REPORT

Highway 95 - Kicking Horse River Bridges

Final Preliminary Geotechnical Report

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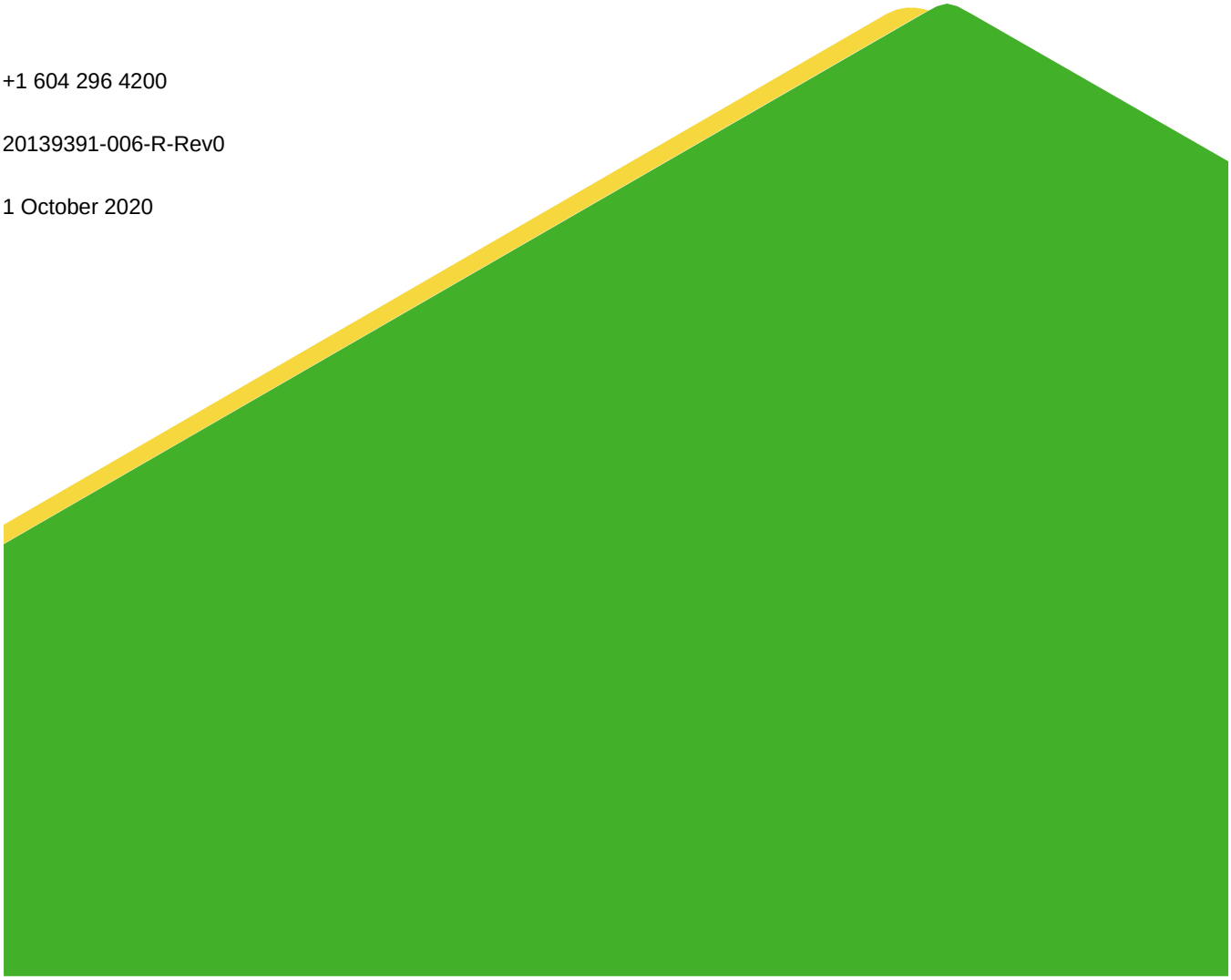

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Associated Engineering (BC) Ltd. (AE) to provide geotechnical services for the Highway 95 – Kicking Horse River Bridges Project (the Project) located in Golden, BC. Golder's geotechnical services were required to support the advancement of the conceptual design for the Project throughout the preliminary design phase.

This report documents Golder's preliminary geotechnical assessment of the Project based on site reconnaissance, available information and a preliminary geotechnical investigation. The results of the information reviewed and obtained, along with our preliminary engineering assessment, are provided in this report. The geotechnical interpretation and engineering comments and recommendations presented herein are based on the highway and bridge design information available at the time of preparing this report and are considered subject to revision upon completion of further geotechnical investigation and analyses.

The scope of this preliminary geotechnical assessment report is limited to the geotechnical assessment and reporting services only, consistent with terms outlined in the contract with AE dated 21 May 2020 and does not include any investigation, testing or assessment of soil and/or groundwater contamination at the site, nor inclusion of bio-environmental, hydrotechnical or archaeological services. It is understood that these services are to be provided by others, where required.

This report should be read in conjunction with the ***"Limitations and Use of This Report"*** which is presented following the text of this report. The reader's attention is specifically drawn to this information as it is essential for the proper use and interpretation of this report.

2.0 PROJECT INFORMATION

The proposed Highway 95 – Kicking Horse River Bridges Project configuration at the time of preparing this report is illustrated in Figure 1. Based on our understanding of the Project design at the time of preparing this report (100% Preliminary Design submission), the main improvements are to include:

- Re-alignment of the Highway 95 approaches and bridge crossing over the Kicking Horse River to the east of the existing highway alignment extending from approximately 500 m north to approximately 200 m south of the river.
- Replacement of the existing bridge structure at Kicking Horse River with a new two-lane bridge (east of the existing bridge) and addition of a new one or two-lane bridge structure to Goulds Island from the south bank (approximately on the existing bridge alignment).
- Various intersection improvements to connect Highway 95 with the local road network, including a major roundabout at 6th St N.
- Replacement of the existing water main crossing beneath Kicking Horse River to outside of proposed Highway 95 and bridge crossing alignment.
- Replacement of the existing overhead BC Hydro powerline crossing to outside of the proposed Highway 95 and bridge crossing alignment
- Various other drainage, parking, walkway and dike alterations/improvements.

3.0 GEOTECHNICAL SCOPE OF WORK

Golder was retained by AE to provide geotechnical services for the Project under AE's existing MoTI consulting services contract 872CS1603. The scope of Golder's geotechnical services, as approved/directed by AE and MoTI generally includes the following:

- Prepare and carry out a preliminary geotechnical investigation program at the site to support the Preliminary Design phase.
- Provide geotechnical engineering support services to the highway, civil and structural design teams including preparation of a Preliminary Geotechnical Report.
- Attendance at risk review/register meeting during Preliminary Design phase.

This preliminary geotechnical assessment report is provided to support the preliminary design phase of the Project and presents a summary of the recent geotechnical investigation activities carried out at the Project site along with preliminary geotechnical recommendations to aid in the development of the project preliminary design being prepared by AE.

4.0 GENERAL SITE DESCRIPTION

4.1 Existing Highway and Land Use

The Project location is in the Kootenay region, as shown in Figure 1. The specific Project site includes the Landmark Kilometre Index (LKI) Segment 2161 between approximately km 103.03 and km 104.08. For reference purposes, Highway 95 is assumed to be aligned in a north-south direction with the north direction in the east lane and south direction in the west lane. Highway 95 through this segment has one northbound and one southbound lane, with two short bridge structures crossing over the Kicking Horse River. Near the bridge crossings, there are existing intersections and exit/entrance lanes at 9th Ave. N., Goulds Island, Park Drive and 11th Ave. S. (from north to south).

The Project site generally follows along the southern side of the CP Rail Right of Way and Highway 1 Right of Way at the exit of the Kicking Horse River valley and entrance to the Columbia River basin. The valley bottom is relatively flat in topography, with gentle undulations and one prominent river feature, the Kicking Horse River. Moderately steep to steep mountain slopes exist to the north of the Project site associated with the Van Horne Range, to the north-west with the moderately steep to steep Dogtooth Range and to the south-east of the Project site associated with the Beaverfoot Range. The bedrock associated with the adjacent mountain ranges dips steeply into the valley bottom and is covered by significant thickness of recent and glacial outwash fluvial and alluvial deposits at the Project site.

Highway 95 is developed over the fluvial and alluvial deposits that extend across the entire Project site. At the Kicking Horse River approaches, the highway is developed over a slightly elevated dike feature comprising generally coarse granular material. Areas in and around the Kicking Horse River have been historically subjected to various phases of development and, as a result, extensive zones of import fill material are anticipated within the Project footprint.

The Project site is located within an urban setting with mostly commercial and industrial land-use adjacent to Highway 95. CP Rail maintains an active track system and maintenance facility north of the river and the current Highway 95 alignment.

4.2 Geological Setting

Existing surficial geological mapping by the Geological Survey of Canada (GSC) for the area of the site is limited and not recent. GSC Map 1497A indicates surficial sediments throughout and adjacent to the Project site composed of “till, alluvium, colluvium, gravel, sand and silt where bedrock is extensively concealed” of the Pleistocene and recent periods. The presence of these deposits was verified during our preliminary geotechnical investigation work conducted in the area. At the Project site, bedrock is not anticipated within 150 m of the ground surface based on review of records obtained at nearby water well installations.

In general, it is anticipated that the natural surficial geology consists of recent fluvial/alluvial, coarse-grained materials deposited by the Kicking Horse River overlying older fluvial/alluvial, finer-grained sediments from the Columbia River basin.

4.3 Site Seismicity

Golder obtained site-specific seismic hazard results from the Natural Resources Canada (NRC) website (http://earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index-eng.php) for the Project site located at 51.298N, 116.963W. A summary of the NRC calculation results is detailed in Appendix C.

The NRC results indicated, as based on the 2015 National Building Code of Canada (NBCC), that the five percent damped peak firm-ground acceleration (PGA) having a 2 percent chance of exceedance during a design life of 50 years (equivalent to having a return period of 1-in-2,475 years), is 0.12 g. Based on preliminary assessment, the highway alignment is anticipated to be considered as Site Class C with non-liquefiable soils in the upper 30 m. The site classification assessment and seismic analysis is detailed further in Section 9.2 below.

4.4 Climate Setting

Selected Canadian Climate Normal data obtained from the Environment Canada webpage (http://climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html) for the nearest station to the Project site is tabulated in Table 1 below.

Table 1: Canadian Climate Normals Data (1981 - 2010)

Station	Location	Elevation	Days with Minimum Temperature Below 0°C	Days with Maximum Temperature Below 0°C	Degree-Days Below 0°C
Golden Airport	51°17’57.000”N 116°58’56.000”W	784.9 m	183.5	70.6	778.4

For the above values, the corresponding frost penetration depth as determined by recommendations presented in the Canadian Foundation Engineering Manual (4th Edition) is about 2.0 m for bare road and gravel surfaces and about 1.2 m in snow-covered areas.

5.0 REVIEW OF BACKGROUND INFORMATION

The following information on the site and subsurface conditions was available to Golder for use in our geotechnical engineering analysis and design:

- *Kicking Horse River Bridges, Hwy 95, Golden, BC, Geotechnical Condition Assessment Memo*, WSP Canada Inc, dated14 April 2014
- *Highway 95 Kicking Horse Bridges 9th Street S to 6th Street North, Golden Planning and Preliminary Engineering*, Associated Engineering BC, dated February 2017
- *Value Analysis Review of Highway 95 - Kicking Horse Bridges for The Ministry of Transportation and Infrastructure,* Value Management Inc, dated 19 March 2017
- *Golden Dike Improvements,* Structural Design Drawings, Reid Jones Christofferson Ltd., dated 23 April 2020
- *Geotechnical Engineering Investigation Report, Proposed Dike Improvements, Golden, BC,* WSP Canada Inc., dated 5 January 2017
- *Borehole Logs,* McIntosh Lalani Engineering Ltd, dated 20 June 2009
- *Kicking Horse River Ice Jam Study, Town of Golden, British Columbia,* Matrix Solutions Inc., April 2018
- *GSC Map 1497A, Geology, Golden (West Half),* Geological Survey of Canada, dated 1979
- *Groundwater Wells and Aquifers Registry, https://apps.nrs.gov.bc.ca/gwells/,* Government of British Columbia, Well Tag Numbers: 108705, 48403, 16956, 14523, and 14555 (the available records are included in Appendix F)

6.0 PRELIMINARY GEOTECHNICAL INVESTIGATION

As discussed previously, a preliminary geotechnical investigation program was carried out for the Project, targeting areas at/near proposed structure foundations and to provide subsurface information coverage across the site. The geotechnical investigation program was conducted in July 2020 and included four deep drilled boreholes.

6.1 Data Presentation

Field identification and classification of the subsurface soil encountered during the geotechnical investigation was classified in general conformance with the BC Ministry of Transportation and Infrastructure (MoTI) "*Geotechnical and Materials Engineering Standards for Bridge Foundation Investigations [Rev 90-04-26]"*. Soil descriptions generally followed MoTI's modified Unified Soils Classification System (USCS). Other pertinent details such as color, moisture and in-situ conditions were recorded to supplement the classification.

The results of the geotechnical investigation are provided on draft Summary Logs in Appendix A and detailed laboratory test results in Appendix B.

6.2 Drilling Investigation Program

A total of four boreholes were conducted between 1 and 18 July 2020. Air-rotary drilling and triple-tube diamond coring drilling methodologies were employed. A list of the boreholes and pertinent details, such as coordinates, depths and dates are provided in Table 2 below. The approximate locations of the boreholes are shown on Figure 1 attached.

Table 2: Summary of Borehole Information

Borehole ID	Coordinates (UTM NAD83 Zone 11U)[1]		Approximate Elevation (geodetic datum)	Termination Depth (mbgs)[2]	Drilling Methodology	Drilling Dates
	Northing	Easting				
BH20-01	5683104	502493	789	45.1	Air-Rotary/HQ3	14 - 17 July 2020
BH20-02	5682959	502569	789	51.4	Air-Rotary/HQ3	01 - 05 July 2020
BH20-03	5683012	502498	790	49.4	Air-Rotary/HQ3	06 - 10 July 2020
BH20-04	5682959	502532	790	28.5	Air-Rotary/HQ3	11 - 13 July 2020

1 – coordinates were taken in the field using a hand-held GPS and are approximate only

2 – mbgs refers to metres below ground surface

For this investigation, each individual borehole was provided with a unique identification number for the hole. All holes were drilled using boring methods and are identified with the prefix ‘BH’ followed by ‘20’ for the year they were drilled (2020). The final two numbers are the unique identification number for the borehole put down.

During this investigation, in-situ testing was carried out within the boreholes and included:

- Split-spoon sampling and standard penetration testing (SPT)
- Grab samples from air-rotary drill cuttings
- HQ3 diamond core recovered soils

Detailed drilling and sampling methodologies are provided in the following sections and results are summarized on the Summary Logs in Appendix A.

Laboratory testing on soils included classification and index testing (such as moisture content, gradation testing, hydrometers and Atterberg limits) and specialized testing (such as sulphate, chloride and corrosivity testing). The testing program is detailed further in Section 6.3 and available results are provided in Appendix B.

6.2.1 Air-Rotary Drilling

An air-rotary (commonly known as ODEX) drill rig equipped with top-drive rotary capabilities was utilized for rotary drilling through overburden on this Project. The Fraste Multi-Drill XL track-mounted rig employed for this drilling was owned and operated by Geotech Drilling Services (Geotech) of Prince George, BC.

Air-rotary drilling employs a down hole percussion hammer that advances an outer casing and cutting shoe (approximately 133 mm diameter) that is rotated and driven into the ground in approximately 1.5 m increments, with the drill cuttings flushed out of the hole using compressed air. Following each drill run, the cutting bit was retrieved, and a split-spoon sampler was lowered down hole to the target depth and a standard penetration test (SPT) was conducted. The air-rotary system provides a fully cased borehole length as casing is advanced behind the cutting shoe.

Air-rotary drilling was employed during this investigation due to its ability to break apart and advance through coarse-grained soils, cobbles and boulders; however, due to the very granular nature of the ground encountered, the cutting shoes were wearing down quickly and the casing advanced behind the cutting shoe became very tight due to friction. Where this occurred, HQ3 soil coring was employed to advance the borehole to termination depth as is described in detail in the following section.

6.2.2 HQ3 Soil Coring

Triple-tube HQ3 diamond drilling was conducted in boreholes where advancement by air-rotary drilling was not productive due to the granular nature of the ground. HQ3 diamond drilling utilizes an 89 mm outer diameter core barrel with an inner core barrel that retrieves a 61 mm diameter core. Generally, HQ3 is utilized in bedrock drilling and when utilized in soil, the core recovery is significantly reduced due to the potential for the soil to fall out of the core barrel or be washed away during drilling.

The casing and core barrel were drilled down using force and high-speed rotation while simultaneously injecting fluid (typically water or light slurry) through the tip of the core barrel to lubricate and cool the cutting bit as well as stabilize the sidewalls of the borehole. The drilling system utilizes an overshot device that is dropped on a wireline through the casing and directly couples onto the outer core barrel assembly, allowing for fast retrieval of the core assembly after each run, typically advanced in 1.5 m increments. Following recovery of the core assembly, a split-spoon sampler is lowered down hole to the target depth and a standard penetration test (SPT) is conducted.

6.2.3 In-Situ Testing and Sampling Using Standard Penetration Tests (SPTs)

Standard Penetration Tests (SPTs) were conducted at selected depths within the overburden soil encountered in the boreholes. SPTs were conducted in general conformance with ASTM D1586 however, the drilling methodologies employed on this Project to advance the boreholes through the coarse-grained material do not directly correlate to ASTM D1586 which specifies the need for a water or mud-balanced borehole to account for pressure balance and prevent heave of basal material.

SPTs utilize a 51 mm diameter open drive split-spoon sampler of 600 mm length that is driven into the ground at a select depth. The sampler is driven using an automatic trip hammer weighing 63.5 kg and dropped from a height of 760 mm. The process allows for measurement of penetration resistance values (or blow counts) per 150 mm advancement and for obtaining disturbed soil samples for visual identification and sampling. The amount of soil sample recovered per SPT varied depending on the penetration depth of the sampler and the in-situ matrix of the soils. Pertinent details of the SPTs conducted are recorded on the Summary Logs in Appendix A.

Where the split-spoon sampler penetrated the full 600 mm, the number of blows required to drive the sampler from 152 mm to 457 mm penetration is reported as the SPT 'N' value. Where the split-spoon sampler reached refusal at less than 600 mm penetration, the total number of blows required to reach refusal is typically inferred as greater than 50 per 150 mm, or very dense/hard soil.

It is noted that the blow counts presented on the Summary Logs in Appendix A are not corrected for energy efficiency, overburden pressure, borehole dimensions, or other factors and are considered raw data. Further, it should be noted that in certain soil strata where gravels, cobbles or larger particles are encountered, the blow counts obtained may not be representative of the soil matrix. In addition, the vibrations created during the air-rotary process may have disturbed the ground in advance of the drilling bit. As such, a combination of engineering judgement and laboratory testing is required during interpretation of the results.

All split-spoon samples collected during the field investigation were sealed in plastic sample bags, labelled and retained for further review and laboratory testing. All soil samples were transported to and stored in Golder's Kelowna warehouse/laboratory. Samples not used for further laboratory testing will be retained until completion of the geotechnical investigation program and ownership will be passed to BC MoTI.

6.2.4 Borehole Closure

All boreholes were backfilled with a combination of bentonite-grout mixture, bentonite chips, cuttings and surfacing gravels/asphalt. All borehole backfilling and closure was conducted in general conformance with the BC Groundwater Protection Regulations. No standpipe piezometer or instrumentation was installed during this investigation program.

Boreholes were grouted and allowed to set for 4 hours. Grout mixes generally followed the industry standard Mikkelsen mix ratio of approximately 2 water : 1 cement : 0.33 bentonite (by weight). Heavier mixes (increased bentonite or with added polymer) were utilized where slurry return loss occurred during drilling or where grout was observed to be seeping into the ground formation. Bentonite chips were used to top up the borehole where grout settled during the setting period. A surficial layer of sand, gravel and/or cold patch asphalt was applied above the grout/bentonite seal as required, based on borehole location and surrounding ground surface conditions.

6.3 Laboratory Testing Program

Laboratory testing was carried out on selected samples of overburden soil collected from the boreholes to verify soil classification and assess the geotechnical properties of the subsurface materials encountered. The laboratory testing program and results are summarized in the following sections and detailed results are provided in Appendix B.

6.3.1 Soils Index Testing

Laboratory soils index testing was undertaken on selected soil samples obtained from the split-spoon samples and grab samples. Testing was conducted at Golder's Kelowna laboratory in general conformance with American Society for Testing Materials (ASTM) standards as follows:

- ASTM D2216 Standard Test Method for Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D6913 Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils

Sample preparation was carried out in general conformance with ASTM D421 Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants. It is important to recognize that the drilling and sampling methods in the field limit the maximum particle size that can be recovered from the boreholes, typically to a maximum of 51 mm. As such, the laboratory gradation test results shown may not incorporate larger particle sizes that were present within the in-situ soils and may not be representative of coarse gravel, cobble or boulder content.

The results of the laboratory index testing are presented in Appendix B.

6.3.2 Soils Specialized Testing

Specialized testing was undertaken on select samples obtained from the boreholes to determine select chemical properties of the subsurface soils related to GUL concrete and corrosivity to steel. Testing of the materials was conducted in general conformance with the following standard testing methods by a third-party laboratory CARO Analytical Services of Kelowna, BC as detailed below.

- ASTM C1218 Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
- CSA A23.2-3B Determination of Total or Water-Soluble Sulphate Content of Soil
- AASHTO T289 Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing
- AASHTO T288 Standard Method of Test for Determining Minimum Laboratory Soil Resistivity
- SM 4500-S2-D Standard Method of Test for Sulfide by Methylene Blue
- ASTM G200 Standard Test Method for Measurement of Oxidation-Reduction Potential (ORP) of Soil

The results of the specialized chemical testing are presented in Appendix B.

7.0 INTERPRETED SUBSURFACE CONDITIONS

Based on review of the available geological information for the area, the available preliminary field investigation information and our visual observations made during site reconnaissance, a summary of the inferred subsurface conditions within and directly adjacent to the Project site are presented in the following sections. It is noted that the subsurface conditions may differ and vary between the boreholes put down at the site and laterally beyond the extent of the area investigated.

7.1 Topsoil and Asphalt

Topsoil comprising a mixture of generally silt and sand with organics was observed in the undeveloped land at BH20-02 and BH20-04. The topsoil was observed to have a thickness of 0.15 m to 0.20 m and can be expected to be encountered in areas of the Project site that are currently landscaped or undeveloped.

Within the two boreholes conducted on paved road/parking lot, BH20-01 and BH20-03, the asphalt was observed to have a thickness of 0.15 m. Asphalt of varying thickness is expected to be encountered in areas of the Project site that are currently developed for roadway and/or parking use.

7.2 Fill

Localized fill materials, comprising generally granular material, were encountered along the existing and proposed highway and bridge alignments. Due to the proximity of the boreholes to the Kicking Horse River, it is anticipated that the fills encountered were placed to raise grade of adjacent lands above river level.

The fills encountered were generally coarse grained in nature comprising sand, gravel and cobbles with trace amounts of silt. However, historical information indicates that the fill materials could contain deleterious materials including metal (wrecked cars and trucks) and wood (stumps and logs).

The fill materials encountered were generally dense to very dense in nature, based on observed resistance to penetration and SPT blow counts; however, caution should be taken when interpreting the SPT blow counts due to the large particle size of the materials which may affect these results. One low (very loose relative density) blow count was observed; however, this value was attributed to disturbance during the drilling processes.

7.3 Fluvial/Alluvial Deposits

Beneath the surficial topsoil and fill materials, overburden materials consisting of Pleistocene and recent deposits were encountered. The thickness of the overburden above bedrock was not determined during the preliminary geotechnical investigation; however, the overburden was observed to extend beyond the 50 m borehole termination depth, possibly extending below 150 m depth based on nearby water well records. The thickness of these deposits in the Project area is not anticipated to vary significantly.

Within the upper recent post-glacial fluvial/alluvial deposits, the soil composition generally comprised sand, gravel, cobbles and boulders with trace to some silt. Generally below 35 m depth, the soil composition generally comprised sand and silt mixtures with trace to some gravel that appeared to be deposited in a lower energy environment, likely by the Columbia River system. These deposits were encountered in each of the boreholes put down on the north and south side of Kicking Horse River. These fluvial/alluvial deposits were generally observed to be dense to very dense based on SPT blow counts and observed resistance to penetration; however, caution should be taken when interpreting the SPT blow counts due to the large particle size of the materials which could effect the results. All boreholes were terminated within these deposits.

Based on the results of the sulphate chemical testing conducted on samples obtained from these deposits the exposure class is low (below S-3 according to Clause 4.1.1.6 of CSA A23.1-14).

The results of preliminary corrosivity testing indicate a potentially aggressive soil chemical environment to steel (such as pipe piles and ground anchors/nails). The results of the chemical testing indicated a low soil resistivity of 1304 ohm-cm, where corrosive environments are generally categorized as less than 2000 ohm-cm. It is noted, however, that resistivity is sensitive to the degree of compaction, moisture and temperature and laboratory tests may not be directly indicative of the in-situ conditions. The reported pH and sulfides content are not within aggressive limits for soil-steel environments. It is recommended that a detailed assessment of the corrosivity of the in-situ soils, including field measurements, be carried out during future geotechnical investigation(s) to verify these preliminary results and to determine the level of corrosion protection required on steel elements.

7.4 Groundwater Conditions

Standpipe piezometers were not installed within the boreholes. Groundwater levels were measured during advancement of the boreholes and ranged between 3.9 m and 5.6 m below the ground surface. Due to the nature of the drilling, these groundwater level measurements may not represent stabilized groundwater levels.

Groundwater is expected to be primarily contained within the surficial fills and fluvial/alluvial deposits. Although not encountered during our preliminary geotechnical investigation, possible artesian conditions could exist where these coarse-grained deposits are confined within or below a relatively less permeable deposit (such as fine-grained or till deposit); however, these conditions are expected to be encountered at considerable depth, based on nearby water well records, and will likely not affect the Project.

The Kicking Horse River is expected to strongly influence the groundwater levels within the Project site and groundwater levels will fluctuate with varying precipitation, season and water flow within the adjacent water course, particularly during periods of heavy rain and snowmelt.

8.0 KEY GEOTECHNICAL ISSUES AND CONSTRAINTS

From our experience in the local area with other MoTI highway improvement projects of similar scope, we consider the following as the key geotechnical issues and constraints that may impact design and construction of the proposed highway improvement components.

- The Project site is expected to be underlain by generally coarse-grained fills and natural deposits extending below 150 m below existing ground surface. Key structural elements such as bridge abutments/piers and some retaining walls will need to be supported on piles which are embedded into these coarse-grained deposits at depth. Advancement of piles through such granular material containing cobbles and/or boulders may present significant difficulty during construction and risk of damaging piles. Additionally, a higher fines-content layer was observed from about 35 m and piles that reach into or terminate directly above this layer may experience reduced axial resistance.
- In order to accommodate the required grade changes for the new roads, road widening and bridge structure approaches within the limited Right-of-Way, retaining wall construction will likely be required. It is understood that three retaining walls are proposed for the Project with one up to about 5 m in vertical height. In general, the natural soil deposits are considered suitable for support of retaining wall structures however, the actual foundation subgrade preparation and foundation design will be dependant upon the overall performance requirements for the structure, ground conditions and external environment. Design/construction of retaining walls on existing fills may require special consideration for site preparation and foundation support, such as localized sub-excavation and backfilling/compaction. Piled foundations may also be required where retaining walls are constructed in areas of potential scour (i.e. directly adjacent to the Kicking Horse River). Retaining walls may need to be constructed using different methodologies subject to available Right-of-Way limits.
- The proximity of Kicking Horse River to the Project structures and the climate setting of the site indicate a significant risk of ice jam and scour. The forces applied by ice jam and reduction in embankment and/or pile capacity due to scour can be significant if not assessed and designed for appropriately. A detailed assessment of such considerations will play a vital role in the overall design of the retaining walls, bridge abutments and piers.

- The existing watermain that crosses beneath the Kicking Horse River is located directly beneath the new proposed bridge alignment. This watermain will require relocation to the east (upstream) of the existing location and due to environmental constraints, the watermain relocation will likely need to be installed using trenchless technology. Selection of the most suitable trenchless methodology for the relocation will be highly dependent upon the watermain profile, tie-in requirements and conditions along the new alignment. Detailed investigation will be required along the new watermain alignment to accurately assess the geotechnical conditions and methodology selection process.

9.0 PRELIMINARY GEOTECHNICAL CONSIDERATIONS

9.1 Natural Hazards

Golder did not carry out a natural hazard review as part of this assignment as it was understood that a natural hazard assessment for the project was carried out by WSP Canada Inc. (WSP) in previous geotechnical studies for the Project. In WSP's study, natural hazards such as slope instability, debris flood/flow and avalanche were reviewed and it was determined that they do not pose a risk to the Project. Given the relatively flat topography at the site, and distance to the steeper canyon terrain upstream, Golder is in general agreement with this conclusion.

Apart from the impacts associated with the natural hydrological and geomorphological processes in the Kicking Horse River, mitigation to address other natural hazards is not considered warranted.

9.2 Seismic Design

Golder obtained site-specific seismic hazard parameters for the 2015 NBCC from National Resources Canada (NRC) as described in Section 4.3. The results of the calculations are presented in Appendix C.

In accordance with the CAN/CSA S6.14 the following seismic parameters apply to the Project site:

- Site Classification: C – non-liquefiable soils based on preliminary simplified liquefaction assessment (detailed in Section 9.2.1)
- Seismic Performance Category: 1 (major-route and other bridges)
- Major Route Structure, Extensive Damage for 2% exceedance in 50 years (1 in 2,475 year return period event)

The seismic site classification was determined by evaluating the SPT N_{60} values obtained from the geotechnical investigation to Table 4.1.8.4-A of the 2015 NBCC; which dictates the site class for ranges of N_{60} values in the upper 30 m of soil. The raw SPT N values obtained from the geotechnical investigation were corrected to standard N_{60} values using an inferred automatic trip hammer efficiency of 85 percent. The average N_{60} value in the upper 30 m of soil across the four boreholes conducted is 56, indicating a Site Class C. It should be noted that where SPT refusal was encountered (typically no movement for 25 blows or greater than 50 blows per 75 mm) the raw SPT N value was taken as a maximum of 50 blows per 300 mm.

In accordance with CAN/CSA S6/14, a liquefaction assessment is required for the structures considered for this Project to determine the risk of liquefaction and subsequent seismic performance. A preliminary one-dimensional liquefaction assessment was carried out and is detailed further in Section 9.2.1.

9.2.1 Simplified Liquefaction Assessment

Golder conducted a simplified liquefaction assessment following methodology presented by Seed and Idriss (1971) and Boulanger and Idriss (2014) utilizing the SPT data obtained from the preliminary geotechnical investigation which were corrected for drop hammer efficiency and overburden pressure. Following the methods presented, a cyclic stress ratio profile for the Project site was developed using the results of the NRC calculations and a cyclic resistance ratio profile was developed for each of the four boreholes using data obtained during the geotechnical investigation. The cyclic resistance ratio and cyclic stress ratio profile comparisons, along with the calculated Factor of Safety against liquefaction, for the four boreholes put down are presented in Appendix C.

The risk of liquefaction is determined by a comparison of the resistance ratio to stress ratio and for each of the four boreholes assessed, the resistance ratio exceeds the stress ratio for the 1-in-2,475 year seismic event over the entire depth of all boreholes, indicating no risk of liquefaction in these materials. Based on the results of the seismic site classification and the preliminary simplified liquefaction assessment, a detailed liquefaction assessment was not undertaken.

9.3 Subgrade Preparation and Site Grading

9.3.1 Site Stripping

Topsoil, organic, deleterious and/or loose fill materials are considered not suitable for direct subgrade support or re-use as embankment/road fill and should be stripped/sub-excavated from the entire footprint of the proposed fill, structure foundation and pavement areas. It is recommended that stripping/sub-excavation of these materials be carried down to underlying, undisturbed, competent mineral soil and/or mineral fill deposits and that the prepared subgrade should be adequately sloped/shaped to prevent ponding of surface and/or groundwater.

Based on the information obtained from the boreholes put down at the site as part of the preliminary geotechnical investigation, the stripping depth extends to about 0.15 m to 0.20 m in the unpaved/ungravelled areas of site. It should be noted that the stripping depths could locally exceed those indicated above, particularly in poorly drained, lower-lying areas. The actual stripping depths/quantities will require further confirmation during future, more detailed, geotechnical investigation activities.

9.3.2 Permanent Embankment Fill Construction

Embankment construction will be required for the new/widened bridge approaches. The embankment subgrade preparation should be carried out as outlined in Section 9.3.1 above. The prepared subgrade should be inspected by the geotechnical Engineer-of-Record, or designated representative, prior to placing highway embankment fills.

Following the subgrade preparation, the proposed highway fills may be constructed consistent with SS 201.37 of the BC MoTI 2012 Standard Specifications for Highway Construction (Standard Specifications), except where Bridge End Fill zones are required which should be constructed consistent with SS 202.23.

In general, it is recommended that fill slopes for embankments be developed no steeper than 2 Horizontal to 1 Vertical (2H:1V). Consideration may be given to developing fill slopes as steep as 1.5H:1V; however, specialized embankment treatment, such as internal reinforcement or construction using coarse angular rock fill or concrete facing will likely be required to achieve the necessary embankment performance requirements identified in MoTI's Supplement to CSA S6-14. Performance criteria are based on the degree of understanding and

consequence factor, which we have assumed to be a typical degree of understanding and typical consequence factor which require a minimum static Factor of Safety of 1.54 and a minimum seismic Factor of Safety of 1.10. Embankments that cannot meet the performance requirements will require special acceptance by MoTI. The required static Factor of Safety may be reduced from 1.54 to 1.43 during detailed design if sufficient geotechnical investigation is conducted to satisfy the requirements to increase the degree of understanding from typical to high.

In light of the above, Golder has carried out slope stability analyses for some general highway widening and embankment raising scenarios, targeting the area along the Highway 95 alignment adjacent to Kicking Horse River where fill heights are greatest, assuming use of Type D fills at 2H:1V slopes. The analysis was carried out using the commercially available slope stability software GeoStudio 2020 by GeoSlope International Ltd. and available local test hole information using the following assumed soil parameters.

Table 3: Slope Analysis Material Properties - Embankment Fill Slopes

Material	Soil Model	Friction (Phi) Angle	Cohesion	Unit Weight
Pavement Structure	Mohr-Coulomb	36 o	0 kPa	20 kN/m3
Type D Fill	Mohr-Coulomb	34 o	0 kPa	19 kN/m3
Existing Fill	Mohr-Coulomb	36 o	0 kPa	19 kN/m3

The results of the analysis are presented in Appendix E. The seismic analysis was carried out assuming a peak ground horizontal acceleration of 0.08 g (approximately equivalent to two-thirds of the design seismic event as outlined in CHBDC S6-14 and the BC MoTI Supplement).

Based on the results of the analyses, the minimum observed static Factor of Safety was 1.57 and seismic Factor of Safety was 1.31 for slopes constructed at 2H:1V using Type D fill at the Kicking Horse River north abutment location where the fills are highest. An additional assessment was carried out at the Kicking Horse River south abutment location and the factors of safety were significantly higher due to the lower fill height at this location.

It is understood that newly placed embankments will generally range up to 5 m in height. A preliminary settlement analysis was carried out using the commercially available software Settle3 v5.006 by RocScience Inc. and available local test hole information. Based on the analysis it is estimated that the potential settlement of embankment fill up to 5 m in height and compression of underlying subgrade soils could be up to 25 mm, generally attributed to elastic settlement. It is anticipated that the majority of settlement due to compression of the underlying subgrade soils will occur during construction; however, settlement due to compression of the embankment fills could continue for an extended period following construction.

9.3.3 Material Re-Use

It is understood that excavations for highway grading will be generally limited in the flatter areas to accommodate pavement construction. The excavated materials originating from the site are expected to be generally either organic (topsoil as described above) or granular in nature. The organic soils are considered unacceptable for material re-use as fills and should be stripped as recommended in Section 9.3.1 and generally wasted or re-used in landscaped areas. Consideration can be given to re-using the granular fills and natural deposits provided they meet the requirements of SS 201.37 and they are free or any soil contamination. We recommend that the estimated available Type D quantities be reduced by approximately 20% to accommodate material wastage due to removal of large size particles, organics, deleterious, and over-wetted material.

It is understood that no other Type D excavation will originate from the site and the Project will likely need to import borrow materials in order to meet material needs. All import borrow materials should meet or exceed Borrow material specifications as per SS 201.44.

9.4 Retaining Walls

At the time of preparing this report, it was understood that up to three retaining wall structures would be required to accommodate the proposed site grading within the geometrical constraints within the Project site. The anticipated retaining walls include:

- Retaining Wall 1 - South side Park Drive lane and west of Highway 95 along the north and east boundaries of the existing laundry mat commercial property.
- Retaining Wall 2 - Goulds Island access road.
- Retaining Wall 3 - North of Kicking Horse River along the west side of the pedestrian walkway.

The anticipated type of retaining wall at each location was unknown at the time of preparing this report. Based on our preliminary assessment, several options for retaining wall construction are considered feasible and are discussed in the following sections.

9.4.1 Mechanically Stabilized Earth

Material stabilized earth (MSE) walls are considered feasible for highway embankment support through the Project site where right-of-way/property limits allows for adequate excavation upslope of the wall(s). Site preparation requirements beneath the walls will likely be similar to that provided in Section 9.3; however, some additional localized excavation and compaction may be required to adequately prepare the subgrade. For current preliminary design purposes, it should be assumed that over-excavation and replacement with structural fill (Bridge End Fill) may be required beneath MSE walls to a depth of approximately 0.6 m beneath the MSE wall facing and reinforced zone. For MSE walls with no external loading applied (except standard traffic loading), it may be assumed that a reinforcement length to height of wall (measured from wall subgrade to paved surface) ratio of 0.7:1 will be necessary. We recommend that consideration be given to providing a sub-drain at the base of the MSE walls to prevent accumulation of water pressure behind the wall. The backfill upslope of the wall should consist of clean, free-draining Bridge End Fill that is hydraulically connected to the sub-drain.

9.4.2 Cast in Place Walls

Where CIP walls are utilized, the following geotechnical recommendations may be used for preliminary design purposes, subject to varying wall configurations:

- Up to 5 m in vertical height and assumes a minimum 3.5 m wide cantilever footing
- Ultimate Bearing Resistance – Ru = 500 kPa
- Ultimate Geotechnical Resistance Factor - φ_{gu} = 0.5 (typical degree of understanding)

It is recommended to bury the base of the CIP walls by at least 1.2 m to provide frost protection and adequate bearing/lateral support.

For retaining walls constructed in areas that can be undermined due to scour, pile support will be required. In particular, retaining walls constructed along the Goulds Island access road should be pile supported to provide continued vertical support in scour environments and to provide sufficient lateral resistance due to ice loading. Steel pipe piles, as discussed below, can be considered to support such retaining walls but it may be more economical to support such retaining walls on concrete or steel H piles depending on the loading demands and sub-surface conditions at the actual foundation locations. It is understood that the Town of Golden's current dike upgrading project is utilizing drilled concrete piles to support retaining walls that are constructed on the water side of the dike crest. It is recommended that the concrete pile installations for that project be reviewed in detail to determine the suitability of such piles for the Highway 95 Project.

9.5 Bridge Foundations

The new bridge foundations are anticipated to consist of deep piles extending into the very dense granular deposits that underlie the site. Based on the preliminary geotechnical investigation results, the piles would not likely extend beyond the depth of the coarse granular fluvial/alluvial deposits that overlie the finer-grained sediments (which were observed at about 35 m depth); however, this would ultimately depend on the required pile resistance and performance requirements.

Golder has carried out a preliminary assessment of axial pile resistance under static conditions using the geotechnical borehole information obtained near the north pier and south pier locations of the main bridge span. The assessment was carried out for 610 mm diameter steel pipe piles with an assumed wall thickness of 19 mm. Further, we have assumed that these piles will conform to ASTM A252 Grade 3 steel and will be driven open-ended with a flush outside driving shoe conforming to APF O-14001 or approval equivalent. The axial pile resistance with depth was calculated using the standard geotechnical software package APile (v.2019.9.5) from Ensoft. The soil parameters used in the analysis assumed a unit weight between 18 kN/m3 and 20 kN/m3, depending on the soil classification, and an internal angle of friction between 34 and 38 depending on the recorded N-Values that were corrected for overburden pressure and drop hammer energy ($N_{1,60}$). It is noted that the $N_{1,60}$-Values used in the analysis were limited to no greater than 50 blows/0.3m.

The calculated unfactored axial resistances under static conditions for both compression resistance and tension resistance are presented in Appendix D.

Based on the geotechnical resistance factors identified in the Canadian Highway Bridge Design Code (CHBDC) S6-14 and the BC MoTI Supplement to the CHBDC S6-14, for a typical degree of understanding (based on preliminary borehole investigation data) and a typical consequence factor, it is recommended that a geotechnical resistance factor of 0.4 be applied to the above calculated axial compressive resistance and a geotechnical resistance factor of 0.3 be applied to the above calculated axial tension resistance. It may be possible to increase the geotechnical resistance factor with more detailed geotechnical investigation or if field verification of the ultimate axial resistance achieved can be demonstrated by dynamic loading testing using a Pile Driving Analyzer (PDA) during construction; however, the higher geotechnical resistance factors cannot be used during design without further investigation or if a test piling program as per BC Supplement to the CHBDC S6-14.

Due to the presence of cobbles and possible boulders within the near-surface fills and fluvial/alluvial deposits, the steel pipe piles may encounter harder driving and/or refusal prior to reaching their target depth. As such, it is recommended that provision for cleaning the soils inside the piles and clearing any obstructions (including wood, steel cobbles and boulders) to facilitate advancement of the piles to the target depth without damaging the piles. In some cases, pile driving with PDA monitoring can be considered to confirm pile driving activities do not overstress the pile.

9.5.1 Lateral Pile Resistance

The minimum pile installation depth may be dictated by the lateral pile demands and estimated scour depth at the pile locations, which were not known at the time of preparing this report. The soil response for laterally loaded piles can be modeled using non-linear ‘p-y’ curves; however, such analysis will need to be carried out during future phases of design.

9.6 Trenchless Watermain Crossing

9.6.1 Watermain Requirements and Trenchless Installation Feasibility

A component of the project scope involves replacing an existing watermain crossing of the Kicking Horse River which is currently located within the footprint of the new proposed bridge alignment. Consideration is being given to watermain relocation to the east (upstream) of the existing location using trenchless installation methods, involving a new 350 mm diameter high density polyethylene (HDPE) pipe with a trenchless installation plan length of approximately 160 m.

Results of the preliminary geotechnical investigation indicate the Project site is expected to be underlain by generally coarse-grained fills and extensive natural post-glacial fluvial/alluvial deposits extending 150 m or possibly greater below existing ground surface. Groundwater levels measured during advancement of the boreholes ranged between 3.9 m and 5.6 m below ground surface. These groundwater level measurements at the boreholes may not represent stabilized conditions and the Kicking Horse River is expected to strongly influence groundwater levels within the Project site, resulting in fluctuations with varying precipitation, season and water flow within the water course, particularly during periods of heavy rain and snowmelt. For the purposes of conducting a geotechnical feasibility assessment of watermain installation using trenchless methods, it has been assumed the river crossing will entail construction within non-cohesive granular soils (predominantly sands and gravels with less than 20 percent fines content, containing cobbles and possibly boulders) below the groundwater table.

Selection of the most suitable trenchless methodology for the relocation will be highly dependent upon the watermain profile, tie-in requirements and conditions along the proposed new alignment. Detailed investigation will be required along the new watermain alignment to accurately assess the geotechnical conditions, finalize methodology selection and inform the detailed design process.

From a geotechnical perspective, trenchless methods typically employed for small diameter installations of limited bore length that involve drilling or tunnelling without use of positive drill fluid/slurry pressure support at the cutting face are not considered appropriate for this project application due to the prevalence of relatively clean, granular soils below water table. Trenchless installation methods in this category include auger boring, pilot tube boring, pipe ramming and conventional tunnelling.

Although various forms of micro tunnelling (the cutting face is supported using slurry pressure) are considered technically feasible, the risk of encountering cobbles and boulders of sufficient size to obstruct machine progress is considered high and would warrant a design that includes a tunnel drive incorporating a relatively large diameter (likely 1.5 m diameter or greater) casing pipe within which the HDPE watermain is installed. This two-pass installation method is not uncommon but contributes significantly to cost and complexity for small diameter utility installation applications as compared to methods employing a single pass installation. Micro tunnelling would also involve shaft construction at the watermain tie-in locations on both sides of the river channel. Based on the available ground surface information and inferred river bottom profile, shaft depths would likely need to be in the range of 10 to 12 m depth extending well below the groundwater table. Shaft construction would require significant excavation support, resulting in increased costs and schedule as compared to methods where surface excavations can be avoided or limited in depth and extent.

Horizontal directional drilling (HDD) is a well-established trenchless method, commonly utilized to install utilities crossing beneath water bodies. The 350 mm diameter HDPE watermain and approximate 160 m installation length are well within the capabilities of the technology and the watermain could be installed in a single pass (without requiring a casing pipe over the full length of the bore) using a relatively compact drill rig and drill fluid management system. Minor regrading is necessary for drill rig setup and drill fluid containment, but shafts are not required. Temporary excavations are generally limited to relatively shallow (less than 4 m depth) open cut trenches necessary to complete the tie-in connections. Drilling within coarse granular soils containing cobbles and possibly boulders can be challenging and problematic for HDD, but mitigation measures have been developed to reduce this ground condition risk.

At this preliminary stage, HDD is considered the most suited trenchless technique for the proposed watermain relocation as it employs use of fluid to support the cutting face/bore and can accommodate installation in a single pass without need for significant excavation and ground support to complete the tie-ins. A general description of the HDD method, preliminary design recommendations for bore size and drill path alignment, and commentary on ground condition risk mitigation are provided below.

9.6.2 General Description of Horizontal Directional Drilling

Horizontal Directional Drilling (HDD) involves boring a small diameter pilot hole from the “drill entry” by a steerable, fluid-jet assisted, mechanical cutting tool, and pulling back from the “drill exit” the utility pipe through the pilot borehole. The pilot borehole is reamed to a diameter large enough to make the pulling back of the utility pipe possible. The reamed hole is typically about 1.5 times the diameter of the utility pipe but for stable soils with straight alignment, installation with about 1.2 times the bored diameter is possible. The hole is stabilized by circulation of a large volume of viscous fluid, generally a bentonite slurry. The drill cuttings are also removed from the hole by circulation of the slurry. To avoid build up of friction along the line of the utility pipe, and to minimize “standby” time of the drilling equipment, the pullback operation is carried out continuously, if possible. A large works area for pipe laying and the capacity to handle large volumes of fluid which may require controlled disposal can be major constraints of large diameter pipe installations by directional drilling.

The drill entry to target level elevation (invert of the pipe crossing profile) is made by the drill line initially inclined at an angle of about 15 degrees (ranging from 10 to 20 degrees) to the horizontal. Once the drill string reaches the target level, drilling to a specified grade commences. The exit is generally between 12 to 15 degrees to the horizontal.

A disadvantage of HDD is that the method can run into serious difficulties while boring through gravelly, cobbly, and bouldery soils. These coarse materials are difficult to be held in suspension and transported to the slurry pit at the entry/exit end. Inside the drilled hole, they can act as obstructions and reaming of the hole or pipe pullback can be problematic. Significant success in boring and in installation of pipes through gravelly soils has been achieved recently with sophisticated mud management; however, HDD through such materials is not without risk and must be appropriately considered during design and carried out by highly skilled contractors only. Maintaining hole stability and avoiding inadvertent return of drilling fluid due to hydraulic fracturing of the overburden soil are also difficult to control during drilling of loose non-cohesive soils and require a high level of mud management and driller skill.

9.6.3 Preliminary Bore Size and Drill Path Alignment

Considering the planned installation of a 350 mm diameter HDPE product pipe in granular soils, the required diameter of the HDD bore is expected to be between 560 and 610 mm (22 and 24 inches). To achieve this bore size, it is anticipated the drilling operation will consist of a pilot bore and one or possibly two reaming passes.

Based on a review of the proposed crossing site and anticipated ground conditions, the following provides a summary of recommendations that should be considered when developing the preliminary HDD drill path alignment for the project.

- The drill entry and exit angles (legs of the U-shaped crossing) should be steeply inclined to rapidly gain ground cover depth but should not exceed 20 degrees to the horizontal.
- Although the bend radius of HDPE pipe is quite tight, the drill steel and the ability to steer the pilot bore to form a tight radius of curvature is a limiting factor. For preliminary design purposes, it is recommended that the vertical radius of curvature of the drill path not be less than 120 m. Compound curves in the drill path (i.e. vertical and horizontal curves combined over the same section of drill path) should be avoided. If this cannot be achieved, the horizontal radius should be more gradual than the vertical radius, greater than 200 m is recommended for preliminary design.
- The middle tangent section of the drill path should be at least 40 m in length to allow for some steering correction of the pilot hole during approach to drill exit target location.
- The required depth of cover beneath the riverbed will need to be finalized at detailed design stage by completing a hydrofracture analysis once a detailed geotechnical investigation and bathymetric survey have been completed. Based on the soils information from the preliminary drilling program indicating a relatively thick sequence of generally coarse granular deposits, we recommend the preliminary design drill path consider a minimum depth of cover of 9 m (approximately 15 times the HDD bore diameter) below the riverbed.
- A 10 m horizontal separation from existing waterline should be maintained for the HDD bore segment. Consideration may be given to skewing the plan alignment of the trenchless crossing at an angle to the existing line rather than running parallel to the existing watermain across the river.

The HDD alignment developed by AE for the 90 percent preliminary design submission package is considered to meet the geometrical recommendations outlined above, although some adjustments may be necessary pending the results of the detailed geotechnical site investigation, bathymetric survey, hydrofracture analysis and detailed design of the tie-ins to the existing main.

9.6.4 Ground Condition Mitigation

It is very likely the sand and gravel surficial deposits (anticipated to contain cobbles and possibly boulders) will require use of a section of steel surface casing at drill entry to maintain fluid circulation and hole stability in the unsaturated zone and to avoid inadvertent drill fluid returns to ground surface (frac-out) in the coarse granular soils. The steel surface casing is installed before pilot hole drilling is started, normally by using an air hammer to drive it in open ended but with a casing shoe. The casing can be inclined at 15 to 20 degrees but cannot be curved. The casing diameter must be large enough to allow the pilot bore and reaming passes to be completed inside the casing. For this project application, it should be assumed that a steel surface casing of 660 to 760 mm (26 to 30 inch) diameter will need to be installed at drill entry to an elevation of approximately 780 m. Casing may not be required at drill exit but care will need to be taken to control drill fluid pressure and pumping rates during final stages of pilot bore. Casing requirements will need to be re-assessed following completion of the detailed geotechnical investigation and hydrofracture analysis. The wall thickness of the casing should be selected such that if the casing is installed by driving, it does not fail/ buckle and the casing can be driven along the specified drill path. The problem of grade control and failure during driving can also be managed by using telescoping casing. The responsibility for structural design of the casing including its size is best left to the contractor, because the design is dependent on its method of installation.

The maintenance of hole stability and minimizing the potential of inadvertent drill fluid returns are also of significant concern for a hole drilled through non-cohesive wet soils under water table, but these risks can often be mitigated using sophisticated mud management methods carried out by highly skilled HDD contractors.

At the banks of the river, the proposed watermain will traverse beneath flood protection dikes. Casing and/or HDD borehole grouting requirements will need to be determined during detailed design for the portion of the new watermain installed beneath the dikes.

9.7 Pavement Structure Design Considerations

At the time of preparing this report, the traffic loading was not known, nor were the subgrade conditions confirmed along the various road elements. However, for preliminary design purposes, the following pavement structures may be assumed:

Highway 95 (T01-15 - Type A Pavement Structure):

- 150 mm thickness Hot Mix Asphalt (HMA)
- 300 mm thickness Well Graded Base (WGB); and
- 300 mm thickness Select Granular Sub-base (SGSB).

Local Roads (Town of Golden Standard for Collector and Industrial Roads):

- 100 mm thickness HMA
- 75 mm thickness WGB; and
- 400 mm thickness SGSB.

It is understood that the Town of Golden utilizes a minimum pavement structure for their local collector roads consisting of 100 mm thickness of HMA, 75 mm of WGB and 300 mm thickness of SGSB. It is our opinion that the 75 mm WGB thickness is insufficient, particularly for heavier truck loading. We suggest that consideration be given to increasing the WGB thickness to 300 mm, particularly if the estimated ESALs on the local roads exceeds 100,000 (consistent with T01-15); however, this will be dependent on where the transition between where BC MoTI standards and municipal standards are applied.

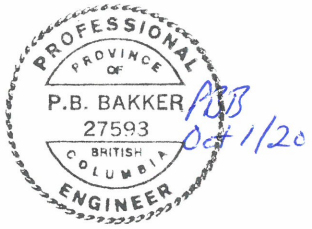
In general, the overall existing condition of the pavement through this segment appeared to be in fair to good condition. It is likely that the existing pavement will require re-surfacing as minimum where it is retained; however, based on our site observations, full-depth reconstruction will not likely be required.

10.0 CLOSURE

The comments and recommendations presented in this report are considered applicable to the proposed highway design as presented in the September 2020, 100% preliminary design drawings provided by AE (referenced in Appendix G). Any alteration during future design phases, changes to the Project scope, highway/road alignments or site grading will be subject to further geotechnical evaluation, analyses and recommendations.

We trust that the information presented in this geotechnical design report is sufficient for your current requirements. Please do not hesitate to contact us should you have any questions or concerns.

Golder Associates Ltd.



James Brunswick, PEng
Geotechnical Engineer

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JB/PB/syd

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This Report is been based on the instructions given to Golder by its Client and communications between Client and Golder. The "**Authorized Users**" and each "**Authorized User**" bidding on or undertaking the work shall rely on their own investigations as well as any interpretation by their own qualified geotechnical engineer of the data contained within the Report, taking specific note of this paragraph and the issues identified elsewhere in this Report. The Authorized Users should review the level of investigation and reporting provided and make their own assessment and interpretation on the sufficiency of this work for their specific purpose(s) and supplement the work where they deem appropriate to achieve the level of information to their independent satisfaction.

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Soil and groundwater conditions shown in the Report are the observed conditions at the time and location of their determination or measurement. Soil and groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. Fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The Report includes only the geotechnical aspects of the subsurface conditions and no chemical information related to the native soil deposits. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference in the Report and have not been investigated or addressed in the Report. The condition of the soil, rock, and groundwater may be significantly altered by construction activities on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying, or freezing and the soil may require protection from these changes during construction.

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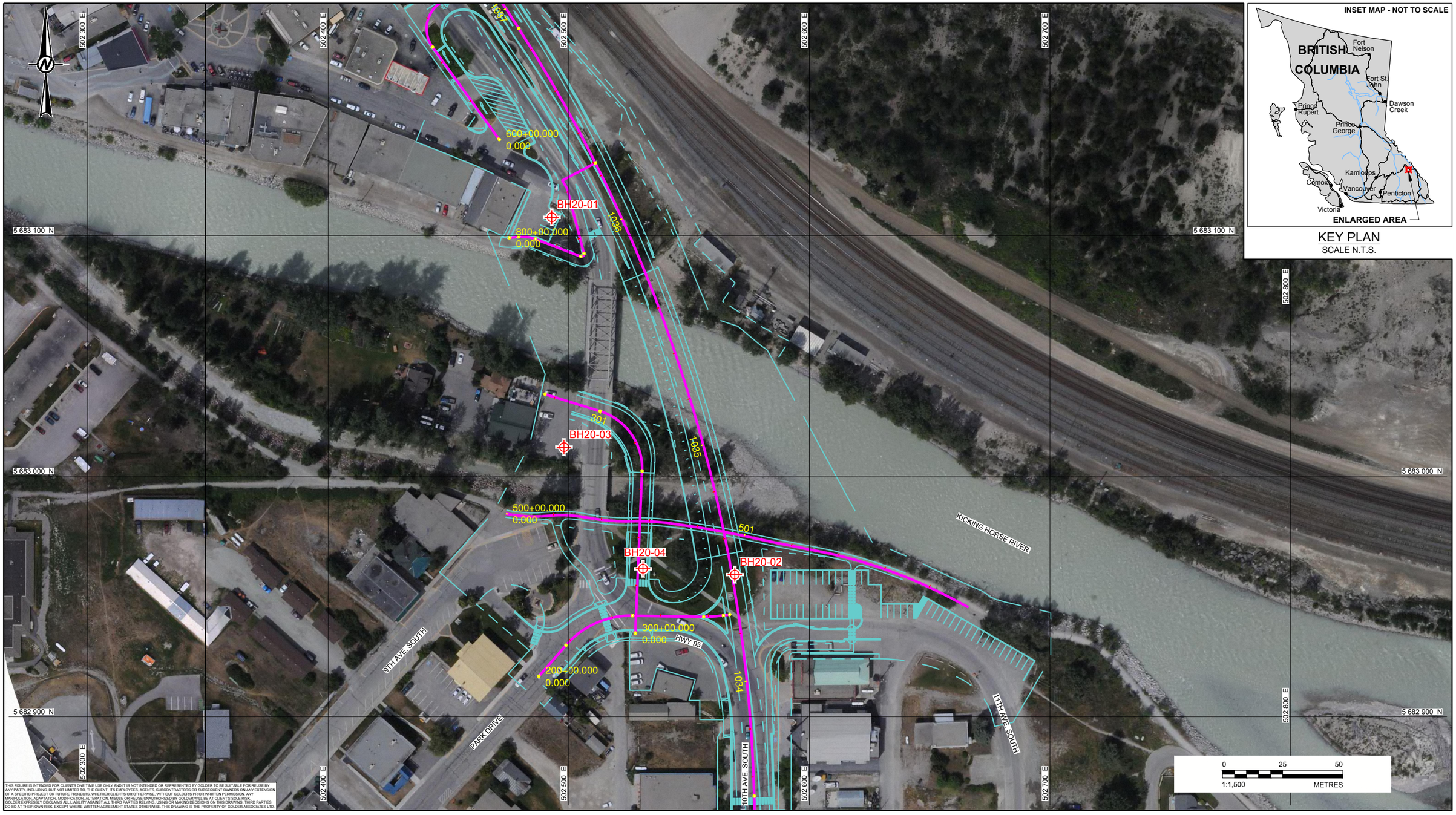
Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.



KEY PLAN
SCALE N.T.S.

LEGEND

- BOREHOLE LOCATION (GOLDER, 2020)
- PROPOSED HIGHWAY 95 ALIGNMENT
- PROPOSED HIGHWAY 95 ALIGNMENT WITH STATION

NOTES

1. COORDINATES ARE IN UTM NAD83, ZONE 11.
2. BOREHOLE LOCATION COORDINATES TAKEN USING HAND-HELD GPS TYPICALLY ACCURATE TO +/- 5 m.

REFERENCES

1. BASE PLAN OBTAINED FROM ASSOCIATED ENGINEERING (BC) LTD. CAD FILE: 400GEOMLANE-OPT4-North.dwg, 400GEOMLANE-OPT4-South.dwg, KH_Major_Alignments.dwg DATE RECEIVED 2020-09-25.

CLIENT
ASSOCIATED ENGINEERING (BC) LTD.

CONSULTANT
GOLDER

YYYY-MM-DD	2020-09-30
DESIGNED	JB
PREPARED	AK
REVIEWED	PB
APPROVED	MY

PROJECT
HIGHWAY 95 - KICKING HORSE RIVER BRIDGES
GOLDEN, B.C.

TITLE
SITE PLAN

PROJECT NO.	PHASE/TASK	REV.	FIGURE
20139391	5000/XXX	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm

APPENDIX A

Summary Logs

MATERIALS CLASSIFICATION LEGEND (AGGREGATES & SOILS)

MAJOR DIVISIONS		SYMBOL	SOIL TYPE
COARSE GRAINED SOIL	GRAVEL AND GRAVELLY SOILS	GW	WELL GRADED GRAVELS OR GRAVEL-SAND MIXTURES, < 5% FINES
		GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, < 5% FINES
		GM*	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
		GC*	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	SW	WELL GRADED SANDS OR GRAVELLY SANDS, < 5% FINES
		SP	POORLY GRADED SANDS OR GRAVELLY SANDS, < 5% FINES
		SM*	SILTY SANDS, SAND-SILT MIXTURES
		SC*	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS $w_L < 50$	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS $w_L > 50$	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, PLASTIC SILTS
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
ORGANIC SOILS		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS
TOPSOIL		TS	TOPSOIL WITH ROOTS, ETC.
COBBLES		SB	ROCK FRAGMENTS AND COBBLES, PARTICLE SIZE 75 mm TO 300 mm
LARGE BOULDERS		LB	BOULDERS, PARTICLE SIZE OVER 300 mm
BEDROCK		BR	BEDROCK

FOR SOILS HAVING 5 - 12% PASSING 0.075 SIEVE, USE DUAL SYMBOL

*GM1; GC1; SM1; SC1; 12 - 20%
*GM2; GC2; SM2; SC2; 20 - 30%
*GM3; GC3; SM3; SC3; 30 - 40%
*GM4; GC4; SM4; SC4; 40 - 50%

} PASSING 0.075 mm SIEVE

ADAPTED FROM: BC MINISTRY OF TRANSPORTATION AND HIGHWAYS *"GEOTECHNICAL AND MATERIALS ENGINEERING STANDARDS FOR BRIDGE FOUNDATION INVESTIGATIONS"*, JANUARY 1991, SHEET REV. 90-04-26.

SUMMARY LOG

Ministry of Transportation and Infrastructure — British Columbia

Drill Hole #: BH20-01

Project: **Highway 95 - Kicking Horse River Bridges**
Location: Golden, BC

Date(s) Drilled: 14 - 17 July 2020
Company: Geotech Driling Ltd.
Driller: Brad Bird
Drill Make/Model: Track Fraste XL
Drilling Method: ODEX Air / HQ3 Coring

Prepared by: 20139391 Golder Associates Ltd.
Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000
Northing/Easting: 5683104 , 502493 Station/Offset: 1036+13 -26.3 m
Elevation: 794.0 m *Coordinates taken with GPS*

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 — SPT "N" (BLOWS/300 mm) — Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
0							ASPHALT 0.15m	AP		
1	ODEX Air Rotary	6.6		1			[FILL] Silty SAND some gravel, fine to coarse sand, fine sub-rounded to rounded gravel, brown, dry, dense.	SM2	**Sieve** (Sa#1) G:12% S:61% F:27%	793
2		25 — 0 mm / 25 Blows		2	0		1.83m [FILL] COBBLES and BOULDERS (inferred) in a sandy GRAVEL matrix, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, dry, to moist very dense.		Very high penetration resistance from 1.8 m to 3.0 m through inferred extremely strong cobbles/ boulders.	792
3								SB/LB	Approx. 70% fluid return at 3.0 m using thick bentonite and polymer mix.	791
4		4.3m 7/16/2020					- wet below 4.3 m depth.			790
5		16 22 18 15 — 6.2 — 40		3	60		4.72m Sandy GRAVEL, fine to coarse sand, fine to coarse sub-rounded to rounded gravel, some silt, brown, with cobbles (inferred), wet, compact to dense.			789
6	HQ3 Coring									788
7										787
8		15 16 15 15 — 6.8 — 31		4	40			GW-GM	**Sieve** (Sa#4) G:57% S:33% F:10%	786
9										785
10										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 45.1 m
Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-01**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Date(s) Drilled: 14 - 17 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5683104 , 502493 Station/Offset: 1036+13 -26.3 m

Elevation: 794.0 m *Coordinates taken with GPS*

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 ; SPT "N" (BLOWS/300 mm) ; Wp% W% WL% 20 40 60 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
10							Sandy GRAVEL, fine to coarse sand, fine to coarse sub-rounded to rounded gravel, some silt, brown, with cobbles (inferred), wet, compact to dense. *(continued)*			
11	HQ3 Coring	SPT 17 18 14 15; 9.3; 32		5	70				**Sieve** (Sa#5) G:43% S:45% F:12%	783
12							11.89m gravelly SAND to GRAVEL and SAND, fine, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, with cobbles (inferred), wet, dense to very dense.			782
13									HQ3 diamond bit worn at 13.1 m depth.	781
14		SPT 30 26 28 30; 7; 54		6	70					780
15										779
16							- sand content increasing at approx. 15.8 m depth.			778
17		SPT 24 23 26 47; 9.2; 49		7	75				**Sieve** (Sa#7) G:29% S:58% F:13%	777
18										776
19										775
20										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 45.1 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-01**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Prepared by: 20139391
Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5683104 , 502493 Station/Offset: 1036+13 -26.3 m

Elevation: 794.0 m *Coordinates taken with GPS*

Date(s) Drilled: 14 - 17 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 ; SPT "N" (BLOWS/300 mm) ; Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
20	HQ3 Coring	69 36 29 26 ; 5.9 ; 65		8	75		gravelly SAND to GRAVEL and SAND, fine, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, with cobbles (inferred), wet, dense to very dense. *(continued)*			
21										773
22										772
23		41 49 44 48 ; 7.4 ; 93		9	75		- gravel and cobble content increasing at approx. 22.6 m depth.	GW-GM/SW-SM	HQ3 diamond bit worn at 22.8 m depth.	771
24										770
25										769
26		31 28 23 25 ; 9.9 ; 51		10	70				**Sieve** (Sa#10) G:49% S:41% F:10%	768
27										767
28										766
29		34 50 ; 9.1 ; 125 mm / 50 Blows		11	65					765
30										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 45.1 m
Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-01**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5683104 , 502493 Station/Offset: 1036+13 -26.3 m

Elevation: 794.0 m *Coordinates taken with GPS*

Date(s) Drilled: 14 - 17 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
30							gravelly SAND to GRAVEL and SAND, fine, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, with cobbles (inferred), wet, dense to very dense. *(continued)*			
31										763
32	HQ3 Coring	49 50 (8.4) 100 mm / 50 Blows		12	50					762
33										761
34										760
							34.75m			
35		22 24 24 50 (18.1) 48		13	55		gravelly SAND, fine sand, some fine to coarse sub-rounded to rounded gravel, some silt, pale brown, with cobbles (inferred), wet, compact to dense, with interbedded very dense layers of sandy gravel of lower strength and iron staining (inferred).			759
36										758
37										757
38								SM1		756
39		20 47 40 27 (14.4) 87		14	70				**Sieve** (Sa#14) G:27% S:54% F:19%	755
40										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 45.1 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-01**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5683104 , 502493 Station/Offset: 1036+13 -26.3 m

Elevation: 794.0 m *Coordinates taken with GPS*

Date(s) Drilled: 14 - 17 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
40							gravelly SAND, fine sand, some fine to coarse sub-rounded to rounded gravel, some silt, pale brown, with cobbles (inferred), wet, compact to dense, with interbedded very dense layers of sandy gravel of lower strength and iron staining (inferred). *(continued)*			
41		70/50 8.5; 75 mm / 50 Blows		15	100					753
							41.76m			
42	HQ3 Coring						SAND and SILT, fine sand, pale brown, moist to wet, dense; with interbedded layers of non-plastic silt.			752
43		28.1		16	25			SM4		751
44										750
45		13/14/20/27 23.6; 34		17	100				**Sieve** (Sa#17) G:0% S:46% F:44%	749
							45.11m			
							End of Hole: Target Depth.			
46										748
47										747
48										746
49										745
50										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 45.1 m

Depth to Top of Rock: NA

SUMMARY LOG

Ministry of Transportation and Infrastructure — BRITISH COLUMBIA

Drill Hole #: BH20-02

Project: **Highway 95 - Kicking Horse River Bridges**
Location: Golden, BC

Date(s) Drilled: 01 - 05 July 2020
Company: Geotech Driling Ltd.
Driller: Brad Bird
Drill Make/Model: Track Fraste XL
Drilling Method: ODEX Air / HQ3 Coring

Prepared by: 20139391 Golder Associates Ltd.
Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000
Northing/Easting: 5682959 , 502569 Station/Offset: 1034+44 1.1 m
Elevation: 794.0 m *Coordinates taken with GPS*

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
0	Hand Dig	37.4		1			[TOPSOIL] SILT, some fine sand, dark brown, with organics (roots), cohesive, w ~ PL, firm. 0.2m	ML		794
							[FILL] Gravelly SAND, fine to coarse sand, fine rounded gravel, trace to some silt, brown, dry to moist, dense. 0.61m	SW-SM		
1		8 21 23 .6 18 — 44		2	75		[FILL] GRAVEL and SAND, fine to coarse, sub-rounded to sub-angular gravel, fine to coarse sand, trace silt, grey-brown, with cobbles and boulders (inferred), dry to moist, dense to very dense.		**Sieve** (Sa#2) G:50% S:41% F:9%	793
2										792
3		11 25 .4 — 0 mm / 25 Blows		3	25			GW-GM		791
4	3.9m 7/1/2020	25 — 0 mm / 25 Blows		4	0		- wet below 3.9 m depth.			790
5	ODEX Air Rotary						5.49m			789
6		8 10 13 8 18 — 23		5	50		Sandy GRAVEL, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, trace silt, brown, wet, compact.			788
7		8 10 14 3.9 19 — 24		6	50					787
8										786
9		4 11 12 5.6 11 — 23		7	50					785
10								GW-		

Legend Sample Type:
A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 51.4 m
Depth to Top of Rock: NA

SUMMARY LOG

Ministry of Transportation and Infrastructure — British Columbia

Drill Hole #: BH20-02

Project: **Highway 95 - Kicking Horse River Bridges**
Location: Golden, BC

Prepared by: 20139391 Golder Associates Ltd.
Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 | Alignment: L1000
Northing/Easting: 5682959 , 502569 | Station/Offset: 1034+44 1.1 m
Elevation: 794.0 m *Coordinates taken with GPS*

Date(s) Drilled: 01 - 05 July 2020
Company: Geotech Driling Ltd.
Driller: Brad Bird
Drill Make/Model: Track Fraste XL
Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	SPT / Pocket Penetrometer (100–400) / Shear Strength (kPa) / SPT "N" (BLOWS/300 mm) / Wp% 20 — W% 40 60 — WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING (Drillers Estimate {G % S % F %})	ELEVATION (m)
10	ODEX Air Rotary	SPT 5 15 16 19 (31); Pocket Pen 7.2		8	65		Sandy GRAVEL, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, trace silt, brown, wet, compact. *(continued)* - compact to dense below 10.4 m depth.	GM		
11										783
12		SPT 4 9 20 20 (29); Pocket Pen 2.9		9	50					782
13										781
14		SPT 10 15 20 28 (35); Pocket Pen 6		10	65				**Sieve** (Sa#10) G:62% S:31% F:7%	780
							14.33m			
15		SPT 8 6 6 7 (12); Pocket Pen 3.2		11	25		GRAVEL and SAND, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, some silt, brown, wet, compact to dense.			779
16										778
17								GW-GM		777
18		SPT 7 17 27 19 (44); Pocket Pen 5.7		12	50					776
19										775
							19.2m			
20							SAND and GRAVEL, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, trace silt, grey-brown, wet, dense.			

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 51.4 m
Depth to Top of Rock: NA

MOTI-SOIL-REV3 20139391_GINT_REV2.GPJ MOTI_DATATEMPLATE_REV3.GDT 10/1/20

SUMMARY LOG

Ministry of Transportation and Infrastructure — BRITISH COLUMBIA

Drill Hole #: **BH20-02**

Project: **Highway 95 - Kicking Horse River Bridges**
Location: Golden, BC

Date(s) Drilled: 01 - 05 July 2020
Company: Geotech Driling Ltd.
Driller: Brad Bird
Drill Make/Model: Track Fraste XL
Drilling Method: ODEX Air / HQ3 Coring

Prepared by: 20139391 Golder Associates Ltd.
Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000
Northing/Easting: 5682959 , 502569 Station/Offset: 1034+44 1.1 m
Elevation: 794.0 m *Coordinates taken with GPS*

DEPTH (m)	DRILLING DETAILS	SPT	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 / SPT "N" (BLOWS/300 mm) / Wp% W% WL% 20 40 60 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING — Drillers Estimate {G % S % F %}	ELEVATION (m)
20								SAND and GRAVEL, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, trace silt, grey-brown, wet, dense. *(continued)*			
21	ODEX Air Rotary	10 15 20 15	2.8 ▲35		13	50				Approx. 150 mm of heave in casing. SPT not representative of in-situ conditions.	773
22											772
23											771
24		16 50	1 ▲90 mm / 50 Blows		14	100		- very dense and with cobbles and boulders (inferred) below 23.5 m depth.		Approx. 50 mm of heave in casing. SPT not representative of in-situ conditions. No fluid return at 24.1 m depth.	770
25											769
26		4 23 39 42	10.1 ▲62		15	75			SW-SM	**Sieve** (Sa#15) G:38% S:53% F:9%	768
27	HQ3 Coring										767
28											766
29											765
30		37 50	6.9 ▲125 mm / 50 Blows		16	50					

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 51.4 m
Depth to Top of Rock: NA

SUMMARY LOG

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Drill Hole #: **BH20-02**

Date(s) Drilled: 01 - 05 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5682959 , 502569 Station/Offset: 1034+44 1.1 m

Elevation: 794.0 m *Coordinates taken with GPS*

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 / SPT "N" (BLOWS/300 mm) / Wp% W% WL% 20 40 60 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
30							SAND and GRAVEL, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, trace silt, grey-brown, wet, dense. *(continued)*			
31										763
32										762
33	HQ3 Coring	84 37 37 30; 9.3; 74		17	65					761
							33.53m			
34							Silty gravelly SAND, fine sand, some fine to coarse sub-rounded to rounded gravel, pale brown, with cobbles (inferred), wet, compact to dense; with interbedded layers of very dense gravelly sand.		Approx. 60% fluid return at 33.5 m depth.	760
35										759
36		27 22 17 16; 16.9; 39		18	65			SM2	**Sieve** (Sa#18) G:24% S:49% F:27%	758
37										757
38										756
39		15 44 49 33; 9.4; 93		19	65					755
							39.62m			
40										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 51.4 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-02**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5682959 , 502569 Station/Offset: 1034+44 1.1 m

Elevation: 794.0 m *Coordinates taken with GPS*

Date(s) Drilled: 01 - 05 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 / SPT "N" (BLOWS/300 mm) / Wp% W% WL% 20 40 60 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
40							Silty SAND fine sand, pale brown, moist to wet, dense; with interbedded layers of non-plastic silt. *(continued)*			
41										753
42	HQ3 Coring	15 19 26 28 (N=45) 20.9		20	100				**Sieve** (Sa#20) G:1% S:66% F:33%	752
43		27.2		21	55			SM3		751
44										750
45		12 18 25 31 (N=43) 23.2		22	100					749
46										748
47		25.2		23	40		46.94m SILT and SAND, low plasticity, fine grained sand, grey, cohesive, w ~ PL, hard.			747
48		12 20 26 34 (N=46) 21.9		24	100				**Sieve** (Sa#24) G:0% S:44% F:56%	746
49								ML		745
50		22.3		25	70					

Legend Sample Type: A-Auger, B-Becker, C-Core, G-Grab, V-Vane, L#-Lab Sample, S-Split Spoon, O-Odex (air rotary), W-Wash (mud return), T-Shelby Tube

Final Depth of Hole: 51.4 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-02**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5682959 , 502569 Station/Offset: 1034+44 1.1 m

Elevation: 794.0 m *Coordinates taken with GPS*

Date(s) Drilled: 01 - 05 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400; SPT "N" (BLOWS/300 mm); Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
50	HQ3 Coring						SILT and SAND, low plasticity, fine grained sand, grey, cohesive, w ~ PL, hard. *(continued)*			
51	SPT: 14, 25, 27, 37	23.3; 52		26	100		51.36m End of Hole: Target Depth.			743
52										742
53										741
54										740
55										739
56										738
57										737
58										736
59										735
60										

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 51.4 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-03**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Date(s) Drilled: 06 - 10 July 2020

Company: Geotech Driling Ltd.

Prepared by: 20139391 Golder Associates Ltd.

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5683012 , 502498 Station/Offset: 1035+16 -55.9 m

Elevation: 792.0 m *Coordinates taken with GPS*

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Logged by: NM Reviewed by: PB

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	SPT	Pocket Penetrometer / Shear Strength (kPa) / SPT "N" (BLOWS/300 mm) / Wp% W% WL%	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
0								ASPHALT 0.15m	AP		
								[FILL] Gravelly SAND, fine to coarse sand, fine sub-rounded to rounded gravel, some silt, brown, dry, loose.			
1		3 3 3 3	6 3		1	40			SW-SM		791
2			10.2		2						790
		5 12 26 30	38 2.3		3	70		2.74m [FILL] Sandy GRAVEL, fine to coarse, sub-rounded to sub-angular gravel, fine to coarse sand, trace silt, grey-brown, with cobbles (inferred), dry, dense.	GW-GM	**Sieve** (Sa#3) G:57% S:35% F:8%	
3											789
		18 46 49 26	95 2.1		4	85		3.66m [FILL] COBBLES and BOULDERS (inferred) in a sandy GRAVEL matrix, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, dry, very dense.	SB/LB	Very high penetration resistance from approx. 3.7 m to 4.0 m and 5.0 m to 5.2 m through inferred extremely strong cobbles/ boulders.	
4											788
5	ODEX Air Rotary										787
	5.6m 7/7/2020	6 22 24 20	46 5.8		5	50		5.18m Sandy GRAVEL, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, some silt and cobbles (inferred), grey-brown, dry, dense. - wet below 5.4 m depth.	GW-GM		
6											786
7		3 10 12 13	22 11.4		6	60		6.71m SAND, fine to coarse sand, some fine to coarse, sub-rounded to rounded gravel, trace silt, grey-brown, wet, loose to compact.		**Sieve** (Sa#6) G:19% S:72% F:9%	785
8											784
9		4 10 10 13	20 9.8		7	50			SW-GW		783
10											

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 49.4 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-03**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Date(s) Drilled: 06 - 10 July 2020

Company: Geotech Driling Ltd.

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5683012 , 502498 Station/Offset: 1035+16 -55.9 m

Elevation: 792.0 m *Coordinates taken with GPS*

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	SPT	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 / SPT "N" (BLOWS/300 mm) / Wp% W% WL% 20 40 60 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
10	ODEX Air Rotary	2 1 8 14	9 13.6		8	50		SAND, fine to coarse sand, some fine to coarse, sub-rounded to rounded gravel, trace silt, grey-brown, wet, loose to compact. *(continued)*			
11											781
12		8 16 17 16	33 23.9		9	70		12.04m GRAVEL and SAND, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, with cobbles (inferred), wet, dense.		Approx. 70% fluid return at 11.9 m depth using thick bentonite mix.	780
13											779
14		6 16 19 17	35 8.1		10	30					778
15											777
16	HQ3 Coring	18 16 14 16	30 8.2		11	40					776
17											775
18											774
19		12 17 19 23	36 9.2		12	55					773
20											

Legend Sample Type: A-Auger, B-Becker, C-Core, G-Grab, V-Vane, L#-Lab Sample, S-Split Spoon, O-Odex (air rotary), W-Wash (mud return), T-Shelby Tube

Final Depth of Hole: 49.4 m

Depth to Top of Rock: NA

SUMMARY LOG

Ministry of Transportation and Infrastructure

Drill Hole #: BH20-03

Project: **Highway 95 - Kicking Horse River Bridges**
Location: Golden, BC

Date(s) Drilled: 06 - 10 July 2020
Company: Geotech Driling Ltd.
Driller: Brad Bird
Drill Make/Model: Track Fraste XL
Drilling Method: ODEX Air / HQ3 Coring

Prepared by: 20139391 Golder Associates Ltd.
Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83
Northing/Easting: 5683012 , 502498
Elevation: 792.0 m
Alignment: L1000
Station/Offset: 1035+16 -55.9 m
Coordinates taken with GPS

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 ; SPT "N" (BLOWS/300 mm) ; Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
20							GRAVEL and SAND, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, with cobbles (inferred), wet, dense. *(continued)* - very dense below 20.8 m depth.	GW-GM	High penetration resistance from approx. 20.8 m to 29.9 m.	772
21										771
22	HQ3 Coring	27 42 46 50 ; 6.9 ; 88		13	75				**Sieve** (Sa#13) G:51% S:38% F:11%	770
23										769
24		25 45 34 24 ; 7.5 ; 79		14	65					768
25										767
26							- increasing sand content below 25.9 m depth.			766
27		30 49 50 ; 30.6 ; 125 mm 950 Blows >>		15	60					765
28										764
29										763
30							29.87m			

Legend Sample Type:
A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 49.4 m
Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-03**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Date(s) Drilled: 06 - 10 July 2020

Company: Geotech Driling Ltd.

Prepared by: 20139391 Golder Associates Ltd.

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5683012 , 502498 Station/Offset: 1035+16 -55.9 m

Elevation: 792.0 m *Coordinates taken with GPS*

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Logged by: NM Reviewed by: PB

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 / SPT "N" (BLOWS/300 mm) / Wp% W% WL% 20 40 60 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
30							SAND and GRAVEL, fine to coarse sand, fine to coarse, sub-rounded to rounded gravel, some silt, grey-brown, with cobbles (inferred), wet, very dense. *(continued)*			
31	HQ3 Coring	13 38 36 40 — 8.4 — 74		16	55					761
32										760
33										759
34		29 49 49 48 — 8.9 — 98		17	70			SM1/GM1	**Sieve** (Sa#17) G:45% S:43% F:12%	758
35										757
36										756
37		50 50 — 10.5 — 90 mm / 50 Blows		18	100					755
38							Sandy SILT, fine sand, pale brown, moist to wet, dense; with interbedded layers of non-plastic silt. 37.49m			754
39										753
40		18 — 17.4 — 38		19	90				**Sieve** (Sa#19)	

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 49.4 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-03**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5683012 , 502498 Station/Offset: 1035+16 -55.9 m

Elevation: 792.0 m *Coordinates taken with GPS*

Date(s) Drilled: 06 - 10 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: ODEX Air / HQ3 Coring

DEPTH (m)	DRILLING DETAILS	SPT / Pocket Penetrometer (100–400) / Shear Strength (kPa) / SPT "N" (BLOWS/300 mm) / Wp% 20 – W% 40 60 – WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
40	HQ3 Coring	19 19 21					Sandy SILT, fine sand, pale brown, moist to wet, dense; with interbedded layers of non-plastic silt. *(continued)*		G:0% S:30% F:70%	
41										751
42								ML		750
43		16 22 25 27; 18.1; 47		20	100					749
44										748
45										747
46		17 20 25 29; 19.1; 45		21	90					746
							46.18m			
47							SILT and SAND, low plasticity, fine grained sand, grey, cohesive, w ~ PL, hard.			745
48								ML		744
49		14 19 26 29; 18.2; 45		22	90				**Sieve** (Sa#22) G:0% S:48% F:52%	743
							49.38m			
50							End of Hole: Target Depth.			

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 49.4 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-04**

BRITISH COLUMBIA — Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**
Location: Golden, BC

Prepared by: 20139391 Golder Associates Ltd.
Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000
Northing/Easting: 5682959 , 502532 Station/Offset: 1034+54 36.0 m
Elevation: 794.0 m *Coordinates taken with GPS*

Date(s) Drilled: 11 - 13 July 2020
Company: Geotech Driling Ltd.
Driller: Brad Bird
Drill Make/Model: Track Fraste XL
Drilling Method: HQ3 Coring

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 / SPT "N" (BLOWS/300 mm) / Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
0							[TOPSOIL] SILT, some fine sand, dark brown, with organics (roots), cohesive, w ~ PL, inferred firm. 0.15m	ML		
1	Hydro-Vacuum Excavation	22.7		1			[FILL] Gravelly SAND, fine to coarse sand, fine to coarse sub-rounded to rounded gravel, some silt, brown, dry, inferred loose to compact. 0.91m	SW-SM		793
2		18 10 35 44 4.3 45		2	65		[FILL] Sandy GRAVEL, fine to coarse, sub-rounded to sub-angular gravel, fine to coarse sand, some silt, grey-brown, with cobbles and boulders (inferred), dry to moist, dense to very dense.			792
3									Approx. 60% fluid return at 3.0 m depth using thick bentonite mix.	791
4										790
5		18 30 50 5.5 125 mm / 50 Blows >>		3	50		- wet below 5.3 m depth.	GW-GM		789
6	HQ3 Coring	0 mm / 25 Blows 25		4	0					788
7										787
8		36 28 24 25 7.3 52		5	50					786
9							8.99m Gravelly SAND, fine to coarse sand, fine sub-rounded to rounded gravel, some silt, brown, wet, compact.			785
10		4 14.7 21		6	75			SW-SM	**Sieve** (Sa#6) G:18% S:72% F:10%	

5.3m 7/12/2020

Legend Sample Type: A-Auger; B-Becker; C-Core; G-Grab; V-Vane; L#-Lab Sample; S-Split Spoon; O-Odex (air rotary); W-Wash (mud return); T-Shelby Tube

Final Depth of Hole: 28.5 m
Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-04**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Date(s) Drilled: 11 - 13 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: HQ3 Coring

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5682959 , 502532 Station/Offset: 1034+54 36.0 m

Elevation: 794.0 m *Coordinates taken with GPS*

DEPTH (m)	DRILLING DETAILS	SPT	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 / SPT "N" (BLOWS/300 mm) / Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
10	HQ3 Coring	6 15 19									
								10.36m Gravelly SAND to GRAVEL and SAND, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, with cobbles (inferred), wet, dense to very dense.			
11		11 19 18 15	9.2 ● 37 ▲		7	75					783
12											782
13		27 20 23 34	7.1 ● 43 ▲		8	60					781
14								- very dense below 13.7 m depth.			780
15		19 31 28 28	7 ● 59 ▲		9	50					779
16		24 48 36 32	7.8 ● 84 ▲		10	85				**Sieve** (Sa#10) G:44% S:44% F:12%	778
17											777
18											776
19		24 26 30 30	8.3 ● 56 ▲		11	75			GM1		775
20											

Legend Sample Type: A-Auger, B-Becker, C-Core, G-Grab, V-Vane, L#-Lab Sample, S-Split Spoon, O-Odex (air rotary), W-Wash (mud return), T-Shelby Tube

Final Depth of Hole: 28.5 m

Depth to Top of Rock: NA

SUMMARY LOG

Drill Hole #: **BH20-04**

Ministry of Transportation and Infrastructure

Project: **Highway 95 - Kicking Horse River Bridges**

Location: Golden, BC

Prepared by: 20139391 Golder Associates Ltd.

Logged by: NM Reviewed by: PB

Datum: UTM Z11, NAD83 Alignment: L1000

Northing/Easting: 5682959 , 502532 Station/Offset: 1034+54 36.0 m

Elevation: 794.0 m *Coordinates taken with GPS*

Date(s) Drilled: 11 - 13 July 2020

Company: Geotech Driling Ltd.

Driller: Brad Bird

Drill Make/Model: Track Fraste XL

Drilling Method: HQ3 Coring

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer / Shear Strength (kPa) 100 200 300 400 / SPT "N" (BLOWS/300 mm) / Wp% 20 W% 40 60 WL% 80	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	ELEVATION (m)
20							Gravelly SAND to GRAVEL and SAND, fine to coarse, sub-rounded to rounded gravel, fine to coarse sand, some silt, grey-brown, with cobbles (inferred), wet, dense to very dense. *(continued)*			
21										773
22	HQ3 Coring	22 25 33 23 — 7 — 58		12	65					772
23										771
24										770
25		24 33 36 34 — 10.3 — 69		13	80				**Sieve** (Sa#13) G:28% S:56% F:16%	769
26										768
27										767
28		49 46 34 29 — 7.8 — 80		14	75					766
							28.5m End of Hole: Target Depth.			
29										765
30										

Legend Sample Type: A-Auger, B-Becker, C-Core, G-Grab, V-Vane, L#-Lab Sample, S-Split Spoon, O-Odex (air rotary), W-Wash (mud return), T-Shelby Tube

Final Depth of Hole: 28.5 m

Depth to Top of Rock: NA

APPENDIX B

Laboratory Testing

GOLDER

Water Content Determination

Test Request #	K20-057	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering	Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH20-02	1	0.15	0.46	GS		37.4	ASTM D2216 Method B	
BH20-04	1	0.30	0.61	GS		22.7	ASTM D2216 Method B	
BH20-01	1	0.91	1.52	GS		8.6	ASTM D2216 Method B	
BH20-03	1	1.07	1.68	SS		3	ASTM D2216 Method B	
BH20-02	2	1.22	1.83	SS		1.6	ASTM D2216 Method B	
BH20-03	2	1.83	2.44	GS		10.2	ASTM D2216 Method B	
BH20-01	2	1.83	1.98	SS			ASTM D2216 Method B	No Sample
BH20-03	3	2.59	3.20	SS		2.3	ASTM D2216 Method B	
BH20-02	3	2.74	3.42	SS		1.4	ASTM D2216 Method B	
BH20-04	2	3.51	4.11	SS		4.3	ASTM D2216 Method B	
BH20-03	4	4.11	4.72	SS		2.1	ASTM D2216 Method B	
BH20-02	4	4.27	4.40	SS			ASTM D2216 Method B	No Sample
BH20-01	3	4.88	5.49	SS		6.2	ASTM D2216 Method B	
BH20-04	3	5.03	5.46	SS		5.5	ASTM D2216 Method B	
BH20-03	5	5.64	6.25	SS		5.8	ASTM D2216 Method B	
BH20-02	5	5.79	6.40	SS		8	ASTM D2216 Method B	
BH20-04	4	6.55	6.55	SS			ASTM D2216 Method B	No Sample
BH20-03	6	7.16	7.77	SS		11.4	ASTM D2216 Method B	
BH20-02	6	7.32	7.92	SS		3.9	ASTM D2216 Method B	
BH20-01	4	7.92	8.53	SS		6.8	ASTM D2216 Method B	

Notes:

Disclaimer:
The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

Tested by: ACianci **Date:** 7/28/2020

Checked by: ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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590 McKay Avenue, Suite 300 Kelowna, British Columbia, Canada, V1Y 5A8
[+1] (250) 860 8424

GOLDER

Water Content Determination

Test Request # K20-057
Client: Associated Engineering
Project Name: Highway 95 - Kicking Horse River Bridges

Project Number: 20139391 (3000/3300)
Project Location: Golden, BC

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH20-04	5	8.08	8.60	SS		7.3	ASTM D2216 Method B	
BH20-03	7	8.69	9.30	SS		9.8	ASTM D2216 Method B	
BH20-02	7	8.84	9.45	SS		5.6	ASTM D2216 Method B	
BH20-04	6	9.60	10.21	SS		14.7	ASTM D2216 Method B	
BH20-03	8	10.21	10.82	SS		13.6	ASTM D2216 Method B	
BH20-02	8	10.36	10.97	SS		7.2	ASTM D2216 Method B	
BH20-01	5	10.97	11.58	SS		9.3	ASTM D2216 Method B	
BH20-04	7	11.13	11.73	SS		9.2	ASTM D2216 Method B	
BH20-03	9	11.73	12.34	SS		23.9	ASTM D2216 Method B	
BH20-02	9	11.89	12.50	SS		2.9	ASTM D2216 Method B	
BH20-04	8	12.65	13.26	SS		7.1	ASTM D2216 Method B	
BH20-02	10	13.41	14.02	SS		6	ASTM D2216 Method B	
BH20-03	10	13.72	14.33	SS		8.1	ASTM D2216 Method B	
BH20-01	6	14.02	14.63	SS		7	ASTM D2216 Method B	
BH20-04	9	14.17	14.78	SS		7	ASTM D2216 Method B	
BH20-02	11	14.94	15.54	SS		3.2	ASTM D2216 Method B	
BH20-03	11	15.24	15.85	SS		8.2	ASTM D2216 Method B	
BH20-04	10	15.70	16.31	SS		7.8	ASTM D2216 Method B	
BH20-01	7	17.07	17.68	SS		9.2	ASTM D2216 Method B	
BH20-02	12	17.98	18.59	SS		5.7	ASTM D2216 Method B	

Notes:

Disclaimer:
The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

Tested by: ACianci **Date:** 7/28/2020
Checked by: ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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GOLDER

Water Content Determination

Test Request #	K20-057	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering	Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges		

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH20-03	12	18.29	18.90	SS		9.2	ASTM D2216 Method B	
BH20-04	11	18.75	19.35	SS		8.3	ASTM D2216 Method B	
BH20-01	8	20.12	20.73	SS		5.9	ASTM D2216 Method B	
BH20-02	13	21.03	21.64	SS		2.8	ASTM D2216 Method B	
BH20-03	13	21.34	21.92	SS		6.9	ASTM D2216 Method B	
BH20-04	12	21.79	22.40	SS		7	ASTM D2216 Method B	
BH20-01	9	23.16	23.77	SS		7.4	ASTM D2216 Method B	
BH20-02	14	24.08	24.32	SS		1	ASTM D2216 Method B	
BH20-03	14	24.38	24.99	SS		7.5	ASTM D2216 Method B	
BH20-04	13	24.84	25.45	SS		10.3	ASTM D2216 Method B	
BH20-01	10	26.21	26.82	SS		9.9	ASTM D2216 Method B	
BH20-02	15	26.37	26.97	SS		10.1	ASTM D2216 Method B	
BH20-03	15	27.43	27.86	SS		30.6	ASTM D2216 Method B	
BH20-04	14	27.89	28.50	SS		7.8	ASTM D2216 Method B	
BH20-01	11	29.26	29.54	SS		9.1	ASTM D2216 Method B	
BH20-02	16	29.41	29.69	SS		6.9	ASTM D2216 Method B	
BH20-03	16	30.48	31.09	SS		8.4	ASTM D2216 Method B	
BH20-01	12	32.31	32.56	SS		8.4	ASTM D2216 Method B	
BH20-02	17	32.46	33.07	SS		9.3	ASTM D2216 Method B	
BH20-03	17	33.53	34.14	SS		8.9	ASTM D2216 Method B	

Notes:

Disclaimer:
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Tested by: ACianci **Date:** 7/28/2020
Checked by: ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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Water Content Determination

Test Request # K20-057
Client: Associated Engineering
Project Name: Highway 95 - Kicking Horse River Bridges

Project Number: 20139391 (3000/3300)
Project Location: Golden, BC

Sample Location	Sample				Soil Description	Water Content %	Method	Remarks
	Ref	Top (m)	Base (m)	Type				
BH20-01	13	35.36	35.95	SS		18.1	ASTM D2216 Method B	
BH20-02	18	35.51	36.12	SS		16.9	ASTM D2216 Method B	
BH20-03	18	36.58	37.12	SS		10.5	ASTM D2216 Method B	
BH20-01	14	38.40	39.01	SS		14.4	ASTM D2216 Method B	
BH20-02	19	38.56	39.17	SS		9.4	ASTM D2216 Method B	
BH20-03	19	39.62	40.23	SS		17.4	ASTM D2216 Method B	
BH20-01	15	41.45	41.68	SS		8.5	ASTM D2216 Method B	
BH20-02	20	41.61	42.21	SS		20.9	ASTM D2216 Method B	
BH20-01	16	41.68	44.50	CC		28.1	ASTM D2216 Method B	
BH20-02	21	42.21	44.65	CC		27.2	ASTM D2216 Method B	
BH20-03	20	42.67	43.28	SS		18.1	ASTM D2216 Method B	
BH20-01	17	44.50	45.11	SS		23.6	ASTM D2216 Method B	
BH20-02	22	44.65	45.26	SS		23.2	ASTM D2216 Method B	
BH20-02	23	45.26	47.70	CC		25.2	ASTM D2216 Method B	
BH20-03	21	45.72	46.33	SS		19.1	ASTM D2216 Method B	
BH20-02	24	47.70	48.31	SS		21.9	ASTM D2216 Method B	
BH20-02	25	48.31	50.75	CC		22.3	ASTM D2216 Method B	
BH20-03	22	48.77	49.38	SS		18.2	ASTM D2216 Method B	
BH20-02	26	50.74	51.36	SS		23.3	ASTM D2216 Method B	

Notes:

Disclaimer:
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Tested by: ACianci **Date:** 7/28/2020
Checked by: ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

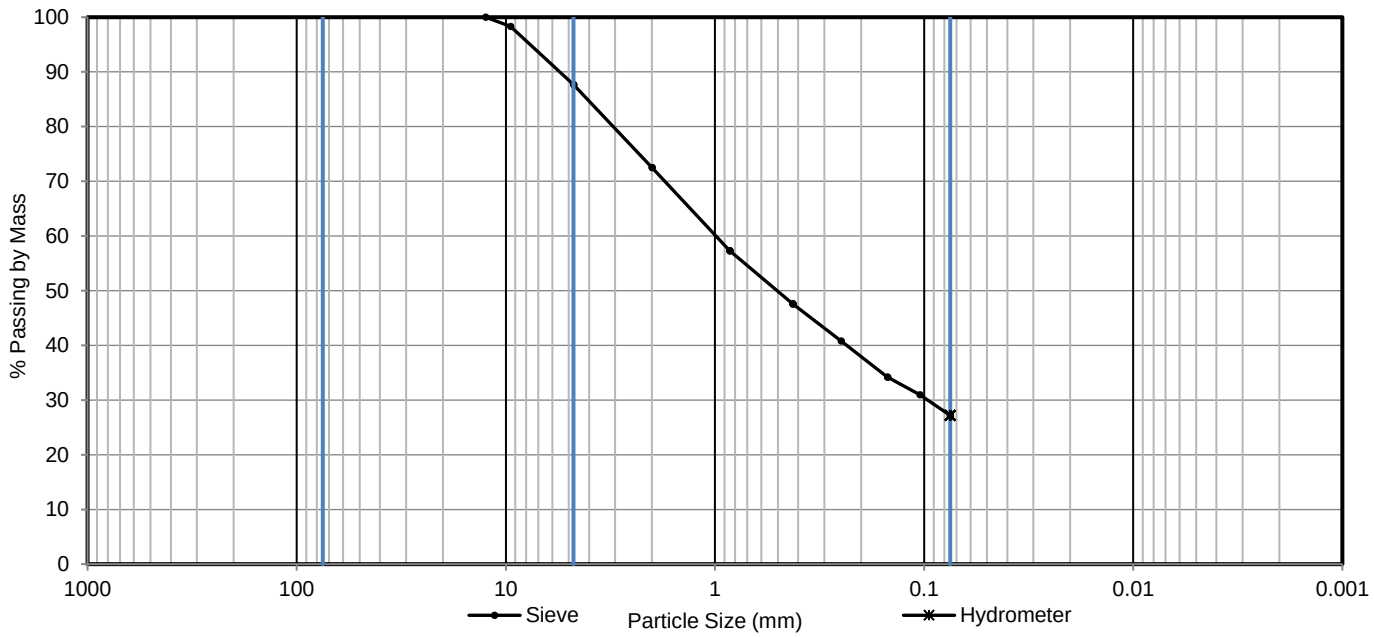
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO202007230	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-01		
Source:				Sample No.:	1		
Soil Description:				Type:	GS		
				Depth (m):	0.91	-	1.52
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/30/2020		
Specimen Description	NA						

% Passing	12	61	27

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1/2"	12.5	100.0		
3/8"	9.5	98.3		
#4	4.75	87.7		
#10	2	72.5		
#20	0.85	57.3		
#40	0.425	47.6		
#60	0.25	40.8		
#100	0.15	34.2		
#140	0.105	31.0		
#200	0.075	27.2		
			D60	0.99
			D30	0.10
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

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Tested by: ACianci **Date:** 7/30/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

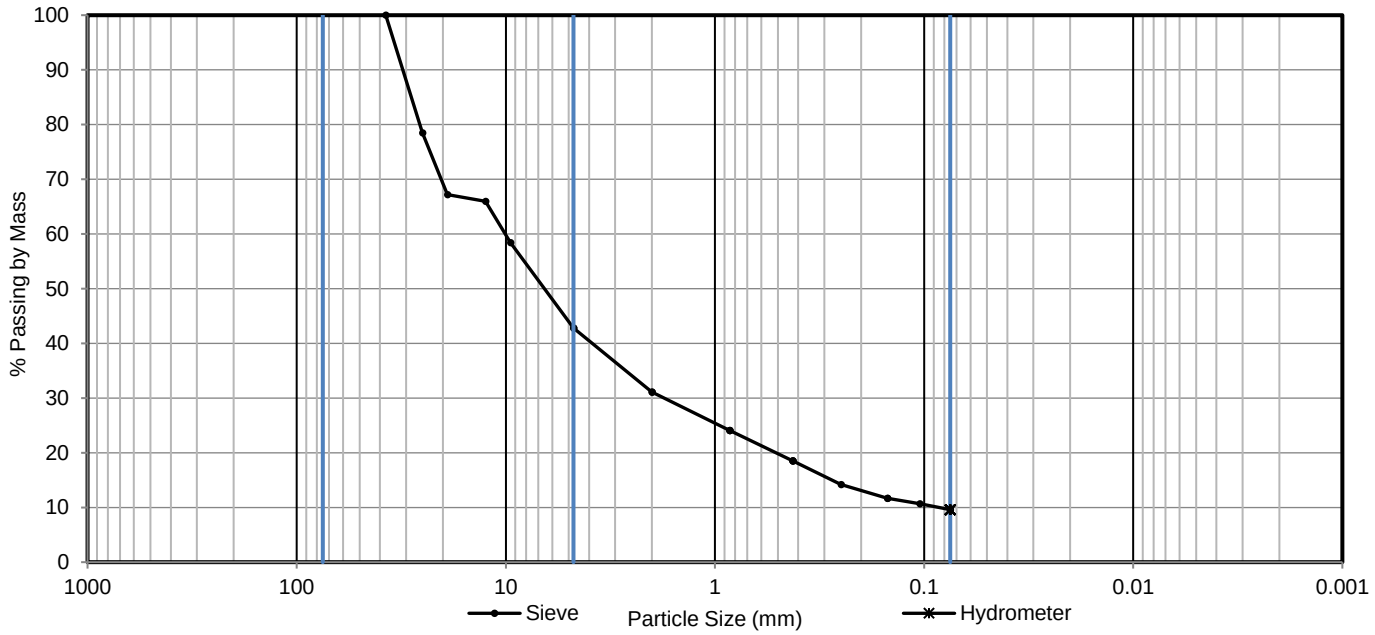
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO202007233	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-01		
Source:				Sample No.:	4		
Soil Description:				Type:	SS		
				Depth (m):	7.92	-	8.53
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/30/2020		
Specimen Description	NA						

% Passing	57	33	10

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	78.5		
3/4"	19	67.2		
1/2"	12.5	66.0		
3/8"	9.5	58.4		
#4	4.75	42.8		
#10	2	31.1		
#20	0.85	24.1		
#40	0.425	18.5		
#60	0.25	14.2		
#100	0.15	11.7		
#140	0.105	10.7		
#200	0.075	9.6		
			D60	10.10
			D30	1.75
			D10	0.08
			Cu	120.00
			Cc	4.00

Notes:

Disclaimer:

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Tested by: ACianci **Date:** 7/30/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

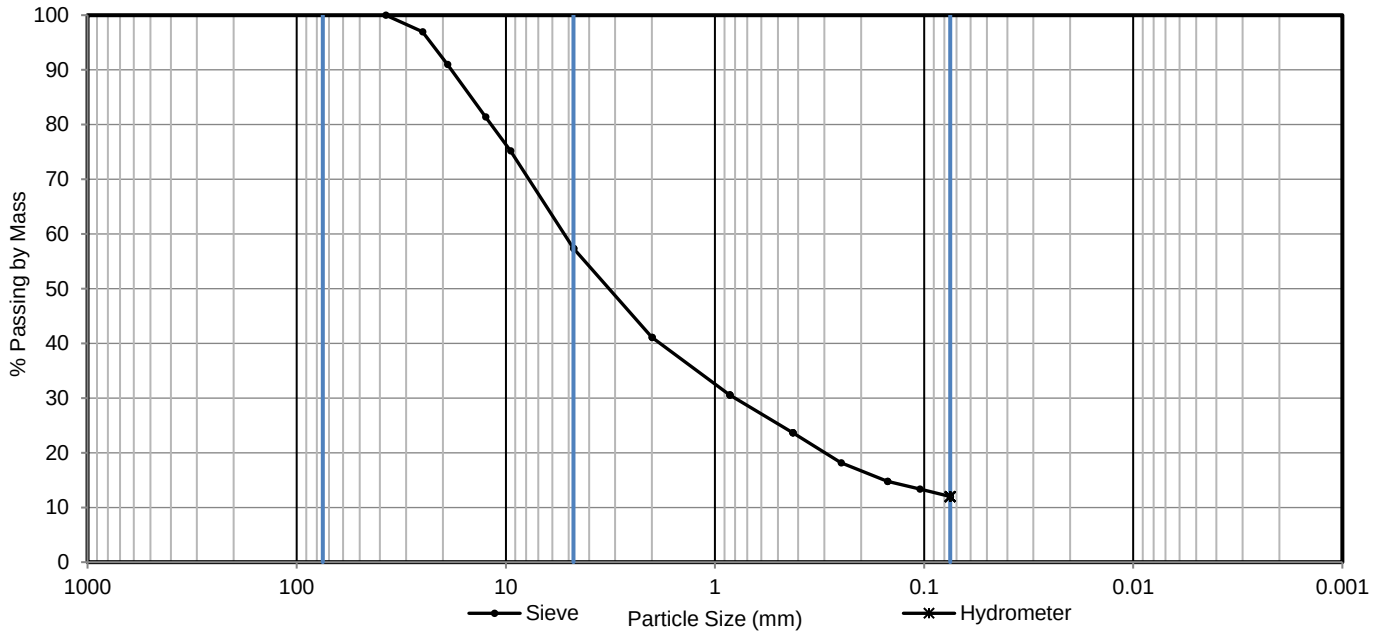
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO202007234	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering			Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-01
Source:				Sample No.:	5
Soil Description:				Type:	SS
				Depth (m):	10.97 - 11.58
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/30/2020
Specimen Description	NA				

% Passing	43	45	12

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	97.0		
3/4"	19	91.0		
1/2"	12.5	81.4		
3/8"	9.5	75.2		
#4	4.75	57.4		
#10	2	41.1		
#20	0.85	30.6		
#40	0.425	23.7		
#60	0.25	18.2		
#100	0.15	14.8		
#140	0.105	13.4		
#200	0.075	12.0		
			D60	5.26
			D30	0.80
			D10	
			Cu	
			Cc	

Notes:

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Tested by: ACianci **Date:** 7/30/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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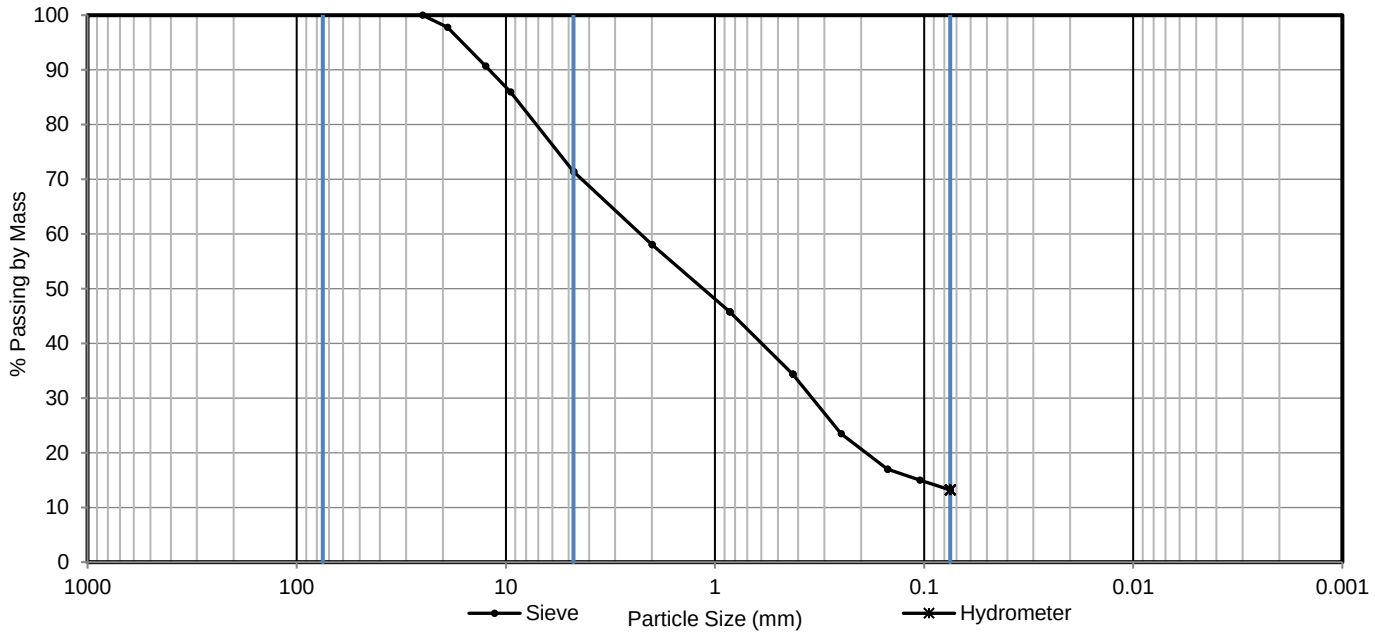
Method B

Test Request #	K20-057	Lab Sample ID:	KELO202007236	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-01		
Source:				Sample No.:	7		
Soil Description:				Type:	SS		
				Depth (m):	17.07	-	17.68
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/5/2020		
Specimen Description	NA						

% Passing	29	58	13

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0		
3/4"	19	97.8		
1/2"	12.5	90.7		
3/8"	9.5	86.0		
#4	4.75	71.4		
#10	2	58.1		
#20	0.85	45.8		
#40	0.425	34.4		
#60	0.25	23.5		
#100	0.15	17.0		
#140	0.105	15.0		
#200	0.075	13.2		
			D60	2.26
			D30	0.34
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

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Tested by: ACianci **Date:** 8/5/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

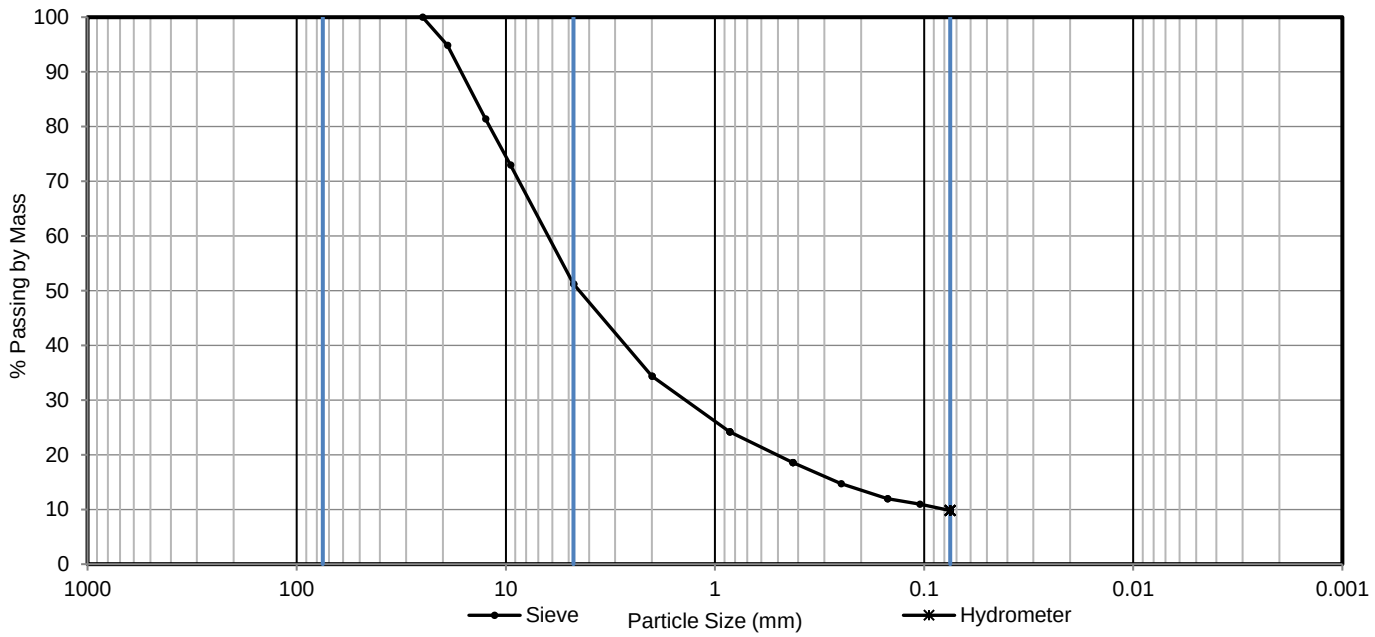
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO202007239	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-01		
Source:				Sample No.:	10		
Soil Description:				Type:	SS		
				Depth (m):	26.21	-	26.82
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/30/2020		
Specimen Description	NA						

% Passing 49 41 10

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0		
3/4"	19	94.9		
1/2"	12.5	81.4		
3/8"	9.5	73.0		
#4	4.75	51.2		
#10	2	34.4		
#20	0.85	24.2		
#40	0.425	18.6		
#60	0.25	14.7		
#100	0.15	12.0		
#140	0.105	11.0		
#200	0.075	9.8		
			D60	6.28
			D30	1.38
			D10	0.08
			Cu	79.00
			Cc	4.00

Notes:

Disclaimer:

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Tested by: ACianci **Date:** 7/30/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

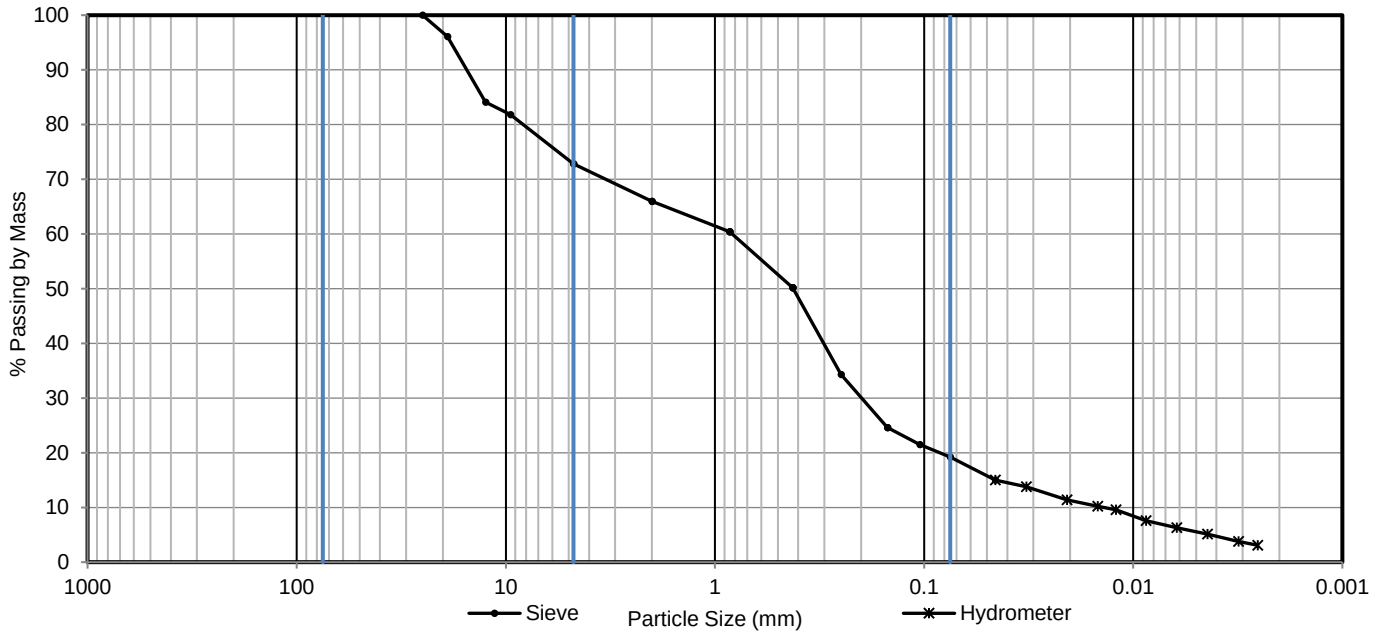
ASTM D6913 and ASTM D422

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072313	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering			Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-01
Source:				Sample No.:	14
Soil Description:				Type:	SS
				Depth (m):	38.40 - 39.01
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/29/2020
Specimen Description	NA				

% Passing	27	54	19

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0	0.0456	15
3/4"	19	96.1	0.0325	14
1/2"	12.5	84.1	0.0208	11
3/8"	9.5	81.8	0.0148	10
#4	4.75	72.8	0.0121	10
#10	2	66.0	0.0087	8
#20	0.85	60.4	0.0062	6
#40	0.425	50.2	0.0044	5
#60	0.25	34.3	0.0031	4
#100	0.15	24.6	0.0025	3
#140	0.105	21.5		
#200	0.075	19.2		
			D60	0.83
			D30	0.20
			D10	0.01
			Cu	60.00
			Cc	4.00

Notes:

Disclaimer:

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Tested by: ACianci **Date:** 7/29/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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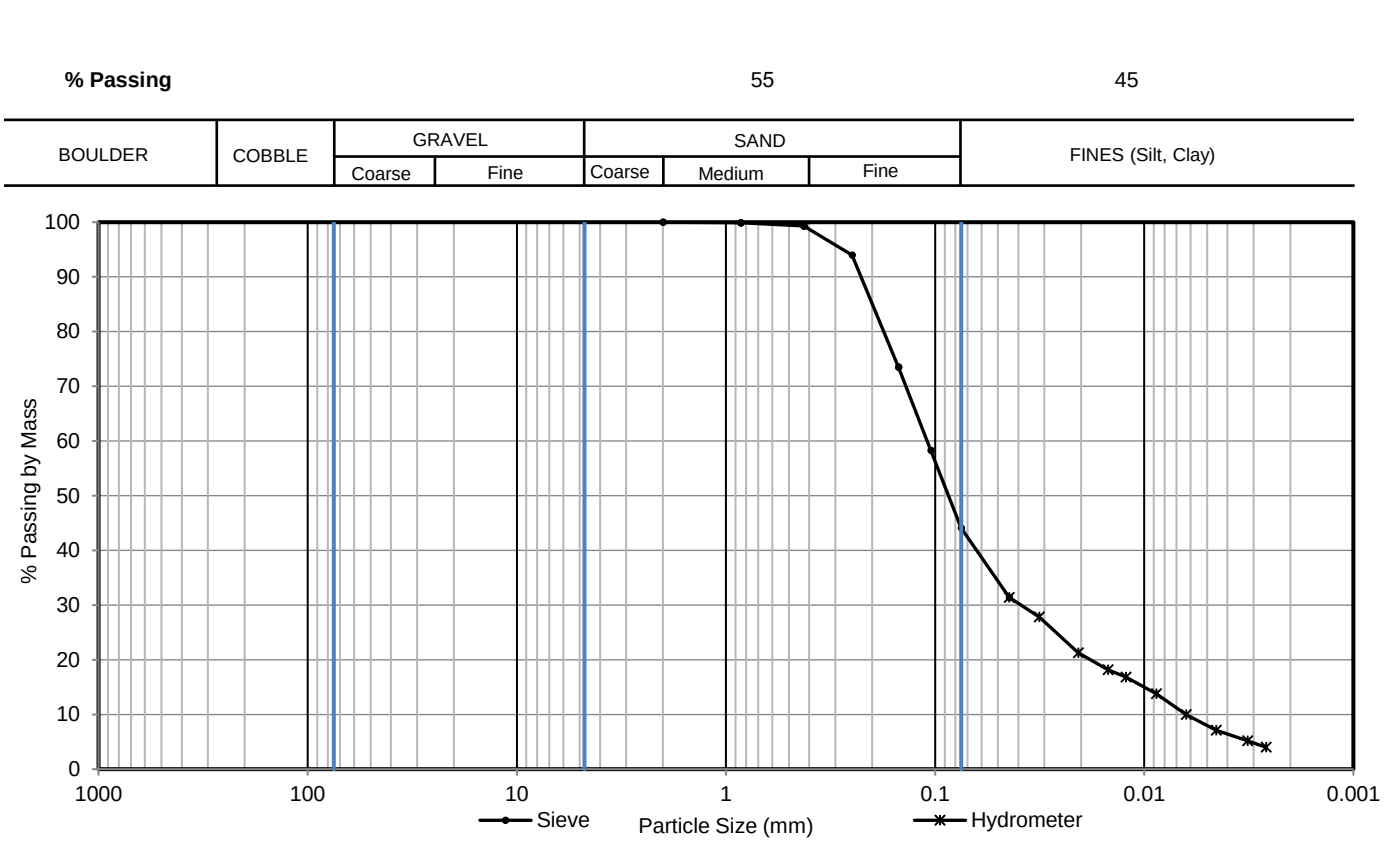
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072316	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering			Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-01
Source:				Sample No.:	17
Soil Description:				Type:	SS
				Depth (m):	44.50 - 45.11
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/7/2020
Specimen Description	NA				



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#10	2	100.0	0.0442	31
#20	0.85	99.9	0.0318	28
#40	0.425	99.3	0.0207	21
#60	0.25	94.0	0.0149	18
#100	0.15	73.5	0.0122	17
#140	0.105	58.3	0.0088	14
#200	0.075	44.1	0.0063	10
			0.0045	7
			0.0032	5
			0.0026	4
			D60	0.11
			D30	0.04
			D10	
			Cu	
			Cc	

Notes:

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Tested by: ACianci **Date:** 8/7/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

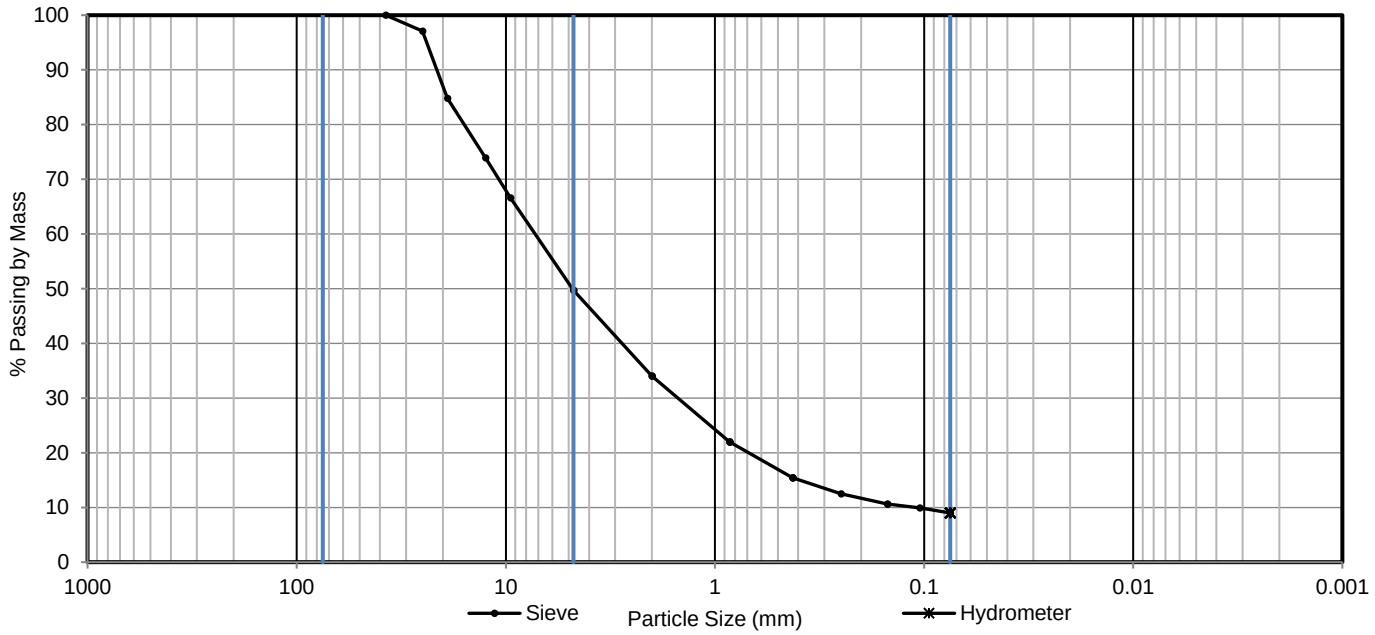
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072318	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-02		
Source:				Sample No.:	2		
Soil Description:				Type:	SS		
				Depth (m):	1.22	-	1.83
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/5/2020		
Specimen Description	NA						

% Passing	50	41	9

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	97.1		
3/4"	19	84.8		
1/2"	12.5	73.9		
3/8"	9.5	66.6		
#4	4.75	49.7		
#10	2	34.0		
#20	0.85	22.0		
#40	0.425	15.4		
#60	0.25	12.5		
#100	0.15	10.6		
#140	0.105	9.9		
#200	0.075	9.0		
			D60	7.25
			D30	1.50
			D10	0.11
			Cu	66.00
			Cc	3.00

Notes:

Disclaimer:

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Tested by: ACianci **Date:** 8/5/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

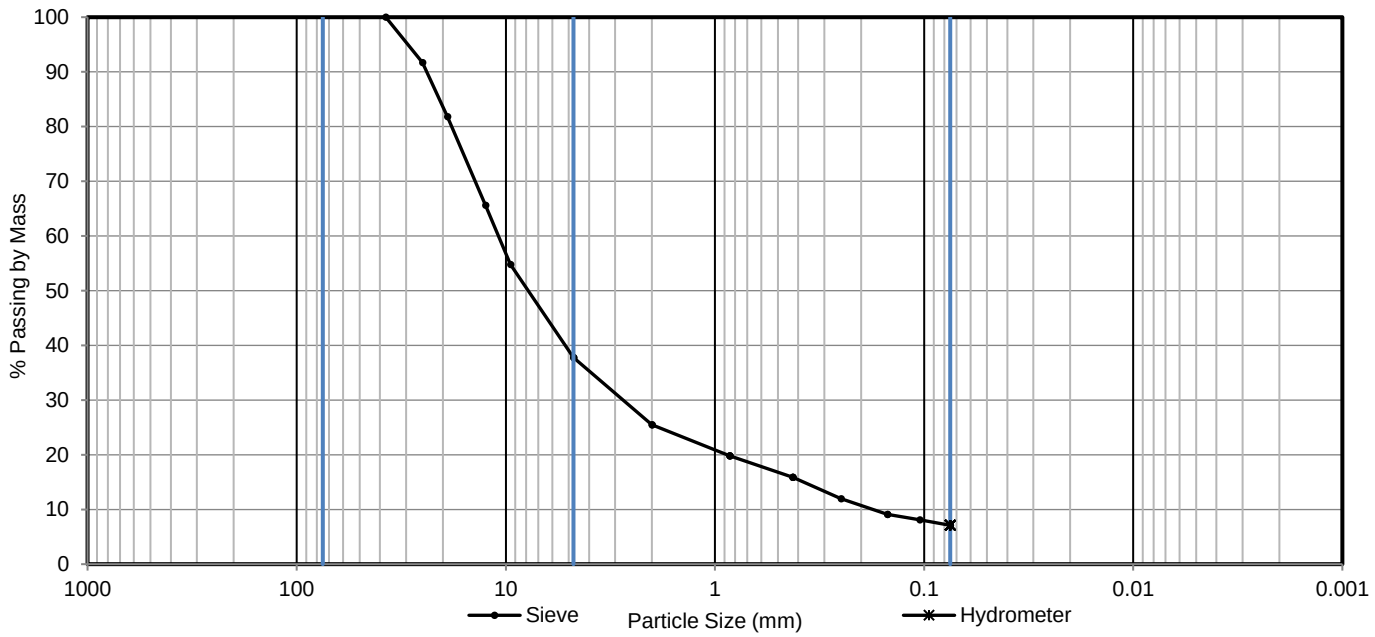
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072326	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-02		
Source:				Sample No.:	10		
Soil Description:				Type:	SS		
				Depth (m):	13.41	-	14.02
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/5/2020		
Specimen Description	NA						

% Passing 62 31 7

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	91.7		
3/4"	19	81.8		
1/2"	12.5	65.6		
3/8"	9.5	54.8		
#4	4.75	37.8		
#10	2	25.5		
#20	0.85	19.8		
#40	0.425	15.9		
#60	0.25	12.0		
#100	0.15	9.1		
#140	0.105	8.1		
#200	0.075	7.1		
			D60	10.80
			D30	2.74
			D10	0.18
			Cu	62.00
			Cc	4.00

Notes:

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Tested by: ACianci **Date:** 8/5/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

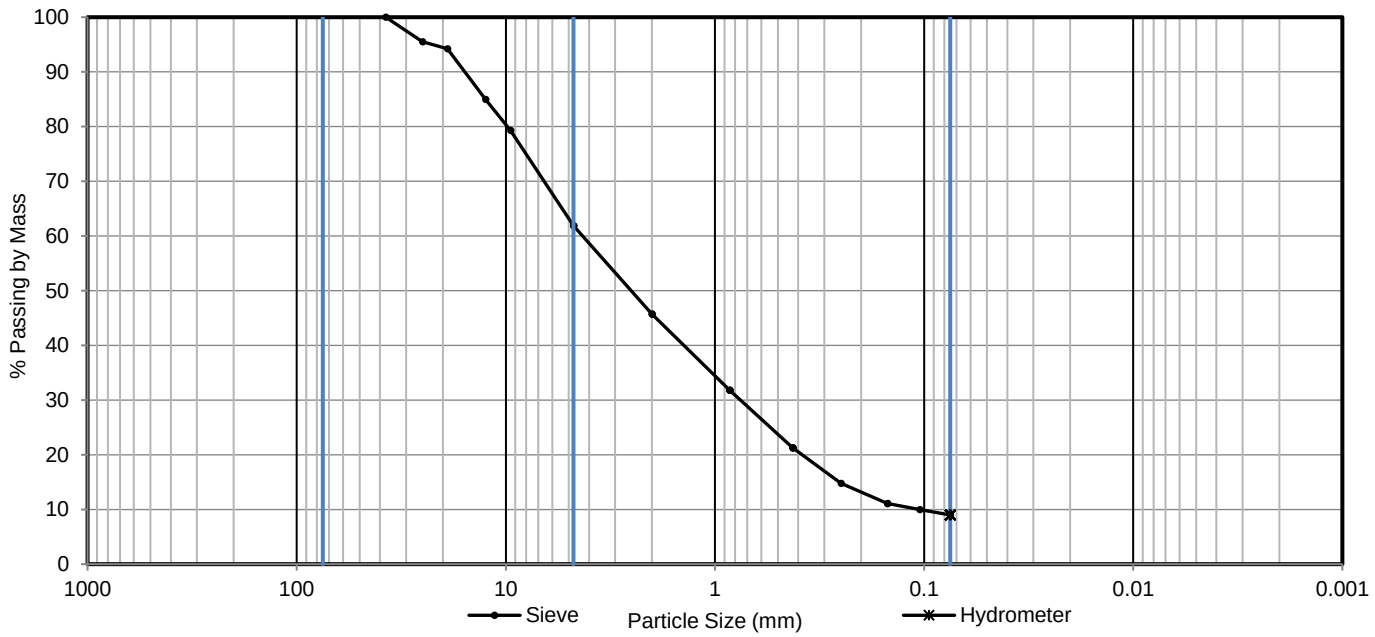
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072331	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-02		
Source:				Sample No.:	15		
Soil Description:				Type:	SS		
				Depth (m):	26.37	-	26.97
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/5/2020		
Specimen Description	NA						

% Passing	38	53	9

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	95.5		
3/4"	19	94.2		
1/2"	12.5	85.0		
3/8"	9.5	79.3		
#4	4.75	61.9		
#10	2	45.7		
#20	0.85	31.8		
#40	0.425	21.3		
#60	0.25	14.8		
#100	0.15	11.1		
#140	0.105	10.0		
#200	0.075	9.0		
			D60	4.29
			D30	0.76
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

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Tested by: ACianci **Date:** 8/5/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

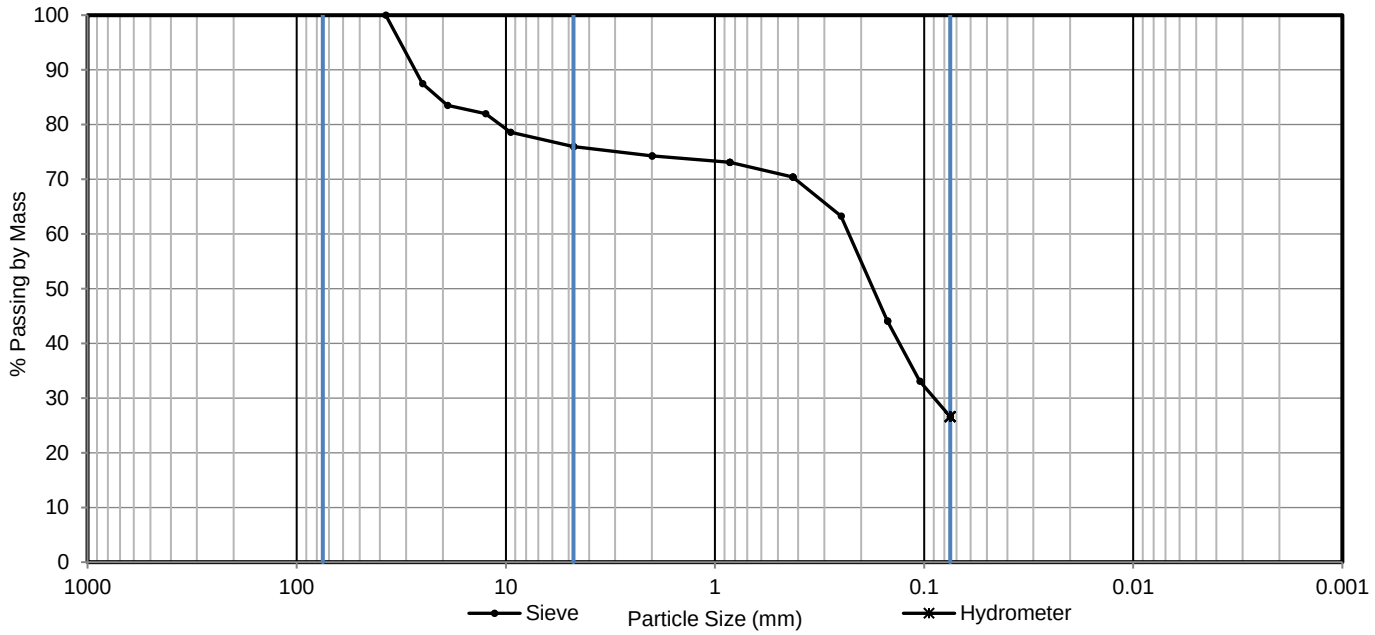
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072334	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-02		
Source:				Sample No.:	18		
Soil Description:				Type:	SS		
				Depth (m):	35.51	-	36.12
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/5/2020		
Specimen Description	NA						

% Passing	24	49	27

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	87.5		
3/4"	19	83.5		
1/2"	12.5	82.0		
3/8"	9.5	78.6		
#4	4.75	76.0		
#10	2	74.3		
#20	0.85	73.1		
#40	0.425	70.4		
#60	0.25	63.3		
#100	0.15	44.1		
#140	0.105	33.1		
#200	0.075	26.6		
			D60	0.23
			D30	0.09
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

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Tested by: ACianci **Date:** 8/5/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

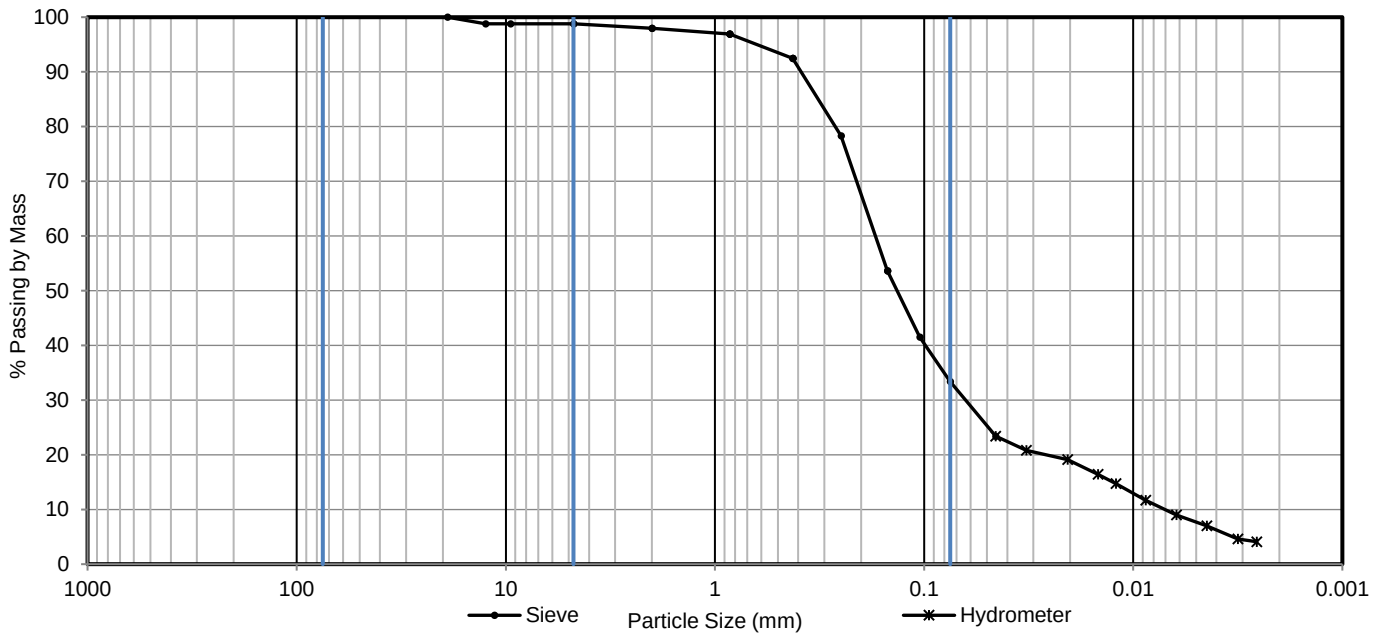
ASTM D6913 and ASTM D422

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072336	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering			Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-02
Source:				Sample No.:	20
Soil Description:				Type:	SS
				Depth (m):	41.61 - 42.21
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/29/2020
Specimen Description	NA				

% Passing	2	65	33

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0454	23
1/2"	12.5	98.8	0.0324	21
3/8"	9.5	98.8	0.0206	19
#4	4.75	98.8	0.0148	16
#10	2	98.0	0.0121	15
#20	0.85	96.9	0.0087	12
#40	0.425	92.5	0.0062	9
#60	0.25	78.3	0.0045	7
#100	0.15	53.6	0.0032	5
#140	0.105	41.5	0.0026	4
#200	0.075	33.4		
			D60	0.17
			D30	0.06
			D10	0.01
			Cu	24.00
			Cc	3.00

Notes:

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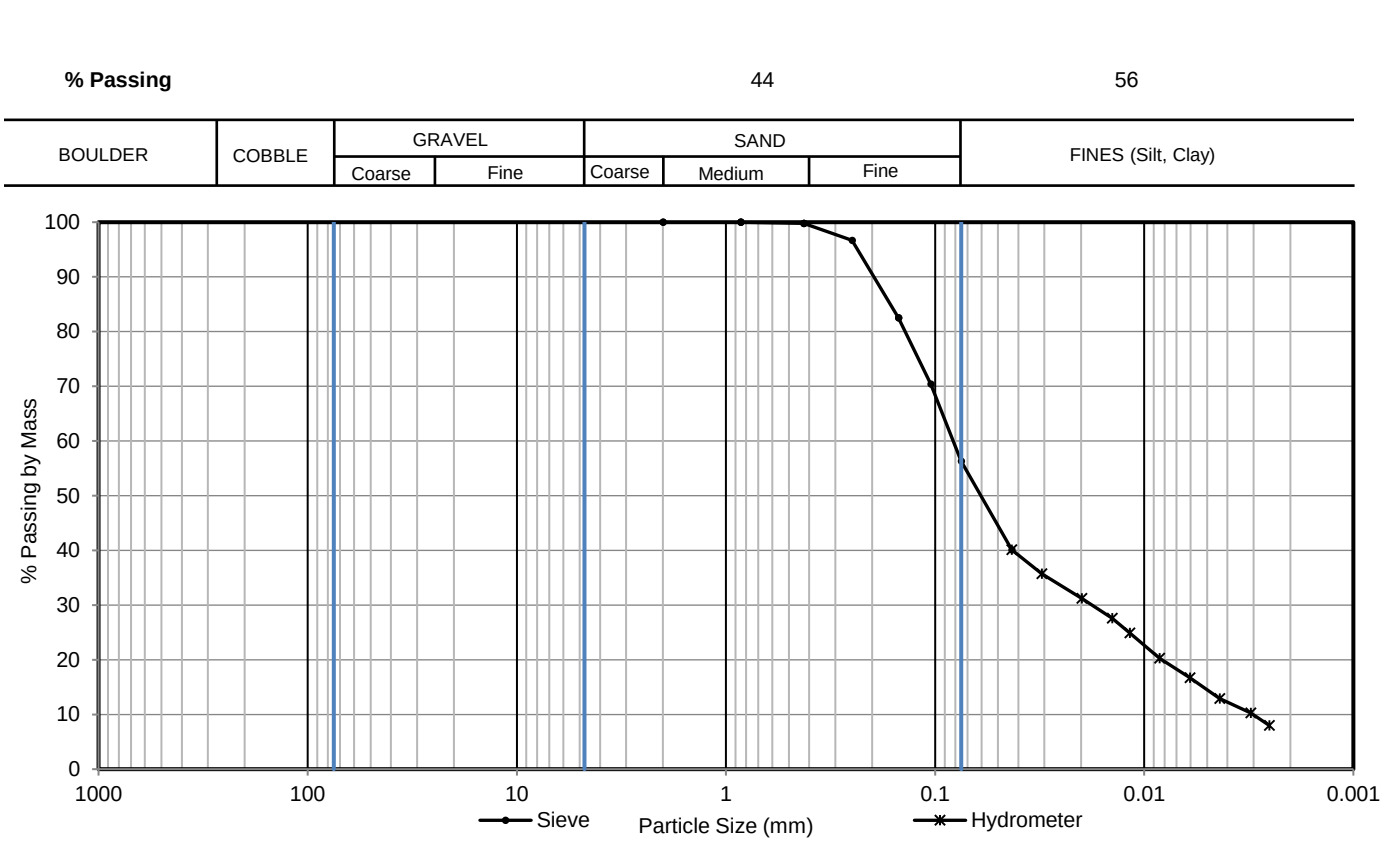
PARTICLE SIZE DISTRIBUTION
ASTM D6913 and ASTM D422
Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072340	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering			Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-02
Source:				Sample No.:	24
Soil Description:				Type:	SS
				Depth (m):	47.70 - 48.31
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/29/2020
Specimen Description	NA				



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#10	2	100.0	0.0430	40
#20	0.85	100.0	0.0309	36
#40	0.425	99.8	0.0199	31
#60	0.25	96.7	0.0142	28
#100	0.15	82.5	0.0117	25
#140	0.105	70.4	0.0084	20
#200	0.075	56.3	0.0061	17
			0.0044	13
			0.0031	10
			0.0025	8
			D60	0.08
			D30	0.02
			D10	
			Cu	
			Cc	

Notes:

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PARTICLE SIZE DISTRIBUTION

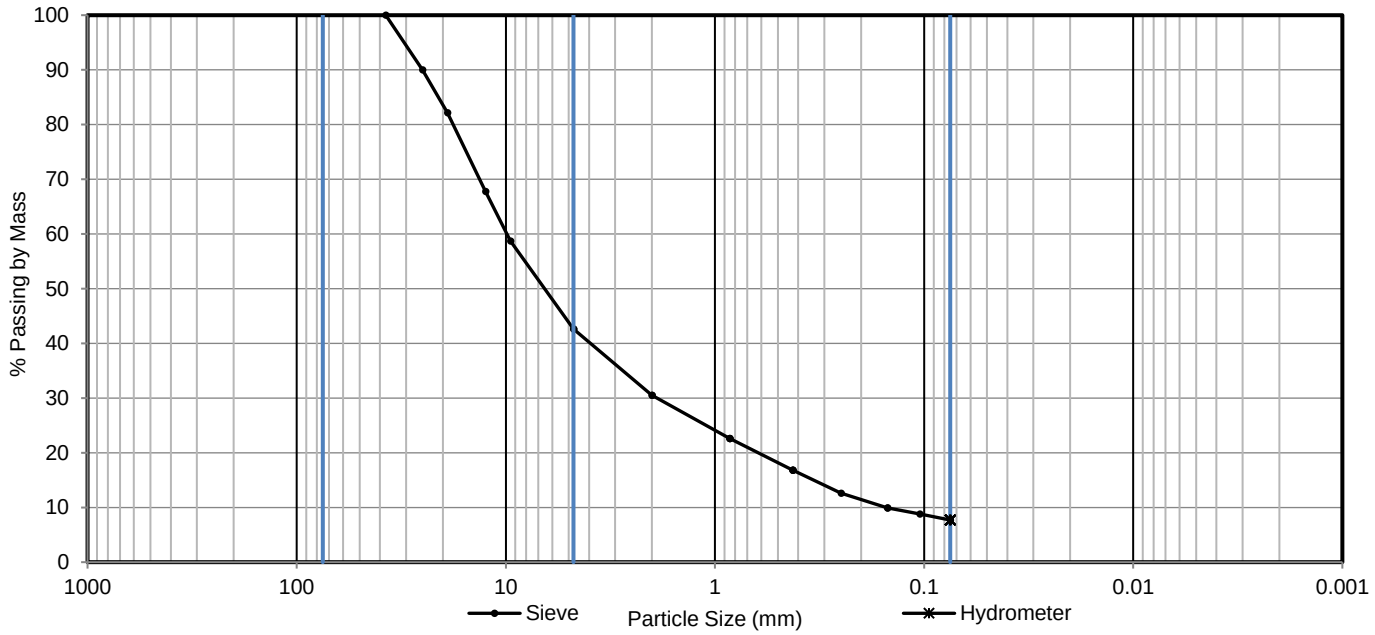
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072345	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-03		
Source:				Sample No.:	3		
Soil Description:				Type:	SS		
				Depth (m):	2.59	-	3.20
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/6/2020		
Specimen Description	NA						

% Passing	57	35	8

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	90.0		
3/4"	19	82.2		
1/2"	12.5	67.8		
3/8"	9.5	58.7		
#4	4.75	42.6		
#10	2	30.5		
#20	0.85	22.6		
#40	0.425	16.8		
#60	0.25	12.6		
#100	0.15	9.9		
#140	0.105	8.8		
#200	0.075	7.7		
			D60	9.88
			D30	1.89
			D10	0.15
			Cu	65.00
			Cc	2.00

Notes:

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PARTICLE SIZE DISTRIBUTION

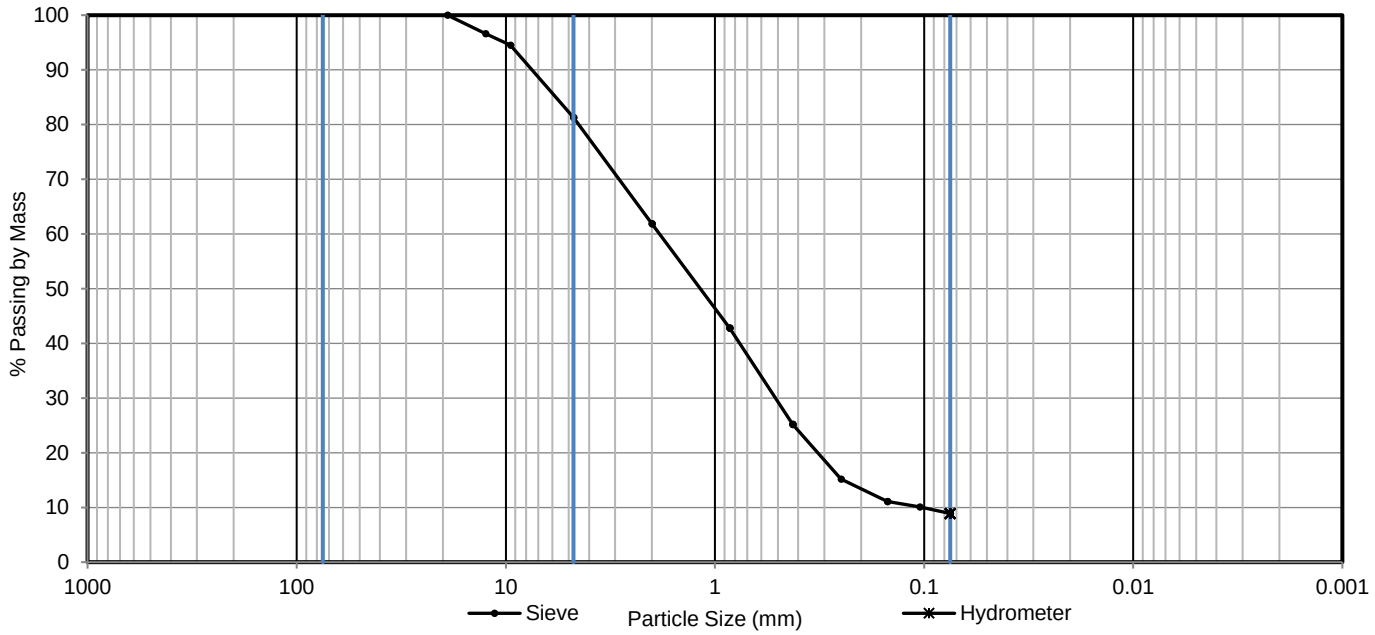
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072348	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering			Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-03
Source:				Sample No.:	6
Soil Description:				Type:	SS
				Depth (m):	7.16 - 7.77
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/6/2020
Specimen Description	NA				

% Passing	19	72	9

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0		
1/2"	12.5	96.6		
3/8"	9.5	94.5		
#4	4.75	81.3		
#10	2	61.9		
#20	0.85	42.8		
#40	0.425	25.2		
#60	0.25	15.2		
#100	0.15	11.1		
#140	0.105	10.1		
#200	0.075	8.9		
			D60	1.84
			D30	0.51
			D10	0.10
			Cu	18.00
			Cc	1.00

Notes:

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Tested by: ACianci **Date:** 8/6/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

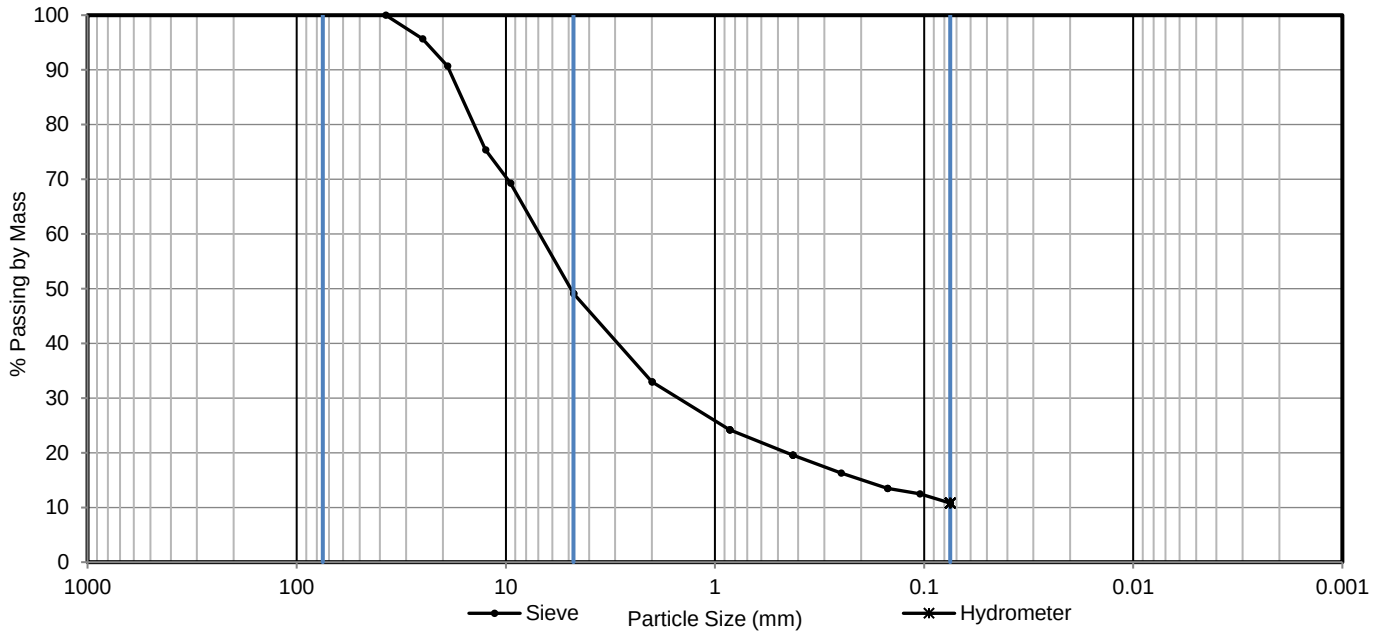
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072355	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-03		
Source:				Sample No.:	13		
Soil Description:				Type:	SS		
				Depth (m):	21.34	-	21.92
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/6/2020		
Specimen Description	NA						

% Passing	51	38	11

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	95.7		
3/4"	19	90.7		
1/2"	12.5	75.4		
3/8"	9.5	69.3		
#4	4.75	49.1		
#10	2	33.0		
#20	0.85	24.2		
#40	0.425	19.6		
#60	0.25	16.3		
#100	0.15	13.5		
#140	0.105	12.5		
#200	0.075	10.8		
			D60	6.90
			D30	1.49
			D10	
			Cu	
			Cc	

Notes:

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Tested by: ACianci **Date:** 8/6/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

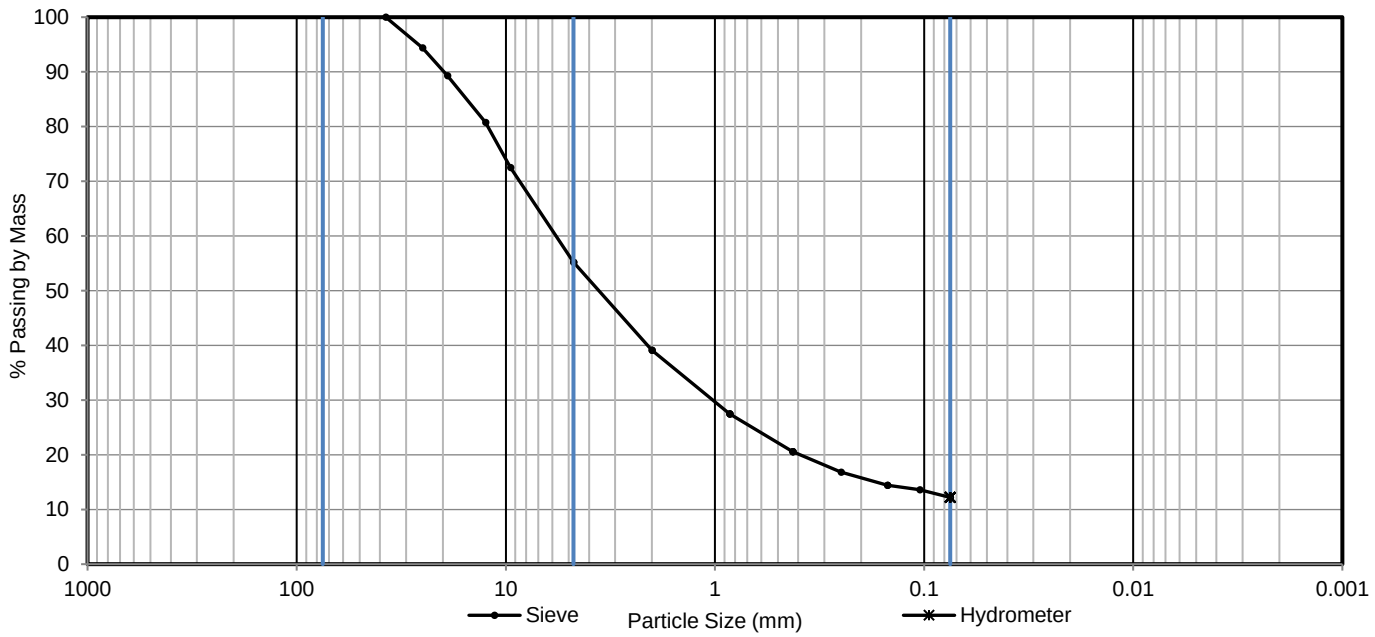
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072359	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-03		
Source:				Sample No.:	17		
Soil Description:				Type:	SS		
				Depth (m):	33.53	-	34.14
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/6/2020		
Specimen Description	NA						

% Passing	45	43	12

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	94.4		
3/4"	19	89.3		
1/2"	12.5	80.8		
3/8"	9.5	72.5		
#4	4.75	55.2		
#10	2	39.1		
#20	0.85	27.5		
#40	0.425	20.6		
#60	0.25	16.8		
#100	0.15	14.4		
#140	0.105	13.6		
#200	0.075	12.2		
			D60	5.76
			D30	1.02
			D10	
			Cu	
			Cc	

Notes:

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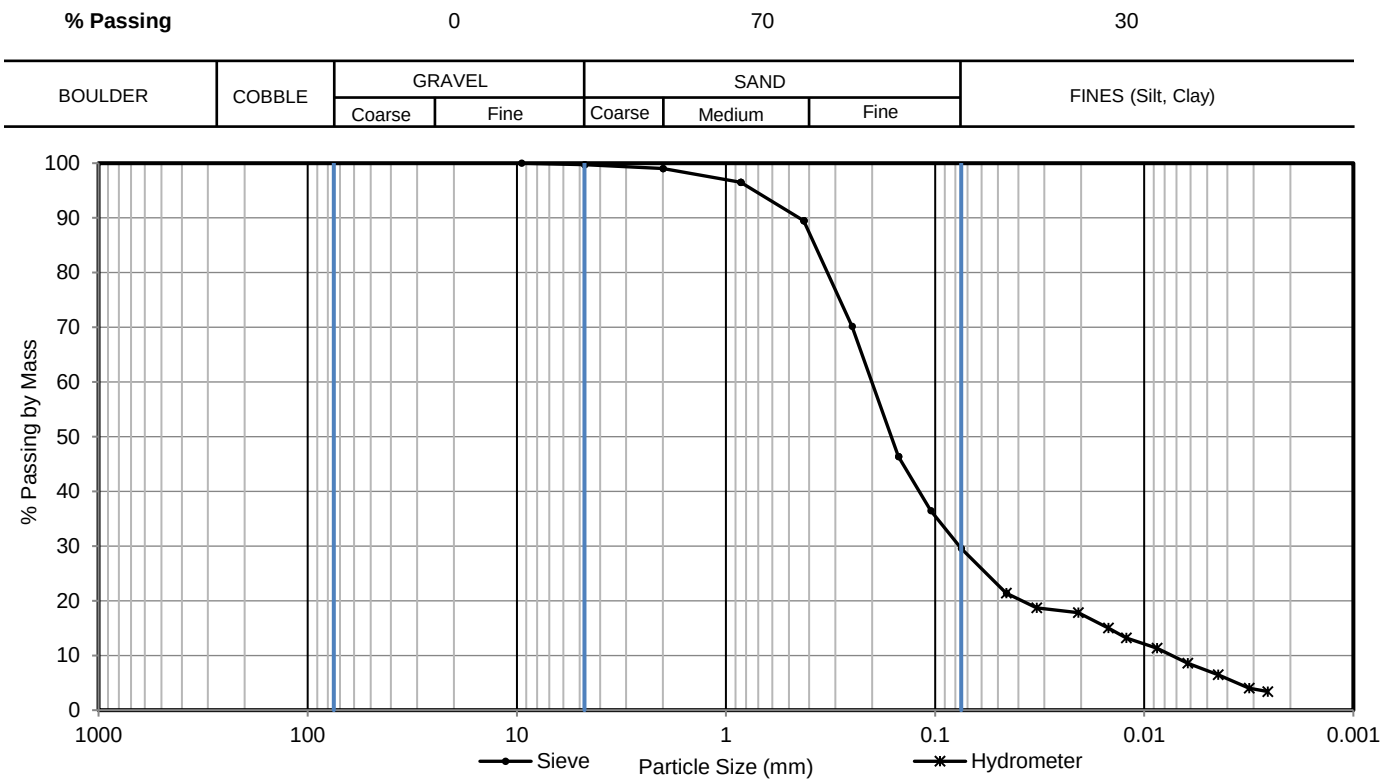
PARTICLE SIZE DISTRIBUTION

ASTM D6913 and ASTM D422

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072361	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering			Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-03
Source:				Sample No.:	19
Soil Description:				Type:	SS
				Depth (m):	39.62 - 40.23
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/29/2020
Specimen Description	NA				



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/8"	9.5	100.0	0.0458	21
#4	4.75	99.7	0.0326	19
#10	2	99.0	0.0207	18
#20	0.85	96.5	0.0148	15
#40	0.425	89.5	0.0122	13
#60	0.25	70.2	0.0087	11
#100	0.15	46.4	0.0062	9
#140	0.105	36.5	0.0044	7
#200	0.075	29.6	0.0032	4
			0.0026	3
			D60	0.20
			D30	0.08
			D10	0.01
			Cu	27.00
			Cc	4.00

Notes:

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Tested by: ACianci **Date:** 7/29/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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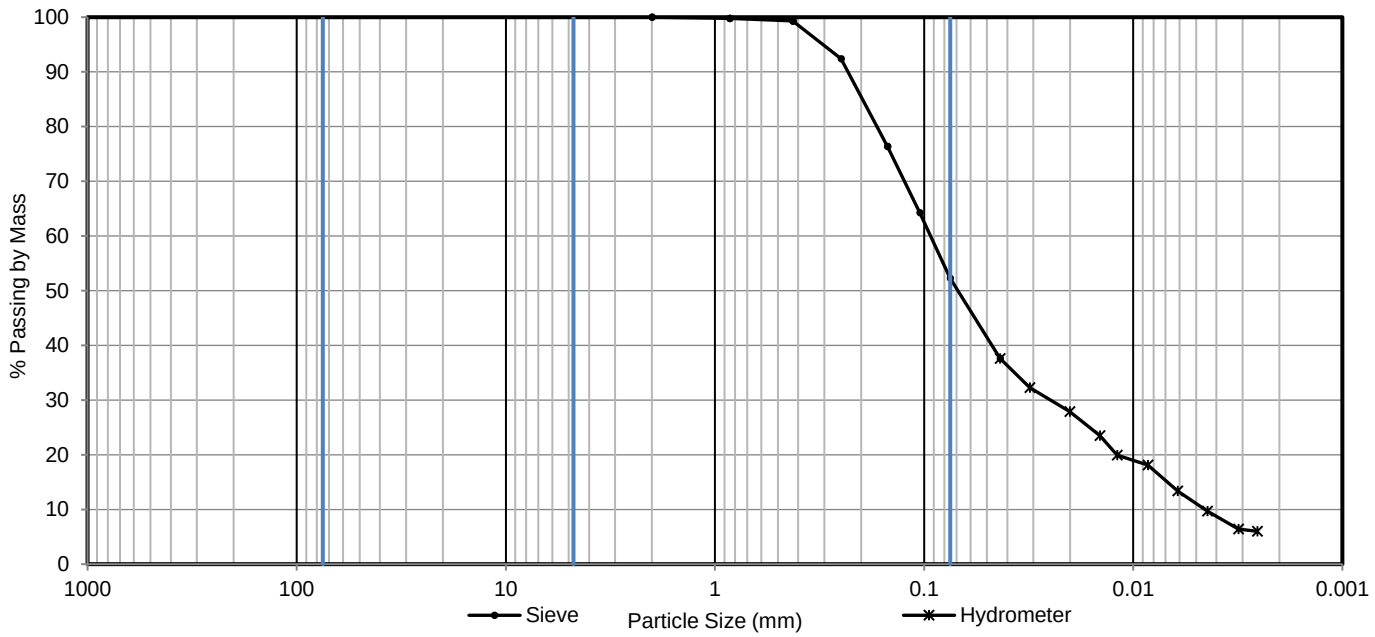
PARTICLE SIZE DISTRIBUTION
ASTM D6913 and ASTM D422
Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072364	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-03		
Source:				Sample No.:	22		
Soil Description:				Type:	SS		
				Depth (m):	48.77	-	49.38
Specimen Reference	NA	Specimen Depth	NA	Date of Test	7/29/2020		
Specimen Description	NA						

% Passing		47		53	
BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
#10	2	100.0	0.0433	38
#20	0.85	99.8	0.0312	32
#40	0.425	99.3	0.0201	28
#60	0.25	92.4	0.0144	24
#100	0.15	76.4	0.0119	20
#140	0.105	64.3	0.0085	18
#200	0.075	52.3	0.0061	13
			0.0044	10
			0.0031	6
			0.0025	6
			D60	0.09
			D30	0.02
			D10	
			Cu	
			Cc	

Notes:

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Tested by: ACianci **Date:** 7/29/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

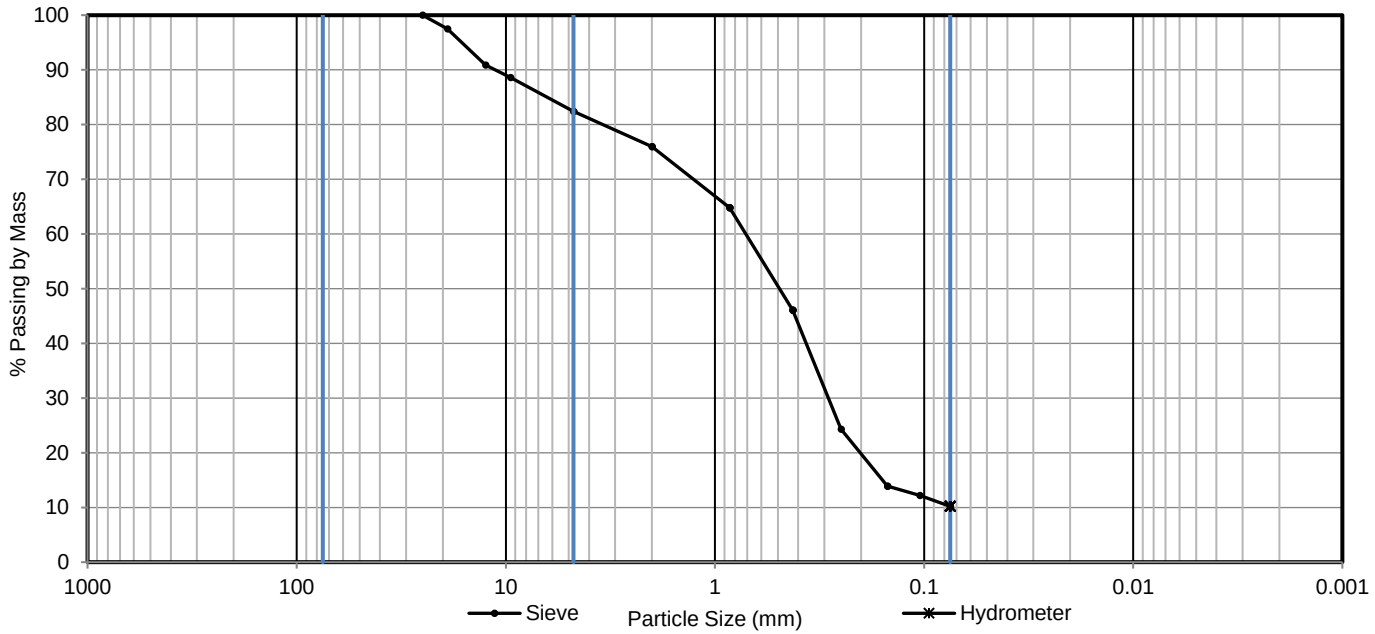
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072370	Project Number:	20139391 (3000/3300)
Client:	Associated Engineering			Project Location:	Golden, BC
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-04
Source:				Sample No.:	6
Soil Description:				Type:	SS
				Depth (m):	9.60 - 10.21
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/6/2020
Specimen Description	NA				

% Passing	18	72	10

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1"	25	100.0		
3/4"	19	97.5		
1/2"	12.5	90.9		
3/8"	9.5	88.6		
#4	4.75	82.4		
#10	2	76.0		
#20	0.85	64.8		
#40	0.425	46.1		
#60	0.25	24.3		
#100	0.15	13.9		
#140	0.105	12.2		
#200	0.075	10.2		
			D60	0.71
			D30	0.29
			D10	
			Cu	
			Cc	

Notes:

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Tested by: ACianci **Date:** 8/6/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

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PARTICLE SIZE DISTRIBUTION

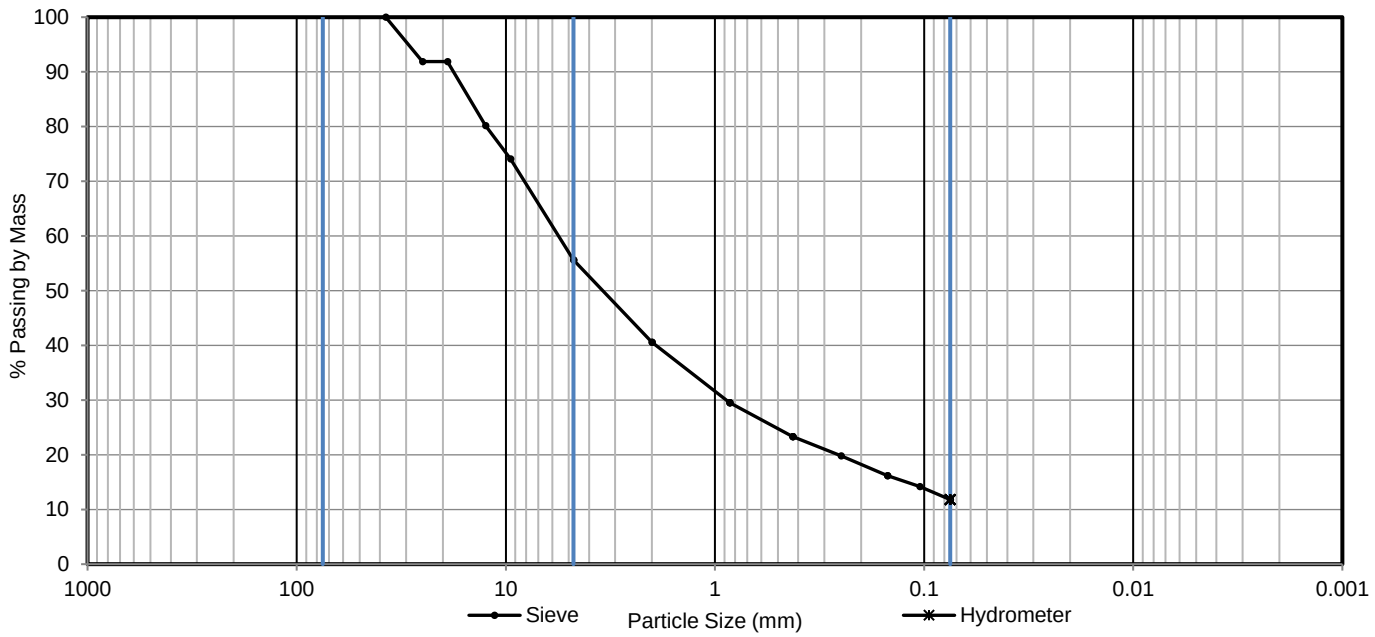
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072374	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-04		
Source:				Sample No.:	10		
Soil Description:				Type:	SS		
				Depth (m):	15.70	-	16.31
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/6/2020		
Specimen Description	NA						

% Passing	44	44	12

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	91.9		
3/4"	19	91.9		
1/2"	12.5	80.2		
3/8"	9.5	74.1		
#4	4.75	55.6		
#10	2	40.6		
#20	0.85	29.5		
#40	0.425	23.3		
#60	0.25	19.8		
#100	0.15	16.2		
#140	0.105	14.2		
#200	0.075	11.8		
			D60	5.60
			D30	0.88
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

Tested by: ACianci **Date:** 8/6/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

Golder Associates

590 McKay Avenue, Suite 300 Kelowna, British Columbia, Canada, V1Y 5A8

[+1] (250) 860 8424

GOLDER

PARTICLE SIZE DISTRIBUTION

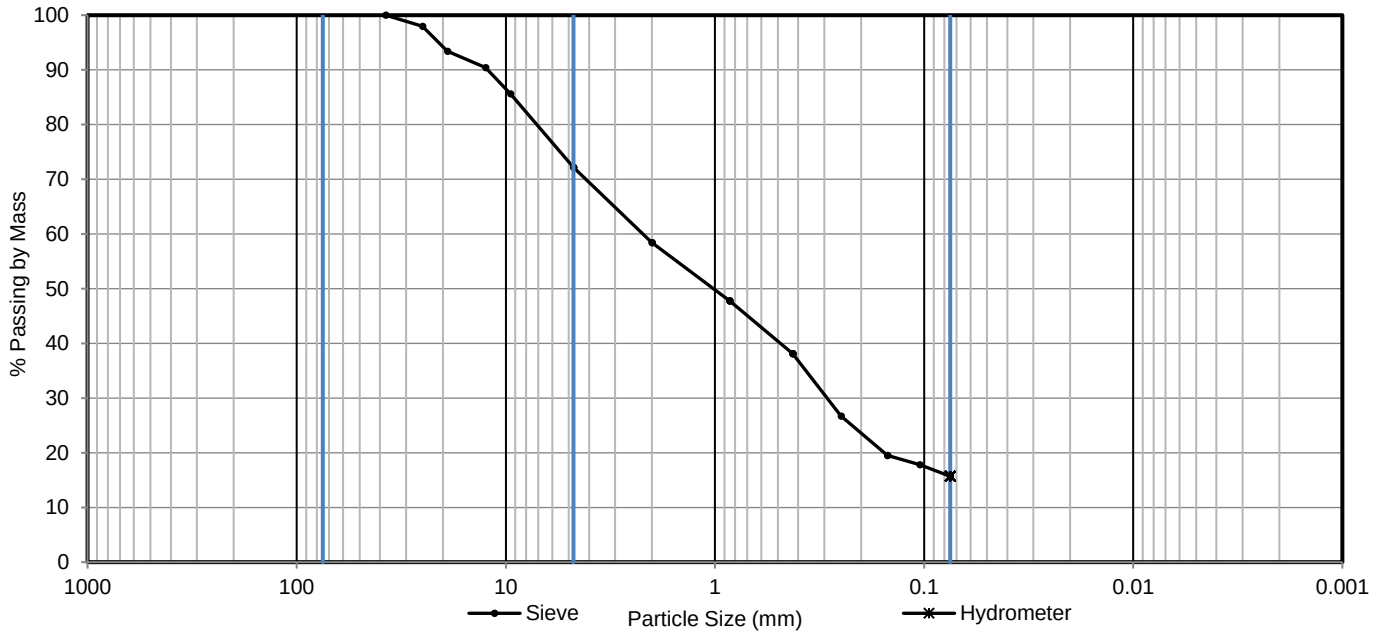
ASTM D6913

Method B

Test Request #	K20-057	Lab Sample ID:	KELO2020072377	Project Number:	20139391 (3000/3300)		
Client:	Associated Engineering			Project Location:	Golden, BC		
Project Name:	Highway 95 - Kicking Horse River Bridges			Sample Source:	BH20-04		
Source:				Sample No.:	13		
Soil Description:				Type:	SS		
				Depth (m):	24.84	-	25.45
Specimen Reference	NA	Specimen Depth	NA	Date of Test	8/6/2020		
Specimen Description	NA						

% Passing	28	57	16

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1 1/2"	37.5	100.0		
1"	25	98.0		
3/4"	19	93.4		
1/2"	12.5	90.4		
3/8"	9.5	85.6		
#4	4.75	72.2		
#10	2	58.4		
#20	0.85	47.8		
#40	0.425	38.1		
#60	0.25	26.7		
#100	0.15	19.5		
#140	0.105	17.8		
#200	0.075	15.7		
			D60	2.21
			D30	0.29
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

The test data given herein pertain to the sample provided only. This report constitutes a testing service only.

Tested by: ACianci **Date:** 8/6/2020 **Checked by:** ACianci **Date:** 8/11/2020 **Reviewed by:** JStotz **Date:** 8/11/2020

Golder Associates

590 McKay Avenue, Suite 300 Kelowna, British Columbia, Canada, V1Y 5A8

[+1] (250) 860 8424

CERTIFICATE OF ANALYSIS

REPORTED TO	Golder Associates Ltd. (Kelowna) 590 McKay Avenue, Suite 300 Kelowna, BC V1Y 5A8		
ATTENTION	Jason Stotz	**WORK ORDER**	0072495
PO NUMBER	20139391/3000/3300	**RECEIVED / TEMP**	2020-07-24 15:27 / 25°C
PROJECT	20139391/3000/3300	**REPORTED**	2020-08-26 14:23
PROJECT INFO	Hwy 95 - Kicking Horse River Bridges	**COC NUMBER**	B47846

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at acrump@caro.ca

Authorized By:

Alana Crump
Team Lead, Client Service

TEST RESULTS

REPORTED TO	Golder Associates Ltd. (Kelowna)	**WORK ORDER**	0072495
PROJECT	20139391/3000/3300	**REPORTED**	2020-08-26 14:23

Analyte	Result	RL	Units	Analyzed	Qualifier
BH20-01 SA1 3'-5' (0072495-01) | Matrix: Soil | Sampled: 2020-07-24					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2020-07-30	
Chloride, Water-Soluble	**0.015**	0.002	%	2020-08-05	
BH20-01 SA3 16'-18' (0072495-02) | Matrix: Soil | Sampled: 2020-07-24					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2020-07-30	
Chloride, Water-Soluble	**0.002**	0.002	%	2020-08-05	
BH20-02 SA1 0.5'-1.5' (0072495-03) | Matrix: Soil | Sampled: 2020-07-24					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2020-07-30	
Chloride, Water-Soluble	**0.004**	0.002	%	2020-08-05	
BH20-02 SA5 19'-21' (0072495-04) | Matrix: Soil | Sampled: 2020-07-24					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2020-07-30	
Chloride, Water-Soluble	< 0.002	0.002	%	2020-08-05	
BH20-04 SA1 1'-2' (0072495-05) | Matrix: Soil | Sampled: 2020-07-24					
General Parameters					
Sulfate, Water-Soluble	< 0.050	0.050	%	2020-08-25	
Chloride, Water-Soluble	< 0.002	0.002	%	2020-08-23	
Sulfide, Total	< 0.50	0.50	mg/kg dry	2020-08-13	
Miscellaneous Subcontracted Parameters					
Refer to Appendix	**Refer to Appendix for Full Report**		-	2020-08-26	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Golder Associates Ltd. (Kelowna)	**WORK ORDER**	0072495
PROJECT	20139391/3000/3300	**REPORTED**	2020-08-26 14:23

Analysis Description	Method Ref.	Technique	Accredited	Location
Chloride, Water Soluble in Soil	ASTM C1218-97	Hot Water Extraction / Hot Water Extraction		Richmond
Sulfate, Water-Soluble in Soil	CSA A23.2-3B / CSA A23.2-2B	Extraction (HCl) / Gravimetry (Barium Sulfate Precipitation)		Richmond
Sulfide, Total in Soil	SM 4500-S2 D* (2017)	Colorimetry (Methylene Blue)		Sublet

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
%	Percent
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/kg dry	Milligrams per kilogram (dry weight basis)
ASTM	ASTM International Test Methods
CSA	Canadian Standards Association Chemical Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline (s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Golder Associates Ltd. (Kelowna)	**WORK ORDER**	0072495
PROJECT	20139391/3000/3300	**REPORTED**	2020-08-26 14:23

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B0G2575										
Blank (B0G2575-BLK1)				Prepared: 2020-07-29, Analyzed: 2020-07-30						
Sulfate, Water-Soluble	< 0.050	0.050	%							
Duplicate (B0G2575-DUP1)			**Source: 0072495-02**	Prepared: 2020-07-29, Analyzed: 2020-07-30						
Sulfate, Water-Soluble	< 0.050	0.050	%		< 0.050				19	
Matrix Spike (B0G2575-MS1)			**Source: 0072495-04**	Prepared: 2020-07-29, Analyzed: 2020-07-30						
Sulfate, Water-Soluble	0.624	0.050	%	0.667	< 0.050	94	63-117			
General Parameters, Batch B0H0149										
Blank (B0H0149-BLK1)				Prepared: 2020-08-04, Analyzed: 2020-08-05						
Chloride, Water-Soluble	< 0.002	0.002	%							
Duplicate (B0H0149-DUP1)			**Source: 0072495-01**	Prepared: 2020-08-04, Analyzed: 2020-08-05						
Chloride, Water-Soluble	0.018	0.002	%		0.015			18		
General Parameters, Batch B0H1638										
Blank (B0H1638-BLK1)				Prepared: 2020-08-20, Analyzed: 2020-08-23						
Chloride, Water-Soluble	< 0.002	0.002	%							
Duplicate (B0H1638-DUP1)			**Source: 0072495-05**	Prepared: 2020-08-20, Analyzed: 2020-08-23						
Chloride, Water-Soluble	0.003	0.002	%		< 0.002					
General Parameters, Batch B0H1937										
Blank (B0H1937-BLK1)				Prepared: 2020-08-23, Analyzed: 2020-08-25						
Sulfate, Water-Soluble	< 0.050	0.050	%							

WSP CANADA INC.
100-20339 96 Avenue
Langley, BC V1M 0E4
T: 604.533.2992

Client: CARO
Project: Laboratory Testing
WO#: 0072495

File No.: 201-03094-00
Task: 11

Sampled By: Client
Tested By: ARP
Date Sampled: 2020-07-24
Date Tested: 2020-08-22

BH20-04 SA1 1'-2' (0072495-05) | Matrix: Soil | Sampled: 2020-07-24

Sample ID	ASSHTO T288 Resistivity (ohm-cm)	ASSHTO T289 pH	ASTM G200 Redox (mV)	ASTM D2216 Moisture Content (%)	Soil Description
0072495-05	1304	7.5	230	23.5	brown silty sand & gravel

Sample tested in as received condition.

WSP Canada Inc.

Per:
Anton Parsons, AScT.

APPENDIX C

Seismic Hazard Calculation (NBCC 2015)

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

Site: 51.298N 116.963W **User File Reference:** Highway 95 - Kicking Horse River Bridges 2020-07-22 18:11 UT

Requested by: Golder Associates Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.150	0.085	0.050	0.012
Sa (0.1)	0.226	0.128	0.075	0.018
Sa (0.2)	0.263	0.153	0.093	0.025
Sa (0.3)	0.234	0.140	0.087	0.025
Sa (0.5)	0.174	0.103	0.064	0.020
Sa (1.0)	0.094	0.057	0.037	0.013
Sa (2.0)	0.046	0.029	0.020	0.007
Sa (5.0)	0.018	0.011	0.007	0.002
Sa (10.0)	0.006	0.004	0.003	0.001
PGA (g)	0.120	0.069	0.041	0.010
PGV (m/s)	0.098	0.060	0.039	0.013

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" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. 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.**

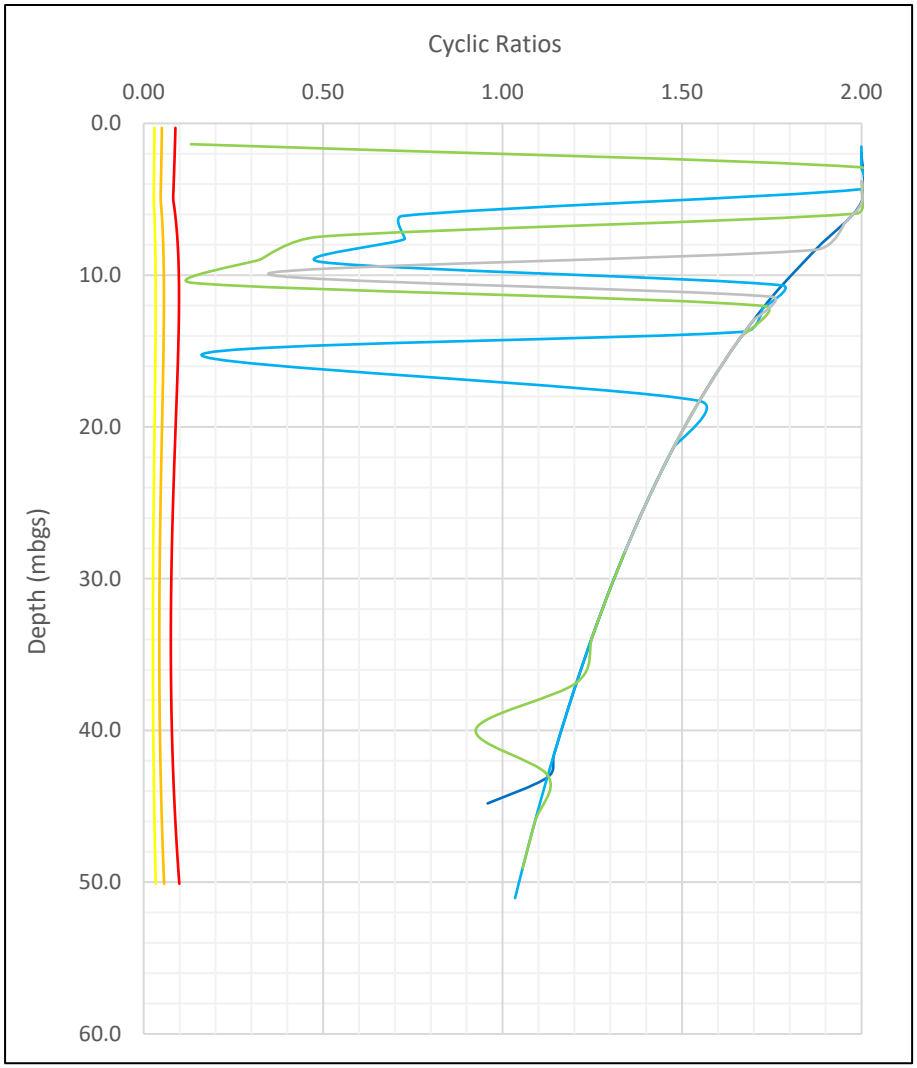
References

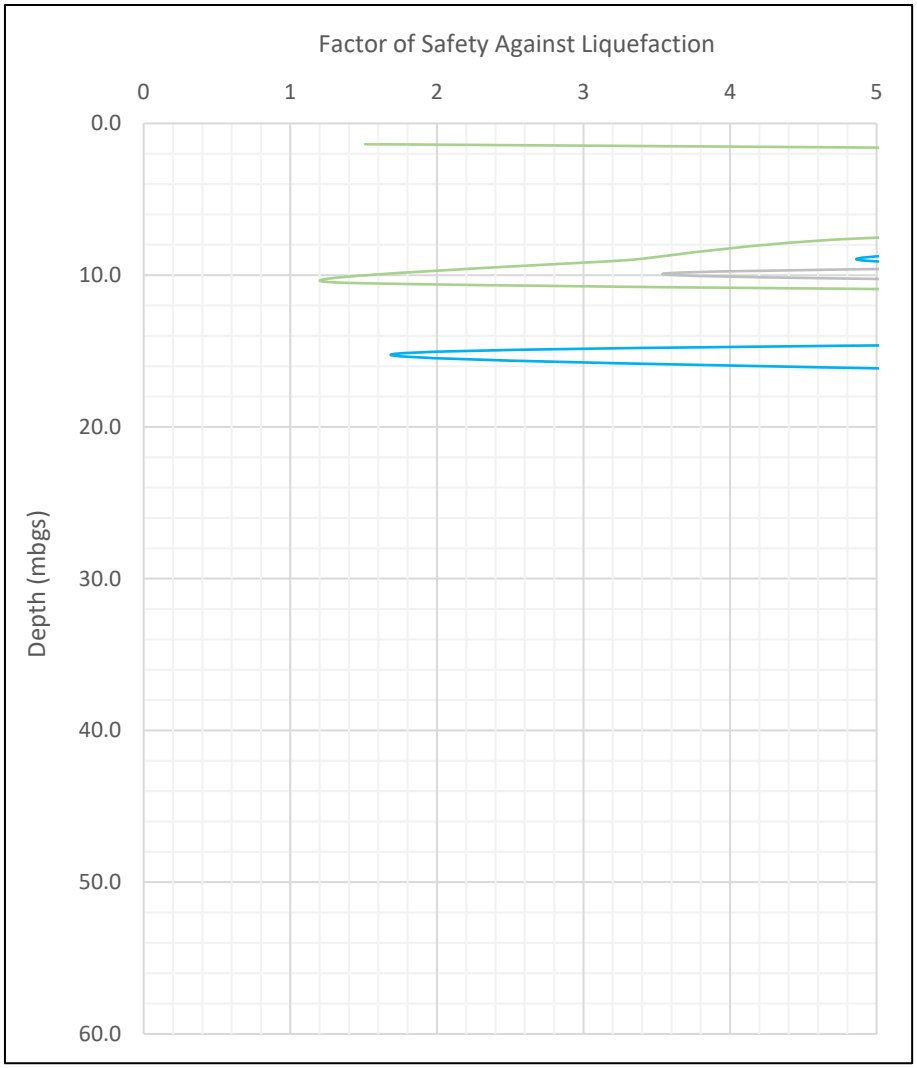
National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
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





NOTE: CYCLIC RATIOS GREATER THAN 2 AND FACTOR'S OF SAFETY GREATER THAN 5 NOT SHOWN FOR SCALING PURPOSES

LEGEND

- CRR BH20-01
- CRR BH20-02
- CRR BH20-03
- CRR BH20-04
- CSR for 1-in-475 yr (2015 NBCC)
- CSR for 1-in-975 yr (2015 NBCC)
- CSR for 1-in-2,475 yr (2015 NBCC)

CLIENT
ASSOCIATED ENGINEERING (BC) LTD.

CONSULTANT
GOLDER

YYYY-MM-DD	2020-09-30
PREPARED	J.BRUNSWICK
DESIGN	J.BRUNSWICK
REVIEW	P.BAKKER
APPROVED	M.YOGENDRAKUMAR

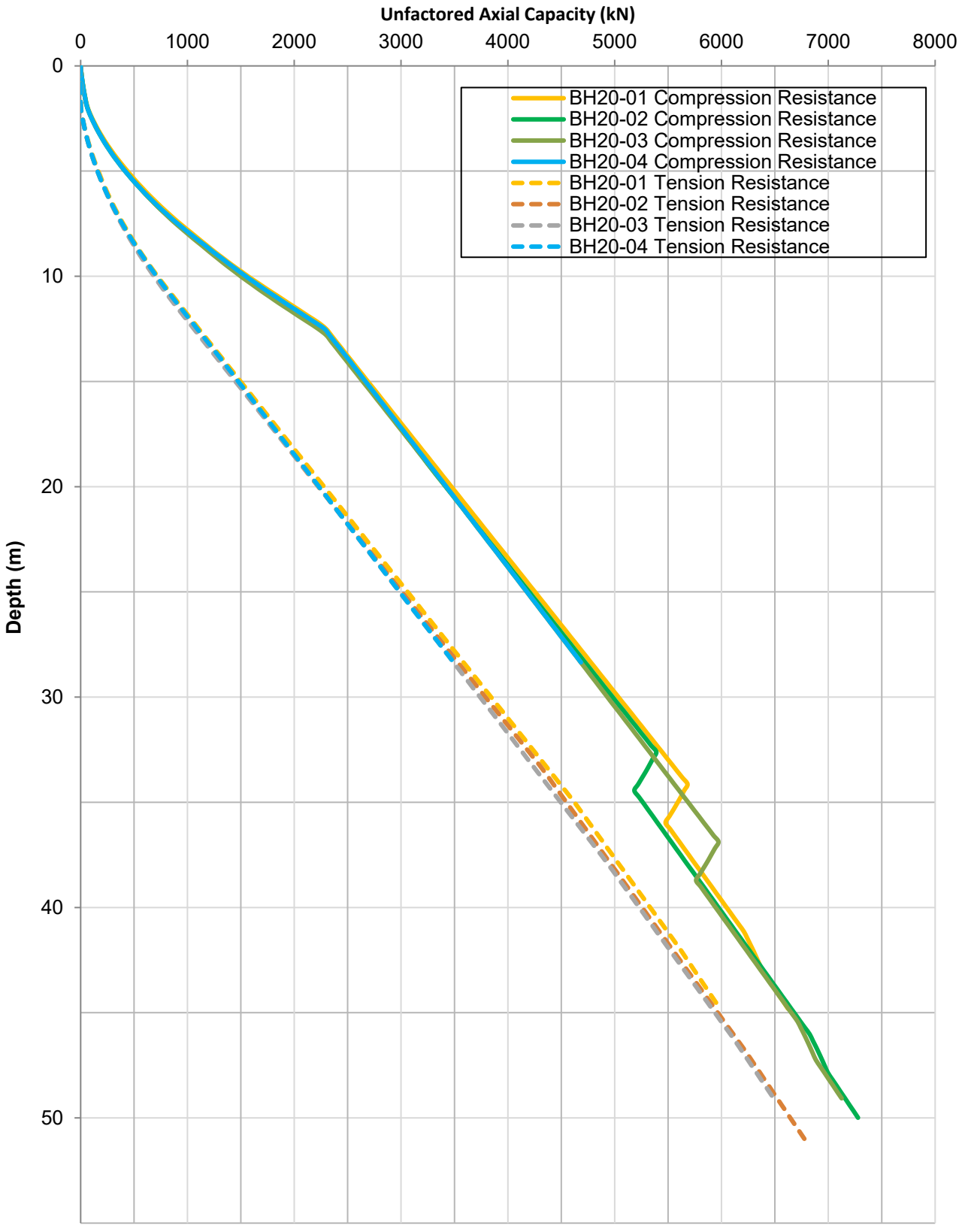
PROJECT
HIGHWAY 95 – KICKING HORSE RIVER BRIDGES
GOLDEN, BC

TITLE
PRELIMINARY LIQUEFACTION ASSESSMENT RESULTS

PROJECT No.	Phase	Rev	FIGURE
20139391	5000	0	C1

APPENDIX D

Axial Pile Capacity Plots



CLIENT
ASSOCIATED ENGINEERING (BC) LTD.

PROJECT
HIGHWAY 95 – KICKING HORSE RIVER BRIDGES
GOLDEN, BC

CONSULTANT
GOLDER

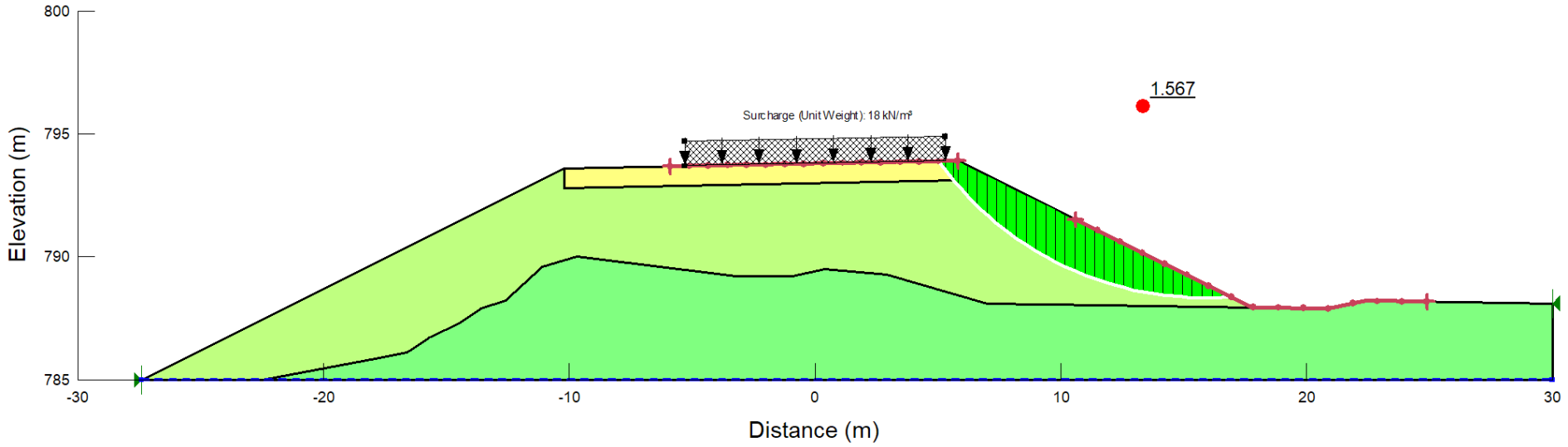
YYYY-MM-DD	2020-09-30
PREPARED	J.BRUNSWICK
DESIGN	J.BRUNSWICK
REVIEW	P.BAKKER
APPROVED	M.YOGENDRAKUMAR

TITLE
STEEL PIPE PILE 610 MM x 19 MM UNFACTORED AXIAL CAPACITY

PROJECT No	PHASE	Rev	FIGURE
20139391	5000	0	D1

APPENDIX E

Slope Stability Assessment



LEGEND

Color	Name	Unit Weight (kN/m³)	Phi' (°)
	Existing Granular Fill	19	36
	Pavement Structure	20	36
	Type D Fill	19	34

CLIENT
ASSOCIATED ENGINEERING (BC) LTD.

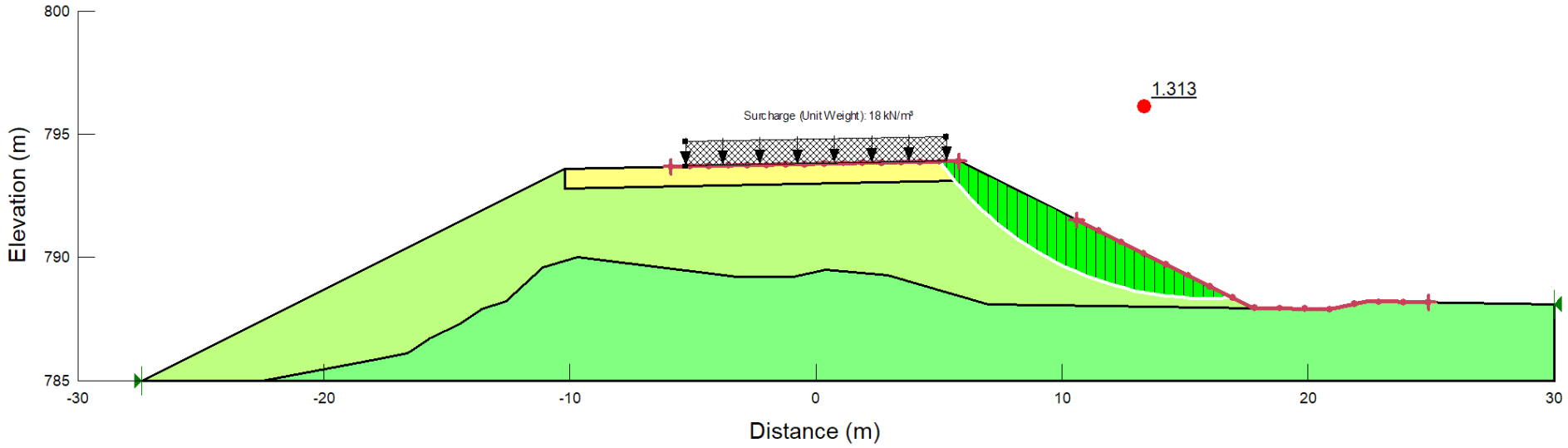
CONSULTANT
GOLDER

YYYY-MM-DD	2020-09-30
PREPARED	J.BRUNSWICK
DESIGN	J.BRUNSWICK
REVIEW	P.BAKKER
APPROVED	M.YOGENDRAKUMAR

PROJECT
HIGHWAY 95 – KICKING HORSE RIVER BRIDGES
GOLDEN, BC

TITLE
SLOPE STABILITY ASSESSMENT
NORTH ABUTMENT – STATIC ASSESSMENT

PROJECT No.	Phase	Rev	FIGURE
20139391	5000	0	E1



LEGEND

Color	Name	Unit Weight (kN/m³)	Phi' (°)
	Existing Granular Fill	19	36
	Pavement Structure	20	36
	Type D Fill	19	34

CLIENT
ASSOCIATED ENGINEERING (BC) LTD.

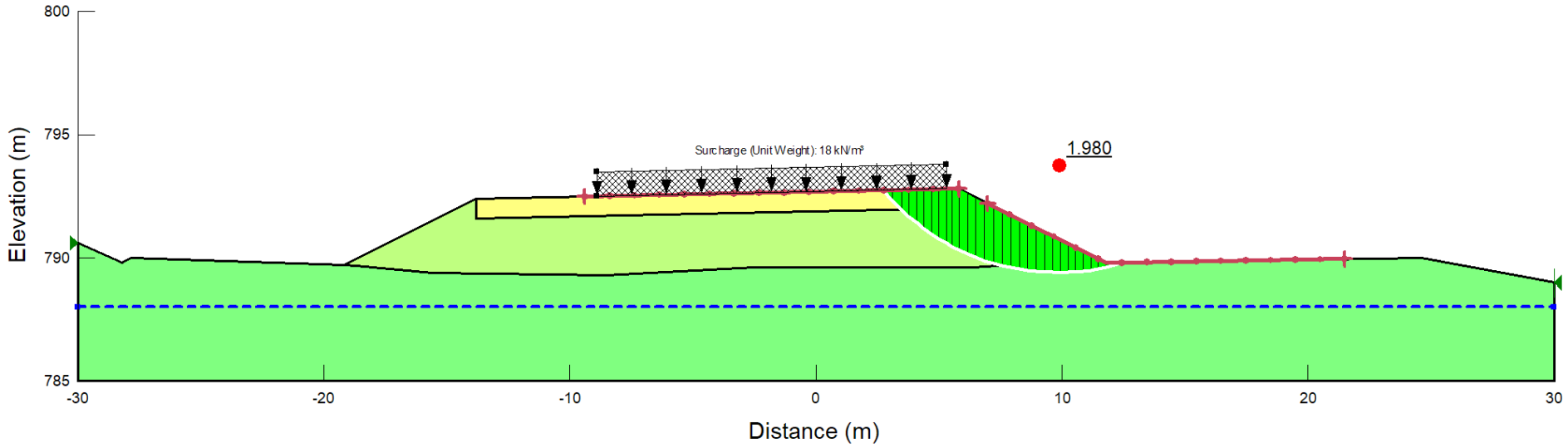
CONSULTANT
GOLDER

YYYY-MM-DD	2020-09-30
PREPARED	J.BRUNSWICK
DESIGN	J.BRUNSWICK
REVIEW	P.BAKKER
APPROVED	M.YOGENDRAKUMAR

PROJECT
HIGHWAY 95 – KICKING HORSE RIVER BRIDGES
GOLDEN, BC

TITLE
SLOPE STABILITY ASSESSMENT
NORTH ABUTMENT – SEISMIC ASSESSMENT (PGHA 0.08 g)

PROJECT No.	Phase	Rev	FIGURE
20139391	5000	0	E2



LEGEND

Color	Name	Unit Weight (kN/m³)	Phi' (°)
	Existing Granular Fill	19	36
	Pavement Structure	20	36
	Type D Fill	19	34

CLIENT
ASSOCIATED ENGINEERING (BC) LTD.

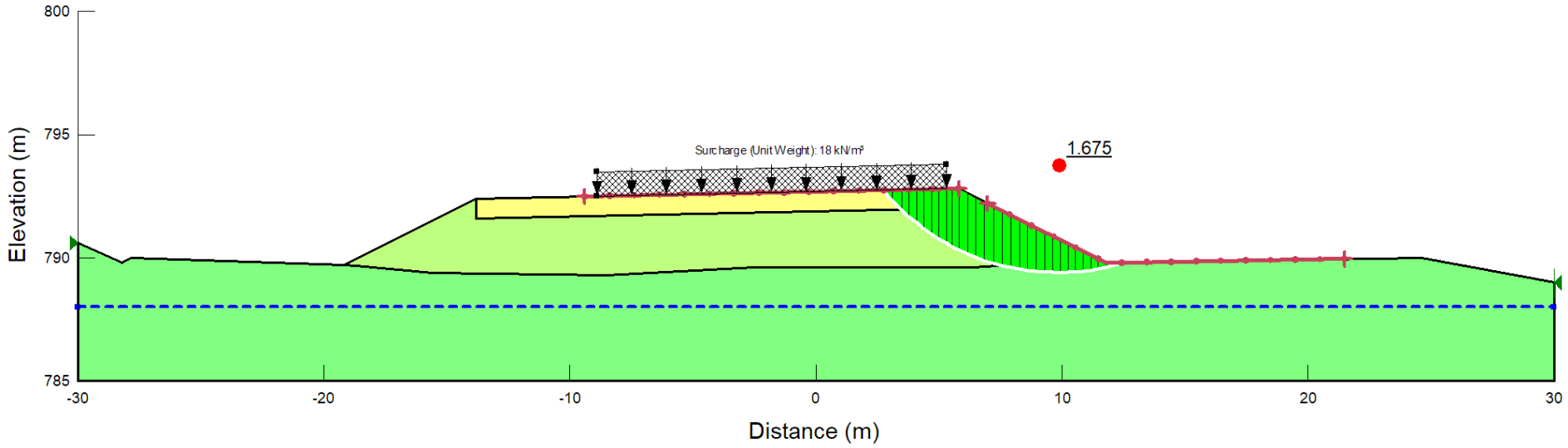
CONSULTANT
GOLDER

YYYY-MM-DD	2020-09-30
PREPARED	J.BRUNSWICK
DESIGN	J.BRUNSWICK
REVIEW	P.BAKKER
APPROVED	M.YOGENDRAKUMAR

PROJECT
HIGHWAY 95 – KICKING HORSE RIVER BRIDGES
GOLDEN, BC

TITLE
SLOPE STABILITY ASSESSMENT
SOUTH ABUTMENT – STATIC ASSESSMENT

PROJECT No.	Phase	Rev	FIGURE
20139391	5000	0	E3



LEGEND

Color	Name	Unit Weight (kN/m³)	Phi' (°)
	Existing Granular Fill	19	36
	Pavement Structure	20	36
	Type D Fill	19	34

CLIENT
ASSOCIATED ENGINEERING (BC) LTD.

CONSULTANT
GOLDER

YYYY-MM-DD	2020-09-30
PREPARED	J.BRUNSWICK
DESIGN	J.BRUNSWICK
REVIEW	P.BAKKER
APPROVED	M.YOGENDRAKUMAR

PROJECT
HIGHWAY 95 – KICKING HORSE RIVER BRIDGES
GOLDEN, BC

TITLE
SLOPE STABILITY ASSESSMENT
SOUTH ABUTMENT – SEISMIC ASSESSMENT (PGHA 0.08 g)

PROJECT No.	Phase	Rev	FIGURE
20139391	5000	0	E4

APPENDIX F

Nearby Water Well Records

BRITISH COLUMBIA

BC Environment

WTN 108705

Water Management Branch, Groundwater Section

WATER WELL RECORD

Date 04 09 22 (YR MO DY)

BCGS MAP 82N026314

WELL No. ____ ELEV ____ Location Accuracy ____

UTM Z11 505283 5683826 N G

UTM Date 19__ Well Type ____

Owners Name & Address Town of Golden c/o Golder Associates 04-1324-068

Legal Description & Address Station Ave., Golden B.C.

Descriptive Location ____

1. TYPE OF WORK: 1 [X] New Well 2 [ ] Reconditioned 3 [ ] Deepened 4 [ ] Abandoned

2. WORK METHOD: 1 [ ] Cable tool 2 [ ] Bored 3 [ ] Jetted 4 [X] Rotary a [ ] mud b [X] air c [ ] reverse [ ] Other ____

3. WATER WELL USE: 1 [ ] Domestic 2 [X] Municipal 3 [ ] Irrigation 4 [ ] Comm. & Ind. [ ] Other ____

4. DRILLING ADDITIVES: none

5. MEASUREMENTS from 1 [X] ground level 2 [ ] top of casing

casing height above ground level ____ ft.

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	20	Clay Sand Gravel	
20	100	Sand Gravel water	
100	102	Cemented Gravel	
102	137	Sand Gravel water	
137	350	Silt	
350	397	Silt Sand Gravel	
		- unable to drill any farther due to material hydraulicing up the casing.	
		- Thompson Drilling to try + advance the casing with his cable tool	

7. CONSULTANT ____

Address ____

8. WELL LOCATION SKETCH

9. CASING: Materials 1 [X] Steel 2 [ ] Galvanized 3 [ ] Wood 4 [ ] Plastic 5 [ ] Concrete [ ] Other ____

							units
Hole Diameter	6&8						ins
Diameter	6						ins
from	0						ft
to	397						ft
Thickness	250						ins
Weight	17						lb/ft

Pitless unit ____ ft 1 [ ] above 2 [ ] below ground level

1 [X] Welded 2 [ ] Cemented 3 [ ] Threaded | 1 [X] New 2 [ ] Used

Perforations: ____

Shoe(s): 1 carbide button

Open hole, from ____ to ____ ft Diameter ____ ins

Grout: ____

10. SCREEN: 1 [ ] Nominal (Telescope) 2 [ ] Pipe Size

Type 1 [ ] Continuous Slot 2 [ ] Perforated 3 [ ] Louvre [ ] Other ____

Material 1 [ ] Stainless Steel 2 [ ] Plastic [ ] Other ____

Set from ____ to ____ ft below ground level

RISER, SCREEN & BLANKS							units
Length							ft
Diam. I D							ins
Slot Size							ins
from							ft
to							ft

Fittings, top ____ bottom ____

Gravel Pack ____

11. DEVELOPED BY: 1 [ ] Surging 2 [ ] Jetting 3 [ ] Air 4 [ ] Bailing 5 [ ] Pumping [ ] Other ____

12. TEST 1 [ ] Pump 2 [ ] Bail 3 [ ] Air Date ____ (YR MO DY)

Rate ____ USgpm Temp ____ °C SWL before test ____ ft

Water Level ____ ft after test of ____ hrs

[ ] DRAWDOWN in ft				[ ] RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING ft	RECOMMENDED PUMPING RATE USgpm

14. WATER TYPE: 1 [ ] fresh 2 [ ] salty 3 [ ] clear 4 [ ] cloudy

colour ____ smell ____ ; gas 1 [ ] yes 2 [ ] no

15. WATER ANALYSIS: 1 Hardness ____ mg/L 2 Iron ____ mg/L 3 Chloride ____ mg/L 4 pH ____ Field Date ____ Lab Date ____ (YR MO DY)

SITE I D No ____

16. FINAL WELL COMPLETION DATA

Well Depth 397 ft Well Yield ____ US gpm

Static Water Level ____ ft Artesian Flow ____ US gpm Pressure Head ____ ft

Back filled ____

Well Head Completion welded plate

17. DRILLER PLEASE PRINT Woodford (SURNAME) Stan (FIRST NAME)

Signature ____ 0505290?

18. CONTRACTOR, Address OWEN'S DRILLING LTD
BOX 730
CRANBROOK, B.C. V1C 4J5

Member, B C G W A [X] yes [ ] no ; ____

Province of British Columbia Ministry of Environment Water Investigations Branch

WATER WELL RECORD

Date 81 (YR) 6 (MO) 29 (DY)

Legal Description & Address _____

Descriptive Location beside town theatre. Beside the River across town from other town well.

Owners Name & Address TOWN OF GOLDEN B.C. WELL #2

NTS MAP _____ ELEV _____ WELL No. _____

UTM Z _____ E _____ N _____ UTM Date 19__

1. TYPE OF WORK 1 ☑ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD 1 ☑ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☐ Rotary a ☐ mud b ☐ air c ☐ reverse 5 ☐ Other _____

3. WATER WELL USE 1 ☐ Domestic 2 ☑ Municipal 3 ☐ Irrigation 4 ☐ Commercial & Industrial 5 ☐ Other _____

4. DRILLING ADDITIVES _____

5. MEASUREMENTS from 1 ☐ ground level 2 ☑ top of casing

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	18	Dry Gravel	
18	28	Boulders and rocks	
28	80	Water bearing gravel	

7. CONSULTANT _____

Address _____

8. WELL LOCATION SKETCH

9. CASING: Materials 1 ☑ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete 6 ☐ Other _____

Hole Diameter							units
Diameter	12						ins
from	0						ft
to	80						ft
Thickness							ins
Weight							lb/ft

Pitless unit _____ ft 1 ☐ above 2 ☐ below ground level

1 ☑ Welded 2 ☐ Cemented 3 ☐ Threaded 4 ☑ New 5 ☐ Used

Perforations: _____

Shoe(s): ✓

Open hole, from _____ to _____ ft Diameter _____ ins

Grout: _____

10. SCREEN: 1 ☑ Nominal 2 ☐ Pipe Size

Type 1 ☑ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre 4 ☐ Other _____

Material 1 ☑ Stainless Steel 2 ☐ Plastic 3 ☐ Other _____

Set from 59 to 80 ft below ground level

SCREEN & BLANKS							units
Length	20						ft
Diam. I D	12						ins
Slot Size	120						ins
from	59						ft
to	80						ft

Fittings, top ✓ packer bottom Bail

Gravel Pack _____

11. DEVELOPED BY: 1 ☑ Surging 2 ☐ Jetting 3 ☐ Air 4 ☑ Bailing 5 ☐ Pumping 6 ☐ Other _____

12. TEST 1 ☑ Pump 2 ☐ Bail Date 81 (YR) 6 (MO) 27 (DY)

Rate 350 USgpm Temp ____ °C SWL before test 15 ft

53 ft after test of 48 hrs ____ mins

TIME in mins & DRAWDOWN in ft				TIME in mins & RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL
				1	20'		
				10	15'		

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
	60 ft	350 USgpm

14. WATER TYPE: 1 ☑ fresh 2 ☐ salty 3 ☑ clear 4 ☐ cloudy

colour _____ smell _____ ; gas 1 ☐ yes 2 ☑ no

15. WATER ANALYSIS: 1 ☐ Hardness _____ mg/l

2 ☐ Iron _____ mg/l 3 ☐ Chloride _____ mg/l

4 ☐ pH ____ Field Date ____

SITE I D No _____ Lab Date ____ (YR) (MO) (DY)

16. FINAL WELL COMPLETION DATA

Well Depth 80 ft Water Flowing _____ USgpm

Static Water Level 15 ft Pressure Head _____ ft

Back filled _____

Well Head Completion Capped

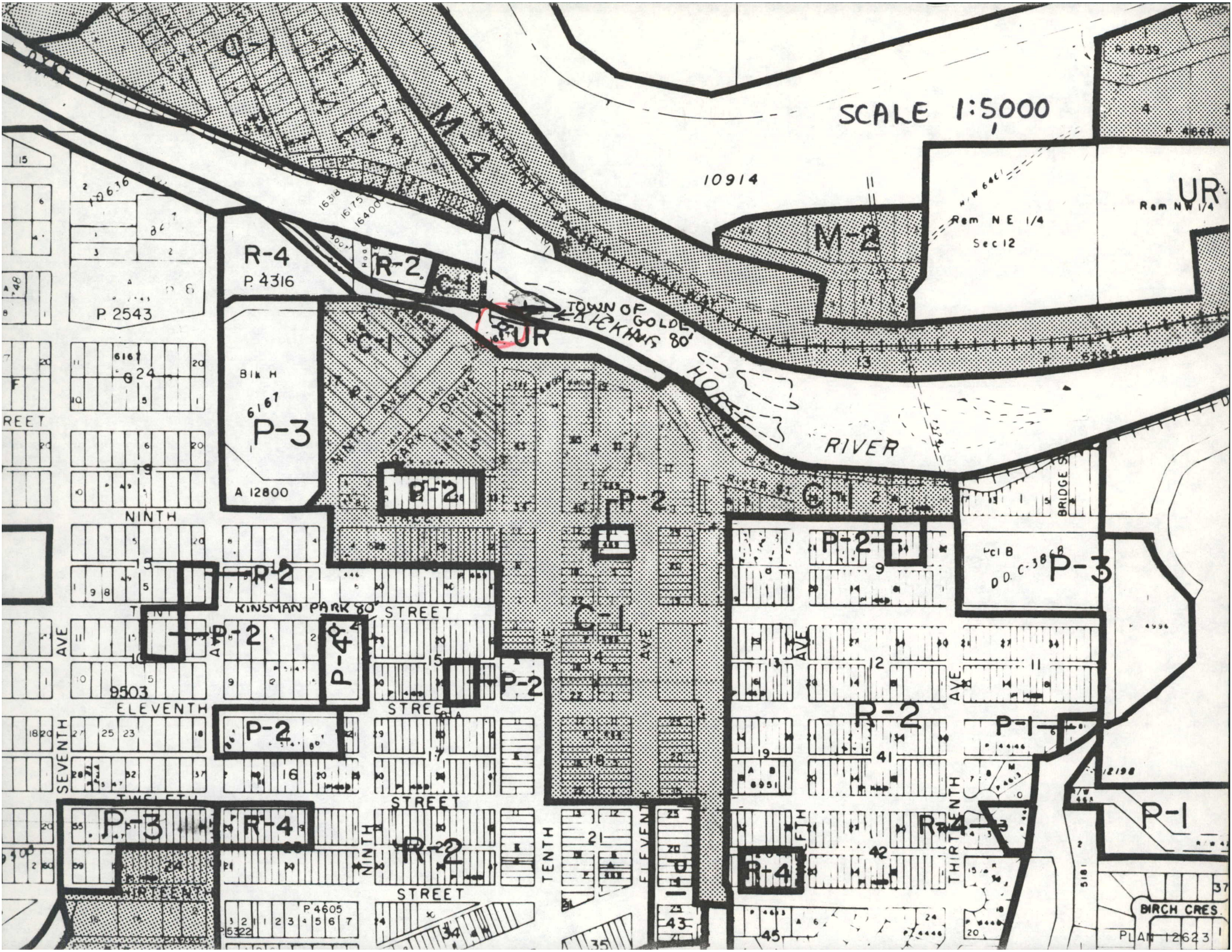
17. DRILLER PLEASE PRINT SURNAME THOMAS FIRST NAME CARL

Signature Carl Thomas

18. CONTRACTOR, Address

THOMAS WELL DRILLING
BOX 404 LUMBY B.C.

Member, BCWWDA ☑ yes ☐ no ; _____


SCALE 1:5,000
C-1
M-4
M-2
UR
Rem NE 1/4
Sec 12
Rem NW 1/4
10914
R-4
P 4316
P 2543
R-2
C-1
UR
TOWN OF GOLDEN
LICKHAUS 80'
HORSE
RIVER
Blk H
6167
P-3
A 12800
P-2
NINTH
AVE
PARK
DRIVE
RIVER ST
BRIDGE
KINSMAN PARK 80'
STREET
9503
ELEVENTH
SEVENTH
TWELFTH
TENTH
THIRTEENTH
P-4
R-2
P-1
R-4
P 4605
BIRCH CRES.
PLAN 12623

82N.026.3.3.4 WT-NO: 48403 OBSERVATION WELL NO. 308

Well #6

WATER WELL RECORD

DEPT. OF ENVIRONMENT, WATER RESOURCES SERVICE, WATER INVESTIGATIONS BRANCH VICTORIA, BRITISH COLUMBIA

12

Z [ ] [ ] WELL NO. [ ] [ ] [ ]

[ ] [ ] [ ] [ ] [ ] [ ] [ ] E

[ ] [ ] [ ] [ ] [ ] [ ] [ ] N

LEGAL DESCRIPTION: LOT ____ SEC. 1 TP. 27 R. 22 W5 D.L. 5 LAND DISTRICT KOOTENAY PLAN ____

DESCRIPTIVE LOCATION Beside river beside town theatre across town from other town well Golden LICENCE NO. ____ DATE ____

Z 27 X 17 Y 1 NO. 15

OWNER'S NAME TOWN OF GOLDEN ADDRESS ____

DRILLER'S NAME ____ ADDRESS ____ DATE COMPLETED 29/6/81

NAT. TOPO. SHEET NO. 18

DEPTH 80' ELEVATION OF ____ ☐ ESTIMATED ☐ SURVEYED CASING DIAM. 12" LENGTH 80'

METHOD OF CONSTRUCTION cable tool CASING DIAM ____ LENGTH ____

SCREEN LOCATION 59'-80' SCREEN ☐ SIZE ____ LENGTH ____ TYPE cont. slot. S.S.

SANITARY SEAL YES ☐ NO ☐ SCREEN ☐ SIZE ____ LENGTH ____ TYPE ____

PERFORATED CASING ☐ LENGTH ____ PERFORATIONS FROM ____ TO ____

GRAVEL PACK ☐ LENGTH ____ DIAM. ____ SIZE GRAVEL, ETC. ____

DISTANCE TO WATER 15' ☐ ESTIMATED WATER LEVEL

FROM ____ ☐ MEASURED ELEVATION ____ ARTESIAN PRESSURE ____

DATE OF WATER LEVEL MEASUREMENT ____ WATER USE municipal

PRODUCTION TEST SUMMARY

DATE 27/6/81

TEST BY ____

BAIL TEST ☐ PUMP TEST ☑ DURATION OF TEST 48 hours

RATE 350 gpm DRAWDOWN ____

WATER LEVEL AT COMPLETION OF TEST 53'

AVAILABLE DRAWDOWN ____ SPECIFIC CAPACITY ____

PERMEABILITY ____ STORAGE COEFF. ____

TRANSMISSIVITY ____

RECOMMENDED PUMPING RATE 350 gpm

RECOMMENDED PUMP SETTING 60'

CHEMISTRY

TEST BY ____ DATE ____

TOTAL DISSOLVED SOLIDS ____ mg/l TEMPERATURE ____ °C pH ____ SILICA (SiO_2) ____ mg/l

CONDUCTANCE ____ μmhos/cm AT 25°C TOTAL IRON (Fe) ____ mg/l TOTAL HARDNESS ($CaCO_3$) ____ mg/l

TOTAL ALKALINITY ($CaCO_3$) ____ mg/l PHEN. ALKALINITY ($Ca\ CO_3$) ____ mg/l MANGANESE (Mn) ____ mg/l

COLOUR ____ ODOUR ____ TURBIDITY ____

ANIONS	mg/l	epm	CATIONS	mg/l	epm
CARBONATE (CO_3)			CALCIUM (Ca)		
BICARBONATE (HCO_3)			MAGNESIUM (Mg)		
SULPHATE (SO_4)			SODIUM (Na)		
CHLORIDE (Cl)			POTASSIUM (K)		
$NO_2 + NO_3$ (NITROGEN)			IRON (DISSOLVED)		
* TKN. (NITROGEN)					
PHOSPHORUS (P)					

* TKN = TOTAL KJELDAHL NITROGEN CHEMISTRY SITE NO. E208035

NO_2 = NITRITE NO_3 = NITRATE

CHEMISTRY FIELD TESTS

TEST BY ____ DATE ____ EQUIPMENT USED ____

LITHOLOGY

FROM	TO	DESCRIPTION
0	18	dry gravel
18	28	boulders and rocks
28	80	water bearing gravel
NOV	1985	LOCATED BY MR PHILIPS TOWN WATER ENGINEER ALSO SEE BACK OF CARD

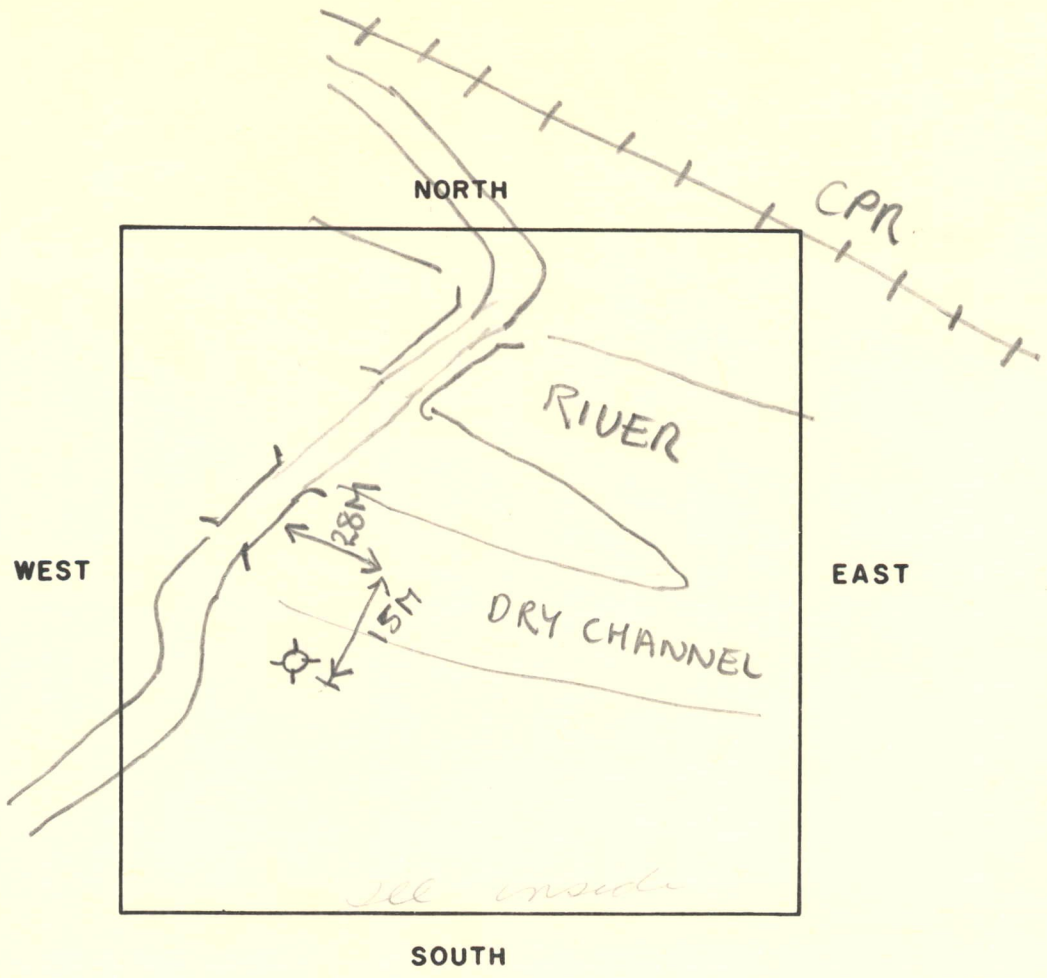
CONTENTS OF FOLDER

☑ DRILL LOG ☐ PUMP TEST DATA ☐ CHEMICAL ANALYSIS

☐ SIEVE ANALYSIS ☐ GEOPHYSICAL LOGS ☐ REPORT

OTHER Established as an observation well Oct 20, 1989
Refer to file 0183613-B-308

SOURCES OF INFORMATION driller



CARD BY MORAVCIK 82 DATE _____

ADDITIONAL DATA ADDED BY _____

REMARKS

82N.026.3.3.4

#64WTN 16956

MERIDIAN | RANGE | SECTION | QUARTER | LAND DISTRICT

GROUND — WATER DIVISION, WATER INVESTIGATIONS BRANCH, DEPT. OF LANDS, FORESTS, and WATER RESOURCES, VICTORIA, B.C.

LOCATION (COMPLETE LEGAL DESCRIPTION) EAST KOOTENAY DIST. (227-XII 41)

OWNER'S NAME ARL MOTEL (AL WESCOTT) ADDRESS 10TH. AVE. E. & 9TH. ST. S., GOLDEN

DRILLER'S NAME BECKER DRILLING ADDRESS DATE OF COMPLETION 1961

DEPTH 100' ELEVATION OF COLLAR 928 CASING DIAM. LENGTH TYPE

METHOD OF DIGGING DRILLED SCREEN ☐ SIZE LENGTH TYPE

LOCATION OF SCREEN DEVELOPED ☐ DESCRIBE 82N/7dW

PERFORATED CASING ☐ LENGTH LOCATION OF PERFORATIONS

GRAVEL PACK ☐ LENGTH DIAM. SIZE GRAVEL, ETC.

PUMP ☐ TYPE POWER

CAPACITY OTHER DATA

COSTS WELL PUMP PUMP HOUSE, ETC.

MAINTENANCE

DISTANCE TO WATER FROM TOP OF CASING 40' ☑ ESTIMATED ☐ MEASURED ELEVATION FLUCTUATION

HIGH WATER MONTH LOW WATER MONTH OBSERVATION DATA ☐ FILE No.

WATER USE IT WAS A VERY GOOD SUPPLY AND THEY SUPPLIED 40 UNITS FROM IT BUT SINCE VILLAGE WATER WAS INTRODUCED THEY HAVE NOT HAD TO USE IT.

MAX. RATE WITHDRAWAL ☑ ESTIMATED ☐ MEASURED Good supply

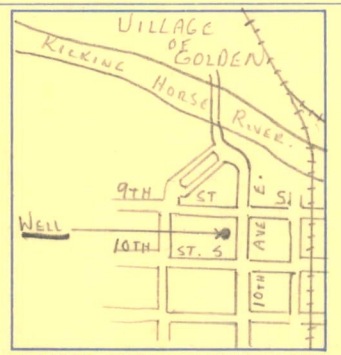
TEMPERATURE PUMPS SAND ☐

CLOGS SCREEN ☐ TYPE DEPOSIT AQUIFER DATA

LICENSE No. DATE LICENSE AMOUNT

DATE APPLICATION USE

SHT. 18



LOCATION SKETCH—INDICATE NORTH

METHOD: DUG, DRIVEN, DRILLED, JETTED, BORED

DEPTH: 0 — 25, 25 — 50, 50 — 100, 100 — 200, 200 — 400, >400

TYPE WELL: OBSERVATION, ABANDONED, DEVELOPED, SCREEN, PERF. CASING, GRAVEL ENV., PUMP

TYPE WELL: FLOWING, NON-FLOW ARTESIAN, WATER TABLE, PART CONFINED

WATER QUALITY: ANALYSIS, SOFT, HARD ✓, HIGH IRON, HIGH SULPHUR, SALTY, ALKALINE, SALINE, POLLUTED, INADEQUATE QUALITY

CAPACITY GPD.: DRY HOLE, INADEQUATE QUANTITY, PUMPING TEST; 0 — 10^3, 10^3 — 10^4, 10^4 — 10^5, 10^5 — 10^6, 10^6

CHARACTER OF SUPPLY AQUIFER: SAND, GRAVEL, TILL

WATER USE: DOMESTIC, GARDEN, STOCK, COOLING, IRRIGATION, INDUSTRIAL, WATERWORKS

RELIABILITY OF DATA: GOOD, FAIR, POOR

ROCK, SPRING

SUPPLY AQUIFER — TENS, UNITS

OTHER AQUIFER PRESENT — TENS, UNITS

OTHER AQUIFER PRESENT — TENS, UNITS

SYSTEMS EQUIPMENT LIMITED. VICTORIA—CANADA O 2231-65 SystemSort

82N.036.1.1.2

MERIDIAN | RANGE (TENS, UNITS) | SECTION (TENS, UNITS) | QUARTER (NE SE SW NW) | LAND DISTRICT (TENS, UNITS)

MUNICIPALITY (TENS, UNITS)

SEE WTN 14555 OF GOLDEN MAP

WTN 14555

WATER RIGHTS BRANCH, DEPT. OF LANDS, FORESTS and WATER RESOURCES, VICTORIA, B.C.

(Z29 X4.7 Y1) WR 13

LOCATION (COMPLETE LEGAL DESCRIPTION) KOOTENAY DISTRICT (EAST)

OWNER'S NAME IMPERIAL BANK OF COMMERCE ADDRESS GOLDEN B.C. 10"

DRILLER'S NAME G. & G. ADDRESS DATE OF COMPLETION AUG. 6 1955

DEPTH 51 ELEVATION OF COLLAR 086 CASING DIAM. LENGTH TYPE

METHOD OF DIGGING DRILLED SCREEN ☒ SIZE LENGTH 6' TYPE

PERFORATED CASING ☐ LENGTH SIZE OPENINGS DEVELOPED ☐ DESCRIBE

82N/7dw

GRAVEL PACK ☐ LENGTH DIAM. SIZE GRAVEL, ETC.

PUMP ☐ TYPE POWER

CAPACITY OTHER DATA

COSTS WELL PUMP PUMP HOUSE, ETC.

MAINTENANCE

DISTANCE TO WATER FROM TOP OF CASING 9'6" ☐ ESTIMATED ☒ MEASURED ELEVATION FLUCTUATION

HIGH WATER MONTH LOW WATER MONTH OBSERVATION DATA ☐ FILE No.

WATER USE

MAX. RATE WITHDRAWAL ☐ ESTIMATED ☐ MEASURED

TEMPERATURE PUMPS SAND ☐

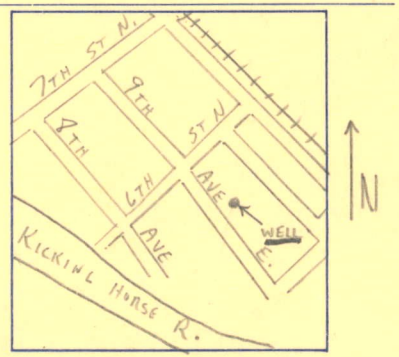
CLOGS SCREEN ☐ TYPE DEPOSIT AQUIFER DATA SAND + GRAVEL

LICENSE No. DATE LICENSE AMOUNT

DATE APPLICATION USE

SHT. 1 B

9TH AVE EAST BETWEEN 5TH. AND 6TH ST. NORTH



LOCATION SKETCH—INDICATE NORTH

GOLDEN

WATER QUALITY: ANALYSIS, SOFT, HARD, HIGH IRON, HIGH SULPHUR, SALTY, ALKALINE, SALINE, POLLUTED, INADEQUATE QUALITY

METHOD: DUG, DRIVEN, DRILLED ✓, JETTED, BORED

DEPTH: 0 — 25, 25 — 50, 50 — 100 ✓, 100 — 200, 200 — 400, >400

TYPE WELL: OBSERVATION, ABANDONED, DEVELOPED, SCREEN ✓, PERF. CASING, GRAVEL ENV., PUMP, FLOWING, NON-FLOW ARTESIAN, WATER TABLE ✓, PART CONFINED

CAPACITY GPD: DRY HOLE, INADEQUATE QUANTITY, PUMPING TEST; $0 - 10^3$, $10^3 - 10^4$, $10^4 - 10^5$, $10^5 - 10^6$ ✓, $> 10^6$

CHARACTER OF SUPPLY AQUIFER: SAND, GRAVEL ✓, TILL

WATER USE: HOUSEHOLD, GARDEN, STOCK, COOLING, IRRIGATION, INDUSTRIAL, WATERWORKS

RELIABILITY OF DATA: GOOD, FAIR ✓, POOR

SUPPLY AQUIFER TENS	SUPPLY AQUIFER UNITS	OTHER AQUIFER PRESENT TENS	OTHER AQUIFER PRESENT UNITS	OTHER AQUIFER PRESENT TENS	OTHER AQUIFER PRESENT UNITS

LOG

FROM	TO	DESCRIPTION	NAME
0	5'	CLAY	
5'	9	GRAVEL + BOULDERS	
9	18	SAND + GRAVEL	
18	22	HARD PAN	
22	38	GRAVEL	
38	51	SAND + GRAVEL (WB)	

SAMPLE No. _____ DATE _____

LAB. _____

COLIFORM ORGANISMS _____

TOTAL BACTERIA _____

COLOUR _____ ODOUR _____

TASTE _____

PUMPING TEST SUMMARY

TEST BY _____

DATE _____ FILE No. _____

SPECIFIC CAPACITY _____ PERMIABILITY _____

STORAGE COEFF _____ POROSITY _____

REMARKS _____

YIELD 600 I.G.P.M.

ANALYSIS

	PPM
Total Hardness	
Carbonate Hard	
Magnesium Hard	
Fe	
SO_2	
Ca	
Mg	
Na	
K	
HCO_3	
CO_3	
Cl	
SO_4	
NO_3	
B	
E	
Total Dis-solids	
Total Alkalinity	
Suspended Solids	
Ph	

OTHER DATA

SIZE ANALYSIS, ETC. _____

CARD BY D. J. DATE March. 1964

SOURCES INFORMATION G.S.C.

82N.026.3.3.4

WTN 14523

WATER RIGHTS BRANCH, DEPT. OF LANDS AND FORESTS, VICTORIA, B.C.

MERIDIAN | RANGE | SECTION (NT-No? 14523) | QUARTER (NE SE SW NW) | LAND DISTRICT

(Z29-X19-Y1) Kootenay District West

LOCATION (COMPLETE LEGAL DESCRIPTION)

OWNER'S NAME F. BRADFORD # 2 Well ADDRESS Golden B.C.

DRILLER'S NAME Bud Henning ADDRESS DATE OF COMPLETION Apr/55

DEPTH 32' ELEVATION OF COLLAR (62') CASING DIAM. 6" Ø LENGTH TYPE

METHOD OF DIGGING Drilled SCREEN ☒ SIZE LENGTH 4' TYPE

PERFORATED CASING ☐ LENGTH SIZE OPENINGS DEVELOPED ☐ DESCRIBE

82N/7dw

GRAVEL PACK ☐ LENGTH DIAM. SIZE GRAVEL, ETC.

PUMP ☐ TYPE POWER

CAPACITY OTHER DATA

COSTS WELL PUMP PUMP HOUSE, ETC.

MAINTENANCE

DISTANCE TO WATER FROM TOP OF CASING 15' M ☐ ESTIMATED ☐ MEASURED ELEVATION FLUCTUATION

HIGH WATER MONTH LOW WATER MONTH OBSERVATION DATA ☐ FILE No.

WATER USE

MAX. RATE WITHDRAWAL ☐ ESTIMATED ☐ MEASURED Capacity 100 IGPM

TEMPERATURE PUMPS SAND ☐

CLOGS SCREEN ☐ TYPE DEPOSIT AQUIFER DATA

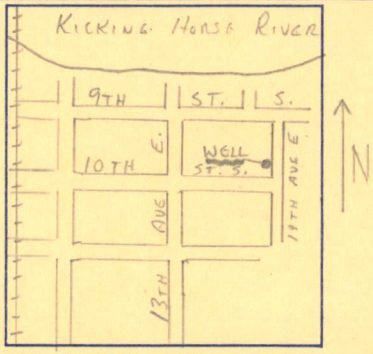
Sand and gravel

LICENSE No. DATE LICENSE AMOUNT

DATE APPLICATION USE

SHT 1 B

14TH Ave East of 10TH ST. South
Well is capped now and is on city water.



LOCATION SKETCH—INDICATE NORTH

METHOD: DUG, DRIVEN, DRILLED, JETTED, BORED

DEPTH: 0 — 25, 25 — 50, 50 — 100, 100 — 200, 200 — 400, >400

OBSERVATION, ABANDONED, DEVELOPED, SCREEN*, PERF. CASING, GRAVEL ENV., PUMP

TYPE WELL: FLOWING, NON-FLOW ARTESIAN, WATER TABLE, PART CONFINED

WATER QUALITY: ANALYSIS, SOFT, HARD, HIGH IRON, HIGH SULPHUR, SALTY, ALKALINE, SALINE, POLLUTED, INADEQUATE QUALITY

CAPACITY GPD.: DRY HOLE, INADEQUATE QUANTITY, PUMPING TEST; 0 — 10^3, 10^3 — 10^4, 10^4 — 10^5, 10^5 — 10^6, > 10^6

MUNICIPALITY: TENS, UNITS

CHARACTER OF SUPPLY AQUIFER: SAND, GRAVEL, TILL

WATER USE: HOUSEHOLD, GARDEN, STOCK, COOLING, IRRIGATION, INDUSTRIAL, WATERWORKS

RELIABILITY OF DATA: GOOD, FAIR, POOR

SUPPLY AQUIFER		OTHER AQUIFER PRESENT		OTHER AQUIFER PRESENT	
TENS	UNITS	TENS	UNITS	TENS	UNITS
1 2 4 7	1 2 4 7	1 2 4 7	1 2 4 7	1 2 4 7	1 2 4 7

SYSTEMS EQUIPMENT LIMITED, VICTORIA—CANADA 0 1065 SYSTEMSORT

LOG

FROM	TO	DESCRIPTION	NAME
0	2	Topsoil	
2	8	Yellow clay	
8	11	Sand and gravel w/boulders	
11	18	Hardpan	
18	32	Sand and gravel W/B	

SAMPLE No. _____ DATE _____

LAB. _____

COLIFORM ORGANISMS _____

TOTAL BACTERIA _____

COLOUR _____ ODOUR _____

TASTE _____

PUMPING TEST SUMMARY

TEST BY _____

DATE _____ FILE No. _____

SPECIFIC CAPACITY _____ PERMIABILITY _____

STORAGE COEFF _____ POROSITY _____

REMARKS _____

OTHER DATA

SIZE ANALYSIS. ETC. _____

CARD BY DMA DATE 8/62

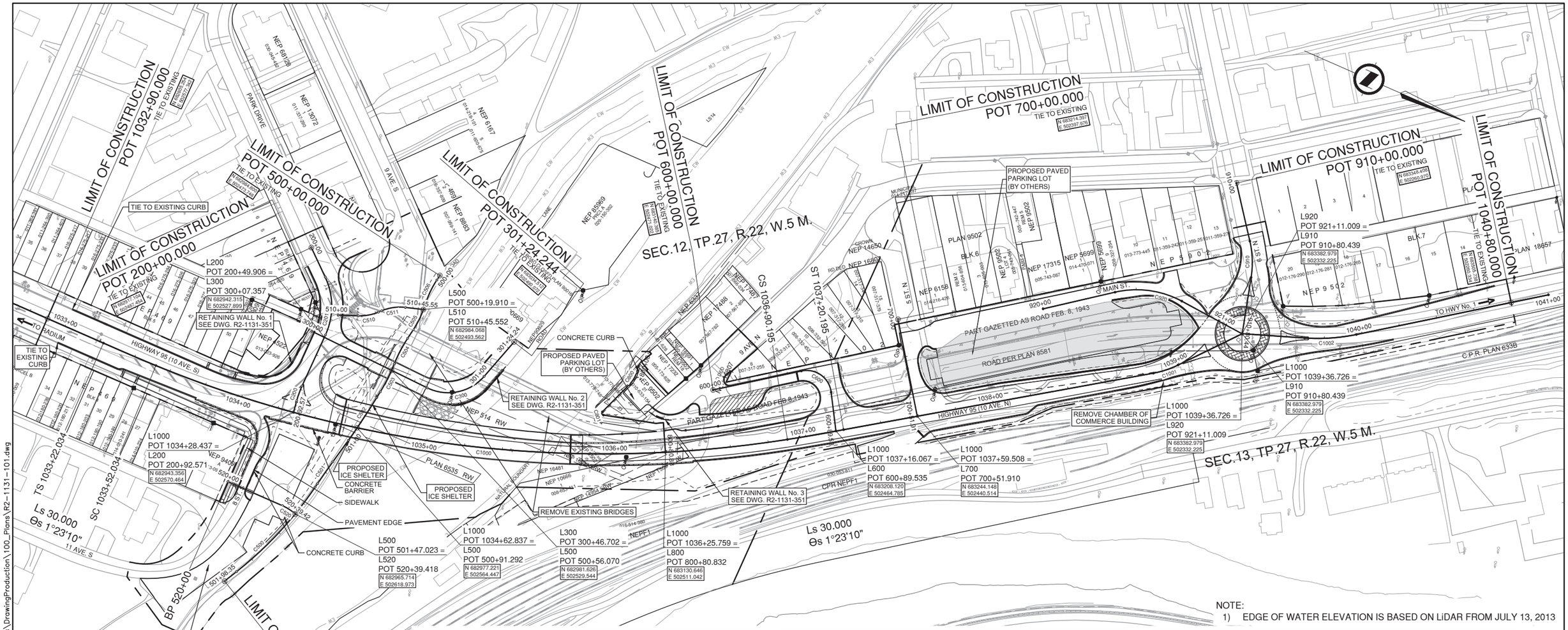
SOURCES INFORMATION Henning

ANALYSIS

	PPM
Total Hardness	
Carbonate Hard	
Magnesium Hard	
Fe	
SO_2	
Ca	
Mg	
Na	
K	
HCO_3	
CO_3	
Cl	
SO_4	
NO_3	
B	
E	
Total Dis-solids	
Total Alkalinity	
Suspended Solids	
Ph	

APPENDIX G

100% Preliminary Design Reference Drawings



CURVE DATA							
TAG	RADIUS	Δ	Tc	ARC LENGTH	Ec	P.I.	STATIONS
C200	50.000	009°25'54"	4.125	8.231	0.170	P.I. STA. 200+82.145 P.I. N. 682941.807 P.I. E. 502560.134	B.C. 200+78.020 E.C. 200+86.251
C201	36.000	049°46'32"	16.701	31.275	3.685	P.I. STA. 200+33.849 P.I. N. 682942.601 P.I. E. 502509.718	B.C. 200+17.148 E.C. 200+48.423
C300	25.000	075°06'23"	19.220	32.771	6.534	P.I. STA. 300+86.815 P.I. N. 683021.703 P.I. E. 502531.222	B.C. 300+67.595 E.C. 301+00.366
C500	200.000	017°23'54"	30.601	60.732	2.328	P.I. STA. 501+60.146 P.I. N. 682963.953 P.I. E. 502632.005	B.C. 501+29.545 E.C. 501+90.276
C501	500.000	001°36'00"	6.982	13.963	0.049	P.I. STA. 501+20.233 P.I. N. 682971.238 P.I. E. 502592.762	B.C. 501+13.251 E.C. 501+27.214
C502	350.000	004°25'41"	13.531	27.049	0.261	P.I. STA. 500+85.872 P.I. N. 682978.453 P.I. E. 502559.153	B.C. 500+72.340 E.C. 500+99.390
C503	100.000	009°26'13"	8.254	16.471	0.340	P.I. STA. 500+60.645 P.I. N. 682981.833 P.I. E. 502534.116	B.C. 500+52.391 E.C. 500+68.862
C504	75.000	011°22'01"	7.464	14.879	0.371	P.I. STA. 500+44.659 P.I. N. 682981.344 P.I. E. 502518.089	B.C. 500+37.195 E.C. 500+52.075
C505	50.000	013°30'06"	5.919	11.782	0.349	P.I. STA. 500+25.956 P.I. N. 682984.478 P.I. E. 502499.594	B.C. 500+20.037 E.C. 500+31.819
C506	50.000	013°36'43"	5.967	11.879	0.355	P.I. STA. 500+08.801 P.I. N. 682983.312 P.I. E. 502482.423	B.C. 500+02.834 E.C. 500+14.713
C510	25.000	024°41'53"	5.473	10.777	0.592	P.I. STA. 510+16.152 P.I. N. 682959.227 P.I. E. 502508.321	B.C. 510+10.679 E.C. 510+21.455

CURVE DATA							
TAG	RADIUS	Δ	Tc	ARC LENGTH	Ec	P.I.	STATIONS
C511	25.000	029°10'16"	6.505	12.728	0.833	P.I. STA. 510+29.825 P.I. N. 682968.777 P.I. E. 502498.299	B.C. 510+23.320 E.C. 510+36.048
C520	25.000	015°55'47"	3.498	6.951	0.244	P.I. STA. 520+34.782 P.I. N. 682961.212 P.I. E. 502617.688	B.C. 520+31.284 E.C. 520+38.235
C600	13.000	095°05'20"	14.209	21.575	6.259	P.I. STA. 600+61.649 P.I. N. 683190.369 P.I. E. 502434.935	B.C. 600+47.440 E.C. 600+69.015
C800	15.000	027°05'35"	3.614	7.093	0.429	P.I. STA. 800+07.530 P.I. N. 683100.306 P.I. E. 502482.639	B.C. 800+03.916 E.C. 800+11.009
C801	1.000	125°33'55"	1.944	2.192	1.186	P.I. STA. 800+33.219 P.I. N. 683091.074 P.I. E. 502506.757	B.C. 800+31.275 E.C. 800+33.466

CURVE DATA							
TAG	RADIUS	Δ	Tc	ARC LENGTH	Ec	P.I.	STATIONS
C910	50.000	021°58'15"	9.706	19.173	0.933	P.I. STA. 910+40.982 P.I. N. 683372.894 P.I. E. 502293.833	B.C. 910+31.276 E.C. 910+50.449
C920	50.000	041°25'26"	18.905	36.149	3.455	P.I. STA. 920+57.700 P.I. N. 683328.190 P.I. E. 502327.754	B.C. 920+38.795 E.C. 920+74.944
C1000	620.000	031°15'01"	173.401	338.161	23.792	P.I. STA. 1035+25.435 P.I. N. 683041.994 P.I. E. 502577.183	B.C. 1033+52.034 E.C. 1036+90.195
C1001	50.000	015°40'22"	6.881	13.677	0.471	P.I. STA. 1038+92.437 P.I. N. 683354.272 P.I. E. 502366.063	B.C. 1038+85.556 E.C. 1038+99.233
C1002	100.000	015°37'41"	13.723	27.276	0.937	P.I. STA. 1039+83.407 P.I. N. 683426.858 P.I. E. 502316.379	B.C. 1039+69.684 E.C. 1039+96.960

NOTE:
1) EDGE OF WATER ELEVATION IS BASED ON LiDAR FROM JULY 13, 2013

100% PRELIMINARY 2020-09-30

FOR PROFILES SEE DWG. No. R2-1131-201 TO 204

FOR TYPICAL SECTIONS SEE DWG. No. R2-1131-301 TO 303

FOR LANING, GEOMETRICS SEE DWG. No. R2-1131-401

FOR DRAINAGE AND UTILITIES SEE DWG. No. R2-1131-701

DESIGN SPEED 50 km/h L1000

DESIGN SPEED 30 km/h L200, L700, L910, L920

DESIGN SPEED 20 km/h L300, L600

Associated Engineering
Suite 500 - 2889 East 12th Avenue, Vancouver, British Columbia, V5M 4T5
Ph: 604 883 1411 Fax: 604 291 6193
www.ae.ca

SCALE 0 10 1:1000 50m

CAD FILENAME R2-1131-101

PLOT DATE 9/30/2020

REV	DATE	REVISIONS	NAME

BRITISH COLUMBIA

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
SOUTHERN INTERIOR REGION
HIGHWAY ENGINEERING AND GEOMATICS

PLAN

HIGHWAY 95 - KICKING HORSE RIVER BRIDGE 1 AND 2 REPLACEMENT AND APPROACHES

STA. 1032+90.000 TO 1042+80.000

S. KING
SENIOR DESIGNER
DATE 2020-09-30

DESIGNED YASUI / ZHANG DATE 2020-09-30
QUALITY CONTROL S. KING DATE 2020-09-30
QUALITY ASSURANCE L. MARR DATE 2020-09-30
DRAWN B. MORRISON DATE 2020-09-30

FILE NUMBER	PROJECT NUMBER	REG	DRAWING NUMBER	REV
2020-2898-00	23325-0000	2	R2-1131-101	

PLOT DATE: 2020/09/30 \\S-van-fs-01\working\2020-2898-00\civil\model\MoTI_Working_Drawings\DrawingProduction\100_Plans\R2-1131-101.dwg

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