# BRITISH COLUMBIA ARCHAEOLOGICAL IMPACT ASSESSMENT INTERIM REPORT FORM

## 1. REPORT TITLE

| | |
|---|---|
| HCA HIP 2021-0151 | Archaeological Impact Assessment of 800 University Drive Phase 1 |

## 2. MANAGEMENT SUMMARY

| | | |
|---|---|---|
| *2.1* | *Protected HCA Sites:* | None |
| *2.2* | *Brief Overview of Study:* | |
| | Tk̓emlúps te Secwépemc (TteS) Natural Resource Department conducted an Archaeological Impact Assessment (AIA) of 800 University Drive, at Thompson Rivers University in Kamloops, BC (Figure 1). Thompson Rivers (the proponent) plans to develop the location to accommodate housing, retail or other buildings as well as upgrade existing roads and utilities. The assessment was conducted in July of 2021 under the direction of a TteS Field Director adhering to the outlined conditions detailed under Heritage Inspection Permit (HIP) 2021-0151.<br><br>An area of potential was identified during the desktop-review, which was confirmed to display high archaeological potential during the field visit. The area was subject to subsurface testing; no artifacts or archaeological features were encountered during the investigation. | |
| *2.3* | *Results:* | |
| | A total of 31 tests were laid in 10 m grid spacing within areas containing high archaeological potential, with 20 of the 31 tests excavated by auger. The remaining 11 tests were not excavated due to concerns of contamination from the historic Guerin Creek landfill. These tests yielded negative results for archaeological materials. | |
| *2.4* | *Management Recommendations:* | |
| | No further work is recommended for the assessed auger test area, as well as the northern parking lot area; should excavation in the western half of the project area exceed the depth of landfill materials, archaeological monitoring is recommended pending safe access for TteS field staff. | |

## 3. ADMINISTRATIVE INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| *3.1* | *Permit Holder:* | Ryan Dickie, M.A | *3.2* | *Permit Holder Affiliation:* | Tk'emlúps te Secwepemc |
| *3.3* | *Proponent Contact:* | Matt Milovick<br>*T: (250) 819-6316*<br>*E: mmilovick@tru.ca* | *3.4* | *Proponent Affiliation:* | Thompson Rivers University,<br>805 TRU Way,<br>Kamloops,<br>BC V2C 0C8 |
| *3.5* | *Interim Report Author(s):* | Carissa Nakesch B.A (TteS NRD); Heleana Moore, B.A. (TteS NRD) | | | |
| *3.6* | *Interim Report Date & Version:* | October 29, 2021 | | | |
| *3.7* | *Notification of Work Date:* | N/A | | | |

## 4. PROPOSED DEVELOPMENT

| | | |
|---|---|---|
| *4.1* | *Description:* | Commercial and residential development |
| *4.2* | *Location:* | 800 University Drive, Kamloops, BC |
| *4.3* | *NTS Mapsheet* | 92I.069 |

## 5. FIELD CREW

**Table 1. Field Crew**

| *Date (dd/mm/yy)* | *Field Director (on site? Y/N)* | *Field Supervisor* | *Other Field Personnel* |
|---|---|---|---|
| 12/07/21 to 14/04/21 | Ryan Dickie (Y) | Carissa Nakesch (TteS) | Cade Hawkins-Bara, Daren Thomas, Heleana Moore (TteS) |

# 6. ARCHAEOLOGICAL METHODS & RESULTS

## 6.1. Pre-field Methodology

☒ Archaeological potential and sites are indicated on the Study Area Map

☐ An AOA and /or archaeological predictive model exists for the study area

Details:

☒ Previous field studies influenced this assessment

Details: AIA of BC Hydro SI-KAM-001 WKA Substation Duct Bank Egress DY0959, Kamloops, Kamloops, Permit #2018-0025 (Ursus 2018)

☒ Review of Provincial Heritage Register

Date Accessed: February 8, 2021

☒ Other

Details: Review of aerial photography indicates that a historic landfill was once located at the eastern extent of the property. Landfill location and extent confirmed by geotechnical assessment report conducted by EXP Services Inc. (Appendix B).

**Table 2. Archaeological Sites in the Vicinity of the Study Area**

| Borden No. | Distance & Direction from the Proposed Development | Site Type | Permit No. of Previous Visits | Site in Conflict (Y/N) |
|---|---|---|---|---|
| EeRc-43 | 1 km north | Cemetery | N/A | N |
| EeRc-58 | 1.2 km northwest | Burial | 1997-0004 | N |
| EeRc-134 | 1 km northwest | Artifact scatter | 2018-0025 | N |
| EeRc-135 | 1 km north | Artifact scatter | 2018-0025 | N |

## 6.2. In-field Methodology

☒ Auger test measurements are a minimum of 41 x 41 cm.

Date Assessed: July 12th to 14th, 2021

Describe if other: A 0.41 m auger bit was used to drill subsurface tests spaced at a 10 m grid; test sediments were then screened through 6mm mesh. All materials were returned into the drilled holes after screening occurred.

| | | | | | |
|---|---|---|---|---|---|
| *6.2.1* | *Number of Crew Members:* | 4-5 | *6.2.2* | *Crew Spacing:* | N/A |
| *6.2.3* | *Other:* | N/A | | | |

## 6.3. In-field Observations

Prior to fieldwork, the project area was subject to a desktop-based review. Archaeological sites within vicinity of the project area and any previous studies in the area are summarized above (Table 2). A review of historic aerial photography (City of Kamloops Map Series Through the Years 1928-2020) indicates that a historic landfill was once situated at the eastern extent of the development location as shown in the 1969 air photo. Geotechnical investigations detailed in the EXP Geotechnical Report (Appendix B) confirm that landfill remnants are present below the surface of the eastern extent of the project area (Figure 2, red line). Although this report details an "edge" of historic landfill debris, the edge is not clear from historical aerial photography. Historic air photos show the presence of a gravel parking lot in the northern extent of the project area appearing in 1986. Current satellite imagery indicates the northern extent of the project area now consists of a paved parking lot area, which has likely been extensively machine altered and leveled. Subsurface testing of this parking lot area is not feasible, but also unnecessary as the area displays low archaeological potential due to the level of historic disturbance. Utility locate survey indicated buried gas, sanitary, and electrical utilities in the eastern project area resulting this the area not being feasible for subsurface testing which also resulted in the low archaeological potential rating due to the high level of repeated disturbance. One grassy area with two rolling knoll features is deemed to display moderate to high archaeological potential at the desktop-review stage; this area of potential was later confirmed during fieldwork.

Fieldwork commenced July 12, 2021, starting with a field assessment of the area of archaeological potential. The area of potential, or auger test area, consists of two grassy knolls bordered by a sidewalk to the south, west, and north of the area. A BC One Call (conducted prior to fieldwork) indicates buried utilities running parallel to the outside of the test area along McGill Road and University Drive. An underground sprinkler irrigation system overlaps the entire test area as well, which was indicated on the client drawings provided.

A total of 31 tests locations were flagged at 10 m intervals. Auger excavation reached depths of up to 1.8 m below surface. Landfill refuse was encountered (AT 52-56 and 75 in Appendix A, Figure 2), further west then what was indicated by the geotechnical report (Figure 2). Testing was constrained to avoid all utilities; unfortunately, the irrigation system was hit at two auger test locations (Appendix A, Figure 2). Although these locations were excavated, they could not be screened due to the high volume of water flowing from the strike. Auger test 47 was also not excavated due to the close proximity to the underground irrigation line.

Only 20 of the 31 auger tests were excavated as the crew was not comfortable working in the historic landfill material for health and safety concerns. The presence of historic landfill debris also resulted in a down-grading of archaeological potential for the western remainder of the test area.

### 6.4. Results & Recommendations

**Table 3. Assessment Results**

| Subsurface Testing | Description | Location (UTM) | Dimensions (L x W) | Subsurface tests | | |
|---|---|---|---|---|---|---|
| | | | | Total | Pos | Neg |
| Auger Test (AT) Area | Urban landscaping of manicured rolling hills with various walkways and pavement surrounding the open landscape. No natural vegetation, and terrain is not natural but landscaped for aesthetic appeal. | 10 U 686659 5616128 (AT 59) | 60 m E-W X 60 m N-S | 20 | 0 | 20 |

A total of 20 auger tests were excavated within the proposed building development, of which none were positive for cultural materials. No protected archaeological sites or resources were identified within the areas of the proposed development that were accessible to archaeological investigation. The remainder of the project area is considered to have low potential for archaeological sites or was obscured by historic landfill material. The area that was successfully tested requires no further work, however due to the unknown depth of proposed future developments and the extent of landfill deposits throughout the area, we recommend that if development is to exceed landfill deposits and impact intact natural sediments, additional archaeological work is conducted. The lack of archaeological materials identified during the field assessments is not an indication of the absence of Secwepemc people on the landscape. Therefore, in the event that cultural materials are discovered over the course of the future proposed construction activities, all work should stop in the vicinity of the find and the Archaeology Branch and Tk'emlúps te Secwépemc Natural Resource Department be notified immediately.

## 7. DISCLOSURE STATEMENT & SIGNATURE

Even the most thorough investigation may fail to reveal the presence of all archaeological materials, including those protected by the Heritage Conservation Act. If unanticipated cultural materials or features, including but not limited to rock art, faunal remains, stone artifacts, and/or ancestral

remains, are encountered within the park, all ground-altering work in the immediate vicinity of the discovery should cease, and the Archaeology Branch must be contacted as soon as possible so that an archaeological management plan can be developed and implemented.

This study is concerned with the identification and documentation of archaeological sites protected under Section 12 of the Heritage Conservation Act. This study was conducted without prejudice to Aboriginal Title and Rights and therefore is not considered consultation for the purpose of defining or limiting the Aboriginal Rights and Title of the Tk'emlúps te Secwépemc or any First Nation.

Tk'emlúps te Secwepemc

Heleana Moore BA
Archaeological Field Director

Leslie LeBourdais BA, BGIS
A\Manager Natural Resources Department

## 8. REFERENCES CITED

Kamloops Through the Years 1928-2020 Map Series. *Kamloops.maps.arcgis.com*, kamloops.maps.arcgis.com/apps/MapSeries/index.html?appid=1b003d8208e844188a3939e895b86489.

Ursus, 2018
AIA of BC Hydro SI-KAM-001 WKA Substation Duct Bank Egress DY0959, Kamloops, Kamloops, Permit #2018-0025. Report on file with Archaeology Branch of British Columbia.

## 9. SHAPE FILES

☒ Study area shape files have been sent to archsiteform@gov.bc.ca

## 10. APPENDICES

**Required:**

☒ General Area Map
☒ Study Area Map
☒ Photo Plate(s)

**If Applicable:**

☒ Detailed Development Map
☒ Subsurface Test Log
☒ Site Forms, Site Maps and Related Documents
☐ Other Details:

**Photo 1.** View east of project area before commencement of auger testing.

**Photo 2.** View west during auger testing.

**Photo 3.** View north of project area after completion of auger testing. Note: this area represents the historic landfill.

**Photo 4.** View south of project area after completion of auger testing. Note McGill Road running east-west.

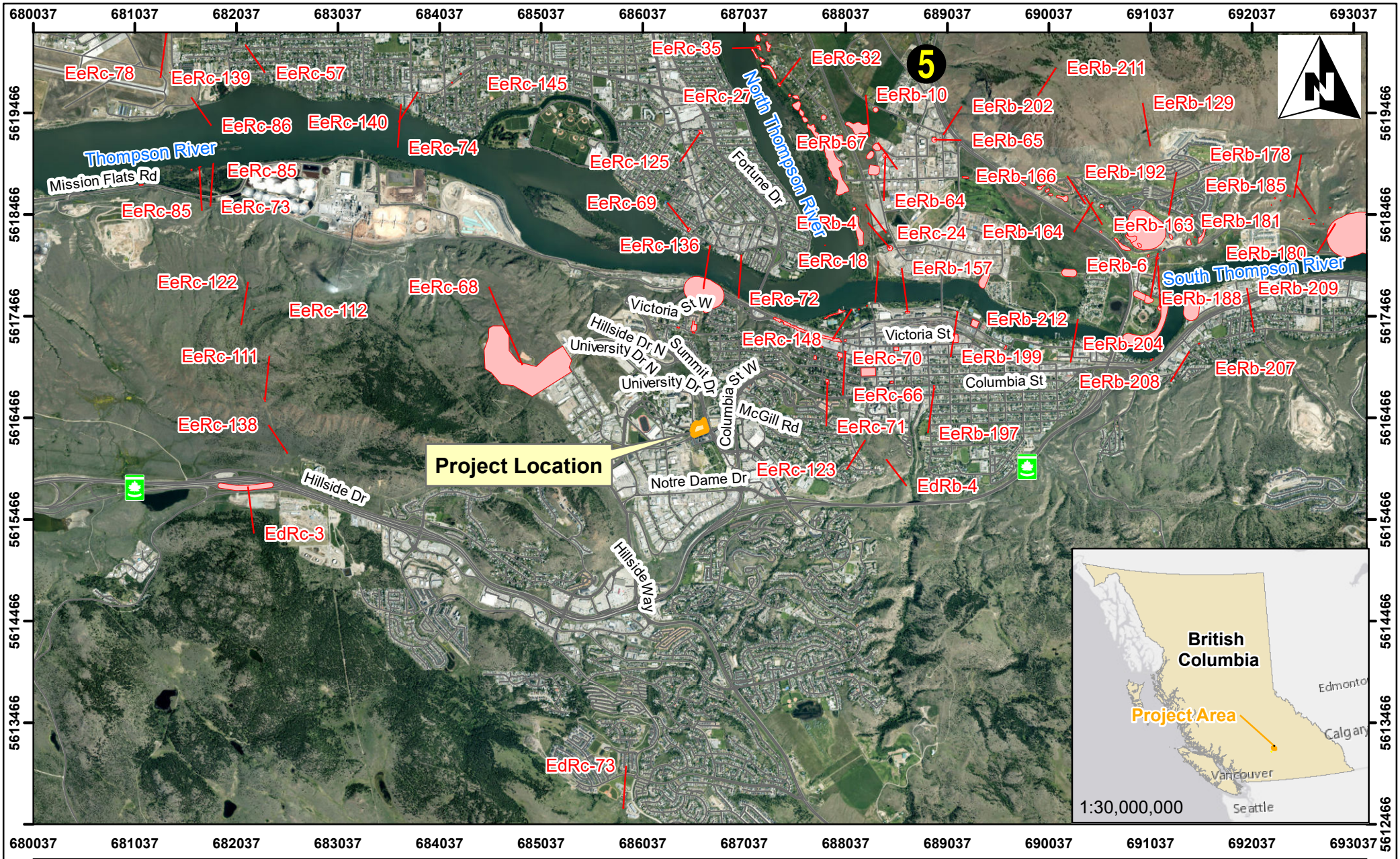



**Figure 1. Project Overview Map**
**Project: Archaeological Impact Assessment of 800 University Drive Phase 1**

**Client: Thompson Rivers University Community Trust**
**General Location: Kamloops, BC**
**Mapsheet #: 92I.069**
**HCA Permit #: 2021-0151**

**Legend**

- Project Location
- Previously Recorded Archaeological Site Boundary
- Road

Data Source: TteS NRD,MFLNRO,GeoBC, TRU Trust
BC Archaeolog Branch, ESRI Basemap
Coordinate System: NAD 83
UTM Zone 10N

0 0.75 1.5 Kilometers

1:50,000

Date: 2021-10-29

Document Path: U:\~NRD~\(1) Projects - CRM\2020\TRU_Trust\Projects\1. 800_University_Dr\Fig1_TRU_800UniversityDrive_ProjectLocation.mxd


**Figure 2. Auger Test Area**
**Project: Archaeological Impact Assessment of 800 University Drive Phase 1**

**Client: Thompson Rivers University Community Trust**
**General Location: Kamloops, BC**
**Mapsheet #: 92I.069**
**HCA Permit #: 2021-0151**

**Legend**

- Photo Location and Orientation
- Negative Auger Test
- Landfill Boundary
- Project Location

Data Source: TteS NRD,MFLNRO,GeoBC, TRU Trust
BC Archaeolog Branch, ESRI Basemap, EXP Services Inc.
Coordinate System: NAD 83
UTM Zone 10N

0 20 40 Meters

1:1,000

Date: 2021-10-29

Document Path: U:\~NRD~\(1) Projects - CRM\2020\TRU_Trust\Projects\1. 800_University_Dr\Fig2_TRU_800UniversityDrive_AugerTestArea.mxd

## Appendix A

## Auger Test Log Phase 1

| | | | | | |
|---|---|---|---|---|---|
| 44 | Negative | 0 | 1.4m | Brown silt/sand | 5% sub round and sub angular |
| 45 | Negative | 0 | 1.0m | Dark brown silt/sand | **0.5% asphalt**, 5% sub round and sub angular |
| 46 | Negative | 0 | 1.5 | Grey sand and pockets of clay | 2% sub round and sub angular |
| 47 | No Test | | | | |
| 48 | Negative | 0 | 1.6m | Brown silt/sand | 2% sub round and sub angular |
| 49 | Negative | 0 | 1.5m | Brown silt/sand | 2% sub round and sub angular |
| 50 | Negative | 0 | 1.8m | Brown silt/sand | 5% sub round and sub angular |
| 51 | Negative | 0 | 1.8m | Brown silt/sand | 5% sub round and sub angular |
| 52 | Negative | 0 | 1.2m | Brown silt | 5% sub round and sub angular |
| 53 | Negative | 0 | 1.2m | Brown silt/sand | 2% sub round and sub angular with glass shards |
| 54 | Negative | 0 | 1.0m | Dark brown silt | **Water line** |

| | | | | | |
|---|---|---|---|---|---|
| 55 | Negative | 0 | 1.5m | Dark brown sand | 0.5% pebbles |
| 56 | Negative | 0 | 1.2m | Light brown sand | 0.5% pebbles |
| 57 | Negative | 0 | 1.2m | Light brown sand | **Buried garbage** |
| 58 | Negative | 0 | 1.3m | Light brown sand | **Buried garbage** |
| 59 | Negative | 0 | 1.3m | Dark brown silt | **Buried garbage** |
| 60 | Negative | 0 | 1.5m | Dark brown silt | **Buried garbage** |
| 61 | Negative | 0 | 1.0m | Light brown sand | **Buried garbage** |
| 62 | Negative | 0 | 1.5m | Dark brown silt | **Buried garbage** |
| 63 | No test | | | | |
| 64 | No test | | | | |
| 65 | No test | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 66 | No test | | | | |
| 67 | No test | | | | |
| 68 | No test | | | | |
| 69 | No test | | | | |
| 70 | No test | | | | |
| 71 | No test | | | | |
| 72 | No test | | | | |
| 73 | No test | | | | |
| 74 | Negative | 0 | 1.0m | Light brown silty sand | 5% sub round and sub angular |

| | | | | | |
|---|---|---|---|---|---|
| 75 | Negative | 0 | 1.6m | Brown silt | 5% sub round and sub angular with **buried garbage** |

## Appendix B

Geotechnical Assessment - EXP

100B – 1425 Pearson Place
Kamloops, BC V1S 1J9 Canada
T: 250.372.5321 • www.exp.com

July 19, 2018

**Mr. Brock Nanson**
**Certes Applied & Natural Sciences**
**c/o Thompson Rivers University**
900 McGill Road
Kamloops, BC V2C 0A8

Email: bnanson@certes.ca

Project No.: KAM-17200041-P
**Subject: Geotechnical Assessment, TRU Corner Parcel Development**

Dear Mr. Nanson:

## 1.0 INTRODUCTION

As requested, **exp** Services Inc. (**exp**), has carried out a geotechnical assessment for the proposed development at Thompson Rivers University (TRU) located at the southeast Corner Parcel and parking lot, Kamloops, BC.

In March, 2017, **exp** conducted drilling investigation for Proposed Development. This report provides the factual results of geotechnical investigation along with general guidelines for site preparation and building foundation design.

**exp's** assessment include only the specified geotechnical aspects of the subsurface conditions at the site, and do not include investigation directed to environmental or archaeological issues. Environmental site assessment (including assessment of environmental impact of the landfill) is outside the scope of exp's work on this project. Nor has a soil corrosivity study been carried out as part of exp's assessment.

## 2.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The proposed development (Corner Lot Site) is located on the northwest corner of Summit Drive and McGill Road and includes the existing parking area between University Drive and Summit Drive at TRU, Kamloops, B.C. (see Figure 1, Site Plan). Based on preliminary information (architectural concept drawing) provided by the client, the proposed development will comprise 6-storey hotel building, underground/aboveground parkade, commercial and residential 4-storey timber frame structures and adjacent paved parking.

The site is bounded to the west by University Drive, east by Summit Drive, south by McGill Road and north university access road and Guerin Creek ravine. In the past, the east portion of the site was used as city garbage damp.

The site is presently occupied by a gravel surfaced parking lot (north portion) and grassy area with some trees (south portion). Several underground services are crossing the site in various directions.
The development site is somewhat rectangular in shape with topography gently sloping to the northeast.

Detailed drawings of the proposed buildings were not available at the time of the report, as such the discussions and recommendations in this report are subject to review during the detailed design phase.

## 3.0 FIELD AND LABORATORY INVESTIGATION

### 3.1 Field Work

**exp's** field investigation included 6 auger drill holes (BH17-01 thru'-06), placed with a truck-mounted auger drill to depths of between 11.0 and 19.9 m below surface grade.

The augerholes were drilled and sampled using hollow stem augers to allow split-spoon (SPT) sampling to be carried out for the full depth of the augerhole.

Standpipe piezometers were installed at BH17-03 to 06 for monitoring of groundwater levels.

Locations of the augerholes are shown on the attached Site Plan, Figure 1. Detailed logs of the augerholes are included in Appendix A.

### 3.2 Laboratory Work

Three samples from the drilling investigation were submitted for soluble sulphate and Ph testing to ALS Environmental Laboratories in Kamloops. The results are attached to the report in Appendix B.

Other laboratory testing included the following:

- Natural moisture content determination on all soil samples collected;
- Particle size distribution on two granular samples; and
- Atterberg Limits of one silt sample.

Moisture content results are included on the borehole logs in Appendix A; the particle size distribution results and Atterberg Limits are included in Appendix B.

## 4.0 RESULTS

### 4.1 Sub-soil Profile

A generalized sub-soil profile within the site would include the following soil units, in order of increasing depth. All units are not necessarily present at any particular testhole.

Unit 1: Topsoil/Organics
Unit 2: Surficial Fill Materials
Unit 3: Colluvial Deposit
Unit 4: Lacustrine Complex
Unit 5: Landfill Material (Refuse)
Unit 6: Bedrock

The soils of these units are described in more detail below.

*Unit 1: Topsoil/Organics (Fill)*
In general, all test holes with the exception of BH17-06 encountered surficial layer of topsoil with organics and roots. The topsoil was assessed to be an imported material (fill). Topsoil layer was relatively thin, (up to about 5 cm).

*Unit 2: Fill Materials*
A stratum of fill was encountered at all test holes. The fill unit was found to depths varying from 0.6m (BH17-01) to possibly greater than 6.1m (at BH17-05).

The fill stratum varied in composition generally consisting of moist, brown to grey Silt with varying quantities of sand and gravel to silty sand. The soils found in this unit were generally found to be in a loose to compact condition.

The below table indicates depth of the fill encountered at each test hole location.

Table 1 – Depth of Fill

| Location | Approximate BH Elevation (m) | Depth of fill soils (m) |
|---|---|---|
| BH17-01 | 512.80 | 0.6 |
| BH17-02 | 513.60 | 0.9 |
| BH17-03 | 514.40 | 0.9 |
| BH17-04 | 513.10 | 2.4 |
| BH17-05 | 511.00 | 6.1* |
| BH17-06 | 503.70 | 3.5* |

*Landfill material (Refuse) encountered below the fill

*Unit 3: Colluvial Deposit*
A layer of possible colluvial deposit was encountered below the fill in BH17-01 to BH17-04 to a depth ranging from 2.4 m (BH17-02) to 5.2 m (BH17-04). This unit was described as fine or medium sand with some silt to sand and silt, brown-grey and grey in colour, moist. This unit was inferred to be in loose or loose to compact condition.

*Unit 4: Lacustrine Complex*
Underlying the Unit 3 soils, a stratum of lacustrine soils was encountered. Soils of this unit are judged to be lake-deposited, and consist of generally moist, interlayered fine to medium sand, sand trace silt, or sand and silt. Laminations are evident in the siltier layers, while rhythmic bedding is detectable in some of the sand layers. This unit was inferred to be generally in compact condition.

*Unit 5: Landfill Material (Refuse)*
A thick layer of landfill material was encountered in BH17-05 and BH17-06. This unit contained sand, silt and various debris (metal, plastic, wood, paper, etc.). Landfill material extended to a depth of 13.4 m below grade in BH17-05 and to 13.7 m in BH17-06.

At the location of BH17-04 a thin layer (0.3 m) of garbage was encountered at a depth of 2.1m below grade.

Table 2 – Depth of Refuse

| Location | Approximate BH Elevation (m) | Depth to Refuse (m) | Bottom of Refuse (m) |
|---|---|---|---|
| BH17-01 | 512.80 | N/A | N/A |
| BH17-02 | 513.60 | N/A | N/A |
| BH17-03 | 514.40 | N/A | N/A |
| BH17-04 | 513.10 | 2.1 | 2.4 |
| BH17-05 | 511.00 | 6.1 | 13.4 |
| BH17-06 | 503.70 | 3.5 | 13.7 |

*Unit 6: Bedrock*
Weathered bedrock was encountered in BH17-05 and BH17-06 at a depth of 17.4 and 13.7 m respectively. Hollow stem auger drill was able to penetrate about 2 m into the bedrock.

Table 3 – Depth to Bedrock

| Location | Approximate BH Elevation (m) | Depth to Bedrock (m) |
|---|---|---|
| BH17-01 | 512.80 | N/A |
| BH17-02 | 513.60 | N/A |
| BH17-03 | 514.40 | N/A |
| BH17-04 | 513.10 | N/A |
| BH17-05 | 511.00 | 17.4 |
| BH17-06 | 503.70 | 13.7 |

### 4.2 Groundwater
Groundwater was encountered at a standpipe piezometers installed in BH17-05 and 06 at a depth of 13.59 and 13.69 m bgs on March 20, 2017 (approximately two weeks after installation). The groundwater table is expected to vary in response to seasonal changes and climactic events.

## 5.0 DISCUSSION AND RECOMMENDATIONS

### 5.1 General
For the clarity of this report, the site was divided into two portions:
- West portion, outside landfill (Site A) and
- East portion, landfill (Site B).

A review of the available aerial photography on the City of Kamloops website indicates that various earthworks operations have been carried out at and adjacent to the site in the past (Landfill operation, Summit Connector, additions to the parking areas, etc.). Approximate boundary of the landfill is provided on Figure 2.

A review of the site topography indicates the east portion of the corner parcel (Site B) is likely underlain by a gully that was infilled with refuse (as confirmed by drilling results).

**Site A**

As discussed in section 4 above, the general stratigraphy of the soils underlying the Site A consist of fill underlain by colluvial and lacustrine soils. Loose soils at the site were found to extended to depths ranging from 2.4 m (BH17-02) to about 7.0 m (BH17-04).

As discussed later in the report, we anticipate shallow foundations (strip footings, spread pads, or raft slab) would be required to bear on Unit 4 soils or structural fill placed over the Unit 4 soils or on deep foundation elements (Piles). We do not recommend placement of foundation elements, floor slabs, etc. on the Unit 1, Unit 2 or Unit 3 soils.

As discussed in the following sections, we recommend that all loose soils under the proposed structures be sub-excavated and replaced with structural fill.

**Site B**
The general stratigraphy of the soils underlying the Site B consist of fill (Unit 2) underlain by landfill material (Unit 5). Fill material at the site was found to be in loose or compact state and extended to the top of landfill material at depths ranging from 3.5 m (BH17-06) to about 6.1 m (BH17-05).

Landfill material extended to depths ranging from 13.4 m (BH17-05) to 13.7 m (BH17-06). Compact silty sand and stiff silt was encountered below the landfill material and extended to a depth of 17.4 m in BH17-05.

Weathered bedrock was encountered in BH17-05 and BH17-06 at a depth of 17.4 m and 13.7 m respectively.

Shallow foundations are not feasible on Site B; therefore, we recommend piles as discussed later in the report.

Based on conceptual architectural drawing we provide the following recommendations for each site.

### 5.1.1 Building Foundation Options

**Site A**
Based on the limited available information, we expect the soils at bearing elevation on Site A will consist of the Unit 4 soils. As such we anticipate that it will be feasible to support the proposed structures on shallow foundation elements (strip footings and spread pads or raft slab) bearing on Unit 4 or on structural fill over the Unit 4 soils. Structural filling would require the sub excavation of all fill and loose colluvium material from beneath the proposed building location. In order to maintain the stability of the temporary excavation slopes in the vicinity of the existing underground utilities, temporary shoring or slope retaining measures may be required.

**Site B**
Proposed structures located within landfill site, should be supported on deep foundations (piles) embedded into bedrock encountered below the landfill. Conceptual pile design parameters are provided in Section 5.4 of this report.

## 5.2 Site A Buildings

### 5.2.1 Site Preparation

Prior to construction, all topsoil, fill (Unit 1), fill (Unit 2) and colluvium (Unit 3) soils should be stripped from the building footprint to expose underlying lacustrine deposits. Stripping and sub-excavation prior to structural filling should extend laterally outside the edges of the perimeter building foundation by a distance equal to the depth of structural fill beneath the foundation (1H:1V splay).

Following stripping and sub-excavation, and upon approval by the geotechnical engineer, the site should be built back up to the required bearing grades by placing structural fill in accordance with section 5.2.2.

### 5.2.2 Structural Fill

Structural fill is defined as fill placed underneath any load bearing area including building foundations, floor slab areas and pavement.

In general, structural fills should consist of approved, clean, free-draining, well-graded 75 mm minus sand and gravel having less than 5% passing the 0.075 mm sieve size by weight. Other select low-plastic mineral soils which are predominantly granular and free of deleterious materials could be suitable for re-use as structural fill, subject to the review and approval by exp.

Structural fills required for support of footings (including fills placed for support of interior bearing walls) should be placed in lifts, each not exceeding 200mm loose thickness and compacted to 100% SPMDD (Standard Proctor Maximum Dry Density) at moisture content at or slightly above the optimum moisture content.

It is the contractor's responsibility to ensure that the extent, location, placement and compaction of structural fill(s) comply with these recommendations. **exp** should be retained to conduct regular in-situ density testing of structural fills as they are constructed for quality control purposes.

### 5.2.3 Excavation and Dewatering

Temporary unsupported excavation side slopes should be developed no steeper than 1.5 horizontal to 1 vertical (1.5H:1V) for dry conditions and slopes no higher than 5 m. Steeper slopes can be considered if suitable shoring is used to support the slope. If wet conditions are encountered the geotechnical engineer must be notified to assess the slope geometry.

At the time of the geotechnical investigation groundwater was not observed within the upper portion of the test holes. Based on the expected depth of excavation, it is anticipated that the dewatering measures will not be required during construction. The water level at the site will vary seasonally and may be encountered within deeper excavations. If groundwater is observed during the excavation, conventional sump and pump dewatering system should be used.

Spoil material should be stockpiled away from the excavation at a distance from the crest of the excavation equal to the excavation depth.

### 5.2.4 Footings

Conventional strip and spread footings within Site A should be founded on a minimum 200 mm thick layer of 19mm minus clean, well-graded, crushed sand and gravel placed directly on compact lacustrine deposit (Unit 4), or on compacted structural fill over the Unit 4 soils. Footings may be designed using a factored ultimate bearing resistance of 175 kPa. It is recommended that the Serviceability Limit States (SLS) soil bearing resistance be limited to 100 kPa. The minimum footing width should be 0.9m. Those bearing capacities apply only for footings and foundation walls (don't apply to raft slab). An alternative will be to support all buildings on raft foundation.

Perimeter footings of heated/unheated spaces should be placed at a minimum depth of 1.2 m and 1.5 m respectively below the final adjacent grade to control the influence of seasonal frost action.

The above assumes that foundation bearing load combinations apply a resultant force to the bearing surface with an angle no greater that 15° from the vertical. Where horizontal load components are such that the above inclination is exceeded, these situations should be reviewed with the geotechnical engineer.

Where footings are required to be stepped in elevation, the upper footing should be located entirely below a theoretical line that rises at an angle of 26.5° (2H: 1V) from the nearest edge of the lower footing.

### 5.2.5 Settlement Analysis

A settlement analysis for the proposed development was conducted using information gathered from the geotechnical drilling investigation. The analysis was conducted using computer modelling software (Settle3D by Rocscience) and additionally using settlement theories for flexible foundations. No architectural, structural, or preliminary design drawings were available during the time of analysis, therefore, several assumptions were made with respect to design grades, loading, and structure type. It is expected that the structure will be supported on shallow foundations where building areas are located on natural, loose to compact sand that is outside of the landfill footprint. Strip foundations with minimum dimensions of 0.9m were used in the analysis with an equivalent loading of 100 kPa (Serviceability Limit States Design).

The subsurface conditions encountered consisted primarily of fine sand with some boreholes encountering silty sand. In general, the sand was loose and became compact around 5m. For the purposes of the analysis, the sand was given a unit weight of 20 kN/m$^3$. A young's modulus of 10 MPa was used for loose sand encountered in the first 5 meters, and 15 MPa thereafter for compact sand to a final depth of 13m.

Total settlements for the proposed structure can be taken as being on the order of <25mm and will primarily depend on the depth of the foundation, the presence of underground parking, and the thickness of structural fill below footing elements.

Some differential settlement is expected, but due to rather homogeneous nature of the encountered soil in the boreholes, we expect that it will be comparably less than the total settlement values. Differential settlement values are also dependent on the length of the proposed structure which has not yet been finalized.

The results and discussion as shown above should be taken as preliminary and subject to review once actual loading conditions can be analyzed.

### 5.2.6 Below Grade Walls

The following parameters can be used for foundation wall design, assuming free draining structural backfill or approved excavation spoil conditions:

- Soil unit weight: 20 kN/m$^3$;
- At-rest earth pressure coefficient (kp): 3.0; and
- Active earth pressure coefficient (ka): 0.33.
- Internal friction angle: 30°

Other surcharge loads, if considered necessary should be included in the foundation wall design. For the purposes of this analysis, it was assumed that retaining walls are restrained at the top.

### 5.2.7 Floor Slab-on-Grade

Due to proposed location of some structures over the landfill, methane gas collection and extraction system may be required under the floor slab. Design of such a system is outside of our current scope of work.

The parkade concrete slab floors should be supported on a minimum 300mm thick clean clear 19mm gravel base course (drainage layer). The upper 100 mm should meet requirements for radon control purposes as required by the BC Building Code. The base course should be placed directly on compacted granular structural fill placed directly over the Unit 4 soils. A layer of filter fabric (Nilex 4551 or approved equivalent) should be installed below the drainage material.

A vapour barrier and piping for radon control purposes should be installed beneath the slab-on-grade as required by the BC Building Code.

For buildings not requiring radon control the slab-on-grade floors should be supported on a base-course layer consisting of minimum 300mm thickness of 19mm minus clean, well-graded, crushed sand and gravel placed directly under the slab. The base-course layer should be placed and compacted to 100% SPMDD. The base course layer should be placed directly on compacted structural fill over the Unit 4 soils. The slab can be designed using an assumed modulus of subgrade reaction "K" equal to 27,000 kN/m$^3$ (100 lb/cu.in.).

### 5.2.8 Site Surface Drainage

Surface runoff must be carefully controlled to avoid flooding and erosion problems within the site and on neighbouring sites. All building sites should be shaped and graded to direct runoff away from the building. Permanent drainage pathways should be constructed to direct runoff to approved discharge locations, such as drainage ditches and storm drains.

### 5.2.9 Sub-surface Drainage

It is required that each building with underground parkade structure where the lowest floor slab elevation is below adjacent exterior grade be constructed with a subsurface perimeter foundation drain. The perimeter drain should consist of a minimum 100mm diameter, perforated, rigid, PVC pipe that is surrounded by at least 300 mm of clean clear gravel or drain rock (19 mm in size),

and fully enveloped in a non-woven geotextile (Nilex 4551 or equivalent). The perimeter drain should be installed with invert elevation no less than 150mm lower than the underside of the adjacent interior floor slab. A qualified geotechnical engineer, or his representative, should inspect the excavation and prepare recommendations on the required subsurface drainage systems once the excavation has been completed.

The perimeter drain should discharge by gravity to the storm sewer system or (if gravity connection is not feasible) to separate pumped sump that discharges to the storm sewer system or another suitable location. On-site infiltration systems (rockpits) for disposal of sub-surface drainage is not recommended and should not be constructed.

**5.2.10 Foundation Wall Drains**
In case where the base of the perimeter footing is 1.5 m or greater below final grade, the drainage composite NuDrain, or an approved equivalent, be installed against the foundation wall with the filter cloth covered porous side facing out, extending from 0.5 m below final grade down to the top of the footing.

Note that the wall drainage composite must have a filter cloth side that is facing out to serve the drainage and ground stability objectives of the wall drains. It is stipulated that dimpled drainage sheets without a filter cloth side facing out do not serve these objectives and must not be used in this application.

The drain rock of the foundation drain should be extended across the top of the perimeter footing on the exterior side of the perimeter wall, to provide hydraulic connection between the NuDrain and the foundation drain.

**5.2.11 Roof Drainage**
Roof drainage systems should discharge to storm sewer via solid pipe.

**5.2.12 Backfill**
All backfill against foundations (a minimum 0.6 m thick layer) should consist of free draining sand and gravel (or drain rock). Material and compaction specifications for backfill would be similar to those discussed in section 5.2.2 of this report for structural fill.

**5.3 Site Grading**
For practical and economic reasons, site grading fill to support roadways and parking areas will consist of selectively excavated (free of deleterious materials), on site fill materials (Unit 2) and native on-site soils derived from the Unit 3 deposit.

Prior to excavating or placing site fills, all surficial material should be stripped. Following stripping, the subgrade in areas to receive fill should be moisture-conditioned by scarifying and watering and then thoroughly compacted with large vibratory equipment. Fill material should be moisture-conditioned to within 2% of the optimum moisture content for compaction by watering and mixing as necessary. It should be spread in thin lifts and each lift compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD) for the bulk of the fill, and to 100% of SPMDD in the top 0.3m.

Permanent cut and fill slope faces should be sloped no steeper than 2H: 1V. Fill slope faces should be over-filled and then trimmed back to the final face to ensure compaction of the surficial fill zone.

For structures supported on shallow foundations located within Site A, a 10 m setback from the edge of the landfill slope is recommended. Otherwise, a deep (pile) foundation option should be implemented.

**5.4 Piling Recommendations**

As discussed in Section 5.1 above, the proposed development footprint was underlain by two separate soil types, consisting of either deleterious garbage and landfill material (Unit 5), or a combination of sands and silts (Unit 4). Due to the varying and heterogeneous nature of the deleterious garbage and fill material underlying the eastern portion of the site, structures in this area supported on conventional shallow foundations should be expected to experience excessive post-construction total and differential settlements. In areas containing garbage and landfill debris, minimal settlement would be expected with a piled foundation option.

Subject to the discussion in Section 5.1 the western portion of the development site, which was underlain by sands and silts, can suitably support conventional shallow foundations. The amount of settlement expected would be comparably larger when compared to a piled foundation, and to mitigate the possibility of differential settlement, it is not recommended the building footprint extents into both zones unless entirely pile supported.

Based on our preliminary review, we have determined that a 610mm diameter pipe pile with a wall thickness of 12.7mm embedded in bedrock is suitable in supporting an ultimate, unfactored load of about 4000 to 5000 kN. The piles should be embedded into the bedrock by about 2 to 3m and driven to refusal. These pile dimensions are suitable and assume that there is a lateral component that requires such an embedment, otherwise, an embedment of 0.5m to 1.0m is acceptable. These piles, due to the presence of garbage and fill, will be end bearing. There are no in situ tests or rock cores available thus we cannot comment on the feasibility of driving such piles through bedrock. It is noteworthy that drilling through the bedrock may be required if piles are unable to be driven and will ultimately be the responsibility of the contractor. The pile capacity can be increased if the pipe pile is filled with concrete, if a larger diameter pile is used, or if the wall thickness is increased. If there are lateral requirements, we should be given the opportunity to review the information once it becomes available. For driven piles, it is recommended that capacities should be confirmed by pile dynamic analyzer (PDA) for at least one or more test piles.

Once final design grades, structure type, number of underground levels, and building loads become available, we should be given the opportunity to review them and refine the settlement estimates and (if requested) provide a detailed pile design for the proposed development.

**5.5 Buried Services**

Pipe bedding, backfill materials and compaction requirements for utility services should be designed and completed in accordance with the latest version of the Master Municipal Construction Documents (MMCD). All excavation for the installation of utilities should be carried out in compliance with the latest WorkSafe BC Regulation.

### 5.6 Asphalt Pavement for Light Vehicle Traffic

For all areas where asphalt pavement for light vehicle traffic is proposed, the following minimum structure is recommended:

- 50mm Asphalt Pavement
- 75mm Base Course (19mm minus)
- 300mm Granular Sub-base Course

It is anticipated that some areas will experience heavy truck traffic (eg. fire and garbage trucks) On this assumption, the following minimum pavement structure is suggested:

- 75mm Asphalt Pavement
- 75mm Base Course (19mm minus)
- 400mm Granular Sub-base Course

### 5.7 Sulphate Resistant Concrete

Due to prevalence of sulphate-bearing soils and groundwater in the Kamloops area, concrete in contact with the ground should be resistant to sulphate attack. As in other parts of Kamloops, the local practise is to use high flyash cement concrete, which imparts sulphate resistance.

Three soil samples were tested for soluble sulphates according to CSA A.23.2 (Clause 4.1.1.6 and Tables 2 and 3). The measured sulphate content (0.273%) in sample from BH17-05 at a depth of 10 feet indicate a severe (S-2) exposure class. Results of sulphate tests conducted on soil samples obtained during the geotechnical investigation is attached in Appendix B.

## 6.0 SEISMIC CONDITIONS

Proposed development is located in geographic area of low seismic activity as indicated in 2012 BC Building Code and 2015 National Building Code.

The interactive website (http://earthquakescanada.nrcan.gc.ca) maintained by Natural Resources Canada was used to obtain site-specific seismic ground motion parameters for seismic design and analysis. Seismic design in the province of British Columbia is based on the 2012 British Columbia Building Code (2012 BCBC). In accordance with the 2010 National Building Code of Canada (2010 NBCC) and 2012 BCBC, structures must be capable of withstanding seismic ground motions having a two (2) percent risk of exceedance over a 50 year design life, corresponding to a return period of 1 in 2,475 years. Based on interpolated seismic hazard values from Natural Resources Canada, the corresponding peak ground acceleration (PGA) and the five (5) percent damped spectral response accelerations for periods (T) of 0.2 seconds, 1.0 seconds and 2.0 seconds are presented below.

| Return Period | PGA | Sa (0.2) | Sa (1.0) | Sa (2.0) |
|---|---|---|---|---|
| 1 : 2,475yr | 0.138 | 0.277 | 0.105 | 0.062 |

Using the spectral acceleration values, Fa and Fv values were obtained from tables (Table 4.1.8.4B and 4.1.8.4C, respectively) provided in the 2012 British Columbia Building Code.

**Site A**

According to the 2012 British Columbia Building Code, the site is considered a Site Class D, with a **Fa** value of **1.3**, and an **Fv** of **1.4**. These foundation factors can be used to estimate the base shear loads prior to the onset of soil liquefaction or, provided that structural measures are implemented, to address the consequences of soil liquefaction such as the impact of loss of bearing capacity, and lateral and vertical permanent ground movements.

**Site B**
According to the 2012 British Columbia Building Code, the site is considered a Site Class E, with a **Fa** value of **2.0**, and an **Fv** of **2.1**.

## 7.0 LIQUEFACTION ANALYSIS

Based on our review of available test hole data within the site and the seismic design parameters defined in Section 6.0 it was assessed that the liquefaction susceptibility of the subsoil underlying the site is unlikely considering their geotechnical characteristics and deep groundwater level within the site.

It is further assessed that the groundwater table is located at significant depth below the proposed building foundations (>10m). Structures constructed on piles embedded in bedrock are not susceptible to liquefaction. Should granular soils layers loose enough to liquefy during a design earthquake event be present below the groundwater table, the overlying soil above the water table will provide an adequate "crust" to prevent punching failure of the building footings.

## 8.0 DESIGN AND FIELD REVIEW

As discussed above, the report is based on preliminary architectural concept drawing. Aspects of the final design pertaining to temporary and permanent geotechnical issues as well as site grading should be reviewed by the geotechnical engineer for conformance with the intent of the recommendations of this report, and subsequent reports, if any.

Field review by the geotechnical engineer during the course of construction should include:

- Review of native subgrade soils and preparation of native subgrade soil surfaces prior to placement of any structural fill, site grading fill or surfacing materials;
- Compaction and materials testing for structural fills, site grading fills and backfills;
- Bearing surfaces prior to placing of foundation forms or retaining walls;
- Geotechnical aspects of roof and foundation drainage;
- Pile installation monitoring;
- Compaction and material testing of surfacing materials.

## 9.0 CLOSURE

This report has been prepared for the purpose of design for the exclusive use of TRU, Certes Applied & Natural Sciences, City of Kamloops, and their designated representatives and may not be used by other parties without the written permission of **exp** Services Inc. The information provided in the report is valid as of this date. However, conditions that are beyond our control or that may occur with the passage of time may invalidate, either in whole or in part, the results, conclusions and recommendations presented herein. Any third party using this report for bidding or construction purposes should perform such

independent study as deemed necessary to satisfy himself of the subsurface conditions to be expected and procedures to be used in conducting works at the site.

This report is based on the information obtained from limited number of test holes at the proposed site and on interpretation of the observed site conditions. It is possible that different soil conditions may be encountered during excavation at locations where no test holes have been advanced. **exp** Services Inc. should be notified immediately to review any new findings and to provide any necessary amendments.

Use of this report is subject to the "Statement of General Conditions" which is attached. The reader's attention is drawn specifically to these conditions as it is considered essential that they be followed for proper use and interpretation of this report.

We trust this report meets with your requirements, however, should any questions arise, please do not hesitate to contact the undersigned.

Sincerely,

**exp.** Services Inc.

Jan Radziszewski, M.Eng., P. Eng.
Senior Geotechnical Engineer


**Reviewed by:**

Stephen Prime, P. Eng.
Associate

Enclosures: "Statement of General Conditions"
Figures
Appendix A: BH Logs
Appendix B: Laboratory Testing Results

# STATEMENT OF GENERAL CONDITIONS

## 1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is made. Geotechnical studies and reports do not include environmental consulting unless specifically stated in the geotechnical report.

## 2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

## 3. BASIS OF THE REPORT

The Report has been prepared for the specific site, development, design objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

## 4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorize only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorized use of the Report.

## 5. INTERPRETATION OF THE REPORT

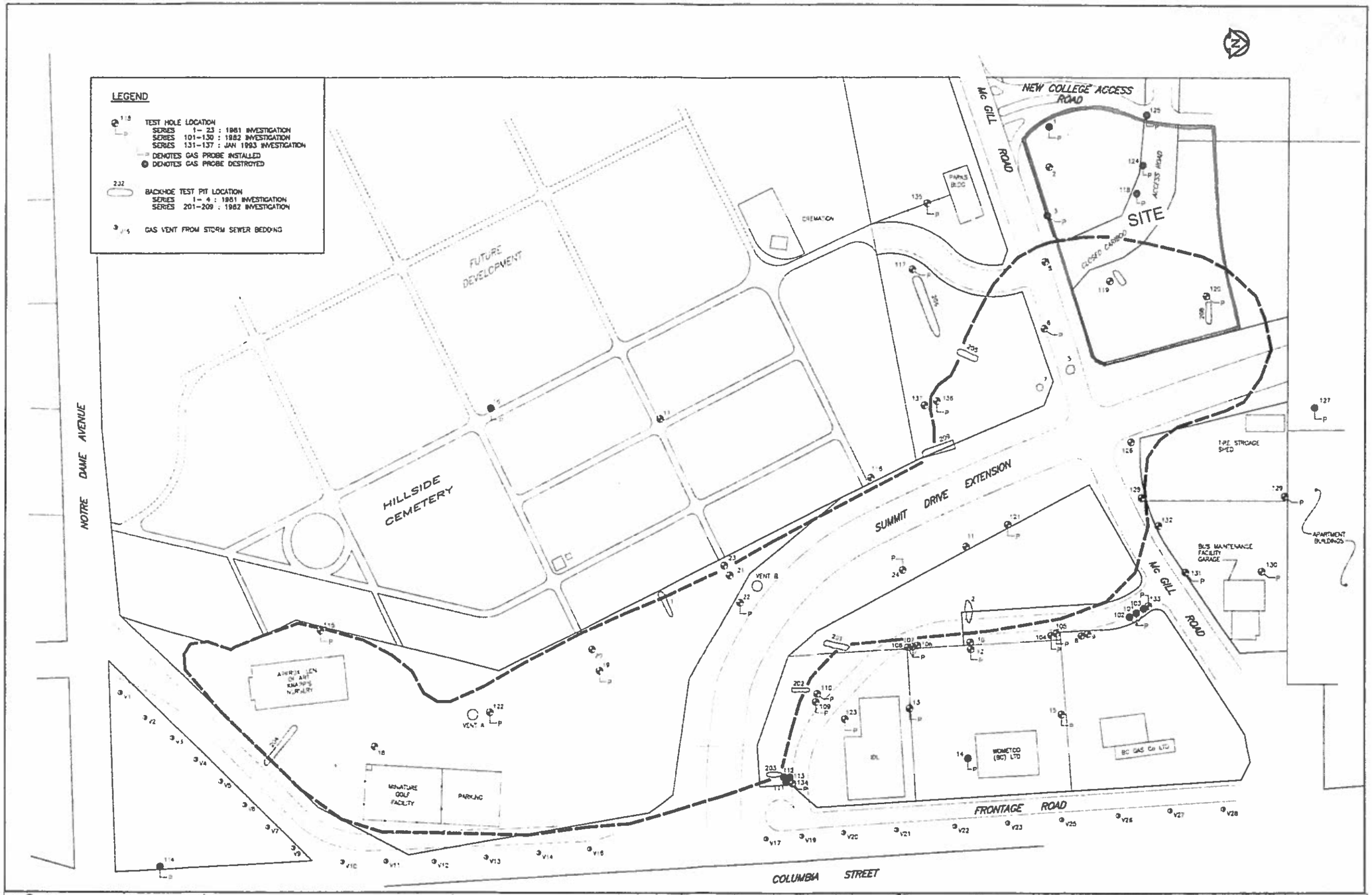
a. Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgemental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilising the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk, Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special

considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b. Reliance on Provided information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons provided information.

c. To avoid misunderstandings, exp. Services Inc. should be retained to work with the other design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to engineering issues. So to, exp. Services Inc. should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices.


| | | | | | | | |
|---|---|---|---|---|---|---|---|
| exp. | CERTES APPLIED & NATURAL SCIENCES | SITE PLAN<br>BOREHOLE LOCATIONS | Des. | JR | Job | 17200041-P | Reference: |
| | TRU CORNER PARCEL DEVELOPMENT | | Drn. | JR | Date | APRIL 2017 | |
| | | | Chk. | SP | Dwg No. | FIGURE 1 | |
| | | | Scale | NTS | | | |




| | | | | | | |
|---|---|---|---|---|---|---|
| exp. | CERTES APPLIED & NATURAL SCIENCES | GUERIN CREEK LANDFILL | Des. | JR | Job | 17200041-P |
| | | | Drn. | JR | Date | APRIL 2017 |
| | TRU CORNER PARCEL DEVELOPMENT | | Chk. | SP | Dwg No. | FIGURE 2 |
| | | | Scale | NTS | | |

Reference:
CITY OF KAMLOOPS,
GUERIN CREEK
LANDFILL GAS
STUDY-PHASE 3

# APPENDIX A: BH LOGS

# APPENDIX B: LABORATORY TEST RESULTS

# APPENDIX A: BH LOGS

exp Services Inc.
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Fax: 1.604.874.2358

# RECORD OF BOREHOLE : BH17-01



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-06
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY _____ CHECKED BY _____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 512.80m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING — Dry
▼ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. / DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY % | SPT N VALUE BLOWS/0.3m ▲ 20 40 60 80 / DYNAMIC CONE BLOWS/0.3m 20 40 60 80 | POCKET PEN. (kPa) ⊙ 100 200 300 400 / FIELD VANE SHEAR (kPa) Peak ● Remold ○ 40 80 120 160 | FINES CONTENT (%) □ 20 40 60 80 / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL 20 40 60 80 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | TOPSOIL and GRASS, 50mm thick over SILT, some sand, brown, wet, (loose) (FILL) | 512.2 | | | | | | |
| 1 | | SAND, fine grained and SILT, layered, grey to brown, moist, (loose) | 0.6 | 1 | SPT | | 8 ▲ | | 20 ○ |
| 2 | | | | | | | | | |
| 3 | | -fine to medium grained, some silt, interlayered, grey, (loose) | 509.4 | 2 | SPT | | 8 ▲ | | 14 ○ |
| 4 | | SAND, medium grained, grey, moist, (loose to compact) | 3.4 | 3 | SPT | | 9 ▲ | | 2 ○ |
| 5 | | | | | | | | | |
| 6 | | -compact | | 4 | SPT | | 17 ▲ | | 3 ○ |
| 7 | | | | | | | | | |
| 8 | | -fine to medium grained | | 5 | SPT | | 23 ▲ | | 9 ○ |
| 9 | | | | 6 | SPT | | 21 ▲ | | 9 ○ |
| 10 | | | | | | | | | |
| | | | 501.8 | 7 | SPT | | 24 ▲ | | 6 ○ |

Bottom of hole at 11.0m.

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# RECORD OF BOREHOLE : BH17-02



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-06
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY _____ CHECKED BY _____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 513.60m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING — Dry
▼ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. / DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY % | SPT N VALUE BLOWS/0.3m ▲ 20 40 60 80 / DYNAMIC CONE BLOWS/0.3m 20 40 60 80 | POCKET PEN. (kPa) ⊙ 100 200 300 400 / FIELD VANE SHEAR (kPa) Peak ● Remold ○ 40 80 120 160 | FINES CONTENT (%) □ 20 40 60 80 / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL 20 40 60 80 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | TOPSOIL and GRASS, 50mm thick over SILT, some fine sand, brown to grey, wet, (loose) (FILL) | 512.7 | | | | | | |
| 1 | | SAND, fine grained, some silt, grey, moist, (loose to comact) | 0.9 | | | | | | |
| 2 | | | | 1 | SPT | | 9 ▲ | | 16 ○ |
| | | | 511.2 | | | | | | |
| 3 | | SAND, medium grained, trace silt, grey, moist, (compact) | 2.4 | | | | | | |
| | | | | 2 | SPT | | 16 ▲ | | 4 ○ |
| 4 | | | | | | | | | |
| 5 | | | | 3 | SPT | | 20 ▲ | | 4 ○ |
| 6 | | | | | | | | | |
| | | | | 4 | SPT | | 18 ▲ | | 4 ○ |
| 7 | | | | | | | | | |
| 8 | | | | 5 | SPT | | 15 ▲ | | 4 ○ |
| 9 | | | | | | | | | |
| | | -fine grained, silty, wet | | 6 | SPT | | 15 ▲ | | 35 ○ |
| 10 | | | | | | | | | |
| 11 | | | | 7 | SPT | | 20 ▲ | | 7 ○ |

(Continued Next Page)

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# RECORD OF BOREHOLE : BH17-02



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-06
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY CHECKED BY

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 513.60m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING — Dry
▽ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. / DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY % | SPT N VALUE BLOWS/0.3m ▲ 20 40 60 80 / DYNAMIC CONE BLOWS/0.3m 20 40 60 80 | POCKET PEN. (kPa) ⊙ 100 200 300 400 / FIELD VANE SHEAR (kPa) Peak ● Remold ○ 40 80 120 160 | FINES CONTENT (%) □ 20 40 60 80 / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL 20 40 60 80 |
|---|---|---|---|---|---|---|---|---|---|
| 12 | | SAND, medium grained, trace silt, grey, moist, (compact) *(continued)* | | | | | | | |
| | | | 500.8 | 8 | SPT | | 25 ▲ | | 11 ○ |

**Bottom of hole at 12.8m.**

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# RECORD OF BOREHOLE : BH17-03

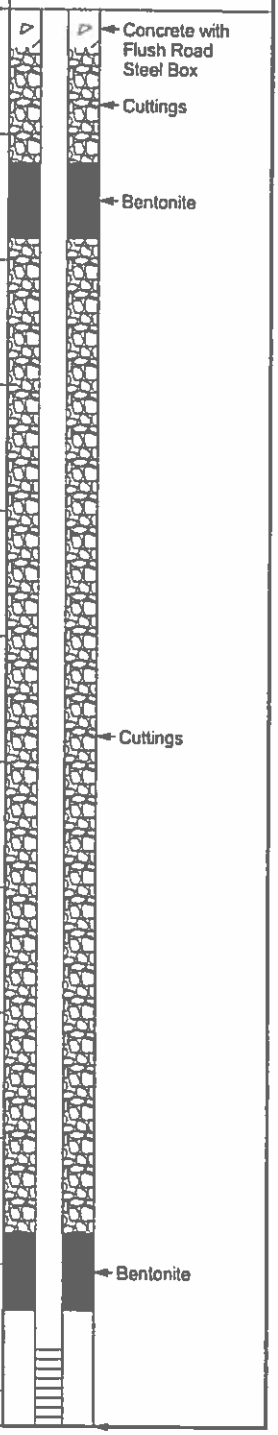


PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-06
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY _____ CHECKED BY _____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 514.40m
GROUND WATER LEVELS: AT TIME OF DRILLING —
AT END OF DRILLING — Dry
AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | RECOVERY % | SPT N VALUE BLOWS/0.3m (20 40 60 80) / DYNAMIC CONE BLOWS/0.3m (20 40 60 80) | POCKET PEN (kPa) (100 200 300 400) / FIELD VANE SHEAR (kPa) Peak Remold (40 80 120 160) | FINES CONTENT (%) (20 40 60 80) / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL (20 40 60 80) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | TOPSOIL and GRASS, 50mm thick over SANDY SILT, brown, moist, (loose) (FILL) | 513.5 | | | | | | |
| 1 | | SAND, medium grained, grey, moist, (loose) | 0.9 | | | | | | |
| 2 | | | | 1 | SPT | | 5 | | 6 |
| 3 | | | | | | | | | |
| 4 | | | | 2 | SPT | | 6 | | 11 |
| | | | 510.4 | | | | | | |
| | | SAND, fine grained, trace silt, pockets of lenses, grey, moist, (compact) | 4.0 | | | | | | |
| 5 | | | 509.5 | 3 | SPT | | 13 | | 18 |
| | | SAND, medium grained, grey, moist, (compact) | 4.9 | | | | | | |
| 6 | | | | 4 | SPT | | 14 | | 6 |
| 7 | | | | | | | | | |
| 8 | | | | 5 | SPT | | 19 | | 5 |
| 9 | | | | | | | | | |
| 10 | | | | 6 | SPT | | 17 | | 5 |
| 11 | | | | 7 | SPT | | 21 | | 4 |

WELL DIAGRAM
Casing Top Elev: 0m




(Continued Next Page)

exp Services Inc.
275 - 3001 Wayburne Drive
Burnaby, BC V5G 4W3
Telephone: 1.604.874.1245
Fax: 1.604.874.2358

# RECORD OF BOREHOLE : BH17-03



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-06
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY
CHECKED BY

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 514.40m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING — Dry
▼ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY % | SPT N VALUE BLOWS/0.3m ▲ 20 40 60 80 / DYNAMIC CONE BLOWS/0.3m 20 40 60 80 | POCKET PEN. (kPa) ⊙ 100 200 300 400 / FIELD VANE SHEAR (kPa) Peak ● Remold ○ 40 80 120 160 | FINES CONTENT (%) □ 20 40 60 80 / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL 20 40 60 80 | WELL DIAGRAM Casing Top Elev: 0m |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | | SAND, medium grained, grey, moist, (compact) *(continued)*<br>-fine grained, layered | 501.6 | 8 | SPT | | 20 ▲ | | 14 ⬠ | Sand<br>50mm dia. slotted |

Bottom of hole at 12.8m.

exp Services Inc.
275 - 3001 Wayburne Drive
Burnaby, BC V5G 4W3
Telephone: 1.604.874.1245
Fax: 1.604.874.2358

# RECORD OF BOREHOLE : BH17-04



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-07
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY _____ CHECKED BY _____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 513.10m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING — Dry
▽ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. / DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY % | SPT N VALUE BLOWS/0.3m (▲) 20 40 60 80 / DYNAMIC CONE BLOWS/0.3m 20 40 60 80 | POCKET PEN. (kPa) (⊙) 100 200 300 400 / FIELD VANE SHEAR (kPa) Peak ● Remold ○ 40 80 120 160 | FINES CONTENT (%) (□) 20 40 60 80 / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL 20 40 60 80 | WELL DIAGRAM Casing Top Elev: m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | TOPSOIL and GRASS, 50mm thick over SAND, trace silt, trace organics, grey to brown, moist, (loose) (FILL) | | | | | | | | Concrete with Flush Road Steel Box |
| 1 | | | | | | | | | | Cuttings |
| 2 | | | 511.0 | 1 | SPT | | 7 ▲ | | 17 ⬠ | Bentonite |
| | | Paper, glass, sand, (GARBAGE) | 2.1 | | | | | | | |
| | | | 510.7 | | | | | | | |
| 3 | | SILT, trace fine sand, grey, moist, (stiff) | 2.4 | | | | | | | |
| | | | | 2 | SPT | | 15 ▲ | | 28 ⬠ | |
| 4 | | | 509.1 | | | | | | | |
| | | SAND and SILT, layered, grey, moist, (loose) | 4.0 | | | | | | | |
| 5 | | | | 3 | SPT | | 8 ▲ | | 30 ⬠ | |
| | | | 507.9 | | | | | | | |
| | | SAND, medium, grey, moist, (loose to compact) | 5.2 | | | | | | | Cuttings |
| 6 | | | | | | | | | | |
| | | | | 4 | SPT | | 9 ▲ | | 3 ⬠ | |
| 7 | | | | | | | | | | |
| | | -compact | | 5 | SPT | | 23 ▲ | | 4 ⬠ | |
| 8 | | | | | | | | | | |
| 9 | | | 504.0 | | | | | | | |
| | | SAND and SILT, layered, grey, moist, (compact) | 9.1 | 6 | SPT | | 16 ▲ | | 27 ⬠ | |
| 10 | | | 502.9 | | | | | | | Bentonite |
| | | SAND, fine, trace silt, layered, grey, moist, (compact) | 10.2 | | | | | | | |
| 11 | | | | 7 | SPT | | 26 ▲ | | 17 ⬠ | |

(Continued Next Page)

exp Services Inc.
275 - 3001 Wayburne Drive
Burnaby, BC V5G 4W3
Telephone: 1.604.874.1245
Fax: 1.604.874.2358

# RECORD OF BOREHOLE : BH17-04



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-07
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY _____ CHECKED BY _____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 513.10m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING — Dry
▽ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. / DEPTH (m) | SAMPLES: NUMBER | SAMPLES: TYPE | SAMPLES: RECOVERY % | SPT N VALUE BLOWS/0.3m (20 40 60 80) / DYNAMIC CONE BLOWS/0.3m (20 40 60 80) | POCKET PEN. (kPa) (100 200 300 400) / FIELD VANE SHEAR (kPa) Peak ● Remold ○ (40 80 120 160) | FINES CONTENT (%) (20 40 60 80) / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL (20 40 60 80) | WELL DIAGRAM Casing Top Elev: m |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | | SAND, fine, trace silt, layered, grey, moist, (compact) *(continued)* | 500.3 | 8 | SPT | | 27 ▲ | | 18 ○ | Sand 50mm dia. slotted |

**Bottom of hole at 12.8m.**

exp Services Inc.
275 - 3001 Wayburne Drive
Burnaby, BC V5G 4W3
Telephone: 1.604.874.1245
Fax: 1.604.874.2358

# RECORD OF BOREHOLE : BH17-05



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-07
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY _____ CHECKED BY _____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 511.00m
GROUND WATER LEVELS: AT TIME OF DRILLING —
AT END OF DRILLING 13.59m
AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. / DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | RECOVERY % | SPT N VALUE BLOWS/0.3m (20 40 60 80) / DYNAMIC CONE BLOWS/0.3m (20 40 60 80) | POCKET PEN. (kPa) (100 200 300 400) / FIELD VANE SHEAR (kPa) Peak Remold (40 80 120 160) | FINES CONTENT (%) (20 40 60 80) / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL (20 40 60 80) | WELL DIAGRAM Casing Top Elev: m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | TOPSOIL and GRASS, 50mm thick over SANDY SILT, trace gravel, brown to grey, wet, (loose) (FILL) | 509.5 | | | | | | | Concrete with Flush Road Steel Box |
| 2 | | SAND, some fine gravel, dark grey, moist, (compact) (FILL) | 1.5 | 1 | SPT | | 25 | | 6 | |
| 3 | | SILT, some fine sand, trace clay, grey, moist, (loose) (FILL) | 508.4 / 2.6 | 2 | SPT | | 7 | | 11 | Cuttings |
| 5 | | | | 3 | SPT | | 9 | | | |
| 6 | | | 504.9 | | | | | | | Bentonite |
| 6 | | SAND, some silt, garbage (metal, plastic...) | 6.1 | 4 | SPT | | 50 / 50/100mm | | | |
| 8 | | | | 5 | SPT | | 55 | | | |
| 9 | | | | 6 | SPT | | 31 | | | |
| 11 | | -some wood debris | | 7 | SPT | | 42 | | | Cuttings |



(Continued Next Page)

exp Services Inc.
275 - 3001 Wayburne Drive
Burnaby, BC V5G 4W3
Telephone: 1.604.874.1245
Fax: 1.604.874.2358

# RECORD OF BOREHOLE : BH17-05



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-07
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY _____ CHECKED BY _____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 511.00m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING 13.59m
▼ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. / DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | RECOVERY % | SPT N VALUE BLOWS/0.3m (20 40 60 80) / DYNAMIC CONE BLOWS/0.3m (20 40 60 80) | POCKET PEN (kPa) (100 200 300 400) / FIELD VANE SHEAR (kPa) Peak ● Remold ○ (40 80 120 160) | FINES CONTENT (%) (20 40 60 80) / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL (20 40 60 80) | WELL DIAGRAM Casing Top Elev: m |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | | SAND, some silt, garbage (metal, plastic...) *(continued)* | | | | | | | | |
| 13 | | -trace wood debris | | 8 | SPT | | 38 ▲ | | | |
| | | SILTY SAND, grey/black, wet, (compact) | 497.6 / 13.4 | | | | | | | |
| 14 | | | | 9 | SPT | | 24 ▲ | | | |
| 15 | | SILT, some fine sand, brown, (compact/stiff) | 496.2 / 14.8 | 10 | SPT | | 14 ▲ | | | Bentonite |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | BEDROCK, weathered, some sand, some gravel, yellowish brown, wet | 493.6 / 17.4 | 11 | SPT | | 92 ▲ | | | Sand - 50mm dia. slotted |
| 19 | | | | | | | | | | |
| | | | 491.1 | 12 | SPT | | 50 ▲ 50/75mm | | | |

Bottom of hole at 19.9m.

exp Services Inc.
275 - 3001 Wayburne Drive
Burnaby, BC V5G 4W3
Telephone: 1.604.874.1245
Fax: 1.604.874.2358

# RECORD OF BOREHOLE : BH17-06



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-08
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY _____ CHECKED BY _____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 503.70m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING 13.69m
▽ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV / DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | RECOVERY % | SPT N VALUE BLOWS/0.3m (20 40 60 80) / DYNAMIC CONE BLOWS/0.3m (20 40 60 80) | POCKET PEN. (kPa) (100 200 300 400) / FIELD VANE SHEAR (kPa) Peak Remold (40 80 120 160) | FINES CONTENT (%) (20 40 60 80) / PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL (20 40 60 80) | WELL DIAGRAM Casing Top Elev: m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | SANDY GRAVEL, trace silt, grey to brown, moist, (compact) (FILL) | 502.2 | | | | | | | Concrete with Flush Road Steel Box |
| 1 | | GRAVELLY SILT, some fine sand, grey to brown, moist, (compact) (FILL) | 1.5 / 501.6 | 1 | SPT | | 33 ▲ | | | |
| 2 | | SILT, some fine sand, grey to brown, moist, (loose) (FILL) | 2.1 | | | | | | | Cuttings/Sand |
| 3 | | | 500.2 | 2 | SPT | | 9 ▲ bouncing | | 10 ○ | |
| 4 | | -at 3.5m black silt mixed with garbage SILT, plastic, metal, wood, (GARBAGE) | 3.5 | | | | | | | Bentonite |
| 5 | | | | 3 | SPT | | 6 ▲ | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | 4 | SPT | | 9 ▲ | | | |
| 9 | | | | | | | | | | Cuttings |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |



(Continued Next Page)

exp Services Inc.
275 - 3001 Waybume Drive
Burnaby, BC V5G 4W3
Telephone: 1.604.874.1245
Fax: 1.604.874.2358

# RECORD OF BOREHOLE : BH17-06



PROJECT NUMBER KAM-17200041-P0
PROJECT NAME TRU - SE Corner Parcel
DRILLING DATE 2017-03-08
DRILLING CONTRACTOR Mud Bay Drilling Co. Ltd.
DRILLING METHOD Hollow Stem Auger
EQUIPMENT TYPE Truck Mounted Auger Drill
LOGGED BY ____ CHECKED BY ____

CLIENT TRU Community Trust
PROJECT LOCATION TRU, Kamloops, BC
BOREHOLE LOCATION See location plan
ELEVATION 503.70m
GROUND WATER LEVELS: ▽ AT TIME OF DRILLING —
▼ AT END OF DRILLING 13.69m
▽ AFTER DRILLING —

| DEPTH (m) | STRATA | SOIL DESCRIPTION | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES RECOVERY % | SPT N VALUE BLOWS/0.3m / DYNAMIC CONE BLOWS/0.3m | POCKET PEN. (kPa) / FIELD VANE SHEAR (kPa) | FINES CONTENT (%) / PLASTIC & LIQUID LIMIT MOISTURE CONTENT | WELL DIAGRAM Casing Top Elev: m |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | | SILT, plastic, metal, wood, (GARBAGE) *(continued)* | | | | | | | | |
| | | | | 5 | SPT | | 22 ▲ | | | |
| 13 | | | | | | | | | | |
| | | ▼ -at 13.72m sandy silt, dark grey, wet, (loose) | 490.0 | | | | | | | |
| 14 | | BEDROCK, weathered, some sand some gravel, grey to brown | 13.7 | | | | | | | Bentonite |
| 15 | | | | | | | | | | Sand - 50mm dia. slotted |
| | | | | 6 | SPT | | 50 ▲ >50/150mm | | | |
| | | | 487.9 | | | | | | | |

Bottom of hole at 15.8m.

# APPENDIX B: LABORATORY TEST RESULTS

exp Services Inc.
**City of Kamloops**

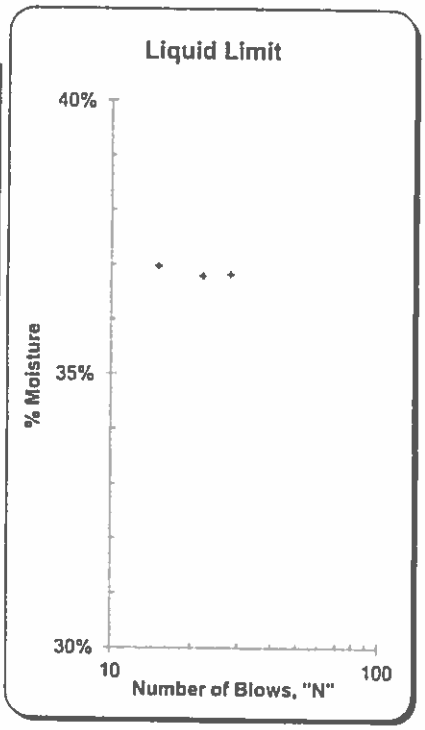
Atterberg Limits ASTM D4318
Project: 172-00041

11805
April 11, 2017

Sample Source: BH17-04
Sample ID: 15-17

**Liquid Limit Determination**

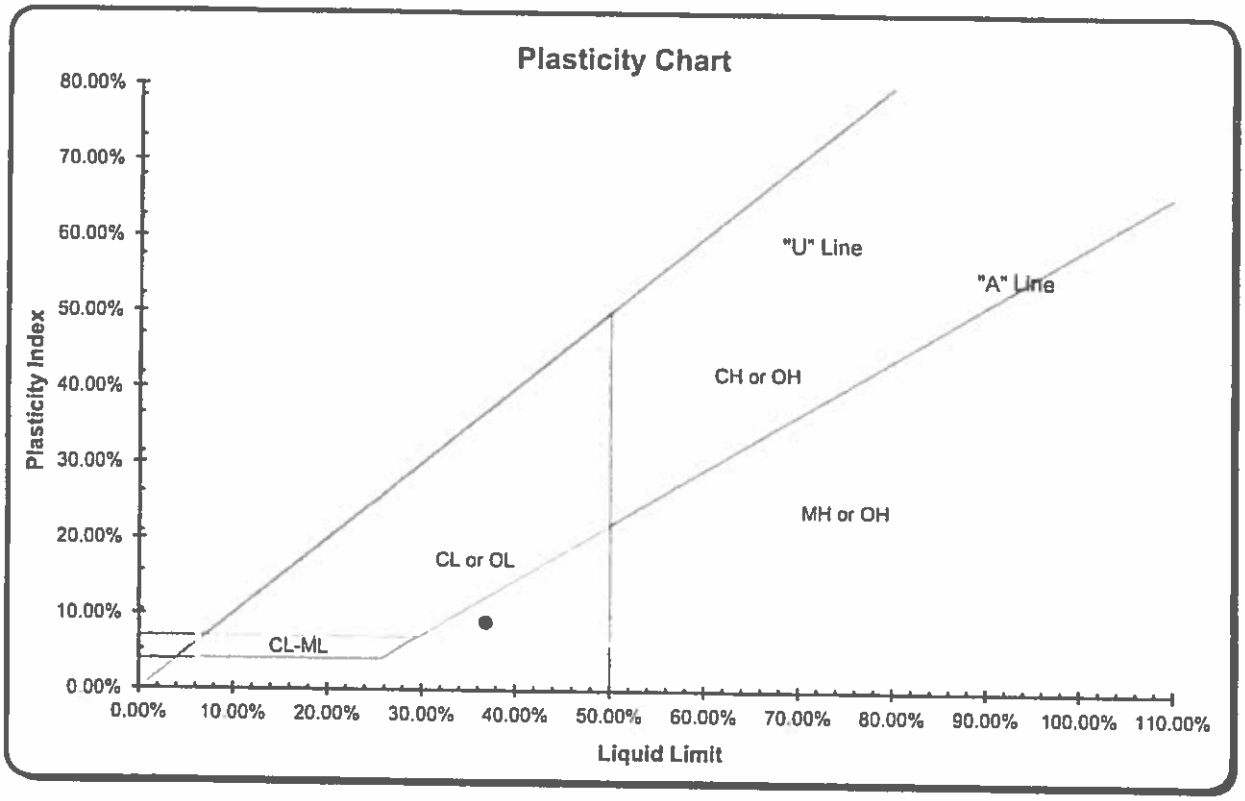
| | #1 | #2 | #3 | #4 | #5 | #6 |
|---|---|---|---|---|---|---|
| Weight of Wet Soils + Pan: | 22.40 | 23.50 | 27.00 | | | |
| Weight of Dry Soils + Pan: | 17.50 | 18.20 | 20.60 | | | |
| Weight of Pan: | 4.20 | 3.80 | 3.30 | | | |
| Weight of Dry Soils: | 13.30 | 14.40 | 17.30 | | | |
| Weight of Moisture: | 4.90 | 5.30 | 6.40 | | | |
| % Moisture: | 36.84% | 36.81% | 36.99% | | | |
| N: | 28 | 22 | 15 | | | |




**Liquid Limit @ 25 Blows:** 36.84%
**Plastic Limit:** 27.71%
**Plasticity Index, $I_P$:** 9.13%
**Moisture Content, $M_C$:** 30.30%

**Plastic Limit Determination**

| | #1 | #2 | #3 | #4 | #5 | #6 |
|---|---|---|---|---|---|---|
| Weight of Wet Soils + Pan: | 10.00 | 10.70 | 12.10 | | | |
| Weight of Dry Soils + Pan: | 8.70 | 9.30 | 10.40 | | | |
| Weight of Pan: | 4.10 | 4.20 | 4.20 | | | |
| Weight of Dry Soils: | 4.60 | 5.10 | 6.20 | | | |
| Weight of Moisture: | 1.30 | 1.40 | 1.70 | | | |
| % Moisture: | 28.26% | 27.45% | 27.4 % | | | |




**Reported by:** _____
Kara Hawkes, EIT

**Reviewed by:** _____

exp Services Inc.
100B - 1425 Pearson Place
Kamloops, BC V1S 1J9
250-372-5321

# SIEVE ANALYSIS REPORT
## SI gradation SERIES

TO
Thompson Rivers University
900 McGill Road
Kamloops, BC
V2C 0C8

ATTN: Warren Asuchak

PROJECT NO. 172-00041
CLIENT Thompson Rivers University
C.C.

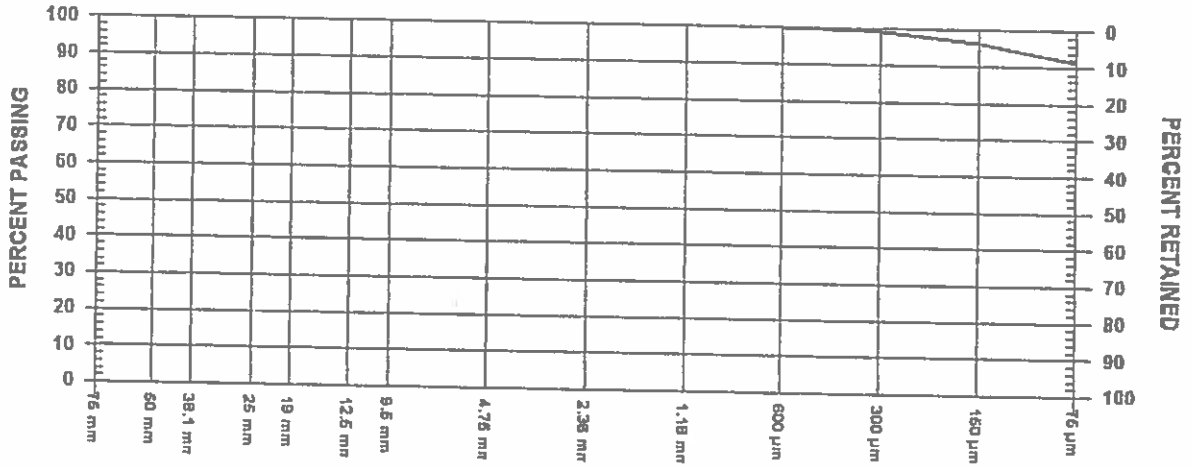
PROJECT TRU SE Corner Parcel

CONTRACTOR

SIEVE TEST NO. 2 DATE RECEIVED Apr 10, 2017 DATE TESTED Apr 10, 2017 DATE SAMPLED Apr 10, 2017

SUPPLIER
SOURCE BH17-04 SA 2 @ 10 -
SPECIFICATION No Spec
MATERIAL TYPE Silt, trace sand

SAMPLED BY JRadziszewski
TESTED BY K. Hawkes
TEST METHOD WASHED




| GRAVEL SIZES | PERCENT PASSING | GRADATION LIMITS |
|---|---|---|
| 75 mm | | |
| 50 mm | | |
| 38.1 mm | | |
| 25 mm | | |
| 19 mm | | |
| 12.5 mm | | |
| 9.5 mm | | |

| SAND SIZES AND FINES | PERCENT PASSING | GRADATION LIMITS |
|---|---|---|
| 4.75 mm | | |
| 2.36 mm | | |
| 1.18 mm | | |
| 600 µm | 100.0 | |
| 300 µm | 99.5 | |
| 150 µm | 96.5 | |
| 75 µm | 91.1 | |

COMMENTS

 Apr 11, 2017 exp Services Inc. PER. J. Hall

exp Services Inc.
100B - 1425 Pearson Place
Kamloops, BC V1S 1J9
250-372-5321

# SIEVE ANALYSIS REPORT
## SI gradation SERIES

TO
Thompson Rivers University
900 McGill Road
Kamloops, BC
V2C 0C8

ATTN: Warren Asuchak

PROJECT NO. 172-00041
CLIENT Thompson Rivers University
C.C.

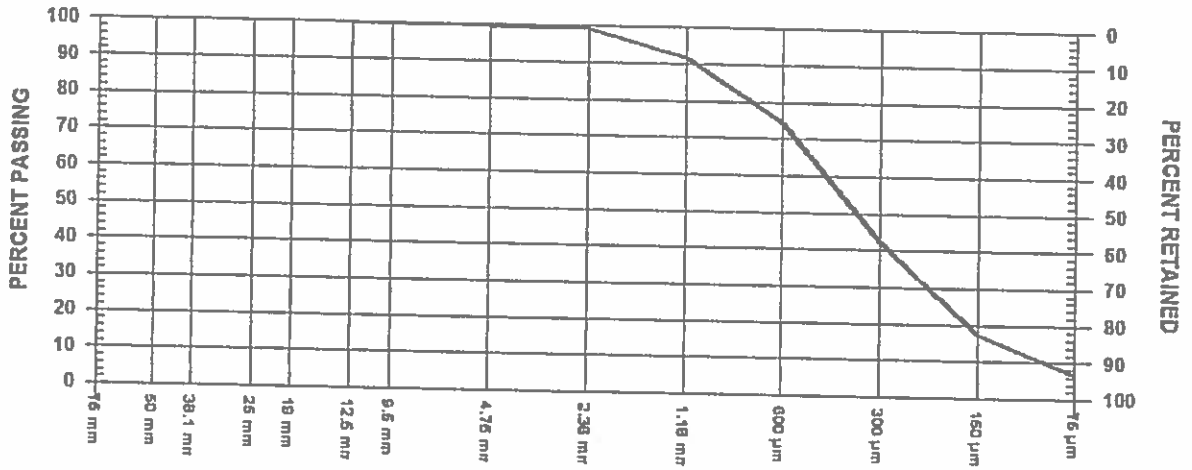
PROJECT TRU SE Corner Parcel

CONTRACTOR

SIEVE TEST NO. 1 DATE RECEIVED Apr 10, 2017 DATE TESTED Apr 10, 2017 DATE SAMPLED Apr 10, 2017

SUPPLIER
SOURCE BH17-02 @ 10-12'
SPECIFICATION No Spec
MATERIAL TYPE Sand, trace silt

SAMPLED BY JRadziszewski
TESTED BY K. Hawkes
TEST METHOD WASHED




| GRAVEL SIZES | PERCENT PASSING | GRADATION LIMITS |
|---|---|---|
| 75 mm | | |
| 50 mm | | |
| 38.1 mm | | |
| 25 mm | | |
| 19 mm | | |
| 12.5 mm | 100.0 | |
| 9.5 mm | 99.7 | |

| SAND SIZES AND FINES | PERCENT PASSING | GRADATION LIMITS |
|---|---|---|
| 4.75 mm | 99.7 | |
| 2.36 mm | 99.2 | |
| 1.18 mm | 91.8 | |
| 600 µm | 74.2 | |
| 300 µm | 42.3 | |
| 150 µm | 17.3 | |
| 75 µm | 6.9 | |

COMMENTS


Apr 11, 2017 exp Services Inc. PER J. Hall

ALS Environmental

| | | | |
|---|---|---|---|
| **Report To** | Stephen Prime, EXP SERVICES INC.<br>100B-1425 Pearson Place<br><br>Kamloops, BC V1S 1J9 | **Date Received**<br>**Report Date**<br>**Report Revision**<br>**Version** | |
| **Client Phone** | 250-372-5321 | | |

# Certificate of Analysis

| | |
|---|---|
| **Lab Work Order #** | L1904228 |
| **Project P.O. #** | |
| **Job Reference** | 17200041 |
| **Legal Site Description** | |
| **C of C Numbers** | |

**Case Narrative/Comments**

Caitlin Fountain

**Caitlin Fountain**
**Account Manager**

22-Mar-2017 14:55
3-Apr-2017 14:54
1
FINAL

EXP SERVICES INC.
ATTN: Stephen Prime
100B- 1425 Pearson Place
Kamloops BC V1S 1J9

Date Received: 22- MAR- 17
Report Date: 03- APR- 17 14:54 (MT)
Version: FINAL

Client Phone: 250- 372- 5321

# Certificate of Analysis

**Lab Work Order #: L1904228**

Project P.O. #: NOT SUBMITTED
Job Reference: 17200041
C of C Numbers:
Legal Site Desc:

Caitlin Fountain

Caitlin Fountain
Account Manager

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1904228-1 | L1904228-2 | L1904228-3 | | |
|---|---|---|---|---|---|
| Description | Soil | Soil | Soil | | |
| Sampled Date | 06-MAR-17 | 06-MAR-17 | 06-MAR-17 | | |
| Sampled Time | 12:00 | 12:00 | 12:00 | | |
| Client ID | BH17-05 AT 10-12' | BH17-02 AT 5-7' | BH17-01 AT 4-6' | | |
| **Grouping** / **Analyte** | | | | | |
| **SOIL** | | | | | |
| **Inorganic Parameters** | | | | | |
| Total Sulphate Ion Content (%) | 0.273 | <0.050 | <0.050 | | |
| **Saturated Paste Extractables** | | | | | |
| pH in Saturated Paste (pH) | 8.09 | 7.80 | 8.12 | | |
| % Saturation (%) | 55.2 | 31.8 | 36.9 | | |

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| PH-PASTE-ED | Soil | pH in Saturated Paste | CSSS 15.2.1 |

pH of a saturated soil paste is measured using a pH electrode and meter.

| | | | |
|---|---|---|---|
| SAT-PCNT-ED | Soil | % Saturation | CSSS 15.2-CALCULATION |

As received samples are pasted to saturation. A sub-sample is weighed, oven dried and re-weighed to determine % saturation.

| | | | |
|---|---|---|---|
| SO4-T-CSA-A23-ED | Soil | Total Sulphate Ion Content | CSA INTERNATIONAL A23.2 |

Total sulphate content is determined by mixing soil with water then hydrochloric acid, and digesting just below boiling point, for 15 minutes. Analysis by ion chromatography follows.
NOTE: the CSA-A23 method states that for a total sulphate ion content greater than 0.2%, soluble sulphate ion content shall be determined on the basis of a water extraction. This water extraction requires the total sulphate ion content result to calculate the correct ratio for the water extraction.

** 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 |
|---|---|
| ED | ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA |

**Chain of Custody Numbers:**

**GLOSSARY OF REPORT TERMS**

*Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.*
*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 of sample.*
*mg/L - milligrams per litre.*
*< - Less than.*
*D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*
*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.*

ALS Environmental

# Quality Control Report

Workorder: L1904228 Report Date: 03-APR-17 

Client: EXP SERVICES INC.
100B-1425 Pearson Place
Kamloops BC V1S 1J9
Contact: Stephen Prime

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| PH-PASTE-ED | Soil | | | | | | | |
| Batch R3685608 | | | | | | | | |
| WG2500393-2 IRM | | SALINITY SOIL5 | | | | | | |
| pH in Saturated Paste | | | 6.85 | | pH | | 6.66-7.26 | 27-MAR-17 |
| WG2500393-4 LCS | | PH-6 | | | | | | |
| pH in Saturated Paste | | | 6.01 | | pH | | 5.8-6.2 | 27-MAR-17 |
| SAT-PCNT-ED | Soil | | | | | | | |
| Batch R3685608 | | | | | | | | |
| WG2500393-2 IRM | | SALINITY SOIL5 | | | | | | |
| % Saturation | | | 110.3 | | % | | 80-120 | 27-MAR-17 |
| SO4-T-CSA-A23-ED | Soil | | | | | | | |
| Batch R3690533 | | | | | | | | |
| WG2503281-3 CRM | | ED-634A CEMENT | | | | | | |
| Total Sulphate Ion Content | | | 92.2 | | % | | 80-120 | 31-MAR-17 |
| WG2503281-2 LCS | | | | | | | | |
| Total Sulphate Ion Content | | | 101.9 | | % | | 70-130 | 01-APR-17 |
| WG2503281-1 MB | | | | | | | | |
| Total Sulphate Ion Content | | | <0.050 | | % | | 0.05 | 31-MAR-17 |

**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.

# Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 15 - 562215

Page of

| Report To | Contact and company name below will appear on the final report |
|---|---|
| Company: | Exp Services |
| Contact: | Stephen Prime |
| Phone: | 250 572 4430 |
| Company address below will appear on the final report | |
| Street: | 102B 1425 Pearson Pl |
| City/Province: | Kamloops |
| Postal Code: | V1S 1J9 |
| Invoice To | Same as Report To [X] YES [ ] NO |
| | Copy of Invoice with Report [X] YES [ ] NO |
| Company: | |
| Contact: | |

**Report Format / Distribution**

Select Report Format: [X] PDF [ ] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report [ ] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax: stephen.prime@exp.com
Email 2:
Email 3:

**Invoice Distribution**

Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax:
Email 2:

**Oil and Gas Required Fields (client use)**

AFE/Cost Center: | PO#:
Major/Minor Code: | Routing Code:
Requisitioner:
Location:
ALS Contact: | Sampler:

**Project Information**

ALS Account # / Quote #:
Job #: 1720041
PO / AFE:
LSD:

ALS Lab / ALS Sample (lab use only)

L1904228-COFC

Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply

Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply

| PRIORITY (Business Days) | | EMERGENCY | |
|---|---|---|---|
| | 4 day [P4] [ ] | | 1 Business day [E1] [ ] |
| | 3 day [P3] [ ] | | Same Day, Weekend or Statutory holiday [E0] [ ] |
| | 2 day [P2] [ ] | | |

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

**Analysis Request**

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

| | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | CSA Sulphate | PH | Number of Containers |
|---|---|---|---|---|---|---|
| BH17-05 At 10-12' | Mar 6/17 | | Soil | X | X | |
| BH17-02 At 5-7' | " | | " | X | X | |
| BH17-01 At 4-6' | " | | " | X | X | |

**Drinking Water (DW) Samples[1] (client use)**

Are samples taken from a Regulated DW System? [ ] YES [ ] NO
Are samples for human drinking water use? [ ] YES [ ] NO

**Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)**

**SAMPLE CONDITION AS RECEIVED (lab use only)**

Frozen [ ] | SIF Observations Yes [ ] No [ ]
Ice Packs [ ] Ice Cubes [ ] | Custody seal intact Yes [ ] No [ ]
Cooling Initiated [ ]

| INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | |
|---|---|---|---|---|---|
| | | | | | |

**SHIPMENT RELEASE (client use)**

| Released by: | Date: | Time: |
|---|---|---|
| | March 22/17 | |

**INITIAL SHIPMENT RECEPTION (lab use only)**

| Received by: | Date: | Time: |
|---|---|---|
| CF | 22 Mar 17 | 2:40pm |

**FINAL SHIPMENT RECEPTION (lab use only)**

| Received by: | Date: | Time: |
|---|---|---|
| | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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 specified on the back page of the white - report copy.

If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT