



Geotechnical Engineering Report Highway 93S – Kootenay Parkway

Report Prepared for
Parks Canada Agency

March 2016



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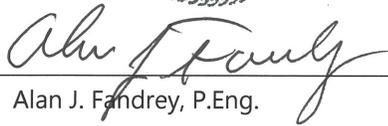
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Certifications

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the Province of British Columbia.




Alan J. Fandrey, P.Eng.

License No.: 192139

March 21, 2016

Date

1.0 Introduction

Barr Engineering and Environmental Science Canada Ltd. (Barr) under authorization and contract with Parks Canada Agency (PCA) completed a geotechnical investigation to support the design of Highway 93S (Kootenay Parkway) roadway improvements.

This report describes the geotechnical investigation, summarizes the laboratory analysis of soil samples and provides recommendations for road improvement design and construction.

1.1 Proposed Construction

Highway 93S stationing starts at Trans-Canada Highway and ends at Radium Hot Springs (a total of 104 km). The northerly 10 km are in Alberta and the balance of Highway 93S is in British Columbia. The proposed improvements primarily involve widening the road by adding climbing lanes, passing lanes, and turn lanes. These improvements will likely occur during the next 5 years. The first scheduled improvements are likely to be completed during 2016.

1.2 Information Provided

Barr was provided with the following documents:

- Kootenay Parkway, Highway 93S Large Crack Investigation 10 year Maintenance and Rehabilitation Plan. John Emery Geotechnical Engineering Limited Consulting Engineers for Public Works and Government Services Canada. Preliminary Report, March 10, 2008.
- Pavement Management Update Western National Parks 2009. Dr. D.R. MacLeod, P.Eng. for Parks Canada. 2009.
- West and North National Parks Pavement Management Update 2012. McElhanney Consulting Services Ltd. for Parks Canada. March 27, 2014.
- Inspection of High Priority Rock and Soil Slopes Kootenay National Park Highway 93S. EBA Engineering Consultants for Parks Canada. November 2007.
- Re-Inspection of High Priority Rock Cut and Soil Slopes Highway 93S – Kootenay National Park. EBA Engineering Consultants for Parks Canada. March 2012.
- Prioritization of Rock Slope Remedial Work for 2014 and Five Year On-going Plan. EBA Engineering Consultants for Parks Canada. December 2013.
- Electronic GIS Data (topography and aerial photography) from Parks Canada

1.3 Scope of Services

The Barr scope of services for this investigation was: 1) conduct a field investigation; 2) perform laboratory testing on selected soils samples obtained during the field investigation; and 3) provide geotechnical recommendations for the pavement, base coarse and subgrade design and construction.

1.4 Report Organization

The balance of this report is organized as follows:

Section 2: Field Investigation

Section 3: Sample Laboratory Testing

Section 4: Design Recommendations

Section 5: Construction Recommendations

2.0 Field Investigation

The field investigation consisted of solid-stem auger (SSA) borings at 44 locations (see [Figure 1](#)). The field investigation was completed during December 10 - 17, 2015.

2.1 Regional Geology

Kootenay National Park extends for more than 95 kilometers parallel to the northwest-southeast trending Rocky Mountains, and along its width from the divide leading to the Bow River valley on the northeast and to the Columbia River on the southwest. The bedrock geology consists mainly of sedimentary rocks laid down as sediments by seas that covered this area. The shallow bedrock belonging to Harrogate Formation mainly consists of limestone and quartzite (Baird, 1964), followed by Brisco/Beaverfoot Formation that generally consists of dolomite and limestones.

2.2 Field Work

2.2.1 Soil Boring Locations

The boring locations and depths were defined by the design team (Barr geotechnical engineers in consultation with McElhanney engineers). These locations were selected primarily because they were within or immediately adjacent to the footprint of the road widening.

Initially 49 borings were proposed, but 5 proposed borings were deleted. Four (4) borings were deleted because they were to be located in an avalanche zone. Another boring was deleted because it was too close to underground utility lines. All borings were on or within 10 m of the highway shoulder. The boring locations were staked by Barr personnel on December 2, 2015. The final boring locations are shown in accompanying [Figure 1](#) whereas the GPS coordinates of the borings are provided in [Table 1](#).

2.2.2 Borings

The soil borings were performed between December 10, 2015, and December 17, 2015, by Earth Drilling Co. Ltd (Earth Drilling) of Calgary, AB using solid-stem auger (SSA) drilling techniques. The driller utilized both a track-mounted and a truck-mounted drill rigs. The borings were performed in accordance with ASTM Test Method D 1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils". The borings were advanced to a maximum depth of 5.54 m and were backfilled using bentonite chips and excavated soil.

The borehole locations are present in [Table 1](#). [Figure 1](#) shows the locations of the soil borings. Copies of the soil boring logs are included in [Appendix A](#) of this report.

A total of 44 boreholes were advanced at the identified locations at depths up to 5.54 m to identify existing near-surface soil stratigraphy and geotechnical properties of the area. A total of 23 boreholes were drilled immediately adjacent to the shoulder of the existing highway. The remaining 21 boreholes were within 10 m of the shoulder.

2.2.3 Boring Logs

Barr personnel were present at the site to observe and coordinate the drilling operations. Materials encountered in the borings were visually and manually classified in accordance with ASTM Test Method D 2488. A chart explaining the classification system is included in [Appendix B](#).

Boring logs were prepared to accompany the discussion of subsurface conditions at the site and are included in [Appendix A](#). The logs describe the materials encountered in the soil borings, present the soil classifications, present the results of field and laboratory tests, and present groundwater measurements.

2.2.4 Standard Penetration Testing and Sampling

Standard penetration tests (SPTs) were performed as the soil borings were advanced. SPTs were completed at 0.76 m intervals to a depth of 4.6 m below grade and then at 1.5 m intervals to the termination depths of the borings. Penetration resistances, measured in blows-per-30 cm (blows per foot, bpf), provide an empirical means of estimating the soil relative density, consistency, and strength.

Blow counts necessary to advance the sampler 30 cm (1 foot; N-values) were recorded in the field and are included on the boring logs (available in [Appendix A](#)). Sampler advancement was stopped if 50 blows were achieved for minimal penetration (less than 15 cm), typically indicating the presence of hard material especially large gravel and/or bedrock. Results of the standard penetration tests (SPTs) are summarized in [Table 2](#).

The samples were removed from the sampler, logged and sealed in the field by Barr personnel and transported to the laboratory.

2.3 Site Soils

In general, the soil borings indicated asphalt or topsoil at the surface underlain by fill material underlain by silty and clayey glacial till soils. These materials are described below.

2.3.1 Topsoil

Topsoil was encountered in 8 of the 44 boreholes. The topsoil ranged in thickness from 0.05 m to 0.25 m.

2.3.2 Asphalt

Asphalt was encountered in 25 boreholes. The (shoulder) asphalt ranged in thickness from 0.1 m to 0.3 m at the borehole locations.

2.3.3 Existing Fill

Fill was encountered in 15 of the boreholes, below topsoil or asphalt. The encountered fill was mostly fine-grained sand and gravel. The fill was typically moist and brown in color.

2.3.4 Lean Clay

Lean clay soils were encountered in 27 boreholes. The thickness of lean clay ranged from a minimum of 0.6 m to a maximum of 4.5 m. The samples consisted of light to dark brown to black clay with trace to some sand and gravel.

The SPT N-values for the lean clays ranged from 24 to 92 blows/30 cm, with an average of 36 blows/30 cm indicating stiff to hard clay. Lower SPT values were attributed to variations in moisture content in the shallow soils.

Unconfined compressive strength from the pocket penetrometer values for the lean clay ranged from 24 kPa to 215 kPa, with an average of 120 kPa, indicating stiff to very stiff clay.

2.3.5 Silts

Some low to non-plastic silts and silty clays were encountered in 4 borings (BBH17, BBH18, BBH19, and BBH20). Laboratory testing also identified possible silts and silty clays in an additional 4 borings (BBH23, BBH31, BBH35, and BBH41). The thickness of the silts ranged from a minimum of 1 m to a maximum of 3 m. The samples consisted of olive to light brown silts and silty clays with trace to some sand and gravel.

The SPT N-values for the silts ranged from 7 to 55 blows/30 cm, with an average of 26 blows/30 cm indicating stiff to very stiff silts. Lower SPT values were attributed to variations in moisture content in the shallow soils.

Unconfined compressive strength from the pocket penetrometer values for the silts ranged from 29 kPa to 215 kPa, with an average of 115 kPa indicating stiff to very stiff silts.

2.3.6 Sand

Sand was encountered in 13 of the boreholes. The thickness of ranged from a minimum of 1 m to a maximum of 3 m. The samples consisted of brown to grey silty to clayey sands with trace to some gravel.

The SPT N-values ranged from 7 to >100 blows/30 cm, with an average of 54 blows/30 cm indicating dense to very dense sand.

Unconfined compressive strength from the pocket penetrometer values for the sand ranged from 72 kPa to 215 kPa, with an average of 85 kPa indicating dense to very dense sand.

2.3.7 Gravel

Clayey and silty gravel was encountered in all the boreholes. The thickness ranged from a minimum of 1 m to a maximum of 5 m. The samples consisted of grey to brown silty to clayey gravel with sand.

The SPT N-values ranged from 18 to 105 blows/30 cm, with an average of 48 blows/30 cm indicating dense to very dense material.

Unconfined compressive strength from the pocket penetrometer values for the gravels was 215 kPa or greater.

2.4 Groundwater

Groundwater was observed in some boreholes. The drillers checked for groundwater as the borings were advanced and again after auger withdrawal and before the boreholes were backfilled. Groundwater was observed in 6 of the 44 borings. The groundwater level data are provide in [Table 1](#).

3.0 Sample Laboratory Testing

A program of general laboratory testing, consisting of moisture content, Atterberg limits, grain size analysis, standard Proctor density, pH, chloride content, soluble sulphate content and California Bearing Ratio (CBR) was completed on selected samples collected from the soil borings. All of the laboratory testing was performed by Clifton Associates of Calgary, AB in January 2016. The results of the laboratory tests can be found in [Appendix B](#). Samples were selected for testing by Barr Engineering.

3.1 Soil Testing

The following tests were performed:

- Moisture content tests in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass"
- Atterberg limit determinations in accordance with ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
- Sieve and hydrometer particle size analysis in accordance with ASTM D422, "Standard Test Method for Particle-Size Analysis of Soils"
- Standard Proctor density tests in accordance with ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))"
- California Bearing Ratio tests in accordance with ASTM D1883-14, "Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils"
- Soil pH according to ASTM D4972, "Standard Test Method for pH of Soils"
- Soluble chloride and soluble sulphate of soils in accordance with EPA Method 9056 "Determination of Inorganic Anions by Ion Chromatography"
- Organic content test in accordance with ASTM D2974 "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils".

All laboratory test results are provided in [Appendix B](#).

3.2 Laboratory Test Results

Laboratory test results are summarized in [Tables 2-4](#) and included in [Appendix B](#).

3.2.1 Moisture Content Testing

A total of 108 moisture content tests were performed. The soils tested included lean clays, silts, sands, and gravels. The test results indicate moisture contents ranging from 2.3 to 53.2 percent. These results indicate

the soils on site are generally in a moist to wet condition, and are likely highly influenced by weather conditions.

3.2.2 Atterberg Limits Testing

A total of 16 Atterberg limits test were conducted on selected lean clay silt, and silty sand samples. The results of the tests indicate that the samples exhibited liquid limits between 21.0 and 41.0 percent, plastic limits between 14.0 and 28.0 percent, and plasticity indices between -1.0 and 16.0 percent.

3.2.3 Particle Size Analysis

A total of 16 grain size analysis tests were performed on clay, sand, and gravel samples. The average percent fines (percent by weight passing the number 200 sieve) ranged from 10.8 to 98.8 percent. Full gradation test results are included in [Appendix B](#).

3.2.4 Moisture-Density Relationship

Five moisture-density relationship tests, as part of CBR tests, were performed. The average maximum dry density from the standard Proctor test was 1920 kg/m³ with an average optimum moisture content of 15.2 percent.

3.2.5 California Bearing Ratio

California Bearing Ratio tests were conducted on ten samples selected because of their location and soil type. Results ranged from 1.3 to 20.8 at 95% maximum Proctor density with 80 percent of the values being greater than 7.5. The summary of CBR results is presented in [Table 3](#).

3.2.6 Chemical Testing

Two samples were tested for chemical content (chloride and sulphate) and pH and one test was conducted to determine organic content. Soil pH ranged from 7.8 to 8.2, chloride content from 193 to 234 mg/L and sulphate from 46 to 102 mg/L. The organic content of the sample tested was 12 percent. Chemical test results are presented in Table 4.

4.0 Design Recommendations

Results of the field and laboratory investigation have been presented earlier in this report. Based on these results, [Section 4](#) provides the design recommendations for the highway. These recommendations are based on the use of typical roadway construction materials, methods and sequences and assumes that the construction will be observed by geotechnical engineers or technicians.

4.1 Pavement Structure Design

[Figure 2](#) shows the recommended minimum pavement structure for the Highway 93S improvements. This design is based on:

- Recommendations and guidelines in “Pavement Structure Design Guidelines” (Technical Circular T-01/15; British Columbia Ministry of Transportation and Infrastructure; January 2015).
- 2015 traffic data and 2035 traffic projections (from McElhanney)
- The historic road condition surveys, which are identified in Section 1.2 of this report
- This geotechnical investigation
- Barr’s roadway assessment based on our October 2015 – January 2016 field work.

The design 20-year Equivalent Single Axle Load (ESAL) for this project is 6.9 million. This was computed based on the provided traffic data and the BC design guidelines (referenced above).

This design is based on a CBR of 4.1, which was selected based on a review of the soils, CBR test results and the likely frequency of poor soils being under the roadway improvements. A Resilient Modulus of 41.55 MPa was estimated by multiplying the CBR by 10.3, per Association of American State Highway and Transportation (AASHTO) guidelines. The pavement system Structural Number of 129mm (5.06 inches) was computed per BC guidelines (referenced above). The BC minimum pavement section meets this Structural Number design value and is the recommended minimum for the design of new pavements.

For existing pavements, the existing in-place Structural Number with the addition of a minimum overlay (to improve the driving surface) exceeds the BC minimum. For these existing pavements it is recommended that prior to the overlay, the existing pavement be either: 1) repaired by crack sealing and patching; or 2) rehabilitated by pulverizing, re-shaping and compacting. [Figure 2](#) shows the rehabilitation option.

4.2 Subgrade Preparation

4.2.1 Anticipated Subgrade

Based on the results of the soil borings, the subgrade soils will generally be sand and gravel, although there will be lean clay and silty clay in a relatively few areas. Based on historic investigations (see Section 1.2) and this investigation poor subgrade and/or poor pavement structure should be anticipated at the following stations:

0+050, 2+300, 3+100, 4+400, 7+200, 11+650, 12+750, 13+350, 16+900, 17+650, 24+300, 26+000, 26+500, 26+800, 31+000, 40+700, 41+950, 48+100, 53+700, 75+200, 76+300, 76+350, 80+700, 82+900, 86+200, 86+800, 91+500, 92+550, 93+700, 95+000, 96+100, 98+000, 99+700, 101+450, 102+100 and 103+150

4.2.2 Subgrade

It is recommended that all organic matter (e.g. roots), topsoil and existing non-engineered fill be removed from areas where new road will be constructed or existing road widened. The removal of this material should be oversized a minimum of 1 m beyond the roadway embankment toe.

The resulting exposed subgrade should be scarified and moisture conditioned to within 2 percent of optimum moisture and re-compacted to a minimum of 95 percent of the Standard Proctor maximum dry density (ASTM D698), except the top 300 mm of subgrade should be compacted to a minimum of 100% of Standard Proctor Density.

4.2.3 Proof-roll

It is recommended that at least the first lift of pavement subgrade and base be proof-rolled with a heavy vehicle in the presence of a geotechnical engineer. The proof-roll will help detect areas of loose or soft subgrade materials that require additional compactive effort or removal and replacement with compacted backfill.

4.2.4 Fill Recommendation

Where fill is required to raise subgrade, it is recommended that it consist of a granular soil with no more than 10 percent passing the number 200 sieve. Fill should be compacted to a minimum of 95 percent of the Standard Proctor maximum dry density, except for the upper 300 mm which should be compacted to a minimum of 100 percent of the Standard Proctor maximum dry density.

4.3 Settlement

Based on anticipated fills of 6 m, it is estimated that the total settlement will be no greater than 200 mm. the maximum estimated differential settlement for a maximum compacted fill thickness of 6 m is anticipated to be 100 mm. The degree of settlement is directly dependent on the quality of construction, as well as adherence to the recommendations of this report.

4.4 Groundwater

Groundwater levels of concern were not found during this investigation and are not anticipated. However, if groundwater levels within about 1.5 m of the ground surface are encountered during construction, a geotechnical engineer should be consulted, as groundwater can have a significant impact on road performance and life.

4.5 Utilities

The utilities along the highway will likely be placed in either native soils or fill material. These soils should generally be suitable for support of underground utilities. Within the zone of frost-heave susceptible soils (up to 3 m below the existing ground surface), insulation may be required. Soils from trench excavations may be used as backfill, provided they are free of debris.

Underground utilities installed in the native soils on site may be designed according to conventional utility line design but with a special precaution for frost heave. However, where utilities are to be installed in fill, the geotechnical engineer should be notified to review the utility requirement. In general, for all utilities to be installed in fill, provisions should be made to protect buried utilities from potential damage due to any potential future differential settlement.

4.6 Drainage

Collecting surface runoff and discharging it away from the road foundations and grading to promote positive runoff away from the foundations are two common and recommended methods for reducing groundwater in the roadway. At least 0.3 m of topsoil, clay, or an exterior slope should be sloped away from the building at grade to prevent direct infiltration of water into the soils behind the highway foundation.

It is recommended that the site be graded to promote positive runoff away from the highway. Landscape areas should be sloped away at 20H:1V or steeper. At least 300 mm of topsoil or clay is recommended for use to reduce infiltration into the pavement structure.

4.7 Frost Depth

As per the Canadian Foundation Engineering Manual (CFEM), the frost depth at the site is estimated to be 2.0 m.

4.8 Soil Chemical Content

Soluble sulphate concentrations were measured as less than 0.03%. These results indicate the potential degree of a sulphate attack on the concrete as "negligible" per CSA guidelines, and therefore site soils are compatible with concrete structures.

Imported fill to be placed in contact with concrete, should be tested during project design for water-soluble sulphate content to determine its suitability for use as a backfill or foundation for concrete structures.

5.0 Construction Recommendations

5.1 Subgrade Preparation

5.1.1 Excavations

Based on the results of the borings completed as part of this geotechnical investigation, and the anticipated design, excavation may not be required.

If excavation is required, competent native soils suitable for support of the proposed construction will likely be found between 1 m and 3 m below the ground surface. A geotechnical engineer should be present during excavation to observe and document that all excavations are extended to sufficient depths such that all unsuitable material is removed.

Depending on construction conditions, excavations may have to be extended locally to remove wet, loose, soft or otherwise unstable soils that become disturbed during the excavation process and lose strength.

To provide lateral support to replacement backfill the excavations should be adequately oversized. It is recommended that the excavations be oversized at least 1 m horizontally beyond the roadway perimeter.

5.1.2 Groundwater Control

Groundwater levels in the vicinity of the project site are approximately between 1.8 m and 3.0 m below the existing ground surface. Considering the groundwater levels and soil types encountered across the site, it is not expected that groundwater will be encountered at shallow depths (less than 1.5m). Groundwater levels fluctuate over time, and higher or lower groundwater levels may be experienced during construction and during the life of the road.

If groundwater levels are encountered at shallower depths (less than 1.5m), a geotechnical engineer should be consulted as high groundwater levels can significantly impact road performance.

Dewatering may be required for the construction in some project areas. In low permeability soils (clays and silts), a system of sloped trenches and sump pits likely will be adequate to dewater shallow excavations on the site. Excavations into more permeable soils (sands and gravel) and below the water table, will likely require more comprehensive dewatering methods. However, the project's shallow excavations in sand and gravel will not likely require a greater dewatering effort than described above.

The impermeable nature of the project silty and clay soils will limit water outflow from fills at elevations below these low permeability soils. In this scenario, dewatering can be achieved by the use of drains along the perimeter of these fills. This dewatering maybe required if the fill construction has not yet been compacted to the project minimums.

5.1.3 Subgrade Construction

Following the removal of unsuitable materials (see Section 4.2), the excavation bottom should be proof-rolled with a fully loaded tandem axle dump truck having a minimum gross weight of 25 tons. Proof-

rolling will aid in identifying areas of unstable subgrade. Proof-rolling should be performed in the presence of a geotechnical engineer. Proof-rolling is not an indication that the subgrade strength is adequate or that it meets design requirements, but simply highlights potentially unsuitable subgrade conditions.

If any soft or weak zones are identified during the proof-roll, the material should be sub cut a minimum of 1 m and replaced with suitably compacted engineered fill material.

Backfill and fill placed over wet or submerged excavation bottoms should initially consist of sand with a maximum particle size of 35 mm, having less than 50 percent of the particles by weight passing a number 40 sieve, and less than 5 percent of the particles by weight passing a number 200 sieve. A geotextile should be placed between the sand and the native subgrade as a means of preventing migration of fines into the fill material. This material should be placed to an elevation at least 600 mm above the excavation bottoms or water surfaces prior to compaction and prior to using alternative backfill and fill materials.

5.1.4 Subgrade Stabilization

If large areas of subgrade are unsuitable, then subgrade stabilization is required and one of the following methods can be utilized:

- **Removal and Replacement** – Inadequate materials can be removed and replaced with granular fill (see Section 4.2). This fill shall be compacted as indicated in Section 4.2. The use of a geotextile fabric or geo-grid may potentially reduce removal and replacement requirements
- **Scarification and Re-compaction** – It may be feasible to scarify, dry, and re-compact the exposed soils. The success of this procedure would depend primarily upon favourable weather and sufficient time to dry the soils. Even with adequate time and weather, however, stable subgrades may not be achievable if the thickness of the soft soil is greater than 500 mm.
- **Soil Stabilization** – The use of cement, lime, or fly-ash as a soil stabilizing agent can be considered in lieu of removal and replacement or scarification and re-compaction. The type and quantity of materials used to stabilize the soils will be dependent upon soil type. Typically lime stabilization is used for higher moisture content silty clay to clayey silt soils similar to those encountered at the site. Fat clay soils may be particularly susceptible to softening and disturbance from rain events and construction traffic and soil stabilization may be beneficial if fat clay is encountered below the proposed roadways. Design of a soil stabilization program should be performed by a geotechnical engineer in conjunction with laboratory testing to provide the proper stabilizing agent, application rate, and depth of soils stabilized.

5.1.5 Placement and Compaction of Fill

It is recommended that engineered fill should be placed in 200 -mm maximum compacted lift thickness, provided standard compaction equipment is used (note that small units such as “jumping jacks” are not recommended for compaction). Compaction requirements are presented in Section 4.

5.2 Utilities

It is expected that the native soils encountered on the site will have some potential for sloughing in steep-sided trenches. Utility trenches will either have to be sloped back or entered only when an appropriate safety cage or trench box, used in accordance with the manufacturer's specifications, is utilized.

5.3 Cold Weather Construction

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

The soils on this project site, particularly the clay till of low-medium plasticity, have the potential to exhibit moderate frost effects (heaving upon freezing and softening upon thawing). The soil beneath and/or adjacent to the highway foundation should be protected from freezing during and after construction to prevent the potential of heaving and cracking.

Utility pipes conveying water and buried with less than 3 m of soil cover should be protected with insulation to avoid damage or breakage as a result of frost action.

5.4 Construction Observations and Testing

5.4.1 Observations

It is recommended that a geotechnical engineer observe all excavations related to subgrade preparations

5.4.2 Construction Material Testing

In-place density testing should be performed on the compacted pavement subgrade and on the aggregate base materials. Density tests should be performed where the construction observer is concerned regarding the adequacy of compaction or at a frequency of one test per lift for every 100 square m of fill placed. Material samples should be submitted to a qualified laboratory for Standard Proctor maximum dry density testing in advance of any in-place density testing.

6.0 References

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Tables

Table 1
Summary of Borehole Location, Elevation, Depth and Depth to Water

ID	NAD83-Northing	NAD83-Easting	Elevation (m)	Depth of Boring (m)	Depth to Water (m)
2015-BBH01-S	5679618	574059	4759	3.7	
2015-BBH02-N	5679788	573080	4917	3.7	
2015-BBH03-N	5679288	571770	5182	5.2	1.8
2015-BBH05-SH-N	5678909	570749	5431	4.0	
2015-BBH06-S	5678429	569935	5606	5.2	
2015-BBH07-S	5677938	568173	5674	3.7	
2015-BBH08-SH-N	5677761	567976	5658	3.7	
2015-BBH09-SH-S	5676703	566924	5566	3.7	
2015-BBH10-SH-S	5676503	566763	5501	3.7	
2015-BBH11-SH-S	5676093	566407	5442	3.7	
2015-BBH12-N	5675662	566303	5419	1.7	
2015-BBH16-S	5671662	562551	4956	3.7	
2015-BBH17-N	5670884	561527	4792	3.0	2.0
2015-BBH18-N	5670592	561131	4779	3.7	
2015-BBH19-SH-S	5669974	560578	4792	3.7	
2015-BBH20-S	5668994	559602	4681	3.7	
2015-BBH21-S	5667259	559125	4604	5.4	2.6
2015-BBH22-S	5665051	560597	4556	4.0	2.4
2015-BBH23-SH-S	5662749	563471	4571	5.5	
2015-BBH24-SH-N	5659142	566525	4380	3.9	
2015-BBH25-N	5653125	571442	4152	5.4	
2015-BBH26-SH-S	5651946	571865	4141	5.5	3.0
2015-BBH28-N	5647969	573793	4045	4.0	
2015-BBH29-SH-N	5645660	573084	4012	2.5	
2015-BBH30-SH-N	5644435	571730	4125	3.9	
2015-BBH31-SH-S	5641864	569585	3945	3.8	3.0
2015-BBH32-S	5641489	569307	3938	3.9	
2015-BBH33-S	5640520	567820	4120	5.3	
2015-BBH34-SH-N	5639284	568069	4059	3.2	
2015-BBH35-SH-N	5638506	567418	3938	3.8	
2015-BBH36-S	5637328	566864	3820	5.3	
2015-BBH37-SH-N	5631051	569452	3783	4.0	
2015-BBH38-SH-S	5628122	570513	3720	3.8	
2015-BBH39-SH-S	5626593	572048	3704	3.1	
2015-BBH40-SH-S	5625885	572801	3694	3.8	
2015-BBH41-SH-N	5624438	574320	3688	3.8	
2015-BBH42-SH-S	5623070	575209	3659	4.0	
2015-BBH43-N	5621187	576440	3655	3.8	
2015-BBH44-SH-N	5617699	577687	3911	5.3	
2015-BBH45-SH-N	5613919	576624	4628	5.5	
2015-BBH46-SH-N	5614197	575541	4831	4.0	
2015-BBH47-S	5610388	569886	3621	4.7	
2015-BBH48-N	5609728	568448	3382	4.6	
2015-BBH49-S	5609653	567780	3317	5.4	

**Table 2
Summary of General Laboratory Results**

Sample Location		USCS Classification	Moisture Content (%)	SPT N (blows/30 cm)	Percent Gravel (%)	Percent Sand (%)	Percent Silt (%)	Percent Clay (%)	Percent Fines (%)	Atterberg Limits (% moisture content)			Pocket Penetromete (tsf)
Boring No.	Depth (m)									Liq. Limit	Plast. Limit	Plast. Index	
2015-BBH01-S	0.00	TOPSOIL	15	43									
	0.23	GC-GM	4.2										
	0.76	GC-GM		38									
	1.52	GC-GM		35									
	2.29	CL	10.1	25	15.1	37.9	29	18	47	21	14	7	3.50
	3.05	GC-GM		94									
	3.30	GC-GM											
3.55	GC-GM												4.50
2015-BBH02-N	0.00	GC-GM	5.2	31									
	0.76	SC-SM		26									
	1.52	SC-SM	5.3	105									
	2.29	GC-GM	7.1										
	3.05	SC-SM											
2015-BBH03-N	0.00	PT	53.2	10									2.00
	0.76	CL		11									3.00
	1.52	CL	26.6	49	6.9	49.9	30.6	12.6	43	22	22	0	4.00
	2.29	CL		28									2.00
	3.05	CL	12.8										4.50
	3.81	SC-SM											
	4.57	SC-SM	14.1										
2015-BBH05-SH-N	0.30	FILL											
	1.07	FILL											
	1.83	GC-GM	2.3	59									
	2.59	GC-GM		81									
	3.35	SC-SM	7										
2015-BBH06-S	0.00	GW-GC	9.2	18									
	0.76	GW-GC		49									
	1.52	GW-GC		72									
	2.29	GW-GC	6.8	105									
	3.05	SC-SM											
	3.81	SC-SM	7.1	77									1.50
	4.57	GC-GM											
2015-BBH07-S	0.00	GC-GM		85									
	0.76	GC-GM	6.1	49	32.3	51.3			16				
	1.52	GC-GM		59									
	2.29	GC-GM	11.5	86									
	3.05	GC-GM	9.9	69									4.50
2015-BBH08-SH-N	0.00	TOPSOIL	13.5	12	19.1	31.2	26.1	23.6	50	26	16	10	2.00
	0.76	CL	12	8									3.00
	1.52	SC-SM											
	2.29	SC-SM											
	3.05	SC-SM	11.5										
2015-BBH09-SH-S	0.00	SC-SM	8.6	37	41.5	47.7			11				
	0.76	SC-SM		32									
	1.52	SC-SM	7.3	71									
	2.13	SC-SM		45									
	3.05	SC-SM		7									
2015-BBH10-SH-S	0.00	TOPSOIL	5.3	31									
	0.76	SC-SM		64									
	1.52	SC-SM	4										
	2.29	SC-SM	6.2	94									
	3.05	SC-SM											
2015-BBH11-SH-S	0.00	SC-SM	5.4	53									
	0.76	SC-SM		41									
	1.52	SC-SM	3.7	54									
	2.29	SC-SM											4.50
	3.05	SC-SM											
2015-BBH12-N	0.00	TOPSOIL	11.7	16	35.5	49.7			15				
	0.76	SC-SM											4.50
	1.52	SC-SM											
2015-BBH16-S	0.00	GC-GM	6.8	24	47.4	39.8			13				
	0.76	CL	8.7	47						21	19	2	4.50
	1.52	GC-GM		42									
	2.29	GC-GM	9.4	22									
	3.05	GC-GM		35									
2015-BBH17-N	0.00	TOPSOIL	18.8	24									
	0.76	CL-ML	22.3	15						21	22	-1	
	1.52	CL-ML		25									
	2.29	GC-GM	5.9	33									
2015-BBH18-N	0.00	TOPSOIL	21.7	46									3.00
	0.76	CL-ML	13.6	55	15.4	23.9	42.7	18	61				
	1.52	CL-ML	19.1	41						31	23	8	4.50
	2.29	GC-GM		66									
	3.05	GC-GM	8.2	43									
2015-BBH19-SH-S	0.00	GC-GM	6.3	25									
	0.76	GC-GM		35									
	1.52	GC-GM	6.1	62						24	22	2	
	2.29	GC-GM		56									
	3.05	CL-ML	14.7	40	11.3	16.6	55.1	17.1	72				4.50

**Table 2
Summary of General Laboratory Results**

Sample Location		USCS Classification	Moisture Content (%)	SPT N (blows/30 cm)	Percent Gravel (%)	Percent Sand (%)	Percent Silt (%)	Percent Clay (%)	Percent Fines (%)	Atterberg Limits (% moisture content)			Pocket Penetromete (tsf)
Boring No.	Depth (m)									Liq. Limit	Plast. Limit	Plast. Index	
2015-BBH20-S	0.00	SC-SM	6.2	29									
	0.76	CL-ML		20									
	1.52	CL-ML	24.4	19		2.7	69	28.3	97			3.50	
	2.29	CL		10								0.50	
	3.05	CL	27.7	10								0.50	
2015-BBH21-S	0.25	GC-GM	7										
	1.01	GC-GM											
	1.78	GC-GM		95									
	2.54	GC-GM	5.3	56	45	43.8			11				
	3.30	GC-GM		48									
	4.06	GC-GM		19									
2015-BBH22-S	4.82	CL	23.3	24									
	0.30	GC-GM											
	1.07	SC-SM	8.7	94									
	1.83	SC-SM		79									
	2.59	GC-GM		61									
2015-BBH23-SH-S	3.35	GC-GM	8.9	42									
	0.34	FILL											
	1.10	FILL	4.7	97									
	1.86	FILL		91									
	2.62	CL	8.4	88									
	3.38	CL		33								2.50	
	4.15	CL	24.7	20						29	23	6	1.50
2015-BBH24-SH-N	4.91	GC-GM	6.7	19									
	0.25	FILL											
	1.01	SC-SM	4.5	47									
	1.78	GC-GM		43									
	2.54	GC-GM	2.9										
2015-BBH25-N	3.30	GC-GM		85									
	0.25	FILL											
	1.01	FILL											
	1.78	GC-GM	3.2	81	40.9	43.1			16				
	2.54	GC-GM		74									
	3.30	GC-GM		70									
	4.06	CL	7.5	82						24.0	20.0	4	
2015-BBH26-SH-S	4.82	CL		36								1.25	
	0.34	FILL											
	1.10	FILL											
	1.86	CL	5.2	78									
	2.62	GC-GM		61									
	3.38	CL	30.1	25								0.50	
2015-BBH28-N	4.15	CL		11								0.00	
	4.91	CL	45.4	0		1.2	43.6	55.2	99	41.0	25.0	16	0.00
	0.34	GC-GM											
	1.10	GC-GM											
	1.87	GC-GM	3.5	28	38.9	46.9			14				
2015-BBH29-SH-N	2.63	CL		13									
	3.39	CL	16.6	24						24.0	21.0	3	
	0.35	FILL											
2015-BBH30-SH-N	1.12	FILL											
	1.88	GC-GM		49									
	0.28	FILL											
	1.04	CL	6.4	51									
	1.80	CL		78									
2015-BBH31-SH-S	2.57	CL	8.6	67									
	3.33	CL		89									
	0.15	FILL	4.0	82									
	0.91	GC-GM		36									
	1.68	CL	7.4	49	31.3	38.5			30				
2015-BBH32-S	2.44	CL		54									
	3.20	CL	25.5	21						21.0	21.0	0	0.00
	0.25	CL	7.0	56									
	1.01	CL		28									
	1.78	CL	16.9	13									1.10
2015-BBH33-S	2.54	CL		9									0.80
	3.30	CL	27.9	14									0.00
	0.08	GC-GM	3.9	48									
	0.84	GC-GM		70									
	1.60	GC-GM											
	2.36	CL	7.9	46									
	3.12	CL		39									
2015-BBH34-SH-N	3.89	SC-SM	12.2	12									
	4.65	CL		18									0.75
	0.27	FILL											
	1.03	GC-GM	5.3	54	50.4	35.9			14				
	1.79	GC-GM		26									
2015-BBH35-SH-N	2.55	GC-GM	2.9	29									
	0.13	CL	6.7	53									
	0.89	CL		42									
	1.65	CL		45									
	2.41	CL		86									
3.18	CL	15.8	27						36.0	28.0	8		

Table 3
Summary of California Bearing Ratio and Standard Proctor Test

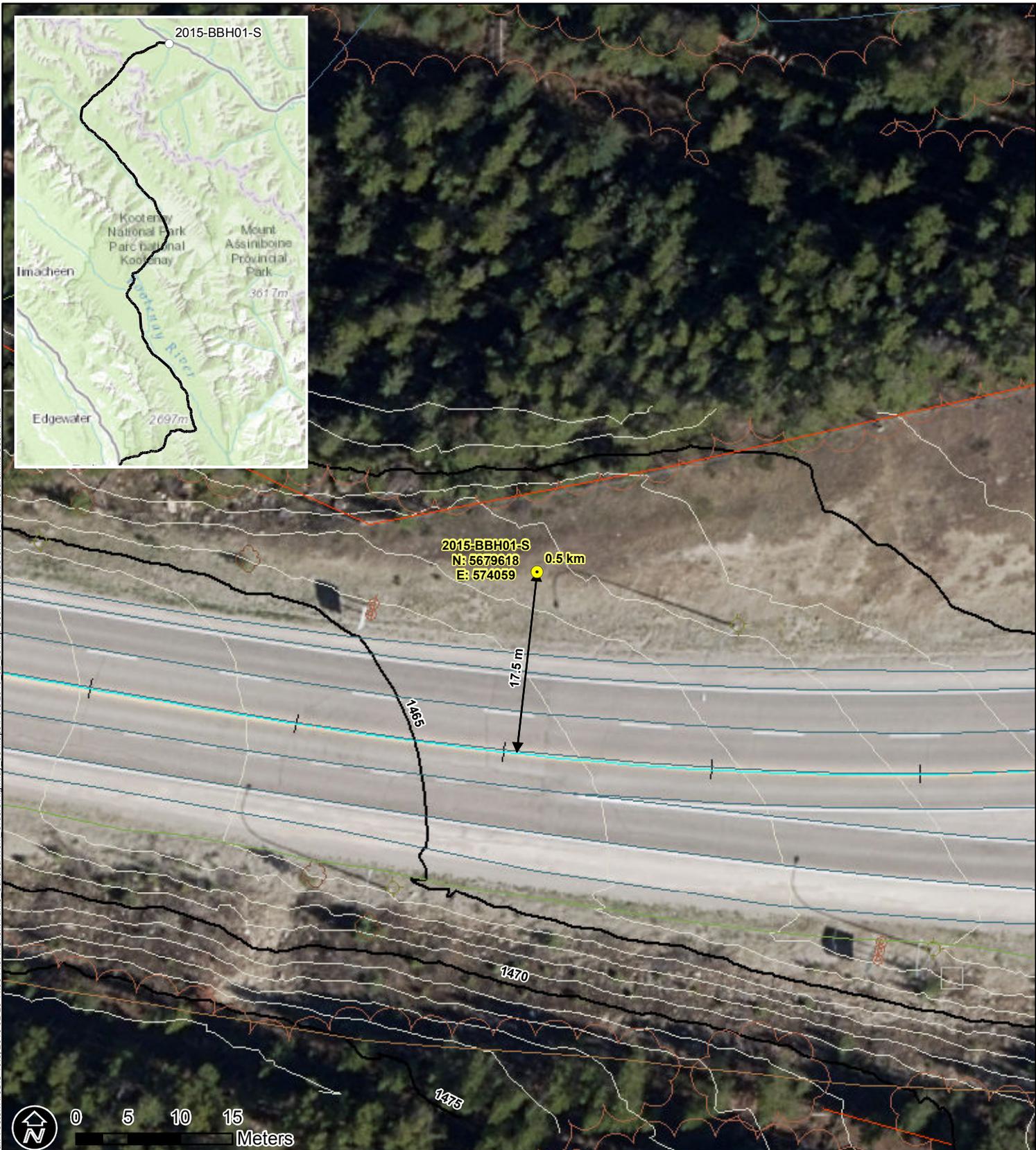
Boring	% Compaction	CBR Value	CBR at 95% Compaction	Max Dry Density	Optimum Moisture	Dry Density
2015-BBH03-N	83.1	1	1.34	1239	34.5	1030
	90.2	1.3				1118
	102.7	1.5				1272
2015-BBH06-S	83.4	1	17.68	2174	7.5	
	87.9	3.2				
	100.4	27.3				
2015-BBH11-SH-S	84.8	0.9	12.72	2265	6.5	
	89.1	2				
	100.3	20.6				
2015-BBH17-N	84.7	1.3	2.33	1786	15.7	1513
	91.2	2.1				1629
	100.6	2.8				1797
2015-BBH24-SH-N	83.4	1.4	11.13	2159	8.9	1801
	89.9	3.1				1941
	100.8	18				2176
2015-BBH28-N	85.2	1.5	10.84	2163	7.8	
	91.2	3.6				
	100.6	18.4				
2015-BBH33-S	79.9	1.2	20.78	2262	6.0	
	86.9	4.9				
	100.6	30.4				
2015-BBH38-SH-S	84.1	1.8	12.08	2194	7.3	1845
	90.6	3.8				1988
	100.7	19.8				2209
2015-BBH39-SH-S	85.8	1.3	9.85	2164	7.8	
	91.4	3.5				
	100.2	16.4				
2015-BBH40-SH-S	80.4	1	7.59	2042	9.6	1642
	91.0	4.4				1858
	98.9	9.54				2020

Table 4
Chemical Test Results on Soil Samples

Boring Number	Depth	pH	Soluble Chloride	Soluble Sulphate
	(ft)		(mg/l)	(mg/l)
2015-BBH01-S	0.0	7.83	193	102
2015-BBH01-S	2.0	8.2	234	45.8
2015-BBH03-N	0.0			
Mean	0.7	8.0	213.5	73.9
Std dev	0.9	0.2	20.5	28.1
Minimum	0.0	7.8	193.0	45.8
Maximum	2.0	8.2	234.0	102.0

Figure

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2015-BBH01-S
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 E: 574059

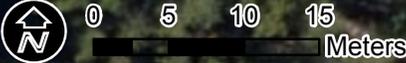
0.5 km

17.5 m

1495

1470

1475

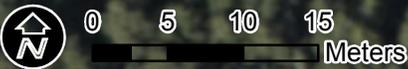
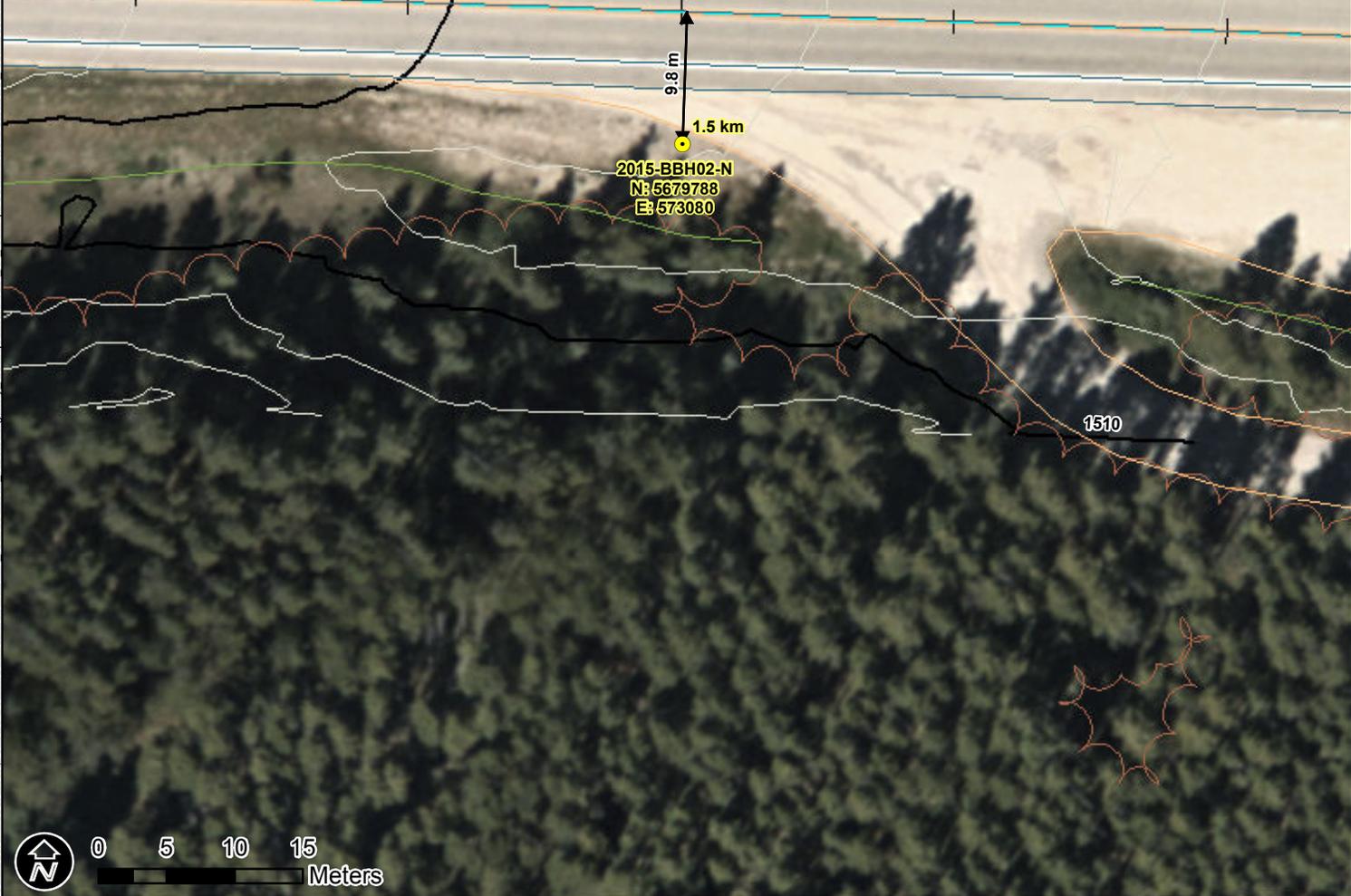
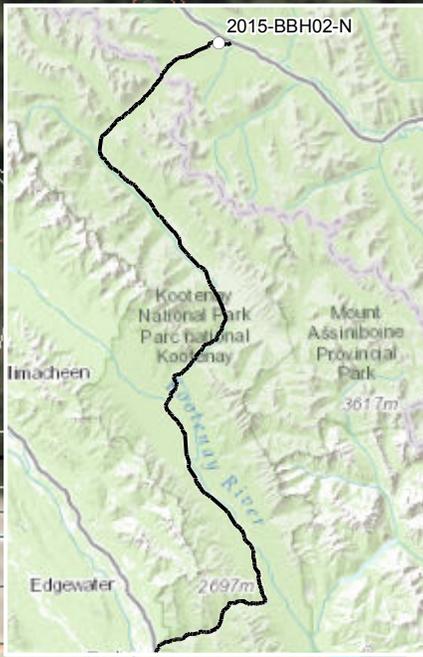


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
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 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH01-S
Highway 93S Kootenay Parkway
Parks Canada

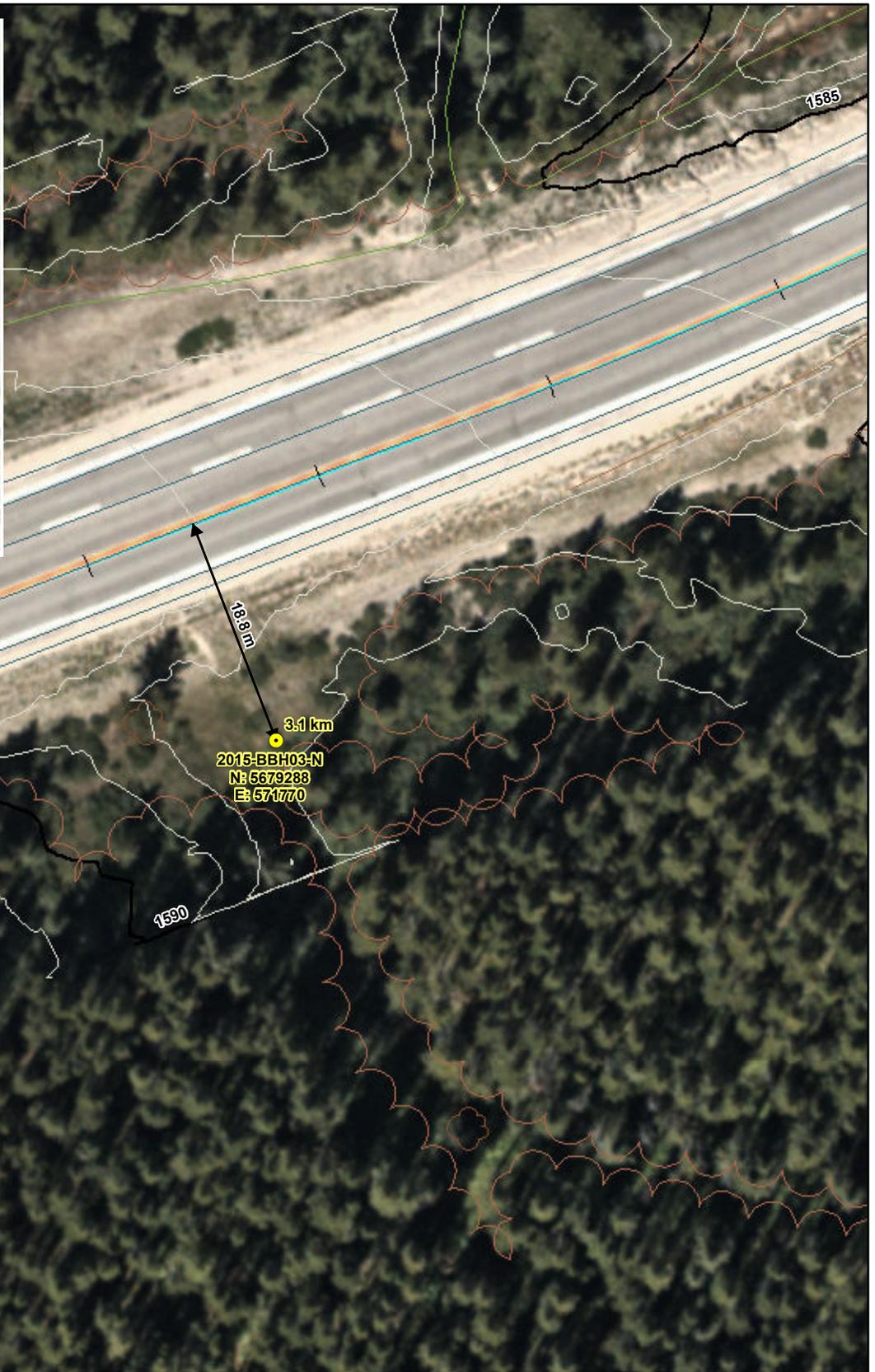
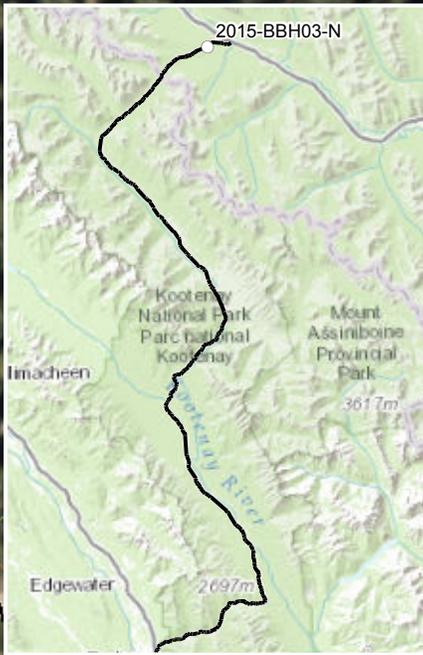
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2015-BBH02-N
Highway 93S Kootenay Parkway
Parks Canada



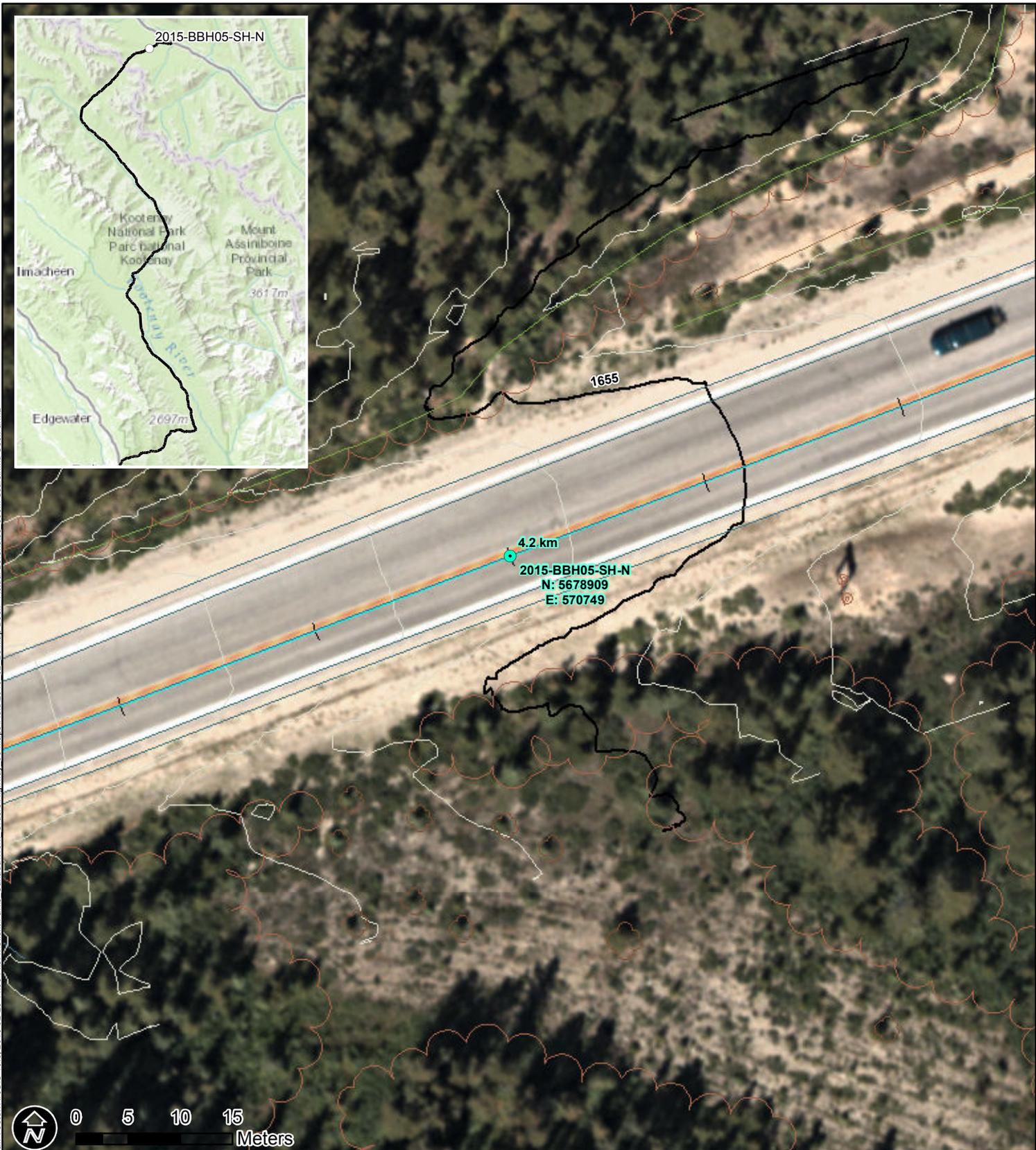
2015-BBH03-N
N: 5679288
E: 571770

- Proposed Borings
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2015-BBH03-N
Highway 93S Kootenay Parkway
Parks Canada

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- | | |
|--|--|
| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
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| ○ Archaeology Site Areas | |

2015-BBH05-SH-N
Highway 93S Kootenay Parkway
Parks Canada

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- | | |
|--|--|
| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
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| ○ Cultural Site Areas | ○ Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ○ Archaeology Site Areas | |

2015-BBH06-S
Highway 93S Kootenay Parkway
Parks Canada

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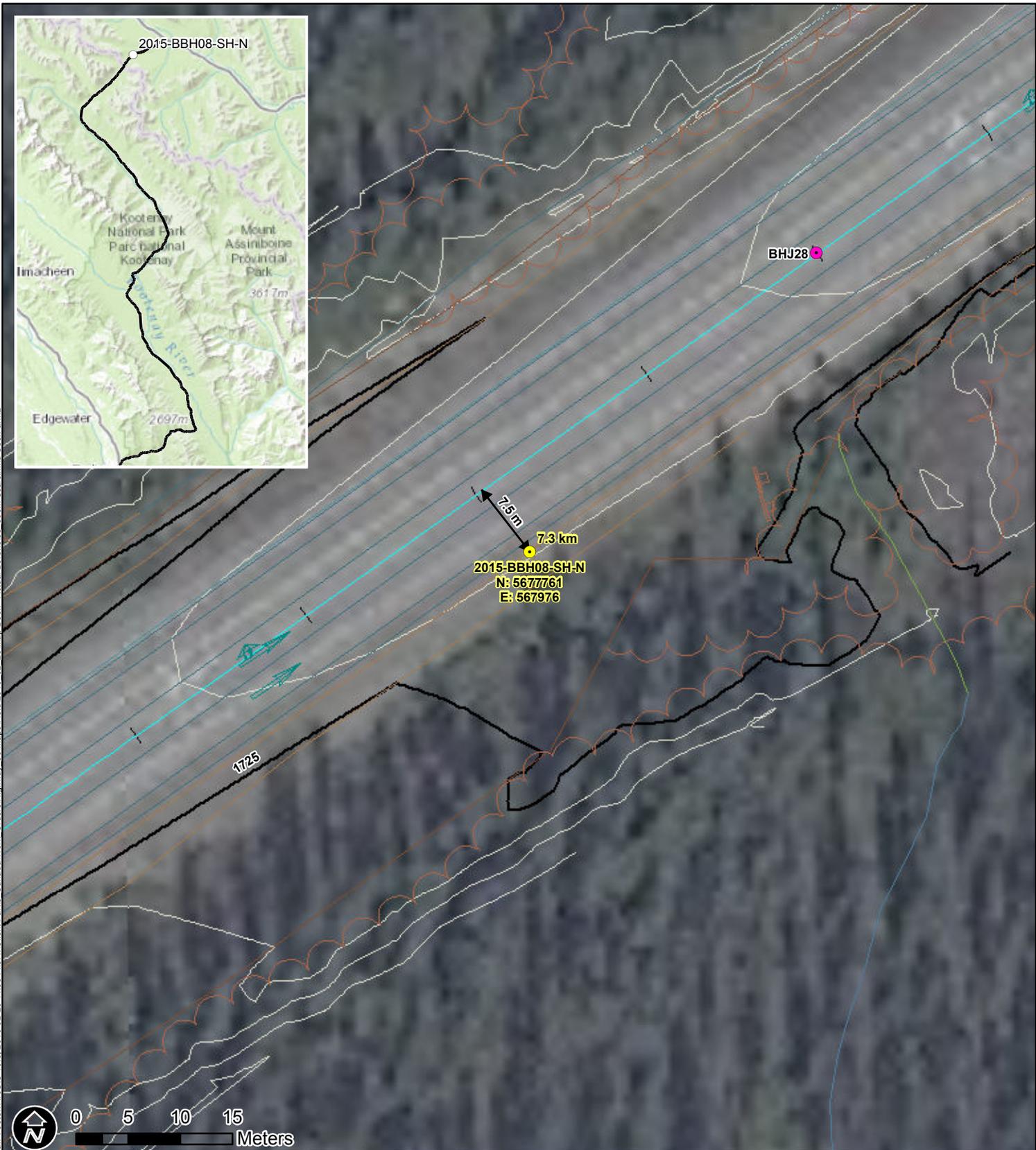
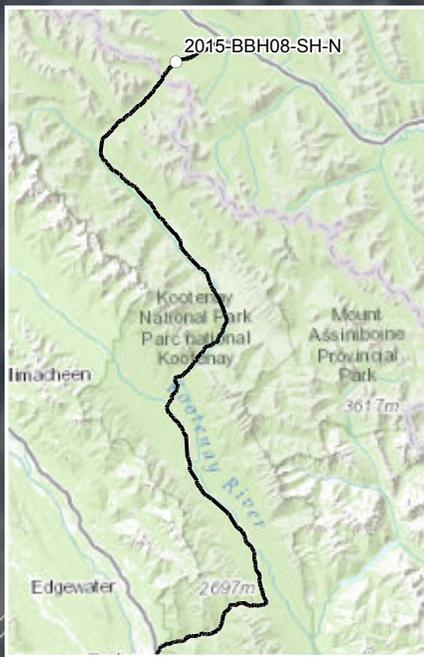


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2015-BBH07-S
Highway 93S Kootenay Parkway
Parks Canada

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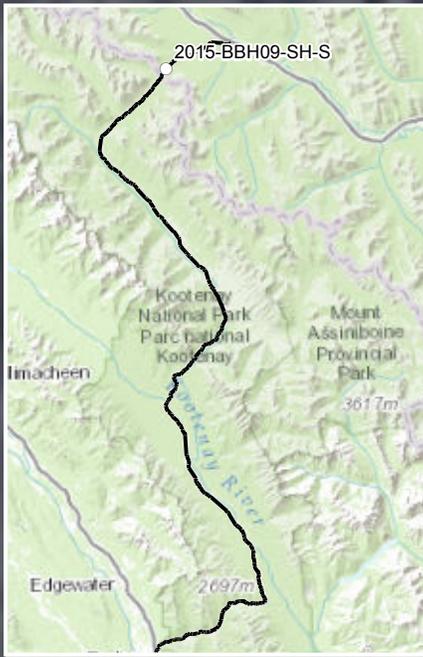


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2015-BBH08-SH-N
Highway 93S Kootenay Parkway
Parks Canada

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2015-BBH09-SH-S
 N: 5676703
 E: 566924

8.8 km

15.9 m



0 5 10 15 Meters

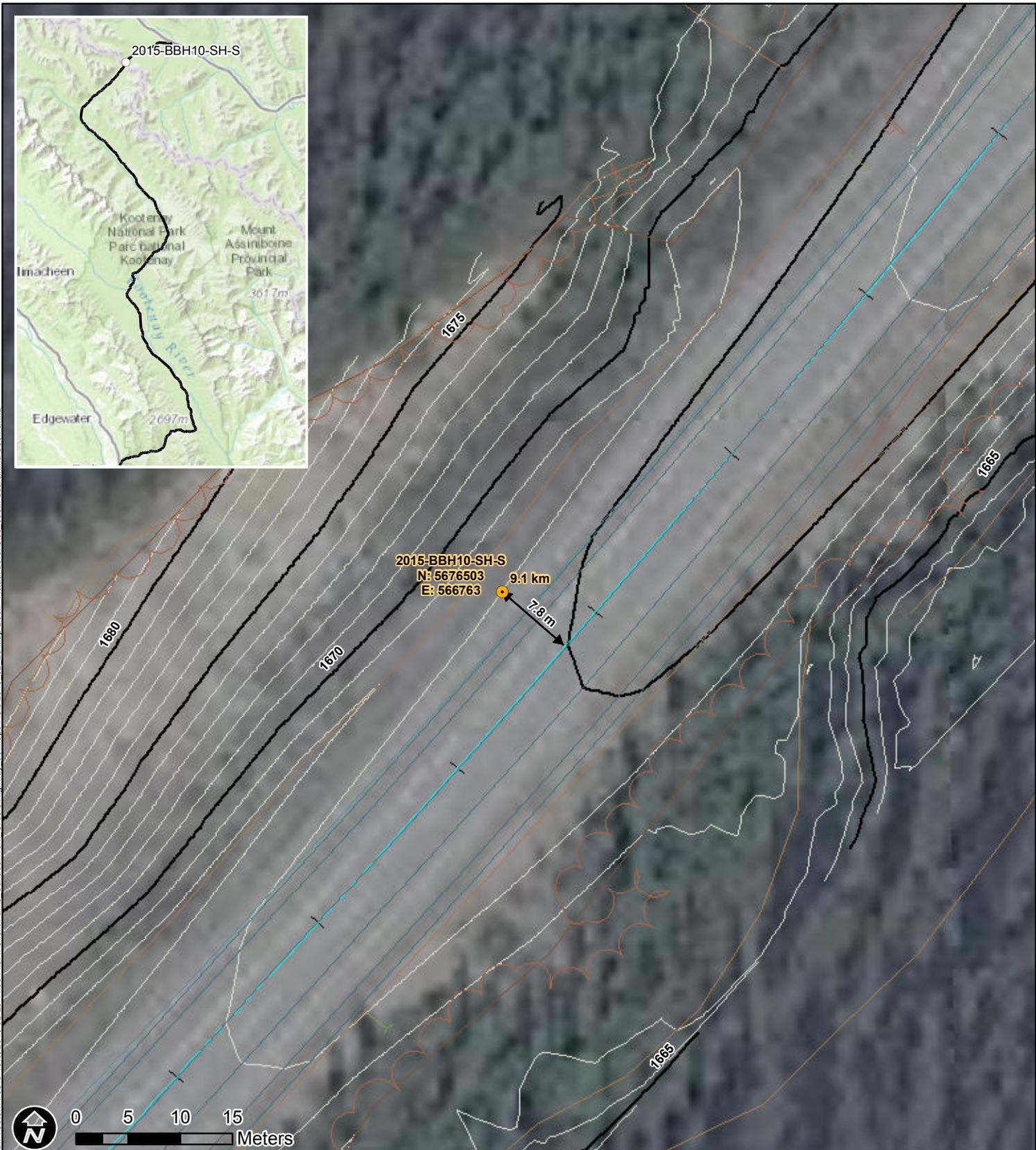
- Proposed Borings
- Proposed Shoulder Borings
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- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH09-SH-S
Highway 93S Kootenay Parkway
Parks Canada

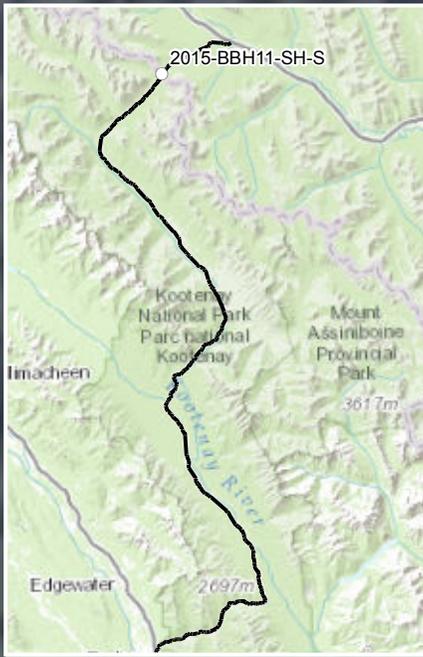
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● Proposed Borings	▲ Watercourse Sensitivity Level
● Proposed Shoulder Borings	▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
● Proposed Borings to be Decided Later if Required	▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
● Existing Boreholes	▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
■ Cultural Sites	▲ 4 - No habitat, runoff drainage or no watercourse present.
○ Cultural Site Areas	○ Ecological Sites (Aqua)
■ Archaeology Site	
○ Archaeology Site Areas	

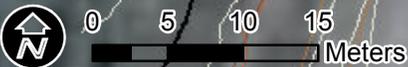
2015-BBH10-SH-S
Highway 93S Kootenay Parkway
Parks Canada

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2015-BBH11-SH-S
 N: 5676093
 E: 566407

9.6 km
 15.1 m

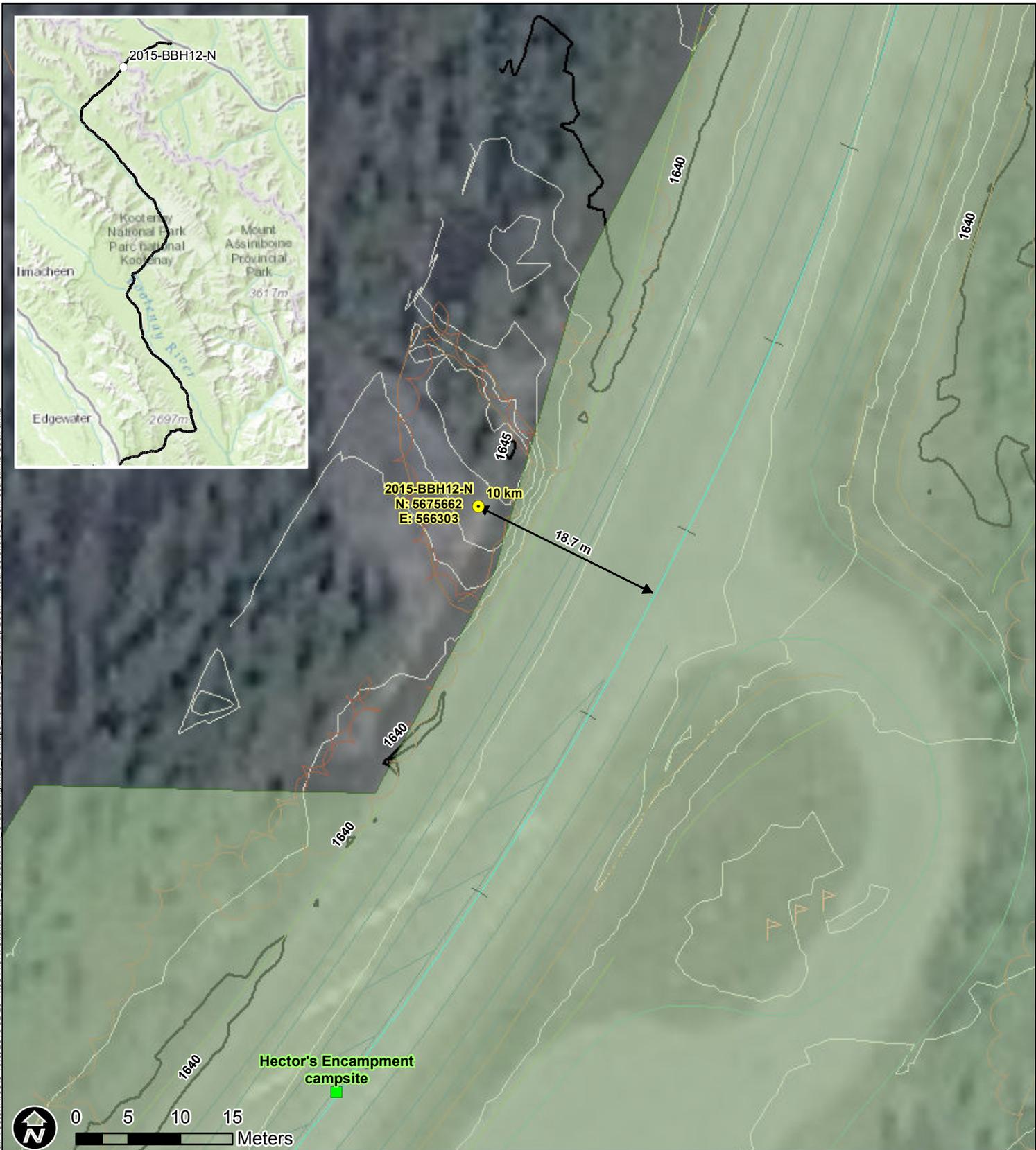
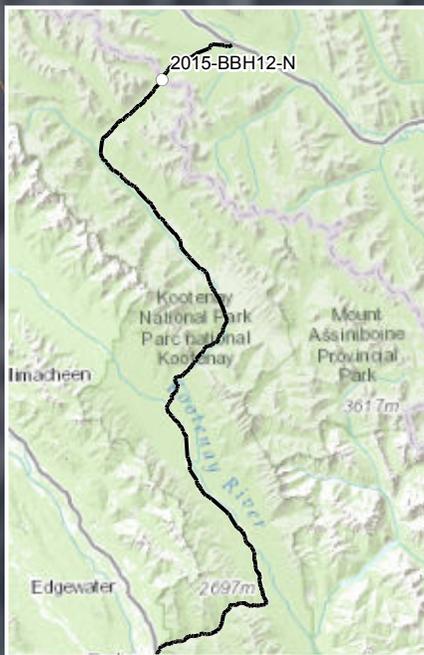


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH11-SH-S
Highway 93S Kootenay Parkway
Parks Canada

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● Proposed Borings	▲ Watercourse Sensitivity Level
● Proposed Shoulder Borings	▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
● Proposed Borings to be Decided Later if Required	▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
● Existing Boreholes	▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
■ Cultural Sites	▲ 4 - No habitat, runoff drainage or no watercourse present.
○ Cultural Site Areas	○ Ecological Sites (Aqua)
■ Archaeology Site	
○ Archaeology Site Areas	

2015-BBH12-N
Highway 93S Kootenay Parkway
Parks Canada

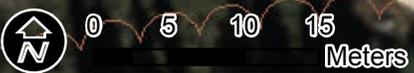
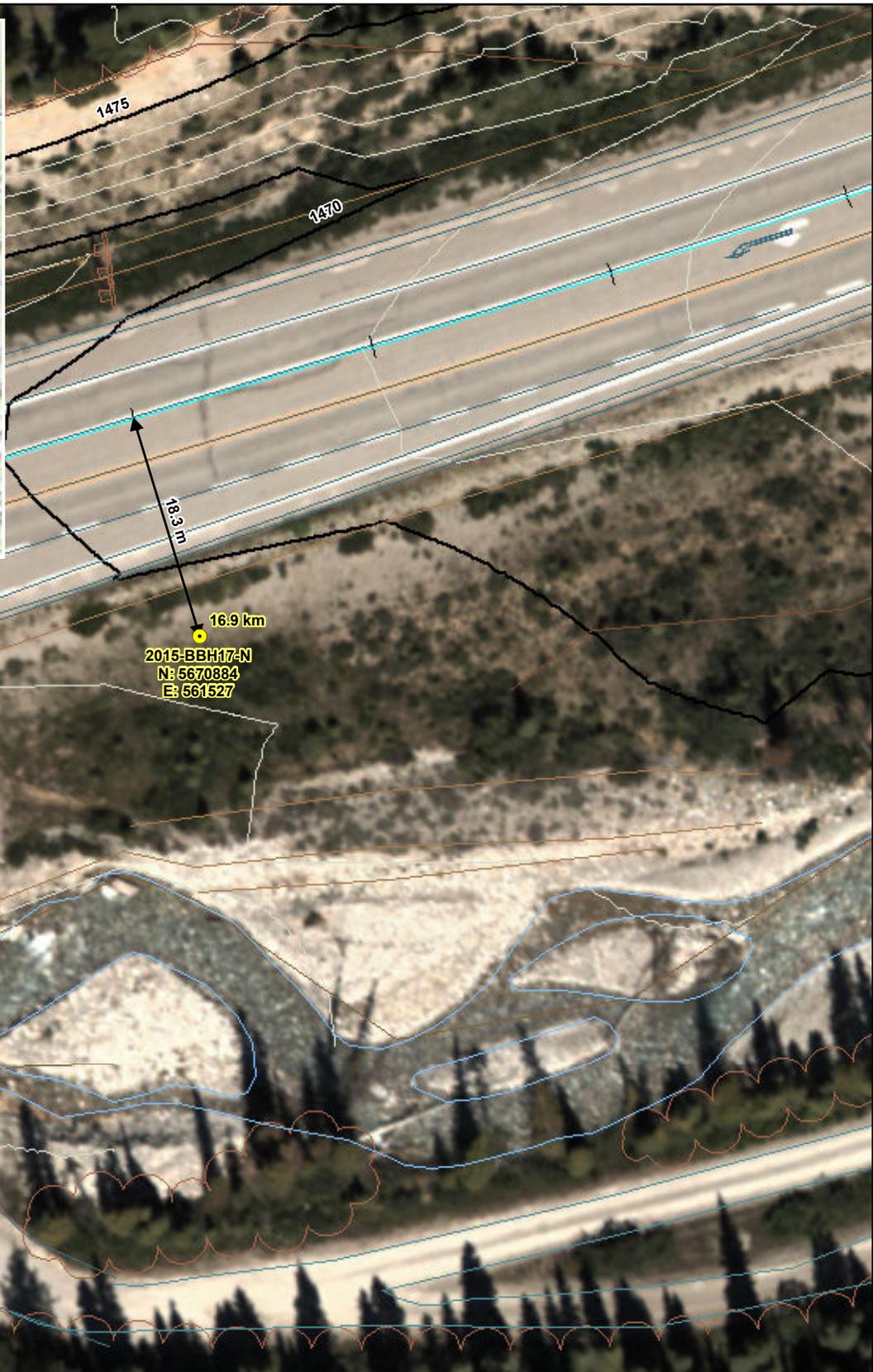
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|--|--|
| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
| ● Proposed Borings to be Decided Later if Required | ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. |
| ● Existing Boreholes | ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. |
| ■ Cultural Sites | ▲ 4 - No habitat, runoff drainage or no watercourse present. |
| ○ Cultural Site Areas | ○ Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ○ Archaeology Site Areas | |

2015-BBH16-S
Highway 93S Kootenay Parkway
Parks Canada

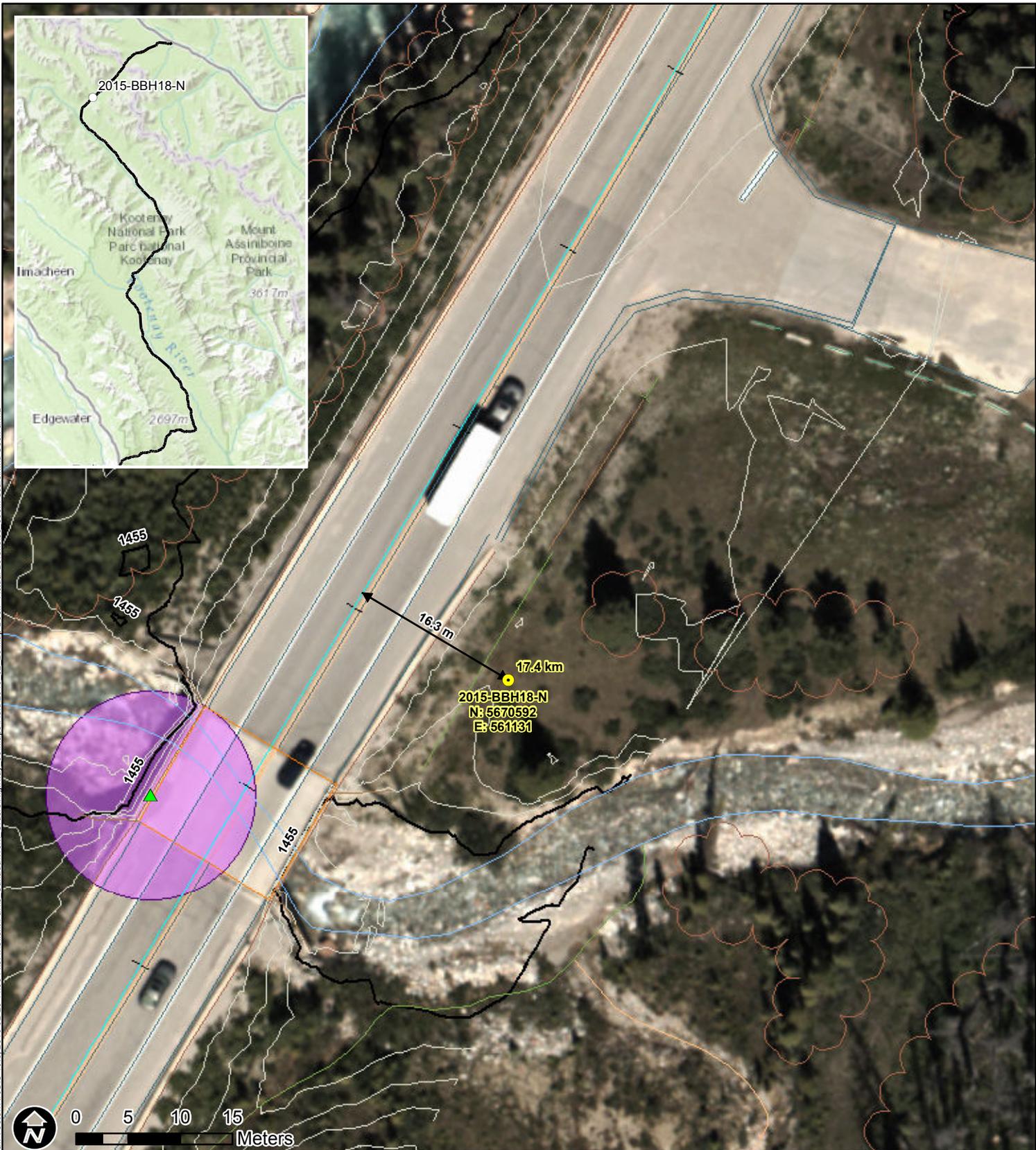
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● Proposed Borings	▲ Watercourse Sensitivity Level
● Proposed Shoulder Borings	▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
● Proposed Borings to be Decided Later if Required	▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
● Existing Boreholes	▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
■ Cultural Sites	▲ 4 - No habitat, runoff drainage or no watercourse present.
○ Cultural Site Areas	○ Ecological Sites (Aqua)
■ Archaeology Site	
○ Archaeology Site Areas	

2015-BBH17-N
Highway 93S Kootenay Parkway
Parks Canada

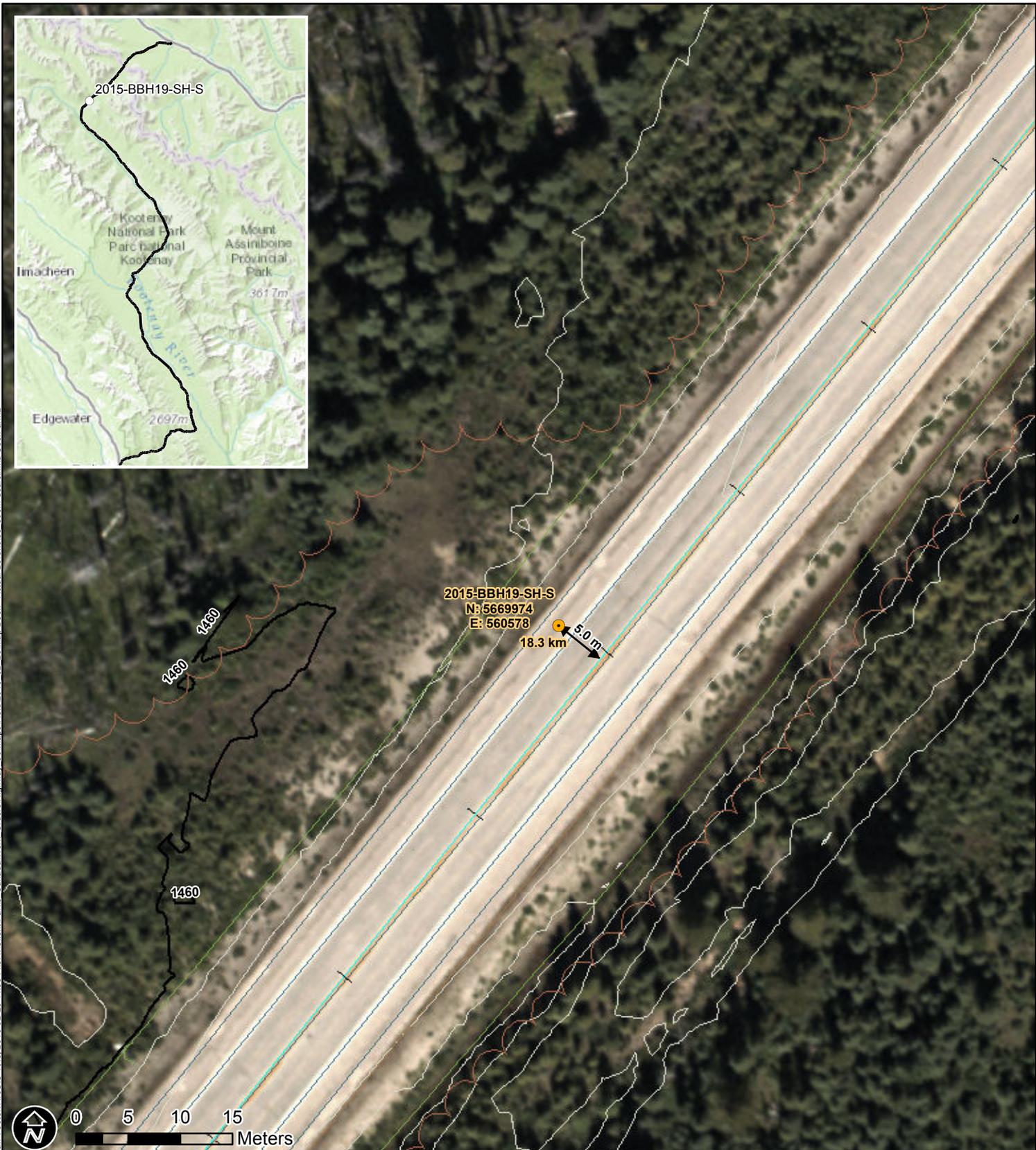
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| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
| ● Proposed Borings to be Decided Later if Required | ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. |
| ● Existing Boreholes | ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. |
| ■ Cultural Sites | ▲ 4 - No habitat, runoff drainage or no watercourse present. |
| ○ Cultural Site Areas | ○ Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ○ Archaeology Site Areas | |

2015-BBH18-N
Highway 93S Kootenay Parkway
Parks Canada

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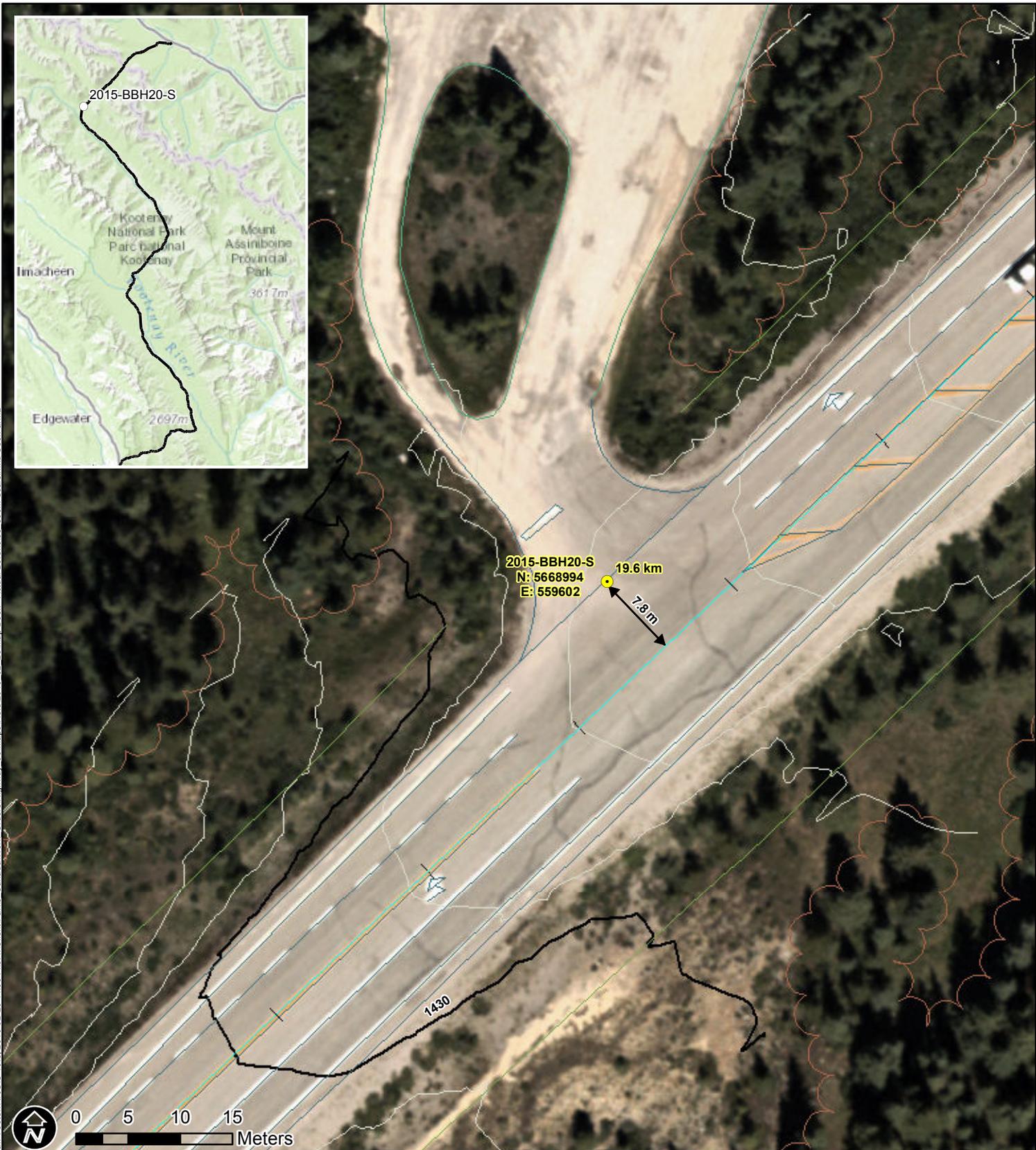
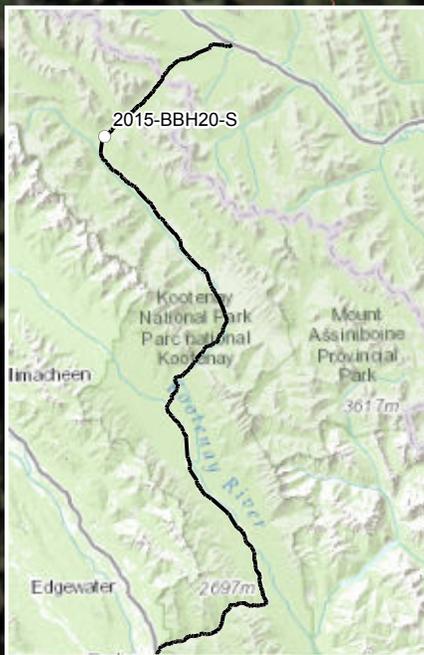


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
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 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH19-SH-S
Highway 93S Kootenay Parkway
Parks Canada

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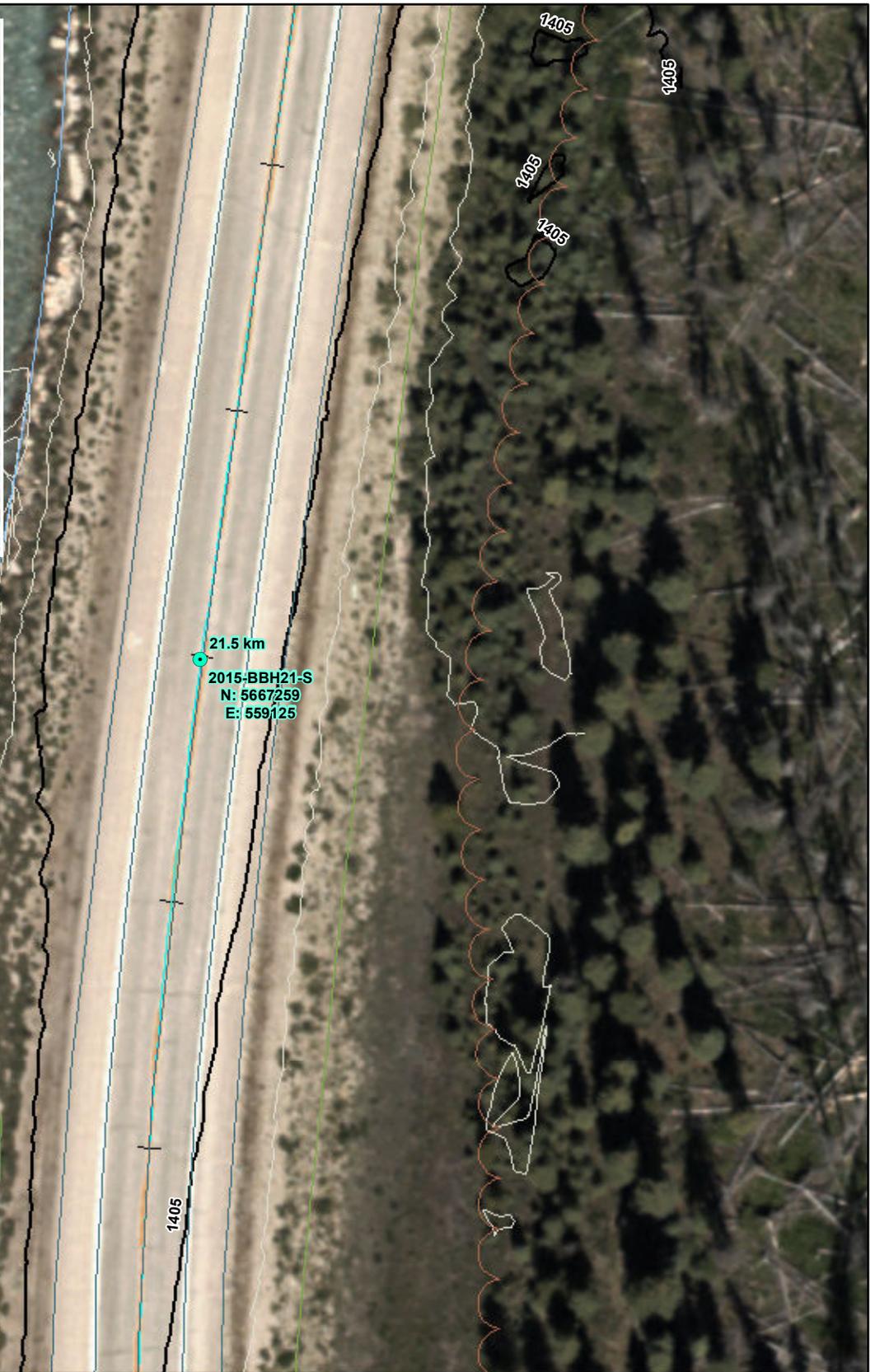
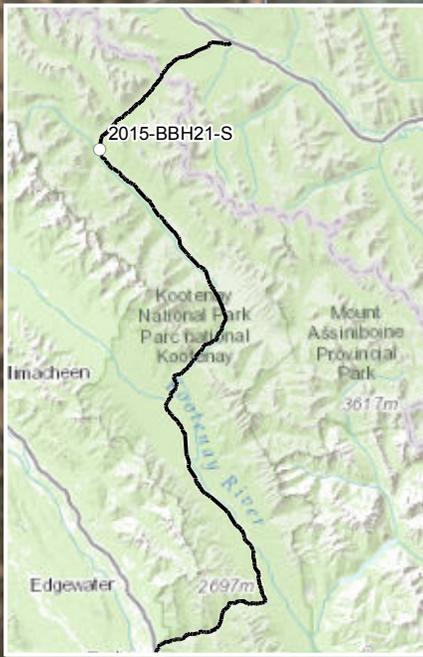


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH20-S
Highway 93S Kootenay Parkway
Parks Canada

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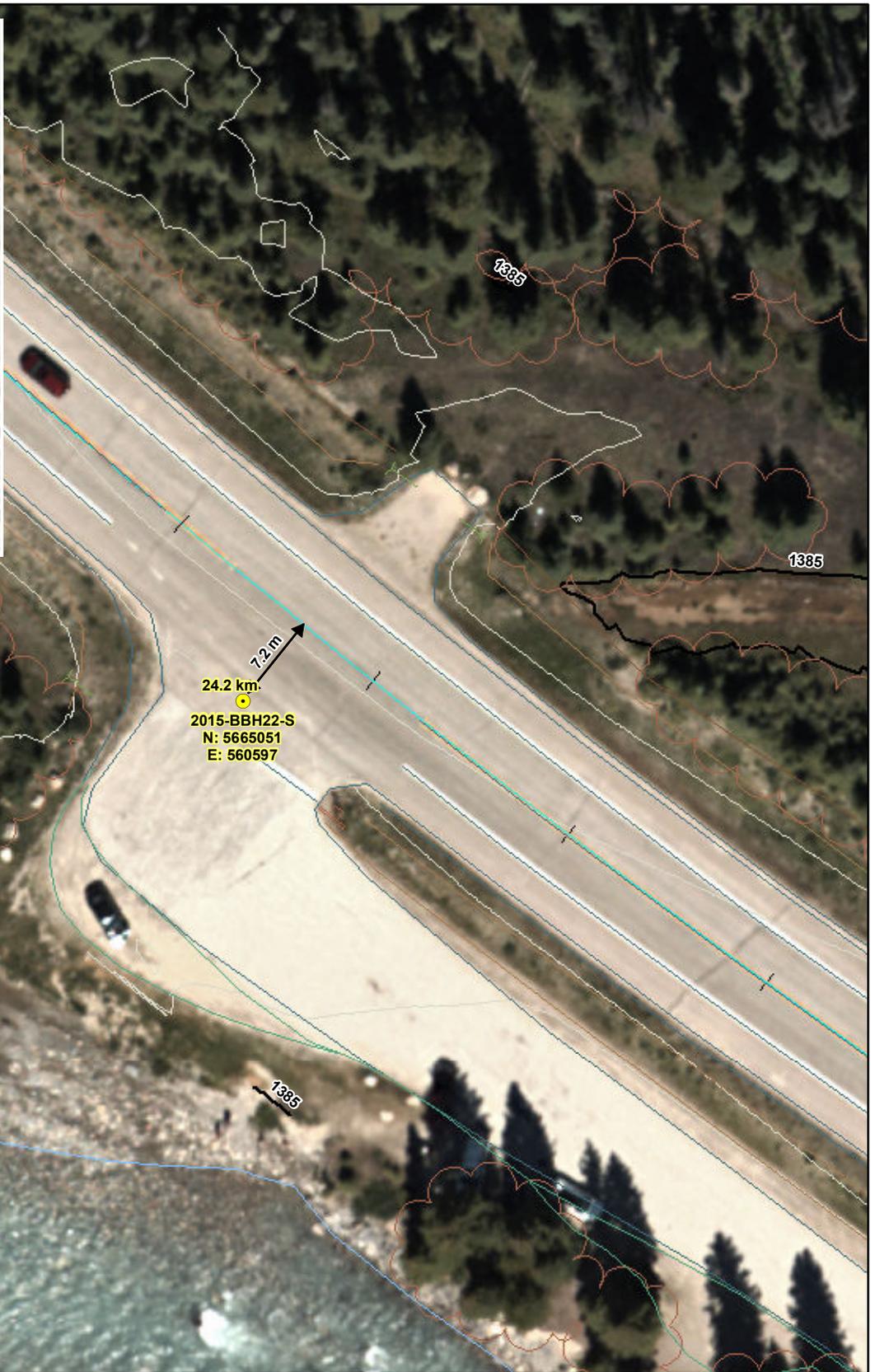
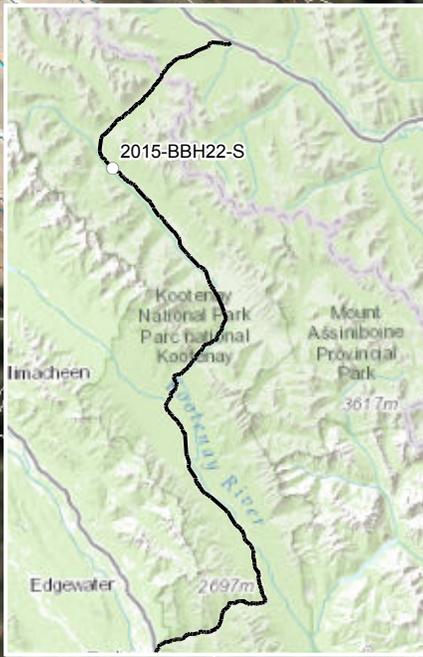


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
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 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH21-S
Highway 93S Kootenay Parkway
Parks Canada

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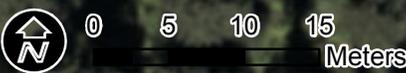
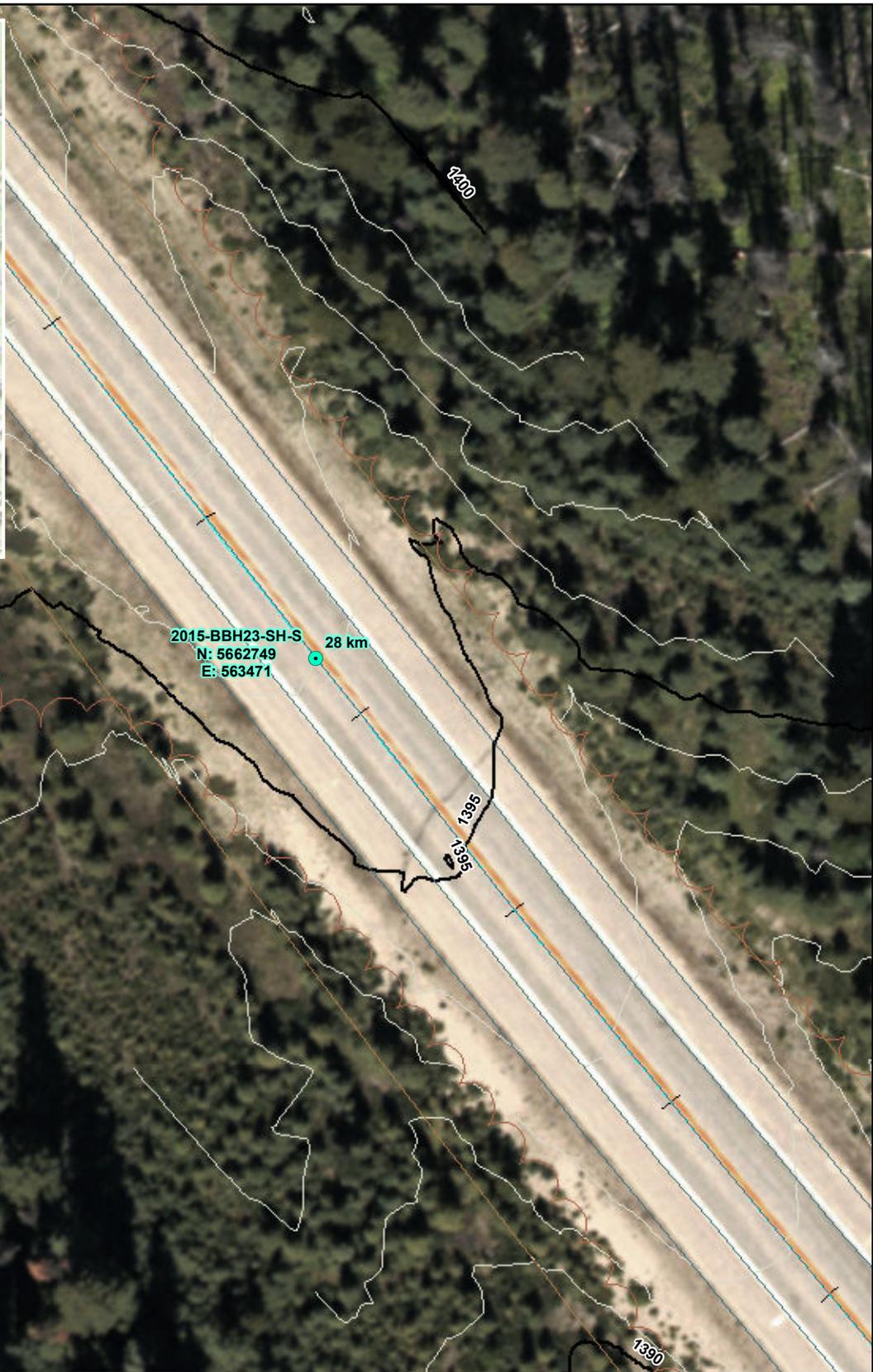
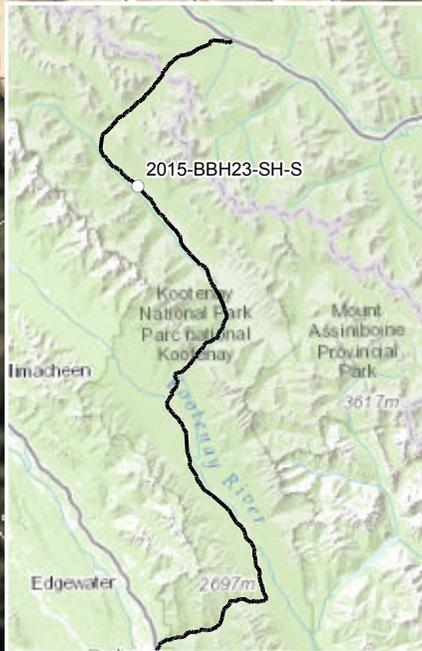


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
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 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH22-S
Highway 93S Kootenay Parkway
Parks Canada

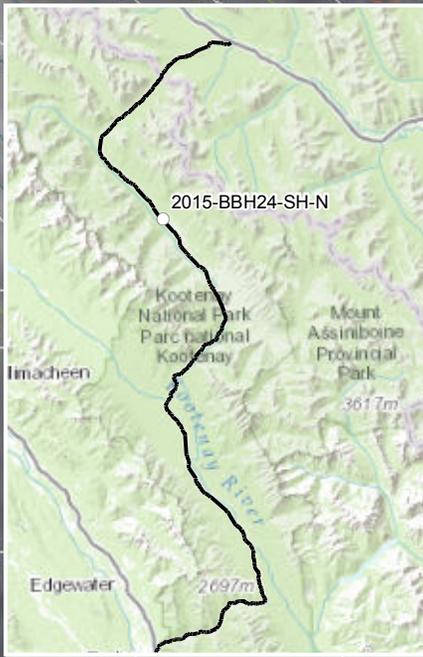
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| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
| ● Proposed Borings to be Decided Later if Required | ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. |
| ● Existing Boreholes | ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. |
| ■ Cultural Sites | ▲ 4 - No habitat, runoff drainage or no watercourse present. |
| ○ Cultural Site Areas | ○ Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ○ Archaeology Site Areas | |

2015-BBH23-SH-S
Highway 93S Kootenay Parkway
Parks Canada

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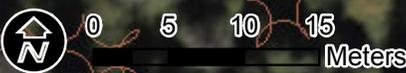
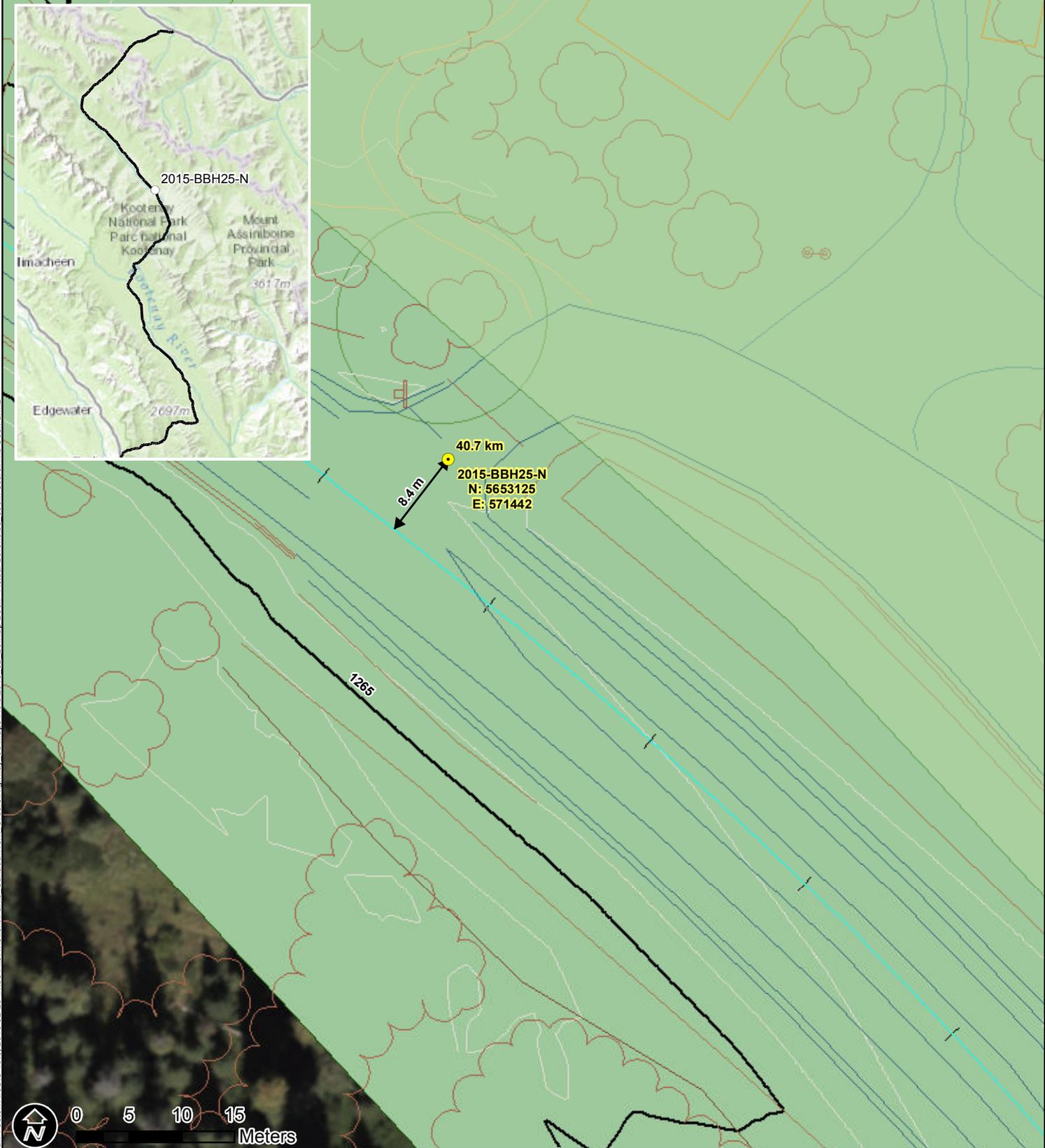


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH24-SH-N
Highway 93S Kootenay Parkway
Parks Canada

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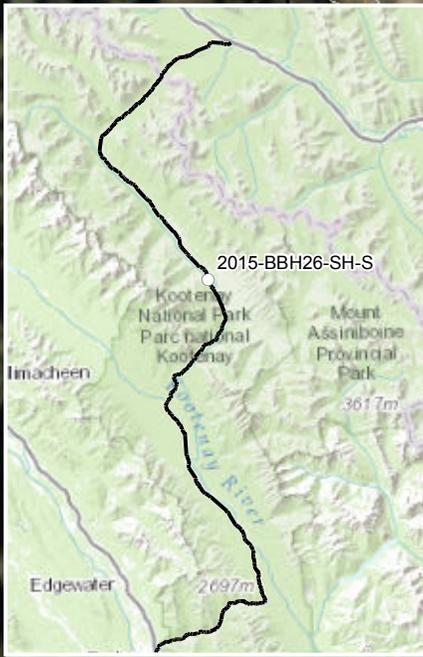


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
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 - Ecological Sites (Aqua)

2015-BBH25-N
Highway 93S Kootenay Parkway
Parks Canada

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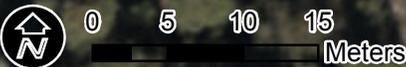
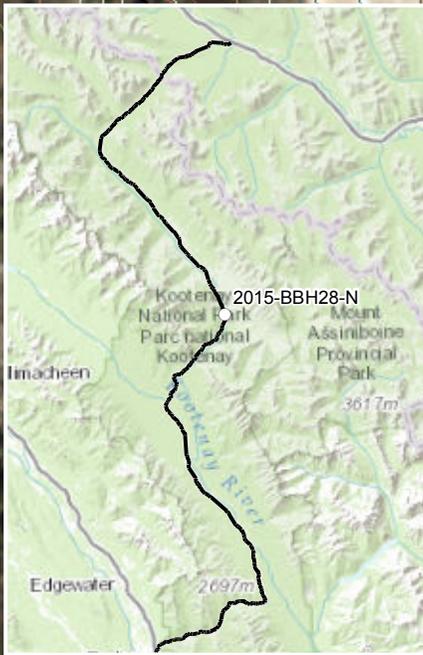


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
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 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH26-SH-S
Highway 93S Kootenay Parkway
Parks Canada

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- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH28-N
Highway 93S Kootenay Parkway
Parks Canada

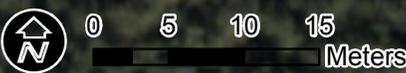
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● Proposed Borings	▲ Watercourse Sensitivity Level
● Proposed Shoulder Borings	▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
● Proposed Borings to be Decided Later if Required	▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
● Existing Boreholes	▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
■ Cultural Sites	▲ 4 - No habitat, runoff drainage or no watercourse present.
○ Cultural Site Areas	○ Ecological Sites (Aqua)
■ Archaeology Site	
○ Archaeology Site Areas	

2015-BBH29-SH-N
Highway 93S Kootenay Parkway
Parks Canada

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● Proposed Borings	▲ Watercourse Sensitivity Level
● Proposed Shoulder Borings	▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
● Proposed Borings to be Decided Later if Required	▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
● Existing Boreholes	▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
■ Cultural Sites	▲ 4 - No habitat, runoff drainage or no watercourse present.
○ Cultural Site Areas	○ Ecological Sites (Aqua)
■ Archaeology Site	
○ Archaeology Site Areas	

2015-BBH30-SH-N
Highway 93S Kootenay Parkway
Parks Canada

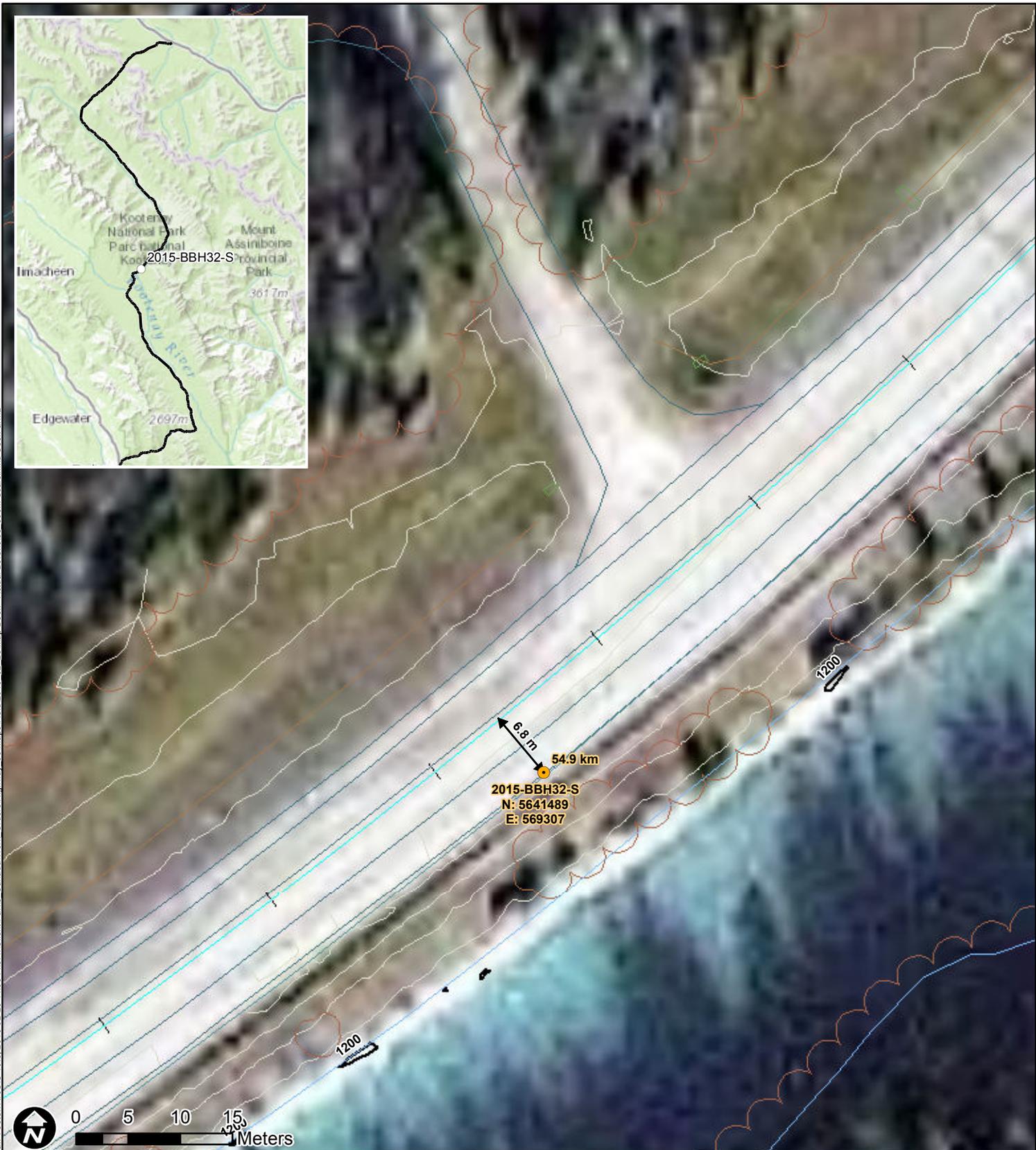
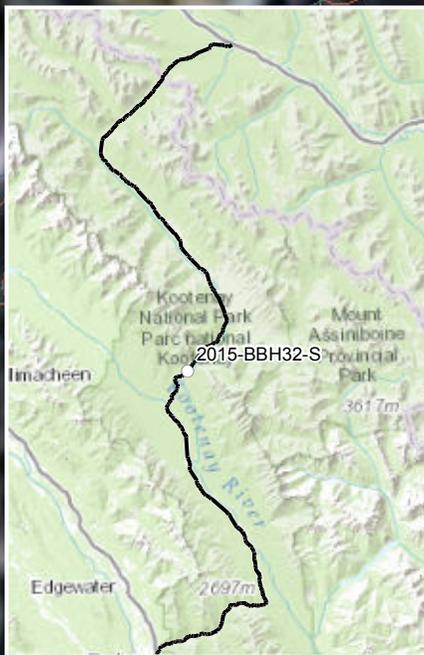
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● Proposed Borings	▲ Watercourse Sensitivity Level
● Proposed Shoulder Borings	▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
● Proposed Borings to be Decided Later if Required	▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
● Existing Boreholes	▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
■ Cultural Sites	▲ 4 - No habitat, runoff drainage or no watercourse present.
■ Cultural Site Areas	○ Ecological Sites (Aqua)
■ Archaeology Site	
■ Archaeology Site Areas	

2015-BBH31-SH-S
Highway 93S Kootenay Parkway
Parks Canada

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- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
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 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH32-S
Highway 93S Kootenay Parkway
Parks Canada

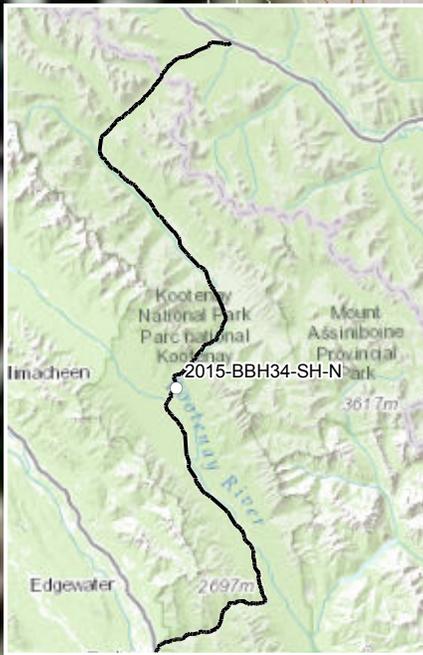
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- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
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 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH33-S
Highway 93S Kootenay Parkway
Parks Canada

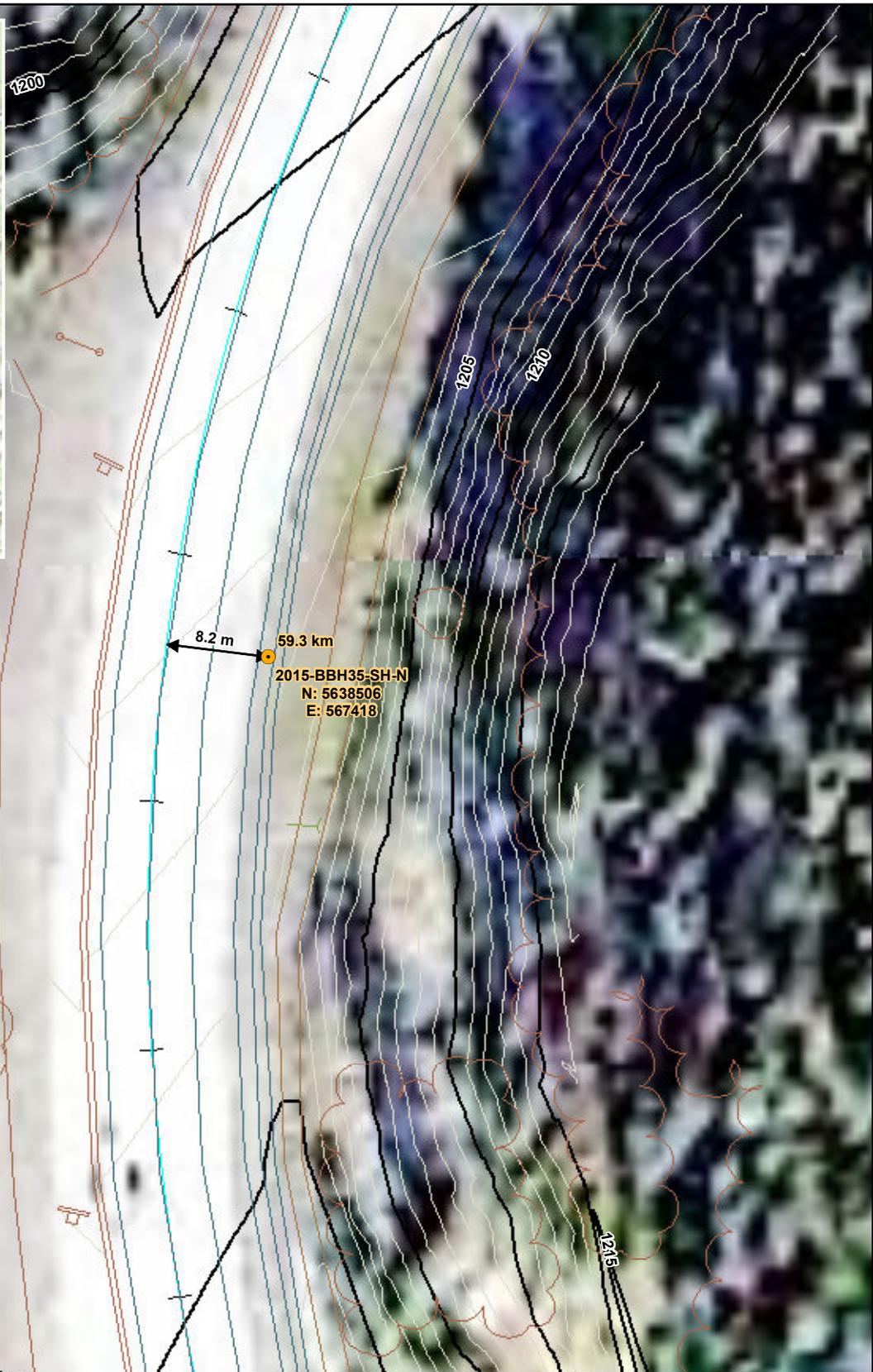


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
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 - Ecological Sites (Aqua)

2015-BBH34-SH-N
Highway 93S Kootenay Parkway
Parks Canada

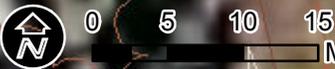
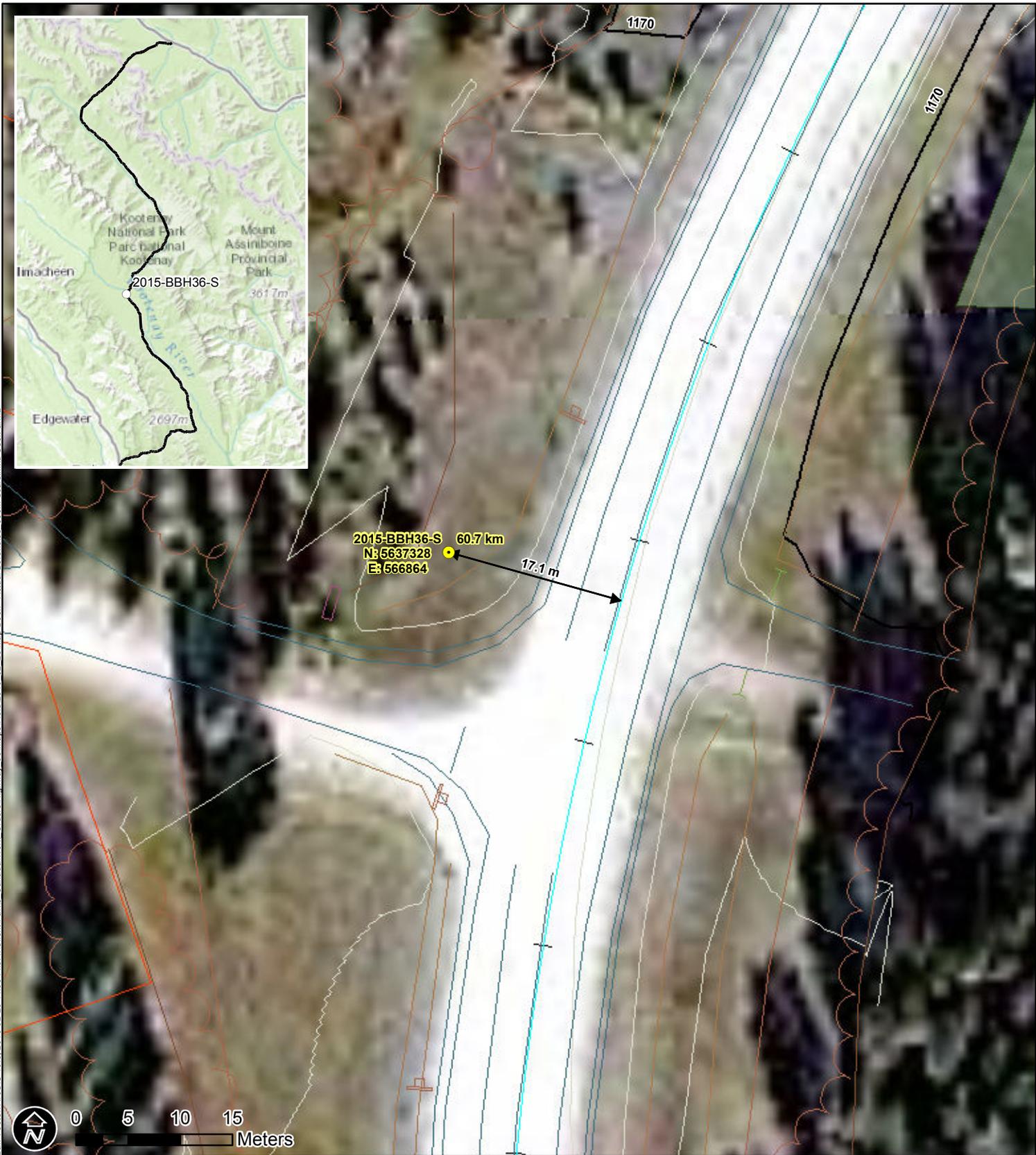
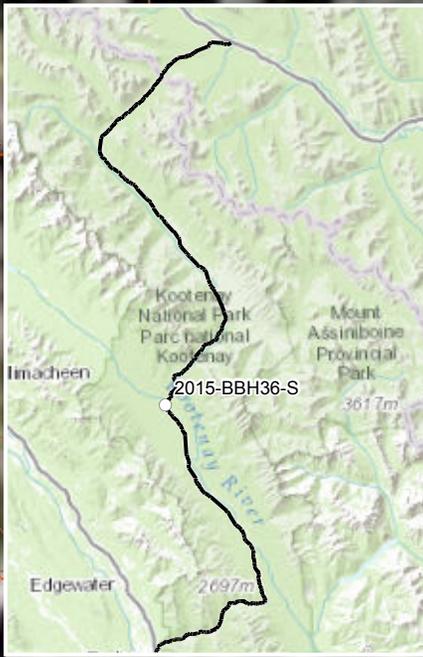
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● Proposed Borings	▲ Watercourse Sensitivity Level
● Proposed Shoulder Borings	▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
● Proposed Borings to be Decided Later if Required	▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
● Existing Boreholes	▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
■ Cultural Sites	▲ 4 - No habitat, runoff drainage or no watercourse present.
○ Cultural Site Areas	○ Ecological Sites (Aqua)
■ Archaeology Site	
○ Archaeology Site Areas	

2015-BBH35-SH-N
Highway 93S Kootenay Parkway
Parks Canada

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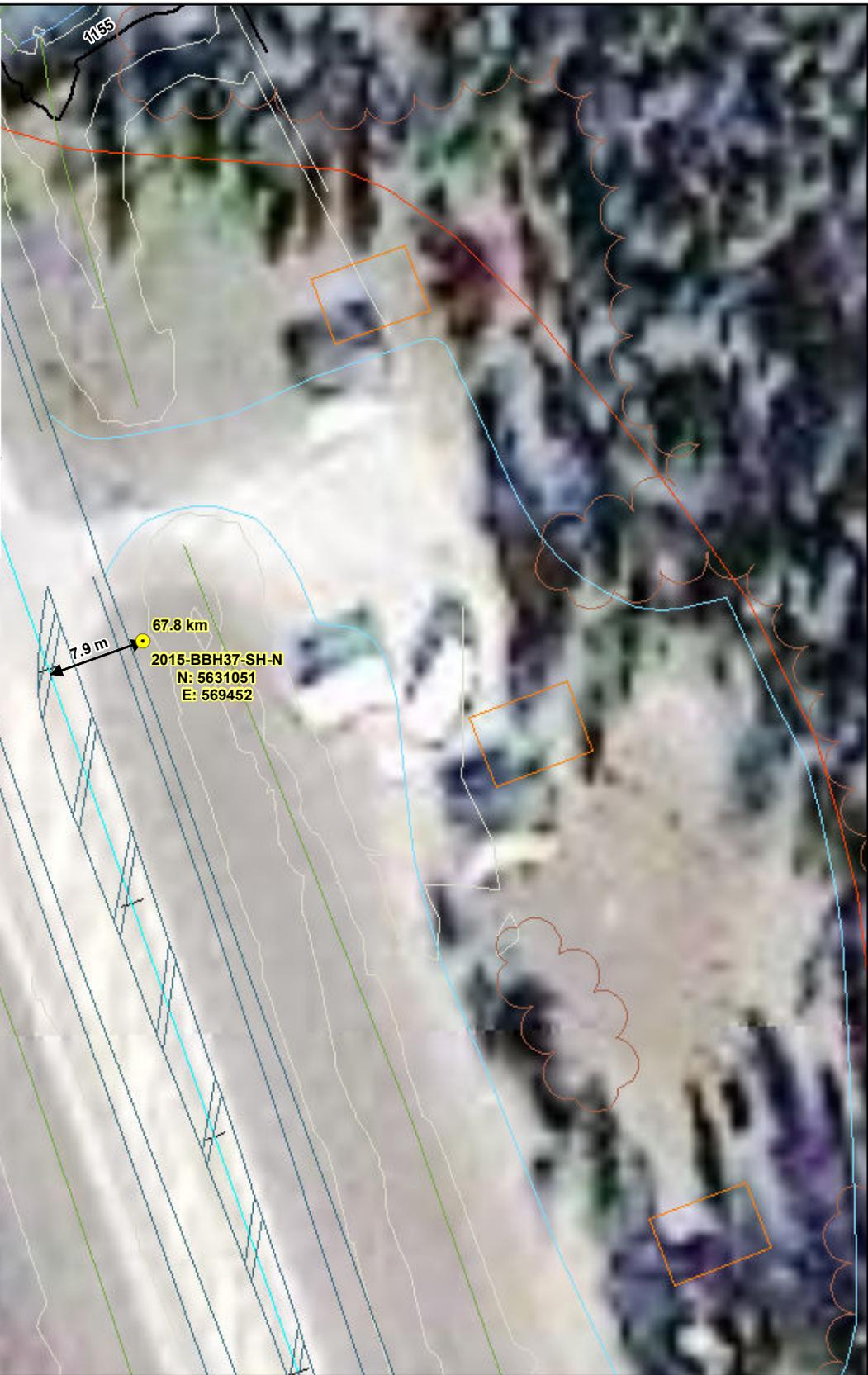
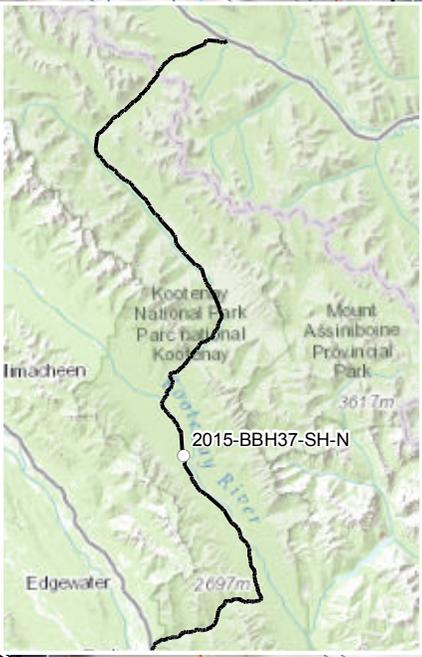


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

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 - Ecological Sites (Aqua)

2015-BBH36-S
Highway 93S Kootenay Parkway
Parks Canada

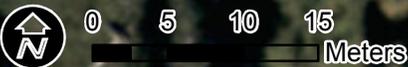
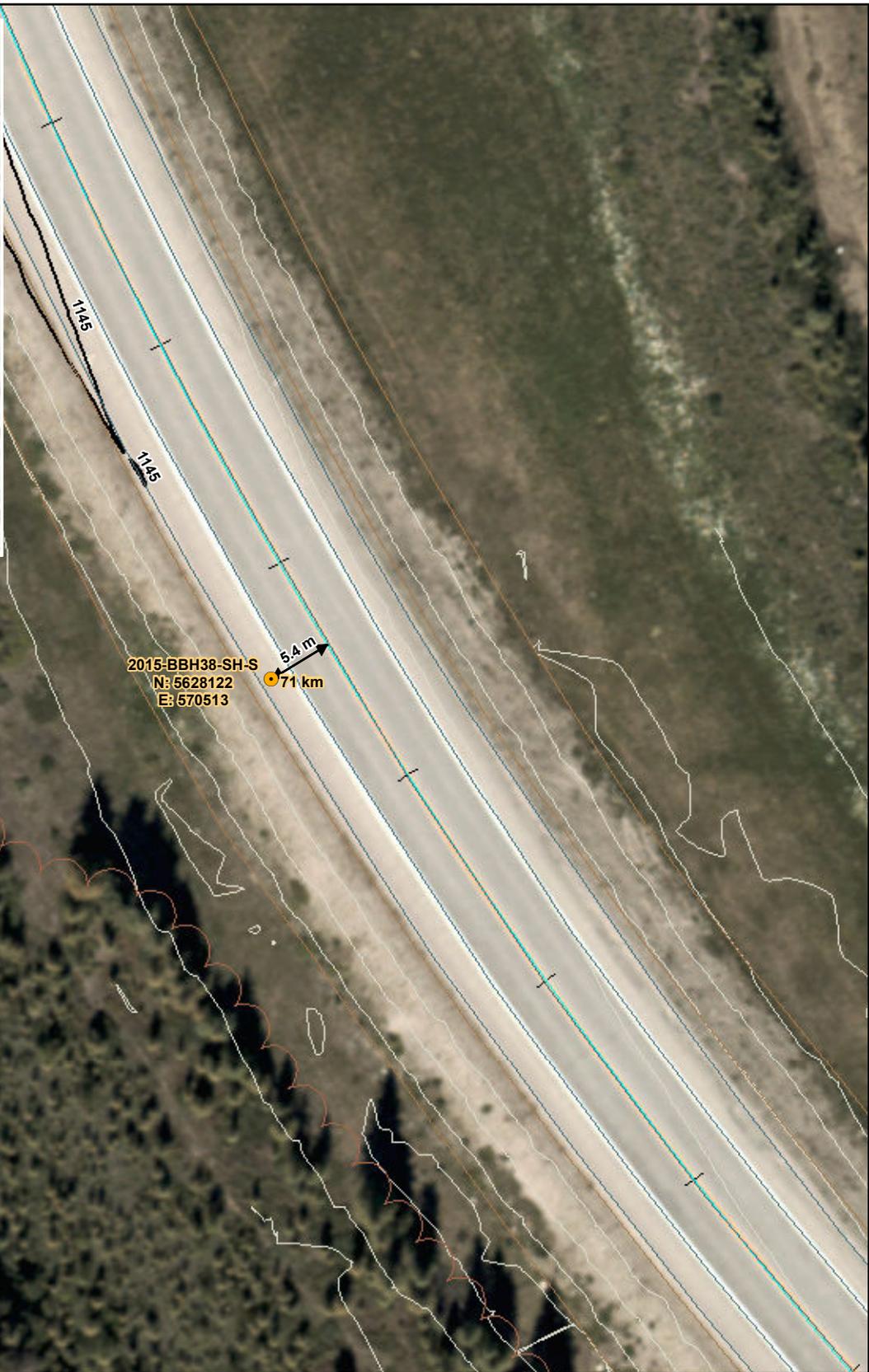
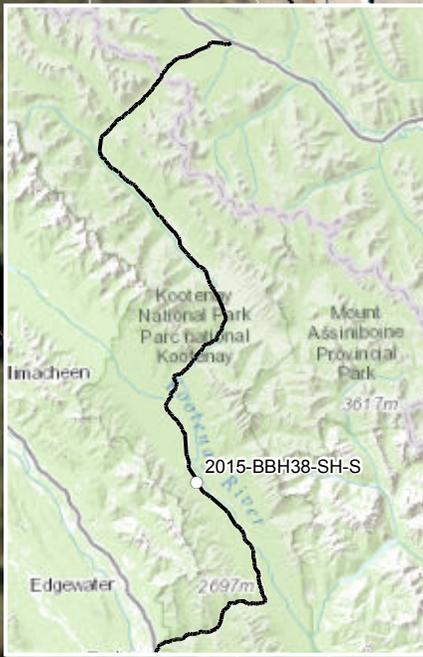
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- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

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 - Ecological Sites (Aqua)

2015-BBH37-SH-N
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
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- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

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 - Ecological Sites (Aqua)

2015-BBH38-SH-S
Highway 93S Kootenay Parkway
Parks Canada

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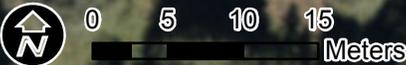
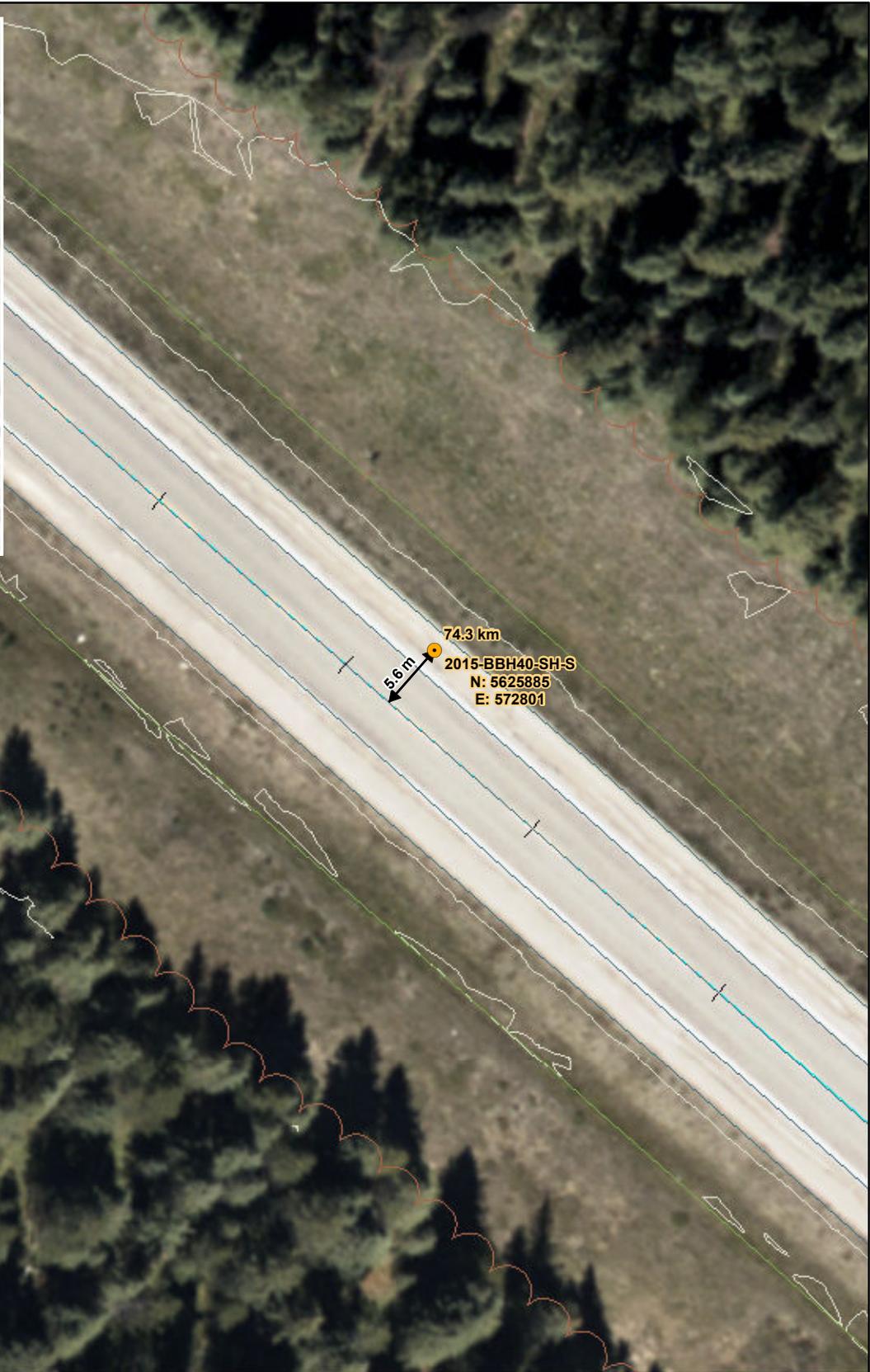


- Proposed Borings
- Proposed Shoulder Borings
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- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

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 - Ecological Sites (Aqua)

2015-BBH39-SH-S
Highway 93S Kootenay Parkway
Parks Canada

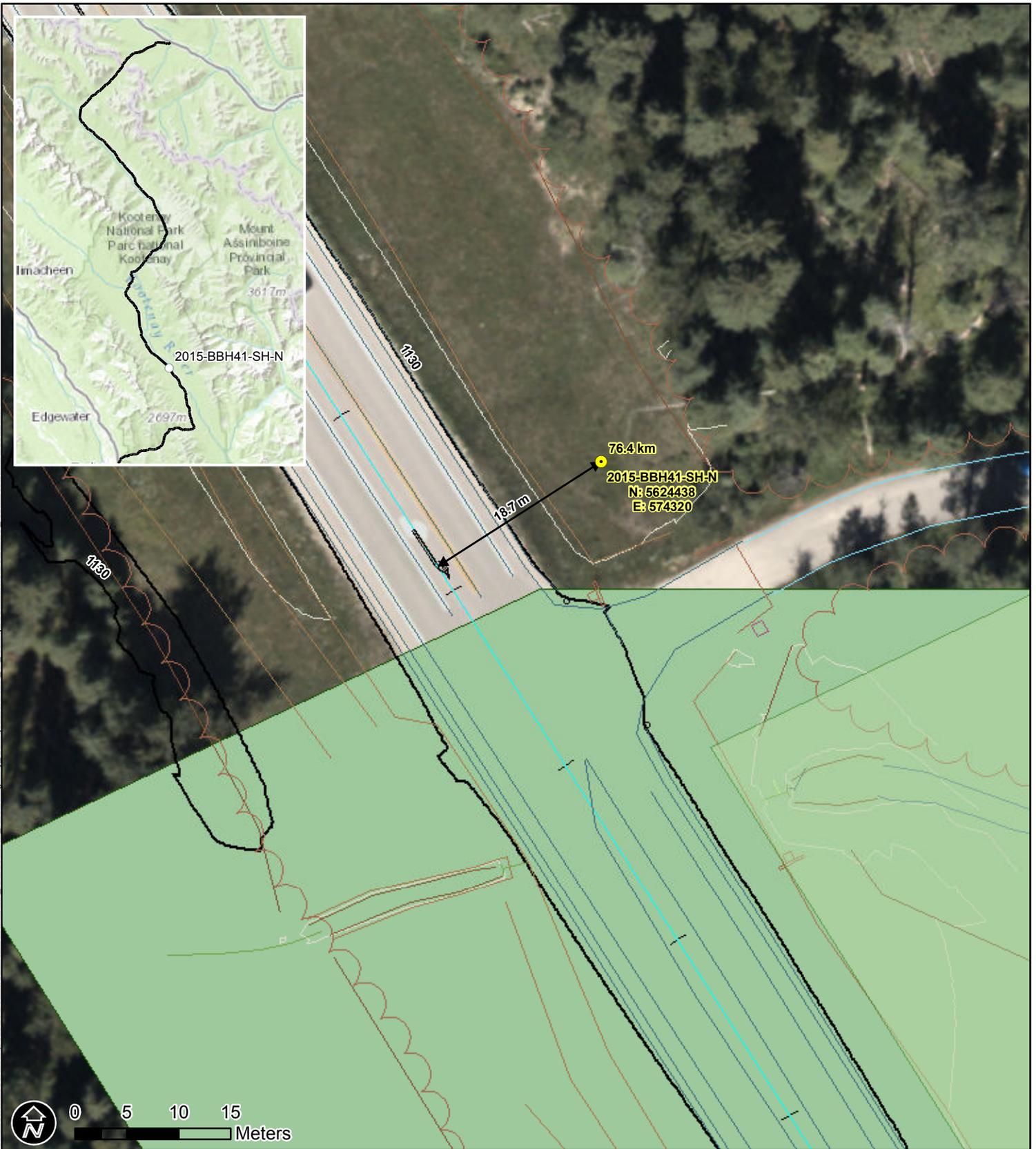
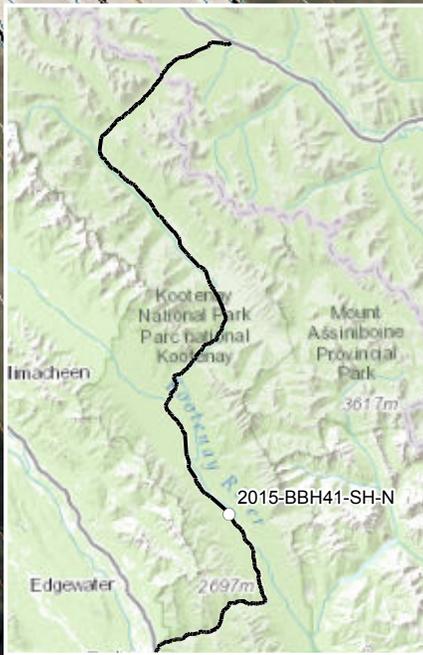
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|--|--|
| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
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| ○ Cultural Site Areas | ○ Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ○ Archaeology Site Areas | |

2015-BBH40-SH-S
Highway 93S Kootenay Parkway
Parks Canada

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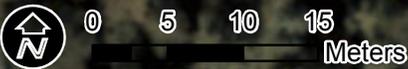
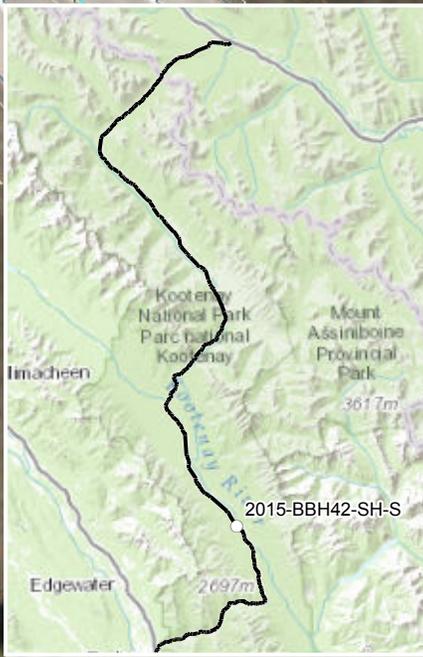


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

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 - Ecological Sites (Aqua)

2015-BBH41-SH-N
Highway 93S Kootenay Parkway
Parks Canada

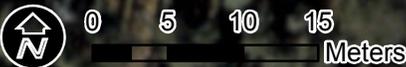
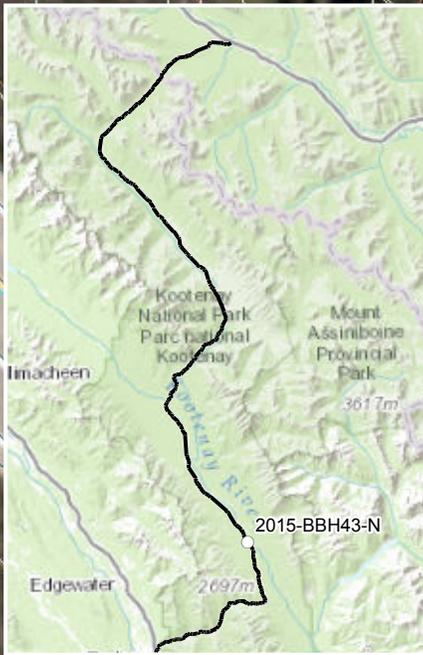
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- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
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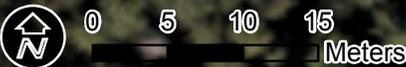
2015-BBH42-SH-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
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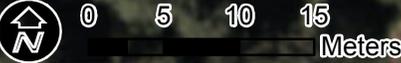
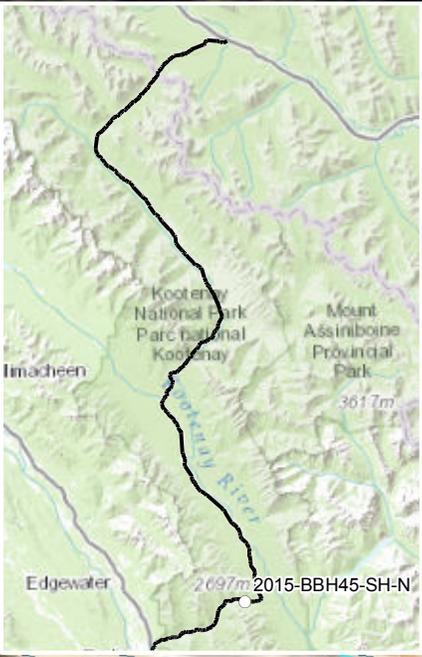
2015-BBH43-N
Highway 93S Kootenay Parkway
Parks Canada



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| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
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| ○ Cultural Site Areas | ○ Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ○ Archaeology Site Areas | |

2015-BBH44-SH-N
Highway 93S Kootenay Parkway
Parks Canada

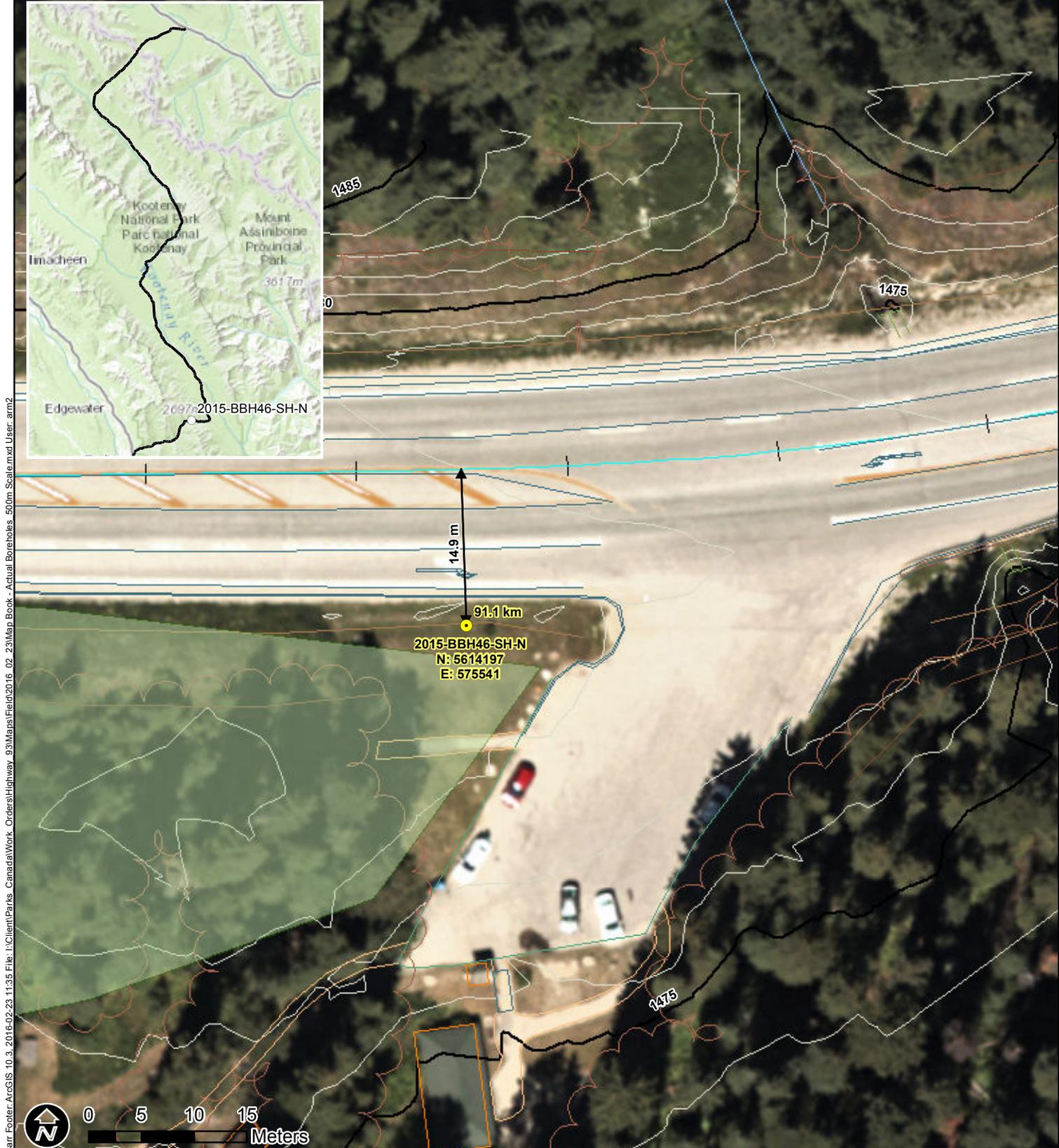
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2015-BBH45-SH-N
Highway 93S Kootenay Parkway
Parks Canada

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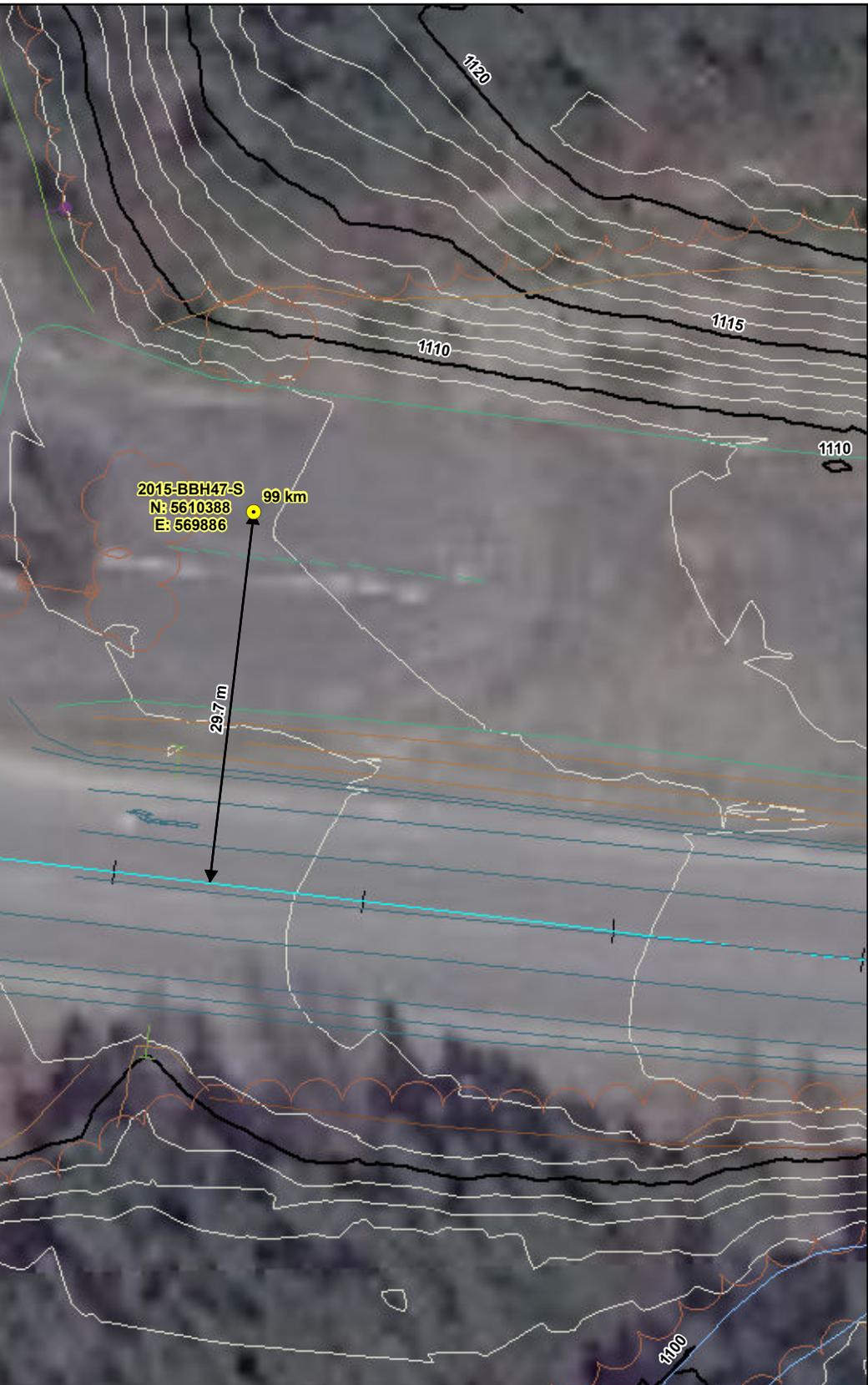


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
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 - Ecological Sites (Aqua)

2015-BBH46-SH-N
Highway 93S Kootenay Parkway
Parks Canada

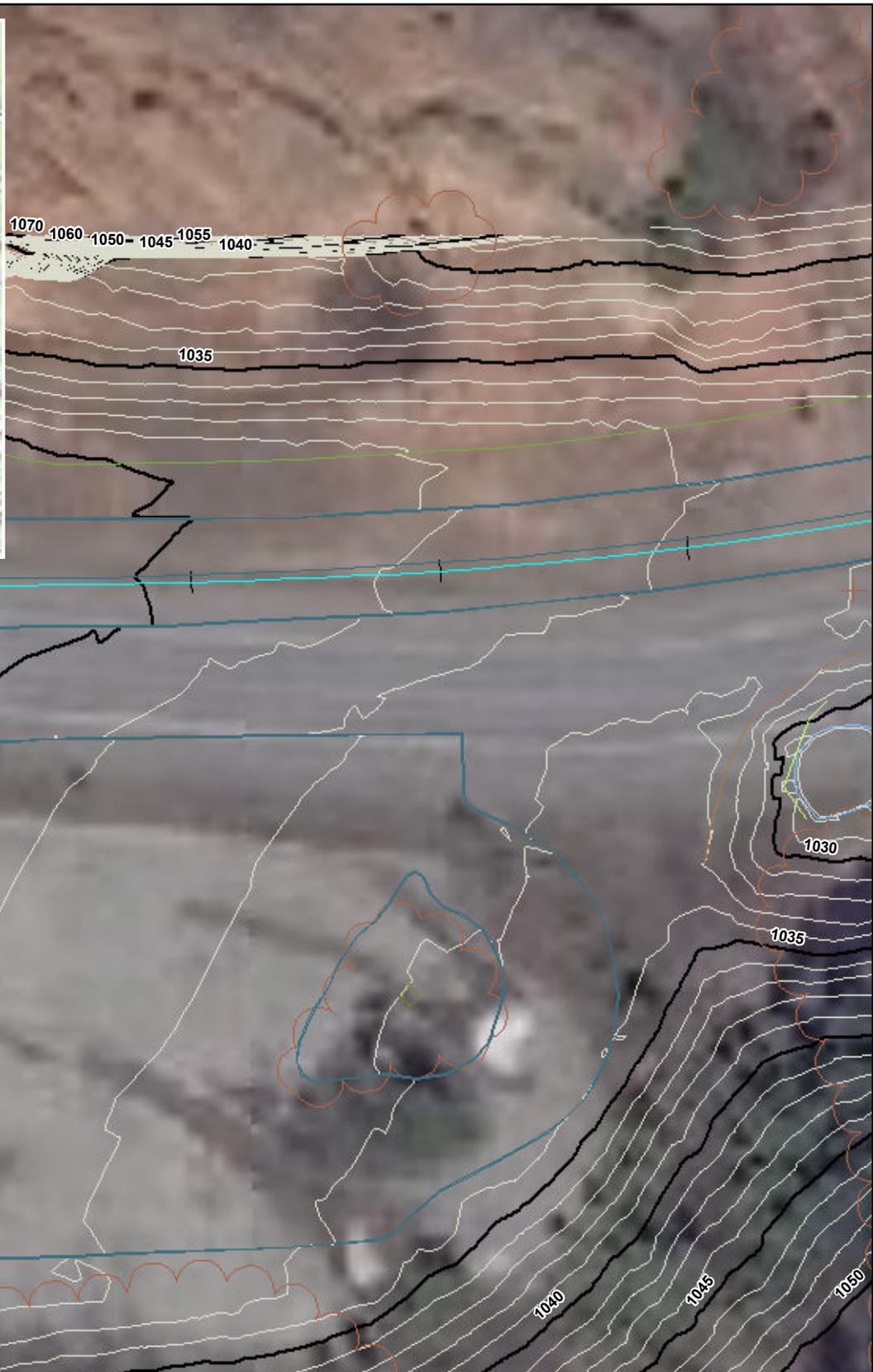
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| ○ Archaeology Site Areas | |

2015-BBH47-S
Highway 93S Kootenay Parkway
Parks Canada

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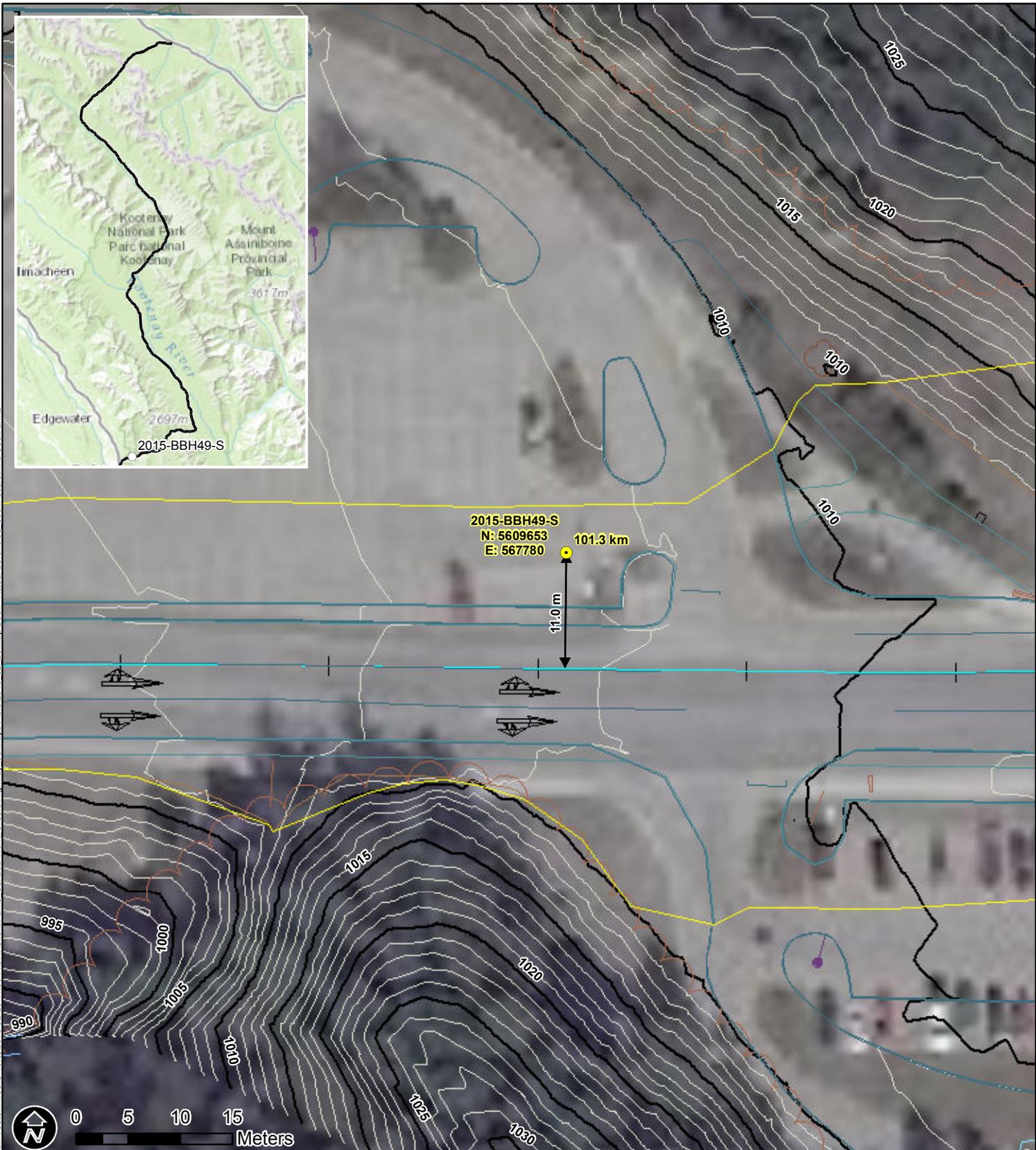
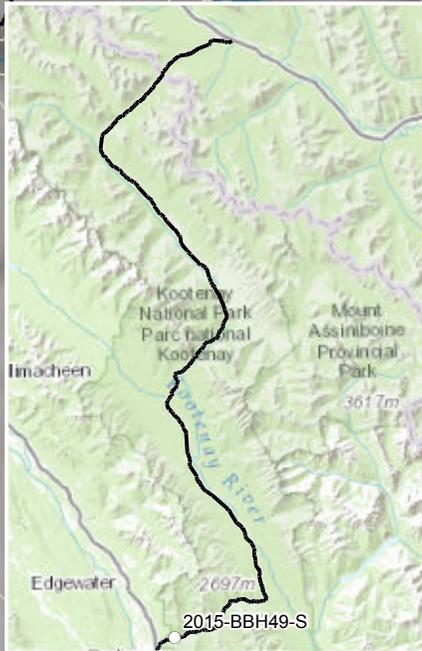


- Proposed Borings
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- Cultural Site Areas
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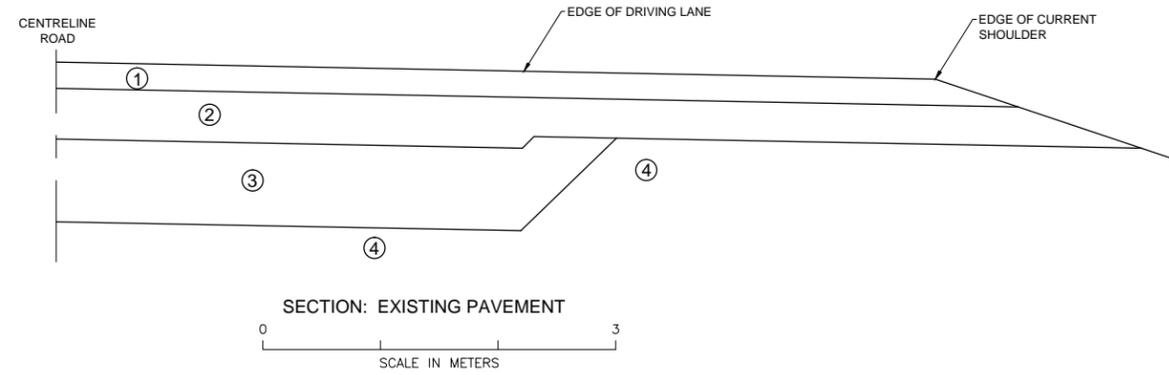
2015-BBH48-N
Highway 93S Kootenay Parkway
Parks Canada

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● Proposed Borings	▲ Watercourse Sensitivity Level
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○ Archaeology Site Areas	

2015-BBH49-S
Highway 93S Kootenay Parkway
Parks Canada

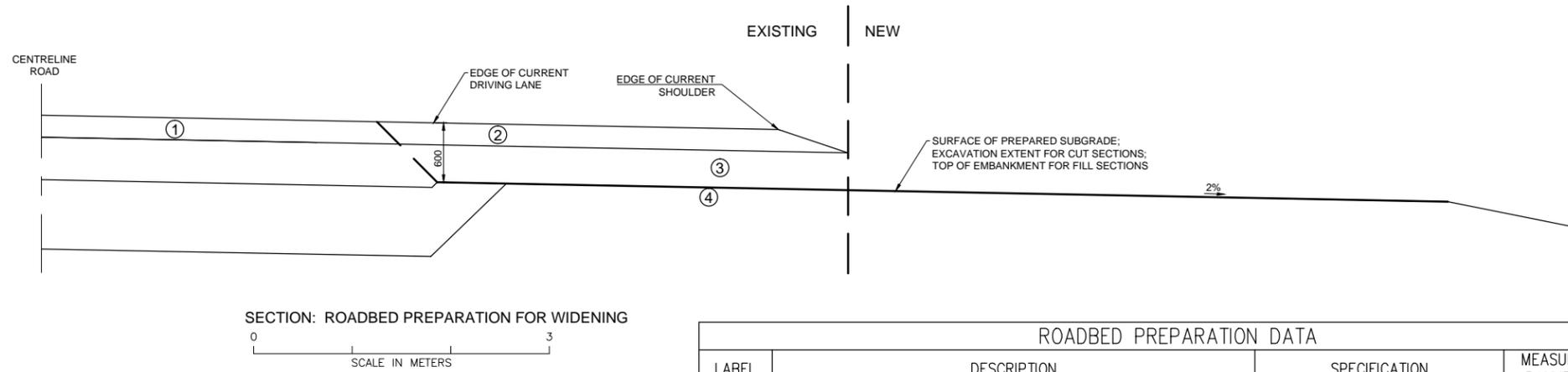


EXISTING SECTION DATA		
LABEL	DESCRIPTION	THICKNESS
1	ASPHALT PAVEMENT	VARIES BETWEEN 90 AND 310; 220 TYPICAL
2	CRUSHED GRAVEL & SAND	VARIES BETWEEN 0 AND 580; 430 TYP; ABOUT 100 THINNER UNDER SHOULDER
3	GENERALLY GRAVEL & SAND	VARIES BETWEEN 200 & 2450; 700 TYP
4	SUBGRADE; TYPICALLY SILTY CLAY; SOMETIMES BEDROCK OR SAND & GRAVEL	

- TABLE NOTES:
- THE TABLE DATA IS BASED ON AVAILABLE DATA.
 - PRIMARY DATA SOURCE IS: KOOTENAY PARKWAY, HIGHWAY 93S, KOOTENAY NATIONAL PARK, LARGE CRACK INVESTIGATION, 10 YEAR MAINTENANCE PLAN; JOHN EMERY GEOTECHNICAL ENGINEERING LTD; MARCH, 2008

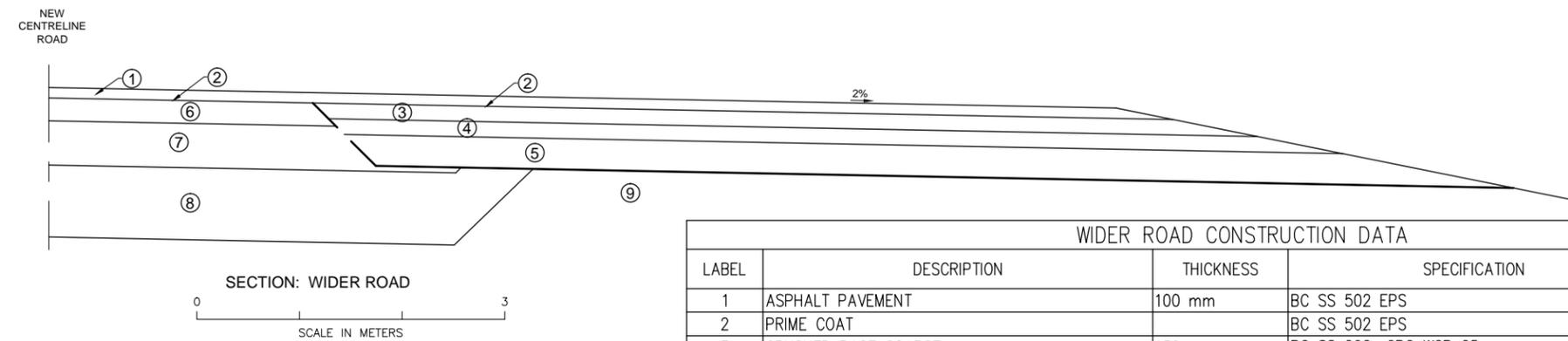
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INFORMATION SHOWN ON THESE DRAWINGS REGARDING EXISTING UTILITIES IS COMPILED FROM SOME RECORD DRAWINGS AND SOME SURVEYS, AND MAY NOT BE COMPLETE OR FULLY ACCURATE. PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL EXPOSE AND CONFIRM THE LOCATIONS AND ELEVATIONS OF ALL EXISTING UTILITIES AND ADVISE THE CORPORATION REPRESENTATIVE OF ANY POTENTIAL CONFLICTS.



ROADBED PREPARATION DATA			
LABEL	DESCRIPTION	SPECIFICATION	MEASUREMENT & PAYMENT UNITS
1	PULVERIZE EXISTING ASPHALT PAVEMENT TO DEPTH OF 250; SHAPE & COMPACT TO 100% STD PROCTOR DENISTY (ASTM D698)	BC SS 511(MODIFIED) & BC SS 503	CUBIC METRE
2	PULVERIZE EXISTING SHOULDER ASPHALT & REMOVE; MATERIAL MAY BE USED FOR SUBGRADE FILL	BC SS 511(MODIFIED) & BC SS 201 TYPE D EXCAVATION	CUBIC METRE
3	REMOVE EXISTING SHOULDER MATERIALS; MATERIAL MAY BE USED FOR SUBGRADE FILL	BC SS 201 TYPE D EXCAVATION	CUBIC METRE
4	SUBGRADE	BC SS 201	CUBIC METRE

- TABLE NOTES:
- "BC" DENOTES THE BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE.
 - "SS" DENOTES STANDARD SPECIFICATION.



WIDER ROAD CONSTRUCTION DATA				
LABEL	DESCRIPTION	THICKNESS	SPECIFICATION	MEASUREMENT & PAYMENT UNITS
1	ASPHALT PAVEMENT	100 mm	BC SS 502 EPS	TONNE
2	PRIME COAT		BC SS 502 EPS	LITRE
3	CRUSHED BASE COARSE	150 mm	BC SS 202; CBC WGB 25 mm	CUBIC METRE
4	CRUSHED BASE COARSE	150 mm	BC SS 202; CBC WGB 75mm, 50 mm OR 25mm	CUBIC METRE
5	SELECT GRANULAR SUB-BASE	300 mm	BC SS 202; SGSB	CUBIC METRE
6	PULVERIZED EXISTING ASPHALT PAVEMENT	ABOUT 250 mm		
7	EXISTING CRUSHED GRAVEL & SAND	VARIES		
8	EXISTING SUB-BASE; GENERALLY GRAVEL & SAND	VARIES		
9	SUBGRADE (EMBANKMENT OR NATIVE MATERIAL)	VARIES	BC SS 201	CUBIC METRE

- TABLE NOTES:
- "BC" DENOTES THE BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE.
 - "SS" DENOTES STANDARD SPECIFICATION.

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
A	2015.12.11	PRELIMINARY DESIGN	-	-

Revision / Revision

A	A detail number / numéro de détail	A
B	B source drawing no. / de dessin no.	B/C
C	C detail on drawing no. / détail sur dessin no.	

Consultant's Stamp / Sceau de l'expert-conseil

Eng. Stamp / Sceau de l'ingénieur

Client/client

Parks Canada Agency Western and Northern Region / L'Agence Parcs Canada Ouest et Nord Région

Consultant's Name / Nom de l'expert-conseil

McElhanney

Project title/Titre du projet

HIGHWAY 93 SOUTH SAFETY IMPROVEMENTS

BANFF & KOOTENAY NATIONAL PARKS

Drawing title/Titre du dessin

CROSS SECTIONS KOOTENAY PARKWAY PAVEMENT STRUCTURE RECOMMENDATIONS

NOT FOR CONSTRUCTION

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
-	-	2016.02.16
Designed by/Concept par	Reviewed by/Revisé par	Scale/Echelle
-	-	AS SHOWN
Parks Canada Project Manager/Administrateur de Projets Parcs Canada		
Client Acceptance/Acceptation du client	Approved by/Approuvé par	
-	-	
Project No./No. du projet	Asset No./No. du bien	Sheet No./No. de la feuille
201536	-	REV A
Drawing Reference No./No. de référence du dessin		
FIGURE 2		

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Appendix A

Boring Logs



Barr Engineering and Environmental Science Canada Ltd.
 808 4th Ave SW Suite 500
 Calgary, AB T2P 3E8
 Telephone: 403-592-8300

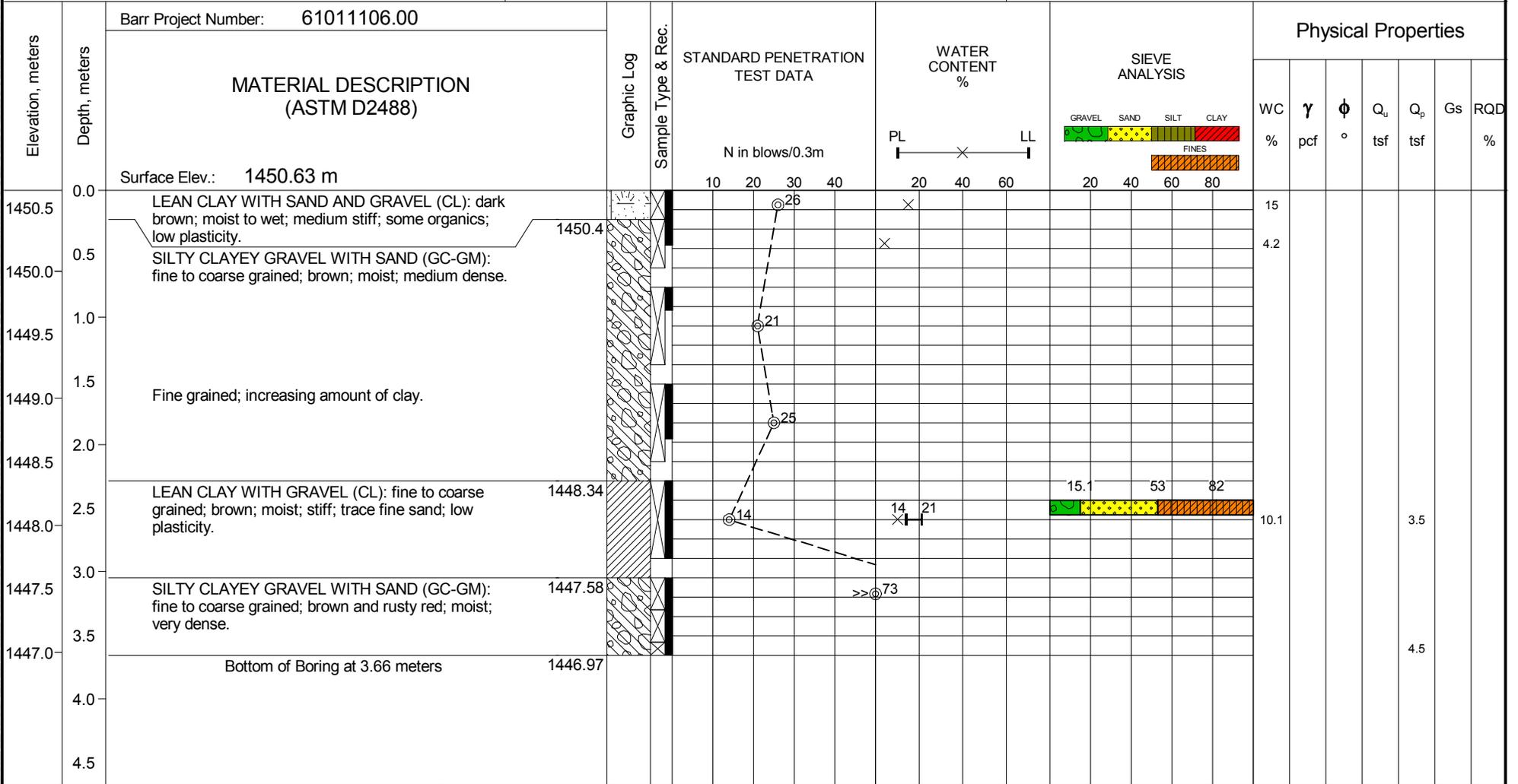
LOG OF BORING 2015-BBH01-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 12.0
 Date Boring Started: 10/12/15
 Date Boring Completed: 10/12/15
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4759.3
 Coordinates: UTM NAD83 N:5679618m, E:574059m
 Datum: NAD83

Remarks: In ditch, close to the utility line, deep snow cover
 Offset of around 0.5 m

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH02-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties										
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %				
1498.5	0.0	Surface Elev.: 1498.61 m	SILTY CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brownish dark grey; moist; medium dense; few organics.			17	40												
1498.0	0.5																		
1497.5	1.0	1497.85	SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brownish dark grey; moist; medium dense to very dense; gravel sizes less than 1".			18													
1497.0	1.5																		
1496.5	2.0																		
1496.0	2.5	1496.32	SILTY CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; very dense.																
1495.5	3.0	1495.56	SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brownish grey; moist; very dense; gravel sizes around 1".																
1495.0	3.5																		
	4.0		Bottom of Boring at 3.66 meters																
	4.5																		

Completion Depth: 12.0	Remarks: Offset of around 0.5 m
Date Boring Started: 10/12/15	
Date Boring Completed: 10/12/15	
Logged By: VLW	
Drilling Contractor: Earth Drilling	
Drilling Method: SSA	
Ground Surface Elevation: 4916.7	
Coordinates: UTM NAD83 N:5679788m, E:573080m	
Datum: NAD83	

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content
		γ Dry Unit Weight
		ϕ Friction Angle
		Q_u Unconfined Compression
		Q_p Hand Penetrometer UC
		Gs Specific Gravity
		RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

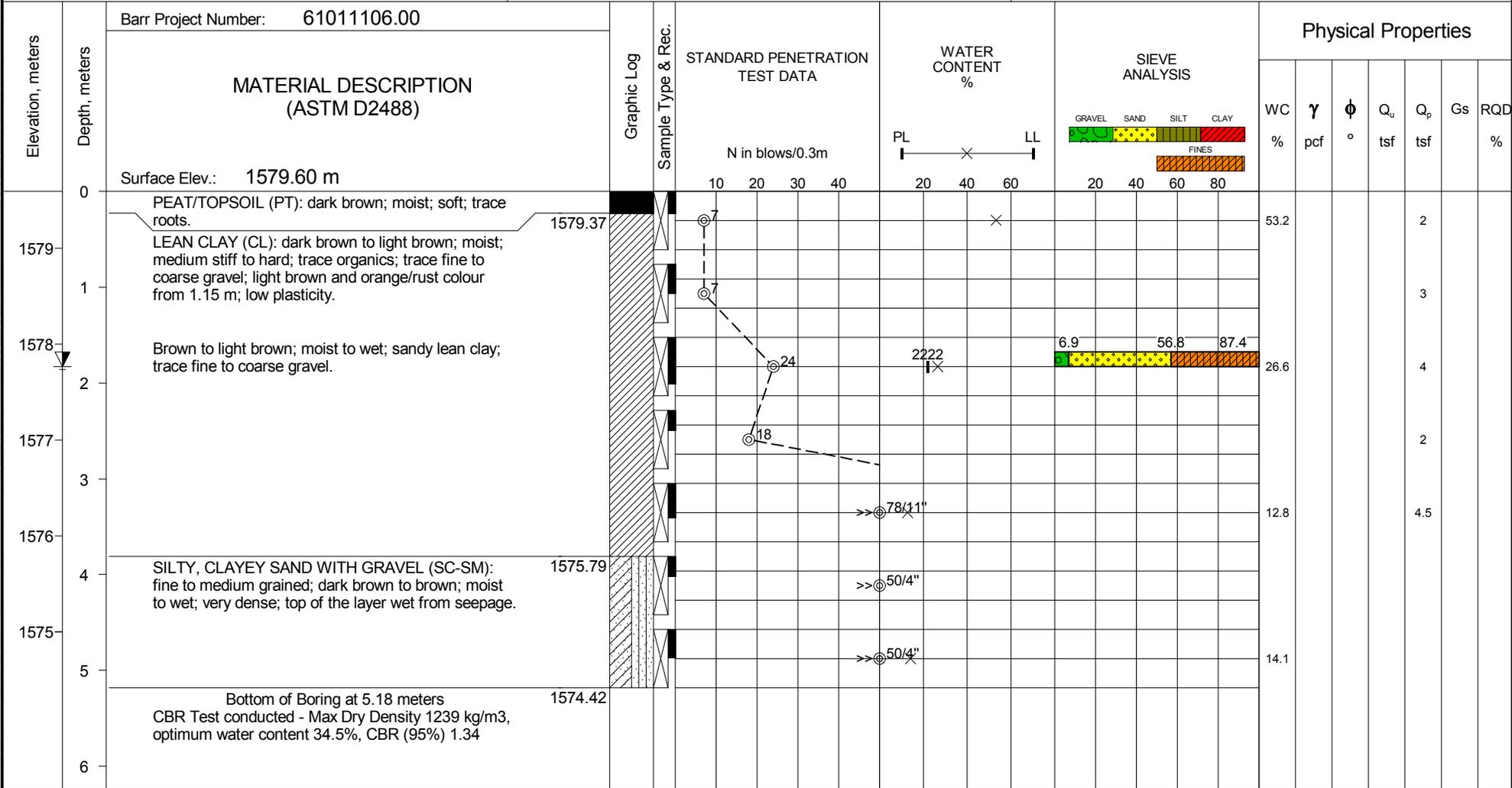
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LOG OF BORING 2015-BBH03-N

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Completion Depth: 17.0 Date Boring Started: 11/12/15 Date Boring Completed: 11/12/15 Logged By: VLW Drilling Contractor: Earth Drilling Drilling Method: SSA Ground Surface Elevation: 5182.4 Coordinates: UTM NAD83 N:5679288m, E:571770m Datum: NAD83	Remarks: Offset of around 4m N	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>SAMPLE TYPES</th> <th>WATER LEVELS (m)</th> <th>LEGEND</th> </tr> </thead> <tbody> <tr> <td> Split Spoon</td> <td> At Time of Drilling 1.83</td> <td>MC Moisture Content γ Dry Unit Weight ϕ Friction Angle</td> </tr> <tr> <td></td> <td></td> <td>Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation</td> </tr> </tbody> </table>	SAMPLE TYPES	WATER LEVELS (m)	LEGEND	Split Spoon	At Time of Drilling 1.83	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle			Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation
SAMPLE TYPES	WATER LEVELS (m)	LEGEND									
Split Spoon	At Time of Drilling 1.83	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle									
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation									

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH05-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT %	SIEVE ANALYSIS	Physical Properties										
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %				
0.0	0.0	Surface Elev.: 1655.37 m	ASPHALT: 9 inches thick.																
1655.0	0.5		FILL (GC-GM): fine to coarse grained; brown; moist; very dense.																
1654.5	1.0																		
1654.0	1.5																		
1653.5	2.0		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; brown; moist to wet; dense to very dense; wet from 2.1 m.																
1653.0	2.5																		
1652.5	3.0																		
1652.0	3.5		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to medium grained; brown; moist to wet; very dense.																
1651.5	4.0		Bottom of Boring at 3.96 meters																
4.5																			

Completion Depth: 13.0
 Date Boring Started: 10/12/15
 Date Boring Completed: 10/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 5431
 Coordinates: UTM NAD83 N:5678909m, E:570749m
 Datum: NAD83

Remarks: wet pockets perched on larger rocks
 Offset of 2.6 m NNW

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH06-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties										
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %				
		Surface Elev.: 1708.56 m																	
1708	0		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark brownish grey to brown; moist to wet; loose to very dense; fine to coarse sand.			8	X												
1707	1		Increasing sand and clay content.			39													
1706	2		Moist to wet.			42													
1705	3	1705.51	SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brown; moist to wet; very dense.			65													
1704	4					87/9"													
1704	5	1703.99	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey and brown; moist to wet; very dense.			56													
	5.18	1703.38	Bottom of Boring at 5.18 meters			80/10"													

Completion Depth: 17.0	Remarks: Offset of around 10 m
Date Boring Started: 11/12/15	
Date Boring Completed: 11/12/15	
Logged By: VLW	
Drilling Contractor: Earth Drilling	
Drilling Method: SSA	
Ground Surface Elevation: 5605.5	
Coordinates: UTM NAD83 N:5678429m, E:569935m	
Datum: NAD83	

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH07-S

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties											
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %					
		Surface Elev.: 1729.56 m																		
1729.5	0.0		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark grey; moist; dense to very dense; trace organics/roots.																	
1729.0	0.5																			
1728.5	1.0					31	X	32.3	83.6	6.1										
1728.0	1.5		Increasing sand content.																	
1727.5	2.0																			
1727.0	2.5		Wet; with blue-grey weathered shale particles.																	
1726.5	3.0		Wet; with blue-grey weathered shale particles.																	
1726.0	3.5					47	X													
	3.66		Bottom of Boring at 3.66 meters																	
	4.0																			
	4.5																			

Completion Depth: 12.0
 Date Boring Started: 11/12/15
 Date Boring Completed: 11/12/15
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 5674.4
 Coordinates: UTM NAD83 N:5677938m, E:568173m
 Datum: NAD83

Remarks: Offset of around 10 m from stake, due to utility line

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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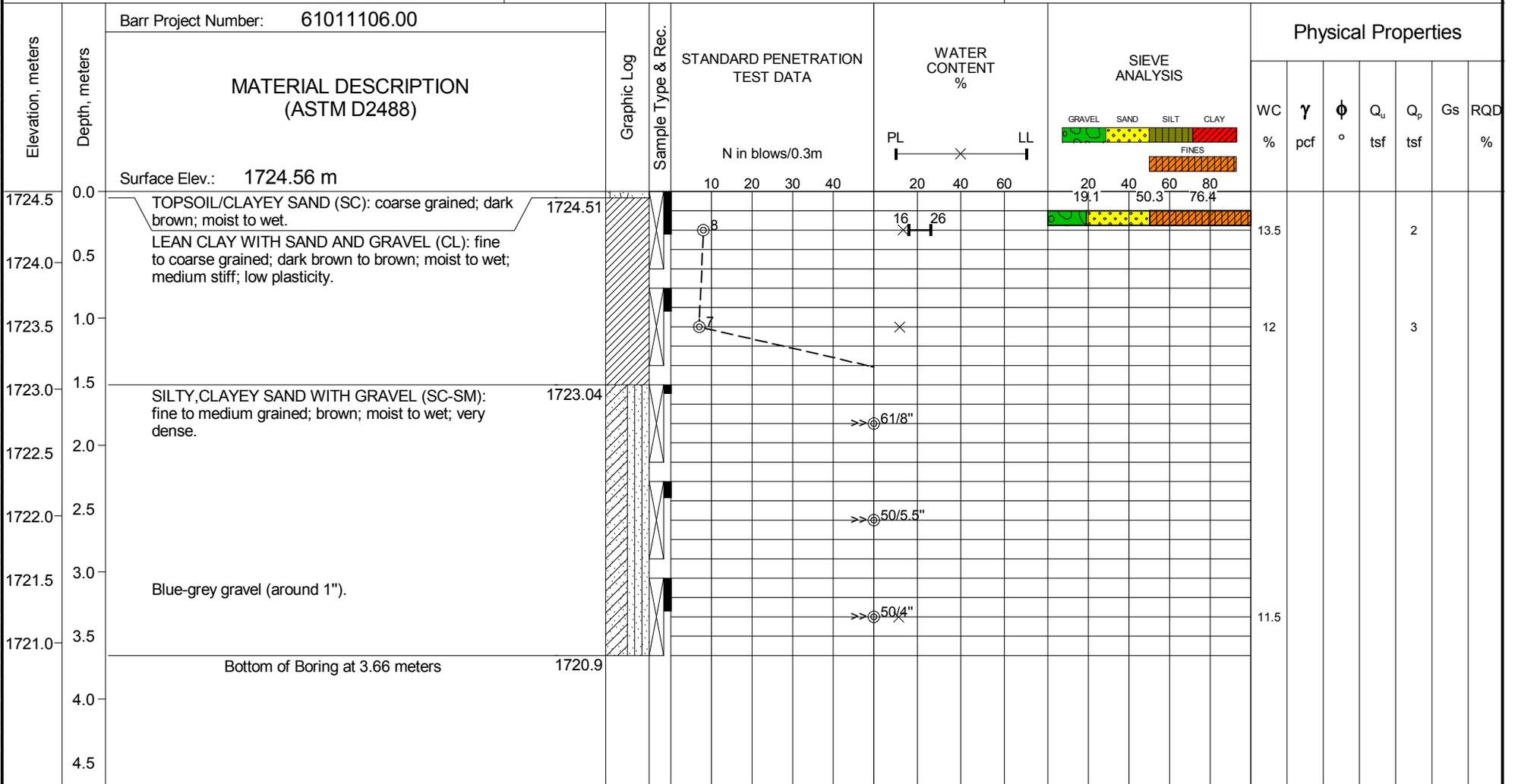
LOG OF BORING 2015-BBH08-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 12.0
 Date Boring Started: 11/12/15
 Date Boring Completed: 11/12/15
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 5658
 Coordinates: UTM NAD83 N:5677761m, E:567976m
 Datum: NAD83

Remarks: Offset of around 0.5 m

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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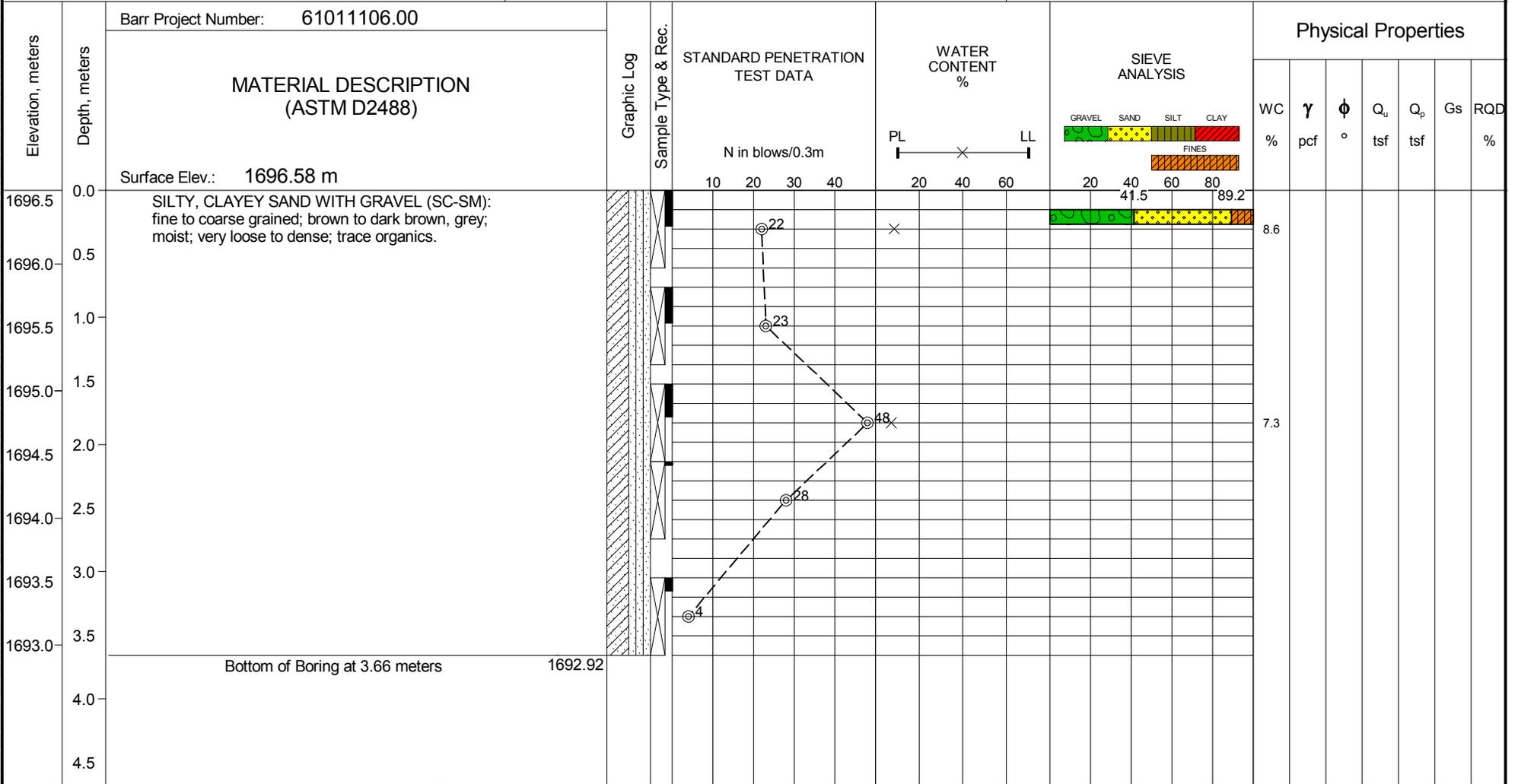
LOG OF BORING 2015-BBH09-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 12.0
 Date Boring Started: 12/12/15
 Date Boring Completed: 12/12/15
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 5566.2
 Coordinates: UTM NAD83 N:5676703m, E:566924m
 Datum: NAD83

Remarks: Offset: 1.5 m from stake

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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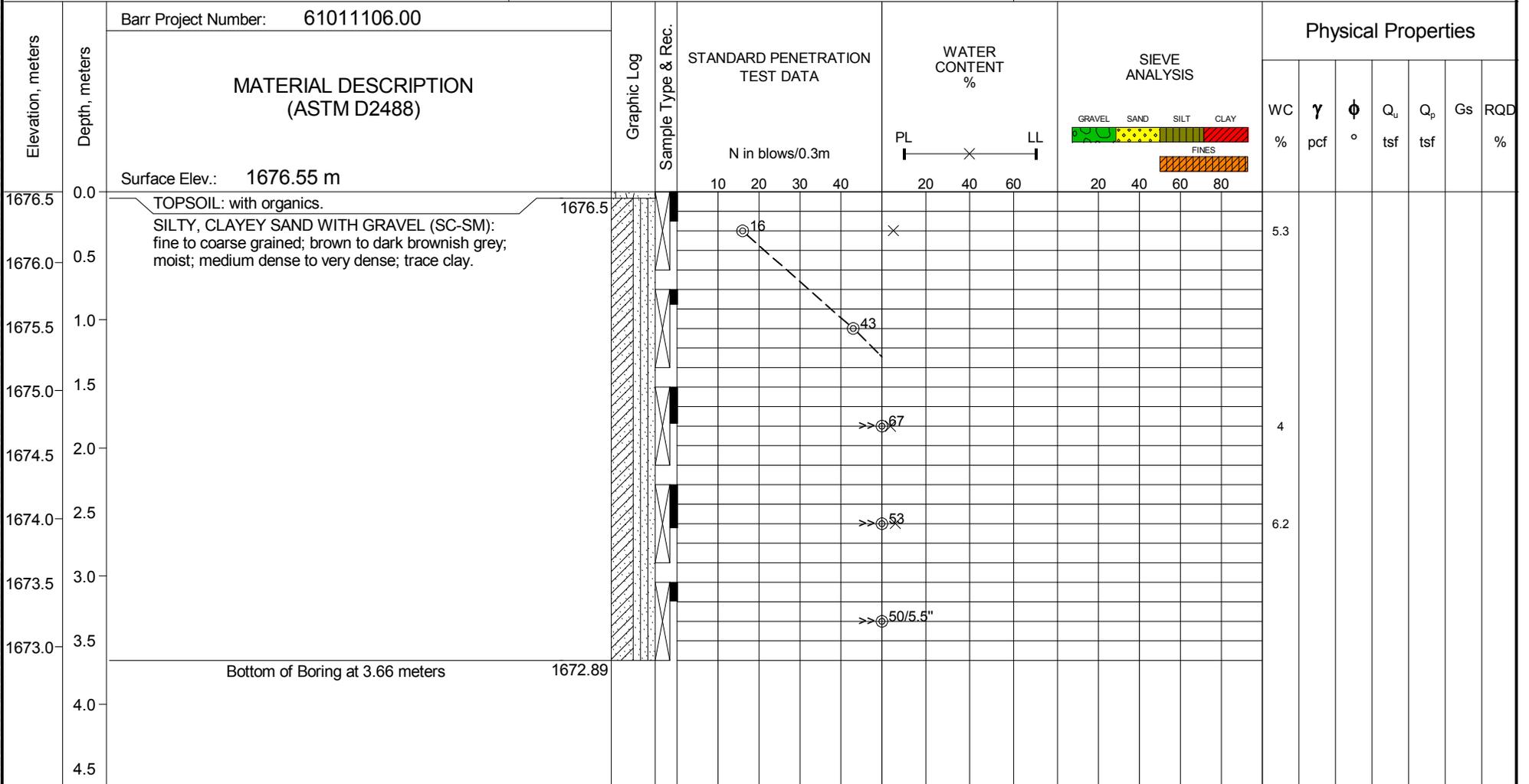
LOG OF BORING 2015-BBH10-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 12.0
 Date Boring Started: 12/12/15
 Date Boring Completed: 12/12/15
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 5500.5
 Coordinates: UTM NAD83 N:5676503m, E:566763m
 Datum: NAD83

Remarks: Offset: 0.3 m from stake

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH11-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties												
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %						
		Surface Elev.: 1658.57 m																			
1658.5	0.0		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brown, grey, moist; medium dense to very dense.			17	X														
1658.0	0.5																				
1657.5	1.0					26															
1657.0	1.5																				
1656.5	2.0																				
1656.0	2.5																				
1655.5	3.0		Purple rock pieces.																		
1655.0	3.5																				
	3.66		Bottom of Boring at 3.66 meters																		
			CBR Test conducted - CBR (95%) 12.72																		
	4.0																				
	4.5																				

Completion Depth: 12.0
 Date Boring Started: 12/12/15
 Date Boring Completed: 12/12/15
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 5441.5
 Coordinates: UTM NAD83 N:5676093m, E:566407m
 Datum: NAD83

Remarks: Offset: 1 m from stake

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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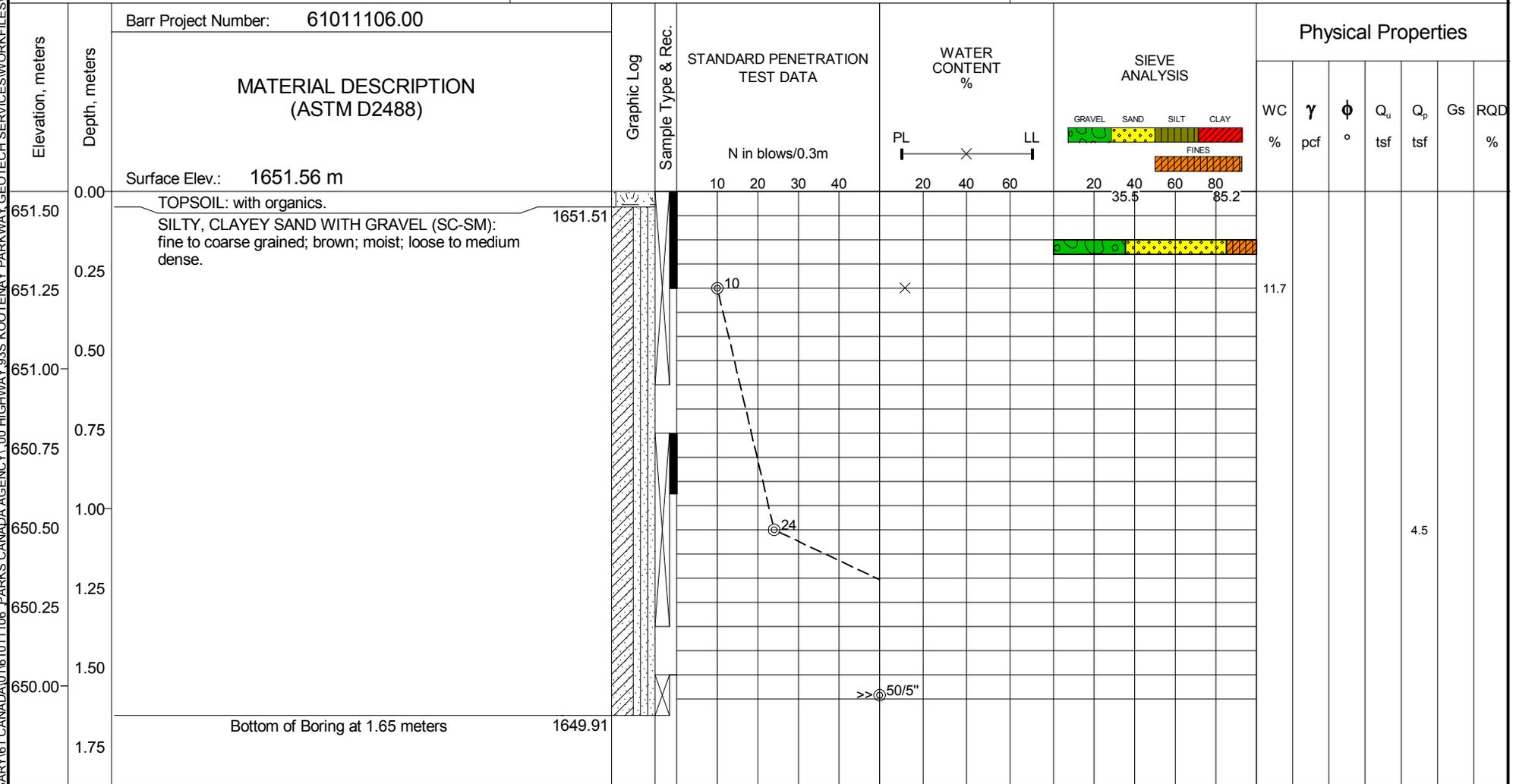
LOG OF BORING 2015-BBH12-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 5.4
 Date Boring Started: 12/12/15
 Date Boring Completed: 12/12/15
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 5418.5
 Coordinates: UTM NAD83 N:5675662m, E:566303m
 Datum: NAD83

Remarks: SPT sampler show broke after sample V51
 Offset: 2m from stake

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH16-S

Project: Highway 93S Geotechnical Investigation Location: Kootenay National Park Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties										
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %				
1510.5	0.0	Surface Elev.: 1510.62 m	TOPSOIL: with organics.																
1510.0	0.5	1510.57	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark grey and brown; moist; medium dense.			16	×												
1509.5	1.0	1509.86	LEAN CLAY WITH GRAVEL (CL): brown; moist; very stiff; trace fine to coarse sand.			20	×												
1509.0	1.5	1509.1	Grey/white; 4" cobble.																
1509.0	1.5	1509.1	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; medium dense.			32													
1508.5	2.0																		
1508.0	2.5					12	×												
1507.5	3.0																		
1507.0	3.5					21													
	3.66	1506.96	Bottom of Boring at 3.66 meters																

Completion Depth: 12.0	Remarks: Offset: 2m from stake
Date Boring Started: 14/12/15	
Date Boring Completed: 14/12/15	
Logged By: VLW	
Drilling Contractor: Earth Drilling	
Drilling Method: SSA	
Ground Surface Elevation: 4956.1	
Coordinates: UTM NAD83 N:5671662m, E:562551m	
Datum: NAD83	

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH17-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties										
								WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %				
	0.0	Surface Elev.: 1460.63 m																
1460.5	0.5	TOPSOIL: some wood pieces. SILTY CLAY WITH SAND (CL/ML): brown to dark brown; moist to wet; stiff to very stiff; trace organics, wood/root; gravel of 2" size at 2.2 m; low plasticity.			15	X												18.8
1459.5	1.0				10													22.3
1458.5	2.0																	
1458.0	2.5	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey; wet; medium dense.			19	X												5.9
	3.0	Bottom of Boring at 3.05 meters Refusal at 3 m. CBR Test conducted - Max Dry Density 1786 kg/m ³ , optimum water content 15.7%, CBR (95%) 2.33																

Completion Depth: 10.0
 Date Boring Started: 14/12/15
 Date Boring Completed: 14/12/15
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4792.1
 Coordinates: UTM NAD83 N:5670884m, E:561527m
 Datum: NAD83

Remarks: Offset: 1.2 m from stake

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling 1.98	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

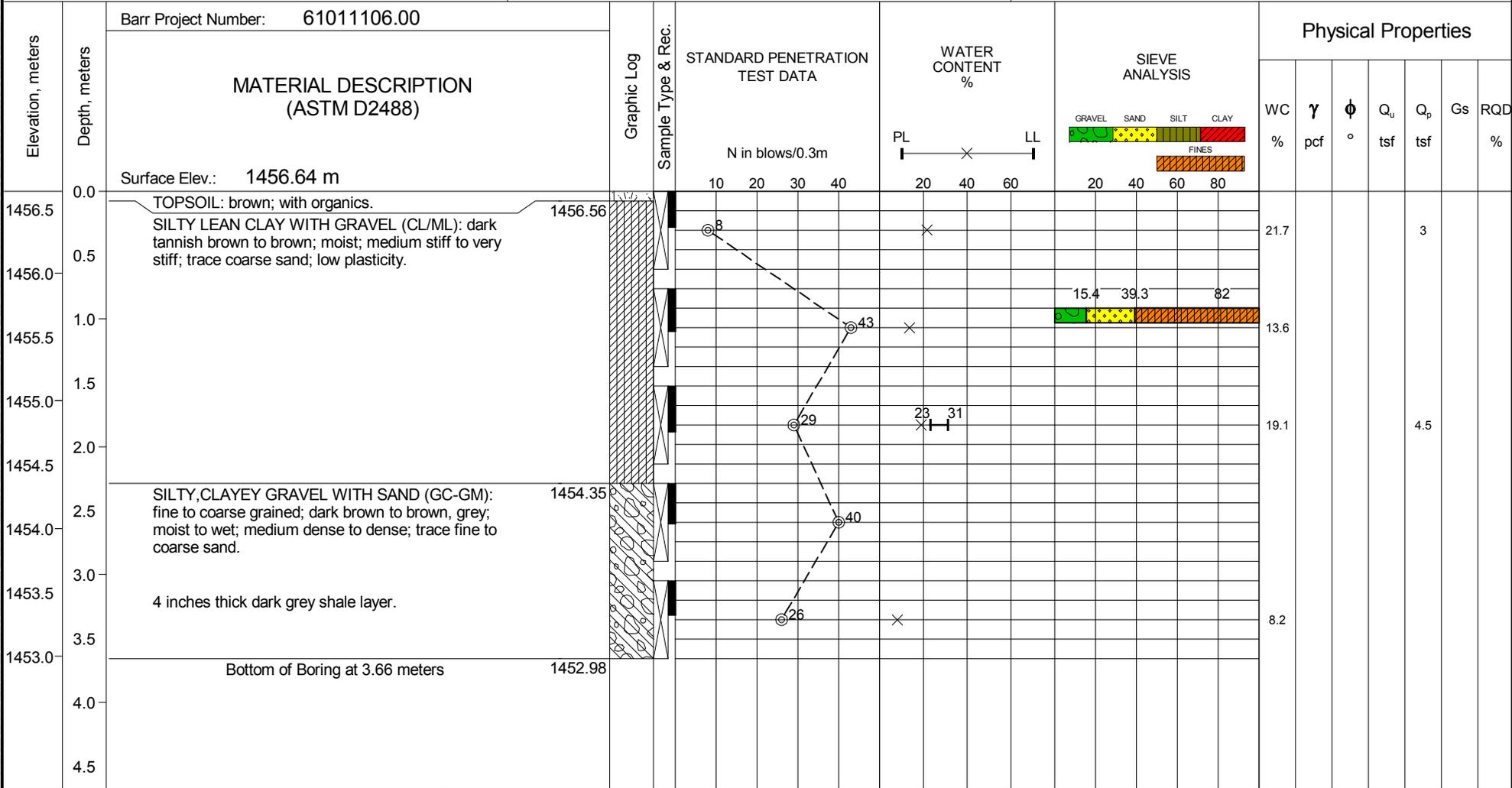
\\BARR.COM\PROJECTS\CALGARY\61 CANADA\0161011106_PARKS CANADA AGENCY\00 HIGHWAY 93S KOOTENAY PARKWAY GEOTECH SERVICES\WORKFILES\GEOTECHNICAL INVESTIGATION\NIP



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LOG OF BORING 2015-BBH18-N

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Completion Depth: 12.0 Date Boring Started: 14/12/15 Date Boring Completed: 14/12/15 Logged By: VLW Drilling Contractor: Earth Drilling Drilling Method: SSA Ground Surface Elevation: 4779 Coordinates: UTM NAD83 N:5670592m, E:561131m Datum: NAD83	Remarks: Offset: 1.5 m from stake	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="width:33%;">SAMPLE TYPES</th> <th style="width:33%;">WATER LEVELS (m)</th> <th style="width:33%;">LEGEND</th> </tr> <tr> <td> Split Spoon</td> <td> At Time of Drilling Dry</td> <td> MC Moisture Content γ Dry Unit Weight ϕ Friction Angle </td> </tr> <tr> <td></td> <td></td> <td> Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation </td> </tr> </table>	SAMPLE TYPES	WATER LEVELS (m)	LEGEND	Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle			Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation
SAMPLE TYPES	WATER LEVELS (m)	LEGEND									
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle									
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation									

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH19-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties											
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %					
		Surface Elev.: 1460.63 m																		
1460.5	0.0		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark brown to brown and grey; moist; medium dense to dense; trace roots and pine needles; gravel size upto 2 inches.			16	×													
1460.0	0.5																			
1459.5	1.0		Shale fragments in the sample.			22														
1459.0	1.5																			
1458.5	2.0					32	×													
1458.0	2.5																			
1457.5	3.0		SILTY LEAN CLAY WITH GRAVEL (CL/ML): brown; moist; very stiff; low plasticity.			33														
1457.0	3.5					25	×													
	3.66		Bottom of Boring at 3.66 meters																	
		1457.58																		
		1456.97																		
	4.0																			
	4.5																			

Completion Depth: 12.0
 Date Boring Started: 14/12/14
 Date Boring Completed: 14/12/14
 Logged By: VLW
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4792.1
 Coordinates: UTM NAD83 N:5669974m, E:560578m
 Datum: NAD83

Remarks: Just off the shoulder to minimize traffic disruption

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH20-S

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties											
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %					
		Surface Elev.: 1426.65 m																		
1426.5	0.0		TOPSOIL: with organics.																	
1426.0	0.5		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; dark brown and grey; moist; medium dense; trace fines.			17	×													
1425.5	1.0		SILTY LEAN CLAY WITH SAND (CL/ML): tannish brown; moist; stiff; trace gravel; low plasticity.			12														
1425.0	1.5																			
1424.5	2.0																			
1424.0	2.5		LEAN CLAY WITH SAND (CL): tannish brown; moist; stiff; medium plasticity.			6														
1423.5	3.0																			
1423.0	3.5					6	×													
	4.0																			
	4.5																			
		Bottom of Boring at 3.66 meters																		

Completion Depth: 12.0	Remarks: Just south of entrance		
Date Boring Started: 14/12/15			
Date Boring Completed: 14/12/15			
Logged By: VLW			
Drilling Contractor: Earth Drilling			
Drilling Method: SSA			
Ground Surface Elevation: 4680.6			
Coordinates: UTM NAD83 N:5668994m, E:559602m			
Datum: NAD83			

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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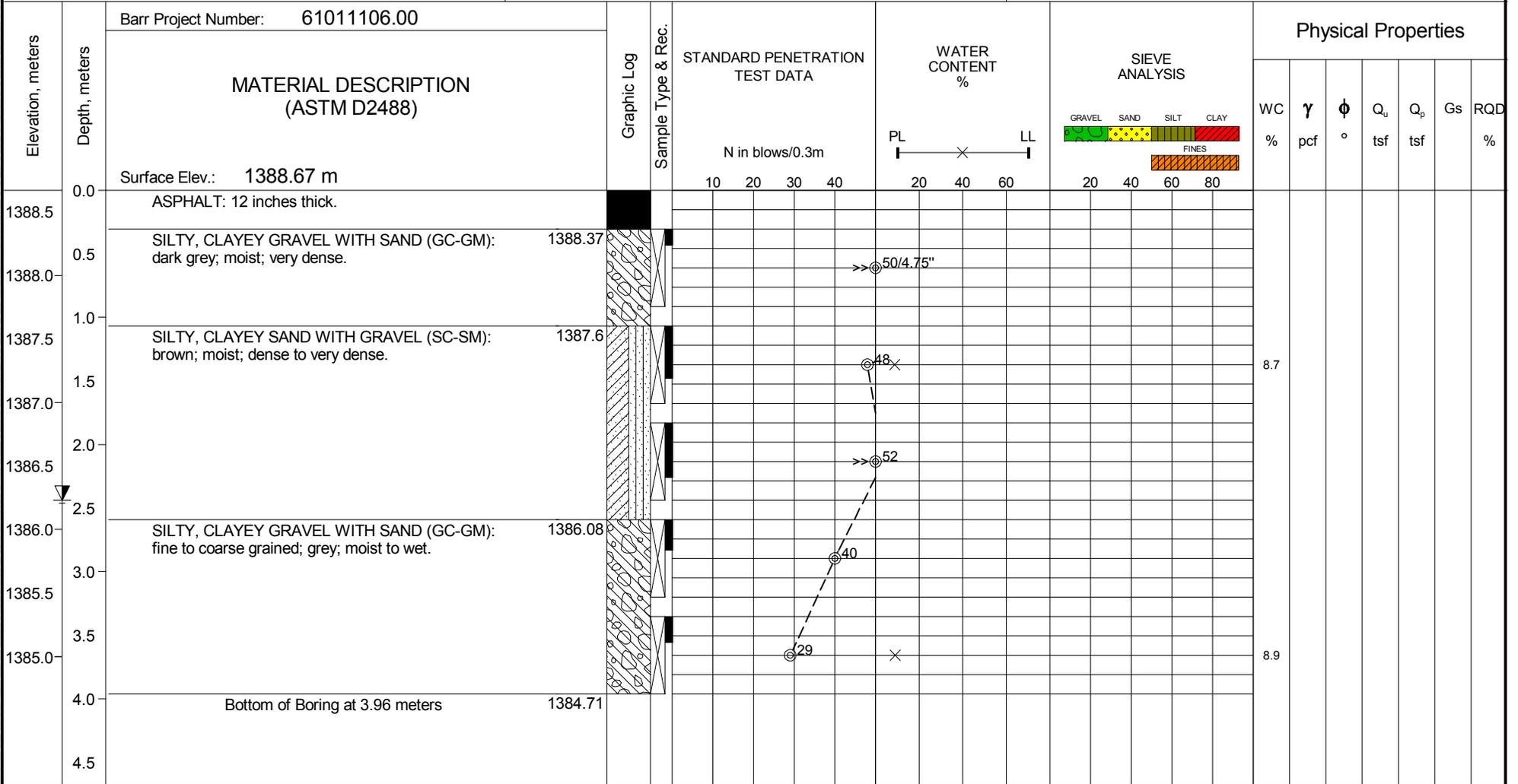
LOG OF BORING 2015-BBH22-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 13.0
 Date Boring Started: 11/12/15
 Date Boring Completed: 11/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4556
 Coordinates: UTM NAD83 N:5665051m, E:560597m
 Datum: NAD83

Remarks:

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling 2.44	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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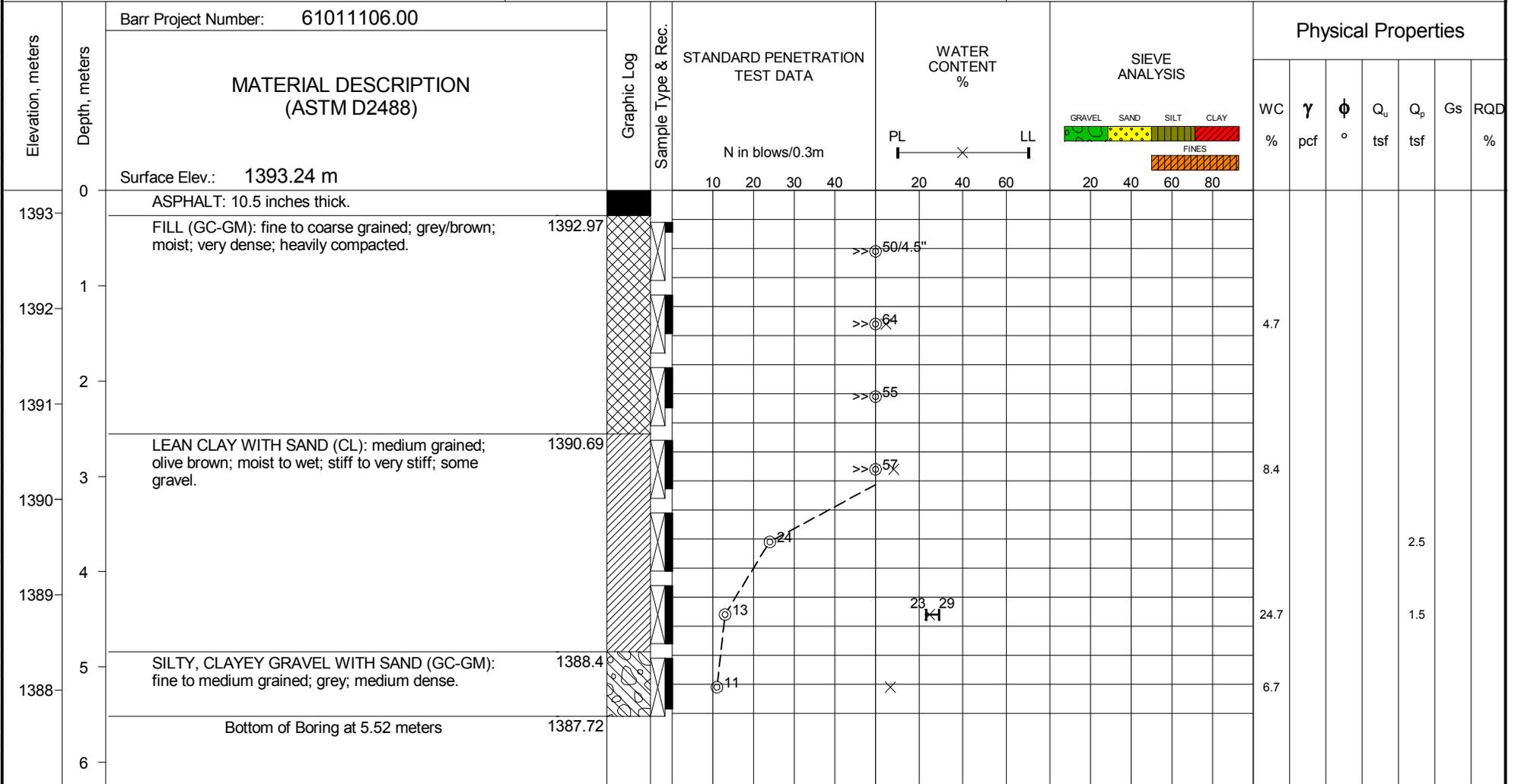
LOG OF BORING 2015-BBH23-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 18.1
 Date Boring Started: 11/12/15
 Date Boring Completed: 11/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4571
 Coordinates: UTM NAD83 N:5662749m, E:563471m
 Datum: NAD83

Remarks:

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH24-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties										
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %				
	0.0	Surface Elev.: 1335.02 m	ASPHALT: 9 inches thick.																
1334.5	0.5		FILL (GC-GM): medium to coarse grained; grey; moist; very dense; heavily compacted.																
1334.0	1.0		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): medium to coarse grained; brown; moist; medium dense; many large quartz rocks.																
1333.5	1.5																		
1333.0	2.0		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; light grey to grey; moist; dense to very dense; cobbles.																
1332.5	2.5		Grey/white gravel.																
1332.0	3.0																		
1331.5	3.5																		
	4.0		Bottom of Boring at 3.91 meters CBR Test conducted - Max Dry Density 2159 kg/m ³ , optimum water content 8.9%, CBR (95%) 11.13																
	4.5																		

Completion Depth: 12.8
 Date Boring Started: 11/12/15
 Date Boring Completed: 11/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4380
 Coordinates: UTM NAD83 N:5659142m, E:566525m
 Datum: NAD83

Remarks: Golf sized rocks in sand/gravel
 Offset of 3 m SW

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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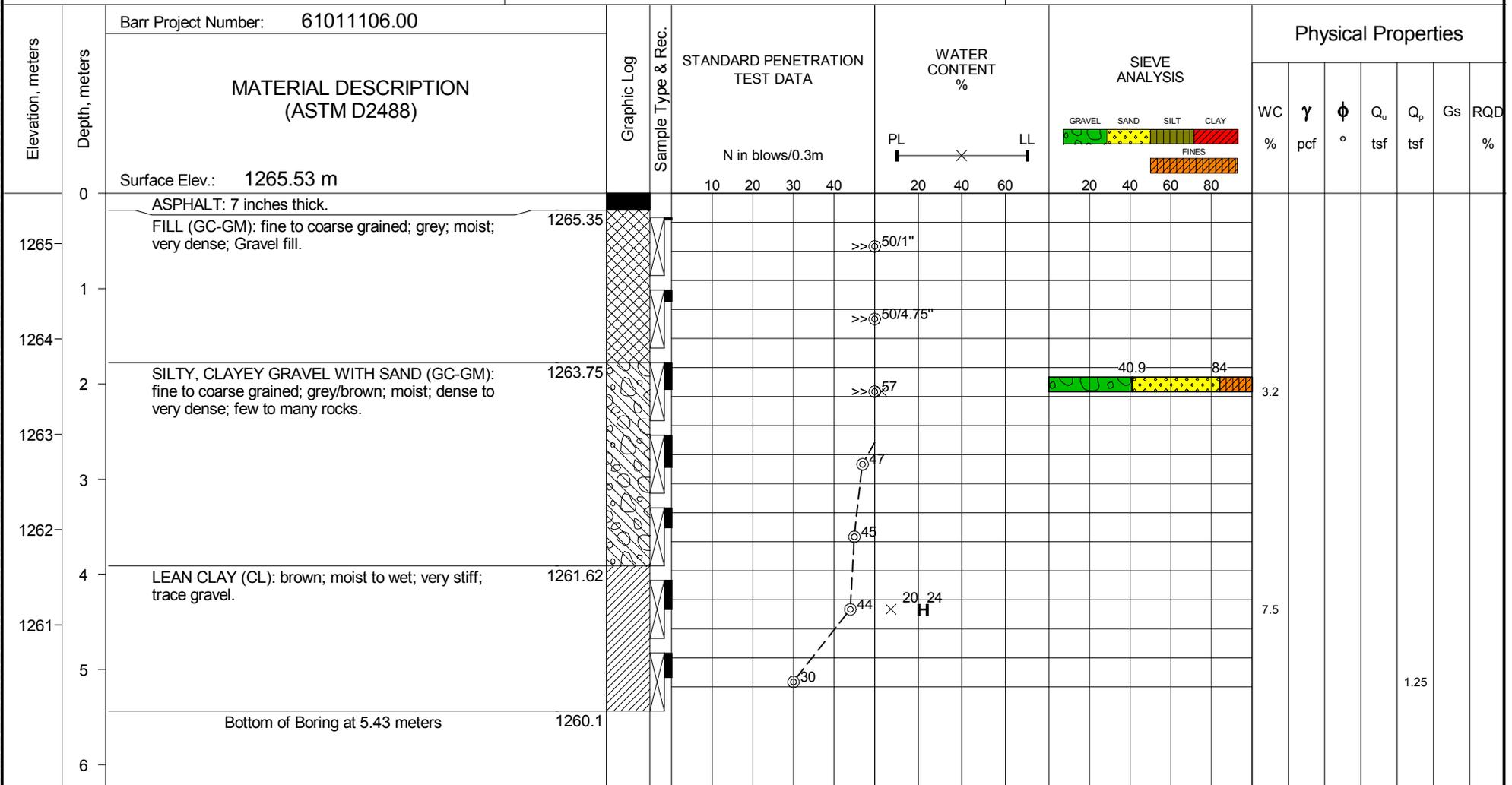
LOG OF BORING 2015-BBH25-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 17.8
 Date Boring Started: 11/12/15
 Date Boring Completed: 11/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4152
 Coordinates: UTM NAD83 N:5653125m, E:571442m
 Datum: NAD83

Remarks:

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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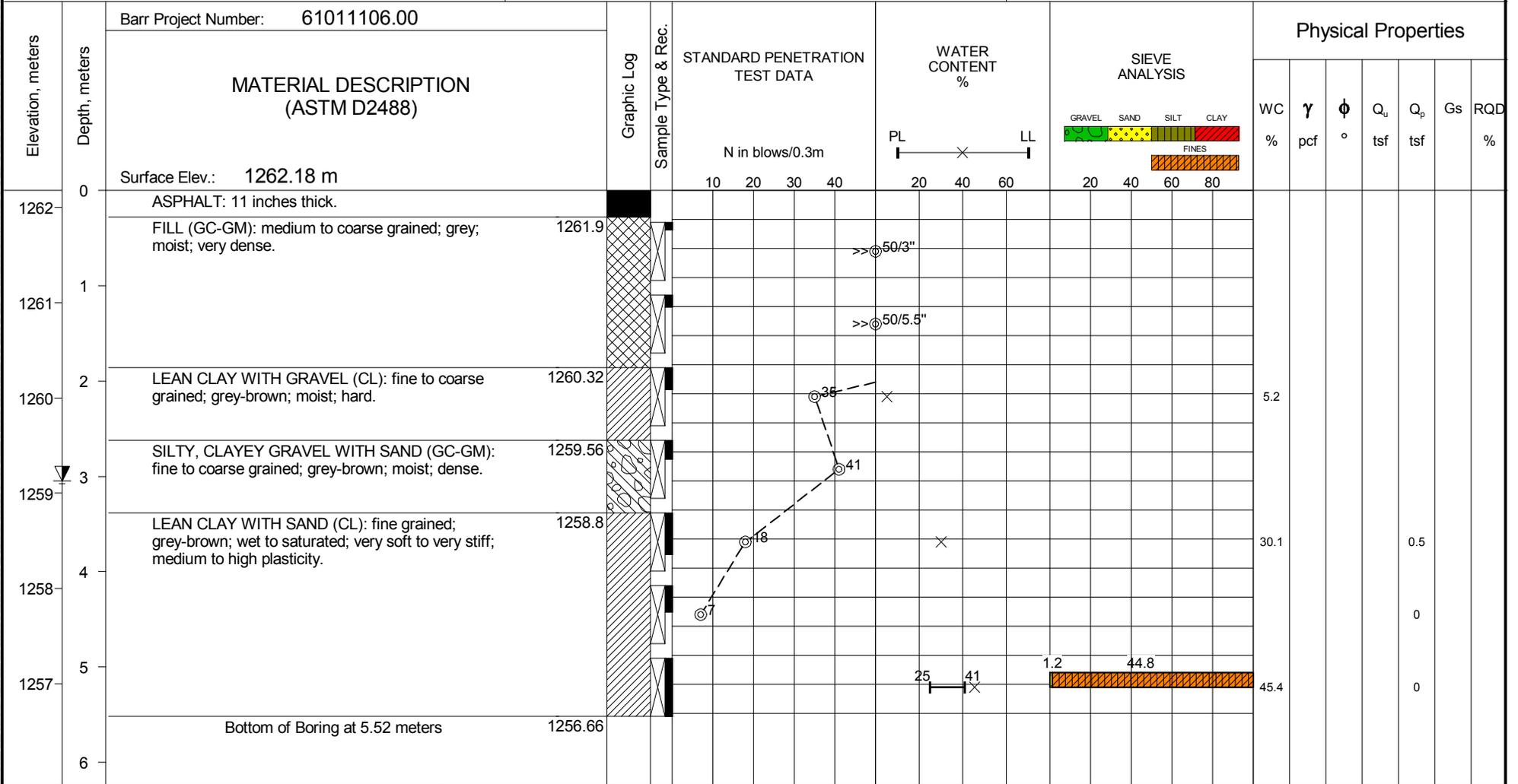
LOG OF BORING 2015-BBH26-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 18.1
 Date Boring Started: 12/12/15
 Date Boring Completed: 12/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4141
 Coordinates: UTM NAD83 N:5651946m, E:571865m
 Datum: NAD83

Remarks: Offset of 3.8 m NW

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling 3.05	MC Moisture Content
		γ Dry Unit Weight
		ϕ Friction Angle
		Q_u Unconfined Compression
		Q_p Hand Penetrometer UC
		Gs Specific Gravity
		RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

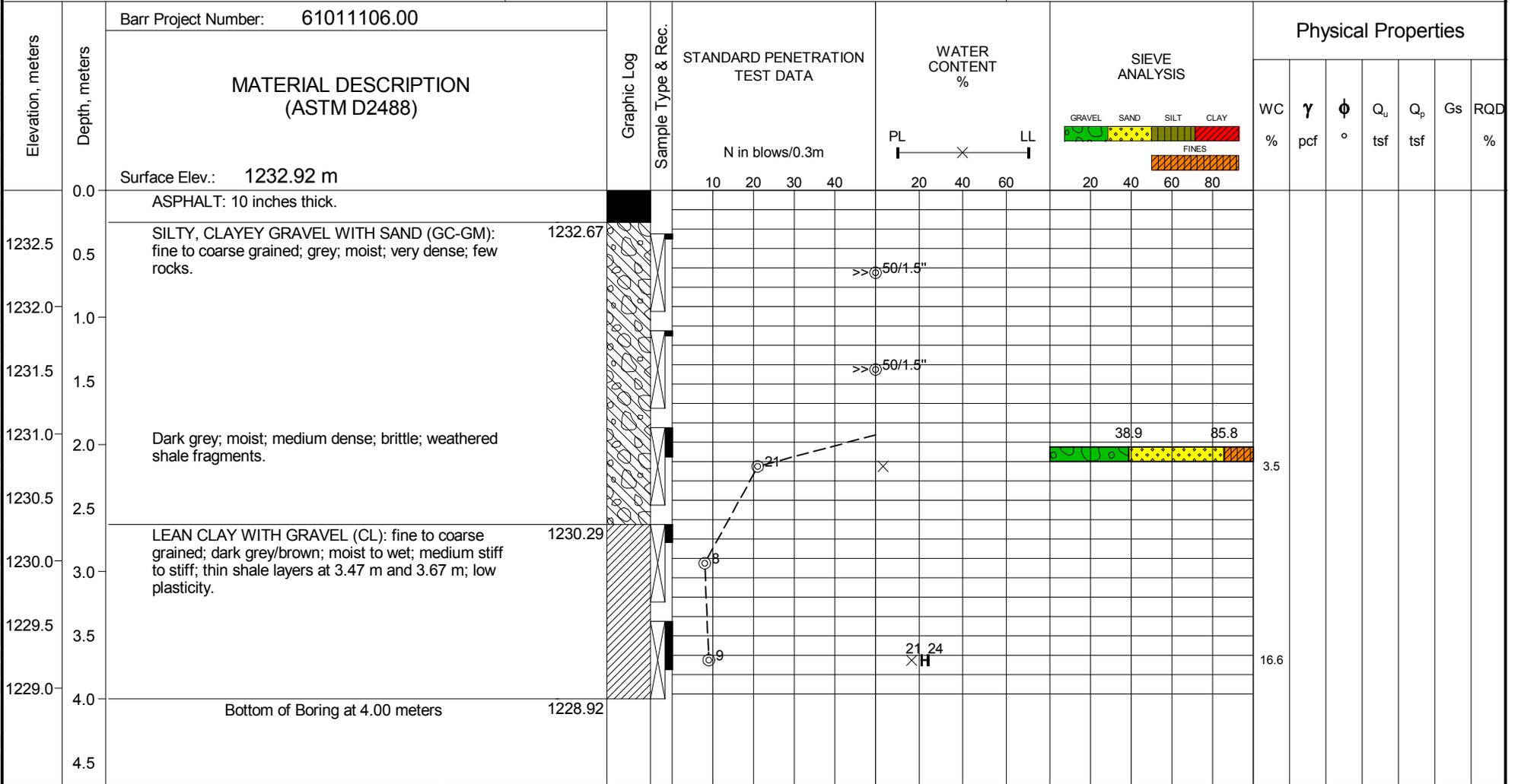
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LOG OF BORING 2015-BBH28-N

Project: Highway 93S Geotechnical Investigation Location: Kootenay National Park Client: Parks Canada Agency



Completion Depth: 13.1	Remarks:
Date Boring Started: 12/12/15	
Date Boring Completed: 12/12/15	
Logged By: ETB	
Drilling Contractor: Earth Drilling	
Drilling Method: SSA	
Ground Surface Elevation: 4045	
Coordinates: UTM NAD83 N:5647969m, E:573793m	
Datum: NAD83	

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content
		γ Dry Unit Weight
		ϕ Friction Angle
		Q_u Unconfined Compression
		Q_p Hand Penetrometer UC
		Gs Specific Gravity
		RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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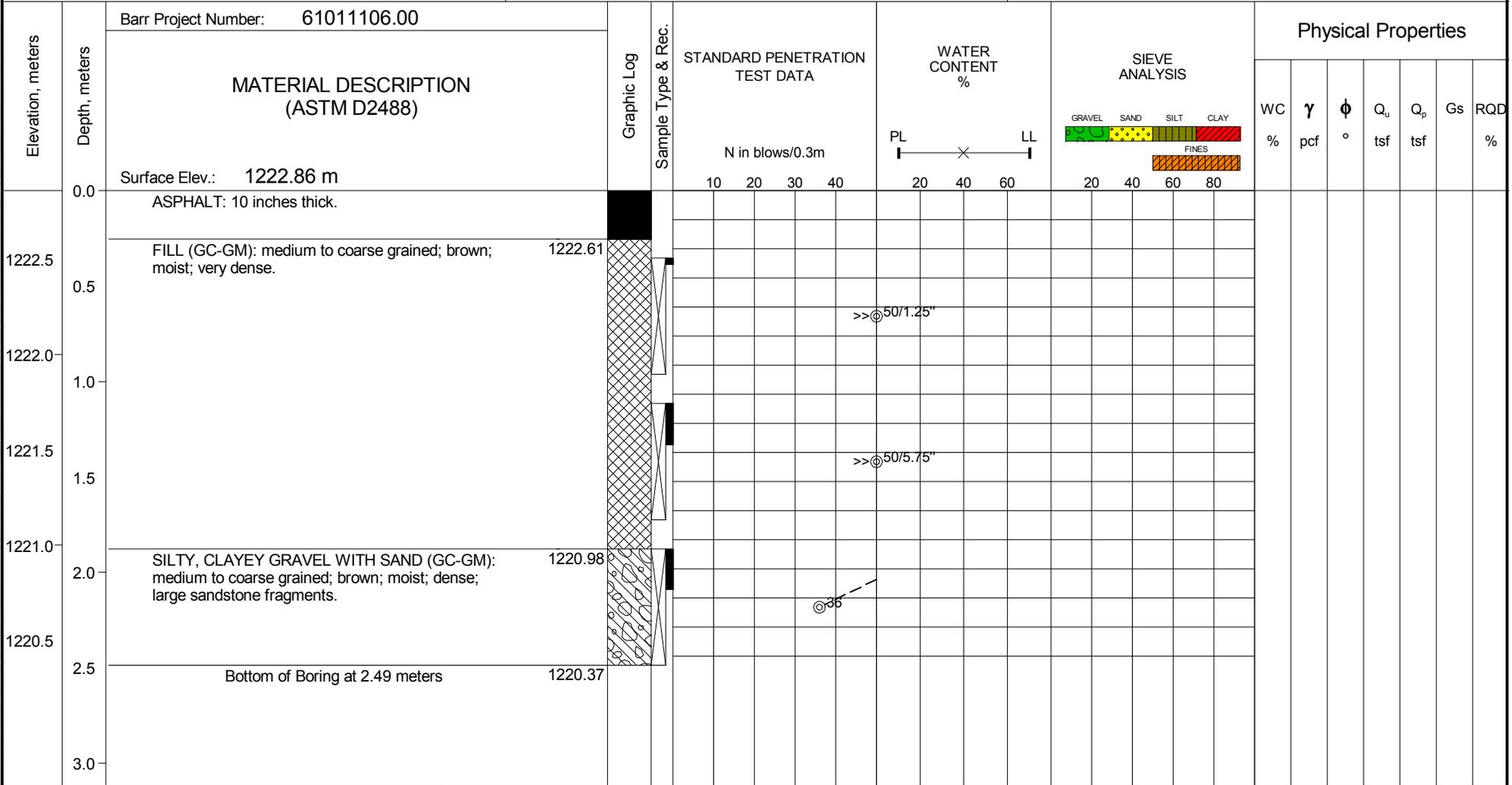


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LOG OF BORING 2015-BBH29-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Completion Depth: 8.2 Date Boring Started: 12/12/15 Date Boring Completed: 12/12/15 Logged By: ETB Drilling Contractor: Earth Drilling Drilling Method: SSA Ground Surface Elevation: 4012 Coordinates: UTM NAD83 N:5645660m, E:573084m Datum: NAD83	Remarks: Refusal due to cobbles/boulders at 2.5 m
SAMPLE TYPES Split Spoon	WATER LEVELS (m) At Time of Drilling Dry
LEGEND MC Moisture Content γ Dry Unit Weight ϕ Friction Angle	Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.



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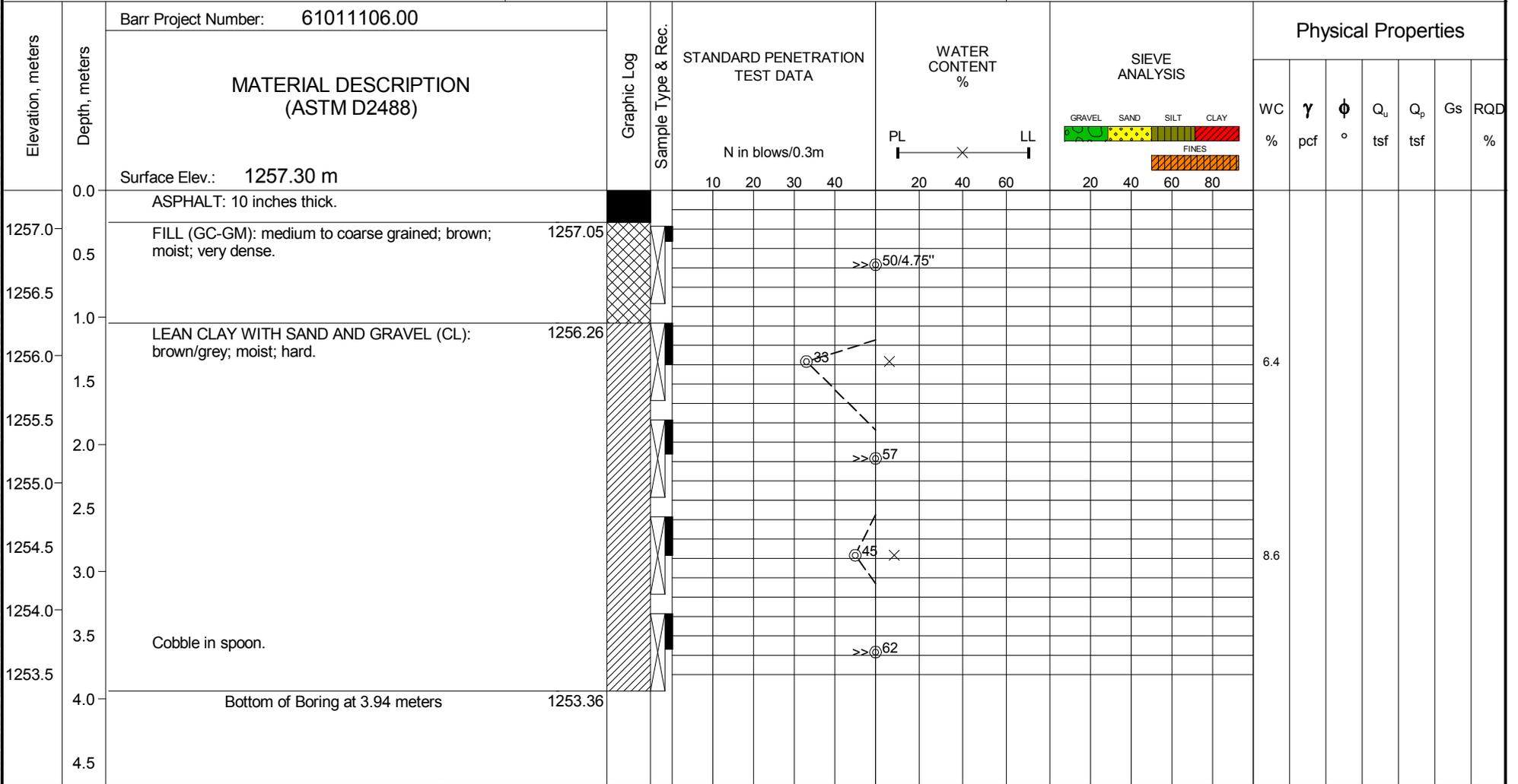
LOG OF BORING 2015-BBH30-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 12.9
 Date Boring Started: 12/12/15
 Date Boring Completed: 12/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4125
 Coordinates: UTM NAD83 N:5644435m, E:571730m
 Datum: NAD83

Remarks: Offset of 3.8 m NW

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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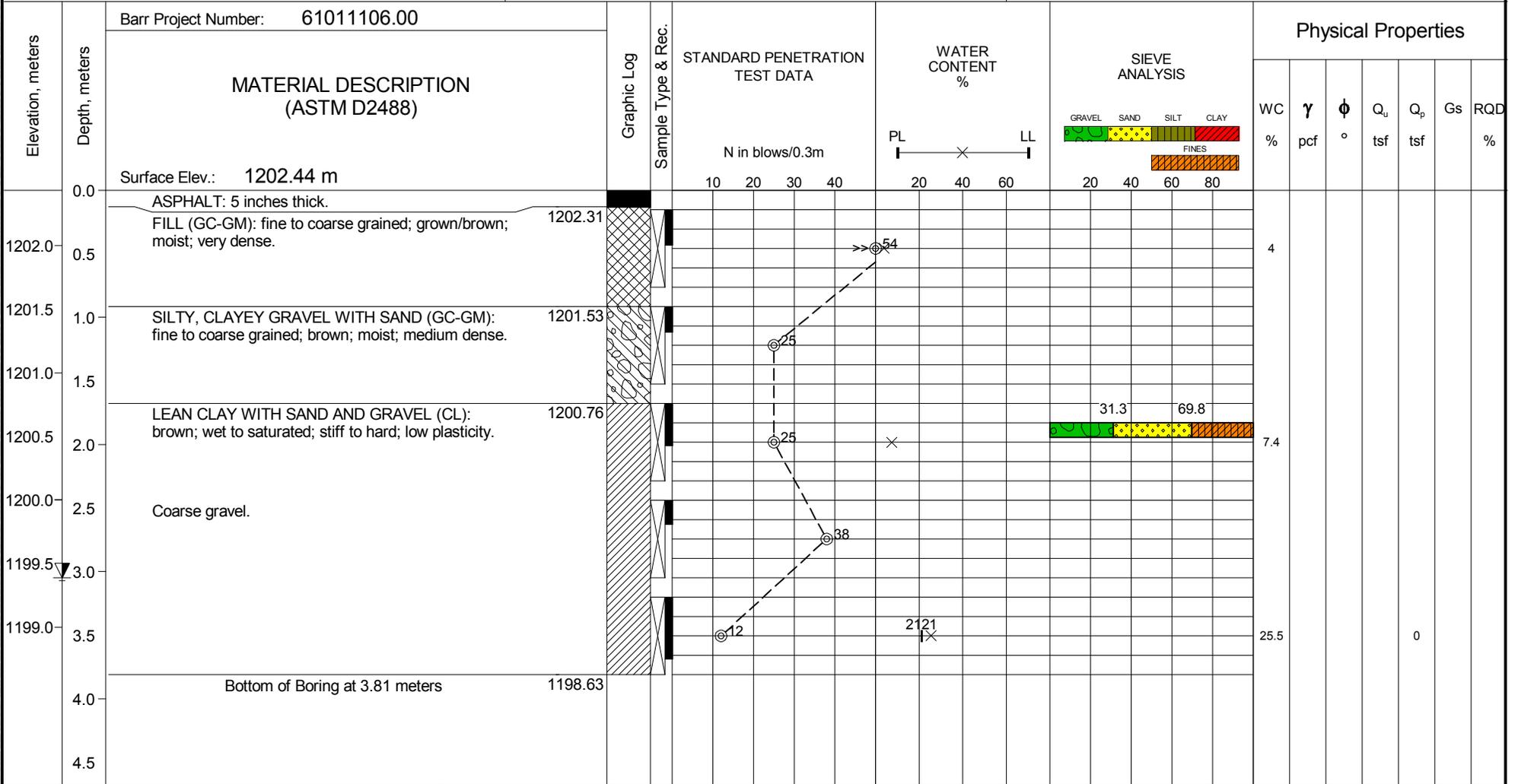
LOG OF BORING 2015-BBH31-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 12.5
 Date Boring Started: 12/12/15
 Date Boring Completed: 12/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3945
 Coordinates: UTM NAD83 N:5641864m, E:569585m
 Datum: NAD83

Remarks: Offset of 3.65 m E

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling 3.05	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH32-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties												
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %						
		Surface Elev.: 1200.30 m																			
1200.0	0.0		LEAN CLAY WITH SAND AND GRAVEL (CL): brown, grey; moist to wet; medium stiff to hard.																		
1199.5	0.5					43	X														
1199.0	1.0					20															
1198.5	1.5																				
1198.0	2.0					9	X														
1197.5	2.5																				
1197.0	3.0					6															
1196.5	3.5		1 inch shale layer.			5	X														
	4.0	Bottom of Boring at 3.91 meters																			
	4.5																				

Completion Depth: 12.8
 Date Boring Started: 14/12/15
 Date Boring Completed: 14/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3938
 Coordinates: UTM NAD83 N:5641489m, E:569307m
 Datum: NAD83

Remarks: Offset: 1.4 m S of stack

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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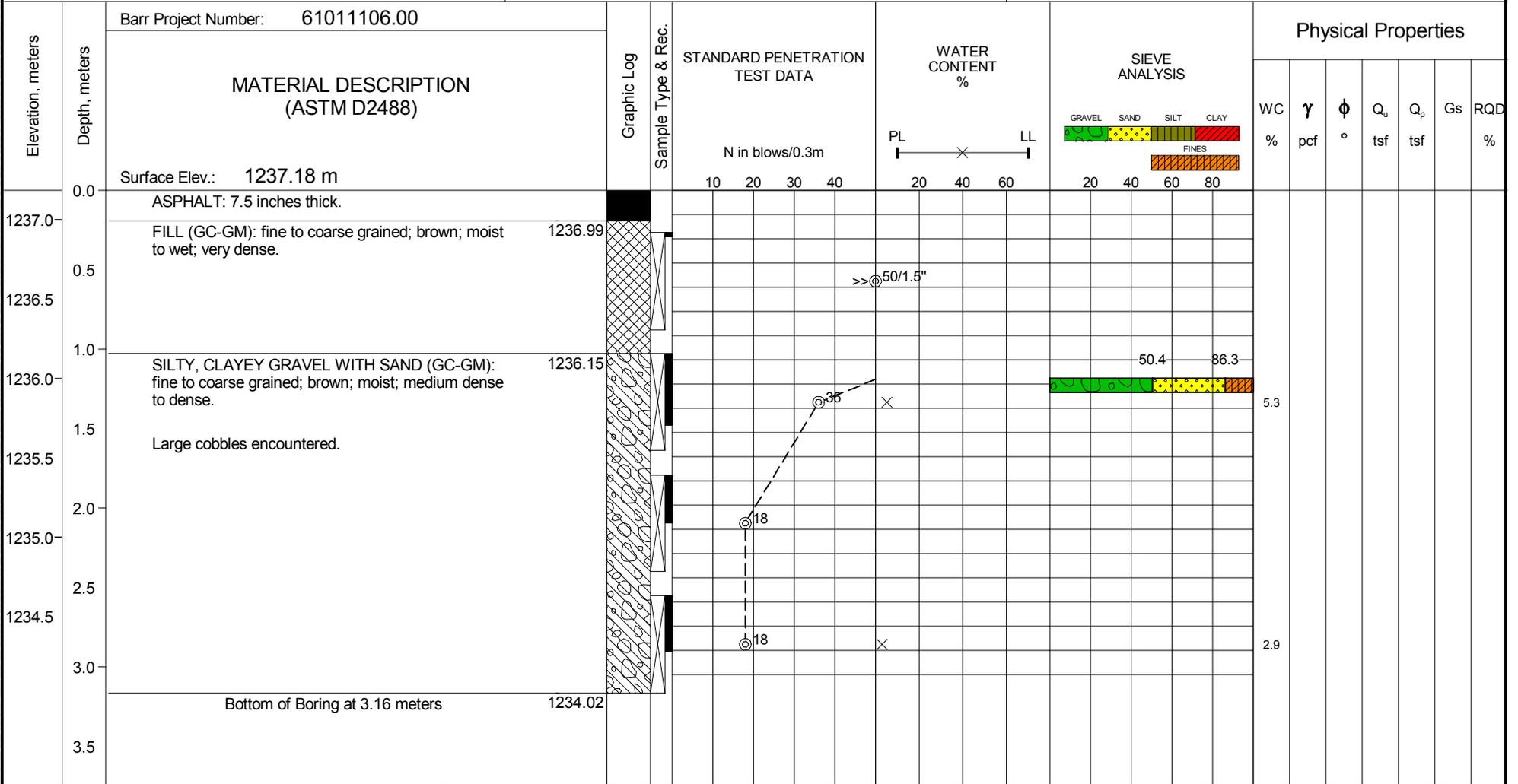
LOG OF BORING 2015-BBH34-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 10.4
 Date Boring Started: 14/12/15
 Date Boring Completed: 14/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4059
 Coordinates: UTM NAD83 N:5639284m, E:568069m
 Datum: NAD83

Remarks: Cave in of cobbles at 1.5 m

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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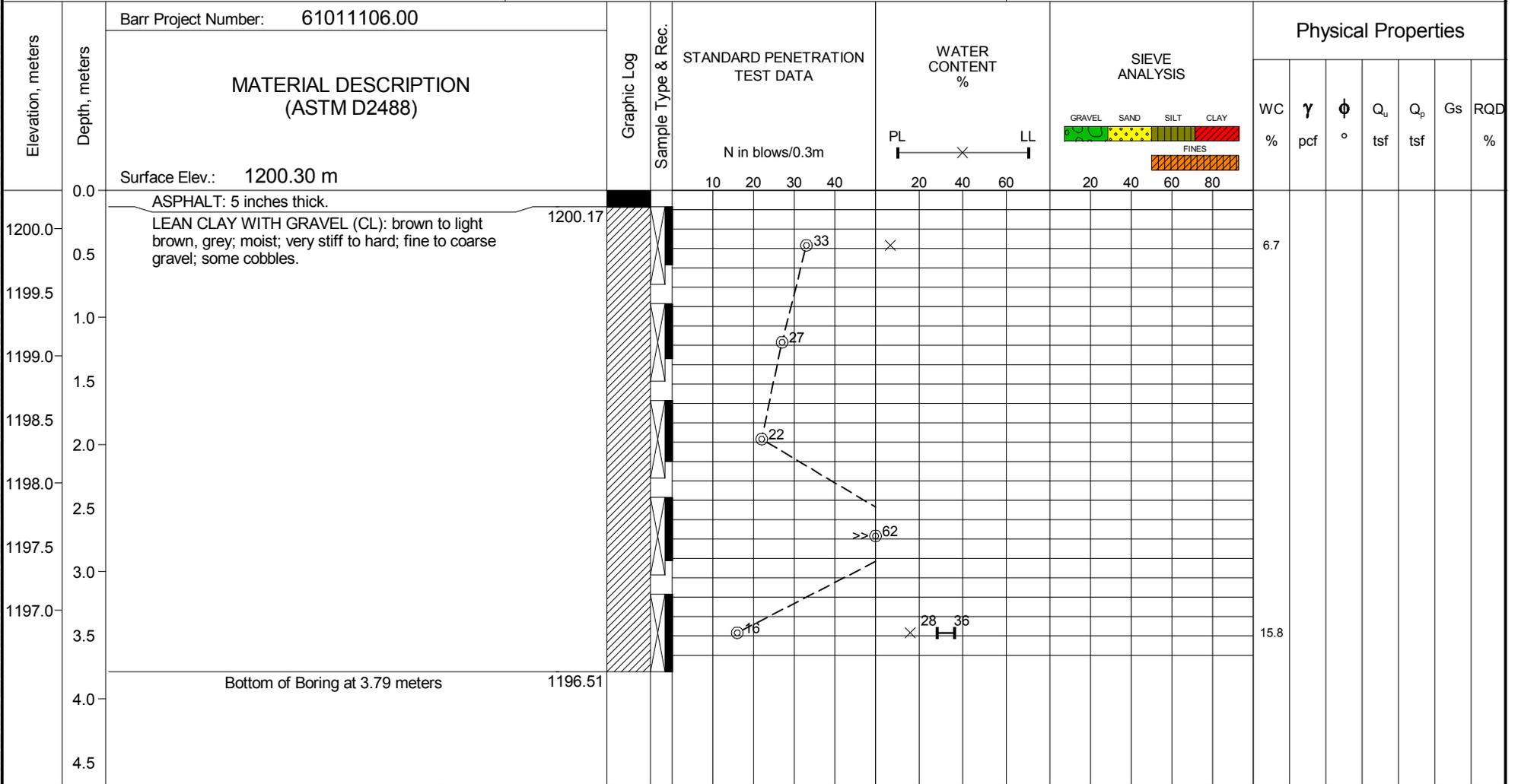


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LOG OF BORING 2015-BBH35-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Completion Depth: 12.4 Date Boring Started: 14/12/15 Date Boring Completed: 14/12/15 Logged By: ETB Drilling Contractor: Earth Drilling Drilling Method: SSA Ground Surface Elevation: 3938 Coordinates: UTM NAD83 N:5638506m, E:567418m Datum: NAD83	Remarks: Pavement cracking at the borehole before drilling started						
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="width:33%;">SAMPLE TYPES</th> <th style="width:33%;">WATER LEVELS (m)</th> <th style="width:33%;">LEGEND</th> </tr> <tr> <td style="text-align: center;"> Split Spoon </td> <td></td> <td> MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle G_s Specific Gravity RQD Rock Quality Designation </td> </tr> </table>	SAMPLE TYPES	WATER LEVELS (m)	LEGEND	Split Spoon		MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle G_s Specific Gravity RQD Rock Quality Designation	
SAMPLE TYPES	WATER LEVELS (m)	LEGEND					
Split Spoon		MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle G_s Specific Gravity RQD Rock Quality Designation					

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH36-S

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties										
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %				
	0	Surface Elev.: 1164.34 m																	
1164	0		ASPHALT: 5.5 inches thick.																
	0.5	1164.2	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark brown to brown; moist; medium dense; trace cobbles.			17	X												
1163	1	1163.44	LEAN CLAY WITH GRAVEL (CL): brown; moist; very stiff; black mottling throughout.			20													2.75
	2					27													
1162	2.5	1161.91	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; brown, grey; moist; medium dense to dense.			24													
1161	3					17	X												3
	4																		
1160	4.5					31													
	5																		
	5.32	1159.02	Bottom of Boring at 5.32 meters			14													

Completion Depth: 17.5
 Date Boring Started: 14/12/15
 Date Boring Completed: 14/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3820
 Coordinates: UTM NAD83 N:5637328m, E:566864m
 Datum: NAD83

Remarks: On the shoulder

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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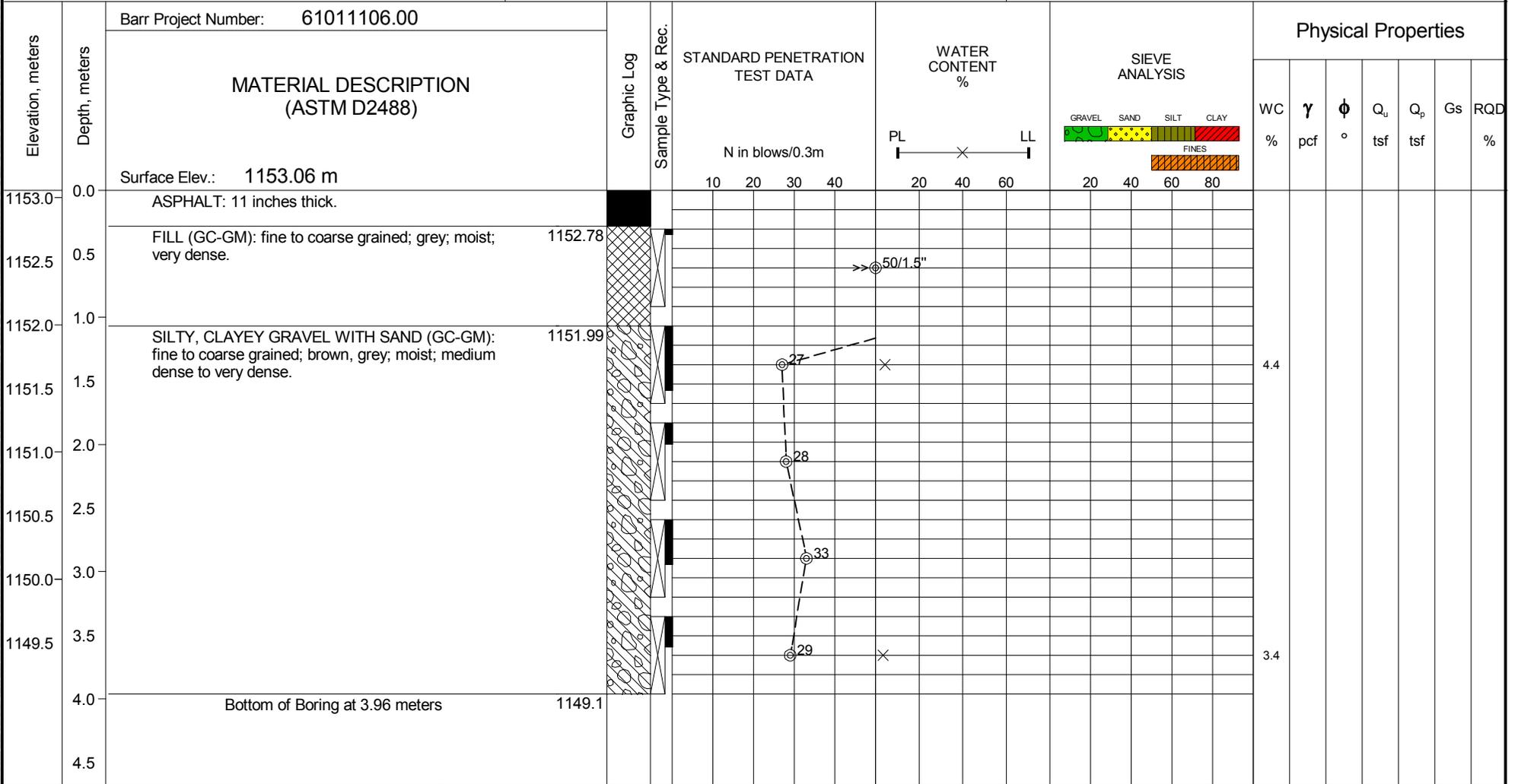
LOG OF BORING 2015-BBH37-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 13.0
 Date Boring Started: 15/12/15
 Date Boring Completed: 15/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3783
 Coordinates: UTM NAD83 N:5631051m, E:569452m
 Datum: NAD83

Remarks: Offset: 2.75 m W of stake

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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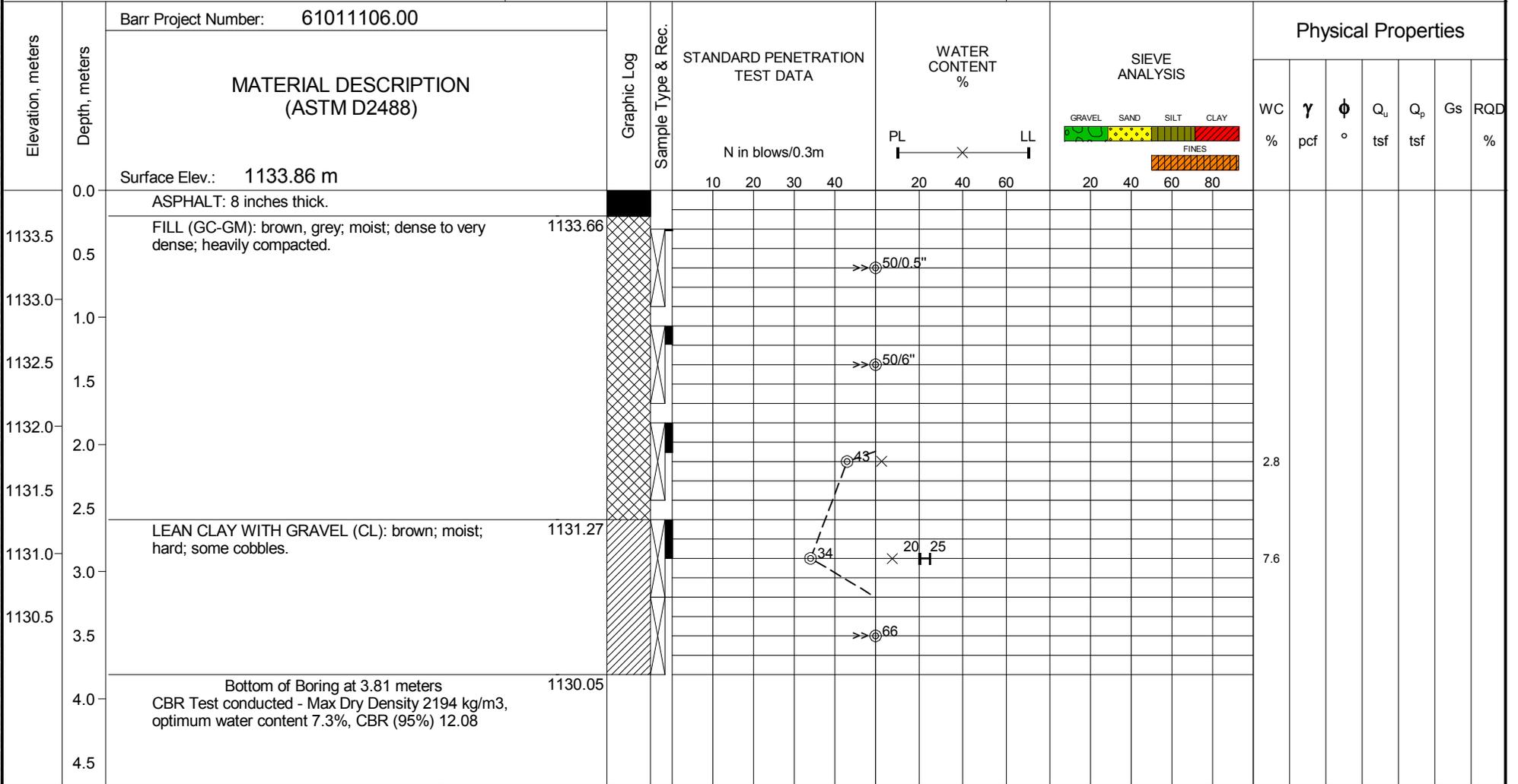
LOG OF BORING 2015-BBH38-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 12.5
 Date Boring Started: 15/12/15
 Date Boring Completed: 15/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3720
 Coordinates: UTM NAD83 N:5628122m, E:570513m
 Datum: NAD83

Remarks: Offset: 7 m E of stake
 Refusal of auger at 3.2 m. Used cone to get the number of blows for the last interval

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	G_s Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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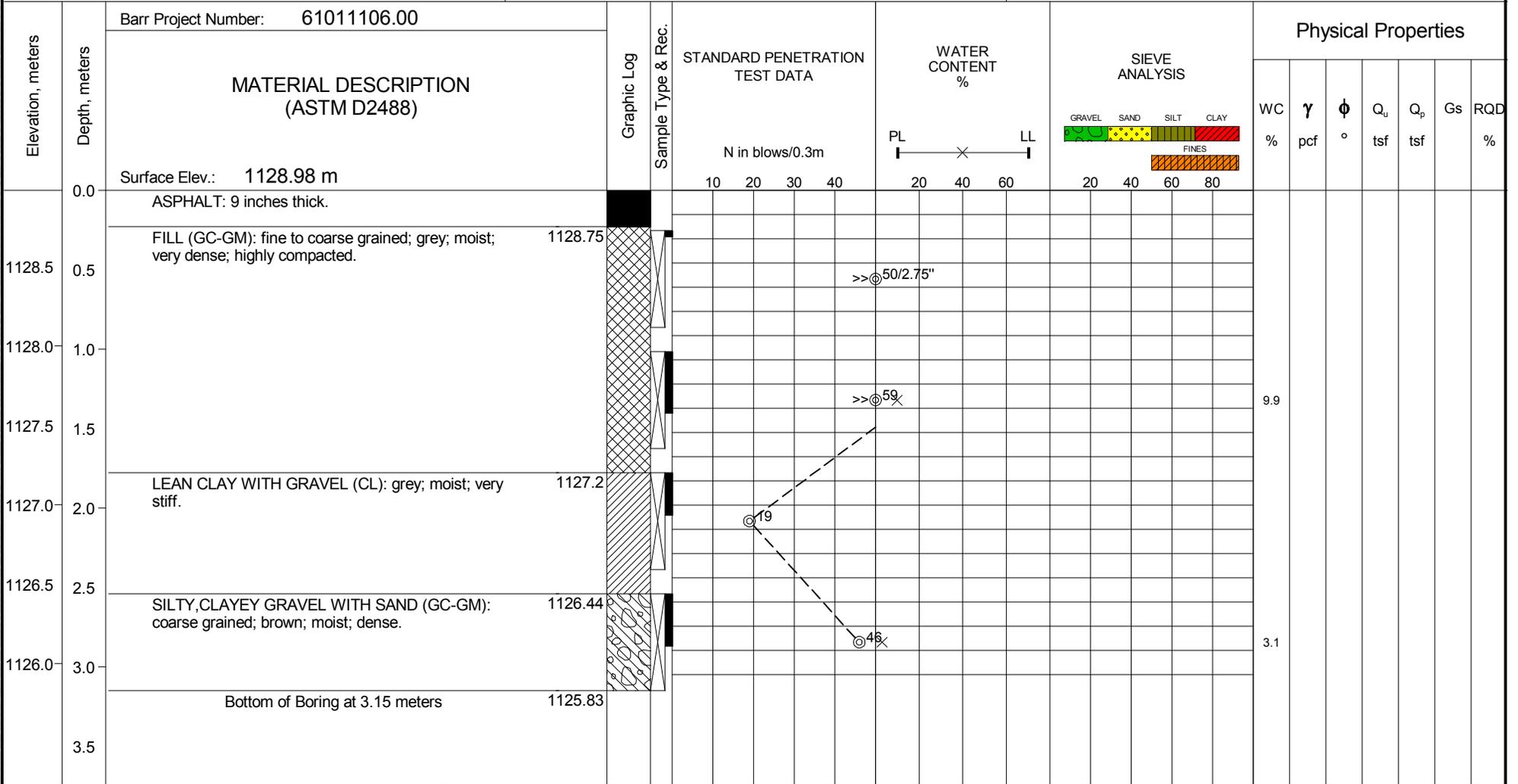
LOG OF BORING 2015-BBH39-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 10.3	Remarks: Borehole collapsed at 1.8 m
Date Boring Started: 15/12/15	
Date Boring Completed: 15/12/15	
Logged By: ETB	
Drilling Contractor: Earth Drilling	
Drilling Method: SSA	
Ground Surface Elevation: 3704	
Coordinates: UTM NAD83 N:5626593m, E:572048m	
Datum: NAD83	

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content
		γ Dry Unit Weight
		ϕ Friction Angle
		Q_u Unconfined Compression
		Q_p Hand Penetrometer UC
		Gs Specific Gravity
		RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH40-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties										
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %				
	0.0	Surface Elev.: 1125.93 m	ASPHALT: 11.5 inches thick.																
1125.5	0.5		FILL (GC-GM): medium to coarse grained; grey; moist; very dense.																
1125.0	1.0																		
1124.5	1.5		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; brown; moist; medium dense; some cobbles.			22													3.8
1124.0	2.0		LEAN CLAY WITH SAND AND GRAVEL (CL): brown; moist to wet; medium stiff to hard. 4 inches thick wood layer.																
1123.5	2.5																		
1123.0	3.0					8													32.8
1122.5	3.5																		
	4.0		Bottom of Boring at 3.81 meters CBR Test conducted - Max Dry Density 2042 kg/m ³ , optimum water content 9.6%, CBR (95%) 7.59			31													

Completion Depth: 12.5
 Date Boring Started: 15/12/15
 Date Boring Completed: 15/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3694
 Coordinates: UTM NAD83 N:5625885m, E:572801m
 Datum: NAD83

Remarks: Offset: 2.1 m NE of stake
 Shoulder cracks

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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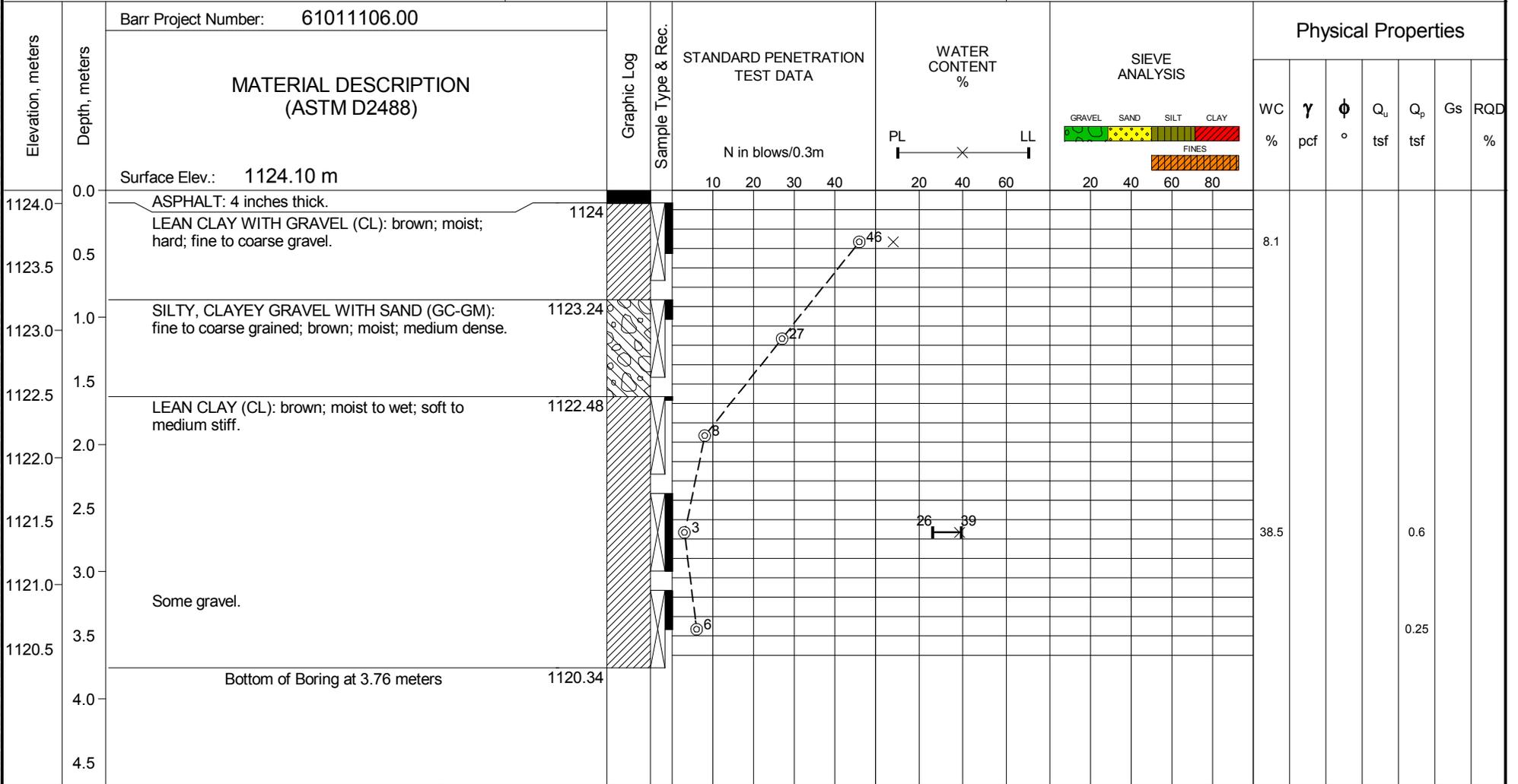
LOG OF BORING 2015-BBH41-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 12.3
 Date Boring Started: 15/12/15
 Date Boring Completed: 15/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3688
 Coordinates: UTM NAD83 N:5624438m, E:574320m
 Datum: NAD83

Remarks:

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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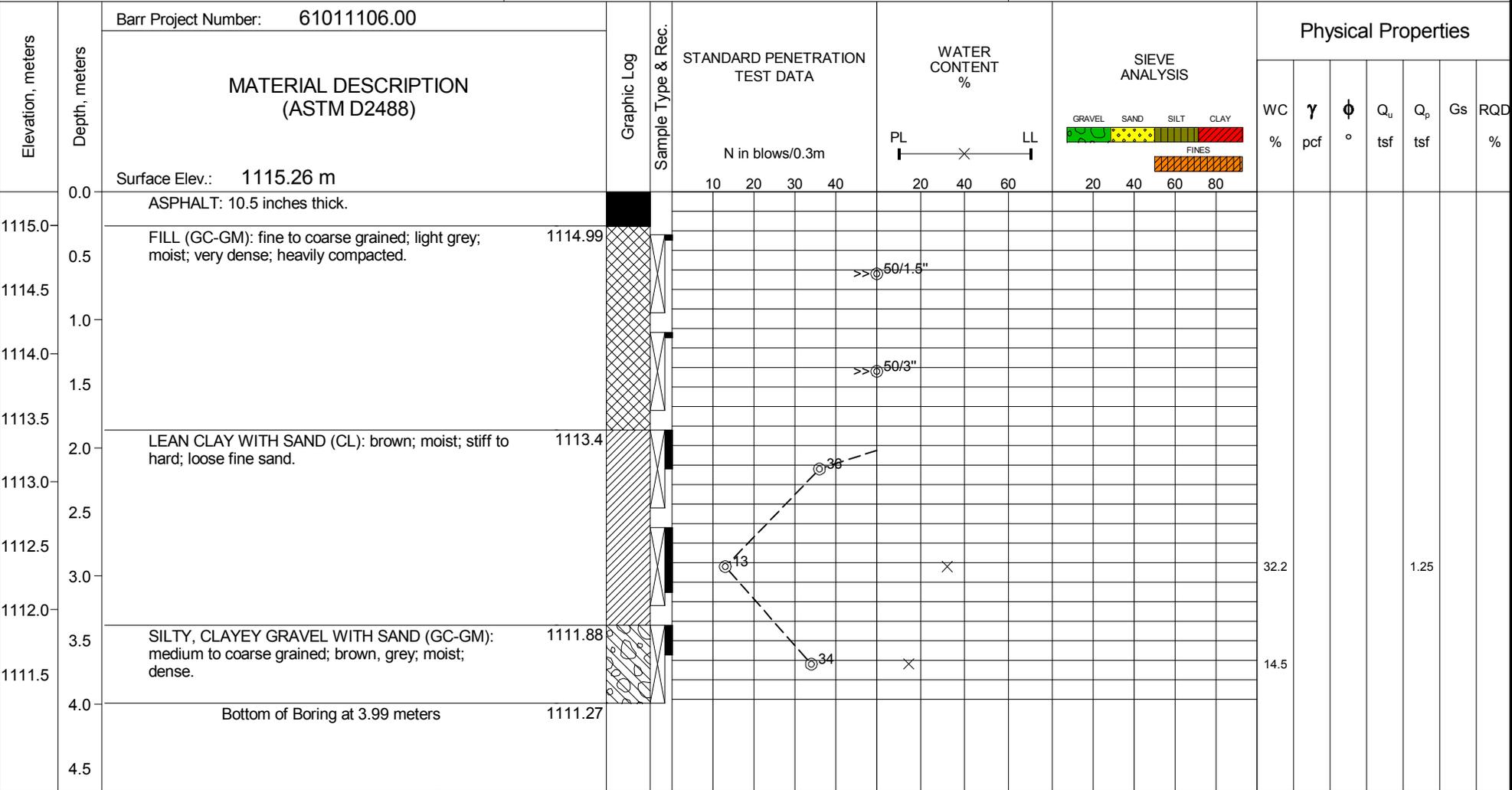


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LOG OF BORING 2015-BBH42-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Completion Depth: 13.1 Date Boring Started: 15/12/15 Date Boring Completed: 15/12/15 Logged By: ETB Drilling Contractor: Earth Drilling Drilling Method: SSA Ground Surface Elevation: 3659 Coordinates: UTM NAD83 N:5623070m, E:575209m Datum: NAD83	Remarks: Pavement cracked	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="width:33%;">SAMPLE TYPES</th> <th style="width:33%;">WATER LEVELS (m)</th> <th style="width:33%;">LEGEND</th> </tr> <tr> <td style="text-align: center;"> Split Spoon </td> <td style="text-align: center;"> At Time of Drilling Dry </td> <td> MC Moisture Content γ Dry Unit Weight ϕ Friction Angle </td> </tr> <tr> <td></td> <td></td> <td> Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation </td> </tr> </table>	SAMPLE TYPES	WATER LEVELS (m)	LEGEND	Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle			Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation
SAMPLE TYPES	WATER LEVELS (m)	LEGEND									
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle									
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation									

The stratification lines represent approximate boundaries. The transition may be gradual.

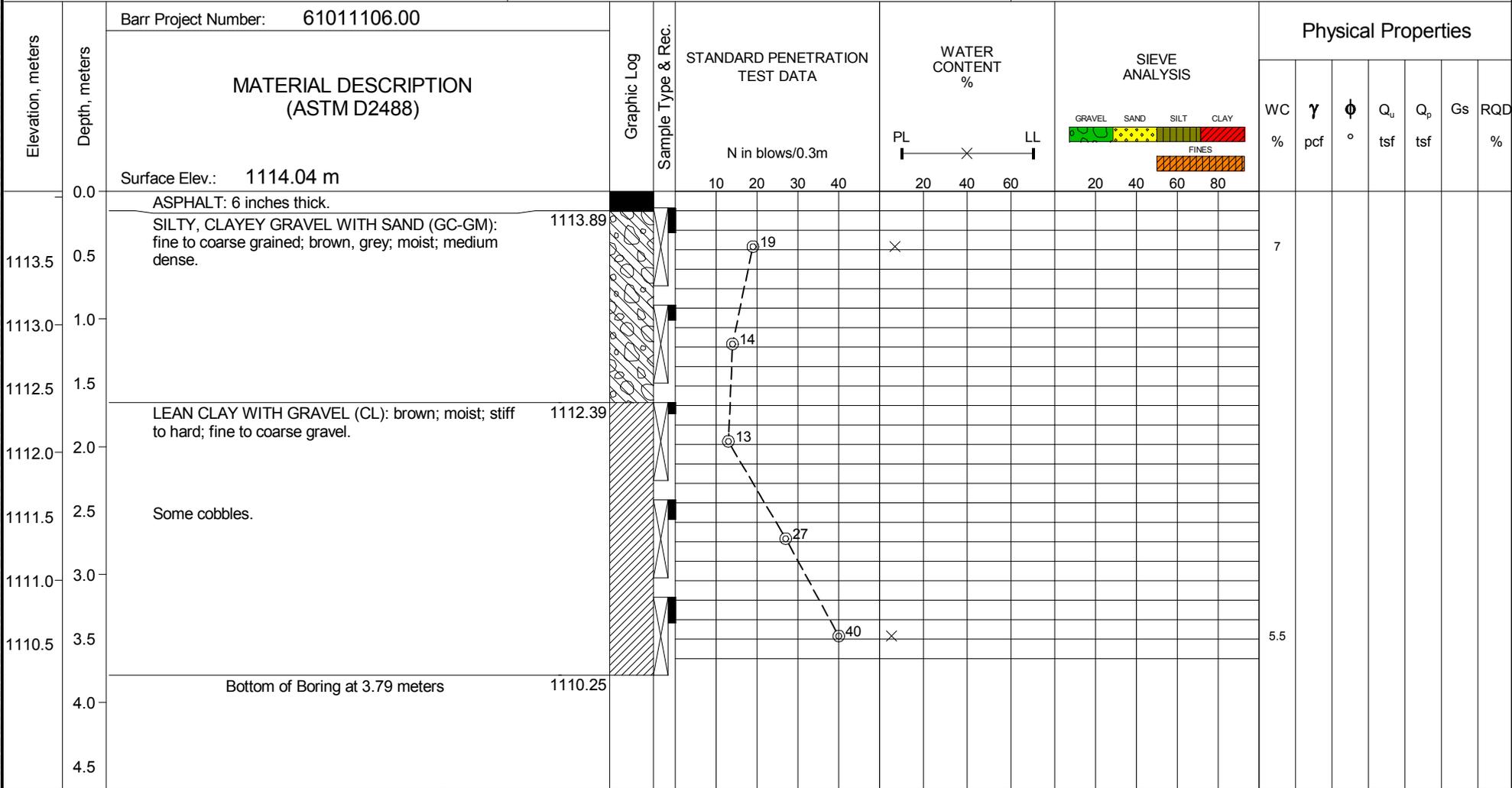
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LOG OF BORING 2015-BBH43-N

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Completion Depth: 12.4	Remarks:
Date Boring Started: 16/12/15	
Date Boring Completed: 16/12/15	
Logged By: ETB	
Drilling Contractor: Earth Drilling	
Drilling Method: SSA	
Ground Surface Elevation: 3655	
Coordinates: UTM NAD83 N:5621187m, E:576440m	
Datum: NAD83	

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content
		γ Dry Unit Weight
		ϕ Friction Angle
		Q_u Unconfined Compression
		Q_p Hand Penetrometer UC
		Gs Specific Gravity
		RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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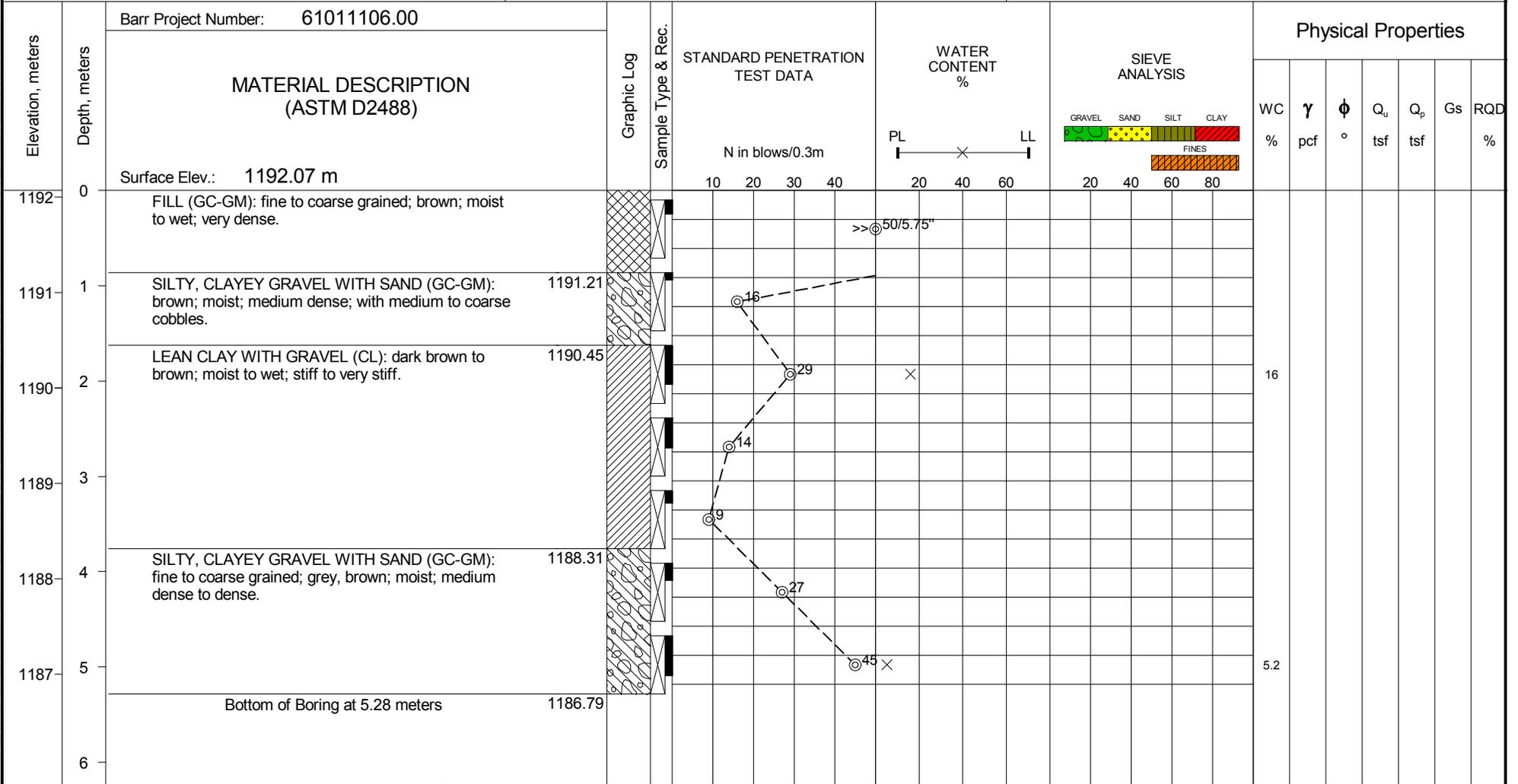
LOG OF BORING 2015-BBH44-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 17.3
 Date Boring Started: 16/12/15
 Date Boring Completed: 16/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3911
 Coordinates: UTM NAD83 N:5617699m, E:577687m
 Datum: NAD83

Remarks:

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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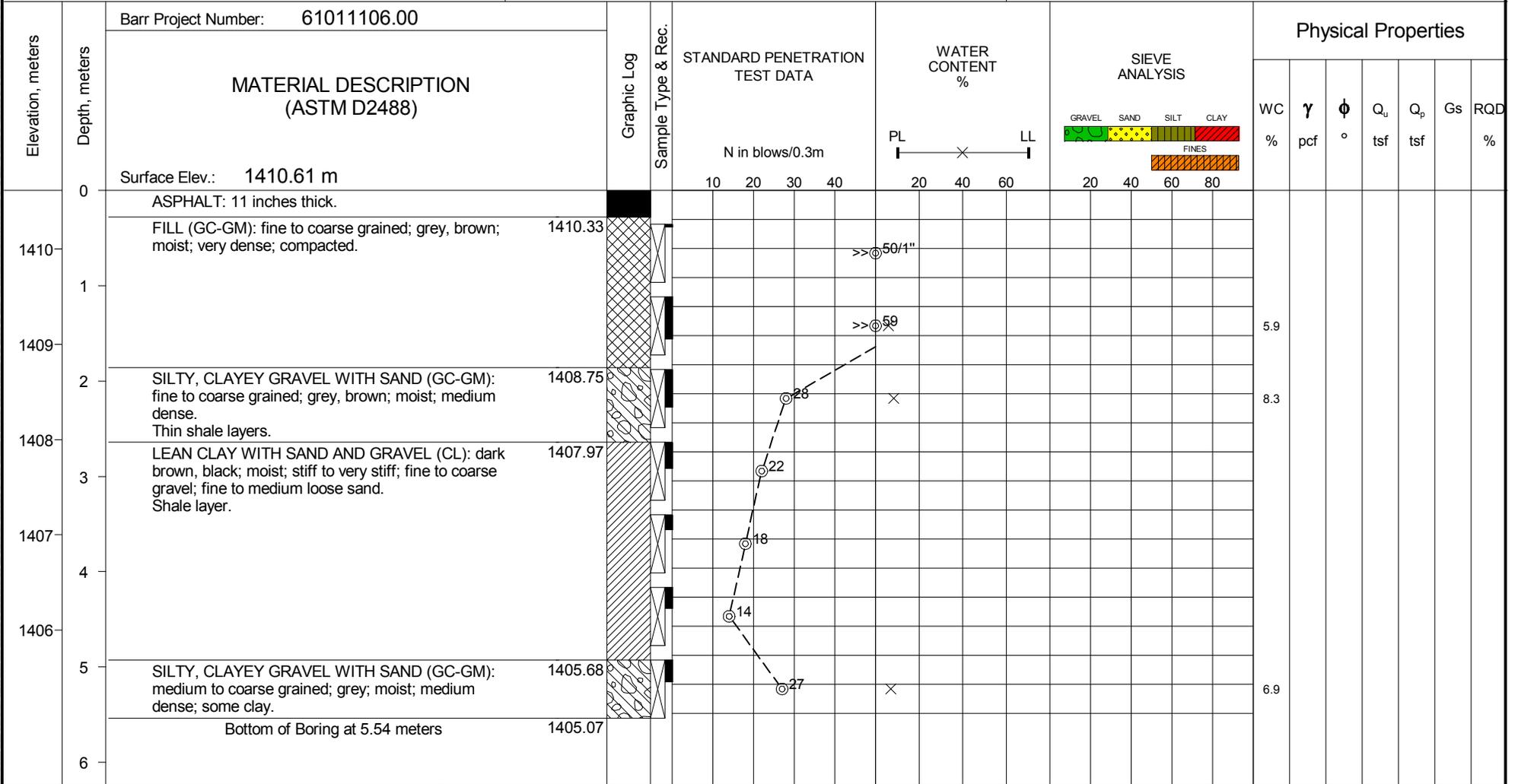
LOG OF BORING 2015-BBH45-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 18.2
 Date Boring Started: 16/12/15
 Date Boring Completed: 16/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4628
 Coordinates: UTM NAD83 N:5613919m, E:576624m
 Datum: NAD83

Remarks: High on road (built up more than 5 m)

SAMPLE TYPES	WATER LEVELS (m)	LEGEND	
Split Spoon	At Time of Drilling Dry	MC Moisture Content	Q_u Unconfined Compression
		γ Dry Unit Weight	Q_p Hand Penetrometer UC
		ϕ Friction Angle	Gs Specific Gravity
			RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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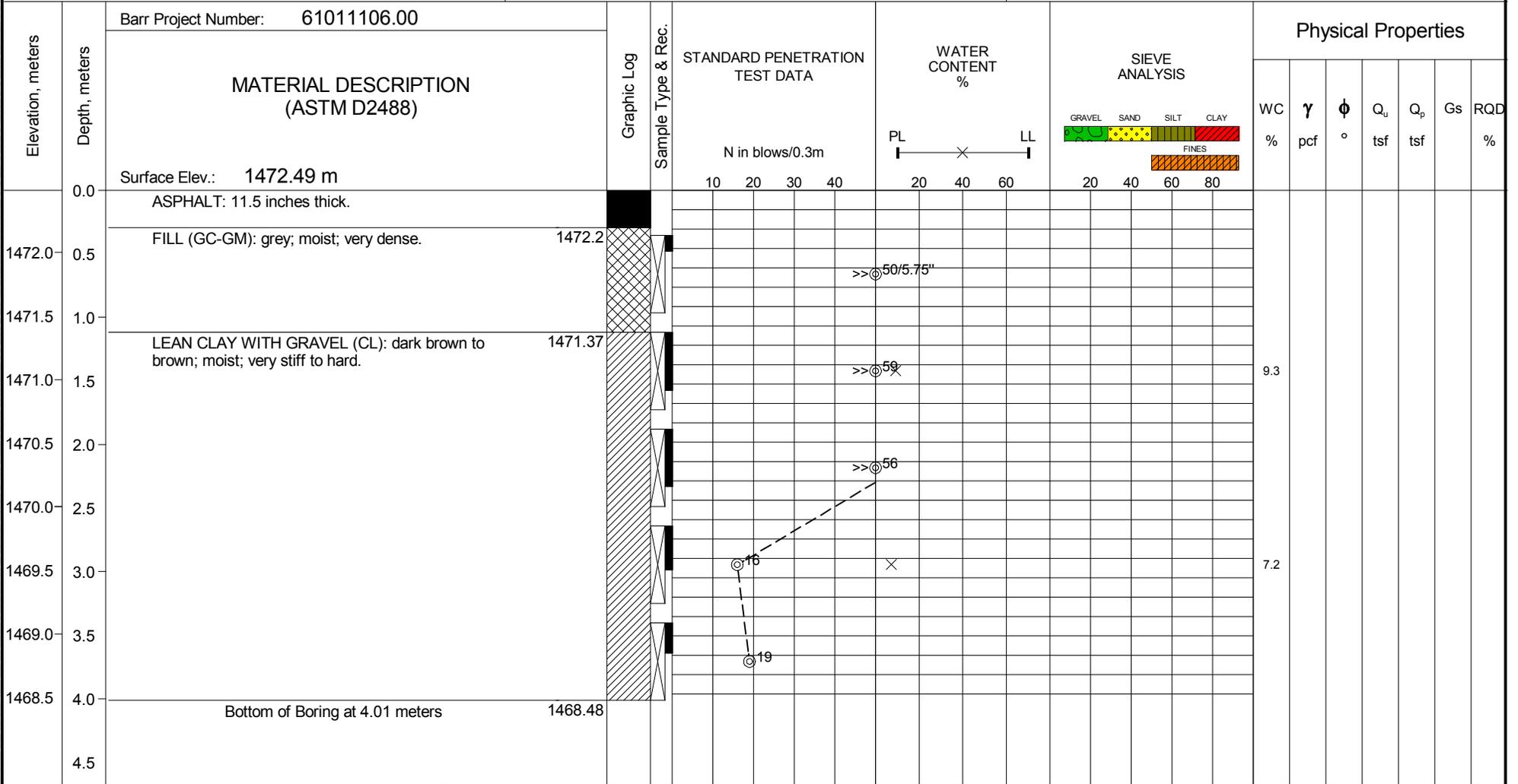
LOG OF BORING 2015-BBH46-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 13.2
 Date Boring Started: 16/12/15
 Date Boring Completed: 16/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 4831
 Coordinates: UTM NAD83 N:5614197m, E:575541m
 Datum: NAD83

Remarks:

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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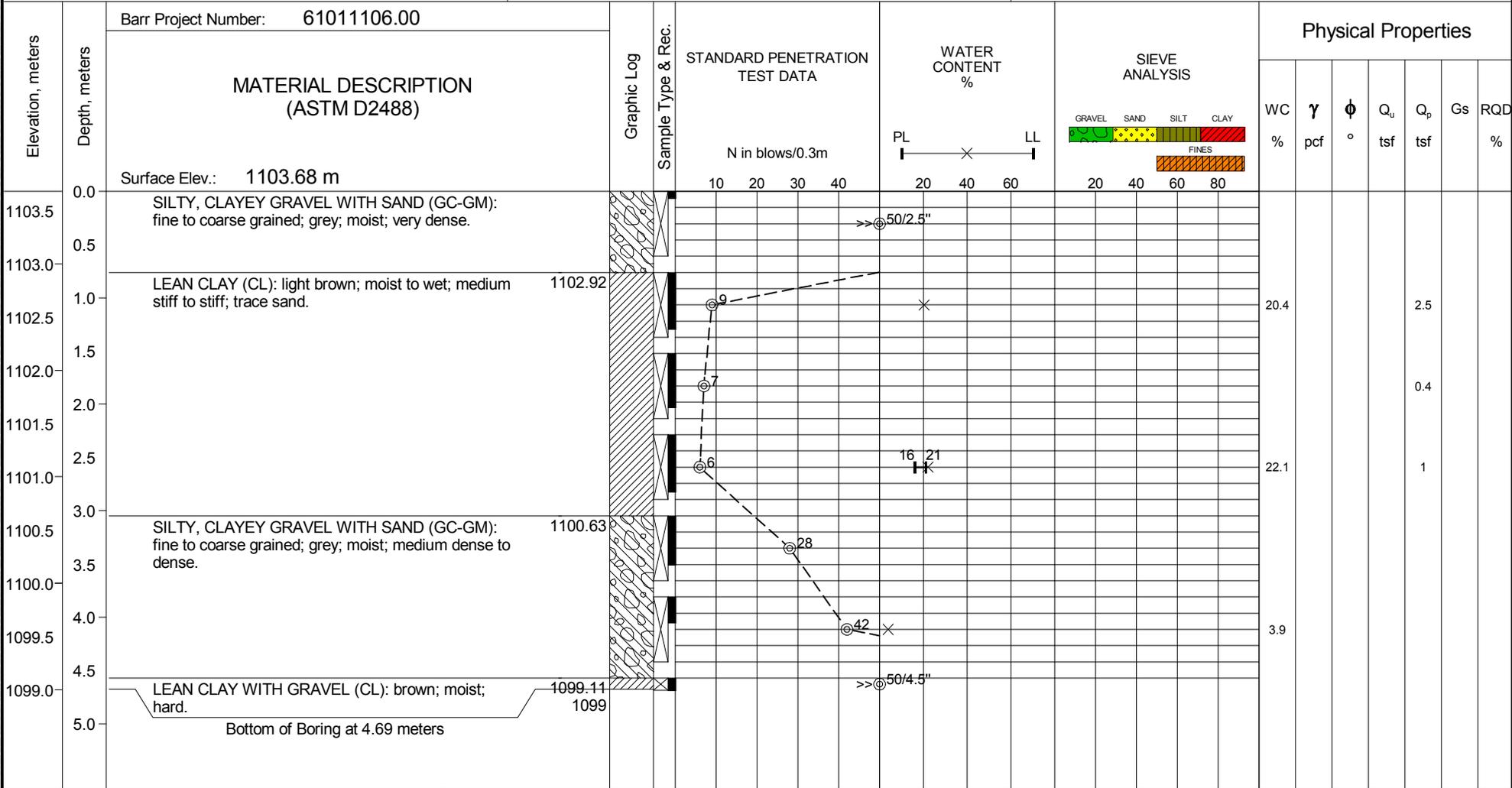


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LOG OF BORING 2015-BBH47-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation	Location: Kootenay National Park	Client: Parks Canada Agency
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Completion Depth: 15.4	Remarks: Offset: 2.6 m N of stake
Date Boring Started: 16/12/15	
Date Boring Completed: 16/12/15	
Logged By: ETB	
Drilling Contractor: Earth Drilling	
Drilling Method: SSA	
Ground Surface Elevation: 3621	
Coordinates: UTM NAD83 N:5610388m, E:569886m	
Datum: NAD83	

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content
		γ Dry Unit Weight
		ϕ Friction Angle
		Q_u Unconfined Compression
		Q_p Hand Penetrometer UC
		Gs Specific Gravity
		RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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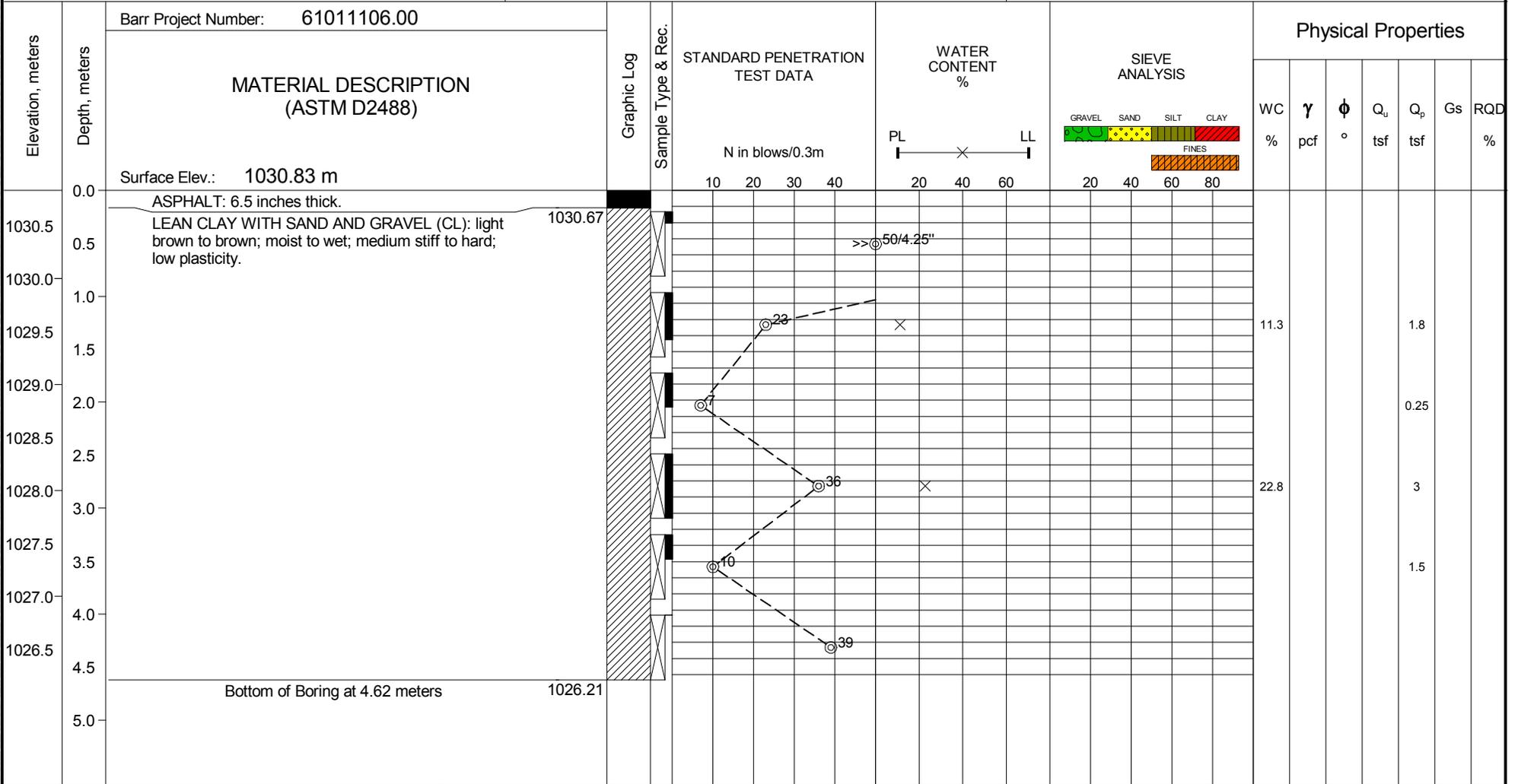
LOG OF BORING 2015-BBH48-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency



Completion Depth: 15.2
 Date Boring Started: 17/12/15
 Date Boring Completed: 17/12/15
 Logged By: ETB
 Drilling Contractor: Earth Drilling
 Drilling Method: SSA
 Ground Surface Elevation: 3382
 Coordinates: UTM NAD83 N:5609728m, E:568448m
 Datum: NAD83

Remarks: Void space between 4.3 m and 5.5 m

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

The stratification lines represent approximate boundaries. The transition may be gradual.

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Appendix B

Laboratory Test Results

Water Content Determination

Borehole No.	2015-BBH45-SH-N	2015-BBH45-SH-N	2015-BBH45-SH-N	2015-BBH46-SH-N	2015-BBH46-SH-N	2015-BBH47-S	2015-BBH47-S	2015-BBH47-S
Depth	2.50	5.00	15.00	2.50	7.50	2.50	7.50	12.50
Tare No.	# 869	# 868	# 870	# 860	# 861	# 867	# 926	# 864
Weight of Tare (g)	11.10	11.20	11.10	11.10	11.10	11.10	11.10	11.10
Wet Sample & Tare (g)	370.30	275.90	344.70	298.60	386.50	261.90	356.40	369.30
Dry Sample & Tare (g)	350.20	255.60	323.20	274.20	361.20	219.40	293.80	356.00
Weight of Water (g)	20.10	20.30	21.50	24.40	25.30	42.50	62.60	13.30
Weight of Dry Sample (g)	339.10	244.40	312.10	263.10	350.10	208.30	282.70	344.90
Water Content (%)	5.9	8.3	6.9	9.3	7.2	20.4	22.1	3.9
Borehole No.	2015-BBH49-S	2015-BBH49-S	2015-BBH48-N	2015-BBH48-N				
Depth	5.00	15.00	2.50	7.50				
Tare No.	# 858	# 859	# 830	# 831				
Weight of Tare (g)	11.10	11.10	11.10	11.10				
Wet Sample & Tare (g)	282.20	341.30	237.70	255.40				
Dry Sample & Tare (g)	266.40	320.90	214.70	210.10				
Weight of Water (g)	15.80	20.40	23.00	45.30				
Weight of Dry Sample (g)	255.30	309.80	203.60	199.00				
Water Content (%)	6.2	6.6	11.3	22.8				
Borehole No.								
Depth								
Tare No.								
Weight of Tare (g)								
Wet Sample & Tare (g)								
Dry Sample & Tare (g)								
Weight of Water (g)								
Weight of Dry Sample (g)								
Water Content (%)								

Remarks

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 Client Barr Engineering Environmental Service Canada
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Water Content Determination

Borehole No.	2015-BBH33-S	2015-BBH33-S	2015-BBH34-SH-N	2015-BBH34-SH-N	2015-BBH35-SH-N	2015-BBH35-SH-N	2015-BBH36-S	2015-BBH36-S
Depth	7.50	12.50	2.50	7.50	0.00	10.00	0.00	10.00
Tare No.	# 826	# 825	# 852	# 815	# 813	# 924	# 829	# 828
Weight of Tare (g)	11.00	11.00	11.10	11.00	10.90	11.10	11.10	11.10
Wet Sample & Tare (g)	272.70	223.70	391.40	219.70	251.00	404.00	243.70	232.60
Dry Sample & Tare (g)	253.60	200.60	372.10	213.80	235.90	350.30	229.20	226.20
Weight of Water (g)	19.10	23.10	19.30	5.90	15.10	53.70	14.50	6.40
Weight of Dry Sample (g)	242.60	189.60	361.00	202.80	225.00	339.20	218.10	215.10
Water Content (%)	7.9	12.2	5.3	2.9	6.7	15.8	6.6	3.0
Borehole No.	2015-BBH37-SH-N	2015-BBH37-SH-N	2015-BBH38-SH-S	2015-BBH38-SH-S	2015-BBH39-SH-S	2015-BBH39-SH-S	2015-BBH40-SH-S	2015-BBH40-SH-S
Depth	2.50	10.00	5.00	7.50	2.50	7.50	2.50	7.50
Tare No.	# 822	# 821	# 818	# 925	# 820	# 819	# 886	# 885
Weight of Tare (g)	11.00	11.10	11.10	11.10	11.10	11.00	11.30	11.20
Wet Sample & Tare (g)	286.50	223.00	248.30	376.60	243.80	268.10	369.20	425.90
Dry Sample & Tare (g)	275.00	216.10	241.90	350.70	222.90	260.30	356.20	323.40
Weight of Water (g)	11.50	6.90	6.40	25.90	20.90	7.80	13.00	102.50
Weight of Dry Sample (g)	264.00	205.00	230.80	339.60	211.80	249.30	344.90	312.20
Water Content (%)	4.4	3.4	2.8	7.6	9.9	3.1	3.8	32.8
Borehole No.	2015-BBH41-SH-N	2015-BBH41-SH-N	2015-BBH42-SH-S	2015-BBH42-SH-S	2015-BBH43-N	2015-BBH43-N	2015-BBH44-SH-N	2015-BBH44-SH-N
Depth	0.00	7.50	7.50	10.00	0.00	10.00	5.00	15.00
Tare No.	# 877	# 851	# 875	# 876	# 874	# 876	# 872	# 871
Weight of Tare (g)	11.10	11.00	11.10	11.10	11.10	11.10	11.20	11.20
Wet Sample & Tare (g)	388.80	327.50	273.10	296.30	363.10	357.10	359.00	414.40
Dry Sample & Tare (g)	360.40	239.50	209.30	260.10	340.20	339.20	311.00	394.50
Weight of Water (g)	28.40	88.00	63.80	36.20	22.90	17.90	48.00	19.90
Weight of Dry Sample (g)	349.30	228.50	198.20	249.00	329.10	328.10	299.80	383.30
Water Content (%)	8.1	38.5	32.2	14.5	7.0	5.5	16.0	5.2

Remarks

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Borehole No.	2015-BBH11-SH-S	2015-BBH11-SH-S	2015-BBH12-N	2015-BBH16-S	2015-BBH16-S	2015-BBH16-S	2015-BBH17-N	2015-BBH17-N
Depth	0.00	5.00	0.00	0.00	2.50	7.50	0.00	2.50
Tare No.	# 893	# 894	# 916	# 915	# 914	# 892	# 884	# 913
Weight of Tare (g)	11.20	11.10	11.10	11.10	11.10	11.10	11.30	11.10
Wet Sample & Tare (g)	381.70	308.30	382.40	372.70	373.20	415.10	347.60	318.60
Dry Sample & Tare (g)	362.70	297.60	343.40	349.70	344.30	380.30	294.50	262.50
Weight of Water (g)	19.00	10.70	39.00	23.00	28.90	34.80	53.10	56.10
Weight of Dry Sample (g)	351.50	286.50	332.30	338.60	333.20	369.20	283.20	251.40
Water Content (%)	5.4	3.7	11.7	6.8	8.7	9.4	18.8	22.3
Borehole No.	2015-BBH17-N	2015-BBH18-N	2015-BBH18-N	2015-BBH18-N	2015-BBH18-N	2015-BBH19-SH-S	2015-BBH19-SH-S	2015-BBH19-SH-S
Depth	7.50	0.00	2.50	5.00	10.00	0.00	5.00	10.00
Tare No.	# 883	# 891	# 912	# 911	# 890	# 889	# 910	# 909
Weight of Tare (g)	11.20	11.10	11.10	11.10	11.10	11.30	11.10	11.10
Wet Sample & Tare (g)	303.60	344.60	348.60	295.40	422.60	418.90	363.70	344.50
Dry Sample & Tare (g)	287.30	285.20	308.10	249.80	391.40	394.60	343.50	301.80
Weight of Water (g)	16.30	59.40	40.50	45.60	31.20	24.30	20.20	42.70
Weight of Dry Sample (g)	276.10	274.10	297.00	238.70	380.30	383.30	332.40	290.70
Water Content (%)	5.9	21.7	13.6	19.1	8.2	6.3	6.1	14.7
Borehole No.	2015-BBH20-S	2015-BBH20-S	2015-BBH20-S	2015-BBH21-S	2015-BBH21-S	2015-BBH21-S	2015-BBH22-S	2015-BBH22-S
Depth	0.00	5.00	10.00	0.00	7.50	15.00	2.50	10.00
Tare No.	# 888	# 908	# 887	# 809	# 907	# 810	# 866	# 865
Weight of Tare (g)	11.20	11.00	11.10	11.00	11.00	10.90	11.10	11.10
Wet Sample & Tare (g)	407.70	346.50	366.60	247.80	421.80	226.30	277.40	402.50
Dry Sample & Tare (g)	384.50	280.70	289.50	232.40	401.00	185.60	256.00	370.40
Weight of Water (g)	23.20	65.80	77.10	15.40	20.80	40.70	21.40	32.10
Weight of Dry Sample (g)	373.30	269.70	278.40	221.40	390.00	174.70	244.90	359.30
Water Content (%)	6.2	24.4	27.7	7.0	5.3	23.3	8.7	8.9

Remarks

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Borehole No.	2015-BBH23-SH-S	2015-BBH23-SH-S	2015-BBH23-SH-S	2015-BBH23-SH-S	2015-BBH25-N	2015-BBH25-N	2015-BBH05-SH-N	2015-BBH05-SH-N
Depth	2.50	7.50	12.50	15.00	5.00	12.50	5.00	10.00
Tare No.	# 880	# 879	# 906	# 878	# 905	# 904	# 812	# 811
Weight of Tare (g)	11.00	11.20	11.10	11.00	11.10	11.10	10.80	11.00
Wet Sample & Tare (g)	372.40	336.60	361.70	297.90	443.60	421.30	231.50	239.20
Dry Sample & Tare (g)	356.20	311.30	292.20	279.80	430.00	392.80	226.60	224.20
Weight of Water (g)	16.20	25.30	69.50	18.10	13.60	28.50	4.90	15.00
Weight of Dry Sample (g)	345.20	300.10	281.10	268.80	418.90	381.70	215.80	213.20
Water Content (%)	4.7	8.4	24.7	6.7	3.2	7.5	2.3	7.0
Borehole No.	2015-BBH26-SH-S	2015-BBH26-SH-S	2015-BBH26-SH-S	2015-BBH24-SH-N	2015-BBH24-SH-N	2015-BBH28-N	2015-BBH28-N	2015-BBH30-SH-N
Depth	5.00	10.00	15.00	2.50	7.50	5.00	10.00	2.50
Tare No.	# 882	# 881	# 903	# 863	# 862	# 902	# 901	# 817
Weight of Tare (g)	10.90	10.80	11.10	11.10	11.00	11.10	11.10	11.10
Wet Sample & Tare (g)	340.50	452.30	353.40	256.20	267.20	395.20	389.30	230.30
Dry Sample & Tare (g)	324.10	350.20	246.60	245.60	260.10	382.20	335.40	217.20
Weight of Water (g)	16.40	102.10	106.80	10.60	7.10	13.00	53.90	13.10
Weight of Dry Sample (g)	313.20	339.40	235.50	234.50	249.10	371.10	324.30	206.10
Water Content (%)	5.2	30.1	45.4	4.5	2.9	3.5	16.6	6.4
Borehole No.	2015-BBH30-SH-N	2015-BBH31-SH-S	2015-BBH31-SH-S	2015-BBH31-SH-S	2015-BBH32-S	2015-BBH32-S	2015-BBH32-S	2015-BBH33-S
Depth	7.50	0.00	5.00	10.00	0.00	5.00	10.00	0.00
Tare No.	# 816	# 814	# 855	# 854	# 853	# 824	# 823	# 827
Weight of Tare (g)	11.00	11.00	11.10	11.10	11.10	11.00	11.10	11.10
Wet Sample & Tare (g)	210.80	227.50	387.00	346.10	420.70	250.10	242.40	245.70
Dry Sample & Tare (g)	194.90	219.10	361.20	278.10	393.90	215.60	191.90	236.80
Weight of Water (g)	15.90	8.40	25.80	68.00	26.80	34.50	50.50	8.90
Weight of Dry Sample (g)	183.90	208.10	350.10	267.00	382.80	204.60	180.80	225.70
Water Content (%)	8.6	4.0	7.4	25.5	7.0	16.9	27.9	3.9

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Borehole No.	2015-BBH01-S	2015-BBH01-S	2015-BBH01-S	2015-BBH02-N	2015-BBH02-N	2015-BBH02-N	2015-BBH03-N	2015-BBH03-N
Depth	0.00	2.00	7.50	0.00	5.00	7.50	0.00	5.00
Tare No.	CG6	CG8	# 922	# 801	# 857	# 856	# 921	# 920
Weight of Tare (g)	507.00	520.60	11.10	10.90	11.00	11.10	11.10	11.10
Wet Sample & Tare (g)	802.40	883.60	399.20	238.40	266.10	223.50	157.10	339.50
Dry Sample & Tare (g)	763.80	869.10	363.50	227.10	253.20	209.40	106.40	270.60
Weight of Water (g)	38.60	14.50	35.70	11.30	12.90	14.10	50.70	68.90
Weight of Dry Sample (g)	256.80	348.50	352.40	216.20	242.20	198.30	95.30	259.50
Water Content (%)	15.0	4.2	10.1	5.2	5.3	7.1	53.2	26.6
Borehole No.	2015-BBH03-N	2015-BBH03-N	2015-BBH06-S	2015-BBH06-S	2015-BBH06-S	2015-BBH07-S	2015-BBH07-S	2015-BBH07-S
Depth	10.00	15.00	0.00	7.50	12.50	2.50	7.50	10.00
Tare No.	# 802	# 803	# 804	# 805	# 806	# 919	# 807	# 808
Weight of Tare (g)	11.00	11.10	10.80	10.90	10.90	11.10	10.90	11.00
Wet Sample & Tare (g)	272.00	235.10	219.10	235.70	238.00	390.00	240.80	272.20
Dry Sample & Tare (g)	242.40	207.40	201.60	221.30	223.00	368.10	217.00	248.70
Weight of Water (g)	29.60	27.70	17.50	14.40	15.00	21.90	23.80	23.50
Weight of Dry Sample (g)	231.40	196.30	190.80	210.40	212.10	357.00	206.10	237.70
Water Content (%)	12.8	14.1	9.2	6.8	7.1	6.1	11.5	9.9
Borehole No.	2015-BBH08-SH-N	2015-BBH08-SH-N	2015-BBH08-SH-N	2015-BBH09-SH-S	2015-BBH09-SH-S	2015-BBH10-SH-S	2015-BBH10-SH-S	2015-BBH10-SH-S
Depth	0.00	2.50	10.00	0.00	5.00	0.00	5.00	7.50
Tare No.	# 918	# 900	# 899	# 917	# 895	# 898	# 897	# 893
Weight of Tare (g)	11.10	11.10	11.20	11.10	11.20	11.30	11.20	11.10
Wet Sample & Tare (g)	328.40	329.10	389.90	350.10	417.80	315.20	464.30	363.80
Dry Sample & Tare (g)	290.70	295.10	350.80	323.20	390.30	299.80	446.70	343.10
Weight of Water (g)	37.70	34.00	39.10	26.90	27.50	15.40	17.60	20.70
Weight of Dry Sample (g)	279.60	284.00	339.60	312.10	379.10	288.50	435.50	332.00
Water Content (%)	13.5	12.0	11.5	8.6	7.3	5.3	4.0	6.2

Remarks

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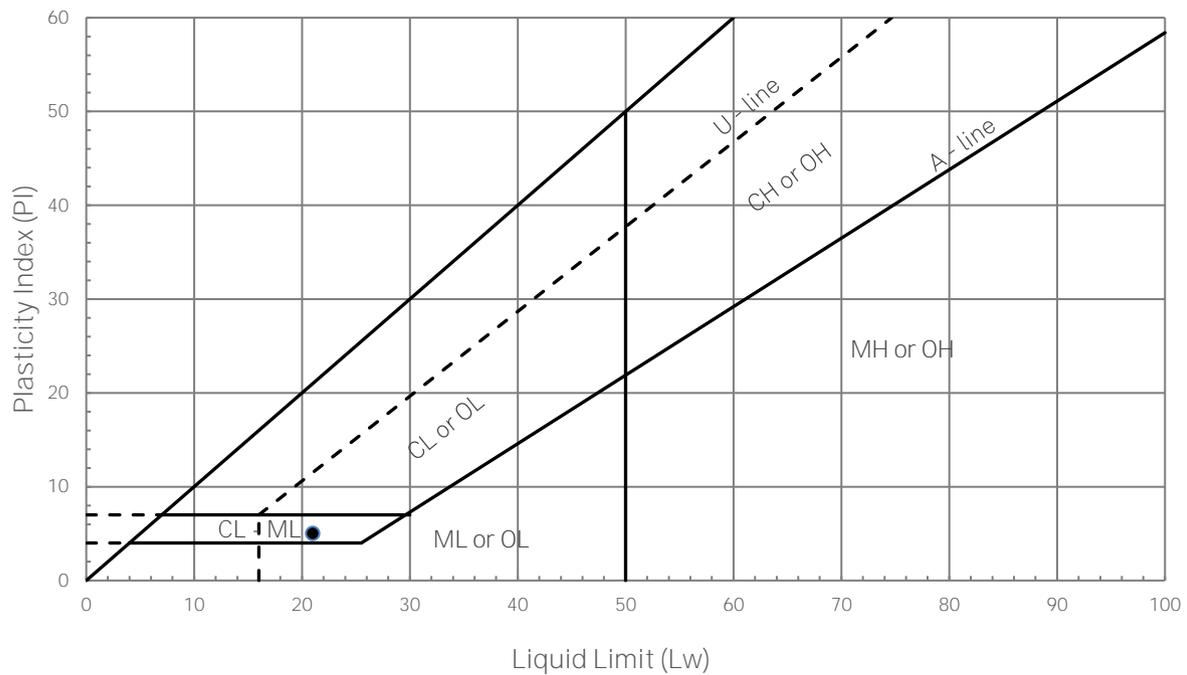
Tech FG

Sample Date

ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	16-Dec-15	Liquid Limit	21	Soil type	Silty clay
Sample No	2015-BBH47-S @ 7.5'	Plastic Limit	16	Classification	CL-ML
Technician	Client	Plasticity Index	5		

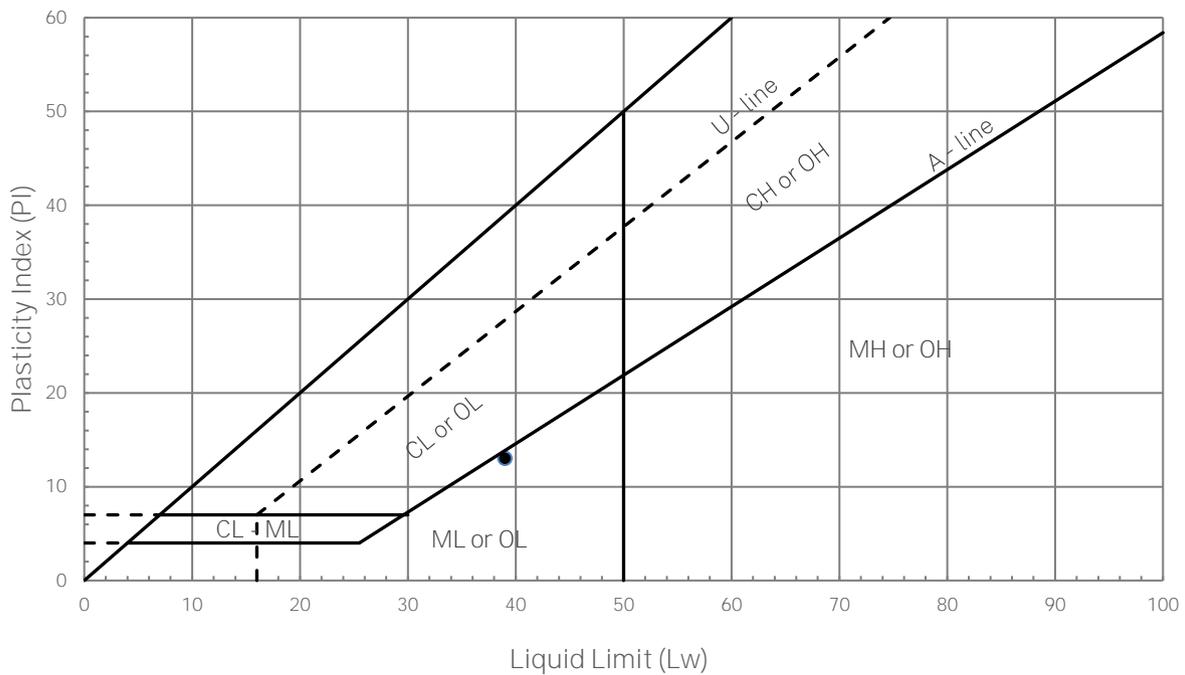


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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	15-Dec-15	Liquid Limit	39	Soil type	Silty clay
Sample No	2015-BBH41-SH-N @ 7.5'	Plastic Limit	26	Classification	ML
Technician	Client	Plasticity Index	13		



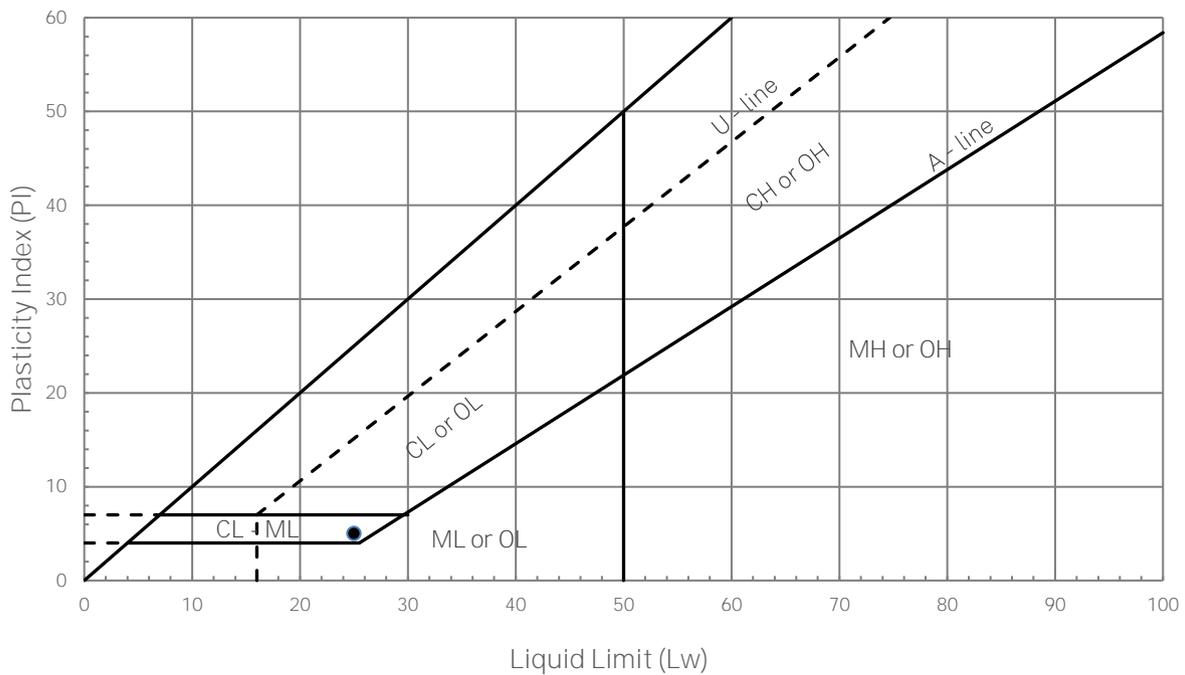
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	15-Dec-15	Liquid Limit	25	Soil type	Silty clay
Sample No	2015-BBH38-SH-S @ 7.5'	Plastic Limit	20	Classification	CL-ML
Technician	Client	Plasticity Index	5		



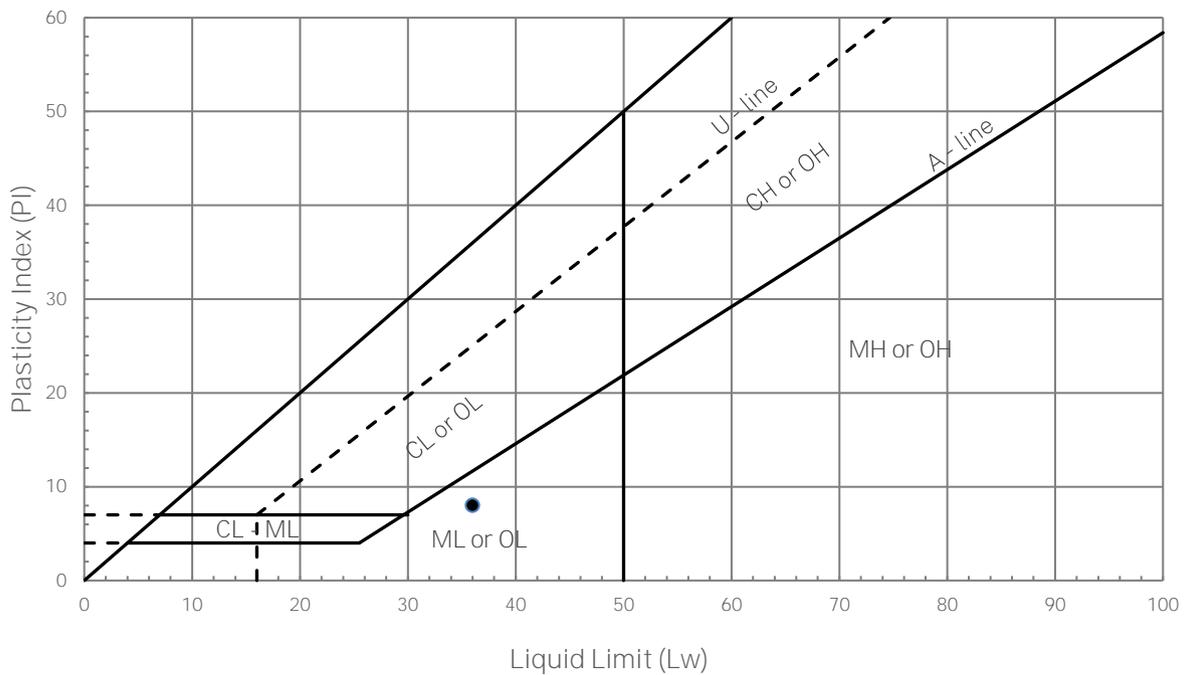
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	36	Soil type	Silty clay
Sample No	2015-BBH35-SH-N @ 10.0'	Plastic Limit	28	Classification	ML
Technician	Client	Plasticity Index	8		



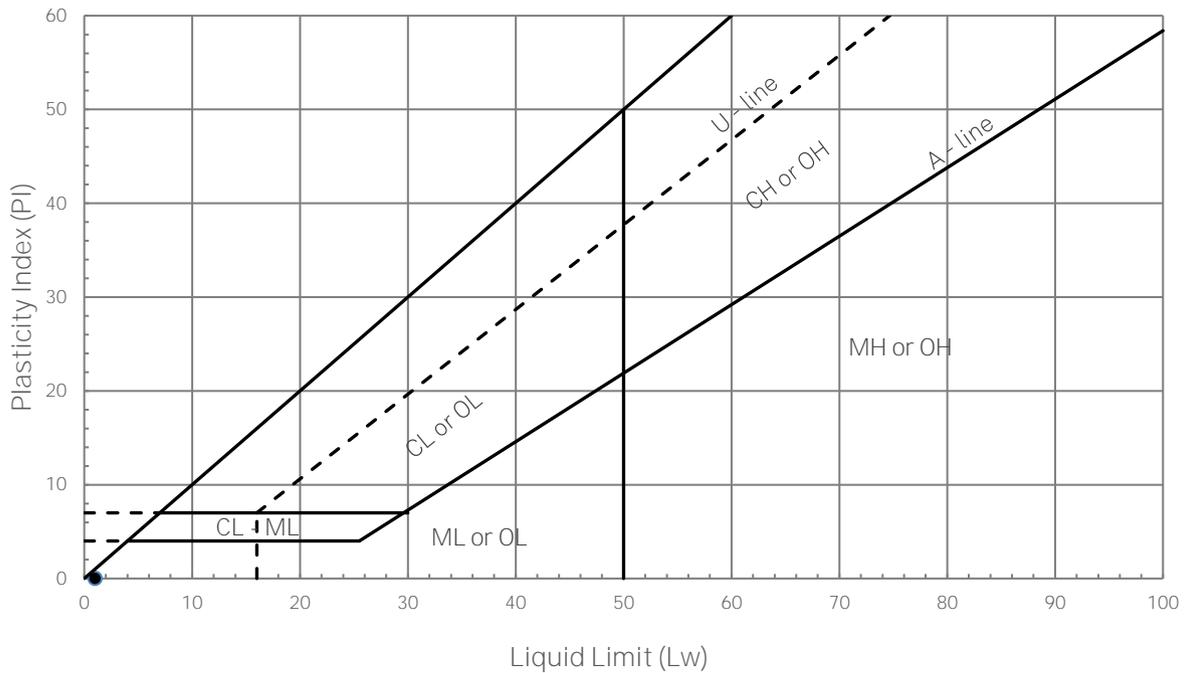
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	-	Soil type	Sandy
Sample No	2015-BBH32-S @ 10.0'	Plastic Limit	-	Classification	-
Technician	Client	Plasticity Index	Non plastic		



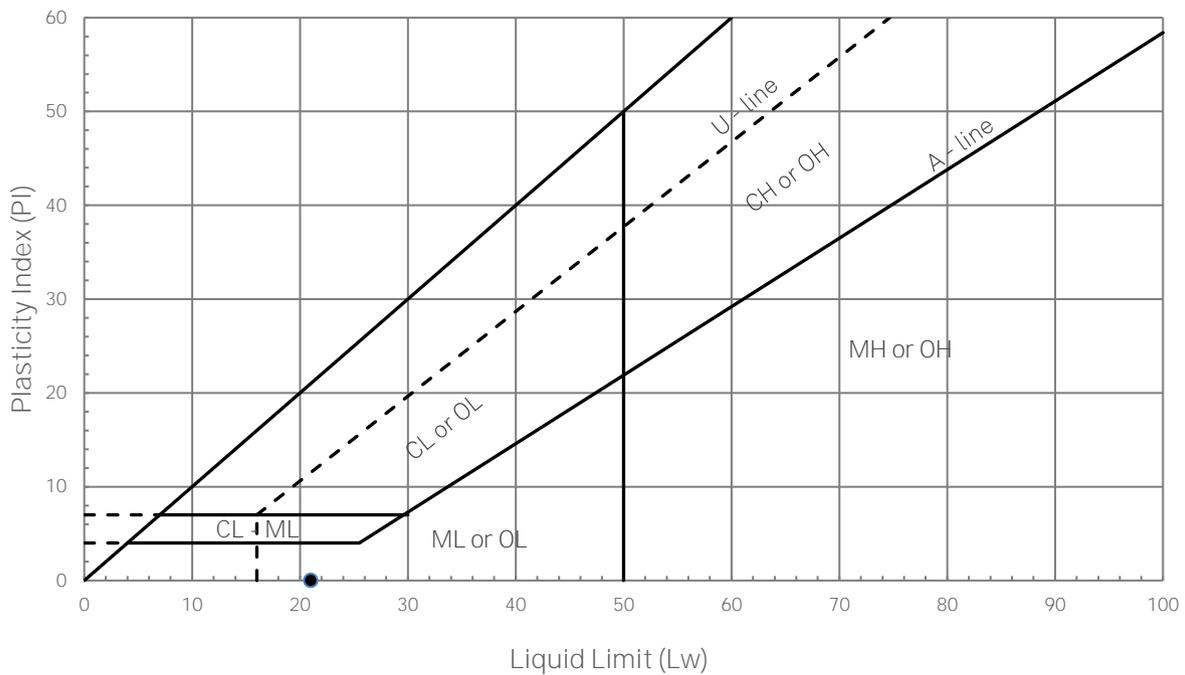
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	12-Dec-15	Liquid Limit	21	Soil type	Sandy silty clay
Sample No	2015-BBH31-SH-S @ 10.0'	Plastic Limit	21	Classification	ML
Technician	Client	Plasticity Index			



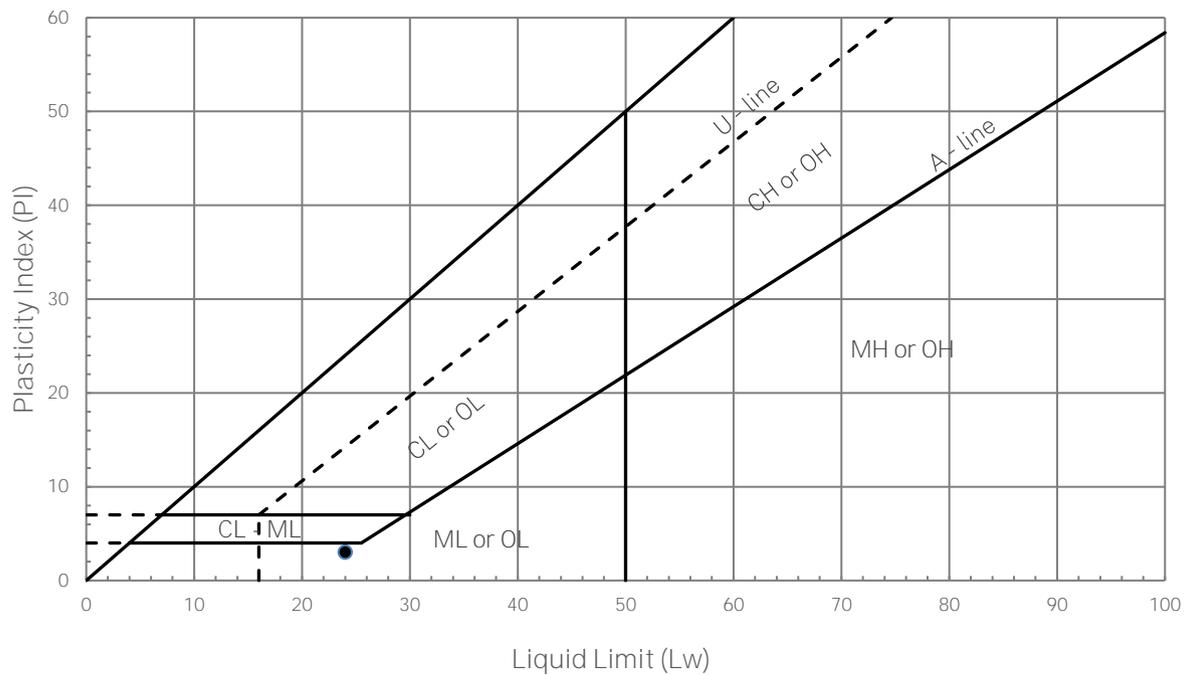
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	12-Dec-15	Liquid Limit	24	Soil type	Sandy silty clay
Sample No	2015-BBH28-N @ 10.0'	Plastic Limit	21	Classification	CL-ML
Technician	Client	Plasticity Index	3		

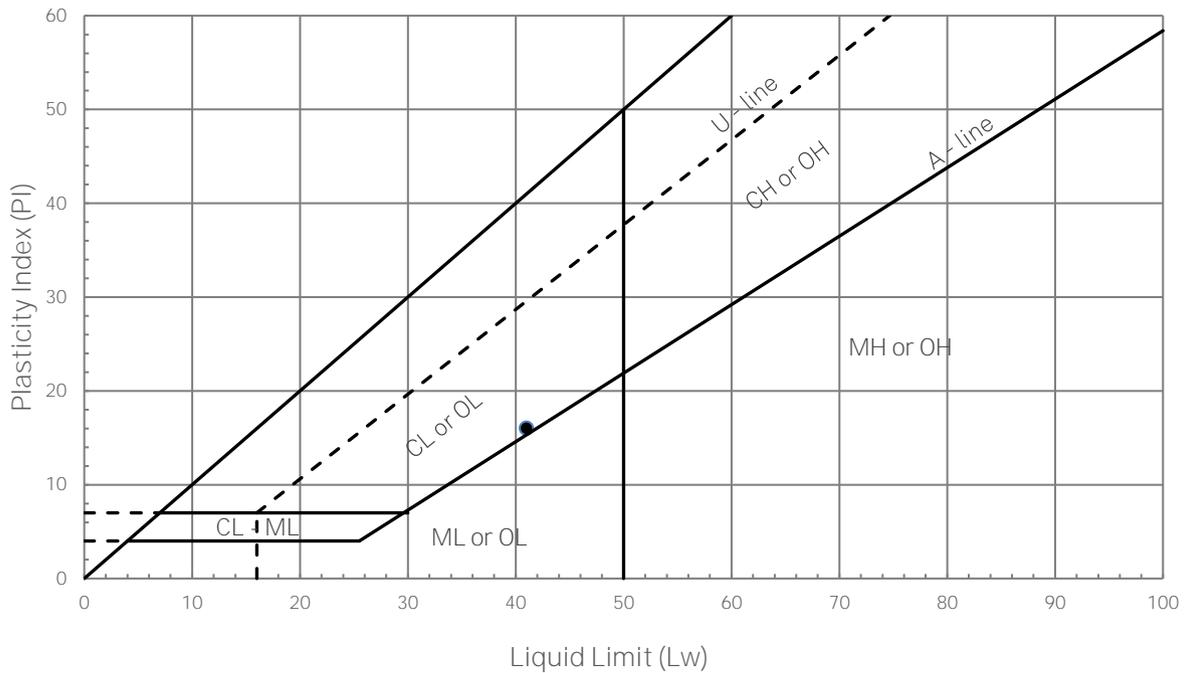


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ASTM D4318

Sample Date	12-Dec-15	Liquid Limit	41	Soil type	Silty clay
Sample No	2015-BBH26-SH-S @ 15.0'	Plastic Limit	25	Classification	CL
Technician	Client	Plasticity Index	16		

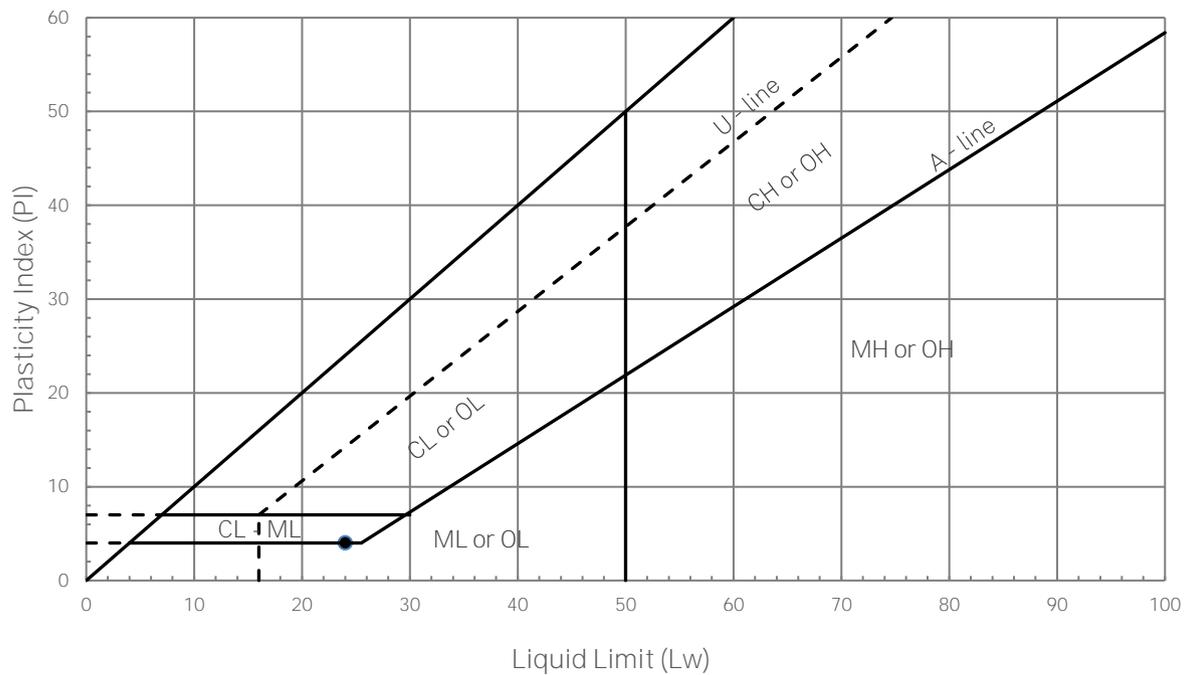


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ASTM D4318

Sample Date	11-Dec-15	Liquid Limit	24	Soil type	Sandy silty clay
Sample No	2015-BBH25-N @ 12.5'	Plastic Limit	20	Classification	CL-ML
Technician	Client	Plasticity Index	4		

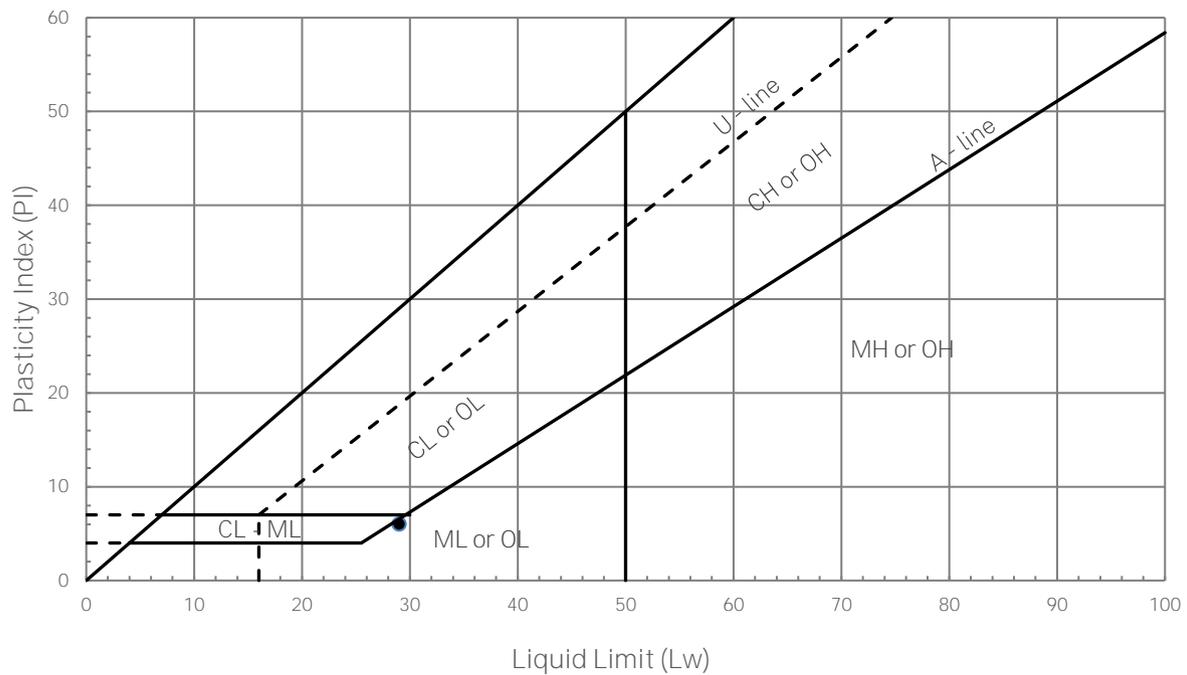


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Client	Barr Engineering Environmental Service Canada
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ASTM D4318

Sample Date	11-Dec-15	Liquid Limit	29	Soil type	Silty clay
Sample No	2015-BBH23-SH-S @ 12.5'	Plastic Limit	23	Classification	ML
Technician	Client	Plasticity Index	6		

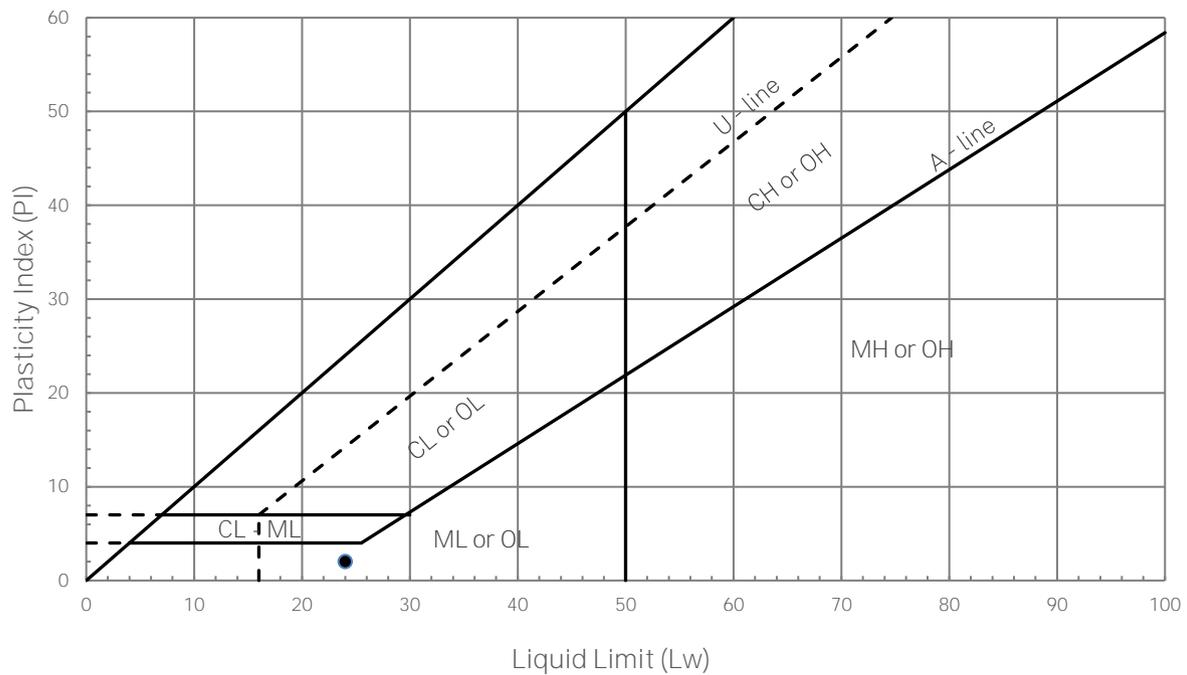


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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	24	Soil type	Sandy silty clay
Sample No	2015-BBH19-SH-S @ 5.0'	Plastic Limit	22	Classification	ML
Technician	Client	Plasticity Index	2		

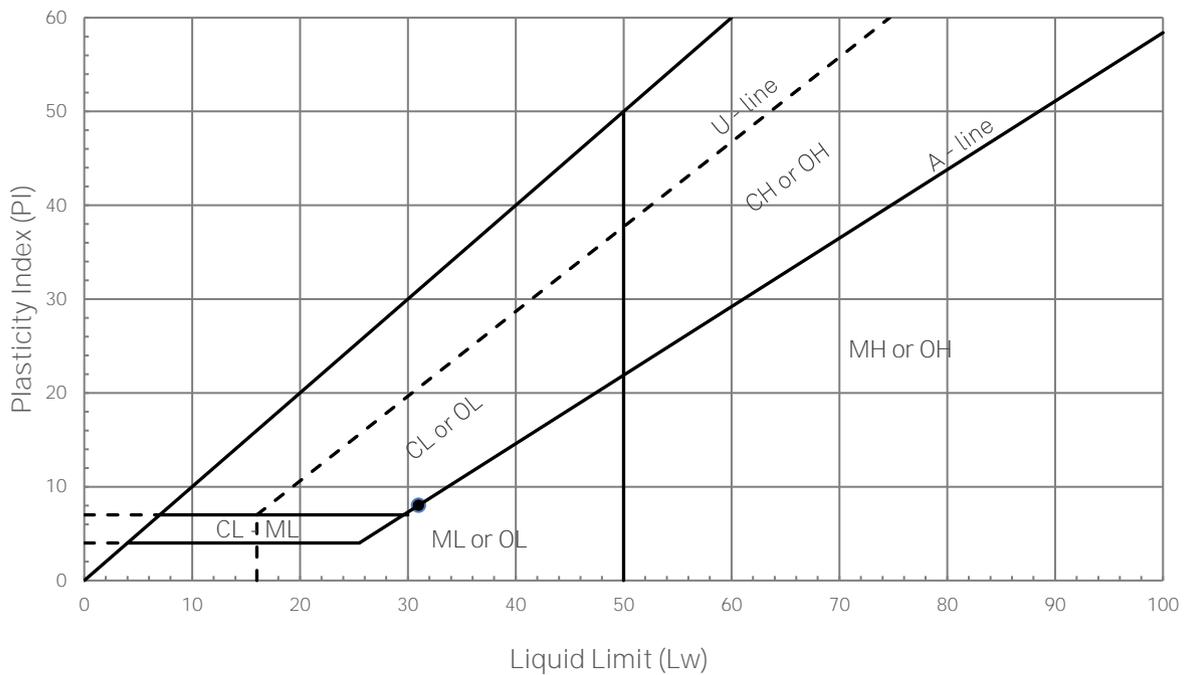


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Client	Barr Engineering Environmental Service Canada
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	12-Dec-15	Liquid Limit	31	Soil type	Silty clay
Sample No	2015-BBH18-N @ 5.0'	Plastic Limit	23	Classification	ML
Technician	Client	Plasticity Index	8		



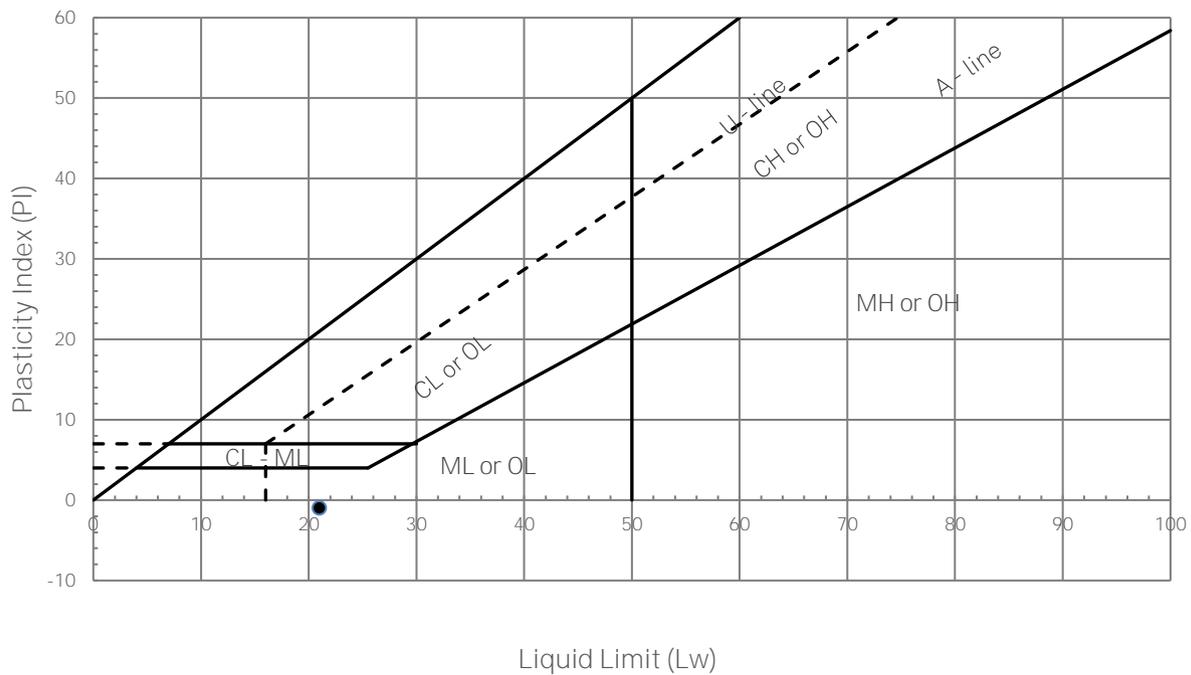
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	21	
Sample No	2015-BBH17-N @ 2.5'	Plastic Limit	22	Soil type
Technician	Client	Plasticity Index	-1	Classification
				ML



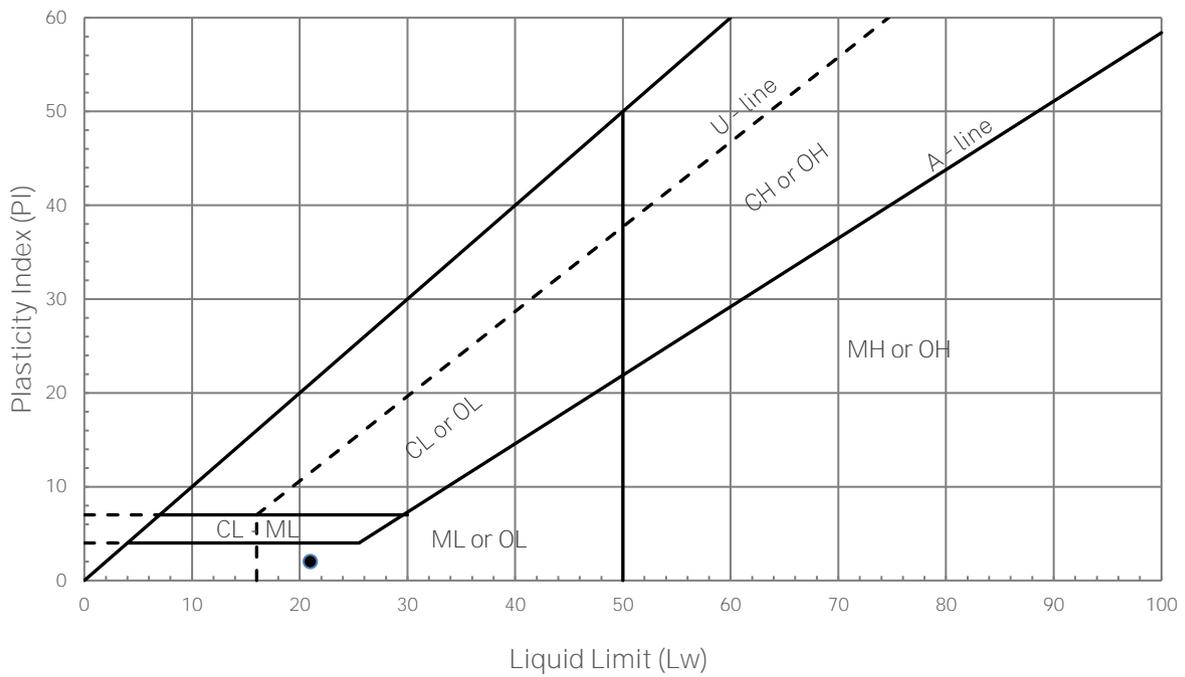
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	21	
Sample No	2015-BBH16-S @ 2.5'	Plastic Limit	19	Soil type
Technician	Client	Plasticity Index	2	Classification
				Sandy silty clay CL-ML



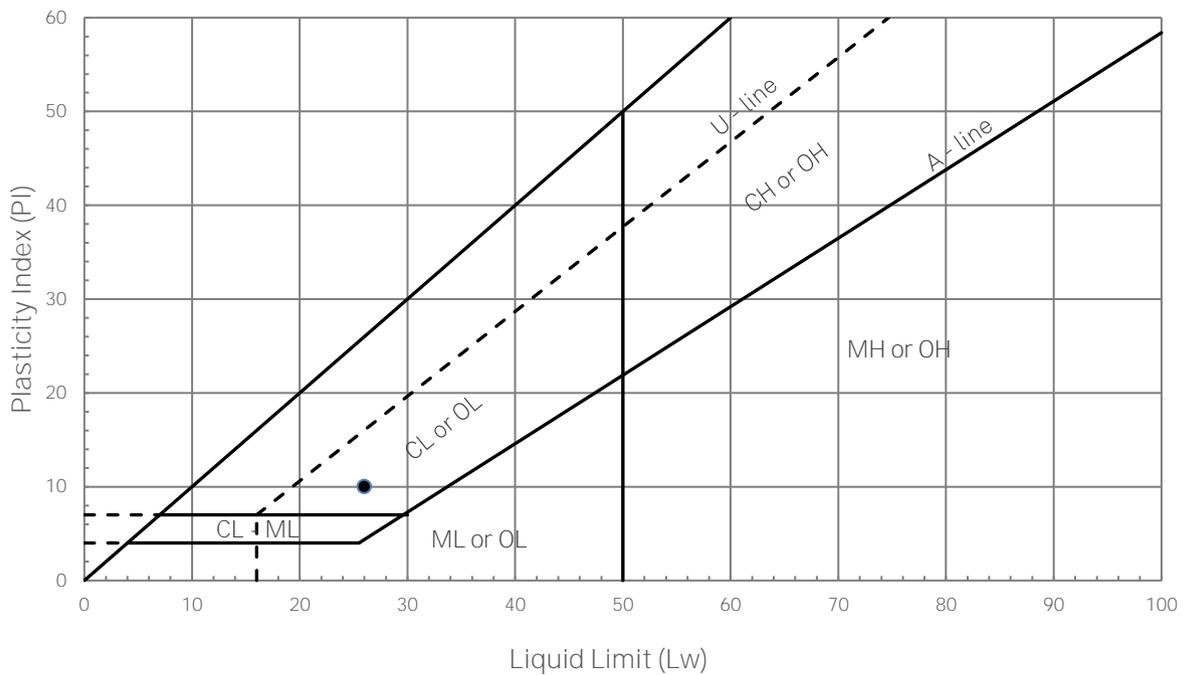
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	11-Dec-15	Liquid Limit	26	Soil type	Silty clay
Sample No	2015-BBH08-SH-N @ 0.0'	Plastic Limit	16	Classification	CL
Technician	Client	Plasticity Index	10		



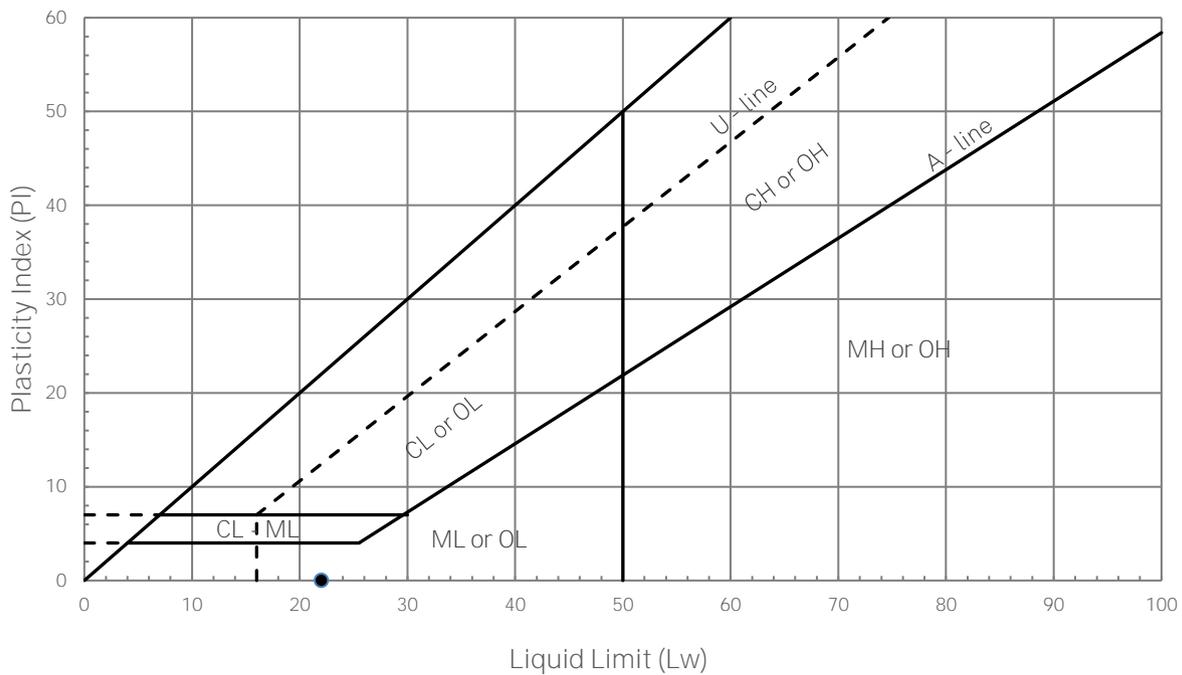
Clifton Associates

Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	11-Dec-15	Liquid Limit	22	Soil type	Sandy silty clay
Sample No	2015-BBH03-N @ 5.0'	Plastic Limit	22	Classification	ML
Technician	Client	Plasticity Index			



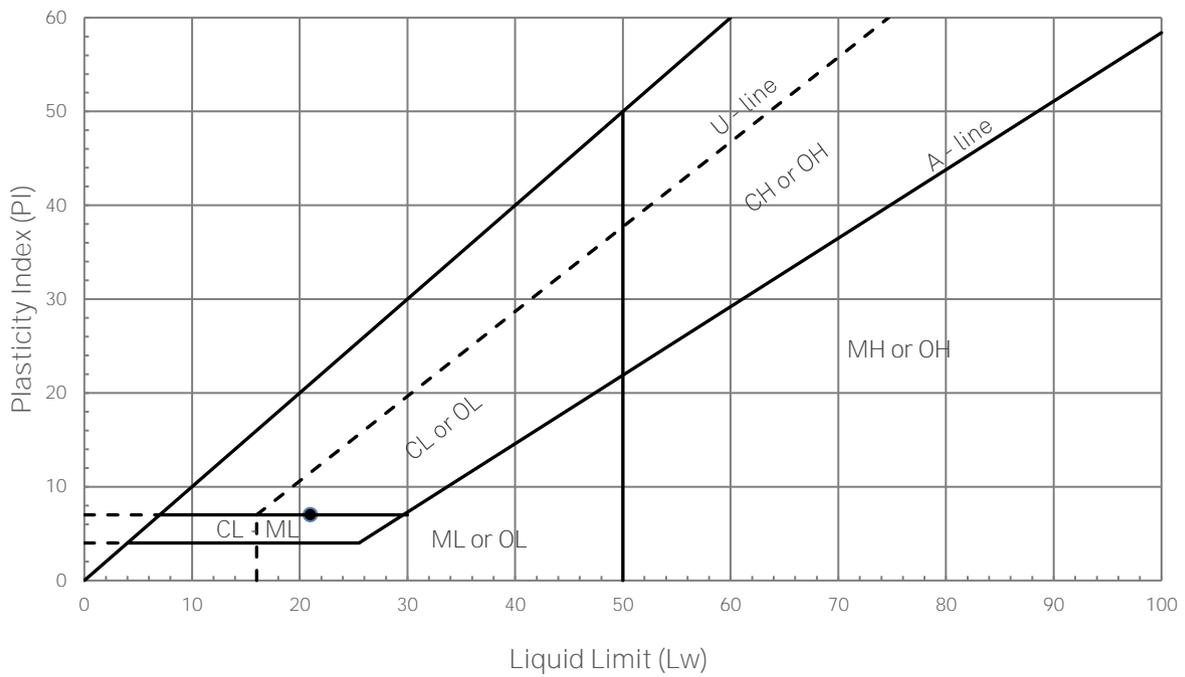
Clifton Associates

Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	10-Dec-15	Liquid Limit	21	
Sample No	2015-BBH01-S @ 7.5'	Plastic Limit	14	Soil type
Technician	Client	Plasticity Index	7	Classification
				CL-ML



Clifton Associates

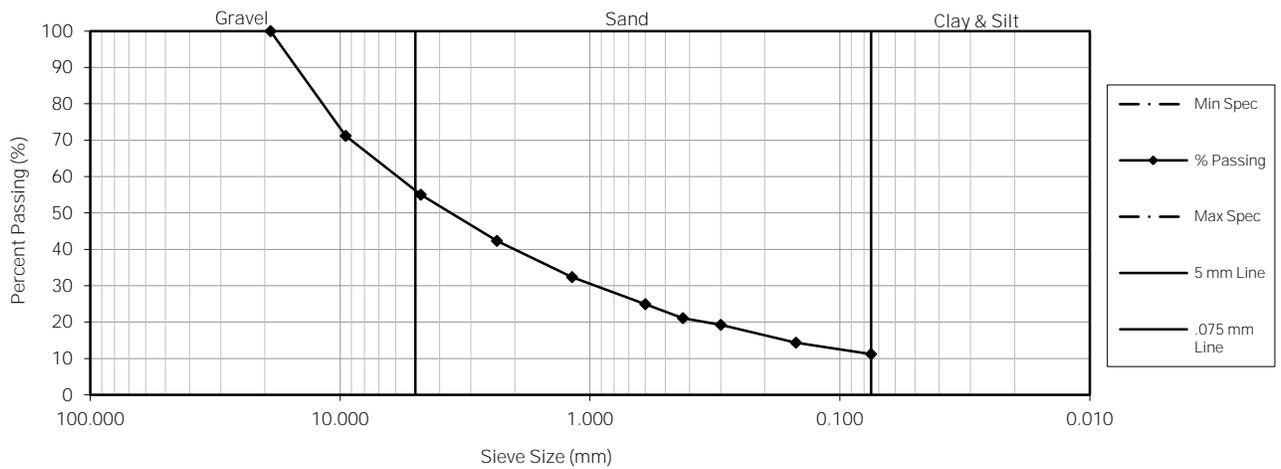
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Mechanical Sieve Analysis

Sample No.	45	Date Received	5 Jan 2016
Date Sampled	10 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH21-S @ 7.5'		

Moisture Content (%)	5.3	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	71.2			
4.750	55.0			
2.360	42.3			
1.180	32.3			
0.600	24.9			
0.425	21.1			
0.300	19.3			
0.150	14.3			
0.075	11.2			



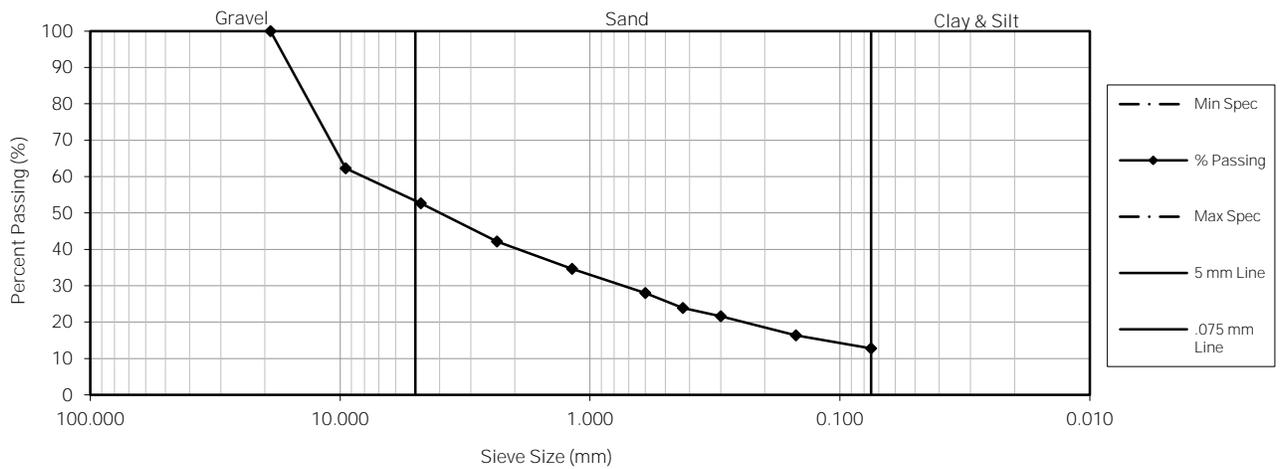
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Mechanical Sieve Analysis

Sample No.	28	Date Received	5 Jan 2016
Date Sampled	14 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH16-S @ 0.0'		

Moisture Content (%)	6.8	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	62.3			
4.750	52.6			
2.360	42.2			
1.180	34.6			
0.600	28.0			
0.425	23.9			
0.300	21.6			
0.150	16.4			
0.075	12.8			



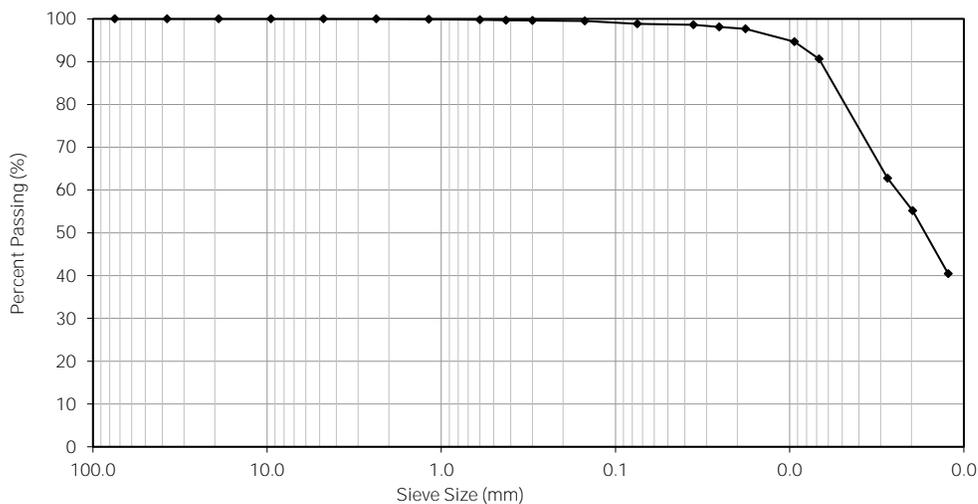
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	12-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Silty clay		
Sample Location	2015-BBH26-SH-S @ 15.0'		

Moisture Content	45.4	Hygroscopic Moisture Content	
Gravel	%	Silt	43.6 %
Sand	1.2 %	Clay	55.2 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	100.0			
4.750	100.0			
2.360	100.0			
1.180	99.9			
0.600	99.8			
0.425	99.7			
0.300	99.6			
0.150	99.5			
0.075	98.8			
0.036	98.6			
0.025	98.1			
0.018	97.6			
0.009	94.7			
0.007	90.7			
0.003	62.8			
0.002	55.2			
0.001	40.5			

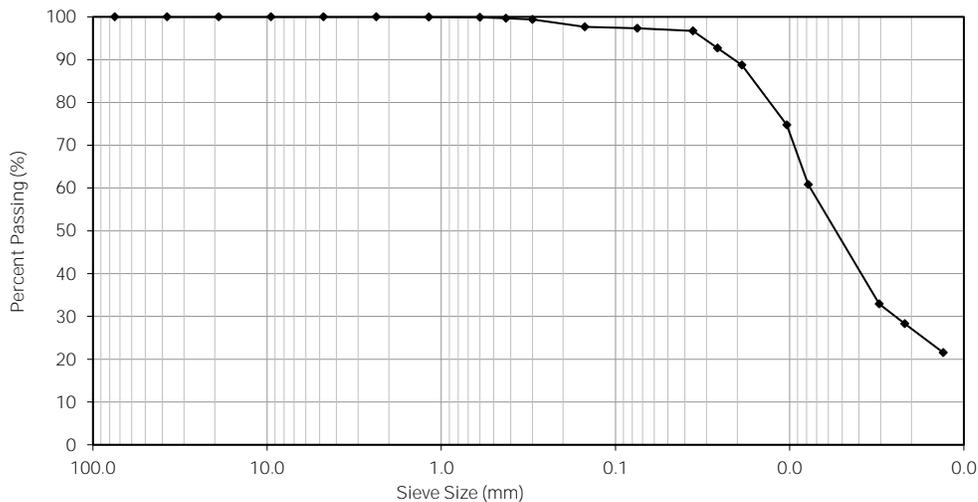


Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	14-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Sandy clayey silt		
Sample Location	2015-BBH20-S @ 5.0'		

Moisture Content	24.4	Hygroscopic Moisture Content	
Gravel	%	Silt	69.0 %
Sand	2.7 %	Clay	28.3 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	100.0			
4.750	100.0			
2.360	100.0			
1.180	100.0			
0.600	99.9			
0.425	99.7			
0.300	99.4			
0.150	97.7			
0.075	97.3			
0.036	96.7			
0.026	92.7			
0.019	88.7			
0.010	74.8			
0.008	60.8			
0.003	32.9			
0.002	28.3			
0.001	21.5			

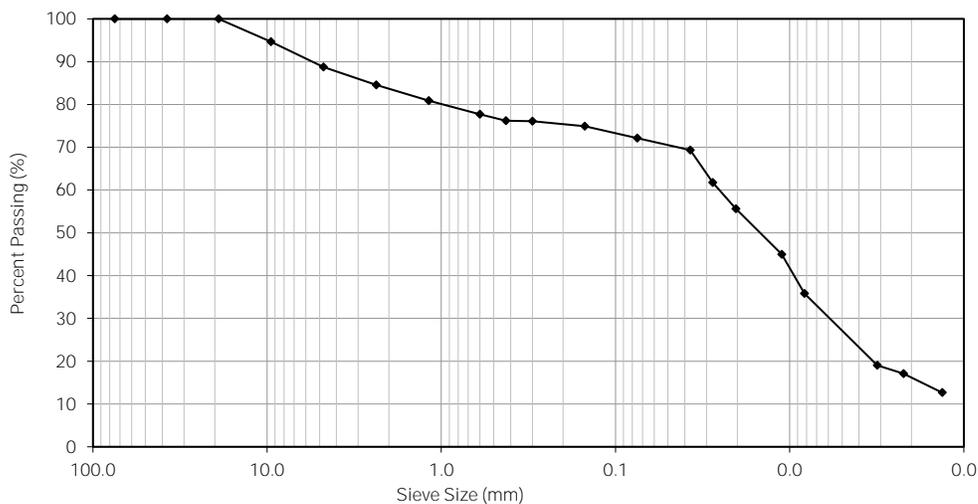


Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	14-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Gravelly sandy clayey silt		
Sample Location	2015-BBH19-SH-S @ 10.0'		

Moisture Content	14.7	Hygroscopic Moisture Content	
Gravel	11.3 %	Silt	55.1 %
Sand	16.6 %	Clay	17.1 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	94.6			
4.750	88.7			
2.360	84.5			
1.180	80.9			
0.600	77.7			
0.425	76.2			
0.300	76.1			
0.150	74.9			
0.075	72.1			
0.037	69.4			
0.028	61.7			
0.020	55.6			
0.011	45.0			
0.008	35.8			
0.003	19.1			
0.002	17.1			
0.001	12.7			

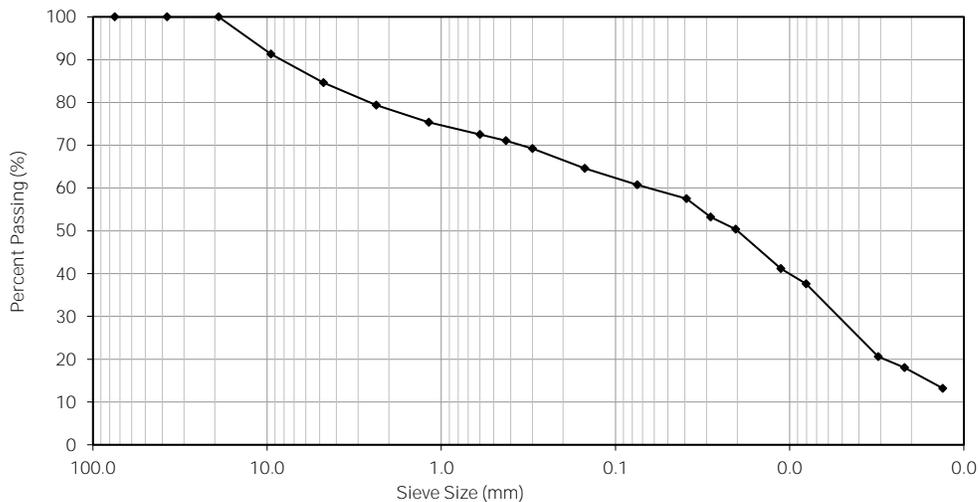


Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	14-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	
Sampled by	Client	Tested by	FG
Sample Description	Gravelly sandy clayey silt		
Sample Location	2015-BBH18-N @ 2.5'		

Moisture Content	13.6	Hygroscopic Moisture Content	
Gravel	15.4 %	Silt	42.7 %
Sand	23.9 %	Clay	18.0 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	91.3			
4.750	84.6			
2.360	79.4			
1.180	75.4			
0.600	72.5			
0.425	71.1			
0.300	69.2			
0.150	64.6			
0.075	60.7			
0.039	57.5			
0.028	53.2			
0.020	50.4			
0.011	41.2			
0.008	37.6			
0.003	20.6			
0.002	18.0			
0.001	13.2			

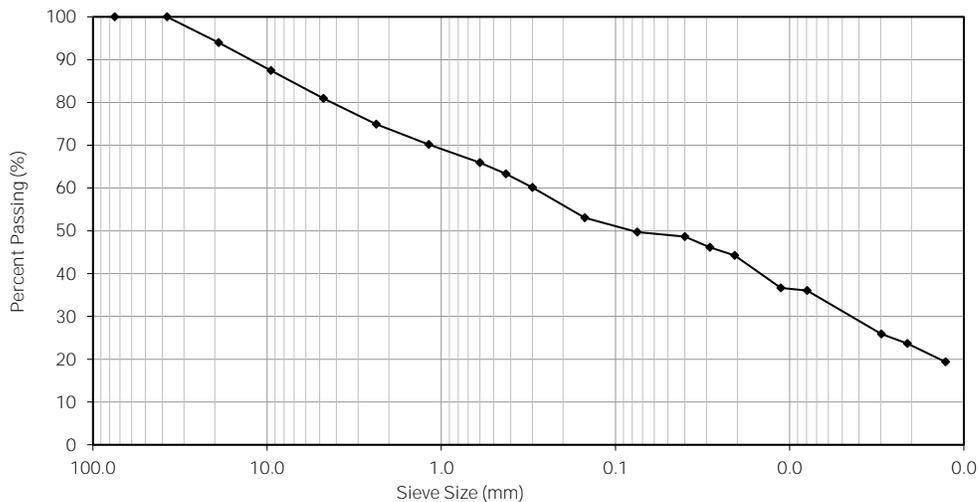


Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	11-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Gravelly sandy clayey silt		
Sample Location	2015-BBH08-SH-N @ 0.0'		

Moisture Content	13.5	Hygroscopic Moisture Content	
Gravel	19.1 %	Silt	26.1 %
Sand	31.2 %	Clay	23.6 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	94.0			
9.500	87.4			
4.750	80.9			
2.360	74.9			
1.180	70.2			
0.600	66.0			
0.425	63.3			
0.300	60.1			
0.150	53.1			
0.075	49.7			
0.040	48.7			
0.029	46.1			
0.021	44.3			
0.011	36.7			
0.008	36.0			
0.003	25.9			
0.002	23.6			
0.001	19.3			

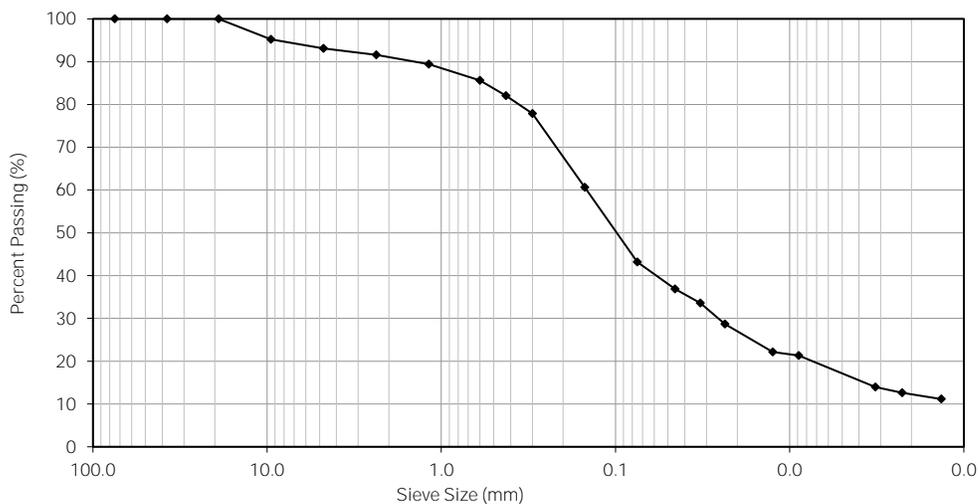


Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	11-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Gravelly silty sand		
Sample Location	2015-BBH03-N @ 5.0'		

Moisture Content	26.6	Hygroscopic Moisture Content	
Gravel	6.9 %	Silt	30.6 %
Sand	49.9 %	Clay	12.6 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	95.2			
4.750	93.1			
2.360	91.6			
1.180	89.4			
0.600	85.6			
0.425	82.1			
0.300	77.9			
0.150	60.6			
0.075	43.2			
0.046	36.9			
0.033	33.6			
0.024	28.7			
0.013	22.1			
0.009	21.3			
0.003	13.9			
0.002	12.6			
0.001	11.2			

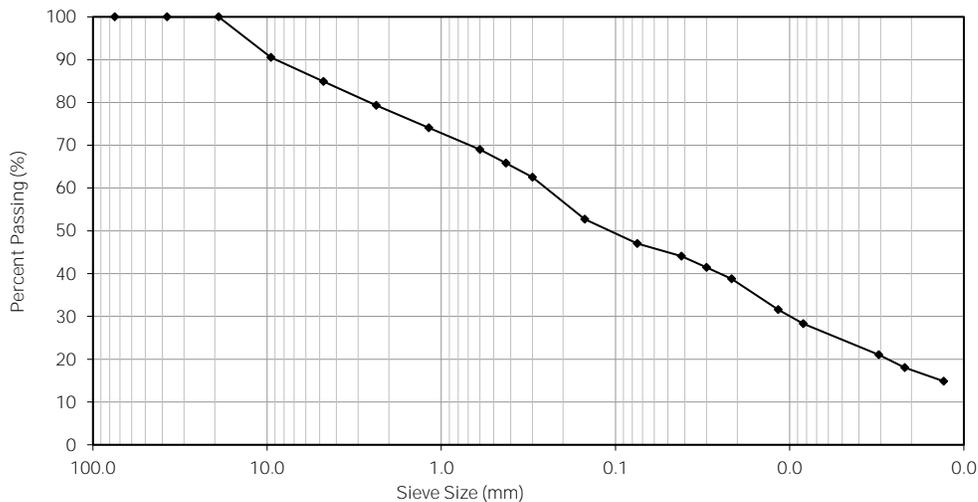


Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	10-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Gravelly sandy clayey silt		
Sample Location	2015-BBH01-S @ 7.5		

Moisture Content	10.1	Hygroscopic Moisture Content	
Gravel	15.1 %	Silt	29.0 %
Sand	37.9 %	Clay	18.0 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	90.5			
4.750	84.9			
2.360	79.3			
1.180	74.1			
0.600	69.0			
0.425	65.8			
0.300	62.5			
0.150	52.7			
0.075	47.0			
0.042	44.1			
0.030	41.4			
0.022	38.8			
0.012	31.6			
0.008	28.3			
0.003	21.0			
0.002	18.0			
0.001	14.9			

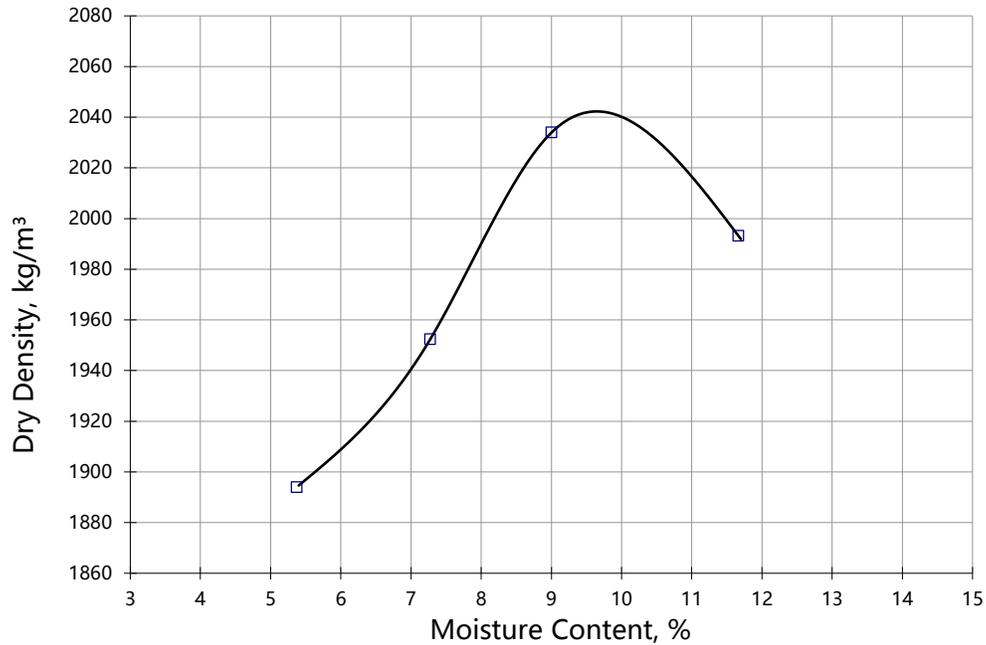


Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method B

Sample No.		Date Received	January 5, 2016
Date Sampled	December 15, 2015	Date Tested	January 6, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH40-SH-S		
Sample Description	Gravelly silty sand		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	2042	kg/m ³	Point 1	1894	@	5.4
Optimum Water Content	9.6	%	Point 2	1952	@	7.3
Rock Corrected Dry Density		kg/m ³	Point 3	2034	@	9.0
Rock Corrected Water Content		%	Point 4	1993	@	11.7
Water Content as Received		%	LL		PL	
Retained on 20mm Sieve		%	PI		USC	



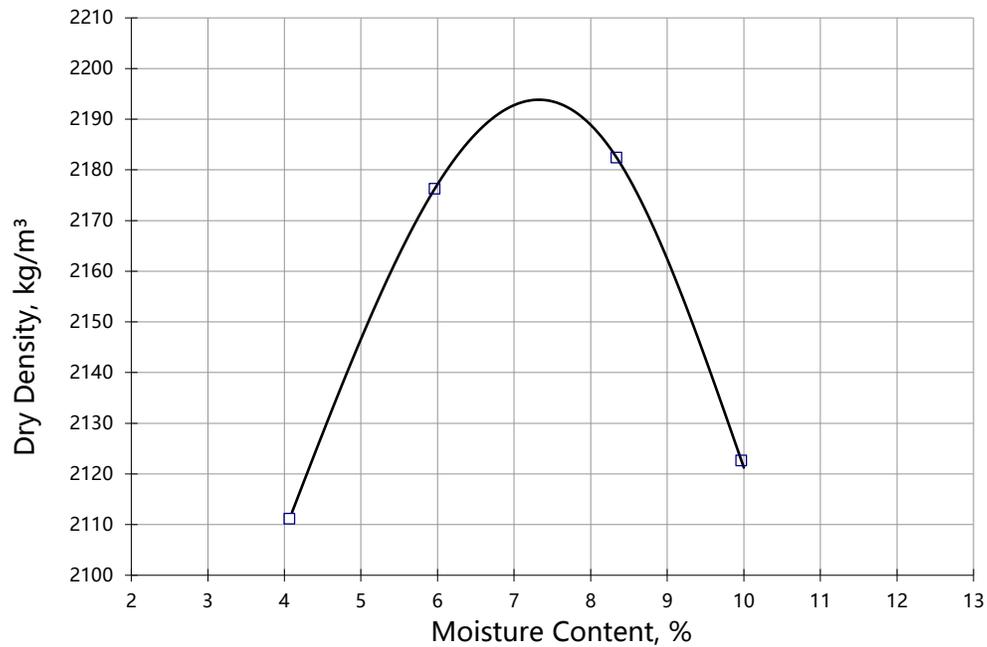
Project No. CG2738
 Client Barr Engineering Environmental Service Canada
 Project Barr - Lab Testing
 Location

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method B

Sample No.		Date Received	January 5, 2016
Date Sampled	December 15, 2015	Date Tested	January 10, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH38-SH-S		
Sample Description	Gravelly silty sand		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	2194	kg/m ³	Point 1	2111	@	4.1
Optimum Water Content	7.3	%	Point 2	2176	@	6.0
Rock Corrected Dry Density		kg/m ³	Point 3	2182	@	8.3
Rock Corrected Water Content		%	Point 4	2123	@	10.0
Water Content as Received		%	LL		PL	
Retained on 20mm Sieve		%	PI		USC	



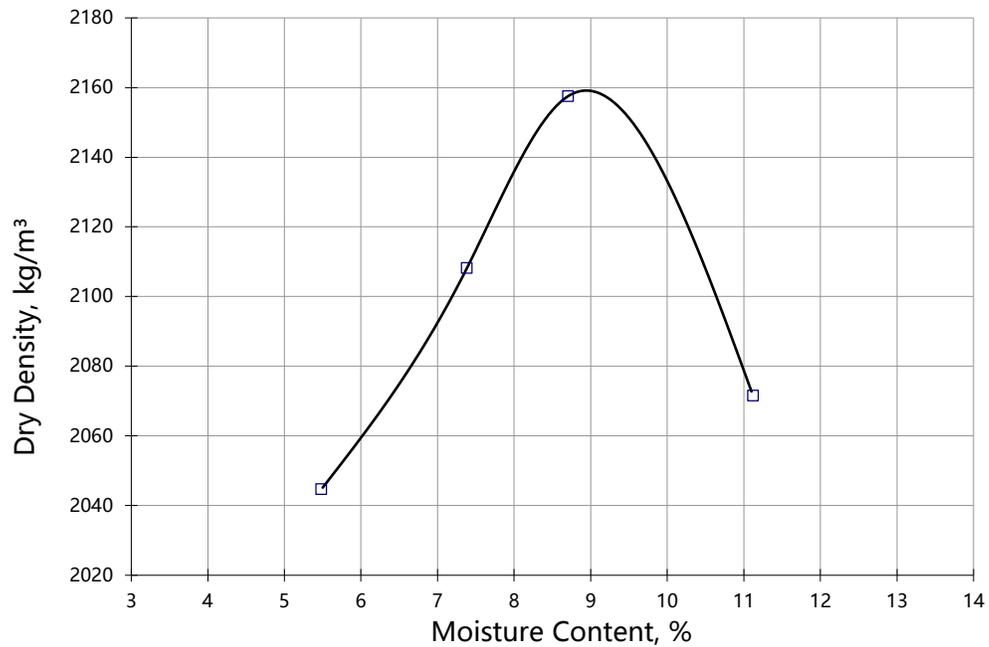
Project No. CG2738
 Client Barr Engineering Environmental Service Canada
 Project Barr - Lab Testing
 Location

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method B

Sample No.		Date Received	January 5, 2016
Date Sampled	December 11, 2015	Date Tested	January 7, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH24-SH-N		
Sample Description	Gravelly silty sand		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	2159	kg/m ³	Point 1	2045	@	5.5
Optimum Water Content	8.9	%	Point 2	2108	@	7.4
Rock Corrected Dry Density		kg/m ³	Point 3	2158	@	8.7
Rock Corrected Water Content		%	Point 4	2072	@	11.1
Water Content as Received		%	LL		PL	
Retained on 20mm Sieve		%	PI		USC	



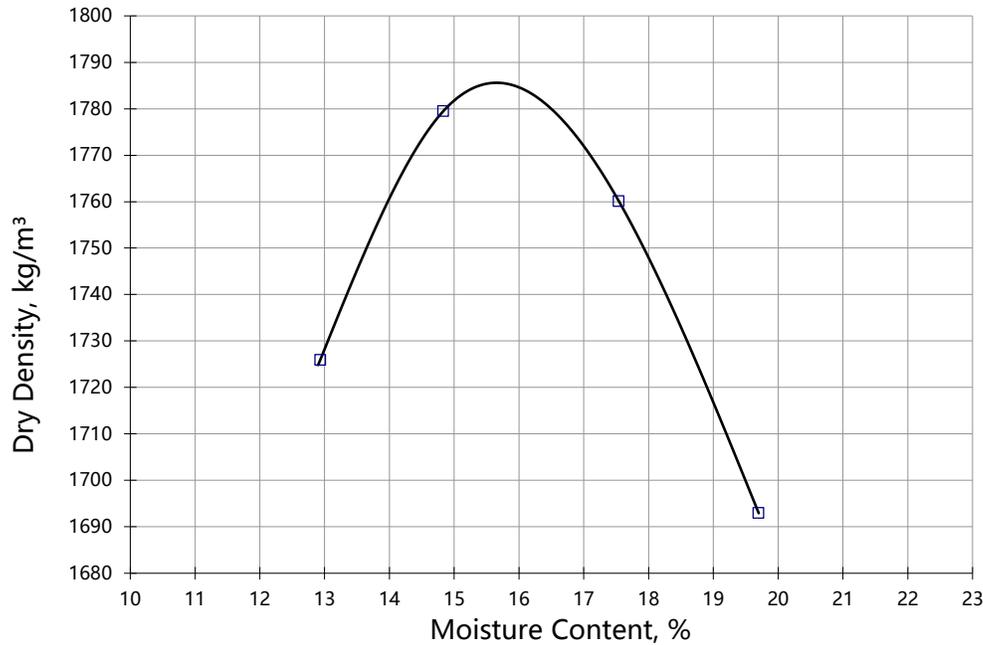
Project No. CG2738
 Client Barr Engineering Environmental Service
 Canada
 Project Barr - Lab Testing
 Location

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method A

Sample No.		Date Received	January 5, 2016
Date Sampled	December 14, 2015	Date Tested	January 6, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH17-N		
Sample Description	Clayey silt		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	1786	kg/m ³	Point 1	1726	@	12.9
Optimum Water Content	15.7	%	Point 2	1779	@	14.8
Rock Corrected Dry Density		kg/m ³	Point 3	1760	@	17.5
Rock Corrected Water Content		%	Point 4	1693	@	19.7
Water Content as Received		%	LL		PL	
Retained on 4.75mm Sieve		%	PI		USC	



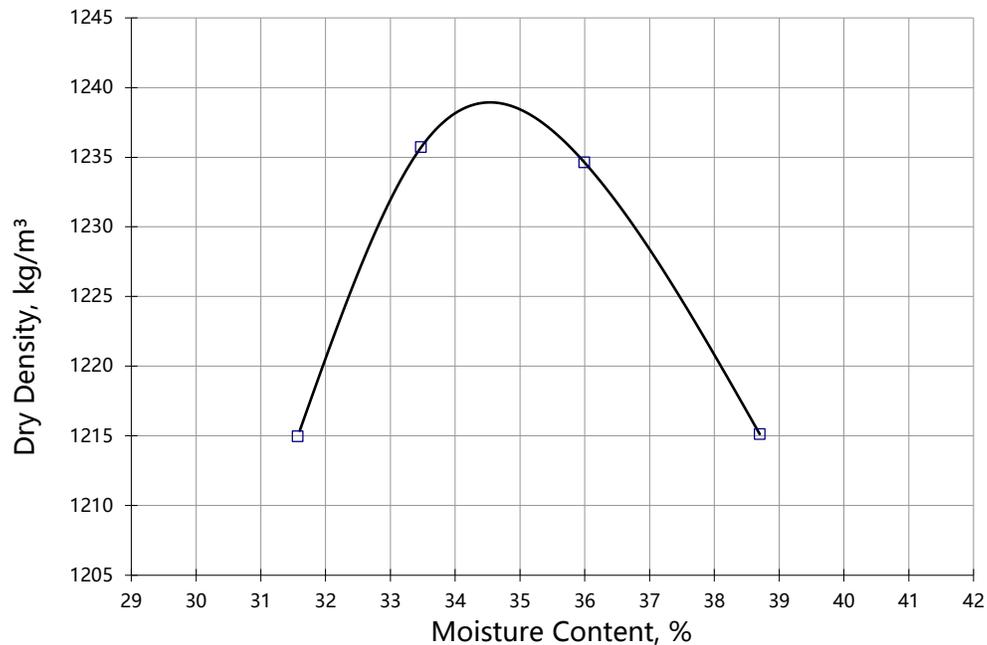
Project No. CG2738
 Client Barr Engineering Environmental Service
 Canada
 Project Barr - Lab Testing
 Location

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method A

Sample No.		Date Received	January 5, 2016
Date Sampled	December 11, 2015	Date Tested	January 6, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH03-N		
Sample Description	Organic loam		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	1239	kg/m ³	Point 1	1215	@	31.6
Optimum Water Content	34.5	%	Point 2	1236	@	33.5
Rock Corrected Dry Density		kg/m ³	Point 3	1235	@	36.0
Rock Corrected Water Content		%	Point 4	1215	@	38.7
Water Content as Received		%	LL		PL	
Retained on 4.75mm Sieve		%	PI		USC	



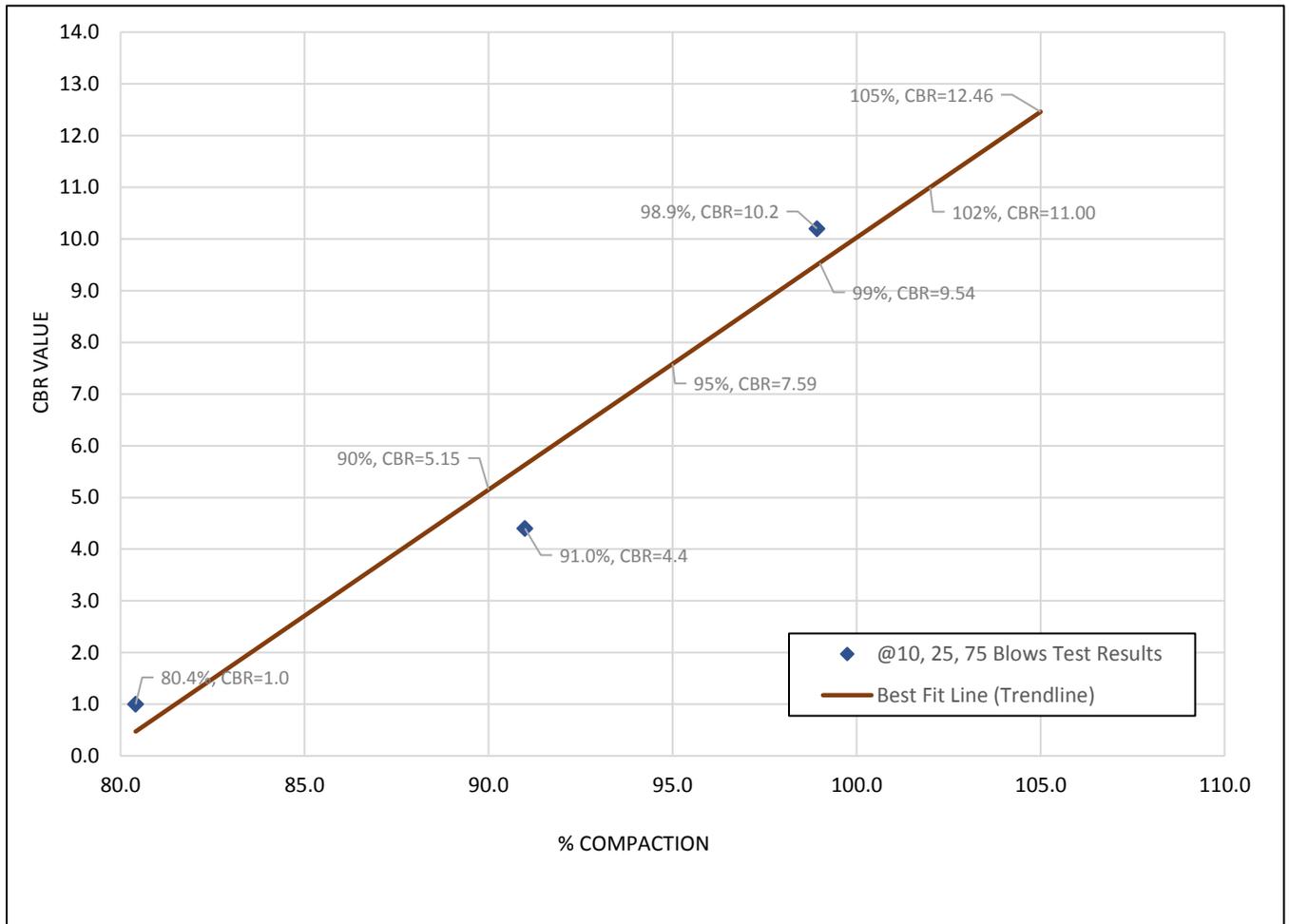
Project No. CG2738
 Client Barr Engineering Environmental Service Canada
 Project Barr - Lab Testing
 Location

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/15/2015	Date Tested	01/15/2016	Max. Dry Density (kg/m ³)	2042
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	9.6
Sample No.	118	Sample ID	2015-BBH40-SH-S		

% Compaction - CBR Value



Approved By _____



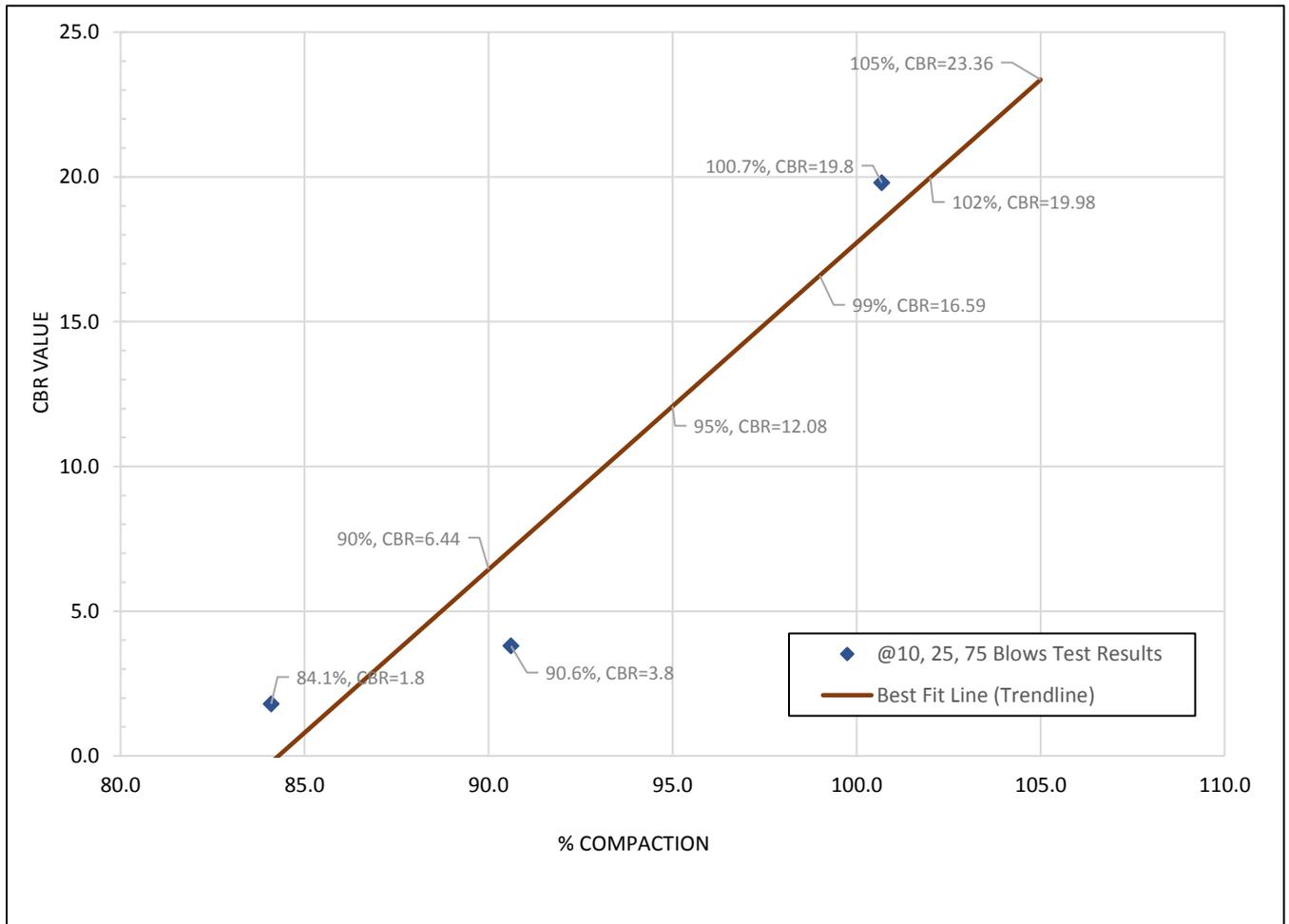
Project No. CG2738
Client Barr Engineering Environmental Service Canada
Project Barr - Lab Testing
Location _____

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/15/2015	Date Tested	01/20/2016	Max. Dry Density (kg/m ³)	2194
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	7.3
Sample No.	116	Sample ID	2015-BBH38-SH-S		

% Compaction - CBR Value



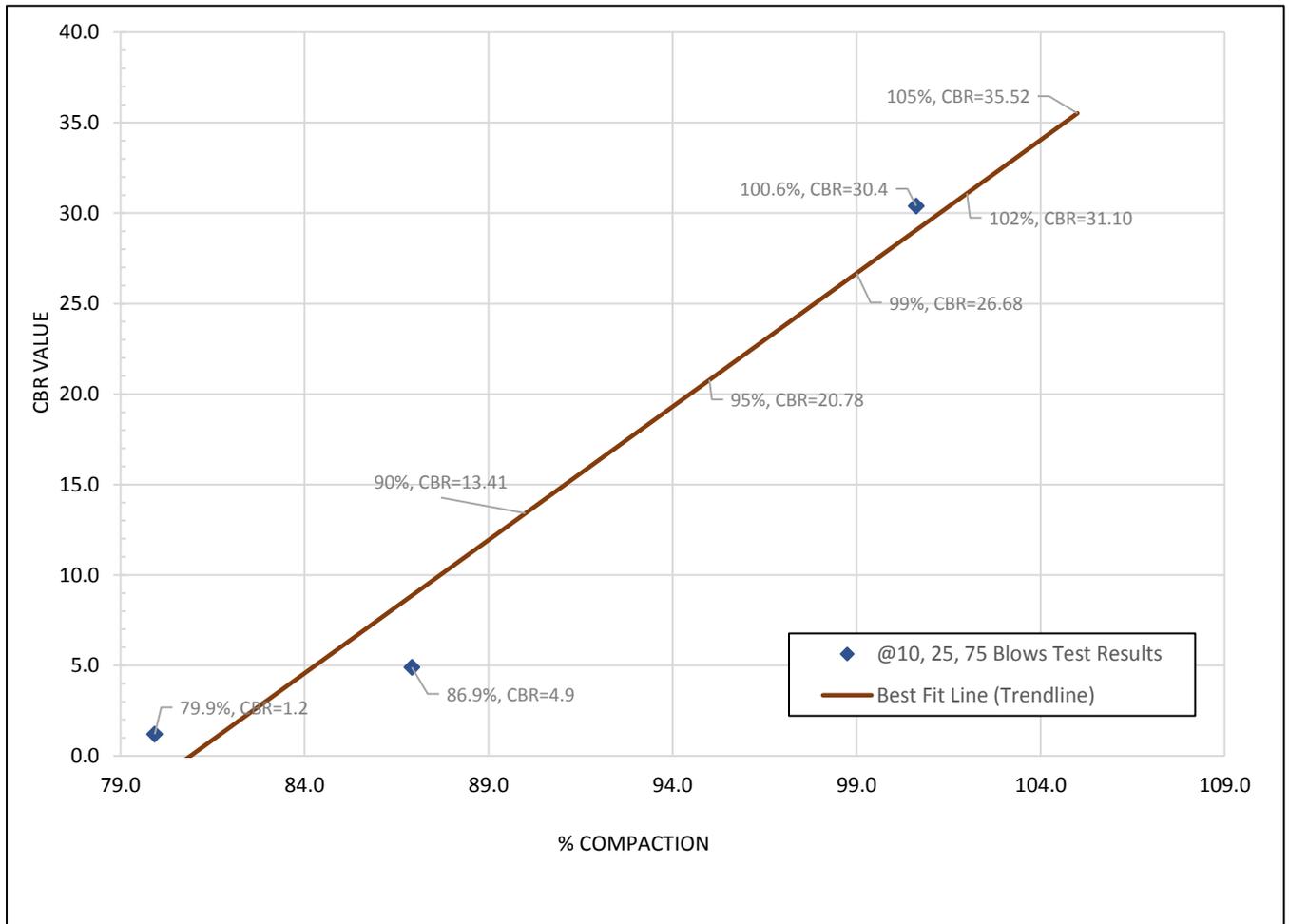
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/14/2015	Date Tested	01/20/2016	Max. Dry Density (kg/m ³)	2262
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	6
Sample No.	115	Sample ID	2015-BBH33-S		

% Compaction - CBR Value



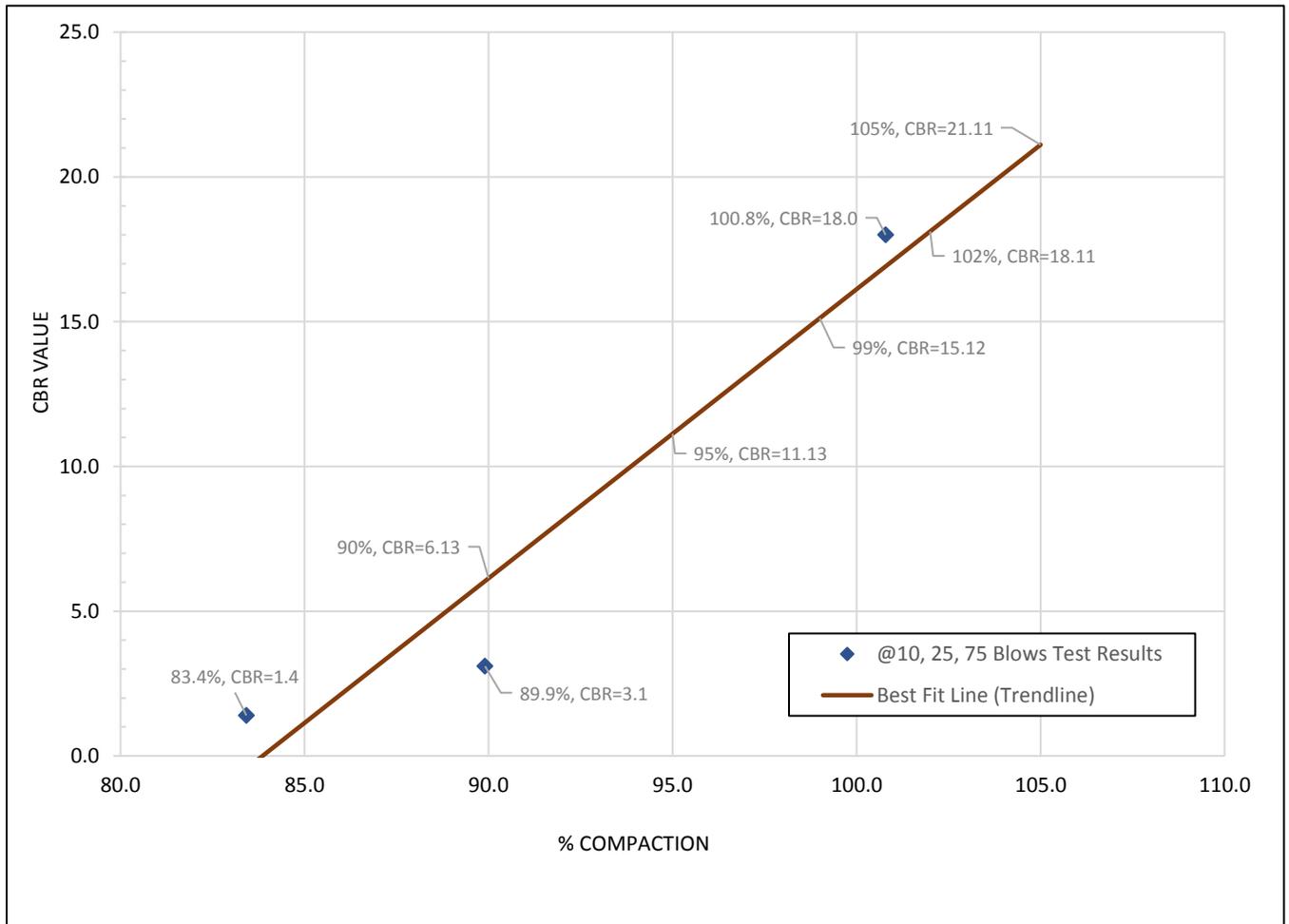
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/11/2015	Date Tested	01/20/2016	Max. Dry Density (kg/m ³)	2159
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	8.9
Sample No.	113	Sample ID	2015-BBH24-SH-N		

% Compaction - CBR Value



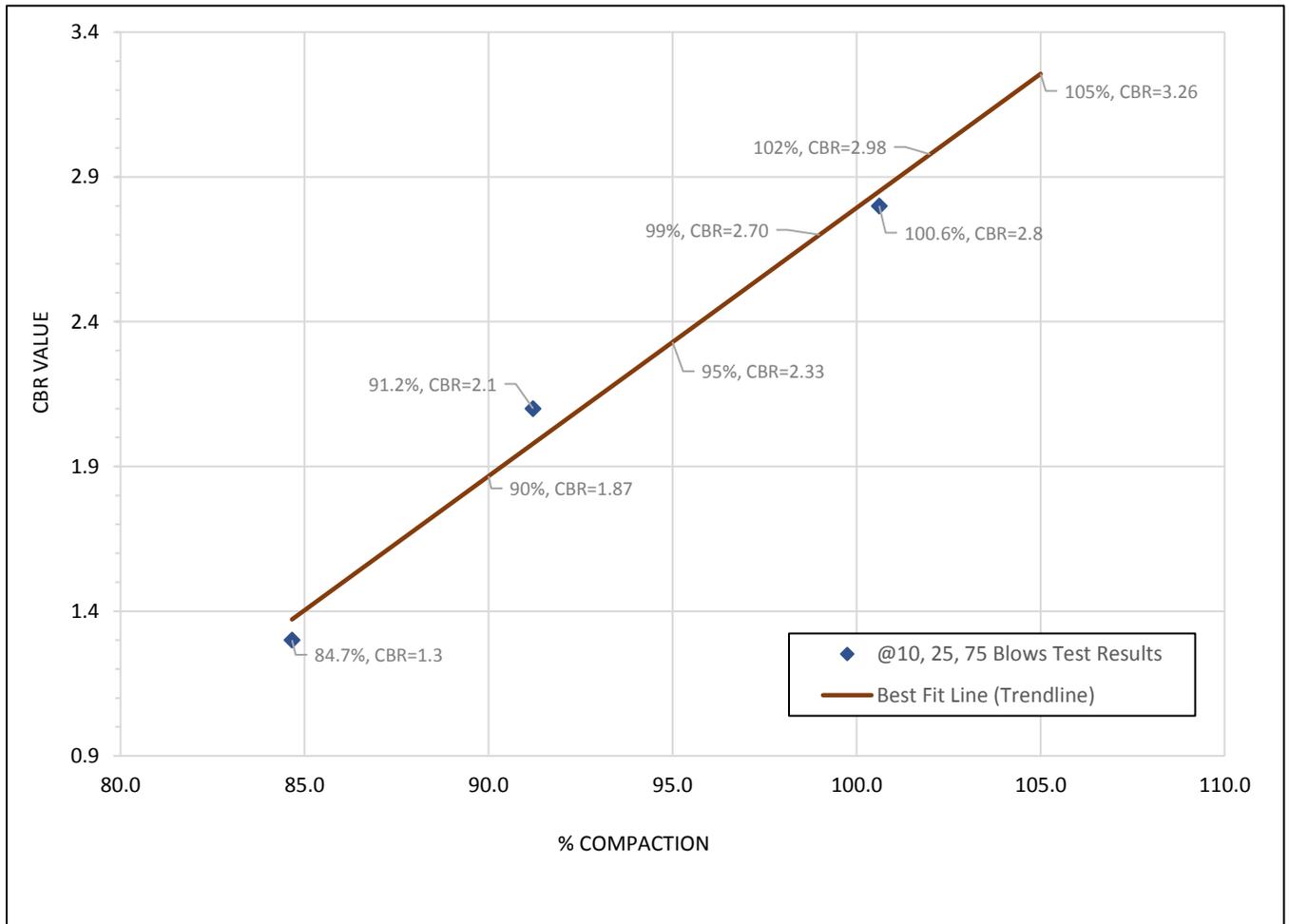
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/14/2015	Date Tested	01/15/2016	Max. Dry Density (kg/m ³)	1786
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	15.7
Sample No.	112	Sample ID	2015-BBH17-N		

% Compaction - CBR Value



Approved By _____



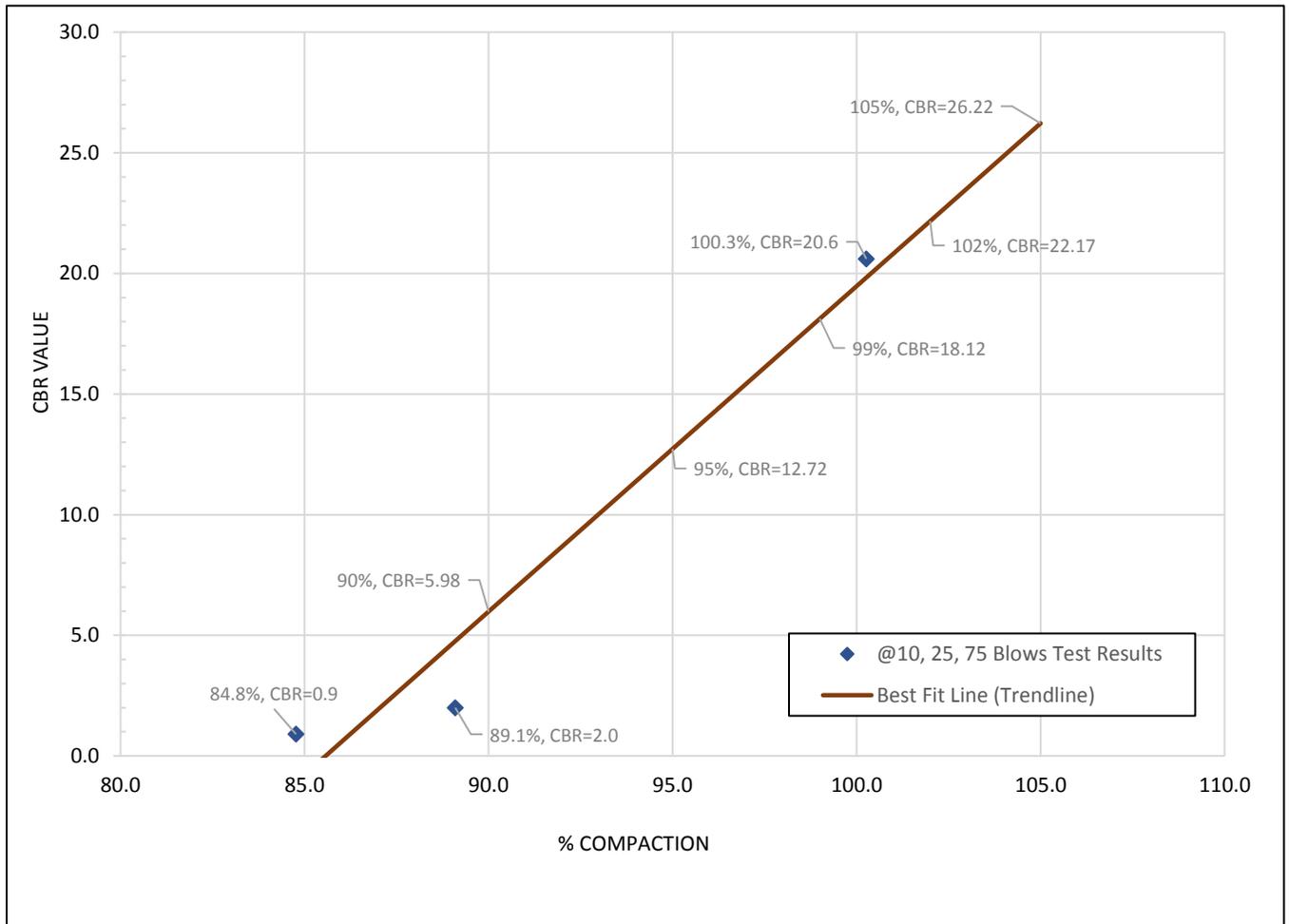
Project No. CG2738
Client Barr Engineering Environmental Service Canada
Project Barr - Lab Testing
Location _____

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/12/2015	Date Tested	01/20/2016	Max. Dry Density (kg/m ³)	2265
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	6.5
Sample No.	111	Sample ID	2015-BBH11-SH-S		

% Compaction - CBR Value



Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Organic Content Determination

Borehole No.			2015-BBH03-N		
Depth	ft		0		
Tare No.			# 5		
Weight of Tare (g)			54.02		
Wet Sample & Tare (g)			88.43		
Dry Sample & Tare (g)			84.82		
Weight of organic (g)			3.61		
Weight of Dry Sample (g)			30.80		
Organic Content (%)			11.7		
Borehole No.					
Depth	ft				
Tare No.					
Weight of Tare (g)					
Wet Sample & Tare (g)					
Dry Sample & Tare (g)					
Weight of organic (g)					
Weight of Dry Sample (g)					
Organic Content (%)					
Borehole No.					
Depth	ft				
Tare No.					
Weight of Tare (g)					
Wet Sample & Tare (g)					
Dry Sample & Tare (g)					
Weight of organic (g)					
Weight of Dry Sample (g)					
Organic Content (%)					
Borehole No.					
Depth	ft				
Tare No.					
Weight of Tare (g)					
Wet Sample & Tare (g)					
Dry Sample & Tare (g)					
Weight of organic (g)					
Weight of Dry Sample (g)					
Organic Content (%)					

Remarks



Clifton Associates

Project No CG2738

Client Barr Engineering Environmental
Service Canada

Project Barr - Lab Testing

Location

Tech FG

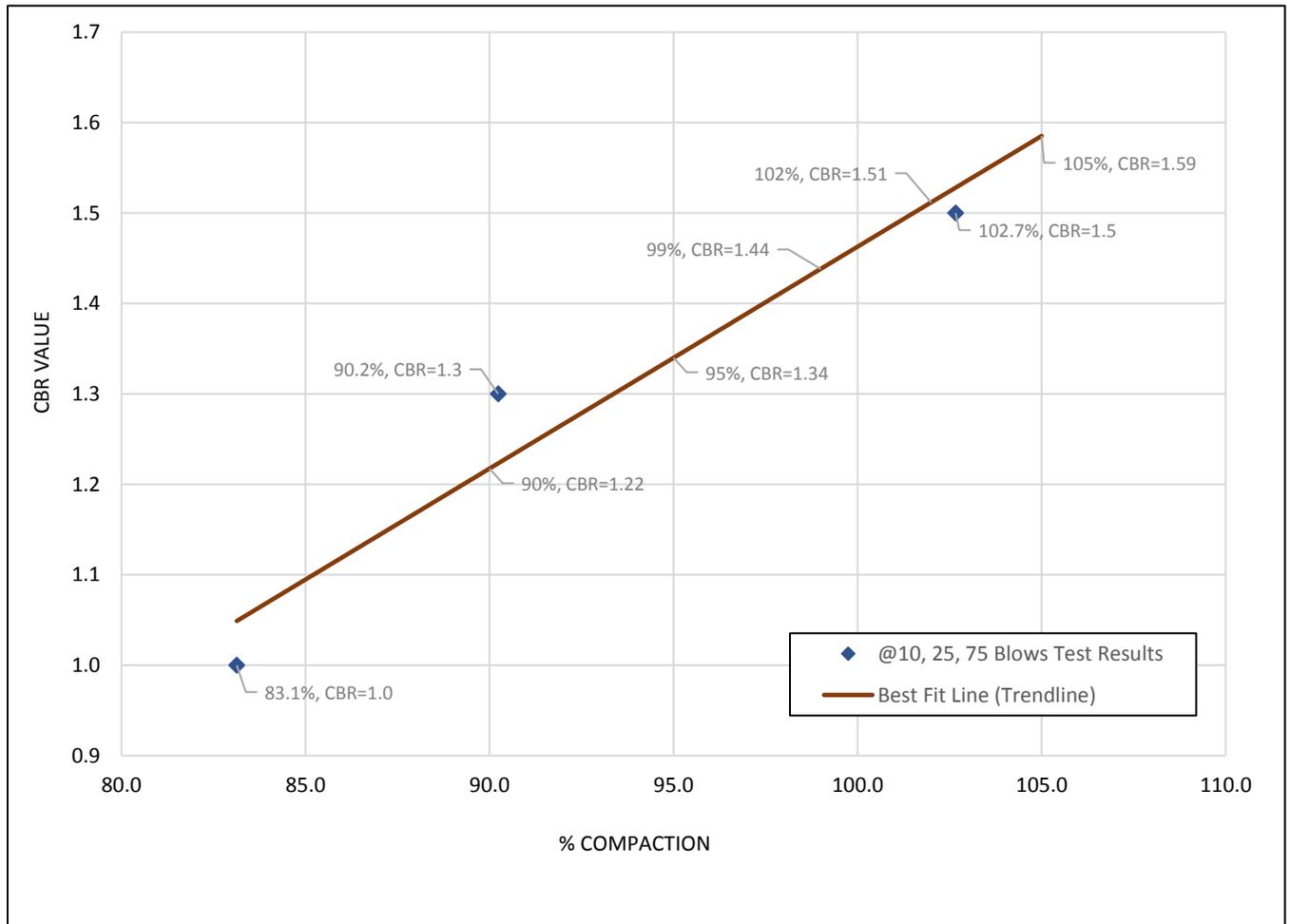
Sample Date 12/11/2015

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/11/2015	Date Tested	01/15/2016	Max. Dry Density (kg/m ³)	1239
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	34.5
Sample No.	109	Sample ID	2015-BBH03-N		

% Compaction - CBR Value



Approved By _____



Project No. CG2738
Client Barr Engineering Environmental Service Canada
Project Barr - Lab Testing
Location _____



Clifton Associates Ltd.
ATTN: Philip Chong
2222 30 Ave NE
Calgary AB T2E 7K9

Date Received: 08-JAN-16
Report Date: 18-JAN-16 08:12 (MT)
Version: FINAL

Client Phone: 403-263-2556

Certificate of Analysis

Lab Work Order #: L1721708
Project P.O. #: NOT SUBMITTED
Job Reference: CG2738
C of C Numbers:
Legal Site Desc:

Nelson Kwan, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1721708-1 BH1 @ 0.0 Sampled By: CLIENT on 08-JAN-16 Matrix: SOIL Miscellaneous Parameters							
% Saturation	44.0		1.0	%		14-JAN-16	R3370313
Chloride (Cl)	193		20	mg/L		16-JAN-16	R3372693
Sulfur (as SO4)	102		6.0	mg/L		14-JAN-16	R3371437
pH in Saturated Paste	7.83		0.10	pH		14-JAN-16	R3370313
Salinity in mg/kg							
Chloride (Cl)	84.8		8.8	mg/kg		16-JAN-16	
Sulfur (as SO4)	44.7		2.6	mg/kg		16-JAN-16	
L1721708-2 BH1 @ 2.0 Sampled By: CLIENT on 08-JAN-16 Matrix: SOIL Miscellaneous Parameters							
% Saturation	27.8		1.0	%		14-JAN-16	R3370313
Chloride (Cl)	234		20	mg/L		16-JAN-16	R3372693
Sulfur (as SO4)	45.8		6.0	mg/L		14-JAN-16	R3371437
pH in Saturated Paste	8.20		0.10	pH		14-JAN-16	R3370313
Salinity in mg/kg							
Chloride (Cl)	65.0		5.6	mg/kg		16-JAN-16	
Sulfur (as SO4)	12.7		1.7	mg/kg		16-JAN-16	

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-PASTE-COL-CL	Soil	Chloride in Soil (Paste) by Colorimetry	CSSS, APHA 4500-Cl E
A soil extract produced by the saturated paste extraction procedure is analyzed for Chloride by Colourimetry.			
PH-PASTE-CL	Soil	pH in Saturated Paste	CSSS 16.2
A soil extract produced by the saturated paste extraction procedure is analyzed by pH meter.			
SAL-MG/KG-CALC-CL	Soil	Salinity in mg/kg	Manual Calculation
SAT-PCNT-CL	Soil	% Saturation	CSSS 18.2-Calculation
SO4-PASTE-ICP-CL	Soil	Sulphate (SO4)	CSSS CH15/EPA 6010B
A soil extract produced by the saturated extraction procedure is analyzed for sulfate by ICPOES.			

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

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

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1721708

Report Date: 18-JAN-16

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Client: Clifton Associates Ltd.
 2222 30 Ave NE
 Calgary AB T2E 7K9
 Contact: Philip Chong

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-PASTE-COL-CL	Soil							
Batch	R3372693							
WG2245406-3	IRM	SAL-STD8						
Chloride (Cl)			88.5		%		70-130	16-JAN-16
WG2245406-1	MB							
Chloride (Cl)			<20		mg/L		20	16-JAN-16
PH-PASTE-CL	Soil							
Batch	R3370313							
WG2245406-3	IRM	SAL-STD8						
pH in Saturated Paste			7.39		pH		6.9-7.5	14-JAN-16
SAT-PCNT-CL	Soil							
Batch	R3370313							
WG2245406-3	IRM	SAL-STD8						
% Saturation			98.1		%		80-120	14-JAN-16
SO4-PASTE-ICP-CL	Soil							
Batch	R3371437							
WG2245406-3	IRM	SAL-STD8						
Sulfur (as SO4)			110.8		%		70-130	14-JAN-16
WG2245406-1	MB							
Sulfur (as SO4)			<6.0		mg/L		6	14-JAN-16

Quality Control Report

Workorder: L1721708

Report Date: 18-JAN-16

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Legend:

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

Hold Time Exceedances:

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

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

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

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



L1721708-COFC

Study / Analytical Request Form
 Toll Free: 1 800 668 9878
 www.alsglobal.com

COC # _____

Page 1 of 1

Report To		Distribution		Service Requested (Rush for routine analysis subject to availability)	
Company: Clifton Associates Ltd. (acct# 10137)	<input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other	<input checked="" type="checkbox"/> Regular (Standard Turnaround Times - Business Days)			
Contact: Philip Chong	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax	<input type="checkbox"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT			
Address: 2222 - 30 Avenue NE Calgary, AB T2E 7K9	Email 1: philip_chong@clifton.ca	<input type="checkbox"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT			
Phone: 403-263-2556 Fax:	Email 2:	<input type="checkbox"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT			
	Email 3:	Analysis Request			

Invoice To Same as Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Client / Project Information		Please indicate below Filtered, Preserved or both (F, P, F/P)								
Hardcopy of Invoice with Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Job #: CG2738											
Company: Clifton Associates Ltd. (vendor04@clifton.ca)	PO / AFE:			SAL-MG/KG-CALC-CL	SAT-PCNT-CL	SO4-PASTE-ICP-CL	Resistivity	Hydrometer	pH	Chloride	Organic	Number of Containers
Contact:	LSD:											
Address:												
Phone: Fax:	Quote #:											

Lab Work Order # (lab use only)	ALS Contact:	Sampler:
------------------------------------	--------------	----------

Item No.	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	SAL-MG/KG-CALC-CL	SAT-PCNT-CL	SO4-PASTE-ICP-CL	Resistivity	Hydrometer	pH	Chloride	Organic	Number of Containers
1	BH1 @ 0.0	08-Jan-16		Soil			X			X	X		
2	BH1 @ 2.0	08-Jan-16		Soil			X			X	X		
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)			SHIPMENT VERIFICATION (lab use only)				
Released by:	Date (dd-mmm-yy): 8-Jan-16	Time (hh-mm):	Received by:	Date: 8-JAN-16	Time: 17:05	Temperature: 8.3°C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF