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March 1, 2024

GeoWest File: GA23-1294-00

McElhanney Consulting Services Ltd.
200 – 858 Beatty Street
Vancouver, BC V6B 1C1

Attention: Valentino Tjia, P. Eng., P.E. – Transportation Engineer
Email: vtjia@mcelhanney.com

Project: University of British Columbia – South Campus Works Yard, On Site Works, Phase 1 Nurseries Road, Vancouver, BC

Subject: Geotechnical Site Assessment Report

Dear Sir:

1. INTRODUCTION

At the request of McElhanney Consulting Services Ltd. (the Client), GeoWest Engineering Ltd. (GeoWest) provides herein a geotechnical site assessment report for the proposed Phase 1 on-site works for the South Campus Works Yard. The site location is shown on the attached Figure 1.

This geotechnical assessment report has been completed in accordance with our proposal P23-1260-00 dated August 21, 2023. Authorization to proceed with the scope of work was received from the Client via signed services agreement on December 18, 2023. Our scope of work for this project did not include assessment of the soil and groundwater at the site with respect to environmental considerations or corrosion potential.

A geotechnical site assessment report for the proposed widening of Nurseries Road was prepared by GeoWest under a separate cover.

2. SITE DESCRIPTION

The area of proposed development (the site) is located in UBC's Vancouver campus and is bordered by UBC South Campus Warehouse to the north, Nurseries Road to the east, forested land to the south and by National Research Council of Canada to the west. The site was generally densely forested at the time of our field work. An existing gravel access road extended from Nurseries Road towards the National Research Council building parkade at the south end of the site.

Topographic information available on City of Vancouver Webmap indicates that the existing ground surface at the site generally slopes down gradually from north to south with elevations ranging from 56 m to 53 m above sea level.

The southern portion of the site was being used to stockpile fill material at the time of our investigation. Several smaller stockpiles of soils, about 1.0 m high, were observed within a fenced off area in the northern portion of the site. Surficial ponding of water was also noted within this area, as the grade within the forested area was noted to be lower than the surrounding grades. An existing ditch was present along the central portion of the site. A second ditch was also noted on the west side of the site, along the existing parkade.

3. PROPOSED CONSTRUCTION

Based on the concept plan prepared by Kasian Architecture and Interior Designer, labelled, "Figure 1.2 Functional Concept Plan" that has been provided to us and subsequent information provided via email correspondence on January 11, 2024, we understand that the following structures are proposed as part of the Phase 1 upgrades:

- Fleet parking lot will be located in the northern portion of the site.
- A truck wash bay will be located to the south of the parking lot and will be enclosed on two sides with a roof.
- Storage area for two 42,000L diesel tanks founded on a 10 m x 5 m x 0.6 m thick concrete slab with an eventual build-out to four tanks.
- Storage area for water reserves and emergency supplies to accommodate four – 2.6 m x 6.1 m containers.
- Compressed Natural Gas (CNG) Fuel station – CNG compressor unit will be founded on a concrete pad. The size of the concrete pad was unknown at the time of preparing this report. Vehicle access will be required for H25 trucks.
- Site resiliency area to be used for storage and stockpiling. The area will be paved.

The locations of the fleet parking, fuel station/wash bay and site resiliency are shown in Figure 2. The storage areas are expected to be located within the parking area. This geotechnical assessment and recommendations provided herein are based on information about locations of proposed structures provided to us at the time of our field work. Additional subsurface investigation and an updated geotechnical report may be required if the locations of proposed structures change during design development.

4. METHODOLOGY

4.1 Subsurface Investigation

To assess the soil and groundwater conditions at the site, GeoWest conducted a subsurface investigation on January 5, 2024. The investigation comprised of advancement of three auger holes (AH24-01 to AH24-03) using a track mounted drill rig equipped with solid-stem continuous flight augers and three hand auger holes (HA24-01 to HA24-03) using a manual auger. The locations of the auger holes are shown on the attached Figure 2.

Auger holes AH24-01 to AH24-03 extended to depths ranging from 3.65 m to 6.1 m below existing grade. Hand auger holes HA24-01 to HA24-03 extended to depths ranging from 0.8 m to 1.0 m below existing grade.

Dynamic Cone Penetration Tests (DCPTs) were conducted adjacent to auger holes AH24-01 and AH24-03. This test is widely used by local geotechnical practitioners and involves advancing a steel cone with the same diameter as a Standard Penetration Test (SPT) split-spoon sampler into the ground using an automatic trip hammer with a weight of 63 kg and a free-fall drop of 750 mm (the same driving energy as the SPT). The number of blows required for each 305 mm interval of depth of advancement of the cone is recorded. The blow counts for the DCPT provide a continuous indication of the *in-situ* relative density/consistency of the soils. The DCPT adjacent to AH24-01 extended to a depth of 4.5 m below existing grade. The DCPT at AH24-03 encountered practical penetration refusal (more than 100 blows required to advance the steel cone a depth of 305 mm) at a depth of about 1.8 m below existing grade. The recorded DCPT blow counts are graphically shown on the relevant soil logs.

The field work was conducted under the full-time review of a member of our geotechnical staff, who logged the soil and groundwater conditions encountered at the auger holes and collected representative disturbed soil samples from the auger flights for visual classification and moisture content. The moisture contents of the tested samples are shown graphically on the soil logs. Soil logs with description of the conditions observed at the auger holes are attached to this report.

The auger holes were backfilled with the drill cuttings and bentonite in accordance with provincial groundwater protection requirements immediately upon completion of logging and sampling the soils.

5. SOIL AND GROUNDWATER CONDITIONS

5.1 Surficial Geology

The Geological Survey of Canada surficial geology map covering Vancouver (Map 1486A) describes the site soils as Vashon Drift and Capilano Sediments comprised of "*glacial drift including lodgment and minor flow till with lenses and interbeds of sub stratified glaciofluvial sand to gravel and lenses and interbeds of glaciolacustrine laminated stoney silt which is underlain by bedrock more than 10 m below the surface (VCb).*"

The native soils encountered during the GeoWest subsurface investigation were generally consistent with the mapped surficial geology.

5.2 Soil Conditions

The attached soil logs should be referred to for the specific soil conditions encountered at each auger hole location. The soil logs attached to this report provides description of the soil conditions encountered at discrete locations. Actual soil conditions remote from the auger holes may vary across the site. Contractors should make their own interpretation of the soil logs and the site conditions for the purposes of bidding and performing work at the site. A summary of the conditions observed at the auger holes is provided below.

5.2.1 Fill and Topsoil

Fill was encountered at AH24-01 to a depth of 0.9 m. The fill comprised of very dense to loose sand with some gravel and trace silt. Samples obtained from the fill had moisture contents ranging from 4.7% to 5.9%.

Fill was encountered at AH24-02 to a depth of 0.6 m comprising of loose to compact silt with some sand with a moisture content of 14.3%. This surficial fill was underlain by additional possible fill comprised of compact sand with some silt and trace gravel to a depth of 0.95 m. The moisture content of the possible lower layer of fill was 18.4%.

Topsoil was encountered in all three hand auger holes, with thickness ranging from 50 mm to 450 mm below existing grade.

5.2.2 Silt, Clayey Silt and Sandy Silt

Organic silt with moisture content of 30 to 46% was encountered at depths of 0.9 m in AH24-01 and AH24-02. The thickness of organic silt was 0.6 m in AH24-01 and 0.3 m in AH24-02. A 0.15 m thick layer of soft silt was encountered below the organic silt in AH24-01.

Stiff to hard silt with some clay to clayey silt was encountered in AH24-01 at a depth of 1.7 m below grade and extended to a depth of 4.4 m. The moisture contents of tested samples ranged from 17 to 22%. Firm to stiff silt with a moisture content of 16 to 26% was interbedded with sand in AH24-02. The lower layer of sandy silt in AH24-02 was 0.9 m thick and extended to the full depth of exploration at 4.5 m.

5.2.3 Sand and Silty Sand

Sand and silty sand were encountered in all test holes. This deposit was loose to very dense in AH24-01 to AH24-03 based on DCPT and visual observations. The sand and silty sand encountered in the hand auger holes was judged to be loose. The moisture content of tested sampled from the auger holes ranged from 9 to 26%. The moisture content of tested sampled from the hand auger holes ranged from 29 to 43%.

The sand to silty sand was encountered to the full depth of exploration at AH24-01, AH24-03, and all hand auger locations.

Although not observed at our test hole locations, cobbles and boulders are commonly encountered within these glacially derived soil deposits.

5.3 Groundwater Conditions

Groundwater seepage was observed at AH24-01 and AH24-02 at a depth of 4.0 m and 1.5 m below grade, respectively. No groundwater seepage was encountered in AH24-03. We infer the observed water at AH24-01 and AH24-03 to be perched groundwater in higher permeability sandy deposits underlain by lower permeability silty deposits.

Groundwater seepage was also encountered at all three hand auger hole locations about 0.15 m to 0.3 m below grade. We also infer that this is perched groundwater, for the same reasons described in the preceding paragraph.

The presence and depth of the perched groundwater seepage is expected to fluctuate seasonally and during/following prolonged periods of heavy rainfall.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General

It is our opinion that the proposed on-site development is feasible from a geotechnical perspective. The native silt and sand are considered suitable for support of the proposed structures, provided they are prepared in accordance with the recommendations provided in this report. All topsoil and soft organic silt should be removed from below the footprint of all buildings, concrete slabs, on-site pavement, and any other settlement sensitive structures.

6.2 Seismic Considerations

Discussion in this section is based on the next edition of the British Columbia Building Code (2024 BCBC), which will be based on the 2020 National Building Code of Canada (NBCC) and is to be partially adopted by the Province of British Columbia on March 8, 2024. The seismic design components of the 2024 BCBC will be adopted in March 2025. The soils encountered at the auger holes are not considered to be subject to liquefaction during the 2024 BCBC design earthquake (two percent of probability of exceedance in 50 years [2475-year return period]).

Based on the test hole information, we expect that a Site Class of X_C could be used for design under the 2024 BCBC. The horizontal Peak Ground Acceleration (PGA) for the site obtained using the *2020 National Building Code of Canada Seismic Hazard Tool* based on the site's UTM coordinates (lat. 49.246/long. -123.231) is 0.535g for Site Class X_C, as per Table 1 below.

Table 1: NBCC 2020 – 2%/50 years (0.000404 per annum) Probability

Sa(0.2, X_C)	Sa(0.5, X_C)	Sa(1.0, X_C)	Sa(2.0, X_C)	Sa(5.0, X_C)	Sa(10.0, X_C)	PGA	PGV
1.14	0.92	0.533	0.324	0.091	0.0381	0.495	0.552

6.3 Site Preparation

Subgrade preparation for the proposed fleet parking lot, storage areas, fuel station and site resiliency area should comprise of removal of all vegetation, topsoil, other organics, organic silt, soft clayey silt and the existing fill including stockpiles in the southern and norther/central portions of the site, and any other softened or disturbed surficial soil to expose a subgrade of comprised of native firm to stiff silt and loose to compact silty sand to sand. Based on the auger holes, the anticipated stripping depths to remove the unsuitable soils are expected to be in the order of 0.1 to 1.7 m but may be greater or lesser in areas remote from the auger holes. Topsoil thicknesses should specifically be expected to be thicker in the forested areas of the property.

The stripped subgrade where it comprises of sand to silty sand should be proof-rolled with a smooth drum compactor under the review of the Geotechnical Engineer prior to the placement of any fill. Proof compaction should also be completed in the presence of the Geotechnical Engineer. Any soft or loose areas encountered during the proof compaction should be recompacted in-situ or be excavated with grade reinstated with engineered fill as described below.

Areas where the subgrade consists of silt, and which will not be covered with engineered fill should be blinded with a 150 mm thick layer of nominally compacted 19 mm clear crushed gravel. Temporary roads should be constructed with 75 mm minus sand and gravel where vehicles and equipment must traverse the site over the stripped subgrade. The thickness of the 75 mm minus sand and gravel will be a function of the weight of the vehicles/equipment that must access the site. GeoWest can provide refined recommendations in this regard when the vehicle/equipment details are defined. However, for preliminary planning we suggest that you use a thickness of 300 mm.

The stripped subgrade should be graded to temporary perimeter ditches or sumps to limit ponding of groundwater or rainfall on the subgrade. Any subgrade disturbed areas after stripping should be removed and replaced with engineered fill.

The Geotechnical Engineer should review the prepared subgrade, prior to the placement of any fill or the construction of foundations or slabs.

6.4 Engineered Fill

In this report, engineered fill refers to permanently placed fill located below pavements (including asphalt and concrete), foundations, slabs, and other settlement-sensitive features.

Imported engineered fill should consist of well-graded granular material containing less than 5 percent fines (material passing the 0.075 mm sieve) by weight, such as 75 mm minus pit run sand and gravel, or a Geotechnical Engineer approved equivalent. The Geotechnical Engineer should be provided with the opportunity to review and approve candidate imported engineered fill materials prior to their use at the site.

We do not recommend the re-use of the fine-grained silty site soils as engineered fill due to difficulties in maintaining these materials at a suitable moisture content for compaction. These soils could be used as general site grading fill outside of the pavement areas, concrete slabs and building footprints or other settlement-sensitive areas, provided they are free of organics or other deleterious materials, and they are at a suitable

moisture content for compaction (within 2 percent of optimum for compaction as determined by a Standard Proctor moisture-density relationship test) at the time of placement. Use of the silty site soils will likely be limited to the drier months of the year, and moisture conditioning may be required to bring them to their optimum moisture content for compaction. The site soils comprised predominantly of silt should not be used where free-draining soil is required.

Engineered fill should be placed over Geotechnical Engineer approved subgrade in discrete lifts a maximum of 300 mm in thickness and should be compacted with vibratory equipment to not less than 95 percent of the material's Modified Proctor maximum dry density (MPD).

Engineered fill below load bearing areas should extend horizontally beyond the load bearing areas based on a 1H:1V offset. For example, where 0.5 m of engineered fill will underlie a building foundation, horizontal excavation should extend at least 0.5 m beyond that footing. The Geotechnical Engineer should review the compaction of the engineered fill, as it is being placed, to confirm that adequate compaction is achieved. General site grading fill should be compacted to not less than 90 percent of its MPD.

The stripped site should be graded to inhibit the ponding of water, which may result in softening of the exposed subgrade. Water should be directed to perimeter swales and sumps which is then discharged to the project Erosion and Sediment Control (ESC) system, and then appropriate off-site facilities.

6.5 Temporary Excavations and Dewatering

We expect that conventional excavation equipment equipped with digging buckets can be used to excavate the site soils. Final grading and subgrade exposure should be conducted using a smooth-mouthed bucket to minimize disturbance to the subgrade.

Splitting or blasting of larger boulders, if encountered may be required. The Contractor should consult with UBC and the City of Vancouver before undertaking any blasting.

We recommend that the sides of unsupported temporary excavations that are greater than 1.2 m in depth and require worker access must not be steeper than 3H:4V. Flatter temporary excavation slopes may be required where groundwater seepage is encountered. If steeper unsupported slopes are proposed, the excavation should be reviewed and approved in writing by a Geotechnical Engineer prior to allowing workers into or adjacent to the excavation. Vehicles should maintain a minimum setback of 1.5 m from the crest of unsupported excavation slopes. Track mounted construction equipment to encroach to the crest of the excavations so long as their tracks are oriented perpendicular to the crest of the slope. Cranes, concrete pump trucks, and other equipment employing outriggers will require excavation offsets evaluated on an individual basis when outrigger load details can be provided to the Geotechnical Engineer. We recommend that temporary excavation slopes be covered with polyethylene sheeting, which is securely fastened at the top and toe of the slopes, to limit the potential for soil erosion by surface water runoff.

It is expected that groundwater and rainwater entering temporary excavations at the site could be adequately controlled using sumps and pumps. Discharge of water collected from temporary excavations should be conducted in accordance with the requirements of the project ESC plan and the City of Vancouver.

6.6 Foundations

It is our opinion that strip foundations may be used to support the wash bay structure. Strip footings constructed on Geotechnical Engineer approved subgrade or on compacted engineered fill placed over the Geotechnical Engineer approved subgrade can be designed based on a serviceability limit state (SLS) soil bearing resistance of 120 kPa and a factored ultimate limit state (ULS) soil bearing resistance of 180 kPa.

As discussed in Section 3, the storage areas for diesel tanks, CNG compression modules, and water reserves will be supported on concrete slabs. The concrete slab should be underlain by 150 mm of 19 mm minus crushed gravel fill, overlain on Geotechnical Engineer approved subgrade. The structural engineer may employ a modulus of subgrade reaction for the design of concrete slabs of 15 MPa/m.

The recommended minimum footing dimensions are 450 mm and 600 mm for strip and pad footings, respectively. The underside of foundations should be located at least 450 mm below finished grade for frost protection and confinement. Greater embedment depths of foundations may be required where foundations are located adjacent to sloping ground. Footings should be stepped at no steeper than 2H:1V. The underside of foundations should be located below a 2H:1V influence line taken up from the base of adjacent deeper excavations for other foundations or underground services, or the soil bearing resistances provided above may need to be reduced.

The Geotechnical Engineer should review the foundation subgrade prior to the placement of foundation formwork to confirm that the provided soil bearing resistances are appropriate for the exposed soil conditions.

Total post-construction settlement of foundations constructed in accordance with the recommendations provided in this report is not anticipated to exceed 25 mm under static loading. Differential post-construction settlement is not expected to exceed 15 mm over a horizontal distance of 10 m.

6.7 Lateral Earth Pressures

For foundation walls, retaining walls, or other buried structures we provide the following recommendations. “At-rest” earth pressure theory is considered applicable to non-yielding top and bottom restrained below-grade walls, such as basement foundation walls and underground storage tanks. It is recommended that an unfactored at-rest lateral earth pressure of 8.4 kPa/m be used for the design of such walls under static loading.

“Active” earth pressure theory is considered applicable to retaining walls that are permitted to rotate slightly, such as cantilever gravity retaining walls. The active soil pressure is estimated to be 5.4 kPa/m at the site for static loading.

It is recommended that a uniform distributed lateral load of 5 kPa be added for the design of below-grade walls and retaining walls under static loading to address compaction induced stress and construction live loads. Surcharge loads on the underground walls and any retaining walls should be assessed based on an at-rest and active lateral earth pressure coefficient of 0.44 and 0.28, respectively, multiplied by the factored vertical load.

For seismic design, the active lateral earth pressure provided above should be combined with the incremental seismic pressure computed using the Mononobe-Okabe (M-O) equations. An inverted triangular pressure

distribution of 3.1 kPa/m can be used to model the incremental seismic lateral earth pressure on basement foundations walls, underground storage tanks, and retaining walls.

The earth pressures provided above assume fully drained conditions adjacent to the below-grade walls, so the wall backfill must comprise free-draining material consistent with the description of engineered fill provided in this report. The earth pressures also assume that the surface of the retained soil is horizontal.

The lateral earth pressures provided above assume that the surface of the retained soil is horizontal and that hydrostatic pressures do not develop, so the backfill must comprise free-draining granular soil as described in Section 6.4 of this report, should be provided. The lateral earth pressures provided are based on unfactored soil properties, so the lateral earth pressures should be assumed to be unfactored as well.

A factored coefficient of friction of 0.4 may be used to estimate the sliding resistance along the soil-concrete interface where the foundation is constructed on a minimum of 100 mm thick layer of 19 mm clear crushed gravel as described in Section 6.3 or on compacted engineered fill as described in this report. An equivalent fluid pressure of 33 kPa/m may be used to estimate the factored ultimate passive resistance of permanently in-place soil in front of underground storage tanks, foundation walls, or retaining walls.

6.8 Slab-on-Grade

We anticipate the wash bay will have a concrete slab-on-grade. The concrete slab-on-grade should be underlain with a minimum 150 mm thick layer of 19 mm minus crushed sand and gravel placed over a minimum 300 mm thick layer of engineered fill placed over a Geotechnical Engineer approved subgrade. The 19 mm minus crushed gravel should contain less than 5 percent fines by weight and be compacted to not less than 95% percent of the material's MPD. It is recommended that the Geotechnical Engineer confirm that the under-slab fill is adequately compacted. The slab-on-grade should be provided with sufficient joints for control of cracks from slab settlement and from thermal expansion and contraction.

A vapour barrier below the slab is not required for any geotechnical purposes. However, available research shows that polyethylene sheeting can be beneficial for reducing shrinkage cracking if properly installed, particularly during the warm summer season, when the top of the slab will dry (shrink) faster than the base of the slab. The low coefficient of friction of the polyethylene vapour barrier allows the underside of slab to move with the hotter slab surface. This ability to move results in a reduced potential for thermal shrinkage slab cracking. We recommend using minimum 10 mil thick poly under the slabs-on-grade, if it is specified for the project.

6.9 On-Site Asphalt Pavement

Following the site preparation recommended in Section 6.3, the following structure is recommended for the fleet parking lot and on-site asphalt paved roads:

- 75 mm of asphalt course underlain by,
- 150 mm of 19 mm minus crushed gravel base course, underlain by,
- 300 mm of 75 mm minus crushed sand and gravel subbase course, underlain by,

- Geotechnical Engineer-approved subgrade or compacted engineered fill placed over Geotechnical Engineer-approved subgrade.

For fleet parking areas designated for use by automobiles only, the thickness of asphalt and base course can be reduced to 65 mm and 100 mm, respectively.

Where fill is required to achieve the underside of sub-base course elevation, it should consist of engineered fill as described in this report.

We recommend that the asphalt, base course, and subbase course conform to the specifications for these materials provided in the Master Municipal Construction Documents (MMCD) Volume II. The pavement structure fills should be placed in discrete lifts and should be compacted to not less than 95% percent of their MPD. Compaction of the subbase and base courses, and any subgrade fill required to achieve the proposed grades, should be confirmed by the Geotechnical Engineer.

6.10 Geotechnical Engineering Review

During design development, site preparation, and construction, the Geotechnical Engineer should be provided with the opportunity to review the following:

- Finalized site grading plan. Additional and/or modified recommendations regarding the proposed construction may be required based on our review of the drawings;
- Unsupported temporary cut slopes;
- Prepared subgrade in the wash bay footprints prior to placement of any fill;
- Imported engineered fill and under-slab fill;
- Site soils considered for re-use as engineered fill;
- Placement and compaction of engineered fill and under-slab fill;
- Soil conditions at foundation grade prior to placement of concrete;
- Foundation wall backfill material and compaction;
- Subgrade for the parking area and on-site roads;
- Placement and compaction of fill for the parking and on-site roads.

GeoWest should be retained to conduct sufficient field reviews during site preparation and construction to ensure that the geotechnical design recommendations contained within this report have been adequately communicated to the design team and to the contractors implementing the design. These field reviews are not carried out for the benefit of the contractors and therefore do not in any way affect their obligations to perform under the terms of their contracts.

7. CLOSURE

This geotechnical assessment report has been prepared by GeoWest Engineering Ltd. exclusively for McElhanney Consulting Services Ltd. and the members of their design team for this specific project. We

acknowledge that UBC and the City of Vancouver may also rely upon this report for permitting purposes. The conclusions and recommendations contained in this report reflect our judgement in light of the information provided to us at the time it was prepared.

Any use of this report by third parties, or any reliance on or decisions made based on it, are the responsibility of such third parties. GeoWest does not accept responsibility for damages suffered, if any, by a third party as a result of their use of this report.

The attached Terms of Reference are an integral part of this geotechnical assessment report.

We trust the information provided herein meets your immediate requirements. If you have any questions or require further information, please contact the undersigned.

Yours truly,
GeoWest Engineering Ltd.

Per: Jassimran Singh, EIT
Staff Geotechnical Engineer

Per: Dejan Jovanovic, P.Eng.
Principal, Senior Geotechnical Engineer

Reviewed By:
John Carter, M.Eng., P.Eng.
Principal, Senior Geotechnical Engineer

Attachments: Terms of Reference
Figures 1 and 2
Soil Logs

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All documents, records, drawings, correspondence, data, files and deliverables, whether hard copy, electronic or otherwise, generated as part of the services for the Client are inherent components of the Report and, collectively, form the instruments of professional services (the "Instruments of Professional Services"). The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to GeoWest by the Client, the communication between GeoWest and the Client, and to any other reports, writings, proposals or documents prepared by GeoWest for the Client relative to the specific site described in the Report, all of which constitute the Report.

To properly understand the information, observations, findings, suggestions, recommendations and opinions contained in the report, reference must be made to the whole of the report. GeoWest cannot be responsible for use by any party of portions of the report without reference to the whole report and its various components.

3. BASIS OF THE REPORT

GeoWest prepared the Report for the Client for the specific site, development, building, design or building assessment objectives and purpose that the Client described to GeoWest. The applicability and reliability of any of the information, observations, findings, suggestions, recommendations and opinions contained in the Report are only valid to the extent that there was no material alteration to or variation from any of the said descriptions provided by the Client to GeoWest unless the Client specifically requested GeoWest to review and revise the Report in light of such alteration or variation.

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5. INTERPRETATION OF THE REPORT

a. **Nature and Exactness of Descriptions:** The classification and identification of soils, rocks and geological units, as well as engineering assessments and estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1 above. The classification and identification of these items are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations or assessments utilizing the standards of Paragraph 1 involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to changes over time and the parties making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or when the Client has special considerations or requirements, the Client must disclose them to GeoWest so that additional or special investigations may be undertaken, which would not otherwise be within the scope of investigations made by GeoWest or the purposes of the Report.

b. **Reliance on Information:** The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site investigation and field review and on the basis of information provided by GeoWest. GeoWest has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, GeoWest cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

c. **Additional Involvement by GeoWest:** To avoid misunderstandings, GeoWest should be retained to assist other professionals to explain relevant engineering findings and to review the geotechnical aspects of the plans, drawings and specifications of other professionals relative to the engineering issues pertaining to the geotechnical consulting services provided by GeoWest. To ensure compliance and consistency with the applicable building codes, legislation, regulations, guidelines and generally-accepted practices, GeoWest should also be retained to provide field review services during the performance of any related work. Where applicable, it is understood that such field review services must meet or exceed the minimum necessary requirements to ascertain that the work being carried out is in general conformity with the recommendations made by GeoWest. Any reduction from the level of services recommended by GeoWest will result in GeoWest providing qualified opinions regarding adequacy of work.

6. ALTERNATE REPORT FORMAT

When GeoWest submits both electronic and hard copy versions of the Instruments of Professional Services, the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding upon GeoWest. The hard copy versions submitted by GeoWest shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions; furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed and sealed versions of the Instruments of Professional Services maintained or retained, or both, by GeoWest shall be deemed to be the overall originals for the Project.

The Client agrees that the electronic file and hard copy versions of Instruments of Professional Services shall not, under any circumstances, no matter who owns or uses them, be altered by any party except GeoWest. The Client warrants that the Instruments of Professional Services will be used only and exactly as submitted by GeoWest.

The Client recognizes and agrees that GeoWest prepared and submitted electronic files using specific software or hardware systems, or both. GeoWest makes no representation about the compatibility of these files with the current or future software and hardware systems of the Client, the Approved Users or any other party. The Client further agrees that GeoWest is under no obligation, unless otherwise expressly specified, to provide the Client, the Approved Users and any other party, or any or all of them, with specific software and hardware systems that are compatible with the electronic files submitted by GeoWest. The Client further agrees that should the Client, an Approved User or a third party require GeoWest to provide specific software or hardware systems or both, compatible with electronic files prepared and submitted by GeoWest, for any reason whatsoever included but not restricted to and order from a court, then the Client will pay GeoWest for all reasonable costs related to the provision of the specific software or hardware systems, or both. The Client further agrees to indemnify and hold harmless GeoWest, its officers, directors, employees, agents, representative or sub-consultant, or any or all of them, against any claim or any nature whatsoever brought against GeoWest, whether in contract or in tort, arising or related to the provision or use or any specific software or hardware provided by GeoWest.

FIGURES

LEGEND

NOTE: ALL LOCATIONS ARE APPROXIMATE

ADAPTED FROM: OPEN STREET MAPS

PROJECT/DWG. NO:

DATE:

TITLE: **SITE LOCATION MAP**

PROJECT: UBC SOUTH CAMPUS WORKS YARD PHASE 1

ADDRESS: UBC SOUTH CAMPUS, NURSERIES ROAD, VANCOUVER

CLIENT: MCELHANNEY CONSULTING SERVICES LTD.

DESIGN BY: GeoWest ENGINEERING

EGBC PERMIT TO PRACTICE NO. 1000607

SEAL:

DESIGN:	DATE:
N/A	FEB 2024
DRAWN: JS	SCALE: NTS
CHECK: DJ	GEOWEST FILE: GA23-1294-00
FIG. NO: 1	

FILE PATH:C:\Users\JassimranSingh\GeoWest\GeoWest - Projects\Projects\2023\GA23-1294-00 McElhanney, UBC South Campus Works Yard, Nurseries Rd. Van\Figures\On-site Works FILE NAME:GA23-1294-00 Figures

LEGEND

APPROXIMATE AUGER HOLE LOCATIONS

NOTE: ALL LOCATIONS ARE APPROXIMATE

ADAPTED FROM: OPEN STREET MAPS

PROJECT/DWG. NO:

DATE:

TITLE: **AUGER HOLE LOCATION PLAN - ONSITE INVESTIGATION**

PROJECT: UBC SOUTH CAMPUS WORKS YARD PHASE 1

ADDRESS: UBC SOUTH CAMPUS, NURSERIES ROAD, VANCOUVER

CLIENT: MCELHANNEY CONSULTING SERVICES LTD.

DESIGN BY: GeoWest ENGINEERING

EGBC PERMIT TO PRACTICE NO. 1000607

SEAL:

DESIGN:	DATE:
N/A	JAN. 2024
DRAWN: JS	SCALE: NTS
CHECK: DJ	GEOWEST FILE: GA23-1294-00
FIG. NO: 2	

FILE PATH:C:\Users\JassimranSingh\GeoWest\GeoWest - Projects\Projects\2023\GA23-1294-00 McElhanney, UBC South Campus Works Yard, Nurseries Rd, Van\Figures\On-site Works FILE NAME:GA23-1294-00 Figures

SOIL LOGS

GeoWest Engineering Ltd
200-34425 McConnell Road
Abbotsford, BC V2S 7P1

UBC South Campus Works Yard (On-Site)
McElhanney Consulting Services Ltd.
Nurseries Road
Vancouver, BC

AH24-01

Project No: GA23-1294-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		Very dense, grey, fine SAND, some gravel, trace silt, moist (fill)			GS1	
	2	Loose, grey, medium to fine SAND, trace gravel, trace silt, moist (fill).			GS2	
		Stiff to firm, dark grey, organic SILT, trace to some sand, organic odour, moist to wet.			GS3	
	4	Turns black at 1.2 m with wood fragments (Peat?)			GS4	
		Soft, mottled clayey SILT, trace to some fine sand, trace gravel, some organics, moist			GS5	
	6	Stiff, grey, SILT, some clay, some fine sand, trace gravel, moist.			GS6	
2		Hard, grey, clayey SILT, trace fine sand, moist.			GS7	
	8					
		Very stiff to stiff, grey, clayey SILT, trace to some fine sand, tarce gravel, moist.			GS8	
	10					
	12					
4		Very stiff, grey, SILT, some clay, some sand, wet.			GS9	P1 Jan 5 2024
	14					
		Compact, grey, fine SAND, some silt, some gravel, moist to wet.			GS10	
	16	Dense, grey, silty SAND, some gravel, trace clay, moist to wet.			GS11	
	18				GS12	
6						
	20	Bottom of hole at 6.1 metres				
	22					
	24					

Refusal
Drilled out

10 20 30 40 50 60 70 80 90

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
AU: Auger Flight

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type: Trip Hammer

DYNAMIC CONE PENETRATION TEST

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Solid Stem Auger / DCPT
Date Drilled: 1/5/2024
Logged by: JS
Checked by: DJ

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

1 LOG PER PAGE 3/1/24

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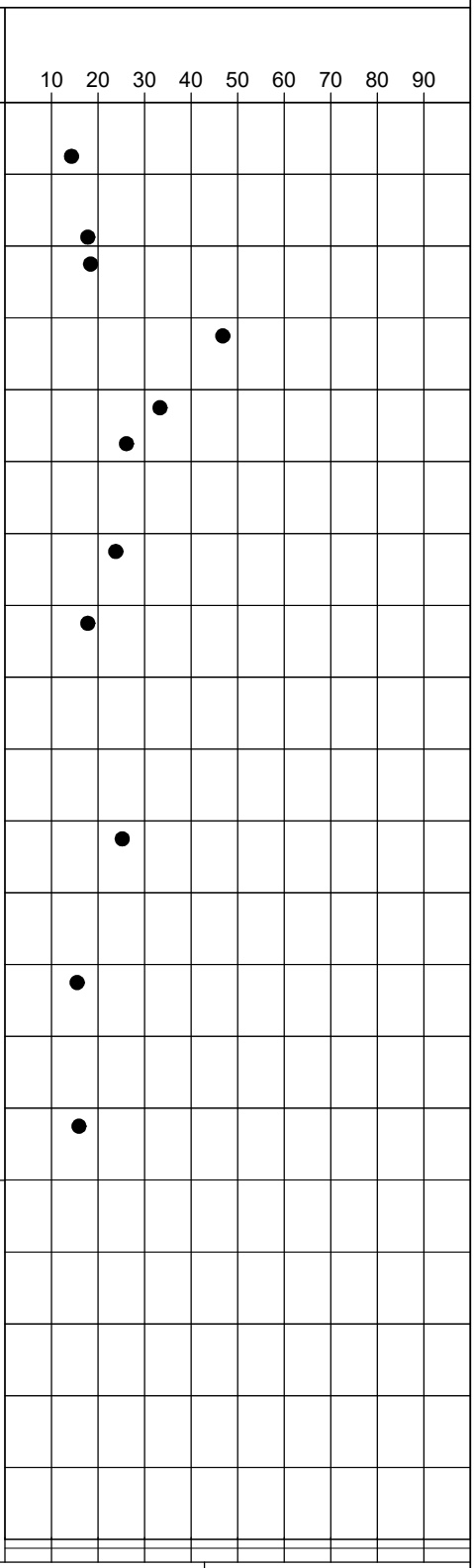
200-34425 McConnell Road
Abbotsford, BC V2S 7P1

UBC South Campus Works Yard (On-Site)
McElhanney Consulting Services Ltd.
Nurseries Road
Vancouver, BC

AH24-02

Project No: GA23-1294-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		Loose to compact, grey, SILT, some sand to sandy, trace gravel, moist (fill)			GS1	
		75mm thick organic silt seam at 0.5 m			GS2	
	2	Compact, grey, very fine SAND, some silt, trace gravel, moist (fill)			GS3	
1		Soft, black, organic SILT, grass roots, wood fragments, wet (Peat?).			GS4	
	4	Compact, brown, SAND, some silt to silty, trace gravel, moist			GS5	
		Frim to stiff, brown, sandy SILT, trace gravel, moist to wet.			GS6	P1 Jan 5 2024
	6	Compact to dense, grey/tan, very fine SAND, trace silt, saturated			GS7	
2		Dense, grey, very fine SAND, trace silt, saturated.			GS8	
	8	Compact to dense, tan/grey mottled SAND, some silt, sat.				
3	10				GS9	
	12	Stiff, grey, sandy SILT, trace gravel, wet.			GS10	
4	14				GS11	
		Bottom of hole at 4.6 metres				
5	16					
	18					
6	20					



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
AU: Auger Flight

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DYNAMIC CONE PENETRATION TEST

Plastic Limit (%) — Moisture Content (%) — Liquid Limit (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Solid Stem Auger
Date Drilled: 1/5/2024
Logged by: JS
Checked by: DJ

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

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UBC South Campus Works Yard (On-Site)
McElhanney Consulting Services Ltd.
Nurseries Road
Vancouver, BC

AH24-03

Project No: GA23-1294-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		Loose, dark brown, SAND, some gravel, trace silt, trace rootlets, moist.			GS1	
		Loose, dark brown SAND, some gravel, some silt, moist.			GS2	
	2	Loose, brown, silty SAND, some gravel to gravelly, moist.				
1					GS3	
	4	Very dense, light grey, very fine SAND, some silt, moist.			GS4	
		Very dense, light grey, very fine SAND, some silt to silty, moist.				
	6					
2						
	8				GS5	
3	10					
					GS6	
	12	DCPT refusal @ 1.8m and Auger refusal @ 3.65 m No groundwater seepage Bottom of hole at 3.7 metres				
4						
	14					

Water Level: 10 20 30 40 50 60 70 80 90

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
AU: Auger Flight

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type: Trip Hammer

DYNAMIC CONE PENETRATION TEST

Plastic Limit (%) — Moisture Content (%) — Liquid Limit (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Solid Stem Auger / DCPT
Date Drilled: 1/5/2024
Logged by: JS
Checked by: DJ

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

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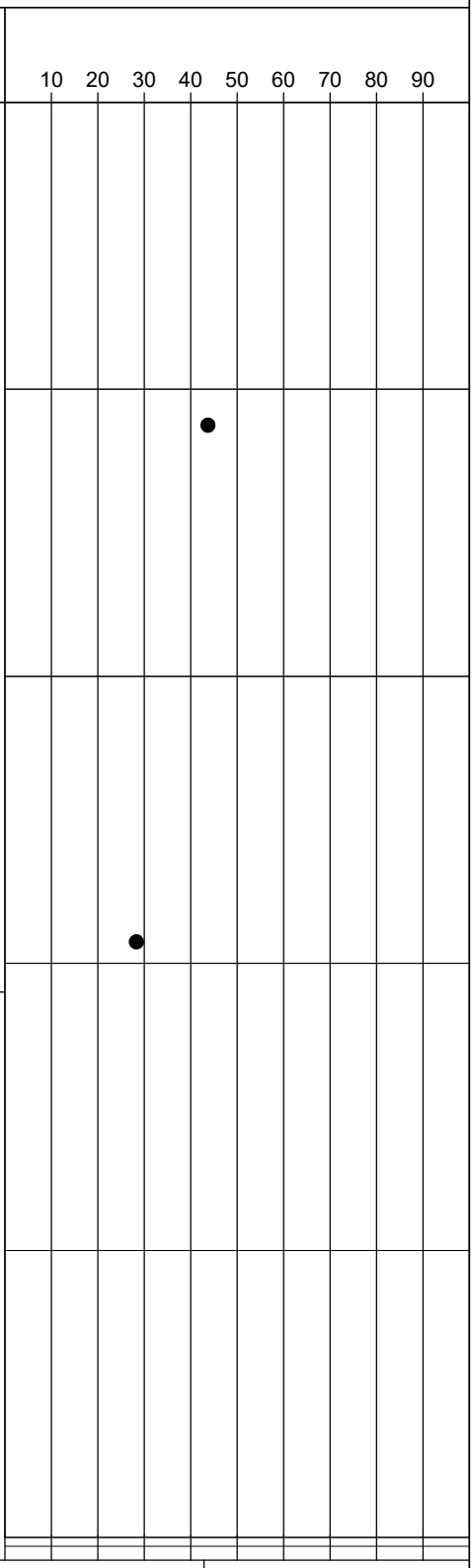
Nurseries Road
Vancouver, BC

HA24-01

Project No: GA23-1294-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		Soft, brown, Organic SILT, moist to wet (TOPSOIL).				
		Loose, tan/brown, SAND, trace silt, trace rootlets, wet				P1 Jan 8 2024
	1				GS1	
0.5						
	2	Loose, tan/brown, SAND, trace silt, trace gravel, wet.				
	3				GS2	
		Bottom of hole at 0.9 metres				
1.0						
	4					
1.5						
	5					



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
AU: Auger Flight

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DYNAMIC CONE PENETRATION TEST

Plastic Limit (%) — Moisture Content (%) — Liquid Limit (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Hand Auger
Date Drilled: 1/5/2024
Logged by: JS
Checked by: DJ

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

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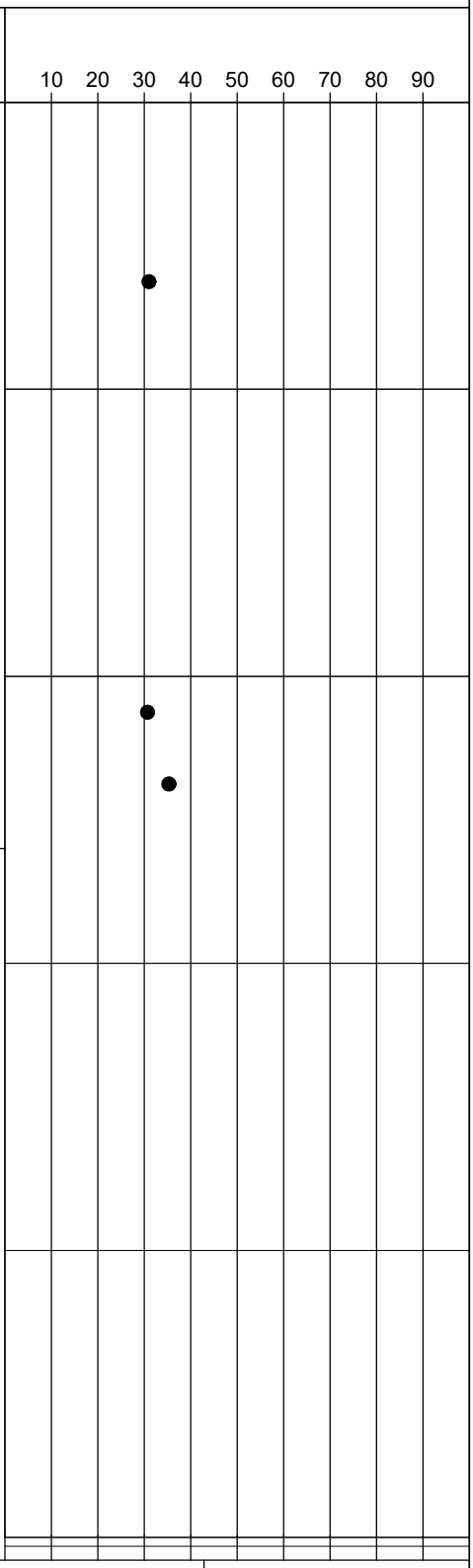
UBC South Campus Works Yard (On-Site)
McElhanney Consulting Services Ltd.
Nurseries Road
Vancouver, BC

HA24-02

Project No: GA23-1294-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		Soft, brown, Organic SILT, moist to wet (TOPSOIL).				
		Loose, brown, SAND, trace to some silt, trace gravel, wet			GS1	P1 Jan 8 2024
0.5	1					
	2	Loose, tan/ brown, silty SAND, wet			GS2 GS3	
		Hand auger refusal at 0.8 m Bottom of hole at 0.8 metres				
1.0	3					
	4					
1.5	5					



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
AU: Auger Flight

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DYNAMIC CONE PENETRATION TEST

Plastic Limit (%) — Moisture Content (%) — Liquid Limit (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Hand Auger
Date Drilled: 1/5/2024
Logged by: JS
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Vancouver, BC

HA24-03

Project No: GA23-1294-00

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		Soft, brown, Organic SILT, moist to wet (TOPSOIL).			GS1	P1 Jan 8 2024
0.5	1	Brown, SAND, some silt, trace rootlets, wet.			GS2	
	2	Increase in gravel content with depth.			GS3	
					GS4	
	3				GS5	
		Grey/brown, mottled silty SAND, trace gravel, wet.			GS6	
1.0		Poor recovery				
		Hand auger resfusal at 1.0 m Bottom of hole at 1.0 metres				
1.5	4					
	5					

10 20 30 40 50 60 70 80 90

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
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N: Number of Blows
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Plastic Limit (%) — Moisture Content (%) — Liquid Limit (%)
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