

Geotechnical Factual Report, Revision 0

BC Hydro Underground West End Substation

December 4, 2019

Prepared for:

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Project No.: 123311418



Revision No.	Date	Description
Α	September 26, 2019	Draft Report
0	November 19, 2019	 Added piezometer installation data Updated laboratory tests Updated Borehole Records Added Acid Rock Drainage (ARD) and Metal Leaching (ML) test results

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1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by BC Hydro to carry out Geotechnical Risk Assessment and Feasibility Design for the Underground West End Substation Project (the Project). This report presents the Geotechnical factual data in support of the Project and includes the results of the geotechnical site exploration and laboratory testing (geotechnical exploration program). The Project site is located at 1150 Nelson Street, Vancouver, British Columbia.

The purpose of the geotechnical exploration program was to obtain information on the subsurface conditions and hence to support the Geotechnical Risk Assessment and Feasibility Design of the proposed underground West End Substation. Borehole locations were proposed by BC Hydro in the Request for Proposal (RFP) #12822, dated April 23, 2019, and adjusted onsite to avoid conflict with the conditions at the site, including existing trees, utilities, and structures.

The geotechnical exploration program was carried out in conjunction with the environmental soil and groundwater (geo-environmental) sampling and testing. The results of the geo-environmental sampling and testing are not discussed in this report and are presented separately.

The work was completed in general accordance with our proposal for RFP #12822: Geotechnical Risk Assessment and Feasibility Design for the underground West End Substation (File No.: 1233-P904931; May 22, 2019). The scope of geotechnical exploration work is provided our letter, "Geotechnical Risk Assessment and Feasibility Design for the Underground West End Substation: Recommended Site Exploration Scope and Additional Testing (Rev. 1)" dated July 4, 2019. In brief, the scope of geotechnical exploration work included the following:

- Desktop review of available information on existing utilities and previous geotechnical exploration work by others;
- Erection of temporary, 2.4 m high fence panels with privacy screens to isolate the workplace, limit visibility, and to control dust and debris for the duration of the exploration;
- Erection of temporary, 2.4 m high fence panels with acoustic panels to control noise generated by the geotechnical exploration work;
- Checking for and locating any existing underground utility lines near the proposed borehole locations;
- Hydro-vacuum excavation at one borehole location to clear or expose a potential buried utility infrastructure prior to drilling and in-situ testing;
- Borehole drilling in five locations using the mud rotary method
 - Two boreholes to approximately 35 m below the existing ground surface (to the bottom of the proposed excavation).
 - Two boreholes to approximately 40 m depth below the existing ground surface (5 m below the bottom of the proposed excavation).
 - One borehole 3 m depth into the bedrock for excavation design and to further delineate the bedrock surface across the Site.
- Borehole drilling using the solid-stem auger method in one location.



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- Standard Penetration Tests (SPTs) at 1.5 m depth intervals in mud rotary boreholes.
- Install standpipe piezometers and vapour wells, which includes:
 - Deep piezometers in three mud rotary boreholes.
 - Shallow piezometers in five mud rotary boreholes, three of them nested with the deeper piezometers.
 - A shallow groundwater well and a vapour well in the auger borehole to assess groundwater and soil vapour.
- Laboratory testing of soil samples collected from split-spoon and grab samples off the auger flights.
 Tests including moisture content, Atterberg Limits, particle size distribution, fines content, pH, conductivity, and sulphate content testing.
- Laboratory testing of bedrock core samples including point load, unconfined compressive strength, and acid rock drainage testing
- Preparation of this Geotechnical Factual Report.

This report describes the Project in brief, the physical setting of the Project, the geotechnical exploration work and the results. This report should be read in conjunction with the *Statement of General Conditions* provided in **Appendix A**.

1.1 PROJECT UNDERSTANDING

The Project is part of BC Hydro's Downtown Vancouver Electricity Supply (DVES) redevelopment plan and is the first project of this plan. This Project includes the construction of a new underground West End Substation (WTE) on the Vancouver School Board's Lord Roberts School Annex property at 1150 Nelson Street in Vancouver, British Columbia (the Site). The existing Lord Roberts School Annex building would be demolished prior to construction of the underground substation.

BC Hydro Pre-Needs Stage drawings WTE-E14-00901 through -00907, provided in RFP #12822, indicate that the WTE would comprise a multi-story underground structure to house high voltage electrical equipment and transformers. The WTE would be approximately 45 m by 88 m in plan and founded approximately 35 m below the existing site grade and located at the southeast end of the Site.

The Pre-Needs Stage drawings provided in the RFP show that a new/replacement school building would occupy an approximate 45 m by 45 m area at the northwest end of the Site. Two levels of underground parking, each 5 m high, would be constructed below the new school building. A ramp down to the underground parking would be constructed on the southwest side of the new school.



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2.0 SITE DESCRIPTION

The proposed WTE substation is located at 1150 Nelson Street in Vancouver, British Columbia, as shown on Figure No. 1. The Site is bounded by Nelson Street to the northeast, Bute Street to the northwest, and Nelson Park to the southwest and southeast and is approximately 135 m (parallel to Nelson Street) by 50 m (parallel to Bute Street).

Existing Lord Roberts School Annex presently occupies the middle of the Site. The existing school building is approximately 50 m long and 35 m wide. A parking lot, approximately 18 m by 25 m, was located near the northeast corner of the school, with access from Nelson Street. A chain link fence surrounded the Site and separated the parking lot from the school grounds.

A playground including jungle gym, swing set, and paved play yard area is located to the northwest of the school building. The remainder of the Site was generally grass-covered during the geotechnical exploration program. Numerous trees were present along the northwest and northeast sides of the Site, and sporadically elsewhere.

A Topographic Survey by BC Hydro (Dwg. No. 455D-S11-00001; dated January 8, 2019) indicates that the Site is relatively flat. Ground surface generally varies between EL. 45 m and EL. 43 m (Geodetic), though much of the site is within 0.5 m of EL. 43.5 m.



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3.0 GEOTECHNICAL SITE EXPLORATION

3.1 WORKPLACE ISOLATION AND NOISE MITIGATION

The workplace was within the Vancouver School Board's property.

A temporary fence was erected to separate the existing playground from the rest of the Site for the duration of our field work. The fence panels were 2.4 m high and included privacy screens to limit visibility and mitigate dust and debris. The temporary fence panels were bolted together, and the ends bolted to the existing chain link fence that surrounds the Site to prevent public access to the workplace. Modu-Loc Fence Rentals (Modu-Loc, New Westminster, British Columbia), under contract to Stantec, supplied, erected, and removed the temporary fencing.

Modu-Loc also supplied 2.4 m high fence panels with acoustic panels (Echo Barriers) that were installed around the drill rig and auxiliary equipment to mitigate noise generated by the geotechnical exploration program. This fencing created a smaller, approximately 12 m by 18 m active work site within the overall workplace.

3.2 UTILITY CLEARANCE

A BC One Call request was submitted to obtain available information on existing utilities near the Site. This request was made prior to executing the field work.

Following the desktop review of the information from BC One Call, a field program was performed using Ground Penetrating Radar (GPR) and electromagnetic (EM) scanning equipment to clear the proposed borehole locations free of any existing underground utility lines. Quadra Locating (Port Coquitlam, British Columbia), contracted to Stantec, carried out the GPR and EM scanning on July 17, 2019.

Presence of underground utilities was noted near planned borehole BH19-03. Hydro-vacuum excavation was used to expose the buried utility infrastructure and clear the locations prior to drilling and in-situ testing. Soil sampling was performed within hydro-vacuum excavated hole using a hand-held sampling tool. The hydro-vacuum excavation was carried out to approximately 3 m depth below the existing ground surface on July 25, 2019 by our subcontractor First Call Energy Ltd.

3.3 BOREHOLE DRILLING AND IN-SITU TESTING

The field work for the geotechnical exploration program was carried out between July 15 and August 9, 2019, adhering to the prescribed working hours of Monday to Friday between 7:30 AM and 5:00 PM. No field work was carried out on weekends or holidays.

The geotechnical exploration program consisted of six boreholes. The boreholes were completed by Sea to Sky Drilling Ltd. (Sea to Sky), under contract to Stantec, using a Mobile B52 truck mounted drill rig. The borehole locations are shown on Figure 1.



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Boreholes BH19-01 to BH19-05 were drilled through the overburden soils with the mud rotary method. The drilling mud consisted of Baroid EZ-MUD® liquid polymer emulsion.

Triple-tube, NQ sized cores were advanced below the overburden soil into the underlying bedrock in boreholes BH19-01 to BH19-05 using diamond bit coring. Continuous bedrock core samples were retrieved every 1.5 m utilizing a wireline and overshot to bring the core to surface. Target depth for bedrock coring was 35 m below the existing ground surface (i.e., to the proposed bottom of the excavation) in BH19-01 and BH19-04, 40 m below the existing ground surface (i.e., 5 m below the proposed bottom of excavation) in BH19-02 and BH19-03, and 3 m into bedrock in BH19-05.

Borehole AH19-06 was drilled using solid-stem augers. The purpose of AH19-06 was to install a shallow groundwater well and a nested vapour well to assess groundwater and soil vapour near borehole BH18-01, where hydrocarbon contained soil was reported to be encountered by others (see Section 3.5 of this report).

Borehole coordinates were recorded with a handheld Global Positioning System (GPS) device with an accuracy of approximately +/-3 m. The borehole coordinates were adjusted where necessary based field measurements of nearby landmarks or structures. Elevations were estimated to the nearest +/- 0.2 m based on 0.2 m contour lines shown on the Topographic Survey provided in RFP #12822 (Dwg. No. 455D-S11-00001, Rev. 2, January 8, 2019).

A summary of the geotechnical site exploration is provided in Table 1.

Table 1: Geotechnical Site Exploration Summary

		UTM Coordinates ¹			Depth		
Borehole	Date	Northing	Easting	Ground Elevation ² , Geodetic	below Ground Surface (m)	Sampling Methods	In-Situ Testing
BH19-01	July 22 to July 23, 2019	5458899	490601	EL. 44.6 m	35.1	Split spoon, NQ rock core	SPT
BH19-02	July 24 to July 26, 2019	5458927	490588	EL. 44.0 m	39.9	Split spoon, NQ rock core	SPT
BH19-03	July 26 to July 31, 2019	5458936	490540	EL. 44.0 m	39.9	Grab, split spoon, NQ rock core	SPT
BH19-04	July 31 to August 2, 2019	5458966	490527	EL. 43.4 m	35.1	Split spoon, NQ rock core	SPT
BH19-05	August 2 to August 7, 2019	5458982	490525	EL. 43.4 m	31.2	Split spoon, NQ rock core	SPT
AH19-06	July 19, 2019	5458903	490582	EL. 43.8 m	4.4	Grab	None
i							

NOTES:

² Based on BC Hydro Dwg. No. 455D-S11-00001, Rev. 2, January 8, 2019 (with an accuracy of +/- 0.2 m)



¹ Based on Handheld GPS unit (with an accuracy of +/- 3 m)

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Upon termination, the boreholes were backfilled with drill cuttings, filter sand, bentonite and grout and reinstated in accordance with the *BC Groundwater Protection Regulation*.

A Stantec geotechnical engineer coordinated the exploration work, located the boreholes in the site, classified the soils and rock encountered within the boreholes, maintained a detailed field log of each borehole, collected soil and rock core samples for laboratory testing, and observed and recorded pertinent site features.

The rock indices recorded in the field for each core run included the following:

- Total Core Recovery (TCR): the total length of core recovered as a percentage of the core run length.
- Solid Core Recovery (SCR): the cumulative length of pieces of solid core as a percentage of the core run length.
- Rock Quality Designation (RQD): the cumulative length of pieces of intact and sound bedrock core that are equal to or greater than 100 mm in length as a percentage of the core run length.

Details of the soil and groundwater conditions, results of the laboratory classification and index testing, borehole backfilling, and monitoring well installations are included on the Borehole Records in **Appendix B**. Soil descriptions presented on the Borehole Records are in general accordance with ASTM D2487 and D2488 for the Unified Soil Classification System (USCS) and with the information presented on the "Symbols and Terms Used in Borehole and Test Pit Records" in **Appendix B**.

Photographs of bedrock core samples are provided in **Appendix E**.

3.3.1 Standard Penetration Tests

Standard Penetration Tests (SPT) were performed at 1.5 m depth intervals in the mud rotary boreholes BH19-01 through BH19-05 using a 51 mm outside diameter, un-lined split spoon sampler driven with an automatic safety hammer in general accordance with ASTM D1586. The SPT involved driving a split spoon sampler with a 63.5 kg hammer, falling from a height of 760 mm. Blow counts were recorded over three consecutive 150 mm intervals during the testing. The SPT blow counts are the cumulative blows for the second and third 150 mm penetration (total 300 mm or less than 300 mm in cases of refusal for further penetration) and are reported on the Borehole Records in **Appendix C**.

3.3.2 Piezometers/Monitoring Wells

Standpipe piezometers, consisting of 25 mm diameter PVC Schedule 40 pipes were installed to enable long term monitoring of groundwater levels at the site and permit environmental groundwater sampling. Nested shallow and deep piezometers were installed in boreholes BH19-02 through BH19-04. Shallow piezometers were installed in boreholes BH19-05, and BH19-06. A flush mount protective cover was installed at the surface of each borehole.

Piezometer installation details are summarized in Table 2.



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Table 2: Summary of Piezometer Installation

Borehole	Piezometer Installation Date	Existing Ground Surface Elevation	Piezometer Screen depth below Existing Ground Surface	Piezometer Screen Elevation
BH19-01	July 23, 2019	EL. 44.6 m	2.8 m to 4.3 m	EL. 41.8 m to EL. 40.3 m
BH19-02	July 26, 2019	EL. 44.0 m	S: 2.8 m to 4.3 m D: 24.8 m to 30.9 m	S: EL. 41.2 m to EL. 39.7 m D: EL. 19.2 m to EL. 13.1 m
BH19-03	July 31, 2019	EL. 44.0 m	S: 2.9 m to 4.4 m D: 21.6 m to 27.7 m	S: EL. 41.1 m to EL. 39.6 m D: EL. 22.4 m to EL. 16.3 m
BH19-04	August 2, 2019	EL. 43.4 m	S: 4.3 m to 5.8 m D: 23.8 m to 29.9 m	S: EL. 39.1 m to EL. 37.6 m D: EL. 19.6 m to EL. 13.5 m
BH19-05	August 6, 2019	EL. 43.4 m	4.7 m to 6.2 m	EL. 38.7 m to EL. 37.2 m
AH19-06	July 19, 2019	EL. 43.8 m	2.2 m to 3.7 m	EL. 41.6 m to EL. 40.1 m
1				

S: shallow nested well

Groundwater measurements were obtained on August 9, 2019 and are shown on the borehole records in **Appendix B**.

3.4 LABORATORY TESTS

Geotechnical laboratory tests were performed on soil samples taken from the SPT split spoons, auger flights, and from the bottom and side walls of the hydro-vacuumed holes. The tests comprised moisture content, Atterberg limits, particle-size distribution, and fines content measurements. Geotechnical laboratory tests performed on bedrock core samples included point load tests (axial and diametral) and unconfined compressive strength.

Chemical testing of soil samples (pH, conductivity and sulphate content testing) was carried out at the Bureau Veritas laboratory, located in Burnaby, British Columbia.

Select bedrock core samples, approximately one sample for every 2 m of rock core retrieved from the geotechnical exploration program, were subjected to Acid Base Accounting (ABA), Shake Flask Extraction (SFE), and Trace Metals testing. The test results would be used to assess Acid Rock Drainage (ARD) and Metal Leaching (ML) potential of the bedrock. The ARD and ML tests were carried out at Global ARD Testing Services Inc., located in Burnaby, British Columbia.

A summary of the laboratory tests is presented in Table 3.



D: deep nested well

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Table 3: Summary of Laboratory Tests

Laboratory Test	Number of Tests Performed
Moisture Content	93
Atterberg Limits	5
Fines Content Measurement (Particles less than 0.075 mm in size / passing sieve No. 200)	27
Particle Size Distribution	16
Soluble pH, Conductivity and Sulphate Content	16
Point Load	45
Unconfined Compressive Strength	16
Acid Rock Drainage	21

3.4.1 Soil Tests

3.4.1.1 Moisture Content

Moisture content tests were performed in general accordance with ASTM D2216. Natural moisture content measurements are presented on the borehole records in **Appendix B**.

3.4.1.2 Atterberg Limits

Atterberg limit tests were using the multi-point method (Method A) described in ASTM D4318 and the results are presented on the borehole records in **Appendix B** and on test reports in **Appendix C1**.

3.4.1.3 Fines Content

Tests for the amount of material finer than 0.075 mm nominal diameter in select soil samples were completed in general accordance with ASTM D1140-14. The test results are presented on the borehole records in **Appendix B**.

3.4.1.4 Particle-Size Distribution

Particle size distribution tests of select soil samples were completed in general accordance with ASTM D6913 and the results are presented on the borehole records in **Appendix B** and on test reports in **Appendix C1**.

3.4.1.5 pH, Conductivity and Sulphate Content

pH, conductivity and sulphate content tests on select soil samples were completed in general accordance with testing standards SM 22 4500-H+B, SM 22 2510 B m, and SM 22 4500-SO42-E m respectively. The results are presented in **Appendix D**.



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3.4.2 Rock Testing

3.4.2.1 Point Load

Point load tests were performed in accordance with ASTM D5731 to estimate Point Load Strength Index, $I_{s(50)}$, values. Tests were performed at least once every 1 m of core length, alternating between axial and diametral sample testing. Samples with an invalid fracture from axial load test were immediately re-tested diametrically.

The point load tests with valid factures are summarized on the Borehole Records in **Appendix B**. All point load test results are provided in **Appendix C.2**.

3.4.2.2 Unconfined Compressive Strength

Unconfined compressive strength (UCS) of rock cores was carried out once for every 3 m of rock core retrieved from the geotechnical exploration program. The UCS tests were performed in accordance with ASTM D7012 – Method C.

The UCS test results are summarized on the Borehole Records in **Appendix B** and the test report sheets are provided in **Appendix C.2**.

3.4.2.3 Acid Rock Drainage

The ARD and ML test results (Certificate of Analysis) are presented in **Appendix F**. Sample preparation, and the test methods are noted on the Certificate of Analysis.

3.5 PREVIOUS WORK BY OTHERS

A geotechnical site exploration, consisting of one borehole, BH18-01, to 20.7 m depth below the existing ground surface was completed by Golder Associates in 2018. Details of this work is provided in the Technical Memorandum by Golder Associates, dated November 13, 2018, included in RFP #12822.

The borehole was drilled using solid-stem augers to approximately 2.7 m depth, followed by HQ3 soil coring method to the termination depth. The approximate location of BH18-01 is shown on Figure 1. The Golder Technical Memorandum indicates hydrocarbon contamination was present within the fill materials between 1.2 m and 1.5 m depth below the existing ground surface and may be gasoline derived.

Record of borehole BH18-01 is provided in **Appendix G**.



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4.0 CLOSURE

This report was prepared for the exclusive use of BC Hydro and its agents for specific application to the Underground West End Substation Project. Any use of this report or the material contained herein by third parties, or for other than the intended purpose, should first be approved in writing by Stantec.

Use of this report is subject to the Statement of General Conditions included in **Appendix A**. It is the responsibility of BC Hydro, who is identified as "the Client" within the Statement of General Conditions, and their agents to review the conditions and notify Stantec should any of them not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the report
- Standard of care
- Interpretation of site conditions
- · Varying or unexpected site conditions
- Planning, design, or construction

We trust that this report meets your present requirements. If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Regards,

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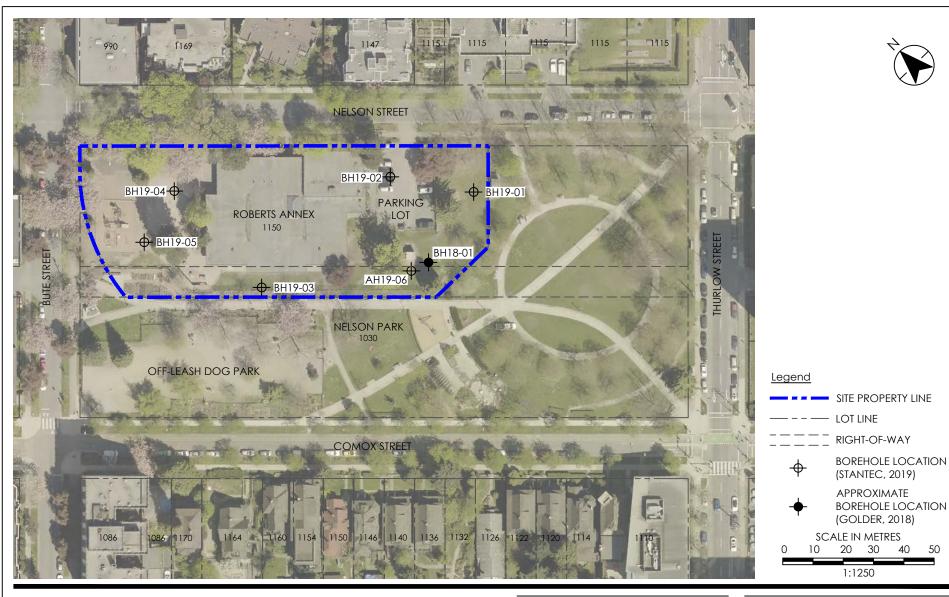
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5.0 FIGURES







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Project No.: 123314418 1:1250 Scale: Date: 2019-SEPT-26 Drawn by: G. HUYNH Checked by:

N. GAUTAM

Project Location

1150 NELSON STREET VANCOUVER, BC

Client/Project **BC HYDRO**

Title

UNDERGROUND WEST END SUBSTATION

BOREHOLE LOCATION PLAN Figure No.

APPENDICES

Appendix A STATEMENT OF GENERAL CONDITIONS





STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec's present understanding of the site-specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site-specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock, and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec will not be responsible to any party for damages incurred as a result of failing to notify Stantec that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc.), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec cannot be responsible for site work carried out without being present.

Appendix B BOREHOLE RECORDS



SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis

Rootmat	vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of visible and invisible fragments of decayed organic matter
Till	unstratified glacial deposit which may range from clay to boulders
Fill	material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure

Desiccated	having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of regular alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

Terminology describing soil types

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris)

Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on Page 2. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Sho	Approximate	
Consistency	kg/cm ² or kips/sq.ft.	kPa	SPT N-Value
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 – 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.

















Boulders









Asphalt

Concrete

Fill

Organics

Silt

Sand Cobbles

Undifferentiated Bedrock

Sedimentary Bedrock

Metamorphic Bedrock

Igneous Bedrock

SAMPLE TYPE

AS, BS, GS	Auger sample; bulk sample; grab sample
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
SO	Sonic tube
SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby Tube or thin wall tube
SV	Shear vane
RC HQ, NQ, BQ, etc.	Rock Core; samples obtained with the use of standard size diamond coring bits.

WATER LEVEL



Measured: in standpipe, piezometer, or well



Inferred: seepage noted, or; measured during or at completion of drilling

RECOVERY FOR SOIL SAMPLES

The recovery is recorded as the length of the soil sample recovered in the direct push, split spoon sampler, Shelby Tube, or sonic tube.

N-VALUE

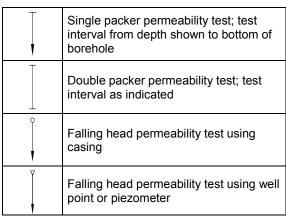
Numbers in this column are the field results of the Standard Penetration Test (SPT): the number of blows of a 140-pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50 for 75 mm or 50/75 mm). Some design methods make use of Nvalues corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60-degree apex cone connected to 'A' size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
Н	Hydrometer analysis
k	Laboratory permeability
Υ	Unit weight
Gs	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
С	Consolidation
Qu	Unconfined compression
Ip	Point Load Index (I _p on Borehole Record equals I _p (50) in which the index is corrected to a reference diameter of 50 mm)



ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Total Core Recovery (TCR) denotes the sum of all measurable rock core recovered in one drill run. The value is noted as a percentage of recovered rock core based on the total length of the drill run.

Solid Core Recovery (SCR) is defined as total length of solid core divided by the total drilled length, presented as a percentage. Solid core is defined as core with one full diameter.

Rock Quality Designation (RQD) is a modified core recovery that incorporates only pieces of solid core that are equal to or greater than 10 cm (4") along the core axis. It is calculated as the total cumulative length of solid core (> 10 cm) as measured along the centerline of the core divided by the total length of borehole drilled for each drill run or geotechnical interval, presented as a percentage. RQD is determined in accordance with ASTM D6032.

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock quality

Rock Mass Quality	Rock Quality Designation Number (RQD)	Alternate (Colloquia	l) Rock Mass Quality
Very Poor Quality	0-25	Very Severely Fractured	Crushed
Poor Quality	25-50	Severely Fractured	Shattered or Very Blocky
Fair Quality	50-75	Fractured	Blocky
Good Quality	75-90	Moderately Jointed	Sound
Excellent Quality	90-100	Intact	Very Sound

Terminology describing rock strength

Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

Terminology describing rock with respect to discontinuity and bedding spacing

Spacing (mm)	Discontinuities Spacing	Bedding
>6000	Extremely Wide	-
2000-6000	Very Wide	Very Thick
600-2000	Wide	Thick
200-600	Moderate	Medium
60-200	Close	Thin
20-60	Very Close	Very Thin
<20	Extremely Close	Laminated
<6	-	Thinly Laminated

PR LO	IENT: OJEC	T: Underground West End St DN: 1150 Nelson Street, Vanc			n			OLE RECO	BH [U ⁻ 54	I CO([M] 5890: ATER	3.0N	49	9058			BH D/	I ELE	EVA M: .	TION G e	. : <u>_12</u>	\H19 333144 3.8m tic	
			Ŀ		SAM				UNE	DRAINI BORAT	ED SI	HEAI	R STRE	ENG1	ΓΗ, C	Cu (k	(Pa) /ANE	E TES	ST	• E •	// /ELL/ ER	Ī
DEFIN (III)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	COVERY (mm) or ICR %	N-VALUE or RQD %	OTHER TESTS / REMARKS	WA	CKET 50 ATER C (N-val) kPd 	ENT	100 & AT) kPc TERB	1	15	0 kP		200	kPa 	BACKFILL/ MONITOR WELL/ PIEZOMETER	
	43.8			<u>_</u>		RE				10	20		ater Con		and B		ount 60	7	0	80		
- - - - - -	43.7	{OPSOIL: brown silty sand with organics, FILL: dark brown silty sand with gravel																				1
- - - - -		- wood debris, 0.9 m to 1.1 m		√ AS	01																	
-	42.4	Light brown SILTY SAND (SM) - trace gravel		¥ AS	02																	
				√ AS	03			Grain Size Analysis: G S Fines 7% 50% 43%		Ω												
7 1 1 1																						
1	40.1																					
	39.4	Light brown poorly graded SAND (SP) with silt and gravel																				×××
-		End of Auger Hole at 4.4 m. Target depth reached. Soil vapour well installed at 1.2 m depth.																				1
		Shallow piezometer installed at 3.7 m depth. Dry on August 9, 2019.																				
1																						
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	ATIC	F:Underground West End S DN:1150 Nelson Street, Vanc RED:July 19, 2019 to Ju	:0U\	er, I	3C				_	58899	.0N 4			DA	I ELEV <i>A</i> ATUM: st 9, 2 0	Ge		
Т			ly Z	.5, 20	SAM	PLES					D SHEA							
	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	OVERY (mm) or ICR %	N-VALUE or RQD %	OTHER TESTS / REMARKS	PO:	50 TER C	kPa ONTEN	★ 100 T & ATT	kPa H ERBER	POCKE 15	VANE TE ET SHEAI O kPa H	R VANI 200	♦ kPa w _L	BACKFILL/ MONITOR WELL/ PIEZOMETER
	, ,					REC						Water Cont	ent (%) and			70 (30	
	4.6	FILL: grey silty sand with gravel, moist										50 2		50	60 7	70 {	50	
+		FILL: brown silty sand with organics, trace wood debris, moist		SS	01	430	5		•	0								
				SS	02A 02B	-530-	-23-			:0	O.							
4:	2.6	Danna hanna (avan CILTY CAND (CAN																
		Dense brown/grey SILTY SAND (SM) - moist		SS	03		38			O :		•						
1																		
4	0.6	Very dense brown/grey poorly graded						Percent Passing #200:							130 blo) ws/22	25 mm	
		SAND (SP) with silt and gravel - moist		SS	04	300	R		(O)								:>>	•
1																		
				SS	05	150	R			:0					65 blc)ws/10	::::: 0 mm :::>>	
3	8.0	Very dense grey/brown SILTY SAND (SM) with gravel																
		- moist		SS	06	350	R	Percent Passing #200: 25%		0					110 blo) ws/20	0 mm	
				SS	07	425	R	Grain Size Analysis: G S Fines 18% 38% 44%		0					120 blc) ws/27	5 mm	
1							-											
<u> </u>																		
\ <i>C</i> VF'	III ev	ymbol 📆 asphalt 🌀		OUT	<u> </u>	100	vCRE	Drilling Cor Drilling Me							ina			d By: NG ved By: A
	ILL 3		SAI			SLO		Completio					, NOC		9	_		of 4

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		DN: <u>1150 Nelson Street, Vanc</u>							[UT. 545		.0N 4	19060	1.0E		i eleva atum: ₋			
DA	ATE BC	DRED: <u>July 19, 2019 to Ju</u>	ıly 2	3, 20	19								st 9, 20)19				
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT		SAM	1	3%	OTHER TESTS / REMARKS	LAB	ORATO	D SHEA ORY TE: 'EN. kPa H	ST ▲	F	FIELD V	(Pa) /ANE TES ET SHEAR 0 kPa	VANE	♦ E □ kPa	BACKFILL/ MONITOR WELL/ PIEZOMETER
5	ELEV	(111)	STRA	TYPE	NUMBER	RECOVERY or TCR	N-VALUE or RQD %		SPT (N-valu		WS/0.3n	∩ ent (%) and	d Blow Co	ount •	• W	1	MON PIE
0 -		Very dense grey/brown SILTY SAND (SM) with gravel - moist		SS	08	0	R		1	0	20 3	30 4	10 3	50	60 7	: : : :		
1 -	33.5	Hard grey fat CLAY (CH) - moist																
2 -				SS	09	610	60				lo.				•			
3 -	31.8	Very dense grey SILTY SAND (SM) with gravel																
		- moist		SS	10	0	R								54 blo	ows/2		
4 –								Percent Passing #200:										
5				SS	11	275	R	29%):::::					58 blo	ws/10	0 mm :::>> <u> </u>	
6 -	28.9	Hard grey fat CLAY (CH) - moist																
7-				SS	12	125	R					0.			57 blo	ws/10	0 mm ::>> •	
								Percent Passing #200:										
8 -		- with sand below 17.7 m		SS	13	0	R	rercent Passing #200: 83%				•			104 blo	ws/25	0 mm	
9 -	25.9	Very dense grey SILTY SAND (SM) - moist																
				SS	14	450	R	Grain Size Analysis: G S Fines 1% 76% 23%		C					109 blo	ws/27	5 mm	
0 –				•				Drilling Cor							. •			d By: NG
ACI	KFILL S	SYMBOL ASPHALT NITE DRILL CUTTINGS	GR SA1	OUT		CON	NCRE UGH	TE Drilling Me	thod: 1	Mud	Rotar	//NG	Roc	k Coı	ring	Re	eview	ed By: A

CLI		Stantec BC Hydro				sOI	(EH	OLE RECO	BH COORDINATES PROJECT NO.: 1233	19-0
		T: <u>Underground West End</u>	Subs	tatio	n				[UTM] BH ELEVATION: 44.6	
		ON: <u>1150 Nelson Street, Var</u>							5458899.0N 490601.0E DATUM: Geodetic	
DA	ГЕ ВС	DRED: <u>July 19, 2019 to .</u>	July 2	23, 20	19				WATER LEVEL: Dry on August 9, 2019	
	_				SAM	PLES			UNDRAINED SHEAR STRENGTH, Cu (kPa)	_
\mathbf{E}	E Z		PLOT			٦			LABORATORY TEST ▲ FIELD VANE TEST ◆ POCKET PEN. ★ POCKET SHEAR VANE □	MELI TER
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	IA PL		쏦	E %	3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	OTHER TESTS / REMARKS	50 kPa 100 kPa 150 kPa 200 kPa	ZOM
[≅]	ELEV	(3333)	STRATA	TYPE	NUMBER	Z K	N-VALUE or RQD %		WATER CONTENT & ATTERBERG LIMITS WP W WL	MONITOR WEI PIEZOMETER
					z		z 5		SPT (N-value) BLOWS/0.3m	
20 \bot		Variables and CHTV CAND (CAA)	11:11			_			Water Content (%) and Blow Count 10 20 30 40 50 60 70 80	
1		Very dense grey SILTY SAND (SM) - moist								
1										
[,										
21 -				SS	15	550	73			
-										
1										
22 -										
1				SS	16	400	100	Percent Passing #200: 14%	100	
1				33	16	400	100			
23 -										
1										
1										
24 -		- with gravel below 23.8 m		SS	17	525	70	Grain Size Analysis: G S Fines 35% 49% 16%		
1				JS		323			Y	
-										
25 -										
]										
-				SS	18	100	R		94 blows/150 mm	
1					.5	1.50				
26 –										
1										
‡										
7 -	17.4			SS	19	300	R		60 blows/75 mm-	
1		Very poor grey SANDSTONE - highly weathered								
]		- extremely to very weak - fine to coarse grained		NQ	20	35	15	UCS = 15.9 MPa		
28 -		_						ls(50), D = 0.3 MPa		
1	16.2	- poor quality below 28 m								
-		Poor grey silty clay SHALE - fresh								
9 -		- very weak		NQ	21	97	40	Is(50), D = 0.5 MPa		
<u> </u>								, , , , , , , , , , , , , , , , , , ,		
-										
-		- extremely weak, 29.7 m to 30.2 m depth								
) —		ı	V/ <i>)</i>	(II II)	I	1	-	Drilling Co	tractor: Sea to Sky Drilling Ltd. Logged B	By: NG
ACK	FILL S	symbol M asphalt	GR	OUT		[CO1	NCRE		nod: Mud Rotary / NQ Rock Coring Reviewed	
	1OTV		IA2		×	SIO	UGH		Depth: 35.1 m Page 3 c	

		BC Hydro T: Underground West End	Subs	tatio	n				BH [U	н С(ТМ]		RDIN	IATES	;						: 12	3H19- 33144 4.6m	
		ON: <u>1150 Nelson Street, Van</u>											4906							ode	tic	
DA	ATE BC	ORED: July 19, 2019 to J	uly 2	23, 20)19				W	ATE	R LE	VEL	Dry	on/	ιAι	ugus	t 9, :	201	9			_
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	ТУРЕ	NUMBER	E E	N-VALUE or RQD %	OTHER TESTS / REMARKS	LA PC	BOR OCKI	ET PE	PRY TIEN. PA ONTER	11 11 & A	▲ ★ 00 kP H ATTERI	FI P'a BERG	G LIMI	ANE 1 T SHE.) kPa H	AR V	200 w	kPa	BACKFILL/ MONITOR WELL/ PIEZOMETER	
30 -		Poor grey silty clay SHALE, - fresh - very weak		NQ	22	100	37	Is(50), D = 0.4 MPa		10	20)	30	40		Blow Cou	60	70	8	0		E
1 - 1:								UCS = 14.2 MPa Is(50), A = 0.1 MPa														
		- very poor quality below 31.1 m		NQ	23	100	25	15(50), A = 0.1 MPa														
2 -	12.0	E. CANDOTONIS						ls(50), D = 0.4 MPa														
3 -		Fair grey SANDSTONE - fresh to slighly weathered - medium strong - fine to medium grained		NQ	24	93	63	Is(50), D = 1.1 MPa														
- - - 4 - -		poor quality below 24.1						UCS = 30.8 MPa Is(50), D = 1.7 MPa														
- - - - - - - - - -	9.9	- poor quality below 34.1 m Poor grey silty clay SHALE - fresh		NQ	25	100	50	Is(50), D = 1.7 MPa														
i5 – - - - - - - - -	9.5	medium strong End of Borehole BH19-01 at 35.1 m. Target depth reached. Shallow piezometer installed at 4.3 m depth. Dry on August 9, 2019.	_\\\/					LOOKE C														
6 -																						
- - 7 - - - - -																						
- - - - 8 -																					_	
39 — - - - - - - -																						
£ 04									1							<u> </u>						Ē
		 -	_					Drilling Co													d By: N	
ACI	(FILL S	SYMBOL 🙀 ASPHALT NITE 🔯 DRILL CUTTINGS [∴ GR ∵ SAI	OUT	D	SLO	NCRE	TE Drilling Me	tnod:	Mι	Ja F	ota	y / N	IQ R	ock	(Cori	ing		Re	eviev	ved By:	_

	IENT:	tantec BC Hydro Underground West End S	Subs	tatio		SOF	REH	OLE RECOI		COC	RDII	NATE	S						. : <u>_12</u>	3 <mark>H19-</mark> 331441 44m
		DN: <u>1150 Nelson Street, Van</u>								mj 8927	.0N	490	588.	.0E				GION		
	TE BC								_ WA	TER L	EVEL	: <u>S</u> e	e l	Not						
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	PLOT		SAM			OTHER TESTS /	LAB	RAINE ORATO CKET P .50	ORY T	EST		i	FIELD	VA KET	NE TE	R VAN	◆ E ■ O kPa	KFILL/ OR WELL/ METER
DEPT	ELEVAT	(uscs)	STRATA PLOT	TYPE	NUMBER	ECOVERY (n	N-VALUE or RQD %	REMARKS		TER Co	 Onte	NT &	ATTE	RBER			١٨.		₩ _L	BACKFILL/ MONITOR WELL PIEZOMETER
o 🚽	44.0					~			1	0 2	20	Water 30	Conter 40	nt (%) ar)	50	Count		70	80	
1	43.9	ASPHALT FILL: brown poorly graded sand with gravel, moist	√	SS	01	275	14			•										
1 -1	43.1	FILL: brown silty sand with gravel		SS	02	525	20			O	•									
- - - - 2 -	42.0	Very dense grey-brown SILTY SAND (SM																		
		- trace to with gravel - moist		SS	03	600	55	Percent Passing #200: 49%		O.										
3 - 1 - 1																				
Z . 1 1 1 1 1				SS	04	125	R										50 bl	ows/1:	25 mm	
				33		123														
2 -								Percent Passing #200: 49%									85 blo) 	25 mm	
- - - - - -				SS	05	600	R			Φ:::									: >>	
1 1 1 7 —																				
4111111				SS	06	600	65			O										
3 -																				
- - - - - -		- with gravel below 8.5 m		SS	07	600	82	Grain Size Analysis: G S Fines 22% 40% 38%		O.									•	
	34.4	Hard grey sandy SILT (ML)																		
Ł ₀	ΣW	ater Level Measured In Shallow Stand	 dpipe	<u> </u>				Drilling Cor	atract.	Jr. 60	o to	Shr	Drill	ing '	 			1:::	OCC	d By: NO
	▼ W	ater Level Measured In Deep Standp YMBOL ASPHALT	oipe	OUT	· · ·	COI														ved By:

PR LO	ENT: OJEC [*] CATIC	T: Underground West End Stone N: 1150 Nelson Street, Vanc	OUV	er, E	n BC	SOF			BH [UT 545	8927	.0N	49	9058			B D	ΗE	LEV.	ATIC	N:		
	TE BC	RED: <u>July 24, 2019 to Ju</u>	ly Z	.o, ∠u		DIEC			$\overline{}$	TER L		_					(kPc	a)			T	Ī
DEРТН (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER		N-VALUE or RQD %	OTHER TESTS / REMARKS	LAB POO	ORATO	ORY PEN. kPa H	TEST	100 & AT	O kP	FI Pra a BERG	ELD OCK 1:	VAI (ET \$ 50 k	NE TE SHEA (Pa	R VA	NE 00 kF		MONITOR WELL/ PIEZOMETER
10		Llevel every seve els CUT (A41)	<u> </u>			_			1 ::::	0 2	20	30	ater Cor	40		Blow C	60		70	80	::::	: 1 [1
1		Hard grey sandy SILT (ML) - trace gravel - moist		SS	08	425	R	Percent Passing #200: 62%		0									ows/			
11 -		Very dense grey poorly graded SAND (SP) - trace gravel - moist																74 bl	ows/	250		
12 -				SS	09	300	R				O							4 01	: : : : : : : : : : : : : : : : : : :	230 1	>>•	
13 -				SS	10	350	R			O							5	54 bl	ows/	125 1	mm :>>•	
14-	29.8	Hard grey fat CLAY (CH)	///																			
- - - 15		- moist		SS	11	575	38					1						ł :				
· 1	28.3																					
16 – 16 –		Very dense to very dense grey poorly graded SAND (SP) - trace silt - moist															7	'9 bl	ows/	250 ı	mm	
- - - 17 -				SS	12	450	R														>> •	
1																						
18 -				SS	13	550	64			Ġ.								•				
- - - 19 -																						
1	24.5	Hard grey-brown SILT (ML) - trace sand - maist		SS SS	14A 14B	-550-	-48-	Percent Passing #200: 98%			0	 ⊙			•							
20 _1	ΔM	- moist 'ater Level Measured In Shallow Stand	lpipe	<u> </u>				Drilling Co	ntract	or: Se	a to	Sk	y Dr	illin	alt	td.	<u>: </u>		T	Loc	aged I	By: NC
		ater Level Measured In Deep Standpi YMBOL RASPHALT	pe GR	OUT	· ·		NCRE															d By: A

Q		Stantec			E	BOF	REH	OLE RECO	RD										В	H19-0)2
		BC Hydro T: Underground West End S	uhe	tatio	n					COC [M]	RDIN	ATES								3314418 4m	8
		DN: <u>1150 Nelson Street, Vanc</u>							-	58927	.0N ·	49058	38.OE	Ξ				on. <mark>Geo</mark>			_
DA	ATE BC	DRED: <u>July 24, 2019 to Ju</u>	ıly 2	26, 20	19			I	_	ATER L						D 1					_
	Ē				SAM	PLES				RAINE BORAT					Cu (k ELD V		TEST		•	ILL/	Œ
DЕРТН (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT		出	(mm) /	S.UE	OTHER TESTS / REMARKS	РО	CKET F 50	PEN. kPa		★ 00 kP		OCKE 150	T SHE D kPa		ANE 200 k		BACKFILL/ MONITOR WELL PIEZOMETER	ELEVATION (m)
D	ELEV	, ,	STRA	TYPE	NUMBER	RECOVER) or TCR	N-VALUE or RQD %			(N-valu	ie) BLO		3m				W _P	w w ⊖ I ●	I	MON PIE	ELE
- 20 -		Hard grey-brown SILT (ML) - trace sand								10 ::::		30	40			60	70	80			- 24
. ▼		- moist																			-
- 21 -		- sandy below 20.7 m		SS	15	600	44				0									<u>-</u>	- 23
	22.2	Very dense grey SILTY SAND (SM) with																			
- 22 - - -		grável - moist						Percent Passing #200:													- 22
 - - 23 -				SS	16	600	68	10,0		O							•				- - 2
- 23 - - - -																					- 2
- 24 –				SS	17	550	56	Grain Size Analysis: G S Fines 17% 70% 13%		O											- 20
- - -																					-
- 25 -																					- 19
- - -				SS	18	575	67			0							•				-
- 26 -																					- 18
 - - 27 -								Percent Passing #200: 29%								-05 k		/225	mm-		- - 17
				SS	19	300	R			O: ::								,225	:>>		-
- 28 -																					- 1
- - - - -				SS	20	175	R		0.							55 k	olows	/125	mm ::>>•		-
- 29 - - 29 -																					- 1:
- - - -				SS	21	200	R			O						50	blow	/s/75	mm ::>>		-
_ ₃₀ _1	Ā //	L Vater Level Measured In Shallow Stand	HHI aqiqt		L	1	I .,	Drilling Cor	1:::: ntract	1::::	a to S	Sky D	rillin	g Lt	d	1: <u>:</u>	:::Li	Log		r⊟.E d By: NG	- 14 ;
BAC	v 👱 ک FILL)	SYMBOL ASPHALT	r Leve <u>l M</u> easurea in Deep Stanapipe												Cor	ing		Rev	view	ed By: A	١

SAMPLES SAMP		5458927.0N 490588.0E DATUM: Geodetic WATER LEVEL: See Notes										27.0	89	UT 545		PROJECT: Underground West End Substation LOCATION: 1150 Nelson Street, Vancouver, BC DATE BORED: July 24, 2019 to July 26, 2019 SAMPLES											
13.7 Very dense grey SILTY SAND (SM) with grove 13.7 Very poor grey SILTSTONE NQ 22 83 0 Ngo), D = 0.1 MPc Ngo), D = 1.6 MPc Ngo), D = 0.1 MPc Ngo)	BACKFILL/ MONITOR WELL/ PIEZOMETER	kPa 	VANE 200	, NE TES HEAR	LD VAN CKET SH 150 kP H LIMITS	FIEL PO	F P kPa H ERBER	▲ ★ 00 k	10 10 1 & A	TEST	ORY EN. kPa 	ATO T PE 50 k	OR. CKE	LAB PO(N-VALUE or RQD %	Ę.			STRATA PLOT	SOIL DESCRIPTION (USCS)	ELEVATION (m)	DEPTH (m) ELEVATION (m)				
Mode		80	<u>8</u> C	7							0	20	0	1			_						30 –				
Fair grey SANDSTONE															, D = 0.1 MPa	0	83	22	NQ		moist Very poor grey SILTSTONE moderately to highly weathered						
Fair grey SILTSTONE -moderately weathered -very weak - coal stain between 30,9 m to 31,1 m -lightly weathered below 31,1 m -fresh to slightly weathered below 32,3 m NQ 24 100 75 IN(S0), D = 1,8 MPa UCS = 33.4 MPa - Very poor quality below 33,8 m NQ 25 30 9 IN(S0), A = 0,1 MPa IN(S0), A = 0,1 MPa IN(S0), D = 0,6 MPa IN(S0), A = 0,3 MPa															= 31.3 MPa	ι					Fair grey SANDSTONE extremely weak slightly to moderately weathered	13.1	31 -				
- slightly weathered below 31.1 m - fresh to slighly weathered below 32.3 m NQ 24 100 75 It (S0), D = 1.8 MPa UCS = 33.4 MPa - very poor quality below 33.8 m NQ 25 30 9 It (S0), D = 1.6 MPa UCS = 33.4 MPa It (S0), D = 1.6 MPa UCS = 33.4 MPa It (S0), D = 1.6 MPa It (S0), D = 1															, A = 2.7 MPa	68	100	23	NQ		medium to coarse grained Fair grey SILTSTONE - moderately weathered - very weak		- - - - 32				
NQ 24 100 /3 15(50), D = 1.6 MPa UCS = 33.4 MPa UCS = 33.4 MPa UCS = 33.4 MPa UCS = 33.4 MPa UCS = 37.4 MPa UCS = 27.4 MPa															, D = 1.8 MPa	l:					- coal stain between 30.9 m to 31.1 m - slightly weatehred below 31.1 m - fresh to slighly weathered below 32.3						
- very poor quality below 33.8 m NQ 25 30 9 Is(50), A = 0.1 MPa NQ 26 96 63 UCS = 27.4 MPa Is(50), D = 0.6 MPa 7.4 7.3 Fair grey SANDSTONE fresh very weak to weak medium to coarse grained Fair grey SILTSTONE															, D = 1.6 MPa		100	24	NQ				33 -				
NQ 25 30 9 Is(50), A = 0.1 MPa - fair quality below 35.4 m NQ 26 96 63 UCS = 27.4 MPa Is(50), D = 0.6 MPa 7.4 7.3 Fair grey SANDSTONE fresh very weak to weak medium to coarse grained Fair grey SILTSTONE Is(50), A = 0.1 MPa Is(50), A = 0.1 MPa															= 33.4 MPa						- very poor quality below 33 8 m		-				
- fair quality below 35.4 m NQ 26 96 63 UCS = 27.4 MPa Is(50), D = 0.6 MPa 7.4 7.3 Fair grey SANDSTONE fresh very weak to weak medium to coarse grained Fair grey SILTSTONE															, A = 0.1 MPa		30	25	NQ		Tony pool quality bolion colonia		34				
NQ 26 96 63 UCS = 27.4 MPa Is(50), D = 0.6 MPa 7.4 7.3 Fair grey SANDSTONE fresh very weak to weak medium to coarse grained Fair grey SILTSTONE																							35 –				
7.4 7.3 Fair grey SANDSTONE fresh very weak to weak medium to coarse grained Fair grey SILTSTONE NQ 26 96 63																					- fair quality below 35.4 m		-				
fresh very weak to weak medium to coarse grained ls(50), A = 0.3 MPa																	96	26	NQ		E CANDCTONE		, ,				
															, A = 0.3 MPa	l:					fresh very weak to weak medium to coarse grained	7.3	- - - - -				
- very weak NQ 27 94 53 UCS = 29.8 MPa															= 29.8 MPa	53	94	27	NQ		- moderately weathered		1 1 1 1 1 1				
- good quality below 38.4 m															, D = 0.6 MPa	l:					- good quality below 38.4 m		8 -				
NQ 28 98 80 Is(50), D = 0.5 MPa															, D = 0.5 MPa		98	28	NQ		- irregular, polished fracture at 39.3 m		- 19 – -				
- medium to coarse grained below 39.6																					- medium to coarse grained below 39.6	4.1	-				

Q		Stantec			ı	ВОЕ	REH	DLE RECO			-											_		BH19			
	IENT:	BC Hydro T: Underground West End S	ubs	tatio	. n						CC	OF	ND!	ΙΑν	ΓES									233144	18		
		ON: <u>1150 Nelson Street, Van</u>								[UT 545		27.0	N	490	0588	8.0E						TION: <u>44m</u> Geodetic					
		ORED: July 24, 2019 to														No											
					SAM	PLES			l	IND	RAI	1ED	SHE	AR	STRE	NGT									T		
£	Ξ		5								OR/ CKET			EST	*			LD V				ANE	•	L/ WELL, TFR			
DEPTH (m)	VIIO	SOIL DESCRIPTION	A PLC		~	mm %	8 ⊞ %	OTHER TESTS / REMARKS					Pa) kPa			0 kF				kPa	OR J			
DEF	ELEVATION (m)	(USCS)	STRATA PLOT	TYPE	NUMBER	ECOVERY or ICR 5	N-VALUE or RQD %	REMARKS	1						& AT 5/0.3r	TERBE	ERG	S LIM	ITS	W	P (v -	' W _L -1	BACKFILL/ MONITOR WELL/ PIEZOMETER			
40						~			l.	1	0	20)	Wat 30		tent (%) 40	and E		60		70	. 8	80		1		
1		End of Borehole BH19-02 at 39.9 m. Target depth reached.																							F		
		Shallow and deep piezometers installed at 4.3 m and 30.9 m depth																							F		
_		below ground surface, respectively. Water levels on August 9, 2019: - at 3.7 m depth in shallow piezometer																							ŧ		
41 – 1		- at 20.8 m depth in deep piezometer							:													::		=	E		
									:																E		
									:																Ė		
42 -									1												1	::		: 	F		
- 1									:																Ė		
]									1																Ē		
43 –									1													::		:	F		
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47 – 47 –									:							1 1 1					1 : :	::		:	Ė		
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48 –																									Ė		
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49 – 1									1																F		
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50 🍱	<u> </u>	L Vater Level Measured In Shallow Stan	dpipe) 				Drilling Cor	u: ntro	acto	or: S	:::l Sec	i to	:L: Sky	/ Dri	⊥∷ illing	: : Lto	d.	:L:		1::	Lc	ogge	: l ed By: N	IG IG		
3ACk	¥ V FILL S		oipe GR	OUT	D	.]CO1	NCRE												ing]_			eviewed By: AA				
ВЕ	1OTM	NITE DRILL CUTTINGS	SAI	ND	***	SLO	UGH		g Method: Mud Rotary / NQ Rock Coring Depth: 39.9 m									П	Page 5 of 5								

Solit DESCRIPTION Soli	PR LO	IENT: OJEC	tantec BC Hydro Underground West End S N: 1150 Nelson Street, Van RED: July 26, 2019 to J	COU	ver, E	3C				[UTM] BH ELE									BH19-C CT NO.: 12331441 8 VATION: 44m I: Geodetic					
4.4. OPSOIL: troop ally sand with agants of trace wood debris moid: 1			SCI 20, 2017 10 3		1, 20		PLES			_							kPa)							
1	DEPTH (m)	ELEVATION (m)		STRATA PLOT	TYPE	NUMBER	COVERY (mm) or TCR %	N-VALUE or RQD %	OTHER TESTS / REMARKS	F	VAT	50 ER CC	EN. kPa H	10 NT & A1	k I 0 kPa H TERBER	POCK 1	ET SHEA 50 kPa	AR VA	00 kPa	BACKFILL/ MONITOR WELL/ PIEZOMETER				
Tissue T		44.0					REC				·			Water Co	ntent (%) ar			70	80					
429 Service grey SILY SAND (SM) 1	0 +	43.8	trace wood debris, moist FILL: brown poorly graded sand with	s,																				
A GS 03 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 -		Very dense grey SILTY SAND (SM)		Gs Gs	01):::											
SS 04 400 31 SS 04 400 31 SS 05 550 R SS 06 425 R SS 06 425 R SS 07 525 R SS 07 525 R SS 08 350 R SS 08 350 R SS 09 82 Several Passing #200 SS 09 82 Slows/225 mm SS 08 350 R SS 09 82 Slows/225 mm SS 09 82 Slows/225 mm SS 08 350 R SS 09 82 Slows/225 mm SS 09 82 Slows/225 mm SS 09 8350 R	1		- trace gravel - moist		∬ Gs	02			Grain Size Analysis: G S Fines 4% 62% 34%															
SS 04 600 31 DS P0 blows/225 mm SS 05 SS0 R DS P0 blows/225 mm SS 06 425 R DS P0 blows/225 mm DS P0 blow	1				Gs	03						Э:::												
SS 05 550 R SS 05 550 R SS 05 550 R SS 05 550 R SS 06 425 R SS 06 425 R SS 07 525 R Percent Posing #200: SS 08 350 R	- 4				V																			
SS 05 550 R	1				SS	04	600	31) : : :		•										
Hard grey sity CLAY (CL-ML)					SS	05	550	R)					90 bl	ows/	225 mm					
SS 06 425 R SS 06 425 R Percent Passing #200: SS 07 525 R Percent Passing #200: SS 08 350 R	1 1 1 1 1		- trace to with sand																					
SS 07 525 R 65% SS 07 525 R 65% SS 08 350 R Percent Passing #200: SS 08 350 R Perce			- moist		SS	06	425	R				Φ.					81 bl		225 mm					
SS 07 525 R 65% SS 07 525 R 65% SS 08 350 R Percent Passing #200: SS 08 350 R Perce																								
SS 08 350 R 85% O O 7 Hard grey fat CLAY (CH)	, -I -I -I -I				SS	07	525	R	Percent Passing #200: 65%			0					82 bl		225 mm					
34.4 Hard grey fat CLAY (CH)	1																							
34.4 Hard grey fat CLAY (CH)					SS	08	350	R	Percent Passing #200: 85%				0				77 bl		250 mm					
) 		Hard grow fat CLAY (CL)																					
	<u> </u>																							
★ Water Level Measured In Shallow Standpipe ★ Water Level Measured In Deep Standpipe ★ Water Level Measured In Deep Standpipe ACKFILL SYMBOL ASPHALT GROUT CONCRETE Drilling Contractor: Sea to Sky Drilling Ltd. Logged By: No Drilling Method: Mud Rotary / NQ Rock Coring Reviewed By:	J -		ater Level Measured In Shallow Stan ater Level Measured In Deep Stands		9					ntra	cto	r: Se	a to	Sky Di	illing I	Ltd.								

PR	LIENT: OJEC	Stantec BC Hydro Underground West End S N: 1150 Nelson Street, Vand			n	ВОГ	REH	OLE RECO	H COORDINATES PROJECT NO.: JTM] BH ELEVATION: 458936.0N 490540.0E DATUM: Geo	_44m				
	ATE BC								458936.0N 490540.0E	aetic				
					SAM	PLES			IDRAINED SHEAR STRENGTH, Cu (kPa)					
DEРТН (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RY (mm)	N-VALUE or RQD %	OTHER TESTS / REMARKS	ABORATORY TEST A FIELD VANE TEST OCKET PEN. * POCKET SHEAR VANE 50 kPa 100 kPa 150 kPa 200 k	SACKFII NITOR P				
	ELI		STR	<u>\</u>	NON	RECOVE	2 × 9		/ATER CONTENT & ATTERBERG LIMITS Wp W W W PT (N-value) BLOWS/0.3m ● 10 20 30 40 50 60 70 80					
10 -		Hard grey fat CLAY (CH) - trace sand - moist		SS	09	600	61		Φ • •					
11 -	32.9	Hard beause grou sith, CLAV (CLAN)												
-		Hard brown-grey silty CLAY (CL-ML) with sand - moist		SS	10	500	R		95 blows/200	mm				
2 -				33	10	300	K							
13 -								Percent Passing #200:						
				SS	11	600	45	77%						
14 –	29.8	Hard grey sandy SILT (ML) - moist												
15 –				SS	12	600	52		ó •					
	28.3	Dense grey SILTY SAND (SM)												
16 - - -		- moist		SS	13	600	47	Percent Passing #200: 22%	0 •					
- - - 17 –	26.8													
-		Firm to hard grey silty CLAY (CL-ML) - trace sand - moist						-		<u></u>				
18 -				SS	14	600	33		○ ○ ○ ○ ○ ○ ○ ○ ○ ○					
19 –														
-				SS	15	600	27	Percent Passing #200: 98%	o ●					
20 -	Σν	ater Level Measured In Shallow Stand	dpine	= =				Drillin at Co	ster: See to Sky Drilling Ltd	agad Pvr. NC				
RAC.	▼ W	ater Leve <u>l M</u> easured In Deep Stand <u>p</u>	oipe GR			וררי יסטו	NCRE			Logged By: NG Reviewed By: A				
	ENTON		SAI		Ŀ <i>⊵</i> ₩	SLO	UGH			ge 2 of 5				

PR	IENT: OJEC	tantec BC Hydro Underground West End Su N:1150 Nelson Street, Vance			n	SOF	REH	OLE RECO	RD BH19- _ BH COORDINATES PROJECT NO.: 1233144 _ [UTM] BH ELEVATION: 44m _ 5458936.0N 490540.0E DATUM: Geodetic							
	TE BC								WATER LEVEL: See Notes							
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER		N-VALUE or RQD %	OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, CU (kPa) LABORATORY TEST ▲ FIELD VANE TEST ← POCKET PEN. ★ POCKET SHEAR VANE □ S0 kPa 100 kPa 150 kPa 200 kPa WATER CONTENT & ATTERBERG LIMITS WP W WL WATER CONTENT & ATTERBERG LIMITS WP W WL							
	ѿ		ST	Ĺ	Ď.	RECOVI	0 N		SPT (N-value) BLOWS/0.3m Water Content (%) and Blow Count							
20 -		Firm to hard grey silty CLAY (CL-ML) - trace sand - moist							10 20 30 40 50 60 70 80							
21 -				SS	16	600	34	Percent Passing #200: 96%								
▼	22.2	v														
22 -		Very dense brown-grey poorly graded SAND (SP) - trace silt - moist		SS	17	325	73	-	σ •							
23 -	20.7				17	323	73									
		Very dense SILTY SAND (SM) with gravel - moist						Grain Size Analysis:								
24 –				SS	18	450	R	G S Fines 21% 46% 33%	90 blows/250 mm							
25 –	19.2	Hard grey sandy SILT (ML) - trace gravel - moist														
				SS	19	600	57	Percent Passing #200: 71%	o •							
26 – - - -																
27 –	16.8															
,		Fair to good grey SILTSTONE - fresh to slightly weathered - weak		NQ	20	100	67	UCS = 25.1 MPa								
28 -				NQ	21	97	57	ls(50), D = 0.8 MPa								
29 -								ls(50), D = 1.9 MPa								
30 ±		ater Level Measured In Shallow Standr ater Leve <u>l M</u> easured In Deep Stand <u>pir</u>)					ntractor: Sea to Sky Drilling Ltd. Logged By: N							
		ymbol 🕍 asphalt 🗀	GR SA1	OUT	<u> </u>		NCRE UGH		ng Method: Mud Rotary / NQ Rock Coring Reviewed By: upletion Depth: 39.9 m Page 3 of 5							

C) 5	Stantec			E	BOF	REH	OLE RECO	RD								В	H19-(— 03
CI	JENT:	BC Hydro							BH	COC	RDIN	NATES		PR	OJEC [*]	T NO.	: <u>12</u>	331441	8
		T: Underground West End							[UT/	1]				ВН	ELEV	ATION	<u> </u>	4m	
LC	CATIO	ON: <u>1150 Nelson Street, Va</u>										49054			ATUM:	_Ge	ode	ic	—
D/	ATE BC	DRED: <u>July 26, 2019 to</u>	July 3	1, 20	19			T				: <u>See</u>							
	ے				SAM	PLES						EAR STRE	Pa) 'ANE TE	T2:	•	ند	Ē		
Œ	ELEVATION (m)		PLOT			<u></u>				KET P		*		POCKE	T SHEA	r vane	•	ILL/ WEL	ELEVATION (m)
DЕРТН (m)	≱I	SOIL DESCRIPTION (USCS)	IA P		뜶	Ē	3,6	OTHER TESTS / REMARKS		50	kPa 	100	kPa +	150) kPa	200	kPa 	ACK ZON	VATÍ
	ELEV		STRATA	TYPE	NUMBER	COVER	N-VALUE or RQD %					NT & AT DWS/0.3r		RG LIMI	its w	W O	W _L	BACKFILL/ MONITOR WEI PIEZOMETER	ELE
						2			10) 2	20	Water Con				70 8	80		
30 -		Fair to good grey SILTSTONE - fresh to slightly weathered	X	NQ	22	98	65												- 14 -
_ =		- weak						Is(50), D = 1.6 MPa											<u> </u>
								UCS = 34.4 MPa											- [
- 31 -		- good quality below 30.8 m							:::::	: : : :	1 : : :		1 1 1 1			1 1 1 1	::::		13
-								L(50) D 05 MD											_
				NQ	23	94	78	Is(50), D = 0.5 MPa											_ _
- - 32 -																			- - 12
-	11.7																		- '2 -
		Good grey SANDSTONE - fresh to slightly weathered						Is(50), D = 1.1 MPa											<u>-</u> -
		- medium strong - fine grained																	-
- 33 -		0 1 1		NQ	24	93	87												- 11
-								Is(50), D = 1.4 MPa											Ē
																			_ [
- 34 –																			- - 10
-																			Ē
				NQ	25	78	57	Is(50), A = 0.8 MPa											Ē
								UCS = 10.4 MPa											- F
- 35 -											:::						::::		- 9 -
_ =				\parallel				-											- Ĺ
-	8.3	Poor grey SILTSTONE																	- F
- 36 -		- fresh - medium strong		NQ	26	98	46	Is(50), A = 1.6 MPa											- 8
=					23														-
																			- [
- - 37 –				\parallel		_													- - - 7
-								Is(50), D = 0.6 MPa											- <i>'</i>
																			-
=				NQ	27	95	35	UCS = 27.9 MPa											-
- 38 -								Is(50), D = 0.6 MPa		: : : : : : : :	1:::		1 : : : :			1::::			- 6
_				H															-
																			-
- - 39 -																			- - 5
-				NQ	28	100	32												Ē
								UCS = 19.5 MPa											- F
	4.1			<u> </u>				Is(50), D = 0.4 MPa								: : : : :			- [
- 40 -	<u>Ā</u> ,	Vater Level Measured In Shallow Sta	andpipe	,	ı	1	-	Drilling Co	ntracto	r: Se	a to	Sky Dr	lling L	_td.	<u> </u>	Lo	ogge	d By: NC	- 4 Э
ВАС	▼ V KFILL S	Vater Level Measured In Deep Stan SYMBOL RSPHALT	apipe GR	OUT	D]CO1	NCRE								ing			ed By: .	
В	ENTO		SAI	۷D		SLO	UGH	Completio	n Dep	h: 3	39.9 r	n				Po	age 4	of 5	

	IENT:	Stantec BC Hydro Underground West End S	uhe	tatio		BOF	REHO	OLE RECOI	_		CO(ORI	DIN	ATE	S							12	H19-(331441 4m
		ON: <u>1150 Nelson Street, Van</u>								-	vij 893	6.01	V 4	4905	540	.0E						det	
DA	TE BC	ORED: <u>July 26, 2019 to Ju</u>	ıly 3	1, 20	019				_	WA	TER	LE\	/EL:	Se	e	Note							
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT		SAM	_	LUE D %	OTHER TESTS / REMARKS		_AB	ORA: CKET	TOR	Y TE I.	ST	▲		IELD OCK	۷A۱	, NE TE HEAI	R VA	NE 00 k		BACKFILL/ MONITOR WELL/ PIEZOMETER
	ELE		STR/	TYPE	NUMBER	RECOVER or TCI	N-VALUE or RQD %			SPT (N-val	lue)	BLO	WS/C).3m Conte	nt (%) and	d Blow C	ount	W F	•	, w	ı ¯	MOR
40 -		End of borehole BH19-03 at 39.9 m. Target depth reached.						50), A = 0.7 MPa		10) ::::	20		30 	4	0 (50	60	7	70 	80		-
1 1 1 1 1 1		Shallow and deep piezometers installed at 4.4 m and 27.7 m depth below ground surface, respectively. Water levels on August 9, 2019: - at 2.8 m depth in shallow piezometer																					
		- at 21.5 m depth in deep piezometer																					
2 -																							. [
3 -																							
4																							.
- - -5 –																							- - - - -
6-																							
.7 - -1 -1 -1																							
8 -																							
1 - 1																							
.9 -																							
<u>1</u> 50 <u>1</u>		Vater Level Measured In Shallow Stanc		<u> </u>				Drilling Cor	ntra	ictr	or: S	ea	to S	iii ikv I	Drill	lina I	td.				Loc	gged	d By: NG
A C !	▼ W	Vater Level Measured In Deep Standp SYMBOL ASPHALT	ipe GR	OUT		CO1 SLO1	NCRET											rino					ed By: A

SAMPLES SOULDESCRIPTION (USCS) SOULDESCRIPTION (USCS) SOURCE SOUR	PRO.	JECT ATIC	BC Hydro : Underground West End S ON: 1150 Nelson Street, Vane RED: August 1, 2019 to	cou	ver,	ВС				[L 54	JTM 458] 966.		490	0527	7.0E Not e	В	H EL	.EVA	AOIT.		3314 3.4m tic	
43.4 ASPHALT	PTH (m)	ATION (m)		A PLOT			Ē	≡ %	OTHER TESTS /	LA	BO	RATC ET P	DRY EN.		*	F	FIELD	VAN (ET SH	IE TES HEAR	VAN		BACKFILL/ MONITOR WELL/	OMETER
43.4		_	(03C3)	STRAT	TYPE	NUMBE	RECOVERY or ICR	N-VALL or RQD	REMARKS					ows	/0.3m	า			W _P	• W	w _L	BA	PIEZ
A3. CONCRETE Strown sity sand, frace gravel SS DIA SS	∪ †	$\overline{}$	ASPHALT	/ X						:::	10	:::	0	30		10	50	60	7	O : : : :	80 : : : :		
1		2 1		,																			Ė
SS 018 05 07 07 07 07 07 07 07 07 07 07 07 07 07	42			J\₩	SS	01A	575	7															F
SS 02 500 26 SN 335 Mes 41.3	1 =		moist (possible fill)		ss	01B	3/3	,					:::						:::				
2 41.3 Grey SUTY SAND (SM) SS 03A S75 - 62 - O O O O O O O O O									Grain Size Analysis:														
Compact brown SANDY SILT (ML)					ss	02	500	26	5% 53% 42%					•									
Compact brown SANDY SILT (ML)	<u> </u>																						
40.7 Hard brown SANDY SILT (ML)	²	-		+																			
### Add Proving SANDY SILT (ML) - moist SS 038 575 - 62 0 - moist	4		- moist			03.4																	
39.9 Compact brown poorly-graded SAND (SP) - frace silt - moist SS 04 425 24 Very dense brown SILTY SAND (SM) with gravel - moist SS 05 450 75 36.4 Hard grey SILT (ML) - frace sond to sandy - frace to with gravel - moist SS 06 500 69 - sandy and with gravel below 8.5 m SS 07 525 R Grain Size Analysis: ST 1985 CR 278 278 278 278 278 278 278 278 278 278	- 40	-	Hard brown SANDY SILT (ML)				575-	62-										•					
Compact brown poorly-graded SAND (SP) - trace silt - moist SS 04 425 24 SS 05 450 75 SS 05 450 75 SS 05 450 75 SS 06 500 69 SS 06 500 69 SS 07 525 R SS 07 52	3 -				33	038																	
SP	39	9.9																					
4 - frace silt - moist	1	(]																		
38.4 Very dense brown SILTY SAND (SM) with gravel - moist SS 05 450 75 Percent Passing #200: A78 A78 Percent Passing #200: A78 A78 A78 A78 A78 A78 A78 A7	4 -		- trace silt							:::	: :	:::			:::				::::		1 1 1 1		
5 - 38.4 Very dense brown SILTY SAND (SM) with gravel - moist SS 0.5 4.50 7.5 Percent Passing #200: Perc	-				SS	04	425	24					٠										
5 - 38.4 Very dense brown SILTY SAND (SM) with gravel - moist SS 0.5 4.50 7.5 Percent Passing #200: Perc																							
Very dense brown SILTY SAND (SM) with gravel - moist SS 05 450 75 Percent Passing #200: SS 05 450 75 Percent Passing #200: SS 06 500 69 SS 06 500 69 SS 07 525 R Cain Size Analysis: SS 07 525 R Cain Size Analysis: SS 07 525 R SS 07 525 R SS 07 525 R SS 07 525 R Cain Size Analysis: SS 07 525 R	⁻	8.4			ł																		
- moist - moist - sandy and with gravel below 8.5 m	ءُ آ]																		
SS 05 450 75 Hard grey SILT (ML) - trace sand to sandy - trace to with gravel - moist - sandy and with gravel below 8.5 m SS 07 525 R Grain Size Analysis: S 5 06 500 69 S 6 500 69 S 7 525 R Grain Size Analysis: S	- 1	-							Percent Passing #200:														
Hard grey SILT (ML) - trace sand to sandy - trace to with gravel - moist ss 06 500 69 Ss 06 500 69 - sandy and with gravel below 8.5 m ss 07 525 R Grain Size Analysis: - sandy and with gravel below 8.5 m ss 07 525 R Grain Size Analysis: - sandy and with gravel below 8.5 m ss 07 525 R Grain Size Analysis: - sandy and with gravel below 8.5 m ss 07 525 R Grain Size Analysis: - sandy and with gravel below 8.5 m ss 07 525 R Grain Size Analysis: - sandy and with gravel below 8.5 m					SS	05	450	75	47%		þ									•			
Hard grey SILT (ML) - trace sand to sandy - trace to with gravel - moist SS 06 500 69 SS 07 525 R Grain Size Analysis: SS 07 525	6 -																				1		
Hard grey SILT (ML) - trace sand to sandy - trace to with gravel - moist SS 06 500 69 SS 06 500 69 - sandy and with gravel below 8.5 m SS 07 525 R Grain Size Analysis: So Fines 20% 26% 54% 93 blows/250 mm >>>●	36	6.8																					
- trace to with gravel - moist SS 06 500 69 - sandy and with gravel below 8.5 m SS 07 525 R Grain Size Analysis: G S Fines 20% 26% 54% O: >> 93 blows/250 mm	-		Hard grey SILT (ML) - trace sand to sandv																				
SS 06 500 69 - sandy and with gravel below 8.5 m SS 07 525 R - sandy and with gravel below 8.5 m SS 07 525 R - 33.8	7 -	-	- trace to with gravel												:::								
- sandy and with gravel below 8.5 m SS 07 525 R Grain Size Analysis: G S Fines 20% 26% 54% O: 93 blows/250 mm	1				SS	06	500	69				0							•				
- sandy and with gravel below 8.5 m SS 07 525 R Grain Size Analysis: G S Fines 20% 26% 54% O: 93 blows/250 mm	1																						
- sandy and with gravel below 8.5 m SS 07 525 R Grain Size Analysis: G S Fines 20% 26% 54% O: 93 blows/250 mm	₈																						
9 - 33.8 ss 07 525 R 20% 26% 54% O	1																						
9 - 33.8 ss 07 525 R 20% 26% 54% O			- sandy and with aravel helow 8.5 m						Grain Size Analysis:												[::::		
33.8	_ 1		zaa, and mingrator bolow 0.0 m		SS	07	525	R	G S Fines 20% 26% 54%			5 : :						: : 93 : :	3 blo	ws/25	0 mm ::>>	•	
	y -																						
	3	3.8																					-
4 1 [XIII	1		Hard grey silty CLAY (CL-ML) with sand	鄁	1																		
▼ Water Level Measured In Shallow Standpipe	1 01 ×	Z W	ater Level Measured In Shallow Stan	dpipe					Daillin or Con		: :			CI-		<u> </u>		::L:	:::	l : : : : T ,	<u> </u>	-I D	
★ Water Level Measured in Shallow Standpipe ▼ Water Level Measured In Deep Standpipe ACKFILL SYMBOL ASPHALT CONCRETE Drilling Contractor: Sea to Sky Drilling Ltd. Logged By Drilling Method: Mud Rotary / NQ Rock Coring Reviewed Reviewed	Ţ	Z W	ater Level Measured In Deep Standp	oipe		· ·	100.	1000										orin -	•				

		Stantec			E	BOF	REH	OLE RECO	RD										H19	
		BC Hydro								COC	RDI	VATES	5). : <u>12</u>		18
		T: <u>Underground West End S</u>								•		4005	o - 0	_				√: <u>4</u> .		
		ON: <u>1150 Nelson Street, Vanc</u>				10				8966						ATUM	: <u>G</u>	<u>eode</u>	lic	
D.	AIF BC	ORED: <u>August 1, 2019 to</u>	AUÇ	JUST 2				Ī		TER L						·Dal			Π	$\overline{}$
	5				SAM	PLES				ORATO						.ra) /ANE1	EST	•	/ ELL/	l ê
Ξ	ت ا		ō			Ē			PO	CKET P			*				AR VAI		FILL/ WEI	NO NO
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	ш	Æ	Ē	≒ %	OTHER TESTS / REMARKS		50	kPa 	1	00 kF	Pa .	15	0 kPa	20	00 kPa	A CK	ELEVATION (m)
	ELEV		STRA	TYPE	NUMBER	ECOVER) or TCR	N-VALUE or RQD %			TER Co (N-valu				BERG	G LIM	ITS	W _P W	W _L	BACKFILL/ MONITOR WELL	ELE.
10 -			ļ,,,			~			1	0 2	20	Water 0	ontent 40		Blow Co	60	70	80		╽
	1	Hard grey silty CLAY (CL-ML) with sand - trace gravel						Percent Passing #200: 60%								: : : : : 92 b	: : : : 2/iows	: : : : : !50 mm		E
<u> </u>	1	- moist		SS	08	350	R			: : O:										F 33
	1																			E
- 11 -	32.3	L							::::		1 : : :			:::	:::					F
	1	Hard grey sandy SILT (ML) - trace gravel																		1 32
		- moist																		E 32
10	1			SS	09	200	R			0:::						50	blows,	75 mm : ::>>	•	E
- 12 -	1																			E
_ :	1								:::::											31
	30.8	Hard grey fat CLAY (CH)																		ŧ
- 13 -	1	- trace sand - moist							:::::	1 1 1 1	1 1 1	<u> </u>		:::	1 1 1		1 1 1	<u> </u>		F
	1							Percent Passing #200: 83%								: : : : : 84 b	: : : : 2/ows	: : : : 250 mm		F
	1			SS	10	400	R				0::									- 30 -
	1																			E
- 14 -	1																			Ŀ
	1																			29
																		<u>: </u> ::::		F
- 15 -	1			SS	11	550	R			: : : :	þ. <u>i</u>			:::	1	: 97 C	iows/2	!75 mm <u>: </u>		F
	1																			Æ
	1																			F 28
	1																			E
- 16 -											1:::									Æ
				SS	12	0	R									50	blows	. '25 mm · · ·>>		E 27
						Ĺ	`													Æ
- 17 -																				F
	26.2	Hard grey lean CLAY (CL)																		Æ
	1	- trace sand																		26
		- moist																		Œ
- 18 -				SS	13	600	53					9	+		•					F
																				E 25
	24.7																			₽ _
- 19 -		Very dense grey poorly graded SAND (SP)																		F
17-	1	- moist																		lŧ.
	23.9		1	SS	14A	L ₆₀₀ -	_53-								•					24
		Hard grey fat CLAY (CH) - moist		SS	14B			Percent Passing #200: 98%				0								F
- 20 -	l	 Vater Level Measured In Shallow Stand	dpipe	<u> </u>		1		Dane C	1::::		1:::	: :	::[:	:::	<u> </u>				-I D	
D . C	▼ V	Vater Level Measured In Deep Standp	ipe		l	100	105	Drilling Co								ina		Logge		
	:KFILL : ENTOI	SYMBOL ASPHALT VITE DRILL CUTTINGS	. GR . SA1	OUT	. <i>⊵</i>	CO1	NCRE	TE Drilling Me Completio					NW K	UCK	Cor	ırıg		Reviev		AM
	LIVIUI	ALIE MOKIFF COLLINGS	JoAl	AD.	₩	JULU	UGH	Completto	преβ	ш. ч	JJ.I r	11						Page :	∠ OT 4	

LOC	ATION: E BOREI	1150 Nelson Street, Vanc		tatic	n				BH COORDINATES PROJECT NO. : 12331 [UTM] BH ELEVATION: 43.4n	
		D: August 1, 2019 to		er,	ВС				5458966.0N 490527.0E DATUM: Geodetic	
DEPTH (m)	(m) NO		Aug	just				<u> </u>	WATER LEVEL: <u>See Notes</u> UNDRAINED SHEAR STRENGTH, Cu (kPa)	$\overline{}$
	ELEVATI	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	1	N-VALUE or RQD %	OTHER TESTS / REMARKS	LABORATORY TEST A FIELD VANE TEST POCKET PEN. * POCKET SHEAR VANE 50 kPa 100 kPa 150 kPa 200 kPa WATER CONTENT & ATTERBERG LIMITS WP W WL SPT (N-value) BLOWS/0.3m	PIEZOMETER
						Æ			Water Content (%) and Blow Count 10 20 30 40 50 60 70 80	
20 - 2:	Ver (SI	rd grey fat CLAY (CH) oist ry dense grey poorly graded SAND P) ace clay	//							
21 -		oist		SS	15	550	62			
Z 2		rd grey fat CLAY (CH) oist								
				SS	16	600	54	Grain Size Analysis: G S Fines 1% 3% 96%	•	
3 -										
4 -				SS	17	600	31			
5 -		rd grey SILT (ML) with sand oist								
				SS	18	600	53	Percent Passing #200: 76%	.o	
6 -										
7 -				SS	19	500	62	Percent Passing #200: 72%	•	
3 -										
3										
9 -		r grey silty clay SHALE		II						
\mathbb{L}_{00}	- fre ✓ Wate	esn er Level Measured In Shallow Stand	bine	NQ	20	86	61	Dellin at C =	1::::: :::: :::: ::::: ::::: ::::: ::::: ::::	
7	▼ Wate	er Leve <u>l M</u> easured In Deep Stand <u>pi</u>	ipe GR		T.:	וררי יחסו	NCRE		htractor: Sea to Sky Drilling Ltd. Logged By thod: Mud Rotary / NQ Rock Coring Reviewed I	

C	9	Stantec			ı	ВОГ	REH	OLE RECO	RD								B	H19-	04
		BC Hydro							BH	COC	RDIN	ATES						<u>33144</u>	18
I		T: <u>Underground West End St</u>							[U]	-							DN: <u>4</u>		
		ON: <u>1150 Nelson Street, Vanc</u>										190527			TUM	: _ C	eode	tic	—
D/	ATE BO	ORED: <u>August 1, 2019 to A</u>	Αυς	just 2	2, 20)19		T	_			See							_
	٦				SAM	PLES						AR STRE ST ▲		CU (KI IELD V	•	TEST	•		Ē
Œ	Š		Ō.			5				CKET P		*					NE 🗖	L Wel	N N
DEРТН (m)	ATIO	SOIL DESCRIPTION (USCS)	'A PI		æ	اقٍ∞	백%	OTHER TESTS / REMARKS		50	kPa 	100	kPa	150	kPa	2	200 kPa	유민	ATK
_ B	ELEVATION (m)	(6303)	STRATA PLOT	ΤΥΡΕ	NUMBER	SOVERY or ICR	N-VALUE or RQD %	REMITTING				T & ATT WS/0.3n		G LIMI	TS	W _P V	W _L	BACKFILL/ MONITOR WELL/ PIEZOMETER	ELEVATION (m)
						REC						Water Cont	ent (%) and			70	00		
- 30 -		- extremely weak to very weak	W	П						0 2	20 3	30 <u>/</u>	10 5	50 <i>6</i>	50 : : :	70	80		F
-		Fair grey silty clay SHALE - fresh	\gg																E - 13
		- extremely weak to very weak	X	NQ	21	87	28												Ē
21																			F
– 31 – -		- extremely weak from 30.9 m to 31.0 m - slightly weathered from 31.1 m to 31.4						ls(50), D = 0.6 MPa											É
		m - very poor quality below 31.1 m																	- 12
-		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		1															Ē
32 -				NQ	22	95	13				: : : :	::::		: : : :			:: : : : :		Ė
-			S																Ė ,,
																			F 1
-		- extremely weak from 32.6 m to 32.8 m						. (50) 5 . 0 5 . 10											Ē
- 33 –			\gg					Is(50), D = 0.5 MPa											Ē
-				NQ	23	95	47												<u>-</u> 10
-								UCC 23.5.4P-											Ē
- 34 -			\bigvee					UCS = 31.5 MPa											Ė
-								Is(50), D = 1.3 MPa											Ė
								UCS = 20.4 MPa											- 9
			\gg	NQ	24	97	39												Ē
- 35 -	8.3		\mathbb{W}	1				Is(50), D = 1.3 MPa	1 1 1 1										E
-		End of borehole BH19-04 at 35.1 m. Target depth reached.																	- - 8
		Shallow and deep piezometers installed at 5.8 m and 29.9 m depth																	Ė
24		below ground surface, respectively. Water levels on August 9, 2019:																	Ė
- 36 - -		- at 4.7 m depth in shallow piezometer - at 21.9 m depth in deep piezometer																	É
_ =		,																	- 7
=																			Ė
37 -										: : : :	:::::	::::		: : : : : : : : : : : : : : : : : : :				1	E
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- 38 -										1		1		1	1 : : :			†	Ė
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- - 39 –												::::						1	Ė
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																			Ē
- 40 -	L ∇ V	 Vater Level Measured In Shallow Stand	nine	<u>,</u>			1	D.300 C	1::::	<u> </u>	1::::	1::::] ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	<u> </u>	L			-1.0	Ė ∩
D . C	▼ V	Vater Level Measured In Deep Standpi	ре		<u> </u>	100		Drilling Co							n~			d By: No	
	KFILL : ENTOI	SYMBOL ASPHALT VITE CORILL CUTTINGS	GR SA1	OUT	<i>₽</i>	CO1	ncre Ncre						KOCk	COI	ng			ved By:	AM
R	LIVIOI	ALLE MORITE COLLINGS]sAl	AD.	₩	∦2LO	UGH	Completio	прер	лп. ч	oo.i m	ı					Page	4 OT 4	

LO	OJEC	BC Hydro T: Underground West End S DN: 1150 Nelson Street, Van RED: August 2, 2019 to	cou	ver, I	ВС				 [UT 545	M] 8982		490525		BH DA	ROJECT HELEVA ATUM: On Au	ATION <u>G</u> e	: <u>4</u>	3.4m tic	
المرا	VIE BC	Augusi 2, 2017 10	T AUG	Jusi	SAM							AR STRE				900.	-,		Ŧ
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE		£	N-VALUE or RQD %	OTHER TESTS / REMARKS	PO(50 IER C	PEN. kPa H	T & ATT	P) kPa 	OCKE 15	/ANE TE ET SHEAI 0 kPa 	200	♦ E □ O kPa W _L	BACKFILL/ MONITOR WELL/ PIFTOMETER	L IEE CIVILLEN
	43.4					Æ			1			Water Cont	ent (%) and			70	80		
0 🖠		TOPSOIL: brown silty sand - few gravel																	+
4		- lew glavel						Grain Size Analysis: G S Fines 10% 65% 25%											ŧ
- 1	42.5			SS	01	450	6	10% 65% 25%											-
1		Compact to very dense brown SILTY SAND (SM)																	
-		- trace gravel - moist		SS	02	450	21												
]																			
=]															
=																			
=				SS	03	125	R								50 blo	: : : ws/12	:::: 25 mm		
=					05	123	K									: : : :			
1																			
1	39.9	Dense to very dense grey well graded		1															٠.
=		SAND with silt (SW-SM) - few to little gravel																	
3		- moist		SS	04	500	59	Grain Size Analysis: G S Fines 12% 78% 10%		· · · · · · · · · · · · · · · · · · ·	:::::		:::::						İ
4				!															
4]														1 目	٠.
4																			
1	07.4			SS	05	550	46				ρ		•						
=	37.4	Very dense SILTY SAND (SM) with grave	el																
1		- trace clay - moist																	
1]															
#				┰				Percent Passing #200:				1::::		: : :	110	: : : :	: : : :		į
=				ss	06	325	R	46%) : : : : :					110 blc	ws/27	′5 mm ∷>> ∷::	•	
=																			
=				}							::::	1::::		1:::					
1	35.2	Hard grey lean to fat CLAY (CL/CH)																	
=		- trace gravel - moist																	
]															Q / hl-	: : : : :	5 ~~~		
' = = =				SS	07	300	R			0					00 010)WS/22	25 mm ::>> ::::	•	
=																			
1	33.6	Very dense grey-brown sandy SILT (ML)	1															
) _1	ΔM	ater Level Measured In Shallow Stan		<u> Н</u>				Drilling Co	ntracto	or: Se	a to S	Sky Dri	Iling L	td.	:1::::	L	ogge	d By: N	10
																\rightarrow			_

PR	IENT: OJEC	BC Hydro T: Underground West End S			n			OLE RECO	H COORDINATES JTM]	PROJECT	NO.: <u>123</u> ON: <u>43</u>	8.4m
	ATE BC	DN: <u>1150 Nelson Street, Vanc</u> DRED: <u>August 2, 2019 to</u>				19			458982.0N 490525.0E /ATER LEVEL: 4.9 m dep l	DATUM: _		
(m)	(m) NC	con percentation	,toī		SAM				OCKET PEN. * PO	D VANE TEST CKET SHEAR \		BACKFILL/ MONITOR WELL/ PIEZOMETER
DЕРТН (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER	RECOVERY (mm) or TCR %	N-VALUE or RQD %	OTHER TESTS / REMARKS	50 kPa 100 kPa ATER CONTENT & ATTERBERG T (N-value) BLOWS/0.3m Water Content (%) and Bic	•	200 kPa	BACKFILL/ MONITOR WELL/ PIEZOMETER
10 –		Very dense grey-brown sandy SILT (ML)						Percent Passing #200:	10 20 30 40 50	60 70	80	-
				SS	08	375	R	62%	O	96 blow	s/225 mm >>	
11 -	32.3	Hard grey fat CLAY (CH) - trace gravel - trace sand										
2-		- moist		SS	09	500			ÓI .	-1	>>(
3 -				SS	10	600			0		>>(
4-	29.2	Hard grey sandy SILT (ML)										
-		- trace gravel - moist										
15 -				SS	11	50	R	Grain Size Analysis: G S Fines 2% 42% 56%	0	50 blo	ws/75 mm_ :>>	-
16 -												
111111				SS	12	0	R			50 blov	ws/50 mm	- - - - -
7 -												
8 -		- trace to some sand below 17.7 m		SS	13	600	75	Percent Passing #200: 90%			•	
, i	24.7	Very dense grey poorly graded SAND										
19 - - -	23.9	with silt (SP-SM) - moist		SS	14A	50-						
20		Hard grey SILT (ML) - trace sand - moist		SS	14B	-525-	<u>-/6-</u>		o.			
<u>~</u> U —	ΔM	/ater Level Measured In Shallow Stanc	pipe	9					tor: Sea to Sky Drilling Ltc		Logged	By: NG
ACI			GR SAI	OUT		CO1 SLOI	NCRE	TE Drilling Me	: Mud Rotary / NQ Rock (pth: 31.2 m	Coring	Review	ed By: A

PR	IENT: OJEC	tantec BC Hydro Underground West End N: 1150 Nelson Street, Var			n			OLE RECO	BH COORDINATES
DA	TE BC	RED: <u>August 2, 2019 t</u>	ο Αυς	gust (3, 20	19			WATER LEVEL: 4.9 m depth on August 9, 2019
DEРТН (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	STRATA PLOT	TYPE	NUMBER		N-VALUE or RQD %	OTHER TESTS / REMARKS	UNDRAINED SHEAR STRENGTH, CU (kPa) LABORATORY TEST
20 –	23.1	Hard grey SILT (ML)	\dashv						10 20 30 40 50 60 70 80
21 -		Tarace sand Timoist Hard grey silty CLAY to clayey SILT (ML/CL) - moist	+\ \	SS	15	600	83	Percent Passing #200: 58%	
22 -									
23 -				SS	16	500	43	Percent Passing #200: 100%	o •
24 –				SS	17	550	38	Percent Passing #200: 90%	
25 –	18.7	Very dense grey poorly graded SAND with silt (SP-SM) - moist							
26 –				SS	18	575	70		•
27 -									
28 -	15.4								
		Good grey SANDSTONE - fresh - very weak to weak - fine to coarse grained		NQ	19	87	85	ls(50), A = 2.1 MPa UCS = 26.7 MPa	
29 -		- fair below 29.6 m						Is(50), D = 0.1 MPa	
₃₀ ±	ΔM	ater Level Measured In Shallow Sta	ındpipe	dpipe				Drilling Co	ntractor: Sea to Sky Drilling Ltd. Logged By: NG
BACI	(FILL S	ymbol 🔛 asphalt	GR	OUT	./>	CON	NCRE JGH		ethod: Mud Rotary / NQ Rock Coring Reviewed By: A

		Stantec			l	ВОІ	REH	OLE RECO		COC)DUIV	ואדרי			חח	0.150	T NIO		311441	
	LIENT:	BC Hydro T: Underground West End	Subs	tatio	'n				[UT BH	COC	RDIN	IAIES							331441 3.4m	18
		ON: <u>1150 Nelson Street, Var</u>								741) 58982	.0N	4905	25.0E							
		ORED: August 2, 2019 to				19			WA	ATER L	.EVEL	4.9	m c	dep			ugust			
					SAM	PLES				RAINE										Ĺ
DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION (USCS)	TA PLOT		Æ	(mm)	3 E	OTHER TESTS / REMARKS		ORATO CKET P 50		•	▲ ★ 00 kPc	PC	OCKE	ANE TI T SHEA) kPa +	R VAN	◆ E ■) kPa	BACKFILL/ MONITOR WELL PIEZOMETER	ELEVATION (m)
٦	ELEV	(4005)	STRATA	TYPE	NUMBER	RECOVERY Or ICR	N-VALUE or RQD %			TER Co		WS/0.	3m		3 LIMI Blow Col		W _P W	W _L	BA MON PIE	ELE
- 30 -		Good grey SANDSTONE	187	11					1	0 2	20 : : :	30	40	5		60 	70	80 : : : :		-
-	13.4	fresh very weak to weak fine to coarse grained		NQ	20	96	70	Is(50), A = 2.2 MPa												- - 13
- 31 -		Fair grey silty clay SHALE - fresh		1				Is(50), D = 0.2 MPa												E
	12.2	- very weak - excellent quality below 30.9 m	_\	NQ	21	100	100	Is(50), D = 0.5 MPa UCS = 11.0 MPa	1 1 1 1		1 : : :		: ::		: : : :	1 1 1 1				Ė
-		End of borehole BH19-05 at 31.2 m. Target depth reached. Shallow piezometer installed at 6.2 m																		- 12 -
- 32 -		depth. Dry on August 9, 2019.																	-	- - - - - - -
																				- 11
- 33 -											: : :									-
																				- - 10
																				 - -
- 34 -																			-	- - - - - 9
- 35 -																				[
35 -																				-
																				- 8 - - - -
- 36 -																				- - - - 7
																				- -
- 37 -	1								::::		: : :					: : :				<u> -</u> - -
																				- 6
- 38 -																				- - -
																				- - - 5
- 39 -																				- - - -
																				- 4
																				- - -
- 40 -	ΣV	l Vater Level Measured In Shallow Star	ndpipe	⊢				Drilling Co	ntract	or: Se	a to	:::: Sky D	::L::: Prilling	لننـ g Lt	d.	1:::	:-:::: L	ogge	d By: NO	L G
ВАС	KFILL S	Symbol Rasphalt	GR	OUT	D]COI	NCRE									ng			ved By:	
	ENTO		SA			SLO	UGH	Completic	n Dep	oth: 3	31.2 n	n					Р	age -	4 of 4	

Appendix C LAB TEST RESULTS



C.1 LABORATORY TEST RESULTS - SOIL





Client: BC Hydro

Project Name: West End Underground Substa.

Project No: 123314418 Date Received: July 26, 2019

Date Tested: August 22, 2019

HQ / WdC / JD Tested By:

LABORATORY OFFICE

3711 North Fraser Way 4730 Kingsway

Suite 500 Suite 400

Burnaby, BC Burnaby, BC

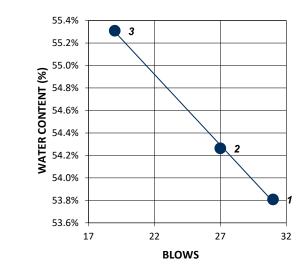
Canada V5H 0C6 Canada V5J 5J2 Tel: (604) 436-3014 Tel: (604) 436-3014

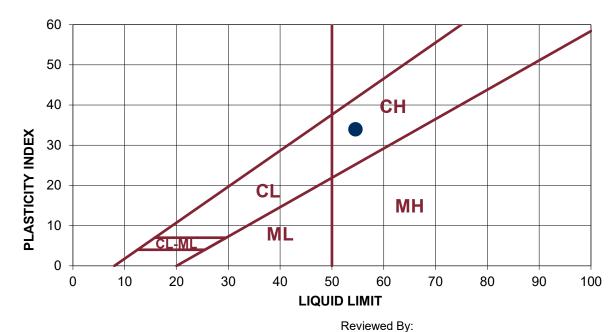
Sample: BH19-01, SS-09, 38'-40'

	LIQUID LIMIT			PLA	STIC LIMIT	
Trial	1	2	3	-Trial	1	2
No. of Blows	31	27	19	Illui	ı	Z
Tare No.				Tare No.		
Wt. Sa. (wet+tare)(g)	6	7	8	Wt. Sa. (wet+tare)(g)	29.81	29.795
Wt. Sa. (dry+tare)(g)	5	5	6	Wt. Sa. (dry+tare)(g)	28.26	28.229
Wt. Tare (g)	1	1	1	Wt. Tare (g)	20.91	20.895
Wt. Dry Soil (g)	3.4	3.4	4.3	Wt. Dry Soil (g)	7.4	7.3
Wt. Water (g)	1.8	1.9	2.4	Wt. Water (g)	1.6	1.6
Water Content (%)	53.8%	54.3%	55.3%	Water Content (%)	21.1%	21.4%

RESULTS

_	IV L	JULIJ
	LL	55
	PL	21
	PI	34
	Natura	I MC (%)
	23	3.0%







ASTM D4318 Method A- Multi-Point Client: BC Hydro

Project Name: West End Underground Substa.

Project No: 123314418 Date Received: July 26, 2019

Date Tested: August 22, 2019

Tested By: HQ / WdC / JD

OFFICE LABORATORY

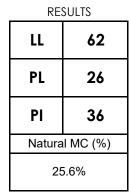
4730 Kingsway 3711 North Fraser Way

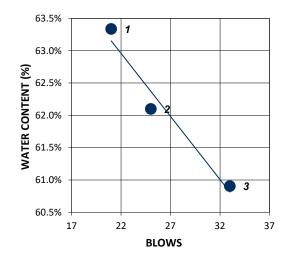
Suite 500 Suite 400

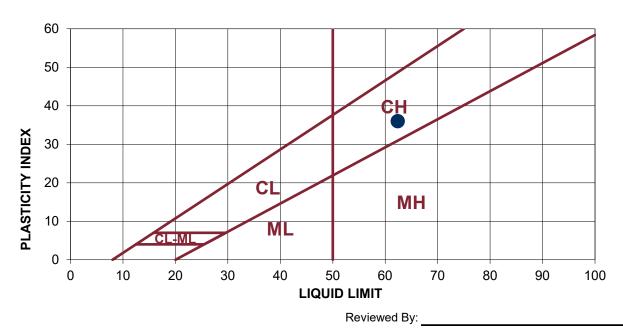
Burnaby, BC Burnaby, BC Canada V5H 0C6 Canada V5J 5J2

Tel: (604) 436-3014 Tel: (604) 436-3014

Sample:	BH19-02, SS-11, 48'-50'					
	LIQUID LIMIT			<u> </u>	ASTIC LIMIT	
Trial	1	2	3	Trial	1	2
No. of Blows	21	25	33	Illui	'	2
Tare No.				Tare No.		
Wt. Sa. (wet+tare)(g)	10	7	12	Wt. Sa. (wet+tare)(g)	28.02	28.561
Wt. Sa. (dry+tare)(g)	7	5	8	Wt. Sa. (dry+tare)(g)	26.54	27.025
Wt. Tare (g)	1	1	1	Wt. Tare (g)	20.93	20.895
Wt. Dry Soil (g)	5.3	3.8	6.9	Wt. Dry Soil (g)	5.6	6.1
Wt. Water (g)	3.4	2.4	4.2	Wt. Water (g)	1.5	1.5
Water Content (%)	63.3%	62.1%	60.9%	Water Content (%)	26.2%	25.1%









ASTM D4318 Method A- Multi-Point Client: BC Hydro

West End Underground Substa. Project Name:

Project No: 123314418 Date Received: July 26, 2019

D

Tested By: HQ / WdC / JD **OFFICE LABORATORY**

4730 Kingsway 3711 North Fraser Way

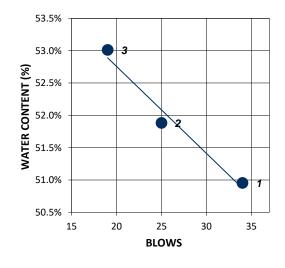
Suite 500 Suite 400 Burnaby, BC Burnaby, BC

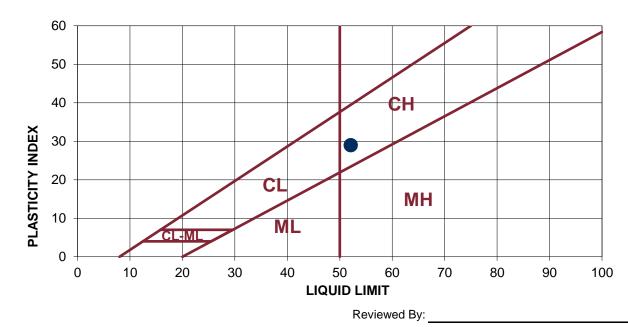
Canada V5H 0C6 Canada V5J 5J2

Date Tested:	August 22, 2019	Tel: (604) 436-3014	Tel: (604) 436-3014
acted By:	HO / WAC / ID		

Sample:	BH19-04, SS-11, 48'-50'					
	LIQUID LIMIT			_ PL <i>A</i>	STIC LIMIT	
Trial	1	2	3	Trial	1	2
No. of Blows	34	25	19		'	
Tare No.				Tare No.		
Wt. Sa. (wet+tare)(g)	7	7	8	Wt. Sa. (wet+tare)(g)	26.62	30.446
Wt. Sa. (dry+tare)(g)	5	5	6	Wt. Sa. (dry+tare)(g)	25.57	28.64
Wt. Tare (g)	1	1	1	Wt. Tare (g)	20.92	20.838
Wt. Dry Soil (g)	4.0	3.5	4.5	Wt. Dry Soil (g)	4.7	7.8
Wt. Water (g)	2.0	1.8	2.4	Wt. Water (g)	1.0	1.8
Water Content (%)	51.0%	51.9%	53.0%	Water Content (%)	22.4%	23.1%

RESULTS				
LL	52			
PL	23			
PI	29			
Natural MC (%)				
20.3%				







ASTM D4318 Method A- Multi-Point Client: BC Hydro

Project Name: West End Underground Substa.

Project No: 123314418 Date Received: July 26, 2019

Date Tested: August 22, 2019

Tested By: HQ / WdC / JD

OFFICE LABORATORY

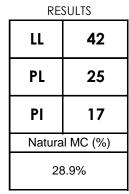
4730 Kingsway 3711 North Fraser Way

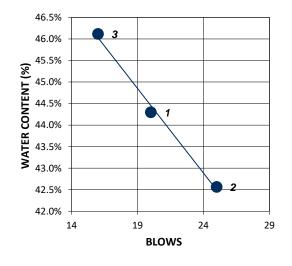
Suite 500 Suite 400

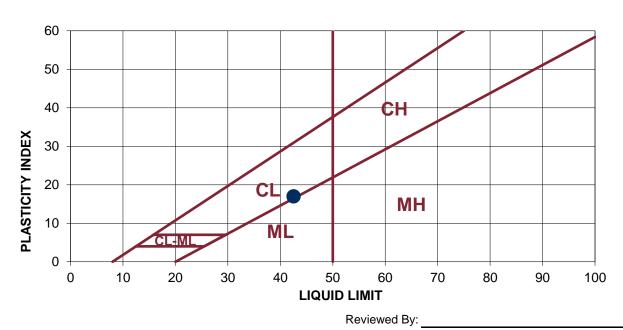
Burnaby, BC Burnaby, BC Canada V5H 0C6 Canada V5J 5J2

Tel: (604) 436-3014 Tel: (604) 436-3014

Sample:	BH19-04, SS-13, 58'-60'					
LIQUID LIMIT				_ PL <i>A</i>	STIC LIMIT	
Trial	1	2	3	Trial	1	2
No. of Blows	20	25	16		'	2
Tare No.				Tare No.		
Wt. Sa. (wet+tare)(g)	11	12	8	Wt. Sa. (wet+tare)(g)	29.18	27.9
Wt. Sa. (dry+tare)(g)	8	9	6	Wt. Sa. (dry+tare)(g)	27.52	26.486
Wt. Tare (g)	1	1	1	Wt. Tare (g)	21.01	20.873
Wt. Dry Soil (g)	6.6	7.6	4.8	Wt. Dry Soil (g)	6.5	5.6
Wt. Water (g)	2.9	3.2	2.2	Wt. Water (g)	1.7	1.4
Water Content (%)	44.3%	42.6%	46.1%	Water Content (%)	25.4%	25.2%









ASTM D4318 Method A- Multi-Point Client: BC Hydro

Project Name: West End Underground Substa.

Project No: 123314418 Date Received: July 26, 2019

Date Tested: August 22, 2019

Tested By: HQ / WdC / JD

OFFICE LABORATORY

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Suite 500 Suite 400
Burnaby, BC Burnaby, BC

Canada V5H 0C6 Canada V5J 5J2
Tel: (604) 436-3014 Tel: (604) 436-3014

Sample:	BH19-05, SS					
	LIQUID LIMIT			_ PLA	STIC LIMIT	
Trial	1	2	3	Trial	1	2
No. of Blows	16	25	27		'	
Tare No.				Tare No.		
Wt. Sa. (wet+tare)(g)	9	7	11	Wt. Sa. (wet+tare)(g)	27.67	29.24
Wt. Sa. (dry+tare)(g)	6	5	8	Wt. Sa. (dry+tare)(g)	26.35	27.601
Wt. Tare (g)	1	1	1	Wt. Tare (g)	20.95	21.055
Wt. Dry Soil (g)	5.1	3.9	6.4	Wt. Dry Soil (g)	5.4	6.5
Wt. Water (g)	3.0	2.2	3.6	Wt. Water (g)	1.3	1.6
Water Content (%)	58.8%	56.4%	55.9%	Water Content (%)	24.3%	25.0%

RESULTS

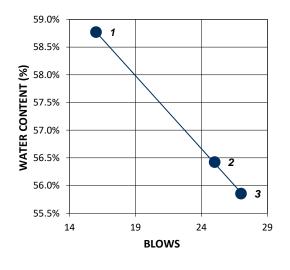
LL 56

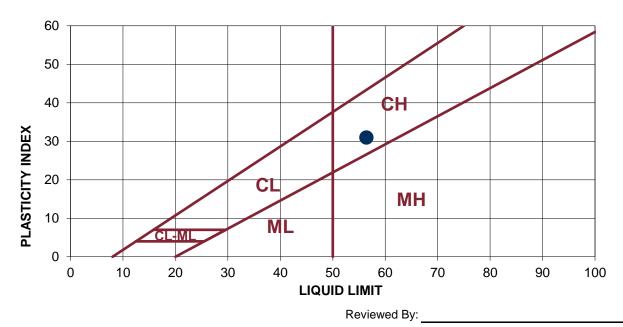
PL 25

PI 31

Natural MC (%)

49.5%







SOURCE:

ASTM C136, ASTM C117

Client: BC Hydro

Project Name: West End Underground Substa.

Project No: 123314418

OFFICE

LABORATORY

4730 Kingsway

3711 North Fraser Way

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Burnaby, BC

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Canada V5J5J2

Tel: (604) 436-3014

Tel: (604) 436-3014

SAMPLE No.: BH19-01, SS-07, 28'-30'

1150 Nelson ST.

TESTED BY: HQ / WdC

DATE RECEIVED: July 25, 2019 DATE TESTED: August 21, 2019

SAMPLE DESCRIPTION: Gray, silty SAND with gravel, (SM)



Sieve	Sample	Specifi	cations
(mm)	% Passing	Lower	Upper
150.0	-	-	-
125.0	-	-	-
100.0	-	-	-
75.0	-	-	-
50.0	-	-	-
38.0	-	-	-
25.0	100.0	-	-
19.0	90.6	-	-
16.0	-	-	-
12.5	-	-	-
9.5	86.4	-	-
4.75	81.8	-	-
2.36	78.8	-	-
1.18	75.2	-	-
0.600	71.0	-	-
0.300	63.4	-	-
0.150	51.6	-	-
0.075	43.5	-	-
Cobble:	0.0%	D ₁₀ :	-
Gravel:	18.2%	D ₃₀ :	-
Sand:	38.3%	D ₆₀ :	0.2597
Fines:	43.5%	C _u :	-
		C _c :	-

Comments:

Reviewed by:



ASTM C136, ASTM C117

Client: BC Hydro

Project Name: West End Underground Substa.

Project No: 123314418

OFFICE

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Burnaby, BC

Burnaby, BC

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Canada V5J5J2

Tel: (604) 436-3014

Tel: (604) 436-3014

SAMPLE No.: BH19-01, SS-14, 63.0'-65.0'

1150 Nelson ST.

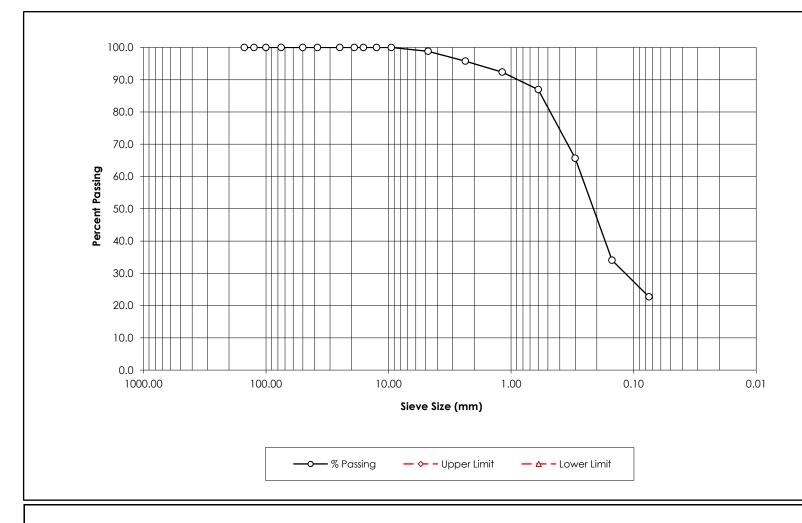
TESTED BY: HQ / WdC

SOURCE:

DATE RECEIVED: July 25, 2019

DATE TESTED: August 23, 2019

SAMPLE DESCRIPTION: Gray, silty SAND, (SM)



Sieve	Sample	Specifi	cations
(mm)	% Passing	Lower	Upper
150.0	-	-	-
125.0	-	-	-
100.0	-	-	-
75.0	-	-	-
50.0	-	-	-
38.0	-	-	-
25.0	-	-	-
19.0	-	-	-
16.0	-	-	-
12.5	-	-	-
9.5	100.0	-	-
4.75	98.8	-	-
2.36	95.7	-	-
1.18	92.4	-	-
0.600	86.9	-	-
0.300	65.6	-	-
0.150	34.1	-	-
0.075	22.7	-	-
Cobble:	0.0%	D ₁₀ :	=
Gravel:	1.2%	D ₃₀ :	0.1266
Sand:	76.1%	D ₆₀ :	0.2794
Fines:	22.7%	C _u :	
		C _c :	
	•		

Comments:

Reviewed by:



ASTM C136, ASTM C117

Client: BC Hydro

Project Name: West End Underground Substa.

Project No: 123314418

OFFICE

LABORATORY

4730 Kingsway

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Suite 500

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Burnaby, BC

Burnaby, BC

Canada V5H 0C6

Canada V5J5J2

Tel: (604) 436-3014

Tel: (604) 436-3014

SAMPLE No.: BH19-01, SS-17, 78.0'-80.0'

1150 Nelson ST.

TESTED BY: HQ / WdC

SOURCE:

DATE RECEIVED: July 25, 2019 DATE TESTED: August 23, 2019

SAMPLE DESCRIPTION: Gray, silty SAND with gravel, (SM)



	Sieve	Sample	Specifi	cations
	(mm)	% Passing	Lower	Upper
	150.0	-	-	-
	125.0	-	-	-
	100.0	-	-	-
	75.0	-	-	-
	50.0	-	-	-
	38.0	100.0	-	-
	25.0	94.0	-	-
	19.0	-	-	-
	16.0	87.2	-	-
	12.5	82.8	-	-
	9.5	76.9	-	-
	4.75	65.6	-	-
	2.36	55.4	-	-
	1.18	45.4	-	-
	0.600	37.4	-	-
	0.300	28.5	-	-
	0.150	21.0	-	-
	0.075	16.2	-	-
	Cobble:	0.0%	D ₁₀ :	-
	Gravel:	34.4%	D ₃₀ :	0.3579
	Sand:	49.4%	D ₆₀ :	3.4864
	Fines:	16.2%	C _u :	_
			C _c :	-
•	-			

Comments:

Reviewed by:



ASTM C136, ASTM C117

Client: BC Hydro

Project Name: West End Underground Substa.

Project No: 123314418

OFFICE

LABORATORY

4730 Kingsway

3711 North Fraser Way

Suite 500

Suite 400

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Burnaby, BC

Canada V5H 0C6

Canada V5J5J2

Tel: (604) 436-3014

Tel: (604) 436-3014

SAMPLE No.: BH19-02, SS-07, 28.0'-30.0'

1150 Nelson ST.

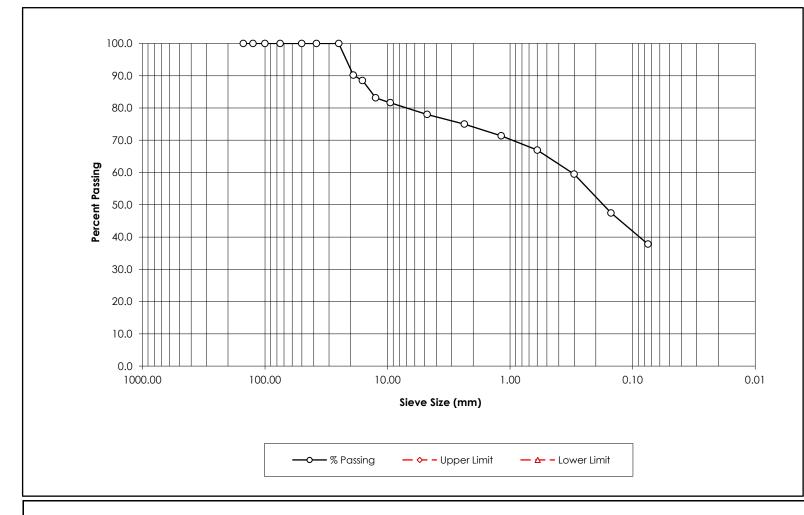
TESTED BY: HQ / WdC

SOURCE:

DATE RECEIVED: July 25, 2019

DATE TESTED: August 23, 2019

SAMPLE DESCRIPTION: Gray, silty SAND with gravel, (SM)



	Sieve	Sample	Specifi	cations
	(mm)	% Passing	Lower	Upper
	150.0	-	-	-
	125.0	-	-	-
	100.0	-	-	-
	75.0	-	-	-
	50.0	-	-	-
	38.0	-	-	-
	25.0	100.0	-	-
	19.0	90.1	-	-
	16.0	88.5	-	-
	12.5	83.1	-	-
	9.5	81.6	-	-
	4.75	78.0	-	-
	2.36	75.0	-	-
	1.18	71.3	-	-
	0.600	67.0	-	-
	0.300	59.5	-	-
	0.150	47.5	-	-
	0.075	37.8	-	-
	Cobble:	0.0%	D ₁₀ :	_
	Gravel:	22.0%	D ₃₀ :	-
	Sand:	40.2%	D ₆₀ :	0.3220
	Fines:	37.8%	C _u :	-
			C _c :	-
_	,			

Comments:

Reviewed by: