PARKS CANADA AGENCY (PCA)

TRANS CANADA HIGHWAY (TCH) KM 81+300 TO 85+500 ANIMAL UNDERPASS STRUCTURES GEOTECHNICAL SERVICES

REPORT

AUGUST 2011
ISSUED FOR REVIEW
EBA FILE: V33101067

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1.0 INTRODUCTION

EBA, a Tetra Tech Company (EBA) was retained by Parks Canada Agency (PCA) to carry out a geotechnical investigation at three proposed animal underpass structures including one bridge and two pipe-arch structures between Km 81+300 and 85+500 on the Trans Canada Highway (TCH) in Yoho National Park, BC. The purpose of this investigation was to determine the subsurface conditions at the proposed animal underpass sites, and provide geotechnical design recommendations for the foundations of the proposed structures. Based on information provided by McElhanney Consulting Services (MCS), we understand that the proposed bridge will be located at Km 83+090 (identified as Wildlife Structure #1), and the proposed pipe-arch structures will be located at Km. 84+920 and 82+260 (identified as Wildlife Structures #2 and 3).

This report provides the factual results of our geotechnical investigation and our geotechnical recommendations with respect to site preparation and foundation design for the proposed animal underpass structures.

The scope of this report is limited solely to the geotechnical aspects of the project.

2.0 SCOPE OF SERVICES

The scope of work for this project was described in EBA's proposal dated May 3, 2011 and includes:

- Site investigation and laboratory testing to determine soil conditions at the proposed animal underpasses;
- Provide recommendations for the bridge footing design parameters;
- Provide recommendations on spread footing foundations for the bridge including bearing capacity, sliding, settlement, ground preparation and geotechnical construction considerations;
- Provide recommendations on the bridge abutment backfill including lateral earth pressure coefficients, friction angle, unit weight and geotechnical construction considerations; and
- Provide geotechnical recommendation for the pipe-arch foundation design and geotechnical construction considerations.

3.0 PROJECT UNDERSTANDING

Drawings were provided by MCS which show the approximate footprints of the three animal underpass structures, preliminary design drawings for the crossing at Sta. 82+260 and a typical section for the proposed bridge. These drawings are included in Appendix B. The following sections outline EBA's understanding of the animal underpass structures based on these drawings.

3.1 Animal Underpass Bridge at Km 83+090 (Wildlife Structure #1)

The MCS drawings indicate that a new bridge will be constructed at Km 83+090. Based on the bridge cross section provided, the east and west bridge abutments are to be supported on strip footings. The strip footings are to be about 5.5 m wide, with an approximately 2 m high by 0.6 m wide reinforced concrete shear key.

The proposed abutment walls are 5 m high. Compacted granular structural fill will be placed at a 1H:1V slope behind the abutment walls from the inside edge of the strip footings. Compacted common fill will then be placed outside this zone. The final TCH grade will be raised by about 0.4 m at the bridge location.

3.2 Animal Underpass at Km 84+920 (Wildlife Structure #2)

The MCS drawings indicate that a new pipe-arch underpass will be constructed at Km. 84+920. EBA has not been provided with detailed information on this crossing structure such as length, invert elevation or typical cross sections; however we understand that it has a similar geometry to the typical cross section provided for the pipe-arch at Km 82+260 (Section 3.3).

Based on the road profile along the TCH (Appendix B) at the proposed underpass location, about 0.6 m of fill is proposed along the existing TCH to raise the grade at the center of the crossing to a final grade of El. 1607 m.

3.3 Animal Underpass at Km 82+260 (Wildlife Structure #3)

The MCS drawings indicate that a new pipe-arch will be constructed at Km 82+260. Based on the cross section provided, we understand that the crossing will be a 7.04 m wide by 4.06 m high corrugated steel plate pipe-arch. The bottom of the pipe-arch will be at about El. 1638.8 m at the north end, with a slope of 0.5% to the south. The total length of the steel pipe-arch is about 50.5 m. The pipe-arch will have up to 2 m of cover. It is understood that the existing TCH will be widened and raised with up to 2 m of fill placement. Since, the existing crossing is below the existing ditch elevation, cut slopes at 2H:1V will be developed for animal access, with a height of approximately 15.5 m to the north and 1 m to the south.

4.0 SITE INVESTIGATION

EBA conducted a geotechnical site investigation in order to assess the subsurface soil and groundwater conditions at the proposed animal underpass locations.

4.1 Field Investigation

The geotechnical field investigation was completed from June 13 to 16, 2011. Drilling was carried out using a truck mounted Becker Hammer (HAV 180 hammer) drill rig with a 170 mm outside diameter casing, supplied and operated by Beck Drilling and Environmental Services Ltd. from Calgary, Alberta. A total of seven (7) Becker open holes, and five (5) Becker closed holes were advanced at selected locations in the footprints of the proposed animal underpass structures. Where both open and closed holes were at the same location, they were drilled approximately 1 m apart. The open holes were carried out to obtain samples of the soils at various depths. The closed holes were used to measure the penetration resistance of the soils. Becker Hammer drilling was selected as it is able to penetrate course gravely and cobbley soils

which are typical of this area. Crossroads Traffic Control from Golden, BC provided traffic control during the field investigation.

Borehole locations were determined based on the drawings provided by MCS which show the proposed structures footprints (Appendix B). Boreholes were advanced on the shoulder or outer lane of the TCH on each side of the proposed crossings. Figures 2 through 4 show the drilled borehole locations which were surveyed by MCS.

Standard Penetration Tests (SPTs) were performed at the proposed bridge location in two Becker open holes (BH2011-03 and BH2011-04) using an automatic trip hammer. SPT testing was limited due to the gravel and cobbles that were encountered, which obstruct the SPT sampler.

Upon completion of the drilling, all boreholes were backfilled with bentonite chips to approximately 1.5 m depth below the existing ground level, followed by approximately 1 m of sand, a 0.3 m concrete plug and an asphalt patch.

EBA's field engineer provided full-time supervision of the drilling which included logging and sampling of the soils, recording the Becker hammer blows per foot for closed ended drill casing and recording SPT data. Details of the subsurface soil and groundwater conditions are presented in the borehole logs in Appendix C.

4.2 Laboratory Testing

Selected soil samples collected from the drilling were brought to EBA's laboratory for further examination, classification and index testing. Lab tests including moisture contents, grain size analyses and a hydrometer were performed on selected samples from the boreholes. Moisture content and hydrometer results presented on the borehole logs in Appendix C, and grain size distribution results are summarized in Appendix D.

5.0 SOIL AND GROUNDWATER CONDITIONS

5.1 EBA 2010 Preliminary Geotechnical/Pavement Assessment Work

EBA undertook a previous geotechnical investigation on the TCH between Km 82+000 and 88+000 in October 2010 to obtain shallow soil conditions and pavement thickness information using test pits and auger drilling. Information on soil conditions from this investigation are summarized in EBA's previous report entitled "Geotechnical and Pavement Assessment, Trans Canada Highway Twinning Project, Alberta and British Columbia, Canada" (2010). The test pit and borehole information from this study in the vicinity of the proposed animal underpasses show that soil conditions consist of sand and gravel mixtures with variable amounts of cobbles and boulders. Layers of silt and clayey silt up to 0.5 m thick were encountered at two locations near the proposed underpasses. However, these layers were in the upper 1.5 m of the soil profile, therefore they will likely be removed prior to construction of the structures and will not influence the design.

5.2 Interpreted Soil Profile and Groundwater

5.2.1 Animal Underpass Bridge at Km 83+090 (Wildlife Structure #1)

Boreholes BH2011-03 and BH2011-04 were drilled by EBA in 2011 near the east and west abutments of the proposed bridge at Km 84+920. Borehole BH2011-03 is located near the west abutment on the south side of the existing TCH eastbound lane, and borehole BH2011-04 is located near the east abutment on the north side of the existing TCH westbound lane. Borehole locations are shown in Figure 3.

The ground conditions encountered at the west abutment of the proposed bridge consisted of gravelly sand to a depth of about 0.6 m below existing ground, overlying sand and gravel to a depth of about 4.6 m, overlying compact to dense gravelly sand with cobbles to a depth of about 8.2 m, overlying sandy gravel with cobbles to the depth of termination of borehole BH2011-03 at 10.1 m. Groundwater was not encountered at BH2011-03 during the field investigation.

The ground conditions encountered in the east abutment of the proposed bridge consisted of 140 mm of asphalt overlying loose to compact gravelly sand to a depth of about 4 m below existing grade, overlying compact medium to coarse sand, some gravel to a depth of about 4.9 m, overlying compact coarse sand with cobbles to a depth of about 6.7 m, overlying compact to dense gravelly sand, some silt with lenses of brown silty clay to the depth of termination of the Becker open hole BH2011-04 at 8.3 m. The closed Becker hole BH2011-04 penetrated to a depth of refusal at 10.1 m. Becker penetration rates of 7 to 21 blows per 0.3 m at depths between 8 m and 8.9 m depth are considered to be loose to compact. However, based on the soil conditions encountered at the bottom of the open hole BH2011-04, this layer is likely to be weathered till-like material or rock.

Moisture contents of the soils encountered at this location ranged from 1.4% to 5.9%. Groundwater was encountered at about 9.8 m below existing grade in BH2011-04.

5.2.2 Animal Underpass at Km 84+920 (Wildlife Structure #2)

Boreholes BH2011-01 and BH2011-02 were drilled by EBA in 2011 in the vicinity of the proposed animal underpass at Km 84+920. Borehole BH2011-01 is located on the south side of the existing TCH eastbound lane, and borehole BH2011-02 is located on the north side of the existing TCH westbound lane. Borehole locations are shown in Figure 4.

The ground conditions encountered in the south side of the proposed pipe-arch (refer to BH2011-01) consisted of 150 mm of asphalt overlying compact gravel and sand, some silt to a depth of about 1.5 m below existing grade, overlying dense to very dense sand, some silt, some gravel with cobbles to a depth of about 7 m, overlying loose to dense gravelly sand to a depth of about 8.3 m, overlying very dense sandy gravel to a depth of about 9.1 m, overlying dense to very dense silty sand and gravel to a depth of about 12.2 m, overlying dense to very dense sand to the depth of termination of 15 m. Moisture contents of the soils encountered in borehole BH2011-01 ranged from 3% to 12%, with increasing moisture content with depth.

The ground conditions encountered in the north side of the proposed pipe-arch also consisted of 150 mm of asphalt overlying sand and gravel, some silt with cobbles to a depth of about 6.4 m below existing grade, overlying silt and sand to a depth of about 8.2 m, overlying sand with cobbles to a depth of about 11.9 m,

overlying sand with thin lenses of silt to a depth of about 12.8 m, overlying sand and silt (Till-like) to the depth of termination at 13.4 m.

Moisture contents of the soils encountered in borehole BH2011-02 ranged from 5% to 13%, and exhibit increasing moisture content with depth. Groundwater was not observed in either borehole.

5.2.3 Animal Underpass at Km 82+260 (Wildlife Structure #3)

Boreholes BH2011-05, BH2011-06 and BH2011-07 were drilled by EBA in 2011 in the vicinity of the proposed animal underpass at Km. 82+260. Borehole BH2011-05 is located on the north side of the existing TCH westbound lane, and boreholes BH2011-06 and BH2011-07 are located on the south side of the existing TCH eastbound lane. Borehole locations are shown in Figure 2.

The ground conditions encountered at the north side of the proposed underpass consisted of 160 mm of asphalt overlying dense sand and gravel to gravelly sand, becoming compact at 2 m, becoming very dense from 2.7 m to the termination depth of 3.9 m. Cobbles are inferred to be present within the native soil deposits. Two boreholes (BH2011-06 and BH2011-07) were drilled on the south side of the proposed underpass at Km 82+260. The ground conditions consisted of compact sand and gravel to gravelly sand to a depth of about 0.8 m becoming dense and extending to the depth of termination. BH2011-06 and BH2011-7 were terminated at depths of 4.2 m and 3.9 m below existing grade due to refusal. Cobbles are inferred to be present.

Moisture contents of the soils encountered at this location ranged from 2% to 6%. Groundwater was encountered at 3.7 m below the existing grade in BH2011-05 and BH2011-06, and 4 m in BH2011-07.

It is expected that drill refusal was encountered on a boulder layer within the soil profile, however there is potential that bedrock exists near surface which would likely prevent installation of the underpass structure. Construction challenges should also be expected if a boulder layer is present at depth.

6.0 DESIGN RECOMMENDATIONS AND CONSTRUCTION CONSIDERATIONS

6.1 Animal Underpass Bridge at Km 83+090 (Wildlife Structure #1)

6.1.1 Recommended Soil Design Parameters

The recommended foundation design parameters in Table 1 represent the average soil parameters below the base of the footings. The groundwater table was estimated to be 5 m below the base of the bridge footings.

Table 1: Recommended Soil Design Parameters – Animal Underpass Bridge at Km 84+920

Parameter	Natural Foundation Soil (Compact Sand, Some Gravel to Gravelly)	Structural Fill[1]	Common Fill[2]
Bulk unit weight, γ (kN/m^3)	20	21	20
Effective cohesion, c' (kPa)	0	0	0
Effective friction angle, ϕ' (degree)	35	38	34

[1] Recommended backfill parameters to be used within the 1H:1V zone behind the abutments.

[2] Recommended backfill parameters for fill outside the 1H:1V zone behind abutments.

6.1.2 Bridge Foundations and Lateral Earth Pressure Coefficients

It is understood that shallow foundations (strip footings of 5.5 m width with a 2 m deep shear key at the edge of the footings furthest from the overpass) are the preferred foundation option for the proposed bridge abutments. The bridge footings will be founded on native compact sand with gravel at about El. +1641 m. It is understood that footings will be placed on about 0.6 m of structural fill bedding.

The factored bearing resistance of the proposed bridge foundations (strip footings of width 5.5 m) is 300 kPa assuming a geotechnical resistance factor of 0.45. This bearing resistance is based on the serviceability limit state and assumes that 35 mm of bridge abutment settlement can occur. Much of this settlement will occur during loading of the foundations. Maximum differential settlements of 15 mm are expected.

Active, at-rest and passive earth pressures acting on the abutments have been calculated assuming that the backfill is common fill (ϕ' = 34 degrees). The static earth pressure coefficients for active, at-rest and passive conditions are estimated to be about 0.27, 0.43 and 3.7, respectively. Passive earth pressure should only be applied to the shear key and neglected for footings embedment. It should be noted that fairly large movements will be required to mobilize the full passive earth pressure against the shear key. A compaction surcharge should only be applied if the abutments are considered rigid. A live load surcharge equal to an equivalent additional fill height of 0.8 m (as per Clause 6.9.5, Canadian Highway Bridge Design Code (CHBDC) CAN/CSA-S6-06) should be applied.

Sliding and overturning of the proposed bridge foundations were analysed using the typical bridge cross section provided by MCS. In the sliding analysis, the ultimate sliding friction angle along the interface between the strip footings and the foundation soil was taken as 0.8 of foundation soil internal friction angle (CHBDC, 2006). The analyses indicate that bridge foundations have static factor of safety values against overturning and sliding greater than 1.5.

6.1.3 Frost Protection for Shallow Foundations

A frost penetration depth of 2.5 m is anticipated for the site. It is expected that this depth of frost penetration may occur in open areas with little to no snow cover. Therefore, it is recommended that shallow foundations be place at a minimum depth of 2.5 m to provide frost protection.

If footings are not provided with this amount of soil cover, the use of insulation or placement of non-frost susceptible soil under the footings should be considered.

6.1.4 Construction Considerations

Soft or wet materials or areas with organic or other unsuitable material should be removed and backfilled with structural fill below the footprint of the proposed bridge footings and behind the abutments. The structural fill should be compacted to 98% of the Standard Proctor Maximum Dry Density (SPMDD). All subgrade should be proof-rolled and reviewed by a geotechnical engineer prior to footing installation.

It is recommended that well graded crushed granular material with less than 8% fine content (particles less than 0.075 mm diameter) be used as structural fill behind the abutment. Common fill behind this structural fill should be free draining granular material. Embankment fills (structural and common fills) should be compacted to 98% of SPMDD at +/- 2% of the optimum moisture content. All lifts should have a maximum 300 mm loose lift thickness. Proper drainage should be provided behind the abutment to reduce hydrostatic pressures.

All temporary excavation should be carried out in accordance with WorkSafe BC Occupational Health and Safety (OHS) Regulations. Surface water should be directed away from excavations. Stockpiling or storage of excavation spoils, construction materials or heavy equipment should not be permitted within 2 m of the crest of any excavation or trench to reduce the potential for slope instability.

Based on the groundwater level information at the proposed bridge location, groundwater is not expected to be an issue for shallow excavations in natural soils. If soil or groundwater conditions vary from those on which our recommendations are based, EBA should review the excavation plan prior to proceeding with construction.

6.2 Animal Underpass at Km 84+920 (Wildlife Structure #2)

6.2.1 Recommended Soil Design Parameters

Based on the results of the field investigation and laboratory testing, recommended soil design parameters are presented in Table 2.

Table 2: Recommended Soil Design Parameters – Animal Underpass at Km 84+920

Parameter	Natural Foundation Soil (Dense to Very Dense Sand and Gravel to Sand, some Gravel)	Common Fill[1]
Bulk unit weight, γ (kN/m^3)	21	20
Effective cohesion, c' (kPa)	0	0
Effective friction angle, ϕ' (degree)	38	34

[1] Recommended construction backfill parameters to be used in the vicinity of the pipe-arch.

6.2.2 Underpass Foundation

We understand that the underpass layout at this location is similar to the animal underpass at Km 82+260. Based on the subsurface soil conditions encountered at boreholes BH2011-01 and BH2011-02, the proposed underpass will likely be founded on dense to very dense sand and gravel. About 0.75 m to 2 m of fill is to be placed above the underpass crown. It is assumed that the grade of the TCH will be raised by approximately 0.6 m.

Installation of the underpass at the proposed grade will reduce the ground pressure at the footing level. Given the reduction in ground pressure at the foundation level and the height of the underpass, bearing capacity and settlement are not considered to be a significant issue for the static case.

Active, at-rest and passive earth pressures acting on the pipe-arch have been estimated assuming that the fill surrounding the pipe-arch is compacted common fill (ϕ' = 34 degrees). The static earth pressure coefficients for active, at-rest and passive conditions are estimated to be about 0.28, 0.44 and 3.5, respectively.

6.2.3 Construction Considerations

Soft or wet materials exposed on the subgrade should be removed and replaced with suitable granular fill within the footprint of the proposed pipe-arch foundation. Exposed loose granular material should be compacted to 98% of SPMDD. In the backfill area and above the pipe, fill material and compaction shall comply with the pipe-arch supplier's specification. Next to the proposed underpass, a temporary cut will be required. All temporary excavation and cut slopes should be carried out in accordance with WorkSafe BC Occupational Health and Safety (OHS) Regulations. Surface water should be directed away from the excavation. Stockpiling or storage of excavation spoils, construction materials or heavy equipment should not be permitted within 2 m of the crest of any excavation or trench to reduce the potential for slope instability.

Based on the groundwater information at this proposed animal underpass location, groundwater seepage may be observed in shallow excavations. If soil or groundwater conditions vary from those on which our recommendations are based, EBA should review the excavation plan prior to proceeding with construction.

6.3 Animal Underpass at Km 82+260 (Wildlife Structure #3)

Due to the shallow depth of water encountered within the boreholes drilled at this crossing location, as well as the potential bedrock/boulder layer at depth, installation of this animal underpass may be problematic. If the water observed within the boreholes represents the groundwater table, then the base of the animal underpass structure will be below water and the location of the crossing may need to be revised. Alternatively the proposed base of the underpass could be raised. The highway grade could also be raised or separate drainage culverts could be installed at elevations lower than the underpass.

Prior to construction of an animal underpass at this location, it is recommended that further investigation is undertaken in order to confirm the static groundwater level, as well as the refusal material at depth.

The recommendations below assume that the water observed was not the regional ground water table and that the ground water table is lower than observations made during drilling.

6.3.1 Recommended Soil Design Parameters

Recommended values of soil design parameters are presented in Table 3.

Table 3: Recommended Soil Design Parameters – Animal Underpass at Km. 82.260

Parameter	Natural Foundation Soil (Dense to Very Dense Sandy Gravel to Gravelly Sand)	Common Fill[1]
Bulk unit weight, γ (kN/m^3)	21	20
Effective cohesion, c' (kPa)	0	0
Effective friction angle, ϕ' (degree)	38	34

[1] Recommended construction backfill parameters to be used in the vicinity of the underpass.

6.3.2 Underpass Foundation

It is expected that the proposed pipe-arch will likely be founded on a dense to very dense sandy gravel layer to the north and a gravelly sand layer to the south. The grade of the existing TCH will be raised by 0.2 m in the area of the crossing. For the purpose of road widening, a thickness of 2 m and 1.25 m of granular fill will be placed on existing grade at the south and north ends of the pipe, respectively.

Installation of the pipe-arch at the proposed grades will reduce the ground pressure at the foundation level when compared to the existing condition. Given the reduction in ground pressure at the foundation level and the depth of the pipe, bearing capacity and settlement are not likely to be a concern.

Active, at-rest and passive earth pressures acting on the pipe-arch have been calculated assuming that the fill on the side of the pipe is compacted engineered fill (ϕ' = 34 degrees) as per the pipe-arch supplier's specifications. The static earth pressure coefficients for active, at-rest and passive conditions are estimated to be about 0.28, 0.44 and 3.5, respectively.

6.3.3 Global Stability of the Cut Slope

Excavation is required at both ends of the underpass to create animal access. It is understood that these slopes will be a maximum of 2H:1V, with a height of approximately 15.5 m and 1 m at the north and south ends respectively.

Based on the results of the field investigation and laboratory testing, the proposed access cut slopes will be within sand and gravel containing cobbles and boulders. Existing slopes in the area are approximately 2H:1V or slightly flatter at the north end of the underpass and are showing no visible signs of instability. The proposed slopes of 2H:1V are considered acceptable based on the available information. A number of large (>1 m diameter) boulders were observed on the surface of the slope, which could lead to challenges during excavation.

6.3.4 Construction Considerations

Soft or wet materials exposed within the subgrade or organic or other unsuitable material should be removed and replaced with approved granular fill within the footprint of the proposed underpass foundation. Loose granular material should be compacted to 98% of Standard Proctor Maximum Dry Density (SPMDD). All subgrade should be reviewed by a geotechnical engineer prior to pipe-arch installation.

A gasket or other seal should be installed in the joints of the individual pipe-arch sections to avoid migration of fines into the underpass. Alternatively, filter cloth could be placed against all joints on the

outside of the pipe-arch. In backfill areas, fill material and compaction shall be in accordance with pipe-arch supplier specifications. Outside the pipe-arch backfill zone, fill should be compacted to 98% of SPMDD and within 2 percent of optimum moisture. Lifts should be 300 mm or less in thickness.

All temporary excavation and the proposed cut slopes should be carried out in accordance with WorkSafe BC Occupational Health and Safety (OHS) Regulations. Surface water should be directed away from the excavation; temporary dewatering may be required. Stockpiling or storage of excavation spoils, construction materials or heavy equipment should not be permitted within 2 m of the crest of any excavation or trench to reduce the potential for slope instability.

Based on the water level observed during drilling, groundwater issues are expected during construction and in the long term. A design that addresses ground water above the proposed pipe arch invert is recommended.

Excavation of the proposed cut slopes should proceed from the top down. Final excavation plans should be reviewed by EBA. Both temporary and permanent cut slopes should be inspected by EBA to confirm that the soil and groundwater conditions are as anticipated.

7.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

EBA, A Tetra Tech Company

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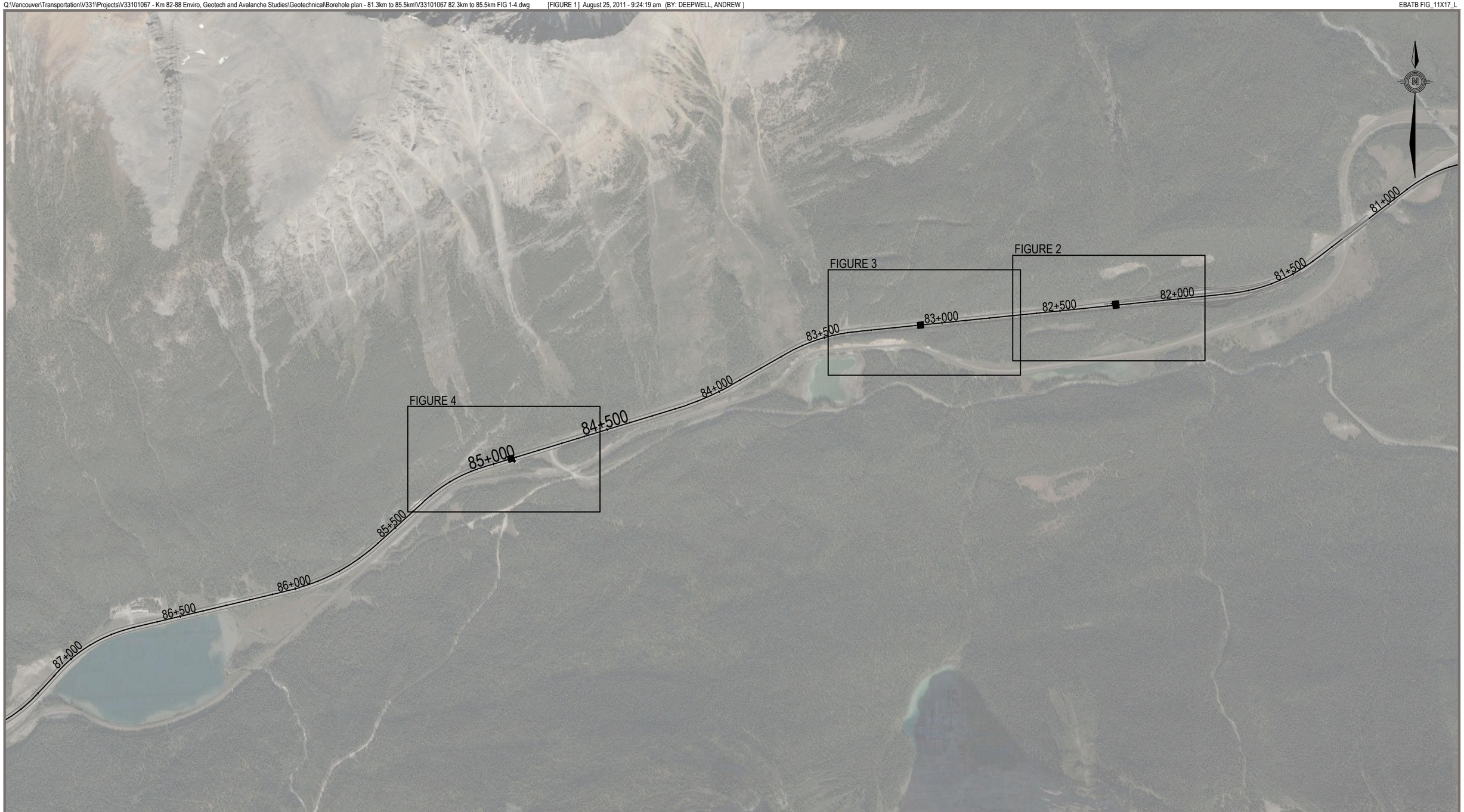
2006. Canadian Standards Association. *Canadian Highway Bridge Design Code, CAN/CSA-S6-06.*

FIGURES



LEGEND

- CENTERLINE
- ROADWAY
- BECKER HAMMER BOREHOLE — BH2011-05
- 2010 TESTPIT — TP2010-17
- 2010 AUGER BOREHOLE — AH2010-11

0 500

Scale: 1: 15 000 (metres)

NOTES

BASE DATA: McELHANNEY CONSULTING SERVICES LTD. (08/09/2010)

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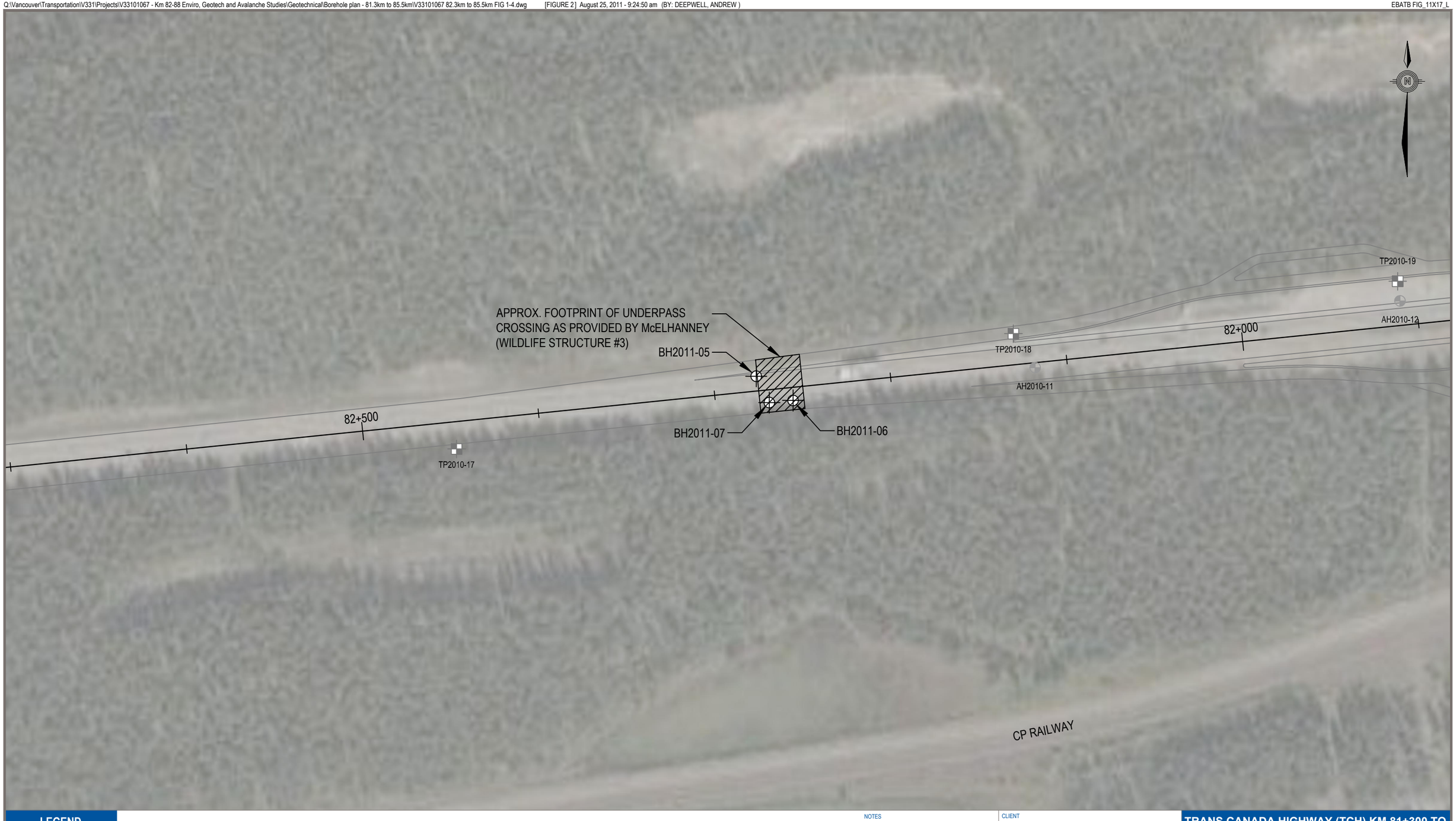
TRANS CANADA HIGHWAY (TCH) KM 81+300 TO 85+500 ANIMAL UNDERPASS STRUCTURES

KEY PLAN

PROJECT NO.	DWN	CKD	REV
V33101067	AD	RB	0

OFFICE	DATE
VANC	August 2011

FIGURE 1



LEGEND

- CENTERLINE
- ROADWAY
- BECKER HAMMER BOREHOLE — BH2011-05
- 2010 TESTPIT — TP2010-17
- 2010 AUGER BOREHOLE — AH2010-11

0 100m

Scale: 1: 2 000 (metres)

NOTES

BASE DATA: McELHANNEY CONSULTING SERVICES LTD. (08/09/2010)

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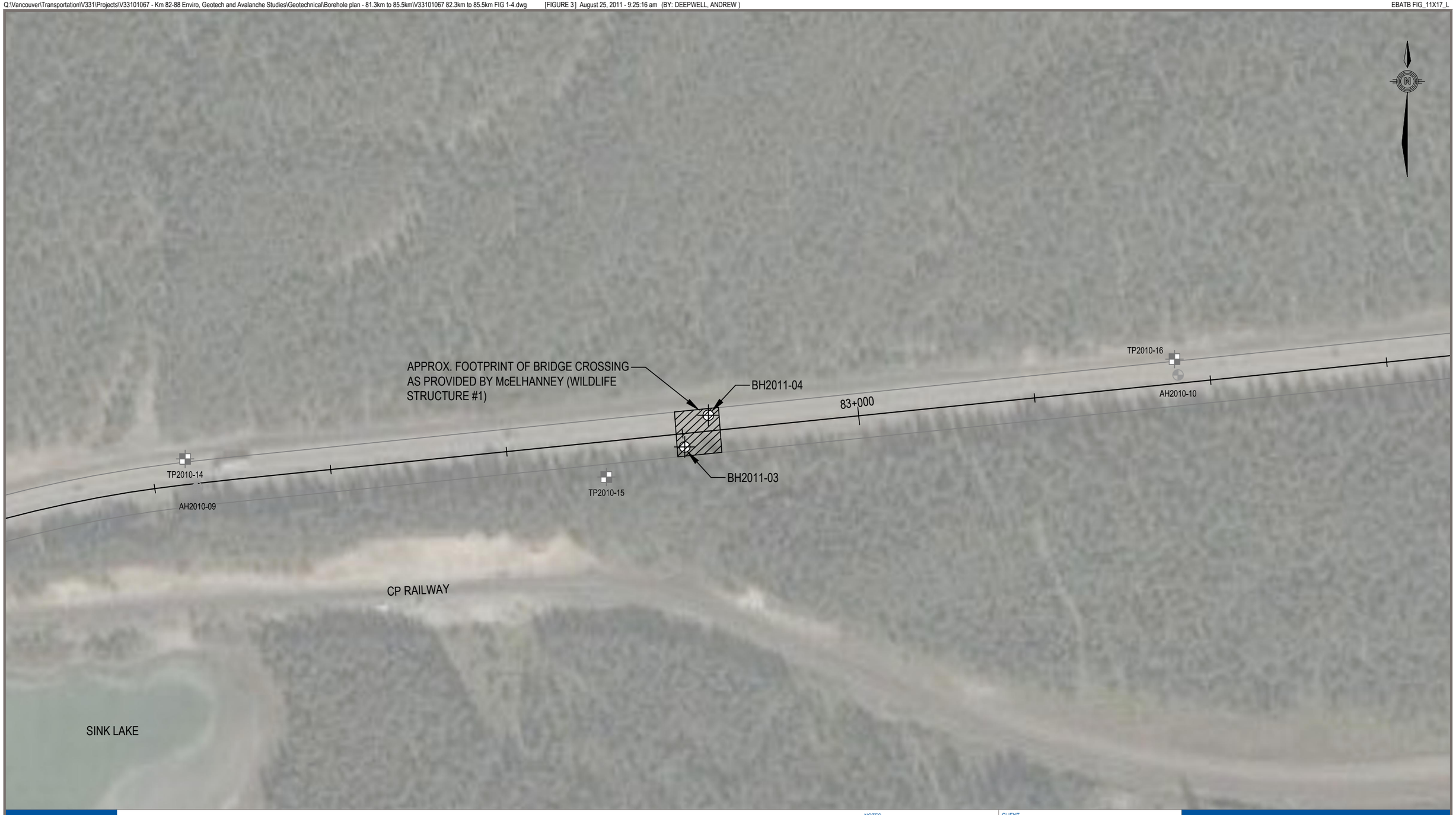
TRANS CANADA HIGHWAY (TCH) KM 81+300 TO 85+500 ANIMAL UNDERPASS STRUCTURES

BOREHOLE LOCATIONS UNDERPASS AT KM 82+260

PROJECT NO.	DWN	CKD	REV
V33101067	AD	RB	0
OFFICE: VANC	DATE: August 2011		

FIGURE 2



LEGEND

- CENTERLINE
- ROADWAY
- BECKER HAMMER BOREHOLE — BH2011-05
- 2010 TESTPIT — TP2010-17
- 2010 AUGER BOREHOLE — AH2010-11

0 100m

Scale: 1: 2 000 (metres)

NOTES

BASE DATA: McELHANNEY CONSULTING SERVICES LTD. (08/09/2010)

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TRANS CANADA HIGHWAY (TCH) KM 81+300 TO 85+500 ANIMAL UNDERPASS STRUCTURES

BOREHOLE LOCATIONS BRIDGE AT KM 83+090

PROJECT NO.	DWN	CKD	REV
V33101067	AD	RB	0

OFFICE: VANC

DATE: August 2011

FIGURE 3

LEGEND

- CENTERLINE
- ROADWAY
- BECKER HAMMER BOREHOLE — BH2011-05
- 2010 TESTPIT — TP2010-17
- 2010 AUGER BOREHOLE — AH2010-11

0 100m

Scale: 1: 2 000 (metres)

NOTES

BASE DATA: McELHANNEY CONSULTING SERVICES LTD. (08/09/2010)

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TRANS CANADA HIGHWAY (TCH) KM 81+300 TO 85+500 ANIMAL UNDERPASS STRUCTURES

BOREHOLE LOCATIONS UNDERPASS AT KM 84+920

PROJECT NO.	DWN	CKD	REV
V33101067	AD	RB	0

OFFICE	DATE
VANC	August 2011

FIGURE 4

APPENDIX A

APPENDIX A EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA’s Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA’s Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA’s instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

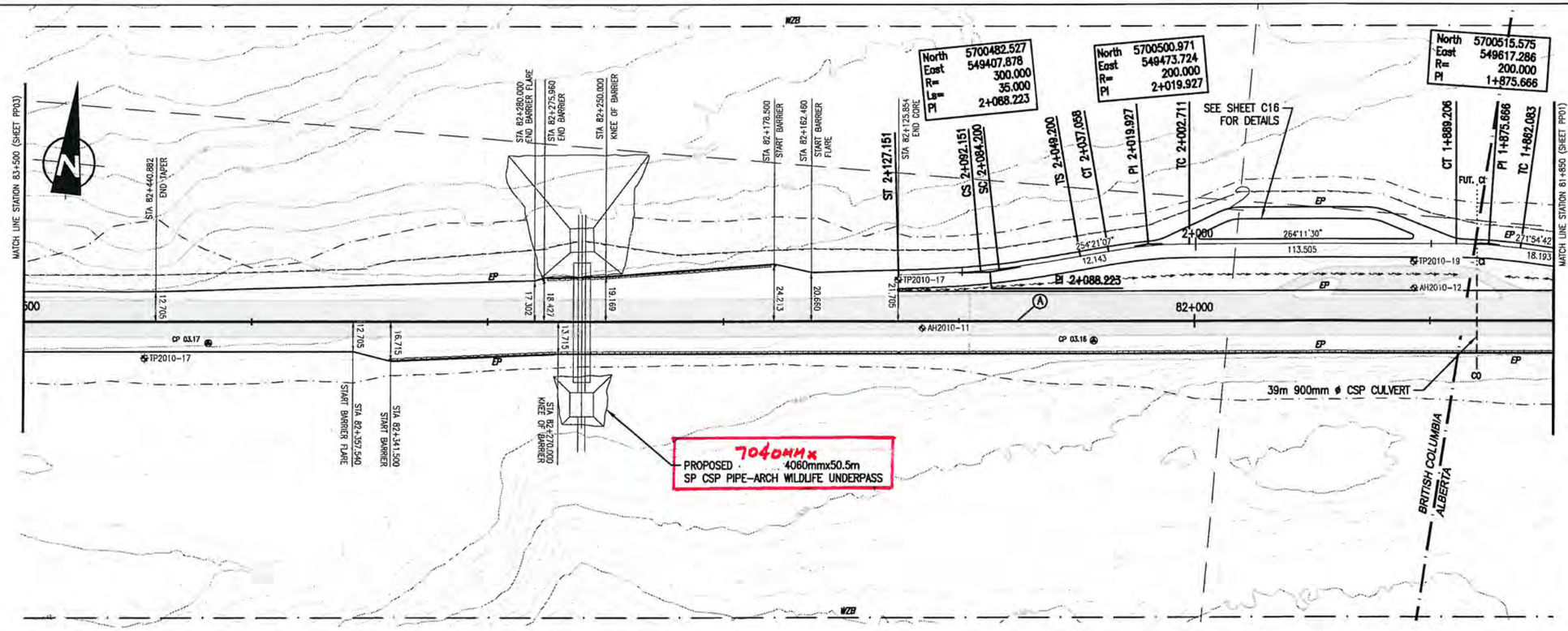
EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

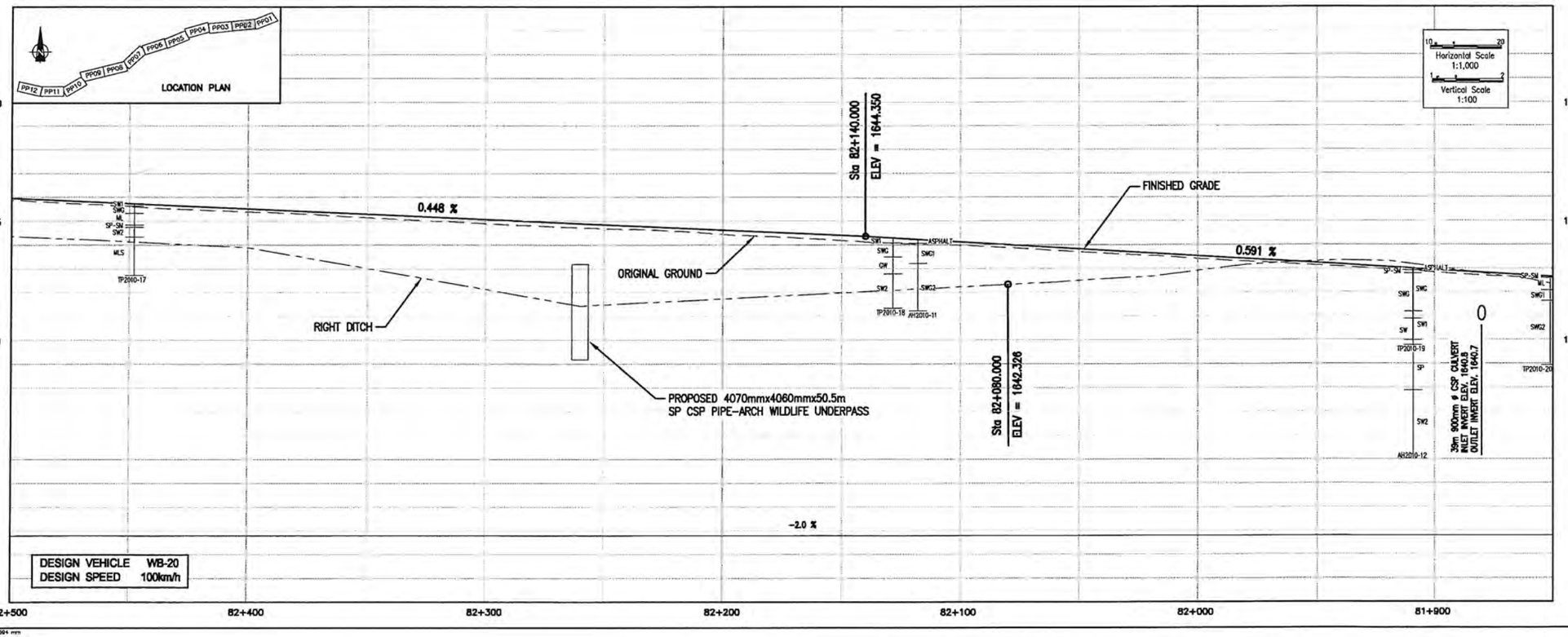
14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

APPENDIX B DRAWINGS PROVIDED BY MCELHANNEY CONSULTING SERVICES





CONTROL POINTS TABLE

Point	Northing	Easting	Elevation
03.14	5700639.0410	559129.9297	1640.5832
03.15	5700498.8099	549805.8900	1642.0724
03.16	5700458.1580	549454.8189	1643.3962
03.17	5700419.1732	549080.9050	1644.6503
03.18	5700383.6213	548733.1518	1645.2547
10.60	5700358.5436	548391.5375	1645.8190
18.22	5700342.5300	548334.4496	1645.5400
18.23	5700317.7249	548100.4125	1644.4140
18.24	5700287.9018	547868.8329	1639.9230
18.25	5700159.3084	547728.7887	1635.1430
18.26	5700062.3498	547583.8818	1629.7859

No.	Date/Date	Description/Description	Drawn by/Dessiné par	Approved/Approuvé
0	01/02/11	INITIAL SUBMISSION	VB	RP

Revision / Revision

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

TRANS CANADA HIGHWAY
TWINNING KM 82 - KM 88
PRELIMINARY DESIGN

YOHO NATIONAL PARK, BC

Drawing title/Titre du dessin

PLAN & PROFILE
STA 81+850 TO STA 82+500

NOT FOR CONSTRUCTION

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle H: 1:1000 V: 1:100

Parks Canada Project Manager/Administrateur de Projets Parcs Canada

Client Acceptance/Acceptation du client — Approved by/Approuvé par

Parks Canada Responsible Officer/Agent Responsable Parcs Canada — Parks Canada Project Manager/Administrateur de Projets Parcs Canada

Project No./No. du projet	Asset No./No. du bien	Sheet No./ No. de la feuille
Drawing Reference No./No. de référence du dessin: 2511 00203 - 0		PP02

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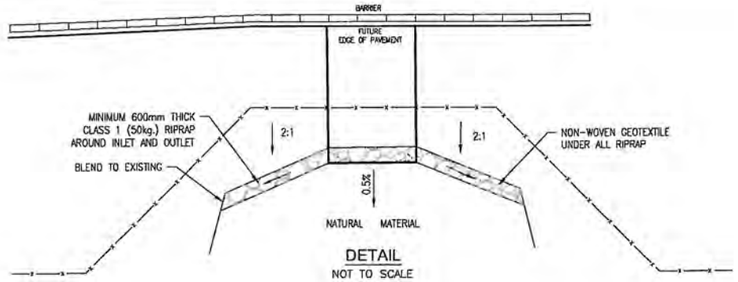
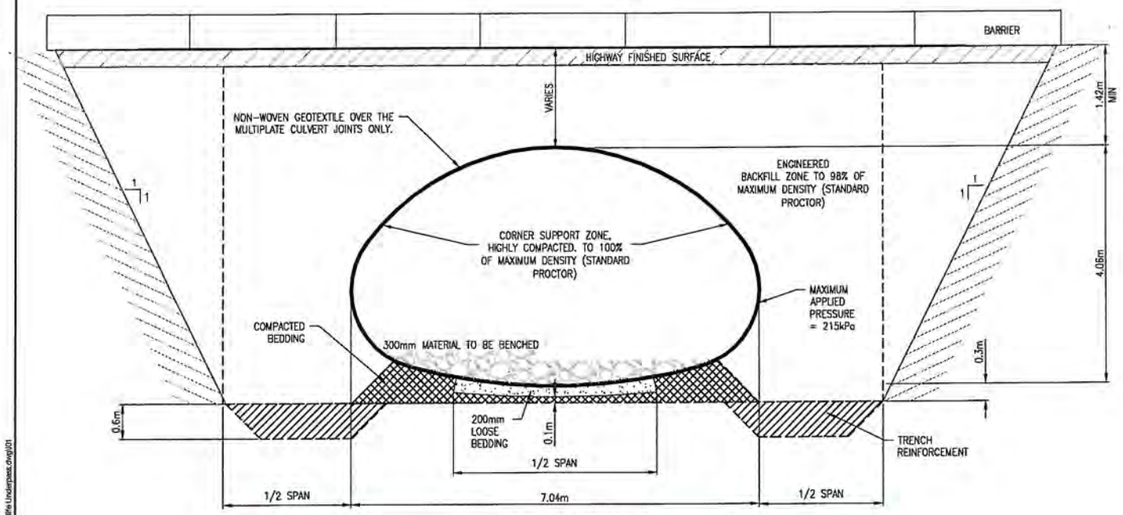
A1 841 x 594 mm



DETAIL
NOT TO SCALE



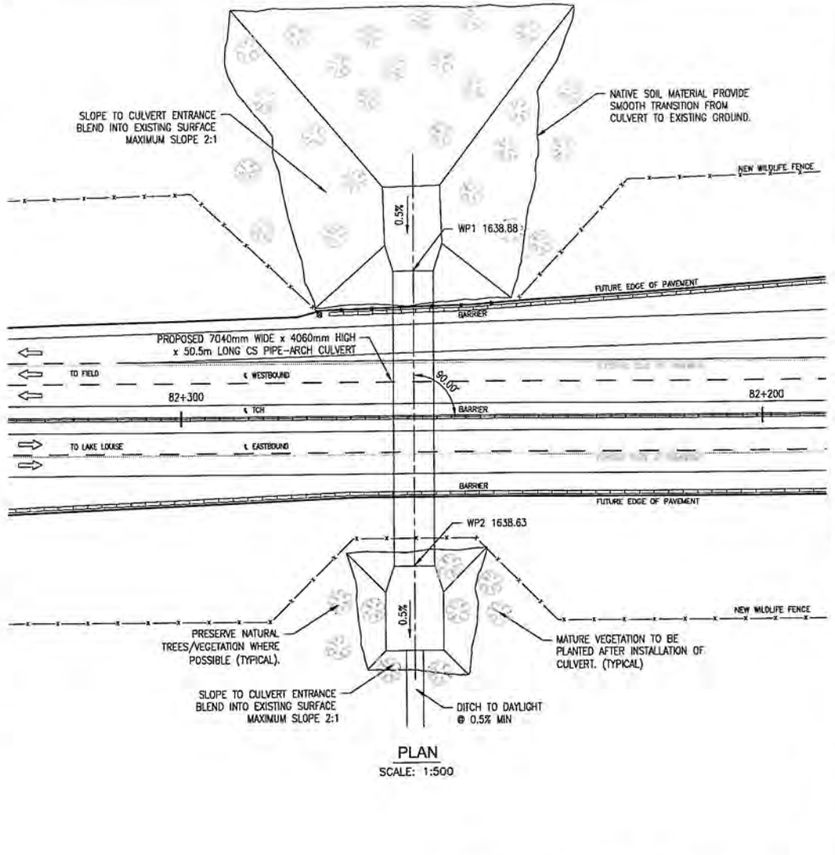
TYPICAL SECTION

PROPOSED 7040mmx4060mmx50.5m SP CSP PIPE-ARCH WILDLIFE UNDERPASS

NOT TO SCALE

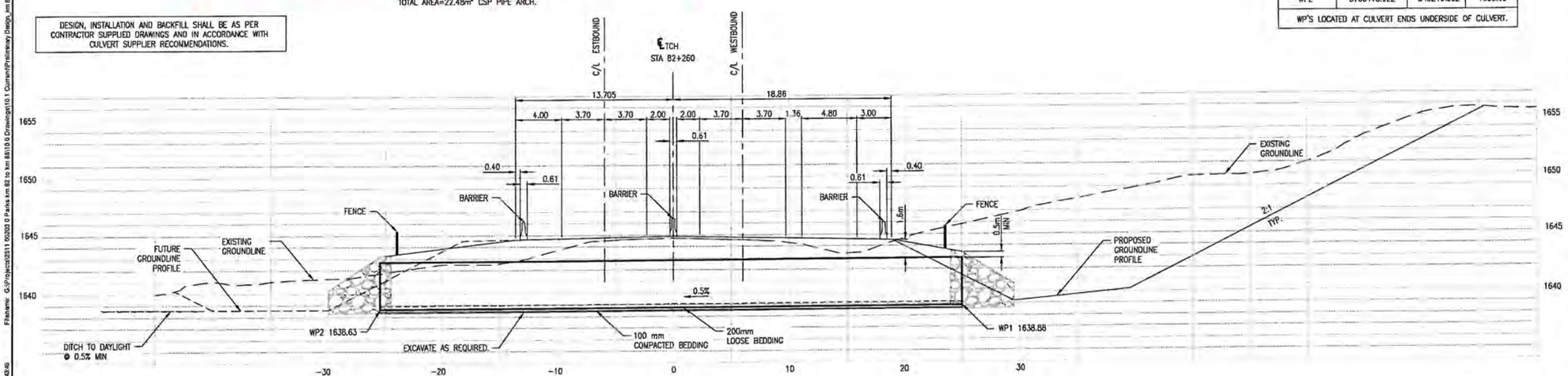
TOTAL AREA=22.48m² CSP PIPE ARCH.

DESIGN, INSTALLATION AND BACKFILL SHALL BE AS PER CONTRACTOR SUPPLIED DRAWINGS AND IN ACCORDANCE WITH CULVERT SUPPLIER RECOMMENDATIONS.



PLAN
SCALE: 1:500

LAYOUT TABLE			
DESCRIPTION	NORTHING	EASTING	ELEVATION
WP1	5700168.163	549235.191	1638.88
WP2	5700418.922	549240.302	1638.63
WP'S LOCATED AT CULVERT ENDS UNDERSIDE OF CULVERT.			



PROPOSED WILDLIFE UNDERPASS PROFILE
SCALE: 1:200

NOT FOR CONSTRUCTION

CONTRACTOR RESPONSIBLE FOR STRUCTURAL DESIGN.

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
0	22/03/11	INITIAL SUBMISSION	VB	RP

Revision / Revision

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

TRANS CANADA HIGHWAY
TWINNING KM 82 - KM 88
PRELIMINARY DESIGN

YOHO NATIONAL PARK, BC

Drawing title/Titre du dessin

WILDLIFE UNDERPASS
PLAN & PROFILE
STA 82+260

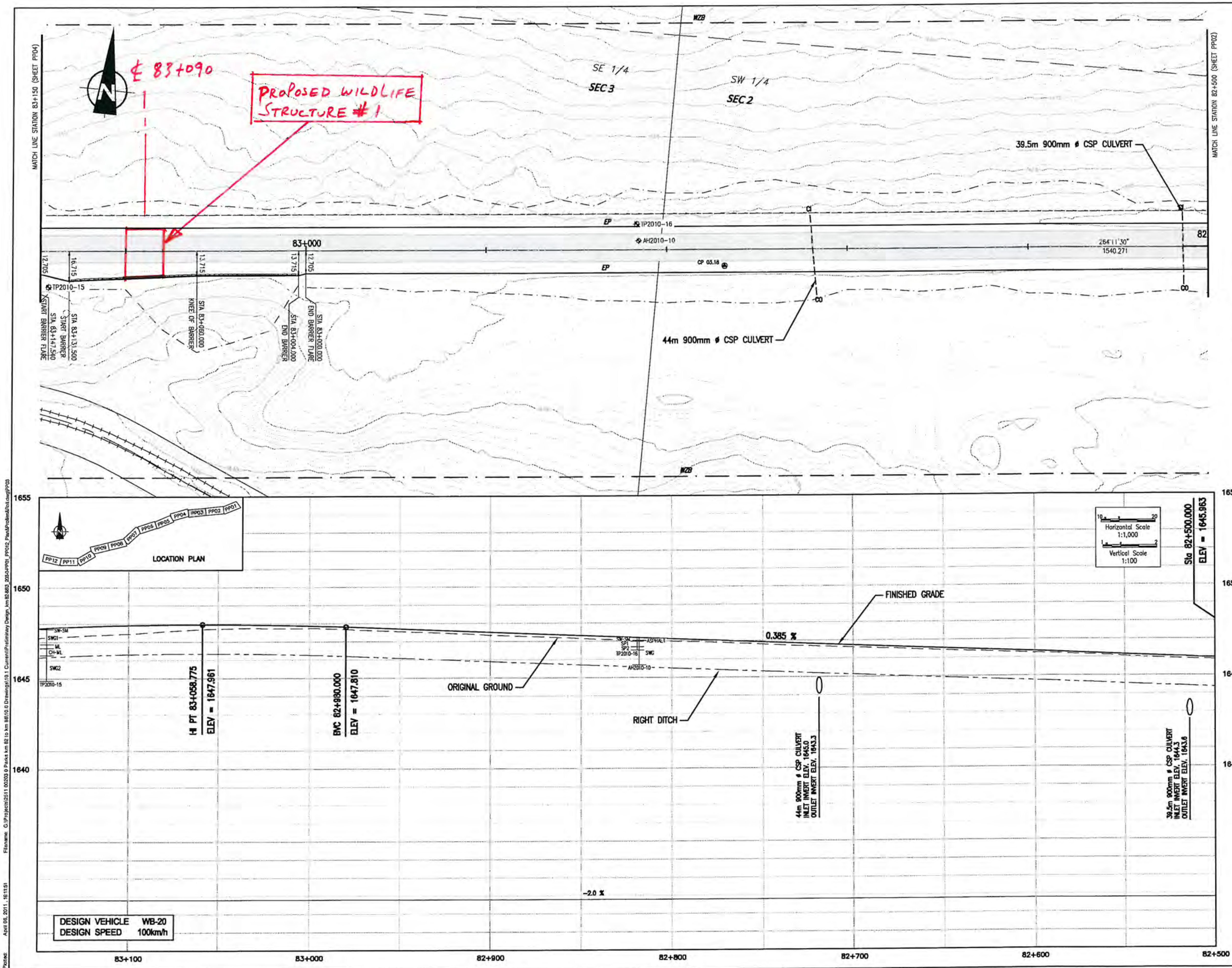
Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
Designed by/Concept par	Reviewed by/Revisé par	Scale/Echelle AS SHOWN

Parks Canada Project Manager/Administrateur de Projets Parcs Canada

Client Acceptance/Acceptation du client | Approved by/Approuvé par

Parks Canada Responsible Officer/Agent Responsable Parcs Canada | Parks Canada Project Manager/Administrateur de Projets Parcs Canada

Project No./No. de projet	Asset No./No. du-bien	Sheet No./ No. de la feuille 101
Drawing Reference No./No. de référence du dessin 2511 00203 - 0		



MATCH LINE STATION 83+150 (SHEET PP04)
MATCH LINE STATION 82+500 (SHEET PP02)
℄ 83+090
PROPOSED WILDLIFE STRUCTURE #1
SE 1/4
SEC 3
SW 1/4
SEC 2
WZB
39.5m 900mm ø CSP CULVERT
44m 900mm ø CSP CULVERT
EP
TP2010-16
AH2010-10
CP 03.18
TP2010-15
83+000
264°11'30"
1540.271
STA 83+147.540
START BARRIER FLARE
STA 83+131.500
START BARRIER
STA 83+060.000
KNEE OF BARRIER
STA 83+004.000
END BARRIER
STA 83+000.000
END BARRIER FLARE
LOCATION PLAN
Horizontal Scale 1:1,000
Vertical Scale 1:100
Sta 82+500.000
ELEV = 1645.963
FINISHED GRADE
0.385 %
ORIGINAL GROUND
RIGHT DITCH
H PT 83+058.775
ELEV = 1647.961
BVC 82+980.000
ELEV = 1647.810
44m 900mm ø CSP CULVERT
INLET INVERT ELEV. 1643.0
OUTLET INVERT ELEV. 1643.3
39.5m 900mm ø CSP CULVERT
INLET INVERT ELEV. 1644.3
OUTLET INVERT ELEV. 1643.6
-2.0 %
DESIGN VEHICLE WB-20
DESIGN SPEED 100km/h
1655
1650
1645
1640
83+100
83+000
82+900
82+800
82+700
82+600
82+500

INFORMATION ON EXISTING UTILITIES MAY NOT BE COMPLETE OR ACCURATE. PRIOR TO CONSTRUCTION CONTRACTOR SHALL EXPOSE LOCATIONS OF ALL EXISTING UTILITIES AND ADVISE THE ENGINEER OF POTENTIAL CONFLICTS.

CONTROL POINTS TABLE

Point	Northing	Easting	Elevation
03.14	5700639.0410	550129.9297	1640.5612
03.15	5700496.6099	549805.8500	1642.0724
03.16	5700458.1580	549454.8160	1643.3962
03.17	5700419.1732	549080.9550	1644.6503
03.18	5700383.6213	548733.1510	1646.2547
10.80	5700358.6438	548301.5376	1646.8190
18.22	5700342.9300	548134.4406	1646.5400
18.23	5700317.7249	548100.4125	1644.4140
18.24	5700267.9018	547886.6329	1639.9230
18.25	5700159.3084	547728.7887	1635.1430
18.26	5700062.3496	547503.6838	1629.7850

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
0	01/02/11	INITIAL SUBMISSION	VB	RP

Revision / Revision

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

TRANS CANADA HIGHWAY TWINNING KM 82 - KM 88 PRELIMINARY DESIGN

YOHO NATIONAL PARK, BC

Drawing title/Titre du dessin

PLAN & PROFILE STA 82+500 TO STA 83+150

NOT FOR CONSTRUCTION

Surveyed by/Arpenté par | Drawn by/Dessiné par | Date/Date

Designed by/Concept par | Reviewed by/Revisé par | Scale/Echelle H: 1:1000 V: 1:100

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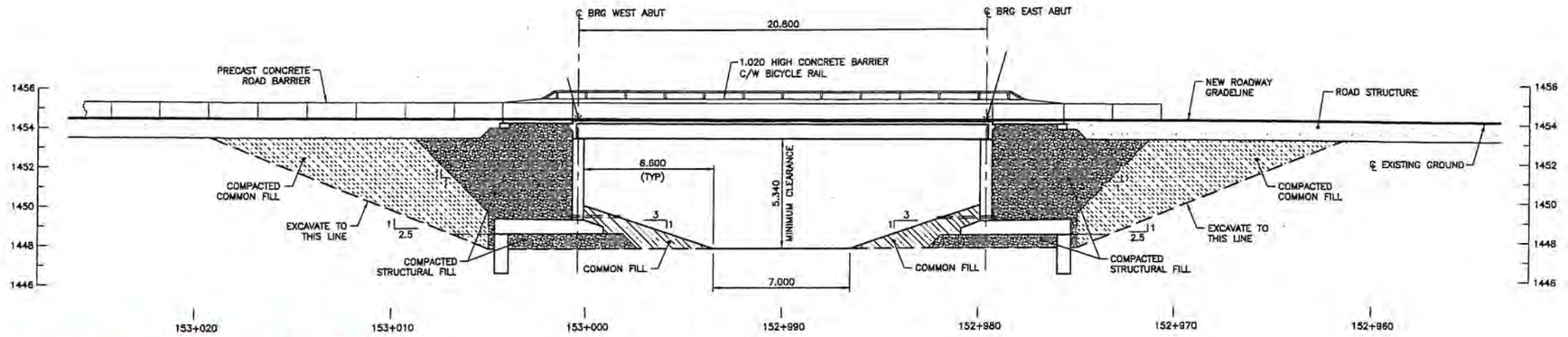
Client Acceptance/Acceptation du client | Approved by/Approuvé par

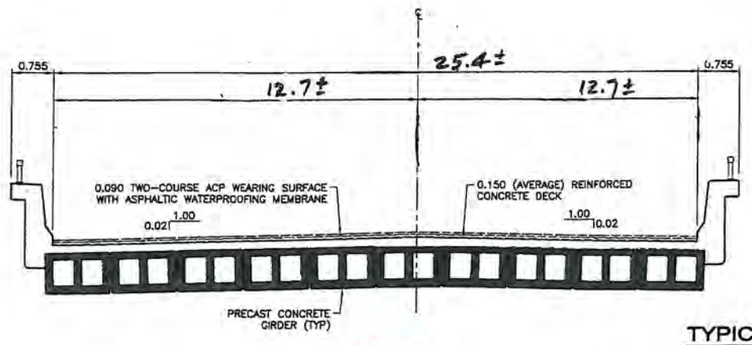
Project No./No. du projet | Asset No./No. du-bien | Sheet No./No. de la feuille PP03

Drawing Reference No./No. de référence du dessin 2511 00203 - 0



WILDLIFE STRUCTURE #1

BRIDGE ELEVATION
1:125 LOOKING NORTH



NTS

TYPICAL BRIDGE SECTION
1:50

A1 841 x 594

CONTROL POINTS TABLE

Point	Northing	Easting	Elevation
03.14	5700639.0410	550129.9287	1640.5832
03.15	5700498.6099	549805.8500	1642.6724
03.16	5700458.1590	549454.8160	1643.3962
03.17	5700419.1732	549080.9500	1644.6503
03.18	5700363.6213	548733.1510	1646.2547
19.80	5700358.6436	548301.9378	1646.8196
18.22	5700342.9300	548334.4486	1646.5400
18.23	5700317.7249	548100.4125	1644.4140
18.24	5700267.9018	547886.8329	1639.9230
18.25	5700159.3084	547728.7887	1635.1430
18.26	5700062.3498	547583.6808	1629.7150

No.	Date/Date	Description/Description	Drawn by/Dessiné par	Approved/Approuvé
D	01/02/11	INITIAL SUBMISSION	VB	RP

Revision / Revision

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

TRANS CANADA HIGHWAY
TWINNING KM 82 - KM 88
PRELIMINARY DESIGN

YOHO NATIONAL PARK, BC

Drawing title/Titre du dessin

PLAN & PROFILE
STA 84+450 TO STA 85+100

NOT FOR CONSTRUCTION

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle H: 1:1000 V: 1:100

Parks Canada Project Manager/Administrateur de Projets Parcs Canada

Client Acceptance/Acceptation du client | Approved by/Approuvé par

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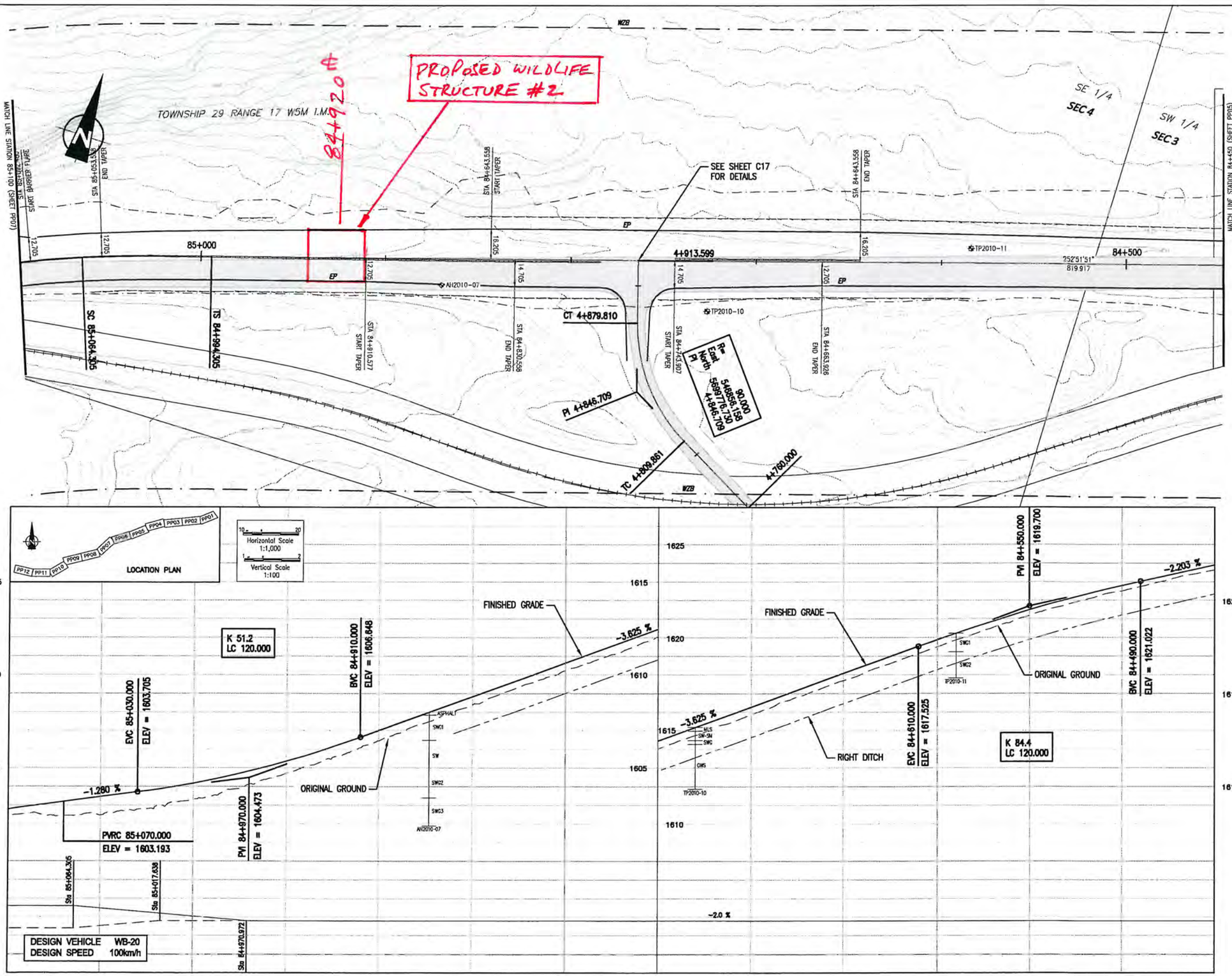
Project No./No. du projet | Asset No./No. du bien | Sheet No./No. de la feuille: PP06

Drawing Reference No./No. de référence du dessin: 2511 00203 - 0



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Filename: G:\Projects\2511 00203 0 Parks km 82 to km 88\10.0 Drawings\10.1 Current\Preliminary Design_km 82-88_2330-PP01 PP012_PlanProfileMid.dwg\PP06
At 841 x 594 mm

APPENDIX C

APPENDIX C BOREHOLE LOGS

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
South Side of Highway	Becker Hammer	V33101067 BH2011-01
N. 5699786.3 E. 546700.7		ELEVATION: 1606m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BPT (N_d)	USC	SOIL SYMBOL	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	BECKER PENETRATION (N_i) 40 80 120 160; UNCONFINED (kPa) 50 100 150 200; POCKET PEN. (kPa) 100 200 300 400	Elevation (m)
0	ASPHALT (150 mm)			33	ASPHAL					1606.0
	GRAVEL and SAND, some silt, occasional cobbles, fine gravel, medium to coarse sand, sub-angular to sub-rounded, damp, compact, tan.		1	34						
1				25	SWG		4.8			1605.0
				26						
				36						
	SAND, some silt, some gravel, fine to medium sand, well graded gravel, sub-angular, damp, very dense, tan.			56						
2			2	169			4			1604.0
	-possible boulder at 2.6 m depth			232					232	
				337					337	
	SAND, some silt, some gravel, occasional cobbles, fine to medium sand, well graded gravel, angular, damp, dense to very dense, tan, trace wood debris.			295					295	
3				146						1603.0
				86						
				75						
4			3	88	SP-SM		3			1602.0
				56						
				52						
5				52						1601.0
				73						
				73						
				50						
6	-frequent fractured pieces of rock at 6.1 m depth (likely broken up cobbles or boulders)			39						1600.0
				38						
				124						
7	SAND, gravelly, trace silt, coarse sand, well graded gravel, sub-rounded to sub-angular, damp to moist, loose to dense, speckled tan, black and white.			80						1599.0
				24						
	-the drill rods sank with almost no effort in this material		4	13	SPG		6			
8				59						1598.0
	GRAVEL, sandy, fine gravel, medium to coarse sand, sub-rounded to sub-angular, damp to moist, very dense, speckled tan, black and white.			134						
				100	GWS					
9				70						1597.0
	GRAVEL and SAND, silty, fine to medium sand, fine gravel, sub-rounded to sub-angular, damp to moist, dense to very dense, tan.			60						
			5				6.9			
				68						
10				76						1596.0

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
South Side of Highway	Becker Hammer	V33101067 BH2011-01
N. 5699786.3 E. 546700.7		ELEVATION: 1606m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BPT (N_0)	USC	SOIL SYMBOL	MOISTURE CONTENT	Elevation (m)
10	-coarsening sand and gravel and 10 m depth			96				1596.0
				67	SP-SM			
11				63				1595.0
				63				
				68				
12				64				1594.0
				50				
	SAND, trace gravel, trace silt, coarse sand, fine gravel, sub-rounded, damp to moist, dense to very dense, speckled black and tan.			55				
			6	80			11	
13	-fine sand and silt material intermixed with this material			94				1593.0
	SAND, some silt, trace clay, trace gravel, fine to medium sand, fine gravel, sub-rounded, damp to moist, very dense, low plastic, tan.			86				
				192	SP			
				269				1592.0
14				530				
	EOH (closed) - 14.2 m - Refusal		7				12	
15	EOH (open) at 15 m - Target depth reached							1591.0
16								1590.0
17								1589.0
18								1588.0
19								1587.0
20								1586.0

PLASTIC M.C. LIQUID (20 40 60 80)

■BECKER PENETRATION (N_0)■ (40 80 120 160)

◆UNCONFINED (kPa)◆ (50 100 150 200)

▲POCKET PEN. (kPa)▲ (100 200 300 400)

EBA, A Tetra Tech Company	LOGGED BY: RB	COMPLETION DEPTH: 15m
	REVIEWED BY: KW	COMPLETE: 6/13/2011
	DRAWING NO:	Page 2 of 2

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
North Side of Highway	Becker Hammer	V33101067 BH2011-02
N. 5699792.7 E. 546677.7		ELEVATION: 1605.4m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	USC	SOIL SYMBOL	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Elevation (m)
0	ASPHALT (150 mm)			ASPHAL					1605.0
	SAND and GRAVEL, some silt, occasional cobbles, well graded sand and gravel, sub-rounded to sub-angular, damp, tan, contains broken pieces of rock.								
1									1604.0
2			1						1603.0
3				SWG					1602.0
4									1601.0
5			2			5	●		1600.0
6	-poor recovery from 5.8 to 6.7 m								1599.0
	SILT and SAND, trace gravel, trace clay, fine, damp, tan. (8% Gravel, 39% Sand, 47% Silt, 6% Clay)								
7	-very poor sample recovery from 6.4 to 8 m depth		3	MLS					1598.0
8									1597.0
	SAND, trace silt, trace gravel, occasional cobbles, fine to medium sand, well graded gravel, damp, tan.								
9									1596.0
10									

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LOGGED BY: RB	COMPLETION DEPTH: 13.4m
REVIEWED BY: KW	COMPLETE: 6/13/2011
DRAWING NO:	Page 1 of 2

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
North Side of Highway	Becker Hammer	V33101067 BH2011-02
N. 5699792.7 E. 546677.7		ELEVATION: 1605.4m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	USC	SOIL SYMBOL	MOISTURE CONTENT	Elevation (m)
10				SP			1595.0
			4			7	
11							1594.0
12	SAND, trace silt, trace gravel, fine to medium sand, fine gravel, sub-angular, damp, tan, occasional pieces of silt with trace clay. -poor sample recovery from 12.2 to 13.1 m -at 13 m a 0.6 m plug developed in the drill rod			SP			1593.0
13	SILT and SAND (TILL-like), trace clay, occasional pieces of broken rock, fine sand, moist, tan and grey, occasional 3 to 5 mm thick interlayers of tan clay.		5 6	TILL		13 13	1592.0
	SILT and SAND (TILL-like), trace to some clay, fine to medium sand, frequent pieces of broken rock, moist, tan with grey pieces of rock.		7				
14	EOH at 13.4 m - Refusal						1591.0
15							1590.0
16							1589.0
17							1588.0
18							1587.0
19							1586.0
20							

PLASTIC — M.C. — LIQUID (20 40 60 80)

STANDARD PENETRATION (N) (20 40 60 80)

UNCONFINED (kPa) (50 100 150 200)

POCKET PEN. (kPa) (100 200 300 400)

EBA, A Tetra Tech Company

LOGGED BY: RB	COMPLETION DEPTH: 13.4m
REVIEWED BY: KW	COMPLETE: 6/13/2011
DRAWING NO:	Page 2 of 2

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
South Side of Highway	Becker Hammer	V33101067 BH2011-03
N. 5700352.1 E. 548405.8		ELEVATION: 1647.3m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	USC	SOIL SYMBOL	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Elevation (m)
0	SAND, gravelly, trace silt, well graded sand, fine gravel, sub-rounded, damp, brown, occasional pieces of tree roots.				SWG					1647.0
1	SAND and GRAVEL, some silt, occasional pieces of broken rock, well graded sand and gravel, angular to sub-rounded, damp.									1646.0
2			1		GWS					1645.0
3	SAND and GRAVEL, trace silt, occasional pieces of broken rock, well graded sand and gravel, sub-rounded to sub-angular, damp, brown.									1644.0
4					GWS					1643.0
5	SAND, gravelly, trace silt, medium to coarse sand, fine gravel, sub-angular, damp to moist, compact, speckled brown, black and grey. -SPT from 4.5 to 5.1 m (8-8-7-8)		2	15	SWG		2.7			1642.0
6				47						1641.0
7	SAND, gravelly, trace silt, occasional cobbles, well graded sand and gravel, sub-rounded to sub-angular, damp, dense, brown. -SPT from 6.1 to 6.7 m (29-25-22-18)		3		SWG		4			1640.0
8										1639.0
9	GRAVEL, sandy, trace silt, medium to coarse sand, fine to coarse gravel, sub-angular to rounded, damp, tan. -gravel becoming angular to sub-angular at 8.8 m -from 8.8 to 10 m poor recovery of broken pieces of rock and rock dust		4				1.4			
			5		GWS		3			1638.0
10										

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LOGGED BY: RB	COMPLETION DEPTH: 10.1m
REVIEWED BY: KW	COMPLETE: 6/15/2011
DRAWING NO:	Page 1 of 2

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
South Side of Highway	Becker Hammer	V33101067 BH2011-03
N. 5700352.1 E. 548405.8		ELEVATION: 1647.3m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	USC	SOIL SYMBOL	MOISTURE CONTENT	Elevation (m)
10	EOH at 10.1 m - Refusal (likely bedrock) -pieces of rock were on the drill bit when the rods were removed							1637.0
11								1636.0
12								1635.0
13								1634.0
14								1633.0
15								1632.0
16								1631.0
17								1630.0
18								1629.0
19								1628.0
20								

PLASTIC M.C. LIQUID (20 40 60 80)

STANDARD PENETRATION (N) (20 40 60 80)

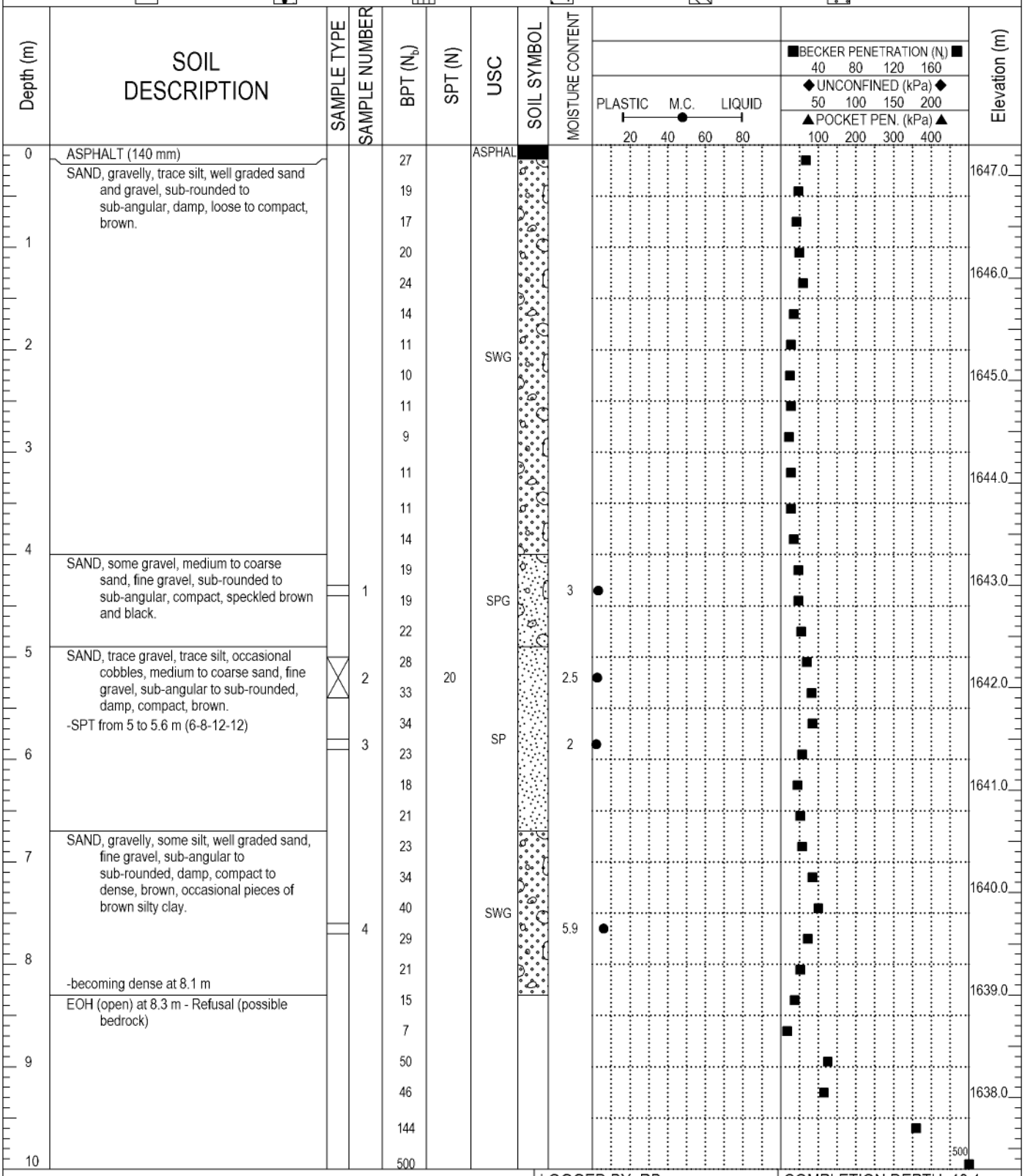
UNCONFINED (kPa) (50 100 150 200)

POCKET PEN. (kPa) (100 200 300 400)

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
North Side of Highway	Becker Hammer	V33101067 BH2011-04
N. 5700370.0 E. 548419.1		ELEVATION: 1647.3m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND



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	REVIEWED BY: KW	COMPLETE: 6/15/2011
	DRAWING NO:	Page 1 of 2

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
North Side of Highway	Becker Hammer	V33101067 BH2011-04
N. 5700370.0 E. 548419.1		ELEVATION: 1647.3m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BPT (N_b)	SPT (N)	USC	SOIL SYMBOL	MOISTURE CONTENT (PLASTIC M.C. LIQUID; 20 40 60 80)	■BECKER PENETRATION (N_i)■ 40 80 120 160; ◆UNCONFINED (kPa)◆ 50 100 150 200; ▲POCKET PEN. (kPa)▲ 100 200 300 400	Elevation (m)
10	EOH (closed) at 10.1 m -the closed Becker hole had water at the bottom at 9.8 m depth									1637.0
11										1636.0
12										1635.0
13										1634.0
14										1633.0
15										1632.0
16										1631.0
17										1630.0
18										1629.0
19										1628.0
20										

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LOGGED BY: RB	COMPLETION DEPTH: 10.1m
REVIEWED BY: KW	COMPLETE: 6/15/2011
DRAWING NO:	Page 2 of 2

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
North Side of Highway	Becker Hammer	V33101067 BH2011-05
N. 5700451.3 E. 549224.0		ELEVATION: 1644.5m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BPT (N_d)	USC	SOIL SYMBOL	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	BECKER PENETRATION (N_i) (40 80 120 160) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Elevation (m)
0	ASPHALT (160 mm)			46	ASPHAL					
	GRAVEL and SAND, trace silt, occasional cobbles, frequent pieces of broken rock, well graded sand and gravel, angular to sub-rounded, damp, dense, brown with white pieces of rock.			57	GWS					1644.0
1				79						
	SAND, gravelly, trace silt, occasional cobbles, occasional pieces of broken rock, well graded sand and gravel, sub-angular to sub-rounded, moist, compact to dense, reddish brown sand with grey pieces of rock.			70						
				68						1643.0
			1	55			6			
2				40	SWG					
				29						1642.0
				29						
	GRAVEL and SAND, trace silt, occasional cobbles, medium to coarse sand, fine gravel, angular to sub-angular, wet, compact to dense, brown sand with black and grey gravel.			29						
3			2		GWS		5.9			
				55						
	GRAVEL, sandy, trace silt, occasional cobbles, medium to coarse sand, well graded gravel, angular to sub-angular, very wet, very dense, brown with black and grey gravel.		3	134	GWS		6			1641.0
4	-water encountered at 3.7 m			91						
				555					555	
	EOH (open) at 3.9 m - Refusal (likely on a boulder)									1640.0
	EOH (closed) at 4.2 m									
5										
										1639.0
6										
										1638.0
7										
										1637.0
8										
										1636.0
9										
										1635.0
10										

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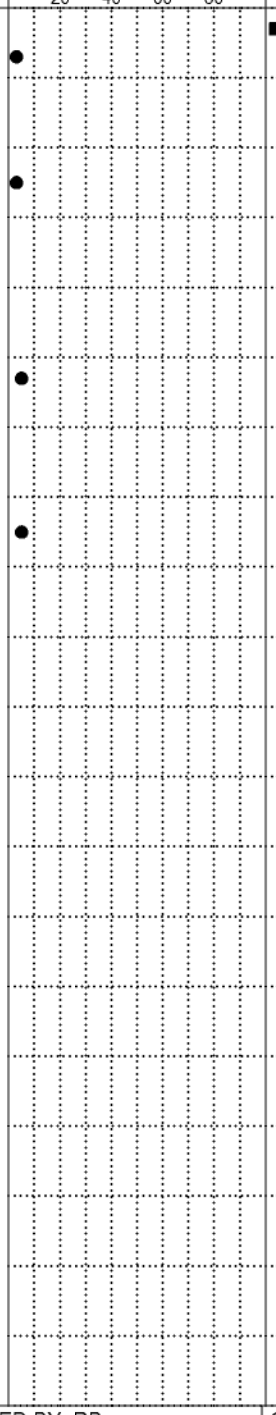
LOGGED BY: RB	COMPLETION DEPTH: 3.9m
REVIEWED BY: KW	COMPLETE: 6/15/2011
DRAWING NO:	Page 1 of 1

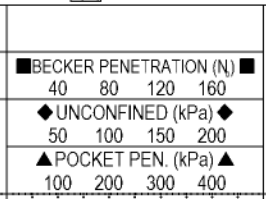
Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
South Side of Highway	Becker Hammer	V33101067 BH2011-06
N. 5700437.7 E. 549246.3		ELEVATION: 1644.4m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BPT (N_b)	USC	SOIL SYMBOL	MOISTURE CONTENT	Elevation (m)
0	SAND, gravelly, trace silt, well graded sand, fine gravel, sub-angular to sub-rounded, damp, compact, greyish brown.		1	8 20	SWG		3	1644.0
1	SAND and GRAVEL, trace silt, occasional cobbles, occasional pieces of broken rock, well graded sand and gravel, sub-rounded to sub-angular, damp, dense, brown.		2	35 57 95	GWS		3	1643.0
2	SAND, gravelly, some silt, occasional cobbles, well graded sand, fine gravel, sub-angular to sub-rounded, damp, dense, brown.		3	73 56 45 40	SWG		5	1642.0
3	SAND, gravelly, trace silt, occasional cobbles, medium to coarse sand, sub-rounded to angular, damp, very dense, brown.			74 61 135	SPG			1641.0
4	SAND, gravelly, occasional pieces of broken rock, coarse sand, well graded gravel, angular to sub-rounded, very wet, very dense, brown. -water encountered at 4 m depth EOH (open) at 4.2 m - Refusal (likely on a boulder)		4	100 80	SPG		5	1640.0
5				58 55 62				1639.0
6				51 131 98				1638.0
7				62 72 63				1637.0
8				58 46 39				1636.0
9				49 54 53				1635.0
10				68 43 64 58				





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LOGGED BY: RB	COMPLETION DEPTH: 12.5m
REVIEWED BY: KW	COMPLETE: 6/16/2011
DRAWING NO:	Page 1 of 2

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
South Side of Highway	Becker Hammer	V33101067 BH2011-06
N. 5700437.7 E. 549246.3		ELEVATION: 1644.4m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BPT (N_0)	USC	SOIL SYMBOL	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	BECKER PENETRATION (N_0) (40 80 120 160) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Elevation (m)
10				75						1634.0
11				54						
				102						1633.0
				116						
				174					216	
12				216						1632.0
				501					501	
	EOH (closed) at 12.5 m									
13										1631.0
14										1630.0
15										1629.0
16										1628.0
17										1627.0
18										1626.0
19										1625.0
20										

EBA, A Tetra Tech Company

LOGGED BY: RB	COMPLETION DEPTH: 12.5m
REVIEWED BY: KW	COMPLETE: 6/16/2011
DRAWING NO:	Page 2 of 2

Trans Canada Highway - Km 81.3 to 85.5	Parks Canada Agency	PROJECT NO. - BOREHOLE NO.
South Side of Highway	Becker Hammer	V33101067 BH2011-07
N. 5700436.4 E. 549231.4		ELEVATION: 1644.5m

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	BPT (N_D)	USC	SOIL SYMBOL	MOISTURE CONTENT
0	SAND and GRAVEL, some silt, occasional cobbles and pieces of broken rock, well graded sand, fine gravel, angular to sub-rounded, damp, compact, brown.			11			
				23			
				34			
1	SAND and GRAVEL, some silt, occasional cobbles and pieces of broken rock, well graded sand, fine gravel, angular to sub-rounded, damp, dense to very dense, brown.			50	SWG		
				73			
				89			
2			1	76			
				47			
	GRAVEL and SAND, trace to some silt, occasional cobbles and pieces of broken rock, well graded sand and gravel, sub-rounded to sub-angular, damp, dense to very dense, brown.			34			
3				60			
	-poor sample recovery from 2.4 to 3.7 m depth			570	GWS		
	EOH (closed) at 3.4 m		2				2
	SAND, gravelly, some silt, frequent fractured pieces of rock, well graded sand and gravel, sub-rounded to angular, very wet, very dense, brown.		3		SWG		6
4	-water encountered at 3.7 m depth						
	EOH (open) at 3.9 m - Refusal (likely on a boulder)						
5							
6							
7							
8							
9							
10							

PLASTIC M.C. LIQUID (20 40 60 80)

BECKER PENETRATION (N_D) (40 80 120 160)

UNCONFINED (kPa) (50 100 150 200)

POCKET PEN. (kPa) (100 200 300 400)

570

Elevation (m)
1644.0
1643.0
1642.0
1641.0
1640.0
1639.0
1638.0
1637.0
1636.0
1635.0

EBA, A Tetra Tech Company

LOGGED BY: RB	COMPLETION DEPTH: 3.9m
REVIEWED BY: KW	COMPLETE: 6/16/2011
DRAWING NO:	Page 1 of 1

APPENDIX D

APPENDIX D SIEVE ANALYSES RESULTS

GRAIN SIZE DISTRIBUTION

ASTM C136 & C117

Project: Trans Canada Highway (TCH) Km 81.3 - 85.5
Animal Underpass Structures

Project Number: V33101067

Date Tested: June 23, 2011

Borehole Number: BH2011-01 Sample 1

Depth: 0.6 m

Soil Description: GRAVEL and SAND, some fines

Cu: N/A

Cc: N/A

Natural Moisture Content: 4.8%

Remarks: Gravel (44%) Sand (43%) Fines (13%)

Sieve Size (mm)	Percent Passing
25.000	100
19.000	98
12.500	89
9.500	80
4.750	56
2.360	42
1.180	32
0.600	25
0.300	20
0.150	16
0.075	12.8

Clay	Silt	Sand			Gravel	
		Fine	Medium	Coarse	Fine	Coarse

Reviewed By: DB P.Eng.

eba
A TETRA TECH COMPANY

GRAIN SIZE DISTRIBUTION

ASTM C136 & C117

Project: Trans Canada Highway (TCH) Km 81.3 - 85.5
Animal Underpass Structures

Project Number: V33101067

Date Tested: June 23, 2011

Borehole Number: BH2011-01 Sample 5

Depth: 9.4 m

Soil Description: GRAVEL & SAND, silty*

Cu: N/A

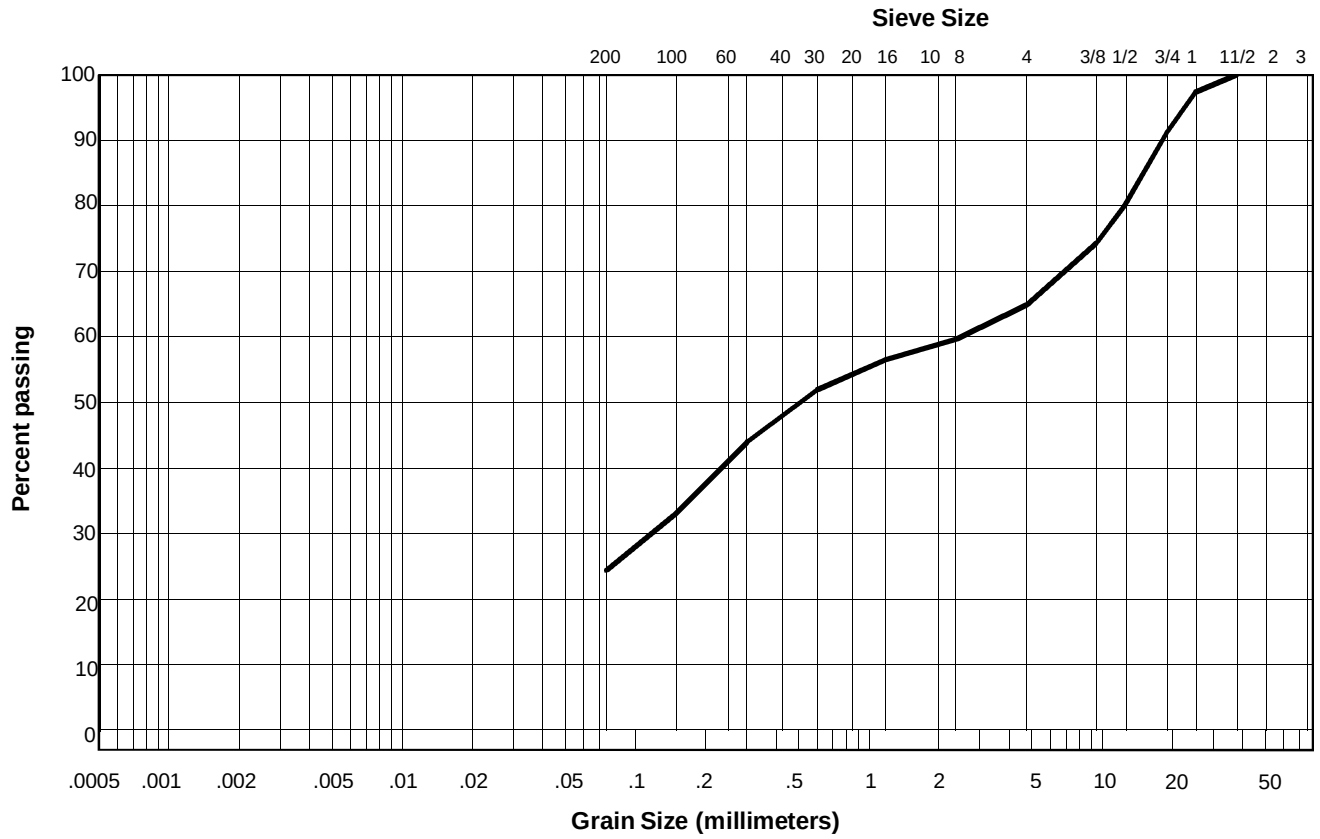
Cc: N/A

Natural Moisture Content: 6.9%

Remarks: Gravel (35%) Sand (41%) Fines (24%)
*Fines description based on visual assessment

Sieve Size (mm)	Percent Passing
37.500	100
25.000	97
19.000	91
12.500	80
9.500	74
4.750	65
2.360	60
1.180	56
0.600	52
0.300	44
0.150	33
0.075	24.4

Clay	Silt	Sand			Gravel	
		Fine	Medium	Coarse	Fine	Coarse



Reviewed By: DB P.Eng.

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A TETRA TECH COMPANY

GRAIN SIZE DISTRIBUTION

ASTM C136 & C117

Project: Trans Canada Highway (TCH) Km 81.3 - 85.5
Animal Underpass Structures

Project Number: V33101067

Date Tested: June 23, 2011

Borehole Number: BH2011-03 Sample 2

Depth: 4.5 m

Soil Description: SAND, gravelly, trace fines

Cu: 12.8

Cc: 1.7

Natural Moisture Content: 2.7%

Remarks: Gravel (26%) Sand (67%) Fines (7%)

Sieve Size (mm)	Percent Passing
37.500	100
25.000	96
19.000	92
12.500	89
9.500	85
4.750	74
2.360	58
1.180	36
0.600	19
0.300	12
0.150	9
0.075	6.7

Clay	Silt	Sand			Gravel	
		Fine	Medium	Coarse	Fine	Coarse

Reviewed By: DB P.Eng.

eba
A TETRA TECH COMPANY

GRAIN SIZE DISTRIBUTION

ASTM C136 & C117

Project: Trans Canada Highway (TCH) Km 81.3 - 85.5
Animal Underpass Structures

Project Number: V33101067

Date Tested: June 23, 2011

Borehole Number: BH2011-03 Sample 4

Depth: 8.3 m

Soil Description: GRAVEL, sandy, trace fines

Cu: 42.0

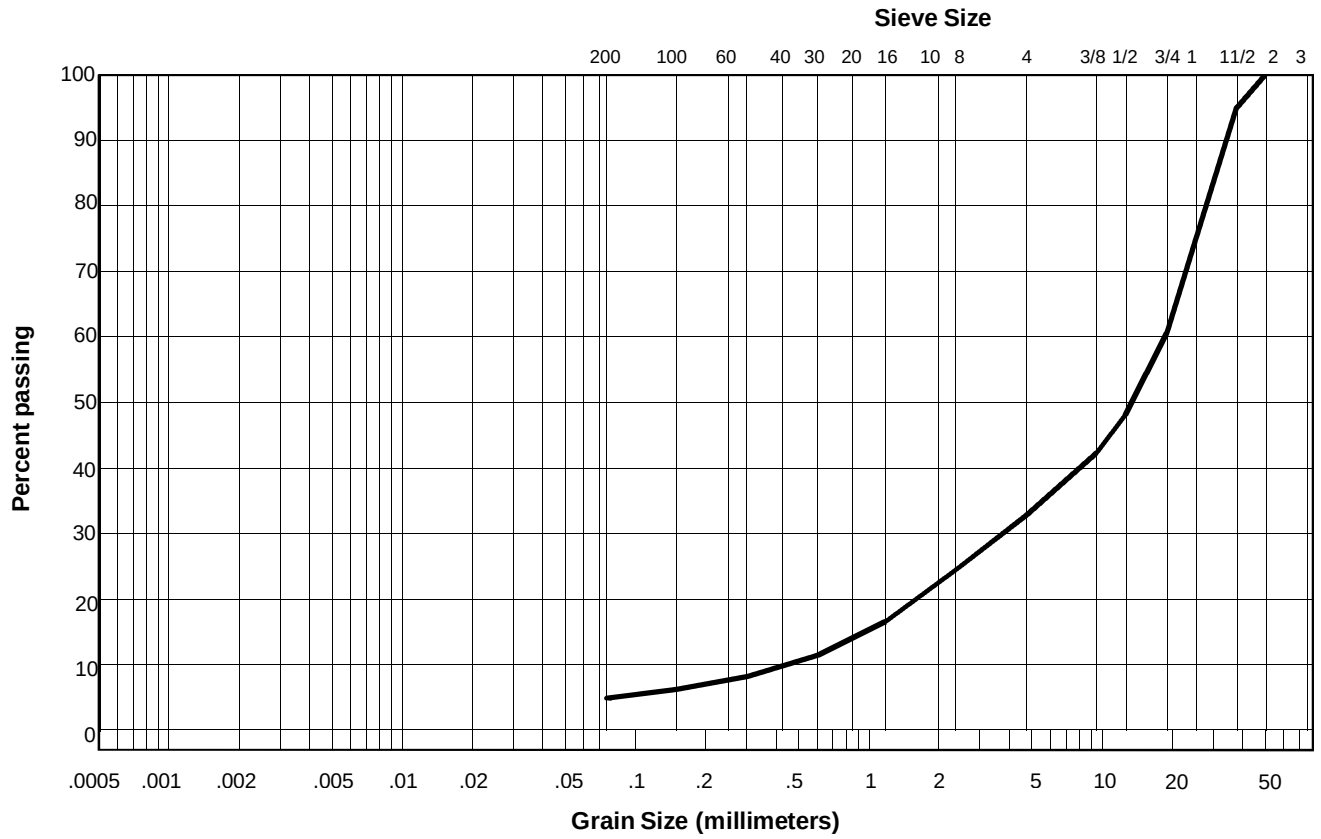
Cc: 1.7

Natural Moisture Content: 1.4%

Remarks: Gravel (67%) Sand (28%) Fines (5%)

Sieve Size (mm)	Percent Passing
50.000	100
37.500	95
25.000	75
19.000	61
12.500	48
9.500	42
4.750	33
2.360	24
1.180	17
0.600	11
0.300	8
0.150	6
0.075	4.9

Clay	Silt	Sand			Gravel	
		Fine	Medium	Coarse	Fine	Coarse



Reviewed By: DB P.Eng.

eba
A TETRA TECH COMPANY

GRAIN SIZE DISTRIBUTION

ASTM C136 & C117

Project: Trans Canada Highway (TCH) Km 81.3 - 85.5
Animal Underpass Structures

Project Number: V33101067

Date Tested: June 23, 2011

Borehole Number: BH2011-04 Sample 2

Depth: 5 m

Soil Description: SAND, trace gravel, trace fines

Cu: 9.6

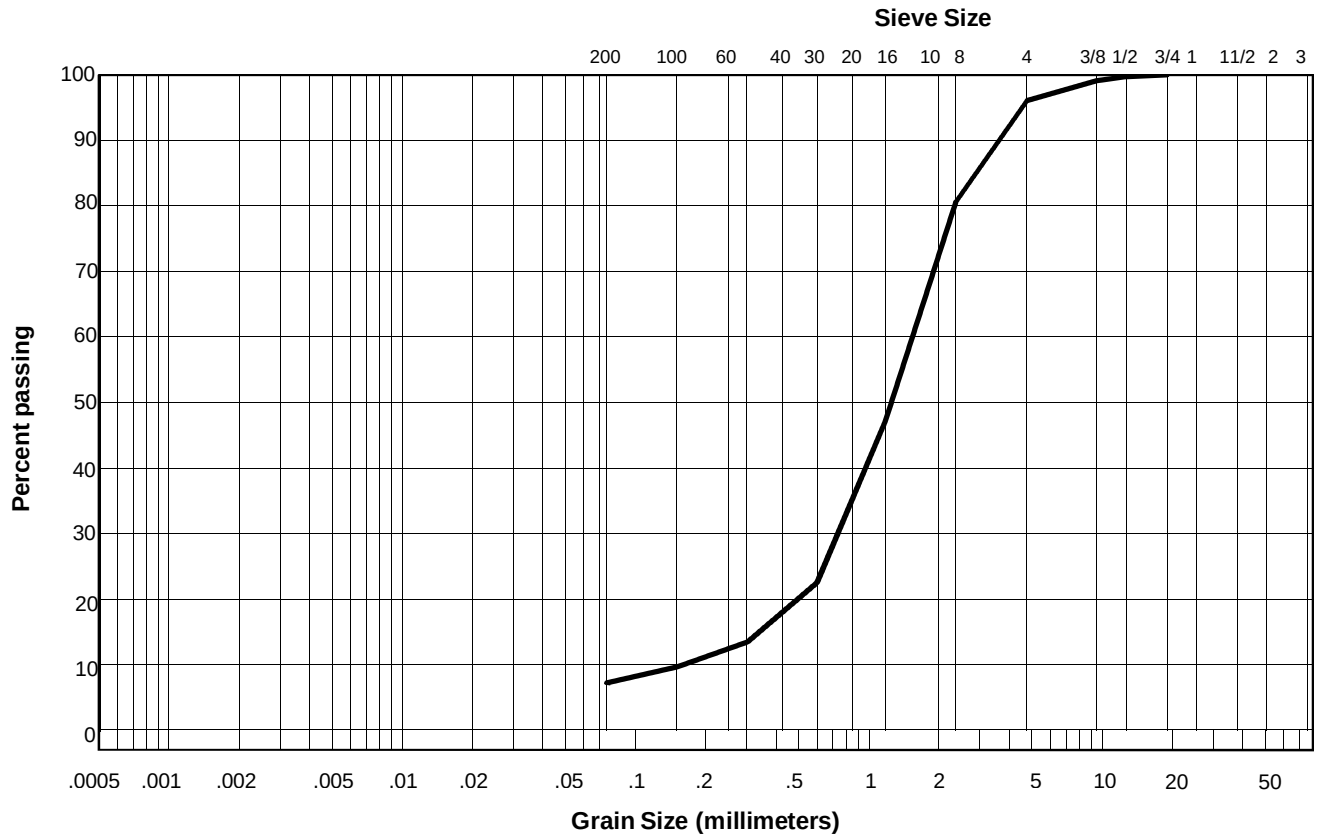
Cc: 2.2

Natural Moisture Content: 2.5%

Remarks: Gravel (4%) Sand (89%) Fines (7%)

Sieve Size	Percent Passing
19.000	100
12.500	100
9.500	99
4.750	96
2.360	81
1.180	47
0.600	22
0.300	13
0.150	10
0.075	7.3

Clay	Silt	Sand			Gravel	
		Fine	Medium	Coarse	Fine	Coarse



Reviewed By: DB P.Eng.

GRAIN SIZE DISTRIBUTION

ASTM C136 & C117

Project: Trans Canada Highway (TCH) Km 81.3 - 85.5
Animal Underpass Structures

Project Number: V33101067

Date Tested: June 23, 2011

Borehole Number: BH2011-04 Sample 4

Depth: 7.6 m

Soil Description: SAND, gravelly, some fines

Cu: N/A

Cc: N/A

Natural Moisture Content: 5.9%

Remarks: Gravel (21%) Sand (60%) Fines (19%)

Sieve Size (mm)	Percent Passing
37.500	100
25.000	98
19.000	97
12.500	93
9.500	90
4.750	79
2.360	64
1.180	51
0.600	42
0.300	33
0.150	25
0.075	19.0

Clay	Silt	Sand			Gravel	
		Fine	Medium	Coarse	Fine	Coarse

Reviewed By: DB P.Eng.

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GRAIN SIZE DISTRIBUTION

ASTM C136 & C117

Project: Trans Canada Highway (TCH) Km 81.3 - 85.5
Animal Underpass Structures

Project Number: V33101067

Date Tested: June 23, 2011

Borehole Number: BH2011-05 Sample 2

Depth: 3 m

Soil Description: GRAVEL and SAND, trace fines

Cu: 61.9

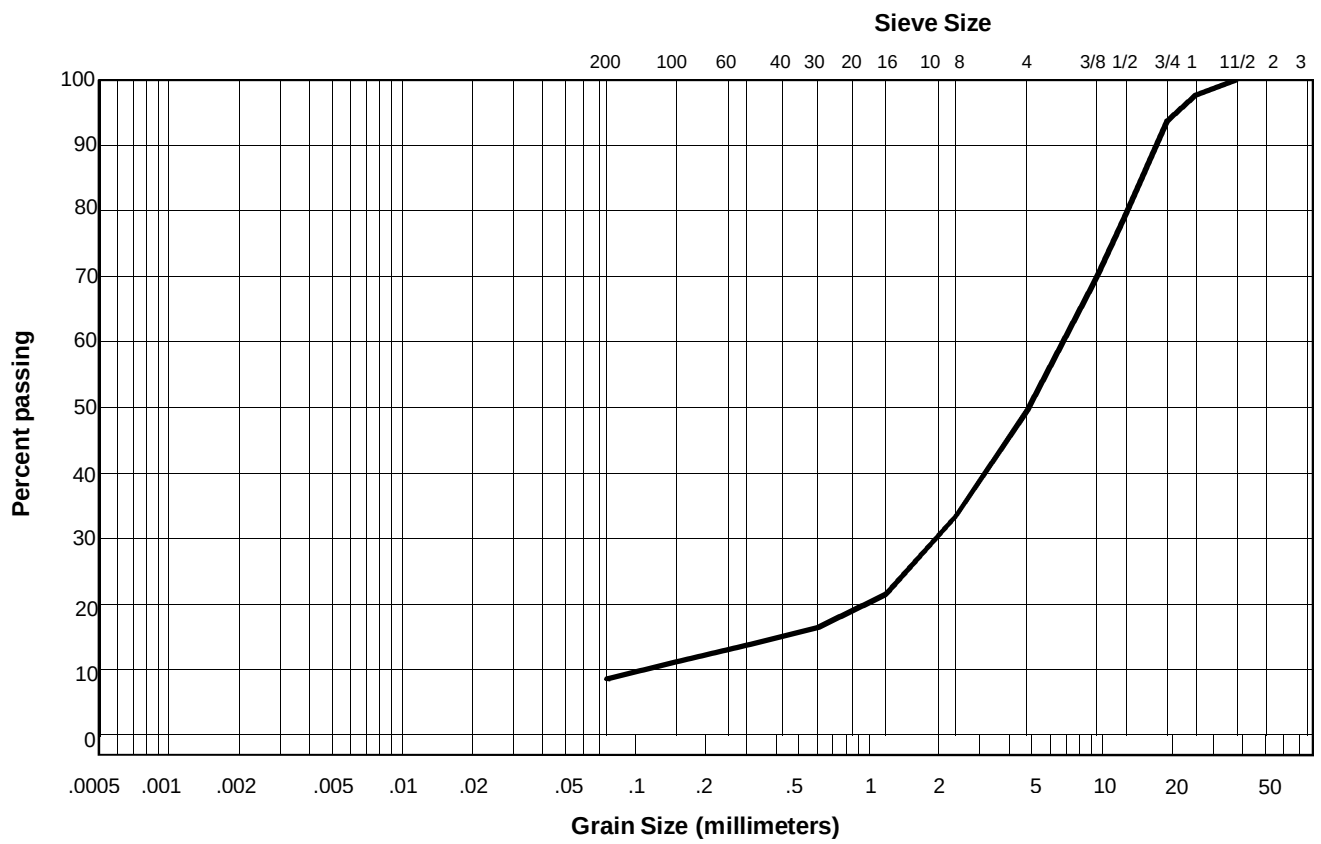
Cc: 5.0

Natural Moisture Content: 5.9%

Remarks: Gravel (50%) Sand (41%) Fines (9%)

Sieve Size (mm)	Percent Passing
37.500	100
25.000	98
19.000	94
12.500	79
9.500	70
4.750	50
2.360	33
1.180	21
0.600	16
0.300	14
0.150	11
0.075	8.5

Clay	Silt	Sand			Gravel	
		Fine	Medium	Coarse	Fine	Coarse



Reviewed By: DB P.Eng.

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GRAIN SIZE DISTRIBUTION

ASTM C136 & C117

Project: Trans Canada Highway (TCH) Km 81.3 - 85.5
Animal Underpass Structures

Project Number: V33101067

Date Tested: June 23, 2011

Borehole Number: BH2011-06 Sample 3

Depth: 2.6 m

Soil Description: SAND, gravelly, some fines

Cu: N/A

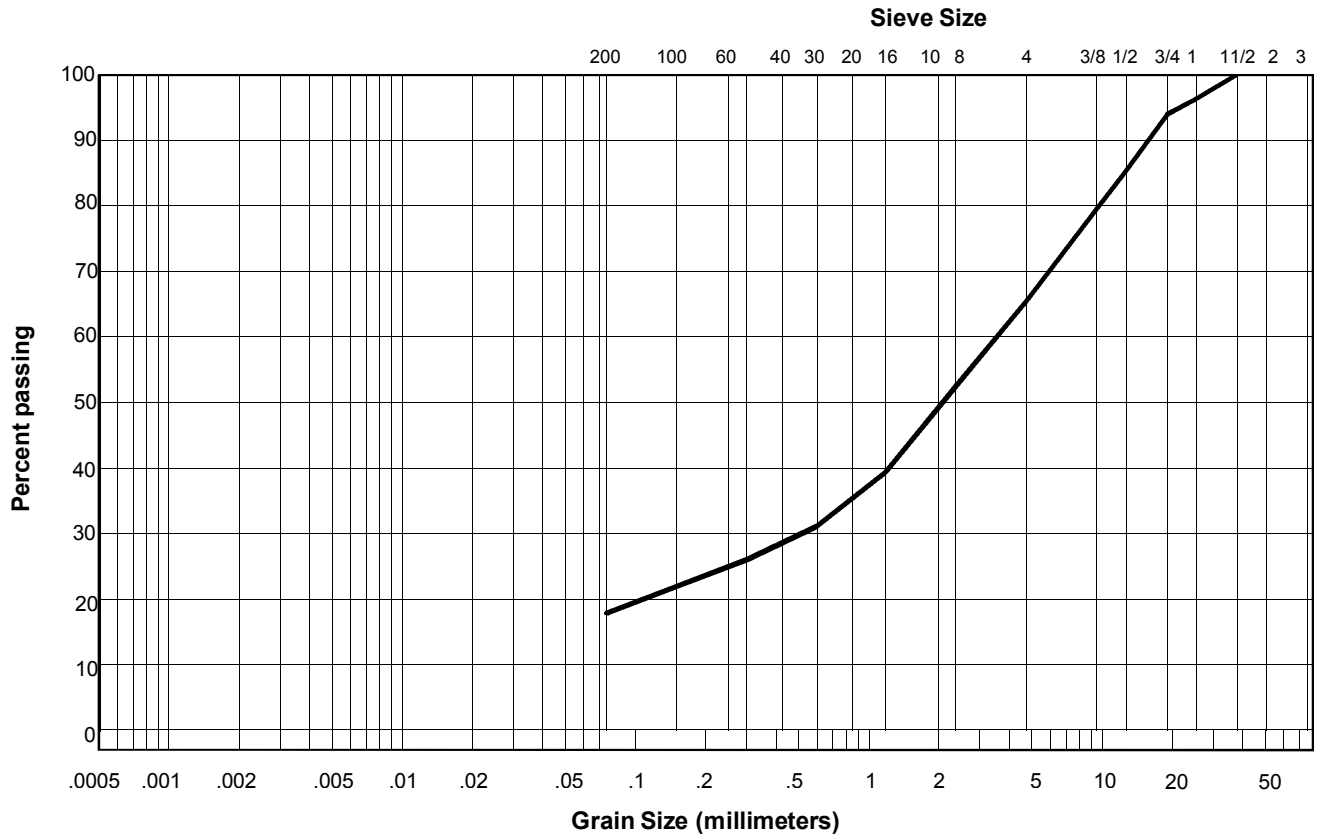
Cc: N/A

Natural Moisture Content: 5.0%

Remarks: Gravel (34%) Sand (48%) Fines (18%)

Sieve Size (mm)	Percent Passing
37.500	100
25.000	96
19.000	94
12.500	85
9.500	80
4.750	66
2.360	52
1.180	39
0.600	31
0.300	26
0.150	22
0.075	17.9

Clay	Silt	Sand			Gravel	
		Fine	Medium	Coarse	Fine	Coarse



Reviewed By: DB P.Eng.

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