Final Geotechnical Site Assessment Report - Pacific Traverse Trail, Pacific Rim National Park Reserve

Vancouver Island, BC
Wood File: KA21151

Prepared for:

Public Works and Government Services Canada
219 – 800 Burrard Street, Vancouver, BC V6Z 0B9

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1.0 Introduction

Wood Environment & Infrastructure Solutions (Wood) is pleased to present this geotechnical site assessment report for the proposed Pacific Traverse Trail project in Pacific Rim National Park, Vancouver Island, BC. This report includes the findings of geotechnical site investigations completed by Amec Foster Wheeler from December 6 to December 16, 2016 (Phase 1), from February 22 to February 27, 2017 (Phase 2), on April 27, 2017 (Phase 2), and from November 6 to November 24, 2017 (Phase 3).

The purpose of this report is to provide geotechnical information for the design of bridge foundations, elevated pathway or boardwalk foundations, at-grade pathways, cut and fill slopes, retaining walls, and Radar Hill parking lot, as a result of significant project design changes that have occured since Amec Foster Wheeler involvement in 2017. The opinions provided in this report are based on review of available geotechnical reports and terrain mapping by others, and information from the geotechnical site investigations completed by Amec Foster Wheeler. It should be noted that the field work completed by Amec Foster Wheeler was over machine and foot accessible areas along the trail alignment, primarily over natural open areas in between heavily treed areas, some foot accessible areas in heavily treed areas, and pathway areas that have been cleared. The recommendations provided in this report are intended as guidance for planning and design.

This report supersedes previous Amec Foster Wheeler reports, memos, and letters prepared for the Pacific Traverse Trail project, in particular the draft geotechnical report[1] prepared by Amec Foster Wheeler dated December 26, 2017.

2.0 Background

2.1 Project

The project consists of design and construction of an approximately 30 km long multi use pathway from Ucluelet to Tofino. The trail is intended for pedestrians and cyclists but is also to be designed to accommodate light emergency and maintenance vehicles. A site location plan is attached as Figure 1.

It is understood that, for the most part, the trail will be supported at-grade, asphalt surfaced and underlain by granular base and subbase courses placed atop geogrid and/ or a geotextile over native subgrade. There will be crossings of wetlands which will consist of elevated pathways or boardwalks comprising of wood panels (timber decks and stringers) elevated on closely spaced steel pier beams founded on posts/piles.

There will be three bridge crossings of creeks (Bridge No.3, No. 19, and No.20) with spans from 20 to about 30 m long.

The trail will traverse over undulating relatively flat-lying areas and across slopes. Retaining walls and cut/ fill slopes will be constructed along the trail at select locations. Some wall/ slope sites will be detailed with culverts to traverse creeks.

As of November 2017, the trail alignment was flagged in the field and about ninety percent of the trail alignment had been cleared, however within areas where proposed retaining walls and slopes are proposed, some areas were not yet cleared. The cleared areas were not necessarily accessible by rubber-

1 "Geotechnical Site Assessment Report – Phase 3 (draft), Pacific Traverse Trail", Amec Foster Wheeler, December 26, 2017

tired and/ or tracked vehicles/ construction equipment. The proposed Radar Hill Parking lot had also been cleared of trees.

The most recent trail construction drawings[2] forwarded to us show the proposed trail alignment and proposed locations of at-grade and elevated trail areas, bridges, retaining walls, cut and fill slopes. The alignment of the proposed trail has not significantly changed since the previous trail construction drawings dated 2017, to which Amec Foster Wheeler referred to in their report of December 26, 2017. The drawings provide both Pacific Rim Highway road stationing and trail stationing. For clarity, as requested by Parsons, stationing referenced in this report and to identify borehole locations are based on the closest Pacific Rim Highway road stationing (not trail stationing). Note that our station referencing is considered approximate. Trail stationing was not used as it was understood that it can change based on any future changes to the trail alignment. Both the road and trail stationing however are noted in the trail design drawings.

In addition, it is understood that elevations presented in the trail design drawings were taken from Lidar information and that Parsons is referencing these elevations in their designs. For clarity, any elevations we reference in this report or in borehole logs are estimated based on elevation information from the trail design drawings. Our work does not include field survey of elevations that are referenced in this report. The elevations reference in this report or in borehole logs should be considered as estimates. Field survey of elevations should be completed by others for detailed design and for bidding purposes.

3.0 Geotechnical Site Investigations

Field work was coordinated with Public Works and Government Services Canada (PWGSC) and Parsons and consisted of hand auger drilled, portable hammer drilled, and solid stem/ hollow stem auger drilled boreholes over areas of, or nearby, the trail alignment. Field work spanned from December 2016 to November 2017, over multiple stages of the project design and trail clearing schedule. Surface, subsurface soil and groundwater conditions were observed and documented during the field work. Standard Penetration Testing (SPT) and Cone Penetration Testing (CPT) were conducted at select borehole locations to determine relative densities and strengths of in-situ soils, in-situ pore water pressures, and to review and compare CPT soil characterization/ interpretation to soils observed from solid stem/ hollow stem auger drilled boreholes. Vane shear tests were conducted using a hand-held field vane (Roctest Model H-60) on clay or clayey silt subgrade to obtain the peak and remoulded soil strengths of the soils at select locations. Select soil samples were obtained from the boreholes and classified in general accordance with the Modified Unified Soil Classification System. The soil samples were submitted to Amec Foster Wheeler's Surrey Civil Engineering Laboratory to confirm field classifications and to conduct tests such as moisture content and Atterberg Limits.

Prior to any drilling, the borehole locations were checked for the presence of underground services by a private underground utility locator in addition to BC One Call and review of any underground utility information provided by PWGSC. Where boreholes were located alongside road shoulders, traffic control was provided. The borehole drilling was monitored by an Amec Foster Wheeler representative, who classified the encountered soils, maintained detailed logs of boreholes and recorded groundwater conditions.

The boreholes were backfilled with the soil cuttings at the completion of the field works.

2 Pacific Rim National Reserve Park, Trail Construction Drawings, Parsons, November 2018

The borehole logs are presented in Appendix A. Approximate borehole locations are shown in Figure 2. The approximate locations of historical boreholes and test pits advanced by others are also shown in Figure 2.

3.1 Solid Stem/ Hollow Stem and Portable Hammer Drilled Boreholes – November 6 to 24, 2017

The trail alignment at this stage of the project was about 90% cleared, except for some proposed slope/ wall areas. The cleared areas of the trail were not grubbed (tree stumps remained in-place, in some areas felled trees were still in-place along the cleared trail).

The purpose of the field work was to advance additional boreholes where required and where accessible to finalize the geotechnical reporting for the project. The field work comprised of the following:

- Five solid stem/ hollow stem drilled boreholes (BH17-08 to BH17-12) from about ten to 30 m depths;
- Two CPT tests (CPT17-08 to CPT17-09) from about 17 to 30 m depths;
- Forty-five portable hand held, portable hammer drilled boreholes (PH17-01 to PH17-45) generally to about six to seven metre depths unless effective refusal was encountered at earlier depths; and
- One hand auger borehole (HA17-18) to about 0.6 m depth.

Generally, the solid stem/ hollow stem drilling and CPTs were advanced over proposed bridge abutment locations to allow design of deeply founded, bridge pile foundations, and over slopes where relatively deep boreholes were desired to model deep seated potential slope movements.

The hand held portable hammer drill was used to advance boreholes along the trail alignment and various slope/ wall locations over ecologically sensitive areas and over areas where there were site constraints for rubber-tired and/ or tracked vehicles/ construction equipment access (cleared but not grubbed areas, and areas not cleared).

3.2 Hand Auger Boreholes – April 27, 2017

The trail alignment at this stage of the project was about 23% cleared. Clearing of trees and ground vegetation was limited to the northerly seven kilometers of the trail alignment only. Hand auger boreholes, field vane shear testing, and general hand probing of subgrade along the limited cleared trail areas were conducted in order to assist in the interim geotechnical design aspects of the trail (mainly to determine typical stripping depths to suitable subgrade along the cleared trail areas). The balance of the trail alignment remained forested. Fifteen hand auger boreholes were advanced (HA17-03 to HA17-17) at select locations along the cleared trail alignment.

Organic material was generally encountered at the ground surface, underlain by mineral sand and/ or silt/clay deposits. A summary of the measured thickness of organic material, subgrade classification below organic material, and soil shear strength properties from field vanes when applicable, encountered in the hand auger boreholes are shown in Table 1 and are presented in more detail on the borehole logs provided in Appendix A.

3.3 Solid Stem/ Hollow Stem Drilled and Hand Auger Boreholes – February 22 to 27, 2017

Clearing of the trail alignment at this stage of the project had not yet commenced. Seven boreholes were drilled along the road shoulder of Pacific Rim Highway (BH17-01 to BH17-07) using an auger drill rig operated by Drillwell Ltd. from February 22 to 27, 2017. In addition, two hand auger boreholes (HA17-01 and HA17-02) were advanced near the toe of select road embankments on February 26, 2017.

Appropriate traffic control measures were provided for drilling on and along the shoulder of the highway. The purpose of the drilling prior to clearing of the trail alignment was to determine soil stratigraphy and strengths anticipated near slopes and bridge abutment locations that will require slope stability modelling and understanding of the ability of soils at greater depths to resist deeply founded, bridge pile supports, to assist in the interim geotechnical design aspects of the trail.

Most of the mineral soil encountered along the north portion of the trail (north of Incinerator Rock) was marine clay. Generally, soils encountered along the south portion of the trail (south of Incinerator Rock) was primarily sands and gravels underlain by marine clay (as encountered in BH17-06 and BH17-07). Compact sand with a thickness of about five metres over marine clay encountered in BH17-01 and BH17-02 was noted to be possibly road embankment backfill.

The thickness of organic material above the mineral soil was measured at drilled borehole and hand augur borehole locations.

3.4 Hand Auger Boreholes - December 6 to 16, 2016

Twenty-three hand auger boreholes (HA16-01 to HA16-23) were advanced and field vane shear testing was completed along portions of the trail alignment that had natural clearing in between forested areas to obtain preliminary geotechnical subsurface information to support preliminary geotechnical design commentary.

3.5 Summary of Borehole Information

Table 1 provides a summary of approximate topsoil thickness, condition of subgrade material, and soil shear strength when appropriate, encountered in boreholes from the geotechnical site investigations.

Table 1: Summary of Borehole Information

Borehole No.	Borehole Depth (m)	Approximate Topsoil Thickness (m)	Mineral Subgrade Material	Soil Shear Strength, Su (kPa)	Sensitivity, S_t
PH17-01	6.1	0.2	1 m thick compact sand layer, followed by very stiff to soft clay	22 (Soft) – 120 (Very Stiff)	-
PH17-02	2.1	0.3	1.5 m thick firm clay layer, followed by dense sand	30	-
PH17-03	7.3	0.4	1.6 m thick compact sand layer, followed by stiff to firm clay	25 (Firm) – 87 (Stiff)	-
PH17-04	6.1	1.0	Very stiff to stiff clay	52 (Stiff) – 188 (Very Stiff)	-

Borehole No.	Borehole Depth (m)	Approximate Topsoil Thickness (m)	Mineral Subgrade Material	Soil Shear Strength, Su (kPa)	Sensitivity, S_t
PH17-05	6.1	1.0	Very stiff to soft clay	22 (Soft) – 180 (Very Stiff)	-
PH17-06	5.6	0.3	Very stiff to stiff clay	30 (Stiff) – 140 (Very Stiff)	-
PH17-07	3.4	0.4	200 mm thick compact sand and gravel fill, followed by firm sandy clay	40	-
PH17-08	2.2	0.5	Stiff to firm clay	40 (Firm) – 75 (Stiff)	-
PH17-09	4.9	1.2	Compact sand interlayered with firm clay	N/A	-
PH17-10	3.2	2.0	Compact sand	N/A	-
PH17-11	6.1	0.5	Stiff to soft clay	28 (Stiff) – 17 (Soft)	-
PH17-12	0.5	0.3	Dense sand and gravel	N/A	-
PH17-13	0.5	0.3	Dense sand and gravel	N/A	-
PH17-14	2.7	1.9	500 mm thick soft clay layer, followed by compact to loose sand. Possible wood logs below 2.7 m.	N/A	-
PH17-15	6.1	2.0	Firm to soft clay	13 (Soft) – 38 (Firm)	-
PH17-16	6.1	1.0	Firm to soft clay	14 (Soft) – 40 (Firm)	-
PH17-17	6.1	1.3	Firm to soft clay	13 (Soft) – 32 (Firm)	-
PH17-18	6.1	Nil	1.2 m thick compact sand layer, followed by stiff to soft clay	19 (Soft) – 125 (Stiff)	-
PH17-19	6.1	0.5	Firm clay interlayered with compact sand	22	-
PH17-20	3.9	1.0	Compact sand	N/A	-
PH17-21	4.1	0.7	Compact sand interlayered with firm clay	26	-

Borehole No.	Borehole Depth (m)	Approximate Topsoil Thickness (m)	Mineral Subgrade Material	Soil Shear Strength, Su (kPa)	Sensitivity, S_t
PH17-22	6.1	0.5	2.4 m thick layer of compact sand, followed by compact sand interlayered with firm clay	26 - 40	-
PH17-23	3.0	0.5	Compact sand	N/A	-
PH17-24	6.1	0.5	Compact sand	N/A	-
PH17-25	6.1	0.5	3.0 m thick layer of compact sand, followed by compact sand interlayered with firm clay	N/A	-
PH17-26	5.6	0.4	Compact sand	N/A	-
PH17-27	5.7	1.2	Compact sand	N/A	-
PH17-28	2.6	0.3	Stiff to firm clay	41 - 45	-
PH17-29	3.0	0.8	Stiff to firm clay	50 (Firm) - 118 (Stiff)	-
PH17-30	3.5	0.6	Stiff to firm clay	44 (Firm) - 122 (Stiff)	-
PH17-31	4.0	0.6	Stiff to firm clay	25 (Firm) - 103 (Stiff)	-
PH17-32	6.1	0.7	Firm to soft clay	20 (Soft)	-
PH17-33	5.5	0.6	900 mm thick compact sand layer, followed by frim to soft clay	22 (Soft) – 45 (Firm)	-
PH17-34	3.3	0.4	Compact sand	N/A	-
PH17-35	2.7	1.0	Compact sand	N/A	-
PH17-36	2.4	1.0	Compact sand	N/A	-
PH17-37	3.2	0.4	Stiff to firm clay	21 (Firm) – Stiff (122)	-
PH17-38	2.0	0.4	Stiff to firm clay	40 (Firm) – Stiff (122)	-
PH17-39	3.5	0.5	Stiff to firm clay	28 (Firm) – Stiff (82)	-
PH17-40	4.2	1.0	Firm clay	22 - 30	-
PH17-41	2.0	0.4	1.4 m thick stiff clay layer, followed by compact sand	95 - 115	-
PH17-42	2.0	0.4	400 mm thick loose sand layer, followed by compact sand and gravel	N/A	-

Borehole No.	Borehole Depth (m)	Approximate Topsoil Thickness (m)	Mineral Subgrade Material	Soil Shear Strength, Su (kPa)	Sensitivity, S_t
PH17-43	1.5	0.3	300 mm thick loose sand layer, followed by compact sand and gravel	N/A	-
PH17-44	1.9	0.7	800 mm thick compact sand layer, followed by compact sand and gravel	N/A	-
PH17-45	2.2	0.7	1.2 m thick loose to compact sand layer, followed by compact sand and gravel	N/A	-
HA17-01	2.1	0.3	1.7 m of clay, soft, over sand, compact	-	-
HA17-02	2.0	Nil	0.9 m of clay, soft, over sand, compact	-	-
HA17-03	1.2	0.4	Clayey silt, soft to firm	23	1.2
HA17-04	1.2	0.3	Clayey silt, soft to firm	-	-
HA17-05	1.0	Nil	600 mm thick sand, compact, followed by silty clay	70	-
HA17-06	1.2	0.3	Clayey silt, soft to firm	-	-
HA17-09	0.8	0.6	Silt, some gravel	-	-
HA17-10	1.5	0.9	300 mm thick sand, compact, followed by clayey silt	35	2.2
HA17-08	1.8	0.3	1.0 m thick sand, compact, followed by silty clay	-	-
HA17-07	1.8	0.3	1.2 m thick sand, compact, followed by clay	-	-
HA17-11	1.8	0.6	Sand, compact	N/A	N/A
HA17-12	1.2	Nil	Sand, compact	N/A	N/A
HA17-13	1.2	0.5	Sand, compact	N/A	N/A
HA17-14	1.1	0.3	400 mm thick sand, compact, followed by clayey silt	70	3.0
HA17-15	1.1	0.2	Sand, compact	N/A	N/A
HA17-16	1.1	0.3	Sand, compact	N/A	N/A
HA17-17	1.2	0.3	Sand, compact	N/A	N/A
HA17-18	0.6	Nil	Loose sand and gravel fill	N/A	N/A

Borehole No.	Borehole Depth (m)	Approximate Topsoil Thickness (m)	Mineral Subgrade Material	Soil Shear Strength, Su (kPa)	Sensitivity, S_t
BH17-01	14.3	Nil	0.3 m asphalt/road base over 4. m thick sand, compact	-	-
BH17-02	12.8	Nil	0.3m asphalt/road base over 4.9m thick sand, compact	-	-
BH17-03	14.3	1.7	Clay, very soft.	-	-
BH17-04	15.8	Nil	0.3m asphalt/road base over clay, stiff to soft.	-	-
BH17-05	15.8	Nil	0.3m asphalt/road base over clay, firm to soft.	-	-
BH17-06	12.7	Nil	0.3m asphalt/road base over sand, compact	N/A	N/A
BH17-07	22.9	1.1	sand, compact	N/A	N/A
BH17-08	16.8	Nil	4 m thick granular fill layer (underlying 130 mm of asphalt), followed by 2.8 m thick compact sand interlayered with peat and soft clay, followed by firm clay	N/A	N/A
BH17-09	29.9	Nil	1.1 m thick granular fill layer (underlying 130 mm of asphalt), followed by stiff to soft clay	N/A	N/A
BH17-10	16.2	Nil	3 m thick granular fill layer (underlying 120 mm of asphalt), followed by 1.3 m thick peat layer, followed by dense sand	N/A	N/A
BH17-11	10.4	Nil	1.5 m thick granular fill layer (underlying 150 mm of asphalt), followed by 4.4 m thick compact sand interlayered with stiff clay, followed by firm clay	N/A	N/A

Borehole No.	Borehole Depth (m)	Approximate Topsoil Thickness (m)	Mineral Subgrade Material	Soil Shear Strength, Su (kPa)	Sensitivity, S_t
BH17-12	10.1	Nil	6.6 m thick granular fill layer (underlying 250 mm of asphalt), followed by 1 m thick firm clay, followed by compact sand	N/A	N/A
HA16-01	2.1	1.2	Clay, soft to stiff	-	-
HA16-02	2.1	0.8	Sand and gravel	N/A	N/A
HA16-03	0.6	0.3	Clay, hard	>280	-
HA16-04	2.1	0.6	Clay, hard	>280	-
HA16-05	2.1	0.6	Clay, hard	>280	-
HA16-06	0.6	0.3	Clay, hard	>280	-
HA16-07	1.5	0.4	Sand	N/A	N/A
HA16-08	1.5	1.0	Sand	N/A	N/A
HA16-09	2.1	0.5	Clay, hard to stiff	-	-
HA16-10	1.8	0.4	Sand	N/A	N/A
HA16-11	2.0	1.1	Sand	N/A	N/A
HA16-12	1.8	0.6	Sand	N/A	N/A
HA16-13	1.5	0.9	Sand	N/A	N/A
HA16-14	2.1	0.3	Clay, soft to stiff	-	-
HA16-15	1.2	0.6	Sand	N/A	N/A
HA16-16	1.1	0.3	Clay, firm to hard	-	-
HA16-17	1.5	0.4	Clay, firm to very stiff	-	-
HA16-18	2.0	1.4	Sand	N/A	N/A
HA16-19	2.1	0.9	Clay, stiff	140	-
HA16-20	1.4	0.9	Sand	N/A	N/A
HA16-21	1.3	1.1	Sand	N/A	N/A
HA16-22	0.5	0.4	Sand and gravel	N/A	N/A
HA16-23	2.1	0.4	Clay, firm to stiff	-	-

Notes:

1. Boreholes are near or on the proposed trail alignment, refer to Figure 2 for relative locations.
2. N/A = not applicable

It is understood that Polar Geoscience Limited completed surficial geology mapping of the project area. The above soil conditions are generally consistent with the surficial geology mapping completed for the project by Polar Geoscience Limited.[3]

It is further understood that Millennia Research Limited has recently conducted archeological work at the site and has measured approximate depths of organics at their test hole locations.

3 Bioterrain, Terrain Stability and Soil Erosion Potential Mapping for The Pacific Traverse Trail, Polar Geoscience Ltd., Polar File No. 750501, August 2016

Review of Amec Foster Wheeler borehole logs and test hole information[4] from Millennia Research Limited may gain a better understanding of the anticipated stripping thickness required to suitable mineral subgrade along the trail alignment. It should be noted that actual stripping thickness will vary between and beyond test hole/ borehole locations.

3.6 Groundwater Conditions

Groundwater depths were measured in 25 mm and 50 mm diameter water monitoring wells, where they were installed in hollow stem/ auger stem boreholes, otherwise groundwater depths were measured in boreholes while drilling or hand auguring. The groundwater depths noted during drilling are presented below in Table 2. Table 3 presents groundwater levels measured in monitoring wells. It should be noted that the observed groundwater is possibly perched. Where the depth of groundwater was noted to be dry, it implies that no groundwater was noted to the depth of the borehole.

Table 2: Groundwater Depth

Borehole Number	Borehole Drilling Date	Measurement Date	Depth to Groundwater (m)
PH17-01	November 6, 2017	November 6, 2017	0
PH17-02	November 6, 2017	November 6, 2017	Dry
PH17-03	November 7, 2017	November 7, 2017	Dry
PH17-06	November 8, 2017	November 8, 2017	Dry
PH17-07	November 8, 2017	November 8, 2017	Dry
PH17-09	November 9, 2017	November 9, 2017	3.3
PH17-10	November 9, 2017	November 9, 2017	2.0
PH17-12	November 9, 2017	November 9, 2017	Dry
PH17-13	November 9, 2017	November 9, 2017	Dry
PH17-14	November 10, 2017	November 10, 2017	2.4
PH17-15	November 10, 2017	November 10, 2017	0
PH17-16	November 10, 2017	November 10, 2017	0
PH17-17	November 10, 2017	November 10, 2017	0
PH17-18	November 11, 2017	November 11, 2017	Dry
PH17-19	November 11, 2017	November 11, 2017	0
PH17-20	November 11, 2017	November 11, 2017	Dry
PH17-21	November 12, 2017	November 12, 2017	Dry
PH17-22	November 12, 2017	November 12, 2017	Dry
PH17-23	November 14, 2017	November 14, 2017	Dry
PH17-24	November 14, 2017	November 14, 2017	Dry
PH17-25	November 15, 2017	November 15, 2017	Dry
PH17-26	November 15, 2017	November 15, 2017	Dry
PH17-27	November 16, 2017	November 16, 2017	Dry
PH17-28	November 16, 2017	November 16, 2017	Dry
PH17-29	November 16, 2017	November 16, 2017	Dry
PH17-30	November 16, 2017	November 16, 2017	Dry
PH17-31	November 16, 2017	November 16, 2017	Dry

4 Shovel Test Logs, Millennia Research Limited, June 22, 2017; Field Maps, Millennia Research Limited, June 12, 2017

Borehole Number	Borehole Drilling Date	Measurement Date	Depth to Groundwater (m)
PH17-32	November 17, 2017	November 17, 2017	Dry
PH17-33	November 17, 2017	November 17, 2017	Dry
PH17-34	November 17, 2017	November 17, 2017	Dry
PH17-35	November 17, 2017	November 17, 2017	Dry
PH17-36	November 17, 2017	November 17, 2017	Dry
PH17-37	November 17, 2017	November 17, 2017	Dry
PH17-38	November 18, 2017	November 18, 2017	Dry
PH17-39	November 18, 2017	November 18, 2017	Dry
PH17-40	November 18, 2017	November 18, 2017	Dry
PH17-41	November 18, 2017	November 18, 2017	Dry
PH17-42	November 18, 2017	November 18, 2017	Dry
PH17-43	November 19, 2017	November 19, 2017	Dry
PH17-44	November 19, 2017	November 19, 2017	Dry
PH17-45	November 19, 2017	November 19, 2017	Dry
HA17-01	February 26, 2017	February 26, 2017	0.3
HA17-02	February 26, 2017	February 26, 2017	0
HA17-03	April 27, 2017	April 27, 2017	0
HA17-04	April 27, 2017	April 27, 2017	0.3
HA17-05	April 27, 2017	April 27, 2017	0.8
HA17-06	April 27, 2017	April 27, 2017	Dry
HA17-07	April 27, 2017	April 27, 2017	0.9
HA17-08	April 27, 2017	April 27, 2017	1.1
HA17-09	April 27, 2017	April 27, 2017	0
HA17-10	April 27, 2017	April 27, 2017	0
HA17-11	April 27, 2017	April 27, 2017	0.1
HA17-12	April 27, 2017	April 27, 2017	0
HA17-13	April 27, 2017	April 27, 2017	0.3
HA17-14	April 27, 2017	April 27, 2017	0.3
HA17-15	April 27, 2017	April 27, 2017	Dry
HA17-16	April 27, 2017	April 27, 2017	Dry
HA17-17	April 27, 2017	April 27, 2017	Dry
HA16-01	December 6, 2016	December 6, 2016	Dry
HA16-02	December 6, 2016	December 6, 2016	Dry
HA16-03	December 7, 2016	December 7, 2016	Dry
HA16-04	December 7, 2016	December 7, 2016	Dry
HA16-05	December 7, 2016	December 7, 2016	Dry
HA16-06	December 7, 2016	December 7, 2016	Dry
HA16-07	December 7, 2016	December 7, 2016	0.3
HA16-08	December 12, 2016	December 12, 2016	0.3
HA16-09	December 13, 2016	December 13, 2016	1.5
HA16-10	December 13, 2016	December 13, 2016	1.0
HA16-11	December 13, 2016	December 13, 2016	0.6

Borehole Number	Borehole Drilling Date	Measurement Date	Depth to Groundwater (m)
HA16-12	December 13, 2016	December 13, 2016	1.5
HA16-13	December 13, 2016	December 13, 2016	0.6
HA16-14	December 14, 2016	December 14, 2016	Dry
HA16-15	December 14, 2016	December 14, 2016	0.5
HA16-16	December 14, 2016	December 14, 2016	Dry
HA16-17	December 14, 2016	December 14, 2016	Dry
HA16-18	December 15, 2016	December 15, 2016	1.1
HA16-19	December 15, 2016	December 15, 2016	Dry
HA16-20	December 15, 2016	December 15, 2016	0.6
HA16-21	December 15, 2016	December 15, 2016	0.5
HA16-22	December 16, 2016	December 16, 2016	Dry
HA16-23	December 16, 2016	December 16, 2016	1.0

Note:

1. Borehole terminated in low permeability cohesive soils. Groundwater levels in these types of soils typically requires one to two weeks to stabilize after drilling.

Table 3: Groundwater Monitoring Results in Monitoring Wells

Borehole Number	Borehole Drilling Date	Measurement Date	Depth to Groundwater (m)
PH17-04	November 7, 2017	November 7, 2017	Dry
PH17-05	November 7, 2017	November 7, 2017	Dry
PH17-08	November 8, 2017	November 8, 2017	Dry
PH17-11	November 9, 2017	November 9, 2017	Dry
BH17-01	February 22, 2017	February 28, 2017	10.1*
BH17-02	February 23, 2017	February 28, 2017	6.3*
BH17-03	February 24, 2017	February 28, 2017	12.0*
BH17-04	February 26, 2017	February 28, 2017	7.6*
BH17-05	February 27, 2017	February 28, 2017	Dry*
BH17-06	February 23, 2017	February 28, 2017	6.0*
BH17-07	February 25, 2017	February 28, 2017	5.9*
BH17-08	November 23, 2017	November 23, 2017	5.4*
BH17-09	November 21, 2017	November 21, 2017	Dry
BH17-10	November 22, 2017	November 22, 2017	7.5
BH17-11	November 23, 2017	November 23, 2017	3.4*
BH17-12	November 24, 2017	November 24, 2017	5.8*

Notes:

1. (*) Measured in installed monitoring well
2. Piezometer installed in low permeability cohesive soils. Groundwater levels in these types of soils typically requires one to two weeks to stabilize after drilling.

It is expected that groundwater depths will fluctuate seasonally, and in response to precipitation. Monitoring wells should be drilled out and grouted or backfilled with bentonite during construction. This should be added to the scope of the construction contractor.

4.0 Discussion and Recommendation

The geotechnical recommendations for global slope stability, cut and fill slopes, retaining walls, pathway at-grade and elevated structures, bridge foundations, excavation and dewatering, backfill, seismic considerations, and Radar Hill parking lot, are presented in the following sections. The recommendations are based on Amec Foster Wheeler's site investigations in December 2016, February 2017, April 2017, and November 2017, review of available geotechnical reports and terrain mapping by others, and the most current project design information.

4.1 Global Slope Stability Assessment

4.1.1 Design

Slope stability assessments were conducted for existing and proposed slope profiles where retaining walls, cut and fill slopes, and bridge locations are being proposed. Below provides a summary of the areas based on location naming by Parsons:

- Site A (approximately Sta. 20+750 to Sta. 20+650);
- Site B (approximately Sta. 19+500 to Sta. 19+350);
- Site C (approximately Sta. 17+100 to 17+000);
- Site D (approximately Sta. 16+500 to 16+450);
- Site F (approximately Sta. 16+300 to Sta. 16+150);
- Site G (approximately Sta. 13+050 to Sta. 12+850);
- Site I (approximately Sta. 8+450 to Sta. 8+200); and
- Site J (approximately Sta. 4+700 to Sta. 4+600).
- Bridge No.3 – north section of trail alignment (over unnamed creek crossing at approximately Sta. 19+875);
- Bridge No.19 – south section of trail alignment alongside Pacific Rim Hwy (over Lost Shoe Creek crossing at approximately Sta. 1+490); and
- Bridge No.20 – south section of trail alignment alongside Wick Road (over Sandhill Creek crossing at approximately Sta. 2+600).

It is understood that construction work for Site G will be procured under a separate construction contract from the rest of the slope areas identified above. Therefore, as requested by PWGSC and Parsons, commentary regarding Site G including global slope stability discussions is not covered in this report but is provided under a separate report submission.

4.1.2 Surface Conditions

Amec Foster Wheeler has reviewed the general condition of the slopes along the trail alignment, most recently, proposed slope/ wall sites and bridge locations were foot traversed in detail on October 26 and 27, and partially on November 9, 2017. Highway 4 was also driven along the stretch between Ucluelet to Tofino for the purpose of observing the general conditions of the road pavements located above the trail slopes.

Proposed slope/ wall sites are generally located against the shoulders of Highway 4 against natural slopes of about two to four metres high except at Site I where natural slopes are about six to ten metres high. Over all the slope/ wall sites, the trail is designed to traverse across each site.

Bridge No.3 location is across a relatively low flowing to dry unnamed creek bed. The site slopes on either side of crossing were about four metres high. Bridge No.19 and No.20 locations are proposed alongside existing road bridges on Pacific Rim Hwy (Lost Shoe Creek crossing) and Wick Road (Sandhill Creek crossing), respectively. Natural slopes on either side of those creek crossings were about four to five metres high.

4.1.3 Background Information

We have reviewed the surficial geology mapping prepared by Polar Geosciences Ltd. They have identified areas of concern for slope stability and erosion and has mapped escarpment areas which have been identified to be potentially unstable.

We have also reviewed available Lidar information along the trail alignment which show definitive areas along the trail alignment of deep seated slope failures. Marine clay is a weaker soil type and slope failures have occurred and can occur in this material. There is evidence of past slope failures along the trail alignment. For example, the trail section against Long Beach from approximately Sta. 16+600 to Sta. 15+600 passes over a series of ancient landslides which most likely were caused by toe erosion of the escarpment by the ocean surf. This is an ongoing natural process. It was reported that cracking of the Highway 4 pavement surface was noted along this area (as evidenced from observed pavement patch work and areas along the highway being patched) and this suggests the slopes have a low factor of safety against slope failures.

4.1.4 Analysis

As mentioned, global slope stability analysis was conducted over select slope cross sections (existing and proposed slope profiles) where proposed retaining walls, cut and fill slopes, and bridges are to be located. Analysis was based on the information gathered in Amec Foster Wheeler geotechnical site investigations, geotechnical test hole information available from others, and design information provided by Parsons. Cross sections analyzed were generally based on where relatively higher pathway fills and retaining walls are envisioned on relatively steeper terrain. The slope stability analysis estimated the factor of safety of the slopes against slope failures, before and after trail construction. Generally, fill and cut slopes to accommodate pathway construction on the slopes were taken at about four metres wide and proposed slope profiles had side slopes of 2H:1V (Horizontal:Vertical). Surcharge loading along the slopes were considered in the analysis to simulate pathway fills and retaining wall areas. Bridge loads were not considered in the analysis as it is understood that the loads will be transferred to piles that extend deep within/ below the slopes.

Soil strength parameters and groundwater levels used in the analysis were estimated based on Amec Foster Wheeler borehole information, geotechnical test hole information available from others, in-situ soil observations in the field, disturbed soil observations in the laboratory, and from local experience.

The program SLOPE/W Version 8.15 was used to conduct static slope analysis. The limit equilibrium stability analysis method computes a minimum factor of safety (FS) for the slope geometry modeled based on several geotechnical factors. The FS represents the ratio of moments and forces resisting sliding failure to the moments and forces acting to induce failure. A FS < 1.0 represents an unstable condition while a FS > or equal to 1.0 indicates a theoretically stable condition. A slope with an FS of at least 1.5 against slope failure is generally desirable for design.

Table 4 below presents a summary of the global slope stability analysis completed for the various proposed slope/wall and bridge sites. SLOPE/W analysis are provided in Appendix C.

Table 4: Slope Stability Analysis Results

Proposed Retaining Wall/Fill Slope/Bridge Reference	Approximate Station of Cross Section Used for Slope Stability Analysis	Amec Foster Wheeler Borehole No. Reference (others in brackets)	Estimated Current Factor of Safety	Estimated Factor of Safety After Construction	Comments
Slope/Wall - Site A	20+700	PH17-18/ PH17-19	2.75	2.80	Natural slope 3 – 4 m high
Slope/Wall - Site B	19+600	BH17-01	1.44	1.42	Natural slope 2 – 4 m high
Slope/Wall - Site C	17+350	BH17-02	1.51	1.51	Natural slope 2 – 4 m high
Slope/Wall - Site D	16+470	PH17-09	1.59	1.62	Natural slope 5 m high
Slope/Wall - Site F	16+550	BH17-03/ PH17-10	2.14	2.03	Natural slope 3 – 4 m high
Slope/Wall - Site I	8+350	BH17-05 (LBH15-23) (LBH15-25)	1.35	1.42	Natural slope 6 – 10 m high
Slope/Wall - Site J	4+650	BH17-06 (LBH15-16)	1.71	1.61	Natural slope 2 – 5 m high
Bridge No.3	see note	BH17-11/ BH17-12	-	-	
Bridge No.19	1+490	BH17-07/ BH17-10	2.20	2.20	
Bridge No.20	see note	BH17-08 (L2HA14-1) (L1BH14-03)	-	-	

Note:

1. The existing slope at the locations of Bridge No.3 and Bridge No.20 is shallower than 2.5H:1V, the slopes were therefore not analyzed.

The analysis assumes that pathway and retaining wall constructions have considered drainage impacts around where they are constructed. The internal slope stability of cut and fill slopes, retaining walls, and bridge abutments are the responsibility of the design builders.

Although slope stability analysis can model slope profiles before and after trail construction, earthwork activity during trail constructions on slopes is difficult to model. Changing a slope profile, that is, removing trees, removing root mats, and changing slope drainage patterns, will affect stability of slopes.

4.2 Cut and Fill Slopes

Slope gradients for cuts and fills should be limited to a maximum of 2H:1V. For the marine clay and other fine-grained deposits, a rock blanket will be required on cut and fill slope faces to reduce the potential for surface slope erosion and to mitigate the potential for soil piping or internal erosion. This can consist of a 500 mm thick layer of coarse crushed rock over a robust non-woven geotextile such as Nilex 4553.

Where the path parallels the existing highway embankment and crosses creeks, where fill slopes are envisioned, fill slopes that are 2H:1V or flatter should be used that extend to the bottom of the natural slope profiles and be keyed in, instead of retaining walls. This is accomplished by widening the highway embankment. This may require the clearing of trees and sub-excavation at the bottom of the fill slope

footprints to accommodate fill slope construction. The existing slopes have low factor of safety against slope failures (in particular where there are creek crossings) and there are observations of past and current slope failures over these areas (as evidenced on Highway 4 from observed pavement patch work and areas along the highway being patched). Retaining walls at these areas are not recommended. Constructing retaining walls over marginally stable slopes in order to reduce clearing of trees at the slope bottoms will effectively load the slopes and will impact slope stability, which is judged to be marginal in the current state.

Significant proposed cut and fill areas should be reviewed on a site-specific basis following pathway clearing.

Slope benches could be indicative of slump blocks remaining from past slope instability. Trail alignment should be selected along the upslope side of these bench features.

The installation of drainage blankets should be carried out beneath and behind proposed fill embankments. Careful thought should be given to the discharge of collected water. It is understood that relatively free draining engineered fill will be utilized as embankment fill. However, in some cases where there is significant water seepage daylighting out of slope cuts, site specific recommendations may be warranted to deal with water issues. A synthetic product such as NuDrain could be considered for this application. Fill slopes should be graded to shed surface water.

We understand that details regarding CSP (Corrugated Steel Pipe) culverts and/or culvert extension design will be provided by the civil engineering consultant.

4.3 Retaining Walls

It is understood that retaining walls will typically be limited to three metres in height and that Parks Canada would like a system with a vegetated face. Mechanically Stabilized Earth (MSE) wall systems, which are comprised of compacted soil reinforced with geogrid and a facing, are expected to be the most suitable wall type for this project. There are several systems available in the marketplace. It is understood that Envirogrid Geocell or Geoweb are under consideration as a system to be specified. The retaining walls can be specified to be vendor designed based on geotechnical parameters that we can provide in the tender package. The materials at the face should be specified to be durable under exposure to ultraviolet light. The vendors would be expected to provide shop drawings sealed by a qualified professional engineer.

Drainage must be provided at the base of retaining wall backfill and care should be given to where collected water is discharged. The ground surface should be graded so that surface water does not pond in the vicinity of retaining walls.

Retaining wall embedment below ground surfaces should be the greater of 450 mm or 1/7 of the height of the wall.

We recommend the following parameters for design of retaining walls:

- Unit weight of granular backfill γ = 20 kN/m^3
- Angle of internal friction for wall granular backfill ϕ'= 36°
- Coefficient of Active Earth Pressure Ka = 0.26
- Coefficient of Passive Earth Pressure Kp = 3.0
- Coefficient of At Rest Earth Pressure Ko = 0.41
- Coefficient of Seismic Earth pressure Kae = 0.64
- Coefficient of sliding friction μ = 0.5

The use of light weight fill such as Expanded Polystyrene Soil (EPS) Geofoam can be considered in place of granular backfill. However, internal stability of the wall system using EPS Geofoam (sliding and overturning resistances, interaction of EPS Geofoam with geogrid) should be reviewed by the wall designer. Nilex may be able to assist with their experiences using EPS Geofoam with geogrid for wall systems. Anchors may be required to provide adequate sliding and overturning resistances. If anchors are required, a different wall face type may be required, i.e. precast concrete. In addition, geomembrane (or poly) resistant to hydrocarbon breakdown should be considered to surround EPS Geofoam.

4.4 Pathway

It is expected that marine clay will be encountered below organic material along the northern portion of the proposed trail alignment. Where marine clay is exposed over wetland areas or disturbed from tree logging and pathway clearing activities, it is expected to be soft, weakened or susceptible to softening. Generally, the marine clay is considered sensitive such that it will lose strength with repetitive loading or precipitation. Towards the south portion of the trail alignment, sand and gravel is expected below organic material underlain by marine clay.

The pathway structure will either be grade supported on fill or elevated on boardwalk sections supported on piles.

4.4.1 At Grade Trail

As mentioned, the trail will be used for pedestrian, bicycles and light maintenance vehicles. However, the designs of pathway structures are governed by the truck axle loads during construction.

In Tables 5, 6, and 7 below, recommended minimum thicknesses for pathway structure are provided based on various subgrade conditions, and a truck axle load of 80 kN (normal highway legal vehicle).

Note that where marine clay or other relatively weak subgrade is exposed such as at wetlands, it is recommended that the pathway structure be underlain by Nilex 4551 non-woven geotextile followed by Tensar BX1100 geogrid, or equivalents.

Where well drained sand and gravelis exposed, the pathway structure can be underlain solely by the geotextile or otherwise as directed by the Owner's appointed geotechnical engineer. Where clear subbase, such as 75 mm minus broken rock, is used, geotextile will be required as a filter beneath the subbase material in order to avoid the movement of fines into the subbase and maintain the drainage properties of the subbase.

It should be further noted that actual pathway structure thicknesses, geogrid, and geotextile requirements should be determined in the field once tree clearing, grubbing and removal of slash and debris is completed. It is possible that actual pathway structure thicknesses will be greater to adequately provide

support for construction activities over softer subgrade. Actual recommendations for pathway structure thicknesses should then be based on proof rolling once the subbase gravel is in place.

As the pathway subgrade may be variable with softening from equipment traffic, precipitation and surface water, we suggest that the subgrade be prepared in the dry season to the extent possible.

Table 5: Case I: For firm to hard clay subgrade (soil shear strength greater than 25 kPa)

Minimum Thickness (mm) of Road Structure (Truck Axle Load of 80 kN)	
Asphalt concrete	50
Granular Base	100
Subbase	450
Geogrid	Tensar BX1100 or equivalent
Geotextile	Nilex 4551 or equivalent

Table 6: Case II: For soft to very soft clay subgrade (soil shear strength less than 25 kPa)

Minimum Thickness (mm) of Road Structure (Truck Axle Load of 80 kN)	
Asphalt concrete	50
Granular Base	100
Subbase	600
Geogrid	Tensar BX1100 or equivalent
Geotextile	Nilex 4551 or equivalent

Table 7: Case III: For well drained, sand and gravel

Minimum Thickness (mm) of Road Structure (Truck Axle Load of 80 kN)	
Asphalt concrete	50
Granular Base	100
Subbase	300
Geotextile	Nilex 4551 or equivalent

Table 8 below provides general guidance to options for preparing pathway construction based on subgrade conditions encountered in boreholes during the geotechnical site investigations. Note that the soil is variable along the alignment and recommended options for pathway construction should be adjusted to suit actual soil conditions at the time of construction. The pathway design options presented in Table 8 are based on interpreting between available borehole information and review of background historical geological information prepared by others. Table 8 should be used for general guidance only and is considered preliminary until after the trail is cleared and grubbed to better determine actual pathway options.

Based on Table 8, it generally indicates that Case I would be applicable for about 33% of the at grade trail, Case II for about 20% of the at grade trail, and Case III for about 47% of the at grade trail. Note these percentages are considered preliminary for discussion purposes only and based on rough stationing and limited interpretations of available information.

Table 8: At-Grade Pathway Design Options

Station (m)	Reference Borehole No.	Pathway Option	Anticipated Subgrade
21+700 to 21+400	PH17-33	Case I	Silt/clay, firm to stiff
21+400 to 20+800	PH17-32	Case II	Silt/clay, very soft to firm
20+800 to 20+200	PH17-18, PH17-19	Case I	Silt/clay, stiff to soft
20+200 to 19+950	PH17-20, PH17-21	Case III	Sand, compact
19+950 to 19+750	PH17-01, PH17-02, PH17-03, BH17-11	Case II	Silt/clay, very soft to firm
19+750 to 17+100	PH17-22, PH17-23, PH17-24, PH17-25, PH17-26, PH17-27, PH17-24, BH17-01, BH17-02	Case III	Sand, compact to dense
17+100 to 16+200	PH17-09, BH17-12, BH17-03	Case II	Silt/clay, very soft to firm
16+250 to 16+100	PH17-10	Case III	Sand, compact to dense
16+100 to 15+400		Case II	Silt/clay, very soft to firm
15+000 to 13+100	PH17-35, PH17-36	Case III	Sand, compact to dense
13+100 to 11+250	PH17-04, PH17-05, PH17-06, PH17-07, PH17-08, PH17-28, PH17-29, PH17-30, BH17-04, BH17-09	Case I	Silt/clay, firm to stiff
11+250 to 9+850	PH17-31	Case II	Silt/clay, very soft to firm
9+850 to 8+350	PH17-37	Case I	Silt/clay, firm to stiff
8+350 to 7+800	PH17-11, BH17-05	Case II	Silt/clay, very soft to firm
7+800 to 7+050	PH17-12	Case I	Silt/clay, firm to stiff
7+050 to 6+550	PH17-16, PH17-17	Case II	Silt/clay, very soft to firm
6+550 to 4+700	PH17-39, PH17-40	Case I	Silt/clay, firm to stiff
4+700 to 0+000	PH17-42, BH17-10, BH17-06	Case III	Sand, compact to dense
0+273 to 2+400	PH17-43, BH17-07	Case III	Sand, compact to dense Note: generally significant organic matter encountered over sand
43+000 to 41+700	PH17-14, PH17-15, BH17-08	Case I	Silt/clay, firm to stiff Note: generally significant organic matter encountered over Silt/clay
41-700 to 40+250	PH17-44, PH17-45	Case III	Sand, compact to dense Note: generally significant organic matter encountered over sand

4.4.1.1 Clay Subgrade Sensitivity

Marine clay is considered sensitive such that it will lose strength with repetitive load applications. The sensitivity (St) of clay on site ranges between 1.2 and 3.0 verified by the field vane tests at select locations and depths. The native clay can be classified as slightly to medium sensitive[5]. The soil strength may be reduced by 20% to 70% or more if disturbed. For example, note the clayey soil characterized in borehole HA17 14 (Appendix A). The clayey soil was described as stiff (has relatively high strength in its present condition) but has a natural moisture content higher than the soil's liquid limit (liquidity index greater than one). The sensitivity of the clayey soil (undisturbed, undrained shear strength of the soil divided by its remolded shear strength) is about three based on field vane shear testing. Soils approaching a sensitivity of four are considered medium sensitive to strength loss. In their natural in-situ states, these types of clays can support relatively heavy loads when slowly loaded. However, in their remolded states, their shear strength is reduced (their ability to support loads is reduced). This loss of shear strength can be seen in borehole log HA17-03 where clayey soil was described as soft and has a natural moisture content higher than the soil's liquid limit. Table 9 provides a summary of soil strengths between clayey soil encountered in HA17-03 and HA17-14.

Table 9: Clayey Soil Strength Comparison

Borehole No.	Subgrade Material.	Subgrade Strength Description	Natural Moisture Content	Soil Strength (peak/remolded), Su (kPa)	Sensitivity, S_t
HA17-03	Clayey silt	Soft to firm	38%	23/19	1.2
HA17-14	Clayey silt	Stiff	59%	70/23	3.0

Note that the sensitivity of the clayey soil in HA17-03 was low because it already had a soft to firm consistency in its natural or in-situ state. However, it had a natural moisture content significantly lower than a similar clayey soil that was in a stiff condition.

4.4.1.2 Road Structure Granular Base and Subbase Specifications

Granular base should be comprised of 25 mm minus well graded, crushed sand and gravel and subbase should be comprised of well graded 75 mm minus pit run or crushed sand and gravel. The materials used for granular base and subbase beneath the pathway could be specified in accordance with either BC MoTI or MMCD standards.

Table 10 and 11 provide MMCD specifications for Granular Base and Crushed Granular Subbase respectively.

5 *Considerations on the Sensitivity of Norwegian Quick Clays*, Geotechnique, Vol. 3, No. 5, 195-200, Rosenqvist, I. Th. (1953)

Table 10: Granular Base Specifications – MMCD

Sieve Designation	Percent Passing (%)	
19 mm		100
12.5 mm	75	100
9.5 mm	60	90
4.75 mm	40	70
2.36 mm	27	55
1.18 mm	16	42
0.600 mm	8	30
0.300 mm	5	20
0.075 mm	2	8

Table 11: Crushed Granular Subbase Specifications – MMCD

Sieve Designation	Percent Passing (%)	
75 mm		100
38 mm	60	100
19 mm	35	80
9.5 mm	26	60
4.75 mm	20	40
2.36 mm	15	30
1.18 mm	10	20
0.6 mm	5	15
0.3 mm	3	10
0.075 mm	0	5

Tables 12 and 13 provide BC MoTI specifications for Well-Graded Base (WGB) and Intermediate Graded Subbase (IGSB) respectively.

Table 12: (WGB) Base Course Specifications – MoTI

Sieve Designation	Percent Passing (%)	
25 mm		100
19 mm	80	100
9.5 mm	50	85
4.75 mm	35	70
2.36 mm	25	50
1.18 mm	15	35
0.300 mm	5	20
0.075 mm	0	5

Table 13: (IGSB) Subbase Specifications – MoTI

Sieve Designation	Percent Passing (%)	
75 mm		100
50 mm	55	100
37.5 mm	40	80
19 mm	17	40
2.36 mm	10	25
0.300 mm	4	15
0.075 mm	0	5

All organics should be stripped from beneath the pathway pavement structure. Fine grained subgrade will be susceptible to significant loss of strength and softening from construction traffic and from precipitation. This is particularly true of the marine clay. The subgrade should be trimmed to grade without traffic on the exposed surface. The geotextile overlain by geogrid should then be placed and the subbase should be pushed out over the geogrid. The geotextile, geogrid and subbase should be placed as soon as possible following excavation to reduce the potential for further softening of the subgrade.

Where highly permeable crushed subbase aggregate is desired, for example where surface water may be ponding on stripped subgrade, BC MoTI specifications for Open Graded Subbase (OGSB) can be considered. For reference, the following Table 14 provides BC MoTI specifications for OGSB.

Table 14: (OGSB) Subbase Specifications – BC MoTI

Sieve Designation	Percent Passing (%)	
75 mm		100
50 mm	70	100
37.5 mm	50	85
19 mm	15	55
6.3 mm	0	20
2.36 mm	0	10
0.300 mm	0	8
0.075 mm	0	5

4.4.1.3 150 mm Minus Crushed Gravel

It is understood from discussions with Parsons that a crushed subbase aggregate of 150 mm minus has been successfully used locally on their past (unrelated) road projects on the island where soft and wet subgrade conditions were encountered. It is judged that a 150 mm minus crushed rock subbase aggregate can be considered as subbase fill over geotextile and geogrid where soft and wet subgrade conditions are encountered but should be reviewed at the time of placement to determine if the placed fill contains significant voids which can result in migration of fines from overlying granular base (smaller size aggregates migrating into the underlying larger size aggregates). If that is the case, then a geotextile may be required between the placed 150 mm minus crushed subbase and the overlying granular base.

4.4.1.4 Recycled Asphalt

It is understood that recycled asphalt is available for use on this project. It is judged that recycled asphalt can be considered for use as base and subbase course materials but should be assessed when the proposed recycled asphalt becomes available for review. In general, recycled asphalt should have relatively free draining capability so as to not impede groundwater flow. Recycled asphalt gradation should fall within the gradation range, as recommended in specifications above, based on its intended use (base or subbase course). The gradation specifications provide practical size aggregates for placing and compacting as recommended fill lifts for trail construction are 200 mm. The suitability of use of any blended material (mixture of recycled asphalt with other fill) should be assessed based on similar material property criteria.

4.4.1.5 Fill Placement, Proof-rolling, and Compaction

The following provides commentary for fill placing, proof-rolling, and compaction that should be considered for road structure construction.

- Where clay subgrade is exposed and is weak (soft to very soft subgrade [soil strength less than 25 kPa]), the first layer of subbase fill to restore subgrade may be up to 450 mm thick. Note the geogrid and geotextile requirements for weak subgrade. The placed layer should be nominally compacted by a steel drum roller without vibration to reduce the potential for further destabilizing of the subgrade. If significant surface deflection is observed under the weight of the roller, then the first layer of subbase fill can be thickened to 600 mm. Subsequent subbase layers should be no greater than 200 mm thick and be compacted to specification with vibration by a steel drum roller;
- Where clay subgrade is exposed and is strong (firm to hard subgrade [soil strength greater than 25 kPa], or where well drained, sand and gravel subgrade is exposed), subbase fill layers to restore subgrade should be no greater than 300 mm thick. Note the geogrid and geotextile requirements for strong subgrade. The placed layers should be compacted with vibration by a steel drum roller;
- Proof rolling should be conducted over the placed, final subbase fill layer before placing granular base. Proof rolling should be conducted with a fully loaded tandem truck with 80 kN axle loads. Tire pressure should be 550 kPa. Any isolated soft areas and/ or areas of observed surface deflection, under the weight of proof rolling, should be over-excavated and grade restored using drier subbase fill. The maximum deflection acceptable under proof rolling is 25 mm;
- Granular base fill should be placed as per design thickness in one layer and compacted with vibration using a steel drum roller; and
- Subbase and base fills should be compacted to at least 98% Standard Proctor Maximum Dry Density (SPMDD), except for the first layer of subbase fill placed over weak subgrade where no compaction criteria are required.

4.4.1.6 Estimated Permeability Characteristics of Well Compacted Subbase Fill

Materials passing the MMCD specifications for crushed granular subbase fill and MoTI specifications for IGSB subbase fill are expected to be relatively permeable. Both have fines content (0.075 mm sieve designation) of five percent or less.

It is expected that permeability values for well compacted subbase fill can be in the range of 10^{-2} to 10^{-3} m/s. Field permeability testing is recommended if actual permeability characteristics of the subbase fill is required.

4.4.1.7 Tree Root Protection

To avoid the pathway heave and damage to the existing trees, appropriate root barriers should be placed around the granular material prism.

If pathway design allows for alternative surfacing other than asphalt, bridging over tree roots by using a combination of Envirogrid Geocell or Geoweb (or equivalent) and granular fill with light compaction around the tree roots can be considered.

It is understood that a 40 mil PVC root barrier is being considered for tree root protection except at wetland areas to promote water flow across the trail. An arborist or tree specialist should be consulted to determine the most appropriate root barrier options for project application over non-wetland and wetland areas.

4.4.1.8 Leaving Stumps Below At-grade Pathway Areas

Stumps left in place beneath the pathways will rot when they are above the seasonal low groundwater level. This will create depressions in the pathways which will require maintenance and premature reconstruction. It is understood however that it is desired to leave some stumps in place as removing stumps can potentially damage adjacent tree root systems. It is further understood that grinding of stumps to at least 100 mm to 150 mm below natural ground surfaces is being considered.

The forestry manual[6] used for this project clearly indicates that leaving the stumps in place would be suitable for short term roads, for five years or less:

> *The introduction of stumps, roots, and embedded logs into the road fill under the travelled portion of the road reduces the long-term stability of the fill. The buried organic material will deteriorate over time and begin to settle. This removes support for the applied wheel loading and results in rutting of the road surface. Water ponding in the ruts may saturate the road fill and lead to failures. Thus, the use of roots, stumps, and embedded logs in the road fill should be restricted and the requirement to permanently deactivate these roads within 5 years of construction enforced.*
>
> *The life of a 5-year road may be extended up to 10 years, but only if regular inspections indicate that the road fill is stable and can still support the design vehicle axle loads. If the road fill begins to show signs of failure, or after the 10 years have passed, the road must be permanently deactivated or reconstructed.*

Leaving stumps in place is common practice when constructing temporary forest roads and tote roads. These types of roads are typically gravel surfaced and require frequent maintenance (re-grading and re-gravelling). However, it is not common practice to keep significant organics such as stumps and topsoil in place below permanent asphalt surfaced roads. As noted previously, stumps will decompose and will create voids which will contribute to ground subsidence. Before stump decomposition, stumps will perform like hard edges around placed fills which will settle differently around buried stumps.

To reduce but not eliminate variable ground movements, it is judged that placing geo-grid reinforcement such as Tensar BX1100 or equivalent be considered regardless of the subgrade strength condition encountered.

Therefore, if stumps and other organics are left beneath the pathway future maintenance should be anticipated to be required to restore depressions.

6 Forest Road Engineering Guidebook, Second Edition, June 2002, BC Government, page 90

It is suggested that the specifications call for 100% grubbing of the pathway area. The contractor could be allowed to leave particular stumps in place when requested by the Owner's representative.

4.4.1.9 Preventing Longitudinal Flow at the Edge of Bog Basins

At the edge of bogs, a high-density polyethylene (HDPE) liner or geomembrane or similar can be Preventing Longitudinal Flow at the Edge of Bog Basins used to contain bog water.

Enviroflex from Nilex is a linear low-density polyethylene (LLDPE) geomembrane that provides similar durability and resistance characteristics in comparison to HDPE geomembrane and is commonly used as landfill cover because of its ability to conform to undulating surfaces.

Generally, the LLDPE geomembrane or equivalent could be lined at the trench bottom and sides at the edge of bog basins, prior to grade restoration with road structure subbase and granular base fills. The LLDPE geomembrane would be placed over any subgrade requirements for geogrid and/ or geotextile and would rise through road structure subbase at the edge of bog basins to at least surrounding adjacent grades. The top edge of the placed LLDPE geomembrane should be keyed into the subbase to reduce future movements of the geomembrane after installation.

A conceptual plan drawing that can be considered for geomembrane keying is provided below in Figure 1 taken from Fig. A7.14 "Conceptual Drawings of Lining Anchor Schemes (After Kays, 1977)" of the Alberta Environmental design manual[5].

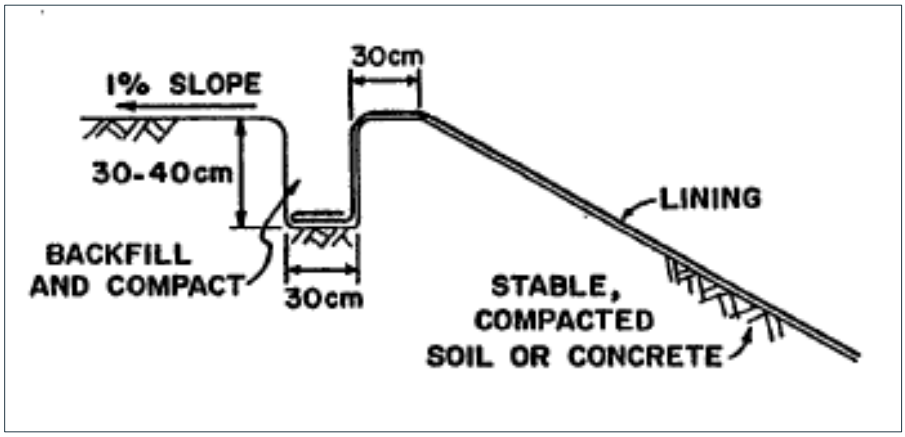

Figure 1: Conceptual Plan Drawing for Keying Geomembrane

Actual design methodology for the placing and keying in of geomembrane should be assessed on site at the time of construction as it will be dependent on depth of trench cuts to restore, groundwater or perched water conditions, available geomembrane roll dimensions, and constructability. Nilex can be contacted to provide site specific design assistance for geomembranes for bog area containment applications.

Product information for LLDPE geomembrane can be found in the Nilex website:
http://nilex.com/products/enviroflex-linear-low-density-polyethylene-lldpe-geomembranes

Another approach would be to avoid excavation of mineral soil and build the path above present grade in these areas.

5 Design and Construction of Liners for Municipal Wastewater Stabilization Ponds, Komex Consultants Ltd. for Alberta Environment, 1985

4.4.1.10 Settlement

Ground settlement can be induced from subgrade settlement due to significant new loads over compressible soil, and pavement structure fill settlement due to improperly compacted fills. Based on the anticipated organic stripping depths and pavement structure thicknesses, it is expected that some subgrade compression will occur. Due to the potential variability of the subgrade conditions, it is judged that some differential settlement should also be expected. The potential for pavement structure fill settlement can be controlled by properly compacting the fills and removal of all organics beneath the pathway. The extent of ground settlements will be difficult to quantify without site specific information.

It is understood that allowable settlement for the trail is greater than that for a typical road. Paving should be delayed when possible to allow some settlement to occur. It is our understanding that, trail construction will commence in 2019 and continue for two construction years (to 2021). Generally, delay of paving by a construction season is considered reasonable to allow the majority of potential ground settlements to occur. Trails will be regraded before paving.

4.4.2 Elevated Trail (Boardwalk Sections)

Where the trail is to be elevated, it is understood that the pathway will comprise of wood panels (timber decks and stringers) elevated on closely spaced steel pier beams founded on posts/piles.

For pile analysis, we have been provided with the following structural design parameters to consider:

- Factored vertical design load per pile = 44 kN;
- Unfactored horizontal design load per pile = 12.5 kN
- Free standing length of pile (length between embedded portion of pile and bottom of pile cap) = 100 mm

4.4.2.1 Helical Piles

It is understood that helical piles are the preferred pile foundation type. For pile analysis, we have considered double or triple helix piles with helix plates spaced apart from each other at least three times the helix diameter (no helix plate group effects).

It is understood that, from a structural design perspective, the preferred helical pile dimensions will have helical plates between 300 to 400 mm diameter and helical shafts between 114 to 168 mm diameter.

Helical piles can be used to achieve both uplift and compressive resistance. The pile systems are typically proprietary, designed and installed by the manufacturer/supplier. The piles are installed to a specified torque, measured with equipment at the ground surface.

The rod size, helix size and spacing, depth of installation and required torque to achieve the desired capacity are to be provided by the pile supplier in a sealed shop drawing.

For this preliminary discussion, to try to understand the possible torque that may be applied to a helix pile, a relationship of pile load capacity to pile installation torque found in CFEM[8] was considered. The relationship is as follows:

8 Canadian Foundation Engineering Manual, 4th Edition (2006)

Qu = Kt x T

Where:

- Qu = Ultimate capacity of the helical pile (kN)
- Kt = Empirical torque factor (/m)
- T = Average installation torque (kN·m)

As recommended in CFEM, an empirical torque factor (Kt) of 10/m was considered based on shaft diameters approaching 200 mm. Based on an estimate for Qu of 1000 kN (ultimate, un-factored) for a helical pile installed into sand (note that a helical pile installed into clayey soil is anticipated to result in a lower Qu), an installation torque in the order of 100 kN·m was estimated.

It is understood that the factored structural design loads for each pile have accounted for temporary loads associated with a pile torqueing machine excavator (assumed to be 180 kN vertical, un-factored) as well as pile torqueing activity (100 kN·m horizontal, un-factored).

For helical piles over bog trail areas, Table 15 below provides a summary of typical soil parameters that can be considered for helical pile designs.

Table 15: Typical Soil Parameters for Helical Pile Design

Boardwalk Trail Section Station (m)	Reference Borehole No.	Anticipated Soil	Typical Soil Parameters		
			Unit Weight (kN/m^3)	Friction Angle (deg.)	Cohesion (kPa)
20+100 to 20+020	HA17-09 HA17-10 PH17-20 PH17-21	Compact sands; sand/silts with some gravel and cobble; clayey silt; clayey gravel	19	0	40
19+720 to 19+680	HA17-07 PH17-22 PH17-23	Clay; sand/clay; sands	19	0	40
18+900 to 18+850	HA17-11 PH17-24 PH17-25	Compact sands; sand/clay	19	0	40
18+720 to 18+580	HA17-13 PH17-26 PH17-27	Compact sands	20	35	0
12+530 to 12+500	HA16-14 L4BH10-21 PH17-28 PH17-29	Firm clay	19	0	40
6+690 to 6+610	HA16-17 PH17-17	Soft to firm clay	19	0	25

1. The stations of elevated boardwalk trail are referenced from Parsons Trail Construction Drawings, dated November 2018.
2. The soil information is referenced to the closest hand auger or portable hammer boreholes.

For helical pile design considerations over bog trail areas, Table 16 below provides a summary of recommended preliminary minimum pile embedment depths, for differing helix plate/shaft pile diameters based on a double or triple helix pile and anticipated end bearing soil conditions, in order to support a factored structural axial load of 44 kN per pile. Analysis were based from borehole log and lab information from hand auger boreholes advanced over at-grade trail areas near bog trail areas in April 2017 and portable drill boreholes advanced over bog trail areas in November 2017. As mentioned, the pile systems are typically proprietary, designed and installed by the manufacturer/supplier. Multiple helix plates per pile or multiple helical piles can be considered by the pile designer to shorten pile embedment depths.

Table 16: Preliminary Minimum Helical Pile Embedment for Elevated Boardwalk to Support a Factored Structural Axial Load of 44 kN per Pile

Boardwalk Trail Section Station (m)	Reference Borehole No.	No. Of Helix Plates	Minimum Pile Embedment (m)					
			Plate/Shaft Diameter 300/ 114 mm (OD)	Plate/Shaft Diameter 350/ 114 mm (OD)	Plate/Shaft Diameter 400/ 114 mm (OD)	Plate/Shaft Diameter 300/ 168 mm (OD)	Plate/Shaft Diameter 350/ 168 mm (OD)	Plate/Shaft Diameter 400/ 168 mm (OD)
20+100 to 20+020	HA17-09 HA17-10 PH17-20 PH17-21	3	5.5 m	4.5 m	4 m	4.5 m	4 m	3.5 m
19+720 to 19+680	HA17-07 PH17-22 PH17-23	3	5.5 m	4.5 m	4 m	4.5 m	4 m	3.5 m
18+900 to 18+850	HA17-11 PH17-24 PH17-25	3	5.5 m	4.5 m	4 m	4.5 m	4 m	3.5 m
18+720 to 18+580	HA17-13 PH17-26 PH17-27	2	4.5 m	3.5 m	3 m	4.5 m	3.5 m	3 m
12+530 to 12+500	HA16-14 L4BH10-21 PH17-28 PH17-29	3	5.5 m	4.5 m	4 m	4.5 m	4 m	3.5 m
6+690 to 6+610	HA16-17 PH17-17	3	9 m	8 m	7 m	7 m	6 m	5.5 m

1. The stations of elevated boardwalk trail are referenced from Parsons Trail Construction Drawings, dated November 2018.
2. The soil information is referenced to the closest hand auger or portable hammer boreholes.

Assumptions:

- No pre-drill is allowed;
- Piles assumed to be continuous without any strength reduction at connections, if any;
- Piles assumed to be spaced away from each other at least three times the pile diameter (no pile group effects);
- No pile group factors have been considered;
- Helix plates should be spaced apart from each other at least three times the helix diameter;
- Piles should be spaced apart from each other at least three times the largest helix diameter; and
- Pile capacity of 44 kN should be confirmed during construction by torque monitoring.

4.4.2.2 Lateral Load Capacity

It is further understood that helical pile installation will require review of lateral load resistance capacities. This review is primarily for the installation of the helical piles, as the torque required to install new helical piles will be restrained by the elevated platform on which the torqueing machine/equipment will be sitting, which is supported on installed helical piles.

Lateral pile analysis was completed to determine the anticipated lateral deflection on the piles (in mm). The p-delta effect on piles has been considered.

For the purpose of lateral pile analysis, the following design parameters were provided:

- Upper 0.5 m is organic material with very low shearing capacity resistance;
- Factored vertical design load per pile = 44 kN;
- Unfactored horizontal design load per pile = 12.5 kN;
- Free standing length of pile (length between embedded portion of pile and bottom of pile cap) = 100 mm;
- Pile wall thickness is 8.6 mm for 114 mm shaft diameter, 7.11 mm for 168 mm shaft diameter;
- Minimum pile embedment depth of 6 m below ground surface;
- Yield stress of steel 310 MPa;
- Piles assumed to be continuous without any strength reduction at connections, if any; and
- Piles assumed to be spaced away from each other at least three times the pile diameter (no pile group effects)

Table 17 provides information regarding the anticipated lateral deflections for helical piles based on the above assumptions for a single pile subject to the loads above.

Table 17: Anticipated Lateral Deflections for Helical Piles During Installation

Boardwalk Trail Section Station (m)	Lateral Deflection (mm) For Shaft Diameter of 114 mm, Pile Wall Thickness of 8.6 mm	Lateral Deflection (mm) For Shaft Diameter of 168 mm, Pile Wall Thickness of 7.11 mm
20+100 to 20+020	32	14
19+720 to 19+680	42	16
18+900 to 18+850	39	16
18+720 to 18+580	39	16
12+530 to 12+500	21	9
6+690 to 6+610	47	21

As previously discussed, the rod size, helix size and spacing, depth of installation and required torque to achieve the desired capacity are to be provided by the pile supplier as pile systems are typically proprietary, designed and installed by the manufacturer/supplier.

Pile specifications should include a requirement for corrosion protection.

4.4.2.3 Steel Pipe Piles

We expect that gravel and cobble may be present within sand layers below organic material (refer to referenced boreholes summarized in Table 15) and/ or dense sand and gravel may be present. If there are issues with installing helical piles through or into dense soil, driven steel pipe piles may need be considered instead of helical piles. These piles can possibly be 200 mm to 250 mm diameter and inserted using a hydraulic hammer attached to an excavator. Installation methodology should be reviewed to confirm appropriateness to reduce potential pile damage due to installation.

Table 18 below provides the anticipated minimum pipe pile embedment depths for select boardwalk trail sections where sand or sand and gravel and/ or cobble were documented in boreholes. Note that the anticipated end bearing soils shown in Table 17 are for general guidance only to understand the anticipated pile capacities over those soil types based on limited borehole information at the time of the geotechnical site investigations, interpreting between available borehole information, and review of background historical geological information prepared by others. Note that the soil is variable along the alignment and recommended options for helical pile or pipe pile options should be adjusted to suit actual soil conditions at the time of construction. Anticipated end bearing soil in Table 17 should be used for general guidance only and is considered preliminary.

Table 18: Minimum Pipe Pile Embedment for Elevated Boardwalk to Support a Factored Structural Axial Load of 44 kN per Pile

Boardwalk Trail Section Station (m)	Reference Borehole No.	Anticipated End Bearing Soil	Minimum Pipe Embedment (m)	
			Pile Diameter 200 mm OD	Pile Diameter 250 mm OD
20+100 to 20+020	HA17-09 HA17-10 PH17-20 PH17-21	Compact sands; sand/silts with some gravel and cobble; clayey silt; clayey gravel	6.5	5.0
19+720 to 19+680	HA17-07 PH17-22 PH17-23	Clay; sand/clay; sands	6.5	5.0
18+900 to 18+850	HA17-11 PH17-24 PH17-25	Compact sands; sand/clay	6.5	5.0
18+720 to 18+580	HA17-13 PH17-26 PH17-27	Compact sands; sand/clay	5.0	5.0

1. The stations of elevated boardwalk trail are referenced from Parsons Trail Construction Drawings, dated November 2018.
2. The soil information is referenced to the closest hand auger and portable drill boreholes.

Assumptions:

- The wall thickness of pipe piles is 14.3 mm; and
- No pre-drill is allowed.

Note that pile group effects will need to be considered if pile spacing is within three pile diameters.

Pile driving analysis should be conducted to develop pile driving criteria. Corrosion protection should be specified.

4.4.2.4 Impact of Piles in Wetland Areas

Helical piles are made from steel and are impervious. They rely on soil interaction against the pile stem and the helix plates to gain bearing resistance. It is expected that helical piles will be used where generally soft clay soils are present and the clay would interact tightly against the piles. It is not expected that a pervious void, that would be susceptible to water-flow, would be created between the steel and surrounding clay. It is expected that driven steel pipe piles will be used where gravels and cobbles are encountered. Permeable layers beneath the clay were not encountered based on any boreholes advanced. It is possible that permeable soils would be encountered at depth, however, this shouldn't be a concern as the piles will not conduct water.

Based on hand augers and portable drill boreholes advanced by Amec Foster Wheeler, it is generally anticipated that the subgrade along the pathway at boardwalk structure areas will expose primarily marine clay or clayey soil of varying degrees of consistency (soft to stiff) and sand underlain by clay or clayey soil. It is anticipated therefore that subgrade at depth will be primarily clay based.

Soils, however, are variable along the alignment such that it is possible that permeable soils may be present at greater depths.

4.5 Bridge Foundations

As discussed, it is understood that there will be three bridge locations; Bridge No.3 (20 m span crossing an unnamed creek at approximately Sta. 19+875), Bridge No.19 (30 m span crossing Lost Shoe Creek at approximately Sta. 1+490), and Bridge No.20 (30 m span crossing Sandhill Creek at approximately Sta. 2+600).

Bridge foundations must extend below the scour depth as indicated in CSA S6-14 - Canadian Highway Bridge Design Code. It is understood that Parsons is responsible for determining the scour depth at each crossing location.

Pile foundations should be designed in accordance with the National Building Code of Canada (2015) which is based on Limit States Methodology. As per the NBCC, the factored geotechnical resistance of a single pile at the Ultimate Limit State (ULS) is determined by multiplying the unfactored (i.e.: ultimate) geotechnical axial resistance, R, by a geotechnical resistance factor, Φ. The basic design equation for limit states Design is satisfied by the factored loads as follows:

$$\Phi R \geq \sum \alpha t \, Snt$$

where: $\sum \alpha t \, Snt$ is the summation of the factored loads applied on a structure as determined by the structural engineer in accordance with code requirements.

The unfactored geotechnical axial resistance of a single pile, R, can be estimated using the following general form:

$$R = \sum_{z=0}^{L} Cqs \, \Delta z + qt \, At - Wp$$

where:

- L = embedment length
- z = depth below grade
- C = circumference of pile
- Δz = subdivided length of pile
- qs = unfactored unit skin friction over the corresponding subdivided length of pile
- qt = unfactored unit end bearing resistance of the pile toe
- Wp = Weight of pile

In order to determine the factored geotechnical resistance in compression at the ULS, the unfactored geotechnical axial resistance of a single pile should be multiplied by a geotechnical resistance factor, Φ, of 0.4.

For the design of piles to resist uplift loads, the factored uplift resistance of a single pile should be multiplied by a geotechnical resistance factor, Φ, of 0.3.

4.5.1 Driven Steel Pipe Piles

We understand that driven steel pipe piles will be considered for the bridges. For the purpose of pile analysis, the following design parameters were provided:

- Consider 610 mm diameter steel pipe piles for all bridges; also consider 762 mm diameter for Bridge No.20
- Steel pipe pile wall thickness of 16 mm for Bridge No.3, and 19 mm for Bridges No.19 and 20
- Yield stress of steel 310 MPa
- Design factored axial load per pile is 580 kN for Bridge No.3 and 870 kN for Bridges No.19 and 20
- Design factored lateral load per pile is 95 kN for Bridge No.3 and 222 kN for Bridges No.19 and 20

The recommended, factored, unit skin friction and unit end bearing resistances for driven steel piles for Bridge No.3, Bridge No.19, and Bridge No.20 are provided in Table 19 below.

Table 19: Factored Values for Skin Friction and End Bearing Resistance for Driven Steel Pipe Piles

Bridge No.	Reference Borehole No.	Depth (m)	Soil Type	Factored Ultimate Shaft Resistance at ULS (kPa)	Factored Ultimate End Bearing Resistance at ULS (kPa)
3	BH17-11 PH17-01 PH17-02 PH17-03	0 to 1.0	Loose Sand, organics	0	0
3		1.0 to 2.0	Compact Sand	12	-
3		2.0 to 7.0	Firm Clay	15	140
3		Below 7.0	Dense Sand and Gravel	25	3000
19	BH17-07 BH17-10 PH17-12 PH17-13	0 to 4.0	Loose Sand, Silt, Clay, organics	0	0
19		4.0 to 18.0	Dense Sand	23	2800
19		18.0 to 23.0	Firm Clay	15	140
20	BH17-08 PH17-14 PH17-15	0 to 2.0	Loose Sand, Silt, Clay, organics	0	0
20		2.0 to 4.0	Soft Clay	7	-
20		4.0 to 7.0	Firm Clay	15	140

The factored single pile axial capacities for various driven pile lengths are presented in Table 20 below.

Table 20: Minimum Pipe Pile Embedment for Bridges to Support Factored Load per Pile

Bridge No.	Reference Borehole No.	Design Factored Load per Pile (kN)	Minimum Pile Length (m) for 610 mm Diameter	Minimum Pile Length (m) for 762 mm Diameter
3	BH17-11 PH17-01 PH17-02 PH17-03	580	10	n/a
19	BH17-07 BH17-10 BH17-12 BH17-13	870	12	n/a
20	BH17-08 PH17-14 PH17-15	870	37	30

Note in Table 20 for Bridge No.20, subsurface information in BH17-08 is available for only up to about 17 m below ground surface. The depth of BH17-08 was based on anticipated pile loads for the bridge at the time of the study in 2017. The pile loads for the bridge have since increased significantly. The minimum pile length of a 610 mm diameter pile noted as 37 m is based on firm clay (the last soil layer in BH17-08) extending to significant depths below ground surface. Additional geotechnical borehole(s) should be considered if bridge pile design is required to extend below current depths of boreholes to confirm or modify geotechnical assumptions made beyond known subsurface ground conditions.

Piles should be spaced at least 1.5 m apart centre to centre. Settlement under service conditions is expected to be less than 50 mm total for the pile group and less than 30 mm differential.

At least one Pile Driving Analyzer (PDA) test is required at each bridge abutment while pile driving. The contractor should perform the test, which should be witnessed by the Owner's appointed geotechnical engineer.

The shaft resistance should be taken below a stable upward projection from the creek bottom which is to be determined for the site. We expect that pile bottoms will be far below this projection.

4.5.1.1 Lateral Load Capacity

It is further understood that steel pipe pile installation will require review of lateral load resistance capacities.

Lateral pile analysis was completed to determine the anticipated lateral deflection on the piles (in mm). The p-delta effect on piles has been considered.

For the purpose of lateral pile analysis, the following design parameters were provided:

- Design factored axial load per pile is 580 kN for Bridge No.3 and 870 kN for Bridges No.19 and 20
- Design factored lateral load per pile is 95 kN for Bridge No.3 and 222 kN for Bridges No.19 and 20
- Free standing length of pile (length between embedded portion of pile and bottom of pile cap) = 1.5 m

- Pile diameter is 610 mm for all Bridges and 762 mm for Bridge No.20
- Pile wall thickness is 16 mm for Bridge No.3 and 19 mm for Bridges No.19 and No.20
- Yield stress of steel 310 MPa; and
- Piles assumed to be continuous without any strength reduction at connections if any
- Piles assumed to be spaced away from each other at least three times the pile diameter (no pile group effects)

Table 21 provides information regarding the anticipated lateral deflections for steel pipe piles based on the above assumptions for a single pile subject to the loads above.

Table 21: Anticipated Lateral Deflections for Steel Pipe Piles

Bridge No.	Design Factored Axial Load Per Pile (kN)	Design Factored Lateral Load Per Pile (kN)	Lateral Deflection (mm)
3	580	95	7
19	870	222	34
20	870	222	36

4.6 Excavation and Dewatering

Temporary excavations greater than 1.2 m deep and steeper than 3/4H:1V requiring worker entry should be shored or flattened in accordance with WorkSafe BC regulations. Should groundwater or surface water inflow soften/loosen the overburden material, flatter slopes than those recommended by WorkSafe BC may be required.

Accumulation of surface water can be expected during periods of extended wet weather. Accordingly, temporary site drainage requirements should be assessed by the contractor in relation to the excavation depths and foundation construction schedule.

4.7 Backfill

Backfill beneath foundations should consist of clean, free draining granular fill compacted in 200 mm thick lifts to at least 100% of Standard Proctor Maximum Dry Density (SPMDD). Backfill beneath a paved or concrete surface should be compacted to 100% of SPMDD.

Quality Assurance geotechnical inspection and compaction testing should be carried out by the Owner's appointed geotechnical engineer to confirm that specification requirements are satisfied.

4.8 Seismic Considerations

The National Building Code of Canada (NBCC) requires that structures be designed to resist collapse when subjected to "strong shaking", defined as ground motions with a return period of 1 in 2,475 years (or two percent probability of exceedance in 50 years).

A secondary objective of the code is to limit damage to buildings caused by low to moderate shaking. NBCC has adopted the use of foundation factors dependent on analysis of ground motion histories adjusted for local site conditions, characterized based on the average shear wave velocity and relative

density of the earth materials in the uppermost 30 m. Based on the presence of soft clay beneath the site, the site should be classified as Site Class E in conformance with Table 4.1.8.4 A of the 2015 NBCC.

Peak Ground Acceleration (PGA) of 0.69 g should be used for this site. The 2015 National Building Code Seismic Hazard Calculation is presented in Appendix B.

4.9 Radar Hill Parking Lot

It is understood that the parking lot area will be used for temporary storage of salvaged timber during the trail construction period. After the construction period, the temporary storage area will be converted to a paved parking lot for visitors to the proposed Pacific Traverse Trail.

Amec Foster Wheeler attended the parking lot site on February 28, 2017 to observe site conditions and to advance several shallow boreholes using a hand auger. At that time, the site was being cleared of trees and bushes. Based on soils extracted from the hand auger boreholes, the subsurface soils can generally be described as consisting of 100 to 200 mm of topsoil underlain by brown, soft to firm, silty clay at the center east portion of the site, and by grey/brown compact/stiff sandy silt towards the rest of the site. Water was observed at the surface over much of the site.

4.9.1 Subgrade Preparation

The subgrade should be prepared by grubbing and removal of organics with an excavator equipped with a trimming bucket. Equipment should avoid travel on the exposed surface. Any ponded water should be pumped out or guided away before placing the geotextile and fill. In areas where soft to firm clay is encountered there should be a sub excavation of 300 mm. Geotextile, Mirafi HP570 or equivalent, should then be placed on the exposed surface.

4.9.2 Granular Fill Design

A minimum granular thickness of 600 mm should be provided. This should be increased to 900 mm in sub excavated areas. The upper 150 mm or greater of the granular fill should consist of 25 mm minus crushed granular base course. The underlying subbase can consist of 75 mm minus crushed or pit run granular material.

If unsuitable subgrade is encountered it should be removed to a maximum depth of 300 mm and replaced with compacted subbase material. The first layer of fill in soft/ sub excavated areas will be up to 450 mm thick. This material should be lightly compacted without vibration in order to reduce the potential for further destabilizing of the subgrade. The overlying subbase should be compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD) in maximum 200 mm thick lifts. The upper base course should be compacted to 100% of SPMDD.

5.0 Limitations and Recommendations

This report has been prepared for the exclusive use of PWGSC for the specific application to the development described within this report. Any use which a third party makes of this report, or any reliance on or decisions made based on it are the responsibility of such third parties. Wood accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report. It has been prepared in accordance with general accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Wood trusts this meets your immediate requirements. If you have questions or require further information, please contact this office.

Respectfully submitted,

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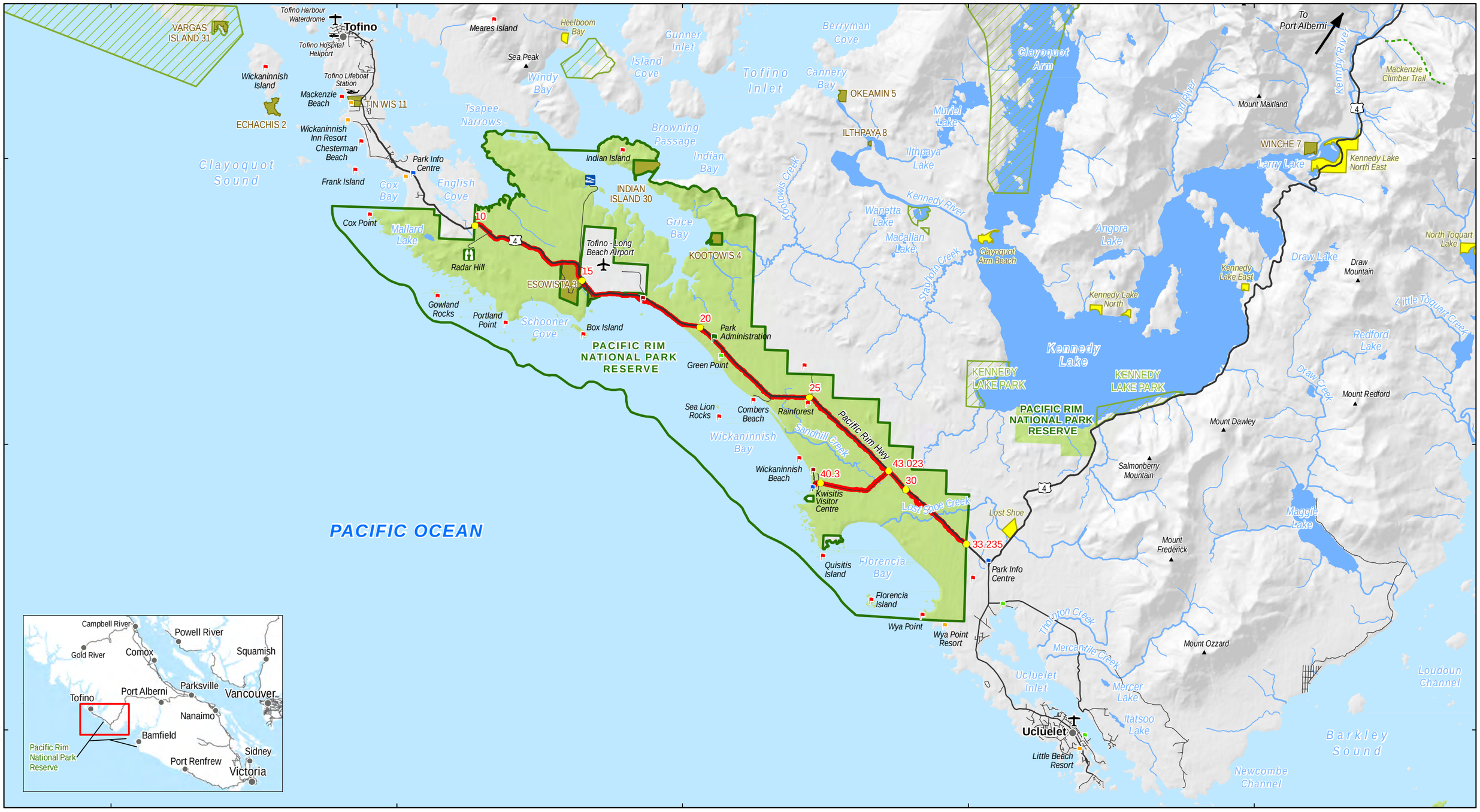
Figures



Legend

- Populated Place
- Airport
- Waterdrome
- Heliport
- Boat Launch
- Watercourse
- Lake
- Highway
- Arterial
- Existing Road
- Recreation Trail
- Pacific Rim National Park Reserve
- Park / Protected Area
- First Nation Reserve
- Recreation Site
- Campground
- Info Centre
- Landmark
- Park Administration
- Picnic Area
- Resort
- Viewpoint
- Proposed PTT Marker
- Proposed PTT Route

0 0.5 1 2 3
Kilometers
Scale 1:125,000

Reference:
DataBC Data Distribution Service
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http://www.data.gov.bc.ca/

CLIENT:
Public Works and Government Services Canada

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PROJECT:
Pacific Traverse Trail

TITLE:
Project Overview

PROJECT NO:	VE52602
REVISION NO:	1
DATE:	December, 2017
SHEET NO:	N/A
FIGURE NO:	Figure 1

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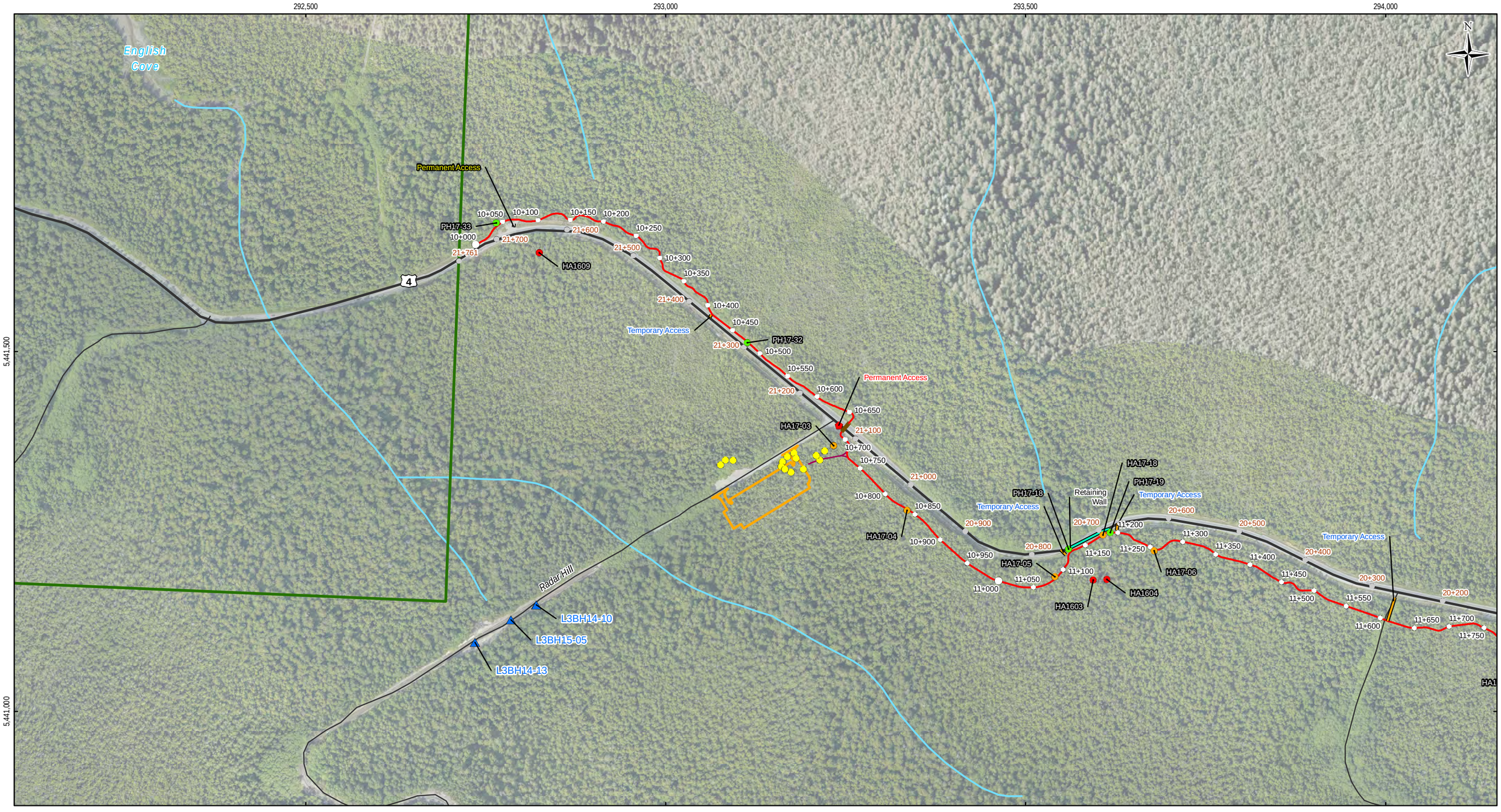

- Borehole - AMECFW
- Portable hole - AMECFW
- Hand Auger Holes (2017 AMECFW)
- Hand Augur Holes (2016 AMECFW)
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- Historical Borehole Data
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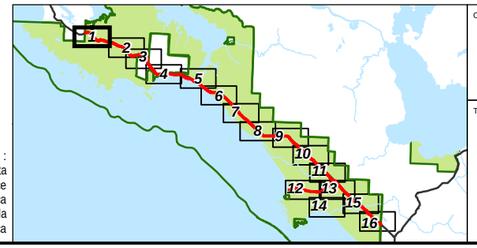
- Temporary Access (October 2017)
- Permanent Access (October 2017))
- Temporary Access (October 2017)
- Proposed Fill Slope / Retaining Walls/ Barrier
- Existing Road Marker
- Highway
- Existing Road
- Watercourse
- Waterbody

0 50 100 200
Meters
Scale 1:5,000

Reference :
DataBC Data Distribution Service
www.data.gov.bc.ca
Parks Canada
www.pc.gc.ca



CLIENT:
Public Works and Government Services Canada

TITLE:
Alignment Mapbook 1:5000
Route Date October 2017
Page 1 of 16

PROJECT:
Pacific Traverse Trail

DATE:	ANALYST:	QA/QC:	
December, 2017	MY	AA	Figure 2

GIS FILE: 22-01-001_Overview_5k_v7
JOB No: VE52602
COORDINATE SYSTEM: NAD 1983 UTM Zone 10N

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5,440,500

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PH17-20 HA17-10 Temporary Access HA1610 PH17-02 BH17-11 HA17-07 Temporary Access PH17-03 HA17-09 PH17-21 HA17-08 PH17-01 Proposed 20m Bridge #3 PH17-22 PH17-23 Temporary Access FillSlope BH17-01 HA17-01 Temporary Access HA17-11 HA17-12 PH17-24 PH17-25 HA17-13 PH17-26 PH17-27 HA17-14 Temporary Access Concrete Barrier HA1611 HA17-15 HA1612 Nuu-chah-nulth Trail ESOWISTA 3

20+100 20+000 19+900 19+800 19+700 19+600 19+500 19+400 19+300 19+200 19+100 19+000 18+900 18+800 18+700 18+600 18+500 18+400 18+300 18+200 18+100 18+000 17+900

11+750 11+800 11+850 11+900 11+950 12+000 12+050 12+100 12+150 12+200 12+250 12+300 12+350 12+400 12+450 12+500 12+550 12+600 12+650 12+700 12+750 12+800 12+850 12+900 12+950 13+000 13+050 13+100 13+150 13+200 13+250 13+300 13+350 13+400 13+450 13+500 13+550 13+600 13+650 13+700 13+750 13+800 13+850 13+900 13+950 14+000 14+050 14+100 14+150

4

- Borehole - AMECFW
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- Proposed Fill Slope / Retaining Walls/ Barrier

- Existing Road Marker
- Highway
- Existing Road
- Watercourse
- Waterbody

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Meters
Scale 1:5,000

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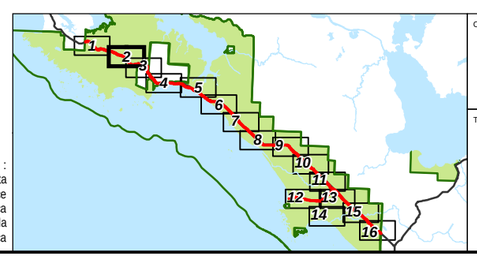

CLIENT:
Public Works and Government Services Canada

TITLE:
Alignment Mapbook 1:5000
Route Date October 2017
Page 2 of 16

PROJECT:
Pacific Traverse Trail

DATE:	ANALYST:	QA/QC:	
December, 2017	MY	AA	Figure 2

GIS FILE: 22-01-001_Overview_5k_v7
JOB No: VE52602
COORDINATE SYSTEM: NAD 1983 UTM Zone 10N

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5,440,000

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19+000 12+950 18+900 13+000 13+050 18+800 13+150 13+200 18+700 13+250 18+600 13+300 13+350 18+500 13+400 13+450 13+500 18+400 13+550 13+600 18+300 13+650 13+700 18+200 13+750 13+800 18+100 13+850 13+900 13+950 18+000 14+000 14+050 14+100 17+900 14+150 14+200 17+800 14+250 17+700 14+300 14+350 17+600 14+400 14+450 17+500 14+500 14+550 17+400 14+600 14+650 17+300 14+700 14+750 17+200 14+800 14+850 14+900 17+100 14+950 15+000 17+000 15+050 15+100 16+900

24 H17-25 HA17-13 PH17-26 PH17-27 HA17-14 HA1611 HA17-15 HA1612 Temporary Access Concrete Barrier Temporary Access PH17-34 HA17-16 Temporary Access Retaining Wall BH17-02 HA17-02 HA17-17 LBH10-05

Grice Bay

Campground

ESOWISTA 3

Nuu-chah-nulth Rd

4

Borehole - AMECFW
Portable hole - AMECFW
Hand Auger Holes (2017 AMECFW)
Hand Augur Holes (2016 AMECFW)
Shovel Pits - Millennia
Historical Borehole Data
Place of Interest
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First Nation Reserve
Pacific Rim National Park Reserve

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Temporary Access (October 2017)
Permanent Access (October 2017))
Temporary Access (October 2017)
Proposed Fill Slope / Retaining Walls/ Barrier

Existing Road Marker
Highway
Existing Road
Watercourse
Waterbody

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Meters
Scale 1:5,000

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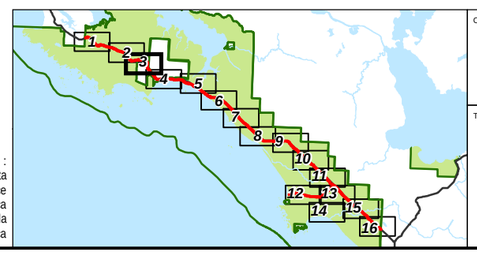

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Public Works and Government Services Canada

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Alignment Mapbook 1:5000
Route Date October 2017
Page 3 of 16

PROJECT:
Pacific Traverse Trail

DATE:	ANALYST:	QA/QC:	
December, 2017	MY	AA	Figure 2

GIS FILE: 22-01-001_Overview_5k_v7
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N

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Nuu-Piit-Taah-Chiith Rd

Village Connector Rd

PH17-09 Concrete Barrier BH17-12 PH17-10 BH17-03 LBH14-01 L4BH14-01 L4BH14-02 LBH14-02 L4BH14-03 LBH14-03 L4BH10-07 LBH10-07 HA1621 HA1620 M.RH-10/RH-2 Retaining Wall Retaining Wall LBH10-08 LBH10-09 4 park access road GAH15-01 GAH15-02 LBH10-34 Temporary Access

ESOWISTA 3

Esowista Rd

Wickaninnish Bay

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- Waterbody

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Scale 1:5,000

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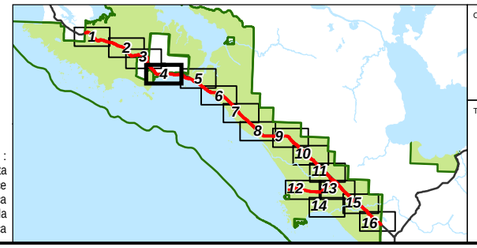

CLIENT:
Public Works and Government Services Canada

PROJECT:
Pacific Traverse Trail

TITLE:
Alignment Mapbook 1:5000
Route Date October 2017
Page 4 of 16

DATE:	ANALYST:	QA/QC:	
December, 2017	MY	AA	Figure 2

GIS FILE: 22-01-001_Overview_5k_v7
JOB No: VE52602
COORDINATE SYSTEM: NAD 1983 UTM Zone 10N

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LBH10-27 Airport Rd LBH10-26 LBH10-10 LBH10-11 LBH10-35 GAH15-03 GAH15-04 GAH15-06 GAH15-05 HA1613 PH17-35

Grice Bay

Wickaninnish Bay

15+000 17+200 14+900 17+150 17+250 14+800 17+300 17+350 14+700 17+400 17+450 14+600 17+500 17+550 14+500 17+600 17+700 17+650 17+750 17+800 17+850 14+400 17+900 17+950 14+300 18+000 18+050 14+200 18+100 18+150 14+100 18+200 18+250 14+000 18+300 18+350 13+900 18+400 18+450 13+800 18+500 18+550 13+700 18+600 18+650 13+600 18+700 18+750 13+500 18+800 13+400

Temporary Access

- Borehole - AMECFW
- Portable hole - AMECFW
- Hand Auger Holes (2017 AMECFW)
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Scale 1:5,000

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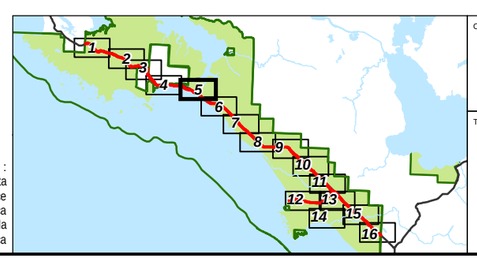

CLIENT:
Public Works and Government Services Canada

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Alignment Mapbook 1:5000
Route Date October 2017
Page 5 of 16

PROJECT:
Pacific Traverse Trail

DATE:	ANALYST:	QA/QC:	
December, 2017	MY	AA	Figure 2

GIS FILE: 22-01-001_Overview_5k_v7
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299,500 300,000 300,500 301,000 301,500

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Temporary Access
18+650 18+700 18+750 18+800 18+850 18+900 18+950 19+000 19+050 19+100 19+150 19+200 19+250 19+450 19+500 19+550 19+600 19+650 19+700 19+750 19+800 19+850 19+900 19+950 20+000 20+050 20+100 20+150 20+200 20+250 20+300 20+350 20+400 20+450 20+500 20+550 20+600 20+650 20+700 20+750 20+800 20+850 20+900
13+500 13+400 13+300 13+200 13+100 13+000 12+900 12+800 12+700 12+600 12+500 12+400 12+300 12+200 12+100 12+000 11+900 11+800 11+700 11+600 11+500
L4BH10-17
PH17-36
4
BH17-04
L4BH14-04
Retaining Wall
PH17-05
BH17-09/CPT17-09
PH17-04
PH17-08
L4BH10-20
L4BH10-21
HA1614
PH17-07
PH17-06
Retaining Wall
Retaining Wall
PH17-28
PH17-29
LBH10-22
PH17-30
LBH10-23
Park Administration
LBH10-36
LBH10-24
LBH14-01
LBH10-32
LBH10-25
Wickaninnish Bay

Borehole - AMECFW
Portable hole - AMECFW
Hand Auger Holes (2017 AMECFW)
Hand Augur Holes (2016 AMECFW)
Shovel Pits - Millennia
Historical Borehole Data
Place of Interest
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Existing Road Marker
Highway
Existing Road
Watercourse
Waterbody

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Meters
Scale 1:5,000

Reference :
DataBC Data Distribution Service
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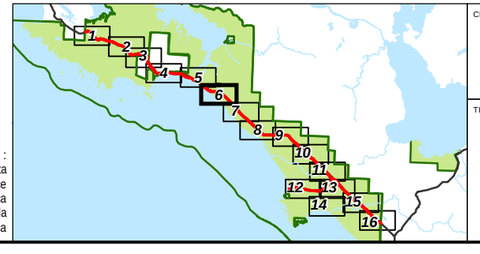

CLIENT:
Public Works and Government Services Canada

TITLE:
Alignment Mapbook 1:5000
Route Date October 2017
Page 6 of 16

PROJECT:
Pacific Traverse Trail

DATE:	ANALYST:	QA/QC:	
December, 2017	MY	AA	Figure 2

GIS FILE: 22-01-001_Overview_5k_v7
JOB No: VE52602
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301,000 301,500 302,000 302,500

5,437,500 5,437,000 5,436,500

N

20+850 20+900 20+950 21+000 21+050 21+100 21+150 21+200 21+250 21+300 21+350 21+400 21+450 21+500 21+550 21+600 21+650 21+700 21+750 21+800 21+850 21+900 21+950 22+000 22+050 22+100 22+150 22+200 22+250 22+300 22+350 22+400

11+400 11+300 11+200 11+100 11+000 10+900 10+800 10+700 10+600 10+500 10+400 10+300 10+200 10+100 10+000

LBH10-25
LBH10-31
GAH15-08
GAH15-07
LBH10-33
LBH10-30
GAH15-11
GAH15-12
GAH15-09
GAH15-10
PH17-31
LBH15-04
LSCPT15-30
LBH15-29

Temporary Access
Temporary Access
Temporary Access
Temporary Access
High Point Reservoir

Green Point Campground

Wickaninnish Bay

4

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Meters
Scale 1:5,000

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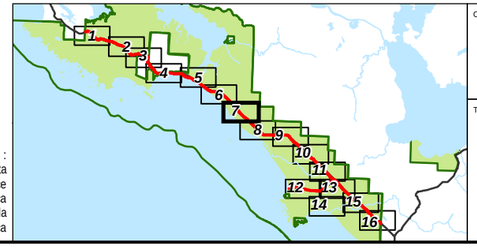

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Public Works and Government Services Canada

TITLE:
Alignment Mapbook 1:5000
Route Date October 2017
Page 7 of 16

PROJECT:
Pacific Traverse Trail

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GIS FILE: 22-01-001_Overview_5k_v7
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22+350
10+000
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22+450
9+900
22+500
Permanent Access
22+550
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22+650
9+700
22+700
22+750
9+600
22+800
22+850
9+500
Permanent Access
22+900
Retaining Wall
22+950
9+400
Temporary Access
23+000
HA1605
23+050
9+300
HA1606
23+100
23+150
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LBH15-27
23+200
9+200
Temporary Access
23+300
23+250
PH17-37
9+100
23+350
HA1623
23+400
9+000
Temporary Access
23+450
23+500
8+900
23+550
LBH15-26
8+800
Temporary Access
23+600
23+700
8+700
23+750
23+800
LBH15-25
8+600
23+850
23+900
PH17-38
Temporary Access
8+500
23+950
24+050
LBH15-23
8+400
24+000
HA1619
24+100
24+150
24+200
8+300
BH17-05
8+200
24+250
24+300
Retaining Wall
LBH15-24
Wickaninnish Bay
Combers Beach

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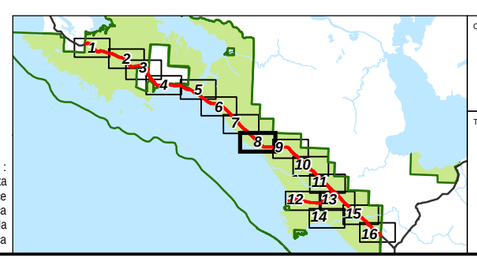

CLIENT:
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Alignment Mapbook 1:5000
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Page 8 of 16

PROJECT:
Pacific Traverse Trail

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304,000 304,500 305,000 305,500

5,436,000

5,435,500

5,435,000

N

Recreation Rd

Rainforest

BH17-05

LBH15-22

LBH15-21

LBH15-20

PH17-11

PH17-16

PH17-17

Temporary Access

Permanent Access

Retaining Wall

4

8+300 8+200 24+400 8+100 24+200 24+250 24+300 24+350 24+450 24+500 8+000 24+550 24+600 24+650 7+900 7+800 24+700 24+750 7+700 24+800 24+850 24+900 7+600 24+950 25+000 7+500 25+050 25+100 7+400 25+150 25+200 7+300 25+250 25+300 7+200 25+350 25+400 7+100 25+450 25+500 7+000 25+550 25+600 25+650 6+900 25+700 6+800 25+750 25+800 25+850 6+700 25+900 25+950 6+600 26+000

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all

Borehole - AMECFW
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Parks Canada
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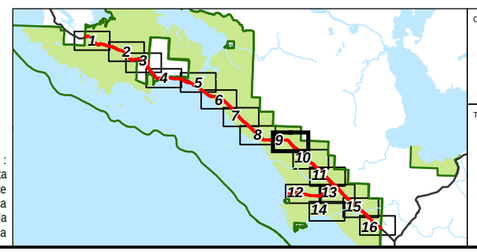

CLIENT:
Public Works and Government Services Canada

TITLE:
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Route Date October 2017
Page 9 of 16

PROJECT:
Pacific Traverse Trail

DATE:	ANALYST:	QA/QC:	
December, 2017	MY	AA	Figure 2

GIS FILE: 22-01-001_Overview_5k_v7
JOB No: VE52602
COORDINATE SYSTEM: NAD 1983 UTM Zone 10N

amec foster wheeler

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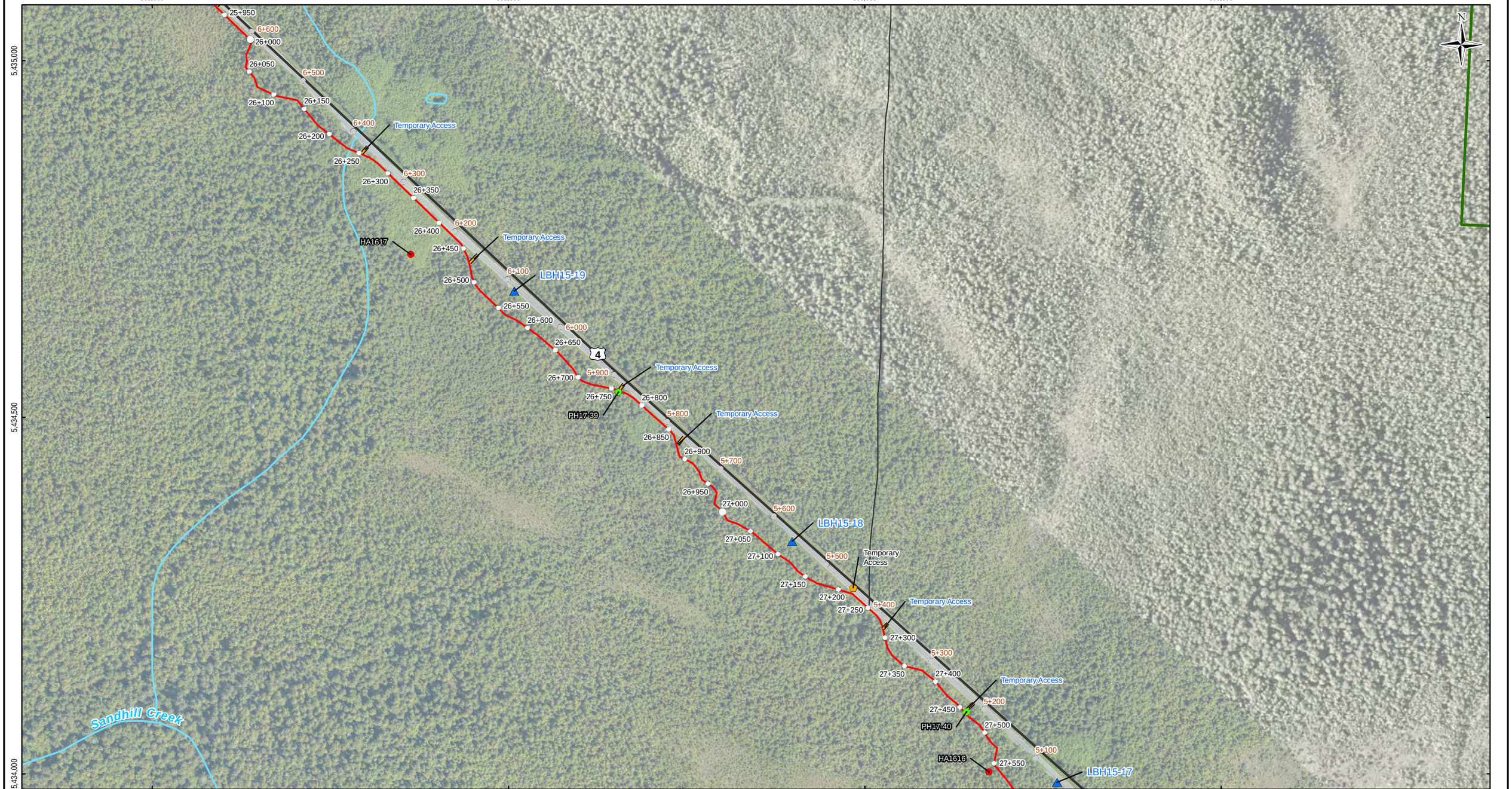

- Borehole - AMECFW
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- Hand Augur Holes (2016 AMECFW)
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- Historical Borehole Data
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- Temporary Access (October 2017)
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- Highway
- Existing Road
- Watercourse
- Waterbody

0 50 100 200
Meters
Scale 1:5,000

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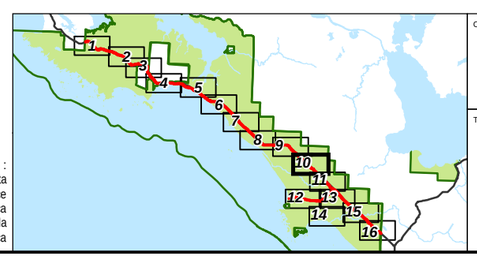

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Pacific Traverse Trail

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306,000 306,500 307,000 307,500

5,434,000 5,433,500 5,433,000

N

Sandhill Creek

PH17-40 27+500 5+100 HA1616 27+550 LBH15-17 27+600 5+000 Temporary Access 27+700 27+650 27+750 4+900 27+800 27+850 27+900 4+800 27+950 Permanent Access LBH15-16 4+700 28+000 Retaining Wall 28+050 Temporary Access 28+100 4+600 BH17-06 28+150 4+500 28+200 28+250 28+300 4+400 28+350 LBH15-15 28+400 4+300 28+450 28+500 4+200 Temporary Access 28+550 PH17-41 28+600 4+100 28+650 LBH15-14 28+700 4+000 28+750 28+800 3+900 28+850 LBH15-13 28+900 28+950 3+800 Permanent Access 29+000 Permanent Access 29+050 3+049 3+000 29+100 43+023 3+700 43+000 29+150 29+200 2+900 42+900 3+600

Long Beach Sewage Lagoon
A1BH14-03
A1BH14-02
R1TP15-02
R1TP15-03
R1TP15-01
A1BH14-01
R1TP15-06
R1TP15-04
R1TP15-05

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0 50 100 200 Meters
Scale 1:5,000

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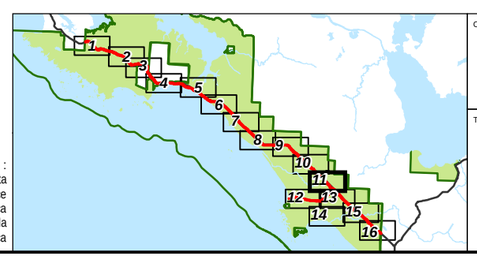

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304,500 305,000 305,500 306,000

5,433,000 5,432,500 5,432,000

N

parking lot
Ocean Terrace Rd
Wick Rd
GAH15-13
GAH-15-14
Wickaninnish Bay
M.AOI95
Kwisitis Visitor Centre
LBH15-03
Wick Road Reservoir
LSCPT15-31
Permanent Access
0+100 0+200 0+300 0+400 0+500 0+600 0+700 0+800 0+900 1+000 1+100 1+200 1+300 1+400 1+500 1+600 1+700 1+800 1+900
40+300 40+400 40+500 40+600 40+700 40+800 40+900 41+000 41+100 41+200 41+300 41+400 41+500 41+600 41+700 41+800 41+900
PH17-45
HA1607
HA1608
PH17-44
Concrete Barrier
Temporary Access
RTH3
RPT4-TH6
RTH1
RPT1
RTH2
RTH5
RPT2
RPT3
RTH4
HA1615

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0 50 100 200
Meters
Scale 1:5,000

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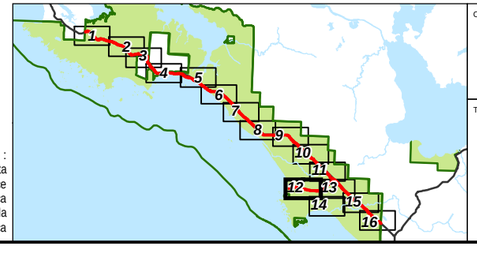

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306,500 307,000 307,500 308,000

5,433,000 5,432,500 5,432,000

N

3+000 43+023 29+100 3+700 43+000 29+150 2+900 42+900 29+200 3+600 29+250 2+800 42+800 29+300 3+500 29+350 L1BH15-01 Permanent Access LBH15-12 42+700 2+700 29+400 3+400 29+450 Retaining Wall L2HA14-1 PH17-15 42+600 L1BH15-02 PH17-14 2+600 29+500 3+300 M:SANDHILL NORTH2 Temporary Access 42+500 Proposed Bridge #20 29+550 Temporary Access L1BH14-01 L1BH15-03 L1BH15-04 29+600 3+200 42+400 2+500 BH17-08/CPT17-03 Retaining Wall L1BH14-02 29+650 LBH15-11 2+400 L1BH15-05 29+700 3+100 42+300 L1BH15-06 29+750 2+300 L1BH15-07 29+800 3+000 42+200 Wick Rd 29+850 LBH15-10 2+200 29+900 2+900 42+100 Temporary Access 29+950 Temporary Access 2+100 PH17-42 30+000 2+800 42+000 Temporary Access 41+900 2+000 30+050 1+900 30+100 2+700 30+150 30+200 2+600 Temporary Access 30+250 LBH15-09 30+300 2+500 30+350 30+400 30+450 2+400 30+500 LBH15-08 30+550 2+300 4 30+600 2+200 30+650

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0 50 100 200
Meters
Scale 1:5,000

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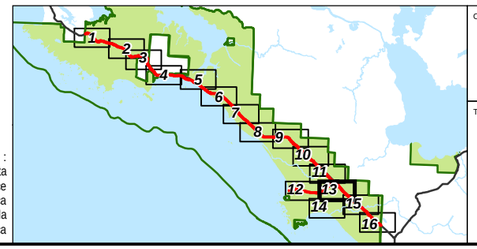

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306,000
306,500
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N
M.ST-16-JC21
M.ST-16-JC10
Lost Shoe Creek
M.ST-62
HA1622
M.ST-17-JC46
M.ST-17-JC3
Florencia Bay

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0 50 100 200
Meters
Scale 1:5,000

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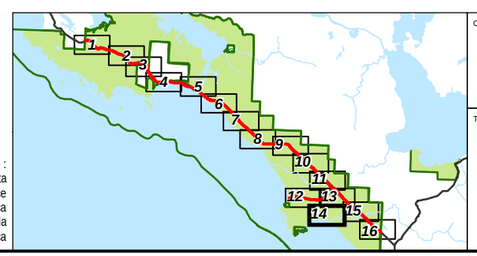

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Pacific Traverse Trail

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308,000
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30+250
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30+350
30+400
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1+700
1+600
1+500
1+400
1+300
1+200
1+100
1+000
LBH15-09
LBH15-08
LBH15-07
LBH15-06
LBH15-28
LSCPT15-32
LBH15-01
LBH15-02
LBH15-05
BH17-10
BH17-07
PH17-12
PH17-13
HA1618
HA1601
HA1602
M:EG1
Temporary Access
Temporary Access
Temporary Access
Temporary Access
Proposed Bridge #19 "Lost Shoe"
Lost Shoe Creek
4

- Borehole - AMECFW
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Meters
Scale 1:5,000

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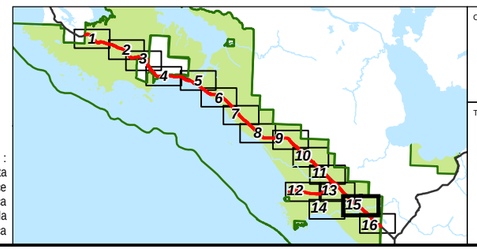

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309,000
309,500
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5,430,500
N
32+100
1+000
32+150
32+200
0+900
32+250
32+300
0+800
32+350
32+400
0+700
Temporary Access
32+450
32+500
PH17-43
32+550
0+600
32+600
32+650
0+500
4
32+700
32+750
0+400
32+800
32+850
0+300
Temporary Access
32+900
0+200
32+950
33+050
33+000
33+100
0+100
33+150
33+200
0+000
33+235
Permanent Access
Swan Lake

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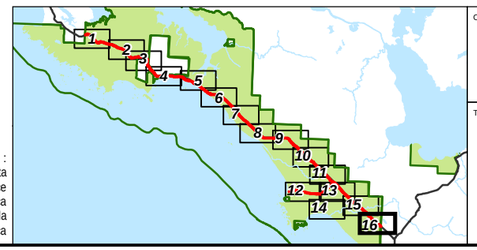

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Appendix A: Borehole Logs

BOREHOLE HA16-01

STARTED: 12/6/2016 **FINISHED:** 12/6/2016

METHOD: Hand Auger

LOCATION: Bridge ID.19, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5431494 **E** 308792 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G		FOREST LITTER/TOPSOIL/PEAT, very soft	
0.4					21.6	
			G		SAND, fine grained, some silt, trace organics, loose, moist, reddish brown to tan	
1			G			
1.2					20.9	
1.4			G		SAND, fine to med. grained, trace silt, compact, moist, tan	
					20.6	
					SAND, fine to coarse grained, trace silt & gravel, compact, moist, tan	
2			G			
2.1					- moist/wet @ 2m	
					19.9	
					End of Hole	
					- no groundwater observed	
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE POCKET PEN ⊙

PEAK ▲ TORVANE ◬

RESIDUAL △

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

23

24

9

9

amec foster wheeler

AMEC FOSTER WHEELER
Environment & Infrastructure
18568 - 96 Avenue, Unit 110
Surrey, B.C. V4N 3P9

PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-01**

BOREHOLE HA16-02

STARTED: 12/6/2016 **FINISHED:** 12/6/2016

METHOD: Hand Auger

LOCATION: Bridge ID.19, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5431471 **E** 308814 **ELEV:** 23 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	ELEVATION
0	G		FOREST LITTER/TOPSOIL/PEAT, very soft	
0.7				22.4
0.8			SAND, fine grained, some silt, trace organics, loose, moist, reddish brown to tan	22.3
1	G			
1.1			SAND, fine to coarse grained, trace silt & gravel, compact, moist, tan	21.9
1.5	G		SAND, fine to med. grained, trace silt, compact, moist, tan	21.5
2			SAND, fine to coarse grained, trace silt & gravel, compact, moist, tan	
2.1	G			20.9
			End of Hole - no groundwater observed	

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

115
14
18
13

N-GEO-CONVERT-2017 KA21151 PACIFIC TRAVERSE TRAIL (HA TEST HOLES DEC 2016).DRAFT.V00.GPJ ALL-1.GDT 12/8/17

amec foster wheeler

AMEC FOSTER WHEELER
Environment & Infrastructure
18568 - 96 Avenue, Unit 110
Surrey, B.C. V4N 3P9

PROJECT NO.: KA21151
PROJECT: PACIFIC TRAVERSE TRAIL
LOCATION: PACIFIC RIM NATIONAL PARK, BC
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 1 OF 1 **BOREHOLE No. HA16-02**

BOREHOLE HA16-03

STARTED: 12/6/2016 **FINISHED:** 12/7/2016

METHOD: Hand Auger

LOCATION: Bridge ID.2, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441182 **E** 293594 **ELEV:** 18 m

DESCRIPTION OF MATERIALS

DEPTH (m)		
0.0	FOREST LITTER/TOPSOIL/PEAT, very soft	17.7
0.3	CLAY, trace sand, hard, reddish brown to tan	
0.6	- field vane refusal, >280 kPa	17.4
	End of Hole	
	- no groundwater observed	

BLOWS PER 152mm | % Fines < No. 200 | SAMPLE TYPE AND NUMBER | SYMBOL | WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90
41 71

N-GEO-CONVERT-2017 KA21151 PACIFIC TRAVERSE TRAIL (HA TEST HOLES DEC 2016).DRAFT.V00.GPJ ALL-1.GDT 12/8/17

amec foster wheeler

AMEC FOSTER WHEELER
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Surrey, B.C. V4N 3P9

PROJECT NO.: KA21151
PROJECT: PACIFIC TRAVERSE TRAIL
LOCATION: PACIFIC RIM NATIONAL PARK, BC
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 1 OF 1 **BOREHOLE No. HA16-03**

BOREHOLE HA16-04

STARTED: 12/7/2016 **FINISHED:** 12/7/2016

METHOD: Hand Auger

LOCATION: Bridge ID.2, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441184 **E** 293613 **ELEV:** 18 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G		FOREST LITTER/TOPSOIL/PEAT, very soft - grey silt inclusion	
0.4					17.6	
0.6			G G		CLAY, silty, trace organics, firm to stiff, brown, mottled - slight seepage @ 0.6m	
1			G		17.4 CLAY, trace sand, hard, reddish brown to grey/brown, mottled - field vane refusal to 1.5m depth, >280 kPa	
2			G		2.1 15.9	
					End of Hole	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

82 273 70 63 62 49 58 180

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PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-04**

BOREHOLE HA16-05

STARTED: 12/7/2016 **FINISHED:** 12/7/2016

METHOD: Hand Auger

LOCATION: Bridge ID.12, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5436013 **E** 302688 **ELEV:** 36 m

DESCRIPTION OF MATERIALS

DEPTH (m)			DESCRIPTION OF MATERIALS
0	0.4	35.6	FOREST LITTER/TOPSOIL/PEAT, very soft
	0.6	35.4	CLAY, silty, trace organics, firm to stiff, brown, mottled
1			CLAY, trace sand, hard, reddish brown to grey/brown, mottled - field vane refusal to 1.5m depth, >280 kPa
2	2.1	33.9	
			End of Hole - no groundwater observed

BLOWS PER 152mm | % Fines < No. 200 | SAMPLE TYPE AND NUMBER | SYMBOL | WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

335
50
79
40
38

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PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-05**

BOREHOLE HA16-06

STARTED: 12/7/2016 **FINISHED:** 12/7/2016

METHOD: Hand Auger

LOCATION: Bridge ID.12, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5436006 **E** 302715 **ELEV:** 36 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
0.4						
0.6					CLAY, silty, trace sand, hard, reddish brown - field vane refusal, >280 kPa	
35.7 / 35.4					End of Hole - no groundwater observed	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

74 119

1 2 3 4 5 6 7 8 9 10

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PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-06**

BOREHOLE HA16-07

STARTED: 12/7/2016 **FINISHED:** 12/7/2016

METHOD: Hand Auger

LOCATION: Bridge ID.20, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432586 **E** 305153 **ELEV:** 21 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G		FOREST LITTER/TOPSOIL/PEAT, very soft	
0.4			G		- groundwater @ 0.3m (20.6)	
			G		SAND, fine to med. grained, trace silt, compact, wet, grey - occasional organic inclusion	
1			G		- trace gravel	
1.5			G		(19.5)	
					End of Hole - sloughing @ 1.5m	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

195 39 31 24

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PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-07**

BOREHOLE HA16-08

STARTED: 12/12/2016 **FINISHED:** 12/12/2016

METHOD: Hand Auger

LOCATION: Bridge ID.19A, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432531 **E** 305380 **ELEV:** 21 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G		FOREST LITTER/TOPSOIL/PEAT, very soft - groundwater @ 0.3m	
1.0					20.0	
1			G		SAND, fine to med. grained, trace silt, compact, wet, grey - occasional organic inclusion	
1.5					19.5	
					- trace gravel End of Hole - sloughing @ 1.5m	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

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PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-08**

BOREHOLE HA16-09

STARTED: 12/13/2016 **FINISHED:** 12/13/2016

METHOD: Hand Auger

LOCATION: Bridge ID.1, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441637 **E** 292824 **ELEV:** 18 m

DESCRIPTION OF MATERIALS

DEPTH (m)			DESCRIPTION OF MATERIALS
0	0.5	17.5	FOREST LITTER/TOPSOIL/PEAT, very soft
	0.8	17.3	CLAY, silty, trace sand, hard, reddish brown to grey/brown, mottled
1	1.0	17.0	- field vane refusal, >280 kPa
			SAND, fine grained, silty, compact to dense, moist, reddish brown
			CLAY, trace sand, very stiff, grey/brown, mottled
			- slight seepage @ 1.5m
2	1.8	16.2	SILT/SAND, trace clay, non-plastic, stiff, grey/brown, mottled
	2.1	15.9	End of Hole
3			
4			
5			
6			
7			
8			
9			
10			

BLOWS PER 152mm

% Fines < No. 200

SAMPLE TYPE AND NUMBER

SYMBOL

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △

POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

▲126

100

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PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

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SHEET 1 OF 1 **BOREHOLE No. HA16-09**

BOREHOLE HA16-10

STARTED: 12/13/2016 **FINISHED:** 12/13/2016

METHOD: Hand Auger

LOCATION: Bridge ID.3, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441082 **E** 294290 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft - grey silt inclusion	
0.4						
			G		SAND, fine to med. grained, trace silt, dense, moist to wet, reddish brown to grey	
1			G		- grey and groundwater seepage @ 1m	
			G			
1.8			G			
2					End of Hole - sloughing @ 1.8m	
21.6						
20.2						
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

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SHEET 1 OF 1 **BOREHOLE No. HA16-10**

BOREHOLE HA16-11

STARTED: 12/13/2016 **FINISHED:** 12/13/2016

METHOD: Hand Auger

LOCATION: Bridge ID.4, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5440359 **E** 295774 **ELEV:** 17 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G		FOREST LITTER/TOPSOIL/PEAT, very soft - grey silt inclusion	
			G		- groundwater seepage @ 0.6m	
1			G		1.1 15.9 SAND, fine to med. grained, trace silt, compact/dense, moist to wet, brown to grey - grey below 1.2m	
			G			
2			G		2.0 15.0 End of Hole - sloughing @ 2.1m	
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151
PROJECT: PACIFIC TRAVERSE TRAIL
LOCATION: PACIFIC RIM NATIONAL PARK, BC
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 1 OF 1 **BOREHOLE No. HA16-11**

BOREHOLE HA16-12

STARTED: 12/13/2016 **FINISHED:** 12/13/2016

METHOD: Hand Auger

LOCATION: Bridge ID.5, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5440353 **E** 296002 **ELEV:** 19 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G		FOREST LITTER/TOPSOIL/PEAT, very soft - grey silt inclusion	
0.5						
					SAND, fine to med. grained, trace silt, compact/dense, moist to wet, brown to grey - silty top 100mm, trace organics	
1			G			
			G		- grey & groundwater seepage @ 1.5m	
1.8			G			
17.2					End of Hole - sloughing @ 1.8m	
18.5						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151
PROJECT: PACIFIC TRAVERSE TRAIL
LOCATION: PACIFIC RIM NATIONAL PARK, BC
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 1 OF 1 **BOREHOLE No. HA16-12**

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BOREHOLE HA16-13

STARTED: 12/13/2016 **FINISHED:** 12/13/2016

METHOD: Hand Auger

LOCATION: Bridge ID.9, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438873 **E** 298975 **ELEV:** 5 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft - grey silt inclusion	
0.6						
0.8			G		- groundwater seepage @ 0.6m (4.3)	
1					SAND, fine grained, trace silt & organics, loose, wet, grey	
1			G		SAND, fine grained, trace silt, compact/dense, moist to wet, grey	
1.5					- silty top 100mm, trace organics (3.5)	
					End of Hole - sloughing @ 1.5m	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151
PROJECT: PACIFIC TRAVERSE TRAIL
LOCATION: PACIFIC RIM NATIONAL PARK, BC
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 1 OF 1 **BOREHOLE No. HA16-13**

BOREHOLE HA16-14

STARTED: 12/14/2016 **FINISHED:** 12/14/2016

METHOD: Hand Auger

LOCATION: Bridge ID.11, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438193 **E** 300010 **ELEV:** 14 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G		FOREST LITTER/TOPSOIL/PEAT, very soft	
0.3						
			G		CLAY, trace sand, hard to very stiff, reddish brown to grey/brown, mottled - field vane refusal to 0.8m depth, >280 kPa	
1			G			
			G			
2			G			
2.1						
11.9					End of Hole - no groundwater seepage observed	
13.7						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90
164
>>
158

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PROJECT NO.: KA21151
PROJECT: PACIFIC TRAVERSE TRAIL
LOCATION: PACIFIC RIM NATIONAL PARK, BC
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 1 OF 1 **BOREHOLE No. HA16-14**

BOREHOLE HA16-15

STARTED: 12/14/2016 **FINISHED:** 12/14/2016

METHOD: Hand Auger

LOCATION: Bridge ID.21, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432191 **E** 306046 **ELEV:** 20 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G		FOREST LITTER/TOPSOIL/PEAT, very soft	
0.6					19.4 - groundwater @ 0.5m	
			G		SAND, fine to med. grained, trace silt & gravel, compact to dense, wet, grey	
1.2					18.8 End of Hole - sloughing @ 1.2m	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151
PROJECT: PACIFIC TRAVERSE TRAIL
LOCATION: PACIFIC RIM NATIONAL PARK, BC
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 1 OF 1 **BOREHOLE No. HA16-15**

BOREHOLE HA16-16

STARTED: 12/14/2016 **FINISHED:** 12/14/2016

METHOD: Hand Auger

LOCATION: Bridge ID.16, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5434003 **E** 306174 **ELEV:** 25 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
0.3					24.7	
			G1		CLAY, trace sand, firm to hard, reddish brown to grey/brown, mottled - field vane refusal @ 1m depth, >280 kPa	
1.0			G2		24.0	
1.1			G3		23.9 SAND & GRAVEL, silty, dense, moist, reddish brown	
					End of Hole - refusal - no groundwater seepage observed	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

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PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-16**

BOREHOLE HA16-17

STARTED: 12/14/2016 **FINISHED:** 12/14/2016

METHOD: Hand Auger

LOCATION: Bridge ID.15, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5434728 **E** 305363 **ELEV:** 36 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
0.4					35.6	
			G		CLAY, trace sand, firm to very stiff, reddish brown to grey/brown, mottled	
1			G			
1.4					34.6	
1.5					34.5	
					Inferred SAND & GRAVEL, dense - no recovery	
					End of Hole - refusal - no groundwater seepage observed	
2						
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

▲ 50

▲ 148

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PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-17**

BOREHOLE HA16-18

STARTED: 12/15/2016 **FINISHED:** 12/15/2016

METHOD: Hand Auger

LOCATION: Bridge ID.18, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5431563 **E** 308768 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
0.9					21.1	
1			G		SAND, silty, fine grained, loose, moist to wet, reddish brown to tan - occasional organic inclusion	
1.4					20.6 - groundwater @ 1.1m - grey @ 1.2m	
2			G		SAND, fine to med. grained, trace silt, compact to dense, wet, grey trace brown - occasional organic inclusion	
2.0			G		20.0 End of Hole	
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180

FIELD VANE POCKET PEN ⊙
PEAK ▲ TORVANE ◬
RESIDUAL △

■ SPT N ◆ DCPT N
Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

N-GEO-CONVERT-2017 KA21151 PACIFIC TRAVERSE TRAIL (HA TEST HOLES DEC 2016).DRAFT.V00.GPJ ALL-1.GDT 12/8/17

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18568 - 96 Avenue, Unit 110
Surrey, B.C. V4N 3P9

PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-18**

BOREHOLE HA16-19

STARTED: 12/15/2016 **FINISHED:** 12/15/2016

METHOD: Hand Auger

LOCATION: Bridge ID.14, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5435642 **E** 303554 **ELEV:** 33 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
0.9					32.1	
1			G		CLAY, trace sand, hard to stiff, reddish brown to grey/brown, mottled - sandy top 150mm - field vane refusal @ 1.5m depth, >280 kPa	
2			G			
2.1			G		30.9	
					End of Hole - no groundwater seepage observed	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

140

80

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PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-19**

BOREHOLE HA16-20

STARTED: 12/15/2016 **FINISHED:** 12/15/2016

METHOD: Hand Auger

LOCATION: Bridge ID.8, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5439229 **E** 297366 **ELEV:** 5 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
0.7					- groundwater @ 0.6m (4.3)	
0.9			G		SAND, silty, fine grained, loose, wet, brown (4.1)	
					- trace to some organic inclusion	
1.4					SAND, fine grained, some to trace silt, compact, brown/grey (3.6)	
					- occasional organic inclusion	
					End of Hole	
					- sloughing @ 1.4m	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-20**

BOREHOLE HA16-21

STARTED: 12/15/2016 **FINISHED:** 12/15/2016

METHOD: Hand Auger

LOCATION: Bridge ID.6&7, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5439214 **E** 297219 **ELEV:** 5 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
					- groundwater @ 0.5m	
0.9						4.1
1			G		SAND, silty, fine grained, loose, wet, brown	
1.1					- some organic inclusion	3.9
1.3					SAND, fine grained, some to trace silt, compact, grey	3.7
					End of Hole	
					- sloughing @ 1.3m	
2						
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-21**

BOREHOLE HA16-22

STARTED: 12/16/2016 **FINISHED:** 12/16/2016

METHOD: Hand Auger

LOCATION: Bridge ID.22, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5431319 **E** 306741 **ELEV:** 20 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
0.4 / 0.5					SAND & GRAVEL, some-trace silt, dense, moist, reddish brown	
19.6 / 19.5					End of Hole - refusal - no groundwater seepage observed	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

1 2 3 4 5 6 7 8 9 10

N-GEO-CONVERT-2017 KA21151 PACIFIC TRAVERSE TRAIL (HA TEST HOLES DEC 2016).DRAFT.V00.GPJ ALL-1.GDT 12/8/17

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PROJECT NO.: KA21151
PROJECT: PACIFIC TRAVERSE TRAIL
LOCATION: PACIFIC RIM NATIONAL PARK, BC
LOGGED BY: EDS **REVIEWED BY:** JL
SHEET 1 OF 1 **BOREHOLE No. HA16-22**

BOREHOLE HA16-23

STARTED: 12/16/2016 **FINISHED:** 12/16/2016

METHOD: Hand Auger

LOCATION: Bridge ID.13, Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5435808 **E** 302885 **ELEV:** 34 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					FOREST LITTER/TOPSOIL/PEAT, very soft	
0.4					33.6	
			G		CLAY, trace sand, hard to firm, reddish brown to grey/brown, mottled	
1			G		- groundwater seepage @ 1m	
			G		- trace sand & gravel below 1.8m	
2			G		2.1 31.9	
					End of Hole	
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

▲36 ▲176 >>▲ ▲186

N-GEO-CONVERT-2017 KA21151 PACIFIC TRAVERSE TRAIL (HA TEST HOLES DEC 2016).DRAFT.V00.GPJ ALL-1.GDT 12/8/17

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PROJECT NO.: KA21151

PROJECT: PACIFIC TRAVERSE TRAIL

LOCATION: PACIFIC RIM NATIONAL PARK, BC

LOGGED BY: EDS **REVIEWED BY:** JL

SHEET 1 OF 1 **BOREHOLE No. HA16-23**

BOREHOLE BH17-01

STARTED: 22/02/2017 **FINISHED:** 22/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 20.0M

COORDINATES (m): N 5440854 **E** 294875 **ELEV:** 20 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
					0.1 Asphalt 114 mm thick. 19.9	
					0.3 Road base - silt, sand, gravel, brown, compact, moist 19.7	
					SAND, silty, trace gravel, brown, trace organics, compact, moist	
					- @ below 0.5 m, fine to medium grained, no silt, no organics	
1			GS1			
					- @ 1.2 m, wet	
	5/6/6/5	9.2	SS1			
2					- @ 2.0 m, some brown silt and clay	
3						
	1/2/6/6		SS2		- @ below 3.0 m, silty - @ 3.1 m to 3.0 m, silty clay, medium plastic - @ 3.4 m to 3.7 m, SILT, some sand, grey, stiff, moist	
4						
	1/4/7/2	11	SS3		- Silty, brown - Some silt, grey	
					4.9 - Brown 15.1	
5					SILT, sandy, grey, stiff, non plastic, moist	
6						
	2/3/4/4		SS4			
					6.7 13.3	
7					CLAY, some silt, grey, very soft, medium to high plastic, moist	
	0/0/0/0		SS5			
8						
9						
	0/1/1/1		SS6			
10						

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PROJECT NO.: KA21151.5
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: bc **REVIEWED BY:** bf
SHEET 1 OF 2 **BOREHOLE No. BH17-01**

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (BH17-01 AND BH17-07).GPJ ALL-1.GDT 3/11/17

BOREHOLE BH17-01

STARTED: 22/02/2017 **FINISHED:** 22/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 20.0M

COORDINATES (m): N 5440854 **E** 294875 **ELEV:** 20 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
11	1/1/1/1		SS7		CLAY, some silt, grey, very soft, medium to high plastic, moist *(continued)*	
12	1/1/1/1		SS8			
13						
14	>50 in 50 mm		SS9		14.2 5.8 SILT, sandy, gravelly, grey, dense, moist 14.3 5.7	
					End of borehole - Monitoring well was installed, bottom of MW at a depth of 13.7 m with a screen of 3.0 m long and backfilled with filter sand.	
15						
16						
17						
18						
19						
20						

2 65
2 65
30

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PROJECT NO.: KA21151.5
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: bc **REVIEWED BY:** bf
SHEET 2 OF 2 **BOREHOLE No. BH17-01**

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (BH17-01 AND BH17-07).GPJ ALL-1.GDT 3/11/17

BOREHOLE BH17-02

STARTED: 23/02/2017 **FINISHED:** 23/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 18.3M

COORDINATES (m): N 5439725 **E** 296494 **ELEV:** 18.3 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0					0.2 Asphalt - two layers - 100 mm (upper) and 50 mm (lower) thick. 18.1
					0.3 Road base - silt, sand, gravel, brown, compact, moist 18.0
					SAND, fine to medium grained, brown, compact, dry
1			G1		
	7/9/12/14	4	SS1		
2					
3			SS2		- @ 3.0 m, wet
	6/12/15/15				
4					
	5/3/9/18		SS3		- @ 4.9 to 5.2 m, silty, some clay, wet
5					5.2 13.1
					CLAY, silty, grey, firm, high plastic, moist
6					
	0/2/2/1		SS4		
7					
	0/5/12/6		SS5-1		7.9 10.4
8		25.8	SS5-2		SAND, silty, grey, compact, moist
					8.2 10.1
					CLAY, grey, soft, moist, high plastic
9					
	0/1/2/1		SS6		
10					

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

11 9 21 27 27 12 45 4 55 17 47 28 3 55

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (BH17-01 AND BH17-07).GPJ ALL-1.GDT 3/11/17

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 1 OF 2 **BOREHOLE No. BH17-02**

BOREHOLE BH17-02

STARTED: 23/02/2017 **FINISHED:** 23/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 18.3M

COORDINATES (m): N 5439725 **E** 296494 **ELEV:** 18.3 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
11	0/0/1/1		SS7		CLAY, grey, soft, moist, high plastic *(continued)*	
12	0/0/1/1		SS8		12.8 5.5	
13					End of borehole - Monitoring well was installed, bottom of MW at a depth of 12.2 m with a screen of 3.0 m long and backfilled with filter sand.	
14						
15						
16						
17						
18						
19						
20						

SS7: 1 — 56
SS8: 1 — 52

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PROJECT NO.: KA21151.5
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: bc **REVIEWED BY:** bf
SHEET 2 OF 2 **BOREHOLE No. BH17-02**

BOREHOLE BH17-03

STARTED: 24/02/2017 **FINISHED:** 24/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 12.1M

COORDINATES (m): N 5439232 **E** 296987 **ELEV:** 12.1 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					0.2 Asphalt - two layers - 150 mm (upper) and 50 mm (lower) thick. 11.9	
					0.5 Road base - silt, sand, gravel, brown, compact, moist 11.6	
					SILT, peaty, some sand, trace gravel, dark brown, soft, moist	
1			G1		1.5 10.6	
					1.7 SAND, silty, brown, trace organics, loose, wet 10.4	
2	0/0/0/1		SS1		CLAY, silty, grey, very soft, wet, medium to high plastic	
3	0/0/1/1		SS2		- @ 3.0 m and below, trace dark brown organics, trace gravel	
4						
5	0/1/1/1		SS3		- @ 4.6 m and below, no organics	
6						
7	0/1/1/1		SS4			
8	0/0/1/1		SS5			
9						
10	0/0/1/1		SS6			

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 1 OF 2 **BOREHOLE No. BH17-03**

BOREHOLE BH17-03

STARTED: 24/02/2017 **FINISHED:** 24/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 12.1M

COORDINATES (m): N 5439232 **E** 296987 **ELEV:** 12.1 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
11	0/1/1/1		SS7		CLAY, silty, grey, very soft, wet, medium to high plastic *(continued)*	
12	0/0/2/2		SS8			
13						
14	0/1/3/3		SS9		14.3 -2.2 End of borehole - Monitoring well was installed, bottom of MW at a depth of 13.7 m with a screen of 3.0 m long and backfilled with filter sand.	
15						
16						
17						
18						
19						
20						

2 37
2 40
4 32

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PROJECT NO.: KA21151.5
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: bc **REVIEWED BY:** bf
SHEET 2 OF 2 **BOREHOLE No. BH17-03**

BOREHOLE BH17-04

STARTED: 26/02/2017 **FINISHED:** 26/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 22.0M

COORDINATES (m): N 5438236 **E** 299975 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0					0.2 Asphalt - two layers - 100 mm (upper) and 50 mm (lower) thick. 21.8
					0.3 Road base - silt, sand, gravel, brown, compact, moist 21.7
					CLAY, trace silt, trace gravel, grey/brown, stiff, moist, medium plastic
1			GS1		
	1/2/3/2		SS1		- @ 1.5 m below, firm, grey
2					
3					- @ 3.0 m below, very soft
	0/0/1/1		SS2		
4					
	0/0/1/0		SS3		
5					
6					
	0/0/0/0		SS4		
7					
	0/0/0/0		SS5		
8					
9					
	0/1/0/1		SS6		
10					

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

38, 30, 5, 33, 1, 152, >>▲, 40, 1, 34, 0, >>▲, 36, 3, 28, 1

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 1 OF 2 **BOREHOLE No. BH17-04**

BOREHOLE BH17-04

STARTED: 26/02/2017 **FINISHED:** 26/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 22.0M

COORDINATES (m): N 5438236 **E** 299975 **ELEV:** 22 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
11	0/0/0/1		SS7		CLAY, trace silt, trace gravel, grey/brown, stiff, moist, medium plastic *(continued)*	
12	0/0/0/1		SS8			
13					13.7 8.3	
14	3/9/14/11	70.2	SS9		SILT, sandy, grey, stiff/compact, moist	
					14.3 7.7	
15	0/0/2/5		SS10		CLAY, trace silt, trace gravel, grey, soft, moist, medium plastic	
16					15.8 6.2	
					End of borehole - Monitoring well was installed, bottom of MW at a depth of 15.2 m with a screen of 3.0 m long and backfilled with filter sand.	
17						
18						
19						
20						

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (BH17-01 AND BH17-07).GPJ ALL-1.GDT 3/11/17

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 2 OF 2 **BOREHOLE No. BH17-04**

BOREHOLE BH17-05

STARTED: 27/02/2017 **FINISHED:** 27/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 31.9M

COORDINATES (m): **N** 5435660 **E** 303714 **ELEV:** 31.9 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0					0.1 Asphalt - 100 mm thick. 31.8
					0.3 Road base - silt, sand, gravel, brown, compact, moist 31.6
					CLAY, trace gravel, grey/brown, firm, moist, medium to high plastic
1			G1		
					- @ 1.2 m below, grey, soft to very soft
2	0/1/1/0		SS1		
3	1/1/1/1		SS2		
4					
5	0/0/0/1		SS3		
6	0/0/1/0		SS4		
7					
8	0/0/0/1		SS5		
9					
10	0/0/0/1		SS6		

WELL INSTALLTION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

49 45 39 58 >> 172 44 48 42

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 1 OF 2 **BOREHOLE No. BH17-05**

BOREHOLE BH17-05

STARTED: 27/02/2017 **FINISHED:** 27/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 31.9M

COORDINATES (m): N 5435660 **E** 303714 **ELEV:** 31.9 m

UNDRAINED SHEAR Su (kPa) 20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L% 10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
11	0/0/1/1		SS7		CLAY, trace gravel, grey/brown, firm, moist, medium to high plastic *(continued)*	
12	0/0/0/1		SS8			
13						
14	0/0/0/2		SS9			
15						
15.8	0/0/1/2		SS10			
16					End of borehole - Monitoring well was installed, bottom of MW at a depth of 15.2 m with a screen of 3.0 m long and backfilled with filter sand. - No seepage encountered while drilling. The monitoring well is dry on 28 Feb 2017.	
16.1						
17						
18						
19						
20						

1 44 >> 0 45 0 41 >> 1 52

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 2 OF 2 **BOREHOLE No. BH17-05**

BOREHOLE BH17-06

STARTED: 23/02/2017 **FINISHED:** 23/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 21.8M

COORDINATES (m): **N** 5433647 **E** 306619 **ELEV:** 21.8 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0					0.1 Asphalt - 75 mm thick. (21.7)
					0.3 Road base - silt, sand, gravel, brown, compact, moist (21.5)
					SAND, silty, some gravel, trace cobbles, brown, compact, moist - @ 0.6 m, wet
1			GS1		
	8/11/10/12		SS1		- @ 1.5 m below, medium to coarse grained sand, trace silt and clay
2					
3					- @ 3.0 m, trace gravel, brown/grey
	3/13/12/13		SS2		- @ 3.3 m, silty, brown
					3.6 SILT, sandy, some clay, brown, stiff, wet (18.2)
4					
	5/5/4/3		SS3		
5					5.0 - @ 4.9 m below, no sand (16.8)
					5.2 CLAY, grey trace brown, firm, medium plastic, moist (16.6)
					SILT, grey, stiff, moist, low plastic
6					
	3/5/6/17		SS4		- @ 6.4 m below, some sand, non plastic 6.6 - @ 6.6 m, some clay, dark grey (15.2)
7					SAND, medium to coarse grained, trace gravel, brown/grey, compact to dense, moist
	1/10/16/19		SS5-1		- @ 7.6 m, fine grained, grey, wet - @ 7.8 m, medium to coarse grained
8		14.5	SS5-2		- @ between 8.1 m and 8.2 m, some silt, non plastic
9					9.1 (12.7)
					End of borehole - Monitoring well was installed, bottom of MW at a depth of 7.3 m with a screen of 1.5 m long and backfilled with filter sand.
10					

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE POCKET PEN ⊙

PEAK ▲ TORVANE ◬

RESIDUAL △

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

23

14 21

25 50

9 38

11 35

20 26

24

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 1 OF 1 **BOREHOLE No. BH17-06**

BOREHOLE BH17-07

STARTED: 25/02/2017 **FINISHED:** 25/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 22.0M

COORDINATES (m): N 5431506 **E** 308859 **ELEV:** 22 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					0.1 Asphalt - 100 mm thick. 21.9	
					Road base - silt, sand, gravel, brown, compact, moist	
					0.5 21.5 SILT, sandy, some gravel, some organics, brown, firm/compact, moist	
1					1.1 20.9 SAND, medium grained, some silt, trace gravel, brown, compact, moist	
					- @ 1.5 m below, trace clay	
	6/7/10/11		SS1			
2						
3					- @ 3.0 m below, no clay, some gravel	
	9/15/14/14		SS2			
4						
					- @ 4.6 m below, gravelly, trace silt, dense	
	18/27/28/26		SS3			
5						
6					- @ 6.1 m below, brown/grey, very dense	
	19/35/39/35		SS4			
7						
					- @ 7.6 m below, fine to medium grained sand, some gravel, trace silt, dense, wet	
8	12/19/24/21		SS5			
9						
	7/16/24/29		SS6			
10						

18
15 17
15 29
6 55
6 74
12 43
15 40

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 1 OF 3 **BOREHOLE No. BH17-07**

BOREHOLE BH17-07

STARTED: 25/02/2017 **FINISHED:** 25/02/2017

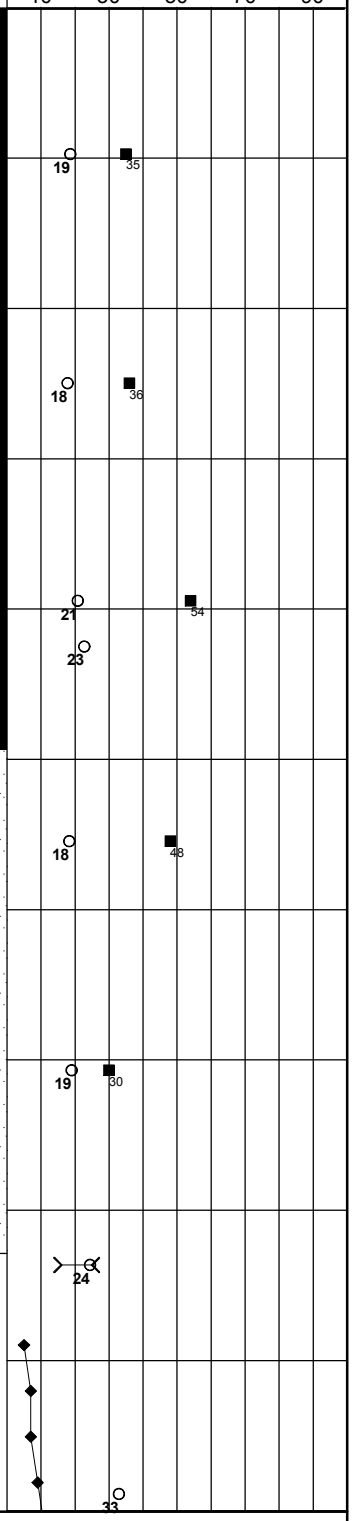
METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 22.0M

COORDINATES (m): N 5431506 **E** 308859 **ELEV:** 22 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
10					SAND, medium grained, some silt, trace gravel, brown, compact, moist *(continued)*	
11	13/17/18/19		SS7		- @ 10.7 m below, trace gravel	
12	6/17/19/19		SS8			
13						
14	8/17/37/41		SS9-1		- @ 13.7 m below, brown/grey, some silt, moist, , 10 mm thick oxidized red brown @ 100 mm spacing	
		14.6	SS9-2		- @ 14.2 m below, brown/grey, fine sand	
15						
16	1/12/36/46		SS10		- @ 15.2 m, brown/grey, fine to medium sand, some silt - @ 15.7 m, brown silty clay, 50 mm thick, moist, medium plastic - @ 15.8 m, grey sandy silt, moist, non plastic	
17	4/14/16/28		SS11		- @ 16.8 m below, grey, fine sand, moist - @ 17.4 m below, sand heave, no accurate SPT and sample, switch to DCPT	
					18.0 4.0	
18			ST2		CLAY, grey, firm to stiff, moist, medium plastic - (18 to 18.3 m sample taken from the outside hollow stem auger after it was pulled out) - (18.3 to 22.9 m sample taken and observed from DCPT rods after it was pulled out)	
19						
20			ST3			



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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

BOREHOLE BH17-07

STARTED: 25/02/2017 **FINISHED:** 25/02/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim National Park, BC ELEV. 22.0M

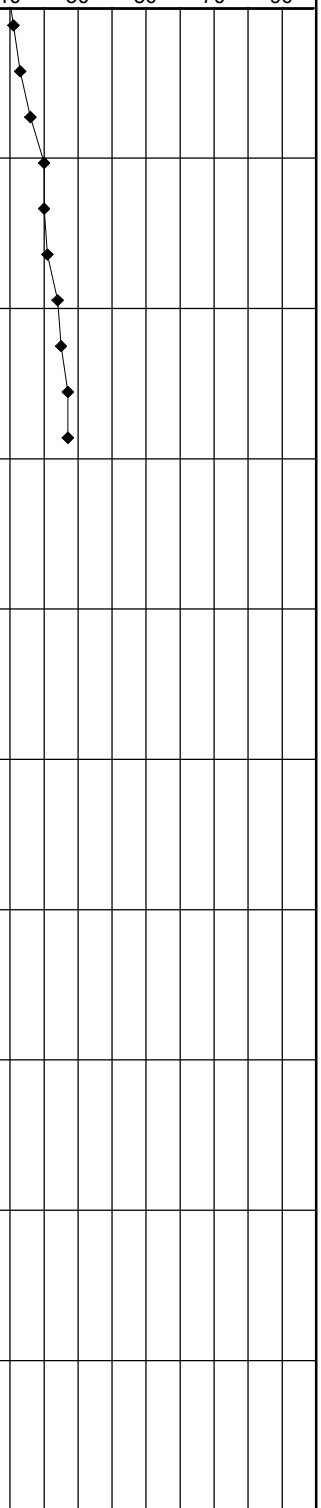
COORDINATES (m): N 5431506 **E** 308859 **ELEV:** 22 m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
21					CLAY, grey, firm to stiff, moist, medium plastic - (18 to 18.3 m sample taken from the outside hollow stem auger after it was pulled out) - (18.3 to 22.9 m sample taken and observed from DCPT rods after it was pulled out) *(continued)*	
22						
22.9 -0.9					End of borehole - Monitoring well was installed, bottom of MW at a depth of 18.3 m with a screen of 3.0 m long and backfilled with filter sand.	
23						
24						
25						
26						
27						
28						
29						
30						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90



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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 3 OF 3 **BOREHOLE No. BH17-07**

BOREHOLE HA17-01

STARTED: 26/02/2017 **FINISHED:** 26/02/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC ELEV. 13.0M

COORDINATES (m): N 5440827 **E** 294845 **ELEV:** 13 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					Topsoil - sandy silt, some organics, brown, soft, moist	
0.3					12.7	
					CLAY, grey/brown, soft, wet	
			G1			
1			G2			
					- @ 1.5 m and below, silty, grey	
			G3			
2.0					11.0	
2		34.3	G4		2.1 SAND, silty, grey, compact, moist 10.9	
					End of borehole	
					- Test hole was backfilled with cuttings.	
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

80

55

60

35

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (HA17-01 AND HA17-02).GPJ ALL-1.GDT 3/11/17

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 1 OF 1 **BOREHOLE No. HA17-01**

BOREHOLE HA17-02

STARTED: 26/02/2017 **FINISHED:** 26/02/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC ELEV. 11.0M

COORDINATES (m): N 5439728 **E** 296480 **ELEV:** 11 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G1		CLAY, silty, brown, soft, wet, medium plastic	
0.9						
1			G2		SAND, some gravel, trace silt/clay, brown, compact	
		4.3	G3			
2.0						
9.0					End of borehole - Test hole was backfilled with cuttings.	
10.1						

37
46
28

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** bf

SHEET 1 OF 1 **BOREHOLE No. HA17-02**

BOREHOLE HA17-03

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5441369 **E** 293233 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, wet	
					0.4	
					SILT, clayey, brown/grey, soft to firm, moist, medium plastic	
			G1			
					1.0	
					SAND, silty, brown, compact, moist	
			G2		1.2	
					End of borehole - Test hole was backfilled with cuttings.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

38 131 159 34

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (HA17-03-HA17-17).GPJ ALL-1.GDT 3/11/17

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-03**

BOREHOLE HA17-04

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5441279 **E** 293335 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					Peat, wet	
0.3						
					SILT, clayey, brown/grey, soft to firm, wet, medium plastic	
					- below 0.8 m, stiff	
1			G1			
1.2					End of borehole - Test hole was backfilled with cuttings.	
2						
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

47

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-04**

BOREHOLE HA17-05

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5441187 **E** 293541 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					SILT, clayey, brown/grey, soft to firm, moist, medium plastic	
0.2						
		46.3	G1		SAND and SILT, brown, compact, wet	
0.5						
					SAND, grey/brown, compact, moist	
0.8						
1.0					CLAY, silty, brown, stiff, wet, field vane Su > 70 kPa	
					End of borehole - Test hole was backfilled with cuttings.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

48

1 2 3 4 5

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-05**

BOREHOLE HA17-06

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): N 5441223 **E** 293679 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, wet	
0.3						
			G1		SILT, clayey, brown/grey, firm to stiff, moist, medium to high plastic	
1.2						
					End of borehole - Test hole was backfilled with cuttings.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

40 >>

1 2 3 4 5

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (HA17-03-HA17-17).GPJ ALL-1.GDT 3/11/17

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-06**

BOREHOLE HA17-07

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5441026 **E** 294390 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					SILT, dark brown, some organics, soft, moist	
					0.3	
					SAND, fine grained, brown, compact, moist	
			G1			
					- below 0.9 m, grey	
					1.5	
					CLAY, some sand, brown, firm, wet	
			G2		1.8	
					End of borehole - Test hole was backfilled with cuttings.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

31

49

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (HA17-03-HA17-17).GPJ ALL-1.GDT 3/11/17

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-07**

BOREHOLE HA17-08

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5441036 **E** 294364 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					SILT, dark brown, some organics, soft, moist	
					0.3	
			G1		SAND, fine grained, brown, compact, moist	
1					- below 1.1 m, grey	
					1.3	
			G2		CLAY, silty, brown, firm, wet	
					1.8	
					End of borehole - Test hole was backfilled with cuttings.	
2						
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

28

50

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (HA17-03-HA17-17).GPJ ALL-1.GDT 3/11/17

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-08**

BOREHOLE HA17-09

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5441079 **E** 294200 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, wet	
					0.6 SILT, some gravel and cobbles, difficult to hand auger	
					0.8 End of borehole - Test hole was backfilled with cuttings.	
1						
2						
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

N-GEO-CONVERT-2017 KA21151 PACIFIL TRAVERSE TRAIL (HA17-03-HA17-17).GPJ ALL-1.GDT 3/11/17

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-09**

BOREHOLE HA17-10

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5441078 **E** 294215 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, wet	
					0.9	
1					SAND, fine grained, brown, compact, moist	
					1.2	
					SILT, clayey, grey, firm, wet, medium plastic	
			G1		1.5	
					End of borehole - Test hole was backfilled with cuttings.	
2						
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

△ 110 >>▲

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. HA17-10**

BOREHOLE HA17-11

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5440680 **E** 295079 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, wet	
					0.6	
		8.2	G1		SAND, fine grained, trace silt, brown, compact, moist	
1					- below 1.2 m, grey	
					1.8	
2					End of borehole - Test hole was backfilled with cuttings.	
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

30

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. HA17-11**

BOREHOLE HA17-12

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): N 5440631 **E** 295100 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G1		SAND, fine grained, brown, compact, wet	
1.2					End of borehole - Test hole was backfilled with cuttings.	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90
49

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-12**

BOREHOLE HA17-13

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5440444 **E** 295258 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, wet	
					0.5	
					SAND, fine grained, brown, compact, moist	
			G1		- below 0.6 m, grey	
1					1.2	
					End of borehole - Test hole was backfilled with cuttings.	
2						
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

32

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-13**

BOREHOLE HA17-14

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5440300 **E** 295429 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					PEAT, below 100 mm, sand and peat mixed, wet	
					0.3	
			G1		SAND, brown, compact to dense, wet	
					0.7	
			G2		SILT, clayey, brown/grey, stiff, wet, medium to high plastic	
1					1.1	
					End of borehole - Test hole was backfilled with cuttings.	
2						
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

41 59 △159 >>▲

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. HA17-14**

BOREHOLE HA17-15

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5440362 **E** 295813 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, some sand, wet	
					0.2	
			G1		SAND, fine grained, brown, compact to dense, moist	
1					- Below 0.9 m, wet	
					1.1	
					End of borehole - Test hole was backfilled with cuttings.	
2						
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

22

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. HA17-15**

BOREHOLE HA17-16

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5440110 **E** 296337 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, wet	
					0.3	
			G1		SAND, fine grained, brown, compact to dense, moist	
					1.1	
					End of borehole - Test hole was backfilled with cuttings.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

35

1 2 3 4 5

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-16**

BOREHOLE HA17-17

STARTED: 27/04/2017 **FINISHED:** 27/04/2017

METHOD: Hand Auger

LOCATION: Pacific Rim National Park, BC

COORDINATES (m): **N** 5439667 **E** 296511 **ELEV:** m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
					Peat, some silt, wet	
					0.3	
					SAND, fine grained, some clay, trace gravel, brown, compact, wet	
1		11.4	G1			
					- Below 1.0 m, no clay, no gravel	
					1.2	
					End of borehole - Test hole was backfilled with cuttings.	
2						
3						
4						
5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

49

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: bc **REVIEWED BY:** aa

SHEET 1 OF 1 **BOREHOLE No. HA17-17**

BOREHOLE HA17-18

STARTED: 11/10/2017 **FINISHED:** 11/10/2017

METHOD: Hand Auger

LOCATION: Pacific Rim Hwy, Road STA 20+700±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441245 **E** 293608 **ELEV:** 16 m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FILL**, sand & gravel, loose, grey	
0.4					15.7	
0.6					**FILL**, gravel, 20mm, angular, loose, grey	
15.4					End of hole - loose fill collapsing, buried utilities present - Hole backfilled with cuttings	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151.6
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 1 OF 1 **BOREHOLE No. HA17-18**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-01

STARTED: 11/6/2017 **FINISHED:** 11/6/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 19+850±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441024 **E** 294411 **ELEV:** 21 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER		
0.2		**FOREST LITTER/TOPSOIL,** soft, moist to wet	20.8
		SAND, fine grain, trace fines, compact, grey/brown, moist to wet	
1.2	G1	**CLAY,** medium plasticity, very stiff to soft, brown	19.8
	G2	- trace-some sand lensing	
		- grey/brown from 1.5m	
		- grey from 1.8m	
	G3		
	G4		
	G5		
5.7		**SAND**, clayey, gravelly, till-like, dense, moist	15.3
6.1	G6		14.9
		End of Borehole	
		- effective refusal	
		- FV; Geonor field vane on undisturbed soil	
		- TV; Torvane at bottom of BQ casing, disturbed	
		- Hole backfilled with cuttings and sealed with bentonite.	

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

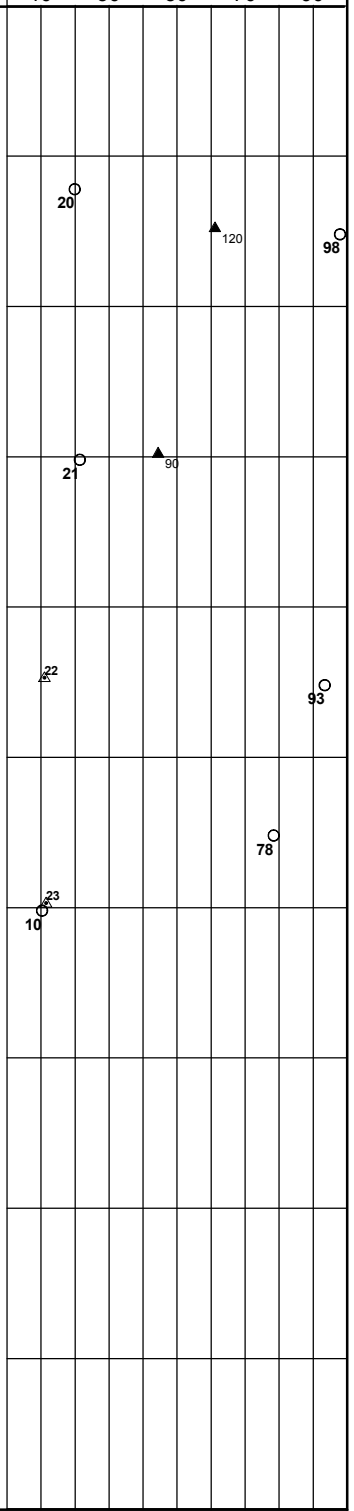
20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90



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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-01**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-02

STARTED: 11/6/2017 **FINISHED:** 11/6/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 19+870±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441036 **E** 294391 **ELEV:** 18 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G1		**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.3					17.7	
					CLAY, medium plasticity, firm, grey - trace peat fibers	
1			G2			
1.8					16.2	
					SAND, clayey, gravelly, till-like, dense, moist	
2			G3		2.1 15.9	
					End of Borehole - Effective Refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

74 39 57 10

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-02**

BOREHOLE PH17-03

STARTED: 11/6/2017 **FINISHED:** 11/7/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 19+905±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5441053 **E** 294369 **ELEV:** 21.5 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0			**FOREST LITTER/TOPSOIL,** soft, moist to wet
0.4			21.2
			SAND, fine grain, trace fines, compact, brown, moist
1	G1		
2.0			19.5
			CLAY, medium plasticity, stiff to firm, brown - trace sand lensing to 3m - grey/brown from 2.2m - grey from 2.5m
3	G2		
4			
5	G3		
6			
7.0			14.5
	G4		**SAND**, clayey, gravelly, till-like, dense, moist
7.3	G5		14.3
			End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.
8			
9			
10			

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

23 25 45 87 73 40 42 21

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-03**

BOREHOLE PH17-04

STARTED: 11/7/2017 **FINISHED:** 11/7/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 12+960±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438211 **E** 300038 **ELEV:** 20 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
1.0			G1		19.1	
1			G2		**CLAY,** medium plasticity, very stiff to stiff, brown - fissured to 1.2m± - grey/brown from 1.5m - grey from 2m	
3			G3		- firm from 3m± - stone encountered, partial BQ casing blockage, recovery highly disturbed - occasional thin clayey sand lense from 3 to 4m	
4			G4		- infer firm/soft below 4.5m	
6.1			G5		13.9	
6					End of Borehole - piezometer installed - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

63 188 31 90 29 33 29

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-04**

BOREHOLE PH17-05

STARTED: 11/7/2017 **FINISHED:** 11/7/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 12+985±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5438219 **E** 300016 **ELEV:** 16 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
1.0						
1					**CLAY,** medium plasticity, very stiff to stiff, brown - fissured to 1.5m±, minor perched water seepage - grey/brown from 2.5m - grey from 3m	
15.1						
3					- firm from 3m±	
4						
5					- infer firm/soft below 4.5m	
6						
6.1						
9.9					End of Borehole - piezometer installed - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

170 180 36 90 26 23 27 22 24

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-05**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-06

STARTED: 11/7/2017 **FINISHED:** 11/8/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 12+960±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438188 **E** 300032 **ELEV:** 14 m

DESCRIPTION OF MATERIALS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	WELL INSTALLTION DETAILS
0			GS1		
0.3					
1			GS2		
2					
3			GS3		
4			GS4		
5					
5.5					
5.6					
6			GS5		
7					
8					
9					
10					

FOREST LITTER/TOPSOIL, soft, moist to wet

CLAY, medium plasticity, very stiff to stiff, brown
- grey/brown from 0.5m
- grey from 1.6m

- trace sand & fine gravel from 2.5m

- stone encountered at 3m, no FV
- firm to stiff below 3m

SAND, fine grained, silty to some silt, infer compact, moist, grey

End of Borehole
- effective refusal @5.6m
- piezometer installed
- FV; Geonor field vane on undisturbed soil
- TV; Torvane at bottom of BQ casing, disturbed
- standpipe piezometer installed
- water level reading Nov 25, 2017, 0.62m (likely perched water)

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18568 - 96 Avenue, Unit 110
Surrey, B.C. V4N 3P9

PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-06**

BOREHOLE PH17-07

STARTED: 11/8/2017 **FINISHED:** 11/8/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 12+985±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5438169 **E** 300013 **ELEV:** 6 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0			**FOREST LITTER/TOPSOIL,** soft, moist to wet
0.4 / 5.7			
0.6 / 5.5	GS1		**FILL,** sand & gravel, compact, wet, brown, - possible road base at abandoned road
1	GS2		**CLAY, sandy/SAND clayey,** lensed, medium to non-platic, infer firm/compact, moist, grey/brown
2			- grey from 2.5m
2.8 / 3.2	GS3		**SAND,** fine grained, trace silt, infer compact, moist, grey
3.0 / 3.0	GS4		**CLAY,** medium plasticity, firm, grey
3.4 / 2.6	GS5		End of Borehole - effective refusal @5.6m - piezometer installed - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - standpipe piezometer installed - piezometer reading Nov 25, 2017 @ 0.10m (likely perched water)
3			
4			
5			
6			
7			
8			
9			
10			

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

36
14
15
14
40
20

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LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-07**

BOREHOLE PH17-08

STARTED: 11/8/2017 **FINISHED:** 11/8/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 13+005±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438202 **E** 299983 **ELEV:** 6 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5						
					CLAY, medium plasticity, stiff to firm, brown/grey	
1						
					- grey from 1.8m	
2						
2.2						
3.8					End of Borehole - effective refusal @5.6m - piezometer installed - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - hole backfilled with cuttings & bentonite seal	
5.5						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

22 75 40 31

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LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-08**

BOREHOLE PH17-09

STARTED: 11/9/2017 **FINISHED:** 11/9/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 16+498±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5439319 **E** 296839 **ELEV:** 16.5 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER		
0		**FOREST LITTER/PEAT,** soft, moist to wet	
1	G1	1.2	15.3
		SAND, fine grain, trace fines, compact, brown, moist	
	G2	1.6	14.9
	G3	**CLAY**, silty, stiff/firm, grey/brown - sandy from 1.8m	
2		2.0	14.5
		SAND, fine grain, some to trace fines, compact, brown, moist - trace clay lensing from 3m - wet from 3.3m	
3	G4		
		3.5	13.0
		CLAY, medium plasticity, firm, brown - occasional thin sand lensing	
4	G5		
		4.4	12.1
		SAND, fine grain, trace fines, compact, brown to grey, moist	
		4.9	11.6
5	G6	End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
6			
7			
8			
9			
10			

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

60 32 60 27 52 21

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LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-09**

BOREHOLE PH17-10

STARTED: 11/9/2017 **FINISHED:** 11/9/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 16+200±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5439233 **E** 297082 **ELEV:** 9.2 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER		
0.3		**FOREST LITTER/TOPSOIL,** soft, moist to wet	8.9
		GRANULAR FILL, sand & gravel, compact to loose, grey, wet	
1.1			8.1
	G1	**PEAT**, very soft, wet, dark brown	
2.0			7.2
	G2	**SAND**, fine grain, gravelly, some fines, compact, grey, moist-wet - poor recovery - clay lense @ 3m	
	G3		
3.2			6.0
		End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

BLOWS PER 152mm

% Fines < No. 200

WELL INSTALLTION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

46

9

13

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-10**

BOREHOLE PH17-11

STARTED: 11/9/2017 **FINISHED:** 11/9/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 1+530±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5435650 **E** 304265 **ELEV:** 37.1 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5					36.6	
1			G1		**CLAY,** medium plasticity, stiff to soft, brown - trace sand lenses - grey/brown from 1m	
2			G2		- grey from 1.6m	
3			G3			
4			G4			
5						
6			G5		6.1 31.0	
7					End of Borehole - effective refusal @5.6m - piezometer installed - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - hole backfilled with cuttings & bentonite seal	
8						
9						
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

28 51 55 23 140 19 31 17 27

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-11**

BOREHOLE PH17-12

STARTED: 11/9/2017 **FINISHED:** 11/9/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 1+460±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5431547 **E** 308822 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0.3					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5					**SAND & GRAVEL**, dense, moist-dry - possible fill, refusal encountered at four attempted locations	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

21.7

21.5

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

1 2 3 4 5 6 7 8 9 10

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-12**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-13

STARTED: 11/9/2017 **FINISHED:** 11/9/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 7+705±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5431505 **E** 308857 **ELEV:** 23 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0.3					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5					**SAND & GRAVEL**, dense, moist-dry - possible fill	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △
POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151.6
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 1 OF 1 **BOREHOLE No. PH17-13**

BOREHOLE PH17-14

STARTED: 11/10/2017 **FINISHED:** 11/10/2017

METHOD: Pionjar/BQ

LOCATION: Wick Road STA 2+595±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432766 **E** 306872 **ELEV:** 13 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0	G1		**FOREST LITTER/TOPSOIL** silty sand with organics, loose, moist to wet
1	G2		
1.9			11.2
2	G3		**CLAY**, silty, trace peat, soft, grey/brown, wet
2.4			10.7
2.7	G4		**SAND**, fine to medium grain, trace fines, compact/loose, grey/brown, moist/wet 10.4
2.7			**WOOD** inferred log 10.3
3			End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

23 47 37

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-14**

BOREHOLE PH17-15

STARTED: 11/10/2017 **FINISHED:** 11/10/2017

METHOD: Pionjar/BQ

LOCATION: Wick Road STA 2+605±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432781 **E** 306878 **ELEV:** 13 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FILL**, sand & gravel, trace organics, loose, moist to wet	
0.4						
12.6					**PEAT/SILT/SAND**, interlayered, soft/loose, wet, dark brown/grey	
1			G1			
2.0						
11.0					**CLAY**, trace peat, soft to firm, grey	
3			G2			
4			G3			
5						
6			G4			
6.1						
6.9					End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

62

13 53

38 48

33 40

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-15**

BOREHOLE PH17-16

STARTED: 11/10/2017 **FINISHED:** 11/10/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 6+800±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5435170 **E** 304995 **ELEV:** 38 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/PEAT,** soft, moist to wet	
					- no recovery from 0.45 to 1m	
1.0			G1			
1					**CLAY**, trace peat, soft to firm, grey/brown	
2						
3			G2		- grey from 3m±	
4						
			G3			
5						
6.1			G4			
6					End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
7						
8						
9						
10						

37.0

31.9

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

40 32 14 35 20 32

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SHEET 1 OF 1 **BOREHOLE No. PH17-16**

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BOREHOLE PH17-17

STARTED: 11/10/2017 **FINISHED:** 11/10/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 6+740±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5435122 **E** 305049 **ELEV:** 38 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0			**FOREST LITTER/PEAT,** soft, moist to wet
1	G1		
1.3			36.8
	G2		**CLAY**, trace peat, soft to firm, grey/brown
			- grey from 1.8m±
3	G3		
4	G4		
5			
6	G5		6.1 31.9
			End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.
7			
8			
9			
10			

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

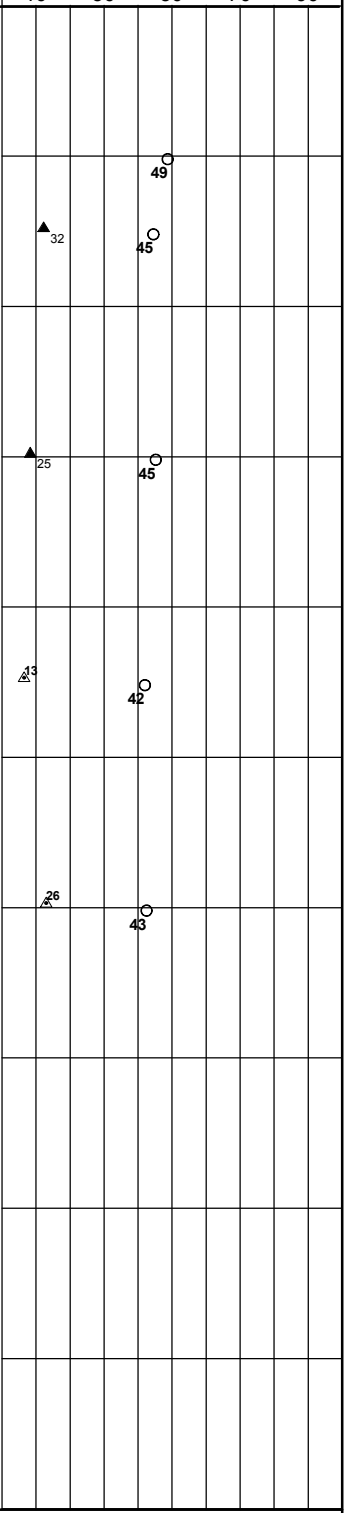
20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90



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SHEET 1 OF 1 **BOREHOLE No. PH17-17**

BOREHOLE PH17-18

STARTED: 11/11/2017 **FINISHED:** 11/11/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 20+750±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5441225 **E** 293560 **ELEV:** 18 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0			**SAND**, silty, trace clay, compact, moist, brown
1	G1		
1.2			
			CLAY, trace peat, stiff to soft, brown
2			
2	G2		
3			- grey/brown from 3m±
			- grey from 3.3m±
4	G3		
5			
6	G4		
6.1			
11.9			End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.
10			

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

68, 38, 125, 23, 62, 24, 19, 27

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SHEET 1 OF 1 **BOREHOLE No. PH17-18**

BOREHOLE PH17-19

STARTED: 11/11/2017 **FINISHED:** 11/11/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 20+695±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441248 **E** 293618 **ELEV:** 18.2 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5						
					CLAY/SAND, interlayered, firm/compact, brown	
1			G1		- grey/brown from 1.5m±	
2					- grey & firm/soft from 2.2m±	
3			G2			
4			G3			
5			G4			
6			G5			
6.1						
12.1					End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
17.7						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

69

55

22

22

22

20

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-19**

BOREHOLE PH17-20

STARTED: 11/11/2017 **FINISHED:** 11/11/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 20+100±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5441105 **E** 294179 **ELEV:** 21.8 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/PEAT,** soft, moist to wet	
1.0					20.8	
1					**SAND**, fine grain, trace fines, compact, brown, moist - trace clay lenses - grey from 1.6m±	
2			G1			
2.8					19.0	
3					**SAND**, fine to medium grain, gravelly, trace fines, compact, brown to grey, moist - trace clay lenses	
			G2			
3.9					17.9	
4					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

28
12

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PROJECT NO.: KA21151.6
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 1 OF 1 **BOREHOLE No. PH17-20**

BOREHOLE PH17-21

STARTED: 11/11/2017 **FINISHED:** 11/12/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 20+045±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5441080 **E** 294222 **ELEV:** 21.6 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER		
0.0			**FOREST LITTER/TOPSOIL,** soft, moist to wet
0.7		20.9	**SAND/CLAY**, interlayered, firm/compact, grey/brown
1.6	G1	20.0	- grey from 1.4m±
			SAND, clayey, compact, moist, grey - trace thin clay lenses
3.0	G2	18.6	**CLAY**, medium plasticity, firm, grey
	G3		
3.9		17.7	
4.1	G4	17.5	**GRAVEL**, clayey, dense, grey - fine grain recovery
			End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.

UNDRAINED SHEAR Su (kPa): 20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%: 10 30 50 70 90

16 (25) 28 26 23 76

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-21**

BOREHOLE PH17-22

STARTED: 11/12/2017 **FINISHED:** 11/12/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 19+710±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5440974 **E** 294518 **ELEV:** 21 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5					20.5	
					SAND, fine grain, trace fines, compact, moist, brown	
1			G1			
2			G2		2.9 18.1	
3			G3		**SAND/CLAY**, interlayered, firm/compact, grey/brown	
4			G4			
5					- grey from 5m±	
6			G5		6.1 14.9	
					End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
7						
8						
9						
10						

82
22
26
20
40
73
30
61

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-22**

BOREHOLE PH17-23

STARTED: 11/12/2017 **FINISHED:** 11/14/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 19+690±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5440952 **E** 294550 **ELEV:** 20.8 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5					20.3	
					SAND, fine grain, trace fines, compact, moist, brown	
1			G1			
2						
3			G2		3.0 17.8	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90
21
28

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PROJECT NO.: KA21151.6
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 1 OF 1 **BOREHOLE No. PH17-23**

BOREHOLE PH17-24

STARTED: 11/14/2017 **FINISHED:** 11/14/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 18+880±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5440549 **E** 295149 **ELEV:** 20.8 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5					20.4	
0.8					20.3	
					CLAY, silty, firm, brown	
					SAND, fine grain, trace fines, compact, moist, brown - trace thin silt or silty lenses	
1			G1			
2					- grey/brown from 1.8m±	
3			G2			
4						
4.5			G3			
5			G4		- 300mm clay lense, firm, @5m±	
6			G5		6.1 14.7	
					End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

28 22 23 27 44

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-24**

BOREHOLE PH17-25

STARTED: 11/15/2017 **FINISHED:** 11/15/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 18+850±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5440520 **E** 295180 **ELEV:** 20.6 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5					20.1	
					SAND, fine grain, trace fines, compact, moist, brown/grey	
1			G1			
2					- grey from 2m± - interlayered silt and silty lenses from 2 to 2.5m±	
3			G2			
3.5					17.1	
					SAND/CLAY, interlayered, firm/compact, grey	
4						
5			G3			
6			G4			
6.1					14.5	
					End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

24 20 35 30

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-25**

BOREHOLE PH17-26

STARTED: 11/15/2017 **FINISHED:** 11/15/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 18+710±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5440416 **E** 295286 **ELEV:** 20.9 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.4						
					SAND, fine grain, trace fines, compact, moist, brown/grey	
1			G1			
2					- grey from 2m± - interlayered silt and silty lenses from 2 to 2.35m±	
3			G2			
4			G3			
5						
5.6						
6			G4		End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
7						
8						
9						
10						
15.3						
20.6						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

27 23 17 22

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-26**

BOREHOLE PH17-27

STARTED: 11/15/2017 **FINISHED:** 11/16/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 18+590±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5440302 **E** 295409 **ELEV:** 21.1 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL/WOOD,** soft, moist to wet	
1			G1		1.2	
					SAND, fine grain, trace fines, compact, moist, brown/grey	
2					- grey from 1.8m±	
					- interlayered clay lenses from 2 to 2.5m±	
3			G2			
4						
5					5.7	
6					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

19 (1 m)
23 (3 m)

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-27**

BOREHOLE PH17-28

STARTED: 11/16/2017 **FINISHED:** 11/16/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 12+560±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438138 **E** 300420 **ELEV:** 30.3 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0			**FOREST LITTER/TOPSOIL,** soft, moist to wet
0.3			
	G1		**CLAY,** medium plasticity, trace fine gravel, stiff to firm, brown - occasional sandy lenses - grey/brown from 0.75m - grey from 1.6m
	G2		
	G3		
2.6			
27.7			End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.
30.0			

BLOWS PER 152mm

% Fines < No. 200

WELL INSTALLTION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

52 21 5 24

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-28**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-29

STARTED: 11/16/2017 **FINISHED:** 11/16/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 12+500±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438136 **E** 300484 **ELEV:** 31.3 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**MIXED FILL** forest litter, topsoil & mineral fill, soft, moist to wet	
0.8					30.5	
1			G1		**CLAY,** medium plasticity, stiff to firm, brown - grey/brown from 1m - grey from 2.9m	
2						
3.0					28.3	
3			G2		End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

30 118 50/31

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-29**

BOREHOLE PH17-30

STARTED: 11/16/2017 **FINISHED:** 11/16/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 11+990±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5437867 **E** 300881 **ELEV:** 33.3 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**MIXED FILL** forest litter, topsoil & mineral fill, soft, moist to wet	
0.6						
1			G1		**CLAY,** medium plasticity, stiff to firm, brown - grey/brown from 0.85m - grey from 2.5m	
2			G2			
3			G3			
3.5						
4					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
5						
6						
7						
8						
9						
10						
29.8						
32.7						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

36 28 20 44 122

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-30**

BOREHOLE PH17-31

STARTED: 11/16/2017 **FINISHED:** 11/16/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 10+430±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5436729 **E** 301905 **ELEV:** 41 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0			G1		**MIXED FILL** forest litter, topsoil & mineral fill, soft, moist to wet	
0.6						
					CLAY, medium plasticity, stiff to firm, brown - grey/brown from 1m - grey from 2m	
			G2			
4.0						
			G3		End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
37.0						
40.5						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

102 20 103 25 38

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-31**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-32

STARTED: 11/17/2017 **FINISHED:** 11/17/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 21+300±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5441512 **E** 293114 **ELEV:** 16.3 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/PEAT,** soft, moist to wet	
0.7						
0.7					**CLAY**, trace peat, firm to soft, brown - trace sand lensing	
1			G1		- grey/brown from 1.3m±	
2					- grey from 2m±	
3			G2			
4			G3			
6			G4			
6.1						
6.1					End of Borehole - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
10						

15.7

10.2

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

29

20 38

20 46

24

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LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-32**

BOREHOLE PH17-33

STARTED: 11/17/2017 **FINISHED:** 11/17/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 21+700±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5441678 **E** 292765 **ELEV:** 16.5 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			G1		**FOREST LITTER/PEAT,** soft, moist to wet	
0.6					15.9	
					SAND, fine grain, silty, compact, moist, brown - trace fine sand lenses	
1.5			G2		15.0	
					CLAY, trace peat, firm to soft, brown	
					- grey/brown from 2m±	
					- grey from 2.5m±	
			G3			
5.5			G4		11.0	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

78

45 30

22 26

22 51

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-33**

BOREHOLE PH17-34

STARTED: 11/17/2017 **FINISHED:** 11/17/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 17+510±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5440183 **E** 296360 **ELEV:** 22.7 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.4						
					SAND, fine grain, compact, moist, brown	
1						
			G1		- grey/brown from 1.8m±	
2						
3						
			G2			
3.3						
19.4					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
22.3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

18

23

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-34**

BOREHOLE PH17-35

STARTED: 11/17/2017 **FINISHED:** 11/17/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 14+170±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438881 **E** 299010 **ELEV:** 4.4 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**MIXED FILL** forest litter, topsoil & mineral fill, soft, moist to wet	
1.0			G1			
3.4					**SAND**, fine grain, compact, moist, brown	
2.7			G2			
1.7					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90
19

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PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 1 OF 1 **BOREHOLE No. PH17-35**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-36

STARTED: 11/17/2017 **FINISHED:** 11/17/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 13+220±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5438340 **E** 299805 **ELEV:** 4.8 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0			**MIXED FILL** forest litter, topsoil & mineral fill, soft, moist to wet
1.0			3.9
1	G1		**SAND**, fine grain, compact, moist, brown
1.4			3.4
			SAND, fine medium grain, gravelly, compact, moist, brown/grey
2	G2		
2.4			2.4
			End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.

BLOWS PER 152mm

% Fines < No. 200

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

17

11

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-36**

BOREHOLE PH17-37

STARTED: 11/17/2017 **FINISHED:** 11/17/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 9+130±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5435835 **E** 302888 **ELEV:** 35.7 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.4					35.4	
					CLAY, medium plasticity, stiff to firm/soft, brown - grey/brown from 0.6m - grey from 2.8m	
1						
2			G1			
3			G2		3.2 32.5	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

35 122 21 47

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-37**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-38

STARTED: 11/18/2017 **FINISHED:** 11/18/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 8+600±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5435659 **E** 303373 **ELEV:** 34 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet - surface disturbed	
0.4					33.7	
			G1		**CLAY,** medium plasticity, very stiff to firm/soft, brown - grey/brown from 1.6m	
2.0			G2		32.0	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

37 122 40 23

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-38**

BOREHOLE PH17-39

STARTED: 11/18/2017 **FINISHED:** 11/18/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 5+890±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5434535 **E** 305654 **ELEV:** 33 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.5						
					CLAY, medium plasticity, stiff to firm, brown - grey/brown from 2m± - grey from 3m±	
2			G1			
3			G2			
3.5						
29.5					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
32.6						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

82 32 28 32

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

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SHEET 1 OF 1 **BOREHOLE No. PH17-39**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-40

STARTED: 11/18/2017 **FINISHED:** 11/18/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 5+220±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5434087 **E** 306143 **ELEV:** 28.6 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0	G1		**MIXED FILL** forest litter, topsoil/peat & mineral fill, soft, moist to wet
1.0			27.6
1			**CLAY,** medium plasticity, firm/soft, grey/brown - grey from 1.5m
2	G2		
3			
4	G3		
4.2			24.4
5			End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.
6			
7			
8			
9			
10			

BLOWS PER 152mm

% Fines < No. 200

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

37 22 36 30 29

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SHEET 1 OF 1 **BOREHOLE No. PH17-40**

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

BOREHOLE PH17-41

STARTED: 11/18/2017 **FINISHED:** 11/18/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 4+190±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5433358 **E** 306871 **ELEV:** 28 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLTION DETAILS
0					**FOREST LITTER/TOPSOIL,** soft, moist to wet	
0.4					27.7	
			G1		**CLAY,** medium plasticity, some to trace fine sand, trace fine gravel, very stiff/stiff, brown	
1			G2			
1.8					26.2	
2			G3		**SAND**, fine grain, trace fines, compact/dense, moist, brown	
2.0					26.0	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

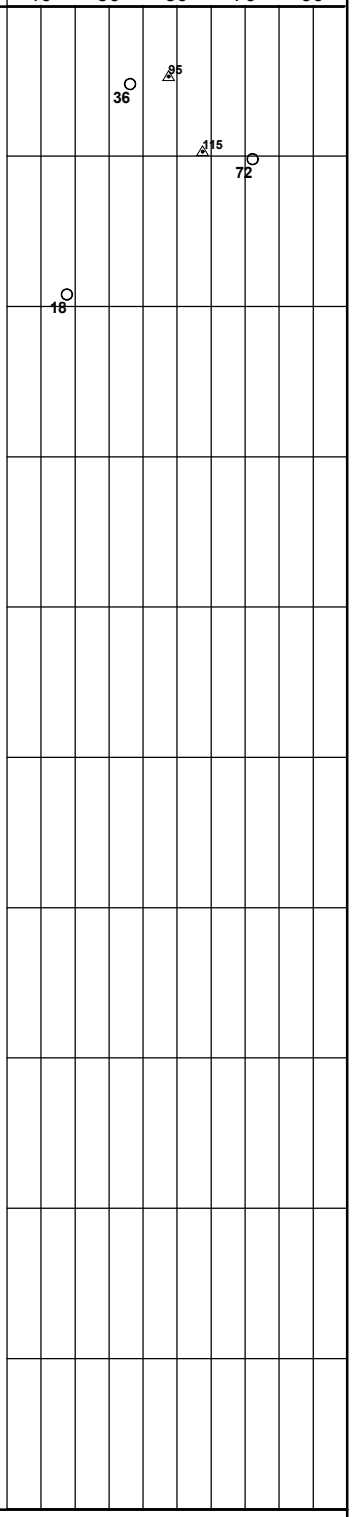
20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90



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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-41**

BOREHOLE PH17-42

STARTED: 11/18/2017 **FINISHED:** 11/18/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 2+895±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432437 **E** 307791 **ELEV:** 25.8 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** sandy, soft, moist to wet	
0.4					25.4	
					SAND, clayey, some fine gravel, loose, brown, moist	
0.8					25.0	
1			G1		**SAND & GRAVEL**, poorly graded, trace fines, compact/dense, moist, brown	
2			G2		2.0 23.8	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
3						
4						
5						
6						
7						
8						
9						
10						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

43

16

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-42**

BOREHOLE PH17-43

STARTED: 11/18/2017 **FINISHED:** 11/19/2017

METHOD: Pionjar/BQ

LOCATION: Pacific Rim Hwy, Road STA 0+670±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5430949 **E** 309415 **ELEV:** 34 m

DESCRIPTION OF MATERIALS

DEPTH (m)	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0			**FOREST LITTER/TOPSOIL,** sandy, soft, moist to wet	
0.3			33.7	
	G1		**SAND,** clayey, trace fine gravel, loose, brown, moist	
0.6			33.4	
			SAND & GRAVEL, poorly graded, trace fines, compact/dense, moist, brown	
1				
	G2			
1.5			32.5	
			End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	
2				
3				
4				
5				
6				
7				
8				
9				
10				

BLOWS PER 152mm

% Fines < No. 200

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △

POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

20

13

N-GEO-CONVERT-2017 KA21151 PH (PH17-1 TO PH17-45, HA17-18).GPJ ALL-1.GDT 12/7/17

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PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-43**

BOREHOLE PH17-44

STARTED: 11/19/2017 **FINISHED:** 11/19/2017

METHOD: Pionjar/BQ

LOCATION: Wick Road STA 1+300±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432437 **E** 305768 **ELEV:** 21.2 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** sandy, soft, moist to wet	
0.7					20.6	
					SAND, fine to medium grain, trace fines, compact/dense, brown, moist	
1			G1			
1.5					19.7	
					SAND, gravelly, trace fines, compact/dense, moist, brown	
1.9			G2		19.3	
					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

20

12

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-44**

BOREHOLE PH17-45

STARTED: 11/19/2017 **FINISHED:** 11/19/2017

METHOD: Pionjar/BQ

LOCATION: Wick Road STA 0+500±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432608 **E** 304988 **ELEV:** 21.5 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					**FOREST LITTER/TOPSOIL,** sandy, soft, moist to wet	
0.7					20.8	
1					**SAND,** fine to medium grain, trace fines, loose to compact, brown, moist	
1			G1			
1.9					19.6	
2			G2		**SAND**, gravelly, trace fines, compact/dense, moist, brown	
2.2					19.3	
3					End of Borehole - effective refusal - FV; Geonor field vane on undisturbed soil - TV; Torvane at bottom of BQ casing, disturbed - Hole backfilled with cuttings and sealed with bentonite.	

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

26

14

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PROJECT NO.: KA21151.6

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 1 **BOREHOLE No. PH17-45**

BOREHOLE BH17-08

STARTED: 11/20/2017 **FINISHED:** 11/23/2017

METHOD: Solid Stem Auger/CPT

LOCATION: Wick Road STA 2+590±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5432752 **E** 306875 **ELEV:** 18 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
0					0.1 **ASPHALT**, 130mm thick	
					17.9 **GRANULAR FILL**, sand & gravel, 19mm to 75mm minus, compact, moist, brown	
1			G1		- geotextile @ 1m±	
2	12 23 32 40		SS1-1			
			G2		- loose from 2.5m±	
3			SS2-2		- wet from 3m	
	3 5 3 3					
4			G3		4.0 14.0	
			G4		4.1 13.9 **ORGANIC SILT**, soft, trace rootlets, frim/soft, dark brown, wet	
					CLAY, silty, grey/brown, soft, wet	
					4.6 13.4 **SAND**, fine grain, silty, loose, wet, grey with reddish brown streaks	
5			G5			
					5.3 12.7 **PEAT**, amorphous, firm, dark brown	
			G6			
					5.8 12.2 **SAND**, fine to coarse grain, trace fines, trace wood pieces, compact, grey wet	
6			G7			
					6.9 11.1 **CLAY**, medium plasticity, firm, grey	
7			G8			
8						
9			G9			
10						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

7
7 55
5
6 8
29
31
32
65
30
46
44

N-GEO-CONVERT-2017 KA21151 PACIFIC TRAVERSE TRAIL (BH17-8 TO BH17-12).GPJ ALL-1.GDT 12/7/17

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

BOREHOLE BH17-08

STARTED: 11/20/2017 **FINISHED:** 11/23/2017

METHOD: Solid Stem Auger/CPT

LOCATION: Wick Road STA 2+590±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5432752 **E** 306875 **ELEV:** 18 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
10			G10		**CLAY**, medium plasticity, firm, grey *(continued)*	
11						
12			G11			
13						
14			G12			
15						
16			G13			
16.8			G14		1.2	
17					End of Borehole - stand pipe piezometer installed - piezometer reading Nov 25, 2017 @ 5.43m	
18						
19						
20						

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

41 39 48 45 39

N-GEO-CONVERT-2017 KA21151 PACIFIC TRAVERSE TRAIL (BH17-8 TO BH17-12).GPJ ALL-1.GDT 12/7/17

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 2 OF 2 **BOREHOLE No. BH17-08**

BOREHOLE BH17-09

STARTED: 11/21/2017 **FINISHED:** 11/21/2017

METHOD: Solid Stem Auger/CPT

LOCATION: Pacific Rim Hwy, Road STA 12+950±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438225 **E** 300046 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0.1					**ASPHALT**, 130mm thick
21.9					**GRANULAR FILL**, sand & gravel, 19mm to 75mm minus, compact, moist, brown
1.1			G1		
20.9					**CLAY**, medium plasticity, stiff to firm, brown
			G2		
					- grey/brown from 2m
2.7					
19.3					**CLAY**, medium plasticity, grey - soft from 2.7m±
			G3		
			G4		
			G5		- some to trace gravel from 6 to 6.5m, fine grain - trace gravel from 6.5m, fine grain
			G6		
			G7		

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN ⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

12 27 40 19 29 30 29

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 4 **BOREHOLE No. BH17-09**

BOREHOLE BH17-09

STARTED: 11/21/2017 **FINISHED:** 11/21/2017

METHOD: Solid Stem Auger/CPT

LOCATION: Pacific Rim Hwy, Road STA 12+950±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438225 **E** 300046 **ELEV:** 22 m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS	UNDRAINED SHEAR Su (kPa) 20 60 100 140 180 / FIELD VANE PEAK ▲ RESIDUAL △ / POCKET PEN ⊙ TORVANE ◬ / ■ SPT N ◆ DCPT N Blows/0.3 m / W_P% W% W_L% 10 30 50 70 90
10			G8		**CLAY**, medium plasticity, grey *(continued)* - soft/firm from 10m±		23
11							
12			G9				29
13							
13.7			G10				23
14							
15			G11		- occasional thin silty/sandy lensing from 15m		27
16							
16.8			G12		- occasional shell fragment from 16.5m		19
17							
18							
18.3			G13		- firm/stiff from 18m±		21
19							
20			G14				21

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

BOREHOLE BH17-09

STARTED: 11/21/2017 **FINISHED:** 11/21/2017

METHOD: Solid Stem Auger/CPT

LOCATION: Pacific Rim Hwy, Road STA 12+950±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5438225 **E** 300046 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

CLAY, medium plasticity, grey *(continued)*

29.9

-7.9

UNDRAINED SHEAR Su (kPa)

20 60 100 140 180

FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%

10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	WELL INSTALLATION DETAILS
21			G15		
22					
23			G16		
24					
25			G17		
26			G18		
27			G19		
28					
29			G20		
30					

27 28 22 30 27 22

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

BOREHOLE BH17-09

STARTED: 11/21/2017 **FINISHED:** 11/21/2017

METHOD: Solid Stem Auger/CPT

LOCATION: Pacific Rim Hwy, Road STA 12+950±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5438225 **E** 300046 **ELEV:** 22 m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
31					End of Borehole - stand pipe piezometers installed - piezometer reading Nov 25, 2017, shallow piezometer @ 1.8m, perched water and/or not stabilized, deep piezometer @ 26.8m, not stabilized, pressurized air escaped when opened.	
32						
33						
34						
35						
36						
37						
38						
39						
40						

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

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PROJECT NO.: KA21151.5
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 4 OF 4 **BOREHOLE No. BH17-09**

BOREHOLE BH17-10

STARTED: 11/22/2017 **FINISHED:** 11/22/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim Hwy, Road STA 1+535±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5431559 **E** 308814 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0					0.1 **ASPHALT**, 120mm thick
					21.9 **GRANULAR FILL**, sand & gravel, 19mm to 75mm minus, compact to loose, moist, brown
1					
2	1 2 5 4		SS2-1		
3					3.0 19.0 **PEAT/ORGANIC SILT**, very soft to firm, trace wood pieces, moist, dark brown
	0 1 3 3		SS2-2		
4					4.3 17.7 **SAND**, fine to medium grain, trace fines, dense, moist, grey/brown
5	17 21 23 23		SS2-3		
6					
	10 15 19 20		SS2-4		
7					- wet from 7.5m±
8	8 18 22 27		SS2-5		
9					- trace gravel, fine to coarse from 9m±
	7 20 24 19		SS2-6		
10					

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

■7 ○27
■4 ○238
○9 ■44
○7 ■34
○18 ■40
○16 ■44

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PROJECT NO.: KA21151.5
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 1 OF 2 **BOREHOLE No. BH17-10**

BOREHOLE BH17-10

STARTED: 11/22/2017 **FINISHED:** 11/22/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim Hwy, Road STA 1+535±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5431559 **E** 308814 **ELEV:** 22 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
11					**SAND**, fine to medium grain, trace fines, dense, moist, grey/brown *(continued)*	
					- 300mm of sand heave, no SPT	
12						
					- some gravel to gravelly, fine grain, from 12.4m±	
13	6 23 43 48		SS2-8			
14	7 16 24 22		SS2-9		- occasional thin silt lense, brown, from 14m±	
15					- compact from 15m±	
					- SS2-10, 75mm of sand heave/slough	
16	2 11 13 12		SS2-10		16.2 5.8	
					End of Borehole - Backfilled with bentonite and cuttings	
17						
18						
19						
20						

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 2 OF 2 **BOREHOLE No. BH17-10**

BOREHOLE BH17-11

STARTED: 11/23/2017 **FINISHED:** 11/23/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim Hwy, Road STA 19+885±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5441073 **E** 294414 **ELEV:** 22 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0					0.2 **ASPHALT**, 150mm thick (21.8)
					GRANULAR FILL, sand & gravel, 75mm minus, compact, moist, brown
1					- buried asphalt @ 1m±
					1.5 (20.5) **SAND**, fine grain, trace-some fines, compact, brown
2	5 5 3 3		SS2-1		2.1 (19.9) **CLAY**, silty, stiff-firm, brown, moist - trace sand lensing
3					2.7 (19.3) **SAND**, fine grain, trace-some fines, compact, grey/brown, wet - wet from 3m
4	2 11 10 7		SS2-2		
					4.4 (17.6) **CLAY**, silty, stiff, grey, wet - trace sand lensing
5	WH 2 1 2		SS2-3		
6					5.9 (16.1) **CLAY**, medium plasticity, firm, grey
7	WH WH WH WH		SS2-4		
8	WH WH WH 1		SS2-5		
9					
10	WH 11 89		SS2-6		9.6 (12.4) **SAND**, clayey, glacial till, gravelly, very dense, grey, moist

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

8 55 26 3 34 0 64 0 64 33 100

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 2 **BOREHOLE No. BH17-11**

BOREHOLE BH17-11

STARTED: 11/23/2017 **FINISHED:** 11/23/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim Hwy, Road STA 19+885±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5441073 **E** 294414 **ELEV:** 22 m

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
	61-75mm (R)				- (R), split spoon refusal	
10.4					**SAND**, clayey, glacial till, gravelly, very dense, grey, moist *(continued)*	
11.6					End of Borehole - effective refusal - stand pipe piezometer installed - piezometer reading Nov 25, 2017 @ 3.34m	

11 12 13 14 15 16 17 18 19 20

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PROJECT NO.: KA21151.5
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 2 OF 2 **BOREHOLE No. BH17-11**

BOREHOLE BH17-12

STARTED: 11/24/2017 **FINISHED:** 11/24/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim Hwy, Road STA 15+570±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): N 5439306 **E** 296841 **ELEV:** 19 m

DESCRIPTION OF MATERIALS

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS
0					0.2 **ASPHALT**, 250mm thick
					18.8 **GRANULAR FILL**, sand & gravel, 75mm minus to fine grain sand, compact, moist, brown
1					1.1 17.9 **MIXED FILL**, sand/silt/organic silt/wood, very loose/very soft, moist, brown to dark brown
2	2 2 1 2		SS2-1		
3					
4	1 0 1 1		SS2-2		
5	1-75mm 14-50mm (R)		SS2-3		- (R), refusal on wood
6					- wet from 6m±
7	2 0 1 1		SS2-4		6.6 12.4 **CLAY**, silty, stiff/firm, grey - trace sand lensing
					7.0 12.0 **CLAY**, medium plasticity, stiff/firm, grey
					7.6 11.4 **SAND**, fine grain, trace-some fines, compact, brown, wet
8	3 9 11 13		SS2-5		
9					
10	2 2		SS2-6		- 150mm silt lense @ 9.7m± - SS2-6, 75mm of heave/slough, N value based on

WELL INSTALLATION DETAILS

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △ POCKET PEN⊙ TORVANE ◬

■ SPT N ◆ DCPT N Blows/0.3 m

W_P% W% W_L%
10 30 50 70 90

3 29 1 52 1 118 1 67 25 28 88

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PROJECT NO.: KA21151.5

PROJECT: Pacific Traverse Trail Project

LOCATION: Pacific Rim National Park, BC

LOGGED BY: EDS **REVIEWED BY:** AA

SHEET 1 OF 2 **BOREHOLE No. BH17-12**

BOREHOLE BH17-12

STARTED: 11/24/2017 **FINISHED:** 11/24/2017

METHOD: Hollow Stem Auger

LOCATION: Pacific Rim Hwy, Road STA 15+570±. Coord's from GPS, indicated accuracy of ±3m. Elev's from Parson's dwg R.081570.001 Rev_2.

COORDINATES (m): **N** 5439306 **E** 296841 **ELEV:** 19 m

DEPTH (m)	BLOWS PER 152mm	% Fines < No. 200	SAMPLE TYPE AND NUMBER	SYMBOL	DESCRIPTION OF MATERIALS	WELL INSTALLATION DETAILS
10.1	11 16				blow count in sand over 75mm, from 352 to 487mm	8.9
					End of Borehole - stand pipe piezometer installed - piezometer reading Nov 25, 2017 @ 5.87m	

UNDRAINED SHEAR Su (kPa)
20 60 100 140 180
FIELD VANE PEAK ▲ RESIDUAL △
POCKET PEN⊙ TORVANE ◬
■ SPT N ◆ DCPT N Blows/0.3 m
W_P% W% W_L%
10 30 50 70 90

11 12 13 14 15 16 17 18 19 20

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PROJECT NO.: KA21151.5
PROJECT: Pacific Traverse Trail Project
LOCATION: Pacific Rim National Park, BC
LOGGED BY: EDS **REVIEWED BY:** AA
SHEET 2 OF 2 **BOREHOLE No. BH17-12**

Appendix B: 2015 National Building Code Seismic Hazard Calculation

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

March 14, 2017

Site: 49.0438 N, 125.6963 W User File Reference: Pacific Rim National Park

Requested by: , Amec Foster Wheeler

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.781	1.244	**1.446**	1.485	**1.346**	**0.872**	**0.529**	**0.169**	**0.059**	**0.688**	**0.930**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. ***These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.062	0.234	0.470
Sa(0.1)	0.095	0.369	0.759
Sa(0.2)	0.127	0.445	0.872
Sa(0.3)	0.130	0.444	0.884
Sa(0.5)	0.111	0.388	0.783
Sa(1.0)	0.065	0.235	0.490
Sa(2.0)	0.035	0.137	0.299
Sa(5.0)	0.0097	0.041	0.094
Sa(10.0)	0.0040	0.014	0.033
PGA	0.054	0.203	0.416
PGV	0.071	0.280	0.538

References

National Building Code of Canada 2015 NRCC no. 56190;
Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

User's Guide - NBC 2015, Structural Commentaries NRCC no. xxxxxx (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français

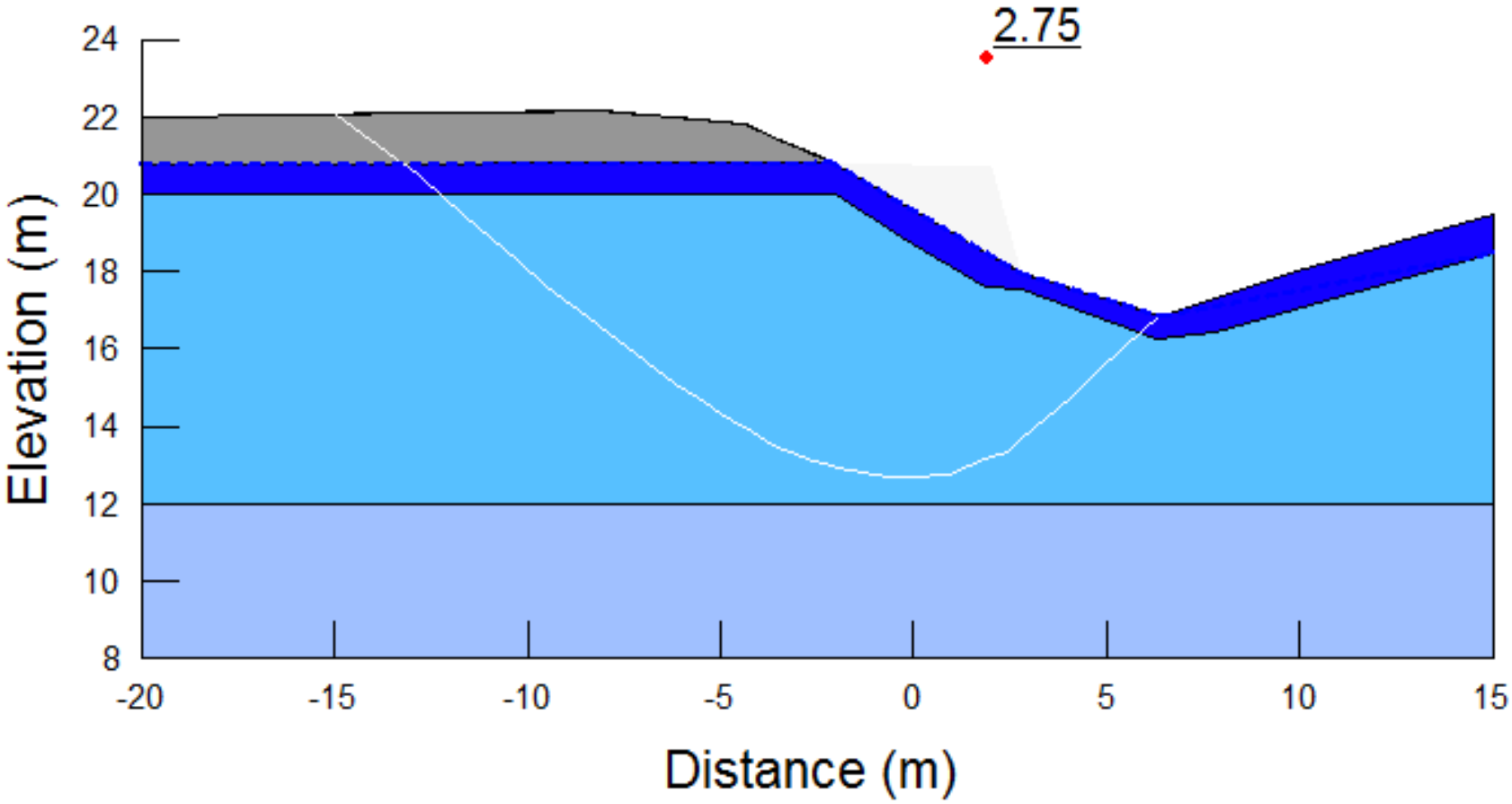
Natural Resources Canada Ressources naturelles Canada

Canada

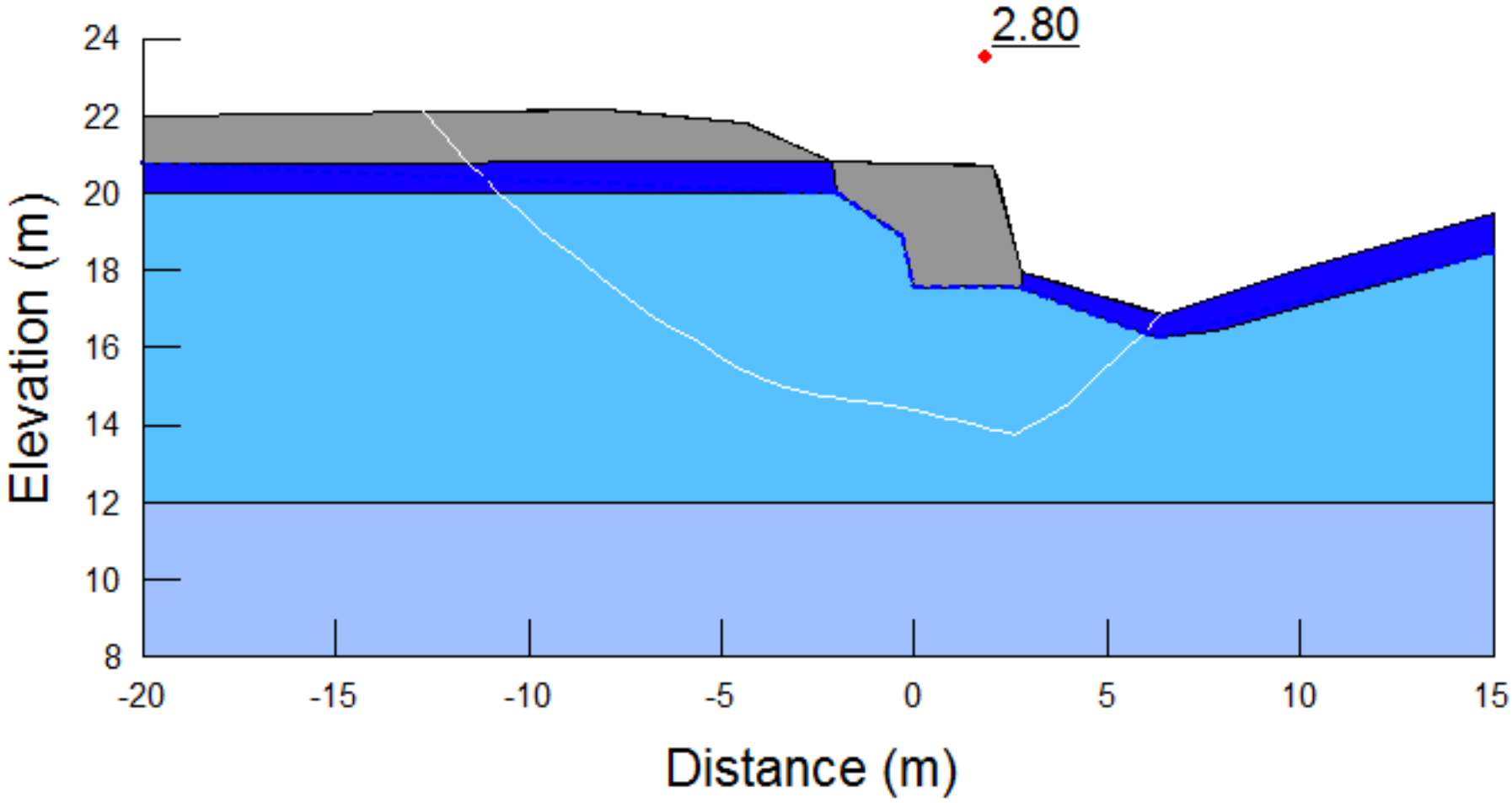
Appendix C: Slope Stability Results

Colour	Material	Unit Weight (kN/m^3)	Phi (°)	Su (kPa)
	Fill	19.0	35	-
	Top Soil	17.0	-	15
	Sand (Very Dense)	19.0	40	-
	Sand (Compact)	19.0	35	-
	Silt (Stiff)	18.0	-	50
	Silt (Stiff to Firm)	18.0	-	40
	Clay (Stiff)	18.0	-	140
	Clay (Stiff to Firm)	18.0	-	65
	Clay (Firm)	18.0	-	50
	Clay (Soft)	17.0	-	40

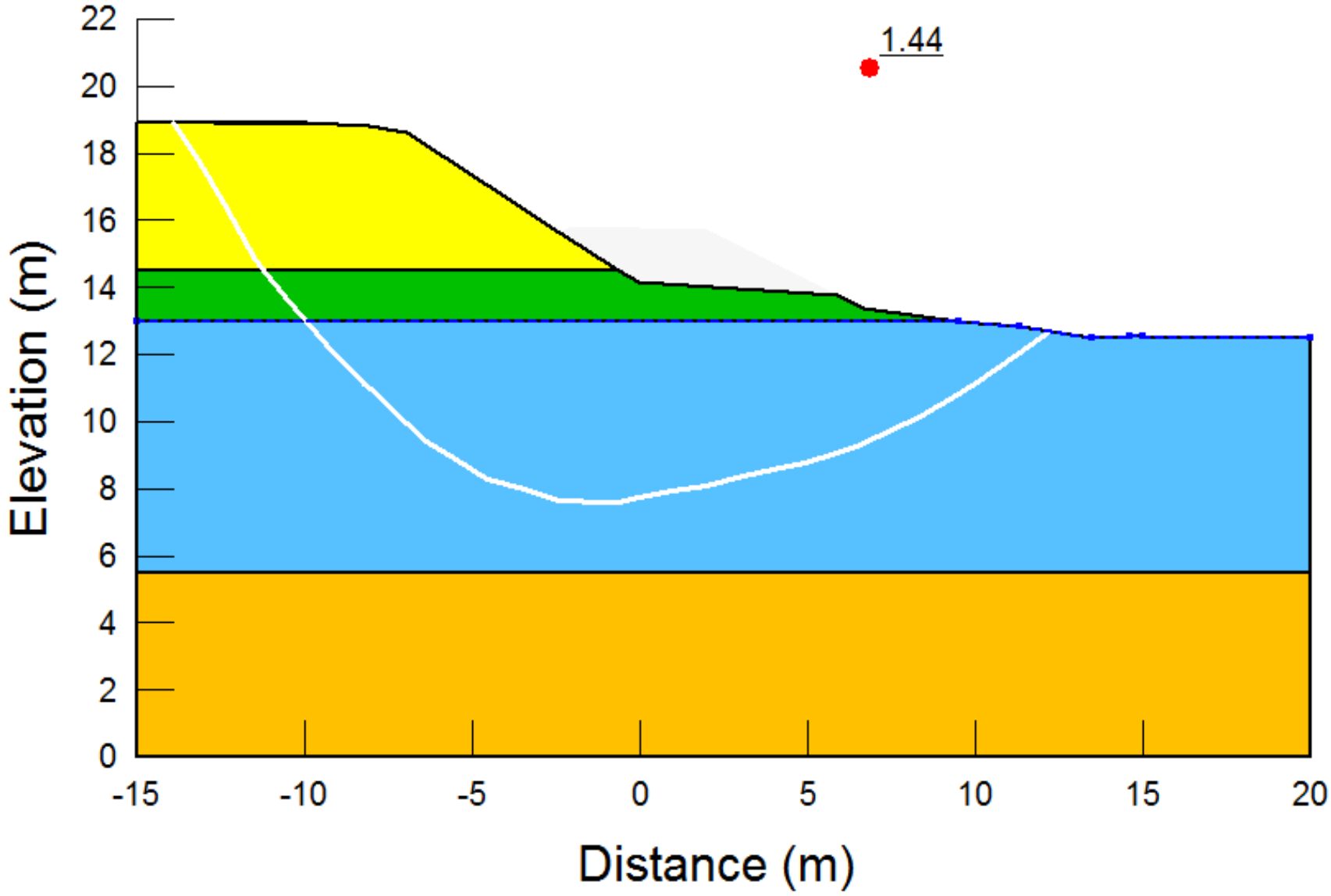
Site A - Current Conditions



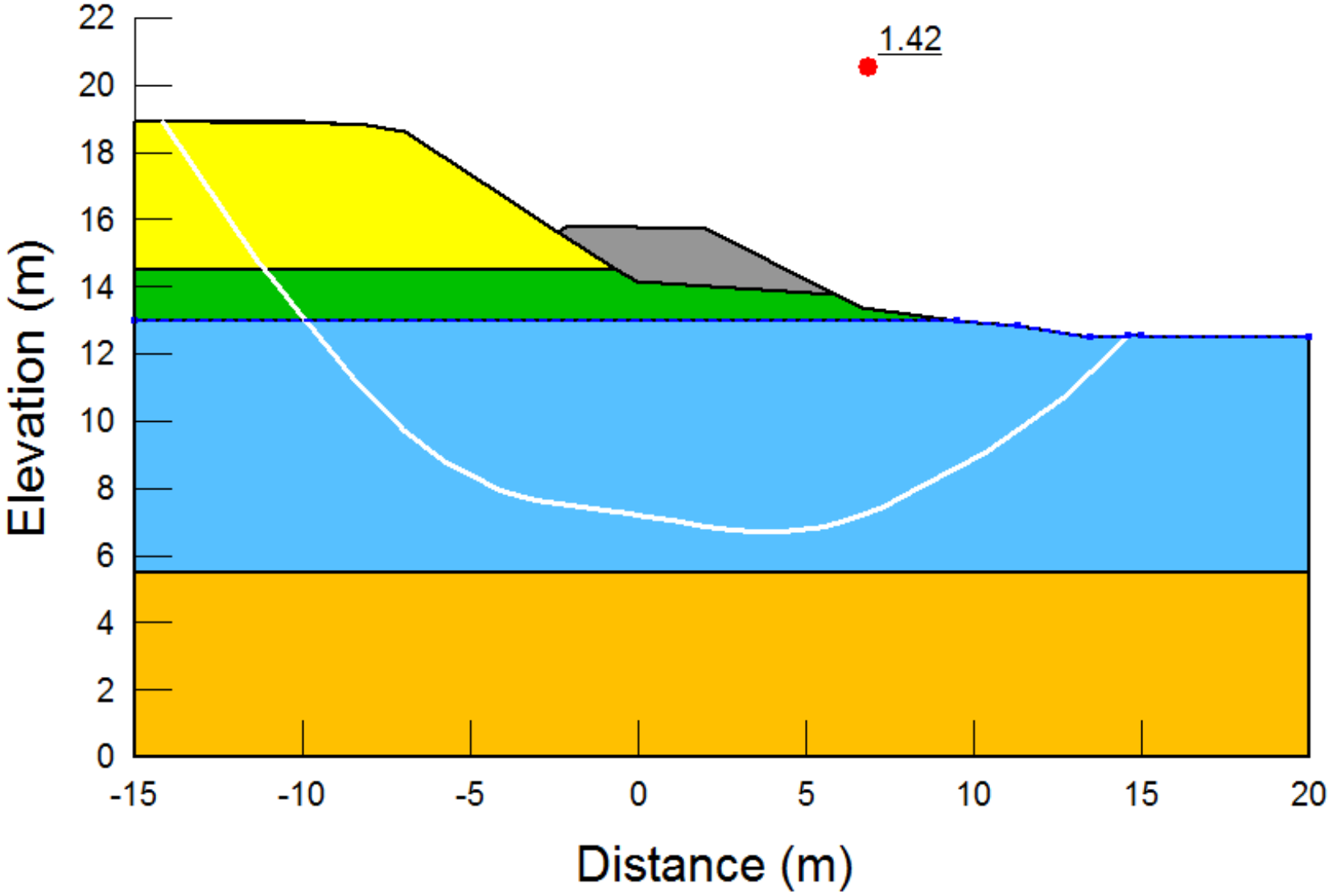
Site A – After Construction



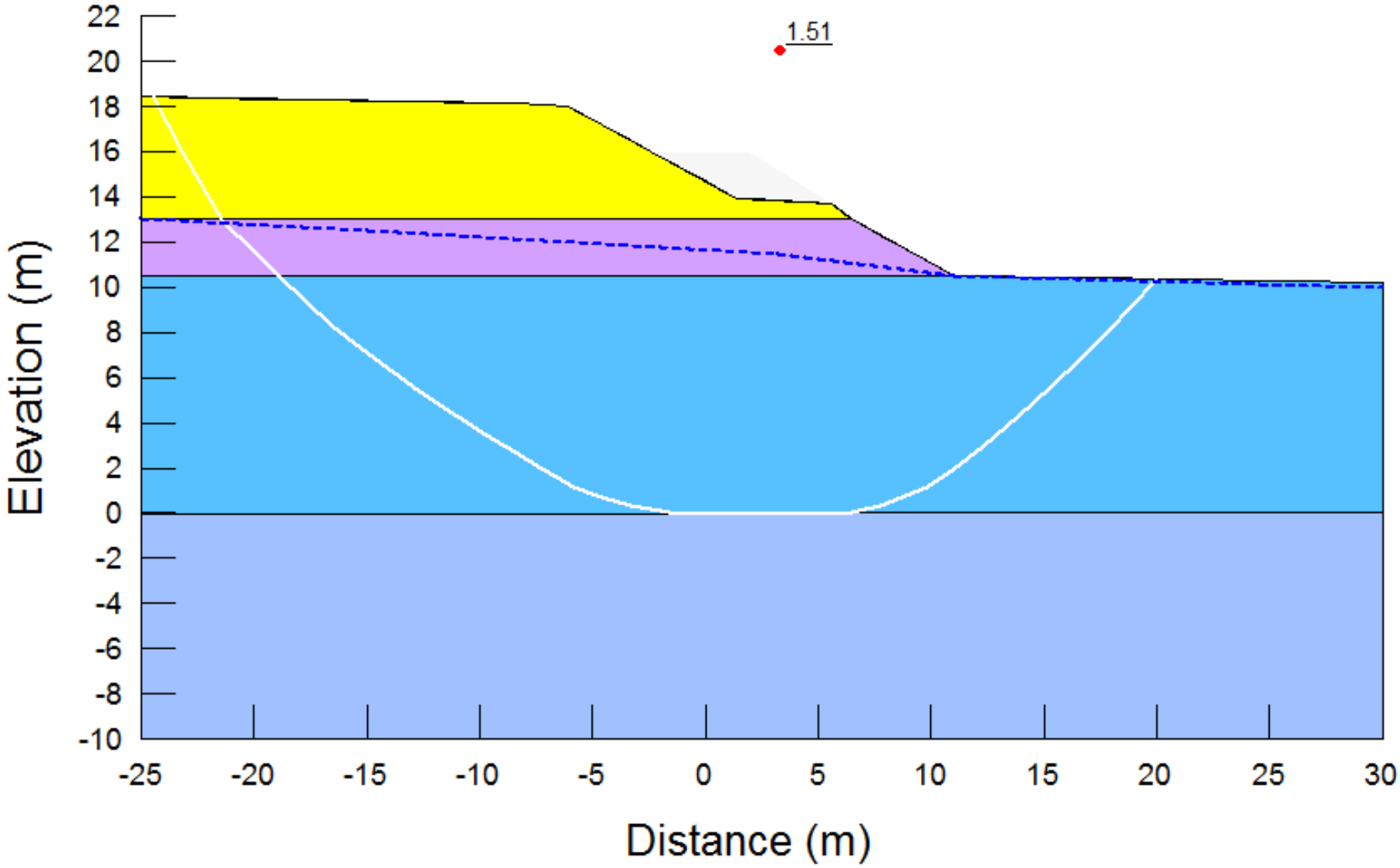
Site B - Current Conditions



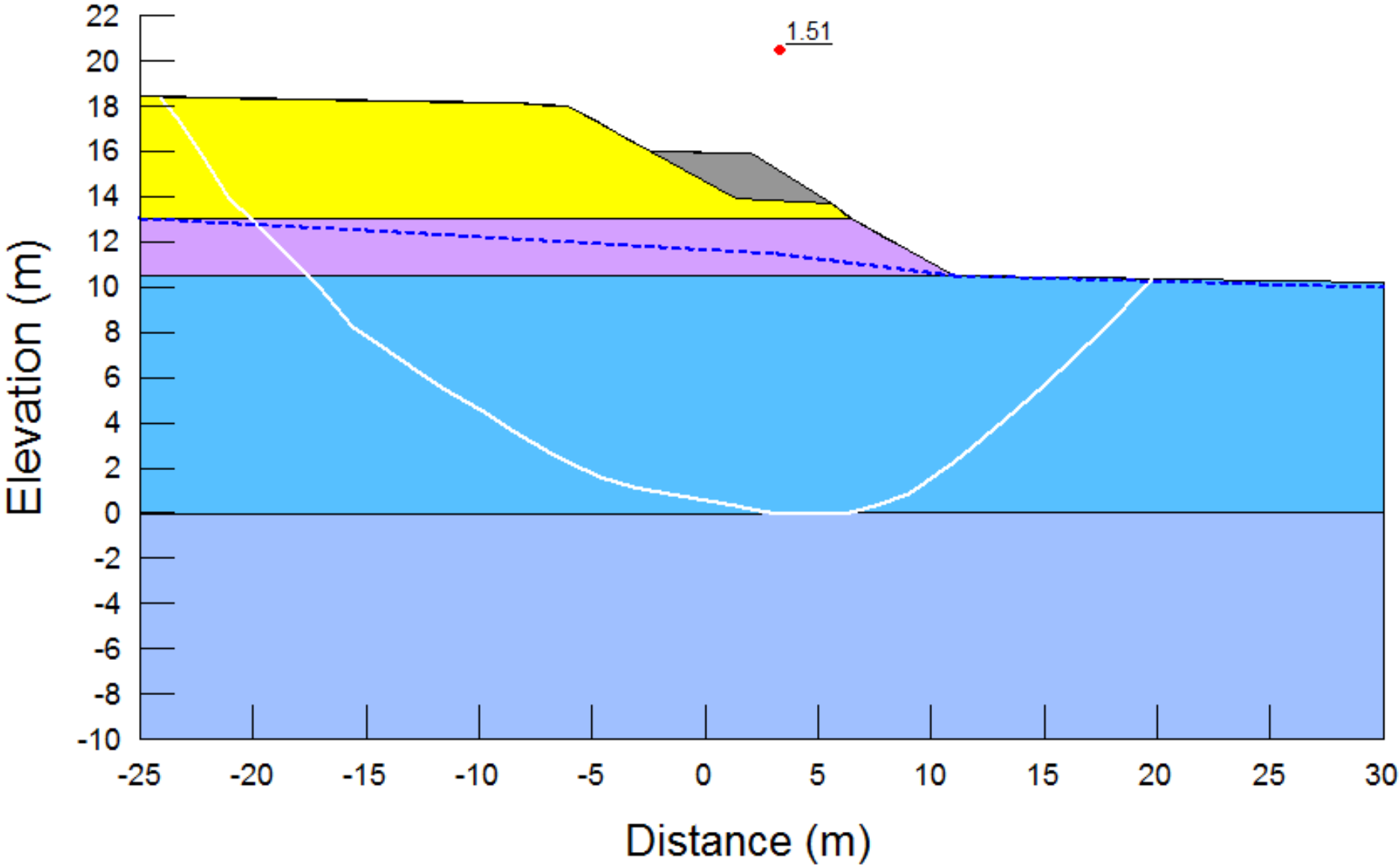
Site B – After Construction



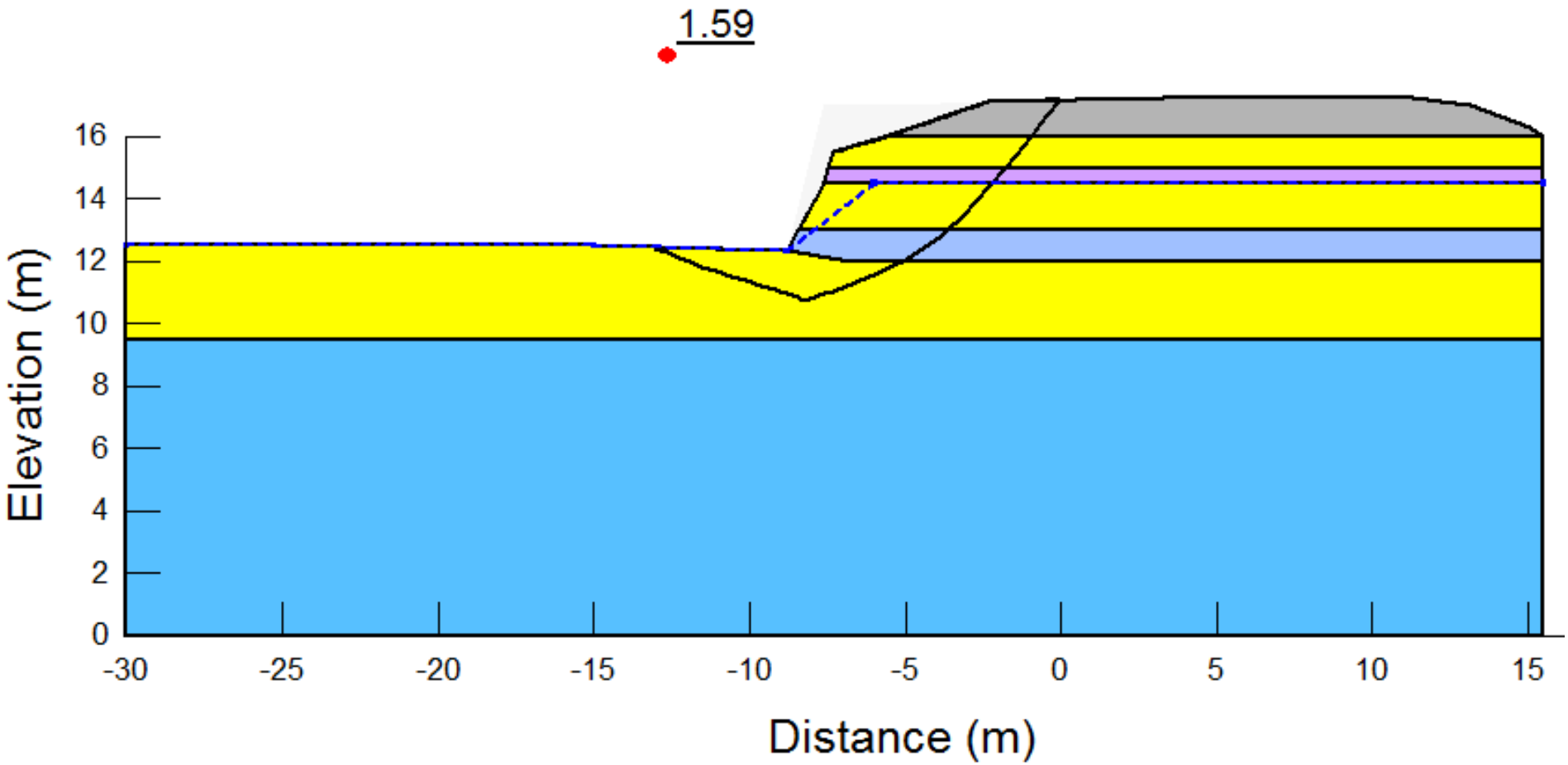
Site C - Current Conditions



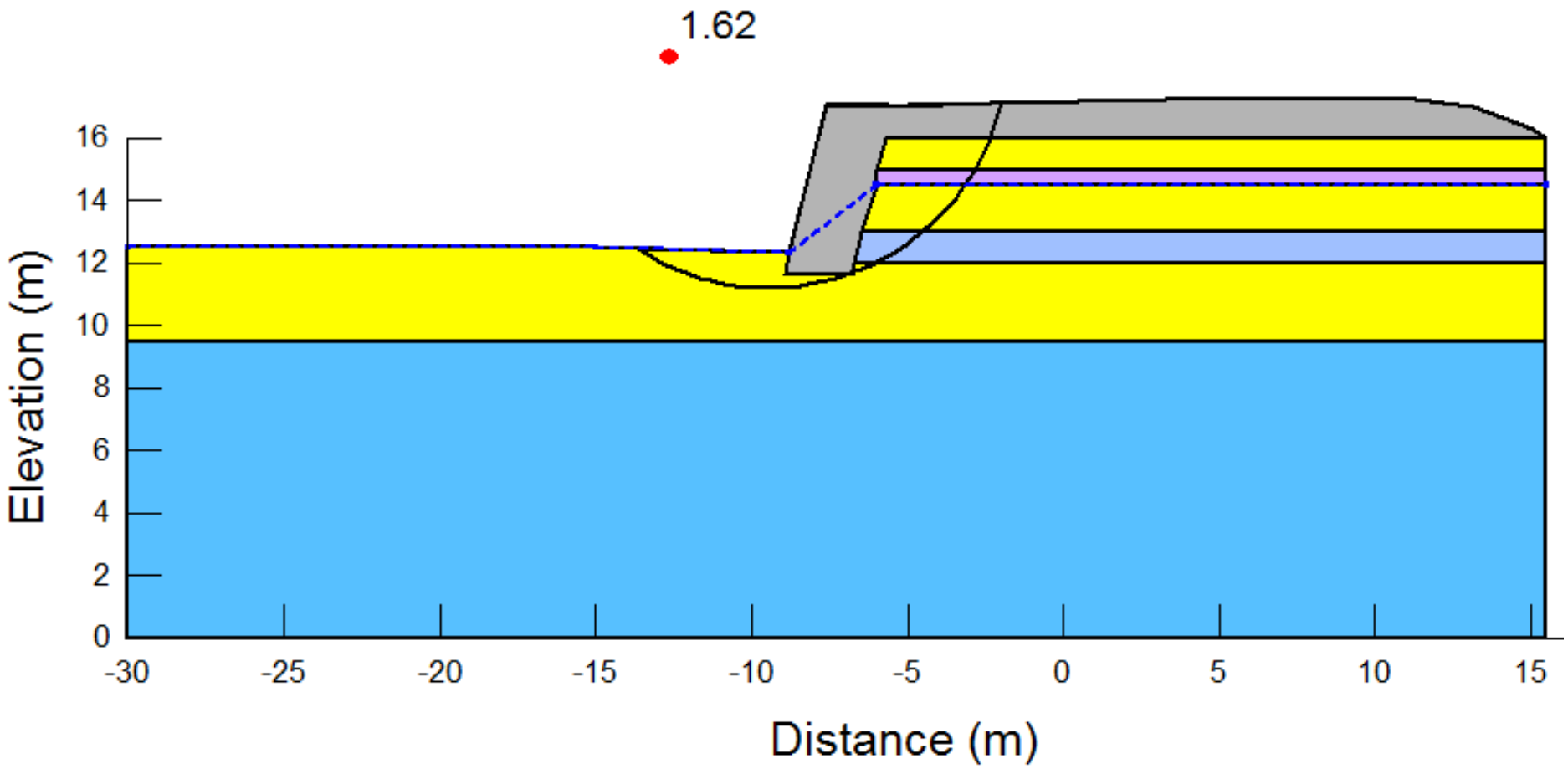
Site C – After Construction



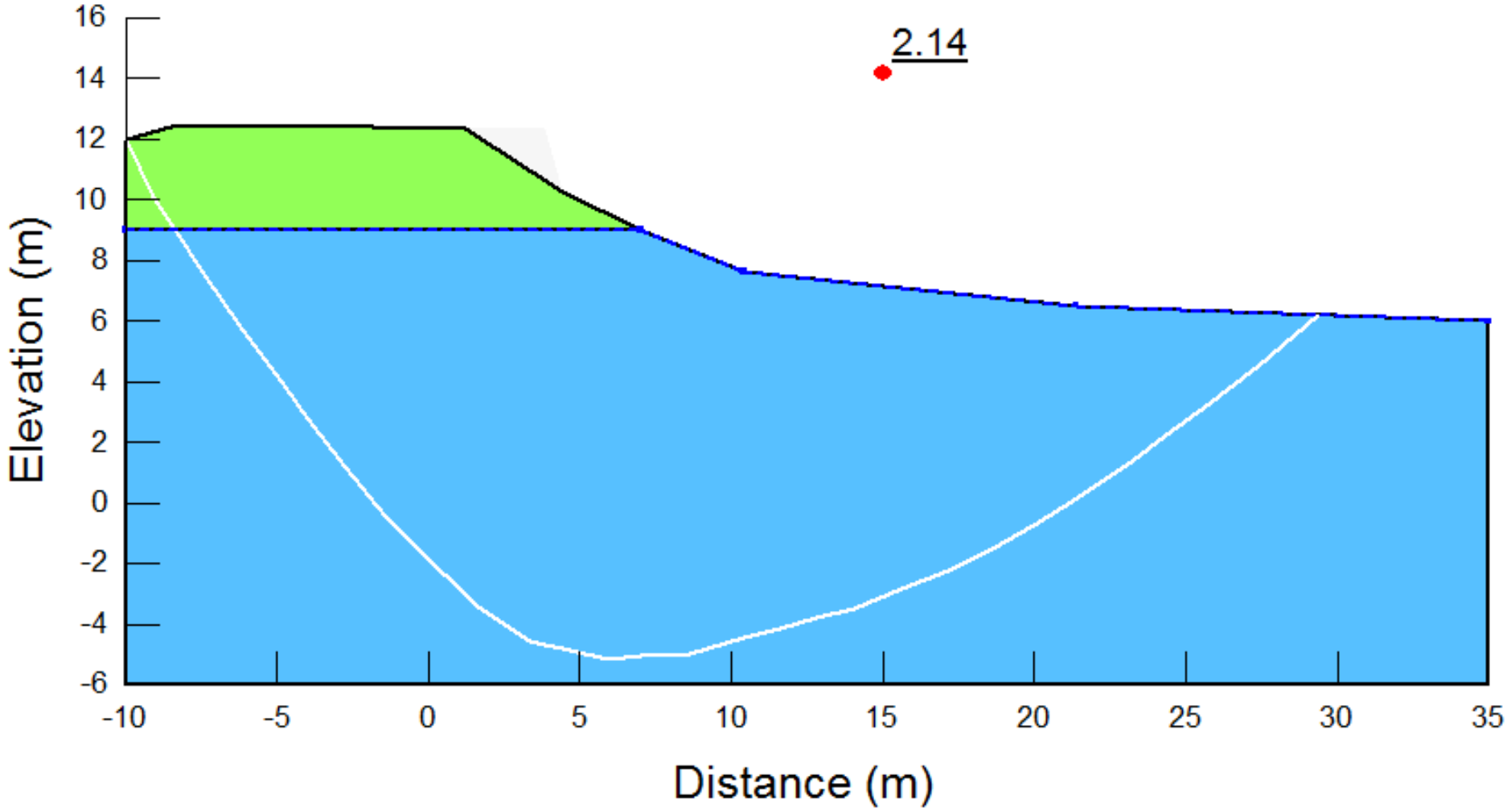
Site D - Current Conditions



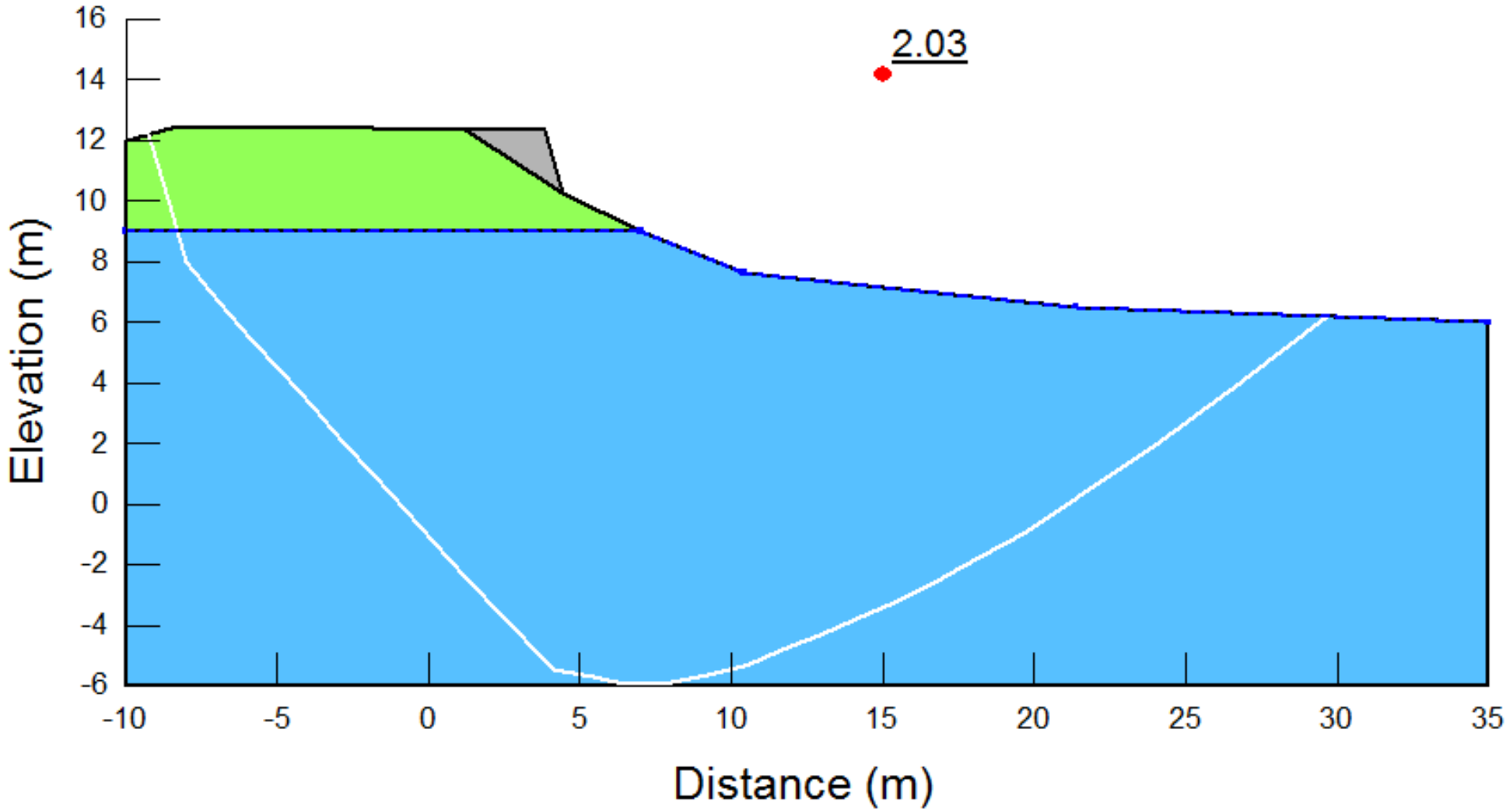
Site D – After Construction



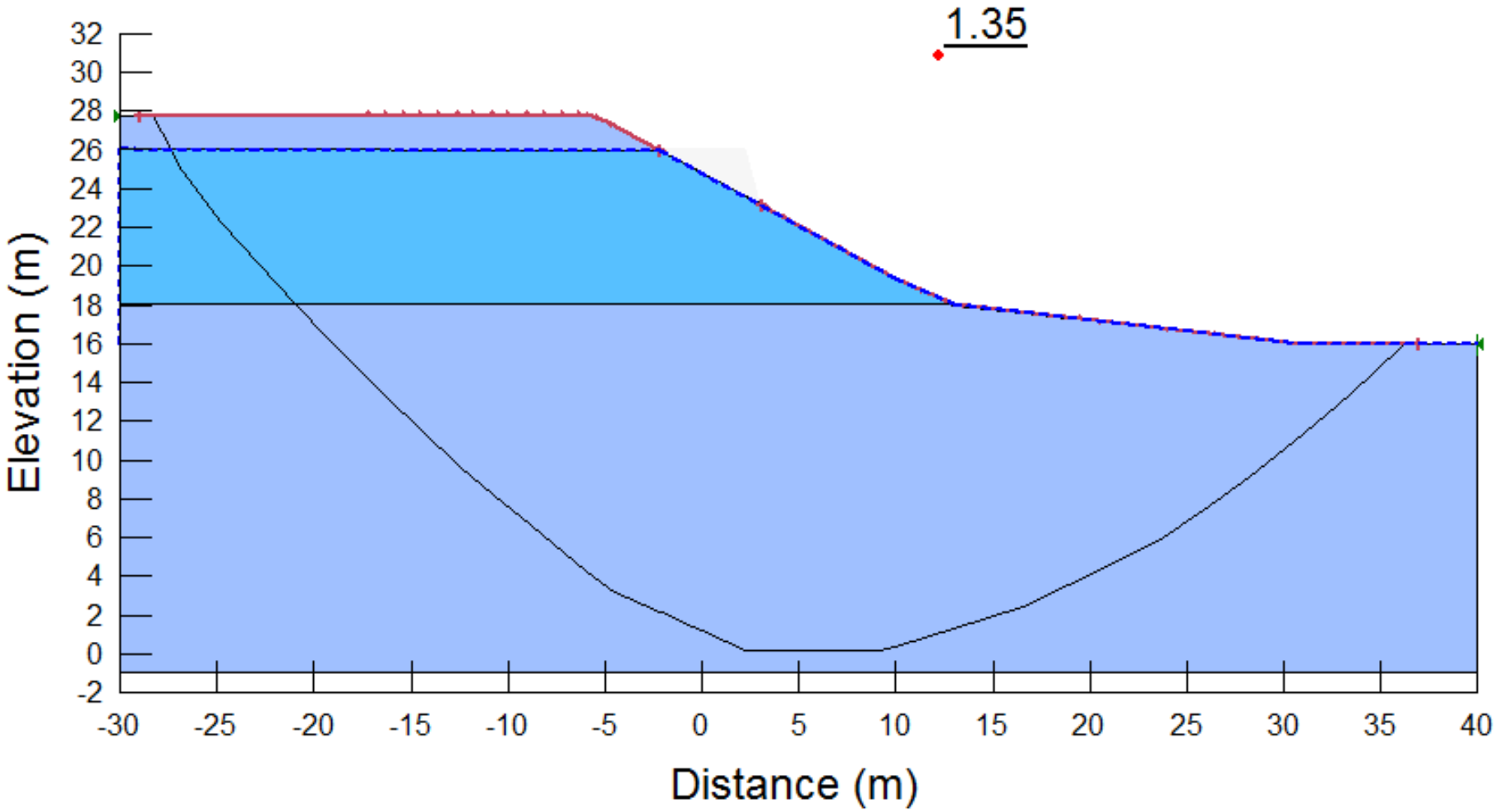
Site F - Current Conditions



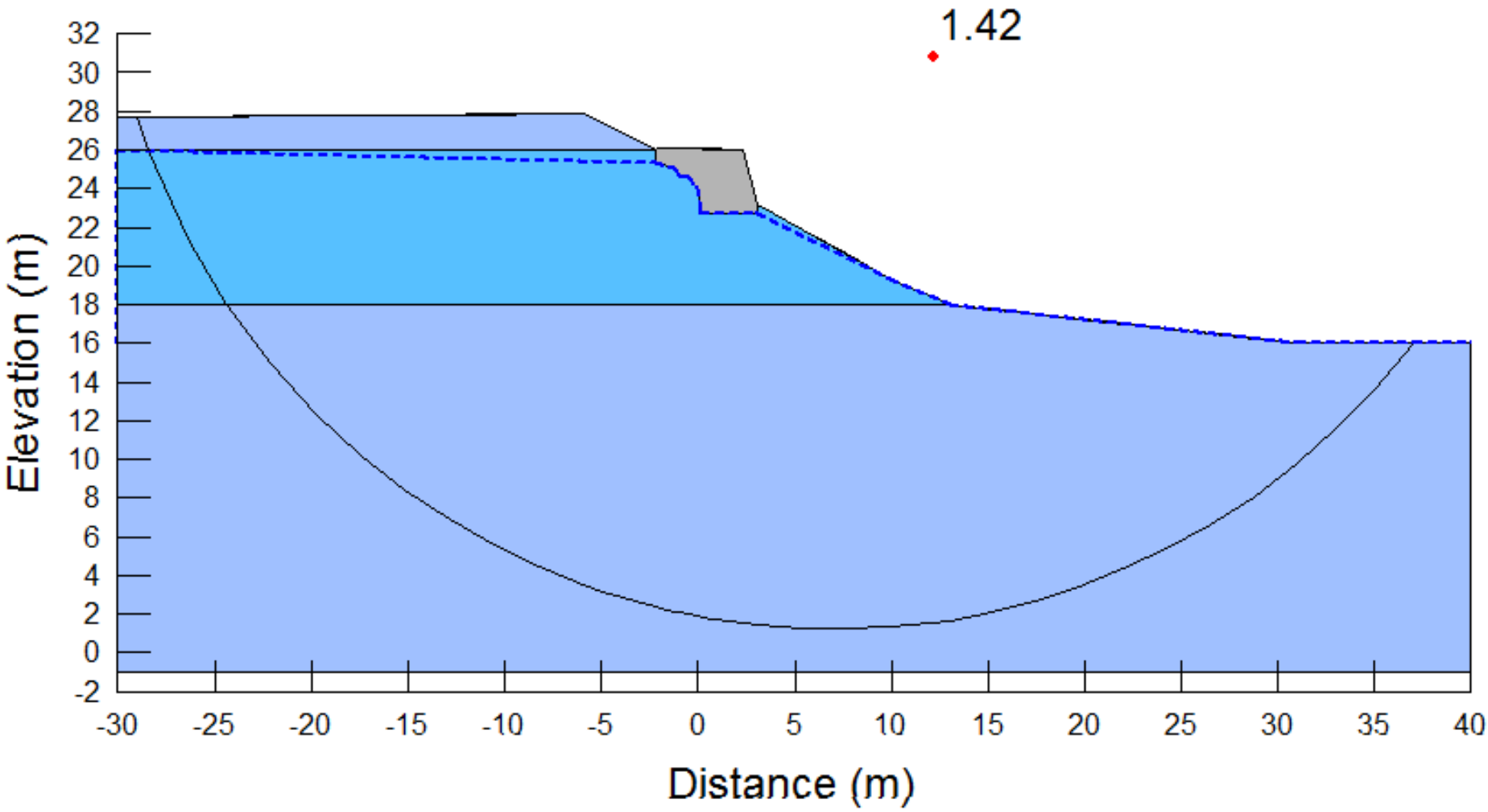
Site F – After Construction



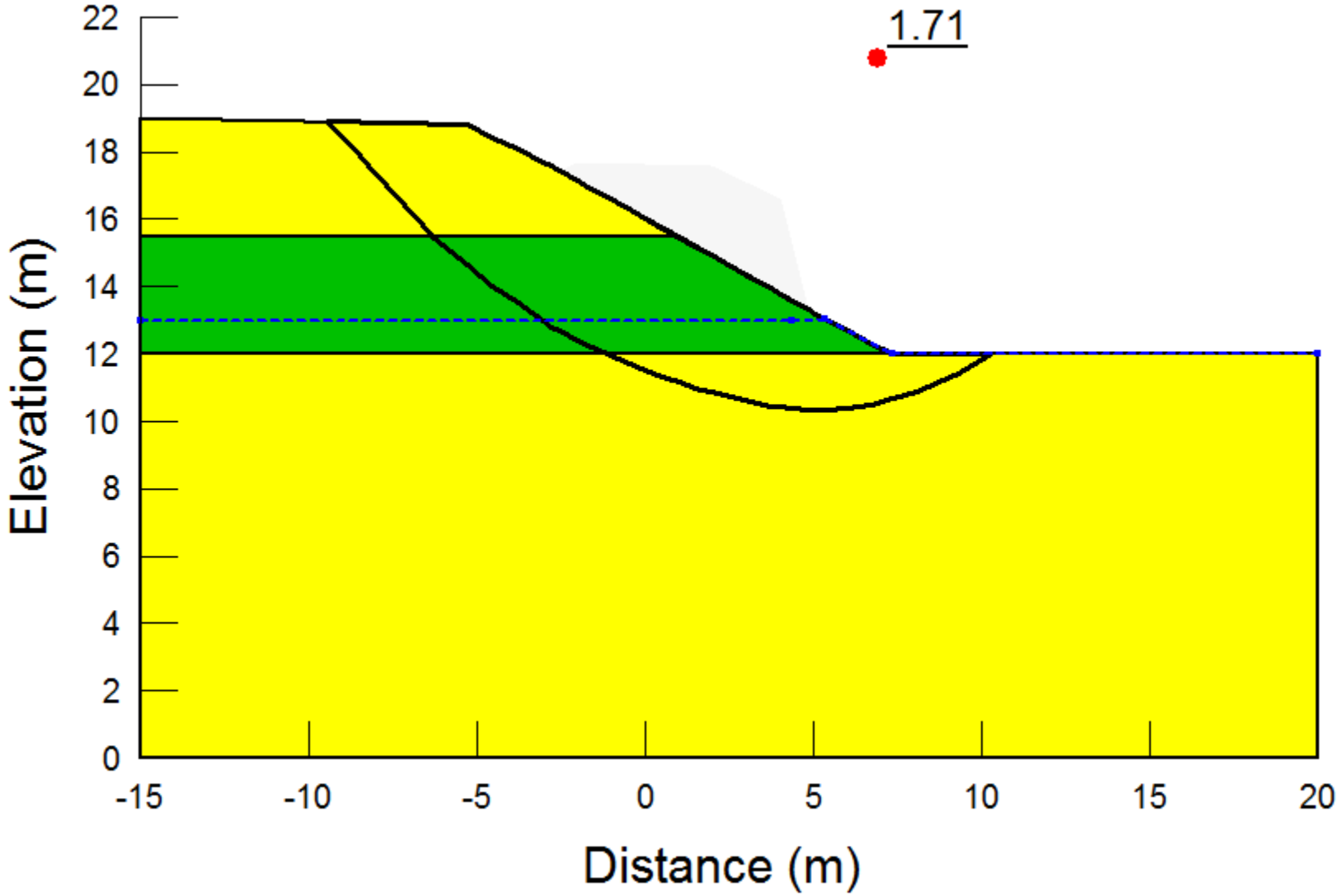
Site I - Current Conditions



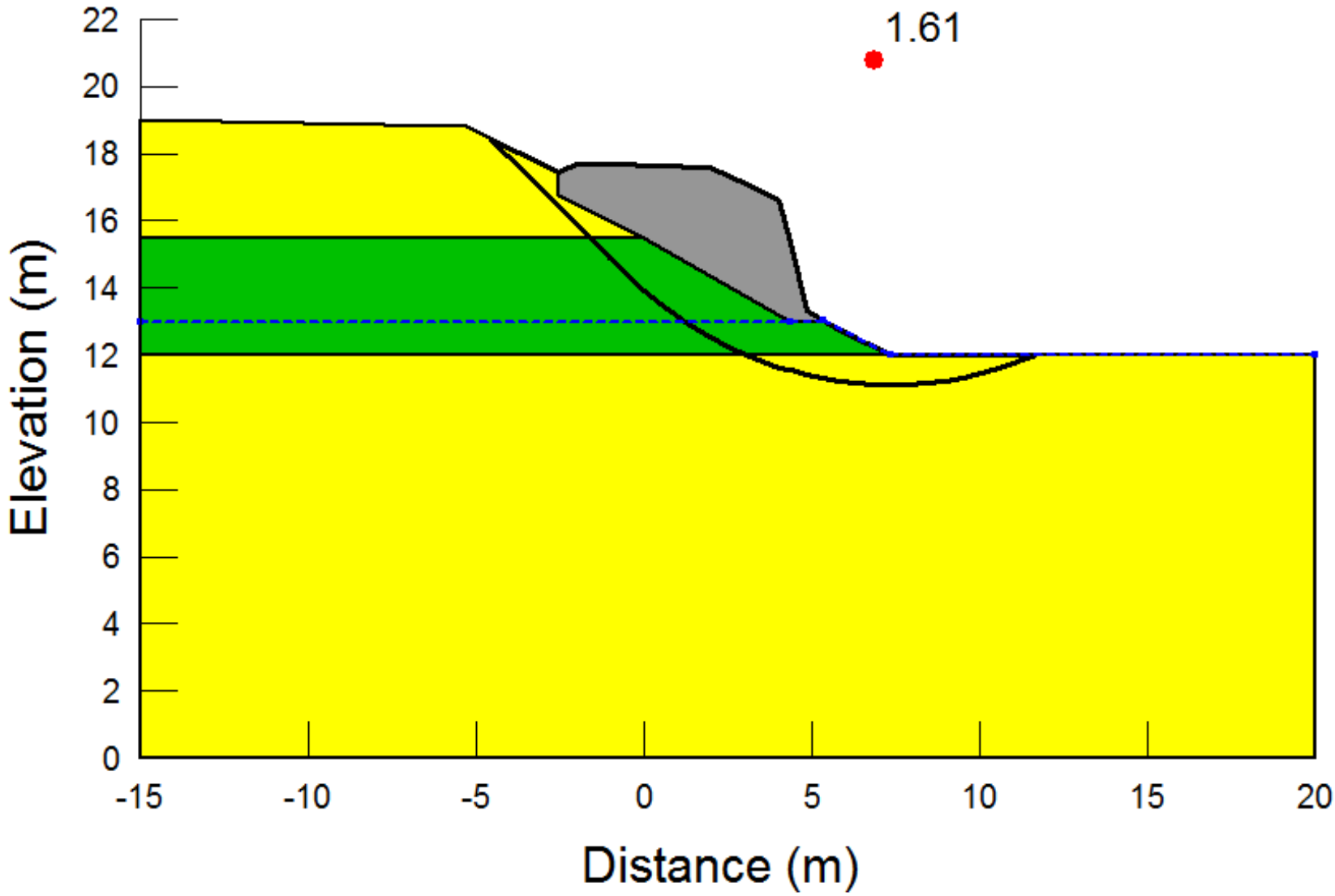
Site I – After Construction



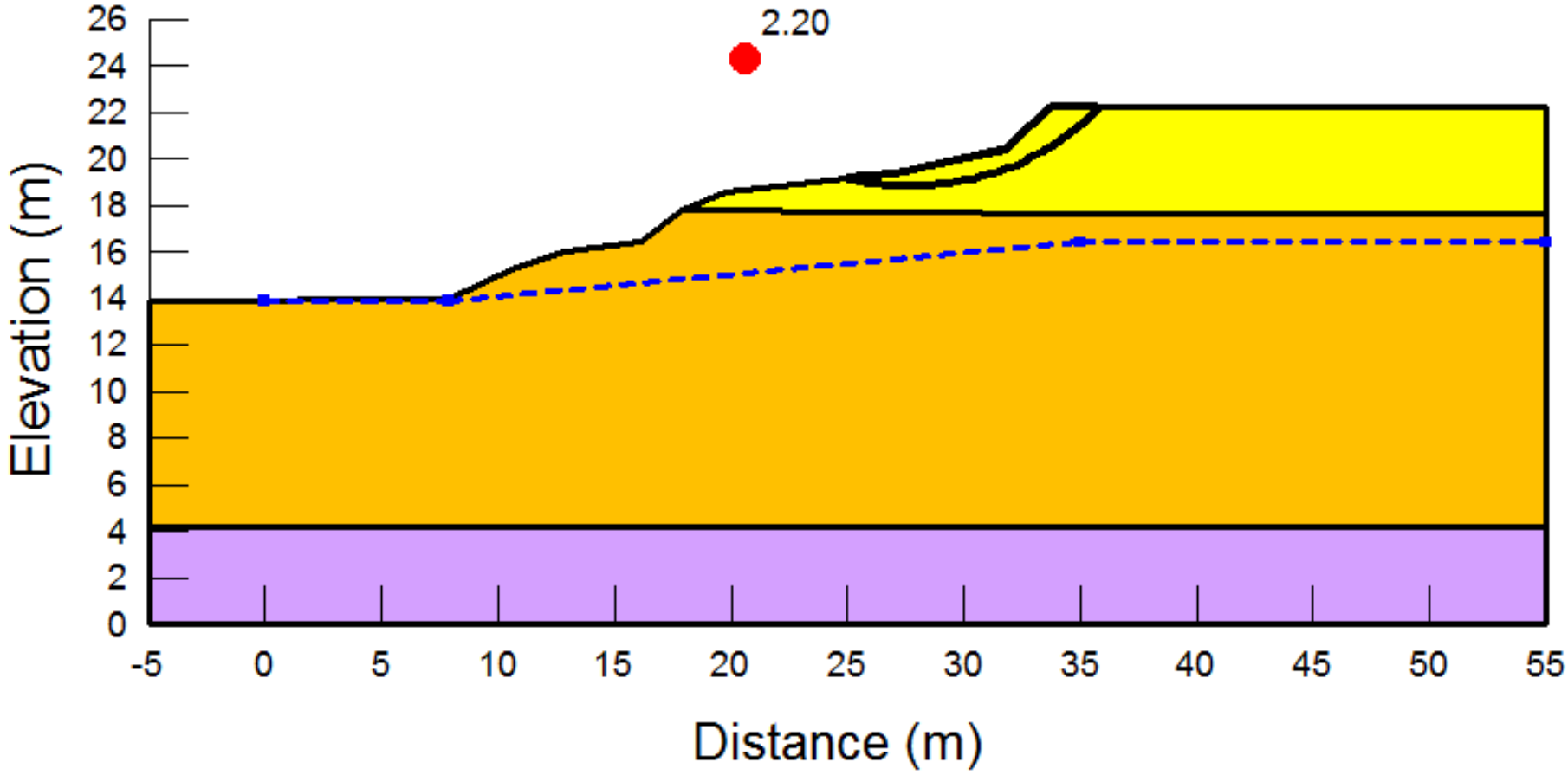
Site J - Current Conditions



Site J – After Construction



Bridge #19 - Current Conditions



Limitations

Limitations

The work performed in the preparation of this report and the conclusions presented herein are subject to the following:

a) The contract between Wood and the Client, including any subsequent written amendment or Change Order dully signed by the parties (hereinafter together referred as the "Contract");

b) Any and all time, budgetary, access and/or site disturbance, risk management preferences, constraints or restrictions as described in the contract, in this report, or in any subsequent communication sent by Wood to the Client in connection to the Contract; and

c) The limitations stated herein.

2. **Standard of care:** Wood has prepared this report in a manner consistent with the level of skill and are ordinarily exercised by reputable members of Wood's profession, practicing in the same or similar locality at the time of performance, and subject to the time limits and physical constraints applicable to the scope of work, and terms and conditions for this assignment. No other warranty, guaranty, or representation, expressed or implied, is made or intended in this report, or in any other communication (oral or written) related to this project. The same are specifically disclaimed, including the implied warranties of merchantability and fitness for a particular purpose.

3. **Limited locations:** The information contained in this report is restricted to the site and structures evaluated by Wood and to the topics specifically discussed in it, and is not applicable to any other aspects, areas or locations.

4. **Information utilized:** The information, conclusions and estimates contained in this report are based exclusively on: i) information available at the time of preparation, ii) the accuracy and completeness of data supplied by the Client or by third parties as instructed by the Client, and iii) the assumptions, conditions and qualifications/limitations set forth in this report.

5. **Accuracy of information:** No attempt has been made to verify the accuracy of any information provided by the Client or third parties, except as specifically stated in this report (hereinafter "Supplied Data"). Wood cannot be held responsible for any loss or damage, of either contractual or extra-contractual nature, resulting from conclusions that are based upon reliance on the Supplied Data.

6. **Report interpretation:** This report must be read and interpreted in its entirety, as some sections could be inaccurately interpreted when taken individually or out-of-context. The contents of this report are based upon the conditions known and information provided as of the date of preparation. The text of the final version of this report supersedes any other previous versions produced by Wood.

7. **No legal representations:** Wood makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

8. **Decrease in property value:** Wood shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.

9. **No third party reliance:** This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or Contract. Any use or reproduction which any third party makes of the report, in whole or in part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. Wood does not represent or warrant the accuracy, completeness, merchantability, fitness for purpose or usefulness of this document, or any information contained in this document, for use or consideration by any third party. Wood accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on this report or anything set out therein. including without limitation, any indirect, special, incidental, punitive or consequential loss, liability or damage of any kind.

10. **Assumptions**: Where design recommendations are given in this report, they apply only if the project contemplated by the Client is constructed substantially in accordance with the details stated in this report. It is the sole responsibility of the Client to provide to Wood changes made in the project, including but not limited to, details in the design, conditions, engineering or construction that could in any manner whatsoever impact the validity of the recommendations made in the report. Wood shall be entitled to additional compensation from Client to review and assess the effect of such changes to the project.

11. **Time dependence**: If the project contemplated by the Client is not undertaken within a period of 18 months following the submission of this report, or within the time frame understood by Wood to be contemplated by the Client at the commencement of Wood's assignment, and/or, if any changes are made, for example, to the elevation, design or nature of any development on the site, its size and configuration, the location of any development on the site and its orientation, the use of the site, performance criteria and the location of any physical infrastructure, the conclusions and recommendations presented herein should not be considered valid unless the impact of the said changes is evaluated by Wood, and the conclusions of the report are amended or are validated in writing accordingly.

    Advancements in the practice of geotechnical engineering, engineering geology and hydrogeology and changes in applicable regulations, standards, codes or criteria could impact the contents of the report, in which case, a supplementary report may be required. The requirements for such a review remain the sole responsibility of the Client or their agents.

    Wood will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

12. **Limitations of visual inspections:** Where conclusions and recommendations are given based on a visual inspection conducted by Wood, they relate only to the natural or man-made structures, slopes, etc. inspected at the time the site visit was performed. These conclusions cannot and are not extended to include those portions of the site or structures, which were not reasonably available, in Wood's opinion, for direct observation.

13. **Limitations of site investigations**: Site exploration identifies specific subsurface conditions only at those points from which samples have been taken and only at the time of the site

investigation. Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions.

The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite this investigation, conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

Final sub-surface/bore/profile logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Customarily, only the final bore/profile logs are included in geotechnical engineering reports.

Bedrock, soil properties and groundwater conditions can be significantly altered by environmental remediation and/or construction activities such as the use of heavy equipment or machinery, excavation, blasting, pile-driving or draining or other activities conducted either directly on site or on adjacent terrain. These properties can also be indirectly affected by exposure to unfavorable natural events or weather conditions, including freezing, drought, precipitation and snowmelt.

During construction, excavation is frequently undertaken which exposes the actual subsurface and groundwater conditions between and beyond the test locations, which may differ from those encountered at the test locations. It is recommended practice that Wood be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered at the test locations, that construction work has no negative impact on the geotechnical aspects of the design, to adjust recommendations in accordance with conditions as additional site information is gained and to deal quickly with geotechnical considerations if they arise.

Interpretations and recommendations presented herein may not be valid if an adequate level of review or inspection by Wood is not provided during construction.

14. **Factors that may affect construction methods, costs and scheduling**: The performance of rock and soil materials during construction is greatly influenced by the means and methods of construction. Where comments are made relating to possible methods of construction, construction costs, construction techniques, sequencing, equipment or scheduling, they are intended only for the guidance of the project design professionals, and those responsible for construction monitoring. The number of test holes may not be sufficient to determine the local underground conditions between test locations that may affect construction costs, construction techniques, sequencing, equipment, scheduling, operational planning, etc.

Any contractors bidding on or undertaking the works should draw their own conclusions as to how the subsurface and groundwater conditions may affect their work, based on their own investigations and interpretations of the factual soil data, groundwater observations, and other factual information.

15. **Groundwater and Dewatering**: Wood will accept no responsibility for the effects of drainage and/or dewatering measures if Wood has not been specifically consulted and involved in the design and monitoring of the drainage and/or dewatering system.

16. **Environmental and Hazardous Materials Aspects**: Unless otherwise stated, the information contained in this report in no way reflects on the environmental aspects of this project, since this aspect is beyond the Scope of Work and the Contract. Unless expressly included in the Scope of Work, this report specifically excludes the identification or interpretation of environmental conditions such as contamination, hazardous materials, wild life conditions, rare plants or archeology conditions that may affect use or design at the site. This report specifically excludes the investigation, detection, prevention or assessment of conditions that can contribute to moisture, mould or other microbial contaminant growth and/or other moisture related deterioration, such as corrosion, decay, rot in buildings or their surroundings. Any statements in this report or on the boring logs regarding odours, colours, and unusual or suspicious items or conditions are strictly for informational purposes

17. **Sample Disposal**: Wood will dispose of all uncontaminated soil and rock samples after 30 days following the release of the final geotechnical report. Should the Client request that the samples be retained for a longer time, the Client will be billed for such storage at an agreed upon rate. Contaminated samples of soil, rock or groundwater are the property of the Client, and the Client will be responsible for the proper disposal of these samples, unless previously arranged for with Wood or a third party.

18. **Effect of iron minerals:** This report does not address issues related to the discovery or presence of iron minerals, such as pyrite, or the effects of iron minerals, if any, in the soil or to be used in concrete. Should specific information be required, additional testing may be requested by the Client for which Wood shall be entitled to additional compensation.

Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited