis Plan
 - Soil Characterization Report
 - Excess Soil Destination Assessment Report
- Tracking
- Registry
- Record Keeping

An initial testing program was conducted during the geotechnical investigation, and the analytical results are discussed in the following sections of this report. Additional soil sampling and analysis may be required as per the above-noted MECP document and/or as per the requirement of the receiving site owner(s), depending on the volume of excess soil generated during construction.

Any soils identified during construction to have been environmentally impacted are to be separately stockpiled and analysed to determine the appropriate measures for handling and disposal. Waste characterization testing (TCLP) to classify the material for disposal as prescribed in O.Reg. 347/558 is required. Leachate analysis (mSPLP) is to be carried out if the excess soil is to be disposed to receiving sites under O.Reg. 406/19. Similarly, groundwater encountered during construction works must also be suitably assessed and handled.

7.1 Applicable Regulatory Standards

The Soil, Ground Water and Sediment Standards for Use Under the New Soil Rules and Excess Soil Quality Standards established in accordance with the O. Reg. 406/19 as amended were consulted in the assessment of the soil at the project site.

The analytical results for soils were compared to the following O. Reg. 406/19 regulatory standards:

- Table 1 (Full Depth Background Site Condition Standards) for Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use (Table 1 RPIICC ESQS)



- Table 2.1 (Full Depth Generic Excess Soil Quality Standards in a Potable Ground Water Condition) for Residential/Parkland/Institutional Property Use (Table 2.1 RPI ESQS)
- Table 2.1 (Full Depth Excess Soil Quality Standards in a Potable Ground Water Condition) for Industrial/Commercial/Community Property Use (Table 2.1 ICC ESQS)

7.2 Handling of Excess Soil

In support of on-site and excess soil management, an initial chemical testing program was conducted as part of this geotechnical investigation. Four (4) soil samples were submitted to ALS Laboratories analysis of Metals and Inorganics, Petroleum Hydrocarbons (PHCs) fractions F1-F4, and Benzene-Toluene-Ethylbenzene-Xylene (BTEX). The table below outlines a summary of the samples submitted for chemical analysis and all exceedances:

Sample	Table 1 RPIICC ESQS	Table 2.1 RPI ESQS	Table 2.1 ICC ESQS	Exceedance Parameter(s)
BH3 SS1	✓	✓	✓	-
BH4 SS1	✓	✓	✓	-
BH6 SS1	✓	✓	✓	-
BH7 SS1	✓	✓	✓	-

The measured concentrations for the samples met Table 1 RPIICC and 2.1 RPIICC Excess Soil Quality Standards (ESQS) for all tested parameters.

It is noted that the soil conditions may differ between and beyond the sample locations. If environmentally impacted soil is encountered during construction, the soil should be segregated, stockpiled and CVD should be contacted for further assessment of the impacted soils.

The results and laboratory certificates of chemical analysis provided by ALS Laboratories are enclosed in Appendix "B". A comparison of the soil chemistry results to the applicable regulatory standard is included in Appendix "C".

CVD further recommends that a disposal plan for excess soils be established to manage the quantity, as well as where and how the excess soils can be disposed of off-site.



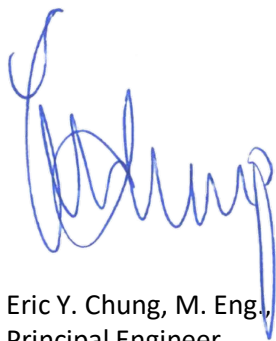
8.0 CLOSURE

The Limitations of Report, as quoted in Appendix A, is an integral part of this report.

We trust that the information presented in this report is complete within our terms of reference. If there are any further questions concerning this report, please do not hesitate to contact our office.

Yours truly,

CHUNG & VANDER DOELEN ENGINEERING LTD.



Eric Y. Chung, M. Eng., P.Eng.
Principal Engineer



APPENDIX A

Limitations of Report



APPENDIX “A”

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes and their respective depths may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. CHUNG & VANDER DOELEN ENGINEERING LIMITED accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.



APPENDIX B

Soil Chemistry Results





CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: WT2501714	Page	: 1 of 7
Client	: Chung and Vander Doelen Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Deepika Subburaj	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 36 WESTHILL DR, WATERLOO	Date Samples Received	: 29-Jan-2025 17:30
PO	: 2297	Date Analysis Commenced	: 30-Jan-2025
C-O-C number	: ----	Issue Date	: 06-Feb-2025 16:20
Sampler	: DS		
Site	: ----		
Quote number	: 2024/2025 Excess Soils Quote		
No. of samples received	: 4		
No. of samples analysed	: 4		

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

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

Signatories

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

Signatories	Position	Laboratory Department
Danielle Gravel	Supervisor - Semi-Volatile Instrumentation	Organics, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Greg Pokocky	Manager - Inorganics	Metals, Waterloo, Ontario
Josphin Masihi	Supervisor I	Centralized Prep, Waterloo, Ontario
Nik Perkio	Senior Analyst	Inorganics, Waterloo, Ontario
Nik Perkio	Senior Analyst	Metals, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	VOC, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Metals, Waterloo, Ontario



No Breaches Found

General Comments

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

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

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

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

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

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

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

Unit	Description
-	no units
%	percent
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mS/cm	millisiemens per centimetre
pH units	pH units

>: greater than.

<: less than.

Red shading is applied where the result or the LOR is greater than the Guideline Upper Limit (or lower than the Guideline Lower Limit, if applicable).

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



Analytical Results Evaluation

Matrix: Soil				Client sample ID	BH3 SS1	BH4 SS1	BH6 SS1	BH7 SS1	----	----	----
				Sampling date/time	15-Jan-2025 12:00	15-Jan-2025 12:00	15-Jan-2025 12:00	16-Jan-2025 12:00	----	----	----
				Sub-Matrix	Soil	Soil	Soil	Soil	----	----	----
Analyte	CAS Number	Method/Lab	Unit		WT2501714-001	WT2501714-002	WT2501714-003	WT2501714-004	-----	-----	-----
Physical Tests											
Conductivity (1:2 leachate)	----	E100-L/WT	mS/cm		0.140	0.194	0.218	0.155	----	----	----
Moisture	----	E144/WT	%		18.7	21.9	12.6	15.2	----	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	pH units		7.10	7.35	7.63	7.35	----	----	----
Cyanides											
Cyanide, weak acid dissociable	----	E336A/WT	mg/kg		<0.050	<0.050	<0.050	<0.050	----	----	----
Fixed-Ratio Extractables											
Calcium, soluble ion content	7440-70-2	E484/WT	mg/L		8.59	12.4	21.5	9.70	----	----	----
Magnesium, soluble ion content	7439-95-4	E484/WT	mg/L		2.81	3.34	3.62	1.30	----	----	----
Sodium, soluble ion content	17341-25-2	E484/WT	mg/L		1.88	13.3	6.18	3.65	----	----	----
Sodium adsorption ratio [SAR]	----	E484/WT	-		0.14	0.86	0.32	0.29	----	----	----
Metals											
Antimony	7440-36-0	E440C/WT	mg/kg		0.16	0.21	0.15	0.10	----	----	----
Arsenic	7440-38-2	E440C/WT	mg/kg		3.83	3.94	3.48	2.93	----	----	----
Barium	7440-39-3	E440C/WT	mg/kg		57.4	61.0	53.9	43.0	----	----	----
Beryllium	7440-41-7	E440C/WT	mg/kg		0.50	0.59	0.54	0.47	----	----	----
Boron	7440-42-8	E440C/WT	mg/kg		6.3	7.7	9.0	8.2	----	----	----
Boron, hot water soluble	7440-42-8	E487/WT	mg/kg		0.43	0.34	0.32	0.21	----	----	----
Cadmium	7440-43-9	E440C/WT	mg/kg		0.270	0.232	0.202	0.136	----	----	----
Chromium	7440-47-3	E440C/WT	mg/kg		17.1	18.9	17.6	15.1	----	----	----
Cobalt	7440-48-4	E440C/WT	mg/kg		6.41	6.71	6.21	5.70	----	----	----
Copper	7440-50-8	E440C/WT	mg/kg		13.2	13.7	15.1	12.4	----	----	----
Lead	7439-92-1	E440C/WT	mg/kg		14.2	13.6	13.8	8.91	----	----	----
Mercury	7439-97-6	E510C/WT	mg/kg		0.0401	0.0307	0.0267	0.0140	----	----	----
Molybdenum	7439-98-7	E440C/WT	mg/kg		0.41	0.33	0.33	0.24	----	----	----
Nickel	7440-02-0	E440C/WT	mg/kg		11.7	13.4	13.1	11.8	----	----	----
Selenium	7782-49-2	E440C/WT	mg/kg		0.24	0.22	<0.20	<0.20	----	----	----
Silver	7440-22-4	E440C/WT	mg/kg		<0.10	<0.10	<0.10	<0.10	----	----	----



Analytical Results Evaluation

Matrix: Soil				Client sample ID	BH3 SS1	BH4 SS1	BH6 SS1	BH7 SS1	----	----	----
				Sampling date/time	15-Jan-2025 12:00	15-Jan-2025 12:00	15-Jan-2025 12:00	16-Jan-2025 12:00	----	----	----
				Sub-Matrix	Soil	Soil	Soil	Soil	----	----	----
Analyte	CAS Number	Method/Lab	Unit	WT2501714-001	WT2501714-002	WT2501714-003	WT2501714-004	-----	-----	-----	
Metals											
Thallium	7440-28-0	E440C/WT	mg/kg	0.103	0.113	0.102	0.085	----	----	----	
Uranium	7440-61-1	E440C/WT	mg/kg	0.519	0.490	0.465	0.442	----	----	----	
Vanadium	7440-62-2	E440C/WT	mg/kg	30.3	31.4	29.2	25.5	----	----	----	
Zinc	7440-66-6	E440C/WT	mg/kg	66.4	64.6	59.3	48.6	----	----	----	
Speciated Metals											
Chromium, hexavalent [Cr VI]	18540-29-9	E532/WT	mg/kg	<0.10	<0.10	<0.10	<0.10	----	----	----	
Volatile Organic Compounds											
Benzene	71-43-2	E611A/WT	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	----	----	----	
Ethylbenzene	100-41-4	E611A/WT	mg/kg	<0.015	<0.015	<0.015	<0.015	----	----	----	
Toluene	108-88-3	E611A/WT	mg/kg	<0.050	<0.050	<0.050	<0.050	----	----	----	
Xylene, m+p-	179601-23-1	E611A/WT	mg/kg	<0.030	<0.030	<0.030	<0.030	----	----	----	
Xylene, o-	95-47-6	E611A/WT	mg/kg	<0.030	<0.030	<0.030	<0.030	----	----	----	
Xylenes, total	1330-20-7	E611A/WT	mg/kg	<0.050	<0.050	<0.050	<0.050	----	----	----	
BTEX, total	----	E611A/WT	mg/kg	<0.10	<0.10	<0.10	<0.10	----	----	----	
Hydrocarbons											
F1 (C6-C10)	----	E581.F1/WT	mg/kg	<5.0	<5.0	<5.0	<5.0	----	----	----	
F2 (C10-C16)	----	E601.SG-L/WT	mg/kg	<10	<10	<10	<10	----	----	----	
F3 (C16-C34)	----	E601.SG-L/WT	mg/kg	<50	<50	<50	<50	----	----	----	
F4 (C34-C50)	----	E601.SG-L/WT	mg/kg	<50	<50	<50	<50	----	----	----	
F1-BTEX	----	EC580/WT	mg/kg	<5.0	<5.0	<5.0	<5.0	----	----	----	
Hydrocarbons, total (C6-C50)	n/a	EC581/WT	mg/kg	<80	<80	<80	<80	----	----	----	
Chromatogram to baseline at nC50	n/a	E601.SG-L/WT	-	YES	YES	YES	YES	----	----	----	
Hydrocarbons Surrogates											
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	E601.SG-L/WT	%	95.7	99.1	97.3	96.8	----	----	----	
Dichlorotoluene, 3,4-	95-75-0	E581.F1/WT	%	85.0	97.1	92.7	86.8	----	----	----	
Volatile Organic Compounds Surrogates											
Bromofluorobenzene, 4-	460-00-4	E611A/WT	%	100	101	100	93.7	----	----	----	
Difluorobenzene, 1,4-	540-36-3	E611A/WT	%	95.8	95.4	95.8	87.8	----	----	----	

Page : 5 of 7
Work Order : WT2501714
Client : Chung and Vander Doelen Engineering Ltd.
Project : 36 WESTHILL DR, WATERLOO



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

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



Summary of Guideline Limits

Analyte	CAS Number	Unit	ON153/04 T1-RPIICC	ON406 T2.1-S-ICC	ON406 T2.1-S-RPI				
Physical Tests									
Conductivity (1:2 leachate)	----	mS/cm	0.57 mS/cm	1.4 mS/cm	0.7 mS/cm				
Moisture	----	%	--	--	--				
pH (1:2 soil:CaCl2-aq)	----	pH units	--	--	--				
Cyanides									
Cyanide, weak acid dissociable	----	mg/kg	0.051 mg/kg	0.051 mg/kg	0.051 mg/kg				
Fixed-Ratio Extractables									
Calcium, soluble ion content	7440-70-2	mg/L	--	--	--				
Magnesium, soluble ion content	7439-95-4	mg/L	--	--	--				
Sodium adsorption ratio [SAR]	----	-	2.4 -	12 -	5 -				
Sodium, soluble ion content	17341-25-2	mg/L	--	--	--				
Metals									
Antimony	7440-36-0	mg/kg	1.3 mg/kg	40 mg/kg	7.5 mg/kg				
Arsenic	7440-38-2	mg/kg	18 mg/kg	18 mg/kg	18 mg/kg				
Barium	7440-39-3	mg/kg	220 mg/kg	670 mg/kg	390 mg/kg				
Beryllium	7440-41-7	mg/kg	2.5 mg/kg	8 mg/kg	4 mg/kg				
Boron, hot water soluble	7440-42-8	mg/kg	--	2 mg/kg	1.5 mg/kg				
Boron	7440-42-8	mg/kg	36 mg/kg	120 mg/kg	120 mg/kg				
Cadmium	7440-43-9	mg/kg	1.2 mg/kg	1.9 mg/kg	1.2 mg/kg				
Chromium	7440-47-3	mg/kg	70 mg/kg	160 mg/kg	160 mg/kg				
Cobalt	7440-48-4	mg/kg	21 mg/kg	80 mg/kg	22 mg/kg				
Copper	7440-50-8	mg/kg	92 mg/kg	230 mg/kg	140 mg/kg				
Lead	7439-92-1	mg/kg	120 mg/kg	120 mg/kg	120 mg/kg				
Mercury	7439-97-6	mg/kg	0.27 mg/kg	0.27 mg/kg	0.27 mg/kg				
Molybdenum	7439-98-7	mg/kg	2 mg/kg	40 mg/kg	6.9 mg/kg				
Nickel	7440-02-0	mg/kg	82 mg/kg	270 mg/kg	100 mg/kg				
Selenium	7782-49-2	mg/kg	1.5 mg/kg	5.5 mg/kg	2.4 mg/kg				
Silver	7440-22-4	mg/kg	0.5 mg/kg	40 mg/kg	20 mg/kg				
Thallium	7440-28-0	mg/kg	1 mg/kg	3.3 mg/kg	1 mg/kg				
Uranium	7440-61-1	mg/kg	2.5 mg/kg	33 mg/kg	23 mg/kg				
Vanadium	7440-62-2	mg/kg	86 mg/kg	86 mg/kg	86 mg/kg				
Zinc	7440-66-6	mg/kg	290 mg/kg	340 mg/kg	340 mg/kg				
Speciated Metals									
Chromium, hexavalent [Cr VI]	18540-29-9	mg/kg	0.66 mg/kg	8 mg/kg	8 mg/kg				
Volatile Organic Compounds									
Benzene	71-43-2	mg/kg	0.02 mg/kg	0.02 mg/kg	0.02 mg/kg				
BTEX, total	----	mg/kg	--	--	--				
Ethylbenzene	100-41-4	mg/kg	0.05 mg/kg	0.05 mg/kg	0.05 mg/kg				



Analyte	CAS Number	Unit	ON153/04 T1-RPIICC	ON406 T2.1-S-ICC	ON406 T2.1-S-RPI				
Volatile Organic Compounds - Continued									
Toluene	108-88-3	mg/kg	0.2 mg/kg	0.2 mg/kg	0.2 mg/kg				
Xylene, m+p-	179601-23-1	mg/kg	--	--	--				
Xylene, o-	95-47-6	mg/kg	--	--	--				
Xylenes, total	1330-20-7	mg/kg	0.05 mg/kg	0.091 mg/kg	0.091 mg/kg				
Hydrocarbons									
Chromatogram to baseline at nC50	n/a	-	--	--	--				
F1 (C6-C10)	----	mg/kg	25 mg/kg	25 mg/kg	25 mg/kg				
F1-BTEX	----	mg/kg	25 mg/kg	25 mg/kg	25 mg/kg				
F2 (C10-C16)	----	mg/kg	10 mg/kg	26 mg/kg	10 mg/kg				
F3 (C16-C34)	----	mg/kg	240 mg/kg	240 mg/kg	240 mg/kg				
F4 (C34-C50)	----	mg/kg	120 mg/kg	3300 mg/kg	2800 mg/kg				
Hydrocarbons, total (C6-C50)	n/a	mg/kg	--	--	--				
Bromobenzotrifluoride, 2- (F2-F4 surrogate)	392-83-6	%	--	--	--				
Dichlorotoluene, 3,4-	95-75-0	%	--	--	--				
Bromofluorobenzene, 4-	460-00-4	%	--	--	--				
Difluorobenzene, 1,4-	540-36-3	%	--	--	--				

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

Key:

ON153/04	Ontario Regulation 153/04 - April 15, 2011 Standards (JUL, 2011)
T1-RPIICC	153 T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
ON406	Ontario Regulation 406/19 - Excess Soils (Bulk) (12-April-2022)
T2.1-S-ICC	406 T2.1 - Volume Independent Soil - Ind/Com/Commu Property Use
T2.1-S-RPI	406 T2.1 - Volume Independent Soil - Res/Park/Inst Property Use

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: WT2501714	Page	: 1 of 13
Client	: Chung and Vander Doelen Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Deepika Subburaj	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 36 WESTHILL DR, WATERLOO	Date Samples Received	: 29-Jan-2025 17:30
PO	: 2297	Issue Date	: 06-Feb-2025 16:21
C-O-C number	: ----		
Sampler	: DS		
Site	: ----		
Quote number	: 2024/2025 Excess Soils Quote		
No. of samples received	: 4		
No. of samples analysed	: 4		

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

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

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

Summary of Outliers

Outliers : Quality Control Samples

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

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

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

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

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

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

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

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

Matrix: **Soil/Solid**

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

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E336A	16-Jan-2025	31-Jan-2025	14 days	15 days	✖ EHT	31-Jan-2025	14 days	0 days	✔
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E336A	15-Jan-2025	31-Jan-2025	14 days	16 days	✖ EHTL	31-Jan-2025	14 days	0 days	✔
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E336A	15-Jan-2025	31-Jan-2025	14 days	16 days	✖ EHTL	31-Jan-2025	14 days	0 days	✔
Cyanides : WAD Cyanide (0.01M NaOH Extraction)										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E336A	15-Jan-2025	31-Jan-2025	14 days	16 days	✖ EHTL	31-Jan-2025	14 days	0 days	✔
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH7 SS1	E581.F1	16-Jan-2025	30-Jan-2025	14 days	14 days	✔	30-Jan-2025	40 days	0 days	✔
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH3 SS1	E581.F1	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	30-Jan-2025	40 days	0 days	✔
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH4 SS1	E581.F1	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	30-Jan-2025	40 days	0 days	✔



Matrix: Soil/Solid

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

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Hydrocarbons : CCME PHC - F1 by Headspace GC-FID										
Glass soil methanol vial [ON MECP] BH6 SS1	E581.F1	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	30-Jan-2025	40 days	0 days	✔
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E601.SG-L	16-Jan-2025	30-Jan-2025	14 days	14 days	✔	31-Jan-2025	40 days	1 days	✔
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E601.SG-L	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	31-Jan-2025	40 days	1 days	✔
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E601.SG-L	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	31-Jan-2025	40 days	1 days	✔
Hydrocarbons : CCME PHCs - F2-F4 by GC-FID (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E601.SG-L	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	31-Jan-2025	40 days	1 days	✔
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E487	16-Jan-2025	05-Feb-2025	180 days	20 days	✔	05-Feb-2025	180 days	0 days	✔
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E487	15-Jan-2025	05-Feb-2025	180 days	21 days	✔	05-Feb-2025	180 days	0 days	✔
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E487	15-Jan-2025	05-Feb-2025	180 days	21 days	✔	05-Feb-2025	180 days	0 days	✔
Metals : Boron-Hot Water Extractable by ICPOES										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E487	15-Jan-2025	05-Feb-2025	180 days	21 days	✔	05-Feb-2025	180 days	0 days	✔



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	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	
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E510C	16-Jan-2025	05-Feb-2025	28 days	20 days	✓	05-Feb-2025	28 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E510C	15-Jan-2025	05-Feb-2025	28 days	21 days	✓	05-Feb-2025	28 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E510C	15-Jan-2025	05-Feb-2025	28 days	21 days	✓	05-Feb-2025	28 days	0 days	✓
Metals : Mercury in Soil/Solid by CVAAS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E510C	15-Jan-2025	05-Feb-2025	28 days	21 days	✓	05-Feb-2025	28 days	0 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E440C	16-Jan-2025	05-Feb-2025	180 days	20 days	✓	05-Feb-2025	180 days	20 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E440C	15-Jan-2025	05-Feb-2025	180 days	21 days	✓	05-Feb-2025	180 days	21 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E440C	15-Jan-2025	05-Feb-2025	180 days	21 days	✓	05-Feb-2025	180 days	21 days	✓
Metals : Metals in Soil/Solid by CRC ICPMS (<355 µm)										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E440C	15-Jan-2025	05-Feb-2025	180 days	21 days	✓	05-Feb-2025	180 days	21 days	✓
Metals : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E484	16-Jan-2025	05-Feb-2025	180 days	20 days	✓	05-Feb-2025	180 days	0 days	✓



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Metals : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E484	15-Jan-2025	05-Feb-2025	180 days	21 days	✓	05-Feb-2025	180 days	0 days	✓
Metals : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E484	15-Jan-2025	05-Feb-2025	180 days	21 days	✓	05-Feb-2025	180 days	0 days	✓
Metals : Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E484	15-Jan-2025	05-Feb-2025	180 days	21 days	✓	05-Feb-2025	180 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E100-L	16-Jan-2025	05-Feb-2025	30 days	20 days	✓	05-Feb-2025	30 days	20 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E100-L	15-Jan-2025	05-Feb-2025	30 days	21 days	✓	05-Feb-2025	30 days	21 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E100-L	15-Jan-2025	05-Feb-2025	30 days	21 days	✓	05-Feb-2025	30 days	21 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E100-L	15-Jan-2025	05-Feb-2025	30 days	21 days	✓	05-Feb-2025	30 days	21 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E144	16-Jan-2025	----	----	----		04-Feb-2025	----	19 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E144	15-Jan-2025	----	----	----		04-Feb-2025	----	20 days	



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E144	15-Jan-2025	----	----	----		04-Feb-2025	----	20 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E144	15-Jan-2025	----	----	----		04-Feb-2025	----	20 days	
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E108A	16-Jan-2025	04-Feb-2025	30 days	19 days	✓	05-Feb-2025	30 days	20 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E108A	15-Jan-2025	04-Feb-2025	30 days	20 days	✓	05-Feb-2025	30 days	21 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E108A	15-Jan-2025	04-Feb-2025	30 days	20 days	✓	05-Feb-2025	30 days	21 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E108A	15-Jan-2025	04-Feb-2025	30 days	20 days	✓	05-Feb-2025	30 days	21 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH7 SS1	E532	16-Jan-2025	31-Jan-2025	30 days	15 days	✓	04-Feb-2025	7 days	4 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH3 SS1	E532	15-Jan-2025	31-Jan-2025	30 days	16 days	✓	04-Feb-2025	7 days	4 days	✓
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH4 SS1	E532	15-Jan-2025	31-Jan-2025	30 days	16 days	✓	04-Feb-2025	7 days	4 days	✓



Matrix: Soil/Solid

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

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Speciated Metals : Hexavalent Chromium (Cr VI) by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH6 SS1	E532	15-Jan-2025	31-Jan-2025	30 days	16 days	✓	04-Feb-2025	7 days	4 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH7 SS1	E611A	16-Jan-2025	30-Jan-2025	14 days	14 days	✓	30-Jan-2025	40 days	0 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH3 SS1	E611A	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	30-Jan-2025	40 days	0 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH4 SS1	E611A	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	30-Jan-2025	40 days	0 days	✓
Volatile Organic Compounds : BTEX by Headspace GC-MS										
Glass soil methanol vial [ON MECP] BH6 SS1	E611A	15-Jan-2025	30-Jan-2025	14 days	15 days	✖ EHTL	30-Jan-2025	40 days	0 days	✓

Legend & Qualifier Definitions

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

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



Quality Control Parameter Frequency Compliance

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

Matrix: **Soil/Solid**

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

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
Analytical Methods							
Laboratory Duplicates (DUP)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1863123	1	10	10.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1862074	1	12	8.3	5.0	✓
Moisture Content by Gravimetry	E144	1862186	1	13	7.6	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1858321	1	4	25.0	5.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1863125	1	16	6.2	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1863124	1	9	11.1	5.0	✓
Boron-Hot Water Extractable by ICPOES	E487	1863127	1	10	10.0	5.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1863126	1	8	12.5	5.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1859129	1	19	5.2	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	1857114	1	20	5.0	5.0	✓
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1857424	1	15	6.6	5.0	✓
BTEX by Headspace GC-MS	E611A	1857113	1	20	5.0	5.0	✓
Laboratory Control Samples (LCS)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1863123	2	10	20.0	10.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1862074	1	12	8.3	5.0	✓
Moisture Content by Gravimetry	E144	1862186	1	13	7.6	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1858321	1	4	25.0	5.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1863125	2	16	12.5	10.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1863124	2	9	22.2	10.0	✓
Boron-Hot Water Extractable by ICPOES	E487	1863127	2	10	20.0	10.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1863126	2	8	25.0	10.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1859129	2	19	10.5	10.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	1857114	1	20	5.0	5.0	✓
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1857424	1	15	6.6	5.0	✓
BTEX by Headspace GC-MS	E611A	1857113	1	20	5.0	5.0	✓
Method Blanks (MB)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1863123	1	10	10.0	5.0	✓
Moisture Content by Gravimetry	E144	1862186	1	13	7.6	5.0	✓
WAD Cyanide (0.01M NaOH Extraction)	E336A	1858321	1	4	25.0	5.0	✓
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C	1863125	1	16	6.2	5.0	✓
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484	1863124	1	9	11.1	5.0	✓
Boron-Hot Water Extractable by ICPOES	E487	1863127	1	10	10.0	5.0	✓
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C	1863126	1	8	12.5	5.0	✓
Hexavalent Chromium (Cr VI) by IC	E532	1859129	1	19	5.2	5.0	✓
CCME PHC - F1 by Headspace GC-FID	E581.F1	1857114	1	20	5.0	5.0	✓



Matrix: **Soil/Solid**

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

Quality Control Sample Type			Count		Frequency (%)		
<i>Analytical Methods</i>	<i>Method</i>	<i>QC Lot #</i>	<i>QC</i>	<i>Regular</i>	<i>Actual</i>	<i>Expected</i>	<i>Evaluation</i>
Method Blanks (MB) - Continued							
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1857424	1	15	6.6	5.0	✔
BTEX by Headspace GC-MS	E611A	1857113	1	20	5.0	5.0	✔
Matrix Spikes (MS)							
WAD Cyanide (0.01M NaOH Extraction)	E336A	1858321	1	4	25.0	5.0	✔
CCME PHC - F1 by Headspace GC-FID	E581.F1	1857114	1	20	5.0	5.0	✔
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L	1857424	1	15	6.6	5.0	✔
BTEX by Headspace GC-MS	E611A	1857113	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 Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSSS Ch. 15 (mod)/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 soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP E3530	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. This method is equivalent to ASTM D4972 and is acceptable for topsoil analysis.
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
WAD Cyanide (0.01M NaOH Extraction)	E336A ALS Environmental - Waterloo	Soil/Solid	APHA 4500-CN I (mod)	Weak Acid Dissociable (WAD) cyanide is determined after extraction by Continuous Flow Analyzer (CFA) with in-line distillation followed by colourmetric analysis.
Metals in Soil/Solid by CRC ICPMS (<355 µm)	E440C ALS Environmental - Waterloo	Soil/Solid	EPA 6020B (mod)	This method is intended to liberate metals that may be environmentally available. Samples are dried, then sieved through a 355 µm sieve, and digested with HNO ₃ and HCl. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Silicate minerals are not solubilized. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. This method does not adequately recover elemental sulfur, and is unsuitable for assessment of elemental sulfur standards or guidelines. Analysis is by Collision/Reaction Cell ICPMS.
Sodium Adsorption Ratio (SAR) - 1:2 Soil:Water (Dry)	E484 ALS Environmental - Waterloo	Soil/Solid	SW846 6010C	A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Boron-Hot Water Extractable by ICPOES	E487 ALS Environmental - Waterloo	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).
Mercury in Soil/Solid by CVAAS (<355 µm)	E510C ALS Environmental - Waterloo	Soil/Solid	EPA 200.2/1631 Appendix (mod)	Samples are sieved through a 355 µm sieve, and digested with HNO ₃ and HCl, followed by CVAAS analysis.
Hexavalent Chromium (Cr VI) by IC	E532 ALS Environmental - Waterloo	Soil/Solid	APHA 3500-CR C	Instrumental analysis is performed by ion chromatography with UV detection.
CCME PHC - F1 by Headspace GC-FID	E581.F1 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	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. Test results are expressed on a dry weight basis. Unless qualified, all required quality control criteria of the CCME PHC method have been met, including response factor and linearity requirements.
CCME PHCs - F2-F4 by GC-FID (Low Level)	E601.SG-L ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	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. Test results are expressed on a dry weight basis. Unless qualified, all required quality control criteria of the CCME PHC method have been met, including response factor and linearity requirements.
BTEX by Headspace GC-MS	E611A ALS Environmental - Waterloo	Soil/Solid	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.
F1-BTEX	EC580 ALS Environmental - Waterloo	Soil/Solid	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 (C6-C50)	EC581 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Hydrocarbons, total (C6-C50) is the sum of CCME Fractions F1(C6-C10), F2(C10-C16), F3(C16-C34), and F4(C34-C50). F4G-sg is not used within this calculation due to overlap with other fractions.



Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl ₂ - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Cyanide Extraction for CFA (0.01M NaOH)	EP333A ALS Environmental - Waterloo	Soil/Solid	ON MECP E3015 (mod)	Extraction for various cyanide analysis is by rotary extraction of the soil with 0.01M Sodium Hydroxide.
Digestion for Metals and Mercury (355 µm Sieve)	EP440C ALS Environmental - Waterloo	Soil/Solid	EPA 200.2 (mod)	Samples are sieved through a 355 µm sieve, and digested with HNO ₃ and HCl. This method is intended to liberate metals that may be environmentally available.
Boron-Hot Water Extractable	EP487 ALS Environmental - Waterloo	Soil/Solid	HW EXTR, EPA 6010B	A dried solid sample is extracted with weak calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES. Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011)
Preparation of Hexavalent Chromium (Cr VI) for IC	EP532 ALS Environmental - Waterloo	Soil/Solid	EPA 3060A	Field moist samples are digested with a sodium hydroxide/sodium carbonate solution as described in EPA 3060A.
VOCs Methanol Extraction for Headspace Analysis	EP581 ALS Environmental - Waterloo	Soil/Solid	EPA 5035A (mod)	VOCs in samples are extracted with methanol. Extracts are then 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.
PHCs and PAHs Hexane-Acetone Tumbler Extraction	EP601 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1 (mod)	Samples are subsampled and Petroleum Hydrocarbons (PHC) and PAHs are extracted with 1:1 hexane:acetone using a rotary extractor.

QUALITY CONTROL REPORT

Work Order	: WT2501714	Page	: 1 of 11
Client	: Chung and Vander Doelen Engineering Ltd.	Laboratory	: ALS Environmental - Waterloo
Contact	: Deepika Subburaj	Account Manager	: Andrew Martin
Address	: 311 Victoria St. N. Kitchener ON Canada N2H 5E1	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: 36 WESTHILL DR, WATERLOO	Date Samples Received	: 29-Jan-2025 17:30
PO	: 2297	Date Analysis Commenced	: 30-Jan-2025
C-O-C number	: ----	Issue Date	: 06-Feb-2025 16:20
Sampler	: DS		
Site	: ----		
Quote number	: 2024/2025 Excess Soils Quote		
No. of samples received	: 4		
No. of samples analysed	: 4		

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
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

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

Signatories	Position	Laboratory Department
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Nik Perkio	Senior Analyst	Waterloo Metals, Waterloo, Ontario
Sarah Birch	VOC Section Supervisor	Waterloo VOC, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Waterloo Metals, Waterloo, Ontario



General Comments

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

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

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



Laboratory Duplicate (DUP) Report

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

Sub-Matrix: Soil/Solid					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: 1862074)											
WT2501714-001	BH3 SS1	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.10	7.08	0.282%	5%	----
Physical Tests (QC Lot: 1862186)											
WT2501789-003	Anonymous	Moisture	----	E144	0.25	%	14.6	14.6	0.00382%	20%	----
Physical Tests (QC Lot: 1863123)											
WT2501942-001	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.449 mS/cm	437	2.71%	20%	----
Cyanides (QC Lot: 1858321)											
WT2501714-001	BH3 SS1	Cyanide, weak acid dissociable	----	E336A	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
Metals (QC Lot: 1863124)											
WT2501942-001	Anonymous	Calcium, soluble ion content	7440-70-2	E484	0.50	mg/L	13.1	12.0	8.76%	30%	----
		Magnesium, soluble ion content	7439-95-4	E484	0.50	mg/L	0.84	0.77	0.07	Diff <2x LOR	----
		Sodium, soluble ion content	17341-25-2	E484	0.50	mg/L	63.0	61.8	1.92%	30%	----
Metals (QC Lot: 1863125)											
WT2501714-001	BH3 SS1	Antimony	7440-36-0	E440C	0.10	mg/kg	0.16	0.15	0.004	Diff <2x LOR	----
		Arsenic	7440-38-2	E440C	0.10	mg/kg	3.83	3.79	1.00%	30%	----
		Barium	7440-39-3	E440C	0.50	mg/kg	57.4	59.1	2.94%	40%	----
		Beryllium	7440-41-7	E440C	0.10	mg/kg	0.50	0.51	0.002	Diff <2x LOR	----
		Boron	7440-42-8	E440C	5.0	mg/kg	6.3	6.6	0.3	Diff <2x LOR	----
		Cadmium	7440-43-9	E440C	0.020	mg/kg	0.270	0.279	3.01%	30%	----
		Chromium	7440-47-3	E440C	0.50	mg/kg	17.1	17.1	0.112%	30%	----
		Cobalt	7440-48-4	E440C	0.10	mg/kg	6.41	6.32	1.33%	30%	----
		Copper	7440-50-8	E440C	0.50	mg/kg	13.2	13.0	1.71%	30%	----
		Lead	7439-92-1	E440C	0.50	mg/kg	14.2	14.3	1.13%	40%	----
		Molybdenum	7439-98-7	E440C	0.10	mg/kg	0.41	0.36	0.05	Diff <2x LOR	----
		Nickel	7440-02-0	E440C	0.50	mg/kg	11.7	11.7	0.160%	30%	----
		Selenium	7782-49-2	E440C	0.20	mg/kg	0.24	0.25	0.002	Diff <2x LOR	----
		Silver	7440-22-4	E440C	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440C	0.050	mg/kg	0.103	0.104	0.002	Diff <2x LOR	----
		Uranium	7440-61-1	E440C	0.050	mg/kg	0.519	0.517	0.362%	30%	----
		Vanadium	7440-62-2	E440C	0.20	mg/kg	30.3	30.2	0.265%	30%	----
		Zinc	7440-66-6	E440C	2.0	mg/kg	66.4	66.3	0.161%	30%	----



Sub-Matrix: Soil/Solid					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
Metals (QC Lot: 1863126)											
WT2501714-001	BH3 SS1	Mercury	7439-97-6	E510C	0.0050	mg/kg	0.0401	0.0410	2.07%	40%	----
Metals (QC Lot: 1863127)											
WT2501690-001	Anonymous	Boron, hot water soluble	7440-42-8	E487	0.10	mg/kg	<0.10 µg/g	<0.10	0.0004	Diff <2x LOR	----
Speciated Metals (QC Lot: 1859129)											
WT2501710-001	Anonymous	Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
Volatile Organic Compounds (QC Lot: 1857113)											
WT2501692-001	Anonymous	Benzene	71-43-2	E611A	0.0050	mg/kg	<0.0050 µg/g	<0.0050	0	Diff <2x LOR	----
		Ethylbenzene	100-41-4	E611A	0.015	mg/kg	0.015 µg/g	<0.015	0.0002	Diff <2x LOR	----
		Toluene	108-88-3	E611A	0.050	mg/kg	<0.050 µg/g	<0.050	0	Diff <2x LOR	----
		Xylene, m+p-	179601-23-1	E611A	0.030	mg/kg	0.070 µg/g	0.065	0.005	Diff <2x LOR	----
		Xylene, o-	95-47-6	E611A	0.030	mg/kg	<0.030 µg/g	<0.030	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 1857114)											
WT2501692-001	Anonymous	F1 (C6-C10)	----	E581.F1	5.0	mg/kg	<5.0 µg/g	<5.0	0	Diff <2x LOR	----
Hydrocarbons (QC Lot: 1857424)											
HA2500237-001	Anonymous	F2 (C10-C16)	----	E601.SG-L	10	mg/kg	<10	<10	0	Diff <2x LOR	----
		F3 (C16-C34)	----	E601.SG-L	50	mg/kg	<50	<50	0	Diff <2x LOR	----
		F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50	<50	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: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1862186)						
Moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 1863123)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Cyanides (QCLot: 1858321)						
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	<0.050	----
Metals (QCLot: 1863124)						
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	<0.50	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	<0.50	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	<0.50	----
Metals (QCLot: 1863125)						
Antimony	7440-36-0	E440C	0.1	mg/kg	<0.10	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	<0.10	----
Barium	7440-39-3	E440C	0.5	mg/kg	<0.50	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	<0.10	----
Boron	7440-42-8	E440C	5	mg/kg	<5.0	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	<0.020	----
Chromium	7440-47-3	E440C	0.5	mg/kg	<0.50	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	<0.10	----
Copper	7440-50-8	E440C	0.5	mg/kg	<0.50	----
Lead	7439-92-1	E440C	0.5	mg/kg	<0.50	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	<0.10	----
Nickel	7440-02-0	E440C	0.5	mg/kg	<0.50	----
Selenium	7782-49-2	E440C	0.2	mg/kg	<0.20	----
Silver	7440-22-4	E440C	0.1	mg/kg	<0.10	----
Thallium	7440-28-0	E440C	0.05	mg/kg	<0.050	----
Uranium	7440-61-1	E440C	0.05	mg/kg	<0.050	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	<0.20	----
Zinc	7440-66-6	E440C	2	mg/kg	<2.0	----
Metals (QCLot: 1863126)						
Mercury	7439-97-6	E510C	0.005	mg/kg	<0.0050	----
Metals (QCLot: 1863127)						
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	<0.10	----



Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Speciated Metals (QCLot: 1859129)						
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	<0.10	----
Volatile Organic Compounds (QCLot: 1857113)						
Benzene	71-43-2	E611A	0.005	mg/kg	<0.0050	----
Ethylbenzene	100-41-4	E611A	0.015	mg/kg	<0.015	----
Toluene	108-88-3	E611A	0.05	mg/kg	<0.050	----
Xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	<0.030	----
Xylene, o-	95-47-6	E611A	0.03	mg/kg	<0.030	----
Hydrocarbons (QCLot: 1857114)						
F1 (C6-C10)	----	E581.F1	5	mg/kg	<5.0	----
Hydrocarbons (QCLot: 1857424)						
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	<10	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	<50	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	<50	----



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: Soil/Solid

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1862074)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1862186)									
Moisture	----	E144	0.25	%	50 %	100	90.0	110	----
Physical Tests (QCLot: 1863123)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1410 µS/cm	100	90.0	110	----
Cyanides (QCLot: 1858321)									
Cyanide, weak acid dissociable	----	E336A	0.05	mg/kg	1.25 mg/kg	92.9	80.0	120	----
Metals (QCLot: 1863124)									
Calcium, soluble ion content	7440-70-2	E484	0.5	mg/L	300 mg/L	102	80.0	120	----
Magnesium, soluble ion content	7439-95-4	E484	0.5	mg/L	50 mg/L	98.6	80.0	120	----
Sodium, soluble ion content	17341-25-2	E484	0.5	mg/L	50 mg/L	100	80.0	120	----
Metals (QCLot: 1863125)									
Antimony	7440-36-0	E440C	0.1	mg/kg	100 mg/kg	99.0	80.0	120	----
Arsenic	7440-38-2	E440C	0.1	mg/kg	100 mg/kg	102	80.0	120	----
Barium	7440-39-3	E440C	0.5	mg/kg	25 mg/kg	97.2	80.0	120	----
Beryllium	7440-41-7	E440C	0.1	mg/kg	10 mg/kg	97.3	80.0	120	----
Boron	7440-42-8	E440C	5	mg/kg	100 mg/kg	97.8	80.0	120	----
Cadmium	7440-43-9	E440C	0.02	mg/kg	10 mg/kg	96.6	80.0	120	----
Chromium	7440-47-3	E440C	0.5	mg/kg	25 mg/kg	96.4	80.0	120	----
Cobalt	7440-48-4	E440C	0.1	mg/kg	25 mg/kg	93.9	80.0	120	----
Copper	7440-50-8	E440C	0.5	mg/kg	25 mg/kg	93.1	80.0	120	----
Lead	7439-92-1	E440C	0.5	mg/kg	50 mg/kg	99.3	80.0	120	----
Molybdenum	7439-98-7	E440C	0.1	mg/kg	25 mg/kg	99.3	80.0	120	----
Nickel	7440-02-0	E440C	0.5	mg/kg	50 mg/kg	94.2	80.0	120	----
Selenium	7782-49-2	E440C	0.2	mg/kg	100 mg/kg	96.3	80.0	120	----
Silver	7440-22-4	E440C	0.1	mg/kg	10 mg/kg	93.9	80.0	120	----
Thallium	7440-28-0	E440C	0.05	mg/kg	100 mg/kg	96.7	80.0	120	----
Uranium	7440-61-1	E440C	0.05	mg/kg	0.5 mg/kg	100	80.0	120	----
Vanadium	7440-62-2	E440C	0.2	mg/kg	50 mg/kg	95.6	80.0	120	----
Zinc	7440-66-6	E440C	2	mg/kg	50 mg/kg	93.8	80.0	120	----
Metals (QCLot: 1863126)									



Sub-Matrix: Soil/Solid					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 1863126) - continued									
Mercury	7439-97-6	E510C	0.005	mg/kg	0.1 mg/kg	94.5	80.0	120	----
Metals (QCLot: 1863127)									
Boron, hot water soluble	7440-42-8	E487	0.1	mg/kg	2 mg/kg	100	70.0	130	----
Speciated Metals (QCLot: 1859129)									
Chromium, hexavalent [Cr VI]	18540-29-9	E532	0.1	mg/kg	0.8 mg/kg	97.4	80.0	120	----
Volatile Organic Compounds (QCLot: 1857113)									
Benzene	71-43-2	E611A	0.005	mg/kg	3.48 mg/kg	95.4	70.0	130	----
Ethylbenzene	100-41-4	E611A	0.015	mg/kg	3.48 mg/kg	99.8	70.0	130	----
Toluene	108-88-3	E611A	0.05	mg/kg	3.48 mg/kg	105	70.0	130	----
Xylene, m+p-	179601-23-1	E611A	0.03	mg/kg	6.95 mg/kg	97.2	70.0	130	----
Xylene, o-	95-47-6	E611A	0.03	mg/kg	3.48 mg/kg	97.8	70.0	130	----
Hydrocarbons (QCLot: 1857114)									
F1 (C6-C10)	----	E581.F1	5	mg/kg	69.2 mg/kg	100	80.0	120	----
Hydrocarbons (QCLot: 1857424)									
F2 (C10-C16)	----	E601.SG-L	10	mg/kg	671 mg/kg	113	70.0	130	----
F3 (C16-C34)	----	E601.SG-L	50	mg/kg	1380 mg/kg	114	70.0	130	----
F4 (C34-C50)	----	E601.SG-L	50	mg/kg	748 mg/kg	108	70.0	130	----



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: Soil/Solid

Sub-Matrix: Soil/Solid					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Cyanides (QCLot: 1858321)										
WT2501714-001	BH3 SS1	Cyanide, weak acid dissociable	----	E336A	1.14 mg/kg	1.24 mg/kg	91.5	70.0	130	----
Volatile Organic Compounds (QCLot: 1857113)										
WT2501692-001	Anonymous	Benzene	71-43-2	E611A	2.44 mg/kg	2.51 mg/kg	97.1	60.0	140	----
		Ethylbenzene	100-41-4	E611A	2.49 mg/kg	2.51 mg/kg	99.2	60.0	140	----
		Toluene	108-88-3	E611A	2.58 mg/kg	2.51 mg/kg	103	60.0	140	----
		Xylene, m+p-	179601-23-1	E611A	4.80 mg/kg	5.02 mg/kg	95.7	60.0	140	----
		Xylene, o-	95-47-6	E611A	2.44 mg/kg	2.51 mg/kg	97.0	60.0	140	----
Hydrocarbons (QCLot: 1857114)										
WT2501692-001	Anonymous	F1 (C6-C10)	----	E581.F1	54.8 mg/kg	50.2 mg/kg	109	60.0	140	----
Hydrocarbons (QCLot: 1857424)										
HA2500237-001	Anonymous	F2 (C10-C16)	----	E601.SG-L	572 mg/kg	517 mg/kg	110	60.0	140	----
		F3 (C16-C34)	----	E601.SG-L	1240 mg/kg	1070 mg/kg	116	60.0	140	----
		F4 (C34-C50)	----	E601.SG-L	677 mg/kg	577 mg/kg	117	60.0	140	----



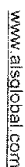
Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

Sub-Matrix:					Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method			Low	High	
Physical Tests (QCLot: 1863123)									
QC-1863123-003	RM	Conductivity (1:2 leachate)	----	E100-L	3260 µS/cm	102	70.0	130	----
Metals (QCLot: 1863124)									
QC-1863124-003	RM	Calcium, soluble ion content	7440-70-2	E484	184 mg/L	102	70.0	130	----
QC-1863124-003	RM	Magnesium, soluble ion content	7439-95-4	E484	66.2 mg/L	101	70.0	130	----
QC-1863124-003	RM	Sodium, soluble ion content	17341-25-2	E484	111 mg/L	99.2	70.0	130	----
Metals (QCLot: 1863125)									
QC-1863125-003	RM	Antimony	7440-36-0	E440C	24.8 mg/kg	94.5	70.0	130	----
QC-1863125-003	RM	Arsenic	7440-38-2	E440C	21.2 mg/kg	96.5	70.0	130	----
QC-1863125-003	RM	Barium	7440-39-3	E440C	788 mg/kg	96.6	70.0	130	----
QC-1863125-003	RM	Beryllium	7440-41-7	E440C	1.82 mg/kg	104	70.0	130	----
QC-1863125-003	RM	Cadmium	7440-43-9	E440C	2.15 mg/kg	92.1	70.0	130	----
QC-1863125-003	RM	Chromium	7440-47-3	E440C	56.9 mg/kg	97.1	70.0	130	----
QC-1863125-003	RM	Cobalt	7440-48-4	E440C	32 mg/kg	94.8	70.0	130	----
QC-1863125-003	RM	Copper	7440-50-8	E440C	969 mg/kg	101	70.0	130	----
QC-1863125-003	RM	Lead	7439-92-1	E440C	919 mg/kg	93.0	70.0	130	----
QC-1863125-003	RM	Molybdenum	7439-98-7	E440C	25.1 mg/kg	97.3	70.0	130	----
QC-1863125-003	RM	Nickel	7440-02-0	E440C	1000 mg/kg	103	70.0	130	----
QC-1863125-003	RM	Selenium	7782-49-2	E440C	1.04 mg/kg	102	60.0	140	----
QC-1863125-003	RM	Silver	7440-22-4	E440C	8.98 mg/kg	94.2	70.0	130	----
QC-1863125-003	RM	Thallium	7440-28-0	E440C	0.907 mg/kg	96.8	70.0	130	----
QC-1863125-003	RM	Uranium	7440-61-1	E440C	3.97 mg/kg	103	70.0	130	----
QC-1863125-003	RM	Vanadium	7440-62-2	E440C	66.2 mg/kg	96.2	70.0	130	----
QC-1863125-003	RM	Zinc	7440-66-6	E440C	828 mg/kg	94.7	70.0	130	----
Metals (QCLot: 1863126)									
QC-1863126-003	RM	Mercury	7439-97-6	E510C	0.068 mg/kg	97.5	70.0	130	----
Metals (QCLot: 1863127)									
QC-1863127-003	RM	Boron, hot water soluble	7440-42-8	E487	1.69 mg/kg	113	60.0	140	----
Speciated Metals (QCLot: 1859129)									
QC-1859129-003	RM	Chromium, hexavalent [Cr VI]	18540-29-9	E532	134 mg/kg	74.7	70.0	130	----





Specialized Requests Form

COC Number: **22 -**

Canada Toll Free: 1 800 668 9878

Page 1 of 1

Environmental Division
Waterloo

Work Order Ref: _____

WT2501714



Telephone : +1 519 866 5910

[illegible]

FEB 2022 FRIJN

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW CCG form. Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges to complete all portions of this form may delay analysis.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

the white - report copy

APPENDIX C

Comparison of the Soil Chemistry Results to the Applicable Regulatory Standards



ANALYTICAL RESULTS FOR SOIL

2297

Ontario Regulation 406/19 (as amended) - Excess Soil Quality Standards

		Sample ID			BH3 SS1	BH4 SS1	BH6 SS1	BH7 SS1
		Depth (m)			0.0 - 0.6	0.0 - 0.6	0.0 - 0.6	0.0 - 0.6
		Date			15-Jan-2025	15-Jan-2025	15-Jan-2025	16-Jan-2025
		Lab Sample ID			WT2501714-001	WT2501714-002	WT2501714-003	WT2501714-004
		T1 RPI ¹	T2.1 RPI ²	T2.1 ICC ³				
General	Electrical Conductivity (EC)	0.57	0.7	1.4	0.140	0.194	0.218	0.155
	pH	-	-	-	7.10	7.35	7.63	7.35
	Cyanide	0.051	0.051	0.051	<0.050	<0.050	<0.050	<0.050
	Sodium Adsorption Ratio (SAR)	2.4	5	12	0.14	0.86	0.32	0.29
Metals & Inorganics	Antimony (Sb)	1.3	7.5	40	0.16	0.21	0.15	0.10
	Arsenic (As)	18	18	18	3.83	3.94	3.48	2.93
	Barium (Ba)	220	390	670	57.4	61.0	53.9	43.0
	Beryllium (Be)	2.5	4	8	0.50	0.59	0.54	0.47
	Boron (B)	36	120	120	6.3	7.7	9.0	8.2
	Boron, Hot Water Soluble	-	1.5	2	0.43	0.34	0.32	0.21
	Cadmium (Cd)	1.2	1.2	1.9	0.270	0.232	0.202	0.136
	Chromium (Cr)	70	160	160	17.1	18.9	17.6	15.1
	Cobalt (Co)	21	22	80	6.41	6.71	6.21	5.70
	Copper (Cu)	92	140	230	13.2	13.7	15.1	12.4
	Lead (Pb)	120	120	120	14.2	13.6	13.8	8.91
	Mercury (Hg)	0.27	0.27	0.27	0.0401	0.0307	0.0267	0.0140
	Molybdenum (Mo)	2	6.9	40	0.41	0.33	0.33	0.24
	Nickel (Ni)	82	100	270	11.7	13.4	13.1	11.8
	Selenium (Se)	1.5	2.4	5.5	0.24	0.22	<0.20	<0.20
	Silver (Ag)	0.5	20	40	<0.10	<0.10	<0.10	<0.10
	Thallium (Tl)	1	1	3.3	0.103	0.113	0.102	0.085
	Uranium (U)	2.5	23	33	0.519	0.490	0.465	0.442
	Vanadium (V)	86	86	86	30.3	31.4	29.2	25.5
	Zinc (Zn)	290	340	340	66.4	64.6	59.3	48.6
	Chromium, Hexavalent - Cr(VI)	0.66	8	8	<0.10	<0.10	<0.10	<0.10
BTEX	Benzene	0.02	0.02	0.02	<0.0050	<0.0050	<0.0050	<0.0050
	Ethylbenzene	0.05	0.05	0.05	<0.015	<0.015	<0.015	<0.015
	Toluene	0.2	0.2	0.2	<0.050	<0.050	<0.050	<0.050
	Xylenes (Total)	0.05	0.091	0.091	<0.050	<0.050	<0.050	<0.050
Petroleum Hydrocarbons (F1-F4)	F1 (C6-C10)	25	25	25	<5.0	<5.0	<5.0	<5.0
	F2 (C10-C16)	10	10	26	<10	<10	<10	<10
	F3 (C16-C34)	240	240	240	<50	<50	<50	<50
	F4 (C34-C50)	120	2800	3300	<50	<50	<50	<50
	F4G-SG (GHH-Silica)	120	2800	3300	N/A	N/A	N/A	N/A

NOTES:

¹ Table 1: Full Depth Background Site Condition Standards for Residential / Parkland / Institutional / Industrial / Commercial / Community Uses

² Table 2.1: Full Depth Excess Soil Quality Standards in a Potable Ground Water Condition (Volume Independent) for Residential / Parkland / Institutional Uses

³ Table 2.1: Full Depth Excess Soil Quality Standards in a Potable Ground Water Condition (Volume Independent) for Industrial / Commercial / Community Uses

1. Units = ug/g (excluding pH/EC/SAR)

2. "-" = Parameter not included in chemical analysis

3. Test results exceed Table 1 RPI/ICC ESQS

4. Test results exceed Table 2.1 RPI ESQS

5. Test results exceed Table 2.1 ICC ESQS

APPENDIX D

Groundwater Levels Readings and Hydraulic Conductivity Values



Summary of Water Levels, Elevations & Fluctuations

36 Westhill Drive, Waterloo
CVD Engineering Ltd.
Project: 2297

Well	Ground Elevation (mASL)	Top Pipe Elevation (mASL)	Stickup (m)	Hydraulic Conductivity (m/s)	Water Level (m Below Ground)		Water Elevation (m Above Sea Level)	
					29-Jan-25	21-Feb-25	29-Jan-25	21-Feb-25
BH 1	387.12	388.03	0.91	2×10^{-8}	3.73	3.94	383.39	383.18
BH 6	384.20	385.02	0.82	3×10^{-8}	2.06	2.25	382.14	381.95
BH 7	386.68	387.51	0.83	-	4.57	4.60	382.11	382.08

- Notes:
- 1) All Elevations Referenced to Geodetic Survey by CVD.
 - 2) **Bolded** elevations represent the maximum water table aquifer elevation measured at each monitoring well
 - 3) Negative water level indicates that water level is above ground.
 - 4) : Monitoring well/piezometer dry
 - 5) Negative fluctuation indicates drop in water level relative to baseline.

APPENDIX E

Well Response Test Analysis Charts





CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 Victoria Street North
Kitchener / Ontario / N2H 5E1
519-742-8979

Response Test - Water Level Data and Analysis

Page 1 of 2

Project: Proposed 7-Storey Apartment Buildings

Number: 2297

Client: Blackdoor DC

Location: 36 Westhill Drive, Waterloo, ON Response Test: BH 1

Test Conducted by: R.S.

Test Date: 2025-02-21

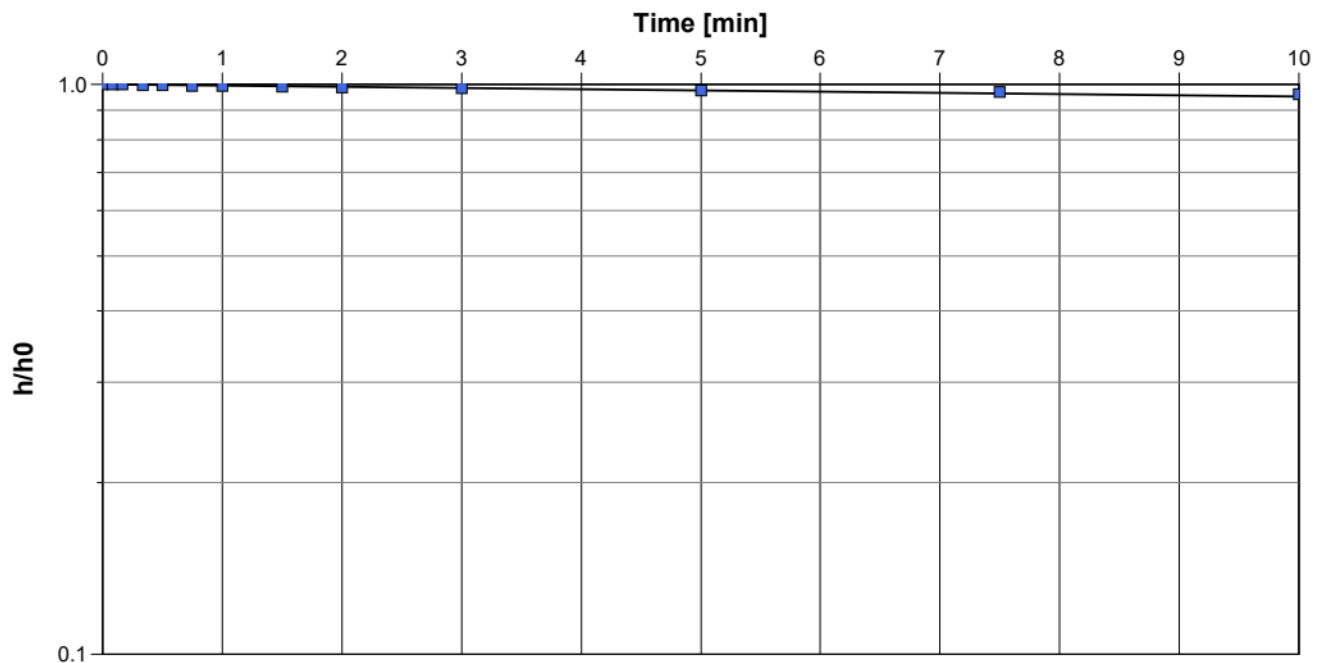
Approximated Aquifer Thickness: 10 m

Water level at t=0 [m]: 7.84

Static Water Level [m]: 3.94

Water level change at t=0 [m]: 3.90

	Time [min]	Water Level [m]	WL Change [m]
1	0	7.84	3.903
2	0.0833	7.838	3.901
3	0.1667	7.836	3.899
4	0.3333	7.834	3.897
5	0.5	7.829	3.892
6	0.75	7.822	3.885
7	1	7.816	3.879
8	1.5	7.803	3.866
9	2	7.796	3.859
10	3	7.777	3.84
11	5	7.75	3.813
12	7.5	7.718	3.781
13	10	7.689	3.752
14	12.5	7.662	3.725
15	15	7.638	3.701



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH 1	1.37×10^{-8}	



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311 Victoria Street North
Kitchener / Ontario / N2H 5E1
519-742-8979

Response Test - Water Level Data and Analysis

Page 2 of 2

Project: Proposed 7-Storey Apartment Buildings

Number: 2297

Client: Blackdoor DC

Location: 36 Westhill Drive, Waterloo, ON Response Test: BH 6

Test Conducted by: R.S.

Test Date: 2025-02-21

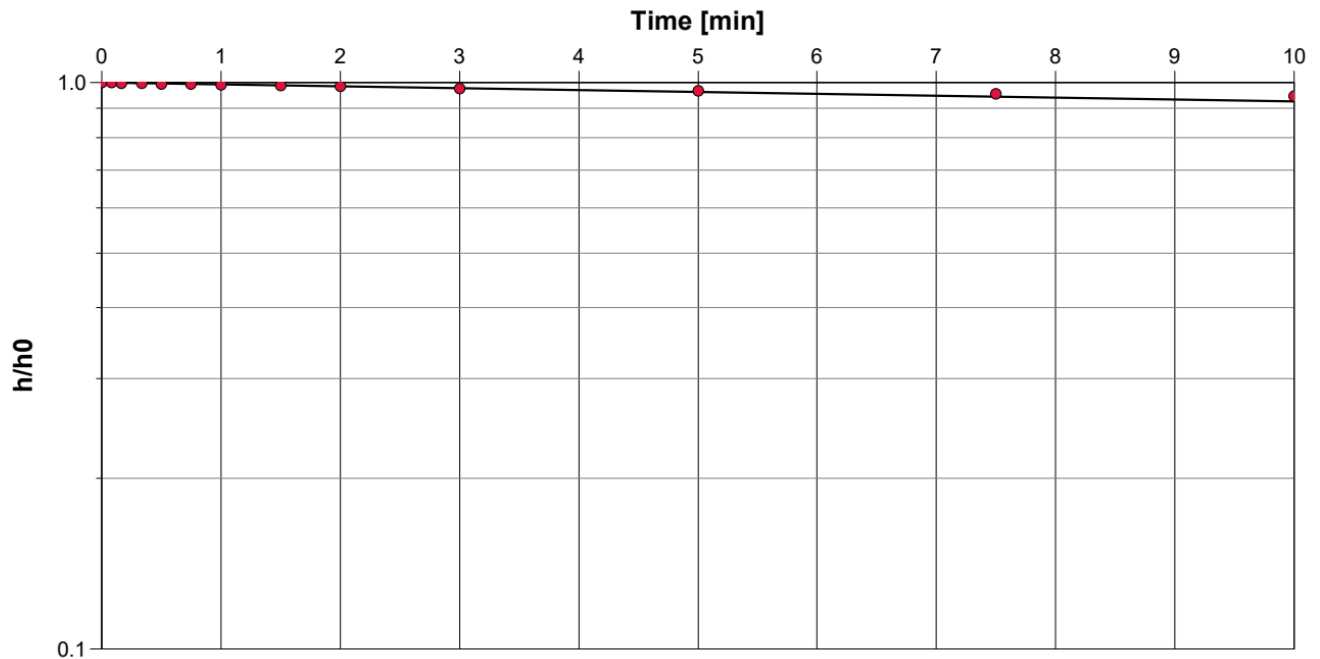
Approximated Aquifer Thickness: 10 m

Water level at t=0 [m]: 5.40

Static Water Level [m]: 2.25

Water level change at t=0 [m]: 3.15

	Time [min]	Water Level [m]	WL Change [m]
1	0	5.40	3.153
2	0.0833	5.397	3.15
3	0.1667	5.393	3.146
4	0.3333	5.389	3.142
5	0.5	5.385	3.138
6	0.75	5.377	3.13
7	1	5.37	3.123
8	1.5	5.358	3.111
9	2	5.349	3.102
10	3	5.325	3.078
11	5	5.292	3.045
12	7.5	5.259	3.012
13	10	5.233	2.986
14	12.5	5.212	2.965
15	15	5.191	2.944



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
BH 6	2.97×10^{-8}

APPENDIX F

Shear Wave Velocity Sounding Report





August 22, 2025
File No.: 2297

Rob Gazzola
Blackdoor DC
75 Sheffield Street
North York, Ontario
M6M 3E9

Re: Shear Wave Velocity Sounding for Seismic Site Classification
Proposed Apartment Buildings
36 Westhill Drive, Waterloo, Ontario

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) was retained by Blackdoor DC to perform a shear wave velocity survey for the proposed apartment buildings located at 36 Westhill Drive in Waterloo, Ontario. The purpose of the investigation was to determine the seismic site classification, based on the average shear wave velocity (V_{s30}) within the upper 30 m of the subsurface, using the Multi-Channel Analysis of Surface Waves (MASW) method. Field work was completed on August 21, 2025.

Background on MASW Method

Multichannel Analysis of Surface Waves (MASW) is a geophysical method used to evaluate subsurface shear wave velocity (V_s) profiles by analyzing the propagation characteristics of surface (Rayleigh) waves. The technique is based on the principle that surface wave velocity is frequency-dependent and varies with depth, allowing for non-invasive, depth-resolved characterization of soil stiffness.

General Procedure

MASW surveys typically involve two types of data acquisition: **active** and **passive**.

- **Active MASW** involves generating surface waves using an impact source (e.g., sledgehammer striking a shot plate) at various offsets from a linear array of geophones. This method is effective for resolving shallow to intermediate depths.
- **Passive MASW** relies on recording ambient seismic noise, i.e., traffic, machinery, and / or natural sources, over longer periods. It captures lower-frequency energy, enabling greater depth resolution and complements the active-source data.

When used together, active and passive MASW techniques provide a broader frequency bandwidth and a more comprehensive V_s profile, typically extending to 30 m depth or more depending on site conditions and array geometry.

Data Processing and Interpretation

Data processing and interpretation were performed using SeisImagerSW™ software developed by Geometrics Inc.

Dispersion Curve Generation

- Active-source records were processed to generate dispersion images for each shot point. The fundamental mode of the Rayleigh wave was manually picked from each image to establish active dispersion curves.
- Passive data was processed using the Spatial Autocorrelation (SPAC) method to derive phase velocities at a range of frequencies, which were similarly used to construct dispersion curves.

The resulting active and passive dispersion curves were combined to produce an average composite dispersion curve representative of the site's subsurface conditions.

Inversion and Shear Wave Velocity Profile Development

The average dispersion curve was inverted using a layered-earth model to generate a one-dimensional shear wave velocity profile. The model consisted of multiple horizontal layers, each defined by its thickness and V_s . The inversion process iteratively adjusted these parameters to best match the theoretical and observed dispersion curves.

Survey Design and Equipment

The MASW survey was conducted using an array of 24 geophones with a natural frequency of 4.5 Hz, connected to a Geometrics Geode seismograph.

For active-source acquisition, two array configurations were utilized: a 23 m spread with 1 m geophone spacing and a 46 m spread with 2 m spacing. For each array, data was collected using two (2) to three (3) source points positioned off both ends of the spread. Active data was recorded with a sampling interval of 0.25 milliseconds. The seismic energy was generated using 10 lb and 16 lb sledgehammers as impact sources.

The passive MASW survey was conducted using an L-shaped array to reduce directional bias associated with elevated ambient noise from two nearby high-volume roadways to the north and west, as well as an active construction site to the north. The array consisted of 12 geophones positioned along the southern half of the active spread at 2 m spacing, with the remaining geophones oriented eastward at a 90° angle, also at 2 m spacing. Ambient seismic noise was recorded over a 20-minute period with a sampling interval of 2 milliseconds.

The MASW array lines are shown on Figure No. 2, appended.



MASW Test Results

The MASW test results are provided graphically in Figure 1 which shows the average shear wave velocity (V_s) values versus depth from ground surface to a depth of 30 m. Tabulated results are provided in Table 1.

Figure No. 1
Shear Wave Velocity Profile
36 Westhill Drive, Waterloo, Ontario

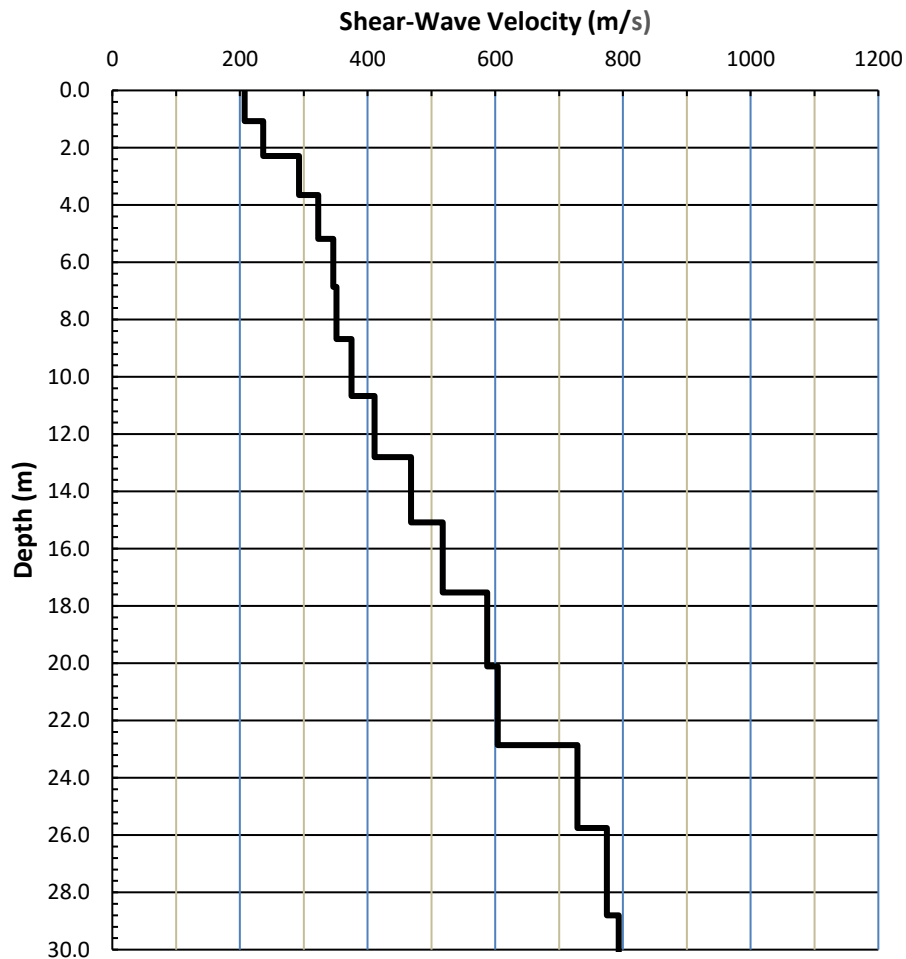


Table 1		
Depth Interval (m)		Shear Wave Velocity (m/s)
From	To	
0	1.1	207
1.1	2.3	236
2.3	3.7	292
3.7	5.2	323
5.2	6.9	346
6.9	8.7	351
8.7	10.7	375
10.7	12.8	411
12.8	15.1	468
15.1	17.5	517
17.5	20.1	587
20.1	22.9	604
22.9	25.8	729
25.8	28.8	775
28.8	30.0	793

The average shear wave velocity in the upper 30 meters of the soil profile (V_{s30}), used for seismic site classification, is calculated using the following equation:

$$V_{s30} = 30 / \sum (d_i / V_{si})$$

Where d_i is the thickness of the i -th soil layer (in meters), and V_{si} is the shear wave velocity (in m/s) corresponding to that layer.

The calculated average V_{s30} value, corresponding seismic site classification, and site designation derived from the MASW survey are summarized in the table below:

Table 2		
Average V_{s30} (m/s)	Seismic Site Classification Table 4.1.8.4.-B, OBC 2024	Site Designation
439	C	X ₄₃₉

Based on the average V_{s30} obtained from the MASW sounding, the site can be classified as Site Class C ($360 < V_s \leq 760$) in accordance with Table 4.1.8.4.-B of the 2024 Ontario Building Code (OBC 2024).

The site designation is X₄₃₉ in accordance with clause 4.1.8.4-(2b) of OBC 2024.



Closure

If you have any questions, please do not hesitate to contact the undersigned.

Yours truly,

CHUNG & VANDER DOELEN ENGINEERING LTD.



Andrew Dale, P.Eng.
Project Engineer





LEGEND

-  Subject Development Property
-  Location of Active Seismic Array
-  Location of Passive Seismic Array

Map Ref.: Region of Waterloo; ESRI; GIS Locator Retrieved August 2025



0 m 15 30
Scale 1:800

Figure 2 - MASW Test Location Plan

Shear Wave Velocity Sounding
for Seismic Site Classification

36 Westhill Drive
Waterloo, ON

Drawn By: YC

Date: August 2025

File No. 2297



CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 2E1 / 519-742-8979

ENCLOSURES



Soil Abbreviations and Terms Used on Record of Borehole Sheets

TERMINOLOGY DESCRIBING COMMON SOIL TYPES:

Topsoil	-	mixture of soil and humus capable of supporting vegetation
Peat	-	mixture of visible and invisible fragments of decayed organic matter
Till	-	unstratified glacial deposit which may range from clay to boulders
Fill	-	soil materials identified as being placed anthropologically

CLASSIFICATION (UNIFIED SYSTEM)

Clay	<0.002mm
Silt	0.002 to .075mm
Sand	0.075 to 4.75mm
	Fine 0.075 to 0.425 mm
	Medium 0.425 to 2.0 mm
	Coarse 2.0 to 4.75 mm
Gravel	4.75 to 75mm
	Fine 4.75 to 19 mm
	Coarse 19 to 75 mm
Cobbles	75 to 300mm
Boulders	>300mm

TERMINOLOGY

Soil Composition	% by Weight
"traces"	<10%
"some"(eg. some silt)	10-20%
Adjective (eg. sandy)	20-35%
"and"(eg. sand and gravel)	35-50%

Standard Penetration Resistance (SPT): Standard Penetration Resistance ('N' Values) refers to the number of blows required to advance a standard (ASTM D1586) 51 mm Ø (2 inch) split-spoon sampler by the use of a free falling, 63.5 Kg (140lbs) hammer. The number of blows from the drop weight is recorded for every 15 cm (6 inches). The hammer is dropped from a distance of 0.76m (30 inches) providing 474.5 Joules per blow. When the sampler is driven a total of 45 cm (18 inches) into the soil, the standard penetration index ('N' Value) is the total number of blows for the last 30 cm (12 inches).

Dynamic Cone Penetration Resistance (DCPT): Dynamic Cone Penetration Resistance is similar to a SPT with the 474.5 Joule/blow impulse provided by the free falling hammer where the split-spoon sampler is replaced by a 51 mm Ø, 60° conical point and the number of blows is recorded continuously for every 30 cm (12 inches).

COHESIVE SOILS CONSISTENCY

	(kPa)	(P.S.F.)	Nominal 'N' Value
Very Soft	<12	<250	0-2
Soft	12-25	250-500	2-4
Firm	25-50	500-1000	4-8
Stiff	50-100	1000-2000	8-15
Very Stiff	100-200	2000-4000	15-30
Hard	>200	>4000	>30

RELATIVE DENSITY OF COHESIONLESS SOIL

	'N' Value
Very Loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

MOISTURE CONDITIONS:

Cohesive Soil
DTPL- Drier than plastic limit
APL- About plastic limit
WTPL- Wetter than plastic limit
MWTPL- Much wetter than plastic limit

Cohesionless Soil
Damp
Moist
Wet
Saturated

SAMPLE TYPES AND ADDITIONAL FIELD TESTS

SS	Split Spoon Sample (obtained from SPT)	GS	Grab Sample	PP	Pocket Penetrometer
AS	Auger Sample	BS	Bulk Sample	VANE	Peak & Remolded shear
		TW	Thin Wall Sample or Shelby Tube	DMT	Flat Plate Dilatometer

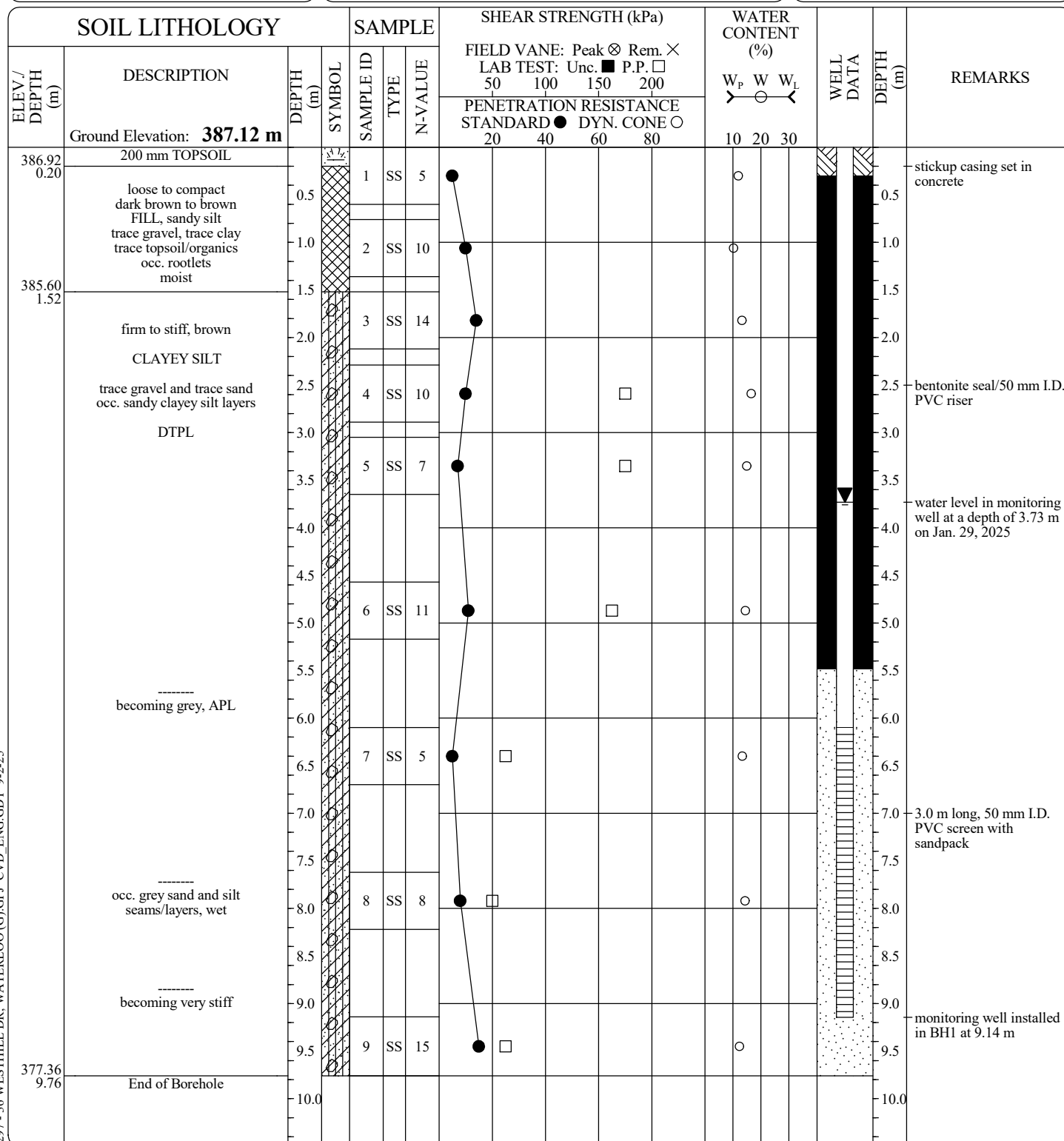
LABORATORY TESTS

SG	Specific Gravity	S	Sieve Analysis	W	Water Content
H	Hydrometer	P	Field Permeability	K	Lab Permeability
W_p	Plastic Limit	W_l	Liquid Limit	I_p	Plasticity Index
GSA	Grain Size Analysis	C	Consolidation	UNC	Unconfined compression



CHUNG & VANDER DOELEN
ENGINEERING LTD.

Enclosure A

FILE No: 2297**BOREHOLE No. 1**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 16 - 25 TO Jan 16 - 25**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: 2297**BOREHOLE No. 2**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 16 - 25 TO Jan 16 - 25**

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									
Ground Elevation: 385.01 m										10 20 30						
384.71 0.30	300 mm TOPSOIL	0.5		1	SS	5	●						○			
384.25 0.76	loose, dark brown to reddish brown FILL, sandy silt trace clay, occ. rootlets moist	1.0		2	SS	5	●						○			
	stiff to firm, brown CLAYEY SILT trace gravel and trace sand occ. sandy clayey silt layers DTPL	1.5														
		2.0		3	SS	13	●			□			○			
		2.5														
		3.0														
		3.5		4	SS	14	●			□			○			
		4.0														
	becoming grey, APL occ. sand and silt seams/layers, wet	4.5														
		5.0		5	SS	8	●			□			○			
		5.5														
		6.0														
		6.5		6	SS	7	●			□			○			
		7.0														
		7.5														
		8.0		7	SS	7	●			□			○			
		8.5														
		9.0														
		9.5		8	SS	7	●			□			○			
375.25 9.76	End of Borehole	10.0														borehole open and dry to 9.76 m bgs upon withdrawal of the drilling augers

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FILE No: 2297**BOREHOLE No. 2**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 16 - 25 TO Jan 16 - 25**

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 ○				10 20 30						
	(continued)																
	Start of Dynamic Cone Penetration Test	11.0														End of Dynamic Cone Penetration Test	
		11.5															
		12.0															
		12.5															
		13.0															
		13.5															
		14.0															
		14.5															
		15.0															
		15.5															
		16.0															
		16.5															
		17.0															
		17.5															
		18.0															
		18.5															
		19.0															
		19.5															
		20.0															
		20.5															

End of Dynamic Cone Penetration Test

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FILE No: 2297**BOREHOLE No. 3**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 15 - 25 TO Jan 15 - 25**

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. □				PENETRATION RESISTANCE STANDARD ● DYN. CONE ○						W _P W W _L		
							50	100	150	200	20	40	60				80	10	20
Ground Elevation: 383.06 m																			
382.56 0.50	500 mm TOPSOIL	0.5		1	SS	4	●												
381.85 1.21	loose to compact reddish brown to brown FILL, sandy silt trace gravel, trace clay trace to some topsoil/organics occ. rootlets, moist	1.0		2	SS	7	●							○					
	stiff to firm, brown	1.5		3	SS	13	●				□			○					
	CLAYEY SILT trace gravel and trace sand occ. sandy clayey silt layers DTPL	2.0																	
	becoming grey, APL	3.5		4	SS	14	●				□			○					
	occ. sand and silt seams/layers, wet	5.0		5	SS	7	●				□			○					
		6.5		6	SS	7	●				□			○					
		8.0		7	SS	10	●				□			○					
373.30 9.76	End of Borehole	9.5		8	SS	7	●				□			○					
		10.0														borehole open and dry to 9.76 m bgs upon withdrawal of the drilling augers			

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FILE No: 2297**BOREHOLE No. 4**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 15 - 25 TO Jan 15 - 25**

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				
386.02 0.38	380 mm TOPSOIL	0.5		1	SS	5								
	very stiff to firm, brown	1.0		2	SS	16								
	CLAYEY SILT trace gravel and trace sand	1.5												
	occ. sandy clayey silt layers	2.0		3	SS	16								
	DTPL	2.5												
		3.0												
		3.5		4	SS	14								
		4.0												
		4.5												
	becoming APL	5.0		5	SS	8								
	occ. sand and silt seams, wet	5.5												
		6.0												
		6.5		6	SS	6								
		7.0												
		7.5												
		8.0		7	SS	8								
		8.5												
		9.0												
		9.5		8	SS	5								
376.64 9.76	End of Borehole	10.0												

borehole open and dry to
9.76 m bgs upon
withdrawal of the drilling
augers

PROJECT MANAGER: **EYC**
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FILE No: 2297**BOREHOLE No. 5**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 14 - 25 TO Jan 14 - 25**

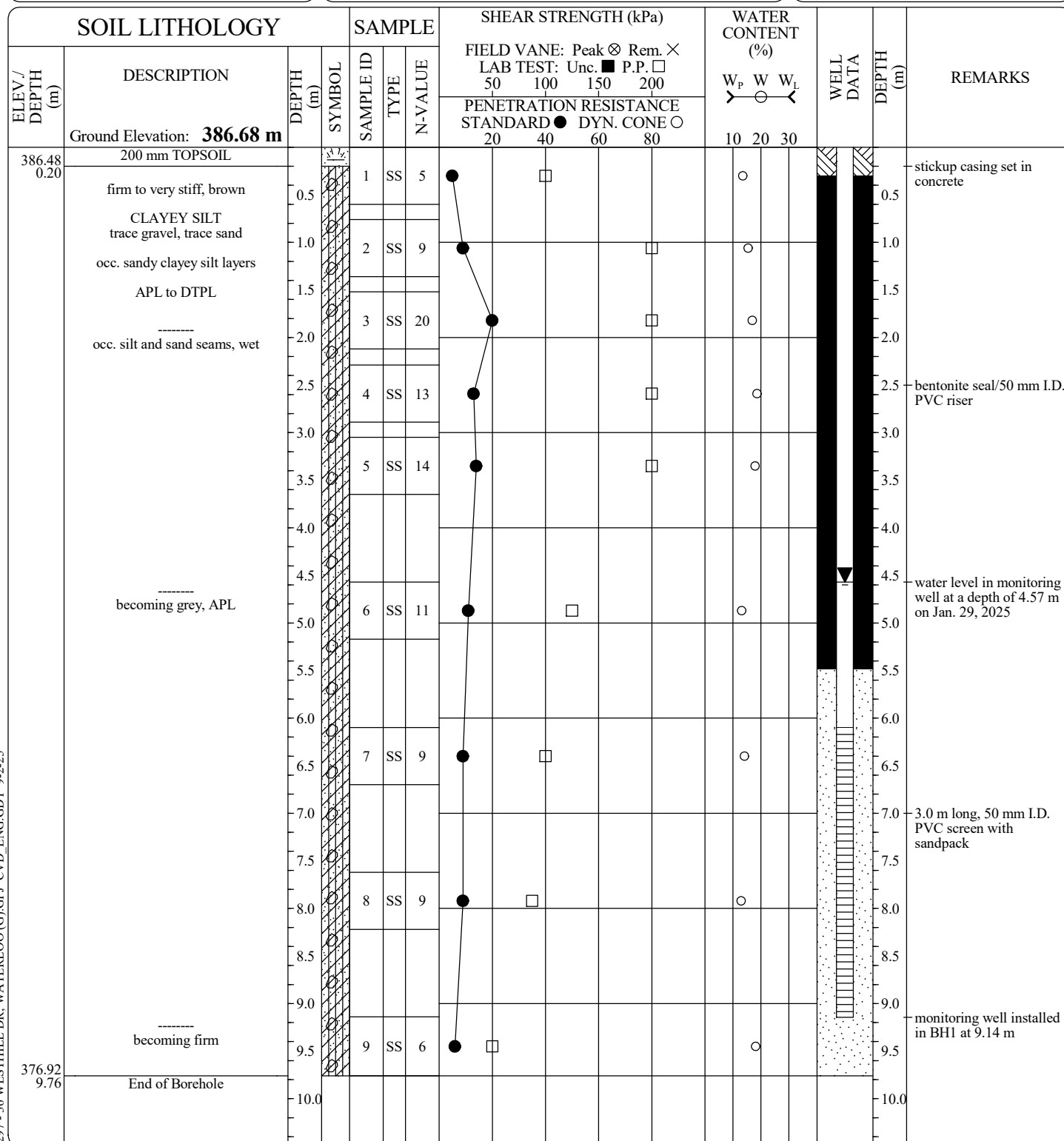
SOIL LITHOLOGY				SAMPLE			SHEAR STRENGTH (kPa)				WATER CONTENT (%)			WELL DATA	DEPTH (m)	REMARKS
ELEV./ DEPTH (m)	DESCRIPTION	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200				PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80					
Ground Elevation: 387.00 m																
386.70 0.30	300 mm TOPSOIL	0.5		1	SS	5	●	□					○			
386.20 0.80	loose, brown FILL, sandy silt trace gravel, trace clay trace to some topsoil/organics occ. rootlets, moist	1.0		2	SS	3	●	□					○			
	soft to very stiff	1.5														
	reddish brown to brown	2.0		3	SS	16	●	□					○			
	CLAYEY SILT trace gravel, trace to some sand	2.5														
	occ. sandy clayey silt layers	3.0														
	APL to DTPL	3.5		4	SS	11	●	□					○			
		4.0														
		4.5														
	----- occ. sand and silt seams, wet	5.0		5	SS	16	●	□					○			
		5.5														
	----- becoming stiff grey, APL	6.0														
		6.5		6	SS	13	●	□					○			
		7.0														
		7.5														
		8.0		7	SS	9	●	□					○			
		8.5														
		9.0														
		9.5		8	SS	11	●	□					○			
377.24 9.76	End of Borehole	10.0														borehole open and dry to 9.76 m bgs upon withdrawal of the drilling augers

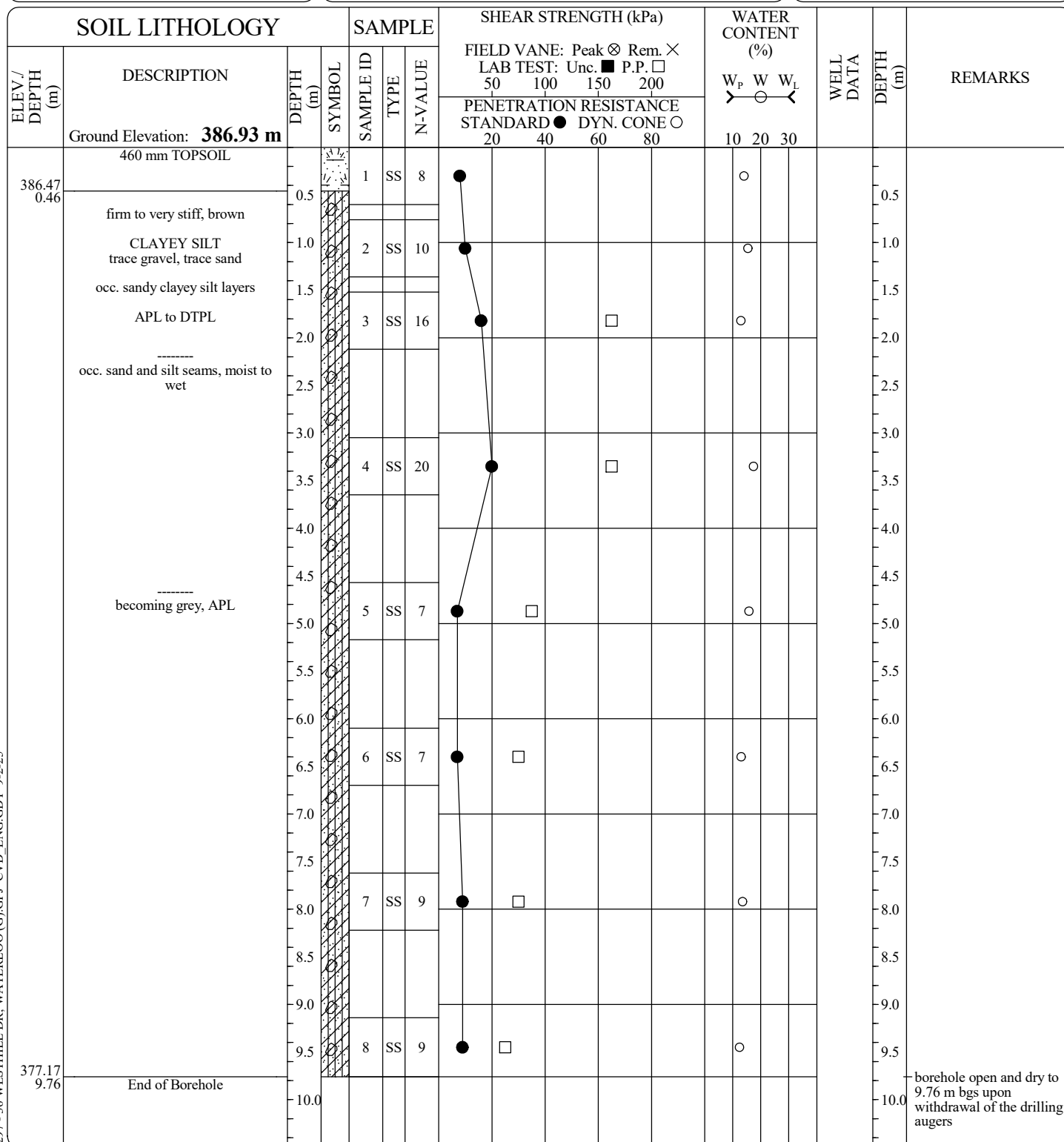
PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
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FILE No: 2297**BOREHOLE No. 6**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 15 - 25 TO Jan 15 - 25**

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					
							Ground Elevation: 384.20 m						10 20 30			
383.90 0.30	300 mm TOPSOIL			1	SS	5	●	□				○			stickup casing set in concrete	
	firm to very stiff, brown	0.5														
	CLAYEY SILT			2	SS	7	●		□			○			bentonite seal/50 mm I.D. PVC riser	
	trace gravel, trace sand	1.0														
	occ. sandy clayey silt layers	1.5														
	APL to DTPL	2.0		3	SS	13	●		□			○			water level in monitoring well at a depth of 2.06 m on Jan. 29, 2025	
		2.5														
		3.0														
	-----	3.5		4	SS	15	●		□			○				
	becoming grey, APL	4.0														
		4.5														
	-----	5.0		5	SS	8	●	□				○			3.0 m long, 50 mm I.D. PVC screen with sandpack	
	becoming stiff	5.5														
	occ. sand and silt seams, wet	6.0														
		6.5		6	SS	8	●	□				○			monitoring well installed in BH1 at 6.1 m	
		7.0														
		7.5														
		8.0		7	SS	9	●	□				○				
		8.5														
		9.0														
		9.5		8	SS	10	●	□				○				
374.44 9.76	End of Borehole	10.0														

PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
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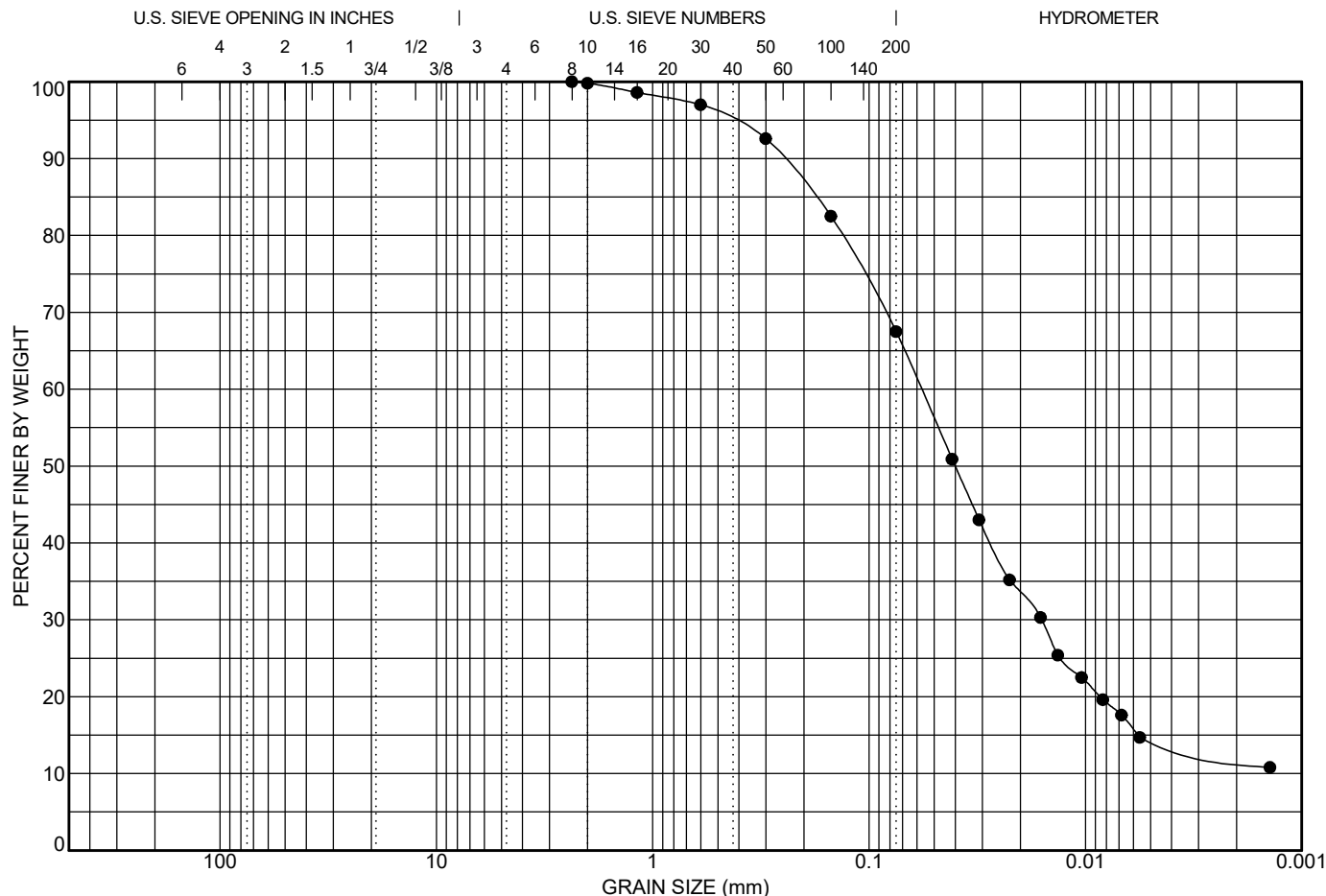
FILE No: 2297**BOREHOLE No. 7**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 16 - 25 TO Jan 16 - 25**PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
ENGINEERING LTD.**311 Victoria Street North
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FILE No: 2297**BOREHOLE No. 8**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 14 - 25 TO Jan 14 - 25**PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
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FILE No: 2297**BOREHOLE No. 9**Client: **Blackdoor DC**Project: **Proposed Apartment Buildings**Location: **36 Westhill Drive, Waterloo, Ontario****EQUIPMENT DATA**Machine: **CME 55 Track**Method: **Hollow Stem Auger**Size: **82 mm I.D.**Date: **Jan 14 - 25 TO Jan 14 - 25**

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. □				PENETRATION RESISTANCE STANDARD ● DYN. CONE ○					
							50	100	150	200	20	40	60			
Ground Elevation: 385.53 m											10 20 30					
385.43 0.10	100 mm TOPSOIL															
	firm to very stiff reddish brown to brown	0.5		1	SS	8	●						○			
	CLAYEY SILT trace gravel, trace sand occ. sandy clayey silt layers	1.0		2	SS	6	●						○			
	APL to DTPL	1.5														
		2.0		3	SS	13	●			□			○			
		2.5		4	SS	13	●			□			⊗			
	some sand	3.0														
		3.5		5	SS	17	●			□			○			
		4.0														
		4.5														
	becoming grey, APL occ. sand and silt seams, wet	5.0		6	SS	12	●			□			○			
		5.5														
		6.0														
		6.5		7	SS	13	●			□			○			
		7.0														
		7.5														
		8.0		8	SS	12	●			□			○			
		8.5														
		9.0														
		9.5		9	SS	13	●			□			○			
375.77 9.76	End of Borehole	10.0														borehole open and dry to 9.76 m bgs upon withdrawal of the drilling augers

PROJECT MANAGER: **EYC****CHUNG & VANDER DOELEN
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
					2.36	0.057	0.016		0.0	32.5		67.5

Date: Feb. 18 - 2025
Client: Blackdoor DC
Contractor:
Source:
Sampled From: BH 1 - SS 8, 7.62 to 8.22 m depth
Sample No.: 1-8
Date Sampled: Jan. 16 - 2025
Sampled By: DS
Lab No.: 87
Date Tested: Feb. 05 - 2025
Type of Material: Sandy Silt, some Clay

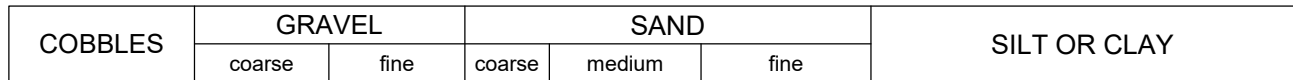
Sieve Size (mm)	Percent Passing	No Specifications



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 Fax: 519-742-7739
 e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

Project: Proposed Apartment Buildings
Location: 36 Westhill Drive, Waterloo, Ontario
File No.: 2297
Enclosure No.: 10



Date:	Feb. 18 - 2025	Sieve Size (mm)	Percent Passing	No Specifications
Client:	Blackdoor DC			
Contractor:				
Source:				
Sampled From:	BH 9 - SS 4, 2.29 to 2.89 m depth			
Sample No.:	9-4			
Date Sampled:	Jan. 16 - 2025			
Sampled By:	DS			
Lab No.:	88			
Date Tested:	Feb. 05 - 2025			
Type of Material:	Clayey Silt, some Sand			



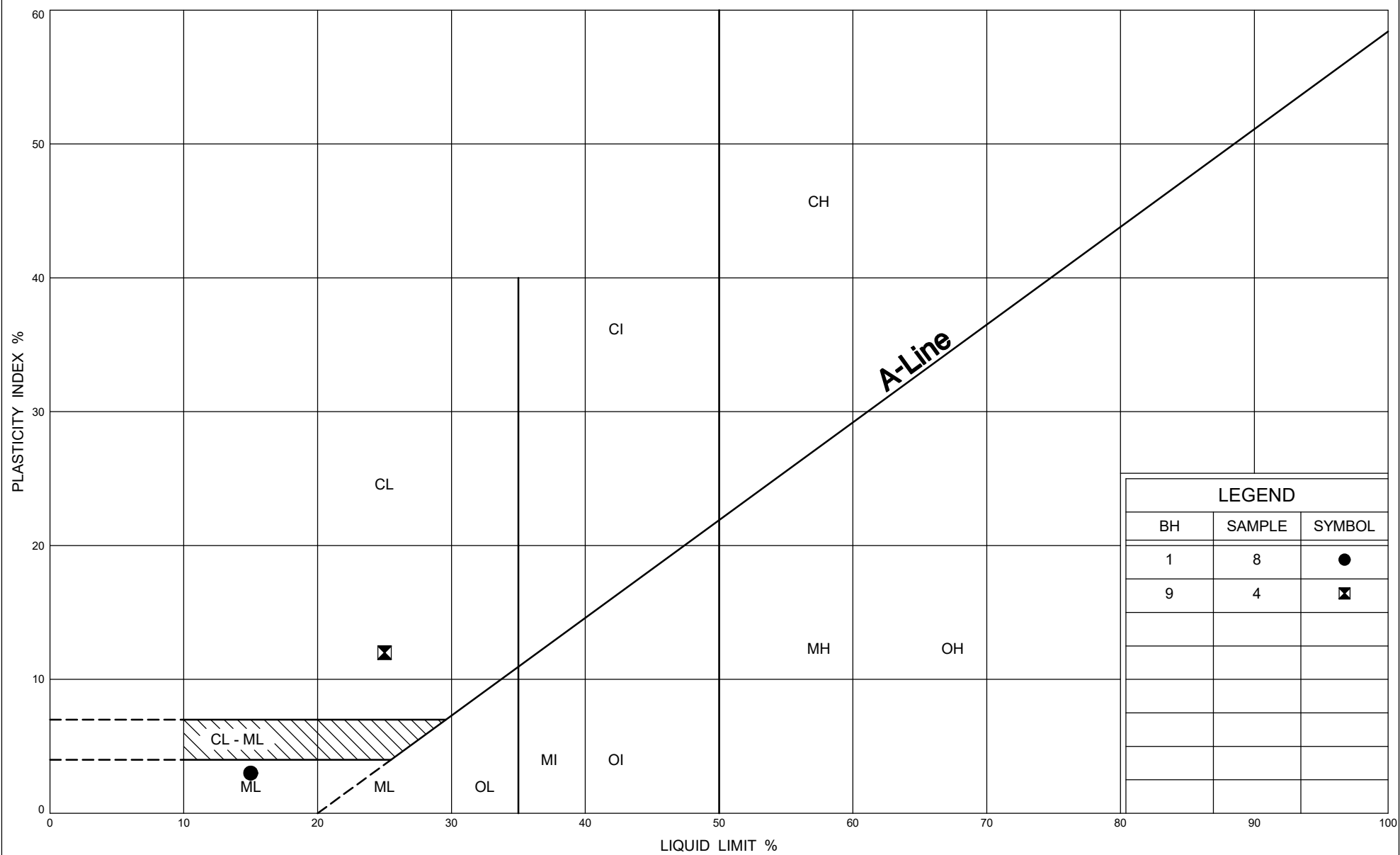
GRAIN SIZE DISTRIBUTION

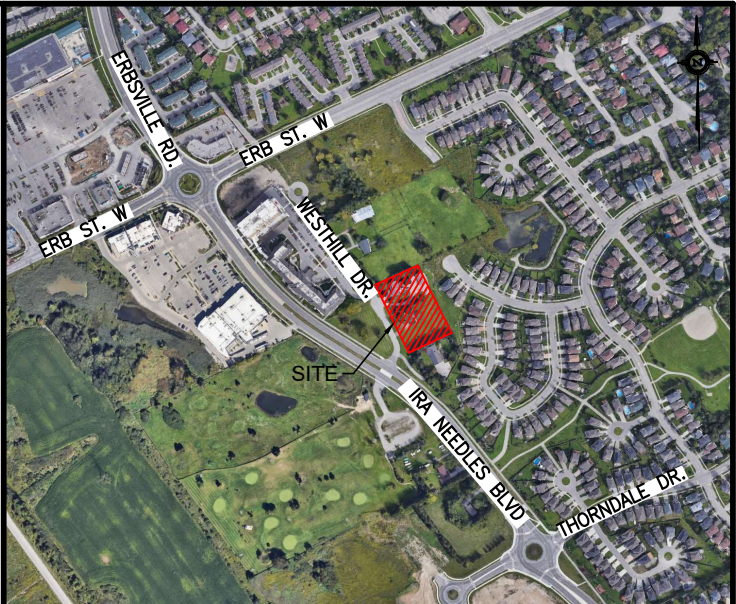
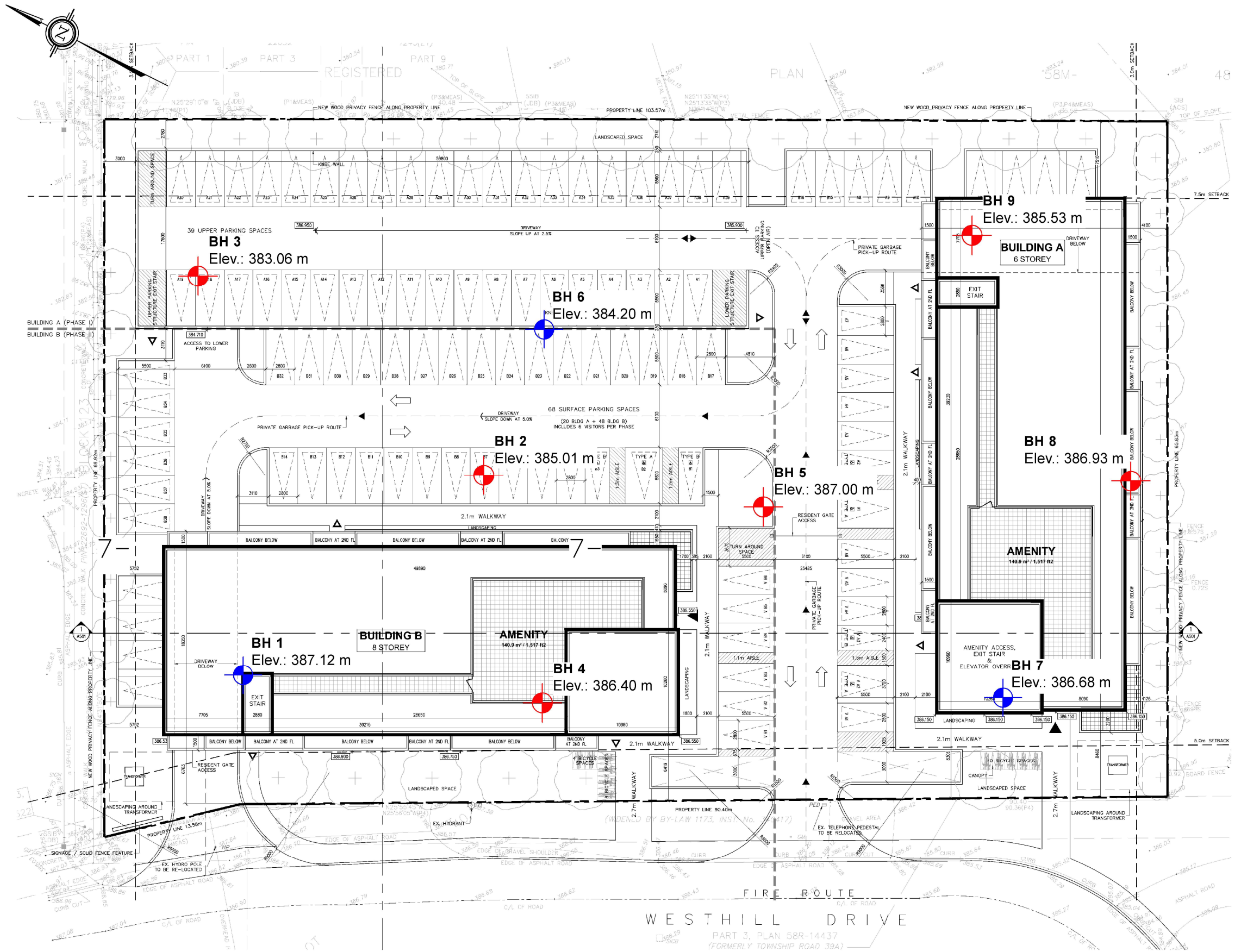
Project: Proposed Apartment Buildings

Location: 36 Westhill Drive, Waterloo, Ontario

File No.: 2297

Enclosure No.: 11





KEY PLAN SOURCE: Google Earth

- LEGEND
- Borehole Location
 - Borehole and Monitoring Well Location

Elev. Ref.: CVD borehole locations and associated ground surface elevations were surveyed using a Network RTK Global Navigation Satellite System (GNSS) Receiver. The survey data was collected using UTM Zone 17N Projection, NAD83(CSRS)v7-2010 datum and Canada Geoid Model HT2_2010v70 (CGVD28).

DWG. Ref.: Architecture Unfolded Inc., "Site Plan", 36 Westhill Dr, Waterloo, Ontario. Dated: August 7, 2025

BOREHOLE LOCATION PLAN

Proposed Apartment Buildings

36 Westhill Drive
Waterloo, Ontario



CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1 / 519-742-8979

Drawn By: DS/AD	Date: September 2025	File No.: 2297
Checked By: EYC	Scale: 1:400	Drawing No.: 1

