Revised
GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED MIXED USE BUILDING (RESIDENTIAL & MEDICAL CENTER)
3033 DUNDAS STREET WEST, MISSISSAUGA, ONTARIO

Client

2504228 Ontario Ltd.

3033 Dundas Street West
Mississauga, ON L5L 3R8

Prepared by:

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Project No. 2100522AG

May 27, 2024

HLV2K
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May 27, 2024 Reference No.2100522AG

2504228 Ontario Ltd.
3033 Dundas Street West
Mississauga, ON L5L 3R8

Attention: Iram K Zando
Email: stateline-builder@hotmail.com

RE: Geotechnical Investigation Report for Proposed Mixed Use Building (Residential & Medical Center) at 3033 Dundas Street West, Mississauga, Ontario

Dear Iram

Enclosed is a copy of geotechnical investigation report related to the above noted site.

For and on behalf of HLV2K Engineering Limited

Irfan Ahmad Khokhar, Ph.D., P.Eng.
Vice President and Principal

Executive Summary

HLV2K Engineering Limited (HLV2K) was retained by 250228 Ontario Ltd. (the client) to provide the geotechnical investigation report for the proposed mixed-use building (Residential & Medical Center) located at 3033 Dundas St West, Mississauga, Ontario.

Based on the information provided to us by the client, it is our understanding that the project will consist of a medical center and twelve storey residential building with three levels of underground parking.

HLV2K does not have any structural information regarding the proposed development.

The purpose of this investigation was to assess the subsurface conditions at the site and provide geotechnical engineering advice and recommendations.

HLV2K Engineering Limited completed a geotechnical investigation for the proposed development at the site. This investigation was carried out by drilling four (4) boreholes (BH101 to BH104) spread on the South-East site to a maximum depth of 30.5m below the existing ground surface. HQ coring technique was used for bedrock coring in Boreholes BH101and BH103. Based on the field investigation and laboratory testing, geotechnical findings and geotechnical engineering recommendations are provided in this report. The approximate locations of these boreholes (BH101 to BH104) are shown on Drawing 1A and the borehole logs from the investigation are attached in Appendix B.

A top layer of asphalt 75mm thickness was encountered at the borehole locations (BH101 & BH104). A 100 to 150mm thick layer of topsoil was encountered at the locations of borehole BH102 & BH103. It should be noted that asphalt/topsoil quantities should not be calculated from the borehole information, as large variations in depth may exist between and beyond boreholes.

A layer of granular fill material was encountered at borehole locations (BH101 & BH104) and extended to depths varying from 0.9m to 1m below the existing ground surface. The fill materials generally consisted of loose to compact sand with gravel. The fill was moist, and generally brown to dark brown in color. It should be noted that the depth of fill can vary in the area of existing structures or in the area of previous excavations.

Native materials were encountered underlying the fill material/topsoil in all the boreholes. The native materials encountered at boreholes were quite consistent and were generally cohesive to non cohesive in nature (i.e., firm to very stiff silty clay to clayey silt till / sand and gravel to silty sand, and dense to very dense) and extending to depths varying 7.7 to 9.1 m below the existing ground surface or to geodetic elevations from 153.6 to 152.4 m. The clayey silt / silty clay till deposit is underlain by Queenston Formation shale bedrock at depths ranging from 7.7 to 9.1 m. The following table summarizes the inferred bedrock depth / elevations interpreted from the borehole data.

Borehole No.	Ground Surface Elevation (m)	Inferred Depth of Shale Bedrock Surface (m)	Inferred Elevation of Shale Bedrock Surface (m)	Notes
BH101/MW	161.5	9.1	152.4	Sampled up to 9 m of Bedrock
BH102/MW	161.3	7.7	153.6	Inferred/augured to bedrock
BH103	161.7	9.1	152.6	Sampled up to 21.4 m of Bedrock
BH104/MW	161.7	7.9	153.8	Inferred/augured to bedrock

During drilling and at the completion of drilling, the short-term groundwater levels were observed in the boreholes at depths varying from 7.4m to 7.5m below the existing ground surface. Monitoring wells were installed at the borehole locations BH101, BH102 and BH104. Groundwater level measurements were made at different times to observe water level fluctuations in the monitoring wells and presented in table 3.3 of this report.

It should be noted that groundwater conditions vary depending on factors such as temperature, season, precipitation, construction activity and other situations, which may be different from those encountered at the time of the monitoring. The possibility of groundwater level fluctuations at the site should be considered when designing and developing the construction plans for the project.

Groundwater problems are anticipated during excavation and installation of foundations below the existing ground surface. A positive dewatering system will be required to deal with water problems during the construction. Details of dewatering requirement are provided in a hydrogeological investigation report prepared by HLV2K.

Since the project will consist of three levels of underground parking and an excavation to a depth of 11m is expected, the proposed structures can be supported by conventional spread and strip footings or mat (raft) foundations founded on the slightly weathered bedrock (at least 3 m below the top surface of shale bedrock) predominantly reddish shale soils for a geotechnical reaction of 500kPa at the Serviceability Limit States (SLS), and for a factored geotechnical resistance of 700kPa at the Ultimate Limit States (ULS).

Alternatively, the proposed structure can be founded on drilled piers (minimum 1m in diameter) to relatively sound shale bedrock, at least 10 m below the top surface of shale bedrock for a net geotechnical reaction of 5000 kPa at SLS and a factored geotechnical reaction of 7500 kPa at ULS.

A coefficient of vertical subgrade reaction (kt) of 80 MPa/m can be used for the design of the mat foundation founded on relatively sound shale bedrock.

An ultimate (failure state) friction coefficient of 0.5 can be used between the concrete and undisturbed weathered shale bedrock. For sound shale bedrock, this coefficient is increased to 0.6. A sliding resistance factor (Ø) equal to 0.8 can be used to derive the factored horizontal resistance at the Ultimate Limit States (ULS) from the ultimate horizontal resistance, i.e., Ruls = ØRu.

With three levels below ground surface, the floor slab can be cast as slab-on-grade provided a minimum 200 mm layer of clear crushed stone (19 mm maximum size) is placed between the underside of the floor slab and the exposed bedrock surface. Considering that the lowest basement finished floor (10m below the existing ground surface) and below the static water table, therefore the perimeter and underfloor drainage systems are recommended to install for the proposed building structure. The recommended drainage systems are subjected to approval of authorities having jurisdiction over the project site. As an alternative, a raft structure can be considered, and then underfloor drains can be installed between the raft slab and floor slab.

Generally, methane gas exists in the bedrock in GTA area, and is more concentrated with depth. Appropriate care and monitoring are essential in all confined bedrock excavations. It is prudent once the excavation is completed to design depth, a gas monitoring assessment be carried out to confirm the concentration of methane. If significant concentrations of methane are observed, a gas venting system will need to be installed under the floor slab.

A temporary shoring system consisting of timber lagging and soldier piles is recommended for the proposed excavations. Alternatively, a caisson wall can be used to support the proposed excavations.

Soil excavations can be carried out with a heavy hydraulic backhoe. Where the excavations will be extended into the bedrock, this will require ripping and/or rock breaking equipment. A rock saw may also be required to reduce the risks of overbreak. Contractors should examine the engineering logs and rock cores to make their own assessment of anticipated excavation plant and production rates/difficulties. The amount of water entering into the excavation can likely be controlled by gravity drainage and conventional pumping. Based on the borehole information, see page from the interface of fill and native deposits and possible wet sandy seams/lenses should be expected but in all likelihood water seepage should be controllable by the use of conventional pumping from collection sumps and ditches for most excavations. Contractors should be prepared to employ more elaborate dewatering procedures if the flow from possible sand seams or pockets becomes a problem. In addition to this, the Contractor must be prepared to mitigate any adverse water ingress from intensely fractured zones of bedrock. According to Lo et al. (1987) 1, the permeability of weathered Queenston Formation shale bedrock ranged from 10^{-4} to 10^{-3} cm/s, which was more than two orders of magnitude higher than that of sound bedrock.

Based on the Site Classification for Seismic Site Response (Table 4.1.8.4.-A) of the National Building Code of Canada 2015 (NBC), the investigated area is in site class C ($360 < VS30 \leq 760$ m/s). The average shear wave velocity value in bedrock measured in the depth interval of 15 to 30 m was 1070 m/s. If this value is used for seismic site classification to take into consideration the proposed building foundation at 15 m below ground surface, as provided by Commentary J, the investigated area falls in site **Class B** ($760 < VS30 \leq 1500$ m/s).

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[1] K.Y. Lo, B.H. Cooke and D.D. Dunbar (1987). Design of buried structures in squeezing rock in Toronto, Canada. Canadian Geotechnical Journal, 24: 232–241.

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1 INTRODUCTION

HLV2K Engineering Limited (HLV2K) was retained by 2504228 Ontario Ltd. (the Client) to complete a geotechnical investigation to evaluate the site conditions at proposed Residential building & Medical Center at 3033 Dundas St W, Mississauga, Ontario (the Site). The site key plan and approximate locations of the boreholes are shown on Drawings 1 and 1A.

This work was conducted in accordance with our proposal 2100522AG dated December 14, 2021. Authorization to Proceed (ATP) was issued to HLV2K on December 14, 2021.

Based on the information provided to us by the client, it is our understanding that the project will consist of Medical Center and twelve storey residential building with three levels of underground parking. Site is currently a vacant lot.

HLV2K does not have any structural information regarding the proposed development.

The purpose of this investigation was to assess the subsurface conditions at four (4) borehole locations (BH101 to BH104) and from the findings in the boreholes make geotechnical engineering recommendations for the following:

1. design parameters required by the structural engineer/civil engineer
2. comments related to earth pressures
3. drainage recommendations
4. frost susceptibility of all soils in the upper 1.2 metres
5. special precautions specific to this site
6. the use of the excavated soil
7. seismic considerations
8. dewatering recommendations

This report is provided based on the terms of reference presented above and, in the text, and on the assumption that the design will be in accordance with the applicable codes and standards. If there is any change in the design features relevant to the geotechnical analyses, or if any question arises concerning the geotechnical aspects of the codes and standards, HLV2K should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of HLV2K can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for the 2504228 Ontario Ltd. (the client) and its architects, consultants, contractors and designers. Third party use of this report without HLV2K's consent is prohibited. The limitation conditions presented in Appendix A form an integral part of the report and they must be considered in conjunction with this report.

2 FIELD AND LABORATORY WORK

Borehole locations for this investigation were established in and marked on the ground by HLV2K personnel in accordance with the client requirements. Prior to drilling operations, underground utilities were cleared at the borehole locations by the public utilities' companies.

For this geotechnical investigation, four boreholes (BH101 to BH104) were drilled to the depths ranging from of 7.7m to 30.5m between January 24 and 31, 2022. The boreholes were advanced by a drilling sub-contractor Davis Drilling LTD located at 873 Nipissing Road, Milton, ON L9T, under the supervision of HLV2K personnel. The boreholes were advanced by utilizing continuous flight solid stem augers. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N (63.5 kg) and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method (ASTM D1586). The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 300 mm (12 inches) was recorded as SPT 'N' value of the soil which indicated the consistency of cohesive soils or compactness of non-cohesive soils. The results of SPT are shown in the Record of Boreholes. The samples were logged in the field and returned to the HLV2K laboratory for detailed examination by the project engineer and for laboratory testing. The approximate borehole locations are shown on Drawing 1A.

Water level observations were made during drilling and at the completion of the drilling operations. Upon completion of drilling, each borehole was backfilled in accordance with current regulations.

The locations of the boreholes were established in the field by HLV2K in consultation with the client. The borehole elevations and locations were surveyed and established by the HLV2K staff. Note, these elevations are approximate only, for relating borehole soil stratigraphy and should not be used or relied on for other purposes.

As well as visual examination in the laboratory, soil samples were tested for water content determinations. Grain size and Atterberg limit analyses were carried out on selected soil samples as presented in Table 2.1. The results of the laboratory tests are presented on the borehole logs, and also on Drawings 2 & 3.

Table 2.1: Sample Details for Grain Size Analyses and Atterberg Limits

Sample No.	Approximate Depth Below the Existing Ground Surface (m)	Approximate Local Elevation (m)	Type of Test	Lab Results
BH102-SS2	0.7 – 1.3	160.6 – 106	MH & AL	Drawing 2
BH104-SS4	2.3 – 2.9	159.4 – 158.8	MH & AL	Drawing 2
BH104-SS7	6.1 – 6.7	155.6 - 155	MH & AL	Drawing 2

Notes: M stands for sieve analysis. MH stands for sieve and hydrometer grain size analyses. AL stands for Atterberg Limits. The results of grain size analyses and Atterberg Limits are presented on subject referenced drawings.

3 RESULTS OF THE INVESTIGATION

The site is located at 3033 Dundas St W, Mississauga, Ontario. The site key plan and the borehole locations are presented on Drawings 1 and 1A. Notes on sample descriptions and the general features of fill material and native soils are presented on Drawing 1B. Detailed subsurface conditions are presented on borehole log sheets, attached as Appendix B.

Details of the subsurface conditions encountered at the borehole locations are provided on the borehole logs following the text of this report. The borehole logs indicate the subsurface conditions only at the borehole locations. Note the material boundaries indicated on the attached sheets are approximate and based on visual observations. These boundaries typically represent a transition from one material type to another and should not be regarded as an exact plane of geological change. It should be pointed out that the subsurface conditions will vary across this site. The subsurface soil and groundwater conditions are summarized as follows.

3.1 Subsurface Conditions

In general, below the fill materials (silty sand with gravel), site is underlain by native soils (loose to dense silty sand to sandy silt, and very soft to hard clayey silt to silty clay till). The subsurface conditions encountered in the boreholes are summarized as follows.

3.1.1 Pavement Structure

The pavement structure at the locations of borehole (BH101 & BH104) consisted of approximately 75 mm asphalt underlain by 825 to 925mm granular base materials which typically were sand and gravel. It should be noted that the asphalt and granular material thicknesses provided here were measured at the borehole locations only and may vary beyond the boreholes. This information is not considered to be sufficient for estimating granular base quantities and associated costs. A summary of the encountered approximate thicknesses is provided in Table 3.1.

Table 3.1: Encountered Pavement Structure

Borehole #	Surface Elevation (m)	Asphalt Thickness (mm)	Granular Thickness (mm)
BH101	161.5	75	825
BH104	161.7	75	925

3.1.2 Fill

A layer of granular fill material was encountered at borehole locations (BH101 & BH104) and extended to depths varying from 0.9m to 1m below the existing ground surface. The fill materials generally consisted of loose to compact sand with gravel. The fill was moist, and generally brown to dark brown in color. It should be noted that the depth of fill can vary in the area of existing structures or in the area of previous excavations.

SPT N-values recorded within this material generally varied from 7 to 36 blows/300mm indicating loose to compact conditions.

Based on visual observation in the field and our experience in the area, it appears that these SPT N values are not representative to determine the compactness. It also indicates that the fill did not receive a systematic compaction. It should be noted that the thickness of fill could vary between and beyond boreholes and this should be considered when estimating.

3.1.3 Native Soils

Native materials were encountered underlying the fill/topsoil material in all the boreholes. The native materials encountered at boreholes were quite consistent and were generally cohesive to non cohesive in nature (i.e., firm to very stiff silty clay to clayey silt till / sand and gravel to silty sand, and dense to very dense) extending to maximum explored depths varying 7.7 to 9.1 m below the existing ground surface or to geodetic elevations from 153.6 to 152.4 m. The grain-size distribution of three (3) selected soil samples from native deposits is enclosed in Drawing 2, and results are summarized in Table 3.2.

Table 3.2: Summary of Grain-Size Distribution

Sample No.	Depth Below the Existing Ground Surface (m)	Sieve and Hydrometer Test Results			
		Gravel %	Sand %	Silt %	Clay %
BH102-SS2	0.7 – 1.3	16	16	41	27
BH104-SS4	2.3 – 2.9	32	50	11	7
BH104-SS7	6.1 – 6.7	5	42	39	14

It should be noted that the thickness of native deposit could vary between and beyond the borehole locations within the depth of investigation, and this should be taken into account when estimating.

3.1.4 Bedrock

The clayey silt / silty clay till deposit is underlain by Queenston Formation shale bedrock at depths ranging from 7.7 to 9.1 m. Reddish brown, weathered to fresh, thinly to thickly bedded weak shale bedrock was encountered at all borehole locations (BH101 to BH104).

According to the “Bedrock Geology of Ontario, Southern Sheet” prepared by the Ministry of Northern Development and Mines (issued 1991), the shale bedrock at the site is of Queenston Formation; typically red-brown in colour and fine grained.

Two Boreholes (BH101 and BH103) were advanced into the bedrock for a vertical distance of 9 to 21.4m by HQ coring. Reddish brown, thin laminated to medium bedded of weak to medium strong limestone zones were found within the shale bedrock. According to Canadian Foundation Engineering Manual (4th edition), the strength of this rock is classified as weak.

The following table summarizes the inferred bedrock depth / elevations interpreted from the borehole data.

Table 3.3: Inferred Depth and Elevation of Shale Bedrock Surface

Borehole No.	Ground Surface Elevation (m)	Inferred Depth of Shale Bedrock Surface (m)	Inferred Elevation of Shale Bedrock Surface (m)	Notes
BH101/MW	161.5	9.1	152.4	Sampled up to 9 m of Bedrock
BH102/MW	161.3	8.3	153	Inferred/augured to bedrock
BH103	161.7	9.1	152.6	Sampled up to 21.4 m of Bedrock

Borehole No.	Ground Surface Elevation (m)	Inferred Depth of Shale Bedrock Surface (m)	Inferred Elevation of Shale Bedrock Surface (m)	Notes
BH104/MW	161.7	8.5	153.2	Inferred/augured to bedrock

Commonly the till overlying the shale contains seams of limestone which would give a false indication of the bedrock level. Similarly, the depth of weathering cannot be determined accurately due to the presence of limestone layers.

The Total Core Recovery (TCR) and Rock Quality Designation (RQD) of the shale bedrock in Boreholes BH101 and BH103 ranged from 92 to 100% and from 17 to 92 % respectively. Based on these values, the rock mass quality can be described as poor to excellent, typically very fair to good. Based on our local experience, it should be noted that the upper approximate 2.0 m bedrock is weathered and may be intensely fractured shale bedrock. This is underlain by markedly improved rock with RQD typically ranging from 50 - 90%, which is consistent with our current observation.

The point load index strength (Is_{50}) of selected 3 samples (Results attached in Drawing 4) ranged between 1.62 to 3.17 MPa. The results indicated that strength anisotropy (axial direction stronger than diametral, due to bedding plane weaknesses inherent in the shale bedrock at the site), thus more reliance is recommended on the axial results. Based on testing results, the shale bedrock is classified as “weak” under the conventions of the International Society for Rock Mechanics (ISRM). The interbedded shaly limestone / limestone layers can be classified as “weak” to “strong”.

It is known that the Queenston Formation shale can deteriorate rapidly when exposed to the atmosphere and water. Although slake durability tests were not performed for this project, tests carried out on this rock formation indicated that the durability of the Queenston Formation is “low” to “medium”, but generally “low”. This suggests that the shale will readily disintegrate or slake in the presence of air and water.

Methane gas exists in the shale bedrock, and more concentrated with depth. Based on our experience in the area, it may be possible, however rare, that methane could be present also in glacial till, due to migration by some means from the shale bedrock. Appropriate care and monitoring is essential during excavation and specifically during the installation of caissons (if applicable). General comments regarding shale bedrock are given in **Appendix D.**

3.2 Groundwater Conditions

During drilling and at the completion of drilling, the short-term groundwater levels were observed in the boreholes at depths varying from 7.4m to 7.5m below the existing ground surface. Monitoring wells were installed at the borehole locations BH101, BH102, and BH104. Groundwater level measurements were made at different times to observe water level fluctuations in the monitoring wells and presented in table 3.3.

Table 3.4: Summary of Groundwater Level Observations in Installed Monitoring Wells

MW ID	Ground Surface Elevation (m)	Borehole Depth (mbgs)	Groundwater Level Observations			
			10-FEB-22		15-FEB-22	
			Depth (mbgs)	Elevation (m)	Depth (mbgs)	Elevation (m)
BH101	161.5	18.1	2.77	158.73	2.77	158.73
BH102	161.3	7.7	2.64	158.66	2.6	158.7
BH104	161.7	7.9	3	158.7	2.97	158.73

Based on the water table readings obtained between February 10 and February 15, 2022, the groundwater level varied from 2.6m to 3m below the existing ground surface, corresponding to geodetic elevations of 158.6m to 158.7m. For design purpose, the groundwater table can be estimated at an approximate depth corresponding to geodetic elevation of 158.8m.

Perched water may be encountered in excavated areas during wet seasons. A perched water condition can occur due to the accumulation of infiltrated water in the more pervious fill overlying less pervious deposit, or at the interface of fill and native soils, especially during wet periods.

Note that the groundwater level can vary and is subjected to seasonal fluctuations and in response to major weather events. The depth of groundwater table can also be influenced by the presence of underground features such as utility trenches, and this may affect the construction procedures, costs and schedules.

Groundwater problems are anticipated during excavation and installation of foundations below the existing ground surface. A positive dewatering system will be required to deal with water problems during the construction. Details of dewatering requirement are provided in a hydrogeological investigation report prepared by HLV2K.

4 DISCUSSION AND RECOMMENDATIONS

4.1 General

Based on the information provided to us by the client, it is our understanding that the project will consist of a medical center & twelve storey residential building with three levels of underground parking. Site is currently a vacant lot.

Final details of the project have not been established, therefore the comments and recommendations provided in this report are to be considered preliminary and suitable for planning and design purposes only. When final details of the project are known, the recommendations given in this report should be reviewed to ensure their applicability.

The following discussion and recommendations are based on the factual data obtained from this investigation and are presented for guidance of the design professionals only.

Contractor’s bidding or providing services on this project should review the data and determine their own conclusions regarding construction methods and scheduling.

4.2 Foundations

We have reviewed the architectural drawings and note that the proposed building will consist of three levels of underground parking, which will extend to a depth of 9.6± m below grade. Therefore, the basement excavation of the proposed building will likely extend to an approximate depth of 10m below grade. In addition, footing excavations of the proposed building will likely extend to a depth of 11± m below grade corresponding to geodetic elevation of 150.3 to 150.5m.

4.2.1 Spread Footing/Mat Foundation

Based on the information provided by the client, the general excavation for the proposed structure will likely be extended into shale bedrock. The shale bedrock at the subject site is considered as competent founding layer to support the proposed foundation loads. The proposed building can be supported by conventional spread and strip footings, or mat (raft) foundations founded on the slightly weathered to fresh bedrock.

Since the project will consist of three levels of underground parking and an excavation to a depth of 11m is expected, the proposed structures can be supported by conventional spread and strip footings or mat (raft) foundations founded on the slightly weathered bedrock (at least 3 m below the top surface of shale bedrock) predominantly reddish shale soils for a geotechnical reaction of 500kPa at the Serviceability Limit States (SLS), and for a factored geotechnical resistance of 700kPa at the Ultimate Limit States (ULS).

Alternatively, the proposed structure can be founded on drilled piers (minimum 1m in diameter) to relatively sound shale bedrock, at least 10 m below the top surface of shale bedrock for a net geotechnical reaction of 5000 kPa at SLS and a factored geotechnical reaction of 7500 kPa at ULS.

A coefficient of vertical subgrade reaction (kt) of 80 MPa/m can be used for the design of the mat foundation founded on relatively sound shale bedrock.

An ultimate (failure state) friction coefficient of 0.6 can be used between the concrete and undisturbed sound shale bedrock. A sliding resistance factor (Ø) equal to 0.8 can be used to derive the factored horizontal resistance at the Ultimate Limit States (ULS) from the ultimate horizontal resistance, i.e. Ruls = ØRu.Top of weathered shale and sound shale must be confirmed through close geotechnical supervision during the construction stage.

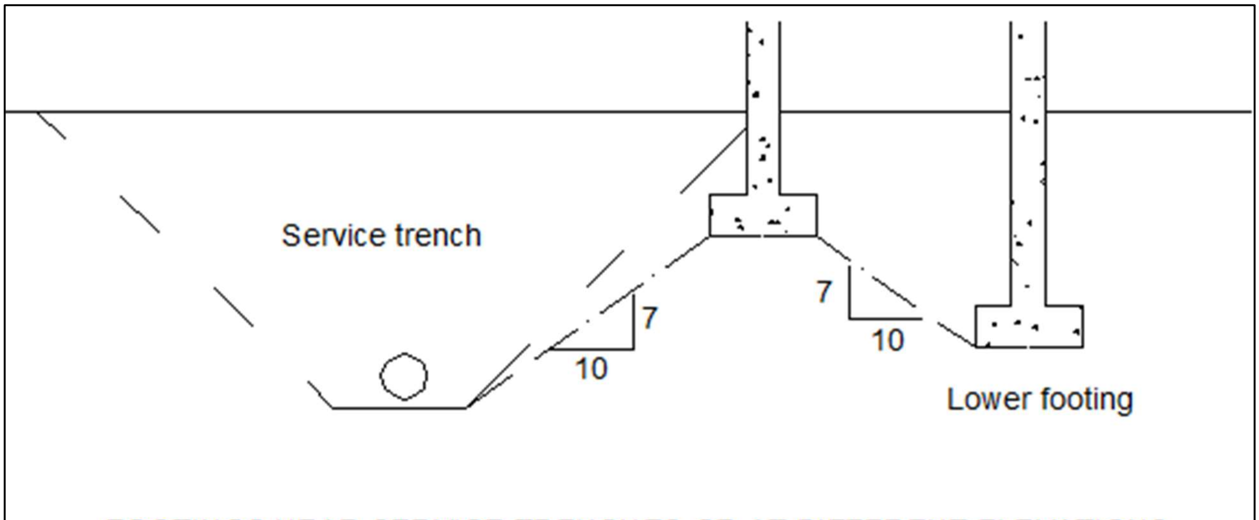
At the assumed levels of the foundations, the settlements under the induced stresses of the proposed building would be less than about 25 mm total and 15 mm differential for spread footings, and 40 mm total and 20 mm differential for mat foundations.

4.2.2 Other Comments on Foundations

Variations in the soil conditions are expected in between the borehole locations, and during construction, the soil bearing pressures should be confirmed by the Geotechnical Engineer of HLV2K.

Rainwater or groundwater seepage into the excavation should be directed away, and any disturbed material should be removed from the base of the excavation. If foundation excavations are expected to remain open for a considerable time, the foundation subgrade should be protected against disturbance by a 50 mm thick layer of lean concrete.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing. Footings close to underground services should also be set back from the services based on this slope limitation as shown in the following Figure.



FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

During winter construction, foundations and slab (if applicable) on grade must not be poured on frozen soil. Foundations must be adequately protected at all times from cold weather and freezing conditions.

Design frost protection depth for the general area is 1.2m. Therefore, for frost protection, new footings should have a permanent earth cover of at least 1.2m or be provided with an equivalent thickness of extruded rigid exterior-grade polystyrene insulation.

The recommended bearing capacities and the corresponding founding elevations would need to be confirmed by the representative of HLV2K during construction. It should be noted that the recommended bearing capacities have been calculated by HLV2K from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by HLV2K to validate the information for use during the construction stage. In this regard, HLV2K should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, HLV2K will assume no responsibility for interpretation of the recommendations in the report.

4.3 Floor Slab and Permanent Drainage

The floor slab and permanent drainage systems for the conventional footing option and for the mat (raft) foundation option are discussed as follows.

4.3.1 With Conventional Footings

Since three (3) levels underground parking are contemplated, the floor slab can be cast as slab-on-grade provided a 200 mm layer of clear crushed stone (19 mm maximum size) is placed between the underside of the floor slab and the exposed bedrock surface.

The design of the basement floor slab may be made on the basis of a value of modulus of subgrade reaction of 80 MPa/m on the surface of the granular base.

It should be noted that groundwater table is above the basement level at the site and therefore, the basement excavation would be carried out with suitable dewatering from inside. The basement substructure would require suitable water proofing measures to keep it in a dry condition.

Considering that the lowest basement finished floor (9.6± m below the existing ground surface) and below the static water table, the recommended perimeter and under floor drainage system is shown in **Drawing 3** (soldier piles and timber lagging). The suggested details for continuous caisson wall (if applicable) are presented attached in **Drawing 4** (if high water ingress control and protection of adjacent structures are required). The perimeter and underfloor drainage system, shown in **Drawing 5**, is recommended for the basement walls if open cut excavations will be undertaken.

Generally, methane gas exists in the bedrock in GTA area, and is more concentrated with depth. Appropriate care and monitoring is essential in all confined bedrock excavations. It is prudent once the excavation is completed to design depth, a gas monitoring assessment be carried out to confirm the concentration of methane. If significant concentrations of methane are observed, a gas venting system will need to be installed under the floor slab.

Noted that the placement of perimeter foundation drains and underfloor drains as presented in **Drawings 3 to 5** is subjected to approval of authorities having jurisdiction over the project site.

4.3.2 With Mat Foundation

If a mat foundation is adopted, an underfloor drainage system should be installed between the floor slab and the mat structure. This option can be preferred if the installation of perimeter foundation drains is not an option due to possible restriction by the authorities having jurisdiction over the project site.

4.3.3 Construction Considerations

Because of the powdery and clayey nature of the shale bedrock when excavated, there is some potential for fouling of drainage systems unless the excavation base is well cleaned and sumps/pumps are filtered and periodically backwashed. On some sites, a skim coat concrete mud slab of maximum 50 mm in thickness (5 MPa compression strength) is placed under conventional footings in order to mitigate this problem. For slabs or mat foundations, the skim coat is limited to 50 mm under the assumption that it will sustain some cracking/structural disconnection which is necessary in order to relieve the sub-slab groundwater pressures, allowing seepage through the mud slab into the subslab drainage layer.

All foundation bases will need to be inspected by HLV2K Engineering Limited prior to pouring concrete or placing the mud slab.

4.4 Elevator Pits

It is anticipated that elevator pits will be installed 1 to 2 m below the basement finished floor level. The elevator pits will likely be installed within the sound shale bedrock. Drainage systems at the base level of the elevator pits are not recommended, due to powdery and clayey nature of the shale bedrock. The elevator pits should be designed as water-tight structures, and water pressure on the pit walls should be considered, assuming the water table at the lowest adjacent basement level of the floor slab.

4.5 Excavations and Backfill Issues

4.5.1 Temporary Shoring

It is understood that the proposed excavations will be supported by a temporary shoring system consisting of soldier piles and timber lagging and/or caisson wall (refer to **Drawings 3 and 4**). The general requirement for caisson wall is given in **Drawing 6**.

Dewatering will be required for the installation of shoring lagging in the intensely fractured zone of bedrock or sandy seams in clayey silt till (if applicable) below the groundwater table.

Rock anchors will be required to support the shoring as the overburden at the site is not competent to resist the tension of anchors, as well, the shale bedrock was encountered at relative shallow depths of 7.9 to 9.1m below the ground surface at borehole locations.

4.5.1.1 Design Parameters

The shoring system may be designed in accordance with the Canadian Foundation Engineering Manual (CFEM), 4th Edition. Though not a design code, the CFEM design manual provides a comprehensive guide for shoring and anchor design. The soil parameters estimated to be applicable for this design are as follows:

1) Earth Pressure Calculation

- for overburden
  Where movement must be minimal, K = 0.45

  Where minor movement (0.002H) can be tolerated, K = 0.25

  Passive earth pressure for soldier piles (unfactored), K_p = 3.2

- for sound shale, K = 0.2
- Surcharges (minimum 12 kPa) due to the adjacent structures, equipment, stockpiles or other loadings behind the wall should also be considered in the design.

2) For Global Stability Check

- For overburden γ = 20 kN/m^3 c = 0 ϕ = 30°
- For weathered shale γ = 22 kN/m^3 c = 400 kPa
- For sound shale γ = 23 kN/m^3 c = 2,000 kPa
- Surcharge (minimum 12 kPa) is to be determined by shoring contractor.

3) For Vertical Loading

For vertical loading of soldier piles in soldier piles and timber lagging, or contiguous caissons, the following should be noted. These are in addition to the relevant parameters given in 1) and 2).

- Respective safe net allowable bearing value for pile/caisson base founded on weathered and sound shale bedrock, $q_{weathered}$ = 2,500 kPa, q_{sound} = 5,000 kPa
- Assuming a slurry procedure and tremie concrete, q = 2,000 kPa
- Adhesion on the buried caisson shaft or behind the shoring system must be neglected when designing the shoring system.

4) For Rock Anchors

Rock anchor design should be in accordance with Section 26, CFEM design manual (4th Edition).

If structures and/or utilities sensitive to movement are located within the zone of influence as determined by the shoring designer, then detailed analyses of movement should be carried out.

A bond stress of 600 kPa can be used in the sound bedrock for the design of rock anchors. Based on the drilling information and our experience in the area, sound bedrock is assumed at least 2.0 m below the top of surface of the inferred shale bedrock.

The top anchor must not be placed lower than 3.0 m below the top of level ground surface. Anchors will require casing when penetrating through sandy deposits (if applicable).

The design bond stress values depend on anchor installation methods and grouting procedures. However, these values are arbitrary. The contractor during installation should assess the actual soil to concrete bond value and thereby, decide on a capacity and confirm its availability. The confirmation procedures consist of field testing (performance tests) at least twice the computed design working load capacity to confirm the geotechnical capacity of the rock anchors. The preferred anchor location for the performance test can be subjected to the maximum anchor design load. Moreover, at least two performance tests will need to be carried out and confirmed by HLV2K.

The soil parameters used in the shoring design and anchor locations will need to be confirmed by this Residential, prior to installation of the temporary shoring system.

The contractor is responsible for the shoring design.

4.5.1.2 Movements of the Temporary Shoring System

Movement of the shoring system is inevitable. Vertically, it will take place as a result from the vertical load on the soldier piles; laterally, from the inclined tiebacks and inward horizontal movement resulted from earth and water pressures. The magnitude of this movement can be controlled by sound construction practices, and it is anticipated that the horizontal movement will be in the range of 0.1 to 0.25%H. Vertical movements increase the horizontal movements because of the reduced stress in the inclined anchors. For this reason, design must be carried out to minimize vertical movement of the shoring system.

To ensure that movements of the shoring are within an acceptable range, monitoring must be carried out. Vertical and horizontal targets on the soldier piles must be located and surveyed before excavation begins. Weekly readings during excavation should show that the movements will be within those predicted; if not, the monitoring results should enable directions to be given to improve the shoring.

4.5.1.3 Construction Considerations

For soldier piles and timber lagging, the soldier piles should be installed in pre-augered holes taken below the deepest excavation. The holes should be filled with at least 20 MPa concrete below the excavation level and half bag mix above the base of the excavation. The concrete strength must be specified by the shoring designer. In sand seams (if applicable) and soft zones of the clayey silt till, temporary liners, mud drilling and other techniques as necessary will be required to prevent ingress of groundwater and loss the surrounding soil during installation of shoring system to protect adjacent structures from adverse impacts. Positive measures may be required to prevent the loss of soil through the spaces between the lagging boards. This could be achieved by placing a geotextile filter cloth behind the lagging boards and jamming geotextile fabric into seepage points where material loss is occurring.

If a caisson wall is used, the soldier piles should be installed in pre-augured holes taken to the founding level where stability of the caisson wall is achieved. The concrete strength for the piles must be specified by the shoring designer. Temporary liners or mud will be required to help prevent the soil from caving during the installation period.

It should be noted that groundwater table is likely above the basement level at the site and therefore, the excavation is anticipated to be carried out with suitable dewatering from inside.

All anchors must be tested as indicated in the CFEM.

4.5.2 Excitability Issues

It is understood that the proposed building will include three (3) levels underground parking , and the finished floor of underground parking at the lowest level is expected approximately 9.6± m below the existing ground surface. Log of Borehole sheets suggest that the excavation will extend into the shale bedrock below the existing groundwater table.

Soil excavations can be carried out with a heavy hydraulic backhoe. Where the excavations will be extended into the bedrock, this will require ripping and/or rock breaking equipment. A rock saw may also be required to reduce the risks of overbreak. Contractors should examine the engineering logs and rock cores to make their own assessment of anticipated excavation plant and production rates/difficulties.

The amount of water entering into the excavation can likely be controlled by gravity drainage and conventional pumping. Based on the borehole information, see page from the interface of fill and native deposits and possible wet sandy seams/lenses should be expected but in all likelihood water seepage should be controllable by the use of conventional pumping from collection sumps and ditches for most excavations. Contractors should be prepared to employ more elaborate dewatering procedures if the flow from possible sand seams or pockets becomes a problem. In addition to this, the Contractor must be prepared to mitigate any adverse water ingress from intensely fractured zones of bedrock. According to Lo et al. (1987) [2], the permeability of weathered Queenston Formation shale bedrock ranged from 10^{-4} to 10^{-3} cm/s, which was more than two orders of magnitude higher than that of sound bedrock.

Note that the glacial clayey silt till is non-sorted sediments and therefore may contain cobbles and boulders. Moreover, possible large obstructions such as buried bricks, asphalt and concrete pieces may be present in the fill materials. Old footings and rubbles may also be encountered during/after site demolition. Provisions must be made in the excavation contract for the removal of possible cobbles, boulders and shale fragments in the tills or obstructions in the fills.

All open excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the soils can be classified as follows:

Fill (typically loose to compact)	Type 3 soil above water level
Clayey silt/Silty Clay till (firm to stiff)	Type 3 soil above and below water level
Clayey silt/Silty Clay till (typically very stiff to hard)	Type 1 to Type 2 soil above and below water

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[2] K.Y. Lo, B.H. Cooke and D.D. Dunbar (1987). Design of buried structures in squeezing rock in Toronto, Canada. Canadian Geotechnical Journal, 24: 232–241.

Wet sand seams/layers (if applicable)	Type 4
Shale Bedrock	Type 1

As a general rule, the excavations in Type 1 to Type 2 soils can be carried out without support using side slopes 1H: 1V, while the bottom 1.2m of the excavation can be cut vertically. The excavation in Type 3 soil can be carried out using minimum side slopes of 1 to 1.5H: 1V. The excavations in Type 4 soils will require minimum flatter side slopes of 3H to 1V. These slopes should be visually monitored for any movement especially if workers are present within the excavation. These temporary slopes should only be utilized for a short duration.

It should be noted that, in Southern Ontario, a large amount of evidence has been observed on the detrimental effect of rock squeeze on underground structures. During the excavation of bedrock, time-dependent displacement would be occurred due to the relief of high initial horizontal stresses (may range up to 25 MPa).[3] Significant residual horizontal displacements were observed with more than 100 days delay time after excavation in previous engineering practices.[3] Therefore, in order to relieve these compressive stresses from the bedrock, it is recommended that an at least 50 mm thick compressible material (e.g. polyurethane foam) should be placed sandwiched between the excavation side slopes and the concrete structural elements.

All excavations should be inspected, evaluated and approved by the Geotechnical Engineer who is familiar with the findings of this investigation. Immediately after the approval, a minimum 50 m thick skim coat of concrete of minimum compressive strength of 5 MPa (i.e. mud slab) can be placed in the excavations for ease of construction.

4.5.3 Backfill Issues

On-site verification of the excavated soils for re-use as backfill by suitably qualified personnel, during construction, would be required. The excavated soils free from topsoil and organics can be used as general construction backfill. Based on visual and tactile examination, the on-site excavated silt and glacial till deposits are considered to be suitable for re-use as general construction backfill provided their moisture contents at the time of construction are at or near optimum. The clayey tills are likely to be excavated in cohesive chunks or blocks and will be difficult to compact in confined areas. For use as backfill, these clayey materials will have to be placed in thin layers. These clayey soils will have to be compacted using heavy equipment suitable for these soils. Unless the clayey materials are properly pulverized and compacted in sufficiently thin lifts, post-construction settlements could occur.

The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture contents, and each layer should be compacted to at least 95% Standard Proctor Maximum Dry Density SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

Note that the excavated soils are subjected to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should therefore be compacted at the surface and/or be covered with tarpaulins to help minimize moisture ingress.

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[3] W.A. Trow and K.Y. Lo (1989). Horizontal displacements induced by rock excavation: Scotia Plaza, Toronto, Ontario. Canadian Geotechnical Journal, 26: 114–121.

The on-site excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as Granular 'B' (OPSS 1010) should be used. Imported granular fill, which can be compacted with handheld equipment, should be used in confined areas.

Stockpiles should be placed well away from the edge of excavation and their height should be controlled so that they do not surcharge the sides of the excavation. Surface drainage should be controlled to prevent flow of surface water into the excavations. Excavation safety and stability of temporary construction slopes and lateral support systems are the contractor's responsibility.

Further considerations and recommendations regarding engineered fill are presented in **Appendix C** in this report.

4.6 Earth Pressure Design Parameters for Permanent Wall

Walls or bracing subject to unbalanced earth pressures must be designed to resist a pressure distribution that can be calculated based on the following expression:

$$p = K [\gamma (h - h_w) + \gamma' h_w + q] + \gamma_w h_w$$

Where p = lateral earth pressure in kPa acting at depth h

K = earth pressure coefficient, $K = 0.4$ for overburden soil, and $K = 0.2$ for sound shale

γ = unit weight, assuming 20.5 kN/m^3 for soils and 22.0 kN/m^3 for shale

h = depth to point of interest in metres

h_w = depth to point of interest below the groundwater level in metres

γ' = submerged unit weight of the exterior soil, (γ - 9.81 kN/m^3)

γ_w = unit weight of water, 9.81 kN/m^3

q = equivalent value of surcharge on the ground surface in kPa (minimum of 12 kPa)

Where the perimeter drainage system prevents the buildup of hydrostatic pressures, the above equation can be simplified to:

$$p = K (\gamma h + q)$$

For the underground parking wall, cast directly along the caisson wall (if applicable), the basement wall must be designed for hydrostatic pressure, even though a drainage board is provided between the caisson wall and the basement wall.

Further information regarding earth pressure and apparent earth pressure distribution is presented as **Drawing 7.**

4.7 Earthquake Considerations

Shear wave velocity test (downhole seismic survey) for seismic site classification was carried out at the location of BH103.

The objective of the survey was to determine site class for seismic site response based on average shear wave velocity value measured in the upper 30 m (VS30). The ASTM D7400-14 Downhole Seismic Testing method was applied for in-situ measurements of shear-wave velocities.

Based on the Site Classification for Seismic Site Response (Table 4.1.8.4.-A) of the National Building Code of Canada 2015 (NBC), the investigated area is in site class C (360 < VS30 ≤ 760 m/s). The average shear wave velocity value in bedrock measured in the depth interval of 15 to 30 m was 1070 m/s. If this value is used for seismic site classification to take into consideration the proposed building foundation at 15 m below ground surface, as provided by Commentary J, the investigated area falls in site **class B** (760 < VS30 ≤ 1500 m/s).

4.8 Pavements

The pavement structures presented in Table 4.1 can be used for the design of proposed parking areas and access roadways during construction under ideal or non-ideal subgrade conditions.

The explored fill generally extended not more than 2 m in the boreholes. The subgrade is expected to consist of earth fill materials and/or native soils depending upon the proposed grades of parking structure. The zone of influence of the pavement subgrade is generally estimated within 1 m below the underside of the granular sub-base.

4.8.1 Ideal Conditions

Under ideal conditions, the zone of the pavement subgrade within 1 m below the underside of the granular sub-base must be compacted to at least 95% of its Standard Proctor Maximum Dry Density (SPMDD) with moisture content 2 to 3% drier than its optimum and then the compaction should be increased to 98% of SPMDD in the upper 0.6 m of the subgrade.

4.8.2 Non-Ideal Conditions

If the roads are to be constructed during the wet seasons and if the subgrade is unsuitable then either the top 1m of the subgrade should be replaced with drier, compacted, select subgrade material meeting as OPSS 1010 or the top 0.8 m of the subgrade should be replaced with granular material meeting the specifications defined in OPSS-1010-13. This will be assessed at the time of access roadways construction and parking area.

The existing fill within 1 m from the underside of sub-base must be excavated and assessed its stability and suitability according to ideal/non-ideal conditions criteria stipulated by the local authority having jurisdiction over the project site. Depending upon evaluation either the excavated material will be re-used or if found to be unsuitable replaced with select subgrade /granular materials.

In preparation of the subgrade, prior to placement of the granular sub-base and base materials, the subgrade must be proof-rolled to determine its stability and suitability for access road construction and parking area by a qualified geotechnical professional.

The recommended pavement structures provided in Table 4.1 are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples. Consequently, the recommended pavement structures should be considered for preliminary design purposes only. A functional design life of eight to ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific data input from the client.

Table 4.1: Recommended Pavement Structure Thickness

Pavement Layer	Compaction Requirements	Light Duty Parking (Cars)	Heavy Duty Parking (Delivery Trucks)
Asphaltic Concrete	92 to 96.5% Maximum Relative Density	40 mm OPSS HL 3 40 mm OPSS HL 8	50 mm OPSS HL 3 75 mm OPSS HL 8
OPSS Granular A Base (or 20mm Crushed Limestone)	100% SPMDD*	150 mm	150 mm
OPSS Granular B	100% SPMDD	200 mm	350 mm

* Denotes Standard Proctor Maximum Dry Density, ASTM-D698

The subgrade must be compacted to 98% SPMDD for at least the upper 300 mm unless accepted HLV2K.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved.

Alternatively, consideration should be given to the use of rigid Portland Cement Concrete pavement where there is intense truck use, parking and turning of vehicles. The following Table 4.2 provides the minimum recommended rigid pavement structure.

Table 4.2: Minimum Rigid Concrete Pavement Structure

Pavement Layer	Compaction Requirements	Heavy Duty Pavement
Portland Cement Concrete (CAN3-CSA A23.1) - Class C-2	CAN3-CSA A23.1	225 mm
Base Course: Granular A (OPSS 1010) or 19 mm Crusher Run Limestone	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm

It must be noted that this structure does not provide full protection of the subgrade from frost penetration; therefore, the pavement slabs must be separated from the building structure.

Control of surface water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum grade of two percent) to provide effective drainage toward subgrade drains. Grading adjacent to the pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement. Continuous pavement subdrains should be provided along both sides of the driveway/access routes and drained into respective catch basins to facilitate drainage of the subgrade and granular materials. The subdrain invert should be maintained at least 0.3 m below subgrade level. Subdrains should also be provided at all catch basins within the parking area.

Concrete should be proportioned, mixed, placed and cured in accordance with the requirements of CSA Standard CAN/CSA-A23.1-19 for class C-2 exposure, with the following key requirements:

minimum 28-day compressive strength:	32 MPa
air entrainment:	5 to 8 %

maximum water/cementing material ratio: 0.45

Concrete should be placed and spread in a manner which avoids segregation. It should be consolidated with a vibratory screed or internal vibrators. Consolidation close to form edges must be given special consideration.

Concrete should be finished to a thickness tolerance of 0 to plus 10 mm. Concrete must be cured adequately to provide durability and strength. Curing can be accomplished by wet blankets, sprinkling, plastic sheets and curing compounds. Curing should begin immediately after loss of bleed water.

Concrete pavement should be provided with joints to control stresses and prevent the formation of irregular cracks. Recommended joint spacing is 24 to 30 times slab thickness to a maximum dimension of about 4.0m. We would also recommend that load transfer dowels be placed at 50 mm spacing at the joints.

Sawed joints should be cut before random cracking occurs in the slab, usually within 6 to 18 hours after concrete placement. The maximum thickness (aperture) of control joints should 6 mm, while the depth of control joints should be about 1/4th of the slab thickness.

The pavement should be closed to traffic until a minimum flexural strength of 2 MPa is attained or an approximate compressive strength of 20 MPa. This minimum strength is generally reached when the concrete can be saw cut without ravelling.

Additional comments on the construction of parking areas and access roadways are as follows:

1. Removal of all fill for pavement is not necessary. As part of the subgrade preparation, proposed parking areas and access roadways should be stripped fill at least in the upper 0.8 m below subgrade and surficially softened native soils and the base then should be thoroughly proof rolled by using a loaded truck. Unstable areas or areas with excessive organic materials should be further sub-excavated. The fill required to raise the grade can consist of inorganic soil, placed in shallow lifts and compacted to minimum 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

2. The locations and extent of sub-drainage required within the paved areas should be reviewed by this Residential in conjunction with the proposed lot grading. Assuming that satisfactory crossfalls in the order of two percent have been provided, subdrains extending from and between catch basins may be satisfactory. In the event that shallower crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by HLV2K.

3. The above pavement structure considers that construction will be carried out during the dry period of the year. If the subgrade becomes excessively wet or rutted during construction activities, additional sub-base material or placement of geogrids may be required. The need for additional sub-base material and/or placement of geogrids including filter fabric to stabilize the base is best determined during construction. It is recommended that the existing subgrade be heavily proof-rolled prior to placement and any areas showing excessive deflection be replaced prior to placing the granular sub-base material.

4. It is recommended that HLV2K be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations.

4.8.3 Stripping, Sub-excavation and Grading

The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Owing to the clayey (i.e. impervious) nature of the subsoil at some locations of the site, proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial for this project. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular materials by heavy construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material may need to be used.

Any fill required for regarding the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 95% of its SPMDD. The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, or as per Region Standards. The compaction of the new fill should be checked by frequent field density tests.

4.8.4 Construction

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to at least 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.8.5 Drainage

All paved surfaces should be sloped to provide satisfactory drainage towards catch basins. Installation of full-length subdrains on all roads is recommended. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

4.9 Engineered Fill and Sub-Excavation

The elevation of the existing grade varies significantly across the site. Detailed site grading plans for the proposed development were not available to us at the time of preparation of this report. However, based on the existing topography at the site, cut and fill operations are expected to require as part of the proposed development.

In the areas where earth fill is required for site grading purposes, engineered fill can be used and similarly, if the area under consideration need to be raised, engineered fill can be used.

Prior to the placement of the engineered fill, all of the existing fill, the loose possible fill/disturbed soil, and surficial softened native soils must be removed, and the exposed surface proof rolled. Any soft spots revealed during proof rolling must be sub-excavated and re-engineered. The depths of sub-excavation required for the construction of engineered fill will be assessed by a geotechnical professional at the time of excavation.

General guidelines for the placement and preparation of engineered fill are presented on **Appendix C**. A geotechnical reaction of 100 to 150 kPa (2000 to 3000 psf) at the Serviceability Limit States (SLS) and factored geotechnical resistances of 150 to 225 kPa at the Ultimate Limit States (ULS) can be used on engineered fill, provided that all requirements on Appendix “C” are adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential. Despite full time supervision, it has been found that contractors frequently bulldoze loose fill into areas and compact only the surface. The inspector, either busy on other portions of the site or absent during “off hours” will be unaware of this condition. For this reason, we cannot guarantee the performance of the engineered fill, and this guarantee must be the responsibility of the contractor. The owner and his representatives must accept the risk involved in the use of engineered fill and offset this risk with the monetary savings of avoiding deep foundations/soil improvement. This potential problem must be recognized and discussed at a pre-construction meeting. Procedures can then be instigated to reduce the risk of settlement resulting from un-compacted fill.

The following is a recommended procedure for engineered fill:

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained, and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages (if applicable), etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and HLV2K Engineering Limited. Without this confirmation no responsibility for the performance of the structure can be accepted by HLV2K Engineering Limited. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by HLV2K Engineering Limited engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur.

6. Full-time geotechnical inspection by HLV2K Engineering Limited during placement of engineered fill is required. Work cannot commence or continue without the presence of the HLV2K representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A geotechnical reaction of 100 to 150 kPa (2000 to 3000psf) may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested, and footings should be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

10. After completion of the pad a second contractor may be selected to install footings. All excavations must be backfilled under full time supervision by HLV2K to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of HLV2K.

11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

4.10 Corrosivity Test Evaluation

Four (4) soil samples were collected for chemical testing for water soluble sulphate parameter chemical testing for corrosivity and sulphate attack. Table 4.3 summarizes the detail of soil sample locations.

Table 4.3: Summary of Soil Samples Submitted for Corrosivity Analysis

Borehole No.	Depth Below Surface(m)	Material
BH102-SS2	0.8 – 1.4	Clayey Silt Till
BH102-SS7	6.1 – 6.7	Silty Sand
BH104-SS3	1.5 – 2.1	Silty Clay
BH104-SS5	3.0 – 3.6	Sand and Gravel

Chemical analyses were conducted by ALS Canada Ltd. of Mississauga, Ontario. ALS is a member of the Canadian Association for Environmental Analytical.

The summary of pH and water-soluble sulphate content, in order to evaluate the subsoil conditions for possible sulphate attack on concrete, is presented on the following Table 4.4 and test results are attached in Appendix F.

Table 4.4: Summary of Corrosivity Test Results

Parameter	BH102-SS2	BH102-SS7	BH104-SS3	BH104-SS5
pH	7.70	7.85	7.81	8.08
Sulphate (µg/g)	31	50	33	39
Resistivity (ohm.cm)	6650	4390	4670	8140
Redox Potential (mV)	313	308	269	261
Sulphides (%)	0.44	0.38	<0.20	0.23
Moisture (%)	14.0	8.95	14.3	5.80

According to Table 3 of CSA Standard, CAN/CSA-A23.1-19, the degree of exposure to sulphate attack is minimum in onsite material based on the test results and therefore Sulphate resistant cement is not necessary in the subsurface concrete.

The need for cathodic protection to gray or ductile cast iron pipe as given in the ANSI/AWWA Rating for soil-test corrosion evaluation is given in the Appendix F. A summary of the evaluation based on the test values are provided as follows:

Table 4.5: Summary of Test Results for Cathodic Protection

Sample Number	Assigned Points
BH102-SS2	4.5
BH102-SS7	4.5
BH104-SS3	4
BH104-SS5	3.5

The resistivity test result indicated that there is a negligible for corrosion of exposed steel when compared to literature reference (J.D. Palmer, Soil Resistivity Measurement and Analysis, Material Performance, Volume 13, 1974). It should be noted that the test used is typically considered a worse case scenario, and in general consideration of additional characteristics of the soil, including pH and moisture condition, the potential for corrosion of reinforcing steel is considered moderate.

It should be noted that there may be other overriding factors in the assessment of corrosion potential, such as the nature of effluent conveyed, the application of de-icing salts in the area and subsequent leaching into the subsoil’s, stray currents etc.

4.11 Geotechnical Review

It is recommended that the project design drawings be submitted to HLV2K for review for compatibility with site subsurface conditions and the recommendations contained in this report.

5 GENERAL COMMENTS

The recommended bearing capacities (Geotechnical Reaction) and the corresponding founding elevations would need to be confirmed by the representative of HLV2K during construction. It should be noted that the recommended bearing capacities have been calculated by HLV2K from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by HLV2K to validate the information for use during the construction.

In this regard, HLV2K should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, HLV2K will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this Residential.

For and on behalf of HLV2K Engineering Limited

Haseeb

Haseeb Hasan, M.Eng.

LICENSED PROFESSIONAL ENGINEER
M.I.A.KHOKHAR
100197668
30/5/2024
PROVINCE OF ONTARIO

Irfan Khokhar, Ph.D., P.Eng., C.Eng.
Principal Geotechnical Engineer

DRAWINGS

SITE LOCATION PLAN

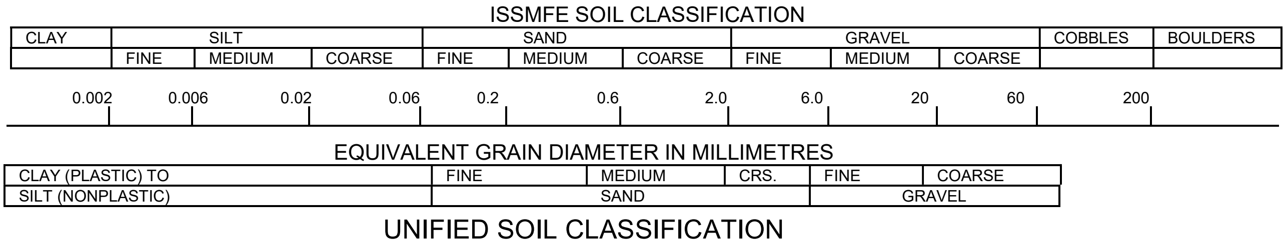
Drawn By: HH	Project: **Geotechnical Investigation Report** **Proposed Office Building** **3033 Dundas Street West in Mississauga, Ontario**	Date: February 28, 2021
Approved By: IK		Project No: 2100522AG
HLV2K ENGINEERING LIMITED	Client: **Zando Developers**	Drawing No 1

BOREHOLE LOCATION PLAN

Drawn By: HH	**Project:** **Geotechnical Investigation Report** **Proposed Office Building** **3033 Dundas Street West in Mississauga, Ontario**	Date: February 28, 2021
Approved By: IK		Project No: 2100522AG
HLV2K ENGINEERING LIMITED	Client: **Zando Developers**	Drawing No 1A

Drawing 1B: Notes on Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by HLV2K Engineering Limited also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

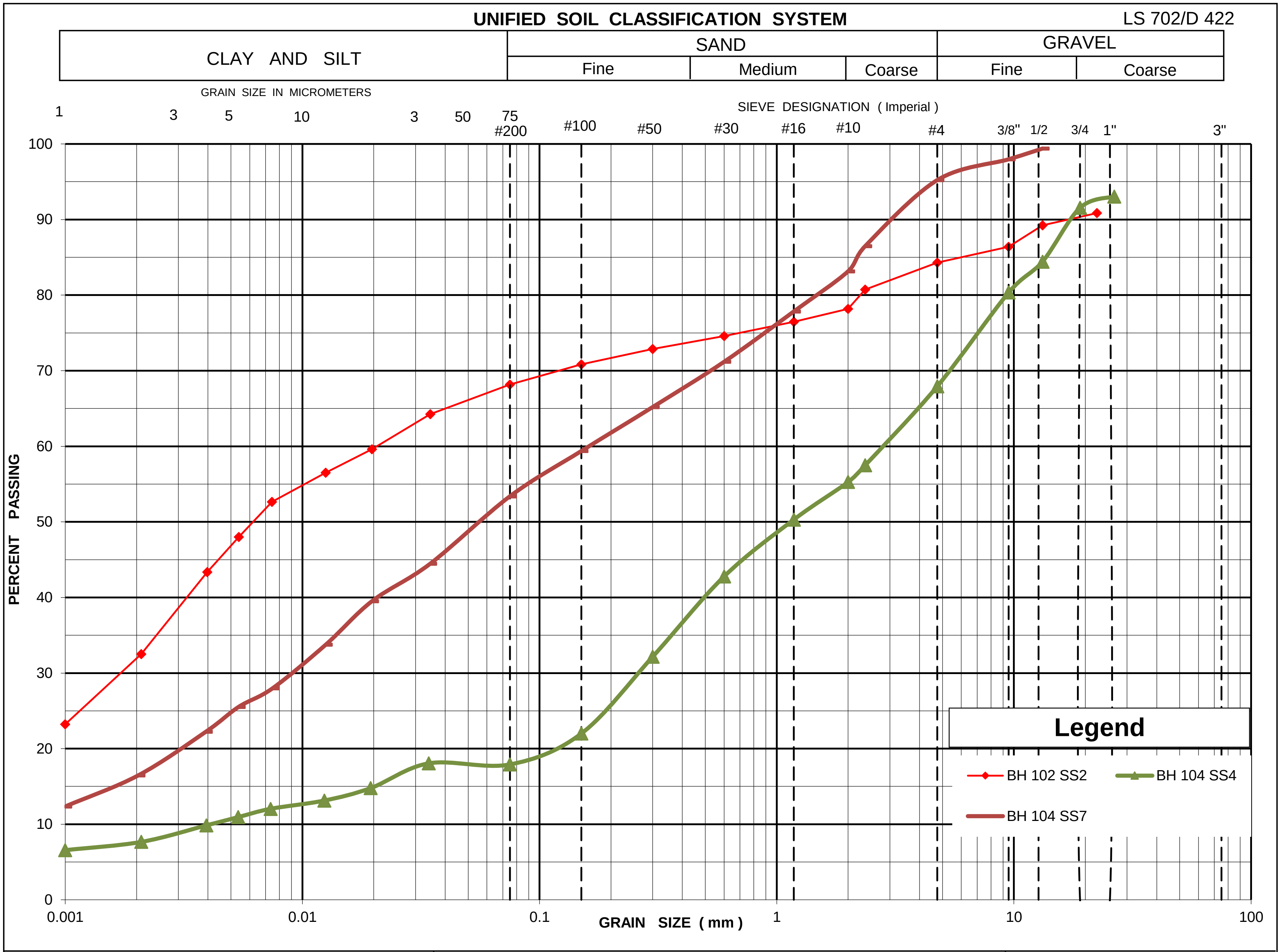
EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advice of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.



HLV2K
ENGINEERING LIMITED

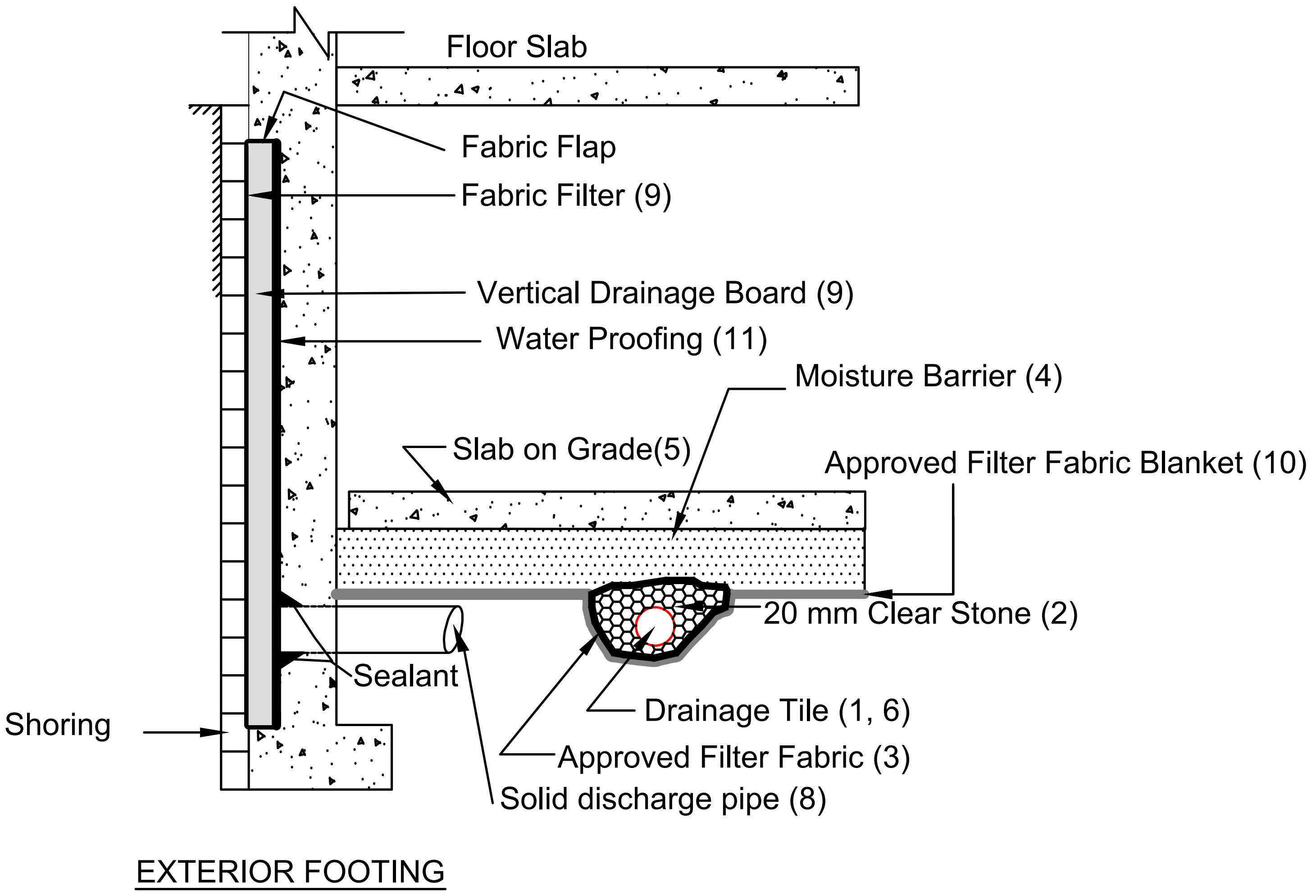
GRAIN SIZE DISTRIBUTION

Drawing No : 2

PROJECT # : 2100522AG

DATE : February 09, 2022

Drawing No. 3



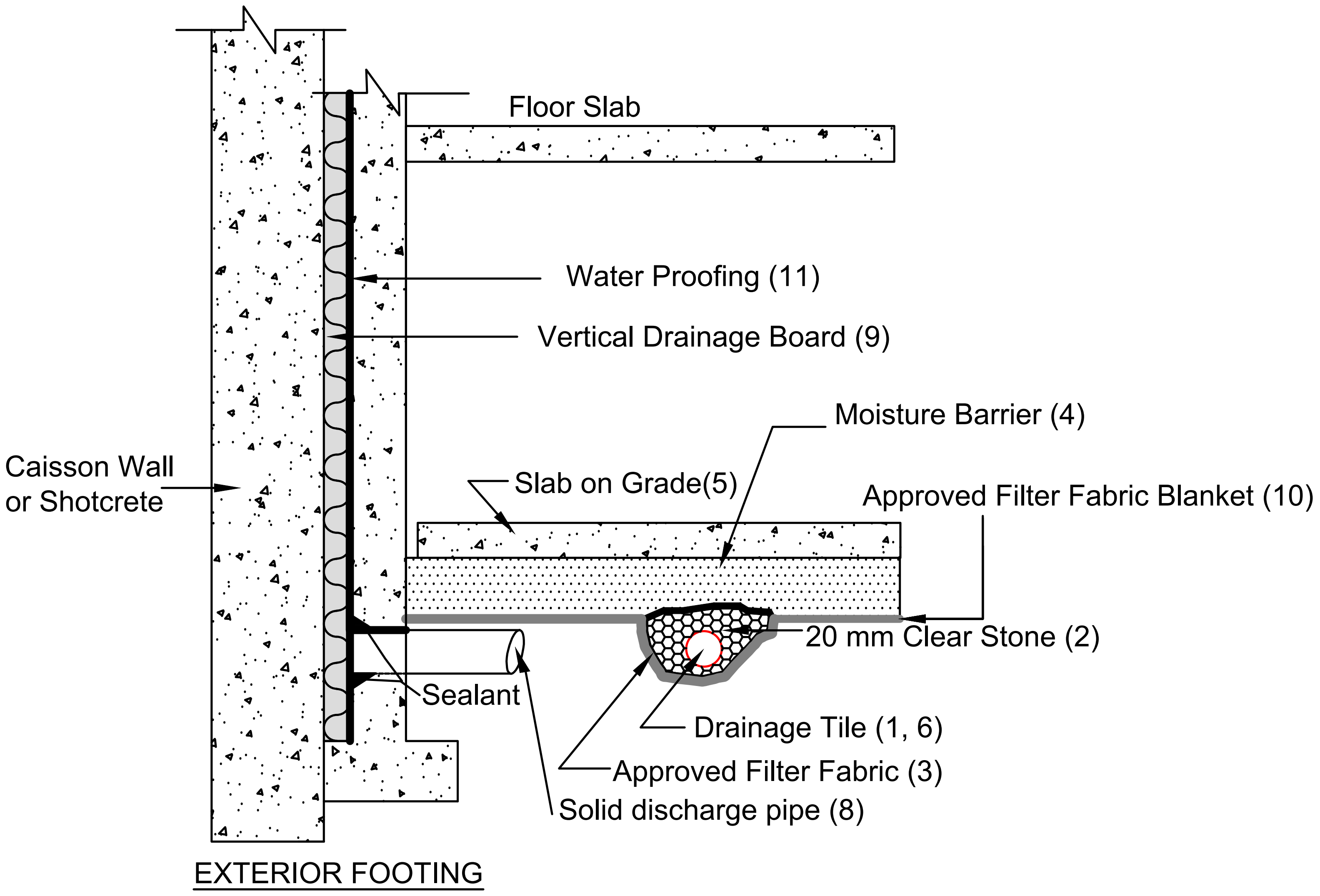
Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter fabric (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Typically, slab on grade is not structurally connected to the wall or footing. However, if it is connected to the wall, it should be designed accordingly.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minium of 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System

(not to scale)

Drawing No. 6



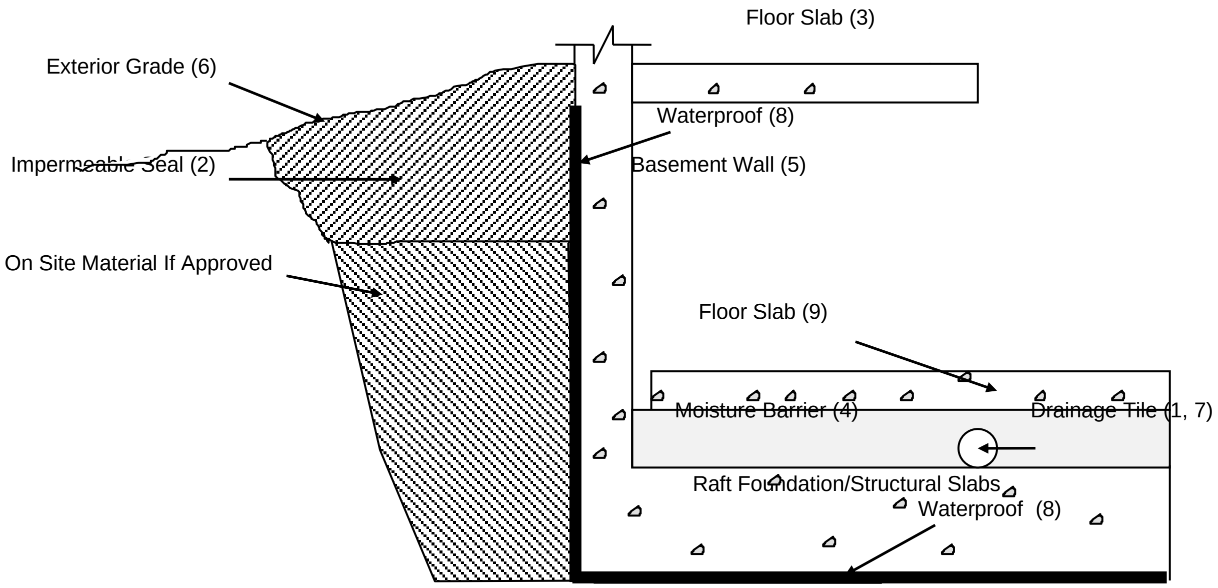
Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter fabric (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Typically, slab on grade is not structurally connected to the wall or footing. However, if it is connected to the wall, it should be designed accordingly.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m (this spacing should also be maintained in the area of shotcrete wall), outletting into a solid pipe leading to a sump.
9. Vertical drainage board mira-drain 6000 or eqivalent with filter cloth should be continous from bottom to 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls must be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System

(not to scale)

Drawing No.5



Notes

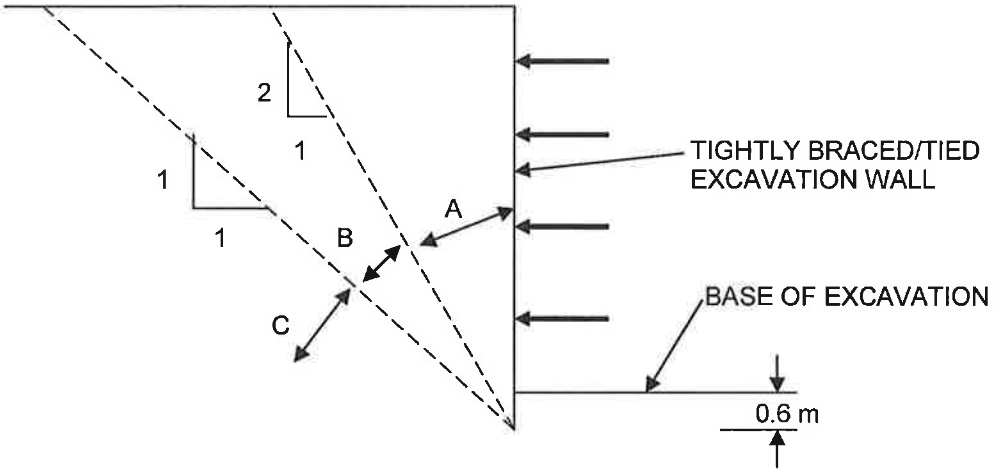
1. Drainage tile to consist of 100 mm (4”) diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be a minimum of 150 mm (6”) below underside of floor slab.
2. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted.
3. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
4. Moisture barrier to be at least 200 mm (8”) of compacted clear 20 mm (3/4”) stone or equivalent free draining material.
5. Basement wall to be water-proofed and the wall has to be designed in consideration of the hydrostatic water pressure.
6. Exterior grade to slope away from building.
7. Underfloor drain invert to be placed on raft foundation slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25’) centres one way.
8. The waterproof should be at least 1 m above the highest groundwater tables. The water-proofing must be designed and approved by design engineer.
9. Slab on grade should not be structurally connected to the wall or footing.

DRAINAGE AND BACKFILL RECOMMENDATIONS

Open Excavation Basement with Underfloor Drainage System
(raft foundations)
(not to scale)

Drawing No. 6

Guidelines for Underpinning in Soil



Zone A Foundations located within this zone may require underpinning. Horizontal and vertical pressures on the excavation wall of non-underpinned foundations must be considered. Horizontal and vertical deformations of foundations within this zone must be considered relative to underpinned and non-underpinned foundations.

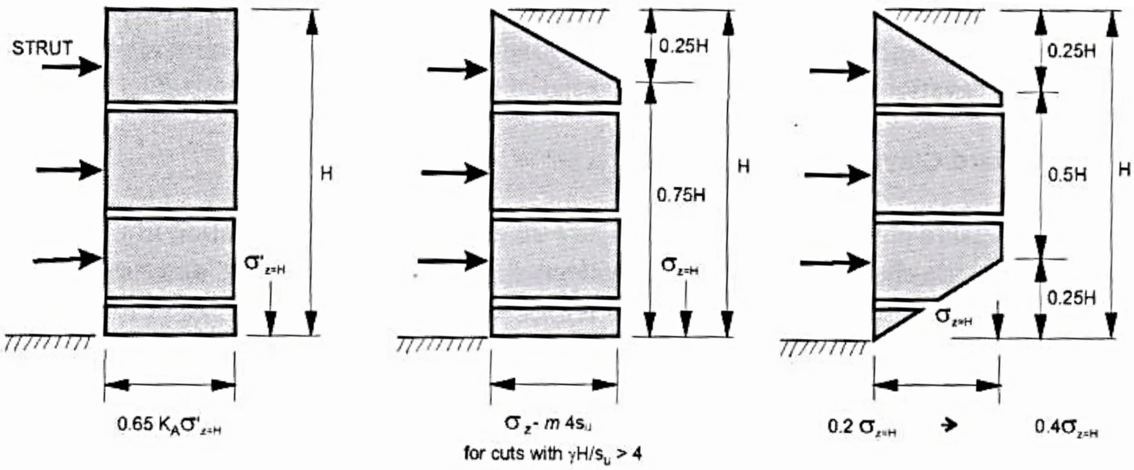
Zone B Foundations located within this zone do not normally require Under-pinning. Horizontal and vertical forces on the excavation wall for non-underpinned foundations must be considered. Horizontal and vertical deformations of foundations within this zone must be considered relative to underpinned and non-underpinned foundations.

Zone C Underpinning to structures is normally founded in this zone. Lateral pressure from underpinning is not normally considered.

(Figure 26.27 from Canadian Foundation Engineering Manual, 4th Edition)

Drawing No. 7

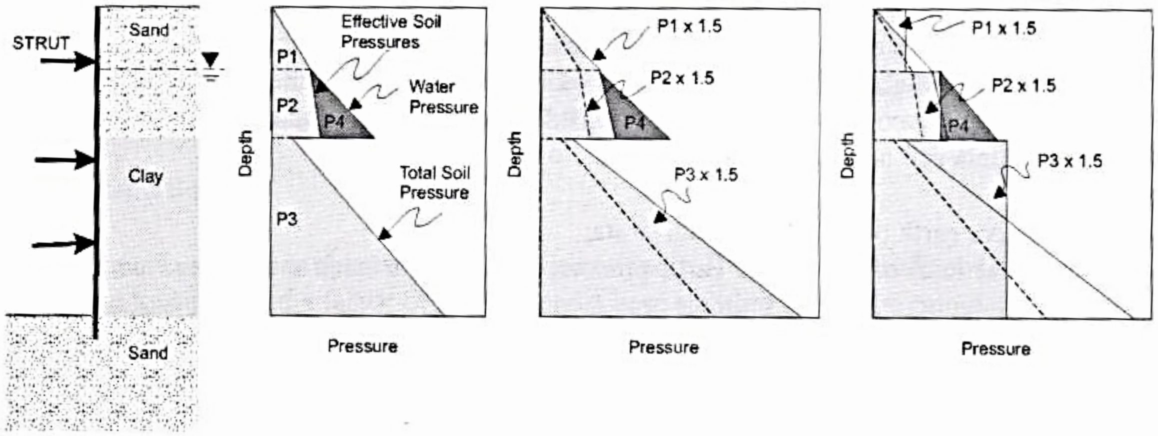
Apparent Earth Pressure Distribution



a) granular soils

b) soft to firm cohesive soils (see text for *m*)

c) stiff to hard cohesive soils



d) method for estimating apparent earth pressures for layered soils

Source: Canadian Geotechnical Society, “Canadian Foundation Engineering Manual”. 4th Edition dated 2006, “Supported Excavations & Flexible Retaining Structures” Section 26.10.3 Page.409, “Braced Retaining Structures Loading Condition”

APPENDICES

Appendix A:

Limitations of Report

Limitations of Report

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to HLV2K Engineering Limited. at the time of preparation. Unless otherwise agreed in writing by HLV2K Engineering Limited, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. 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. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

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.

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 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 conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

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. HLV2K 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.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time. Any user of this report specifically denies any right to claims against the Consultant, Sub-Consultants, their Residentialrs, agents and employees in excess of the fee paid for professional services.

Appendix B:

Borehole Logs, Rock Core Logs and Core Photographs

LOG OF BOREHOLE BH101

PROJECT: Proposed Office Building

CLIENT: Zando Developers

PROJECT LOCATION: 3033 Dundas Street West, Mississauga

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan N 4819684.643 E 606488.4049

DRILLING DATA

Method: Hollow Stem Augur

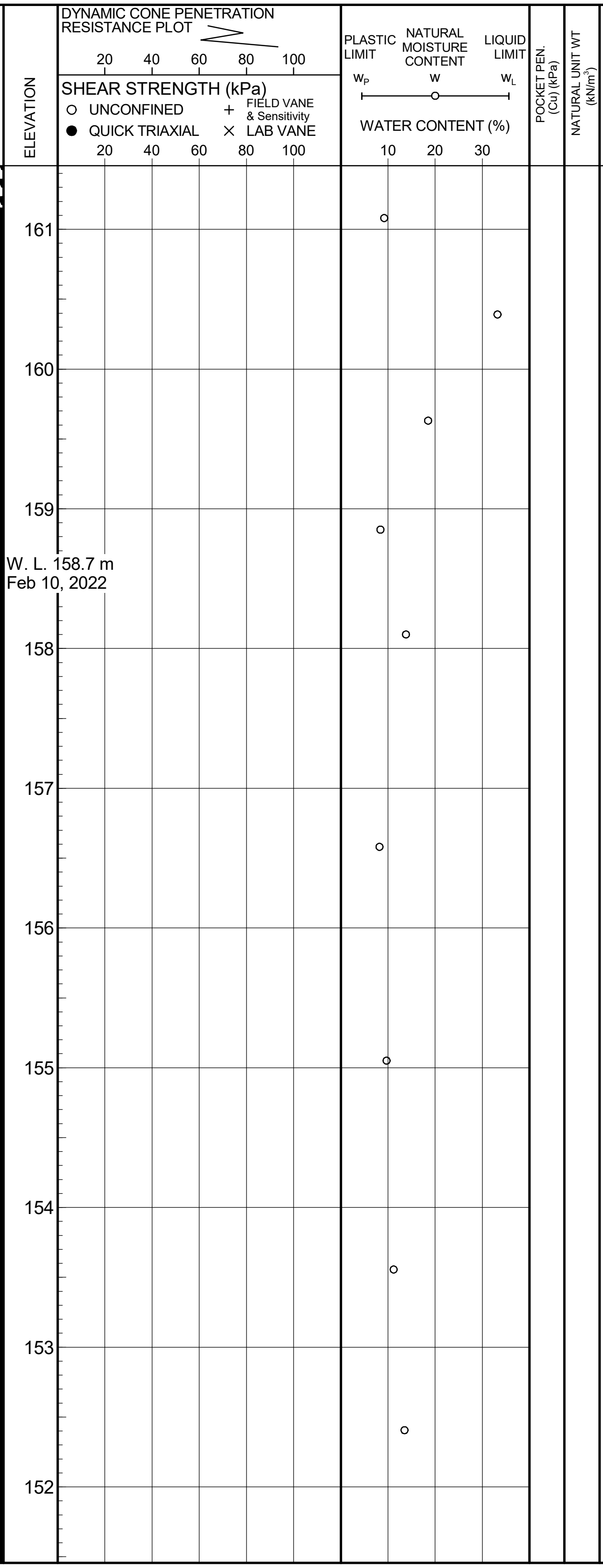
Diameter: 150

Date: Jan/25/2022

REF. NO.: 2100522AG

DRAWING NO.: 1

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
161.5						
161.4 0.1	**Asphalt:** 75mm **Sand and Gravel:** black, moist, loose to compact	1	SS	28		
160.6 0.9	**Silty Clay:** trace to some gravel, trace sand, brown , moist, firm to stiff	2	SS	11		
		3	SS	15		
159.3 2.2	**Sand and Gravel:** brown, wet, dense to very dense wet below 2.3	4	SS	37	W. L. 158.7 m Feb 10, 2022	
		5	SS	59		
		6	SS	50 / 75mm		
155.4 6.1	**Silty Clay:** reddish brown, wet, hard	7	SS	44		
154.8 6.7	**Silty Sand:** some clay, trace gravel, trace weathered shale, reddish brown, wet, very dense	8	SS	50 / 50mm		
152.5 9.0	**Bedrock:** weathered shale, reddish brown	9	SS	50 / 100mm		Coring started at 9.1m
152.4 9.1						



Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

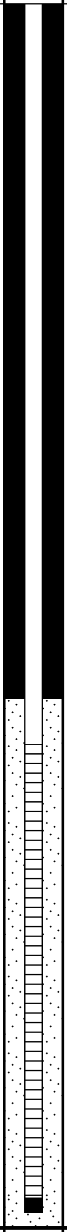
GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH101

PROJECT: Proposed Office Building
CLIENT: Zando Developers
PROJECT LOCATION: 3033 Dundas Street West, Mississauga
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4819684.643 E 606488.4049

DRILLING DATA
Method: Hollow Stem Augur
Diameter: 150
Date: Jan/25/2022

REF. NO.: 2100522AG
DRAWING NO.: 1

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION					
11 12 13 14 15 16 17 18							151 150 149 148 147 146 145 144					
143.4 18.1	**End of Borehole:** borehole terminated at 18.1m Upon completion: 1) Cave-in: open 2) Water: dry											

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

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH102

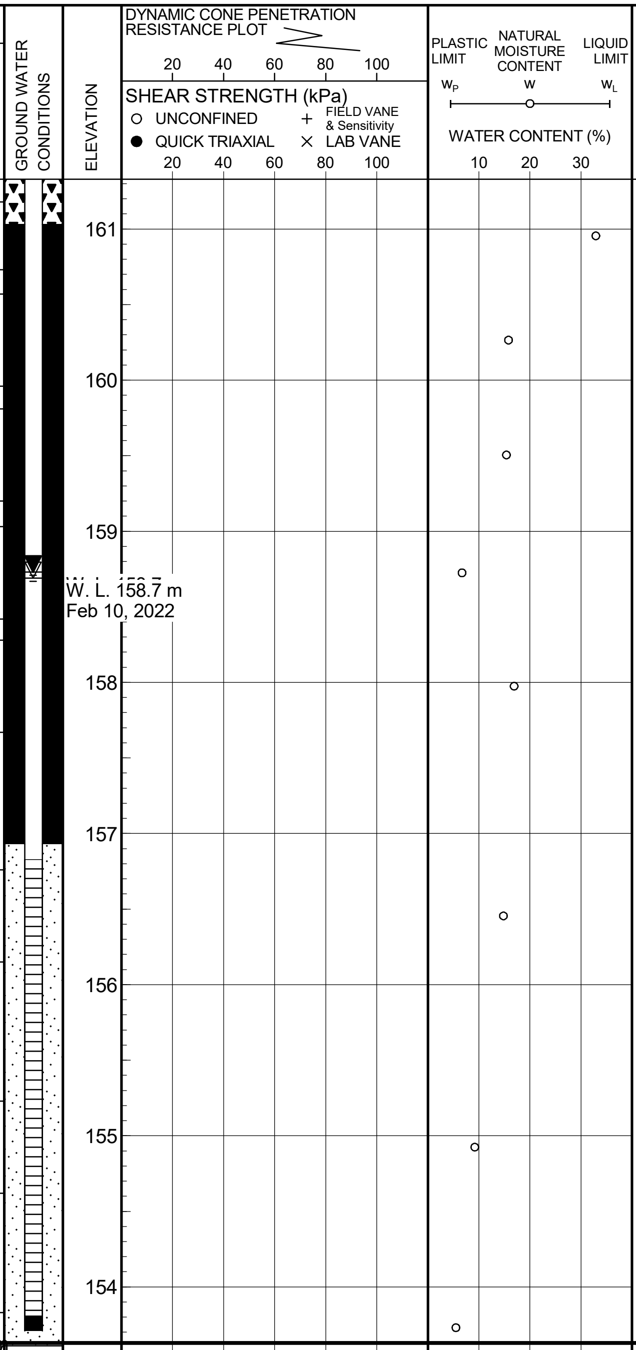
1 OF 1

PROJECT: Proposed Office Building
CLIENT: Zando Developers
PROJECT LOCATION: 3033 Dundas Street West, Mississauga
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4819650.475 E 606461.5423

DRILLING DATA
Method: Hollow Stem Augur
Diameter: 150
Date: Jan/31/2022

REF. NO.: 2100522AG
DRAWING NO.: 2

SOIL PROFILE		SAMPLES			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m			GR SA SI CL
161.3							
0.0 161.2	**Topsoil:** 150mm						
0.2	**Silty Sand:** trace rootlets, dark brown to brown, moist, loose	1	SS	5			
160.6 0.8	**Clayey Silt Till:** trace to some gravel, some sand, reddish brown to brown , moist, stiff to very stiff	2	SS	11			16 16 41 27
		3	SS	13			
		4	SS	24			
158.3 3.0	**Sand and Gravel:** brown, moist to wet, very dense wet below 3.1	5	SS	72			
		6	SS	50			
155.3 6.0	**Silty Sand:** some gravel, trace clay, reddish brown to brown , moist, very dense	7	SS	70			
153.8 7.5 153.6	**Bedrock:** weathered shale, reddish brown	8	SS	50 / 100mm			
7.7	**End of Borehole:** borehole terminated at 7.7m Upon completion: 1) Cave-in: open 2) Water: 7.5mbgs						



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

GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ $^{\varepsilon}$=3% Strain at Failure

HLV2K ENGINEERING LIMITED

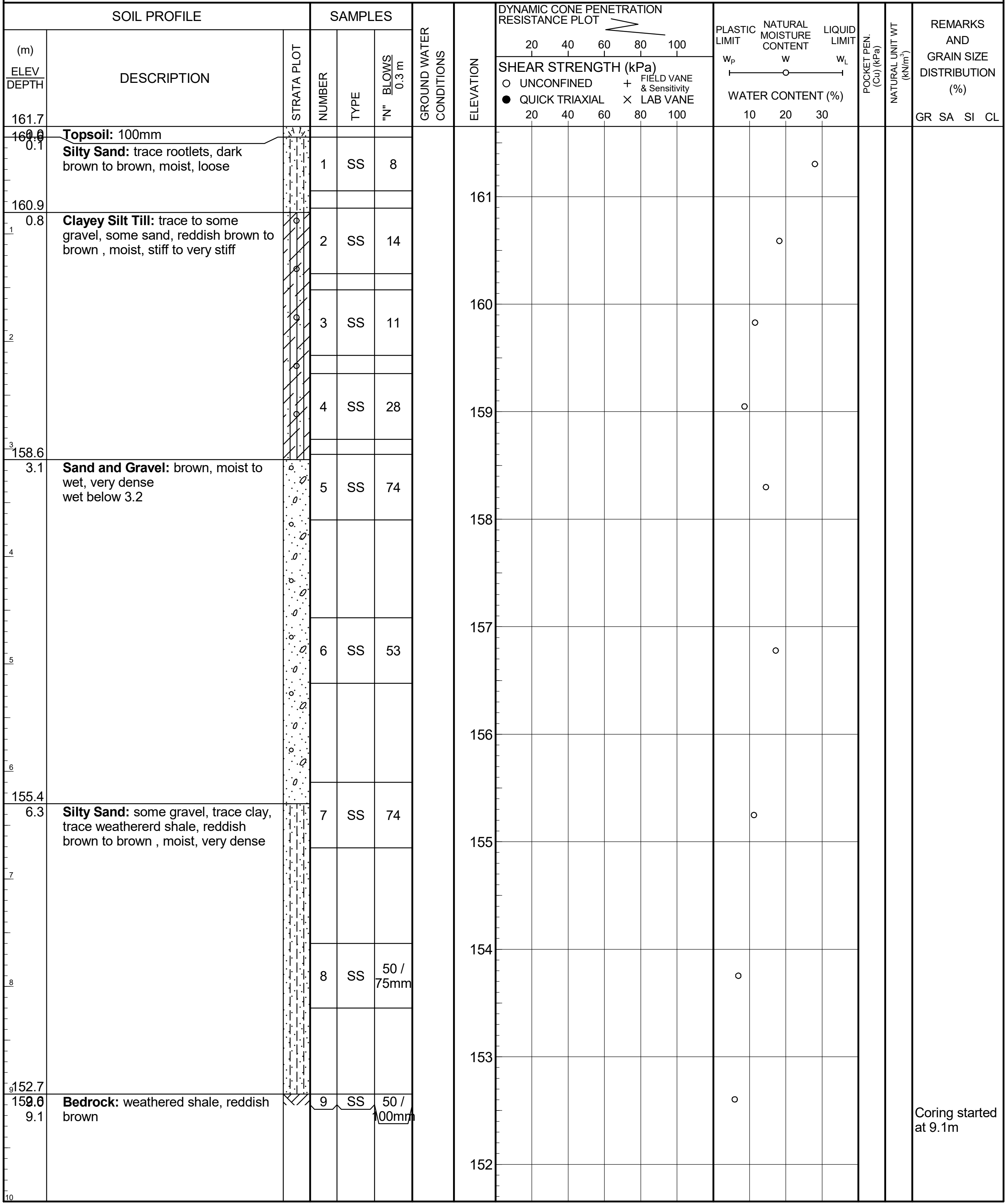
LOG OF BOREHOLE BH103

PROJECT: Proposed Office Building
CLIENT: Zando Developers
PROJECT LOCATION: 3033 Dundas Street West, Mississauga
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4819651.821 E 606447.2562

DRILLING DATA
Method: Hollow Stem Augur
Diameter: 150
Date: Jan/25/2022

REF. NO.: 2100522AG
DRAWING NO.: 3

SOIL PROFILE		SAMPLES			REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m	GR SA SI CL
161.7					
161.6 0.1	**Topsoil:** 100mm				
	Silty Sand: trace rootlets, dark brown to brown, moist, loose	1	SS	8	
160.9 0.8	**Clayey Silt Till:** trace to some gravel, some sand, reddish brown to brown , moist, stiff to very stiff	2	SS	14	
		3	SS	11	
		4	SS	28	
158.6 3.1	**Sand and Gravel:** brown, moist to wet, very dense wet below 3.2	5	SS	74	
		6	SS	53	
155.4 6.3	**Silty Sand:** some gravel, trace clay, trace weathererd shale, reddish brown to brown , moist, very dense	7	SS	74	
		8	SS	50 / 75mm	
152.7 152.6 9.1	**Bedrock:** weathered shale, reddish brown	9	SS	50 / 100mm	Coring started at 9.1m



Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ 3=3% Strain at Failure

LOG OF BOREHOLE BH103

PROJECT: Proposed Office Building
CLIENT: Zando Developers
PROJECT LOCATION: 3033 Dundas Street West, Mississauga
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4819651.821 E 606447.2562

DRILLING DATA
Method: Hollow Stem Augur
Diameter: 150
Date: Jan/25/2022

REF. NO.: 2100522AG
DRAWING NO.: 3

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m							
11							151					
12							150					
13							149					
14							148					
15							147					
16							146					
17							145					
18							144					
19							143					
20							142					

Continued Next Page

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

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ $^{\varepsilon}$=3% Strain at Failure

LOG OF BOREHOLE BH103

PROJECT: Proposed Office Building
CLIENT: Zando Developers
PROJECT LOCATION: 3033 Dundas Street West, Mississauga
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4819651.821 E 606447.2562

DRILLING DATA
Method: Hollow Stem Augur
Diameter: 150
Date: Jan/25/2022

REF. NO.: 2100522AG
DRAWING NO.: 3

SOIL PROFILE			SAMPLES									
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
							141					
21												
							140					
22												
							139					
23												
							138					
24												
							137					
25												
							136					
26												
							135					
27												
							134					
28												
							133					
29												
							132					
30												

Continued Next Page

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

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ^{8}=3% Strain at Failure

HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH103

PROJECT: Proposed Office Building
CLIENT: Zando Developers
PROJECT LOCATION: 3033 Dundas Street West, Mississauga
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4819651.821 E 606447.2562

DRILLING DATA
Method: Hollow Stem Augur
Diameter: 150
Date: Jan/25/2022

REF. NO.: 2100522AG
DRAWING NO.: 3

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m							
131.2												
30.5	**End of Borehole:** borehole terminated at 30.5m Upon completion: 1) Cave-in: open 2) Water: dry											

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

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

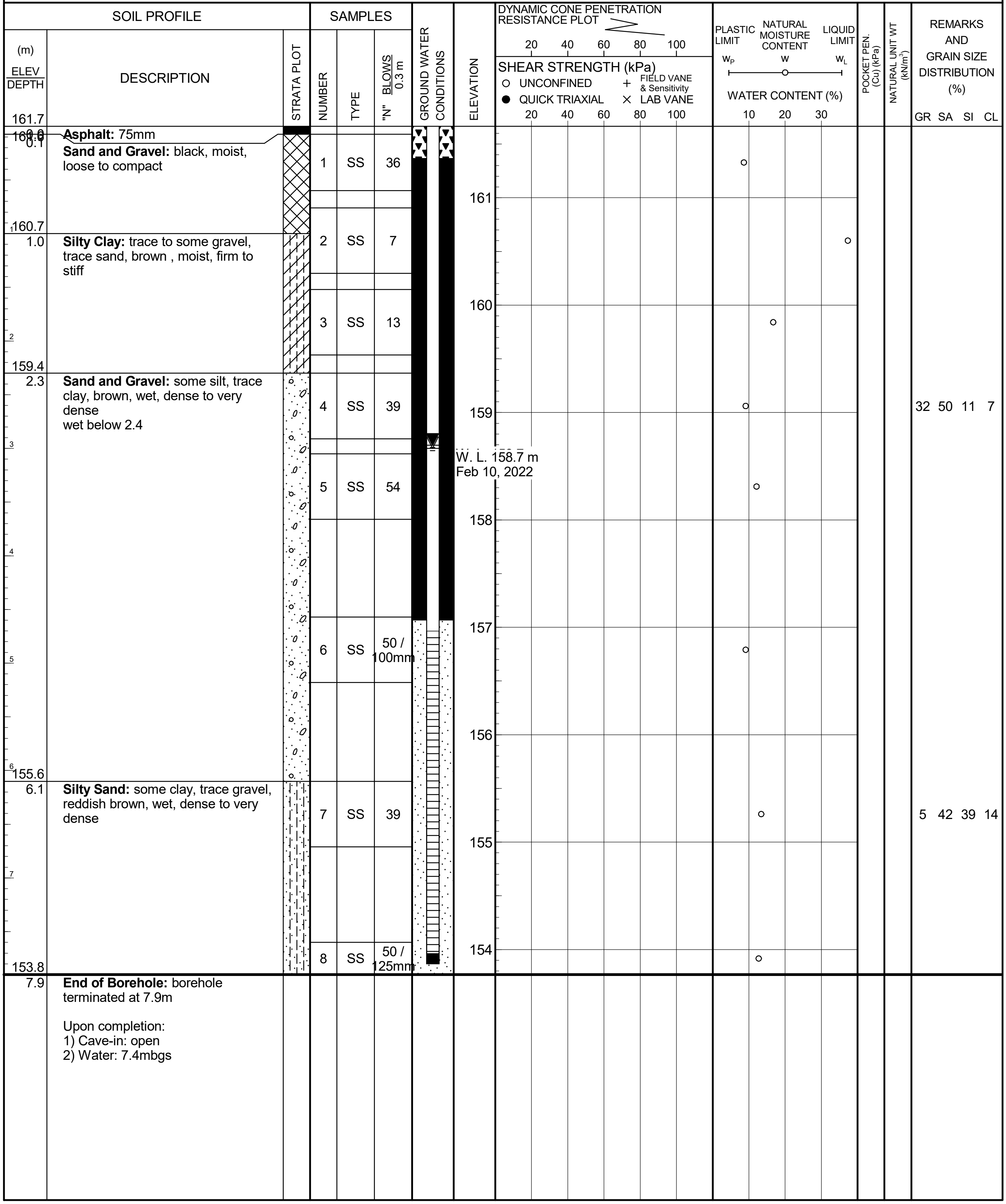
HLV2K ENGINEERING LIMITED

LOG OF BOREHOLE BH104

PROJECT: Proposed Office Building
CLIENT: Zando Developers
PROJECT LOCATION: 3033 Dundas Street West, Mississauga
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4819685.908 E 606472.7118

DRILLING DATA
Method: Hollow Stem Augur
Diameter: 150
Date: Jan/26/2022

REF. NO.: 2100522AG
DRAWING NO.: 4



(m) ELEV DEPTH	DESCRIPTION
161.7	
161.6 0.1	**Asphalt:** 75mm **Sand and Gravel:** black, moist, loose to compact
160.7 1.0	**Silty Clay:** trace to some gravel, trace sand, brown , moist, firm to stiff
159.4 2.3	**Sand and Gravel:** some silt, trace clay, brown, wet, dense to very dense wet below 2.4
155.6 6.1	**Silty Sand:** some clay, trace gravel, reddish brown, wet, dense to very dense
153.8 7.9	**End of Borehole:** borehole terminated at 7.9m Upon completion: 1) Cave-in: open 2) Water: 7.4mbgs

NUMBER	TYPE	"N" BLOWS / 0.3 m	GR	SA	SI	CL
1	SS	36				
2	SS	7				
3	SS	13				
4	SS	39	32	50	11	7
5	SS	54				
6	SS	50 / 100mm				
7	SS	39	5	42	39	14
8	SS	50 / 125mm				

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

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

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

Appendix C:

General Requirements for Engineered Fill

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites if suitable. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, HLV2K Engineering Limited (HLV2K) recommends use of OPSS Granular 'B' sand and gravel fill material only.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill should not be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year. If the project demands placement of engineered fill in winter (December 15- April1) it can be placed only under the following conditions:

- All frozen material and or snow must be removed before placement of engineered fill on a daily basis
- Only Granular B Type 2 or Granular A (including crushed concrete or crushed limestone)
- The fill placement must be supervised on a full time basis by a geotechnical consultant

The location of the foundations on the engineered soil pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Foundations placed within the engineered soil pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows, however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and HLV2K Engineering Limited. Without this confirmation no responsibility for the performance of the structure can be accepted by HLV2K Engineering Limited. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by an HLV2K engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by HLV2K during placement of engineered fill is required. Work cannot commence or continue without the presence of HLV2K representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. The allowable bearing pressure provided in the accompanying report may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

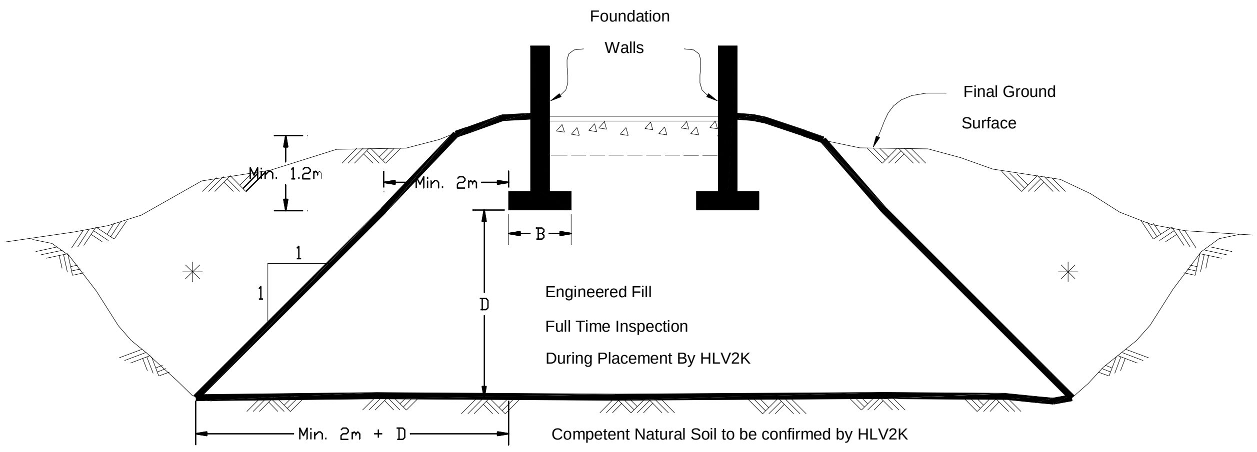
10. After completion of the pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from HLV2K Engineering Limited prior to footing concrete placements. All excavations must be backfilled under full time HLV2K Engineering Limited supervision by HLV2K to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of HLV2K Engineering Limited.

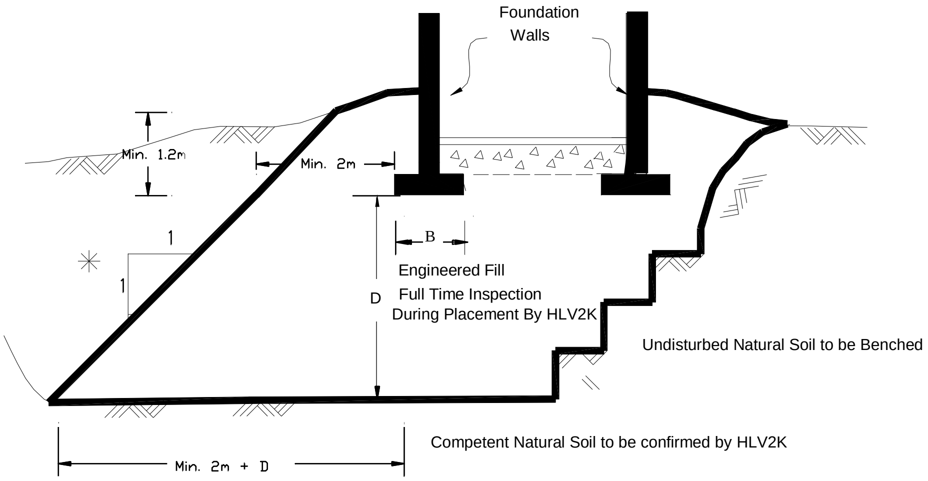
11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with HLV2K Engineering Limited report attached.





✳ Backfill in this area to be as per the HLV2K report

Appendix D:

General Requirements for Bedrock in GTA

GENERAL COMMENTS – BEDROCK IN METRO TORONTO AREA

The bedrock that makes spread footings or caissons a popular choice for high-rise foundation support is a shale or shale limestone composition. The highest member, the Queenston Formation, is generally found west of Toronto, while the Georgian Bay Formation underlies most of Metro Toronto, with the Collingwood Formation east of Toronto. The Queenston is, relatively speaking, the weaker of the three formations that are likely to support caissons or footings.

The Georgian Bay as well as the Queenston and Collingwood Formation are of Middle Ordovician Age. It is defined as the rock unit that overlies the bluish grey shales of the Collingwood Formation and is in turn overlain by the red shale of the Queenston Formation. The Georgian Bay Formation consists of bluish and grey shale with interbeds of sandstone, limestone and dolostone. Towards the west where the Georgian Bay formation underlies the Queenston Formation, the limestone content increases significantly and limestone and/or sandstone may comprise as much as 70 to 90 percent of the bedrock. The hard layers are usually less than about 100 to 150 mm thick but some layers are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at some sites. The layers are actually lenses and they can vary significantly in thickness over short distances.

The upper portion of the bedrock is commonly weathered for a depth of 600 to 1000 mm and within this weathered zone hard limestone layers or lenses are common. These hard limestone layers can result in contractual problems for augers, and can provide misleading bedrock elevations. Where the weathering is more extensive a shale till layer may be found above the bedrock. In the sound bedrock, the limestone, sandstone, dolostone is hard to very hard.

Stress relief features such as folds and faults are common in the bedrock. In these features, the rock is heavily fractured and sheared, and contains layers of shale rubble and clay. Weathering is much deeper than the surrounding rock in these features and often there is a lateral migration of the stress relief features resulting in sound unweathered bedrock overlying fractured and weather bedrock. The stress relief features are usually in the order of 4 to 6 m wide, but the depth can vary from 4 to 5 m to in excess of 10 m. These features occur randomly.

The bedrock contains significant high locked in horizontal stresses. These stresses can impose significant loads on tunnel walls but the slower rate of construction for basements allows for a relaxation of these stresses and they are not normally a problem for basement construction.

Methane gas exists in the bedrock, normally below the top 1000 mm and more concentrated with depth. Appropriate care and monitoring is essential in all confined bedrock excavations, particularly caissons and tunnels.

Groundwater seepage below the top 1000 mm is generally small, however, at several locations in Toronto and Mississauga large quantities have been encountered.

Bedding joints in the bedrock are very close-to-close, smooth planar in the shale and rough planar in the limestone. Significant vertical jointing is common.

Where the bedrock was cored, a detailed description of the rock core is appended to the borehole log.

Design features related to the bedrock are discussed in other sections of this report, and these general comments must be considered with these comments.

Appendix E:

Deep Hole Seismic Classification Report

FRONTWAVE
GEOPHYSICS

February 11, 2022
Rev. February 14, 2022

File No. F-22053

Irfan Ahmad Khokhar, Ph.D., P.Eng., C.Eng
Vice President and Principal
HLV2K Engineering Limited
2179 Dunwin Drive, Unit 4,
Mississauga, Ontario
L5L 1X2

Email: irfan.khokhar@hlv2k.com

Re: Shear wave velocity test for seismic site classification at 3033 Dundas Street West, Mississauga, Ontario.

Dear Mr. Khokhar:

Frontwave Geophysics Inc. was retained by HLV2K Engineering Limited to carry out a downhole seismic survey at the site located at 3033 Dundas Street West, Mississauga, Ontario.

The objective of the survey was to determine site class for seismic site response based on average shear wave velocity value measured in the upper 30 m (V_S30). The ASTM D7400-14 Downhole Seismic Testing method was applied for in-situ measurements of shear-wave velocities.

The survey was carried out in borehole BH103 to a depth of 30 m. The location of the test borehole is shown in Figure 1.

The fieldwork was conducted on February 10th, 2022.

This report describes basic principles of the downhole seismic technique, survey design, interpretation method, and presents the results of the investigation in chart and table format.

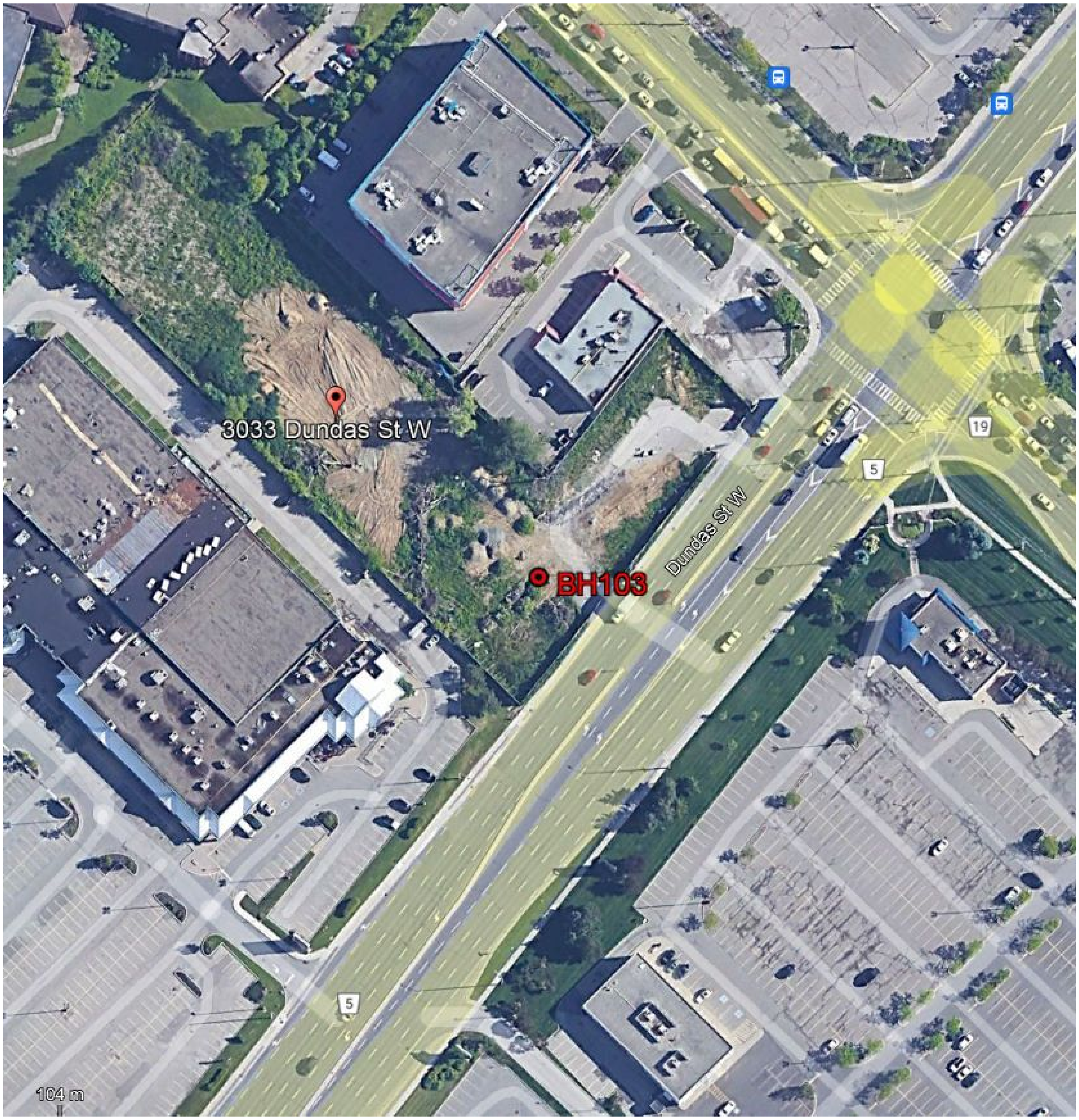


Figure 1. Location of the test borehole (BH103), 3033 Dundas St W, Mississauga, ON.

Downhole Seismic Survey

Overview

The downhole seismic survey is a direct measurement of seismic wave velocities in a borehole. The seismic energy is generated at the ground surface close to the top of the borehole and arrivals of seismic waves are recorded by receivers positioned in the borehole at selected depths. Travel times of seismic waves from the source to receivers are then used to calculate interval and average velocities of body waves. Arrivals of compressional (P) and shear (S) waves can be recorded using vertically and horizontally oriented sensors and sources, respectively.

Survey Design

The receiver used was a 3-component Geostuff BHG-2 borehole geophone. The geophone is equipped with three orthogonally oriented sensors, 15 Hz natural frequency, and a motor-driven clamp to press the geophone firm against the wall of the borehole and hold it in place at a selected depth.

The recording equipment was a P.A.S.I. Gea-24 seismograph. The record length was set to 250 ms with a 0.05 ms sampling interval.

The data were collected with one metre test interval starting at the bottom of the borehole at 30 m below ground surface and ending at a depth of 1 m. The seismic source was offset 1 m from the top of the borehole. Preferential S-wave energy was generated by horizontally striking a metal bar in a direction perpendicular to the direction of the source offset. At each test depth, shots in two opposite directions were executed to record S-wave arrivals of opposite polarity. A 5.5-kg sledgehammer was used as an energy source.

Interpretation

RadEx Pro software package was used for processing of the downhole seismic data. The processing involved stacking of S-wave shot records obtained with opposite source directions, identification and picking of S-wave first arrivals at each test depth.

A shear wave velocity depth profile is obtained by calculating average velocities for each depth interval. The following equation, implying straight ray paths (neglecting refraction effects), was used:

$$Vi = (D_2 - D_1)/(t_2D_2/L_2 - t_1D_1/L_1)$$

where:

D_1, D_2 – depth to the top (1) and bottom (2) of the interval,

L_1, L_2 – distance from the source to receivers at the top and bottom of the interval (taking into account the offset of the source from the borehole),

t_1, t_2 – arrival times to the top and bottom of the interval.

Accuracy of the results

Conventionally, a 5% error margin is assumed for direct measurements of seismic velocities. In practice, it means that the downhole seismic data can be used to provide reliable site classification if the calculated V_S30 value is not within 5% of a site class boundary.

RESULTS

The collected downhole data were of good quality; the S-wave first arrivals were well defined. Stacked S-wave seismic record obtained in borehole BH103 is presented in Figure 2.

The results of the downhole survey are presented in Figure 3 in the form of a shear wave velocity depth profile; Table 1 presents the measured and calculated data.

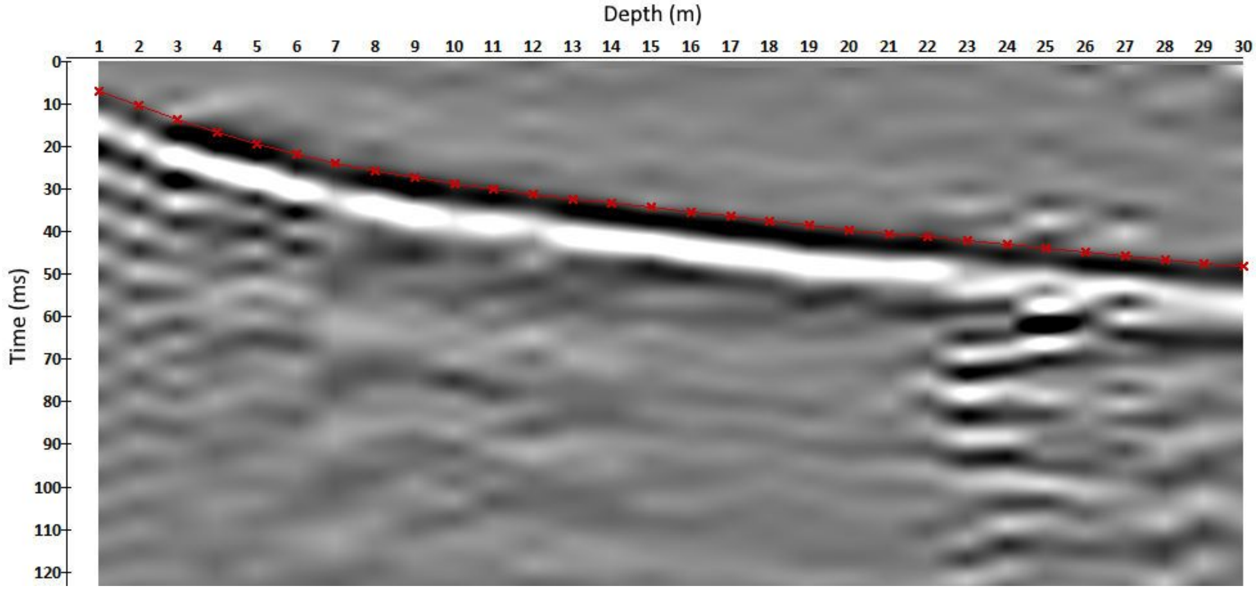


Figure 2. Stacked seismic record from horizontally oriented shots and sensors showing picked shear wave arrivals.

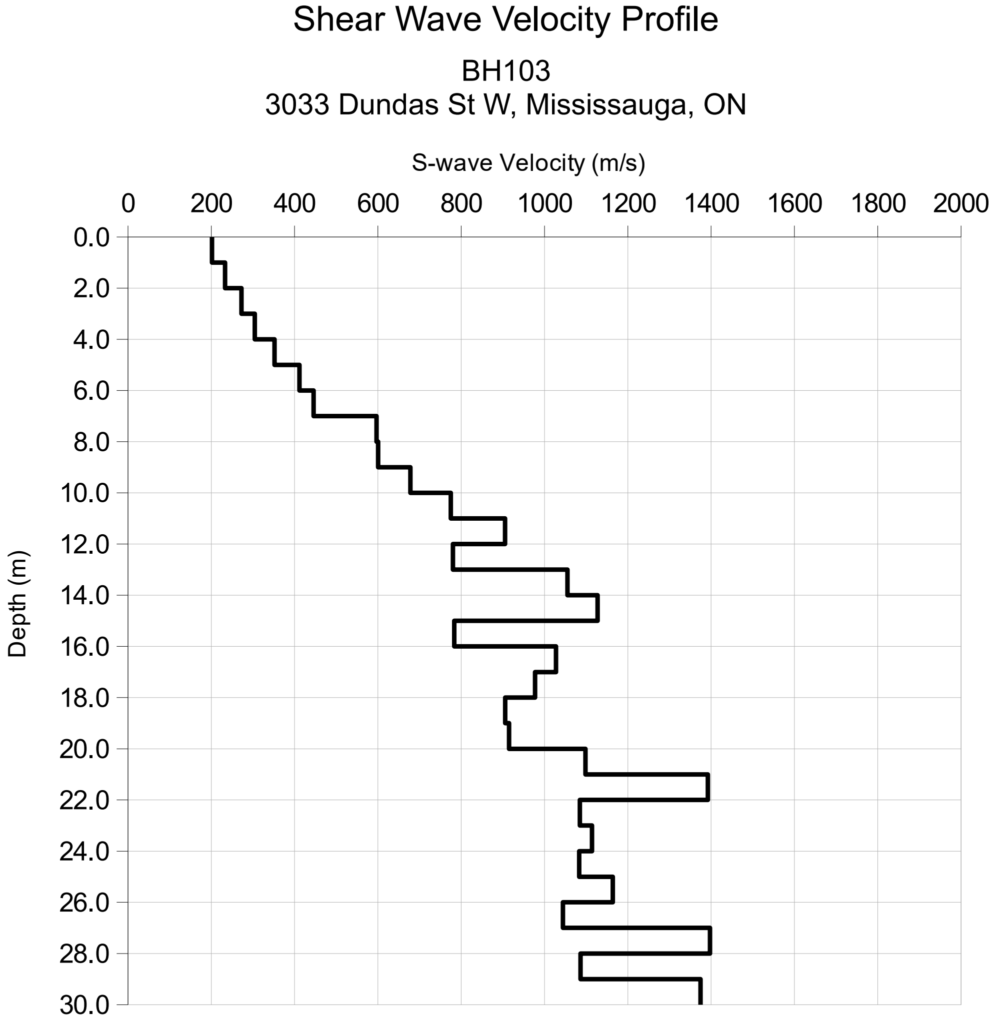


Figure 3. Shear wave velocity profile from the downhole seismic test.

Table 1. Shear wave arrival times and interval calculations.

Depth (m)	S-wave Arrival Time (ms)	Depth Interval (m)	Interval S-wave Velocity (m/s)	Interval Time (ms)
1	7.0	0 to 1	202	4.96
2	10.3	1 to 2	233	4.29
3	13.6	2 to 3	273	3.67
4	16.7	3 to 4	304	3.28
5	19.4	4 to 5	352	2.84
6	21.8	5 to 6	412	2.43
7	24.0	6 to 7	446	2.24
8	25.6	7 to 8	597	1.68
9	27.2	8 to 9	601	1.67
10	28.7	9 to 10	678	1.48
11	29.9	10 to 11	775	1.29
12	31.0	11 to 12	905	1.10
13	32.3	12 to 13	780	1.28
14	33.2	13 to 14	1055	0.95
15	34.1	14 to 15	1128	0.89
16	35.4	15 to 16	783	1.28
17	36.4	16 to 17	1028	0.97
18	37.4	17 to 18	977	1.02
19	38.5	18 to 19	905	1.10
20	39.6	19 to 20	915	1.09
21	40.5	20 to 21	1098	0.91
22	41.2	21 to 22	1392	0.72
23	42.1	22 to 23	1085	0.92
24	43.0	23 to 24	1114	0.90
25	43.9	24 to 25	1083	0.92
26	44.8	25 to 26	1164	0.86
27	45.7	26 to 27	1044	0.96
28	46.4	27 to 28	1397	0.72
29	47.4	28 to 29	1086	0.92
30	48.1	29 to 30	1375	0.73

For seismic site classification, the average shear wave velocity within the upper 30 meters (V_S30) is defined as the travel-time weighted average velocity from surface to a depth of 30 m and calculated using the following formula:

$$V_S30 = 30 / \Sigma (d/V_S),$$

where d is the thickness of any layer and V_S is the layer S-wave velocity. In other words, V_S30 is calculated as 30 m divided by the sum of the S-wave travel times for each depth interval within the topmost 30 m.

The V_S30 value obtained from the downhole seismic test in borehole BH103 was 624 m/s.

Based on the Site Classification for Seismic Site Response (Table 4.1.8.4.-A) of the National Building Code of Canada 2015 (NBC), the investigated area is in site class C ($360 < V_S30 \leq 760$ m/s).

At the request of the client, the site classification was also determined from shear wave velocity values averaged over the depth interval of 15 to 30 m to take into account the proposed building foundation at 15 m below ground surface. In borehole BH103, the shale bedrock was encountered at a depth of 9.1 m; thus, the building will be founded directly on rock. According to Commentary J (Paragraph 96) of the National Building Code of Canada 2015 (NBC), the shear wave velocity values measured in the top of bedrock may be extrapolated if the rock conditions are known to be continuous to a depth of 30 m below the foundation of the proposed building.

The average shear wave velocity value in bedrock measured in the depth interval of 15 to 30 m was 1070 m/s. If this value is used for seismic site classification to take into consideration the proposed building foundation at 15 m below ground surface, as provided by Commentary J, the investigated area falls in site class B ($760 < V_S30 \leq 1500$ m/s).

Table 2 summarizes the results of the survey.

Table 2. V_S30 values from the downhole data.

Borehole	Depth Range (m)	V_S30 (m/s)	NBC 2015 Seismic Site Class
BH103	0 to 30	624	C
	15 to 45	1070	B

We hope you find this report satisfactory. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Frontwave Geophysics Inc.

Ilia Gusakov, P.Geo.
Geophysicist
(647) 514-4724
ilia.gusakov@frontwave.ca

PROFESSIONAL GEOSCIENTIST
ILIA GUSAKOV
PRACTISING MEMBER
3161
ONTARIO

Appendix F:

Chemical Testing Laboratory Certificates of Analysis & AWWA Rating for Corrosion Evaluation

HLV2K Engineering Limited (Brampton)
ATTN: Mariam Mohammadi
2179 Dunwin Drive
Unit 4
Mississauga ON L5L 1X2

Date Received: 01-FEB-22
Report Date: 09-FEB-22 15:11 (MT)
Version: FINAL

Client Phone: 437-370-0317

Certificate of Analysis

Lab Work Order #: L2682687
Project P.O. #: NOT SUBMITTED
Job Reference: 2100522AG
C of C Numbers:
Legal Site Desc:

Amanda Overholster

Amanda Overholster
Account Manager

ANALYTICAL REPORT

Summary of Guideline Exceedances

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use						
L2682687-2	BH102 SS1	Metals	Barium (Ba)	282	220	ug/g
L2682687-4	BH104 SS1	Saturated Paste Extractables	SAR	11.1	2.4	SAR

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

Physical Tests - SOIL

			Lab ID	L2682687-1	L2682687-2	L2682687-3	L2682687-4	L2682687-5	L2682687-6	L2682687-7	L2682687-8	L2682687-9
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH101 SS1	BH102 SS1	BH103 SS1	BH104 SS1	BH101 SS5	BH102 SS6	BH103 SS7	BH104 SS7	BH102 SS2
Analyte	**Unit**	**Guide Limits #1**	**#2**									
Conductivity	mS/cm	0.57	-	0.344	0.219	0.550	0.205					0.150
% Moisture	%	-	-	32.7	23.4	31.6	8.38	9.58	11.9	10.6	11.9	14.0
pH	pH units	-	-	7.26	7.67	7.40	7.96					7.70
Redox Potential	mV	-	-									313
Resistivity	ohm*cm	-	-									6650

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Physical Tests - SOIL

			Lab ID	L2682687-10	L2682687-11	L2682687-12
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH102 SS7	BH104 SS3	BH104 SS5
		Guide Limits				
Analyte	**Unit**	**#1**	**#2**			
Conductivity	mS/cm	0.57	-	0.228	0.214	0.123
% Moisture	%	-	-	8.95	14.3	5.80
pH	pH units	-	-	7.85	7.81	8.08
Redox Potential	mV	-	-	308	269	261
Resistivity	ohm*cm	-	-	4390	4670	8140

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

ANALYTICAL REPORT

Leachable Anions & Nutrients - SOIL

			Lab ID	L2682687-9	L2682687-10	L2682687-11	L2682687-12
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH102 SS2	BH102 SS7	BH104 SS3	BH104 SS5
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Chloride	ug/g	-	-	9.3	67.1	58.2	11.0

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Anions and Nutrients - SOIL

			Lab ID	L2682687-9	L2682687-10	L2682687-11	L2682687-12
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH102 SS2	BH102 SS7	BH104 SS3	BH104 SS5
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Sulphate	ug/g	-	-	31	50	33	39

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Cyanides - SOIL

			Lab ID	L2682687-1	L2682687-2	L2682687-3	L2682687-4
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH101 SS1	BH102 SS1	BH103 SS1	BH104 SS1
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Cyanide, Weak Acid Diss	ug/g	0.051	-	<0.050	<0.050	<0.050	<0.050

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Inorganic Parameters - SOIL

		Guide Limits					
			Lab ID	L2682687-9	L2682687-10	L2682687-11	L2682687-12
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH102 SS2	BH102 SS7	BH104 SS3	BH104 SS5
Analyte	**Unit**	**#1**	**#2**				
Acid Volatile Sulphides	mg/kg	-	-	0.44	0.38	<0.20	0.23

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

ANALYTICAL REPORT

Saturated Paste Extractables - SOIL

			Lab ID	L2682687-1	L2682687-2	L2682687-3	L2682687-4
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH101 SS1	BH102 SS1	BH103 SS1	BH104 SS1
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
SAR	SAR	2.4	-	0.38	1.26	2.23	🟥 11.1 SAR:M
Calcium (Ca)	mg/L	-	-	58.4	21.1	56.2	1.44
Magnesium (Mg)	mg/L	-	-	5.73	2.39	2.79	<0.50
Sodium (Na)	mg/L	-	-	11.5	22.9	63.2	48.2

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Metals - SOIL

			Lab ID	L2682687-1	L2682687-2	L2682687-3	L2682687-4
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH101 SS1	BH102 SS1	BH103 SS1	BH104 SS1
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Antimony (Sb)	ug/g	1.3	-	<1.0	<1.0	<1.0	<1.0
Arsenic (As)	ug/g	18	-	8.9	6.3	5.1	8.0
Barium (Ba)	ug/g	220	-	213	282	169	37.4
Beryllium (Be)	ug/g	2.5	-	0.69	0.88	0.78	<0.50
Boron (B)	ug/g	36	-	9.1	14.5	14.6	7.8
Boron (B), Hot Water Ext.	ug/g	36	-	0.31	0.22	1.31	0.11
Cadmium (Cd)	ug/g	1.2	-	<0.50	<0.50	<0.50	<0.50
Chromium (Cr)	ug/g	70	-	23.0	25.1	21.6	11.0
Cobalt (Co)	ug/g	21	-	9.4	15.6	9.9	5.7
Copper (Cu)	ug/g	92	-	34.2	57.3	42.9	29.7
Lead (Pb)	ug/g	120	-	36.3	11.0	9.3	16.0
Mercury (Hg)	ug/g	0.27	-	0.0766	0.0131	0.0345	0.0120
Molybdenum (Mo)	ug/g	2	-	<1.0	1.1	<1.0	<1.0
Nickel (Ni)	ug/g	82	-	20.3	30.4	22.8	11.4
Selenium (Se)	ug/g	1.5	-	<1.0	<1.0	<1.0	<1.0
Silver (Ag)	ug/g	0.5	-	<0.20	<0.20	<0.20	<0.20
Thallium (Tl)	ug/g	1	-	<0.50	<0.50	<0.50	<0.50
Uranium (U)	ug/g	2.5	-	<1.0	<1.0	<1.0	<1.0
Vanadium (V)	ug/g	86	-	30.0	36.1	30.3	19.4
Zinc (Zn)	ug/g	290	-	130	71.5	63.6	49.9

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Speciated Metals - SOIL

			Lab ID	L2682687-1	L2682687-2	L2682687-3	L2682687-4
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH101 SS1	BH102 SS1	BH103 SS1	BH104 SS1
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Chromium, Hexavalent	ug/g	0.66	-	<0.20	<0.20	<0.20	<0.20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Volatile Organic Compounds - SOIL

			Lab ID	L2682687-5	L2682687-6	L2682687-7	L2682687-8
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH101 SS5	BH102 SS6	BH103 SS7	BH104 SS7
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
Benzene	ug/g	0.02	-	<0.0068	<0.0068	<0.0068	<0.0068
Ethylbenzene	ug/g	0.05	-	<0.018	<0.018	<0.018	<0.018
Toluene	ug/g	0.2	-	<0.080	<0.080	<0.080	<0.080
o-Xylene	ug/g	-	-	<0.020	<0.020	<0.020	<0.020
m+p-Xylenes	ug/g	-	-	<0.030	<0.030	<0.030	<0.030
Xylenes (Total)	ug/g	0.05	-	<0.050	<0.050	<0.050	<0.050
Surrogate: 4-Bromofluorobenzene	%	-	-	105.4	108.5	105.2	101.6
Surrogate: 1,4-Difluorobenzene	%	-	-	114.2	116.2	113.5	110.0

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Hydrocarbons - SOIL

			Lab ID	L2682687-5	L2682687-6	L2682687-7	L2682687-8
			Sample Date	01-FEB-22	01-FEB-22	01-FEB-22	01-FEB-22
			Sample ID	BH101 SS5	BH102 SS6	BH103 SS7	BH104 SS7
		Guide Limits					
Analyte	**Unit**	**#1**	**#2**				
F1 (C6-C10)	ug/g	25	-	<5.0	<5.0	<5.0	<5.0
F1-BTEX	ug/g	25	-	<5.0	<5.0	<5.0	<5.0
F2 (C10-C16)	ug/g	10	-	<10	<10	<10	<10
F3 (C16-C34)	ug/g	240	-	<50	<50	<50	<50
F4 (C34-C50)	ug/g	120	-	<50	<50	<50	<50
Total Hydrocarbons (C6-C50)	ug/g	-	-	<72	<72	<72	<72
Chrom. to baseline at nC50		-	-	YES	YES	YES	YES
Surrogate: 2-Bromobenzotrifluoride	%	-	-	80.3	81.9	80.5	82.2
Surrogate: 3,4-Dichlorotoluene	%	-	-	90.8	96.5	96.5	92.3

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use

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

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

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
CINT	Cooling initiated. Samples were received packed with ice or ice packs and were sampled the same day as received.

Qualifiers for Individual Parameters Listed:

Qualifier	Description
SAR:M	Reported SAR represents a maximum value. Actual SAR may be lower if both Ca and Mg were detectable.

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
B-HWS-R511-WT	Soil	Boron-HWE-O.Reg 153/04 (July 2011)	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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

BTX-511-HS-WT	Soil	BTEX-O.Reg 153/04 (July 2011)	SW846 8260

BTX is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/MS.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

CN-WAD-R511-WT	Soil	Cyanide (WAD)-O.Reg 153/04 (July 2011)	MOE 3015/APHA 4500CN I-WAD

The sample is extracted with a strong base for 16 hours, and then filtered. The filtrate is then distilled where the cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

CR-CR6-IC-WT	Soil	Hexavalent Chromium in Soil	SW846 3060A/7199

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 7199, published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution.

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).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

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).

F1-F4-511-CALC-WT	Soil	F1-F4 Hydrocarbon Calculated Parameters	CCME CWS-PHC, Pub #1310, Dec 2001-S

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

F1-HS-511-WT	Soil	F1-O.Reg 153/04 (July 2011)	E3398/CCME TIER 1-HS

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

F2-F4-511-WT	Soil	F2-F4-O.Reg 153/04 (July 2011)	CCME Tier 1

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
HG-200.2-CVAA-WT	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

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).

ALS Test Code	Matrix	Test Description	Method Reference**
MET-200.2-CCMS-WT	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020B (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). For tests intended to support Ontario regulations, the <2mm fraction is ground to pass through a 0.355 mm sieve. Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

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), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample 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 and then analyzed using a pH meter and electrode.

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).

ALS Test Code	Matrix	Test Description	Method Reference**
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580

This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

ALS Test Code	Matrix	Test Description	Method Reference**
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

ALS Test Code	Matrix	Test Description	Method Reference**
SAR-R511-WT	Soil	SAR-O.Reg 153/04 (July 2011)	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.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

ALS Test Code	Matrix	Test Description	Method Reference**
SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

ALS Test Code	Matrix	Test Description	Method Reference**
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J

This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H2S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
XYLENES-SUM-CALC-WT	Soil	Sum of Xylene Isomer Concentrations	CALCULATION

Total xylenes represents the sum of o-xylene and m&p-xylene.

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

Chain of Custody Numbers:

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

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

GLOSSARY OF REPORT TERMS

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

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

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

Quality Control Report

Workorder: L2682687 Report Date: 09-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-HWS-R511-WT	**Soil**							
Batch R5716448								
WG3693356-4 DUP		**L2682687-2**						
Boron (B), Hot Water Ext.		0.22	0.19		ug/g	13	30	08-FEB-22
WG3693356-2 IRM		**WT SAR4**						
Boron (B), Hot Water Ext.			94.2		%		70-130	08-FEB-22
WG3693356-3 LCS								
Boron (B), Hot Water Ext.			98.9		%		70-130	08-FEB-22
WG3693356-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	08-FEB-22
Batch R5716756								
WG3693769-4 DUP		**L2683111-1**						
Boron (B), Hot Water Ext.		<0.10	<0.10	RPD-NA	ug/g	N/A	30	08-FEB-22
WG3693769-2 IRM		**WT SAR4**						
Boron (B), Hot Water Ext.			93.6		%		70-130	08-FEB-22
WG3693769-3 LCS								
Boron (B), Hot Water Ext.			102.0		%		70-130	08-FEB-22
WG3693769-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	08-FEB-22
BTX-511-HS-WT	**Soil**							
Batch R5714056								
WG3692951-4 DUP		**WG3692951-3**						
Benzene		<0.0068	<0.0068	RPD-NA	ug/g	N/A	40	07-FEB-22
Ethylbenzene		<0.018	<0.018	RPD-NA	ug/g	N/A	40	07-FEB-22
m+p-Xylenes		<0.030	<0.030	RPD-NA	ug/g	N/A	40	07-FEB-22
o-Xylene		<0.020	<0.020	RPD-NA	ug/g	N/A	40	07-FEB-22
Toluene		<0.080	<0.080	RPD-NA	ug/g	N/A	40	07-FEB-22
WG3692951-2 LCS								
Benzene			106.6		%		70-130	07-FEB-22
Ethylbenzene			96.8		%		70-130	07-FEB-22
m+p-Xylenes			105.7		%		70-130	07-FEB-22
o-Xylene			99.3		%		70-130	07-FEB-22
Toluene			101.8		%		70-130	07-FEB-22
WG3692951-1 MB								
Benzene			<0.0068		ug/g		0.0068	07-FEB-22
Ethylbenzene			<0.018		ug/g		0.018	07-FEB-22
m+p-Xylenes			<0.030		ug/g		0.03	07-FEB-22
o-Xylene			<0.020		ug/g		0.02	07-FEB-22

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BTX-511-HS-WT	**Soil**							
Batch R5714056								
WG3692951-1 MB								
Toluene			<0.080		ug/g		0.08	07-FEB-22
Surrogate: 1,4-Difluorobenzene			130.8		%		50-140	07-FEB-22
Surrogate: 4-Bromofluorobenzene			118.8		%		50-140	07-FEB-22
WG3692951-5 MS		**WG3692951-3**						
Benzene			107.6		%		60-140	07-FEB-22
Ethylbenzene			92.1		%		60-140	07-FEB-22
m+p-Xylenes			101.2		%		60-140	07-FEB-22
o-Xylene			97.8		%		60-140	07-FEB-22
Toluene			99.5		%		60-140	07-FEB-22
CL-R511-WT	**Soil**							
Batch R5714356								
WG3692257-7 CRM		**AN-CRM-WT**						
Chloride			100.2		%		70-130	04-FEB-22
WG3692257-8 DUP		**WG3692257-9**						
Chloride		27.9	25.2		ug/g	10	30	04-FEB-22
WG3692257-6 LCS								
Chloride			102.2		%		80-120	04-FEB-22
WG3692257-5 MB								
Chloride			<5.0		ug/g		5	04-FEB-22
CN-WAD-R511-WT	**Soil**							
Batch R5713705								
WG3692315-3 DUP		**L2683218-1**						
Cyanide, Weak Acid Diss		<0.50	<0.50	RPD-NA	ug/g	N/A	35	07-FEB-22
WG3692315-2 LCS								
Cyanide, Weak Acid Diss			97.4		%		80-120	04-FEB-22
WG3692315-1 MB								
Cyanide, Weak Acid Diss			<0.050		ug/g		0.05	04-FEB-22
WG3692315-4 MS		**L2683218-1**						
Cyanide, Weak Acid Diss			107.1		%		70-130	07-FEB-22
CR-CR6-IC-WT	**Soil**							
Batch R5715476								
WG3692028-4 CRM		**WT-SQC012**						
Chromium, Hexavalent			82.8		%		70-130	07-FEB-22
WG3692028-3 DUP		**L2682939-3**						
Chromium, Hexavalent		1.83	2.24		ug/g	20	35	07-FEB-22
WG3692028-2 LCS								

Quality Control Report

Workorder: L2682687 Report Date: 09-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CR-CR6-IC-WT	**Soil**							
Batch R5715476								
WG3692028-2 LCS								
Chromium, Hexavalent			95.7		%		80-120	07-FEB-22
WG3692028-1 MB								
Chromium, Hexavalent			<0.20		ug/g		0.2	07-FEB-22
EC-WT	**Soil**							
Batch R5713492								
WG3692277-4 DUP		**WG3692277-3**						
Conductivity		0.193	0.196		mS/cm	1.6	20	04-FEB-22
WG3692277-2 IRM		**WT SAR4**						
Conductivity			88.0		%		70-130	04-FEB-22
WG3692530-1 LCS								
Conductivity			92.5		%		90-110	04-FEB-22
WG3692277-1 MB								
Conductivity			<0.0040		mS/cm		0.004	04-FEB-22
Batch R5716677								
WG3693326-4 DUP		**WG3693326-3**						
Conductivity		0.183	0.194		mS/cm	6.2	20	08-FEB-22
WG3693326-2 IRM		**WT SAR4**						
Conductivity			107.6		%		70-130	08-FEB-22
WG3693847-1 LCS								
Conductivity			96.5		%		90-110	08-FEB-22
WG3693326-1 MB								
Conductivity			<0.0040		mS/cm		0.004	08-FEB-22
Batch R5717875								
WG3693811-4 DUP		**WG3693811-3**						
Conductivity		0.0837	0.0836		mS/cm	0.1	20	09-FEB-22
WG3693811-2 IRM		**WT SAR4**						
Conductivity			91.3		%		70-130	09-FEB-22
WG3694304-1 LCS								
Conductivity			97.2		%		90-110	09-FEB-22
WG3693811-1 MB								
Conductivity			<0.0040		mS/cm		0.004	09-FEB-22
F1-HS-511-WT	**Soil**							
Batch R5714056								
WG3692951-4 DUP		**WG3692951-3**						
F1 (C6-C10)		<5.0	<5.0	RPD-NA	ug/g	N/A	30	07-FEB-22
WG3692951-2 LCS								

Quality Control Report

Workorder: L2682687 Report Date: 09-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F1-HS-511-WT	**Soil**							
Batch R5714056								
WG3692951-2 LCS								
F1 (C6-C10)			104.1		%		80-120	07-FEB-22
WG3692951-1 MB								
F1 (C6-C10)			<5.0		ug/g		5	07-FEB-22
Surrogate: 3,4-Dichlorotoluene			111.1		%		60-140	07-FEB-22
WG3692951-5 MS		**WG3692951-3**						
F1 (C6-C10)			104.4		%		60-140	07-FEB-22
F2-F4-511-WT	**Soil**							
Batch R5712988								
WG3691628-3 DUP		**WG3691628-5**						
F2 (C10-C16)		<10	<10	RPD-NA	ug/g	N/A	40	03-FEB-22
F3 (C16-C34)		<50	<50	RPD-NA	ug/g	N/A	40	03-FEB-22
F4 (C34-C50)		52	<50	RPD-NA	ug/g	N/A	40	03-FEB-22
WG3691628-2 LCS								
F2 (C10-C16)			83.5		%		70-130	03-FEB-22
F3 (C16-C34)			82.0		%		70-130	03-FEB-22
F4 (C34-C50)			84.9		%		70-130	03-FEB-22
WG3691628-1 MB								
F2 (C10-C16)			<10		ug/g		10	03-FEB-22
F3 (C16-C34)			<50		ug/g		50	03-FEB-22
F4 (C34-C50)			<50		ug/g		50	03-FEB-22
Surrogate: 2-Bromobenzotrifluoride			81.8		%		60-140	03-FEB-22
WG3691628-4 MS		**WG3691628-5**						
F2 (C10-C16)			83.1		%		60-140	03-FEB-22
F3 (C16-C34)			81.2		%		60-140	03-FEB-22
F4 (C34-C50)			83.7		%		60-140	03-FEB-22
HG-200.2-CVAA-WT	**Soil**							
Batch R5715878								
WG3693273-2 CRM		**WT-SS-2**						
Mercury (Hg)			100.5		%		70-130	08-FEB-22
WG3693273-6 DUP		**WG3693273-5**						
Mercury (Hg)		0.0131	0.0135		ug/g	3.2	40	08-FEB-22
WG3693273-3 LCS								
Mercury (Hg)			104.5		%		80-120	08-FEB-22
WG3693273-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	08-FEB-22

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-200.2-CVAA-WT	**Soil**							
Batch R5717503								
WG3693737-2	**CRM**	**WT-SS-2**						
Mercury (Hg)			100.0		%		70-130	09-FEB-22
WG3693737-6	**DUP**	**WG3693737-5**						
Mercury (Hg)		0.0180	0.0181		ug/g	0.8	40	09-FEB-22
WG3693737-3	**LCS**							
Mercury (Hg)			97.5		%		80-120	09-FEB-22
WG3693737-1	**MB**							
Mercury (Hg)			<0.0050		mg/kg		0.005	09-FEB-22
MET-200.2-CCMS-WT	**Soil**							
Batch R5716598								
WG3693273-2	**CRM**	**WT-SS-2**						
Antimony (Sb)			93.0		%		70-130	08-FEB-22
Arsenic (As)			98.9		%		70-130	08-FEB-22
Barium (Ba)			104.2		%		70-130	08-FEB-22
Beryllium (Be)			95.5		%		70-130	08-FEB-22
Boron (B)			8.2		mg/kg		3.5-13.5	08-FEB-22
Cadmium (Cd)			94.7		%		70-130	08-FEB-22
Chromium (Cr)			101.1		%		70-130	08-FEB-22
Cobalt (Co)			103.1		%		70-130	08-FEB-22
Copper (Cu)			105.2		%		70-130	08-FEB-22
Lead (Pb)			99.8		%		70-130	08-FEB-22
Molybdenum (Mo)			98.4		%		70-130	08-FEB-22
Nickel (Ni)			102.8		%		70-130	08-FEB-22
Selenium (Se)			0.13		mg/kg		0-0.34	08-FEB-22
Silver (Ag)			91.1		%		70-130	08-FEB-22
Thallium (Tl)			0.075		mg/kg		0.029-0.129	08-FEB-22
Uranium (U)			95.2		%		70-130	08-FEB-22
Vanadium (V)			101.6		%		70-130	08-FEB-22
Zinc (Zn)			98.2		%		70-130	08-FEB-22
WG3693273-6	**DUP**	**WG3693273-5**						
Antimony (Sb)		0.36	0.37		ug/g	1.3	30	08-FEB-22
Arsenic (As)		6.33	6.21		ug/g	1.9	30	08-FEB-22
Barium (Ba)		282	272		ug/g	3.6	40	08-FEB-22
Beryllium (Be)		0.88	0.86		ug/g	2.0	30	08-FEB-22
Boron (B)		14.5	15.5		ug/g	6.7	30	08-FEB-22

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5716598								
WG3693273-6 DUP		**WG3693273-5**						
Cadmium (Cd)		0.104	0.098		ug/g	6.0	30	08-FEB-22
Chromium (Cr)		25.1	25.8		ug/g	2.5	30	08-FEB-22
Cobalt (Co)		15.6	15.3		ug/g	2.2	30	08-FEB-22
Copper (Cu)		57.3	56.8		ug/g	0.8	30	08-FEB-22
Lead (Pb)		11.0	10.5		ug/g	4.8	40	08-FEB-22
Molybdenum (Mo)		1.12	1.07		ug/g	4.6	40	08-FEB-22
Nickel (Ni)		30.4	30.1		ug/g	1.2	30	08-FEB-22
Selenium (Se)		<0.20	<0.20	RPD-NA	ug/g	N/A	30	08-FEB-22
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	08-FEB-22
Thallium (Tl)		0.151	0.144		ug/g	4.4	30	08-FEB-22
Uranium (U)		0.493	0.477		ug/g	3.3	30	08-FEB-22
Vanadium (V)		36.1	36.3		ug/g	0.5	30	08-FEB-22
Zinc (Zn)		71.5	71.8		ug/g	0.4	30	08-FEB-22
WG3693273-4 LCS								
Antimony (Sb)			105.3		%		80-120	08-FEB-22
Arsenic (As)			102.2		%		80-120	08-FEB-22
Barium (Ba)			97.7		%		80-120	08-FEB-22
Beryllium (Be)			94.5		%		80-120	08-FEB-22
Boron (B)			89.5		%		80-120	08-FEB-22
Cadmium (Cd)			96.0		%		80-120	08-FEB-22
Chromium (Cr)			100.5		%		80-120	08-FEB-22
Cobalt (Co)			99.8		%		80-120	08-FEB-22
Copper (Cu)			99.9		%		80-120	08-FEB-22
Lead (Pb)			99.3		%		80-120	08-FEB-22
Molybdenum (Mo)			98.0		%		80-120	08-FEB-22
Nickel (Ni)			98.8		%		80-120	08-FEB-22
Selenium (Se)			103.6		%		80-120	08-FEB-22
Silver (Ag)			93.6		%		80-120	08-FEB-22
Thallium (Tl)			101.7		%		80-120	08-FEB-22
Uranium (U)			95.4		%		80-120	08-FEB-22
Vanadium (V)			103.1		%		80-120	08-FEB-22
Zinc (Zn)			119.1		%		80-120	08-FEB-22
WG3693273-1 MB								
							0.1	

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch	**R5716598**							
WG3693273-1	**MB**							
Antimony (Sb)			<0.10		mg/kg		0.1	08-FEB-22
Arsenic (As)			<0.10		mg/kg		0.1	08-FEB-22
Barium (Ba)			<0.50		mg/kg		0.5	08-FEB-22
Beryllium (Be)			<0.10		mg/kg		0.1	08-FEB-22
Boron (B)			<5.0		mg/kg		5	08-FEB-22
Cadmium (Cd)			<0.020		mg/kg		0.02	08-FEB-22
Chromium (Cr)			<0.50		mg/kg		0.5	08-FEB-22
Cobalt (Co)			<0.10		mg/kg		0.1	08-FEB-22
Copper (Cu)			<0.50		mg/kg		0.5	08-FEB-22
Lead (Pb)			<0.50		mg/kg		0.5	08-FEB-22
Molybdenum (Mo)			<0.10		mg/kg		0.1	08-FEB-22
Nickel (Ni)			<0.50		mg/kg		0.5	08-FEB-22
Selenium (Se)			<0.20		mg/kg		0.2	08-FEB-22
Silver (Ag)			<0.10		mg/kg		0.1	08-FEB-22
Thallium (Tl)			<0.050		mg/kg		0.05	08-FEB-22
Uranium (U)			<0.050		mg/kg		0.05	08-FEB-22
Vanadium (V)			<0.20		mg/kg		0.2	08-FEB-22
Zinc (Zn)			<2.0		mg/kg		2	08-FEB-22
Batch	**R5717157**							
WG3693737-2	**CRM**	**WT-SS-2**						
Antimony (Sb)			104.9		%		70-130	08-FEB-22
Arsenic (As)			112.4		%		70-130	08-FEB-22
Barium (Ba)			122.9		%		70-130	08-FEB-22
Beryllium (Be)			107.2		%		70-130	08-FEB-22
Boron (B)			9.2		mg/kg		3.5-13.5	08-FEB-22
Cadmium (Cd)			114.3		%		70-130	08-FEB-22
Chromium (Cr)			109.8		%		70-130	08-FEB-22
Cobalt (Co)			112.4		%		70-130	08-FEB-22
Copper (Cu)			111.3		%		70-130	08-FEB-22
Lead (Pb)			117.4		%		70-130	08-FEB-22
Molybdenum (Mo)			108.0		%		70-130	08-FEB-22
Nickel (Ni)			112.5		%		70-130	08-FEB-22
Selenium (Se)			0.16		mg/kg		0-0.34	08-FEB-22
Silver (Ag)			107.2		%		70-130	08-FEB-22

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5717157								
WG3693737-2 CRM		**WT-SS-2**						
Thallium (Tl)			0.083		mg/kg		0.029-0.129	08-FEB-22
Uranium (U)			107.5		%		70-130	08-FEB-22
Vanadium (V)			111.2		%		70-130	08-FEB-22
Zinc (Zn)			107.4		%		70-130	08-FEB-22
WG3693737-6 DUP		**WG3693737-5**						
Antimony (Sb)		0.46	0.48		ug/g	3.3	30	08-FEB-22
Arsenic (As)		10.9	10.8		ug/g	0.3	30	08-FEB-22
Barium (Ba)		116	122		ug/g	4.5	40	08-FEB-22
Beryllium (Be)		0.85	0.79		ug/g	7.8	30	08-FEB-22
Boron (B)		15.1	14.7		ug/g	2.7	30	08-FEB-22
Cadmium (Cd)		0.284	0.268		ug/g	5.8	30	08-FEB-22
Chromium (Cr)		25.5	25.7		ug/g	0.9	30	08-FEB-22
Cobalt (Co)		12.3	12.6		ug/g	2.0	30	08-FEB-22
Copper (Cu)		23.2	23.3		ug/g	0.5	30	08-FEB-22
Lead (Pb)		12.8	12.8		ug/g	0.0	40	08-FEB-22
Molybdenum (Mo)		5.41	5.42		ug/g	0.1	40	08-FEB-22
Nickel (Ni)		32.5	32.8		ug/g	0.8	30	08-FEB-22
Selenium (Se)		0.33	0.38		ug/g	14	30	08-FEB-22
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	08-FEB-22
Thallium (Tl)		0.345	0.361		ug/g	4.4	30	08-FEB-22
Uranium (U)		1.52	1.57		ug/g	2.9	30	08-FEB-22
Vanadium (V)		38.8	39.3		ug/g	1.3	30	08-FEB-22
Zinc (Zn)		66.6	65.5		ug/g	1.6	30	08-FEB-22
WG3693737-4 LCS								
Antimony (Sb)			101.9		%		80-120	08-FEB-22
Arsenic (As)			106.6		%		80-120	08-FEB-22
Barium (Ba)			104.6		%		80-120	08-FEB-22
Beryllium (Be)			95.1		%		80-120	08-FEB-22
Boron (B)			95.3		%		80-120	08-FEB-22
Cadmium (Cd)			105.4		%		80-120	08-FEB-22
Chromium (Cr)			102.8		%		80-120	08-FEB-22
Cobalt (Co)			103.7		%		80-120	08-FEB-22
Copper (Cu)			102.8		%		80-120	08-FEB-22

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5717157								
WG3693737-4 LCS								
Lead (Pb)			97.9		%		80-120	08-FEB-22
Molybdenum (Mo)			99.3		%		80-120	08-FEB-22
Nickel (Ni)			101.8		%		80-120	08-FEB-22
Selenium (Se)			106.8		%		80-120	08-FEB-22
Silver (Ag)			90.7		%		80-120	08-FEB-22
Thallium (Tl)			97.6		%		80-120	08-FEB-22
Uranium (U)			93.5		%		80-120	08-FEB-22
Vanadium (V)			106.7		%		80-120	08-FEB-22
Zinc (Zn)			98.3		%		80-120	08-FEB-22
WG3693737-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	08-FEB-22
Arsenic (As)			<0.10		mg/kg		0.1	08-FEB-22
Barium (Ba)			<0.50		mg/kg		0.5	08-FEB-22
Beryllium (Be)			<0.10		mg/kg		0.1	08-FEB-22
Boron (B)			<5.0		mg/kg		5	08-FEB-22
Cadmium (Cd)			<0.020		mg/kg		0.02	08-FEB-22
Chromium (Cr)			<0.50		mg/kg		0.5	08-FEB-22
Cobalt (Co)			<0.10		mg/kg		0.1	08-FEB-22
Copper (Cu)			<0.50		mg/kg		0.5	08-FEB-22
Lead (Pb)			<0.50		mg/kg		0.5	08-FEB-22
Molybdenum (Mo)			<0.10		mg/kg		0.1	08-FEB-22
Nickel (Ni)			<0.50		mg/kg		0.5	08-FEB-22
Selenium (Se)			<0.20		mg/kg		0.2	08-FEB-22
Silver (Ag)			<0.10		mg/kg		0.1	08-FEB-22
Thallium (Tl)			<0.050		mg/kg		0.05	08-FEB-22
Uranium (U)			<0.050		mg/kg		0.05	08-FEB-22
Vanadium (V)			<0.20		mg/kg		0.2	08-FEB-22
Zinc (Zn)			<2.0		mg/kg		2	08-FEB-22
MOISTURE-WT	**Soil**							
Batch R5712592								
WG3691442-3 DUP		**L2682615-40**						
% Moisture		17.8	17.7		%	0.8	20	01-FEB-22
WG3691442-2 LCS								
% Moisture			99.7		%		90-110	01-FEB-22

Quality Control Report

Workorder: L2682687 Report Date: 09-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5712592								
WG3691442-1 MB								
% Moisture			<0.25		%		0.25	01-FEB-22
Batch R5712947								
WG3691589-3 DUP		**L2682836-1**						
% Moisture		2.95	2.88		%	2.4	20	03-FEB-22
WG3691589-2 LCS								
% Moisture			100.6		%		90-110	03-FEB-22
WG3691589-1 MB								
% Moisture			<0.25		%		0.25	03-FEB-22
PH-WT	**Soil**							
Batch R5713415								
WG3691534-1 DUP		**L2682615-25**						
pH		7.31	7.37	J	pH units	0.06	0.3	04-FEB-22
WG3692472-1 LCS								
pH			7.04		pH units		6.9-7.1	04-FEB-22
Batch R5713458								
WG3692302-1 DUP		**L2682894-3**						
pH		7.90	7.92	J	pH units	0.02	0.3	04-FEB-22
WG3692474-1 LCS								
pH			7.03		pH units		6.9-7.1	04-FEB-22
REDOX-POTENTIAL-WT	**Soil**							
Batch R5712870								
WG3691713-1 CRM		**WT-REDOX**						
Redox Potential			99.4		%		90-110	02-FEB-22
WG3691443-1 DUP		**L2682687-10**						
Redox Potential		308	273		mV	12	25	02-FEB-22
SAR-R511-WT	**Soil**							
Batch R5716597								
WG3693326-4 DUP		**WG3693326-3**						
Calcium (Ca)		29.5	32.3		mg/L	9.1	30	08-FEB-22
Sodium (Na)		5.39	5.76		mg/L	6.6	30	08-FEB-22
Magnesium (Mg)		2.60	2.89		mg/L	11	30	08-FEB-22
WG3693326-2 IRM		**WT SAR4**						
Calcium (Ca)			121.0		%		70-130	08-FEB-22
Sodium (Na)			110.9		%		70-130	08-FEB-22
Magnesium (Mg)			122.5		%		70-130	08-FEB-22

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SAR-R511-WT	**Soil**							
Batch R5716597								
WG3693326-5 LCS								
Calcium (Ca)			100.0		%		80-120	08-FEB-22
Sodium (Na)			98.4		%		80-120	08-FEB-22
Magnesium (Mg)			98.2		%		80-120	08-FEB-22
WG3693326-1 MB								
Calcium (Ca)			<0.50		mg/L		0.5	08-FEB-22
Sodium (Na)			<0.50		mg/L		0.5	08-FEB-22
Magnesium (Mg)			<0.50		mg/L		0.5	08-FEB-22
Batch R5716797								
WG3693811-4 DUP		**WG3693811-3**						
Calcium (Ca)		6.04	6.64		mg/L	9.5	30	08-FEB-22
Sodium (Na)		4.65	4.97		mg/L	6.7	30	08-FEB-22
Magnesium (Mg)		<0.50	<0.50	RPD-NA	mg/L	N/A	30	08-FEB-22
WG3693811-2 IRM		**WT SAR4**						
Calcium (Ca)			94.9		%		70-130	08-FEB-22
Sodium (Na)			93.0		%		70-130	08-FEB-22
Magnesium (Mg)			95.9		%		70-130	08-FEB-22
WG3693811-5 LCS								
Calcium (Ca)			104.3		%		80-120	08-FEB-22
Sodium (Na)			102.2		%		80-120	08-FEB-22
Magnesium (Mg)			102.6		%		80-120	08-FEB-22
WG3693811-1 MB								
Calcium (Ca)			<0.50		mg/L		0.5	08-FEB-22
Sodium (Na)			<0.50		mg/L		0.5	08-FEB-22
Magnesium (Mg)			<0.50		mg/L		0.5	08-FEB-22
SO4-WT	**Soil**							
Batch R5714356								
WG3692257-7 CRM		**AN-CRM-WT**						
Sulphate			111.6		%		60-140	04-FEB-22
WG3692257-8 DUP		**WG3692257-9**						
Sulphate		67	66		ug/g	1.4	25	04-FEB-22
WG3692257-6 LCS								
Sulphate			103.4		%		70-130	04-FEB-22
WG3692257-5 MB								
Sulphate			<20		ug/g		20	04-FEB-22
SULPHIDE-WT	**Soil**							

Quality Control Report

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SULPHIDE-WT	**Soil**							
Batch R5713293								
WG3692234-3 DUP		**L2682316-1**						
Acid Volatile Sulphides		3.02	1.62	DUP-H	mg/kg	61	45	03-FEB-22
WG3692234-2 LCS								
Acid Volatile Sulphides			97.7		%		70-130	03-FEB-22
WG3692234-1 MB								
Acid Volatile Sulphides			<0.20		mg/kg		0.2	03-FEB-22

Legend:

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

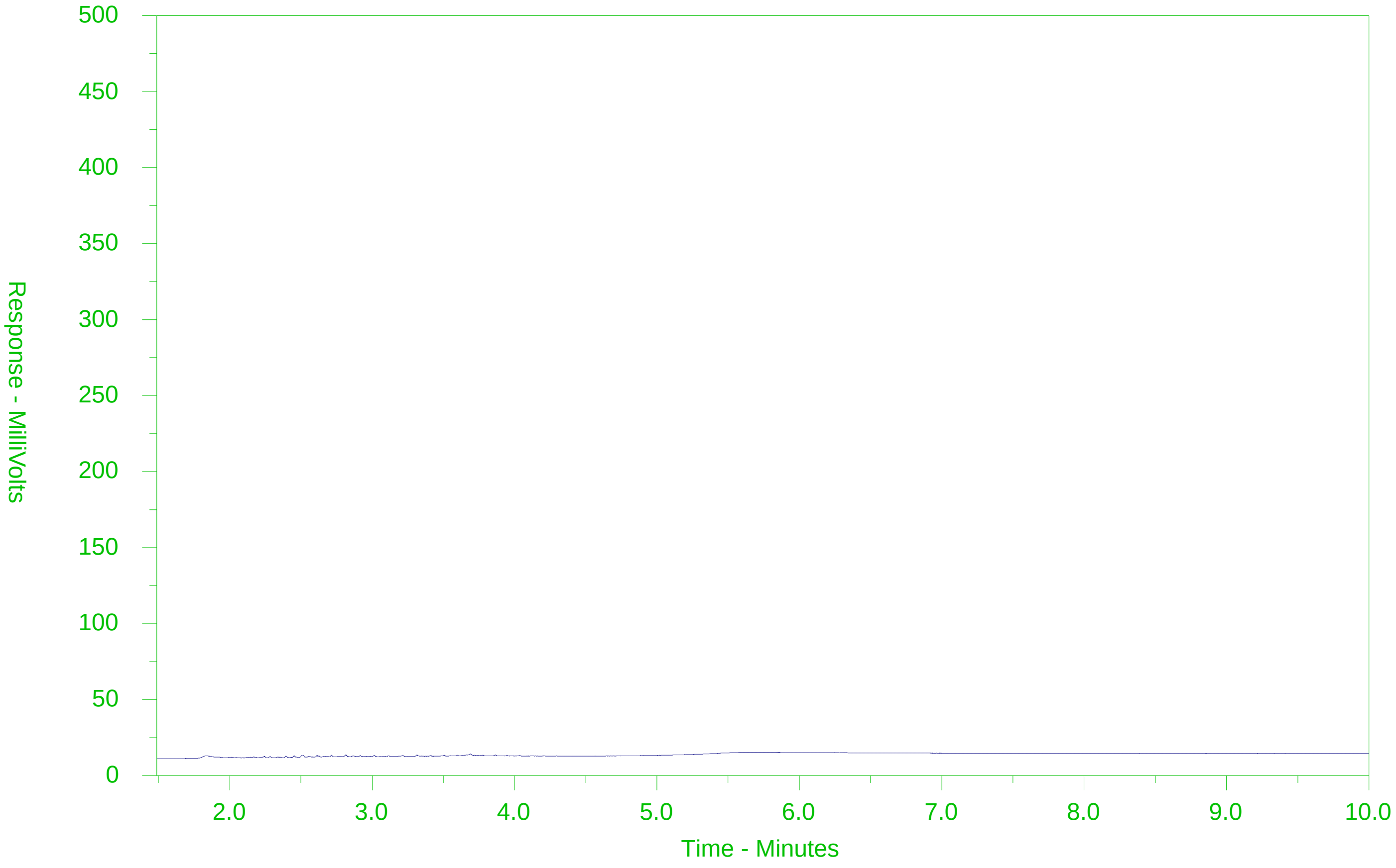
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where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

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

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

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2682687-5
Client Sample ID: BH101 SS5



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C 346°F	287°C 549°F	481°C 898°F	575°C 1067°F

Gasoline → ← Motor Oils/Lube Oils/Grease →
← Diesel/Jet Fuels →

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

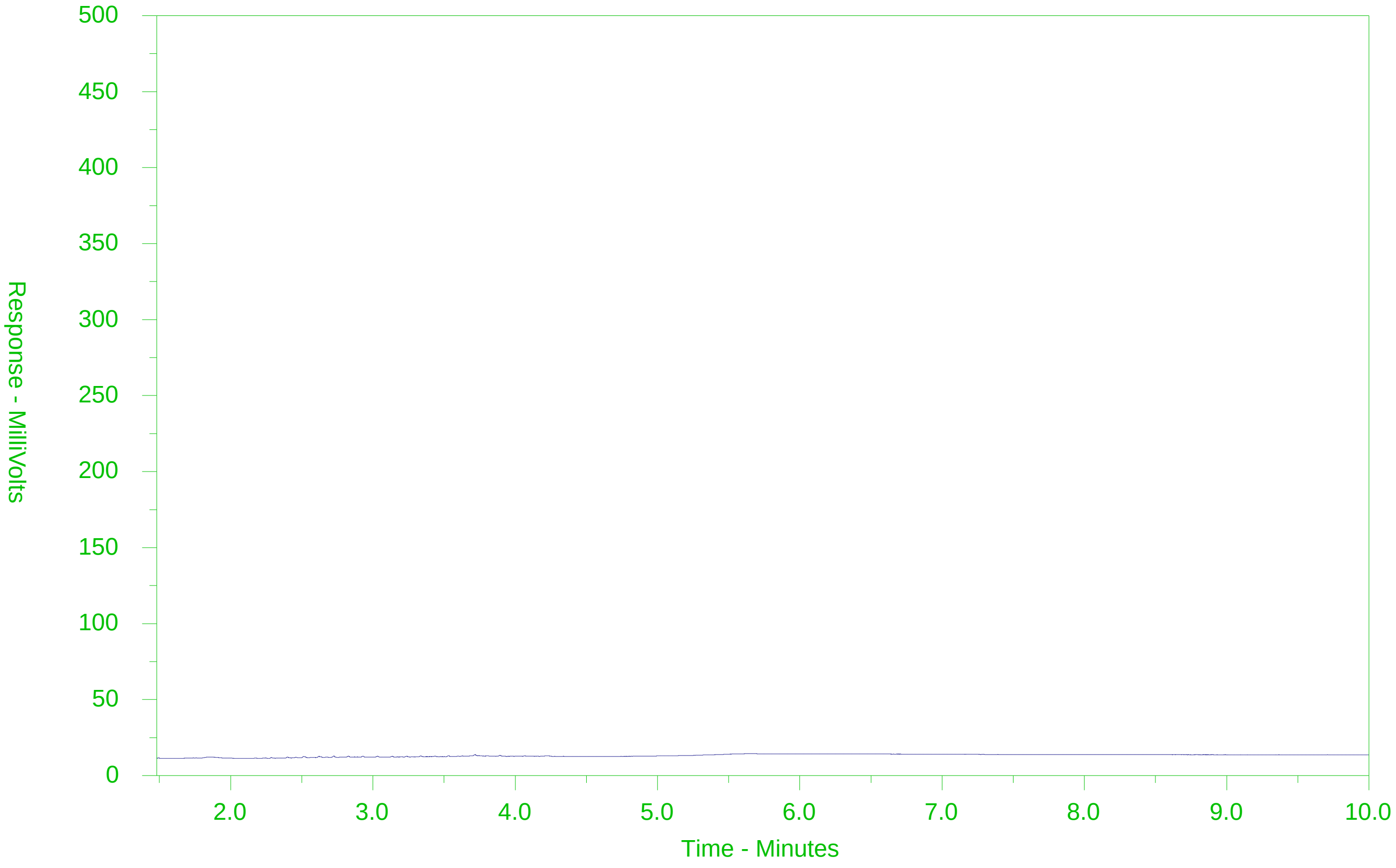
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID:	L2682687-6
Client Sample ID:	BH102 SS6



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

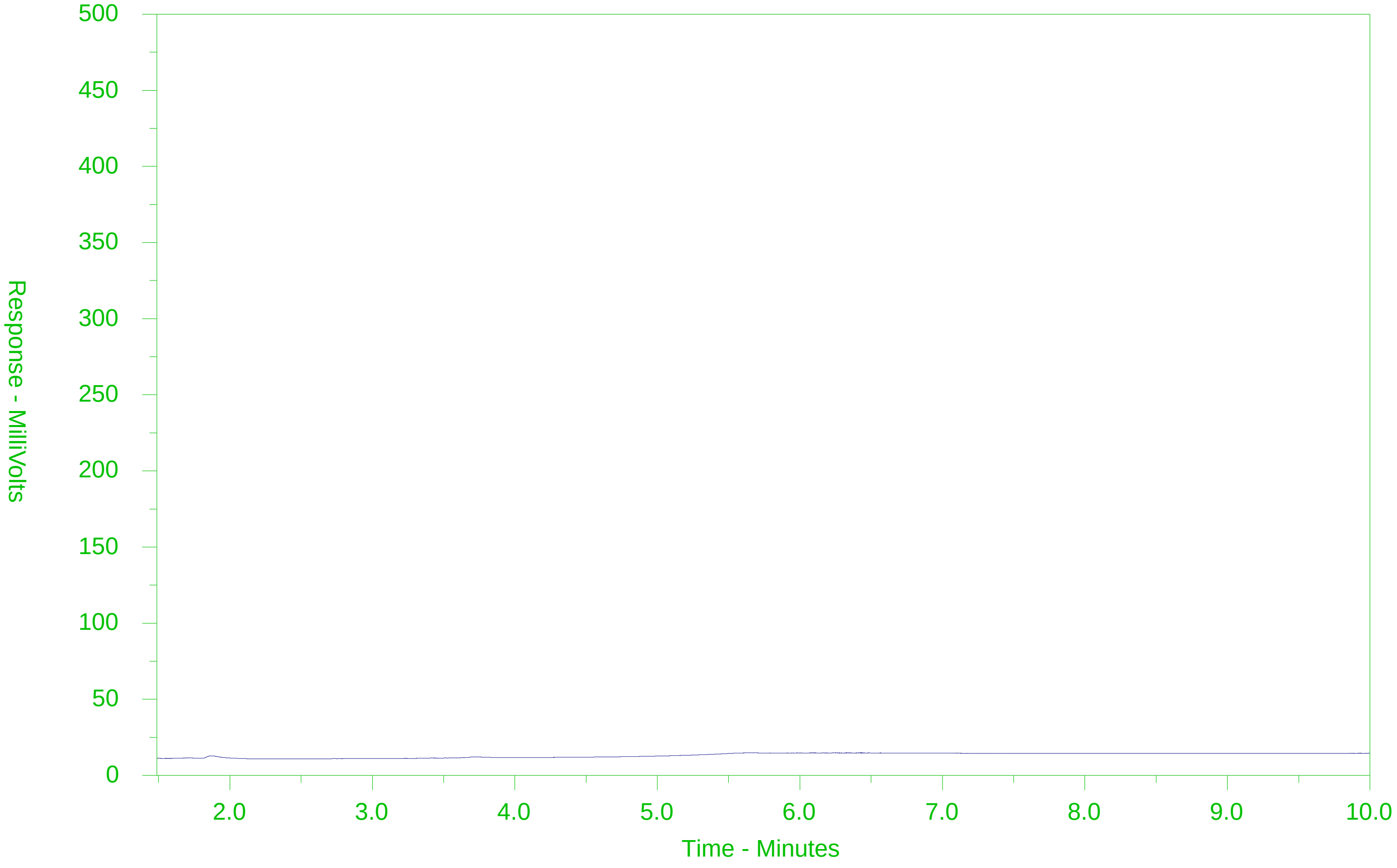
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2682687-7
Client Sample ID: BH103 SS7



←F2→	←F3→	←F4→	
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

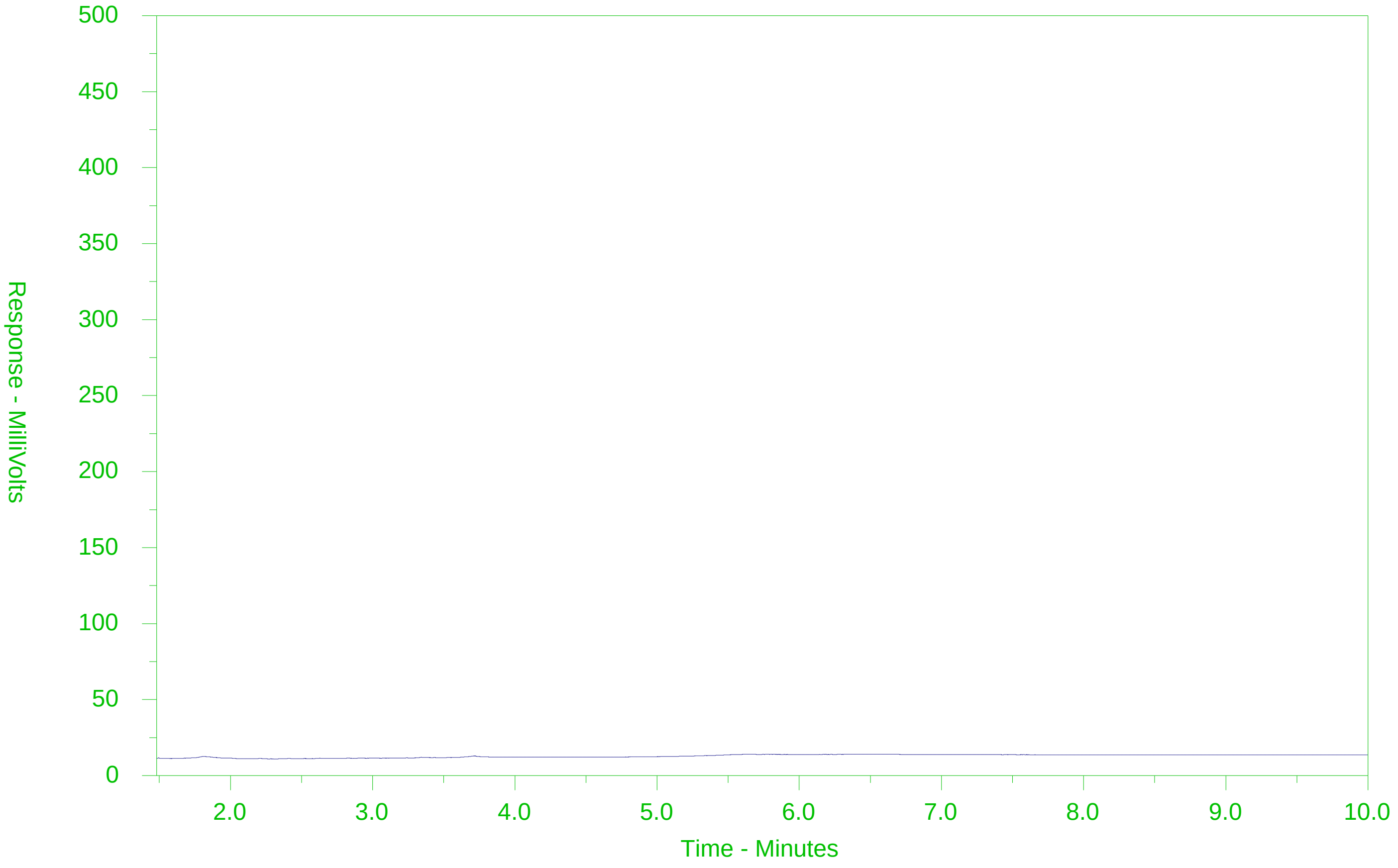
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

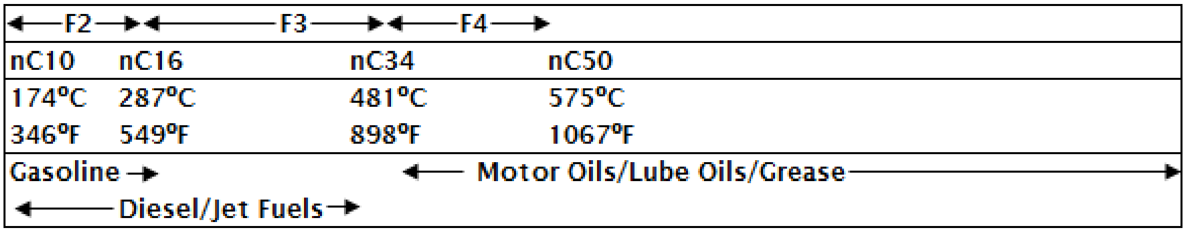
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2682687-8
Client Sample ID: BH104 SS7





←F2→	←F3→		←F4→
nC10	nC16	nC34	nC50
174°C	287°C	481°C	575°C
346°F	549°F	898°F	1067°F
Gasoline →		← Motor Oils/Lube Oils/Grease →	
← Diesel/Jet Fuels →			

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 -

FH

Canada Toll Free: 1 800 668 9878

Page of

ALS www.alsglobal.com

Report To Contact and company name below will appear on the final report
Company: HLV2K Engineering Limited
Contact: Mariam Mohammadi
Phone: 6479753676
Company address below will appear on the final report
Street: 4-2179 Dunwin Drive
City/Province: Mississauga, ON
Postal Code: L5L 1X2

Invoice To
Same as Report To ☑ YES ☐ NO
Copy of Invoice with Report ☑ YES ☐ NO
Company: HLV2K Engineering Limited
Contact: Manny Virani

Project Information
ALS Account # / Quote #: 84316
Job #: 2100522AG
PO / AFE:
LSD:

ALS Lab Work Order # (ALS use only): L2682687 JD

Reports / Recipients
Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax john.lametti@HLV2K.com
Email 2 mariam.mohammadi@HLV2K.com
Email 3 whitney.goodwin@HLV2K.com

Invoice Recipients
Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax Invoice@HLV2K.com
Email 2

Oil and Gas Required Fields (client use)
AFE/Cost Center:
PO#
Major/Minor Code:
Routing Code:
Requisitioner:
Location:

ALS Contact:
Sampler:

Turnaround Time (TAT) Requested
☒ Routine [R] if received by 3pm M-F - no surcharge
☐ 4 day [P4] if received by 3pm M
☐ 3 day [P3] if received by 3pm M
☐ 2 day [P2] if received by 3pm M
☐ 1 day [E] if received by 3pm M-
☐ Same day [E2] if received by 10a
fees may apply to rush requests o
routine tests

L2682687-COFC

ERE

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

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

Analysis Request

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

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	O. Reg. 153/04 - Metals & Inorganics	O.Reg. 153/04 - VOCs	O.Reg. 153/04 - PHC F1-F4	O.Reg. 153/04 - PAH	O.Reg. 153/04 - OC Pesticides	O.Reg. 153/04 - PCB	O.Reg. 153/04 - BTEX	O.Reg. 153/04 - EC and SAR	Corrosivit	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH101 SS1	01-Feb-22	13:00	Soil	1	X											
	BH102 SS1				1	X											
	BH103 SS1				1	X											
	BH104 SS1				1	X											
	BH101 SS5				3			X				X					
	BH102 SS6				3			X				X					
	BH103 SS7				3			X				X					
	BH104SS7				3			X				X					
	BH102 SS2				1									X			
	BH102 SS7				1									X			
	BH104 SS3				1									X			
	BH104 SS5				1									X			

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System?
☐ YES ☐ NO
Are samples for human consumption/ use?
☐ YES ☐ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)
Ontario Regulation 153/04 - April 15, 2011 Standards - T1 - Soil - RPI/ICC Property Use

SAMPLE RECEIPT DETAILS (ALS use only)
Cooling Method: ☐ NONE ☐ ICE ☑ ICE PACKS ☐ FROZEN ☑ COOLING INITIATED
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO
Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A
INITIAL COOLER TEMPERATURES °C: 17.5
FINAL COOLER TEMPERATURES °C: 6.3

SHIPMENT RELEASE (client use)
Released by: Date: Time:

INITIAL SHIPMENT RECEPTION (ALS use only)
Received by: HK Date: 2/01/22 Time: 15:02

FINAL SHIPMENT RECEPTION (ALS use only)
Received by: FH Date: 2022-02-01 Time: 5:00PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

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

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

HLV2K Engineering Limited (Brampton)
ATTN: Mariam Mohammadi
2179 Dunwin Drive
Unit 4
Mississauga ON L5L 1X2

Date Received: 01-FEB-22
Report Date: 07-FEB-22 14:34 (MT)
Version: FINAL

Client Phone: 437-370-0317

Certificate of Analysis

Lab Work Order #: L2682730
Project P.O. #: NOT SUBMITTED
Job Reference: 2100522AG
C of C Numbers:
Legal Site Desc:

Amanda Overholster

Amanda Overholster
Account Manager

ANALYTICAL REPORT

Summary of Guideline Exceedances

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit

Federal & Provincial Waste Regulations (MAR, 2008) - Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

(No parameter exceedances)

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

ANALYTICAL REPORT

Sample Preparation - WASTE

			Lab ID	L2682730-1
			Sample Date	01-FEB-22
			Sample ID	TCLP-1
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Initial pH	pH units	-	-	9.58
Final pH	pH units	-	-	5.70

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

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

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

TCLP Extractables - WASTE

			Lab ID	L2682730-1
			Sample Date	01-FEB-22
			Sample ID	TCLP-1
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Aroclor 1242	mg/L	-	-	<0.00020
Aroclor 1248	mg/L	-	-	<0.00020
Aroclor 1254	mg/L	-	-	<0.00020
Aroclor 1260	mg/L	-	-	<0.00020
Benzo(a)pyrene	mg/L	0.001	-	<0.0010
Cyanide, Weak Acid Diss	mg/L	20	-	<0.10
Fluoride (F)	mg/L	150.0	-	<10
Nitrate and Nitrite as N	mg/L	1000	-	<4.0
Nitrate-N	mg/L	-	-	<2.0
Nitrite-N	mg/L	-	-	<2.0
Total PCBs	mg/L	0.3	-	<0.00040
Surrogate: Chrysene d12	%	-	-	98.9

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

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

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

TCLP Metals - WASTE

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2682730-1 Sample Date: 01-FEB-22 Sample ID: TCLP-1
Arsenic (As)	mg/L	2.5	-	<0.050
Barium (Ba)	mg/L	100	-	1.16
Boron (B)	mg/L	500	-	<2.5
Cadmium (Cd)	mg/L	0.5	-	<0.0050
Chromium (Cr)	mg/L	5.0	-	<0.050
Lead (Pb)	mg/L	5.0	-	<0.025
Mercury (Hg)	mg/L	0.1	-	<0.00010
Selenium (Se)	mg/L	1.0	-	<0.025
Silver (Ag)	mg/L	5.0	-	<0.0050
Uranium (U)	mg/L	10	-	<0.25

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

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

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

ANALYTICAL REPORT

TCLP VOCs - WASTE

			Lab ID	L2682730-1
			Sample Date	01-FEB-22
			Sample ID	TCLP-1
Analyte	**Unit**	**Guide Limits #1**	**Guide Limits #2**	
1,1-Dichloroethylene	mg/L	1.4	-	<0.025
1,2-Dichlorobenzene	mg/L	20.0	-	<0.025
1,2-Dichloroethane	mg/L	0.5	-	<0.025
1,4-Dichlorobenzene	mg/L	0.5	-	<0.025
Benzene	mg/L	0.5	-	<0.025
Carbon tetrachloride	mg/L	0.5	-	<0.025
Chlorobenzene	mg/L	8	-	<0.025
Chloroform	mg/L	10	-	<0.10
Dichloromethane	mg/L	5.0	-	<0.50
Methyl Ethyl Ketone	mg/L	200.0	-	<1.0
Tetrachloroethylene	mg/L	3	-	<0.025
Trichloroethylene	mg/L	5	-	<0.025
Vinyl chloride	mg/L	0.2	-	<0.050
Surrogate: 4-Bromofluorobenzene	%	-	-	90.3

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

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

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

ANALYTICAL REPORT

Volatile Organic Compounds - WASTE

				Lab ID	L2682730-1
				Sample Date	01-FEB-22
				Sample ID	TCLP-1
		Guide Limits			
Analyte	**Unit**	**#1**	**#2**		
Surrogate: 1,4-Difluorobenzene	%	-	-		100.5

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

🟨 Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

🟥 Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

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

ANALYTICAL REPORT

Polychlorinated Biphenyls - WASTE

			Lab ID	L2682730-1
			Sample Date	01-FEB-22
			Sample ID	TCLP-1
		Guide Limits		
Analyte	**Unit**	**#1**	**#2**	
Surrogate: Decachlorobiphenyl	%	-	-	69.5
Surrogate: Tetrachloro-m-xylene	%	-	-	89.5

Guide Limit #1: Ontario Ministry of the Environment, General Waste Control Regulation No. 347/90

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

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

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
CINT	Cooling initiated. Samples were received packed with ice or ice packs and were sampled the same day as received.

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
BAP-ONT-TCLP-WT	Waste	Benzo(a)pyrene for O. Reg 347	SW 846 8270-GC-MS on TCLP Leachate
CN-TCLP-WT	Waste	Cyanide for O. Reg 347	APHA 4500CN I

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from APHA Method 4500-CN I. "Weak Acid Dissociable Cyanide". Weak Acid Dissociable (WAD) cyanide is determined by in-line sample distillation with final determination by colourimetric analysis.

F-TCLP-WT	Waste	Fluoride (F) for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

HG-TCLP-WT	Waste	Mercury (CVAA) for O.Reg 347	EPA 1631E

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 1631E).

LEACH-TCLP-WT	Waste	Leachate Procedure for Reg 347	EPA 1311

Inorganic and Semi-Volatile Organic contaminants are leached from waste samples in strict accordance with US EPA Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP). Test results are reported in leachate concentration units (normally mg/L).

MET-TCLP-WT	Waste	O.Reg 347 TCLP Leachable Metals	EPA 6020B

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020B).

N2N3-TCLP-WT	Waste	Nitrate/Nitrite-N for O. Reg 347	EPA 300.1

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fiber filter. The extract is then analyzed using procedures adapted from EPA 300.1 and is analyzed by Ion Chromatography with conductivity and/or UV detection.

PCB-TCLP-WT	Waste	PCBs for O. Reg 347	SW846 8270
VOC-TCLP-WT	Waste	VOC for O. Reg 347	SW846 8260

A sample of waste is leached in a zero headspace extractor at 30–2 rpm for 18–2.0 hours with the appropriate leaching solution. After tumbling the leachate is analyzed directly by headspace

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

technology, followed by GC/MS using internal standard quantitation.

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

Chain of Custody Numbers:

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

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

GLOSSARY OF REPORT TERMS

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

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

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

Quality Control Report

Workorder: L2682730 Report Date: 07-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BAP-ONT-TCLP-WT	**Waste**							
Batch R5713898								
WG3692628-4 DUP		**WG3692628-6**						
Benzo(a)pyrene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	06-FEB-22
WG3692628-2 LCS								
Benzo(a)pyrene			95.5		%		50-150	06-FEB-22
WG3692628-1 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	06-FEB-22
Surrogate: Chrysene d12			100.6		%		50-150	06-FEB-22
WG3692628-3 MB								
Benzo(a)pyrene			<0.0010		mg/L		0.001	06-FEB-22
Surrogate: Chrysene d12			102.3		%		50-150	06-FEB-22
WG3692628-5 MS		**WG3692628-6**						
Benzo(a)pyrene			88.0		%		50-150	06-FEB-22
CN-TCLP-WT	**Waste**							
Batch R5713554								
WG3692534-3 DUP		**L2682953-1**						
Cyanide, Weak Acid Diss		<0.10	<0.10	RPD-NA	mg/L	N/A	50	04-FEB-22
WG3692534-2 LCS								
Cyanide, Weak Acid Diss			109.8		%		70-130	04-FEB-22
WG3692534-1 MB								
Cyanide, Weak Acid Diss			<0.10		mg/L		0.1	04-FEB-22
WG3692534-4 MS		**L2682953-1**						
Cyanide, Weak Acid Diss			107.9		%		50-140	04-FEB-22
F-TCLP-WT	**Waste**							
Batch R5713599								
WG3692481-3 DUP		**L2682504-1**						
Fluoride (F)		<10	<10	RPD-NA	mg/L	N/A	30	04-FEB-22
WG3692481-2 LCS								
Fluoride (F)			99.2		%		70-130	04-FEB-22
WG3692481-1 MB								
Fluoride (F)			<10		mg/L		10	04-FEB-22
WG3692481-4 MS		**L2682504-1**						
Fluoride (F)			95.9		%		50-150	04-FEB-22
HG-TCLP-WT	**Waste**							
Batch R5713489								
WG3692490-3 DUP		**L2682509-4**						
Mercury (Hg)		<0.00010	<0.00010	RPD-NA	mg/L	N/A	50	04-FEB-22
WG3692490-2 LCS								

Quality Control Report

Workorder: L2682730 Report Date: 07-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TCLP-WT	**Waste**							
Batch R5713489								
WG3692490-2 LCS								
Mercury (Hg)			101.0		%		70-130	04-FEB-22
WG3692490-1 MB								
Mercury (Hg)			<0.00010		mg/L		0.0001	04-FEB-22
WG3692490-4 MS		**L2682509-4**						
Mercury (Hg)			97.4		%		50-140	04-FEB-22
MET-TCLP-WT	**Waste**							
Batch R5713533								
WG3692499-4 DUP		**WG3692499-3**						
Silver (Ag)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	04-FEB-22
Arsenic (As)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	04-FEB-22
Boron (B)		<2.5	<2.5	RPD-NA	mg/L	N/A	50	04-FEB-22
Barium (Ba)		0.62	0.61		mg/L	0.9	50	04-FEB-22
Cadmium (Cd)		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	04-FEB-22
Chromium (Cr)		<0.050	<0.050	RPD-NA	mg/L	N/A	50	04-FEB-22
Lead (Pb)		<0.025	0.026	RPD-NA	mg/L	N/A	50	04-FEB-22
Selenium (Se)		<0.025	<0.025	RPD-NA	mg/L	N/A	50	04-FEB-22
Uranium (U)		<0.25	<0.25	RPD-NA	mg/L	N/A	50	04-FEB-22
WG3692499-2 LCS								
Silver (Ag)			103.4		%		70-130	04-FEB-22
Arsenic (As)			99.1		%		70-130	04-FEB-22
Boron (B)			94.0		%		70-130	04-FEB-22
Barium (Ba)			104.3		%		70-130	04-FEB-22
Cadmium (Cd)			96.3		%		70-130	04-FEB-22
Chromium (Cr)			98.5		%		70-130	04-FEB-22
Lead (Pb)			99.8		%		70-130	04-FEB-22
Selenium (Se)			96.7		%		70-130	04-FEB-22
Uranium (U)			104.5		%		70-130	04-FEB-22
WG3692499-1 MB								
Silver (Ag)			<0.0050		mg/L		0.005	04-FEB-22
Arsenic (As)			<0.050		mg/L		0.05	04-FEB-22
Boron (B)			<2.5		mg/L		2.5	04-FEB-22
Barium (Ba)			<0.50		mg/L		0.5	04-FEB-22
Cadmium (Cd)			<0.0050		mg/L		0.005	04-FEB-22
Chromium (Cr)			<0.050		mg/L		0.05	04-FEB-22

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TCLP-WT	**Waste**							
Batch R5713533								
WG3692499-1 MB								
Lead (Pb)			<0.025		mg/L		0.025	04-FEB-22
Selenium (Se)			<0.025		mg/L		0.025	04-FEB-22
Uranium (U)			<0.25		mg/L		0.25	04-FEB-22
WG3692499-5 MS		**WG3692499-3**						
Silver (Ag)			136.8		%		50-140	04-FEB-22
Arsenic (As)			114.5		%		50-140	04-FEB-22
Boron (B)			119.4		%		50-140	04-FEB-22
Barium (Ba)			114.3		%		50-140	04-FEB-22
Cadmium (Cd)			108.8		%		50-140	04-FEB-22
Chromium (Cr)			110.8		%		50-140	04-FEB-22
Lead (Pb)			111.1		%		50-140	04-FEB-22
Selenium (Se)			115.1		%		50-140	04-FEB-22
Uranium (U)			120.1		%		50-140	04-FEB-22
N2N3-TCLP-WT	**Waste**							
Batch R5713599								
WG3692481-3 DUP		**L2682504-1**						
Nitrate-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	04-FEB-22
Nitrite-N		<2.0	<2.0	RPD-NA	mg/L	N/A	25	04-FEB-22
WG3692481-2 LCS								
Nitrate-N			105.8		%		70-130	04-FEB-22
Nitrite-N			106.7		%		70-130	04-FEB-22
WG3692481-1 MB								
Nitrate-N			<2.0		mg/L		2	04-FEB-22
Nitrite-N			<2.0		mg/L		2	04-FEB-22
WG3692481-4 MS		**L2682504-1**						
Nitrate-N			103.7		%		50-150	04-FEB-22
Nitrite-N			104.7		%		50-150	04-FEB-22
PCB-TCLP-WT	**Waste**							
Batch R5713713								
WG3692631-4 DUP		**WG3692631-6**						
Aroclor 1242		<0.00020	<0.00020	RPD-NA	mg/L	N/A	50	04-FEB-22
Aroclor 1248		<0.00020	<0.00020	RPD-NA	mg/L	N/A	50	04-FEB-22
Aroclor 1254		<0.00020	<0.00020	RPD-NA	mg/L	N/A	50	04-FEB-22
Aroclor 1260		<0.00020	<0.00020	RPD-NA	mg/L	N/A	50	04-FEB-22
WG3692631-2 LCS								

Quality Control Report

Workorder: L2682730 Report Date: 07-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PCB-TCLP-WT	**Waste**							
Batch R5713713								
WG3692631-2 LCS								
Aroclor 1242			100.2		%		65-130	04-FEB-22
Aroclor 1248			82.6		%		65-130	04-FEB-22
Aroclor 1254			88.7		%		65-130	04-FEB-22
Aroclor 1260			84.3		%		65-130	04-FEB-22
WG3692631-1 MB								
Aroclor 1242			<0.00020		mg/L		0.0002	04-FEB-22
Aroclor 1248			<0.00020		mg/L		0.0002	04-FEB-22
Aroclor 1254			<0.00020		mg/L		0.0002	04-FEB-22
Aroclor 1260			<0.00020		mg/L		0.0002	04-FEB-22
Surrogate: Decachlorobiphenyl			62.1		%		50-150	04-FEB-22
Surrogate: Tetrachloro-m-xylene			73.3		%		50-150	04-FEB-22
WG3692631-3 MB								
Aroclor 1242			<0.00020		mg/L		0.0002	04-FEB-22
Aroclor 1248			<0.00020		mg/L		0.0002	04-FEB-22
Aroclor 1254			<0.00020		mg/L		0.0002	04-FEB-22
Aroclor 1260			<0.00020		mg/L		0.0002	04-FEB-22
Surrogate: Decachlorobiphenyl			69.5		%		50-150	04-FEB-22
Surrogate: Tetrachloro-m-xylene			79.3		%		50-150	04-FEB-22
WG3692631-5 MS		**WG3692631-6**						
Aroclor 1242			107.8		%		50-150	04-FEB-22
Aroclor 1254			99.8		%		50-150	04-FEB-22
Aroclor 1260			96.6		%		50-150	04-FEB-22
VOC-TCLP-WT	**Waste**							
Batch R5713560								
WG3692263-1 LCS								
1,1-Dichloroethylene			100.2		%		70-130	03-FEB-22
1,2-Dichlorobenzene			99.8		%		70-130	03-FEB-22
1,2-Dichloroethane			99.6		%		70-130	03-FEB-22
1,4-Dichlorobenzene			97.6		%		70-130	03-FEB-22
Benzene			96.9		%		70-130	03-FEB-22
Carbon tetrachloride			95.7		%		60-140	03-FEB-22
Chlorobenzene			99.0		%		70-130	03-FEB-22
Chloroform			98.9		%		70-130	03-FEB-22
Dichloromethane			104.3		%		70-130	03-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-TCLP-WT	**Waste**							
Batch R5713560								
WG3692263-1 LCS								
Methyl Ethyl Ketone			102.4		%		50-150	03-FEB-22
Tetrachloroethylene			105.0		%		70-130	03-FEB-22
Trichloroethylene			99.2		%		70-130	03-FEB-22
Vinyl chloride			90.3		%		60-130	03-FEB-22
WG3692263-2 MB								
1,1-Dichloroethylene			<0.025		mg/L		0.025	03-FEB-22
1,2-Dichlorobenzene			<0.025		mg/L		0.025	03-FEB-22
1,2-Dichloroethane			<0.025		mg/L		0.025	03-FEB-22
1,4-Dichlorobenzene			<0.025		mg/L		0.025	03-FEB-22
Benzene			<0.025		mg/L		0.025	03-FEB-22
Carbon tetrachloride			<0.025		mg/L		0.025	03-FEB-22
Chlorobenzene			<0.025		mg/L		0.025	03-FEB-22
Chloroform			<0.10		mg/L		0.1	03-FEB-22
Dichloromethane			<0.50		mg/L		0.5	03-FEB-22
Methyl Ethyl Ketone			<1.0		mg/L		1	03-FEB-22
Tetrachloroethylene			<0.025		mg/L		0.025	03-FEB-22
Trichloroethylene			<0.025		mg/L		0.025	03-FEB-22
Vinyl chloride			<0.050		mg/L		0.05	03-FEB-22
Surrogate: 1,4-Difluorobenzene			99.7		%		70-130	03-FEB-22
Surrogate: 4-Bromofluorobenzene			92.2		%		70-130	03-FEB-22
WG3692263-3 MS		**L2682730-1**						
1,1-Dichloroethylene			102.9		%		50-140	03-FEB-22
1,2-Dichlorobenzene			99.7		%		50-140	03-FEB-22
1,2-Dichloroethane			96.2		%		50-140	03-FEB-22
1,4-Dichlorobenzene			101.3		%		50-140	03-FEB-22
Benzene			97.5		%		50-140	03-FEB-22
Carbon tetrachloride			98.5		%		50-140	03-FEB-22
Chlorobenzene			99.9		%		50-140	03-FEB-22
Chloroform			99.1		%		50-140	03-FEB-22
Dichloromethane			102.6		%		50-140	03-FEB-22
Methyl Ethyl Ketone			90.8		%		50-140	03-FEB-22
Tetrachloroethylene			110.7		%		50-140	03-FEB-22
Trichloroethylene			101.5		%		50-140	03-FEB-22
Vinyl chloride			91.9		%		50-140	03-FEB-22

Quality Control Report

Workorder: L2682730 Report Date: 07-FEB-22

Client: HLV2K Engineering Limited (Brampton)
2179 Dunwin Drive Unit 4
Mississauga ON L5L 1X2
Contact: Mariam Mohammadi

Legend:

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

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

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

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

Chain of Custody (COC) / Analytical Request Form

ALS
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

COC Number: 20 -

FM

Page of

Report To	Contact and company name below will appear on the final report
Company:	HLV2K Engineering Limited
Contact:	Mariam Mohammadi
Phone:	6479753676
	Company address below will appear on the final report
Street:	4-2179 Dunwin Drive
City/Province:	Mississauga, ON
Postal Code:	L5L 1X2
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	HLV2K Engineering Limited
Contact:	Manny Virani

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A
☑ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax john.lametti@HLV2K.com
Email 2 mariam.mohammadi@HLV2K.com
Email 3 Irfan.Khokhar@HLV2K.com

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax Invoice@HLV2K.com
Email 2

Turnaroun

☑ Routine [R] if received by 3
☐ 4 day [P4] if received by 3
☐ 3 day [P3] if received by 3
☐ 2 day [P2] if received by 3
☐ 1 day [E] if received by 3p
☐ Same day [E2] if received
fees may apply to rush reques
routine tests

L2682730-COFC

EL HERE

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

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

Project Information

ALS Account # / Quote #: 84316
Job #: 2100522AG
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

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

ALS Lab Work Order # (ALS use only): L2682730 JD

Analysis Request

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

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	TCLP - Metals & Inorganic	TCLP - VOCs	TCLP - benzo(a)pyrene	TCLP - Total PCBs											SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
						N																
	TCLP 1	01-Feb-22	13:00	soil	2	X	/	X	X													

Drinking Water (DW) Samples[1] (client use)	**Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)**
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human consumption/ use? ☐ YES ☐ NO	Ontario General Waste Control Regulation 347/90

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☐ ICE ☑ ICE PACKS ☐ FROZEN ☑ COOLING INITIATED
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO
Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
17.5				6.3			

SHIPMENT RELEASE (client use)			**INITIAL SHIPMENT RECEPTION (ALS use only)**			**FINAL SHIPMENT RECEPTION (ALS use only)**		
Released by:	Date:	Time:	Received by: H.K	Date: 2/01/22	Time: 15:05	Received by: FH	Date: 2022-02-01	Time: 5PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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

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