Final

2013 Down Valley Interim Hydraulic Upgrades Field Investigation Data and Analysis Report TA016 Faro Mine Remediation Project

Prepared for

Government of Yukon and Government of Canada as represented by Aboriginal Affairs and Northern Development Canada

March 28, 2014

CH2MHILL®

309 Strickland Street, Suite 301
Whitehorse, Yukon Y1A 2J9

Contents

Section **Page**

Acronyms and Abbreviations ..... **v**

1 Introduction **1-1**
1.1 Site Description 1-1
1.2 Purpose 1-1
1.3 Scope of Work 1-2

2 Background **2-1**
2.1 Previous Investigations 2-1
2.2 Geochemical Screening Criteria 2-1
2.2.1 Solids 2-1
2.2.2 Deionized Water Leach Extraction 2-1
2.2.3 Acid-base Accounting 2-2

3 Field Investigation Activities **3-1**
3.1 Rose Creek Diversion Activities 3-1
3.2 Intermediate Dam Activities 3-2
3.3 North Fork Rock Drain Activities 3-2
3.3.1 Geophysical Investigation 3-2
3.3.2 Drilling 3-2
3.3.3 Geotechnical Inspection 3-3
3.3.4 Dye Test 3-3
3.4 Borrow Investigation 3-4
3.5 Laboratory Testing Methodology 3-4
3.5.1 Geochemical Testing (Soil) 3-4
3.5.2 Geotechnical Samples (Soil) 3-5
3.5.3 Geotechnical Samples (Rock) 3-5
3.5.4 Quality Assurance/Quality Control 3-5
3.5.5 Sample Handling 3-5
3.5.6 Data Quality Evaluation Report 3-5
3.5.7 Deviations 3-6

4 Data Summary **4-1**
4.1 Rose Creek Diversion Activities 4-1
4.1.1 Vegetation Reconnaissance 4-1
4.1.2 Animal Burrows Reconnaissance 4-1
4.1.3 Dike Crest Grading Reconnaissance 4-1
4.1.4 Slope Stability Reconnaissance 4-1
4.1.5 Riprap and Large-Diameter Riprap Reconnaissance 4-2
4.1.6 Seepage Reconnaissance 4-2
4.1.7 Overflow Weir (Fuse Plug) Reconnaissance 4-2
4.2 Intermediate Dam Activities 4-3
4.3 North Fork Rock Drain Assessment Activities 4-3
4.3.1 Geophysical Investigation 4-3
4.3.2 Geotechnical Inspection 4-4
4.3.3 Dye Test 4-4
4.4 Borrow Investigation Results 4-5
4.4.1 Geochemical Results 4-5
4.4.2 Geotechnical Results 4-5

Section **Page**

5 Recommendations 5-1

6 References 6-1

Appendices

A Rose Creek Diversion Inspection Memo
B Photo Log
C Intermediate Dam Pond Test Pits
D Geophysical Survey – Rose Creek Diversion
E Rose Creek Diversion Drilling
F Dye Test
G Laboratory Reports
H Data Quality Evaluation Report

Tables (all tables appear at the end of this report)

2-1 Metals and General Chemistry
2-2 Deionized Water leach Extraction
2-3 Acid-Base Accounting
3-1 Rock Drain Dye Test
4-1 Grain Size Distribution
4-2 NFRD Borehole Summary
4-3 Petrographic Examination of Coarse Aggregate
4-4 Unconfined Compressive Strength of Intact Rock Core Specimens
4-5 Specific Absorption Table
4-6 Petrographic Examination of Coarse Aggregate

Figures (all figures appear at the end of this report)

1-1 Vicinity and Location Map
1-2 Down Valley Interim Hydraulic Upgrades Keymap
3-1 2013 Intermediate Dam and Spillway Test Pit Locations
3-2 2013 Rock Drain Bore Hole Locations
3-3 2013 Rock Drain Dye Test Locations
3-4 2013 Borrow Source Search Test Pit Locations
4-1 Dye Test Results

Acronyms and Abbreviations

ABA	acid-base accounting
ALS	ALS Global Laboratories
AP	acid potential
ASTM	ASTM International (formerly the American Society for Testing and Materials)
Aurora	Aurora Geosciences Ltd.
CCME	Canadian Council of Ministers of the Environment
CH2M HILL	CH2M HILL Canada Limited
cm	centimetre
CVD	Cross Valley Dam
DI	deionized
DQE	data quality evaluation
DVIHU	Down Valley Interim Hydraulic Upgrades
FMC	Faro Mine Complex
FSP	field sampling plan
GAI	geochemical abundance index
GARD	global acid rock drainage
GPR	ground-penetrating radar
GPS	global positioning system
HQ	hazard quotient
ID	Intermediate Dam
kg	kilogram
km	kilometre
km^2	square kilometre
kN	kilonewton
m	metre
MEND	Mine Environment Neutral Drainage
ml	millilitre
MPa	megapascal
NFRC	North Fork Rose Creek
NFRD	North Fork Rock Drain
NNP	net neutralization potential
NP	neutralization potential
NWL	Lower Northwest
QA/QC	quality assurance and quality control
RCD	Rose Creek Diversion

RCTA	Rose Creek Tailings Area
SOP	standard operating procedure
SRK	SRK Consulting Engineers and Scientists; SRK Consulting (Canada) Inc., Steffen Robertson and Kirsten Consulting Engineers and Scientists
TEES	Tlicho Engineering and Environmental Services
UPL	Upper Parking Lot
UTM	Universal Transverse Mercator
WRD	waste rock dump

SECTION 1

Introduction

CH2M HILL Canada Limited (CH2M HILL) was retained by the Government of Yukon and the Government of Canada as represented by Aboriginal Affairs and Northern Development Canada to conduct remedial investigations and associated activities at the Faro Mine Complex (FMC) in Faro, Yukon. These phased activities support the overall long-term goal of remediating the FMC and reducing environmental impacts including those associated with acid rock drainage entering nearby watercourses. This report presents the investigation data obtained for use in the Down Valley Interim Hydraulic Upgrades (DVIHU).

1.1 Site Description

The FMC is located at 62°18'39.74" N and 133°18'18.06" W in south-central Yukon, 15 kilometres (km) north of Faro and nearly 200 km northeast of Whitehorse (Figure 1-1). The FMC has a footprint of more than 25 square kilometres (km^2) and consists of the following three areas:

- The Faro Mine Area, incorporating the Faro Pit, waste rock dumps (WRDs), the Emergency Tailings Area (ETA), a disused mill, and associated buildings (Figure 1-2)
- The Rose Creek Tailings Area (RCTA) and is located in the Rose Creek Valley (Figure 1-2)
- The Vangorda/Grum Area, which is on the Vangorda Plateau and includes the Grum and Vangorda Pits and WRDs (Figure 1-2)

The Faro Mine Area includes the Faro Pit, WRDs, the ETA, a mill, and associated buildings. The Faro Pit is approximately 1,675 metres (m) long and 975 m wide and encompasses 1.06 km^2. The Faro Pit bottom is at 975 m above mean sea level, an elevation 335 m lower than the highest point of the western pit wall. The WRDs amount to more than 260 million tonnes of material covering approximately 1.06 km^2. Faro Creek flows around the northeastern edge of the pit in the Faro Creek Diversion. The former mill and associated buildings are south of the pit. The ETA is located just southeast of the former mill area (CH2M HILL, 2012a).

The RCTA encompasses the Rose Creek tailings impoundment, which is at the base of Rose Creek Valley, about 2.5 km southwest of the Faro Mine Area. The impoundment houses more than 55 million tonnes of tailings within an unlined containment area approximately 4 km long and 1 km wide. The tailings were deposited between 1969 and 1992. A series of three dams hold the tailings in place the Primary Dam, the Secondary Dam, and the Intermediate Dam [ID]. Rose Creek flows around the RCTA in the riprap-lined Rose Creek Diversion (RCD).

The Vangorda/Grum Area consists of two open pits, three disposal areas for waste rock, and an area of exposed waste rock along the access road to Vangorda Pit. Grum Pit is approximately 1,100 m long, 700 m wide, and 200 m deep. It encompasses approximately 0.77 km^2. The Vangorda Pit is approximately 1,150 m long, 350 m wide, and 150 m deep. It encompasses approximately 0.42km^2.

1.2 Purpose

This report presents the collection and interpretation of geologic, geotechnical, and hydrologic information collected during the 2013 field investigation to support design of the DVIHU. The DVIHU will increase the hydraulic capacity of the ID spillway so that it can safely pass a 1-in-500-year flood event. The hydraulic capacity of the ID spillway will be increased by raising the effective height of the dam and by increasing the cross-sectional area of the spillway. A secondary objective is to improve the RCD so that it can safely accommodate the 1-in-500-year flood event without overtopping the dike. The RCD improvements include raising the dike crest including at the overflow weir (fuse plug) location, removal of vegetation, and repair and augmentation of riprap slope protection. As part of the DVIHU, attenuation of peak flows in the North Fork Rose Creek (NFRC) by the North Fork Rock Drain (NFRD) was considered including preliminary stability evaluation of the NFRD.

Data were collected under this investigation to address the following design needs:

- Identify areas of the RCD where vegetation removal and maintenance or repair are required.
- Collect geotechnical and hydraulic information for evaluations of the Haul Road embankment (including the NFRD) to function as a stable water-retaining structure during large flood events and to attenuate flood flows.
- Collect geotechnical information to evaluate feasibility of raising the dam crest by embedding geomembrane in the compacted clay core of the ID and extending the geomembrane vertically to the crest of the ID to provide a seepage cutoff. Information gathered includes the depth of excavation to the top of the clay core, the trench stability, and observations of potential frost damage.

The 2013 field investigation addressed the following data gaps associated with the DVIHU design:

- Areas and length of the RCD where vegetation removal will be required. Preliminary criteria require removal of woody vegetation with stems or stalks larger than 50 millimeters (mm) in diameter and higher than 2 m. Further coordination with the Government of Yukon is needed to refine these preliminary criteria and to develop site-specific vegetation monitoring and removal measures.
- Areas and dimensions where sloughing of the RCD dike slopes is evident and where riprap has ravelled into the channel.
- Areas or zones of depressions in the RCD dike crest, including the depth of the depressions.
- Locations and extent of other conditions along the RCD or related areas that may need maintenance or repair.
- Site investigations that may be required to better determine strength properties of the waste rock and the foundation soils in the NFRD.
- Characteristics of groundwater and surface water flows through the NFRD.
- Depth of the compacted clay core in the ID and variability of the depth across the existing dam crest.
- The condition of the top zone of the clay core in the ID, including composition, width, relative moisture content and density, and presence of cracks or other defects.
- Nature of the material overlying the compacted clay core in the ID, including the composition, relative density, and the temporary stability of excavation side walls in this material, for construction purposes.
- Nature of the materials in the upper 2 m of the ID spillway channel, including particle size, relative density, and excavatibility, for construction purposes.
- Nature and volume of the materials in the Faro Upper Parking Lot (UPL) WRD and Lower Northwest (NWL) WRD.

1.3 Scope of Work

The following field investigation was performed during the 2013 field season:

- Visually observed, mapped, and documented conditions along the entire length of the RCD. This included observations and documentation of areas of ravelled riprap slopes, erosion, and over-steepened slopes and areas where maintenance and repair are necessary. It also included delineation of areas where vegetation removal is needed.
- Excavated, logged, and sampled seven test pits along the crest of the ID to assess the condition of the clay core and embankment material.
- Excavated, logged, and sampled three test pits in the ID spillway to assess the material in the upper spillway channel.
- Completed five geophysical surveys across the NFRC, upstream and downstream from the NFRD, to characterize the bedrock topography in the area. The geophysical surveys provided additional information to

support the estimation of the depth of the competent bedrock surface and the thickness of weathered bedrock overlying competent bedrock.

- Drilled, logged, and sampled two boreholes to evaluate foundation conditions at the downstream toe of the Haul Road embankment (including the NFRD) and calibrate the geophysical surveys conducted in the NFRC.
- Established continuous flow monitoring stations on the NFRC upstream from the NFRD at Station R10 and downstream from the NFRD at Station X2. Stations collected continuous water surface elevation data via data loggers.
- Performed dye tests to monitor flow through the NFRD.
- Installed staff gauges and regularly measured pond elevation directly upstream from the NFRD at Station NF1 and directly downstream from the NFRD at Station NF2.
- Excavated, logged, and sampled 15 test pits in the UPL WRD and NWL WRD to evaluate the suitability of the material for use in gabion baskets.

SECTION 2

Background

This section includes a summary of the previous investigation as well as Geochemical screening criteria.

2.1 Previous Investigations

In 2002, SRK Consulting Engineers and Scientists (SRK) performed a preliminary borrow investigation based on information compiled from historical investigations (SRK, 2002). Areas investigated included existing developed borrow sources and potential new borrow sources within the Faro and Vangorda/Grum areas of the site, as well as nearby offsite locations including the UPL WRD and NWL WRD. Based on the results of the 2002 sampling program, a more comprehensive field investigation was conducted in 2003, which included the excavation of 60 test pits with limited analytical soil sampling including 8 tests pits completed in the calcium-silicate exposures at the Faro waste dumps. Laboratory analysis was performed to assess the acid-generating potential of the material. That report included an assessment of location, volumes, and characteristics of potential borrow materials. The investigation estimated that volume of calcium-silicate rock would be in the order of 600,000 cubic metres (SRK, 2003).

2.2 Geochemical Screening Criteria

2.2.1 Solids

Solids collected for geochemical analysis were subjected to a suite of testing, including total metal analysis, 96-hour deionized (DI) water leach extraction, and acid-base accounting (ABA). Total metal analysis was performed to evaluate the relative metal concentrations among collected samples and identify samples with anomalous metal contents. The results of the total metal analysis do not indicate elemental concentrations anticipated in downstream drainage or necessarily represent concentrations that present a potential issue to the receiving environment. The reactivity of the material, and the elements therein, will control the availability or release, and over the longer term, how the reactivity of the material changes through weathering.

The total metal concentrations were compared with the median soil concentrations and elemental crustal abundance concentrations to identify relative elevated concentrations. The median soil content concentrations were sourced from the *Global Acid Rock Drainage (GARD) Guide (*International Network for Acid Prevention, 2013). Concentrations of elemental crustal abundance were sourced from Price (1997) and presented as 10 times the average value in the continental crust. Concentrations 12 to 24 times the median soil content are considered elevated and have a geochemical abundance index (GAI) of 3, calculated by:

$$GAI = \log_2(\text{element concentration}/1.5*\text{median soil concentration})$$

Table 2-1 identifies concentrations considered elevated (i.e., have a GAI of 3 or greater) with a grey-shaded background. Concentrations considered elevated based on comparisons to 10 times the elemental crustal abundance concentrations are shown in italics.

2.2.2 Deionized Water Leach Extraction

The results from the 96-hour DI water leach extraction were compared with the *Federal Interim Groundwater Quality Guidelines* for the protection of aquatic life assuming industrial land use. The *Federal Interim Groundwater Quality Guidelines* is based on the assumption that there is at least a 10-m flow path between the sample location and the nearest surface water body that prevents exposure to freshwater aquatic life (Environment Canada, 2010).

Certain parameters depend on other measured criteria (i.e., hardness and pH) and require additional guidance provided by the *Canadian Environmental Quality Guidelines* for freshwater aquatic life to provide screening levels

(Canadian Council of Ministers of the Environment [CCME], 2007). Results from the leach extraction test and comparisons to screening levels are presented in Table 2-2.

2.2.3 Acid-base Accounting

The ABA analysis was performed on samples from the DVIHU investigation to assess the material's potential to produce or neutralize acid mine drainage. This evaluation will support the decision-making process regarding construction material suitability. ABA testing is used to predict the tendency of a material to generate or neutralize acid by providing a "snapshot" of the balance between the acid production (AP) and acid neutralization, based on the sulphur content and presence of neutralizing species such as carbonate minerals. Indices used to evaluate ABA data include paste pH, neutralization potential (NP) to AP ratios (NP:AP), and net neutralization potential (NNP). Generally, these criteria are divided into the following categories: (1) potentially acid-generating, (2) non-acid-generating, and (3) intermediate for the ABA characteristics. The following are the threshold values (United States Environmental Protection Agency, 1999):

- NP:AP values greater than 3:1 suggest non-acid-generating material.
- NP:AP values less than 1:1 suggest potentially acid-generating material.
- NP:AP values between 1:1 and 3:1 suggest intermediate or "uncertain" material.
- NNP values greater than zero suggests net acid-neutralizing material.
- NNP values less than zero suggests net acid-generating material.

To prevent further production of acid mine drainage, construction materials should be non-acid-generating. ABA results are presented in Table 2-3.

SECTION 3

Field Investigation Activities

The 2013 field investigation included the following activities in areas around the CVD, RCD, and RCTA:

- Excavating 10 test pits along the ID crest and within the ID spillway.
- Observing, mapping, and photographing geological and vegetative conditions along the RCD.
- Performing five dye tests at the NFRD.
- Advancing two borings at the downstream toe of the NFRD.
- Completing five surficial geophysical investigations adjacent to the NFRD and upstream in the NFRC area.
- Performing visual geotechnical investigation of the upstream and downstream slopes of the NFRD.
- Excavating 15 test pits in the UPL WRD and NWL WRD.

Field investigation activities and laboratory testing were generally completed in accordance with the ID Crest Test Pits – 2013 Field Sampling Plan (FSP) (CH2M HILL, 2013a), the RCD Delineation and Mapping – 2013 FSP (CH2M HILL, 2013b), the NFRC Rock Drain Assessment – 2013 FSP (CH2M HILL, 2013c), and the Phase II Borrow Investigation – 2013 FSP (CH2M HILL, 2013d). Activities were performed in compliance with the project health and safety plan (CH2M HILL, 2013e). The following standard operating procedures (SOPs) were used (SOP titles provided only the first time referenced):

- Drilling was conducted in accordance with SOP INV001, *Drilling* (CH2M HILL, 2012b).
- Test pits were completed in accordance with SOP INV017, *Logging and Sampling of Test Pits* (CH2M HILL, 2013f).
- Soil samples were collected in accordance with SOP INV003, *Borehole Sampling and Testing* (CH2M HILL, 2013g).
- Soil and bedrock core were logged in accordance with SOP PCS001, *Boring Logs Completion, Soil Classification, and Logging* (CH2M HILL, 2012c).
- Soil, rock, and solids samples were collected from drill cuttings for geochemical and geotechnical testing in accordance with SOP SMP006, *Surface and Subsurface Soil Sampling* (CH2M HILL, 2012d).
- Soil and rock samples were collected and labelled in accordance with SOP SMP011, *Sample Nomenclature* (CH2M HILL, 2012e) and shipped to the testing laboratory in accordance with SOP PCS002, *Sample Packing and Shipping – Environmental* (CH2M HILL, 2012f) and SOP PCS016, *Sample Packing, Shipping, and Storage (Geotechnical)* (CH2M HILL, 2012g).
- Dye tests were completed in accordance with SOP MSR035, *Open Channel Time of Travel Test* (CH2M HILL, 2013h).

3.1 Rose Creek Diversion Activities

The field inspection was conducted on July 26 and 27, 2013, by CH2M HILL. The inspection consisted of walking the RCD dike from upstream to downstream and documenting the channel and dike condition. The results of this inspection are presented in Appendix A.

The geo-referenced observations were located with a Garmin GPSMap 60CSx handheld global positioning system (GPS) unit to collect Universal Transverse Mercator (UTM) coordinates and elevations. The accuracy of this device varies, but is estimated as ±3 to 4 m during the inspection. All UTM coordinates reference the NAD83 datum locations with specific detailed geo-referenced observations and are shown in Appendix A. Photos are provided in both Appendices A and B.

3.2 Intermediate Dam Activities

Ten test pits (CH13-201-TP001 through CH13-201-TP010) were excavated July 29 and 30, 2013, along the ID crest and ID spillway by Tlicho Engineering and Environmental Services (TEES) using a Caterpillar 345C excavator equipped with a 1.2-m-wide bucket. The test pits were excavated to a maximum depth of 1.7 m beneath the crest of the dam and 2.7 m below the existing ground surface within the spillway. The locations of the test pits are shown in Figure 3-1. CH2M HILL identified the proposed locations, supervised the excavations, collected samples, and logged each test pit. The test pits were backfilled and compacted with the excavator bucket immediately after the materials and conditions were recorded on test pit logs.

Each test pit was logged according to SOP INV017 (CH2M HILL, 2013f). Thirteen samples were collected for laboratory analysis. The collected samples were labelled in accordance with SOP SMP011 (CH2M HILL, 2012e) and shipped to the testing laboratory in accordance with SOP PCS002 (CH2M HILL, 2012f) and SOP PCS016 (CH2M HILL, 2012g).

Test pit logs are provided in Appendix C, and photos are provided in Appendix B.

3.3 North Fork Rock Drain Activities

3.3.1 Geophysical Investigation

CH2M HILL retained Aurora to conduct an integrated geophysical investigation involving multiple geophysical methods. Several methods were deployed along five geophysical lines across the NFRC up and downstream of the NFRD.

The Aurora report (see Appendix D), provides details about geophysical field layout, processing, and global positioning system (i.e., GPS); however, the geophysical methods used are summarized below. Later sections of this report describe the results.

The geophysical methods used at CVD included the following:

- **Resistivity (short dipole)** – an electrical method where direct current is injected into the ground and voltage measurements are recorded at varying distances from the current source. The result is a cross section of the electrical resistivity of the subsurface, known as a pseudo-section. The resistivity variations shown on the pseudo-section can be interpreted to estimate geologic properties, such as lithology and groundwater saturation.
- **Ground-penetrating radar** – a radar transceiver is moved along the ground surface to produce a radar gram of the subsurface. For the NFRC investigation, several frequency (25-, 50-, 100-, and 500-megahertz) radar antennae were deployed. As a general rule, higher frequencies have higher resolution but lower penetrating power. One of the primary objectives was to determine whether GPR would produce a clear and interpretable radar reflection from the bedrock interface for the NFRC channel.
- **Seismic refraction** – an acoustic method that is useful for distinguishing depth to bedrock and bedrock rippability. A refraction survey produces a cross section of seismic velocities, which can be interpreted to estimate geologic properties, such as the interface between weathered and unweathered bedrock.
- **Seismic reflection** – like refraction, this is an acoustic method. Although processed seismic reflection data resemble a GPR radar gram in appearance, reflection data generally penetrate deeper than GPR. As with GPR, reflection was conducted for evaluating whether it could produce an interpretable reflection from the bedrock interface in the NFRC.

3.3.2 Drilling

Geotech Drilling Services Ltd. (Geotech) advanced two shallow borings to evaluate the NFRD foundation conditions and calibrate geophysical surveys. A Fraste Mito track-mounted ODEX drill rig with the capability to switch to rock coring (hazard quotient [HQ] size) was mobilized to the site to advance borings through the soil and

rock. Boreholes CH13-203-BH001 and CH13-203-BH002 (Figure 3-2) were installed between July 29 and August 9, 2013.

Each borehole was drilled in accordance with SOP INV001 (CH2M HILL, 2012b) and logged by CH2M HILL in accordance with SOP PCS001 (CH2M HILL, 2012c). Sixteen samples were collected for laboratory analysis. The collected samples were labelled in accordance with SOP SMP011 (CH2M HILL, 2012e) and shipped to the testing laboratory in accordance with SOP PCS002 (CH2M HILL, 2012f) and SOP PCS016 (CH2M HILL, 2012g).

Borehole logs are provided in Appendix E, and photos area provided in Appendix B.

3.3.3 Geotechnical Inspection

A CH2M HILL geotechnical engineer conducted a field inspection of the NFRD embankment condition on July 30, 2013. The field inspection consisted of walking the heel, toe, and crest of the NFRD; observing the embankment condition, taking photographs, and cataloging observations; and locating the observations using a Garmin model GPSMap 60CSx handheld GPS unit. The estimated accuracy of the unit varies, but is estimated as ±3 to 4 m. The inspection considered observations made by BGC Engineering, Inc. (BGC) during the inspection conducted in 2005 and 2006.

3.3.4 Dye Test

The following five dye tests were conducted at the NFRC in 2013: three tests on July 8 and 9, and two tests on September 11 and 12. During each test, dye was injected at a point on the upstream side of the NFRD while a location on the downstream side of the NFRD was monitored for dye emergence.

The injection and monitoring points used in the tests are shown in Figure 3-3. Before the first test on July 8, the length of the upstream bank of the NFRD was searched for locations where drainage through the dam was audible or visible. The NFRD pond appeared stagnant along the upstream edge of the NFRD, except at two isolated locations where water flowed into the toe of the NFRD (Injection Point 1 and Injection Point 2). Dye was alternately injected into these locations during the dye tests.

Procedures followed SOP MSR035, *Open Channel Time of Travel Test* (CH2M HILL, 2013h). Two XLM V2 sondes equipped with optical fluorescence probes were deployed during each test, typically at the injection point and outlet monitoring point; however, for the second and third dye tests (performed on July 9), they were both deployed at separate monitoring points. The sondes were set up to automatically record measurements at 30-second intervals, and their times were synchronized to Pacific Daylight Time. The sondes were rented from Pine Environmental in Burnaby, British Columbia. They were calibrated daily according to SOP MSR003, *Field Water Quality Measurements and Calibration* (CH2M HILL, 2013i). The dye used for the tests was Bright Dyes FWT Red 200 liquid rhodamine dye. For the first dye test on July 8, two 60-mililitre (ml) syringes were filled with dye and expelled directly into the dye injection location. For all subsequent tests, 100 ml of dye was mixed with 400-ml of DI water in a 500-ml sample bottle, and the diluted dye solution was poured into the injection location. Upon injecting the dye, the water within a 1-m radius of the injection location was mixed vigorously using wooden sticks.

During the first two tests (conducted on July 8 and 9), the downstream monitoring sonde was deployed at the location marked as Monitoring Point 1 in Figure 3-3. This location was selected because it was the approximate centre of the downstream flowing face of the NFRD and it appeared that the discharge in this area had a high flow rate relative to more distal areas. However, during the first two tests, the dye emerged at areas of the NFRD approximately 15 m from Monitoring Point 1, and no dye was detected by the sonde. During subsequent tests, the downstream monitoring sonde was deployed at the areas where dye emerged during the first tests, Monitoring Points 2 and 3.

The water level in the NFRD pond was monitored by TEES throughout 2013 by routinely surveying the water level elevation at Station NF1. During dye testing, several water level measurements from Station NF1 were recorded, including measurements on July 8, July 9, and September 12.

The results from the NFRD dye tests are reported in Section 4 of this report and are summarized in Table 3-1. Dye test data are provided in Appendix F, and photos from the dye tests are provided in Appendix B.

3.4 Borrow Investigation

Fifteen test pits (CH13-108-TP001 through CH13-108-TP015) were excavated from July 10 through 15, 2013, at locations in the UPL WRD and NWL WRD using a Caterpillar D9 track dozer with a detachable large blade. The locations of the test pits are shown in Figure 3-4. Test pit excavation was completed by TEES. CH2M HILL identified the proposed location, supervised the excavation, collected samples, and logged each test pit.

Geological characteristics were logged in accordance with ASTM International (ASTM) D5435-12, *Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock*, and test pit composition was logged in accordance with SOP INV017 (CH2M HILL, 2013f). Five samples were collected for geochemical characterization, and three rock samples were collected for geotechnical characterization. Rock pieces were selected that represented the rock types found with minimal evidence of weathering. The collected samples were labelled in accordance with SOP SMP011 (CH2M HILL, 2012e) and shipped to the testing laboratory in accordance with SOP PCS002 (CH2M HILL, 2012f) and SOP PCS016 (CH2M HILL, 2012g).

Photos from the borrow investigation are provided in Appendix B.

3.5 Laboratory Testing Methodology

Laboratory testing for geotechnical characterization of soil and rock samples was completed by Golder Associates Ltd. Three samples were collected between July 10 and 15, 2013, and submitted to Golder in Burnaby. Laboratory testing for geochemical characterization was completed by ALS Global Laboratories (ALS). Thirteen samples including duplicates were collected between July 10 and August 9 2013, and were submitted to ALS in Whitehorse. Laboratory reports are provided in Appendix G. Analytical results are tabulated in Tables 2-1 through 4-6. The following sections summarize the laboratory tests performed and the methods used.

3.5.1 Geochemical Testing (Soil)

Soil samples collected from test pits CH13-108-TP001 through CH13-108-TP015 in the UPL WRD and NWL WRD were submitted to ALS for analysis.

Five samples were analyzed for the following:

- Total metal analysis
- Paste pH (Price, 2009)
- Total inorganic carbon
- Moisture:

  One sample was selected for a 96-hour DI water leach extraction and the leachate was analyzed for:

  - pH, oxidation-reduction potential, and conductivity
  - Alkalinity (including calculated carbonate and bicarbonate) if leachate pH was >4.5
  - Acidity
  - Sulphate
  - Dissolved metals

  Four samples were analyzed for ABA procedures, which included the following:

  - Acid-soluble sulphate-S
  - Barium sulphates (extractable barium using lithium metaborate fusion)
  - Total sulphur
  - Neutralization potential (modified –Sobek)
  - Acid-soluble sulphate

3.5.2 Geotechnical Samples (Soil)

Soil samples were collected for geotechnical laboratory testing from test pits along the crest of the ID, the spillway, and boreholes near the downstream toe of the NFRD. Geotechnical samples were collected at various depths for analysis. Relatively undisturbed samples were collected from the borings using a Standard Penetration Test split-spoon sampler. Soil samples were collected in bags, and samples selected for laboratory testing were submitted for the following analyses:

- 12 Atterberg limits tests (ASTM D4318, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*)
- 21 gradation tests (ASTM D6913, *Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis*)
- 19 natural moisture content measurements (ASTM D2216, *Standard Test Methods for Laboratory Determination of Water [Moisture] Content of Soil and Rock by Mass)*

3.5.3 Geotechnical Samples (Rock)

Three samples were analyzed for specific gravity and absorption to evaluate the rock's ability to absorb water. Analysis was in accordance with ASTM D6473, *10 Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control*. Result values less than 1 to 0.5 percent are considered suitable for use as riprap.

Two samples underwent petrographic examination to identify deleterious minerals. Analysis was in accordance with ASTM C295, *12 Standard Guide for Petrographic Examination of Aggregates for Concrete*. Testing requires six to eight small samples.

Three samples were tested for Unconfined Compressive Strength (UCS) to evaluate the rock's strength and assist with evaluating material strength. Testing was in accordance with ASTM D7012, *13 Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures*.

3.5.4 Quality Assurance/Quality Control

CH2M HILL has incorporated a quality assurance and quality control (QA/QC) plan into the FSP (CH2M HILL, 2013j). QA/QC field samples were collected during soil sampling activities and used to evaluate the quality of the analytical data generated. QA/QC measures during the 2013 field investigation included the collection and submission of duplicate samples, amounting to at least 10 percent of the samples collected, and equipment blank samples. Laboratory data collected in 2013 were validated in accordance with the quality assurance project plan (CH2M HILL, 2013j). The findings of this data validation are reported in two data quality evaluation (DQE) reports specific to each sample matrix (i.e., water or solids). Analytical data are stored in the Environmental Quality Information System database, EQuIS ™.

Field QA/QC samples are designed for the following: (1) identify potential matrix interferences, (2) evaluate sources of sample contamination (equipment blanks) and variations introduced by sample collection, handling, and analysis (duplicate field samples), and (3) verify the effectiveness of analytical methods (matrix spike and matrix spike duplicate samples).

3.5.5 Sample Handling

Samples were collected and labelled in accordance with SOP SMP011 (CH2M HILL, 2012e) and shipped to the testing laboratories in accordance with SOP PCS002 (CH2M HILL, 2012f) and SOP PCS016 (CH2M HILL, 2012g). Samples of the drill cuttings were shipped to ALS for analysis or to be held for possible future analyses. Following rock coring and logging, rock cores were packaged in accordance with SOP PCS016 (CH2M HILL, 2012g).

3.5.6 Data Quality Evaluation Report

DQE reports, prepared by the project chemist, summarize the results of the QA/QC activities prescribed in the quality assurance project plan and provide a complete data usability assessment. The quality assurance project

plan identifies the method-specific QA/QC requirements for each analytical parameter and matrix and defines a plan to test that the correct sampling, analytical, and data reduction procedures are followed by conducting audits and performing data validation.

DQE reports are intended as a general data quality assessment designed to summarize data issues. DQE reports prepared for Task Authorization (TA) 016 solids data are provided in Appendix H.

3.5.7 Deviations

Five additional test pits, for a total of 15, were installed in the UPL WRD and NWL WRD. Ten test pits were initially planned in TA007 (I) Fiscal Year 2013-2014 Field Investigation (CH2M HILL, 2013k). The additional five test pits were installed because of the heterogeneous nature of the UPL and NWL WRDs.

No tests pit logs for CH13-108-TP001 through CH13-108-TP015 were generated because of the unconventional nature of the material (mixed waste rock). Instead, notes were taken on observed size distributions and rock types.

The NFRD dye test was performed in July, rather than at freshet as planned in the FSP, because of budgeting constraints.

SECTION 4

Data Summary

This section presents the results of the 2013 DVIHU field activities.

4.1 Rose Creek Diversion Activities

4.1.1 Vegetation Reconnaissance

Significant vegetative growth was noted along the berm during the RCD inspection. Woody vegetation was observed on both the left (channel side) and right (tailings side) of the diversion dike and on the left side of the channel. The type, distribution, and size of vegetation varied widely along the berm, making it difficult to succinctly describe specific locations of problematic vegetation to be remedied. In places, dense thickets occupy the berm and complicate berm inspection. In other places the vegetation exists at an acceptable level that is not considered deleterious to the dike. All vegetation, if not addressed, is expected to increase in size and severity with time.

Common woody vegetative types observed were of the genera *Betula* (birch and alder), *Salix* (willow), *Populus* (poplar, aspen), and to a lesser extent *Abies* (fir). Other boreal riparian vegetation was also observed. Vegetation sizes observed varied from young forbs to small trees up to approximately 10 centimetre (cm) caliper diameter.

4.1.2 Animal Burrows Reconnaissance

Evidence of large rodents was observed during the RCD dike inspection. Direct evidence of genera *Castor* (Canadian beaver) and *Erethizon* (porcupine), both of which are known to dig burrows, was noted during the inspection. Areas of significant burrow excavation were not positively identified; however, several voids that may have been partially attributed to burrowing rodents are described in the field notes (Attachment 4 of Appendix A). Voids provided beneath large riprap and cover provided by woody vegetation likely contribute to the presence of borrowing rodents on the dike.

4.1.3 Dike Crest Grading Reconnaissance

During the inspection period, the dike crest was generally uniform without obvious signs of settlement or subsidence. However, a slight dip less than 0.3 m was observed at Point 91 (Attachment 2 of Appendix A). At this location, the dike is higher than the adjacent tailings ponds. Evidence of seepage or fines migration was not apparent on the right side of the dike, and the explicit cause for the dip is unknown. The dip may be attributed to thawing or consolidation settlement in the time since dike construction.

At multiple locations along the dike crest, ruts or puddles were observed (Figure 9 of RCDC Inspection Summary within Appendix A). The grading of the dike crest should be maintained to prevent development of these water-collecting depressions that can soften and destabilize the dike and allow progressive rutting and structure deterioration. The crest should be graded to direct water off the dike.

4.1.4 Slope Stability Reconnaissance

The RCD dike exhibits numerous signs of instability. The majority of the right bank of the RCD dike exhibits evidence of previous and ongoing slope movement. Long sections of dike have tension cracking, scarps, channel constrictions, and other signs of shallow instability. Many areas appear to have been previously repaired, both discrete slides and for long sections of the dike. This report does not include a review of the dike history or its past modifications; however, the presence of slope repairs, riprap modifications and augmentations, and geotechnical instrumentation installation suggests that dike stability has likely been identified by others.

The generally cohesionless nature of the dike fill prevents the persistence of acute signs of slope instability (small tension cracks, scarps, etc.) for long periods of time. Regardless, these features were common on the right side of the channel during the inspection. The slope instability phenomena observed were generally characteristic of

shallow slides and sloughs; evidence of deep seated failure surfaces or other mechanisms that would compromise the dike crest were not noted during the inspection. In some locations, the presence of thick vegetation prevented thorough inspection of the left and right channel slopes.

The RCD dike is constructed with a compacted till seepage liner, overlain by a compacted sand and gravel blanket, then armored with riprap. The relatively shallow nature of the sloughs and slumps observed in the RCD dike appear to be relatively shallow and are not expected to have significantly disturbed the wide compacted till seepage liner. However, in many locations, the riprap channel lining has slumped downward, leaving portions of the dike over-steepened and exposed to erosion, animal burrows, and other problems.

Soil conditions on the left side of the channel are typically in “cut” and are less uniform than those on the right side. The right side of the dike was constructed with a relatively uniform engineered fill, whereas the left-side cut slopes expose variable native materials. In several locations where the RCD excavation encountered sound rock, the excavation of the left side of the channel was extended into the hillside as a borrow source for rock during construction. These areas generally appear stable. Away from the rock cut slopes, significant zones of slope failure, cracking, and sloughing were observed on the left side of the channel. These slope failures are generally shallow, but may transport materials and debris into the RCD. As with the right side, there is evidence that previous slope failures have been identified and repaired by others.

4.1.5 Riprap and Large-Diameter Riprap Reconnaissance

The riprap and large-diameter riprap armoring of the RCD is highly variable along its length. In places, slope instability or sloughing has carried riprap downward leaving portions of the slope exposed. Elsewhere, previous slope repairs have placed riprap of contrasting size, shape (rounded versus angular), and lithology. In some locations, riprap sloughing has impinged on channel width. In other places, riprap has initially sloughed, then augmented with additional riprap (weight), which contributed to additional sloughing.

The higher-gradient portions of the channel are armored with large-diameter riprap. The condition of these sections of channel generally appears more uniform than the conventionally armored channel sections and have fewer signs of distress. However, in several locations, these large stones have moved downward and into the channel, or have left portions of the channel unprotected. Additionally, many locations armored with large-diameter riprap have significant vegetative growth. In some cases, large voids have been identified behind the large-diameter riprap, and the underlying embankment fill is subject to erosion and scour. The higher-gradient areas on the downstream portion of the RCD have a higher concentration of dense willow growth than the lower-gradient portions of the channel.

4.1.6 Seepage Reconnaissance

No instances of adverse seepage through the dike were noted during the inspection. However, in an area on the upstream end of the channel, the toe of the dike slope and the channel bottom exhibited dark red staining. This may be due to tailings water seeping into the channel (see Point 11 in Attachments 1 through 4 of Appendix A). This seepage does not appear to compromise the stability of the RCD dike, but may indicate an ineffective liner or otherwise poor containment within the tailings ponds. The inspection was conducted during a relatively low flow period in the channel.

4.1.7 Overflow Weir (Fuse Plug) Reconnaissance

The overflow weir (fuse plug) portion of the RCD is a depressed section of the dike that permits flow of excess water into the Intermediate Impoundment. The structure is referred to as a fuse plug; however, this section is heavily reinforced with large-diameter stone and does not appear to be readily fusible in an overtopping event. The depressed section of the fuse plug is slightly lower than the surrounding berm and may function as an armored overflow spillway.

4.2 Intermediate Dam Activities

The results of the test pits indicate that the ID core material generally consists of silty, clayey sand and gravel with cobbles. Near the centerline of the dam, the dam core material is within 0.3 to 0.6 m of the ground surface. On the upstream side of the dam, the top of the dam core material becomes deeper. The top of the dam core material was observed to be approximately parallel to the upstream face of the dam, at an offset of approximately 4 m horizontally. The embankment material surrounding the core generally consisted of well-graded gravel with silt, sand, and cobbles.

The subsurface material within the spillway consisted of coarse-grained alluvial soil that was able to be excavated with the Caterpillar 345C excavator. Within the upper 1 m below the ground surface, the soil contained up to 50 percent cobbles and boulders, up to a maximum size of 61 cm.

Figure 3-1 provides the test pit location, Table 4-1 provides laboratory results, Appendix C provides test pit logs, and Appendix B provides photos.

4.3 North Fork Rock Drain Assessment Activities

4.3.1 Geophysical Investigation

A detailed description of the results of the NFRC geophysical investigation conducted by Aurora is provided in Appendix D. A high-level description is provided in this section.

Geophysics survey line CH13-203-GX001 abuts the upstream side of the NFRD east of the NFRC. Survey results for CH13-203-GX001 suggest frozen overburden lenses at the centre and west portion of the line (note that the west portion of the line corresponds to the east channel bank). Depth to bedrock (velocity of ~2,000 metres/second) ranges from 10 metres below ground surface (mbgs) for the west and central portions of the line to 6 mbgs along the eastern portion of the line.

Geophysics survey line CH13-203-GX002 runs across the NFRC upstream from the NFRD. Survey results for CH13-203-GX002 suggest frozen overburden at both ends of the survey with smaller discontinuous lenses over the central portion of the line. Estimated depth to bedrock ranges from 20 mbgs west of the line (corresponding to the west channel bank) to 2 mbgs east of the line (east channel bank).

Geophysics survey line CH13-203-GX003 abuts the downstream side of the NFRD crossing the NFRC. Survey results for CH13-203-GX003 suggest frozen overburden east of the line with estimated depths to bedrock of 25 mbgs west of the line, 3 mbgs at the centre, and 8 mbgs east of the line.

Geophysics survey line CH13-203-GX004 is on the western bank of the NFRC upstream from the NFRD. Survey results suggest frozen lenses west of the line and estimate the depth to bedrock to range from 10 to 15 mbgs.

Geophysics survey line CH13-203-GX005 crosses the NFRC upstream from the NFRD. Survey results suggest frozen overburden over the entire length of the survey line with variable depths to bedrock ranging from 10 to 20 mbgs.

4.3.1.1 Geotechnical Assessment

The geotechnical investigation at the NFRD included advancing two boreholes, CH13-203-BH001 and CH13-203-BH002, at the base of the NFRD. Standard Penetration Tests (ASTM D1586) were typically conducted at 0.75-m increments to a depth of 5 m and at 1.5-m increments below 5 m within overburden materials until bedrock was encountered. Blow counts were recorded at three continuous 150-mm intervals for a total of 45 cm of sampling length. The sampler was driven an additional 15 cm to collect an adequate sample for laboratory testing. Boreholes locations (CH-13-203-BH001 and CH13-203-BH002) are shown in Figure 3-2. Standard Penetration Test blow count results are provided in Appendix E.

An NFRD borehole summary is provided in Table 4-2. For CH13-203-BH001, weathered bedrock was encountered at 7.6 m below grade and is white and became grey at 11 m. An HQ diamond bit was used for rock coring from 10.7 m to the end of the borehole at 11.2 m. For CH13-203-BH002, weathered phyllite bedrock was encountered

at 7.6 m below grade and is light grey. No HQ diamond bit was used for rock coring as the weather phyllite was too soft to core. The borehole was completed at 11.3 m.

No weak materials of consequence to embankment stability were identified in the boreholes. Instead, coarse-grained alluvium was encountered above the underlying bedrock. The alluvium generally consisted of alternating layers of sandy, gravelly, and cobble materials with lesser amounts of silt and boulders. Surface soils consisted of a thin layer of peaty organic material. In CH13-203-BH002on the eastside of the NFRD, large boulders were encountered floating in the soil profile. Weathered phyllite bedrock was encountered at a depth of 10.7 m in CH13-203-BH001 and at 7.6 m in CH13-203-BH002. In both locations, the rock was too weathered to obtain recovery in the HQ triple tube core barrel and was instead sampled with a standard 50-mm outside-diameter split-spoon sampler.

Bright orange drill cuttings were observed at a depth of 8.2 m in BH002 near the upper contact with the bedrock. The boreholes were abandoned by backfilling to the ground surface with bentonite chips.

Borehole logs are presented in Appendix E, and select exploration photographs are presented in Appendix B.

4.3.2 Geotechnical Inspection

At the time of the inspection, the upstream and downstream faces of the NFRD were observed to be generally in good condition with no signs of significant sloughing, instability, or particle migration. Conditions were similar to those documented during the previous inspection.

The following key observations were made during the inspection:

- One notable erosion pocket was observed on the downstream face of the NFRD. The origin of this pocket is unknown, but is possibly attributed to erosion of particles during a previous high water event, or a poorly placed boulder that rolled out of position. The pocket is approximately 0.9 m deep and 1.2 m wide and appears to expose a surficial zone of relatively fine (gravelly) material.
- Several vertical streaks of finer-grained material were observed on both faces of the NFRD originating at the dike crest. These streaks were visible in the previous BGC inspection and are attributed to minor sloughing from placement of the vehicle barrier berms placed at the top of the Haul Road and from storm water runoff from the Haul Road crest. The streaks originate at the crest and are not purported to be associated with seepage or fines migration from the interior of the berm. In some locations, there was minor rill and gully erosion observed in the streaks.
- Silt and woody debris were observed in a well-defined high water mark on the upstream side of the NFRD. Both the silt thickness and the large wood density generally decreased with increasing elevation. In places, the silt was approximately 10 cm thick and beginning to grow young grass. The woody debris consisted of logs and stumps of varying size. Some anthropogenic debris was also observed.
- Flow exiting the downstream toe of the NFRD was steady and clear at the time of the inspection, occurring over an estimated 50-m-wide interval with stronger flows on the left and right sides.

4.3.3 Dye Test

The results from the five dye tests (Trials 1 through 5) performed at the NFRD in 2013 are summarized in Table 3-1 and discussed below. Time series plots of rhodamine concentrations recorded during the tests are presented in Figure 4-1. The locations of the dye injection and monitoring points are shown in Figure 3-3.

During Trials 1 and 4, dye was injected at Injection Point 1 (see Figure 3-3), at the western corner of the NFRD pond. Approximately 1 hour after each injection, the dye emerged from the western corner of the downstream flowing face of the NFRD in a 2-m-wide turbulent pool (Monitoring Point 3). At peak discharge, the dye was clearly visible at the emergence point and downstream throughout a 3-m-wide channel that merges with the main channel of NFRC at Station NF2. The dye faded across the width of the NFRC approximately 60 m downstream from its emergence point and was only faintly visible 900 m downstream at Station X2. During Trial 1, the downstream monitoring sonde was deployed at Monitoring Point 1 and did not detect rhodamine. The estimated

time elapsed between injection and peak discharge was 1 hour. During Trial 4, the downstream monitoring sonde was deployed at Monitoring Point 3, and the dye was detected; peak rhodamine concentration was recorded 64 minutes after injection.

During Trials 2, 3, and 5, dye was injected at Injection Point 2 (see Figure 3-3), at the southern corner of the NFRD pond. Approximately 1 hour after each injection, the dye emerged from the eastern corner of the downstream flowing face of the NFRD in a 1-m-wide turbulent pool (Monitoring Point 2). At peak discharge, the dye was clearly visible at the emergence point, and it a formed a distinct band along the eastern bank of the NFRC that stretched downstream approximately 70 m before fading across the width of the creek. The dye was faintly visible 900 m downstream at Station X2. During Trial 2, the downstream monitoring sonde was deployed at Monitoring Point 1 and did not detect rhodamine. The estimated time elapsed between injection and peak discharge was 1 hour. During Trials 3 and 5, the downstream monitoring sonde was deployed at Monitoring Point 2, and the dye was detected; peak rhodamine concentration was recorded 64 minutes after injection and 51 minutes after injection for Trials 3 and 5, respectively.

The measured residence time within the NFRD ranged from 51 to 64 minutes. The discrete, localized areas where the dye was injected and detected suggest that flow through the NFRD occurs within defined preferential pathways, and negligible transverse mixing occurs across the width of the channel under the flow conditions tested. The residence time between Injection Point 2 and Monitoring Point 2 was shorter during the September 12 test than during the July 9 test. This may be attributed to the increased water level in the NFRD pond, which was approximately 12 cm higher during the September test.

4.4 Borrow Investigation Results

4.4.1 Geochemical Results

Five samples (not including duplicates) collected from the UPL WRD and NWL WRD were submitted for total metal analysis. Comparison of total metal results to the GARD Guide indicate that the majority of the results fall within the guidelines (see Table 2-1). Of the five samples analyzed, one had elevated arsenic, four had elevated bismuth, two had elevated cadmium, four had elevated lead, three had elevated selenium, two had elevated silver, and one had elevated zinc. Comparison of the total metal concentrations to the Mine Environment Neutral Drainage (MEND) guidelines indicate that two samples had elevated total phosphorous.

One sample from test pit CH13-311-TP015 was selected for a 96-hour DI water leach test. Concentrations of soluble constituents mobilized through DI water extraction exceeded the guidelines for aluminum and selenium (see Table 2-2).

Results from ABA analyses on samples collected from the UPL WRD and NWL WRD indicate neutral to high paste pH (median 8.58) and NP values ranging from 105 kilograms (kg) calcium carbonate/tonne to 142 kg calcium carbonate/tonne with a median value of 118 kg calcium carbonate/tonne (see Table 2-3). The median NP-to-AP ratio (37.6) and NNP value (115.4) identify the material as a net-neutralizing material.

4.4.2 Geotechnical Results

The results from test pitting, field logging, and laboratory analysis of samples from the UPL WRD and NWL WRD indicate the WRDs consist of a geologically heterogeneous material. Mixed gradation and mineralogy were observed at all depths and in all test pits; no spatial variation patterns were observed. These observations are consistent with the construction methods and estimated rock-type proportions indicated in historical records (Robertson Geoconsultants, 1996). These records indicate that the UPL WRD and NWL WRD were constructed from free-dumped unsegregated waste rock stripped primarily from the Faro Zone I pit (Robertson Geoconsultants, 1996).

The UPL WRD is estimated to consist of 40 to 70 percent material smaller than 3 inches, with the remaining fraction composed of highly to slightly weathered, medium strong to strong phyllite and schist, cobbles, and boulders. Previous investigations estimated that the UPL WRD was composed of 5 percent sulphides, 25 percent

schist, and 70 percent calcium-silicate (Robertson Geoconsultants, 1996), which agrees with observations made by CH2M HILL.

A visual inspection of the eastern section of the NWL WRD found the area contained industrial waste, so the investigation was restricted to the western portion of the WRD). This portion of the NWL WRD is estimated to consist of 30 to70 percent material smaller than 3 inches. with the remaining fraction composed of phyllite and schist cobbles and boulders. Previous estimates indicate that the WRD was composed of 8 percent sulphides, 37 percent schist, 30 percent calcium-silicate, 15 percent intrusive, and 10 percent overburden (Robertson Geoconsultants, 1996). CH2M HILL did not observe significant overburden or igneous rocks, but it is possible that this material is located at a greater depth within the WRD. The majority of rock encountered in the NWL WRD was phyllite and schist of varying mineralogy including sulphides and calcium-silicates.

Petrographic analysis, unconfined compressive strength (UCS), and specific absorption tests were conducted on rock samples from test pit CH12-311-TP002, excavated in the UPL WRD. Results indicate the sample was a schist that contained 90.3 percent “good” and 9.7 percent “fair” quality material (see Table 4-3). Predominant minerals in the sample included quartz, calcite, phyllosilicates, epidote, and zoisite with trace pyrite and chalcopyrite. Under UCS testing, the sample failed at a maximum load of 150.3 kilonewton (KN) with a stress of 92.3 mega Pascal (MPa) by shear along a discontinuity (see Table 4-4). The sample exhibited an average specific absorption of 1.09 percent (see Table 4-59).

Petrographic analysis, UCS, and specific absorption tests were conducted on rock samples collected from test pit CH13-108-TP011, excavated in the NWL WDR. Results indicate the sample was a schist that contained 91.1 percent “good” material and 8.9 “fair” quality material (see Table 4-6). Dominant minerals were quartz and chlorite with minor prehnite, feldspar, zoisite, epidote, and muscovite. Under UCS testing, the sample failed at a maximum load of 133.6 KN with a stress of 81.9 MPa by vertical fracturing/shear along a discontinuity (Table 4-4). The sample exhibited an average specific absorption of 0.19 percent (Table 9). 4-5).

UCS and specific absorption tests were performed on a sample from test pit CH13-108-TP008, excavated in the NWL WDR. The specimen failed under a maximum load of 105.3 KN with a stress of 64.5 MPa by shear along a discontinuity/spalling (Table 4-4). The sample exhibited an average specific absorption of 1.13 percent (Table 4-5).

The laboratory testing indicates that calcium-silicate in the UPL WRD and NWL WRD is suitable material for construction, but that material only constitutes 30 percent of the bulk material within the WRDs. If the material is used for gabion baskets, it would need to be isolated from the other rock types by selective screening.

SECTION 5

Recommendations

Based on the RCD investigation, vegetation removal from the channel slopes, localized re-gradation of the dike, and placement or augmentation of riprap are recommended. Several other isolated problems require specific corrective action, which are covered in the *Task Authorization 016 Down Valley Interim Hydraulic Upgrades Phase 2 – Basis of Design Report* (CH2M HILL, 2014).

Based on 2013 test pit data in the ID spillway, the material excavated from the ID spillway is suitable for use as backfill behind the proposed gabion walls; however no geochemical sampling has been performed on this material to date. Geochemical samples should be collected during the 2014 field season to test paste pH, total metals, and ABA. This work will be included in the 2014 FSP and will support the final Probable Maximum Flood ID spillway design.

The foundation material for the NFRD is composed of phyllite situated 7.6 to 10.7 mbgs. The visual inspection of the NFRD found that it was generally in good condition; continued monitoring and maintenance should be performed. The dye test results indicate that the residence time within the NFRD ranged from 51 to 64 minutes and suggest that flow occurs within defined preferential pathways within and beneath the NFRD and negligible transverse mixing occurs across the width of the channel.

Because of the variable material types found at the UPL WRD and NWL WRD, and the effort required to isolate the suitable material (calcium-silicate) from the other rock types, the material should not be used for the DVIHU. The preferred hard rock borrow for the riprap material needed for the DVIHU construction materials is the Grum Waste Rock Dump Quarry or the Granitic Rock Outcrop. Investigation of these borrow locations is addressed in the TA018 field investigation.

SECTION 6

References

ASTM International (ASTM). 2013. D7012 – 13 Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures. ASTM International (ASTM). Annual Book of Standards. West Conshohocken, PA.

ASTM International (ASTM). 2012. C295/C295M – 12 Standard Guide for Petrographic Examination of Aggregates for Concrete. ASTM International (ASTM). Annual Book of Standards. West Conshohocken, PA.

ASTM International (ASTM). 2012. D5435 – 12 Standard Test Method for Diagnostic Soil Test for Plant Growth and Food Chain Protection. ASTM International (ASTM). Annual Book of Standards. West Conshohocken, PA.

ASTM International (ASTM). 2011. D1586 – Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM International (ASTM). 2010. D4318 – 10 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils. ASTM International (ASTM). Annual Book of Standards. West Conshohocken, PA.

ASTM International (ASTM). 2010. D6473 – 10 Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control. ASTM International (ASTM). Annual Book of Standards. West Conshohocken, PA.

ASTM International (ASTM). 2009. D2488 – 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). ASTM International (ASTM). Annual Book of Standards. West Conshohocken, PA.

ASTM International (ASTM). 2009. D6913 – 04 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis. ASTM International (ASTM). Annual Book of Standards. West Conshohocken, PA.

ASTM International (ASTM). 2008. D4643 – 08 Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating. ASTM International (ASTM). Annual Book of Standards. West Conshohocken, PA.

BGC Engineering Inc. (BGC). 2005. *Task 22F. Rose Creek Diversion Channel, Preliminary Geotechnical Evaluation, Faro Mine YT*. Prepared for Deloitte & Touche Inc. December.

BGC Engineering Inc. (BGC). 2004. *Evaluation of the North Fork Rock Drain*. Draft report prepared for Deloitte and Touche Inc.

Canadian Council of Ministers of the Environment (CCME). 2007. *Canadian Environmental Quality Guidelines*. Retrieved from http://st-ts.ccme.ca/

Canadian Dam Association (CDA). 2007. *CDA Dam Safety Guidelines 2007*.

CH2M HILL Canada Limited (CH2M HILL). 2014. *Task Authorization 016 Down Valley Interim Hydraulic Upgrades Phase 2 – Basis of Design Report, Faro Mine Remediation Project.* Prepared for Government of Canada as represented by the Government of Yukon and Aboriginal Affairs and Northern Development Canada. Final. February 14.

CH2M HILL Canada Limited (CH2M HILL). 2013a. ID Crest Test Pits – 2013 Field Sampling Plan. Prepared for Government of Yukon.

CH2M HILL Canada Limited (CH2M HILL). 2013b. RCD Delineation and Mapping– 2013 Field Sampling Plan. Prepared for Government of Yukon.

CH2M HILL Canada Limited (CH2M HILL). 2013c. NFRC Rock Drain Assessment – 2013 Field Sampling Plan. Prepared for Government of Yukon.

CH2M HILL Canada Limited (CH2M HILL). 2013d. Phase II Borrow Investigation – 2013 Field Sampling Plan. Prepared for Government of Yukon.

CH2M HILL Canada Limited (CH2M HILL). 2013e. *2013 Field Health and Safety Plan, Faro Mine Remediation Project.* March.

CH2M HILL Canada Limited (CH2M HILL). 2013f. Standard Operating Procedure INV017, *Logging and Sampling of Test Pits.* Prepared for Government of Yukon.

CH2M HILL Canada Limited (CH2M HILL). 2013g. Standard Operating Procedure INV003, *Borehole Sampling and Testing*. Prepared for Government of Yukon. May.

CH2M HILL Canada Limited (CH2M HILL). 2013h. Standard Operating Procedure MSR035, *Open Channel Time of Travel Test.* Prepared for Government of Yukon.

CH2M HILL Canada Limited (CH2M HILL). 2013i. Standard Operating Procedure MSR003, *Field Water Quality Measurements and Calibration*. Prepared for Government of Yukon.

CH2M HILL Canada Limited (CH2M HILL). 2013j. *Construct Cross Valley Dam Interception System - 2013 Field Sampling Plan.* Prepared for Government of Yukon. June.

CH2M HILL Canada Limited (CH2M HILL). 2013k. *Task Authorization 007(I) Fiscal Year 2013-2014 Field Investigation Project Design Team for Faro Mine Remediation, Contract Number C00010250.* Task Authorization Request. Prepared for Government of Yukon. May 31.

CH2M HILL Canada Limited (CH2M HILL) 2012a. *Conceptual Site Model, Faro Mine Remediation Project.*

CH2M HILL Canada Limited (CH2M HILL) 2012b. Standard Operating Procedure INV001*, Drilling*. Prepared for Government of Yukon. March.

CH2M HILL Canada Limited (CH2M HILL) 2012c. Standard Operating Procedure PCS001*, Boring Logs Completion, Soil Classification, and Logging*. Prepared for Government of Yukon. March.

CH2M HILL Canada Limited (CH2M HILL). 2012d. Standard Operating Procedure SMP006, *Surface and Subsurface Soil Sampling.* Prepared for Government of Yukon. September.

CH2M HILL Canada Limited (CH2M HILL) 2012e. Standard Operating Procedure SMP011*, Sample Nomenclature.* Prepared for Government of Yukon. March.

CH2M HILL Canada Limited (CH2M HILL) 2012f. Standard Operating Procedure PCS002*, Sample Packing and Shipping (Environmental).* Prepared for Government of Yukon. May.

CH2M HILL Canada Limited (CH2M HILL) 2012g. Standard Operating Procedure PCS016*, Sample Packing, Shipping and Storage (Geotechnical).* Prepared for Government of Yukon. May.

Environment Canada. 2010. *Federal Interim Groundwater Quality Guidelines.*

International Network for Acid Prevention. 2013. *Global Acid Rock Drainage (GARD) Guide*. Available at: http://www.gardguide.com/index.php/Main_Page. Accessed October 2013.

International Organization for Standardization (ISO). 2000. Method 15178. Soil quality – Determination of total sulphur by dry combustion.

Lawrence, R.W., G.P. Poling, and P.B. Marchant. 1989*. Investigation of PREDICTIVE techniques for Acid Mine Drainage*. Prepared for Energy Mines and Resources, Canada. MEND Report 1.16.1(a). March.

Mine Environment Neutral Drainage (MEND). 1991. *Acid Rock Drainage Prediction Manual, a Manual of Chemical Evaluation Procedures for the Prediction of Acid Generation from Mine Wastes*. Prepared for Canada Centre for Mineral and Energy Technology, Mineral Sciences Laboratories Division, Department of Energy, Mines and Resources, Canada. March.

Northwest Hydraulic Consultants Ltd. 2006. *RCDC Options Analysis Summary*. Memorandum prepared for John Brodie, FMCPO. February 28.

Northwest Hydraulic Consultants Ltd. 2006. *RCDC Detail Design Issues*. Memorandum prepared for John Brodie, FMCPO. March 20.

Northwest Hydraulic Consultants Ltd. 2006. *Faro Mine Hydraulic Capacity Analysis*. Prepared for Deloitte & Touche Inc. June.

Price, W.A. 2009. "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials." *MEND Report*. 1.20.1. p. 579.

Price, W.A. 1997. *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia*. B.C. Ministry of Employment and Investment; p141 plus appendices

Robertson Geoconsultants Inc. 1996. *Anvil Range Mining Complex – Integrated Comprehensive Abandonment Plan*. Prepared for Anvil Range Mining Corporation. November.

SRK Consulting (Canada) Inc. (SRK). 2006. *Additional Borrow Studies, Anvil Range Mining Complex, Yukon, 2004/05 Task 11a*. Prepared for Deloitte & Touche Inc., on behalf of Faro Mine Closure Planning Office. March.

SRK Consulting Engineers and Scientists (SRK). 2006. Anvil Range Mining Complex Additional Borrow Studies 2005/06 Task 17a.

SRK Consulting Engineers and Scientists (SRK). 2004. *Geochemical Studies of Waste Rock at the Anvil Range Mining Complex, Phase III Report. Prepared for Deloitte and Touche*. June.

SRK Consulting Engineers and Scientists (SRK). 2003. *Phase 2 Borrow Source Survey Faro Mine, Yukon.*

SRK Consulting Engineers and Scientists (SRK). 2002. 1CD003.12 Anvil Range Mining Corporation Interim Receivership Phase 1 Borrow Source Survey.

United States Environmental Protection Agency. 1999. *EPA and Hardrock Mining: A Sourcebook for Industry in the Northwest and Alaska.* Draft Guidance Document from EPA Region 10; EPA-10-R-99-016.

Williams, Cliff. 1975. *Significant Event Report, Environment Canada, Department of Indian Affairs and Northern Development*. March 20.

Tables

TABLE 2-1

Metals and General Chemistry

Faro Mine Remediation Project

				Location	CH13-108-TP002	CH13-108-TP006	CH13-108-TP009	CH13-108-TP011	CH13-108-TP015
				Sample ID	CH13-108-TP002_SOa	CH13-108-TP006_SOa	CH13-108-TP009_SOa	CH13-108-TP011_SOa	CH13-108-TP015_SOa
				Sample Depth (ft.)	0 - 5	0 - 5	0 - 5	0 - 5	0 - 5
				Sample Date	7/12/2013	7/13/2013	7/13/2013	7/13/2013	7/15/2013
Analyte		**GARD** [a]	**MEND** [b]						
Aluminum	mg/kg	852,000	823,000		**30,100**	**39,500**	**35,900**	**35,300**	**32,800**
Antimony	mg/kg	60	2		**1.07**	**0.47**	**0.4**	**0.35**	**0.83**
Arsenic	mg/kg	72	18		**13.7**	**7.71**	**15.1**	**8.1**	**54.7**
Barium	mg/kg	6,000	4,250		**320**	**332**	**352**	**177**	**262**
Beryllium	mg/kg	72	28		**1.9**	**2.17**	**2.11**	**2.69**	**1.8**
Bismuth	mg/kg	-	0.09		< 0.2	**9.8**	**0.33**	**0.23**	**3.19**
Boron	mg/kg	-	-		< 10	< 10	< 10	< 10	< 10
Cadmium	mg/kg	4.2	1.5		**0.725**	**9.87**	**0.965**	**0.262**	**1.87**
Calcium	mg/kg	180,000	415,000		**39,300**	**43,200**	**36,400**	**51,500**	**29,300**
Chromium	mg/kg	840	1,020		**109**	**66.6**	**74.5**	**57.3**	**207**
Cobalt	mg/kg	96	250		**23.1**	**24.5**	**27.8**	**22.3**	**43.2**
Copper	mg/kg	360	600		**41.9**	**253**	**50.3**	**32.5**	**83.6**
Inorganic Carbon (as $CaCO_3$ Equivalent)	%	-	-		**7.96**	**11.4**	**9.54**	**9.55**	**5.14**
Iron	mg/kg	480,000	563,000		**41,600**	**48,600**	**50,000**	**37,700**	**65,100**
Lead	mg/kg	420	140		**343**	**460**	**148**	**73.4**	**437**
Lithium	mg/kg	300	200		**41.6**	**68.6**	**51.8**	**49.9**	**57.4**
Magnesium	mg/kg	60,000	200,000		**15,900**	**17,200**	**19,900**	**14,200**	**28,500**
Manganese	mg/kg	12,000	9,500		**794**	**1220**	**859**	**757**	**840**
Mercury	mg/kg	0.72	-		**0.277**	**0.0604**	**0.0378**	**0.0343**	**0.0217**
Moisture	%	-	-		**8.66**	**3.94**	**3.62**	**5.4**	**3.86**
Molybdenum	mg/kg	24	12		**0.52**	< 0.5	**1.54**	< 0.5	**1.76**
Nickel	mg/kg	600	840		**77.4**	**51**	**62.7**	**45.6**	**220**
Paste pH	pH Units	-	-		**7.76**	**7.71**	**7.46**	**7.75**	**6.84**
pH (1:2 soil: water)	pH Units	-	-		**8.58**	**8.61**	**8.09**	**8.59**	**8.2**
pH, Deionized Water	pH Units				N/A	N/A	N/A	N/A	**7.95**
Potassium	mg/kg	168,000	200,000		**2,070**	**7,770**	**6,490**	**3,550**	**5,660**
Selenium	mg/kg	4.8	0.5		< 0.2	**1.34**	**0.6**	**0.22**	**1.22**
Silver	mg/kg	-	0.75		**0.55**	**2.09**	**0.28**	**0.13**	**1.39**
Sodium	mg/kg	60,000	236,000		**260**	**1,500**	**370**	**860**	**300**
Strontium	mg/kg	3,000	3,700		**179**	**163**	**150**	**199**	**80.2**
Thallium	mg/kg	108	96		**0.205**	**0.318**	**0.39**	**0.167**	**0.739**
Tin	mg/kg	48	23		< 2	**4.5**	< 2	< 2	**2.5**
Titanium	mg/kg	-	56,500		**83**	**805**	**324**	**156**	**341**
Total Inorganic Carbon	%	-	-		**0.96**	**1.37**	**1.14**	**1.15**	**0.62**
Total Phosphorus	mg/kg	800	10,500		**494**	**479**	***853***	**429**	***1,020***
Uranium	mg/kg	24	27		**1.12**	**1.46**	**1.65**	**1.28**	**1.61**
Vanadium	mg/kg	1,080	1,200		**51.5**	**65.3**	**86.4**	**46.7**	**109**
Zinc	mg/kg	1,080	700		**609**	**710**	**264**	**144**	**353**

[a] Median soil content reported from International Network for Acid Prevention. 2013. *Global Acid Rock Drainage (GARD) Guide* . Available at: http://www.gardguide.com/index.php/Main_Page. Accessed on October, 2013.

[b] Values from Price, W.A. 1997. *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia* . B.C. Ministry of Employment and Investment; p141 plus appendices.

Notes:

Bold indicates the analyte was detected.

Italics indicate the analyte was identified at concentrations that exceed 10 times the crustal abundance.

Shading indicates the analyte was identified at concentrations 12 to 24 times the median soil content determined as having a geochemical abundance index (GAI) of 3 calculated by GAI = $\log_2$(conc/1.5*mean soil concentration).

% = percent

< = denotes less than laboratory method detection limit

$CaCO_3$ = calcium carbonate

ID = identification

MEND = Mine Environment Neutral Drainage

mg/kg = milligram per kilogram

N/A = not analyzed

TABLE 2-2
Deionized Water Leach Extraction
Faro Mine Remediation Project

		Location	CH13-108-TP015
		Sample ID	CH13-108-TP015_Soa
		Sample Depth (m)	0 - 1.5
		Sample Date	7/15/2013
Analyte	**Units**	**FIGQG**	
Acidity, DI	mg/L	-	**3**
Alkalinity, Total, DI	mg/L	-	**88.3**
Aluminum, DI	mg/L	0.1 [a]	**0.0175**
Antimony, DI	mg/L	-	**0.00046**
Arsenic, DI	mg/L	0.005	< 0.001
Barium, DI	mg/L	-	**0.0819**
Barium, LMB	ppm	-	**1185**
Beryllium, DI	mg/L	1.5	< 0.0005
Boron, DI	mg/L	-	**0.016**
Cadmium, DI	mg/L	Variable [b]	**0.000057**
Calcium, DI	mg/L	-	**66.3**
Chromium, DI	mg/L	0.0089	< 0.0005
Cobalt, DI	mg/L	-	**0.00036**
Copper, DI	mg/L	0.002	< 0.001
Iron, DI	mg/L	0.3	< 0.03
Lead, DI	mg/L	0.001	**0.00026**
Lithium, DI	mg/L	-	**0.0166**
Magnesium, DI	mg/L	-	**13.7**
Manganese, DI	mg/L	-	**0.0593**
Mercury, DI	mg/L	2.60E-05	< 0.00005
Molybdenum, DI	mg/L	0.073	**0.0105**
Nickel, DI	mg/L	0.025	**0.00094**
ORP Leachable, DI	mv	-	**345**
pH, DI	pH Units	-	**7.95**
Potassium, DI	mg/L	-	**13.6**
Selenium, DI	mg/L	0.001	**0.00158**
Silicon, DI	mg/L	-	**3.15**
Silver, DI	mg/L	0.0001	< 0.00005
Sodium, DI	mg/L	-	**2.1**
Specific Conductance, DI	us/cm	-	**454**
Strontium, DI	mg/L	DI = deionized water	**1.05**
Sulfate, DI	mg/L		**140**
Sulfur, DI	mg/L	-	**48.3**
Thallium, DI	mg/L	0.0008	< 0.0001
Titanium, DI	mg/L	-	< 0.01
Uranium, DI	mg/L	0.015	**0.0016**
Vanadium, DI	mg/L	-	< 0.001
Zinc, DI	mg/L	0.03	< 0.01

Notes:

[a] CCME guideline is pH dependent; 0.005 mg/L if pH < 6.5, 0.1 mg/L if pH ≥ 6.5

[b] CCME guideline is hardness dependent; cadmium concentration = $10^{0.86[\log10(\text{hardness})]-3.2}$ / 1000 mg/L

Bold indicates the analyte was detected.

Shading indicates the result exceeded screening criteria.

- = no guideline

CCME = Canadian Council of the Ministers of the Environment.

FIGQG = Federal Interim Groundwater Quality Guidelines for the protection of aquatic life assuming industrial land use

DI = deionized water

ID = identification

mg/L = milligram per litre

ORP = oxygen reduction potential

LMB = Lithium Metaborate Fusion

m = meters

TABLE 2-3

Acid-Base Accounting

Faro Mine Remediation Project

	Location	CH13-108-TP002	CH13-108-TP006	CH13-108-TP009	CH13-108-TP011
	Sample ID	CH13-108-TP002_SOa	CH13-108-TP006_SOa	CH13-108-TP009_SOa	CH13-108-TP011_SOa
	Sample Depth (m)	0 - 1.5	0 - 1.5	0 - 1.5	0 - 1.5
	Sample Date	7/12/2013	7/13/2013	7/13/2013	7/13/2013
Analyte	**Units**				
Barium	%	0.032	0.0332	0.0352	0.0177
Lead	%	0.0343	0.046	0.0148	0.00734
Zinc	%	0.0609	0.071	0.0264	0.0144
Sulfur	%	0.16	0.1	0.17	0.12
Neutralization Potential, (as $CaCO_3$ Eq.)	T $CaCO_3$/1000 T	120	116	105	142
Sulphate, Acid Soluble	%	< 0.01	N/A	0.03	N/A
Sulphide	%	0.12	0.05	0.12	0.11
AP Calculated	-	3.64	1.55	3.62	3.35
NP:AP	-	32.92	74.92	29.01	42.35
NNP	-	116.36	114.45	101.38	138.65

Notes:

% = percent

< = less than

AP = Acid production

$CaCO_3$ Eq. = Calcium carbonate equivalent

m = meters

ID = identification

N/A = not analyzed

NNP = net neutralization potential

NP:AP = neutralization potential to acid production ratio

T $CaCO_3$/1000 T = tonnes calcium carbonate per 1,000 tonnes of material

TABLE 3-1

Rock Drain Dye Test

Faro Mine Remediation Project

Trial Number	Date	Rock Drain Pond Elevation Measured at NF1	Dye Injection Point	Downstream Monitoring Point(s)	Time of Dye Injection	Time of Peak Downstream Detection	Retention Time In Rock Drain	Comments
1	8-Jul-13	1090.136 masl	Injection Point 1	Monitoring Point 1	11:48	ND	1 hour [a]	Dye emerged from the Rock Drain at Monitoring Point 3. No visible dye or significant flourescence measurements were observed at Monitoring Point 1.
2	9-Jul-13	1090.181 masl	Injection Point 2	Monitoring Point 1	11:29	ND	1 hour [a]	Dye emerged from the Rock Drain at Monitoring Point 2. No visible dye or significant flourescence measurements were observed at Monitoring Point 1.
3	9-Jul-13	1090.181 masl	Injection Point 2	Monitoring Point 2	16:01	17:05	1:04	
4	11-Sep-13	1090.301 masl	Injection Point 3	Monitoring Point 2	12:48	13:52	1:04	
5	12-Sep-13	NM	Injection Point 1	Monitoring Point 3	15:26	16:17	0:51	

[a] Approximate travel time based on visual observation of emergent dye.

Notes:

masl = metres above sea level

ND = no detection

NM = No elevation measurement recorded on this date

TABLE 4-1
Grain Size Distribution
Faro Mine Remediation Project

				Gradation [a] (mass %)					
				Cobbles	Gravel	Fines			
Location ID	Sample ID	Location	Sample Date	>3"	4.75 mm - 3"	< 0.075 mm	Sand	USCS [b]	USDA [b]
CH13-201-TP001	CH13-201-TP001_SOA	Intermediate Dam Crest	29/07/13	0	51	13	37		Sandy loam
CH13-201-TP001	CH13-201-TP001_SOB	Intermediate Dam Crest	29/07/13	0	33	24	44	Silty, clayey sand with gravel	Sandy loam
CH13-201-TP002	CH13-201-TP002_SOA	Intermediate Dam Crest	29/07/13	0	31	26	42	Silty, clayey sand with gravel	Sandy loam
CH13-201-TP003	CH13-201-TP003_SOA	Intermediate Dam Crest	29/07/13	0	14	19	67	-	Sandy loam/loamy sand
CH13-201-TP003	CH13-201-TP003_SOB	Intermediate Dam Crest	29/07/13	0	9	32	60	Silty, clayey sand	Sandy loam
CH13-201-TP003	CH13-201-TP003_SOC	Intermediate Dam Crest	29/07/13	0	23	26	52	-	Sandy loam
CH13-201-TP004	CH13-201-TP004_SOA	Intermediate Dam Crest	29/07/13	0	21	14	66	-	Loamy sand
CH13-201-TP004	CH13-201-TP004_SOB	Intermediate Dam Crest	29/07/13	0	8	36	55	Silty, clayey sand	Sandy loam
CH13-201-TP005	CH13-201-TP005_SOA	Intermediate Dam Crest	29/07/13	0	15	20	66	-	Sandy loam
CH13-201-TP005	CH13-201-TP005_SOB	Intermediate Dam Crest	29/07/13	0	21	31	48	Silty, clayey sand with gravel	Sandy loam
CH13-201-TP006	CH13-201-TP006_SOA	Intermediate Dam Crest	29/07/13	0	7	30	63	Silty, clayey sand	Sandy loam
CH13-201-TP007	CH13-201-TP007_SOA	Intermediate Dam Crest	29/07/13	0	52	12	36		Sandy loam
CH13-201-TP007	CH13-201-TP007_SOB	Intermediate Dam Crest	29/07/13	0	23	24	53	Silty sand with gravel	Sandy loam
CH13-203-BH001	CH13-203-BH001_SOA	North Fork Rose Creek	29/07/13	-	-	-	0	-	-
CH13-203-BH001	CH13-203-BH001_SOB	North Fork Rose Creek	29/07/13	-	-	-	0	Silty, clayey sand with gravel	-
CH13-203-BH001	CH13-203-BH001_SOC	North Fork Rose Creek	29/07/13	-	-	-	0	-	-
CH13-203-BH001	CH13-203-BH001_SOD	North Fork Rose Creek	29/07/13	-	-	-	0	-	-
CH13-203-BH001	CH13-203-BH001_SOE	North Fork Rose Creek	29/07/13	0	10	23	68	-	Loamy sand
CH13-203-BH001	CH13-203-BH001_SOF	North Fork Rose Creek	29/07/13	0	12	12	76	-	Sand
CH13-203-BH001	CH13-203-BH001_SOG	North Fork Rose Creek	29/07/13	0	24	10	66	-	Loamy sand
CH13-203-BH001	CH13-203-BH001_SOH	North Fork Rose Creek	29/07/13	0	9	11	79	-	Sand
CH13-203-BH002	CH13-203-BH002_SOA	North Fork Rose Creek	9/8/2014	0	10	21	69	Silty sand	Loamy sand
CH13-203-BH002	CH13-203-BH002_SOB	North Fork Rose Creek	9/8/2014	0	8	36	57	Silty sand	Sandy loam
CH13-203-BH002	CH13-203-BH002_SOC	North Fork Rose Creek	9/8/2014	0	15	10	75	Well-graded sand with silt and gravel	Sand
CH13-203-BH002	CH13-203-BH002_SOD	North Fork Rose Creek	9/8/2014	0	14	9	78	Well-graded sand with silt	Sand
CH13-203-BH002	CH13-203-BH002_SOE	North Fork Rose Creek	9/8/2014	-	-	-	0	-	-
CH13-203-BH002	CH13-203-BH002_SOF	North Fork Rose Creek	9/8/2014	-	-	-	0	-	-
CH13-203-BH002	CH13-203-BH002_SOG	North Fork Rose Creek	9/8/2014	-	-	-	0	-	-
CH13-203-BH002	CH13-203-BH002_SOH	North Fork Rose Creek	9/8/2014	-	-	-	0	-	-

[a] Gradation totals may not equal 100 because of rounding.

[b] Classification is based on lab sample and may not reflect larger particle sizes observed in the field.

Notes:
% = percent
> = greater than
ID = identification
mbgs = metres below ground surface
mm = millimetre
USCS = Unified Soil Classification System
USDA = United States Department of Agriculture

TABLE 4-2
NFRD Borehole Summary
Faro Mine Remediation Project

Borehole Number	Location	Northing	Easting	Ground Surface Elevation (masl)	Completion Depth (mbgs)	Depth to Bedrock (mbgs)
CH13-203-BH001	West side of NFRC	584,729	6,912,973	1086.030	14.0	10.7
CH13-203-BH002	East side of NFRC	584,687	6,913,037	1088.626	11.3	7.6

Notes:
mbgs = metres below ground surface
masl = metres above sea level
Northing, easting, and elevation values are approximate based on survey with handheld GPS unit.

TABLE 4-3

Petrographic Examination of Coarse Aggregate

Faro Mine Remediation Project

	Sample ID	CH13-108-TP002_Rka		
	Petrographic Description / Physical Quality	**Percent by Count (mm)**		
		19 x 12.5	**12.5 x 9.5**	**Total**
Good	Schist 1A - Dark green to grey, fine grained, strong.	8.8	11.7	10.2
	Schist 1B - As above, with oxidation staining on at least one face, strong.	5.9	2.2	4.1
	Schist 2A - Medium green to grey, fine grained, strong.	36.2	46.2	41.2
	Schist 2B - As above, with oxidation staining on at least one face, strong.	12.2	4.8	8.5
	Schist 3A - Light green to grey, fine grained.	26.9	20.1	23.5
	Schist 3B - As above, with oxidation staining on at least one face.	1.6	4	2.8
	Subtotal	**91.6**	**89.0**	**90.3**
Fair	Schist 1A - Dark green to grey, fine grained, medium strength.	0.3	0.7	0.5
	Schist 1B - As above, with oxidation staining on at least one face, medium strength.	0.6	1.1	0.9
	Schist 2A - Medium green to grey, fine grained, medium strength.	3.7	4.4	4.1
	Schist 2B - As above, with oxidation staining on at least one face, medium strength.	1.6	1.5	1.5
	Schist 3A - Light green to grey, fine grained, medium strength.	0.9	0.7	0.8
	Schist 3B - As above, with oxidation staining on at least one face, medium strength.	1.3	2.6	1.9
	Subtotal	**8.4**	**9.1**	**9.7**
	TOTALS	**100.0**	**100.0**	**100.0**

Notes:

ID = identification

mm = millimetre

TABLE 4-4

Unconfined Compressive Strength of Intact Rock Core Specimens

Faro Mine Remediation Project

Sample ID	Diameter (mm)	Height (mm)	Area (cm^2)	Volume (cm^3)	Mass (g)	Wet Density (kg/m^3)	Moisture (%)	Dry Density (kg/m^3)	Maximum Load (kN)	Stress (s) (Mpa)	Failure Mode (Type)	Failure Mode (deg)
CH13-108-TP002_Rk	45.53	94.44	16.28	153.76	416.2	2707	0.53	2693	150.3	92.3	1	~2
CH13-108-TP008_Rk	45.57	92.41	16.31	150.72	410.5	2724	0.84	2701	105.3	64.6	1\3	N/A
CH13-108-TP011_Rk	45.58	91.76	16.32	149.72	423.00	2825	0.05	2824	133.6	81.9	2\1	~8

Notes:

cm^2 = square centimetre

cm^3 = cubic centimetre

deg = fracture angle in degrees measured from the core axis

g = gram

kg/m^3 = kilogram per cubic metre

kN = kilonewton

mm = millimetre

MPa = megapascal

N/A = not applicable

Failure Modes:

(1) Shear along foliation / discontinuity

(2) Vertical fracture(s)

(3) Spalling

TABLE 4-5

Specific Absorption

Faro Mine Remediation Project

Sample ID		Mass (g)	Relative Density (Dry Basis) (g/cm^3)	Relative Density (SSD Basis) (g/cm^3)	Relative Density (Apparent) (g/cm^3)	Absorption (%)
CH13-108-TP002_Rka	1	4,993.70	2.680	2.707	2.755	1.02
	2	1,855.80	2.622	2.660	2.727	1.48
	3	2,651.20	2.679	2.692	2.716	0.51
	4	2,298.20	2.523	2.579	2.673	2.22
	5	2,306.00	2.739	2.745	2.756	0.23
	Average		**2.648**	**2.677**	**2.726**	**1.09**
CH13-108-TP008_Rka	1	4,694.60	2.691	2.726	2.788	1.290
	2	4,309.10	2.624	2.682	2.785	2.200
	3	3,325.30	2.757	2.785	2.838	1.040
	4	3,410.70	2.702	2.716	2.740	0.510
	5	1,967.60	2.667	2.682	2.710	0.590
	Average		**2.688**	**2.718**	**2.772**	**1.130**
CH13-108-TP011_Rka	1	5,845.70	2.877	2.881	2.889	0.15
	2	5,006.80	2.818	2.828	2.846	0.34
	3	3,704.30	2.826	2.829	2.836	0.12
	4	5,915.90	2.817	2.822	2.829	0.15
	5	4,069	2.827	2.831	2.84	0.17
	Average		**2.833**	**2.838**	**2.848**	**0.19**

Notes:

% = percent

g = gram

g/cm^3 = gram per cubic centimetre

ID = identification

SSD = Saturated Surface Dry

TABLE 4-6

Petrographic Examination of Coarse Aggregate

Faro Mine Remediation Project

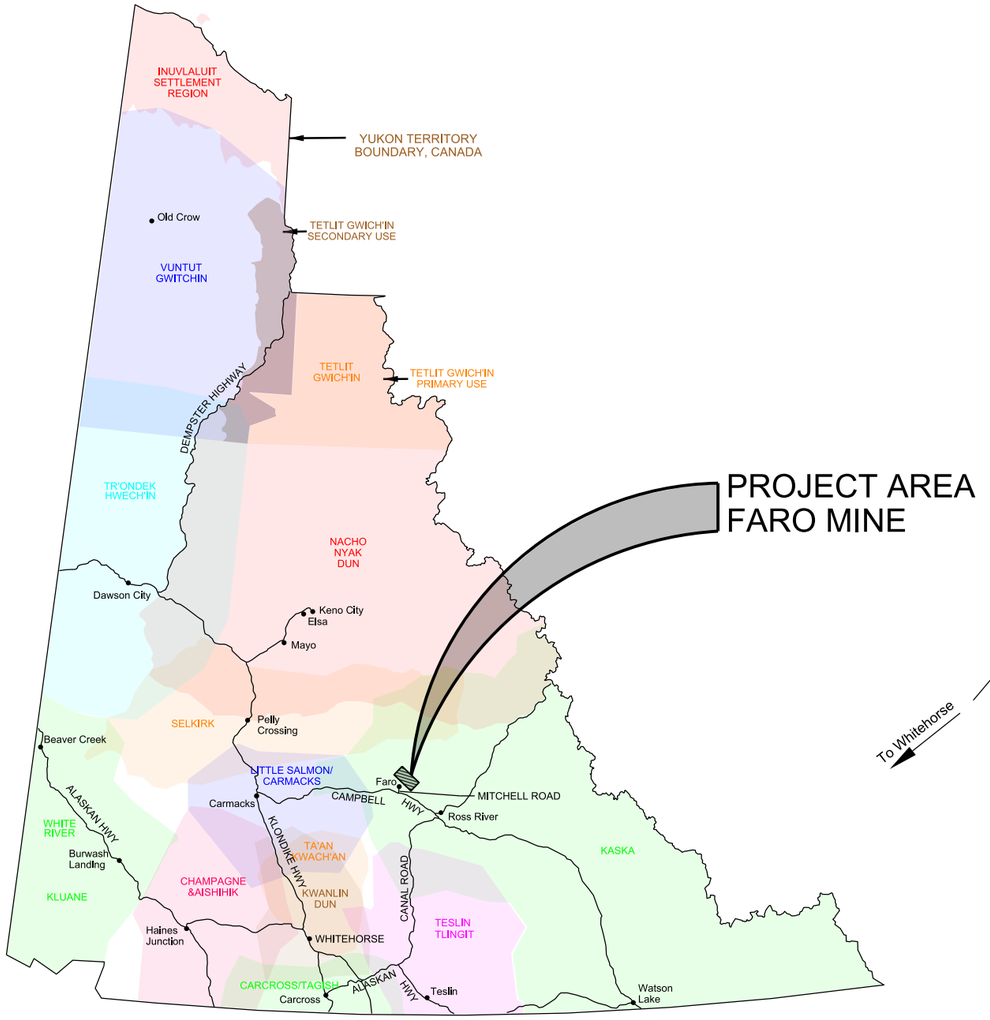
	Sample ID	CH13-108-TP011_Rka		
	Petrographic Description / Physical Quality	**Percent by Count (mm)**		
		19 x 12.5	**12.5 x 9.5**	**Total**
Good	Schist 1A - Finely banded black/white, very fine grained, strong.	37.6	44.4	41
	Schist 1B - As above, pronounced flat particle shapes, strong.	4.8	5.0	4.9
	Schist 2A - Finely banded black/white with green tint, strong.	44.0	34.7	39.4
	Schist 2B - As above, pronounced flat particle shapes, strong.	5.2	1.8	3.5
	Schist 3 - Finely banded black/white with green tint and brown oxidation staining, strong.	2.0	2.6	2.3
	Subtotal	**93.6**	**88.5**	**91.1**
Fair	Schist 1A - Finely banded black/white, very fine grained, brittle, medium strength.	2.4	4.4	3.4
	Schist 1B - As above, pronounced flat particle shapes, brittle, medium strength.	0.4	0.9	0.6
	Schist 2A - Finely banded black/white with green tint, brittle, medium strength.	2.8	3.2	3.0
	Schist 2B - As above, pronounced flat particle shapes, brittle, medium strength.	0.4	1.8	1.1
	Schist 3 - Finely banded black/white with green tint and brown oxidation staining, brittle, medium strength.	0.4	1.2	0.8
	Subtotal	**6.4**	**11.5**	**8.9**
	TOTALS	**100.0**	**100.0**	**100.0**

Notes:

ID = identification

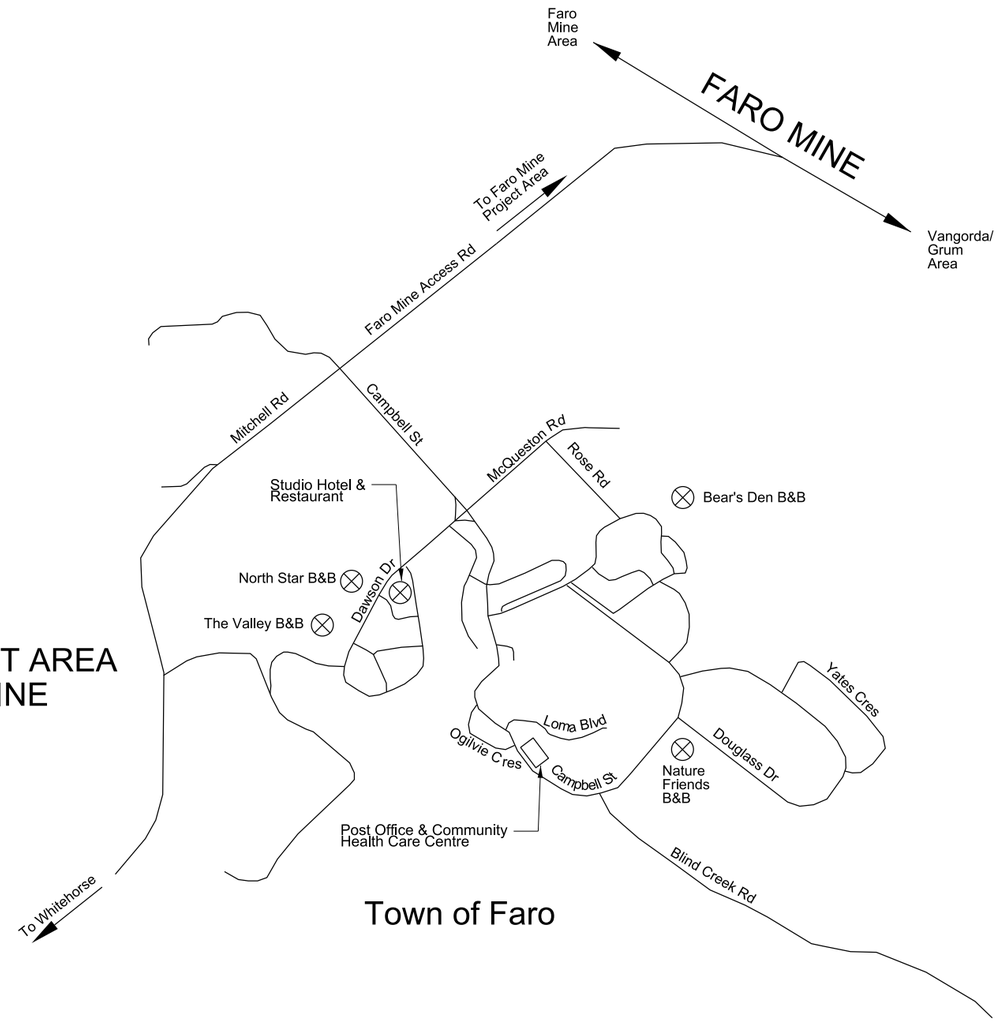
mm = millimetre

Figures



VICINITY MAP

NOT TO SCALE

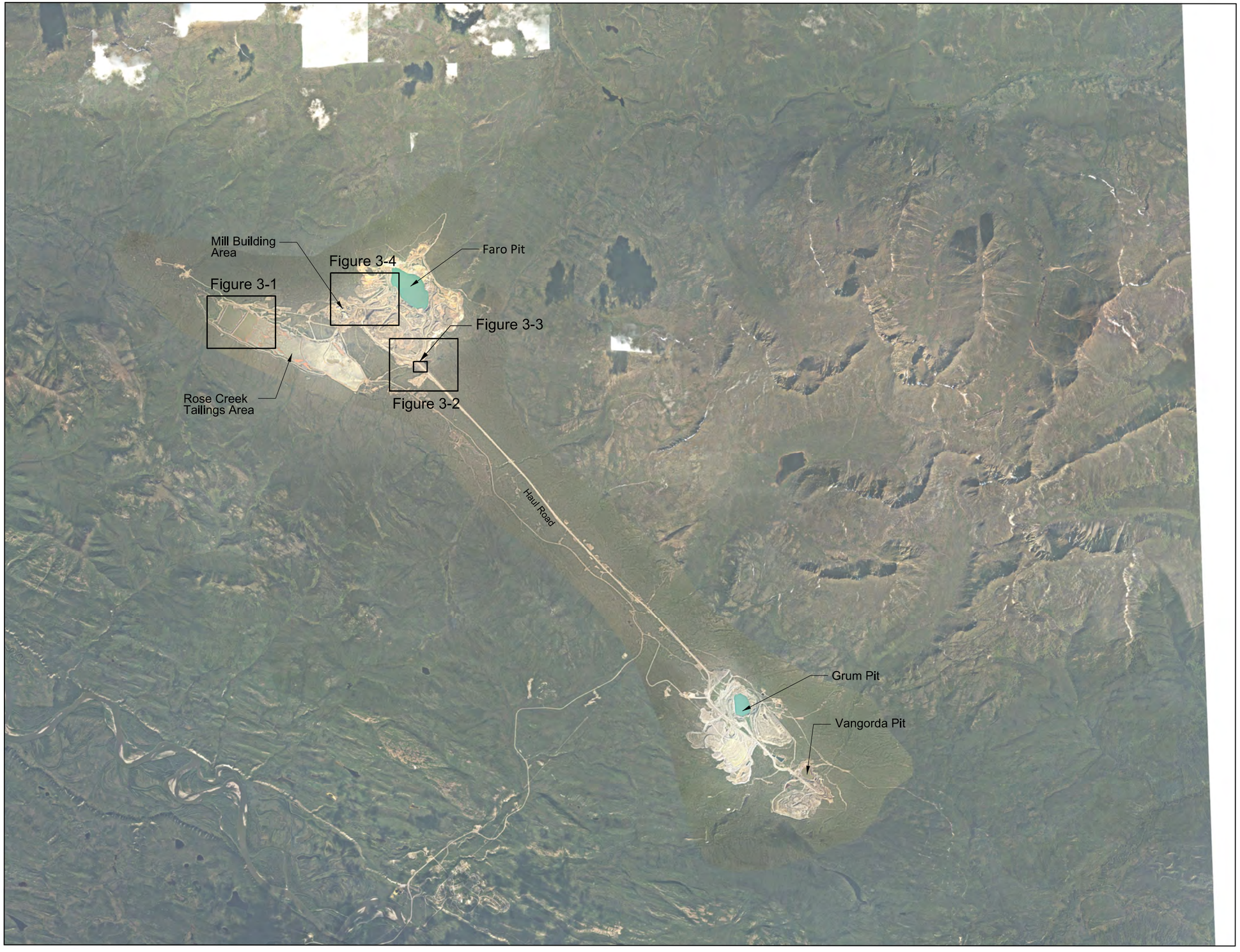


LOCATION MAP

NOT TO SCALE

FIGURE 1-1
Vicinity and Location Map
Faro Mine Remediation Project

CH2MHILL



N

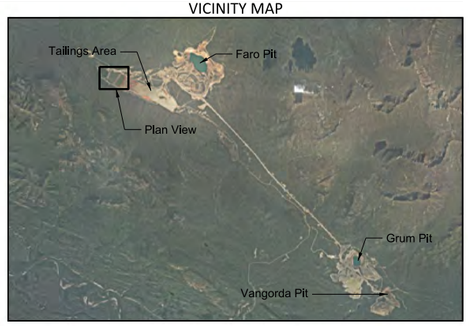
0 1800 3600

METRES

Note:
Aerial photo shown dated August 2012.

FIGURE 1-2
DVIHU Figure Keymap
Faro Mine Remediation Project

VICINITY MAP



N

0 100 200

METRES

LEGEND

Contour (5-metre Interval)

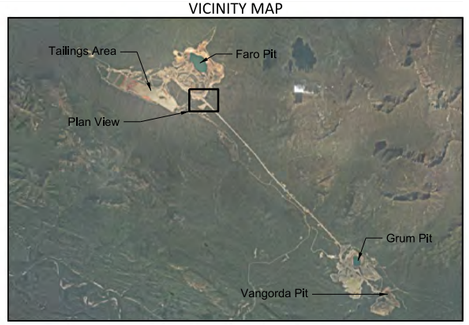
2013 Test Pit Locations (Note 2)

Notes:
1. Aerial Photo Shown Dated August 2012.
2. Sample Locations Shown Based on Field Survey By Challenger Geomatics on August 2013.

FIGURE 3-1
2013 Intermediate Dam and Spillway Test Pit Locations
Faro Mine Remediation Project

CH2MHILL

VICINITY MAP



N

0 100 200

METRES

LEGEND

- Contour (5-metre Interval)
- Seismic Refraction Lines (Note 2)
- 2013 Bore Hole Locations (Note 2)
- 2013 Staff Guage Locations (Install at Existing Surface Water Station)

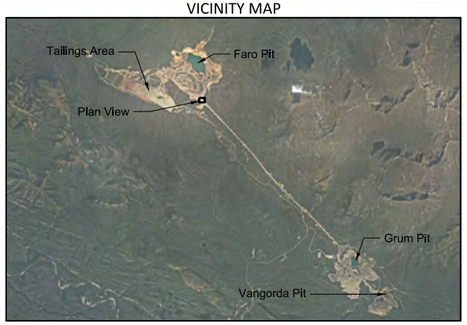
Notes:

1. Aerial Photo Shown Dated August 2012.
2. Sample Loations Shown Based on Field Survey By Challenger Geomatics on August 2013

FIGURE 3-2
2013 Rock Drain Bore Hole Locations
Faro Mine Remediation Project

CH2MHILL

VICINITY MAP



N

0 20 40

METRES

LEGEND

- 2013 Staff Guage Locations (Note 2)
- Dye Test Injection/Monitoring Locations (Handheld GPS)

Notes:

1. Aerial Photo Shown Dated August 2012.
2. Sample Loations Shown Based on Field Survey By Challenger Geomatics on August 2013

FIGURE 3-3
2013 Rock Drain Dye Test Locations
Faro Mine Remediation Project

CH2MHILL

N

0 100 200
METRES

LEGEND

- Surficial Geology (Note 2)
- Area Withdrawn from Staking Mineral Claims (OIC #2008/168)
- Bedrock Geology - Gabbro (OSMg)
- Bedrock Geology - Calc-cilicate (COVcs)
- Bedrock Geology - Shist (UPCMMs)
- Target Quarry or Borrow Area Investigation for 2013
- 2013 Test Pit Location (Note 4)

LEGEND (from Bond, 1999)

QUATERNARY

HOLOCENE

MINE DISTURBANCE

MD- mine disturbance; consisting of an open-pit and stripped till and bedrock accumulations. Bedrock and surficial sediments exposed in open pit.

MINE TAILINGS

MT - mine tailings; consisting of sand, silt and some clay.

ORGANIC DEPOSITS

O - organics; consisting of woody sedge peat, variable thickness. White River ash accumulations are commonly associated with poorly drained peaty areas.

ALLUVIAL DEPOSITS

Ap - alluvial plain; silt, sand and pebbles with reworked cobbles and boulders occurring as bars, overbank floodplain deposits, 0 - 10 m thick; floodplain subject to periodic floods. Small valley alluvial plains may not be mapped at this scale.

Ap (active) - alluvial plain; area of Pelly River floodplain that has been recently active.

At - alluvial terrace; silt, sand, and pebbles with reworked cobbles and boulders occurring as low terrace deposits, 0 - 10 m thick.

Af - alluvial fan; coarse sand, pebbles, cobbles and mudflow deposits, up to or >10 m thick. Appear as vegetated, often peat covered, landforms developed during post-glacial sedimentation.

Ax - complexes of Ap and Af undivided. Common when a stream is unconfined and also in narrow valleys where side-entry alluvial fans cannot be differentiated from an alluvial plain.

PLEISTOCENE AND HOLOCENE (UNDIVIDED)

COLLUVIAL DEPOSITS

Cv - colluvium veneer; conforms to bedrock topography, <1 m thick.

Ca - colluvium apron; coalescing colluvial fans at the base of a slope, >1 m thick.

Cz - mass wasting; includes slumping, debris slides and rockfalls. Slumping and rockfalls are Common on Mt. Mye.

LATE PLEISTOCENE (WISCONSINAN) - McCONNELL GLACIATION

GLACIOLACUSTRINE DEPOSITS

Lb - glaciolacustrine blanket; 1- 40 m thick.

GLACIOFLUVIAL DEPOSITS

Gp - glaciofluvial plain; 3 - 10 m thick.

Gt - glaciofluvial terrace; <10 m thick.

Gx - glaciofluvial complex; 1 - 30 m thick, composed of deposits of outwash, glaciolacustrine and minor till deposited in an ice contact environment. Hummocky topography is associated with this depositional setting. Crevasse fillings were mapped in the upper part of Vangorda Creek valley.

GLACIAL DEPOSITS

Tv - till veneer; conforms to underlying topography, <1 m thick.

Tb - till blanket; gently to moderately sloping plain controlled by bedrock or underlying surficial deposits, >1 m thick.

Tx - till complex; till blanket or veneer composed of meltout till and minor ice contact glaciofluvial deposits.

LOWER CAMBRIAN TO CRETACEOUS

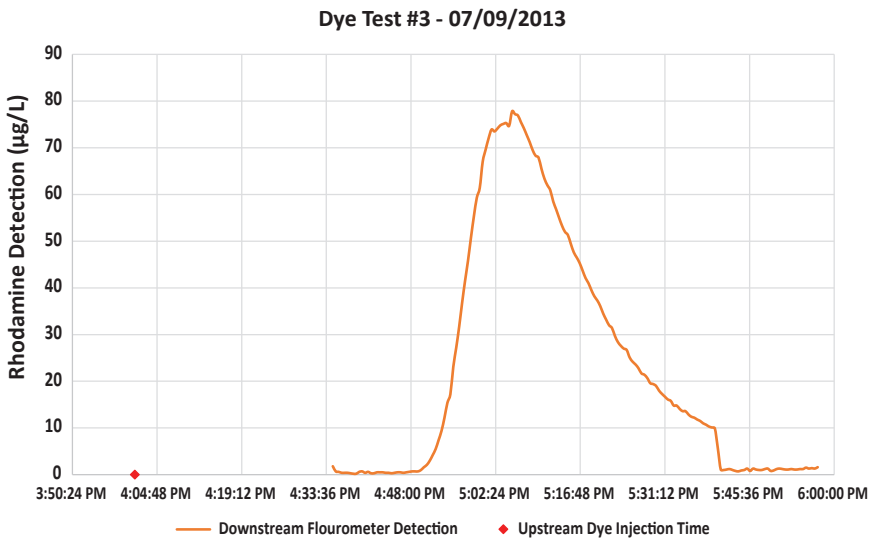
BEDROCK

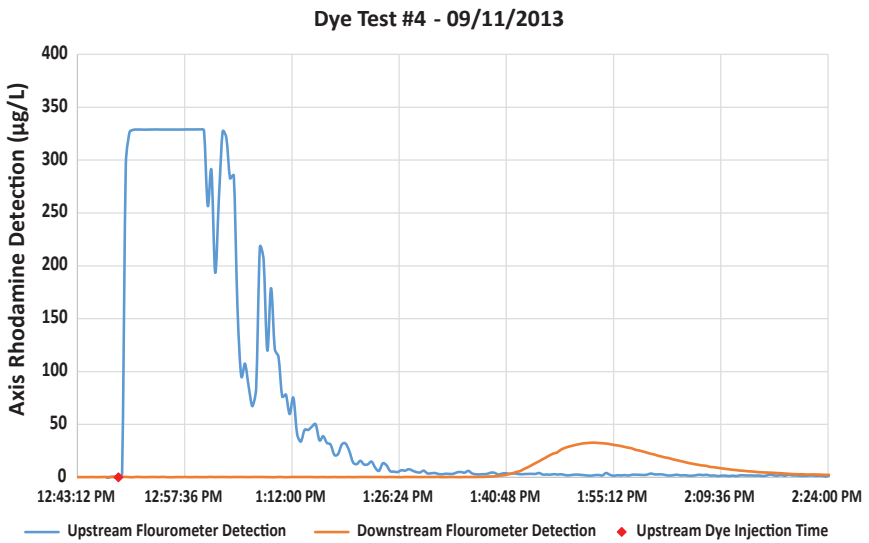
R - bedrock; common on plateau summits and ridges on Mt. Mye and Sheep Mountain.

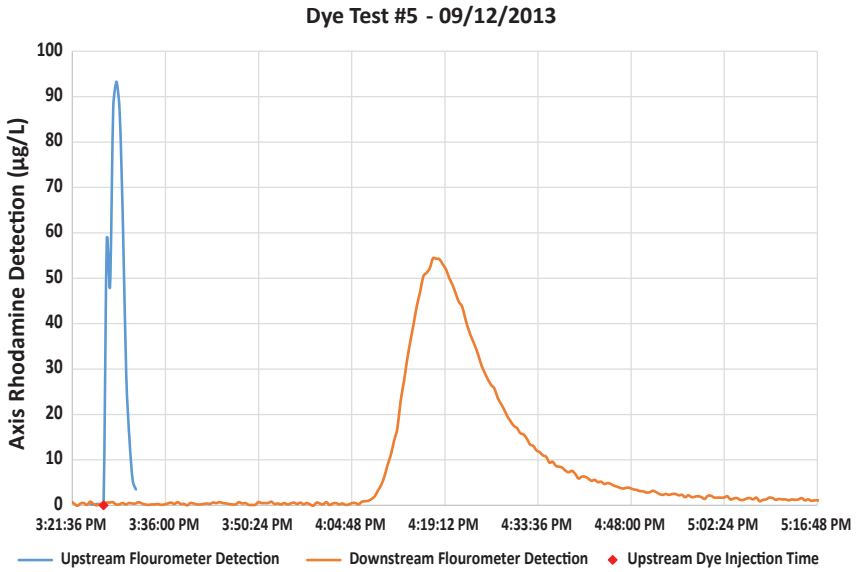
Notes:

1. Aerial Photo Shown Dated August 2012.
2. Source Reference: Bond, J.D. (Open File 1999-10) Surficial Geology Map and Till Geochemistry of Mount Mye and Faro (105K/6W, Central Yukon Territory.
3. Bond, Jeffrey D., 2001: Quaternary Geology and Till Geochemistry of the Anvil District (parts 105K/2, 3, 5, 6 and 7) Central Yukon Territory. Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada.
4. Sample Locations Shown Based on Field Surveys by Challenge Geomatics on August 2013.

FIGURE 3-4
2013 Borrow Source Search Test Pit Locations
Faro Mine Remediation Project







Note:
µg/L = microgram per litre

FIGURE 4-1
Dye Test Results
Faro Mine Remediation Project

Appendix A
Rose Creek Diversion Inspection Memo

RCD Inspection Summary
Faro Mine Remediation Project

PREPARED FOR: Project File

COPY TO: Dick Crim/PDX
Jaco Esterhuizen/CVO

PREPARED BY: Mark Kacmarcik/CVO

DATE: November 11, 2013

PROJECT NUMBER: 472645

Overview

This memorandum summarizes the observations made during the geotechnical inspection of the Rose Creek Diversion (RCD). This inspection was completed as part of the Down Valley Intermediate Hydraulic Upgrades (DVIHU) being developed for the Faro Mine Complex (FMC). The field inspection was conducted on July 26 and 27, 2013, by CH2M HILL geotechnical engineer Mark Kacmarcik with field assistance from William Stevely and Len Forsyth. The inspection consisted of walking the RCD dike and documenting the channel and dike condition.

This memorandum summarizes the general condition of the existing channel as documented during the inspection period and observable from the dike crest at that time. However, this memorandum does not provide final recommendations for channel improvements. Such recommendations will be made later after considering the results of this inspection (this memorandum), the DVIHU design criteria, the history of the channel, and other factors. The attached field notes present specific detailed observations that are geo-referenced and tabulated in Microsoft Excel spreadsheet format. The locations of these observations are shown in Attachment 1 and 2. These notes can also be viewed electronically with Google Earth software using the attached Keyhole Markup Language (KML) file.

The geo-referenced observations were located with a Garmin GPSMap 60CSx handheld global positioning system (GPS) unit to collect Universal Transverse Mercator (UTM) coordinates and elevations. The accuracy of this device varies, but is estimated as ±3 to 4 metres during the inspection. All UTM coordinates reference the WGS84 datum.

The inspection was conducted over 2 days and generally consisted of walking the diversion embankment from upstream to downstream and recording specific observations along the way. The attached notes commonly reference the “left” and “right” sides of the channel or the dike— the reader is reminded that these terms are relative to an observer facing *downstream*, as is conventional in dam and levee-related work. With the general east-west orientation of the RCD, the left side is generally the southern side, and the right side is the northern side. The field observations are documented in Attachment 3.

Vegetation

Significant vegetative growth was noted along the dike during the RCD inspection. Woody vegetation was observed on both the left (channel side) and right (tailings side) of the dike and on the left side of the channel. The type, distribution, and size of vegetation varies widely along the dike, making it difficult to succinctly describe specific locations of problematic vegetation to be remedied. In places, dense thickets occupy the dike and complicate dike inspection. In other places the vegetation exists as an acceptable level that is not considered deleterious to the dike. All vegetation, if not addressed, is expected to increase in size and severity with time.

Common woody vegetative types observed were of the genera *Betula* (birch and alder), *Salix* (willow), *Populus* (poplar, aspen), and to a lesser extent *Abies* (fir). Other boreal riparian vegetation was also observed. Vegetation sizes observed varied from young forbs to small trees up to approximately 4 inches in caliper diameter.

Figures 1 through 3 provide a few general photos of typical vegetation conditions encountered along the dike. Additional photos of the vegetative condition of the dike are provided in Attachment 4.

FIGURE 1
Image shows small woody vegetation near upstream end of the RCD (looking upstream).

FIGURE 2
Image shows dense woody vegetation on left side of channel dike. The view of the channel in this segment is obscured by the vegetation (looking downstream).

FIGURE 3
***Salix* (willow) vegetation on channel side of dike in high-gradient section of the RCD (looking upstream).**

Animal Burrows

Evidence of large rodents was observed during the RCD dike inspection. Direct evidence of genera *Castor* (Canadian beaver) and *Erethizon* (porcupine), both of which are known to dig burrows, was noted during the inspection. Areas of significant burrow excavation were not positively identified; however, several voids that may have been partially attributed to burrowing rodents are described in the field notes (Attachments 3). Voids provided beneath large riprap and cover provided by woody vegetation likely contribute to the presence of borrowing rodents on the RCD dike.

Figures 4 and 5 show documented evidence of burrowing rodents observed on the RCD dike.

FIGURE 4
Birch stump provides evidence of *Castor* (beaver) activity near the upstream end of the RCD.

FIGURE 5
Porcupine observed occupying void below large riprap near upstream half of the RCD. Also note woody vegetation.

Dike Crest Grading

During the inspection period, the dike crest was generally uniform without obvious signs of settlement or subsidence. However, a slight dip less than 0.3 metre was observed at Point 91 (see Attachments 2). At this location, the RCD dike is higher than the adjacent tailings ponds. Evidence of seepage or fines migration was not apparent on the right side of the dike, and the explicit cause for the dip is unknown.

At multiple locations along the dike crest, ruts or puddles were observed (Figure 6). The grading of the dike crest should be maintained to prevent development of these water-collecting depressions that can soften and destabilize the dike and allow progressive rutting and structure deterioration. The crest should be graded to direct water off the dike.

FIGURE 6
Large puddle on crest of RCD dike (looking downstream). Also note stockpiled material on the left side of the photo. This material is piled at the top of the channel slope and contributes additional stresses that may destabilize the dike.

Slope Stability

The RCD dike exhibits numerous signs of instability. The majority of the right bank of the RCD exhibits evidence of previous and ongoing slope movement. Long sections of dike have tension cracking, scarps, channel constrictions, and other signs of shallow instability. Many areas appear to have been previously repaired, both discrete slides and long sections of the dike. This memorandum does not include a review of the dike history or its past modifications; however, the presence of slope repairs, riprap modifications and augmentations, and geotechnical instrumentation installation suggests that dike stability has been an ongoing problem.

The generally cohesionless nature of the dike fill prevents the persistence of acute signs of slope instability (small tension cracks, scarps, etc.) for long periods of time. Regardless, these features were common on the right side of the channel during the inspection. The slope instability phenomena observed were generally characteristic of shallow slides and sloughs; evidence of deep seated failure surfaces or other mechanisms that would compromise the dike crest were not noted during the inspection. In some locations, the presence of thick vegetation prevented thorough inspection of the channel slopes.

The RCD dike is constructed with a compacted glacial till seepage liner, overlain by a compacted sand and gravel blanket, then armored with riprap. The sloughs and slumps observed in the RCD dike appear to be relatively shallow and are not expected to have significantly disturbed the underlying compacted till seepage liner. However, in many locations, the riprap channel lining has slumped downward, leaving portions of the dike over-steepened and exposed to erosion, animal burrows, and other problems.

The left side of the channel is typically in “cut,” and the slope geometry is less uniform than that on the right side. The right side of the dike is a relatively uniform engineered fill, whereas the left-side cut slopes expose variable native materials. In several locations where the RCD excavation encountered sound rock, the excavation of the left side of the channel was extended into the hillside as a borrow source for rock during construction. These areas generally appear stable. Away from the rock cut slopes, significant zones of slope failure, cracking, and sloughing were observed on the left side of the channel. These slope failures are generally shallow, but may transport materials and debris into the RCD . As with the right side, previous slope failures have been identified and repaired by others.

Figures 7 through 14 show common slope instability features observed during the inspection.

FIGURE 7
Placement of riprap suggests previous slope instability and repair (looking downstream).

FIGURE 8
Common appearance of tension cracking on dike crest (looking downstream). Note absence of riprap erosion protection.

FIGURE 9
Apparent previous slope failure and repair on left side of RCD (channel flow is from left to right).

FIGURE 10
Extensive sloughing and cracking on left bank of the RCD. Larger scarps are estimated to be 60 to 90 centimetres in height (channel flow is from left to right).

FIGURE 11
Note riprap augmentation and installation of geotechnical instrumentation.

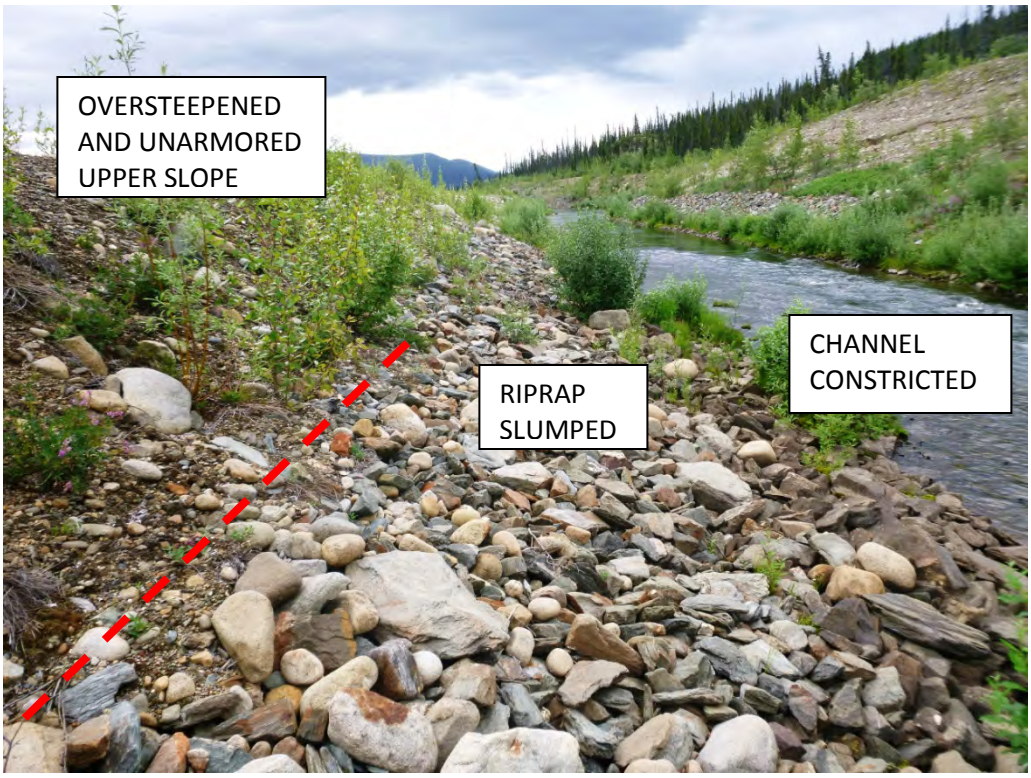


FIGURE 12
Note bilinear slope angle and channel constriction. Riprap material appears to have sloughed into the RCD, impinging on channel width and leaving upper portion of channel unarmored (looking upstream).

FIGURE 13
Placement of rounded riprap on top portion of the RCD dike and presence of scarp and tension crack (looking downstream). Divisions on white staff are at 30-centimetre intervals; open tension crack is approximately 30 centimetres deep in this photo.

FIGURE 14
Tension cracking in edge of dike and stockpiled material at top of slope. Similar small tension cracks are a common occurrence along much of the existing dike. Also note presence of young woody vegetation.

Riprap and Jetty Stone

The riprap and jetty stone armoring of the RCD channel is highly variable along the channel length. In places, slope instability or sloughing has carried riprap downward leaving portions of the slope exposed. Elsewhere, previous slope repairs have placed riprap of contrasting size, shape (rounded versus angular), and lithology. In some locations, riprap sloughing has impinged on channel width. In other places, riprap has initially sloughed, then was augmented with additional riprap (weight), which contributed to additional sloughing.

The higher-gradient portions of the channel are armored with jetty stone (i.e., large-diameter riprap). The condition of these sections of channel generally appears more uniform than the conventionally armored channel sections and have fewer signs of distress. However, in several locations, these large stones have moved downward and into the channel, or have left portions of the channel unprotected. Additionally, many locations armored with large-diameter riprap have significant vegetative growth. In some cases, large voids have been identified behind the jetty stone, and the underlying embankment fill may be subject to erosion and scour. The higher-gradient areas on the downstream portion of the RCD have a higher concentration of dense willow growth than the lower-gradient portions of the channel.

Figures 15 through 26 show common riprap variability observed along the channel during the inspection.

FIGURE 15
Note ridge of riprap in center of channel and placement of new rounded riprap at top of slope. Ridge possibly formed from sloughing of channel armoring into channel (looking upstream).

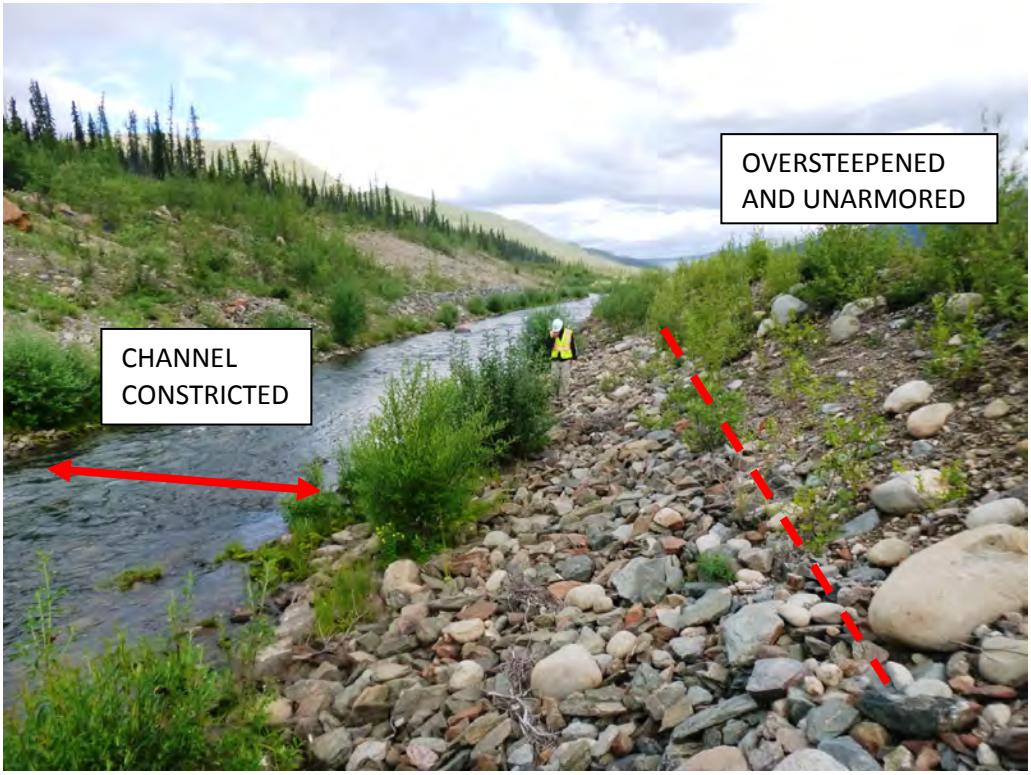


FIGURE 16
Note slumped channel bank steeper above and flatter below with riprap impinging on channel width.

FIGURE 17
Note transition to larger jetty stone riprap at gradient inflection point. Larger stone is placed in areas of high gradient.

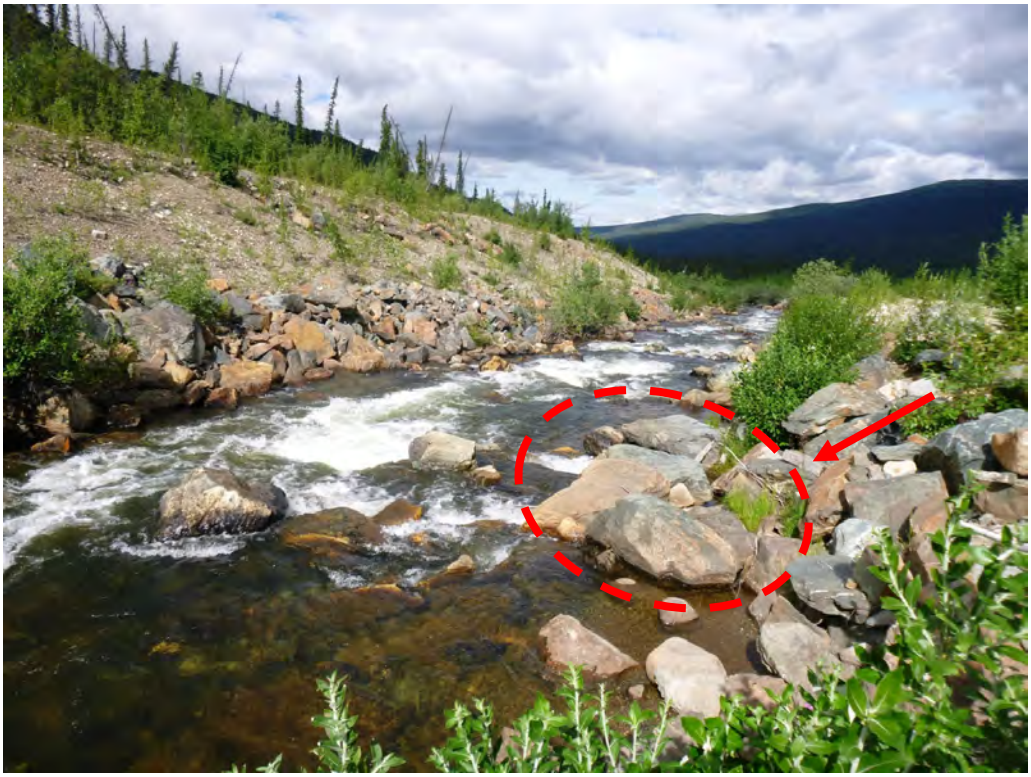


FIGURE 18
Sloughing of large stone into channel and large boulders in center of channel (looking downstream).

FIGURE 19
Note measurement of void behind jetty stone. This void is approximately 1.8 metres deep (water flow is from top left to bottom right).

FIGURE 20
Note large prominent boulder in center of stream with potential to flag debris (water flow is left to right).

FIGURE 21
Large boulder in center of stream with accumulated debris (log). Also note advanced vegetative growth (channel flow is left to right).

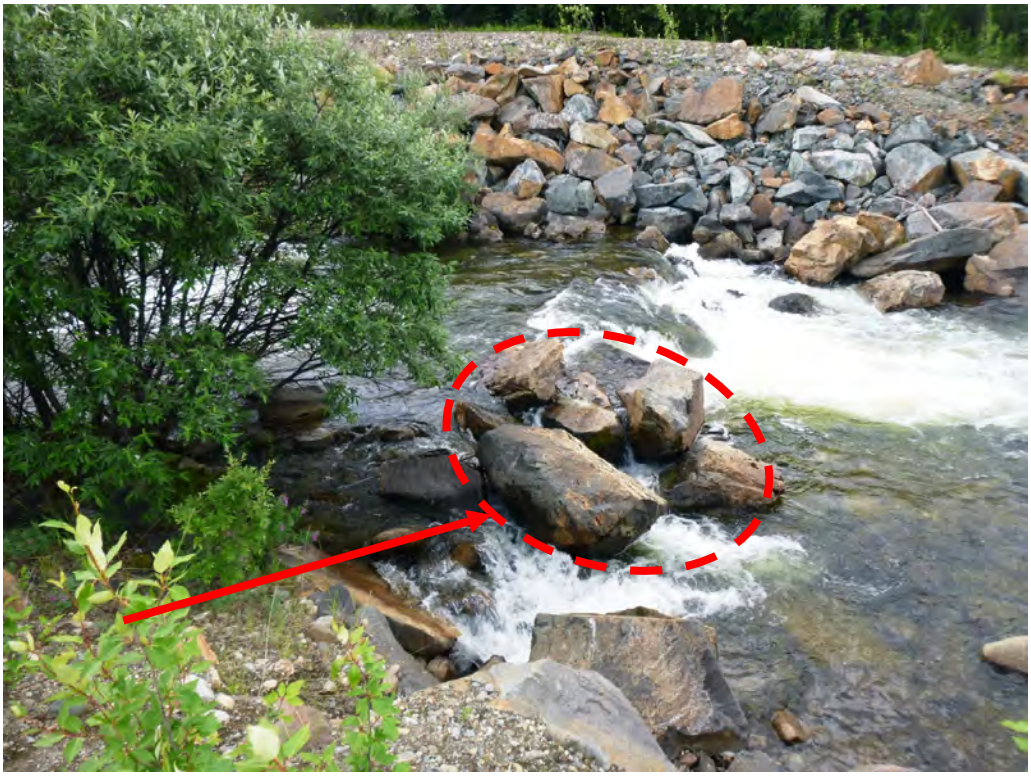


FIGURE 22
Note large boulders in stream and exposed embankment fill in foreground.

Seepage

No instances of adverse seepage through the dike were noted during the inspection. However, in an area on the upstream end of the channel, the toe of the dike slope and the channel bottom exhibited dark red staining. This may be due to tailings water seeping into the channel (see Point 11 in Attachments 1). This seepage does not appear to compromise the stability of the RCD dike, but may indicate an ineffective liner or otherwise poor containment within the tailings ponds. The inspection was conducted during a relatively low flow period in the channel.

FIGURE 23
Note zone of concentrated reddish staining near toe of slope. Possibly indicating seepage from tailings into RCD (looking upstream).

FIGURE 24
Alternate view of reddish staining (looking upstream).

Fuse Plug

The fuse plug portion of the RCD is a depressed section of the dike that permits flow of excess water into the intermediate tailings pond. The structure is referred to as a fuse plug; however, the section is heavily reinforced with large-diameter stone and does not appear to be readily fusible in an overtopping event. The depressed section of the fuse plug is slightly lower than the surrounding dike and may function as an armored overflow spillway.

FIGURE 25
View of fuse plug armoring. Flood flow would travel from right to left. Note large-diameter stone.

FIGURE 26
Downstream view from crest of fuse plug. Note large (±2-metre-diameter) stone.

References

Federal Emergency Management Agency (FEMA). 2005. *Technical Manual for Dam Owners: Impacts of Animals on Earthen Dams*. FEMA 473. September.

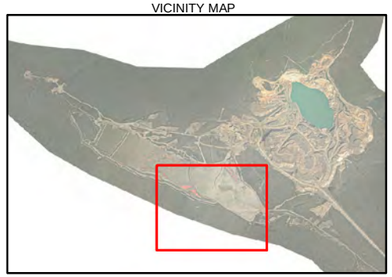
U.S. Army Corps of Engineers (USACE). 2009. *ETL 1110-2-571, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures*. April.

Attachments

Attachment 1 – Observation Locations (upstream half)
Attachment 2 – Observation Locations (downstream half)
Attachment 3 – Inspection Observation Log
Attachment 4 – Inspection Photographs

Attachment 1
Observation Locations (upstream half)

VICINITY MAP



LEGEND

Geotechnical observation location, see Attachment 3.

Notes:

1. Observation locations shown in figure correspond to observations listed in Attachment 3.
2. Observation locations shown were collected usng a handheld GPS device with an approximate accuracy of ±10-12 feet.

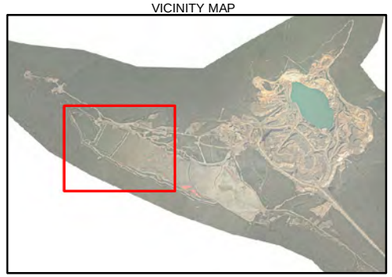
0 300 600
Feet

N

Attachment 1
Observation Locations (upstream half)
RCDC Inspection Memorandum
Faro Mine Remediation Project

Attachment 2
Observation Locations (downstream half)

VICINITY MAP



LEGEND

Geotechnical observation location, see Attachment 3.

Notes:

1. Observation locations shown in figure correspond to observations listed in Attachment 3.
2. Observation locations shown were collected usng a handheld GPS device with an approximate accuracy of ±10-12 feet.

0 300 600
Feet

N

Attachment 2
Observation Locations (downstream half)
RCDC Inspection Memorandum
Faro Mine Remediation Project

Attachment 3
Inspection Observation Log

ATTACHMENT 3

Petrographic Examination of Coarse Aggregate

Faro Mine Remediation Project

Number	Date Time	Description	NOTES	Altitude	X (Project Coordinates)	Y (Project Coordinates)
4	7/26/2013 12:04	BEGIN RCDC ADJACENT TO TAILINGS BERM (INTERPRETED U/S END OF RCDC)	BEGIN RCDC ADJACENT TO TAILINGS BERM (INTERPRETED U/S END OF RCDC)	1061.4	583336.706	6912696.614
5	7/26/2013 12:07	60CM DIAMETER DEWATERING WELL AND POWER POLE AT TOE OF EXST TAILINGS BERM	60 cm DIAMETER DEWATERING WELL AND POWER POLE AT TOE OF EXST TAILINGS BERM	1061.7	583306.1491	6912681.366
6	7/26/2013 12:08	60CM DIAMETER DEWATERING WELL AND POWER POLE AT TOE OF EXST TAILINGS BERM	60 cm DIAMETER DEWATERING WELL AND POWER POLE AT TOE OF EXST TAILINGS BERM	1061.4	583290.1485	6912655.892
7	7/26/2013 12:14	LARGE ROCK AT INTERSECTION OF 3 SEPARATE CHANNELS FROM PUMPHOUSE POND. ACTIVE BEAVER ACTIVITY OBSERVED.	LARGE ROCK AT INTERSECTION OF 3 SEPARATE CHANNELS FROM PUMPHOUSE POND. ACTIVE BEAVER ACTIVITY OBSERVED.	1062.1	583267.3674	6912584.22
8	7/26/2013 12:18	BEGIN RIPRAP ON RIGHT SIDE OF CHANNEL	BEGIN RIPRAP ON RIGHT SIDE OF CHANNEL	1062.4	583216.6046	6912535.369
9	7/26/2013 12:21	TENSION CRACKING OBSERVED ON RIGHT BANK ±15M IN LENGTH. RIPRAP LEAN AND DEGRADED. RIPRAP DOES NOT BUTTRESS UPPER SLOPE. BERM IS APPROX 2M TALL AND APPEARS COMPRISED OF WELL-GRADED SANDY GRAVEL FILL. EROSION AND OVERSTEEPENING OF BANK OBSERVED IN THIS AREA.	TENSION CRACKING OBSERVED ON RIGHT BANK ±15M IN LENGTH. RIPRAP LEAN AND DEGRADED. RIPRAP DOES NOT BUTTRESS UPPER SLOPE. BERM IS APPROX 2M TALL AND APPEARS COMPRISED OF WELL-GRADED SANDY GRAVEL FILL. EROSION AND OVERSTEEPENING OF BANK OBSERVED IN THIS AREA.	1062.4	583196.8782	6912534.656
10	7/26/2013 12:30	ROSE CREEK BECOMES SINGLE ENGINEERED CHANNEL	ROSE CREEK BECOMES SINGLE ENGINEERED CHANNEL	1063.1	583162.3536	6912541.378
11	7/26/2013 12:32	RED STAINING OBSERVED ON RIGHT BANK. POSSIBLE SEEPAGE FROM TAILINGS POND (?). SEEPAGE IS APPROX 3' ABOVE WSEL AND 7' BELOW TOP OF BANK. NO RIPRAP PRESENT.	RED STAINING OBSERVED ON RIGHT BANK. POSSIBLE SEEPAGE FROM TAILINGS POND (?). SEEPAGE IS APPROX 3' ABOVE WSEL AND 7' BELOW TOP OF BANK. NO RIPRAP PRESENT.	1064.8	583130.5711	6912556.638
12	7/26/2013 12:39	STAFF GAGE (XXXX.40M 7/26/2013 12:40PM)	STAFF GAGE (XXXX.40M 7/26/2013 12:40PM)	1064.5	583119.8341	6912565.399
13	7/26/2013 12:42	APPARENT PREVIOUS SLIDE REPAIR WITH LARGE ANGULAR RIPRAP ON RIGHT SIDE OF CHANNEL. APPROX 8M LONG.	APPARENT PREVIOUS SLIDE REPAIR WITH LARGE ANGULAR RIPRAP ON RIGHT SIDE OF CHANNEL. APPROX 8M LONG.	1064.8	583054.0268	6912604.892
14	7/26/2013 12:48	LOW WATER EQUIPMENT CROSSING (FORD). LARGE PUDDLE OBSERVED ON CREST, APPROX 26M LONG AND 10CM DEEP. RECOMMEND REGRADING TO PREVENT PUDDLING.	LOW WATER EQUIPMENT CROSSING (FORD). LARGE PUDDLE OBSERVED ON CREST, APPROX 26M LONG AND 10CM DEEP. RECOMMEND REGRADING TO PREVENT PUDDLING.	1066	582941.801	6912677.451
15	7/26/2013 12:51	APPARENT PREVIOUS SLIDE REPAIR WITH LARGE ANGULAR RIPRAP ON RIGHT SIDE OF CHANNEL. APPROX 10M LONG.	APPARENT PREVIOUS SLIDE REPAIR WITH LARGE ANGULAR RIPRAP ON RIGHT SIDE OF CHANNEL. APPROX 10M LONG.	1066.5	582921.4599	6912684.861
16	7/26/2013 12:56	SMALL PILE OF UNCOMPACTED FILL PLACED AT TOP OF SLOPE. APPROX 0.5 TO 1.0M TALL, 31M IN LENGTH. PURPOSE UNKNOWN. LONGITUDINAL CRACKING OBSERVED NEAR TOP OF SLOPE. ADDS SURCHARGE (DRIVING FORCE) TO SLOPE, RECOMMEND REMOVAL OR RELOCATION AWAY FROM SLOPE.	SMALL PILE OF UNCOMPACTED FILL PLACED AT TOP OF SLOPE. APPROX 0.5 TO 1.0M TALL, 31M IN LENGTH. PURPOSE UNKNOWN. LONGITUDINAL CRACKING OBSERVED NEAR TOP OF SLOPE. ADDS SURCHARGE (DRIVING FORCE) TO SLOPE, RECOMMEND REMOVAL OR RELOCATION AWAY FROM SLOPE.	1070.5	582848.8991	6912729.428
17	7/26/2013 13:02	APPARENT PREVIOUS SLIDE REPAIR WITH VERY LARGE RIPRAP (≤1M DIA). PORCUPINE PRESENT.	APPARENT PREVIOUS SLIDE REPAIR WITH VERY LARGE RIPRAP (±1M DIA). PORCUPINE PRESENT.	1067.4	582796.5053	6912759.005
18	7/26/2013 13:08	WIDENED SECTION OF CHANNEL, REASON UNKNOWN. TENSION CRACKING OBSERVED PARALLEL TO RIGHT BANK, APPROX 33M LONG. AUGMENT RIPRAP.	WIDENED SECTION OF CHANNEL, REASON UNKNOWN. TENSION CRACKING OBSERVED PARALLEL TO RIGHT BANK, APPROX 33M LONG. AUGMENT RIPRAP.	1067.7	582658.7649	6912834.955
19	7/26/2013 13:15	PENINSULA EXTENDING INTO WIDENED SECTION OF CHANNEL, PURPOSE UNKNOWN. MAY BE TRAINING BARB TO KEEP FLOW AWAY FROM FUSE PLUG	PENINSULA EXTENDING INTO WIDENED SECTION OF CHANNEL, PURPOSE UNKNOWN. MAY BE TRAINING BARB TO KEEP FLOW AWAY FROM FUSE PLUG	1066.7	582556.1295	6912895.393

ATTACHMENT 3

Petrographic Examination of Coarse Aggregate

Faro Mine Remediation Project

Number	Date Time	Description	NOTES	Altitude	X (Project Coordinates)	Y (Project Coordinates)
20	7/26/2013 13:23	FUSE PLUG AREA. NEED TO CONFIRM DESIGN INTENT, HEAVILIY ARMORED ON DOWNSTREAM SIDE WITH VERY LARGE ROCK. DOES NOT APPEAR "FUSEABLE," MAY FUNCTION AS AN OVERFLOW SECTION RATHER THAN FUSE PLUG (??) SEVERAL LARGE BOULDERS UP TO 2M DIAMETER OBSERVED. CONTINUOUS RIPRAP ARMORING OF RIGHT BANK OF CHANNEL BEGINS DOWNSTREAM OF FUSE PLUG	FUSE PLUG AREA. NEED TO CONFIRM DESIGN INTENT, HEAVILIY ARMORED ON DOWNSTREAM SIDE WITH VERY LARGE ROCK. DOES NOT APPEAR "FUSEABLE," MAY FUNCTION AS AN OVERFLOW SECTION RATHER THAN FUSE PLUG (??) SEVERAL LARGE BOULDERS UP TO 2M DIAMETER OBSERVED. CONTINUOUS RIPRAP ARMORING OF RIGHT BANK OF CHANNEL BEGINS DOWNSTREAM OF FUSE PLUG	1070.3	582485.6225	6912939.016
21	7/26/2013 13:33	CRACKING AND SLOPE DEFORMATION OBSERVED. APPROX 0.8M OF VERTICAL DEFORMATION. RIPRAP APPEARS PRONE TO BREAKDOWN (WEATHERING, FREEZING, ETC)	CRACKING AND SLOPE DEFORMATION OBSERVED. APPROX 0.8M OF VERTICAL DEFORMATION. RIPRAP APPEARS PRONE TO BREAKDOWN (WEATHERING, FREEZING, ETC)	1068.1	582439.6836	6912910.802
22	7/26/2013 13:38	CHANNEL GRADIENT INCREASES. BEDROCK OBSERVED ON LEFT SIDE OF CHANNEL AND IN CHANNEL INVERT. APPARENT PREVIOUS SLIDE REPAIR ON LEFT SIDE OF CHANNEL (ROUND RIPRAP WITH GEOTEXTILE UNDERLAYMENT0	CHANNEL GRADIENT INCREASES. BEDROCK OBSERVED ON LEFT SIDE OF CHANNEL AND IN CHANNEL INVERT. APPARENT PREVIOUS SLIDE REPAIR ON LEFT SIDE OF CHANNEL (ROUND RIPRAP WITH GEOTEXTILE UNDERLAYMENT0	1070.1	582412.9678	6912916.275
23	7/26/2013 13:42	CRACKING AND MINOR SCARP OBSERVED ON LEFT SIDE OF CHANNEL.	CRACKING AND MINOR SCARP OBSERVED ON LEFT SIDE OF CHANNEL.	1067.9	582384.3005	6912923.148
24	7/26/2013 13:46	PREVIOUS SLOPE FAILURE OBSERVED ON RIGHT BANK, IMPINGES ON CHANNEL WIDTH. REMOVE SLOUGHED MATERIAL AND RECONSTRUCT CHANNEL BANK.	PREVIOUS SLOPE FAILURE OBSERVED ON RIGHT BANK, IMPINGES ON CHANNEL WIDTH. REMOVE SLOUGHED MATERIAL AND RECONSTRUCT CHANNEL BANK.	1070.3	582268.0158	6912955.285
25	7/26/2013 13:50	SLOPE FAILURE OBSERVED ON RIGHT BANK, APPROX 10-12M LONG, 30CM TALL SCARP, CRACK IS LOCATED APPROX 2/3 OF SLOPE HEIGHT	SLOPE FAILURE OBSERVED ON RIGHT BANK, APPROX 10-12M LONG, 30CM TALL SCARP, CRACK IS LOCATED APPROX 2/3 OF SLOPE HEIGHT	1065.7	582207.6546	6912969.963
26	7/26/2013 13:52	SLOPE FAILURE OBSERVED ON RIGHT BANK, APPROX 29M LONG WITH 0.8M VERTICAL DISPLACEMENT	SLOPE FAILURE OBSERVED ON RIGHT BANK, APPROX 29M LONG WITH 0.8M VERTICAL DISPLACEMENT	1066.9	582173.2622	6912975.806
27	7/26/2013 13:55	SLOPE FAILURE OBSERVED ON RIGHT BANK.	SLOPE FAILURE OBSERVED ON RIGHT BANK.	1065.5	582116.3411	6912993.914
28	7/26/2013 13:57	SLOPE FAILURE OBSERVED ON RIGHT BANK.	SLOPE FAILURE OBSERVED ON RIGHT BANK.	1068.4	582086.492	6913008.896
29	7/26/2013 14:00	CHANNEL GRADIENT DECREASES AND CHANNEL BECOMES WIDER.	CHANNEL GRADIENT DECREASES AND CHANNEL BECOMES WIDER.	1067.7	582044.0792	6913022.791
30	7/26/2013 14:02	PREVIOUS SLOPE FAILURE, ROUNDED RIPRAP PLACED ON SLOPE	PREVIOUS SLOPE FAILURE, ROUNDED RIPRAP PLACED ON SLOPE	1067.9	582011.1837	6913037.366
31	7/26/2013 14:07	NOTABLE STREAM ENTERS CHANNEL FROM LEFT. END PHASE 1 INSPECTION.	NOTABLE STREAM ENTERS CHANNEL FROM LEFT. END PHASE 1 INSPECTION.	1065.3	581871.4947	6913115.863
32	7/26/2013 14:36	PILE OF UNCOMPACTED FILL PLACED ADJACENT TO TAILINGS BERM (ABOVE CHANNEL BANK, BELOW TAILINGS BERM CREST) UNSURE IF THIS REDUCES CHANNEL CONVEYANCE CAPACITY.	PILE OF UNCOMPACTED FILL PLACED ADJACENT TO TAILINGS BERM (ABOVE CHANNEL BANK, BELOW TAILINGS BERM CREST) UNSURE IF THIS REDUCES CHANNEL CONVEYANCE CAPACITY.	1063.3	582827.5494	6912750.41
33	7/26/2013 14:50	ROUNDED RIPRAP OBSERVED ON RIGHT BANK, VERY STEEP, PREVIOUS SLOPE FAILURE REPAIR (?)	ROUNDED RIPRAP OBSERVED ON RIGHT BANK, VERY STEEP, PREVIOUS SLOPE FAILURE REPAIR (?)	1065.3	581848.6055	6913132.355
34	7/26/2013 14:51	PREVIOUS SLOPE FAILURE, APPROX 30CM SCARP. CHANNEL WIDTH INCREASES. ROCK OBSERVED OUTCROPPING ON LEFT SIDE OF CHANNEL.	PREVIOUS SLOPE FAILURE, APPROX 30CM SCARP. CHANNEL WIDTH INCREASES. ROCK OBSERVED OUTCROPPING ON LEFT SIDE OF CHANNEL.	1065.5	581831.701	6913143.533
35	7/26/2013 14:54	SLOPE FAILURE OBSERVED ON RIGHT BANK	SLOPE FAILURE OBSERVED ON RIGHT BANK	1063.8	581780.6361	6913168.142
36	7/26/2013 14:57	SLOPE FAILURE OBSERVED ON RIGHT BANK	SLOPE FAILURE OBSERVED ON RIGHT BANK	1063.1	581678.3201	6913210.225
37	7/26/2013 15:00	POSSIBLE LONG SCARP ON LEFT SIDE BANK. TO BE CONFIRMED BY FIELD INSPECTION. APPROX 59M LONG.	POSSIBLE LONG SCARP ON LEFT SIDE BANK. TO BE CONFIRMED BY FIELD INSPECTION. APPROX 59M LONG.	1064.5	581638.7078	6913224.193
38	7/26/2013 15:03	SLOPE FAILURE ON RIGHT BANK	SLOPE FAILURE ON RIGHT BANK	1063.1	581597.655	6913246.262
39	7/26/2013 15:05	SLOPE FAILURE ON RIGHT BANK	SLOPE FAILURE ON RIGHT BANK	1062.6	581559.5131	6913267.957
40	7/26/2013 15:08	SLOPE FAILURE ON RIGHT BANK, ROUNDED RIPRAP	SLOPE FAILURE ON RIGHT BANK, ROUNDED RIPRAP	1063.8	581523.489	6913287.81
41	7/26/2013 15:17	APPARENT SLOPE FAILURE REPAIR	APPARENT SLOPE FAILURE REPAIR	1063.3	581285.9491	6913356.037

ATTACHMENT 3

Petrographic Examination of Coarse Aggregate

Faro Mine Remediation Project

Number	Date Time	Description	NOTES	Altitude	X (Project Coordinates)	Y (Project Coordinates)
42	7/27/2013 9:44	BEGIN ROCK CUT ON LEFT SIDE OF CHANNEL (ENDS AT PT 44)	BEGIN ROCK CUT ON LEFT SIDE OF CHANNEL (ENDS AT PT 44)	1066	581050.9913	6913484.972
43	7/27/2013 9:48	RECOMMEND REPAIR RIPRAP AND REMOVE LARGE BOULDERS FROM CHANNEL	RECOMMEND REPAIR RIPRAP AND REMOVE LARGE BOULDERS FROM CHANNEL	1063.8	580928.7122	6913507.202
44	7/27/2013 9:51	END ROCK CUT ON LEFT SIDE OF CHANNEL (STARTS AT PT 42)	END ROCK CUT ON LEFT SIDE OF CHANNEL (STARTS AT PT 42)	1062.9	580902.8323	6913512.706
45	7/27/2013 9:52	SMALL SLIDE ON LEFT SIDE, APPROX 7M LONG AND LOCATED APPROX 3/4 WAY UP THE SLOPE, SCARP APPROX 30CM. ADDITIONAL LONGITUDINAL CRACKING OBSERVED BOTH U/S AND D/S. SLOUGHING OBSERVED ON RIGHT SIDE.	SMALL SLIDE ON LEFT SIDE, APPROX 7M LONG AND LOCATED APPROX 3/4 WAY UP THE SLOPE, SCARP APPROX 30CM. ADDITIONAL LONGITUDINAL CRACKING OBSERVED BOTH U/S AND D/S. SLOUGHING OBSERVED ON RIGHT SIDE.	1063.3	580877.5032	6913519.004
46	7/27/2013 9:59	BEGIN LARGE LONG FAILURE ON LEFT SIDE OF CHANNEL	BEGIN LARGE LONG FAILURE ON LEFT SIDE OF CHANNEL	1062.4	580842.4434	6913542.119
47	7/27/2013 10:04	END LARGE LONG FAILURE ON LEFT SIDE OF CHANNEL (STREAM COMES INTO CHANNEL FROM SOUTH)	END LARGE LONG FAILURE ON LEFT SIDE OF CHANNEL (STREAM COMES INTO CHANNEL FROM SOUTH)	1061.4	580758.4631	6913593.922
48	7/27/2013 10:06	END PLACEMENT OF LARGE ROUNDED RIPRAP ON UPPER 1/2 OF RIGHT BANK (NR. LOCATION OF ORANGE WELLS BGC05-03, BGC05-04, BGC05-05). SLOUGHING AND CRACKING OBSERVED ON RIGHT BANK DOWNSTREAM OF RIPRAP.	END PLACEMENT OF LARGE ROUNDED RIPRAP ON UPPER 1/2 OF RIGHT BANK (NR. LOCATION OF ORANGE WELLS BGC05-03, BGC05-04, BGC05-05). SLOUGHING AND CRACKING OBSERVED ON RIGHT BANK DOWNSTREAM OF RIPRAP.	1060.7	580762.2794	6913590.336
49	7/27/2013 10:12	OLD SLUMP IN NON-RIPRAPPED ZONE ON RIGHT BANK HAS OVERSTEEPEND SLOPE AND IMPINGED ON CHANNEL WIDTH APPROX 40M LONG. CRACKING IS PRESENT ON SLOPE NEAR TOP OF SLUMPED RIPRAP (APPROX 1/2 WAY UP SLOPE). RECOMMEND REMOVAL OF RIPRAP, RESTORATION OF CHANNEL LINING, AND ARMORING WITH ANGULAR RIPRAP	OLD SLUMP IN NON-RIPRAPPED ZONE ON RIGHT BANK HAS OVERSTEEPEND SLOPE AND IMPINGED ON CHANNEL WIDTH APPROX 40M LONG. CRACKING IS PRESENT ON SLOPE NEAR TOP OF SLUMPED RIPRAP (APPROX 1/2 WAY UP SLOPE). RECOMMEND REMOVAL OF RIPRAP, RESTORATION OF CHANNEL LINING, AND ARMORING WITH ANGULAR RIPRAP	1059.3	580734.3802	6913600.14
50	7/27/2013 10:24	REMOVE LARGE BOULDER FROM CHANNEL. MONITOR EROSION ON LEFT BANK AND EXISTING EROSION CONTROL STONE	REMOVE LARGE BOULDER FROM CHANNEL. MONITOR EROSION ON LEFT BANK AND EXISTING EROSION CONTROL STONE	1058.8	580715.766	6913613.733
51	7/27/2013 10:26	BEGIN LARGE ROUNDED RIPRAP PLACEMENT ON TOP HALF OF SLOPE. (ENDS AT PT. 56). LOWER HALF OF SLOPE IS EXISTING ANGULAR RIPRAP	BEGIN LARGE ROUNDED RIPRAP PLACEMENT ON TOP HALF OF SLOPE. (ENDS AT PT. 56). LOWER HALF OF SLOPE IS EXISTING ANGULAR RIPRAP	1062.6	580699.6992	6913618.361
52	7/27/2013 10:33	LONG CRACK OBSERVED ON LEFT SIDE OF CHANNEL AT TOP OF SLOPE. APPROX 15CM SCARP OBSERVED, 40M IN LENGTH	LONG CRACK OBSERVED ON LEFT SIDE OF CHANNEL AT TOP OF SLOPE. APPROX 15CM SCARP OBSERVED, 40M IN LENGTH	1061.4	580628.1636	6913667.681
53	7/27/2013 10:37	RECOMMEND MONITORING OF EROSION AND WATCH FOR POSSIBLE INITIATION OF SLOPE FAILURE ON LEFT BANK. EXISTING INCLINOMETER CASING CD-21 INSTALLED ON RIGHT BANK. RECOMMEND MONITORING OF SLOPE AND EROSION ON TAILINGS SIDE OF RCDC BERM.	RECOMMEND MONITORING OF EROSION AND WATCH FOR POSSIBLE INITIATION OF SLOPE FAILURE ON LEFT BANK. EXISTING INCLINOMETER CASING CD-21 INSTALLED ON RIGHT BANK. RECOMMEND MONITORING OF SLOPE AND EROSION ON TAILINGS SIDE OF RCDC BERM.	1063.1	580610.0655	6913674.935
54	7/27/2013 10:46	CRACKING OBSERVED ON LEFT SIDE OF CHANNEL APPROX 1/2 UP SLOPE	CRACKING OBSERVED ON LEFT SIDE OF CHANNEL APPROX 1/2 UP SLOPE	1060.2	580543.3117	6913697.847
55	7/27/2013 10:50	PREVIOUS SLOUGHING IMPINGING ON CHANNEL WIDTH. CRACKING OBSERVED ON RIGHT BANK. EXCAVATE AND REMOVE, RESTORE CHANNEL LINING, AND REPLACE RIPRAP. CRACK	PREVIOUS SLOUGHING IMPINGING ON CHANNEL WIDTH. CRACKING OBSERVED ON RIGHT BANK. EXCAVATE AND REMOVE, RESTORE CHANNEL LINING, AND REPLACE RIPRAP. CRACK	1062.9	580516.0032	6913702.54
56	7/27/2013 10:54	END ROUNDED RIPRAP PLACED ON TOP HALF OF RIGHT BANK (STARTED AT PT. 51)	END ROUNDED RIPRAP PLACED ON TOP HALF OF RIGHT BANK (STARTED AT PT. 51)	1062.4	580495.3295	6913713.522
57	7/27/2013 10:55	ROCK OUTCROPPING ON LEFT BANK. CRACKING AND SLUMPING OBSERVED ON RIGHT BANK.	ROCK OUTCROPPING ON LEFT BANK. CRACKING AND SLUMPING OBSERVED ON RIGHT BANK.	1062.6	580480.4542	6913718.18
58	7/27/2013 11:00	SLOPE FAILURE SCARP OBSERVED ON LEFT BANK. APPROX 15CM TALL AND 20M LONG.	SLOPE FAILURE SCARP OBSERVED ON LEFT BANK. APPROX 15CM TALL AND 20M LONG.	1061.7	580435.9432	6913744.638

ATTACHMENT 3

Petrographic Examination of Coarse Aggregate

Faro Mine Remediation Project

Number	Date Time	Description	NOTES	Altitude	X (Project Coordinates)	Y (Project Coordinates)
59	7/27/2013 11:03	EXISTING INCLINOMETER CASING BH94CD-1 ON RIGHT BANK. CRACKING OBSERVED ON RIGHT BANK, MEAS CRACK APPROX. 50CM DEEP	EXISTING INCLINOMETER CASING BH94CD-1 ON RIGHT BANK. CRACKING OBSERVED ON RIGHT BANK, MEAS CRACK APPROX. 50CM DEEP	1062.9	580416.1797	6913760.88
60	7/27/2013 11:08	PREVIOUS SLUMP IMPINGES ON CHANNEL WIDTH. EXCAVATE RIPRAP, RESTORE CHANNEL LINING, AND PROTECT SLOPE WITH ANGULAR RIPRAP.	PREVIOUS SLUMP IMPINGES ON CHANNEL WIDTH. EXCAVATE RIPRAP, RESTORE CHANNEL LINING, AND PROTECT SLOPE WITH ANGULAR RIPRAP.	1062.6	580349.8808	6913805.985
61	7/27/2013 11:13	CRACKING AND SLUMPING OBSERVED ON RIGHT SIDE OF CHANNEL. LARGE LONG SLOPE FAILURE SCARP BEGINS AT TOP OF SLOPE ON LEFT SIDE.	CRACKING AND SLUMPING OBSERVED ON RIGHT SIDE OF CHANNEL. LARGE LONG SLOPE FAILURE SCARP BEGINS AT TOP OF SLOPE ON LEFT SIDE.	1062.4	580306.9033	6913826.909
62	7/27/2013 11:16	SLUMPING IMPINGES ON CHANNEL WIDTH. EXCAVATE SLUMPED MATERIAL, RESTORE CHANNEL LINING, AND ARMOR WITH ANGULAR RIPRAP.	SLUMPING IMPINGES ON CHANNEL WIDTH. EXCAVATE SLUMPED MATERIAL, RESTORE CHANNEL LINING, AND ARMOR WITH ANGULAR RIPRAP.	1061.7	580280.3208	6913842.432
63	7/27/2013 11:21	LEFT ABUTMENT OF INTERMEDIATE DAM. LARGE ROCK OUTCROP AT LEFT SIDE OF CHANNEL. GRADIENT OF CHANNEL INCREASES.	LEFT ABUTMENT OF INTERMEDIATE DAM. LARGE ROCK OUTCROP AT LEFT SIDE OF CHANNEL. GRADIENT OF CHANNEL INCREASES.	1060.7	580253.8926	6913866.651
64	7/27/2013 11:26	LARGE ROUNDED RIPRAP PLACED ON RIGHT BANK. CHANNEL IS SOMEWHAT NARROWER.	LARGE ROUNDED RIPRAP PLACED ON RIGHT BANK. CHANNEL IS SOMEWHAT NARROWER.	1060.9	580166.447	6913890.858
65	7/27/2013 11:30	EXISTING ACCESS ROAD CONSTRUCTED ACROSS RCDC. LEADS ACROSS CHANNEL TO LARGE ROCK QUARRY SITE. NO GEOTECHNICAL ISSUES OBSERVED WITH ROADWAY.	EXISTING ACCESS ROAD CONSTRUCTED ACROSS RCDC. LEADS ACROSS CHANNEL TO LARGE ROCK QUARRY SITE. NO GEOTECHNICAL ISSUES OBSERVED WITH ROADWAY.	1058.3	580085.7999	6913918.907
66	7/27/2013 11:34	BEGIN LINE OF BOULDERS PARALLEL TO CENTERLINE OF CHANNEL, TO BE REMOVED. APPROX 66M LONG (ENDS AT PT. 67).	BEGIN LINE OF BOULDERS PARALLEL TO CENTERLINE OF CHANNEL, TO BE REMOVED. APPROX 66M LONG (ENDS AT PT. 67).	1060.9	580031.9795	6913960.193
67	7/27/2013 11:37	END LINE OF BOULDERS PARALLEL TO CENTERLINE OF CHANNEL, TO BE REMOVED. (STARTS AT PT. 66)	END LINE OF BOULDERS PARALLEL TO CENTERLINE OF CHANNEL, TO BE REMOVED. (STARTS AT PT. 66)	1059.5	579985.9816	6913994.98
68	7/27/2013 11:38	CHANNEL GRADIENT INCREASES.	CHANNEL GRADIENT INCREASES.	1058	579977.3295	6914001.571
69	7/27/2013 11:42	LARGE PILE OF LARGE DIAMETER JETTY STONE (1.0 TO 2.0M DIAMETER) ON TAILINGS SIDE OF RCDC BERM. POSSIBLE SLIDE REPAIR (?)	LARGE PILE OF LARGE DIAMETER JETTY STONE (1.0 TO 2.0M DIAMETER) ON TAILINGS SIDE OF RCDC BERM. POSSIBLE SLIDE REPAIR (?)	1053	580023.6237	6914038.898
70	7/27/2013 11:50	FAINT EXISTING ACCESS ROAD CLIMBS TAILINGS SIDE OF RCDC BERM.	FAINT EXISTING ACCESS ROAD CLIMBS TAILINGS SIDE OF RCDC BERM.	1052.3	580203.1685	6913910.46
71	7/27/2013 12:14	RESTORE LARGE JETTY STONE ON RIGHT BANK UP TO CREST OF BERM.	RESTORE LARGE JETTY STONE ON RIGHT BANK UP TO CREST OF BERM.	1058.3	579969.2206	6914004.944
72	7/27/2013 12:17	REMOVE LARGE BOULDERS (3 @ 1.5M DIAMETER) FROM CHANNEL.	REMOVE LARGE BOULDERS (3 @ 1.5M DIAMETER) FROM CHANNEL.	1055.6	579962.4532	6914015.035
73	7/27/2013 12:19	5FT DEEP VOID OBSERVED IN CHANNEL ARMORING ON RIGHT SIDE. POSSIBLE EROSION OR SCOURING BEHIND THE STONE.	5FT DEEP VOID OBSERVED IN CHANNEL ARMORING ON RIGHT SIDE. POSSIBLE EROSION OR SCOURING BEHIND THE STONE.	1054	579960.8769	6914031.158
74	7/27/2013 12:25	CONFIRM THAT EXISTING JETTY STONE ADEQUATELY PROTECTS BERM. AUGMENT STONE IF NECESSARY.	CONFIRM THAT EXISTING JETTY STONE ADEQUATELY PROTECTS BERM. AUGMENT STONE IF NECESSARY.	1052	579886.2799	6914098.92
75	7/27/2013 12:27	CONFIRM THAT EXISTING JETTY STONE ADEQUATELY PROTECTS BERM. AUGMENT STONE IF NECESSARY. REMOVE APPROX 1.5M DIAMETER BOULDER FROM CHANNEL.	CONFIRM THAT EXISTING JETTY STONE ADEQUATELY PROTECTS BERM. AUGMENT STONE IF NECESSARY. REMOVE APPROX 1.5M DIAMETER BOULDER FROM CHANNEL.	1051.8	579865.8589	6914110.357
76	7/27/2013 12:30	MONITOR FOR EROSION BETWEEN LARGE RIPRAP ON STEEP GRADE.	MONITOR FOR EROSION BETWEEN LARGE RIPRAP ON STEEP GRADE.	1049.4	579862.7116	6914122.876
77	7/27/2013 12:31	CONFIRM THAT EXISTING JETTY STONE ADEQUATELY PROTECTS BERM. AUGMENT STONE IF NECESSARY.	CONFIRM THAT EXISTING JETTY STONE ADEQUATELY PROTECTS BERM. AUGMENT STONE IF NECESSARY.	1048.7	579845.7618	6914129.938
78	7/27/2013 12:33	CONFIRM THAT EXISTING JETTY STONE ADEQUATELY PROTECTS BERM. AUGMENT STONE IF NECESSARY.	CONFIRM THAT EXISTING JETTY STONE ADEQUATELY PROTECTS BERM. AUGMENT STONE IF NECESSARY.	1047.5	579815.7236	6914149.394
79	7/27/2013 12:35	REMOVE TREES, AUGMENT LARGE RIPRAP, PROTECT AGAINST EROSION.	REMOVE TREES, AUGMENT LARGE RIPRAP, PROTECT AGAINST EROSION.	1047	579805.9746	6914156.406

ATTACHMENT 3

Petrographic Examination of Coarse Aggregate

Faro Mine Remediation Project

Number	Date Time	Description	NOTES	Altitude	X (Project Coordinates)	Y (Project Coordinates)
80	7/27/2013 12:38	REMOVE LARGE 1.5M DIAMETER BOULDERS FROM CHANNEL	REMOVE LARGE 1.5M DIAMETER BOULDERS FROM CHANNEL	1045.1	579737.0981	6914188.645
81	7/27/2013 12:41	AUGMENT RIPRAP TO ARMOR TO TOP OF BERM	AUGMENT RIPRAP TO ARMOR TO TOP OF BERM	1040	579719.9658	6914199.047
82	7/27/2013 12:47	STREAM ENTERS CAHNNEL FROM LEFT SIDE	STREAM ENTERS CAHNNEL FROM LEFT SIDE	1043.6	579682.6148	6914232.038
83	7/27/2013 12:48	REMOVE LARGE BOULDERS OUT OF STREAM AND ARMOR EXISTING STREAM BANK.	REMOVE LARGE BOULDERS OUT OF STREAM AND ARMOR EXISTING STREAM BANK.	1040.3	579678.6096	6914247.991
84	7/27/2013 12:53	REMOVE LARGE BOULDER FROM CENTER OF STREAM WHICH HAS POTENTIAL TO COLLECT DEBRIS.	REMOVE LARGE BOULDER FROM CENTER OF STREAM WHICH HAS POTENTIAL TO COLLECT DEBRIS.	1033.5	579666.0571	6914381.54
85	7/27/2013 12:55	CHANNEL GRADIENT DECREASES. RIPRAP SIZE DECREASES.	CHANNEL GRADIENT DECREASES. RIPRAP SIZE DECREASES.	1033.1	579650.3827	6914411.257
86	7/27/2013 13:02	GRADIENT AND RIPRAP SIZE INCREASES.	GRADIENT AND RIPRAP SIZE INCREASES.	1031.6	579512.2255	6914619.833
87	7/27/2013 13:03	REMOVE LARGE BOULDER WITH POTENTIAL TO COLLECT DEBRIS.	REMOVE LARGE BOULDER WITH POTENTIAL TO COLLECT DEBRIS.	1030.7	579506.826	6914626.949
88	7/27/2013 13:07	REMOVE LARGE BOULDERS ACCUMULATED ON RIGHT SIDE OF CHANNEL.	REMOVE LARGE BOULDERS ACCUMULATED ON RIGHT SIDE OF CHANNEL.	1025.1	579460.7686	6914710.666
89	7/27/2013 13:09	DOWNSTREAM END OF ENGINEERED CHANNEL. END OF RIPRAP SLOPE PROTECTION	DOWNSTREAM END OF ENGINEERED CHANNEL. END OF RIPRAP SLOPE PROTECTION	1022.2	579442.1695	6914763.385
90	7/27/2013 13:10	STAFF GAGE (XXXX.40M 7/27/2013 @ 12:11)	STAFF GAGE (XXXX.40M 7/27/2013 @ 12:11)	1020.8	579436.2464	6914772.94
91	7/27/2013 13:44	SLIGHT DIP OBSERVED IN CREST OF BERM. NO APPARENT DISTRESS OBSERVED ON CHANNEL SIDES.	SLIGHT DIP OBSERVED IN CREST OF BERM. NO APPARENT DISTRESS OBSERVED ON CHANNEL SIDES.	1060.7	580404.0713	6913779.758

Attachment 4
Inspection Photographs

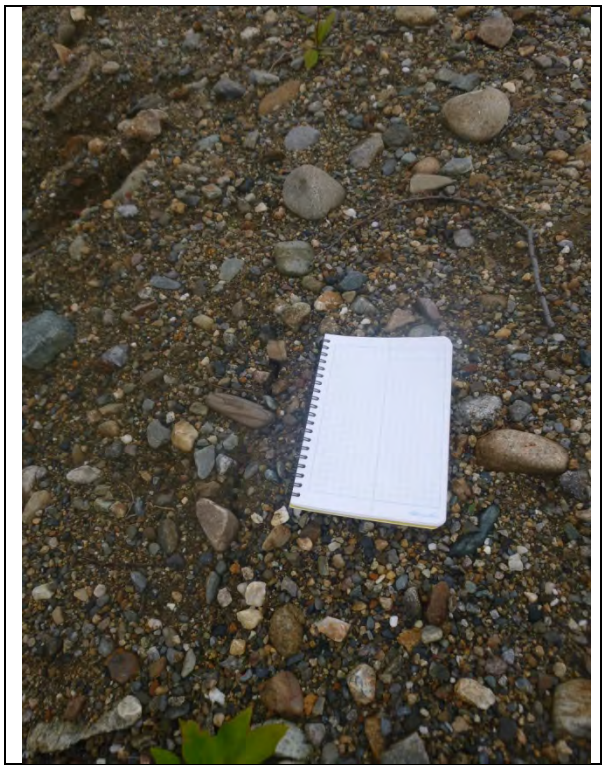
Photograph 1: P1010581.jpg

Photograph 2: P1010582.jpg

Photograph 3: P1010583.jpg

Photograph 4: P1010584.jpg

Photograph 5: P1010585.jpg



Photograph 6: P1010586.jpg

Photograph 7: P1010587.jpg

Photograph 8: P1010588.jpg

Photograph 9: P1010589.jpg

Photograph 10: P1010590.jpg

Photograph11: P1010591.jpg

Photograph 12: P1010592.jpg

Photograph 13: P1010593.jpg

Photograph 14: P1010594.jpg

Photograph 15: P1010595.jpg

Photograph 16: P1010596.jpg

Photograph 17: P1010597.jpg

Photograph 18: P1010598.jpg

Photograph 19: P1010599.jpg

Photograph 20: P1010600.jpg

Photograph 21: P1010601.jpg

Photograph 22: P1010602.jpg

Photograph 23: P1010603.jpg

Photograph 24: P1010604.jpg

Photograph 25: P1010605.jpg

Photograph 26: P1010606.jpg

Photograph 27: P1010607.jpg

Photograph 28: P1010608.jpg

Photograph 29: P1010609.jpg

Photograph 30: P1010610.jpg

Photograph 31: P1010611.jpg

Photograph 32: P1010612.jpg

Photograph 33: P1010613.jpg

Photograph 34: P1010614.jpg

Photograph 35: P1010615.jpg

Photograph 36: P1010616.jpg

Photograph 37: P1010617.jpg

Photograph 38: P1010618.jpg

Photograph 39: P1010619.jpg

Photograph 40: P1010620.jpg

Photograph 41: P1010621.jpg

Photograph 42: P1010622.jpg

Photograph 43: P1010623.jpg

Photograph 44: P1010624.jpg

Photograph 45: P1010625.jpg

Photograph 46: P1010626.jpg

Photograph 47: P1010627.jpg

Photograph 48: P1010628.jpg

Photograph 49: P1010629.jpg

Photograph 50: P1010630.jpg

Photograph 51: P1010656.jpg

Photograph 52: P1010657.jpg

Photograph 53: P1010658.jpg

Photograph 54: P1010659.jpg

Photograph 55: P1010660.jpg

Photograph 56: P1010661.jpg

Photograph 57: P1010662.jpg

Photograph 58: P1010663.jpg

Photograph 59: P1010664.jpg

Photograph 60: P1010665.jpg

Photograph 61: P1010666.jpg

Photograph 62: P1010668.jpg

Photograph 63: P1010669.jpg

Photograph 64: P1010670.jpg

Photograph 65: P1010671.jpg

Photograph 66: P1010672.jpg

Photograph 67: P1010674.jpg

Photograph 68: P1010675.jpg

Photograph 69: P1010676.jpg

Photograph 70: P1010677.jpg

Photograph 71: P1010678.jpg

Photograph 72: P1010679.jpg

Photograph 73: P1010680.jpg

Photograph 74: P1010682.jpg

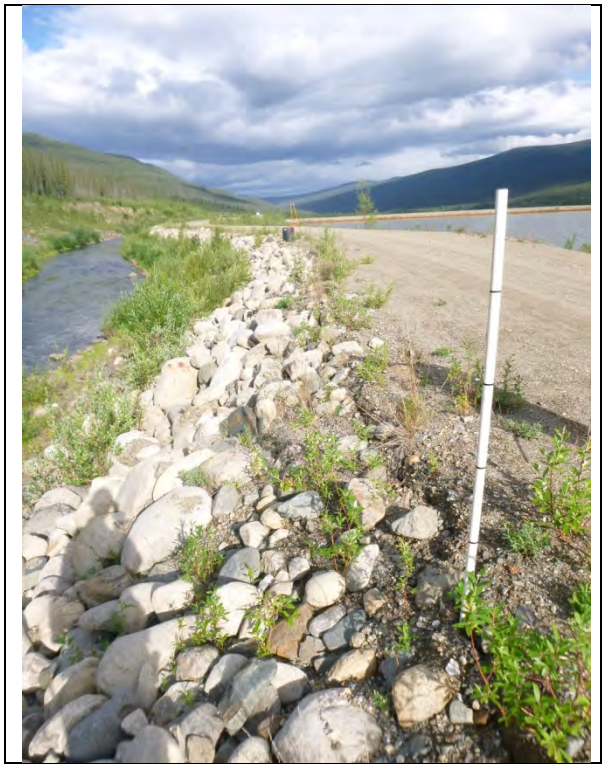
Photograph 75: P1010682.jpg

Photograph 76: P1010683.jpg

Photograph 77: P1010684.jpg

Photograph 78: P1010685.jpg

Photograph 79: P1010686.jpg

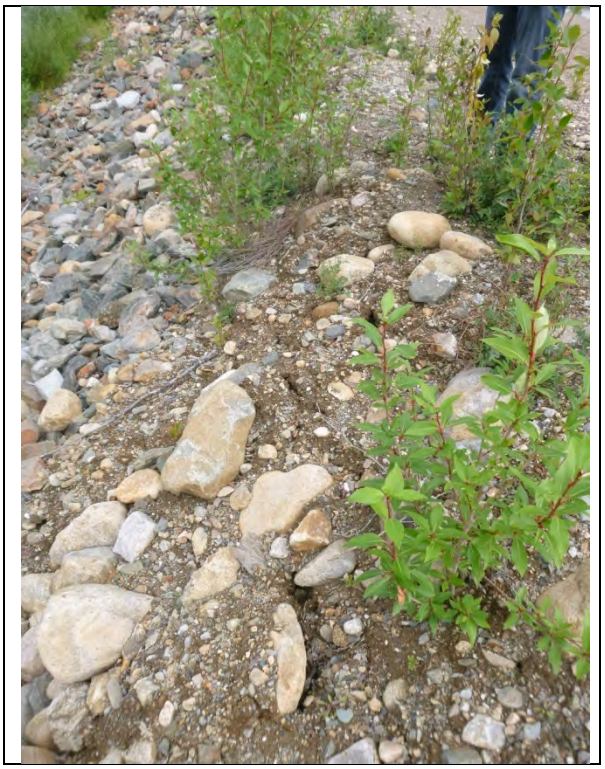


Photograph 80: P1010687.jpg

Photograph 81: P1010688.jpg

Photograph 82: P1010689.jpg

Photograph 83: P1010690.jpg



Photograph 84: P1010691.jpg

Photograph 85: P1010692.jpg

Photograph 86: P1010693.jpg

Photograph 87: P1010694.jpg

Photograph 88: P1010695.jpg

Photograph 89: P1010696.jpg

Photograph 90: P1010697.jpg

Photograph 91: P1010698.jpg

Photograph 92: P1010699.jpg

Photograph 93: P1010700.jpg

Photograph 94: P1010701.jpg

Photograph 95: P1010702.jpg

Photograph 96: P1010703.jpg

Photograph 97: P1010704.jpg

Photograph 98: P1010705.jpg

Photograph 99: P1010706.jpg

Photograph 100: P1010707.jpg

Photograph 101: P1010708.jpg

Photograph 102: P1010709.jpg

Photograph 103: P1010710.jpg

Photograph 104: P1010711.jpg

Photograph 105: P1010712.jpg

Photograph 106: P1010713.jpg

Photograph 107: P1010714.jpg

Photograph 108: P1010715.jpg

Photograph 109: P1010716.jpg

Photograph 110: P1010717.jpg

Photograph 111: P1010718.jpg

Photograph 112: P1010719.jpg

Photograph 113: P1010720.jpg

Photograph 114: P1010721.jpg

Photograph 115: P1010722.jpg

Photograph 116: P1010723.jpg

Photograph 117: P1010724.jpg

Photograph 118: P1010725.jpg

Photograph 119: P1010726.jpg

Photograph 120: P1010727.jpg

Photograph 121: P1010728.jpg

Photograph 122: P1010729.jpg

Photograph 123: P1010730.jpg

Photograph 124: P1010731.jpg

Photograph 125: P1010732.jpg

Photograph 126: P1010733.jpg

Photograph 127: P1010734.jpg

Photograph 128: P1010735.jpg

Photograph 129: P1010736.jpg

Photograph 130: P1010737.jpg

Photograph 131: P1010738.jpg

Photograph 132: P1010739.jpg

Photograph 133: P1010740.jpg

Photograph 134: P1010741.jpg

Appendix B
Photo Log

Photograph 1: calc-silicate2.jpg

Photograph 2: calcsilicate3.jpg

Photograph 3: CH13-108-TP001 .jpg

Photograph 4: CH13-108-TP001.jpg

Photograph 5: CH13-201-TP0010.jpg

Photograph 6: CH13-201-TP0010_cobble_unit.jpg

Photograph 7: CH13-201-TP0010_General_Location.jpg

Photograph 8: CH13-201-TP0010_General_Locationb.jpg

Photograph 9: CH13-201-TP001a.jpg

Photograph 10: CH13-201-TP003.jpg

Photograph 11: CH13-201-TP004.jpg

Photograph 12: CH13-201-TP005.jpg

Photograph 13: CH13-201-TP005_large rock from bottom of pit.jpg

Photograph 14: CH13-201-TP006a.jpg

Photograph 15: CH13-201-TP006b.jpg

Photograph 16: CH13-201-TP007.jpg

Photograph 17: CH13-201-TP007b.jpg

Photograph 18: CH13-201-TP007c.jpg

Photograph 19: CH13-201-TP009.jpg

Photograph 20: CH13-201-TP009_cobble_unit.jpg

Photograph 21: Epidote Amphibolite.jpg

Photograph 22: IMG_BRRW_CH13-108-TP006 __20130713.jpg

Photograph 23: IMG_BRRW_CH13-108-TP006 _Collected sample_20130713.jpg

Photograph 24: IMG_BRRW_CH13-108-TP006 _Test pit wall_20130713_001.jpg

Photograph 25: IMG_BRRW_CH13-108-TP006 _Test pit wall_20130713_002.jpg

Photograph 26: IMG_BRRW_CH13-108-TP007 _rock_20130713_001.jpg

Photograph 27: IMG_BRRW_CH13-108-TP007 _rock_20130713_002.jpg

Photograph 28: IMG_BRRW_CH13-108-TP007 _schist_20130713_001.jpg

Photograph 29: IMG_BRRW_CH13-108-TP007 _schist_20130713_002.jpg

Photograph 30: IMG_BRRW_CH13-108-TP008_130713_Other_001.jpg

Photograph 31: IMG_BRRW_CH13-108-TP008_130713_Other_002.jpg

Photograph 32: IMG_BRRW_CH13-108-TP008_130713_Test pit wall_001.jpg

Photograph 33: IMG_BRRW_CH13-108-TP008_130713_Test pit wall_002.jpg

Photograph 34: IMG_BRRW_CH13-108-TP009_130713_General location image.jpg

Photograph 35: IMG_BRRW_CH13-108-TP009_130713_Other.jpg

Photograph 36: IMG_BRRW_CH13-108-TP009_130713_Test pit wall.jpg

Photograph 37: IMG_BRRW_CH13-108-TP01 _130711_Test pit wall_002.jpg

Photograph 38: IMG_BRRW_CH13-108-TP010_130713_General location image.jpg

Photograph 39: IMG_BRRW_CH13-108-TP011_130713_Collected sample.jpg

Photograph 40: IMG_BRRW_CH13-108-TP011_130713_Test pit wall.jpg

Photograph 41: IMG_BRRW_CH13-108-TP012_130713_Collected sample.jpg

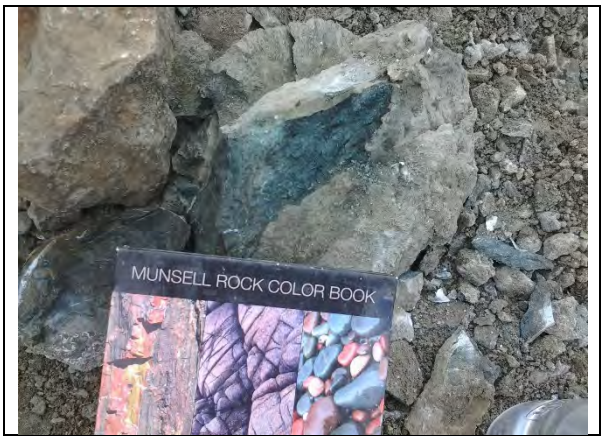
Photograph 42: IMG_BRRW_CH13-108-TP012_130713_Other.jpg

Photograph 43: IMG_BRRW_CH13-108-TP012_130713_Test pit wall_001.jpg

Photograph 44: IMG_BRRW_CH13-108-TP012_130713_Test pit wall_002.jpg

Photograph 45: IMG_BRRW_CH13-108-TP02 _130711_Test pit wall_001.jpg

Photograph 46: IMG_BRRW_CH13-108-TP02_130711_Other_001.jpg



Photograph 47: IMG_BRRW_CH13-108-TP02_130711_Other_002.jpg

Photograph 48: IMG_BRRW_CH13-108-TP02_130711_Test pit wall_002.jpg

Photograph 49: IMG_BRRW_CH13-108-TP03 _130711_Other_001.jpg

Photograph 50: IMG_BRRW_CH13-108-TP03 _130711_Other_002.jpg

Photograph 51: IMG_BRRW_CH13-108-TP03 _130711_Test pit wall_001.jpg

Photograph 52: IMG_BRRW_CH13-108-TP03 _130711_Test pit wall_002.jpg

Photograph 53: IMG_BRRW_CH13-108-TP04 _130711_Other_001.jpg

Photograph 54: IMG_BRRW_CH13-108-TP04 _130711_Other_002.jpg

Photograph 55: IMG_BRRW_CH13-108-TP04 _130711_Test pit wall.jpg

Photograph 56: IMG_BRRW_CH13-108-TP05 _130711_Other_001.jpg

Photograph 57: IMG_BRRW_CH13-108-TP05 _130711_Other_002.jpg

Photograph 58: IMG_BRRW_CH13-108-TP05 _130711_Test pit wall_001.jpg

Photograph 59: IMG_BRRW_CH13-108-TP05 _130711_Test pit wall_002.jpg

Photograph 60: Lower Northwest Dump 1.jpg

Photograph 61: Lower Northwest Dump 2.jpg

Photograph 62: Lower Northwest Dump 3.jpg

Photograph 63: Lower Northwest Dump 4.jpg

Photograph 64: Lower Northwest Dump 5.jpg

Photograph 65: Lower Northwest Dump 6.jpg

Photograph 66: Lower Northwest Dump.jpg

Photograph 67: LowerNorthwestDump_1.jpg

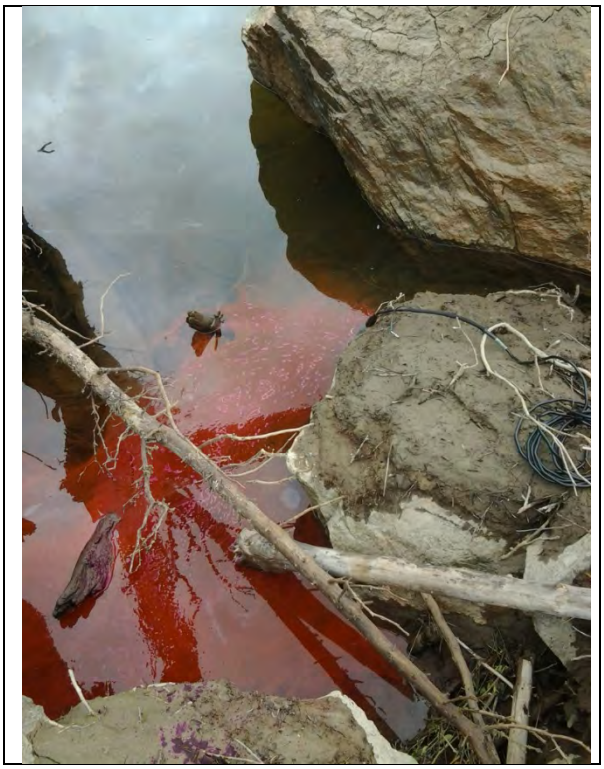
Photograph 68: Upper Parking Lot Dump (2).jpg

Photograph 69: Upper Parking Lot Dump 2.jpg

Photograph 70: Upper Parking Lot Dump 3.jpg

Photograph 71: Upper Parking Lot Dump.jpg

Photograph 72: Weathered Rock at the Lower Parking Lot Dump.jpg



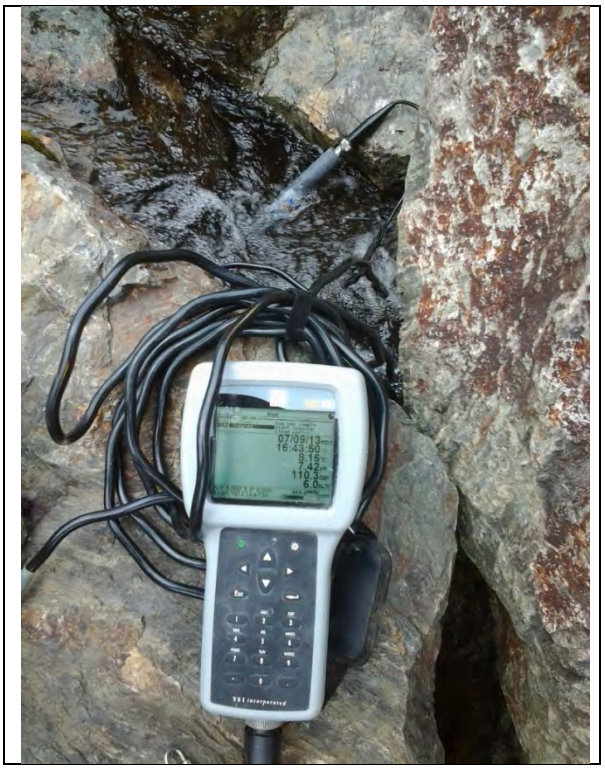
Photograph 73: Dye test – Injection Point 1 approximatley 30 minutes after injection 20130708 12h19m.jpg

Photograph 74: Dye test– Monitoring Point 1 before test 20130708 12h04m.jpg

Photograph 75: Dye test – View looking upstream from NF2 with dye flowing from Monitoring Point 3 20130708 13h13m.jpg

Photograph 76: Dye test – Looking downstream at Monitoring Point #1 with dye flowing from Monitoring Point #2 20130709 12h31m.jpg

Photograph 77: Dye Test – Injecting dye at Injection Point 2 20130709 16h02m.jpg



Photograph 78: Dye test – Start of dye detection at Monitoring Point 2 20130709 16h52m.jpg

Photograph 79: Dye Test – Visible dye at Monitoring Point 2 at approximately peak concentration_20130709 17h02m.jpg

Photograph 80: Dye test – Injection Point 1 before test 20130911 12h49m.jpg

Photograph 81: Dye test – Monitoring Point 3 before test 20130911 13h49m.jpg

Photograph 82: Dye Test – Injection Point 2 before injection 20130912 15h29m.jpg

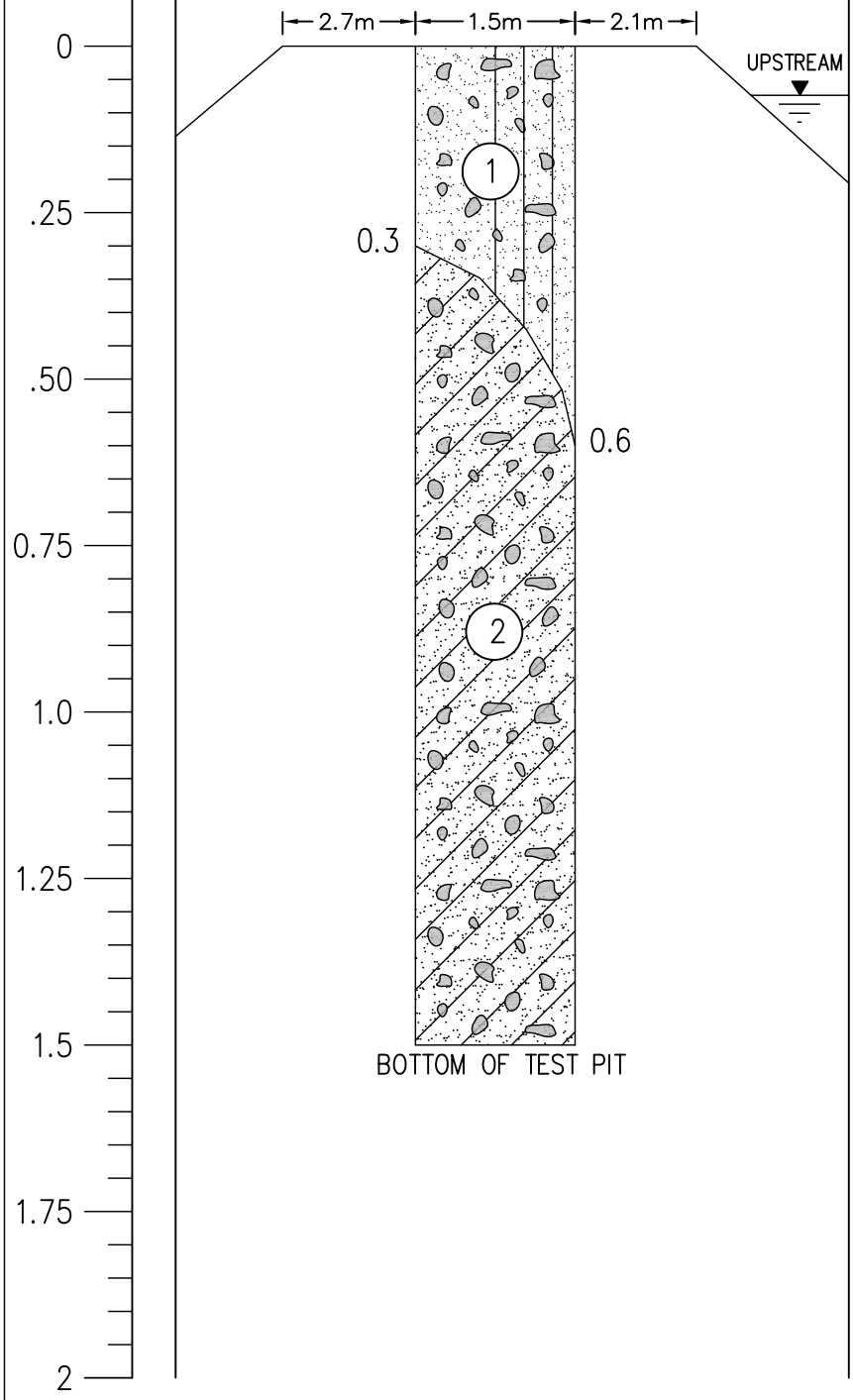
Photograph 83: Dye test – Injection Point 2 after injection 20130912 15h28m.jpg

Appendix C
Intermediate Dam Pond Test Pits

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13–201–TP001	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Faro Mine Complex 2013 Fieldwork
LOCATION: Intermediate Pond Dam and Spillway
APPROX. ELEVATION: 1049 meters
EXCAVATION CONTRACTOR: TEES
EXCAVATION EQUIPMENT: CAT 345C Excavator
DATE EXCAVATED: July 29, 2013
WATER LEVELS: None Encountered
LENGTH: ~4 meters
WIDTH: 1.5 meters
DEPTH: 1.5 meters



SOIL DESCRIPTION

(1) **Well-graded Gravel with Silt and Sand and Cobbles (GW-GM)s:** brown, moist, estimated medium dense, non-plastic, subangular gravel, 10% to 15% silt, maximum particle size 51cm

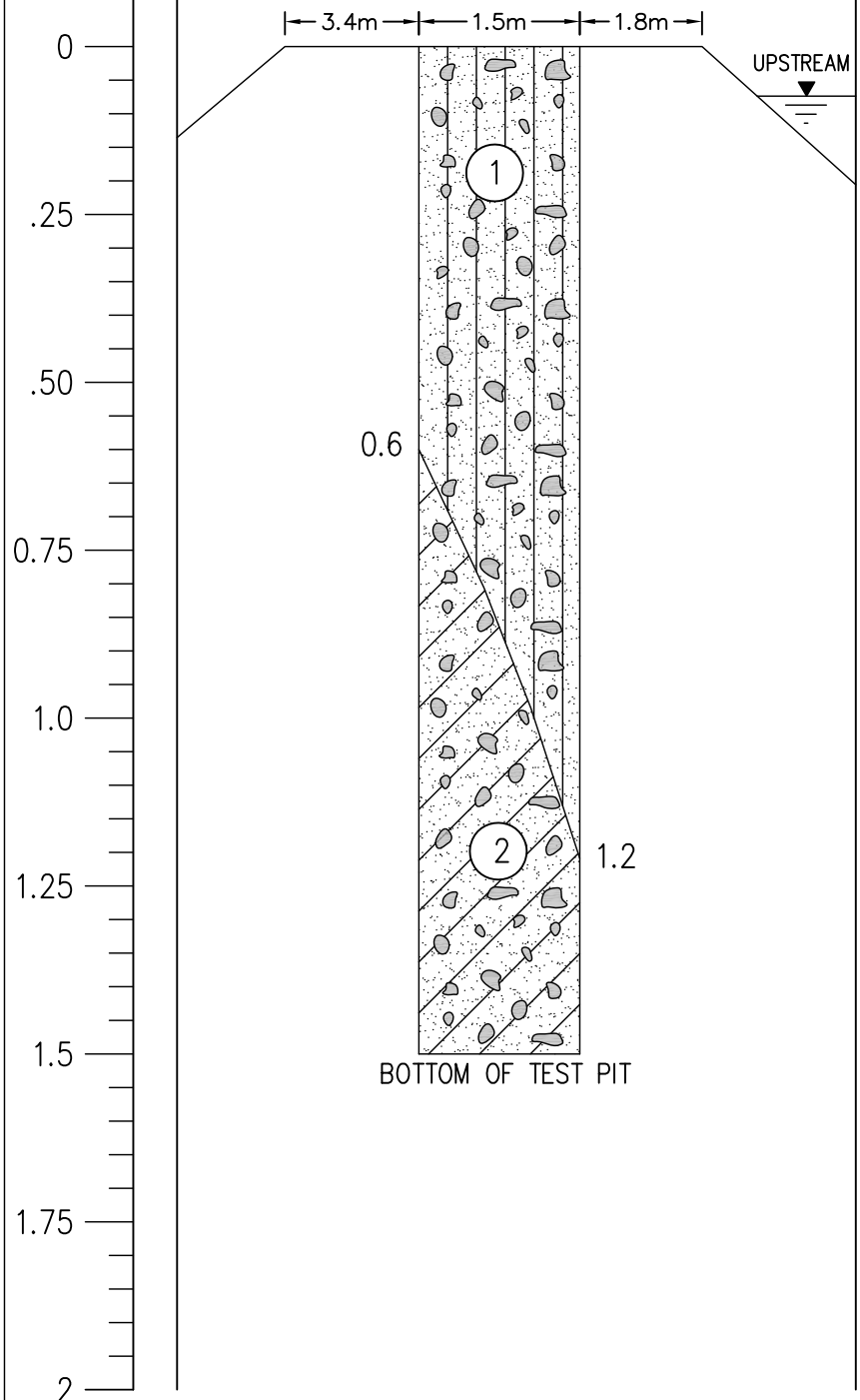
(2) (Dam Core Material)

Silty/Clayey Sand with Gravel and Cobbles (SC-SM)g: grayish brown, moist, estimated medium dense, low plasticity, subrounded to subangular gravel and cobbles, 20% clay and silt, 35% gravel/cobbles, 45% sand, maximum particle size 30cm, moisture is below plastic limit.

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13–201–TP002	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Faro Mine Complex 2013 Fieldwork
LOCATION: Intermediate Pond Dam and Spillway
APPROX. ELEVATION: 1049 meters
EXCAVATION CONTRACTOR: TEES
EXCAVATION EQUIPMENT: CAT 345C Excavator
DATE EXCAVATED: July 29, 2013
WATER LEVELS: None Encountered
LENGTH: ~4 meters
WIDTH: 1.5 meters
DEPTH: 1.5 meters



SOIL DESCRIPTION

(1) **Silty Gravel with Sand and Cobbles (GM)s:** brown, moist, estimated medium dense, non-plastic, subangular gravel, 15% silt, 45% gravel, 40% sand, maximum particle size 15cm

(2) (Dam Core Material)

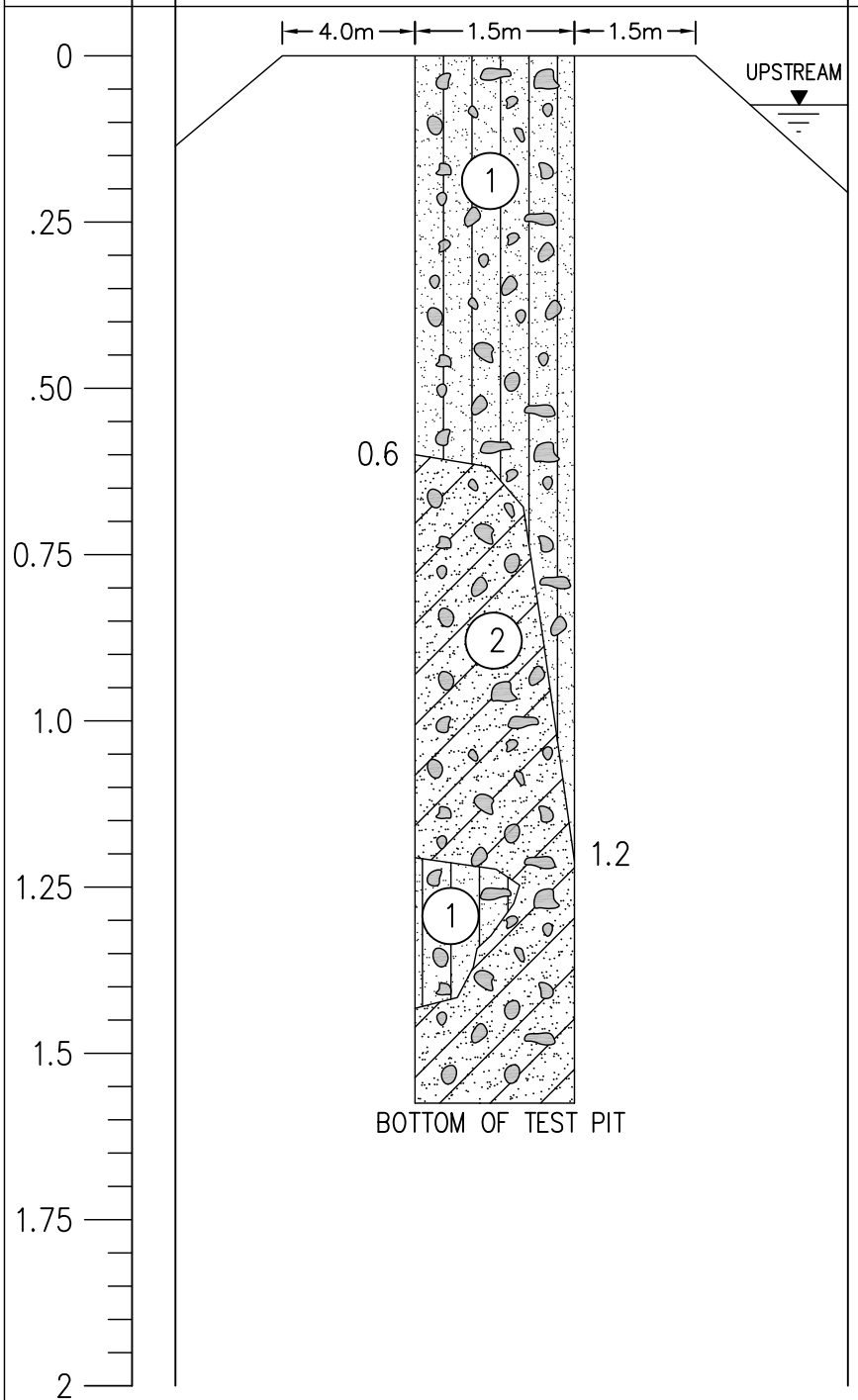
Silty/Clayey Gravel with Sand and Cobbles (GC-GM)s: grayish brown, moist, estimated dense, low plasticity, subrounded to subangular gravel and cobbles, 15% to 20% clay and silt, 40% to 45% gravel/cobbles, 40% to 45% sand, maximum particle size 25cm, moisture is below plastic limit.

CH2MHILL

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13–201–TP003	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Faro Mine Complex 2013 Fieldwork
LOCATION: Intermediate Pond Dam and Spillway
APPROX. ELEVATION: 1049 meters
EXCAVATION CONTRACTOR: TEES
EXCAVATION EQUIPMENT: CAT 345C Excavator
DATE EXCAVATED: July 29, 2013
WATER LEVELS: None Encountered
LENGTH: ~4 meters
WIDTH: 1.5 meters
DEPTH: 1.65 meters



SOIL DESCRIPTION

(1) **Silty Gravel with Sand and Cobbles (GM)s:** brown, moist, estimated medium dense, non-plastic, subangular gravel, 10% to 15% silt, 45% gravel, 40% sand, maximum particle size 23cm

Note: The boundary between materials is indefinite, appears to be mixing zone. Layers and zones of Silty Gravel observed within dam core material.

(2) (Dam Core Material)

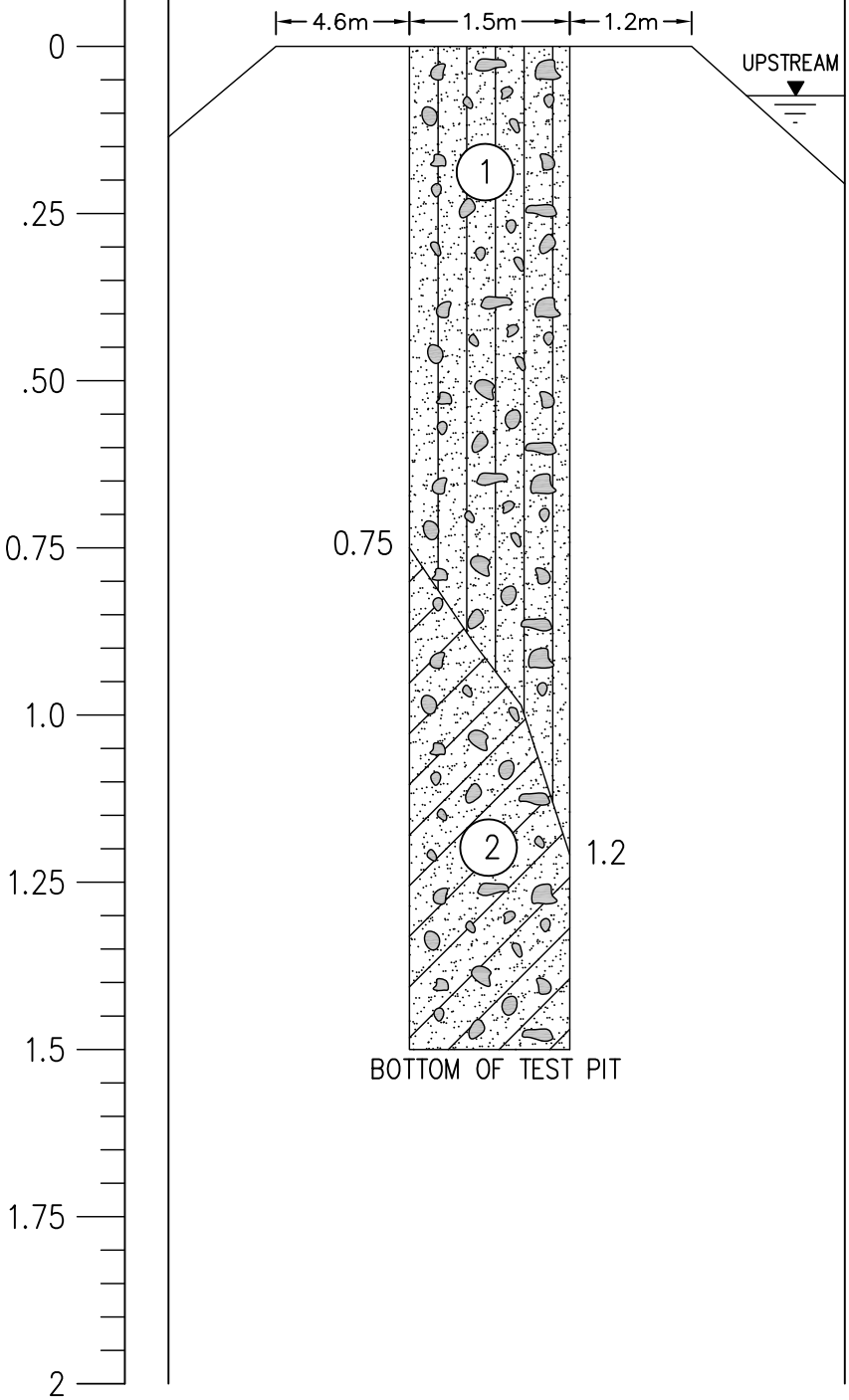
Silty/Clayey Sand with Gravel and Cobbles (SC-SM)g: grayish brown, moist, estimated medium dense, low plasticity, surounded to subangular gravel and cobbles, 20% to 25% clay and silt, 35% gravel/cobbles, 40% to 45% sand, moisture is below plastic limit.

CH2MHILL

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13–201–TP004	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Faro Mine Complex 2013 Fieldwork
LOCATION: Intermediate Pond Dam and Spillway
APPROX. ELEVATION: 1049 meters
EXCAVATION CONTRACTOR: TEES
EXCAVATION EQUIPMENT: CAT 345C Excavator
DATE EXCAVATED: July 29, 2013
WATER LEVELS: None Encountered
LENGTH: ~4 meters
WIDTH: 1.5 meters
DEPTH: 1.5 meters



SOIL DESCRIPTION

(1) **Silty Sand with Gravel and Cobbles (SM)g:** brown, moist, estimated medium dense, non-plastic, subrounded to subangular gravel, 15% silt, 40% gravel, 45% sand, maximum particle size 30cm

(2) (Dam Core Material)

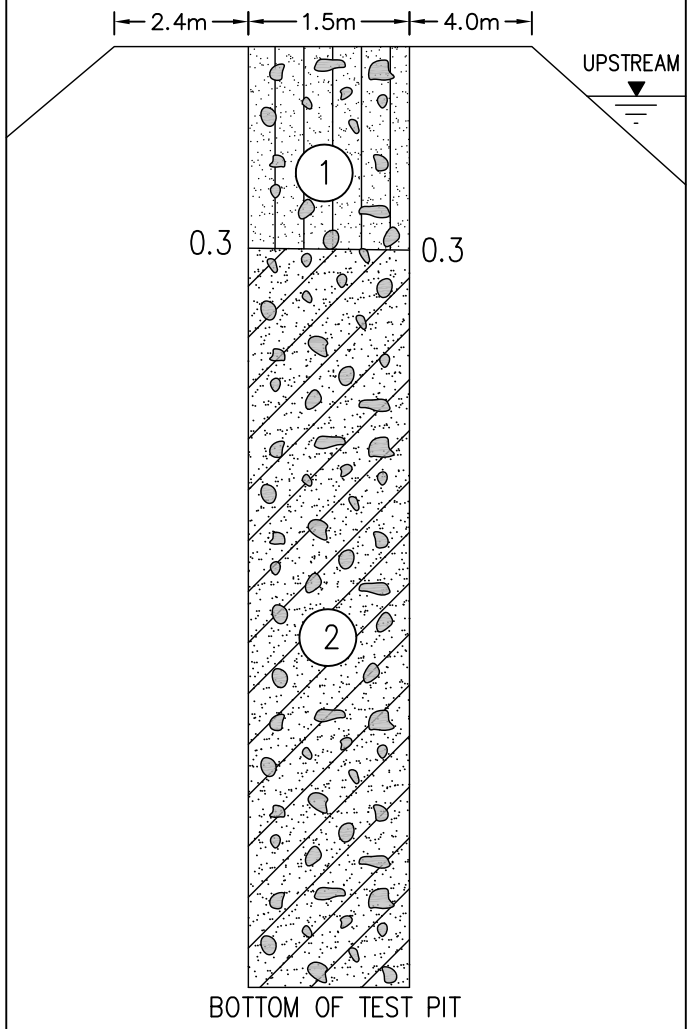
Silty/Clayey Sand with Gravel and Cobbles (SC-SM)g: grayish brown, moist, estimated dense, low plasticity, surounded to subangular gravel and cobbles, 20% to 25% clay and silt, 35% gravel/cobbles, 40% to 45% sand, maximum particle size 60cm, moisture is below plastic limit.

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13–201–TP005	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Faro Mine Complex 2013 Fieldwork
LOCATION: Intermediate Pond Dam and Spillway
APPROX. ELEVATION: 1049 meters
EXCAVATION CONTRACTOR: TEES
EXCAVATION EQUIPMENT: CAT 345C Excavator
DATE EXCAVATED: July 29, 2013
WATER LEVELS: None Encountered
LENGTH: ~4 meters
WIDTH: 1.5 meters
DEPTH: 1.4 meters

DEPTH (m) | SAMPLES | GRAPHIC LOG (HORIZONTAL NOT TO SCALE) | SOIL DESCRIPTION



0
.25
.50
0.75
1.0
1.25
1.5
1.75
2

(1) **Silty Gravel with Sand and Cobbles (GM)s:** brown, moist, estimated medium dense, non-plastic, subangular gravel, 15% silt, 45% gravel, 40% to 45% sand, maximum particle size 23cm

(2) (Dam Core Material)

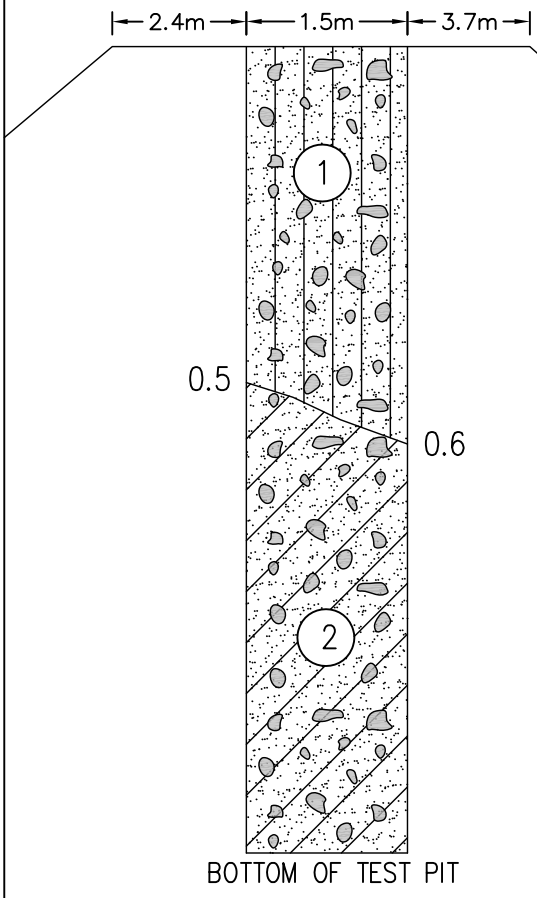
Silty/Clayey Sand with Gravel and Cobbles (SC-SM)g: grayish brown, moist, estimated dense, low plasticity, subangular gravel and cobbles, 20% to 25% clay and silt, 35% gravel/cobbles, 45% sand, maximum particle size 20cm, moisture is below plastic limit, high dry strength

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13–201–TP006	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Faro Mine Complex 2013 Fieldwork
LOCATION: Intermediate Pond Dam and Spillway
APPROX. ELEVATION: 1049 meters
EXCAVATION CONTRACTOR: TEES
EXCAVATION EQUIPMENT: CAT 345C Excavator
DATE EXCAVATED: July 29, 2013
WATER LEVELS: None Encountered
LENGTH: ~4 meters
WIDTH: 1.5 meters
DEPTH: 1.2 meters

DEPTH (m) | SAMPLES | GRAPHIC LOG (HORIZONTAL NOT TO SCALE) | SOIL DESCRIPTION



0
.25
.50
0.75
1.0
1.25
1.5
1.75
2

(1) **Silty Sand with Gravel (SM)g:** brown, moist, estimated medium dense, non-plastic, subangular gravel, 15% silt, 45% sand, 40% gravel, maximum particle size 20cm, more gravel content on upstream side of trench

(2) (Dam Core Material)

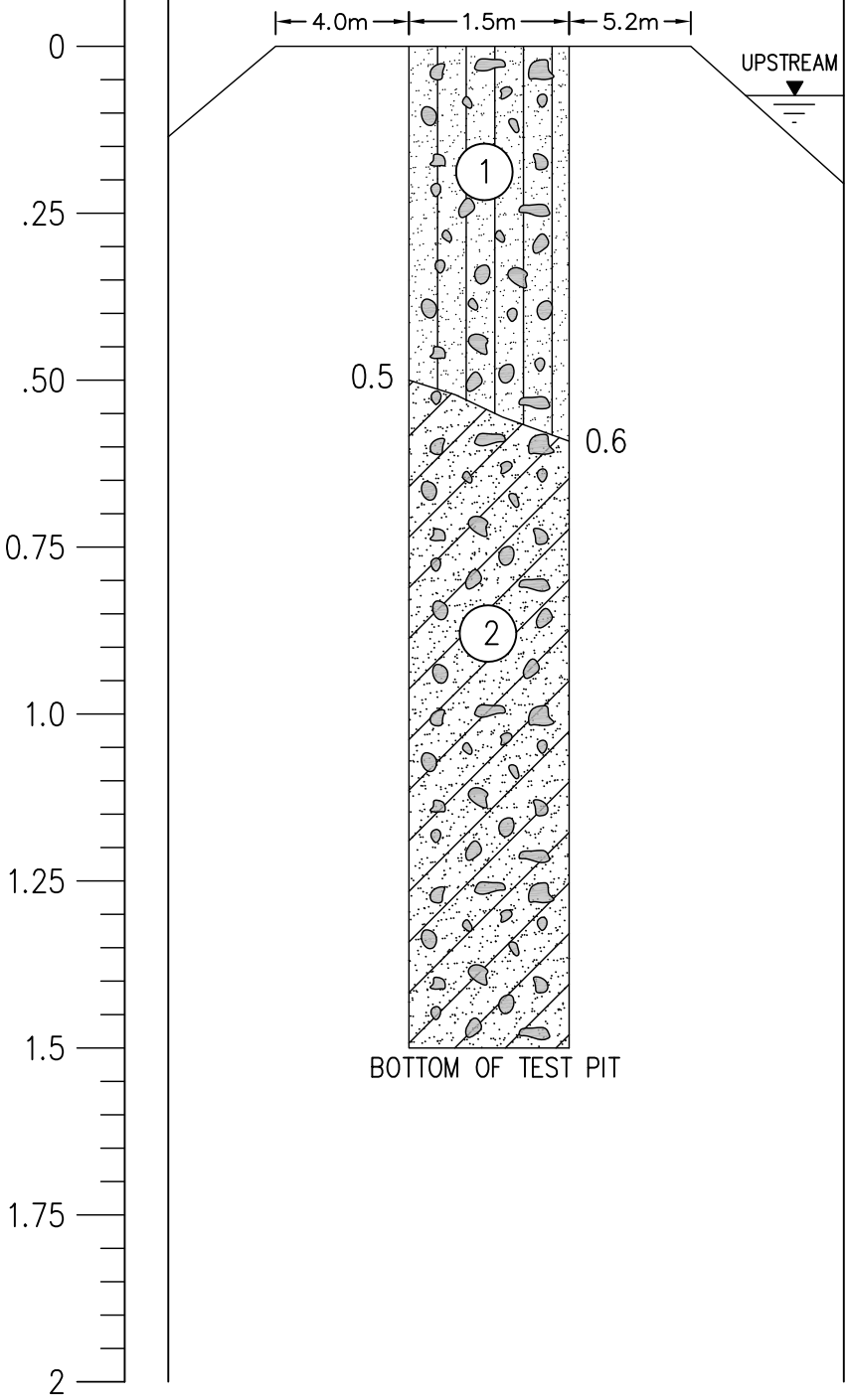
Clayey Sand with Gravel and Cobbles (SC)g: grayish brown, moist, estimated dense, low to medium plasticity, surounded to subangular gravel and cobbles, 20% to 25% clay and silt, 30% gravel/cobbles, 50% sand, maximum particle size 30cm, moisture is below plastic limit, high dry strength

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13–201–TP007	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Faro Mine Complex 2013 Fieldwork
LOCATION: Intermediate Pond Dam and Spillway
APPROX. ELEVATION: 1049 meters
EXCAVATION CONTRACTOR: TEES
EXCAVATION EQUIPMENT: CAT 345C Excavator
DATE EXCAVATED: July 29, 2013
WATER LEVELS: None Encountered
LENGTH: ~4 meters
WIDTH: 1.5 meters
DEPTH: 1.5 meters

DEPTH (m) | SAMPLES | GRAPHIC LOG (HORIZONTAL NOT TO SCALE) | SOIL DESCRIPTION



(1) **Silty Gravel with Sand and Cobbles (GM)s:** brown, moist, estimated dense, non-plastic, subangular gravel, 15% silt, 30% sand, 55% gravel, maximum particle size 10 cm

(2) (Dam Core Material)

Clayey Sand with Gravel and Cobbles (SC)g: grayish brown, moist, estimated dense, medium plasticity, subangular gravel and cobbles with some angular, 25% clay and silt, 25% to 30% gravel/cobbles, 45% to 50% sand, maximum particle size 20cm, moisture is below plastic limit.

CH2MHILL

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13-201-TP-008	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Intermediate Pond Dam and Spillway
LOCATION: Spillway
APPROXIMATE ELEVATION: 1045.00 m (NAVD88)
EXCAVATION CONTRACTOR: TEES
EXCAVATION EQUIPMENT: CAT 345C, 48" bucket
DATE EXCAVATED: 7/29/2013
LOGGER: M. Twede
WATER LEVELS: ---
LENGTH: 4m
WIDTH: 1.5m
DEPTH: 2.7 m

DEPTH BELOW SURFACE	SAMPLE TYPE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	COMMENTS: OBJECTS, DEBRIS, ROOTS, ETC.
		Fill/Alluvium **Well-graded Gravel and Cobbles with Sand (GW)s:** brown, moist, estimated loose, non-plastic, subangular and subrounded, maximum particle size 36cm, 35% to 40% cobbles, 30% Sand, 30% gravel		thin layer of dry silt at ground surface
1		**Alluvium** **Well-graded Sand with Gravel and Cobbles (SW)g:** brown, moist, estimated loose to medium dense, non-plastic, subangular, maximum particle size 25cm, 7% cobbles, 50% Sand, 35% gravel, 5% silt		
2				
		Bottom of Hole at 2.70 m below ground surface 7/29/2013		No Free Water Encountered
3				

CH2MHILL

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13-201-TP-009	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Intermediate Pond Dam and Spillway | LOCATION: Spillway

APPROXIMATE ELEVATION: 1043.00 m (NAVD88) | EXCAVATION CONTRACTOR: TEES

EXCAVATION EQUIPMENT: CAT 345C, 48" bucket | DATE EXCAVATED: 7/30/2013 | LOGGER: M. Twede

WATER LEVELS: --- | LENGTH: 4m | WIDTH: 1.5m | DEPTH: 2.1 m

DEPTH BELOW SURFACE	SAMPLE TYPE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	COMMENTS: OBJECTS, DEBRIS, ROOTS, ETC.
		Fill/Alluvium **Well-graded Gravel and Cobbles with Sand (GW)s:** brown, moist, estimated loose, non-plastic, subangular and subrounded, maximum particle size 36cm, 50% cobbles, 25% Sand, 20% gravel, 5% silt		
1		**Alluvium** **Poorly-graded Sand (SP):** brown, moist, medium grained sand, non-plastic, 90% Sand, 10% silt		
		Alluvium **Well-graded Sand with Gravel (SW)g:** brown, moist, estimated medium dense, non-plastic, subangular, 60% Sand, 35% gravel, 5% silt		
2				No Free Water Encountered
		Bottom of Hole at 2.10 m below ground surface 7/30/2013		
3				

CH2MHILL

PROJECT NUMBER:	TEST PIT NUMBER:	
472645.07.DV.FI.01	CH13-201-TP-010	SHEET 1 OF 1

TEST PIT LOG

PROJECT: Intermediate Pond Dam and Spillway | LOCATION: Spillway

APPROXIMATE ELEVATION: 1041.00 m (NAVD88) | EXCAVATION CONTRACTOR: TEES

EXCAVATION EQUIPMENT: CAT 345C, 48" bucket | DATE EXCAVATED: 7/30/2013 | LOGGER: M. Twede

WATER LEVELS: --- | LENGTH: 4m | WIDTH: 1.5m | DEPTH: 2.1 m

DEPTH BELOW SURFACE	SAMPLE TYPE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	COMMENTS: OBJECTS, DEBRIS, ROOTS, ETC.
		Fill/Alluvium **Well-graded Gravel and Cobbles with Sand (GW)s:** brown, moist, estimated loose, non-plastic, subangular and subrounded, maximum particle size 61cm, 50% cobbles, 25% Sand, 25% gravel		
1		**Alluvium** **Silty, Clayey Sand with Gravel and Cobbles (SC-SM)g:** grayish brown, moist, low plasticity, subangular and subrounded		
2				No Free Water Encountered
		Bottom of Hole at 2.10 m below ground surface 7/30/2013		
3				

Appendix D
Geophysical Survey – Rose Creek Diversion

Geophysical Survey – Faro Mine Remediation – Rose Creek Rock Drain - RCD

NTS: 105K/06, Whitehorse Mining District, Yukon Territory, Canada

WORK PERFORMED:
July 7-August 18, 2013

Prepared for:
CH2MHILL

Prepared by:

AURORA GEOSCIENCES

TECHNICAL REPORT
Geophysical Survey – Faro Mine Remediation – Rose Creek Rock Drain - RCD

Prepared for:
CH2M Hill Canada Limited
Whitehorse, YT Y1A 4N2

Prepared by:
Aurora Geosciences Ltd.
34A Laberge Road, Whitehorse, Yukon, Y1A5Y9
Phone: (867) 668.7672 Fax: (867) 393.3577
www.aurorageosciences.com

Author
Phil Jackson, P.Geoph.

TABLE OF CONTENTS

1 SUMMARY 1

2 INTRODUCTION 2

3 LOCATION & ACCESS 2

4 WORK PROGRAM 2

4.1 LINE CUTTING & GRIDDING 2
4.1.1 Equipment 4
4.1.2 Field Procedures 4
4.1.3 Products 4
4.2 SHORT DIPOLE RESISTIVITY SURVEY 5
4.2.1 Equipment 5
4.2.2 Field Procedures 5
4.2.3 Data processing and products 5
4.3 GROUND PENETRATING RADAR (GPR) SURVEY 6
4.3.1 Equipment 7
4.3.2 Field Procedures 7
4.3.3 Data processing and products 8
4.4 SEISMIC REFRACTION SURVEY 9
4.4.1 Equipment 9
4.4.2 Survey specifications 9
4.4.3 Data processing 10
4.4.4 Inversion results & products 12
4.5 SEISMIC REFLECTION SURVEY 15
4.5.1 Survey specifications 15
4.5.2 Data processing 16
4.5.3 Inversion results & products 18

5 DISCUSSION AND INTERPRETATION 19

LIST OF FIGURES

FIGURE 1. SURVEY LOCATION MAP 3
FIGURE 2. RCD-2 INVERSION CONVERGENCE 12
FIGURE 3. RCD-3 INVERSION CONVERGENCE 13
FIGURE 4. RCD-4 INVERSION CONVERGENCE 14
FIGURE 5. RCD-5 INVERSION CONVERGENCE 14
FIGURE 6. RCD-1 COMPOSITE SECTION 22
FIGURE 7. RCD-2 COMPOSITE SECTION 23
FIGURE 8. RCD-3 COMPOSITE SECTION 24
FIGURE 9. RCD-4 COMPOSITE SECTION 25
FIGURE 10. RCD-5 COMPOSITE SECTION 26

LIST OF TABLES

TABLE 1. SEISMIC LINE ORIGINS 10

LIST OF APPENDICES

APPENDIX I.....PROJECT LOG
APPENDIX II.....RESISTIVITY INVERSIONS
APPENDIX III..... GPR RADARGRAMS
APPENDIX IV .....SEISMIC REFRACTION SECTIONS
APPENDIX V ..... SEISMIC REFLECTION SECTIONS

1 SUMMARY

The geophysical investigations at the Rose Creek Rock Drain, located approximately 15 kilometers North of Faro, are a portion of a larger project at the Faro Mine, Faro, Yukon Territory. The purpose of the investigations at the Rose Creek Rock Drain was to assist in the design of environmental mitigation measures by estimating the thickness of weathered bedrock above competent bedrock, distinguish layers of high and low relative permeability, and to identify the depth from surface to the underlying competent bedrock contact along five survey lines.

This report describes procedures and results of line cutting, short dipole resistivity, ground penetrating radar (GPR), seismic reflection and seismic refraction surveys conducted in the area between July 9th and August 16th, 2013.

Linecutting was required on all of the survey lines. Non-differential GPS waypoints were recorded at 50 meter stations. Topography was measured along the line using a laser range finder.

The short-dipole resistivity survey consists of an all-in-one multimode resistivity imaging system using multi-core cables. 72 electrodes are plugged into the ground at fixed 5 meter spacing rolling forward by increments of 24 dipoles (where applicable). Longer dipole spacing sequences were used beyond n=10 where ground conditions produced unacceptable noise levels. Final data sets were compiled and inverted using RES2DINV Geotomo software.

The multi frequency GPR survey was conducted with a Mala geosciences RAMAC GPR system operated at 25, 50, 100 and 500 MHz. Conventional GPR data processing was applied incorporating geometric registration, drift corrections, user gain, deconvolution, velocity analysis, and depth conversion.

The seismic refraction and reflection surveys were conducted with a 48 channel digital engineering seismograph using a 4 meter phone spacing and an ATV mounted hammer digipulse as the energy source. The data was processed and interpreted primarily using the Pickwin™ and PlotRefa™ software packages. Refraction processing included initial data checks, topographic data reduction, first break picking, composite shot file assembly and inversion. Reflection processing included initial data checks, topographic data reductions, data import, registration and trimming, shot stack assembly, trace kills, band pass filters, gain, bottom mute, velocity analysis, normal move out correction, time depth conversion, static shifts and interpretation.

In general, the resistivity data imaged shallow zones of permeability on all lines. The GPR survey showed distinct zones of signal character changes which correlate well with permeability, however only shallow discontinuous reflectors are seen on the majority of the radargrams. The seismic refraction inversions provide the most useful tool in interpreting depths to the water table as well as weathered and fresh bedrock contacts. All final interpreted depths are shown superimposed on contoured seismic velocities and gridded resistivity to create composite sections for each survey line. Select locations along the survey lines should be drill tested at to verify and refine the interpretations included in this report.

2 INTRODUCTION

Aurora Geosciences Ltd. was retained by CH2M Hill Canada Limited to conduct line cutting, Ground Penetrating Radar (GPR), seismic refraction and seismic refraction surveys. The surveys at the Rose Creek Rock Drain (RCD) are a portion of a larger 2013 geophysical project at the Faro Mine, Faro, Yukon Territory, which included five separate areas:

- Cross Valley Dam (CVD)
- DVIHU (Down Valley / Rock Drain) Assessment (RCD)
- Borrow Search Investigations at Granitic Rock Outcrop
- Grum Waste Rock (WR) Quarry
- New Vangorda Creek Diversion (VCD)

The purpose of the investigations at the Rose Creek Rock Drain was to assist in the design of environmental mitigation measures by estimating the thickness of weathered bedrock above competent bedrock, distinguish layers of high and low relative permeability, and to identify the depth from surface to the underlying competent bedrock contact along the length of five survey lines. Based on previous investigations, the local stratigraphy consists of a layer of glacial till and or alluvium overburden overlying weathered phyllite and schist. Permafrost is mapped on the north slope of the valley walls. The depth to competent bedrock is predicted to be in the range of 10 to 50 meters. All geographic locations in this report are relative to North American Datum 1983. Non-geodetic coordinates are expressed in Universal Transverse Mercator Zone 8N metric coordinates. All measurements are expressed in the metric system unless they are measurements quoted from historic reports expressed in other units of measure. All geophysical data units are in the metric SI system.

3 LOCATION & ACCESS

The geophysics crew was based in the town of Faro, YT for the duration of the project with all areas accessible by truck. The Rose Creek Rock Drain is approximately 15 kilometers north of Faro; a detailed map of the surveyed lines is shown in Figure 1.

4 WORK PROGRAM

This section describes the work program conducted at Rose Creek Rock Drain in 2013. Line cutting, short-dipole resistivity, Ground Penetrating Radar (GPR), seismic reflection and seismic refraction surveys were conducted on five survey lines. Appendix I contains a project log.

4.1 Line cutting & gridding

Line cutting and grid installation were conducted on the property to facilitate accurate location control for the geophysical surveys.

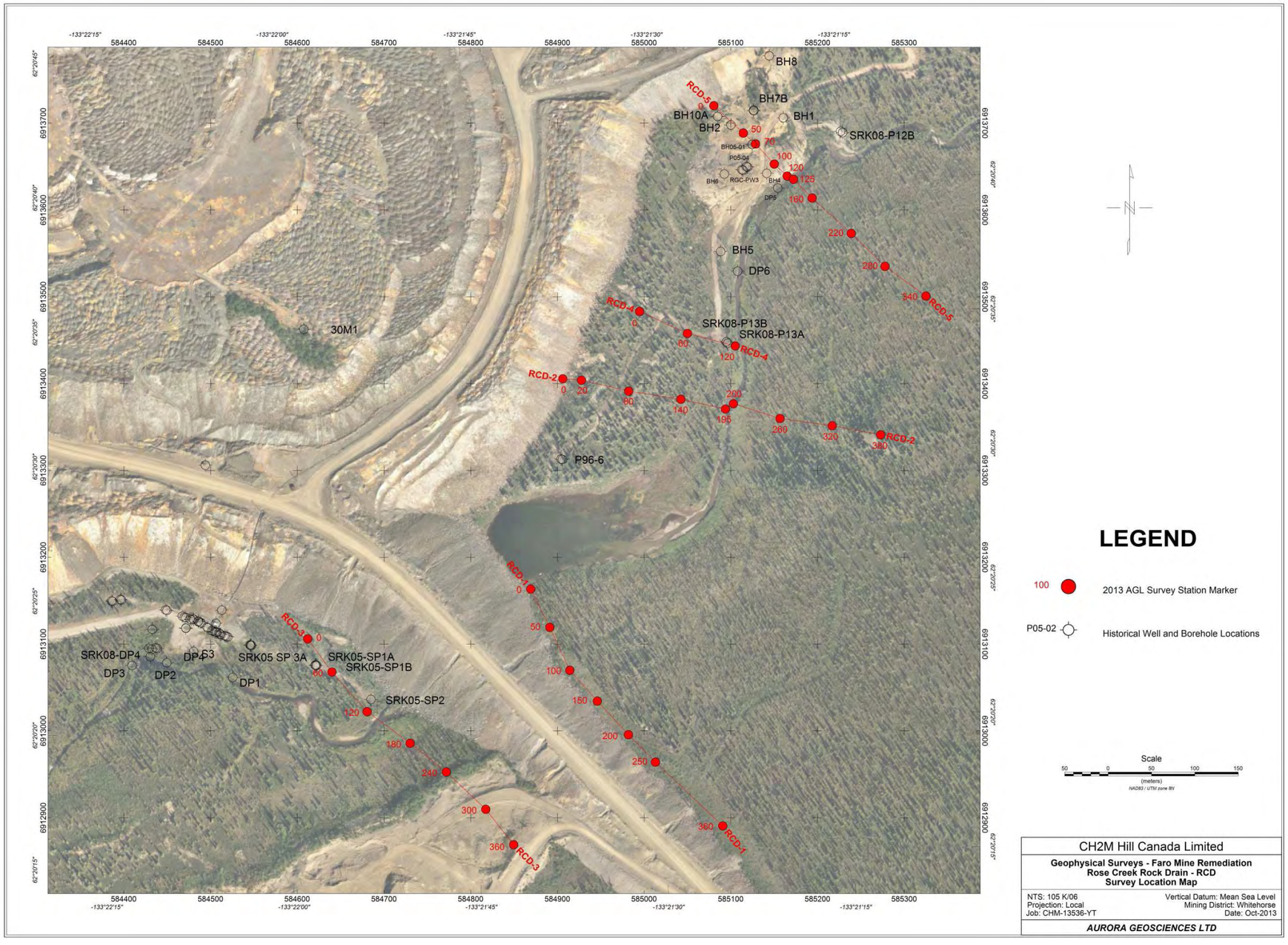


Figure 1. Survey Location Map

4.1.1 Equipment

The crew was equipped with the following instruments and equipment:

Equipment:	2 – Husqvarna 245 saws 2 – Sets brushing / chaining equipment 1 – Laser range finder
Communications:	1 – Satellite phone 2 – VHF radios
Vehicles:	1 – 1Ton truck 2 – Polaris ATV
Safety:	2 – Each of PPE including hard hat, safety glasses, steel-toed boots, hearing protection, long sleeved shirts, hip chaps (line cutting), hard hat with visor (line cutting), gloves, reflective vest and work pants as required by health and safety plans 1 – Each of fire extinguisher, first aid kit and potable water
Other:	3 – GPS receivers 1 - Laptop & color printer w/ Geosoft 1 - Field office equipment 1 - Repairs & tool kit 5 KV gas generator

4.1.2 Field Procedures

Line cutting was conducted according to the following specifications:

Station spacing:	50 meters
Chainage:	Stations: straight chained
Station marking:	Survey lines: Half-length pickets with metal tags
Registration:	Non-differential GPS measurements recorded at 50 m intervals. Horizontal and vertical distances measured between stations with a laser range finder

4.1.3 Products

Digital data included with this report comprises:

GPS measurements – station location	Topography\RCD GPS Waypoints.xls
Final data – laser range finder measurements	Topography\RCD Topography.xls

The survey grid is plotted on the location map shown in Figure 1.

4.2 Short-Dipole Resistivity Survey

A short-dipole resistivity survey was conducted on RCD on July 10th and 13th, 2013. The purpose of the survey was to identify zones of permeability along the five survey lines.

4.2.1 Equipment

The crew was equipped with the following instruments and equipment:

Instruments & Equipment	Syscal Pro Resistivity & IP System 72 including transmitter, receiver, switch, cables, battery and software
Communications:	1 – Satellite phone 2 – VHF radios
Vehicles:	1 – 1Ton truck 2 – Polaris ATV
Safety:	2 – Each of PPE including hard hat, safety glasses, steel-toed boots, hearing protection, long sleeved shirts, gloves, reflective vest and work pants as required by health and safety plans 1 – Each of fire extinguisher, first aid kit and potable water
Other:	3 – GPS receivers 1 - Laptop & color printer w/ Geosoft 1 - Field office equipment 1 - Repairs & tool kit 5 KV gas generator

4.2.2 Field Procedures

The resistivity survey consists of an all-in-one multimode resistivity imaging system using multi-core cables. 72 electrodes are plugged into the ground at fixed 5 meter spacing rolling forward by increments of 24 dipoles (where applicable). Longer dipole spacing sequences were used beyond n=10 where ground conditions produced unacceptable noise levels.

Resistivity surveying was conducted according to the following specifications and procedures:

Array:	dipole - dipole
Dipole Spacing:	5m (n= 1-10), 15m (n=10-20) & 30m (n=20-32)
Separations Read:	n = 1 to 32 (maximum)
Tx mode / signal:	Standard time domain signal(0.5 s +on, 0.5 s off)
Parameters Read:	Contact Resistance Primary voltage Spontaneous Potential

4.2.3 Data processing and products

The resistivity survey data is processed and interpreted using the following procedures:

1. Download & archive: Data is downloaded from the field instruments and raw data files are archived.

2. Data review: The resistivity data is reviewed and edited prior to preparing pseudosections and datasets for inversion. Duplicate readings are averaged and duplicates removed from the database to leave only a single reading at each station and separation. Readings with large errors which did not repeat within 10% are deleted from the database.

3. Pseudosection plotting: Pseudosections of the apparent resistivity are prepared from the final edited data. Sections are scaled to the range on each line.

4. Data formatting: The resistivity (in normalized V/I) and topographic data are formatted for entry into the RES2DINV inversion program.

5. Image extraction: After the modelling was complete, data ranges are compiled and overall data scales are assigned for the resistivity model. A resistivity scale covering the range from 0 to 3000 ohm-m is used as a standard scale for all resistivity models in the composite sections. Final images are generated with the inversion software and converted to JPEGs without further editing.

Final digital data is appended to this report in Excel spreadsheet format. All rogue readings,those with unacceptable errors, and those which did not repeat are deleted from this final data set. Also included are GPS position measurements taken along the survey lines. These show the averaged location of the survey point in UTM coordinates, NAD 1983 datum, Zone 7N projection. This data is contained in an ASCII text file (GPS Points.txt).
The inversion results are collated in Appendix II. These images show the observed data, the model generated response for comparison and the 2D resistivity distribution in the final model

Digital data included with this report comprises:

Final Quality controlled databases	Resistivity\"LINE"\Final data\"Line" Res Final.xls &.gdb
Raw Data	Resistivity\"LINE"\Raw data*.bin
Inversion results	Resistivity\"LINE"\Res2D Inversion*.*

Appendix II contains final inversion images.

4.3 Ground Penetrating Radar (GPR) Survey

A Ground Penetrating Radar (GPR) survey was conducted on the RCD lines between July 14th and August 8th, 2013. The purpose of the survey was to estimate the thickness of weathered bedrock above the competent bedrock, distinguish layers of high and low relative permeability, and to identify the depth from surface to the underlying competent bedrock contact along the five survey lines.

4.3.1 Equipment

The crew was equipped with the following instruments and equipment:

Instruments & Equipment	1 – Ramac GPR Pro Ex Controller 1 – Ramac Pro Ex Optical Module 1 – Control Unit II (CUII) 1 – 25, 50, 100 MHz Rough Terrain & 500MHz shielded Antenna 1 – Monitor Rad Explorer Software
Communications:	1 – Satellite phone 2 – VHF radios
Vehicles:	1 – 1Ton truck 2 – Polaris ATV
Safety:	2 – Each of PPE including hard hat, safety glasses, steel-toed boots, hearing protection, long sleeved shirts, gloves, reflective vest and work pants as required by health and safety plans 1 – Each of fire extinguisher, first aid kit and potable water
Other:	3 – GPS receivers 1 - Laptop & color printer w/ Geosoft 1 - Field office equipment 1 - Repairs & tool kit 5 KV gas generator

4.3.2 Field Procedures

The GPR system is normally worn and operated by a single operator for high frequency surveys, or is carried and guided by several operators with the controller being either worn or towed. The transmitter and receiver electronics are mounted on their respective antennas and linked via fibre optic cables to the controller unit. Both the transmitter and receiver are controlled by the RAMAC monitor running interface software which configures the system, stores the collected data and allows the operator to view the radargrams in real time.

The line, read with successive passes for each individual frequency, was completed as a profile survey. The Rough Terrain Antenna (RTA) are oriented in-line with the survey direction and spaced a fixed distance apart. The survey is conducted by moving the antenna pair along the line. The data is then plotted using radargrams which show the centre of the antennas (x) on the horizontal axis and the signal on the y-axis as a function of time (t), with arrival time increasing vertically downward. The reflections appear at various distances below the time zero line at the top of the radargram. These distances below the time zero line are proportional to the arrival times which in turn are roughly proportional to the depth to target. Thus, the reflections display a pattern which generally correlates with their subsurface location. During data processing, the arrival times may be converted to depths and the reflections are then displayed at the apparent depths of the sources. Reflections are displayed as grey shade plots.

GPR surveying was conducted according to the following specifications and procedures:

Centre Frequency:	25, 50 & 100 MHz
Measurement Interval:	10cm (maximum), determined by operating frequency.

Antenna Separation:	4m (25 MHz), 2m (50MHz), 1m (100MHz)
Triggering:	Time: 0.75s (25MHz), 0.5s (50MHz) and 0.25s (100MHz) and 0.1s (500MHz)
Station Registration:	The apparent horizontal distance at which each surveyed control line picket was encountered was recorded manually and used in the data processing to register the lines.

4.3.3 Data processing and products

The GPR survey data was processed and interpreted using the following procedures:

1. Download & archive: Data is downloaded from the field instruments and raw data files are archived.
2. Geometric registration: Trace coordinates are updated and interpolated to match recorded markers during data acquisition.
3. De-wow: Low frequency antenna to antenna reverberations are removed by cutting frequencies generally below ¼ of the centre frequency.
4. Trace kills: traces collected during static data collection time or outside survey markers are removed.
5. Drift removal and resetting of time zero: The time zero line on the radargrams is reset to the first arrival of the ground wave.
6. Gain: Compensation for damping losses is achieved by multiplication of linear, exponential and programmed gain functions where appropriate.
7. Deconvolution: Spiking deconvolution is applied to sharpen the reflections.
8. X-Flip: Applied to data acquired in opposite survey directions to achieve consistent viewing directions from west to east.
9. Depth conversion: using average ground velocity using measured diffraction hyperbolas
10. Printing: JPEG format showing the location of the line registration points and all picked reflectors.

The radargrams show the horizontal position along the x-axis in local station coordinates and both travel time and apparent depth along the y-axis. The radargrams have not been compensated for topography and are plotted with considerable vertical exaggeration. The reflections are plotted as alternating black (positive) and white (negative) bands. The first arrival - a triplet which is continuous across the section- is the ground wave between the antennas and not a feature of interest. Ringing is also present and is manifested by parallel bands of recurring reflections which tend to run across the section and obliterate any weaker reflections arriving in the same time window. The depth conversion was performed with a velocity of 0.11 m/ns for frozen ground and 0.06 m/ns in areas interpreted as thawed wet sediment. Velocities are selected based on a combination of diffraction hyperbola analysis and known borehole depths. In general, with the exception of RCD-1, reflections are flat lying and discontinuous an all radargrams. The survey is effective in delineating permafrost zones evident through distinct changes in echo characteristics. The reflectors are largely attributed to the base of permafrost. RCD1 shows a strong and distinct reflector over the whole of the line interpreted as a change in lithology. Differences

in the electrical properties of overlying material must be considered to interprete accurate depth estimates.

Digital data included with this report comprises:

Raw and Processed GPR field data	Digital Data\GPR\Data\"Line"_"Frequency"*.*

Appendix III contains processed radargrams for all surveyed frequencies.

4.4 Seismic Refraction Survey

A seismic refraction survey was conducted between July 18th and August 17th, 2013. The purpose of the survey was to estimate the thickness of weathered bedrock above the competent bedrock, distinguish layers of high and low relative permeability, and to identify the depth from surface to the underlying competent bedrock contact along the five survey lines.

4.4.1 Equipment

The crew was equipped with the following instruments and equipment:

Instruments & Equipment	2 – Geode G24 seismographs 2 – 24 channel cable with 5m takeouts 30 – Mark Products 40Hz vertical component geophones ATV mounted source, sledge hammer and plate
Communications:	1 – Satellite phone 2 – VHF radios
Vehicles:	1 – 1Ton truck 2 – Polaris ATV
Safety:	2 – Each of PPE including hard hat, safety glasses, steel-toed boots, hearing protection, long sleeved shirts, gloves, reflective vest and work pants as required by health and safety plans 1 – Each of fire extinguisher, first aid kit and potable water
Other:	3 – GPS receivers 1 - Laptop w/ Geosoft 1 - Field office equipment 1 - Repairs & tool kit 5 KV gas generator

4.4.2 Survey specifications

The refraction seismic survey was performed according to the following specifications:

Channels:	48

Receiver spacing:	4 m
Shot locations:	Offset shots – 60 m off each end of line (nominal) End of line shots – Phones 1 and 48 Mid-spread – Phone 24
Record length:	512 ms
Sampling:	62 µs
Source effort:	Digipulse: 10 blows Hammer: 15 blows

4.4.3 Data processing

The refraction seismic survey data is processed primarily using the ReflexW, Pickwin™ and PlotRefa™ software packages. The following procedures and methods are used and described in order below:

1. *Initial data checks.* The seismic refraction data is of acceptable quality overall with some shot records containing unacceptable data. Bad data included shot records with a few dead traces and some shot records with very poor signal strength in portions of a spread due to bad ground or intervening geological features between the shot and geophones. The initial data checks begin with checking each data file against the observer's field records to verify that the receiver and shot locations were correct. In cases where there is a discrepancy between the observer's record of the receiver locations and the receiver locations in the file header, the file header was corrected if it can be conclusively established that the discrepancy resulted from a simple keying error; otherwise the shot record is rejected. End of line and mid-spread shots are recorded within a spread with the shot point at a geophone location. Consequently, it is easy to verify the shot location from the shot record as the shot occurs at the geophone with the near zero time arrival. In some cases there were obvious discrepancies between the observer's records and the observed shot location. In this instance, the shot location as indicated by the shot record is used to correct the observer's records. In cases where there is ambiguity, the observer's records are considered correct.

2. *Topographic data reduction.* Topographic reduction consists of calculating the horizontal (line) coordinates and elevation of each shot and receiver relative to acquisition coordinates. The seismic surveys are conducted down line in the same direction as the posted station pickets and the nominal survey line coordinates. The origins of the seismic lines used in the acquisition and processing are summarized in the table below:

Table 1. Seismic line origins

Line	Station	X (m)	Z (m)	UTME	UTMN
RCD-1	0	0.00	103.68	584869	6913163
RCD-2	4	4.00	127.62	584910	6913405

RCD-3	0	0.00	109.33	584596	6913109
RCD-4	0	0.00	118.92	584995	6913483
RCD-5	0	0.00	187.27	585080	6913720

3. *Pick first breaks.* First arrivals are picked with Pickwin™ and stored in ASCII format *.vs files containing the shot location and the first arrivals by phone and x-coordinate. In making these picks, the interpreter is guided by knowledge of the expected pattern of arrivals from two or more refractors and the likely response of permafrost patches. The latter can produce anomalously fast and early first arrivals in groups of phones along a spread in a pattern which does not fit the expected sequence of progressively flattening first arrivals moving away from the shot location.

4. *Composite shot file assembly.* The first arrivals are assembled in a composite shot file in PlotRefa™ and inverted with the same software. After assembly, each shot is checked to ensure that the shot location is correct. Thereafter, first arrivals are examined and where necessary edited by the interpreter. Arrivals which could not be picked accurately are assigned a 0 arrival time during picking; these were removed after assembly in the composite shot file. Arrival times which are affected by receiver statics - typically a delay affecting arrival times from several shots at the same geophone – are corrected by moving them into line with neighboring arrival times. Minor smoothing is also done since random phone-to-phone variations do not normally reflect refractor topography but are primarily caused by noise in the shot record. Finally, the line topography is imported into the inversion package to correct the phone and shot elevations. The finite element inversion algorithm used in the inversion could not handle variations in horizontal (x) phone locations and the nominal phone locations (4 meters apart) were used for all subsequent processing.

5. *Inversion.* The data are inverted using a tomographic ray-tracing algorithm. A four meter (horizontal) cell size was used in the inversion. The initial model is a layered model with a vertical variation in seismic velocity parallel to surface topography of from 300 to 5,250 m/s over a depth of 20 to 30 meters. The inversion is allowed to run for 10 or 20 iterations, the model is adjusted to improve the fit between the predicted and observed data by varying the velocity in each cell along the modeled ray paths. Root mean square (RMS) misfit between the observed and measured data is taken as the indicator of goodness-of-fit and the algorithm sought to minimize the RMS error in successive iterations. The inversion algorithm is unable to model data from shots fired off either end of the seismic line. Upon completion of the inversion, a final ray-tracing is performed with a different algorithm to verify the robustness of the model. The final products of the inversion consist of: predicted and observed travel times for each shot and station (Inversion results) in a T-X (travel time / distance) plot; the velocity model (Final model); and the ray-traced model showing the final model with calculated ray paths(Ray traced model). This, together with a T-X plot of only the observed data (Travel time plot), is shown in the summary plots for each refraction survey for each line.

4.4.4 Inversion results & products

The seismic refraction inversion results are described below, by line.

RCD-1

A "fast" spot in the travel time curves from stations 230 - 280 may be discontinuous permafrost(?). The final inversion model is an excellent fit to the data with a best-fit RMS error 0.28 ms. Average velocity measurements taken from the observed arrivals in the T-X plot for the direct wave and first two apparent refractions - assuming a three-layer model - yielded an upper layer velocity of 530 m/s, a middle layer velocity of 1,500 m/s and a lower layer velocity of 3,900 m/s.

RCD-2

Data from stations 180 to 210 is poor likely due to poor, noisy ground conditions; large-offset shots yield no interpretable data from this interval. Minor static corrections affecting pairs of shots (end-of-line and corresponding far-offset shots) are corrected. The inversion results are poor with a best-fit model showing an RMS error of 6.08 ms, subsequently improved by ray-tracing to 5.57 ms. Inversion convergence behaviour is shown in Figure 2.

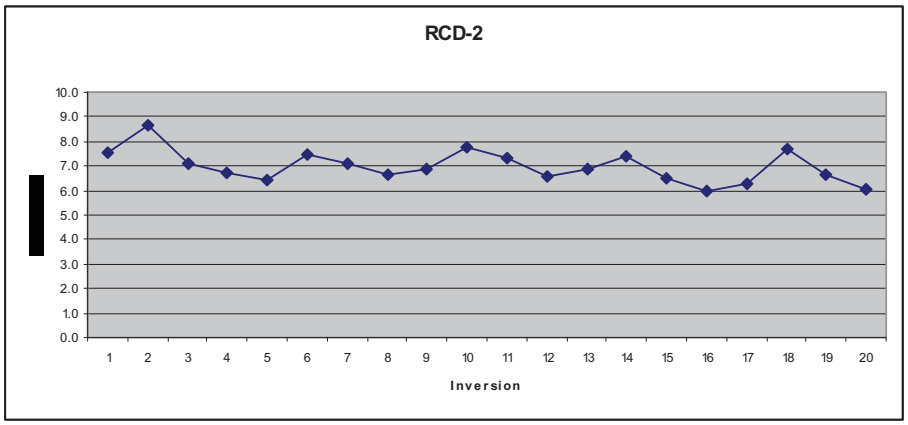


Figure 2. RCD-2 inversion convergence

Final results suggest that there is considerable variation in bedrock type based on the distribution of layers with velocities from 2500 to 5000 m/s. The layer boundaries produced by the inversion in some areas are steeply dipping. The inversion does not fit the data from station 200 to 360 m very well although the flat fast arrivals on the east section of the line are consistent with high velocity, shallow bedrock. Average velocity measurements taken from the observed arrivals in the T-X plot for the direct wave and first two apparent refractions - assuming a three-layer model - yielded an upper layer velocity of 734 m/s, a middle layer velocity of 1,418 m/s and a lower layer velocity of 3,733 m/s.

RCD-3

The data for line RCD-3 are good with no areas where first arrivals could not be clearly read. Only minor smoothing was required together with the removal of travel times for geophones located at shot points. The inversion is acceptable with final RMS error of 2.12 ms. Inversion convergence behaviour is shown below in Figure 3.

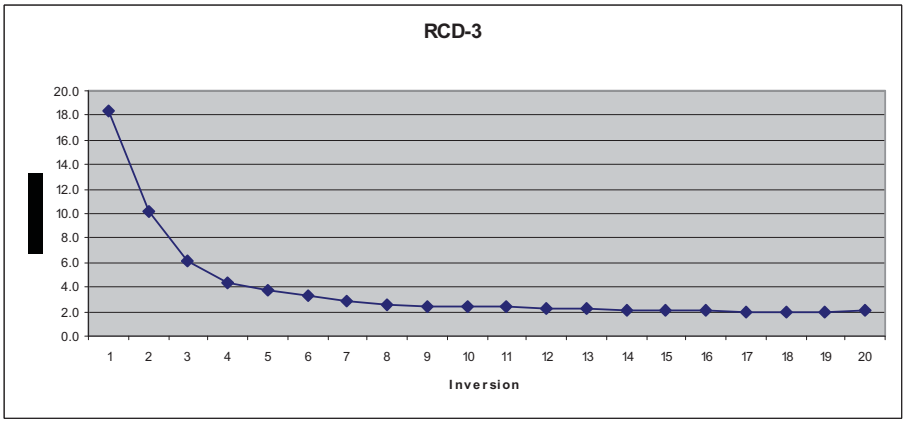


Figure 3. RCD-3 inversion convergence

There is good agreement between the inversion results and the observed data with only minor discrepancies. Average velocity measurements taken from the observed arrivals in the T-X plot for the direct wave and first two apparent refractions - assuming a three-layer model - yielded an upper layer velocity of 470 m/s, a middle layer velocity of 1,753 m/s and a lower layer velocity of 4,702 m/s.

RCD-4

The data for Line RCD-4 is good with no areas where first arrivals could not be clearly read. Only minor smoothing was required together with the removal of travel times for geophones located at shot points. The inversion is good with final RMS error of 1.35 ms after ray tracing. Inversion convergence behaviour is shown in Figure 4.

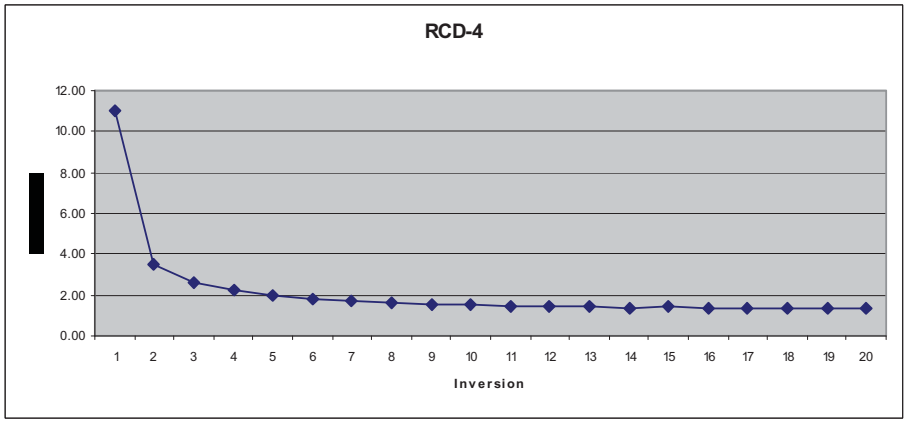


Figure 4. RCD-4 inversion convergence

There is good agreement between the inversion results and the observed data with only minor discrepancies. Average velocity measurements taken from the observed arrivals in the T-X plot for the direct wave and first two apparent refractions - assuming a three-layer model - yielded an upper layer velocity of 435 m/s, a middle layer velocity of 1,257 m/s and a lower layer velocity of 3,110 m/s.

RCD-5

The data for line RCD-5 is good with no areas where first arrivals could not be clearly read. Only minor smoothing was required together with the removal of travel times for geophones located at shot points. Data up line (NW or towards origin) for Shots 91 & 92 at station 196 are removed because the travel time crossed over the refraction arrival from the nearly coincident shot at the end of spread 1. This created instability in the inversion. Despite this, an inversion with a poor final RMS of 4.71 ms was achieved after ray tracing. Inversion convergence behaviour is shown below:

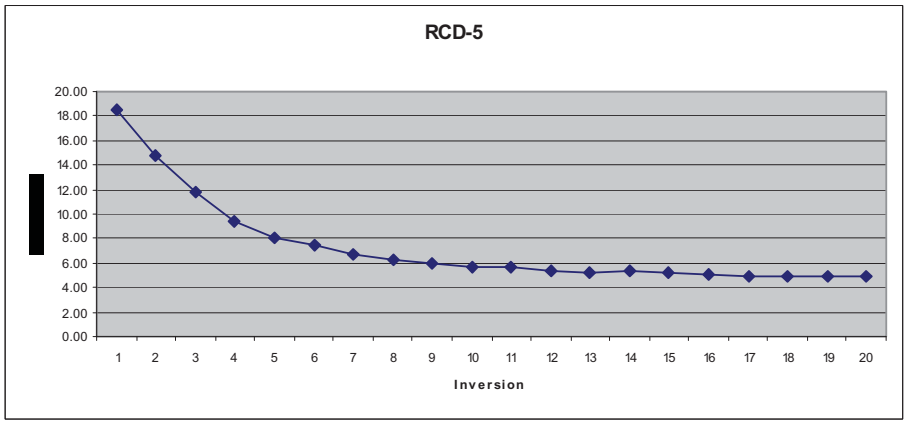


Figure 5. RCD-5 inversion convergence

The inversion failed to tightly fit data from 115 to 155 meters and from 240 to 260 meters. Average velocity measurements taken from the observed arrivals in the T-X plot for the direct wave and first two apparent refractions - assuming a three-layer model - yielded an upper layer velocity of 567 m/s, a middle layer velocity of 1,523 m/s and a lower layer velocity of 3,732 m/s.

Digital data is appended to this report in the digital data archive, seismic refraction folder. This includes the raw shot files (*.dat / SEG2), the picked first arrival files (*.vs / ASCII) and the final inversion model in Excel format. The latter contains the coordinates (x,z) of the centre of each model cell in seismic acquisition coordinates together with the cell velocity in metres per second (m/s).

Appendix IV contains summary plots of the inversion results. These show, by line:

- the final inversion results (observed versus predicted travel times)
- the final model in color contour format
- the ray-traced final model showing predicted ray paths in the final model
- the observed travel times alone, after editing.

4.5 Seismic Reflection Survey

A seismic reflection survey was conducted on line five on July 18th and 19th, 2013. The purpose of the survey was to estimate the thickness of weathered bedrock above the competent bedrock, distinguish layers of high and low relative permeability, and to identify the depth from surface to the underlying competent bedrock contact along the length of the line

4.5.1 Survey specifications

The reflection seismic survey was performed according to the following specifications:

Channels:	48
Receiver spacing:	4 m
Shot spacing:	8 m
Minimum offset:	4 m
Maximum offset:	188 m
Nominal maximum fold:	24
Record length:	512 ms
Sampling:	62 µs
Source effort:	Digipulse: 10 blows

Hammer: 15 blows

The nominal subsurface coverage with these survey parameters was 8 meters.

4.5.2 Data processing

The reflection seismic survey data was processed primarily using the ReflexW™ software package. The following the procedures and methods were used, described in order below:

1. *Initial data checks.* The seismic reflection data is of acceptable quality overall with some shot records containing unacceptable data. Bad data includes shot records with a few dead traces and some shot records with very poor signal strength in portions of a spread due to bad ground or intervening geological features between the shot and geophones. The initial data checks begin with checking each data file against the observer's field records to verify that the receiver and shot locations were correct. In cases where there is a discrepancy between the observer's record of the receiver locations and the receiver locations in the file header, the file header is corrected if it could be conclusively established that the discrepancy resulted from a simple keying error; otherwise the shot record is rejected. This did not occur on line RCD-5. All of the reflection shots were recorded within a spread with the shot point at a geophone location. Consequently, it is easy to verify the shot location from the shot record as the shot occurs at the geophone with the zero time arrival. In some cases there are obvious discrepancies between the observer's records and the observed shot location. In this instance, the shot location as indicated by the shot record is used to correct the observer's records. In cases where there is ambiguity, the observer's records are taken as correct. At the end of this step, the checked data files are collected and renumbered in a sequential processing sequence in a raw file bin.

2. *Topographic data reduction.* All station locations are referenced to nominal seismic line coordinates, commencing at 0 meters at the start of the line. Topographic measurements of the horizontal and vertical distances between stations are reduced to common line coordinates. The origin of the seismic line (Station 0) is assigned an elevation of 187.27 meters; the common datum used in the calculation of all other station elevations and in the reflection seismic processing. This datum is also used in the seismic refraction processing and modeling. The station coordinates used in the seismic reflection and refraction processing and modeling match those used in the field along the seismic line.

3. *Data import, registration and trimming.* A processing spreadsheet containing the shot records to be processed together with shot and receiver locations (horizontal / elevation coordinates) is assembled. From this, a line elevation file containing the surface topography is created in ASCII. In addition, geographic registration (.DST) files incorporating the shot and receiver geometry for each data file were created in the prescribed format in ASCII. A separate .DST file is required for each shot record. Once these files are prepared, the shot records are imported into the program and registered to geographic coordinates using the line elevation file and the .DST files. Thereafter, the shot records are trimmed to remove ground roll and all signal prior to the arrival of the head wave, leaving signal recorded in the *optimum window* after the first arriving energy and before the arrival

of the slower ground roll. The ground roll is removed using a bottom mute with a 5 ms taper and a 400 m/s velocity. This removed all data which would have arrived after a ground roll wave travelling at 400 m/s away from the nominal shot location in the updated file header. Data recorded before the first arrival is noise and removed using an operator-specified top mute with a 5 ms taper. These first arrivals are coherent and display a predictable pattern in the shot record; the processor identifies the first arrivals and removes all data in the shot record arriving before them. Upon completion of this processing, each trimmed shot record is exported in SEG2 format to trimmed data file bin.

4. *Shot stack assembly.* All of the shot records to be processed are collected in a single shot stack file. Subsequent processing up to the CMP stack is performed on the shot stack.

5. *Trace kills.* The shot stack is examined in detail and trace kills are performed on dead traces only.

6. *Band pass filtering.* The F-k filter spectrum of these data is calculated and examined to characterize the frequency spectrum of the signal. The geophones have a nominal peak response at 30 Hz and reflection and refraction data is dominated by frequency response centred around 40 Hz, with little signal above 150 Hz. Several filter panels are created by applying band pass filters with varying specifications to determine which specifications produce the sharpest reflection parabolas after the first arrivals. A trapezoidal band pass filter with a pass region of 80 to 200 Hz, a low cut at 30 Hz and a high cut at 300 Hz are used in the final processing.

7. *Gain.* An exponential (energy) gain correction is applied to the data using an exponent of 8. No AGC or trace balancing gain is performed.

8. *Bottom mute.* The exponential gain creates signal in the muted regions below the optimum window records. This is removed with a bottom mute set at 400 m/s using a 5 ms taper and any gain generated signal in the ground roll noise cone, initially removed during the trimming of the shot records.

9. *Velocity analysis.* Because the shot stack is relatively small, velocity analysis are performed on the entire shot stack for Line RCD-5. Every 5th shot record is selected for velocity analysis and a 1-D common mid-point (CMP) stacking velocity model is constructed from the analysis. The shot records are analyzed by calculating the semblance using NMO velocities ranging from 0 to 5000 m/s in 50 m/s increments. Reflection hyperbolas are interactively fit to each analyzed shot record and corresponding semblance plot using reflection fit in the shot record and corresponding high amplitude responses in the semblance plot as a guide. This process is guided by the assumption that seismic velocities increase with depth and consist of at least three reflections (low velocity layer, top of water table and one or more bedrock reflections). The number of fitted reflections, and hence the complexity of the velocity model, is minimized since velocity model complexity in a single shot can cause smearing when applied to correcting and stacking a larger number of surrounding shots.

This is particularly troublesome with shallow reflection surveys where lateral inhomogeneities and reflector relief are high. Each 1D velocity model is saved in a separate file and these are amalgamated to create a two dimensional (offset distance, record time) velocity model for subsequent normal move-out correction, CMP sorting and stacking.

10. *Normal moveout correction, CMP sorting and stacking.* The 2D velocity model is used to correct the shot stack for normal moveout. Thereafter, the records are sorted into common mid-point (CMP) bins and stacked to generate a brute stack containing a single trace for each CMP reflection point. The nominal fold of coverage is 24 fold.

11. *Band pass filtering.* CMP stacking can generate low frequencies because of stack smearing, which results from misfit between the velocity model in the sampled trace (every 5th shot in this instance) and the optimum velocity model for the adjoining shot records. The reflectors stack, but because of residual moveout the expected sharp reflection is smeared into a larger, lower frequency response. To mitigate this effect, the brute stack is band pass filtered using the same 30-80-200-300 Hz filter applied in step 6.

12. *Time-depth conversion.* The final stack is transformed into a depth section using the 2D velocity model. This transformation results in some stretching and compression of portions of the reflection section, depending upon the vagaries of the 2D velocity model.

13. *Static shift.* A final topographic correction is applied to the depth section based on the line elevation file. Each final stack trace is shifted so that its time-zero mark is coincident with the receiver elevation.

14. *Interpretation.* Several versions of the final section are created using various trace gains in order to image reflections with various amplitude responses. These are registered to geographic coordinates in ArcGIS and reflections were picked from them in a single shapefile. This data are in turn superimposed on the final refraction velocity model for interpretation.

4.5.3 Inversion results & products

The survey identifies reflectors to greater than 100 meters, but the resolution between 0 and 15 meters below surface is very poor as a consequence of the phone interval and loss of high frequencies (dispersion) resulting from ground conditions. The deeper reflection pattern complements, and to some extent verifies, the lateral inhomogeneity in the refraction velocity model. There are reflections at velocity boundaries in the refraction model and steeply dipping reflections at steeply dipping velocity boundaries in the refraction model.

Digital data is appended to this report in the seismic reflection folder and includes the following products:

- Raw shot records in SEG2 format

- Final processed stacked section in SEG2 format
- Images of the final processed stacked reflection section in JPEG format
- Shapefile of the reflections (*RCD-5 reflections.shp*)

Appendix V contains plots of the final reflection section wiggle trace, grey shade and colour contour display formats.

5 DISCUSSION AND INTERPRETATION

All estimations were completed through comparison of survey results together with drillhole information. RCD-4 was surveyed with the intention of using this line as a guide for all subsequent lines in the area. As such, the following general guides are used on lines where survey results could not be confirmed with local borehole data or there is a lack of additional information or survey results.

- Seismic velocity of groundwater 1500 m/s
- Seismic velocity of weathered and fresh bedrock: 1700m/s – 2100m/s

Composite section maps are compiled from survey results and final interpretation picks have been identified. Figures 6 to 10 are composite sections for lines 1 through 5, respectively. Interpolated GPR reflectors (where applicable), seismic velocity contours and reflectors (where available) and general drilehole information are superimposed on gridded resistivity. The sections are compensated for topography with the x-axis registered to local station coordinates and depths in elevation with a 2:1 vertical exaggeration shown along the y-axis. All depths derived herein should be drill tested at selected locations to verify and refine the interpretations included in this report. Results from the five survey lines are discussed here by line, in turn.

1. RCD1. There is no available borehole data associated with this line. A strong distinct GPR reflector is observed over entire length of the line and is clearly evident on the 25, 50 and 100 MHz radargrams. Depth comparison with other surveys suggest the reflector is deep within the bedrock and may represent a lithological contact. The GPR reflector in the composite section is placed using a velocity of 0.11m/ns over areas of permafrost and 0.06 m/ns for thawed ground. The east and west ends of the line have lower resistivity at shallow depths and attenuated GPR signals suggesting areas of thawed ground. The GPR signal attenuation at the east end of the line suggests clayey and wet sediments. The GPR response shows a change in character between stations 60 and 260, likely representing a zone of discontinuous permafrost. Shallow, discontinuous reflectors coincident with zones of high resistivity are observed in the central portion of the survey line and interpreted as weathered bedrock or fracture zones. Distinct reflectors are not attributed to groundwater alone, thus a seismic refraction velocity of 1500 m/s is used for the interpreted depth.
2. RCD2. There is no available borehole data associated with this line. The resistivity inversion highlights shallow zones of high resistivity at both ends of the survey line interpreted as frozen

overburden. Smaller discontinuous permafrost lenses are also visible over the central portion of the line. The GPR survey had no interpretable reflectors on the 500 MHz survey. Sparse, discontinuous and generally flat lying reflectors are best observed in the 100 MHz radargram. Distinct reflectors are not apparent, yet the many reflections suggest zones of fracturing or weathered bedrock at the west end of the line between stations 30 and 140 as well as the east end of the line between stations 310 and 350. The tight contour distribution of the seismic velocities also suggests shallow bedrock in the center of the line while broader contours at the east and west ends support the interpreted zones of fractured or weathered bedrock.

3. RCD3. The resistivity inversion highlights a low resistivity zone on the west end of the line consistent with thawed wet ground intersected in boreholes SRK05-SP1A & B. Discontinuous resistivity highs observed between stations 180 and 280 likely represent frozen lenses. A more continuous resistivity high that continues from station 300 through to the end of the line is interpreted to be permafrost. The GPR survey confirms zones of thawed and frozen ground inferred from signal attenuation and a change in character of the observed response. The signal is generally more attenuated on the west side of the survey line. The east side shows weak flat-lying reflectors down to 10 meters below the surface. The seismic data and borehole logs confirm a bedrock velocity of approximately 2100 m/s and serves as the main guide in selecting the bedrock boundary. From the west end of the line to station 300 the groundwater boundary is interpreted to be at 1500m/s and is not supported by any additional data. The interpreted groundwater boundary shallows slightly from station 300 through to the east end of the line to correlate with the base of the resistive body, interpreted as permafrost.
4. RCD4. The resistivity inversion highlights a strong and discontinuous shallow high on the west end of the survey line from station 0 to 50. An isolated shallow resistivity high is observed again at the east end of the line. Frozen gravel and sand is confirmed at these locations by drillholes SRK08-P13 A & B. The measured resistivity of approximately 1000 Ohm-m suggests there is likely some water at the grain boundaries. Discontinuous flat lying reflectors are best observed in the 100 MHz radargram interpreted to be water table reflectors. Variable velocity between frozen and thawed ground causes difficulty in depth estimation, 0.11 m/ns is selected in the radargrams and is appropriate for frozen sediments. The radar reflector coincident with the borehole location confirms the water table or base of permafrost as the likely source. The GPR signal attenuation supports the frozen and thawed zones of overburden. Seismic data correlates well with the drillhole results, the following approximate velocities are used in selecting the interpreted boundaries.

    a. Groundwater: 1500m/s
    b. Weathered bedrock: 1700m/s
    c. Fresh bedrock: 2100 m/s

5. RCD5. The resistivity inversion highlights shallow discontinuous highs over the entire length of the survey line, interpreted as zones of frozen overburden. Good correlation is observed between the base of resistivity highs, interpreted water table, and borehole confirmation. Groundwater depths generally correlate with shallow resistive areas and seismic velocities

ranging between 1000 and 2000 m/s. Discontinuous flat-lying GPR reflectors in the center of the survey line are observed and likely represent ground water levels or the base of permafrost and are best observed in the 50 and 100 MHz radargrams. The GPR shows distinct signal character and attenuation changes over the survey line however no bedrock reflectors are evident. A combination of seismic velocities, seismic reflectors, resistivity boundaries, and GPR reflectors has been used to select the interpreted boundaries in the composite section.

Digital data included with this report comprises:

Composite Section Shape files	Digital Data\Composite Section\"Line"*.shp
Composite Section Packed Maps	Digital Data\Composite Section\"Line" – Comp Section.map

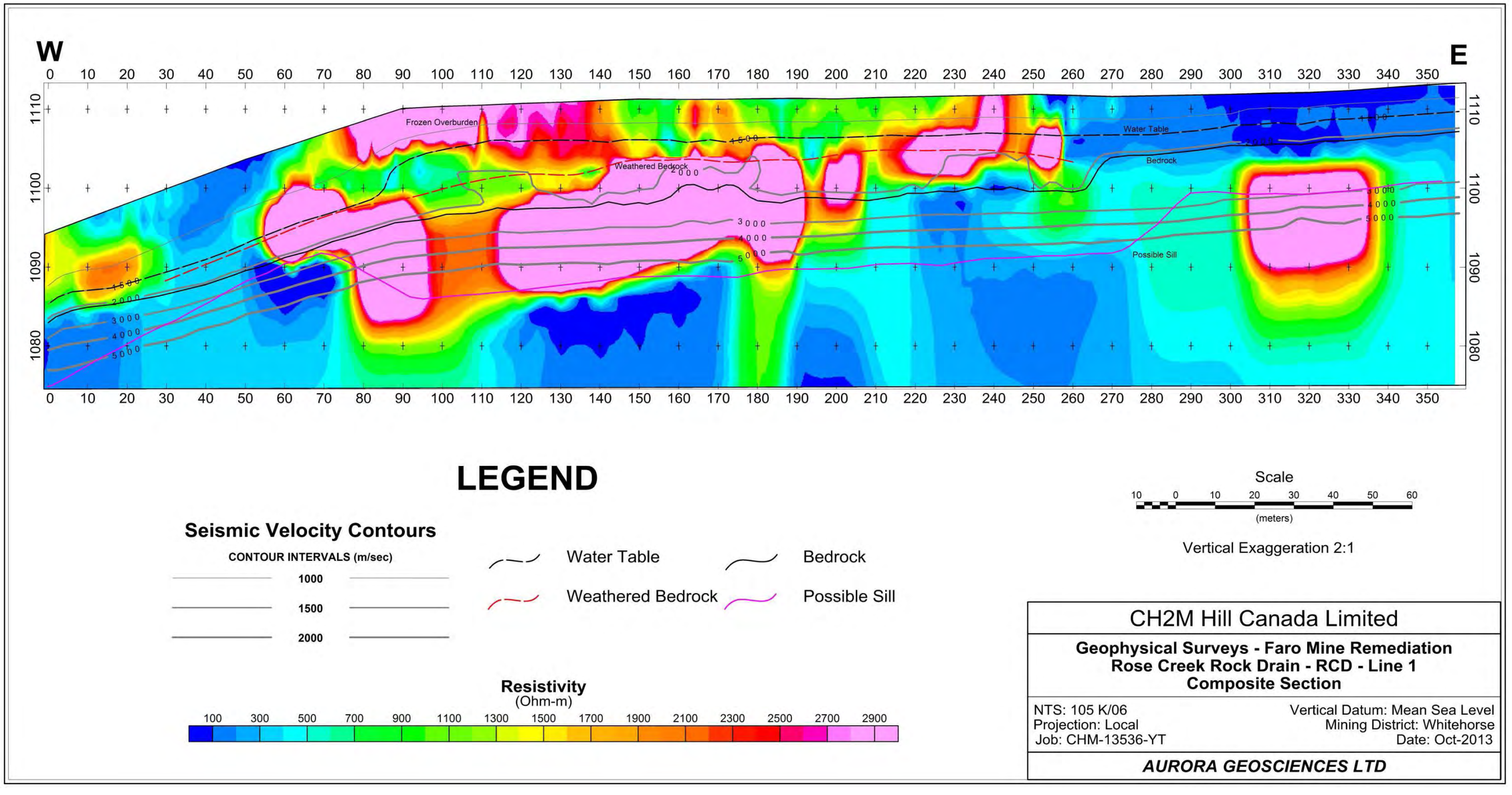
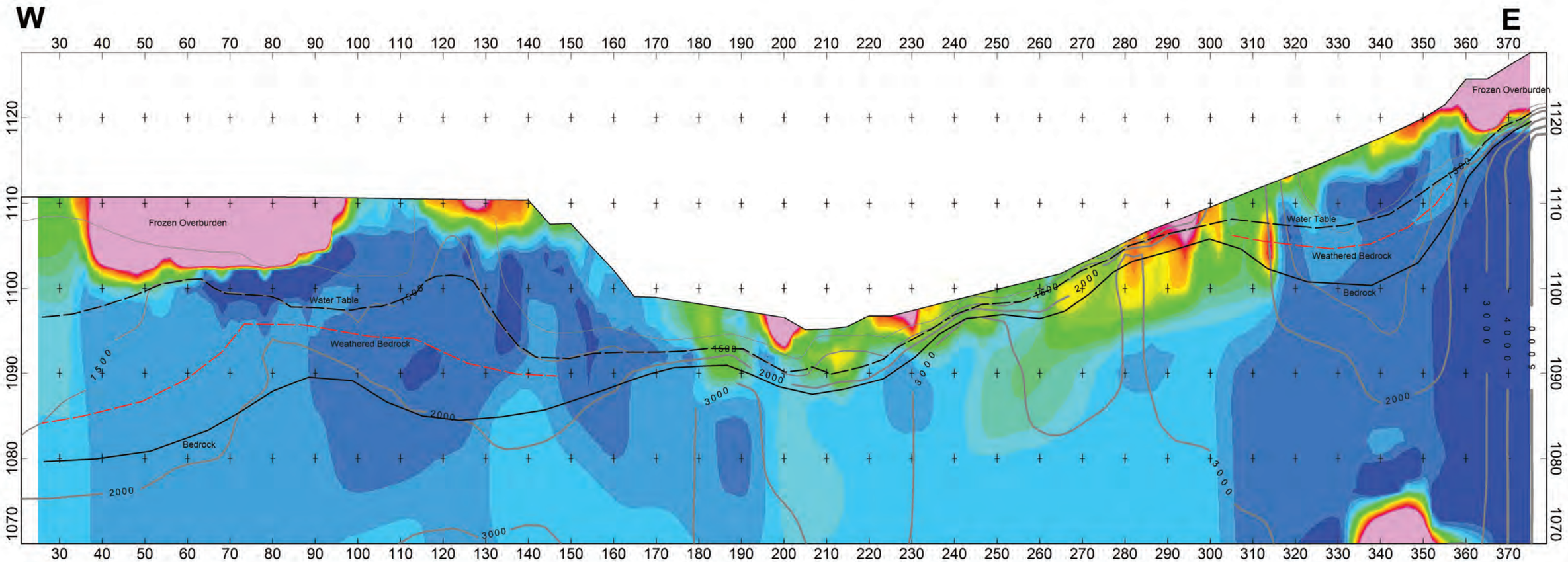


Figure 6. RCD-1 composite section



LEGEND

Seismic Velocity Contours

CONTOUR INTERVALS (m/sec)

1000

1500

2000

Water Table

Weathered Bedrock

Bedrock

100 300 500 700 900 1100 1300 1500 1700 1900 2100 2300 2500 2700 2900

Resistivity
(Ohm-m)

Scale

10 0 10 20 30 40 50 60
(meters)

Vertical Exaggeration 2:1

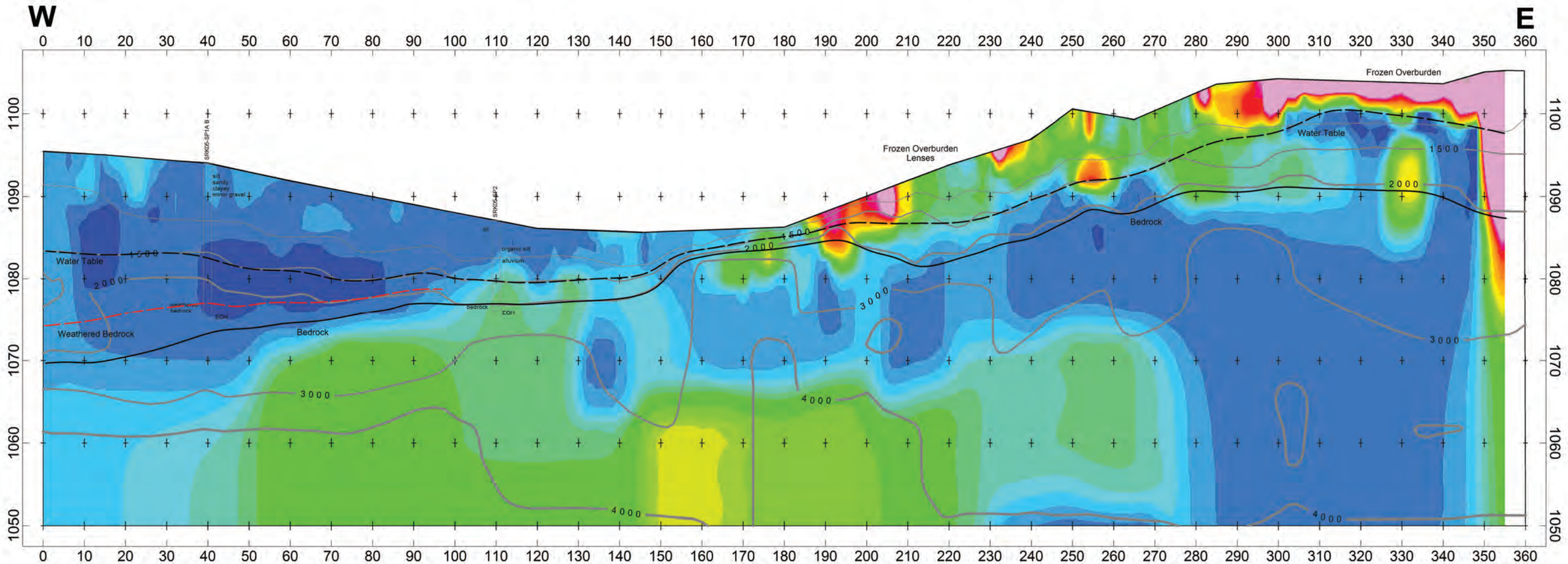
CH2M Hill Canada Limited

Geophysical Surveys - Faro Mine Remediation
Rose Creek Rock Drain - RCD - Line 2
Composite Section

NTS: 105 K/06
Projection: Local
Job: CHM-13536-YT

Vertical Datum: Mean Sea Level
Mining District: Whitehorse
Date: Oct-2013

AURORA GEOSCIENCES LTD



LEGEND

Seismic Velocity Contours

CONTOUR INTERVALS (m/sec)

1000

1500

2000

Water Table

Weathered Bedrock

Bedrock

BH05-01

Historic Borehole

100 300 500 700 900 1100 1300 1500 1700 1900 2100 2300 2500 2700 2900

Resistivity
(Ohm-m)

Scale

10 0 10 20 30 40 50 60

(meters)

Vertical Exaggeration 2:1

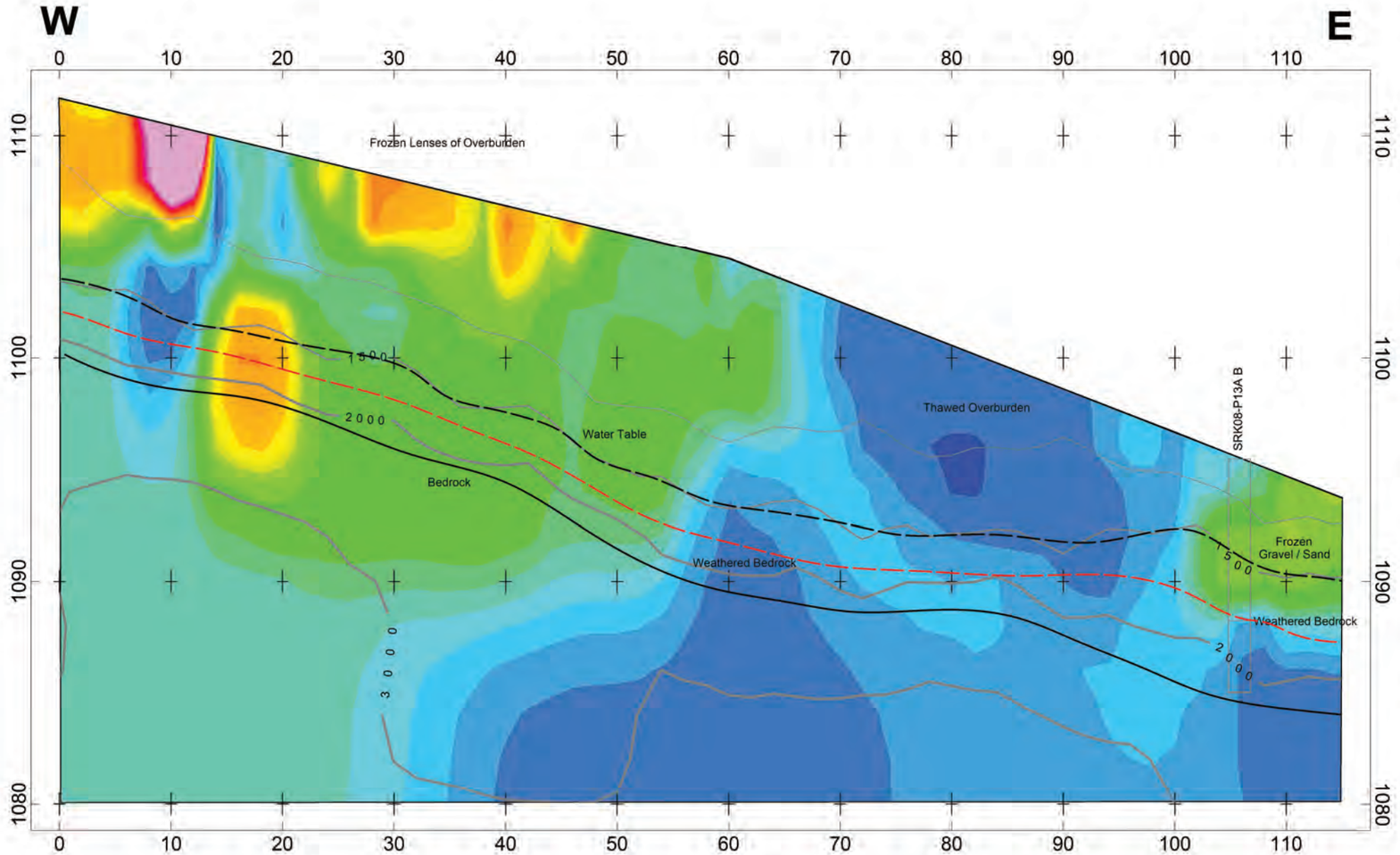
CH2M Hill Canada Limited

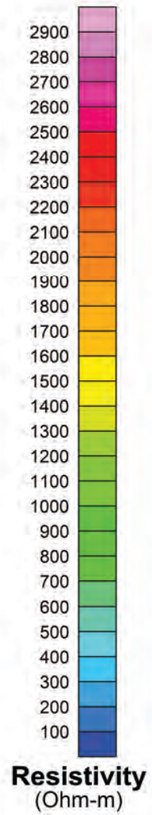
Geophysical Surveys - Faro Mine Remediation
Rose Creek Rock Drain - RCD - Line 3
Composite Section

NTS: 105 K/06
Projection: Local
Job: CHM-13536-YT

Vertical Datum: Mean Sea Level
Mining District: Whitehorse
Date: Oct-2013

AURORA GEOSCIENCES LTD





LEGEND

Seismic Velocity Contours

CONTOUR INTERVALS (m/sec)

1000

1500

2000

Water Table

Weathered Bedrock

Bedrock

BH05-01

Historic Borehole

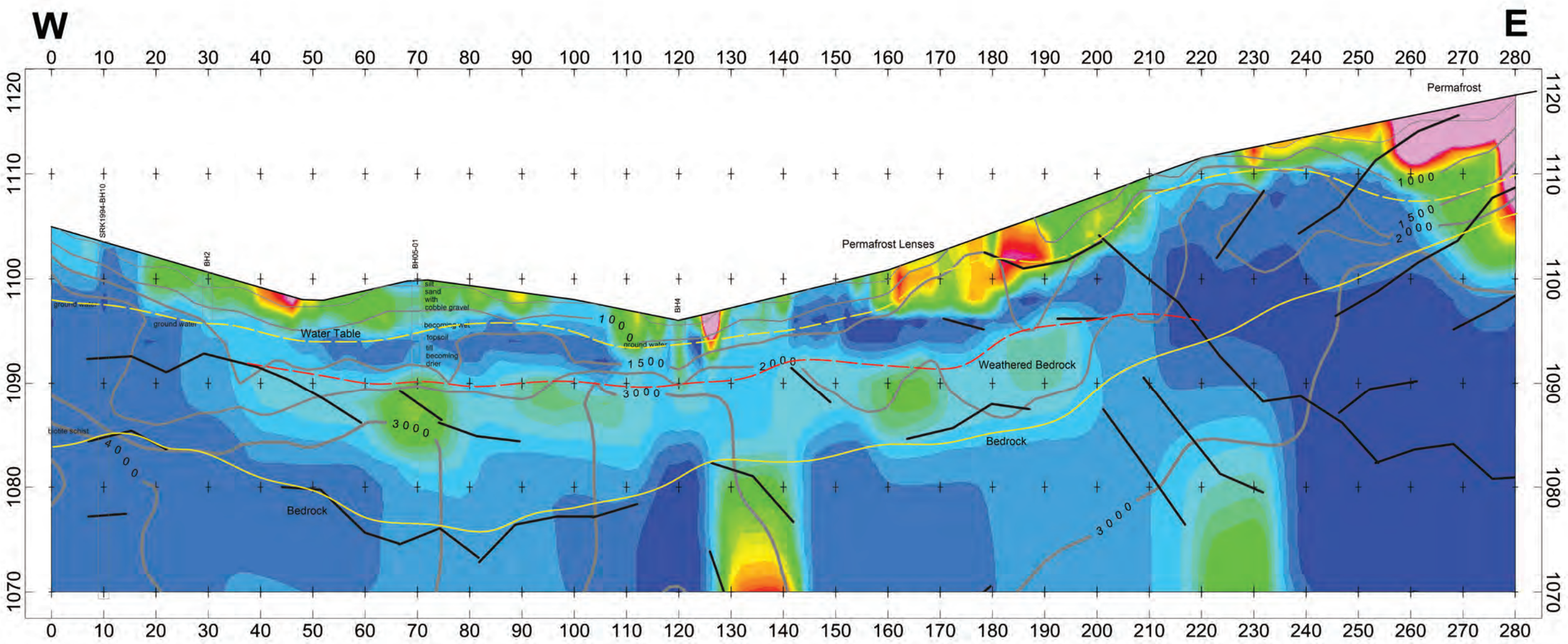
Scale

5 0 5 10 15 20 25 30 35

(meters)

Vertical Exaggeration 2:1

CH2M Hill Canada Limited	
Geophysical Surveys - Faro Mine Remediation Rose Creek Rock Drain - RCD - Line 4 Composite Section	
NTS: 105 K/06 Projection: Local Job: CHM-13536-YT	Vertical Datum: Mean Sea Level Mining District: Whitehorse Date: Oct-2013
AURORA GEOSCIENCES LTD	



LEGEND

Seismic Velocity Contours

CONTOUR INTERVALS (m/sec)

1000

1500

2000

Water Table

Weathered Bedrock

Bedrock

Seismic Reflectors

BH05-01

Historic Borehole

100 300 500 700 900 1100 1300 1500 1700 1900 2100 2300 2500 2700 2900

Resistivity
(Ohm-m)

Scale

10 0 10 20 30 40 50

(meters)

Vertical Exaggeration 2:1

CH2M Hill Canada Limited

Geophysical Surveys - Faro Mine Remediation
Rose Creek Rock Drain - RCD - Line 5
Composite Section

NTS: 105 K/06
Projection: Local
Job: CHM-13536-YT

Vertical Datum: Mean Sea Level
Mining District: Whitehorse
Date: Oct-2013

AURORA GEOSCIENCES LTD

Appendix I

Project Log

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT
DAILY REPORT FORM

DATE:	July 7, 2013

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic		
GPR		
Total Line-km surveyed		0

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source		
GPR Gear		
Line cutting gear		
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	10
Field Hand	Shawn Scott	10
	Jeremy Beales	10
	Dimitri Spassov	10
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	no

OTHER

weather

Mostly Sunny, 20C

Notes (incidents, other)

Drive from whitehorse to faro. Checked into the valley BB. Visisted faro mine site and went through TEES site orientation. Met with Shawn and discused what was needed for the safety orientation the following day.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT
DAILY REPORT FORM

DATE:	July 8, 2013

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic		
GPR		
Total Line-km surveyed		0

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source		
GPR Gear		
Line cutting gear		
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	10
Field Hand	Shawn Scott	10
	Jeremy Beales	10
	Dimitri Spassov	10
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	no, first submission today

OTHER

weather

Mostly Cloudy, 15C

Notes (incidents, other)

Safety breifings. AHA completion. Site visit to CVD and Rose creek Drainage.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT
DAILY REPORT FORM

DATE:	July 9, 2013

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting	CVD, RCD1	.06, .28
Resistivity	CVD	0.42
Seismic		
GPR		
Total Line-km surveyed		0.76

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear	72 dp Syscal Pro	6 hours
ATV 1		
ATV 2		
ATV with mounted seismic source		
GPR Gear		
Line cutting gear	Chainsaws used	2
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeremy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	July 8, 2013

OTHER

weather

Mostly Cloudy, 15C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box / safety meting at 7am. Crew split into two teams. Andre and Jeremy cut, chained and did resistivity on CVD line. The crew did not finish off the resistivity on the entire line and picked up the gear with one cable still left to read. When chaining out the line the crew noticed it was 200m shorter than on the job specs Shawn and Dimitri Line cut Rose creek drain assesment line 1. They did not finish the line because they spent lots of time searching for an acess trail that wasn't apparent as it should be.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT
DAILY REPORT FORM

DATE:	July 10, 2013

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting	RCD1, RCD5	.08, .20
Resistivity	CVD, RCD 1	0.6, 0.36
Seismic		
GPR		
Total Line-km surveyed		1.96

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear	72 dp Syscal Pro	10 hours
ATV 1		
ATV 2		
ATV with mounted seismic source		
GPR Gear		
Line cutting gear	Chainsaws used	2
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeremy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	July 9, 2013

OTHER

weather

Mostly Cloudy, 15C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeremy finished resistivity on CVD line and RCD L1. Shawn and Dimitri finished line cutting Rose creek drain assesment line 1 and cut RCD L5. The reason for the low production on the linecutting crew is because the double up quad wouldn't start up due to dead battery, so shawn and dimitri tried to get it going with no luck. The truck was dangerously low on fuel so they decided to fuel it up, and use it to acess the lines.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT
DAILY REPORT FORM

DATE:	July 11, 2013

PREPARED BY:Andre Lebel
crew chief/geophysicist

OPERATIONS

Item	Survey Line Numbers	Line-km surveyed
Line Cutting	RCD4, RCD3, RCD2	.100, .400, .120
Resistivity	RCD4, RCD 5	.10,.3
Seismic		
GPR		
Total Line-km surveyed		1.02

LOGISTICS & EQUIPMENT

Type	Description	Hrs or units
Seismic Gear		
Resisitivity gear	72 dp Syscal Pro	10 hours
ATV 1		
ATV 2		
ATV with mounted seismic source		
GPR Gear		
Line cutting gear	Chainsaws used	2
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	Person	Hours worked
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeremy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	July 10, 2013

OTHER

weather
Mostly Cloudy, 15C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeremy finished resistivity on RCD I5 and RCD L4 and started to cut RCD L2 Shawn and Dimitri finished line cutting on RCD Line 4 and cut RCD L3.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July 12, 2013

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	Survey Line Numbers	Line-km surveyed
Line Cutting	RCD2, BC1, VCD1	.25, .400, .10
Resistivity	RCD2	0.36
Seismic		
GPR		
Total Line-km surveyed		1.11

LOGISTICS & EQUIPMENT

Type	Description	Hrs or units
Seismic Gear		
Resisitivity gear	72 dp Syscal Pro	10 hours
ATV 1		
ATV 2		
ATV with mounted seismic source		
GPR Gear		
Line cutting gear	Chainsaws used	2
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	Person	Hours worked
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeremy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	July 11, 2013

OTHER

weather

Mostly Cloudy, 15C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeremy finished resistivity on RCD l3 and started to cut vcd l1 Shawn and Dimitri finished Line cut Rose creek drain assesment line 2 and cut BCD 1, and VCD 1. Andre and Jeremy joined the cutting crew after finishing the line because there wasn't enough time to finish another line. The resistivity line was surveyed backwards so that the TX did not have to carried accross the creek.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July 13, 2013

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting	VCD2, VCD3, VCD4, BSGRO	0.15, 0.02, 0.050, 0.3
Resistivity	RCD3,GWRQ	0.36, 0.24
Seismic		
GPR		
Total Line-km surveyed		1.12

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear	72 dp Syscal Pro	10 hours
ATV 1		
ATV 2		
ATV with mounted seismic source		
GPR Gear		
Line cutting gear	Chainsaws used	1
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeremy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	July 12, 2013

OTHER

weather

Mostly Sunny, 25 C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeremy finished resistivity on RCD l3 and GWRQ. Shawn and Dimitri finished cutting Vangorda creek drain assesment. There was some confusion on where to cut the VCD line, after talking to John they decided to stick to the contract. Shawn may have more line to cut on VCD.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July 14, 2013

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting	VCD4, VCD5, Borrow creek	0.045, 0.1, 0.7
Resistivity		
Seismic		
GPR	CVD, RCD5, RCD4, RCD2	0.9, 0.3, 0.12, 0.36
	Note, CVD done with 25 & 50 MHz	
	RCD5, 4 & 2 with 50 MHz	
Total Line-km surveyed		2.525

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source		
GPR Gear	25, 50 MHz RTA	10 hours
Line cutting gear	Chainsaws used	1
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeremy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

OTHER

weather

Mostly Sunny, 25 C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeremy did GPR on cvd line and RCD 5,4 and 2. Andre Broke a fiber optic cable on the 25 Mhz RTA on the cvd line. They were able to switch it for the spare with no delay. Shawn and Dimitri finished cutting Borrow creek and redid some of the cutting on the Vangorda creek drain assesment because there was confusion of where to cut the previous day.

Previous Day's Field Report Submitted	July 13, 2013

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July 15, 2013

PREPARED BY:Andre Lebel
crew chief/geophysicist

OPERATIONS

Item	Survey Line Numbers	Line-km surveyed
Line Cutting	VCD7,VCD6,VCD5	.210, .020, .045
Resistivity		
Seismic	CVD	0.18
GPR	RCD3	0.6
Note, RCD 3 done with 25 & 50 MHz		
Total Line-km surveyed		1.055

LOGISTICS & EQUIPMENT

Type	Description	Hrs or units
Seismic Gear		10 hours
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipulse	10 hours
GPR Gear	25, 50 MHz RTA	3 hours
Line cutting gear	Chainsaws used	1
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	Person	Hours worked
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeremy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	July 14, 2013

OTHER

weather
Mostly Sunny, 25 C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeremy did Seismic on cvd line. A slow day on the siesmic took most of the day to do the first spread. Shawn and Dimitri finished cutting Vangorta creek drainage. Started GPR on Line RCD3.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT
DAILY REPORT FORM

DATE:	July 16, 2013

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic	CVD	0.18
GPR		
Total Line-km surveyed		0.18

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		10 hours
Resisitivity gear	72 dp Syscal Pro	5 hours
ATV 1	Arctic cat	1
ATV 2		
ATV with mounted seismic source	Polaris w digipulse	10 hours
GPR Gear		
Line cutting gear	Chainsaws used	1
Hotel/B&B Accommodation	Valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeremy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	July 15, 2013

OTHER

weather

Mostly Sunny, 25 C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeremy did Seismic on cvd line. Continued on from where we left off the previous day. Also did a few refraction shots on the middle spread. Shawn and Dimitri chained out the VCD line for the GPR in the morning. Then switched to resistivity on VCD after Dave had a meeting with Ch2mHill and they wanted Resistivity and Seismic done on the VCD line as well. They set it all up by 4pm then thunderstorms were in the area, and it was late in the day so they rolled up the cables to get a fresh start in the morning. The rest of the GPR gear arrived in on the plane that CH2mHill chartered.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-17-13

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity	VCD	0.24
Seismic-Reflection	CVD	0.09
Seismic-Refraction	CVD	0.27
GPR		
Total Line-km surveyed		0.6

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		10 Hrs
Resisitivity gear		10 Hrs
ATV 1	Arctiv cat	1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	10 Hrs
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**46**

Previous Day's Field Report Submitted	July 8th

OTHER

weather

Mostly Sunny, 20 C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeromy did Seismic on cvd line. Continued on from where we left off the previous day. Also did two refraction shots on the 0 to 188 spread and the 288 to 476. Shawn and Dimitri set up the and read the resistivity on the VCD line. They read one full reading and moved 2 60m cables to the end and did another roll reading.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-18-13

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity	NVCD	0.48
Seismic	RCD5	0.18
GPR		
Total Line-km surveyed		0.66

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		10 Hrs
Resisitivity gear		10 Hrs
ATV 1	Arctic cat	1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	3 Hrs
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**46**

Previous Day's Field Report Submitted	July 8th

OTHER

weather

rainy in the morning. Cleared up in the afternoon. 20C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeromy did Seismic on RCD5 line. There was equipment working on the new vangorta line, so we decided to work on the RCD5 line. The quad with the seismic source got jamed into reverse, and we couldn't use it no more. Used the Hamer for most of the spread on the RCD line. Shawn and Dimitri did 4 cable rolls on the res on the Vangorta line, or an equivalent of 480 m.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-19-13

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity	NVCD	0.36
Seismic	RCD5	0.18
GPR		
Total Line-km surveyed		0.54

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		10 Hrs
Resisitivity gear		10 Hrs
ATV 1	Artic cat	1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	3 Hrs
GPR Gear	25 and 50 Mhz RTA,	1 Hr
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**46**

Previous Day's Field Report Submitted	July 8th

OTHER

weather

rainy in the morning. Cleared up in the afternoon. 20C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeromy inished Seismic on RCD5 line. Used the Hamer for most of the spread on the RCD line. one reflection and refraction spread. Read LRCD 5 on the west side of the creek and LRCD 4 with the 25 Mhz GPR. Shawn and Dimitri did 3 cable rolls on the res on the Vangorta line, or an equivalent of 360 m.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-19-13

PREPARED BY:Andre Lebel

crew chief/geophysicist

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity	NVCD	0.24
Seismic	NVCD	0.015
GPR		
Total Line-km surveyed		0.255

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		10 Hrs
Resisitivity gear		10 Hrs
ATV 1	Artic cat	1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	3 Hrs
GPR Gear	25 and 50 Mhz RTA,	1 Hr
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 2	White	1 day
Truck 1	Blue	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief/geophysicist	Andre Lebel	11.5
Field Hand	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**46**

Previous Day's Field Report Submitted	July 8th

OTHER

weather

Mixed sun and clouds with some rain. 20C

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Andre and Jeromy worked of NVCD line soing the seismic starting from the south end. Only got 16m of production. Shawn and Dimitri lent a hand once the res was finished untill 3pm. Tried to use the ATV to read the bottom end of that line, but the moving along was very slow due to steep trails. At around 2pm seismic cable got caught around the wheel of the ATV which snaped the cable. Crew dicided to get the ATV off the line and pick up the gear. Shawn and Dimitri did 2 cable rolls on the res on the Vangorta line, or an equivalent of 240 m. To finish off the res on all the areas.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-21-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting	VCD	0.300
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR		
Total Line-km surveyed		0.3

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	1
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted

OTHER

weather

Cloudy, drizzle, heavy rain.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Jeremy and Dmitri used the range finder to survey the Granite Outcrop line (1km) and the Vangorda line (1.5km) before cutting a wider path along the northen part of the Vangorda line in prepatration for the seismic survey. Shawn helped set-up the range finder and dropped off and picked up the other crew while working on repairing the cable.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-22-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity	VCD	0.300
Seismic-Reflection		
Seismic-Refraction	VCD	0.015
GPR		
Total Line-km surveyed		0.315

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		1
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	1
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

OTHER

weather

Cloudy, drizzle.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew split into two teams. Jeremy and Dmitri continued to work on widening the Vangorda line for the ATV-mounted seismic source. Shawn continued to work on fixing the broken seismic cable.
In the afternoon the entire crew worked to set up and test the seismic equipment and take the refraction readings off the north-eastern end of the line (-90) and (-08).

Previous Day's Field Report Submitted	

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-23-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection	VCD	0.188
Seismic-Refraction	VCD	0.015
GPR		
Total Line-km surveyed		0.203

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		1
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

OTHER

weather

Cloudy, drizzle, heavy rain.

Previous Day's Field Report Submitted

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am. Crew set up and worked on the northern end of the Vangorda line, completing one full spread of reflection and refraction. ATV mounted source broke it's start cable and half of the line was completed using the hand held sledge. A second spread was set up but was bogged down in noisy lines and troubleshooting before packing up for home.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-24-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection	VCD	0.188
Seismic-Refraction	VCD	0.030
GPR		
Total Line-km surveyed		0.218

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		1
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	13.5
Field Hand	Jeromy Beales	13.5
Field Hand	Dimitri Spassov	13.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

OTHER

weather

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 8pm. Tool box \ safety meting at 7am. Dmitri and Jeremy had the line set up by 10am while Shawn fixed the ATV mounted source. The whole crew was troubleshooting until the first reading at 10:40. The first spread was completed by 1pm and readings began on the 2nd spread of the day at 2:20pm. Troubleshooting on the second spread was constant (problems with ATV, permafrost and trigger) and the line was completed around 6:30pm. Packed and back to the B&B by 8pm.

Previous Day's Field Report Submitted	

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-25-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection	NVCD	0.188
Seismic-Refraction	NVCD	0.030
GPR		
Total Line-km surveyed		0.218

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		1
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted

OTHER

weather

Sunny and hot.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 5:45pm. Tool box \ safety meting at 7am.
First spread set up by 9am on Vangorda stations 288-476
Second spread set up at stations 384- 572 at 12pm.
Second spread finished at 3:45pm.
All gear packed and loaded on the truck by 4:45 pm

GPR

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-26-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection	NVCD	0.188
Seismic-Refraction	NVCD	0.030
GPR		
Total Line-km surveyed		0.218

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		1
ATV 1		1
ATV 2		1
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	12.5
Field Hand	Jeromy Beales	12.5
Field Hand	Dimitri Spassov	12.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

OTHER

weather

Cloudy. Some rain.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 7pm. Tool box \ safety meting at 7am.
First spread set up by 9am on Vangorda stations 480-668.
Troubleshooting noisy channels until 9:30am.
Second spread set up at stations 576- 764 at 12:30pm.
Second spread finished at 5:20 pm.
All gear packed and loaded on the truck by 6:15 pm

Previous Day's Field Report Submitted	

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-27-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity	NVCD	0.188
Seismic-Reflection	NVCD	0.030
Seismic-Refraction		
GPR		
Total Line-km surveyed		0.218

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		1
ATV 1		1
ATV 2		1
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	12.5
Field Hand	Jeromy Beales	12.5
Field Hand	Dimitri Spassov	12.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

OTHER

weather

Cloudy, some sun, some rain.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 7pm. Tool box \ safety meting at 7am.
First spread set up by 9:30am on Vangorda stations 672-856.
Second spread set up at stations 768-956 at 2:30pm.
Second spread finished at 4:45 pm.
All gear packed and loaded on the truck by 6 pm.

Previous Day's Field Report Submitted	

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-28-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection	NVCD	0.188
Seismic-Refraction	NVCD	0.030
GPR		
Total Line-km surveyed		0.218

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		1
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	13.5
Field Hand	Jeromy Beales	13.5
Field Hand	Dimitri Spassov	13.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted

OTHER

weather

Sunny and hot.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 8pm. Tool box \ safety meting at 7am.
First spread set up by 10am on Vangorda stations 864-1052.
Second spread set up at stations 960-1148 at 2:30pm.
Second spread finished at 5:45 pm.
All gear packed and loaded on the truck by 7 pm.
Battery issues continue, most of the line is completed with the sledge hammer.
One station on the second spread is skipped after Dmitri was stung many times by wasps from the nest at station.
Back up gear for seismic arrives at the B&B during the day.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-29-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection	NVCD	0.094
Seismic-Refraction		
GPR	RCD 005,004,002 @25Mhz	0.700
Total Line-km surveyed		0.794

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		1
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25 and 50 Mhz RTA,	25Mhz
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	12.5
Field Hand	Jeromy Beales	12.5
Field Hand	Dimitri Spassov	12.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 7pm. Tool box \ safety meting at 7am.
Set up a full seismic spread at Vangorda stations 1056-1244 by 10am.
The survey was interrupted by road work being done on behalf of the client within 100m of the line a little after 12pm. This interruption happened despite daily conversations with the client about potential interference from excavators and drills near the site. Shawn checked with the client and the heavy equipment foreman that morning before beginning to work.
The crew went back to the base, did some maintenance work on the truck, loaded GPR gear and proceeded to survey the Rose Creek rock drain until 4:30pm.
At 5pm the crew returned to the seismic survey, and completed the first spread.
All gear packed and loaded on the truck by 6:20pm.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-30-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR	Granite Outcrop	2.000
Total Line-km surveyed		2

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25 and 50 Mhz RTA,	1
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted

OTHER

weather

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 2:30pm. Tool box \ safety meting at 7am.
The crew spent the morning packing up all of the seismic gear, including all three ATVs and moving them 10km west to the Rose Creek Drainage in anticipation of the next seismic lines.
Around 12pm, Shawn and Jeremy surveyed the granite outcrop line with the 25MHz and 50MHz GPR. Dimitri picked up the others with their equipment at the end of the line and the crew took a half day of rest.
Conference call with Phil, Charles and Shawn in the afternoon.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	July-31-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR		
Total Line-km surveyed		0

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25 and 50 Mhz RTA,	
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Truck (K&K Rental)	Brown	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Jeromy Beales	11.5
Field Hand	Dimitri Spassov	11.5
Field Hand	Matthias Zinsli	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**4**

Previous Day's Field Report Submitted	

OTHER

weather

Hot.

Notes (incidents, other)

Crew took a day's rest and caught up on a few little errands.
Matthias drove in to Faro, arriving around 1pm.
Jeremy and Dimitri returned to Whitehorse in the same truck shortly after.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-01-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR	Grum Borrow, RCD2,RCD5	1.060
Total Line-km surveyed		1.06

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	100 and 50 Mhz RTA	1
Line cutting gear	Chainsaws used	0
Hotel/B&B Accommodation	valley B&B	1 room1
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Matthias Zinsli	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**2**

Previous Day's Field Report Submitted	

OTHER

weather

Sunny, then rainy, then stormy, then sunny again.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am.
Matthias needed to complete safety training with TEES (onsite security) and with CH2MHill.
This was done quickly though the morning.
Around 12pm Shawn and Matthias surveyed the topography of the Grum Borrow line (200m) and surveyed with the 50MHz and 100MHz GPR.
There was a shut down of mine activities due to lightning between 130pm and 230pm.
During this time the crew moved to the Rose Creek drainage and after a safe pause from the lightning, began surveying lijnes RCD5 and RCD2 with the 100MHz GPR.
All gear was packed in the truck by 5pm.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-02-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR	RCD2, RCD4, RCD5, RCD1	1.600
Total Line-km surveyed		1.6

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	1
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	1 room1
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	10.5
Field Hand	Matthias Zinsli	10.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**2**

Previous Day's Field Report Submitted	

OTHER

weather

Hot and sunny all day long.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6pm. Tool box \ safety meting at 7am.
Some safety review at the CH2MHIll office until 830am.
The rest of the morning was spent surveying RCD5,RCD4 and RCD2 with the 500MHz and 100 MHz GPR, as well as trouble shooting some issues with the 500MHz antenna.
In the afternoon, moved to the haul road to survey RCD1 with the 25MHz, 50MHz and 25MHz GPR.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-03-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR	VCD, Granite Outcrop	5.500
Total Line-km surveyed		5.5

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	1
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	1 room1
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	10.5
Field Hand	Matthias Zinsli	10.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**2**

Previous Day's Field Report Submitted	

OTHER

weather

Hot and sunny. High of 28C.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 5pm. Tool box \ safety meting at 7am.
The morning and early afternoon was spent surveying the Vangorda line with the 25, 50 and 100 MHz GPR.
Some time spent troubleshooting the 500MHz shielded antenna.
The final frequency for the Granite Outcrop line (100 MHz) was surveyed in the afternoon.
All gear packed in the truck and ready to go by 4:45pm.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-04-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR	CVD	0.450
	RCD5	0.3
	WTP	3.44
Total Line-km surveyed		4.19

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		0
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	1
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	1 room1
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11
Field Hand	Matthias Zinsli	11
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**2**

Previous Day's Field Report Submitted	

OTHER

weather

Largely overcast, some light rain. Sunnier in the afternoon.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 5:30pm. Tool box \ safety meting at 7am.
The morning was spent surveying the Cross Valley Dam and the Rose Creek Drainage with the 100MHz GPR unit.
In the afternoon, a grid was laid out for the Water Treatment Plant area and a little over half of the lines were surveyed with the 100MHz GPR.
The truck was packed and ready to leave at 4:45pm

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT
DAILY REPORT FORM

DATE:	August-05-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	Survey Line Numbers	Line-km surveyed
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR	WTP 100MHz	2.710
		3
Total Line-km surveyed		5.71

LOGISTICS & EQUIPMENT

Type	Description	Hrs or units
Seismic Gear		
Resisitivity gear		
ATV 1		0
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	1
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Truck 2	Brown Rental	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	Person	Hours worked
Aurora - Crew chief	Shawn Scott	11
Field Hand	Matthias Zinsli	11
Field Hand	Jeremy Beales	
Driver	Kenny	
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Largely overcast, some light rain.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 5:45pm. Tool box \ safety meting at 7am.
Work was entirely on the new Water Treatment Plant site. The crew finished surveying the grid with the 100MHz antenna by noon. In the afternoon, the GPR equipment was packed to be shipped back to Whitehorse and one last attempt was made to troubleshoot the 500MHz GPR with surprising results. The crew then spent the rest of the day starting the 500MHz portion of the WTP site.
Truck was packed and ready to leave at 5:15pm.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-06-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		0.144
GPR	WTP 500MHz	3.150
Total Line-km surveyed		3.294

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25,50,100&500MHz	1
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Matthias Zinsli	11.5
Field Hand	Jeremy Beales	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Hot. Some rain at the end of the day. Just enough to make the seismic data noisy.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6:15pm. Tool box \ safety meting at 7am.
Work started in the morning at the new Water Treatment Plant site and continued until the whole grid had been surveyed with the 500MHz GPR at about 1pm. Some work was done surveying the WTP with the rangefinder but this was left unfinished to allow enough time to complete refraction seismic on the Rose Creek Drain at line 4. The line was completed by 5 and the truck was packed to go at about 5:45.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-07-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		0.188
GPR	Vangorda 500MHz	1.500
Total Line-km surveyed		1.688

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	1
GPR Gear	25,50,100&500MHz	1
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Matthias Zinsli	11.5
Field Hand	Jeremy Beales	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Started off a little rainy? But overcast and cool by the time work started.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6:15pm. Tool box \ safety meting at 7am.
Started with the seismic (refraction) on RCD2 and finished around noon. Then MZ and JB transported the gear to the next line and stashed it for an early start tomorrow, and chained and flagged the seismic stations for the next day. SS surveyed the Vangorda line with the 500MHz.
The truck was packed and ready to leave at 5:35PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-07-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction	RCD2	0.188
GPR	RCD1 500MHz	0.360
	RCD3 500MHz	0.36
	CVD 500MHz	0.45
Total Line-km surveyed		1.358

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	1
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Matthias Zinsli	11.5
Field Hand	Jeremy Beales	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Light rain through a lot of the day. Threatened lightning all day.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6:15pm. Tool box \ safety meting at 7am.
Hustled to finish RCD2 seismic before drill mobed to area in the morning.
In the afternoon 500MHz GPR on the three lines above and touch-up range-finder surveying.
The truck was packed and ready to leave at 5:30PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-09-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction	RCD1	0.360
GPR		
Total Line-km surveyed		0.36

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		1
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Matthias Zinsli	11.5
Field Hand	Jeremy Beales	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather
Warm and sunny.

Notes (incidents, other)
Left B &B at 6:30 am, and arrived back at 6:15pm. Tool box \ safety meting at 7am. Two lines of overlapping seismic refraction on RCD1. The truck was packed and ready to leave at 5:30PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-10-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction	Grum Quarry	0.200
GPR		
Total Line-km surveyed		0.2

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	8
Field Hand	Matthias Zinsli	8
Field Hand	Jeremy Beales	8
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather
Warm and sunny.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 3:15pm. Tool box \ safety meting at 7am.
The crew spent the morning conducting the refraction seismic survey on the Grum quarry line and conducting quality control on the topographic data with the laser range finder. A slightly shorter day was taken to allow the crew to rest in the afternoon and work on data processing.
The truck was packed and ready to leave at 2:30PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-11-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection	Vangorda	0.094
Seismic-Refraction	Vangorda	0.094
GPR		
Total Line-km surveyed		0.188

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	10.5
Field Hand	Matthias Zinsli	10.5
Field Hand	Jeremy Beales	10.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted

OTHER

weather

Very warm and sunny. Heat stroke starting to be a significant risk.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 5pm. Tool box \ safety meting at 7am.
Equipment moved from the grum to the Vangorda and a single spread was surveyed.
The truck was packed and ready to leave at 4:15PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-12-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection	Vangorda	0.169
Seismic-Refraction	Vangorda	0.169
GPR		
Total Line-km surveyed		0.338

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11
Field Hand	Matthias Zinsli	11
Field Hand	Jeremy Beales	11
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather
Very warm and sunny.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 5:45pm. Tool box \ safety meting at 7am.
Finished the Vangorda reflection and refraction.
The truck was packed and ready to leave at 5:00PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-13-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction	Granite Outcrop	0.200
GPR		
Total Line-km surveyed		0.2

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	10.5
Field Hand	Matthias Zinsli	10.5
Field Hand	Jeremy Beales	10.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather
Very warm and sunny.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 5:30pm. Tool box \ safety meting at 7am.
The crew first set up to survey the RCD3 line but had to tear down and move to the Granite Outcrop line. Some problems with the trigger cable slowed things down and after delays and repairs, only one spread was surveyed.
The whole line was chained and flagged every 4m in preparation for the next 2 days.
The truck was packed and ready to leave at 5:00PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-14-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction	Granite Outcrop	0.200
GPR		
Total Line-km surveyed		0.2

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	11.5
Field Hand	Matthias Zinsli	11.5
Field Hand	Jeremy Beales	11.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Clear in the morning, turning to thunder showers and hail.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6:30pm. Tool box \ safety meting at 7am.
The crew first set up to seismic survey line on the Granite Outcrop while Shawn spent the morning in the office. By the afternoon the weather had turned and the crew had to wait and work in intervals between lightning sessions.
The truck was packed and ready to leave at 6:00PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-15-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction		
GPR	WTP	2.700
Total Line-km surveyed		2.7

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	1
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	10.5
Field Hand	Matthias Zinsli	10.5
Field Hand	Jeremy Beales	10.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Sunny some large clouds in morning, sunny/thundershowers in the afternoon.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 5pm. Tool box \ safety meting at 7am.
In case of forcasted lightning the crew switched plans and began resurveying the Water Treatment Plant with the 500 MHz antenna. All lines had to be chained out again and old station markers that had washed away were replaced.
Problems with the antenna ended the day's GPR surveying but all line stations were chained and marked.
A second antenna was arranged for delivery by Sunday at the latest.
The truck was packed and ready to leave at 4:15PM.

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-16-13

PREPARED BY: Shawn Scott

crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction	Granite Outcrop	0.600
GPR		
Total Line-km surveyed		0.6

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	10.5
Field Hand	Matthias Zinsli	10.5
Field Hand	Jeremy Beales	10.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Clear in the morning, cloudy in the afternoon, thgunderstorms in the evening.

Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6:30pm. Tool box \ safety meting at 7am.
A good productive day!
Three spreads of refraction seismic were surveyed and the Granite Outcrop line was completed.
Some difficulties when the sledge broke but this was fixed in time to avoid the lightning storm that was moving in.
The truck was packed and ready to leave at 5:15PM.

AURORA GEOSCIENCES

Faro Mine Remediation - Geophysical Surveys CHM-13536-YT

DAILY REPORT FORM

DATE:	August-17-13

PREPARED BY: Shawn Scott
crew chief

OPERATIONS

Item	*Survey Line Numbers*	*Line-km surveyed*
Line Cutting		
Resistivity		
Seismic-Reflection		
Seismic-Refraction	RCD3	0.400
GPR		
Total Line-km surveyed		0.4

LOGISTICS & EQUIPMENT

Type	*Description*	*Hrs or units*
Seismic Gear		1
Resisitivity gear		
ATV 1		
ATV 2		
ATV with mounted seismic source	Polaris w digipluse	
GPR Gear	25,50,100&500MHz	
Line cutting gear	Chainsaws used	
Hotel/B&B Accommodation	valley B&B	2 rooms
Truck 1	White	1 day
Lower tier subconsultant equipment/material		
Other		

PERSONNEL

Company / position	*Person*	*Hours worked*
Aurora - Crew chief	Shawn Scott	10.5
Field Hand	Matthias Zinsli	10.5
Field Hand	Jeremy Beales	10.5
Visitors onsite and purpose		
Other/lower tier subconsultant		
Total persons in camp		**3**

Previous Day's Field Report Submitted	

OTHER

weather

Cloudy and scattered showers.

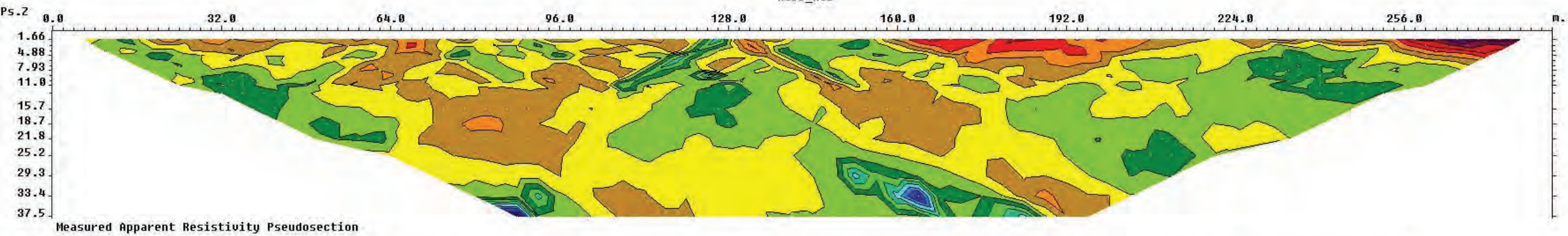
Notes (incidents, other)

Left B &B at 6:30 am, and arrived back at 6:30pm. Tool box \ safety meting at 7am.
Two spreads of refraction seismic were surveyed and the Rose Creek Drainage line 3 was completed.
Some additional time was spent detailing the topography on the Water Treatment Plant site.
The truck was packed and ready to leave at 5:00PM.

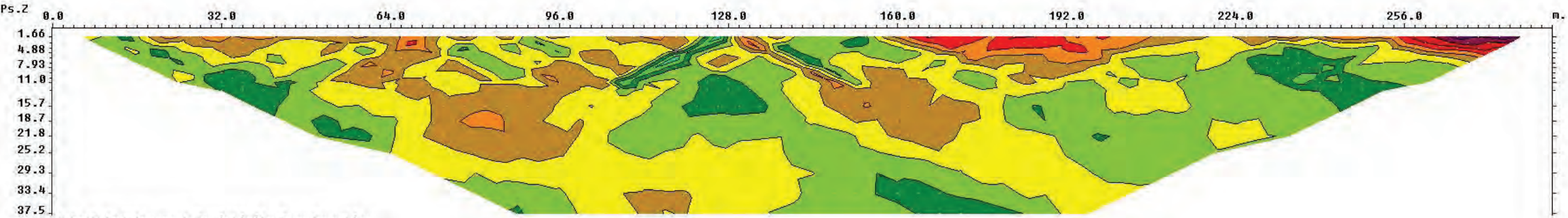
Appendix II

Resistivity Inversions

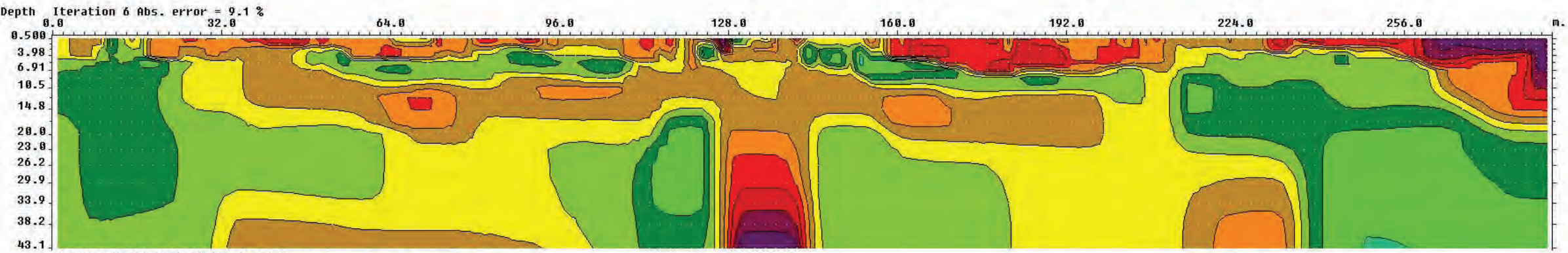
RCD5_Res



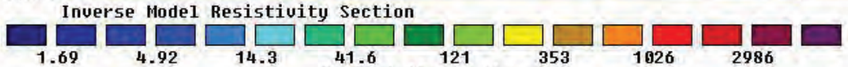
Measured Apparent Resistivity Pseudosection



Calculated Apparent Resistivity Pseudosection



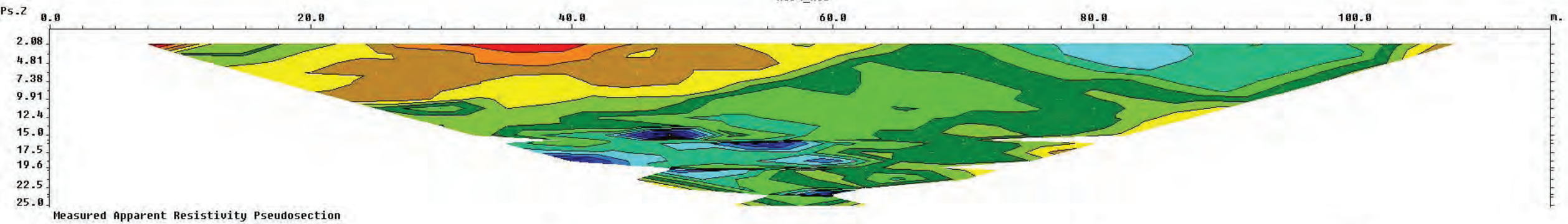
Inverse Model Resistivity Section

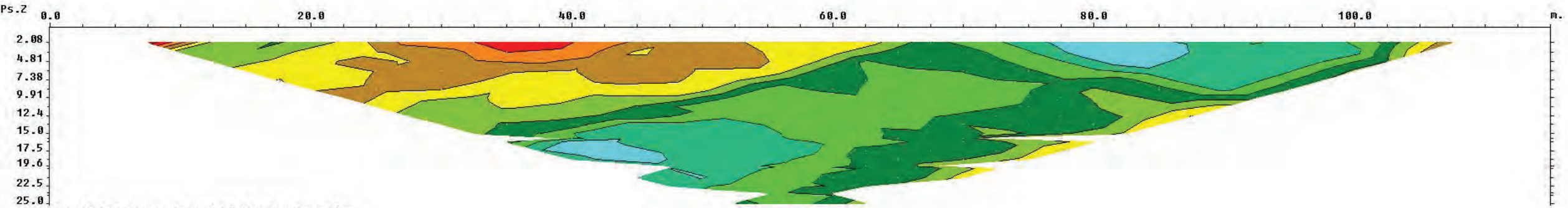


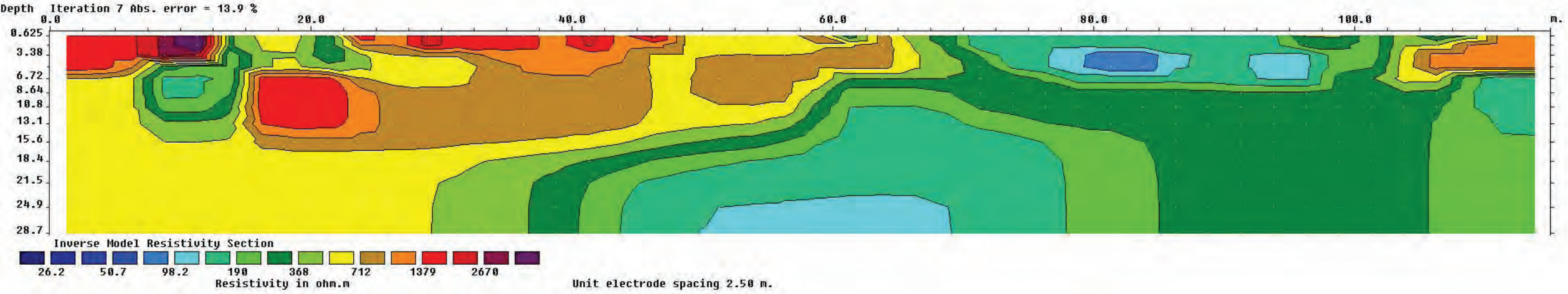
Resistivity in ohm.m

Unit electrode spacing 2.00 m.

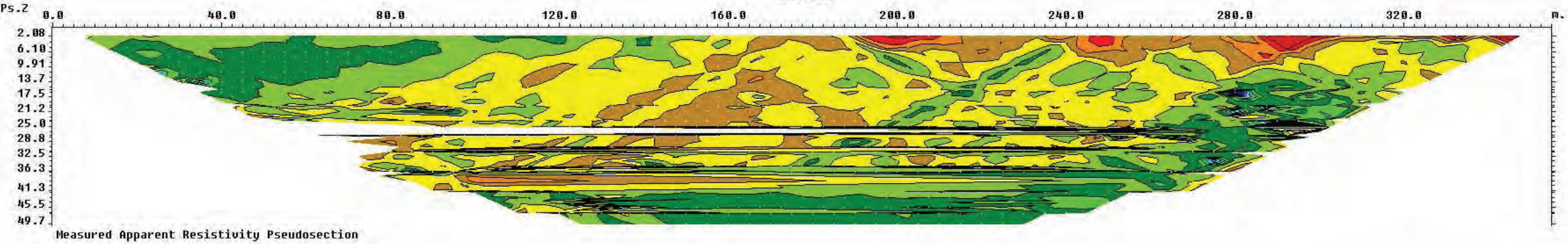
RCD4_Res


Ps.Z
0.0
20.0
40.0
60.0
80.0
100.0
m.
2.08
4.81
7.38
9.91
12.4
15.0
17.5
19.6
22.5
25.0
Measured Apparent Resistivity Pseudosection

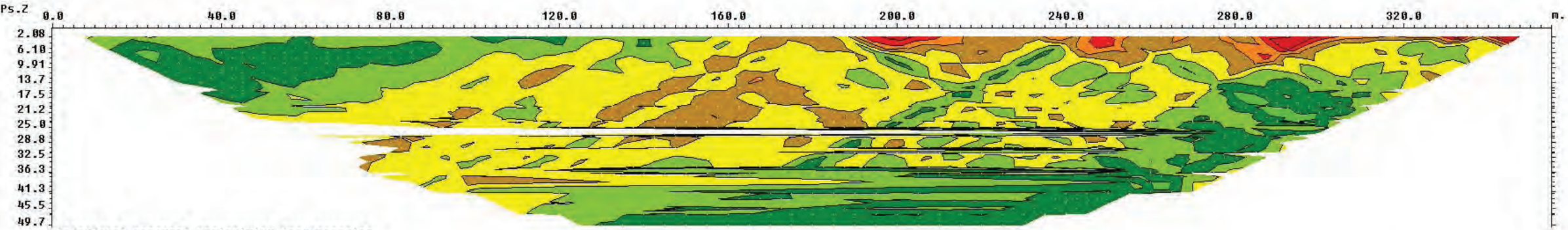

Ps.Z
0.0
20.0
40.0
60.0
80.0
100.0
m.
2.08
4.81
7.38
9.91
12.4
15.0
17.5
19.6
22.5
25.0
Calculated Apparent Resistivity Pseudosection


Depth
Iteration 7 Abs. error = 13.9 %
0.0
20.0
40.0
60.0
80.0
100.0
m.
0.625
3.38
6.72
8.64
10.8
13.1
15.6
18.4
21.5
24.9
28.7
Inverse Model Resistivity Section
26.2
50.7
98.2
190
368
712
1379
2670
Resistivity in ohm.m
Unit electrode spacing 2.50 m.

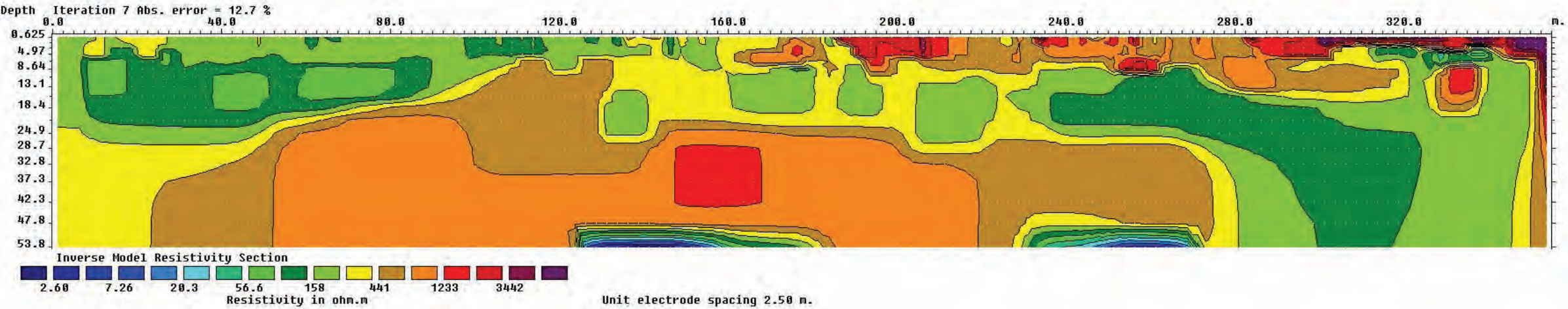
RCD3_Res



Measured Apparent Resistivity Pseudosection



Calculated Apparent Resistivity Pseudosection

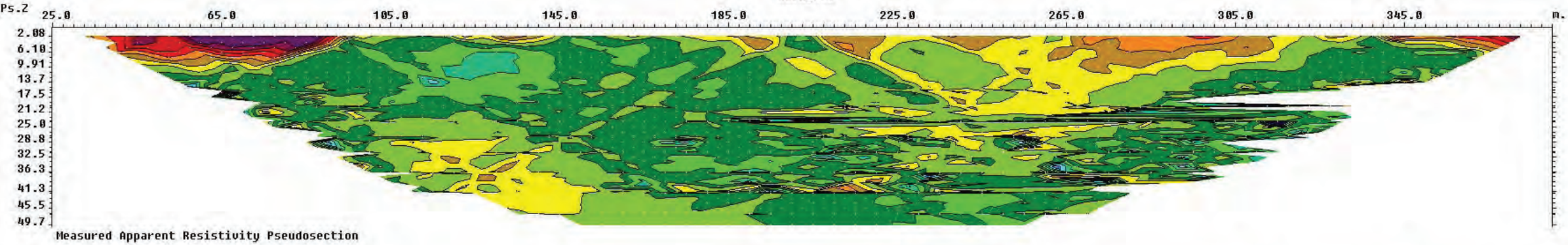


Inverse Model Resistivity Section

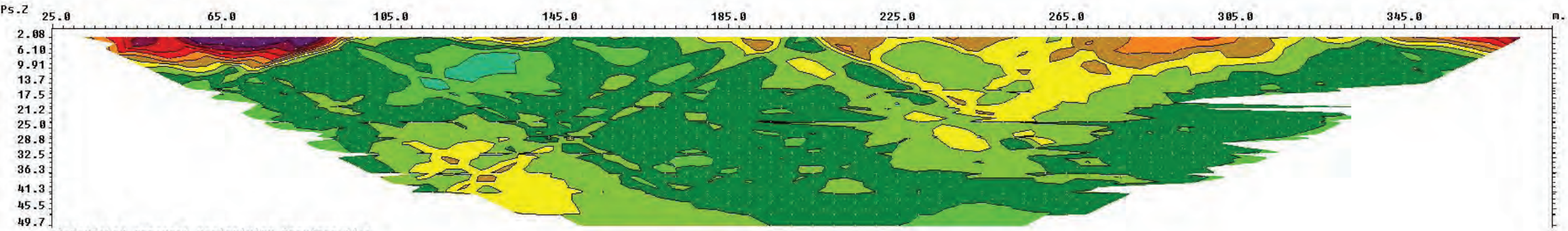
Resistivity in ohm.m

Unit electrode spacing 2.50 m.

RCD2_Res

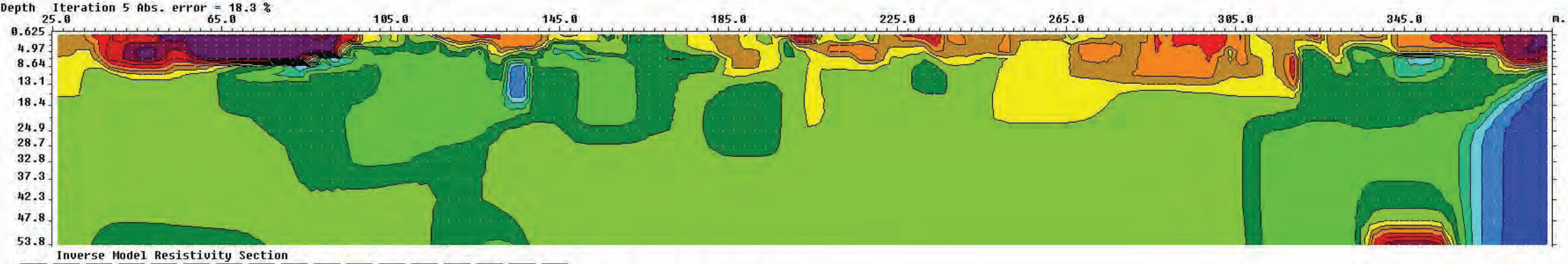


Measured Apparent Resistivity Pseudosection



Calculated Apparent Resistivity Pseudosection

Depth Iteration 5 Abs. error = 18.3 %

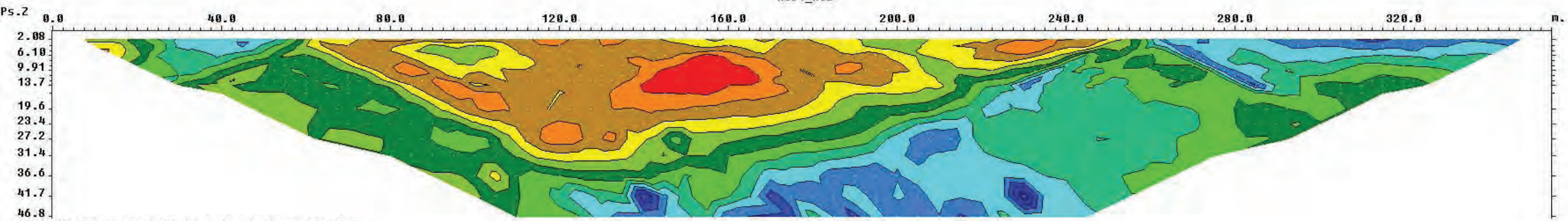


Inverse Model Resistivity Section

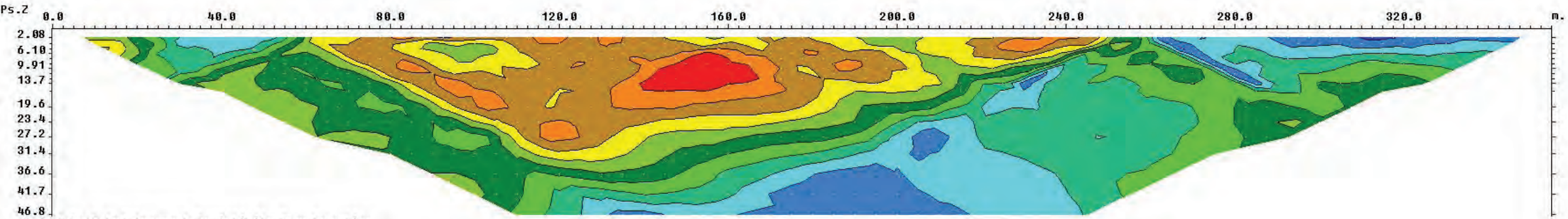
Resistivity in ohm.m

Unit electrode spacing 2.50 m.

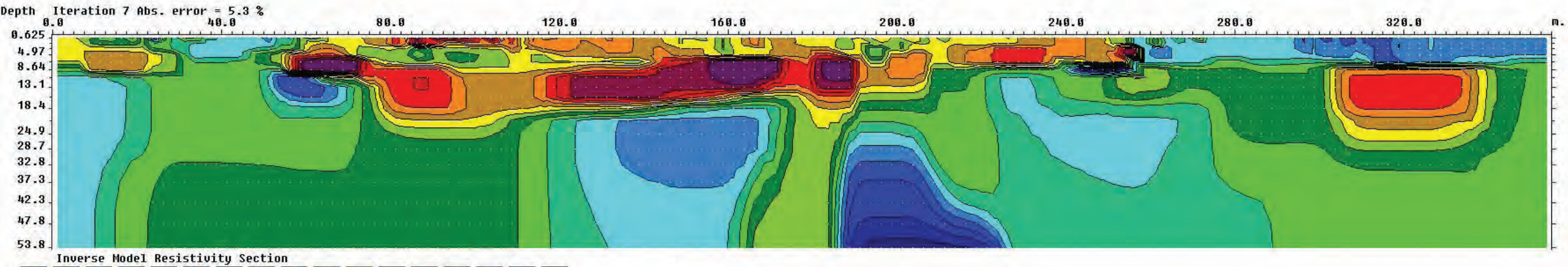
RCD1_Res



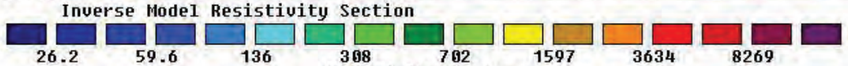
Measured Apparent Resistivity Pseudosection



Calculated Apparent Resistivity Pseudosection



Inverse Model Resistivity Section



Resistivity in ohm.m

Unit electrode spacing 2.50 m.

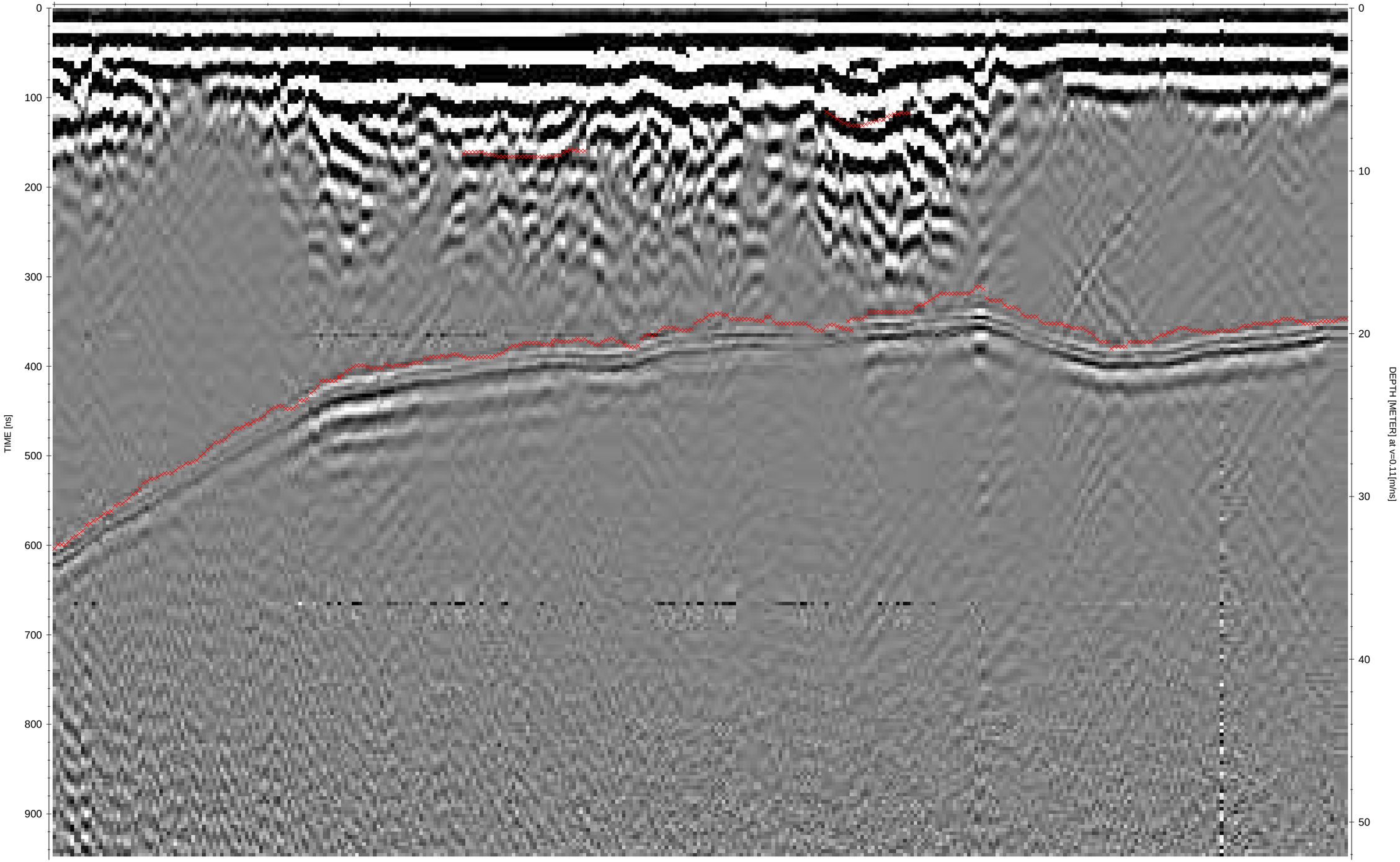
Appendix III

GPR Radargrams

RCD-1 - 25MHz

YP000000.05T

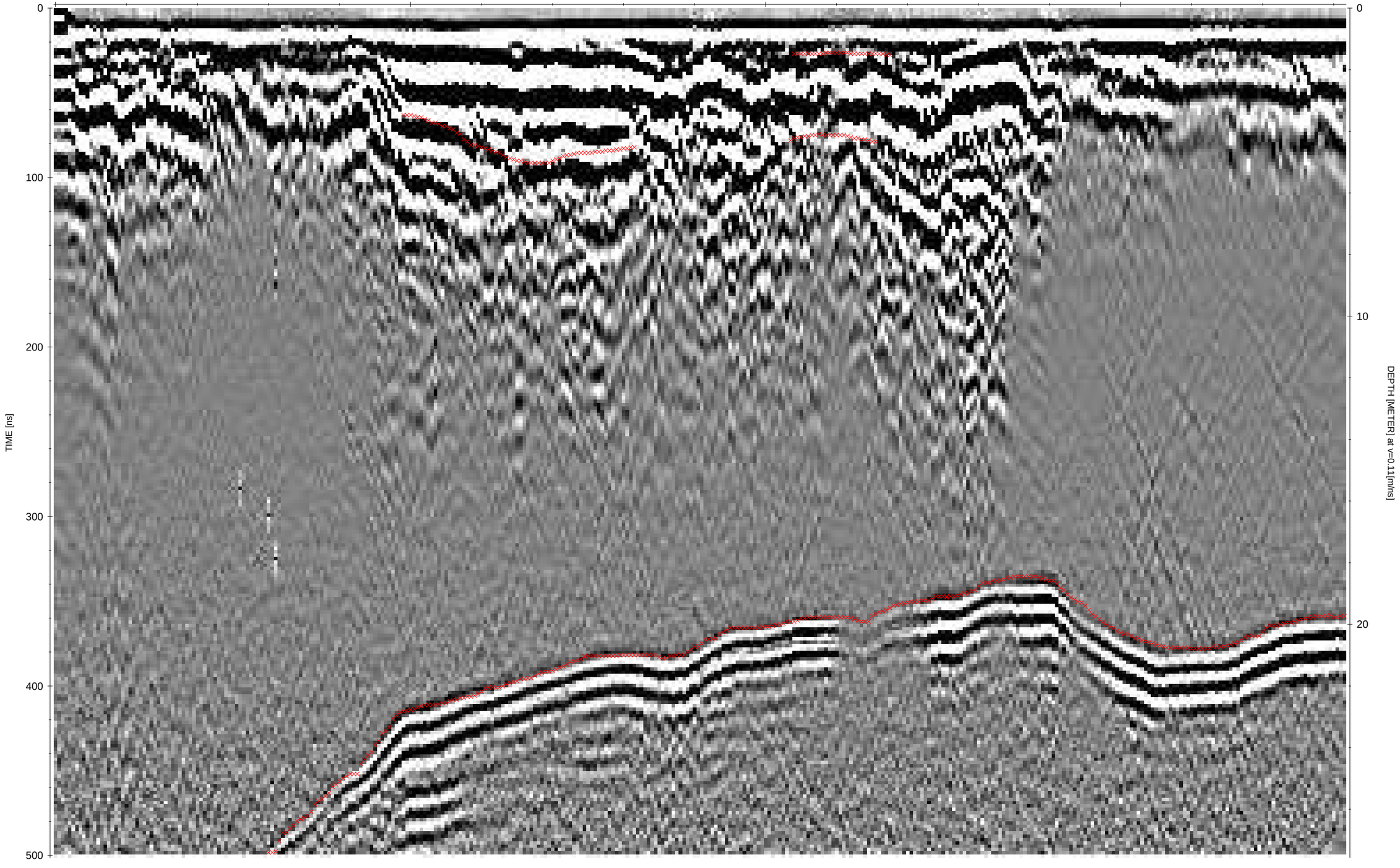
DISTANCE [METER]

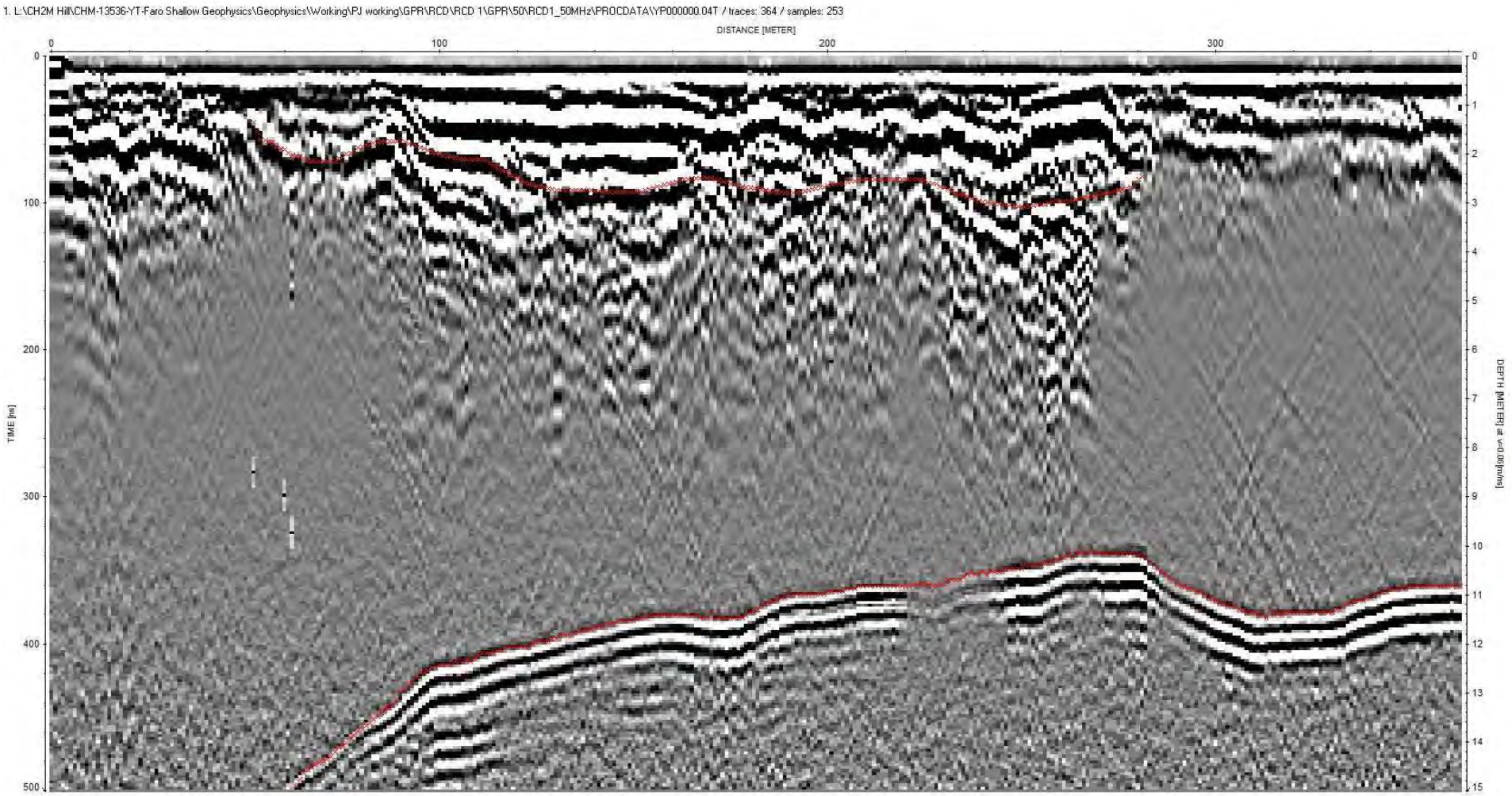


RCD-1 - 50MHz

YP000000.04T

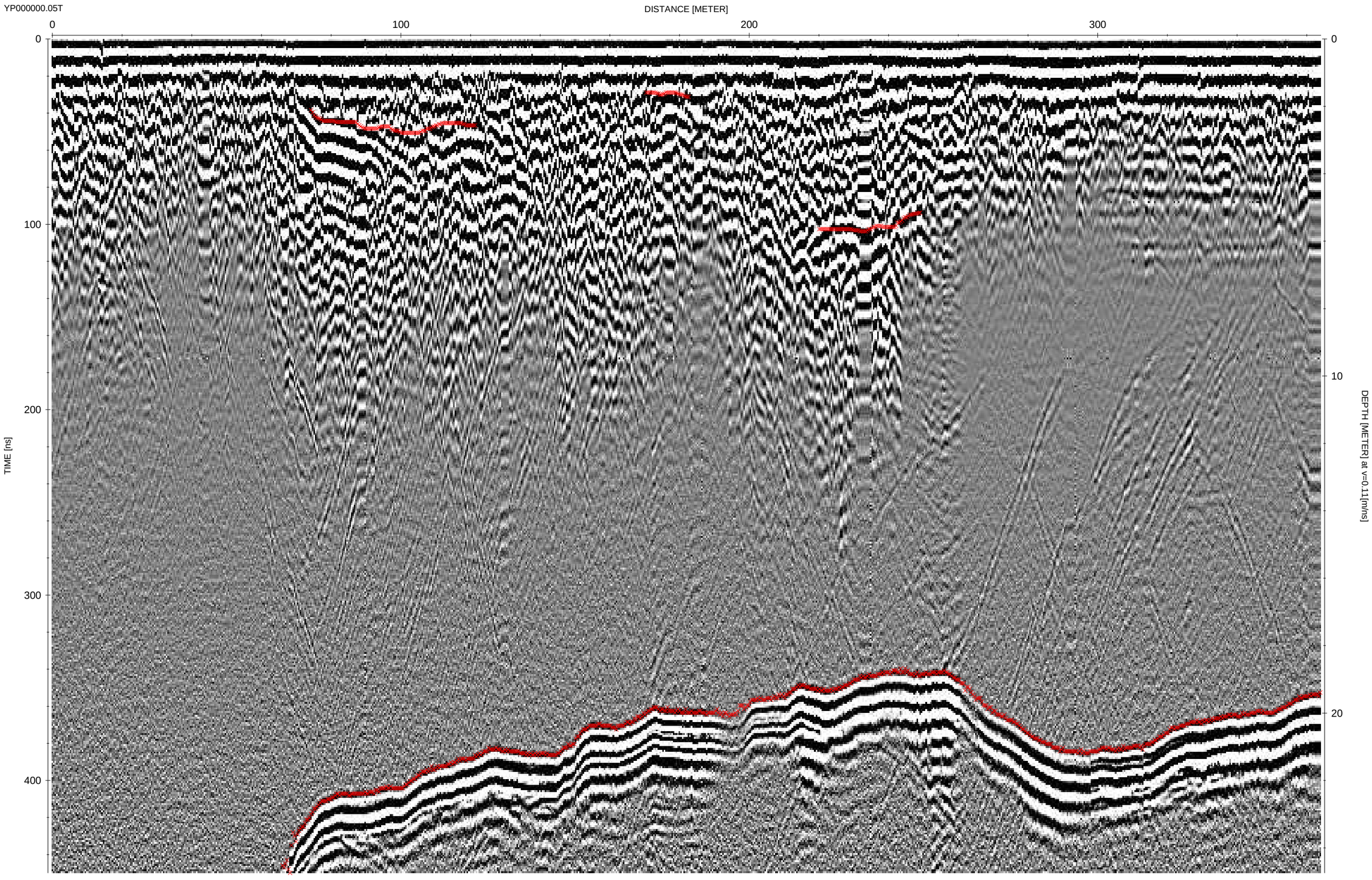
DISTANCE [METER]




1. L:\CH2M Hill\CHM-13536-YT-Faro Shallow Geophysics\Geophysics\Working\PJ working\GPR\RCD\RCD 1\GPR\50\RCD1_50MHz\PROCDATA\YP000000.04T / traces: 364 / samples: 253
DISTANCE [METER]
0
100
200
300
TIME [ns]
0
100
200
300
400
500
DEPTH [METER] at v=0.06[m/ns]
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

RCD-1 - 100MHz

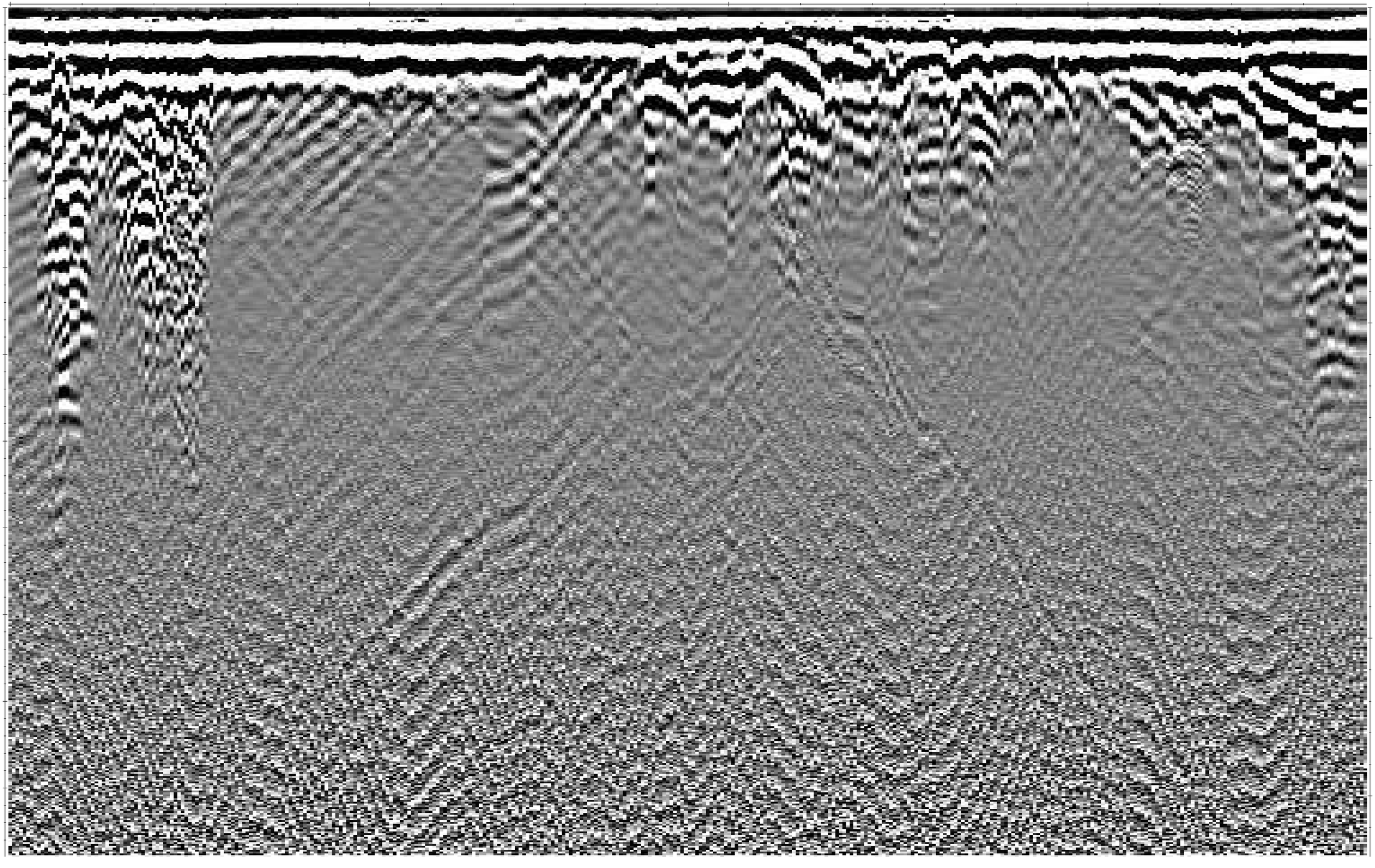
YP000000.05T



RCD2 - 25MHz

YP000000.05T

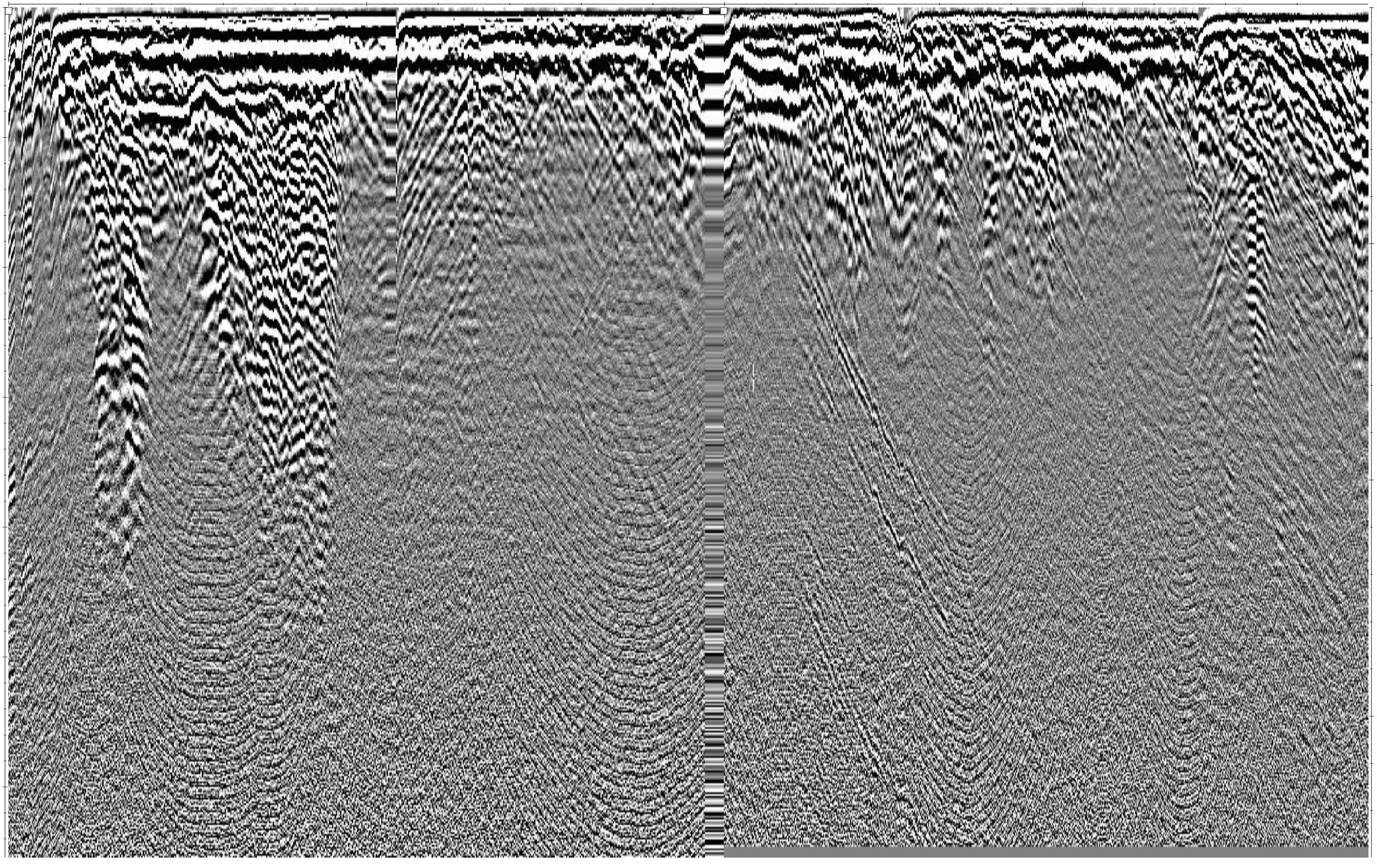
DISTANCE [METER]



RCD2 - 50MHz

YP000000.06T

DISTANCE [METER]



RCD2 - 100MHz

YP000000.09T

DISTANCE [METER]

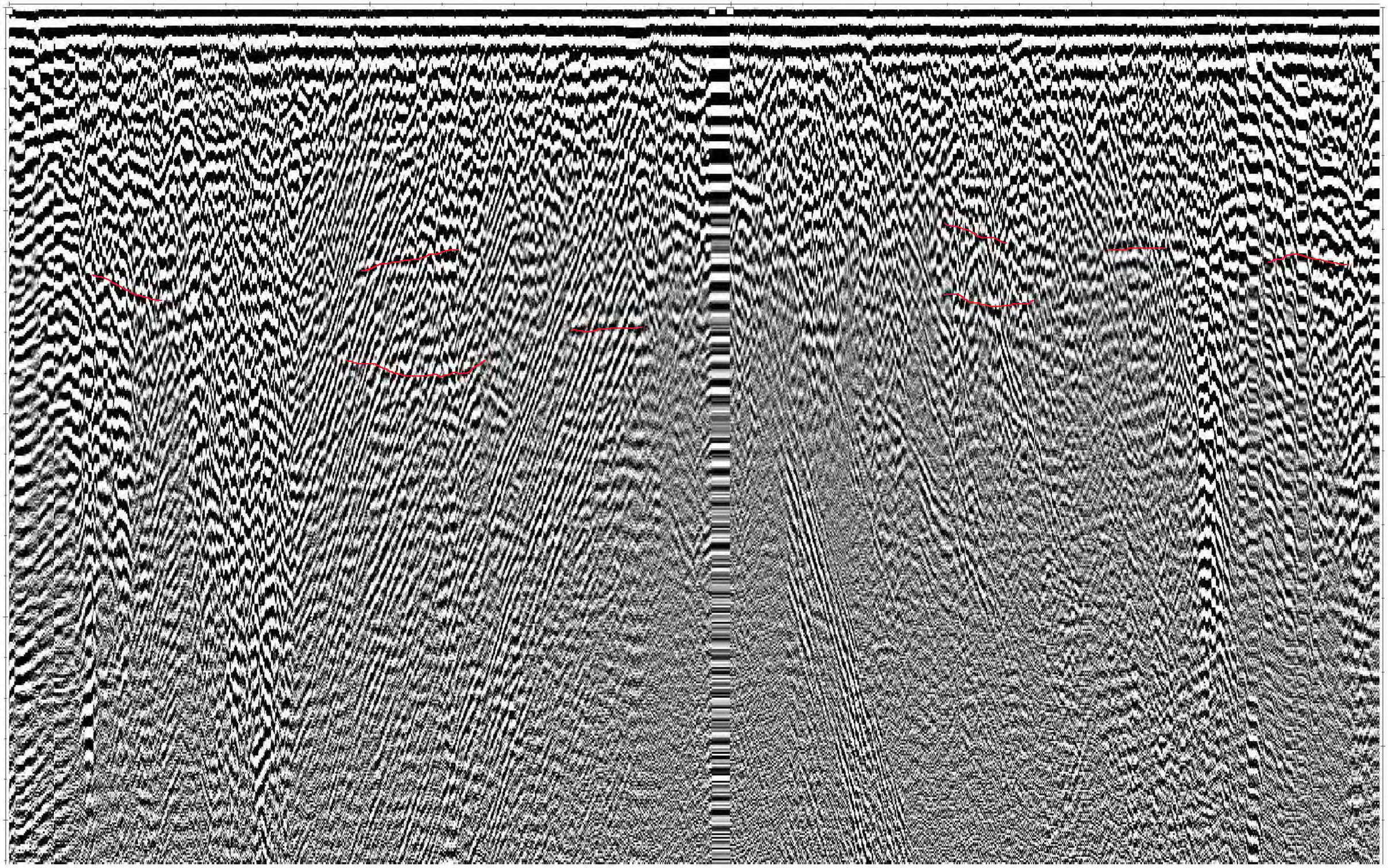
0 100 200 300

TIME [ns]

0 100 200 300 400

DEPTH [METER] at v=0.11[m/ns]

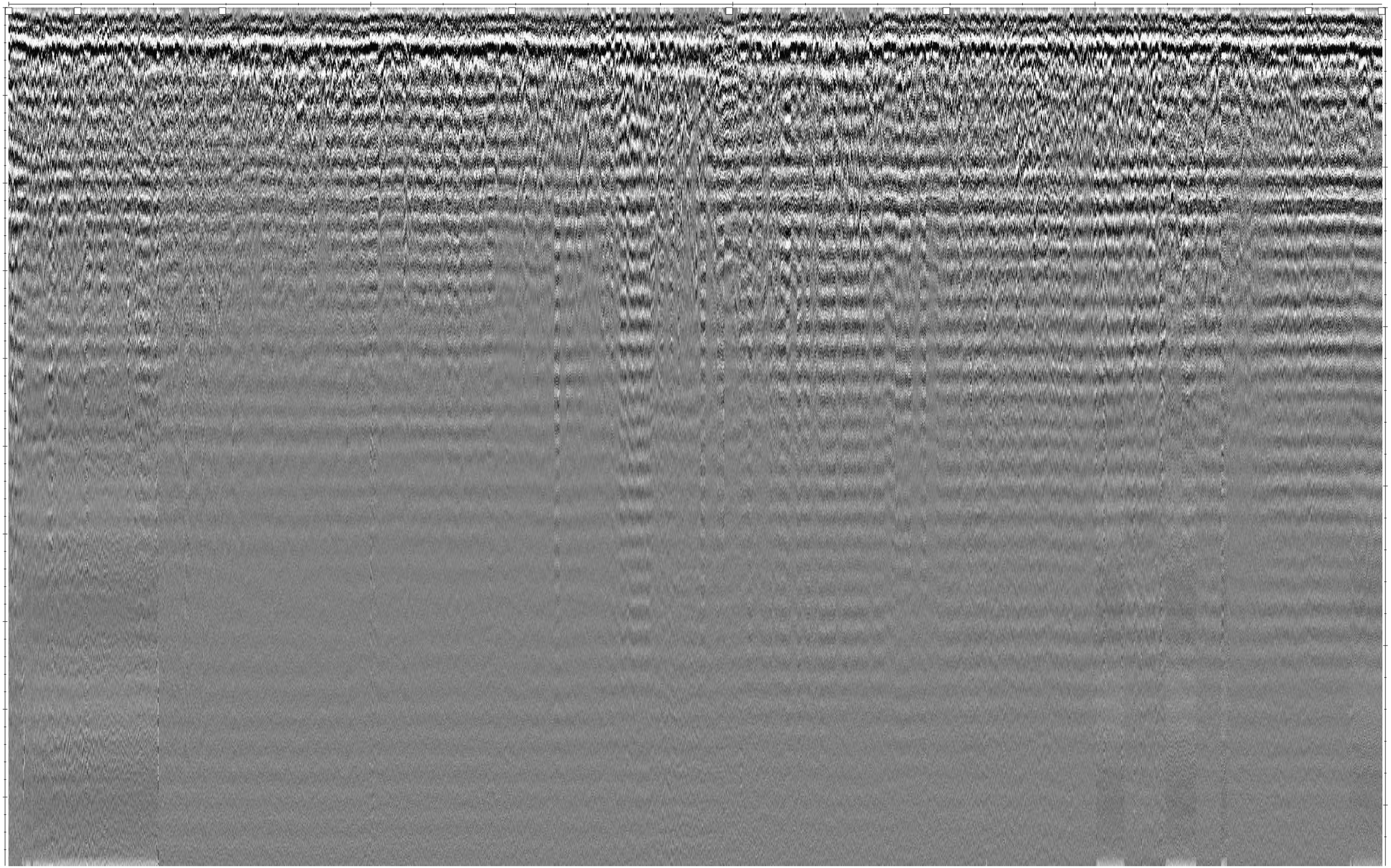
0 10 20



RCD2 - 500MHz

YP000000.05T

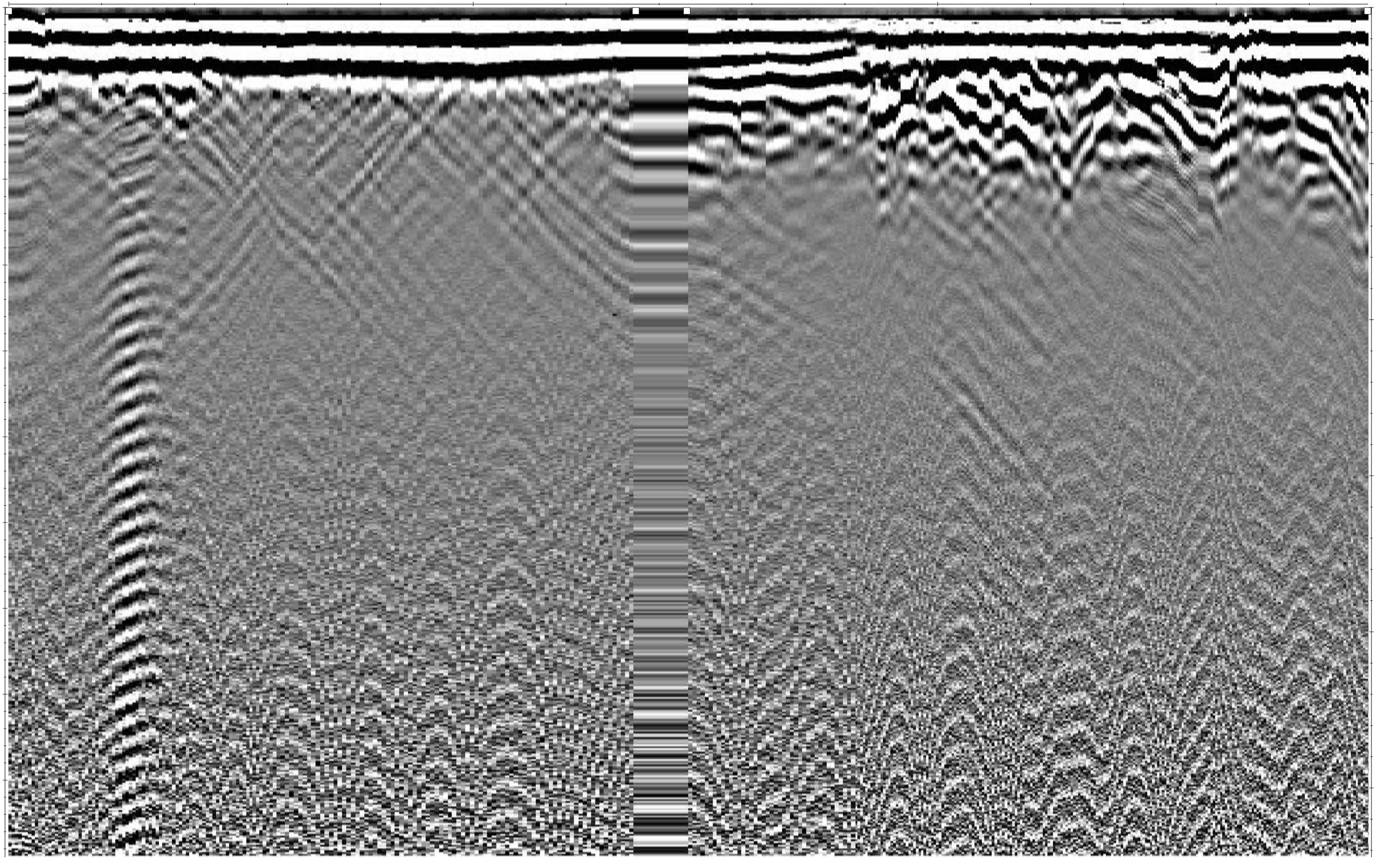
DISTANCE [METER]



RCD3 - 25MHz

YP000000.05T

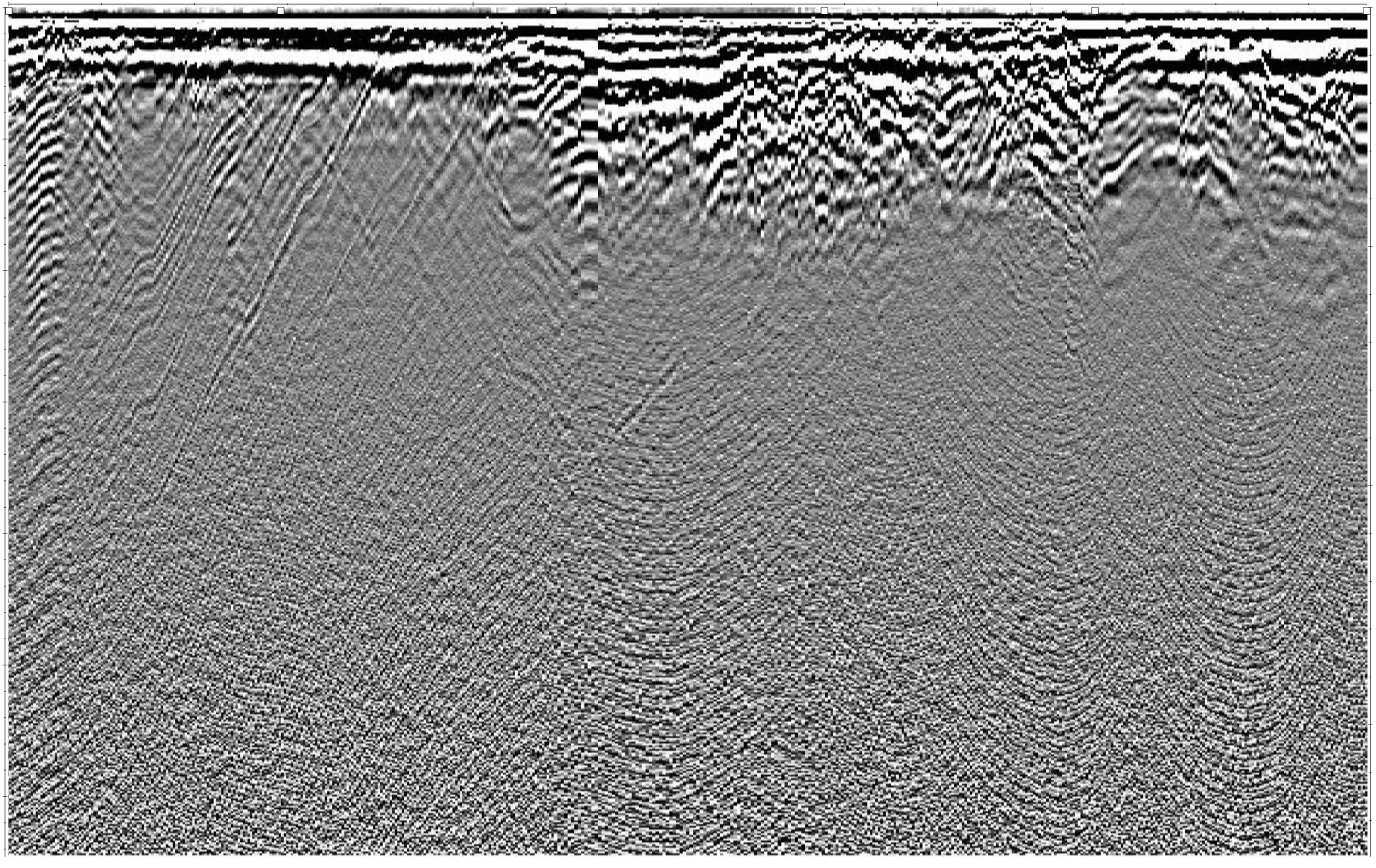
DISTANCE [METER]



RCD3 - 50MHz

YP000000.06T

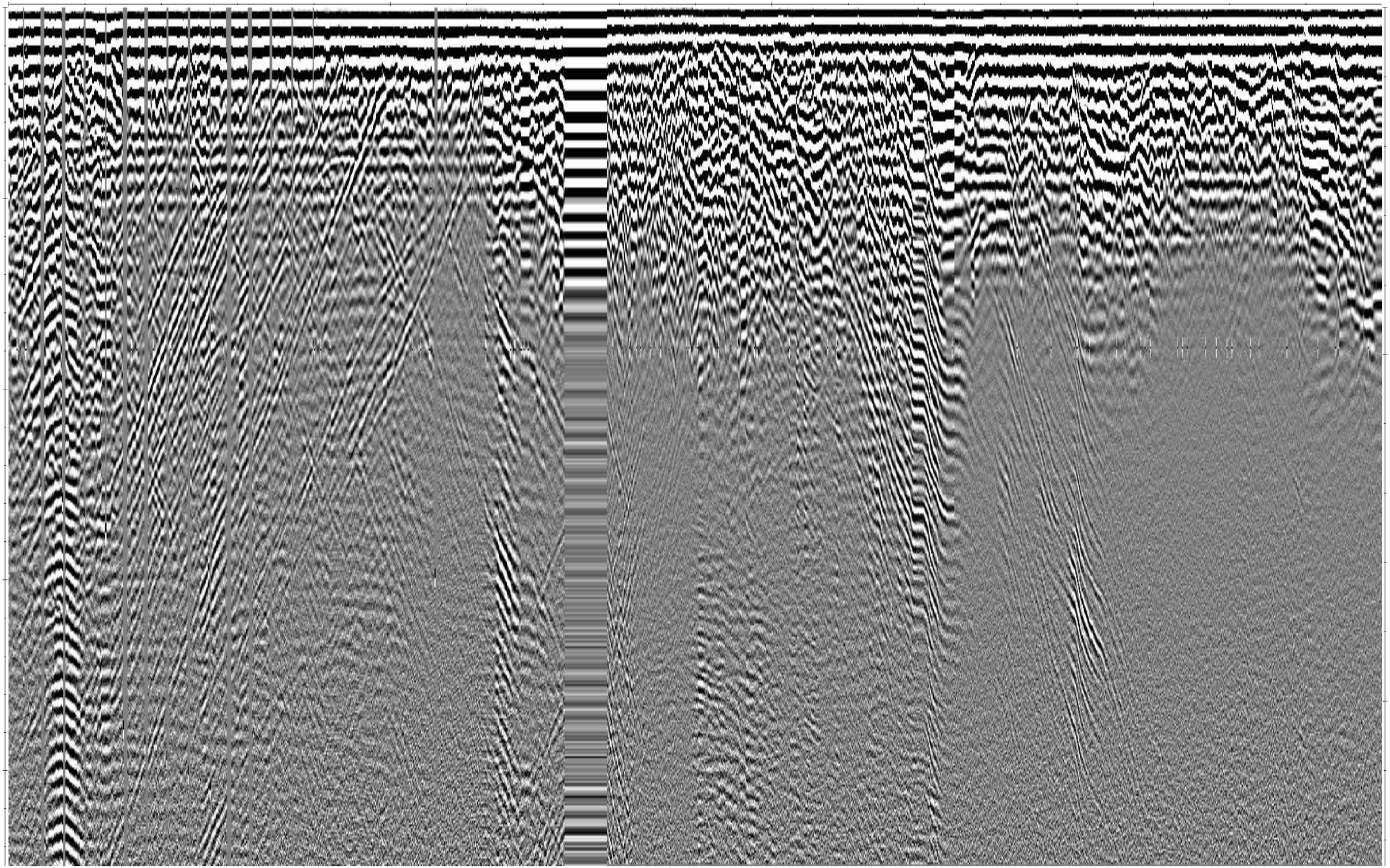
DISTANCE [METER]



RCD3 - 100MHz

YP000000.09T

DISTANCE [METER]



RCD4 - 25MHz

YP000000.06T

DISTANCE [METER]

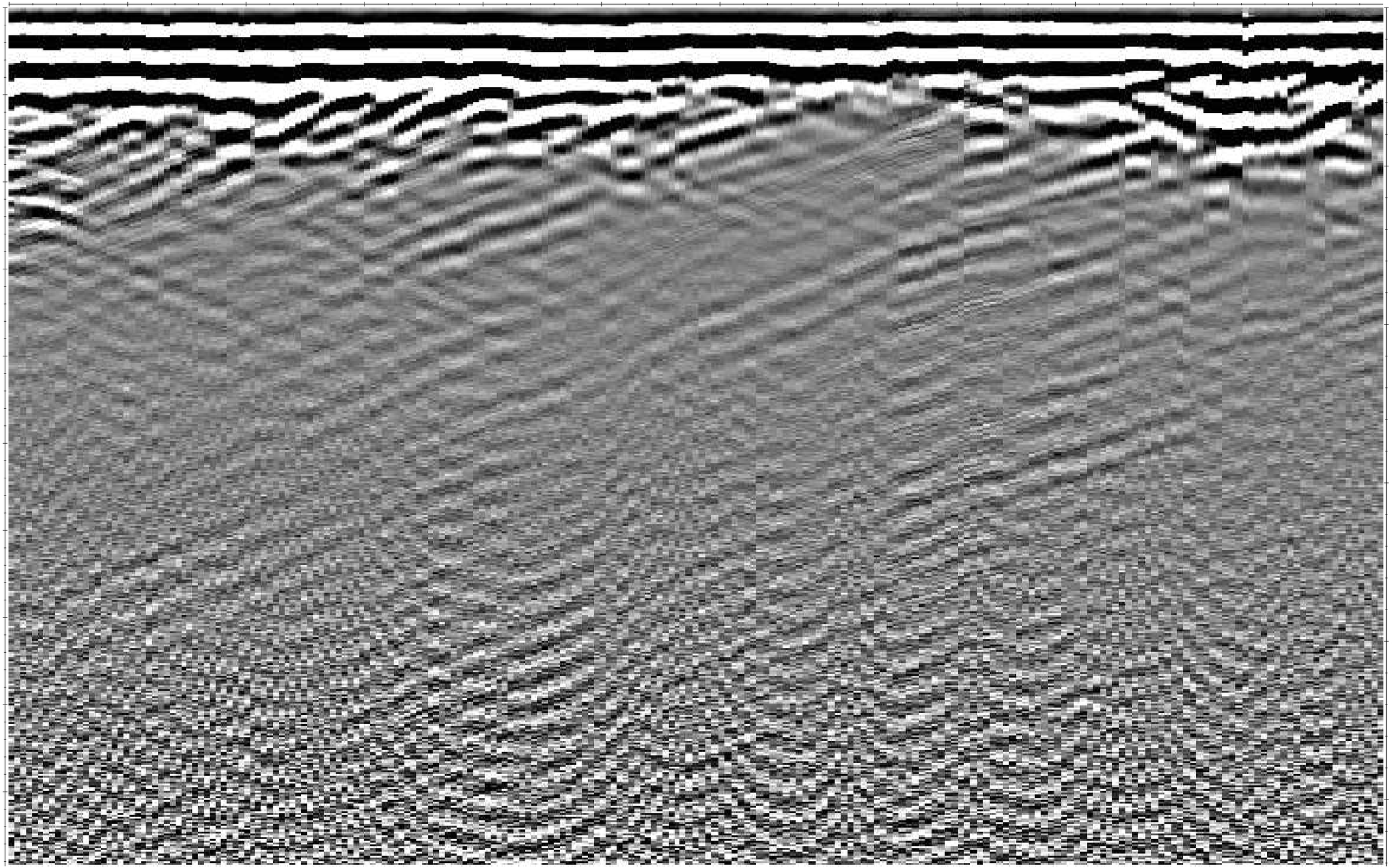
0 10 20 30 40 50 60 70 80 90 100 110

TIME [ns]

0 100 200 300 400 500 600 700 800 900

DEPTH [METER] at v=0.11[m/ns]

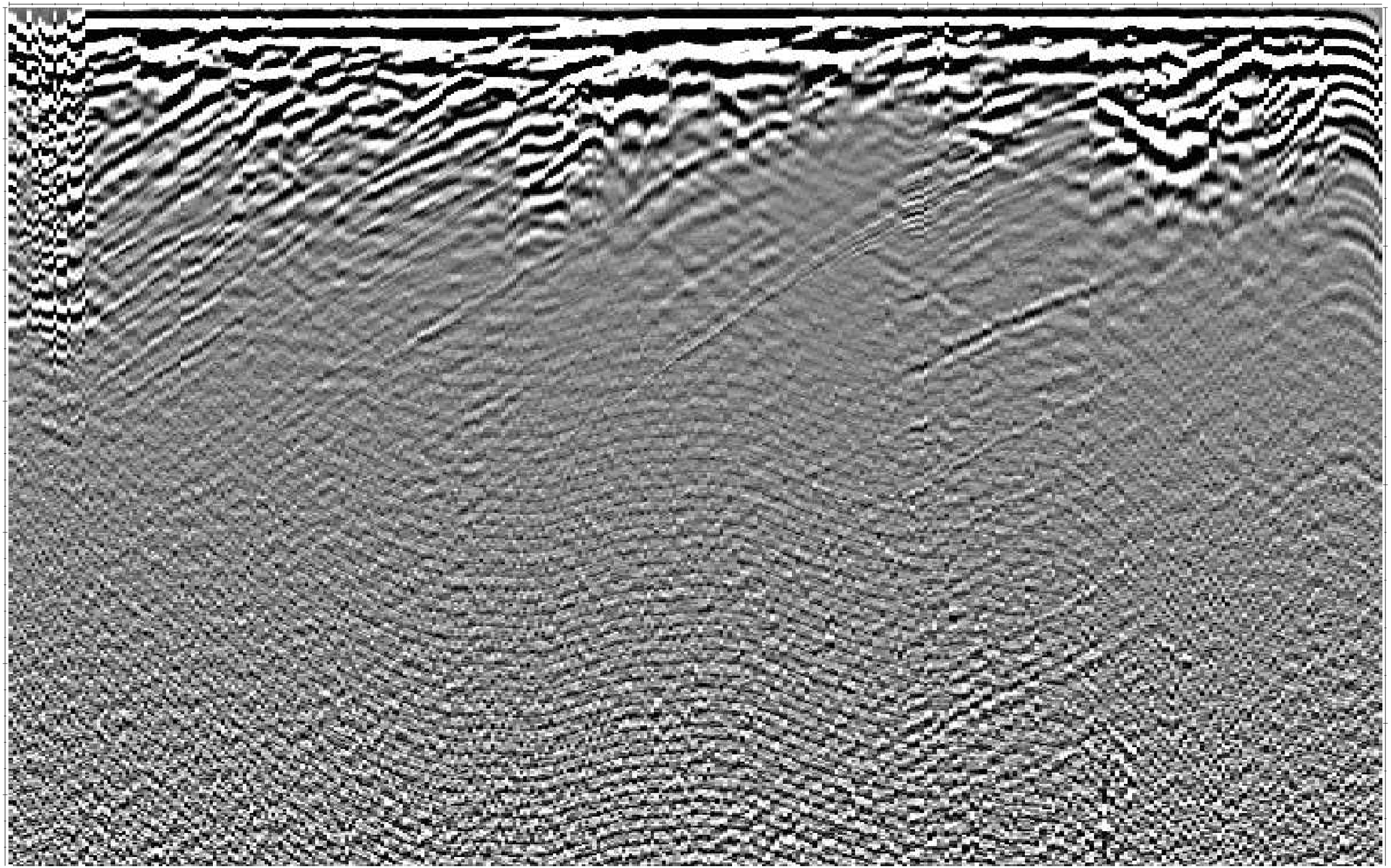
0 10 20 30 40 50



RCD4 - 50MHz

YP000000.07T

DISTANCE [METER]



RCD4 - 100MHz

YP000000.04T

DISTANCE [METER]

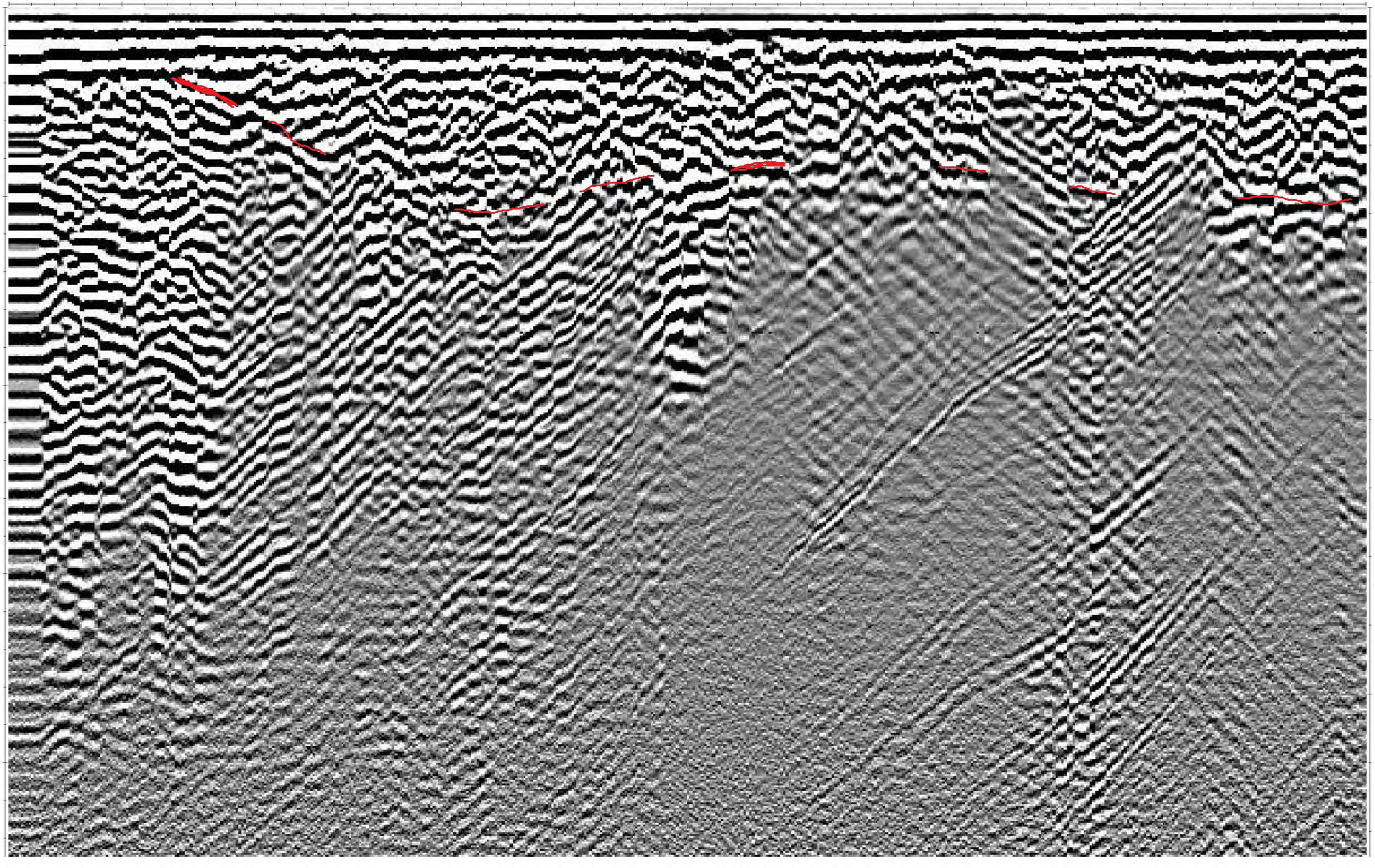
0 10 20 30 40 50 60 70 80 90 100 110 120

TIME [ns]

0 100 200 300 400

DEPTH [METER] at v=0.11[m/ns]

0 10 20



RCD4 - 500MHz

YP000000.04T

DISTANCE [METER]

0 10 20 30 40 50 60 70 80 90 100 110 120

TIME [ns]

0 10 20 30 40 50 60 70 80 90

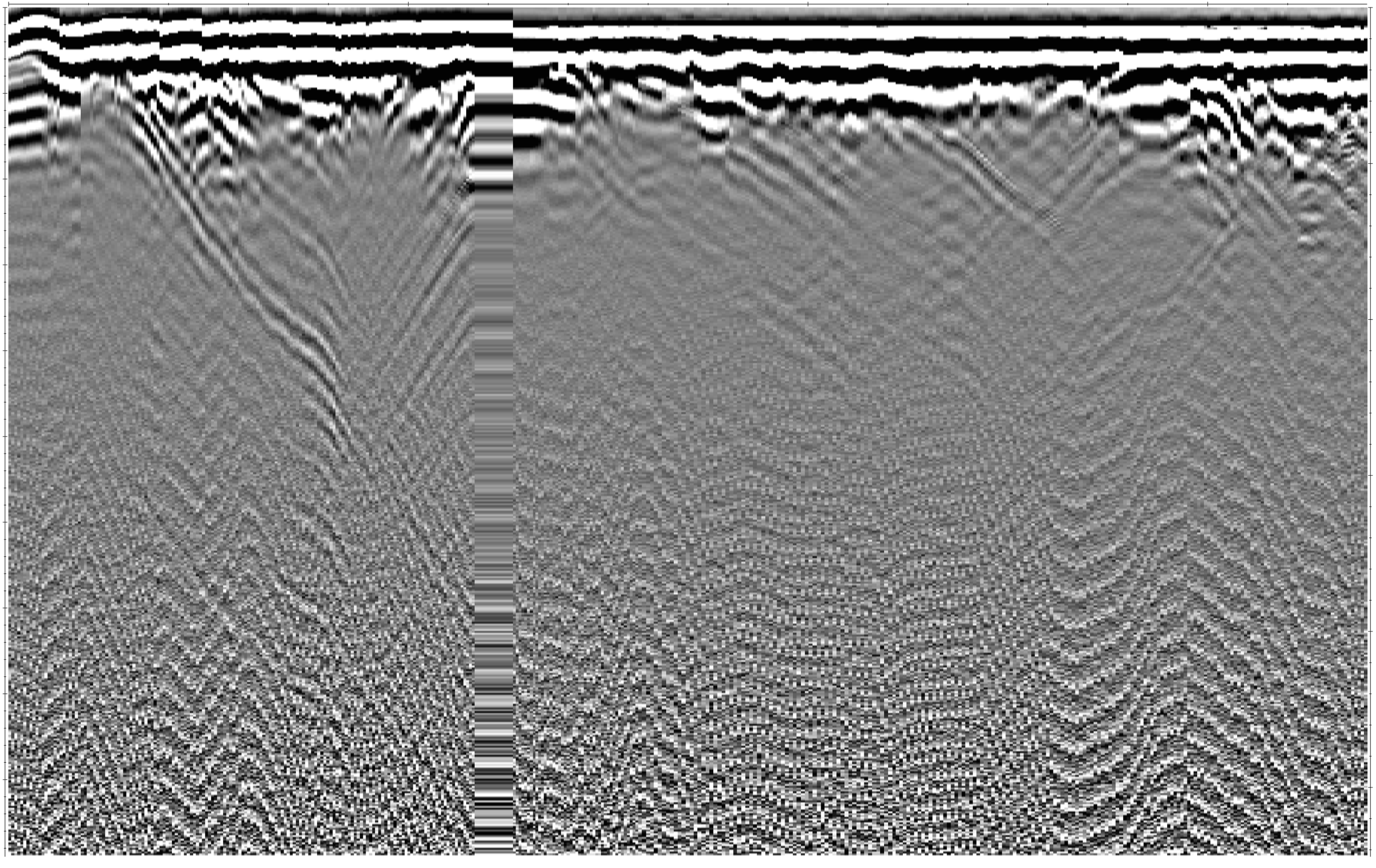
DEPTH [METER] at v=0.11[m/ns]

0 1 2 3 4 5

RCD5 - 25MHz

YP000000.05T

DISTANCE [METER]



RCD5 - 50MHz

YP000000.06T

DISTANCE [METER]

0 100 200 300

TIME [ns]

0 100 200 300 400 500 600

DEPTH [METER] at v=0.11[m/ns]

0 10 20 30

RCD5 - 100MHz

YP000000.05T

DISTANCE [METER]

0 100 200 300

TIME [ns]

0 100 200 300 400

DEPTH [METER] at v=0.11[m/ns]

0 10 20

RCD5 - 500MHz

YP000000.04T

DISTANCE [METER]

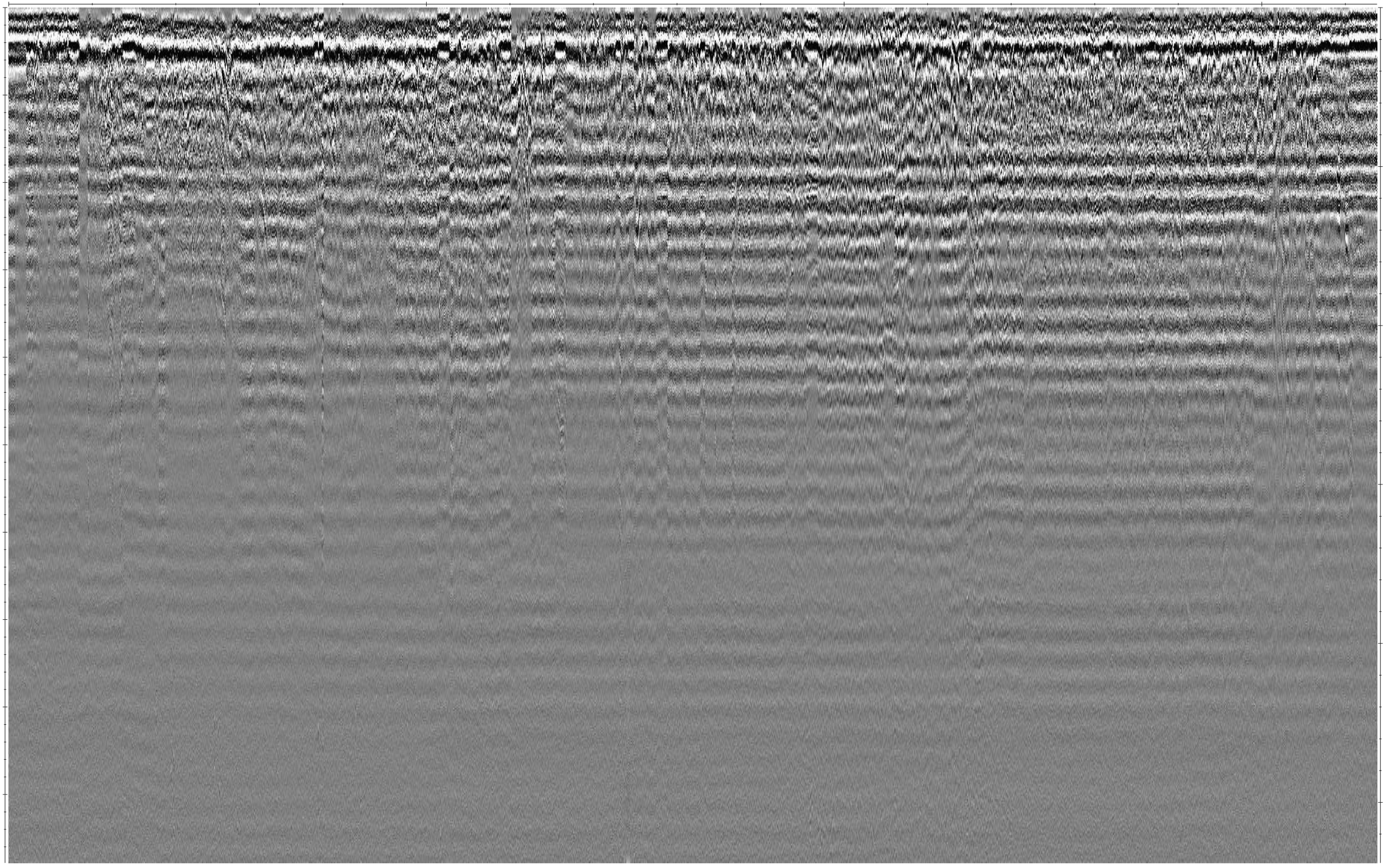
0 100 200 300

TIME [ns]

0 10 20 30 40 50 60 70 80 90

DEPTH [METER] at v=0.11[m/ns]

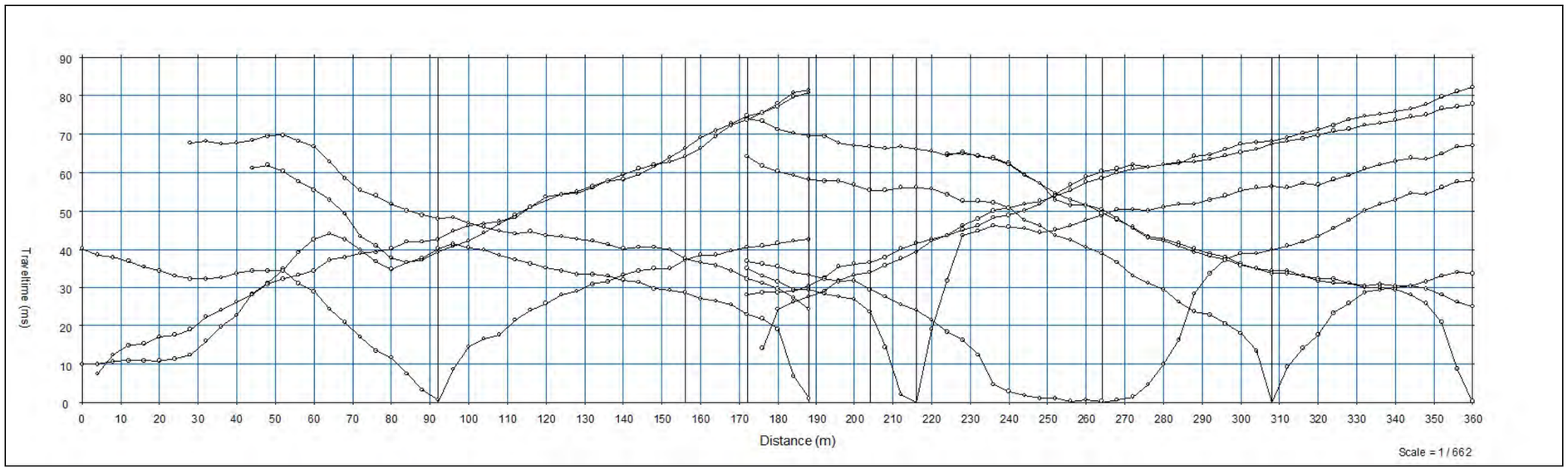
0 1 2 3 4 5



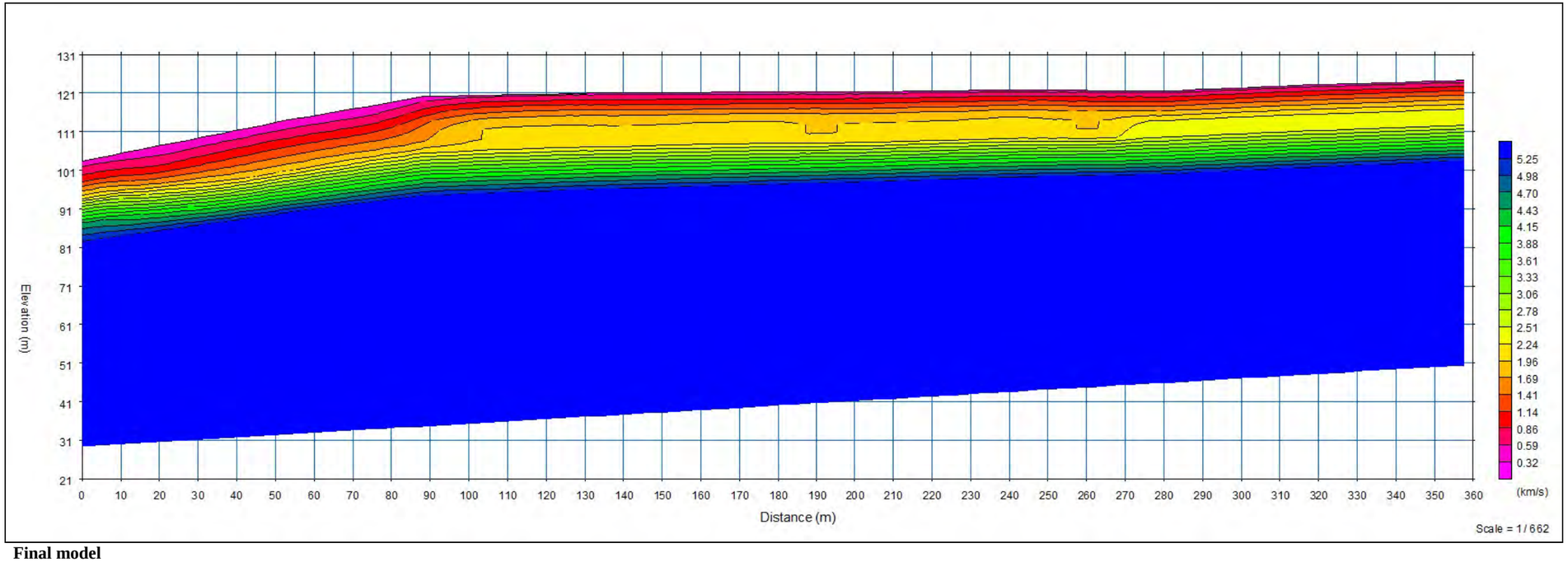
Appendix IV

Seismic Refraction Sections

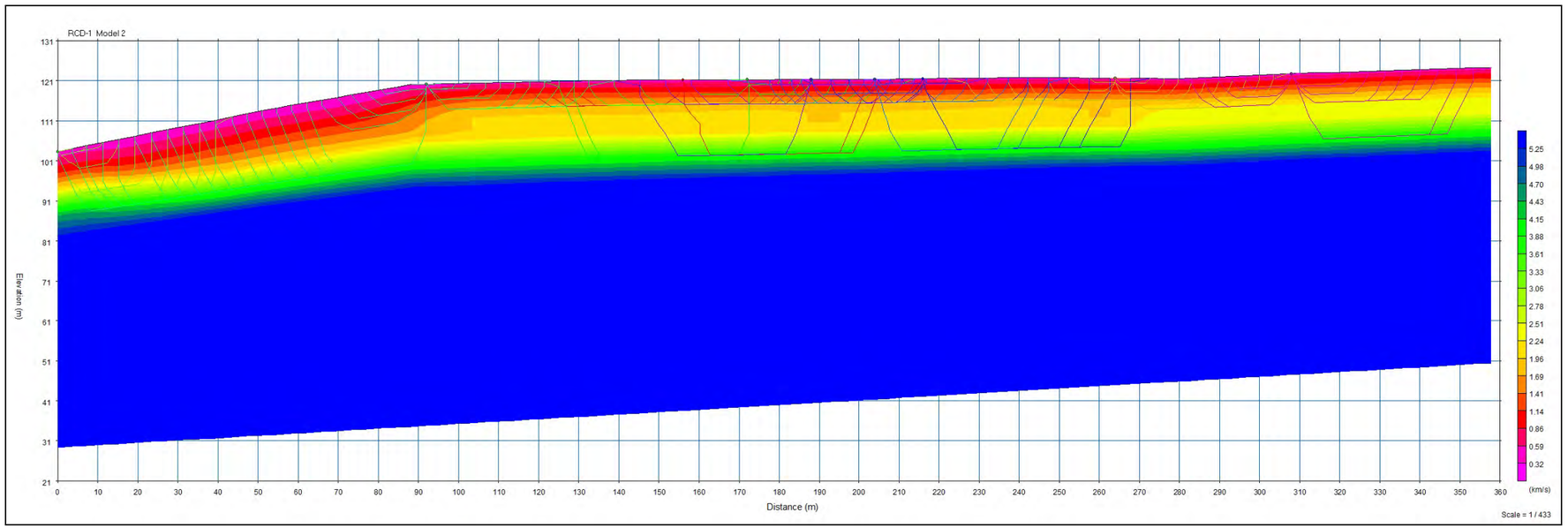
Line RCD-1



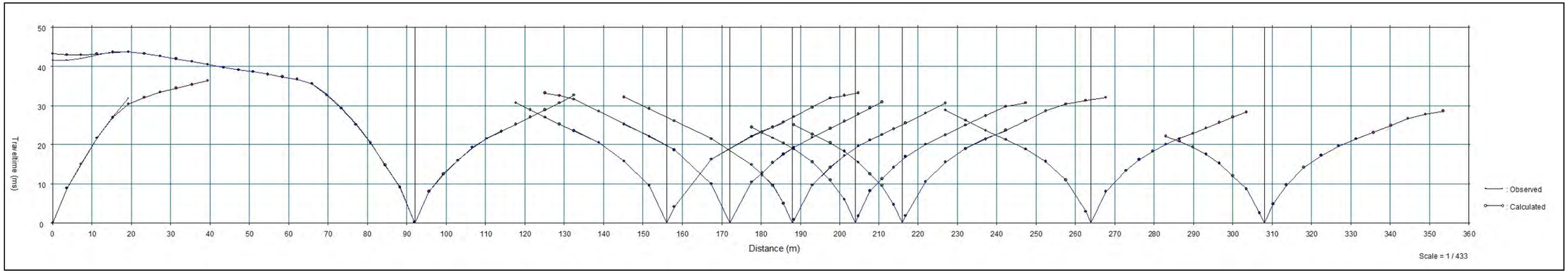
Raw travel time curves



Final model

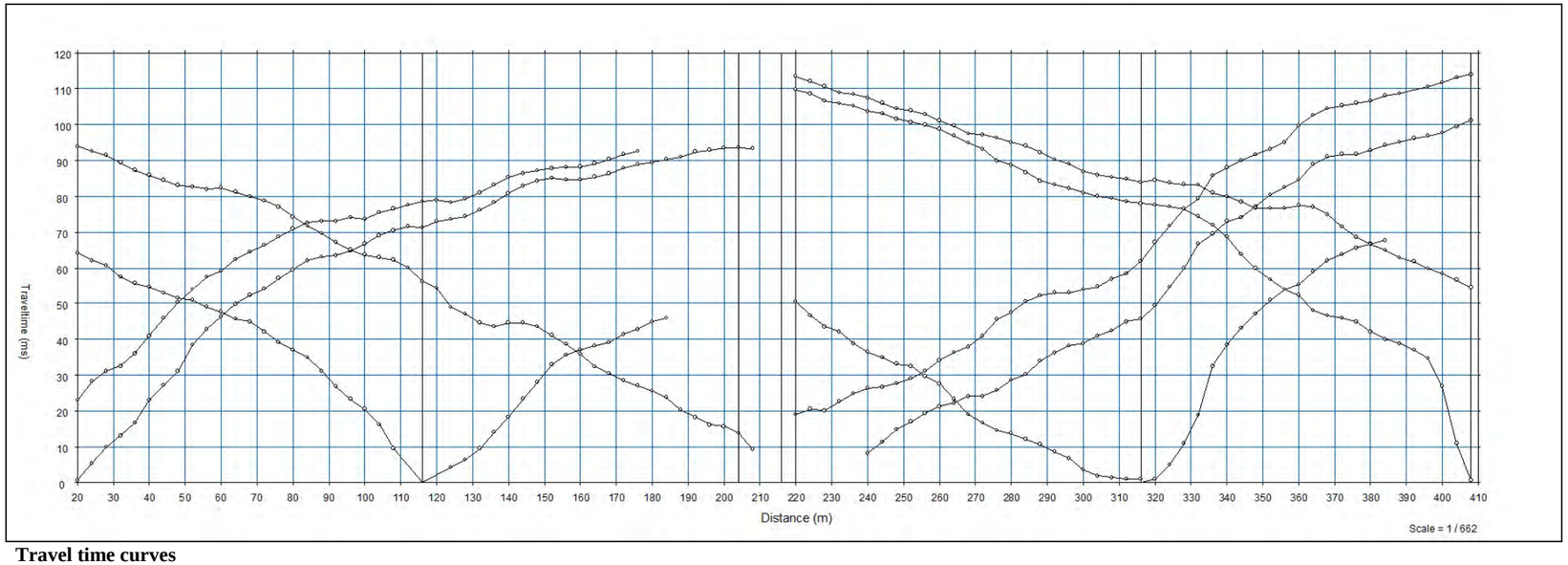


Ray tracing - final model

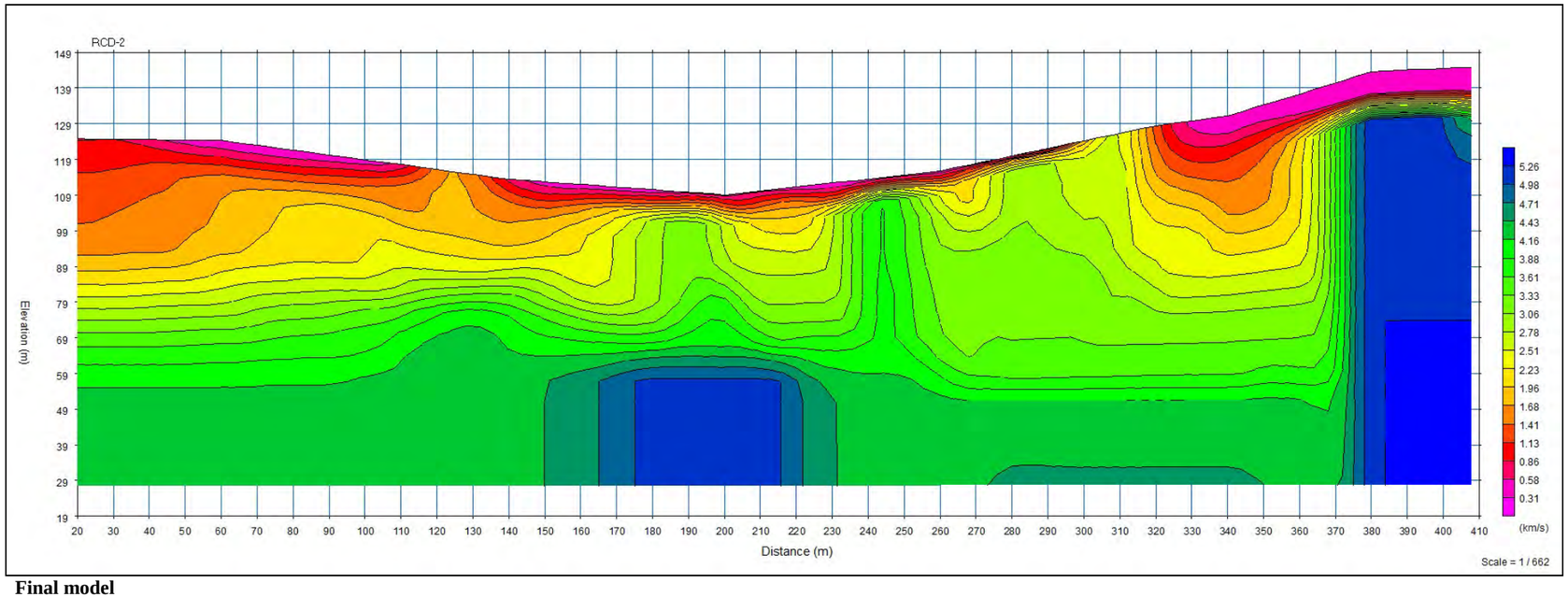


Inversion resulte

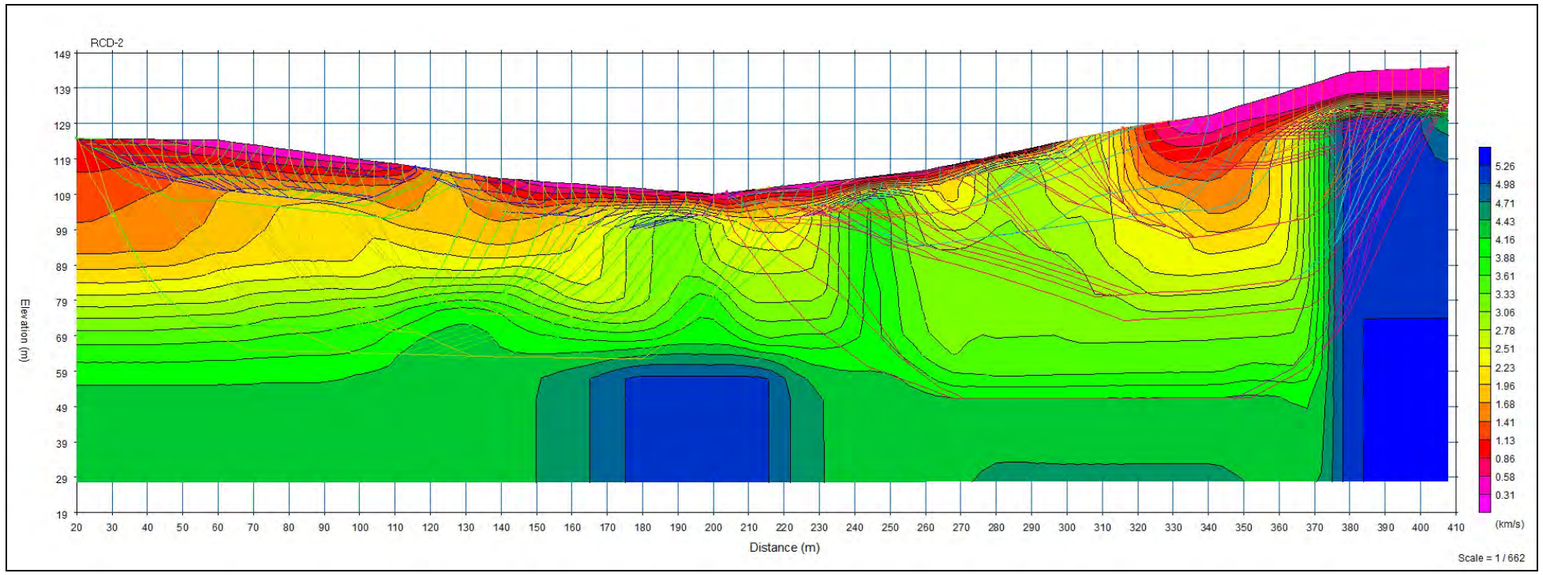
Line RCD-2



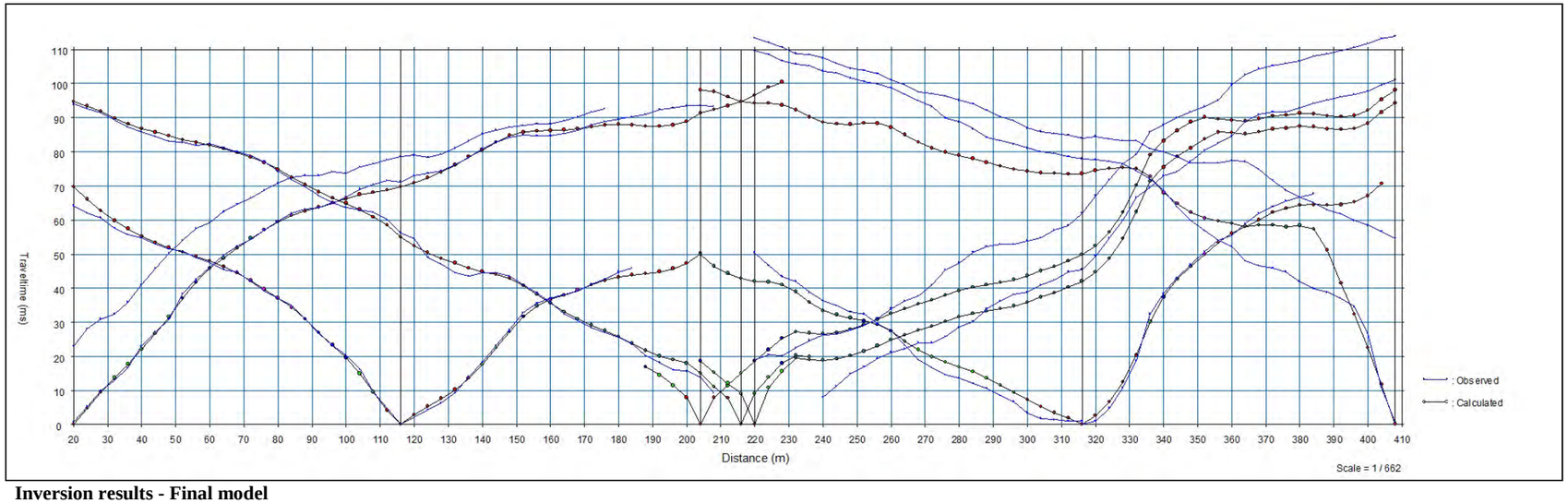
Travel time curves



Final model

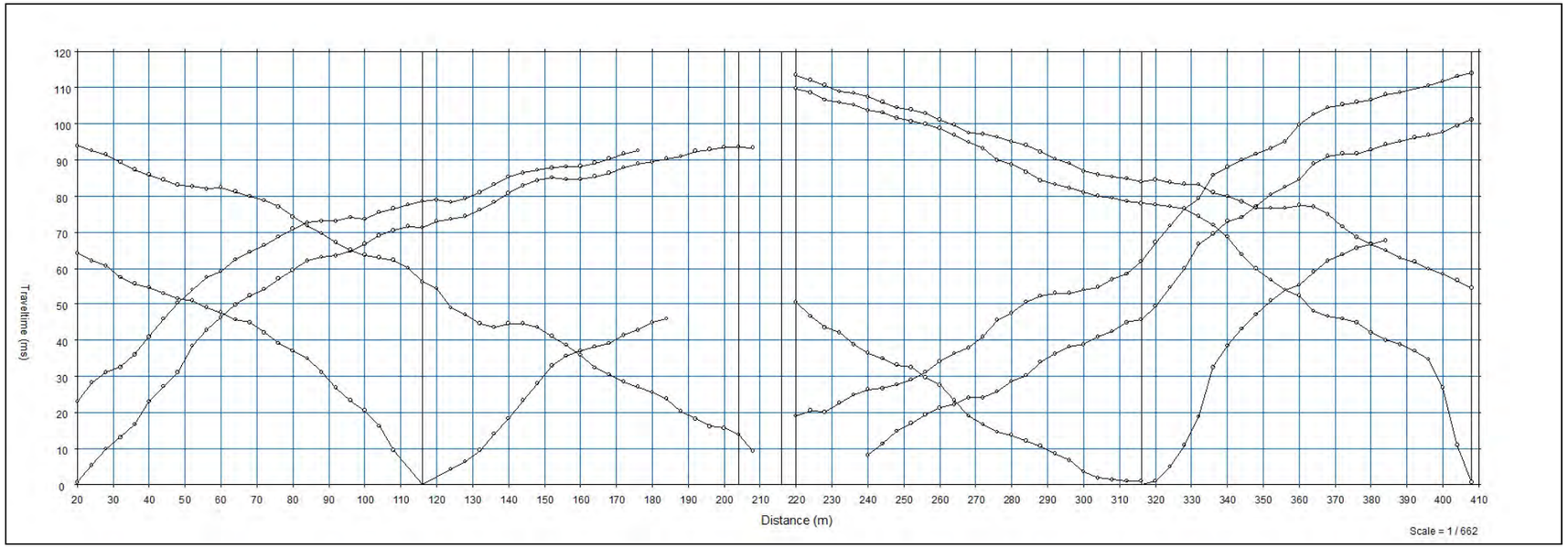


Ray tracing - Final model

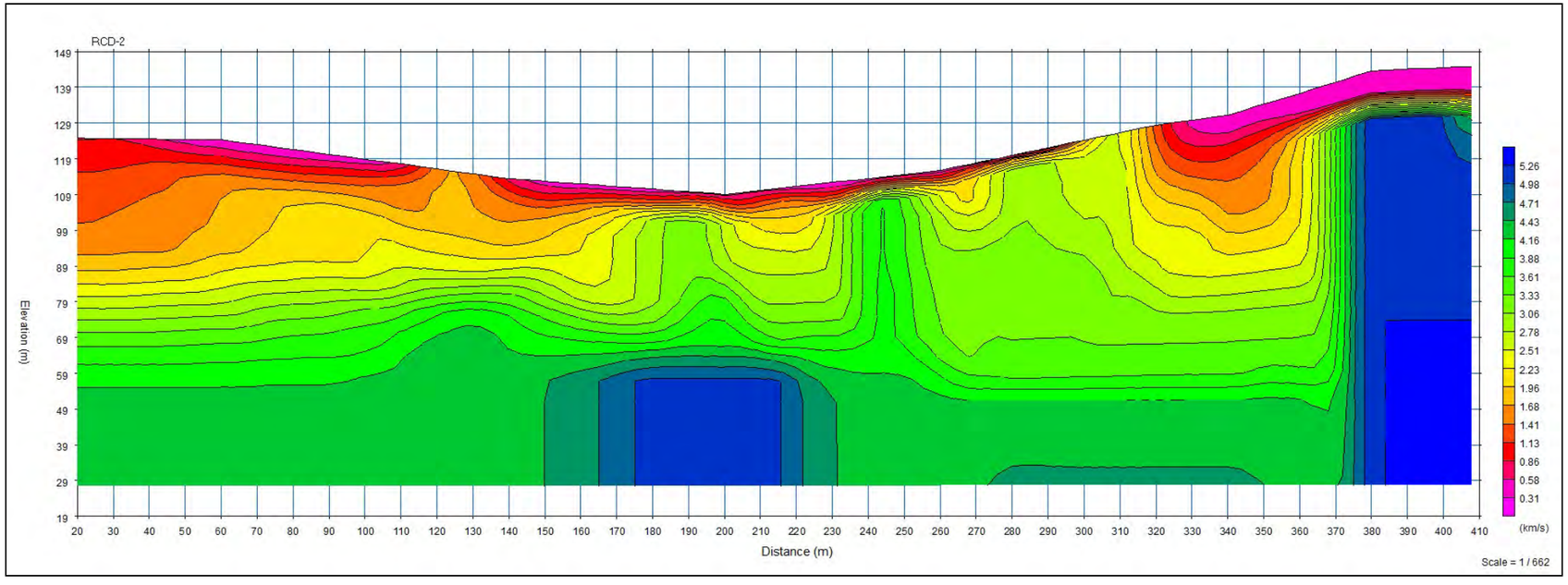


Inversion results - Final model

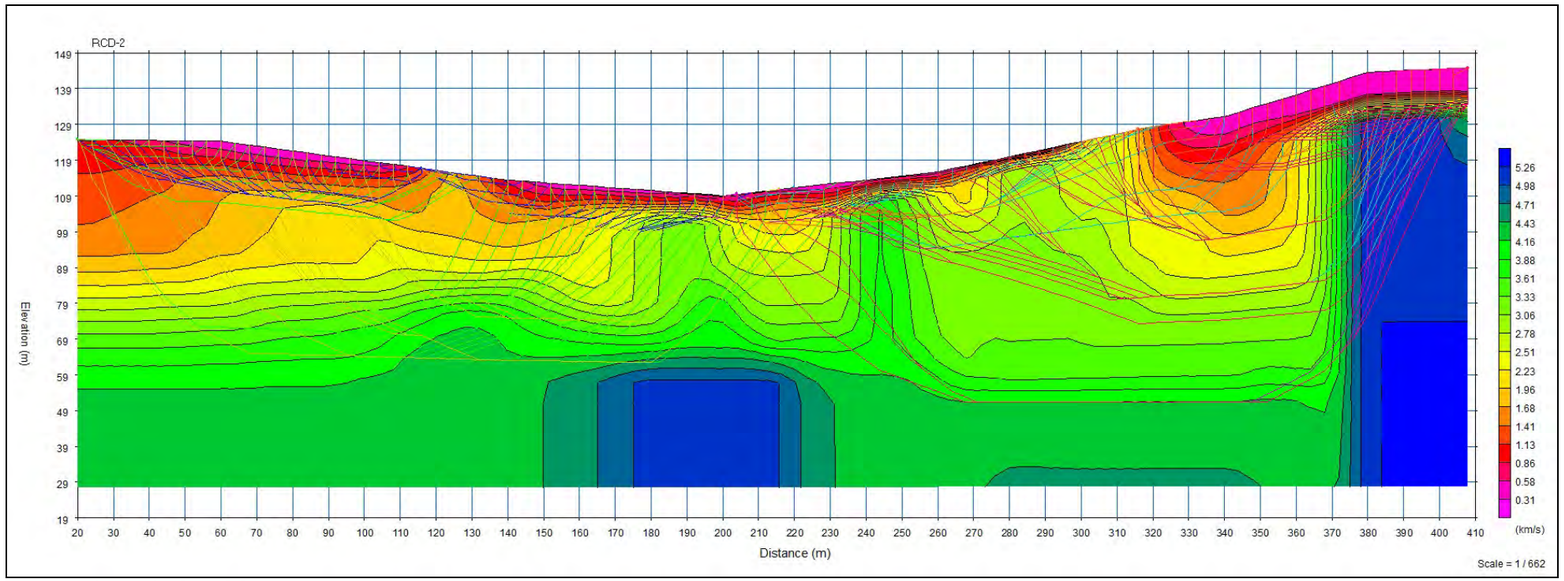
Line RCD-3



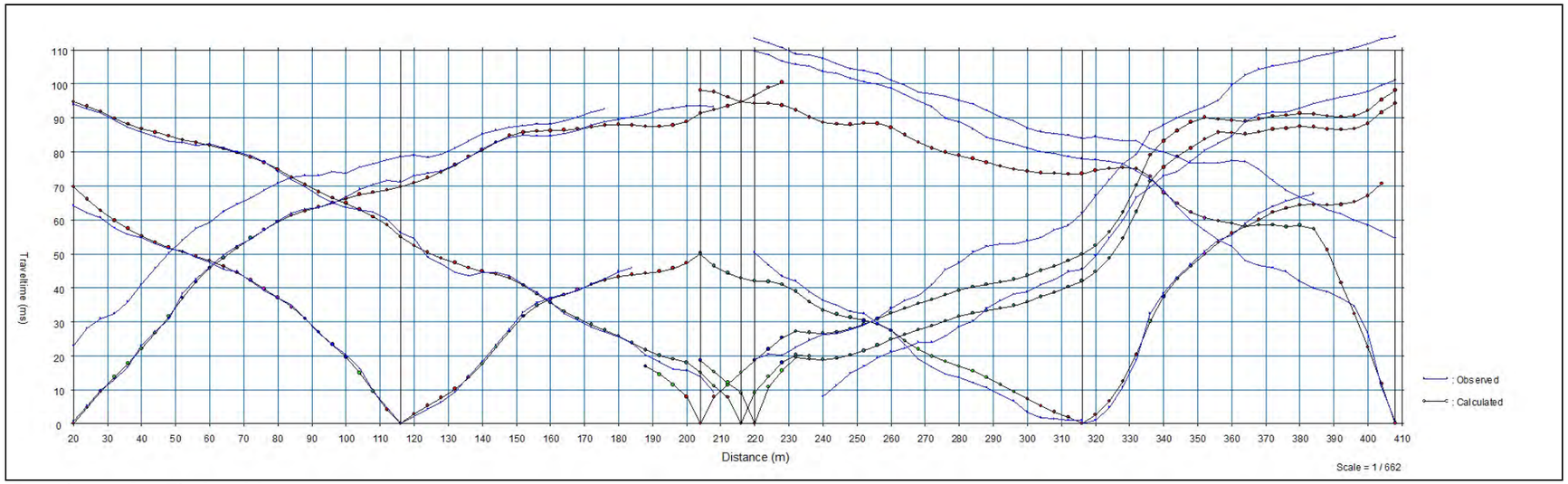
Travel time curves



Final model

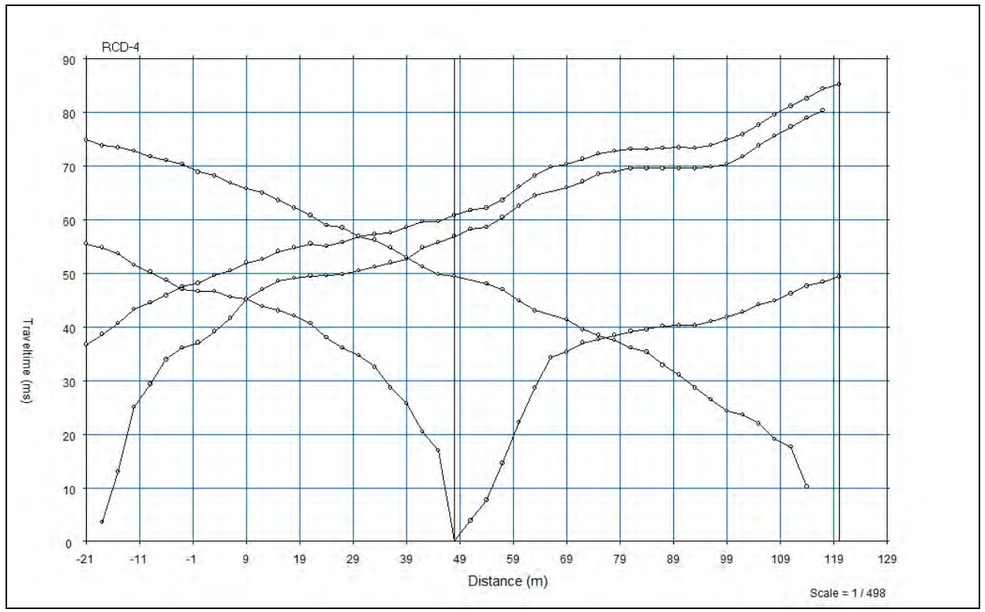


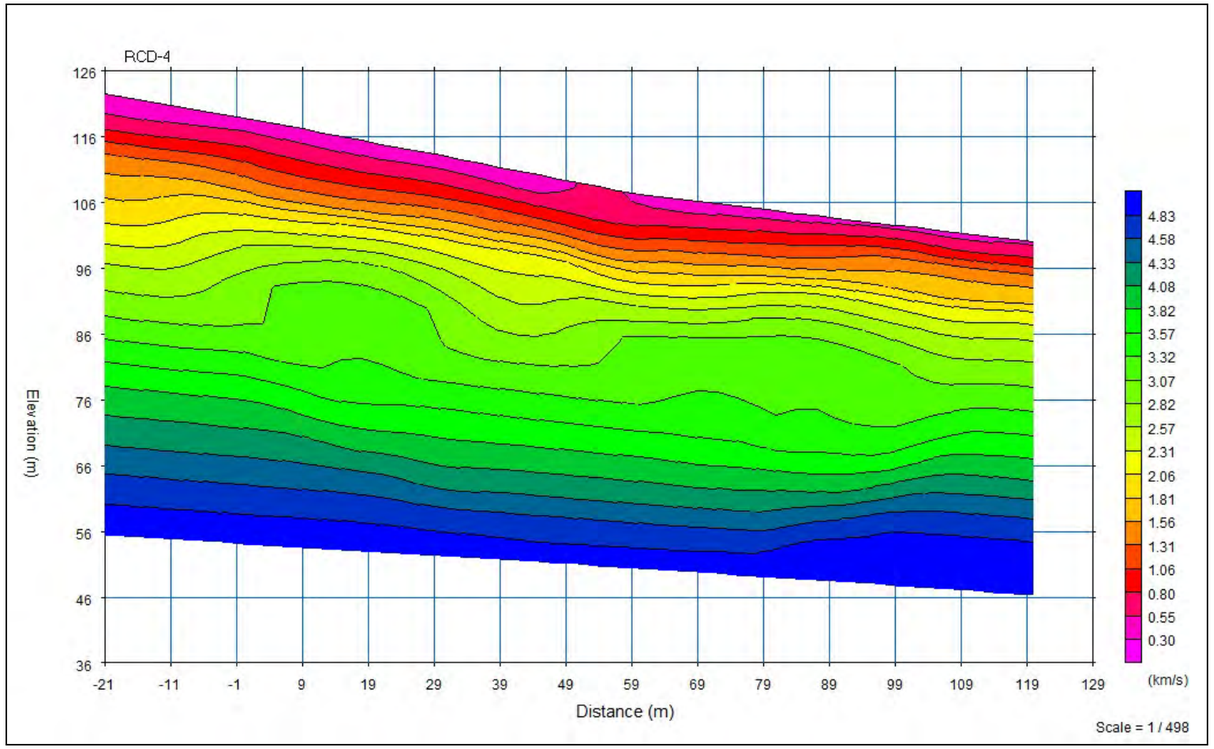
Ray tracing - Final model

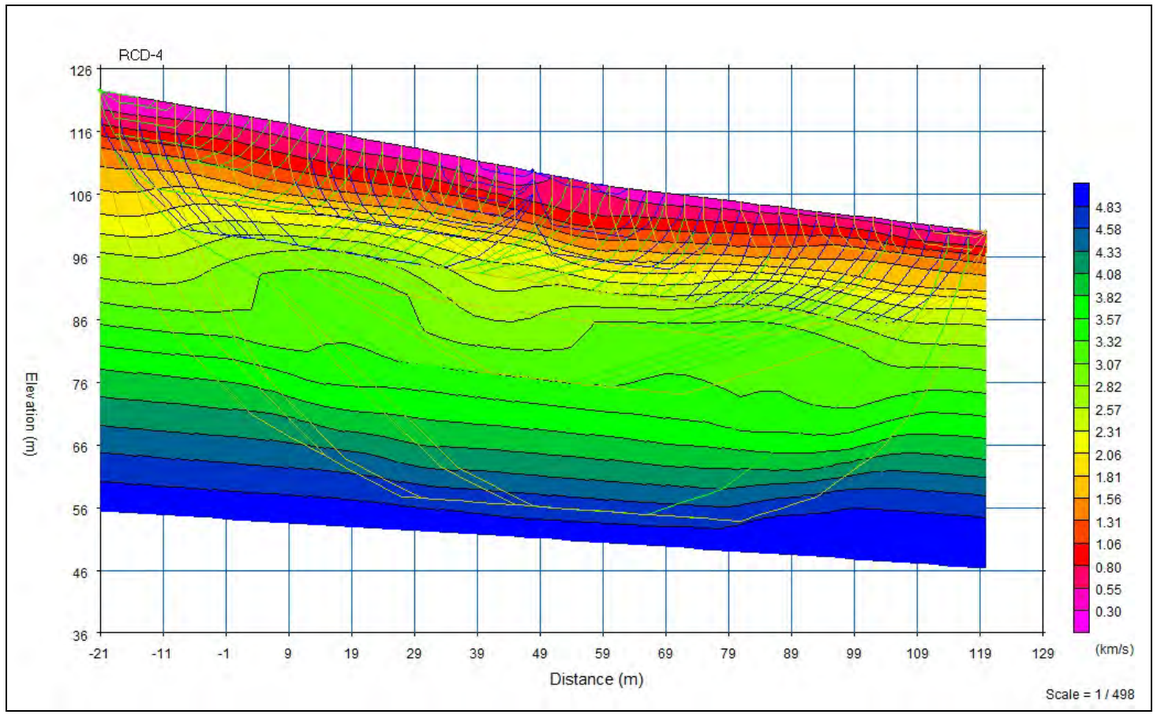


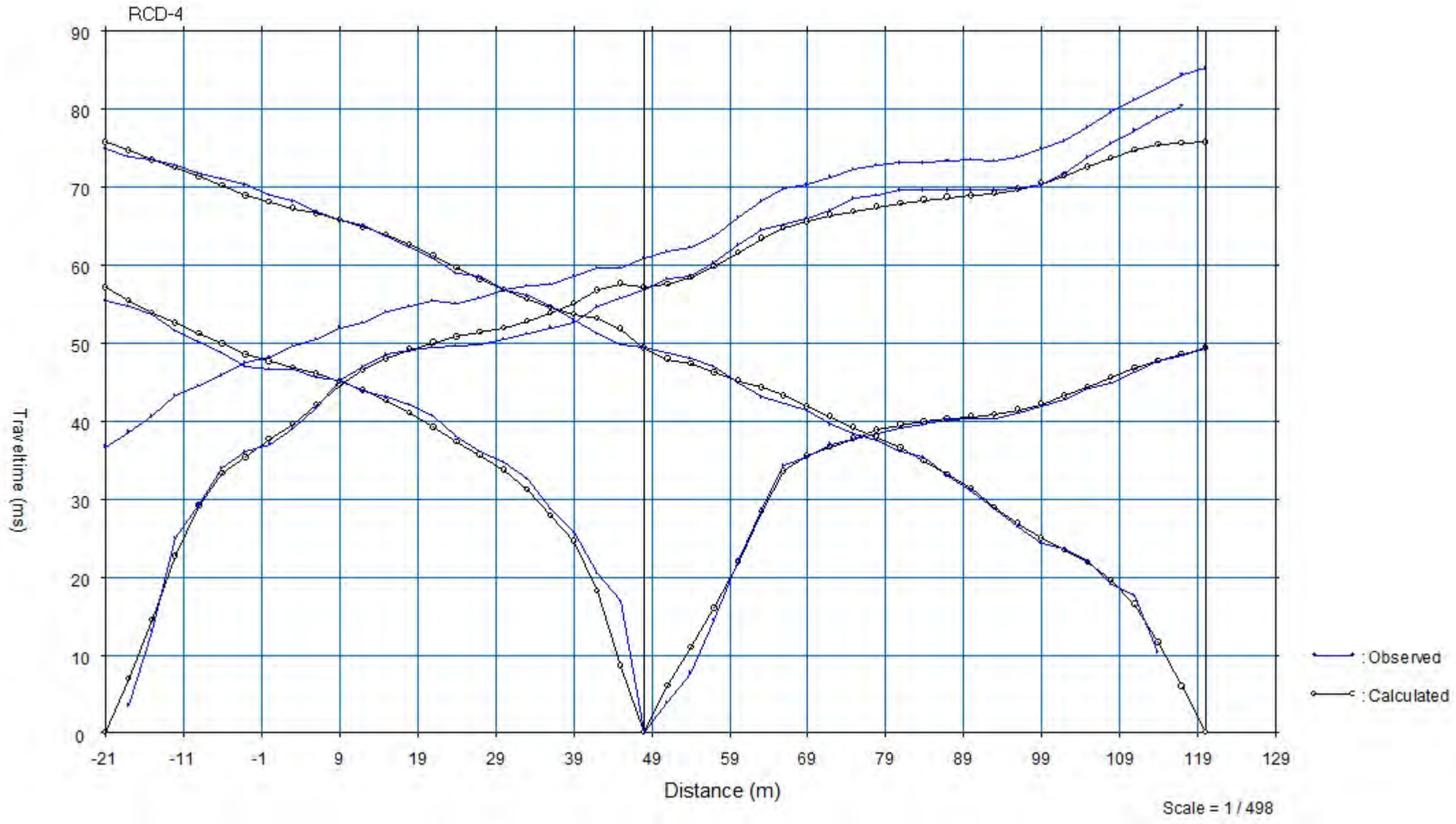
Inversion results - Final model

Line RCD-4

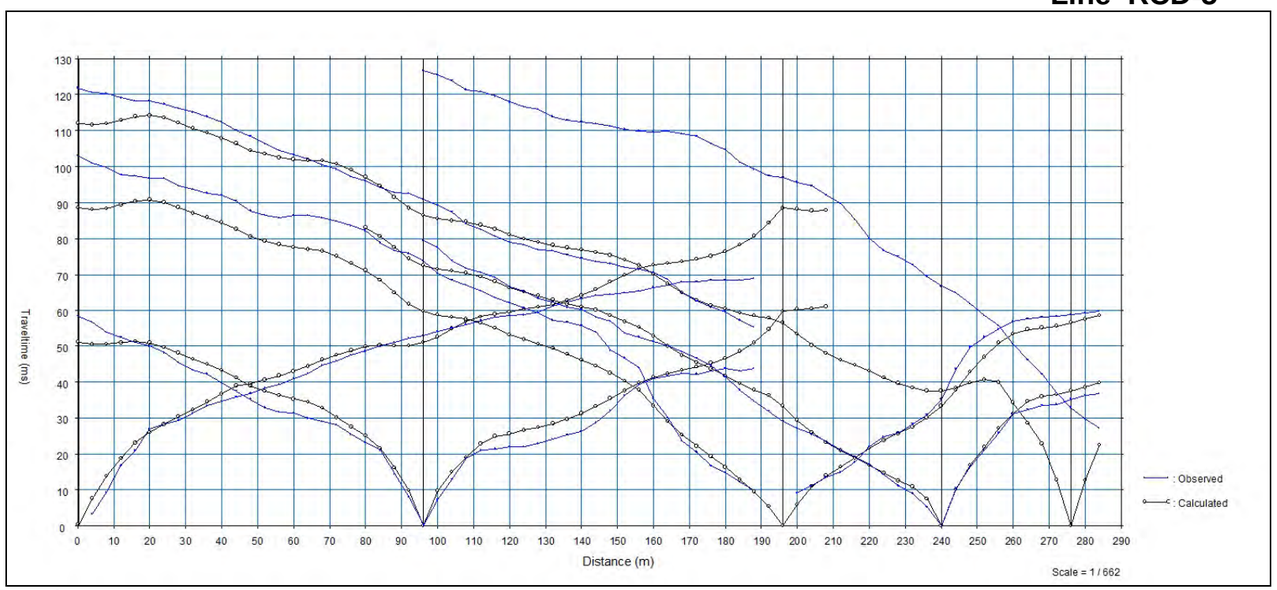

RCD-4
Traveltime (ms)
Distance (m)
Scale = 1 / 498
0
10
20
30
40
50
60
70
80
90
-21
-11
-1
9
19
29
39
49
59
69
79
89
99
109
119
129


RCD-4
126
116
106
96
86
76
66
56
46
36
Elevation (m)
-21
-11
-1
9
19
29
39
49
59
69
79
89
99
109
119
129
Distance (m)
4.83
4.58
4.33
4.08
3.82
3.57
3.32
3.07
2.82
2.57
2.31
2.06
1.81
1.56
1.31
1.06
0.80
0.55
0.30
(km/s)
Scale = 1 / 498

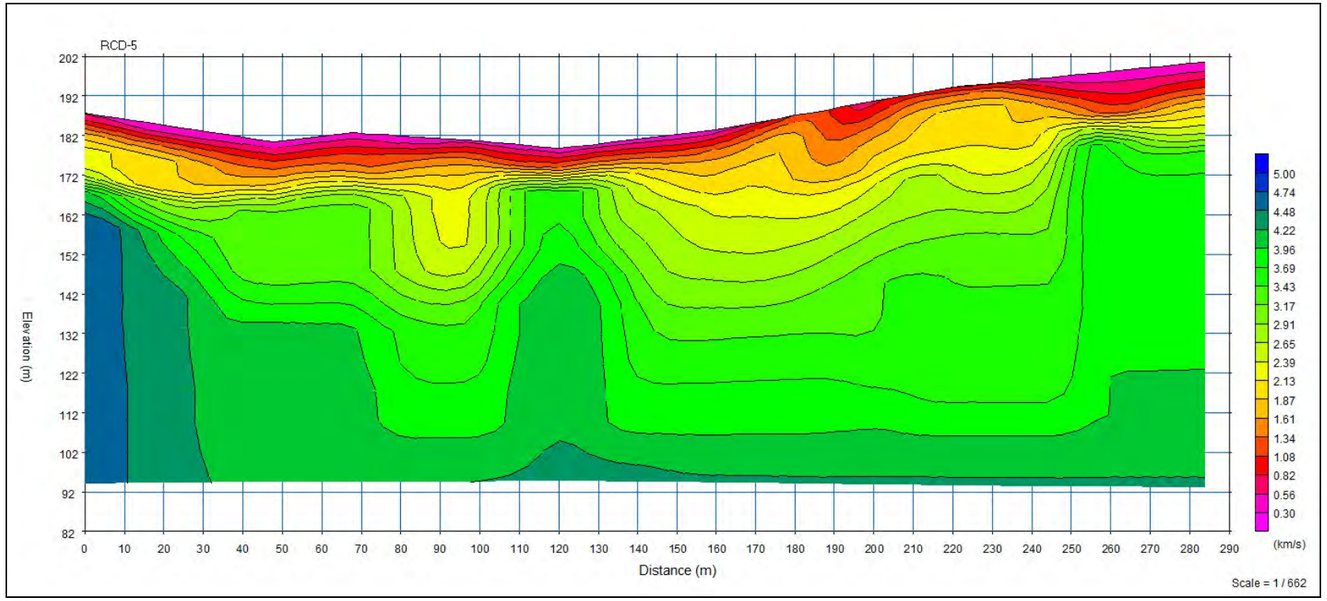

RCD-4
126
116
106
96
86
76
66
56
46
36
Elevation (m)
-21
-11
-1
9
19
29
39
49
59
69
79
89
99
109
119
129
Distance (m)
4.83
4.58
4.33
4.08
3.82
3.57
3.32
3.07
2.82
2.57
2.31
2.06
1.81
1.56
1.31
1.06
0.80
0.55
0.30
(km/s)
Scale = 1 / 498


RCD-4
Traveltime (ms)
90
80
70
60
50
40
30
20
10
0
-21
-11
-1
9
19
29
39
49
59
69
79
89
99
109
119
129
Distance (m)
: Observed
: Calculated
Scale = 1 / 498

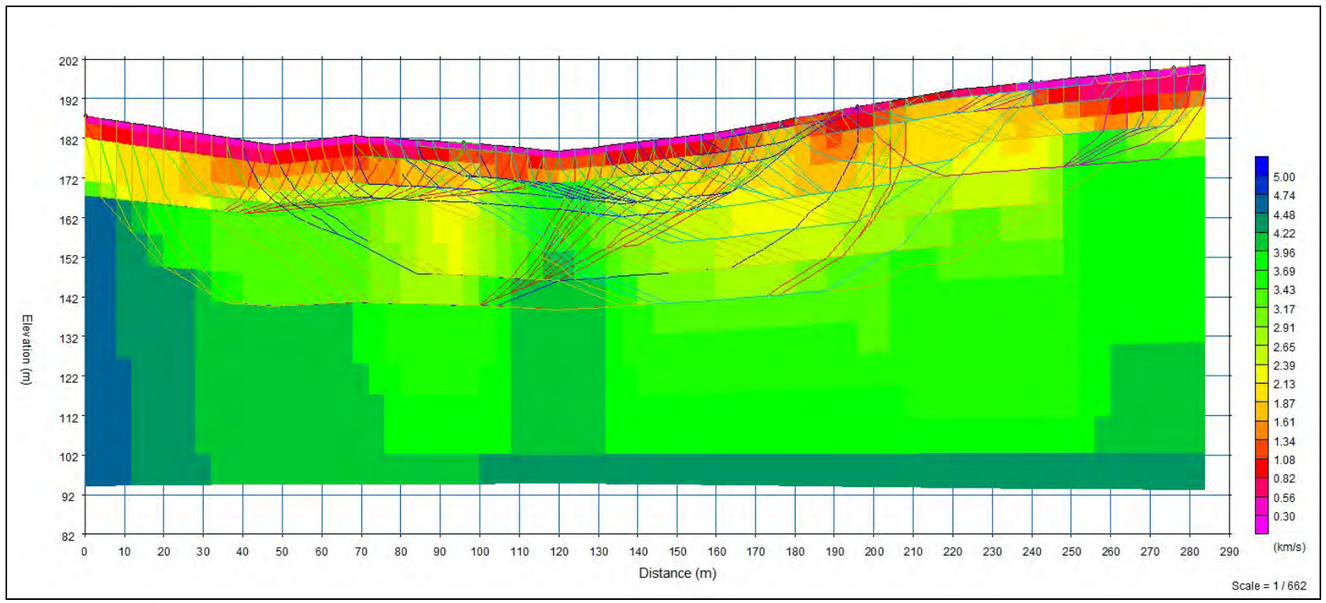
Line RCD-5



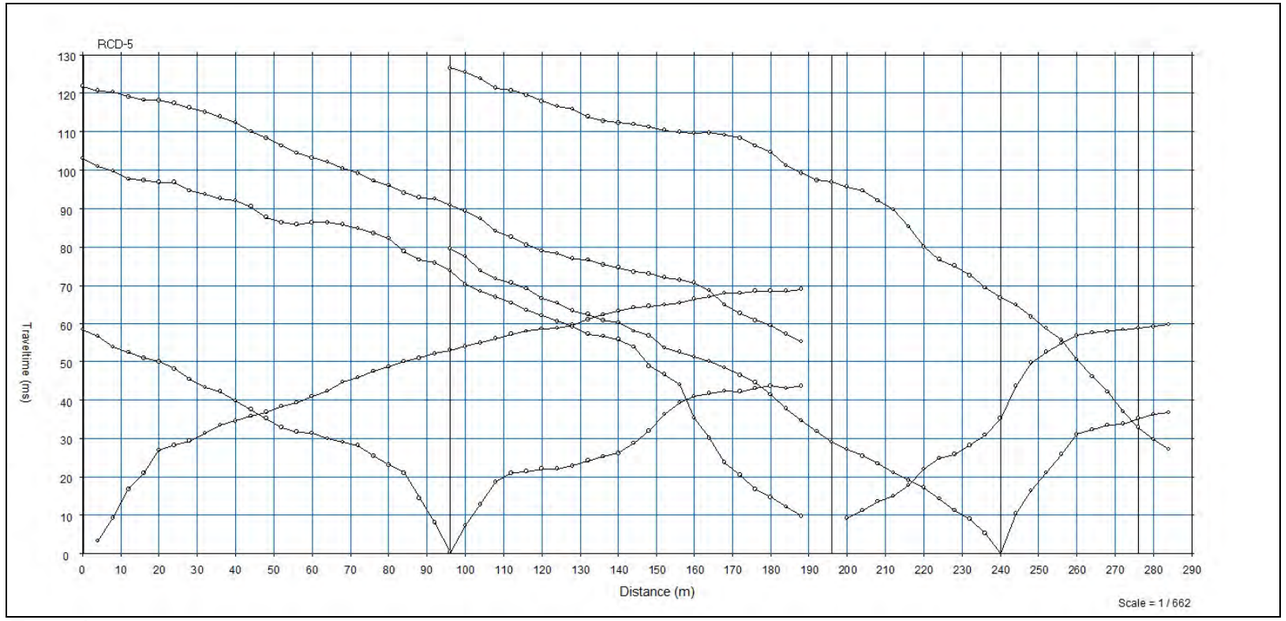
Inversion results - Final model



Final model



Ray tracing - Final model

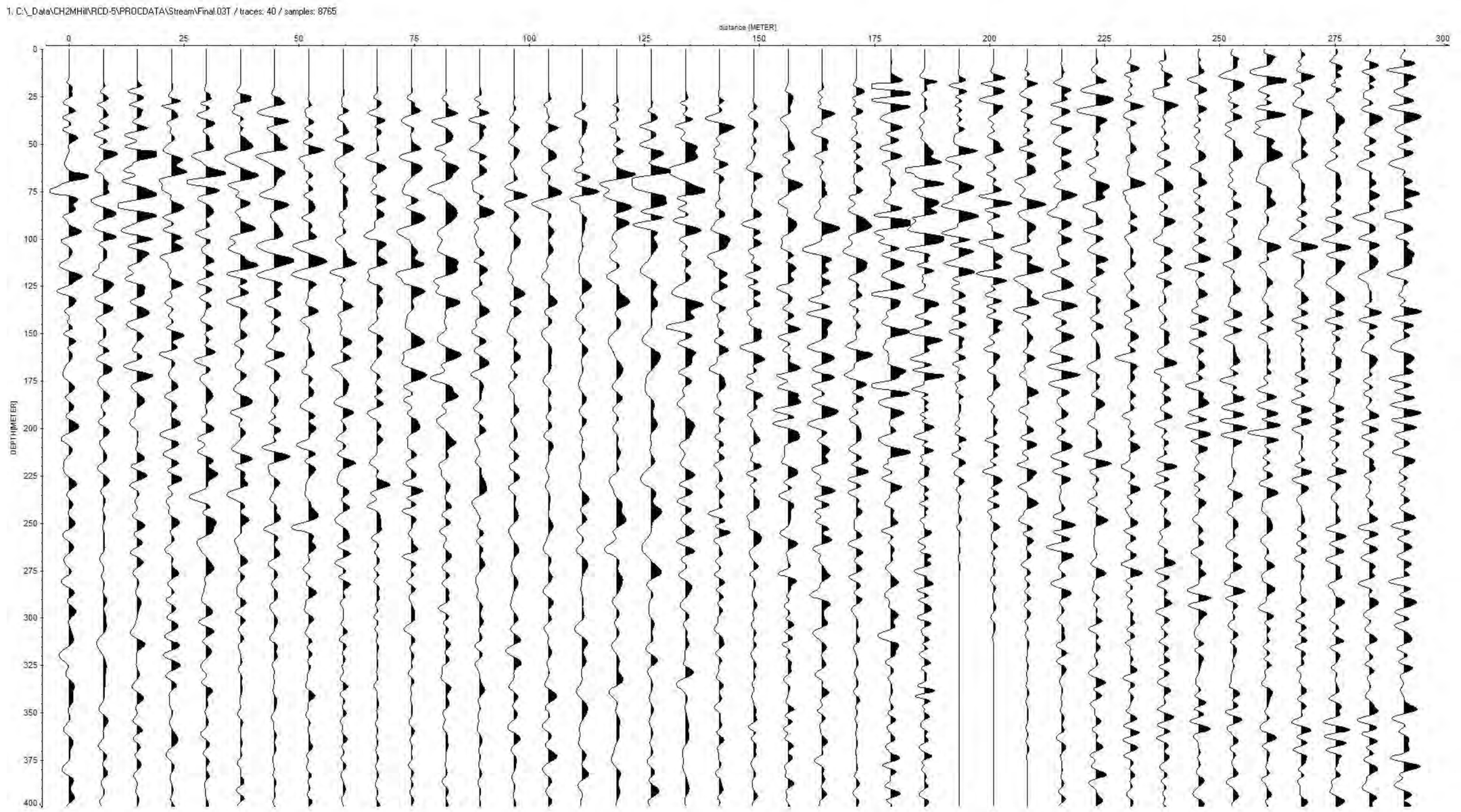


Travel times

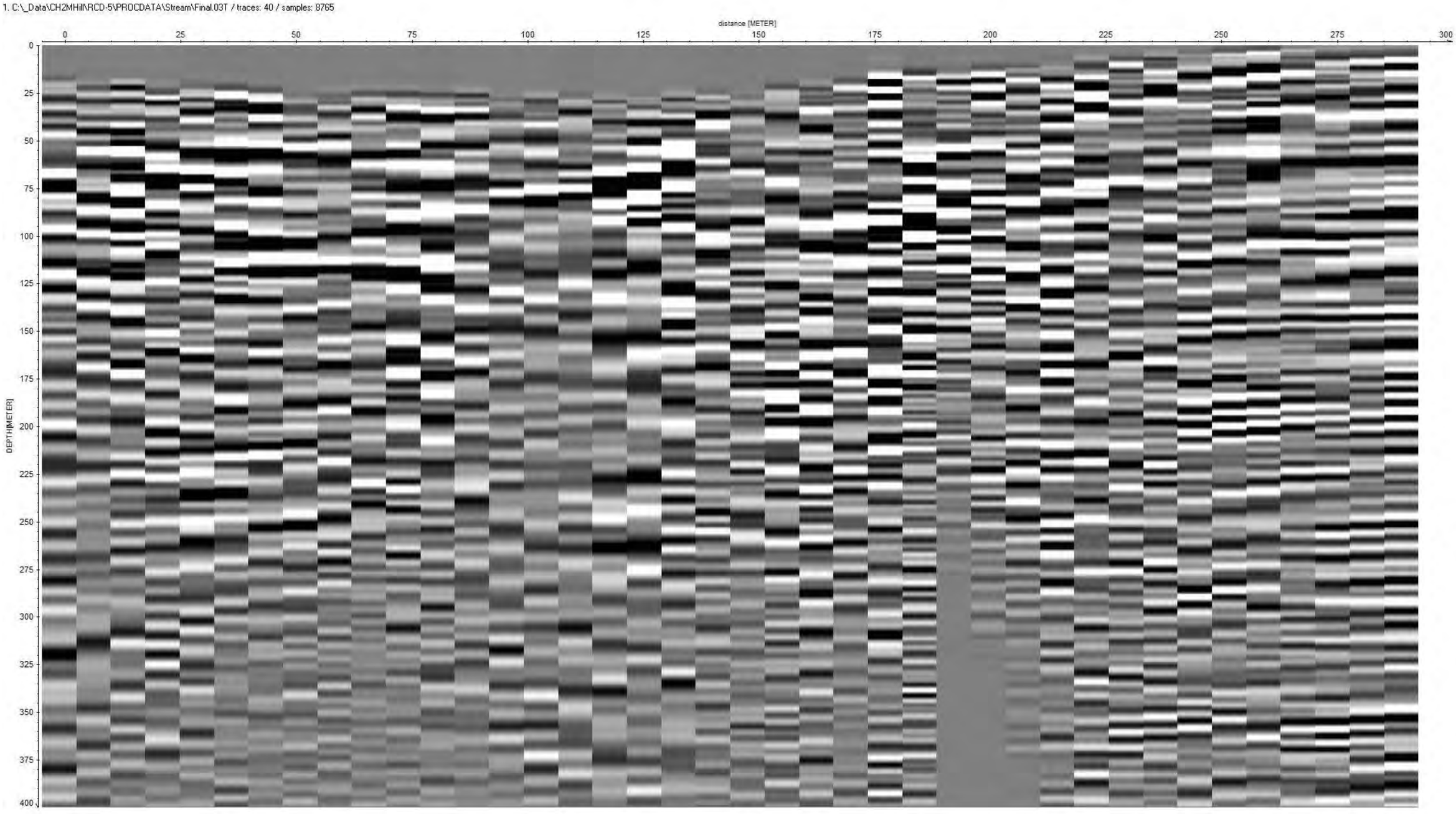
Appendix V

Seismic Reflection Sections

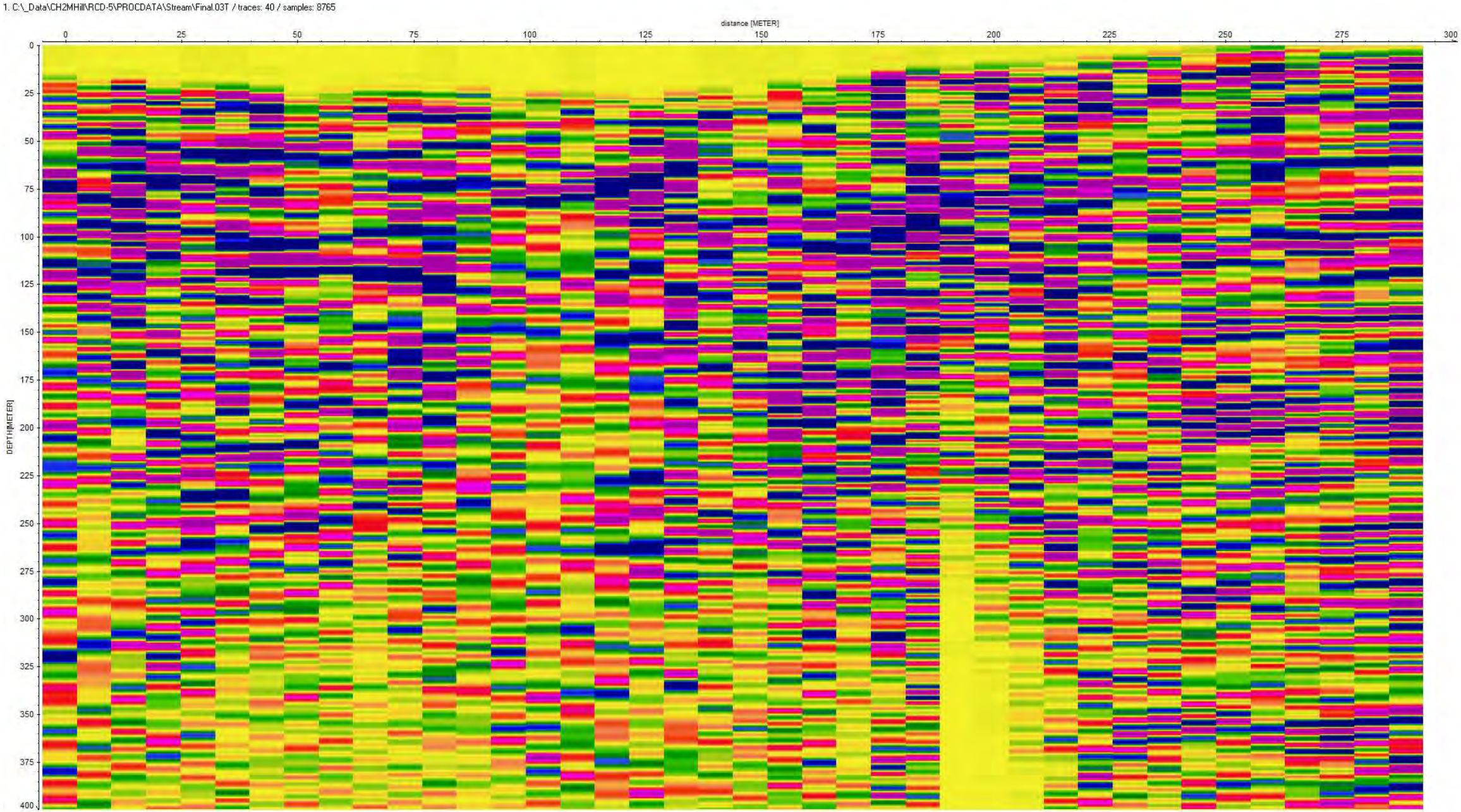
Line RCD-5 – Final reflection seismic section



Line RCD-5 – Final reflection seismic section



Line RCD-5 – Final reflection seismic section



Appendix E
Rose Creek Diversion Drilling

SHEET 1 of 2

PROJECT NUMBER: 472645

BORING NUMBER: *CH13-203-BH001*

SOIL BORING LOG

PROJECT NAME: Faro Mine Remediation Project

HOLE DEPTH (m): 14.02

DRILLING CONTRACTOR: Geotech Drilling

TOP OF CASING ELEVATION: 1085.930

NORTHING: 6913036.303

EASTING: 584688.926

DATE STARTED: 7/29/2013

DATE COMPLETED: 7/31/2013

WATER LEVEL: --

DATUM: NAD83 CSRS/Field Survey by Challenger Geomatic

DRILLING EQUIPMENT: Dual Rotary Foremost DR24; Fraste Mito HWT ODEX; HQ triple tube in Rock

LOCATION: Downsteam side of Rock Drain

LOGGED BY: M. Kacmarcik

DEPTH (m bgs)	RECOVERY (%)	SAMPLE TYPE	SPT RESULTS 6"-6"-6"-6" (N)	SIZE DISTRIBUTION %G	%S	%F	Moisture Content	Liquid Limit	Plasticity Index	SOIL DESCRIPTION	Graphic Log	COMMENTS (e.g.: DRILLING FLUID LOSS, TESTS, OR DRILLER COMMENTS, ETC.)
												-- Depth to groundwater not measured or not encountered at 19:30 done for day 7/29/13, at 08:00 7/30/13 switch to rock coring, see rock core log, take water level measurement, driller must core through +/- 2.5cm lip on shoe of casing, approximately 2 hours to set up water pump
1	25	SS	1-2-3-2 (5)				11			**(FILL) SILTY SAND WITH GRAVEL (SM)**, brown, moist, loose, estimated +/- 30% medium plasticity silt, roots and organics present. Sand is fine to coarse and sub-angular, gravel is angular.		SOa at 13:48 1-SS at 09:44 began drilling, SPT hammer not working (hydraulic issue). 13:46 Hammer fixed.
2	50	SS	2-1-1-4 (2)				12	23	5	**(FILL) SANDY SILT WITH GRAVEL (ML)**, brown, moist to wet, soft, gravel up to 1/2 diameter, gray mottling, estimated +/- 50% medium plasticity silt.		SOb at 13:56 2-SS
3	45	SS	1-5-4-4 (9)				9			**(ALLUVIUM) SILTY SAND WITH GRAVEL (SM)**, light brown, wet, loose, +/- 2 thick organic peat layer, estimated +/- 65% fine sand, sub-rounded gravel up to 25mm diameter.		SOc at 14:05 3-SS at 2.4m possible contact with native soil
4	60	SS	2-7-4-7 (11)				14			**(ALLUVIUM) SILTY SAND WITH GRAVEL (SM)**, gray, wet, medium dense, estimated +/-60% fine to medium sand, 15% gravel. Gravel is sub-rounded to sub-angular, organics present.		SOd at 14:19 4-SS, thin ash layer observed near top of sample
5	70	SS	6-12-15-17 (27)	10	67	23				**SILTY SAND (SM)**, gray brown, wet, medium dense. Gravel is sub-rounded and angular broken by sampler. Max gravel size is +/- 1 diameter, estimated +/-10% silt.		SOe at 14:37 5-SS, sample is alluvium fines, content varies across sample
6												much water produced in cuttings
7	80	SS	9 (9")	12	76	12				**WELL-GRADED SAND WITH SILT (SW-SM)**, well-graded, orange-brown, wet, very dense, maximum size is +/-20mm diameter. Estimated +/- 5% silt. Coarse particles sub-angular to sub-rounded.		SOf at 14:58 6-SS, suspect larger gravels/cobbles in-situ Air compressor overheats, 1 hour to fix. Resume drilling at 16:01. Air compressor overheats, 1 hour to fix. Resume drilling at 16:01. Driller notes heaving sands and bit blocked by sand. Air bubbles and silt noted in stream.
8	60	MCS	33-36-29-36 (65)	24	66	10				**WELL-GRADED SAND WITH GRAVEL (SW)**, well-graded, orange-brown, wet, very dense, maximum size is +/- 2 diameter rounded gravel, sand is sub-angular, fine to coarse, estimated +/- 5% silt.		SOg at 17:40 7-SS, drive MCS wl brass lining using SPT hammer
9												
10	90	MCS	5 (5")	9	80	11				**WELL-GRADED SAND WITH SILT (SW-SM)**, poorly graded, orange-brown, wet, very dense. Gravels are rounded, sand is medium.		SOh at 18:15 8-MCS, drive sampler with brass lining and SPT hammer refusal on granite boulder/cobble, chips observed in sampler refusal on granite boulder/cobble, chips observed in sampler slower drilling below at 10.21m bgs (bedrock contact)
11	90 91	SS SS	22 (22") 22 (22")							**(BEDROCK) WEATHERED**, white, wet, very dense. Apparent horizontal foliation (Phyllite). (BEDROCK) WEATHERED, white, wet, very dense. Apparent horizontal foliation (Phyllite). Begin Rock Coring at 11.0 ft bgs See the next sheet for the rock core log		at 18:56 9-SS at 18:56 9-SS
12												

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
437783	CH13-203-BH001 SHEET 2 OF 2

ROCK CORE LOG

PROJECT : LF-09 LOCATION : Downsteam side of Rock Drain (6913036.3 N, 584688.9 E)

ELEVATION : 1085.9 ft DRILLING CONTRACTOR : Geotech Drilling

CORING EQUIPMENT AND METHOD : ORIENTATION :

WATER LEVELS : -- START : 7/29/2013 END : 7/31/2013 LOGGER : M. Kacmarcik

DEPTH AND ELEVATION BELOW SURFACE (m)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	20 18		>10	no continuous core recovered		**BEDROCK**, medium grey (N5) and medium dark gray (N4), moderately weathered, hard, R3, mechanical breaks show apparent metamorphic foliation and metallic luster Core bit caught in casing shoe, pull up casing. Begin ID-HQ @ 15:26, No recovery. Add 0.91m section of rod. Out of fuel (16:00).	-- Depth to groundwater not measured or not encountered at 19:30 done for day 7/29/13, at 08:00 7/30/13 switch to rock coring, see rock core log, take water level measurement, driller must core through +/- 2.5cm lip on shoe of casing, approximately 2 hours to set up water pump drill rig vibrating wildly, poor recovery in weathered rock, recovered rock is horizontal mech breaks <5cm long drill rig vibrating wildly, poor recovery in weathered rock, recovered rock is horizontal mech breaks <5cm long at 11:43 to 12:15 11-HQ at 11:43 to 12:15 11-HQ core barrel stuck in borehole, spent rest of day trying to remove (12:15-17:30) core barrel stuck in borehole, spent rest of day trying to remove (12:15-17:30) at 08:00 7/31/13 resume, extract core barrel at 09:30, low recovery borehole collapsed to 1.8m bgs, back filled to ground surface with bentonite chips
	7 9		>10	no continuous core recovered, maximum length is 50mm		Core bit caught in casing shoe, pull up casing. Begin ID-HQ @ 15:26, No recovery. Add 0.91m section of rod. Out of fuel (16:00). several healed fractures with white mineralization, bedrock similar to above Bottom of Core at 14.02 metres bgs	
15 1070.9							
20 1065.9							
25 1060.9							
30 1055.9							
35 1050.9							
40 1045.9							

SHEET 1 of 2	PROJECT NUMBER: 472645	BORING NUMBER: *CH13-203-BH002*

SOIL BORING LOG

PROJECT NAME: Faro Mine Remediation Project	**HOLE DEPTH (m):** 11.28	**DRILLING CONTRACTOR:** Geotech Drilling	
TOP OF CASING ELEVATION: 1088.630	**NORTHING:** 6912973.142	**EASTING:** 584732.031	**DATE STARTED:** 8/9/2013 / **DATE COMPLETED:** 8/9/2013
WATER LEVEL: --2.16	**DATUM:** NAD83 CSRS/Field Survey by Challenger Geomatic	**DRILLING EQUIPMENT:** Fraste Mito HWT ODEX; HQ triple tube in Rock	
LOCATION: Downstream side of Rock Drain		**LOGGED BY:** M. Kacmarcik	

DEPTH (m bgs)	RECOVERY (%)	SAMPLE TYPE	SPT RESULTS 6"-6"-6"-6" (N)	SIZE DISTRIBUTION %G	%S	%F	Moisture Content	Liquid Limit	Plasticity Index	SOIL DESCRIPTION	Graphic Log	COMMENTS (e.g.: DRILLING FLUID LOSS, TESTS, OR DRILLER COMMENTS, ETC.)
										Ground surface is newly constructed access road approximately 1.2m above original grade.		
1	25	SS	3-3-4-3 (7)	10	69	21	17	36	7	**SILTY SAND (SM)**, brown, moist, loose, estimated +/- 20% silt, 60% fine to coarse sand, 20% rounded to sub-angular fine gravel up to 20mm diameter.		SOa at 08:28 1-SS, low recovery due to cobbles in soft fill
2	60	SS	3-5-6-9 (11)	8	56	36	26	44	12	**SILTY SAND (SM)**, brown, moist, medium dense, estimated +/-30% silt, 50% fine to coarse sand, 20% gravel. Ash and organics observed in sample.		SOb at 08:40 2-SS
										BOULDER (GRANITIC)		driller notes boulder from 2.3m to 3.0m bgs, skip SS at 2.3m Groundwater encountered at 2.16mbgs.
3	45	SS	9-10-7-8 (17)	15	75	10	11	19	3	**WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)**, Less gravel, and wet.		SOc at 09:02 3-SS, becomes wet in 3-SS, driller notes much water during drilling
4												
5	45	SS	14-11-18-21 (29)	14	77	9	15	18	3	**WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)**, Less gravel.		SOd at 09:24 4-SS
6												

SHEET 2 of 2

PROJECT NUMBER: 472645

BORING NUMBER: *CH13-203-BH002*

SOIL BORING LOG

PROJECT NAME: Faro Mine Remediation Project		**HOLE DEPTH (m):** 11.28	**DRILLING CONTRACTOR:** Geotech Drilling
TOP OF CASING ELEVATION: 1088.630	**NORTHING:** 6912973.142	**EASTING:** 584732.031	**DATE STARTED:** 8/9/2013 / **DATE COMPLETED:** 8/9/2013
WATER LEVEL: --2.16	**DATUM:** NAD83 CSRS/Field Survey by Challenger Geomatic		**DRILLING EQUIPMENT:** Fraste Mito HWT ODEX; HQ triple tube in Rock
LOCATION: Downstream side of Rock Drain			**LOGGED BY:** M. Kacmarcik

DEPTH (m bgs)	RECOVERY (%)	SAMPLE TYPE	SPT RESULTS 6"-6"-6"-6" (N)	SIZE DISTRIBUTION %G	%S	%F	Moisture Content	Liquid Limit	Plasticity Index	SOIL DESCRIPTION	Graphic Log	COMMENTS (e.g.: DRILLING FLUID LOSS, TESTS, OR DRILLER COMMENTS, ETC.)
	60	SS	12-9-9-10 (18)				11			Classification varies across sample SP-SM, SM, GM. Top 30cm are brown, wet, medium dense. Bottom 7cm are olive brown, wet, medium dense, and siltier gravel. Bottom 7cm appears to have ash in matrix.		SOe at 09:46 5-SS, driller notes +/- 0.5m diameter boulder from 6.9m to 7.3m bgs, cuttings are granitic
7										**BOULDER (GRANITIC)**		
	40	SS	23-40 (40")				7			**(BEDROCK) WEATHERED PHYLLITE**, light gray, moist, hared, orange-brown staining observed in sample. Rock appears layered in paper-thin sheets.		SOf at 10:36 6-SS, too soft to core, continue drilling and sampling, drill cuttings become bright orange-brown and wet at 8.2m bgs
8												
9												
	100	SS	19-14-23-25 (37)				8			**(BEDROCK) WEATHERED PHYLLITE**, less dense than above. Nearly decomposed. Breaks along horizontal foliation. Resembles stiff lean clay.		SOg at 11:03 7-SS, orange cuttings continue 9.1m to 10.7m bgs, very wet
10												
	95	SS	14-22-24 (46)				16			**(BEDROCK) WEATHERED PHYLLITE**, similar to above, becoming more dense from 11.1m to 11.3m bgs.		SOh at 11:35 8-SS
11												
										Boring Terminated at 11.28 metres bgs		back fill to surface

CH2MHILL

Appendix F
Dye Test

Date	Time	Temp	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C		mV	ug/L
7/9/2013	16:30:02	8.04	7.42	118	1.8
7/9/2013	16:30:32	8.04	7.43	117	0.7
7/9/2013	16:31:02	8.05	7.42	117	0.6
7/9/2013	16:31:32	8.05	7.42	117	0.4
7/9/2013	16:32:02	8.05	7.42	117	0.4
7/9/2013	16:32:32	8.06	7.42	117	0.4
7/9/2013	16:33:02	8.06	7.42	117	0.3
7/9/2013	16:33:32	8.06	7.42	117	0.2
7/9/2013	16:34:02	8.07	7.42	116	0.2
7/9/2013	16:34:32	8.07	7.42	116	0.6
7/9/2013	16:35:02	8.07	7.41	116	0.7
7/9/2013	16:35:32	8.08	7.41	116	0.4
7/9/2013	16:36:02	8.08	7.42	115	0.6
7/9/2013	16:36:32	8.08	7.42	115	0.3
7/9/2013	16:37:02	8.09	7.41	115	0.3
7/9/2013	16:37:32	8.09	7.41	115	0.5
7/9/2013	16:38:02	8.09	7.41	114	0.5
7/9/2013	16:38:32	8.1	7.41	114	0.5
7/9/2013	16:39:02	8.1	7.41	114	0.4
7/9/2013	16:39:32	8.1	7.41	114	0.4
7/9/2013	16:40:02	8.11	7.41	114	0.3
7/9/2013	16:40:32	8.11	7.41	114	0.4
7/9/2013	16:41:02	8.11	7.41	113	0.5
7/9/2013	16:41:32	8.12	7.41	113	0.5
7/9/2013	16:42:02	8.12	7.42	113	0.4
7/9/2013	16:42:32	8.12	7.42	113	0.5
7/9/2013	16:43:02	8.13	7.42	113	0.6
7/9/2013	16:43:32	8.13	7.42	113	0.7
7/9/2013	16:44:02	8.13	7.42	112	0.7
7/9/2013	16:44:32	8.14	7.42	112	0.7
7/9/2013	16:45:02	8.14	7.42	112	1
7/9/2013	16:45:32	8.14	7.42	111	1.6
7/9/2013	16:46:02	8.15	7.42	111	2.1
7/9/2013	16:46:32	8.15	7.42	111	3
7/9/2013	16:47:02	8.15	7.42	111	4.2
7/9/2013	16:47:32	8.16	7.42	110	5.5
7/9/2013	16:48:02	8.16	7.42	110	7.4
7/9/2013	16:48:32	8.16	7.42	110	9.4
7/9/2013	16:49:02	8.16	7.42	110	12.2
7/9/2013	16:49:32	8.17	7.42	110	15.4
7/9/2013	16:50:02	8.17	7.42	110	17.2
7/9/2013	16:50:32	8.17	7.42	109	23.1
7/9/2013	16:51:02	8.18	7.42	109	27.2
7/9/2013	16:51:32	8.18	7.42	109	31.7
7/9/2013	16:52:02	8.19	7.42	109	36.8

Date	Time	Temp	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C		mV	ug/L
7/9/2013	16:52:32	8.19	7.42	108	41.5
7/9/2013	16:53:02	8.19	7.42	108	45.8
7/9/2013	16:53:32	8.19	7.42	108	50.7
7/9/2013	16:54:02	8.2	7.43	108	55.3
7/9/2013	16:54:32	8.2	7.43	108	59.3
7/9/2013	16:55:02	8.2	7.42	108	61.4
7/9/2013	16:55:32	8.21	7.43	107	67
7/9/2013	16:56:02	8.21	7.43	107	69.6
7/9/2013	16:56:32	8.21	7.43	107	72
7/9/2013	16:57:02	8.22	7.43	107	73.9
7/9/2013	16:57:32	8.22	7.43	107	73.5
7/9/2013	16:58:02	8.22	7.43	107	74.1
7/9/2013	16:58:32	8.22	7.43	107	74.8
7/9/2013	16:59:02	8.23	7.43	106	75.1
7/9/2013	16:59:32	8.23	7.43	106	75.3
7/9/2013	17:00:02	8.23	7.43	107	74.7
7/9/2013	17:00:32	8.24	7.43	106	77.8
7/9/2013	17:01:02	8.24	7.43	106	77.2
7/9/2013	17:01:32	8.24	7.43	106	76.9
7/9/2013	17:02:02	8.25	7.43	106	75.5
7/9/2013	17:02:32	8.25	7.43	106	74.2
7/9/2013	17:03:02	8.25	7.43	106	72.7
7/9/2013	17:03:32	8.26	7.43	106	71.2
7/9/2013	17:04:02	8.26	7.43	106	69.5
7/9/2013	17:04:32	8.26	7.43	106	68.3
7/9/2013	17:05:02	8.26	7.43	107	67.9
7/9/2013	17:05:32	8.27	7.43	107	65.5
7/9/2013	17:06:02	8.27	7.44	107	63.4
7/9/2013	17:06:32	8.27	7.44	107	62
7/9/2013	17:07:02	8.27	7.44	107	60.9
7/9/2013	17:07:32	8.28	7.44	106	58.5
7/9/2013	17:08:02	8.28	7.44	106	56.8
7/9/2013	17:08:32	8.28	7.44	106	55
7/9/2013	17:09:02	8.28	7.44	106	53.3
7/9/2013	17:09:32	8.29	7.44	106	52
7/9/2013	17:10:02	8.29	7.43	106	51.3
7/9/2013	17:10:32	8.29	7.44	105	49.4
7/9/2013	17:11:02	8.29	7.44	105	47.6
7/9/2013	17:11:32	8.3	7.44	105	46.5
7/9/2013	17:12:02	8.3	7.44	105	45.3
7/9/2013	17:12:32	8.3	7.44	105	43.7
7/9/2013	17:13:02	8.3	7.44	105	42.1
7/9/2013	17:13:32	8.31	7.44	105	41
7/9/2013	17:14:02	8.31	7.44	104	39.5
7/9/2013	17:14:32	8.31	7.44	104	38.2

Date	Time	Temp	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C		mV	ug/L
7/9/2013	17:15:02	8.32	7.43	104	37.3
7/9/2013	17:15:32	8.32	7.44	104	36.1
7/9/2013	17:16:02	8.32	7.44	104	34.5
7/9/2013	17:16:32	8.32	7.44	104	33.2
7/9/2013	17:17:02	8.33	7.44	104	32
7/9/2013	17:17:32	8.33	7.44	103	31.4
7/9/2013	17:18:02	8.33	7.44	103	29.7
7/9/2013	17:18:32	8.33	7.44	103	28.4
7/9/2013	17:19:02	8.33	7.44	103	27.6
7/9/2013	17:19:32	8.34	7.44	103	27
7/9/2013	17:20:02	8.34	7.44	103	26.7
7/9/2013	17:20:32	8.34	7.44	103	25.1
7/9/2013	17:21:02	8.35	7.44	103	24.2
7/9/2013	17:21:32	8.35	7.44	102	23.6
7/9/2013	17:22:02	8.35	7.44	102	22.8
7/9/2013	17:22:32	8.35	7.44	102	21.7
7/9/2013	17:23:02	8.36	7.44	102	21.4
7/9/2013	17:23:32	8.36	7.44	102	20.7
7/9/2013	17:24:02	8.36	7.44	102	19.6
7/9/2013	17:24:32	8.36	7.44	102	19.4
7/9/2013	17:25:02	8.36	7.44	102	19
7/9/2013	17:25:32	8.37	7.44	101	18
7/9/2013	17:26:02	8.37	7.44	101	17.3
7/9/2013	17:26:32	8.37	7.44	101	16.7
7/9/2013	17:27:02	8.37	7.44	101	16.1
7/9/2013	17:27:32	8.37	7.44	101	15.8
7/9/2013	17:28:02	8.38	7.44	101	14.8
7/9/2013	17:28:32	8.38	7.44	100	14.8
7/9/2013	17:29:02	8.38	7.44	100	14.1
7/9/2013	17:29:32	8.38	7.44	100	13.6
7/9/2013	17:30:02	8.38	7.44	100	13.6
7/9/2013	17:30:32	8.39	7.44	100	12.9
7/9/2013	17:31:02	8.39	7.44	100	12.4
7/9/2013	17:31:32	8.39	7.44	100	12.2
7/9/2013	17:32:02	8.39	7.44	99	11.8
7/9/2013	17:32:32	8.4	7.44	99	11.5
7/9/2013	17:33:02	8.4	7.45	99	11
7/9/2013	17:33:32	8.4	7.45	99	10.7
7/9/2013	17:34:02	8.4	7.45	99	10.3
7/9/2013	17:34:32	8.4	7.45	99	10.1
7/9/2013	17:35:02	8.41	7.44	99	9.9
7/9/2013	17:35:32	8.39	7.01	115	5.7
7/9/2013	17:36:02	8.61	7.33	105	1.1
7/9/2013	17:36:32	8.75	7.13	115	1
7/9/2013	17:37:02	8.88	7.17	112	1.1

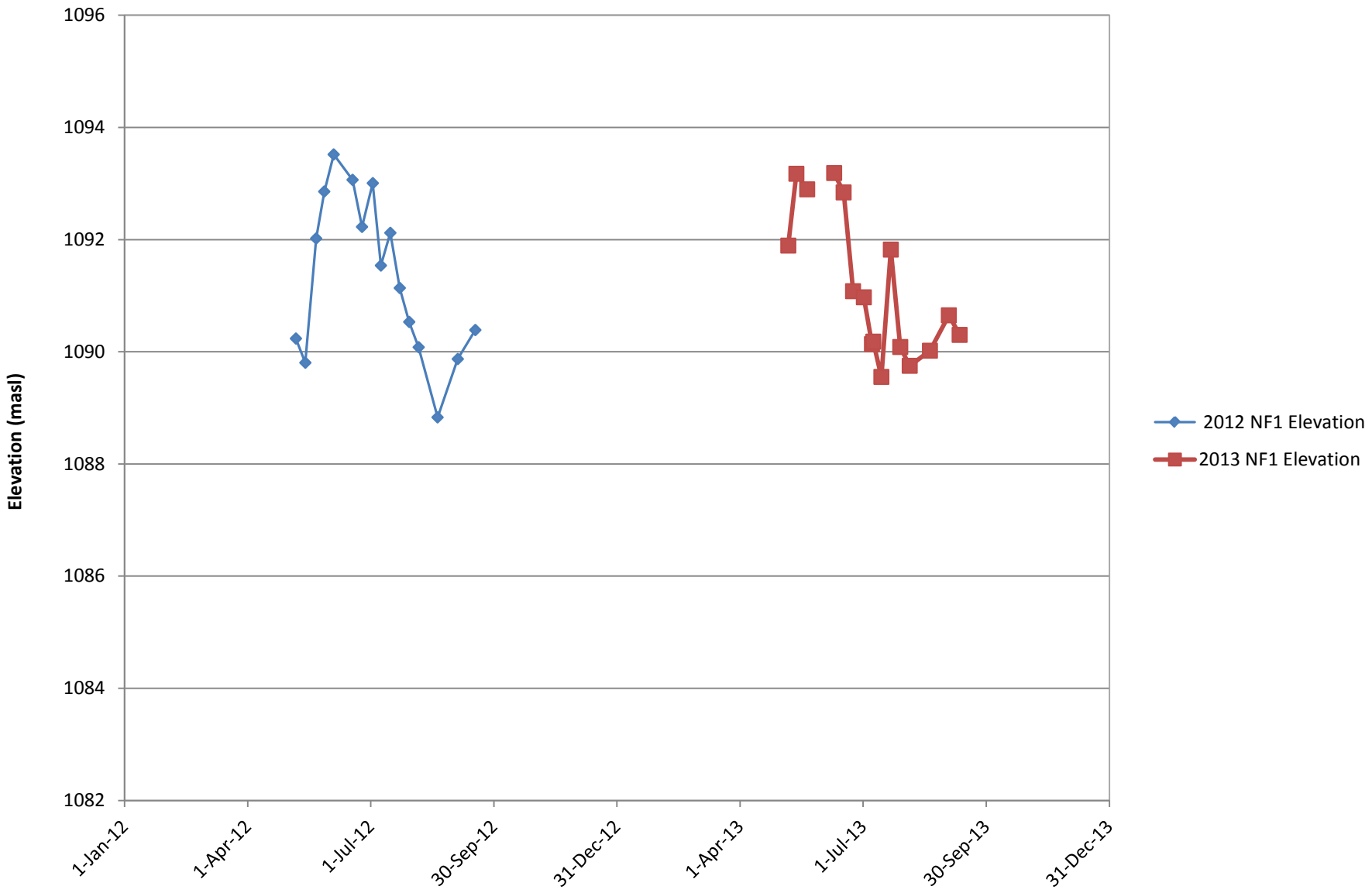
Date	Time	Temp	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C		mV	ug/L
7/9/2013	17:37:32	8.99	7.52	93	1.2
7/9/2013	17:38:02	9.12	7.55	92	1
7/9/2013	17:38:32	9.23	7.56	91	0.8
7/9/2013	17:39:02	9.36	7.57	90	0.7
7/9/2013	17:39:32	9.53	7.57	89	0.9
7/9/2013	17:40:02	9.68	7.57	88	1
7/9/2013	17:40:32	9.81	7.58	88	1.3
7/9/2013	17:41:02	9.93	7.55	88	0.8
7/9/2013	17:41:32	10.03	7.55	87	1.3
7/9/2013	17:42:02	10.11	7.56	87	1.1
7/9/2013	17:42:32	10.22	7.56	87	1
7/9/2013	17:43:02	10.31	7.57	87	1
7/9/2013	17:43:32	10.39	7.57	87	1.2
7/9/2013	17:44:02	10.46	7.57	87	1.3
7/9/2013	17:44:32	10.55	7.57	86	0.8
7/9/2013	17:45:02	10.63	7.57	86	0.9
7/9/2013	17:45:32	10.69	7.57	85	1.2
7/9/2013	17:46:02	10.75	7.57	86	1.3
7/9/2013	17:46:32	10.82	7.57	86	1.2
7/9/2013	17:47:02	10.88	7.53	87	1.1
7/9/2013	17:47:32	10.89	7.53	87	1.1
7/9/2013	17:48:02	10.93	7.51	87	1.2
7/9/2013	17:48:32	10.97	7.48	87	1.1
7/9/2013	17:49:02	11.02	7.45	86	1.1
7/9/2013	17:49:32	11.06	7.44	86	1.2
7/9/2013	17:50:02	11.1	7.43	85	1.2
7/9/2013	17:50:32	11.15	7.42	85	1.5
7/9/2013	17:51:02	11.19	7.42	85	1.3
7/9/2013	17:51:32	11.24	7.42	84	1.4
7/9/2013	17:52:02	11.29	7.41	84	1.3
7/9/2013	17:52:32	11.15	7.42	76	1.6

North Fork of Rose Creek
Water Elevations - NF1

Date	Elevation (masl)	Freeboard* (masl)	Comments
7-May-12	1090.236	4.534	
14-May-12	1089.805	4.965	
22-May-12	1092.020	2.750	
28-May-12	1092.857	1.913	
4-Jun-12	1093.518	1.252	
11-Jun-12			no access - photos taken
18-Jun-12	1093.065	1.705	
25-Jun-12	1092.227	2.543	
3-Jul-12	1093.006	1.764	
9-Jul-12	1091.538	3.232	
16-Jul-12	1092.120	2.650	
23-Jul-12	1091.137	3.633	
30-Jul-12	1090.532	4.238	
6-Aug-12	1090.081	4.689	
20-Aug-12	1088.831	5.939	
4-Sep-12	1089.871	4.899	
17-Sep-12	1090.388	4.382	
7-May-13	1091.893	2.877	
13-May-13	1093.174	1.596	
21-May-13	1092.896	1.874	
27-May-13			no access - photos taken
3-Jun-13			no access - photos taken
10-Jun-13	1093.187	1.583	
17-Jun-13	1092.841	1.929	
24-Jun-13	1091.080	3.690	
2-Jul-13	1090.971	3.799	
8-Jul-13	1090.136	4.634	
9-Jul-13	1090.181	4.589	
15-Jul-13	1089.552	5.218	
22-Jul-13	1091.822	2.948	
29-Jul-13	1090.085	4.685	
5-Aug-13	1089.750	5.020	
20-Aug-13	1090.019	4.751	
3-Sep-13	1090.650	4.120	
11-Sep-13	1090.301	4.469	

*Freeboard calculated based on maximum elevation of 1094.77 m asl

North Fork of Rose Creek
NF1 Water Elevations



North Fork of Rose Creek
2012 Water Elevations - NF2

Date	Elevation* (masl)	Freeboard** (masl)	Average Elevation (masl)	Comments
7-May-12	1085.915	0.629		
7-May-12	1085.584	0.96		
7-May-12	1085.514	1.03		
7-May-12	1085.617	0.927		
14-May-12	1087.244	-0.7	1086.158	
14-May-12	1086.411	0.133		
14-May-12	1085.903	0.641		
14-May-12	1085.214	1.33		
14-May-12	1086.019	0.525		
22-May-12	1087.583	-1.039	1087.188	
22-May-12	1087.244	-0.7		
22-May-12	1086.68	-0.136		
22-May-12	1087.284	-0.74		
22-May-12	1087.147	-0.603		
28-May-12	1087.215	-0.671	1086.887	
28-May-12	1087.097	-0.553		
28-May-12	1087.04	-0.496		
28-May-12	1086.295	0.249		
28-May-12	1086.79	-0.246		
4-Jun-12	1086.701	-0.157	1086.894	
4-Jun-12	1086.863	-0.319		
4-Jun-12	1086.869	-0.325		
4-Jun-12	1087.142	-0.598		
4-Jun-12	1086.897	-0.353		
11-Jun-12	1087.559	-1.015	1087.354	
11-Jun-12	1087.484	-0.94		
11-Jun-12	1087.524	-0.98		
11-Jun-12	1087.254	-0.71		
11-Jun-12	1086.949	-0.405		
18-Jun-12	1087.136	-0.592	1086.856	
18-Jun-12	1087.212	-0.668		
18-Jun-12	1087.093	-0.549		
18-Jun-12	1085.973	0.571		
18-Jun-12	1086.864	-0.32		
25-Jun-12	1086.63	-0.086		
25-Jun-12	1087.006	-0.462		
25-Jun-12	1087.069	-0.525		
25-Jun-12	1087.229	-0.685		
25-Jun-12	1086.564	-0.02	1086.900	
3-Jul-12	1087.272	-0.728		
3-Jul-12	1087.222	-0.678		
3-Jul-12	1086.984	-0.44		
3-Jul-12	1086.7	-0.156		
3-Jul-12	1086.859	-0.315	1087.0074	
9-Jul-12	1086.499	0.045		

North Fork of Rose Creek
2012 Water Elevations - NF2

Date	Elevation* (masl)	Freeboard** (masl)	Average Elevation (masl)	Comments
9-Jul-12	1086.787	-0.243		
9-Jul-12	1087.043	-0.499		
9-Jul-12	1086.763	-0.219		
9-Jul-12	1086.795	-0.251	1086.777	
16-Jul-12	1086.616	-0.072		
16-Jul-12	1087.003	-0.459		
16-Jul-12	1086.289	0.255		
16-Jul-12	1086.063	0.481		
16-Jul-12	1085.781	0.763	1086.350	
23-Jul-12	1086.790	-0.246		
23-Jul-12	1086.834	-0.29		
23-Jul-12	1086.865	-0.321		
23-Jul-12	1086.892	-0.348		
23-Jul-12	1086.902	-0.358	1086.857	
30-Jul-12	1085.884	0.66		
30-Jul-12	1086.411	0.133		
30-Jul-12	1086.784	-0.24		
30-Jul-12	1085.964	0.58		
30-Jul-12	1086.374	0.17	1086.283	
6-Aug-12	1085.735	0.809		
6-Aug-12	1086.542	0.002		
6-Aug-12	1086.41	0.134		
6-Aug-12	1086.487	0.057		
6-Aug-12	1086.477	0.067	1086.3302	
20-Aug-12	1085.827	0.717		
20-Aug-12	1086.096	0.448		
20-Aug-12	1086.514	0.03		
20-Aug-12	1086.251	0.293		
20-Aug-12	1086.154	0.39	1086.1684	
4-Sep-12	1086.412	0.132		
4-Sep-12	1086.355	0.189		
4-Sep-12	1086.464	0.08		
4-Sep-12	1086.554	-0.01		
4-Sep-12	1086.404	0.14	1086.4378	
17-Sep-12	1086.301	0.243		
17-Sep-12	1086.644	-0.1		
17-Sep-12	1086.734	-0.19		
17-Sep-12	1086.536	0.008		
17-Sep-12	1086.646	-0.102	1086.5722	
7-May-13	1086.585	-0.041	1086.585	
13-May-13	1085.987	0.557		
13-May-13	1088.374	-1.83		
13-May-13	1088.398	-1.854		
13-May-13	1088.27	-1.726		

North Fork of Rose Creek
2012 Water Elevations - NF2

Date	Elevation* (masl)	Freeboard** (masl)	Average Elevation (masl)	Comments
13-May-13	1088.27	-1.726	1087.8598	
21-May-13	1087.903	-1.359		
21-May-13	1087.874	-1.33		
21-May-13	1087.956	-1.412		
21-May-13	1087.751	-1.207		
21-May-13	1087.616	-1.072	1087.82	
27-May-13	1089.253	-2.709		
27-May-13	1088.462	-1.918		
27-May-13	1088.005	-1.461		
27-May-13	1087.881	-1.337		
27-May-13	1087.664	-1.12	1088.253	
3-Jun-13	1089.156	-2.612		
3-Jun-13	1088.479	-1.935		
3-Jun-13	1087.946	-1.402		
3-Jun-13	1088.124	-1.58		
3-Jun-13	1088.296	-1.752	1088.400	
10-Jun-13	1087.178	-0.634		
10-Jun-13	1087.173	-0.629		
10-Jun-13	1087.197	-0.653		
10-Jun-13	1087.097	-0.553		
10-Jun-13	1086.952	-0.408	1087.119	
17-Jun-13	1087.006	-0.462		
17-Jun-13	1087.105	-0.561		
17-Jun-13	1087.063	-0.519		
17-Jun-13	1086.942	-0.398		
17-Jun-13	1086.902	-0.358	1087.004	
24-Jun-13	1080.363	6.181		
24-Jun-13	1086.079	0.465		
24-Jun-13	1086.326	0.218		
24-Jun-13	1086.337	0.207		
24-Jun-13	1086.871	-0.327	1085.195	
2-Jul-13	1086.969	-0.425		
2-Jul-13	1087.306	-0.762		
2-Jul-13	1087.027	-0.483		
2-Jul-13	1087.035	-0.491		
2-Jul-13	1086.816	-0.272	1087.031	
8-Jul-13	1086.543	0.001		
8-Jul-13	1086.503	0.041		
8-Jul-13	1086.453	0.091		
8-Jul-13	1086.411	0.133		
8-Jul-13	1086.043	0.501	1086.3906	
15-Jul-13	1085.527	1.017		
15-Jul-13	1086.409	0.135		
15-Jul-13	1086.208	0.336		
15-Jul-13	1085.505	1.039		

North Fork of Rose Creek
2012 Water Elevations - NF2

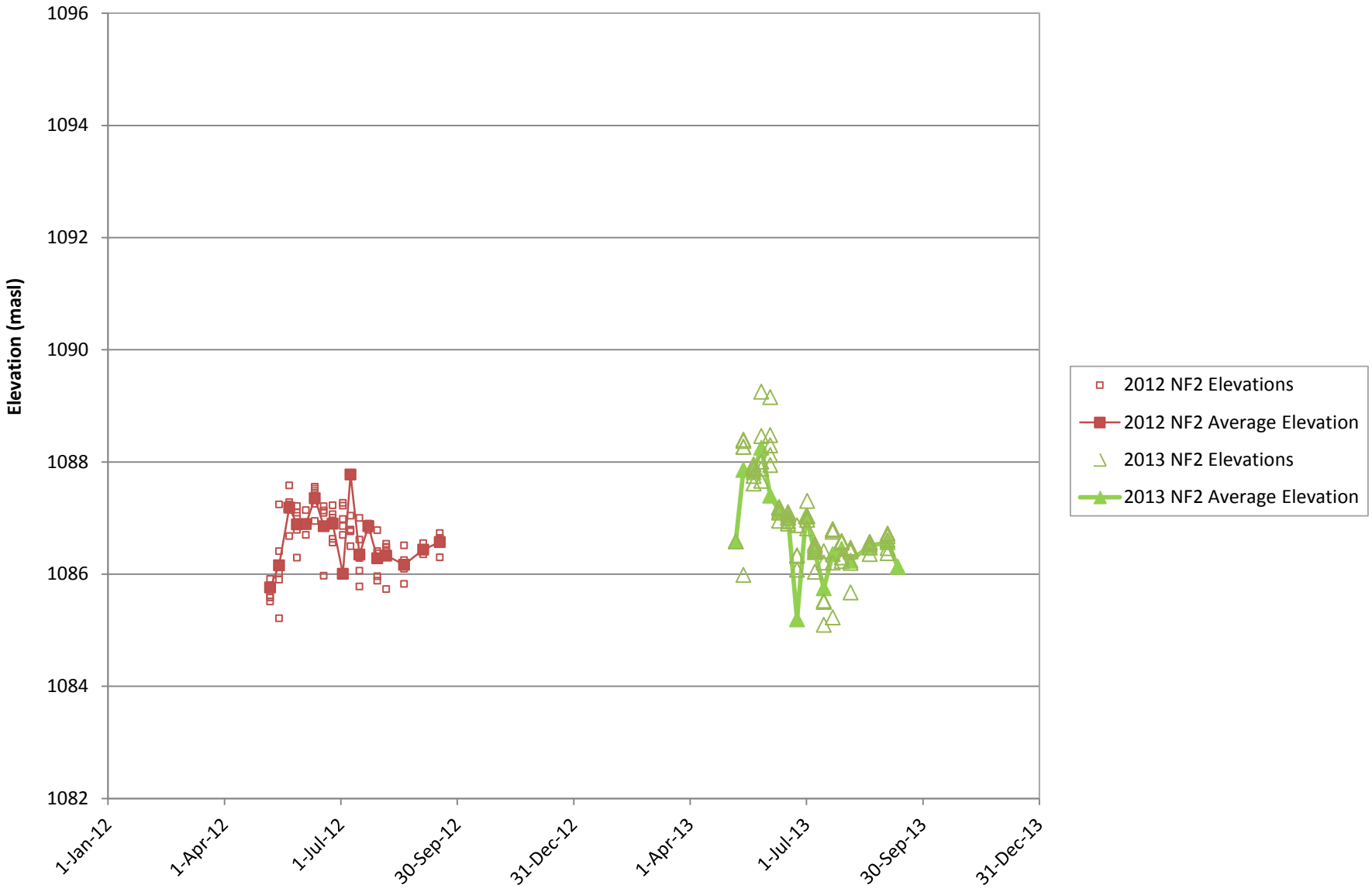
Date	Elevation* (masl)	Freeboard** (masl)	Average Elevation (masl)	Comments
15-Jul-13	1085.097	1.447	1085.7492	
22-Jul-13	1085.229	1.315		
22-Jul-13	1086.803	-0.259		
22-Jul-13	1086.206	0.338		
22-Jul-13	1086.756	-0.212		
22-Jul-13	1086.786	-0.242	1086.356	
29-Jul-13	1086.233	0.311		
29-Jul-13	1086.564	-0.02		
29-Jul-13	1086.565	-0.021		
29-Jul-13	1086.299	0.245		
29-Jul-13	1086.591	-0.047	1086.4504	
5-Aug-13	1085.674	0.87		
5-Aug-13	1086.201	0.343		
5-Aug-13	1086.471	0.073		
5-Aug-13	1086.448	0.096		
5-Aug-13	1086.404	0.14	1086.2396	
20-Aug-13	1086.359	0.185		
20-Aug-13	1086.566	-0.022		
20-Aug-13	1086.54	0.004		
20-Aug-13	1086.473	0.071		
20-Aug-13	1086.575	-0.031	1086.5026	
3-Sep-13	1086.375	0.169		
3-Sep-13	1086.464	0.08		
3-Sep-13	1086.678	-0.134		
3-Sep-13	1086.606	-0.062		
3-Sep-13	1086.724	-0.18	1086.5694	
11-Sep-13	1086.245	0.299		
11-Sep-13	1086.703	-0.159		
11-Sep-13	1086.616	-0.072		
11-Sep-13	1085.69	0.854		
11-Sep-13	1086.132	0.412	1086.2772	

* Max elevation measured at several locations across rock drain on date - average used to determine head

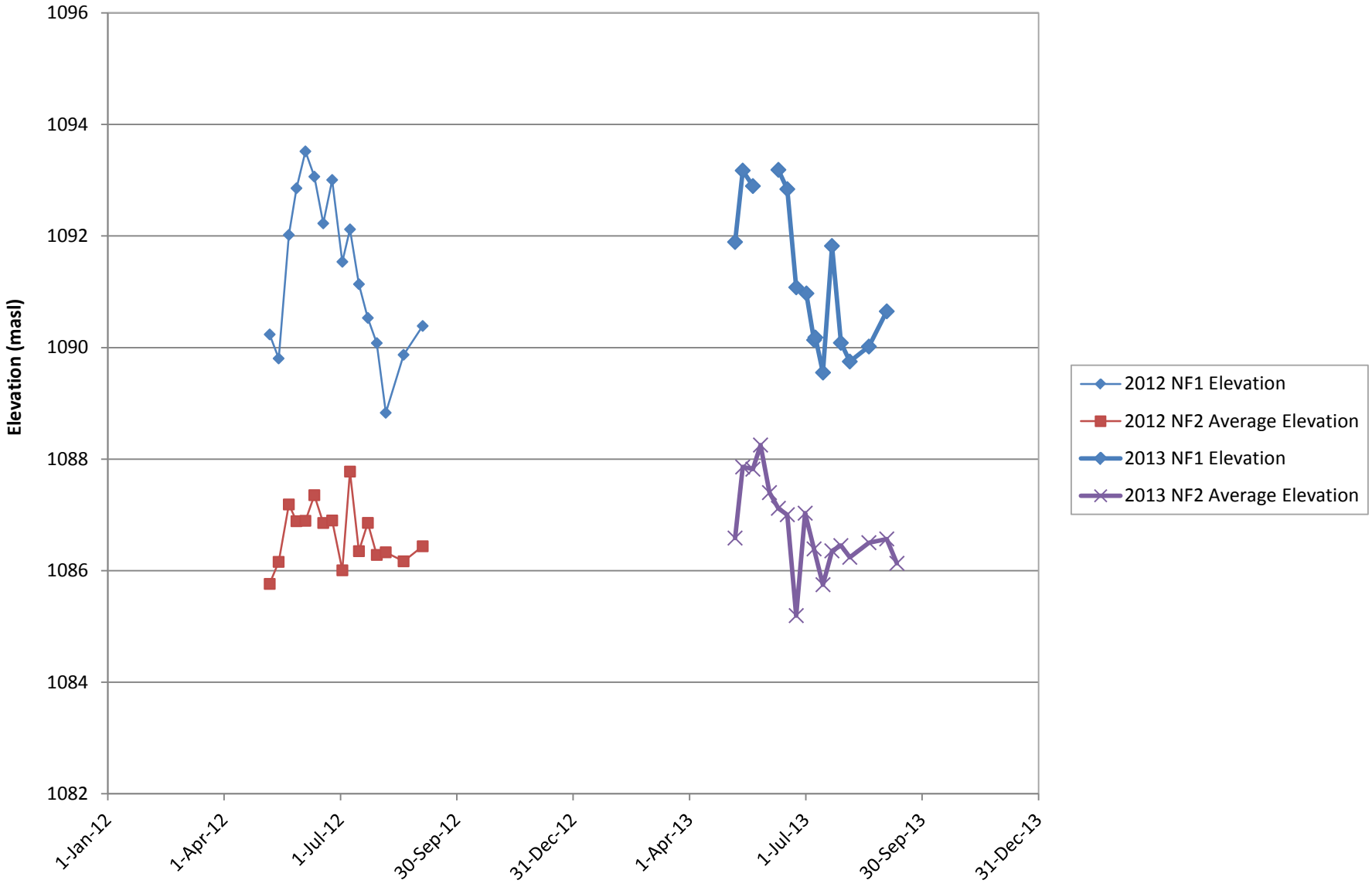
**Freeboard calculated based on maximum elevation of 1086.544 m asl

North Fork of Rose Creek
NF2 Water Elevations

NF2 Elevations



North Fork of Rose Creek
NF1 NF2 Water Elevations



7-May-12	1085.763
14-May-12	1086.158
22-May-12	1087.188
28-May-12	1086.887
4-Jun-12	1086.894
11-Jun-12	1087.354
18-Jun-12	1086.856
25-Jun-12	1086.900
3-Jul-12	1086.007
9-Jul-12	1087.777
16-Jul-12	1086.350
23-Jul-12	1086.857
30-Jul-12	1086.283
6-Aug-12	1086.330
20-Aug-12	1086.168
4-Sep-12	1086.438
17-Sep-12	1086.572
7-May-13	1086.585
13-May-13	1087.8598
21-May-13	1087.82
27-May-13	1088.253
3-Jun-13	1087.4
10-Jun-13	1087.119
17-Jun-13	1087.004
24-Jun-13	1085.195
1-Jul-13	1087.031
8-Jul-13	1086.391
15-Jul-13	1085.749
22-Jul-13	1086.356
29-Jul-13	1086.45
5-Aug-13	1086.24
20-Aug-13	1086.5026
3-Sep-13	1086.5694
11-Sep-13	1086.132

Project Number	Field Team	Date and Time	Location	Weather - Temperature (â—‹C)	Weather - Cloud Cover	Weather - Precipitation	Weather - Precipitation (other)	Weather - Wind Strength	Weather - Wind Direction (from)	GPS Coordinates - Injection Point	Sample Medium	Sample Medium (other)	YSI ID Number	YSI Calibration Date	Pre-test Injection Point - Conductivity (ms/cmÃ·â—‹C)	Pre-test Injection Point - Temperature (â—‹C)	Pre-test Injection Point - pH	Pre-test Injection Point - ORP (mV)	Pre-test Injection Point - Dissolved Oxygen (mg/L)	Pre-test Injection Point - Colour	Pre-test Injection Point - Colour (other)	Injection Point Image 1	Injection Point Image 2	Dye Release Time	Notes
472645	ac,bt	13-09-11 12:45:15	NF1	10	100%	None		Light	NW	62.341071876577665:-133.362161886946 24	Surface		15968	13-09-11	0.166	4.86	8.33	204.3	999	Clear		file:///storage/sdcard0/memento/images/Dye%20Test%20Setup%20-%20Injection%20Location%202013-09-11%2012.48.48.jpg	file:///storage/sdcard0/memento/images/Dye%20Test%20Setup%20-%20Injection%20Location%202013-09-11%2012.49.21.jpg	13-09-11 12:48:28	

Project Number	Location ID	Monitoring Point - GPS Coordinates	Field Team	Date and Time	YSI ID	Monitoring Point - pH (units)	Monitoring Point - Specific Conductivity (mS/cmÂ·â—‹C)	Monitoring Point - Temperature (â—‹C)	Monitoring Point - ORP (mV)	Monitoring Point - Dissolved Oxygen (mg/L)	Monitoring Point - Rhodamin (ug/L)	Image 1	Image 2	Notes
472645	Downstream side of rock drain	62.33910571195485:-133.36447641358 22	ac, bt	13-09-11 13:46:46	07A1480	7.76	0	-9.999	72.6	-9999	28.2	file:///storage/sdcard0/memento/images/Dye%20Test%20Setup%20-%20Monitoring%20Location%20 2013-09-11%2013.48.57.jpg	file:///storage/sdcard0/memento/images/Dye%20Test%20Setup%20-%20Monitoring%20Location%202013-09-11%2013.49.39.jpg	

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/11/2013	12:47:12	4.88	0.166	0.102	8.45	230	-0.8
9/11/2013	12:47:42	4.8	0.166	0.102	8.3	204	0.5
9/11/2013	12:48:12	4.75	0.166	0.102	8.17	191	0.6
9/11/2013	12:48:42	4.75	0.16	0.098	8.15	189	0.7
9/11/2013	12:49:12	4.73	0.158	0.097	8.04	184	3.4
9/11/2013	12:49:42	4.74	0.16	0.098	7.96	184	295.8
9/11/2013	12:50:12	4.75	0.159	0.098	7.86	183	326.3
9/11/2013	12:50:42	4.73	0.159	0.097	7.81	181	328.6
9/11/2013	12:51:12	4.74	0.158	0.097	7.74	182	328.9
9/11/2013	12:51:42	4.73	0.158	0.097	7.69	180	328.9
9/11/2013	12:52:12	4.73	0.158	0.097	7.65	180	328.8
9/11/2013	12:52:42	4.73	0.158	0.097	7.62	181	328.9
9/11/2013	12:53:12	4.73	0.158	0.097	7.58	182	328.9
9/11/2013	12:53:42	4.75	0.158	0.097	7.55	183	329
9/11/2013	12:54:12	4.74	0.158	0.097	7.52	185	328.9
9/11/2013	12:54:42	4.74	0.158	0.097	7.49	186	328.9
9/11/2013	12:55:12	4.73	0.158	0.097	7.45	188	328.9
9/11/2013	12:55:42	4.73	0.158	0.097	7.42	190	328.9
9/11/2013	12:56:12	4.73	0.158	0.097	7.39	192	328.9
9/11/2013	12:56:42	4.73	0.158	0.097	7.36	193	328.9
9/11/2013	12:57:12	4.73	0.158	0.097	7.33	195	328.9
9/11/2013	12:57:42	4.74	0.157	0.097	7.31	196	329
9/11/2013	12:58:12	4.74	0.157	0.096	7.29	198	329
9/11/2013	12:58:42	4.74	0.157	0.097	7.26	199	329
9/11/2013	12:59:12	4.75	0.157	0.096	7.24	200	329
9/11/2013	12:59:42	4.75	0.157	0.096	7.22	202	329
9/11/2013	13:00:12	4.75	0.157	0.096	7.2	204	328
9/11/2013	13:00:42	4.75	0.157	0.096	7.18	205	256.9
9/11/2013	13:01:12	4.75	0.157	0.096	7.16	206	290.1
9/11/2013	13:01:42	4.75	0.157	0.096	7.14	207	193.7
9/11/2013	13:02:12	4.76	0.157	0.096	7.12	208	263.8
9/11/2013	13:02:42	4.76	0.157	0.096	7.11	209	326.9
9/11/2013	13:03:12	4.76	0.157	0.096	7.1	210	321.2
9/11/2013	13:03:42	4.76	0.157	0.096	7.09	211	282.5
9/11/2013	13:04:12	4.76	0.157	0.096	7.08	211	285.5
9/11/2013	13:04:42	4.76	0.157	0.096	7.07	212	159.4
9/11/2013	13:05:12	4.77	0.157	0.096	7.06	213	95.7
9/11/2013	13:05:42	4.76	0.157	0.096	7.05	213	107.6
9/11/2013	13:06:12	4.77	0.157	0.096	7.04	214	85.7
9/11/2013	13:06:42	4.77	0.157	0.096	7.04	214	67.2
9/11/2013	13:07:12	4.77	0.157	0.096	7.03	215	84
9/11/2013	13:07:42	4.77	0.157	0.096	7.03	215	217.4
9/11/2013	13:08:12	4.78	0.157	0.096	7.03	216	206.2
9/11/2013	13:08:42	4.77	0.157	0.096	7.03	216	120
9/11/2013	13:09:12	4.77	0.157	0.096	7.02	216	178.9

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/11/2013	13:09:42	4.77	0.157	0.096	7.02	217	121.6
9/11/2013	13:10:12	4.77	0.157	0.096	7.02	217	114
9/11/2013	13:10:42	4.77	0.157	0.096	7.02	217	76.4
9/11/2013	13:11:12	4.77	0.157	0.096	7.02	217	78.3
9/11/2013	13:11:42	4.78	0.161	0.099	7.03	217	59.8
9/11/2013	13:12:12	4.78	0.163	0.1	7.03	217	75.3
9/11/2013	13:12:42	4.78	0.163	0.1	7.03	217	41
9/11/2013	13:13:12	4.78	0.163	0.1	7.03	217	33.7
9/11/2013	13:13:42	4.78	0.163	0.1	7.04	217	44.8
9/11/2013	13:14:12	4.8	0.163	0.1	7.04	217	44.8
9/11/2013	13:14:42	4.79	0.165	0.101	7.05	217	48
9/11/2013	13:15:12	4.8	0.167	0.102	7.05	217	50.1
9/11/2013	13:15:42	4.81	0.167	0.103	7.05	217	35
9/11/2013	13:16:12	4.82	0.167	0.103	7.06	216	38.9
9/11/2013	13:16:42	4.83	0.167	0.103	7.06	216	32.6
9/11/2013	13:17:12	4.84	0.167	0.103	7.07	216	30.9
9/11/2013	13:17:42	4.85	0.167	0.103	7.07	216	21.3
9/11/2013	13:18:12	4.86	0.167	0.103	7.08	215	22
9/11/2013	13:18:42	4.87	0.167	0.103	7.08	215	31
9/11/2013	13:19:12	4.87	0.167	0.103	7.09	215	32
9/11/2013	13:19:42	4.88	0.167	0.103	7.09	215	25.1
9/11/2013	13:20:12	4.88	0.167	0.103	7.1	215	14.3
9/11/2013	13:20:42	4.89	0.167	0.103	7.11	214	12.4
9/11/2013	13:21:12	4.89	0.167	0.103	7.11	214	15.6
9/11/2013	13:21:42	4.89	0.166	0.103	7.12	214	12.1
9/11/2013	13:22:12	4.89	0.167	0.103	7.12	213	12.3
9/11/2013	13:22:42	4.89	0.166	0.103	7.13	213	14.9
9/11/2013	13:23:12	4.89	0.166	0.103	7.14	213	9
9/11/2013	13:23:42	4.9	0.166	0.103	7.14	213	6.1
9/11/2013	13:24:12	4.89	0.166	0.103	7.15	212	13.2
9/11/2013	13:24:42	4.89	0.166	0.103	7.15	212	11.4
9/11/2013	13:25:12	4.89	0.166	0.103	7.16	212	5.9
9/11/2013	13:25:42	4.88	0.166	0.103	7.16	211	5.4
9/11/2013	13:26:12	4.89	0.166	0.102	7.17	211	5
9/11/2013	13:26:42	4.88	0.166	0.102	7.17	211	6.7
9/11/2013	13:27:12	4.87	0.166	0.102	7.18	211	6.3
9/11/2013	13:27:42	4.87	0.166	0.102	7.18	210	7.7
9/11/2013	13:28:12	4.86	0.166	0.102	7.19	210	6.3
9/11/2013	13:28:42	4.85	0.166	0.102	7.2	210	5
9/11/2013	13:29:12	4.86	0.166	0.102	7.2	210	4.6
9/11/2013	13:29:42	4.86	0.166	0.102	7.2	210	6.3
9/11/2013	13:30:12	4.85	0.166	0.102	7.21	209	3.7
9/11/2013	13:30:42	4.84	0.166	0.102	7.21	209	3.8
9/11/2013	13:31:12	4.83	0.166	0.102	7.22	209	4.1
9/11/2013	13:31:42	4.83	0.166	0.102	7.22	209	3.1

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/11/2013	13:32:12	4.83	0.166	0.102	7.22	209	2.9
9/11/2013	13:32:42	4.83	0.166	0.102	7.23	208	3.4
9/11/2013	13:33:12	4.83	0.166	0.102	7.23	208	3.2
9/11/2013	13:33:42	4.83	0.166	0.102	7.23	208	3.4
9/11/2013	13:34:12	4.83	0.166	0.102	7.24	208	4.8
9/11/2013	13:34:42	4.83	0.166	0.102	7.24	208	5
9/11/2013	13:35:12	4.84	0.166	0.102	7.25	208	4.4
9/11/2013	13:35:42	4.83	0.166	0.102	7.25	208	6.1
9/11/2013	13:36:12	4.83	0.166	0.102	7.25	208	3.7
9/11/2013	13:36:42	4.83	0.166	0.102	7.25	207	2.9
9/11/2013	13:37:12	4.84	0.166	0.102	7.26	207	2.8
9/11/2013	13:37:42	4.84	0.166	0.102	7.26	207	3
9/11/2013	13:38:12	4.85	0.166	0.102	7.26	207	3.2
9/11/2013	13:38:42	4.86	0.166	0.102	7.27	207	4.4
9/11/2013	13:39:12	4.86	0.166	0.102	7.27	207	4.3
9/11/2013	13:39:42	4.86	0.166	0.102	7.27	207	2.7
9/11/2013	13:40:12	4.87	0.166	0.102	7.27	206	3.5
9/11/2013	13:40:42	4.87	0.166	0.102	7.28	206	3.9
9/11/2013	13:41:12	4.86	0.166	0.102	7.28	206	3.3
9/11/2013	13:41:42	4.87	0.166	0.102	7.28	206	3.6
9/11/2013	13:42:12	4.86	0.166	0.102	7.28	206	3.4
9/11/2013	13:42:42	4.87	0.166	0.102	7.29	206	2.9
9/11/2013	13:43:12	4.87	0.166	0.102	7.29	206	3.1
9/11/2013	13:43:42	4.87	0.166	0.102	7.29	206	3.2
9/11/2013	13:44:12	4.89	0.166	0.102	7.29	205	3.3
9/11/2013	13:44:42	4.9	0.165	0.102	7.29	205	3.2
9/11/2013	13:45:12	4.9	0.166	0.102	7.3	205	4.1
9/11/2013	13:45:42	4.92	0.166	0.102	7.3	205	2.6
9/11/2013	13:46:12	4.94	0.165	0.102	7.3	205	2.7
9/11/2013	13:46:42	4.94	0.166	0.102	7.3	205	2.5
9/11/2013	13:47:12	4.95	0.165	0.102	7.31	205	3
9/11/2013	13:47:42	4.94	0.165	0.102	7.31	205	2.6
9/11/2013	13:48:12	4.95	0.165	0.102	7.31	205	2.9
9/11/2013	13:48:42	4.95	0.166	0.102	7.31	204	2.1
9/11/2013	13:49:12	4.95	0.165	0.102	7.31	204	1.9
9/11/2013	13:49:42	4.94	0.165	0.102	7.32	204	2.4
9/11/2013	13:50:12	4.95	0.165	0.102	7.32	204	2.6
9/11/2013	13:50:42	4.94	0.165	0.102	7.32	204	2.4
9/11/2013	13:51:12	4.94	0.165	0.102	7.32	204	2.1
9/11/2013	13:51:42	4.94	0.165	0.102	7.32	204	1.7
9/11/2013	13:52:12	4.94	0.165	0.102	7.32	203	1.6
9/11/2013	13:52:42	4.94	0.165	0.102	7.32	203	2.1
9/11/2013	13:53:12	4.93	0.165	0.102	7.32	203	2.2
9/11/2013	13:53:42	4.94	0.165	0.102	7.32	203	1.8
9/11/2013	13:54:12	4.94	0.165	0.102	7.32	203	4.1

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/11/2013	13:54:42	4.95	0.165	0.102	7.33	203	2.4
9/11/2013	13:55:12	4.96	0.165	0.102	7.33	203	1.5
9/11/2013	13:55:42	4.96	0.165	0.102	7.33	203	2
9/11/2013	13:56:12	4.96	0.165	0.102	7.33	203	1.8
9/11/2013	13:56:42	4.98	0.165	0.102	7.33	202	2.1
9/11/2013	13:57:12	5.01	0.165	0.102	7.33	202	1.7
9/11/2013	13:57:42	4.98	0.165	0.102	7.33	202	2.5
9/11/2013	13:58:12	5.01	0.165	0.102	7.33	202	2.5
9/11/2013	13:58:42	5.01	0.165	0.102	7.33	202	2.4
9/11/2013	13:59:12	5.01	0.165	0.102	7.34	202	2.2
9/11/2013	13:59:42	5	0.165	0.102	7.34	202	2.5
9/11/2013	14:00:12	5.02	0.165	0.102	7.34	202	3.6
9/11/2013	14:00:42	5.03	0.165	0.102	7.34	201	2.8
9/11/2013	14:01:12	5.04	0.165	0.102	7.34	201	2.8
9/11/2013	14:01:42	5.04	0.165	0.102	7.34	201	2.8
9/11/2013	14:02:12	5.04	0.165	0.102	7.34	201	2.1
9/11/2013	14:02:42	5.04	0.165	0.102	7.34	201	1.7
9/11/2013	14:03:12	5.04	0.165	0.102	7.35	201	2
9/11/2013	14:03:42	5.04	0.165	0.102	7.35	201	2.5
9/11/2013	14:04:12	5.04	0.165	0.102	7.35	201	1.8
9/11/2013	14:04:42	5.04	0.165	0.102	7.35	201	2
9/11/2013	14:05:12	5.04	0.165	0.102	7.35	201	1.6
9/11/2013	14:05:42	5.05	0.165	0.102	7.35	201	1.5
9/11/2013	14:06:12	5.05	0.165	0.102	7.35	200	1.9
9/11/2013	14:06:42	5.04	0.165	0.102	7.35	200	2.5
9/11/2013	14:07:12	5.05	0.165	0.102	7.36	200	2.1
9/11/2013	14:07:42	5.05	0.165	0.102	7.36	200	2.4
9/11/2013	14:08:12	5.04	0.165	0.102	7.36	200	1.6
9/11/2013	14:08:42	5.05	0.165	0.102	7.36	200	1.8
9/11/2013	14:09:12	5.06	0.165	0.102	7.36	200	1.2
9/11/2013	14:09:42	5.05	0.165	0.102	7.36	200	1.6
9/11/2013	14:10:12	5.06	0.165	0.102	7.36	200	1.6
9/11/2013	14:10:42	5.07	0.165	0.102	7.36	200	1.2
9/11/2013	14:11:12	5.08	0.165	0.102	7.36	199	1.6
9/11/2013	14:11:42	5.11	0.164	0.102	7.36	199	1.2
9/11/2013	14:12:12	5.13	0.164	0.102	7.36	199	1.9
9/11/2013	14:12:42	5.1	0.165	0.102	7.36	199	1.9
9/11/2013	14:13:12	5.11	0.165	0.102	7.37	199	1.7
9/11/2013	14:13:42	5.11	0.165	0.102	7.37	199	1.8
9/11/2013	14:14:12	5.12	0.165	0.102	7.37	199	1.6
9/11/2013	14:14:42	5.12	0.165	0.102	7.37	199	1.7
9/11/2013	14:15:12	5.12	0.165	0.102	7.37	199	1.3
9/11/2013	14:15:42	5.13	0.164	0.102	7.37	199	1.6
9/11/2013	14:16:12	5.15	0.164	0.102	7.37	199	2.6
9/11/2013	14:16:42	5.15	0.164	0.102	7.37	198	1.9

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/11/2013	14:17:12	5.15	0.164	0.102	7.37	198	1.6
9/11/2013	14:17:42	5.15	0.165	0.102	7.37	198	2.2
9/11/2013	14:18:12	5.16	0.165	0.102	7.37	198	1.5
9/11/2013	14:18:42	5.17	0.164	0.102	7.37	198	2.4
9/11/2013	14:19:12	5.18	0.164	0.102	7.37	198	1.8
9/11/2013	14:19:42	5.17	0.164	0.102	7.37	198	1.8
9/11/2013	14:20:12	5.19	0.164	0.102	7.37	198	1.5
9/11/2013	14:20:42	5.19	0.164	0.102	7.37	198	1.4
9/11/2013	14:21:12	5.19	0.164	0.102	7.37	198	1.5
9/11/2013	14:21:42	5.2	0.164	0.102	7.37	197	1.8
9/11/2013	14:22:12	5.2	0.164	0.102	7.37	197	1.5
9/11/2013	14:22:42	5.21	0.164	0.102	7.37	197	1.5
9/11/2013	14:23:12	5.21	0.164	0.102	7.38	197	1.5
9/11/2013	14:23:42	5.2	0.164	0.102	7.38	197	0.8
9/11/2013	14:24:12	5.21	0.164	0.102	7.38	197	1.4
9/11/2013	14:24:42	5.21	0.164	0.102	7.38	197	1.2
9/11/2013	14:25:12	5.21	0.164	0.102	7.38	197	1.7
9/11/2013	14:25:42	5.21	0.164	0.102	7.38	197	1.4
9/11/2013	14:26:12	5.21	0.164	0.102	7.38	197	1.1
9/11/2013	14:26:42	5.22	0.164	0.102	7.38	197	1.6
9/11/2013	14:27:12	5.21	0.164	0.102	7.38	197	1.2
9/11/2013	14:27:42	5.21	0.164	0.102	7.38	196	1.5
9/11/2013	14:28:12	5.22	0.164	0.102	7.38	196	1.5
9/11/2013	14:28:42	5.24	0.164	0.102	7.38	196	1.8
9/11/2013	14:29:12	5.24	0.164	0.102	7.38	196	1.3
9/11/2013	14:29:42	5.24	0.164	0.102	7.38	196	2.9
9/11/2013	14:30:12	5.25	0.164	0.102	7.38	196	1
9/11/2013	14:30:42	5.25	0.164	0.102	7.38	196	0.8
9/11/2013	14:31:12	5.27	0.164	0.102	7.38	196	0.9
9/11/2013	14:31:42	5.26	0.164	0.102	7.38	196	1.3
9/11/2013	14:32:12	5.27	0.164	0.102	7.38	196	1
9/11/2013	14:32:42	5.27	0.164	0.102	7.39	196	1.3
9/11/2013	14:33:12	5.26	0.164	0.102	7.39	196	1.6
9/11/2013	14:33:42	5.24	0.164	0.102	7.39	196	1.8
9/11/2013	14:34:12	5.25	0.164	0.102	7.39	196	1.4
9/11/2013	14:34:42	5.26	0.164	0.102	7.39	196	1.5
9/11/2013	14:35:12	5.25	0.164	0.102	7.39	196	1.5
9/11/2013	14:35:42	5.27	0.164	0.102	7.39	196	1.7
9/11/2013	14:36:12	5.26	0.164	0.102	7.39	196	1.6
9/11/2013	14:36:42	5.27	0.164	0.102	7.39	195	1.3
9/11/2013	14:37:12	5.29	0.164	0.102	7.39	195	1.4
9/11/2013	14:37:42	5.29	0.164	0.102	7.39	195	1.4
9/11/2013	14:38:12	5.35	0.164	0.102	7.39	195	1
9/11/2013	14:38:42	5.35	0.164	0.102	7.39	195	1.4
9/11/2013	14:39:12	5.34	0.164	0.102	7.39	195	0.9

Date M/D/Y	Time hh:mm:ss	Temp C	SpCond mS/cm	Cond mS/cm	pH	ORP mV	Rhodamine ug/L
9/11/2013	14:39:42	5.33	0.164	0.102	7.39	195	1.3
9/11/2013	14:40:12	5.33	0.164	0.102	7.39	195	1.4
9/11/2013	14:40:42	5.33	0.164	0.102	7.39	195	1.1
9/11/2013	14:41:12	5.33	0.164	0.102	7.39	195	1.5
9/11/2013	14:41:42	5.34	0.164	0.102	7.39	195	1.7
9/11/2013	14:42:12	5.36	0.164	0.102	7.39	195	1.4
9/11/2013	14:42:42	5.39	0.164	0.103	7.39	195	0.8
9/11/2013	14:43:12	5.39	0.164	0.103	7.39	195	1.1
9/11/2013	14:43:42	5.42	0.164	0.103	7.39	195	1.3
9/11/2013	14:44:12	5.44	0.164	0.103	7.39	195	1.7
9/11/2013	14:44:42	5.44	0.164	0.103	7.39	194	1.7
9/11/2013	14:45:12	5.45	0.164	0.103	7.39	194	1.1
9/11/2013	14:45:42	5.46	0.164	0.103	7.39	194	1.2
9/11/2013	14:46:12	5.47	0.164	0.103	7.39	194	1.2
9/11/2013	14:46:42	5.47	0.164	0.103	7.39	194	1.1
9/11/2013	14:47:12	5.48	0.164	0.103	7.39	194	1.1
9/11/2013	14:47:42	5.49	0.164	0.103	7.39	194	1.2
9/11/2013	14:48:12	5.5	0.164	0.103	7.39	194	1.3
9/11/2013	14:48:42	5.49	0.164	0.103	7.39	194	1.1
9/11/2013	14:49:12	5.49	0.164	0.103	7.39	194	0.8
9/11/2013	14:49:42	5.48	0.164	0.103	7.39	194	1.2
9/11/2013	14:50:12	5.49	0.164	0.103	7.39	194	1.1

Date	Time	Temp	SpCond	Cond	pH	pHmV	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	mV	ug/L
9/11/2013	12:02:37	-9.99	0	0	8.46	-74.2	120	0.5
9/11/2013	12:03:07	-9.99	0	0	8.13	-59.9	139	0.3
9/11/2013	12:03:37	-9.99	0	0	7.73	-43.2	148	0.5
9/11/2013	12:04:07	-9.99	0	0	7.92	-51.1	161	0.3
9/11/2013	12:04:37	-9.99	0	0	7.9	-50.3	156	0.2
9/11/2013	12:05:07	-9.99	0	0	7.88	-49.4	150	0.3
9/11/2013	12:05:37	-9.99	0	0	7.86	-48.4	144	0.2
9/11/2013	12:06:07	-9.99	0	0	7.84	-47.5	140	0.3
9/11/2013	12:06:37	-9.99	0	0	7.82	-46.8	136	0.4
9/11/2013	12:07:07	-9.99	0	0	7.81	-46.3	132	0.3
9/11/2013	12:07:37	-9.99	0	0	7.77	-44.6	131	0.1
9/11/2013	12:08:07	-9.99	0	0	7.78	-45.2	126	0.4
9/11/2013	12:08:37	-9.99	0	0	7.77	-44.8	123	0.2
9/11/2013	12:09:07	-9.99	0	0	7.77	-44.6	120	0.2
9/11/2013	12:09:37	-9.99	0	0	7.76	-44.4	118	0.2
9/11/2013	12:10:07	-9.99	0	0	7.76	-44.1	115	0.2
9/11/2013	12:10:37	-9.99	0	0	7.75	-44	113	0.2
9/11/2013	12:11:07	-9.99	0	0	7.75	-43.9	111	0.3
9/11/2013	12:11:37	-9.99	0	0	7.75	-43.8	110	0.2
9/11/2013	12:12:07	-9.99	0	0	7.75	-43.7	108	0.2
9/11/2013	12:12:37	-9.99	0	0	7.72	-42.5	108	0.2
9/11/2013	12:13:07	-9.99	0	0	7.74	-43.5	104	0.2
9/11/2013	12:13:37	-9.99	0	0	7.74	-43.5	103	0.2
9/11/2013	12:14:07	-9.99	0	0	7.74	-43.5	102	0.3
9/11/2013	12:14:37	-9.99	0	0	7.74	-43.4	101	0.3
9/11/2013	12:15:07	-9.99	0	0	7.74	-43.3	99	0.2
9/11/2013	12:15:37	-9.99	0	0	7.74	-43.3	99	0.3
9/11/2013	12:16:07	-9.99	0	0	7.73	-43.2	98	0.1
9/11/2013	12:16:37	-9.99	0	0	7.74	-43.3	96	0.3
9/11/2013	12:17:07	-9.99	0	0	7.73	-43.2	96	0.2
9/11/2013	12:17:37	-9.99	0	0	7.7	-41.9	96	0.2
9/11/2013	12:18:07	-9.99	0	0	7.73	-43.2	94	0.3
9/11/2013	12:18:37	-9.99	0	0	7.74	-43.3	93	0.3
9/11/2013	12:19:07	-9.99	0	0	7.73	-43.2	92	0.3
9/11/2013	12:19:37	-9.99	0	0	7.73	-43.2	92	0.3
9/11/2013	12:20:07	-9.99	0	0	7.73	-43.2	91	0.3
9/11/2013	12:20:37	-9.99	0	0	7.74	-43.3	91	0.3
9/11/2013	12:21:07	-9.99	0	0	7.73	-43.2	90	0.2
9/11/2013	12:21:37	-9.99	0	0	7.73	-43.2	89	0.2
9/11/2013	12:22:07	-9.99	0	0	7.73	-43.2	89	0.2
9/11/2013	12:22:37	-9.99	0	0	7.71	-42	90	0.1
9/11/2013	12:23:07	-9.99	0	0	7.73	-43.2	88	0.2
9/11/2013	12:23:37	-9.99	0	0	7.73	-43.2	88	0.3
9/11/2013	12:24:07	-9.99	0	0	7.73	-43.1	87	0.3
9/11/2013	12:24:37	-9.99	0	0	7.73	-43.1	87	0.2

Date	Time	Temp	SpCond	Cond	pH	pHmV	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	mV	ug/L
9/11/2013	12:25:07	-9.99	0	0	7.73	-43.1	87	0.3
9/11/2013	12:25:37	-9.99	0	0	7.73	-43.1	86	0.2
9/11/2013	12:26:07	-9.99	0	0	7.73	-43.1	86	0.2
9/11/2013	12:26:37	-9.99	0	0	7.73	-43.1	85	0.2
9/11/2013	12:27:07	-9.99	0	0	7.73	-43.1	85	0.2
9/11/2013	12:27:37	-9.99	0	0	7.71	-42	86	0.2
9/11/2013	12:28:07	-9.99	0	0	7.73	-43.1	84	0.2
9/11/2013	12:28:37	-9.99	0	0	7.73	-43.1	84	0.3
9/11/2013	12:29:07	-9.99	0	0	7.73	-43.1	84	0.3
9/11/2013	12:29:37	-9.99	0	0	7.73	-43.2	84	0.3
9/11/2013	12:30:07	-9.99	0	0	7.73	-43.1	83	0.3
9/11/2013	12:30:37	-9.99	0	0	7.73	-43.2	83	0.4
9/11/2013	12:31:07	-9.99	0	0	7.73	-43.1	83	0.3
9/11/2013	12:31:37	-9.99	0	0	7.73	-43.1	83	0.3
9/11/2013	12:32:07	-9.99	0	0	7.73	-43.1	83	0.2
9/11/2013	12:32:37	-9.99	0	0	7.71	-42	84	0.2
9/11/2013	12:33:07	-9.99	0	0	7.73	-43.2	82	0.2
9/11/2013	12:33:37	-9.99	0	0	7.73	-43.2	82	0.2
9/11/2013	12:34:07	-9.99	0	0	7.74	-43.3	82	0.3
9/11/2013	12:34:37	-9.99	0	0	7.74	-43.3	81	0.3
9/11/2013	12:35:07	-9.99	0	0	7.74	-43.3	81	0.3
9/11/2013	12:35:37	-9.99	0	0	7.74	-43.2	81	0.2
9/11/2013	12:36:07	-9.99	0	0	7.73	-43.2	81	0.2
9/11/2013	12:36:37	-9.99	0	0	7.73	-43.2	81	0.2
9/11/2013	12:37:07	-9.99	0	0	7.74	-43.3	80	0.2
9/11/2013	12:37:37	-9.99	0	0	7.71	-42.1	82	0.4
9/11/2013	12:38:07	-9.99	0	0	7.74	-43.3	80	0.1
9/11/2013	12:38:37	-9.99	0	0	7.74	-43.3	80	0.3
9/11/2013	12:39:07	-9.99	0	0	7.74	-43.4	80	0.2
9/11/2013	12:39:37	-9.99	0	0	7.74	-43.3	80	0.2
9/11/2013	12:40:07	-9.99	0	0	7.74	-43.4	79	0.3
9/11/2013	12:40:37	-9.99	0	0	7.74	-43.3	79	0.3
9/11/2013	12:41:07	-9.99	0	0	7.74	-43.4	79	0.3
9/11/2013	12:41:37	-9.99	0	0	7.74	-43.4	79	0.3
9/11/2013	12:42:07	-9.99	0	0	7.74	-43.5	79	0.3
9/11/2013	12:42:37	-9.99	0	0	7.71	-42.3	80	0.3
9/11/2013	12:43:07	-9.99	0	0	7.74	-43.5	78	0.2
9/11/2013	12:43:37	-9.99	0	0	7.74	-43.4	78	0.2
9/11/2013	12:44:07	-9.99	0	0	7.74	-43.5	78	0.2
9/11/2013	12:44:37	-9.99	0	0	7.74	-43.5	78	0.2
9/11/2013	12:45:07	-9.99	0	0	7.74	-43.5	78	0.3
9/11/2013	12:45:37	-9.99	0	0	7.74	-43.5	78	0.2
9/11/2013	12:46:07	-9.99	0	0	7.74	-43.5	78	0.2
9/11/2013	12:46:37	-9.99	0	0	7.74	-43.6	77	0.3
9/11/2013	12:47:07	-9.99	0	0	7.74	-43.6	77	0.3

Date	Time	Temp	SpCond	Cond	pH	pHmV	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	mV	ug/L
9/11/2013	12:47:37	-9.99	0	0	7.71	-42.4	79	0.2
9/11/2013	12:48:07	-9.99	0	0	7.74	-43.6	77	0.2
9/11/2013	12:48:37	-9.99	0	0	7.74	-43.6	77	0.2
9/11/2013	12:49:07	-9.99	0	0	7.74	-43.6	77	0.4
9/11/2013	12:49:37	-9.99	0	0	7.74	-43.6	77	0.4
9/11/2013	12:50:07	-9.99	0	0	7.74	-43.6	77	0.2
9/11/2013	12:50:37	-9.99	0	0	7.74	-43.6	77	0.1
9/11/2013	12:51:07	-9.99	0	0	7.74	-43.6	77	0.4
9/11/2013	12:51:37	-9.99	0	0	7.74	-43.6	77	0.3
9/11/2013	12:52:07	-9.99	0	0	7.74	-43.6	76	0.2
9/11/2013	12:52:37	-9.99	0	0	7.71	-42.3	78	0.2
9/11/2013	12:53:07	-9.99	0	0	7.74	-43.6	76	0.3
9/11/2013	12:53:37	-9.99	0	0	7.74	-43.6	76	0.3
9/11/2013	12:54:07	-9.99	0	0	7.74	-43.6	76	0.2
9/11/2013	12:54:37	-9.99	0	0	7.74	-43.6	76	0.4
9/11/2013	12:55:07	-9.99	0	0	7.74	-43.7	76	0.2
9/11/2013	12:55:37	-9.99	0	0	7.75	-43.7	76	0.1
9/11/2013	12:56:07	-9.99	0	0	7.75	-43.7	76	0.1
9/11/2013	12:56:37	-9.99	0	0	7.75	-43.8	75	0.3
9/11/2013	12:57:07	-9.99	0	0	7.75	-43.8	76	0.2
9/11/2013	12:57:37	-9.99	0	0	7.72	-42.7	77	0.3
9/11/2013	12:58:07	-9.99	0	0	7.75	-43.8	75	0.2
9/11/2013	12:58:37	-9.99	0	0	7.75	-43.8	75	0.2
9/11/2013	12:59:07	-9.99	0	0	7.75	-43.8	75	0.3
9/11/2013	12:59:37	-9.99	0	0	7.75	-43.9	75	0.2
9/11/2013	13:00:07	-9.99	0	0	7.75	-43.8	75	0.2
9/11/2013	13:00:37	-9.99	0	0	7.75	-43.8	75	0.2
9/11/2013	13:01:07	-9.99	0	0	7.75	-43.8	75	0.4
9/11/2013	13:01:37	-9.99	0	0	7.75	-43.7	75	0.2
9/11/2013	13:02:07	-9.99	0	0	7.75	-43.8	75	0.3
9/11/2013	13:02:37	-9.99	0	0	7.72	-42.6	76	0.3
9/11/2013	13:03:07	-9.99	0	0	7.75	-43.8	75	0.3
9/11/2013	13:03:37	-9.99	0	0	7.75	-43.9	75	0.2
9/11/2013	13:04:07	-9.99	0	0	7.75	-43.9	75	0.3
9/11/2013	13:04:37	-9.99	0	0	7.75	-43.9	75	0.3
9/11/2013	13:05:07	-9.99	0	0	7.75	-43.9	75	0.3
9/11/2013	13:05:37	-9.99	0	0	7.75	-43.9	75	0.3
9/11/2013	13:06:07	-9.99	0	0	7.75	-43.9	75	0.2
9/11/2013	13:06:37	-9.99	0	0	7.75	-43.9	74	0.3
9/11/2013	13:07:07	-9.99	0	0	7.75	-44	74	0.3
9/11/2013	13:07:37	-9.99	0	0	7.73	-42.8	76	0.3
9/11/2013	13:08:07	-9.99	0	0	7.75	-43.9	74	0.3
9/11/2013	13:08:37	-9.99	0	0	7.75	-43.9	74	0.2
9/11/2013	13:09:07	-9.99	0	0	7.75	-43.9	74	0.2
9/11/2013	13:09:37	-9.99	0	0	7.75	-44	74	0.1

Date	Time	Temp	SpCond	Cond	pH	pHmV	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	mV	ug/L
9/11/2013	13:10:07	-9.99	0	0	7.75	-44	74	0.3
9/11/2013	13:10:37	-9.99	0	0	7.75	-44	74	0.3
9/11/2013	13:11:07	-9.99	0	0	7.75	-44	74	0.1
9/11/2013	13:11:37	-9.99	0	0	7.75	-44	74	0.2
9/11/2013	13:12:07	-9.99	0	0	7.75	-44	74	0.3
9/11/2013	13:12:37	-9.99	0	0	7.73	-42.9	76	0.3
9/11/2013	13:13:07	-9.99	0	0	7.75	-44	74	0.3
9/11/2013	13:13:37	-9.99	0	0	7.75	-44	74	0.3
9/11/2013	13:14:07	-9.99	0	0	7.75	-44.1	74	0.3
9/11/2013	13:14:37	-9.99	0	0	7.75	-44.1	74	0.3
9/11/2013	13:15:07	-9.99	0	0	7.75	-44.1	74	0.2
9/11/2013	13:15:37	-9.99	0	0	7.75	-44.1	74	0.2
9/11/2013	13:16:07	-9.99	0	0	7.76	-44.1	74	0.3
9/11/2013	13:16:37	-9.99	0	0	7.76	-44.1	74	0.2
9/11/2013	13:17:07	-9.99	0	0	7.75	-44.1	74	0.2
9/11/2013	13:17:37	-9.99	0	0	7.73	-42.9	76	0.3
9/11/2013	13:18:07	-9.99	0	0	7.75	-44.1	74	0.2
9/11/2013	13:18:37	-9.99	0	0	7.75	-44.1	74	0.2
9/11/2013	13:19:07	-9.99	0	0	7.75	-44.1	74	0.2
9/11/2013	13:19:37	-9.99	0	0	7.76	-44.1	74	0.3
9/11/2013	13:20:07	-9.99	0	0	7.76	-44.2	74	0.2
9/11/2013	13:20:37	-9.99	0	0	7.76	-44.1	74	0.2
9/11/2013	13:21:07	-9.99	0	0	7.76	-44.2	74	0.3
9/11/2013	13:21:37	-9.99	0	0	7.76	-44.1	74	0.3
9/11/2013	13:22:07	-9.99	0	0	7.76	-44.2	74	0.3
9/11/2013	13:22:37	-9.99	0	0	7.73	-43	75	0.3
9/11/2013	13:23:07	-9.99	0	0	7.76	-44.1	74	0.3
9/11/2013	13:23:37	-9.99	0	0	7.76	-44.2	74	0.3
9/11/2013	13:24:07	-9.99	0	0	7.76	-44.2	74	0.3
9/11/2013	13:24:37	-9.99	0	0	7.76	-44.3	74	0.2
9/11/2013	13:25:07	-9.99	0	0	7.76	-44.3	74	0.3
9/11/2013	13:25:37	-9.99	0	0	7.76	-44.3	73	0.3
9/11/2013	13:26:07	-9.99	0	0	7.76	-44.3	74	0.2
9/11/2013	13:26:37	-9.99	0	0	7.76	-44.3	73	0.1
9/11/2013	13:27:07	-9.99	0	0	7.76	-44.3	73	0.3
9/11/2013	13:27:37	-9.99	0	0	7.73	-43.1	75	0.3
9/11/2013	13:28:07	-9.99	0	0	7.76	-44.3	73	0.3
9/11/2013	13:28:37	-9.99	0	0	7.76	-44.4	73	0.3
9/11/2013	13:29:07	-9.99	0	0	7.76	-44.4	73	0.2
9/11/2013	13:29:37	-9.99	0	0	7.76	-44.4	73	0.3
9/11/2013	13:30:07	-9.99	0	0	7.76	-44.3	73	0.3
9/11/2013	13:30:37	-9.99	0	0	7.76	-44.4	73	0.3
9/11/2013	13:31:07	-9.99	0	0	7.76	-44.5	73	0.3
9/11/2013	13:31:37	-9.99	0	0	7.76	-44.4	73	0.4
9/11/2013	13:32:07	-9.99	0	0	7.76	-44.5	73	0.2

Date	Time	Temp	SpCond	Cond	pH	pHmV	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	mV	ug/L
9/11/2013	13:32:37	-9.99	0	0	7.74	-43.2	75	0.2
9/11/2013	13:33:07	-9.99	0	0	7.76	-44.5	73	0.3
9/11/2013	13:33:37	-9.99	0	0	7.76	-44.5	73	0.3
9/11/2013	13:34:07	-9.99	0	0	7.76	-44.4	73	0.2
9/11/2013	13:34:37	-9.99	0	0	7.76	-44.4	73	0.2
9/11/2013	13:35:07	-9.99	0	0	7.76	-44.4	73	0.3
9/11/2013	13:35:37	-9.99	0	0	7.76	-44.4	73	0.3
9/11/2013	13:36:07	-9.99	0	0	7.76	-44.3	73	0.3
9/11/2013	13:36:37	-9.99	0	0	7.76	-44.4	73	0.3
9/11/2013	13:37:07	-9.99	0	0	7.76	-44.4	73	0.4
9/11/2013	13:37:37	-9.99	0	0	7.73	-43.1	75	0.4
9/11/2013	13:38:07	-9.99	0	0	7.76	-44.3	73	0.6
9/11/2013	13:38:37	-9.99	0	0	7.76	-44.3	73	0.8
9/11/2013	13:39:07	-9.99	0	0	7.76	-44.2	73	0.8
9/11/2013	13:39:37	-9.99	0	0	7.76	-44.2	73	1.4
9/11/2013	13:40:07	-9.99	0	0	7.76	-44.2	73	1.7
9/11/2013	13:40:37	-9.99	0	0	7.76	-44.2	73	2.2
9/11/2013	13:41:07	-9.99	0	0	7.76	-44.1	73	3
9/11/2013	13:41:37	-9.99	0	0	7.76	-44.1	73	3.8
9/11/2013	13:42:07	-9.99	0	0	7.75	-44	73	5
9/11/2013	13:42:37	-9.99	0	0	7.73	-42.8	75	5.8
9/11/2013	13:43:07	-9.99	0	0	7.75	-44.1	73	7.7
9/11/2013	13:43:37	-9.99	0	0	7.75	-44	73	9.3
9/11/2013	13:44:07	-9.99	0	0	7.76	-44.1	73	11.1
9/11/2013	13:44:37	-9.99	0	0	7.76	-44.1	73	13.1
9/11/2013	13:45:07	-9.99	0	0	7.76	-44.1	73	14.9
9/11/2013	13:45:37	-9.99	0	0	7.76	-44.1	73	16.9
9/11/2013	13:46:07	-9.99	0	0	7.75	-44.1	73	18.8
9/11/2013	13:46:37	-9.99	0	0	7.76	-44.1	73	20.8
9/11/2013	13:47:07	-9.99	0	0	7.75	-44	73	22.5
9/11/2013	13:47:37	-9.99	0	0	7.73	-43	74	23.5
9/11/2013	13:48:07	-9.99	0	0	7.76	-44.1	73	26.1
9/11/2013	13:48:37	-9.99	0	0	7.76	-44.1	73	27.7
9/11/2013	13:49:07	-9.99	0	0	7.76	-44.2	73	28.9
9/11/2013	13:49:37	-9.99	0	0	7.75	-44.1	73	29.8
9/11/2013	13:50:07	-9.99	0	0	7.76	-44.1	73	30.7
9/11/2013	13:50:37	-9.99	0	0	7.75	-44.1	73	31.4
9/11/2013	13:51:07	-9.99	0	0	7.75	-44	73	32.1
9/11/2013	13:51:37	-9.99	0	0	7.75	-43.9	73	32.4
9/11/2013	13:52:07	-9.99	0	0	7.75	-43.9	73	32.7
9/11/2013	13:52:37	-9.99	0	0	7.72	-42.6	75	32.8
9/11/2013	13:53:07	-9.99	0	0	7.75	-43.8	73	32.5
9/11/2013	13:53:37	-9.99	0	0	7.75	-43.8	73	32.3
9/11/2013	13:54:07	-9.99	0	0	7.75	-43.7	74	32
9/11/2013	13:54:37	-9.99	0	0	7.74	-43.6	74	31.5

Date	Time	Temp	SpCond	Cond	pH	pHmV	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	mV	ug/L
9/11/2013	13:55:07	-9.99	0	0	7.74	-43.5	74	30.8
9/11/2013	13:55:37	-9.99	0	0	7.74	-43.4	74	30.3
9/11/2013	13:56:07	-9.99	0	0	7.74	-43.3	73	29.7
9/11/2013	13:56:37	-9.99	0	0	7.74	-43.3	73	28.9
9/11/2013	13:57:07	-9.99	0	0	7.73	-43.2	73	28.1
9/11/2013	13:57:37	-9.99	0	0	7.7	-41.9	75	27.5
9/11/2013	13:58:07	-9.99	0	0	7.73	-43.1	74	26.1
9/11/2013	13:58:37	-9.99	0	0	7.73	-43	74	25.4
9/11/2013	13:59:07	-9.99	0	0	7.73	-43	75	24.5
9/11/2013	13:59:37	-9.99	0	0	7.73	-42.8	74	23.5
9/11/2013	14:00:07	-9.99	0	0	7.72	-42.8	74	22.4
9/11/2013	14:00:37	-9.99	0	0	7.72	-42.7	75	21.7
9/11/2013	14:01:07	-9.99	0	0	7.72	-42.6	75	20.5
9/11/2013	14:01:37	-9.99	0	0	7.72	-42.5	75	19.7
9/11/2013	14:02:07	-9.99	0	0	7.71	-42.3	75	18.8
9/11/2013	14:02:37	-9.99	0	0	7.68	-40.9	77	18.2
9/11/2013	14:03:07	-9.99	0	0	7.71	-42	76	17.1
9/11/2013	14:03:37	-9.99	0	0	7.7	-41.9	76	16.3
9/11/2013	14:04:07	-9.99	0	0	7.7	-41.8	76	15.5
9/11/2013	14:04:37	-9.99	0	0	7.7	-41.7	76	14.7
9/11/2013	14:05:07	-9.99	0	0	7.7	-41.5	76	13.8
9/11/2013	14:05:37	-9.99	0	0	7.69	-41.5	76	13.1
9/11/2013	14:06:07	-9.99	0	0	7.69	-41.4	76	12.4
9/11/2013	14:06:37	-9.99	0	0	7.69	-41.4	76	11.8
9/11/2013	14:07:07	-9.99	0	0	7.69	-41.3	76	11.2
9/11/2013	14:07:37	-9.99	0	0	7.66	-40	77	10.9
9/11/2013	14:08:07	-9.99	0	0	7.69	-41.2	75	9.9
9/11/2013	14:08:37	-9.99	0	0	7.69	-41.1	76	9.6
9/11/2013	14:09:07	-9.99	0	0	7.68	-41.1	75	9.1
9/11/2013	14:09:37	-9.99	0	0	7.68	-41	75	8.6
9/11/2013	14:10:07	-9.99	0	0	7.68	-40.9	76	8.1
9/11/2013	14:10:37	-9.99	0	0	7.68	-40.9	76	7.7
9/11/2013	14:11:07	-9.99	0	0	7.68	-40.8	76	7.2
9/11/2013	14:11:37	-9.99	0	0	7.67	-40.6	77	6.9
9/11/2013	14:12:07	-9.99	0	0	7.67	-40.5	77	6.4
9/11/2013	14:12:37	-9.99	0	0	7.64	-39	80	6.2
9/11/2013	14:13:07	-9.99	0	0	7.66	-40	78	5.8
9/11/2013	14:13:37	-9.99	0	0	7.65	-39.7	79	5.6
9/11/2013	14:14:07	-9.99	0	0	7.65	-39.5	79	5.3
9/11/2013	14:14:37	-9.99	0	0	7.64	-39.2	79	4.9
9/11/2013	14:15:07	-9.99	0	0	7.64	-39	79	4.7
9/11/2013	14:15:37	-9.99	0	0	7.63	-38.8	80	4.6
9/11/2013	14:16:07	-9.99	0	0	7.63	-38.6	79	4.4
9/11/2013	14:16:37	-9.99	0	0	7.62	-38.4	80	4.3
9/11/2013	14:17:07	-9.99	0	0	7.62	-38.2	80	4

Date	Time	Temp	SpCond	Cond	pH	pHmV	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	mV	ug/L
9/11/2013	14:17:37	-9.99	0	0	7.58	-36.7	82	3.9
9/11/2013	14:18:07	-9.99	0	0	7.61	-37.8	81	3.6
9/11/2013	14:18:37	-9.99	0	0	7.6	-37.6	81	3.4
9/11/2013	14:19:07	-9.99	0	0	7.6	-37.4	81	3.1
9/11/2013	14:19:37	-9.99	0	0	7.59	-37.2	82	3
9/11/2013	14:20:07	-9.99	0	0	7.59	-36.9	82	2.9
9/11/2013	14:20:37	-9.99	0	0	7.58	-36.6	82	2.9
9/11/2013	14:21:07	-9.99	0	0	7.57	-36.4	82	2.6
9/11/2013	14:21:37	-9.99	0	0	7.57	-36.1	83	2.7
9/11/2013	14:22:07	-9.99	0	0	7.56	-35.8	82	2.7
9/11/2013	14:22:37	-9.99	0	0	7.52	-34.2	85	2.6
9/11/2013	14:23:07	-9.99	0	0	7.55	-35.2	84	2.5
9/11/2013	14:23:37	-9.99	0	0	7.54	-34.9	84	2.3
9/11/2013	14:24:07	-9.99	0	0	7.53	-34.6	84	2.3
9/11/2013	14:24:37	-9.99	0	0	7.52	-34.3	85	2.2
9/11/2013	14:25:07	-9.99	0	0	7.52	-34	85	2.1
9/11/2013	14:25:37	-9.99	0	0	7.51	-33.7	85	2
9/11/2013	14:26:07	-9.99	0	0	7.51	-33.5	85	1.9

Photograph Injection Poin	Select Injection	Select Mon	Date and ti	Image 1	Image 1 de	Other	Image 2	Image 2 de	Other	Image 3	Image 3 de	Other	Image 4	Image 4 de	Other
Monitoring Point		Downstrea	13-09-11 1	file:///stor	Other	no color ch	file:///stor	Other	orange water shortly after peak flouresence						
Injection Point	NF1		13-09-11 1	file:///stor	Other	injection point after dye has disappeared									

Project Number	Field Team	Date and Time	Location	Weather - Temperature (â—‹C)	Weather - Cloud Cover	Weather - Precipitation	Weather - Precipitation (other)	Weather - Wind Strength	Weather - Wind Direction (from)	GPS Coordinates - Injection Point	Sample Medium	Sample Medium (other)	YSI ID Number	YSI Calibration Date	Pre-test Injection Point - Conductivity (ms/cmÂ·â—‹C)	Pre-test Injection Point - Temperature (â—‹C)	Pre-test Injection Point - pH	Pre-test Injection Point - ORP (mV)	Pre-test Injection Point - Dissolved Oxygen (mg/L)	Pre-test Injection Point - Colour	Pre-test Injection Point - Colour (other)	Injection Point Image 1	Injection Point Image 2	Dye Release Time	Notes
472645	ac	13-09-12 15:23:39	southeast corner of rock drain pond	15	25%	None		None		62.34033458964 9814:- 133.3614828753 2708	Surface		15968	13-08-30			7.83	289.2		Clear		file:///storage/sdcard0/mementor/images/Dye%20Test%20Setup%20-%20Injection%20Location%2020		13-09-12 15:26:38	

Project Number	Location ID	Monitoring Point - GPS Coordinates	Field Team	Date and Time	YSI ID	Monitoring Point - pH (units)	Monitoring Point - Specific Conductivity (mS/cmÂ·â—‹C)	Monitoring Point - Temperature (â—‹C)	Monitoring Point - ORP (mV)	Monitoring Point - Dissolved Oxygen (mg/L)	Monitoring Point - Rhodamin (ug/L)	Image 1	Image 2	Notes
472645	southeast corner of downstream side of rock drain	62.33900696112227:-133.36368978023276	ac	13-09-12 17:27:29	07A1480	7.51	0.151	5.94	176.4		0.6			

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/12/2013	15:11:52	5.33	0.152	0.095	7.7	197	-0.8
9/12/2013	15:12:22	5.32	0.152	0.095	7.55	208	2.5
9/12/2013	15:12:52	5.32	0.152	0.095	7.55	209	0.6
9/12/2013	15:13:22	5.32	0.152	0.095	7.55	210	0.4
9/12/2013	15:13:52	5.32	0.152	0.095	7.54	211	0.3
9/12/2013	15:14:22	5.32	0.151	0.094	7.52	211	0.4
9/12/2013	15:14:52	5.33	0.151	0.094	7.52	210	0.6
9/12/2013	15:15:22	5.33	0.151	0.094	7.51	210	0.3
9/12/2013	15:15:52	5.33	0.151	0.094	7.51	209	0.7
9/12/2013	15:16:22	5.33	0.151	0.094	7.5	209	0.4
9/12/2013	15:16:52	5.33	0.151	0.094	7.49	209	0.1
9/12/2013	15:17:22	5.33	0.151	0.094	7.49	209	0.4
9/12/2013	15:17:52	5.34	0.15	0.094	7.48	209	0.5
9/12/2013	15:18:22	5.34	0.15	0.094	7.47	209	0.2
9/12/2013	15:18:52	5.34	0.151	0.094	7.46	209	-0.5
9/12/2013	15:19:22	5.34	0.151	0.094	7.45	209	0.1
9/12/2013	15:19:52	5.34	0.151	0.094	7.44	209	0.1
9/12/2013	15:20:22	5.35	0.151	0.094	7.43	209	0.6
9/12/2013	15:20:52	5.35	0.151	0.094	7.42	209	0.2
9/12/2013	15:21:22	5.35	0.151	0.094	7.42	209	0.8
9/12/2013	15:21:52	5.35	0.151	0.094	7.42	209	0.4
9/12/2013	15:22:22	5.36	0.151	0.094	7.41	209	-0.1
9/12/2013	15:22:52	5.36	0.151	0.094	7.41	209	0.4
9/12/2013	15:23:22	5.36	0.151	0.094	7.41	209	0.5
9/12/2013	15:23:52	5.36	0.151	0.094	7.41	209	0.1
9/12/2013	15:24:22	5.37	0.151	0.094	7.41	209	0.8
9/12/2013	15:24:52	5.37	0.151	0.094	7.41	208	0.3
9/12/2013	15:25:22	5.37	0.151	0.094	7.41	208	0
9/12/2013	15:25:52	5.37	0.151	0.094	7.41	208	0.3
9/12/2013	15:26:22	5.37	0.151	0.094	7.4	208	0.1
9/12/2013	15:26:52	5.38	0.151	0.094	7.4	208	0.6
9/12/2013	15:27:22	5.38	0.151	0.094	7.41	208	0.6
9/12/2013	15:27:52	5.38	0.151	0.094	7.4	208	0.7
9/12/2013	15:28:22	5.38	0.151	0.094	7.41	208	0.2
9/12/2013	15:28:52	5.39	0.151	0.094	7.41	208	0.2
9/12/2013	15:29:22	5.39	0.15	0.094	7.41	208	0.5
9/12/2013	15:29:52	5.39	0.151	0.094	7.41	208	0.2
9/12/2013	15:30:22	5.39	0.151	0.094	7.41	207	0.5
9/12/2013	15:30:52	5.39	0.15	0.094	7.41	207	0.4
9/12/2013	15:31:22	5.4	0.15	0.094	7.42	207	0.4
9/12/2013	15:31:52	5.4	0.15	0.094	7.42	207	0.7
9/12/2013	15:32:22	5.4	0.15	0.094	7.42	207	0.4
9/12/2013	15:32:52	5.41	0.15	0.094	7.42	206	0.2
9/12/2013	15:33:22	5.41	0.15	0.094	7.42	206	0.1
9/12/2013	15:33:52	5.41	0.15	0.094	7.42	206	0.2

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/12/2013	15:34:22	5.41	0.15	0.094	7.42	206	0.2
9/12/2013	15:34:52	5.41	0.15	0.094	7.42	206	0.3
9/12/2013	15:35:22	5.42	0.151	0.094	7.42	206	0.1
9/12/2013	15:35:52	5.42	0.151	0.094	7.43	205	0.2
9/12/2013	15:36:22	5.42	0.151	0.094	7.43	205	0.4
9/12/2013	15:36:52	5.42	0.151	0.094	7.43	205	0.6
9/12/2013	15:37:22	5.43	0.151	0.094	7.44	205	0.3
9/12/2013	15:37:52	5.43	0.151	0.094	7.44	204	0.7
9/12/2013	15:38:22	5.43	0.151	0.094	7.44	204	0.3
9/12/2013	15:38:52	5.43	0.151	0.094	7.44	204	0.3
9/12/2013	15:39:22	5.44	0.151	0.094	7.44	204	0
9/12/2013	15:39:52	5.44	0.151	0.094	7.45	203	0.5
9/12/2013	15:40:22	5.44	0.151	0.094	7.45	203	0.4
9/12/2013	15:40:52	5.44	0.151	0.094	7.45	203	0.2
9/12/2013	15:41:22	5.45	0.15	0.094	7.45	203	0.2
9/12/2013	15:41:52	5.45	0.15	0.094	7.45	203	0.3
9/12/2013	15:42:22	5.45	0.151	0.094	7.45	202	0.4
9/12/2013	15:42:52	5.45	0.151	0.094	7.45	202	0.3
9/12/2013	15:43:22	5.45	0.151	0.094	7.45	202	0.6
9/12/2013	15:43:52	5.46	0.151	0.094	7.45	202	0.5
9/12/2013	15:44:22	5.46	0.151	0.094	7.45	201	0.7
9/12/2013	15:44:52	5.46	0.151	0.094	7.46	201	0.5
9/12/2013	15:45:22	5.46	0.151	0.094	7.46	201	0.4
9/12/2013	15:45:52	5.46	0.151	0.094	7.46	201	0.3
9/12/2013	15:46:22	5.47	0.151	0.094	7.46	201	0.2
9/12/2013	15:46:52	5.47	0.151	0.094	7.46	200	0.2
9/12/2013	15:47:22	5.47	0.151	0.094	7.46	200	0.7
9/12/2013	15:47:52	5.47	0.15	0.094	7.47	200	0.4
9/12/2013	15:48:22	5.48	0.15	0.094	7.47	200	0.5
9/12/2013	15:48:52	5.48	0.151	0.094	7.47	199	0.1
9/12/2013	15:49:22	5.48	0.151	0.094	7.47	199	0.1
9/12/2013	15:49:52	5.48	0.151	0.094	7.47	199	0.1
9/12/2013	15:50:22	5.48	0.151	0.094	7.47	199	0.7
9/12/2013	15:50:52	5.49	0.151	0.094	7.47	199	0.5
9/12/2013	15:51:22	5.49	0.151	0.094	7.47	198	0.5
9/12/2013	15:51:52	5.49	0.151	0.094	7.48	198	0.5
9/12/2013	15:52:22	5.49	0.151	0.094	7.48	198	0.8
9/12/2013	15:52:52	5.5	0.151	0.094	7.47	198	0.3
9/12/2013	15:53:22	5.5	0.151	0.094	7.48	197	0.4
9/12/2013	15:53:52	5.5	0.151	0.095	7.48	197	0.2
9/12/2013	15:54:22	5.5	0.151	0.095	7.48	197	0.5
9/12/2013	15:54:52	5.5	0.151	0.095	7.48	196	0.2
9/12/2013	15:55:22	5.51	0.151	0.095	7.48	196	0.4
9/12/2013	15:55:52	5.51	0.151	0.095	7.48	196	0.6
9/12/2013	15:56:22	5.51	0.151	0.095	7.48	196	0.3

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/12/2013	15:56:52	5.51	0.151	0.095	7.48	196	0.6
9/12/2013	15:57:22	5.52	0.151	0.095	7.49	195	0.2
9/12/2013	15:57:52	5.52	0.151	0.095	7.48	195	0.5
9/12/2013	15:58:22	5.52	0.15	0.094	7.49	195	0.2
9/12/2013	15:58:52	5.52	0.15	0.094	7.49	195	-0.1
9/12/2013	15:59:22	5.53	0.15	0.094	7.49	195	0.6
9/12/2013	15:59:52	5.53	0.15	0.094	7.49	195	0.4
9/12/2013	16:00:22	5.53	0.15	0.095	7.49	194	0.2
9/12/2013	16:00:52	5.53	0.15	0.095	7.49	194	0.7
9/12/2013	16:01:22	5.54	0.151	0.095	7.49	194	0.1
9/12/2013	16:01:52	5.54	0.151	0.095	7.49	193	0.4
9/12/2013	16:02:22	5.54	0.151	0.095	7.49	194	0.5
9/12/2013	16:02:52	5.54	0.151	0.095	7.49	193	0.2
9/12/2013	16:03:22	5.55	0.151	0.095	7.5	193	0.4
9/12/2013	16:03:52	5.55	0.151	0.095	7.49	193	0.1
9/12/2013	16:04:22	5.55	0.151	0.095	7.5	193	0.2
9/12/2013	16:04:52	5.55	0.151	0.095	7.49	193	0.5
9/12/2013	16:05:22	5.56	0.151	0.095	7.49	193	0.5
9/12/2013	16:05:52	5.56	0.151	0.095	7.49	192	0.2
9/12/2013	16:06:22	5.56	0.151	0.095	7.5	192	0.8
9/12/2013	16:06:52	5.56	0.151	0.095	7.49	192	0.9
9/12/2013	16:07:22	5.57	0.151	0.095	7.49	192	1
9/12/2013	16:07:52	5.57	0.151	0.095	7.5	191	1.4
9/12/2013	16:08:22	5.57	0.151	0.095	7.5	191	2
9/12/2013	16:08:52	5.57	0.151	0.095	7.5	191	3.3
9/12/2013	16:09:22	5.58	0.151	0.095	7.49	191	4.5
9/12/2013	16:09:52	5.58	0.151	0.095	7.5	191	6.4
9/12/2013	16:10:22	5.58	0.151	0.095	7.5	191	9
9/12/2013	16:10:52	5.58	0.151	0.095	7.5	191	11.2
9/12/2013	16:11:22	5.59	0.151	0.095	7.5	190	14.3
9/12/2013	16:11:52	5.59	0.151	0.095	7.5	190	17
9/12/2013	16:12:22	5.59	0.151	0.095	7.5	190	23
9/12/2013	16:12:52	5.6	0.151	0.095	7.51	190	27.2
9/12/2013	16:13:22	5.6	0.151	0.095	7.5	190	32
9/12/2013	16:13:52	5.6	0.151	0.095	7.51	190	36.1
9/12/2013	16:14:22	5.6	0.151	0.095	7.5	190	39.9
9/12/2013	16:14:52	5.61	0.151	0.095	7.5	190	43.9
9/12/2013	16:15:22	5.61	0.151	0.095	7.5	190	46.9
9/12/2013	16:15:52	5.61	0.151	0.095	7.5	189	50.4
9/12/2013	16:16:22	5.61	0.151	0.095	7.51	189	51.2
9/12/2013	16:16:52	5.62	0.151	0.095	7.51	189	52.2
9/12/2013	16:17:22	5.62	0.151	0.095	7.5	189	54.4
9/12/2013	16:17:52	5.62	0.151	0.095	7.51	189	54.3
9/12/2013	16:18:22	5.63	0.151	0.095	7.5	189	54.2
9/12/2013	16:18:52	5.63	0.151	0.095	7.5	188	53.1

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/12/2013	16:19:22	5.63	0.151	0.095	7.5	188	52
9/12/2013	16:19:52	5.63	0.151	0.095	7.51	188	50.1
9/12/2013	16:20:22	5.64	0.151	0.095	7.51	188	48.6
9/12/2013	16:20:52	5.64	0.151	0.095	7.5	188	46.7
9/12/2013	16:21:22	5.64	0.151	0.095	7.51	188	44.8
9/12/2013	16:21:52	5.65	0.151	0.095	7.51	188	43.8
9/12/2013	16:22:22	5.65	0.151	0.095	7.5	188	41.1
9/12/2013	16:22:52	5.65	0.151	0.095	7.51	187	38.7
9/12/2013	16:23:22	5.65	0.151	0.095	7.51	187	36.8
9/12/2013	16:23:52	5.66	0.151	0.095	7.51	187	35.1
9/12/2013	16:24:22	5.66	0.151	0.095	7.51	187	33.1
9/12/2013	16:24:52	5.66	0.151	0.095	7.51	187	30.8
9/12/2013	16:25:22	5.66	0.151	0.095	7.51	187	29.2
9/12/2013	16:25:52	5.67	0.151	0.095	7.51	187	27.7
9/12/2013	16:26:22	5.67	0.151	0.095	7.51	186	26.5
9/12/2013	16:26:52	5.67	0.151	0.095	7.51	186	25.7
9/12/2013	16:27:22	5.67	0.151	0.095	7.51	186	23.7
9/12/2013	16:27:52	5.68	0.151	0.095	7.51	186	22.4
9/12/2013	16:28:22	5.68	0.151	0.095	7.51	186	21.1
9/12/2013	16:28:52	5.68	0.151	0.095	7.51	186	19.6
9/12/2013	16:29:22	5.69	0.151	0.095	7.51	186	18.5
9/12/2013	16:29:52	5.69	0.151	0.095	7.51	186	17.5
9/12/2013	16:30:22	5.69	0.151	0.095	7.51	186	17
9/12/2013	16:30:52	5.69	0.151	0.095	7.51	186	15.9
9/12/2013	16:31:22	5.7	0.151	0.095	7.51	186	15.6
9/12/2013	16:31:52	5.7	0.151	0.095	7.51	185	14.7
9/12/2013	16:32:22	5.7	0.151	0.095	7.51	185	13.4
9/12/2013	16:32:52	5.71	0.151	0.095	7.52	185	13.1
9/12/2013	16:33:22	5.71	0.151	0.095	7.51	185	12.1
9/12/2013	16:33:52	5.71	0.151	0.095	7.51	185	11.7
9/12/2013	16:34:22	5.71	0.151	0.095	7.52	185	11
9/12/2013	16:34:52	5.72	0.151	0.095	7.52	185	10.7
9/12/2013	16:35:22	5.72	0.151	0.095	7.51	185	9.4
9/12/2013	16:35:52	5.72	0.151	0.095	7.51	185	9.6
9/12/2013	16:36:22	5.73	0.151	0.095	7.51	184	8.7
9/12/2013	16:36:52	5.73	0.151	0.095	7.51	184	8.5
9/12/2013	16:37:22	5.73	0.151	0.095	7.52	184	8.3
9/12/2013	16:37:52	5.73	0.151	0.095	7.52	184	7.6
9/12/2013	16:38:22	5.74	0.151	0.095	7.51	184	7.3
9/12/2013	16:38:52	5.74	0.151	0.095	7.52	184	7.6
9/12/2013	16:39:22	5.74	0.151	0.095	7.51	184	6.9
9/12/2013	16:39:52	5.75	0.151	0.095	7.51	184	5.9
9/12/2013	16:40:22	5.75	0.151	0.095	7.52	184	6.3
9/12/2013	16:40:52	5.75	0.151	0.095	7.51	183	6.3
9/12/2013	16:41:22	5.75	0.151	0.095	7.52	183	5.9

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/12/2013	16:41:52	5.75	0.151	0.095	7.51	183	5.4
9/12/2013	16:42:22	5.76	0.151	0.095	7.51	184	5.6
9/12/2013	16:42:52	5.76	0.151	0.095	7.52	183	5.1
9/12/2013	16:43:22	5.76	0.151	0.096	7.51	183	5.2
9/12/2013	16:43:52	5.76	0.151	0.096	7.51	183	4.7
9/12/2013	16:44:22	5.77	0.151	0.096	7.51	183	4.9
9/12/2013	16:44:52	5.77	0.151	0.096	7.51	183	4.7
9/12/2013	16:45:22	5.77	0.151	0.096	7.51	183	4.3
9/12/2013	16:45:52	5.77	0.151	0.096	7.51	183	4.1
9/12/2013	16:46:22	5.77	0.151	0.096	7.51	183	3.8
9/12/2013	16:46:52	5.78	0.151	0.096	7.51	183	3.7
9/12/2013	16:47:22	5.78	0.151	0.096	7.51	183	3.9
9/12/2013	16:47:52	5.78	0.151	0.096	7.51	182	3.8
9/12/2013	16:48:22	5.78	0.151	0.096	7.51	182	3.5
9/12/2013	16:48:52	5.78	0.151	0.096	7.51	182	3.4
9/12/2013	16:49:22	5.79	0.151	0.096	7.51	182	3.1
9/12/2013	16:49:52	5.79	0.151	0.096	7.51	182	3.1
9/12/2013	16:50:22	5.79	0.151	0.096	7.52	182	2.8
9/12/2013	16:50:52	5.79	0.151	0.096	7.51	182	2.9
9/12/2013	16:51:22	5.79	0.151	0.096	7.51	182	3.2
9/12/2013	16:51:52	5.79	0.151	0.096	7.51	182	2.9
9/12/2013	16:52:22	5.8	0.151	0.096	7.51	182	2.5
9/12/2013	16:52:52	5.8	0.151	0.096	7.51	182	2.3
9/12/2013	16:53:22	5.8	0.151	0.096	7.51	182	2.5
9/12/2013	16:53:52	5.8	0.151	0.096	7.51	181	2.3
9/12/2013	16:54:22	5.8	0.151	0.096	7.51	182	2.5
9/12/2013	16:54:52	5.8	0.151	0.096	7.51	181	2.5
9/12/2013	16:55:22	5.81	0.151	0.096	7.51	181	2.2
9/12/2013	16:55:52	5.81	0.151	0.096	7.51	181	2.3
9/12/2013	16:56:22	5.81	0.151	0.096	7.51	181	1.8
9/12/2013	16:56:52	5.81	0.151	0.096	7.51	181	2.2
9/12/2013	16:57:22	5.81	0.151	0.096	7.52	181	1.8
9/12/2013	16:57:52	5.82	0.151	0.096	7.51	181	1.9
9/12/2013	16:58:22	5.82	0.151	0.096	7.51	181	2
9/12/2013	16:58:52	5.82	0.151	0.096	7.51	181	1.8
9/12/2013	16:59:22	5.82	0.151	0.096	7.51	180	1.4
9/12/2013	16:59:52	5.82	0.151	0.096	7.51	181	2.1
9/12/2013	17:00:22	5.82	0.151	0.096	7.51	180	2.1
9/12/2013	17:00:52	5.82	0.151	0.096	7.51	180	1.7
9/12/2013	17:01:22	5.82	0.151	0.096	7.51	180	1.7
9/12/2013	17:01:52	5.83	0.151	0.096	7.52	180	1.7
9/12/2013	17:02:22	5.83	0.151	0.096	7.51	180	1.7
9/12/2013	17:02:52	5.83	0.151	0.096	7.51	180	2
9/12/2013	17:03:22	5.83	0.151	0.096	7.51	180	1.3
9/12/2013	17:03:52	5.84	0.151	0.096	7.51	180	1.5

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/12/2013	17:04:22	5.84	0.151	0.096	7.51	180	1.6
9/12/2013	17:04:52	5.84	0.151	0.096	7.51	180	1.2
9/12/2013	17:05:22	5.84	0.151	0.096	7.51	180	1.2
9/12/2013	17:05:52	5.84	0.151	0.096	7.51	180	1.5
9/12/2013	17:06:22	5.84	0.151	0.096	7.51	179	1.6
9/12/2013	17:06:52	5.85	0.151	0.096	7.51	180	1.3
9/12/2013	17:07:22	5.85	0.151	0.096	7.52	179	1.7
9/12/2013	17:07:52	5.85	0.151	0.096	7.51	179	0.9
9/12/2013	17:08:22	5.85	0.151	0.096	7.51	179	1.2
9/12/2013	17:08:52	5.85	0.151	0.096	7.52	179	1.3
9/12/2013	17:09:22	5.85	0.151	0.096	7.51	179	1.7
9/12/2013	17:09:52	5.86	0.151	0.096	7.51	179	1.6
9/12/2013	17:10:22	5.86	0.151	0.096	7.51	179	1.2
9/12/2013	17:10:52	5.86	0.151	0.096	7.52	179	1.4
9/12/2013	17:11:22	5.86	0.151	0.096	7.51	179	1.3
9/12/2013	17:11:52	5.86	0.151	0.096	7.52	179	1.3
9/12/2013	17:12:22	5.87	0.151	0.096	7.51	179	1.1
9/12/2013	17:12:52	5.87	0.151	0.096	7.51	179	1.3
9/12/2013	17:13:22	5.87	0.151	0.096	7.51	178	1.2
9/12/2013	17:13:52	5.87	0.151	0.096	7.52	178	1.3
9/12/2013	17:14:22	5.87	0.151	0.096	7.52	178	1.6
9/12/2013	17:14:52	5.88	0.151	0.096	7.52	178	1.1
9/12/2013	17:15:22	5.88	0.151	0.096	7.52	178	1.3
9/12/2013	17:15:52	5.88	0.151	0.096	7.52	178	1
9/12/2013	17:16:22	5.88	0.151	0.096	7.52	178	1.1
9/12/2013	17:16:52	5.88	0.151	0.096	7.51	179	1.1
9/12/2013	17:17:22	5.89	0.151	0.096	7.51	179	1
9/12/2013	17:17:52	5.89	0.151	0.096	7.52	178	0.9
9/12/2013	17:18:22	5.89	0.151	0.096	7.51	178	1.3
9/12/2013	17:18:52	5.89	0.151	0.096	7.52	178	1.2
9/12/2013	17:19:22	5.9	0.151	0.096	7.51	178	0.9
9/12/2013	17:19:52	5.9	0.151	0.096	7.51	178	0.7
9/12/2013	17:20:22	5.9	0.151	0.096	7.51	178	1
9/12/2013	17:20:52	5.9	0.151	0.096	7.51	178	1
9/12/2013	17:21:22	5.91	0.151	0.096	7.52	178	1
9/12/2013	17:21:52	5.91	0.151	0.096	7.52	178	1.2
9/12/2013	17:22:22	5.91	0.151	0.096	7.52	177	0.7
9/12/2013	17:22:52	5.92	0.151	0.096	7.52	177	0.7
9/12/2013	17:23:22	5.92	0.151	0.096	7.52	177	0.9
9/12/2013	17:23:52	5.92	0.151	0.096	7.52	177	0.6
9/12/2013	17:24:22	5.92	0.151	0.096	7.52	177	1
9/12/2013	17:24:52	5.93	0.151	0.096	7.52	177	0.5
9/12/2013	17:25:22	5.93	0.151	0.096	7.52	177	0.8
9/12/2013	17:25:52	5.93	0.151	0.096	7.52	177	0.8
9/12/2013	17:26:22	5.93	0.151	0.096	7.52	177	1

Date	Time	Temp	SpCond	Cond	pH	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	ug/L
9/12/2013	17:26:52	5.94	0.151	0.096	7.52	177	0.6
9/12/2013	17:27:22	5.94	0.151	0.096	7.51	177	0.9
9/12/2013	17:27:52	5.94	0.151	0.096	7.52	177	0.8
9/12/2013	17:28:22	5.94	0.151	0.096	7.52	177	0.9
9/12/2013	17:28:52	5.94	0.151	0.096	7.52	177	0.9
9/12/2013	17:29:22	5.95	0.151	0.096	7.52	176	0.8
9/12/2013	17:29:52	5.95	0.151	0.096	7.52	176	1
9/12/2013	17:30:22	5.95	0.151	0.096	7.52	176	0.7
9/12/2013	17:30:52	5.96	0.151	0.096	7.52	176	0.8

Date	Time	Temp	SpCond	Cond	pH	pHmV	ORP	Rhodamine
M/D/Y	hh:mm:ss	C	mS/cm	mS/cm		mV	mV	ug/L
9/12/2013	15:24:26	-9.99	0	0	7.87	-49.1	284	0.2
9/12/2013	15:24:56	-9.99	0	0	7.84	-47.8	287	0.2
9/12/2013	15:25:26	-9.99	0	0	7.82	-46.9	290	0.3
9/12/2013	15:25:56	-9.99	0	0	7.81	-46.4	290	0.2
9/12/2013	15:26:26	-9.99	0	0	7.76	-44.2	292	0.3
9/12/2013	15:26:56	-9.99	0	0	7.73	-43.2	292	58.3
9/12/2013	15:27:26	-9.99	0	0	8.54	-77.5	328	48.2
9/12/2013	15:27:56	-9.99	0	0	7.77	-44.6	298	87.8
9/12/2013	15:28:26	-9.99	0	0	7.79	-45.4	298	93.3
9/12/2013	15:28:56	-9.99	0	0	7.78	-45.3	298	86.3
9/12/2013	15:29:26	-9.99	0	0	7.79	-45.5	298	61.5
9/12/2013	15:29:56	-9.99	0	0	7.79	-45.6	298	29
9/12/2013	15:30:26	-9.99	0	0	7.8	-45.8	296	14.6
9/12/2013	15:30:56	-9.99	0	0	7.8	-46.1	297	5.5
9/12/2013	15:31:26	-9.99	0	0	7.78	-45	296	3.5

Photograph Injection Point Or Monitoring Point?	Select Injection Location	Select Monitoring Point	Date and time	Image 1	Image 1 description	Other	Image 2	Image 2 description	Other	Image 3	Image 3 description	Other	Image 4	Image 4 description	Other
Injection Point	southeast corner of rock drain pond		13-09-12 15:28:55	file:///storage/sdcard0/memento/images/Photograph%20Dye%20Test%202013-09-12%2015.29.05.jpg	General location image		file:///storage/sdcard0/memento/images/Photograph%20Dye%20Test%202013-09-12%2015.30.29.jpg	Other	closeup of injection point						
Monitoring Point		southeast corner of downstream side of rock drain	13-09-12 17:27:15	file:///storage/sdcard0/memento/images/Photograph%20Dye%20Test%202013-09-12%2017.30.02.jpg	General location image		file:///storage/sdcard0/memento/images/Photograph%20Dye%20Test%202013-09-12%2017.30.51.jpg	Other	closeup of monitoring point						

Project Number	Field Team	Date and Time	Location	Weather - Temperature (â—‹C)	Weather - Cloud Cover	Weather - Precipitation	Weather - Precipitation (other)	Weather - Wind Strength	Weather - Wind Direction (from)	GPS Coordinates - Injection Point	Sample Medium	Sample Medium (other)	YSI ID Number	YSI Calibration Date	Pre-test Injection Point - Conductivity (ms/cmÃ·â—‹C)	Pre-test Injection Point - Temperature (â—‹C)	Pre-test Injection Point - pH	Pre-test Injection Point - ORP (mV)	Pre-test Injection Point - Dissolved Oxygen (mg/L)	Pre-test Injection Point - Colour	Pre-test Injection Point - Colour (other)	Injection Point Image 1	Injection Point Image 2	Dye Release Time	Notes
472645	AC, JB, JR	7/8/2013 11:32	rock drain upstream side	15	100%	None		Light	E	62.34074454391116:-133.36217921416846	Surface		11403	7/8/2013	0.3	7.77	6.85	260.8	0.5	Clear		file:///storage/sdcard0/memento/images/6a)%20Dye%20Test%20Log%20-%20Setup%202013-07-08%2011.56.42.jpg	file:///storage/sdcard0/memento/images/6a)%20Dye%20Test%20Log%20-%20Setup%202013-07-08%2011.57.48.jpg	7/8/2013 11:48	injected at area of rock drain where water percolation through the rocks is audible. not audible to the east of this location.
472645	AC	7/9/2013 11:10	South corner of rock drain.	12	75%, 100%	None		None		62.34032452276997:-133.36146547677427	Surface		n/a	7/9/2013	9999	9999	9999	9999	9999	Clear		file:///storage/sdcard0/memento/images/6a)%20Dye%20Test%20Log%20-%20Setup%202013-07-09%2011.12.51.jpg	file:///storage/sdcard0/memento/images/6a)%20Dye%20Test%20Log%20-%20Setup%202013-07-09%2011.15.22.jpg	7/9/2013 11:29	injected into small trickle (~1l/min) beneath stump root plate.
472645	AC	7/9/2013 11:10	South corner of rock drain.	18	25%	None		None		62.34032452276997:-133.36146547677427	Surface		n/a	7/9/2013	9999	9999	9999	9999	9999	Clear		file:///storage/sdcard0/memento/images/6a)%20Dye%20Test%20Log%20-%20Setup%202013-07-09%2011.12.51.jpg	file:///storage/sdcard0/memento/images/6a)%20Dye%20Test%20Log%20-%20Setup%202013-07-09%2011.15.22.jpg	7/9/2013 16:01	injected into small trickle (~1l/min) beneath stump root plate.

Project Number	Field Team	Date and Time	Location ID	Sample ID	Weather - Temperature (â—‹C)	Weather - Cloud Cover	Weather - Precipitation	Weather - Precipitation (other)	Weather - Wind Strength	Weather - Wind Direction (from)	GPS Coordinates - Injection Point	Sample Medium	Sample Medium (other)	YSI ID Number	YSI Calibration Date	Pre-test Injection Point - Conductivity (ms/cmÂ·â—‹C)	Pre-test Injection Point - Temperature (â—‹C)	Pre-test Injection Point - pH
472645.07.	JR	13-07-08 11:55:06	n/a	n/a	13	100%	None		Light	NE	62.339139624	Surface		15968	13-07-08	999	999	999

Pre-test Injection Point - ORP (mV)	Pre-test Injection Point - Dissolved Oxygen (mg/L)	Pre-test Injection Point - Colour	Pre-test Injection Point - Colour (other)	Injection Point Image 1	Injection Point Image 2	Dye Release Time	Notes
999	999	Clear		file:///stor	file:///stor	13-07-08 1	Fluorometer was set up on SE fork of Rock Drain discharge. No colour change observed throughout the duration of the dye test. Colour change was observed at the NW fork of the Rock Drain discharge at approximately 12:50, however, there was no flurometer at this location to detect Rhodamine.

Appendix G
Laboratory Reports

Golder Associates Ltd. - Burnaby Laboratory
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C8

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	13-1417-0047/4000
Project:	BSI CALC-SILICATE WASTE ROCK 2013
Client:	CH2M HILL
Location:	FARO MINE COMPLEX -FARO YK.
Lab ID	194

Failure Mode

(1) Diagonal shear plane(s) (5) Conical
(2) Vertical fracture(s) (6) Spalling
(3) Vertical splitting (7) Other
(4) Shear along foliation / discontinuity Note: (deg) measured from core axis

	TAR 16								Wet		Dry	Maximum	Stress			
No.	**Borehole**	**Sample**	**Depth**	**Dia**	**Ht**	**A**	**V**	**Mass**	**Density**	**W**	**Density**	**Load**	**σ**	**Rock Type**	**Failure Mode**	
	#	#	(m)	(mm)	(mm)	(cm^2)	(cm^3)	(g)	(kg/m^3)	(%)	(kg/m^3)	(kN)	(MPa)		Type	(deg)
1	CH13-108	TP002_RKa	N/A	45.53	94.44	16.28	153.76	416.20	2707	0.53	2693	150.30	92.3	Not Provided	4	~2
2	CH13-108	TP008_RKa	N/A	45.57	92.41	16.31	150.72	410.50	2724	0.84	2701	105.30	64.6	Not Provided	4/6	N/A
3	CH13-108	TP011_RKa	N/A	45.58	91.76	16.32	149.72	423.00	2825	0.05	2824	133.60	81.9	Not Provided	2/4	~8

G. Patton	October 10, 2013	L.Perrey	October 15,2013
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	13-1417-0047/4000	**TAR 16 - Borehole:**	**CH13-108**
Project:	BSI CALC-SILICATE WASTE ROCK 2013	**Sample Number:**	TP002_RKa
Location:	FARO MINE COMPLEX -FARO YK.	**Depth (m):**	N/A
Client:	CH2M HILL	**Lab ID No:**	194

Testing Results

Max Load (kN)	**150.30**
Stress ů (MPa)	**92.3**
Pace Rate (kN/s)	1.25
Lithology	Not Provided

Sample Measurements

Diameter (mm)	45.53
Height (mm)	94.44
Area (cm^2)	16.28
Volume (cm^3)	153.76
Mass (g)	416.20
Moisture Content (%)	0.53
Wet Density (kg/m^3)	2706.83
Dry Density (kg/m^3)	2692.51

Failure Mode

Type: **4**

Degrees:* **~2**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

** The test data given herein pertain to the sample provided only. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.*

BEFORE TEST

AFTER TEST

G. Patton	October 10, 2013	L.Perrey	October 15,2013
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	13-1417-0047/4000	**TAR 16 - Borehole:**	**CH13-108**
Project:	BSI CALC-SILICATE WASTE ROCK 2013	**Sample Number:**	TP008_RKa
Location:	FARO MINE COMPLEX -FARO YK.	**Depth (m):**	N/A
Client:	CH2M HILL	**Lab ID No:**	194

Testing Results

Max Load (kN)	**105.30**
Stress ů (MPa)	**64.6**
Pace Rate (kN/s)	1.25
Lithology	Not Provided

Sample Measurements

Diameter (mm)	45.57
Height (mm)	92.41
Area (cm^2)	16.31
Volume (cm^3)	150.72
Mass (g)	410.50
Moisture Content (%)	0.84
Wet Density (kg/m^3)	2723.62
Dry Density (kg/m^3)	2700.89

Failure Mode

Type: **4/6**

Degrees:* **N/A**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

** The test data given herein pertain to the sample provided only. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.*

BEFORE TEST

AFTER TEST

G. Patton	October 10, 2013	L.Perrey	October 15,2013
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	13-1417-0047/4000	**TAR 16 - Borehole:**	**CH13-108**
Project:	BSI CALC-SILICATE WASTE ROCK 2013	**Sample Number:**	TP011_RKa
Location:	FARO MINE COMPLEX -FARO YK.	**Depth (m):**	N/A
Client:	CH2M HILL	**Lab ID No:**	194

Testing Results

Max Load (kN)	**133.60**
Stress ů (MPa)	**81.9**
Pace Rate (kN/s)	1.25
Lithology	Not Provided

Sample Measurements

Diameter (mm)	45.58
Height (mm)	91.76
Area (cm^2)	16.32
Volume (cm^3)	149.72
Mass (g)	423.00
Moisture Content (%)	0.05
Wet Density (kg/m^3)	2825.20
Dry Density (kg/m^3)	2823.86

Failure Mode

Type: **2/4**

Degrees:* **~8**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

** The test data given herein pertain to the sample provided only. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.*

BEFORE TEST

AFTER TEST

G. Patton	October 10, 2013	L.Perrey	October 15,2013
TESTED BY	DATE	CHECKED BY	DATE

SPECIFIC GRAVITY AND ABSORPTION OF ROCK FOR EROSION CONTROL

ASTM D6473

October 18, 2013
Project Number: 13-1417-0047-2000

CH2M Hill
1100 – 1st Street SE
Calgary, Alberta
T2G 1B1

ATTENTION: Mr. Mark Cichy

PROJECT: BSI Calc-Silicate Waste Rock 2013

Sample:	**CH13-108-TP002_Rka**
Source:	**Calc-Silicate Waste Rock, Tar #16, Faro Mine Complex, Yukon**

Date sampled: July 10, 2013
Date tested: October 2, 2013

Sampled by: Client
Tested by: DC

Rock #	Mass (grams)	Relative Density (g/cm^3) (Dry Basis)	Relative Density (g/cm^3) (SSD Basis)	Relative Density (g/cm^3) (Apparent)	Absorption (%)
1	4993.7	2.680	2.707	2.755	1.02
2	1855.8	2.622	2.660	2.727	1.48
3	2651.2	2.679	2.692	2.716	0.51
4	2298.2	2.523	2.579	2.673	2.22
5	2306.0	2.739	2.745	2.756	0.23
AVERAGE		**2.648**	**2.677**	**2.726**	**1.09**

Reported by: S. John, AScT

Reviewed by: _____
L. Hu, M. Sc. E., P.Eng.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

SPECIFIC GRAVITY AND ABSORPTION OF ROCK FOR EROSION CONTROL

ASTM D6473

October 18, 2013
Project Number: 13-1417-0047-2000

CH2M Hill
1100 – 1st Street SE
Calgary, Alberta
T2G 1B1

ATTENTION: Mr. Mark Cichy

PROJECT: BSI Calc-Silicate Waste Rock 2013

Sample:	**CH13-108-TP008_Rka**
Source:	**Calc-Silicate Waste Rock, Tar #16, Faro Mine Complex, Yukon**

Date sampled: July 13, 2013
Date tested: October 2, 2013

Sampled by: Client
Tested by: DC

Rock #	Mass (grams)	Relative Density (g/cm^3) (Dry Basis)	Relative Density (g/cm^3) (SSD Basis)	Relative Density (g/cm^3) (Apparent)	Absorption (%)
1	4694.6	2.691	2.726	2.788	1.29
2	4309.1	2.624	2.682	2.785	2.20
3	3325.3	2.757	2.785	2.838	1.04
4	3410.7	2.702	2.716	2.740	0.51
5	1967.6	2.667	2.682	2.710	0.59
AVERAGE		**2.688**	**2.718**	**2.772**	**1.13**

Reported by: S. John, AScT

Reviewed by: _____
L. Hu, M. Sc. E., P.Eng.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

SPECIFIC GRAVITY AND ABSORPTION OF ROCK FOR EROSION CONTROL

ASTM D6473

October 18, 2013
Project Number: 13-1417-0047-2000

CH2M Hill
1100 – 1st Street SE
Calgary, Alberta
T2G 1B1

ATTENTION: Mr. Mark Cichy

PROJECT: BSI Calc-Silicate Waste Rock 2013

Sample:	**CH13-108-TP011_Rka**
Source:	**Calc-Silicate Waste Rock, Tar #16, Faro Mine Complex, Yukon**

Date sampled: July 13, 2013
Date tested: October 2, 2013

Sampled by: Client
Tested by: DC

Rock #	Mass (grams)	Relative Density (g/cm^3) (Dry Basis)	Relative Density (g/cm^3) (SSD Basis)	Relative Density (g/cm^3) (Apparent)	Absorption (%)
1	5845.7	2.877	2.881	2.889	0.15
2	5006.8	2.818	2.828	2.846	0.34
3	3704.3	2.826	2.829	2.836	0.12
4	5915.9	2.817	2.822	2.829	0.15
5	4069.0	2.827	2.831	2.840	0.17
AVERAGE		**2.833**	**2.838**	**2.848**	**0.19**

Reported by: S. John, AScT

Reviewed by: _____
L. Hu, M. Sc. E., P.Eng.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

PETROGRAPHIC EXAMINATION OF COARSE AGGREGATE

ASTM C 295

CH2M Hill
1100 – 1st Street SE
Calgary, Alberta, T2G 1B1

November 13, 2013
Project Number: 13-1417-0047.2000

Attention: Mr. Mark Cichy

PROJECT: **BSI CALC-SILICATE WASTE ROCK 2013**

Sample:	**CH13-108-TP002_Rka**

Date sampled: September 2013 **Sampled by:** Client

	PETROGRAPHIC DESCRIPTION/ PHYSICAL QUALITY	PERCENT BY SIEVE FRACTION (mm)		
		12.5 mm	9.5 mm	TOTAL
GOOD	**Schist 1A** – Dark green to grey, fine grained, strong.	8.8	11.7	10.2
	Schist 1B – as above, with oxidation staining on at least one face, strong.	5.9	2.2	4.1
	Schist 2A – Medium green to grey, fine grained, strong.	36.2	46.2	41.2
	Schist 2B - as above, with oxidation staining on at least one face, strong.	12.2	4.8	8.5
	Schist 3A – Light green to grey, fine grained.	26.9	20.1	23.5
	Schist 3B - as above, with oxidation staining on at least one face.	1.6	4.0	2.8
	Subtotal	91.6	89.0	90.3
FAIR	**Schist 1A** – Dark green to grey, fine grained, medium strength.	0.3	0.7	0.5
	Schist 1B – as above, with oxidation staining on at least one face, medium strength.	0.6	1.1	0.9
	Schist 2A – Medium green to grey, fine grained, medium strength.	3.7	4.4	4.1
	Schist 2B - as above, with oxidation staining on at least one face, medium strength.	1.6	1.5	1.5
	Schist 3A – Light green to grey, fine grained, medium strength.	0.9	0.7	0.8
	Schist 3B - as above, with oxidation staining on at least one face, medium strength.	1.3	2.6	1.9
	Subtotal	8.4	9.1	9.7
	TOTALS	100.0	100.0	100.0

PETROGRAPHER: _____
A. Briggs, M.Sc., P. Geo.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Sample CH13-108-TP002 Rka

General

The sample consisted entirely of crushed material, which was generated by crushing cobble-sized rock particles in a laboratory crusher. It was split and sieved into its constituent sieve size fractions in preparation for the petrographic examination.

Particle shape was angular with a morphology which was mostly cubic with some flat and/or elongated pieces. All of the particles had rough, fresh fracture surfaces on all sides, and sharp edges.

Lithologic Composition

Identification of rock types and minerals was done using a stereomicroscope with magnifications from 8x to about 50x, supplemented by basic geologic diagnostic methods. One thin section was prepared and examined to aid in the mineralogical identification of the sample. Chemical analysis was not carried out.

The sample was composed entirely of schist. The dominant grain size was 0.001 – 0.01 mm, with a maximum grain size of 0.03 mm. The rock was composed of quartz, calcite, phyllosilicates, epidote and zoisite. Compositional lamination was typically observed; individual laminae measured 0.2 – 2.5 mm across and were dominated either by quartz and chlorite or by calcite and epidote group minerals. These laminae were separated by very thin metal-oxide-dominated laminae containing fine grained ilmenite, rutile and sphene. Other opaque minerals include trace pyrite and chalcopyrite. Patchy alteration to clay was observed throughout the thin section, but was concentrated along a fracture. The clay aggregations are thought to also contain metal oxide, which are responsible for most of the light brown staining observed in many particles.

In hand sample the colour of the rock varied from dark green and grey to light green and grey; the lighter coloured varieties were more calcite-rich.

The sample was separated into categories based on colour and the presence/absence of alteration staining, as detailed in the table on the previous page. Schist 2, consisting of medium green and grey schist, made up more than 55% of the sample, while the dark variety accounted for nearly 16% of the particles and the light-coloured more calcite-rich schist contributed about 29% of the particles. There was no apparent difference in physical-mechanical quality between the different types of schist.

Nearly 20% of the schist particles exhibited some alteration staining on at least one face. Staining of the dark coloured schist was dark brownish red and tended to occur on only one particle face. This staining is thought to consist mainly of hematite occurring in discreet fractures along which the rock broke during crushing. Staining of the light coloured particles was light brown and was more commonly observed on all particle surfaces and throughout the affected particles.

Although stained particles were more commonly of lesser strength than unstained equivalents for all types of schist, this difference in strength was more marked in the light green to grey schist, likely reflecting a difference in the nature of staining. The light brown staining is due to the presence of clay minerals together with fine grained metallic oxides and extends throughout the affected particles. By contrast, the hematite staining may only occur very locally on the surfaces of the particles and does not affect the competence of individual particles.

Physical-Mechanical Quality

In addition to the geologic classification of the aggregate, the sample was also examined for characteristics relevant to engineering uses. Aspects such as porosity, strength, tenacity, presence or absence of vugs, voids, fissures, cracks, coatings, particle shape and impurities in the particles were considered in the assignment of individual particles into various quality classifications.

Consistent with the CSA A23.2-15A method, the relative proportions of material classified as being of "Good" and "Fair" physical-mechanical quality were determined, as presented in the table above.

Based on the physical-mechanical properties of sample CH13-108-TP002_Rka observed in the Petrographic examination the material would be considered suitable for use in most applications, including concrete. However, further analysis should be carried out to determine the identity of the very fine grained, brown clay mineral that is a major component of the rock to rule out the presence of expansive clay minerals. X-ray diffraction with Rietveld analysis is the recommended approach to provide this identification.

Alkali-Aggregate Reaction Potential

The Petrographic Examination indicates that the sample was composed of schist, a rock type that contains some quartz, which may contribute under certain circumstances to a deleterious expansive reaction in concrete termed *"Alkali-Aggregate Reaction"* (AAR). The quartz was very fine grained and exhibited undulatory extinction; both characteristics are associated increased likelihood of AAR.

In order to evaluate this potential, the sample should be tested using a suitable method, such as the Accelerated Mortar Bar method given in CSA as A23.2-25A, should the material be considered for use as concrete aggregate.

Summary

The crushed sample CH13-108-TP002_Rka was composed of fine to fine grained schist and contained 90.3% "Good" quality material and 9.7% "Fair" quality material.

On the basis of the Petrographic Examination, and subject to satisfactory compliance with applicable specification requirements, further identification of the major clay mineral and subject to evaluation of the potential for AAR, Sample CH13-108-TP002_Rka would be considered suitable for a variety of aggregate applications, as outlined above.

A. Briggs, M.Sc., P. Geo.

Reviewed by:

FOR: F. Shrimer, P.Geo.

PETROGRAPHIC EXAMINATION OF COARSE AGGREGATE

ASTM C 295

CH2M Hill
1100 – 1st Street SE
Calgary, Alberta, T2G 1B1

November 14, 2013
Project Number: 13-1417-0047.2000

Attention: Mr. Mark Cichy

PROJECT: **BSI CALC-SILICATE WASTE ROCK 2013**

Sample:	**CH13-108-TP011_Rka**

Date sampled: September 2013 **Sampled by:** Client

	PETROGRAPHIC DESCRIPTION/ PHYSICAL QUALITY	PERCENT BY SIEVE FRACTION (mm)		
		12.5 mm	9.5 mm	TOTAL
GOOD	**Schist 1A** – Finely banded black/white, very fine grained, strong.	37.6	44.4	41.0
	Schist 1B – as above, pronounced flat particle shapes, strong.	4.8	5.0	4.9
	Schist 2A – Finely banded black/white with green tint, strong.	44.0	34.7	39.4
	Schist 2B - as above, pronounced flat particle shapes, strong.	5.2	1.8	3.5
	Schist 3 – Finely banded black/white with green tint and brown oxidation staining, strong.	2.0	2.6	2.3
	Subtotal	*93.6*	*88.5*	*91.1*
FAIR	**Schist 1A** – Finely banded black/white, very fine grained, brittle, medium strength.	2.4	4.4	3.4
	Schist 1B – as above, pronounced flat particle shapes, brittle, medium strength.	0.4	0.9	0.6
	Schist 2A – Finely banded black/white with green tint, brittle, medium strength.	2.8	3.2	3.0
	Schist 2B - as above, pronounced flat particle shapes, brittle, medium strength.	0.4	1.8	1.1
	Schist 3 – Finely banded black/white with green tint and brown oxidation staining, brittle, medium strength.	0.4	1.2	0.8
	Subtotal	*6.4*	*11.5*	*8.9*
	TOTALS	100.0	100.0	100.0

PETROGRAPHER: _____
A. Briggs, M.Sc., P. Geo.

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

Sample CH13-108-TP011_Rka

General

The sample consisted entirely of crushed rock that was generated by crushing cobble-sized rock particles in a laboratory crusher. It was split and sieved into its constituent sieve size fractions in preparation for the petrographic examination.

Particle shape was angular with a morphology which was mostly cubic with some flat and/or elongated pieces. All of the particles had rough, fresh fracture surfaces on all sides and sharp edges.

Lithologic Composition

Identification of rock types and minerals was done using a stereomicroscope with magnifications from 8x to about 50x, supplemented by basic geologic diagnostic methods. One thin section was examined to aid in the mineralogical identification of the sample. Chemical analysis was not carried out.

The sample was composed of schist, in which the dominating minerals were quartz and chlorite, with minor prehnite, feldspar, zoisite, epidote and muscovite. Quartz and chlorite had a grain size of 0.05 – 0.1 mm; occasional calcite and feldspar measured up to 0.5 mm. Quartz exhibited undulatory extinction, which is an indication of strain. Opaque minerals included ilmenite, <1% pyrrhotite, pentlandite and chalcopyrite. Some of the ilmenite was oxidized.

The schist rocks comprising the sample were subdivided as follows: (1) Fresh finely banded black and white/grey schist made up almost 45% of the sample and (2) schist with a brownish green tint was similar in appearance and accounted for a further 42%. The cause for this tint is thought to be alteration of prehnite and other minerals to very fine grained phyllosilicates, such as chlorite or clay, particularly along fractures in the rock mass and the outer surfaces of the cobbles. However, it appears that the alteration is not abundant enough to negatively influence the competency affected particles. Most of the particles in these two categories were strong, with less than 10% in each category being of medium strength.

Particles that had a pronounced flat particle shape were separately classified and accounted for about 10% of the sample. These constituted portions of the rock that were dominated by phyllosilicates, mostly chlorite and muscovite; flat shapes and slightly lower strengths were typical of these particles.

The category denoted "Schist 3" comprised particles with more pervasive greenish tint and staining. These accounted for the remaining approximately 3% of the sample; a significant portion was of only medium strength.

Physical-Mechanical Quality

In addition to the geologic classification of the aggregate, the sample was also examined for characteristics relevant to engineering uses. Aspects such as porosity, strength, tenacity, presence or absence of vugs, voids, fissures, cracks, coatings, particle shape and impurities in the particles were considered in the assignment of individual particles into various quality classifications.

Consistent with the CSA A23.2-15A method, the relative proportions of material classified as being of "Good" and "Fair" physical-mechanical quality were determined, as presented in the table above.

Based on the physical-mechanical properties of sample CH13-108-TP011_Rka observed in the Petrographic examination, the material would be considered suitable for use in most applications, including concrete. However, this rock type is highly variable, due to the different strength, fabric and physical characteristics of the constituent minerals and the degree of alteration and weathering. Therefore, the results of this petrographic examination may not be applicable to material that is more altered and/or contains a higher proportion of phyllosilicates, and thus may have markedly different physical mechanical properties and overall lower strength.

Alkali-Aggregate Reaction Potential

The Petrographic Examination indicates that the sample was composed of schist, a rock type that contains some quartz, which may contribute under certain circumstances to a deleterious expansive reaction in concrete termed *"Alkali-Aggregate Reaction"* (AAR).

In order to evaluate this potential, the sample should be tested using a suitable method, such as the Accelerated Mortar Bar test (CSA A23.2-25A), if the material is to be considered for use as concrete aggregate.

Summary

The crushed sample CH13-108-TP011_Rka was composed of fine to fine grained schist and contained 91.1% "Good" quality material and 8.9% "Fair" quality material.

On the basis of the Petrographic Examination, and subject to satisfactory compliance with applicable specification requirements, and subject to evaluation of the potential for AAR, Sample CH13-108-TP011_Rka would be considered suitable for a variety of aggregate applications.

A. Briggs, M.Sc., P. Geo.

Reviewed by:

FOR: F. Shrimer, P.Geo.

CH2M HILL, INC
ATTN: Bernice Kidd
2525 Airpark Drive
Redding CA

Date Received: 15-JUL-13
Report Date: 22-OCT-13 15:43 (MT)
Version: FINAL REV. 2

Client Phone: 530-229-3203

Certificate of Analysis

Lab Work Order #: L1332158

Project P.O. #: 472645.16.DV.DM.01, PO=604564
Job Reference: BSI CALC-SILICATE WASTE ROCK 2013 108.4-1
C of C Numbers: ALS07141303, ALS07141303H
Legal Site Desc:

Comments:

22-OCT-13: Additional QC data has been included.

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1332158-1	L1332158-2	L1332158-3	L1332158-4	
	Description	Soil	Soil	Soil	Soil	
	Sampled Date	12-JUL-13	13-JUL-13	13-JUL-13	13-JUL-13	
	Sampled Time	14:40	11:45	15:30	16:00	
	Client ID	CH13-108-TP002_SOA	CH13-108-TP006_SOA	CH13-108-TP009_SOA	CH13-108-TP011_SOA	
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)	8.66	3.94	3.62	5.40	
	pH (1:2 soil:water) (pH)	8.58	8.61	8.09	8.59	
Organic / Inorganic Carbon	Inorganic Carbon (%)	0.96	1.37	1.14	1.15	
	Inorganic Carbon (as CaCO3 Equivalent) (%)	7.96	11.4	9.54	9.55	
Saturated Paste Extractables	Paste pH (pH)	7.76	7.71	7.46	7.75	
Acid Base Accounting	Neutralization Potential (NP) (tCaCO3/1Kt)	120	116	105	142	
Metals	Aluminum (Al) (mg/kg)	30100	39500	35900	35300	
	Antimony (Sb) (mg/kg)	1.07	0.47	0.40	0.35	
	Arsenic (As) (mg/kg)	13.7	7.71	15.1	8.10	
	Barium (Ba) (mg/kg)	320	332	352	177	
	Beryllium (Be) (mg/kg)	1.90	2.17	2.11	2.69	
	Bismuth (Bi) (mg/kg)	<0.20	9.80	0.33	0.23	
	Boron (B) (mg/kg)	<10	<10	<10	<10	
	Cadmium (Cd) (mg/kg)	0.725	9.87	0.965	0.262	
	Calcium (Ca) (mg/kg)	39300	43200	36400	51500	
	Chromium (Cr) (mg/kg)	109	66.6	74.5	57.3	
	Cobalt (Co) (mg/kg)	23.1	24.5	27.8	22.3	
	Copper (Cu) (mg/kg)	41.9	253	50.3	32.5	
	Iron (Fe) (mg/kg)	41600	48600	50000	37700	
	Lead (Pb) (mg/kg)	343	460	148	73.4	
	Lithium (Li) (mg/kg)	41.6	68.6	51.8	49.9	
	Magnesium (Mg) (mg/kg)	15900	17200	19900	14200	
	Manganese (Mn) (mg/kg)	794	1220	859	757	
	Mercury (Hg) (mg/kg)	0.277	0.0604	0.0378	0.0343	
	Molybdenum (Mo) (mg/kg)	0.52	<0.50	1.54	<0.50	
	Nickel (Ni) (mg/kg)	77.4	51.0	62.7	45.6	
	Phosphorus (P) (mg/kg)	494	479	853	429	
	Potassium (K) (mg/kg)	2070	7770	6490	3550	
	Selenium (Se) (mg/kg)	<0.20	1.34	0.60	0.22	
	Silver (Ag) (mg/kg)	0.55	2.09	0.28	0.13	
	Sodium (Na) (mg/kg)	260	1500	370	860	
	Strontium (Sr) (mg/kg)	179	163	150	199	
	Sulfur (S)-Total (mg/kg)	1600	1000	1700	1200	
	Thallium (Tl) (mg/kg)	0.205	0.318	0.390	0.167	
	Tin (Sn) (mg/kg)	<2.0	4.5	<2.0	<2.0	

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1332158-1	L1332158-2	L1332158-3	L1332158-4	
	Description	Soil	Soil	Soil	Soil	
	Sampled Date	12-JUL-13	13-JUL-13	13-JUL-13	13-JUL-13	
	Sampled Time	14:40	11:45	15:30	16:00	
	Client ID	CH13-108-TP002_SOA	CH13-108-TP006_SOA	CH13-108-TP009_SOA	CH13-108-TP011_SOA	
Grouping	**Analyte**					
SOIL						
Metals	Titanium (Ti) (mg/kg)	83.0	805	324	156	
	Uranium (U) (mg/kg)	1.12	1.46	1.65	1.28	
	Vanadium (V) (mg/kg)	51.5	65.3	86.4	46.7	
	Zinc (Zn) (mg/kg)	609	710	264	144	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
B-200.2-CCMS-VA	Soil	Boron in Soil by CRC ICPMS	EPA 200.2/6020A

"This analysis is carried out using procedures from CSR Analytical Method: ""Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment."

C-INORG-SK	Soil	Inorganic Carbon / Calcium Carbonate	SSSA (1996) P455-456

When carbonates are decomposed with acid in an open system, carbon dioxide is released to the atmosphere. The decrease in sample weight resulting from CO2 loss is proportional to the carbonate content of the soil.

Reference:
Loeppert, R.H. and Suarez, D.L. 1996. Gravimetric Method for Loss of Carbon Dioxide. P. 455-456 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/245.7

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry(EPA Method 245.7).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

NP-TU	Soil	Neutralization Potential (NP)	Sobek 3.2.3, MOD
PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PH-PASTE-VA	Soil	pH in Soil (Paste) by Meter	Carter-CSSS / APHA 4500 H

A soil extract produced by the saturated paste extraction procedure is analyzed by pH meter.

S-TOT-LECO-SK	Soil	Total Sulphur by combustion method	ISO 15178:2000

The sample is ignited in a combustion analyzer where sulfur in the reduced SO2 gas is determined using a thermal conductivity detector.

Reference Information

** 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
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
TU	ALS ENVIRONMENTAL - TUCSON, ARIZONA, USA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

ALS07141303 ALS07141303H

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.

Quality Control Report

Client: CH2M HILL, INC
2525 Airpark Drive
Redding CA 96001
Contact: Bernice Kidd

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-200.2-CCMS-VA	**Soil**							
Batch R2660150								
WG1714539-6 CRM		**VA-CANMET-TILL1**						
Boron (B)			3		mg/kg		0-13	29-JUL-13
WG1714539-1 MB								
Boron (B)			<10		mg/kg		10	29-JUL-13
C-INORG-SK	**Soil**							
Batch R2655400								
WG1709105-51 DUP		**L1332158-3**						
Inorganic Carbon		1.14	1.07		%	7.1	20	20-JUL-13
WG1709105-32 IRM		**0.1%IC**						
Inorganic Carbon			134.3		%		60-140	20-JUL-13
WG1709105-33 IRM		**0.4%IC**						
Inorganic Carbon			109.3		%		80-120	20-JUL-13
WG1709105-48 IRM		**0.1%IC**						
Inorganic Carbon			133.9		%		60-140	20-JUL-13
WG1709105-49 IRM		**0.4%IC**						
Inorganic Carbon			110.1		%		80-120	20-JUL-13
WG1709105-52 IRM		**0.1%IC**						
Inorganic Carbon			124.1		%		60-140	20-JUL-13
WG1709105-53 IRM		**0.4%IC**						
Inorganic Carbon			109.3		%		80-120	20-JUL-13
WG1709105-34 MB								
Inorganic Carbon			<0.10		%		0.1	20-JUL-13
WG1709105-50 MB								
Inorganic Carbon			<0.10		%		0.1	20-JUL-13
WG1709105-54 MB								
Inorganic Carbon			<0.10		%		0.1	20-JUL-13
HG-200.2-CVAF-VA	**Soil**							
Batch R2660098								
WG1714539-3 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			96.9		%		70-130	29-JUL-13
WG1714539-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	29-JUL-13
MET-200.2-CCMS-VA	**Soil**							
Batch R2660150								
WG1714539-3 CRM		**VA-CANMET-TILL1**						
Aluminum (Al)			106.1		%		70-130	29-JUL-13
Antimony (Sb)			109.2		%		70-130	29-JUL-13
Arsenic (As)			110.2		%		70-130	29-JUL-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2660150								
WG1714539-3 CRM		**VA-CANMET-TILL1**						
Barium (Ba)			103.7		%		70-130	29-JUL-13
Beryllium (Be)			0.53		mg/kg		0.34-0.74	29-JUL-13
Bismuth (Bi)			104.6		%		70-130	29-JUL-13
Cadmium (Cd)			91.9		%		70-130	29-JUL-13
Calcium (Ca)			108.9		%		70-130	29-JUL-13
Chromium (Cr)			111.1		%		70-130	29-JUL-13
Cobalt (Co)			103.7		%		70-130	29-JUL-13
Copper (Cu)			101.4		%		70-130	29-JUL-13
Iron (Fe)			98.4		%		70-130	29-JUL-13
Lead (Pb)			95.0		%		70-130	29-JUL-13
Lithium (Li)			102.8		%		70-130	29-JUL-13
Magnesium (Mg)			102.4		%		70-130	29-JUL-13
Manganese (Mn)			105.0		%		70-130	29-JUL-13
Molybdenum (Mo)			0.72		mg/kg		0.24-1.24	29-JUL-13
Nickel (Ni)			107.0		%		70-130	29-JUL-13
Phosphorus (P)			106.1		%		70-130	29-JUL-13
Potassium (K)			103.3		%		70-130	29-JUL-13
Selenium (Se)			0.34		mg/kg		0.12-0.52	29-JUL-13
Silver (Ag)			0.23		mg/kg		0.12-0.32	29-JUL-13
Sodium (Na)			111.9		%		70-130	29-JUL-13
Strontium (Sr)			105.1		%		70-130	29-JUL-13
Thallium (Tl)			0.120		mg/kg		0.075-0.175	29-JUL-13
Tin (Sn)			1.0		mg/kg		0-3	29-JUL-13
Titanium (Ti)			106.4		%		70-130	29-JUL-13
Uranium (U)			109.2		%		70-130	29-JUL-13
Vanadium (V)			110.1		%		70-130	29-JUL-13
Zinc (Zn)			105.3		%		70-130	29-JUL-13
WG1714539-1 MB								
Aluminum (Al)			<50		mg/kg		50	29-JUL-13
Antimony (Sb)			<0.10		mg/kg		0.1	29-JUL-13
Arsenic (As)			<0.050		mg/kg		0.05	29-JUL-13
Barium (Ba)			<0.50		mg/kg		0.5	29-JUL-13
Beryllium (Be)			<0.20		mg/kg		0.2	29-JUL-13
Bismuth (Bi)			<0.20		mg/kg		0.2	29-JUL-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2660150								
WG1714539-1 MB								
Cadmium (Cd)			<0.050		mg/kg		0.05	29-JUL-13
Calcium (Ca)			<50		mg/kg		50	29-JUL-13
Chromium (Cr)			<0.50		mg/kg		0.5	29-JUL-13
Cobalt (Co)			<0.10		mg/kg		0.1	29-JUL-13
Copper (Cu)			<0.50		mg/kg		0.5	29-JUL-13
Iron (Fe)			<50		mg/kg		50	29-JUL-13
Lead (Pb)			<0.50		mg/kg		0.5	29-JUL-13
Lithium (Li)			<5.0		mg/kg		5	29-JUL-13
Magnesium (Mg)			<20		mg/kg		20	29-JUL-13
Manganese (Mn)			<1.0		mg/kg		1	29-JUL-13
Molybdenum (Mo)			<0.50		mg/kg		0.5	29-JUL-13
Nickel (Ni)			<0.50		mg/kg		0.5	29-JUL-13
Phosphorus (P)			<50		mg/kg		50	29-JUL-13
Potassium (K)			<100		mg/kg		100	29-JUL-13
Selenium (Se)			<0.20		mg/kg		0.2	29-JUL-13
Silver (Ag)			<0.10		mg/kg		0.1	29-JUL-13
Sodium (Na)			<100		mg/kg		100	29-JUL-13
Strontium (Sr)			<0.50		mg/kg		0.5	29-JUL-13
Thallium (Tl)			<0.050		mg/kg		0.05	29-JUL-13
Tin (Sn)			<2.0		mg/kg		2	29-JUL-13
Titanium (Ti)			<1.0		mg/kg		1	29-JUL-13
Uranium (U)			<0.050		mg/kg		0.05	29-JUL-13
Vanadium (V)			<0.20		mg/kg		0.2	29-JUL-13
Zinc (Zn)			<1.0		mg/kg		1	29-JUL-13
MOISTURE-VA	**Soil**							
Batch R2656983								
WG1714543-2 LCS								
Moisture			99.8		%		70-130	25-JUL-13
WG1714543-1 MB								
Moisture			<0.25		%		0.25	25-JUL-13
S-TOT-LECO-SK	**Soil**							
Batch R2652090								
WG1709086-2 IRM		**1646A_SOIL**						
Sulfur (S)-Total			3000		mg/kg		2500-4600	18-JUL-13
WG1709086-3 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
S-TOT-LECO-SK	**Soil**							
Batch R2652090								
WG1709086-3 MB								
Sulfur (S)-Total			<500		mg/kg		500	18-JUL-13

Quality Control Report

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

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.

ALS Environmental

August 20, 2013

Client: ALS Environmental- Canada
8081 Lougheed Hwy, Ste 100
Burnaby, BC V5A 1W9
CANADA
Attn: Amber Springer
Project: L1332158 **Date Received:** July 23, 2013

Certificate of Analysis

Client ID:	Sample Date:	Lab #:		Moisture, Total 3.1 wt%	Neutralization Potential Sobek 3.2.3, MOD $CaCO_3$/1,000t
L1332158- 1	7/14/2013	T1301033- 001		3.60	120
L1332158- 2	7/14/2013	T1301033- 002		8.09	116
L1332158- 3	7/14/2013	T1301033- 003		5.53	105
L1332158- 4	7/14/2013	T1301033- 004		7.18	142

Notes:
Samples were air dried then ground to < 60 mesh.

Digitally signed by Wendy Hyatt
Date: 2013.08.20 14:06:33 -07'00'

Wendy Hyatt, Project Chemist

August 20, 2013

Client: ALS Environmental- Canada
8081 Lougheed Hwy, Ste 100
Burnaby, BC V5A 1W9
CANADA
Attn: Amber Springer
Project: L1332158 **Date Received:** July 23, 2013

Quality Control

				Moisture, Total	Neutralization Potential
				3.1	Sobek 3.2.3, MOD
				wt%	$CaCO_3$/1,000t
Prep Blank				<0.01	< 1
Laboratory Control Sample (LCS) - Rice Flour CN 3451			Observed Value	9.61	n/a
			True Value	9.50	
			%R	**101**	
Laboratory Control Sample (LCS) - Na_2CO3 CN 1045			Observed Value	n/a	985
			True Value		1,000
			%R		**99**
Duplicate Results			*T1301036-001	1.10 **	
			Duplicate	1.10 **	
			%R	**0**	
Duplicate Results				*T1301036-001	63
				Duplicate	58
				%RPD	**8**

* Sample from the same batch, but a different project.

**Residual moisture - does not include air dry moisture.

CH2MHILL

CHAIN OF CUSTODY RECORD

7/14/2013 9:37:36 AM

Project Name Faro
Location Faro Mine Complex - Faro YK
Project Number 472645.16.DV.DM.01
Project Manager Heather MacDonald
Sample Manager Charles Shewen

Task Order 108.4-1
Project BSI CALC-SILICATE WASTE ROCK 2013
Turnaround Time 10 Days
Shipping Oate: 7/13/2013
COC Number: ALS07141303

				Container:	4oz jar	1 Gallon	1 Gallon	1 Gallon	1 Gallon	1 Gallon			
				Preservatives:	4°C	4°C	4°C	4°C	4°C	4°C			
				Filtered:	NA	NA	NA	NA	NA	NA			
				Holding Time:	14	28	14	180	180	28			
	DATE	TIME	Matrix		(ASTM 22:16) Moisture	(CSSS/APHA4500H) Paste pH	(EPA200.0/245.7/SW6020A) Total Metals Table 1	(ISO 15178-2000) Total Sulphur	(ModifiedSobek) Mod Neutralization Potential	(SSSA (1999) P455-456) TIC		Number of Containers	COMMENTS
CH13-108-TP002_SOa	7/12/2013	14:40	Soil		X	X	X	X	X	X		4	
CH13-108-TP006_SOa	7/13/2013	11:45	Soil		X	X	X	X	X	X		4	
CH13-108-TP009_SOa	7/13/2013	15:30	Soil		X	X	X	X	X	X		4	
CH13-108-TP011_SOa	7/13/2013	16:00	Soil		X	X	X	X	X	X		4	
											TOTAL NUMBER OF CONTAINERS	16	

L1332158-COFC

	Signatures	Date/Time
Approved by		
Sampled by		
Relinquished by		7/14/13 1200
Received by		
Relinquished by		15-Jul-13 5.4°C, 7.9°C 9:25
Received by		

Shipping Details

Method of Shipment: FedEx
On Ice: yes / no
Airbill No:
Lab Name: ALS Vancouver
Lab Phone: (604) 253-4188

ATTN:

Sample Custody
and
Amber Springer

Special Instructions:

Tar16 PO:604564 Metals Table1 Perform Lab Dup/MS on samples

Report Copy to
Bernice Kidd
(530) 229-3203

CH2MHILL

CHAIN OF CUSTODY RECORD

7/14/2013 9:37:52 AM

Project Name Faro
Location Faro Mine Complex - Faro YK
Project Number 472645.16.DV.DM.01
Project Manager Heather MacDonald
Sample Manager Charles Shewen

Task Order 108.4-1
Project BSI CALC-SILICATE WASTE ROCK 2013
Turnaround Time 10 Days
Shipping Date: 7/13/2013
COC Number: ALS07141303H

	DATE	TIME	Matrix	Container:											Number of Containers	COMMENTS
				1 Gallon	1 Gallon	1 Gallon	1 Gallon	1 Gallon	1 Gallon	1 Gallon	1 Gallon	1 Gallon	1 Gallon			
				Preservatives: 4°C	4°C	4°C	4°C	4°C	4°C	4°C	4°C	4°C	4°C			
				Filtered: NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			
				Holding Time: 14	14	14	14	180	180	14	14	14	14			
				(DI/APHA2510) DI Conductivity	(DI/APHA4500H) DI pH	(DI/ASTMD1498) DI ORP	(DI/E245.7) DI Diss Mercury	(DI/E300) DI Sulphate	(DI/EPA600/2-78-054) Acid Soluable Sulfate	(DI/SM2310) DI Acidity	(DI/SM2320) DI Alkalinity	(DI/SW6020A) DI Diss Metals	(SW6020A) Ba(Li) Metaborate			
CH13-108-TP002_SOa	7/12/2013	14:40	Soil	X	X	X	X	X	X	X	X	X	X		3	HOLD
CH13-108-TP006_SOa	7/13/2013	11:45	Soil	X	X	X	X	X	X	X	X	X	X		3	HOLD
CH13-108-TP009_SOa	7/13/2013	15:30	Soil	X	X	X	X	X	X	X	X	X	X		3	HOLD
CH13-108-TP011_SOa	7/13/2013	16:00	Soil	X	X	X	X	X	X	X	X	X	X		3	HOLD
														TOTAL NUMBER OF CONTAINERS	12	

L1332158-COFC

	Signatures	Date/Time
Approved by		
Sampled by		
Relinquished by		7/14/13 1200
Received by		
Relinquished by		
Received by		

Shipping Details
Method of Shipment: FedEx
On Ice: yes / no
Airbill No:
Lab Name: ALS Vancouver
Lab Phone: (604) 253-4188

ATTN:
Sample Custody
and
Amber Springer

Special Instructions:
Tar16 PO:604564 Metals Table1 Perform Lab Dup/MS on samples

Report Copy to
Bernice Kidd
(530) 229-3203

CH2M HILL, INC
ATTN: Bernice Kidd
2525 Airpark Drive
Redding CA

Date Received: 17-JUL-13
Report Date: 22-OCT-13 15:44 (MT)
Version: FINAL REV. 2

Client Phone: 530-229-3203

Certificate of Analysis

Lab Work Order #: L1333673

Project P.O. #: 472645.16.DV.DM.01, PO=604564
Job Reference: BSI CALC-SILICATE WASTE ROCK 2013 108.4-1
C of C Numbers: ALS07161301, ALS07161301H, ALS07161301R
Legal Site Desc:

Comments:

22-OCT-13: Additional QC data has been included.

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1333673-1				
		Description	Soil				
		Sampled Date	15-JUL-13				
		Sampled Time	14:50				
		Client ID	CH13-108-TP015_SOA				
Grouping	**Analyte**						
SOIL							
Physical Tests	Moisture (%)		3.86				
	pH (1:2 soil:water) (pH)		8.20				
Organic / Inorganic Carbon	Inorganic Carbon (%)		0.62				
	Inorganic Carbon (as CaCO3 Equivalent) (%)		5.14				
Saturated Paste Extractables	Paste pH (pH)		6.84				
Acid Base Accounting	Neutralization Potential (NP) (tCaCO3/1Kt)		63.0				
Metals	Aluminum (Al) (mg/kg)		32800				
	Antimony (Sb) (mg/kg)		0.83				
	Arsenic (As) (mg/kg)		54.7				
	Barium (Ba) (mg/kg)		262				
	Beryllium (Be) (mg/kg)		1.80				
	Bismuth (Bi) (mg/kg)		3.19				
	Boron (B) (mg/kg)		<10				
	Cadmium (Cd) (mg/kg)		1.87				
	Calcium (Ca) (mg/kg)		29300				
	Chromium (Cr) (mg/kg)		207				
	Cobalt (Co) (mg/kg)		43.2				
	Copper (Cu) (mg/kg)		83.6				
	Iron (Fe) (mg/kg)		65100				
	Lead (Pb) (mg/kg)		437				
	Lithium (Li) (mg/kg)		57.4				
	Magnesium (Mg) (mg/kg)		28500				
	Manganese (Mn) (mg/kg)		840				
	Mercury (Hg) (mg/kg)		0.0217				
	Molybdenum (Mo) (mg/kg)		1.76				
	Nickel (Ni) (mg/kg)		220				
	Phosphorus (P) (mg/kg)		1020				
	Potassium (K) (mg/kg)		5660				
	Selenium (Se) (mg/kg)		1.22				
	Silver (Ag) (mg/kg)		1.39				
	Sodium (Na) (mg/kg)		300				
	Strontium (Sr) (mg/kg)		80.2				
	Sulfur (S)-Total (mg/kg)		7100				
	Thallium (Tl) (mg/kg)		0.739				
	Tin (Sn) (mg/kg)		2.5				

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1333673-1				
		Description	Soil				
		Sampled Date	15-JUL-13				
		Sampled Time	14:50				
		Client ID	CH13-108-TP015_SOA				
Grouping	**Analyte**						
SOIL							
Metals	Titanium (Ti) (mg/kg)		341				
	Uranium (U) (mg/kg)		1.61				
	Vanadium (V) (mg/kg)		109				
	Zinc (Zn) (mg/kg)		353				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
B-200.2-CCMS-VA	Soil	Boron in Soil by CRC ICPMS	EPA 200.2/6020A

"This analysis is carried out using procedures from CSR Analytical Method: ""Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment."

C-INORG-SK	Soil	Inorganic Carbon / Calcium Carbonate	SSSA (1996) P455-456

When carbonates are decomposed with acid in an open system, carbon dioxide is released to the atmosphere. The decrease in sample weight resulting from CO2 loss is proportional to the carbonate content of the soil.

Reference:
Loeppert, R.H. and Suarez, D.L. 1996. Gravimetric Method for Loss of Carbon Dioxide. P. 455-456 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAFS	EPA 200.2/245.7

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry(EPA Method 245.7).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve (this sieve step is omitted for international soil samples), and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

NP-TU	Soil	Neutralization Potential (NP)	Sobek 3.2.3, MOD
PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PH-PASTE-VA	Soil	pH in Soil (Paste) by Meter	Carter-CSSS / APHA 4500 H

A soil extract produced by the saturated paste extraction procedure is analyzed by pH meter.

S-TOT-LECO-SK	Soil	Total Sulphur by combustion method	ISO 15178:2000

The sample is ignited in a combustion analyzer where sulfur in the reduced SO2 gas is determined using a thermal conductivity detector.

Reference Information

** 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
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
TU	ALS ENVIRONMENTAL - TUCSON, ARIZONA, USA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

ALS07161301 ALS07161301H ALS07161301R

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.

Quality Control Report

Client: CH2M HILL, INC
2525 Airpark Drive
Redding CA 96001
Contact: Bernice Kidd

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-200.2-CCMS-VA	**Soil**							
Batch R2663563								
WG1716415-4 CRM		**VA-CANMET-TILL1**						
Boron (B)			3		mg/kg		0-13	31-JUL-13
WG1716415-1 MB								
Boron (B)			<10		mg/kg		10	31-JUL-13
C-INORG-SK	**Soil**							
Batch R2653160								
WG1710665-3 IRM		**0.1%IC**						
Inorganic Carbon			119.6		%		60-140	20-JUL-13
WG1710665-4 IRM		**0.4%IC**						
Inorganic Carbon			109.2		%		80-120	20-JUL-13
WG1710665-5 MB								
Inorganic Carbon			<0.10		%		0.1	20-JUL-13
HG-200.2-CVAF-VA	**Soil**							
Batch R2663085								
WG1716415-3 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			104.2		%		70-130	31-JUL-13
WG1716415-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	31-JUL-13
MET-200.2-CCMS-VA	**Soil**							
Batch R2663563								
WG1716415-3 CRM		**VA-CANMET-TILL1**						
Aluminum (Al)			98.6		%		70-130	31-JUL-13
Antimony (Sb)			105.2		%		70-130	31-JUL-13
Arsenic (As)			107.5		%		70-130	31-JUL-13
Barium (Ba)			99.8		%		70-130	31-JUL-13
Beryllium (Be)			0.53		mg/kg		0.34-0.74	31-JUL-13
Bismuth (Bi)			100.0		%		70-130	31-JUL-13
Cadmium (Cd)			84.5		%		70-130	31-JUL-13
Calcium (Ca)			103.8		%		70-130	31-JUL-13
Chromium (Cr)			105.7		%		70-130	31-JUL-13
Cobalt (Co)			103.3		%		70-130	31-JUL-13
Copper (Cu)			99.8		%		70-130	31-JUL-13
Iron (Fe)			98.0		%		70-130	31-JUL-13
Lead (Pb)			92.7		%		70-130	31-JUL-13
Lithium (Li)			103.6		%		70-130	31-JUL-13
Magnesium (Mg)			100.9		%		70-130	31-JUL-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2663563								
WG1716415-3 CRM		**VA-CANMET-TILL1**						
Manganese (Mn)			99.2		%		70-130	31-JUL-13
Molybdenum (Mo)			0.71		mg/kg		0.24-1.24	31-JUL-13
Nickel (Ni)			104.2		%		70-130	31-JUL-13
Phosphorus (P)			109.4		%		70-130	31-JUL-13
Potassium (K)			105.7		%		70-130	31-JUL-13
Selenium (Se)			0.33		mg/kg		0.12-0.52	31-JUL-13
Silver (Ag)			0.22		mg/kg		0.12-0.32	31-JUL-13
Sodium (Na)			106.1		%		70-130	31-JUL-13
Strontium (Sr)			102.9		%		70-130	31-JUL-13
Thallium (Tl)			0.116		mg/kg		0.075-0.175	31-JUL-13
Tin (Sn)			1.0		mg/kg		0-3	31-JUL-13
Titanium (Ti)			105.6		%		70-130	31-JUL-13
Uranium (U)			119.3		%		70-130	31-JUL-13
Vanadium (V)			106.8		%		70-130	31-JUL-13
Zinc (Zn)			100.9		%		70-130	31-JUL-13
WG1716415-1 MB								
Aluminum (Al)			<50		mg/kg		50	31-JUL-13
Antimony (Sb)			<0.10		mg/kg		0.1	31-JUL-13
Arsenic (As)			<0.050		mg/kg		0.05	31-JUL-13
Barium (Ba)			<0.50		mg/kg		0.5	31-JUL-13
Beryllium (Be)			<0.20		mg/kg		0.2	31-JUL-13
Bismuth (Bi)			<0.20		mg/kg		0.2	31-JUL-13
Cadmium (Cd)			<0.050		mg/kg		0.05	31-JUL-13
Calcium (Ca)			<50		mg/kg		50	31-JUL-13
Chromium (Cr)			<0.50		mg/kg		0.5	31-JUL-13
Cobalt (Co)			<0.10		mg/kg		0.1	31-JUL-13
Copper (Cu)			<0.50		mg/kg		0.5	31-JUL-13
Iron (Fe)			<50		mg/kg		50	31-JUL-13
Lead (Pb)			<0.50		mg/kg		0.5	31-JUL-13
Lithium (Li)			<5.0		mg/kg		5	31-JUL-13
Magnesium (Mg)			<20		mg/kg		20	31-JUL-13
Manganese (Mn)			<1.0		mg/kg		1	31-JUL-13
Molybdenum (Mo)			<0.50		mg/kg		0.5	31-JUL-13
Nickel (Ni)			<0.50		mg/kg		0.5	31-JUL-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-VA	**Soil**							
Batch R2663563								
WG1716415-1 MB								
Phosphorus (P)			<50		mg/kg		50	31-JUL-13
Potassium (K)			<100		mg/kg		100	31-JUL-13
Selenium (Se)			<0.20		mg/kg		0.2	31-JUL-13
Silver (Ag)			<0.10		mg/kg		0.1	31-JUL-13
Sodium (Na)			<100		mg/kg		100	31-JUL-13
Strontium (Sr)			<0.50		mg/kg		0.5	31-JUL-13
Thallium (Tl)			<0.050		mg/kg		0.05	31-JUL-13
Tin (Sn)			<2.0		mg/kg		2	31-JUL-13
Titanium (Ti)			<1.0		mg/kg		1	31-JUL-13
Uranium (U)			<0.050		mg/kg		0.05	31-JUL-13
Vanadium (V)			<0.20		mg/kg		0.2	31-JUL-13
Zinc (Zn)			<1.0		mg/kg		1	31-JUL-13
MOISTURE-VA	**Soil**							
Batch R2660401								
WG1716410-2 LCS								
Moisture			99.8		%		70-130	29-JUL-13
WG1716410-1 MB								
Moisture			<0.25		%		0.25	29-JUL-13
S-TOT-LECO-SK	**Soil**							
Batch R2653163								
WG1710656-2 IRM		**1646A_SOIL**						
Sulfur (S)-Total			3400		mg/kg		2500-4600	20-JUL-13
WG1710656-3 MB								
Sulfur (S)-Total			<500		mg/kg		500	20-JUL-13

Quality Control Report

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

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.

August 20, 2013

Client: ALS Environmental- Canada
8081 Lougheed Hwy, Ste 100
Burnaby, BC V5A 1W9
CANADA
Attn: Amber Springer
Project: L1333673 **Date Received:** July 23, 2013

Certificate of Analysis

Client ID:	Sample Date:	Lab #:		Moisture, Total 3.1 wt%	Neutralization Potential Sobek 3.2.3, MOD $CaCO_3$/1,000t
L1333673- 1	7/15/2013	T1301036- 001		3.05	63

Notes:
Samples were air dried then ground to < 60 mesh.

Digitally signed by Wendy Hyatt
Date: 2013.08.20 14:13:56 -07'00'

Wendy Hyatt, Project Chemist

ADDRESS 3860 S. Palo Verde Road, Suite 302, Tucson, AZ 85714
PHONE +1 520 573 1061
FAX +1 520 573 1063

August 20, 2013

Client: ALS Environmental- Canada
8081 Lougheed Hwy, Ste 100
Burnaby, BC V5A 1W9
CANADA
Attn: Amber Springer
Project: L1333673 **Date Received:** July 23, 2013

Quality Control

				Moisture, Total	Neutralization Potential
				3.1	Sobek 3.2.3, MOD
				wt%	$CaCO_3$/1,000t
Prep Blank				<0.01	< 1
Laboratory Control Sample (LCS) - Rice Flour CN 3451			Observed Value	9.61	n/a
			True Value	9.50	
			%R	**101**	
Laboratory Control Sample (LCS) - Na_2CO3 CN 1045			Observed Value	n/a	985
			True Value		1,000
			%R		**99**
Duplicate Results			T1301036-001	1.10 **	
			Duplicate	1.10 **	
			%R	**0**	
Duplicate Results				T1301036-001	63
				Duplicate	58
				%RPD	**8**

**Residual moisture - does not include air dry moisture.

CH2MHILL

CHAIN OF CUSTODY RECORD

7/16/2013 1:13:28 PM

Project Name Faro
Location Faro Mine Complex - Faro YK
Project Number 472645.16.DV.DM.01
Project Manager Heather MacDonald
Sample Manager Charles Shewen

Task Order 108.4-1
Project BSI CALC-SILICATE WASTE ROCK 2013
Turnaround Time 3 Days
Shipping Date: 7/16/2013
COC Number: ALS07161301R

	Container:	Preservatives:	Filtered:	Holding Time:	
	1 Gallon	4°C	NA	180	(ISO 15178-2000) Total Sulphur

	DATE	TIME	Matrix		Number of Containers	COMMENTS
CH13-108-TP015_SOa	7/15/2013	14:50	Soil	X	1	
				TOTAL NUMBER OF CONTAINERS	1	

QUOTE

L1333673-COFC

	Signatures	Date/Time
Approved by		
Sampled by		7/16/13 1500
Relinquished by		
Received by		
Relinquished by		17-JUL-13
Received by		9:42

6.5°C, 4.3°C

Shipping Details

Method of Shipment: FedEx
On Ice: yes / no
Airbill No:
Lab Name: ALS Vancouver
Lab Phone: (604) 253-4188

ATTN:

Sample Custody
and
Amber Springer

Special Instructions:

Tar16 PO:604564 Metals Table1 Perform Lab Dup/MS on samples

Report Copy to
Bernice Kidd
(530) 229-3203

CH2MHILL

CHAIN OF CUSTODY RECORD

7/16/2013 1:14:06 PM

Project Name Faro
Location Faro Mine Complex - Faro YK
Project Number 472645.16.DV.DM.01
Project Manager Heather MacDonald
Sample Manager Charles Shewen

Task Order 108.4-1
Project BSI CALC-SILICATE WASTE ROCK 2013
Turnaround Time 10 Days
Shipping Date: 7/16/2013
COC Number: ALS07161301

				Container:	4oz jar	1 Gallon	1 Gallon	1 Gallon	1 Gallon			
				Preservatives:	4'C	4'C	4'C	4'C	4'C			
				Filtered:	NA	NA	NA	NA	NA			
				Holding Time:	14	28	14	28	28			
	DATE	TIME	Matrix		(ASTM 2216) Moisture	(CSSS/APHA4500H) Paste pH	(EPA200.0/245.7/SW6020A) Total Metals Table 1	(ModifiedSobek) Mod Neutralization Potential	(SSSA (1996) P455-456) TIC		Number of Containers	COMMENTS
CH13-108-TP015_SOa	7/15/2013	14:50	Soil		X	X	X	X	X		3	
										TOTAL NUMBER OF CONTAINERS	3	

L1333673-COFC

Signatures	Date/Time
Approved by	
Sampled by	
Relinquished by	7/16/13 1507
Received by	
Relinquished by	
Received by	

Shipping Details

Method of Shipment: FedEx
On Ice: yes / no
Airbill No:
Lab Name: ALS Vancouver
Lab Phone: (604) 253-4188

ATTN:

Sample Custody
and
Amber Springer

Special Instructions:

Tar16 PO:604564 Metals Table1 Perform Lab Dup/MS on samples

Report Copy to

Bernice Kidd
(530) 229-3203

CH2MHILL

CHAIN OF CUSTODY RECORD

7/16/2013 1:13:48 PM

Project Name Faro
Location Faro Mine Complex - Faro YK
Project Number 472645.16.DV.DM.01
Project Manager Heather MacDonald
Sample Manager Charles Shewen

Task Order 108.4-1
Project BSI CALC-SILICATE WASTE ROCK 2013
Turnaround Time 10 Days
Shipping Date: 7/16/2013
COC Number: ALS07161301H

	DATE	TIME	Matrix	Container:	Preservatives:	Filtered:	Holding Time:	(DI/APHA2510) DI Conductivity	(DI/APHA4500H) DI pH	(DI/ASTMD1498) DI ORP	(DI/E245.7) DI Diss Mercury	(DI/E300) DI Sulphate	(DI/EPA600/2-78-054) Acid Soluable Sulfate	(DI/SM2310) DI Acidity	(DI/SM2320) DI Alkalinity	(DI/SW6020A) DI Diss Metals	(SW6020A) Ba(Li) Metaborate	Number of Containers	COMMENTS
				1 Gallon	4'C	NA	14												
				1 Gallon	4'C	NA	14												
				1 Gallon	4'C	NA	14												
				1 Gallon	4'C	NA	14												
				1 Gallon	4'C	NA	180												
				1 Gallon	4'C	NA	180												
				1 Gallon	4'C	NA	14												
				1 Gallon	4'C	NA	14												
				1 Gallon	4'C	NA	14												
				1 Gallon	4'C	NA	14												
CH13-108-TP015_SOa	7/15/2013	14:50	Soil					X	X	X	X	X	X	X	X	X	X	3	HOLD
																	TOTAL NUMBER OF CONTAINERS	3	

L1333673-COFC

Signatures	Date/Time
Approved by	
Sampled by	
Relinquished by	7/16/13 1500
Received by	
Relinquished by	
Received by	

Shipping Details
Method of Shipment: FedEx
On Ice: yes / no
Airbill No:
Lab Name: ALS Vancouver
Lab Phone: (604) 253-4188

ATTN:
Sample Custody
and
Amber Springer

Special Instructions:
Tar16 PO:604564 Metals Table1 Perform Lab Dup/MS on samples

Report Copy to
Bernice Kidd
(530) 229-3203

CH2M HILL, INC
ATTN: Bernice Kidd
2525 Airpark Drive
Redding CA 96001

Date Received: 31-JUL-13
Report Date: 13-AUG-13 17:54 (MT)
Version: FINAL

Client Phone: 530-229-3203

Certificate of Analysis

Lab Work Order #: L1340658

Project P.O. #: 472645.16DV.DM.01 "PO=604564"
Job Reference: DVIHU INTM. DAM CREST TEST PITS
C of C Numbers: ALS07301301
Legal Site Desc:

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1340658-1	L1340658-2	L1340658-3	L1340658-4	L1340658-5
	Description	Soil	Soil	Soil	Soil	Soil
	Sampled Date	29-JUL-13	29-JUL-13	29-JUL-13	29-JUL-13	29-JUL-13
	Sampled Time	14:45	14:40	14:25	13:25	13:30
	Client ID	CH13-201-TP001_SOA	CH13-201-TP001_SOB	CH13-201-TP002_SOA	CH13-201-TP003_SOA	CH13-201-TP003_SOB
Grouping	**Analyte**					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED
	% Moisture (%)		8.05	6.34		6.72
	Liquid Limit (LL) (%)		23	24		25
	Plasticity Index (PI) (%)		5	5		6

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1340658-6	L1340658-7	L1340658-8	L1340658-9	L1340658-10
	Description	Soil	Soil	Soil	Soil	Soil
	Sampled Date	29-JUL-13	29-JUL-13	29-JUL-13	29-JUL-13	29-JUL-13
	Sampled Time	13:40	12:30	12:35	12:00	12:05
	Client ID	CH13-201-TP003_SOC	CH13-201-TP004_SOA	CH13-201-TP004_SOB	CH13-201-TP005_SOA	CH13-201-TP005_SOB
Grouping	**Analyte**					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED
	% Moisture (%)			8.18		7.81
	Liquid Limit (LL) (%)			26		24
	Plasticity Index (PI) (%)			7		7

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1340658-11	L1340658-12	L1340658-13		
	Description	Soil	Soil	Soil		
	Sampled Date	29-JUL-13	29-JUL-13	29-JUL-13		
	Sampled Time	11:15	10:30	10:40		
	Client ID	CH13-201-TP006_SOA	CH13-201-TP007_SOA	CH13-201-TP007_SOB		
Grouping	**Analyte**					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED		
	% Moisture (%)	7.63		7.42		
	Liquid Limit (LL) (%)	23		22		
	Plasticity Index (PI) (%)	4		4		

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ATTERBERG-SK	Soil	Atterberg limits	CARTER CSSS 58

The liquid limit (or upper plastic limit) is the point at which the soil becomes semifluid, like softened butter. In operational terms, the liquid limit is defined as the water content at which a trapezoidal groove cut in moist soil is closed after 25 taps on a hard rubber plate (ASTM D-18, 1958).

The plastic limit (or lower plastic limit) is defined as the water content at which soil begins to crumble on being rolled into a thread 1/8 inch (or 3 mm) in diameter. It represents the lowest water content at which soil can be deformed readily without cracking.

The plastic index (which is the difference between the liquid and plastic limits) gives an indication of the "clayeyness" or plasticity of a clay and is employed in engineering classification systems for soils.

References: McKeague, J.A. 1978. Atterberg Limits pp 50 - 55 In: Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci. p. 50 - 55

GRAIN SIZE-SK	Soil	Grain Size Analysis	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

MOIST-SK	Soil	Moisture Content	ASTM D2216-80

The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.

Reference: ASTM D2216-80

** 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
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

ALS07301301

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.

Quality Control Report

Client: CH2M HILL, INC
2525 Airpark Drive
Redding CA 96001
Contact: Bernice Kidd

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed

Quality Control Report

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.

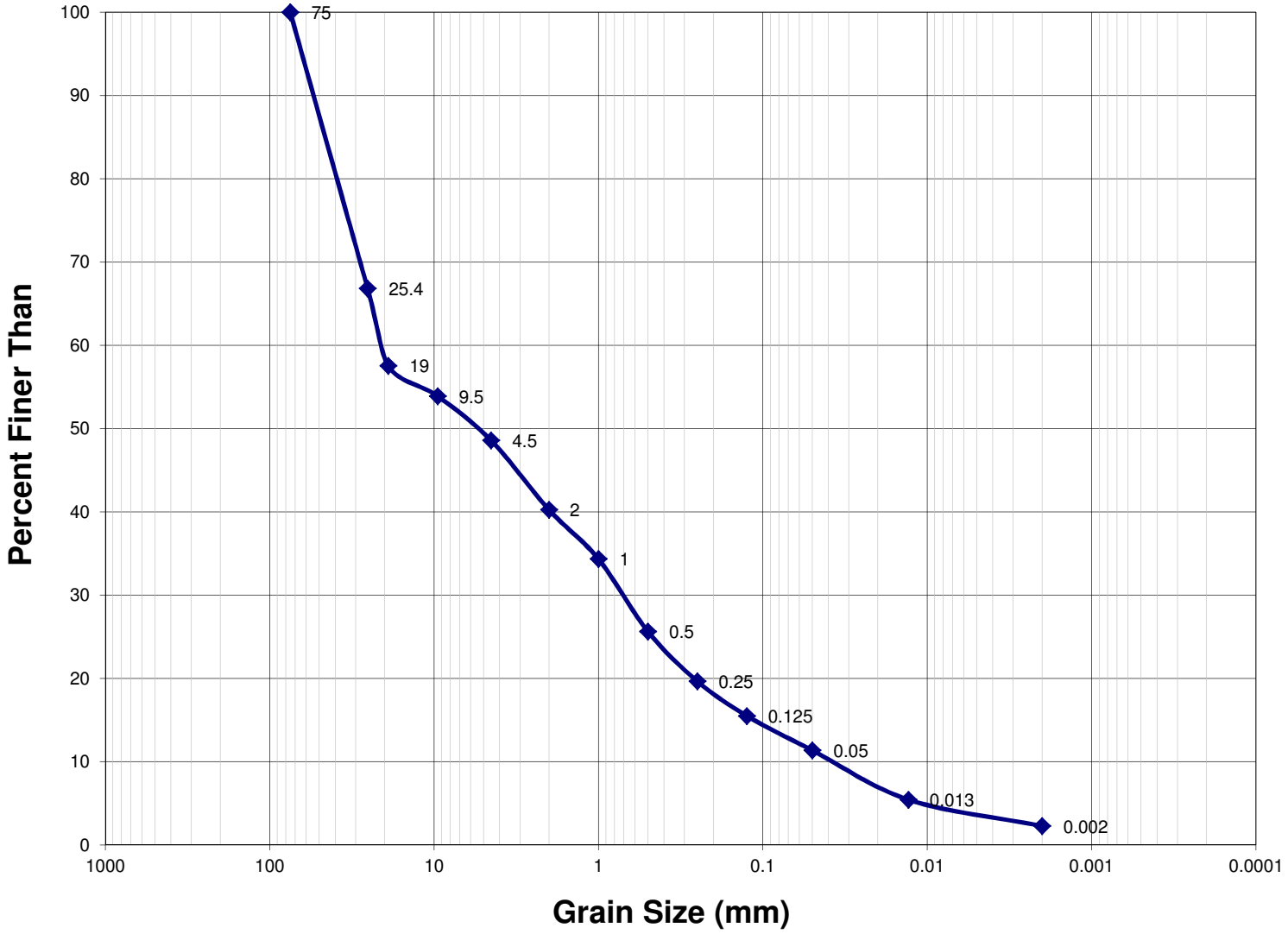
Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP001_SOA
Lab ID: L1340658-1

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	51
Coarse Sand	2.0mm - 4.75mm	9
Medium Sand	0.425mm - 2.0mm	15
Fine Sand	0.075mm - 0.425mm	13
Fines	< 0.075mm	13

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	60
Sand	0.05mm - 2mm	29
Silt	0.002mm - 0.05mm	9
Clay	< 0.002mm	2
Texture	Sandy loam	

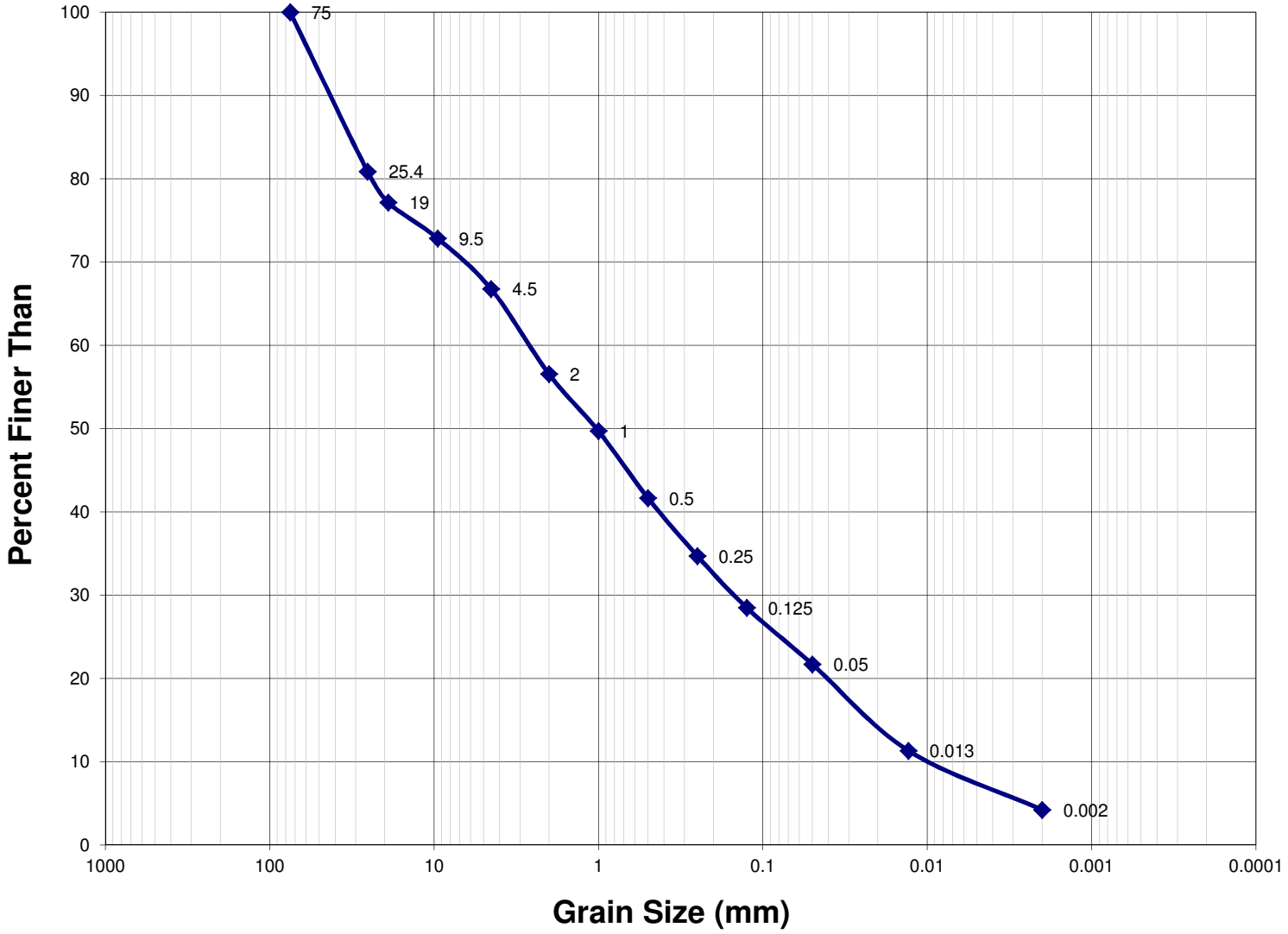
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP001_SOB
Lab ID: L1340658-2

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	33
Coarse Sand	2.0mm - 4.75mm	11
Medium Sand	0.425mm - 2.0mm	15
Fine Sand	0.075mm - 0.425mm	18
Fines	< 0.075mm	24

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	43
Sand	0.05mm - 2mm	35
Silt	0.002mm - 0.05mm	17
Clay	< 0.002mm	4
Texture	Sandy loam	

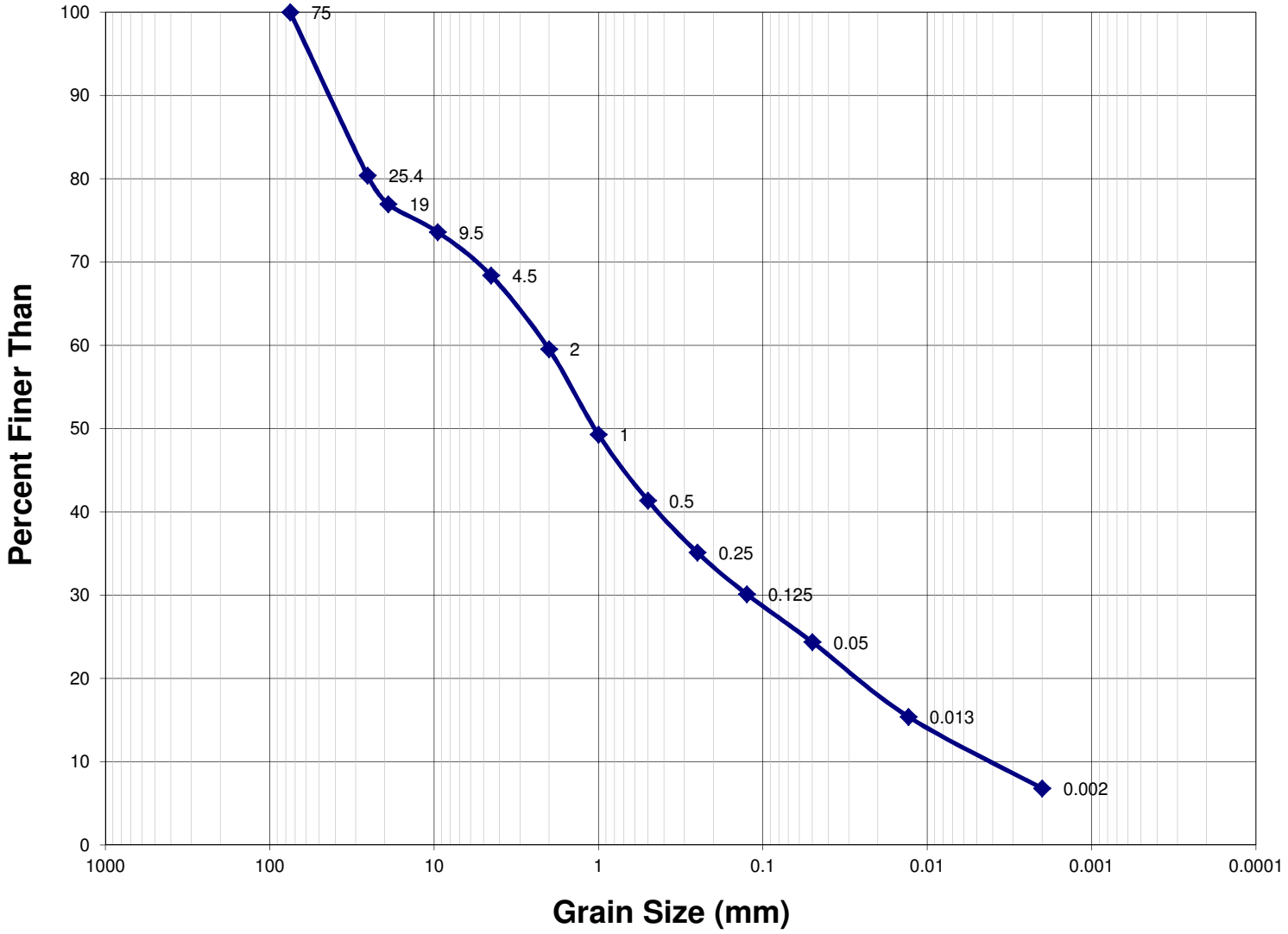
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP002_SOA
Lab ID: L1340658-3

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	31
Coarse Sand	2.0mm - 4.75mm	9
Medium Sand	0.425mm - 2.0mm	18
Fine Sand	0.075mm - 0.425mm	15
Fines	< 0.075mm	26

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	40
Sand	0.05mm - 2mm	35
Silt	0.002mm - 0.05mm	18
Clay	< 0.002mm	7
Texture	Sandy loam	

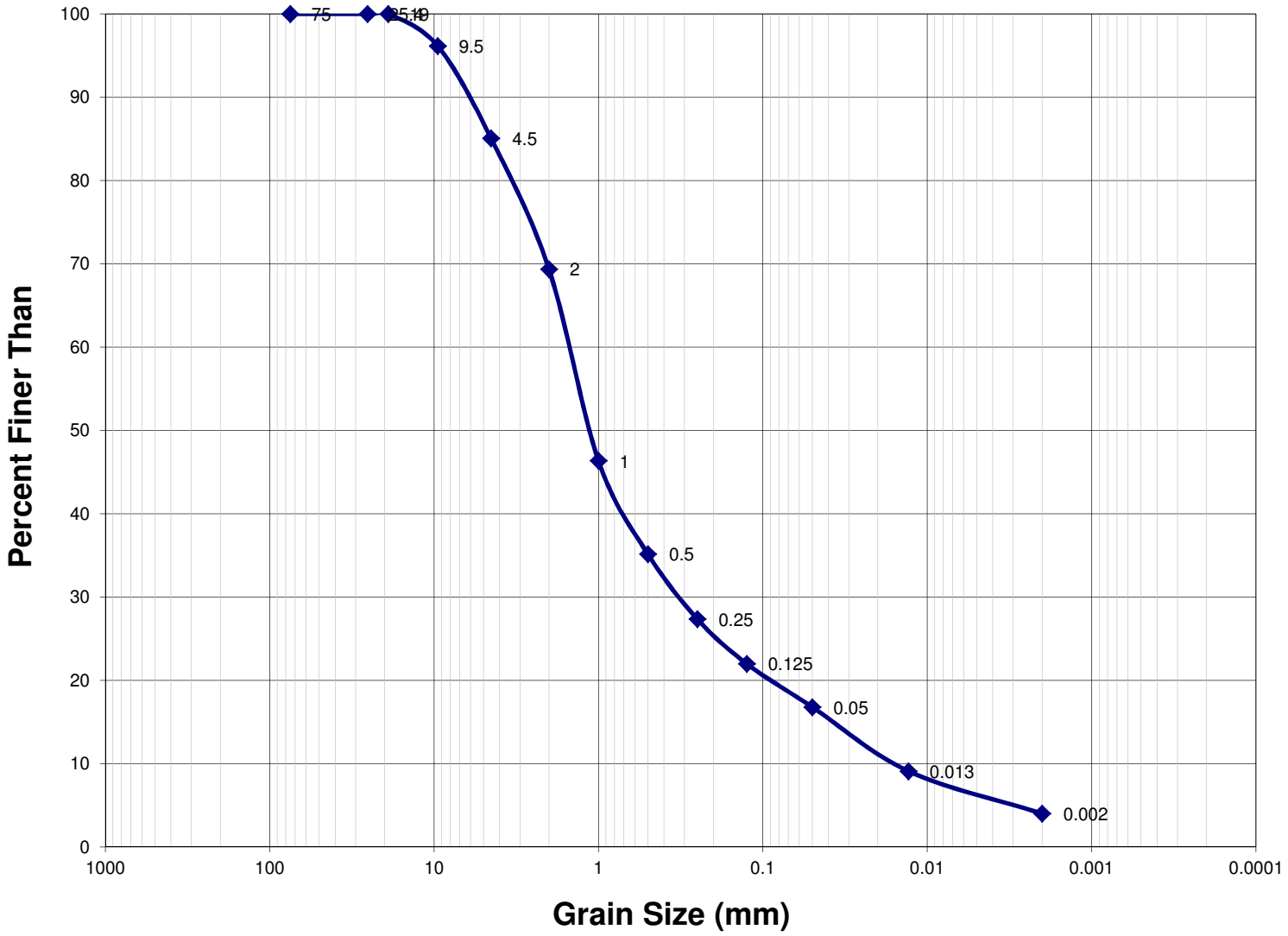
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP003_SOA
Lab ID: L1340658-4

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	14
Coarse Sand	2.0mm - 4.75mm	16
Medium Sand	0.425mm - 2.0mm	34
Fine Sand	0.075mm - 0.425mm	17
Fines	< 0.075mm	19

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	31
Sand	0.05mm - 2mm	53
Silt	0.002mm - 0.05mm	13
Clay	< 0.002mm	4

Texture: Sandy loam / Loamy sand

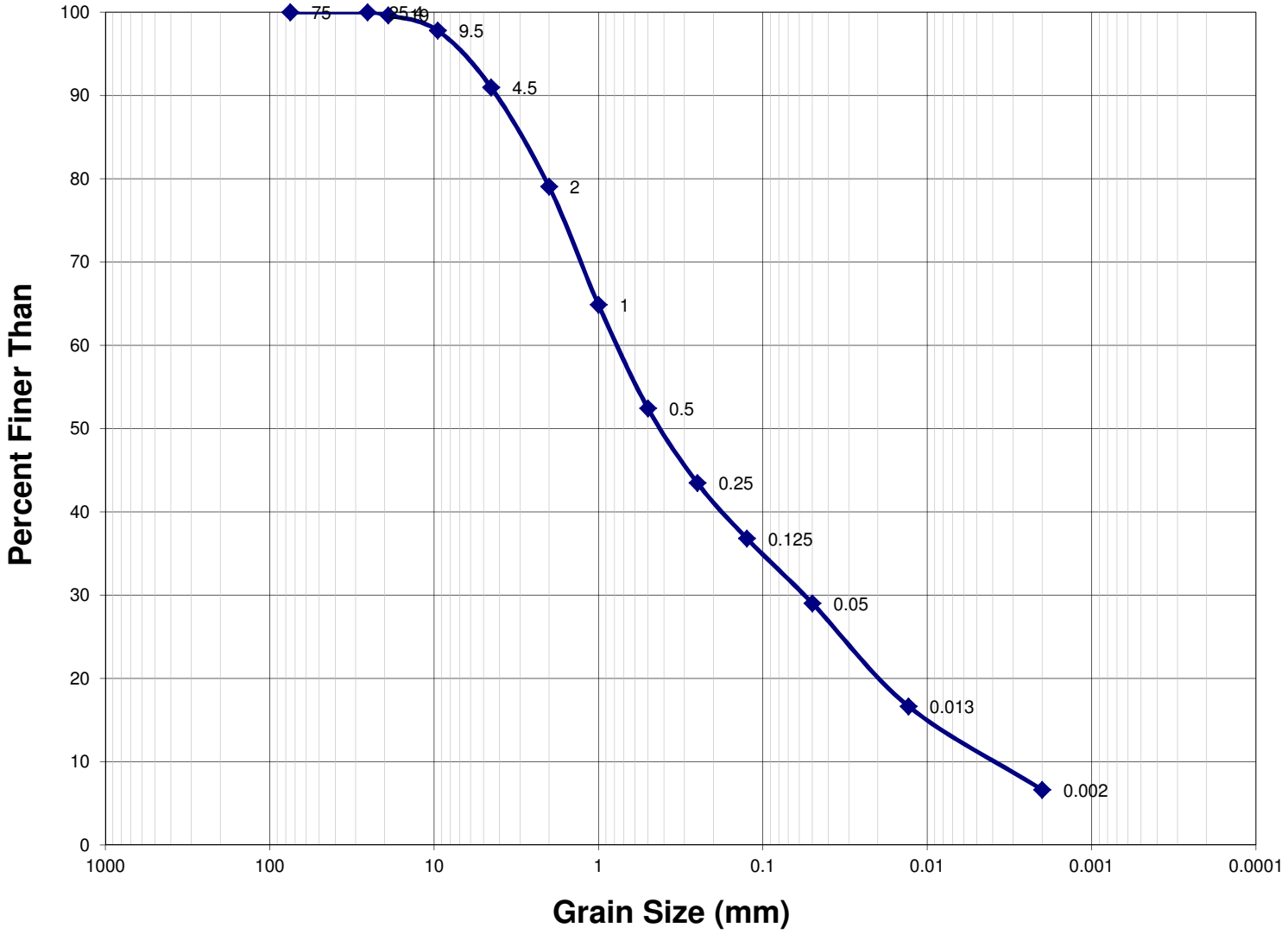
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP003_SOB
Lab ID: L1340658-5

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	9
Coarse Sand	2.0mm - 4.75mm	12
Medium Sand	0.425mm - 2.0mm	27
Fine Sand	0.075mm - 0.425mm	21
Fines	< 0.075mm	32

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	21
Sand	0.05mm - 2mm	50
Silt	0.002mm - 0.05mm	22
Clay	< 0.002mm	7

Texture Sandy loam

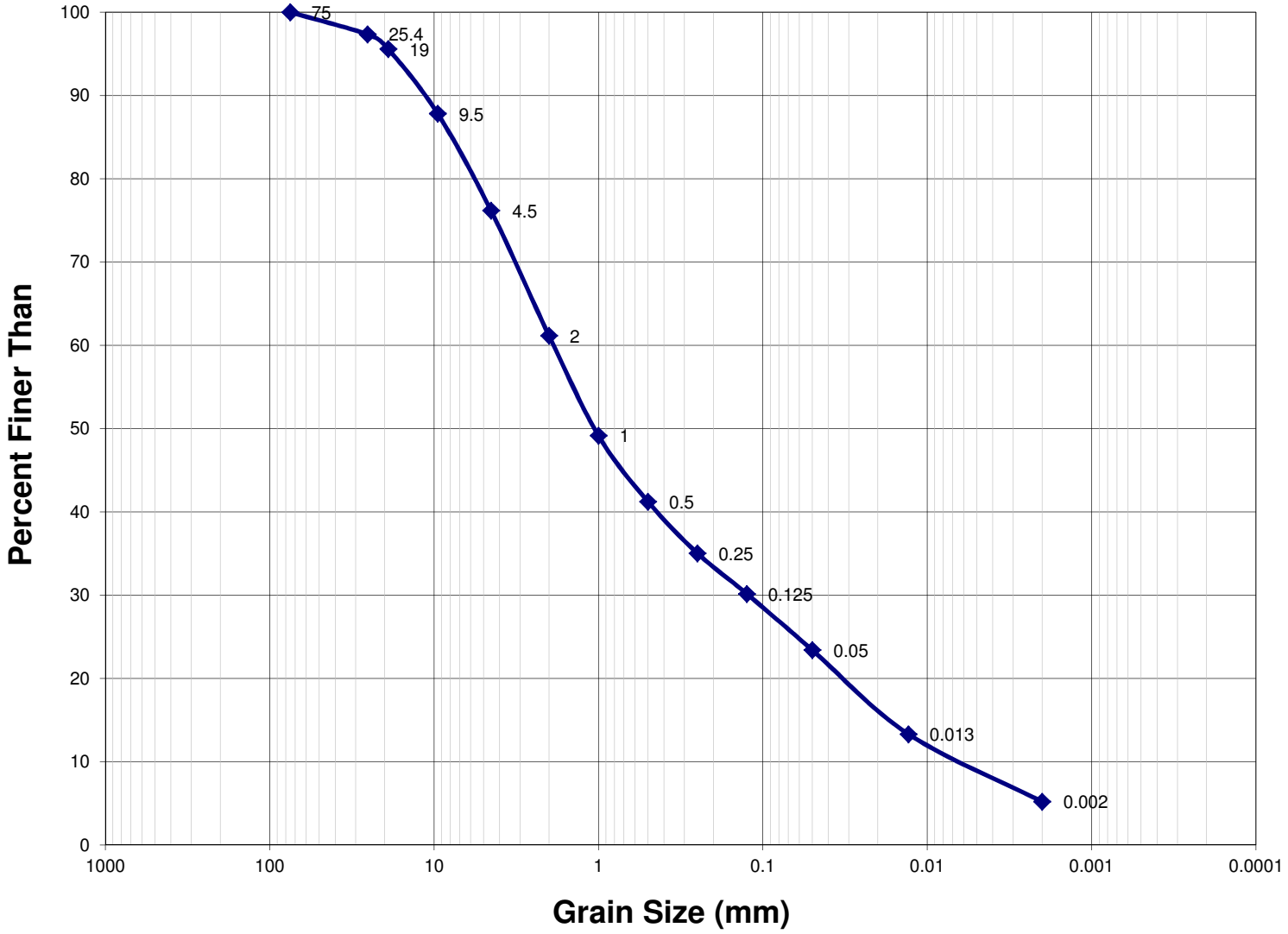
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP003_SOC
Lab ID: L1340658-6

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	23
Coarse Sand	2.0mm - 4.75mm	16
Medium Sand	0.425mm - 2.0mm	20
Fine Sand	0.075mm - 0.425mm	16
Fines	< 0.075mm	26

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	39
Sand	0.05mm - 2mm	38
Silt	0.002mm - 0.05mm	18
Clay	< 0.002mm	5
Texture	Sandy loam	

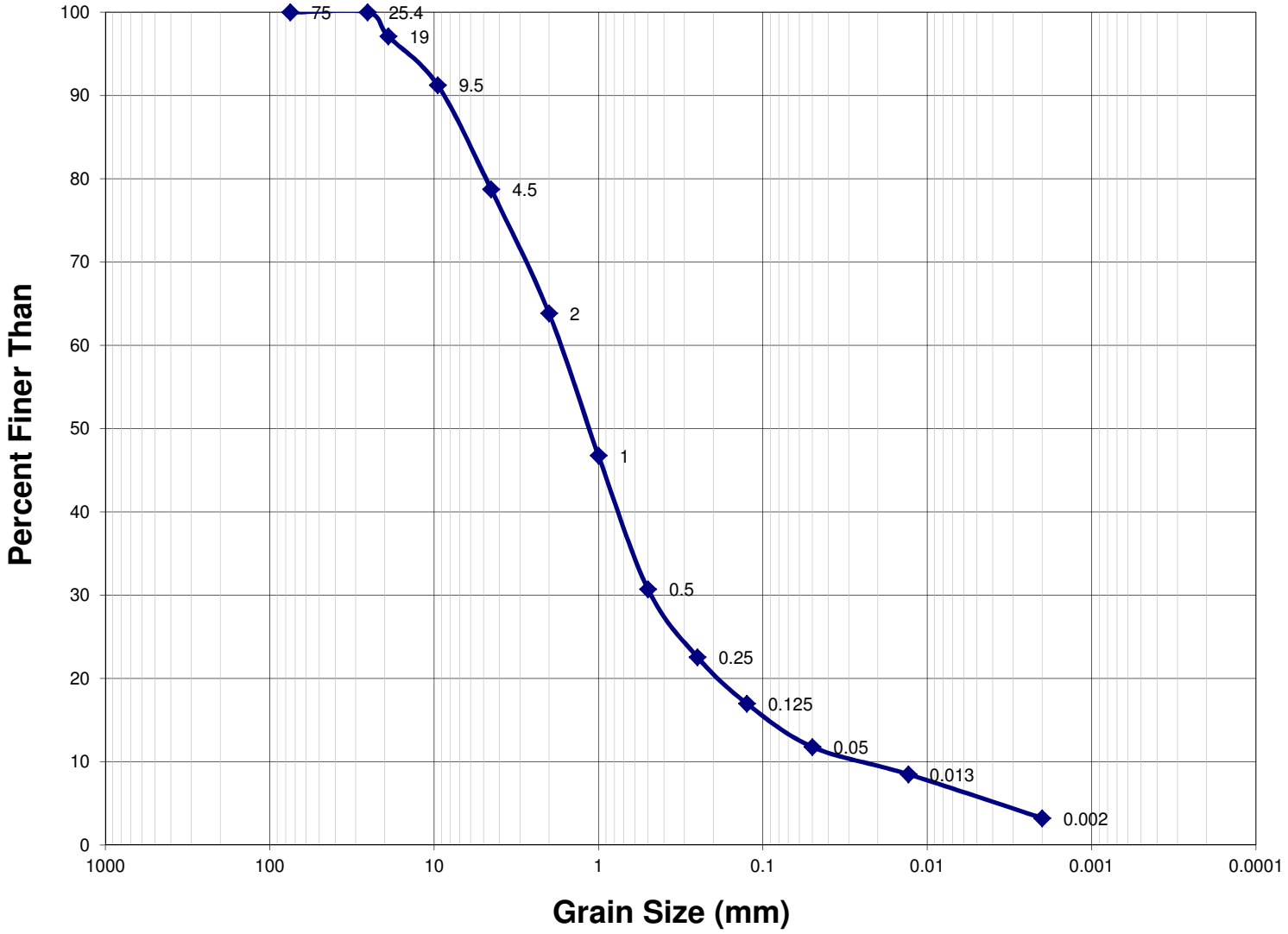
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP004_SOA
Lab ID: L1340658-7

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	21
Coarse Sand	2.0mm - 4.75mm	16
Medium Sand	0.425mm - 2.0mm	33
Fine Sand	0.075mm - 0.425mm	17
Fines	< 0.075mm	14

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	36
Sand	0.05mm - 2mm	52
Silt	0.002mm - 0.05mm	9
Clay	< 0.002mm	3
Texture	Loamy sand	

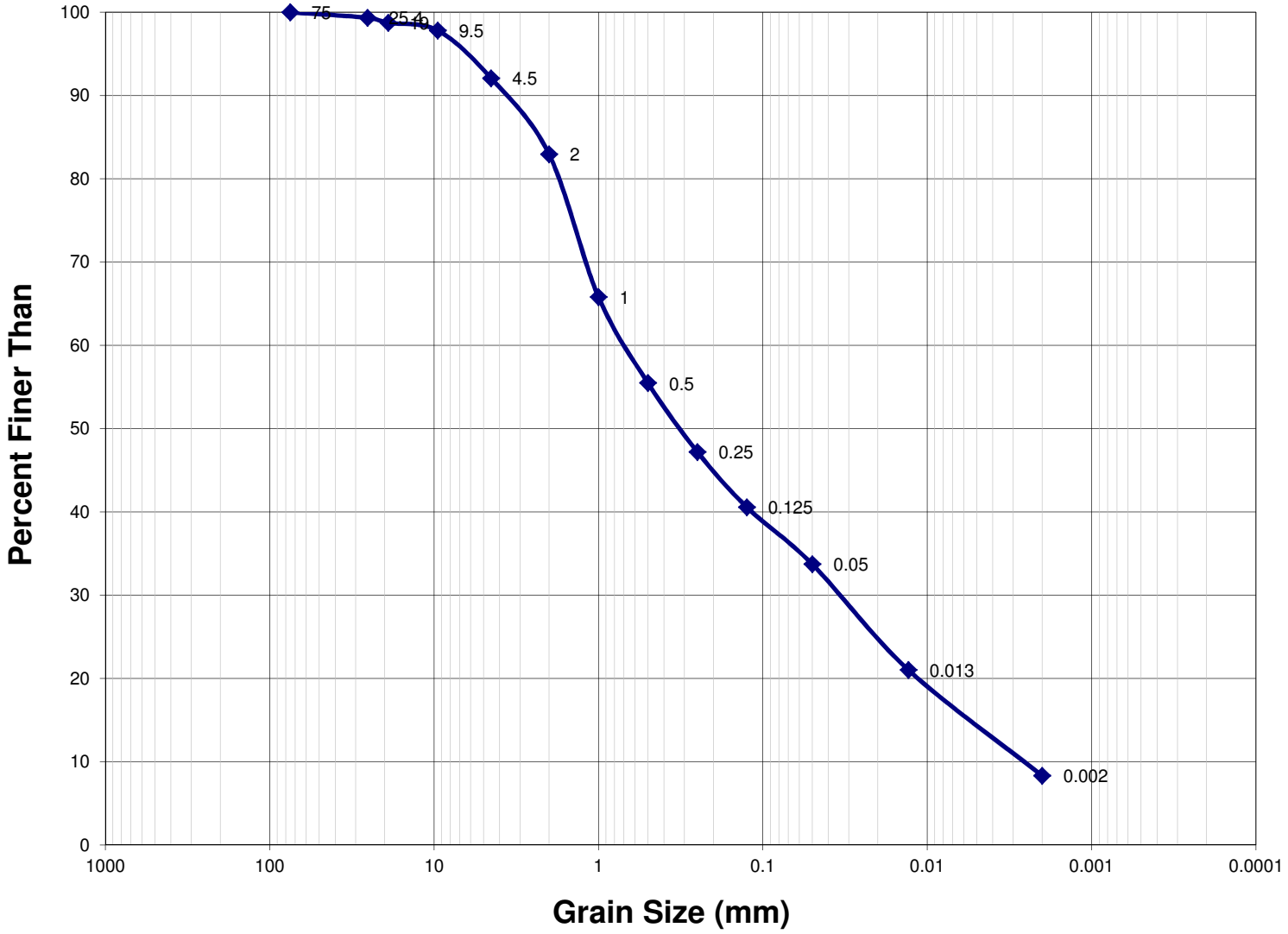
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP004_SOB
Lab ID: L1340658-8

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	8
Coarse Sand	2.0mm - 4.75mm	9
Medium Sand	0.425mm - 2.0mm	27
Fine Sand	0.075mm - 0.425mm	19
Fines	< 0.075mm	36

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	17
Sand	0.05mm - 2mm	49
Silt	0.002mm - 0.05mm	25
Clay	< 0.002mm	8
Texture	Sandy loam	

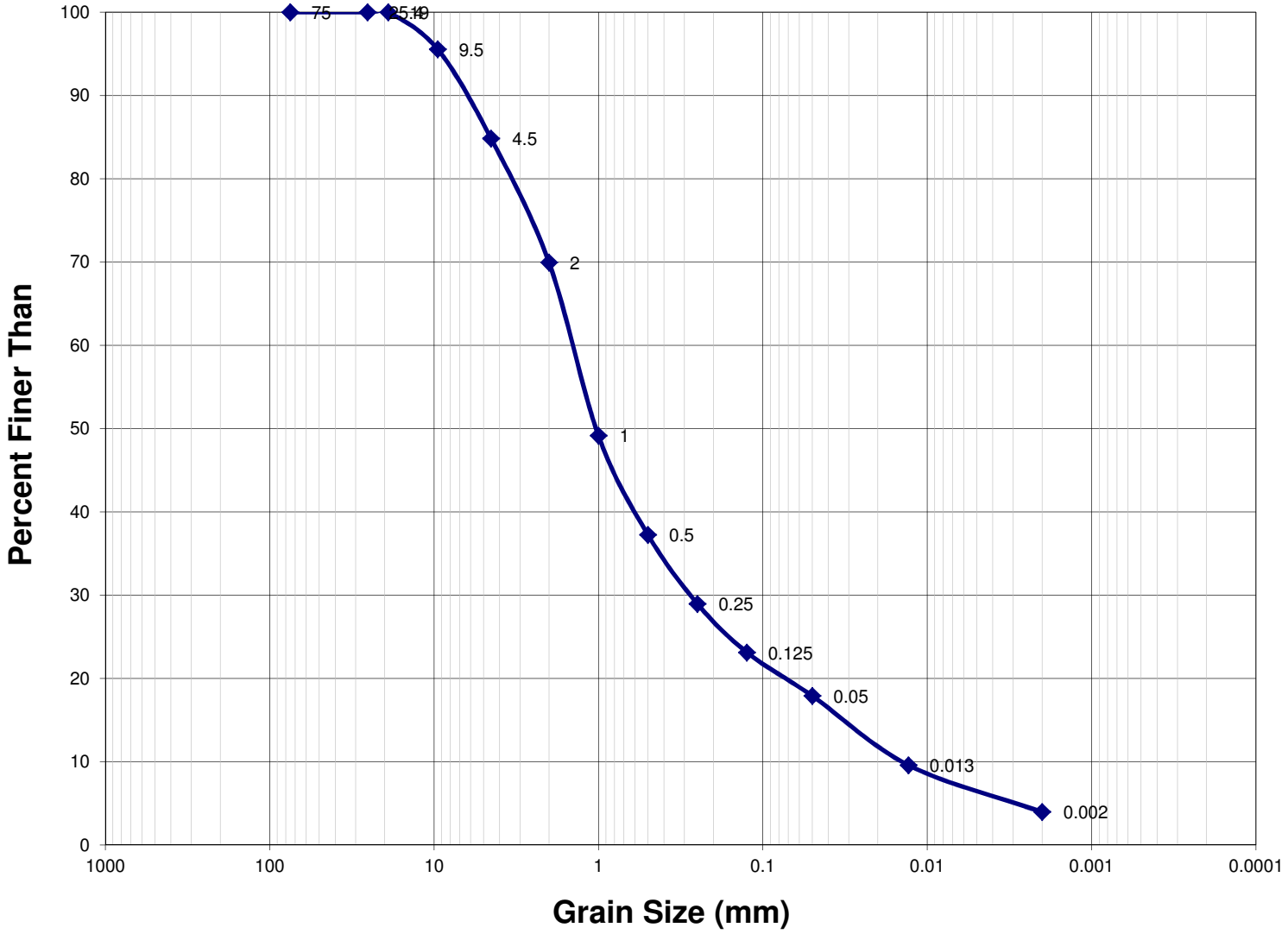
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP005_SOA
Lab ID: L1340658-9

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	15
Coarse Sand	2.0mm - 4.75mm	15
Medium Sand	0.425mm - 2.0mm	33
Fine Sand	0.075mm - 0.425mm	18
Fines	< 0.075mm	20

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	30
Sand	0.05mm - 2mm	52
Silt	0.002mm - 0.05mm	14
Clay	< 0.002mm	4

Texture Sandy loam

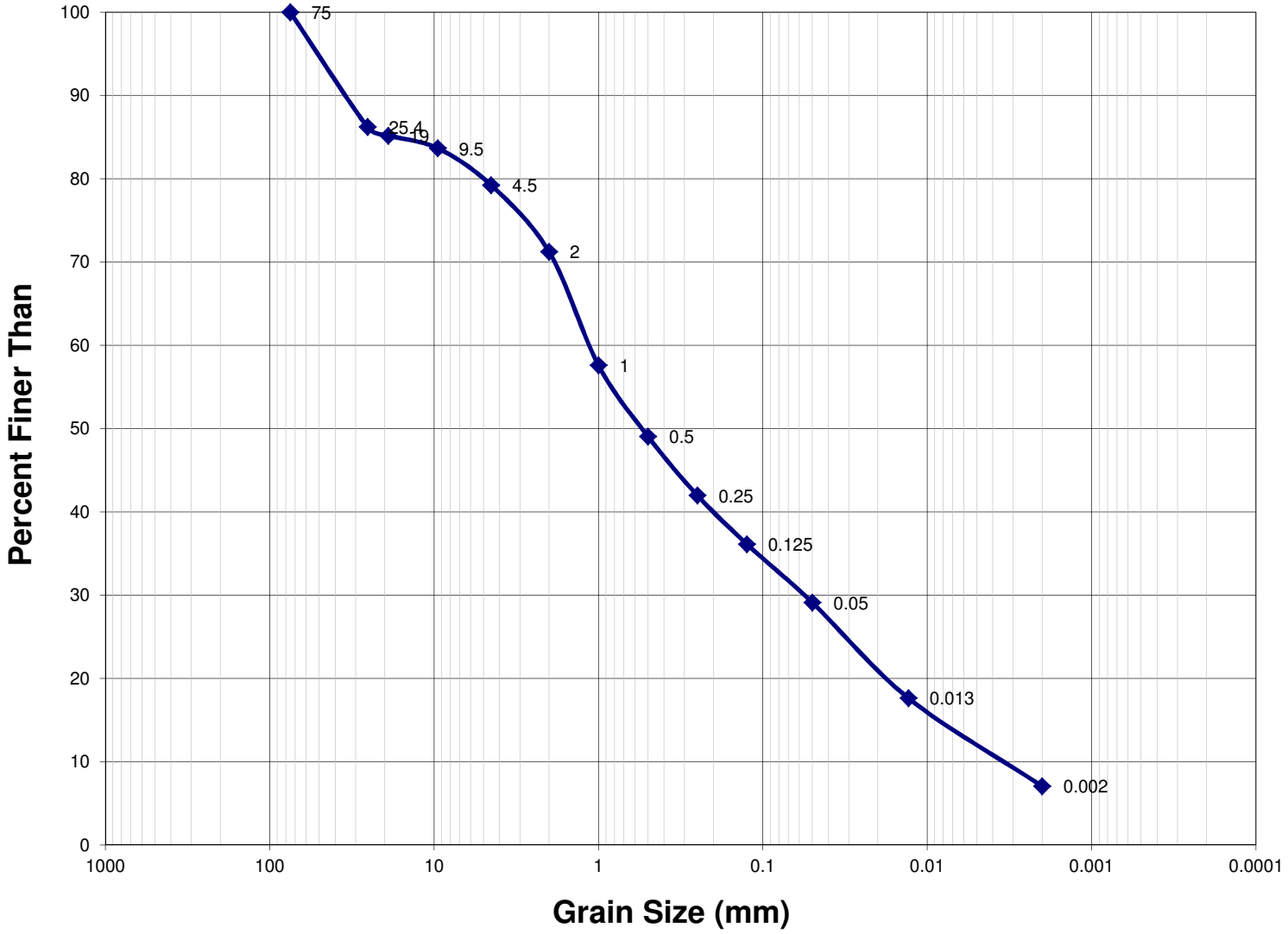
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP005_SOB
Lab ID: L1340658-10

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	21
Coarse Sand	2.0mm - 4.75mm	8
Medium Sand	0.425mm - 2.0mm	22
Fine Sand	0.075mm - 0.425mm	18
Fines	< 0.075mm	31

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	29
Sand	0.05mm - 2mm	42
Silt	0.002mm - 0.05mm	22
Clay	< 0.002mm	7
Texture	Sandy loam	

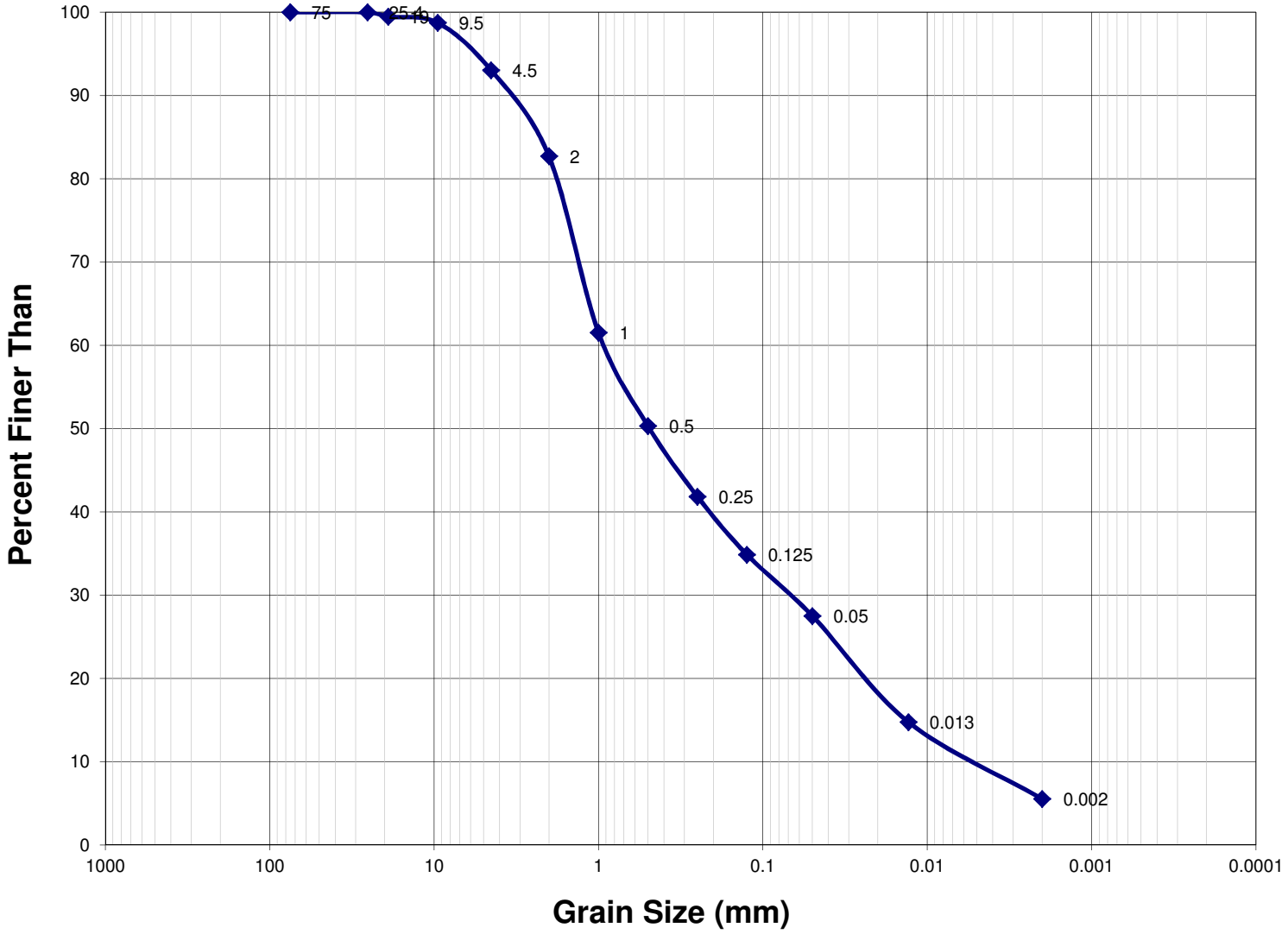
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP006_SOA
Lab ID: L1340658-11

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	7
Coarse Sand	2.0mm - 4.75mm	11
Medium Sand	0.425mm - 2.0mm	32
Fine Sand	0.075mm - 0.425mm	20
Fines	< 0.075mm	30

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	17
Sand	0.05mm - 2mm	55
Silt	0.002mm - 0.05mm	22
Clay	< 0.002mm	6
Texture	Sandy loam	

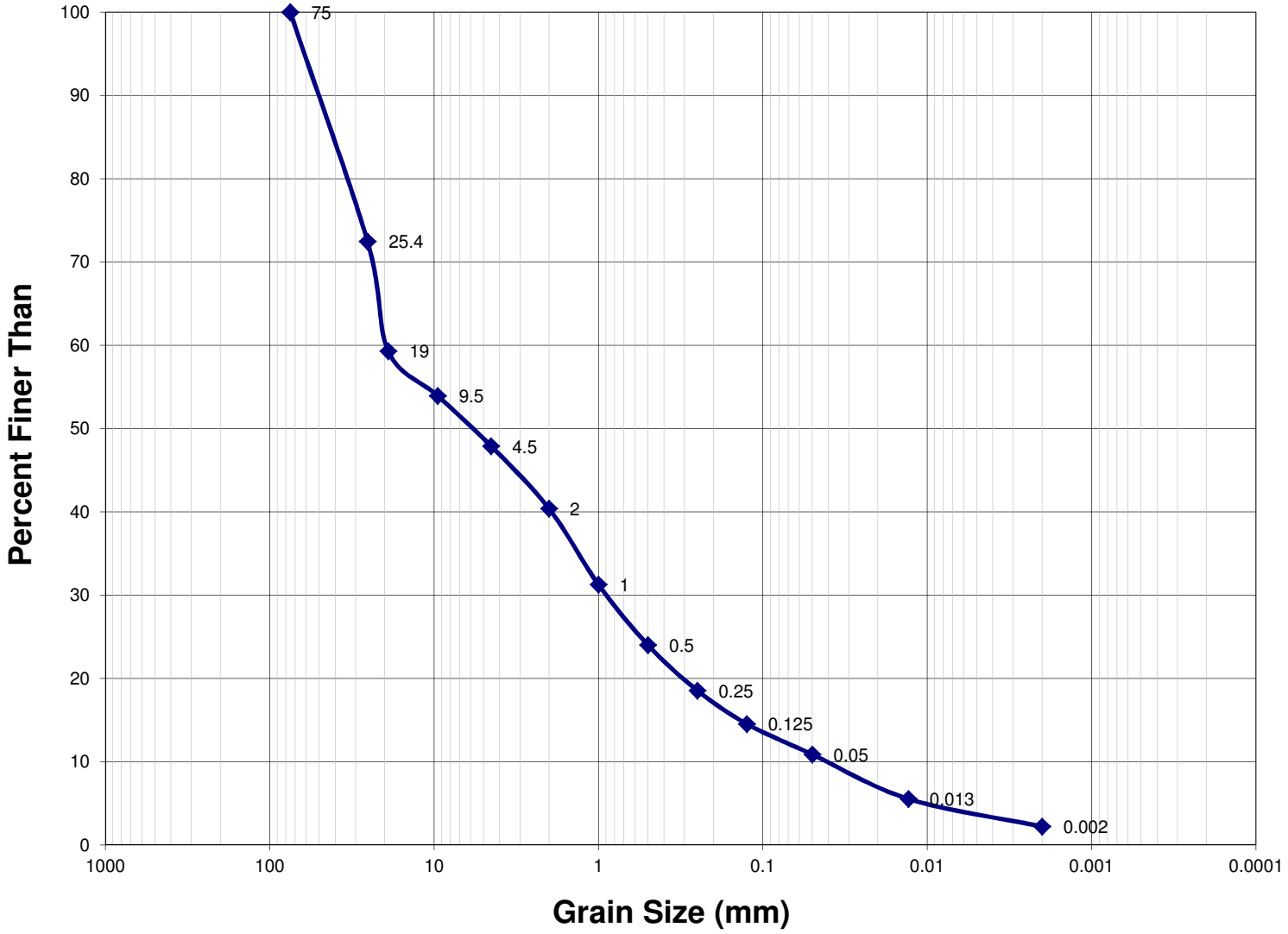
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP007_SOA
Lab ID: L1340658-12

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	52
Coarse Sand	2.0mm - 4.75mm	8
Medium Sand	0.425mm - 2.0mm	16
Fine Sand	0.075mm - 0.425mm	12
Fines	< 0.075mm	12

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	60
Sand	0.05mm - 2mm	30
Silt	0.002mm - 0.05mm	9
Clay	< 0.002mm	2
Texture	Sandy loam	

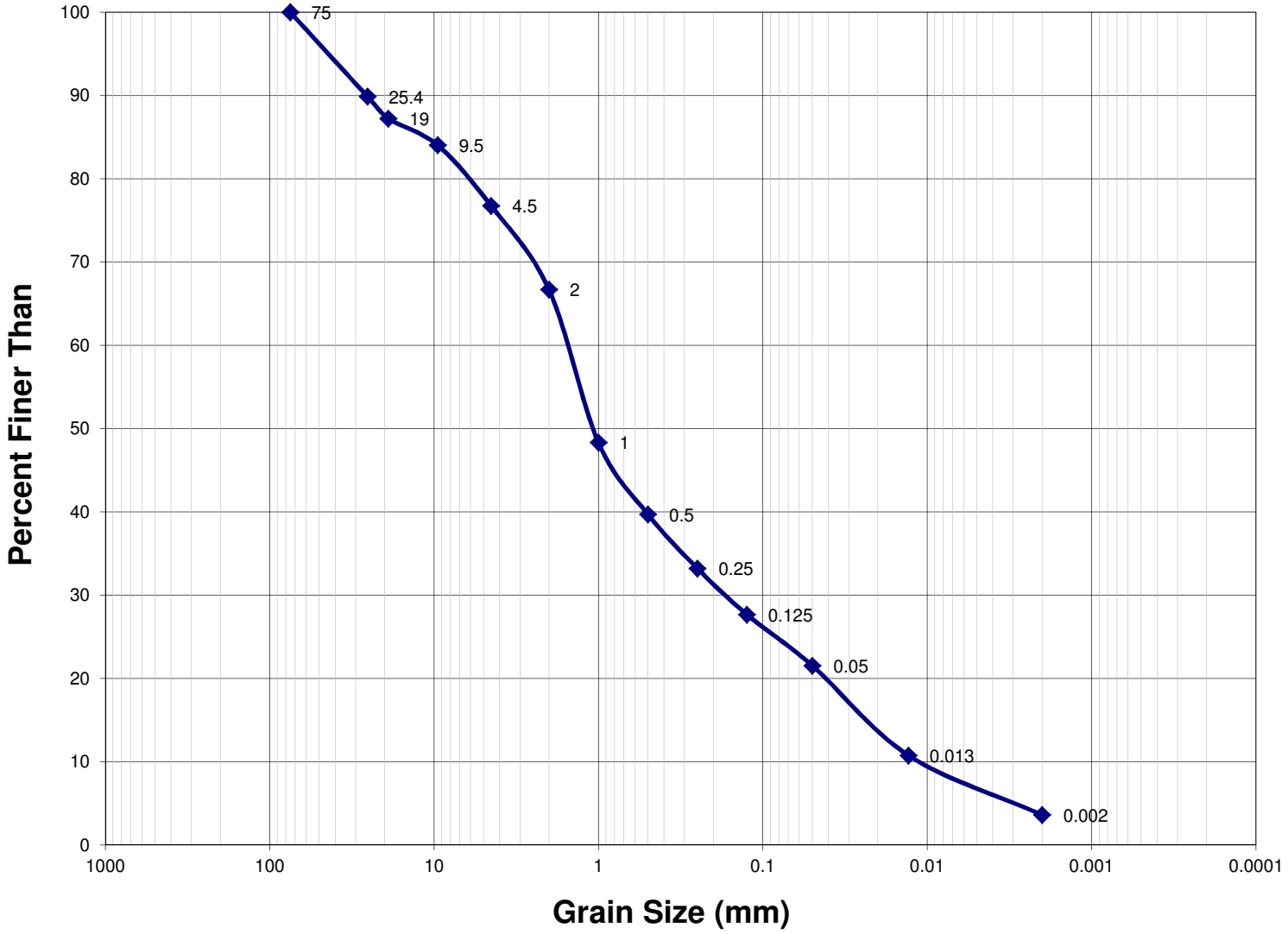
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-201-TP007_SOB
Lab ID: L1340658-13

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	23
Coarse Sand	2.0mm - 4.75mm	10
Medium Sand	0.425mm - 2.0mm	27
Fine Sand	0.075mm - 0.425mm	16
Fines	< 0.075mm	24

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	33
Sand	0.05mm - 2mm	45
Silt	0.002mm - 0.05mm	18
Clay	< 0.002mm	4
Texture	Sandy loam	

Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

CH2MHILL

CHAIN OF CUSTODY RECORD

7/30/2013 10:35:49 AM

Project Name Faro Mine
Location Faro Mine Complex - Faro YK
Project Number 472645.16.DV.DM.01
Project Manager Jaco Esterhuizen
Sample Manager Charles Shewen

Task Order 201.2/2
Project DVIHU INTM. DAM CREST TEST PITS
Turnaround Time 10 Days
Shipping Date: 7/30/2013
COC Number: ALS07301301

	Container:	4oz jar	1 Gallon	1 Gallon
	Preservatives:	4°C	4°C	4°C
	Filtered:	NA	NA	NA
	Holding Time:	14	NA	NA
		(ASTM 2216) Moisture	(ASTM D422) Gradation/Sieve/Hydrometer	(ASTM D4318) Atterberg Limits

L1340658-COFC

	DATE	TIME	Matrix				Number of Containers	COMMENTS
CH13-201-TP001_SOa	7/29/2013	14:45	Soil		X		1	
CH13-201-TP001_SOb	7/29/2013	14:40	Soil	X	X	X	3	
CH13-201-TP002_SOa	7/29/2013	14:25	Soil	X	X	X	3	
CH13-201-TP003_SOa	7/29/2013	13:25	Soil		X		1	
CH13-201-TP003_SOb	7/29/2013	13:30	Soil	X	X	X	3	
CH13-201-TP003_SOc	7/29/2013	13:40	Soil		X		1	
CH13-201-TP004_SOa	7/29/2013	12:30	Soil		X		1	
CH13-201-TP004_SOb	7/29/2013	12:35	Soil	X	X	X	3	
CH13-201-TP005_SOa	7/29/2013	12:00	Soil		X		1	
CH13-201-TP005_SOb	7/29/2013	12:05	Soil	X	X	X	3	
CH13-201-TP006_SOa	7/29/2013	11:15	Soil	X	X	X	3	
CH13-201-TP007_SOa	7/29/2013	10:30	Soil		X		1	
CH13-201-TP007_SOb	7/29/2013	10:40	Soil	X	X	X	3	
						TOTAL NUMBER OF CONTAINERS	27	

Signatures		Date/Time
Approved by		
Sampled by	Jaco Esterhuizen	7/30/13 1040
Relinquished by		
Received by		7/31/13
Relinquished by		
Received by	18.2, 18.1°C, 17.5°C	9.15

Shipping Details
Method of Shipment: FedEx
On Ice: yes / no
Airbill No:
Lab Name: ALS Vancouver
Lab Phone: (604) 253 4188

ATTN:
Sample Custody
and
Amber Springer

Special Instructions:
Tar16 PO:604564 Metals Table1 Perform Lab Dup/M on samples

Report Copy to
Bernice Kidd
(530) 229-3203

CH2M HILL, INC
ATTN: Bernice Kidd
2525 Airpark Drive
Redding CA 96001

Date Received: 01-AUG-13
Report Date: 22-OCT-13 14:36 (MT)
Version: FINAL REV. 2

Client Phone: 530-229-3203

Certificate of Analysis

Lab Work Order #: L1341927

Project P.O. #: 472645.16.DV.DM.01 PO = 604564
Job Reference: BSI CALC - SILICATE WASTE ROCK 2013 108.401
C of C Numbers:
Legal Site Desc:

Comments: Additional QC data has been included.

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1341927-1	L1341927-2	L1341927-3		
	Description	soil	soil	soil		
	Sampled Date	12-JUL-13	13-JUL-13	15-JUL-13		
	Sampled Time	14:40	15:30	14:50		
	Client ID	CH13-108-TP002_SOA	CH13-108-TP009_SOA	CH13-108-TP015_SOA		
Grouping	**Analyte**					
SOIL						
Physical Tests	Moisture (%)			5.89		
	Acid Soluble Sulphate Sulphur (%)	<0.01	0.03	0.01		
Leachable Anions & Nutrients	Acidity (as CaCO3) (mg/L)			3.0		
	Alkalinity, Total (as CaCO3) (mg/L)			88.3		
	Conductivity (uS/cm)			454		
	pH (pH)			7.95		
	Oxidation-Reduction Potential (ORP) (mV)			345		
	Sulfate (SO4) (mg/L)			140		
Total Metals	Barium by borate-fusion (ppm)	667	998	1185		
Leachable Metals	Aluminum (Al)-Leachable (mg/L)			0.0175		
	Antimony (Sb)-Leachable (mg/L)			0.00046		
	Arsenic (As)-Leachable (mg/L)			<0.0010		
	Barium (Ba)-Leachable (mg/L)			0.0819		
	Beryllium (Be)-Leachable (mg/L)			<0.00050		
	Boron (B)-Leachable (mg/L)			0.016		
	Cadmium (Cd)-Leachable (mg/L)			0.000057		
	Calcium (Ca)-Leachable (mg/L)			66.3		
	Chromium (Cr)-Leachable (mg/L)			<0.00050		
	Cobalt (Co)-Leachable (mg/L)			0.00036		
	Copper (Cu)-Leachable (mg/L)			<0.0010		
	Iron (Fe)-Leachable (mg/L)			<0.030		
	Lead (Pb)-Leachable (mg/L)			0.00026		
	Lithium (Li)-Leachable (mg/L)			0.0166		
	Magnesium (Mg)-Leachable (mg/L)			13.7		
	Manganese (Mn)-Leachable (mg/L)			0.0593		
	Mercury (Hg)-Leachable (mg/L)			<0.000050		
	Molybdenum (Mo)-Leachable (mg/L)			0.0105		
	Nickel (Ni)-Leachable (mg/L)			0.00094		
	Potassium (K)-Leachable (mg/L)			13.6		
	Selenium (Se)-Leachable (mg/L)			0.00158		
	Silicon (Si)-Leachable (mg/L)			3.15		
	Silver (Ag)-Leachable (mg/L)			<0.000050		
	Sodium (Na)-Leachable (mg/L)			2.1		
	Strontium (Sr)-Leachable (mg/L)			1.05		
	Sulfur (S)-Leachable (mg/L)			48.3		
	Thallium (Tl)-Leachable (mg/L)			<0.00010		
	Titanium (Ti)-Leachable (mg/L)			<0.010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1341927-1	L1341927-2	L1341927-3		
	Description	soil	soil	soil		
	Sampled Date	12-JUL-13	13-JUL-13	15-JUL-13		
	Sampled Time	14:40	15:30	14:50		
	Client ID	CH13-108-TP002_SOA	CH13-108-TP009_SOA	CH13-108-TP015_SOA		
Grouping	**Analyte**					
SOIL						
Leachable Metals	Uranium (U)-Leachable (mg/L)			0.00160		
	Vanadium (V)-Leachable (mg/L)			<0.0010		
	Zinc (Zn)-Leachable (mg/L)			<0.010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Leachable	MS-B	L1341927-3
Matrix Spike	Magnesium (Mg)-Leachable	MS-B	L1341927-3
Matrix Spike	Silicon (Si)-Leachable	MS-B	L1341927-3
Matrix Spike	Strontium (Sr)-Leachable	MS-B	L1341927-3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACY-SHKFL96-PCT-VA	Soil	Acidity by PCT (96 hour SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES

"This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water . The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using procedures adapted from APHA Method 2310 "Acidity".

ALK-SHKFL96-PCT-VA	Soil	Alkalinity by PCT (96 hour SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES

"This analysis is based upon the extraction procedure outlined in ""Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia"" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water . The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using procedures adapted from APHA Method 2320 "Alkalinity"

EC-SHKFL96-PCT-VA	Soil	EC by PCT (96 hour SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES

"This analysis is based upon the extraction procedure outlined in ""Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using procedures adapted from APHA Method 2510 "Conductivity".

HG-SHKFL96-CVAFS-VA	Soil	Mercury by CVAFS (96 hour SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines,
(Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water . The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

ME-MS81-AX	Soil		ME-MS81
MET-SHKFL96-CCMS-VA	Soil	Metals by CCMS (SHAKEFLASK - 96hours)	BC MINISTRY OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines,
(Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water . The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - mass spectrophotometry (EPA Method 6020A).

MET-SHKFL96-ICP-VA	Soil	Metals by ICPOES (SHAKEFLASK - 96Hours)	BC MINISTRY OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines,
(Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water . The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

ORP-SHKFL96-VA	Soil	ORP by Electrode (96 hour SHAKEFLASK)	BC MIN. OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water . The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using procedures carried out in accordance "ASTM" method D1498-00 "Oxidation-Reduction Potential of Water" published by the American Society for Testing and Materials (ASTM), May 2000. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.

PH-SHKFL96-MAN-VA	Soil	pH by Manual Meter (96 HOUR SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water . The extract is then allowed to settle and subsequently analysed using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

Reference Information

SO4-SHKFL96-TURB-VA Soil SO4 by Turbidimetric(96 hour SHAKEFLASK) BC MINISTRY OF ENERGY AND MINES

This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 96 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using procedures adapted from APHA Method 4500-SO4 "Sulfate". Sulfate is determined using the turbidimetric method."

SULPHUR-S-GRA06A-AX Soil Sulphur (S) S-GRA06a

** 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
AX	ALS MINERALS - VANCOUVER, B.C., CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, 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.

Quality Control Report

Client: CH2M HILL, INC
2525 Airpark Drive
Redding CA 96001
Contact: Bernice Kidd

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ACY-SHKFL96-PCT-VA	**Soil**							
Batch R2673785								
WG1724348-2 DUP		**L1341927-3**						
Acidity (as CaCO3)		3.0	2.9		mg/L	1.3	25	16-AUG-13
ALK-SHKFL96-PCT-VA	**Soil**							
Batch R2673799								
WG1724348-2 DUP		**L1341927-3**						
Alkalinity, Total (as CaCO3)		88.3	80.2		mg/L	9.6	20	16-AUG-13
WG1724348-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	16-AUG-13
WG1727870-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	16-AUG-13
EC-SHKFL96-PCT-VA	**Soil**							
Batch R2673799								
WG1724348-2 DUP		**L1341927-3**						
Conductivity		454	445		uS/cm	2.0	25	16-AUG-13
WG1724348-1 MB								
Conductivity			<2.0		uS/cm		2	16-AUG-13
WG1727870-1 MB								
Conductivity			<2.0		uS/cm		2	16-AUG-13
HG-SHKFL96-CVAFS-VA	**Soil**							
Batch R2673889								
WG1724348-2 DUP		**L1341927-3**						
Mercury (Hg)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	40	16-AUG-13
WG1724348-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	16-AUG-13
WG1728348-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	16-AUG-13
WG1724348-3 MS		**L1341898-4**						
Mercury (Hg)-Leachable			98.5		%		70-130	16-AUG-13
MET-SHKFL96-CCMS-VA	**Soil**							
Batch R2675059								
WG1724348-2 DUP		**L1341927-3**						
Aluminum (Al)-Leachable		0.0175	0.0158		mg/L	10	40	18-AUG-13
Antimony (Sb)-Leachable		0.00046	0.00044		mg/L	4.1	40	18-AUG-13
Arsenic (As)-Leachable		<0.0010	<0.0010	RPD-NA	mg/L	N/A	40	18-AUG-13
Barium (Ba)-Leachable		0.0819	0.0780		mg/L	4.9	40	18-AUG-13
Beryllium (Be)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	40	18-AUG-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFL96-CCMS-VA	**Soil**							
Batch R2675059								
WG1724348-2 DUP		**L1341927-3**						
Boron (B)-Leachable		0.016	0.014		mg/L	12	40	18-AUG-13
Cadmium (Cd)-Leachable		0.000057	0.000054		mg/L	3.8	40	18-AUG-13
Chromium (Cr)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	40	18-AUG-13
Cobalt (Co)-Leachable		0.00036	0.00034		mg/L	6.3	40	18-AUG-13
Copper (Cu)-Leachable		<0.0010	<0.0010	RPD-NA	mg/L	N/A	40	18-AUG-13
Lead (Pb)-Leachable		0.00026	0.00032		mg/L	22	40	18-AUG-13
Lithium (Li)-Leachable		0.0166	0.0153		mg/L	8.3	40	18-AUG-13
Manganese (Mn)-Leachable		0.0593	0.0536		mg/L	10	40	18-AUG-13
Molybdenum (Mo)-Leachable		0.0105	0.00935		mg/L	12	40	18-AUG-13
Nickel (Ni)-Leachable		0.00094	0.00101		mg/L	7.4	40	18-AUG-13
Selenium (Se)-Leachable		0.00158	0.00153		mg/L	3.1	40	18-AUG-13
Silver (Ag)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	40	18-AUG-13
Strontium (Sr)-Leachable		1.05	1.05		mg/L	0.3	40	18-AUG-13
Thallium (Tl)-Leachable		<0.00010	<0.00010	RPD-NA	mg/L	N/A	40	18-AUG-13
Uranium (U)-Leachable		0.00160	0.00141		mg/L	12	40	18-AUG-13
Vanadium (V)-Leachable		<0.0010	<0.0010	RPD-NA	mg/L	N/A	40	18-AUG-13
Zinc (Zn)-Leachable		<0.010	<0.010	RPD-NA	mg/L	N/A	40	18-AUG-13
WG1724348-1 MB								
Aluminum (Al)-Leachable			<0.0050		mg/L		0.005	18-AUG-13
Antimony (Sb)-Leachable			<0.00010		mg/L		0.0001	18-AUG-13
Arsenic (As)-Leachable			<0.0010		mg/L		0.001	18-AUG-13
Barium (Ba)-Leachable			<0.0010		mg/L		0.001	18-AUG-13
Beryllium (Be)-Leachable			<0.00050		mg/L		0.0005	18-AUG-13
Boron (B)-Leachable			<0.010		mg/L		0.01	18-AUG-13
Cadmium (Cd)-Leachable			<0.000050		mg/L		0.00005	18-AUG-13
Chromium (Cr)-Leachable			<0.00050		mg/L		0.0005	18-AUG-13
Cobalt (Co)-Leachable			<0.00010		mg/L		0.0001	18-AUG-13
Copper (Cu)-Leachable			<0.0010		mg/L		0.001	18-AUG-13
Lead (Pb)-Leachable			<0.00010		mg/L		0.0001	18-AUG-13
Lithium (Li)-Leachable			<0.0050		mg/L		0.005	18-AUG-13
Manganese (Mn)-Leachable			<0.00050		mg/L		0.0005	18-AUG-13
Molybdenum (Mo)-Leachable			<0.00010		mg/L		0.0001	18-AUG-13
Nickel (Ni)-Leachable			<0.00050		mg/L		0.0005	18-AUG-13
Selenium (Se)-Leachable			<0.00050		mg/L		0.0005	18-AUG-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFL96-CCMS-VA	**Soil**							
Batch **R2675059**								
WG1724348-1 **MB**								
Silver (Ag)-Leachable			<0.000050		mg/L		0.00005	18-AUG-13
Strontium (Sr)-Leachable			<0.00050		mg/L		0.0005	18-AUG-13
Thallium (Tl)-Leachable			<0.00010		mg/L		0.0001	18-AUG-13
Uranium (U)-Leachable			<0.000010		mg/L		0.00001	18-AUG-13
Vanadium (V)-Leachable			<0.0010		mg/L		0.001	18-AUG-13
Zinc (Zn)-Leachable			<0.010		mg/L		0.01	18-AUG-13
Batch **R2675866**								
WG1724348-3 **MS**		**L1341898-4**						
Aluminum (Al)-Leachable			91.2		%		70-130	19-AUG-13
Antimony (Sb)-Leachable			99.4		%		70-130	19-AUG-13
Arsenic (As)-Leachable			99.9		%		70-130	19-AUG-13
Barium (Ba)-Leachable			105.4		%		70-130	19-AUG-13
Beryllium (Be)-Leachable			95.7		%		70-130	19-AUG-13
Boron (B)-Leachable			85.0		%		70-130	19-AUG-13
Cadmium (Cd)-Leachable			99.8		%		70-130	19-AUG-13
Chromium (Cr)-Leachable			97.6		%		70-130	19-AUG-13
Cobalt (Co)-Leachable			97.6		%		70-130	19-AUG-13
Copper (Cu)-Leachable			91.2		%		70-130	19-AUG-13
Lead (Pb)-Leachable			95.2		%		70-130	19-AUG-13
Lithium (Li)-Leachable			87.6		%		70-130	19-AUG-13
Manganese (Mn)-Leachable			97.3		%		70-130	19-AUG-13
Molybdenum (Mo)-Leachable			93.3		%		70-130	19-AUG-13
Nickel (Ni)-Leachable			92.9		%		70-130	19-AUG-13
Selenium (Se)-Leachable			96.0		%		70-130	19-AUG-13
Silver (Ag)-Leachable			96.6		%		70-130	19-AUG-13
Strontium (Sr)-Leachable			N/A	MS-B	%		-	19-AUG-13
Thallium (Tl)-Leachable			96.3		%		70-130	19-AUG-13
Vanadium (V)-Leachable			96.3		%		70-130	19-AUG-13
Zinc (Zn)-Leachable			100.4		%		70-130	19-AUG-13
MET-SHKFL96-ICP-VA	**Soil**							
Batch **R2673699**								
WG1724348-2 **DUP**		**L1341927-3**						
Calcium (Ca)-Leachable		66.3	64.2		mg/L	3.2	40	15-AUG-13
Iron (Fe)-Leachable		<0.030	<0.030	RPD-NA	mg/L	N/A	40	15-AUG-13

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFL96-ICP-VA	**Soil**							
Batch R2673699								
WG1724348-2 DUP		**L1341927-3**						
Magnesium (Mg)-Leachable		13.7	13.1		mg/L	4.0	40	15-AUG-13
Potassium (K)-Leachable		13.6	12.0		mg/L	12	40	15-AUG-13
Silicon (Si)-Leachable		3.15	2.98		mg/L	5.4	40	15-AUG-13
Sodium (Na)-Leachable		2.1	<2.0	RPD-NA	mg/L	N/A	40	15-AUG-13
Sulfur (S)-Leachable		48.3	47.5		mg/L	1.6	40	15-AUG-13
Titanium (Ti)-Leachable		<0.010	<0.010	RPD-NA	mg/L	N/A	40	15-AUG-13
WG1724348-1 MB								
Calcium (Ca)-Leachable			<0.050		mg/L		0.05	15-AUG-13
Iron (Fe)-Leachable			<0.030		mg/L		0.03	15-AUG-13
Magnesium (Mg)-Leachable			<0.10		mg/L		0.1	15-AUG-13
Potassium (K)-Leachable			<2.0		mg/L		2	15-AUG-13
Silicon (Si)-Leachable			<0.050		mg/L		0.05	15-AUG-13
Sodium (Na)-Leachable			<2.0		mg/L		2	15-AUG-13
Sulfur (S)-Leachable			<0.50		mg/L		0.5	15-AUG-13
Titanium (Ti)-Leachable			<0.010		mg/L		0.01	15-AUG-13
WG1724348-3 MS		**L1341898-4**						
Calcium (Ca)-Leachable			N/A	MS-B	%		-	15-AUG-13
Iron (Fe)-Leachable			105.2		%		70-130	15-AUG-13
Magnesium (Mg)-Leachable			N/A	MS-B	%		-	15-AUG-13
Potassium (K)-Leachable			104.4		%		70-130	15-AUG-13
Silicon (Si)-Leachable			N/A	MS-B	%		-	15-AUG-13
Sodium (Na)-Leachable			101.4		%		70-130	15-AUG-13
Titanium (Ti)-Leachable			102.6		%		70-130	15-AUG-13
ORP-SHKFL96-VA	**Soil**							
Batch R2673841								
WG1724348-2 DUP		**L1341927-3**						
Oxidation-Reduction Potential (ORP)		345	337		mV	2.2	25	16-AUG-13
PH-SHKFL96-MAN-VA	**Soil**							
Batch R2673221								
WG1724348-2 DUP		**L1341927-3**						
pH		7.95	8.01	J	pH	0.06	0.3	15-AUG-13
SO4-SHKFL96-TURB-VA	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-SHKFL96-TURB-VA	**Soil**							
Batch R2674164								
WG1724348-2 DUP		**L1341927-3**						
Sulfate (SO4)		140	127		mg/L	9.9	30	16-AUG-13
WG1724348-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	16-AUG-13
WG1727982-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	16-AUG-13
WG1727982-5 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	16-AUG-13

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Moisture content							
	3	15-JUL-13 14:50	11-AUG-13 14:03	14	27	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1341927 were received on 01-AUG-13 18:33.

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.

ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 19- AUG- 2013
Account: APN

CERTIFICATE VA13137952

Project: L1341927
P.O. No.: L1341927
This report is for 3 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 6- AUG- 2013.

The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE	AMBER SPRINGER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 22	Sample login - Rcd w/o BarCode
PUL- 31	Pulverize split to 85% < 75 um
PUL- QC	Pulverizing QC Test

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME- MS81	Lithium Borate Fusion ICP- MS	ICP- MS
S- GRA06a	Sulfate Sulfur (HCl leachable)	WST- SEQ

To: ALS ENVIRONMENTAL
ATTN: AMBER SPRINGER
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 19- AUG- 2013
Account: APN

Project: L1341927

CERTIFICATE OF ANALYSIS VA13137952

Sample Description	Method	WEI-21	ME-MS81	S-GRA06a
	Analyte	Recvd Wt.	Ba	S
	Units	kg	ppm	%
	LOR	0.02	0.5	0.01
L1341927-1		0.28	667	<0.01
L1341927-2		0.26	998	0.03
L1341927-3		0.28	1185	0.01

***** See Appendix Page for comments regarding this certificate *****

ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Project: L1341927

CERTIFICATE OF ANALYSIS VA13137952

CERTIFICATE COMMENTS

LABORATORY ADDRESSES

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

Applies to Method:			
LOG- 22	ME- MS81	PUL- 31	PUL- QC
S- GRA06a	WEI- 21		

ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 19- AUG- 2013
Account: APN

QC CERTIFICATE VA13137952

Project: L1341927
P.O. No.: L1341927
This report is for 3 Crushed Rock samples submitted to our lab in Vancouver, BC, Canada on 6- AUG- 2013.
The following have access to data associated with this certificate:

ALSE VANCOUVER WEBTRIEVE	AMBER SPRINGER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 22	Sample login - Rcd w/o BarCode
PUL- 31	Pulverize split to 85% < 75 um
PUL- QC	Pulverizing QC Test

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME- MS81	Lithium Borate Fusion ICP- MS	ICP- MS
S- GRA06a	Sulfate Sulfur (HCl leachable)	WST- SEQ

To: ALS ENVIRONMENTAL
ATTN: AMBER SPRINGER
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Finalized Date: 19- AUG- 2013
Account: APN

Project: L1341927

QC CERTIFICATE OF ANALYSIS VA13137952

Sample Description	Method Analyte Units LOR	ME-MS81 Ba ppm 0.5	S-GRA06a S % 0.01
STANDARDS			
HV-2			0.18
Target Range - Lower Bound			0.16
Upper Bound			0.20
OREAS 146		>10000	
Target Range - Lower Bound		11450	
Upper Bound		>10000	
RTS-1			1.26
Target Range - Lower Bound			1.14
Upper Bound			1.34
SY-4		345	
Target Range - Lower Bound		306	
Upper Bound		375	
BLANKS			
BLANK		<0.5	
Target Range - Lower Bound		<0.5	
Upper Bound		1.0	
BLANK			<0.01
Target Range - Lower Bound			<0.01
Upper Bound			0.02
DUPLICATES			
ORIGINAL		556	
DUP		554	
Target Range - Lower Bound		527	
Upper Bound		583	
ORIGINAL			0.02
DUP			0.02
Target Range - Lower Bound			<0.01
Upper Bound			0.03

***** See Appendix Page for comments regarding this certificate *****

ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: ALS ENVIRONMENTAL
100 - 8081 LOUGHEED HWY.
BURNABY BC V5A 1W9

Project: L1341927

QC CERTIFICATE OF ANALYSIS VA13137952

CERTIFICATE COMMENTS

Applies to Method:	**LABORATORY ADDRESSES** Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada. LOG- 22 ME- MS81 PUL- 31 S- GRA06a WEI- 21	PUL- QC

L1341927

		Old ALS ID	CH2M Sample ID	Analysis Required	Notes
50g	1	**New File #1**	L1333599-1	CH13-311-SS027_SOa	Barium (ALS Minerals)	50g to Minerals. Sublet COC request = "Barium by ME-MS81)
300g	2	(Job = 472645.06.AD.01.04.13)	L1333599-3	CH13-311-SS029_SOa		TOC = C-TOT-ORG-WB-SK
	3		L1333599-6	CH13-311-SS032_SOa		
	4		L1333599-7	CH13-311-SS033_SOa	Each sample: TOC, Barium	50g to Minerals. 50g to SK. ~200g for VA.
	5		L1333599-10	CH13-311-SS036_SOa	(ALS Minerals), 96-hr	
↓	6		L1333599-11	CH13-311-SS037_SOa	Shakeflask Tests *	
100g	1	**New File #2**	L1332158-1	CH13-108-TP002_SOa	Each sample: Barium (ALS Minerals), Acid Soluble SO4 (ALS Minerals)	→ See below
100g	2	(Job = 472645.16.DV.DM.01)	L1332158-3	CH13-108-TP009_SOa		100g to Minerals.
300+g	3		L1333673-1	CH13-108-TP015_SOa	Barium, Acid-Soluble SO4, 96-hr Shakeflask Tests	100g to Minerals. ~200g required for VA.

* ACY-SHKFL96-PCT-VA
ALK-SHKFL96-PCT-VA
EC-SHKFL96-PCT-VA
MET-SHKF96-FULL-VA
ORP-SHKFL96-VA
PH-SHKFL96-MAN-VA
PREP-SHKFL96-VA
SO4-SHKFL96-TURB-VA

Minerals Sublet: - SULPHUR-S-GRA06A-AX
- WEIGHT-WEI-21-AX

"Data is required in an EDD output designed for upload into our LIMS" on sublet form.

L1341927-COFC

CH2M HILL, INC
ATTN: Bernice Kidd
2525 Airpark Drive
Redding CA

Date Received: 02-AUG-13
Report Date: 15-AUG-13 17:49 (MT)
Version: FINAL

Client Phone: 530-229-3203

Certificate of Analysis

Lab Work Order #: L1342249

Project P.O. #: 472645.16.DV.DM.01, PO=604564
Job Reference: DVIHU NORTH FORK RCRD 2013 203.3A
C of C Numbers: ALS08011301
Legal Site Desc:

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1342249-1	L1342249-2	L1342249-3	L1342249-4	L1342249-5
	Description	Soil	Soil	Soil	Soil	Soil
	Sampled Date	29-JUL-13	29-JUL-13	29-JUL-13	29-JUL-13	29-JUL-13
	Sampled Time	13:48	13:56	14:05	14:19	14:37
	Client ID	CH13-203-BH001_SOA	CH13-203-BH001_SOB	CH13-203-BH001_SOC	CH13-203-BH001_SOD	CH13-203-BH001_SOE
Grouping	**Analyte**					
SOIL						
Physical Tests	Grain Size Curve					SEE ATTACHED
	% Moisture (%)	10.5	11.8	9.10	13.5	
	Liquid Limit (LL) (%)		23			
	Plasticity Index (PI) (%)		5			
Particle Size	MUST PSA % > 75um (%)		55.3	47.9	42.0	

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1342249-6	L1342249-7	L1342249-8		
	Description	Soil	Soil	Soil		
	Sampled Date	29-JUL-13	29-JUL-13	29-JUL-13		
	Sampled Time	14:58	17:40	18:15		
	Client ID	CH13-203-BH001_SOF	CH13-203-BH001_SOG	CH13-203-BH001_SOH		
Grouping	**Analyte**					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED		
	% Moisture (%)					
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					
Particle Size	MUST PSA % > 75um (%)					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ATTERBERG-SK	Soil	Atterberg limits	CARTER CSSS 58

The liquid limit (or upper plastic limit) is the point at which the soil becomes semifluid, like softened butter. In operational terms, the liquid limit is defined as the water content at which a trapezoidal groove cut in moist soil is closed after 25 taps on a hard rubber plate (ASTM D-18, 1958).

The plastic limit (or lower plastic limit) is defined as the water content at which soil begins to crumble on being rolled into a thread 1/8 inch (or 3 mm) in diameter. It represents the lowest water content at which soil can be deformed readily without cracking.

The plastic index (which is the difference between the liquid and plastic limits) gives an indication of the "clayeyness" or plasticity of a clay and is employed in engineering classification systems for soils.

References: McKeague, J.A. 1978. Atterberg Limits pp 50 - 55 In: Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci. p. 50 - 55

GRAIN SIZE-SK	Soil	Grain Size Analysis	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

MOIST-SK	Soil	Moisture Content	ASTM D2216-80

The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.

Reference: ASTM D2216-80

PSA-MUST-SK	Soil	% Particles > 75um (Coarse/Fine)	ASTM D422-63-SIEVE

An air-dried sample is reduced to < 2 mm size and mixed with a dispersing agent (Calgon solution). The sample is washed through a 200 mesh (75 µm) sieve. The retained mass of sample is used to determine % sand fraction.

Reference: ASTM D422-63

** 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
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

ALS08011301

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.

Quality Control Report

Client: CH2M HILL, INC
2525 Airpark Drive
Redding CA 96001
Contact: Bernice Kidd

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOIST-SK	**Soil**							
Batch R2669330								
WG1723019-1 DUP		**L1342249-1**						
% Moisture		10.5	10.6		%	0.6	25	09-AUG-13
PSA-MUST-SK	**Soil**							
Batch R2671178								
WG1723084-1 DUP		**L1342249-4**						
MUST PSA % > 75um		42.0	41.3	J	%	0.68	5	09-AUG-13

Quality Control Report

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.

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.

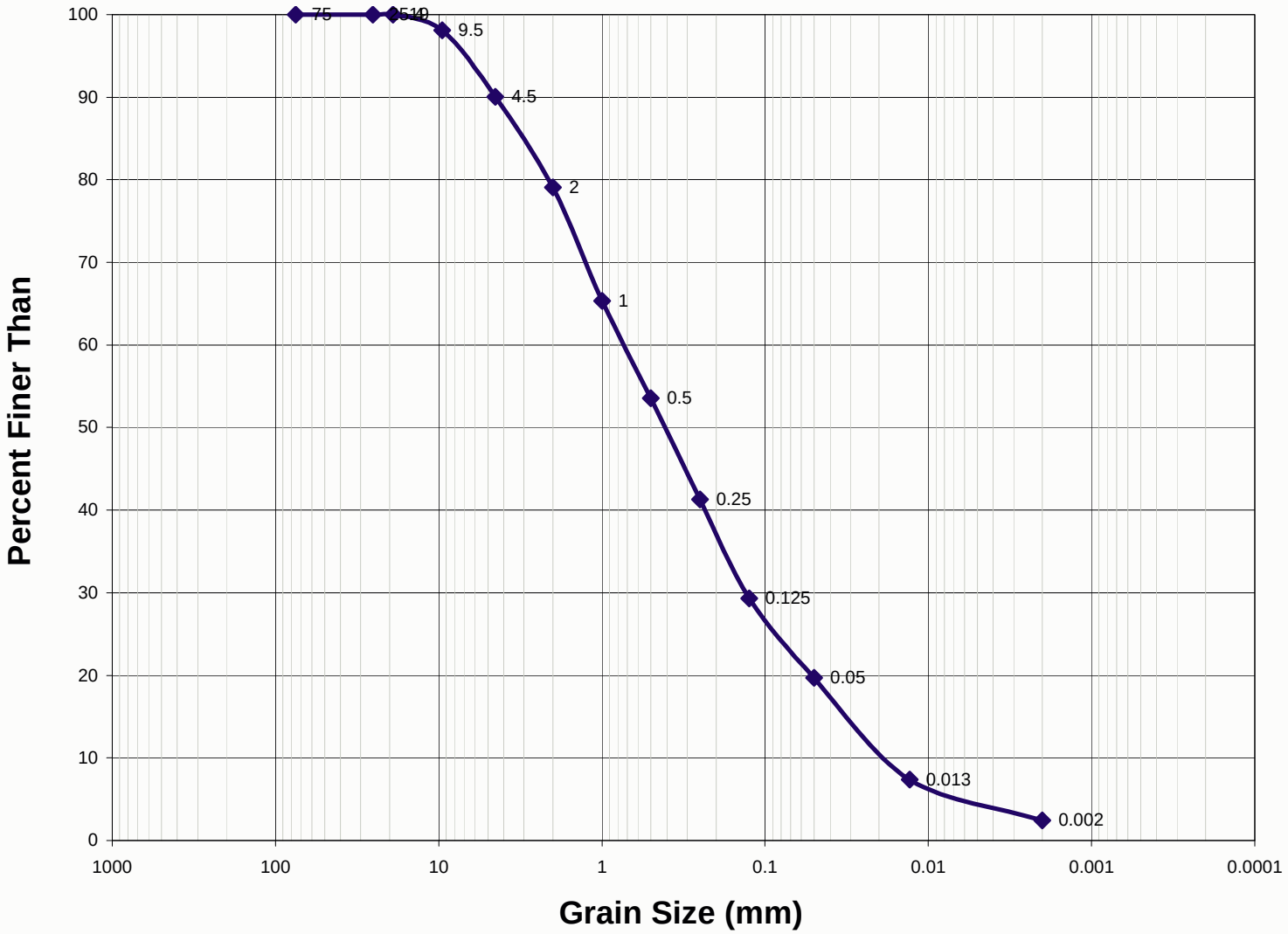
Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-203-BH001_SOE
Lab ID: L1342249-5

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	10
Coarse Sand	2.0mm - 4.75mm	11
Medium Sand	0.425mm - 2.0mm	26
Fine Sand	0.075mm - 0.425mm	31
Fines	< 0.075mm	23

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	21
Sand	0.05mm - 2mm	59
Silt	0.002mm - 0.05mm	17
Clay	< 0.002mm	2
Texture	Loamy sand	

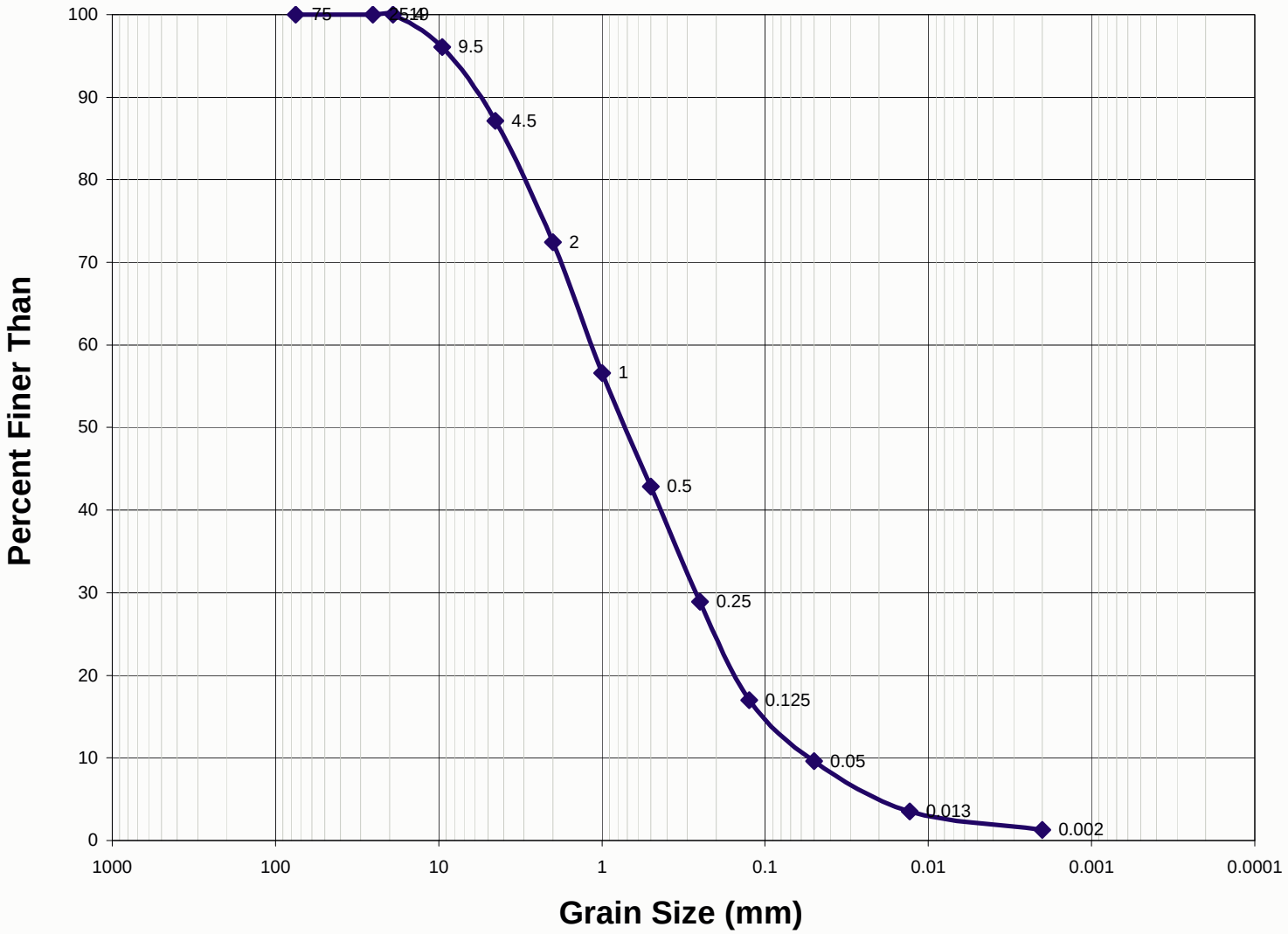
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-203-BH001_SOF
Lab ID: L1342249-6

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	12
Coarse Sand	2.0mm - 4.75mm	15
Medium Sand	0.425mm - 2.0mm	30
Fine Sand	0.075mm - 0.425mm	31
Fines	< 0.075mm	12

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	28
Sand	0.05mm - 2mm	63
Silt	0.002mm - 0.05mm	8
Clay	< 0.002mm	1
Texture	Sand	

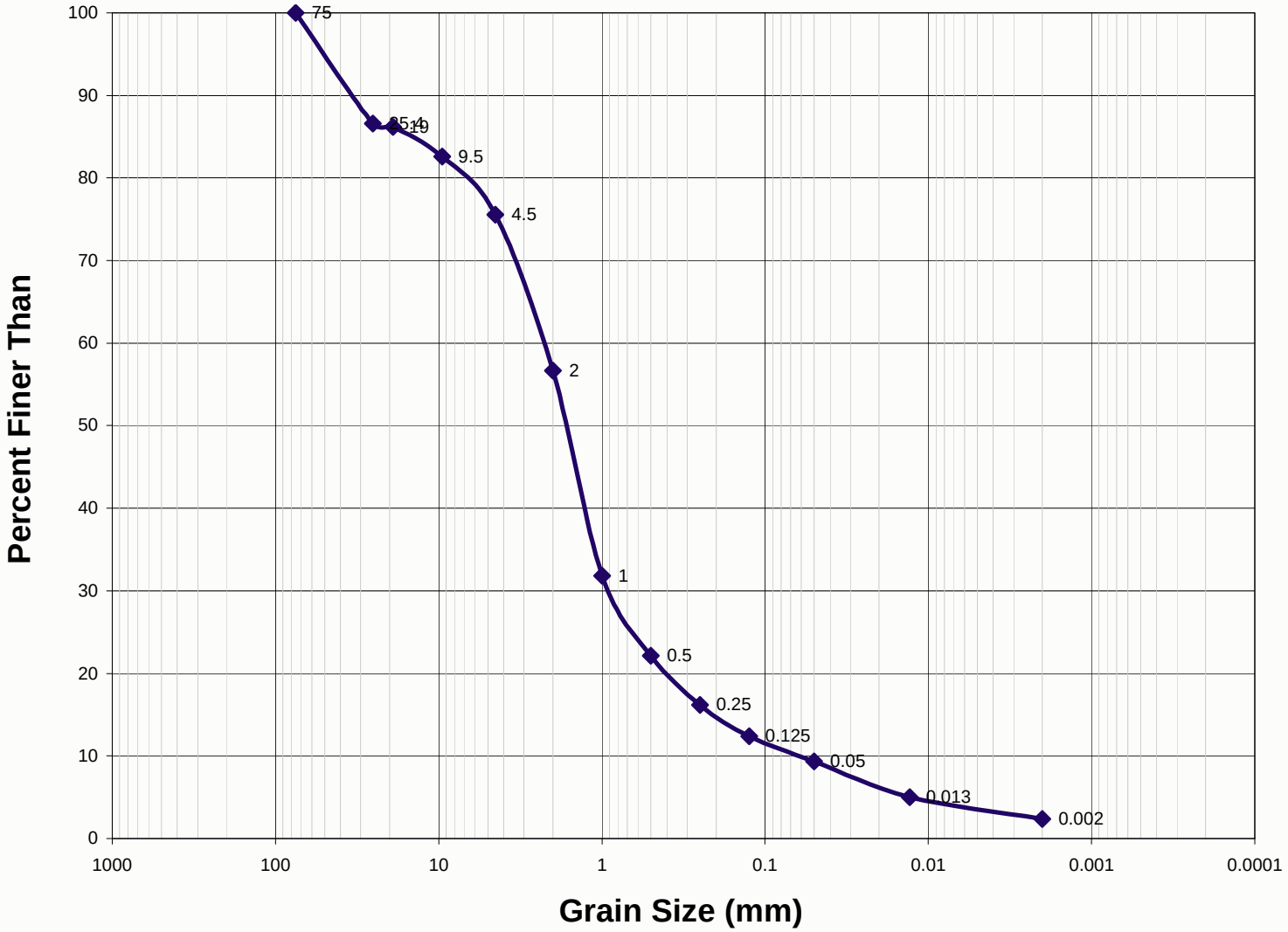
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-203-BH001_SOG
Lab ID: L1342249-7

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	24
Coarse Sand	2.0mm - 4.75mm	19
Medium Sand	0.425mm - 2.0mm	35
Fine Sand	0.075mm - 0.425mm	12
Fines	< 0.075mm	10

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	43
Sand	0.05mm - 2mm	47
Silt	0.002mm - 0.05mm	7
Clay	< 0.002mm	2
Texture	Loamy sand	

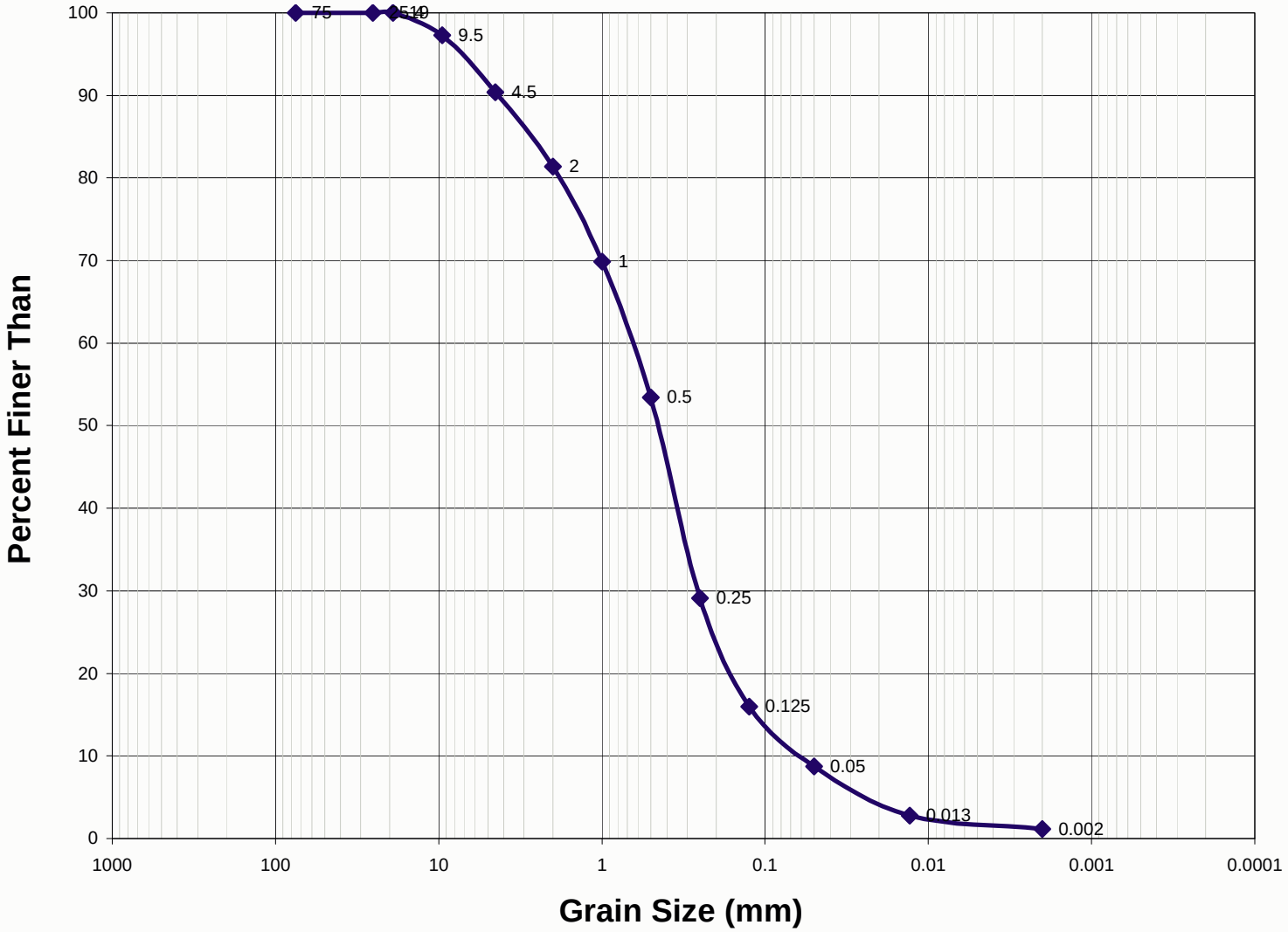
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-203-BH001_SOH
Lab ID: L1342249-8

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	9
Coarse Sand	2.0mm - 4.75mm	9
Medium Sand	0.425mm - 2.0mm	28
Fine Sand	0.075mm - 0.425mm	42
Fines	< 0.075mm	11

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	19
Sand	0.05mm - 2mm	73
Silt	0.002mm - 0.05mm	8
Clay	< 0.002mm	1
Texture	Sand	

Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

CH2MHILL **CHAIN OF CUSTODY RECORD** *8/1/2013 9:38:46 AM* Page 1 OF 1

Project Name Faro
Location Faro Mine Complex - Faro YK
Project Number 472645.16.DV.DM.01
Project Manager Jaco Esterhuizen
Sample Manager Charles Shewen

Task Order 203.3A
Project DVIHU NORTH FORK RCRD 2013
Turnaround Time 10 Days
Shipping Date: 8/1/2013
COC Number: ALS08011301

				Container:	4oz jar	1 Gallon	1 Gallon	1 Gallon		
				Preservatives:	4°C	4°C	4°C	4°C		
				Filtered:	NA	NA	NA	NA		
				Holding Time:	14	NA	NA	NA		
	DATE	TIME	Matrix		(ASTM 2216) Moisture	(ASTM 4318) Atterberg limits	(ASTM D1140) Percent Fines Determination	(ASTM D422) Gradation		Number of Containers	COMMENTS
CH13-203-BH001_SOa	7/29/2013	13:48	Soil		X					1	
CH13-203-BH001_SOb	7/29/2013	13:56	Soil		X	X	X			3	
CH13-203-BH001_SOc	7/29/2013	14:05	Soil		X		X			2	
CH13-203-BH001_SOd	7/29/2013	14:19	Soil		X		X			2	
CH13-203-BH001_SOe	7/29/2013	14:37	Soil					X		1	
CH13-203-BH001_SOf	7/29/2013	14:58	Soil					X		1	
CH13-203-BH001_SOg	7/29/2013	17:40	Soil					X		1	
CH13-203-BH001_SOh	7/29/2013	18:15	Soil					X		1	
									TOTAL NUMBER OF CONTAINERS	12	

L1342249-COFC

	Signatures	Date/Time
Approved by		
Sampled by		
Relinquished by	[signature]	08/01/13 0945
Received by		
Relinquished by		11:51 2-Aug-13
Received by	[signature]	

15.1°C
13.4°C

Shipping Details
Method of Shipment: FedEx
On Ice: yes / no
Airbill No:
Lab Name: ALS Vancouver
Lab Phone: (604) 253-4188

ATTN:
Sample Custody
and
Amber Springer

Special Instructions:
Tar16 PO:604564 Metals Table1 Perform Lab Dup/M on samples

Report Copy to
Bernice Kidd
(530) 229-3203

CH2M HILL, INC
ATTN: Bernice Kidd
2525 Airpark Drive
Redding CA 96001

Date Received: 12-AUG-13
Report Date: 22-AUG-13 12:10 (MT)
Version: FINAL

Client Phone: 530-229-3203

Certificate of Analysis

Lab Work Order #: L1347051

Project P.O. #: 472645.16.DV.DM.01 PO=604564
Job Reference: DVIHU NORTH FORK RCRD 2013 203.3A
C of C Numbers: ALS08111302
Legal Site Desc:

Amber Springer
Account Manager

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1347051-1	L1347051-2	L1347051-3	L1347051-4	L1347051-5
	Description	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampled Date	09-AUG-13	09-AUG-13	09-AUG-13	09-AUG-13	09-AUG-13
	Sampled Time	08:28	08:40	09:02	09:24	09:46
	Client ID	CH13-203-BH002_SOA	CH13-203-BH002_SOB	CH13-203-BH002_SOC	CH13-203-BH002_SOD	CH13-203-BH002_SOE
Grouping	**Analyte**					
SOIL						
Physical Tests	Grain Size Curve	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED	SEE ATTACHED	
	Moisture (%)	17.3	25.6	11.3	15.0	10.7
	Liquid Limit (LL) (%)	36	44	19	18	
	Plasticity Index (PI) (%)	7	12	3	3	

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1347051-6	L1347051-7	L1347051-8		
	Description	SOIL	SOIL	SOIL		
	Sampled Date	09-AUG-13	09-AUG-13	09-AUG-13		
	Sampled Time	10:36	11:03	11:35		
	Client ID	CH13-203-BH002_SOF	CH13-203-BH002_SOG	CH13-203-BH002_SOH		
Grouping	**Analyte**					
SOIL						
Physical Tests	Grain Size Curve					
	Moisture (%)	6.77	8.23	15.9		
	Liquid Limit (LL) (%)					
	Plasticity Index (PI) (%)					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ATTERBERG-SK	Soil	Atterberg limits	CARTER CSSS 58

The liquid limit (or upper plastic limit) is the point at which the soil becomes semifluid, like softened butter. In operational terms, the liquid limit is defined as the water content at which a trapezoidal groove cut in moist soil is closed after 25 taps on a hard rubber plate (ASTM D-18, 1958).

The plastic limit (or lower plastic limit) is defined as the water content at which soil begins to crumble on being rolled into a thread 1/8 inch (or 3 mm) in diameter. It represents the lowest water content at which soil can be deformed readily without cracking.

The plastic index (which is the difference between the liquid and plastic limits) gives an indication of the "clayeyness" or plasticity of a clay and is employed in engineering classification systems for soils.

References: McKeague, J.A. 1978. Atterberg Limits pp 50 - 55 In: Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci. p. 50 - 55

GRAIN SIZE-SK	Soil	Grain Size Analysis	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** 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
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

ALS08111302

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.

Quality Control Report

Client: CH2M HILL, INC
2525 Airpark Drive
Redding CA 96001
Contact: Bernice Kidd

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-VA	**Soil**							
Batch R2677275								
WG1731504-2 LCS								
Moisture			99.6		%		70-130	21-AUG-13
WG1731504-1 MB								
Moisture			<0.25		%		0.25	21-AUG-13

Quality Control Report

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.

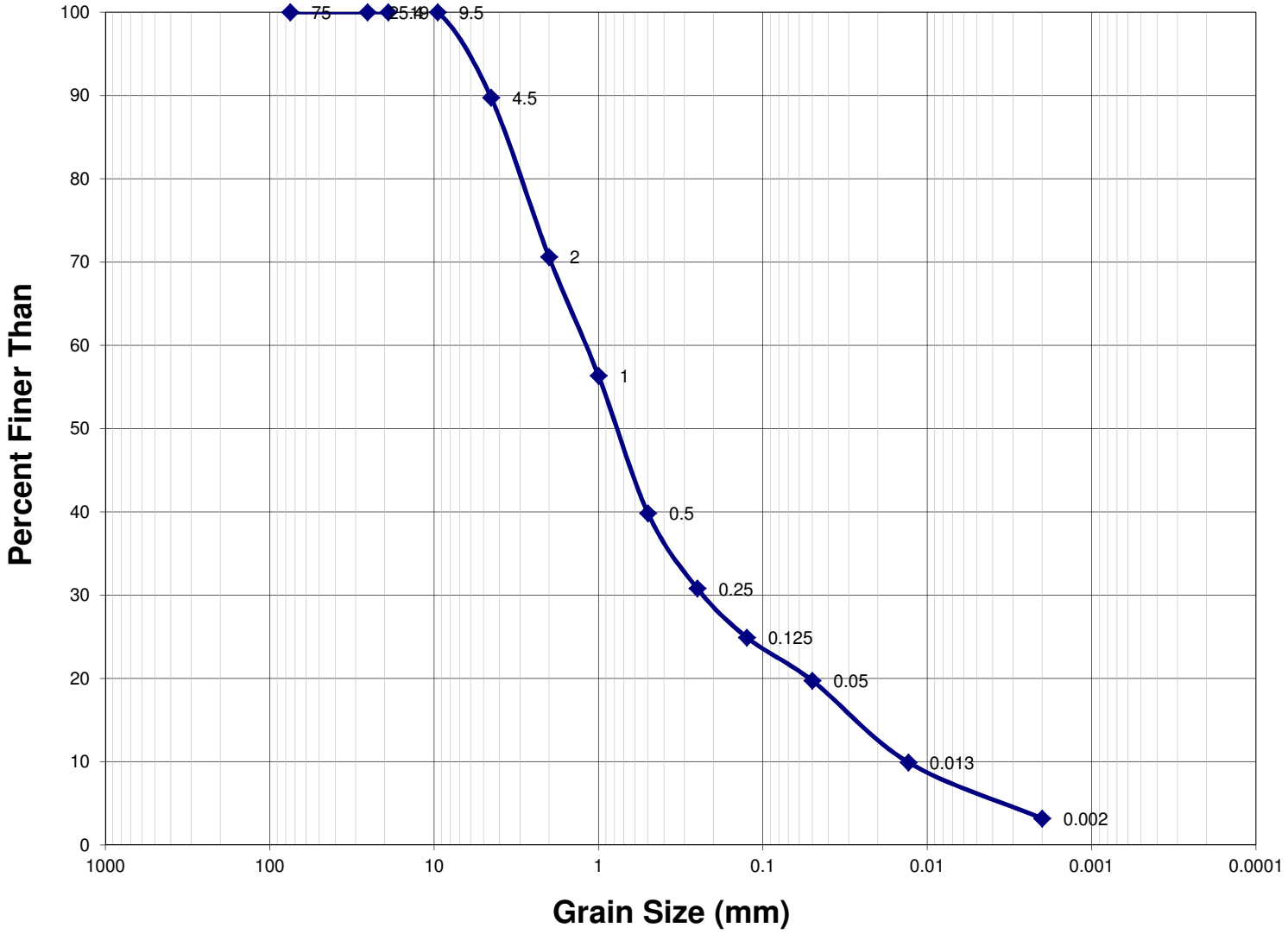
Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-203-BH002_SOA
Lab ID: L1347051-1

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	10
Coarse Sand	2.0mm - 4.75mm	20
Medium Sand	0.425mm - 2.0mm	31
Fine Sand	0.075mm - 0.425mm	18
Fines	< 0.075mm	21

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	29
Sand	0.05mm - 2mm	51
Silt	0.002mm - 0.05mm	17
Clay	< 0.002mm	3
Texture	Sandy loam	

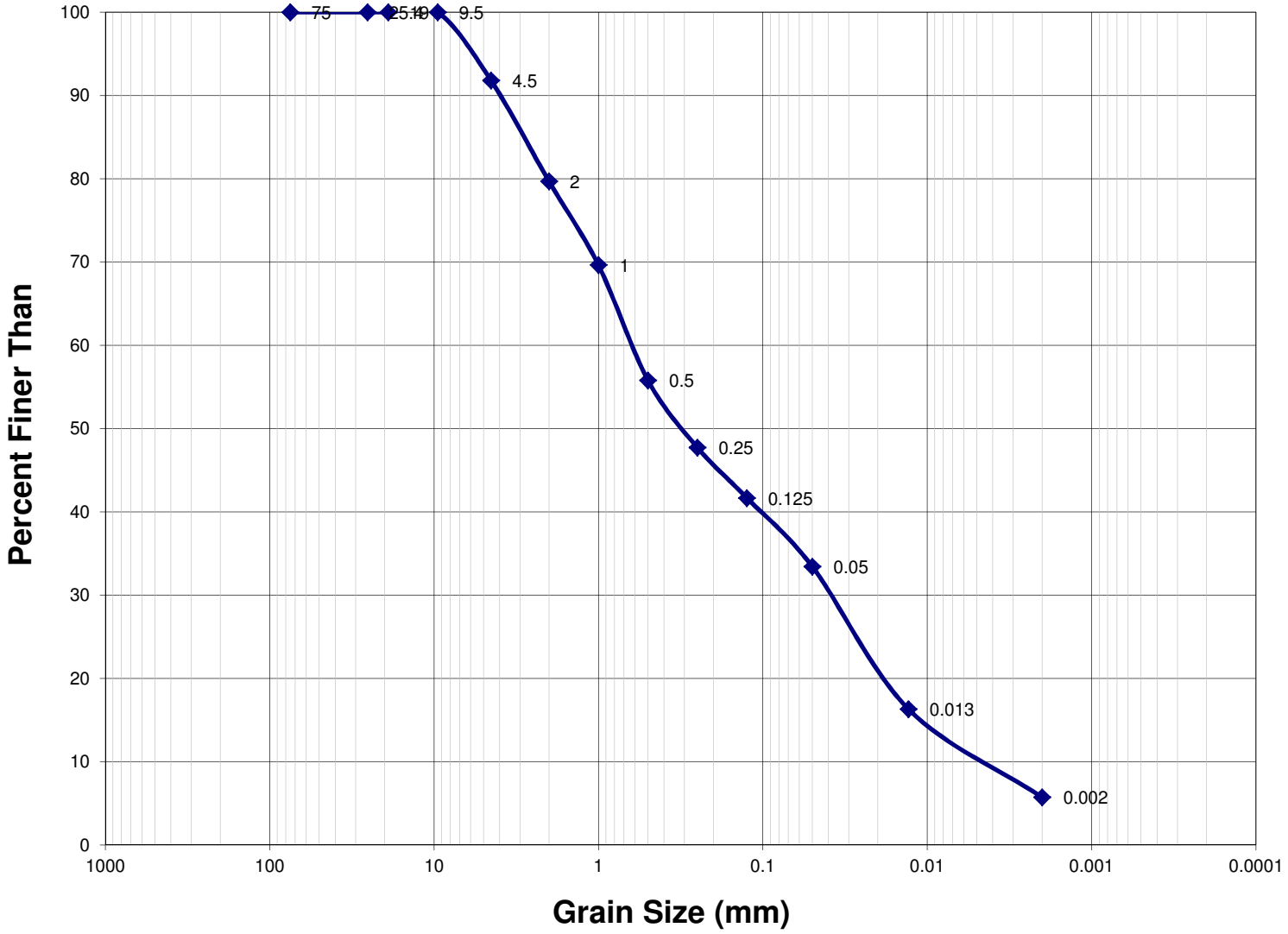
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-203-BH002_SOB
Lab ID: L1347051-2

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	8
Coarse Sand	2.0mm - 4.75mm	13
Medium Sand	0.425mm - 2.0mm	24
Fine Sand	0.075mm - 0.425mm	20
Fines	< 0.075mm	36

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	20
Sand	0.05mm - 2mm	46
Silt	0.002mm - 0.05mm	28
Clay	< 0.002mm	6

Texture: Sandy loam

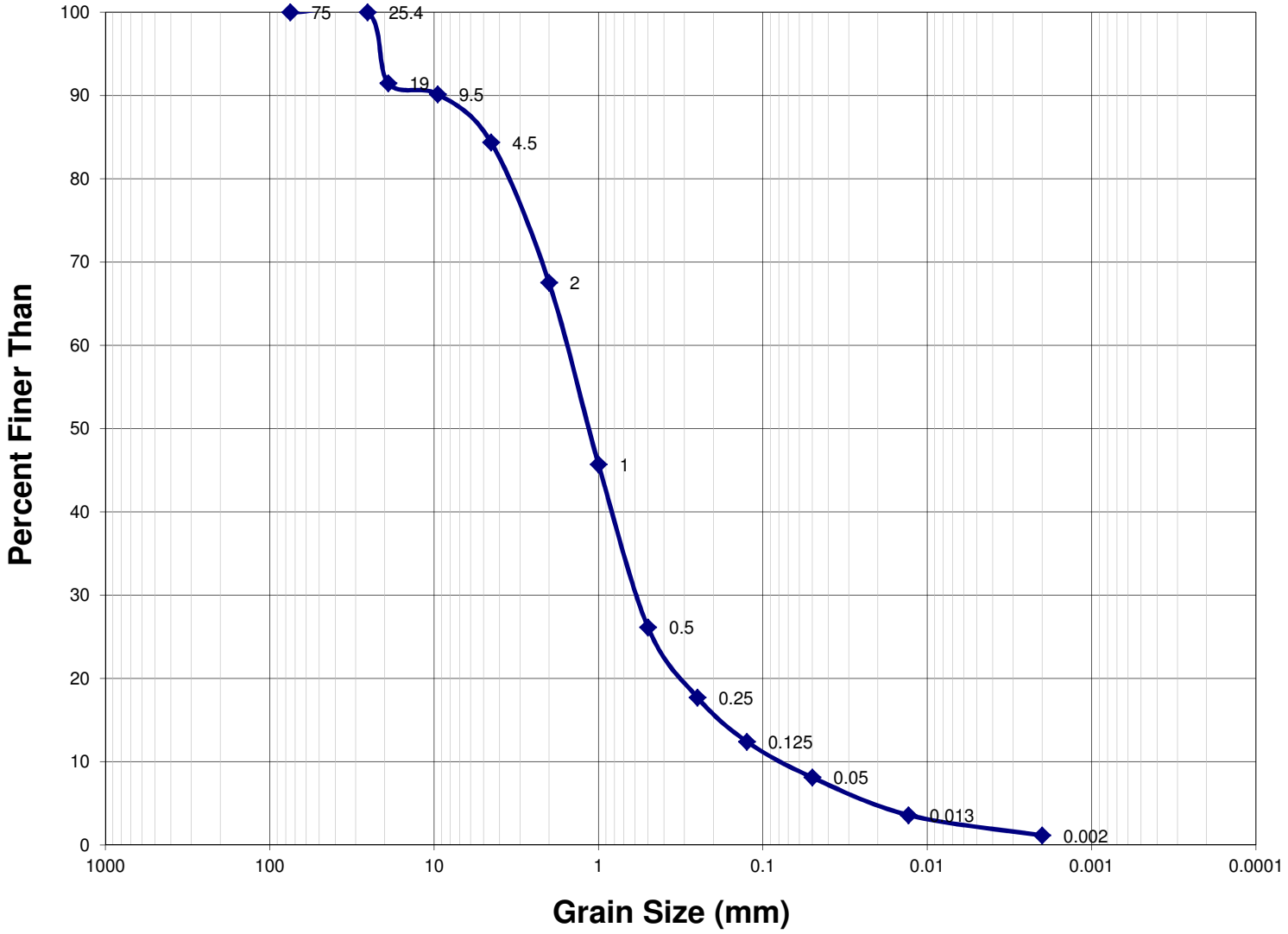
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-203-BH002_SOC
Lab ID: L1347051-3

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	15
Coarse Sand	2.0mm - 4.75mm	17
Medium Sand	0.425mm - 2.0mm	41
Fine Sand	0.075mm - 0.425mm	17
Fines	< 0.075mm	10

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	32
Sand	0.05mm - 2mm	59
Silt	0.002mm - 0.05mm	7
Clay	< 0.002mm	1

Texture Sand

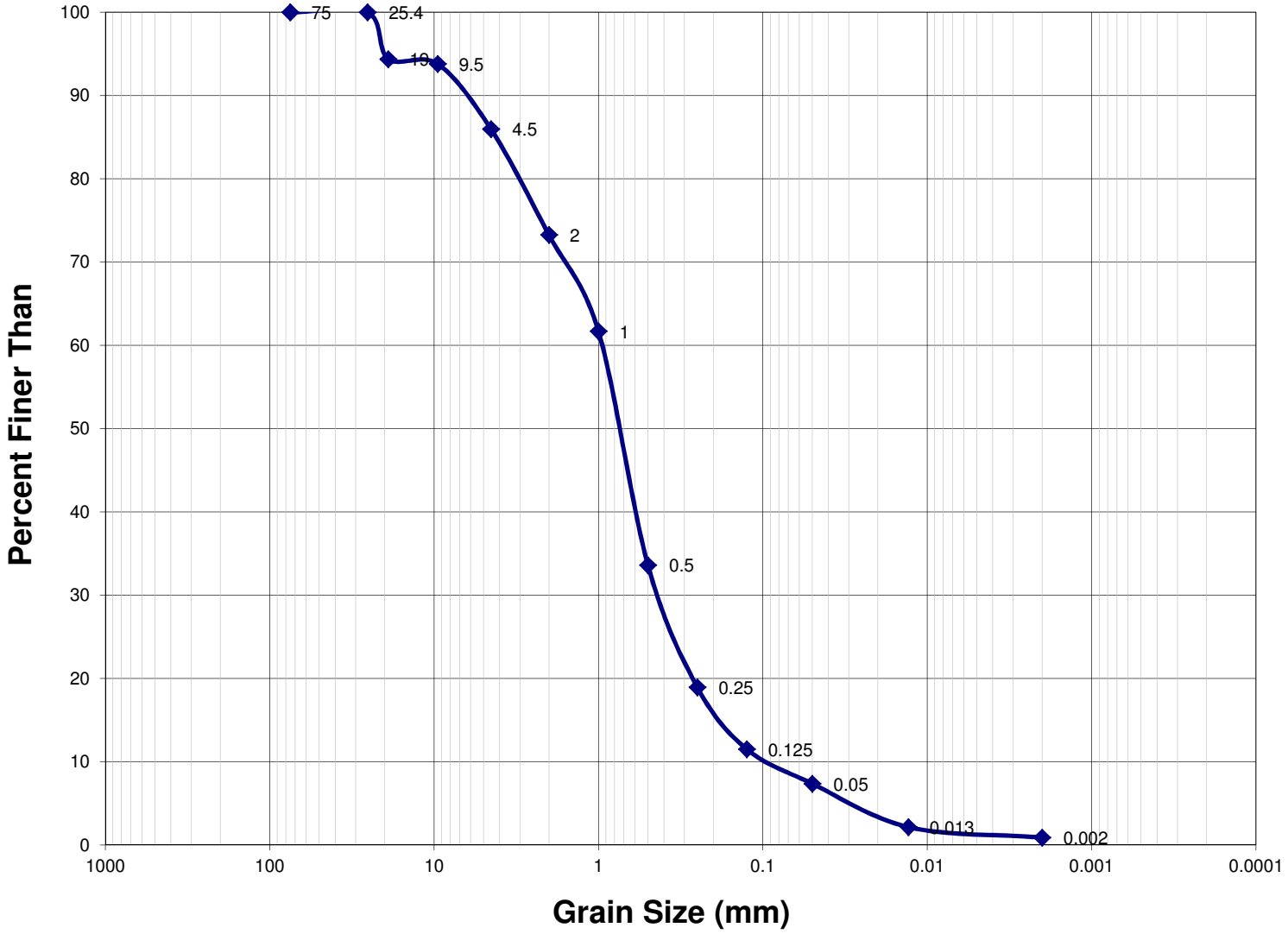
Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES
Environmental Division

819-58th Street, Saskatoon, SK S7K 6X5

Client Name: CH2M HILL, INC
Project: CHM400-CHM200-VA
Sample ID: CH13-203-BH002_SOD
Lab ID: L1347051-4

Particle Size Distribution Curve



Summary of Results

Unified Soil Classification System (USCS)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	4.75mm - 3"	14
Coarse Sand	2.0mm - 4.75mm	13
Medium Sand	0.425mm - 2.0mm	40
Fine Sand	0.075mm - 0.425mm	25
Fines	< 0.075mm	9

Canadian Soil Survey Committee (CSSC)

Size Class	Size Range	Wt. (%)
Cobbles	> 3"	0
Gravel	2mm - 3"	27
Sand	0.05mm - 2mm	66
Silt	0.002mm - 0.05mm	6
Clay	< 0.002mm	1

Texture Sand

Method Reference: Can. Soc. Soil Sci. (1993) Method 47.2

L1347051

CH2MHILL **CHAIN OF CUSTODY RECORD** *8/10/2013 10:09:40 AM* Page 1 OF 1

Project Name Faro
Location Faro Mine Complex - Faro YK
Project Number 472645.16.DV.DM.01
Project Manager Jaco Esterhuizen
Sample Manager Charles Shewen

Task Order 203.3A
Project DVIHU NORTH FORK RCRD 2013
Turnaround Time 10 Days
Shipping Date: 8/10/2013
COC Number: ALS08111302

				Container:	4oz jar	1 Gallon Ziploc	1 Gallon Ziploc			
				Preservatives:	4°C	4°C	4°C			
				Filtered:	NA	NA	NA			
				Holding Time:	14	NA	NA			
	DATE	TIME	Matrix		(ASTM 2216) Moisture	(ASTM 4318) Atterberg limits	(ASTM D422) Gradation	L1347051-COFC	Number of Containers	COMMENTS
CH13-203-BH002_SOa	8/9/2013	8:28	Soil		X	X	X		3	
CH13-203-BH002_SOb	8/9/2013	8:40	Soil		X	X	X		3	
CH13-203-BH002_SOc	8/9/2013	9:02	Soil		X	X	X		3	
CH13-203-BH002_SOd	8/9/2013	9:24	Soil		X	X	X		3	
CH13-203-BH002_SOe	8/9/2013	9:46	Soil		X				1	
CH13-203-BH002_SOf	8/9/2013	10:36	Soil		X				1	
CH13-203-BH002_SOg	8/9/2013	11:03	Soil		X				1	
CH13-203-BH002_SOh	8/9/2013	11:35	Soil		X				1	
								TOTAL NUMBER OF CONTAINERS	16	

	Signatures	Date/Time
Approved by		
Sampled by		6/11/13 1200
Relinquished by		
Received by		
Relinquished by	5.7°C	12-Aug-13
Received by	7.0°C	10:15

Shipping Details
Method of Shipment: FedEx
On Ice: yes / no
Airbill No:
Lab Name: ALS Vancouver
Lab Phone: (604) 253-4188

ATTN:
Sample Custody
and
Amber Springer

Special Instructions:
Tar16 PO:604564 Metals Table1 Perform Lab Dup/MS on samples

Report Copy to
Bernice Kidd
(530) 229-3203

Appendix H
Data Quality Evaluation Report

APPENDIX H

Fall 2013 North Fork Rose Creek Rock Drain Assessment, Intermediate Dam Crest Test Pits, and Faro-Grum-Vangorda Borrow Sources Sampling Data Quality Evaluation Report

Waste rock and soil samples were collected and analyzed during the Fall 2013 North Fork Rose Creek Rock Drain Assessment, Intermediate Dam Crest Test Pits, and Faro-Grum-Vangorda Borrow Sources sampling events in support of the Faro Mine Remediation Project. All analytical data were evaluated as described in the *Quality Assurance Project Plan, Faro Mine Remediation Project* (QAPP) (CH2M HILL, 2013). This Data Quality Evaluation report summarizes the results of the Quality Assurance/Quality Control (QA/QC) activities prescribed in the QAPP and provides a complete data usability assessment. The QAPP identifies the method-specific QC requirements for each analytical parameter and matrix and defines a plan to test that the correct sampling, analytical, and data reduction procedures are followed using audits and data validation.

This report is intended as a general data quality assessment designed to summarize data issues.

Analytical Data

A total of 5 native waste rock and 19 native environmental soil samples were collected from July 12 through August 9, 2013. Samples were analyzed by the ALS network of laboratories, including the ALS Whitehorse, Yukon Territory and ALS Vancouver in Burnaby, British Columbia laboratories. The majority of the analyses were performed by the ALS Vancouver laboratory. The laboratories divided the samples into 6 sample delivery groups (SDG). Summaries of the samples collected are presented in Tables 1 and 2. A total of 16 methods were used to analyze the environmental samples. Samples were collected and couriered to the ALS Whitehorse laboratory. After pulling sample aliquots in to support the analyses performed at the ALS Whitehorse laboratory, samples were then shipped by overnight carrier to the ALS Vancouver laboratory for analysis. Selected samples were analyzed for one or more of the following analytes/methods:

- **GeoTechnical Methods:**
  - Percent Fines Determination by Method ASTM D422-63
  - Atterburg Limits by Method ASTM D4318
- **GeoChemical Methods:**
  - Moisture by Method ASTM 2216
  - Oxidation/Reduction Potential (ORP) by Method ASTM D1498
  - Specific Conductance by Method CSSS/APHA 2510B
  - pH by Method CSSS/APHA 4500H
  - Mercury by Method E245.7
  - Acid Soluble Sulfate by Method EPA600/2-78-054
  - Sulfur by Method ISO 15178:2000
  - Neutralization Potential by Modified Method SOBEK-3.2.3
  - Acidity by Method SM2310
  - Alkalinity by Method SM2320B
  - Sulfate by Method SM4110B
  - Inorganic Carbon by Method SSSA P455-456
  - Total Metals by Methods SW6010B (ICP) and/or SW6020A (ICPMS)

Each SDG was evaluated by CH2M HILL chemists for data quality. Analytical performance was initially assessed on an SDG basis or an analytical batch basis. Several SDGs may be associated with the same laboratory QC samples.

The association of laboratory QC samples and environmental samples from the same analytical batches is determined by the laboratory lot control number.

For the GeoTechnical methods, the data were evaluated for completeness of the data. For all other methods, data were assessed using Level II validation as indicated below:

- Review of the data set narrative to identify issues that the laboratory reported in the data deliverable
- Check of sample integrity (sample collection, preservation, and holding times)
- Evaluation of basic QC measurements used to assess the accuracy, precision and representativeness of data, including QC blanks, LCS, MS, surrogate recovery when applicable, and field or laboratory duplicate results
- Review of sample results, target compound lists, and detection limits to verify that project analytical requirements are met
- Initiation of corrective actions, as necessary, based on the data review findings
- Verification that hardcopy results match electronic deliverable results
- Qualification of the data using appropriate qualifier flags, as necessary, to reflect data usability limitations

Field samples were also reviewed to ascertain field compliance and data quality issues. This included a review of field duplicates (FDs) and EBs. Ten waste rock samples and a FD were planned to be collected. The Borrow Source Technical Lead reduced the number of samples to 5 and inadvertently removed the FD that was planned to be performed on one of the eliminated samples.

Data flags were assigned according to the QC acceptance limits defined in the QAPP (CH2M HILL, 2013). The data validation flags for each SDG are summarized in each data quality validation report. These flags, and the reason for each flag, are recorded in the electronic validation database. Multiple flags can routinely be applied to a specific sample method/matrix/analyte combination, but there will be only one final flag. As discussed below, a final flag is applied to the data on the basis of the flags entered into the database and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

Data flags can be separated into the following two categories to be used in estimating both contractor and analytical completeness:

- Flags caused by laboratory deviation from requirements in the QAPP (CH2M HILL, 2013)
- Flags applied because of the nature of the sample matrix or method limitations

The database keeps track of the type of protocol violation, and contractual and analytical completeness during data validation.

The data flags are those listed in the QAPP (CH2M HILL, 2013) and are defined as follows:

J - Analyte was present but the reported value may not be accurate or precise.

UJ - Analyte was not detected above the detection limit objective. However, the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R - Result has been rejected for use.

U - Analyte was analyzed for but not detected at the specified detection limit.

None - A database flag with no QC implications. A flag is not applied. This is a placeholder for calculating QC criteria issues that do not require flagging.

Exclude - A database flag with no QC implications. When multiple data points have been reported, such as dilutions or re-extractions, the data that best match QAPP QC requirements (CH2M HILL, 2013) are presented to the data users and the remainders are marked with this flag.

= - A database flag with no QC implications. A place holder for the DQE reporting purposes noting that the reported result is a detected concentration greater than the RL.

Findings

The data set identified in Tables 1 and 2 was evaluated against the method and project-specific criteria. The frequency of field and laboratory QC samples and the associated control criteria are specified in the QAPP (CH2M HILL, 2013). These control criteria were used to evaluate the laboratory data. With the exception of the lack of a FD, previously noted above, all criteria were met, and no validation flags were applied. A summary of the percent completeness by method, analyte, and matrix is provided in Table 3.

Laboratory Qualifiers

The laboratory applied informational qualifiers to multiple results to note analytical issues such as dilutions, blank contamination, matrix effects, limited sample volume, holding time, and reanalyses. These qualifiers were reviewed and where the informational qualifiers did not result in a validation flags noting a QC exceedances, these qualifiers where replaced with the concentration flags “U” or “=”.

Overall Assessment

Completeness is calculated and reported for each method, matrix, and analyte combination as outlined in the QAPP (CH2M HILL, 2013). The number of valid (not qualified with an “R” flag) results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. A summary of the completeness percentages can be found in Table 8.

The QAPP completeness goal is 90 percent and the overall data completeness is 100 percent.

Out of 284 normal data points, no additional data qualification was made. The quality of the analytical program and laboratory are sufficient to meet the project data quality objectives.

Evaluation of 100 percent of the chemical data was performed by using the QAPP (CH2M HILL, 2013) as a guide for data quality evaluation.

No systematic protocol errors were identified on the basis of the QA program set up or during the monitoring of the field or laboratory efforts.

Data Management

Faro Mine Remediation sampling activity logs and laboratory analytical data are maintained in a project database and/or in project files, where appropriate. Data were collected and stored in a manner consistent with the requirements of the QAPP (CH2M HILL, 2013).

All raw data will be maintained on file in the laboratory, and will be available upon request. Complete documentation of sample preparation and analysis and associated QC information will be maintained in a manner that allows easy retrieval in the event that additional information is required. The following minimum documentation should be kept for each project:

- Original work order, COC forms, and other pertinent documents received with the samples
- Records of communication between the laboratory, field personnel, and the client
- Corrective action reports
- Laboratory data reports
- Laboratory logbooks and all raw sample preparation and analytical data
- Electronic data and all pertinent SOPs

Field records to be retained as a minimum will include correspondence, COC forms, field notes, field equipment performance records, maintenance logs, field procedures, corrective action reports, field personnel files, and project-related reports.

The receipt of electronic and pdf laboratory data was logged into the sample tracking program to determine completeness and contractor turnaround time compliance.

The laboratory uploaded electronic data to the Faro Mine EQuIS site. CH2M HILL chemists downloaded this data into the validation program. All data quality evaluation is done using a semiautomated data validation program

that uses laboratory pdf report and electronic data simultaneously. All validation flags and discoveries are entered into the validation database and are linked directly to each individual data point. This process validates pdf report data and electronic data simultaneously.

All data quality evaluation reports are generated from the validation database. Final validation flags are uploaded to the Faro Mine EQuIS site.

The data management system was designed to maintain the usability and integrity of the data through a series of procedures and QC checks that began at the field site and carried through to the generation of data for the user. These data included both the chemical data and field operation information. Both the chemical data and the field data were handled according to the guidelines established in the QAPP (CH2M HILL, 2013) and in the *Faro Mine Data Management Plan* (CH2M HILL, 2013).

The laboratory pdf reports are stored in the project files and project local area network hard drive areas in the CH2M HILL office in Redding, California. The original field data forms are stored on the Faro Mine SharePoint site. Laboratories are required to archive the analytical data as outlined in the QAPP (CH2M HILL, 2013).

Works Cited

CH2M HILL. 2013. *Faro Mine Data Management Plan.* August.

CH2M HILL. 2013. *Quality Assurance Project Plan, Faro Mine Remediation Project.* July.

Tables

TABLE 1

Sample Summary by Chain of Custody – Data Summary

CoC Number	Sample Date	Matrix	Sample ID / QAQC Type	SDG	Laboratory
ALS07141303					
	12-Jul-13	SOIL	CH13-108-TP002_SOa / N	L1332158	ALS
	13-Jul-13		CH13-108-TP006_SOa / N	L1332158	ALS
			CH13-108-TP009_SOa / N	L1332158	ALS
			CH13-108-TP011_SOa / N	L1332158	ALS
ALS07141303H					
	12-Jul-13	SOIL	CH13-108-TP002_SOa / N	L1341927	ALS
	13-Jul-13		CH13-108-TP009_SOa / N	L1341927	ALS
ALS07161301					
	15-Jul-13	SOIL	CH13-108-TP015_SOa / N	L1333673	ALS
ALS07161301H					
	15-Jul-13	SOIL	CH13-108-TP015_SOa / N	L1341927	ALS
ALS07161301R					
	15-Jul-13	SOIL	CH13-108-TP015_SOa / N	L1333673	ALS
ALS07301301					
	29-Jul-13	SOIL	CH13-201-TP001_SOb / N	L1340658	ALS
			CH13-201-TP002_SOa / N	L1340658	ALS
			CH13-201-TP003_SOb / N	L1340658	ALS
			CH13-201-TP004_SOb / N	L1340658	ALS
			CH13-201-TP005_SOb / N	L1340658	ALS
			CH13-201-TP006_SOa / N	L1340658	ALS
			CH13-201-TP007_SOb / N	L1340658	ALS
ALS08011301					
	29-Jul-13	SOIL	CH13-203-BH001_SOa / N	L1342249	ALS
			CH13-203-BH001_SOb / N	L1342249	ALS
			CH13-203-BH001_SOc / N	L1342249	ALS
			CH13-203-BH001_SOd / N	L1342249	ALS
ALS08111302					
	09-Aug-13	SOIL	CH13-203-BH002_SOa / N	L1347051	ALS
			CH13-203-BH002_SOb / N	L1347051	ALS
			CH13-203-BH002_SOc / N	L1347051	ALS

TABLE 1

Sample Summary by Chain of Custody – Data Summary

CoC Number	Sample Date	Matrix	Sample ID / QAQC Type	SDG	Laboratory
ALS08111302					
	09-Aug-13	SOIL	CH13-203-BH002_SOd / N	L1347051	ALS
			CH13-203-BH002_SOe / N	L1347051	ALS
			CH13-203-BH002_SOf / N	L1347051	ALS
			CH13-203-BH002_SOg / N	L1347051	ALS
			CH13-203-BH002_SOh / N	L1347051	ALS

QAQC Type

N = normal environmental sample
FD = field duplicate
MS = matrix spike
SD = spike duplicate
TB = trip blank
EB = equipment blank
AB = ambient blank
FB = field blank

TABLE 2

Sample Chronology – Data Summary

Laboratory	SDG	Sample ID	Method	Sample Date	Receive Date	Extract Date	Analysis Date
ALS	L1332158	CH13-108-TP002_SOa	ASTM 2216	7/12/2013	7/15/2013		7/25/2013
		CH13-108-TP002_SOa	CSSS/APHA 4500H	7/12/2013	7/15/2013		7/29/2013
		CH13-108-TP002_SOa	E245.7	7/12/2013	7/15/2013	7/24/2013	7/29/2013
		CH13-108-TP002_SOa	ISO 15178:2000	7/12/2013	7/15/2013	7/18/2013	7/18/2013
		CH13-108-TP002_SOa	MOD-SOBEK-3.2.3	7/12/2013	7/15/2013		8/27/2013
		CH13-108-TP002_SOa	SSSA P 455-456	7/12/2013	7/15/2013		7/24/2013
		CH13-108-TP002_SOa	SSSA P 455-456	7/12/2013	7/15/2013	7/20/2013	7/20/2013
		CH13-108-TP002_SOa	SW6010B	7/12/2013	7/15/2013	7/24/2013	7/29/2013
		CH13-108-TP006_SOa	ASTM 2216	7/13/2013	7/15/2013		7/25/2013
		CH13-108-TP006_SOa	CSSS/APHA 4500H	7/13/2013	7/15/2013		7/29/2013
		CH13-108-TP006_SOa	E245.7	7/13/2013	7/15/2013	7/24/2013	7/29/2013
		CH13-108-TP006_SOa	ISO 15178:2000	7/13/2013	7/15/2013	7/18/2013	7/18/2013
		CH13-108-TP006_SOa	MOD-SOBEK-3.2.3	7/13/2013	7/15/2013		8/27/2013
		CH13-108-TP006_SOa	SSSA P 455-456	7/13/2013	7/15/2013		7/24/2013
		CH13-108-TP006_SOa	SSSA P 455-456	7/13/2013	7/15/2013	7/20/2013	7/20/2013
		CH13-108-TP006_SOa	SW6010B	7/13/2013	7/15/2013	7/24/2013	7/29/2013
		CH13-108-TP009_SOa	ASTM 2216	7/13/2013	7/15/2013		7/25/2013
		CH13-108-TP009_SOa	CSSS/APHA 4500H	7/13/2013	7/15/2013		7/29/2013
		CH13-108-TP009_SOa	E245.7	7/13/2013	7/15/2013	7/24/2013	7/29/2013
		CH13-108-TP009_SOa	ISO 15178:2000	7/13/2013	7/15/2013	7/18/2013	7/18/2013
		CH13-108-TP009_SOa	MOD-SOBEK-3.2.3	7/13/2013	7/15/2013		8/27/2013
		CH13-108-TP009_SOa	SSSA P 455-456	7/13/2013	7/15/2013		7/24/2013
		CH13-108-TP009_SOa	SSSA P 455-456	7/13/2013	7/15/2013	7/20/2013	7/20/2013
		CH13-108-TP009_SOa	SW6010B	7/13/2013	7/15/2013	7/24/2013	7/29/2013
		CH13-108-TP011_SOa	ASTM 2216	7/13/2013	7/15/2013		7/25/2013
		CH13-108-TP011_SOa	CSSS/APHA 4500H	7/13/2013	7/15/2013		7/29/2013
		CH13-108-TP011_SOa	E245.7	7/13/2013	7/15/2013	7/24/2013	7/29/2013
		CH13-108-TP011_SOa	ISO 15178:2000	7/13/2013	7/15/2013	7/18/2013	7/18/2013
		CH13-108-TP011_SOa	MOD-SOBEK-3.2.3	7/13/2013	7/15/2013		8/27/2013
		CH13-108-TP011_SOa	SSSA P 455-456	7/13/2013	7/15/2013		7/24/2013
		CH13-108-TP011_SOa	SSSA P 455-456	7/13/2013	7/15/2013	7/20/2013	7/20/2013
		CH13-108-TP011_SOa	SW6010B	7/13/2013	7/15/2013	7/24/2013	7/29/2013
	L1333673	CH13-108-TP015_SOa	ASTM 2216	7/15/2013	7/17/2013		7/29/2013
		CH13-108-TP015_SOa	CSSS/APHA 4500H	7/15/2013	7/17/2013		7/31/2013
		CH13-108-TP015_SOa	CSSS/APHA 4500H	7/15/2013	7/17/2013		8/2/2013

TABLE 2

Sample Chronology – Data Summary

Laboratory	SDG	Sample ID	Method	Sample Date	Receive Date	Extract Date	Analysis Date
ALS	L1333673	CH13-108-TP015_SOa	E245.7	7/15/2013	7/17/2013	7/29/2013	7/31/2013
		CH13-108-TP015_SOa	ISO 15178:2000	7/15/2013	7/17/2013	7/20/2013	7/20/2013
		CH13-108-TP015_SOa	MOD-SOBEK-3.2.3	7/15/2013	7/17/2013		8/27/2013
		CH13-108-TP015_SOa	SSSA P 455-456	7/15/2013	7/17/2013		7/20/2013
		CH13-108-TP015_SOa	SSSA P 455-456	7/15/2013	7/17/2013	7/20/2013	7/20/2013
		CH13-108-TP015_SOa	SW6010B	7/15/2013	7/17/2013	7/29/2013	7/31/2013
	L1340658	CH13-201-TP001_SOb	ASTM 2216	7/29/2013	7/31/2013	8/9/2013	8/9/2013
		CH13-201-TP001_SOb	ASTM D4318	7/29/2013	7/31/2013	8/12/2013	8/12/2013
		CH13-201-TP002_SOa	ASTM 2216	7/29/2013	7/31/2013	8/9/2013	8/9/2013
		CH13-201-TP002_SOa	ASTM D4318	7/29/2013	7/31/2013	8/12/2013	8/12/2013
		CH13-201-TP003_SOb	ASTM 2216	7/29/2013	7/31/2013	8/9/2013	8/9/2013
		CH13-201-TP003_SOb	ASTM D4318	7/29/2013	7/31/2013	8/12/2013	8/12/2013
		CH13-201-TP004_SOb	ASTM 2216	7/29/2013	7/31/2013	8/9/2013	8/9/2013
		CH13-201-TP004_SOb	ASTM D4318	7/29/2013	7/31/2013	8/12/2013	8/12/2013
		CH13-201-TP005_SOb	ASTM 2216	7/29/2013	7/31/2013	8/9/2013	8/9/2013
		CH13-201-TP005_SOb	ASTM D4318	7/29/2013	7/31/2013	8/12/2013	8/12/2013
		CH13-201-TP006_SOa	ASTM 2216	7/29/2013	7/31/2013	8/9/2013	8/9/2013
		CH13-201-TP006_SOa	ASTM D4318	7/29/2013	7/31/2013	8/12/2013	8/12/2013
		CH13-201-TP007_SOb	ASTM 2216	7/29/2013	7/31/2013	8/9/2013	8/9/2013
		CH13-201-TP007_SOb	ASTM D4318	7/29/2013	7/31/2013	8/12/2013	8/12/2013
	L1341927	CH13-108-TP002_SOa	EPA600/2-78-054	7/12/2013	8/1/2013	8/19/2013	8/19/2013
		CH13-108-TP002_SOa	SW6020A	7/12/2013	8/1/2013	8/19/2013	8/19/2013
		CH13-108-TP009_SOa	EPA600/2-78-054	7/13/2013	8/1/2013	8/19/2013	8/19/2013
		CH13-108-TP009_SOa	SW6020A	7/13/2013	8/1/2013	8/19/2013	8/19/2013
		CH13-108-TP015_SOa	ASTM 2216	7/15/2013	8/1/2013		8/11/2013
		CH13-108-TP015_SOa	ASTMD1498_DI	7/15/2013	8/1/2013		8/16/2013
		CH13-108-TP015_SOa	CSSS/APHA 2510B_DI	7/15/2013	8/1/2013		8/16/2013
		CH13-108-TP015_SOa	CSSS/APHA 4500H_DI	7/15/2013	8/1/2013		8/15/2013
		CH13-108-TP015_SOa	E245.7_DI	7/15/2013	8/1/2013		8/16/2013
		CH13-108-TP015_SOa	EPA600/2-78-054	7/15/2013	8/1/2013	8/19/2013	8/19/2013
		CH13-108-TP015_SOa	SM2310_DI	7/15/2013	8/1/2013		8/16/2013
		CH13-108-TP015_SOa	SM2320B_DI	7/15/2013	8/1/2013		8/16/2013
		CH13-108-TP015_SOa	SM4110B_DI	7/15/2013	8/1/2013		8/16/2013
		CH13-108-TP015_SOa	SW6010B_DI	7/15/2013	8/1/2013		8/15/2013
		CH13-108-TP015_SOa	SW6020A	7/15/2013	8/1/2013	8/19/2013	8/19/2013

TABLE 2

Sample Chronology – Data Summary

Laboratory	SDG	Sample ID	Method	Sample Date	Receive Date	Extract Date	Analysis Date
ALS	L1341927	CH13-108-TP015_SOa	SW6020A_DI	7/15/2013	8/1/2013		8/18/2013
	L1342249	CH13-203-BH001_SOa	ASTM 2216	7/29/2013	8/2/2013	8/9/2013	8/9/2013
		CH13-203-BH001_SOb	ASTM 2216	7/29/2013	8/2/2013	8/9/2013	8/9/2013
		CH13-203-BH001_SOb	ASTM D422-63	7/29/2013	8/2/2013	8/9/2013	8/9/2013
		CH13-203-BH001_SOb	ASTM D4318	7/29/2013	8/2/2013	8/14/2013	8/14/2013
		CH13-203-BH001_SOc	ASTM 2216	7/29/2013	8/2/2013	8/9/2013	8/9/2013
		CH13-203-BH001_SOc	ASTM D422-63	7/29/2013	8/2/2013	8/9/2013	8/9/2013
		CH13-203-BH001_SOd	ASTM 2216	7/29/2013	8/2/2013	8/9/2013	8/9/2013
		CH13-203-BH001_SOd	ASTM D422-63	7/29/2013	8/2/2013	8/9/2013	8/9/2013
	L1347051	CH13-203-BH002_SOa	ASTM 2216	8/9/2013	8/12/2013		8/21/2013
		CH13-203-BH002_SOa	ASTM D4318	8/9/2013	8/12/2013	8/20/2013	8/20/2013
		CH13-203-BH002_SOb	ASTM 2216	8/9/2013	8/12/2013		8/21/2013
		CH13-203-BH002_SOb	ASTM D4318	8/9/2013	8/12/2013	8/20/2013	8/20/2013
		CH13-203-BH002_SOc	ASTM 2216	8/9/2013	8/12/2013		8/21/2013
		CH13-203-BH002_SOc	ASTM D4318	8/9/2013	8/12/2013	8/20/2013	8/20/2013
		CH13-203-BH002_SOd	ASTM 2216	8/9/2013	8/12/2013		8/21/2013
		CH13-203-BH002_SOd	ASTM D4318	8/9/2013	8/12/2013	8/20/2013	8/20/2013
		CH13-203-BH002_SOe	ASTM 2216	8/9/2013	8/12/2013		8/21/2013
		CH13-203-BH002_SOf	ASTM 2216	8/9/2013	8/12/2013		8/21/2013
		CH13-203-BH002_SOg	ASTM 2216	8/9/2013	8/12/2013		8/21/2013
		CH13-203-BH002_SOh	ASTM 2216	8/9/2013	8/12/2013		8/21/2013

TABLE 3

Site Completeness by Analyte – Qualified Data

			Number of Occurrences									
Method	**Analyte**	**Units**	**Analyses**	**Detects**	**Non-detects**	**Blank Flags**	**J Flags**	**M Flags**	**Contractor R Flags**	**Total R Flags**	**Contractor Percent Completeness**	**Overall Percent Completeness**
ASTM 2216	Moisture	PERCENT	24	24							100	100
ASTM D422-63	MUST PSA % > 75um	PERCENT	3	3							100	100
ASTM D4318	MOISTURE AT LIQUID LIMIT	PERCENT	12	12							100	100
ASTM D4318	PLASTICITY INDEX	PERCENT	12	12							100	100
ASTMD1498_D	ORP Leachable, DI	MV	1	1							100	100
CSSS/APHA 25	Specific Conductance, DI	US/CM	1	1							100	100
CSSS/APHA 45	Paste pH	PH UNITS	5	5							100	100
CSSS/APHA 45	pH (1:2 soil:water)	PH UNITS	5	5							100	100
CSSS/APHA 45	Paste pH, DI	PH UNITS	1	1							100	100
E245.7	Mercury	MG/KG	5	5							100	100
E245.7_DI	Mercury, DI	MG/L	1		1						100	100
EPA600/2-78-0	Sulfate, Acid Soluble	PERCENT	3	2	1						100	100
ISO 15178:200	Sulfur	MG/KG	5	5							100	100
MOD-SOBEK-3	Neutralization Potential (as CaCO3 Eq.)	T CACO3/1	5	5							100	100
SM2310_DI	Acidity, DI	MG/L	1	1							100	100
SM2320B_DI	Alkalinity, Total, DI	MG/L	1	1							100	100
SM4110B_DI	Sulfate, DI	MG/L	1	1							100	100
SSSA P 455-45	Inorganic Carbon (as CACO3 Equivalent)	PERCENT	5	5							100	100
SSSA P 455-45	Total Inorganic Carbon	PERCENT	5	5							100	100
SW6010B	Aluminum	MG/KG	5	5							100	100
SW6010B	Antimony	MG/KG	5	5							100	100
SW6010B	Arsenic	MG/KG	5	5							100	100
SW6010B	Barium	MG/KG	5	5							100	100
SW6010B	Beryllium	MG/KG	5	5							100	100
SW6010B	Bismuth	MG/KG	5	4	1						100	100
SW6010B	Boron	MG/KG	5		5						100	100
SW6010B	Cadmium	MG/KG	5	5							100	100
SW6010B	Calcium	MG/KG	5	5							100	100
SW6010B	Chromium	MG/KG	5	5							100	100

TABLE 3

Site Completeness by Analyte – Qualified Data

			Number of Occurrences									
Method	**Analyte**	**Units**	**Analyses**	**Detects**	**Non-detects**	**Blank Flags**	**J Flags**	**M Flags**	**Contractor R Flags**	**Total R Flags**	**Contractor Percent Completeness**	**Overall Percent Completeness**
SW6010B	Cobalt	MG/KG	5	5							100	100
SW6010B	Copper	MG/KG	5	5							100	100
SW6010B	Iron	MG/KG	5	5							100	100
SW6010B	Lead	MG/KG	5	5							100	100
SW6010B	Lithium	MG/KG	5	5							100	100
SW6010B	Magnesium	MG/KG	5	5							100	100
SW6010B	Manganese	MG/KG	5	5							100	100
SW6010B	Molybdenum	MG/KG	5	3	2						100	100
SW6010B	Nickel	MG/KG	5	5							100	100
SW6010B	Phosphorus	MG/KG	5	5							100	100
SW6010B	Potassium	MG/KG	5	5							100	100
SW6010B	Selenium	MG/KG	5	4	1						100	100
SW6010B	Silver	MG/KG	5	5							100	100
SW6010B	Sodium	MG/KG	5	5							100	100
SW6010B	Strontium	MG/KG	5	5							100	100
SW6010B	Thallium	MG/KG	5	5							100	100
SW6010B	Tin	MG/KG	5	2	3						100	100
SW6010B	Titanium	MG/KG	5	5							100	100
SW6010B	Uranium	MG/KG	5	5							100	100
SW6010B	Vanadium	MG/KG	5	5							100	100
SW6010B	Zinc	MG/KG	5	5							100	100
SW6010B_DI	Calcium, DI	MG/L	1	1							100	100
SW6010B_DI	Iron, DI	MG/L	1		1						100	100
SW6010B_DI	Magnesium, DI	MG/L	1	1							100	100
SW6010B_DI	Potassium, DI	MG/L	1	1							100	100
SW6010B_DI	Silicon, DI	MG/L	1	1							100	100
SW6010B_DI	Sodium, DI	MG/L	1	1							100	100
SW6010B_DI	Sulfur, DI	MG/L	1	1							100	100
SW6010B_DI	Titanium, DI	MG/L	1		1						100	100

TABLE 3

Site Completeness by Analyte – Qualified Data

			Number of Occurrences									
Method	**Analyte**	**Units**	**Analyses**	**Detects**	**Non-detects**	**Blank Flags**	**J Flags**	**M Flags**	**Contractor R Flags**	**Total R Flags**	**Contractor Percent Completeness**	**Overall Percent Completeness**
SW6020A	Barium, LMB	PPM	3	3							100	100
SW6020A_DI	Aluminum, DI	MG/L	1	1							100	100
SW6020A_DI	Antimony, DI	MG/L	1	1							100	100
SW6020A_DI	Arsenic, DI	MG/L	1		1						100	100
SW6020A_DI	Barium, DI	MG/L	1	1							100	100
SW6020A_DI	Beryllium, DI	MG/L	1		1						100	100
SW6020A_DI	Boron, DI	MG/L	1	1							100	100
SW6020A_DI	Cadmium, DI	MG/L	1	1							100	100
SW6020A_DI	Chromium, DI	MG/L	1		1						100	100
SW6020A_DI	Cobalt, DI	MG/L	1	1							100	100
SW6020A_DI	Copper, DI	MG/L	1		1						100	100
SW6020A_DI	Lead, DI	MG/L	1	1							100	100
SW6020A_DI	Lithium, DI	MG/L	1	1							100	100
SW6020A_DI	Manganese, DI	MG/L	1	1							100	100
SW6020A_DI	Molybdenum, DI	MG/L	1	1							100	100
SW6020A_DI	Nickel, DI	MG/L	1	1							100	100
SW6020A_DI	Selenium, DI	MG/L	1	1							100	100
SW6020A_DI	Silver, DI	MG/L	1		1						100	100
SW6020A_DI	Strontium, DI	MG/L	1	1							100	100
SW6020A_DI	Thallium, DI	MG/L	1		1						100	100
SW6020A_DI	Uranium, DI	MG/L	1	1							100	100
SW6020A_DI	Vanadium, DI	MG/L	1		1						100	100
SW6020A_DI	Zinc, DI	MG/L	1		1						100	100