# *Appendix 7-A*

*Murray River Coal Project: Hydrogeology Baseline Report*

HD Mining International Ltd.

# MURRAY RIVER COAL PROJECT
# Hydrogeology Baseline Report








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July 2014

# MURRAY RIVER COAL PROJECT
# HYDROGEOLOGY BASELINE REPORT

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**Prepared for:**

HD Mining International Ltd.

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# Executive Summary

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# Executive Summary

This report presents a cumulative summary of hydrogeologic information assembled for the Murray River Coal Project (the Project) to date. The assembled information includes a compilation of information from other environmental components providing context to the hydrogeologic environment (climate, geology, hydrology), hydrogeologic data collected for other nearby projects, deep hydrogeologic data derived from mine inflow studies conducted for the Project (AMEC 2010; 2012), and the findings of a baseline hydrogeology study conducted for the Project.

Field programs conducted as early as 1977 (for the Quintette Coal project prior to development) and as late as 2014 have generated datasets consisting of overburden and bedrock geologic properties, hydraulic conductivities, groundwater levels, and groundwater chemistry.

Soil and rock samples recovered during borehole advancement were used to characterise geologic conditions and develop hydrostratigraphic delineations. Core recovered from 34 exploration boreholes, ranging in depth from 500 to 1350 m, have been used to characterise the deep lithologies in the Underground Mine Zone. Soil and shallow bedrock samples have been collected from an additional 30 boreholes, which were drilled as a focussed effort to study the baseline hydrogeologic conditions for the Project.

Hydraulic tests were conducted as drilling advanced through bedrock horizons, and used to measure hydraulic conductivity (K) of the medium. Hydraulic tests were used to measure K along ten deep (up to 955 metres below grade (mbg)) test intervals. Falling-head tests were conducted in packer zones along 26 intervals in nine boreholes during the baseline hydrogeology study. 23 K measurements derived from single well response tests conducted for other Projects (Quintette and Hermann Coal Projects) within the local study area have also been used.

Individual standpipe piezometers (wells) were installed in 30 boreholes following completion of drilling. Two vibrating wire piezometers (VWPs) were installed in each of two additional boreholes following completion of drilling. Wells were developed by air lifting with compressed air or surging and over pumping with an inertial pump. Single well response tests (rising and falling head slug tests) were conducted in 21 installed wells, serving to further characterise K of the saturated geologic materials. Groundwater levels were measured using an electric water level meter in all wells, and using a read-out box for VWPs. Continuous water level records were acquired using pressure transducers deployed in five wells.

The hydrogeology baseline study included collection of groundwater samples from 23 wells for characterisation of groundwater quality. Samples collected for the Hermann and Quintette Coal Projects within the local study area have been reviewed in characterising groundwater quality trends as well. Most wells were sampled on a seasonal basis to capture seasonal variability over a hydrologic year. Wells were purged sufficiently prior to collection of samples. Field hydrochemical parameters were measured, and stabilisation criteria were used to determine completion of purging. Quality control protocol included collection of duplicate samples, and use of field, travel, and equipment blanks.

The tested hydraulic conductivities of the overburden materials were highly variable, as is generally expected for glacial deposition environments. A coarse granular deposit situated at the southern end of

the Underground Mine Zone produced the highest estimate (4E-4 m/s). Tests conducted in morainal and colluvial sediments ranged three orders of magnitude (4E-9 to 2E-6 m/s).

The tested hydraulic conductivities of the bedrock were also highly variable. Bedrock K measurements ranged from 6E-6 m/s to 4E-10 m/s. Measurements on the scale of E-6 and E-7 m/s have only been observed in the top 100 m of the subsurface, and indicate relatively high joint densities of fractures. Measurements on the scale of E-10 m/s, which have been measured at the full range of tested depths, likely approach K of the rock matrix, where joint density is very low.

Groundwater level measurements indicate that groundwater flows from foothill highland areas towards the Murray River. Vertical hydraulic gradients measured using twinned wells indicate that the Murray River acts as a regional discharge zone and smaller tributaries act as localized discharge zones for shallow groundwater.

Groundwater levels vary seasonally by one to two metres. The periods of greatest recharge and highest water levels occur following spring freshet, major summer convective storm cycles, and mid-winter warm spells.

Groundwater throughout the local study area is slightly basic (mean pH of 7.2 to 8.4). Calcium and bicarbonate tend to be the dominant ions in the shallow groundwater (less than 50 mbg), and sodium and bicarbonate dominate in the deeper groundwater. TDS trends upwards with depth.

Concentrations of dissolved barium, iron, lithium, and manganese have consistently exceeded the BC Ministry of Environment's guidelines for the protection of freshwater aquatic life or raw drinking water supply in samples collected from a number of well. Elevated concentrations of the aforementioned metals are considered natural baseline occurrences. Positive detections of aluminum, arsenic, chromium, copper, and selenium have exceeded guidelines for the protection of freshwater aquatic life or drinking water in isolated samples.

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# MURRAY RIVER COAL PROJECT
# HYDROGEOLOGY BASELINE REPORT

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# Glossary and Abbreviations

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# Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

| | |
|---|---|
| **AMEC** | AMEC Earth and Infrastructure |
| **ARD** | Acid Rock Drainage |
| **BC MOE** | British Columbia Ministry of Environment |
| **BCWQG FAL** | British Columbia Water Quality Guidelines for Fresh Water Aquatic Life |
| **CDDL** | Canadian Dehua Drilling Ltd. |
| **CDIMG** | Canadian Dehua International Mines Group Inc. |
| **FWAL** | Fresh water aquatic life |
| **GPS** | Global Positioning System |
| **ID** | Identification |
| **K** | Hydraulic conductivity |
| **LSA** | Local Study Area |
| **masl** | metres above mean sea level |
| **mbg** | metres below grade |
| **MPa** | Megapascals |
| **Mtpa** | Million tons per annum |
| **PAH** | Polycyclic Aromatic Hydrocarbons |
| **PRC** | Peace River Coalfield |
| **PVC** | Polyvinyl Chloride |
| **ERM-Rescan** | ERM Canada Ltd. |
| **RSA** | Regional Study Area |
| **VWP** | Vibrating Wire Piezometer |

# 1. Introduction

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# 1. Introduction

HD Mining International Ltd. (HD Mining) proposes to develop the Murray River Coal Project (the Project) as a 6 million tonne per annum (6 Mtpa) underground metallurgical coal mine. The property is located approximately 12.5 km south of Tumbler Ridge, British Columbia (Figure 1-1), and consists of 57 coal licences covering an area of 16,024 hectares. The Project is located within the Peace River Coalfield (PRC), an area with a long history of metallurgical grade coal mining, mainly open pit mining. HD Mining is proposing to access deeper zones of the coal field (600 to 1,000 m below surface) using underground mining techniques.

In October 2011, HD Mining submitted an application to the BC Ministry of Energy and Mines and Ministry of Environment seeking permission to complete a bulk sampling program as part of exploration of the property. In March 2012, HD Mining received approval to conduct a 100,000 tonne bulk sample for the purpose of conducting testing to assist in developing markets for the coal.

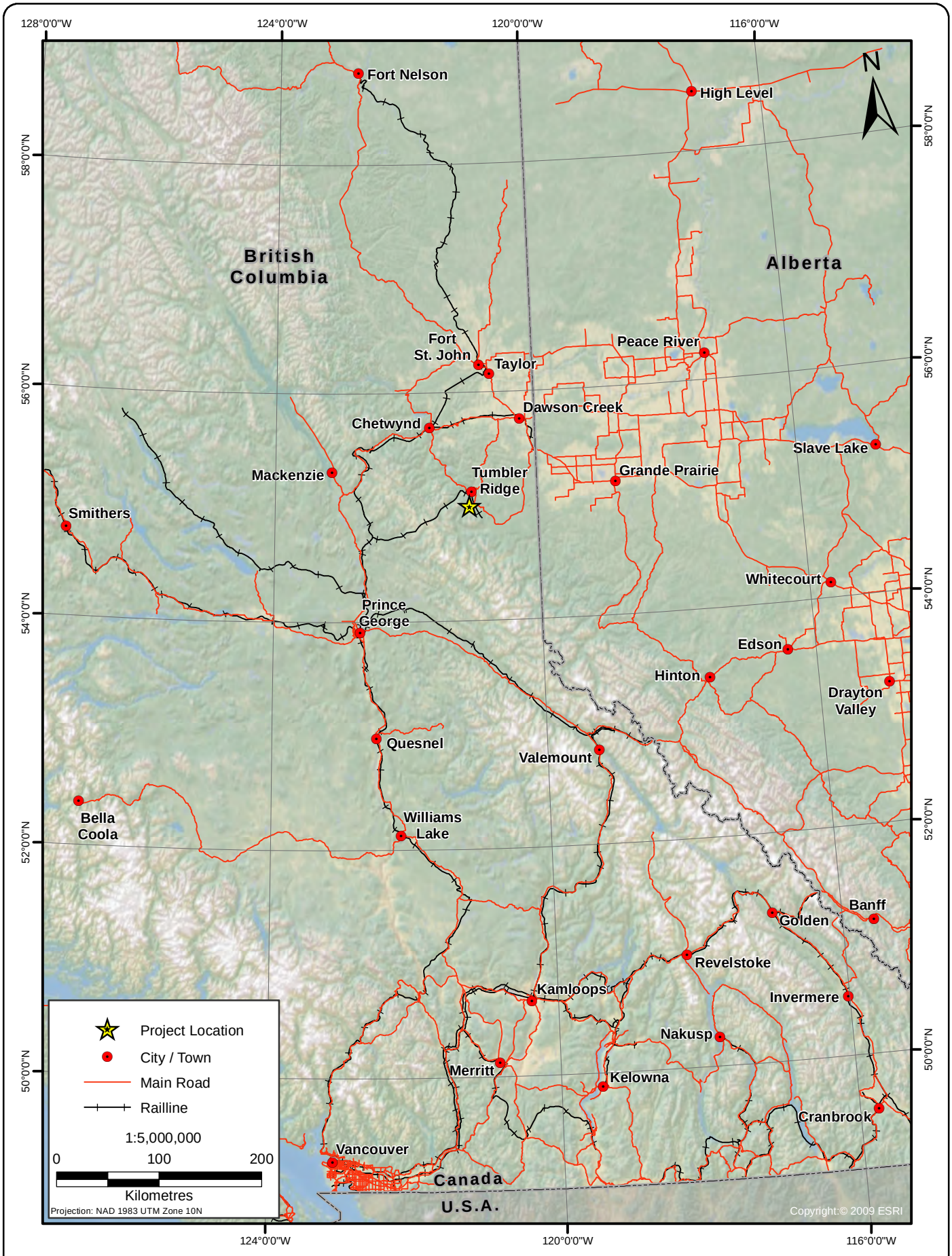
Beyond the bulk sample program, in order to develop a full mine at the proposed 6 Mtpa production level, the Project is subject to both the BC and Canadian environmental assessment processes. Development of any infrastructure for the full mine is not permitted before the requirements of these processes are met.

To support HD Mining's planning and development of the Project, and to contribute to the environmental assessment process, environmental and socio-economic baseline studies were initiated by ERM Consultants Canada Ltd. (ERM Rescan). Project-specific studies began in 2010 and have continued through 2014. As appropriate and available, historical data from government sources and neighbouring projects, as well as traditional use/knowledge information, have been compiled and incorporated into the analysis.

In order to help guide the scope of baseline studies, regional and local study areas (RSA and LSA, respectively) have been developed (Figures 1-2 and 1-3). The RSA is intended to encompass an area beyond-which effects of the Project would not be expected. It is also intended to be hdyrogeologically relevant, based on the groundwater catchment divides indicated by terrain and rivers / streams in the region. The LSA encompasses an area surrounding the proposed Project infrastructure within-which direct effects from the Project may be anticipated. The LSA boundary has also been developed following natural terrain and drainage boundaries in order to be hydrogeologically relevant.

This report presents a cumulative summary of all hydrogeology information compiled for the Project to date.

An understanding of the Project hydrogeology is necessary in order to conduct a sound assessment of potential effects of the Project on the environment, as well as for the design and implementation of an appropriate groundwater monitoring plan.

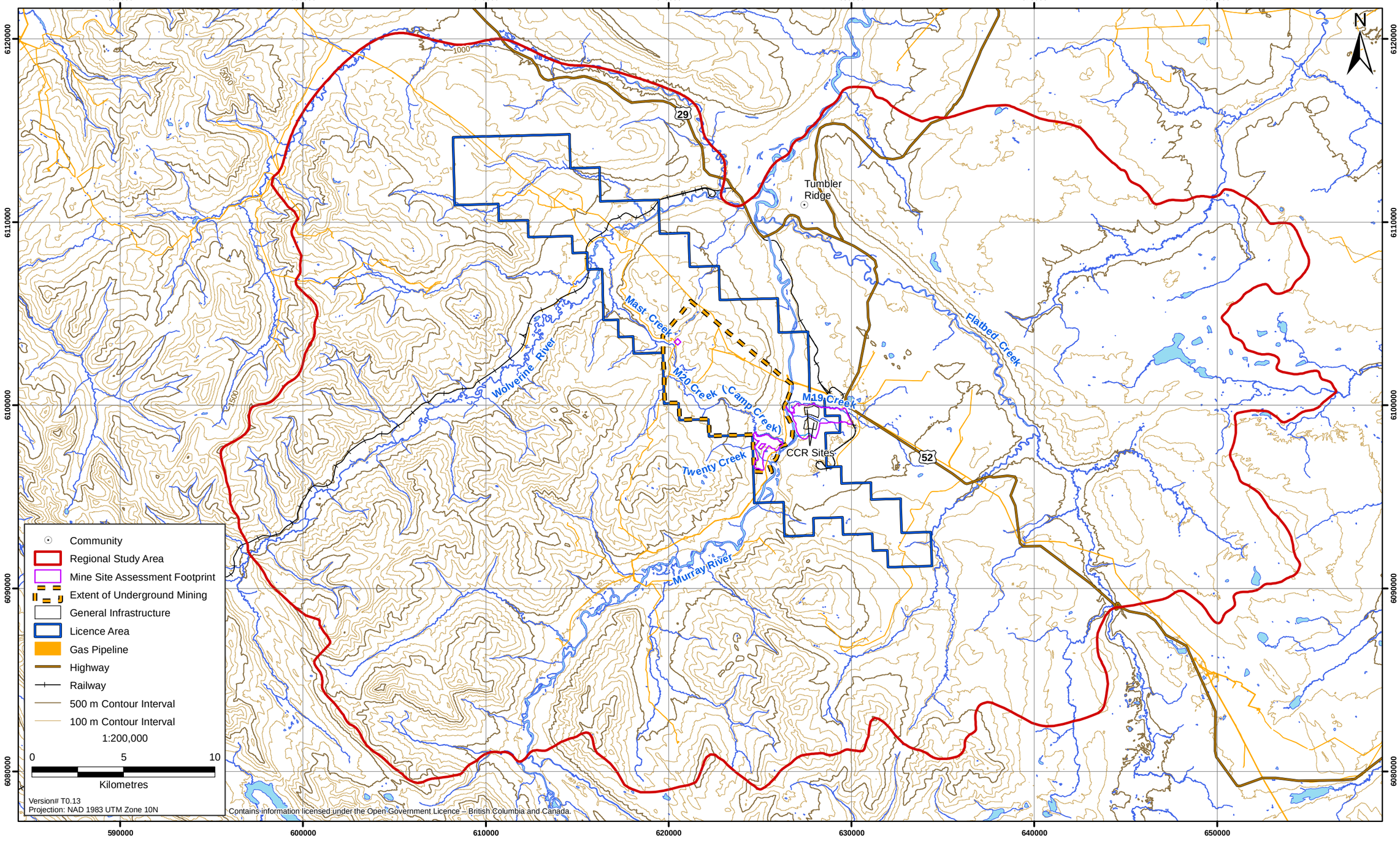



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# Project Location

Figure 1-1

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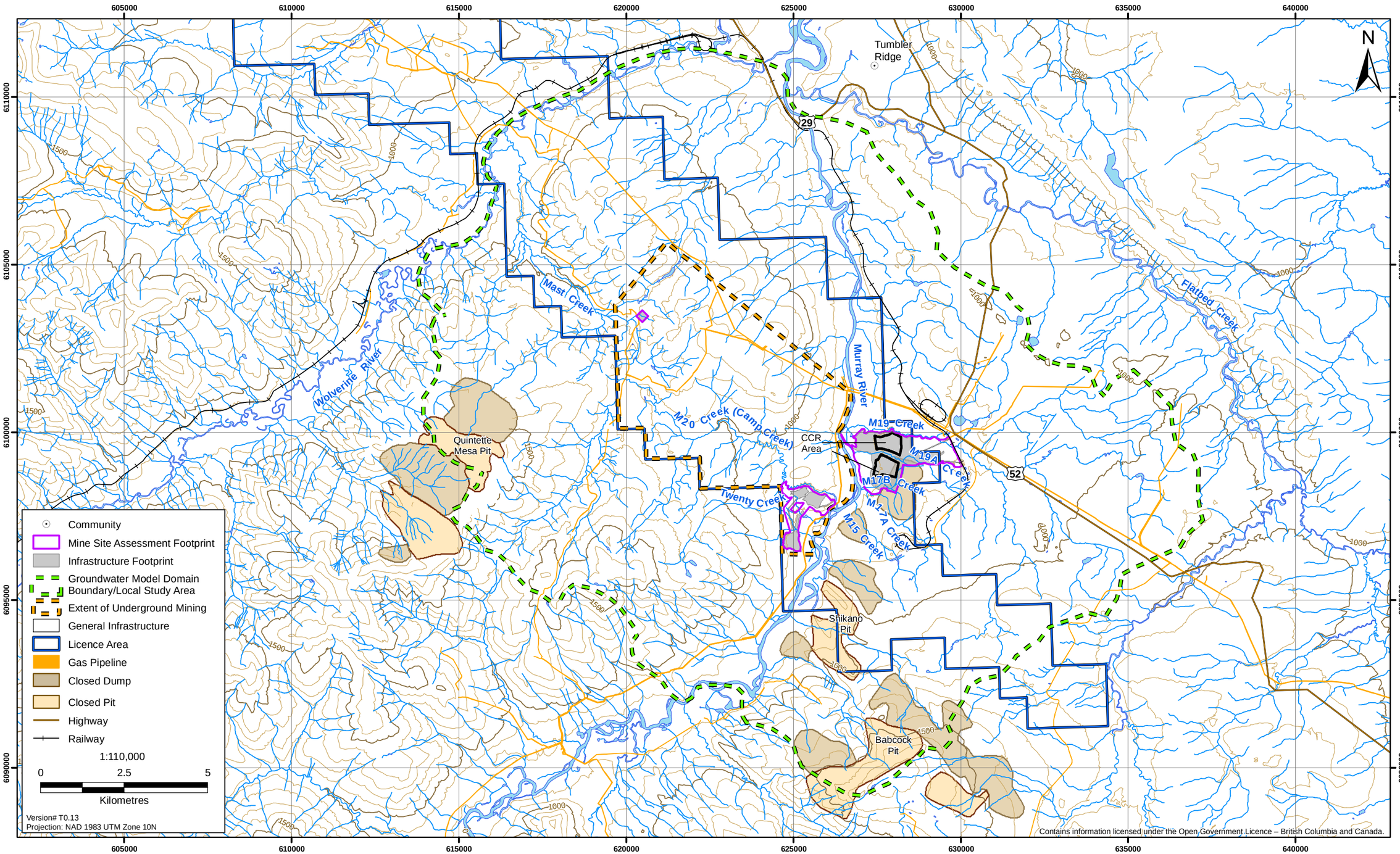



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**Figure 1-2**

## Baseline Hydrogeology Regional Study Area

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**Figure 1-3**

## Baseline Hydrogeology Local Study Area

The objectives of the hydrogeology baseline program were to:

- characterize the baseline, pre-development groundwater conditions;
- characterize the overburden and bedrock types present and their hydraulic conductivities, and identify hydrostratigraphic units;
- characterize groundwater levels and groundwater flow directions, recharge and discharge zones, and groundwater quality;
- evaluate seasonal variability in groundwater levels and groundwater quality; and
- provide sufficient baseline information upon-which to base assessment of the Project's potential environmental effects and to design an appropriate groundwater monitoring program.

The following chapters outline the available background information that supports the hydrogeology baseline study (Chapter 2); rationale used to identify and place the monitoring sites and a description of the methods used to collect the Project-specific data (Chapter 3); the results of data collection (Chapter 4); and a summary that synthesizes the findings of the baseline program (Chapter 5).

# 2. Background Information

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# 2. Background Information

Information provided by other resources that are pertinent to the characterisation of baseline hydrogeology conditions for the Project is presented here. Existing pertinent geologic, meteorologic, and hydrologic conditions that influence the groundwater environment are summarized, with reference to primary sources for additional detail. The regional hydrogeologic context is presented with reference to other nearby projects with existing data. Finally, results of other hydrogeology site investigations conducted at the Project site are presented.

## 2.1 GEOLOGY

### 2.1.1 Bedrock

The proposed mine site is located within the Peace River Coalfield (PRC) in the eastern foothills of the Canadian Rocky Mountains, in the transition area between the more faulted and tightly folded areas in the west to the less structurally complex areas in the east (Norwest 2010). The western margin of the foothills belt is usually classified as the easternmost major thrust fault that emplaced Paleozoic strata over Mesozoic strata. The eastern margin of the foothills is a series of en echelon thrust faults that separate the foothills from the gently dipping strata of the Alberta Plateau (Norwest 2010). The foothills belt is characterized by folded and faulted Mesozoic sedimentary rock.

The stratigraphic column observed in core recovered during exploration drilling consists of formations belonging to the Lower Cretaceous Fort St. John Group (Table 2.1-1). The Hasler formation has consistently been documented as the shallowest member, however this shallowest member is also being regarded as an undifferentiated group which may include other younger members. The Gates formation contains the target coal beds, and is typically the deepest member documented in exploration boreholes. The Moosebar and Gething formations have been observed below the Gates formation in deeper boreholes.

**Table 2.1-1. Stratigraphy Observed at the Murray River Coal Project Site (Norwest 2010)**

| Epoch | Group | Formation | Lithology |
|---|---|---|---|
| Upper Cretaceous | Dunvegan | | Coarse clastic sedimentary rocks |
| Lower Cretaceous | Fort St. John | Cruiser | Mudstone, siltstone, shale, fine clastic sedimentary rocks |
| | | Goodrich | Coarse clastic sedimentary rocks |
| | | Hasler | Silty dark grey marine shale with sideritic concretions; minor sandstone and conglomerate; siltstone in lower part; basal conglomerate |
| | | Boulder Creek | Fine-grained, well-sorted sandstone; carbonaceous sandstone; massive conglomerate; siltstone; mudstone; minor coal |
| | | Hulcross | Dark Grey marine shale and siltstone with sideritic concretions |
| | | Gates | Fine-grained, well-sorted sandstone; carbonaceous sandstone and mudstone; coal; shale; minor conglomerate |
| | | Moosebar | Dark grey marine shale with sideritic concretions; siltstone; glauconitic sandstone; chert conglomerate at base |
| | Bullhead | Gething | Fine- to coarse-grained calcareous, carbonaceous sandstone; coal; carbonaceous shale and conglomerate; siltstone |

Regional geologic mapping indicates the Cruiser and Goodrich formations overlie the Hasler formation at the CCR site (Massey et al. 2005). The Cruiser and Goodrich formations may also overly the Hasler along northeastern reaches of the Project site on the western side of the Murray River.

Folding and faulting have been documented within and around the local study area (Appendix F). A sequence of anticlines and synclines with northwest/southeast axes span the study area. The Mesa thrust fault outcrops a few kilometres west of the south mine site, striking southeast. Less extensive strike-slip faults have been observed along fold limbs, with traces trending northwest/southeast.

A sequence of cross-sections generated from geologic modelling exercises is provided in Appendix F. Additional information documenting bedrock geology at the Project site may be found in Norwest (2010).

### 2.1.2 Quaternary Geology

Sediments in the LSA are dominated by glacial deposits with lesser amounts of fluvials, colluvials and organics (surficial distributions are shown in Figure 2.1-1). Morainal sediments cover approximately half the LSA, consisting of well-compacted, non-stratified mixtures of sand, silt, and clay, with a heterogeneous mixture of sub-rounded to angular coarse fragments. Glaciofluvial materials are found along the slopes of the Murray River valley, consisting of stratified sands and silts with frequent rounded to sub-rounded coarse fragments. Fluvial deposits dominate the flood plains of the Murray River valley, consisting largely of well-sorted, stratified sands and gravels, and sometimes containing considerable fractions of silt and clay.Colluvial materials are found along moderate to steep slopes throughout the LSA, consisting of poorly sorted, heterogeneous materials. Organic materials are found in wet lowlands, consisting of poorly to moderately decomposed peat.

Additional information documenting overburden materials found on the Project site may be found in the Terrain and Soils Baseline Report (ERM 2013).

## 2.2 CLIMATE AND METEOROLOGY

Meteorological conditions in the Tumbler Ridge region are heavily influenced by the orographic shadow created by the Rocky Mountains, which are situated to the west and southwest. In general, moist coastal air masses from the west release precipitation on the western side of the Rocky Mountains, resulting in drier conditions to the east. Mean annual precipitation at weather stations near the project site range from 450 to 800 mm.

Precipitation amounts are greatest during the summer months, when convective weather systems bring thunderstorms (Figure 2.2-1). The majority of precipitation from November to April occurs as snow and represents about 30 to 50% of the annual total precipitation.

Mean monthly temperatures in the region range from a high of 15˚C in July to a low of -10˚C in January (Figure 2.2-1). Temperatures are generally above freezing from April to October; however, freezing conditions may occur at any time of the year at higher elevations. Mid-winter thaws may also occur on occasion due to Chinook winds.

Additional information documenting climate and meteorology in the Tumbler Ridge Region and at the Project site may be found in the Meteorology Baseline Report (Rescan 2013a).

610000 615000 620000 625000 630000 635000

6105000 6100000 6095000 6090000

N

Wolverine River
Mast Creek
Flatbed Creek
Murray River
M20 Creek / Camp Creek
M19 Creek
CCR Sites
52
Twenty Creek
M17A Creek
M15 Creek

**Surficial Material Type**

- Anthropogenic
- Colluvial
- Weathered Bedrock
- Fluvial
- Glaciofluvial
- Morainal
- Bedrock
- Organic
- Water

- Community
- Groundwater Model Domain Boundary/Local Study Area
- Mine Site Assessment Footprint
- Extent of Underground Mining
- Licence Area
- General Infrastructure
- Gas Pipeline
- Highway
- Railway

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0 2 4

Kilometres

Version# T0.13
Projection: NAD 1983 UTM Zone 10N

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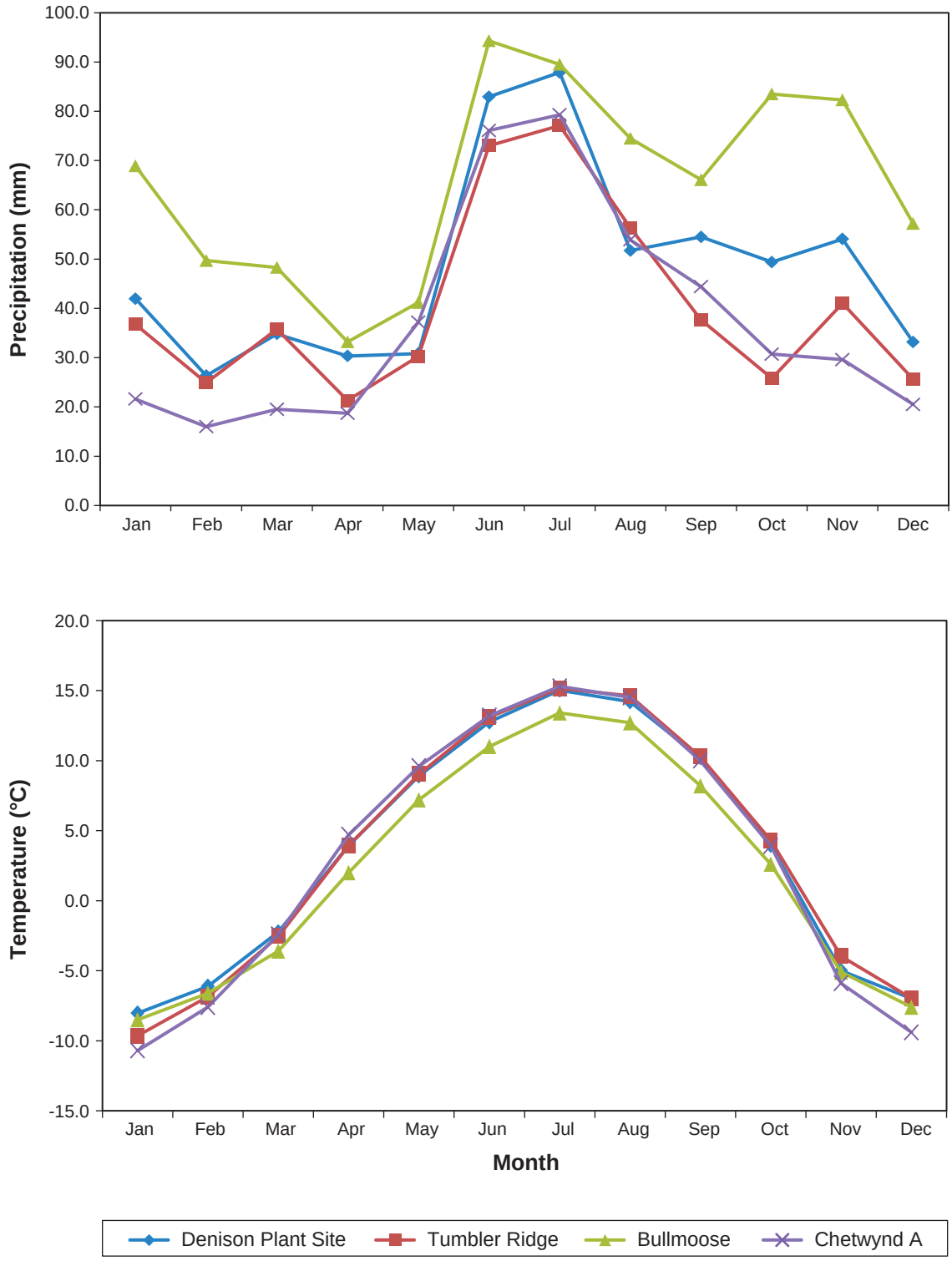
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Figure 2.1-1

## Distribution of Surficial Sediments in the Local Study Area

**Figure 2.2-1**

**Monthly Precipitation and Temperature Data Obtained from Meteorology Stations within and near the Local Study Area**



## 2.3 HYDROLOGY

On the west side of Murray River, the mine sites are situated within the Twenty and M20 Creek (also referred to as Camp Creek) drainage basins. The CCR site is situated within the drainage basins of two small creeks (M17 and M19A), which report eastward to the Murray River.

The Murray River flows northward, discharging into the Pine River 40 km downstream from the Village of Chetwynd, BC. Both the Pine and Murray Rivers belong to the greater Peace River drainage system, which drains into the Arctic Ocean via the Slave and Mackenzie Rivers.

Streams generally peak during spring freshet (April), with high flow rates continuing into mid-summer, as sustained by convective rainfall events. Moderate flow rates are generally observed from late summer to mid-fall. Low flows occur from mid-fall through early spring, as sustained by groundwater discharge.

Additional information documenting the hydrologic setting for the Project may be found in the Hydrology Baseline Report (ERM Rescan 2014).

## 2.4 EXISTING HYDROGEOLOGY DATA FOR NEARBY PROJECTS

Three nearby mineral projects have generated baseline hydrogeology data within the RSA and LSA. Components of the Quintette and Hermann Projects are situated within the LSA. Other components of the Quintette and Hermann Projects are situated within the RSA, as well as the Roman and Trend Projects. Hydrogeology data collected for these projects that are situated within the catchment basins with potential to interact with the Project are briefly summarized herein. Monitoring wells installed to support these projects that are within the LSA for the Murray River Project are shown on Figure 2.4-1.

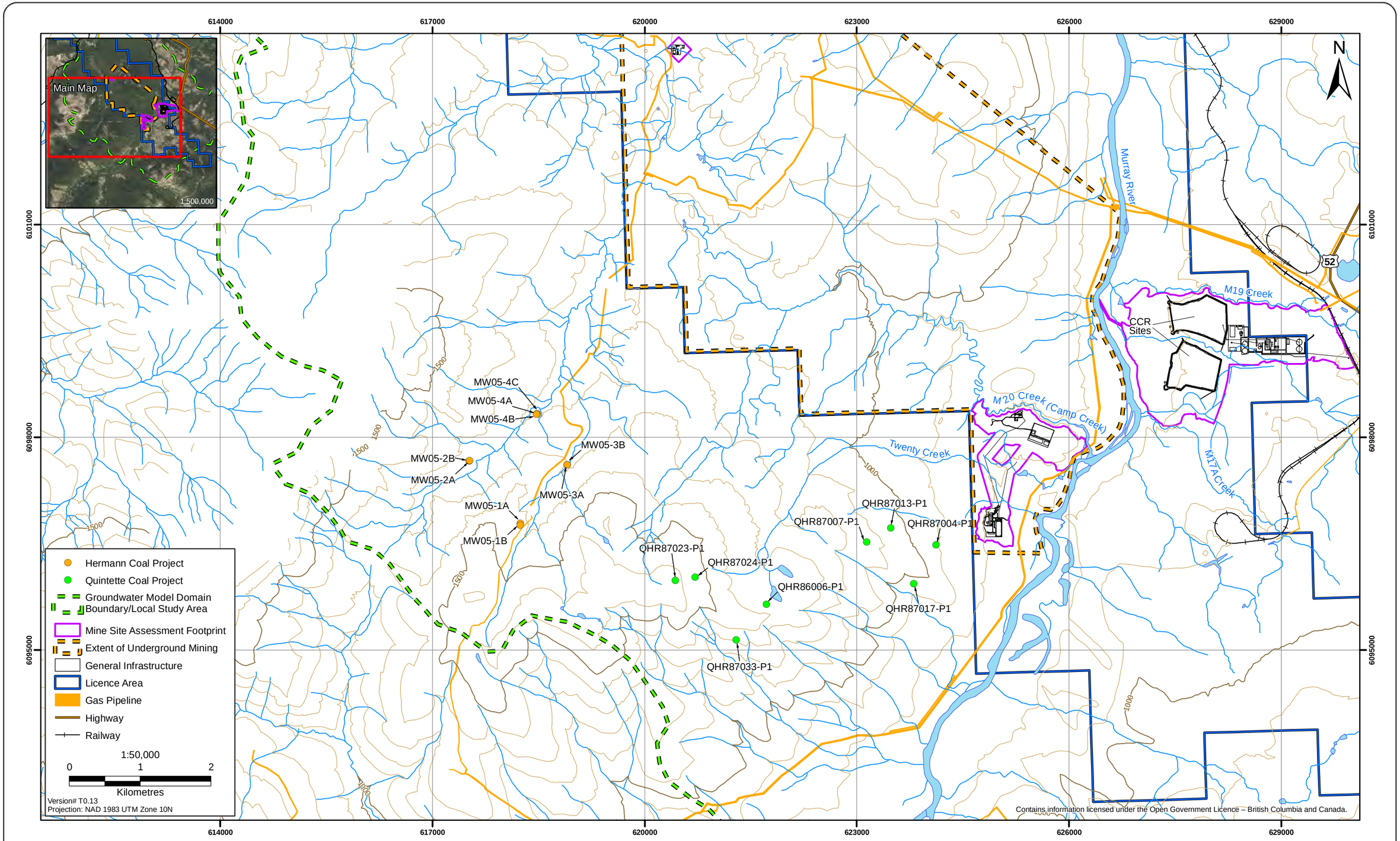
### 2.4.1 Hermann Coal Project

Baseline groundwater conditions established for the Hermann Mine project are presented in full in Western Canadian Coal (2007). Ten monitoring wells were installed in the upper M20 Creek basin, with collection of permeability, water level, and water quality data. Available data are summarized in Table 2.4-1.

**Table 2.4-1. Permeability and Water Level Measurements Obtained in Baseline Studies Conducted for the Hermann Coal Project (Adapted from Western Canadian Coal 2007)**

| Monitoring Well ID | Ground Elevation | Screen Depth | | | | Groundwater Level (masl) A | | |
|---|---|---|---|---|---|---|---|---|
| | | From | To | K (m/s) | Screened lithology | Dec-05 | Feb-06 | Aug-06 |
| MW05-1A | 1422.46 | 48.92 | 55.02 | 8.0E-08 | Siltstone | 1415.68 | 1413.51 | 1413.86 |
| MW05-1B | 1422.46 | 14.63 | 20.73 | 1.0E-08 | Siltstone | 1417.82 | 1415.73 | 1415.78 |
| MW05-2A | 1262.82 | 57.9 | 60.96 | 1.0E-09 | Sandstone | 1233.65 | 1251.21 | 1247.85 |
| MW05-2B | 1262.82 | 24.08 | 27.13 | 7.0E-07 | Sandstone | 1260.66 | 1259.05 | 1259.51 |
| MW05-3A | 1291.58 | 48.46 | 51.51 | 6.0E-06 | Siltstone | 1299.18 | 1298.18 | 1292.18 |
| MW05-3B | 1291.58 | 23.16 | 26.21 | 4.0E-08 | Siltstone | 1292.54 | 1292.44 | 1292.24 |
| MW05-4A | 1201.44 | 78.64 | 81.69 | 1.0E-07 | Siltstone | 1200.85 | 1200.87 | na |
| MW05-4B | 1201.44 | 48.16 | 51.21 | 6.0E-06 | Siltstone | 1198.86 | 1199.35 | 1198.94 |
| MW05-4C | 1201.44 | 9.9 | 12.95 | 2.0E-06 | Morainal Sediments | 1194.96 | 1194.67 | 1194.47 |
| HR005-11 [A] | 1231.06 | na | 204.5 | 2.0E-06 | various | 1231.21 | na | 1230.21 |

*na indicates data not available*
*[A] Open borehole*




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MURRAY RIVER COAL PROJECT

**Figure 2.4-1**

## Existing Groundwater Monitoring Instrumentation Installed at Nearby Mining Projects

Recharge zones were established spanning most of the project area, with a local discharge zone along M20 Creek. Water level records are only available for one monitoring event, conducted in December 2005. Measured water levels ranged from 7 mbg in recharge areas to 7 m above grade (artesian) near M20 creek.

Hydraulic conductivity estimates ranged from 1E-9 m/s to 6E-6 m/s for the eight measurements conducted along intervals of bedrock (depths ranging 15 to 80 mbg in siltstone and sandstone formations). The single measurement conducted in overburden material (morainal sediments) was 2E-6 m/s. The wide ranging of hydraulic conductivities measured in the bedrock indicates a strong influence of fractures and fault zones on permeability.

Groundwater quality data indicate the fluids in bedrock fractures is fresh (total dissolved solids ranging from 294 to 789 mg/L) with neutral pH (ranging 7.4 to 8.3). Calcium and bicarbonate are the dominant anions in the shallower groundwater, with a transition from calcium towards sodium dominance in the deeper groundwater. Total dissolved solids generally increase with depth. Dissolved metals concentrations are generally below BC Ministry of Environment's guidelines for the protection of freshwater aquatic life and raw drinking water supply, and the occasional exceedances that have been documented may be artefacts of sampling practices.

### 2.4.2 Quintette Coal Project

The Quintette Project includes historic mining activities that occurred from 1982 to 2000, and a proposed expansion that has not commenced construction at the time of writing. Historic activities included development of the Mesa and Wolverine Pits and adjacent waste dumps that partially lie within the upper M20 Creek drainage basin, and a tailings storage facility immediately up-slope of the proposed CCR site (referred to as the Old Tailings Storage Facility). Numerous other decommissioned workings are present east and southeast of the Murray River, outside of the catchment basins that may interact with the Murray River Project.

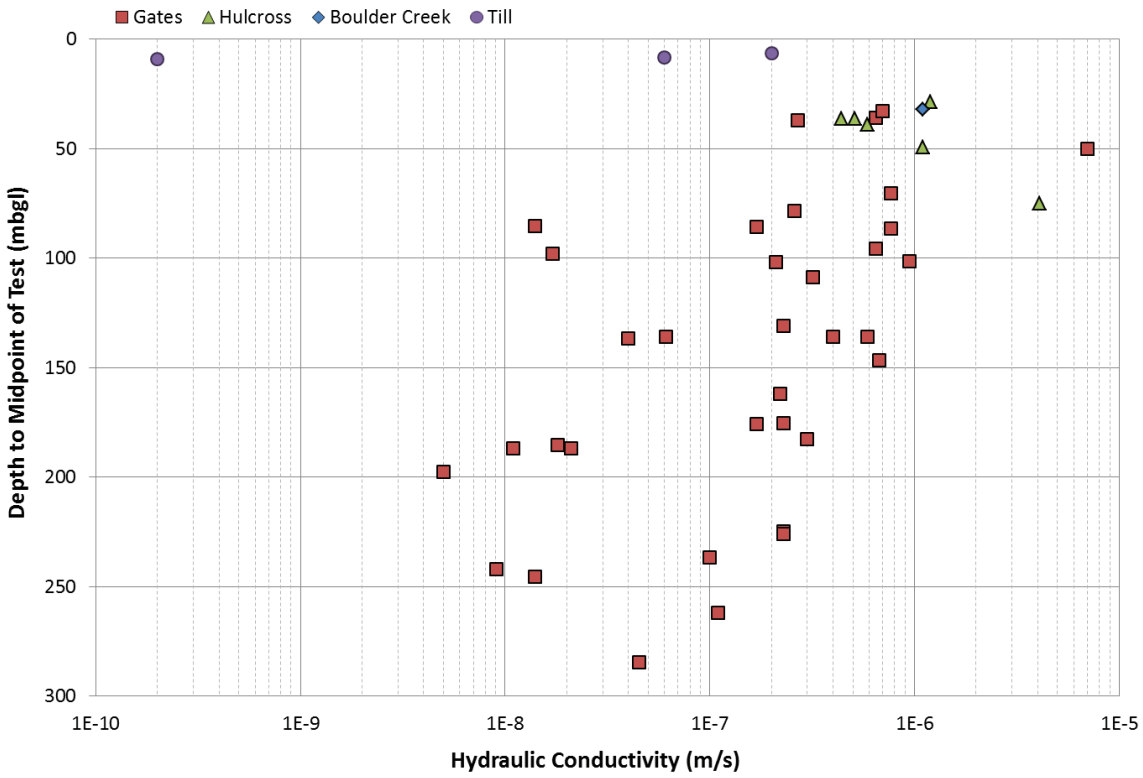
A number of hydrogeology studies have been carried out in relation to the Quintette Project development, dating as early as 1977. Findings of most of these studies are documented in SRK (2012) which presents the baseline groundwater conditions established for the proposed Quintette Mine expansion project. Most proposed workings and related hydrogeology data are not within the catchment basins that may interact with the Murray River Project, as M17 creek and the Murray River provide discharge zones that isolate project components associated with the two projects from one-another. The exception is the Old Tailings Storage Facility, which is up-gradient of the proposed CCR site. No documentation of hydrogeological investigation with coverage of the the Old Tailings Storage Facility has been identified.

SRK (2012) documents 43 hydraulic conductivity measurements for the Mount Babcock area of the Quintette Project Site (southeast of the Murray River). Hydraulic conductivities ranged from 5E-9 m/s to 6E-6 m/s in the bedrock (Gates and Hulcross formations), and from 2E-10 m/s to 2E-7 m/s in the overburden. A general decline in hydraulic conductivity with depth is suggested by the dataset (Figure 2.4-2), which includes tests up to depths of 250 to 300 mbg. While the Gates and Hulcross formations are also found on the Murray River Project site, they are at greater depths and in the presence of different structural features. Hydraulic conductivity of the bedrock is expected to be influenced by a combination of depth, geologic composition, and the structural setting.

Water level measurements documented in SRK (2012) do not capture seasonal variability, as the frequency of measurement is not adequate.

**Figure 2.4-2**

**Hydraulic Conductivity Estimates**
**Published for the Nearby Quintette Coal Project**



In addition to the studies documented in SRK (2012), a field study was carried out in the upper M20 creek catchment basin in 1987 to support mine inflow design and baseline groundwater quality characterisation for the proposed Grizzly and Transfer pits and associated waste rock dumps (findings summarized in Table 2.4-2, adopted from Section 8 in Hermann Mien Project EA Certificate Application). Two groundwater samples collected from 115 and 130 mbg reflect slightly alkaline (pH 8.1 and 8.3), hard (hardness of 2.5 and 272 mg/L as $CaCO_3$) groundwater with bicarbonate and calcium as the dominant ions. Hydraulic conductivities were consistently low, ranging from 6E-6 to 9E-10 m/s.

**Table 2.4-2. Permeability and Water Level Measurements Obtained in the Previously Proposed Grizzly and Transfer Pit Area**

| Monitoring Well ID | Ground Elevation | Screen Depth | | K (m/s) | Screened lithology | Groundwater Level (masl)[A] |
|---|---|---|---|---|---|---|
| | | From | To | | | |
| QHR87004-P1 | 931.67 | 100.4 | 92.1 | 2.0E-07 | Coal (J seam) | 894.55 |
| QHR87004-P2 | | 64.34 | 57.04 | 2.0E-07 | na | 924.91 |
| QHR87004-S3 | | 52.8 | 49.75 | - | na | 924.4 |
| QHR87007-P1 | 1117.65 | 169.75 | 166.45 | 2.0E-08 | na | 1060.75 |
| QHR87007-P2 | | 133.6 | 122.6 | - | Coal (G seam) | 1059.19 |
| QHR87007-S3 | | 110 | 106.95 | - | na | 1059.19 |
| QHR87013-P1 | 1041.15 | 139.63 | 131.83 | 8.0E-09 | na | 1037.49 |
| QHR87013-P2 [A] | | 118.02 | 110.12 | 6.0E-06 | na | 1044.24 (artesian) |
| QHR87013-S3 | | 100.7 | 97.65 | - | na | flowing artesian |
| QHR87017-P1 | 1014.93 | 161.35 | 158.3 | 4.0E-09 | na | 997.05 |
| QHR87017-P2 [A] | | 135.15 | 128.45 | 6.0E-06 | na | 1016.27 (artesian) |
| QHR87017-S3 | | 127.2 | 119.5 | - | na | flowing artesian |
| QHR87023-P1 | 1601.62 | 169.5 | 162.5 | 3.0E-09 | na | 1520.64 |
| QHR87023-P2 | | 130.5 | 124.7 | 3.0E-09 | Coal (G seam) | 1520.89 |
| QHR87023-S3 | | 104.8 | 101.75 | - | Coal (F seam) | 1579.94 |
| QHR87024-P1 | 1564.25 | 97.3 | 88.7 | 1.0E-09 | na | 1524.1 |
| QHR87024-P2 | | 69.45 | 62.75 | 9.0E-10 | na | 1532.56 |
| QHR87024-S3 | | 37.8 | 34.75 | - | na | 1551.22 |
| QHR87033-P1 | 1437.7 | 99 | 93.9 | 5.0E-08 | na | 1386.34 |
| QHR87033-S2 | | 71.6 | 68.55 | - | Coal (J seam) | 1383.25 |
| QHR86006-P1 | 1325.06 | 99.2 | 94.6 | - | siltstone | 1326.99 |
| QHR86006-P2 | | 69.3 | 61.5 | 7.0E-08 | Coal (J seam) | 1331.5 (artesian) |
| QHR86006-S3 | | 38.7 | 35.65 | - | Siltstone | flowing artesian |

*na indicates data not available*
*[A] Groundwater sample collected*

## 2.5 RESULTS OF OTHER HYDROGEOLGY SITE INVESTIGATIONS CONDUCTED FOR THE PROJECT

AMEC Environmental and Infrastructure (AMEC) conducted packer and pumping tests in deep boreholes at the project site. The results provide data that may be used to estimate permeability of the deeper formations that would be encountered in underground mine workings (AMEC 2010, 2012). The calculated hydraulic conductivities are presented in Table 2.5-1.

**Table 2.5-1. Hydrogeologic Properties Obtained from Deep Borehole Tests (Adapted from AMEC 2010; 2012)**

| Borehole ID | Test no. | Formation [C] | Ground elevation (masl) | Test Interval Location (masl) | | Test Type [B] | Hydraulic Conductivity (m/s) | Storativity | Interpreted Pieometric Head (masl) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Top | Bottom | | | | |
| H2 | 1 | Boulder Creek | 1111.9 | 510.0 | 240.0 | CD-R | 5.E-09 | - | 1094 |
| | 2 | Hasler | | 910.0 | 530.0 | CD-R | 2.E-09 | - | > 1134 |
| | 4 | Hasler and Overburden | | 1090.0 | 530.0 | CH-R | 4.E-10 | - | - |
| H16W | 1 | Gates | 835.5 | 40.0 | -120.0 | CH-R | 6.E-09 | 3.E-04 | 831.5 |
| | 2 | Gates/Hulcross/ Boulder Creek | | 260.0 | -120.0 | CH-R | 2.E-09 | 2.E-05 | - |
| | 3 | Hasler | | 610.0 | 570.0 | CD-R | 3.E-08 | - | 815.4 |
| H16 [A] | OW | Boulder Creek / Hulcross | 836 | 250.0 | 120.0 | - | - | - | 853.8 |
| H16A | OW | Tertiary | 839.3 | 65.0 | 72.0 | - | - | - | 784.9 |
| P1R35 | 1 | Gates | 1083 | 482.0 | 413.0 | P-DR | 5.E-10 | - | 1097.7 |
| | 2 | Gates | | 531.0 | 483.0 | P-I | 2.E-07 | - | - |
| | 3 | Gates | | 617.0 | 563.0 | P-I | 3.E-08 | - | - |
| | 4 | Boulder Creek | | 811.0 | 728.0 | P-I | 3.E-08 | - | - |

Prior to most tests and after setting packers to isolate the test interval, the hydraulic head in the test zone was allowed to equilibrate. The equilibration period was generally too short to attain true static water levels, therefore the measurements are considered estimates and have only been used in a qualitative sense for more involved interpretation of the hydrogeologic system. Water levels reported for certain tests have been omitted from Table 2.5-1, because the documentation does not clarify that an equilibration period was sustained prior to commencement of the test.

Two different types of packer tests were performed at different intervals in one borehole (P1R35). One shut-in test was performed (referred to as a recovery and discharge test in AMEC 2010), followed by three injection (lugeon) tests. A shut-in test involves monitoring change in pressure in the test interval without displacement of a water column, and was used for one very low permeability test interval. Injection packer tests involve attaining steady zone pressures while injecting fluids into the test zone at multiple sustained discharge rates.

Two different types of pumping tests were conducted: constant discharge and constant head. Pumping was conducted for 40 to 48 hours, followed by monitoring for 24 to 56 hours during recovery. Further documentation of the methodologies is provided in the report prepared by AMEC, which is included in Appendix A.

The packer configuration used to isolate test intervals in borehole P1R35 did not provide for verifiable isolation of the test interval from below. Bentonite grout was backfilled into the borehole up to the base of the test interval, and capped with a Van Ruth Plug. Data were not collected to indicate adequacy of interval hydraulic isolation. As such, the reported hydraulic conductivities may be over-estimations.

Considerable amounts of dissolved gases were observed in the discharge fluids during the pumping tests. The presence of gas complicated the attainment of constant discharge. A gas separator was used

during constant-head tests, which prevented the use of a packer to isolate test intervals. A complete discussion of limitations imposed on the results is discussed in Appendix A.

Measured piezometric heads ranged from 54 mbg at H16A to flowing artesian within the top test interval at H2. Measured hydraulic conductivities were generally low, ranging from 3E-8 m/s to 4E-10 m/s.

Water samples collected from fluids recovered during pumping tests provide information pertaining to groundwater quality along the test intervals. However, given the large volumes of the test intervals and low flow rates attained during the pumping tests, it is likely that recovered fluids contained some proportion of drilling fluids. Samples were rather alkaline (pH ranging 7.6 to 10.6) and depleted in dissolved oxygen (field measurements all below 1 mg/L). Dominant ions were consistently bicarbonate/carbonate and sodium, with lesser but significant concentrations of chloride, sulphate, and calcium. Dissolved concentrations of iron, cadmium, and lithium exceeded guidelines with some consistency. Tabulated laboratory analytical chemistry results are presented in Appendix A.

# 3. Methodology

# 3. Methodology

## 3.1 BOREHOLE DRILLING AND LOGGING

ERM Rescan hydrogeologists supervised drilling programs on four occasions from 2011 to 2013, with the objective of logging the recovered materials for hydrogeologic properties, and installing instrumentation for further hydrogeologic characterization. Drilling targets were selected largely based on the locations of proposed mine infrastructure with the potential to interact with the groundwater environment. A number of drilling targets were also set up-gradient of the proposed infrastructure and in the down-gradient receiving environment.

Cuttings and core recovered from drilling were logged to characterize hydrogeologic aspects of the intercepted lithologies. Overburden materials were logged for grain size distribution, plasticity, moisture content, and other properties as appropriate. Recovered rock core logging focused on fracture characterization (textural classification, rock quality designation, weathering grade, fracture type, healing, and infill).

ERM Rescan hydrogeologists supervised the advancement of 12 boreholes over a six month period in 2011, situated at various elevations within the M20 creek drainage basin. Seven boreholes were drilled by Canadian Dehua International Mines Group (CDIMG) using a rotary air hammer system, with target depths ranging from 100 m to 10 m. Packer tests were conducted in one of the air hammer boreholes (packer testing methodology discussed in section 3.4). Five boreholes were drilled by CDIMG using a diamond rotary (water circulation) configuration, and served the dual purpose of coal exploration and hydrogeologic data collection. The diamond rotary configuration was used to install two deep wells and two deep vibration wire piezometers (VWP; well and VWP installation methods are discussed in section 3.2), at depths up to 210 m. Packer tests were conducted in one of the diamond rotary boreholes.

In May 2012, five boreholes were drilled by Geotech Drilling Services Ltd. with monitoring well installation. A rotary air hammer configuration was used to advance the boreholes. Boreholes targeted the perimeter of the bulk sample waste rock facility and storage ponds in the Underground Mine Zone.

Six boreholes were drilled at the CCR Site by Mud Bay Drilling in October 2012. A twinned borehole configuration (one shallow and one deep borehole side-by-side) was established at three sites, for monitoring well installations. The shallow boreholes were drilled using a solid stem auger in the overburden and a rotary air hammer in the shallow bedrock. A diamond mud rotary drilling method (NQ rods) was used to advance the deep boreholes. Packer tests were conducted in the deeper boreholes.

In July 2013, seven boreholes were drilled at the CCR Site by Mud Bay Drilling. These boreholes served the dual purpose of geotechnical and hydrogeologic data collection. Drilling was supervised by a hydrogeologist from ERM Rescan and a geotechnical engineer from Ausenco Canada Inc. (Ausenco). A diamond mud-rotary drilling method (HQ rods) was used to advance the boreholes. Five boreholes had target depths of approximately 30 m, while two had target depths in the range of 100 m. Packer tests were conducted at various depths in each borehole as drilling progressed.

Geologic borehole logs prepared by CDIMG for coal resource exploration boreholes have been reviewed and used to prepare the hydrogeologic conceptual model described in Chapter 5 of this report. Data derived from the geologic logs are limited to bedrock lithology interpretation and inference of fault zone locations.

## 3.2 MONITORING WELL AND VIBRATING WIRE PIEZOMETER INSTALLATION

Monitoring wells or VWPs were installed in boreholes following completion of drilling. Installations were conducted by drill crews under the supervision of an ERM Rescan hydrogeologist. A total of 30 monitoring wells and four VWPs were installed (Table 3.2-1; Figure 3.2-1). Well construction diagrams are provided alongside borehole logs in Appendix B.

VWPs were installed in two boreholes in 2011. Two VWPs were installed in each borehole, including one rated to a maximum pressure of 1.0 megapascal (MPa) at a depth of approximately 100 m below grade (mbg), and one rated to 2.0 MPa at a depth of 200 mbg. VWPs were calibrated in a laboratory prior to shipment to the field, and tested in the field prior to installation. The VWPs were taped to a PVC support pipe and lowered down the borehole to the target depths. Boreholes were then backfilled with grout to ground surface.

Hydrogeologic borehole logs were used to design the monitoring wells. Screens were generally installed along zones interpreted to exhibit the highest hydraulic conductivity in the borehole (e.g. heavily fractured bedrock or sand deposits), or along lithologies of interest.

Well materials consistent of schedule 40 PVC pipe with diameters of one inch (25 mm), 1.25 inches (32 mm) or two inches (51 mm). Well screens consisted of slotted pipe with 0.246 mm slot sizes (size no. 10).

A filter sand pack was installed along the slotted pipe and extending above and below. Bentonite chips or coated pellets were placed above the sand pack, and sometimes also below. The borehole was then backfilled up to ground surface with bentonite, a bentonite/cuttings mix, or grout. A well cap was provided for each well and a steel well monument was installed.

## 3.3 WELL DEVELOPMENT

Monitoring wells were developed by one of air-lifting, mechanical surging, or over-pumping methods (Table 3.3-1). For each development method, attempts were made to remove a target water volume in the range of ten well volumes. Turbidities were monitored, and development was deemed adequate when field parameters (turbidity, specific conductance, pH, and ORP) approached equilibrium.

Air-lifting was conducted using a gasoline-powered, 120 psi air compressor. A 5/8” high-density polyethylene (HDPE) tube was fitted to the compressor outlet, fixed to the well collar, and lower into the well such that the outlet was located at the centre of the well screen. Air was allowed to flow continuously into wells that yielded adequate water volume to maintain flow. Lower-yielding wells were developed intermittently: Water was removed down to the HDPE tubing inlet, and then allowed to recover prior to further removal. Water was channeled into a cup upon arrival at the well collar to assess field parameters.

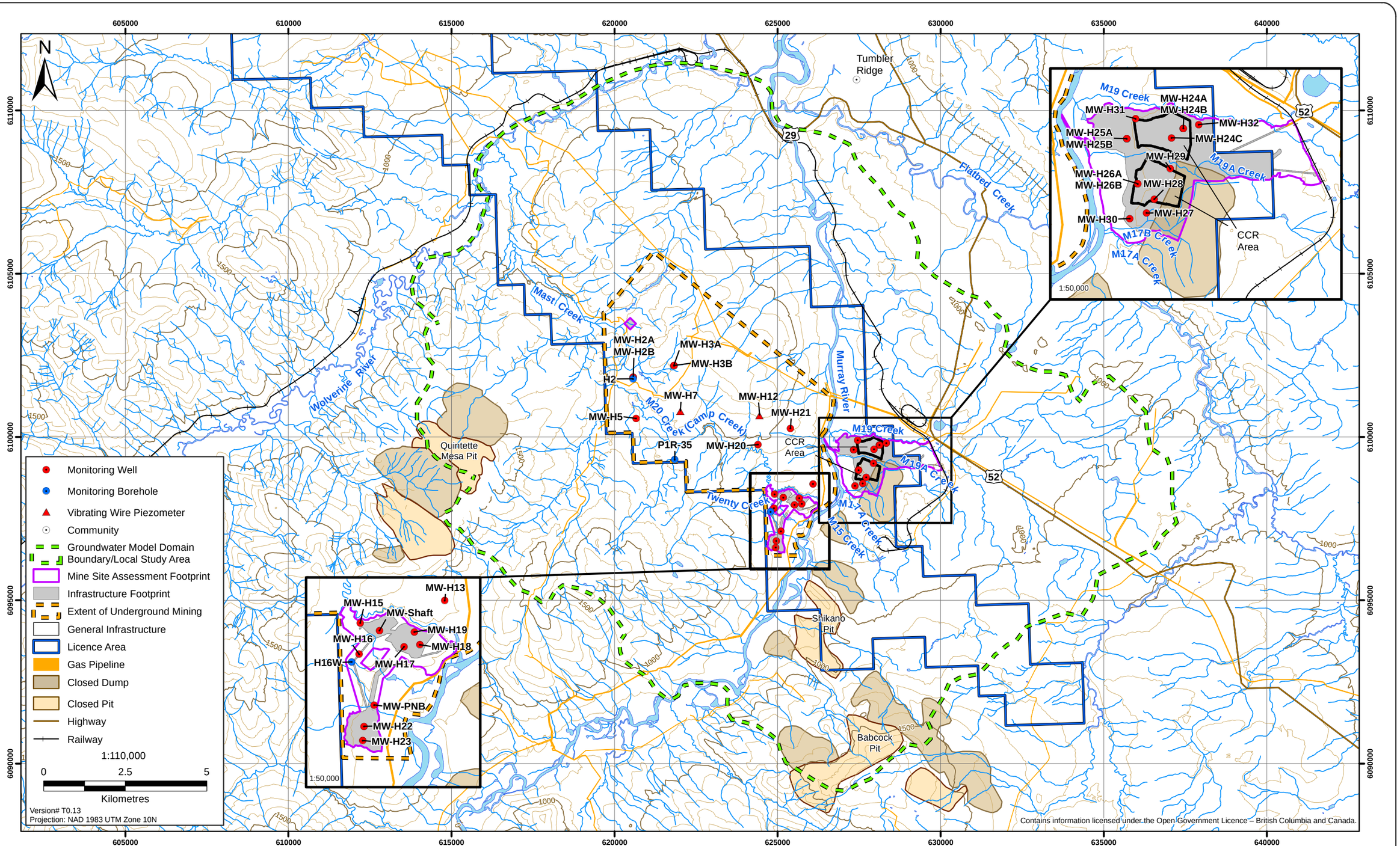
Mechanical surging was conducted using a mechanical inertial pumping system. A one-inch diameter check valve was fixed to the end of a 5/8” HDPE tube, and lowered into the well to the centre of the well screen. Repetitive up and down motion of the check valve created a surging action, and purged water from the well.

Over pumping was conducted using a peristaltic pump in wells with slow recharge. Pumping was conducted at a flow rate that produced considerable drawdown in the well. Flow was sustained for at least ten well volumes, and field parameters were assessed for approach to equilibrium conditions.

**Table 3.2-1. Groundwater Monitoring Instrumentation Completion Details**

| Instrument ID [A] | Collar Location | | | Ground Elevation (masl) | Stick-up Height (m) | Borehole Diameter (m) | Depth of Hole (mbgs) | Well Diameter (m) | Sand Pack | | Screened Interval [B] | | General Area | Drilling Method | Screened Lithology |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Northing (m) Zone 10U (NAD83) | Easting (m) Zone 10U (NAD83) | Elevation (masl) | | | | | | Top (mbgs) | Bottom (mbgs) | Top (mbgs) | Bottom (mbgs) | | | |
| MW-H2A | 6,101,837 | 620,575 | 1,104.341 | 1103.141 | 1.20 | 0.105 | 90.80 | 0.051 | 82.30 | 88.00 | 83.43 | 88.00 | Drainage basin | Rotary air hammer | Shale |
| MW-H2B | 6,101,831 | 620,567 | 1,103.370 | 1102.900 | 0.47 | 0.105 | 15.20 | 0.051 | 9.20 | 13.00 | 9.90 | 12.90 | Drainage basin | Rotary air hammer | Glacial Till |
| MW-H3A | 6,102,191 | 621,818 | 1,215.700 | 1215.250 | 0.45 | 0.076 | 200.00 | 0.025 | 170.00 | 193.00 | 183.00 | 193.00 | Drainage basin | NQ mud rotary | Sandstone |
| MW-H3B | 6,102,191 | 621,821 | 1,215.700 | 1215.250 | 0.45 | 0.105 | 8.80 | 0.025 | 4.50 | 8.80 | 5.30 | 8.50 | Drainage basin | Rotary air hammer | Overburden |
| MW-H5 | 6,100,571 | 620,658 | 1,102.500 | 1101.820 | 0.68 | 0.105 | 30.50 | 0.051 | 26.15 | 30.50 | 27.50 | 30.50 | Drainage basin | Rotary air hammer | Gravelly Sand |
| VWP-H7-1MPa | 6,100,872 | 622,015 | 1,131.500 | | - | 0.076 | 250.00 | - | - | - | 92.45 | | Drainage basin | NQ mud rotary | Siltstone |
| VWP-H7-2MPa | | | | | | | | | | | 210.33 | | | | Siltstone/Mudstone |
| WWP-H12-1MPa | 6,100,659 | 624,446 | 1,120.800 | | - | 0.076 | 250.00 | - | - | - | 115.92 | | Drainage basin | NQ mud rotary | Siltstone |
| WWP-H12-2MPa | | | | | | | | | | | 210.26 | | | | Siltstone/Mudstone |
| MW-H13 | 6,098,569 | 626,086 | 821.580 | 820.800 | 0.78 | 0.076 | 250.00 | 0.025 | 65.00 | 69.00 | 65.95 | 69.00 | Drainage basin | NQ mud rotary | Shale |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 853.177 | 1.22 | 0.105 | 104.22 | 0.051 | 89.00 | 100.00 | 93.90 | 100.00 | North Site | Rotary air hammer | Sandstone |
| MW-H16 | 6,097,821 | 624,891 | 839.467 | 838.597 | 0.87 | 0.105 | 70.60 | 0.051 | 66.80 | 70.60 | 67.45 | 70.50 | North Site | Rotary air hammer | Sandstone (Boulder Creek Formation) |
| MW-H17 | 6,097,925 | 625,520 | 829.960 | 829.300 | 0.66 | 0.105 | 8.50 | 0.051 | 4.90 | 8.50 | 5.45 | 8.50 | North Site | Rotary air hammer | Mudstone |
| MW-H18 | 6,097,953 | 625,740 | 831.697 | 830.877 | 0.82 | 0.105 | 17.06 | 0.051 | 10.00 | 13.60 | 10.45 | 13.50 | North Site | Rotary air hammer | Mudstone |
| MW-H19 | 6,098,131 | 625,663 | 833.344 | 832.574 | 0.77 | 0.105 | 8.70 | 0.051 | 5.10 | 8.70 | 5.65 | 8.70 | North Site | Rotary air hammer | Mudstone |
| MW-H20 | 6,099,766 | 624,397 | 954.200 | 953.405 | 0.80 | 0.960 | 101.00 | 0.051 | 37.20 | 41.00 | 37.75 | 40.80 | Drainage basin | NQ mud rotary | Sandstone |
| MW-H21 | 6,100,259 | 625,390 | 917.000 | 917.000 | 0 | 0.076 | 121.00 | 0.025 | 50.10 | 54.00 | 50.65 | 53.70 | Drainage basin | NQ mud rotary | Mudstone |
| MW-H22 | 6,096,815 | 624,960 | 784.422 | 783.572 | 0.85 | 0.105 | 25.10 | 0.051 | 21.60 | 25.10 | 22.05 | 25.10 | South Site | Rotary air hammer | Sandy silt |
| MW-H23 | 6,096,618 | 624,942 | 785.698 | 784.898 | 0.80 | 0.105 | 25.10 | 0.051 | 21.60 | 25.10 | 22.05 | 25.10 | South Site | Rotary air hammer | Sand |
| MW-H24A | 6,099,756 | 628,116 | 832[C] | 831.200 | 0.80 | 0.076 | 67.10 | 0.032 | 44.20 | 48.50 | 44.85 | 47.90 | CCR Site | NQ mud rotary | Mudstone and siltstone |
| MW-H24B | 6,099,756 | 628,119 | 832[C] | 831.100 | 0.90 | 0.105 | 8.60 | 0.032 | 5.00 | 8.60 | 5.55 | 8.60 | CCR Site | Rotary air hammer | siltstone |
| MW-H24C | 6,099,625 | 627,954 | 825[C] | 824.080 | 0.92 | 0.096 | 13.72 | 0.032 | 8.80 | 13.72 | 9.23 | 12.28 | CCR Site | NQ mud rotary | siltstone |
| MW-H25A | 6,099,615 | 627,334 | 766[C] | 765.300 | 0.70 | 0.076 | 80.00 | 0.032 | 58.20 | 62.00 | 58.95 | 62.00 | CCR Site | NQ mud rotary | Mudstone and fine sandstone |
| MW-H25B | 6,099,615 | 627,332 | 766[C] | 765.300 | 0.70 | 0.105 | 6.10 | 0.032 | 1.30 | 4.70 | 1.55 | 4.60 | CCR Site | Auger | Glacial till |
| MW-H26A | 6,098,990 | 627,478 | 792[C] | 791.220 | 0.78 | 0.076 | 64.30 | 0.032 | 29.20 | 33.00 | 29.84 | 32.89 | CCR Site | NQ mud rotary | Mudstone and fine sandstone |
| MW-H26B | 6,098,987 | 627,485 | 792[C] | 791.350 | 0.65 | 0.105 | 6.10 | 0.032 | 1.30 | 4.60 | 1.55 | 4.60 | CCR Site | Auger | Well graded sand |
| MW-H27 | 6,098,578 | 627,607 | 810[C] | 809.530 | 0.47 | 0.096 | 39.20 | 0.032 | 34.03 | 37.63 | 34.58 | 37.63 | CCR Site | NQ mud rotary | Mudstone and fine sandstone |
| MW-H28 | 6,098,772 | 627,715 | 819[C] | 818.300 | 0.70 | 0.096 | 93.27 | 0.032 | 13.37 | 17.07 | 13.92 | 16.97 | CCR Site | NQ mud rotary | Mudstone and fine sandstone |
| MW-H29 | 6,099,198 | 627,938 | 826[C] | 825.300 | 0.70 | 0.096 | 98.45 | 0.032 | 7.71 | 11.61 | 8.26 | 11.31 | CCR Site | NQ mud rotary | Mudstone and fine sandstone |
| MW-H30 | 6,098,501 | 627,372 | 793[C] | 792.270 | 0.73 | 0.096 | 22.86 | 0.032 | 10.91 | 14.81 | 11.46 | 14.51 | CCR Site | NQ mud rotary | Glacial Till (Silty Clay) |
| MW-H31 | 6,099,893 | 627,456 | 798[C] | 797.320 | 0.68 | 0.096 | 32.31 | 0.032 | 26.82 | 30.42 | 27.37 | 30.42 | CCR Site | NQ mud rotary | Glacial Till (Silty Clay) |
| MW-H32 | 6,099,810 | 628,333 | 840[C] | 839.630 | 0.37 | 0.096 | 30.48 | 0.032 | 26.53 | 30.13 | 27.08 | 30.13 | CCR Site | NQ mud rotary | Mudstone and fine sandstone |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 777.713 | 1.14 | 0.105 | 49.60 | 0.051 | 44.90 | 48.60 | 45.45 | 48.50 | South Site | Rotary air hammer | Glacial Till |
| MW-Shaft | 6,098,150 | 625,176 | 846.032 | 845.212 | 0.82 | 0.105 | 5.10 | 0.051 | 1.90 | 5.10 | 2.05 | 5.10 | North Site | Rotary air hammer | Glacial Till |

[A] *MW in ID number indicates monitoring well; VWP in ID number indicates vibrating wire piezometer*
[B] *screen slot size 10 (0.246 mm)*
[C] *geodetic data collected using a hand-held GPS*




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# Groundwater Monitoring Instrumentation Installed at the Project Site

Figure 3.2-1

**Table 3.3-1. Well Development Details**

| Well ID | General Area | Date Developed | Development Method | Approximate Well Volume (L) | Approximate Purged Volume (L) |
|---|---|---|---|---|---|
| MW-H2A | Camp Ck. basin | 1-Jul-11 | Air-lift | 160 | 400 |
| MW-H2B | Camp Ck. basin | 2-Jul-11 | Air-lift | 15 | 250 |
| MW-H3A | Camp Ck. basin | not developed | | | - |
| MW-H3B | Camp Ck. basin | not developed | | | - |
| MW-H5 | Camp Ck. basin | 2-Jul-11 | Air-lift | 60 | 250 |
| MW-H13 | Camp Ck. basin | not developed | | | - |
| MW-H15 | Underground Mine Zone | 2-Jul-11 | Air-lift | 100 | 400 |
| MW-H16 | Underground Mine Zone | 2-Jul-11 | Air-lift | 80 | 400 |
| MW-H17 | Underground Mine Zone | 5-May-2012 | Mechanical surging | 7 | 200 |
| MW-H18 | Underground Mine Zone | 5-May-2012 | Mechanical surging | 10 | 200 |
| MW-H19 | Underground Mine Zone | 5 & 6-May-2012 | Mechanical surging | 3 | 20 |
| MW-H20 | Camp Ck. basin | 2-Jul-11 | Air-lift | 30 | 300 |
| MW-H21 | Camp Ck. basin | not developed | | | - |
| MW-H22 | Underground Mine Zone | 9-May-2012 | Mechanical surging | 15 | 150 |
| MW-H23 | Underground Mine Zone | 9-May-2012 | Mechanical surging | 10 | 150 |
| MW-H24A | CCR Site | 20-Oct-2012 | Air-lift | 25 | 30 |
| MW-H24B | CCR Site | 21-Oct-2012 | Mechanical surging | 3 | 40 |
| MW-H24C | CCR Site | 23-Jul-2013 | Air-lift | 9 | 100 |
| MW-H25A | CCR Site | 31-Oct-2012 | Air-lift | 50 | 150 |
| MW-H25B | CCR Site | 21-Oct-2012 | Mechanical surging | 3 | 25 |
| MW-H26A | CCR Site | 28-Oct-2012 | Air-lift | 30 | 140 |
| MW-H26B | CCR Site | 30-Oct-2012 | Mechanical surging | 3 | 70 |
| MW-H27 | CCR Site | 26 & 27-Oct-2013 | Air-lift | 22 | 60 |
| MW-H28 | CCR Site | 1-Aug-2013 | Air-lift | 4 | 35 |
| MW-H29 | CCR Site | 1-Aug-2013 | Air-lift | 5 | 60 |
| MW-H30 | CCR Site | not developed | | | - |
| MW-H31 | CCR Site | 21-Jul-13 | Air-lift | 12 | 12 |
| MW-H32 | CCR Site | 22-Jul-13 | Air-lift | 15 | 15 |
| MW-PNB | Underground Mine Zone | 2-Jul-11 | Air-lift | 75 | 350 |
| MW-Shaft | Underground Mine Zone | 9-Feb-14 | over-pumping | 1.1 | 10 |

## 3.4 HYDRAULIC CONDUCTIVITY TESTING

Single well and open hole response tests were conducted to assess the permeability of overburden and bedrock geologic materials. Testing methodologies included rising and falling-head tests in installed monitoring wells, and falling-head tests conducted in open borehole intervals isolated with inflatable packers. Packer tests were conducted at intermediate stages as drilling advanced.

Single well response tests were conducted in installed monitoring wells following development and settlement of the water level to natural equilibrium. Rising-head tests were initiated by removing a slug of water from a monitoring well using a bailer. Falling-head tests were initiated by adding a slug of

water into a well. The hydraulic response to the induced change in water level was monitored using a pressure transducer. Static water levels were established prior to test initiation using an electric water level meter.

Open-hole falling-head slug tests were conducted while drilling was advancing. For each test, two packers were inflated with nitrogen gas to isolate the top of the test zone. The water level in the zone was allowed to stabilize for an hour prior to testing. Tests were initiated by adding water to the drill rods, and the hydraulic response recorded using a pressure transducer. The packers and drill rods were leak-tested at each borehole. Up to four tests were conducted in a given borehole.

Hydraulic conductivities were estimated by analysing the hydraulic responses using the Hvorslev (1951) and Bouwer & Rice (1976) methods. Sensitivity analyses were conducted for a subset of the tests to assess the effects of certain input parameters with a high level of uncertainty on the resulting hydraulic conductivity estimates. These included aquifer thickness, sand pack porosity, and aquifer type (unconfined or confined).

## 3.5 WATER LEVELS, HYDRAULIC GRADIENTS, FLOW DIRECTIONS AND POTENTIOMETRIC SURFACE

Groundwater levels in all monitoring wells were measured on a seasonal basis, except where prevented by access limitations. Water levels were measured manually in wells using an electric water level meter, and in VWPs using a portable electronic readout box.

A potentiometric surface contour map was developed using mean water level measurements from each well, as well as VWP measurements and static water levels estimated for deep hydrogeologic testing (refer to Appendix A). A single mean level was calculated to represent twinned well pairs. Water levels were spatially-referenced using surveyed well collar locations. Surfer 8 (Godler Software® 2008) was used to generate spatial contours of water level from the data points. Groundwater flow directions and horizontal hydraulic gradients were interpreted from the potentiometric contour map. Adjustment and extrapolation of the contour lines have been made using professional judgment with consideration for the terrain, surface water features, and trends within the spatial extents of the dataset.

Differences in water levels between twinned shallow and deep wells were used to measure vertical hydraulic gradients. The vertical hydraulic gradients aided in identification of groundwater recharge and discharge zones.

## 3.6 GROUNDWATER SAMPLING

The objectives of groundwater sampling, as discussed in the Water and Air Baseline Monitoring Guidance Document for Mine Proponents (BC MOE 2012), were as follows:

- to assess the ambient groundwater conditions before potential effects from the proposed mine occur;
- to identify whether baseline concentrations naturally exceed provincial water quality guidelines and whether site-specific water quality objectives may need to be established;
- to use baseline information to predict and assess future impacts;
- to determine the need for groundwater monitoring and management during the life of the mine; and
- to allow the comparison of baseline with operational and post-closure water quality data in order to identify whether water quality is affected by mine-related activities.

All groundwater sampling was conducted in accordance with guidance provided in the *BC Field Sampling Manual* (BC MOE 2003). Prior to sampling, water was purged from wells until field parameters attained prescribed equilibrium conditions and at least one full well volume was purged. Purging methods that minimized turbidity and water level depression were used as much as possible.

Pumping technologies used to purge wells included inertial pumps, peristaltic pumps, and bladder pumps. Inertial pumps were used for early sampling, and were phased out of use in sampling activities due to their tendency to generate turbidity. A peristaltic pump was used where water levels less than 8 mbg could be sustained. A bladder pump was used where water levels were greater than 8 mbg.

Field parameters were measured using a YSI multi-parameter probe. A variety of models were used, and as a minimum the measurable field parameters included pH, specific conductance (SC), temperature, and oxidation-reduction potential (ORP). Field parameters were temperature-corrected by formulas integrated into the tool. Inspection of calibration was conducted on a regular basis, with a target frequency of once each day the tool is used.

Groundwater samples were collected in a suite of bottles, and preserved as follows:

- **General chemistry**: 1 L plastic bottle with no preservative added;
- **Total metals**: 250 ml plastic bottle with a capsule of 1:4 solution of nitric acid preservative added;
- **Dissolved metals**: 250 ml plastic bottle with a capsule of 1:4 solution of nitric acid preservative added following field filtering with a 45 µm disposable paper filter;
- **Total mercury**: 40 mL glass vial with a capsule of 1:1 hydrochloric acid;
- **Dissolved mercury**: 40 mL glass vial with a capsule of 1:1 hydrochloric acid added following field filtering with a 45 µm disposable paper filter;
- **Total organic carbon (TOC)**: 125 ml glass bottle with a capsule of 1:1 solution of hydrochloric acid preservative added;
- **Chemical Oxygen Demand**: 250 mL glass bottle with a capsule of 1:1 solution of sulfuric acid;
- **Nutrients**: 250-mL amber glass bottle with a capsule of 1:1 solution of sulfuric acid added;
- **Phenols**: 250 mL amber glass bottle with a capsule of 1:1 solution of sulfuric acid added; and
- **Polycyclic Aromatic Hydrocarbons**: 500-mL amber glass bottle preserved with sodium bisulfate.

One in every ten groundwater samples was collected as a blind duplicate for quality assurance/quality control (QA/QC). Blind duplicates were analysed for laboratory precision using relative percent difference (RPD) calculations. Target RPDs were 20% for analyte concentrations more than five times the detection limit, and 100% for lesser concentrations.

A suite of blanks were submitted to the laboratory to establish controls on potential sources of sample contamination. Field blanks were collected by decanting deionized water (provided by ALS Environmental of Burnaby, BC) into sample bottles using the corresponding preservation methods. Trip blanks were prepared by the laboratory and carried throughout a given site visit. An equipment blank was prepared for the bladder pump by passing deionized water through the stainless steel system prior to decanting it into sample bottles.

The groundwater quality results were screened against guidelines published by the British Columbia Ministry of Environment for the protection of freshwater aquatic life and for raw drinking water supply (BC MOE 2014). Approved chronic exposure guidelines were used where they existed. Working Water Quality Guidelines for the protection for freshwater aquatic life were used where approved guidelines did not exist. Drinking water quality guidelines published by Health Canada (Health Canada 2012) were used where no approved BC raw drinking water supply guidelines existed.

Analysis and discussion generally focuses on dissolved species. The majority of suspended solids entrained in groundwater samples are sampling artefacts, and not representative of particulate truly suspended in the seeping groundwater. Concentrations of total metals and other analytes that include a particulate component are skewed as a result of artificial entrainment of solids. Guidelines intended for application to total concentrations have been applied to dissolved components.

# 4. Results

# 4. Results

## 4.1 HYDROGEOLOGIC BOREHOLE LOGGING

Overburden and bedrock materials observed in the boreholes logged by ERM Rescan hydrogeologists were generally consistent with the test pit materials documented in terrain and soils evaluations (Rescan 2013b), and coal exploration boreholes. Logs derived from the hydrogeologic drilling programs are provided in Appendix B.

Overburden thickness varied from 1 m to 57 m. Thickness was generally greater along valley bottoms and at lower elevations. Materials generally consists with morainal, glaciofluvial, and colluvial deposits. Well-graded sands with significant fines content were frequently observed at higher elevations in the M20 Creek basin and throughout the proposed Underground Mine Zone. Fines (silt and clay) were observed along steep slopes in the M20 creek basin (MW-H20 and H21), and throughout the CCR site.

Mudstones and siltstones belonging to the Hassler formation were observed immediately beneath the overburden. Occasional sandstone layers were observed in the shallow bedrock (less than 50 mbg). Sandstones and siltstones observed in the deeper bedrock core may belong to the Boulder Creek Formation. Fracture densities were generally quite low, with RQD ranging from 75% to 100%. Lower RQD (60 to 75%) was sometimes logged over the top ten metres of bedrock, coinciding with moderate weathering. Fracture zones (multiple intersecting joints, or RQD less than 50%) were rare.

The lithologies observed in borehole samples were used in the development of a hydrogeologic conceptual model for the local study area, as discussed in Chapter 5.

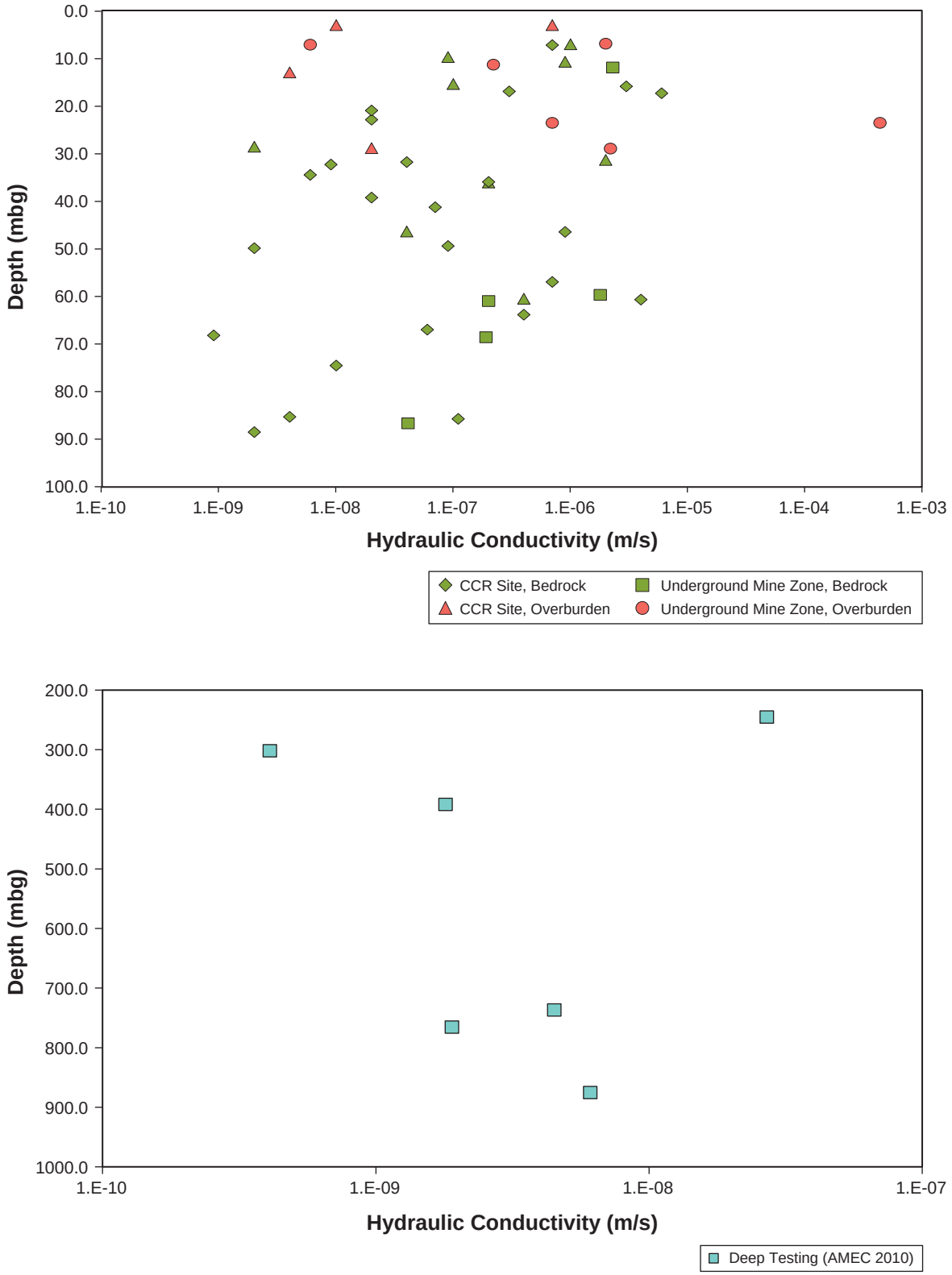
## 4.2 HYDRAULIC CONDUCTIVITY MEASUREMENTS

Hydraulic conductivity estimates are presented in Figure 4.2-1. Tabulated estimates and analysis reports are provided in Appendix C.

Hydraulic conductivity of the overburden was highly variable, as is generally expected for glacial deposition environments. A coarse granular deposit situated at the southern end of the Underground Mine Zone produced the highest estimate (4E-4 m/s). Tests conducted in morainal and colluvial sediments ranged three orders of magnitude (4E-9 to 2E-6 m/s).

The data suggest poor relations between fracture zones / depth and the measured hydraulic conductivities of the bedrock at depths up to 100 mbg, due to spatial heterogeniety in the extent of weathering. At depths less than 20 m, where moderate weathering and relatively low RQD have been commonly observed, K varied from 2E-8 to 6E-6 m/s (geometric mean of 1E-6 m/s). At depths ranging 20 to 100 m, where occasional moderate RQD and fracture zones have been observed, K estimates range from 9E-10 m/s to 4E-6 m/s (geometric mean of 5E-8 m/s).

The lower K measurements (on the scale of 1E-9 to 1E-10 m/s) observed occasionally at depths exceeding 30 m are interpreted to approach values attributable to fractured bedrock, where joint frequency is very low and lithostatic pressure sustains very tight joint aperture. Higher K measurements observed in the bedrock are interpreted to indicate presence of joints and fracture zones with adequate aperture and frequency to transmit fluids more rapidly than the competent rock mass.


0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Depth (mbg)
1.E-10
1.E-09
1.E-08
1.E-07
1.E-06
1.E-05
1.E-04
1.E-03
Hydraulic Conductivity (m/s)
CCR Site, Bedrock
CCR Site, Overburden
Underground Mine Zone, Bedrock
Underground Mine Zone, Overburden
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
1000.0
Depth (mbg)
1.E-10
1.E-09
1.E-08
1.E-07
Hydraulic Conductivity (m/s)
Deep Testing (AMEC 2010)

Tests conducted at 57 – 62 mbg in MW-H2A, 54 – 67 mbg in MW-H24A, and 225 – 265 mbg in H16W may coincide with brittle deformational structures, as suggested by K values that are considerably greater than the dataset.

## 4.3 GROUNDWATER LEVELS, FLOW DIRECTIONS, HYDRAULIC GRADIENTS, AND POTENTIOMETRIC SURFACE

Time series of groundwater level records are presented in Figures 4.3-1 (highlands in the Underground Mine Zone), 4.3-2 (Southern Underground Mine Zone), 4.3-3 (CCR Site), 4.3-4 and 4.3-5 (pressure transducer records). Manual measurements are also tabulated in Appendix D.

The data indicate that the water table follows the regional topography. Higher water levels were measured in wells installed at higher elevations, and lower at lower elevations. Wells installed atop local steep slopes exhibited rather low water levels (53 m at MW-H13, 54 m at MW-H15, and 61 m at MW-H16), indicating that local variation in topography has little relation to the water table elevation. Artesian conditions have been observed at MW-H5, situated near the geographic centre of the M20 Creek Basin, at mid-slope relative to the creek and watershed divide.

Seasonal variability demonstrated in the dataset is interpreted to be driven by precipitation and snowmelt. Water levels tend to be at annual highs between May and August, when freshet and convective storms bring the greatest recharge. However the pressure transducer data have also shown considerable recharge events following mid-winter warm spells. Seasonal variability in groundwater levels is on the scale of one to two metres (Figures 4.3-4 and 4.3-5).

Calculated vertical hydraulic gradients (Table 4.3-1) indicate downward flow at most twinned wells, which are situated located at higher elevations and mid to upper-slopes. Downward gradients are interpreted as groundwater recharge zones, where precipitation and snowmelt provide input to the groundwater system. An upward gradient has been measured at MW-H26. MW-H26 is located adjacent to a wetland connected to the Murray River, and is interpreted to be a groundwater discharge zone. Therefore the data support the hypothesis that the Murray River (and associated low-lying wetlands) acts as the dominant groundwater discharge zone for the local study area.

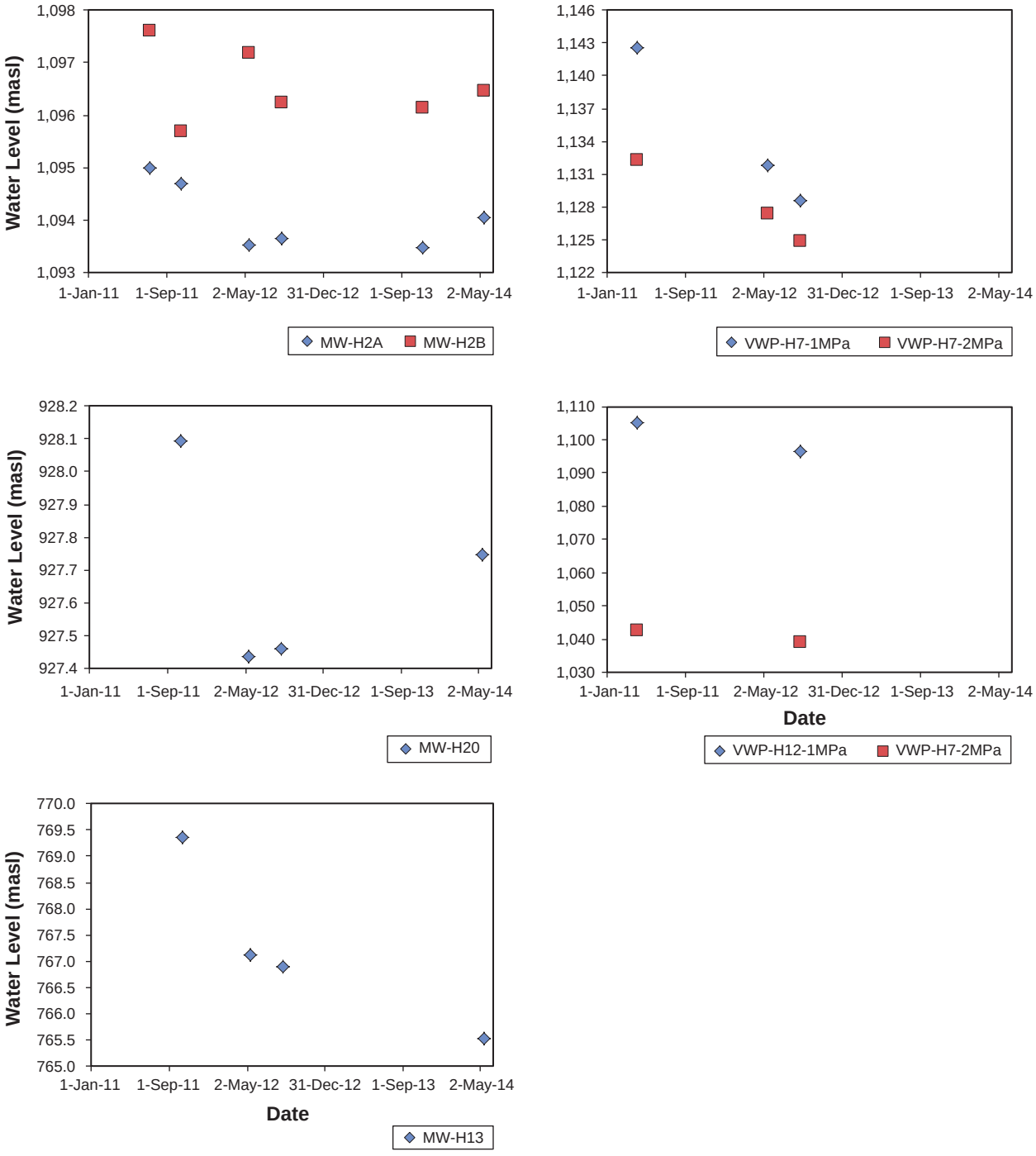
Inspection of the potentiometric surface map (Figure 4.3-6) indicates that groundwater flows along regional topographic relief, from upper to lower elevations. Groundwater within the Camp Creek drainage basin generally trends eastward towards the Murray River, with some convergence towards Camp Creek at the centre of the basin. Groundwater beneath the CCR site flows westward towards the Murray River, discharging in the adjacent wetland that reports to the river.

Water level measurements indicate a local groundwater divide is present beneath the site of the bulk sample waste rock dump and Shaft. Recharge reporting to the northern reaches of this area would flow northward; recharge reporting to the southern reaches would flow southward. Shallow groundwater would discharge to the nearby streams. Deeper groundwater would mix with that arriving from upper reaches of the corresponding catchment basin and flow eastward towards the Murray River.

Shallow groundwater is expected to flow under greater influence from tributary creeks. Shallow groundwater near Camp, M19A, M17, and other small creeks is expected to report to these creeks. Artesian conditions observed at MW-H5 (screened 30 mbg in confined granular sediments) suggest a quite extensive capture zone for Camp Creek. Deeper groundwater is expected to converge towards the Murray River. Shallow flow systems discharging into tributary creeks and deeper regional flow systems discharging into the Murray River are present in both the Underground Mine Zone and CCR Site.

**Figure 4.3-1**

**Water Level Measurements for Wells Installed throughout the Underground Mine Zone**



## Figure 4.3-2

## Water Level Measurements for Wells Installed at the Southern End of the Underground Mine Zone

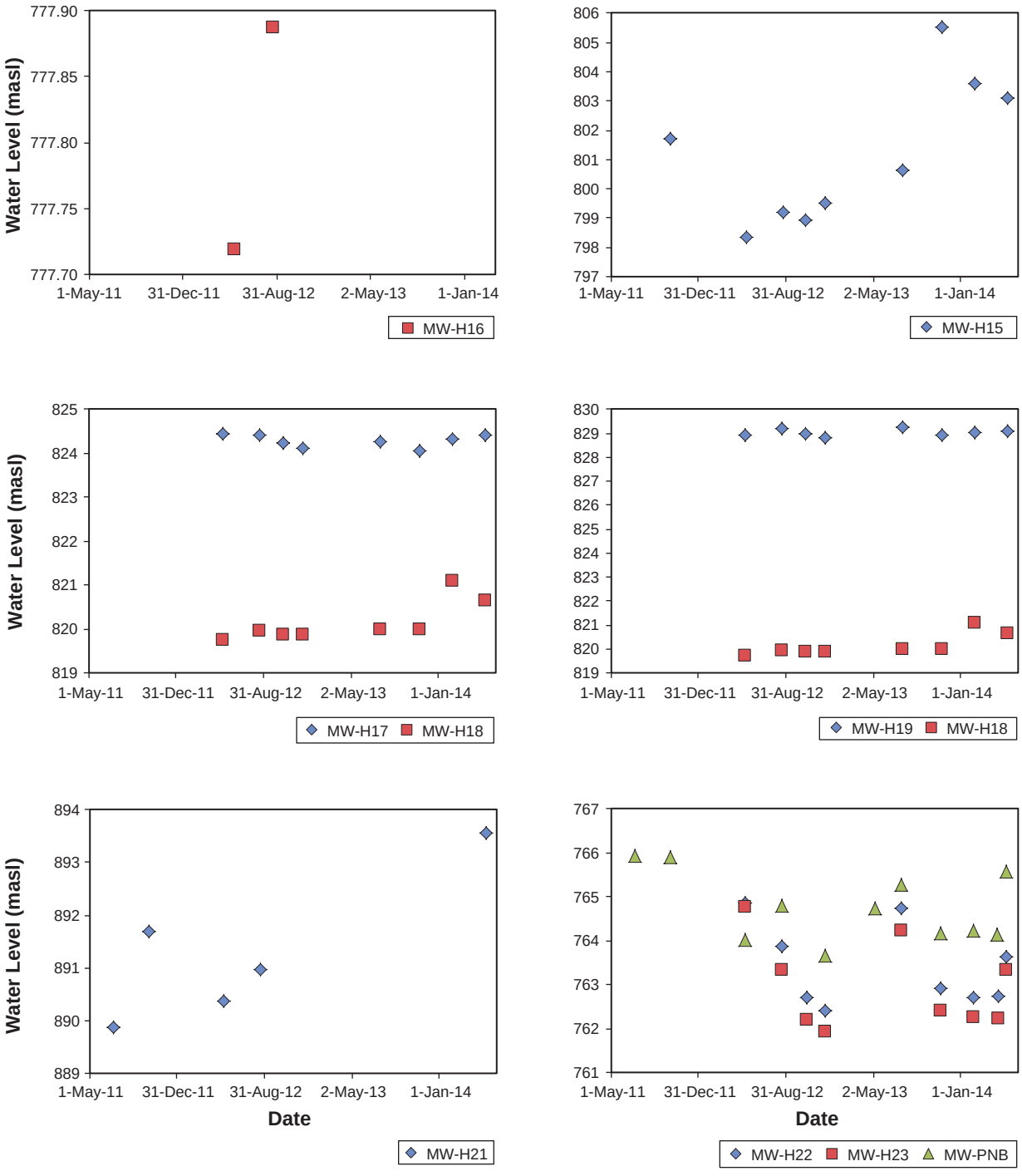


**Figure 4.3-3**

**Water Level Measurements for Wells Installed at the Coarse Coal Reject Site**

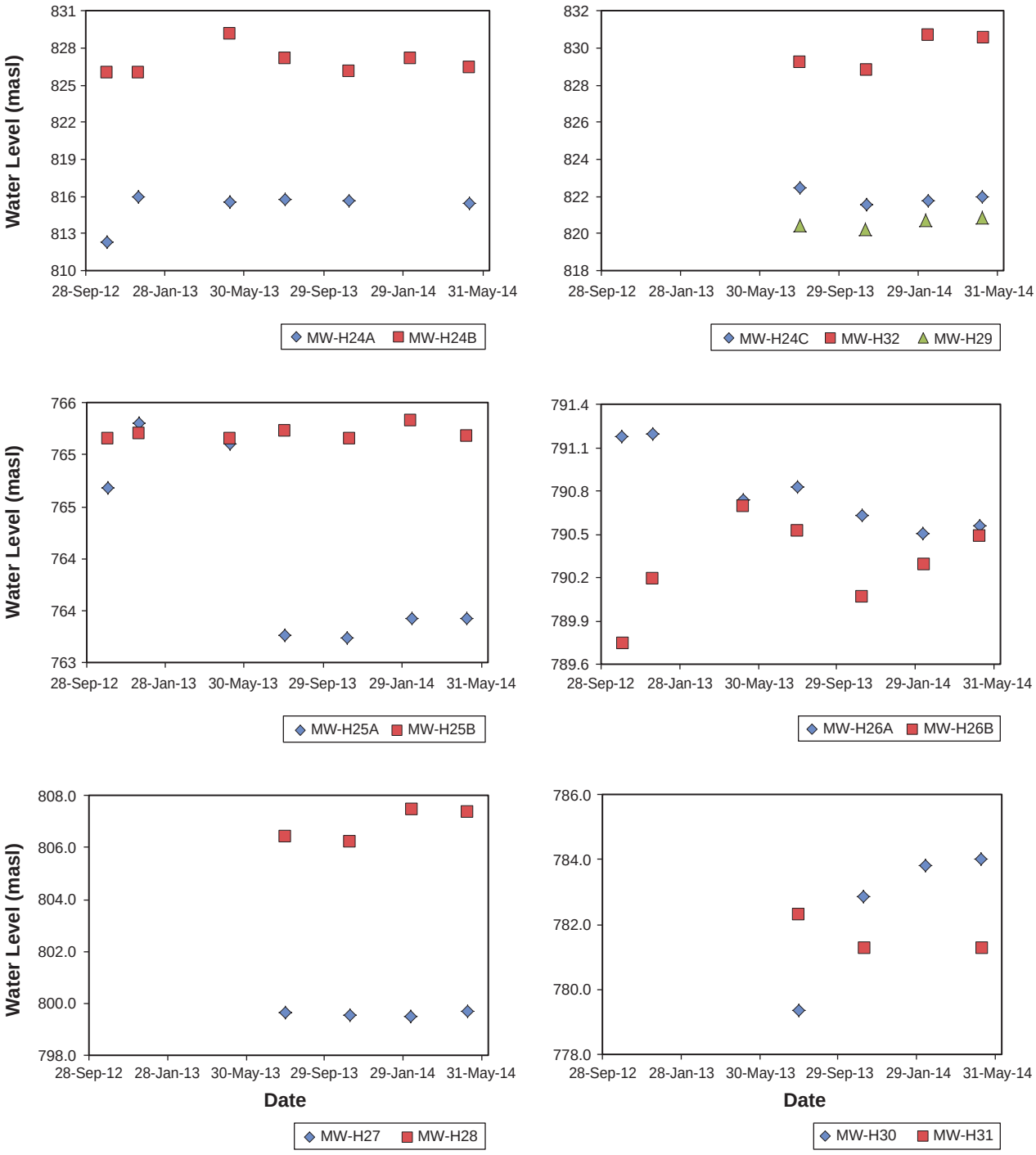
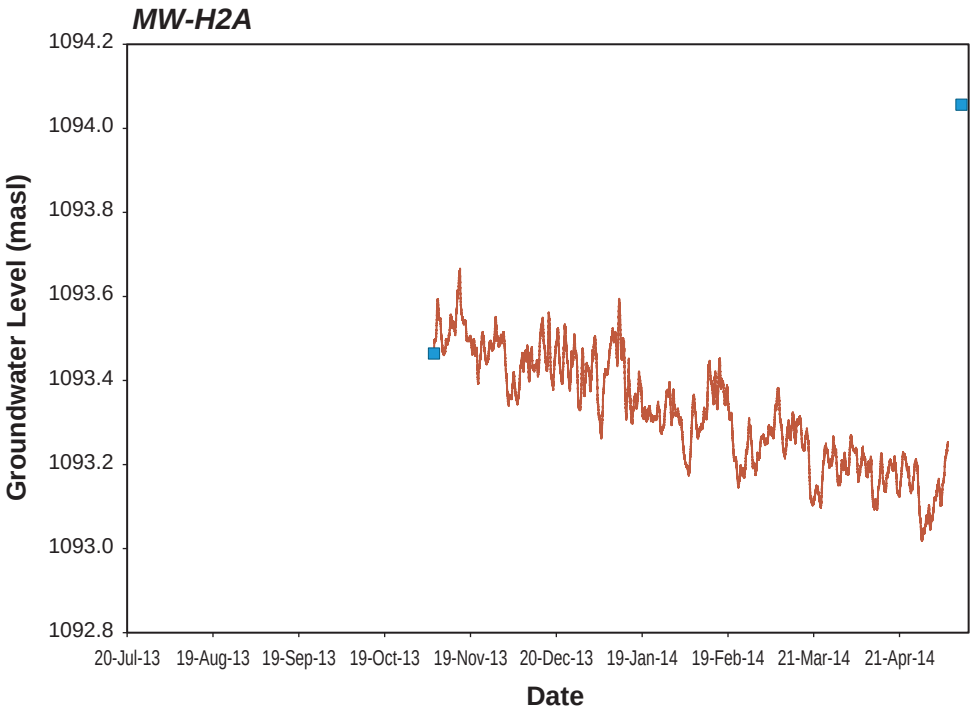
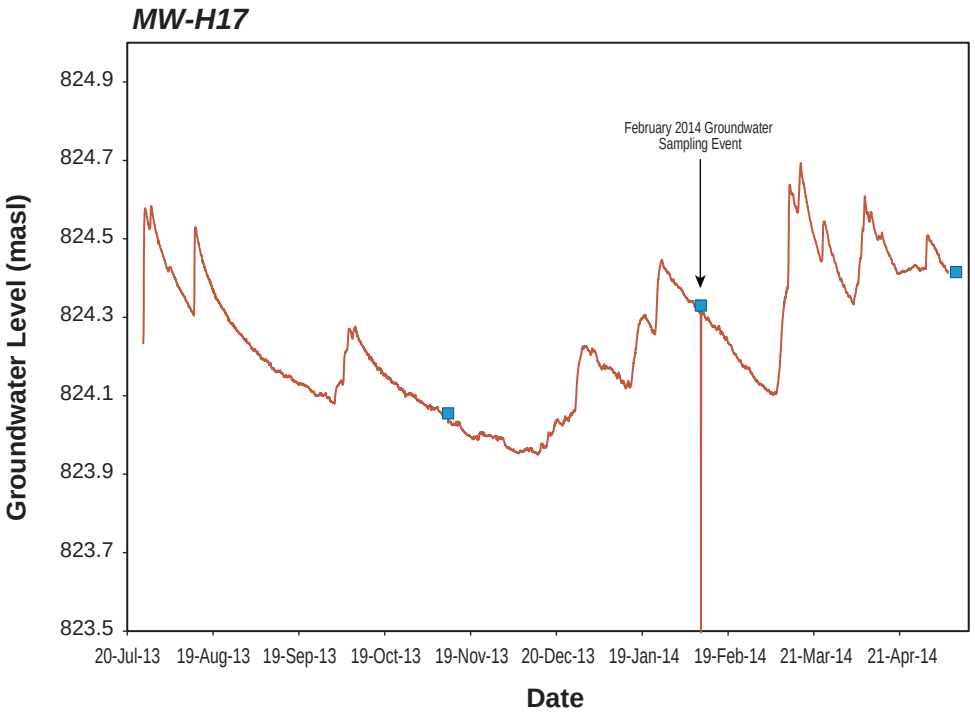


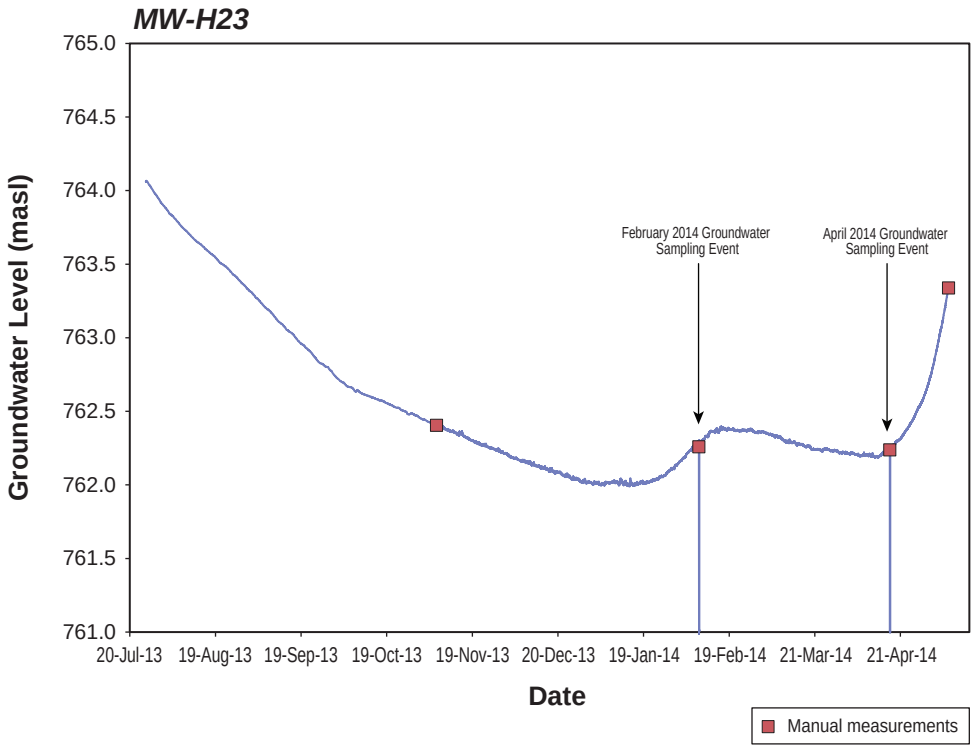
**Figure 4.3-4**

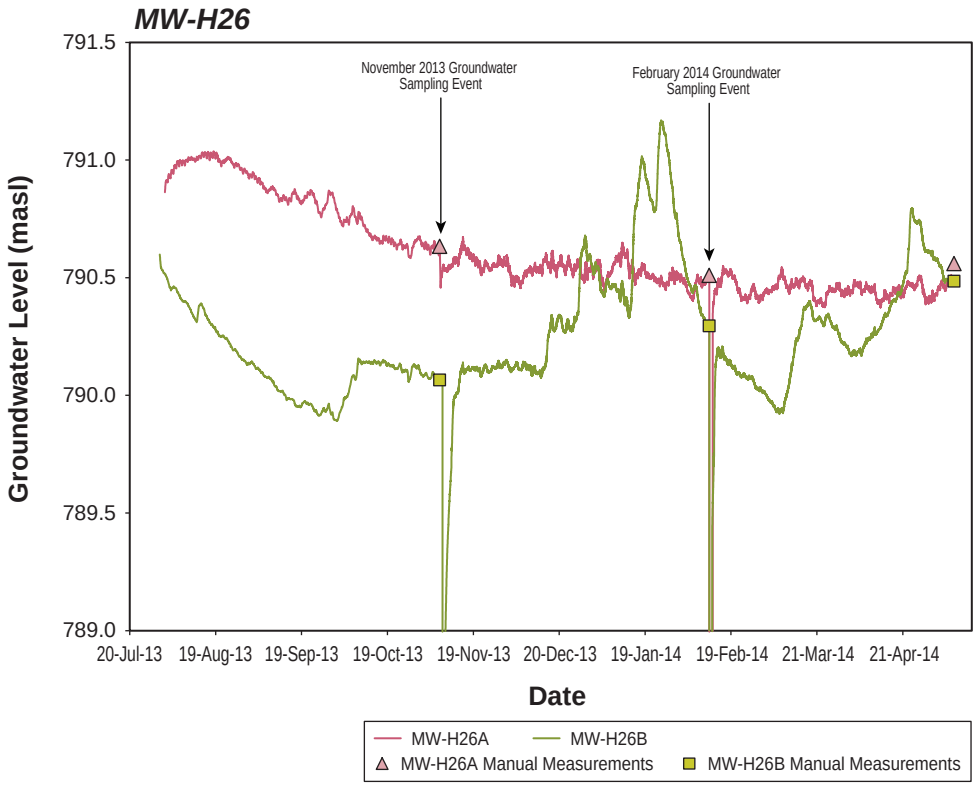
**Continuous Water Level Timeseries Obtained from Deployed Pressure Transducers: MW-H2A and MW-H17**

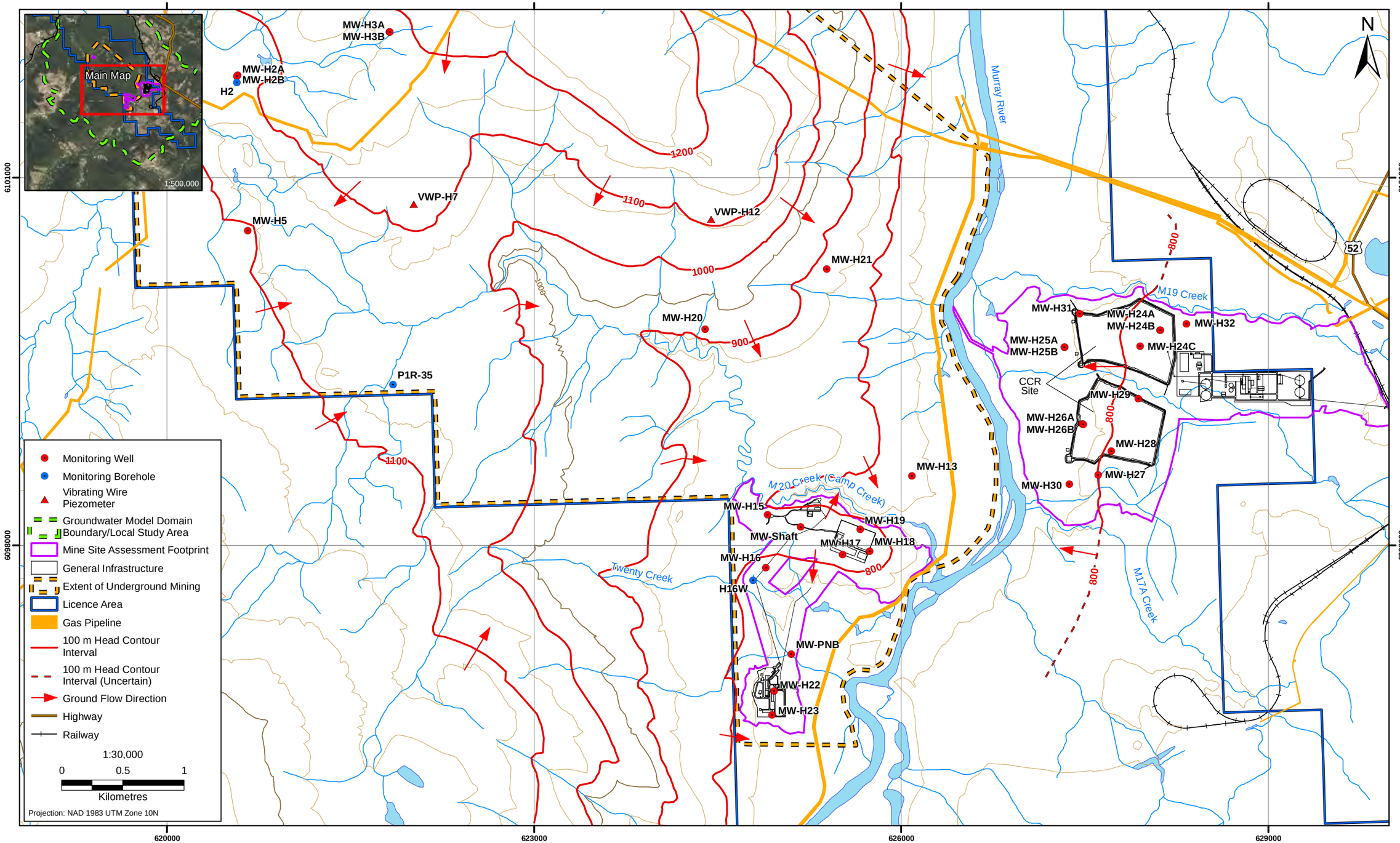



*Note: Blue squares represent manual measurements.*


MW-H23
765.0
764.5
764.0
763.5
763.0
762.5
762.0
761.5
761.0
Groundwater Level (masl)
February 2014 Groundwater Sampling Event
April 2014 Groundwater Sampling Event
20-Jul-13
19-Aug-13
19-Sep-13
19-Oct-13
19-Nov-13
20-Dec-13
19-Jan-14
19-Feb-14
21-Mar-14
21-Apr-14
Date
Manual measurements


MW-H26
791.5
791.0
790.5
790.0
789.5
789.0
Groundwater Level (masl)
November 2013 Groundwater Sampling Event
February 2014 Groundwater Sampling Event
20-Jul-13
19-Aug-13
19-Sep-13
19-Oct-13
19-Nov-13
20-Dec-13
19-Jan-14
19-Feb-14
21-Mar-14
21-Apr-14
Date
MW-H26A
MW-H26B
MW-H26A Manual Measurements
MW-H26B Manual Measurements




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Figure 4.3-6

Potentiometric Surface Map

**Table 4.3-1. Vertical Hydraulic Gradients**

| Twinned Monitoring Well Site | Date | Deep Well Groundwater Elevation (masl) | Shallow Well Groundwater Elevation (masl) | Vertical Distance Between Screen Midpoints (m) | Vertical Gradients | Flow Direction |
|---|---|---|---|---|---|---|
| MW-H2 | 10-Jul-11 | 1,094.991 | 1,097.600 | 74.10 | 0.035 | Down |
| | 18-Oct-11 | 1,094.701 | 1,095.680 | | 0.013 | |
| | 13-May-12 | 1,093.523 | 1,097.178 | | 0.049 | |
| | 23-Aug-12 | 1,093.646 | 1,096.230 | | 0.035 | |
| | 6-Nov-13 | 1,093.464 | 1,096.145 | | 0.036 | |
| | 13-May-14 | 1,094.056 | 1,096.470 | | 0.033 | |
| MW-H3 | 7-Jul-11 | 1,189.010 | 1,213.870 | 174.85 | 0.142 | Down |
| VWP-H7 | 4-Apr-11 | 1,132.240 | 1,142.600 | 117.50 | 0.088 | Down |
| | 13-May-12 | 1,127.420 | 1,131.790 | | 0.037 | |
| | 24-Aug-12 | 1,124.860 | 1,128.620 | | 0.032 | |
| VWP-H12 | 4-Apr-11 | 1,042.510 | 1,105.190 | 94.00 | 0.667 | Down |
| | 24-Aug-12 | 1,039.140 | 1,096.610 | | 0.611 | |
| MW-H24 | 1-Nov-12 | 812.280 | 826.044 | 39.55 | 0.348 | Down |
| | 18-Dec-12 | 815.975 | 826.027 | | 0.254 | |
| | 7-May-13 | 815.538 | 829.158 | | 0.344 | |
| | 31-Jul-13 | 815.800 | 827.140 | | 0.287 | |
| | 7-Nov-13 | 815.655 | 826.102 | | 0.264 | |
| | 11-May-14 | 815.460 | 826.465 | | 0.278 | |
| MW-H25 | 1-Nov-12 | 764.685 | 765.160 | 57.10 | 0.008 | Down |
| | 18-Dec-12 | 765.300 | 765.210 | | -0.002 | Up |
| | 7-May-13 | 765.110 | 765.158 | | 0.001 | Down |
| | 31-Jul-13 | 763.256 | 765.158 | | 0.033 | |
| | 5-Nov-13 | 763.235 | 765.160 | | 0.034 | |
| | 13-Feb-14 | 763.430 | 765.330 | | 0.033 | |
| | 9-May-14 | 763.425 | 765.175 | | 0.031 | |
| MW-H26 | 29-Oct-12 | 791.178 | 789.742 | 29.75 | -0.048 | Up |
| | 18-Dec-12 | 791.200 | 790.190 | | -0.034 | |
| | 7-May-13 | 790.735 | 790.693 | | -0.001 | |
| | 31-Jul-13 | 790.825 | 790.524 | | -0.010 | |
| | 7-Nov-13 | 790.633 | 790.065 | | -0.019 | |
| | 10-Feb-14 | 790.510 | 790.295 | | -0.007 | |
| | 9-May-14 | 790.560 | 790.485 | | -0.003 | |

Data at depths exceeding 100 mbg is limited. It is expected that, compared to shallow groundwater, deep groundwater flow is driven by regional topographic features or regional geology structures (e.g. folds and faults).

## 4.4 GROUNDWATER QUALITY

A summary of the number of monitoring wells and the number of samples collected from each well over the course of the baseline study is provided in Table 4.4-1. Certain wells were not accessible on occasion due to unsafe access conditions or damage to the well, or were found frozen during winter months.

Laboratory analytical reports for all groundwater samples are provided in Appendix E, along with tabulated guideline screening results and QA/QC calculations.

This section begins with a discussion of the implications of the laboratory QA/QC assessment (section 4.4.1). The discussion of groundwater quality follows (section 4.4.2), drawing from laboratory results to generate summary statistics and develop general trends, and drawing from guideline screening results to assign meaning to the results.

### 4.4.1 Quality Assurance/Quality Control

Tabualted RPD, CBE, and laboratory analyses for blanks are provided in Appendix E.

In most cases, the RPD values for blind duplicates were below thresholds, indicating adequate precision for the laboratory analyses. Two or more RPD values exceeded thresholds for acidity (4), carbonate alkalinity (2), turbidity (4), and total suspended solids (2). A number of RPDs for total metals exceeded thresholds in conjunction with those for turbidity and total suspended solids; however, the precision remained adequate for dissolved metals in these cases. Total alkalinity precision was acceptable (RPDs of 2.4 % and 0.3 % where carbonate alkalinity exceeded threshold RPD, likely indicating adjustment of carbonate species balance in response to exposure to the atmosphere.

Laboratory results for all field, trip, and equipment blanks consistently reported analyte concentrations below detection limits. This suggests that no detectable sample contamination arose from transport, handling, or re-usable sampling equipment.

### 4.4.2 Analyte Concentrations and Guideline Exceedances

Summary statistics for physical parameters, anions, nutrients, and dissolved metals have been calculated for each of the Underground Mine Zone (Tables 4.4-2 and 4.4-3), the Southern Underground Mine Zone (Tables 4.4-4 and 4.4-5), and the Coarse Coal Reject Site (Tables 4.4-6 and 4.4-7). These baseline summary statistics provide a general indication of groundwater quality at the corresponding sites.

Groundwater samples collected from MW-H24A, which is located at the CCR site, indicate contamination with cement grout, which is sourced in the borehole backfill material (very basic pH, anomalously high dissolved ion concentrations). Results from MW-H24A have been omitted from further discussion and calculation of summary statistics.

#### *4.4.2.1 Physical Parameters*

Hardness: Hardness of the groundwater varied, but generally shallow groundwater was hard (> 100 mg/L) and reported one order of magnitude greater concentrations relative to groundwater in the deeper bedrock. Although there are no guidelines for hardness, total metal concentrations guidelines for freshwater aquatic life are hardness depended for certain parameters: cadmium, copper, lead, manganese, nickel, silver, and zinc.

pH: pH values tended to be on the basic side of neutral, with mean values of 8.2 in the Underground Mine Zone, 7.4 at the Southern Underground Mine Zone, and 8.1 at the CCR site. The slightly alkaline tendency likely reflects the prevalence of bicarbonate found throughout the site.

**Table 4.4-1. Groundwater Samples Collected During the Hydrogeology Baseline Study**

| Well | Location | Middle Screen Depth (mbg) | Screened Lithology | Summer 2011 | Fall 2011 | Winter 2011/12 | Spring 2012 | Summer 2012 | Fall 2012 | Winter 2012/13 | Spring 2013 | Summer 2013 | Fall 2013 | Winter 2014 | Spring 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-H2A | Camp Ck. Basin | 85.7 | Mudstone | | | | | | | | | | | | |
| MW-H2B | Camp Ck. Basin | 11.4 | Overburden | | | | | | | | | | | | |
| MW-H5 | Camp Ck. Basin | 29.0 | Overburden | | | | | | | | | | | | |
| MW-H15 | Underground Mine Zone | 97.0 | Sandstone | | | | | | | | | | | | |
| MW-H16 | Underground Mine Zone | 69.0 | Sandstone | | | | | | | | | | | | |
| MW-H17 | Underground Mine Zone | 7.0 | Mudstone | | | | | | | | | | | | |
| MW-H18 | Underground Mine Zone | 12.0 | Mudstone | | | | | | | | | | | | |
| MW-H19 | Underground Mine Zone | 7.2 | Mudstone | | | | | | | | | | | | |
| MW-H20 | Camp Ck. Basin | 39.3 | Sandstone | | | | | | | | | | | | |
| MW-H22 | Underground Mine Zone | 23.6 | Overburden | | | | | | | | | | | | |
| MW-H23 | Underground Mine Zone | 23.6 | Sand | | | | | | | | | | | | |
| MW-H24A | CCR Site | 46.4 | Mudstone and siltstone | | | | | | | | | | | | |
| MW-H24B | CCR Site | 7.1 | siltstone | | | | | | | | | | | | |
| MW-H24C | CCR Site | 10.8 | siltstone | | | | | | | | | | | | |
| MW-H25A | CCR Site | 60.5 | Siltstone | | | | | | | | | | | | |
| MW-H25B | CCR Site | 3.1 | Overburden | | | | | | | | | | | | |
| MW-H26A | CCR Site | 31.4 | Siltstone | | | | | | | | | | | | |
| MW-H26B | CCR Site | 3.1 | Overburden | | | | | | | | | | | | |
| MW-H27 | CCR Site | 36.1 | Siltstone | | | | | | | | | | | | |
| MW-H28 | CCR Site | 15.4 | Siltstone | | | | | | | | | | | | |
| MW-H29 | CCR Site | 9.8 | Siltstone | | | | | | | | | | | | |
| MW-PNB | Underground Mine Zone | 47.0 | Overburden | | | | | | | | | | | | |
| MW-Shaft | Underground Mine Zone | 3.6 | Overburden | | | | | | | | | | | | |

*Grey highlighting indicates a groundwater sample was collected.*

**Table 4.4-2. Groundwater Quality Summary Statistics for the Underground Mine Zone: Physical Tests, Anions, and Nutrients**

| Parameter | Units | # Samples | # samples below detection limit | Mean [J] | Standard Deviation [J] | Minimum | Maximum | DW Guidelines [A] | FWAL Guideline [A] |
|---|---|---|---|---|---|---|---|---|---|
| **Field Measurements** | | | | | | | | | |
| pH | - | 10 | 0 | 8.21 | 0.63 | 6.87 | 9.00 | 6.5-8.5 | 6.5-9.0 [D, G] |
| Oxidation-Reduction Potential | mV | 4 | 0 | 30 | 88 | -30 | 190 | | ng |
| Specific Conductance | µS/cm | 10 | 0 | 1000 | 550 | 271 | 1600 | | ng |
| **Physical Tests (Laboratory)** | | | | | | | | | |
| Hardness (as $CaCO_3$) | mg/L | 13 | 0 | 130 | 120 | 7.3 | 310 | | ng |
| Total Dissolved Solids | mg/L | 4 | 0 | 650 | 430 | 160 | 1200 | | ng |
| **Anions and Nutrients** | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | 13 | 9 | 1.6 | 1.7 | *1.0* | 5.1 | | ng |
| Alkalinity, Total (as $CaCO_3$) | mg/L | 13 | 0 | 490 | 300 | 130 | 940 | | ng |
| Ammonia, Total (as N) | mg/L | 10 | 3 | 0.19 | 0.22 | *0.0050* | 0.72 | | 0.45 to 29 [H] |
| Bromide (Br) | mg/L | 13 | 13 | na | na | *0.50* | *0.50* | | ng |
| Chloride (Cl) | mg/L | 13 | 3 | 5.4 | 4.2 | *0.50* | 13 | 250 | 150 [C] |
| Fluoride (F) | mg/L | 13 | 0 | 0.77 | 0.77 | 0.084 | 2.1 | 1 [C] | K |
| Nitrate (as N) | mg/L | 13 | 9 | 0.038 | 0.094 | *0.0050* | 0.41 | 10 [L] | 3 [C] |
| Nitrite (as N) | mg/L | 13 | 13 | 0.0025 | 0.0028 | *0.0010* | 0.010 | 1 | 0.02 [C] |
| Total Nitrogen | mg/L | 10 | 0 | 0.66 | 0.35 | 0.17 | 1.4 | | ng |
| Orthophosphate-Dissolved (as P) | mg/L | 13 | 1 | 0.10 | 0.13 | *0.0010* | 0.43 | | ng |
| Phosphorus (P)-Total Dissolved | mg/L | 13 | 1 | 0.13 | 0.15 | *0.0020* | 0.44 | 0.01 [E] | between 0.005 and 0.015 [B, E] |
| Sulfate ($SO_4$) | mg/L | 13 | 4 | 8.8 | 6.6 | *0.50* | 29 | 500 | 128 to 429 [F] |

*ng = no approved water quality guideline*

*na = not applicable*

*underlined values exceed FWAL guidelines*

*Red values exceed Drinking Water Guidelines*

*shaded/italic values are below reported detection limits.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[J] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

**Table 4.4-3. Groundwater Quality Summary Statistics for the Underground Mine Zone: Dissolved Metals**

| Parameter | Units | # Samples | # samples below detection limit | Mean [S] | Standard Deviation [S] | Minimum | Maximum | FWAL Guideline [A] | DW Guidelines [A] |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum (Al)-Dissolved | mg/L | 13 | 3 | 0.45 | 1.2 | *0.0030* | 5.0 | 0.05 [B,E] | 0.2 |
| Antimony (Sb)-Dissolved | mg/L | 13 | 6 | 0.00087 | 0.0018 | *0.00010* | 0.0077 | 0.02 [B, R] | 0.06 [B, T] |
| Arsenic (As)-Dissolved | mg/L | 13 | 1 | 0.0017 | 0.0016 | *0.00020* | 0.0060 | 0.005 [B] | 0.025 [B] |
| Barium (Ba)-Dissolved | mg/L | 13 | 0 | 0.72 | 0.73 | 0.12 | 2.7 | 1 [B, C, R] | 1 [B, T] |
| Beryllium (Be)-Dissolved | mg/L | 13 | 13 | na | na | *0.00010* | *0.00010* | 0.0053 [B, C, R] | |
| Bismuth (Bi)-Dissolved | mg/L | 13 | 13 | na | na | *0.00050* | *0.00050* | ng | |
| Boron (B)-Dissolved | mg/L | 13 | 3 | 0.10 | 0.09 | *0.010* | 0.20 | 1.2 [B] | 5 [B] |
| Cadmium (Cd)-Dissolved | mg/L | 13 | 8 | 0.000015 | 0.000014 | *0.000010* | 0.000060 | B, R, N | 0.005 [B, T] |
| Calcium (Ca)-Dissolved | mg/L | 13 | 0 | 33 | 30 | 1.9 | 79 | na | |
| Chromium (Cr)-Dissolved | mg/L | 13 | 8 | 0.00028 | 0.00054 | *0.00010* | 0.0023 | 0.0089 [B, P] | 0.05 [B, T] |
| Cobalt (Co)-Dissolved | mg/L | 13 | 4 | 0.00028 | 0.00023 | *0.00010* | 0.00087 | 4 [B, C] | |
| Copper (Cu)-Dissolved | mg/L | 13 | 9 | 0.0067 | 0.022 | *0.00050* | 0.094 | 0.0004 to 0.002 [B, C, F] | 0.5 [B] |
| Iron (Fe)-Dissolved | mg/L | 13 | 6 | 0.28 | 0.39 | *0.030* | 1.1 | 0.35 | 0.3 [B, T] |
| Lead (Pb)-Dissolved | mg/L | 13 | 7 | 0.00016 | 0.00027 | *0.000050* | 0.0010 | B, C, H | 0.05 [B] |
| Lithium (Li)-Dissolved | mg/L | 13 | 4 | 0.50 | 0.55 | 0.0020 | 1.3 | 0.096 [R] | |
| Magnesium (Mg)-Dissolved | mg/L | 13 | 0 | 11 | 11 | 0.62 | 28 | ng | |
| Manganese (Mn)-Dissolved | mg/L | 13 | 0 | 0.21 | 0.24 | 0.0017 | 0.63 | B, C, J | 0.05 [B, T] |
| Mercury (Hg)-Dissolved | mg/L | 13 | 13 | na | na | *0.000010* | *0.000010* | 0.0000125 to 0.0002 [B, C, K] | 0.001 [B] |
| Molybdenum (Mo)-Dissolved | mg/L | 13 | 0 | 0.0047 | 0.0064 | 0.00025 | 0.025 | 1 [B, C] | 0.25 [B] |
| Nickel (Ni)-Dissolved | mg/L | 13 | 3 | 0.0011 | 0.0011 | *0.00050* | 0.0042 | 0.025 to 0.15 [B, C, R, Q] | |
| Potassium (K)-Dissolved | mg/L | 13 | 0 | 0.93 | 0.46 | 0.47 | 2.5 | 195 [R] | |
| Selenium (Se)-Dissolved | mg/L | 13 | 4 | 0.00021 | 0.00022 | *0.00010* | 0.00081 | 0.002 [B] | 0.01 [B] |
| Silicon (Si)-Dissolved | mg/L | 13 | 0 | 4.4 | 2.5 | 2.4 | 12 | ng | |
| Silver (Ag)-Dissolved | mg/L | 13 | 12 | *0.000010* | 0.0000056 | *0.000010* | 0.000028 | 0.0005 to 0.0015 [B, C, L] | |
| Sodium (Na)-Dissolved | mg/L | 13 | 2 | 170 | 170 | *1.0* | 390 | ng | 200 [B, T] |
| Strontium (Sr)-Dissolved | mg/L | 13 | 0 | 0.21 | 0.15 | 0.066 | 0.64 | ng | |
| Thallium (Tl)-Dissolved | mg/L | 13 | 10 | *0.000010* | 0.0000089 | *0.000010* | 0.000042 | 0.0003 [B, R] | |
| Tin (Sn)-Dissolved | mg/L | 13 | 11 | 0.00012 | 0.00018 | *0.00010* | 0.00083 | ng | |
| Titanium (Ti)-Dissolved | mg/L | 13 | 11 | 0.017 | 0.036 | *0.010* | 0.16 | 2 [B, R] | |
| Uranium (U)-Dissolved | mg/L | 13 | 0 | 0.0027 | 0.0034 | 0.00012 | 0.010 | 0.3 [B, R] | 0.02 [B, T] |
| Vanadium (V)-Dissolved | mg/L | 13 | 8 | 0.0028 | 0.0052 | *0.0010* | 0.022 | 0.006 [B, R] | |
| Zinc (Zn)-Dissolved | mg/L | 13 | 10 | 0.012 | 0.029 | *0.0030* | 0.12 | B, C, M | 5 [B] |

*ng = no approved water quality guideline*

*na = not applicable*

*underlined values exceed guidelines*

*shaded/italic values are below reported detection limits.*

*red values exceed drinking water guidelines*

*(continued)*

**Table 4.4-3. Groundwater Quality Summary Statistics for the Underground Mine Zone: Dissolved Metals (completed)**

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[G] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $log_{10}$(Hardness)].*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

**Table 4.4-4. Groundwater Quality Summary Statistics for the Southern Underground Mine Zone: Physical Tests, Anions, and Nutrients**

| Parameter | Units | # Samples | # samples below detection limit | Mean [J] | Standard Deviation [J] | Minimum | Maximum | DW Guidelines [A] | FWAL Guideline [A] |
|---|---|---|---|---|---|---|---|---|---|
| **Field Measurements** | | | | | | | | | |
| pH | - | 28 | 0 | 7.39 | 0.59 | 7.00 | 9.00 | 6.5-8.5 | 6.5-9.0 [D, G] |
| Oxidation-Reduction Potential | mV | 20 | 0 | 75 | 92 | 0 | 250 | | ng |
| Specific Conductance | µS/cm | 28 | 0 | 720 | 426 | 247 | 1956 | | ng |
| **Physical Tests (Laboratory)** | | | | | | | | | |
| Hardness (as $CaCO_3$) | mg/L | 36 | 0 | 230 | 130 | 7.3 | 650 | | ng |
| Total Dissolved Solids | mg/L | 9 | 0 | 470 | 350 | 250 | 1250 | | ng |
| **Anions and Nutrients** | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | 36 | 16 | 6.9 | 20 | *1.0* | 120 | | ng |
| Alkalinity, Total (as $CaCO_3$) | mg/L | 36 | 0 | 360 | 160 | 188 | 770 | | ng |
| Ammonia, Total (as N) | mg/L | 33 | 12 | 0.14 | 0.21 | *0.0050* | 0.81 | | 0.45 to 29 [H] |
| Bromide (Br) | mg/L | 35 | 34 | na | na | *0.50* | 1.4 | | ng |
| Chloride (Cl) | mg/L | 36 | 17 | 46 | 63 | *0.50* | 220 | 250 | 150 [C] |
| Fluoride (F) | mg/L | 36 | 1 | 0.35 | 0.48 | 0.05 | 2.1 | 1 [C] | K |
| Nitrate (as N) | mg/L | 36 | 13 | 0.12 | 0.15 | *0.0050* | 0.49 | 10 [L] | 3 [C] |
| Nitrite (as N) | mg/L | 36 | 26 | 0.0047 | 0.0070 | *0.0010* | 0.033 | 1 | 0.02 [C] |
| Total Nitrogen | mg/L | 33 | 0 | 0.72 | 0.86 | 0.08 | 4.1 | | ng |
| Orthophosphate-Dissolved (as P) | mg/L | 36 | 13 | 0.035 | 0.10 | *0.0010* | 0.43 | | ng |
| Phosphorus (P)-Total Dissolved | mg/L | 34 | 13 | 0.037 | 0.09 | *0.0020* | 0.44 | 0.01 [E] | between 0.005 and 0.015 [B, E] |
| Sulfate ($SO_4$) | mg/L | 36 | 1 | 26 | 32 | *5.0* | 170 | 500 | 128 to 429 [F] |

*ng = no approved water quality guideline*

*na = not applicable*

*underlined values exceed FWAL guidelines*

*red values exceed drinking water guidelines*

*shaded/italic values are below reported detection limits.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here*

[H] *Ammonia guidelines temperature and pH dependent.*

[J] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

**Table 4.4-5. Groundwater Quality Summary Statistics for the Southern Underground Mine Zone: Dissolved Metals**

| Parameter | Units | # Samples | # samples below detection limit | Mean [S] | Standard Deviation [S] | Minimum | Maximum | FWAL Guideline [A] | DW Guidelines [A] |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum (Al)-Dissolved | mg/L | 36 | 18 | 0.066 | 0.33 | *0.0030* | 2.0 | 0.05 [D,E] | 0.2 |
| Antimony (Sb)-Dissolved | mg/L | 36 | 16 | 0.00073 | 0.0017 | *0.00010* | 0.0077 | 0.02 [D, K] | 0.06 [D, I] |
| Arsenic (As)-Dissolved | mg/L | 36 | 7 | 0.0010 | 0.0013 | *0.00010* | 0.0060 | 0.005 [D] | 0.025 [D] |
| Barium (Ba)-Dissolved | mg/L | 36 | 0 | 0.57 | 0.52 | 0.11 | 2.7 | 1 [D, C, K] | 1 [D, I] |
| Beryllium (Be)-Dissolved | mg/L | 35 | 36 | na | na | *0.00010* | *0.00010* | 0.0053 [D, C, K] | |
| Bismuth (Bi)-Dissolved | mg/L | 35 | 36 | na | na | *0.00050* | *0.00050* | ng | |
| Boron (B)-Dissolved | mg/L | 36 | 14 | 0.067 | 0.083 | *0.010* | 0.25 | 1.2 [D] | 5 [D] |
| Cadmium (Cd)-Dissolved | mg/L | 36 | 8 | 0.000037 | 0.000030 | *0.000010* | 0.00015 | B, R, N | 0.005 [D, I] |
| Calcium (Ca)-Dissolved | mg/L | 36 | 0 | 66 | 38 | 4.9 | 190 | na | |
| Chromium (Cr)-Dissolved | mg/L | 34 | 18 | 0.00019 | 0.00024 | *0.00010* | 0.00096 | 0.0089 [D, F] | 0.05 [D, I] |
| Cobalt (Co)-Dissolved | mg/L | 36 | 8 | 0.00052 | 0.00049 | *0.00010* | 0.0018 | 4 [D, C] | |
| Copper (Cu)-Dissolved | mg/L | 36 | 20 | 0.0033 | 0.016 | *0.00050* | 0.094 | 0.0004 to 0.002 [D, | 0.5 [D] |
| Iron (Fe)-Dissolved | mg/L | 36 | 21 | 0.10 | 0.20 | *0.030* | 0.97 | 0.35 | 0.3 [D, I] |
| Lead (Pb)-Dissolved | mg/L | 36 | 31 | 0.000063 | 0.00012 | *0.000050* | 0.00071 | B, C, H | 0.05 [D] |
| Lithium (Li)-Dissolved | mg/L | 36 | 0 | 0.21 | 0.35 | 0.0031 | 1.1 | 0.096 [K] | |
| Magnesium (Mg)-Dissolved | mg/L | 36 | 0 | 17 | 8.5 | 1.3 | 41 | ng | |
| Manganese (Mn)-Dissolved | mg/L | 36 | 0 | 0.15 | 0.26 | 0.00066 | 1.1 | B, C, J | 0.05 [D, I] |
| Mercury (Hg)-Dissolved | mg/L | 35 | 35 | na | na | *0.000020* | 0.000017 | 0.0002 [B, C, K] | 0.001 [B] |
| Molybdenum (Mo)-Dissolved | mg/L | 36 | 0 | 0.0071 | 0.011 | 0.00025 | 0.053 | 1 [D, C] | 0.25 [D] |
| Nickel (Ni)-Dissolved | mg/L | 36 | 5 | 0.0024 | 0.0020 | *0.00050* | 0.0080 | 0.025 to 0.15 [D, C, | |
| Potassium (K)-Dissolved | mg/L | 36 | 0 | 1.1 | 0.50 | 0.55 | 2.7 | 195 [K] | |
| Selenium (Se)-Dissolved | mg/L | 36 | 6 | 0.00044 | 0.00044 | *0.00010* | 0.0026 | 0.002 [D] | 0.01 [D] |
| Silicon (Si)-Dissolved | mg/L | 36 | 0 | 3.6 | 0.73 | 2.3 | 5.4 | ng | |
| Silver (Ag)-Dissolved | mg/L | 36 | 36 | na | na | *0.000010* | *0.000010* | [D, C, E] | |
| Sodium (Na)-Dissolved | mg/L | 36 | 5 | 97 | 140 | *1.0* | 440 | ng | 200 [D, I] |
| Strontium (Sr)-Dissolved | mg/L | 36 | 0 | 0.26 | 0.24 | 0.088 | 0.94 | ng | |
| Thallium (Tl)-Dissolved | mg/L | 36 | 25 | 0.000012 | 0.000011 | *0.000010* | 0.000056 | 0.0003 [D, K] | |
| Tin (Sn)-Dissolved | mg/L | 36 | 28 | 0.00020 | 0.00036 | *0.00010* | 0.0020 | ng | |
| Titanium (Ti)-Dissolved | mg/L | 36 | 31 | 0.0072 | 0.0062 | *0.010* | 0.039 | 2 [D, K] | |
| Uranium (U)-Dissolved | mg/L | 36 | 0 | 0.0018 | 0.0024 | 0.00024 | 0.010 | 0.3 [D, K] | 0.02 [D, I] |
| Vanadium (V)-Dissolved | mg/L | 36 | 32 | 0.00088 | 0.0013 | *0.0010* | 0.0081 | 0.006 [D, K] | |
| Zinc (Zn)-Dissolved | mg/L | 36 | 28 | 0.0064 | 0.020 | *0.0030* | 0.12 | B, C, M | 5 [B] |

*ng = no approved water quality guideline*

*na = not applicable*

*underlined values exceed guidelines*

*shaded/italic values are below reported detection limits.*

*red values exceed drinking water guidelines*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

*(continued)*

**Table 4.4-5. Groundwater Quality Summary Statistics for the Southern Underground Mine Zone: Dissolved Metals (completed)**

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$ ; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[G] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $log_{10}$ (Hardness)].*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$log_{10}$ (hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

**Table 4.4-6. Groundwater Quality Summary Statistics for the Coarse Coal Reject Site: Physical Tests, Anions, and Nutrients**

| Parameter | Units | # Samples | # samples below detection limit | Mean [J] | Standard Deviation [J] | Minimum | Maximum | DW Guidelines [X] | FWAL Guideline [A] |
|---|---|---|---|---|---|---|---|---|---|
| **Field Measurements** | | | | | | | | | |
| pH | - | 36 | 0 | 8.05 | 0.65 | 7.02 | 9.21 | 6.5-8.5 | 6.5-9.0 [D, G] |
| Oxidation-Reduction Potential | mV | 36 | 0 | -5 | 79 | -150 | 140 | | ng |
| Specific Conductance | µS/cm | 36 | 0 | 780 | 340 | 270 | 1900 | | ng |
| **Physical Tests (Laboratory)** | | | | | | | | | |
| Hardness (as $CaCO_3$) | mg/L | 38 | 0 | 150 | 150 | 8.4 | 390 | | ng |
| Total Dissolved Solids | mg/L | 6 | 0 | 650 | 340 | 310 | 1300 | | 1290 |
| **Anions and Nutrients** | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | 38 | 22 | 3.0 | 3.6 | *1.0* | 13 | | ng |
| Alkalinity, Total (as $CaCO_3$) | mg/L | 38 | 0 | 450 | 160 | 240 | 760 | | ng |
| Ammonia, Total (as N) | mg/L | 38 | 0 | 0.26 | 0.17 | 0.0071 | 0.51 | | 0.45 to 29 [H] |
| Bromide (Br) | mg/L | 38 | 36 | na | na | *0.50* | 2.10 | | ng |
| Chloride (Cl) | mg/L | 38 | 19 | 3.5 | 5.2 | *0.50* | 30 | 250 | 150 [C] |
| Fluoride (F) | mg/L | 38 | 0 | 0.46 | 0.33 | 0.09 | 1.1 | 1 [C] | K |
| Nitrate (as N) | mg/L | 38 | 28 | 0.021 | 0.026 | *0.0050* | 0.12 | 10 [L] | 3 [C] |
| Nitrite (as N) | mg/L | 38 | 27 | 0.0040 | 0.0032 | *0.0010* | 0.014 | 1 | 0.02 [C] |
| Total Nitrogen | mg/L | 38 | 0 | 0.61 | 0.85 | 0.13 | 5.4 | | ng |
| Orthophosphate-Dissolved (as P) | mg/L | 38 | 11 | 0.036 | 0.065 | *0.0010* | 0.38 | | ng |
| Phosphorus (P)-Total Dissolved | mg/L | 38 | 11 | 0.041 | 0.068 | *0.0020* | 0.39 | 0.01 [E] | between 0.005 and 0.015 [B, E] |
| Sulfate ($SO_4$) | mg/L | 38 | 9 | 36 | 75 | 1.0 | 410 | 500 | 128 to 429 [F] |

*ng = no approved water quality guideline*

*na = not applicable*

*underlined values exceed BC FWAL guidelines*

*shaded/italic values are below reported detection limits.*

*Red values exceed drinking water guidelines*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[J] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

**Table 4.4-7. Groundwater Quality Summary Statistics for the Coarse Coal Reject Site: Dissolved Metals**

| Parameter | Units | # Samples | # samples below detection limit | Mean [S] | Standard Deviation [S] | Minimum | Maximum | FWAL Guideline [A] | DW Guidelines [A] |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum (Al)-Dissolved | mg/L | 38 | 8 | 0.018 | 0.032 | *0.0030* | 0.13 | 0.05 [B,E] | 0.2 |
| Antimony (Sb)-Dissolved | mg/L | 38 | 17 | 0.00030 | 0.00037 | *0.00010* | 0.0017 | 0.02 [B, R] | 0.06 [B, T] |
| Arsenic (As)-Dissolved | mg/L | 38 | 3 | 0.0024 | 0.0066 | *0.00010* | 0.041 | 0.005 [B] | 0.025 [B] |
| Barium (Ba)-Dissolved | mg/L | 38 | 0 | 0.59 | 0.44 | 0.04 | 1.4 | 1 [B, C, R] | 1 [B, T] |
| Beryllium (Be)-Dissolved | mg/L | 38 | 38 | na | na | *0.00010* | *0.00010* | 0.0053 [B, C, R] | |
| Bismuth (Bi)-Dissolved | mg/L | 38 | 38 | na | na | *0.00050* | *0.00050* | ng | |
| Boron (B)-Dissolved | mg/L | 38 | 1 | 0.12 | 0.087 | *0.010* | 0.22 | 1.2 [B] | 5 [B] |
| Cadmium (Cd)-Dissolved | mg/L | 38 | 22 | 0.000022 | 0.000026 | *0.000010* | 0.00011 | B, R, N | 0.005 [B, T] |
| Calcium (Ca)-Dissolved | mg/L | 38 | 0 | 39 | 39 | 2.7 | 99 | na | |
| Chromium (Cr)-Dissolved | mg/L | 38 | 28 | 0.00012 | 0.00017 | *0.00010* | 0.0011 | 0.0089 [B, P] | 0.05 [B, T] |
| Cobalt (Co)-Dissolved | mg/L | 38 | 13 | 0.00077 | 0.00083 | *0.00010* | 0.0034 | 4 [B, C] | |
| Copper (Cu)-Dissolved | mg/L | 38 | 28 | 0.00050 | 0.00048 | *0.00050* | 0.0019 | 0.0004 to 0.002 [B, C, F] | 0.5 [B] |
| Iron (Fe)-Dissolved | mg/L | 38 | 11 | 0.39 | 0.72 | *0.030* | 3.7 | 0.35 | 0.3 [B, T] |
| Lead (Pb)-Dissolved | mg/L | 38 | 25 | 0.000065 | 0.00010 | *0.000050* | 0.00064 | B, C, H | 0.05 [B] |
| Lithium (Li)-Dissolved | mg/L | 38 | 0 | 0.25 | 0.27 | 0.0012 | 0.76 | 0.096 [R] | |
| Magnesium (Mg)-Dissolved | mg/L | 38 | 0 | 13 | 13 | 0.31 | 37 | ng | |
| Manganese (Mn)-Dissolved | mg/L | 38 | 0 | 0.30 | 0.38 | 0.0051 | 1.5 | B, C, J | 0.05 [B, T] |
| Mercury (Hg)-Dissolved | mg/L | 38 | 37 | na | na | *0.000010* | 0.000012 | 0.0000125 to 0.0002 [B, C, K] | 0.001 [B] |
| Molybdenum (Mo)-Dissolved | mg/L | 38 | 0 | 0.0055 | 0.0060 | 0.00016 | 0.023 | 1 [B, C] | 0.25 [B] |
| Nickel (Ni)-Dissolved | mg/L | 38 | 11 | 0.0026 | 0.0025 | *0.00050* | 0.0095 | 0.025 to 0.15 [B, C, R, Q] | |
| Potassium (K)-Dissolved | mg/L | 38 | 0 | 1.0 | 0.60 | 0.30 | 2.5 | 195 [R] | |
| Selenium (Se)-Dissolved | mg/L | 38 | 18 | 0.00024 | 0.00039 | *0.00010* | 0.0021 | 0.002 [B] | 0.01 [B] |
| Silicon (Si)-Dissolved | mg/L | 38 | 0 | 4.3 | 1.3 | 2.7 | 6.7 | ng | |
| Silver (Ag)-Dissolved | mg/L | 38 | 36 | na | 0.0000070 | *0.000010* | 0.000048 | 0.0005 to 0.0015 [B, C, L] | |
| Sodium (Na)-Dissolved | mg/L | 38 | 0 | 160 | 140 | 6.2 | 360 | ng | 200 [B, T] |
| Strontium (Sr)-Dissolved | mg/L | 38 | 0 | 0.21 | 0.12 | 0.024 | 0.52 | ng | |
| Thallium (Tl)-Dissolved | mg/L | 38 | 30 | 0.000011 | 0.000016 | *0.000010* | 0.00010 | 0.0003 [B, R] | |
| Tin (Sn)-Dissolved | mg/L | 38 | 26 | 0.00013 | 0.00015 | *0.00010* | 0.00076 | ng | |
| Titanium (Ti)-Dissolved | mg/L | 38 | 34 | 0.0055 | 0.002 | *0.010* | 0.012 | 2 [B, R] | |
| Uranium (U)-Dissolved | mg/L | 38 | 0 | 0.0015 | 0.0019 | 0.00002 | 0.0076 | 0.3 [B, R] | 0.02 [B, T] |
| Vanadium (V)-Dissolved | mg/L | 38 | 34 | 0.00081 | 0.00080 | *0.0010* | 0.0042 | 0.006 [B, R] | |
| Zinc (Zn)-Dissolved | mg/L | 38 | 27 | 0.0022 | 0.0015 | *0.0030* | 0.0077 | B, C, M | 5 [B] |

*ng = no approved water quality guideline*

*na = not applicable*

*underlined values exceed guidelines*

*shaded/italic values are below reported detection limits.*

*red values exceed drinking water guidelines*

*(continued)*

**Table 4.4-7. Groundwater Quality Summary Statistics for the Coarse Coal Reject Site: Dissolved Metals (completed)**

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[G] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $log_{10}$(Hardness)].*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

Turbidity and Total Suspended Solids: Elevated turbidity has been measured at a number of wells, and is interpreted to be a sampling artefact in most cases. Elevated turbidity was generally observed during the early sampling events, prior to identification of the need to implement low-flow sampling methods throughout the site. Samples that meet the turbidity target of 50 NTU or less have been attained at 22 of 23 sampled monitoring wells at least once.

#### *4.4.2.2 Nutrients*

Ammonia concentrations were consistently below guideline concentrations and occasionally below detection limits. Nitrate and nitrite concentrations were consistently an order of magnitude or more below guideline concentrations, and occasionally below detection limits.

Dissolved phorphorus concentrations were generally outside the guideline range intended for lake ecosystems, and above the drinking water guideline intended for that sourced in lakes. Natural groundwater is typically depleted of phosphorous, and little relation exists between stable concentrations in the aquatic habitats for-which the guideline is intended, and the concentration in the groundwater discharging into these environments.

#### *4.4.2.3 Major Anions*

Bicarbonate was the dominant anion in groundwater samples collected throughout the Project site, with concentrations ranging from 134 to 937 mg/L as $CaCO_3$.

Elevated concentrations of sulphate have been observed sporadically at wells located in the southern half of the CCR site, where concentrations ranged from non-detection (< 5 mg/L) to 223 mg/L. Otherwise sulphate concentrations were typically less than 30 mg/L.

Chloride concentrations were quite low (less than 15 mg/L) in the Underground Mine Zone and at the CCR site. In contrast, the mean chloride concentration at the Southern Underground Mine Zone was 46 mg/L.

Fluoride concentrations were frequently elevated in wells screening deeper bedrock. Concentrations exceeded the hardness-dependent guideline on occasion in the Underground Mine Zone and on the CCR site.

#### *4.4.2.4 Dissolved Metals*

Cations were dominated by sodium or calcium, depending on depth. Shallower groundwater contained highest concentrations of calcium, while deeper groundwater contained greater concentrations of sodium. Magnesium was also frequently found at considerable concentrations, with a mean concentration around 12 mg/L throughout the Project site. Potassium and strontium, two ions commonly found in nature, were present at lower concentrations (maximum of 2.7 mg/L for potassium, 0.94 mg/L for strontium).

The majority of trace metals were frequently not detected and generally at concentrations well below both drinking water and freshwater aquatic life guidelines. Metals for-which no guidelines were exceeded in any groundwater samples include antimony, beryllium, bismuth, boron, cadmium, cobalt, lead, mercury, molybdenum, nickel, silver, thallium, tin, titanium, uranium, and zinc. Others are discussed individually below.

Certain trace metals were reported at levels exceeding guidelines for the first sample collected from the well following installation, and reported at much lower concentrations there-after. These

anomalous exceedances are interpreted as artefacts of drilling, possibly impurities leached from the drilling equipment or circulation fluid additives. Anomalous concentrations falling into this category have been dis-regarded in characterizing the natural baseline groundwater conditions.

Aluminum: six wells screened in deeper bedrock reported dissolved aluminum concentrations in exceedance of the 0.05 mg/L guideline for the protection of freshwater aquatic life. Two of these samples also exceeded the guideline of 0.2 mg/L for drinking water, with concentrations an order of magnitude greater than the guideline. With the exception of samples collected at MW-H26A, the exceedances occurred in samples collected shortly following drilling, and may reflect residual drilling impact. The exceedances observed at MW-H26A are interpreted as a natural baseline condition.

Arsenic: dissolved arsenic concentrations above the 0.005 mg/L total arsenic guideline for aquatic life were reported for three groundwater samples: one collected from each of MW-H20, MW-H24C, and MW-H28. The sole exceedance at MW-H24C also exceeded the drinking water guideline for total arsenic. Baseline dissolved arsenic concentrations were generally on the scale of micrograms per litre throughout the site.

Barium: The total barium guideline concentration of 1 mg/L (for both aquatic life and drinking water) is exceeded for a number of samples at a number of wells. The calculated mean concentrations for barium are 0.7, 0.6, and 0.6 mg/L at the Underground Mine Zone, Southern Underground Mine Zone, and CCR Site respectively. The reported concentrations of barium near or slightly above the guidelines are interpreted as natural baseline conditions.

Chromium: Exceedances of the total chromium guidelines (both aquatic life and drinking water) were reported for two wells at the CCR site: MW-H25A and MW-H26A. The single exceedance reported for MW-H25A was for the first sample collected from the well, and is interpreted as a drilling artefact. Non-detects have been reported for all subsequent samples from MW-H25A. Two exceedances have been reported at MW-H26A, as well as consistent detections. The elevated chromium levels at MW-H26A are interpreted as a baseline groundwater occurrence.

Copper: Dissolved copper concentrations frequently exceeded guideline concentrations for the protection of aquatic life (not for drinking water). The laboratory detection limit (0.05 µg/L for most samples) exceeded the chronic exposure guideline concentration applicable when hardness is greater than 50 mg/L as $CaCO_3$ (0.04 µg/L). The mean copper concentrations calculated for the Underground Mine Zone (0.0067 mg/L) and Southern Underground Mine Zone (0.0033 mg/L) were above the upper chronic exposure guideline (0.002 mg/L for hardness < 50 mg/L as $CaCO_3$), while it was well below this benchmark at the CCR Site ( 0.00050 mg/L ).

Iron: the maximum dissolved iron concentrations exceeded both drinking water and aquatic life guidelines (0.3 and 0.35 mg/L respectively) in a number of wells, including a subset of the wells in the Underground Mine Zone, the Southern Underground Mine Zone, and CCR Site. The mean iron concentration at the CCR site (0.39 mg/L) exceeded both guidelines marginally. Mean concentrations in the Underground Mine Zone (0.28 mg/L) and in the Southern Underground Mine Zone (0.10 mg/L) were somewhat below both guidelines.

Lithium: Lithium concentrations exceed the 0.096 mg/L guideline for aquatic life at a number of wells throughout the project site. These are interpreted as a natural baseline occurrence. Mean concentrations ranged from 0.21 mg/L at the Southern Underground Mine Zone to 0.50 in the Underground Mine Zone.

Manganese: dissolved manganese concentrations frequently exceeded the drinking water guideline (0.05 mg/L) published by Health Canada, which is intended as an aesthetic guideline (Health Canada 2012). The observed manganese levels are interpreted as natural baseline concentrations. Mean values ranged from 0.15 mg/L at the Southern Underground Mine Zone to 0.30 mg/L at the CCR site.

Selenium: dissolved selenium concentrations in exceedance of the total selenium guideline for aquatic life (0.002 mg/L) were reported for the first samples collected from two wells located at the CCR Site and three wells at the Underground Mine Zone. Exceedances were not reported for subsequent samples at these wells or any others. These exceedences are interpreted as artefacts of drilling, possibly impurities leached from the drill bit or rods, as selenium is used in certain metal alloys.

### 4.4.3 Site-wide Groundwater Quality

The sampled groundwater may be classified under two different groundwater facies (as shown in Figure 4.4-1): Ca-$HCO_3$ type, and Na-$HCO_3$ type. The calcium bicarbonate facies is typical of the shallow groundwater, whereas the sodium-bicarbonate facies is typical of the groundwater deeper in the bedrock.

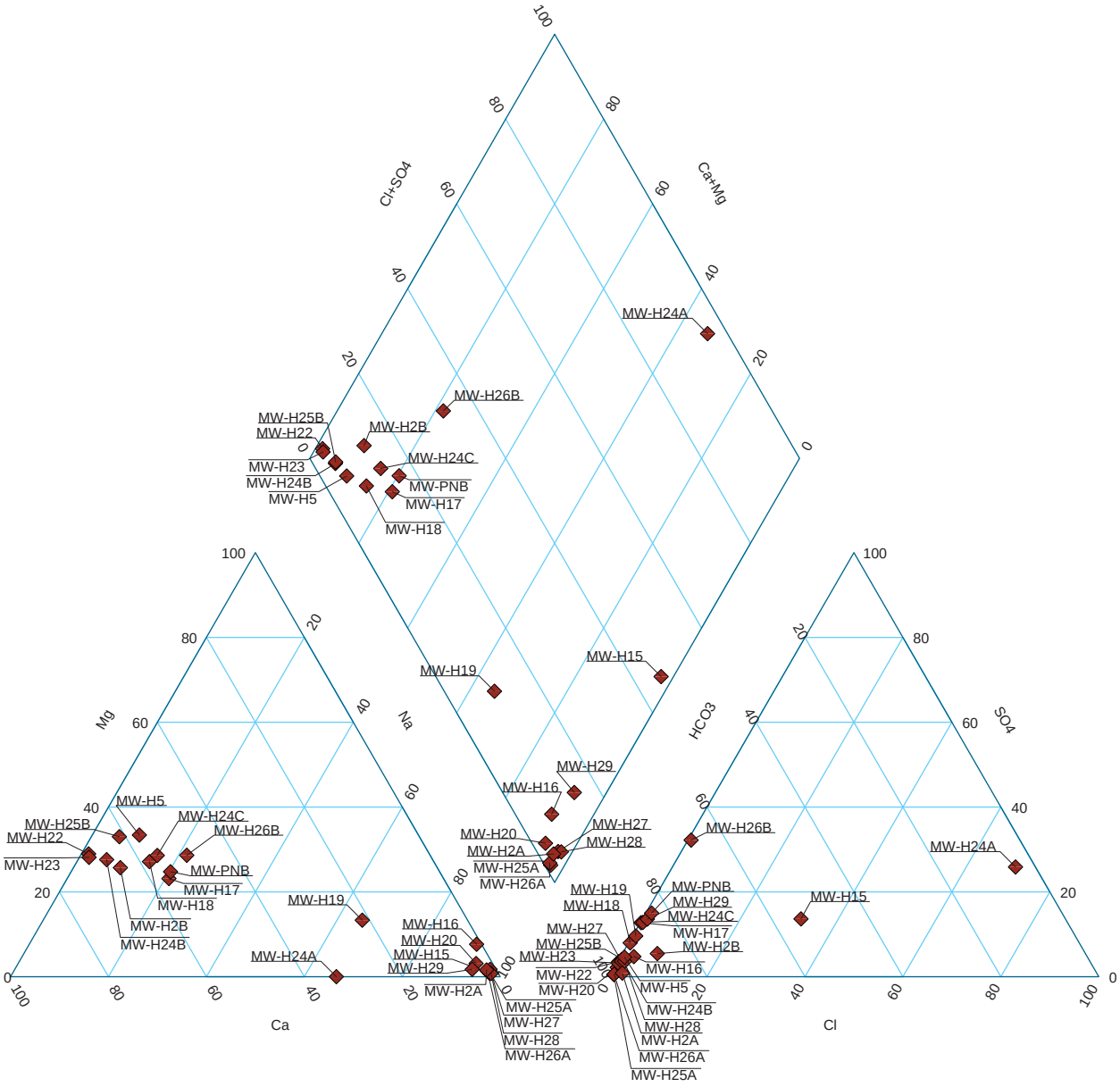
Groundwater throughout the project site is slightly alkaline (mean pH of 8.4 to 7.2). Shallow groundwater is hard due to the dominance of calcium among the cations, whereas the deeper groundwater is soft due to the replacement of calcium with sodium. Total dissolved solids (TDS) increases with depth. The shallow groundwater may be classified as fresh (TDS less than 1000 mg/L). At depths exceeding 50 mbg the TDS begins to surpass the transition from fresh to brakish.

The dissolved metal concentrations in the groundwater are generally at suitable levels to support aquatic habitat in discharge zones and drinking water in supply wells. Naturally elevated levels of barium, iron, lithium, and manganese have been demonstrated in the groundwater sampling data. Elevated concentrations of barium and lithium are tied to TDS, and seasonally consistent guideline exceedances are limited to the deeper (greater than 50 mbg) groundwater. Iron concentrations exceeding the dissolved iron guidelines have been reported at a range of depths, and are likely driven by local variability in sediment and bedrock minerology.

Positive detections of aluminum, arsenic, chromium, copper, and selenium have exceeded aquatic life or drinking water guidelines in isolated cases. Guideline exceedances for these metals were generally reported for samples collected shortly after drilling and installation of the wells, and are interpreted as drilling artefacts. The detection limit for copper frequently exceeded the aquatic life guideline (detection limit of 0.05 µg/L, guideline of 0.04 µg/L in many cases), and copper concentrations could not be concluded to be below the guideline where this was the case.

**Figure 4.4-1**

**Piper Plot of Major Ion Concentrations in Groundwater**



# 5. Hydrogeologic Conceptual Model

ERM

# 5. Hydrogeologic Conceptual Model

A hydrogeologic conceptual model has been developed based on the available meteorological, geological, and hydrological information and data as summarized in Chapter 2, and the findings of the hydrogeology baseline studies present throughout this report. The conceptual model described here has been refined for use in the development of a numerical groundwater model and for effects assessments of groundwater quantity and quality for the Project.

Figures 5-1, 5-2, 5-3, and 5-4 show the geologic setting with conceptual groundwater flow directions, water levels, and areas of groundwater recharge and discharge.

## 5.1 HYDROSTRATIGRAPHIC FEATURES AND PROPERTIES

The Project is situated within a folded and faulted series of Lower Cretaceous clastic sedimentary rocks, underlying a covering dominated by glacially-derived sediments and river sediments. The majority of the rock mass is composed of mudstones and siltstones, which are inter-bedded with sandstone and coal seams. The geometry of the strata is controlled by two principal factors: structural features (presence of synclines, antyclines, faults and dense joint sets) and erosion (presence of river and creek valleys dissecting the bedrock formations).

The bedrock is saturated except where it crops above the water table, and as such constitutes a fractured bedrock medium for saturated groundwater flow. Most of the formations are characterized by low hydraulic conductivity.

The Hasler formation (and other undifferentiated sediments above the Boulder Creek Formation) has hosted 40 hydraulic conductivity (K) measurements within the LSA, which show K ranging from 6E-6 m/s to 9E-10 m/s (geometric mean of 8E-8 m/s). The range in the Hasler formation is interpreted to represent variability in joint density, where the lower measurements approach the permeability of the rock matrix.

The permeability appears to generally decrease with depth. The two K measurements in the Boulder Creek formation were 5E-9 m/s and 3E-8 m/s. Two measurements spanning the lower Boulder Creek, Hulcross, and upper Gates formations were 6E-9 m/s, and 2E-9 m/s. The extent of the Gates formation containing Coal Seams may present an isolated exception to the K versus depth trend: K has been reported to be as high as 2E-7 m/s (Appendix A) in the extent of the Gates Formation containing the F, G, and I coal seams.

Due to a sizeable presence of sandstone in the stratigraphic columns of the Boulder Creek and Gates formations, they may behave as aquifers on a regional scale. The Hasler and Hulcross formations may behave as regional aquitards due to the dominance of mudstones and siltstones in these formations. The limited hydraulic conductivity data available for the deeper strata of the Project area is not sufficient to clearly designate bedrock formations within the project area as aquifers or aquitards.

Surficial deposits vary greatly in thickness and lithological character from place to place. Principal deposit types include fluvial, glaciofluvial, morainal, colluvial and wetland sediments. Fluvial and glaciofluvial sediments are present mainly along the bottoms of river valleys, morainal sediments cover much of the ground surface of the hills and mountains, colluvial sediments are common along steeper slopes, while wetland sediments accumulated in terrain depressions or at the base of significant groundwater seeps.

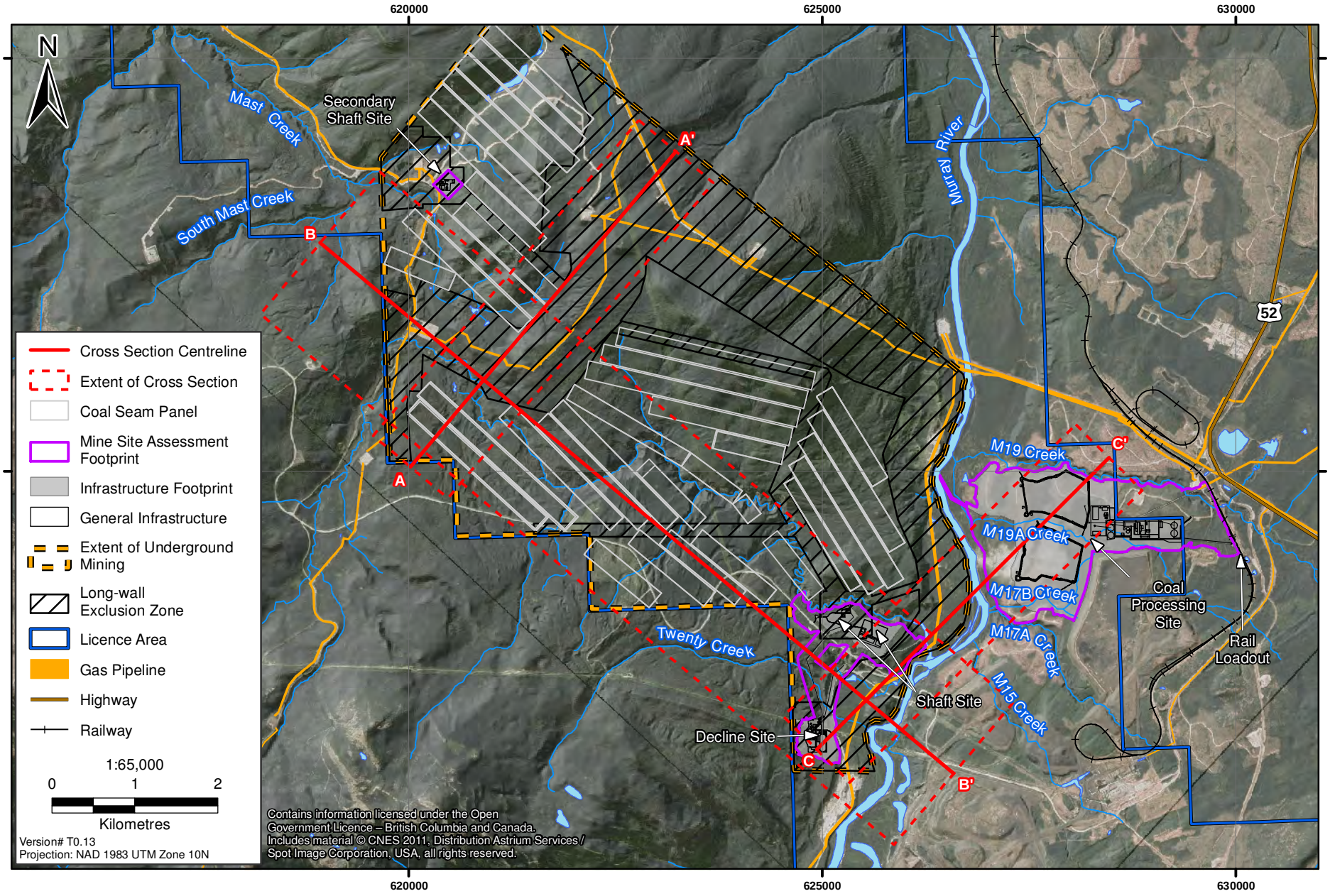



Figure 5-1

hcl Mining

MURRAY RIVER COAL PROJECT

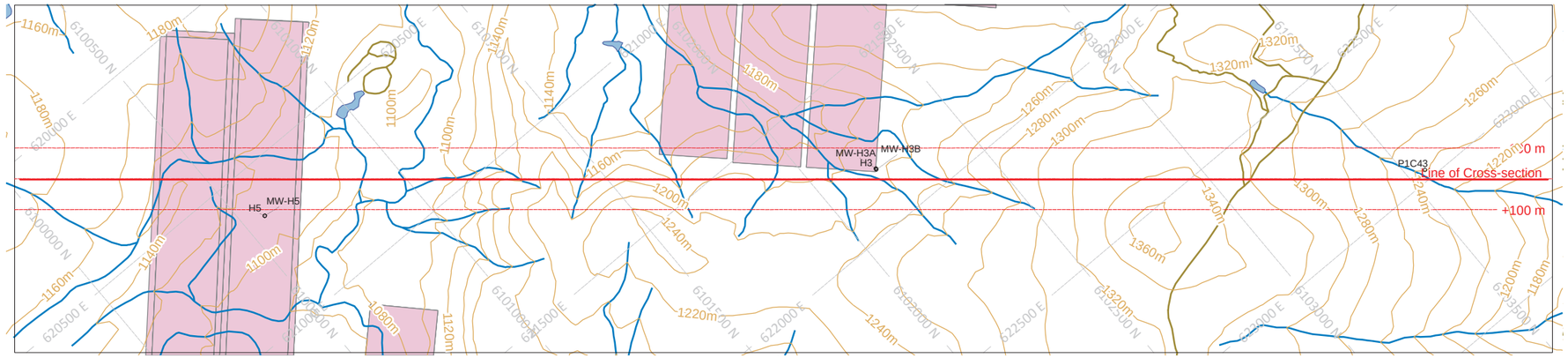
# Location of Cross Sections

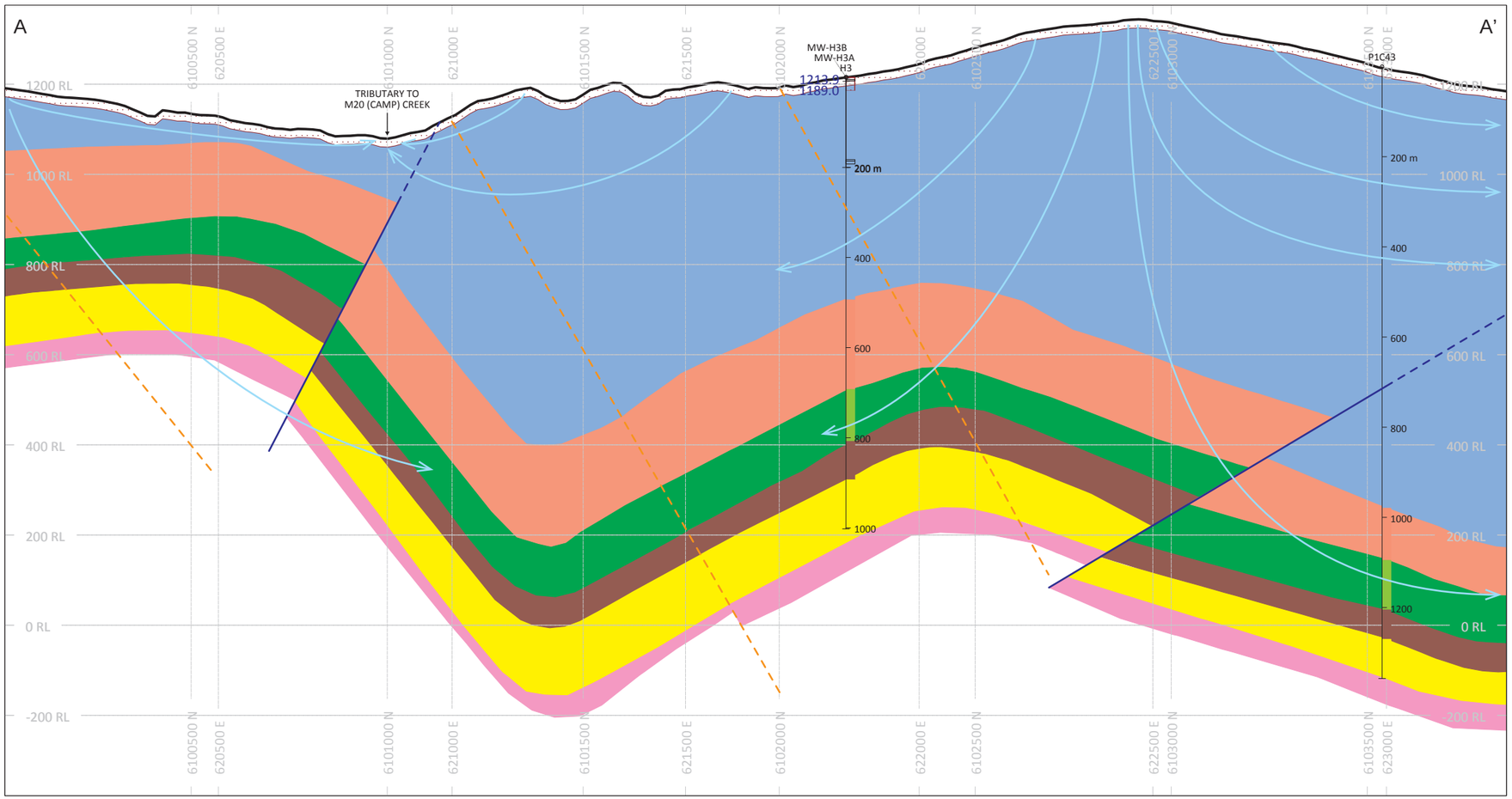
Figure 5-1

Rescan an ERM company

**Figure 5-2**

**Hydrogeologic Conceptual Model: Cross-Section in the Underground Mine Zone along Upper Reaches of the Camp Creek Drainage Basin (A – A')**




HOLES PLOTTED

TOTAL 4

H3 MW-H3A MW-H3B P1C43

Contours
Transportation
Stream
Coal Seam Panel
Water/Wetlands

Topography
Groundwater Flow Line
Overburden
Hasler and undifferentiated
Boulder Creek
Hulcross
Upper Gates
Middle Gates
Lower Gates
Hydrogeology Well
777.8 Water Table
Fault, Interpretted from Geophysics
Fault, Inferred

**SECTION SPECS:**

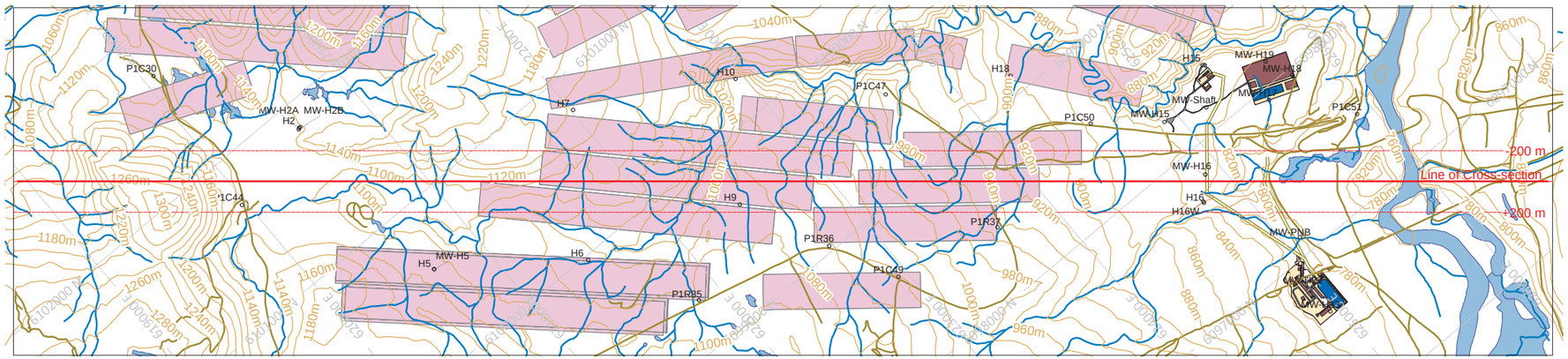
| | | |
|---|---|---|
| REF. PT. E, N | 621650 m | 6101940 m |
| EXTENTS | 5000 m | 1754 m |
| SECTION TOP, BOT | 1375 m | -378.5 m |
| TOLERANCE +/- | 100 m | |
| VERTICAL EXAG. | 1.5 m | |

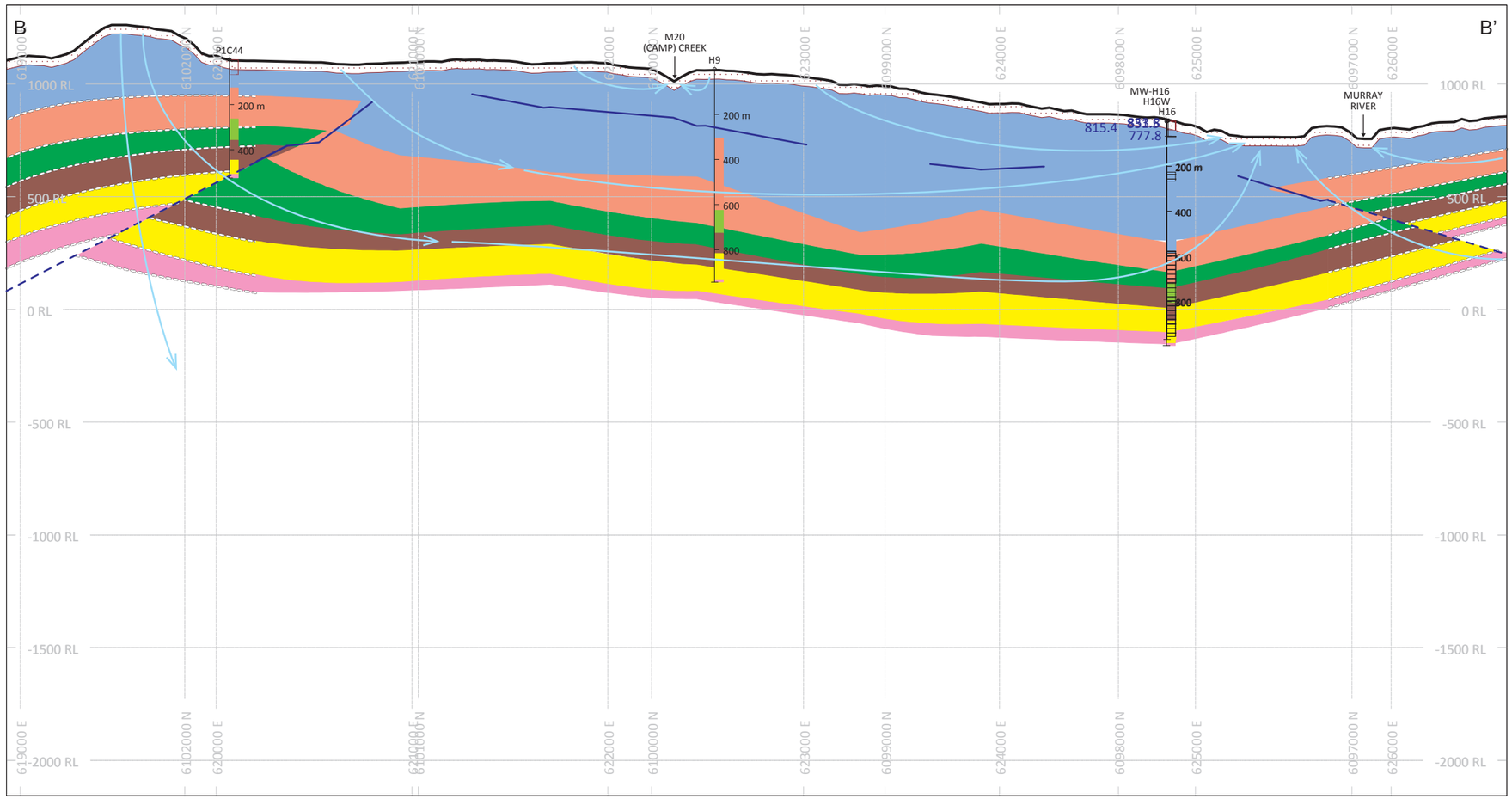
SCALE
(m)
-100 0 100 200 300 400 500
NAD83 / UTM zone 10

AZIMUTH = 45°
N
W E
S

**Figure 5-3**

**Hydrogeologic Conceptual Model:**
**Cross-Section along the Camp Creek Drainage Basin (B — B')**




HOLES PLOTTED

TOTAL 5

H16 P1C44 | H16W | H9 | MW-H16

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water/Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel
- Topography
- Groundwater Flow Line
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred
- Interpretted Stratigraphic Contact

**SECTION SPECS:**

| | | |
|---|---|---|
| REF. PT. E, N | 622760 m | 6099550 m |
| EXTENTS | 10000 m | 3508 m |
| SECTION TOP, BOT | 1351 m | -2157 m |
| TOLERANCE +/- | 200 m | |
| VERTICAL EXAG. | 1.5 m | |

SCALE

(m)

-200 0 200 400 600 800 1000

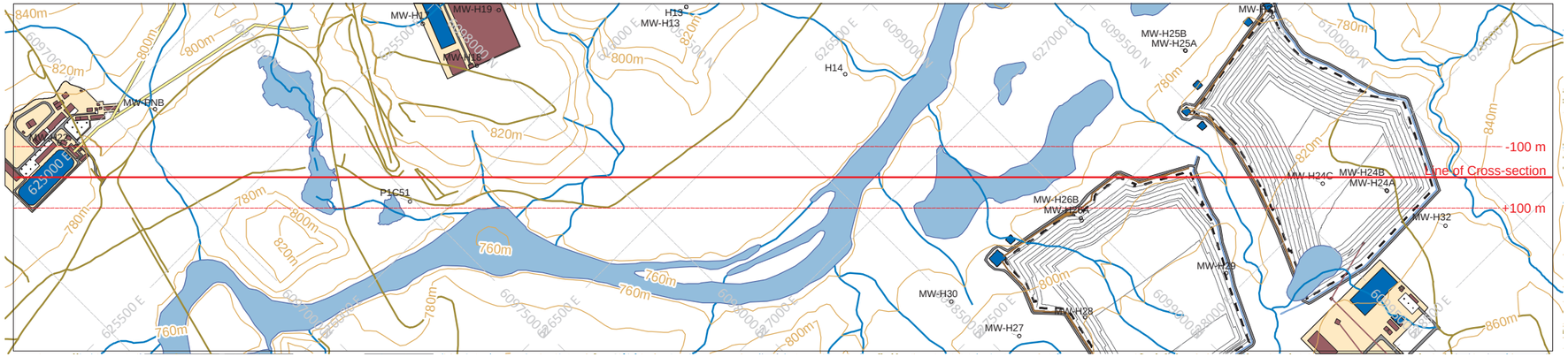
NAD83 / UTM zone 10

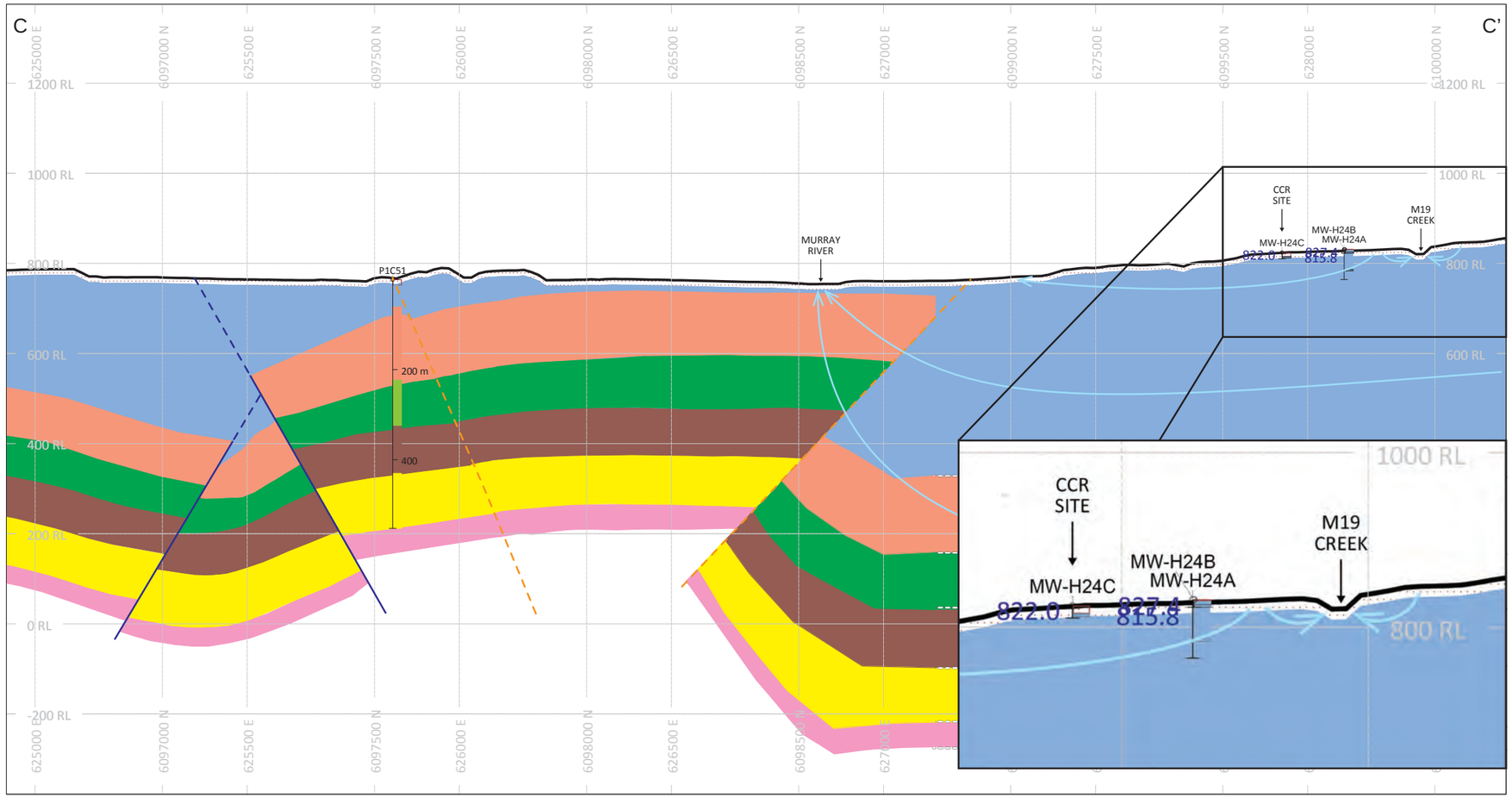
AZIMUTH = 130°

N W E S

**Figure 5-4**

**Hydrogeologic Conceptual Model: Cross-Section along the Southern Underground Mine Zone and Coarse Coal Reject Site (C – C′)**




HOLES PLOTTED

TOTAL 4

MW-H24A MW-H24B MW-H24C P1C51

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water/Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel
- Topography
- Groundwater Flow Line
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred
- Interpretted Stratigraphic Contact

**SECTION SPECS:**

| | | |
|---|---|---|
| REF. PT., E, N | 626700 m | 6098400 m |
| EXTENTS | 5000 m | 1754 m |
| SECTION TOP, BOT | 1375 m | -378.5 m |
| TOLERANCE +/- | 100 m | |
| VERTICAL EXAG. | 1.5 m | |

SCALE

(m)

-100 0 100 200 300 400 500

NAD83 / UTM zone 10

AZIMUTH = 45°

N W E S

Grain size distribution is the primary factor determining hydraulic properties of surficial sediments. Sand/gravel and clay/silt are at the opposite ends of a spectrum of high- and low-K sediments, respectively. K of gravelly sand situated in the southern Underground Mine Zone have ranged as high as 4E-4 m/s, and measurements in fines in the CCR site are as low as 4E-9 m/s.

Groundwater levels in bedrock formations indicate confined conditions, except near bedrock outcrop / sub-crop areas close to deeply incised valleys. Groundwater in overburden deposits is most often present under unconfined conditions, although some wells at the CCR Site exhibit confined conditions where a clay layer overlies a granular deposit.

## 5.2 GROUNDWATER FLOW REGIME (DIRECTION AND GRADIENTS)

The Project is located in a Mountain foothill area dissected by the broad valleys containing the Murray and Wolverine Rivers. Foothills within the regional study areas rise over 1,000 meters above the valley bottoms: Mount Babcock 1,855 masl) rises 1,080 m above the Murray River (770 masl).

Such terrain results in certain consequences to a groundwater flow system. Groundwater is recharged by greater precipitation at higher elevations, while valley bottoms constitute discharge zones. Local groundwater flow systems develop above intermediate and regional flow systems, whereby localized groundwater flow discharges to small tributaries, and deeper groundwater discharges to larger streams and rivers. However, folding and faulting formations may modify these patterns.

Thus, the groundwater flow system in the Project area is characterized by groundwater flowing from the upper foothills towards the Murray River, with anisotropy introduced by folds, faults and local topography (Figures 5-2 to 5-4). Local topography creates intermediate and shallow systems existing above regional systems (Figures 5-2 to 5-4). The Camp Creek basin behaves as an intermediate catchment basin. The small watersheds containing M19A, M17B, and M19 creeks behave as local catchment basins for shallow groundwater flow in the CCR site and adjacent areas. The watersheds of Twenty Creek, and other minor tributaries within the Underground Mine Zone behave as local catchment basins as well.

## 5.3 SPATIAL AND TEMPORAL VARIATIONS IN RECHARGE AND DISCHARGE

Recharge to groundwater is a function of range of variables, such as precipitation, temperature, evapotranspiration, soil type, land use, and slope aspect. On a regional scale, variability in precipitation is expected to play a dominating role, whereby greater precipitation (and by extension greater recharge) is received at greater elevations due to the orographic effect.

Temporal variations in natural recharge and discharge are expected to be minor. Documented seasonal variations in groundwater levels have been as high as 2 m. Given the scale of topographic relief within the local study area, these water level variations are expected to be too small to give rise to meaningful changes in hydraulic gradients or the patterns of groundwater flow.

## 5.4 SURFACE WATER – GROUNDWATER INTERACTIONS

All streams are fed to a varying degree by overland flow, interflow (lateral movement of water below ground surface but above the water table) and groundwater discharge. Stream flow is dominated by groundwater discharge (often referred to as base flow) during the winter or prolonged periods of low precipitation. During periods of flooding (e.g. freshet), streams may be recharging groundwater, particularly along reaches at higher elevations. Stream reaches at lower elevations are predominantly situated in groundwater discharge zones. The groundwater likely supports wetlands found along the flood plains of the Murray River during non-peak flow periods.

# 6. Conclusions

# 6. Conclusions

The contents of this hydrogeology baseline report for the Project were derived from the field information and other relevant information collected between 2010 and 2014. Groundwater monitoring instruments were installed to characterize baseline groundwater conditions, and to provide the means for long-term groundwater level and quality monitoring, once mine operations commence.

Key baseline hydrogeological observations for the Project include the following:

- At the scale of the local study area, groundwater flows from foothill highland areas towards the Murray River, which acts as a regional groundwater discharge zone. At a more localized scale, shallower groundwater reports to Camp Creek and other tributaries bordering and splitting the Underground Mine Zone and the CCR site.
- The groundwater levels vary seasonally by one to two metres. The periods of greatest recharge and highest water levels occur following freshet, major convective storm cycles during the summer, and mid-winter warm spells.
- The vertical hydraulic gradients calculated for twinned wells indicate groundwater recharge zones are present at topographic highs and discharge zones at topographic lows. A portion of the shallow groundwater passing through the Underground Mine Zone and CCR site discharges to tributaries of the Murray River, while the remainder flows towards the base of the Murray River basin.
- The site containing the bulk sample waste rock facility and proposed shaft is underlain by a thin layer of glacial till, followed by mudstone. The water table at this site is found between 4 and 11 mbg, beneath the overburden. This site behaves as a local groundwater divide, whereby groundwater flows towards the southwest and northeast from the centre of the site. Hydraulic conductivity measurements have ranged from E-6 to E-9 m/s.
- The far southern reaches of the Underground Mine Zone (containing the bulk sample portal) is underlain by a layer of granual glaciofluvial sediments followed by mudstones and siltstones. The water table is around 15 to 20 mbg, giving rise to an unconfined aquifer in the sediments with K of E-4 to E-6 m/s. Groundwater flows to the south-east towards the Murray River.
- The CCR site is underlain by morainal deposits (well graded fine sands and tight clay) followed by siltstones, fine sandstones, and mudstones. The water table situated in the bedrock at upper elevations, and overburden at lower elevations. The tight clay unit acts as a semi-confining layer, and was observed to be thickest at lower elevations and pinching out up-slope. Groundwater flows westward towards the Murray River, and the lower reaches of the CCR site are within a discharge zone adjacent to a wetland connected with the Murray River. The estimated K of the overburden materials ranges from E-6 m/s (sands) to E-9 m/s (clays). Bedrock K measurements range from E-6 to E-9 m/s.
- Groundwater throughout the local study area is slightly basic (mean pH of 7.2 to 8.4). Calcium and bicarbonate tend to be the dominant ions in the shallow groundwater (less than 50 mbg), and sodium and bicarbonate dominate in the deeper groundwater. TDS trends upwards with depth.
- Concentrations of dissolved barium, iron, lithium, and manganese have consistently exceeded guidelines for the protection of freshwater aquatic life or drinking water in samples collected from a number of well. Elevated concentrations of the aforementioned metals are considered natural baseline occurrences. Positive detections of aluminum, arsenic, chromium, copper, and selenium have exceeded the BC MOE guidelines for the protection of freshwater aquatic life or raw drinking water supply in isolated samples.

# References

ERM

# References

Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.


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# Appendix A

## Hydrogeologic Site Investigation Reports Prepared by AMEC

ERM

April 1, 2010

**Project No. KX13432**

Canadian Dehua International Mines Group Inc.
1411 – 409 Granville Street
Vancouver, British Columbia
V6C 1T2

**Attention: Mr. James Luo**

**Re: Packer Testing to Assess Bedrock Permeability**
**Tumbler Ridge, B.C.**

## 1.0 INTRODUCTION

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC), has completed a packer testing program within an NQ (75.7 mm diameter) diamond drilled hole (Borehole PIR-35, hereafter referenced as the 'Site',) approximately 12.5 km south of Tumbler Ridge, BC (Figure 1).

This report is submitted following comments and questions received concerning a draft report dated March 29, 2010. The data, contents, and conclusions provided herein supercedes the contents of the March 29, 2010 draft report.

## 2.0 BACKGROUND

AMEC understands that Canadian Dehua International Mines Group (CDIMG) Inc. is proposing to develop an underground mine to extract metallurgical (coking) coal. A drill program to collect and analyze core samples was on-going at the time AMEC's services were requested.

Upon AMEC's arrival on-site on February 23, 2010, borehole PIR-35 had been drilled to 671 m below grade by Black Hawk Drilling Ltd. (BHDL). AMEC personnel were introduced to Jinquean Zheng, CDIMG mine manager and provided with a copy of CDIMG's borehole log for PIR-35. The PIR-35 borehole lithology between 200 m and 671 m below grade, as recorded by CDIMG personnel, is provided in Figure 2. Generally, the borehole lithology between 200 m and 671 m below grade was reported as mudstone with occasional layers of sandstone. BHDL reported flowing conditions from borehole PIR-35 below 316 m below grade. CDIMG requested that packer tests be performed at PIR-35 adjacent sandstone layers between 601-650 m (zone 1), 552-600 m (zone 2), 466-520 m (zone 3) and 272-355 (zone 4).

## 3.0 OBJECTIVE AND SCOPE

The objective of packer testing is to estimate the permeability of bedrock along discrete intervals in a borehole using pneumatic inflatable packers. AMEC understands that these estimates of

bedrock permeability will be used with other more detailed estimates of bedrock permeability for mine feasibility and design.

To meet the stated objective, AMEC has completed the following scope of work:

- Reviewed bedrock lithology as presented on the PIR-35 borehole log and recorded by CDIMG in order to determine the discrete interval for each packer test;
- Recorded the shut-in pressure to determine the static head of water above-grade;
- Lowered NQ packers into borehole PIR-35 using the driller's wireline and conducted rising head and injection tests at the following depth intervals: 601-670 m bgl, 552-600 m bgl, 465-520m bgl, and 272-355m bgl;
- Compiled and interpreted the packer testing data; and
- Prepared this report.

## 4.0 SITE DESCRIPTION AND SURROUNDING LAND USE

The site is located approximately 12.5 km southwest of Tumbler Ridge and is situated within the sub-alpine of the northern Rocky Mountains. Global Positioning Satellite (GPS) coordinates of the borehole at ground surface are as follows:

- 621852 E
- 6099308 N
- 1083 m above sea level (asl)

Access to the site from Tumbler Ridge is along 30 km of gravel-surfaced forestry roads. The ground immediately adjacent to the borehole consisted of sandy silts and clay. Based on visual observations, surface drainage and overland runoff at the site is toward the southeast. A small unnamed creek was located approximately 20 m southwest of the site and flowed southeast. Water from this unnamed creek was used for the drilling and injection testing.

Surrounding land use consists of forested crown land. The site is located approximately 20 km northeast of the former Quintette coal mine.

## 5.0 FIELD WORK

On February 23, 2010 AMEC personal mobilized from Prince George to Tumbler Ridge and met with Jinquan Zheng, Mine Manager with CDIMG. AMEC was provided a borehole log for borehole PIR-35. Borehole PIR-35 was drilled to 671 m below grade and was reported to be flowing. AMEC and CDIMG agreed that packer tests would be conducted between 601-670 m bgl (zone 1), 552-600 m bgl (zone 2), 466-520 m bgl (zone 3) and 272-355 bgl (zone 4).

BHDL was requested to raise the diamond drill bit to the top of Test Zone 1 (600 m below grade) and record the shut-in pressure of the open flowing borehole. Use of a three-packer system, whereby, the lower two packers sealed off a discrete interval was considered. Since there was some risk of losing the lower packer of the three packer configuration down the hole

as a consequence of caving in the borehole, a two packer configuration was used. The packer assembly was provided by RST Instruments of Coquitlam, B.C.

Test Zone 1 was hydraulically isolated by inflating the two packer configuration at the top of the test zone. The base of the remaining test zones were hydraulically isolated by grouting up the base of the borehole with a bentonite grout using a tremie pipe extending from the base of the drill bit and setting a Van Ruth cementing and wedging plug at the base of the test zone. The Van Ruth cementing and wedging (CW) plug was used as opposed to a Van Ruth Cementing and Wedging Bottom Packer (CWBP) since the CWBP was not available on-site at the time the testing took place. The upper limit of each test zone was hydraulically isolated from the remainder of the borehole by inflating the two packer configuration at that depth.

The two packer configuration consists of two NQ sized packers separated by a seating cone (Figure 3). A 0.3 m long 25 mm diameter perforated galvanized steel pipe extends below the lower packer. The perforated pipe is capped at one end and houses a 1500 PSI P-25 pressure transducer and datalogger supplied by Pioneer Petro-tech of Calgary, Alberta. The packer assembly was lowered to the drill bit using the drill rig wireline. The seating cone of the packer assembly is designed to sit upon the drill bit such that the upper packer remained within the NQ drill rods and the lower packer and the pressure transducer extend below the drill bit into the open borehole. A 6 mm diameter high-pressure Teflon tube connected the packer assembly to a nitrogen gas cylinder at grade. To facilitate the insertion and extraction of the high-pressure gas line and to minimize the potential for it to become tangled with the wire line, black electrical tape was used to attach the gas line to the wire line along 20 m intervals. Gas flow to the packer assembly was controlled using a gas regulator capable of providing pressures up to 13,800 kPa (2000 psi).

Packers were inflated using an appropriate inflation pressure accounting for the static head of water (equivalent to the shut-in pressure $\mathbf{P_1}$), the pressure required to expand the packer to the borehole wall (the expansion pressure = 110 psi from RST unconfined N packer inflation curve) and the pressure required to form a tight seal against the borehole wall (the sealing pressure = 750 psi from RST confined N packer inflation curve). The range of suitable inflation pressures as outlined in the RST packer manual is calculated as follows:

$\mathbf{P_1}$ = Static head of water
$\mathbf{P_2}$ = 100 psi + Head of water in shaft

$\mathbf{Pp_{max}} = \mathbf{P_1}$ + Sealing Pressure (750 psi)

$\mathbf{Pp_{min}} = \mathbf{P_2}$ + Expansion Pressure (110 psi)

Inflation pressure ($\mathbf{P_i}$) needed is:

$$\mathbf{Pp_{max} > P_i > Pp_{min}}$$

After the packers had been inflated and the gas regulator showed that the gas levels were maintaining a constant pressure, the stuffing box (comprised of a threaded steel casing and four rubber disks) sealed the top of the drill rods (Figure 3). A 25 mm diameter high density hydraulic hose connected the stuffing box to a manifold housing a GPI G2 Industrial Grade

digital flow meter, and a by-pass valve. The inlet of the manifold was attached to a pump by a high pressure hydraulic hose.

The digital flow meter was calibrated by pumping water into a container of known volume and recording the time taken to fill the container while simultaneously recording the flow rate using the flow meter. The flow rate recorded using the stop watch was consistent with the flow rate recorded by the flow meter.

Following completion of each test, packers were disconnected from the nitrogen gas cylinder and deflated while the nitrogen gas cylinder was turned off.

The tests performed at each Test Zone are summarized in Table 1:

**Table 1**
**Packer Test Summary**

| Test Zone | Test Interval (m bgl) | | Test Zone Length (m) | Shut-In Test | Discharge Test | Recovery Test | Injection Test |
|---|---|---|---|---|---|---|---|
| | Top | Bottom | | | | | |
| 1 | 601 | 670 | 69 | x | x | x | |
| 2 | 552 | 600 | 48 | x | | | x |
| 3 | 466 | 520 | 54 | x | | | x |
| 4 | 272 | 355 | 83 | x | | | x |

At Test Zone 1, a recovery test followed by discharge test was performed. Rationale for performing these tests is based on the following:

- Test Zone 1 had a static water level above grade (the test zone flowing); and
- The flow rate from Test Zone 1 was recorded at 0.17 $m^3$/day (generally considered to be a low flow rate). Since flow rate is directly proportional to the permeability, the permeability was thought to be too low to be suitable for an injection test;

The recovery test was performed by closing the by-pass valve and recording the increase in pressure over a period of time until the maximum pressure was achieved and held constant. This maximum pressure was the shut-in pressure and equivalent to the static groundwater level above-grade. After the maximum pressure was held constant the discharge test began by opening the by-pass valve and recording the rate of decrease in pressure.

Injection tests were performed at Test Zones 2, 3 and 4. Rationale for performing injection tests at Test Zones 2, 3, and 4 is based on the following:

- The flow rate from Test Zone 2 was recorded at 31 $m^3$/day (generally considered to be a high flow rate). Since flow rate is directly proportional to the permeability, the permeability was thought to be higher and suitable for an injection test; and
- Flow rates were not recorded at Test Zones 3 and 4. However, flow rates were considered to be higher than observed at Test Zone 1 and consequently suitable for an injection test;

Injection testing consisted of pumping water into the Test Zone at a constant flow rate over a period of approximately 10 minutes. The pressure in the borehole corresponding to this constant flow rate was recorded using the pressure transducer. The flow rate was increased two or three additional increments and the corresponding pressure in the borehole was recorded. Following injection of the maximum flow rate, the flow rate was decreased by one or two increments and the corresponding decreasing pressure in the borehole was recorded.

## 6.0 RESULTS AND INTERPRETATION

Packer testing data is presented in Appendix A. During the discharge test, the change in flow rate was not recorded with change in pressure immediately following opening of the by-pass valve. As such, the discharge test data interpretation is not presented here.

However, recovery test data was interpreted using the Cooper-Jacob solution of the modified non-equilibrium equation.

$$KL = \frac{2.3Q}{4\pi\Delta P}$$

Where:

**K** = permeability (hydraulic conductivity) in m/sec
**L** = test length in m
**Q** = mean flow rate from the test zone in $m^3$/sec
**ΔP** = change in pressure over one log cycle on a pressure vs. log (T/T') plot
**T** = elapsed time since the start of the discharge test
**T'** = elapsed time since the by-pass valve is closed

**ΔP** is determined graphically by plotting the pressure versus the ratio of T/T' on a semi-logarithmic graph.

For Test Zones 2-4, the differential head pressure (**H** = test pressure less the shut-in pressure) was plotted versus flow rate for each flow rate injected into the borehole. A linear best fit trend-line was applied to the graph. The arithmetic mean flow rate (**Q**) was calculated and the corresponding differential head (**H**) was picked off the graph using the trend line. The permeability of the test zone was estimated using the following formula:

$$K = \frac{Q \ln (L/R)}{2 \pi LH}$$

Where:

**K** = permeability (hydraulic conductivity) in m/sec
**Q** = flow rate in $m^3$/sec
**L** = test length in m
**R** = borehole radius in m
**H** = differential head in m

Using the interpretive formulas provided above, the estimated permeability for each Test Zone is presented in Table 2.

**Table 2**
**Permeability Test Results**

| Test Zone | Test Interval (m bgl) | | Test Zone Length (m) | Static Water Level (m above grade) | Recorded Flow Rate ($m^3$/day) from Test Zone | Differential Head (m) from Appendix A Graphs | ΔP (m of water) | Permeability K (m/sec) |
|---|---|---|---|---|---|---|---|---|
| | Top | Bottom | | | | | | |
| 1 | 601 | 670 | 69 | 14.7 | 0.17 | n/a | 11.7 | $4.5 \times 10^{-10}$ |
| 2 | 552 | 600 | 48 | 14.7 | 31 | 40.0 | n/a | $2.1 \times 10^{-7}$ |
| 3 | 466 | 520 | 54 | 15.9 | - | 50.0 | n/a | $3.0 \times 10^{-8}$ |
| 4 | 272 | 355 | 83 | 15.8 | - | 34.4 | n/a | $2.9 \times 10^{-8}$ |

**Notes:** - denotes flow rate from the test zone not recorded in the field.
n/a indicates differential head or change in pressure not applicable.

Table 2 also presents the calculated static water level above grade for the PIR-35 flowing well at each test zone. These levels were calculated based on the difference between the test zone pressure (converted to metres of water above the pressure transducer) and the depth below grade of the pressure transducer. Test zone pressures are not presented in Table 2, since they are dependent upon the depth of the pressure transducer.

Table 2 also presents recorded flow rates from PIR-35 at Test Zones 1 and 2. Flow rates from Test Zones 3 and 4 were not recorded by AMEC field personnel. Table 2 presents the differential head used to calculate the permeability at Test Zones 2, 3 and 4 and the change in pressure over one log cycle (**ΔP**) used to calculate the permeability at Test Zone 1.

The permeabilities presented in Table 2 were generally consistent with the flow rates observed, or recorded, at grade.

## 7.0 CONCLUSION

The permeability estimates provided in Table 2 are considered preliminary and insufficient for detailed mine design. Since the permeability estimates were recorded only at one location (borehole PIR-35), the permeability estimates provided above are also considered insufficient to assess mine feasibility. The permeability estimates are considered to have the following limitations:

- The length of the test zones ranged between 48 m and 83 m and transected both mudstone and sandstone layers (as described by CDIMG). As a consequence of these long test zones straddling different lithologies, the estimated permeabilities can only be considered bulk permeability estimates and are not considered to be representative of any one lithologic unit;
- A test to assess the tightness of the drill rods was not performed as part of this assessment. Leakage from the drill rods may have occurred during permeability

testing. If some leakage is assumed to have occurred across the drill rod joints, then the permeability estimates would generally be greater (more conservative) than the representative permeability; and

- The testing was performed after the borehole had been drilled and consequently, the base of Test Zones 2, 3, and 4 were grouted beneath a Van Ruth cement and wedging plug. Generally, the Van Ruth cement and wedging plug is not considered to be water tight. For water tight applications, the manufacturer recommends use of a Van Ruth Cementing and Wedging Bottom Packer. Consequently during testing some leakage may have occurred through the base of the borehole. If this did occur, the permeability estimates would generally be greater (more conservative) than the representative permeability.

## 8.0 CLOSURE

This report has been prepared for the exclusive use of the Canadian Dehua International Mines Group Inc. and its authorized agents for which this project was commissioned. The preliminary permeability testing was conducted in accordance with industry standard practices and the proposed scope of work for this project. No other warranty, expressed or implied, is made. The general limitations of this report are specified in Appendix B.

We trust this information meets your current requirements. If you have any questions or concerns, please contact the undersigned at your convenience.

Respectfully submitted,

**AMEC Earth & Environmental**
**a division of AMEC Americas Limited**

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
Apr 9 | 2010
D.S. GREEN

Tammera Kostya, BSc, GIT
Hydrogeologist

Scott Green, P.Eng.
Associate Hydrogeologist

Reviewed By:

Dan Emerson, P.Geo.
Associate Hydrogeologist

Attachments:

Figure 1: Site Location Map
Figure 2: PIR-35 Borehole Log
Figure 3: Wireline Double Packer Setup

Appendix A: Packer Testing Results
Appendix B: General Limitations

## 9.0 REFERENCES

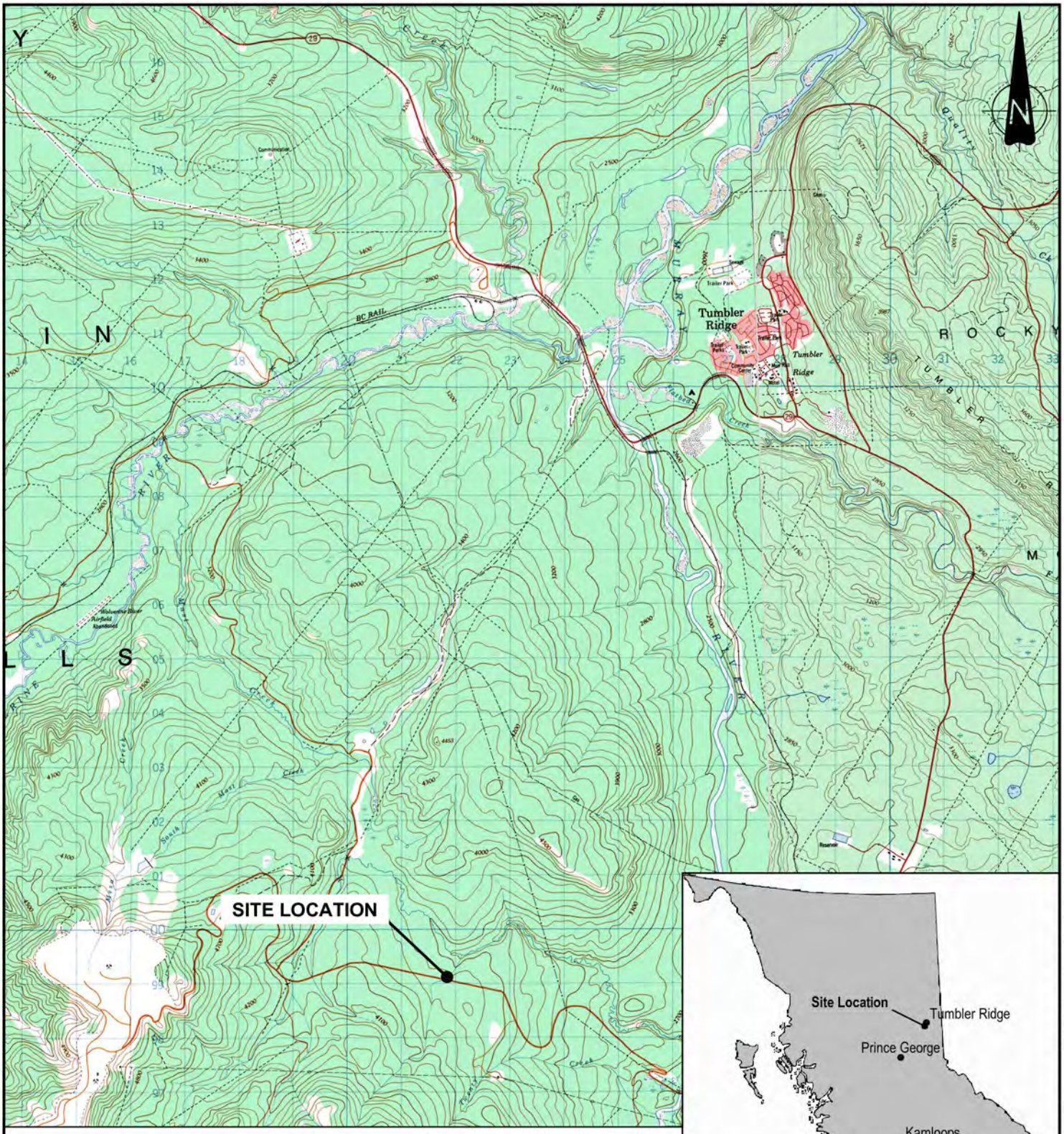
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Royle, M. ***Standard Operating Procedures for Borehole Packer Testing***. 23 p***.***

RST Instruments Ltd., 2005. ***Borehole Packers Instruction Manual,*** 25 p.

# FIGURES



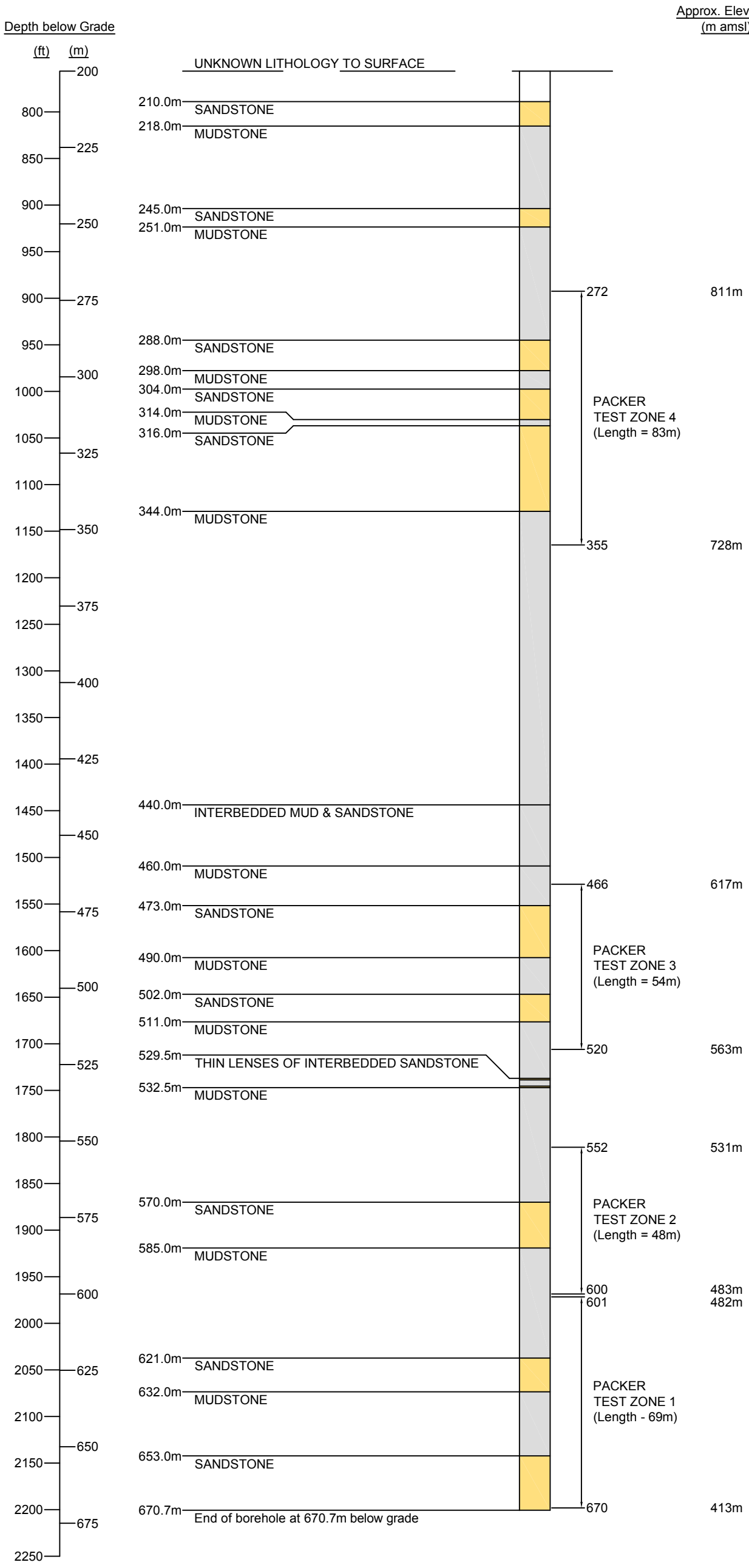

Note: Image provided by Spectrum Digital Mapping
NTS map sheets 93P2 (1989 Edition 3, contour interval 50') & 93P3 (1989 Edition 3, contour interval 100')


AMEC Earth & Environmental
3456 Opie Crescent
Prince George, BC, CANADA V2N 2P9
Tel. (250) 564-3243
Fax (250) 562-7045


CLIENT
CANADIAN DEHUA INTERNATIONAL MINES GROUP INC.

| | | | |
|---|---|---|---|
| TITLE: **SITE LOCATION PLAN** | DWN BY: B.Brown | DATUM: NAD27 | DATE: MARCH 2010 |
| PROJECT: PACKER TESTING TUMBLER RIDGE, BC | CHK'D BY: T.Kostya | REV. NO.: A | PROJECT NO: KX13432 |
| | PROJECTION: UTM Zone 10 | SCALE: 1:100 000 | FIGURE 1 |

S:\External\KX13432-CDI-TR-CAD\KX13432-Fig1-NTS.dwg – PRG-fig1 – Mar. 25, 2010 1:12pm – ben.brown

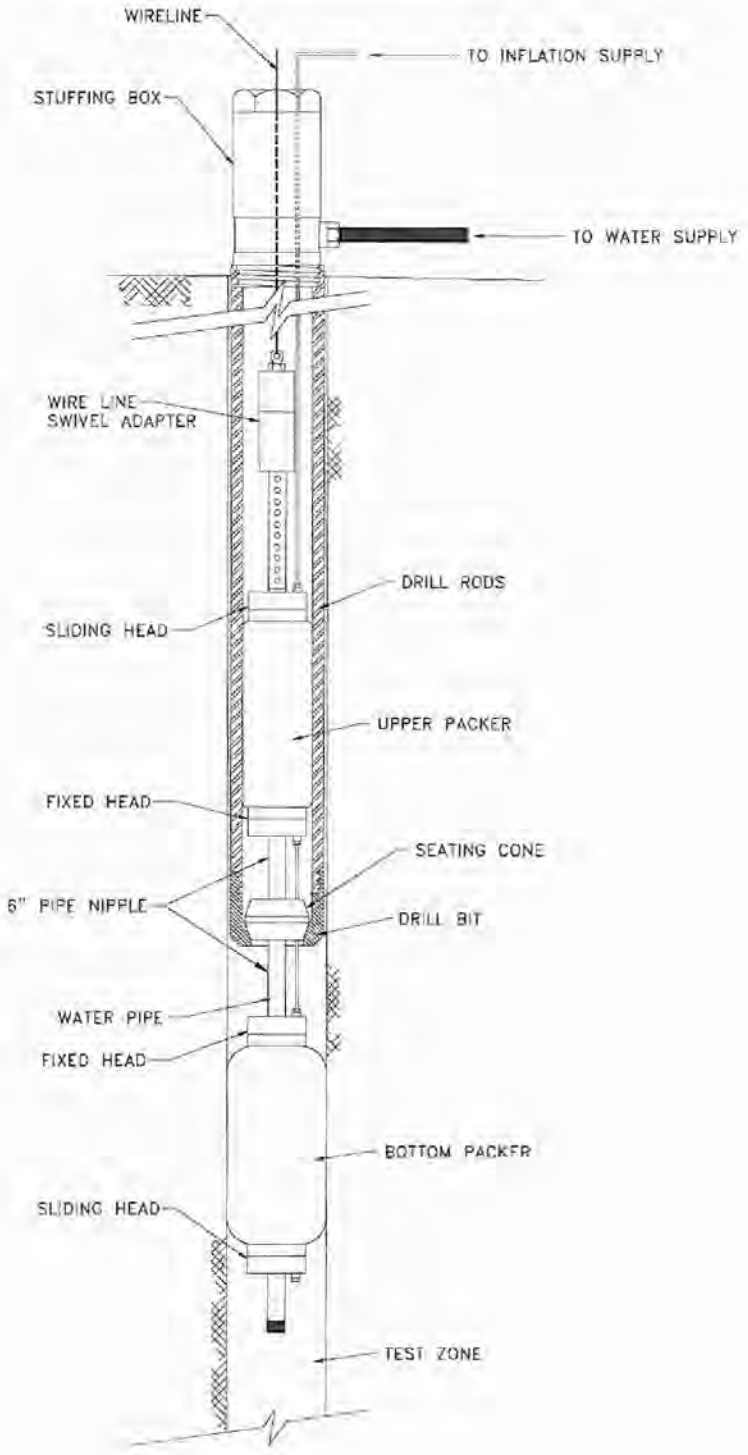



NOTES
1. Borehole cemented & sealed upon completion of packing testing.
2. Borehole stratigraphy recorded by Canadian Dehua International Mines Group Inc. personnel.
3. Location: 621852E, 6099308N, approximate ground-level elevation 1083m recorded using a hand-held GPS unit.

| | | | | | |
|---|---|---|---|---|---|
| CLIENT LOGO | CLIENT<br>CANADIAN DEHUA INTERNATIONAL MINES GROUP INC. | DWN BY: B.Brown<br>CHK'D BY: T.Kostya | TITLE<br>PIR-35 BOREHOLE LOG | REV. NO.: A<br>DATE: MARCH 2010 | |
| AMEC Earth & Environmental<br>3456 Opie Crescent<br>Prince George, BC, CANADA V2N 2P9<br>Tel. (250) 564-3243<br>Fax (250) 562-7045 | | DATUM: NAD83<br>PROJECTION: N/A<br>SCALE: AS SHOWN | PROJECT<br>PACKER TESTING<br>TUMBLER RIDGE, BC | PROJECT NO: KX13432<br>FIGURE 2 | |



This drawing was originally produced in colour.




NOTES
1. Figure taken from RST Instuments Ltd. 'Borehole Packers Instruction Manual'.

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Prince George, BC, CANADA V2N 2P9
Tel. (250) 564-3243
Fax (250) 562-7045

CLIENT
CANADIAN DEHUA INTERNATIONAL MINES GROUP INC.

| TITLE | DWN BY: | DATUM: | DATE: |
|---|---|---|---|
| WIRELINE DOUBLE PACKER SETUP | B.Brown | NAD83 | MARCH 2010 |
| PROJECT | CHK'D BY: | REV. NO.: | PROJECT NO: |
| PACKER TESTING TUMBLER RIDGE, BC | S.Green | A | KX13432 |
| | PROJECTION: UTM Zone 10 | SCALE: N.T.S. | FIGURE 3 |

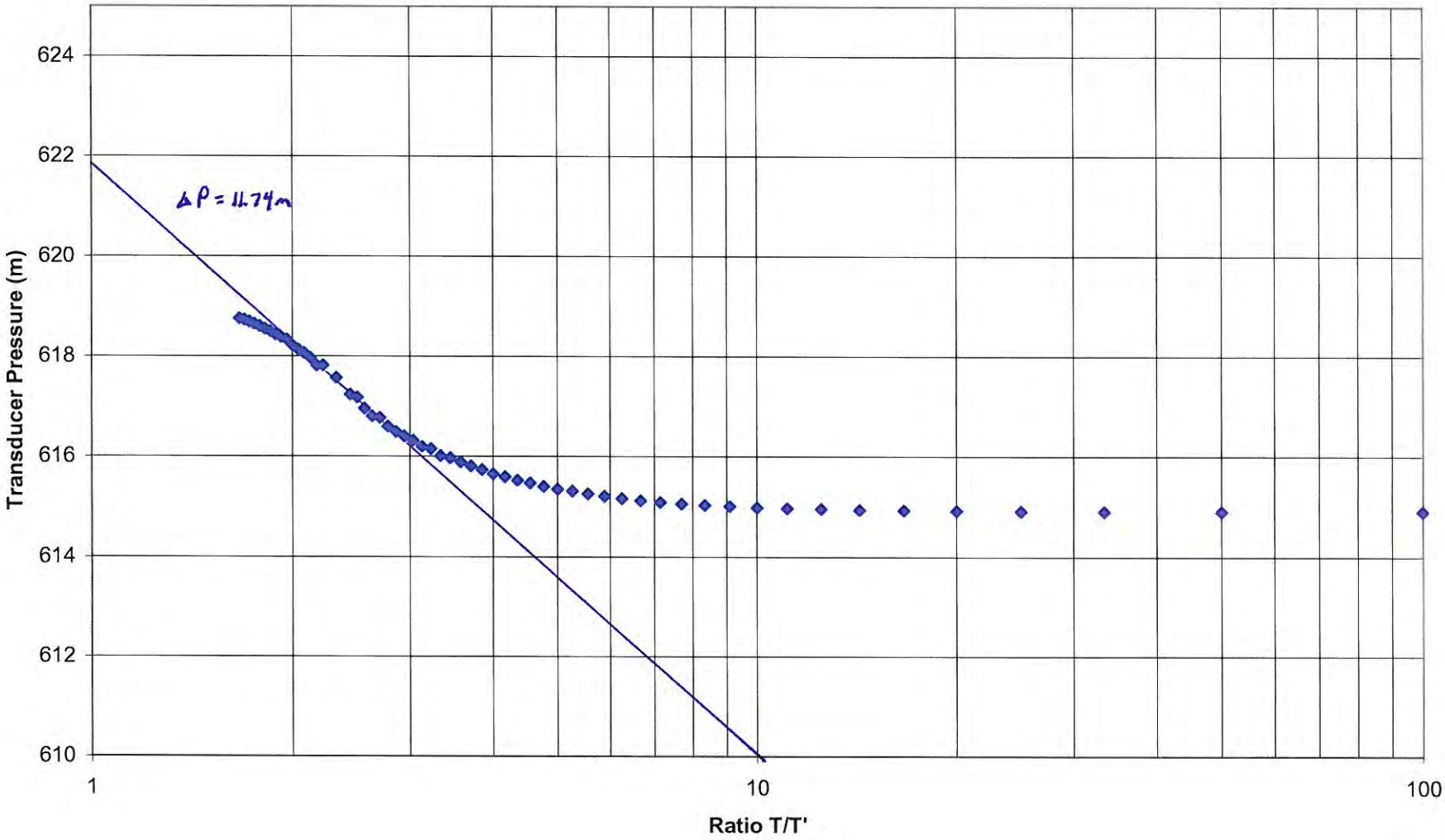
S:\External\KX13432-CDI-TR-CAD\KX13432-Fig3-WirelineDoublePackerSetup.dwg - AEE-M-AP - Mar. 26, 2010 9:33am - ben.brown

This drawing was originally produced in colour.

# APPENDIX A

# PACKER TESTING DATA

**Murray River Coal Project PIR-35 Packer Testing**
**Test Zone 1 Recovery Test**



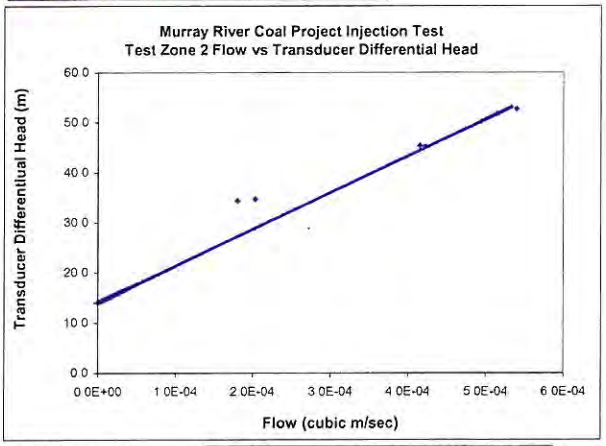
SHEET 1 OF 1

# HYDROLOGIC TEST FIELD DATA SHEET

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | Murray River Coal Project | PROJECT NO: | KX13432 | DRILLHOLE: | PIR-35 |
| AREA: | Tumbler Ridge | TEST DATE: | 26-Feb-10 | TEST NO: | 2 |
| DIP: | 90 ° (FROM HORIZONTAL) | STATIC WATER DEPTH: (Estimated downhole) | -13.7 m | TOP OF TEST INTERVAL: | 551.50 m (DOWN HOLE) |
| HOLE DIA. | 75.7 mm | GAUGE HEIGHT (Above Ground) | 2.0 m | BOTTOM OF TEST INTERVAL: | 600.00 m (DOWN HOLE) |

## INJECTION TEST

| GAUGE PRESSURE (psi) | EFFECTIVE TEST ZONE PRESSURE (m head) | STEADY FLOW (litres / min) | K (m/s) |
|---|---|---|---|
| 50 | 24.0 | 12.20 | 1.38E-07 |
| 80 | 45.4 | 25.36 | 2.19E-07 |
| 100 | 59.7 | 32.37 | 2.40E-07 |
| 80 | 45.4 | 24.93 | 2.15E-07 |
| 50 | 24.0 | 10.82 | 1.23E-07 |




INTERPRETATION REFERENCE: "Field Permeability Test Methods and Applications to Solution Mining" - USB of Mines, 1977

INTERPRETATION TYPE OF FLOW:

| | |
|---|---|
| LAMINAR | NO |
| TURBULENT | NO |
| DILATION | NO |
| WASH-OUT | NO |
| VOID FILLING | YES |

| Hydraulic Conductivity | m/s |
|---|---|
| MAX k= | 2.40E-07 |
| MIN k= | 1.23E-07 |
| AVG k= | 1.87E-07 |
| Interpreted k = | 2.1E-07 |

OBSERVATIONS:

## FALLING HEAD TEST

PERMEABILITY COEFICIENT CALCULATIONS

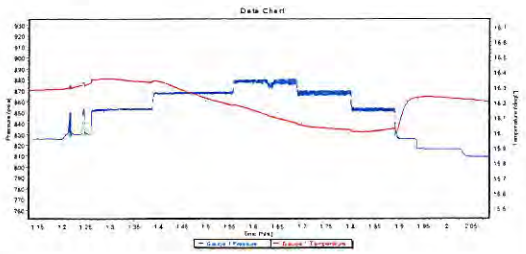
| | |
|---|---|
| STATIC WATER PRESSURE (psi) | |
| BORE HOLE RADIUS (m) | |
| DRILL ROD RADIUS (m) | |
| TEST INTERVAL LENGTH (m) | |

TEST PARAMETERS

| | |
|---|---|
| DURATION OF FALLING HEAD TEST (s) | |
| INITIAL PRESSURE READING (psi) | |
| FINAL PRESSURE READING (psi) | |
| FINAL PRESSURE RATIO RECORDED | |

INTERPRETATION REFERENCE:

OBSERVATIONS:




Single Packer was TEST BY:

REVIEWED BY:

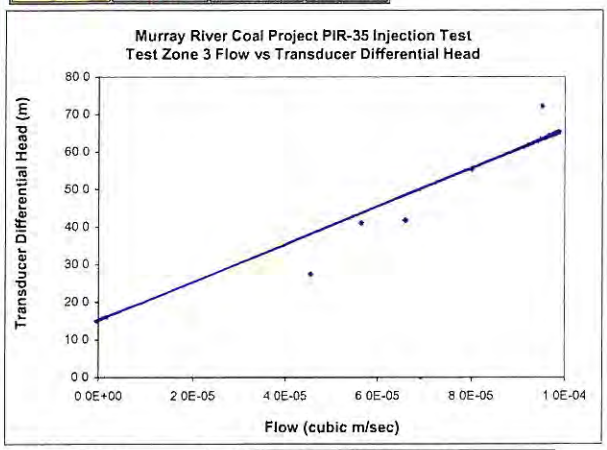
SHEET 1 OF 1

# HYDROLOGIC TEST FIELD DATA SHEET

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | Murray River Coal Project | PROJECT NO: | KX13432 | DRILLHOLE: | PIR-35 |
| AREA: | Tumbler Ridge | TEST DATE: | 28-Feb-10 | TEST NO: | 3 |
| DIP: | 90 ° (FROM HORIZONTAL) | STATIC WATER DEPTH: (Estimated downhole) | -15.1 m | TOP OF TEST INTERVAL: | 466.50 m (DOWN HOLE) |
| HOLE DIA. | 75.7 mm | GAUGE HEIGHT (Above Ground) | 2.0 m | BOTTOM OF TEST INTERVAL: | 520.00 m (DOWN HOLE) |

## INJECTION TEST

| GAUGE PRESSURE (psi) | EFFECTIVE TEST ZONE PRESSURE (m head) | STEADY FLOW (litres / min) | K (m/s) |
|---|---|---|---|
| 40 | 15.5 | 2.73 | 3.59E-08 |
| 60 | 29.8 | 3.96 | 3.41E-08 |
| 80 | 44.1 | 4.79 | 3.12E-08 |
| 100 | 58.4 | 5.70 | 2.84E-08 |
| 60 | 29.8 | 3.39 | 2.98E-08 |




INTERPRETATION REFERENCE: "Field Permeability Test Methods and Applications to Solution Mining" - USB of Mines, 1977

INTERPRETATION TYPE OF FLOW:

| | |
|---|---|
| LAMINAR | NO |
| TURBULENT | NO |
| DILATION | NO |
| WASH-OUT | NO |
| VOID FILLING | YES |

| Hydraulic Conductivity | m/s |
|---|---|
| MAX k = | 3.59E-08 |
| MIN k = | 2.84E-08 |
| AVG k = | 3.19E-08 |
| Interpreted k = | 3.0E-08 |

OBSERVATIONS:

## FALLING HEAD TEST

PERMEABILITY COEFICIENT CALCULATIONS

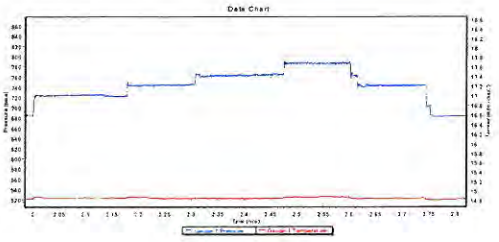
| | |
|---|---|
| STATIC WATER PRESSURE (psi) | |
| BORE HOLE RADIUS (m) | |
| DRILL ROD RADIUS (m) | |
| TEST INTERVAL LENGTH (m) | |

TEST PARAMETERS

| | |
|---|---|
| DURATION OF FALLING HEAD TEST (s) | |
| INITIAL PRESSURE READING (psi) | |
| FINAL PRESSURE READING (psi) | |
| FINAL PRESSURE RATIO RECORDED | |

INTERPRETATION REFERENCE:

OBSERVATIONS:




Single Packer was TEST BY:

REVIEWED BY:

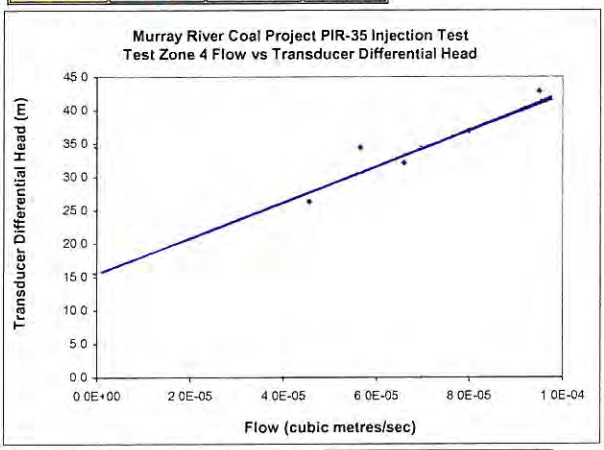
SHEET 1 OF 1

# HYDROLOGIC TEST FIELD DATA SHEET

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: | Murray River Coal Project | PROJECT NO: | KX13432 | DRILLHOLE: | PIR-35 |
| AREA: | Tumbler Ridge | TEST DATE: | 1-Mar-10 | TEST NO: | 4 |
| DIP: | 90 ° (FROM HORIZONTAL) | STATIC WATER DEPTH: (Estimated downhole) | -15.3 m | TOP OF TEST INTERVAL: | 271.50 m (DOWN HOLE) |
| HOLE DIA. | 75.7 mm | GAUGE HEIGHT (Above Ground) | 2.0 m | BOTTOM OF TEST INTERVAL: | 355.00 m (DOWN HOLE) |

## INJECTION TEST

| GAUGE PRESSURE (psi) | EFFECTIVE TEST ZONE PRESSURE (m head) | STEADY FLOW (litres / min) | K (m/s) |
|---|---|---|---|
| 40 | 15.2 | 2.73 | 2.54E-08 |
| GAUGE PRESSURE (psi) | EFFECTIVE TEST ZONE PRESSURE (m head) | STEADY FLOW (litres / min) | K (m/s) |
| 60 | 29.5 | 3.96 | 3.02E-08 |
| GAUGE PRESSURE (psi) | EFFECTIVE TEST ZONE PRESSURE (m head) | STEADY FLOW (litres / min) | K (m/s) |
| 80 | 43.8 | 4.79 | 3.18E-08 |
| GAUGE PRESSURE (psi) | EFFECTIVE TEST ZONE PRESSURE (m head) | STEADY FLOW (litres / min) | K (m/s) |
| 100 | 58.1 | 5.70 | 3.26E-08 |
| GAUGE PRESSURE (psi) | EFFECTIVE TEST ZONE PRESSURE (m head) | STEADY FLOW (litres / min) | K (m/s) |
| 60 | 29.5 | 3.39 | 2.41E-08 |




INTERPRETATION REFERENCE: "Field Permeability Test Methods and Applications to Solution Mining" - USB of Mines, 1977

INTERPRETATION TYPE OF FLOW:

| | |
|---|---|
| LAMINAR | NO |
| TURBULENT | NO |
| DILATION | NO |
| WASH-OUT | NO |
| VOID FILLING | YES |

| Hydraulic Conductivity | m/s |
|---|---|
| MAX k= | 3.26E-08 |
| MIN k= | 2.41E-08 |
| AVG k= | 2.88E-08 |
| Interpreted k = | 2.9E-08 |

OBSERVATIONS:

## FALLING HEAD TEST

PERMEABILITY COEFICIENT CALCULATIONS

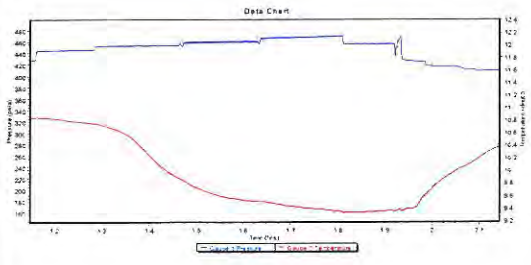
| | |
|---|---|
| STATIC WATER PRESSURE (psi) | |
| BORE HOLE RADIUS (m) | |
| DRILL ROD RADIUS (m) | |
| TEST INTERVAL LENGTH (m) | |

TEST PARAMETERS

| | |
|---|---|
| DURATION OF FALLING HEAD TEST (s) | |
| INITIAL PRESSURE READING (psi) | |
| FINAL PRESSURE READING (psi) | |
| FINAL PRESSURE RATIO RECORDED | |

INTERPRETATION REFERENCE:

OBSERVATIONS:




Single Packer was TEST BY:

REVIEWED BY:

# APPENDIX B

# GENERAL LIMITATIONS

## Limitations

1. The work performed in this report was carried out in accordance with the AMEC's proposal PK09-179 to Canadian Dehua International Mines Group and AMEC's Professional Services Agreement. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our contract.

2. The report has been prepared in accordance with generally accepted engineering practice. No other warranty, either expressed or implied, is made as to the professional service provided under the terms of our contract and included in this report.

3. The services performed and outlined in this report were based upon data collected, in part, by others at the locations identified at the time that sampling was performed. Our opinion cannot be extended to portions of the site which were not sampled or tested.

4. The objective of this report was to estimate permeability at the locations tested at the site, within the context of our contract and existing environmental regulations within the applicable jurisdiction. Evaluating compliance of past or future owners with applicable local, provincial and federal government laws and regulations was not included in our contract for services.

5. Conclusions relating to the lithology at the site are made based on data collected by others, and assumptions described in this report. It should be noted that bedrock permeabilities at locations other than those locations described could be different than the locations tested.

6. The conclusions of this report are based in part, on the information provided by others. The possibility remains that unexpected environmental conditions may be encountered at the site in locations not specifically investigated. Should such an event occur, AMEC Earth & Environmental must be notified in order that we may determine if modifications to our conclusions are necessary.

# SINGLE WELL RESPONSE TESTS
# PROPOSED MURRAY RIVER UNDERGROUND COAL MINE
# TUMBLER RIDGE, B.C.

Submitted to:
**Canadian Dehua International Mines Group Inc.**
820 – 1130 West Pender Street
Vancouver, British Columbia
V6E 4A4

Submitted by:
**AMEC Environment & Infrastructure**
**a division of AMEC Americas Limited**
913 Laval Crescent
Kamloops, B.C.
V2C 5P4

6 January 2012

KX13505

## EXECUTIVE SUMMARY

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), has completed several single well response tests at two PW diameter boreholes (H2 and H16W). The test boreholes are located between 10.9 km southwest and 12.3 km south of Tumbler Ridge, BC.

The objectives of the project are to obtain a preliminary estimate of hydraulic conductivity, piezometric head, sustainable groundwater discharge rates and groundwater quality at each test zone based on pumping tests performed at three test zones at each borehole location. A further objective is to estimate groundwater inflows to underground mine workings (the Decline, the Men and Materials Shaft, the Bulk Sample Area and Ancillary Drifts).

Two observation wells (H16A and H16) were completed within 135 m and 27 m of Borehole H16W, respectively. Test zones were specified by Canadian Dehua International Mines Group (CDIMG) based on their interpretation of borehole lithology, previously mapped stratigraphic units, geophysical borehole logs and drilling constraints. Generally, each test zone was subject to a 24 hour period for equilibration of piezometric head, followed by a 40 to 48 hour constant head or constant discharge test, followed by a recovery period of between 24 and 57 hours. Each borehole was tested from the bottom up such that the deepest test zone in each borehole was tested first and the shallowest test zone at each borehole was tested last. Pump and packer assemblies were arranged in different configurations depending upon the depth of the test interval and whether a constant discharge, or constant head test was performed.

During each constant discharge and constant head test (except at Test 4 at Borehole H2), groundwater discharge field parameters (temperature, specific conductance, pH, dissolved oxygen and oxidation-reduction potential) were recorded to monitor groundwater quality. Following between 16 hours and 48 hours of pumping a groundwater discharge sample was collected from each test zone and submitted for laboratory analysis of a suite of parameters specified by Rescan Environmental Services Ltd.

*Interpreted Results*

Although the piezometric heads at each test zone did not equilibrate within the 24 hour monitoring period, the interpreted piezometric heads in bedrock at both Borehole H2 and Borehole H16W ranged between 1,134 m above mean sea level (Hasler Formation at Borehole H2) and 815.4 m above mean sea level (Hasler Formation at Borehole H16W). The piezometric head in the tertiary sediments at Borehole H16A was recorded at 784.9 m above mean sea level (amsl).

Based on recovery test data collected from each test zone, aquifer transmissivities ranged between 0.02 $m^2$/day (in the Hasler Formation between 1,090 m and 530 m amsl at Borehole H2) and 0.11 $m^2$/day (in the Boulder Creek Formation between 510 m and 240 m amsl at Borehole H2). The estimated transmissivity at each test zone is converted to hydraulic conductivity using the length of each test zone. Storativity in the Gates and Hulcross formations

adjacent Borehole H16W was estimated using time-drawdown data to range between $3.1 \times 10^{-4}$ and $2.4 \times 10^{-5}$.

*Groundwater Quality*

Comparison of analytical chemistry results with B.C. *Approved and Working Water Quality Guidelines* (BCWQG) identified between 10 analytes (from between 510 m and 240 m amsl at Borehole H2) and 14 analytes (from between 260 m and -120 m amsl and between 40 m and -120 m amsl at Borehole H16W) exceeding the BCWQG for freshwater aquatic life.

*Groundwater Inflows to Underground Mine Workings*

Using the Goodman approximation and dimensions provided on Norwest Drawings 4.1 and 4.2 dated June 2011, preliminary groundwater inflows to the Decline are estimated to range between 0.03 $m^3$/day (11 L/hour) in the Boulder Creek Formation and 0.08 $m^3$/day (34 L/hour) in the Hasler Formation. Using the Thiem equation and Norwest Drawings 3.1 and 3.6 dated June 2011, preliminary groundwater inflows to the Men and Materials Shaft are estimated to range between 13.7 $m^3$/day (570 L/hour) in the Gates Formation and 9.9 $m^3$/day (412 L/hour) in the Hasler Formation. Using the Goodman approximation and dimensions provided on Norwest Drawings 5.7, 5.8 and Table 5.1 dated June 2011, groundwater inflows to the Bulk Sample Area (BSA) and Ancillary Drifts are estimated to be 0.11 $m^3$/day (41 L/hour) from the Gates Formation.

Groundwater inflow rates into underground mine workings (such as the decline, the men and materials shaft, the bulk sample area and ancillary drifts) have been estimated based on interpreted piezometric heads, transmissivities and hydraulic conductivities at borehole H16W. Borehole H16W is located 840 m from the decline portal, 760 m from the decline's intersection with the F seam, 540 m from the Men and Materials shaft and the most proximal location of the BSA, and 1,300 m from the most distal point of the BSA. Since the piezometric head and transmissivity in the Gates formation was only tested at Borehole H16W, the variability of these parameters in the Gates formation is unknown. Consequently, groundwater inflow rates into underground mine workings provided in this report assume that the hydraulic conductivity, transmissivity and piezometric head estimated based on data collected from the Gates formation at Borehole H16W is representative of these parameters for the entire Gates formation. Given this uncertainty, the estimated groundwater inflows presented in this report can only be considered approximate.

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## 1.0 INTRODUCTION

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), has completed several single well response tests at two PW (143.5 mm) diameter boreholes (H2 and H16W). The test boreholes are located between 10.9 km southwest and 12.3 km south of Tumbler Ridge, BC (Figure 1).

## 2.0 BACKGROUND

Canadian Dehua International Mines Group Inc. (CDIMG) would like to develop an underground mine to extract metallurgical (coking) coal. As part of a pre-feasibility assessment of dewatering the mine areas, CDIMG retained AMEC to perform packer testing on Borehole P1R-35 during February 2010. AMEC compiled and interpreted the packer testing results and provided CDIMG with a letter report dated 1 April 2010. The purpose of the packer testing was to provide a preliminary estimate of the hydraulic conductivity of the stratigraphy intersected at P1R-35 as a component of mine feasibility and design.

Borehole P1R-35 is located between 2.8 km (H2) and 3.4 km (H16W) from the boreholes designated for pumping tests. Borehole P1R-35 was observed to be flowing above grade across stratigraphic units between 270 m and 670 m below grade. Based on shut-in pressure tests, hydraulic heads ranged between 14.7 m and 15.9 m above grade. The maximum flow rate recorded during packer testing at P1R-35 was 31 $m^3$/day (1,300 L/hour or 5.7 USgpm) between 550 m and 600 m below grade.

AMEC understands that CDIMG has commissioned Norwest Corporation (Norwest) of Salt Lake City, Utah to design the Murray River mine. Further, AMEC understands that an environmental impact assessment (EIA) is the responsibility of Rescan Environmental Services Ltd. (RESL) of Vancouver, B.C. In addition to characterizing the hydraulic conductivity of the rock across various test zones, CDIMG would also like to characterize the groundwater discharge quality from various test zones.

## 3.0 OBJECTIVES AND SCOPE OF WORK

The objectives of the project are to develop a preliminary estimate of hydraulic conductivity, piezometric head, sustainable groundwater discharge rates and groundwater quality at each test zone. A further objective is to estimate groundwater inflows to underground mine workings (the Decline, the Men and Materials Shaft, the Bulk Sample Area and Ancillary Drifts).

To achieve the stated objective, AMEC has performed the following scope of work:

- Purchased two submersible pumps (Grundfos 16S100 – 75DS c/w Franklin 575 Volt, 3 phase, 10 HP motors) and two inflatable packers (IPI 120 mm OD Riser Packer Assembly);

- Purchased two additional submersible pumps (Grundfos 5S15-31DS c/w Franklin 230 Volt, single Phase, 1.5 HP motors);
- Purchased a 25 mm diameter stainless steel flow meter (up to 10 USgpm);
- Purchased a Karlington 120 mm diameter stainless steel rotating gas separator;
- Reviewed bedrock core collected from H2 and H16W;
- Prepared a groundwater discharge management plan for submission to the Prince George office of the Environmental Protection Division of B.C. Ministry of Environment;
- Coordinated with Foraco Drilling and CDIMG drilling staff on drilling progress and borehole design and preparation;
- Lowered and removed submersible pump and packer assembly on 50 mm diameter steel drop pipe on four different occasions to three different depths at borehole H2,
- Lowered and removed submersible pump on NQ diameter (70 mm o.d.) steel drop pipe on three different occasions to two different depths at borehole H16W,
- Recorded piezometric head at each zone tested;
- During testing performed at Borehole H16W, monitored depth to groundwater at two observation wells (Borehole H16 and Borehole H16A);
- Conducted a 40 hour constant discharge test at three test zones (Test 1 and 2 at Borehole H2 and Test 3 at Borehole H16W);
- Conducted a constant head test at three test zones (Test 4 at Borehole H2 and Tests 1 and 2 at Borehole H16W);
- Conducted a recovery test at each zone tested;
- At a selected test zone at borehole H2 conducted a step test (Test 3);
- Recorded groundwater discharge quality field parameters (temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) from each test zone;
- Collected a groundwater discharge sample from each test zone;
- Commissioned laboratory analysis of each groundwater discharge sample;
- Compiled field and laboratory groundwater discharge quality data;
- Compiled pumping test data;
- Interpreted pumping test data from each test zone; and
- Prepared this report.

Generally, the scope of work was performed in accordance with the scope of work outlined in AMEC's December 1, 2010 proposal to CDIMG, with the following exceptions:

- Testing at Borehole H14 was not performed as a consequence of restricted use of the access road by Spectra Energy (road authority) and safety concerns related to reported elevated methane concentrations in the area.
- At Borehole H2, constant discharge tests were performed at two test zones (600 m – 870 m and 200 m – 575 m). In place of a third constant discharge test at a shallower depth, CDIMG requested that a constant head test be conducted using methodology specified by CDIMG personnel at the interval between 20 m (the depth of the surface casing) and 575 m. A packer was not used for this test.
- At Borehole H16W, a constant discharge test was performed at one test zone (230 m – 270 m). Two of the tests conducted were constant head tests and followed test methodology specified by CDIMG personnel (797 m – 960 m and 600 m – 730 m). A packer was not used for either constant head test performed at Borehole H16W.

- At Borehole H2, a step test was performed between 200 m and 580 m below grade, whereby the pump discharged at rates of 0.06 L/sec (1 USgpm), 0.09 L/sec (1.5 USgpm), 0.13 L/sec (2 USgpm), and 0.16 L/sec (2.5 USgpm), each for approximately 30 minutes.
- In order to have more control with pumping rates and more representative flow rates during constant head tests, additional equipment was purchased on behalf of CDIMG. Specifically, this equipment included two 1.5 hp Grundfos submersible pumps, one 25 mm diameter flow meter and a 120 mm diameter rotating gas separator.
- During testing performed at Borehole H16W, monitored depth to groundwater at two observation wells (Borehole H16 and Borehole H16A).
- At the request of CDIMG, developed a groundwater discharge management plan and submitted the groundwater discharge management plan to B.C. Environment Prince George office for their information.

## 4.0 BOREHOLE LOCATIONS AND ACCESS

The Murray River lease is located approximately 12.5 km southwest of Tumbler Ridge and is situated within the sub-alpine bio-geoclimatic zone of the northern Rocky Mountains. Surveyed UTM coordinates (relative to a NAD 83 Zone 10 N coordinate reference system) and ground level elevations (to an accuracy of ±0.05 m using a Trimble GNSS R8 RTK base station) of each tested borehole (as provided by Integrated Pro-Action Corporation – IPaC) are summarized in Table 1.

**Table 1**
**Borehole Location Summary**
**(as provided by IPaC)**

| Borehole | Northing | Easting | Ground Elevation (m amsl) |
|---|---|---|---|
| H2 | 6101836.4 | 620583.7 | 1,111.9 |
| H16W | 6097712.7 | 624789.1 | 835.5 |
| H16A | 6097821.5 | 624890.9 | 839.3 |

A surveyed location and ground elevation for Borehole H16 was not provided by IPaC. However, AMEC measured the distance from Borehole H16W to Borehole H16 using a surveyor's chain (measuring tape) at 27 m.

The straight-line distance from Tumbler Ridge to Borehole H2 and Borehole H16W is 12.3 km and 10.9 km, respectively. Road access to each borehole from Tumbler Ridge is between 24 km (H16W) and 46 km (H2) following the local asphalt and gravel surfaced road network. From Tumbler Ridge, drive south for 13 km along the Grand Prairie Highway 29, west along the Murray River forest service road until kilometre 9.4. The Murray River forest service road is surfaced with asphalt until kilometre 4, where it becomes surfaced with graded gravel. At kilometre 9.4, turn right onto the Mast forestry service road. Access to borehole H16W is on

the left hand side at kilometre 1.6 of the Mast Road. Access to borehole H2 requires further travel along the Mast Road to kilometre 11.2, where one turns right onto an unnamed forest service road. Access to borehole H2 is on the right hand side at kilometre 2.8 along the unnamed forest service road.

## 5.0 GROUNDWATER DISCHARGE MANAGEMENT PLAN

In response to concern expressed by representatives of the Environmental Protection Division (EPD) of B.C. Environment's Prince George office in an e-mail dated December 2, 2010, and at the request of CDIMG, AMEC prepared a groundwater discharge management plan in a letter dated December 10, 2010. A copy of the groundwater discharge management plan is provided in Appendix A.

The groundwater discharge management plan described anticipated groundwater discharge rates and test period durations from each test zone proposed at each borehole. As per B.C. Environment's request, the groundwater discharge management plan called for excavation of pits in the shallow soils adjacent each borehole having the capacity to store 150 % of the anticipated groundwater discharge volume, assuming no exfiltration of the water from the base of the pit. Further, the groundwater discharge management called for AMEC personnel to record dimensions of, and photograph, each pit excavated. The letter detailed that it was AMEC's responsibility to make sure that adequate storage capacity was available in the excavated pits, prior to starting the pumping test. Prior to the start of each pumping test, AMEC personnel forwarded copies of pit dimensions and pit photographs to the appropriate representatives of EPD of B.C. Environment.

## 6.0 TEST METHODOLOGY

### 6.1 TEST ZONES

Test zones were specified by CDIMG based on their interpretation of borehole lithology, previously mapped stratigraphic units, geophysical borehole logs and drilling constraints. Specification of test zone lengths and depths was beyond AMEC's scope of work. Test zones for each borehole are summarized in Table 2.

**Table 2**
**Test Zones (as specified by CDIMG)**

| Borehole | Test No. | Test Interval (m amsl) | | Test Zone Length (m) | Test Zone Diameter (mm) | CDIMG Interpreted Geological Formation |
|---|---|---|---|---|---|---|
| | | Bottom | Top | | | |
| H2 | 1 | 240 | 510 | 270 | 143.5 | Boulder Creek |
| | 2 | 530 | 910 | 380 | 143.5 | Hasler |
| | 3 | 530 | 910 | 380 | 143.5 | Hasler |
| | 4 | 530 | 1090 | 580 | 143.5 | Hasler and Overburden |
| H16W | 1 | -120 | 40 | 160 | 96.1 | Gates |
| | 2 | -120 | 260 | 380 | 96.1 – 127 | Gates/Hulcross/ Boulder Creek |
| | 3 | 560 | 600 | 40 | 127 | Hasler |

Table 2 shows that test zone lengths ranged between 40 m and 560 m. At some test zones, more than one test method was applied. For example, Borehole H2 test numbers 2 and 3 were performed at the same test zone, but different test methods were applied.

## 6.2 TEST METHODS

### 6.2.1 Borehole Drilling Summary

Borehole drilling details were specified by CDIMG and were beyond AMEC's scope of work. However, in order to conceptualize groundwater recharge to the boreholes, AMEC provides this summary of its understanding of borehole drilling details. Conceptualized borehole details based on information provided by CDIMG and Foraco and Guardian Drilling are provided in Appendix B. The procedure used to drill Borehole H2 was different from the procedure used to drill Borehole H16W.

*Borehole H2 Drilling*

Borehole H2 was drilled by Foraco Drilling of Kamloops, B.C. At Borehole H2, a PQ diameter (122.8 mm or 4.835 inches) borehole was drilled to 240 m amsl (total depth). Upon achievement of total depth, the drill string was tripped out and the borehole was widened (reamed) from between the SWT surface casing and 5 m below the top of the lowermost test zone (507 m amsl). The borehole diameter after reaming was 143.5 mm (5.65 inches). After reaming, Borehole H2 was flushed with water in order to remove silt and fine-grained sand from the borehole. Finally, the borehole was lined with PWT casing to the top of the first test zone (600 m below grade as shown in Appendix B). After completion of the first test at H2 (between 510 m and 240 m amsl), AMEC observed large quantities of driller's grease in the borehole. AMEC learned after testing of Borehole H2 had been completed, that Foraco had applied the

grease to the outside of the PWT casing as it was lowered into the borehole. AMEC understands that the purpose of the driller's grease was 1) to facilitate installation and removal of the PWT casing and 2) to reduce the risk of caving of the open borehole. A consequence of the addition of the driller's grease is that it is considered likely to have reduced the permeability of each test zone by some unquantifiable amount.

*Borehole H16W Drilling*

Borehole H16W was drilled by Guardian Drilling of Saskatoon, Saskatchewan using a VD5000 diamond drill rig. Borehole H16W was drilled to a total depth of -120 m amsl and had a progressively reducing diameter with depth. A summary of the Borehole H16W diameters with depth is provided in Table 3.

**Table 3**
**H16W Diameters with Depth**

| Depth (m below grade) | | Elevation (m amsl) | | Installation Type | Clear Inside Diameter (mm) |
|---|---|---|---|---|---|
| Top | Bottom | Top | Bottom | | |
| Grade | 34 | 835 | 801 | SWT Casing | 153.4 |
| 34 | 500 | 801 | 336 | PWT Casing | 127.0 |
| 500 | 792 | 336 | 44 | PQ drill rod | 103.2 |
| 792 | 960 | 44 | -124 | HQ Open Hole | 96.1 |

In order to isolate the Gates Formation during the first pumping test, a grout plug comprised of a mixture of cement and Sikka 212 is reported to have been installed at Borehole H16W in the annular space between the PQ drill rod and the borehole wall between 48 m and 38 m amsl. Immediately following completion of Test No. 1 (with the pump set at 356 m amsl), the submersible pump, rotating gas separator and memory gauge were lost down the hole. During recovery efforts, pieces of the pump were recovered. However, the pump motor, rotating gas separator and memory gauge remained in the borehole. Based on information provided by the Guardian driller, the smashed pump was wedged in the borehole at 785 m below grade. Since the PQ drill rods could not be removed from the borehole (as a consequence of the grout plug set at the perimeter of the casing between 48 m and 38 m amsl), the PQ drill rods were perforated, using a casing perforator, between 260 m and 220 m amsl. However, based on information provided by the driller following completion of Test 2, AMEC learned that no grout was placed in the borehole prior to performance of Test 2. Since the smashed pump is not considered to be an adequate hydraulic seal, the Test 2 interval is taken to be between 260 m and 220 m amsl plus the open borehole that comprised Test Zone I (between 40 m and -120 m amsl).

Since the drillers were not able to pull the PWT casing, Test Zone III was created by injection of grout into the borehole to 412 m below grade. Following injection of grout, the PWT casing was perforated between 233 m and 273 m below grade, using a casing perforator.

*Observation Well Installations*

Two observation wells (H16 and H16A) were completed adjacent to Borehole H16W. Based on information provided by CDIMG, conceptualized borehole details for each observation well are provided in Appendix B. Borehole H16 is reportedly drilled to 966 m below grade in the Gates formation. An HQ diameter drill rod is reportedly installed to 587 m below grade. The annular space at the base of the HQ drill rod, is reported to be sealed with a cement plug between 572 m and 587 m below grade. Borehole H16 is reported to be HQ open hole between 587 m and 657 m below grade and NQ open hole between 657 m and 966 m below grade. Since a ground level elevation at Borehole H16 was not available, installation details could only be reported in depths below grade and could not be reported relative to a geodetic reference.

Borehole H16A is completed as a 50 mm diameter PVC monitoring well with 6 m of slotted screen set between 767.5 m and 773.5 m amsl. A sand pack is completed in the borehole annulus immediately adjacent the well screen and to a depth of 777.5 m amsl. The sand pack is overlain by a 5.5 m thick bentonite seal set between 783.0 m and 777.5 m below grade.

### 6.2.2 Test Descriptions

Each borehole was tested from the bottom up such that the deepest test zone in each borehole was tested first and the shallowest test zone at each borehole was tested last. Pump and packer assemblies were arranged in different configurations depending upon the depth of the test interval and whether a constant discharge, or constant head test was performed. The various pump and packer configurations are presented in Figure 3. The maximum outside diameter of each pump and packer assembly was consistently 120 mm.

For constant discharge tests, the pump and packer assembly consisted of either a 1.2 m long (1.5 hp) or 2.5 m (10 hp) submersible pump threaded onto a 2.1 m long inflatable packer. For constant head test methods, the pump assembly consisted of the same submersible pumps with a rotating gas separator installed between the pump end and the pump motor. No packer was used during the CDIMG specified constant head tests. The 1.5 hp submersible pump was used for shallow pump settings (220 m and less), while the 10 hp submersible pump was used for deep pump settings (greater than 220 m).

In all configurations, a Pioneer Petrotech PPS25 electronic memory gauge was set within a perforated pipe clamped a short distance above the pump intake. The Pioneer Petrotech memory gauge consisted of a non-vented pressure transducer, thermometer and datalogger contained in a stainless-steel housing 25 mm (1 inch) diameter and 279 mm (11 inches) long. Since the memory gauge was non-vented, pressure transducer data was compensated for atmospheric pressure using an additional PPS25 memory gauge dedicated to recording atmospheric pressure at ground surface adjacent each borehole tested. For each test performed the memory gauges were synchronized, and programmed, to record pressure and temperature at 1 minute intervals.

At Borehole H2 AMEC's sub-contractor, Ingram Well and Pump Service (IWPS), lowered the appropriate submersible pump and packer assembly on 50 mm diameter galvanized steel drop pipe to the appropriate pump setting. At Borehole H16W, pump and packer assemblies were lowered using NQ drill rod (60.5 mm inside diameter) provided by Guardian Drilling. Submersible pump and packer settings, test methodology and pump and/or packer configuration used is summarized in Table 4.

**Table 4**
**Test Methodologies, Pump and Packer Assembly and Pump Setting Summary**

| Borehole | Test No. | Submersible Pump Intake Elevation (m amsl) | Packer Depth (m below grade) | Test Method Specified By | Head Equilibration | Constant Discharge | Recovery | Step Test | Constant Head | Pump and Packer Configuration (see Fig. 3) |
|---|---|---|---|---|---|---|---|---|---|---|
| H2 | 1 | 508 | 511 | AMEC | √ | √ | √ | | | 2 |
| | 2 | 908 | 911 | AMEC | √ | √ | √ | | | 1 |
| | 3 | 908 | 911 | AMEC | | | | √ | | 1 |
| | 4 | 1010 | n/a | CDIMG | | | √ | | √ | 4 |
| H16W | 1 | 356 | n/a | CDIMG | √ | | √ | | √ | 3 |
| | 2 | 350 | n/a | CDIMG | | | √ | | √ | 3 |
| | 3 | 624 | 627 | AMEC | √ | √ | √ | | | 1 |

*Test Methods Specified by AMEC*

AMEC specified test methodology for constant discharge tests consisted of having IWPS lower the pump and packer assembly to the top of the test zone. At Borehole H2, the specified pump setting was such that the top of the packer was set generally 1 m below the PWT casing drive shoe. For Test 1 performed at Borehole H2, the pump intake was set 3.6 m below the PWT casing. After the pump and packer were set at the specified depth, the packer was inflated using nitrogen gas. The purpose of the packer was to prevent groundwater from flowing along the perimeter of the PWT casing into the test zone, effectively sealing the test zone from external sources of recharge. Each test performed according to AMEC methodology consisted of the following sequence of tests:

- A 24 hour period following inflation of the packer whereby the piezometric pressure of the test zone was allowed to equilibrate;
- A 40 hour constant discharge test whereby groundwater was discharged at a constant flow rate; and
- A 24 hour recovery test whereby the recovery of the water level was monitored.

*Test Methods Specified by CDIMG*

CDIMG test methodology for constant head tests consisted of having IWPS lower the submersible pump and rotating gas separator assembly to the base of the test zone. The purpose of the rotating gas separator was to separate dissolved gases from the groundwater prior to discharge in the drop pipe. This separation at the pump intake allowed for better control of the discharge rate. The rotating gas separator could not be used in the AMEC specified methodology because no effective means of allowing the gas to pass across the packer was available at the time of testing. A rotating gas separator was not used during Test 4 at borehole H2 since it was during the performance of this test, that the extent of dissolved gases in the groundwater, and the requirement for better control of the groundwater discharge rate became apparent. Each test performed according to CDIMG methodology consisted of the following sequence of tests:

- A 40 to 48 hour constant head test whereby the discharge rate was adjusted in order to achieve a constant head;
- A 24 hour recovery test whereby the recovery of the water level was monitored.

Test 1 at Borehole H16W included a 24 hour period of piezometric head equilibration prior to starting the constant head test. Otherwise, piezometric head equilibration was not performed prior to constant head tests.

*Piezometric Head Equilibration*

Piezometric head equilibration was performed as part of Tests 1 and 2 at Borehole H2 and Tests 1 and 3 at Borehole H16W. The test was performed prior to conducting any pumping and immediately following inflation of the packer. Rationale for performing this test prior to performance of any pumping is to obtain the baseline piezometric head of the test interval to which the piezometric head can be compared during recovery. For test zones having piezometric pressures below the top of the steel drop pipe, real-time piezometric pressure was recorded using a calibrated electric sounder as depth below the top of the steel drop pipe. For test zones having piezometric pressures above the top of the steel drop pipe, real-time piezometric pressure was recorded using a pressure gauge threaded into a steel top cap threaded into the drop pipe. Except during Test 3 at Borehole H16W, real-time piezometric pressure data was recorded in addition to pressure data recorded using the PPS25 Memory Gauge. The real-time pressure data was monitored in order to know when the piezometric pressure in each test zone had equilibrated to its static level.

The piezometric head at Observation Well H16A (approximately 135 m north of Borehole H16W) was recorded simply by lowering the calibrated electric sounder to the depth of the piezometric surface. Water levels at Borehole H16A were only recorded three days prior to, and during, Test 3 at Borehole H16W. Water levels were not recorded at Borehole H16A during Tests 1 and 2 performed at Borehole H16W.

Since Observation Well H16 was flowing above-grade and was noticeably releasing gas (bubbling), some additional effort was required to record the piezometric head at this location (approximately 27 m south of Borehole H16W). Over the three days leading up to the start of Test 3 at Borehole H16W, a 9.1 m length of HQ drill rod was threaded vertically above-grade (Appendix C, Photo 1). After the piezometric head was observed flowing above 9.1 m above grade, an apparatus was manufactured that allowed gas pressure to be released from the borehole, while a hydraulic head was recorded. HQ rod was sealed at 0.35 m above grade and two 19 mm diameter steel pipes extended above the HQ rod cap (Appendix C, Photo 2). A pressure gauge was threaded into one of the 19 mm diameter stand pipes at approximately 0.6 m above grade, while a pressure release valve was threaded into the top of the other 19 mm diameter stand pipe at approximately 1.3 m above-grade (Appendix C, Photos 3). The intake of the 19 mm diameter pipe having the pressure release valve was at grade, while the intake of the 19 mm diameter pipe having the pressure gauge was approximately 0.9 m below grade and connected to a flexible polyethylene 19 mm pipe that was bent vertically upward such that its intake was approximately 0.8 m below grade (Appendix C, Photo 4). The purpose of the polyethylene pipe is to prevent gas from becoming trapped in that pipe so that the pressure gauge measures only water pressure. The purpose of the pressure release valve is to release gas from the wellhead. The trick was to adjust the pressure release valve to allow sufficient gas to pass out of the wellhead such that the water level in the well remained above the lower 19 mm diameter pipe intake (0.8 m below grade) to the pressure gauge but below the pressure release valve (1.3 m above grade). This method was only used to measure piezometric head above-grade at Observation Well H16.

*Constant Discharge Test*

Constant discharge tests were performed as part of Tests 1 and 2 at Borehole H2 and at Test 3 at Borehole H16W. Submersible pumps were powered by either a 3 phase (for the GS100-75DS pumps) or a single phase (for the 5S15-31 pumps) diesel-powered generator. Discharged groundwater was directed from the drill rods via an elbow fitting into flat-lay discharge hose. The flat-lay discharge hose was directed into a plastic pail of known volume. Overflow water from the plastic pail, was allowed to runoff overland into the excavated pit.

Routinely throughout the test, the flow rate was recorded by directing the discharge from the flat-lay pipe to a plastic pail having a known volume. The time taken for the groundwater discharge to fill the pail of known volume was recorded in order to obtain an estimate of the groundwater flow rate.

Real-time drawdown was recorded during each test at Borehole H2 and Tests 1 and 2 at Borehole H16W using a calibrated electric sounder. Further, the change in piezometric pressure was recorded at 1 minute intervals by the PPS25 Memory gauge.

Groundwater from each test zone was discharged for 40 hours. Generally, groundwater discharge rates from each test zone fluctuated by ±0.06 L/sec (±1 USgpm). Mean flow rates at each test zone are presented in Table 5.

**Table 5**
**Mean Constant Discharge Test Pumping Rates**

| Borehole | Test No. | Test Zone (m amsl) | | Pumping Rate (L/sec) | | | Pumping Rate (USgpm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Bottom | Top | Max | Min | Average | Max | Min | Average |
| H2 | 1 | 240 | 510 | 0.32 | 0.17 | 0.19 | 5.0 | 2.7 | 3.0 |
| | 2 | 530 | 910 | 1.4 | 0.06 | 0.16 | 22 | 1.0 | 2.5 |
| H16 | 3 | 560 | 600 | 0.38 | 0.04 | 0.07 | 6.0 | 0.7 | 1.2 |

Pumping rates were generally not held constant throughout the constant discharge test since a mixture of methane gas and groundwater was discharged simultaneously. Since a mixture of gas and water recharges the drop pipe, the flow rate from the test zone decreases and the pump is not able to discharge at its rated capacity. One of the impacts of the water and gas mixture on the test data was such that following an initial rapid lowering of the piezometric pressure in the test zone, the piezometric pressure typically recovers for the remainder of the constant discharge test.

To remedy this problem, consideration was given to using the rotating gas separator during constant discharge tests. However, no effective means of discharging the separated gas across the packer was available at the time that testing was performed. Consequently, the rotating gas separator was not used when the packer was inflated in the borehole.

While pumping from H16W during Test No. 3, piezometric pressures were monitored at Observation Well H16 (27 m south from H16W) and H16A (135 m north from H16W).

*Recovery Test*

A recovery test was performed at each test zone. After the 40 hour pumping period, the pump was turned off and the water level in the test zone was allowed to recover. Recovery test durations ranged between 24 hours and 56 hours and are summarized in Table 6.

**Table 6**
**Recovery Test Durations**

| Borehole | Test No. | Test Zone (m amsl) | | Recovery Test Duration (Hours) |
|---|---|---|---|---|
| | | Bottom | Top | |
| H2 | 1 | 240 | 510 | 29.5 |
| | 2 | 530 | 910 | 56 |
| | 3 | 530 | 1,090 | 57 |
| H16W | 1 | -120 | 40 | 53 |
| | 2 | -120 | 260 | 54 |
| | 3 | 570 | 610 | 24 |

*Step Test*

In order to characterize the specific capacity at Borehole H2 between 200 m and 580 m below grade (Test 3), a step test was performed that consisted of pumping this test zone at four different pumping rates at 30 minute intervals (1 USgpm, 1.5 USgpm, 2 USgpm, and 2.5 USgpm). Thirty minute intervals were selected since it was considered likely that if the pumping rates were held constant for a period longer than 30 minutes, the piezometric pressure would have been drawn down to the pump intake.

No further step tests were performed as part of the single well response test program, since the results of the H2 step test showed that the storage component of the bedrock was significant enough that drawdown for each incremental increase in flow rate was inconsistent.

*Constant Head Test Specified by CDIMG*

During an April 12, 2011 conference call between AMEC and CDIMG representatives, it was agreed that a supplementary test would be performed using the test methodology specified by CDIMG.

The constant head test was performed as part of Test 4 at Borehole H2 and Tests 1 and 2 at Borehole H16W. Packers were not used in the performance of any of the constant head tests. At Test 4 at Borehole H2, the test was performed using only the submersible pump set at 712 m amsl. No rotating gas separator was used in the performance of Test 4 at Borehole H2. A rotating gas separator was used in-line with the submersible pump intake and motor in the performance of Tests 1 and 2 at Borehole H16W.

The test consisted of adjusting the pumping rate in order to maintain a constant head for the test interval. At Test 4 of Borehole H2, the pump was actually turned off for two periods of 72 minutes and the recovery of the test interval was monitored during these periods.

AMEC understands that some effort was made by CDIMG to set a concrete seal in the annular space between the borehole wall and the outside perimeter of the PQ casing between 50 m and 40 m amsl (at the top of Test Interval 1 at Borehole H16W). However, as a consequence the fact that there was no testing performed to assess the integrity of the concrete seals, there is some question whether concrete at this depth formed an effective seal to prevent water from infiltrating the test zone.

## 6.3 FIELD-RECORDED GROUNDWATER DISCHARGE QUALITY

During constant discharge tests and constant head tests (except at Test 4 of Borehole H2), AMEC recorded groundwater discharge quality field parameters (temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential). These parameters were recorded in the field, since they are known to change between the time that the sample is collected and the time that the sample is tested in the analytical laboratory.

Groundwater discharge quality was recorded in the field at H2 between 600 m and 870 m below grade and each test performed at H16W using a YSI 556 MDS. Groundwater discharge quality was recorded in the field at H2 between 200 m and 575 m below grade using YSI pro-plus. Calibration records for the YSI 556 MDS are provided in Appendix D.

Field groundwater discharge quality was recorded by discharging groundwater into a clean 22 litre (5 Igal.) plastic pail. The YSI instrument was inserted in the plastic pail and pre-programmed to record temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential at 2 minute intervals. Groundwater was allowed to overflow from the plastic pail. Field recorded groundwater discharge quality immediately prior to groundwater sample collection is presented on field sampling sheets presented in Appendix D. Continuous monitoring of groundwater discharge quality at two minute intervals throughout each test is presented graphically in Appendix E.

## 6.4 GROUNDWATER SAMPLE COLLECTION

Groundwater discharge samples were collected from each test interval following between 16 hours (Test 2, Borehole H2) and 49.5 hours (Test 1, Borehole H16W) of pumping. In fact, two groundwater discharge samples were collected from the Test 1 interval at Borehole H2 (600 m – 870 m below grade). The first sample collected from this test interval was collected after two hours of pumping, and the second sample collected from this test interval was collected after 36 hours of pumping. This first sample was collected after only two hours of pumping because at the time the groundwater discharge rate was decreasing significantly, and it was not clear that the borehole was capable of sustaining groundwater discharge for the entire 40 hour pumping period.

Each groundwater discharge sample was collected simply by placing the mouth of each sample bottle into the flow of water discharging from the flat-lay discharge hose. None of the samples were filtered in the field. Sample filtration, when appropriate, was performed at the analytical laboratory. Immediately following groundwater sample collection, field personnel completed a field data sheet that outlines field water quality recorded at the time of groundwater sample collection. Completed field data sheets are presented in Appendix D.

Each collected groundwater discharge sample was submitted for analytical testing of the following analytical suite at ALS Environmental.

- General chemistry
- Dissolved Metals
- Total Metals
- Dissolved Methane
- Total organic carbon
- Total cyanides
- Dissolved Hydrogen Sulphide
- Ammonia

Dissolved methane in groundwater discharge samples was analysed at ALS analytical laboratory in Calgary, Alberta, within 24 hours of sample collection. The remainder of parameters were analysed at ALS analytical laboratory in Burnaby, B.C.

Following AMEC's delivery of analytical testing results to CDIMG on May 6, 2011, AMEC received an e-mail from CDIMG on May 9, 2011 requesting that collected groundwater discharge samples be analyzed for the following additional total and dissolved metals concentrations:

- Beryllium
- Bismuth
- Cobalt
- Lithium
- Molybdenum
- Nickel
- Phosphorus
- Silicon
- Strontium
- Thallium
- Tin
- Titanium
- Vanadium

Furthermore, the May 9 2011 e-mail also requested analysis of the following total and dissolved metals to lower detection limits as listed:

- Selenium (0.001 mg/L)
- Mercury (0.00001 mg/L)
- Cadmium (0.000017 mg/L)

## 7.0 RESULTS

### 7.1 PIEZOMETRIC EQUILIBRATION

Piezometric head equilibration test results are presented graphically in Appendix F. Only the piezometric heads recorded during Test 3 at Borehole H16W equilibrated during the test period to a constant head. The other three test intervals where piezometric head equilibration was performed, either oscillated about some interval (Test 1 Borehole H2 and Test 1 Borehole H16W), or (in the case of Test 2 Borehole H2) asymptotically approached a constant head that was not quite achieved during the test period.

### 7.2 CONSTANT DISCHARGE TEST

Graphs showing constant discharge test data are presented in Appendix G. Based on review of the graphs presented in Appendix G, the following observations were made:

- Each constant discharge test data set showed rapid drawdown (to the top of the packer at Tests 1 and 2 performed at Borehole H2 and to 735 m amsl at Test 3 performed at Borehole H16W) during the initial 40 minutes of pumping;
- At Borehole H2, water levels in the test zone 510 m – 240 m amsl (Test 1) began to recover after 60 minutes of pumping when pumping rates were 0.19 L/sec (3 USgpm) or less.

- At Borehole H2, water levels in the test zone 910 m – 530 m amsl (Test 2) began to recover after 53 minutes of pumping when pumping rates were 0.19 L/sec (3 USgpm) or less.
- At Borehole H16W, water levels in the test zone 610 m – 570 m amsl (Test 3) began to recover after 6 minutes of pumping when pumping rates were 0.09 L/sec (1.4 USgpm) or less.
- As a consequence of variable flow rates throughout each constant discharge test, trends apparent in the constant discharge data sets were inconsistent and could not be used to reliably estimate the transmissivity of either test zone.
- Pumping during Test 3 at Borehole H16W at the average pumping rate of 0.07 L/sec did not affect the groundwater level at Borehole H16A (completed in the tertiary sediments).
- Pumping from Borehole H16W during Test 1, 2, and 3 lowered water levels at Borehole H16 by 67 m, 61m, and 1.7 m, respectively.

## 7.3 RECOVERY TEST

Graphs showing recovery test data are presented in Appendix H. Based on review of the graphs presented in Appendix H, the following observations were made:

- Recovery test data collected from most recovery tests (except Test No. 4 at Borehole H2 and Test No. 1 at Borehole H16W) show dual-porosity trends with an initial early-time trend indicative of recovery of secondary fractures and a mid-time trend indicative of recovery of primary intra-granular porosity.
- Recovery test data collected from Test No. 4 at Borehole H2 and Test No. 1 at Borehole H16W were similar in that they did not show an early-time trend indicative of recovery of secondary fracture porosity.
- With the exceptions of Test No. 4 at Borehole H2 and Test No. 1 at Borehole H16W, the extent of recovery at all other intervals tested suggests incomplete recovery of storage and that the pumping tests caused some de-watering of the test interval.
- During recovery of Test No. 4 at Borehole H2, some unknown external influence was exerted upon the aquifer while it was recovering between 3,750 minutes and 4,250 minutes following the start of the test. A similar unknown external influence was observed in the water level during the Test No. 2 Borehole H2 Constant Discharge Test after 75 minutes of pumping. These unknown external influences may be a correction of the piezometric heads following discharge of gas from the borehole.

## 7.4 CONSTANT HEAD TEST

Graphs showing constant head test data are presented in Appendix I. Based on review of the graphs presented in Appendix I, the following observation was made:

- The constant head test data was collected during Test No. 1 at Borehole H16W is considered to have the best quality of the tests performed. This test was the first test performed using the rotating gas separator.

Table 7 presents the range of pumping rates within which the constant head for each test interval was achieved.

**Table 7**
**Range of Pumping Rates and Resultant Range of Heads**
**for Constant Head Tests Performed**

| Borehole | Test No. | Test Interval (m amsl) | | Pumping Range for Constant Head (L/Sec) | | Constant Head Range (m below grade) | |
|---|---|---|---|---|---|---|---|
| | | Top | Bottom | Max | Min | Max | Min |
| H2 | 4 | 1,090 | 530 | <0.06 | n/a | 60 | 70 |
| H16W | 1 | 40 | -120 | 0.08 | 0.08 | 281 | 284 |
| | 2 | 260 | -120 | 0.15 | 0.13 | 250 | 267 |

## 7.5 FIELD-RECORDED GROUNDWATER DISCHARGE QUALITY

Field-recorded groundwater discharge quality results are presented graphically in Appendix E. Based on review of the graphs presented in Appendix E, the following observations were made:

- *In-situ* groundwater temperatures at each zone generally increased throughout the test period. Gradual consistent increases of *in-situ* groundwater temperature are attributed to heat imparted to the water in the test zone originating from the submersible pump. Abrupt infrequent increases in *in-situ* temperature may be indicative of positive, or negative recharge boundaries in the aquifer;
- Early-time *in-situ* groundwater temperatures are considered to be most representative of *in-situ* groundwater temperature;
- Early time *in-situ* groundwater temperatures ranged between 9 ºC (200 m – 600 m at Borehole H2) and 18 ºC (600 m – 870 m at Borehole H2). Generally, *in-situ* groundwater temperatures were higher at the deeper test intervals.
- As a consequence of the method of groundwater discharge temperature measurement, groundwater discharge temperatures are influenced by both *in-situ* groundwater temperatures and air temperature.
- Generally, specific conductance data recorded for each test began at a relatively low magnitude then increased abruptly at elapsed pumping times ranging between 20 minutes (Test 2 at Borehole H16W and Test 1 at Borehole H2) and 600 minutes (Test 2 Borehole H2);
- Following the initial abrupt increase, specific conductance data appeared to achieve, or trended toward, a consistent value at each test performed at Borehole H16W. Specific conductance reported in groundwater discharge at Test 1 at Borehole H2 increased at a constant rate. No clear trend is apparent in the specific conductance data collected from Test 2 and Borehole H2;
- Late-time specific conductance data is considered to be most representative of the *in-situ* specific conductance at each test interval;
- Late-time specific conductance data ranged between 990 µS/cm (Test 2 Borehole H2) and 1,960 µS/cm (Test 1 Borehole H2). At each borehole, higher specific conductance values were reported from the deeper test zones.
- Generally, where late-time pH data shows a relatively consistent trend, this late-time pH data is considered to be most representative of the *in-situ* pH. However, since late-time

pH data reported at Test 1 Borehole H16W exhibited a clear downward trend at the end of the test, a representative *in-situ* groundwater pH is considered to be less than 7.9.

- Late-time pH data ranged between 7.5 (Test 2 Borehole H16W) and 9.3 (Test 3 Borehole H16W); At each borehole, higher pH values were reported in shallower test zones.
- Generally, dissolved oxygen (DO) concentrations decreased gradually throughout the test period to some consistently low DO concentration. Late–time DO concentrations are considered to be most representative of the *in-situ* DO concentration. The exception was DO concentrations reported at Test 2 at Borehole H2 where no clear trend was apparent;
- Late-time representative DO concentrations ranged between 0.1 mg/L (Test 1 Borehole H2) and 1.1 mg/L (Test 3 Borehole H16W); No clear DO concentration trend could be identified with depth;
- Positive oxidation-reduction potential (ORP) values in groundwater discharge suggests that groundwater discharge originates from an oxidized chemical environment, whereas negative ORP values suggests that groundwater discharge originates from a reduced chemical environment.
- Since groundwater in the borehole is expected to be oxidized, generally ORP is expected to trend downward throughout each test from a positive value to, or toward an increasingly negative value. This general trend was observed at each of the tests performed at Borehole H16W. Generally, a reverse trend (from reduced conditions to oxidized conditions) was observed in the tests performed at Borehole H2.
- Late-time ORP values are considered to be representative of the chemical environment of the aquifer. At each borehole tested, groundwater became more oxidized toward the ground surface. At the end of most tests performed (except Test 3 at Borehole H16W) the groundwater discharge at the end of the test (when the sample was collected) originated from a reduced chemical environment. Groundwater discharged at the end of Test 3 Borehole H16W originated from an oxidized chemical environment.

## 7.6 ANALYTICAL TESTING

Analytical chemistry results for samples collected from Borehole H2 are presented in Table 8 and results for samples collected from Borehole H16W are presented in Table 9 (both tables are presented at the back of the text). Analytical laboratory reports are presented in Appendix J.

Analytical chemistry results presented in Tables 8 and 9 are compared with the B.C. Approved and Working Water Quality Guidelines (BCWQG) 30 day average concentration for the preservation of freshwater aquatic life. The BCWQG freshwater aquatic life guidelines are considered to be the water quality threshold for discharge into local surface water bodies. Since the groundwater samples originate from an oxygen-poor (reducing chemical) environment below the ground surface, many of the analytes tested exceeded the BCWQG freshwater aquatic life guidelines.

Analytes in groundwater samples collected from Borehole H2 after 40 hours of pumping listed in Table 10 were beyond acceptable limits for discharge into surface water bodies.

**Table 10**
**H2 Groundwater Discharge Analytes Exceeding BCWQG Freshwater Aquatic Guidelines**

| Test 1<br>600 m – 870 m | Test 2<br>200 m – 580 m | Test 4<br>20 m – 580 m |
|---|---|---|
| • Dissolved Oxygen | • Dissolved Oxygen | • pH |
| • True Colour | • pH | • Turbidity |
| • Turbidity | • Turbidity | • Total Alkalinity |
| • Total Alkalinity | • Total Alkalinity | • Fluoride |
| • Fluoride | • Ammonia | • Total Cadmium |
| • Total Calcium | • Total Calcium | • Total Calcium |
| • Total and Dissolved Iron | • Total Copper | • Total Chromium |
| • Total and Dissolved Lithium | • Total Iron | • Total Copper |
| • Total Zinc | • Total Lead | • Total Iron |
| • Dissolved Aluminum | • Total and Dissolved Lithium | • Total Lead |
| | • Total Zinc | • Total and Dissolved Lithium |
| | • Dissolved Aluminum | • Total Zinc |
| | | • Dissolved Aluminum |

Total alkalinity and total calcium exceedances listed above are dependent upon the sensitivity of the receiving environment to acid inputs. All dissolved cadmium concentrations and the total cadmium concentration in samples collected from 200 m – 580 m below grade and 600 m – 870 m below grade were reported by the analytical laboratory as less than the analytical detection limit (ranging between 0.0010 mg/L and 0.000020 mg/L) that was greater than the BCWQG freshwater aquatic life guideline (0.000010 mg/L).

The dissolved tin concentration (0.00020 mg/L) in the groundwater discharge sample collected from 600 m – 870 m at H2 (Test 1) after thirty-six hours of pumping exceeded the BCWQG working freshwater aquatic life guideline for tri-butyl tin (0.000008 mg/L), tri-phenyl tin (0.000022 mg/L), and Di-n-butyl tin (0.00008 mg/L), but was less than the working freshwater aquatic life guideline for tri-ethyl tin (0.0004 mg/L). However, the recorded dissolved tin concentration is equal to the analytical detection limit for tin (0.00020 mg/L). Consequently, several of the tin species guidelines are less than the laboratory analytical detection limit.

Analytes in groundwater samples collected from Borehole H16W after 24 hours of pumping listed in Table 11 were beyond acceptable limits for discharge into surface water bodies.

**Table 11**
**H16W Groundwater Discharge Analytes Exceeding BCWQG Freshwater Aquatic Guidelines**

| Test 1 | Test 2 | Test 3 |
|---|---|---|
| 800 m – 960 m | 580 m – 960 m | 230 m – 270 m |
| • Dissolved Oxygen | • Dissolved Oxygen | • Dissolved Oxygen |
| • True Colour | • True Colour | • True Colour |
| • pH | • Turbidity | • pH |
| • Turbidity | • Total Alkalinity | • Turbidity |
| • Total Alkalinity | • Fluoride | • Total Alkalinity |
| • Fluoride | • Ammonia | • Fluoride |
| • Dissolved Sulfide | • Total Calcium | • Ammonia |
| • Ammonia | • Total Chromium | • Total Copper |
| • Total Cadmium | • Total Copper | • Total Iron |
| • Total Calcium | • Total and Dissolved Iron | • Total and Dissolved Lead |
| • Total Iron | • Total and Dissolved Lead | • Total and Dissolved Lithium |
| • Total and Dissolved Lithium | • Total and Dissolved Lithium | • Dissolved Aluminum |
| • Total Zinc | • Total Silver | |
| • Dissolved Aluminum | • Total Zinc | |

Total alkalinity and total calcium exceedances listed above are dependent upon the sensitivity of the receiving environment to acid inputs. All dissolved cadmium concentrations and the total cadmium concentration in samples collected from 500 m – 960 m below grade and 230 m – 270 m below grade were reported by the analytical laboratory as less than an analytical detection limit (0.000085 mg/L) that was greater than the BCWQG freshwater aquatic life guideline (0.000010 mg/L). The laboratory attributed the increase in analytical detection limit to a requirement for dilution of the sample.

Concentrations of all other analytes tested were within the acceptable limits of the BCWQG freshwater aquatic life guidelines.

Several of the exceedances at both H2 and H16W were total metals concentrations. Generally, the majority of the BCWQG metals guidelines are listed for total metals, as opposed to dissolved metals. Generally, when groundwater samples are collected from a reducing chemical environment and brought into an oxidized chemical environment, metals have been known to precipitate from a dissolved state and (by the time they are analysed at the analytical laboratory) are recorded as a total metal concentration. When dissolved metals precipitate, they increase the turbidity in the sample. Consequently, we would expect turbidity levels in the sample to change from the time that the sample is collected in the field to the time that the sample is analyzed at the laboratory.

Unfortunately, turbidity was not recorded in the field when the sample was collected. Laboratory turbidity values for representative aquifer samples ranged between 8.25 NTU (Test 3 Borehole

H16W) and 186 NTU (Test 2, Borehole H16W). Comparing total and dissolved Iron concentrations in representative aquifer samples, the total iron concentrations are consistently greater than the dissolved iron concentrations (as is expected). At some test intervals (such as Test 1 at Borehole H2 and Test 3 at Borehole H16W), the total iron concentration is the same order of magnitude as the dissolved iron concentration. Based on this comparison, it is unlikely that the total metals exceedances from these test intervals are a consequence of precipitation of metals from solution due to changing oxidation-reduction conditions. At the remaining test intervals, the total iron concentrations are either one, or two, orders of magnitude greater than the dissolved iron concentration. At these test intervals, it is likely that some (since some metals precipitate quicker than other metals) of the total metals exceedances listed in Tables 10 and 11) are a consequence of changing oxidation-reduction conditions.

## 8.0 INTERPRETATION

### 8.1 HYDRAULIC GRADIENTS

Numerically, Table 12 summarizes the measured and interpreted piezometric head results for each test interval. The interpreted piezometric heads for Borehole H2 are presented graphically on Figure 4 and for Borehole H16W on Figure 5.

**Table 12**
**Piezometric Head Equilibration Summary**

| Borehole | Test No. | Test Zone (m amsl) | | Formation (as interpreted by CDIMG) | Monitoring Period (Hours) | Measured Piezometric Head Range (m amsl) | | Interpreted Piezometric Head (m amsl) |
|---|---|---|---|---|---|---|---|---|
| | | Top | Bottom | | | Max | Min | |
| H2 | 1 | 510 | 240 | Boulder Creek | 45.63 | 1,116.5 | 1,093.1 | 1,094 |
| | 2 | 910 | 530 | Hasler | 40.92 | 1,134.2 | 1,111.2 | >1,134 |
| H16W | 1 | 40 | -120 | Gates | 23.55 | 832.7 | 826.5 | 831.5 |
| | 3 | 610 | 570 | Hasler | 22.55 | 819.2 | 815.4 | 815.4 |
| H16* | 3 | 250 | 120 | Boulder Creek/Hulcross | 1.5 | 859.4 | 853.8 | 853.8 |
| H16A | 3 | 65 | 72 | Tertiary | 140.4 | 785.2 | 784.8 | 784.9 |

**Note**: * Ground level elevation at Borehole H16 is assumed to be equal to the ground level elevation at Borehole H16W.

The equilibrated piezometric head was not recorded at the start of the following tests:

- Test 4 (between 1,090 m amsl and 530 m amsl) at Borehole H2;
- Test 2 (between 260 m amsl and -120 m amsl) at Borehole H16W or Borehole H16.

Consequently piezometric heads for these Test Zones are not presented in Table 12 or on Figures 4 and 5.

The measured piezometric head for Test 2 at Borehole H2 (presented in Table 12) is likely greater than the representative piezometric head, based on the following rationale:

- The fluid in Borehole H2 was, in fact, a mixture of methane gas and groundwater;
- The methodology used to record piezometric pressures at this test zone (using a pressure gauge), likely recorded a combination of gas pressure and groundwater pressure;
- The fluid density is likely less than the density of water; and
- Piezometric head is inversely proportional to fluid density.

The extent to which it is greater than the representative piezometric head is unknown. Although the measured piezometric head at Test 2, Borehole H2 did not equilibrate to a steady-state within the 24 hour test period, the measured piezometric head appeared to asymptotically approach a steady-state less than 24 m above-grade (but greater than the maximum measured piezometric head). Since the maximum measured piezometric head was less than the equilibrated piezometric head and the measured piezometric head is interpreted to be greater than the representative piezometric head, the interpreted piezometric head was simply taken to be the maximum measured piezometric head.

Based on the results presented in Table 12 and in Figure 4, a downward vertical gradient of 0.12 m/m was calculated across the contact between the Hasler and Boulder Creek formations at Borehole H2. A vertical gradient cannot be interpreted at Borehole H16W since a piezometric equilibration test was not performed for Test 2 at Borehole H16W and because the test interval for Test 2 at Borehole H16W was interpreted to be 260 m to -120 m below grade (no impermeable seal was installed at the base of the intended Test 2 Interval). Since three piezometric pressures (required to define a plane) were not recorded in the same geological formation, a horizontal hydraulic gradient and groundwater flow direction could not be defined.

## 8.2 TRANSMISSIVITY

As a consequence of the storage capacity of the sedimentary bedrock and the relatively long test zones, it is unlikely that the storage capacity of the bedrock aquifers intersected by H2 or H16W were ever depleted sufficiently during either the constant discharge tests or constant head tests to estimate the bedrock aquifer transmissivity using these data sets. Consequently, only recovery test data has been used to estimate transmissivity.

Recovery test data is presented as Ratio t/t' vs. residual drawdown. These recovery test graphs are presented such that the start of the recovery test begins at the highest value of t/t'. As the recovery test proceeds, time elapses from right to left across the recovery test curve. Consequently the late-time recovery test slope is furthest to the left side of the graph and the early-time recovery test slope is furthest to the right side of the graph.

Recovery test data set (except at Test 4, Borehole H2 and Test 1, Borehole H16W) shows the classic dual porosity recovery trend, whereby the early-time recovery slope is affected by storage, the mid-time recovery slope shows the effect of the primary porosity of the bedrock and the late-time recovery slope is considered representative of the bedrock aquifer transmissivity based primarily on secondary porosity.

Using the Cooper-Jacob approximation of the modified non-equilibrium well equation, the formation transmissivity (**T**) is estimated (in $m^2$/day) using a plot of residual drawdown and elapsed time on semi-logarithmic paper and the following relationship:

$$T=0.183Q/\Delta s$$

Where **Q** is the mean pumping rate ($m^3$/day) during the constant discharge test and **Δs** is the residual drawdown (m) across one logarithmic cycle. Since the late-time residual drawdown is considered to be most representative of the transmissivity of the bedrock aquifer, **Δs** is determined from the slope of the late-time recovery curve.

The hydraulic conductivity (**K**) of the bedrock is estimated using the transmissivity (**T**) and the thickness (**b**) of the test zone and the following relationship:

$$K=T/b$$

Based on the late-time recovery slopes presented in Appendix H, the input variables and resultant transmissivities and hydraulic conductivities for each test performed are provided in Table 13.

**Table 13**
**Interpreted Transmissivities and Hydraulic Conductivities**

| Borehole | Test Interval (m amsl) | | Test Zone Thickness (m) | Formation | Hydraulic Conductivity (m/sec) | Transmissivity ($m^2$/day) |
|---|---|---|---|---|---|---|
| | Top | Bottom | | | | |
| **Constant Rate Recovery Tests** | | | | | | |
| H2 | 510 | 240 | 270 | Boulder Creek | $4.5 \times 10^{-9}$ | 0.11 |
| | 910 | 530 | 380 | Hasler | $1.8 \times 10^{-9}$ | 0.06 |
| H16W | 610 | 570 | 40 | Hasler | $2.7 \times 10^{-8}$ | 0.10 |
| **Constant Head Recovery Tests** | | | | | | |
| H2 | 1,090 | 530 | 560 | Hasler | $4.1 \times 10^{-10}$ | 0.02 |
| H16W | 40 | -120 | 160 | Gates | $6.1 \times 10^{-9}$ | 0.08 |
| H16W | 260 | -120 | 380 | Gates/Hulcross /Boulder Creek | $1.9 \times 10^{-9}$ | 0.03 |

Hydraulic conductivities and transmissivities presented in Table 13 are estimates based strictly on the data collected. However calculated transmissivities and hydraulic conductivities have likely been affected by field conditions at the time that testing was performed and, in some cases, may not be representative. Field conditions that may have affected the calculated hydraulic conductivity and transmissivity data are as follows:

- **All Tests performed at Borehole H2**: AMEC's subcontractor, IWPS, observed excessive amounts of grease on their equipment upon removal from the open borehole. Upon further investigation of the source of the grease, Foraco Drilling indicated that grease was applied to the outer circumference of the PW casing in order to prevent the casing from becoming stuck in the hole. The residual grease on the borehole wall is likely to have impeded the flow of groundwater into the H2 test intervals and it is considered likely that transmissivities and hydraulic conductivities presented in Table 13 for Borehole H2 are lower than the representative hydraulic conductivities and transmissivities. As a consequence of the fact that most of the movement of the casing in the borehole would have taken place at the top of the borehole (when compared to the bottom of the borehole), the grease is likely to have affected hydraulic conductivities and transmissivities to a greater extent at the top of the borehole and to a lesser extent at the bottom of the borehole. This may explain the fact that Borehole H2 hydraulic conductivities and transmissivities presented in Table 13 increase with depth.
- **All Constant Head Recovery Tests**: Since inflatable packers were not used to isolate test zones during performance of constant head recovery tests, the source of groundwater recharge to the test interval is not clearly defined. As a consequence of this, the estimated hydraulic conductivities may be greater than the representative hydraulic conductivity.
- **Borehole H2 Test Interval 20 m – 580 m**: The top of the test interval was defined as the base of the SW casing (at 20 m below grade.). However, since there was no seal applied to the base of the SW casing, it is conceivable that some groundwater recharge to the test interval originated from above 20 m below grade and was introduced to the

test interval via the annular space between the borehole wall and the SW casing. If, in actual fact, there was groundwater recharge from above the test interval, then the hydraulic conductivity and transmissivity presented for the constant head recovery test at Borehole H2 in Table 13 is likely an over-estimate of the representative hydraulic conductivity and transmissivity.

- **Borehole H16W, Test Interval 800 m – 960 m**: AMEC understands that Guardian Drilling installed a seal (between 787 m and 797 m below grade) comprised of concrete with some Sikka 212 grout in the annular space between the PQ drill rod and the PQ borehole wall, above the HQ open borehole. A contact (or bond) log was not developed for this concrete plug and consequently, there is no way to know if the concrete seal was fractured or not. The estimated hydraulic conductivity and transmissivity presented in Table 13 for this test interval assumes that the concrete plug was adequately set and did not fracture after it was set. If the plug did not adequately set, or did fracture, then the hydraulic conductivity and transmissivity results presented in Table 13 would be an over-estimate of the representative hydraulic conductivity and transmissivity.
- **Borehole H16W, Test Interval 580 m – 960 m**: Following completion of Test 1 at Borehole H16W, the submersible pump, rotating gas separator, and NQ drill rod fell down the borehole. Although the drill rod was recovered, the pump and gas separator were never recovered and were reported by the driller to be wedged against the PQ drill rods at below 785 m below grade. Although the PQ drill rod was perforated between 577 m and 617 m below grade, AMEC learned through discussions with the Guardian driller following completion of Test 2, that the base of borehole H16W was never grouted. Since the smashed pump and gas separator are not considered to be a suitable hydraulic seal to define the base of the test interval, groundwater recharge during Test 2 originated from between 577 m and 617 m and from the HQ open borehole between 800 m and 960 m below grade. As such, the aquifer thickness used to define the hydraulic conductivity was 200 m (={960 m-800 m}+{617 m-577 m}). Since the resultant transmissivity (0.03 $m^2$/day) and hydraulic conductivity (1.9 x $10^{-9}$ m/sec) of this aggregate Test 2 interval is less than the transmissivity (0.08 $m^2$/day) and hydraulic conductivity (6.1 x $10^{-9}$ m/sec) of the Test 1 interval (800 m – 960 m), the representative transmissivity and hydraulic conductivity of the Test 2 upper component interval (577 m – 617 m) is likely less than the estimated transmissivity and hydraulic conductivity presented in Table 13.
- **Methane Gas Discharging from Each Test Interval (except Test 3 at Borehole H16W)**. For those tests where methane gas was observed discharging from the test interval (in addition to groundwater), fluid released from the geological formations is, in fact, a two-phase mixture (gas and water). AMEC has reported hydraulic conductivity results, assuming that the density and viscosity of the fluid is equal to the density and fluid of water. However, since the fluid discharged from the formation is a two-phase fluid comprised of gas and water, the density of the fluid discharged during these tests was likely less than the density of groundwater and the viscosity of the fluid is likely less than the viscosity of groundwater. However, since the fluid density is directly proportional to hydraulic conductivity and fluid viscosity is indirectly proportional to hydraulic conductivity, the extent to which the estimated hydraulic conductivities are

representative of field conditions, is not immediately clear and is dependent upon the relative magnitudes of the density and viscosity of the fluid mixture.

## 8.3 STORAGE COEFFICIENT

During Tests 1 and 2 at Borehole H16W, drawdown was monitored at Borehole H16 (27 m south southeast of Borehole H16W). Using the time-drawdown data and a transformation of the Cooper-Jacob approximation of the modified non-equilibrium well equation:

$$S=(2.25\ T\ t_o)/r^2$$

the storativity (**S**) was estimated, where **T** is the aquifer transmissivity (in $m^2$/day), **r** is the distance of the observation well from the pumping well (in m), and $\mathbf{t_o}$ is the intercept of the observation well straight line projection at zero drawdown (in days).

This calculation was performed for drawdown recorded at Borehole H16 during both Test 1 and Test 2. The estimated storativities are presented in Table 14.

**Table 14**
**Interpreted Storativities at Borehole H16W**

| Borehole | Test No. | Formation | Interpreted Storativity |
|---|---|---|---|
| H16W | 1 | Boulder Creek/ Hulcross/Gates | $3.1 \times 10^{-4}$ |
| | 2 | Boulder Creek/ Hulcross/Gates | $2.4 \times 10^{-5}$ |

In order to confirm the storativity estimates presented in Table 14, storativities were also calculated using a distance-drawdown curve based on drawdown recorded at Borehole H16 following 3000 minutes of pumping at Borehole H16W (Test 2) and 4000 minutes of pumping (Test 1) and the slope of the time-drawdown curve. The resultant storativities based on the distance-drawdown curves were on the order of $4 \times 10^{-6}$ and could not confirm the storativities presented in Table 14. Since the storativity estimated based on distance-drawdown graphs ($4 \times 10^{-6}$) is based on drawdown at only one point, this storativity is not considered to be representative of the storativity of the aquifer. Although the storativities presented in Table 14 are considered to be affected by methane gas mixed in with the groundwater in the formation, these storativities are considered to be more representative than the storativity estimated based on the distance-drawdown graph.

## 8.4 ESTIMATED INFLOW RATES

Based on the estimated hydraulic conductivities, transmissivities, and piezometric heads, inflow rates from underground mine workings (the decline, the shaft, and the Bulk Sample Area - BSA) have been estimated.

### 8.4.1 Decline

Estimated inflow rates to the decline have been estimated using the following information:

- dimensions provided on Figures 4.1 and 4.2 by Norwest Corporation (the Murray River Underground Mine Designer) and attached as Appendix K; and
- The Goodman Approximation (Freeze and Cherry, 1979) for estimating flows into tunnels:

$$q = \frac{2\pi K \Delta h}{\ln(2\Delta h / r)}$$

where **q** is the groundwater flux (in $m^2$/sec) into the tunnel per m of tunnel, **K** is the hydraulic conductivity (in m/sec), ***Δh*** is the distance (in m) between the center of the tunnel and the piezometric head and **r** is the radius of the tunnel (in m).

Based on the surveyed elevations of the ground level at the decline portal (788.7 m amsl) and Borehole H16W (835.5 m amsl) provided by Integrated Pro-Action Corporation (IPaC), the distances between the centre of the decline and the piezometric head (***Δh***) were estimated. Since the hydraulic conductivity for the Hasler formation at Borehole H16W was based on a relatively short test interval (40 m), this hydraulic conductivity was taken to be representative of the formation and no factor of safety was applied. However, since the Test 1 and 2 intervals across the Gates, Hulcross and Boulder Creek formations at Borehole H16W were 160 m and 380 m, respectively, the hydraulic conductivities for these formations are uncertain and a factor of safety of ½ an order of magnitude has been applied to these hydraulic conductivities to estimate the groundwater inflow rates from the Boulder Creek, Hulcross and Gates formations. Since a representative piezometric head was not recorded at the Hulcross formation, the Hulcross formation was assumed to have the same piezometric head as that recorded for the Gates formation.

Based on these assumptions, and the estimated hydraulic conductivities and piezometric heads presented above, the estimated groundwater flow rates into the decline are presented in Table 15.

**Table 15**
**Preliminary Estimate of Groundwater Flow Rates into the Decline**

| Formation | Groundwater Inflows to Decline | | | Cumulative Groundwater Inflows to Decline | | |
|---|---|---|---|---|---|---|
| | USgpm | L/Hour | $m^3$/day | USgpm | L/Hour | $m^3$/day |
| **Hasler** | 135 | 30,700 | 738 | 135 | 30,700 | 738 |
| **Boulder Creek** | 8 | 1,720 | 41 | 143 | 32,400 | 779 |
| **Hulcross** | 6 | 1,390 | 33 | 149 | 33,800 | 812 |
| **Gates** | 44 | 10,100 | 242 | 193 | 43,900 | 1,054 |

Since the groundwater inflows presented in Table 15 are dependent upon the distance between the centre of the tunnel and the piezometric head (***Δh***), this ***Δh*** term increases as one moves further away from the portal along the decline. Since ***Δh*** is directly proportional to the flow rate, the flow rate also increases as one moves further away from the portal along the decline. Consequently, groundwater flow rates presented in Table 15 are maximum flow rates anticipated in each formation using the maximum ***Δh*** for that formation.

Norwest Figure 4.1 entitled Belt Decline Cross Section (dated June 22, 2011), shows two faults crossing the proposed location of the decline. Since, to the best of AMEC's knowledge, Borehole H16W did not intersect any fault zone, hydraulic conductivities estimated based on testing at Borehole H16W will not be representative of hydraulic conductivities at either fault zone. Fractures associated with fault zones can be associated with increased permeability and therefore are expected to contribute groundwater inflows to the decline significantly greater than those inflows presented in Table 15. Since none of the boreholes tested (H2 or H16W) intersected a fault zone, it is not possible to estimate the groundwater inflows to the decline originating from these fault zones with any confidence. In order to estimate groundwater inflows at locations where the faults transect the proposed alignment of the decline, a pumping test would be required at a test interval that intersects a fault zone.

### 8.4.2 Men and Materials Shaft

Groundwater inflows to the men and materials shaft have been estimated using the following information:

- Dimensions provided on Figures 3.1 and 3.6 by Norwest Corporation and attached as Appendix K; and
- The Cooper-Jacob approximation was used to estimate the sustainable yield from each formation tested at Borehole H16W;
- The flow rate (**Q**) for each formation was estimated using the piezometric heads, the stratigraphic elevation provided in Norwest's Figure 3.1, and the 11.2 m diameter men and materials shaft the expanded diameter men and materials shaft, using the Thiem equation:

$$Q=\frac{2.73\ T\ (H-h)}{Log\ R/r}$$

where **r** is the radius of the well, **R** is the radius of influence of the pumping well, **H-h** is the available drawdown (piezometric head less the base elevation of the formation) in the pumping well, and **T** is the transmissivity of the aquifer. To estimate the sustainable yield from the men and materials shaft, the radius of influence from Borehole H16W was assumed to be the same as the radius of influence from the men and materials shaft.

The resultant estimated flow rates from each test interval at Borehole H16W and each formation to be intersected by the shaft are presented on Table 16.

**Table 16**
**Preliminary Estimate of Groundwater Flow Rates into the Men and Materials Shaft**

| Formation | Groundwater Inflows | | | Cumulative Groundwater Inflows | | |
|---|---|---|---|---|---|---|
| | USgpm | L/Hour | $m^3$/day | USgpm | L/Hour | $m^3$/day |
| **Hasler** | 1.8 | 412 | 10 | 1.8 | 412 | 10 |
| **Boulder Creek** | 2.0 | 461 | 11 | 3.8 | 873 | 21 |
| **Hulcross** | 2.4 | 544 | 13 | 6.2 | 1,420 | 34 |
| **Gates** | 2.5 | 571 | 14 | 8.8 | 1,990 | 48 |

Estimated groundwater in-flows presented in Table 16 are based on pump intakes (and total available drawdowns) set at the base of each formation. Consequently, groundwater flow rates presented in Table 16 are maximum flow rates anticipated in each formation using the maximum total available drawdown for that formation.

While removing the pump and packer assembly, AMEC field personnel reported the water in the wells to be 'boiling' as significant volumes of methane gas discharged from the water. The fluid discharged from the men and materials shaft is expected to be a mixture of methane and groundwater. For this reason, the sustainable pumping rates are considered to be preliminary and assume that a gas separator will be connected in-line with the submersible pump.

Norwest Figure 3.1 Men & Materials Shaft Cross Section (dated April 27, 2011) shows no mapped faults across the proposed Shaft alignment. In the event that a fault zone is intersected by the men and materials shaft, then groundwater inflow rates can be expected to be greater than those presented in Table 16.

### 8.4.3 Bulk Sample Area and Ancillary Drifts

Groundwater inflows to the bulk sample area (BSA) and Ancillary Drifts are based on the following information:

- Entry and cross-cut dimensions provided on Table 5.1 on page 5-9 of Norwest's document entitled *4827- Murray River Bulk Sample Plan*;
- Norwest Figure Nos. 5.7 and 5.8 dated June 20, 2011 and June 17, 2011, respectively (attached as Appendix K); and
- The Goodman Approximation (Freeze and Cherry, 1979) for estimating flows into tunnels:

$$q = \frac{2\pi K \Delta h}{\ln(2\Delta h / r)}$$

where **q** is the groundwater flux (in $m^2$/sec) into the tunnel per m of tunnel, ,**K** is the hydraulic conductivity (in m/sec), ***Δh*** is the distance (in m) between the center of the tunnel and the piezometric head and **r** is the radius of the tunnel (in m).

Since the bulk sample target area is understood to be the F seam in the Gates formation, the hydraulic conductivity used to estimate groundwater inflows to the BSA and Ancillary Drifts is the estimated hydraulic conductivity ($6.1 \times 10^{-9}$ m/sec) based on testing in the Gates formation at H16W plus a factor of safety equal to ½ an order of magnitude ($1.1 \times 10^{-8}$ m/sec). Furthermore, the ***Δh*** used to estimate groundwater inflows to the BSA and Ancillary Drifts is based on the piezometric head recorded in the Gates formation at Borehole H16W (4.0 m below grade), and an assumed elevation of the F seam at the BSA (323 m amsl).

The BSA is configured as 5 rectangular entries (3.5 m x 6 m in cross-section) and a dozen rectangular cross-cuts (same sectional dimensions as cross-cuts) separated by large rectangular pillars. Entries are understood to be on 45 m centres, while cross-cuts are understood to be on 52 m centres. Since neither the entries, nor cross-cuts are "tunnels" (as referenced in Goodman Approximation), and since groundwater inflows via pillar walls is expected to be minimal relative to entry and cross-cut ceilings and floors, the Goodman tunnel radius **r** was estimated as follows:

1. The combined external surface area of the ceilings, floors, and external walls of the entries and cross-cuts was calculated (32,100 $m^2$);
2. An equivalent surface area of a cylinder was determined using a range of radii;
3. The equivalent radius of a tunnel (8.9 m) having a length equal to the length of the BSA shown on Norwest drawings (572 m) was used to estimate groundwater inflows to the BSA. The surface area of such a tunnel is equivalent to the combined external surface area of the entries and cross-cuts.

Ancillary drifts connecting the men and materials shaft with the BSA were shown on Norwest's Figure 5.7. Although no detailed dimensions for the ancillary drifts were provided in Norwest's Figure nos. 5.7 and 5.8, AMEC has assumed that these drifts will have the same dimensions as the entries in the BSA (specifically 3.5 m x 6 m) and that the total length of these drifts is 860 m. To estimate groundwater inflows to the ancillary drifts, the equivalent radius (**r**) was estimated to be 1.5 m. The resultant inflows into the BSA and ancillary drifts are presented in Table 17.

**Table 17**
**Preliminary Estimate of Groundwater Inflows to the BSA and Ancillary Drifts**

| UMW | Equivalent Radius (m) | Groundwater Inflow | | | Cumulative Groundwater Inflow | | |
|---|---|---|---|---|---|---|---|
| | | USgpm | L/Hour | $m^3$/day | USgpm | L/Hour | $m^3$/day |
| **Bulk Sample Area** | 8.9 | 67 | 15,300 | 367 | 67 | 15,300 | 367 |
| **Ancillary Drifts** | 1.5 | 74 | 16,700 | 401 | 141 | 32,000 | 768 |

Flow rates presented in Table 17 are based (in part) on testing performed at Borehole H16W, where no fault zones were intersected. Norwest's Figure nos. 5.7 and 5.8 do not show the presence of any faults in the BSA. In the event that a fault zone is intersected in the BSA or by ancillary drifts, flows greater than those presented in Table 17 can be expected.

## 9.0 CONCLUSIONS

Estimates of piezometric head, transmissivity, and hydraulic conductivity have been made at six test intervals at two locations (H16W and H2 separated by 5.9 km) and are summarized on Table 18 (attached at the back of the text). Interpreted piezometric heads in bedrock ranged between 22 m above grade (Hasler Formation at Borehole H2) to 20 m below grade (Hasler Formation borehole H16W). At the only location where the depth to groundwater was recorded in the Tertiary sediments (Observation Well H16A), the depth to groundwater was recorded at 54 m below grade.

Estimated transmissivities ranged between 0.02 $m^2$/day (Hasler Formation at Borehole H2) to 0.11 $m^2$/day (Boulder Creek Formation at Borehole H2). Estimated hydraulic conductivities ranged between 2.7 x $10^{-8}$ m/sec (Hasler Formation at Borehole H16W) and 4.1 x $10^{-10}$ m/sec (Hasler Formation at Borehole H2). The estimated hydraulic conductivities were based, in part, on the length of the test intervals. As a consequence of the long test intervals, the transmissivities are considered to be more representative than the hydraulic conductivities. The fact that the maximum and minimum hydraulic conductivities were both recorded in the Hasler Formation at different locations, suggests that some variability exists in the hydraulic conductivity across that formation.

Generally, hydraulic conductivities and transmissivities estimated at Borehole H2 are considered to be under-estimated as a consequence of the grease that driller's applied to the borehole casing in order to facilitate it's movement in and out of the borehole. The degree to which these hydraulic conductivities and transmissivities are under-estimated is unknown. However, the degree to which they are under-estimated is expected to decrease with depth (that is the hydraulic conductivity and transmissivity estimated for the Boulder Creek formation at Borehole H2 is considered to be more representative than the hydraulic conductivity and transmissivity estimated for the Hasler Formation at Borehole H2).

Hydraulic conductivities and transmissivities estimated based on constant head test data is considered to be over-estimated since packers were not used during these tests. Although a concrete plug was installed at the top of one of these test intervals, since a contact (or bond) log of this concrete plug was not performed, it is unknown if the concrete acted as a suitable plug during this test (Test 1 at Borehole H16W). Methane gas observed discharging from each test interval (except from the Hasler formation at H16W), indicates that the fluid discharged from these test intervals is, in fact, a two phase system. The gas is expected to decrease the viscosity of the fluid to something less than water, and is expected to decrease the density of the fluid to something less than water. Since the fluid density is directly proportional to hydraulic conductivity and fluid viscosity is indirectly proportional to hydraulic conductivity, the effect of the gas on the hydraulic conductivity is unknown.

Groundwater inflow rates originating from each stratigraphic unit and cumulative groundwater inflow rates into underground mine workings (the decline, the men and materials shaft, the bulk sample area and ancillary drifts) have been estimated based on interpreted piezometric heads, transmissivities and hydraulic conductivities at Borehole H16W and are summarized on Table

19 (provided at the back of the text). Borehole H16W is located 840 m from the decline portal, 760 m from the base of the decline, 540 m from the Men and Materials shaft and the most proximal location of the BSA, and 1,300 m from the most distal point of the BSA. Since the piezometric head and transmissivity in the Gates formation was only tested at Borehole H16W, the variability of these parameters in the Gates formation is unknown. Consequently, groundwater inflow rates into underground mine workings provided in this report assume that the hydraulic conductivity, transmissivity and piezometric head estimated based on data collected from the Gates formation at Borehole H16W is representative of these parameters for the entire Gates formation. Given this uncertainty, the estimated groundwater inflows presented in this report can only be approximate.

Furthermore, since Borehole H16W did not intersect any faults, no hydraulic conductivity testing has been conducted in a fault zone. Consequently, faults mapped transecting the proposed decline alignment (and any unmapped faults intersecting the BSA and men and materials shaft) are expected to increase the groundwater inflow rate at these locations. The extent to which the groundwater inflows increase in a fault zone is unknown and will be dependent upon the hydraulic conductivity of these faults and the continuity of the fractures associated with these faults.

## 10.0 CLOSURE

This report has been prepared for the exclusive use of the Canadian Dehua International Mines Group Inc. and its authorized agents for which this project was commissioned. The preliminary single well response testing was conducted in accordance with industry standard practices and the proposed scope of work for this project. No other warranty, expressed or implied, is made. The general limitations of this report are specified in Appendix L.

We trust this information meets your current requirements. If you have any questions or concerns, please contact the undersigned at your convenience.

Respectfully submitted,

**AMEC Environment & Infrastructure**
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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA D.S. GREEN

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# TABLES

## TABLE 8: H2 ANALYTICAL CHEMISTRY RESULTS

| | | P2C21 (H2) D 600-870m | | #2 P2C21 (H2) D 600-870m | | #3 P2C21 (H2) D 200-600m | | #4 P2C21 (H2) D 20-600m | | 30 day Average BCWQG for Freshwater Aquatic Life | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Analytical Report | | L991762 / L991723-1 | L991723-2 | L992415 / L992288-1 | L992288-3 | L993814 / L993769-1 | L993769-3 | L995935 / L996144-1 | L996144-3 | Workng | Approved |
| Date | | April 3, 2011; 11:00 | | April 4, 2011; 21:00 | | April 11, 2011; 00:00 | | April 16, 2011; 17:00 | | | |
| Sampled by: | | AMEC | | AMEC | | AMEC | | AMEC | | | |
| **Physical Tests** | **Units** | | | | | | | | | | |
| Temperature (Field) | deg. Celsius | 6.2 | nr | 5.2 | nr | 3.3 | nr | nr | nr | ng | 18[F] |
| Dissolved Oxygen (Field) | mg/L | **0.21** | nr | **0.24** | nr | **0.80** | nr | nr | nr | ng | >8 |
| True Colour | CU | <5.0 | na | **10.7** | na | <5.0 | na | <5.0 | na | ng | 5 |
| Conductivity (Lab) | µS/cm | 1130 | na | 1800 | na | 1080 | na | 1720 | na | ng | ng |
| Specific Conductance (Field) | µS/cm | 927 | nr | 1990 | nr | 983 | nr | nr | nr | ng | ng |
| Total Dissolved Solids (Lab) | mg/L | 667 | na | 1140 | na | 675 | na | 993 | na | ng | ng |
| Hardness | CaCO3 | 111 | 137 | 32.1 | 32.5 | 39.2 | 45.1 | 14.1 | 30.2 | ng | ng |
| pH (Lab) | pH units | 8.32 | na | 8.25 | na | **9.19** | na | **10.60** | na | ng | 6.5-9.0 |
| pH (Field) | pH units | 8.3 | nr | 8.1 | nr | **9.2** | nr | nr | nr | ng | 6.5-9.0 |
| Turbidity (Lab) | NTU | **354** | na | **21.5** | na | **66.5** | na | **124** | na | ng | 8 |
| **Dissolved Anions and Nutrients** | | | | | | | | | | | |
| Alkalinity - Total CaCO3 | mg/L | **496** | na | **989** | na | **362** | na | **728** | na | 20[A] | ng |
| Chloride | mg/L | 64.8 | na | 26.9 | na | 105 | na | 79 | na | ng | 150 |
| Fluoride | mg/L | <0.20 | na | **2.89** | na | <0.20 | na | **1.09** | na | ng | 0.2[D] |
| Sulphide as S (Dissolved) | mg/L | <0.020 | na | <0.020 | na | <0.020 | na | na | na | 0.002 | ng |
| Sulphate | mg/L | 38.5 | na | 17.6 | na | 43.6 | na | 52 | na | ng | 100 |
| Ammonia as N | mg/L | 0.359 | na | 0.496 | na | **0.488** | na | 1.69 | na | ng | 0.132-0.942[G] |
| Nitrate Nitrogen | mg/L | <0.050 | na | <0.050 | na | <0.050 | na | <0.10 | na | ng | 3.0 |
| Nitrite Nitrogen | mg/L | <0.010 | na | <0.010 | na | <0.010 | na | <0.020 | na | ng | 0.2[H] |
| **Organic/Inorganic Parameters** | | | | | | | | | | | |
| Sulphide as S (Un-ionized) | mg/L | <0.020 | na | <0.020 | na | <0.020 | na | na | na | 0.002 | ng |
| Total Organic Carbon | mg/L | 7.26 | na | 5.09 | na | 5.56 | na | 12.8 | na | ng | ±20 % of median |
| **Cyanides** | | | | | | | | | | | |
| Cyanide, Total | mg/L | <0.0050 | na | <0.0050 | na | <0.0050 | na | na | na | ng | ng |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | mg/L | 17.2 | 20.9 | 0.231 | 0.259 | 2.05 | 2.16 | 2.72 | 2.87 | ng | ng |
| Antimony | mg/L | <0.0025 | 0.00044 | <0.0025 | <0.00020 | <0.0025 | 0.00160 | <0.0025 | 0.00168 | 0.014 | ng |
| Arsenic | mg/L | **0.00500** | **0.00505** | 0.00111 | 0.00121 | 0.00316 | 0.00294 | 0.002 | 0.00249 | ng | 0.005 |
| Barium | mg/L | 2.60 | 2.70 | 2.15 | 2.23 | 0.776 | 0.835 | 0.669 | 0.722 | 5 | ng |
| Beryllium | mg/L | na | <0.0010 | na | <0.0010 | na | <0.0010 | na | <0.0010 | 0.0053 | ng |
| Bismuth | mg/L | na | <0.0010 | na | <0.0010 | na | <0.0010 | na | <0.0010 | ng | ng |
| Boron | mg/L | 0.16 | 0.171 | 0.30 | 0.311 | 0.14 | 0.155 | 0.16 | 0.176 | ng | 1.2 |
| Cadmium | mg/L | <0.0010 | **0.000076** | <0.0010 | <0.000020 | <0.0010 | <0.000020 | <0.0010 | **0.000049** | 0.00001[B] | ng |
| Calcium | mg/L | 33.1 | 33.1 | 8.07 | 8.07 | 10.2 | 10.2 | 8.12 | 8.12 | 8[A] | ng |
| Chromium | mg/L | **0.049** | **0.0508** | <0.010 | 0.00245 | <0.010 | 0.00749 | **0.012** | **0.0131** | 0.0089 | ng |
| Cobalt | mg/L | na | 0.00338 | na | <0.00020 | na | 0.00044 | na | 0.00069 | ng | 0.004 |
| Copper | mg/L | **0.0143** | **0.0140** | <0.0050 | <0.0010 | <0.0050 | **0.0035** | <0.0050 | **0.0045** | ng | 0.002[D] |
| Iron | mg/L | **11.4** | **11.4** | **2.94** | **2.94** | **1.37** | **1.37** | **1.63** | **1.64** | 0.3 | 1 |
| Lead | mg/L | **0.0068** | **0.00694** | <0.0025 | 0.00029 | <0.0025 | **0.00096** | <0.0025 | **0.00138** | 0.0004-0.000007[C] | 0.0046[J] |
| Lithium | mg/L | na | **0.514** | na | **0.509** | na | **0.716** | na | **0.929** | 0.096 | ng |
| Magnesium | mg/L | 13.2 | 13.2 | 3.00 | 3.00 | 4.76 | 4.76 | 2.41 | 2.41 | ng | ng |
| Manganese | mg/L | 0.126 | 0.134 | 0.040 | 0.0467 | 0.017 | 0.0165 | 0.015 | 0.0172 | ng | 0.82[K] |
| Mercury | mg/L | <0.00020 | <0.000050 | <0.00020 | <0.000010 | <0.00020 | <0.000010 | <0.00020 | <0.000010 | ng | 0.00002[L] |
| Molybdenum | mg/L | na | 0.0205 | na | 0.00714 | na | 0.0131 | na | 0.0172 | ng | 1 |
| Nickel | mg/L | na | **0.0260** | na | <0.0010 | na | 0.0036 | na | 0.0050 | 0.025[D] | ng |
| Phosphorus | mg/L | na | 0.40 | na | <0.30 | na | <0.30 | na | <0.30 | ng | ng |
| Potassium | mg/L | 8.72 | 9.82 | 1.79 | 2.05 | 2.26 | 2.34 | 2.86 | 3.26 | 373-432[E] | ng |
| Selenium | mg/L | <0.0050 | 0.00078 | <0.0050 | <0.00020 | <0.0050 | 0.00085 | <0.0050 | 0.00037 | ng | 0.002 |
| Silicon | mg/L | na | 47.0 | na | 5.36 | na | 8.52 | na | 11.0 | ng | ng |
| Silver | mg/L | na | **0.000146** | na | <0.000020 | na | <0.000020 | na | 0.000023 | ng | 0.00005[D] |
| Sodium | mg/L | 217 | 206 | 466 | 436 | 238 | 231 | 393 | 382 | ng | ng |
| Strontium | mg/L | na | 0.538 | na | 0.580 | na | 0.191 | na | 0.139 | ng | ng |
| Thallium | mg/L | na | <0.00020 | na | <0.00020 | na | <0.00020 | na | <0.00020 | 0.0063 | ng |
| Tin | mg/L | na | **0.00047** | na | <0.00020 | na | <0.00020 | na | <0.00020 | 0.0004-0.00008[C] | ng |
| Titanium | mg/L | na | 0.581 | na | <0.010 | na | 0.026 | na | 0.033 | 2.0-4.6[E] | ng |
| Uranium | mg/L | 0.00120 | 0.00118 | <0.00050 | 0.000263 | 0.00084 | 0.000763 | <0.00050 | 0.000372 | 0.3 | ng |
| Vanadium | mg/L | na | 0.0648 | na | <0.0020 | na | 0.0113 | na | 0.0145 | 0.02 | ng |
| Zinc | mg/L | **0.110** | **0.115** | <0.050 | **0.0285** | <0.050 | **0.0380** | <0.050 | **0.0402** | ng | 0.0075[M] |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | mg/L | **0.153** | **0.0857** | **0.168** | **0.168** | **0.324** | **0.324** | **0.466** | **0.467** | ng | 0.05 |
| Antimony | mg/L | <0.0025 | 0.00027 | <0.0025 | 0.00021 | <0.0025 | 0.00177 | <0.0025 | 0.00184 | 0.014 | ng |
| Arsenic | mg/L | 0.00140 | 0.00148 | 0.00112 | 0.00102 | 0.00296 | 0.00236 | 0.00191 | 0.00202 | ng | ng |
| Barium | mg/L | 1.41 | 1.47 | 2.02 | 2.19 | 0.625 | 0.659 | 0.270 | 0.297 | 5 | ng |
| Beryllium | mg/L | na | <0.00050 | na | <0.0010 | na | <0.0010 | na | <0.0010 | 0.0053 | ng |
| Bismuth | mg/L | na | <0.00050 | na | <0.0010 | na | <0.0010 | na | <0.0010 | ng | ng |
| Boron | mg/L | 0.10 | 0.108 | 0.28 | 0.288 | 0.14 | 0.167 | 0.15 | 0.174 | ng | ng |
| Cadmium | mg/L | <0.0010 | **0.000011** | <0.0010 | <0.000020 | <0.0010 | <0.000020 | <0.0010 | <0.000020 | 0.00001[B] | ng |
| Calcium | mg/L | 28.5 | 28.5 | 8.02 | 8.02 | 8.36 | 8.36 | 3.46 | 3.46 | 8[A] | ng |
| Chromium | mg/L | <0.010 | 0.00102 | <0.010 | 0.00043 | <0.010 | 0.00127 | <0.010 | 0.00245 | 0.0089 | ng |
| Cobalt | mg/L | na | 0.00016 | na | <0.00020 | na | <0.00020 | na | <0.00020 | ng | ng |
| Copper | mg/L | <0.0050 | <0.00050 | <0.0050 | <0.0010 | <0.0050 | <0.001 0 | <0.0050 | <0.0010 | ng | ng |
| Iron | mg/L | **1.71** | **1.72** | **2.55** | **2.55** | 0.069 | 0.069 | 0.052 | 0.052 | 0.3 | ng |
| Lead | mg/L | <0.0025 | 0.000061 | <0.0025 | 0.00010 | <0.0025 | <0.00010 | <0.0025 | <0.00010 | 0.0004-0.000007[C] | ng |
| Lithium | mg/L | na | **0.300** | na | **0.511** | na | **0.736** | na | **0.927** | 0.096 | ng |
| Magnesium | mg/L | 9.69 | 9.69 | 2.93 | 2.93 | 4.44 | 4.44 | 1.33 | 1.33 | ng | ng |
| Manganese | mg/L | 0.075 | 0.0778 | 0.039 | 0.0409 | <0.010 | 0.00496 | <0.010 | 0.00030 | ng | ng |
| Mercury | mg/L | <0.00020 | <0.000010 | <0.00020 | <0.000010 | <0.00020 | <0.000010 | <0.00020 | <0.000010 | ng | ng |
| Molybdenum | mg/L | na | 0.0195 | na | 0.00697 | na | 0.0125 | na | 0.0161 | ng | ng |
| Nickel | mg/L | na | 0.00182 | na | <0.0010 | na | 0.0015 | na | <0.0010 | 0.025[D] | ng |
| Phosphorus | mg/L | na | <0.30 | na | <0.30 | na | <0.30 | na | <0.30 | ng | ng |
| Potassium | mg/L | 2.50 | 2.88 | 1.79 | 2.03 | 1.72 | 1.73 | 2.30 | 2.63 | 373-432[E] | ng |
| Selenium | mg/L | <0.0050 | 0.00022 | <0.0050 | <0.00020 | <0.0050 | 0.00076 | <0.0050 | 0.00038 | ng | ng |
| Silicon | mg/L | na | 3.67 | na | 5.20 | na | 5.82 | na | 7.70 | ng | ng |
| Silver | mg/L | na | <0.000010 | na | <0.000020 | na | <0.000020 | na | <0.000020 | ng | ng |
| Sodium | mg/L | 166 | 167 | 454 | 446 | 239 | 243 | 398 | 405 | ng | ng |
| Strontium | mg/L | na | 0.405 | na | 0.552 | na | 0.167 | na | 0.0894 | ng | ng |
| Thallium | mg/L | na | <0.00010 | na | <0.00020 | na | <0.00020 | na | <0.00020 | 0.0063 | ng |
| Tin | mg/L | na | **0.00022** | na | 0.00020 | na | <0.00020 | na | <0.00020 | 0.0004-0.00008[C] | ng |
| Titanium | mg/L | na | <0.010 | na | <0.010 | na | <0.010 | na | <0.010 | 2.0-4.6[E] | ng |
| Uranium | mg/L | <0.00050 | 0.000374 | <0.00050 | 0.000245 | 0.00076 | 0.000661 | <0.00050 | 0.000227 | 0.3 | ng |
| Vanadium | mg/L | na | <0.0010 | na | <0.0020 | na | 0.0051 | na | 0.0067 | 0.02 | ng |
| Zinc | mg/L | <0.050 | 0.0100 | <0.050 | 0.0074 | <0.050 | <0.0060 | <0.050 | <0.0060 | ng | ng |
| **Hydrocarbons** | | | | | | | | | | | |
| Dissolved Methane | mg/L | 3.59 | na | 14.5 | na | 18.9 | na | 9.14 | na | ng | ng |

**Notes:**

| | |
|---|---|
| nr | not recorded in the field |
| na | not analyzed at the laboratory |
| ng | No guideline listed |
| < | Less than analytical detection limit |
| CU | Colour Units |
| µS/cm | Micro siemens per centimetre |
| NTU | Nephelometric turbidity units |
| mg/L | Milligrams per litre equivalent to parts per million by volume |
| A | Dependent on sensitivity of surface water body to acid inputs as described in *Second Report on Chemical Sensitivity of BC Lakes to Acidic Inputs* dated September, 1987 |
| B | Hardness dependent guideline=10exp(0.86[log{hardness}]-3.2 |
| C | Dependent on type of organo-metallic compound |
| D | Hardness dependent guideline |
| E | Dependent upon *Daphnia Magna* toxicity testing |
| F | Mean weekly maximum discharge temperature into streams with unknown fish distribution |
| G | pH and temperature dependent |
| H | Chloride dependent |
| J | Hardness dependent guideline=3.31+EXP(1.273*LN(Average hardness)-4.705) |
| K | Hardness dependent guideline=(0.0044*Average Hardness)+0.605 |
| L | Dependent on type of organo-metallic compound. Guideline assumes that <0.5% of total mercury is methyl mercury |
| M | Assumes hardness of receiving environment is less than 90 mg/L. If hardness of receiving environment exceeds 90 mg/L, guideline in µg/L=7.5 +0.75*(hardness-90) |
| BCWQG | British Columbia Water Quality Guidelines taken from: *A Compendium of Working Water Quality Guidelines for British Columbia* , Science and Information Branch, Ministry of Environment, August 2006 *Approved Water Quality Guidelines* , Environmental Protection Division, Ministry of Environment, January 2010 |
| **Bold** | Indicates concentration exceeds BCWQG Approved Water Quality Guideline |
| **Bold and Underlined** | Indicates concentration exceeds BCWQG Working Water Quality Guideline |
| Shaded | Indicates method detection limit exceeds BCWQG Approved or Working Water Quality Guideline |

## TABLE 9: H16W ANALYTICAL CHEMISTRY RESULTS

| | | H16W D 800-1000 m | #2 H16W 500-730m | H16W 233m-273m | 30 day Average BCWQG for Freshwater Aquatic Life | |
|---|---|---|---|---|---|---|
| Analytical Report | | **L1023033/L1022659** | **L1039171/L1039100** | **L1044658/L1044535** | | |
| Date | | **June 23, 2011; 11:00** | **August 1, 2011; 13:00** | **August 14, 2011; 14:00** | **Working** | **Approved** |
| Sampled by: | | **AMEC** | **AMEC** | **AMEC** | | |
| **Physical Tests** | **Units** | | | | | |
| Temperature (Field) | deg. Celsius | 10.4 | 10.4 | 10 | ng | 18[F] |
| Dissolved Oxygen (Field) | mg/L | **0.37** | **0.10** | **0.94** | ng | >8 |
| True Colour | CU | **7** | **13.2** | **5.5** | ng | 5 |
| Conductivity (Lab) | µS/cm | 1810 | 1850 | 1460 | ng | ng |
| Specific Conductance (Field) | µS/cm | 1810 | 1900 | 1390 | ng | ng |
| Total Dissolved Solids (Lab) | mg/L | 1170 | 1210 | 842 | ng | ng |
| Hardness | CaCO3 | 11 | 22.5 | 14.4 | ng | ng |
| pH (Lab) | pH units | **9.5** | 8.18 | **9.43** | ng | 6.5-9.0 |
| pH (Field) | pH units | **9.5** | 7.60 | **9.4** | ng | 6.5-9.0 |
| Turbidity (Lab) | NTU | **75.5** | **186** | **8.25** | ng | 8 |
| **Dissolved Anions and Nutrients** | | | | | | |
| Alkalinity - Total CaCO3 | mg/L | 868 | 985 | 787 | 20[A] | ng |
| Bromide | mg/L | <0.50 | <1.0 | <0.50 | ng | ng |
| Chloride | mg/L | 79.7 | 75 | 11.5 | ng | 150 |
| Fluoride | mg/L | **0.64** | **3.82** | **1.82** | ng | 0.2[D] |
| Sulphide as S (Dissolved) | mg/L | **0.118** | <0.020 | <0.020 | 0.002 | ng |
| Sulphate | mg/L | 20.1 | <10 | <5.0 | ng | 100 |
| Ammonia as N | mg/L | **0.939** | **2.9** | **1.04** | ng | 0.131-2.09[G] |
| Nitrate Nitrogen | mg/L | <0.050 | <0.10 | <0.050 | ng | 3.0 |
| Nitrite Nitrogen | mg/L | <0.010 | <0.020 | <0.010 | ng | 0.2[H] |
| **Organic/Inorganic Parameters** | | | | | | |
| Sulphide as S (Un-ionized) | mg/L | <0.020 | <0.020 | <0.020 | 0.002 | ng |
| Total Organic Carbon | mg/L | 27.9 | 15.9 | 5.23 | ng | ±20 % of median |
| **Cyanides** | | | | | | |
| Cyanide, Total | mg/L | <0.0050 | 0.0889 | 0.0756 | ng | ng[O] |
| **Total Metals** | | | | | | |
| Aluminum | mg/L | 0.933 | 1.12 | 0.314 | ng | ng[N] |
| Antimony | mg/L | <0.0025 | <0.0025 | <0.0025 | 0.014 | ng |
| Arsenic | mg/L | 0.0033 | <0.0025 | <0.0025 | ng | 0.005 |
| Barium | mg/L | 0.61 | 1.74 | 0.455 | 5 | ng |
| Beryllium | mg/L | <0.0050 | <0.0050 | <0.0050 | 0.0053 | ng |
| Bismuth | mg/L | <0.20 | <0.20 | <0.20 | ng | ng |
| Boron | mg/L | 0.26 | 0.33 | 0.30 | ng | 1.2 |
| Cadmium | mg/L | **0.000112** | <0.000085 | <0.000085 | 0.00001[B] | ng |
| Calcium | mg/L | **10.1** | **11.6** | 6.19 | 8[A] | ng |
| Chromium | mg/L | 0.0088 | **0.0127** | <0.0050 | 0.0089 | ng |
| Cobalt | mg/L | <0.0015 | <0.0015 | <0.0015 | ng | 0.004 |
| Copper | mg/L | 0.0113 | **3.96** | **0.0614** | ng | 0.002[D] |
| Iron | mg/L | **1.57** | **11.1** | **0.577** | 0.3 | 1 |
| Lead | mg/L | <0.0025 | **1.41** | **0.0318** | 0.0004-0.000007[C] | 0.0036[J] |
| Lithium | mg/L | **0.926** | **1.23** | **1.32** | 0.096 | ng |
| Magnesium | mg/L | 1.31 | 2.19 | 0.99 | ng | ng |
| Manganese | mg/L | 0.0301 | 0.170 | 0.0159 | ng | 0.68[K] |
| Mercury | mg/L | <0.000010 | <0.000010 | <0.000010 | ng | 0.00002[L] |
| Molybdenum | mg/L | 0.0223 | 0.0108 | 0.0053 | ng | 1 |
| Nickel | mg/L | 0.0064 | 0.0092 | <0.0050 | 0.025[D] | ng |
| Phosphorus | mg/L | <0.30 | 0.52 | <0.30 | ng | ng |
| Potassium | mg/L | 4.7 | <2.0 | 3.2 | 373-432[E] | ng |
| Selenium | mg/L | <0.0050 | <0.0050 | <0.0050 | ng | 0.002 |
| Silicon | mg/L | 9.54 | 7.35 | 4.50 | ng | ng |
| Silver | mg/L | <0.00010 | **0.00017** | <0.00010 | ng | 0.00005[D] |
| Sodium | mg/L | 412 | 497 | 364 | ng | ng |
| Strontium | mg/L | 0.12 | 0.276 | 0.116 | ng | ng |
| Thallium | mg/L | <0.0010 | <0.0010 | <0.0010 | 0.0063 | ng |
| Tin | mg/L | <0.0025 | <0.0025 | <0.0025 | 0.0004-0.00008[C] | ng |
| Titanium | mg/L | 0.016 | 0.023 | <0.010 | 2.0-4.6[E] | ng |
| Uranium | mg/L | <0.0010 | <0.0010 | <0.0010 | 0.3 | ng |
| Vanadium | mg/L | 0.006 | <0.0050 | <0.0050 | 0.02 | ng |
| Zinc | mg/L | **0.0937** | **0.889** | <0.050 | ng | 0.0075[M] |
| **Dissolved Metals** | | | | | | |
| Aluminum | mg/L | **0.257** | 0.032 | **0.123** | ng | 0.05 |
| Antimony | mg/L | <0.0025 | <0.0025 | <0.0025 | 0.014 | ng |
| Arsenic | mg/L | 0.003 | <0.0025 | <0.0025 | ng | ng |
| Barium | mg/L | 0.295 | 0.997 | 0.380 | 5 | ng |
| Beryllium | mg/L | <0.0050 | <0.0050 | <0.0050 | 0.0053 | ng |
| Bismuth | mg/L | <0.20 | <0.20 | <0.20 | ng | ng |
| Boron | mg/L | 0.25 | 0.33 | 0.29 | ng | ng |
| Cadmium | mg/L | <0.000085 | <0.000085 | <0.000085 | 0.00001[B] | ng |
| Calcium | mg/L | 2.82 | 6.09 | 4.33 | 8[A] | ng |
| Chromium | mg/L | <0.0050 | <0.0050 | <0.0050 | 0.0089 | ng |
| Cobalt | mg/L | <0.0015 | <0.0015 | <0.0015 | ng | ng |
| Copper | mg/L | <0.0050 | 0.0750 | 0.0167 | ng | ng |
| Iron | mg/L | 0.161 | **0.667** | 0.144 | 0.3 | ng |
| Lead | mg/L | <0.0025 | **0.0358** | **0.0029** | 0.0004-0.000007[C] | ng |
| Lithium | mg/L | **0.927** | **1.26** | **1.16** | 0.096 | ng |
| Magnesium | mg/L | 0.96 | 1.76 | 0.88 | ng | ng |
| Manganese | mg/L | 0.006 | 0.107 | 0.0067 | ng | ng |
| Mercury | mg/L | <0.000010 | <0.000010 | <0.000010 | ng | ng |
| Molybdenum | mg/L | 0.0216 | 0.0100 | 0.0050 | ng | ng |
| Nickel | mg/L | <0.0050 | <0.0050 | <0.0050 | 0.025[D] | ng |
| Phosphorus | mg/L | <0.30 | <0.30 | <0.30 | ng | ng |
| Potassium | mg/L | 4.4 | <2.0 | 3.0 | 373-432[E] | ng |
| Selenium | mg/L | <0.0050 | <0.0050 | <0.0050 | ng | ng |
| Silicon | mg/L | 8.6 | 5.25 | 4.01 | ng | ng |
| Silver | mg/L | <0.00010 | <0.00010 | <0.00010 | ng | ng |
| Sodium | mg/L | 406 | 481 | 349 | ng | ng |
| Strontium | mg/L | 0.0796 | 0.226 | 0.101 | ng | ng |
| Thallium | mg/L | <0.0010 | <0.0010 | <0.0010 | 0.0063 | ng |
| Tin | mg/L | <0.0025 | <0.0025 | <0.0025 | 0.0004-0.00008[C] | ng |
| Titanium | mg/L | <0.010 | <0.010 | <0.010 | 2.0-4.6[E] | ng |
| Uranium | mg/L | <0.0010 | <0.0010 | <0.0010 | 0.3 | ng |
| Vanadium | mg/L | <0.0050 | <0.0050 | <0.0050 | 0.02 | ng |
| Zinc | mg/L | 0.0138 | 0.159 | <0.0050 | ng | ng |
| **Hydrocarbons** | | | | | | |
| Dissolved Methane | mg/L | 7.88 | 22.0 | 11.0 | ng | ng |

**Notes:**

| | |
|---|---|
| nr | not recorded in the field |
| na | not analyzed at the laboratory |
| ng | No guideline listed |
| < | Less than analytical detection limit |
| CU | Colour Units |
| µS/cm | Micro siemens per centimetre |
| NTU | Nephelometric turbidity units |
| mg/L | Milligrams per litre equivalent to parts per million by volume |
| A | Dependent on sensitivity of surface water body to acid inputs as described in *Second Report on Chemical Sensitivity of* |
| B | Hardness dependent guideline=10exp(0.86[log{hardness}]-3.2 |
| C | Dependent on type of organo-metallic compound |
| D | Hardness dependent guideline |
| E | Dependent upon *Daphnia Magna* toxicity testing |
| F | Mean weekly maximum discharge temperature into streams with unknown fish distribution |
| G | pH and temperature dependent |
| H | Chloride dependent |
| J | Hardness dependent guideline=3.31+EXP(1.273*LN(Average hardness)-4.705) |
| K | Hardness dependent guideline=(0.0044*Average Hardness)+0.605 |
| L | Dependent on type of organo-metallic compound. Guideline assumes that <0.5% of total mercury is methyl mercury |
| M | Assumes hardness of receiving environment is less than 90 mg/L. If hardness of receiving environment exceeds 90 mg |
| N | Since pH exceeds 6.5 |
| O | Approved guideline only provided for weak acid dissociable cyanide |
| BCWQG | British Columbia Water Quality Guidelines taken from: |
| | *A Compendium of Working Water Quality Guidelines for British Columbia* , Science and Information Branch, Ministry of |
| | *Approved Water Quality Guidelines* , Environmental Protection Division, Ministry of Environment, January 2010 |
| **Bold** | Indicates concentration exceeds BCWQG Approved Water Quality Guideline |
| **Bold and Underlined** | Indicates concentration exceeds BCWQG Working Water Quality Guideline |
| Shaded | Indicates method detection limit exceeds BCWQG Approved or Working Water Quality Guideline |

**Table 18: Test Intervals and Aquifer Properties Summary Table**

| Borehole | Elevation at Grade (m amsl) | Test Number | Test Interval (m amsl) Bottom | Test Interval (m amsl) Top | Length (m) | Formation | Piezometric Head (m) | Transmissivity ($m^2$/day) | Hydraulic Conductivity (m/sec) | Storativity |
|---|---|---|---|---|---|---|---|---|---|---|
| H2 | 1,111.90 | 1 | 240 | 510 | 270 | Boulder Creek | 1,094 | 0.11 | $4.5x10^{-9}$ | - |
| | | 2 | 530 | 910 | 380 | Hasler | >1,134 | 0.06 | $1.8x10^{-9}$ | - |
| | | 4 | 530 | 1090 | 560 | Hasler and Tertiary | nm | 0.02 | $4.1x10^{-10}$ | - |
| H16W | 835.5 | 1 | -120 | 40 | 160 | Gates | 831 | 0.08 | $6.1x10^{-9}$ | $3.1x10^{-4}$ |
| | | 2 | -120 | 260 | 380 | Gates/Hulcross/Boulder Creek | nm | 0.03 | $1.9x10^{-9}$ | $2.4x10^{-5}$ |
| | | 3 | 560 | 600 | 40 | Hasler | 815 | 0.10 | $2.7x10^{-8}$ | - |

**Notes:**

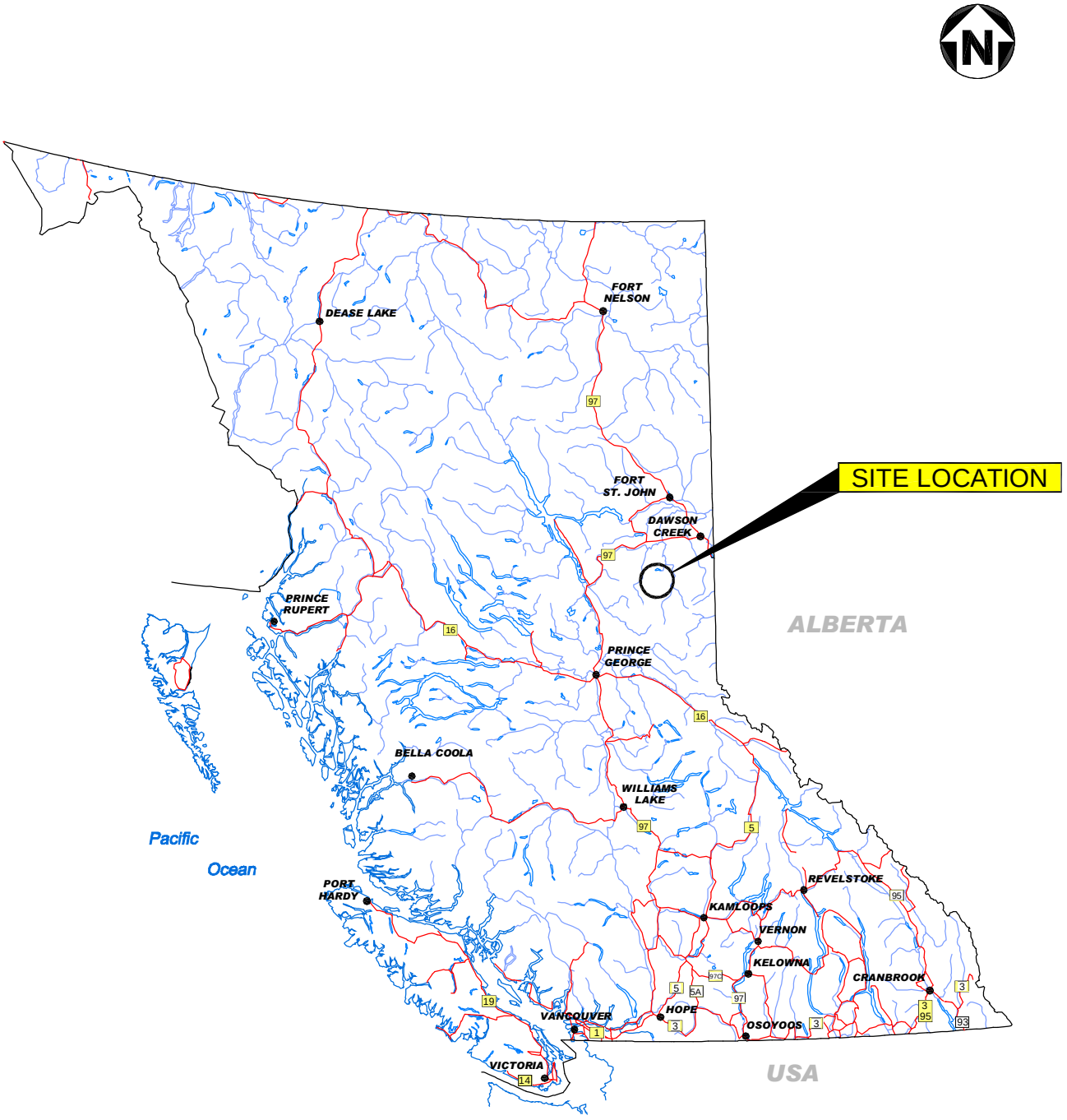
- Storativity not calculated due to insufficient data

nm piezometric head equilibration not performed at the request of CDIMG

**Table 19: Estimated Groundwater Inflow Rates to Underground Mine Workings**

| UMW | Equivalent Radius (m) | Maximum Differential Head (m) | Formation | Hydraulic Conductivity (m/sec) | Length (m) | GW Flux (q) | Estimated Groundwater Flow Rate | | | Cumulative Groundwater Flow Rate | | | Reference Methodology |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $m^2$/sec | USgpm | L/Hour | $m^3$/day | USgpm | L/Hour | $m^3$/day | |
| Decline | 3.2 | 285 | Hasler | 2.70E-08 | 915 | 9.3E-06 | 135 | 30725 | 738 | 135 | 30725 | 738 | Goodman, 1965 |
| | | 375 | Boulder Creek | 6.90E-09 | 160 | 3.0E-06 | 8 | 1716 | 41 | 143 | 32441 | 779 | |
| | | 367 | Hulcross | 1.10E-08 | 83 | 4.7E-06 | 6 | 1394 | 33 | 149 | 33835 | 812 | |
| | | 497 | Gates | 1.10E-08 | 467 | 6.0E-06 | 44 | 10062 | 242 | 193 | 43897 | 1054 | |
| Bulk Sample Area | 8.9 | 509 | Gates | 1.10E-08 | 572 | 7.4E-06 | 67 | 15282 | 367 | 67 | 15282 | 367 | |
| Ancillary Drifts | 1.5 | 509 | Gates | 1.10E-08 | 860 | 5.4E-06 | 74 | 16702 | 401 | 141 | 31983 | 768 | |
| | | **Available Drawdown (m)** | | **Transmissivity ($m^2$/day)** | **Radius of Influence (m)** | | | | | | | | |
| Men and Materials Shaft | 5.6 | 128 | Hasler | 0.10 | $1.3x10^4$ | 1.1E-04 | 1.8 | 412 | 9.9 | 1.8 | 412 | 10 | Thiem, 1906 |
| | | 284 | Boulder Creek | 0.03 | $9.9x10^2$ | 1.3E-04 | 2.0 | 461 | 11.0 | 3.8 | 873 | 21 | |
| | | 357 | Hulcross | 0.03 | $9.9x10^2$ | 1.5E-04 | 2.4 | 544 | 13.0 | 6.2 | 1417 | 34 | |
| | | 506 | Gates | 0.09 | $7.1x10^9$ | 1.6E-04 | 2.5 | 571 | 13.7 | 8.8 | 1988 | 48 | |
| | | | | | Preliminary Estimate of Maximum Combined Flow Rate from Decline, Men and Materials Shaft, BSA and Ancillary Drifts= | | | | | 343 | 77868 | 1869 | |

**FIGURES**



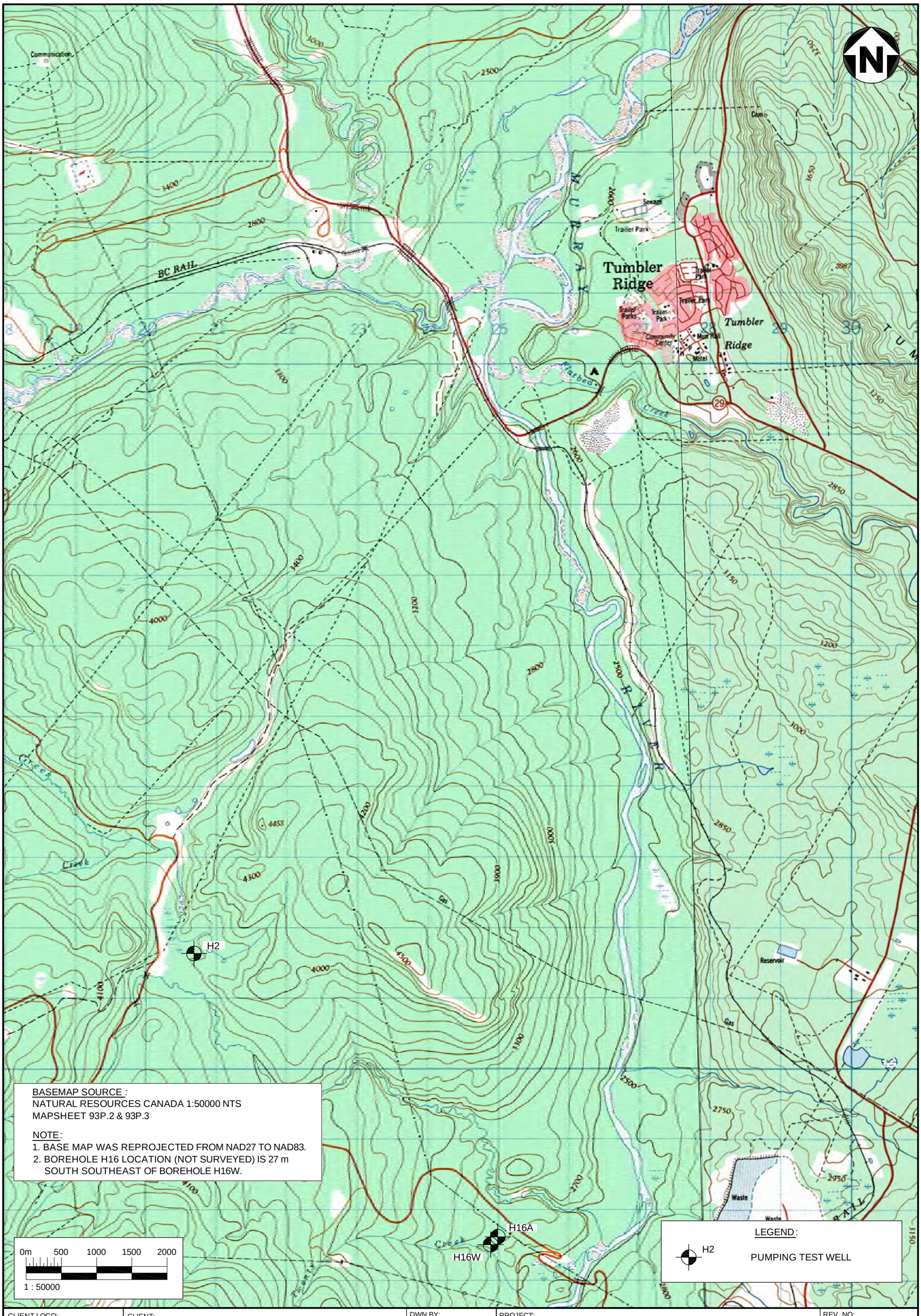

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Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT LOGO:

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

| | | | |
|---|---|---|---|
| PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS | DWN BY: MW | DATUM: -- | DATE: NOVEMBER 2011 |
| TITLE: SITE LOCATION | CHK'D BY: SG | REV. NO: A | PROJECT NO: KX13505.050 |
| | PROJECTION: -- | SCALE: NOT TO SCALE | FIGURE NO: 1 |

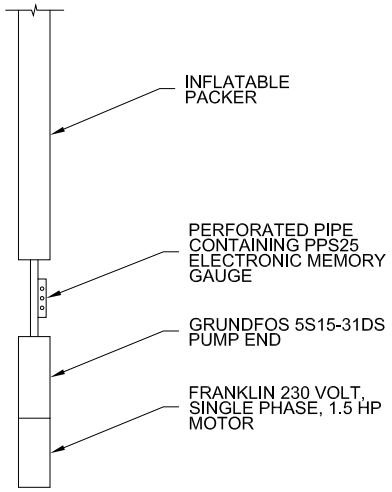
G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505-001_Site Location.dwg - Fig 1 - Nov. 16, 2011 1:08pm - michael.m.wong




| | | | | |
|---|---|---|---|---|
| CLIENT LOGO: DEHUA | CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP | DWN BY: MW | PROJECT: MURRAY RIVER SINGLE WELL REPONSE TESTS | REV. NO: A |
| | | CHK'D BY: SG | | DATE: NOVEMBER 2011 |
| | | DATUM: NAD 83 | | PROJECT NO: KX13505.050 |
| AMEC Environment & Infrastructure<br>Suite 600 - 4445 Lougheed Highway<br>Burnaby, BC V5C 0E4<br>Tel. 604-294-3811 Fax 604-294-4664 | amec | PROJECTION: UTM Zone 10 | TITLE: BOREHOLE LOCATION PLAN | FIGURE NO: 2 |
| | | SCALE: AS SHOWN | | |

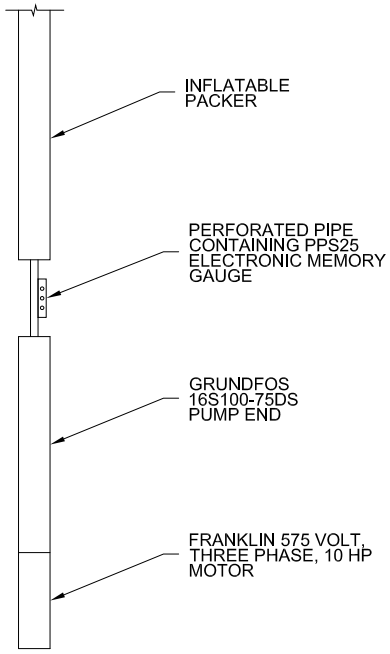
G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505.050-002.dwg - Fig 2 - Nov. 29, 2011 12:24pm - michael.m.wong

SHALLOW SET 1.5 HP PUMP WITH PACKER



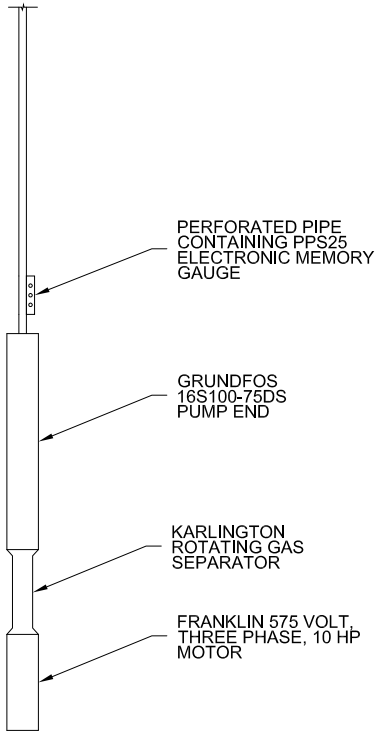

CONFIGURATION 1

DEEP SET 10 HP PUMP WITH PACKER



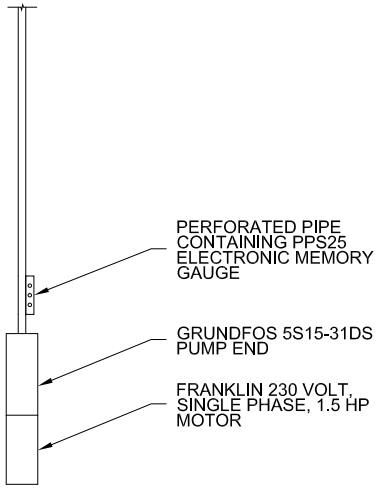

CONFIGURATION 2

DEEP SET CONSTANT HEAD TEST WITHOUT PACKER




CONFIGURATION 3

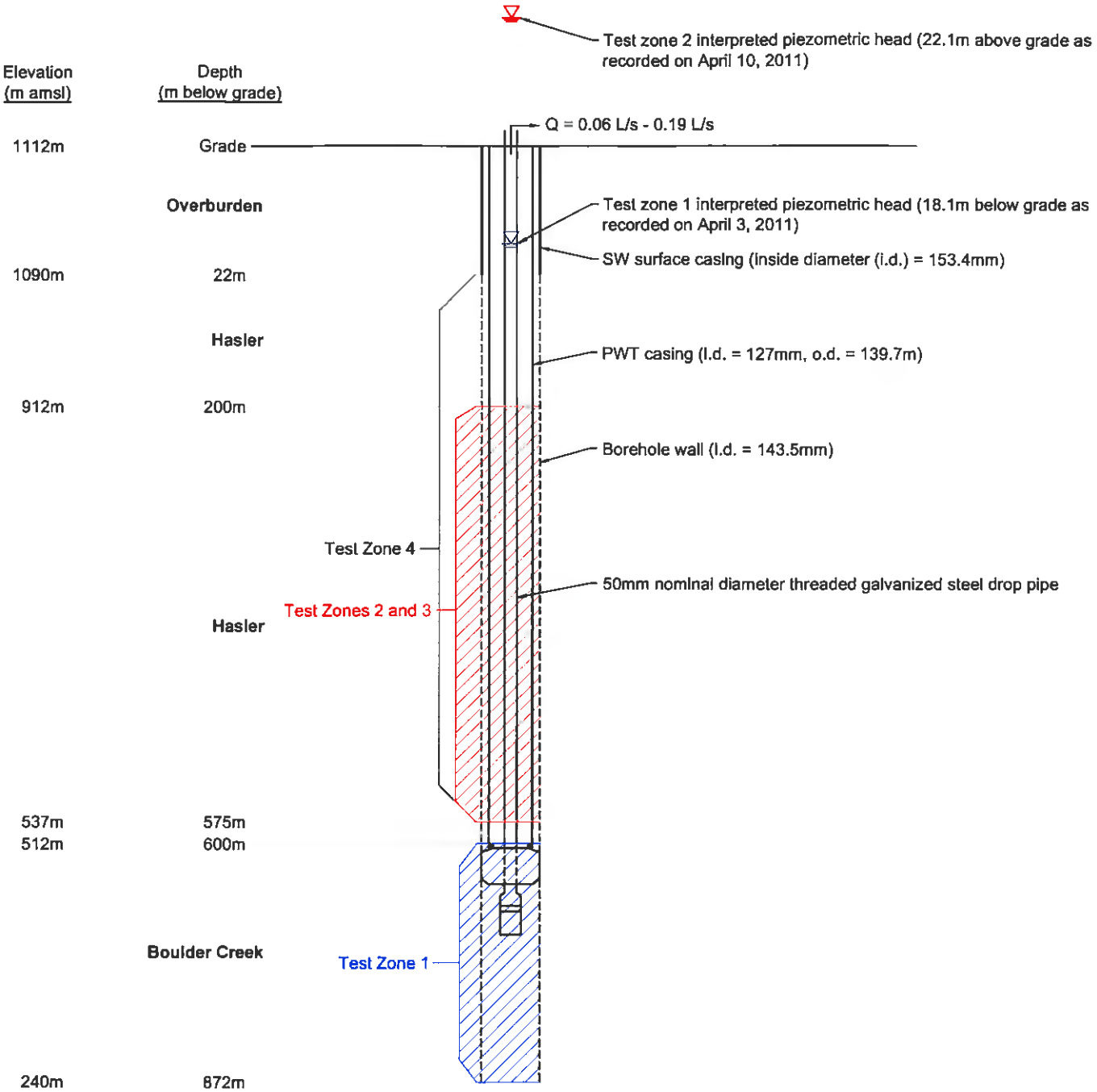
SHALLOW SET CONSTANT HEAD TEST WITHOUT PACKER




CONFIGURATION 4

| | | | |
|---|---|---|---|
| CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP | DWN BY: MW | PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS | REV. NO: A |
| | CHK'D BY: SG | | DATE: NOVEMBER 2011 |
| | DATUM: – | TITLE: PUMP AND PACKER CONFIGURATONS | PROJECT NO: KX13505.050 |
| | PROJECTION: -- | | FIGURE NO: 3 |
| | SCALE: NOT TO SCALE | | |

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Notes:

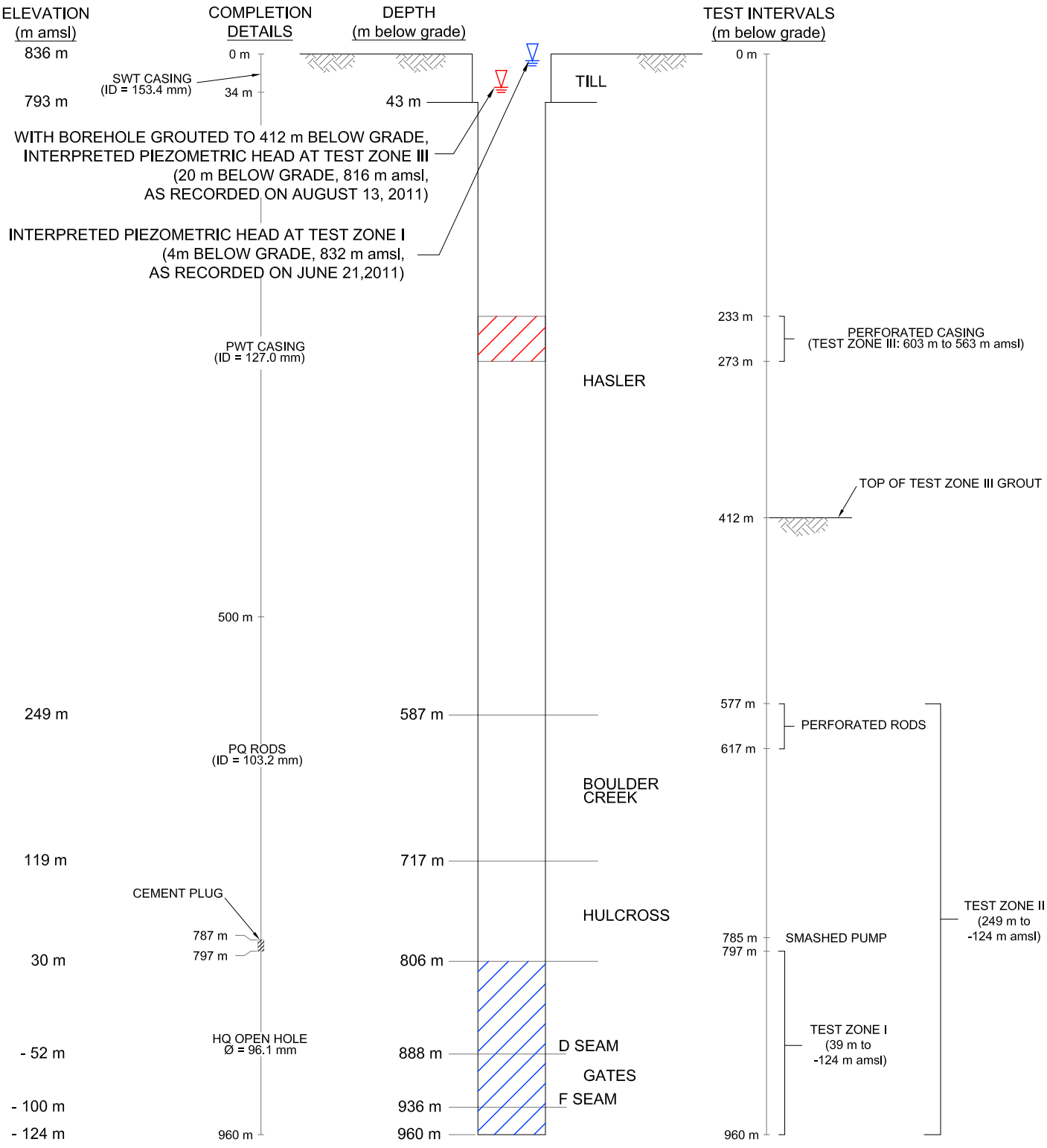
1. Borehole H2 stratigraphy provided by Canadian Dehua International Mines Group Inc.
2. Borehole H2 location (based on information provided by IPAC using a Trimble GNSS R8 RTK base station to +/- 0.05m accuracy) relative to UTM Zone 10N map projection.
3. Northing: 6101836.4, Easting: 620583.7


AMEC Environment & Infrastructure
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Fax (250) 374-2944


CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

| | | | |
|---|---|---|---|
| TITLE: BOREHOLE H2 TEST ZONES AND INTERPRETED PIEZOMETRIC HEAD | DRAWN BY: I.Macleod | DATUM: NAD83 | DATE: DECEMBER 2011 |
| | CHECKED BY: S.Green | REV. No: A | PROJECT No.: KX13505 |
| PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS | PROJECTION: UTM Zone 10 | SCALE: NTS | FIGURE No.: 4 |

P:\DRAFTING\Kamloops - Drafting\KX13500 - KX13598\KX13505-Drafting\KX13505-Fig4-BOREHOLE.dwg - 8.5 X 11 - Portrait - Dec. 08, 2011 4:49pm - ian.j.macleod




NOTES:
1. BOREHOLE H16W STRATIGRAPHY PROVIDED BY CANADIAN DEHUA INTERNATIONAL MINES GROUP (CDIMG) INC.
2. BOREHOLE H16W LOCATION (BASED ON INFORMATION PROVIDED BY IPaC USING A TRIMBLE GNSS R8 RTK BASE STATION TO ±0.05 m ACCURACY) RELATIVE TO UTM ZONE 10N MAP PROJECTION.
3. NORTHING: 6097712.7 EASTING: 624789.1
4. amsl - ABOVE MEAN SEA LEVEL


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CLIENT LOGO:

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

| PROJECT: | DWN BY: | DATUM: | DATE: |
|---|---|---|---|
| MURRAY RIVER SINGLE WELL RESPONSE TESTS | MW | – | NOVEMBER 2011 |
| TITLE: BOREHOLE H16W TEST ZONES AND INTERPRETED PIEZOMETRIC HEADS | CHK'D BY: SG | REV. NO: A | PROJECT NO: KX13505.050 |
| | PROJECTION: – | SCALE: NOT TO SCALE | FIGURE NO: 5 |

G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505-005_Borehole H16W.dwg - Fig 5 - Dec. 09, 2011 10:41am - michael.m.wong

# APPENDIX A

# GROUNDWATER DISCHARGE MANAGEMENT PLAN

10 December 2010

**AMEC Project No. KX13505**

Canadian Dehua International Mines Group Inc.
820 – 1130 West Pender Street
Vancouver, British Columbia
V6E 4A4

**Attention: Mr. Vincent Li, P.Eng. P.Geo.**

**RE: Groundwater Discharge Management Plan**
**Single Well Response Tests**
**Proposed Murray River Underground Coal Mine**
**Tumbler Ridge, B.C.**

AMEC Earth and Environmental, a division of AMEC Americas Limited (AMEC) has prepared this groundwater discharge containment plan for the consideration of the Canadian Dehua International Mines Group (CDIMG) and the Environmental Protection Division (EPD) of B.C. Environment. The groundwater discharge containment plan is provided in preparation of single well response tests to be performed at three locations on CDIMG's mineral claim approximately 12 km south of Tumbler Ridge, B.C.

## 1.0 OBJECTIVE AND LOCATION

The objective of the single well response tests is to develop a preliminary estimate of groundwater flow and transmissivity of the rock at each test zone and to develop a preliminary characterization of groundwater quality from each test zone.

Seven pumping tests are proposed at three boreholes (P2C21, P2C24, and P2C27). A borehole location plan is attached as Figure 1. Three pumping tests will be performed at discrete intervals at each of two boreholes (P2C21 and P2C24) and a single pumping test will be performed across a fault zone at P2C24. P2C21 is located approximately 450 m north of an unnamed creek. P2C24 is located approximately 1 km north of the same unnamed creek. P2C27 is located approximately 150 m west of the Murray River.

At the time of release of this letter, AMEC had not inspected the proposed borehole locations in the field. However, based on the locations presented in Figure 1, borehole P2C21 appears to be located on the fringe of the floodplain of the unnamed creek and between 25 m and 30 m above the elevation of the unnamed creek. Borehole P2C24 appears to be located in the uplands on a south facing slope and at least 270 m above the elevation of the unnamed creek.

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Borehole P2C27 appears to be located within the Murray River floodplain. The ground level elevation above the Murray River is unknown but expected to be less than 15 m above the elevation of the Murray River. Generally, the shallow soil stratigraphy in the unnamed creek and Murray River floodplains is expected to consist of permeable alluvial sediments comprised of gravel, sand, and some silt. The shallow soil stratigraphy in the uplands adjacent P2C24 is expected to consist of less permeable well-graded glacial till deposits comprised of gravel, sand, silt and clay.

Although the actual test interval depth will be dependent upon the bedrock lithology intersected at each borehole, the approximate test intervals and borehole locations relative to surface water bodies are summarized in Table 1.

**Table 1**
**Proposed Single Well Response Tests**

| Borehole | Distance to Most Proximal Surface Water Body (m) | Proposed Test Interval (m below ground surface) | | Maximum Anticipated Groundwater Discharge Volume ($m^3$) |
|---|---|---|---|---|
| | | Top | Bottom | |
| P2C21 | 450 | 320 | 520 | 180 |
| | | 520 | 720 | 180 |
| | | 720 | 920 | 180 |
| P2C24 | 1,000 | 400 | 600 | 180 |
| P2C27 | 150 | 220 | 360 | 180 |
| | | 360 | 560 | 180 |
| | | 560 | 760 | 180 |

## 2.0 TEST PROGRAM

A submersible pump and inflatable packer will be lowered to the top of each test zone. After the packer is inflated, 24 hours will be allowed to pass in order for the piezometric pressure of the test zone to be restored to its pressure prior to having drilled the borehole. The piezometric pressure (also known as the shut-in pressure) will be recorded 24 hours following inflation of the packer. Each single well response test will consist of pumping the borehole for a 40 hour period at a constant flow rate ranging between 2.3 $m^3$/hour (10 USgpm) and 4.5 $m^3$/hour (20 USgpm). The projected flow rates are based on the physical limitations of the submersible pump that will be installed to conduct each test. The actual flow rate will be dependent upon the depth of the pump and the piezometric pressure of the test zone. The transmissivity of the test zone may not allow the test zone to be pumped for the entire 40 hour duration. If the transmissivity of the test zone is too low, then the water level in the borehole could draw down to the top of the test zone before the end of the 40 hour test period. If this condition is experienced, then the

submersible pump will be turned off and the rate at which the groundwater level in the borehole recovers after the pump is turned off will be recorded.

Under the proposed test plan, the groundwater discharge volumes per test are expected to range between 92 $m^3$ and 180 $m^3$. Consequently, for seven proposed single well response tests, a total maximum groundwater volume to be extracted is 1,260 $m^3$ (Table1).

The groundwater discharge quality is currently unknown. Part of the proposed scope of work is to collect samples of the groundwater discharge during the final hour of each pumping test to characterize its quality. Throughout each pumping test, field groundwater quality parameters (temperature, specific conductance, pH, dissolved oxygen and oxidation-reduction potential) will be recorded in the groundwater discharge. As a consequence of the depths of proposed test intervals, groundwater discharge quality is expected to be highly mineralized, having elevated total dissolved solids (TDS) concentrations.

## 3.0 GROUNDWATER DISCHARGE MANAGEMENT PLAN

During each pumping test, groundwater will be discharged into large pits excavated into the shallow soils. Prior to the initiation of each test, pits having the capacity to store 150 % of the maximum discharge volume (assuming no exfiltration from the base and walls of the pit) for the test will be completed (as per EPD's request via e-mail dated December 2, 2010). AMEC understands that a tracked excavator will be available on-site prior to each pumping test in order to excavate one or more pit(s). AMEC personnel will be on-site during and prior to initiation of each pumping test. AMEC will record the approximate pit dimensions using a measuring tape and will calculate each pit volume. AMEC will photograph the excavated pit(s) 4 days prior to each initiation of each pumping test and send photographs via e-mail to Bruce.Carmichael@gov.bc.ca and copied to John.Clark@gov.bc.ca.

It is expected that some water will exfiltrate from the base and walls of each pit during the pumping test. The exfiltration rate will be dependent upon the permeability of the soils within which the pit is excavated. Since the permeability of the alluvial sediments is expected to be greater than the permeability of the glacial till, less exfiltration is expected from pits excavated in the glacial till than from pits excavated in the alluvial sediments. As a consequence of the proximity of borehole P2C27 (150 m) to the Murray River, and the expected higher permeability in the alluvial sediments in the Murray River floodplain, pits excavated to accept groundwater discharge from P2C27 will be excavated between 150 m and 200 m west of P2C27 near the fringe of the floodplain. Rationale for this location of the groundwater discharge pits is to allow for more mixing (and dilution) of groundwater exfiltrating from the base of the pits prior to its discharge into the Murray River.

AMEC understands that two pits having approximate dimensions 2 m x 3 m x 15 m have been excavated adjacent the location of P2C21. In order for the capacity of these pits to meet B.C.

Environment EPD requirements for having adequate capacity prior to the start of the first pumping test, at least one additional pit (2 m x 3 m x 15 m) will have to be excavated. AMEC personnel will measure the dimensions of these pits and photograph them upon arrival on-site. AMEC will forward photographs to B.C. Environment EPD via e-mail, 4 days prior to initiation of pumping.

## 4.0 CLOSURE

We trust this information meets your current requirements. If you have any questions or concerns, please contact the undersigned at your convenience.

Sincerely,

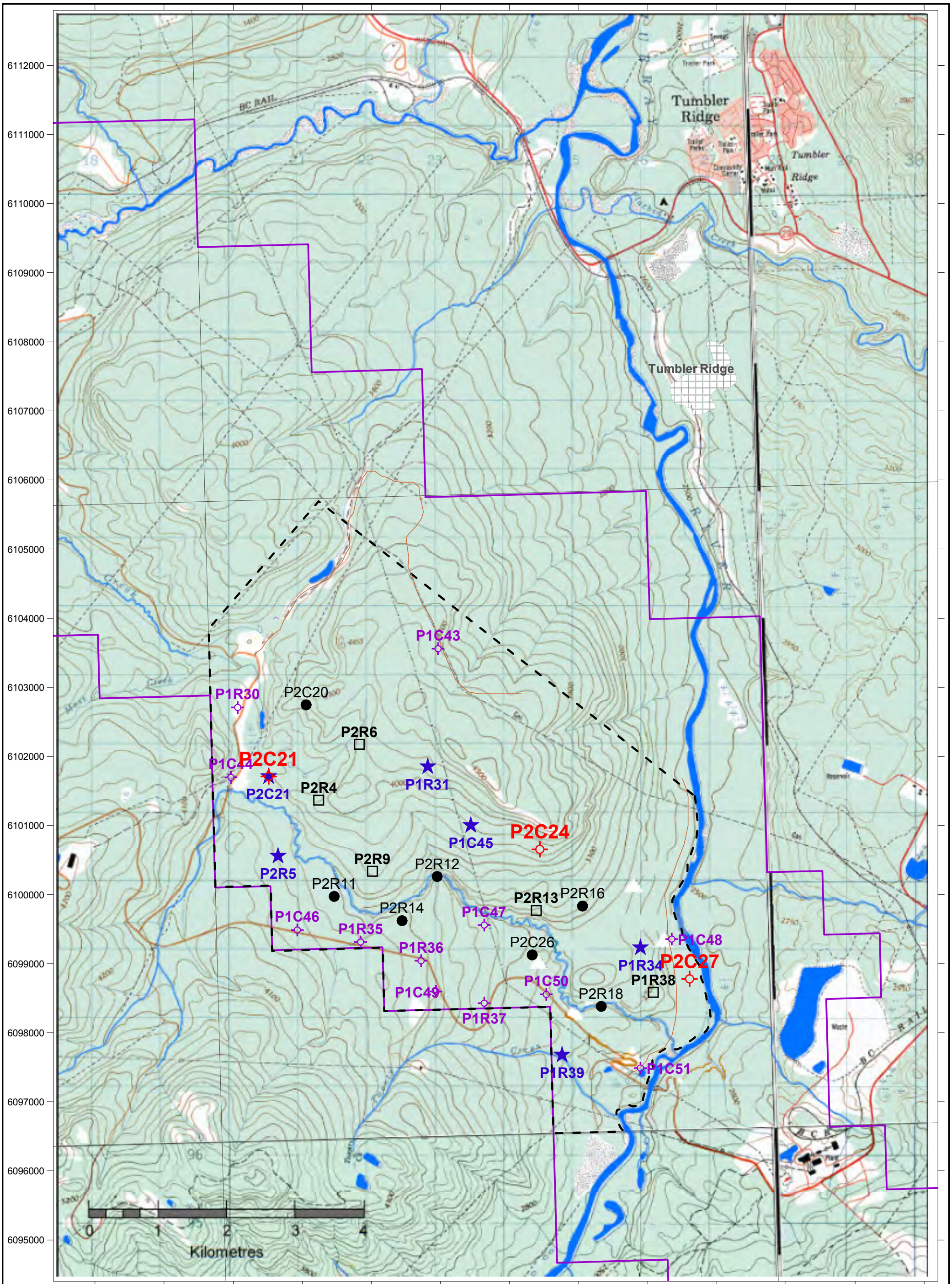
**AMEC Earth & Environmental,**
**A division of AMEC Americas Limited**

Scott Green, P.Eng.
Associate Hydrogeologist

Tammera Kostya, G.I.T.
Hydrogeologist

SG/TK/sw
Attachment:

Figure 1: Phase II Coal Exploration Drilling Status to Date (as provided by Canadian Dehua International Mines Group Inc.)




Completed Drill Hole Locations in Phase I

Dehua Pumping Test Well Locations in Phase II

Completed Drill Hole Locations in Phase II

Drilling in Progressing Locations in Phase II

Planned, but not Drilled Drill Hole Locations in Phase II

# Phase II Coal Exploration

## Drilling Status To Date

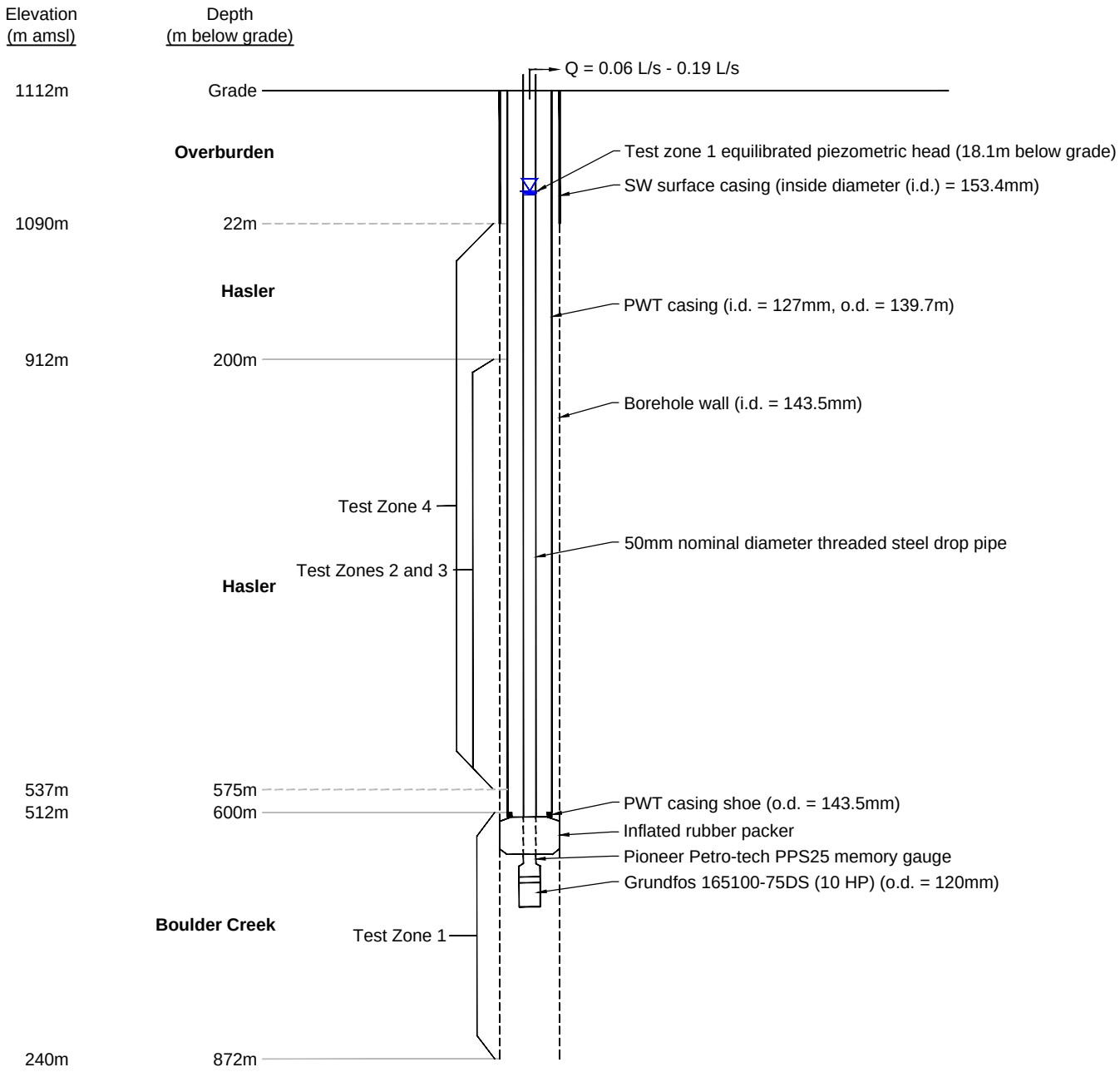

Canadian Dehua International Mines Group Inc.

820 - 1130 West Pender Street
Vancouver, BC V6E 4A4 Canada
Tel: 1-604-697-0118
Fax: 1-604-697-0113


| Prepared By: Vincent Li | 2010.12.02 | Figure: 1 |
|---|---|---|

# APPENDIX B

# CONCEPTUALIZED BOREHOLE INSTALLATION DETAILS




Notes:

1. Borehole H2 stratigraphy provided by Canadian Dehua International Mines Group Inc.
2. Borehole H2 location (based on information provided by IPAC using a Trimble GNSS R8 RTK base station to +/- 0.05m accuracy) relative to UTM Zone 10N map projection.
3. Northing: 6101836.4, Easting: 620583.7


AMEC Environment & Infrastructure
913 Laval Crescent
Kamloops, BC, CANADA V2C 5P4
Tel. (250) 374-1347
Fax (250) 374-2944

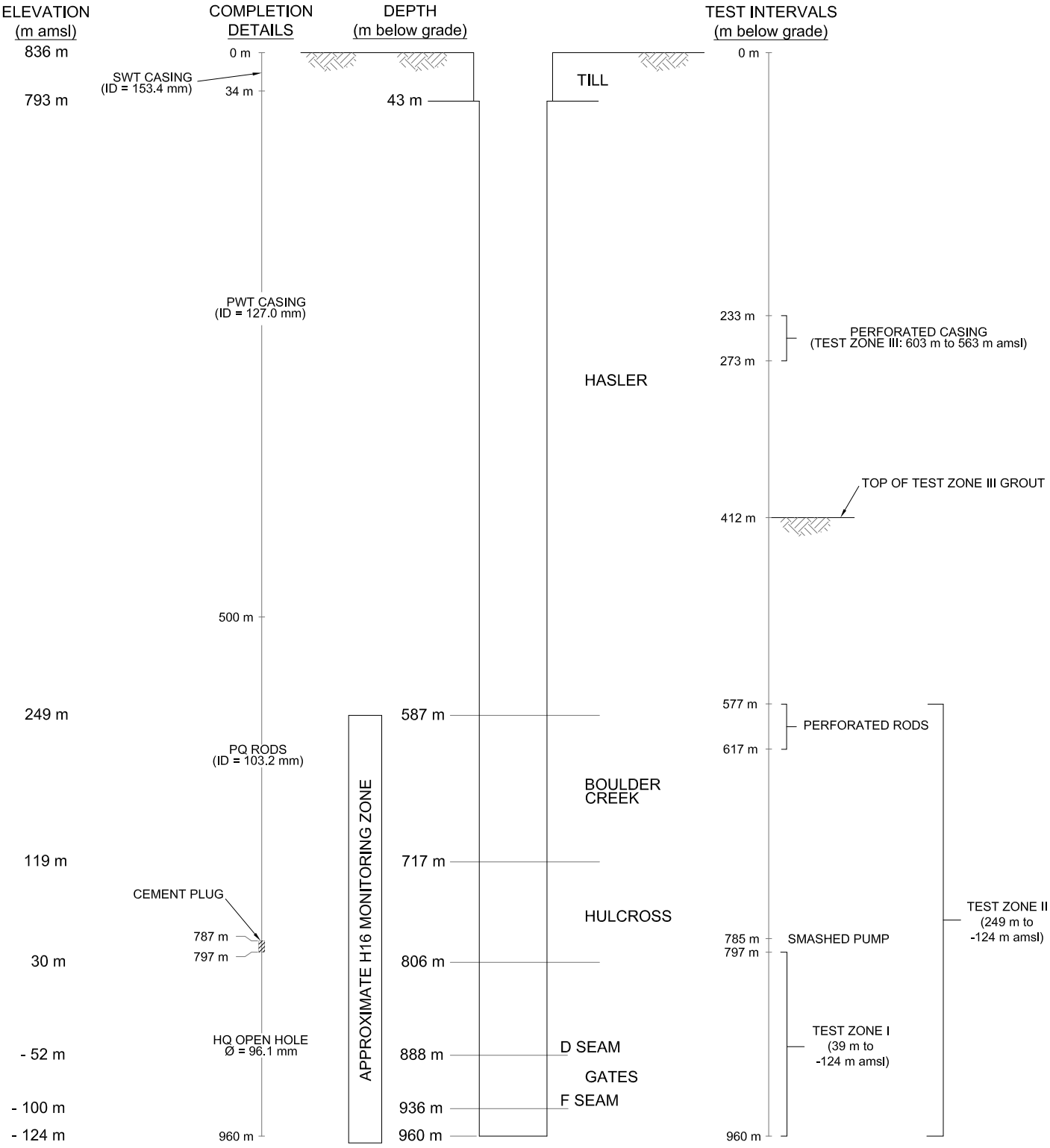

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

TITLE: BOREHOLE H2 TEST ZONES AND CONSTANT HEAD TEST CONFIGURATION

PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS

| DRAWN BY: | DATUM: | DATE: |
|---|---|---|
| I.Macleod | NAD83 | DECEMBER 2011 |
| CHECKED BY: | REV. No.: | PROJECT No.: |
| S.Green | A | KX13505 |
| PROJECTION: | SCALE: | FIGURE No.: |
| UTM Zone 10 | NTS | B-1 |

P:\DRAFTING\Kamloops – Drafting\KX13500 – KX13599\KX13505–Drafting\KX13505–FigB1–BOREHOLE.dwg – 8.5 X 11 – Portrait – Nov. 29, 2011 2:46pm – ian.j.macleod




NOTES:
1. BOREHOLE H16W STRATIGRAPHY PROVIDED BY CANADIAN DEHUA INTERNATIONAL MINES GROUP (CDIMG) INC.
2. BOREHOLE H16W LOCATION (BASED ON INFORMATION PROVIDED BY IPaC USING A TRIMBLE GNSS R8 RTK BASE STATION TO ±0.05 m ACCURACY) RELATIVE TO UTM ZONE 10N MAP PROJECTION.
3. NORTHING: 6097712.7 EASTING: 624789.1


AMEC Environment & Infrastructure
Suite 600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

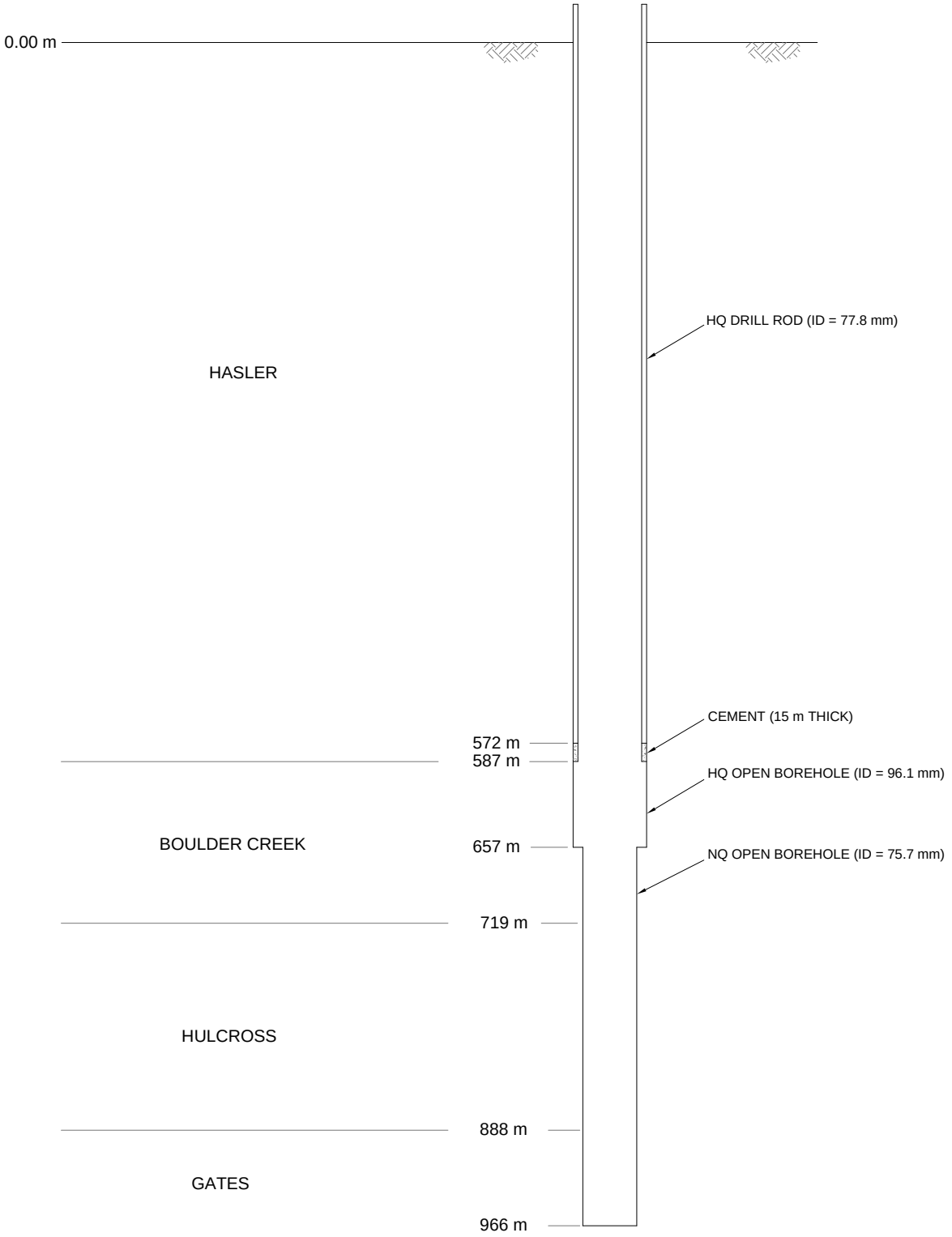

CLIENT LOGO:

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

| | | | |
|---|---|---|---|
| PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS | DWN BY: MW | DATUM: – | DATE: NOVEMBER 2011 |
| TITLE: BOREHOLE H16W TEST ZONES | CHK'D BY: SG | REV. NO: A | PROJECT NO: KX13505.050 |
| | PROJECTION: – | SCALE: NOT TO SCALE | FIGURE NO: B-2 |

G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505-B2_Borehole H16W.dwg - Fig B-2 - Dec. 08, 2011 4:25pm - michael.m.wong

# H16 OBSERVATION WELL COMPLETION DETAILS
(AS PROVIDED BY CDIMG)




NOTE: BOREHOLE H16 STRATIGRAPHY PROVIDED BY CANADIAN DEHUA INTERNATIONAL MINES GROUP (CDIMG) INC.


AMEC Environment & Infrastructure
Suite 600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

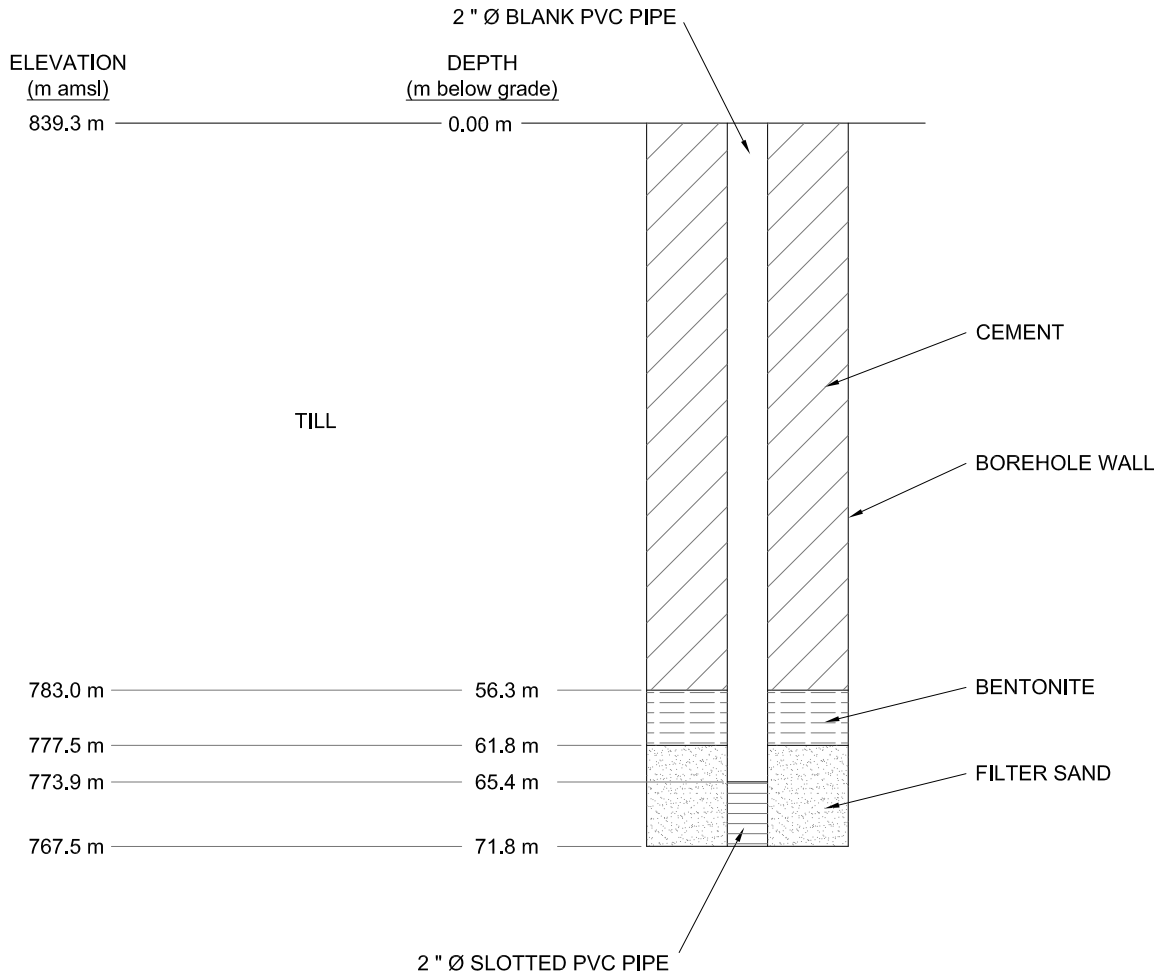

CLIENT LOGO:

CLIENT:
CANADIAN DEHUA INTERNATIONAL MINES GROUP

| | | | |
|---|---|---|---|
| PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS | DWN BY: MW | DATUM: -- | DATE: NOVEMBER 2011 |
| TITLE: H16 OBSERVATION WELL COMPLETION DETAILS | CHK'D BY: SG | REV. NO: A | PROJECT NO: KX13505.050 |
| | PROJECTION: -- | SCALE: NOT TO SCALE | FIGURE NO: B-3 |

G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505-B3_Borehole H16 details.dwg - Fig B-3 - Nov. 29, 2011 12:41pm - michael.m.wong

# H16A OBSERVATION WELL COMPLETION DETAILS
(AS PROVIDED BY CDIMG)




NOTES:

1. M AMSL: METRES ABOVE MEAN SEA LEVEL.
2. BOREHOLE H16A STRATIGRAPHY PROVIDED BY CANADIAN DEHUA INTERNATIONAL MINES GROUP (CDIMG) INC.
3. BOREHOLE H16W LOCATION (BASED ON INFORMATION PROVIDED BY IPaC USING A TRIMBLE GNSS R8 RTK BASE STATION TO ±0.05 m ACCURACY) RELATIVE TO UTM ZONE 10N MAP PROJECTION.
4. NORTHING: 6097821.5 EASTING: 624890.9


AMEC Environment & Infrastructure
Suite 600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664


| | | | |
|---|---|---|---|
| CLIENT LOGO: | CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP | | |
| PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS | DWN BY: MW | DATUM: – | DATE: NOVEMBER 2011 |
| TITLE: H16A OBSERVATION WELL COMPLETION DETAILS | CHK'D BY: SG | REV. NO: A | PROJECT NO: KX13505.050 |
| | PROJECTION: – | SCALE: NOT TO SCALE | FIGURE NO: B-4 |


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# APPENDIX C

# SITE PHOTOGRAPHS



**Photo 1:** View toward the south southeast from Borehole H16W. The drill rig in the centre of the photo is supporting 9.1 m of HQ drill rod (above-grade) threaded into the top of Observation Well H16. Groundwater is flowing over the top of the extended drill rod.



**Photo 2:** Photo shows two 19 mm diameter steel pipes extending above grade from the threaded HQ top cap. The shorter of the 19 mm diameter steel pipes is capped with a pressure gauge and the taller of the 19 mm diameter steel pipes is capped with a pressure release valve such that methane gas can escape from the system.



**Photo 3:** Close-up photograph showing the detail of the pressure release valve threaded into the top of the longer 19 mm diameter pipe. The yellow handles are ball valves to release water from the system when the groundwater head rises too high in the system.



**Photo 4:** Photo showing the length of the short 19 mm diameter steel rod below the threaded HQ top cap. The photo shows the short 19 mm diameter pipe extends some distance (approximately 0.6 m) below the HQ top cap. The bottom of the short 19 mm diameter steel rod has a flexible polyethylene tube affixed to its base. The purpose of the flexible polyethylene tube is to prevent an air-lock from occurring within the short 19 mm diameter tube (dedicated to measuring water pressure).

NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC ENVIRONMENT & INFRASTRUCTURE REPORT No. KX13505.050 DATED DECEMBER 2011.

CLIENT LOGO:

CLIENT:
CANADIAN DEHUA INTERNATIONAL MINES GROUP

AMEC Environment & Infrastructure
Suite 600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

| | |
|---|---|
| DWN BY: | MW |
| CHK'D BY: | SG |
| DATUM: | -- |
| PROJECTION: | -- |
| SCALE: | NOT TO SCALE |

PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS

TITLE: SITE PHOTOGRAPHS

| | |
|---|---|
| DATE: | NOVEMBER 2011 |
| PROJECT NO: | KX13505.050 |
| REV. NO: | A |
| FIGURE NO: | C1 |

G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505.050-photo.dwg - Appendix C1 - Nov. 29, 2011 5:16pm - michael.m.wong

# APPENDIX D

# FIELD SAMPLING SHEETS AND YSI CERTIFICATES OF CALIBRATION

# FIELD REPORT

amec

| Client | Project No. KX13505 | Well/Site ID H2 600m-870m |
|---|---|---|
| ODIN.G | Facility Murray River Coal | Date (d.m.y) April 3, 2011 |

## Site Description ☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☐ Borehole, ☐ Probe, ☐ Other: Test #1

| | |
|---|---|
| Air Temp.: 0 | ☒ °C ☐ °F Weather: |
| Well Locked? | ☐ Yes ☒ No Damaged/Repairs Needed: |
| ☐ TOC ☒ MP | Description: Top of NQ Drill Rod |
| TOC/MP Stickup: < 2 | ☒ m ☐ ft above/below ground Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.65" |
| Site Remarks (nearby wells pumping, tide, stream stage, etc.) | |

## Water Level Data Measurement Units: ☐ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC:

| ☐ E-Tape, # PPS 25 ☐ Steel Tape ☒ Other Memory Gauge | Initial | Confirmed | At start of purging | At end of sampling | | Remarks |
|---|---|---|---|---|---|---|
| Time (hh:mm) | Mar 31/11 23:20 | Apr 2/11 20:55 | | | | |
| Depth to Water | -4.6 | 18.0 | | | | |
| Water Level (WL) | - | - | | | | |
| Tape Correction | - | - | | | | |
| Depth to Product | - | - | | | | |
| Prod. Recovery ☐ litres ☐ gallons | - | - | | | | |

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

## Field WQ Data Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 16S100-7S05

| Casing Volume:[___(TD) - ___(WL)]x3.14x[___(ID)/2]²x[___(Unit conv. factor)] = ___ ☐ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation) 30 60 70 80 90 | | | | | | ☐ Well goes dry while purging | |
|---|---|---|---|---|---|---|---|
| ☐ Cum. Vol., ☒ Pump Rate 1.5 gpm | 4 | 3 | 3 | 3 | (final) | Meter/ Probe | Remarks |
| Time Measured (hh:mm) | 10:20 | 10:30 | 10:40 | 10:50 | 11:00 | | |
| pH ☒ Temp. Compensated | 2.38 | 8.36 | 8.33 | 8.31 | 8.32 | | |
| Temperature ☒ °C, ☐ °F | 5.61 | 5.71 | 5.77 | 5.94 | 6.14 | | |
| Dissolved Oxygen (mg/L) | 0.31 | 0.27 | 0.34 | 0.26 | 0.21 | | |
| Conductivity ☒ SC or ☐ EC (µS/cm) | 3,043 | 2,310 | 1,644 | 1,277 | 1,017 | | |
| Redox Potential (Eh) | -363 | -348 | -272 | -275 | -285 | | |
| Turbidity (NTU) | - | - | - | - | - | | |
| Colour/Tint | - | - | - | - | - | | |
| Odour | - | - | - | - | - | | |
| | | | | | | | |

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

## Sample Data Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump; Description: Grundfos 16S100-7S05

| Field Sample ID (unique ID on bottles) | Result Code | Date (d.m.y) | Time (hh:mm) | Bottles (total to lab) | Filtered (0.45µm) | Lab ID | Case ID | SDG ID | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| P2c21(H2) 600m | 870m | Apr. 3/11 | 11.00 | 10 | 0 | | | | ALS Lab No: L991723 |
| | | | | | | | | | /L991762 |
| | | | | | | | | | |
| | | | | | | | | | |

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

| Sampled By (print) Tammara Hartyo | Signature | Entered into Database / / by | Page 1 of 1 |
|---|---|---|---|

# FIELD REPORT

amec

| Client | Project No. | Well/Site ID |
|---|---|---|
| COIM G | KX13505 | H2 600m-870m |
| | Facility Murray River Coal | Date (d.m.y) April 4, 2011 |

**Site Description** ☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☒ Borehole, ☐ Probe, ☐ Other: Test #1

| | |
|---|---|
| Air Temp.: 11.4 ☒ °C ☐ °F | Weather: |
| Well Locked? ☐ Yes ☒ No | Damaged/Repairs Needed: None |
| ☐ TOC ☒ MP | Description: Top of NQ drill rod |
| TOC/MP Stickup: ~2 ☒ m ☐ ft above/below ground | Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.65" |
| Site Remarks (nearby wells pumping, tide, stream stage, etc.) | |

**Water Level Data** Measurement Units: ☒ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 872m below grade

| ☐ E-Tape, #PPS 25 ☐ Steel Tape ☐ Other | Initial | Confirmed | At start of purging | At end of sampling | | Remarks |
|---|---|---|---|---|---|---|
| | Mar 31/11 | Apr 2/11 | | | | |
| Time (hh:mm) | 23:20 | 20.55 | | | | |
| Depth to Water | -4.6 | 18.0 | | | | |
| Water Level (WL) | - | - | | | | |
| Tape Correction | - | - | | | | |
| Depth to Product | - | - | | | | |
| Prod. Recovery ☐ litres ☐ gallons | - | - | | | | |

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

**Field WQ Data** Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 16S100-75D5

Casing Volume: [270(TD) - ___(WL)]x3.14x[143(ID)/2]$^2$x[0.1(Unit conv. factor)] = 4,365 ☒ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation) ☐ Well goes dry while purging

| ☐ Cum. Vol., ☒ Pump Rate USGPM | 3 | 3 | 3 | 3 | (final) | Meter/ Probe | Remarks |
|---|---|---|---|---|---|---|---|
| Time Measured (hh:mm) | 20:20 | 20:30 | 20:40 | 20:50 | 21:00 | | |
| pH ☒ Temp. Compensated | 8.14 | 8.13 | 8.13 | 8.13 | 8.07 | | |
| Temperature ☒ °C, ☐ °F | 5.12 | 5.19 | 52 | 5.2 | 5.19 | | |
| Dissolved Oxygen (mg/L) | 0.18 | 0.16 | 0.15 | 0.18 | 0.25 | | |
| Conductivity ☒ SC or ☐ EC (µS/cm) | 1,978 | 1,980 | 1,982 | 1,985 | 1,982 | | |
| Redox Potential (Eh) | -232 | -232 | -232 | -232 | -222 | | |
| Turbidity (NTU) | | - | - | - | - | | |
| Colour/Tint | | - | - | - | | | |
| Odour | - | - | - | - | - | | |
| | | | | | | | |

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

**Sample Data** Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump; Description: Grundfos 16S100-75D5

| Field Sample ID (unique ID on bottles) | Result Code | Date (d.m.y) | Time (hh:mm) | Bottles (total to lab) | Filtered (0.45µm) | Lab ID | Case ID | SDG ID | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| PZC21(H2)600-870m | | Apr 4/11 | 21:00 | 10 | none | | | | ALS Lab # L992288 |
| | | | | | | | | | /L992415 |
| | | | | | | | | | |
| | | | | | | | | | |

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

| Sampled By (print) Tammera Kostyn | Signature | Entered into Database / / by | Page 1 of 1 |
|---|---|---|---|

# FIELD REPORT

amec

| Client | Project No. | Well/Site ID |
|---|---|---|
| CDIMG | KX13505 | H2 202m 575m |
| | Facility Murray River Coal | Date (d.m.y) April 11 2011 |

**Site Description** ☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☐ Borehole, ☐ Probe, ☐ Other: Test #2

| | |
|---|---|
| Air Temp.: 3.0 ☒ °C ☐ °F | Weather: |
| Well Locked? ☐ Yes ☒ No | Damaged/Repairs Needed: None |
| ☐ TOC ☒ MP | Description: Top of drill rod |
| TOC/MP Stickup: ☐ m ☐ ft above/below ground | Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 565" |
| Site Remarks (nearby wells pumping, tide, stream stage, etc.) | |

**Water Level Data** Measurement Units: ☒ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 575m below grade

| ☒ E-Tape, #P11-25 Memory Gauge ☐ Steel Tape ☒ Other | Initial | Confirmed | At start of purging | At end of sampling | | Remarks |
|---|---|---|---|---|---|---|
| | Apr. 8 | Apr. 10 | | | | |
| Time (hh:mm) | 15:00 | 6:19 | | | | |
| Depth to Water | 0.67 | -22.13 | | | | Head never completely |
| Water Level (WL) | 0.67 | -22.13 | | | | equilibrated. 22.13m |
| Tape Correction | - | - | | | | assumed. |
| Depth to Product | - | - | | | | |
| Prod. Recovery ☐ litres ☐ gallons | - | - | | | | |

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

**Field WQ Data** Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 16S100-75DS

Casing Volume: [375 (TD) - 22.13 (WL)] x 3.14 x [14.3 (ID)/2]² x [0.1 (Unit conv. factor)] = 6,416 ☒ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation) ☐ Well goes dry while purging

| ☐ Cum. Vol., ☒ Pump Rate USgpm | 1 | 1 | 1 | 1 | 1 (final) | Meter/ Probe | Remarks |
|---|---|---|---|---|---|---|---|
| Time Measured (hh:mm) | 22:01 | 22:11 | 22:21 | 22:30 | 22:42 | | |
| pH ☒ Temp. Compensated | 9.08 | 9.08 | 9.08 | 9.47 | 9.23 | | |
| Temperature ☒ °C, ☐ °F | 3.4 | 3.4 | 3.3 | 3.6 | 3.3 | | |
| Dissolved Oxygen (mg/L) | 0.7 | 0.7 | 0.7 | 4.3 | 0.8 | | |
| Conductivity ☒ SC or ☐ EC (µS/cm) | 903 | 906 | 905 | 987 | 983 | | |
| Redox Potential (Eh) | -19.9 | -19.0 | -18.1 | -32.6 | -101.4 | | |
| Turbidity (NTU) | - | - | - | - | - | | |
| Colour/Tint | - | - | - | - | - | | |
| Odour | - | - | - | - | - | | |
| | | | | - | - | | |

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

**Sample Data** Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump; Description: Grundfos 16S100-75DS

| Field Sample ID (unique ID on bottles) | Result Code | Date (d.m.y) | Time (hh:mm) | Bottles (total to lab) | Filtered (0.45µm) | Lab ID | Case ID | SDG ID | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ALS Lab Report Nos. |
| P2C21(H2)202m-602m | | Apr 11/11 | 0:00 | 10 | 0 | | | | L993769 / L993814 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

| | | | |
|---|---|---|---|
| Sampled By (print) Tamara Kaulen | Signature | Entered into Database / / by | Page 1 of 1 |

# FIELD REPORT

amec

| Client | Project No. KX13505 | Well/Site ID H2 20m - 580m |
|---|---|---|
| CDIMG | Facility Murray River Coal | Date (d.m.y) 16 April, 2011 |

**Site Description** ☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☒ Borehole, ☐ Probe, ☐ Other: Test #4

| | |
|---|---|
| Air Temp.: 7.9 ☒ °C ☐ °F | Weather: |
| Well Locked? ☐ Yes ☒ No | Damaged/Repairs Needed: None |
| ☐ TOC ☒ MP | Description: Top of NQ drill Rod |
| TOC/MP Stickup: ☐ m ☐ ft above/below ground | Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.65" |
| Site Remarks (nearby wells pumping, tide, stream stage, etc.) | |

**Water Level Data** Measurement Units: ☒ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 580m below grade

| ☒ E-Tape, #PPS 25 Memory Gauge ☐ Steel Tape ☐ Other | Initial Apr 15/11 | Confirmed | At start of purging | At end of sampling | | Remarks |
|---|---|---|---|---|---|---|
| Time (hh:mm) | 11:44 | | | | | |
| Depth to Water | 0.5m | | | | | |
| Water Level (WL) | | | | | | |
| Tape Correction | | | | | | |
| Depth to Product | | | | | | |
| Prod. Recovery ☐ litres ☐ gallons | | | | | | |

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

**Field WQ Data** Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 5S15-31DS

Casing Volume: [582(TD) - 0.5(WL)] x 3.14 x [143(ID)/2]² x [10/(Unit conv. factor)] = 9.370 ☒ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation) ☐ Well goes dry while purging

| ☐ Cum. Vol., ☒ Pump Rate | | | | | (final) | Meter/ Probe | Remarks |
|---|---|---|---|---|---|---|---|
| Time Measured (hh:mm) | 16:20 | 16:30 | 16:40 | 16:50 | 17:00 | | |
| pH ☒ Temp. Compensated | nr | nr | nr | nr | nr | | |
| Temperature ☒ °C, ☐ °F | nr | nr | nr | nr | nr | | |
| Dissolved Oxygen (mg/L) | | | | | | | |
| Conductivity ☒ SC or ☐ EC (µS/cm) | | | | | | | |
| Redox Potential (Eh) | nr | nr | nr | nr | nr | | |
| Turbidity (NTU) | - | - | - | - | - | | nr = not recorded |
| Colour/Tint | - | - | - | - | - | | |
| Odour | - | - | - | - | - | | |
| | | | | | | | |

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

**Sample Data** Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump; Description: Grundfos 5S15-31DS

| Field Sample ID (unique ID on bottles) | Result Code | Date (d.m.y) | Time (hh:mm) | Bottles (total to lab) | Filtered (0.45µm) | Lab ID | Case ID | SDG ID | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| P2021(42) 20-600m | | 16 Apr/11 | 17:00 | 10 | 0 | | | | ALS Lab # L996144 /L995935 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

| | | | |
|---|---|---|---|
| Sampled By (print) Tammara Kostyo | Signature | Entered into Database / / by | Page 1 of 1 |

Sample # 1 960
Test Zone - 800 - [redacted] m
Gates Formation

# FIELD REPORT

amec

| Client | Project No. | Well/Site ID |
|---|---|---|
| Dehua | KX13505.3 | H16W |
| | Facility: Well site | Date (d.m.y): 23/06/11 11 AM |

## Site Description
☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☑ Borehole, ☐ Probe, ☐ Other: Test F1

| | |
|---|---|
| Air Temp.: 13 ☑ °C ☐ °F | Weather: Warm, Overcast |
| Well Locked? ☐ Yes ☑ No | Damaged/Repairs Needed: N/A |
| ☐ TOC ☐ MP | Description: |
| TOC/MP Stickup: 1 ☑ m ☐ ft above/below ground | Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☑ Other: [redacted]" 3.78" |
| Site Remarks (nearby wells pumping, tide, stream stage, etc.) | Coal Exploration Area |

## Water Level Data
Measurement Units: ☑ m, ☐ ft  Well or Borehole Total Depth (TD) from MP or TOC: 960m below grade

| ☐ E-Tape, #____ ☐ Steel Tape ☑ Other | Initial | Confirmed | At start of purging | At end of sampling | | Remarks |
|---|---|---|---|---|---|---|
| Time (hh:mm) | | | June 21/11 9:30am | June 23/11 11am | | - Recorded By data logger (TC) BF Pumping test) - Sample Collected ~49 hrs into the test. |
| ~~Depth to Water~~ WL | | | 3.8mbg | 2.80mbg | | |
| Water Level (WL) | | | | | | |
| Tape Correction | | | | | | |
| Depth to Product | | | | | | |
| Prod. Recovery ☐ litres ☐ gallons | | | | | | |

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

## Field WQ Data
Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump Description: Pumping test - 49 hrs into test

Casing Volume:[____(TD) - ____(WL)]x3.14x[____(ID)/2]$^2$x[____(Unit conv. factor)] = ____ ☐ Litres ☐ gallons
(2L/m for a 2" Casing, is a close approximation)
☐ Well goes dry while purging
Insitu Field data Chem by YSI 556

| ☐ Cum. Vol., ☑ Pump Rate | 1.25 GPM | | | | (final) | Meter/ Probe | Remarks |
|---|---|---|---|---|---|---|---|
| Time Measured (hh:mm) | 11am | | | | | | |
| pH ☐ Temp. Compensated | 9.46 | | | | | | |
| Temperature ☑ °C, ☐ °F | 10.37 | | | | | | → Influenced by air temperature & overal distance ground water must travel to YSI * Downhole datalogger Recorded GW Temp @ time of sampling = 31.3 °C |
| Dissolved Oxygen (mg/L) (~~%Sat~~) | 0.37 | | | | | | |
| Conductivity ☑ SC or ☐ EC ~~(µS/cm)~~ | 1.811 | | | | | | |
| Redox Potential (Eh) ORP (mV) | -163 | | | | | | |
| Turbidity (NTU) | NA | | | | | | |
| Colour/Tint | slightly Turbid * @ time of sampling | | | | | | |
| Odour | Methane gas | | | | | | |
| | | | | | | | |

During 1st 36 m³ of pumping visual water quality was white murky (very turbid) & high pH = 11.3

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

## Sample Data
Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump; Description:

| Field Sample ID (unique ID on bottles) | Result Code | Date (d.m.y) | Time (hh:mm) | Bottles (total to lab) | Filtered (0.45µm) | Lab ID | Case ID | SDG ID | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| H16W 800-1000 | | 3/4/11 | 11am | 10 | | | | | SEE ALS Reports |
| | | | | | | | | | L1022659/L1023033 |
| | | | | | | | | | |
| | | | | | | | | | |

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

| Sampled By (print) T. Kostiya | Signature J. Kostiya | Entered into Database __/__/__ by | Page 1 of 1 |
|---|---|---|---|

# FIELD REPORT

amec

| Client | Project No. | Well/Site ID |
|---|---|---|
| Daehan | Kx13505.03 | H16 W 577m-960m |
| | Facility Wellsite | Date (d.m.y) Aug 1/11 1pm |

## Site Description

☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☐ Borehole, ☐ Probe, ☐ Other: Test #2

| | |
|---|---|
| Air Temp.: ~15 ☑°C ☐°F | Weather: Clear, Sunny, Warm |
| Well Locked? ☐ Yes ☑ No | Damaged/Repairs Needed: |
| ☐ TOC ☐ MP | Description: |
| TOC/MP Stickup: 2 ☑ m ☐ ft above/below ground | Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☐ Other: 3.78"-4.06" |
| Site Remarks (nearby wells pumping, tide, stream stage, etc.) | Coal Exploration Area |

## Water Level Data

Measurement Units: ☐ m, ☐ ft  Well or Borehole Total Depth (TD) from MP or TOC:

| ☐ E-Tape, #____ ☐ Steel Tape ☐ Other | Initial | Confirmed | At start of ~~purging~~ | At end of sampling | | Remarks |
|---|---|---|---|---|---|---|
| Time (hh:mm) | | | July 30/11 2pm | Aug 2/11 2Am | | -Recorded by datalogger (~60 hrs pumping test) |
| Depth to Water WL | | | ~8mbg | | | |
| Water Level (WL) | | | | | | -sample collected ~47 hrs into pumping test |
| Tape Correction | | | | | | |
| Depth to Product | | | | | | |
| Prod. Recovery ☐ litres ☐ gallons | | | | | | |

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

## Field WQ Data

Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump Description: Pumping test - 47 hrs into test

Casing Volume:[____(TD) - ____(WL)]x3.14x[____(ID)/2]$^2$x[____(Unit conv. factor)] = ____ ☐ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation)  ☐ Well goes dry while purging

Insitu Field Data chem by YSI 556

| ☐ Cum. Vol., ☑ Pump Rate | 2GPM | | | | (final) | Meter/ Probe | Remarks |
|---|---|---|---|---|---|---|---|
| Time Measured (hh:mm) | 1PM | | | | | | |
| pH ☐ Temp. Compensated | 7.65 | | | | | | |
| Temperature ☐°C, ☐°F | 10.10°C | | | | | | → Influenced by air temp. |
| Dissolved Oxygen (mg/L) (mS/cm) | 0.10 | | | | | | * overal distance groundwater must travel to YSI |
| Conductivity ☐ SC or ☑ EC (~~µS/cm~~) | 1.898 | | | | | | |
| Redox Potential (Eh) ORP(mV) | -197.6 | | | | | | |
| Turbidity (NTU) | NA | | | | | | → Downhole Datalogger recorded GW Temp @ time of sampling = 17°C |
| Colour/Tint | Turbid black | | | | | | |
| Odour | Smell of gas | | | | | | |
| | | | | | | | |

1st hr water colour was milky white - within the next couple hrs colour turned to turbid black

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

## Sample Data

Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump; Description:

| Field Sample ID (unique ID on bottles) | Result Code | Date (d.m.y) | Time (hh:mm) | Bottles (total to lab) | Filtered (0.45µm) | Lab ID | Case ID | SDG ID | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| #2 H16W 500730 | | 1/8/11 | 1pm | 10 | | | | | SEE ALS Reports |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

| | | | |
|---|---|---|---|
| Sampled By (print) T. Koshyq | Signature | Entered into Database __/__/__ by | Page 1 of 1 |

# FIELD REPORT

amec

| Client | Project No. | Well/Site ID |
|---|---|---|
| Canadian Dehua International Mines | KX13505.030 | H16W 233m-273m |
| | Facility Murray River Coal | Date (d.m.y) August 14 2011 |

## Site Description

☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☒ Borehole, ☐ Probe, ☐ Other: Test #3

Air Temp.: ☐ °C ☐ °F Weather:

Well Locked? ☐ Yes ☒ No Damaged/Repairs Needed:

☐ TOC ☒ MP Description: Top of NQ drill rod / drop pipe

TOC/MP Stickup: 0.2 ☒ m ☐ ft above/below ground Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.0"

Site Remarks (nearby wells pumping, tide, stream stage, etc.)

## Water Level Data

Measurement Units: ☒ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 412 m below grade

| ☐ E-Tape, #____ ☐ Steel Tape ☐ Other 22.25 Mamac Gauge | Initial | Confirmed | At start of purging | At end of sampling | | Remarks |
|---|---|---|---|---|---|---|
| Time (hh:mm) | Aug 12 17:20 | Aug 13 11:47 | | | | |
| Depth to Water (m below TOC) | 113.9 | 22.11 | | | | |
| Water Level (WL) | – | 22.11 | | | | |
| Tape Correction | – | – | | | | |
| Depth to Product | – | – | | | | |
| Prod. Recovery ☐ litres ☐ gallons | – | – | | | | |

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

## Field WQ Data

Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 5S15-31QS

Casing Volume:[____(TD) - ____(WL)]x3.14x[____(ID)/2]$^2$x[____(Unit conv. factor)] = ____ ☐ Litres ☐ gallons
(2L/m for a 2" Casing, is a close approximation)

☐ Well goes dry while purging

| ☐ Cum. Vol., ☒ Pump Rate Usgpm | | | | | (final) | Meter/ Probe | Remarks |
|---|---|---|---|---|---|---|---|
| Time Measured (hh:mm) | 13:20 | 13:30 | 13:40 | 13:50 | 14:00 | | |
| pH ☒ Temp. Compensated | 9.37 | 9.36 | 9.36 | 9.36 | 9.37 | | |
| Temperature ☒ °C, ☐ °F | 9.83 | 9.65 | 9.68 | 9.94 | 10.03 | | |
| Dissolved Oxygen (mg/L) | 2.96 | 1.00 | 1.00 | 0.97 | 0.94 | | |
| Conductivity ☒ SC or ☐ EC (µS/cm) | 1390 | 1389 | 1389 | 1390 | 1392 | | |
| Redox Potential (Eh) | 52 | 53 | 52 | 52 | 51.6 | | |
| Turbidity (NTU) | – | – | – | – | – | | |
| Colour/Tint | – | – | – | – | clear | | |
| Odour | – | – | – | – | None | | |
| | | | | | | | |

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

## Sample Data

Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump; Description:

| Field Sample ID (unique ID on bottles) | Result Code | Date (d.m.y) | Time (hh:mm) | Bottles (total to lab) | Filtered (0.45µm) | Lab ID | Case ID | SDG ID | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| H16W 233-273 | | Aug.14 | 14:00 | 10 | 0 | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

| | | | |
|---|---|---|---|
| Sampled By (print) Scott Green | Signature | Entered into Database __/__/__ by | Page 1 of 1 |

## YSI 556
## Calibration Sheet

amec

This is to certify that this instrument has been calibrated to the manufacturer's specifications.

| | |
|---|---|
| Project Number | KX13463 |
| Project Location | Mcleod Lake |
| Employee | Tammera Kostyk |

Calibrated by Matt Sarkar

| | |
|---|---|
| Date Checked Out | 15 March 2011 |
| Date Returned | |

Procedures Prior to Departure (check-off steps and record results in the table below as necessary).

| | |
|---|---|
| ✓ | 1 Check flow cell fit by installing probe in flow cell |
| ✓ | 2 Check for broken or loose probes. |
| ✓ | 3 Check DO membrane visually. |
| ✓ | 4 Check pH probe reservoir for contamination visually |
| ✓ | 5 Check that correct parameters are displayed on the handset |
| ✓ | 6. Check for correct date and adjust accordingly. |
| ✓ | 7 Check that handset memory is clear |
| ✓ | 8 Perform a three point manual pH calibration (Use 7.01 buffer solution first) |
| ✓ | 9. Perform a specific conductance calibration |
| ✓ | 10 Perform an ORP check with 240 mV solution |

Procedures Every two weeks (or as required)

1 Check to see if the unit will be in use in the near future. The pH probe will need to be stored differently (See Manual) if unit is not in use for more than 1 month

Procedures Upon Return (record results in the tables below)

1 Clean probes (store multi-probe in calibration cell with approximately 1/8" of water, ensure that probes are not submerged)
2 Clean and inspect 20 m cable
3. Clean and inspect flow cell
4. Ensure there are no errors or problems with the instrument.
5 Ensure that at least one full bottle of each calibration solution is on hand and has not expired
6 Ensure that extra batteries are on hand
7 Download memory from the handset (clear the handset memory after downloading)
8. Place completed copies of this sheet in the project file and YSI clip-board

| Calibration Information | | | | | | |
|---|---|---|---|---|---|---|
| Para | pH | | | Sp. Cond | DO | ORP |
| Calibration Solution Value | 7.01 | 4.01 | 10.01 | 1413 µS/cm | 100% | 240 mV |
| Reading Following Calibration | 7.03 | 3.95 | 10.05 | 1413 | 92.7 | 237.5 |

| Packing List | |
|---|---|
| Manual | |
| Carrying Case | |
| Cal Sol'ns | |
| Flow Cell | ✓ |
| Barb Fittings | ✓ |
| Extra Batteries | ✓ |
| | |
| Other (Membrane kit) | |
| Other | |

If additional calibration solutions are required, let Jen Mathie know and she will order them (speak to Matt Sarkor if Jen is not available).

If the instrument is not working properly, contact Matt Sarkor.

## YSI 556
## Calibration Sheet

amec

This is to certify that this instrument has been calibrated to the manufacturer's specifications.

| | |
|---|---|
| Project Number | KX13463 |
| Project Location | Mcleod Lake |
| Employee | Tammera Kostyk |

Calibrated by Matt Sarkar

| | |
|---|---|
| Date Checked Out | 15 March 2011 |
| Date Returned | |

Procedures Prior to Departure (check-off steps and record results in the table below as necessary).

| | |
|---|---|
| ✓ | 1 Check flow cell fit by installing probe in flow cell |
| ✓ | 2 Check for broken or loose probes. |
| ✓ | 3 Check DO membrane visually. |
| ✓ | 4 Check pH probe reservoir for contamination visually |
| ✓ | 5 Check that correct parameters are displayed on the handset |
| ✓ | 6. Check for correct date and adjust accordingly. |
| ✓ | 7 Check that handset memory is clear |
| ✓ | 8 Perform a three point manual pH calibration (Use 7.01 buffer solution first) |
| ✓ | 9. Perform a specific conductance calibration |
| ✓ | 10 Perform an ORP check with 240 mV solution |

Procedures Every two weeks (or as required)

1 Check to see if the unit will be in use in the near future. The pH probe will need to be stored differently (See Manual) if unit is not in use for more than 1 month

Procedures Upon Return (record results in the tables below)

1 Clean probes (store multi-probe in calibration cell with approximately 1/8" of water, ensure that probes are not submerged)
2 Clean and inspect 20 m cable
3. Clean and inspect flow cell
4. Ensure there are no errors or problems with the instrument.
5 Ensure that at least one full bottle of each calibration solution is on hand and has not expired
6 Ensure that extra batteries are on hand
7 Download memory from the handset (clear the handset memory after downloading)
8. Place completed copies of this sheet in the project file and YSI clip-board

| Calibration Information | | | | | | |
|---|---|---|---|---|---|---|
| Para | pH | | | Sp. Cond | DO | ORP |
| Calibration Solution Value | 7.01 | 4.01 | 10.01 | 1413 µS/cm | 100% | 240 mV |
| Reading Following Calibration | 7.03 | 3.95 | 10.05 | 1413 | 92.7 | 237.5 |

| Packing List | |
|---|---|
| Manual | |
| Carrying Case | |
| Cal Sol'ns | |
| Flow Cell | ✓ |
| Barb Fittings | ✓ |
| Extra Batteries | ✓ |
| | |
| Other (Membrane kit) | |
| Other | |

If additional calibration solutions are required, let Jen Mathie know and she will order them (speak to Matt Sarkor if Jen is not available).

If the instrument is not working properly, contact Matt Sarkor.

## YSI 556
## Calibration Sheet

This is to certify that this instrument has been calibrated to the manufacturer's specifications.

| | |
|---|---|
| Project Number | KX13528 |
| Project Location | Fort Ware |
| Employee | Matt Sarkor |

| | |
|---|---|
| Date Checked Out | May 25, 2011 |
| Date Returned | |

Procedures Prior to Departure (check-off steps and record results in the table below as necessary):

- ✓ 1. Check flow cell fit by installing probe in flow cell.
- ✓ 2. Check for broken or loose probes.
- ✓ 3. Check DO membrane visually.
- ✓ 4. Check pH probe reservoir for contamination visually.
- ✓ 5. Check that correct parameters are displayed on the handset
- ✓ 6. Check for correct date and adjust accordingly.
- ✓ 7. Check that handset memory is clear.
- ✓ 8. Perform a three point manual pH calibration **(Use 7.01 buffer solution first).**
- ✓ 9. Perform a specific conductance calibration
- ✓ 10. Perform an ORP check with 240 mV solution

Procedures Every two weeks (or as required):

1. Check to see if the unit will be in use in the near future. The pH probe will need to be stored differently (See Manual) if unit is not in use for more than 1 month

Procedures Upon Return (record results in the tables below):

1. Clean probes (store multi-probe in calibration cell with approximatey 1/8" of water; ensure that probes are not submerged)
2. Clean and inspect 20 m cable
3. Clean and inspect flow cell
4. Ensure there are no errors or problems with the instrument
5. Ensure that at least one full bottle of each calibration solution is on hand and has not expired
6. Ensure that extra batteries are on hand
7. Download memory from the handset (clear the handset memory after dowloading)
8. Place completed copies of this sheet in the project file and YSI clip-board

| Calibration Information | | | | | | |
|---|---|---|---|---|---|---|
| Para | pH | | | Sp. Cond | DO | ORP |
| Calibration Solution Value | 7.03 / 7.01 / 7.00 | 4.01 / 4.03 | 10.01 / 10.01 | 1413 µS/cm / 1431 | 100% / 101.6 | 235 / 248 mV / 241.1 ← Before Cal |
| Reading Following Calibration | 7.02 | 4.00 | 10.01 | 1413 | 93.7 | 236.0 |

| Packing List | |
|---|---|
| Manual | |
| Carrying Case | ✓ |
| Cal Sol'ns | |
| Flow Cell | ✓ |
| Barb Fittings | ✓ |
| Extra Batteries | ✓ |
| | |
| Other (Membrane kit) | |
| Other | |

If additional calibration solutions are required, let Jen Mathie know and she will order them (speak to Matt Sarkor if Jen is not available).

If the instrument is not working properly, contact Matt Sarkor.

**YSI 556**
**Calibration Sheet**

**This is to certify that this instrument has been calibrated to the manufacturer's specifications.**

| | |
|---|---|
| Project Number | KX13505 |
| Project Location | H16W - Timber Ridge |
| Employee | Scott Gro |

| | |
|---|---|
| Date Checked Out | June 2011 |
| Date Returned | August 16 2011 |

Field Calibration Date: August 10 2011

Procedures Prior to Departure (check-off steps and record results in the table below as necessary):

| | |
|---|---|
| | 1. Check flow cell fit by installing probe in flow cell. |
| | 2. Check for broken or loose probes. |
| | 3. Check DO membrane visually. |
| | 4. Check pH probe reservoir for contamination visually. |
| | 5. Check that correct parameters are displayed on the handset. |
| | 6. Check for correct date and adjust accordingly. |
| | 7. Check that handset memory is clear. |
| ✓ | 8. Perform a three point manual pH calibration **(Use 7.01 buffer solution first).** |
| ✓ | 9. Perform a specific conductance calibration |
| ✓ | 10. Perform an ORP check with 240 mV solution |

Procedures Every two weeks (or as required):

1. Check to see if the unit will be in use in the near future. The pH probe will need to be stored differently (See Manual) if unit is not in use for more than 1 month.

Procedures Upon Return (record results in the tables below):

1. Clean probes (store multi-probe in calibration cell with approximatey 1/8" of water; ensure that probes are not submerged)
2. Clean and inspect 20 m cable
3. Clean and inspect flow cell
4. Ensure there are no errors or problems with the instrument.
5. Ensure that at least one full bottle of each calibration solution is on hand and has not expired
6. Ensure that extra batteries are on hand
7. Downolad memory from the handset (clear the handset memory after dowloading)
8. Place completed copies of this sheet in the project file and YSI clip-board

| Calibration Information | | | | | | |
|---|---|---|---|---|---|---|
| Para | pH | | | Sp. Cond | DO | ORP |
| Calibration Solution Value | 7.01 | 4.01 | 10.01 | 1413 µS/cm | 100% | 240 mV |
| Reading Following Calibration | 6.995 | 4.002 | na | 1440 | 90.2 | 235 |
| Temperature (°c) at Calibration | 28.00 | 28.00 | | 26.00 | 26.78 | |

Pressure (mm Hg) at DO calibration = 685.6 mm Hg

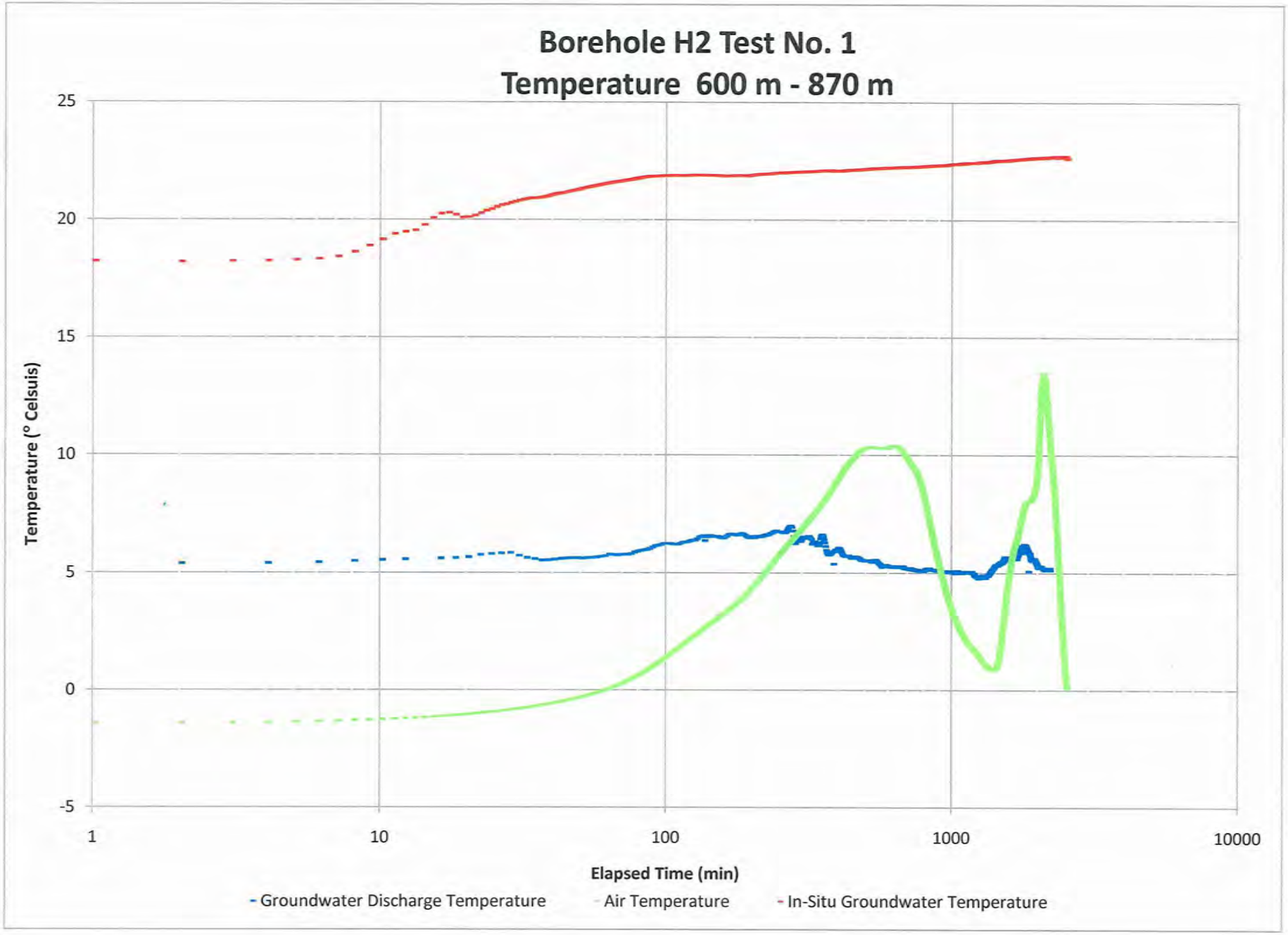
| | |
|---|---|
| Packing List | |
| Manual | |
| Carrying Case | |
| Cal Sol'ns | |
| Flow Cell | |
| Barb Fittings | |
| Extra Batteries | |
| | |
| Other (Membrane kit) | |
| Other | |

If additional calibration solutions are required, let Jen Mathie know and she will order them (speak to Matt Sarkor if Jen is not available).

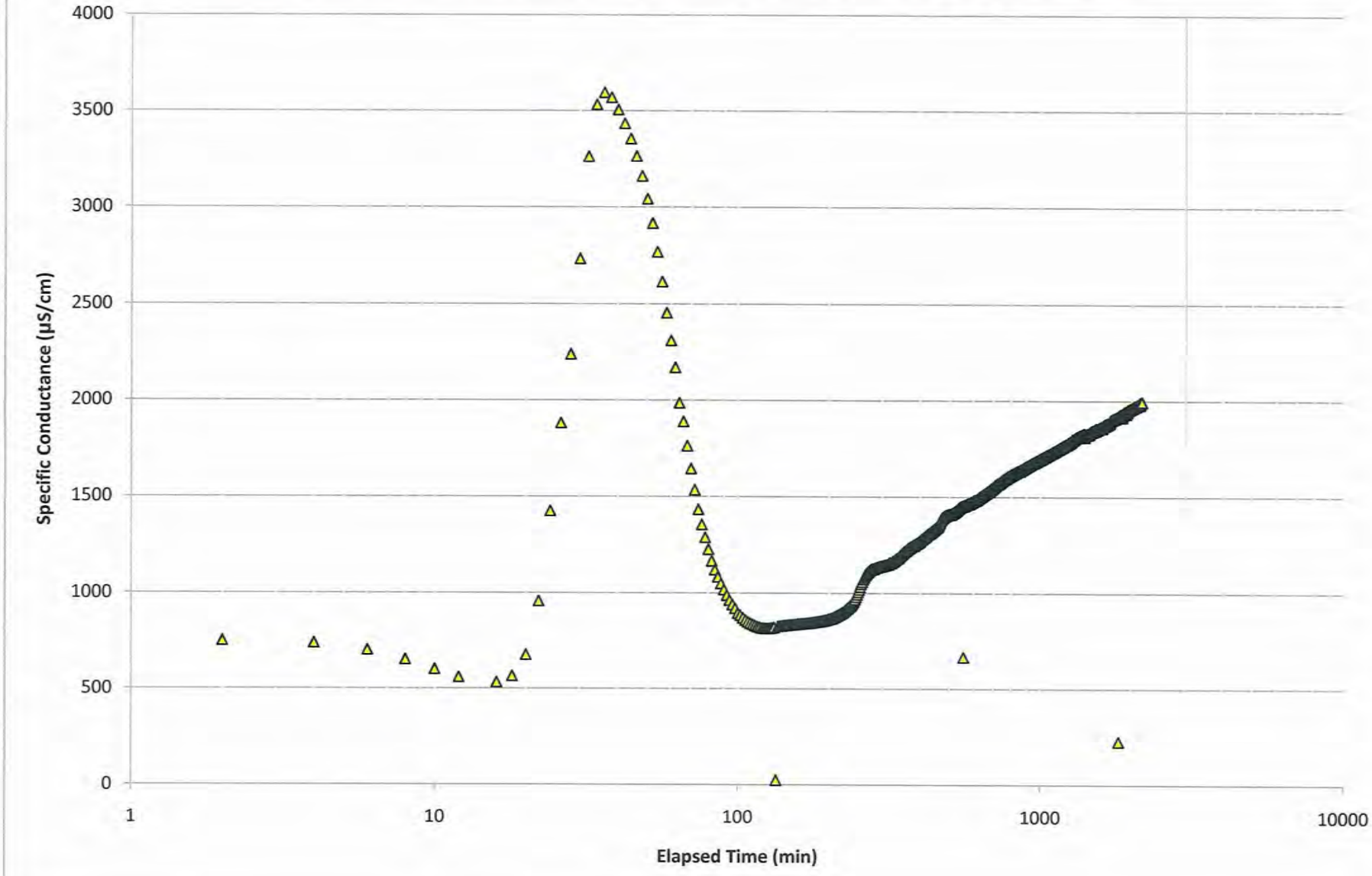
If the instrument is not working properly, contact Matt Sarkor.

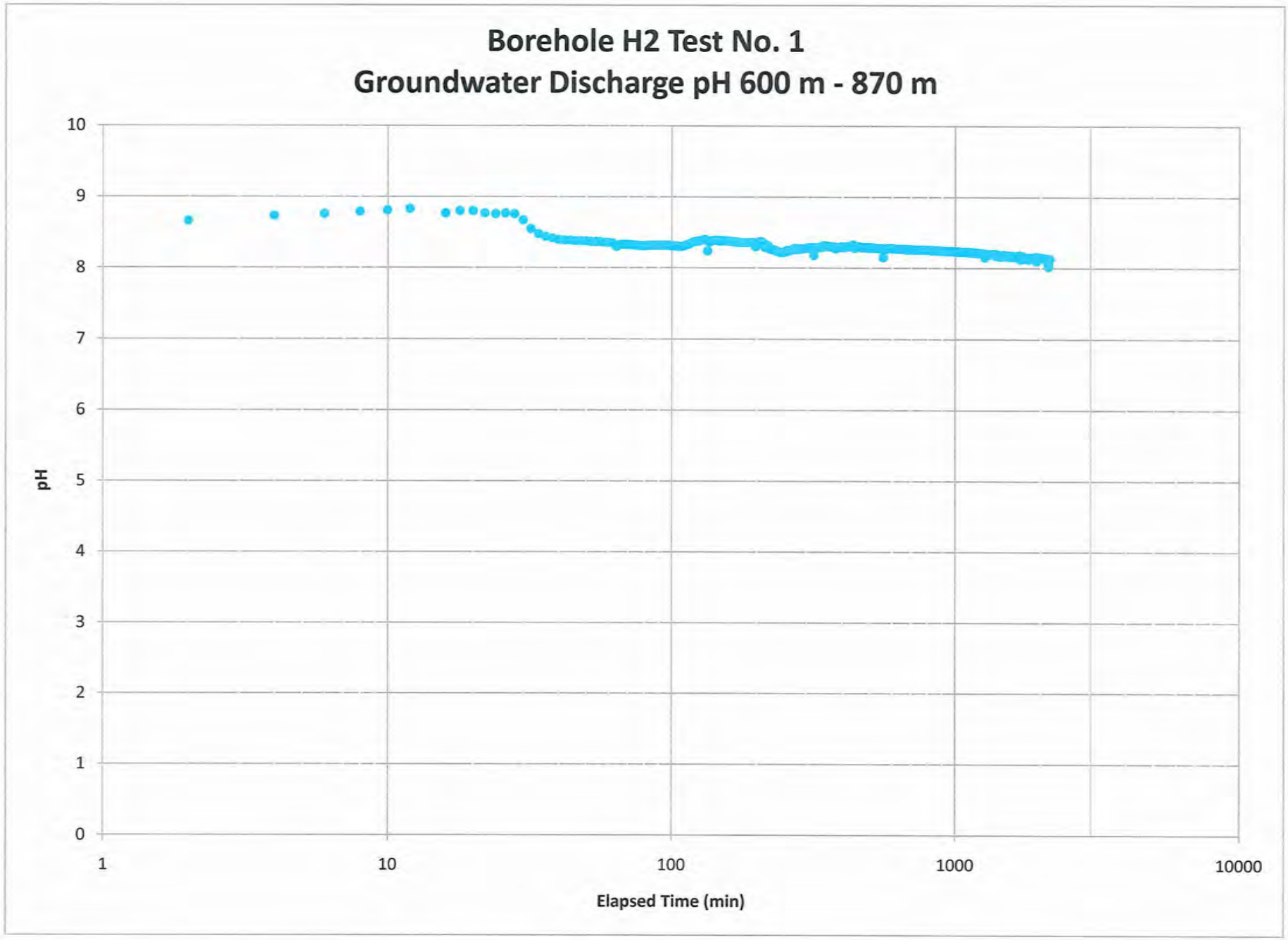
# APPENDIX E

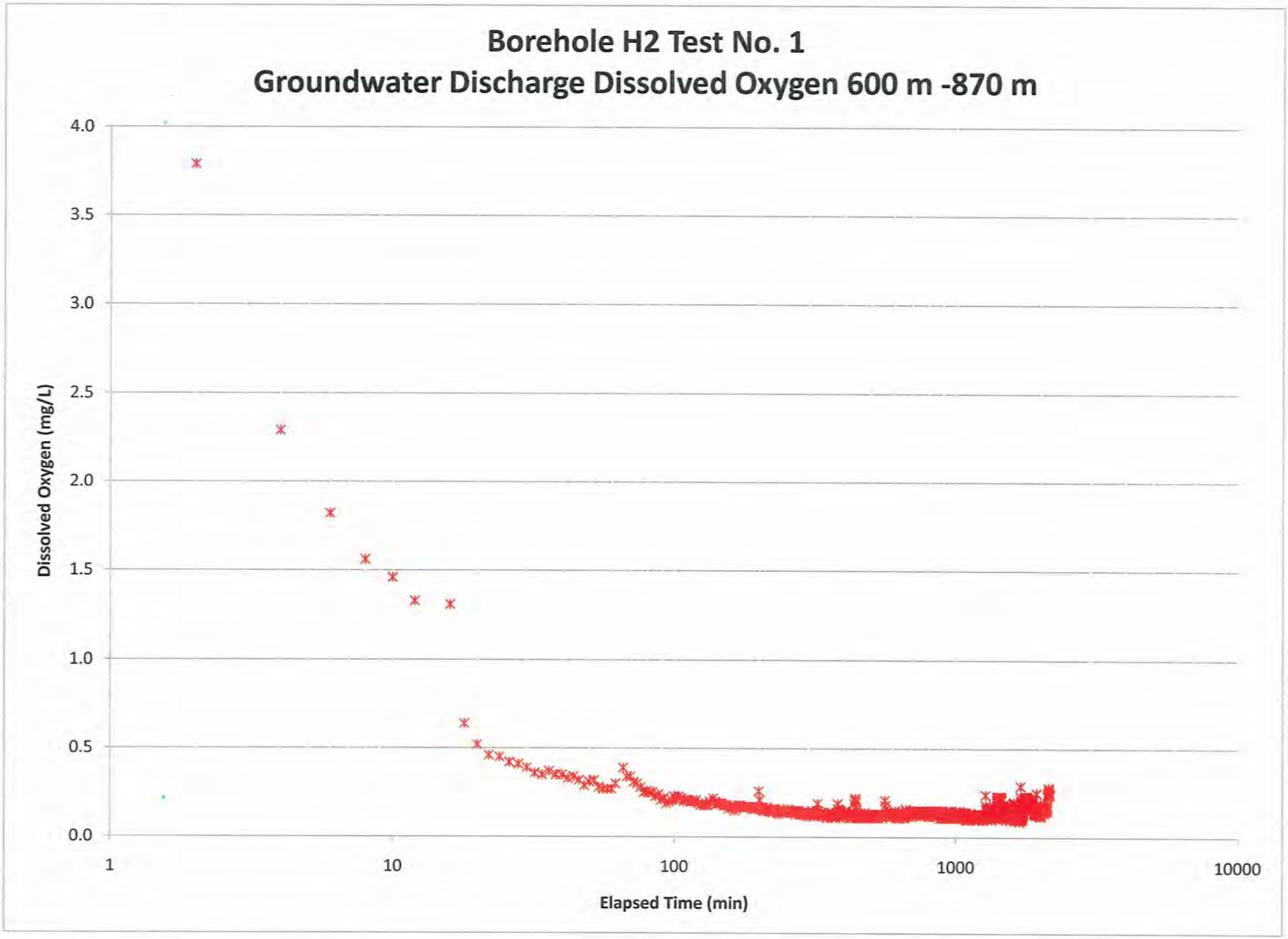
# FIELD RECORDED GROUNDWATER DISCHARGE QUALITY GRAPHS


Borehole H2 Test No. 1
Temperature 600 m - 870 m
25
20
15
10
5
0
-5
Temperature (° Celsuis)
1
10
100
1000
10000
Elapsed Time (min)
Groundwater Discharge Temperature
Air Temperature
In-Situ Groundwater Temperature

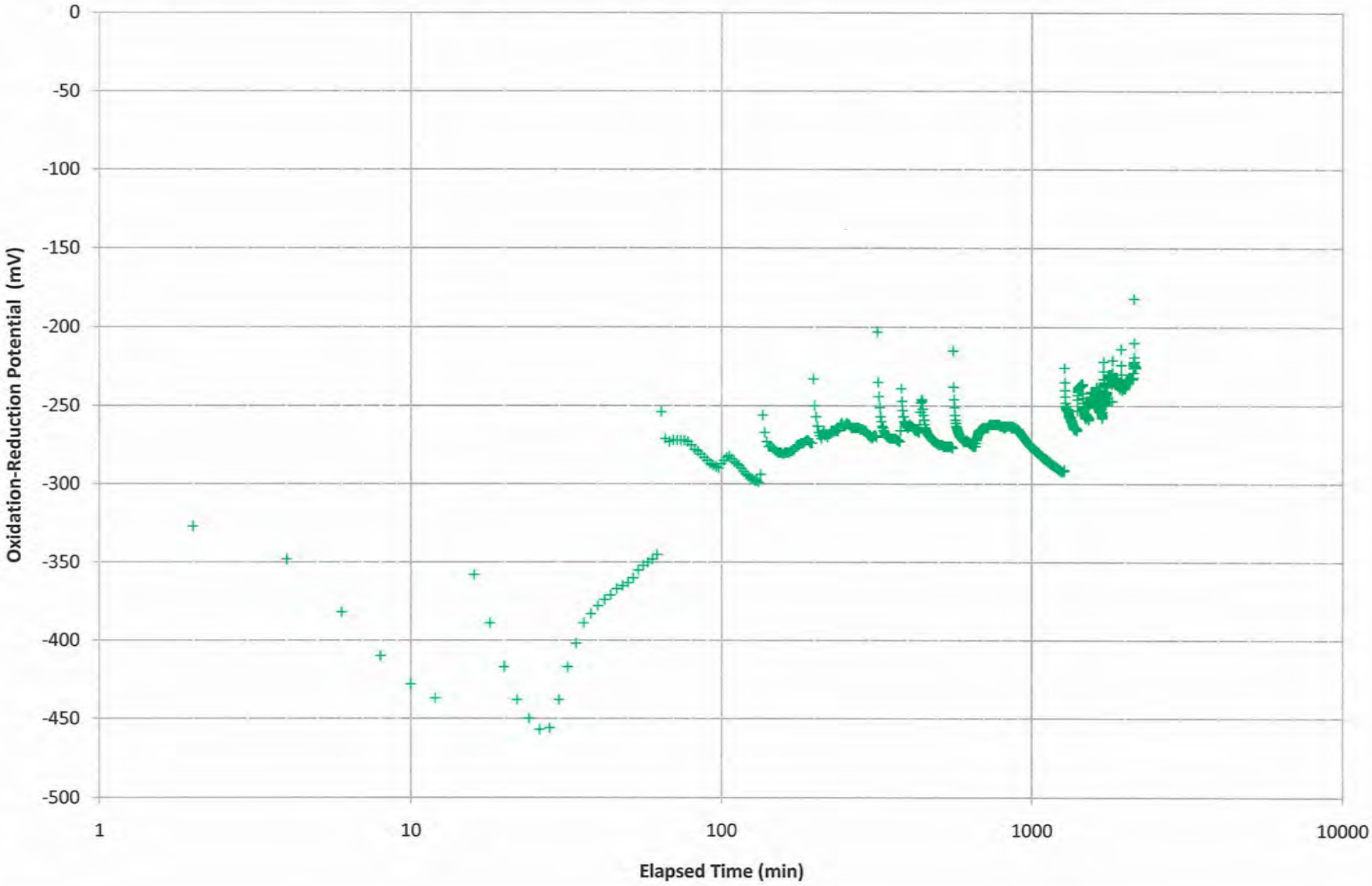
# Borehole H2 Test No.1
## Groundwater Discharge Specific Conductance 600 m-870 m

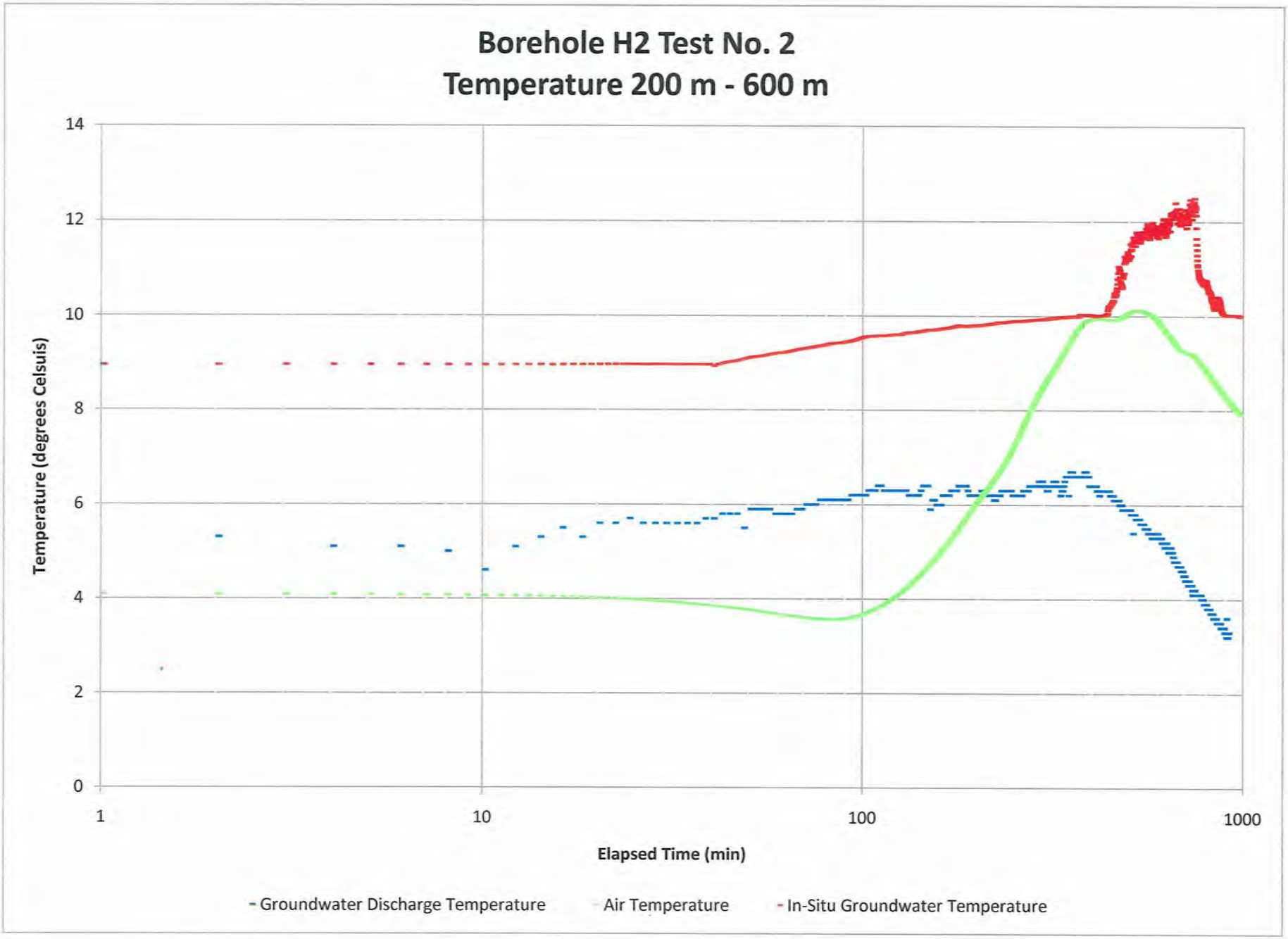


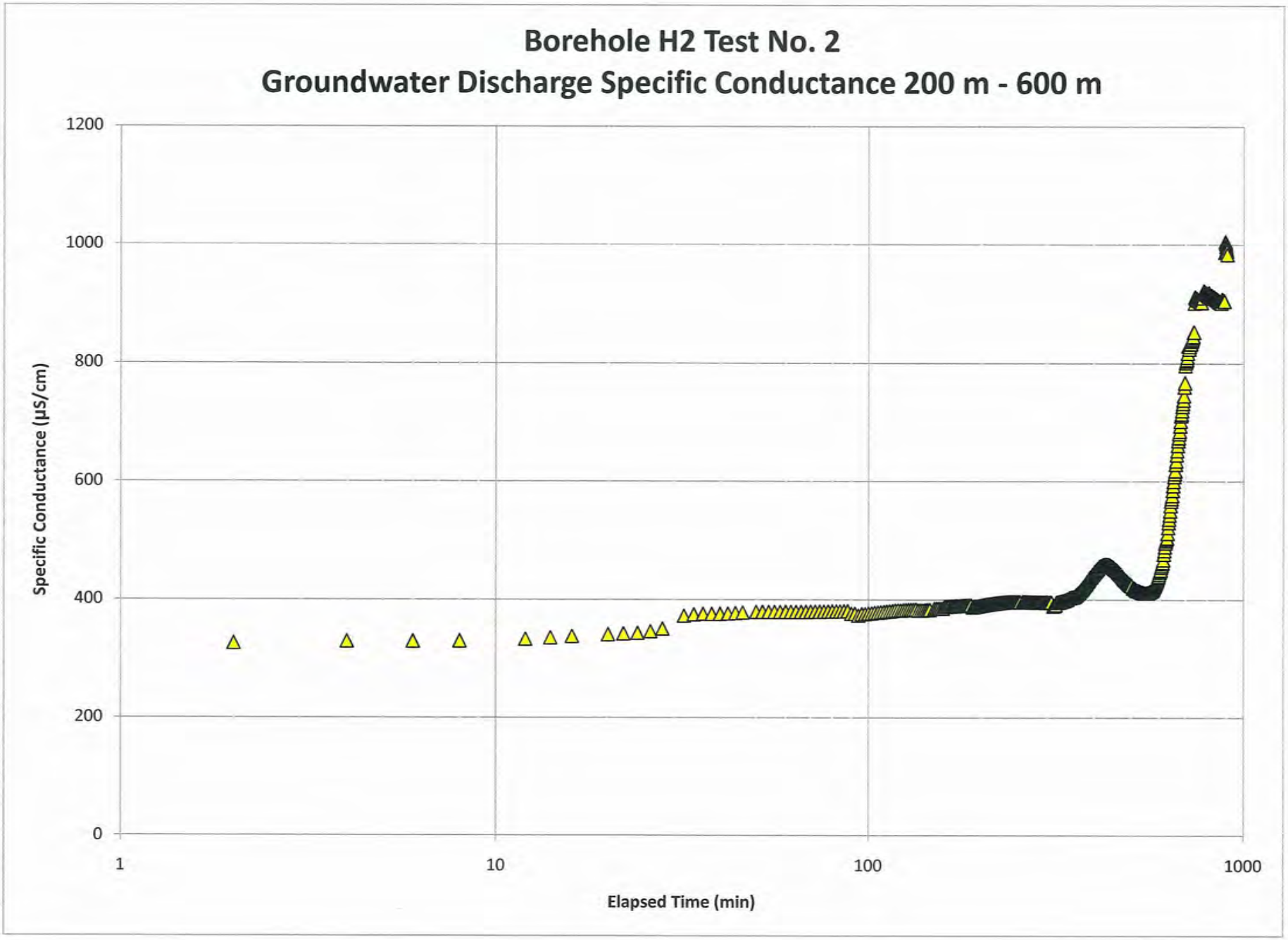

Borehole H2 Test No. 1
Groundwater Discharge pH 600 m - 870 m
pH
10
9
8
7
6
5
4
3
2
1
0
1
10
100
1000
10000
Elapsed Time (min)

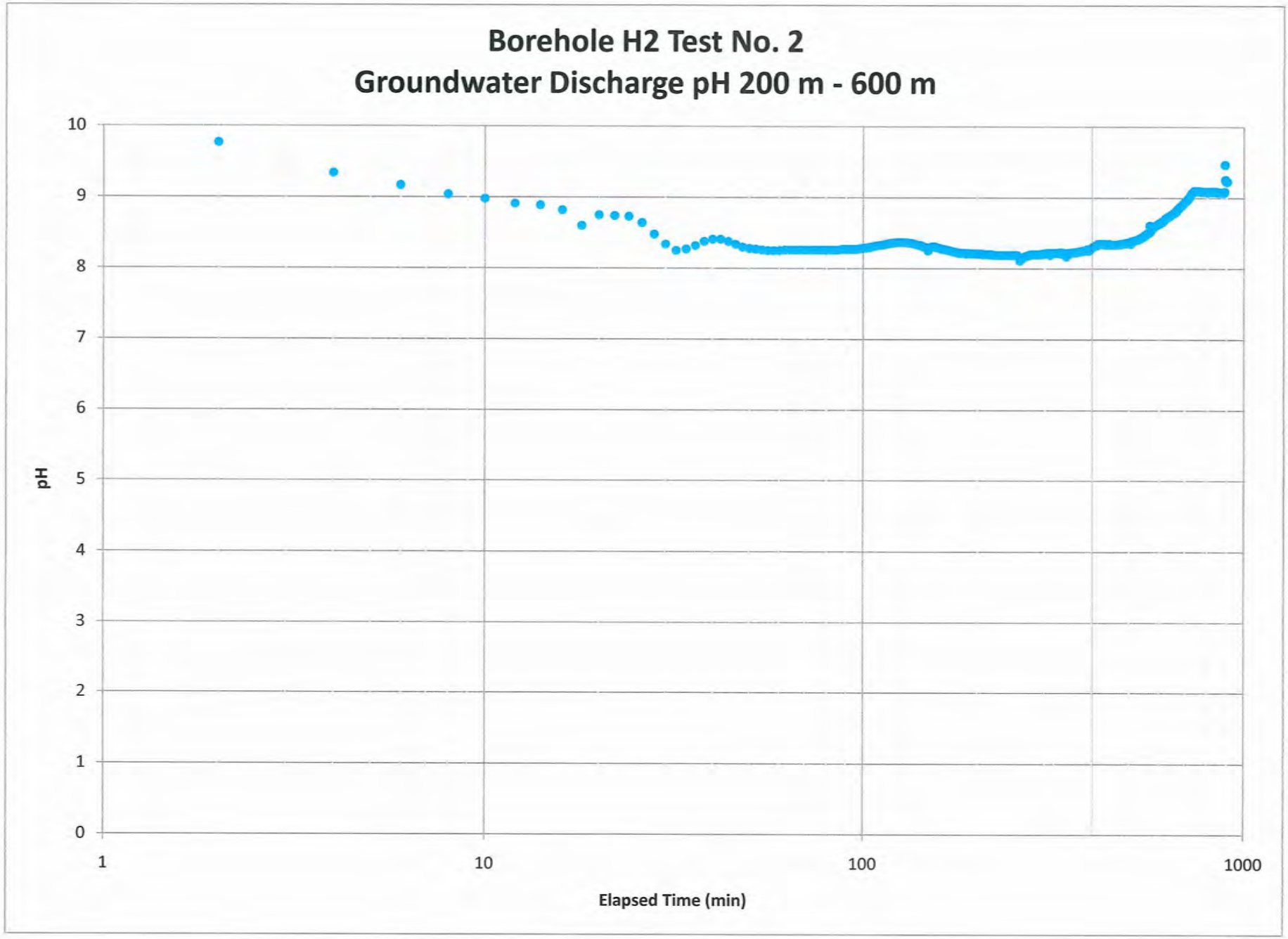

Borehole H2 Test No. 1
Groundwater Discharge Dissolved Oxygen 600 m -870 m
Dissolved Oxygen (mg/L)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
10
100
1000
10000
Elapsed Time (min)

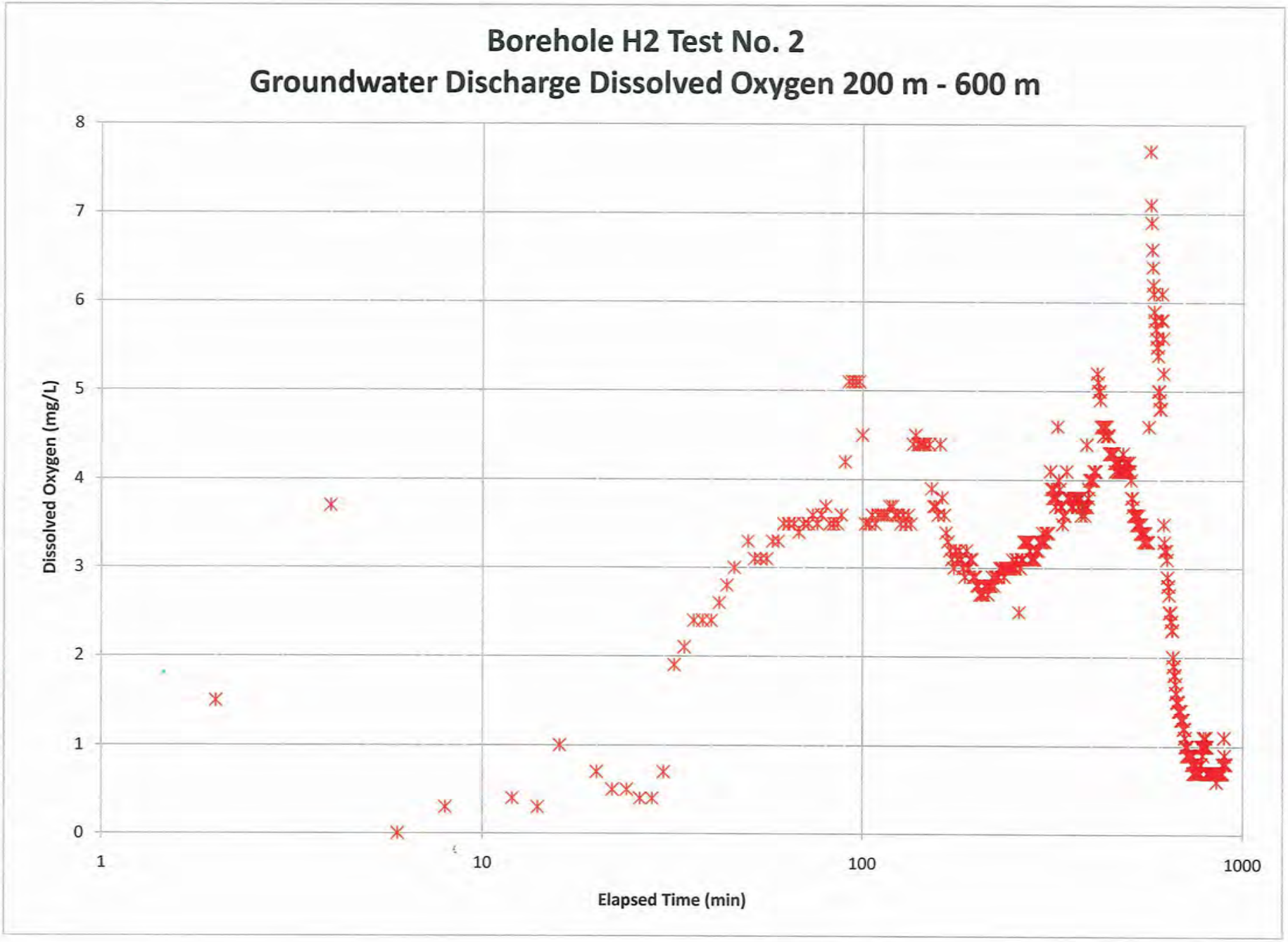
# Borehole H2 Test No. 1
## Groundwater Discharge Oxidation Reduction Potential 600 m -870 m

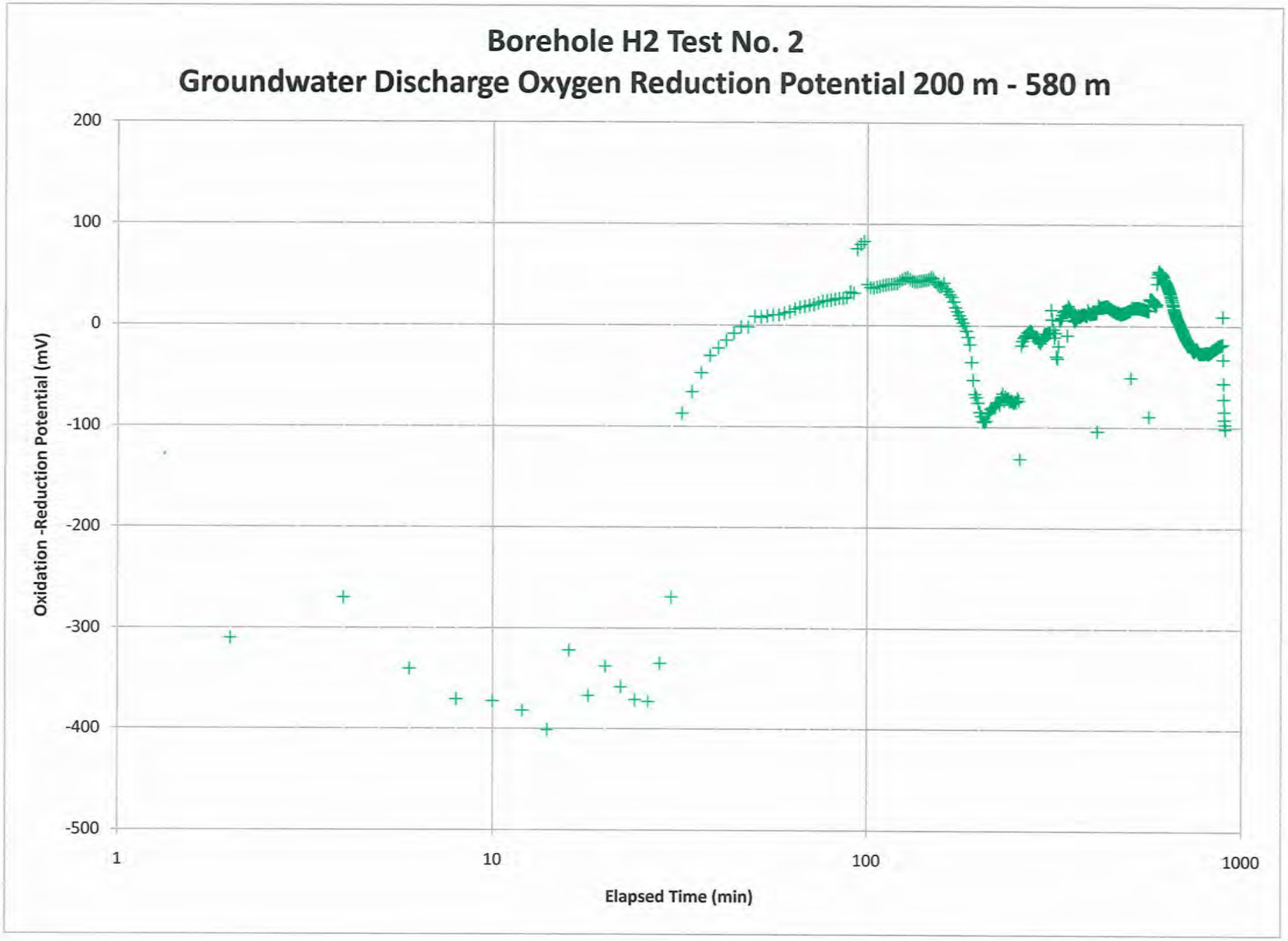



Borehole H2 Test No. 2
Temperature 200 m - 600 m
Temperature (degrees Celsuis)
14
12
10
8
6
4
2
0
1
10
100
1000
Elapsed Time (min)
Groundwater Discharge Temperature
Air Temperature
In-Situ Groundwater Temperature

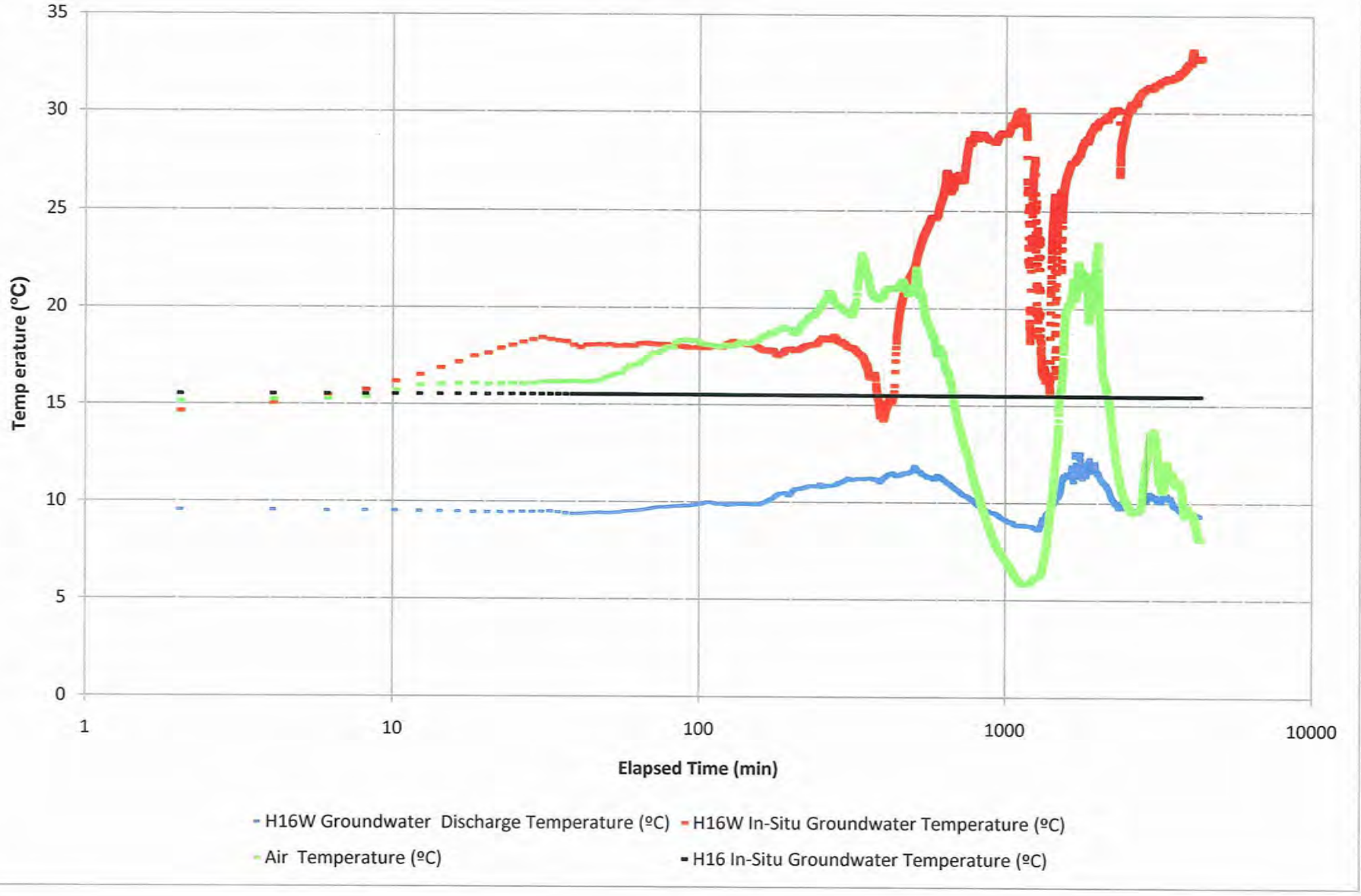

Borehole H2 Test No. 2
Groundwater Discharge Specific Conductance 200 m - 600 m
Specific Conductance (µS/cm)
1200
1000
800
600
400
200
0
1
10
100
1000
Elapsed Time (min)


Borehole H2 Test No. 2
Groundwater Discharge pH 200 m - 600 m
10
9
8
7
6
5
4
3
2
1
0
pH
1
10
100
1000
Elapsed Time (min)

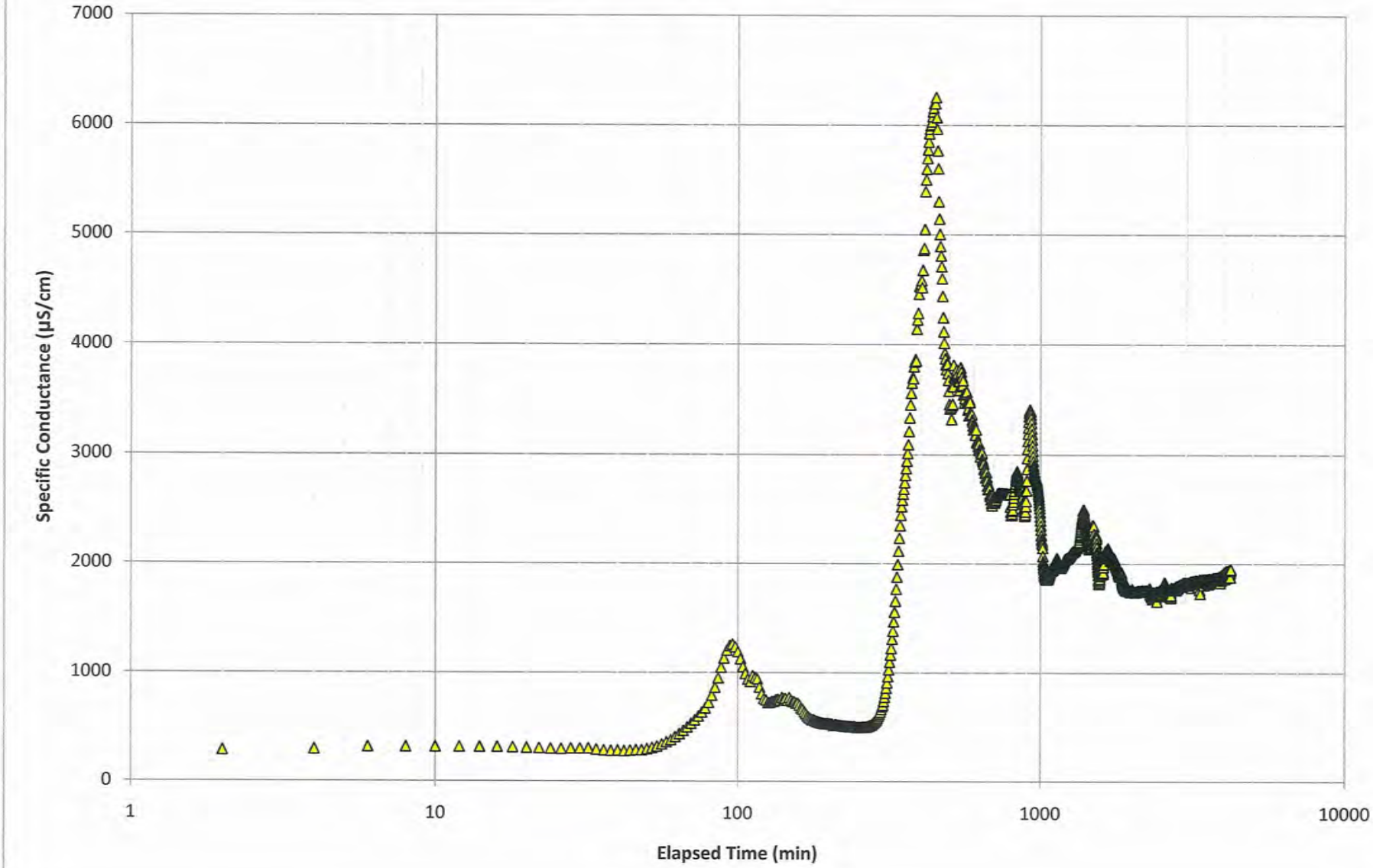

Borehole H2 Test No. 2
Groundwater Discharge Dissolved Oxygen 200 m - 600 m
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
8
1
10
100
1000
Elapsed Time (min)

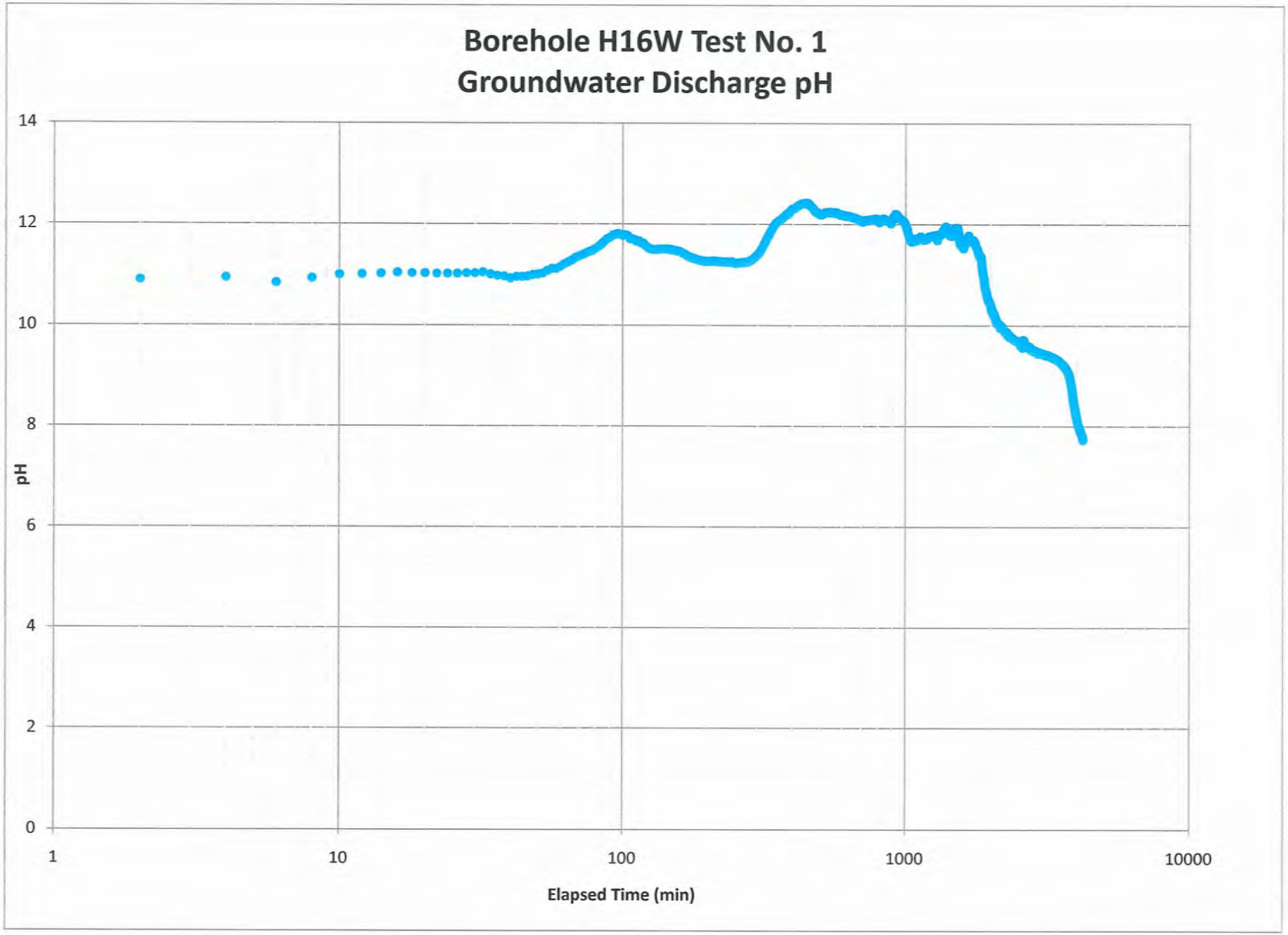

Borehole H2 Test No. 2
Groundwater Discharge Oxygen Reduction Potential 200 m - 580 m
200
100
0
-100
-200
-300
-400
-500
Oxidation -Reduction Potential (mV)
1
10
100
1000
Elapsed Time (min)

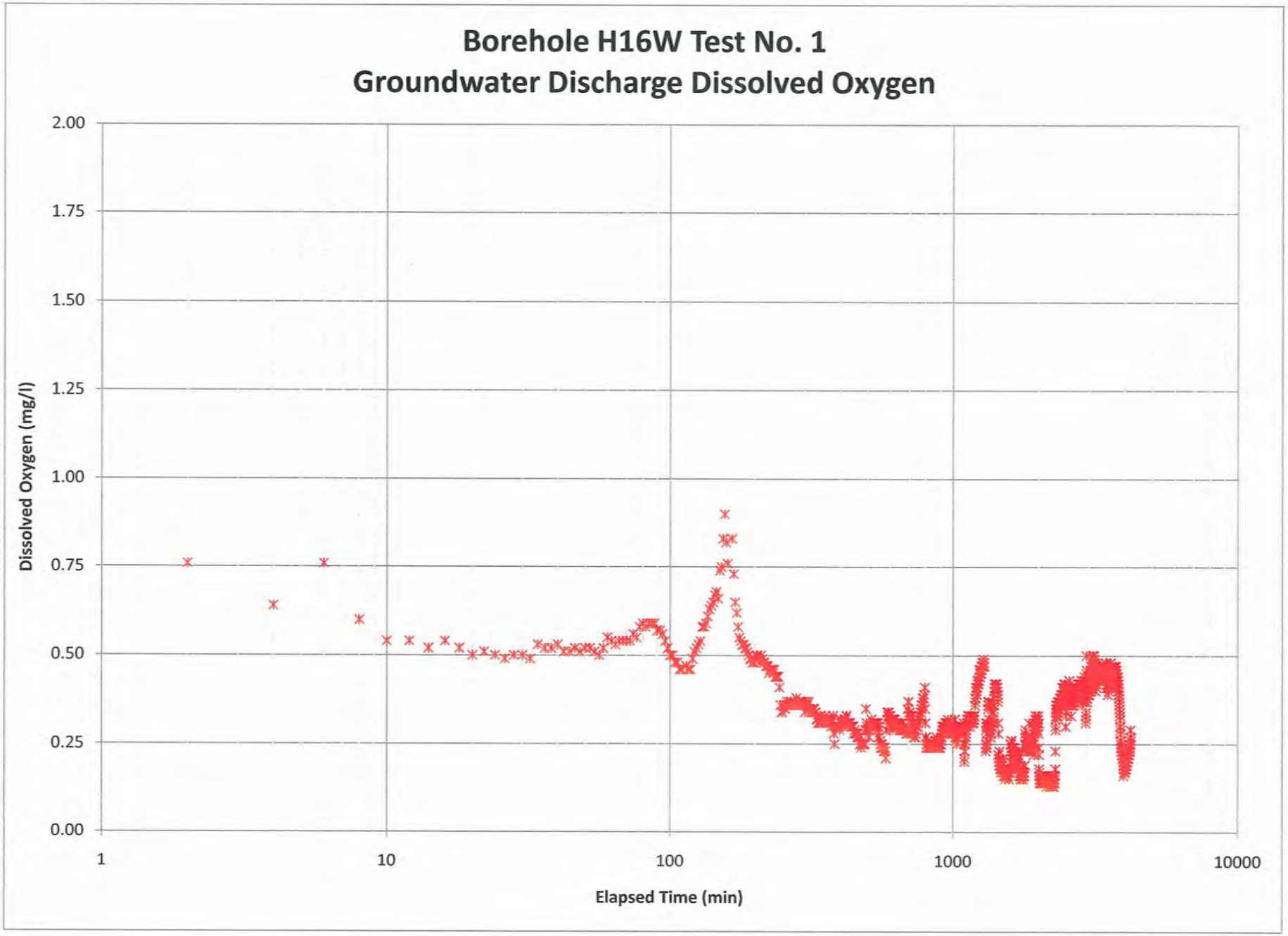
# Borehole H16W Test No. 1
## Temperature

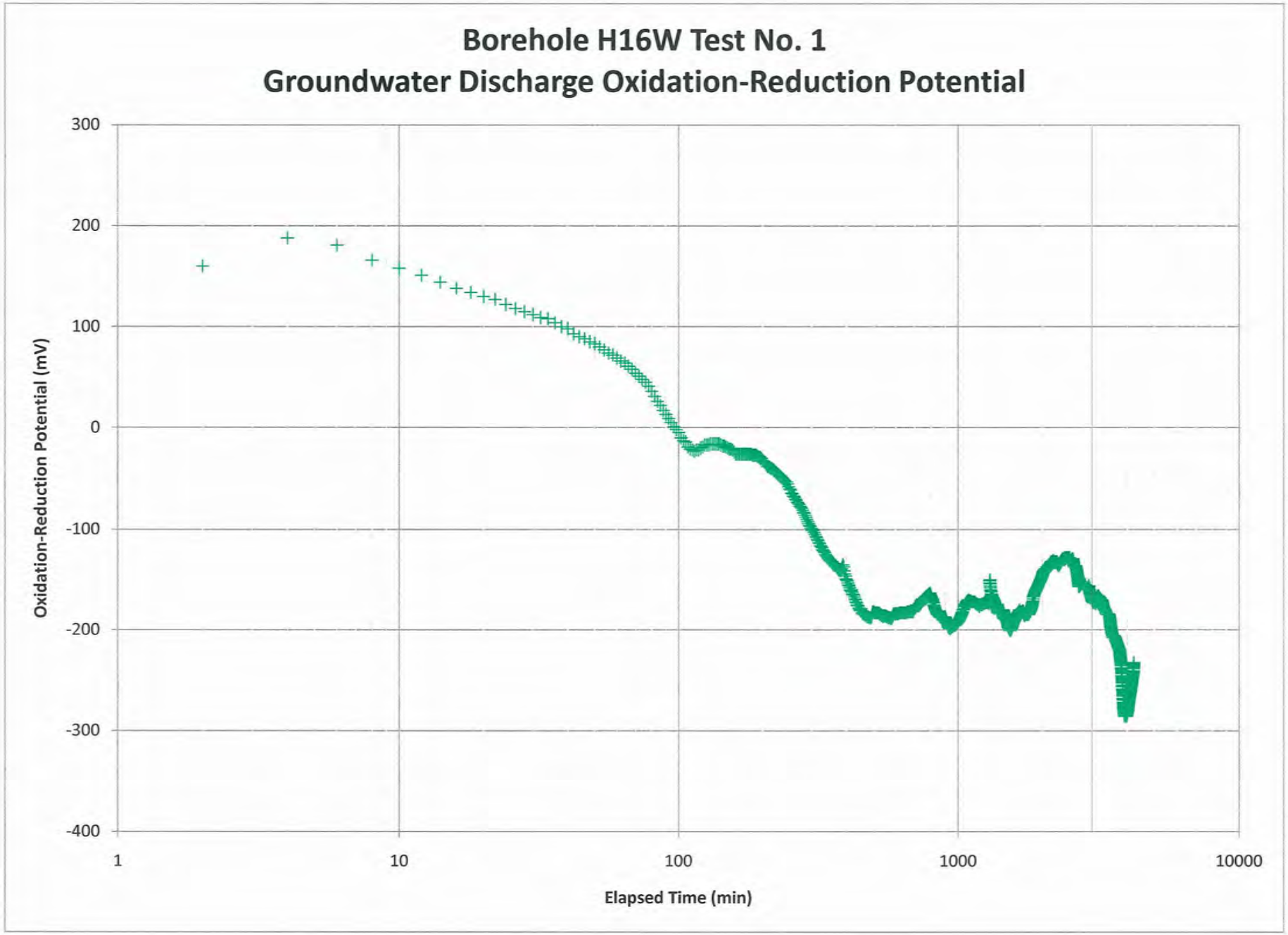


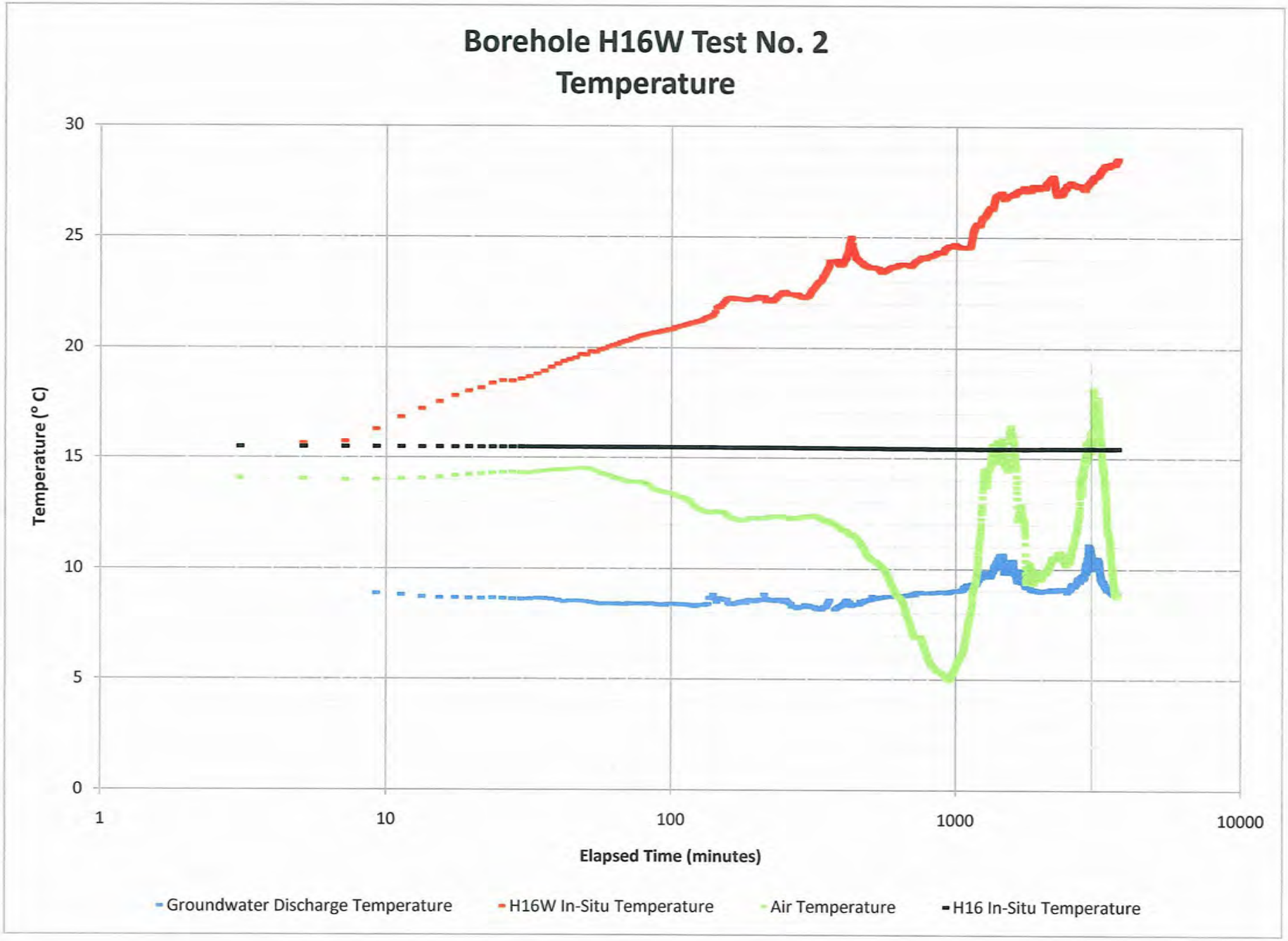
# Borehole H16W Test No. 1
## Groundwater Discharge Specific Conductance

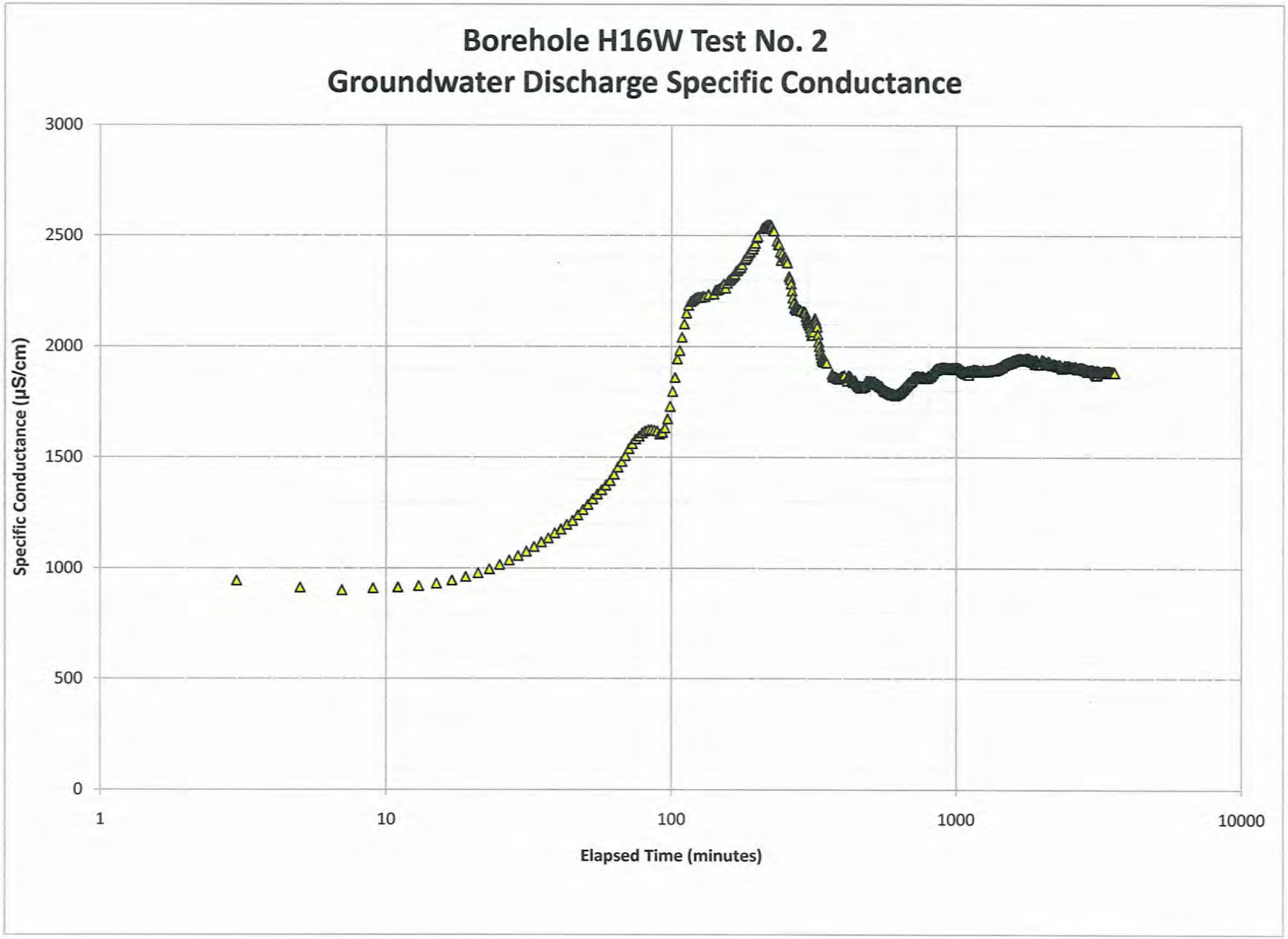


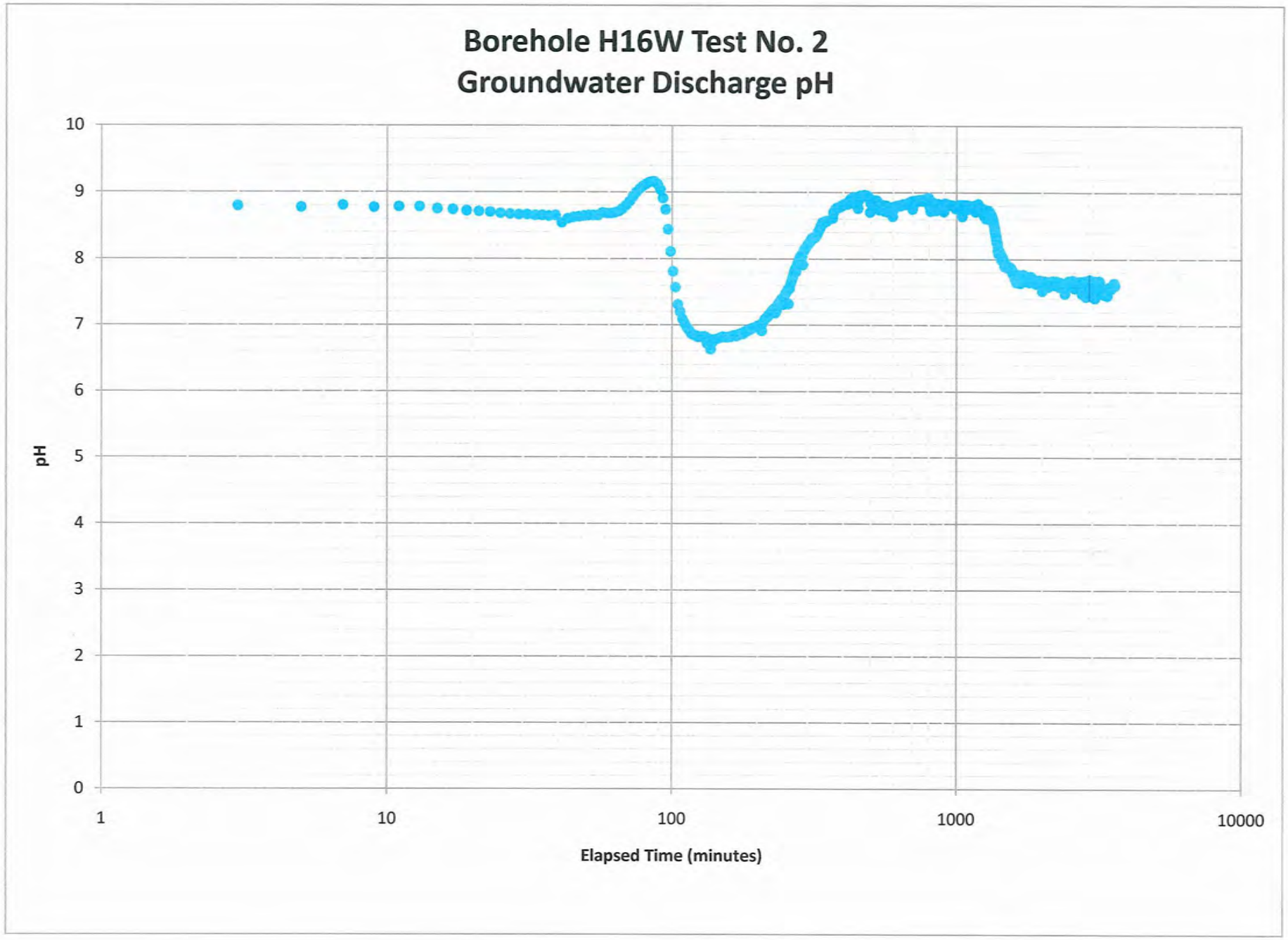

Borehole H16W Test No. 1
Groundwater Discharge pH
14
12
10
8
6
4
2
0
pH
1
10
100
1000
10000
Elapsed Time (min)


Borehole H16W Test No. 1
Groundwater Discharge Dissolved Oxygen
Dissolved Oxygen (mg/l)
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1
10
100
1000
10000
Elapsed Time (min)

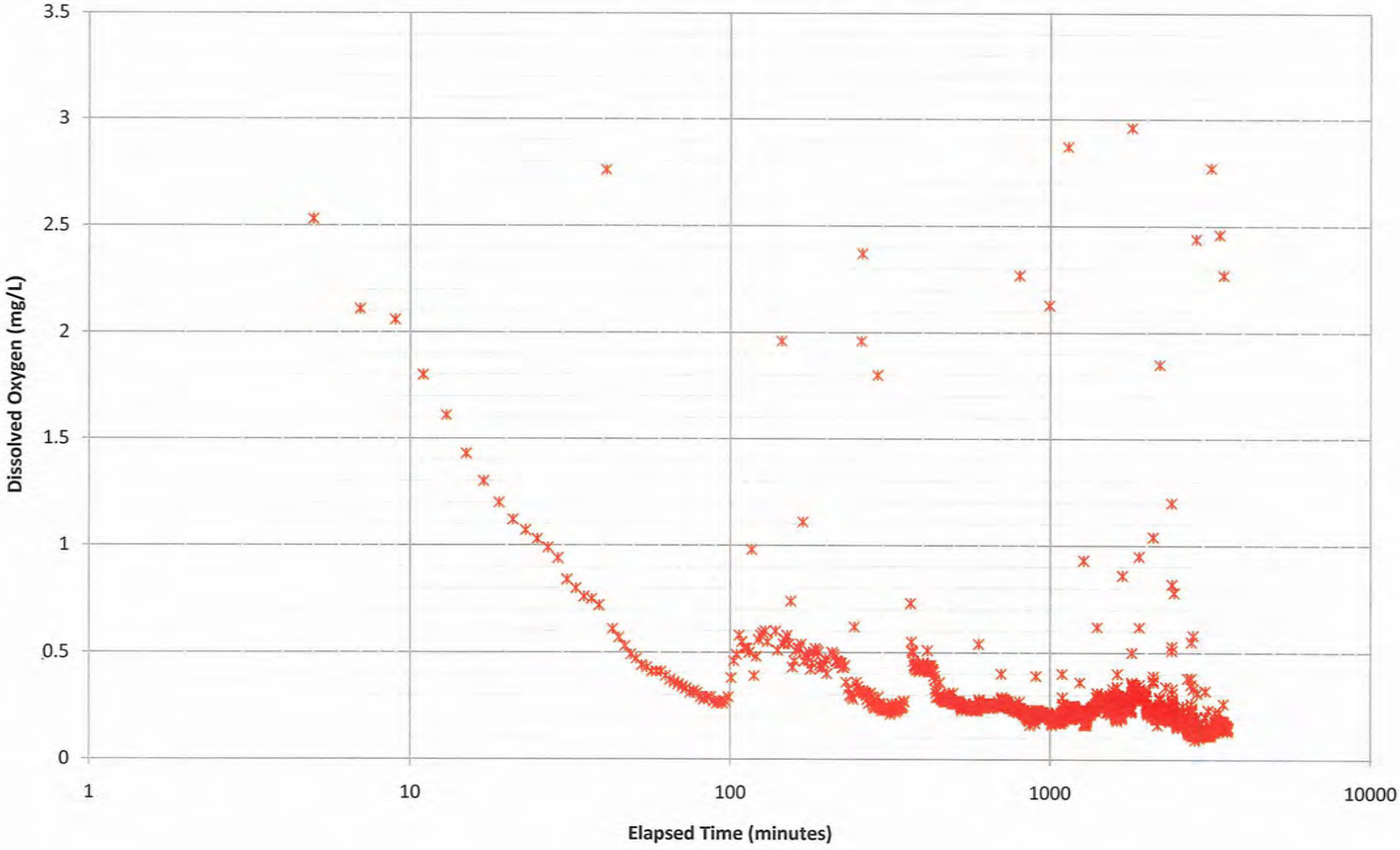

Borehole H16W Test No. 1
Groundwater Discharge Oxidation-Reduction Potential
300
200
100
0
-100
-200
-300
-400
Oxidation-Reduction Potential (mV)
1
10
100
1000
10000
Elapsed Time (min)


Borehole H16W Test No. 2
Temperature
30
25
20
15
10
5
0
Temperature (° C)
1
10
100
1000
10000
Elapsed Time (minutes)
Groundwater Discharge Temperature
H16W In-Situ Temperature
Air Temperature
H16 In-Situ Temperature

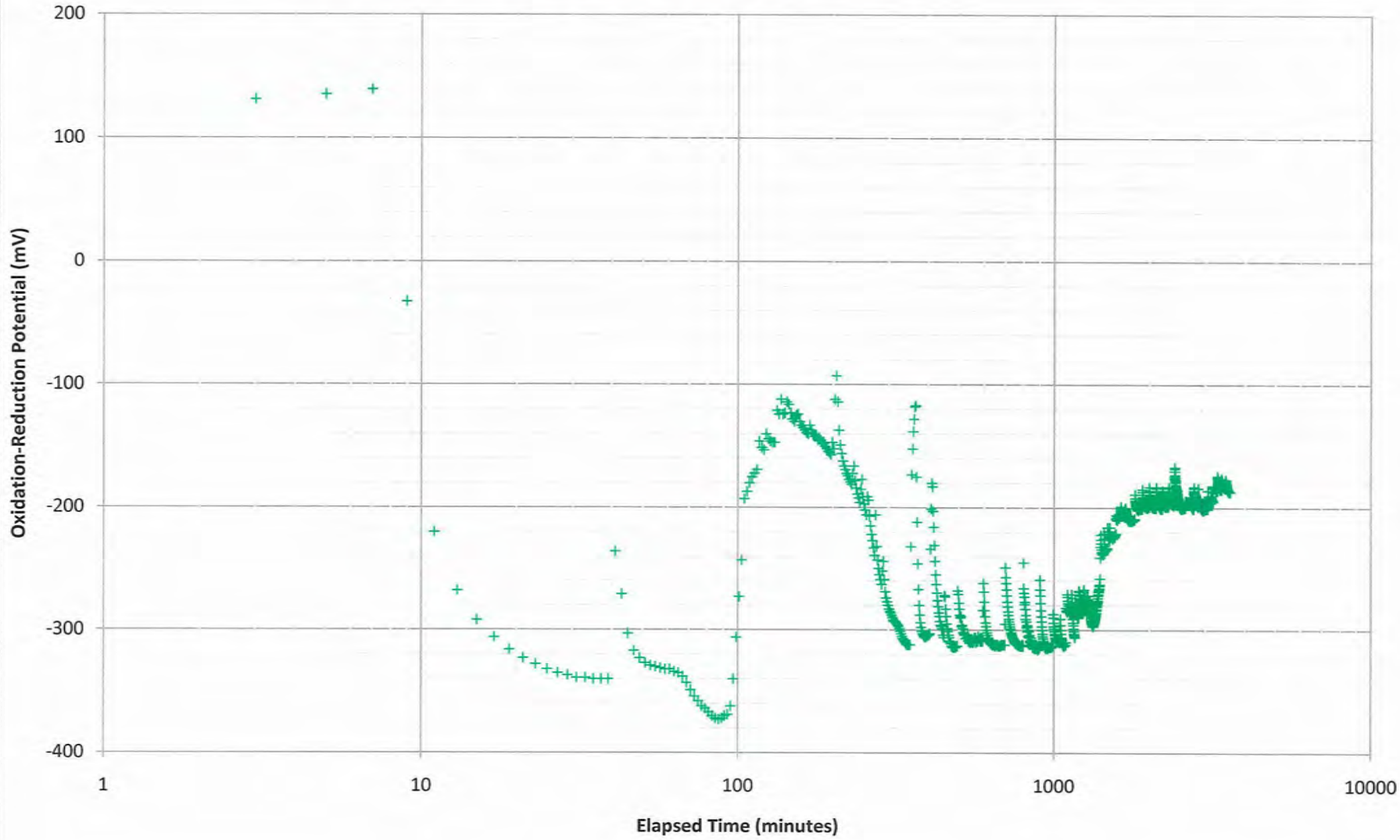

Borehole H16W Test No. 2
Groundwater Discharge Specific Conductance
Specific Conductance (µS/cm)
3000
2500
2000
1500
1000
500
0
1
10
100
1000
10000
Elapsed Time (minutes)


Borehole H16W Test No. 2
Groundwater Discharge pH
pH
10
9
8
7
6
5
4
3
2
1
0
1
10
100
1000
10000
Elapsed Time (minutes)

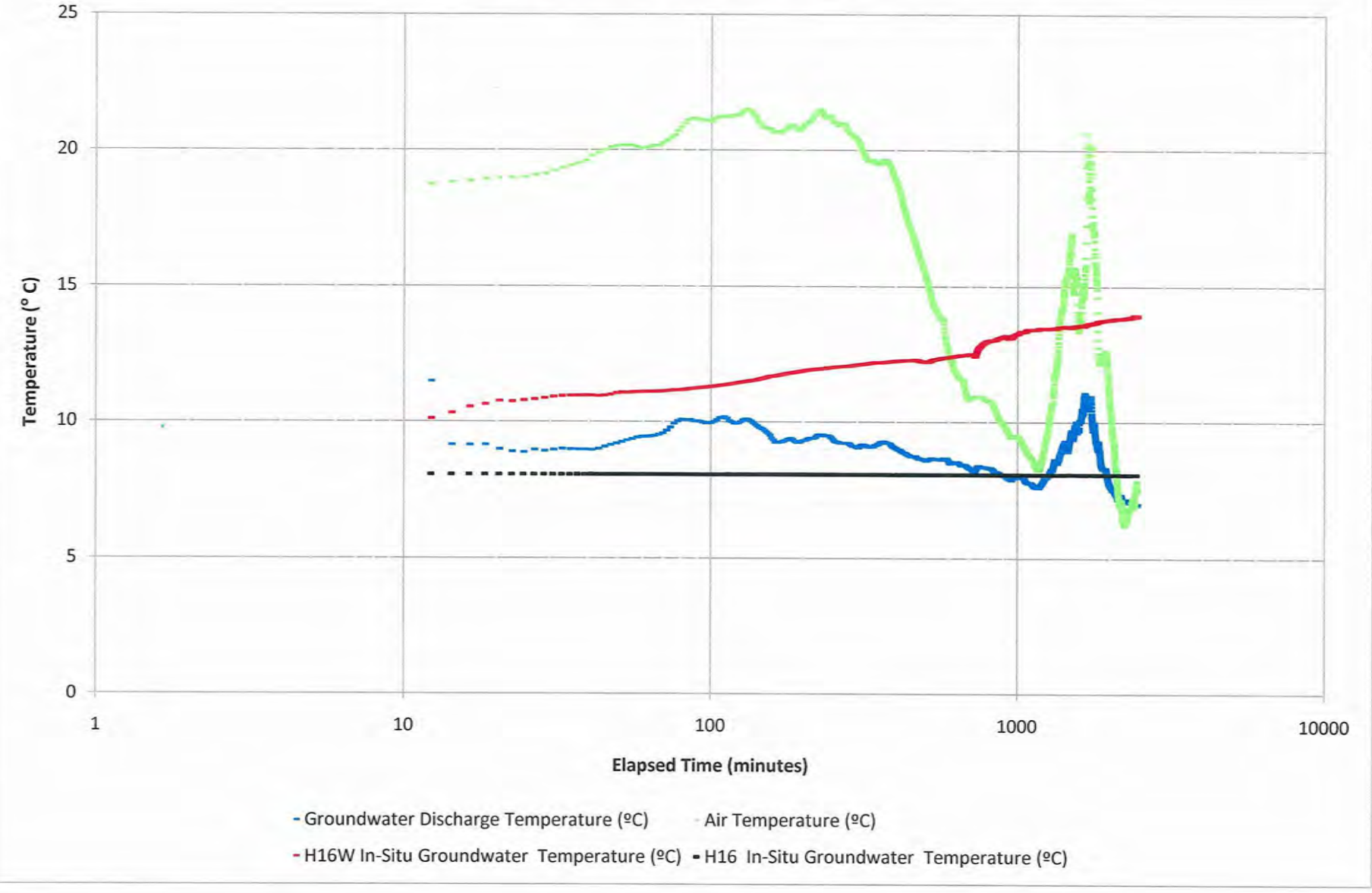
# Borehole H16W Test No. 2
## Groundwater Discharge Dissolved Oxygen



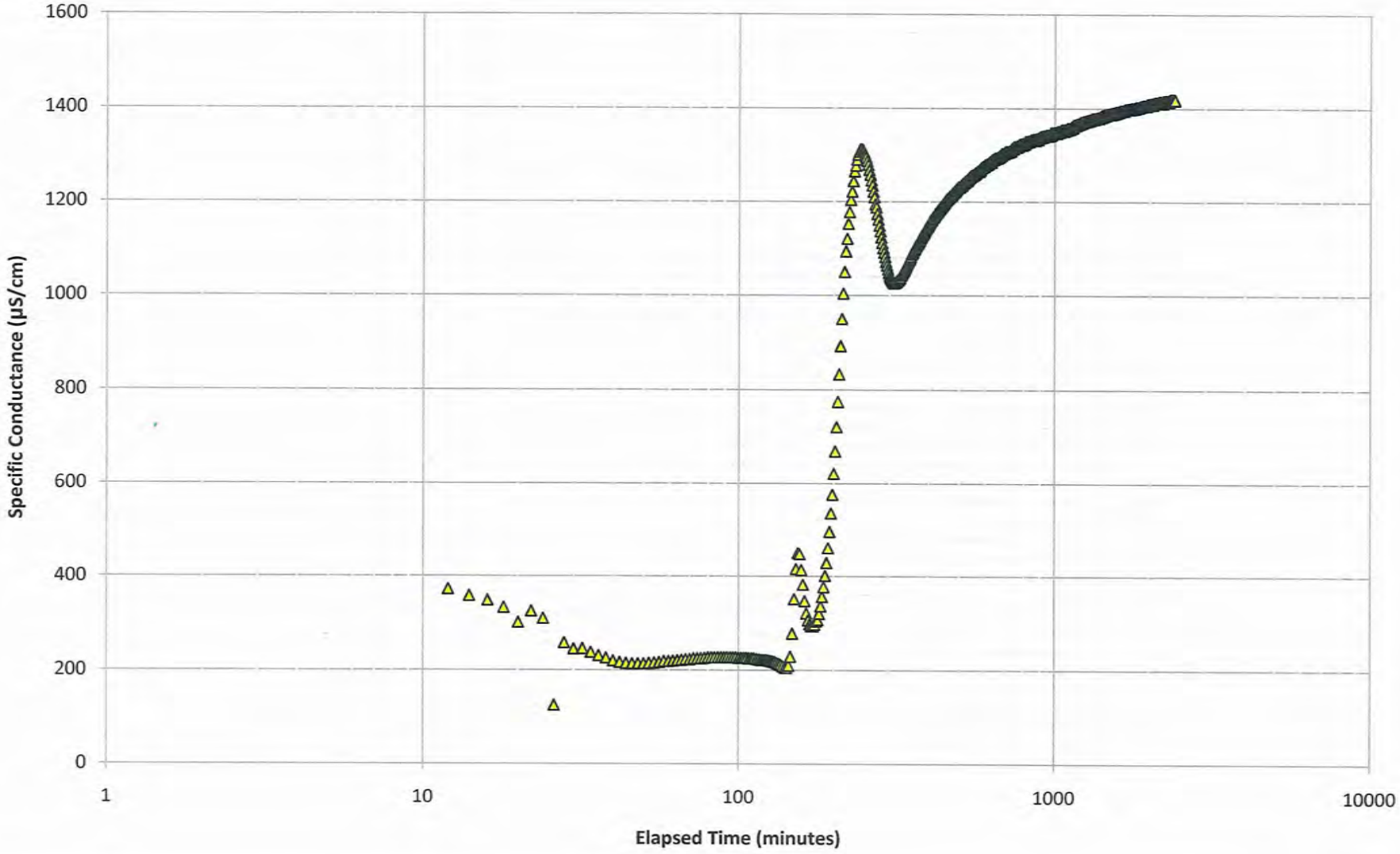
# Borehole H16W Test No. 2
## Groundwater Discharge Oxidation-Reduction Potential

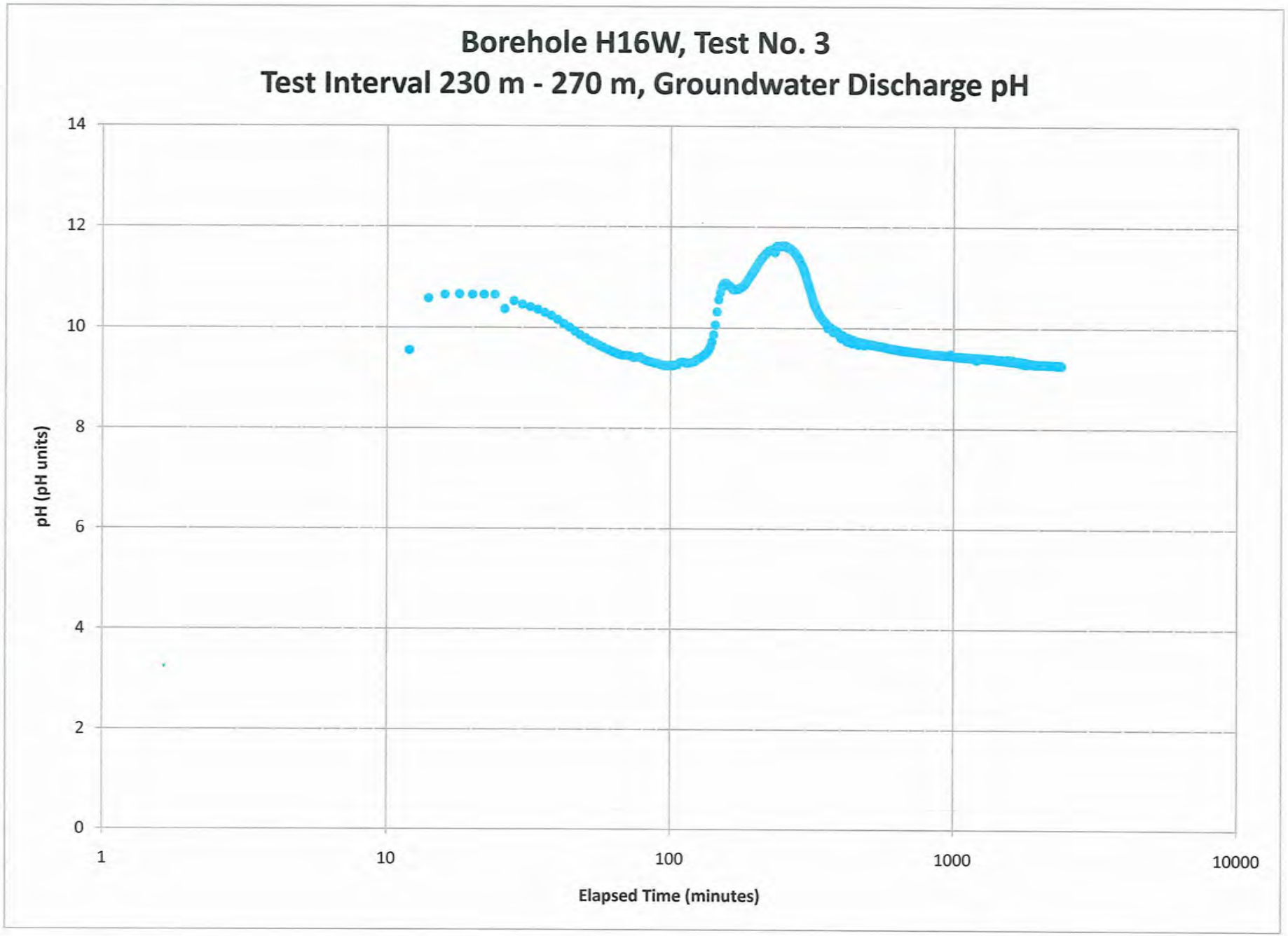


# Borehole H16W Test No. 3
## Temperature 230 m - 270 m

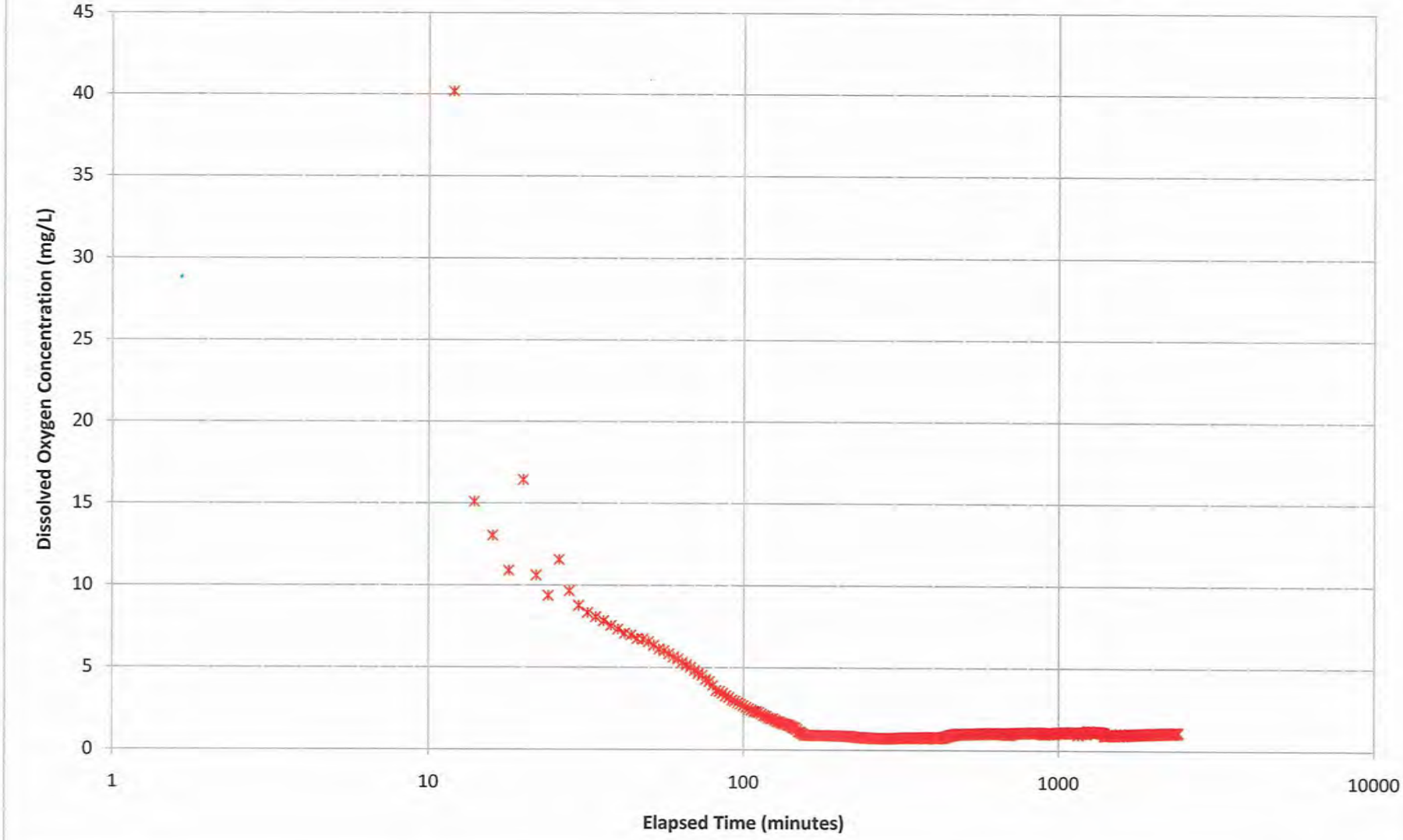


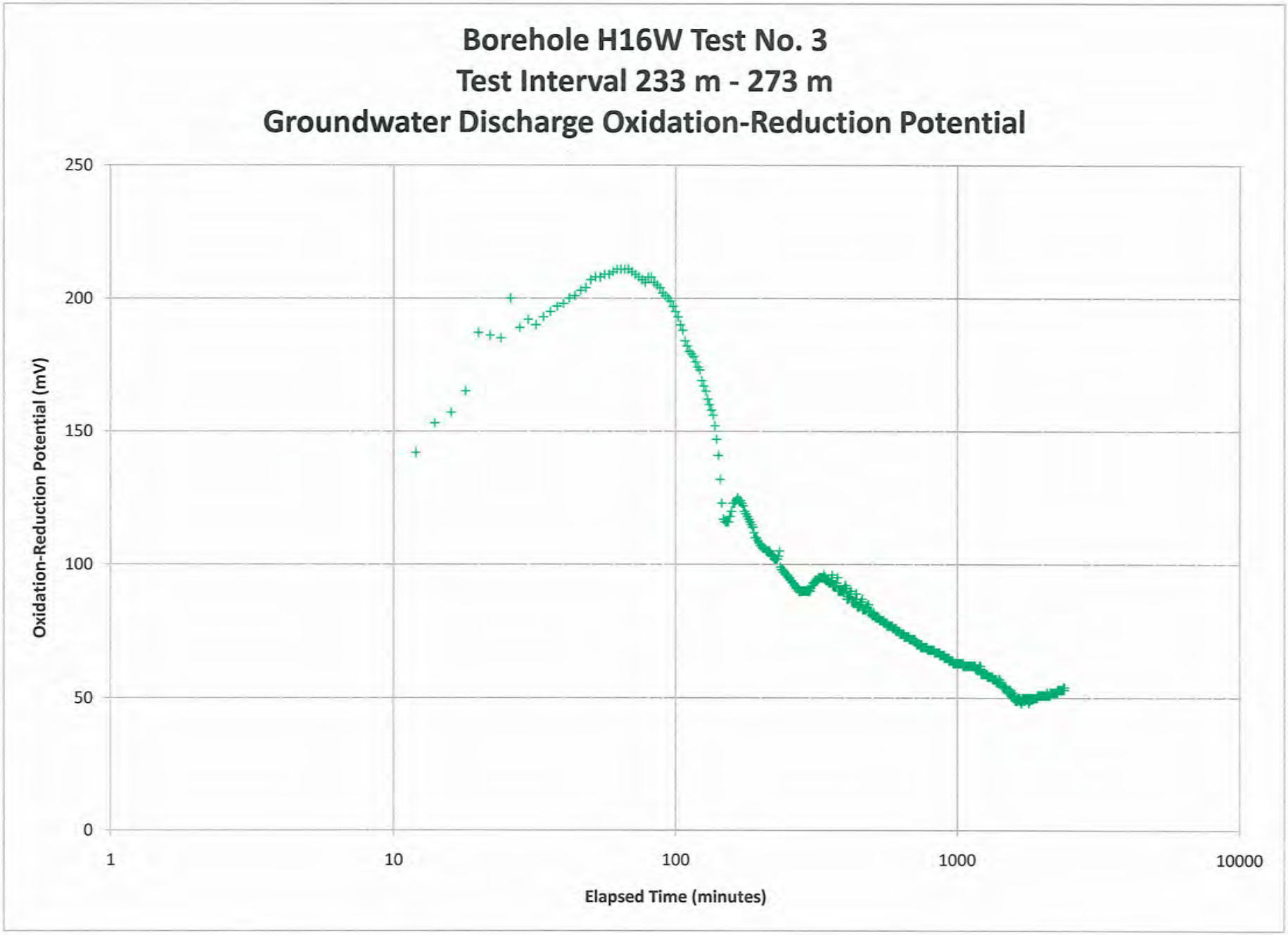
# Borehole H16W Test No. 3
## Test Interval 230 m - 270 m
## Groundwater Discharge Specific Conductance




Borehole H16W, Test No. 3
Test Interval 230 m - 270 m, Groundwater Discharge pH
pH (pH units)
14
12
10
8
6
4
2
0
1
10
100
1000
10000
Elapsed Time (minutes)

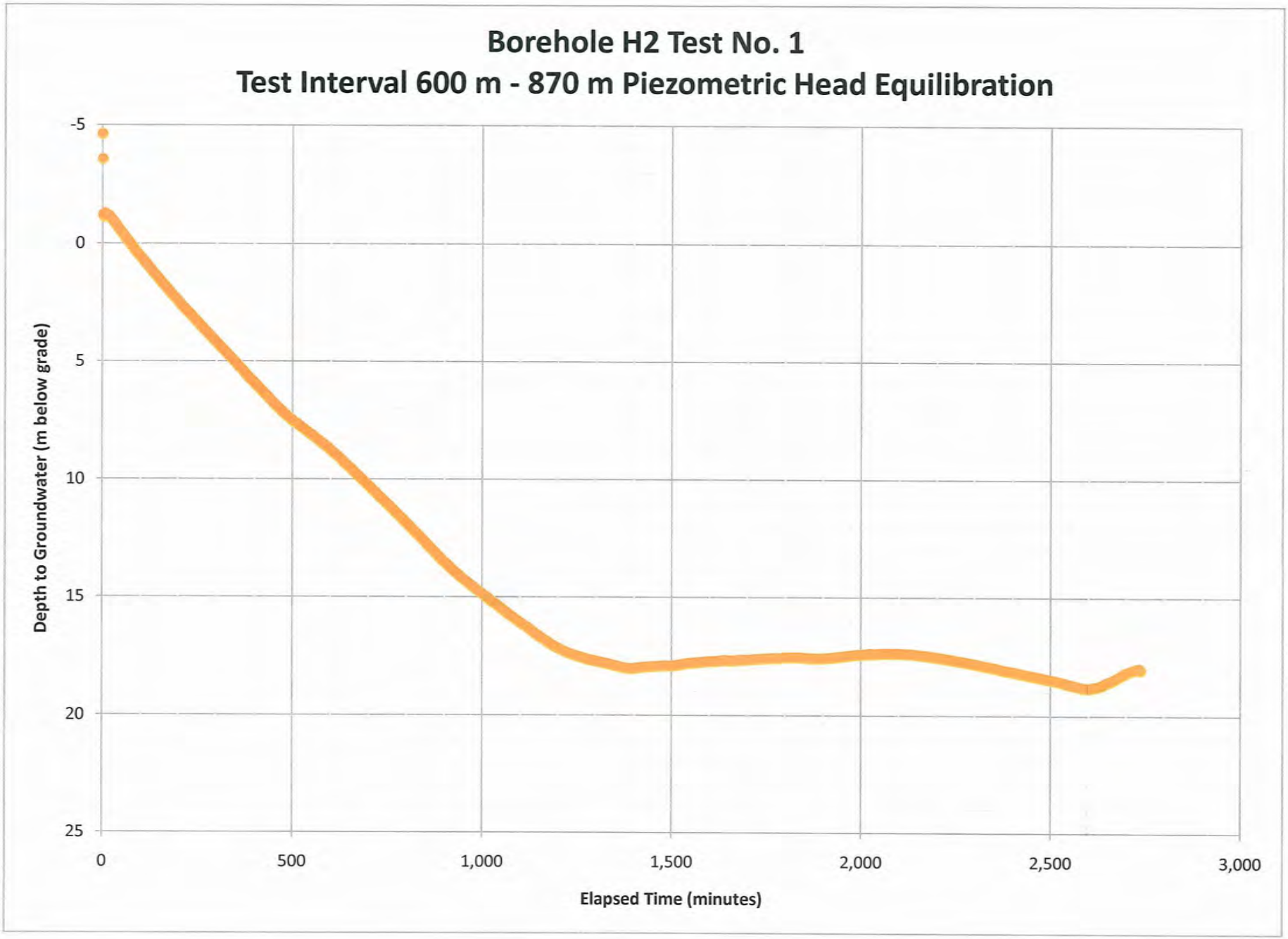
# Borehole H16W Test No. 3
## Test Interval 230 m - 270 m
## Groundwater Discharge Dissolved Oxygen Concentration

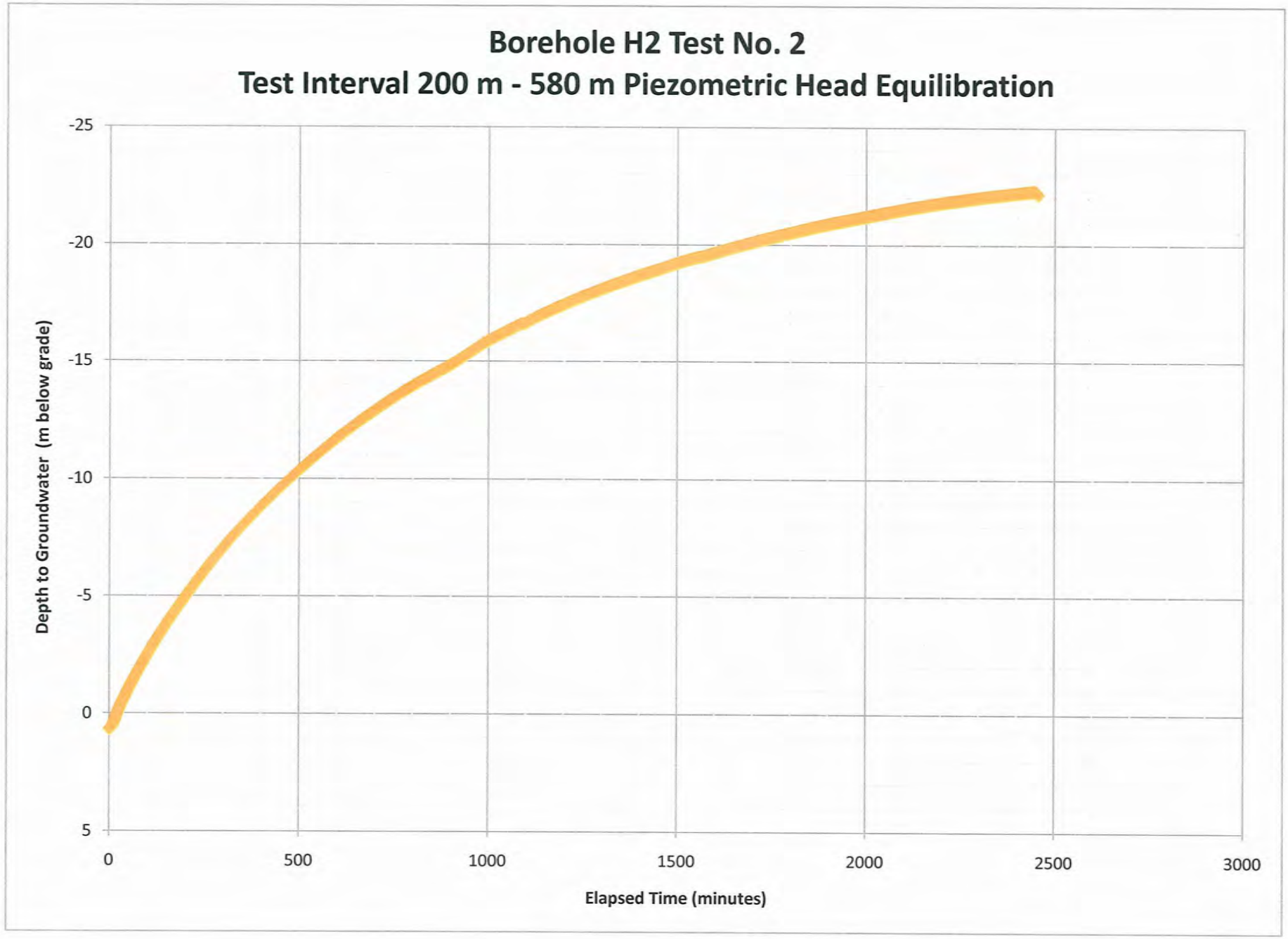


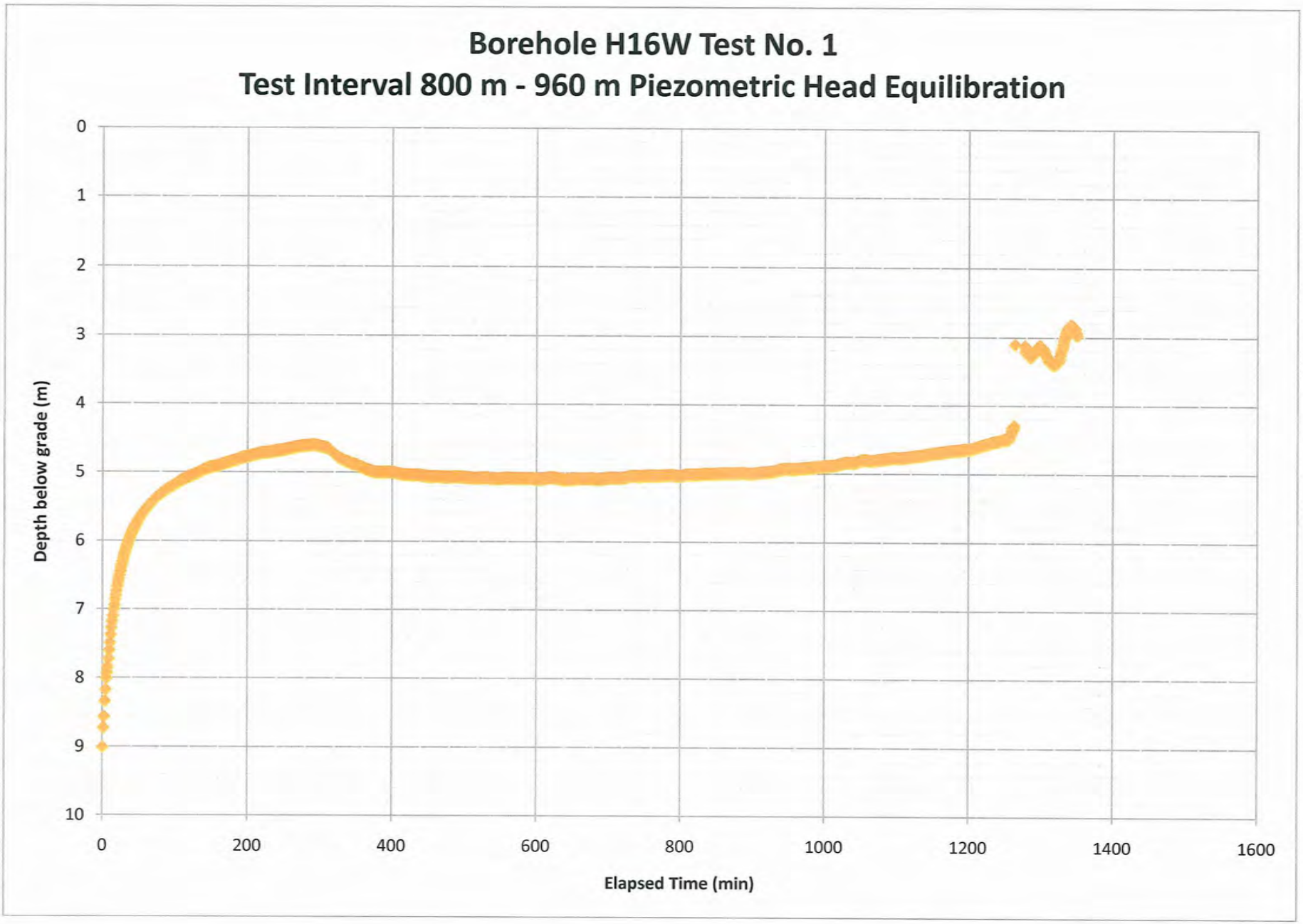

Borehole H16W Test No. 3
Test Interval 233 m - 273 m
Groundwater Discharge Oxidation-Reduction Potential
Oxidation-Reduction Potential (mV)
250
200
150
100
50
0
1
10
100
1000
10000
Elapsed Time (minutes)

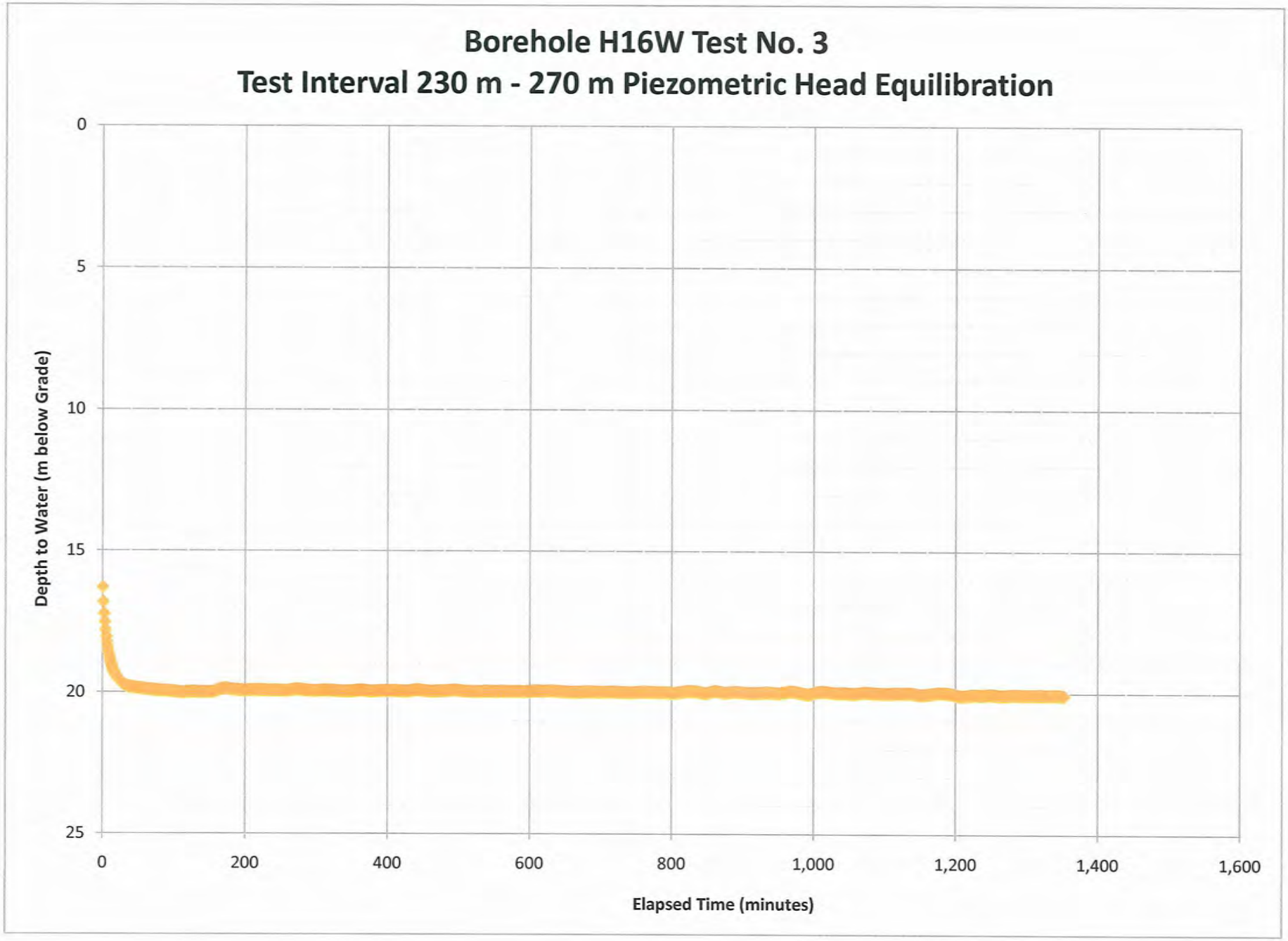
# APPENDIX F

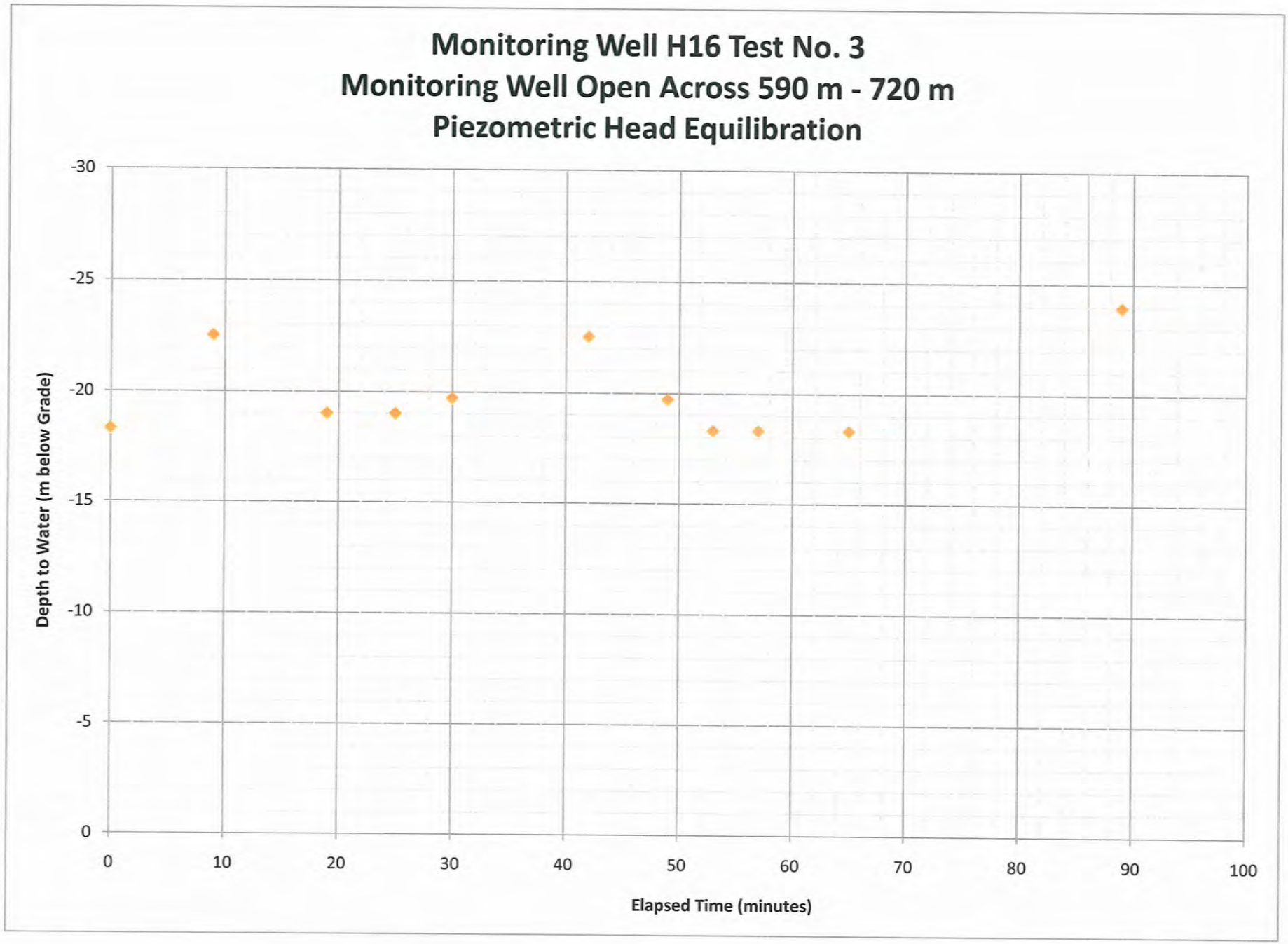
# EQUILIBRATED PIEZOMETRIC HEADS

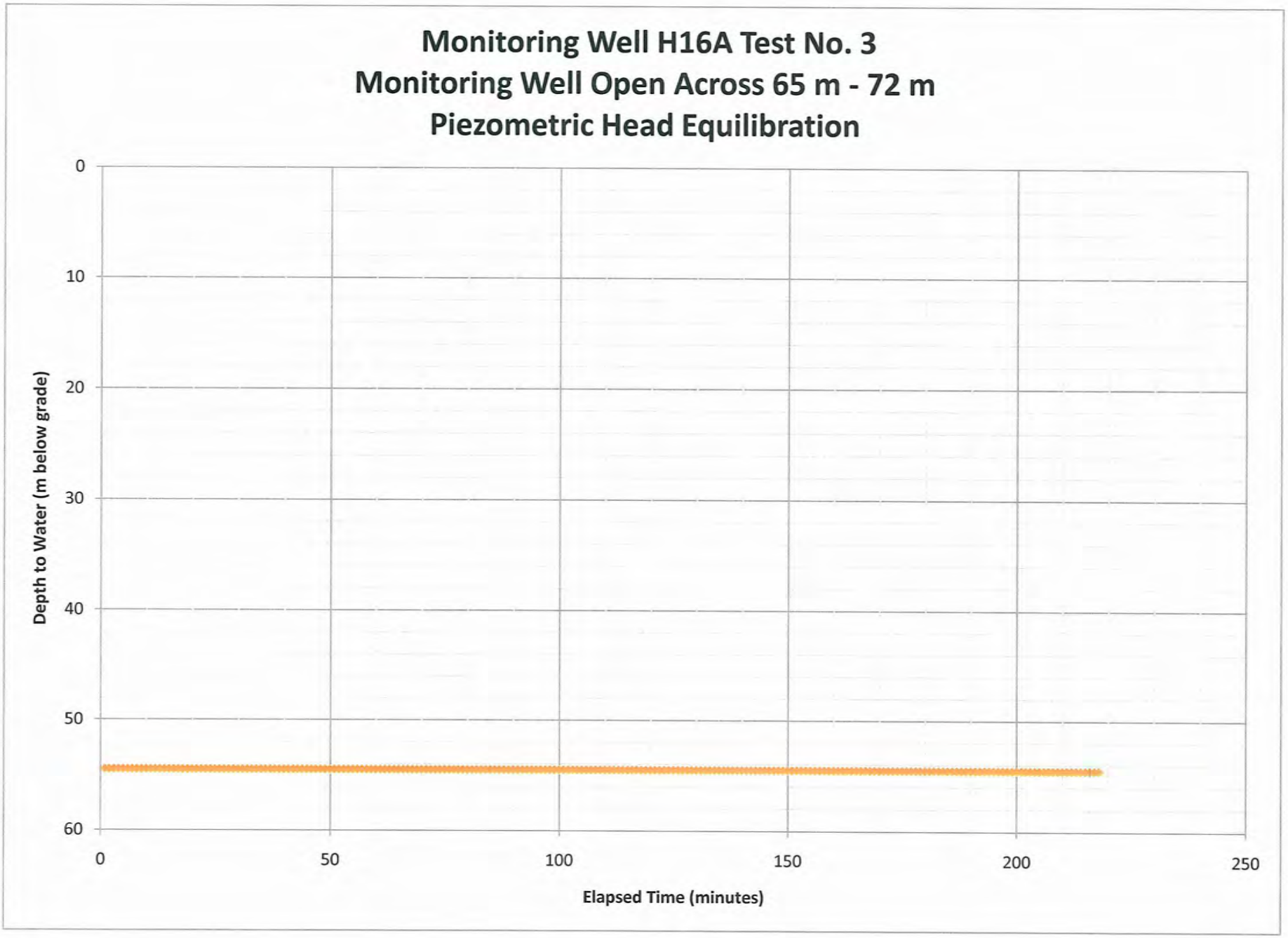

Borehole H2 Test No. 1
Test Interval 600 m - 870 m Piezometric Head Equilibration
Depth to Groundwater (m below grade)
-5
0
5
10
15
20
25
0
500
1,000
1,500
2,000
2,500
3,000
Elapsed Time (minutes)


Borehole H2 Test No. 2
Test Interval 200 m - 580 m Piezometric Head Equilibration
Depth to Groundwater (m below grade)
-25
-20
-15
-10
-5
0
5
0
500
1000
1500
2000
2500
3000
Elapsed Time (minutes)


Borehole H16W Test No. 1
Test Interval 800 m - 960 m Piezometric Head Equilibration
Depth below grade (m)
0
1
2
3
4
5
6
7
8
9
10
0
200
400
600
800
1000
1200
1400
1600
Elapsed Time (min)

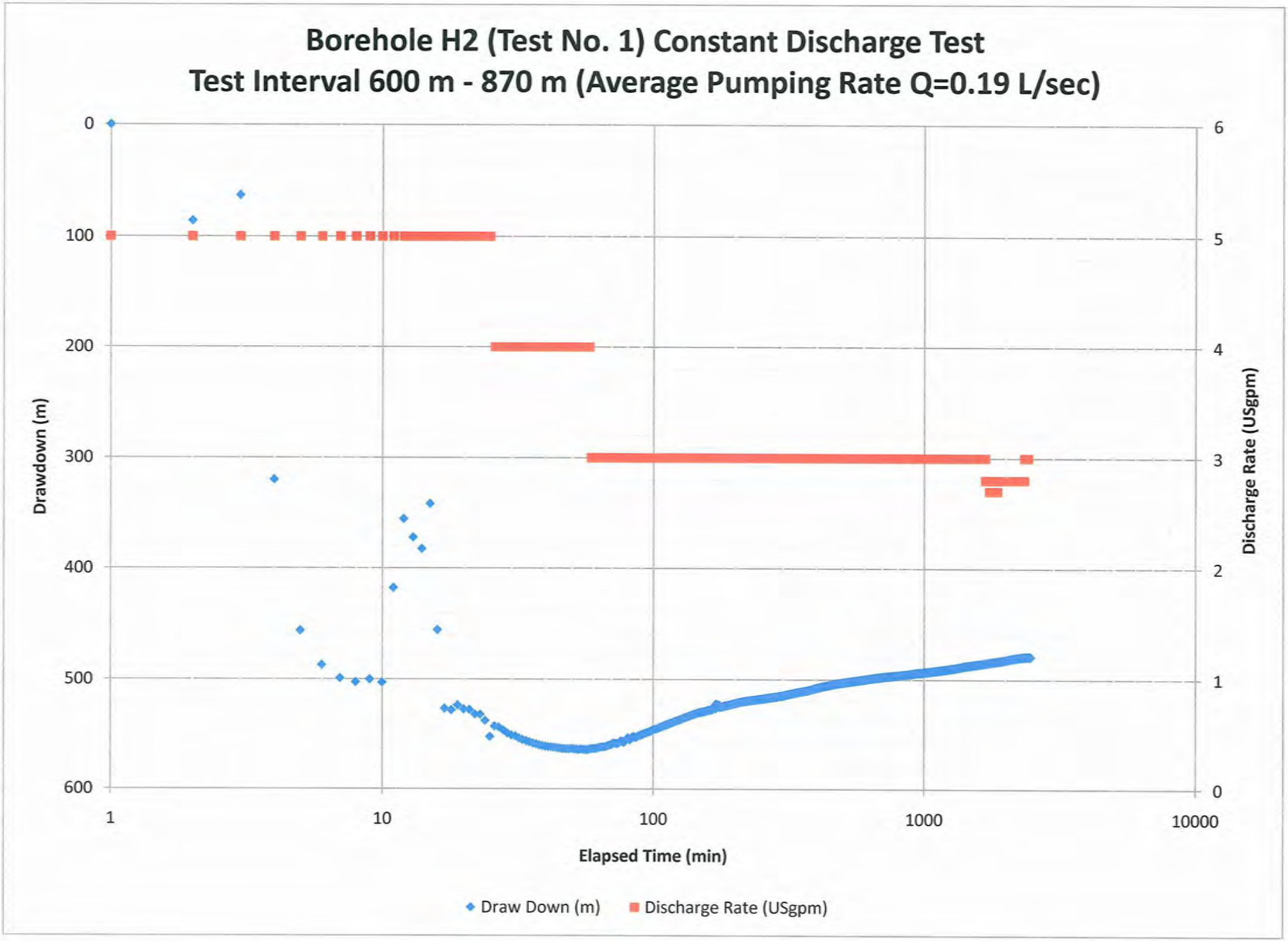

Borehole H16W Test No. 3
Test Interval 230 m - 270 m Piezometric Head Equilibration
Depth to Water (m below Grade)
0
5
10
15
20
25
0
200
400
600
800
1,000
1,200
1,400
1,600
Elapsed Time (minutes)

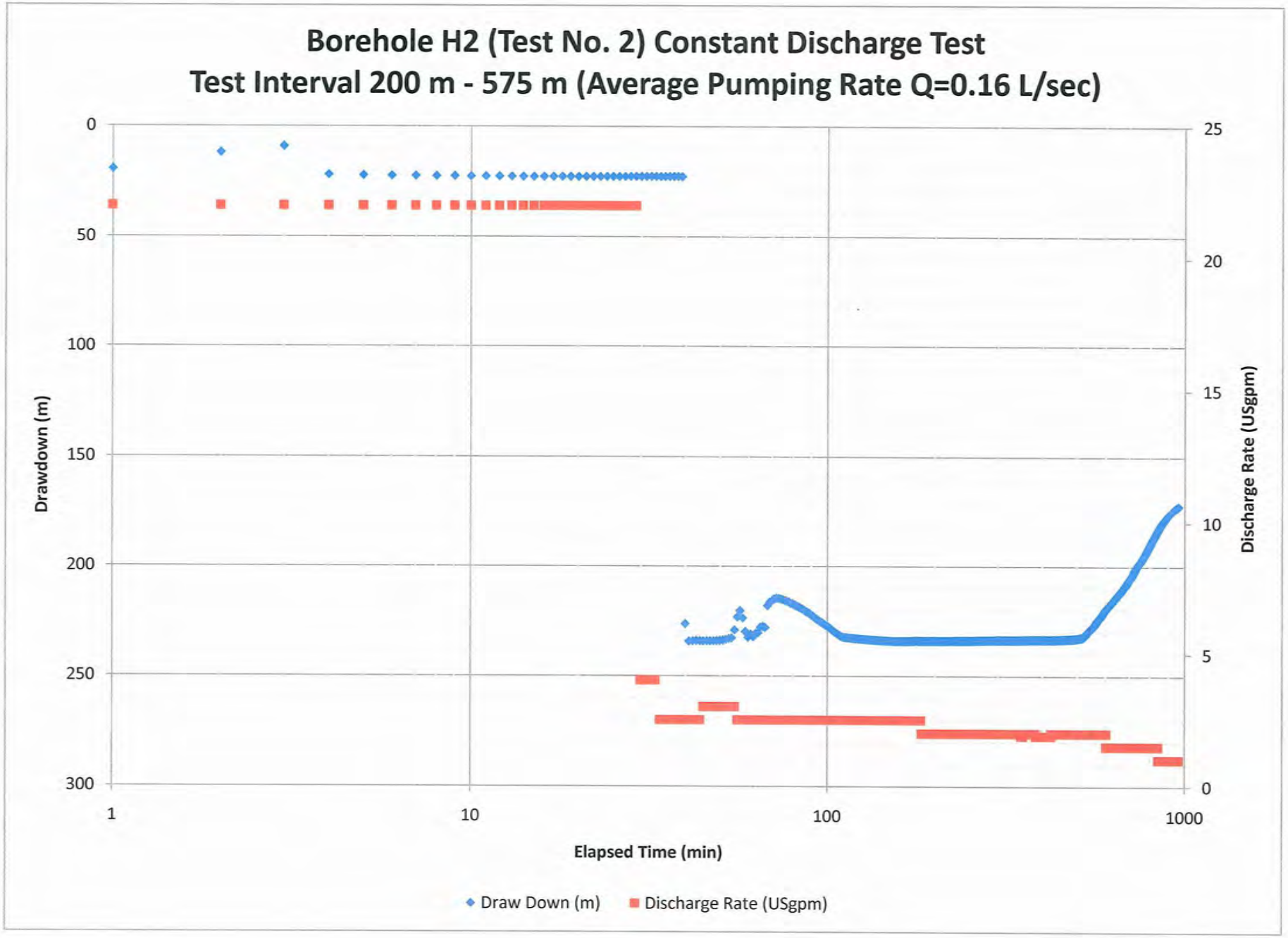

Monitoring Well H16 Test No. 3
Monitoring Well Open Across 590 m - 720 m
Piezometric Head Equilibration
Depth to Water (m below Grade)
-30
-25
-20
-15
-10
-5
0
0
10
20
30
40
50
60
70
80
90
100
Elapsed Time (minutes)

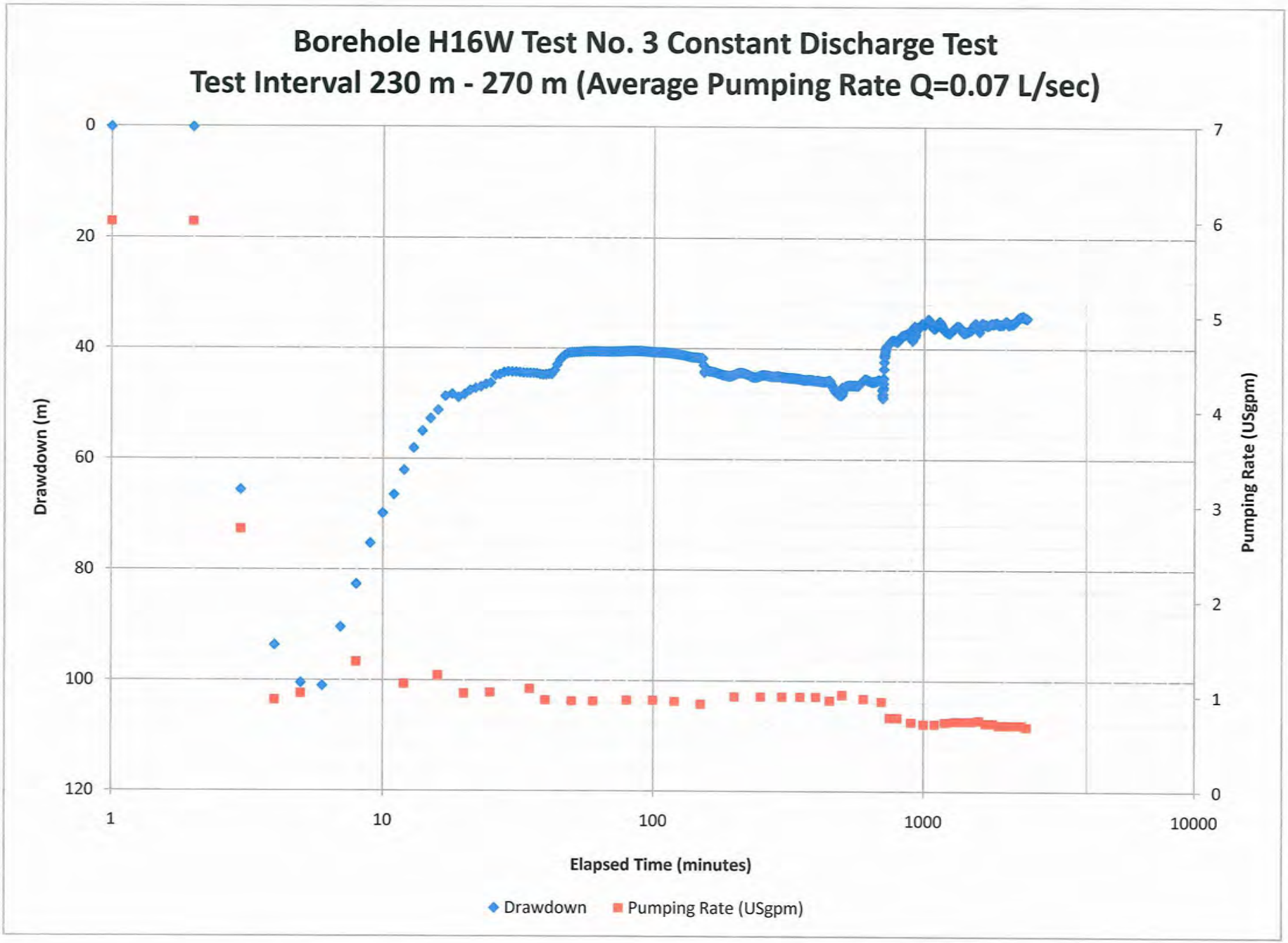

Monitoring Well H16A Test No. 3
Monitoring Well Open Across 65 m - 72 m
Piezometric Head Equilibration
Depth to Water (m below grade)
0
10
20
30
40
50
60
0
50
100
150
200
250
Elapsed Time (minutes)

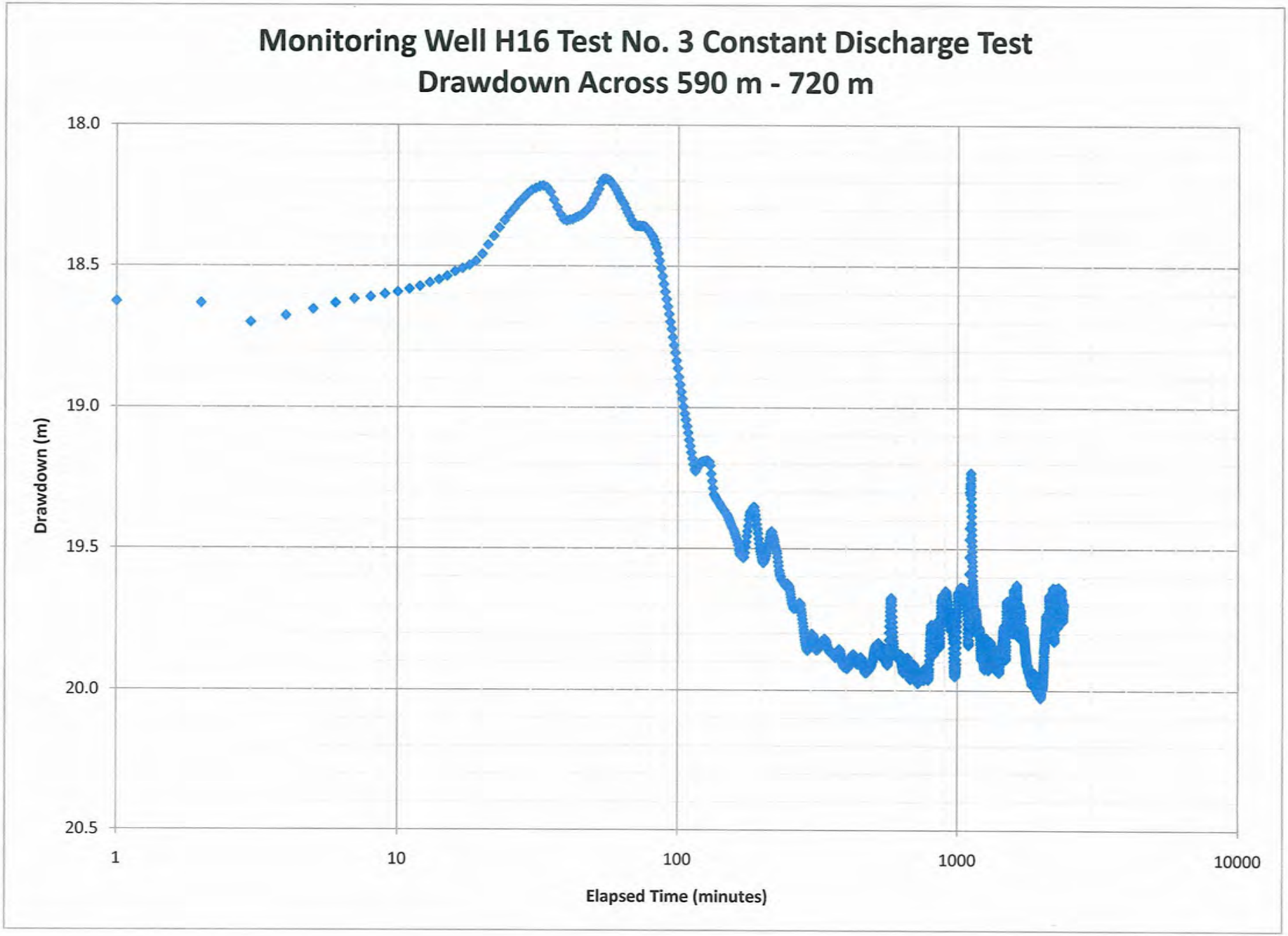
# APPENDIX G

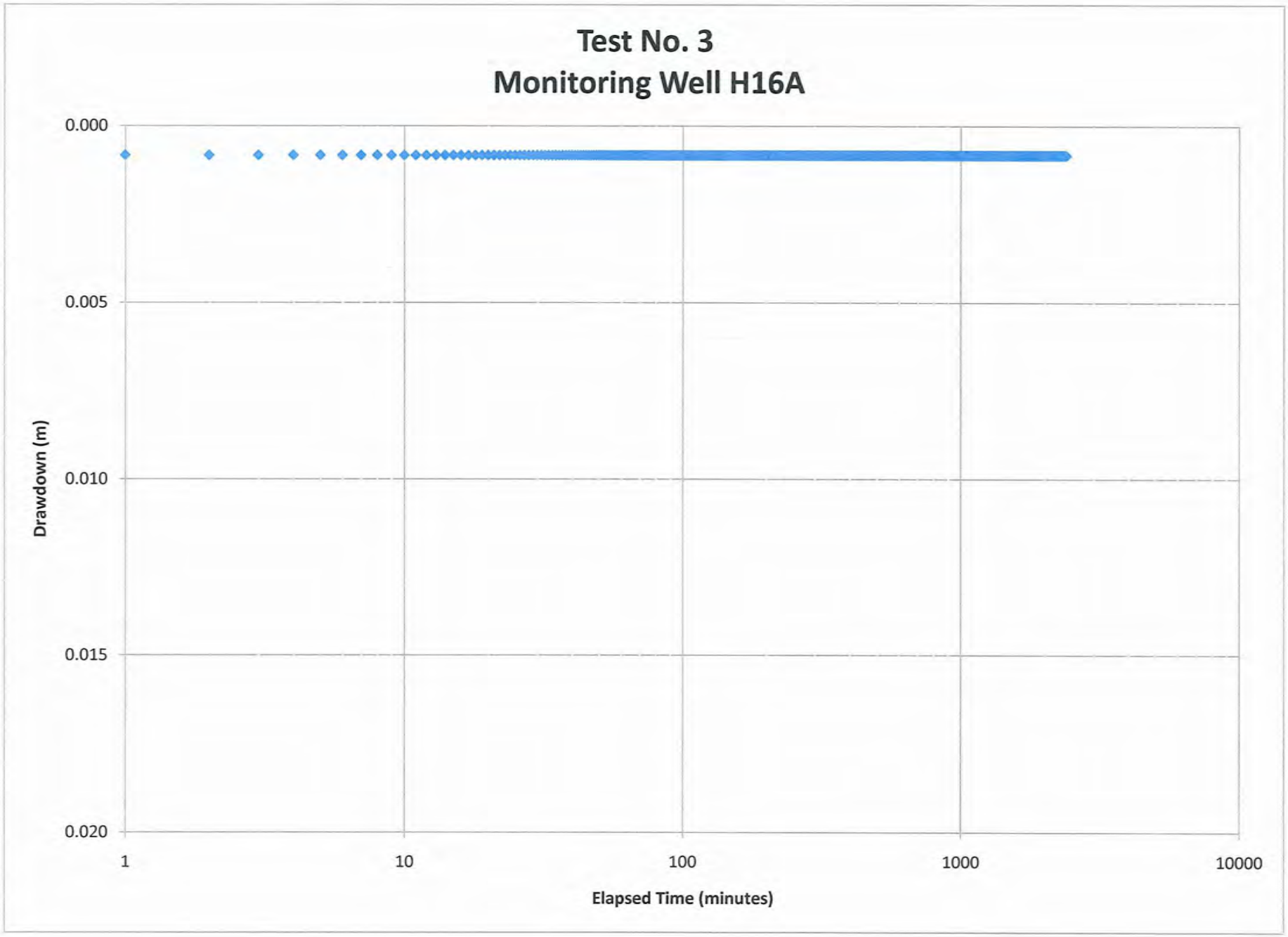
# CONSTANT DISCHARGE HEAD DATA


Borehole H2 (Test No. 1) Constant Discharge Test
Test Interval 600 m - 870 m (Average Pumping Rate Q=0.19 L/sec)
Drawdown (m)
0
100
200
300
400
500
600
Discharge Rate (USgpm)
6
5
4
3
2
1
0
1
10
100
1000
10000
Elapsed Time (min)
Draw Down (m)
Discharge Rate (USgpm)


Borehole H2 (Test No. 2) Constant Discharge Test
Test Interval 200 m - 575 m (Average Pumping Rate Q=0.16 L/sec)
Drawdown (m)
0
50
100
150
200
250
300
Discharge Rate (USgpm)
25
20
15
10
5
0
1
10
100
1000
Elapsed Time (min)
Draw Down (m)
Discharge Rate (USgpm)

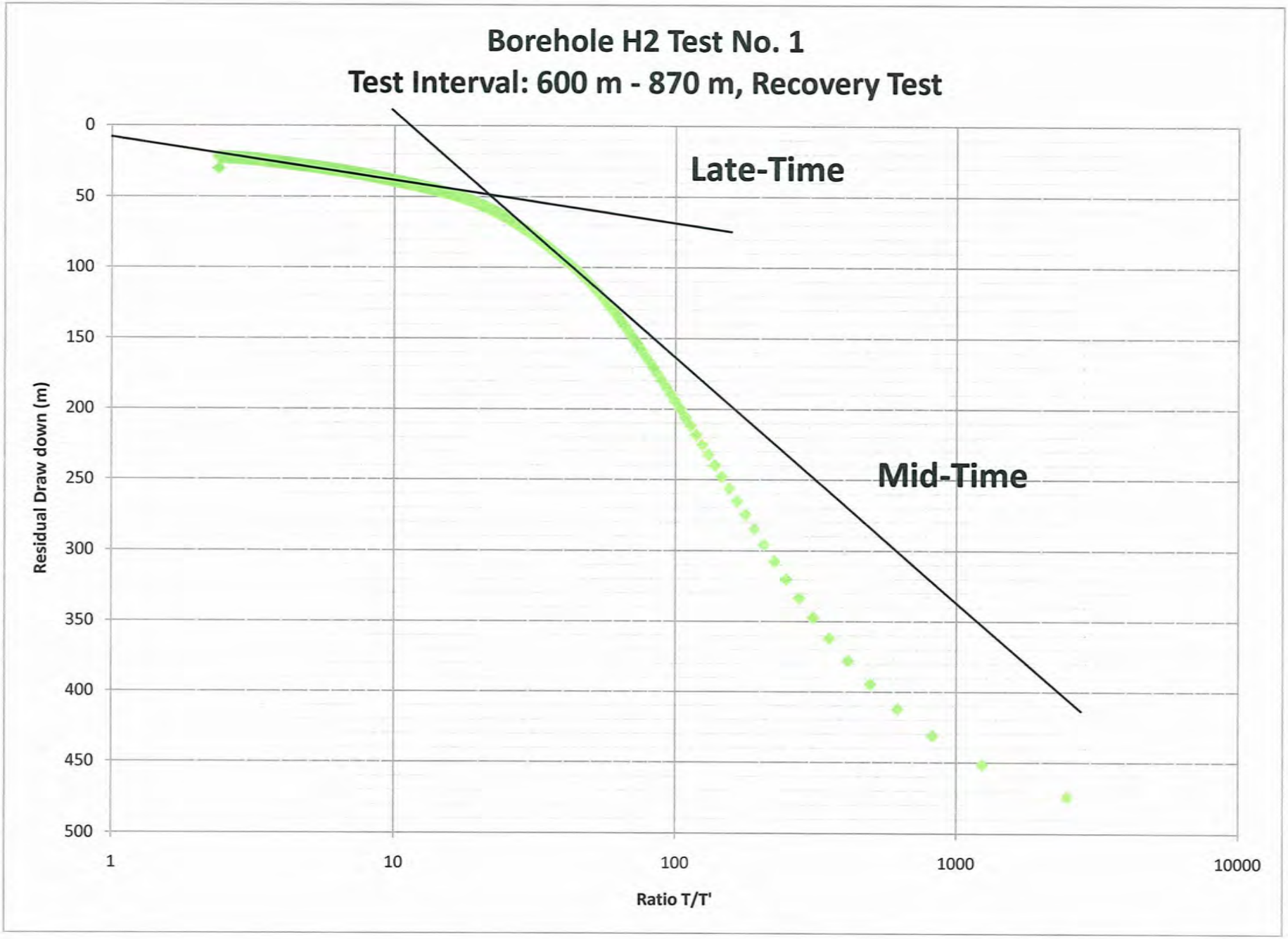

Borehole H16W Test No. 3 Constant Discharge Test
Test Interval 230 m - 270 m (Average Pumping Rate Q=0.07 L/sec)
Drawdown (m)
0
20
40
60
80
100
120
Pumping Rate (USgpm)
7
6
5
4
3
2
1
0
1
10
100
1000
10000
Elapsed Time (minutes)
Drawdown
Pumping Rate (USgpm)

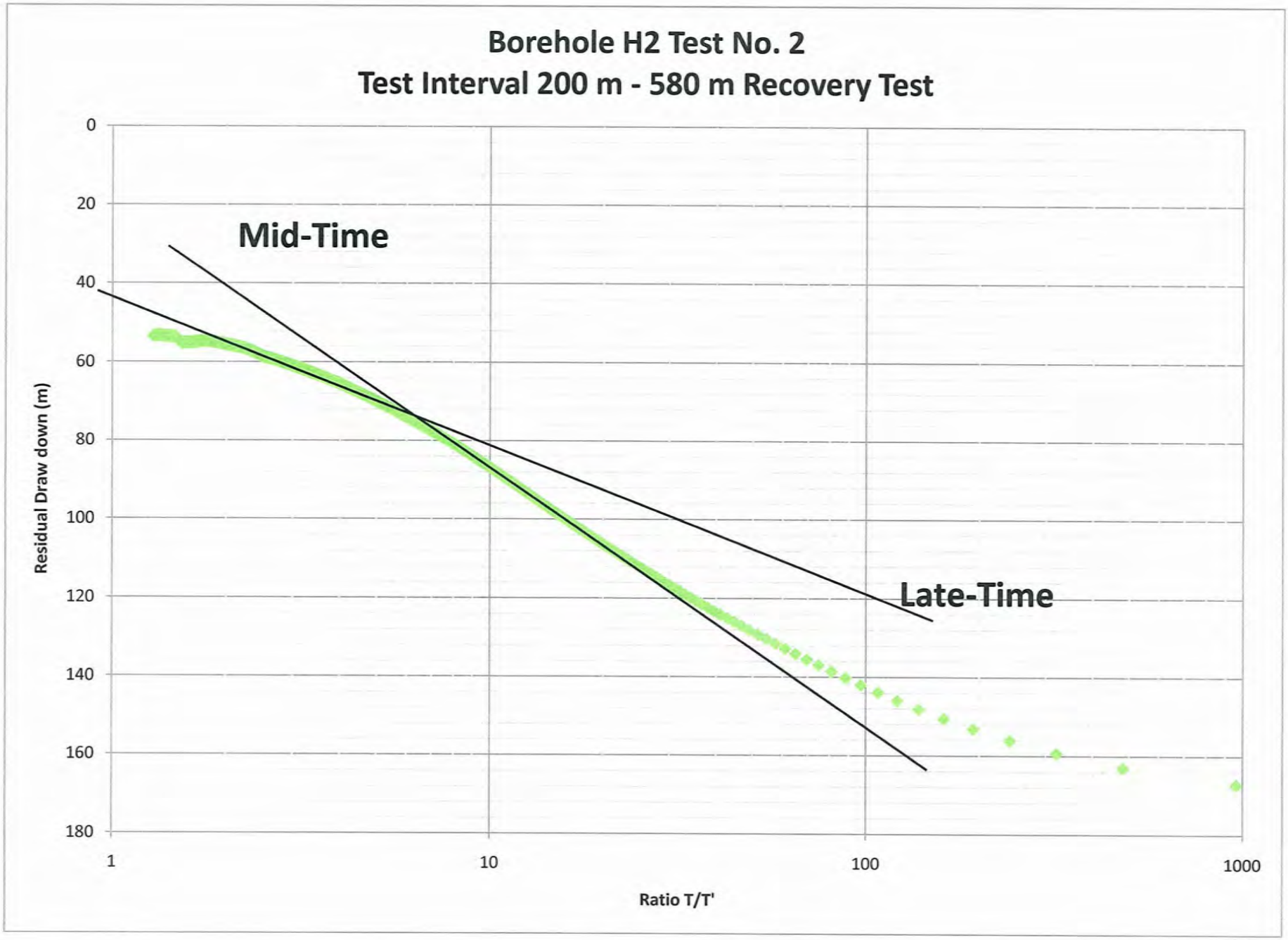

Monitoring Well H16 Test No. 3 Constant Discharge Test
Drawdown Across 590 m - 720 m
18.0
18.5
19.0
19.5
20.0
20.5
Drawdown (m)
1
10
100
1000
10000
Elapsed Time (minutes)

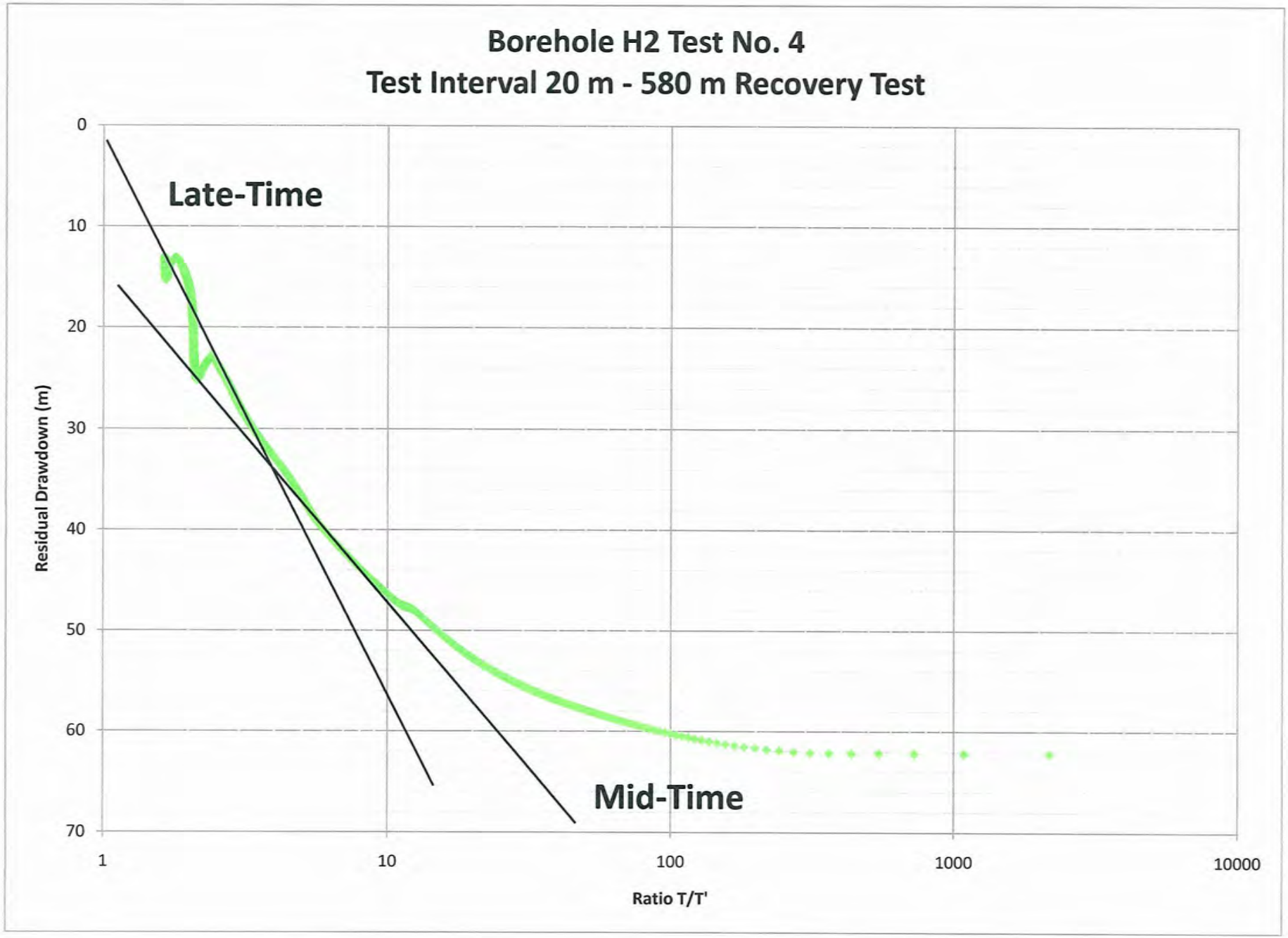

Test No. 3
Monitoring Well H16A
0.000
0.005
0.010
0.015
0.020
Drawdown (m)
1
10
100
1000
10000
Elapsed Time (minutes)

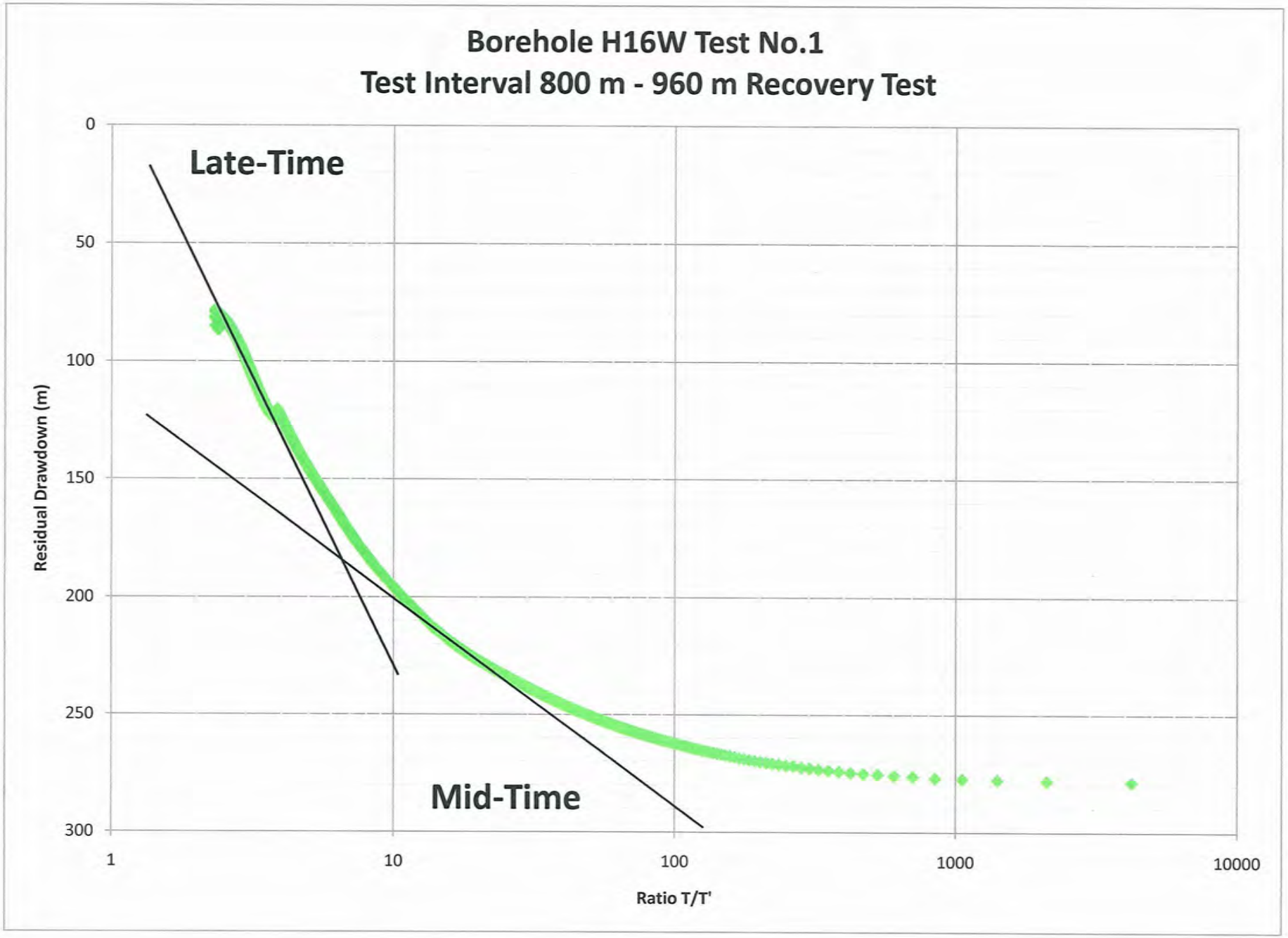
# APPENDIX H

# RECOVERY TEST DATA

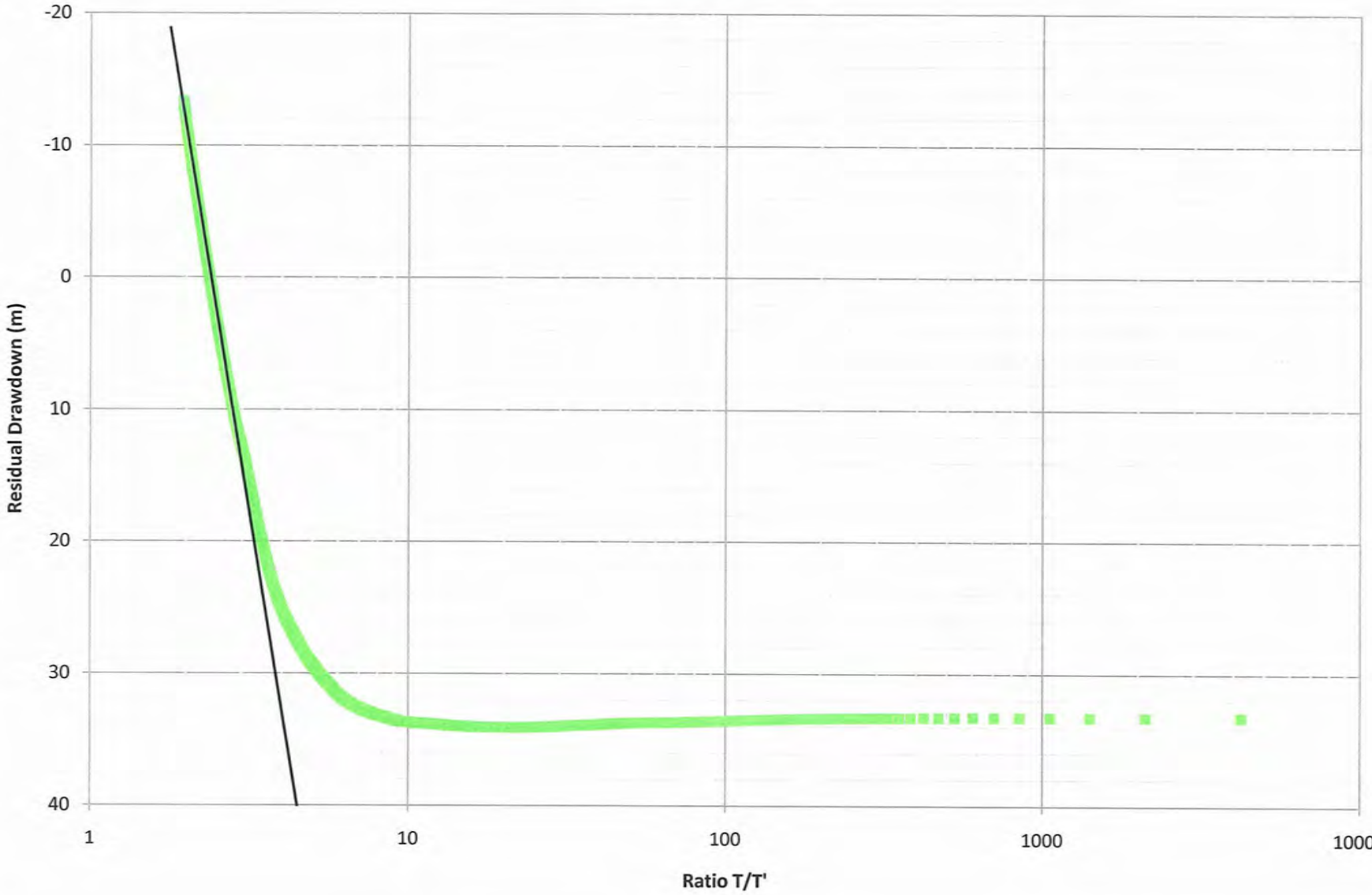

Borehole H2 Test No. 1
Test Interval: 600 m - 870 m, Recovery Test
Late-Time
Mid-Time
Residual Draw down (m)
0
50
100
150
200
250
300
350
400
450
500
1
10
100
1000
10000
Ratio T/T'


Borehole H2 Test No. 2
Test Interval 200 m - 580 m Recovery Test
Mid-Time
Late-Time
Residual Draw down (m)
0
20
40
60
80
100
120
140
160
180
1
10
100
1000
Ratio T/T'

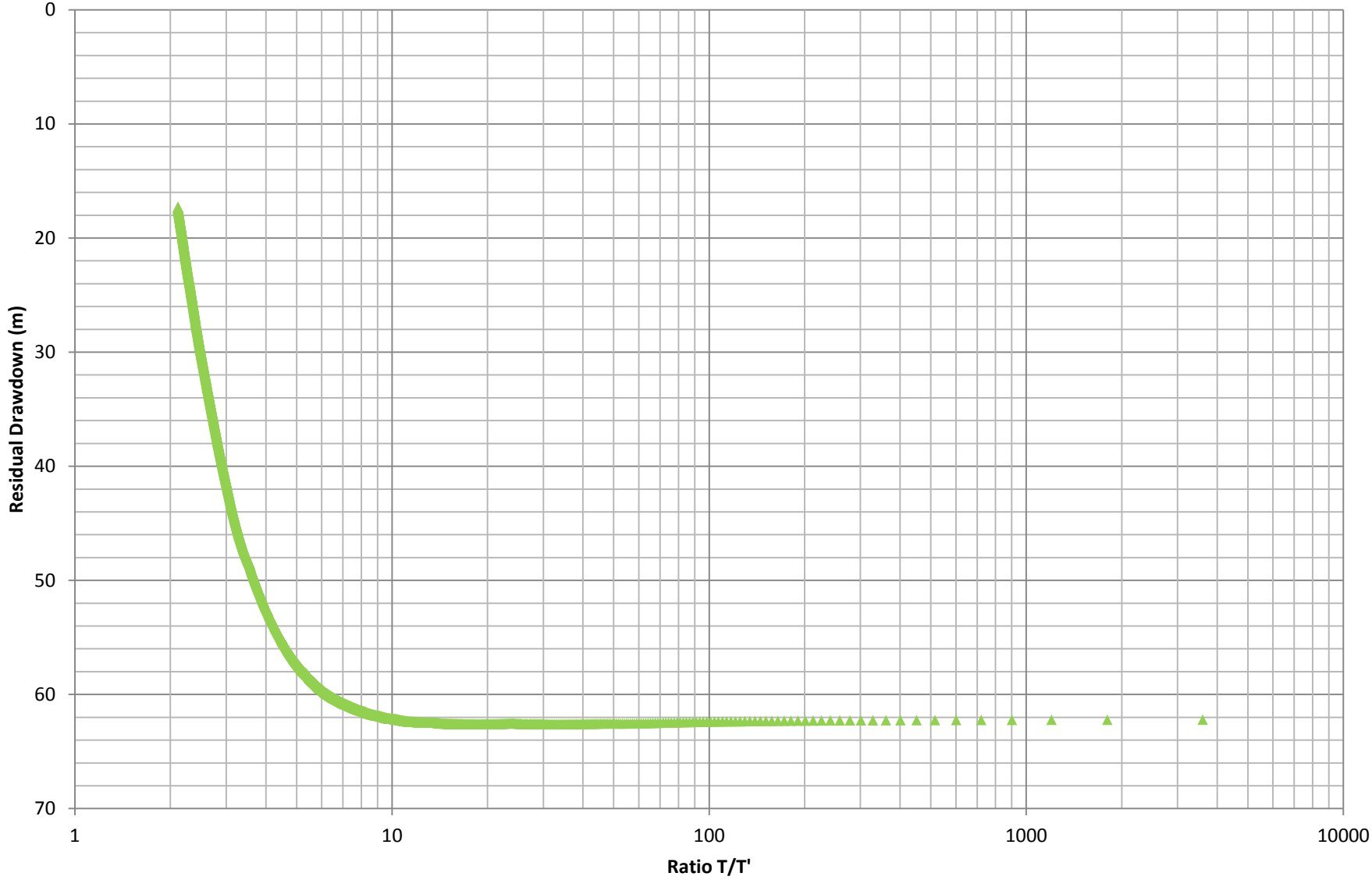

Borehole H2 Test No. 4
Test Interval 20 m - 580 m Recovery Test
Late-Time
Mid-Time
Residual Drawdown (m)
0
10
20
30
40
50
60
70
1
10
100
1000
10000
Ratio T/T'

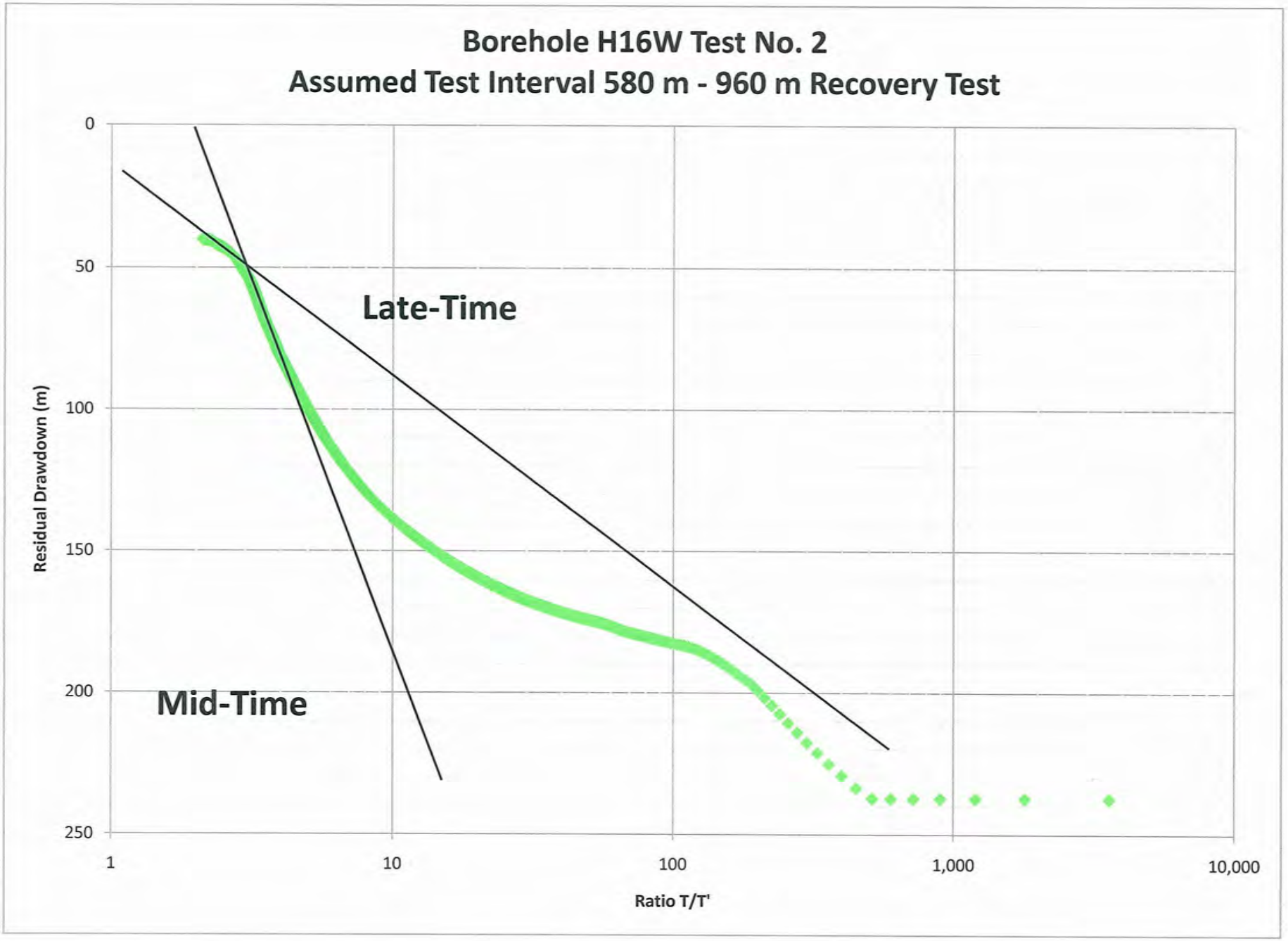

Borehole H16W Test No.1
Test Interval 800 m - 960 m Recovery Test
Late-Time
Mid-Time
Residual Drawdown (m)
0
50
100
150
200
250
300
1
10
100
1000
10000
Ratio T/T'

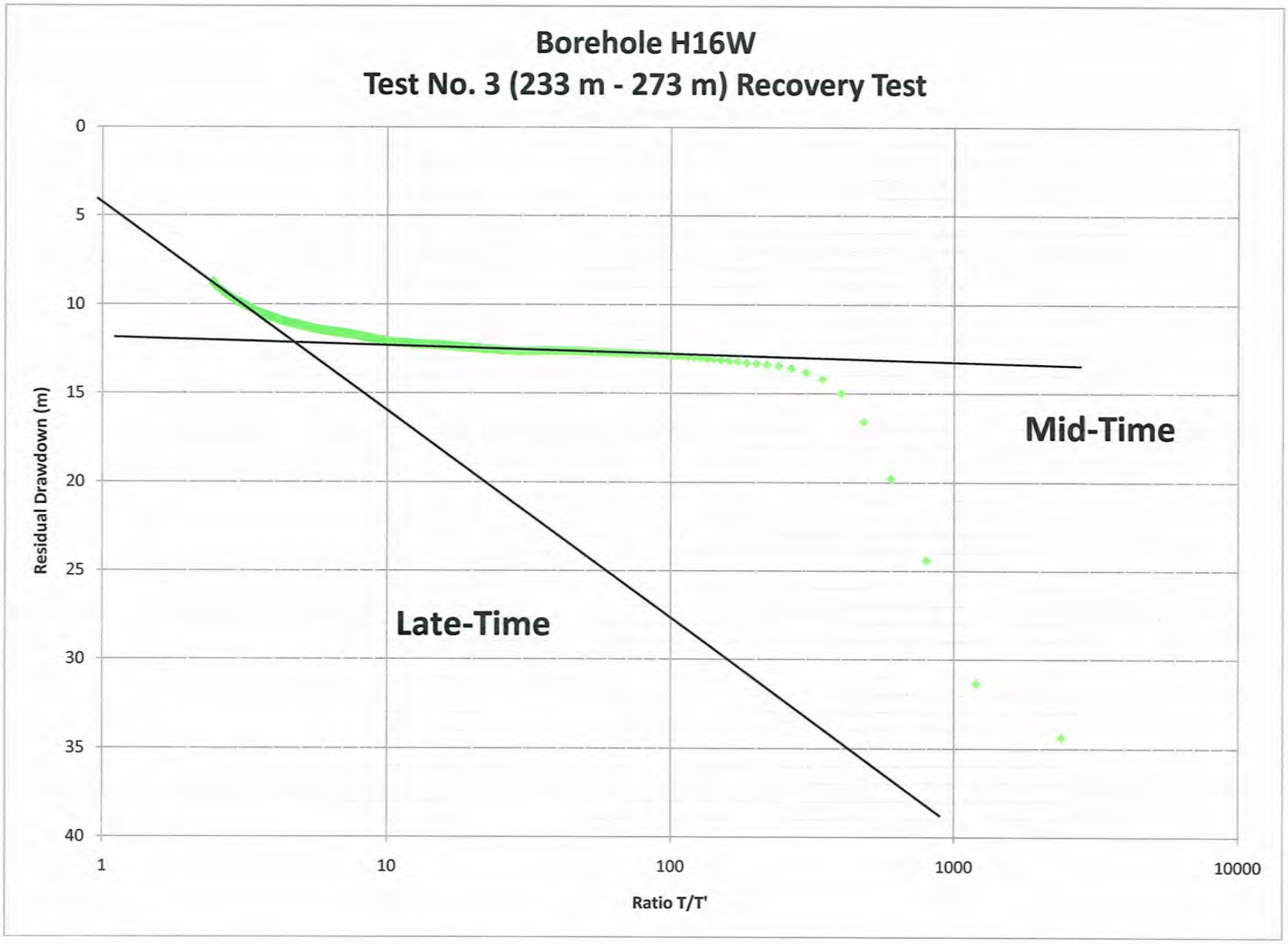
# Borehole H16 Observation Well Test No. 1
## Recovery Test



# Borehole H16 Observation Well Test No. 2
## Recovery Test

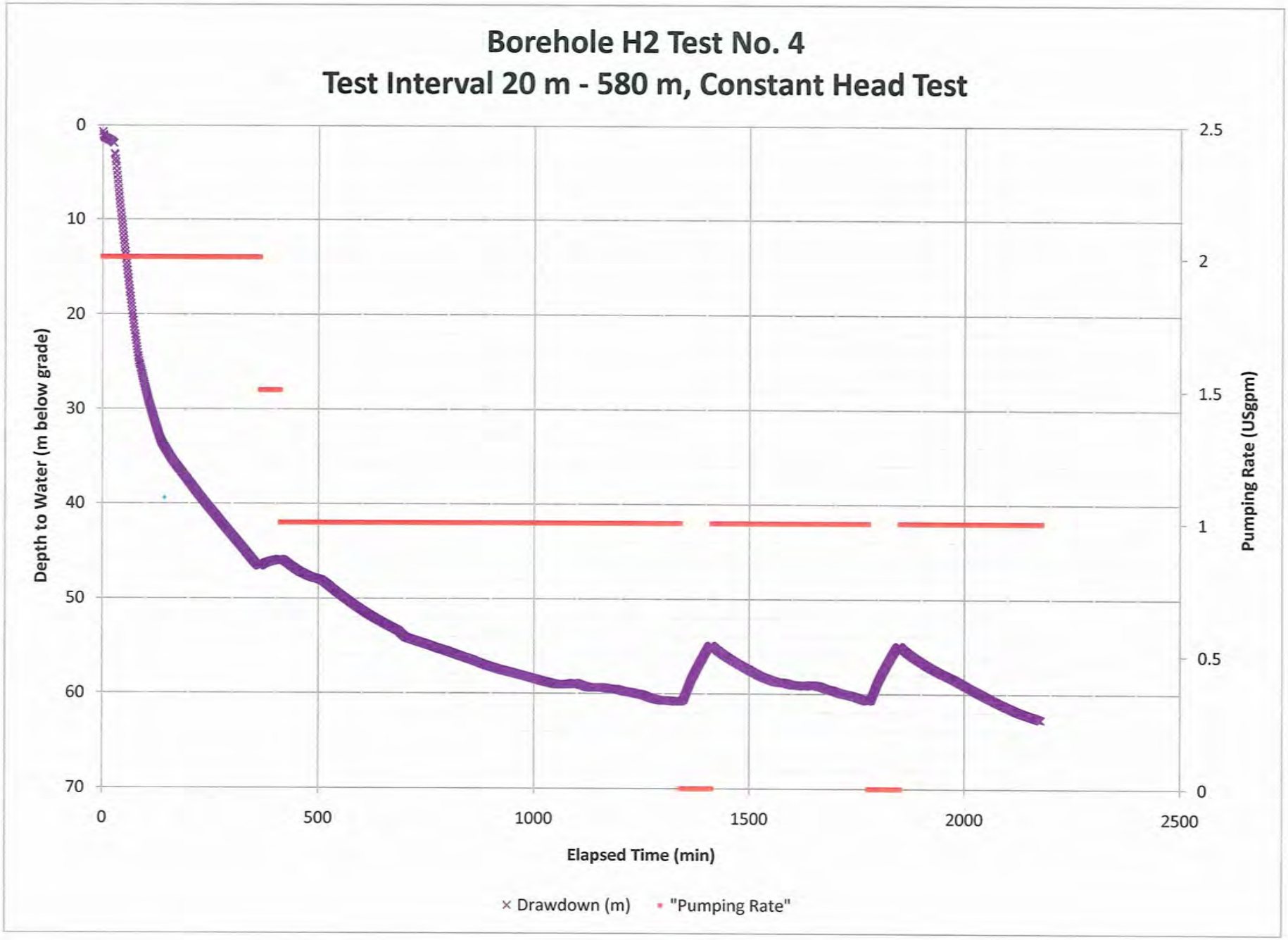


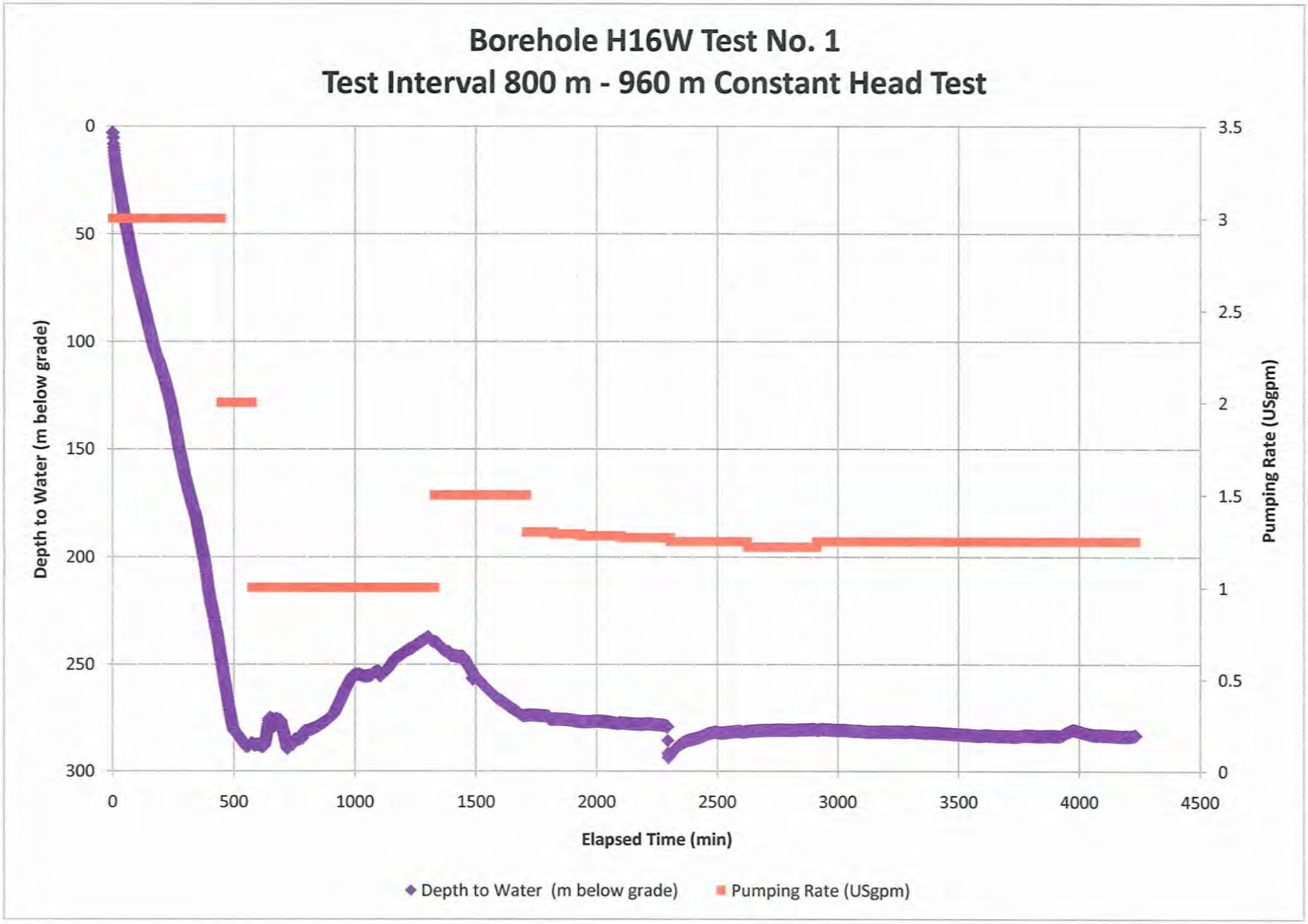

Borehole H16W Test No. 2
Assumed Test Interval 580 m - 960 m Recovery Test
Late-Time
Mid-Time
Residual Drawdown (m)
0
50
100
150
200
250
1
10
100
1,000
10,000
Ratio T/T'

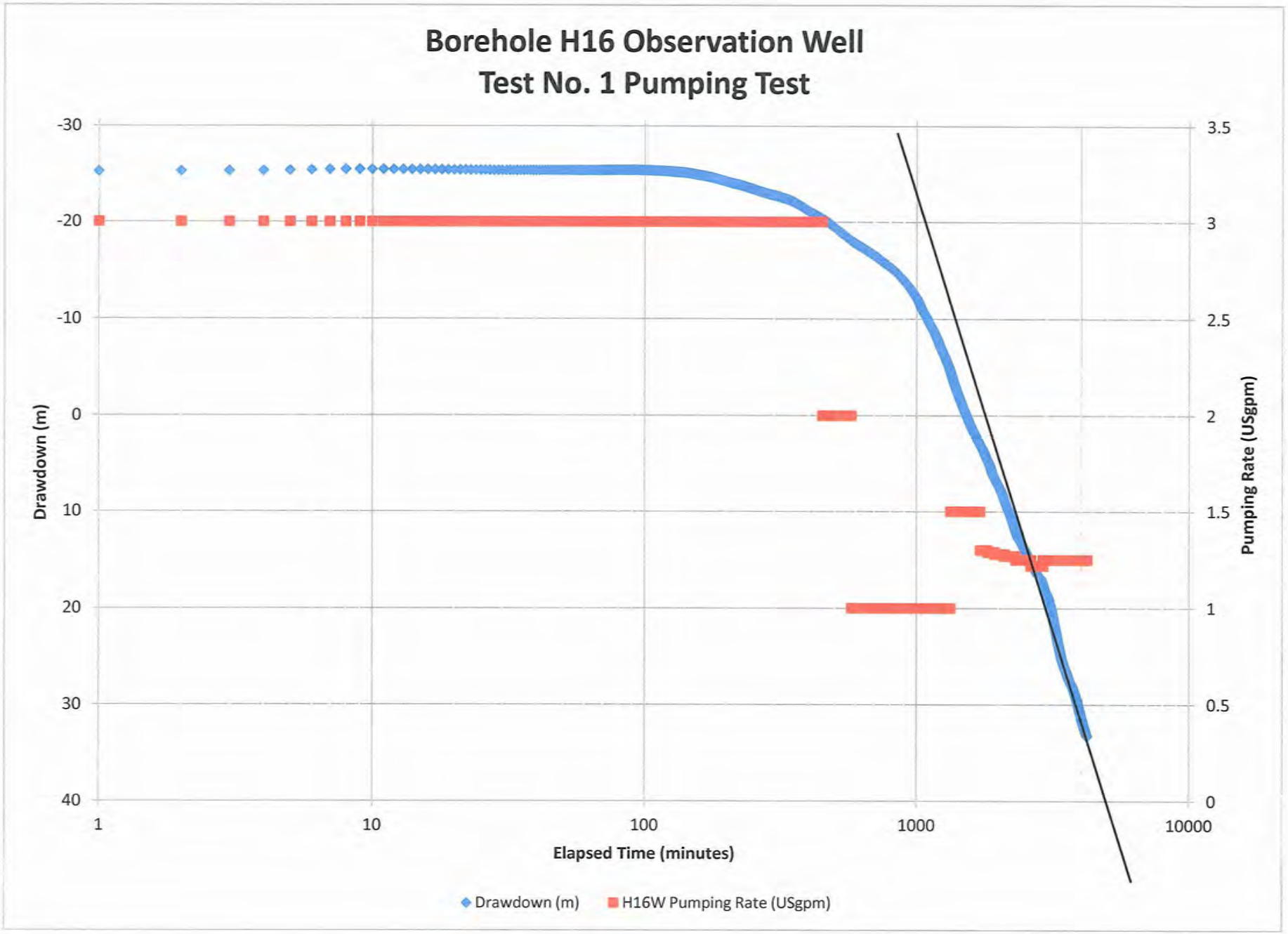

Borehole H16W
Test No. 3 (233 m - 273 m) Recovery Test
Residual Drawdown (m)
0
5
10
15
20
25
30
35
40
1
10
100
1000
10000
Ratio T/T'
Mid-Time
Late-Time

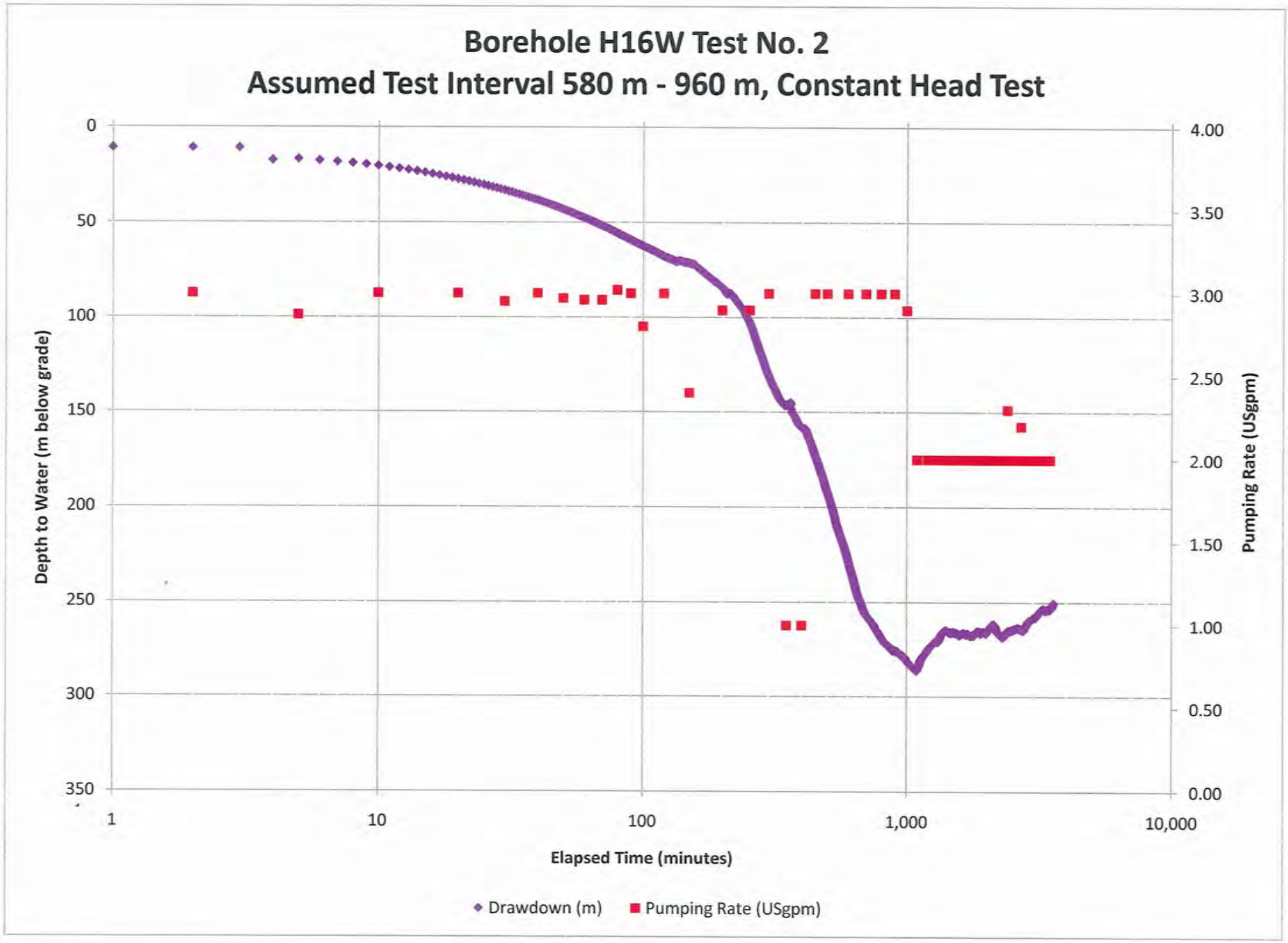
# APPENDIX I

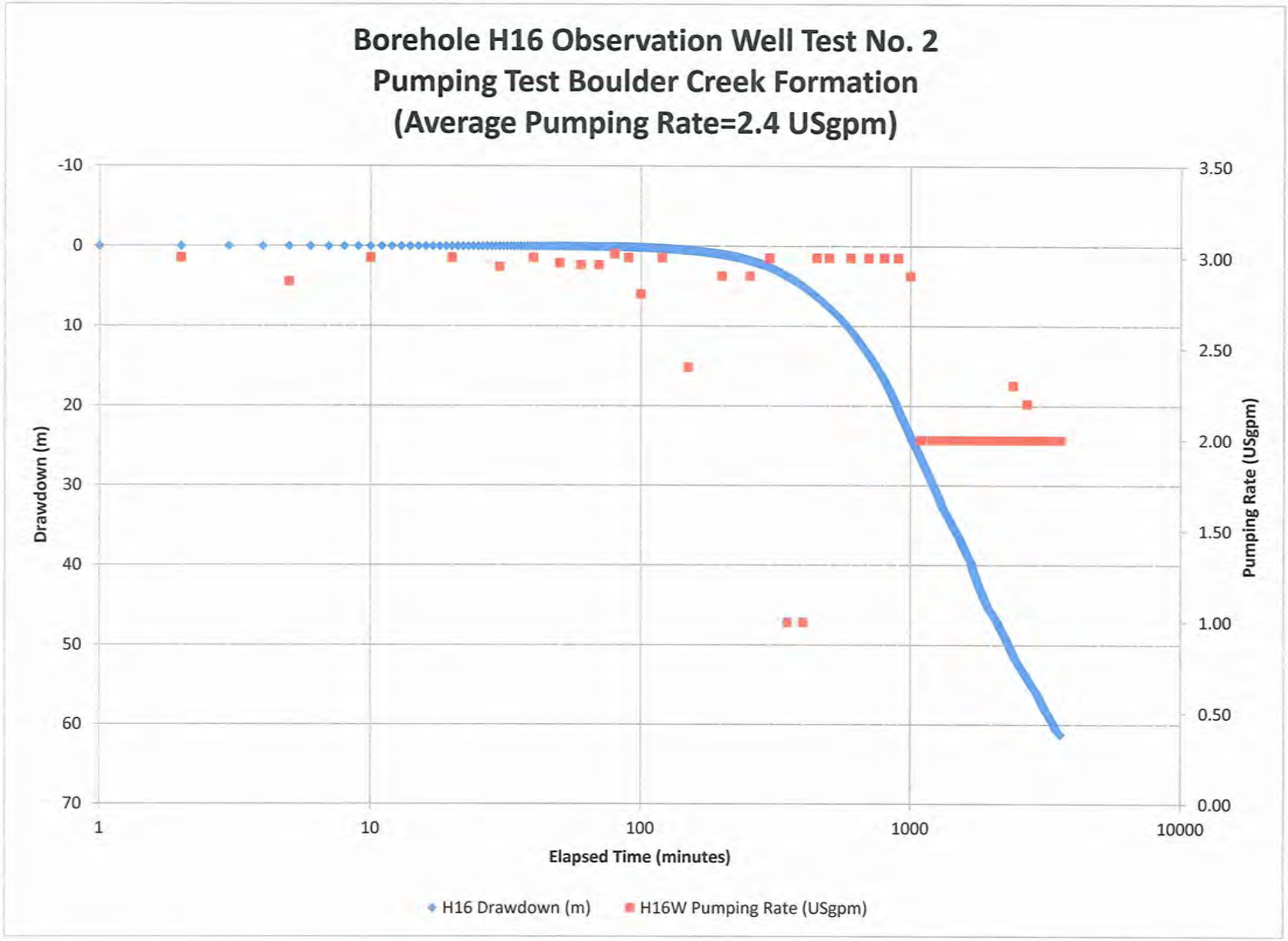
# CONSTANT HEAD TEST DATA


Borehole H2 Test No. 4
Test Interval 20 m - 580 m, Constant Head Test
Depth to Water (m below grade)
0
10
20
30
40
50
60
70
Pumping Rate (USgpm)
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
Elapsed Time (min)
Drawdown (m)
"Pumping Rate"


Borehole H16W Test No. 1
Test Interval 800 m - 960 m Constant Head Test
Depth to Water (m below grade)
0
50
100
150
200
250
300
Pumping Rate (USgpm)
3.5
3
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Elapsed Time (min)
Depth to Water (m below grade)
Pumping Rate (USgpm)


Borehole H16 Observation Well
Test No. 1 Pumping Test
-30
-20
-10
0
10
20
30
40
Drawdown (m)
3.5
3
2.5
2
1.5
1
0.5
0
Pumping Rate (USgpm)
1
10
100
1000
10000
Elapsed Time (minutes)
Drawdown (m)
H16W Pumping Rate (USgpm)


Borehole H16W Test No. 2
Assumed Test Interval 580 m - 960 m, Constant Head Test
Depth to Water (m below grade)
0
50
100
150
200
250
300
350
Pumping Rate (USgpm)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1
10
100
1,000
10,000
Elapsed Time (minutes)
Drawdown (m)
Pumping Rate (USgpm)


Borehole H16 Observation Well Test No. 2
Pumping Test Boulder Creek Formation
(Average Pumping Rate=2.4 USgpm)
-10
0
10
20
30
40
50
60
70
Drawdown (m)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Pumping Rate (USgpm)
1
10
100
1000
10000
Elapsed Time (minutes)
H16 Drawdown (m)
H16W Pumping Rate (USgpm)

# APPENDIX J

# ANALYTICAL LABORATORY REPORTS

AMEC EARTH & ENVIRONMENTAL
ATTN: TAMMERA KOSTYA
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 04-APR-11
Report Date: 19-MAY-11 17:45 (MT)
Version: FINAL REV. 2

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L991723**
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051120

**Comments:** ADDITIONAL 17-MAY-11 16:37
ADDITIONAL 11-MAY-11 12:46

Selam Worku
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L991723-1 | L991723-2 | | | |
| | **Description** | | | | | |
| | **Sampled Date** | 03-APR-11 | 03-APR-11 | | | |
| | **Sampled Time** | 11:00 | 11:00 | | | |
| | **Client ID** | P2C21 (H2) DEPTH:600-870M | P2C21 (H2) DEPTH:600-870M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | | | | |
| | Conductivity (uS/cm) | 1130 | | | | |
| | Hardness (as CaCO3) (mg/L) | 111 | 137 | | | |
| | pH (pH) | 8.32 | | | | |
| | Total Dissolved Solids (mg/L) | 667 | | | | |
| | Turbidity (NTU) | 354 | | | | |
| **Anions and Nutrients** | Alkalinity, Total (as CaCO3) (mg/L) | 496 | | | | |
| | Ammonia as N (mg/L) | 0.359 | | | | |
| | Chloride (Cl) (mg/L) | 64.8 | | | | |
| | Fluoride (F) (mg/L) | <0.20 | | | | |
| | Nitrate (as N) (mg/L) | <0.050 | | | | |
| | Nitrite (as N) (mg/L) | <0.010 | | | | |
| | Sulfate (SO4) (mg/L) | 38.5 | | | | |
| | Sulphide as S (Dissolved) (mg/L) | <0.020 | | | | |
| **Cyanides** | Cyanide, Total (mg/L) | <0.0050 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 7.26 | | | | |
| **Inorganic Parameters** | Sulphide As S (Un-ionized) (mg/L) | <0.020 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 17.2 | 20.9 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.0025 DLA | 0.00044 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00500 | 0.00505 | | | |
| | Barium (Ba)-Total (mg/L) | 2.60 | 2.70 | | | |
| | Beryllium (Be)-Total (mg/L) | | <0.0010 DLA | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.0010 DLA | | | |
| | Boron (B)-Total (mg/L) | 0.16 | 0.171 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0010 DLA | 0.000076 | | | |
| | Calcium (Ca)-Total (mg/L) | 33.1 | 33.1 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.049 | 0.0508 | | | |
| | Cobalt (Co)-Total (mg/L) | | 0.00338 | | | |
| | Copper (Cu)-Total (mg/L) | 0.0143 | 0.0140 | | | |
| | Iron (Fe)-Total (mg/L) | 11.4 | 11.4 | | | |
| | Lead (Pb)-Total (mg/L) | 0.0068 | 0.00694 | | | |
| | Lithium (Li)-Total (mg/L) | | 0.514 | | | |
| | Magnesium (Mg)-Total (mg/L) | 13.2 | 13.2 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.126 | 0.134 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.00020 | <0.000050 DLM | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L991723-1 | L991723-2 | | | |
| | **Description** | | | | | |
| | **Sampled Date** | 03-APR-11 | 03-APR-11 | | | |
| | **Sampled Time** | 11:00 | 11:00 | | | |
| | **Client ID** | P2C21 (H2) DEPTH:600-870M | P2C21 (H2) DEPTH:600-870M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Molybdenum (Mo)-Total (mg/L) | | 0.0205 | | | |
| | Nickel (Ni)-Total (mg/L) | | 0.0260 | | | |
| | Phosphorus (P)-Total (mg/L) | | 0.40 | | | |
| | Potassium (K)-Total (mg/L) | 8.72 | 9.82 | | | |
| | Selenium (Se)-Total (mg/L) | <0.0050 DLA | 0.00078 | | | |
| | Silicon (Si)-Total (mg/L) | | 47.0 | | | |
| | Silver (Ag)-Total (mg/L) | | 0.000146 | | | |
| | Sodium (Na)-Total (mg/L) | 217 | 206 | | | |
| | Strontium (Sr)-Total (mg/L) | | 0.538 | | | |
| | Thallium (Tl)-Total (mg/L) | | <0.00020 DLA | | | |
| | Tin (Sn)-Total (mg/L) | | 0.00047 | | | |
| | Titanium (Ti)-Total (mg/L) | | 0.581 | | | |
| | Uranium (U)-Total (mg/L) | 0.00120 | 0.00118 | | | |
| | Vanadium (V)-Total (mg/L) | | 0.0648 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.110 | 0.115 | | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 0.153 | 0.0857 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.0025 DLA | 0.00027 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00140 | 0.00148 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 1.41 | 1.47 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.00050 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.00050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.10 | 0.108 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0010 DLA | 0.000011 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 28.5 | 28.5 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.010 DLA | 0.00102 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | | 0.00016 | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.0050 DLA | <0.00050 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 1.71 | 1.72 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.0025 DLA | 0.000061 | | | |
| | Lithium (Li)-Dissolved (mg/L) | | 0.300 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 9.69 | 9.69 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.075 | 0.0778 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.00020 | <0.000010 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.0195 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.00182 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.30 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.50 | 2.88 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L991723-1 | L991723-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 03-APR-11 | 03-APR-11 | | | |
| | Sampled Time | 11:00 | 11:00 | | | |
| | Client ID | P2C21 (H2) DEPTH:600-870M | P2C21 (H2) DEPTH:600-870M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Selenium (Se)-Dissolved (mg/L) | <0.0050 DLA | 0.00022 | | | |
| | Silicon (Si)-Dissolved (mg/L) | | 3.67 | | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 166 | 167 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.405 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.00010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00022 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.010 | | | |
| | Uranium (U)-Dissolved (mg/L) | <0.00050 DLA | 0.000374 | | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.0010 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.050 | 0.0100 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ALK-COL-VA** | Water | Alkalinity by Colourimetric (Automated) | APHA 310.2 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **C-TOT-ORG-LOW-CL** | Water | Total Organic Carbon | APHA 5310 C-Instrumental |
| **CN-T-MID-HH-COL-VA** | Water | Total Cyanide by HH Distillation | APHA 4500-CN Cyanide |
| This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 "Color" |
| This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 Color |
| This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| **HG-DIS-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS | EPA SW-846 3005A & EPA 245.7 |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7). | | | |
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7). | | | |
| **HG-TOT-CVAFS-VA** | Water | Total Mercury in Water by CVAFS | EPA 245.7 |

# Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-DIS-LOW-MS-VA** Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-TOT-LOW-MS-VA** Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**S2-D-COL-VA** Water Dissolved Sulphide by Colorimetric APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

**S2-UNION-MANCALC-VA** Water Un-ionized Hydrogen sulphide (Man. calc) APHA -4500-S2 H.

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

**TDS-VA** Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

# Reference Information

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA |

**Chain of Custody Numbers:**

10-051120

**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: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: TAMMERA KOSTYA

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ALK-COL-VA** | **Water** | | | | | | | |
| **Batch R2154083** | | | | | | | | |
| **WG1262048-11 CRM** | | **VA-ALKL-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 97 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-14 CRM** | | **VA-ALKM-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 95 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-17 CRM** | | **VA-ALKH-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 98 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-2 CRM** | | **VA-ALKL-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 98 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-20 CRM** | | **VA-ALKL-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 100 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-23 CRM** | | **VA-ALKM-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 102 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-26 CRM** | | **VA-ALKH-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 98 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-29 CRM** | | **VA-ALKL-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 97 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-5 CRM** | | **VA-ALKM-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 98 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-8 CRM** | | **VA-ALKH-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 100 | | % | | 85-115 | 06-APR-11 |
| **WG1262048-1 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-10 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-13 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-16 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-19 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-22 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-25 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-28 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-4 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **WG1262048-7 MB** | | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ALK-COL-VA** | **Water** | | | | | | | |
| **Batch R2154083** | | | | | | | | |
| **WG1262048-7 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2149505** | | | | | | | | |
| **WG1261471-10 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 100 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 100 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-1 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **WG1261471-3 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **WG1261471-5 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **WG1261471-7 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **WG1261471-9 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2149505** | | | | | | | | |
| **WG1261471-10 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 99 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 99 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-1 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 05-APR-11 |
| **WG1261471-3 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 05-APR-11 |
| **WG1261471-5 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 05-APR-11 |
| **WG1261471-7 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 05-APR-11 |
| **WG1261471-9 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 05-APR-11 |
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2149505** | | | | | | | | |
| **WG1261471-10 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 96 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 97 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-1 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| **WG1261471-3 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| **WG1261471-5 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| **WG1261471-7 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| **WG1261471-9 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2149505** | | | | | | | | |
| **WG1261471-10 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 102 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 103 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-1 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |
| **WG1261471-3 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |
| **WG1261471-5 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |
| **WG1261471-7 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |
| **WG1261471-9 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2149505** | | | | | | | | |
| **WG1261471-10 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 101 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 101 | | % | | 85-115 | 05-APR-11 |
| **WG1261471-1 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2149505** | | | | | | | | |
| **WG1261471-3 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **WG1261471-5 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **WG1261471-7 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **WG1261471-9 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 05-APR-11 |
| **C-TOT-ORG-LOW-CL** | **Water** | | | | | | | |
| **Batch R2162852** | | | | | | | | |
| **WG1263546-5 DUP** | | **L991723-1** | | | | | | |
| Total Organic Carbon | | 7.26 | 7.39 | | mg/L | 1.9 | 20 | 08-APR-11 |
| **WG1263546-2 LCS** | | | | | | | | |
| Total Organic Carbon | | | 89 | | % | | 80-120 | 08-APR-11 |
| **WG1263546-1 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 08-APR-11 |
| **CN-T-MID-HH-COL-VA** | **Water** | | | | | | | |
| **Batch R2146304** | | | | | | | | |
| **WG1261386-2 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 106 | | % | | 80-120 | 05-APR-11 |
| **WG1261386-1 MB** | | | | | | | | |
| Cyanide, Total | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2146043** | | | | | | | | |
| **WG1261366-10 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 105 | | % | | 85-115 | 05-APR-11 |
| **WG1261366-13 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 103 | | % | | 85-115 | 05-APR-11 |
| **WG1261366-2 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 98 | | % | | 85-115 | 05-APR-11 |
| **WG1261366-5 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 102 | | % | | 85-115 | 05-APR-11 |
| **WG1261366-7 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 104 | | % | | 85-115 | 05-APR-11 |
| **WG1261366-1 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 05-APR-11 |
| **WG1261366-12 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 05-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2146043** | | | | | | | | |
| **WG1261366-4 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 05-APR-11 |
| **WG1261366-6 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 05-APR-11 |
| **WG1261366-9 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 05-APR-11 |
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2153544** | | | | | | | | |
| **WG1261990-9 CRM** | | **VA-EC-PCT-CONTROL** | | | | | | |
| Conductivity | | | 98 | | % | | 90-110 | 06-APR-11 |
| **WG1261990-1 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-2 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-3 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-4 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-5 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-6 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-7 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **HG-DIS-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2140644** | | | | | | | | |
| **WG1261086-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Dissolved | | | 94 | | % | | 80-120 | 04-APR-11 |
| **WG1261086-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 04-APR-11 |
| **Batch R2146084** | | | | | | | | |
| **WG1261008-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2140644** | | | | | | | | |
| **WG1261086-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Dissolved | | | 94 | | % | | 80-120 | 04-APR-11 |
| **WG1261086-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 04-APR-11 |
| **Batch R2146084** | | | | | | | | |
| **WG1261008-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| **HG-TOT-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2140644** | | | | | | | | |
| **WG1261086-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Total | | | 94 | | % | | 80-120 | 04-APR-11 |
| **WG1261086-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000050 | | mg/L | | 0.00005 | 04-APR-11 |
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2188255** | | | | | | | | |
| **WG1278364-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Total | | | 98 | | % | | 80-120 | 12-MAY-11 |
| **WG1278364-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000010 | | mg/L | | 0.00001 | 12-MAY-11 |
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2151463** | | | | | | | | |
| **WG1261008-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 05-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Beryllium (Be)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Bismuth (Bi)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 05-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2151463** | | | | | | | | |
| **WG1261008-1 MB** | | | | | | | | |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 05-APR-11 |
| Selenium (Se)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 05-APR-11 |
| Strontium (Sr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Thallium (Tl)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 05-APR-11 |
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2144305** | | | | | | | | |
| **WG1261008-2 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Dissolved | | | 100 | | % | | 80-120 | 04-APR-11 |
| Boron (B)-Dissolved | | | 99 | | % | | 80-120 | 04-APR-11 |
| Calcium (Ca)-Dissolved | | | 102 | | % | | 80-120 | 04-APR-11 |
| Iron (Fe)-Dissolved | | | 97 | | % | | 80-120 | 04-APR-11 |
| Magnesium (Mg)-Dissolved | | | 100 | | % | | 80-120 | 04-APR-11 |
| Phosphorus (P)-Dissolved | | | 100 | | % | | 80-120 | 04-APR-11 |
| Silicon (Si)-Dissolved | | | 107 | | % | | 80-120 | 04-APR-11 |
| Sodium (Na)-Dissolved | | | 102 | | % | | 80-120 | 04-APR-11 |
| Titanium (Ti)-Dissolved | | | 105 | | % | | 80-120 | 04-APR-11 |
| Zinc (Zn)-Dissolved | | | 97 | | % | | 80-120 | 04-APR-11 |
| **WG1261008-1 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 04-APR-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 04-APR-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 04-APR-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 04-APR-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 04-APR-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 04-APR-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 04-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2144305** | | | | | | | | |
| **WG1261008-1 MB** | | | | | | | | |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 04-APR-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 04-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 04-APR-11 |
| **MET-DIS-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2146489** | | | | | | | | |
| **WG1261008-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 05-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 05-APR-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| **MET-T-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2151463** | | | | | | | | |
| **WG1261119-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 05-APR-11 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Barium (Ba)-Total | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Beryllium (Be)-Total | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Bismuth (Bi)-Total | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 05-APR-11 |
| Cadmium (Cd)-Total | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Lithium (Li)-Total | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |
| Manganese (Mn)-Total | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-T-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2151463** | | | | | | | | |
| **WG1261119-1 MB** | | | | | | | | |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Potassium (K)-Total | | | <0.050 | | mg/L | | 0.05 | 05-APR-11 |
| Selenium (Se)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 05-APR-11 |
| Strontium (Sr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Thallium (Tl)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| Vanadium (V)-Total | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 05-APR-11 |
| **Batch R2155983** | | | | | | | | |
| **WG1261119-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Total | | | 106 | | % | | 80-120 | 06-APR-11 |
| Antimony (Sb)-Total | | | 92 | | % | | 80-120 | 06-APR-11 |
| Arsenic (As)-Total | | | 90 | | % | | 80-120 | 06-APR-11 |
| Barium (Ba)-Total | | | 91 | | % | | 80-120 | 06-APR-11 |
| Beryllium (Be)-Total | | | 91 | | % | | 80-120 | 06-APR-11 |
| Bismuth (Bi)-Total | | | 87 | | % | | 80-120 | 06-APR-11 |
| Boron (B)-Total | | | 83 | | % | | 80-120 | 06-APR-11 |
| Cadmium (Cd)-Total | | | 89 | | % | | 80-120 | 06-APR-11 |
| Chromium (Cr)-Total | | | 88 | | % | | 80-120 | 06-APR-11 |
| Cobalt (Co)-Total | | | 87 | | % | | 80-120 | 06-APR-11 |
| Copper (Cu)-Total | | | 86 | | % | | 80-120 | 06-APR-11 |
| Lead (Pb)-Total | | | 90 | | % | | 80-120 | 06-APR-11 |
| Lithium (Li)-Total | | | 90 | | % | | 80-120 | 06-APR-11 |
| Manganese (Mn)-Total | | | 88 | | % | | 80-120 | 06-APR-11 |
| Molybdenum (Mo)-Total | | | 93 | | % | | 80-120 | 06-APR-11 |
| Nickel (Ni)-Total | | | 88 | | % | | 80-120 | 06-APR-11 |
| Potassium (K)-Total | | | 88 | | % | | 80-120 | 06-APR-11 |
| Selenium (Se)-Total | | | 91 | | % | | 80-120 | 06-APR-11 |
| Silver (Ag)-Total | | | 93 | | % | | 80-120 | 06-APR-11 |
| Sodium (Na)-Total | | | 89 | | % | | 80-120 | 06-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-T-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2155983** | | | | | | | | |
| **WG1261119-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Strontium (Sr)-Total | | | 91 | | % | | 80-120 | 06-APR-11 |
| Thallium (Tl)-Total | | | 88 | | % | | 80-120 | 06-APR-11 |
| Tin (Sn)-Total | | | 92 | | % | | 80-120 | 06-APR-11 |
| Uranium (U)-Total | | | 93 | | % | | 80-120 | 06-APR-11 |
| Vanadium (V)-Total | | | 90 | | % | | 80-120 | 06-APR-11 |
| Zinc (Zn)-Total | | | 88 | | % | | 80-120 | 06-APR-11 |
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2144305** | | | | | | | | |
| **WG1261119-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Total | | | 100 | | % | | 80-120 | 04-APR-11 |
| Boron (B)-Total | | | 98 | | % | | 80-120 | 04-APR-11 |
| Calcium (Ca)-Total | | | 101 | | % | | 80-120 | 04-APR-11 |
| Iron (Fe)-Total | | | 98 | | % | | 80-120 | 04-APR-11 |
| Magnesium (Mg)-Total | | | 100 | | % | | 80-120 | 04-APR-11 |
| Phosphorus (P)-Total | | | 99 | | % | | 80-120 | 04-APR-11 |
| Silicon (Si)-Total | | | 105 | | % | | 80-120 | 04-APR-11 |
| Sodium (Na)-Total | | | 101 | | % | | 80-120 | 04-APR-11 |
| Titanium (Ti)-Total | | | 105 | | % | | 80-120 | 04-APR-11 |
| Zinc (Zn)-Total | | | 94 | | % | | 80-120 | 04-APR-11 |
| **WG1261119-1 MB** | | | | | | | | |
| Barium (Ba)-Total | | | <0.010 | | mg/L | | 0.01 | 04-APR-11 |
| Boron (B)-Total | | | <0.10 | | mg/L | | 0.1 | 04-APR-11 |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 04-APR-11 |
| Iron (Fe)-Total | | | <0.030 | | mg/L | | 0.03 | 04-APR-11 |
| Magnesium (Mg)-Total | | | <0.10 | | mg/L | | 0.1 | 04-APR-11 |
| Phosphorus (P)-Total | | | <0.30 | | mg/L | | 0.3 | 04-APR-11 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 04-APR-11 |
| Sodium (Na)-Total | | | <2.0 | | mg/L | | 2 | 04-APR-11 |
| Titanium (Ti)-Total | | | <0.010 | | mg/L | | 0.01 | 04-APR-11 |
| Zinc (Zn)-Total | | | <0.0050 | | mg/L | | 0.005 | 04-APR-11 |
| **MET-TOT-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2146489** | | | | | | | | |
| **WG1261119-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 05-APR-11 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2146489** | | | | | | | | |
| **WG1261119-1 MB** | | | | | | | | |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 05-APR-11 |
| Cadmium (Cd)-Total | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Chromium (Cr)-Total | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 05-APR-11 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Manganese (Mn)-Total | | | <0.000050 | | mg/L | | 0.00005 | 05-APR-11 |
| Potassium (K)-Total | | | <0.050 | | mg/L | | 0.05 | 05-APR-11 |
| Selenium (Se)-Total | | | <0.0010 | | mg/L | | 0.001 | 05-APR-11 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 05-APR-11 |
| **Batch R2156323** | | | | | | | | |
| **WG1261119-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Total | | | 99 | | % | | 80-120 | 06-APR-11 |
| Antimony (Sb)-Total | | | 94 | | % | | 80-120 | 06-APR-11 |
| Arsenic (As)-Total | | | 96 | | % | | 80-120 | 06-APR-11 |
| Cadmium (Cd)-Total | | | 96 | | % | | 80-120 | 06-APR-11 |
| Chromium (Cr)-Total | | | 97 | | % | | 80-120 | 06-APR-11 |
| Copper (Cu)-Total | | | 95 | | % | | 80-120 | 06-APR-11 |
| Lead (Pb)-Total | | | 94 | | % | | 80-120 | 06-APR-11 |
| Manganese (Mn)-Total | | | 95 | | % | | 80-120 | 06-APR-11 |
| Potassium (K)-Total | | | 96 | | % | | 80-120 | 06-APR-11 |
| Selenium (Se)-Total | | | 97 | | % | | 80-120 | 06-APR-11 |
| Uranium (U)-Total | | | 98 | | % | | 80-120 | 06-APR-11 |
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2150703** | | | | | | | | |
| **WG1262176-2 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 101 | | % | | 85-115 | 06-APR-11 |
| **WG1262176-4 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 103 | | % | | 85-115 | 06-APR-11 |
| **WG1262176-6 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 102 | | % | | 85-115 | 06-APR-11 |
| **WG1262176-1 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| **WG1262176-3 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| **WG1262176-5 MB** | | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2150703** | | | | | | | | |
| **WG1262176-5 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| **WG1262176-8 MS** | | **L991860-6** | | | | | | |
| Ammonia as N | | | 96 | | % | | 75-125 | 06-APR-11 |
| **PH-PCT-VA** | **Water** | | | | | | | |
| **Batch R2158204** | | | | | | | | |
| **WG1262551-10 CRM** | | **VA-PH7-BUF** | | | | | | |
| pH | | | 6.99 | | pH | | 6.9-7.1 | 07-APR-11 |
| **S2-D-COL-VA** | **Water** | | | | | | | |
| **Batch R2149565** | | | | | | | | |
| **WG1261924-2 DUP** | | **L991723-1** | | | | | | |
| Sulphide as S (Dissolved) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 05-APR-11 |
| **WG1261924-1 MB** | | | | | | | | |
| Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 05-APR-11 |
| **S2-UNION-MANCALC-VA** | **Water** | | | | | | | |
| **Batch R2154523** | | | | | | | | |
| **WG1262109-1 DUP** | | **L991723-1** | | | | | | |
| Sulphide As S (Un-ionized) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 25 | 05-APR-11 |
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2167723** | | | | | | | | |
| **WG1263487-2 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 95 | | % | | 85-115 | 08-APR-11 |
| **WG1263487-5 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 98 | | % | | 85-115 | 08-APR-11 |
| **WG1263487-8 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 99 | | % | | 85-115 | 08-APR-11 |
| **WG1263487-1 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 08-APR-11 |
| **WG1263487-4 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 08-APR-11 |
| **WG1263487-7 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 08-APR-11 |
| **TURBIDITY-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **TURBIDITY-VA** | **Water** | | | | | | | |
| **Batch R2146103** | | | | | | | | |
| **WG1261475-11 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 105 | | % | | 85-115 | 05-APR-11 |
| **WG1261475-2 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 109 | | % | | 85-115 | 05-APR-11 |
| **WG1261475-5 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 109 | | % | | 85-115 | 05-APR-11 |
| **WG1261475-8 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 105 | | % | | 85-115 | 05-APR-11 |
| **WG1261475-1 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 05-APR-11 |
| **WG1261475-10 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 05-APR-11 |
| **WG1261475-4 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 05-APR-11 |
| **WG1261475-7 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 05-APR-11 |

**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. |

# Quality Control Report



**Hold Time Exceedances:**

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 03-APR-11 11:00 | 07-APR-11 13:20 | 0.25 | 98 | hours | EHTR-FM |
| **Total Metals** | | | | | | | |
| Total Mercury in Water by CVAFS(Low) | | | | | | | |
| | 2 | 03-APR-11 11:00 | 12-MAY-11 13:21 | 28 | 39 | days | EHT |

**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 L991723 were received on 04-APR-11 11:30.

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.

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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 G**
ANALYTICAL CHEMISTRY & TESTING SERVIC

**Environmental Division**

**Chain of Custody / Analytical Reque**
**Canada Toll Free: 1 800 668 98**
www.alsglobal.com

*L91723-COFC*

10-051120

Page ___ of ___

| | | | |
|---|---|---|---|
| **Report To** | AMEC | **Report Format / Distribution** | (to availability) |
| Company: | | Standard: ✓ Other (specify): | Regular (Standard Turnaround Times)) |
| Contact: | T. Kostya | Select: PDF ✓ Excel ✓ Digital Fax | Priority, Date Req'd: _____ (Surcharges apply) |
| Address: | 3456 Opie Cres | Email 1: Tammera.kostya@amec.com | Emergency (1 Business Day) - 100% Surcharge |
| | Prince George BC V2N 2P9 | Email 2: Scott.green@amec.com | For Emergency < 1 Day, ASAP or Weekend - Contact ALS |
| Phone: | (250) 564-3243 Fax: | | **Analysis Request** |
| **Invoice To** | Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | ( Indicate Filtered or Preserved, F/P ) |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: KX13505 | |
| Company: | | PO / AFE: | |
| Contact: | | LSD: | |
| Address: | | | |
| Phone: | Fax: | Quote #: | |
| **Lab Work Order # (lab use only)** | L91723 | **ALS Contact:** | **Sampler:** |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Gen. Chem. | Diss. Metals | Total Metals | TOC | Cyanides | NH3 (Ammonia) | S2- -UNION - MANUAL | S2- D-(OZ-VA | | | | | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P2C21(H2) Depth: 600-832m | Apr13/11 | 11am | $H_2O$ | X | X | X | X | X | X | X | X | | | | | |
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**Special Instructions / Regulations / Hazardous Details**

See Selam Worku 4 directions (Dissolved $H_2S$)

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| J. Kostya | Apr13/11 | 4:30pm | JP | Apr 4/11 | 11:30 | 2 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 04-APR-11
Report Date: 11-APR-11 13:53 (MT)
Version: FINAL

Client Phone: 250-564-3243

# Certificate of Analysis

Lab Work Order #: L991762
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051119

KELLY HUNT
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L991762-1 P2 C21 (H2) DEPTH 600-870M<br>Sampled By: CLIENT on 03-APR-11 @ 11:00<br>Matrix: WATER | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| Methane, dissolved | 3.59 | | 0.0050 | mg/L | 05-APR-11 | 05-APR-11 | R2158283 |

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

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| METHANE-DIS-CL | Water | Methane, dissolved | EPA 5021/8015-HEADSPACE GC-FID |
| Results reported in | | | |

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

**Chain of Custody Numbers:**

10-051119

**GLOSSARY OF REPORT TERMS**

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

**ALS Laboratory Group**
ANALYTICAL CHEMISTRY & TESTING SERVICES

**Environmental Division**

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

L991762 10-051119

Page ___ of ___

| | | |
|---|---|---|
| **Report To** AMEC | **Report Format / Distribution** | **Service Requested:** (Rush subject to availability) |
| Company: | Standard: ✓ Other (specify): | Regular (Standard Turnaround Times)) |
| Contact: T. Kostyg | Select: PDF ✓ Excel ✓ Digital Fax | Priority, Date Req'd: _____ (Surcharges apply) |
| Address: 3456 Opie Cres. Prince George BC, V2N 2P9 | Email 1: tammera.kostyg@amec.com | Emergency (1 Business Day) - 100% Surcharge |
| Phone: (250) 564-3243 Fax: | Email 2: Scott.green@amec.com | For Emergency < 1 Day, ASAP or Weekend - Contact ALS |
| **Invoice To** Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | **Analysis Request** |
| Copy of Invoice with Report? (circle) Yes or No | Job #: KX13505 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: Fax: | Quote #: | |
| | **ALS Contact:** | **Sampler:** |

| Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Diss. Methane | Number of Containers |
|---|---|---|---|---|---|
| P2C21 (H2) Depth 600-870m | April 3/11 | 11am | $H_2O$ | X | |

**Special Instructions / Regulations / Hazardous Details**

See Selam Worku for direction

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
|---|---|---|---|---|---|---|---|---|---|---|
| J. Kostyg | April 3/11 | 4:30 pm | D. Mouchi | 04-April-11 | 13:54 | 17 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: TAMMERA KOSTYA
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 05-APR-11
Report Date: 19-MAY-11 17:48 (MT)
Version: FINAL REV. 3

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L992288**
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051118

**Comments:** ADDITIONAL 17-MAY-11 16:40
ADDITIONAL 11-MAY-11 14:02

Selam Worku
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L992288-1 | L992288-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 04-APR-11 | 04-APR-11 | | | |
| | Sampled Time | 21:00 | 21:00 | | | |
| | Client ID | #2 P2C21 (H2) 600-870M | #2 P2C21 (H2) 600-870M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 10.7 | | | | |
| | Conductivity (uS/cm) | 1800 | | | | |
| | Hardness (as CaCO3) (mg/L) | 32.1 | 32.5 | | | |
| | pH (pH) | 8.25 | | | | |
| | Total Dissolved Solids (mg/L) | 1140 | | | | |
| | Turbidity (NTU) | 21.5 | | | | |
| **Anions and Nutrients** | Alkalinity, Total (as CaCO3) (mg/L) | 989 | | | | |
| | Ammonia as N (mg/L) | 0.496 | | | | |
| | Chloride (Cl) (mg/L) | 26.9 | | | | |
| | Fluoride (F) (mg/L) | 2.89 | | | | |
| | Nitrate (as N) (mg/L) | <0.050 | | | | |
| | Nitrite (as N) (mg/L) | <0.010 | | | | |
| | Sulfate (SO4) (mg/L) | 17.6 | | | | |
| | Sulphide as S (Dissolved) (mg/L) | <0.020 | | | | |
| **Cyanides** | Cyanide, Total (mg/L) | <0.0050 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 5.09 | | | | |
| **Inorganic Parameters** | Sulphide As S (Un-ionized) (mg/L) | <0.020 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.231 | 0.259 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.0025 DLA | <0.00020 DLA | | | |
| | Arsenic (As)-Total (mg/L) | 0.00111 | 0.00121 | | | |
| | Barium (Ba)-Total (mg/L) | 2.15 | 2.23 | | | |
| | Beryllium (Be)-Total (mg/L) | | <0.0010 DLA | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.0010 DLA | | | |
| | Boron (B)-Total (mg/L) | 0.30 | 0.311 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0010 DLA | <0.000020 DLA | | | |
| | Calcium (Ca)-Total (mg/L) | 8.07 | 8.07 | | | |
| | Chromium (Cr)-Total (mg/L) | <0.010 DLA | 0.00245 | | | |
| | Cobalt (Co)-Total (mg/L) | | <0.00020 DLA | | | |
| | Copper (Cu)-Total (mg/L) | <0.0050 DLA | <0.0010 DLA | | | |
| | Iron (Fe)-Total (mg/L) | 2.94 | 2.94 | | | |
| | Lead (Pb)-Total (mg/L) | <0.0025 DLA | 0.00029 | | | |
| | Lithium (Li)-Total (mg/L) | | 0.509 | | | |
| | Magnesium (Mg)-Total (mg/L) | 3.00 | 3.00 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.040 | 0.0467 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.00020 | <0.000010 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L992288-1 | L992288-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 04-APR-11 | 04-APR-11 | | | |
| | Sampled Time | 21:00 | 21:00 | | | |
| | Client ID | #2 P2C21 (H2) 600-870M | #2 P2C21 (H2) 600-870M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Molybdenum (Mo)-Total (mg/L) | | 0.00714 | | | |
| | Nickel (Ni)-Total (mg/L) | | DLA <0.0010 | | | |
| | Phosphorus (P)-Total (mg/L) | | <0.30 | | | |
| | Potassium (K)-Total (mg/L) | 1.79 | 2.05 | | | |
| | Selenium (Se)-Total (mg/L) | DLA <0.0050 | DLA <0.00020 | | | |
| | Silicon (Si)-Total (mg/L) | | 5.36 | | | |
| | Silver (Ag)-Total (mg/L) | | DLA <0.000020 | | | |
| | Sodium (Na)-Total (mg/L) | 466 | 436 | | | |
| | Strontium (Sr)-Total (mg/L) | | 0.580 | | | |
| | Thallium (Tl)-Total (mg/L) | | DLA <0.00020 | | | |
| | Tin (Sn)-Total (mg/L) | | DLA <0.00020 | | | |
| | Titanium (Ti)-Total (mg/L) | | <0.010 | | | |
| | Uranium (U)-Total (mg/L) | DLA <0.00050 | 0.000263 | | | |
| | Vanadium (V)-Total (mg/L) | | DLA <0.0020 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.050 | 0.0285 | | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 0.168 | 0.168 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | DLA <0.0025 | 0.00021 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00112 | 0.00102 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 2.02 | 2.19 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | | DLA <0.0010 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | DLA <0.0010 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.28 | 0.288 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | DLA <0.0010 | DLA <0.000020 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 8.02 | 8.02 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | DLA <0.010 | 0.00043 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | | DLA <0.00020 | | | |
| | Copper (Cu)-Dissolved (mg/L) | DLA <0.0050 | DLA <0.0010 | | | |
| | Iron (Fe)-Dissolved (mg/L) | 2.55 | 2.55 | | | |
| | Lead (Pb)-Dissolved (mg/L) | DLA <0.0025 | 0.00010 | | | |
| | Lithium (Li)-Dissolved (mg/L) | | 0.511 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 2.93 | 2.93 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.039 | 0.0409 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.00020 | <0.000010 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.00697 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | DLA <0.0010 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.30 | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.79 | 2.03 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L992288-1 | L992288-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 04-APR-11 | 04-APR-11 | | | |
| | Sampled Time | 21:00 | 21:00 | | | |
| | Client ID | #2 P2C21 (H2) 600-870M | #2 P2C21 (H2) 600-870M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Selenium (Se)-Dissolved (mg/L) | <0.0050 DLA | <0.00020 DLA | | | |
| | Silicon (Si)-Dissolved (mg/L) | | 5.20 | | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000020 DLA | | | |
| | Sodium (Na)-Dissolved (mg/L) | 454 | 446 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.552 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.00020 DLA | | | |
| | Tin (Sn)-Dissolved (mg/L) | | 0.00020 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.010 | | | |
| | Uranium (U)-Dissolved (mg/L) | <0.00050 DLA | 0.000245 | | | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.0020 DLA | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.050 | 0.0074 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **C-TOT-ORG-LOW-CL** | Water | Total Organic Carbon | APHA 5310 C-Instrumental |
| **CN-T-MID-HH-COL-VA** | Water | Total Cyanide by HH Distillation | APHA 4500-CN Cyanide |
| This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 "Color" |
| This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 Color |
| This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| **HG-DIS-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS | EPA SW-846 3005A & EPA 245.7 |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7). | | | |
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold | | | |

# Reference Information

vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-CVAFS-VA** Water Total Mercury in Water by CVAFS EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-DIS-LOW-MS-VA** Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-TOT-LOW-MS-VA** Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**S2-D-COL-VA** Water Dissolved Sulphide by Colorimetric APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

**S2-UNION-MANCALC-VA** Water Un-ionized Hydrogen sulphide (Man. calc) APHA -4500-S2 H.

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

# Reference Information

| | | | |
|---|---|---|---|
| **TDS-VA** | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA |

**Chain of Custody Numbers:**

10-051118

**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: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: TAMMERA KOSTYA

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ALK-PCT-VA** | **Water** | | | | | | | |
| **Batch R2173370** | | | | | | | | |
| **WG1264195-8 CRM** | | **VA-ALK-PCT-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 104 | | % | | 85-115 | 12-APR-11 |
| **WG1264195-1 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 12-APR-11 |
| **WG1264195-2 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 12-APR-11 |
| **WG1264195-3 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 12-APR-11 |
| **WG1264195-4 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 12-APR-11 |
| **WG1264195-5 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 12-APR-11 |
| **WG1264195-6 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 12-APR-11 |
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2154503** | | | | | | | | |
| **WG1261998-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 100 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-9 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 100 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-1 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 06-APR-11 |
| **WG1261998-4 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 06-APR-11 |
| **WG1261998-6 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 06-APR-11 |
| **WG1261998-8 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 06-APR-11 |
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2154503** | | | | | | | | |
| **WG1261998-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 99 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-9 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 99 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-1 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 06-APR-11 |
| **WG1261998-4 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 06-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2154503** | | | | | | | | |
| **WG1261998-6 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 06-APR-11 |
| **WG1261998-8 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 06-APR-11 |
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2154503** | | | | | | | | |
| **WG1261998-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 94 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-9 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 94 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-1 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 06-APR-11 |
| **WG1261998-4 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 06-APR-11 |
| **WG1261998-6 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 06-APR-11 |
| **WG1261998-8 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 06-APR-11 |
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2154503** | | | | | | | | |
| **WG1261998-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 101 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-9 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 103 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-1 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| **WG1261998-4 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| **WG1261998-6 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| **WG1261998-8 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2154503** | | | | | | | | |
| **WG1261998-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 101 | | % | | 85-115 | 06-APR-11 |
| **WG1261998-9 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 101 | | % | | 85-115 | 06-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2154503** | | | | | | | | |
| **WG1261998-1 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 06-APR-11 |
| **WG1261998-4 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 06-APR-11 |
| **WG1261998-6 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 06-APR-11 |
| **WG1261998-8 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 06-APR-11 |
| **C-TOT-ORG-LOW-CL** | **Water** | | | | | | | |
| **Batch R2163703** | | | | | | | | |
| **WG1263692-2 LCS** | | | | | | | | |
| Total Organic Carbon | | | 86 | | % | | 80-120 | 09-APR-11 |
| **WG1263692-1 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 09-APR-11 |
| **CN-T-MID-HH-COL-VA** | **Water** | | | | | | | |
| **Batch R2163889** | | | | | | | | |
| **WG1263065-2 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 103 | | % | | 80-120 | 08-APR-11 |
| **WG1263065-4 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 109 | | % | | 80-120 | 08-APR-11 |
| **WG1263065-1 MB** | | | | | | | | |
| Cyanide, Total | | | <0.0050 | | mg/L | | 0.005 | 08-APR-11 |
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2151563** | | | | | | | | |
| **WG1261982-2 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 100 | | % | | 85-115 | 06-APR-11 |
| **WG1261982-5 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 98 | | % | | 85-115 | 06-APR-11 |
| **WG1261982-1 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 06-APR-11 |
| **WG1261982-4 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 06-APR-11 |
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2153544** | | | | | | | | |
| **WG1261990-9 CRM** | | **VA-EC-PCT-CONTROL** | | | | | | |
| Conductivity | | | 98 | | % | | 90-110 | 06-APR-11 |
| **WG1261990-1 MB** | | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2153544** | | | | | | | | |
| **WG1261990-1 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-2 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-3 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-4 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-5 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-6 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **WG1261990-7 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 06-APR-11 |
| **HG-DIS-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2150343** | | | | | | | | |
| **WG1262156-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Dissolved | | | 88 | | % | | 80-120 | 06-APR-11 |
| **WG1261689-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| **WG1262156-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2150343** | | | | | | | | |
| **WG1262156-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Dissolved | | | 88 | | % | | 80-120 | 06-APR-11 |
| **WG1261689-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 06-APR-11 |
| **WG1262156-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 06-APR-11 |
| **HG-TOT-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2155524** | | | | | | | | |
| **WG1262679-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Total | | | 95 | | % | | 80-120 | 07-APR-11 |
| **WG1262679-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000050 | | mg/L | | 0.00005 | 07-APR-11 |
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2188255** | | | | | | | | |
| **WG1278364-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Total | | | 98 | | % | | 80-120 | 12-MAY-11 |
| **WG1278364-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000010 | | mg/L | | 0.00001 | 12-MAY-11 |
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2191350** | | | | | | | | |
| **WG1261689-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 06-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| Beryllium (Be)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 06-APR-11 |
| Bismuth (Bi)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 06-APR-11 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 06-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 06-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 06-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 06-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 06-APR-11 |
| Selenium (Se)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 06-APR-11 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 06-APR-11 |
| Strontium (Sr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Thallium (Tl)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 06-APR-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 06-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 06-APR-11 |
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2150684** | | | | | | | | |
| **WG1261689-2 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Dissolved | | | 99 | | % | | 80-120 | 05-APR-11 |
| Boron (B)-Dissolved | | | 99 | | % | | 80-120 | 05-APR-11 |
| Calcium (Ca)-Dissolved | | | 102 | | % | | 80-120 | 05-APR-11 |
| Iron (Fe)-Dissolved | | | 98 | | % | | 80-120 | 05-APR-11 |
| Magnesium (Mg)-Dissolved | | | 99 | | % | | 80-120 | 05-APR-11 |
| Phosphorus (P)-Dissolved | | | 101 | | % | | 80-120 | 05-APR-11 |
| Silicon (Si)-Dissolved | | | 102 | | % | | 80-120 | 05-APR-11 |
| Sodium (Na)-Dissolved | | | 102 | | % | | 80-120 | 05-APR-11 |
| Titanium (Ti)-Dissolved | | | 105 | | % | | 80-120 | 05-APR-11 |
| Zinc (Zn)-Dissolved | | | 97 | | % | | 80-120 | 05-APR-11 |
| **WG1261689-1 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 05-APR-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 05-APR-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 05-APR-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 05-APR-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 05-APR-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 05-APR-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 05-APR-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 05-APR-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 05-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 05-APR-11 |
| **MET-DIS-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2149464** | | | | | | | | |
| **WG1261689-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 06-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 06-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 06-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 06-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 06-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 06-APR-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 06-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2149464** | | | | | | | | |
| **WG1261689-1 MB** | | | | | | | | |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 06-APR-11 |
| **Batch R2156323** | | | | | | | | |
| **WG1261689-2 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Dissolved | | | 95 | | % | | 80-120 | 06-APR-11 |
| Antimony (Sb)-Dissolved | | | 90 | | % | | 80-120 | 06-APR-11 |
| Arsenic (As)-Dissolved | | | 94 | | % | | 80-120 | 06-APR-11 |
| Cadmium (Cd)-Dissolved | | | 92 | | % | | 80-120 | 06-APR-11 |
| Chromium (Cr)-Dissolved | | | 94 | | % | | 80-120 | 06-APR-11 |
| Copper (Cu)-Dissolved | | | 91 | | % | | 80-120 | 06-APR-11 |
| Lead (Pb)-Dissolved | | | 89 | | % | | 80-120 | 06-APR-11 |
| Manganese (Mn)-Dissolved | | | 91 | | % | | 80-120 | 06-APR-11 |
| Potassium (K)-Dissolved | | | 92 | | % | | 80-120 | 06-APR-11 |
| Selenium (Se)-Dissolved | | | 92 | | % | | 80-120 | 06-APR-11 |
| Uranium (U)-Dissolved | | | 90 | | % | | 80-120 | 06-APR-11 |
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2156084** | | | | | | | | |
| **WG1262078-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Total | | | 101 | | % | | 80-120 | 06-APR-11 |
| Boron (B)-Total | | | 100 | | % | | 80-120 | 06-APR-11 |
| Calcium (Ca)-Total | | | 103 | | % | | 80-120 | 06-APR-11 |
| Iron (Fe)-Total | | | 98 | | % | | 80-120 | 06-APR-11 |
| Magnesium (Mg)-Total | | | 101 | | % | | 80-120 | 06-APR-11 |
| Phosphorus (P)-Total | | | 101 | | % | | 80-120 | 06-APR-11 |
| Silicon (Si)-Total | | | 101 | | % | | 80-120 | 06-APR-11 |
| Sodium (Na)-Total | | | 102 | | % | | 80-120 | 06-APR-11 |
| Titanium (Ti)-Total | | | 107 | | % | | 80-120 | 06-APR-11 |
| Zinc (Zn)-Total | | | 96 | | % | | 80-120 | 06-APR-11 |
| **WG1262078-1 MB** | | | | | | | | |
| Barium (Ba)-Total | | | <0.010 | | mg/L | | 0.01 | 06-APR-11 |
| Boron (B)-Total | | | <0.10 | | mg/L | | 0.1 | 06-APR-11 |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 06-APR-11 |
| Iron (Fe)-Total | | | <0.030 | | mg/L | | 0.03 | 06-APR-11 |
| Magnesium (Mg)-Total | | | <0.10 | | mg/L | | 0.1 | 06-APR-11 |
| Phosphorus (P)-Total | | | <0.30 | | mg/L | | 0.3 | 06-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2156084** | | | | | | | | |
| **WG1262078-1 MB** | | | | | | | | |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 06-APR-11 |
| Sodium (Na)-Total | | | <2.0 | | mg/L | | 2 | 06-APR-11 |
| Titanium (Ti)-Total | | | <0.010 | | mg/L | | 0.01 | 06-APR-11 |
| Zinc (Zn)-Total | | | <0.0050 | | mg/L | | 0.005 | 06-APR-11 |
| **MET-TOT-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2156643** | | | | | | | | |
| **WG1262078-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 07-APR-11 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 07-APR-11 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 07-APR-11 |
| Cadmium (Cd)-Total | | | <0.000050 | | mg/L | | 0.00005 | 07-APR-11 |
| Chromium (Cr)-Total | | | <0.00050 | | mg/L | | 0.0005 | 07-APR-11 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 07-APR-11 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 07-APR-11 |
| Manganese (Mn)-Total | | | <0.000050 | | mg/L | | 0.00005 | 07-APR-11 |
| Potassium (K)-Total | | | <0.050 | | mg/L | | 0.05 | 07-APR-11 |
| Selenium (Se)-Total | | | <0.0010 | | mg/L | | 0.001 | 07-APR-11 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 07-APR-11 |
| **Batch R2158743** | | | | | | | | |
| **WG1262078-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Total | | | 100 | | % | | 80-120 | 07-APR-11 |
| Antimony (Sb)-Total | | | 95 | | % | | 80-120 | 07-APR-11 |
| Arsenic (As)-Total | | | 96 | | % | | 80-120 | 07-APR-11 |
| Cadmium (Cd)-Total | | | 94 | | % | | 80-120 | 07-APR-11 |
| Chromium (Cr)-Total | | | 99 | | % | | 80-120 | 07-APR-11 |
| Copper (Cu)-Total | | | 97 | | % | | 80-120 | 07-APR-11 |
| Lead (Pb)-Total | | | 93 | | % | | 80-120 | 07-APR-11 |
| Manganese (Mn)-Total | | | 98 | | % | | 80-120 | 07-APR-11 |
| Potassium (K)-Total | | | 99 | | % | | 80-120 | 07-APR-11 |
| Selenium (Se)-Total | | | 94 | | % | | 80-120 | 07-APR-11 |
| Uranium (U)-Total | | | 94 | | % | | 80-120 | 07-APR-11 |
| **NH3-F-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2163923** | | | | | | | | |
| **WG1263698-2 CRM** Ammonia as N | | **VA-NH3-F** | 104 | | % | | 85-115 | 10-APR-11 |
| **WG1263698-4 CRM** Ammonia as N | | **VA-NH3-F** | 100 | | % | | 85-115 | 10-APR-11 |
| **WG1263698-6 CRM** Ammonia as N | | **VA-NH3-F** | 106 | | % | | 85-115 | 10-APR-11 |
| **WG1263698-1 MB** Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 10-APR-11 |
| **WG1263698-3 MB** Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 10-APR-11 |
| **WG1263698-5 MB** Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 10-APR-11 |
| **WG1263698-10 MS** Ammonia as N | | **L992473-5** | 103 | | % | | 75-125 | 10-APR-11 |
| **WG1263698-8 MS** Ammonia as N | | **L993278-3** | 105 | | % | | 75-125 | 10-APR-11 |
| **PH-PCT-VA** | **Water** | | | | | | | |
| **Batch R2153544** | | | | | | | | |
| **WG1261990-10 CRM** pH | | **VA-PH7-BUF** | 7.00 | | pH | | 6.9-7.1 | 06-APR-11 |
| **S2-D-COL-VA** | **Water** | | | | | | | |
| **Batch R2149565** | | | | | | | | |
| **WG1261924-1 MB** Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 05-APR-11 |
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2174245** | | | | | | | | |
| **WG1264239-2 LCS** Total Dissolved Solids | | | 98 | | % | | 85-115 | 11-APR-11 |
| **WG1264239-5 LCS** Total Dissolved Solids | | | 99 | | % | | 85-115 | 11-APR-11 |
| **WG1264239-8 LCS** Total Dissolved Solids | | | 101 | | % | | 85-115 | 11-APR-11 |
| **WG1264239-1 MB** Total Dissolved Solids | | | <10 | | mg/L | | 10 | 11-APR-11 |
| **WG1264239-4 MB** Total Dissolved Solids | | | <10 | | mg/L | | 10 | 11-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2174245** | | | | | | | | |
| **WG1264239-7 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 11-APR-11 |
| **TURBIDITY-VA** | **Water** | | | | | | | |
| **Batch R2151663** | | | | | | | | |
| **WG1262063-2 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 106 | | % | | 85-115 | 06-APR-11 |
| **WG1262063-5 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 103 | | % | | 85-115 | 06-APR-11 |
| **WG1262063-8 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 104 | | % | | 85-115 | 06-APR-11 |
| **WG1262063-1 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 06-APR-11 |
| **WG1262063-4 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 06-APR-11 |
| **WG1262063-7 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 06-APR-11 |

**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. |

# Quality Control Report



**Hold Time Exceedances:**

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 04-APR-11 21:00 | 06-APR-11 13:15 | 0.25 | 40 | hours | EHTR-FM |
| **Total Metals** | | | | | | | |
| Total Mercury in Water by CVAFS(Low) | | | | | | | |
| | 2 | 04-APR-11 21:00 | 12-MAY-11 13:21 | 28 | 38 | days | EHT |

**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 L992288 were received on 05-APR-11 16:50.

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

# Short Holding Tim

10-051118

Page 1 of 1

Environmental Division

*Rush Processing*

*L992288-COFC*

| | | | |
|---|---|---|---|
| **Report To** | AMEC | Other (specify): | **Service Requested:** (Rush subject to availability) |
| Company: | | Select: PDF ✓ Excel ✓ Digital Fax | Regular (Standard Turnaround Times)) |
| Contact: | T. Kostya | Email 1: tammera.kostya@amec.com | Priority, Date Req'd: _____ (Surcharges apply) |
| Address: | 3456 Opie Cres. Prince George, BC, V2N 2P9 | Email 2: scott.green@amec.com | Emergency (1 Business Day) - 100% Surcharge |
| Phone: | (250) 5643243 Fax: | | For Emergency < 1 Day, ASAP or Weekend - Contact ALS |
| **Invoice To** | Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | **Analysis Request** |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: KX13505 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | | PO / AFE: | |
| Contact: | | LSD: | |
| Address: | | | |
| Phone: | Fax: | Quote #: | |
| **Lab Work Order #** (lab use only) | L992288 | **ALS Contact:** | **Sampler:** |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Gen. Chem | Diss. Metals | Tot. Metals | TOC | Cyanides | NH3 (Ammonia) | S2-Union-MANCAL-VA | S2-D-COL-VA | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | #2 P2C21 (H2) 600-870m | 04-04-11 | 9 pm - 9:30 | H2O | X | X | X | X | X | X | X | X | |
| | ★ 9:30pm pH = 8.13 Temp (°C) = 5.21 | | | | | | | | | | | | |

**Special Instructions / Regulations / Hazardous Details**

# bottles stated 10pm but really sampled @ 9pm / Gen Chem ⇒ + H2S Diss + all other inquires Please see Selam Worku

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| J. Kostya | April 5/11 | 10am | | 11/4/5 | 4:50pm | 5 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 06-APR-11
Report Date: 12-APR-11 14:06 (MT)
Version: FINAL

Client Phone: 250-564-3243

# Certificate of Analysis

Lab Work Order #: L992415
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051117

KELLY HUNT
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L992415-1 #2 P2C21 (H2) 600-870CM<br>Sampled By: CLIENT on 04-APR-11 @ 21:00<br>Matrix: WATER | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| Methane, dissolved | 14.5 | | 0.0050 | mg/L | 06-APR-11 | 06-APR-11 | R2158283 |

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

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| METHANE-DIS-CL | Water | Methane, dissolved | EPA 5021/8015-HEADSPACE GC-FID |
| Results reported in | | | |

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

**Chain of Custody Numbers:**

10-051117

**GLOSSARY OF REPORT TERMS**

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

**ALS Laboratory Group**
ANALYTICAL CHEMISTRY & TESTING SERVICES

**Environmental Division**

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

10-051117
L992415 Page 1 of 1

| | |
|---|---|
| **Report To** AMEC | **Report Format / Distribution** |
| Company: | Standard: ✓ Other (specify): |
| Contact: T. Kostya | Select: PDF ✓ Excel ✓ Digital Fax |
| Address: 3456 Opie Cres. Prince George, BC, V2N 2P9 | Email 1: tammera.kostya@amec.com |
| Phone: (250) 564-3243 Fax: | Email 2: scott.green@amec.com |
| **Invoice To** Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** |
| Copy of Invoice with Report? (circle) Yes or No | Job #: KX13505 |
| Company: | PO / AFE: |
| Contact: | LSD: |
| Address: | |
| Phone: Fax: | Quote #: |
| | **ALS Contact:** Sampler: |

**Service Requested:** (Rush subject to availability)
- ✓ Regular (Standard Turnaround Times))
- Priority, Date Req'd: _____ (Surcharges apply)
- Emergency (1 Business Day) - 100% Surcharge
- For Emergency < 1 Day, ASAP or Weekend - Contact ALS

**Analysis Request**
( Indicate Filtered or Preserved, F/P )

| Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Diss. Mo Hg | Number of Containers |
|---|---|---|---|---|---|
| #2 P2C2 (H2) 600-870m | 4-4-11 | 9:00 pm | $H_2O$ | X | |

**Special Instructions / Regulations / Hazardous Details**

Please contact Salam Worku for directions

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
|---|---|---|---|---|---|---|---|---|---|---|
| T. Kostya | April 5/11 | 10am | Laura C | 6-Apr-11 | 8:35 | 14 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: TAMMERA KOSTYA
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 11-APR-11
Report Date: 19-MAY-11 17:49 (MT)
Version: FINAL REV. 3

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L993769**
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-140410

**Comments:** ADDITIONAL 17-MAY-11 16:39
ADDITIONAL 11-MAY-11 14:05
Note that the Cyanide sample was preserved upon receipt at ALS FSJ.

Selam Worku
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L993769-1 | L993769-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 11-APR-11 | 11-APR-11 | | | |
| | Sampled Time | | | | | |
| | Client ID | #3 P2C21(H2) D 200-600 M | #3 P2C21(H2) D 200-600 M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | | | | |
| | Conductivity (uS/cm) | 1080 | | | | |
| | Hardness (as CaCO3) (mg/L) | 39.2 | 45.1 | | | |
| | pH (pH) | 9.19 | | | | |
| | Total Dissolved Solids (mg/L) | 675 | | | | |
| | Turbidity (NTU) | 66.5 | | | | |
| **Anions and Nutrients** | Alkalinity, Total (as CaCO3) (mg/L) | 362 | | | | |
| | Ammonia as N (mg/L) | 0.488 | | | | |
| | Chloride (Cl) (mg/L) | 105 | | | | |
| | Fluoride (F) (mg/L) | <0.20 | | | | |
| | Nitrate (as N) (mg/L) | <0.050 | | | | |
| | Nitrite (as N) (mg/L) | <0.010 | | | | |
| | Sulfate (SO4) (mg/L) | 43.6 | | | | |
| | Sulphide as S (Dissolved) (mg/L) | <0.020 | | | | |
| **Cyanides** | Cyanide, Total (mg/L) | <0.0050 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 5.56 | | | | |
| **Inorganic Parameters** | Sulphide As S (Un-ionized) (mg/L) | <0.020 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 2.05 | 2.16 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.0025 DLA | 0.00160 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00316 | 0.00294 | | | |
| | Barium (Ba)-Total (mg/L) | 0.776 | 0.835 | | | |
| | Beryllium (Be)-Total (mg/L) | | <0.0010 DLA | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.0010 DLA | | | |
| | Boron (B)-Total (mg/L) | 0.14 | 0.155 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0010 DLA | <0.000020 DLA | | | |
| | Calcium (Ca)-Total (mg/L) | 10.2 | 10.2 | | | |
| | Chromium (Cr)-Total (mg/L) | <0.010 DLA | 0.00749 | | | |
| | Cobalt (Co)-Total (mg/L) | | 0.00044 | | | |
| | Copper (Cu)-Total (mg/L) | <0.0050 DLA | 0.0035 | | | |
| | Iron (Fe)-Total (mg/L) | 1.37 | 1.37 | | | |
| | Lead (Pb)-Total (mg/L) | <0.0025 DLA | 0.00096 | | | |
| | Lithium (Li)-Total (mg/L) | | 0.716 | | | |
| | Magnesium (Mg)-Total (mg/L) | 4.76 | 4.76 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.017 | 0.0165 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.00020 | <0.000010 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L993769-1 | L993769-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 11-APR-11 | 11-APR-11 | | | |
| | Sampled Time | | | | | |
| | Client ID | #3 P2C21(H2) D 200-600 M | #3 P2C21(H2) D 200-600 M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Molybdenum (Mo)-Total (mg/L) | | 0.0131 | | | |
| | Nickel (Ni)-Total (mg/L) | | 0.0036 | | | |
| | Phosphorus (P)-Total (mg/L) | | <0.30 | | | |
| | Potassium (K)-Total (mg/L) | 2.26 | 2.34 | | | |
| | Selenium (Se)-Total (mg/L) | <0.0050 DLA | 0.00085 | | | |
| | Silicon (Si)-Total (mg/L) | | 8.52 | | | |
| | Silver (Ag)-Total (mg/L) | | <0.000020 DLA | | | |
| | Sodium (Na)-Total (mg/L) | 238 | 231 | | | |
| | Strontium (Sr)-Total (mg/L) | | 0.191 | | | |
| | Thallium (Tl)-Total (mg/L) | | <0.00020 DLA | | | |
| | Tin (Sn)-Total (mg/L) | | <0.00020 DLA | | | |
| | Titanium (Ti)-Total (mg/L) | | 0.026 | | | |
| | Uranium (U)-Total (mg/L) | 0.00084 | 0.000763 | | | |
| | Vanadium (V)-Total (mg/L) | | 0.0113 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.050 | 0.0380 | | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 0.324 | 0.324 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.0025 DLA | 0.00177 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00296 | 0.00236 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.625 | 0.659 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.0010 DLA | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.0010 DLA | | | |
| | Boron (B)-Dissolved (mg/L) | 0.14 | 0.167 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0010 DLA | <0.000020 DLA | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 8.36 | 8.36 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.010 DLA | 0.00127 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00020 DLA | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.0050 DLA | <0.0010 DLA | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.069 | 0.069 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.0025 DLA | <0.00010 DLA | | | |
| | Lithium (Li)-Dissolved (mg/L) | | 0.736 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 4.44 | 4.44 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | <0.010 DLA | 0.00496 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.00020 | <0.000010 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.0125 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.0015 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.30 | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.72 | 1.73 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L993769-1 | L993769-2 | | | |
| | **Description** | | | | | |
| | **Sampled Date** | 11-APR-11 | 11-APR-11 | | | |
| | **Sampled Time** | | | | | |
| | **Client ID** | #3 P2C21(H2) D 200-600 M | #3 P2C21(H2) D 200-600 M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Selenium (Se)-Dissolved (mg/L) | <0.0050 DLA | 0.00076 | | | |
| | Silicon (Si)-Dissolved (mg/L) | | 5.82 | | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000020 DLA | | | |
| | Sodium (Na)-Dissolved (mg/L) | 239 | 243 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.167 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.00020 DLA | | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00020 DLA | | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.010 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00076 | 0.000661 | | | |
| | Vanadium (V)-Dissolved (mg/L) | | 0.0051 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.050 | <0.0060 DLA | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Sample Submission Listed:**

| Qualifier | Description |
|---|---|
| SFPL | Sample was Filtered and Preserved at the laboratory - sample # 1 - Dissolved Metals |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ALK-COL-VA** | Water | Alkalinity by Colourimetric (Automated) | APHA 310.2 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **C-TOT-ORG-LOW-CL** | Water | Total Organic Carbon | APHA 5310 C-Instrumental |
| **CN-T-MID-HH-COL-VA** | Water | Total Cyanide by HH Distillation | APHA 4500-CN Cyanide |

This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method.

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 "Color" |

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 Color |

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States

# Reference Information

Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-CVAFS-VA** Water Total Mercury in Water by CVAFS EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-DIS-LOW-MS-VA** Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-TOT-LOW-MS-VA** Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**S2-D-COL-VA** Water Dissolved Sulphide by Colorimetric APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

**S2-UNION-MANCALC-VA** Water Un-ionized Hydrogen sulphide (Man. calc) APHA -4500-S2 H.

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

| | | | |
|---|---|---|---|
| **TDS-VA** | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA |

**Chain of Custody Numbers:**

10-140410

**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

Workorder: L993769 Report Date: 19-MAY-11 

Client: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: TAMMERA KOSTYA

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ALK-COL-VA** | **Water** | | | | | | | |
| **Batch R2176582** | | | | | | | | |
| **WG1265717-11 CRM** | | **VA-ALKL-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 95 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-14 CRM** | | **VA-ALKM-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 100 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-17 CRM** | | **VA-ALKH-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 108 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-2 CRM** | | **VA-ALKL-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 106 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-20 CRM** | | **VA-ALKL-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 99 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-23 CRM** | | **VA-ALKM-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 104 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-26 CRM** | | **VA-ALKH-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 103 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-5 CRM** | | **VA-ALKM-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 111 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-8 CRM** | | **VA-ALKH-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 98 | | % | | 85-115 | 14-APR-11 |
| **WG1265717-1 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **WG1265717-10 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **WG1265717-13 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **WG1265717-16 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **WG1265717-19 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **WG1265717-22 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **WG1265717-25 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **WG1265717-4 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **WG1265717-7 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <2.0 | | mg/L | | 2 | 14-APR-11 |
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2173747** | | | | | | | | |
| **WG1264699-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 98 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 99 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-1 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **WG1264699-10 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **WG1264699-4 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **WG1264699-6 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **WG1264699-8 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2173747** | | | | | | | | |
| **WG1264699-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 99 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 103 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-1 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 12-APR-11 |
| **WG1264699-10 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 12-APR-11 |
| **WG1264699-4 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 12-APR-11 |
| **WG1264699-6 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 12-APR-11 |
| **WG1264699-8 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 12-APR-11 |
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2173747** | | | | | | | | |
| **WG1264699-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 99 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 97 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-1 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 12-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2173747** | | | | | | | | |
| **WG1264699-10 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 12-APR-11 |
| **WG1264699-4 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 12-APR-11 |
| **WG1264699-6 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 12-APR-11 |
| **WG1264699-8 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 12-APR-11 |
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2173747** | | | | | | | | |
| **WG1264699-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 100 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 100 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-1 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 12-APR-11 |
| **WG1264699-10 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 12-APR-11 |
| **WG1264699-4 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 12-APR-11 |
| **WG1264699-6 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 12-APR-11 |
| **WG1264699-8 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 12-APR-11 |
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2173747** | | | | | | | | |
| **WG1264699-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 102 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 103 | | % | | 85-115 | 12-APR-11 |
| **WG1264699-1 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **WG1264699-10 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **WG1264699-4 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **WG1264699-6 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2173747** | | | | | | | | |
| **WG1264699-8 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 12-APR-11 |
| **CN-T-MID-HH-COL-VA** | **Water** | | | | | | | |
| **Batch R2174417** | | | | | | | | |
| **WG1265278-2 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 85 | | % | | 80-120 | 13-APR-11 |
| **WG1265278-5 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 100 | | % | | 80-120 | 13-APR-11 |
| **WG1265278-1 MB** | | | | | | | | |
| Cyanide, Total | | | <0.0050 | | mg/L | | 0.005 | 13-APR-11 |
| **WG1265278-4 MB** | | | | | | | | |
| Cyanide, Total | | | <0.0050 | | mg/L | | 0.005 | 13-APR-11 |
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2172900** | | | | | | | | |
| **WG1264615-2 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 94 | | % | | 85-115 | 12-APR-11 |
| **WG1264615-4 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 95 | | % | | 85-115 | 12-APR-11 |
| **WG1264615-7 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 98 | | % | | 85-115 | 12-APR-11 |
| **WG1264615-1 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 12-APR-11 |
| **WG1264615-3 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 12-APR-11 |
| **WG1264615-6 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 12-APR-11 |
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2173370** | | | | | | | | |
| **WG1264195-9 CRM** | | **VA-EC-PCT-CONTROL** | | | | | | |
| Conductivity | | | 96 | | % | | 90-110 | 12-APR-11 |
| **WG1264195-1 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 12-APR-11 |
| **WG1264195-2 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 12-APR-11 |
| **WG1264195-3 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 12-APR-11 |
| **WG1264195-4 MB** | | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2173370** | | | | | | | | |
| **WG1264195-4 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 12-APR-11 |
| **WG1264195-5 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 12-APR-11 |
| **WG1264195-6 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 12-APR-11 |
| **HG-DIS-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2175588** | | | | | | | | |
| **WG1264808-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 14-APR-11 |
| **WG1264808-4 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 14-APR-11 |
| **Batch R2176934** | | | | | | | | |
| **WG1266529-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Dissolved | | | 93 | | % | | 80-120 | 15-APR-11 |
| **WG1266529-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 15-APR-11 |
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2175588** | | | | | | | | |
| **WG1264808-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 14-APR-11 |
| **WG1264808-4 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 14-APR-11 |
| **Batch R2176934** | | | | | | | | |
| **WG1266529-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Dissolved | | | 93 | | % | | 80-120 | 15-APR-11 |
| **WG1266529-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 15-APR-11 |
| **HG-TOT-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2174104** | | | | | | | | |
| **WG1265303-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Total | | | 112 | | % | | 80-120 | 13-APR-11 |
| **WG1265303-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2188255** | | | | | | | | |
| **WG1278364-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Total | | | 98 | | % | | 80-120 | 12-MAY-11 |
| **WG1278364-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000010 | | mg/L | | 0.00001 | 12-MAY-11 |
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2174403** | | | | | | | | |
| **WG1264808-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Beryllium (Be)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Bismuth (Bi)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 13-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 13-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Selenium (Se)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Strontium (Sr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Thallium (Tl)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 13-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| **WG1264808-4 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2174403** | | | | | | | | |
| **WG1264808-4 MB** | | | | | | | | |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Beryllium (Be)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Bismuth (Bi)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 13-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 13-APR-11 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Selenium (Se)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Strontium (Sr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Thallium (Tl)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 13-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| **Batch R2176931** | | | | | | | | |
| **WG1264808-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Dissolved | | | 103 | | % | | 80-120 | 14-APR-11 |
| Antimony (Sb)-Dissolved | | | 101 | | % | | 80-120 | 14-APR-11 |
| Arsenic (As)-Dissolved | | | 105 | | % | | 80-120 | 14-APR-11 |
| Barium (Ba)-Dissolved | | | 99 | | % | | 80-120 | 14-APR-11 |
| Beryllium (Be)-Dissolved | | | 101 | | % | | 80-120 | 14-APR-11 |
| Bismuth (Bi)-Dissolved | | | 115 | | % | | 80-120 | 14-APR-11 |
| Boron (B)-Dissolved | | | 93 | | % | | 80-120 | 14-APR-11 |
| Cadmium (Cd)-Dissolved | | | 97 | | % | | 80-120 | 14-APR-11 |
| Chromium (Cr)-Dissolved | | | 101 | | % | | 80-120 | 14-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2176931** | | | | | | | | |
| **WG1264808-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Cobalt (Co)-Dissolved | | | 102 | | % | | 80-120 | 14-APR-11 |
| Copper (Cu)-Dissolved | | | 101 | | % | | 80-120 | 14-APR-11 |
| Lead (Pb)-Dissolved | | | 102 | | % | | 80-120 | 14-APR-11 |
| Lithium (Li)-Dissolved | | | 101 | | % | | 80-120 | 14-APR-11 |
| Manganese (Mn)-Dissolved | | | 97 | | % | | 80-120 | 14-APR-11 |
| Molybdenum (Mo)-Dissolved | | | 103 | | % | | 80-120 | 14-APR-11 |
| Nickel (Ni)-Dissolved | | | 103 | | % | | 80-120 | 14-APR-11 |
| Potassium (K)-Dissolved | | | 100 | | % | | 80-120 | 14-APR-11 |
| Selenium (Se)-Dissolved | | | 103 | | % | | 80-120 | 14-APR-11 |
| Silver (Ag)-Dissolved | | | 102 | | % | | 80-120 | 14-APR-11 |
| Sodium (Na)-Dissolved | | | 96 | | % | | 80-120 | 14-APR-11 |
| Strontium (Sr)-Dissolved | | | 98 | | % | | 80-120 | 14-APR-11 |
| Thallium (Tl)-Dissolved | | | 99 | | % | | 80-120 | 14-APR-11 |
| Tin (Sn)-Dissolved | | | 95 | | % | | 80-120 | 14-APR-11 |
| Uranium (U)-Dissolved | | | 99 | | % | | 80-120 | 14-APR-11 |
| Vanadium (V)-Dissolved | | | 104 | | % | | 80-120 | 14-APR-11 |
| Zinc (Zn)-Dissolved | | | 95 | | % | | 80-120 | 14-APR-11 |
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2174387** | | | | | | | | |
| **WG1264808-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Dissolved | | | 99 | | % | | 80-120 | 12-APR-11 |
| Boron (B)-Dissolved | | | 101 | | % | | 80-120 | 12-APR-11 |
| Calcium (Ca)-Dissolved | | | 104 | | % | | 80-120 | 12-APR-11 |
| Iron (Fe)-Dissolved | | | 96 | | % | | 80-120 | 12-APR-11 |
| Magnesium (Mg)-Dissolved | | | 101 | | % | | 80-120 | 12-APR-11 |
| Phosphorus (P)-Dissolved | | | 101 | | % | | 80-120 | 12-APR-11 |
| Silicon (Si)-Dissolved | | | 108 | | % | | 80-120 | 12-APR-11 |
| Sodium (Na)-Dissolved | | | 100 | | % | | 80-120 | 12-APR-11 |
| Titanium (Ti)-Dissolved | | | 104 | | % | | 80-120 | 12-APR-11 |
| Zinc (Zn)-Dissolved | | | 96 | | % | | 80-120 | 12-APR-11 |
| **WG1264808-1 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 12-APR-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 12-APR-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 12-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2174387** | | | | | | | | |
| **WG1264808-1 MB** | | | | | | | | |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 12-APR-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 12-APR-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 12-APR-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 12-APR-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 12-APR-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 12-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 12-APR-11 |
| **WG1264808-4 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 12-APR-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 12-APR-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 12-APR-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 12-APR-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 12-APR-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 12-APR-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 12-APR-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 12-APR-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 12-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 12-APR-11 |
| **MET-DIS-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2174408** | | | | | | | | |
| **WG1264808-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 13-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| **WG1264808-4 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2174408** | | | | | | | | |
| **WG1264808-4 MB** | | | | | | | | |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 13-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| **Batch R2176931** | | | | | | | | |
| **WG1264808-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Dissolved | | | 103 | | % | | 80-120 | 14-APR-11 |
| Antimony (Sb)-Dissolved | | | 101 | | % | | 80-120 | 14-APR-11 |
| Arsenic (As)-Dissolved | | | 105 | | % | | 80-120 | 14-APR-11 |
| Cadmium (Cd)-Dissolved | | | 97 | | % | | 80-120 | 14-APR-11 |
| Chromium (Cr)-Dissolved | | | 101 | | % | | 80-120 | 14-APR-11 |
| Copper (Cu)-Dissolved | | | 101 | | % | | 80-120 | 14-APR-11 |
| Lead (Pb)-Dissolved | | | 102 | | % | | 80-120 | 14-APR-11 |
| Manganese (Mn)-Dissolved | | | 97 | | % | | 80-120 | 14-APR-11 |
| Potassium (K)-Dissolved | | | 100 | | % | | 80-120 | 14-APR-11 |
| Selenium (Se)-Dissolved | | | 103 | | % | | 80-120 | 14-APR-11 |
| Uranium (U)-Dissolved | | | 99 | | % | | 80-120 | 14-APR-11 |
| **MET-T-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2174403** | | | | | | | | |
| **WG1264801-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Barium (Ba)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Beryllium (Be)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Bismuth (Bi)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Boron (B)-Total | | | <0.010 | | mg/L | | 0.01 | 13-APR-11 |
| Cadmium (Cd)-Total | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Chromium (Cr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-T-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2174403** | | | | | | | | |
| **WG1264801-1 MB** | | | | | | | | |
| Cobalt (Co)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Lithium (Li)-Total | | | <0.0050 | | mg/L | | 0.005 | 13-APR-11 |
| Manganese (Mn)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Molybdenum (Mo)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Nickel (Ni)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Potassium (K)-Total | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Selenium (Se)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Silver (Ag)-Total | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Sodium (Na)-Total | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Strontium (Sr)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Thallium (Tl)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Tin (Sn)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| Vanadium (V)-Total | | | <0.0010 | | mg/L | | 0.001 | 13-APR-11 |
| Zinc (Zn)-Total | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| **Batch R2176931** | | | | | | | | |
| **WG1264801-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Total | | | 101 | | % | | 80-120 | 14-APR-11 |
| Antimony (Sb)-Total | | | 99 | | % | | 80-120 | 14-APR-11 |
| Arsenic (As)-Total | | | 98 | | % | | 80-120 | 14-APR-11 |
| Barium (Ba)-Total | | | 94 | | % | | 80-120 | 14-APR-11 |
| Beryllium (Be)-Total | | | 99 | | % | | 80-120 | 14-APR-11 |
| Bismuth (Bi)-Total | | | 110 | | % | | 80-120 | 14-APR-11 |
| Boron (B)-Total | | | 94 | | % | | 80-120 | 14-APR-11 |
| Cadmium (Cd)-Total | | | 92 | | % | | 80-120 | 14-APR-11 |
| Chromium (Cr)-Total | | | 95 | | % | | 80-120 | 14-APR-11 |
| Cobalt (Co)-Total | | | 97 | | % | | 80-120 | 14-APR-11 |
| Copper (Cu)-Total | | | 96 | | % | | 80-120 | 14-APR-11 |
| Lead (Pb)-Total | | | 99 | | % | | 80-120 | 14-APR-11 |
| Lithium (Li)-Total | | | 99 | | % | | 80-120 | 14-APR-11 |
| Manganese (Mn)-Total | | | 93 | | % | | 80-120 | 14-APR-11 |
| Molybdenum (Mo)-Total | | | 100 | | % | | 80-120 | 14-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-T-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2176931** | | | | | | | | |
| **WG1264801-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Nickel (Ni)-Total | | | 97 | | % | | 80-120 | 14-APR-11 |
| Potassium (K)-Total | | | 95 | | % | | 80-120 | 14-APR-11 |
| Selenium (Se)-Total | | | 100 | | % | | 80-120 | 14-APR-11 |
| Silver (Ag)-Total | | | 101 | | % | | 80-120 | 14-APR-11 |
| Sodium (Na)-Total | | | 94 | | % | | 80-120 | 14-APR-11 |
| Strontium (Sr)-Total | | | 95 | | % | | 80-120 | 14-APR-11 |
| Thallium (Tl)-Total | | | 96 | | % | | 80-120 | 14-APR-11 |
| Tin (Sn)-Total | | | 92 | | % | | 80-120 | 14-APR-11 |
| Uranium (U)-Total | | | 97 | | % | | 80-120 | 14-APR-11 |
| Vanadium (V)-Total | | | 97 | | % | | 80-120 | 14-APR-11 |
| Zinc (Zn)-Total | | | 90 | | % | | 80-120 | 14-APR-11 |
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2174387** | | | | | | | | |
| **WG1264801-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Total | | | 101 | | % | | 80-120 | 12-APR-11 |
| Boron (B)-Total | | | 101 | | % | | 80-120 | 12-APR-11 |
| Calcium (Ca)-Total | | | 104 | | % | | 80-120 | 12-APR-11 |
| Iron (Fe)-Total | | | 97 | | % | | 80-120 | 12-APR-11 |
| Magnesium (Mg)-Total | | | 103 | | % | | 80-120 | 12-APR-11 |
| Phosphorus (P)-Total | | | 101 | | % | | 80-120 | 12-APR-11 |
| Silicon (Si)-Total | | | 109 | | % | | 80-120 | 12-APR-11 |
| Sodium (Na)-Total | | | 102 | | % | | 80-120 | 12-APR-11 |
| Titanium (Ti)-Total | | | 105 | | % | | 80-120 | 12-APR-11 |
| Zinc (Zn)-Total | | | 95 | | % | | 80-120 | 12-APR-11 |
| **WG1264801-1 MB** | | | | | | | | |
| Barium (Ba)-Total | | | <0.010 | | mg/L | | 0.01 | 12-APR-11 |
| Boron (B)-Total | | | <0.10 | | mg/L | | 0.1 | 12-APR-11 |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 12-APR-11 |
| Iron (Fe)-Total | | | <0.030 | | mg/L | | 0.03 | 12-APR-11 |
| Magnesium (Mg)-Total | | | <0.10 | | mg/L | | 0.1 | 12-APR-11 |
| Phosphorus (P)-Total | | | <0.30 | | mg/L | | 0.3 | 12-APR-11 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 12-APR-11 |
| Sodium (Na)-Total | | | <2.0 | | mg/L | | 2 | 12-APR-11 |
| Titanium (Ti)-Total | | | <0.010 | | mg/L | | 0.01 | 12-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2174387** | | | | | | | | |
| **WG1264801-1 MB** | | | | | | | | |
| Zinc (Zn)-Total | | | <0.0050 | | mg/L | | 0.005 | 12-APR-11 |
| **MET-TOT-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2174408** | | | | | | | | |
| **WG1264801-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | <0.0030 | | mg/L | | 0.003 | 13-APR-11 |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 13-APR-11 |
| Cadmium (Cd)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Chromium (Cr)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 13-APR-11 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Manganese (Mn)-Total | | | <0.000050 | | mg/L | | 0.00005 | 13-APR-11 |
| Potassium (K)-Total | | | <0.050 | | mg/L | | 0.05 | 13-APR-11 |
| Selenium (Se)-Total | | | <0.0010 | | mg/L | | 0.001 | 13-APR-11 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 13-APR-11 |
| **Batch R2176931** | | | | | | | | |
| **WG1264801-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Total | | | 101 | | % | | 80-120 | 14-APR-11 |
| Antimony (Sb)-Total | | | 99 | | % | | 80-120 | 14-APR-11 |
| Arsenic (As)-Total | | | 98 | | % | | 80-120 | 14-APR-11 |
| Cadmium (Cd)-Total | | | 92 | | % | | 80-120 | 14-APR-11 |
| Chromium (Cr)-Total | | | 95 | | % | | 80-120 | 14-APR-11 |
| Copper (Cu)-Total | | | 96 | | % | | 80-120 | 14-APR-11 |
| Lead (Pb)-Total | | | 99 | | % | | 80-120 | 14-APR-11 |
| Manganese (Mn)-Total | | | 93 | | % | | 80-120 | 14-APR-11 |
| Potassium (K)-Total | | | 95 | | % | | 80-120 | 14-APR-11 |
| Selenium (Se)-Total | | | 100 | | % | | 80-120 | 14-APR-11 |
| Uranium (U)-Total | | | 97 | | % | | 80-120 | 14-APR-11 |
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2174145** | | | | | | | | |
| **WG1265287-2 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 104 | | % | | 85-115 | 13-APR-11 |
| **WG1265287-4 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 102 | | % | | 85-115 | 13-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2174145** | | | | | | | | |
| **WG1265287-6 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 99 | | % | | 85-115 | 13-APR-11 |
| **WG1265287-1 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 13-APR-11 |
| **WG1265287-3 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 13-APR-11 |
| **WG1265287-5 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 13-APR-11 |
| **WG1265287-8 MS** | | **L993420-12** | | | | | | |
| Ammonia as N | | | 96 | | % | | 75-125 | 13-APR-11 |
| **PH-PCT-VA** | **Water** | | | | | | | |
| **Batch R2173370** | | | | | | | | |
| **WG1264195-10 CRM** | | **VA-PH7-BUF** | | | | | | |
| pH | | | 6.98 | | pH | | 6.9-7.1 | 12-APR-11 |
| **S2-D-COL-VA** | **Water** | | | | | | | |
| **Batch R2173589** | | | | | | | | |
| **WG1264582-2 DUP** | | **L993769-1** | | | | | | |
| Sulphide as S (Dissolved) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 12-APR-11 |
| **WG1264582-1 MB** | | | | | | | | |
| Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 12-APR-11 |
| **S2-UNION-MANCALC-VA** | **Water** | | | | | | | |
| **Batch R2173629** | | | | | | | | |
| **WG1264757-1 DUP** | | **L993769-1** | | | | | | |
| Sulphide As S (Un-ionized) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 25 | 12-APR-11 |
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2177711** | | | | | | | | |
| **WG1266601-10 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 101 | | % | | 85-115 | 15-APR-11 |
| **WG1266601-2 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 100 | | % | | 85-115 | 15-APR-11 |
| **WG1266601-4 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 100 | | % | | 85-115 | 15-APR-11 |
| **WG1266601-7 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 100 | | % | | 85-115 | 15-APR-11 |
| **WG1266601-1 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 15-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2177711** | | | | | | | | |
| **WG1266601-3 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 15-APR-11 |
| **WG1266601-6 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 15-APR-11 |
| **WG1266601-9 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 15-APR-11 |
| **TURBIDITY-VA** | **Water** | | | | | | | |
| **Batch R2174388** | | | | | | | | |
| **WG1265079-2 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 104 | | % | | 85-115 | 13-APR-11 |
| **WG1265079-5 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 102 | | % | | 85-115 | 13-APR-11 |
| **WG1265079-8 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 104 | | % | | 85-115 | 13-APR-11 |
| **WG1265079-1 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 13-APR-11 |
| **WG1265079-4 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 13-APR-11 |
| **WG1265079-7 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 13-APR-11 |

**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. |

# Quality Control Report



**Hold Time Exceedances:**

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 11-APR-11 | 12-APR-11 09:27 | 0.25 | 24 | hours | EHTR-FM |
| **Total Metals** | | | | | | | |
| Total Mercury in Water by CVAFS(Low) | | | | | | | |
| | 2 | 11-APR-11 | 12-MAY-11 13:21 | 28 | 31 | days | EHT |

**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 L993769 were received on 11-APR-11 09:35.

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.

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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.

~~10~~-140410

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

L993769

Page 1 of 1

| | | | |
|---|---|---|---|
| **Report To** | AMEC | **Report Format / Distribution** | **Service Request:** (Rush subject to availability - Contact ALS to confirm TAT) |
| Company: | | Standard: ✓ Other (specify): | Regular (Standard Turnaround Times - Business Days) |
| Contact: | T. Kostyg | Select: PDF ✓ Excel ✓ Digital Fax | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 3456 Opie Cres. Prince George, BC, V2N ~~6Z~~ 2P9 | Email 1: tammera.kostya@amec.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | | Email 2: Scott.green@amec.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: | (250) 564-3243 Fax: | | |
| **Invoice To** | Same as Report ? (circle) (Yes) or No (if No, provide details) | **Client / Project Information** | **Analysis Request** |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: KX13505 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | | PO / AFE: | |
| Contact: | | LSD: | |
| Address: | | | |
| Phone: | Fax: | Quote #: | |
| **Lab Work Order # (lab use only)** | | **ALS Contact:** | **Sampler:** |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Gen Chem * | Diss. metals * | Tot. metals | TOC | Cyanides | Ammonia | $H_2S$ / Sulfide - Union Manacle-Vg | S2-D-COL-VA | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | #3 P2C21 (H2) D: 200-600m | 11-04-11 | 12 AM | $H_2O$ | X | X | X | X | X | X | X | X | |
| | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | |

pH = Temp = — will call with info

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

* See Selam Worku * Preservative added 8hrs later (April 11/11 @9am) of Diss. Metals NOT Filtered & Pres

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| T. Kosty | April 11/11 | 9:30am | MRB | April 11 | 9:35 | 1 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 11-APR-11
Report Date: 14-APR-11 16:01 (MT)
Version: FINAL

Client Phone: 250-564-3243

# Certificate of Analysis

Lab Work Order #: L993814
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-140409

Nikolce Trajanoski
Supervisor

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L993814-1 #3 P2C21(H2) D 200-600M<br>Sampled By: NOT PROVIDED on 11-APR-11<br>Matrix: WATER | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| Methane, dissolved | 18.9 | | 0.0050 | mg/L | 12-APR-11 | 13-APR-11 | R2175444 |

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

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| METHANE-DIS-CL | Water | Methane, dissolved | EPA 5021/8015-HEADSPACE GC-FID |
| Results reported in | | | |

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

**Chain of Custody Numbers:**

10-140409

**GLOSSARY OF REPORT TERMS**

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

10-140409

# Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L993814

Page 1 of ___

| | | | |
|---|---|---|---|
| **Report To** | AMEC | **Report Format / Distribution** | **Service Request:** (Rush subject to availability - Contact ALS to confirm TAT) |
| Company: | | Standard: ✓ Other (specify): | Regular (Standard Turnaround Times - Business Days) |
| Contact: | T. Kosteg | Select: PDF Excel ✓ Digital Fax | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 3456 Opie Cres. Prince George, BC, V2N 2P9 | Email 1: tammera.kosteg@amec.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| Phone: | (250) 564-3243 Fax: | Email 2: scott.green@amec.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| **Invoice To** | Same as Report ? (circle) (Yes) or No (if No, provide details) | **Client / Project Information** | **Analysis Request** |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: | ( Indicate Filtered or Preserved, F/P ) |
| Company: | | PO / AFE: | Diss. Methane |
| Contact: | | LSD: | |
| Address: | | | |
| Phone: | Fax: | Quote #: | |
| **Lab Work Order # (lab use only)** | | **ALS Contact:** | **Sampler:** |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Number of Containers |
|---|---|---|---|---|---|
| | #3 P2C21 (#2) D: 200-600m | 11-04-11 | 12am | H2O | |

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

* See Selam Work for details

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| J. Kosteg | April 11/11 | 9:30am | MQ | Apr. 11/11 | 9:30 | 6 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: TAMMERA KOSTYA
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 18-APR-11
Report Date: 19-MAY-11 17:50 (MT)
Version: FINAL REV. 3

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L996144**
Project P.O. #: TUMBLER RIDGE
Job Reference: KX13505
Legal Site Desc:
C of C Numbers:

**Comments:** ADDITIONAL 17-MAY-11 16:41
ADDITIONAL 11-MAY-11 14:06
Although Cyanide analysis is requested for, note that the required sample bottle was not submitted.

Selam Worku
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L996144-1 | L996144-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 16-APR-11 | 16-APR-11 | | | |
| | Sampled Time | 17:00 | 17:00 | | | |
| | Client ID | #4 P2C21 (H2)D 20-600M | #4 P2C21 (H2)D 20-600M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | | | | |
| | Conductivity (uS/cm) | 1720 | | | | |
| | Hardness (as CaCO3) (mg/L) | 14.1 | 30.2 | | | |
| | pH (pH) | 10.60 | | | | |
| | Total Dissolved Solids (mg/L) | 993 | | | | |
| | Turbidity (NTU) | 124 | | | | |
| **Anions and Nutrients** | Alkalinity, Total (as CaCO3) (mg/L) | 728 | | | | |
| | Ammonia as N (mg/L) | 1.69 | | | | |
| | Chloride (Cl) (mg/L) | 79 | | | | |
| | Fluoride (F) (mg/L) | 1.09 | | | | |
| | Nitrate (as N) (mg/L) | <0.10 | | | | |
| | Nitrite (as N) (mg/L) | <0.020 | | | | |
| | Sulfate (SO4) (mg/L) | 52 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 12.8 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 2.72 | 2.87 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.0025 DLA | 0.00168 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00200 | 0.00249 | | | |
| | Barium (Ba)-Total (mg/L) | 0.669 | 0.722 | | | |
| | Beryllium (Be)-Total (mg/L) | | <0.0010 DLA | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.0010 DLA | | | |
| | Boron (B)-Total (mg/L) | 0.16 | 0.176 | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.0010 DLA | 0.000049 | | | |
| | Calcium (Ca)-Total (mg/L) | 8.12 | 8.12 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.012 | 0.0131 | | | |
| | Cobalt (Co)-Total (mg/L) | | 0.00069 | | | |
| | Copper (Cu)-Total (mg/L) | <0.0050 DLA | 0.0045 | | | |
| | Iron (Fe)-Total (mg/L) | 1.63 | 1.64 | | | |
| | Lead (Pb)-Total (mg/L) | <0.0025 DLA | 0.00138 | | | |
| | Lithium (Li)-Total (mg/L) | | 0.929 | | | |
| | Magnesium (Mg)-Total (mg/L) | 2.41 | 2.41 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.015 | 0.0172 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.00020 | <0.000010 | | | |
| | Molybdenum (Mo)-Total (mg/L) | | 0.0172 | | | |
| | Nickel (Ni)-Total (mg/L) | | 0.0050 | | | |
| | Phosphorus (P)-Total (mg/L) | | <0.30 | | | |
| | Potassium (K)-Total (mg/L) | 2.86 | 3.26 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L996144-1 | L996144-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 16-APR-11 | 16-APR-11 | | | |
| | Sampled Time | 17:00 | 17:00 | | | |
| | Client ID | #4 P2C21 (H2)D 20-600M | #4 P2C21 (H2)D 20-600M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Selenium (Se)-Total (mg/L) | <0.0050 DLA | 0.00037 | | | |
| | Silicon (Si)-Total (mg/L) | | 11.0 | | | |
| | Silver (Ag)-Total (mg/L) | | 0.000023 | | | |
| | Sodium (Na)-Total (mg/L) | 393 | 382 | | | |
| | Strontium (Sr)-Total (mg/L) | | 0.139 | | | |
| | Thallium (Tl)-Total (mg/L) | | <0.00020 DLA | | | |
| | Tin (Sn)-Total (mg/L) | | <0.00020 DLA | | | |
| | Titanium (Ti)-Total (mg/L) | | 0.033 | | | |
| | Uranium (U)-Total (mg/L) | <0.00050 DLA | 0.000372 | | | |
| | Vanadium (V)-Total (mg/L) | | 0.0145 | | | |
| | Zinc (Zn)-Total (mg/L) | <0.050 | 0.0402 | | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 0.466 | 0.467 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.0025 DLA | 0.00184 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00191 | 0.00202 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.270 | 0.297 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.0010 DLA | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.0010 DLA | | | |
| | Boron (B)-Dissolved (mg/L) | 0.15 | 0.174 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.0010 DLA | <0.000020 DLA | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 3.46 | 3.46 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.010 DLA | 0.00245 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.00020 DLA | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.0050 DLA | <0.0010 DLA | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.052 | 0.052 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.0025 DLA | <0.00010 DLA | | | |
| | Lithium (Li)-Dissolved (mg/L) | | 0.927 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 1.33 | 1.33 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | <0.010 DLA | 0.00030 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.00020 | <0.000010 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.0161 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.0010 DLA | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.30 | | | |
| | Potassium (K)-Dissolved (mg/L) | 2.30 | 2.63 | | | |
| | Selenium (Se)-Dissolved (mg/L) | <0.0050 DLA | 0.00038 | | | |
| | Silicon (Si)-Dissolved (mg/L) | | 7.70 | | | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000020 DLA | | | |
| | Sodium (Na)-Dissolved (mg/L) | 398 | 405 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L996144-1 | L996144-2 | | | |
|---|---|---|---|---|---|---|
| | Description | | | | | |
| | Sampled Date | 16-APR-11 | 16-APR-11 | | | |
| | Sampled Time | 17:00 | 17:00 | | | |
| | Client ID | #4 P2C21 (H2)D 20-600M | #4 P2C21 (H2)D 20-600M | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Strontium (Sr)-Dissolved (mg/L) | | 0.0894 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.00020 DLA | | | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00020 DLA | | | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.010 | | | |
| | Uranium (U)-Dissolved (mg/L) | <0.00050 DLA | 0.000227 | | | |
| | Vanadium (V)-Dissolved (mg/L) | | 0.0067 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.050 | <0.0060 DLA | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Sample Submission Listed:**

| Qualifier | Description |
|---|---|
| SFPL | Sample was Filtered and Preserved at the laboratory - sample # 1 - Dissolved Metals |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| MB-LOR | Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required. |
| 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** |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 "Color" |

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 Color |

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold

# Reference Information

vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-CVAFS-VA** Water Total Mercury in Water by CVAFS EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-DIS-LOW-MS-VA** Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-TOT-LOW-MS-VA** Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

# Reference Information

| | | | |
|---|---|---|---|
| **TDS-VA** | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BC, 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: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: TAMMERA KOSTYA

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ALK-PCT-VA** | **Water** | | | | | | | |
| **Batch R2182757** | | | | | | | | |
| **WG1271304-8 CRM** | | **VA-ALK-PCT-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 109 | | % | | 85-115 | 28-APR-11 |
| **WG1271304-1 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 28-APR-11 |
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2178206** | | | | | | | | |
| **WG1266961-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 101 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 101 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-9 DUP** | | **L996144-1** | | | | | | |
| Chloride (Cl) | | 79 | 78 | | mg/L | 0.19 | 20 | 18-APR-11 |
| **WG1266961-1 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **WG1266961-10 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **WG1266961-4 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **WG1266961-6 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **WG1266961-8 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2178206** | | | | | | | | |
| **WG1266961-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 110 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 109 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-9 DUP** | | **L996144-1** | | | | | | |
| Fluoride (F) | | 1.09 | 1.11 | | mg/L | 1.6 | 20 | 18-APR-11 |
| **WG1266961-1 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 18-APR-11 |
| **WG1266961-10 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 18-APR-11 |
| **WG1266961-4 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 18-APR-11 |
| **WG1266961-6 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 18-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2178206** | | | | | | | | |
| **WG1266961-8 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 18-APR-11 |
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2178206** | | | | | | | | |
| **WG1266961-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 99 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 100 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-9 DUP** | | **L996144-1** | | | | | | |
| Nitrite (as N) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 18-APR-11 |
| **WG1266961-1 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 18-APR-11 |
| **WG1266961-10 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 18-APR-11 |
| **WG1266961-4 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 18-APR-11 |
| **WG1266961-6 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 18-APR-11 |
| **WG1266961-8 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 18-APR-11 |
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2178206** | | | | | | | | |
| **WG1266961-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 102 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 102 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-9 DUP** | | **L996144-1** | | | | | | |
| Nitrate (as N) | | <0.10 | <0.10 | RPD-NA | mg/L | N/A | 20 | 18-APR-11 |
| **WG1266961-1 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 18-APR-11 |
| **WG1266961-4 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 18-APR-11 |
| **WG1266961-6 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 18-APR-11 |
| **WG1266961-8 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 18-APR-11 |
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2178206** | | | | | | | | |
| **WG1266961-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 104 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 105 | | % | | 85-115 | 18-APR-11 |
| **WG1266961-9 DUP** | | **L996144-1** | | | | | | |
| Sulfate (SO4) | | 52 | 49 | | mg/L | 6.2 | 20 | 18-APR-11 |
| **WG1266961-1 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **WG1266961-10 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **WG1266961-4 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **WG1266961-6 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **WG1266961-8 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 18-APR-11 |
| **CARBONS-TOC-VA** | **Water** | | | | | | | |
| **Batch R2180491** | | | | | | | | |
| **WG1270216-1 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 93 | | % | | 80-120 | 21-APR-11 |
| **WG1270216-3 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 93 | | % | | 80-120 | 21-APR-11 |
| **WG1270216-5 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 94 | | % | | 80-120 | 21-APR-11 |
| **WG1270216-7 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 93 | | % | | 80-120 | 21-APR-11 |
| **WG1270216-2 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 21-APR-11 |
| **WG1270216-4 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 21-APR-11 |
| **WG1270216-6 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 21-APR-11 |
| **WG1270216-10 MS** | | **L995883-1** | | | | | | |
| Total Organic Carbon | | | N/A | MS-B | % | | - | 21-APR-11 |
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2178289** | | | | | | | | |
| **WG1267710-2 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 100 | | % | | 85-115 | 19-APR-11 |
| **WG1267710-4 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 100 | | % | | 85-115 | 19-APR-11 |
| **WG1267710-1 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 19-APR-11 |
| **WG1267710-3 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 19-APR-11 |
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2178452** | | | | | | | | |
| **WG1267739-9 CRM** | | **VA-EC-PCT-CONTROL** | | | | | | |
| Conductivity | | | 98 | | % | | 90-110 | 19-APR-11 |
| **WG1267739-1 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 19-APR-11 |
| **WG1267739-2 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 19-APR-11 |
| **WG1267739-3 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 19-APR-11 |
| **WG1267739-4 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 19-APR-11 |
| **WG1267739-5 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 19-APR-11 |
| **WG1267739-6 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 19-APR-11 |
| **HG-DIS-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2181346** | | | | | | | | |
| **WG1270976-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Dissolved | | | 92 | | % | | 80-120 | 27-APR-11 |
| **WG1270976-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 27-APR-11 |
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2178301** | | | | | | | | |
| **WG1267052-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| **WG1267052-5 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2181346** | | | | | | | | |
| **WG1270976-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Dissolved | | | 92 | | % | | 80-120 | 27-APR-11 |
| **WG1270976-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 27-APR-11 |
| **HG-TOT-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2178301** | | | | | | | | |
| **WG1267876-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Total | | | 98 | | % | | 80-120 | 19-APR-11 |
| **WG1267876-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2188764** | | | | | | | | |
| **WG1278985-2 CRM** | | **VA-HG-WATRM** | | | | | | |
| Mercury (Hg)-Total | | | 99 | | % | | 80-120 | 13-MAY-11 |
| **WG1278985-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000010 | | mg/L | | 0.00001 | 13-MAY-11 |
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2178844** | | | | | | | | |
| **WG1267052-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 19-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Beryllium (Be)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Bismuth (Bi)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 19-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 19-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 19-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2178844** | | | | | | | | |
| **WG1267052-1 MB** | | | | | | | | |
| Selenium (Se)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 19-APR-11 |
| Strontium (Sr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Thallium (Tl)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 19-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 19-APR-11 |
| **WG1267052-5 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 19-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Barium (Ba)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Beryllium (Be)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Bismuth (Bi)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Boron (B)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 19-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Cobalt (Co)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 19-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Molybdenum (Mo)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Nickel (Ni)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 19-APR-11 |
| Selenium (Se)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Silver (Ag)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| Sodium (Na)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 19-APR-11 |
| Strontium (Sr)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Thallium (Tl)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Tin (Sn)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-D-CCMS-VA** | **Water** | | | | | | | |
| **Batch R2178844** | | | | | | | | |
| **WG1267052-5 MB** | | | | | | | | |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 19-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 19-APR-11 |
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2178266** | | | | | | | | |
| **WG1267052-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Dissolved | | | 98 | | % | | 80-120 | 18-APR-11 |
| Boron (B)-Dissolved | | | 99 | | % | | 80-120 | 18-APR-11 |
| Calcium (Ca)-Dissolved | | | 100 | | % | | 80-120 | 18-APR-11 |
| Iron (Fe)-Dissolved | | | 97 | | % | | 80-120 | 18-APR-11 |
| Magnesium (Mg)-Dissolved | | | 100 | | % | | 80-120 | 18-APR-11 |
| Phosphorus (P)-Dissolved | | | 100 | | % | | 80-120 | 18-APR-11 |
| Silicon (Si)-Dissolved | | | 103 | | % | | 80-120 | 18-APR-11 |
| Sodium (Na)-Dissolved | | | 101 | | % | | 80-120 | 18-APR-11 |
| Titanium (Ti)-Dissolved | | | 104 | | % | | 80-120 | 18-APR-11 |
| Zinc (Zn)-Dissolved | | | 95 | | % | | 80-120 | 18-APR-11 |
| **WG1267052-1 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 18-APR-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 18-APR-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 18-APR-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 18-APR-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 18-APR-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 18-APR-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 18-APR-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 18-APR-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 18-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 18-APR-11 |
| **WG1267052-5 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 18-APR-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 18-APR-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 18-APR-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 18-APR-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 18-APR-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 18-APR-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 18-APR-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 18-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2178266** | | | | | | | | |
| **WG1267052-5 MB** | | | | | | | | |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 18-APR-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 18-APR-11 |
| **MET-DIS-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2178825** | | | | | | | | |
| **WG1267052-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 19-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 19-APR-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 19-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| **WG1267052-5 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0030 | | mg/L | | 0.003 | 19-APR-11 |
| Antimony (Sb)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Arsenic (As)-Dissolved | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Cadmium (Cd)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Chromium (Cr)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Copper (Cu)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Lead (Pb)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Manganese (Mn)-Dissolved | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Potassium (K)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 19-APR-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 19-APR-11 |
| Uranium (U)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2178266** | | | | | | | | |
| **WG1267412-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Total | | | 101 | | % | | 80-120 | 18-APR-11 |
| Boron (B)-Total | | | 101 | | % | | 80-120 | 18-APR-11 |
| Calcium (Ca)-Total | | | 101 | | % | | 80-120 | 18-APR-11 |
| Iron (Fe)-Total | | | 98 | | % | | 80-120 | 18-APR-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2178266** | | | | | | | | |
| **WG1267412-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Magnesium (Mg)-Total | | | 102 | | % | | 80-120 | 18-APR-11 |
| Phosphorus (P)-Total | | | 102 | | % | | 80-120 | 18-APR-11 |
| Silicon (Si)-Total | | | 105 | | % | | 80-120 | 18-APR-11 |
| Sodium (Na)-Total | | | 103 | | % | | 80-120 | 18-APR-11 |
| Titanium (Ti)-Total | | | 106 | | % | | 80-120 | 18-APR-11 |
| Zinc (Zn)-Total | | | 95 | | % | | 80-120 | 18-APR-11 |
| **WG1267412-1 MB** | | | | | | | | |
| Barium (Ba)-Total | | | <0.010 | | mg/L | | 0.01 | 18-APR-11 |
| Boron (B)-Total | | | <0.10 | | mg/L | | 0.1 | 18-APR-11 |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 18-APR-11 |
| Iron (Fe)-Total | | | <0.030 | | mg/L | | 0.03 | 18-APR-11 |
| Magnesium (Mg)-Total | | | <0.10 | | mg/L | | 0.1 | 18-APR-11 |
| Phosphorus (P)-Total | | | <0.30 | | mg/L | | 0.3 | 18-APR-11 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 18-APR-11 |
| Sodium (Na)-Total | | | <2.0 | | mg/L | | 2 | 18-APR-11 |
| Titanium (Ti)-Total | | | <0.010 | | mg/L | | 0.01 | 18-APR-11 |
| Zinc (Zn)-Total | | | <0.0050 | | mg/L | | 0.005 | 18-APR-11 |
| **MET-TOT-LOW-MS-VA** | **Water** | | | | | | | |
| **Batch R2178825** | | | | | | | | |
| **WG1267412-1 MB** | | | | | | | | |
| Antimony (Sb)-Total | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Arsenic (As)-Total | | | <0.00010 | | mg/L | | 0.0001 | 19-APR-11 |
| Cadmium (Cd)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Chromium (Cr)-Total | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Copper (Cu)-Total | | | <0.00050 | | mg/L | | 0.0005 | 19-APR-11 |
| Lead (Pb)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Manganese (Mn)-Total | | | <0.000050 | | mg/L | | 0.00005 | 19-APR-11 |
| Potassium (K)-Total | | | <0.050 | | mg/L | | 0.05 | 19-APR-11 |
| Selenium (Se)-Total | | | <0.0010 | | mg/L | | 0.001 | 19-APR-11 |
| Uranium (U)-Total | | | <0.000010 | | mg/L | | 0.00001 | 19-APR-11 |
| **Batch R2178844** | | | | | | | | |
| **WG1267412-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | 0.0056 | MB-LOR | mg/L | | 0.003 | 19-APR-11 |
| **NH3-F-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2179335** | | | | | | | | |
| **WG1269024-2 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 94 | | % | | 85-115 | 21-APR-11 |
| **WG1269024-4 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 95 | | % | | 85-115 | 21-APR-11 |
| **WG1269024-6 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 95 | | % | | 85-115 | 21-APR-11 |
| **WG1269024-8 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia as N | | | 94 | | % | | 85-115 | 21-APR-11 |
| **WG1269024-1 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 21-APR-11 |
| **WG1269024-3 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 21-APR-11 |
| **WG1269024-5 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 21-APR-11 |
| **WG1269024-7 MB** | | | | | | | | |
| Ammonia as N | | | <0.0050 | | mg/L | | 0.005 | 21-APR-11 |
| **WG1269024-10 MS** | | **L996197-10** | | | | | | |
| Ammonia as N | | | 96 | | % | | 75-125 | 21-APR-11 |
| **WG1269024-12 MS** | | **L995862-5** | | | | | | |
| Ammonia as N | | | 88 | | % | | 75-125 | 21-APR-11 |
| **PH-PCT-VA** | **Water** | | | | | | | |
| **Batch R2178452** | | | | | | | | |
| **WG1267739-10 CRM** | | **VA-PH7-BUF** | | | | | | |
| pH | | | 6.99 | | pH | | 6.9-7.1 | 19-APR-11 |
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2179637** | | | | | | | | |
| **WG1269212-10 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 99 | | % | | 85-115 | 21-APR-11 |
| **WG1269212-13 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 105 | | % | | 85-115 | 21-APR-11 |
| **WG1269212-2 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 102 | | % | | 85-115 | 21-APR-11 |
| **WG1269212-5 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 102 | | % | | 85-115 | 21-APR-11 |
| **WG1269212-7 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 98 | | % | | 85-115 | 21-APR-11 |
| **WG1269212-1 MB** | | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2179637** | | | | | | | | |
| **WG1269212-1 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 21-APR-11 |
| **WG1269212-12 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 21-APR-11 |
| **WG1269212-4 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 21-APR-11 |
| **WG1269212-6 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 21-APR-11 |
| **WG1269212-9 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 21-APR-11 |
| **TURBIDITY-VA** | **Water** | | | | | | | |
| **Batch R2178291** | | | | | | | | |
| **WG1267711-2 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 105 | | % | | 85-115 | 19-APR-11 |
| **WG1267711-5 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 105 | | % | | 85-115 | 19-APR-11 |
| **WG1267711-8 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 104 | | % | | 85-115 | 19-APR-11 |
| **WG1267711-1 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 19-APR-11 |
| **WG1267711-4 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 19-APR-11 |
| **WG1267711-7 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 19-APR-11 |

**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. |
| MB-LOR | Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required. |
| 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** | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 16-APR-11 17:00 | 19-APR-11 14:31 | 0.25 | 70 | hours | EHTR-FM |

**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 L996144 were received on 18-APR-11 14:13.

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.

# Short Holding Time

## Rush Processing

ALS Environmen

10-140411

*L996144-COFC*

Page 1 of 1

| | |
|---|---|
| **Report To** | AMEC |
| Company: | |
| Contact: | J. Kostya |
| Address: | 3456 Opie Cres. Prince George, BC V2N 2P9 |
| Phone: | Fax: |
| **Invoice To** | Same as Report ? (circle) (Yes) or No (if No, provide details) |
| | Copy of Invoice with Report? (circle) Yes or No |
| Company: | |
| Contact: | |
| Address: | |
| Phone: | Fax: |
| **Lab Work Order # (lab use only)** | L996144 |

**Report Format / Distribution**

Standard: ✓ Other (specify):

Select: PDF ✓ Excel ✓ Digital Fax

Email 1: tammera.kostya@amec.com

Email 2: scott.green@amec.com

**Client / Project Information**

Job #: EX13505

PO / AFE:

LSD: Tumblers Ridge

Quote #:

**ALS Contact:** **Sampler:**

**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)

- Regular (Standard Turnaround Times - Business Days) ✓
- Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
- Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
- Same Day or Weekend Emergency - Contact ALS to confirm TAT

**Analysis Request**

( Indicate Filtered or Preserved, F/P )

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Potability Package (24 T. Metals) | Diss. Metals | TOC | Cyanides | Ammonia | | | | | | | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | #4 P2c21 (H2)D 20-600m | 16-04-11 | 5pm | $H_2O$ | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
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**Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details**

* No Diss. $H_2S$ samples to analyze * Please see Selam Work when received for details.

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| J. Kostya | April 17/11 | 10am | JP | Apr 18/11 | 11:40 | 7 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: T.KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 18-APR-11
Report Date: 26-APR-11 15:48 (MT)
Version: FINAL

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L995935**
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051116

KELLY HUNT
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L995935-1 #4 P2C21(H2) D20-600M<br>Sampled By: T.KOSTYA on 16-APR-11 @ 17:00<br>Matrix: WATER | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| Methane, dissolved | 9.14 | | 0.0050 | mg/L | 21-APR-11 | 21-APR-11 | R2180040 |

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

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| METHANE-DIS-CL | Water | Methane, dissolved | EPA 5021/8015-HEADSPACE GC-FID |
| Results reported in | | | |

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

**Chain of Custody Numbers:**

10-051116

**GLOSSARY OF REPORT TERMS**

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

**ALS Laboratory Group**
ANALYTICAL CHEMISTRY & TESTING SERVICES

**Environmental Division**

4121

# Chain of Custody / Analytical Request Form

**Canada Toll Free: 1 800 668 9878**

www.alsglobal.com

L995935

10-051116

Page 1 of 1

| | |
|---|---|
| **Report To** | AMEC |
| Company: | |
| Contact: | T. Kostya |
| Address: | #3456 Opie Cres. Prince George, BC, V2N 2P9 |
| Phone: | (250) 564-3243 Fax: |
| **Invoice To** | Same as Report ? (circle) Yes or No (if No, provide details) |
| | Copy of Invoice with Report? (circle) Yes or No |
| Company: | |
| Contact: | |
| Address: | |
| Phone: | Fax: |

**Report Format / Distribution**

Standard: ✓ Other (specify):

Select: PDF ✓ Excel ✓ Digital Fax

Email 1: tammera.kostya@amec.com

Email 2: Scott.green@amec.com

**Client / Project Information**

Job #: KX13505

PO / AFE:

LSD:

Quote #:

ALS Contact: Selam Worku

Sampler: T. Kostya

**Service Requested:** (Rush subject to availability)

Regular (Standard Turnaround Times)) ✓

Priority, Date Req'd: _____ (Surcharges apply)

Emergency (1 Business Day) - 100% Surcharge

For Emergency < 1 Day, ASAP or Weekend - Contact ALS

**Analysis Request**

( Indicate Filtered or Preserved, F/P )

| Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Diss. Methane | Number of Containers |
|---|---|---|---|---|---|
| #4 P2C21 (H2) D 20 - 600m | 16-04-11 | 5PM | H2O | X | |

**Special Instructions / Regulations / Hazardous Details**

Please See Selam Worku when received for details

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
|---|---|---|---|---|---|---|---|---|---|---|
| T. Kostya | April 17 | 10am | SR | 18 Apr | 8:55 | 14 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: Tammera Kostya
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 24-JUN-11
Report Date: 19-JUL-11 17:38 (MT)
Version: FINAL REV. 2

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L1023033**
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.300
Legal Site Desc:
C of C Numbers: C037617

**Comments:** ADDITIONAL 15-JUL-11 14:57
Alkalinity analysis has been added.

19-JUL-11: Revised report

Andre Langlais
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1023033-1 | | | | |
|---|---|---|---|---|---|---|
| | Description | WATER | | | | |
| | Sampled Date | 23-JUN-11 | | | | |
| | Sampled Time | 11:00 | | | | |
| | Client ID | H16W 800-1000M | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 7.0 | | | | |
| | Conductivity (uS/cm) | 1810 | | | | |
| | Hardness (as CaCO3) (mg/L) | 11.0 | | | | |
| | pH (pH) | 9.50 | | | | |
| | Total Dissolved Solids (mg/L) | 1170 | | | | |
| | Turbidity (NTU) | 75.5 | | | | |
| **Anions and Nutrients** | Alkalinity, Total (as CaCO3) (mg/L) | 868 | | | | |
| | Ammonia (as N) (mg/L) | 0.939 | | | | |
| | Bromide (Br) (mg/L) | <0.50 | | | | |
| | Chloride (Cl) (mg/L) | 79.7 | | | | |
| | Fluoride (F) (mg/L) | 0.64 | | | | |
| | Nitrate (as N) (mg/L) | <0.050 | | | | |
| | Nitrite (as N) (mg/L) | <0.010 | | | | |
| | Sulfate (SO4) (mg/L) | 20.1 | | | | |
| | Sulphide as S (Dissolved) (mg/L) | 0.118 | | | | |
| **Cyanides** | Cyanide, Total (mg/L) | <0.0050 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 27.9 | | | | |
| **Inorganic Parameters** | Sulphide As S (Un-ionized) (mg/L) | <0.020 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.933 | | | | |
| | Antimony (Sb)-Total (mg/L) | <0.0025 DLA | | | | |
| | Arsenic (As)-Total (mg/L) | 0.0033 | | | | |
| | Barium (Ba)-Total (mg/L) | 0.610 | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.0050 DLA | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.20 | | | | |
| | Boron (B)-Total (mg/L) | 0.26 | | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000112 | | | | |
| | Calcium (Ca)-Total (mg/L) | 10.1 | | | | |
| | Chromium (Cr)-Total (mg/L) | 0.0088 | | | | |
| | Cobalt (Co)-Total (mg/L) | <0.0015 DLA | | | | |
| | Copper (Cu)-Total (mg/L) | 0.0113 | | | | |
| | Iron (Fe)-Total (mg/L) | 1.57 | | | | |
| | Lead (Pb)-Total (mg/L) | <0.0025 DLA | | | | |
| | Lithium (Li)-Total (mg/L) | 0.926 | | | | |
| | Magnesium (Mg)-Total (mg/L) | 1.31 | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0301 | | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1023033-1 | | | | |
| | **Description** | WATER | | | | |
| | **Sampled Date** | 23-JUN-11 | | | | |
| | **Sampled Time** | 11:00 | | | | |
| | **Client ID** | H16W 800-1000M | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Molybdenum (Mo)-Total (mg/L) | 0.0223 | | | | |
| | Nickel (Ni)-Total (mg/L) | 0.0064 | | | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | | | | |
| | Potassium (K)-Total (mg/L) | 4.7 | | | | |
| | Selenium (Se)-Total (mg/L) | <0.0050 DLA | | | | |
| | Silicon (Si)-Total (mg/L) | 9.54 | | | | |
| | Silver (Ag)-Total (mg/L) | <0.00010 DLA | | | | |
| | Sodium (Na)-Total (mg/L) | 412 | | | | |
| | Strontium (Sr)-Total (mg/L) | 0.120 | | | | |
| | Thallium (Tl)-Total (mg/L) | <0.0010 DLA | | | | |
| | Tin (Sn)-Total (mg/L) | <0.0025 DLA | | | | |
| | Titanium (Ti)-Total (mg/L) | 0.016 | | | | |
| | Uranium (U)-Total (mg/L) | <0.0010 DLA | | | | |
| | Vanadium (V)-Total (mg/L) | 0.0059 | | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0937 | | | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 0.257 | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.0025 DLA | | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.0030 | | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.295 | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.20 | | | | |
| | Boron (B)-Dissolved (mg/L) | 0.25 | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000085 DLA | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 2.82 | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.0015 DLA | | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.161 | | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.0025 DLA | | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.927 | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 0.96 | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0060 | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0216 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 4.4 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1023033-1 | | | | |
| | **Description** | WATER | | | | |
| | **Sampled Date** | 23-JUN-11 | | | | |
| | **Sampled Time** | 11:00 | | | | |
| | **Client ID** | H16W 800-1000M | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Selenium (Se)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 8.60 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.00010 DLA | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 406 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0796 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.0010 DLA | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.0025 DLA | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | | | | |
| | Uranium (U)-Dissolved (mg/L) | <0.0010 DLA | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0138 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| 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** |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| **CN-T-MID-HH-COL-VA** | Water | Total Cyanide by HH Distillation | APHA 4500-CN Cyanide |
| This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 "Color" |
| This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 Color |
| This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7). | | | |

# Reference Information

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | Water | Diss. Metals in Water by ICPMS (CCME) | EPA SW-846 3005A/6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-TOT-CCME-MS-VA** | Water | Total Metals in Water by ICPMS (CCME) | EPA SW-846 3005A/6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **S2-D-COL-VA** | Water | Dissolved Sulphide by Colorimetric | APHA 4500-S2 D. - SULPHIDE |

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

| | | | |
|---|---|---|---|
| **S2-UNION-MANCALC-VA** | Water | Un-ionized Hydrogen sulphide (Man. calc) | APHA -4500-S2 H. |

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

| | | | |
|---|---|---|---|
| **TDS-VA** | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|

# Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

**Chain of Custody Numbers:**

C037617

**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: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: Tammera Kostya

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ALK-PCT-VA** | **Water** | | | | | | | |
| **Batch R2221050** | | | | | | | | |
| **WG1314258-8 CRM** | | **VA-ALK-PCT-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 102 | | % | | 85-115 | 18-JUL-11 |
| **WG1314258-1 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-JUL-11 |
| **WG1314258-2 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-JUL-11 |
| **WG1314258-3 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-JUL-11 |
| **WG1314258-4 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-JUL-11 |
| **WG1314258-5 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-JUL-11 |
| **WG1314258-6 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-JUL-11 |
| **WG1314258-7 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-JUL-11 |
| **ANIONS-BR-IC-VA** | **Water** | | | | | | | |
| **Batch R2210229** | | | | | | | | |
| **WG1301747-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Bromide (Br) | | | 95 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Bromide (Br) | | | 99 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-1 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 24-JUN-11 |
| **WG1301747-10 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 24-JUN-11 |
| **WG1301747-4 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 24-JUN-11 |
| **WG1301747-6 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 24-JUN-11 |
| **WG1301747-8 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 24-JUN-11 |
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2210229** | | | | | | | | |
| **WG1301747-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 102 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Chloride (Cl) | | | 102 | | % | | 85-115 | 24-JUN-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2210229** | | | | | | | | |
| **WG1301747-1 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **WG1301747-10 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **WG1301747-4 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **WG1301747-6 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **WG1301747-8 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2210229** | | | | | | | | |
| **WG1301747-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 102 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Fluoride (F) | | | 107 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-1 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 24-JUN-11 |
| **WG1301747-10 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 24-JUN-11 |
| **WG1301747-4 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 24-JUN-11 |
| **WG1301747-6 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 24-JUN-11 |
| **WG1301747-8 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 24-JUN-11 |
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2210229** | | | | | | | | |
| **WG1301747-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 99 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrite (as N) | | | 100 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-1 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 24-JUN-11 |
| **WG1301747-10 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 24-JUN-11 |
| **WG1301747-4 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 24-JUN-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2210229** | | | | | | | | |
| **WG1301747-6 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 24-JUN-11 |
| **WG1301747-8 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 24-JUN-11 |
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2210229** | | | | | | | | |
| **WG1301747-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 99 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Nitrate (as N) | | | 96 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-1 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 24-JUN-11 |
| **WG1301747-10 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 24-JUN-11 |
| **WG1301747-4 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 24-JUN-11 |
| **WG1301747-6 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 24-JUN-11 |
| **WG1301747-8 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 24-JUN-11 |
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2210229** | | | | | | | | |
| **WG1301747-11 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 105 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-2 CRM** | | **VA-IC-IVA2-ION23110** | | | | | | |
| Sulfate (SO4) | | | 104 | | % | | 85-115 | 24-JUN-11 |
| **WG1301747-1 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **WG1301747-10 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **WG1301747-4 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **WG1301747-6 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **WG1301747-8 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 24-JUN-11 |
| **CARBONS-TOC-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **CARBONS-TOC-VA** | **Water** | | | | | | | |
| **Batch R2214629** | | | | | | | | |
| **WG1307653-1 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 96 | | % | | 80-120 | 05-JUL-11 |
| **WG1307653-3 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 95 | | % | | 80-120 | 05-JUL-11 |
| **WG1307653-5 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 93 | | % | | 80-120 | 05-JUL-11 |
| **WG1307653-7 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 95 | | % | | 80-120 | 05-JUL-11 |
| **WG1307653-9 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 96 | | % | | 80-120 | 05-JUL-11 |
| **WG1307653-2 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 05-JUL-11 |
| **WG1307653-4 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 05-JUL-11 |
| **WG1307653-6 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 05-JUL-11 |
| **WG1307653-8 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 05-JUL-11 |
| **WG1307653-11 MS** | | **L1023213-2** | | | | | | |
| Total Organic Carbon | | | 97 | | % | | 70-130 | 05-JUL-11 |
| **WG1307653-13 MS** | | **L1023435-9** | | | | | | |
| Total Organic Carbon | | | N/A | MS-B | % | | - | 05-JUL-11 |
| **WG1307653-16 MS** | | **L1024161-12** | | | | | | |
| Total Organic Carbon | | | 110 | | % | | 70-130 | 05-JUL-11 |
| **CN-T-MID-HH-COL-VA** | **Water** | | | | | | | |
| **Batch R2212348** | | | | | | | | |
| **WG1305163-2 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 99 | | % | | 80-120 | 30-JUN-11 |
| **WG1305163-4 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 96 | | % | | 80-120 | 30-JUN-11 |
| **WG1305163-1 MB** | | | | | | | | |
| Cyanide, Total | | | <0.0050 | | mg/L | | 0.005 | 30-JUN-11 |
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2209759** | | | | | | | | |
| **WG1302299-2 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 97 | | % | | 85-115 | 25-JUN-11 |
| **WG1302299-5 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 99 | | % | | 85-115 | 25-JUN-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2209759** | | | | | | | | |
| **WG1302299-1 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 25-JUN-11 |
| **WG1302299-4 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 25-JUN-11 |
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2211301** | | | | | | | | |
| **WG1302856-9 CRM** | | **VA-EC-PCT-CONTROL** | | | | | | |
| Conductivity | | | 100 | | % | | 90-110 | 27-JUN-11 |
| **WG1302856-14 DUP** | | **L1023033-1** | | | | | | |
| Conductivity | | 1810 | 1820 | | uS/cm | 0.33 | 10 | 27-JUN-11 |
| **WG1302856-1 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 27-JUN-11 |
| **WG1302856-2 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 27-JUN-11 |
| **WG1302856-3 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 27-JUN-11 |
| **WG1302856-4 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 27-JUN-11 |
| **WG1302856-5 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 27-JUN-11 |
| **WG1302856-6 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 27-JUN-11 |
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2210343** | | | | | | | | |
| **WG1302061-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 27-JUN-11 |
| **WG1302061-5 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 27-JUN-11 |
| **WG1303135-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 27-JUN-11 |
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2210343** | | | | | | | | |
| **WG1303135-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000010 | | mg/L | | 0.00001 | 27-JUN-11 |
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch** | **R2210685** | | | | | | | |
| **WG1302061-1** | **MB** | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 27-JUN-11 |
| Antimony (Sb)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 27-JUN-11 |
| Arsenic (As)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 27-JUN-11 |
| Beryllium (Be)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.0002 | 27-JUN-11 |
| Chromium (Cr)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Cobalt (Co)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 27-JUN-11 |
| Copper (Cu)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Lead (Pb)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 27-JUN-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.01 | 27-JUN-11 |
| Manganese (Mn)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 27-JUN-11 |
| Molybdenum (Mo)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Nickel (Ni)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Silver (Ag)-Dissolved | | | <0.000020 | | mg/L | | 0.0001 | 27-JUN-11 |
| Thallium (Tl)-Dissolved | | | <0.00020 | | mg/L | | 0.001 | 27-JUN-11 |
| Tin (Sn)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 27-JUN-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.005 | 27-JUN-11 |
| Uranium (U)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 27-JUN-11 |
| **WG1302061-5** | **MB** | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 27-JUN-11 |
| Antimony (Sb)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 27-JUN-11 |
| Arsenic (As)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 27-JUN-11 |
| Beryllium (Be)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.0002 | 27-JUN-11 |
| Chromium (Cr)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Cobalt (Co)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 27-JUN-11 |
| Copper (Cu)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Lead (Pb)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 27-JUN-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.01 | 27-JUN-11 |
| Manganese (Mn)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 27-JUN-11 |
| Molybdenum (Mo)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Nickel (Ni)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 27-JUN-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2210685** | | | | | | | | |
| **WG1302061-5 MB** | | | | | | | | |
| Silver (Ag)-Dissolved | | | <0.000020 | | mg/L | | 0.0001 | 27-JUN-11 |
| Thallium (Tl)-Dissolved | | | <0.00020 | | mg/L | | 0.001 | 27-JUN-11 |
| Tin (Sn)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 27-JUN-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.005 | 27-JUN-11 |
| Uranium (U)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 27-JUN-11 |
| **Batch R2210891** | | | | | | | | |
| **WG1302061-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Dissolved | | | 101 | | % | | 80-120 | 27-JUN-11 |
| Antimony (Sb)-Dissolved | | | 98 | | % | | 80-120 | 27-JUN-11 |
| Arsenic (As)-Dissolved | | | 99 | | % | | 80-120 | 27-JUN-11 |
| Beryllium (Be)-Dissolved | | | 103 | | % | | 80-120 | 27-JUN-11 |
| Cadmium (Cd)-Dissolved | | | 100 | | % | | 80-120 | 27-JUN-11 |
| Chromium (Cr)-Dissolved | | | 101 | | % | | 80-120 | 27-JUN-11 |
| Cobalt (Co)-Dissolved | | | 99 | | % | | 80-120 | 27-JUN-11 |
| Copper (Cu)-Dissolved | | | 98 | | % | | 80-120 | 27-JUN-11 |
| Lead (Pb)-Dissolved | | | 98 | | % | | 80-120 | 27-JUN-11 |
| Lithium (Li)-Dissolved | | | 104 | | % | | 80-120 | 27-JUN-11 |
| Manganese (Mn)-Dissolved | | | 101 | | % | | 80-120 | 27-JUN-11 |
| Molybdenum (Mo)-Dissolved | | | 99 | | % | | 80-120 | 27-JUN-11 |
| Nickel (Ni)-Dissolved | | | 104 | | % | | 80-120 | 27-JUN-11 |
| Selenium (Se)-Dissolved | | | 102 | | % | | 80-120 | 27-JUN-11 |
| Silver (Ag)-Dissolved | | | 100 | | % | | 80-120 | 27-JUN-11 |
| Thallium (Tl)-Dissolved | | | 102 | | % | | 80-120 | 27-JUN-11 |
| Tin (Sn)-Dissolved | | | 100 | | % | | 80-120 | 27-JUN-11 |
| Vanadium (V)-Dissolved | | | 101 | | % | | 80-120 | 27-JUN-11 |
| Uranium (U)-Dissolved | | | 98 | | % | | 80-120 | 27-JUN-11 |
| **Batch R2213748** | | | | | | | | |
| **WG1302061-4 DUP** | | **L1023033-1** | | | | | | |
| Antimony (Sb)-Dissolved | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Arsenic (As)-Dissolved | | 0.0030 | 0.0029 | | mg/L | 2.5 | 20 | 04-JUL-11 |
| Beryllium (Be)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Cadmium (Cd)-Dissolved | | <0.000085 | 0.000077 | | mg/L | 6.9 | 20 | 04-JUL-11 |
| Chromium (Cr)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Cobalt (Co)-Dissolved | | <0.0015 | <0.0015 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2213748** | | | | | | | | |
| **WG1302061-4 DUP** | | **L1023033-1** | | | | | | |
| Copper (Cu)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Lead (Pb)-Dissolved | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Lithium (Li)-Dissolved | | 0.927 | 0.905 | | mg/L | 2.5 | 20 | 04-JUL-11 |
| Manganese (Mn)-Dissolved | | 0.0060 | 0.00676 | | mg/L | 12 | 20 | 04-JUL-11 |
| Molybdenum (Mo)-Dissolved | | 0.0216 | 0.0217 | | mg/L | 0.36 | 20 | 04-JUL-11 |
| Nickel (Ni)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Selenium (Se)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Silver (Ag)-Dissolved | | <0.00010 | <0.00010 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Thallium (Tl)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Tin (Sn)-Dissolved | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Vanadium (V)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| Uranium (U)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 04-JUL-11 |
| **Batch R2215915** | | | | | | | | |
| **WG1302061-4 DUP** | | **L1023033-1** | | | | | | |
| Aluminum (Al)-Dissolved | | 0.257 | 0.255 | | mg/L | 0.81 | 20 | 07-JUL-11 |
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2211054** | | | | | | | | |
| **WG1302061-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Dissolved | | | 98 | | % | | 80-120 | 27-JUN-11 |
| Bismuth (Bi)-Dissolved | | | 99 | | % | | 80-120 | 27-JUN-11 |
| Boron (B)-Dissolved | | | 100 | | % | | 80-120 | 27-JUN-11 |
| Calcium (Ca)-Dissolved | | | 103 | | % | | 80-120 | 27-JUN-11 |
| Iron (Fe)-Dissolved | | | 97 | | % | | 80-120 | 27-JUN-11 |
| Magnesium (Mg)-Dissolved | | | 101 | | % | | 80-120 | 27-JUN-11 |
| Phosphorus (P)-Dissolved | | | 102 | | % | | 80-120 | 27-JUN-11 |
| Potassium (K)-Dissolved | | | 101 | | % | | 80-120 | 27-JUN-11 |
| Silicon (Si)-Dissolved | | | 107 | | % | | 80-120 | 27-JUN-11 |
| Sodium (Na)-Dissolved | | | 103 | | % | | 80-120 | 27-JUN-11 |
| Strontium (Sr)-Dissolved | | | 102 | | % | | 80-120 | 27-JUN-11 |
| Titanium (Ti)-Dissolved | | | 101 | | % | | 80-120 | 27-JUN-11 |
| Zinc (Zn)-Dissolved | | | 96 | | % | | 80-120 | 27-JUN-11 |
| **WG1302061-1 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 27-JUN-11 |
| Bismuth (Bi)-Dissolved | | | <0.20 | | mg/L | | 0.2 | 27-JUN-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2211054** | | | | | | | | |
| **WG1302061-1 MB** | | | | | | | | |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 27-JUN-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 27-JUN-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 27-JUN-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 27-JUN-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 27-JUN-11 |
| Potassium (K)-Dissolved | | | <2.0 | | mg/L | | 2 | 27-JUN-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 27-JUN-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 27-JUN-11 |
| Strontium (Sr)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 27-JUN-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 27-JUN-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 27-JUN-11 |
| **WG1302061-5 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 27-JUN-11 |
| Bismuth (Bi)-Dissolved | | | <0.20 | | mg/L | | 0.2 | 27-JUN-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 27-JUN-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 27-JUN-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 27-JUN-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 27-JUN-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 27-JUN-11 |
| Potassium (K)-Dissolved | | | <2.0 | | mg/L | | 2 | 27-JUN-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 27-JUN-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 27-JUN-11 |
| Strontium (Sr)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 27-JUN-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 27-JUN-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 27-JUN-11 |
| **Batch R2215223** | | | | | | | | |
| **WG1302061-4 DUP** | | **L1023033-1** | | | | | | |
| Barium (Ba)-Dissolved | | 0.295 | 0.292 | | mg/L | 0.89 | 20 | 07-JUL-11 |
| Bismuth (Bi)-Dissolved | | <0.20 | <0.20 | RPD-NA | mg/L | N/A | 20 | 07-JUL-11 |
| Boron (B)-Dissolved | | 0.25 | 0.25 | | mg/L | 0.015 | 20 | 07-JUL-11 |
| Calcium (Ca)-Dissolved | | 2.82 | 2.82 | | mg/L | 0.053 | 20 | 07-JUL-11 |
| Iron (Fe)-Dissolved | | 0.161 | 0.151 | | mg/L | 6.8 | 20 | 07-JUL-11 |
| Magnesium (Mg)-Dissolved | | 0.96 | 0.96 | | mg/L | 1.0 | 20 | 07-JUL-11 |
| Phosphorus (P)-Dissolved | | <0.30 | <0.30 | RPD-NA | mg/L | N/A | 20 | 07-JUL-11 |
| Potassium (K)-Dissolved | | 4.4 | 4.4 | | mg/L | 1.1 | 20 | 07-JUL-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2215223** | | | | | | | | |
| **WG1302061-4 DUP** | | **L1023033-1** | | | | | | |
| Silicon (Si)-Dissolved | | 8.60 | 8.52 | | mg/L | 0.91 | 20 | 07-JUL-11 |
| Sodium (Na)-Dissolved | | 406 | 405 | | mg/L | 0.39 | 20 | 07-JUL-11 |
| Strontium (Sr)-Dissolved | | 0.0796 | 0.0795 | | mg/L | 0.15 | 20 | 07-JUL-11 |
| Titanium (Ti)-Dissolved | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 07-JUL-11 |
| Zinc (Zn)-Dissolved | | 0.0138 | 0.0136 | | mg/L | 1.4 | 20 | 07-JUL-11 |
| **MET-TOT-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2211355** | | | | | | | | |
| **WG1303050-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Total | | | 109 | | % | | 80-120 | 28-JUN-11 |
| Antimony (Sb)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Arsenic (As)-Total | | | 104 | | % | | 80-120 | 28-JUN-11 |
| Beryllium (Be)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Cadmium (Cd)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Chromium (Cr)-Total | | | 102 | | % | | 80-120 | 28-JUN-11 |
| Cobalt (Co)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Copper (Cu)-Total | | | 99 | | % | | 80-120 | 28-JUN-11 |
| Lead (Pb)-Total | | | 101 | | % | | 80-120 | 28-JUN-11 |
| Lithium (Li)-Total | | | 104 | | % | | 80-120 | 28-JUN-11 |
| Manganese (Mn)-Total | | | 105 | | % | | 80-120 | 28-JUN-11 |
| Molybdenum (Mo)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Nickel (Ni)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Selenium (Se)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Silver (Ag)-Total | | | 102 | | % | | 80-120 | 28-JUN-11 |
| Thallium (Tl)-Total | | | 102 | | % | | 80-120 | 28-JUN-11 |
| Tin (Sn)-Total | | | 105 | | % | | 80-120 | 28-JUN-11 |
| Uranium (U)-Total | | | 104 | | % | | 80-120 | 28-JUN-11 |
| Vanadium (V)-Total | | | 106 | | % | | 80-120 | 28-JUN-11 |
| **Batch R2211707** | | | | | | | | |
| **WG1303050-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | <0.0050 | | mg/L | | 0.005 | 28-JUN-11 |
| Antimony (Sb)-Total | | | <0.00050 | | mg/L | | 0.0005 | 28-JUN-11 |
| Arsenic (As)-Total | | | <0.00050 | | mg/L | | 0.0005 | 28-JUN-11 |
| Beryllium (Be)-Total | | | <0.0010 | | mg/L | | 0.001 | 28-JUN-11 |
| Cadmium (Cd)-Total | | | <0.000010 | | mg/L | | 0.0002 | 28-JUN-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2211707** | | | | | | | | |
| **WG1303050-1 MB** | | | | | | | | |
| Chromium (Cr)-Total | | | <0.0010 | | mg/L | | 0.001 | 28-JUN-11 |
| Cobalt (Co)-Total | | | <0.00030 | | mg/L | | 0.001 | 28-JUN-11 |
| Copper (Cu)-Total | | | <0.0010 | | mg/L | | 0.001 | 28-JUN-11 |
| Lead (Pb)-Total | | | <0.00050 | | mg/L | | 0.001 | 28-JUN-11 |
| Lithium (Li)-Total | | | <0.0050 | | mg/L | | 0.01 | 28-JUN-11 |
| Manganese (Mn)-Total | | | <0.00030 | | mg/L | | 0.001 | 28-JUN-11 |
| Molybdenum (Mo)-Total | | | <0.0010 | | mg/L | | 0.001 | 28-JUN-11 |
| Nickel (Ni)-Total | | | <0.0010 | | mg/L | | 0.001 | 28-JUN-11 |
| Selenium (Se)-Total | | | <0.0010 | | mg/L | | 0.001 | 28-JUN-11 |
| Silver (Ag)-Total | | | <0.000020 | | mg/L | | 0.0001 | 28-JUN-11 |
| Thallium (Tl)-Total | | | <0.00020 | | mg/L | | 0.001 | 28-JUN-11 |
| Tin (Sn)-Total | | | <0.00050 | | mg/L | | 0.001 | 28-JUN-11 |
| Uranium (U)-Total | | | <0.00020 | | mg/L | | 0.0002 | 28-JUN-11 |
| Vanadium (V)-Total | | | <0.0010 | | mg/L | | 0.005 | 28-JUN-11 |
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2211640** | | | | | | | | |
| **WG1303050-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Total | | | 100 | | % | | 80-120 | 28-JUN-11 |
| Bismuth (Bi)-Total | | | 100 | | % | | 80-120 | 28-JUN-11 |
| Boron (B)-Total | | | 101 | | % | | 80-120 | 28-JUN-11 |
| Calcium (Ca)-Total | | | 108 | | % | | 80-120 | 28-JUN-11 |
| Iron (Fe)-Total | | | 99 | | % | | 80-120 | 28-JUN-11 |
| Magnesium (Mg)-Total | | | 104 | | % | | 80-120 | 28-JUN-11 |
| Phosphorus (P)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Potassium (K)-Total | | | 104 | | % | | 80-120 | 28-JUN-11 |
| Silicon (Si)-Total | | | 110 | | % | | 80-120 | 28-JUN-11 |
| Sodium (Na)-Total | | | 105 | | % | | 80-120 | 28-JUN-11 |
| Strontium (Sr)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Titanium (Ti)-Total | | | 103 | | % | | 80-120 | 28-JUN-11 |
| Zinc (Zn)-Total | | | 97 | | % | | 80-120 | 28-JUN-11 |
| **WG1303050-1 MB** | | | | | | | | |
| Barium (Ba)-Total | | | <0.010 | | mg/L | | 0.01 | 28-JUN-11 |
| Bismuth (Bi)-Total | | | <0.20 | | mg/L | | 0.2 | 28-JUN-11 |
| Boron (B)-Total | | | <0.10 | | mg/L | | 0.1 | 28-JUN-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2211640** | | | | | | | | |
| **WG1303050-1 MB** | | | | | | | | |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 28-JUN-11 |
| Iron (Fe)-Total | | | <0.030 | | mg/L | | 0.03 | 28-JUN-11 |
| Magnesium (Mg)-Total | | | <0.10 | | mg/L | | 0.1 | 28-JUN-11 |
| Phosphorus (P)-Total | | | <0.30 | | mg/L | | 0.3 | 28-JUN-11 |
| Potassium (K)-Total | | | <2.0 | | mg/L | | 2 | 28-JUN-11 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 28-JUN-11 |
| Sodium (Na)-Total | | | <2.0 | | mg/L | | 2 | 28-JUN-11 |
| Strontium (Sr)-Total | | | <0.0050 | | mg/L | | 0.005 | 28-JUN-11 |
| Titanium (Ti)-Total | | | <0.010 | | mg/L | | 0.01 | 28-JUN-11 |
| Zinc (Zn)-Total | | | <0.0050 | | mg/L | | 0.005 | 28-JUN-11 |
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2215715** | | | | | | | | |
| **WG1307733-10 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 98 | | % | | 85-115 | 08-JUL-11 |
| **WG1307733-2 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 98 | | % | | 85-115 | 08-JUL-11 |
| **WG1307733-4 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 89 | | % | | 85-115 | 08-JUL-11 |
| **WG1307733-6 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 94 | | % | | 85-115 | 08-JUL-11 |
| **WG1307733-8 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 95 | | % | | 85-115 | 08-JUL-11 |
| **WG1307733-1 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 08-JUL-11 |
| **WG1307733-3 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 08-JUL-11 |
| **WG1307733-5 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 08-JUL-11 |
| **WG1307733-7 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 08-JUL-11 |
| **WG1307733-9 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 08-JUL-11 |
| **WG1307733-12 MS** | | **L1022280-17** | | | | | | |
| Ammonia (as N) | | | 93 | | % | | 75-125 | 08-JUL-11 |
| **WG1307733-14 MS** | | **L1022303-25** | | | | | | |
| Ammonia (as N) | | | 98 | | % | | 75-125 | 08-JUL-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **PH-PCT-VA** | **Water** | | | | | | | |
| **Batch R2211301** | | | | | | | | |
| **WG1302856-10 CRM** | | **VA-PH7-BUF** | | | | | | |
| pH | | | 7.09 | | pH | | 6.9-7.1 | 27-JUN-11 |
| **WG1302856-14 DUP** | | **L1023033-1** | | | | | | |
| pH | | 9.50 | 9.51 | J | pH | 0.01 | 0.2 | 27-JUN-11 |
| **S2-D-COL-VA** | **Water** | | | | | | | |
| **Batch R2210878** | | | | | | | | |
| **WG1303226-6 DUP** | | **L1023033-1** | | | | | | |
| Sulphide as S (Dissolved) | | 0.118 | 0.114 | | mg/L | 3.4 | 20 | 27-JUN-11 |
| **WG1303226-1 MB** | | | | | | | | |
| Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 27-JUN-11 |
| **WG1303226-3 MB** | | | | | | | | |
| Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 27-JUN-11 |
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2213663** | | | | | | | | |
| **WG1305968-2 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 102 | | % | | 85-115 | 04-JUL-11 |
| **WG1305968-5 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 100 | | % | | 85-115 | 04-JUL-11 |
| **WG1305968-1 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 04-JUL-11 |
| **WG1305968-4 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 04-JUL-11 |
| **TURBIDITY-VA** | **Water** | | | | | | | |
| **Batch R2209760** | | | | | | | | |
| **WG1302329-2 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 106 | | % | | 85-115 | 25-JUN-11 |
| **WG1302329-5 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 106 | | % | | 85-115 | 25-JUN-11 |
| **WG1302329-1 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 25-JUN-11 |
| **WG1302329-4 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 25-JUN-11 |

**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** | | | | | | | |
| Total Dissolved Solids by Gravimetric | | | | | | | |
| | 1 | 23-JUN-11 11:00 | 04-JUL-11 14:19 | 7 | 11 | days | EHT |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 23-JUN-11 11:00 | 27-JUN-11 16:36 | 0.25 | 102 | hours | EHTR-FM |
| **Anions and Nutrients** | | | | | | | |
| Alkalinity by Auto. Titration | | | | | | | |
| | 1 | 23-JUN-11 11:00 | 18-JUL-11 13:11 | 14 | 25 | days | EHT |

**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 L1023033 were received on 24-JUN-11 12:30.

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.

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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.

**Short Holding Time**

Rush Processing

CHAIN OF CUSTO
CANADA TO
WWW

*L10230033-COFC*

COC # C037617

Page 1 of 1

| REPORT TO: | REPORT FORMAT / DISTRIBUTION | REQUESTED |
|---|---|---|
| COMPANY: AMEC | STANDARD ✓ OTHER | ✓ REGULAR SERVICE (DEFAULT) |
| CONTACT: T. Kostya | PDF ✓ EXCEL ✓ CUSTOM FAX | RUSH SERVICE (2-3 DAYS) |
| ADDRESS: 3456 Opie Cres. | EMAIL 1: tammera.kostya@amec.com | PRIORITY SERVICE (1 DAY or ASAP) |
| Prince George, BC, V2N 2P9 | EMAIL 2: Scott.green@amec.com | EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS |
| PHONE (250) 564-3243 FAX: (250) 562-7045 | | ANALYSIS REQUEST |
| INVOICE TO: SAME AS REPORT ? (YES) / NO | INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → → | |
| COMPANY: | CLIENT / PROJECT INFORMATION: | |
| CONTACT: | JOB #: KX13505.300 | |
| ADDRESS: | PO /AFE: | |
| | Legal Site Description: | |
| PHONE: FAX: | QUOTE #: AMEC quote | |
| Lab Work Order # (lab use only): L10230033 | SAMPLER (Initials): | |

| Sample # | SAMPLE IDENTIFICATION (This description will appear on the report) | DATE | TIME | SAMPLE TYPE | Potability | Total Metals | Dissolved Metals | TOC | $NH_3$ | Cyanide | S2- (UNION-MANUAL) | S2- (COL-VA) | | | | HAZARDOUS ? | HIGHLY CONTAMINATED ? | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [redacted] | H16W 800-1000m | June 23/11 | 11am | $H_2O$ | X | X | X | X | X | X | X | X | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | pH= | 9.48 | | | | | | | | | | | | | | | | |
| | Temp= | 10.43°C | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | metals to include vanadium, molybdenum, cobalt & silver | | | | | | | | | | | | | | | | | |

| GUIDELINES / REGULATIONS | SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS |
|---|---|
| * CCME & BC CSR | Potability = pH, Hardness, TDS, conductivity, turbidity, colour, Diss. Anions (Cl, F, S, Sulphate), Nutrients # Please see Selam 4 details |

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.**

| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | SAMPLE CONDITION (lab use only) | |
|---|---|---|---|---|---|
| J. Kostya | June 23/11 11am | HD 11/06/24 | 12:30 | TEMPERATURE | SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details) |
| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | 5 | |

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

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GENF14.00

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRES
PRINCE GEORGE BC V2N 2P9

Date Received: 24-JUN-11
Report Date: 04-JUL-11 12:37 (MT)
Version: FINAL

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L1022659**
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.300
Legal Site Desc:
C of C Numbers: C037618

Kelly Hunt
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L1022659-1 H16W 800-1000M<br>Sampled By: CLIENT on 23-JUN-11 @ 11:00<br>Matrix: WATER | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| Methane, dissolved | 7.88 | | 0.0050 | mg/L | 27-JUN-11 | 27-JUN-11 | R2210316 |

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

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| METHANE-DIS-CL | Water | Methane, dissolved | EPA 5021/8015-HEADSPACE GC-FID |
| Results reported in | | | |

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

**Chain of Custody Numbers:**

C037618

**GLOSSARY OF REPORT TERMS**

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

**ALS Laboratory Group**
ANALYTICAL CHEMISTRY & TESTING SERVICES

**Environmental Division**

# CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

**CANADA TOLL FREE 1-800-668-9878**

www.alsenviro.com

COC # C037618

L1022659

Page 1 of 1

| REPORT TO: | REPORT FORMAT / DISTRIBUTION | SERVICE REQUESTED |
|---|---|---|
| COMPANY: AMEC | STANDARD ✓ OTHER ____ | ✓ REGULAR SERVICE (DEFAULT) |
| CONTACT: T. Kostyn | PDF ✓ EXCEL ____ CUSTOM ____ FAX ____ | RUSH SERVICE (2-3 DAYS) |
| ADDRESS: 3456 Opie Cres. | EMAIL 1: tammera.kostyn@amec.com | PRIORITY SERVICE (1 DAY or ASAP) |
| Prince George, BC V2N 2P7 | EMAIL 2: scott.greene@amec.com | EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS |
| PHONE: (250) 564-3243 FAX: (250) 562-7045 | | ANALYSIS REQUEST |
| INVOICE TO: SAME AS REPORT ? (YES) NO | INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → → | |
| COMPANY: | CLIENT / PROJECT INFORMATION: | |
| CONTACT: | JOB #: Kx13505.300 | |
| ADDRESS: | PO /AFE: | |
| | Legal Site Description: | |
| PHONE: FAX: | QUOTE #: AMEC Quote | |
| | SAMPLER (Initials): | |

| SAMPLE IDENTIFICATION (This description will appear on the report) | DATE | TIME | SAMPLE TYPE | Diss. Methan | HAZARDOUS ? | HIGHLY CONTAMINATED ? | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|
| HHW 800-1000m | June 23/11 | 11am | H2O | X | | | |
| | | | | | | | |
| | | | | | | | |
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**GUIDELINES / REGULATIONS**

CCME & BC CSR

**SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS**

See Selam 4 details

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.**

| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | TEMPERATURE | SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details) |
|---|---|---|---|---|---|
| J. Kostyn | 11am June 23/11 | Laura C | 24-Jun-11 | | |
| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: 08:50 | 9°C | |

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GENF14.00

AMEC EARTH & ENVIRONMENTAL
ATTN: Tammera Kostya
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 02-AUG-11
Report Date: 17-AUG-11 17:52 (MT)
Version: FINAL

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L1039171**

Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.03
C of C Numbers: C037609
Legal Site Desc:

Selam Worku
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1039171-1 | | | | |
|---|---|---|---|---|---|---|
| | Description | H2O | | | | |
| | Sampled Date | 01-AUG-11 | | | | |
| | Sampled Time | 13:00 | | | | |
| | Client ID | #2 H16W 500-730M | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 13.2 | | | | |
| | Conductivity (uS/cm) | 1850 | | | | |
| | Hardness (as CaCO3) (mg/L) | 22.5 | | | | |
| | pH (pH) | 8.18 | | | | |
| | Total Dissolved Solids (mg/L) | 1210 | | | | |
| | Turbidity (NTU) | 186 | | | | |
| **Anions and Nutrients** | Alkalinity, Total (as CaCO3) (mg/L) | 985 | | | | |
| | Ammonia (as N) (mg/L) | 2.9 | | | | |
| | Bromide (Br) (mg/L) | <1.0 | | | | |
| | Chloride (Cl) (mg/L) | 75 | | | | |
| | Fluoride (F) (mg/L) | 3.82 | | | | |
| | Nitrate (as N) (mg/L) | <0.10 | | | | |
| | Nitrite (as N) (mg/L) | <0.020 | | | | |
| | Sulfate (SO4) (mg/L) | <10 | | | | |
| | Sulphide as S (Dissolved) (mg/L) | <0.020 | | | | |
| **Cyanides** | Cyanide, Total (mg/L) | 0.0889 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 15.9 | | | | |
| **Inorganic Parameters** | Sulphide As S (Un-ionized) (mg/L) | <0.020 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 1.12 | | | | |
| | Antimony (Sb)-Total (mg/L) | <0.0025 DLA | | | | |
| | Arsenic (As)-Total (mg/L) | <0.0025 DLA | | | | |
| | Barium (Ba)-Total (mg/L) | 1.74 | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.0050 DLA | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.20 | | | | |
| | Boron (B)-Total (mg/L) | 0.33 | | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.000085 DLA | | | | |
| | Calcium (Ca)-Total (mg/L) | 11.6 | | | | |
| | Chromium (Cr)-Total (mg/L) | 0.0127 | | | | |
| | Cobalt (Co)-Total (mg/L) | <0.0015 DLA | | | | |
| | Copper (Cu)-Total (mg/L) | 3.96 | | | | |
| | Iron (Fe)-Total (mg/L) | 11.1 | | | | |
| | Lead (Pb)-Total (mg/L) | 1.41 | | | | |
| | Lithium (Li)-Total (mg/L) | 1.23 | | | | |
| | Magnesium (Mg)-Total (mg/L) | 2.19 | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.170 | | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1039171-1 | | | | |
|---|---|---|---|---|---|---|
| | Description | H2O | | | | |
| | Sampled Date | 01-AUG-11 | | | | |
| | Sampled Time | 13:00 | | | | |
| | Client ID | #2 H16W 500-730M | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Molybdenum (Mo)-Total (mg/L) | 0.0108 | | | | |
| | Nickel (Ni)-Total (mg/L) | 0.0092 | | | | |
| | Phosphorus (P)-Total (mg/L) | 0.52 | | | | |
| | Potassium (K)-Total (mg/L) | <2.0 | | | | |
| | Selenium (Se)-Total (mg/L) | <0.0050 DLA | | | | |
| | Silicon (Si)-Total (mg/L) | 7.35 | | | | |
| | Silver (Ag)-Total (mg/L) | 0.00017 | | | | |
| | Sodium (Na)-Total (mg/L) | 497 | | | | |
| | Strontium (Sr)-Total (mg/L) | 0.276 | | | | |
| | Thallium (Tl)-Total (mg/L) | <0.0010 DLA | | | | |
| | Tin (Sn)-Total (mg/L) | <0.0025 DLA | | | | |
| | Titanium (Ti)-Total (mg/L) | 0.023 | | | | |
| | Uranium (U)-Total (mg/L) | <0.0010 DLA | | | | |
| | Vanadium (V)-Total (mg/L) | <0.0050 DLA | | | | |
| | Zinc (Zn)-Total (mg/L) | 0.889 | | | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 0.032 | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.0025 DLA | | | | |
| | Arsenic (As)-Dissolved (mg/L) | <0.0025 DLA | | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.997 | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.20 | | | | |
| | Boron (B)-Dissolved (mg/L) | 0.33 | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000085 DLA | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 6.09 | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.0015 DLA | | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0750 | | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.667 | | | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.0358 | | | | |
| | Lithium (Li)-Dissolved (mg/L) | 1.26 | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 1.76 | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.107 | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0100 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | | | | |
| | Potassium (K)-Dissolved (mg/L) | <2.0 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1039171-1 | | | | |
|---|---|---|---|---|---|---|
| | Description | H2O | | | | |
| | Sampled Date | 01-AUG-11 | | | | |
| | Sampled Time | 13:00 | | | | |
| | Client ID | #2 H16W 500-730M | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Selenium (Se)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.25 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.00010 DLA | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 481 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.226 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.0010 DLA | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.0025 DLA | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | | | | |
| | Uranium (U)-Dissolved (mg/L) | <0.0010 DLA | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.159 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| **CN-T-MID-HH-COL-VA** | Water | Total Cyanide by HH Distillation | APHA 4500-CN Cyanide |
| This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 "Color" |
| This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | APHA 2120 Color |
| This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7). | | | |
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

# Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | Water | Diss. Metals in Water by ICPMS (CCME) | EPA SW-846 3005A/6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-TOT-CCME-MS-VA** | Water | Total Metals in Water by ICPMS (CCME) | EPA SW-846 3005A/6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **S2-D-COL-VA** | Water | Dissolved Sulphide by Colorimetric | APHA 4500-S2 D. - SULPHIDE |

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

| | | | |
|---|---|---|---|
| **S2-UNION-MANCALC-VA** | Water | Un-ionized Hydrogen sulphide (Man. calc) | APHA -4500-S2 H. |

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

| | | | |
|---|---|---|---|
| **TDS-VA** | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|

# Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

**Chain of Custody Numbers:**

C037609

**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: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: Tammera Kostya

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ALK-PCT-VA** | **Water** | | | | | | | |
| **Batch R2228859** | | | | | | | | |
| **WG1323382-8 CRM** | | **VA-ALK-PCT-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 101 | | % | | 85-115 | 03-AUG-11 |
| **WG1323382-1 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 03-AUG-11 |
| **WG1323382-2 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 03-AUG-11 |
| **WG1323382-3 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 03-AUG-11 |
| **WG1323382-4 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 03-AUG-11 |
| **WG1323382-5 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 03-AUG-11 |
| **WG1323382-6 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 03-AUG-11 |
| **ANIONS-BR-IC-VA** | **Water** | | | | | | | |
| **Batch R2229331** | | | | | | | | |
| **WG1323459-15 LCS** | | | | | | | | |
| Bromide (Br) | | | 91 | | % | | 70-130 | 03-AUG-11 |
| **WG1323459-2 LCS** | | | | | | | | |
| Bromide (Br) | | | 88 | | % | | 70-130 | 03-AUG-11 |
| **WG1323459-1 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| **WG1323459-10 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| **WG1323459-13 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| **WG1323459-4 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| **WG1323459-7 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| **WG1323459-11 MS** | | **L1038624-5** | | | | | | |
| Bromide (Br) | | | 108 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-14 MS** | | **L1038624-23** | | | | | | |
| Bromide (Br) | | | 87 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-5 MS** | | **L1039147-12** | | | | | | |
| Bromide (Br) | | | 85 | | % | | 75-125 | 03-AUG-11 |
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2229331** | | | | | | | | |
| **WG1323459-15 LCS** | | | | | | | | |
| Chloride (Cl) | | | 106 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-2 LCS** | | | | | | | | |
| Chloride (Cl) | | | 106 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-1 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-10 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-13 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-4 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-7 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-11 MS** | | **L1038624-5** | | | | | | |
| Chloride (Cl) | | | 108 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-14 MS** | | **L1038624-23** | | | | | | |
| Chloride (Cl) | | | 112 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-5 MS** | | **L1039147-12** | | | | | | |
| Chloride (Cl) | | | 110 | | % | | 75-125 | 03-AUG-11 |
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2229331** | | | | | | | | |
| **WG1323459-15 LCS** | | | | | | | | |
| Fluoride (F) | | | 114 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-2 LCS** | | | | | | | | |
| Fluoride (F) | | | 115 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-1 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 03-AUG-11 |
| **WG1323459-10 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 03-AUG-11 |
| **WG1323459-13 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 03-AUG-11 |
| **WG1323459-4 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 03-AUG-11 |
| **WG1323459-7 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 03-AUG-11 |
| **WG1323459-11 MS** | | **L1038624-5** | | | | | | |
| Fluoride (F) | | | 120 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-14 MS** | | **L1038624-23** | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2229331** | | | | | | | | |
| **WG1323459-14 MS** | | **L1038624-23** | | | | | | |
| Fluoride (F) | | | 124 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-5 MS** | | **L1039147-12** | | | | | | |
| Fluoride (F) | | | 122 | | % | | 75-125 | 03-AUG-11 |
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2229331** | | | | | | | | |
| **WG1323459-15 LCS** | | | | | | | | |
| Nitrite (as N) | | | 109 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-2 LCS** | | | | | | | | |
| Nitrite (as N) | | | 113 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-1 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| **WG1323459-10 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| **WG1323459-13 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| **WG1323459-4 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| **WG1323459-7 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| **WG1323459-11 MS** | | **L1038624-5** | | | | | | |
| Nitrite (as N) | | | 108 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-14 MS** | | **L1038624-23** | | | | | | |
| Nitrite (as N) | | | 115 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-5 MS** | | **L1039147-12** | | | | | | |
| Nitrite (as N) | | | 106 | | % | | 75-125 | 03-AUG-11 |
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2229331** | | | | | | | | |
| **WG1323459-15 LCS** | | | | | | | | |
| Nitrate (as N) | | | 111 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-2 LCS** | | | | | | | | |
| Nitrate (as N) | | | 111 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-1 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323459-10 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323459-13 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2229331** | | | | | | | | |
| **WG1323459-4 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323459-7 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323459-11 MS** | | **L1038624-5** | | | | | | |
| Nitrate (as N) | | | 115 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-14 MS** | | **L1038624-23** | | | | | | |
| Nitrate (as N) | | | 118 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-5 MS** | | **L1039147-12** | | | | | | |
| Nitrate (as N) | | | 116 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-8 MS** | | **L1039411-4** | | | | | | |
| Nitrate (as N) | | | 114 | | % | | 75-125 | 03-AUG-11 |
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2229331** | | | | | | | | |
| **WG1323459-15 LCS** | | | | | | | | |
| Sulfate (SO4) | | | 103 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-2 LCS** | | | | | | | | |
| Sulfate (SO4) | | | 103 | | % | | 85-115 | 03-AUG-11 |
| **WG1323459-1 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-10 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-13 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-4 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-7 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 03-AUG-11 |
| **WG1323459-11 MS** | | **L1038624-5** | | | | | | |
| Sulfate (SO4) | | | 105 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-14 MS** | | **L1038624-23** | | | | | | |
| Sulfate (SO4) | | | 110 | | % | | 75-125 | 03-AUG-11 |
| **WG1323459-5 MS** | | **L1039147-12** | | | | | | |
| Sulfate (SO4) | | | 108 | | % | | 75-125 | 03-AUG-11 |
| **CARBONS-TOC-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **CARBONS-TOC-VA** | **Water** | | | | | | | |
| **Batch R2229806** | | | | | | | | |
| **WG1325129-10 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 106 | | % | | 80-120 | 04-AUG-11 |
| **WG1325129-12 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 105 | | % | | 80-120 | 04-AUG-11 |
| **WG1325129-2 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 100 | | % | | 80-120 | 04-AUG-11 |
| **WG1325129-4 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 104 | | % | | 80-120 | 04-AUG-11 |
| **WG1325129-6 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 102 | | % | | 80-120 | 04-AUG-11 |
| **WG1325129-8 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 97 | | % | | 80-120 | 04-AUG-11 |
| **WG1325129-1 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 04-AUG-11 |
| **WG1325129-11 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 04-AUG-11 |
| **WG1325129-3 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 04-AUG-11 |
| **WG1325129-5 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 04-AUG-11 |
| **WG1325129-7 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 04-AUG-11 |
| **WG1325129-9 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 04-AUG-11 |
| **CN-T-MID-HH-COL-VA** | **Water** | | | | | | | |
| **Batch R2231142** | | | | | | | | |
| **WG1326616-2 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 100 | | % | | 80-120 | 09-AUG-11 |
| **WG1326616-5 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 97 | | % | | 80-120 | 09-AUG-11 |
| **WG1326616-1 MB** | | | | | | | | |
| Cyanide, Total | | | <0.0050 | | mg/L | | 0.005 | 09-AUG-11 |
| **WG1326616-4 MB** | | | | | | | | |
| Cyanide, Total | | | <0.0050 | | mg/L | | 0.005 | 09-AUG-11 |
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2228612** | | | | | | | | |
| **WG1323439-2 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 102 | | % | | 85-115 | 03-AUG-11 |
| **WG1323439-5 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 104 | | % | | 85-115 | 03-AUG-11 |
| **WG1323439-3 DUP** | | **L1039171-1** | | | | | | |
| Colour, True | | 13.2 | 13.2 | | CU | 0.30 | 20 | 03-AUG-11 |
| **WG1323439-1 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 03-AUG-11 |
| **WG1323439-4 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 03-AUG-11 |
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2228859** | | | | | | | | |
| **WG1323382-9 CRM** | | **VA-EC-PCT-CONTROL** | | | | | | |
| Conductivity | | | 99 | | % | | 90-110 | 03-AUG-11 |
| **WG1323382-1 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 03-AUG-11 |
| **WG1323382-2 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 03-AUG-11 |
| **WG1323382-3 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 03-AUG-11 |
| **WG1323382-4 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 03-AUG-11 |
| **WG1323382-5 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 03-AUG-11 |
| **WG1323382-6 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 03-AUG-11 |
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2229295** | | | | | | | | |
| **WG1323258-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 04-AUG-11 |
| **Batch R2230037** | | | | | | | | |
| **WG1323258-2 DUP** | | **L1039171-1** | | | | | | |
| Mercury (Hg)-Dissolved | | <0.000010 | <0.000010 | RPD-NA | mg/L | N/A | 20 | 05-AUG-11 |
| **WG1325386-2 LCS** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | 87 | | % | | 80-120 | 05-AUG-11 |
| **WG1325386-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 05-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2230037** | | | | | | | | |
| **WG1325386-10 MS** | | **L1039945-1** | | | | | | |
| Mercury (Hg)-Dissolved | | | 90 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-11 MS** | | **L1039949-8** | | | | | | |
| Mercury (Hg)-Dissolved | | | 91 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-12 MS** | | **L1039952-2** | | | | | | |
| Mercury (Hg)-Dissolved | | | 92 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-18 MS** | | **L1040222-5** | | | | | | |
| Mercury (Hg)-Dissolved | | | 87 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-20 MS** | | **L1039955-13** | | | | | | |
| Mercury (Hg)-Dissolved | | | 89 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-24 MS** | | **L1039680-11** | | | | | | |
| Mercury (Hg)-Dissolved | | | 88 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-32 MS** | | **L1039680-23** | | | | | | |
| Mercury (Hg)-Dissolved | | | 88 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-42 MS** | | **L1039171-1** | | | | | | |
| Mercury (Hg)-Dissolved | | | 75 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-44 MS** | | **L1040275-2** | | | | | | |
| Mercury (Hg)-Dissolved | | | 82 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-45 MS** | | **L1040275-12** | | | | | | |
| Mercury (Hg)-Dissolved | | | 90 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-48 MS** | | **L1040370-5** | | | | | | |
| Mercury (Hg)-Dissolved | | | 84 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-49 MS** | | **L1040389-5** | | | | | | |
| Mercury (Hg)-Dissolved | | | 85 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-52 MS** | | **L1040291-5** | | | | | | |
| Mercury (Hg)-Dissolved | | | 90 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-8 MS** | | **L1040136-4** | | | | | | |
| Mercury (Hg)-Dissolved | | | 90 | | % | | 70-130 | 05-AUG-11 |
| **WG1325386-9 MS** | | **L1038427-2** | | | | | | |
| Mercury (Hg)-Dissolved | | | 98 | | % | | 70-130 | 05-AUG-11 |
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2228567** | | | | | | | | |
| **WG1323898-2 LCS** | | | | | | | | |
| Mercury (Hg)-Total | | | 91 | | % | | 80-120 | 03-AUG-11 |
| **WG1323898-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000010 | | mg/L | | 0.00001 | 03-AUG-11 |
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2229379** | | | | | | | | |
| **WG1323258-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Dissolved | | | 91 | | % | | 80-120 | 03-AUG-11 |
| Antimony (Sb)-Dissolved | | | 90 | | % | | 80-120 | 03-AUG-11 |
| Arsenic (As)-Dissolved | | | 88 | | % | | 80-120 | 03-AUG-11 |
| Beryllium (Be)-Dissolved | | | 87 | | % | | 80-120 | 03-AUG-11 |
| Cadmium (Cd)-Dissolved | | | 89 | | % | | 80-120 | 03-AUG-11 |
| Chromium (Cr)-Dissolved | | | 88 | | % | | 80-120 | 03-AUG-11 |
| Cobalt (Co)-Dissolved | | | 88 | | % | | 80-120 | 03-AUG-11 |
| Copper (Cu)-Dissolved | | | 84 | | % | | 80-120 | 03-AUG-11 |
| Lead (Pb)-Dissolved | | | 88 | | % | | 80-120 | 03-AUG-11 |
| Lithium (Li)-Dissolved | | | 84 | | % | | 80-120 | 03-AUG-11 |
| Manganese (Mn)-Dissolved | | | 88 | | % | | 80-120 | 03-AUG-11 |
| Molybdenum (Mo)-Dissolved | | | 88 | | % | | 80-120 | 03-AUG-11 |
| Nickel (Ni)-Dissolved | | | 89 | | % | | 80-120 | 03-AUG-11 |
| Selenium (Se)-Dissolved | | | 88 | | % | | 80-120 | 03-AUG-11 |
| Silver (Ag)-Dissolved | | | 87 | | % | | 80-120 | 03-AUG-11 |
| Thallium (Tl)-Dissolved | | | 89 | | % | | 80-120 | 03-AUG-11 |
| Tin (Sn)-Dissolved | | | 90 | | % | | 80-120 | 03-AUG-11 |
| Vanadium (V)-Dissolved | | | 89 | | % | | 80-120 | 03-AUG-11 |
| Uranium (U)-Dissolved | | | 88 | | % | | 80-120 | 03-AUG-11 |
| **WG1323258-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| Antimony (Sb)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 03-AUG-11 |
| Arsenic (As)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 03-AUG-11 |
| Beryllium (Be)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.0002 | 03-AUG-11 |
| Chromium (Cr)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Cobalt (Co)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 03-AUG-11 |
| Copper (Cu)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Lead (Pb)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 03-AUG-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.01 | 03-AUG-11 |
| Manganese (Mn)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 03-AUG-11 |
| Molybdenum (Mo)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Nickel (Ni)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2229379** | | | | | | | | |
| **WG1323258-1 MB** | | | | | | | | |
| Silver (Ag)-Dissolved | | | <0.000020 | | mg/L | | 0.0001 | 03-AUG-11 |
| Thallium (Tl)-Dissolved | | | <0.00020 | | mg/L | | 0.001 | 03-AUG-11 |
| Tin (Sn)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 03-AUG-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.005 | 03-AUG-11 |
| Uranium (U)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 03-AUG-11 |
| **Batch R2233780** | | | | | | | | |
| **WG1323258-2 DUP** | | **L1039171-1** | | | | | | |
| Aluminum (Al)-Dissolved | | 0.032 | 0.035 | | mg/L | 12 | 20 | 12-AUG-11 |
| Antimony (Sb)-Dissolved | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Arsenic (As)-Dissolved | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Beryllium (Be)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Cadmium (Cd)-Dissolved | | <0.000085 | <0.000050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Chromium (Cr)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Cobalt (Co)-Dissolved | | <0.0015 | <0.0015 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Copper (Cu)-Dissolved | | 0.0750 | 0.0770 | | mg/L | 2.7 | 20 | 12-AUG-11 |
| Lead (Pb)-Dissolved | | 0.0358 | 0.0395 | | mg/L | 9.7 | 20 | 12-AUG-11 |
| Lithium (Li)-Dissolved | | 1.26 | 1.28 | | mg/L | 1.8 | 20 | 12-AUG-11 |
| Manganese (Mn)-Dissolved | | 0.107 | 0.104 | | mg/L | 3.2 | 20 | 12-AUG-11 |
| Molybdenum (Mo)-Dissolved | | 0.0100 | 0.0097 | | mg/L | 3.6 | 20 | 12-AUG-11 |
| Nickel (Ni)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Selenium (Se)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Silver (Ag)-Dissolved | | <0.00010 | <0.00010 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Thallium (Tl)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Tin (Sn)-Dissolved | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Vanadium (V)-Dissolved | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Uranium (U)-Dissolved | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2229155** | | | | | | | | |
| **WG1323258-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Dissolved | | | 99 | | % | | 80-120 | 03-AUG-11 |
| Bismuth (Bi)-Dissolved | | | 99 | | % | | 80-120 | 03-AUG-11 |
| Boron (B)-Dissolved | | | 98 | | % | | 80-120 | 03-AUG-11 |
| Calcium (Ca)-Dissolved | | | 105 | | % | | 80-120 | 03-AUG-11 |
| Iron (Fe)-Dissolved | | | 96 | | % | | 80-120 | 03-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2229155** | | | | | | | | |
| **WG1323258-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Magnesium (Mg)-Dissolved | | | 99 | | % | | 80-120 | 03-AUG-11 |
| Phosphorus (P)-Dissolved | | | 101 | | % | | 80-120 | 03-AUG-11 |
| Potassium (K)-Dissolved | | | 101 | | % | | 80-120 | 03-AUG-11 |
| Silicon (Si)-Dissolved | | | 106 | | % | | 80-120 | 03-AUG-11 |
| Sodium (Na)-Dissolved | | | 99 | | % | | 80-120 | 03-AUG-11 |
| Strontium (Sr)-Dissolved | | | 103 | | % | | 80-120 | 03-AUG-11 |
| Titanium (Ti)-Dissolved | | | 101 | | % | | 80-120 | 03-AUG-11 |
| Zinc (Zn)-Dissolved | | | 97 | | % | | 80-120 | 03-AUG-11 |
| **WG1323258-1 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 03-AUG-11 |
| Bismuth (Bi)-Dissolved | | | <0.20 | | mg/L | | 0.2 | 03-AUG-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 03-AUG-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 03-AUG-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 03-AUG-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 03-AUG-11 |
| Potassium (K)-Dissolved | | | <2.0 | | mg/L | | 2 | 03-AUG-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 03-AUG-11 |
| Strontium (Sr)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 03-AUG-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **Batch R2231963** | | | | | | | | |
| **WG1323258-2 DUP** | | **L1039171-1** | | | | | | |
| Barium (Ba)-Dissolved | | 0.997 | 0.998 | | mg/L | 0.066 | 20 | 09-AUG-11 |
| Bismuth (Bi)-Dissolved | | <0.20 | <0.20 | RPD-NA | mg/L | N/A | 20 | 09-AUG-11 |
| Boron (B)-Dissolved | | 0.33 | 0.32 | | mg/L | 2.5 | 20 | 09-AUG-11 |
| Calcium (Ca)-Dissolved | | 6.09 | 6.06 | | mg/L | 0.51 | 20 | 09-AUG-11 |
| Iron (Fe)-Dissolved | | 0.667 | 0.726 | | mg/L | 8.6 | 20 | 09-AUG-11 |
| Magnesium (Mg)-Dissolved | | 1.76 | 1.76 | | mg/L | 0.37 | 20 | 09-AUG-11 |
| Phosphorus (P)-Dissolved | | <0.30 | <0.30 | RPD-NA | mg/L | N/A | 20 | 09-AUG-11 |
| Potassium (K)-Dissolved | | <2.0 | <2.0 | RPD-NA | mg/L | N/A | 20 | 09-AUG-11 |
| Silicon (Si)-Dissolved | | 5.25 | 5.25 | | mg/L | 0.071 | 20 | 09-AUG-11 |
| Sodium (Na)-Dissolved | | 481 | 481 | | mg/L | 0.00093 | 20 | 09-AUG-11 |
| Strontium (Sr)-Dissolved | | 0.226 | 0.226 | | mg/L | 0.20 | 20 | 09-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2231963** | | | | | | | | |
| **WG1323258-2 DUP** | | **L1039171-1** | | | | | | |
| Titanium (Ti)-Dissolved | | <0.010 | <0.010 | RPD-NA | mg/L | N/A | 20 | 09-AUG-11 |
| Zinc (Zn)-Dissolved | | 0.159 | 0.157 | | mg/L | 1.3 | 20 | 09-AUG-11 |
| **MET-TOT-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2229379** | | | | | | | | |
| **WG1323317-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Total | | | 96 | | % | | 80-120 | 03-AUG-11 |
| Antimony (Sb)-Total | | | 98 | | % | | 80-120 | 03-AUG-11 |
| Arsenic (As)-Total | | | 94 | | % | | 80-120 | 03-AUG-11 |
| Beryllium (Be)-Total | | | 96 | | % | | 80-120 | 03-AUG-11 |
| Cadmium (Cd)-Total | | | 95 | | % | | 80-120 | 03-AUG-11 |
| Chromium (Cr)-Total | | | 94 | | % | | 80-120 | 03-AUG-11 |
| Cobalt (Co)-Total | | | 95 | | % | | 80-120 | 03-AUG-11 |
| Copper (Cu)-Total | | | 90 | | % | | 80-120 | 03-AUG-11 |
| Lead (Pb)-Total | | | 94 | | % | | 80-120 | 03-AUG-11 |
| Lithium (Li)-Total | | | 92 | | % | | 80-120 | 03-AUG-11 |
| Manganese (Mn)-Total | | | 94 | | % | | 80-120 | 03-AUG-11 |
| Molybdenum (Mo)-Total | | | 96 | | % | | 80-120 | 03-AUG-11 |
| Nickel (Ni)-Total | | | 95 | | % | | 80-120 | 03-AUG-11 |
| Selenium (Se)-Total | | | 94 | | % | | 80-120 | 03-AUG-11 |
| Silver (Ag)-Total | | | 95 | | % | | 80-120 | 03-AUG-11 |
| Thallium (Tl)-Total | | | 95 | | % | | 80-120 | 03-AUG-11 |
| Tin (Sn)-Total | | | 97 | | % | | 80-120 | 03-AUG-11 |
| Uranium (U)-Total | | | 99 | | % | | 80-120 | 03-AUG-11 |
| Vanadium (V)-Total | | | 95 | | % | | 80-120 | 03-AUG-11 |
| **WG1323317-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| Antimony (Sb)-Total | | | <0.00050 | | mg/L | | 0.0005 | 03-AUG-11 |
| Arsenic (As)-Total | | | <0.00050 | | mg/L | | 0.0005 | 03-AUG-11 |
| Beryllium (Be)-Total | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Cadmium (Cd)-Total | | | <0.000010 | | mg/L | | 0.0002 | 03-AUG-11 |
| Chromium (Cr)-Total | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Cobalt (Co)-Total | | | <0.00030 | | mg/L | | 0.001 | 03-AUG-11 |
| Copper (Cu)-Total | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Lead (Pb)-Total | | | <0.00050 | | mg/L | | 0.001 | 03-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2229379** | | | | | | | | |
| **WG1323317-1 MB** | | | | | | | | |
| Lithium (Li)-Total | | | <0.0050 | | mg/L | | 0.01 | 03-AUG-11 |
| Manganese (Mn)-Total | | | <0.00030 | | mg/L | | 0.001 | 03-AUG-11 |
| Molybdenum (Mo)-Total | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Nickel (Ni)-Total | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Selenium (Se)-Total | | | <0.0010 | | mg/L | | 0.001 | 03-AUG-11 |
| Silver (Ag)-Total | | | <0.000020 | | mg/L | | 0.0001 | 03-AUG-11 |
| Thallium (Tl)-Total | | | <0.00020 | | mg/L | | 0.001 | 03-AUG-11 |
| Tin (Sn)-Total | | | <0.00050 | | mg/L | | 0.001 | 03-AUG-11 |
| Uranium (U)-Total | | | <0.00020 | | mg/L | | 0.0002 | 03-AUG-11 |
| Vanadium (V)-Total | | | <0.0010 | | mg/L | | 0.005 | 03-AUG-11 |
| **Batch R2233780** | | | | | | | | |
| **WG1323317-2 DUP** | | **L1039171-1** | | | | | | |
| Aluminum (Al)-Total | | 1.12 | 1.17 | | mg/L | 3.7 | 20 | 12-AUG-11 |
| Antimony (Sb)-Total | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Arsenic (As)-Total | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Beryllium (Be)-Total | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Cadmium (Cd)-Total | | <0.000085 | <0.000050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Chromium (Cr)-Total | | 0.0127 | 0.0133 | | mg/L | 4.6 | 20 | 12-AUG-11 |
| Cobalt (Co)-Total | | <0.0015 | <0.0015 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Copper (Cu)-Total | | 3.96 | 4.18 | | mg/L | 5.2 | 20 | 12-AUG-11 |
| Lead (Pb)-Total | | 1.41 | 1.37 | | mg/L | 3.4 | 20 | 12-AUG-11 |
| Lithium (Li)-Total | | 1.23 | 1.27 | | mg/L | 3.7 | 20 | 12-AUG-11 |
| Manganese (Mn)-Total | | 0.170 | 0.166 | | mg/L | 2.3 | 20 | 12-AUG-11 |
| Molybdenum (Mo)-Total | | 0.0108 | 0.0110 | | mg/L | 2.1 | 20 | 12-AUG-11 |
| Nickel (Ni)-Total | | 0.0092 | 0.0090 | | mg/L | 1.7 | 20 | 12-AUG-11 |
| Selenium (Se)-Total | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Silver (Ag)-Total | | 0.00017 | 0.00019 | | mg/L | 8.0 | 20 | 12-AUG-11 |
| Thallium (Tl)-Total | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Tin (Sn)-Total | | <0.0025 | <0.0025 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Uranium (U)-Total | | <0.0010 | <0.0010 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| Vanadium (V)-Total | | <0.0050 | <0.0050 | RPD-NA | mg/L | N/A | 20 | 12-AUG-11 |
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2229155** | | | | | | | | |
| **WG1323317-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Total | | | 102 | | % | | 80-120 | 03-AUG-11 |
| Bismuth (Bi)-Total | | | 102 | | % | | 80-120 | 03-AUG-11 |
| Boron (B)-Total | | | 101 | | % | | 80-120 | 03-AUG-11 |
| Calcium (Ca)-Total | | | 106 | | % | | 80-120 | 03-AUG-11 |
| Iron (Fe)-Total | | | 100 | | % | | 80-120 | 03-AUG-11 |
| Magnesium (Mg)-Total | | | 103 | | % | | 80-120 | 03-AUG-11 |
| Phosphorus (P)-Total | | | 103 | | % | | 80-120 | 03-AUG-11 |
| Potassium (K)-Total | | | 106 | | % | | 80-120 | 03-AUG-11 |
| Silicon (Si)-Total | | | 109 | | % | | 80-120 | 03-AUG-11 |
| Sodium (Na)-Total | | | 109 | | % | | 80-120 | 03-AUG-11 |
| Strontium (Sr)-Total | | | 107 | | % | | 80-120 | 03-AUG-11 |
| Titanium (Ti)-Total | | | 105 | | % | | 80-120 | 03-AUG-11 |
| Zinc (Zn)-Total | | | 98 | | % | | 80-120 | 03-AUG-11 |
| **WG1323317-1 MB** | | | | | | | | |
| Barium (Ba)-Total | | | <0.010 | | mg/L | | 0.01 | 03-AUG-11 |
| Bismuth (Bi)-Total | | | <0.20 | | mg/L | | 0.2 | 03-AUG-11 |
| Boron (B)-Total | | | <0.10 | | mg/L | | 0.1 | 03-AUG-11 |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| Iron (Fe)-Total | | | <0.030 | | mg/L | | 0.03 | 03-AUG-11 |
| Magnesium (Mg)-Total | | | <0.10 | | mg/L | | 0.1 | 03-AUG-11 |
| Phosphorus (P)-Total | | | <0.30 | | mg/L | | 0.3 | 03-AUG-11 |
| Potassium (K)-Total | | | <2.0 | | mg/L | | 2 | 03-AUG-11 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 03-AUG-11 |
| Sodium (Na)-Total | | | <2.0 | | mg/L | | 2 | 03-AUG-11 |
| Strontium (Sr)-Total | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| Titanium (Ti)-Total | | | <0.010 | | mg/L | | 0.01 | 03-AUG-11 |
| Zinc (Zn)-Total | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **Batch R2231963** | | | | | | | | |
| **WG1323317-2 DUP** | | **L1039171-1** | | | | | | |
| Barium (Ba)-Total | | 1.74 | 1.70 | | mg/L | 2.6 | 20 | 09-AUG-11 |
| Bismuth (Bi)-Total | | <0.20 | <0.20 | RPD-NA | mg/L | N/A | 20 | 09-AUG-11 |
| Boron (B)-Total | | 0.33 | 0.32 | | mg/L | 2.1 | 20 | 09-AUG-11 |
| Calcium (Ca)-Total | | 11.6 | 11.4 | | mg/L | 1.8 | 20 | 09-AUG-11 |
| Iron (Fe)-Total | | 11.1 | 11.0 | | mg/L | 0.87 | 20 | 09-AUG-11 |
| Magnesium (Mg)-Total | | 2.19 | 2.15 | | mg/L | 1.9 | 20 | 09-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2231963** | | | | | | | | |
| **WG1323317-2 DUP** | | **L1039171-1** | | | | | | |
| Phosphorus (P)-Total | | 0.52 | 0.51 | | mg/L | 1.2 | 20 | 09-AUG-11 |
| Potassium (K)-Total | | <2.0 | <2.0 | RPD-NA | mg/L | N/A | 20 | 09-AUG-11 |
| Silicon (Si)-Total | | 7.35 | 7.25 | | mg/L | 1.3 | 20 | 09-AUG-11 |
| Sodium (Na)-Total | | 497 | 483 | | mg/L | 2.9 | 20 | 09-AUG-11 |
| Strontium (Sr)-Total | | 0.276 | 0.269 | | mg/L | 2.7 | 20 | 09-AUG-11 |
| Titanium (Ti)-Total | | 0.023 | 0.023 | | mg/L | 2.2 | 20 | 09-AUG-11 |
| Zinc (Zn)-Total | | 0.889 | 0.878 | | mg/L | 1.2 | 20 | 09-AUG-11 |
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2228657** | | | | | | | | |
| **WG1323344-2 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 101 | | % | | 85-115 | 03-AUG-11 |
| **WG1323344-4 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 96 | | % | | 85-115 | 03-AUG-11 |
| **WG1323344-6 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 97 | | % | | 85-115 | 03-AUG-11 |
| **WG1323344-8 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 97 | | % | | 85-115 | 03-AUG-11 |
| **WG1323344-1 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323344-3 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323344-5 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323344-7 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323344-9 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 03-AUG-11 |
| **WG1323344-13 MS** | | **L1039022-1** | | | | | | |
| Ammonia (as N) | | | 93 | | % | | 75-125 | 03-AUG-11 |
| **WG1323344-15 MS** | | **L1037476-1** | | | | | | |
| Ammonia (as N) | | | 96 | | % | | 75-125 | 03-AUG-11 |
| **PH-PCT-VA** | **Water** | | | | | | | |
| **Batch R2228859** | | | | | | | | |
| **WG1323382-10 CRM** | | **VA-PH7-BUF** | | | | | | |
| pH | | | 7.00 | | pH | | 6.9-7.1 | 03-AUG-11 |
| | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **S2-D-COL-VA** | **Water** | | | | | | | |
| **Batch R2229813** | | | | | | | | |
| **WG1325218-5 DUP** | | **L1039171-1** | | | | | | |
| Sulphide as S (Dissolved) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 04-AUG-11 |
| **WG1325218-1 MB** | | | | | | | | |
| Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 04-AUG-11 |
| **WG1325218-3 MB** | | | | | | | | |
| Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 04-AUG-11 |
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2232858** | | | | | | | | |
| **WG1327354-2 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 101 | | % | | 85-115 | 09-AUG-11 |
| **WG1327354-5 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 100 | | % | | 85-115 | 09-AUG-11 |
| **WG1327354-8 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 104 | | % | | 85-115 | 09-AUG-11 |
| **WG1327354-1 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 09-AUG-11 |
| **WG1327354-4 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 09-AUG-11 |
| **WG1327354-7 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 09-AUG-11 |
| **TURBIDITY-VA** | **Water** | | | | | | | |
| **Batch R2228628** | | | | | | | | |
| **WG1323872-2 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 102 | | % | | 85-115 | 03-AUG-11 |
| **WG1323872-5 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 100 | | % | | 85-115 | 03-AUG-11 |
| **WG1323872-1 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 03-AUG-11 |
| **WG1323872-4 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 03-AUG-11 |

**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. |

# Quality Control Report



**Hold Time Exceedances:**

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | |
| Total Dissolved Solids by Gravimetric | | | | | | | |
| | 1 | 01-AUG-11 13:00 | 09-AUG-11 12:54 | 7 | 8 | days | EHT |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 01-AUG-11 13:00 | 03-AUG-11 09:27 | 0.25 | 44 | hours | EHTR-FM |

**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 L1039171 were received on 02-AUG-11 16:25.

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.

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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**

**CHAIN OF CUST**
**CANADA**

COC # C037609

Page 1 of 1

| | | |
|---|---|---|
| REPORT TO: AMEC | REPORT FORMAT / DISTRIBUTION | SERVICE REQUESTED |
| COMPANY: | STANDARD ✓ OTHER | ✓ REGULAR SERVICE (DEFAULT) |
| CONTACT: T. Koshya | PDF ✓ EXCEL ✓ CUSTOM FAX | RUSH SERVICE (2-3 DAYS) |
| ADDRESS: 3456 Opie Cres. Prince George, BC V2N 2P9 | EMAIL 1: tammera.koshya@amec.com | PRIORITY SERVICE (1 DAY or ASAP) |
| PHONE: (250) 564-3243 FAX: (250) 562-7045 | EMAIL 2: scott.green@amec.com | EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS |
| INVOICE TO: SAME AS REPORT ? (YES) NO | INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → → | ANALYSIS REQUEST |
| COMPANY: | CLIENT / PROJECT INFORMATION: | |
| CONTACT: | JOB #: KX13505.03 | |
| ADDRESS: | PO /AFE: | |
| | Legal Site Description: | |
| PHONE: FAX: | QUOTE #: | |
| Lab Work Order # (lab use only): [redacted] L1053917 | SAMPLER (Initials): | |

| Sample # | SAMPLE IDENTIFICATION (This description will appear on the report) | DATE | TIME | SAMPLE TYPE | Potability | Total metals | Dissolved metals | TOC | $NH_3$ | Cyanide | S2-UNION-MANCALC-VA | S2-D-COL-VA | HAZARDOUS ? | HIGHLY CONTAMINATED ? | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [redacted] | #2 H16W 500-730m | Aug 1/11 | 1 PM | $H_2O$ | X | X | X | X | X | X | X | X | | | |
| | pH = 7.67 | | | | | | | | | | | | | | |
| | Temp = 10.34°C | | | | | | | | | | | | | | |

**GUIDELINES / REGULATIONS**

CCME + BC CSR *Included vanadium, cobalt, molybdenum + silver

**SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS**

Potability to include - Alkalinity, Anions (Cl, F, S, Sulphate), pH, Hardness, Colour, Nutrients
* Please Sekam to confirm all Details + Plus more !!!

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.**

| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | SAMPLE CONDITION (lab use only) | |
|---|---|---|---|---|---|
| J. Koshya | Aug 1/11 2PM | Walter - Aug. 2, 2011 | 8:25 | TEMPERATURE | SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details) |
| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | 10.1 9.0 C | |

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

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GENF14.00

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 02-AUG-11
Report Date: 09-AUG-11 15:21 (MT)
Version: FINAL

Client Phone: 250-564-3243

# Certificate of Analysis

**Lab Work Order #: L1039100**

Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.03
C of C Numbers: C037608
Legal Site Desc:

Kelly Hunt
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L1039100-1 #2 H16W 500-730M<br>Sampled By: CLIENT on 01-AUG-11 @ 13:00<br>Matrix: WATER | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| Methane, dissolved | 22.0 | | 0.0050 | mg/L | 03-AUG-11 | 09-AUG-11 | R2228660 |

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

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| METHANE-DIS-CL | Water | Methane, dissolved | EPA 5021/8015-HEADSPACE GC-FID |
| Results reported in | | | |

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

**Chain of Custody Numbers:**

C037608

**GLOSSARY OF REPORT TERMS**

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

**ALS Laboratory Group**
ANALYTICAL CHEMISTRY & TESTING SERVICES

**Environmental Division**

# CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

**CANADA TOLL FREE 1-800-668-9878**

www.alsenviro.com

COC # C037608



| REPORT TO: | REPORT FORMAT / DISTRIBUTION | SERVICE REQUESTED |
|---|---|---|
| COMPANY: AMEC | STANDARD ✓ OTHER ____ | REGULAR SERVICE (DEFAULT) ✓ |
| CONTACT: T. Kostya | PDF ✓ EXCEL ✓ CUSTOM ____ FAX ____ | RUSH SERVICE (2-3 DAYS) |
| ADDRESS: 3456 Opie Cres. | EMAIL 1: tammera.kostya@amec.com | PRIORITY SERVICE (1 DAY or ASAP) |
| Prince George, BC V2N 2D9 | EMAIL 2: scott.gisco@amec.com | EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS |
| PHONE (250) 564-3243 FAX: (250) 562-7095 | | |
| INVOICE TO: SAME AS REPORT ? (YES) NO | INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → → | ANALYSIS REQUEST |
| COMPANY: | CLIENT / PROJECT INFORMATION: | |
| CONTACT: | JOB #: KX13505.03 | |
| ADDRESS: | PO /AFE: | |
| | Legal Site Description: | |
| PHONE: FAX: | QUOTE #: | |
| | SAMPLER (Initials): | |

| SAMPLE IDENTIFICATION (This description will appear on the report) | DATE | TIME | SAMPLE TYPE | Diss. Methane | HAZARDOUS ? | HIGHLY CONTAMINATED ? | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|
| # 2H16W 500-730m | Aug 1/11 | 1PM | $H_2O$ | X | | | |
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**GUIDELINES / REGULATIONS**

CCME + BC CSR

**SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS**

* See Selam 4 Details

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.**

| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | TEMPERATURE | SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details) |
|---|---|---|---|---|---|
| J. Kostya | Aug 1/11 2pm | | Aug 2 15h | 11 | |
| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | | |

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

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GENF14.00

AMEC EARTH & ENVIRONMENTAL
ATTN: Scott Green
913 Laval Crescent
Kamloops BC V2C 5P4

Date Received: 15-AUG-11
Report Date: 26-OCT-11 17:42 (MT)
Version: DRAFT REV. 2

Client Phone: 250-374-1347

# Certificate of Analysis

**Lab Work Order #: L1044658**

Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.030
C of C Numbers: C037610
Legal Site Desc:

**Comments:** ADDITIONAL 26-OCT-11 14:32

26-OCT-11: Please note: Bromide and Total and Dissolved Bismuth, Phosphorus, Silicon and Strontium have been added to this report, no other data has been changed.

Selam Worku
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1044658-1 | | | | |
| | **Description** | WATER | | | | |
| | **Sampled Date** | 14-AUG-11 | | | | |
| | **Sampled Time** | 14:00 | | | | |
| | **Client ID** | H16W 233M-273M | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 5.5 | | | | |
| | Conductivity (uS/cm) | 1460 | | | | |
| | Hardness (as CaCO3) (mg/L) | 14.4 | | | | |
| | pH (pH) | 9.43 | | | | |
| | Total Dissolved Solids (mg/L) | 842 | | | | |
| | Turbidity (NTU) | 8.25 | | | | |
| **Anions and Nutrients** | Alkalinity, Total (as CaCO3) (mg/L) | 787 | | | | |
| | Ammonia (as N) (mg/L) | 1.04 | | | | |
| | Bromide (Br) (mg/L) | <0.50 | | | | |
| | Chloride (Cl) (mg/L) | 11.5 | | | | |
| | Fluoride (F) (mg/L) | 1.82 | | | | |
| | Nitrate (as N) (mg/L) | <0.050 | | | | |
| | Nitrite (as N) (mg/L) | <0.010 | | | | |
| | Sulfate (SO4) (mg/L) | <5.0 | | | | |
| | Sulphide as S (Dissolved) (mg/L) | <0.020 | | | | |
| **Cyanides** | Cyanide, Total (mg/L) | 0.0756 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 5.23 | | | | |
| **Inorganic Parameters** | Sulphide As S (Un-ionized) (mg/L) | <0.020 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.314 | | | | |
| | Antimony (Sb)-Total (mg/L) | <0.0025 DLA | | | | |
| | Arsenic (As)-Total (mg/L) | <0.0025 DLA | | | | |
| | Barium (Ba)-Total (mg/L) | 0.455 | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.0050 DLA | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.20 | | | | |
| | Boron (B)-Total (mg/L) | 0.30 | | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.000085 DLA | | | | |
| | Calcium (Ca)-Total (mg/L) | 6.19 | | | | |
| | Chromium (Cr)-Total (mg/L) | <0.0050 DLA | | | | |
| | Cobalt (Co)-Total (mg/L) | <0.0015 DLA | | | | |
| | Copper (Cu)-Total (mg/L) | 0.0614 | | | | |
| | Iron (Fe)-Total (mg/L) | 0.577 | | | | |
| | Lead (Pb)-Total (mg/L) | 0.0318 | | | | |
| | Lithium (Li)-Total (mg/L) | 1.32 | | | | |
| | Magnesium (Mg)-Total (mg/L) | 0.99 | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0159 | | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1044658-1 | | | | |
|---|---|---|---|---|---|---|---|
| | | Description | WATER | | | | |
| | | Sampled Date | 14-AUG-11 | | | | |
| | | Sampled Time | 14:00 | | | | |
| | | Client ID | H16W 233M-273M | | | | |
| **Grouping** | **Analyte** | | | | | | |
| **WATER** | | | | | | | |
| **Total Metals** | Molybdenum (Mo)-Total (mg/L) | | 0.0053 | | | | |
| | Nickel (Ni)-Total (mg/L) | | <0.0050 DLA | | | | |
| | Phosphorus (P)-Total (mg/L) | | <0.30 | | | | |
| | Potassium (K)-Total (mg/L) | | 3.2 | | | | |
| | Selenium (Se)-Total (mg/L) | | <0.0050 DLA | | | | |
| | Silicon (Si)-Total (mg/L) | | 4.50 | | | | |
| | Silver (Ag)-Total (mg/L) | | <0.00010 DLA | | | | |
| | Sodium (Na)-Total (mg/L) | | 364 | | | | |
| | Strontium (Sr)-Total (mg/L) | | 0.116 | | | | |
| | Thallium (Tl)-Total (mg/L) | | <0.0010 DLA | | | | |
| | Tin (Sn)-Total (mg/L) | | <0.0025 DLA | | | | |
| | Titanium (Ti)-Total (mg/L) | | <0.010 | | | | |
| | Uranium (U)-Total (mg/L) | | <0.0010 DLA | | | | |
| | Vanadium (V)-Total (mg/L) | | <0.0050 DLA | | | | |
| | Zinc (Zn)-Total (mg/L) | | <0.050 | | | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | | 0.123 | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.0025 DLA | | | | |
| | Arsenic (As)-Dissolved (mg/L) | | <0.0025 DLA | | | | |
| | Barium (Ba)-Dissolved (mg/L) | | 0.380 | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.0050 DLA | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.20 | | | | |
| | Boron (B)-Dissolved (mg/L) | | 0.29 | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | | <0.000085 DLA | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | | 4.33 | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | | <0.0050 DLA | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | | <0.0015 DLA | | | | |
| | Copper (Cu)-Dissolved (mg/L) | | 0.0167 | | | | |
| | Iron (Fe)-Dissolved (mg/L) | | 0.144 | | | | |
| | Lead (Pb)-Dissolved (mg/L) | | 0.0029 | | | | |
| | Lithium (Li)-Dissolved (mg/L) | | 1.16 | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | | 0.88 | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.0067 | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000010 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.0050 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | <0.0050 DLA | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | <0.30 | | | | |
| | Potassium (K)-Dissolved (mg/L) | | 3.0 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1044658-1 | | | | |
| | **Description** | WATER | | | | |
| | **Sampled Date** | 14-AUG-11 | | | | |
| | **Sampled Time** | 14:00 | | | | |
| | **Client ID** | H16W 233M-273M | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Selenium (Se)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 4.01 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.00010 DLA | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 349 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.101 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.0010 DLA | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.0025 DLA | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | | | | |
| | Uranium (U)-Dissolved (mg/L) | <0.0010 DLA | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0050 DLA | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0050 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| **CN-T-MID-HH-COL-VA** | Water | Total Cyanide by HH Distillation | APHA 4500-CN Cyanide |
| This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method. | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |
| This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7). | | | |
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |
| This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7). | | | |
| **MET-DIS-CCME-MS-VA** | Water | Diss. Metals in Water by ICPMS (CCME) | EPA SW-846 3005A/6020A |

# Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-TOT-CCME-MS-VA** Water Total Metals in Water by ICPMS (CCME) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**S2-D-COL-VA** Water Dissolved Sulphide by Colorimetric APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

**S2-UNION-MANCALC-VA** Water Un-ionized Hydrogen sulphide (Man. calc) APHA -4500-S2 H.

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

**TDS-VA** Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA |

**Chain of Custody Numbers:**

C037610

# Reference Information

**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: AMEC EARTH & ENVIRONMENTAL
913 Laval Crescent
Kamloops BC V2C 5P4
Contact: Scott Green

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ALK-PCT-VA** | **Water** | | | | | | | |
| **Batch R2237167** | | | | | | | | |
| **WG1332468-8 CRM** | | **VA-ALK-PCT-CONTROL** | | | | | | |
| Alkalinity, Total (as CaCO3) | | | 102 | | % | | 85-115 | 18-AUG-11 |
| **WG1332468-1 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-AUG-11 |
| **WG1332468-2 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-AUG-11 |
| **WG1332468-3 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-AUG-11 |
| **WG1332468-7 MB** | | | | | | | | |
| Alkalinity, Total (as CaCO3) | | | <1.0 | | mg/L | | 1 | 18-AUG-11 |
| **ANIONS-BR-IC-VA** | **Water** | | | | | | | |
| **Batch R2237044** | | | | | | | | |
| **WG1330926-15 LCS** | | | | | | | | |
| Bromide (Br) | | | 99 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-2 LCS** | | | | | | | | |
| Bromide (Br) | | | 100 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-1 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 16-AUG-11 |
| **WG1330926-10 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 16-AUG-11 |
| **WG1330926-13 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 16-AUG-11 |
| **WG1330926-4 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 16-AUG-11 |
| **WG1330926-7 MB** | | | | | | | | |
| Bromide (Br) | | | <0.050 | | mg/L | | 0.05 | 16-AUG-11 |
| **WG1330926-11 MS** | | **L1042238-18** | | | | | | |
| Bromide (Br) | | | 115 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-5 MS** | | **L1041405-29** | | | | | | |
| Bromide (Br) | | | 98 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-8 MS** | | **L1041405-39** | | | | | | |
| Bromide (Br) | | | 113 | | % | | 75-125 | 16-AUG-11 |
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2237044** | | | | | | | | |
| **WG1330926-15 LCS** | | | | | | | | |
| Chloride (Cl) | | | 107 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-2 LCS** | | | | | | | | |
| Chloride (Cl) | | | 107 | | % | | 85-115 | 16-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-CL-IC-VA** | **Water** | | | | | | | |
| **Batch R2237044** | | | | | | | | |
| **WG1330926-1 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-10 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-13 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-4 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-7 MB** | | | | | | | | |
| Chloride (Cl) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-11 MS** | | **L1042238-18** | | | | | | |
| Chloride (Cl) | | | 109 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-14 MS** | | **L1043928-1** | | | | | | |
| Chloride (Cl) | | | 105 | | % | | 75-125 | 16-AUG-11 |
| **ANIONS-F-IC-VA** | **Water** | | | | | | | |
| **Batch R2237044** | | | | | | | | |
| **WG1330926-15 LCS** | | | | | | | | |
| Fluoride (F) | | | 107 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-2 LCS** | | | | | | | | |
| Fluoride (F) | | | 107 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-1 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 16-AUG-11 |
| **WG1330926-10 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 16-AUG-11 |
| **WG1330926-13 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 16-AUG-11 |
| **WG1330926-4 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 16-AUG-11 |
| **WG1330926-7 MB** | | | | | | | | |
| Fluoride (F) | | | <0.020 | | mg/L | | 0.02 | 16-AUG-11 |
| **WG1330926-11 MS** | | **L1042238-18** | | | | | | |
| Fluoride (F) | | | 113 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-14 MS** | | **L1043928-1** | | | | | | |
| Fluoride (F) | | | 106 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-5 MS** | | **L1041405-29** | | | | | | |
| Fluoride (F) | | | 108 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-8 MS** | | **L1041405-39** | | | | | | |
| Fluoride (F) | | | 109 | | % | | 75-125 | 16-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-NO2-IC-VA** | **Water** | | | | | | | |
| **Batch R2237044** | | | | | | | | |
| **WG1330926-15 LCS** | | | | | | | | |
| Nitrite (as N) | | | 112 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-2 LCS** | | | | | | | | |
| Nitrite (as N) | | | 111 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-1 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| **WG1330926-10 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| **WG1330926-13 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| **WG1330926-4 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| **WG1330926-7 MB** | | | | | | | | |
| Nitrite (as N) | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| **WG1330926-11 MS** | | **L1042238-18** | | | | | | |
| Nitrite (as N) | | | 113 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-14 MS** | | **L1043928-1** | | | | | | |
| Nitrite (as N) | | | 98 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-5 MS** | | **L1041405-29** | | | | | | |
| Nitrite (as N) | | | 103 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-8 MS** | | **L1041405-39** | | | | | | |
| Nitrite (as N) | | | 105 | | % | | 75-125 | 16-AUG-11 |
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2237044** | | | | | | | | |
| **WG1330926-2 LCS** | | | | | | | | |
| Nitrate (as N) | | | 115 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-1 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330926-10 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330926-13 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330926-4 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330926-7 MB** | | | | | | | | |
| Nitrate (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330926-11 MS** | | **L1042238-18** | | | | | | |
| Nitrate (as N) | | | 120 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-5 MS** | | **L1041405-29** | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **ANIONS-NO3-IC-VA** | **Water** | | | | | | | |
| **Batch R2237044** | | | | | | | | |
| **WG1330926-5 MS** | | **L1041405-29** | | | | | | |
| Nitrate (as N) | | | 117 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-8 MS** | | **L1041405-39** | | | | | | |
| Nitrate (as N) | | | 118 | | % | | 75-125 | 16-AUG-11 |
| **ANIONS-SO4-IC-VA** | **Water** | | | | | | | |
| **Batch R2237044** | | | | | | | | |
| **WG1330926-15 LCS** | | | | | | | | |
| Sulfate (SO4) | | | 104 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-2 LCS** | | | | | | | | |
| Sulfate (SO4) | | | 104 | | % | | 85-115 | 16-AUG-11 |
| **WG1330926-1 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-10 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-13 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-4 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-7 MB** | | | | | | | | |
| Sulfate (SO4) | | | <0.50 | | mg/L | | 0.5 | 16-AUG-11 |
| **WG1330926-11 MS** | | **L1042238-18** | | | | | | |
| Sulfate (SO4) | | | 107 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-5 MS** | | **L1041405-29** | | | | | | |
| Sulfate (SO4) | | | 103 | | % | | 75-125 | 16-AUG-11 |
| **WG1330926-8 MS** | | **L1041405-39** | | | | | | |
| Sulfate (SO4) | | | 104 | | % | | 75-125 | 16-AUG-11 |
| **CARBONS-TOC-VA** | **Water** | | | | | | | |
| **Batch R2237240** | | | | | | | | |
| **WG1332549-1 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 100 | | % | | 80-120 | 17-AUG-11 |
| **WG1332549-3 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 102 | | % | | 80-120 | 17-AUG-11 |
| **WG1332549-5 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 100 | | % | | 80-120 | 17-AUG-11 |
| **WG1332549-7 CRM** | | **VA-TOC-C-CAFFEINE** | | | | | | |
| Total Organic Carbon | | | 102 | | % | | 80-120 | 17-AUG-11 |
| **WG1332549-2 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 17-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **CARBONS-TOC-VA** | **Water** | | | | | | | |
| **Batch R2237240** | | | | | | | | |
| **WG1332549-4 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 17-AUG-11 |
| **WG1332549-6 MB** | | | | | | | | |
| Total Organic Carbon | | | <0.50 | | mg/L | | 0.5 | 17-AUG-11 |
| **WG1332549-9 MS** | | **L1042238-19** | | | | | | |
| Total Organic Carbon | | | 121 | | % | | 70-130 | 17-AUG-11 |
| **CN-T-MID-HH-COL-VA** | **Water** | | | | | | | |
| **Batch R2238672** | | | | | | | | |
| **WG1334837-2 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 97 | | % | | 80-120 | 22-AUG-11 |
| **WG1334837-3 CRM** | | **VA-HH-TCN-CONTROL** | | | | | | |
| Cyanide, Total | | | 102 | | % | | 80-120 | 22-AUG-11 |
| **WG1334837-1 MB** | | | | | | | | |
| Cyanide, Total | | | <0.0050 | | mg/L | | 0.005 | 22-AUG-11 |
| **COLOUR-TRUE-VA** | **Water** | | | | | | | |
| **Batch R2235390** | | | | | | | | |
| **WG1331049-2 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 104 | | % | | 85-115 | 16-AUG-11 |
| **WG1331049-5 CRM** | | **VA-COL-C-25** | | | | | | |
| Colour, True | | | 105 | | % | | 85-115 | 16-AUG-11 |
| **WG1331049-1 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 16-AUG-11 |
| **WG1331049-4 MB** | | | | | | | | |
| Colour, True | | | <5.0 | | CU | | 5 | 16-AUG-11 |
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2235829** | | | | | | | | |
| **WG1330994-9 CRM** | | **VA-EC-PCT-CONTROL** | | | | | | |
| Conductivity | | | 106 | | % | | 90-110 | 16-AUG-11 |
| **WG1330994-1 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 16-AUG-11 |
| **WG1330994-2 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 16-AUG-11 |
| **WG1330994-3 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 16-AUG-11 |
| **WG1330994-4 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 16-AUG-11 |
| **WG1330994-5 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 16-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **EC-PCT-VA** | **Water** | | | | | | | |
| **Batch R2235829** | | | | | | | | |
| **WG1330994-6 MB** | | | | | | | | |
| Conductivity | | | <2.0 | | uS/cm | | 2 | 16-AUG-11 |
| **HG-DIS-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2235384** | | | | | | | | |
| **WG1331347-2 LCS** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | 98 | | % | | 80-120 | 16-AUG-11 |
| **WG1331347-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 16-AUG-11 |
| **Batch R2235978** | | | | | | | | |
| **WG1330739-1 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 17-AUG-11 |
| **WG1330739-4 MB** | | | | | | | | |
| Mercury (Hg)-Dissolved | | | <0.000010 | | mg/L | | 0.00001 | 17-AUG-11 |
| **HG-TOT-LOW-CVAFS-VA** | **Water** | | | | | | | |
| **Batch R2235384** | | | | | | | | |
| **WG1331347-2 LCS** | | | | | | | | |
| Mercury (Hg)-Total | | | 98 | | % | | 80-120 | 16-AUG-11 |
| **WG1331347-1 MB** | | | | | | | | |
| Mercury (Hg)-Total | | | <0.000010 | | mg/L | | 0.00001 | 16-AUG-11 |
| **WG1331347-14 MS** | | **L1043645-4** | | | | | | |
| Mercury (Hg)-Total | | | 91 | | % | | 70-130 | 16-AUG-11 |
| **WG1331347-15 MS** | | **L1042238-15** | | | | | | |
| Mercury (Hg)-Total | | | 97 | | % | | 70-130 | 16-AUG-11 |
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2236073** | | | | | | | | |
| **WG1330739-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Dissolved | | | 103 | | % | | 80-120 | 16-AUG-11 |
| Antimony (Sb)-Dissolved | | | 102 | | % | | 80-120 | 16-AUG-11 |
| Arsenic (As)-Dissolved | | | 102 | | % | | 80-120 | 16-AUG-11 |
| Beryllium (Be)-Dissolved | | | 103 | | % | | 80-120 | 16-AUG-11 |
| Cadmium (Cd)-Dissolved | | | 107 | | % | | 80-120 | 16-AUG-11 |
| Chromium (Cr)-Dissolved | | | 103 | | % | | 80-120 | 16-AUG-11 |
| Cobalt (Co)-Dissolved | | | 101 | | % | | 80-120 | 16-AUG-11 |
| Copper (Cu)-Dissolved | | | 100 | | % | | 80-120 | 16-AUG-11 |
| Lead (Pb)-Dissolved | | | 102 | | % | | 80-120 | 16-AUG-11 |
| Lithium (Li)-Dissolved | | | 101 | | % | | 80-120 | 16-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2236073** | | | | | | | | |
| **WG1330739-3 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Manganese (Mn)-Dissolved | | | 103 | | % | | 80-120 | 16-AUG-11 |
| Molybdenum (Mo)-Dissolved | | | 103 | | % | | 80-120 | 16-AUG-11 |
| Nickel (Ni)-Dissolved | | | 103 | | % | | 80-120 | 16-AUG-11 |
| Selenium (Se)-Dissolved | | | 102 | | % | | 80-120 | 16-AUG-11 |
| Silver (Ag)-Dissolved | | | 99 | | % | | 80-120 | 16-AUG-11 |
| Thallium (Tl)-Dissolved | | | 102 | | % | | 80-120 | 16-AUG-11 |
| Tin (Sn)-Dissolved | | | 105 | | % | | 80-120 | 16-AUG-11 |
| Vanadium (V)-Dissolved | | | 102 | | % | | 80-120 | 16-AUG-11 |
| Uranium (U)-Dissolved | | | 99 | | % | | 80-120 | 16-AUG-11 |
| **WG1330739-1 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| Antimony (Sb)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 16-AUG-11 |
| Arsenic (As)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 16-AUG-11 |
| Beryllium (Be)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.0002 | 16-AUG-11 |
| Chromium (Cr)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Cobalt (Co)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 16-AUG-11 |
| Copper (Cu)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Lead (Pb)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 16-AUG-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.01 | 16-AUG-11 |
| Manganese (Mn)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 16-AUG-11 |
| Molybdenum (Mo)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Nickel (Ni)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Silver (Ag)-Dissolved | | | <0.000020 | | mg/L | | 0.0001 | 16-AUG-11 |
| Thallium (Tl)-Dissolved | | | <0.00020 | | mg/L | | 0.001 | 16-AUG-11 |
| Tin (Sn)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 16-AUG-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.005 | 16-AUG-11 |
| Uranium (U)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 16-AUG-11 |
| **WG1330739-4 MB** | | | | | | | | |
| Aluminum (Al)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| Antimony (Sb)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 16-AUG-11 |
| Arsenic (As)-Dissolved | | | <0.00050 | | mg/L | | 0.0005 | 16-AUG-11 |
| Beryllium (Be)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Cadmium (Cd)-Dissolved | | | <0.000010 | | mg/L | | 0.0002 | 16-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch** | **R2236073** | | | | | | | |
| **WG1330739-4** | **MB** | | | | | | | |
| Chromium (Cr)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Cobalt (Co)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 16-AUG-11 |
| Copper (Cu)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Lead (Pb)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 16-AUG-11 |
| Lithium (Li)-Dissolved | | | <0.0050 | | mg/L | | 0.01 | 16-AUG-11 |
| Manganese (Mn)-Dissolved | | | <0.00030 | | mg/L | | 0.001 | 16-AUG-11 |
| Molybdenum (Mo)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Nickel (Ni)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Selenium (Se)-Dissolved | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Silver (Ag)-Dissolved | | | <0.000020 | | mg/L | | 0.0001 | 16-AUG-11 |
| Thallium (Tl)-Dissolved | | | <0.00020 | | mg/L | | 0.001 | 16-AUG-11 |
| Tin (Sn)-Dissolved | | | <0.00050 | | mg/L | | 0.001 | 16-AUG-11 |
| Vanadium (V)-Dissolved | | | <0.0010 | | mg/L | | 0.005 | 16-AUG-11 |
| Uranium (U)-Dissolved | | | <0.00020 | | mg/L | | 0.0002 | 16-AUG-11 |
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch** | **R2236045** | | | | | | | |
| **WG1330739-3** | **CRM** | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Dissolved | | | 97 | | % | | 80-120 | 17-AUG-11 |
| Bismuth (Bi)-Dissolved | | | 98 | | % | | 80-120 | 17-AUG-11 |
| Boron (B)-Dissolved | | | 98 | | % | | 80-120 | 17-AUG-11 |
| Calcium (Ca)-Dissolved | | | 99 | | % | | 80-120 | 17-AUG-11 |
| Iron (Fe)-Dissolved | | | 97 | | % | | 80-120 | 17-AUG-11 |
| Magnesium (Mg)-Dissolved | | | 98 | | % | | 80-120 | 17-AUG-11 |
| Phosphorus (P)-Dissolved | | | 100 | | % | | 80-120 | 17-AUG-11 |
| Potassium (K)-Dissolved | | | 101 | | % | | 80-120 | 17-AUG-11 |
| Silicon (Si)-Dissolved | | | 101 | | % | | 80-120 | 17-AUG-11 |
| Sodium (Na)-Dissolved | | | 95 | | % | | 80-120 | 17-AUG-11 |
| Strontium (Sr)-Dissolved | | | 101 | | % | | 80-120 | 17-AUG-11 |
| Titanium (Ti)-Dissolved | | | 100 | | % | | 80-120 | 17-AUG-11 |
| Zinc (Zn)-Dissolved | | | 96 | | % | | 80-120 | 17-AUG-11 |
| **WG1330739-1** | **MB** | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 17-AUG-11 |
| Bismuth (Bi)-Dissolved | | | <0.20 | | mg/L | | 0.2 | 17-AUG-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 17-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-DIS-ICP-VA** | **Water** | | | | | | | |
| **Batch R2236045** | | | | | | | | |
| **WG1330739-1 MB** | | | | | | | | |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 17-AUG-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 17-AUG-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 17-AUG-11 |
| Potassium (K)-Dissolved | | | <2.0 | | mg/L | | 2 | 17-AUG-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 17-AUG-11 |
| Strontium (Sr)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 17-AUG-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 17-AUG-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 17-AUG-11 |
| **WG1330739-4 MB** | | | | | | | | |
| Barium (Ba)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 17-AUG-11 |
| Bismuth (Bi)-Dissolved | | | <0.20 | | mg/L | | 0.2 | 17-AUG-11 |
| Boron (B)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 17-AUG-11 |
| Calcium (Ca)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-11 |
| Iron (Fe)-Dissolved | | | <0.030 | | mg/L | | 0.03 | 17-AUG-11 |
| Magnesium (Mg)-Dissolved | | | <0.10 | | mg/L | | 0.1 | 17-AUG-11 |
| Phosphorus (P)-Dissolved | | | <0.30 | | mg/L | | 0.3 | 17-AUG-11 |
| Potassium (K)-Dissolved | | | <2.0 | | mg/L | | 2 | 17-AUG-11 |
| Silicon (Si)-Dissolved | | | <0.050 | | mg/L | | 0.05 | 17-AUG-11 |
| Sodium (Na)-Dissolved | | | <2.0 | | mg/L | | 2 | 17-AUG-11 |
| Strontium (Sr)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 17-AUG-11 |
| Titanium (Ti)-Dissolved | | | <0.010 | | mg/L | | 0.01 | 17-AUG-11 |
| Zinc (Zn)-Dissolved | | | <0.0050 | | mg/L | | 0.005 | 17-AUG-11 |
| **MET-TOT-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2236073** | | | | | | | | |
| **WG1330735-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Aluminum (Al)-Total | | | 107 | | % | | 80-120 | 16-AUG-11 |
| Antimony (Sb)-Total | | | 84 | | % | | 80-120 | 16-AUG-11 |
| Arsenic (As)-Total | | | 102 | | % | | 80-120 | 16-AUG-11 |
| Beryllium (Be)-Total | | | 84 | | % | | 80-120 | 16-AUG-11 |
| Cadmium (Cd)-Total | | | 106 | | % | | 80-120 | 16-AUG-11 |
| Chromium (Cr)-Total | | | 106 | | % | | 80-120 | 16-AUG-11 |
| Cobalt (Co)-Total | | | 102 | | % | | 80-120 | 16-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-CCME-MS-VA** | **Water** | | | | | | | |
| **Batch R2236073** | | | | | | | | |
| **WG1330735-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Copper (Cu)-Total | | | 101 | | % | | 80-120 | 16-AUG-11 |
| Lead (Pb)-Total | | | 83 | | % | | 80-120 | 16-AUG-11 |
| Lithium (Li)-Total | | | 83 | | % | | 80-120 | 16-AUG-11 |
| Manganese (Mn)-Total | | | 104 | | % | | 80-120 | 16-AUG-11 |
| Molybdenum (Mo)-Total | | | 82 | | % | | 80-120 | 16-AUG-11 |
| Nickel (Ni)-Total | | | 105 | | % | | 80-120 | 16-AUG-11 |
| Selenium (Se)-Total | | | 102 | | % | | 80-120 | 16-AUG-11 |
| Silver (Ag)-Total | | | 81 | | % | | 80-120 | 16-AUG-11 |
| Thallium (Tl)-Total | | | 84 | | % | | 80-120 | 16-AUG-11 |
| Tin (Sn)-Total | | | 86 | | % | | 80-120 | 16-AUG-11 |
| Uranium (U)-Total | | | 82 | | % | | 80-120 | 16-AUG-11 |
| Vanadium (V)-Total | | | 104 | | % | | 80-120 | 16-AUG-11 |
| **WG1330735-1 MB** | | | | | | | | |
| Aluminum (Al)-Total | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| Antimony (Sb)-Total | | | <0.00050 | | mg/L | | 0.0005 | 16-AUG-11 |
| Arsenic (As)-Total | | | <0.00050 | | mg/L | | 0.0005 | 16-AUG-11 |
| Beryllium (Be)-Total | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Cadmium (Cd)-Total | | | <0.000010 | | mg/L | | 0.0002 | 16-AUG-11 |
| Chromium (Cr)-Total | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Cobalt (Co)-Total | | | <0.00030 | | mg/L | | 0.001 | 16-AUG-11 |
| Copper (Cu)-Total | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Lead (Pb)-Total | | | <0.00050 | | mg/L | | 0.001 | 16-AUG-11 |
| Lithium (Li)-Total | | | <0.0050 | | mg/L | | 0.01 | 16-AUG-11 |
| Manganese (Mn)-Total | | | <0.00030 | | mg/L | | 0.001 | 16-AUG-11 |
| Molybdenum (Mo)-Total | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Nickel (Ni)-Total | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Selenium (Se)-Total | | | <0.0010 | | mg/L | | 0.001 | 16-AUG-11 |
| Silver (Ag)-Total | | | <0.000020 | | mg/L | | 0.0001 | 16-AUG-11 |
| Thallium (Tl)-Total | | | <0.00020 | | mg/L | | 0.001 | 16-AUG-11 |
| Tin (Sn)-Total | | | <0.00050 | | mg/L | | 0.001 | 16-AUG-11 |
| Uranium (U)-Total | | | <0.00020 | | mg/L | | 0.0002 | 16-AUG-11 |
| Vanadium (V)-Total | | | <0.0010 | | mg/L | | 0.005 | 16-AUG-11 |
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-TOT-ICP-VA** | **Water** | | | | | | | |
| **Batch R2236078** | | | | | | | | |
| **WG1330735-4 CRM** | | **VA-HIGH-WATRM** | | | | | | |
| Barium (Ba)-Total | | | 103 | | % | | 80-120 | 17-AUG-11 |
| Bismuth (Bi)-Total | | | 100 | | % | | 80-120 | 17-AUG-11 |
| Boron (B)-Total | | | 102 | | % | | 80-120 | 17-AUG-11 |
| Calcium (Ca)-Total | | | 102 | | % | | 80-120 | 17-AUG-11 |
| Iron (Fe)-Total | | | 102 | | % | | 80-120 | 17-AUG-11 |
| Magnesium (Mg)-Total | | | 103 | | % | | 80-120 | 17-AUG-11 |
| Phosphorus (P)-Total | | | 102 | | % | | 80-120 | 17-AUG-11 |
| Potassium (K)-Total | | | 105 | | % | | 80-120 | 17-AUG-11 |
| Silicon (Si)-Total | | | 107 | | % | | 80-120 | 17-AUG-11 |
| Sodium (Na)-Total | | | 104 | | % | | 80-120 | 17-AUG-11 |
| Strontium (Sr)-Total | | | 106 | | % | | 80-120 | 17-AUG-11 |
| Titanium (Ti)-Total | | | 105 | | % | | 80-120 | 17-AUG-11 |
| Zinc (Zn)-Total | | | 96 | | % | | 80-120 | 17-AUG-11 |
| **WG1330735-1 MB** | | | | | | | | |
| Barium (Ba)-Total | | | <0.010 | | mg/L | | 0.01 | 17-AUG-11 |
| Bismuth (Bi)-Total | | | <0.20 | | mg/L | | 0.2 | 17-AUG-11 |
| Boron (B)-Total | | | <0.10 | | mg/L | | 0.1 | 17-AUG-11 |
| Calcium (Ca)-Total | | | <0.050 | | mg/L | | 0.05 | 17-AUG-11 |
| Iron (Fe)-Total | | | <0.030 | | mg/L | | 0.03 | 17-AUG-11 |
| Magnesium (Mg)-Total | | | <0.10 | | mg/L | | 0.1 | 17-AUG-11 |
| Phosphorus (P)-Total | | | <0.30 | | mg/L | | 0.3 | 17-AUG-11 |
| Potassium (K)-Total | | | <2.0 | | mg/L | | 2 | 17-AUG-11 |
| Silicon (Si)-Total | | | <0.050 | | mg/L | | 0.05 | 17-AUG-11 |
| Sodium (Na)-Total | | | <2.0 | | mg/L | | 2 | 17-AUG-11 |
| Strontium (Sr)-Total | | | <0.0050 | | mg/L | | 0.005 | 17-AUG-11 |
| Titanium (Ti)-Total | | | <0.010 | | mg/L | | 0.01 | 17-AUG-11 |
| Zinc (Zn)-Total | | | <0.0050 | | mg/L | | 0.005 | 17-AUG-11 |
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2235494** | | | | | | | | |
| **WG1330736-10 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 98 | | % | | 85-115 | 16-AUG-11 |
| **WG1330736-2 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 96 | | % | | 85-115 | 16-AUG-11 |
| **WG1330736-4 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 93 | | % | | 85-115 | 16-AUG-11 |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **NH3-F-VA** | **Water** | | | | | | | |
| **Batch R2235494** | | | | | | | | |
| **WG1330736-6 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 99 | | % | | 85-115 | 16-AUG-11 |
| **WG1330736-8 CRM** | | **VA-NH3-F** | | | | | | |
| Ammonia (as N) | | | 99 | | % | | 85-115 | 16-AUG-11 |
| **WG1330736-1 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330736-3 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330736-5 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330736-7 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330736-9 MB** | | | | | | | | |
| Ammonia (as N) | | | <0.0050 | | mg/L | | 0.005 | 16-AUG-11 |
| **WG1330736-14 MS** | | **L1044178-6** | | | | | | |
| Ammonia (as N) | | | 104 | | % | | 75-125 | 16-AUG-11 |
| **WG1330736-18 MS** | | **L1042720-2** | | | | | | |
| Ammonia (as N) | | | 100 | | % | | 75-125 | 16-AUG-11 |
| **PH-PCT-VA** | **Water** | | | | | | | |
| **Batch R2235829** | | | | | | | | |
| **WG1330994-10 CRM** | | **VA-PH7-BUF** | | | | | | |
| pH | | | 7.01 | | pH | | 6.9-7.1 | 16-AUG-11 |
| **S2-D-COL-VA** | **Water** | | | | | | | |
| **Batch R2236543** | | | | | | | | |
| **WG1332739-5 DUP** | | **L1044658-1** | | | | | | |
| Sulphide as S (Dissolved) | | <0.020 | <0.020 | RPD-NA | mg/L | N/A | 20 | 17-AUG-11 |
| **WG1332739-1 MB** | | | | | | | | |
| Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 17-AUG-11 |
| **WG1332739-3 MB** | | | | | | | | |
| Sulphide as S (Dissolved) | | | <0.020 | | mg/L | | 0.02 | 17-AUG-11 |
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2235865** | | | | | | | | |
| **WG1330740-11 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 99 | | % | | 85-115 | 16-AUG-11 |
| **WG1330740-2 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 101 | | % | | 85-115 | 16-AUG-11 |
| **WG1330740-5 LCS** | | | | | | | | |

# Quality Control Report



| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **TDS-VA** | **Water** | | | | | | | |
| **Batch R2235865** | | | | | | | | |
| **WG1330740-5 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 101 | | % | | 85-115 | 16-AUG-11 |
| **WG1330740-8 LCS** | | | | | | | | |
| Total Dissolved Solids | | | 98 | | % | | 85-115 | 16-AUG-11 |
| **WG1330740-1 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 16-AUG-11 |
| **WG1330740-10 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 16-AUG-11 |
| **WG1330740-4 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 16-AUG-11 |
| **WG1330740-7 MB** | | | | | | | | |
| Total Dissolved Solids | | | <10 | | mg/L | | 10 | 16-AUG-11 |
| **TURBIDITY-VA** | **Water** | | | | | | | |
| **Batch R2235192** | | | | | | | | |
| **WG1331033-2 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 102 | | % | | 85-115 | 16-AUG-11 |
| **WG1331033-5 CRM** | | **VA-TURB-SPK-8** | | | | | | |
| Turbidity | | | 101 | | % | | 85-115 | 16-AUG-11 |
| **WG1331033-1 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 16-AUG-11 |
| **WG1331033-4 MB** | | | | | | | | |
| Turbidity | | | <0.10 | | NTU | | 0.1 | 16-AUG-11 |

**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. |

# Quality Control Report



**Hold Time Exceedances:**

| ALS Product Description | Sample ID | Sampling Date | Date Processed | Rec. HT | Actual HT | Units | Qualifier |
|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | |
| pH by Meter (Automated) | | | | | | | |
| | 1 | 14-AUG-11 14:00 | 16-AUG-11 10:22 | 0.25 | 44 | hours | EHTR-FM |

**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 L1044658 were received on 15-AUG-11 11:10.

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.

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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.

# Short Holding Time

Rush Processing

ALS

*L1044658-COFC*

IEST FORM 8

COC # C037610

Page 1 of 1

| | | |
|---|---|---|
| REPORT TO: AMEC Environment + Infrastructure | REPOR | SERVICE REQUESTED |
| COMPANY: | STANDARD ✓ OTHER ____ | X REGULAR SERVICE (DEFAULT) |
| CONTACT: Scott Green | PDF ✓ EXCEL ✓ CUSTOM ____ FAX ____ | RUSH SERVICE (2-3 DAYS) |
| ADDRESS: 913 Laval Crescent | EMAIL 1: Scott.green@amec.com | PRIORITY SERVICE (1 DAY or ASAP) |
| Kamloops, B.C. V2C 5P4 | EMAIL 2: Tammera.Kostya@amec.com | EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS |
| PHONE: 250-374-1347 FAX: 250-374-2944 | | ANALYSIS REQUEST |
| INVOICE TO: SAME AS REPORT ? YES / NO | INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → → | |
| COMPANY: | CLIENT / PROJECT INFORMATION: | |
| CONTACT: | JOB #: KX13505.030 | |
| ADDRESS: | PO /AFE: | |
| | Legal Site Description: | |
| PHONE: FAX: | QUOTE #: | |
| Lab Work Order # (lab use only): L1044658 | SAMPLER (Initials): Scott Green SG | |

| Sample # | SAMPLE IDENTIFICATION (This description will appear on the report) | DATE | TIME | SAMPLE TYPE | P Toxicity (No Bacteria) | P Total Metals | P Dissolved Metals | P TOC | P Ammonia | P Cyanides | P S2-UNION-MANGALVA | P S2-O-COL-VA | HAZARDOUS ? | HIGHLY CONTAMINATED ? | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [redacted] | H16W 233m - 273m | August 14, 2011 | 14:00 | Water | X | X | X | X | X | X | X | X | | | |
| [redacted] | | | | | | | | | | | | | | | |
| [redacted] | | | | | | | | | | | | | | | |
| [redacted] | Temp = 10.03 °C | | | | | | | | | | | | | | |
| [redacted] | pH (Temp compensated) = 9.37 | | | | | | | | | | | | | | |
| [redacted] | Specific Conductance = 1392 µS/cm | | | | | | | | | | | | | | |
| [redacted] | ORP = 51.6 mV | | | | | | | | | | | | | | |
| [redacted] | DO = 0.94 mg/L | | | | | | | | | | | | | | |
| [redacted] | | | | | | | | | | | | | | | |
| [redacted] | | | | | | | | | | | | | | | |

| GUIDELINES / REGULATIONS | SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS |
|---|---|
| CCME + BC Approved and Working Criteria | |

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.**

| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | SAMPLE CONDITION (lab use only) |
|---|---|---|---|---|
| Scott Green | Aug. 14/2011 15:00 | HD | 11/08/15 | TEMPERATURE: 7 |
| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details) |
| | | | 11:10 | |

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF14

AMEC EARTH ENVIRONMENTAL
ATTN: SCOTT GREEN
913 LAVAL CRESCENT
KAMLOOPS BC V2C 5P4

Date Received: 15-AUG-11
Report Date: 23-AUG-11 14:52 (MT)
Version: FINAL

Client Phone: 250-374-1347

# Certificate of Analysis

**Lab Work Order #: L1044535**

Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.030
C of C Numbers: C037611
Legal Site Desc:

Kelly Hunt
Account Manager

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

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample Details/Parameters | Result | Qualifier* | D.L. | Units | Extracted | Analyzed | Batch |
|---|---|---|---|---|---|---|---|
| L1044535-1 H16W 233M-273M<br>Sampled By: CLIENT on 14-AUG-11 @ 14:00<br>Matrix: WATER | | | | | | | |
| **Miscellaneous Parameters** | | | | | | | |
| Methane, dissolved | 11.0 | | 0.0050 | mg/L | 23-AUG-11 | 23-AUG-11 | R2239217 |

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

# Reference Information

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| METHANE-DIS-CL | Water | Methane, dissolved | EPA 5021/8015-HEADSPACE GC-FID |
| Results reported in | | | |

** 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 |
|---|---|
| CL | ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA |

**Chain of Custody Numbers:**

C037611

**GLOSSARY OF REPORT TERMS**

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

4077

**ALS Laboratory Group**
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division AGR400

# CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

CANADA TOLL FREE 1-800-668-9878

www.alsenviro.com

COC # C037611
L1044535

Page 1 of 1

| REPORT TO: | REPORT FORMAT / DISTRIBUTION | SERVICE REQUESTED |
|---|---|---|
| COMPANY: AMEC Environment & Infrastructure | STANDARD X OTHER ___ | X REGULAR SERVICE (DEFAULT) |
| CONTACT: 913 Laval Crescent | PDF X EXCEL X CUSTOM ___ FAX ___ | RUSH SERVICE (2-3 DAYS) |
| ADDRESS: Kamloops, B.C V2C 5P4 | EMAIL 1: Scott.green@amec.com | PRIORITY SERVICE (1 DAY or ASAP) |
| Attention: Scott Green | EMAIL 2: Domenico.Kostyo@amec.com | EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS |
| PHONE: 250-374-1347 FAX: 250-374-2944 | | ANALYSIS REQUEST |
| INVOICE TO: SAME AS REPORT ? YES / NO | INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → | |
| COMPANY: | CLIENT / PROJECT INFORMATION: | |
| CONTACT: | JOB #: KX13505.030 | |
| ADDRESS: | PO /AFE: | |
| | Legal Site Description: | |
| PHONE: FAX: | QUOTE #: | |
| | SAMPLER (Initials): | |

| SAMPLE IDENTIFICATION (This description will appear on the report) | DATE | TIME | SAMPLE TYPE | Dissolved Methane | HAZARDOUS | HIGHLY | NUMBER OF CONTAINERS |
|---|---|---|---|---|---|---|---|
| H16W 233m-273m | August 14, 2011 | 14:00 | Water | X | | | |

**GUIDELINES / REGULATIONS**

CCME + BC Approved Working Criteria

**SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS**

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.**

| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: | TEMPERATURE | SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details) |
|---|---|---|---|---|---|
| Scott Green | Aug. 14/11 15:00 | | 15 Aug 11 | 2°C | |
| RELINQUISHED BY: | DATE & TIME: | RECEIVED BY: | DATE & TIME: 12:12 | | |

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

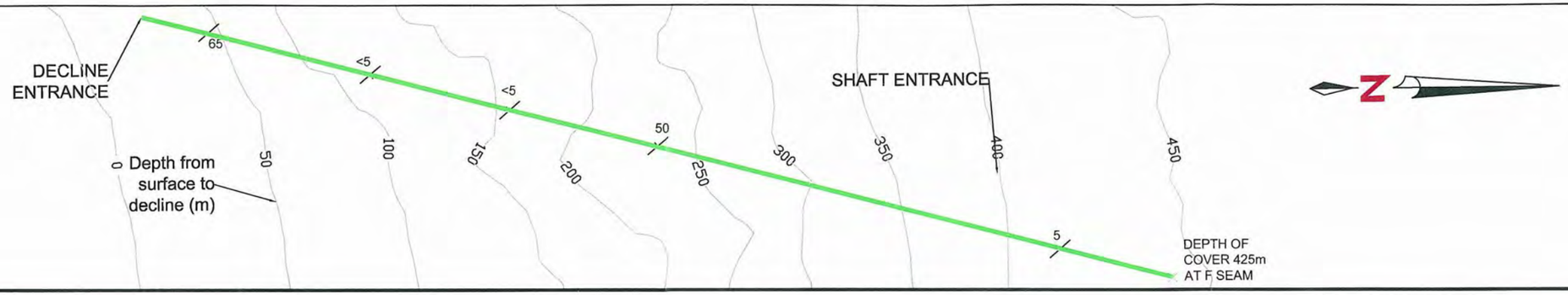
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GENF14.00

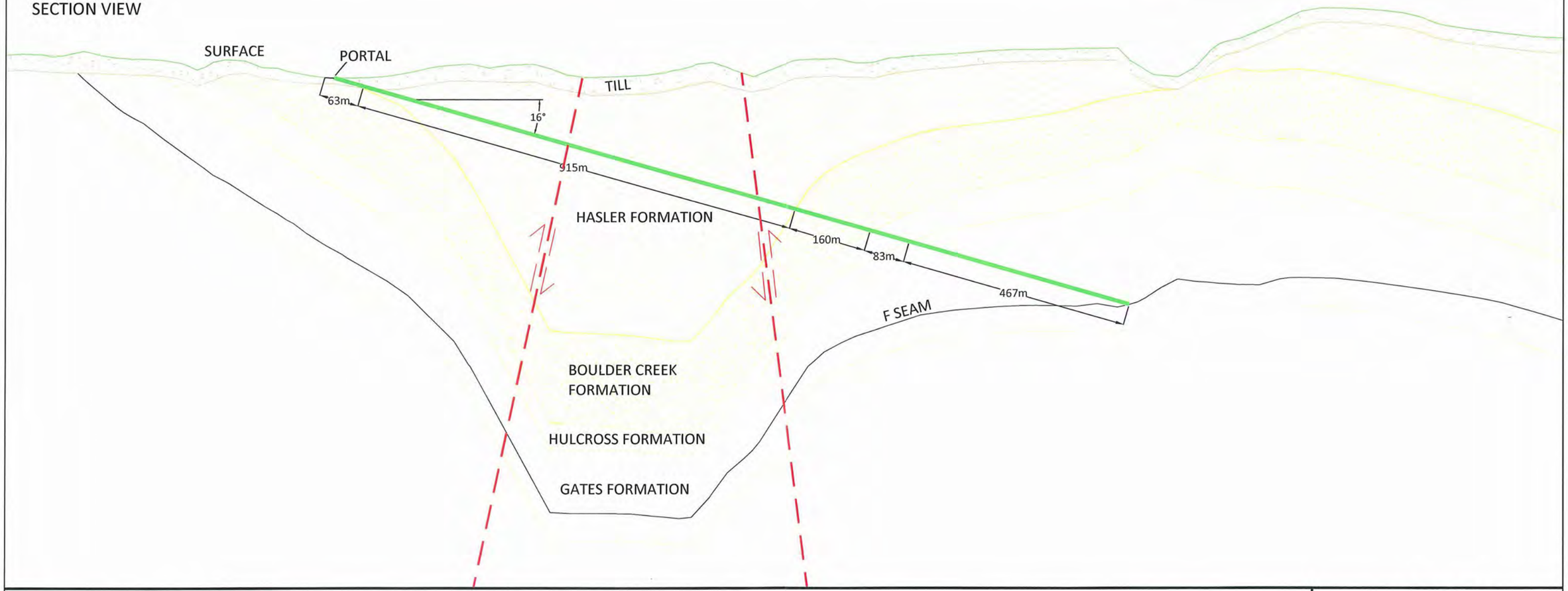
# APPENDIX K

## UNDERGROUND MINE WORKINGS DESIGN DRAWINGS
## (as provided by NORWEST Corporation)

PLAN VIEW




SECTION VIEW




LEGEND

- SURFACE
- BELT DECLINE
- FAULT LINE
- F SEAM
- 50 DEPTH OF COVER CONTOUR LINE

| | | |
|---|---|---|
| TILL | 63m LENGTH | |
| HASLER FORMATION | 915m LENGTH | |
| BOULDER CREEK FORMATION | 160m LENGTH | 1,688m |
| HULCROSS FORMATION | 83m LENGTH | |
| GATES FORMATION | 467m LENGTH | |

DIP DIRECTION — STRIKE OF BEDS

0 100 200 300 400

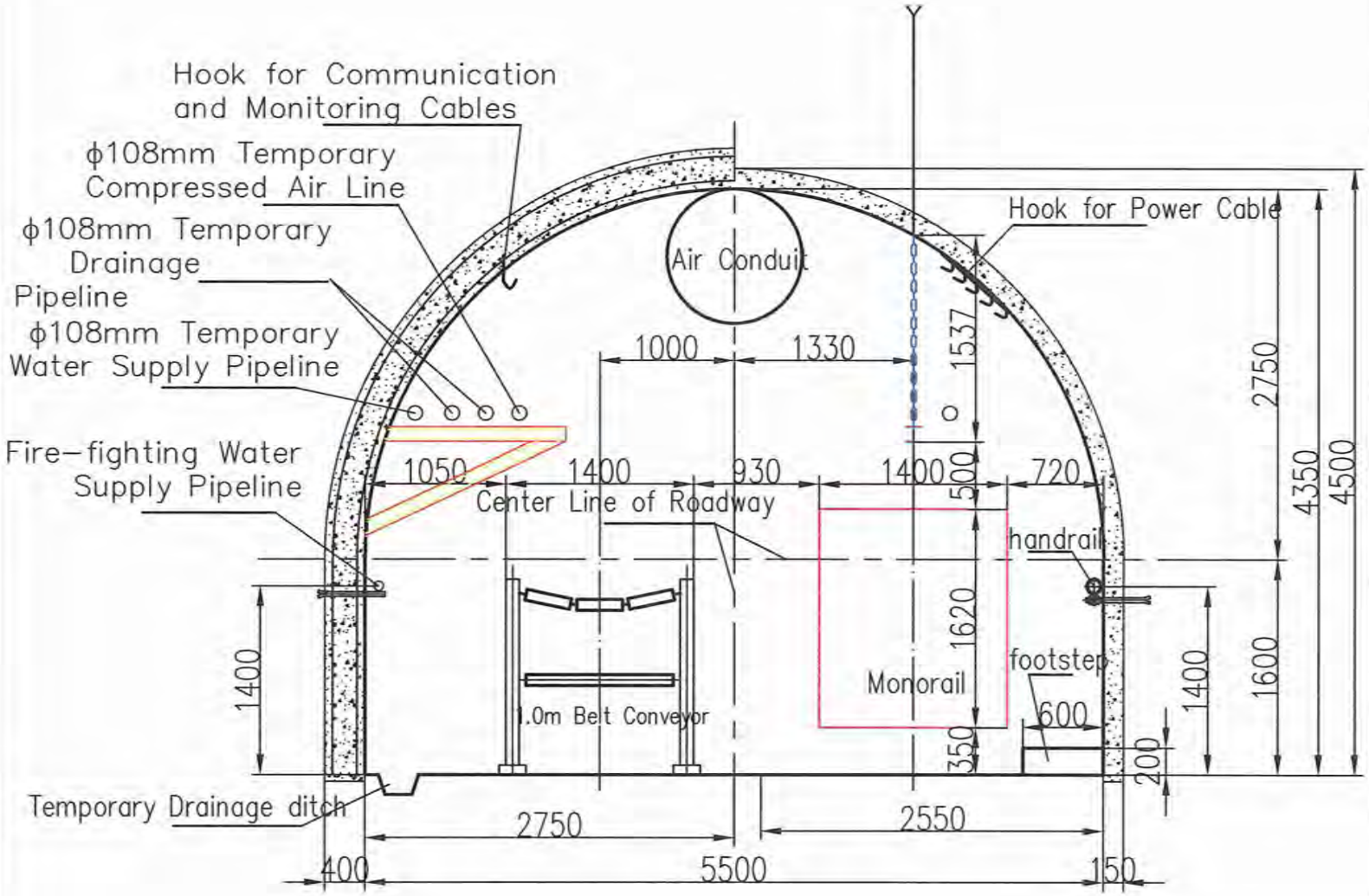
METERS

FIGURE 4.1

BELT DECLINE
CROSS SECTION

DATE: 06/22/2011
FILE: 4827belt-declin
SCALE: 1:200

NORWEST CORPORATION




LEGEND

Note: Drawing from Shenyang Design Institute
Not for Construction

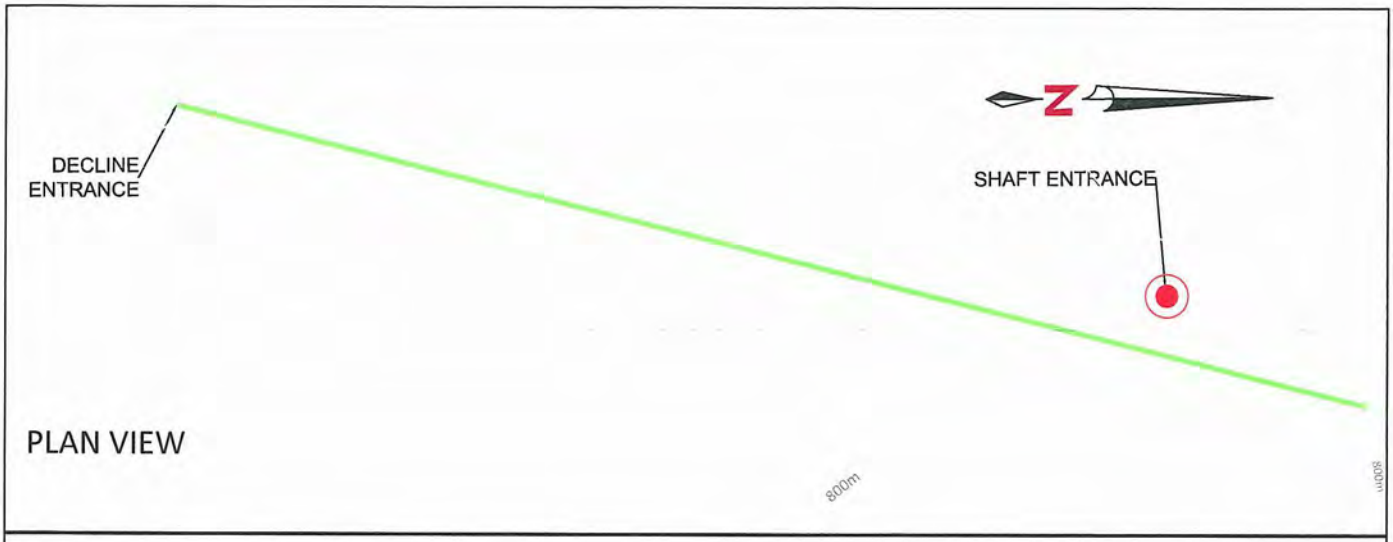
SCALE: 1:1200

FIGURE 4.2

DECLINE TYPICAL PROFILE DURING CONSTRUCTION

DATE: 06/07/2011
FILE: 4627\PROFILE

NORWEST CORPORATION




PLAN VIEW

SECTION VIEW




LEGEND

| | | |
|---|---|---|
| TILL | 7m LENGTH | |
| HASLER FORMATION | 158m LENGTH | |
| BOULDER CREEK FORMATION | 117m LENGTH | 527m |
| HULCROSS FORMATION | 73m LENGTH | |
| GATES FORMATION | 172m LENGTH | |

HORIZONTAL SCALE = VERTICAL SCALE

0 50 100 150 200

METERS

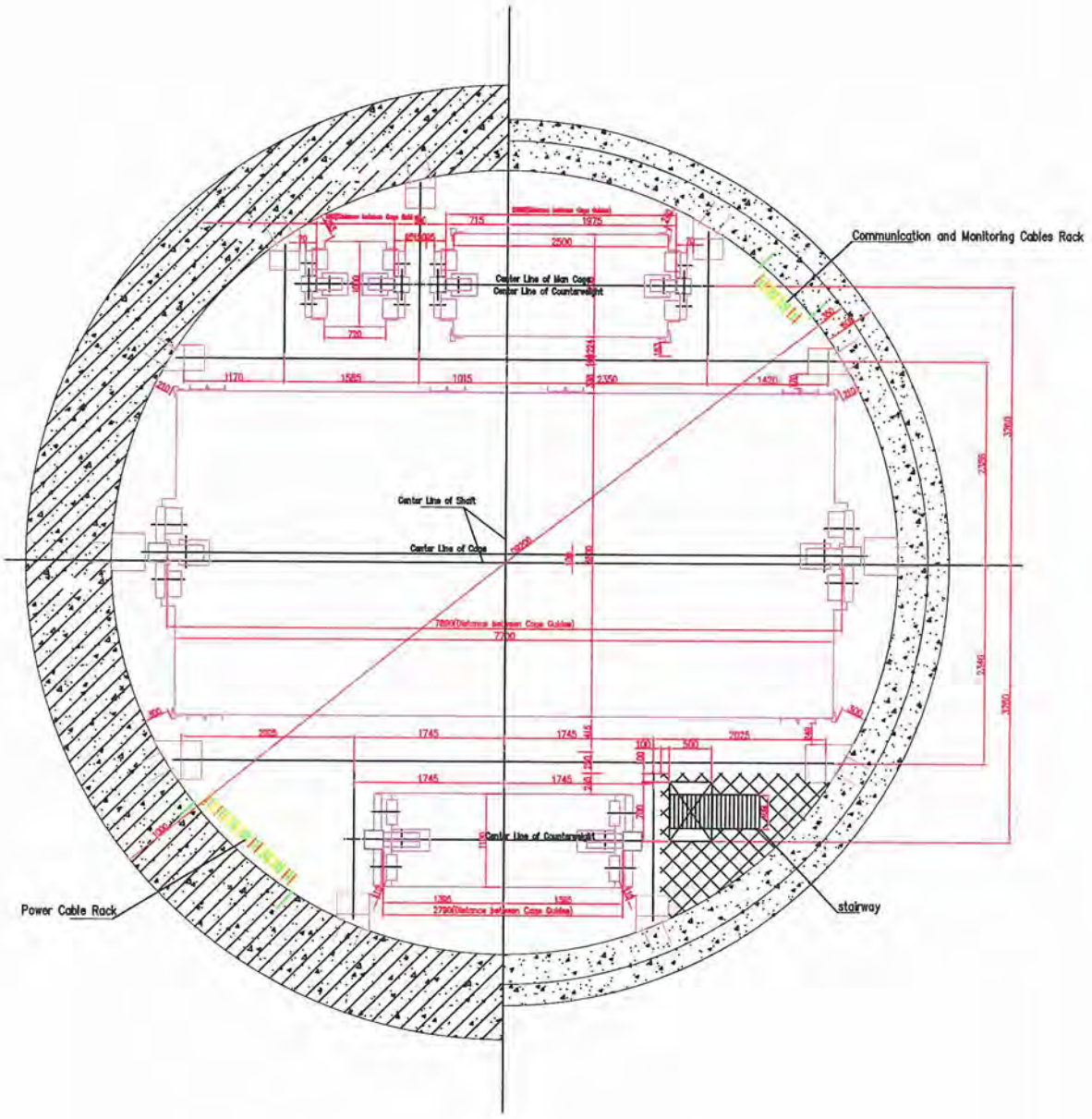
FIGURE 3.1

MEN & MATERIALS SHAFT CROSS SECTION

DATE: 04/27/2011 SCALE: 1: 150

FILE: 4827\BELTDECL

NORWEST CORPORATION




Permanent Shaft Installation

Note: Dimensions are mm

FIGURE 3.6

SHAFT
PERMANENT
INSTALLATION

DATE: 06/23/2011
FILE: 4827\9.2MSHAFT

SCALE: 1:2000

NORWEST CORPORATION

**Table 5.1 ARMPS Input Variables**

| Variable | Value |
|---|---|
| Entry Height | 3.5m |
| Depth of Cover | 525m |
| Cross Cut Angle | 90 Degrees |
| Entry Width | 6m |
| Number of Entries | 5 |
| Crosscut Center Spacing | 52m |
| Entry center spacing | 45m |

The basic configuration selected for bulk sample mine plan is five entries. Two of these entries are intake air and two are return air. One entry is used for the conveyor belt. The conveyor belt entry is isolated from the intake and return entries by stopping. The air in the conveyor belt entry is directed as return air.

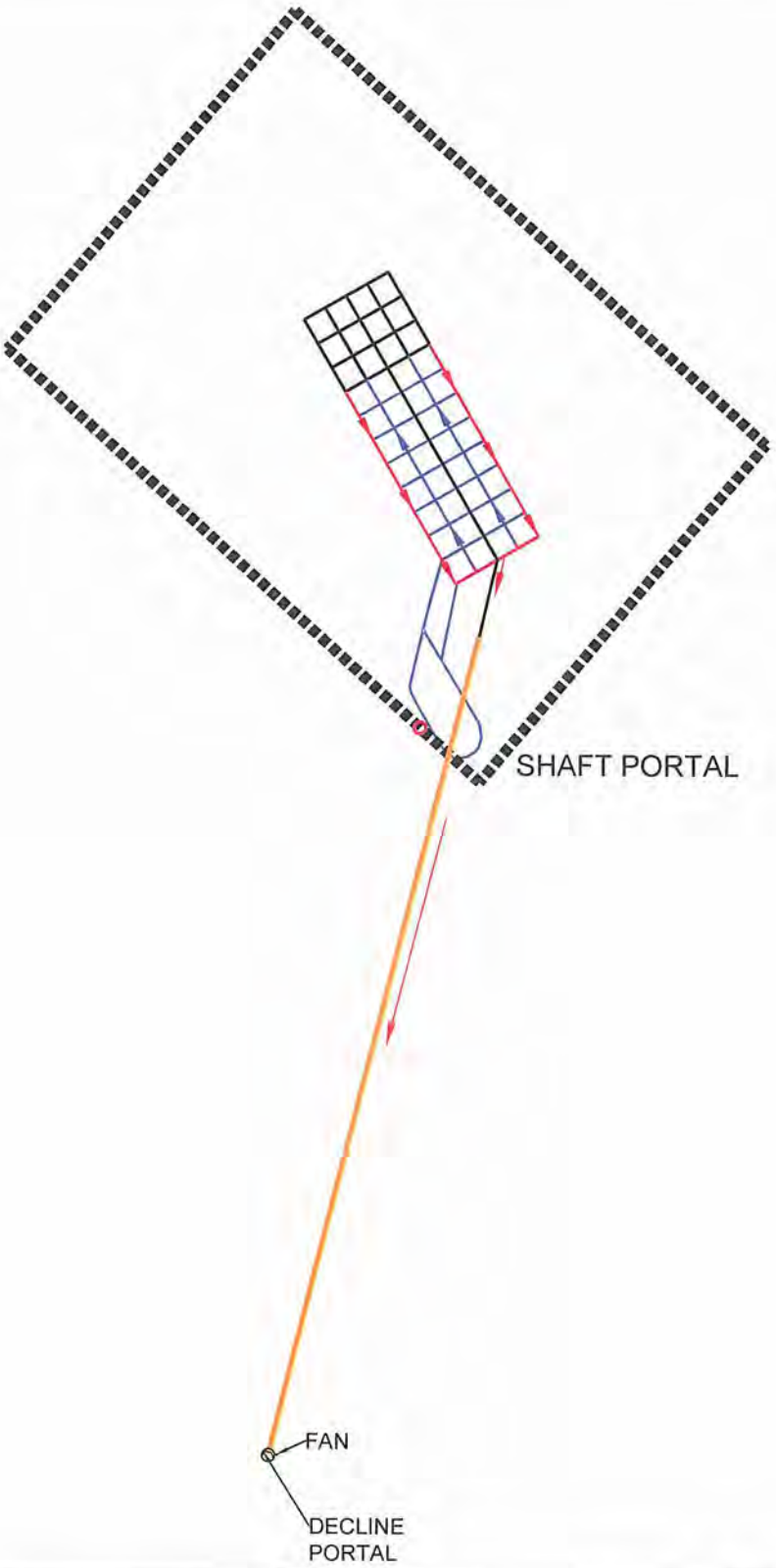
#### Effect of Limited Data

Given the limited number of samples, the absence of any coal strength testing, the lack of bedding plane properties (joint studies which identify major and minor joint orientation and frequency), the lack of actual ground control measurement data, and the absence of in-situ stress measurements, numerical modeling methods are not indicated at this time.

Based upon the current geologic information the maximum depth of overburden at the Murray River bulks sample projected mining area is 525m. For this ARPMS analysis the maximum overburden depth has been used.

Using the input variables listed in Table 5.1 results in a pillar stability factor of 2.5. It should be noted that this stability factor does not allow for any impacts of future mining along these entries or for multiple seam mining. Increased pillar stability factors may be realized by increasing the cross cut and entry centers.

Figure 5.7 shows the anticipated mining plan area and access from the shaft and decline and general ventilation. Five entries will be driven. Crosscuts are on 52m centers and entries are on 45m centers. This results in pillars that are about 46m long and 39m wide. Appendix A shows the ARMPS output.




LEGEND

- BELT DECLINE
- CONVEYOR BELT
- INTAKE
- RETURN

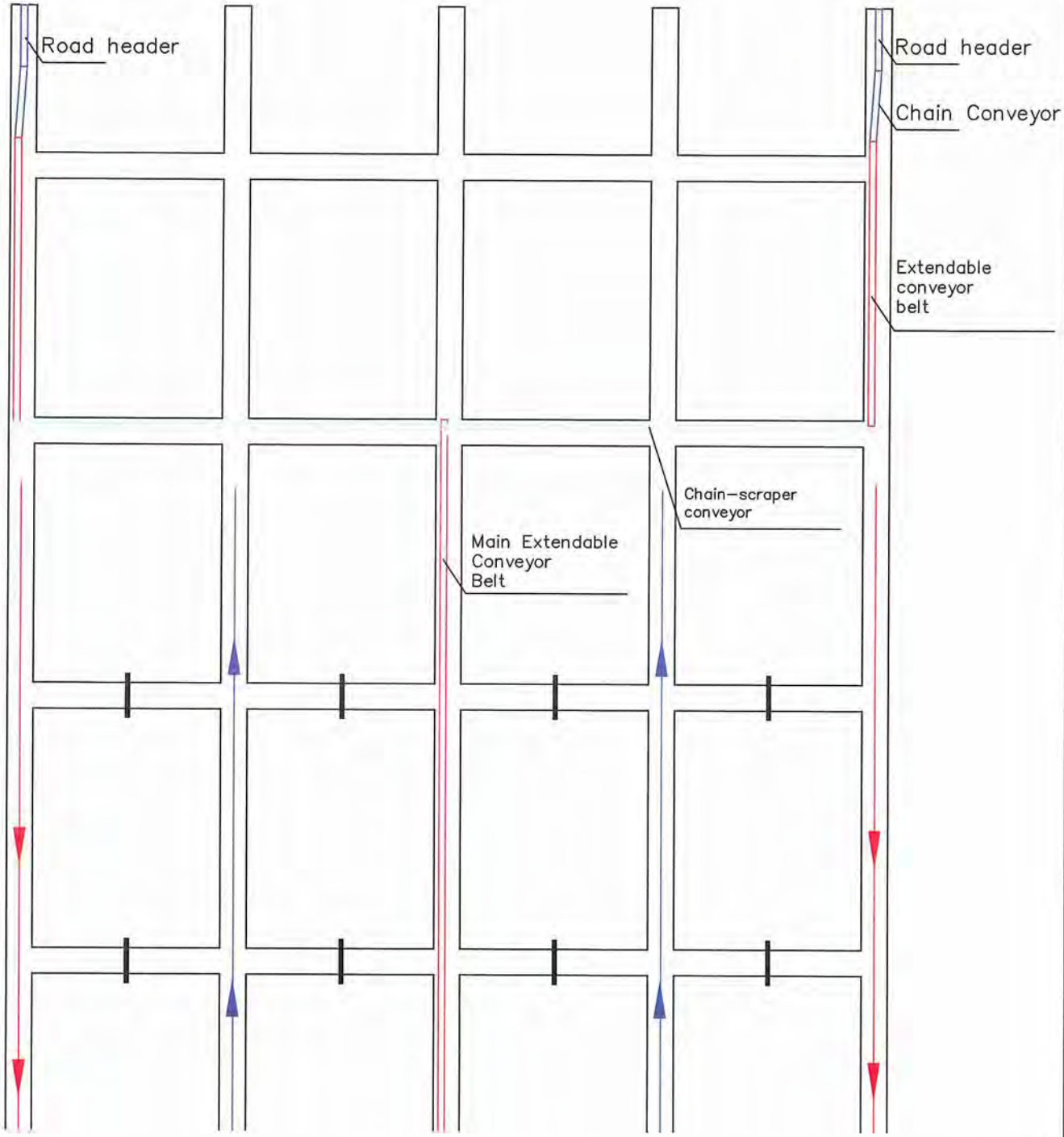
N

0 50 100 150 200
METER

FIGURE 5.7

BULK SAMPLE MINING
VENTILATION
DIAGRAM

| | | |
|---|---|---|
| DATE: 06/20/2011 | SCALE: 1:340 | NORWEST CORPORATION |
| FILE: 4827FIG 5.7 | | |




LEGEND

- Extendable Conveyor Belt
- Chain Conveyor
- Intake air
- Return Air
- Stopping

Note: Face Ventilation devices not shown

FIGURE 5.8

MINE GENERAL VENTILATION DIAGRAM

DATE: 06/17/2011 | SCALE: NTS | NORWEST CORPORATION

FILE:4827\CONVEYOR

# APPENDIX L

# GENERAL LIMITATIONS

## Limitations

1. The work performed in this report was carried out in accordance with the Standard Terms and Conditions made part of our contract. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our contract.

2. The report has been prepared in accordance with generally accepted engineering practices. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our contract and included in this report.

3. The services performed and outlined in this report were based upon interpretation of data collected from seven test zones at two boreholes. Interpretations made from data collected at these locations are for these locations. Our opinion cannot be extended to portions of the site not investigated.

4. The objective of this report was to assess hydrogeological conditions at the location indicated, within the context of our contract and generally accepted engineering principles.

5. Our observations relating to the subsurface conditions at the site are described in this report. It should be noted that subsurface conditions other than those described in this report could be present.

6. The conclusions of this report are based in part on the information provided by others. The possibility remains that unexpected subsurface conditions may be encountered at the site in locations not specifically investigated. Should such an event occur, AMEC Environment & Infrastructure must be notified in order that we may determine if modifications to our conclusions are necessary.

# Appendix B

## Borehole Logs and Monitoring Well Diagrams

ERM

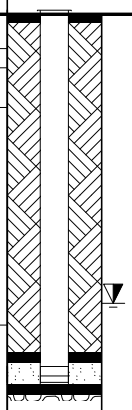
Rescan Environmental Services Ltd.
Sixth Floor, 1111 W Hastings Street
Vancouver, B.C., V6E 2J3 Canada

# Borehole # MW-H13



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 3/5/11 **COMPLETED** 3/7/11
**CASING (TOC) ELEVATION** 821.58 m **HOLE SIZE** 0.076 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.025 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (NQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** Dehua **UTM** 10U, N 6098569 m & E 626086 m
**AT TIME OF DRILLING** ---
**NOTES** No protective casing.
**AFTER DRILLING** 53.908 m 8/22/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0–60 | | | | | POORLY GRADED SAND, brown, rounded, medium grained, dry, loose, homogeneous, [Glacial Till] |
| | | | | | WELL GRADED SAND WITH GRAVEL, pale brown, subrounded, medium to coarse grained, dry, dense, stratified |
| | | | | | POORLY GRADED SAND, brown, rounded, medium grained, dry, dense, homogeneous |
| | | | | | WELL GRADED SAND WITH GRAVEL, dark brown, subrounded, medium to coarse grained, moist, very dense, stratified |
| 60–185 | | | II | | MUSTONE, slightly weathered, massive, dark grey, fine, hard, [Hasler Formation] |
| 185–250 | | | I | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, light grey, fine, very hard, [Boulder Creek] |




Bottom of hole at 250.00 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

Rescan Environmental Services Ltd.
Sixth Floor, 1111 W Hastings Street
Vancouver, B.C., V6E 2J3 Canada

# Borehole # MW-H15



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 4/18/11 **COMPLETED** 4/18/11
**CASING (TOC) ELEVATION** 854.397 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Hughes **UTM** 10U, N 6098376 m & E 625334 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 53.994 m 8/23/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, subrounded, fine to coarse grained, dry, dense, stratified, [Glacial Till] |
| 10 | | | II | | MUDSTONE, massive, dark grey, fine, medium hard, [Hasler Formation] |
| 50 | | | I | | SANDSTONE WITH MUDSTONE, interbedded, light grey, fine, dense, [Boulder Creek] |
| 95 | | | | | SANDSTONE WITH MUDSTONE, interbedded, fossiliferous, light grey, fine, dense |

Bottom of hole at 104.22 m.

WELL DIAGRAM

1.22 m Stickup
Concrete 0 - 0.3 m
0.3 - 87 m Grout
Bentonite 87-89 m
Filter Sand 89-100 m
Screen 94-100 m
Bentonite Plug 100-102 m
Sand Backfill 102-104.2 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

Rescan Environmental Services Ltd.
Sixth Floor, 1111 W Hastings Street
Vancouver, B.C., V6E 2J3 Canada

# Borehole # MW-H16



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 6/22/11 **COMPLETED** 6/23/11
**CASING (TOC) ELEVATION** 839.467 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Hughes **UTM** 10U, N 6097821 m & E 624891 m
**AT TIME OF DRILLING** ---
**NOTES** Damaged well casing at 50 mbgs. Water level measurements only.
**AFTER DRILLING** 60.71 m 8/21/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, subrounded, fine to coarse grained, dry, dense, stratified, [Glacial Till] |
| 10 | | | III | | MUDSTONE, moderately weathered, massive, dark grey, fine, hard, [Hasler Formation] |
| 45 | | | I | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, light brown, fine, hard, [Boulder Creek] |
| 70 | | | | | Bottom of hole at 70.60 m. |

WELL DIAGRAM

Stickup 0.87 m

Grout 0-65 m

Bentonite
65-66.8 m
Filter Sand
66.8-70.6 m
Screen
67.5-70.5 m

Rescan Environmental Services Ltd.
Sixth Floor, 1111 W Hastings Street
Vancouver, B.C., V6E 2J3 Canada

# Borehole # MW-H17

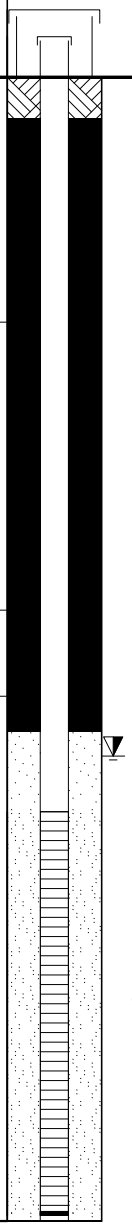


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/3/12 **COMPLETED** 5/4/12
**CASING (TOC) ELEVATION** 829.96 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Geotech Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Auger/Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6097925 m & E 625520 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 5.046 m 7/23/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, subrounded, fine to coarse grained, dry, loose, stratified, [Glacial Till] |
| 2 | | | | | SILTY SAND WITH GRAVEL, COBBLES, light brown, well graded, subrounded, fine to coarse grained, moist, medium dense, stratified |
| 4 | | | | | SILTY SAND, light brown, poorly graded, rounded, fine grained, wet, medium dense, homogeneous |
| | | | III | | MUDSTONE, moderately weathered, massive, dark grey, fine, medium hard, [Hasler Formation] |
| 6 | | | | | |
| 8 | | | | | |

Bottom of hole at 8.50 m.

WELL DIAGRAM




ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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Sixth Floor, 1111 W Hastings Street
Vancouver, B.C., V6E 2J3 Canada

# Borehole # MW-H18

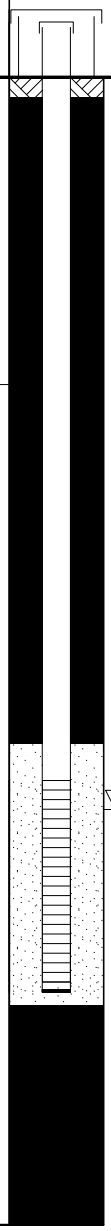


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/2/12 **COMPLETED** 5/3/12
**CASING (TOC) ELEVATION** 831.697 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Geotech Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Auger/Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6097953 m & E 625740 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 10.887 m 7/23/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | SILTY SAND WITH GRAVEL, COBBLES, light brown, well graded, rounded, medium to coarse grained, dry, dense, stratified, [Glacial Till] |
| 5 | | | III | | MUDSTONE, moderately weathered, massive, dark grey, fine, medium hard, [Hasler Formation] |
| 10 | | | II | | |
| 15 | | | I | | |

Bottom of hole at 17.06 m.

WELL DIAGRAM



Rescan Environmental Services Ltd.
Sixth Floor, 1111 W Hastings Street
Vancouver, B.C., V6E 2J3 Canada

# Borehole # MW-H19

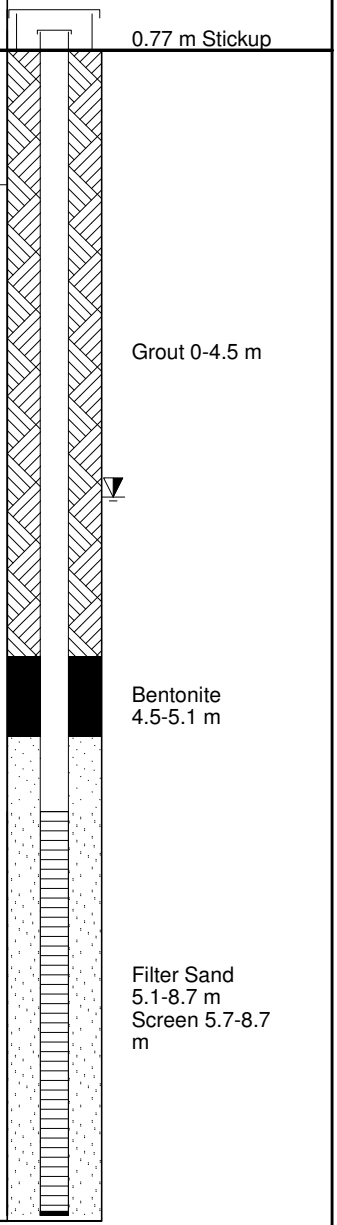


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/1/12 **COMPLETED** 5/2/12
**CASING (TOC) ELEVATION** 833.344 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Geotech Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Auger/Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6098131 m & E 625663 m
**AT TIME OF DRILLING** ---
**NOTES** Slow groundwater recharge.
**AFTER DRILLING** 3.32 m 7/23/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, rounded, fine to coarse grained, dry, medium dense, stratified, [Glacial Till] |
| | | | II | | MUDSTONE, highly weathered, massive, dark grey, fine, medium hard, [Hasler Formation] |
| 2 | | | | | |
| 4 | | | I | | |
| 6 | | | | | |
| 8 | | | I | | |

Bottom of hole at 8.70 m.

WELL DIAGRAM




ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H20



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/19/11 **COMPLETED** 5/23/11
**CASING (TOC) ELEVATION** 954.2 m **HOLE SIZE** 0.1
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (HQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Hughes **UTM** 10U, N 6099766 m & E 624397 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 25.945 m 8/22/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SILT, ORGANICS, brown, poorly graded, fine grained, dry, soft, homogeneous, low plasticity |
| 5 | | | | | GRAVELLY SILT, brown, well graded, subangular, fine to coarse grained, dry, firm, blocky, non plastic |
| 10 | | | III | | GRAVELLY CLAY WITH SAND, brown, well graded, subangular, fine to coarse grained, moist, hard, blocky, medium plasticity |
| 15 | | | | | SILTSTONE, moderately weathered, dark grey, fine, medium hard, dry, [Hasler Formation] |
| 20 | | | II | | MUDSTONE WITH SILTSTONE, slightly weathered, interbedded, light grey, fine, hard, dry |
| 25 | | | | | |
| 30 | | | | | |
| 35 | | | | | |
| 40 | | | I | | SANDSTONE, unweathered, dark brown, medium, hard, wet, [Boulder Creek]<br>Major water-bearing zone at 40 m |
| 45 | | | | | |
| 50 | | | | | |
| 55 | | | I | | MUDSTONE WITH SILTSTONE, unweathered, interbedded, light grey, fine, very hard, dry |
| 60 | | | | | |
| 65 | | | | | |
| 70 | | | | | |
| 75 | | | | | |
| 80 | | | | | |
| 85 | | | | | |
| 90 | | | | | |
| 95 | | | | | |
| 100 | | | | | |

WELL DIAGRAM

Stickup 0.80 m
Concrete
Grout 0.3-36 m
Bentonite 36-37.2 m
Filter Sand 37.2-41 m
Screen 37.8-40.8 m
Bentonite Plug 41-42.5 m
Sand Backfill 42.5-101 m

Bottom of hole at 101.00 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H21



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 3/1/11 **COMPLETED** 3/1/11
**CASING (TOC) ELEVATION** 917 m **HOLE SIZE** 0.076 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.025 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (NQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** Dehua **UTM** 10U, N 6100259 m & E 625390 m
**AT TIME OF DRILLING** ---
**NOTES** No well cover; casing is flush with the surface.
**AFTER DRILLING** 26.02 m 8/22/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | GRAVELLY CLAY WITH SAND, brown, well graded, fine to coarse grained, moist, hard, blocky |
| 40 | | | II | | MUDSTONE AND SILTSTONE, slightly weathered, massive, light grey, fine, dry, [Hasler Formation] |

WELL DIAGRAM

Concrete

Grout 0.3-49 m

Bentonite
49-50.1 m
Filter Sand
50.1-54 m
Screen
50.7-53.7 m
Bentonite Plug
53.7-56 m

Sand Backfill
56-121m

Bottom of hole at 121.00 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H22

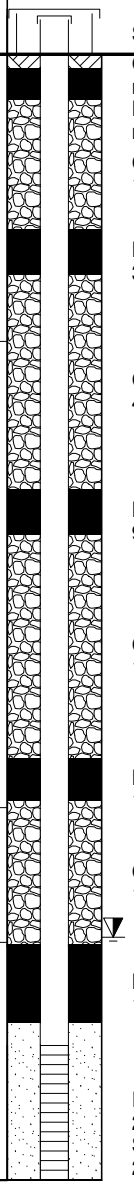


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/5/12 **COMPLETED** 5/5/12
**CASING (TOC) ELEVATION** 784.422 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Geotech Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6096815 m & E 624960 m
**AT TIME OF DRILLING** ---
**NOTES** Turbid water column.
**AFTER DRILLING** 19.69 m 8/21/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, rounded, fine to coarse grained, dry, dense, stratified, [Glacial Till] |
| 5 | | | | | POORLY GRADED SAND, light brown, medium grained, dry, medium dense, homogeneous, [Alluvium] |
| 10 | | | | | |
| 15 | | | | | SANDY SILT, light brown, well graded, fine to medium grained, moist, dense, stratified |
| 20 | | | | | SANDY SILT, light brown, well graded, fine to medium grained, wet, dense, stratified |
| 25 | | | | | |

Bottom of hole at 25.10 m.

WELL DIAGRAM




ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

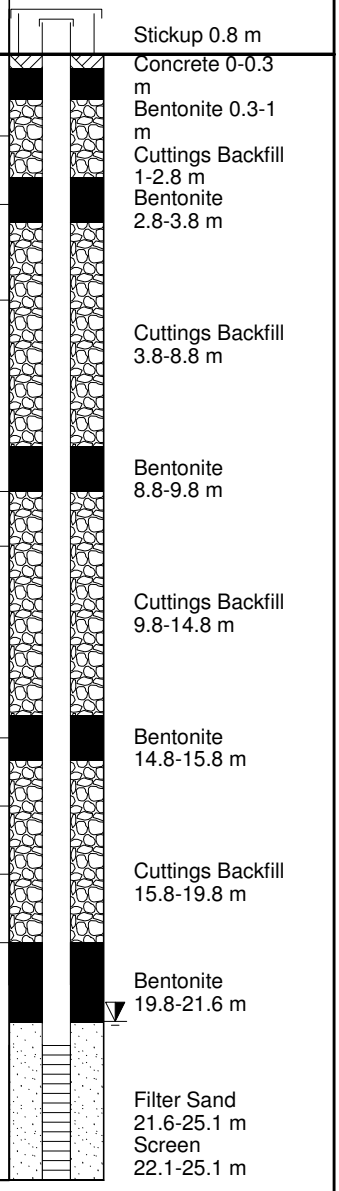
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# Borehole # MW-H23



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/5/12 **COMPLETED** 5/9/12
**CASING (TOC) ELEVATION** 785.698 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Geotech Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6096618 m & E 624942 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 21.561 m 8/21/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, medium to coarse grained, dry, dense, stratified |
| | | | | | GRAVELLY SILT WITH SAND, SOME COBBLES, light brown, well graded, medium to coarse grained, dry, very dense, stratified, [Glacial Till] |
| | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, medium to coarse grained, dry, dense, lensed |
| 5 | | | | | GRAVELLY SILT WITH SAND, light brown, well graded, medium to coarse grained, dry, dense, stratified |
| 10 | | | | | POORLY GRADED SAND, light brown, medium grained, dry, medium dense, homogeneous, [Alluvium] |
| | | | | | SILTY SAND, SOME GRAVEL, light brown, well graded, medium to coarse grained, moist, medium dense, stratified |
| 15 | | | | | SILT WITH GRAVEL, light brown, well graded, fine to coarse grained, moist, medium dense, stratified |
| | | | | | SANDY SILT, light brown, well graded, medium to coarse grained, moist, dense, stratified |
| | | | | | GRAVELLY SILT AND SAND, light brown, well graded, coarse grained, moist, dense, lensed |
| 20 | | | | | POORLY GRADED SAND, light brown, medium grained, wet, dense, homogeneous |
| 25 | | | | | |




Bottom of hole at 25.10 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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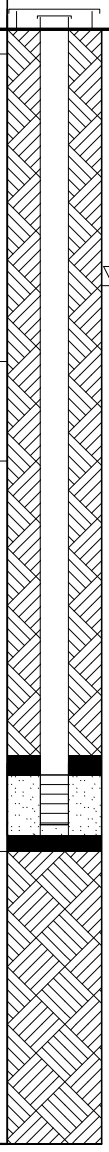
# Borehole # MW-H24A



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 10/13/12 **COMPLETED** 10/20/12
**CASING (TOC) ELEVATION** 832 m **HOLE SIZE** 0.076 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (NQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6099756 m & E 628116 m
**AT TIME OF DRILLING** ---
**NOTES** Very slow groundwater recharge. High pH level.
**AFTER DRILLING** 15.44 m 7/30/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SAND WITH SILT AND GRAVEL, ORGANICS, brown, well graded, subrounded, fine to coarse grained, moist, dense, stratified, [Glacial Till] |
| 5 | | | II | | SILTSTONE, slightly weathered, massive, dark grey, fine, medium hard, [Hasler Formation] Layer RQD = 80% |
| 20 | | | I | | SILTSTONE AND MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, hard, Layer RQD = 65% |
| 25 | | | I | | SILTSTONE AND MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, Layer RQD = 85% |
| 45 | | | I | | |
| 50 | | | | | SILTSTONE AND SANDSTONE, unweathered, interbedded, dark grey, medium, very hard, Layer RQD = 90% |
| 65 | | | | | Bottom of hole at 67.10 m. |

WELL DIAGRAM



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# Borehole # MW-H24B



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 10/20/12 **COMPLETED** 10/20/12
**CASING (TOC) ELEVATION** 832 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6099756 m & E 628119 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 3.96 m 7/30/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | SAND WITH SILT AND GRAVEL, ORGANICS, brown, subrounded, fine to coarse grained, moist, dense, stratified, [Glacial Till] |
| | | | II | | SILTSTONE, slightly weathered, massive, light grey, fine, hard, [Hasler Formation] Layer RQD = 80% |
| 5 | | | | | |

WELL DIAGRAM




Bottom of hole at 8.60 m.

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# Borehole # MW-H24C



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 7/20/13 **COMPLETED** 7/20/13
**CASING (TOC) ELEVATION** 825 m **HOLE SIZE** 0.096 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (HQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6099625 m & E 627954 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 1.595 m 7/30/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | GRAVELLY ORGANIC SOIL, dark brown, well graded, angular, fine to coarse grained, dry, loose |
| | | | | | SILT, light brown, poorly graded, fine grained, moist, loose, homogeneous |
| 5 | | | | | CLAYEY SILT, pale grey, fine grained, moist, firm |
| 10 | | | III | | MUDSTONE, moderately weathered, massive, dark gray, very fine, medium hard, wide fracture spacing, Layer RQD = 65% |

WELL DIAGRAM

Stickup 0.92 m
Concrete 0-0.3 m
Bentonite Pellets 0.3-8.8 m
Filter Sand 8.8-13.7 m
Screen 9.2-12.3 m

Bottom of hole at 13.72 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H25A



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 10/22/12 **COMPLETED** 10/31/12
**CASING (TOC) ELEVATION** 766 m **HOLE SIZE** 0.076 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (NQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6099615 m & E 627334 m
**AT TIME OF DRILLING** ---
**NOTES** Turbid water column.
**AFTER DRILLING** 2.074 m 7/30/2013 measured from surface

| Depth (m) | Material Description |
|---|---|
| 0 | GRAVELLY ORGANIC SOIL, light brown, well graded, angular, fine to coarse grained, dry, dense, stratified, [Road Base] |
| 5 | HOG FUEL, orange, moist, loose |
| | SILT, dark brown, poorly graded, moist, firm, homogeneous |
| | CLAYEY GRAVEL AND SAND, pale grey, well graded, subrounded, fine to coarse grained, moist, medium dense, stratified |
| 10 | SILTY CLAY, grey, moist, stiff, homogeneous, [Glaciolacustrine Deposit] |
| 60 | MUDSTONE WITH SANDSTONE, slightly weathered, interbedded, dark grey, very fine, [Hasler Formation] Layer RQD = 60% |
| 65 | MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, very fine, Layer RQD = 75% |

WELL DIAGRAM: Stickup 0.70 m; Cement Grout 0-56.8 m; Bentonite Pellets 56.8-58.2 m; Filter Sand 58.2-62 m; Screen 58.9-62 m; Bentonite Plug 62-64 m; Grout 64-80 m

Bottom of hole at 80.00 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H25B

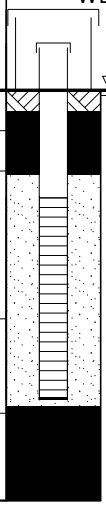


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 10/22/12 **COMPLETED** 10/22/12
**CASING (TOC) ELEVATION** 766 m **HOLE SIZE** 0.105 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Solid Stem Auger
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6099615 m & E 627332 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 0.076 m 7/30/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | GRAVELLY ORGANIC SOIL, light brown, well graded, angular, fine to coarse grained, dry, medium dense, stratified, [Road Base] |
| | | | | | HOG FUEL, orange, moist |
| | | | | | SILT, dark brown, poorly graded, moist, firm, homogeneous |
| | | | | | CLAYEY GRAVEL AND SAND, pale grey, well graded, subrounded, fine to coarse grained, moist, dense, stratified |
| 5 | | | | | SILTY CLAY, grey, moist, stiff, homogeneous, [Glaciolacustrine Deposit] |

Bottom of hole at 6.10 m.

WELL DIAGRAM



Stickup 0.70 m
Concrete 0-0.3 m
Bentonite Chips 0.3-1.3 m
Filter Sand 1.3-4.7 m
Screen 1.6-4.6 m
Bentonite 4.7-6.1 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H26A



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 10/23/12 **COMPLETED** 10/28/12
**CASING (TOC) ELEVATION** 792 m **HOLE SIZE** 0.076 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (NQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6098990 m & E 627478 m
**AT TIME OF DRILLING** ---
**NOTES** Turbid water column.
**AFTER DRILLING** 0.395 m 7/30/2013 measured from sufrace

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | GRAVELLY ORGANIC SOIL, light brown, well graded, angular, fine to coarse grained, dry, dense, [Road Base] |
| 5 | | | | | SILTY SAND WITH GRAVEL, brown, well graded, subrounded, fine to coarse grained, dry, dense, stratified |
| | | | | | SANDY SILT WITH GRAVEL, brown, well graded, subrounded, fine to coarse grained, moist, dense, stratified |
| 10 | | | | | SILTY CLAY, grey, moist, stiff, homogeneous, [Glaciolacustrine Deposit] |
| 15 | | | | | |
| 20 | | | | | |
| 25 | | | | | |
| 30 | | | I | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, hard, [Hasler Formation] Layer RQD = 90% |
| 35 | | | | | |
| 40 | | | | | |
| 45 | | | | | |
| 50 | | | | | |
| 55 | | | | | |
| 60 | | | | | |

WELL DIAGRAM

Stickup 0.78 m

Cement Grout
0-28.4 m

Bentonite
Pellets
28.4-29.2 m
Filter Sand
29.2-33.0 m
Screen
29.8-32.9 m
Bentonite Plug
35-36 m
Sand 36-39.6 m

Grout 39.6-64.3
m

Bottom of hole at 64.30 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H26B

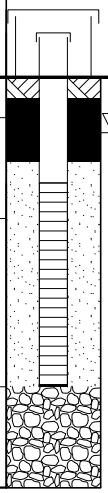


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 10/27/12 **COMPLETED** 10/28/12
**CASING (TOC) ELEVATION** 792 m **HOLE SIZE** 0.105 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Solid Stem Auger
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6098987 m & E 627485 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 0.826 m 7/30/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | GRAVELLY ORGANIC SOIL, light brown, well graded, angular, fine to coarse grained, dry, dense, [Road base] |
| | | | | | SILTY SAND WITH GRAVEL, brown, well graded, fine to coarse grained, dry, medium dense, stratified |
| | | | | | SILT WITH GRAVEL, brown, well graded, fine to coarse grained, moist, firm, blocky |
| 5 | | | | | SILTY CLAY, grey, fine grained, moist, stiff, homogeneous, [Glaciolacustrine Deposit] |

Bottom of hole at 6.10 m.

WELL DIAGRAM



Stickup 0.65 m
Concrete 0-0.3 m
Bentonite Chips 0.3-1.25 m
Filter Sand 1.3-4.6 m
Screen 1.6-4.6 m
Slough 4.6-6.1 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H27



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 7/22/13 **COMPLETED** 7/23/13
**CASING (TOC) ELEVATION** 810 m **HOLE SIZE** 0.096 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (HQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6098578 m & E 627607 m
**AT TIME OF DRILLING** ---
**NOTES** Turbid water column.
**AFTER DRILLING** 9.895 m 7/31/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | ORGANIC SOIL, dark brown, fine to coarse grained, dry |
| | | | | | SILT, light yellow, medium grained, moist, loose, homogeneous |
| | | | | | SILTY CLAY, dark grey, fine to medium grained, moist, firm |
| 5 | | | | | |
| | | | | | SITLY CLAY, SANDY, dark grey, fine to coarse grained, moist, stiff, uniformly bedded fine sand lenses |
| | | | | | SITLY CLAY, dark grey, fine grained, moist, very stiff |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |
| 25 | | | | | |
| 30 | | | I | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, very fine to fine, medium hard, medium fracture spacing, [Hasler Formation] Layer RQD = 65% fracture zone |
| 35 | | | | | |

WELL DIAGRAM

Stickup 0.47 m
Concrete 0-0.3 m
Bentonite Grout
Bentonite Pellets 33.1-34 m
Filter Sand 34-37.63 m
Screen 34.6-37.6 m

Bottom of hole at 39.20 m.

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# Borehole # MW-H28



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 7/24/13 **COMPLETED** 7/27/13
**CASING (TOC) ELEVATION** 819 m **HOLE SIZE** 0.096 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (HQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6098772 m & E 627715 m
**AT TIME OF DRILLING** ---
**NOTES** Turbid water column and slow well recovery.
**AFTER DRILLING** 4.878 m 7/31/2013 measured from sufrace

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | ORGANIC SOIL, light brown, fine to coarse grained, dry, loose |
| | | | | | SILTY SAND, light yellow, well graded, fine to medium grained, moist, dense |
| 5 | | | II | | SILTY CLAY, dark grey, fine grained, moist, very stiff |
| 10 | | | | | |
| 15 | | | I | | MUDSTONE WITH SANDSTONE, slightly weathered, interbedded, dark grey, fine, medium hard, medium fracture spacing, 15° bedding angle, [Hasler Formation] Layer RQD = 70% fractured with clay infil |
| | | | | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, Layer RQD = 100% competent zone |
| 20 | | | | | |
| 25 | | | | | |
| 30 | | | | | |
| 35 | | | | | |
| 40 | | | | | |
| 45 | | | | | Close fracture spacing, Layer RQD = 20% fracture zone with clay infill |
| | | | | | Layer RQD = 100% competent zone |
| 50 | | | | | Wide fracture spacing, Layer RQD = 100% long vertical fractures with some clay infill |
| | | | | | Layer RQD = 100% competent zone |
| 55 | | | | | |
| 60 | | | | | |
| | | | I | | SILTSTONE WITH SANDSTONE, unweathered, interbedded, light grey, fine to medium, very hard, 15° bedding angle, Layer RQD = 100% competent zone |
| 65 | | | | | |
| 70 | | | | | |
| 75 | | | | | |
| | | | | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, 15° bedding angle, [Hasler Formation] Layer RQD = 100% competent zone |
| 80 | | | | | |
| 85 | | | | | |
| 90 | | | | | |

WELL DIAGRAM

Stickup 0.7 m
Concrete 0-0.3 m
Bentonite Grout 0-28.4 m
Bentonite Pellets28.4-29.2 m
Filter Sand 13.4-17.1 m
Screen 13.9-17 m
Bentonite Plug 18.2-20 m
Van Ruth Plug 20 m
Open Hole 20.1-93.3 m

Bottom of hole at 93.27 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H29



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 7/27/13 **COMPLETED** 8/1/13
**CASING (TOC) ELEVATION** 826 m **HOLE SIZE** 0.096 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (HQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6099198 m & E 627938 m
**AT TIME OF DRILLING** ---
**NOTES** Turbid water column.
**AFTER DRILLING** 4.878 m 7/31/2013 measured from sufrace

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | ORGANIC SOIL, light brown, fine to coarse grained, dry, loose |
| 5 | | | III | | POORLY GRADED SAND, light yellow, coarse grained, moist, dense |
| | | | | | SILTY SAND, GRAVELLY, dark yellow, coarse grained, moist, dense |
| 10 | | | II | | MUDSTONE WITH SANDSTONE, moderately weathered, interbedded, dark grey, fine, medium hard, very close fracture spacing, 15° bedding angle, [Hasler Formation] Layer RQD = 20% fracture zone with clay infil |
| 15 | | | | | MUDSTONE WITH SANDSTONE, slightly weathered, interbedded, dark grey, fine, very hard, close fracture spacing, Layer RQD = 30% fractured with clay infil |
| 20 | | | | | Close fracture spacing, Layer RQD = 90% competent zone |
| | | | I | | SILTSTONE WITH SANDSTONE, unweathered, interbedded, light grey, medium, very hard, wide fracture spacing, 15° bedding angle, Layer RQD = 85% some fractures |
| 25 | | | | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, wide fracture spacing, Layer RQD = 95% competent zone |
| 30 | | | | | Layer RQD = 100% competent zone |
| 35 | | | | | |
| 40 | | | | | |
| 45 | | | | | |
| 50 | | | I | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, [Hasler Formation] Layer RQD = 100% competent zone to bottom of hole |
| 55 | | | | | |
| 60 | | | | | |
| 65 | | | | | |
| 70 | | | | | |
| 75 | | | | | |
| 80 | | | | | |
| 85 | | | | | |
| 90 | | | | | |
| 95 | | | | | |

WELL DIAGRAM

Stickup 0.7 m
Concrete 0-0.3 m
Bentonite Pellets 0.3-7.7 m
Filter Sand 7.7-11.6 m
Screen 8.3-11.3 m
Bentonite Plug 11.6-13.1 m
Van Ruth Plug 13.1 m
Open Hole 13.2-98.5 m

Bottom of hole at 98.45 m.

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# Borehole # MW-H2A



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/13/11 **COMPLETED** 5/14/11
**CASING (TOC) ELEVATION** 1104.341 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** J. Castaneda **UTM** 10U, N 6101837 m & E 620575 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 9.495 m 8/23/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | GRAVELLY SILT WITH SAND, brown, well graded, subrounded, fine to coarse grained, moist, dense, stratified, [Glacial Till] |
| 15 | | | III | | MUDSTONE AND SILTSTONE, moderately weathered, massive, dark grey, fine, hard, [Hasler Formation] |
| 90 | | | | | Bottom of hole at 90.80 m. |

WELL DIAGRAM

Stickup 1.19 m

Grout 0-81

Bentonite 81-82.3 m

Filter Sand 82.3-88 m

Screen 83.4-88 m

Bentonite 88.1-89.3 m

Slough 89.3-90.8 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H2B

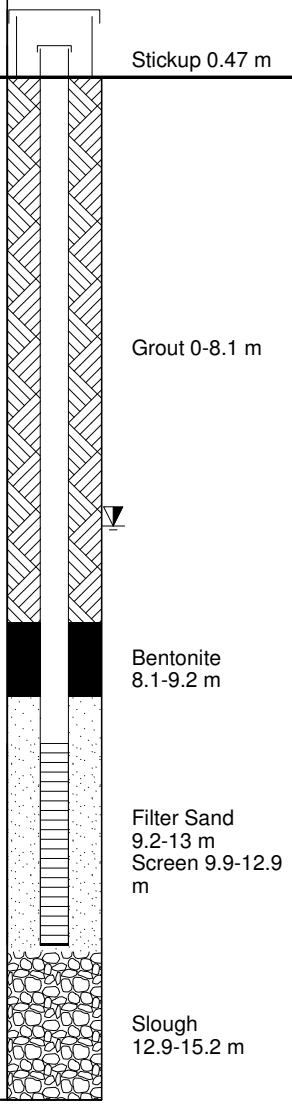


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/13/11 **COMPLETED** 5/13/11
**CASING (TOC) ELEVATION** 1103.37 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** J. Castaneda **UTM** 10U, N 6101831 m & E 620567 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 6.67 m 8/23/2012 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | GRAVELLY SILT WITH SAND, brown, well graded, subrounded, fine to coarse grained, moist, dense, stratified, [Glacial Till] |
| 5 | | | | | |
| 10 | | | | | |
| 15 | | | | | |

Bottom of hole at 15.20 m.

WELL DIAGRAM



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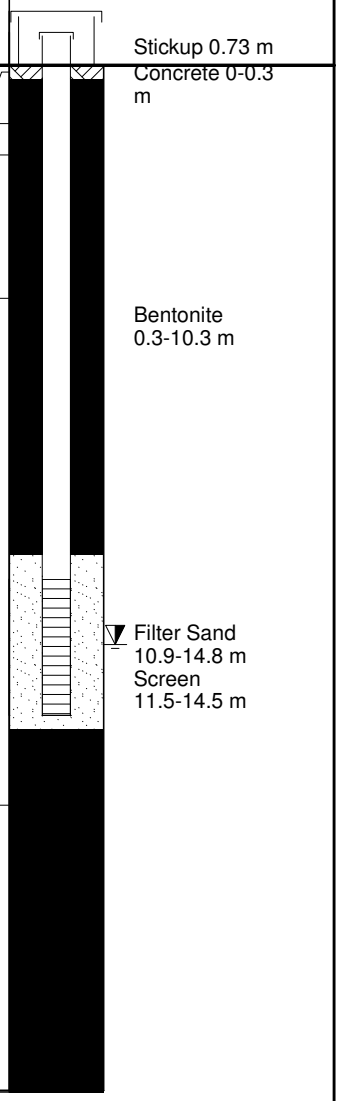
# Borehole # MW-H30



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 7/21/13 **COMPLETED** 7/23/13
**CASING (TOC) ELEVATION** 793 m **HOLE SIZE** 0.096 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (HQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6098501 m & E 627372 m
**AT TIME OF DRILLING** ---
**NOTES** Very slow groundwater recharge. Water level measurements only.
**AFTER DRILLING** 12.914 m 7/31/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | ORGANIC SOIL, dark brown, fine to coarse grained, dry |
| | | | | | POORLY GRADED SAND, light yellow, fine to medium grained, moist, loose, homogeneous |
| | | | | | POORLY GRADED SAND, dark yellow, medium to coarse grained, moist, dense |
| | | | | | SITLY CLAY, GRAVELLY, dark grey, fine to coarse grained, stiff |
| 5 | | | | | SITLY CLAY, dark grey, fine grained, very stiff |
| 10 | | | | | |
| 15 | | | I | | MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, very fine to fine, medium hard, very wide fracture spacing, [Hasler Formation] Layer RQD = 100% |
| 20 | | | | | |

WELL DIAGRAM




Bottom of hole at 22.86 m.

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# Borehole # MW-H31

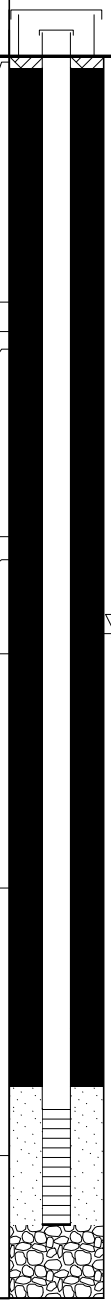


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 7/18/13 **COMPLETED** 7/19/13
**CASING (TOC) ELEVATION** 798 m **HOLE SIZE** 0.096 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (HQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6099893 m & E 627456 m
**AT TIME OF DRILLING** ---
**NOTES** Very slow groundwater recharge. Water level measurements only.
**AFTER DRILLING** 15.02 m 7/31/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | ORGANIC SOIL, dark brown, fine to coarse grained, dry |
| | | | | | TILL, brown, medium to coarse grained, moist, dense |
| 5 | | | | | |
| | | | | | SILT, light grey, fine grained, moist, very stiff, homogeneous |
| | | | | | SILT WITH GRAVEL, light grey, fine to coarse grained, moist, hard |
| | | | | | SILT, light brown, fine grained, moist, very stiff, homogeneous |
| 10 | | | | | |
| | | | II | | SANDSTONE, slightly weathered, dark yellow, medium to coarse, medium hard |
| | | | | | SITLY CLAY, dark brown, fine to medium grained, moist, very stiff |
| 15 | | | | | |
| | | | | | SITLY CLAY, GRAVELLY, brown, fine to coarse grained, dry, very dense |
| 20 | | | | | |
| | | | | | SITLY CLAY, dark brown, fine to medium grained, moist, very stiff |
| 25 | | | | | |
| | | | | | SITLY CLAY, dark brown, fine to medium grained, moist, very stiff, bedded fine sand lenses |
| 30 | | | | | |

Bottom of hole at 32.31 m.

WELL DIAGRAM




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# Borehole # MW-H32



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 7/17/13 **COMPLETED** 7/18/13
**CASING (TOC) ELEVATION** 840 m **HOLE SIZE** 0.096 m
**DRILLING CONTRACTOR** MudBay Drilling Co. Ltd.
**CASING TYPE** Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (HQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Martinka **UTM** 10U, N 6099810 m & E 628333 m
**AT TIME OF DRILLING** ---
**NOTES** Very slow groundwater recharge. Water level measurements only.
**AFTER DRILLING** 10.401 m 7/31/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | GRAVELLY ORGANIC SOIL, dark brown, well graded, fine to coarse grained, dry, dense |
| | | | | | TILL, light brown, well graded, medium to coarse grained, moist, very dense |
| 10 | | | II | | SILTSTONE, slightly weathered, light grey, fine, medium hard, medium fracture spacing, Layer RQD = 65% |
| 15 | | | II | | SILTSTONE WITH MUDSTONE, unweathered, interbedded, dark grey, fine to very fine, hard, very wide fracture spacing, 0° bedding angle, Layer RQD = 75% fracture zone 17.4-19.8 m |
| 20 | | | I | | SILTSTONE WITH SANDSTONE, unweathered, interbedded, light grey, fine to medium, medium hard, medium fracture spacing, 0° bedding angle, Layer RQD = 100% |
| 30 | | | | | Bottom of hole at 30.48 m. |

WELL DIAGRAM

Stickup 0.37 m
Concrete 0-0.3 m
Bentonite Grout 0.3-25.2
Bentonite Pellets 25.2-26.5 m
Filter Sand 26.5-30.1 m
Screen 27.1-30.1 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H3A



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/15/11 **COMPLETED** 5/15/11
**CASING (TOC) ELEVATION** 1215.7 m **HOLE SIZE** 0.076 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.025 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Diamond (NQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** J. Castaneda **UTM** 10U, N 6102191 m & E 621818 m
**AT TIME OF DRILLING** ---
**NOTES** Site no longer accessible.
**AFTER DRILLING** 26.25 m 7/7/2011 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, rounded, fine to coarse grained, dry, dense, stratified, [Glacial Till] |
| 30 | | | II | | SILTSTONE AND MUDSTONE WITH SANDSTONE, slightly weathered, interbedded, light brown, fine, hard, [Boulder Creek] |

WELL DIAGRAM

Stickup 0.45 m

Grout 0-165 m

Bentonite 165-170 m

Filter Sand 170-193 m
Screen 183-193 m

Bentonite Seal 193-200m

Bottom of hole at 200.00 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-H3B



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 5/18/11 **COMPLETED** 5/18/11
**CASING (TOC) ELEVATION** 1215.7 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** J. Castaneda **UTM** 10U, N 6102191 m & E 621818 m
**AT TIME OF DRILLING** ---
**NOTES** Site no longer accessible.
**AFTER DRILLING** 0.93 m 7/7/2011 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, rounded, fine to coarse grained, dry to moist, dense, stratified, [Glacial Till] |

WELL DIAGRAM

Stickup 0.45 m

Grout 0-3 m

Bentonite 3-4.5 m

Filter Sand 4.5-8.8 m

Screen 5.3-8.5 m

Bottom of hole at 8.80 m.

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# Borehole # MW-H5



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 4/22/11 **COMPLETED** 4/22/11
**CASING (TOC) ELEVATION** 1102.5 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Hughes **UTM** 10U, N 6100571 m & E 620658 m
**AT TIME OF DRILLING** ---
**NOTES** Flowing artesian well.
**AFTER DRILLING** -0.68 m 8/22/2012 Flowing

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| | | | | | SILTY SAND WITH GRAVEL, light brown, well graded, subrounded, fine to coarse grained, dry, loose, stratified, [Glacial Till] |
| 25 | | | | | SILTY CLAY, dark grey, moist, stiff, homogeneous, [Glaciolacustrine Deposit] |
| 30 | | | | | WELL GRADED GRAVEL WITH SAND, brown to black, subangular, medium to coarse grained, dense, stratified |

WELL DIAGRAM

Stickup 0.68 m

Grout 0-25.2 m

Bentonite
25.2-26.2 m

Filter Sand
26.15-30.5 m

Screen
27.5-30.5 m

Bottom of hole at 30.50 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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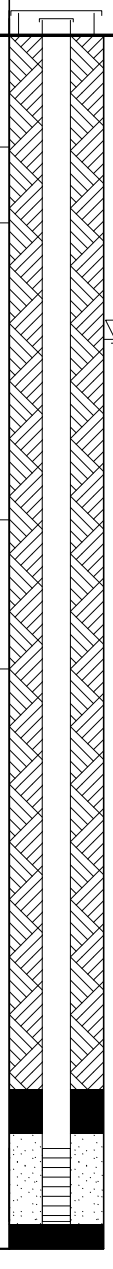
# Borehole # MW-PNB



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 4/30/11 **COMPLETED** 4/30/11
**CASING (TOC) ELEVATION** 778.853 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Hughes **UTM** 10U, N 6097114 m & E 625101 m
**AT TIME OF DRILLING** ---
**NOTES**
**AFTER DRILLING** 12.435 m 7/21/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SILTY SAND WITH GRAVEL, brown, well graded, rounded, fine to coarse grained, moist, loose, stratified, [Glacial Till] |
| 5 | | | | | SILT WITH GRAVEL, brown, well graded, subrounded, fine to coarse grained, moist, medium dense, stratified |
| 10 | | | | | SILTY SAND WITH GRAVEL, brown, well graded, rounded, fine to coarse grained, moist, dense, stratified |
| 20 | | | | | GRAVELLY SAND, brown, well graded, subrounded, medium to coarse grained, moist, medium dense, stratified |
| 25 | | | | | SILTY SAND WITH GRAVEL, dark brown, well graded, rounded, fine to coarse grained, wet, dense, stratified |
| 45 | | | | | Bottom of hole at 49.60 m. |

WELL DIAGRAM



Stickup 1.14 m
Grout 0-43.1
Bentonite 43.1-44.9 m
Filter Sand 44.9-48.6 m
Screen 45.5-48.5 m
Bentonite Plug 48.6-49.6 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # MW-Shaft

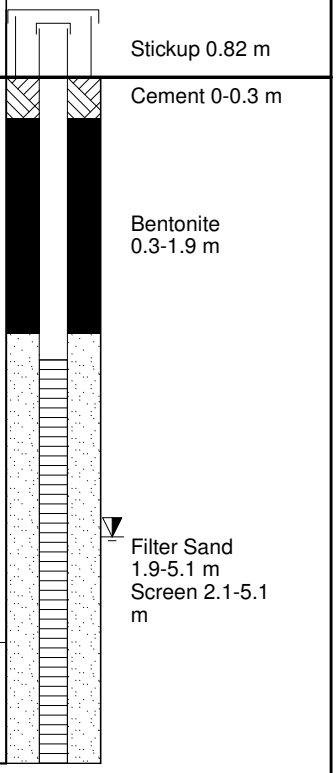


**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 7/9/11 **COMPLETED** 7/9/11
**CASING (TOC) ELEVATION** 846.032 m **HOLE SIZE** 0.11 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** Diameter 0.025 m Schedule 40 PVC. Slot size 10 screen.
**DRILLING METHOD** Air Rotary
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Hughes **UTM** 10U, N 6098150 m & E 625176 m
**AT TIME OF DRILLING** ---
**NOTES** Damaged well casing. Water level measurements only.
**AFTER DRILLING** 3.415 m 7/23/2013 measured from surface

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SILTY SAND WITH GRAVEL, brown, well graded, subrounded, fine to coarse grained, moist, loose, stratified, [Glacial Till] |
| 4 | | | | | SILT WITH GRAVEL, brown, well graded, rounded, fine to coarse grained, moist, medium dense, stratified |

Bottom of hole at 5.10 m.

WELL DIAGRAM




ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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# Borehole # VWP-H12



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 4/1/11 **COMPLETED** 4/1/11
**CASING (TOC) ELEVATION** 1120.8 m **HOLE SIZE** 0.076 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** No casing
**DRILLING METHOD** Diamond (NQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Hughes **UTM** 10U, N 6100659 m & E 624446 m
**AT TIME OF DRILLING** ---
**NOTES** Vibrating Wire Piezometer (VWP), 1.0 MPa and 2.0 MPa
**AFTER DRILLING** 24.19 m 8/24/2012 measured from surface (1.0 MPa)

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | | | SILTY SAND WITH GRAVEL, brown, well graded, rounded, medium to coarse grained, moist, dense, stratified, [Glacial Till] |
| 15 | | | III | | SILTSTONE, moderately weathered, massive, dark grey, fine, hard, [Hasler Formation] |
| 115 | | | I | | MUDSTONE AND SILTSTONE, unweathered, massive, dark grey, fine, very hard, [Boulder Creek] |
| 250 | | | | | Bottom of hole at 250.00 m. |

WELL DIAGRAM

0 - 0.3 m
Concrete

0.3 - 113.5 m
Grout

113.5 - 115 m
Bentonite
116 m 1.0 MPa
VWP

116.3 - 207.5 m
Grout

207.5 - 209
Bentonite
210 m 2.0 MPa
VWP
Van Ruth Plug
210.5 - 250 m
Grout

Rescan Environmental Services Ltd.
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Vancouver, B.C., V6E 2J3 Canada

# Borehole # VWP-H7



**CLIENT** HD Mining Ltd.
**PROJECT NAME** Environmental Baseline - Murray River Coal Project
**PROJECT NUMBER** 0194106-0002-0005
**PROJECT LOCATION** 12 km south of Tumbler Ridge, BC
**DATE STARTED** 4/1/11 **COMPLETED** 4/1/11
**CASING (TOC) ELEVATION** 1131.5 m **HOLE SIZE** 0.076 m
**DRILLING CONTRACTOR** Canadian Dehua Drilling
**CASING TYPE** No casing
**DRILLING METHOD** Diamond (NQ) Triple Tube Coring
**GROUNDWATER LEVELS:**
**LOGGED BY** R. Hughes **UTM** 10U, N 6100782 m & E 622015 m
**AT TIME OF DRILLING** ---
**NOTES** Vibrating Wire Piezometer (VWP), 1.0 MPa and 2.0 MPa
**AFTER DRILLING** 2.88 m 8/24/2012 measured from surface (1.0 MPa)

| Depth (m) | Sample Type | Sample Number | Weathering Grade | Graphic Log | Material Description |
|---|---|---|---|---|---|
| 0 | | | II | | SILTY SAND WITH GRAVEL, brown, well graded, rounded, fine to coarse grained, moist, dense, stratified, [Glacial Till] |
| | | | | | SILTSTONE, slightly weathered, massive, dark grey, fine, very hard, Hasler Formation |
| | | | I | | MUDSTONE AND SILTSTONE, unweathered, massive, dark grey, fine, very hard, Boulder Creek Formation |

WELL DIAGRAM

- 0 - 0.3 m Concrete
- 0.3 - 90.5 m Grout
- 90.5 - 92 m Bentonite
  92.5 m 1.0 MPa VWP
- 92.3 - 207.5 m Grout
- 207.5 - 209 Bentonite
  210 m 2.0 MPa VWP
  Van Ruth Plug
  210.5 - 250 m Grout

Bottom of hole at 250.00 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

# Appendix C

## Hydraulic Conductivity Tables and Analysis Reports

ERM

## Appendix C. Hydraulic Conductivity Tables and Analysis Reports

### Hydraulic Conductivity Estimates Derived from Single Well Response Tests

| Monitoring Well ID | Date Tested | General Area | Formation | Vertical Depths Below Ground | | | Hydraulic Conductivity (m/s) |
|---|---|---|---|---|---|---|---|
| | | | | Top of Tested Interval (mbg) | Bottom of Tested Interval (mbg) | Vertical Tested Length (mbg) | |
| MW-H2A | 10-Jul-11 | Camp Ck. Basin | Hasler | 83.4 | 88.0 | 4.6 | 1.1E-07 |
| MW-H2B | 10-Jul-11 | Camp Ck. Basin | Overburden | 9.9 | 12.9 | 3.0 | 2.2E-07 |
| MW-H5 | 9-Jul-11 | Camp Ck. Basin | Overburden | 27.5 | 30.5 | 3.0 | 2.2E-06 |
| MW-H20 | 9-Jul-11 | Camp Ck. Basin | Hasler | 37.8 | 40.8 | 3.0 | 2.0E-08 |
| MW-H17 | 22-Aug-12 | Underground Mine Zone | Overburden | 5.5 | 8.5 | 3.0 | 2.0E-06 |
| MW-H18 | 23-Aug-12 | Underground Mine Zone | Hasler | 10.5 | 13.5 | 3.0 | 2.3E-06 |
| MW-H19 | 25-Aug-12 | Underground Mine Zone | Overburden | 5.7 | 8.7 | 3.0 | 6.0E-09 |
| MW-H22 | 21-Aug-12 | Underground Mine Zone | Overburden | 22.1 | 25.1 | 3.0 | 7.0E-07 |
| MW-H23 | 21-Jul-13 | Underground Mine Zone | Overburden | 22.1 | 25.1 | 3.0 | 4.4E-04 |
| MW-H24A | 19-Dec-12 | CCR Site | Hasler | 44.9 | 47.9 | 3.0 | 4.0E-08 |
| MW-H24B | 24-Oct-12 | CCR Site | Hasler | 5.6 | 8.6 | 3.0 | 1.0E-06 |
| MW-H24C | 21-Jul-13 | CCR Site | Hasler | 9.3 | 12.3 | 3.0 | 9.0E-07 |
| MW-H25A | 21-Jul-13 | CCR Site | Hasler | 59.0 | 62.0 | 3.0 | 4.0E-07 |
| MW-H25B | 24-Oct-12 | CCR Site | Overburden | 1.6 | 4.6 | 3.0 | 7.0E-07 |
| MW-H26A | 21-Jul-13 | CCR Site | Hasler | 29.9 | 32.9 | 3.0 | 2.0E-06 |
| MW-H26B | 31-Oct-12 | CCR Site | Overburden | 1.6 | 4.6 | 3.0 | 1.0E-08 |
| MW-H27 | 28-Jul-13 | CCR Site | Hasler | 34.6 | 37.6 | 3.0 | 2.0E-07 |
| MW-H28 | 1-Aug-13 | CCR Site | Hasler | 14.0 | 17.0 | 3.0 | 1.0E-07 |
| MW-H29 | 1-Aug-13 | CCR Site | Hasler | 8.3 | 11.3 | 3.0 | 9.0E-08 |
| MW-H30 | 24-Jul-13 | CCR Site | Overburden | 11.5 | 14.5 | 3.0 | 4.0E-09 |
| MW-H31 | 21-Jul-13 | CCR Site | Overburden | 27.4 | 30.4 | 3.0 | 2.0E-08 |
| MW-H32 | 22-Jul-13 | CCR Site | Hasler | 27.1 | 30.1 | 3.0 | 2.0E-09 |

## Appendix C. Hydraulic Conductivity Tables and Analysis Reports

### Hydraulic Conductivity Estimates Derived from Falling-Head Packer Tests

| Monitoring Well ID | Date Tested | General Area | Formation | Vertical Depths Below Ground | | | Hydraulic Conductivity (m/s) |
|---|---|---|---|---|---|---|---|
| | | | | Top of Tested Interval (mbg) | Bottom of Tested Interval (mbg) | Vertical Tested Length (m) | |
| MW-H2A Zone 1 | 10-May-2011 | Camp Ck. Basin | Hasler | 30.5 | 91.5 | 61.0 | 2.0E-07 |
| MW-H2A Zone 2 | | Camp Ck. Basin | Hasler | 45.7 | 91.5 | 45.8 | 1.9E-07 |
| MW-H20 Zone 1 | 21-May-2011 | Camp Ck. Basin | Hasler | 72.6 | 100.7 | 28.1 | 4.1E-08 |
| MW-H20 Zone 2 | | Camp Ck. Basin | Hasler | 57.4 | 62.0 | 4.6 | 1.8E-06 |
| MW-H24A Zone 1 | 15-Oct-2012 | CCR Site | Hasler | 9.8 | 25.0 | 15.2 | 6.0E-06 |
| MW-H24A Zone 2 | | CCR Site | Hasler | 25.3 | 38.4 | 13.1 | 4.0E-08 |
| MW-H24A Zone 3 | 19-Oct-2012 | CCR Site | Hasler | 38.4 | 54.6 | 16.2 | 9.0E-07 |
| MW-H24A Zone 4 | | CCR Site | Hasler | 54.3 | 67.1 | 12.8 | 4.0E-06 |
| MW-H25A Zone 1 | 31-Oct-2012 | CCR Site | Hasler | 58.5 | 69.2 | 10.7 | 4.0E-07 |
| MW-H25A Zone 2 | | CCR Site | Hasler | 69.2 | 79.9 | 10.7 | 1.0E-08 |
| MW-H26A Zone 1 | 26-Oct-2012 | CCR Site | Hasler | 34.1 | 48.5 | 14.4 | 7.0E-08 |
| MW-H26A Zone 2 | 27-Oct-2012 | CCR Site | Hasler | 49.7 | 64.3 | 14.6 | 7.0E-07 |
| MW-H27 Zone 1 | 23-Jul-2013 | CCR Site | Hasler | 32.8 | 39.2 | 6.4 | 2.0E-07 |
| MW-H28 Zone 1 | 24-Jul-2013 | CCR Site | Hasler | 13.3 | 18.6 | 5.3 | 3.0E-06 |
| MW-H28 Zone 2 | 24-Jul-2013 | CCR Site | Hasler | 19.1 | 26.8 | 7.7 | 2.0E-08 |
| MW-H28 Zone 3 | 25-Jul-2013 | CCR Site | Hasler | 27.3 | 41.8 | 14.5 | 6.0E-09 |
| MW-H28 Zone 4 | 26-Jul-2013 | CCR Site | Hasler | 42.2 | 56.7 | 14.5 | 9.0E-08 |
| MW-H28 Zone 5 | 26-Jul-2013 | CCR Site | Hasler | 57.5 | 76.5 | 19.0 | 6.0E-08 |
| MW-H28 Zone 6 | 27-Jul-2013 | CCR Site | Hasler | 77.3 | 93.3 | 16.0 | 4.0E-09 |
| MW-H29 Zone 1 | 28-Jul-2013 | CCR Site | Hasler | 5.8 | 8.8 | 3.0 | 7.0E-07 |
| MW-H29 Zone 2 | 28-Jul-2013 | CCR Site | Hasler | 9.6 | 24.4 | 14.8 | 3.0E-07 |
| MW-H29 Zone 3 | 28-Jul-2013 | CCR Site | Hasler | 25.1 | 39.6 | 14.5 | 9.0E-09 |
| MW-H29 Zone 4 | 29-Jul-2013 | CCR Site | Hasler | 40.4 | 59.4 | 19.0 | 2.0E-09 |
| MW-H29 Zone 5 | 29-Jul-2013 | CCR Site | Hasler | 58.7 | 77.7 | 19.0 | 9.0E-10 |
| MW-H29 Zone 6 | 30-Jul-2013 | CCR Site | Hasler | 78.5 | 98.5 | 20.0 | 2.0E-09 |
| MW-H30 Zone 1 | 22-Jul-2013 | CCR Site | Hasler | 19.1 | 22.9 | 3.8 | 2.0E-08 |

**Hole #:** MW- H2A
**Test #:** 2

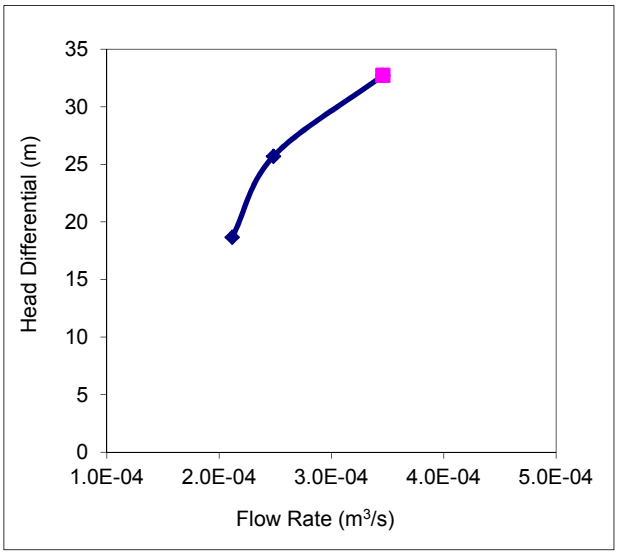
**Input Parameters**

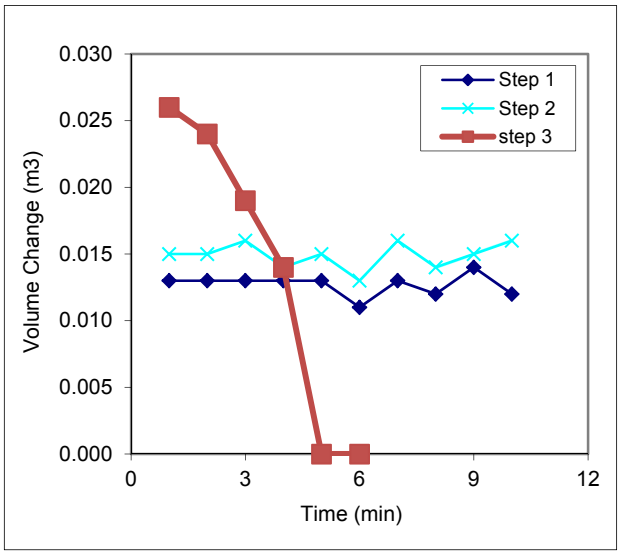
| | |
|---|---|
| Top of Packer Test Interval (mah): | 30.0 |
| Bottom of Packer Test Interval (mah): | 91.0 |
| **L**: Length of Test Interval (mah) | 61.0 |
| Test Interval Midpoint (mah): | 61 |
| Stickup Height (mah): | 1.40 |
| Pressure Gauge Height (m above ground): | 1.40 |
| Depth to Water Table (mah): | 4.60 |
| Borehole Diameter (mm): | 96.0 |
| **r**: Borehole Radius (m): | 0.048 |
| **A**: Angle From Horizontal (deg): | 90 |

* mah indicates "meters along hole"

$$K = \frac{Q \ln\left(\frac{L \sin(A)}{r}\right)}{2\pi L dH \sin(A)}$$

| Pressure (psi) | Q: Flowrate ($m^3/s$): | Pressure (m of water) | dH: Head Differential (m) | K: Hydraulic Conductivity (m/s) |
|---|---|---|---|---|
| 20.0 | 2.1E-04 | 14.1 | 18.7 | 2.1E-07 |
| 30.0 | 2.5E-04 | 21.1 | 25.7 | 1.8E-07 |
| 40.0 | 3.5E-04 | 28.1 | 32.7 | 2.0E-07 |
| | | | **Geo Mean K:** | **2.E-07** |




**Remarks:** Test aborted during third step due to depletion of water reserves.

**Hole #:** **MW- 2HA**
**Test #:** **1**

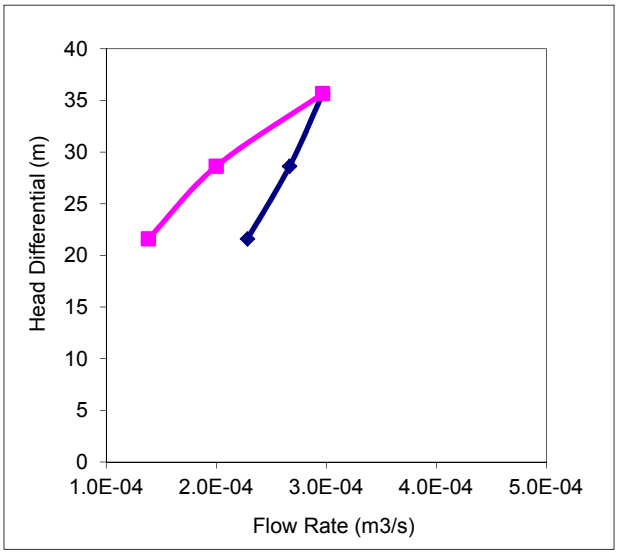
**Input Parameters**

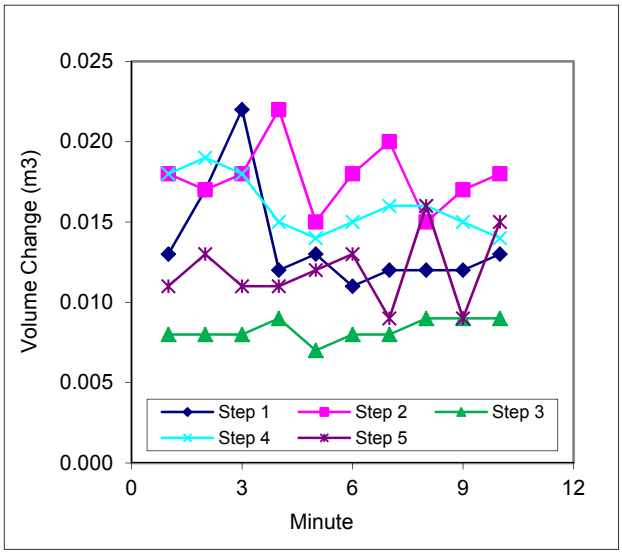
| | |
|---|---|
| Top of Packer Test Interval (mah): | 45.0 |
| Bottom of Packer Test Interval (mah): | 91.0 |
| **L**: Length of Test Interval (mah) | 46.0 |
| Test Interval Midpoint (mah): | 68 |
| Stickup Height (mah): | 1.40 |
| Pressure Gauge Height (m above ground): | 1.40 |
| Depth to Water Table (mah): | 7.53 |
| Borehole Diameter (mm): | 96.0 |
| **r**: Borehole Radius (m): | 0.048 |
| **A**: Angle From Horizontal (deg): | 90 |

* mah indicates "meters along hole"

$$K = \frac{Q \ln\left(\frac{L \sin(A)}{r}\right)}{2\pi L dH \sin(A)}$$

| Pressure (psi) | Q: Flowrate ($m^3/s$): | Pressure (m of water) | dH: Head Differential (m) | K: Hydraulic Conductivity (m/s) |
|---|---|---|---|---|
| 20.0 | 2.3E-04 | 14.1 | 21.6 | 2.5E-07 |
| 30.0 | 2.7E-04 | 21.1 | 28.6 | 2.2E-07 |
| 40.0 | 3.0E-04 | 28.1 | 35.7 | 2.0E-07 |
| 30.0 | 2.0E-04 | 21.1 | 28.6 | 1.7E-07 |
| 20.0 | 1.4E-04 | 14.1 | 21.6 | 1.5E-07 |
| | | | **Geo Mean** | **1.9.E-07** |

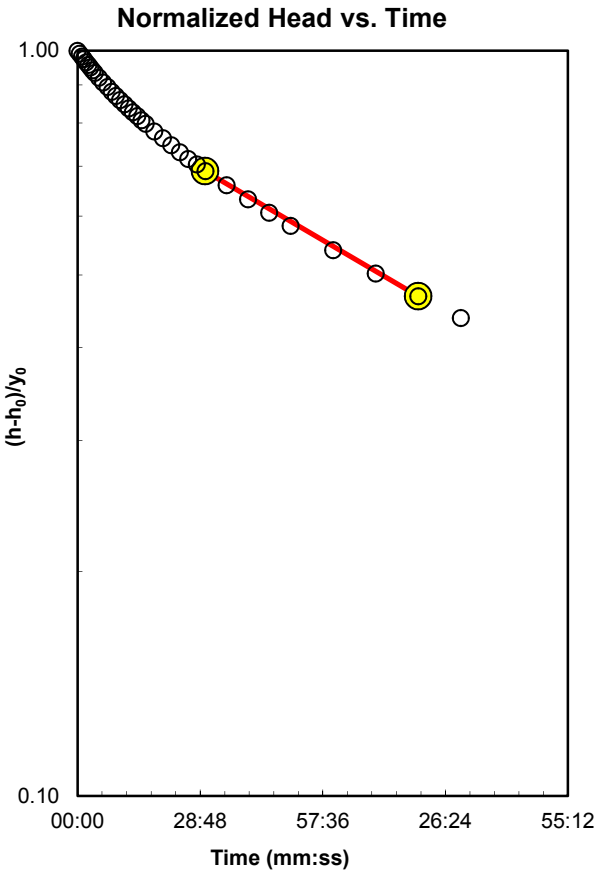



**Remarks:** Test completed normally. Some difficulty maintaining injection pressures.

| MW-H20<br>Double Packer - Falling Head Test<br>Date: 5/21/2011 | |
|---|---|
| Static Water Level (mbgs): | 53.4 |
| Initial displacement (y0): | 16.05 |
| Initial Water Level (h0): | 37.35 |
| Hole elevation (masl): | 948 |
| Top of packer interval (mbgs): | 72.63 |
| Bottom of packer interval (mbgs): | 100.67 |
| Volume hole flushed (L): | 1900 |
| Duration of flush (hrs.): | 1.1 |

| Time Elapsed (s) | Water Level (h) | Normalized Head (m/m) |
|---|---|---|
| 0 | 37.35 | 1 |
| 30 | 37.5 | 0.991 |
| 60 | 37.64 | 0.982 |
| 90 | 37.77 | 0.974 |
| 120 | 37.91 | 0.965 |
| 150 | 38.04 | 0.957 |
| 180 | 38.16 | 0.950 |
| 210 | 38.29 | 0.941 |
| 240 | 38.41 | 0.934 |
| 300 | 38.63 | 0.920 |
| 360 | 38.85 | 0.907 |
| 420 | 39.05 | 0.894 |
| 480 | 39.26 | 0.881 |
| 540 | 39.44 | 0.870 |
| 600 | 39.62 | 0.859 |
| 660 | 39.8 | 0.847 |
| 720 | 39.97 | 0.837 |
| 780 | 40.13 | 0.827 |
| 840 | 40.29 | 0.817 |
| 900 | 40.45 | 0.807 |
| 960 | 40.59 | 0.798 |
| 1080 | 40.89 | 0.779 |
| 1200 | 41.15 | 0.763 |
| 1320 | 41.41 | 0.747 |
| 1440 | 41.67 | 0.731 |
| 1560 | 41.91 | 0.716 |
| 1680 | 42.11 | 0.703 |
| 1800 | 42.34 | 0.689 |
| 2100 | 42.81 | 0.660 |
| 2400 | 43.26 | 0.632 |
| 2700 | 43.67 | 0.606 |
| 3000 | 44.06 | 0.582 |
| 3600 | 44.73 | 0.540 |
| 4200 | 45.34 | 0.502 |
| 4800 | 45.88 | 0.469 |
| 5400 | 46.37 | 0.438 |
| **K (m/s)** | | **4.E-08** |
| Analysis Method | | Bouwer & Rice |



Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H17 (Rising Head Slug Test)
Date: 08/14/13
Time: 09:07:31

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 22 August 2012
Test Well: MW-H17

## AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H17

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.15 m
Static Water Column Height: 3.608 m
Casing Radius: 0.0255 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 3.608 m

No. of Observations: 24

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0. | 360. | 0.0174 |
| 30. | 0.0891 | 390. | 0.016 |
| 60. | 0.0504 | 420. | 0.0145 |
| 90. | 0.0435 | 450. | 0.0129 |
| 120. | 0.0386 | 480. | 0.0101 |
| 150. | 0.0349 | 510. | 0.0103 |
| 180. | 0.0312 | 540. | 0.0087 |
| 210. | 0.029 | 570. | 0.0072 |
| 240. | 0.0267 | 600. | 0.0051 |
| 270. | 0.0238 | 630. | 0.0045 |
| 300. | 0.022 | 660. | 0.0022 |
| 330. | 0.0194 | 690. | 0.001 |

## SOLUTION

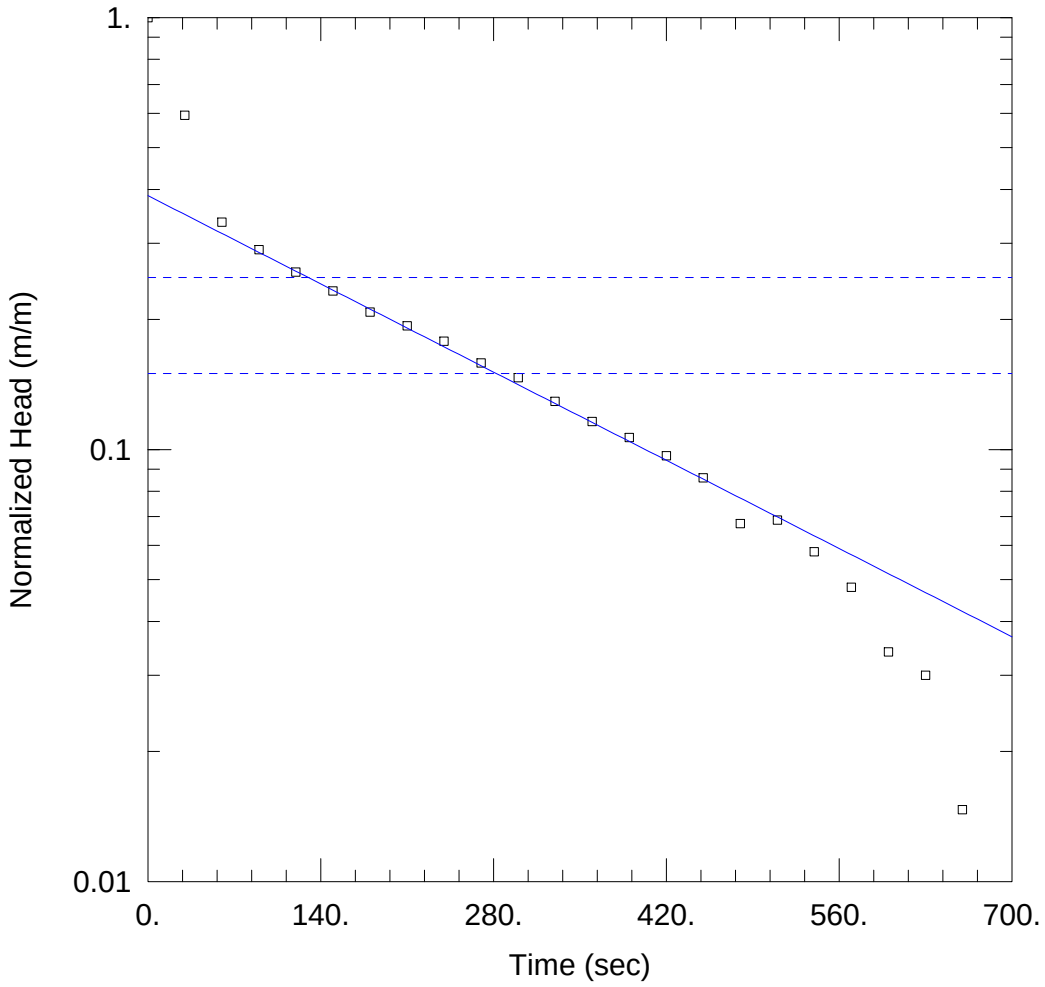
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.454E-6 | m/sec |
| y0 | 0.05803 | m |

K = 0.0001454 cm/sec
T = K*b = 2.908E-5 m²/sec (0.2908 sq. cm/sec)




## MW-H17 (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H17
Test Date: 22 August 2012

### AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H17)

Initial Displacement: 0.15 m
Total Well Penetration Depth: 3.608 m
Casing Radius: 0.0255 m
Static Water Column Height: 3.608 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

### SOLUTION

Aquifer Model: Unconfined
K = 1.454E-6 m/sec
Solution Method: Hvorslev
y0 = 0.05803 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H18 (Rising Head Slug Test)
Date: 08/14/13
Time: 11:43:12

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 25 August 2012
Test Well: MW-H18

## AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H18

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3 m
Static Water Column Height: 2.573 m
Casing Radius: 0.0255 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 2.573 m
Total Well Penetration Depth: 2.573 m
Corrected Casing Radius (Butler Method): 0.03701 m
Expected Initial Displacement: 1. m

No. of Observations: 38

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.3 | 570. | 0.1183 |
| 30. | 0.2844 | 600. | 0.1116 |
| 60. | 0.2734 | 630. | 0.1047 |
| 90. | 0.2622 | 660. | 0.0985 |
| 120. | 0.2499 | 690. | 0.0921 |
| 150. | 0.2405 | 720. | 0.0853 |
| 180. | 0.2306 | 750. | 0.0806 |
| 210. | 0.2205 | 780. | 0.0752 |
| 240. | 0.2109 | 810. | 0.0689 |
| 270. | 0.201 | 840. | 0.0626 |
| 300. | 0.1912 | 870. | 0.0558 |
| 330. | 0.1826 | 900. | 0.0504 |
| 360. | 0.1736 | 930. | 0.0454 |
| 390. | 0.1641 | 960. | 0.0404 |
| 420. | 0.1565 | 990. | 0.0357 |
| 450. | 0.1491 | 1020. | 0.0317 |
| 480. | 0.141 | 1050. | 0.0257 |
| 510. | 0.1348 | 1080. | 0.0225 |
| 540. | 0.1263 | 1110. | 0.0171 |

## SOLUTION

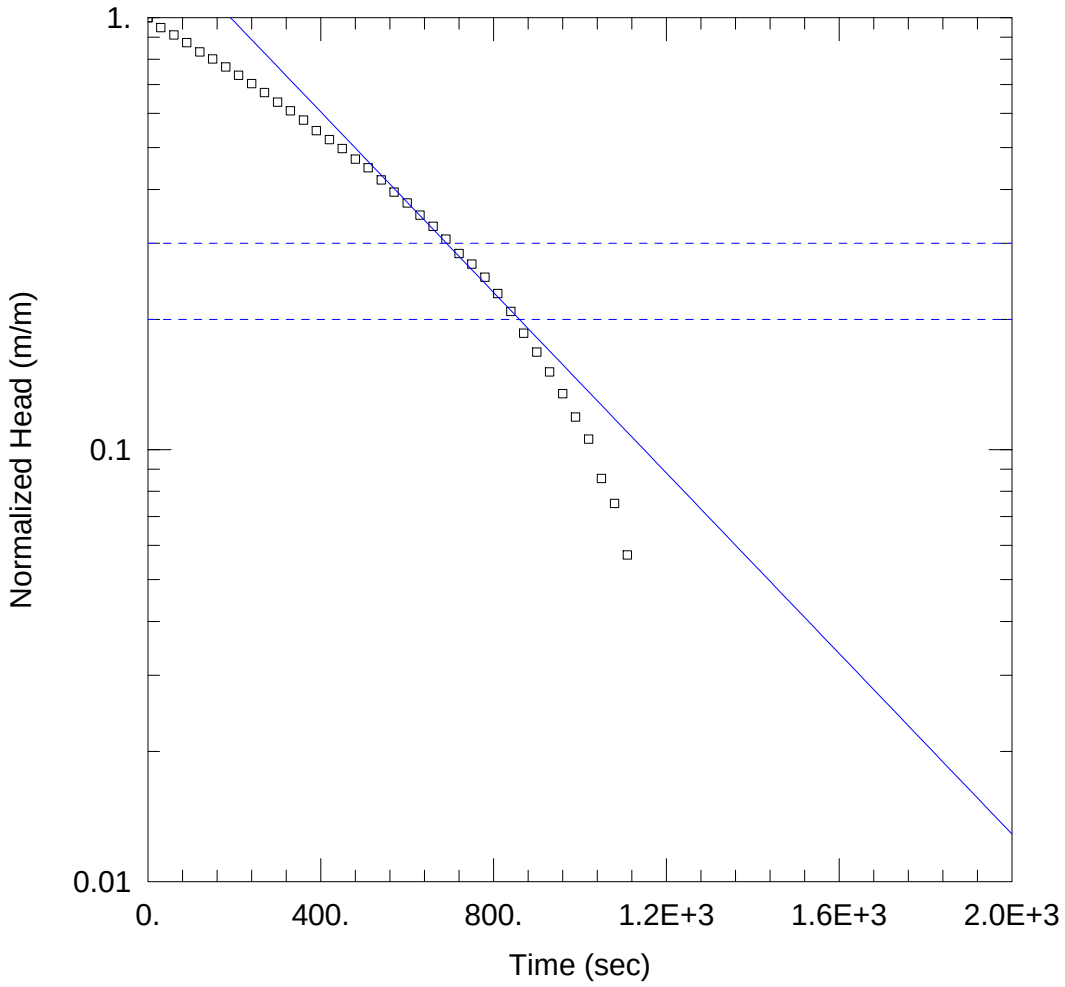
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.483

## VISUAL ESTIMATION RESULTS

Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.59E-6 | m/sec |
| y0 | 0.4748 | m |

K = 0.000159 cm/sec
T = K*b = 3.179E-5 m²/sec (0.3179 sq. cm/sec)




## MW-H18 (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H18
Test Date: 25 August 2012

### AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H18)

Initial Displacement: 0.3 m
Total Well Penetration Depth: 2.573 m
Casing Radius: 0.0255 m
Static Water Column Height: 2.573 m
Screen Length: 2.573 m
Well Radius: 0.0525 m
Gravel Pack Porosity: 0.

### SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.59E-6 m/sec
y0 = 0.4748 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H19 (Rising Head Slug Test)
Date: 08/14/13
Time: 09:15:30

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 25 August 2012
Test Well: MW-H19

## AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H19

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.5 m
Static Water Column Height: 5.336 m
Casing Radius: 0.0225 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 5.336 m

No. of Observations: 201

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0. | 3030. | 0.3001 |
| 30. | 0.3526 | 3060. | 0.2996 |
| 60. | 0.3342 | 3090. | 0.3001 |
| 90. | 0.3291 | 3120. | 0.2997 |
| 120. | 0.3243 | 3150. | 0.3002 |
| 150. | 0.3218 | 3180. | 0.3002 |
| 180. | 0.3221 | 3210. | 0.2998 |
| 210. | 0.3196 | 3240. | 0.2986 |
| 240. | 0.3196 | 3270. | 0.2983 |
| 270. | 0.3188 | 3300. | 0.2974 |
| 300. | 0.3186 | 3330. | 0.2995 |
| 330. | 0.3166 | 3360. | 0.2968 |
| 360. | 0.3172 | 3390. | 0.2977 |
| 390. | 0.3163 | 3420. | 0.2965 |
| 420. | 0.3166 | 3450. | 0.2984 |
| 450. | 0.3145 | 3480. | 0.2984 |
| 480. | 0.3154 | 3510. | 0.2976 |
| 510. | 0.3138 | 3540. | 0.2985 |
| 540. | 0.3141 | 3570. | 0.2965 |
| 570. | 0.3136 | 3600. | 0.2976 |
| 600. | 0.3137 | 3630. | 0.2967 |
| 630. | 0.3147 | 3660. | 0.2976 |
| 660. | 0.3131 | 3690. | 0.2972 |
| 690. | 0.3121 | 3720. | 0.2978 |
| 720. | 0.3119 | 3750. | 0.2973 |
| 750. | 0.3096 | 3780. | 0.2963 |
| 780. | 0.3123 | 3810. | 0.2959 |
| 810. | 0.3112 | 3840. | 0.2964 |
| 840. | 0.312 | 3870. | 0.2966 |
| 870. | 0.3113 | 3900. | 0.2956 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 0.3111 | 3930. | 0.2941 |
| 930. | 0.3117 | 3960. | 0.2951 |
| 960. | 0.3093 | 3990. | 0.2966 |
| 990. | 0.3105 | 4020. | 0.2954 |
| 1020. | 0.3102 | 4050. | 0.2947 |
| 1050. | 0.3109 | 4080. | 0.2955 |
| 1080. | 0.3113 | 4110. | 0.2944 |
| 1110. | 0.3092 | 4140. | 0.2947 |
| 1140. | 0.31 | 4170. | 0.2958 |
| 1170. | 0.3098 | 4200. | 0.2956 |
| 1200. | 0.3102 | 4230. | 0.2941 |
| 1230. | 0.3102 | 4260. | 0.2938 |
| 1260. | 0.3107 | 4290. | 0.2939 |
| 1290. | 0.31 | 4320. | 0.2946 |
| 1320. | 0.3092 | 4350. | 0.2938 |
| 1350. | 0.3101 | 4380. | 0.2933 |
| 1380. | 0.3084 | 4410. | 0.2956 |
| 1410. | 0.3093 | 4440. | 0.2934 |
| 1440. | 0.3096 | 4470. | 0.2932 |
| 1470. | 0.3097 | 4500. | 0.2934 |
| 1500. | 0.3087 | 4530. | 0.2922 |
| 1530. | 0.3081 | 4560. | 0.2936 |
| 1560. | 0.3091 | 4590. | 0.2931 |
| 1590. | 0.3069 | 4620. | 0.2935 |
| 1620. | 0.3071 | 4650. | 0.2925 |
| 1650. | 0.3073 | 4680. | 0.2936 |
| 1680. | 0.3084 | 4710. | 0.2934 |
| 1710. | 0.3079 | 4740. | 0.2925 |
| 1740. | 0.3068 | 4770. | 0.2921 |
| 1770. | 0.3063 | 4800. | 0.2932 |
| 1800. | 0.3065 | 4830. | 0.2944 |
| 1830. | 0.3064 | 4860. | 0.2926 |
| 1860. | 0.3059 | 4890. | 0.2933 |
| 1890. | 0.3044 | 4920. | 0.2931 |
| 1920. | 0.3049 | 4950. | 0.2924 |
| 1950. | 0.3046 | 4980. | 0.2937 |
| 1980. | 0.3057 | 5010. | 0.2916 |
| 2010. | 0.3065 | 5040. | 0.2925 |
| 2040. | 0.3057 | 5070. | 0.2918 |
| 2070. | 0.3055 | 5100. | 0.2921 |
| 2100. | 0.3057 | 5130. | 0.2921 |
| 2130. | 0.3055 | 5160. | 0.2938 |
| 2160. | 0.305 | 5190. | 0.2911 |
| 2190. | 0.305 | 5220. | 0.2934 |
| 2220. | 0.3051 | 5250. | 0.2925 |
| 2250. | 0.3044 | 5280. | 0.2928 |
| 2280. | 0.3049 | 5310. | 0.2919 |
| 2310. | 0.304 | 5340. | 0.2921 |
| 2340. | 0.3051 | 5370. | 0.292 |
| 2370. | 0.3028 | 5400. | 0.2911 |
| 2400. | 0.3036 | 5430. | 0.291 |
| 2430. | 0.3031 | 5460. | 0.292 |
| 2460. | 0.303 | 5490. | 0.2916 |
| 2490. | 0.3035 | 5520. | 0.2915 |
| 2520. | 0.3025 | 5550. | 0.291 |
| 2550. | 0.303 | 5580. | 0.2922 |
| 2580. | 0.3041 | 5610. | 0.2908 |
| 2610. | 0.3014 | 5640. | 0.2915 |
| 2640. | 0.3016 | 5670. | 0.2919 |
| 2670. | 0.3027 | 5700. | 0.2913 |
| 2700. | 0.302 | 5730. | 0.2909 |
| 2730. | 0.3002 | 5760. | 0.2916 |
| 2760. | 0.3018 | 5790. | 0.291 |
| 2790. | 0.3016 | 5820. | 0.2902 |
| 2820. | 0.301 | 5850. | 0.2909 |
| 2850. | 0.3014 | 5880. | 0.2896 |
| 2880. | 0.2991 | 5910. | 0.2896 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2910. | 0.3009 | 5940. | 0.2906 |
| 2940. | 0.3016 | 5970. | 0.2898 |
| 2970. | 0.3006 | 6000. | 0.2908 |
| 3000. | 0.2996 | | |

## SOLUTION

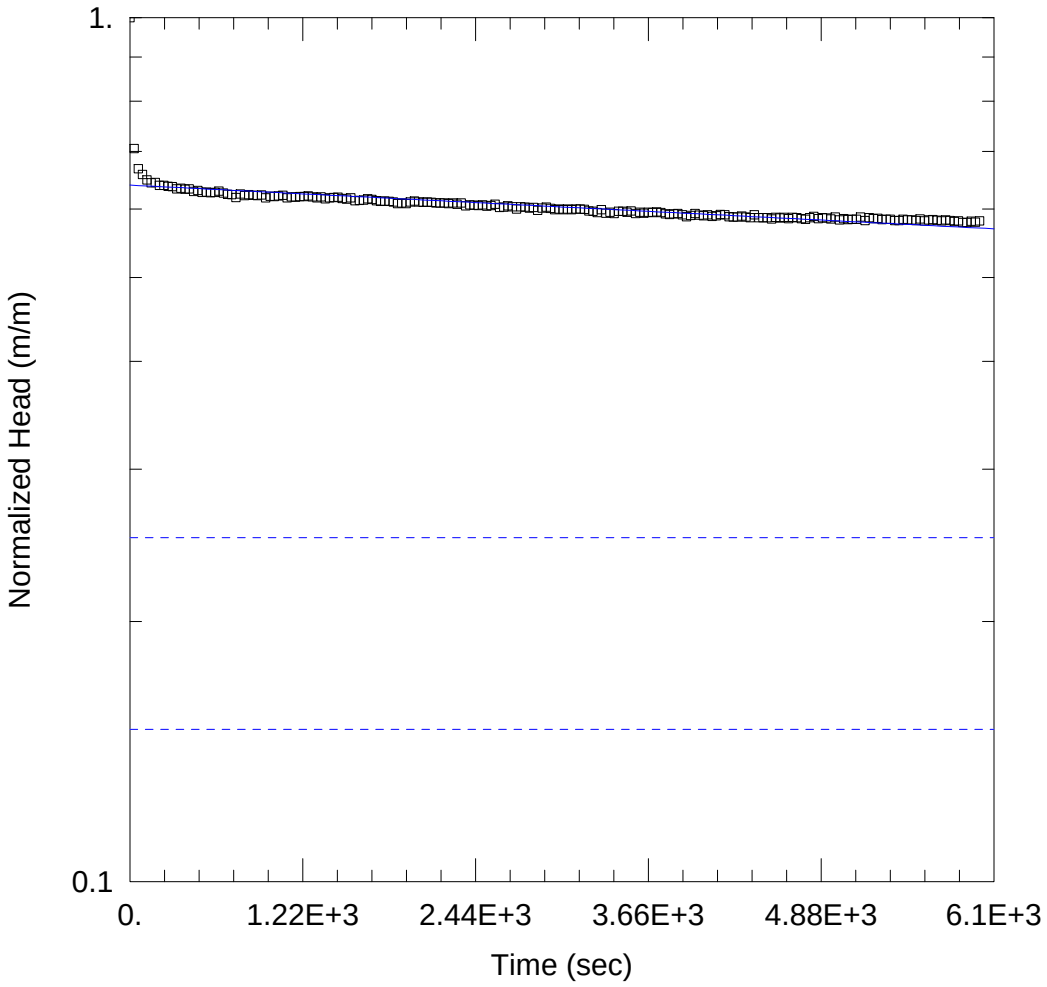
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 6.433E-9 | m/sec |
| y0 | 0.3199 | m |

K = 6.433E-7 cm/sec
T = K*b = 1.287E-7 m²/sec (0.001287 sq. cm/sec)




## MW-H19 (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H19
Test Date: 25 August 2012

### AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H19)

Initial Displacement: 0.5 m
Total Well Penetration Depth: 5.336 m
Casing Radius: 0.0225 m
Static Water Column Height: 5.336 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

### SOLUTION

Aquifer Model: Unconfined
K = 6.433E-9 m/sec
Solution Method: Hvorslev
y0 = 0.3199 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H22 (Rising Head Slug Test)
Date: 08/14/13
Time: 11:35:46

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 21 August 2012
Test Well: MW-H22

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H22

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3 m
Static Water Column Height: 5.41 m
Casing Radius: 0.0255 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 5.41 m

No. of Observations: 37

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.3 | 570. | 0.0427 |
| 30. | 0.1859 | 600. | 0.0399 |
| 60. | 0.1342 | 630. | 0.038 |
| 90. | 0.1077 | 660. | 0.0373 |
| 120. | 0.0926 | 690. | 0.0348 |
| 150. | 0.0844 | 720. | 0.0338 |
| 180. | 0.0781 | 750. | 0.0321 |
| 210. | 0.0726 | 780. | 0.0309 |
| 240. | 0.0692 | 810. | 0.0284 |
| 270. | 0.0659 | 840. | 0.0274 |
| 300. | 0.0633 | 870. | 0.0262 |
| 330. | 0.0611 | 900. | 0.0234 |
| 360. | 0.0577 | 930. | 0.0233 |
| 390. | 0.0551 | 960. | 0.0218 |
| 420. | 0.0538 | 990. | 0.0214 |
| 450. | 0.0512 | 1020. | 0.0196 |
| 480. | 0.0488 | 1050. | 0.0185 |
| 510. | 0.0469 | 1080. | 0.018 |
| 540. | 0.0439 | | |

## SOLUTION

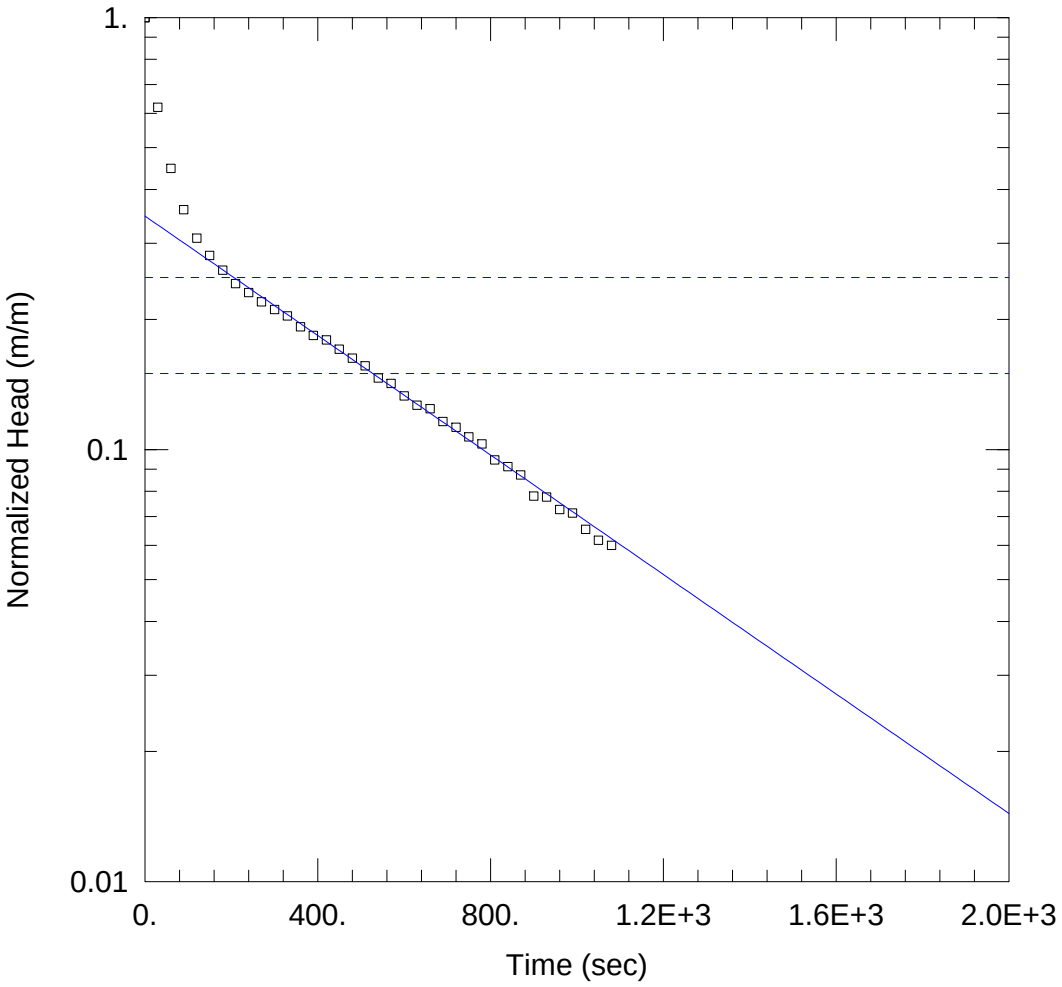
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

## VISUAL ESTIMATION RESULTS

Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 6.895E-7 | m/sec |
| y0 | 0.1041 | m |

K = 6.895E-5 cm/sec
T = K*b = 3.448E-5 m²/sec (0.3448 sq. cm/sec)




## MW-H22 (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H22
Test Date: 21 August 2012

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H22)

Initial Displacement: 0.3 m
Total Well Penetration Depth: 5.41 m
Casing Radius: 0.0255 m
Static Water Column Height: 5.41 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

### SOLUTION

Aquifer Model: Unconfined
K = 6.895E-7 m/sec
Solution Method: Hvorslev
y0 = 0.1041 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H23 (Risign Head Slug Test)
Date: 08/14/13
Time: 09:40:51

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H23

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

### Test Well: MW-H23

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.5 m
Static Water Column Height: 3.62 m
Casing Radius: 0.0255 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 3.62 m

No. of Observations: 9

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 4.5 | 0.1143 | 7. | 0.0107 |
| 5. | 0.0635 | 7.5 | 0.0092 |
| 5.5 | 0.04 | 8. | 0.0087 |
| 6. | 0.031 | 8.5 | 0. |
| 6.5 | 0.0161 | | |

## SOLUTION

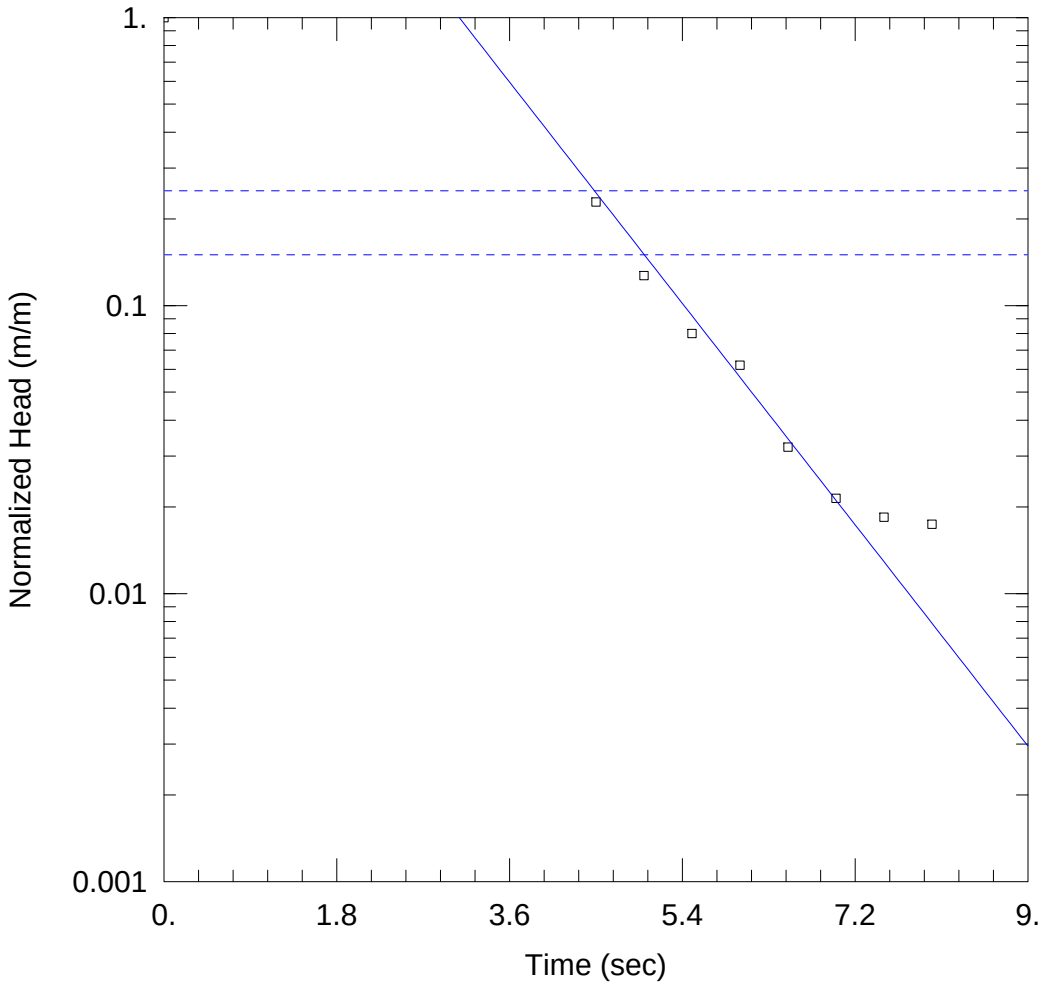
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 0.0004258 | m/sec |
| y0 | 10.31 | m |

K = 0.04258 cm/sec
T = K*b = 0.02129 m²/sec (212.9 sq. cm/sec)




## MW-H23 (RISIGN HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H23
Test Date: 21 July 2013

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H23)

Initial Displacement: 0.5 m
Total Well Penetration Depth: 3.62 m
Casing Radius: 0.0255 m
Static Water Column Height: 3.62 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

### SOLUTION

Aquifer Model: Unconfined
K = 0.0004258 m/sec
Solution Method: Hvorslev
y0 = 10.31 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A (Rising Head Slug Test)
Date: 08/14/13
Time: 12:02:49

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 19 December 2012
Test Well: MW-H24A

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

### Test Well: MW-H24A

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.2 m
Static Water Column Height: 32. m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 32. m

No. of Observations: 25

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.2 | 7800. | 0.512 |
| 600. | 1.09 | 8400. | 0.4821 |
| 1200. | 1.009 | 9000. | 0.4435 |
| 1800. | 0.9431 | 9600. | 0.4051 |
| 2400. | 0.883 | 1.02E+4 | 0.3654 |
| 3000. | 0.8302 | 1.08E+4 | 0.3299 |
| 3600. | 0.7813 | 1.14E+4 | 0.2976 |
| 4200. | 0.7409 | 1.2E+4 | 0.2614 |
| 4800. | 0.694 | 1.26E+4 | 0.2264 |
| 5400. | 0.6579 | 1.32E+4 | 0.1909 |
| 6000. | 0.6192 | 1.38E+4 | 0.1578 |
| 6600. | 0.5783 | 1.44E+4 | 0.1223 |
| 7200. | 0.5437 | | |

## SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 4.511E-8 | m/sec |
| y0 | 4.896 | m |

K = 4.511E-6 cm/sec

T = K*b = 4.511E-6 m²/sec (0.04511 sq. cm/sec)

NOTES

Well may not be sufficiently developed due to a slow recovery.

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A Zone 1 (Falling Head Packer Test, vertical interval 9.8-25 m)
Date: 08/14/13
Time: 12:55:16

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 15 October 2012
Test Well: MW-H24A Zone 1

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H24A Zone 1

X Location: 0. m
Y Location: 0. m

Initial Displacement: 4.81 m
Static Water Column Height: 20.21 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 15.25 m
Total Well Penetration Depth: 20.21 m

No. of Observations: 26

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 4.81 | 390. | 1.299 |
| 30. | 4.191 | 420. | 1.177 |
| 60. | 3.736 | 450. | 1.062 |
| 90. | 3.355 | 480. | 0.9551 |
| 120. | 3.029 | 510. | 0.8545 |
| 150. | 2.747 | 540. | 0.7591 |
| 180. | 2.501 | 570. | 0.6696 |
| 210. | 2.276 | 600. | 0.5859 |
| 240. | 2.075 | 630. | 0.5064 |
| 270. | 1.893 | 660. | 0.4335 |
| 300. | 1.727 | 690. | 0.3636 |
| 330. | 1.581 | 720. | 0.2988 |
| 360. | 1.431 | 750. | 0.2367 |

## SOLUTION

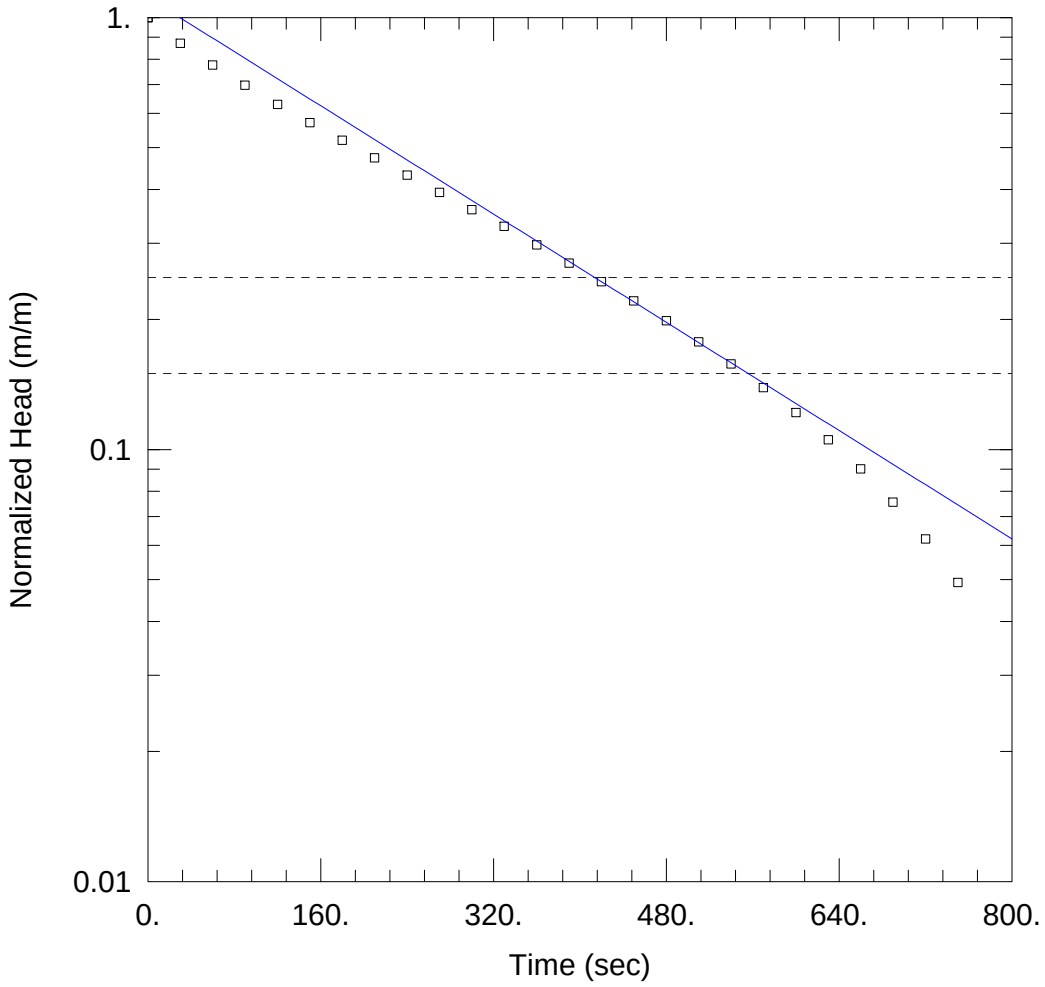
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1668

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.024E-6 | m/sec |
| y0 | 5.35 | m |

K = 0.0001024 cm/sec




MW-H24A ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 9.8-25 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A Zone 1
Test Date: 15 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.024E-6 m/sec
y0 = 5.35 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A Zone 2 (Falling Head Packer Test, vertical interval 25.3-38.4 m)
Date: 08/14/13
Time: 12:57:13

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 19 October 2012
Test Well: MW-H24 Zone 2

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H24A Zone 2

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.91 m
Static Water Column Height: 38.1 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 11.9 m
Total Well Penetration Depth: 38.1 m

No. of Observations: 132

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.91 | 1980. | 1.495 |
| 30. | 1.896 | 2010. | 1.491 |
| 60. | 1.89 | 2040. | 1.485 |
| 90. | 1.881 | 2070. | 1.48 |
| 120. | 1.872 | 2100. | 1.473 |
| 150. | 1.863 | 2130. | 1.469 |
| 180. | 1.854 | 2160. | 1.464 |
| 210. | 1.847 | 2190. | 1.458 |
| 240. | 1.838 | 2220. | 1.454 |
| 270. | 1.832 | 2250. | 1.448 |
| 300. | 1.824 | 2280. | 1.443 |
| 330. | 1.817 | 2310. | 1.439 |
| 360. | 1.812 | 2340. | 1.432 |
| 390. | 1.803 | 2370. | 1.429 |
| 420. | 1.796 | 2400. | 1.425 |
| 450. | 1.789 | 2430. | 1.42 |
| 480. | 1.783 | 2460. | 1.416 |
| 510. | 1.776 | 2490. | 1.411 |
| 540. | 1.771 | 2520. | 1.404 |
| 570. | 1.765 | 2550. | 1.4 |
| 600. | 1.757 | 2580. | 1.395 |
| 630. | 1.75 | 2610. | 1.388 |
| 660. | 1.746 | 2640. | 1.385 |
| 690. | 1.739 | 2670. | 1.38 |
| 720. | 1.732 | 2700. | 1.375 |
| 750. | 1.726 | 2730. | 1.37 |
| 780. | 1.72 | 2760. | 1.365 |
| 810. | 1.714 | 2790. | 1.359 |
| 840. | 1.706 | 2820. | 1.356 |
| 870. | 1.7 | 2850. | 1.351 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 1.695 | 2880. | 1.345 |
| 930. | 1.689 | 2910. | 1.341 |
| 960. | 1.683 | 2940. | 1.335 |
| 990. | 1.678 | 2970. | 1.331 |
| 1020. | 1.672 | 3000. | 1.326 |
| 1050. | 1.665 | 3030. | 1.321 |
| 1080. | 1.66 | 3060. | 1.316 |
| 1110. | 1.654 | 3090. | 1.311 |
| 1140. | 1.649 | 3120. | 1.307 |
| 1170. | 1.642 | 3150. | 1.301 |
| 1200. | 1.638 | 3180. | 1.298 |
| 1230. | 1.632 | 3210. | 1.292 |
| 1260. | 1.626 | 3240. | 1.287 |
| 1290. | 1.62 | 3270. | 1.283 |
| 1320. | 1.615 | 3300. | 1.278 |
| 1350. | 1.609 | 3330. | 1.274 |
| 1380. | 1.604 | 3360. | 1.268 |
| 1410. | 1.598 | 3390. | 1.263 |
| 1440. | 1.593 | 3420. | 1.259 |
| 1470. | 1.587 | 3450. | 1.254 |
| 1500. | 1.581 | 3480. | 1.249 |
| 1530. | 1.575 | 3510. | 1.245 |
| 1560. | 1.57 | 3540. | 1.24 |
| 1590. | 1.564 | 3570. | 1.236 |
| 1620. | 1.559 | 3600. | 1.23 |
| 1650. | 1.555 | 3630. | 1.225 |
| 1680. | 1.549 | 3660. | 1.221 |
| 1710. | 1.544 | 3690. | 1.22 |
| 1740. | 1.538 | 3720. | 1.213 |
| 1770. | 1.533 | 3750. | 1.208 |
| 1800. | 1.527 | 3780. | 1.203 |
| 1830. | 1.522 | 3810. | 1.199 |
| 1860. | 1.517 | 3840. | 1.195 |
| 1890. | 1.511 | 3870. | 1.19 |
| 1920. | 1.507 | 3900. | 1.186 |
| 1950. | 1.502 | 3930. | 1.179 |

## SOLUTION

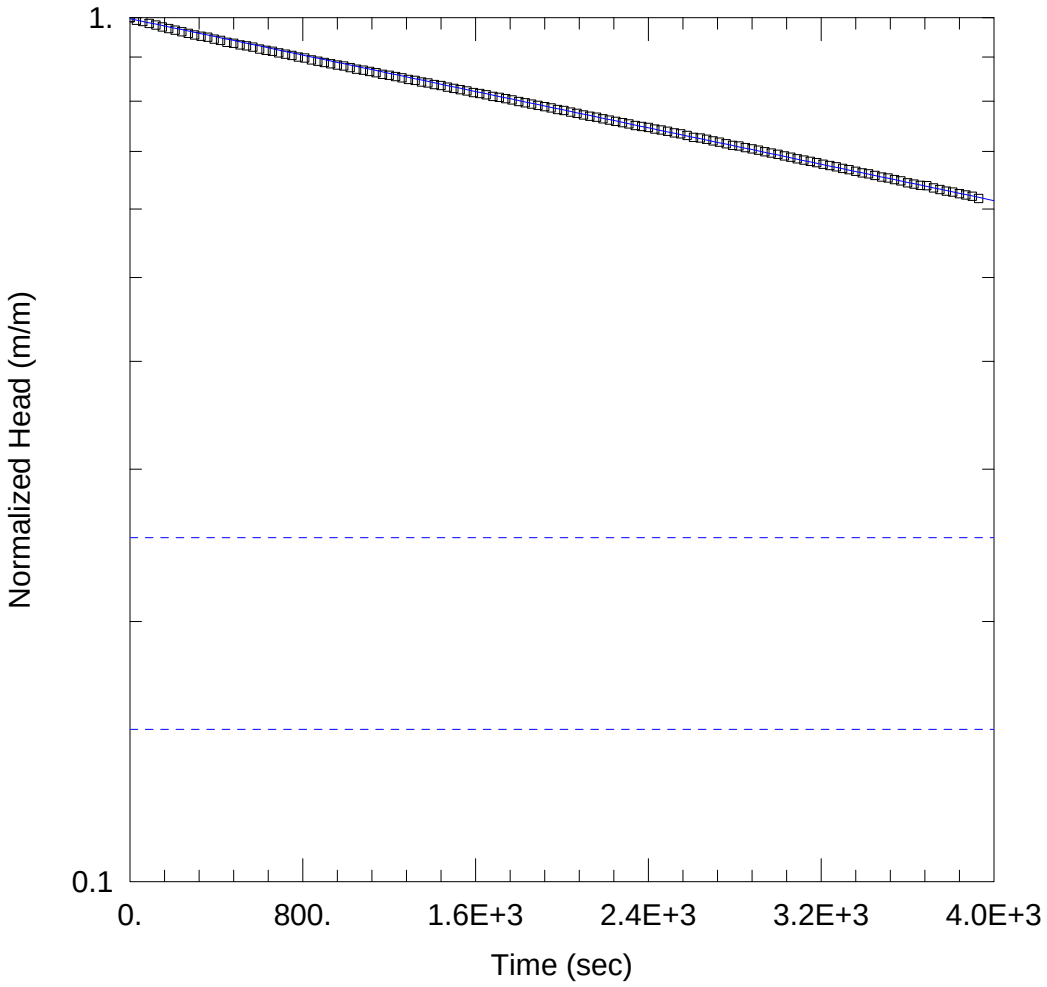
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.174

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 4.224E-8 | m/sec |
| y0 | 1.904 | m |

K = 4.224E-6 cm/sec
T = K*b = 4.224E-6 m²/sec (0.04224 sq. cm/sec)




MW-H24A ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 25.3-38.4 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24 Zone 2
Test Date: 19 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 4.224E-8 m/sec
y0 = 1.904 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A Zone 3 (Falling Head Packer Test, vertical interval 38.4-54.6 m)
Date: 08/14/13
Time: 13:01:09

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 19 October 2012
Test Well: MW-H24A Zone 3

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H24A Zone 3

X Location: 0. m
Y Location: 0. m

Initial Displacement: 4.04 m
Static Water Column Height: 48.44 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 12.2 m
Total Well Penetration Depth: 48.44 m

No. of Observations: 33

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 4.04 | 510. | 1.359 |
| 30. | 3.851 | 540. | 1.27 |
| 60. | 3.59 | 570. | 1.184 |
| 90. | 3.35 | 600. | 1.105 |
| 120. | 3.134 | 630. | 1.029 |
| 150. | 2.928 | 660. | 0.9565 |
| 180. | 2.739 | 690. | 0.8866 |
| 210. | 2.566 | 720. | 0.8205 |
| 240. | 2.406 | 750. | 0.7576 |
| 270. | 2.256 | 780. | 0.6946 |
| 300. | 2.116 | 810. | 0.6341 |
| 330. | 1.982 | 840. | 0.5748 |
| 360. | 1.86 | 870. | 0.5172 |
| 390. | 1.752 | 900. | 0.4609 |
| 420. | 1.648 | 930. | 0.4046 |
| 450. | 1.549 | 960. | 0.3516 |
| 480. | 1.453 | | |

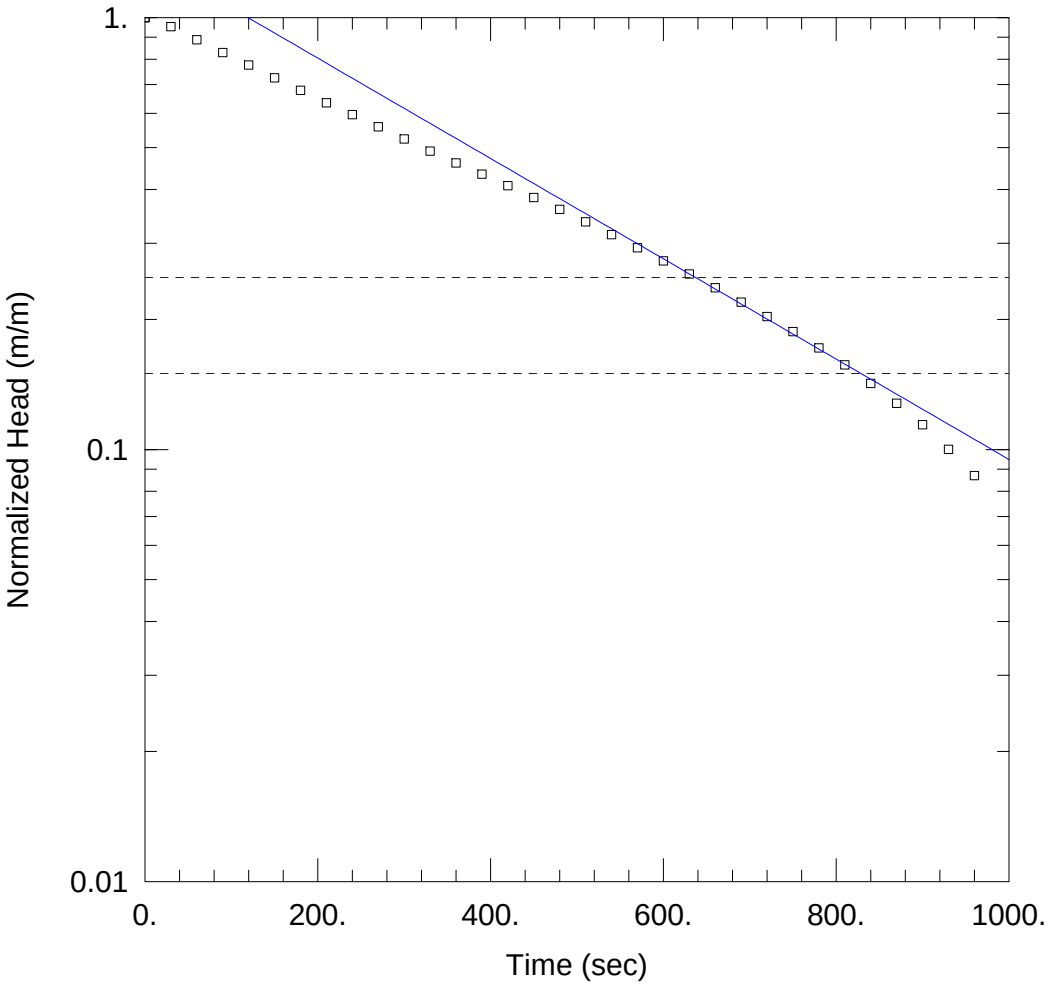
## SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1733

## VISUAL ESTIMATION RESULTS

Estimated Parameters

| Parameter | Estimate |
|---|---|




MW-H24A ZONE 3 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 38.4-54.6 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A Zone 3
Test Date: 19 October 2012

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 9.132E-7 m/sec
y0 = 5.553 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A Zone 4 (Falling Head Packer Test, vertical interval 54.3-67.1 m)
Date: 08/15/13
Time: 13:34:38

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A Zone 4

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H24A Zone 4

X Location: 0. m
Y Location: 0. m

Initial Displacement: 5.01 m
Static Water Column Height: 63. m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 11.8 m
Total Well Penetration Depth: 63. m

No. of Observations: 20

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 5.01 | 300. | 2.34 |
| 30. | 4.65 | 330. | 2.185 |
| 60. | 4.44 | 360. | 1.94 |
| 90. | 3.97 | 390. | 1.62 |
| 120. | 3.66 | 420. | 1.195 |
| 150. | 3.28 | 450. | 0.86 |
| 180. | 3.07 | 480. | 0.6 |
| 210. | 2.85 | 510. | 0.39 |
| 240. | 2.67 | 540. | 0.215 |
| 270. | 2.51 | 570. | 0.08 |

## SOLUTION

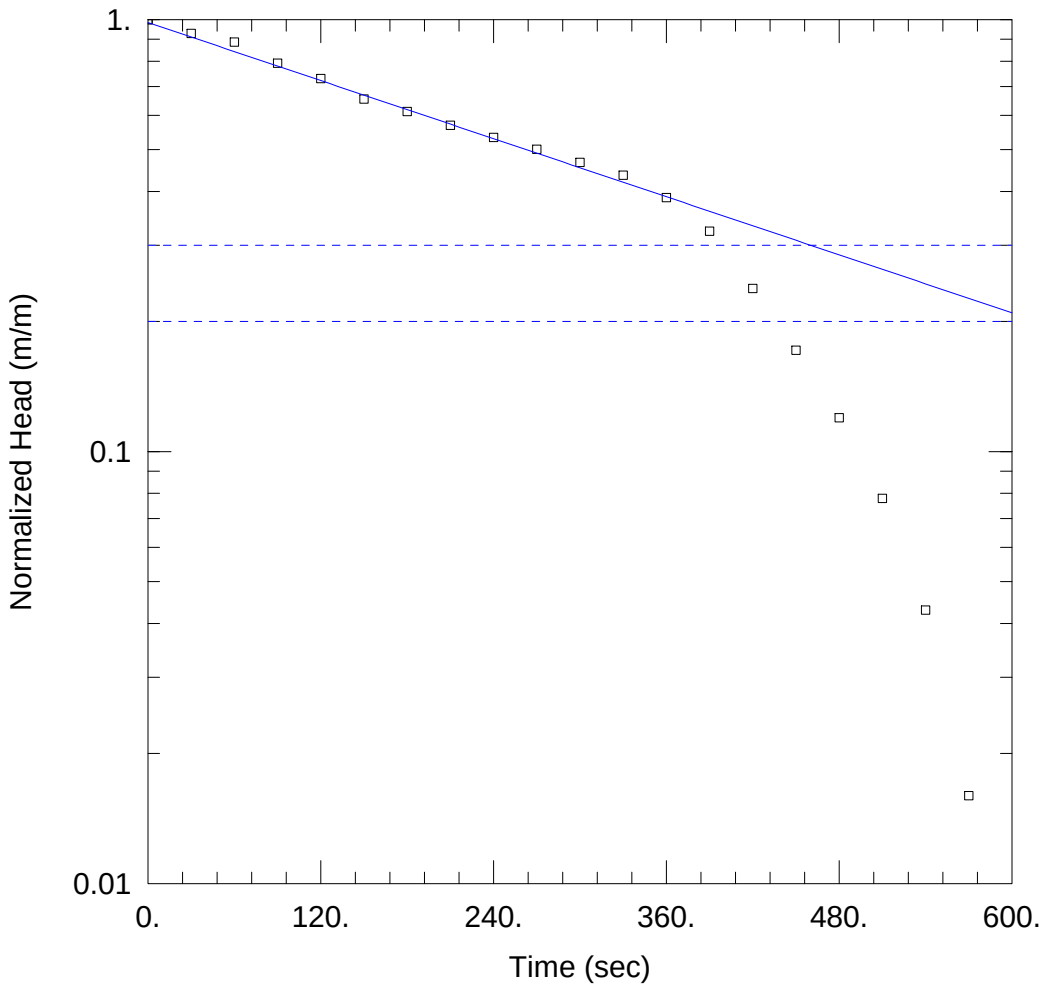
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.956

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 7.823E-7 | m/sec |
| y0 | 4.931 | m |

K = 7.823E-5 cm/sec
T = K*b = 7.823E-5 m²/sec (0.7823 sq. cm/sec)




MW-H24A ZONE 4 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 54.3-67.1 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A Zone 4

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

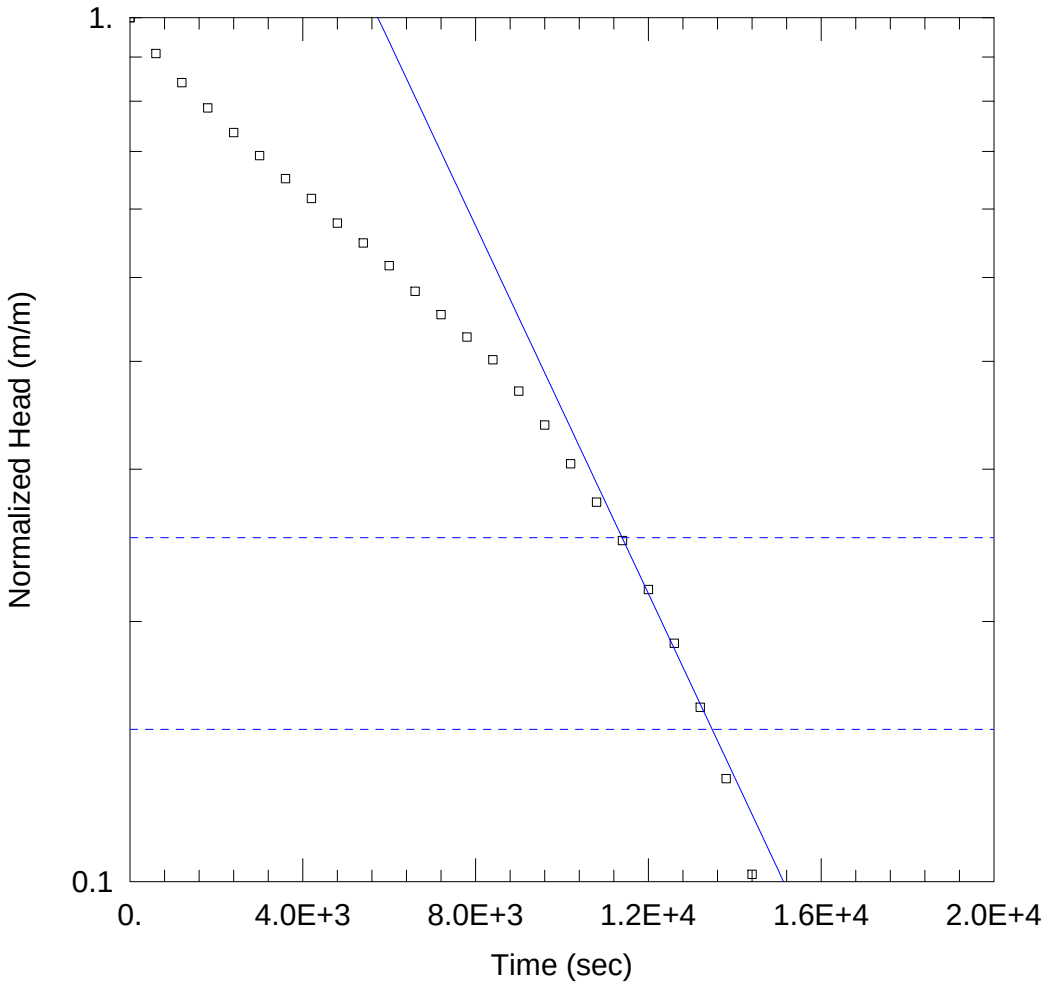
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 7.823E-7 m/sec

y0 = 4.931 m




## MW-H24A (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A
Test Date: 19 December 2012

### AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H24A)

Initial Displacement: 1.2 m
Total Well Penetration Depth: 32. m
Casing Radius: 0.016 m
Static Water Column Height: 32. m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Confined
K = 4.511E-8 m/sec
Solution Method: Hvorslev
y0 = 4.896 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24B (Rising Head Slug Test)
Date: 08/14/13
Time: 10:19:25

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 24 October 2012
Test Well: MW-H24B

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H24B

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.141 m
Static Water Column Height: 4.64 m
Casing Radius: 0.016 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 4.64 m

No. of Observations: 47

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.141 | 360. | 0.0053 |
| 15. | 0.0519 | 375. | 0.0048 |
| 30. | 0.0374 | 390. | 0.0045 |
| 45. | 0.0288 | 405. | 0.0045 |
| 60. | 0.0263 | 420. | 0.0037 |
| 75. | 0.0239 | 435. | 0.0035 |
| 90. | 0.0205 | 450. | 0.0033 |
| 105. | 0.0187 | 465. | 0.0038 |
| 120. | 0.0172 | 480. | 0.0027 |
| 135. | 0.0151 | 495. | 0.0021 |
| 150. | 0.0145 | 510. | 0.0032 |
| 165. | 0.0126 | 525. | 0.0026 |
| 180. | 0.0119 | 540. | 0.003 |
| 195. | 0.0114 | 555. | 0.0021 |
| 210. | 0.0098 | 570. | 0.0021 |
| 225. | 0.0094 | 585. | 0.0024 |
| 240. | 0.0091 | 600. | 0.002 |
| 255. | 0.0082 | 615. | 0.0019 |
| 270. | 0.0071 | 630. | 0.0016 |
| 285. | 0.0067 | 645. | 0.0012 |
| 300. | 0.0065 | 660. | 0.0018 |
| 315. | 0.0061 | 675. | 0.0013 |
| 330. | 0.0059 | 690. | 0.0013 |
| 345. | 0.0057 | | |

## SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev

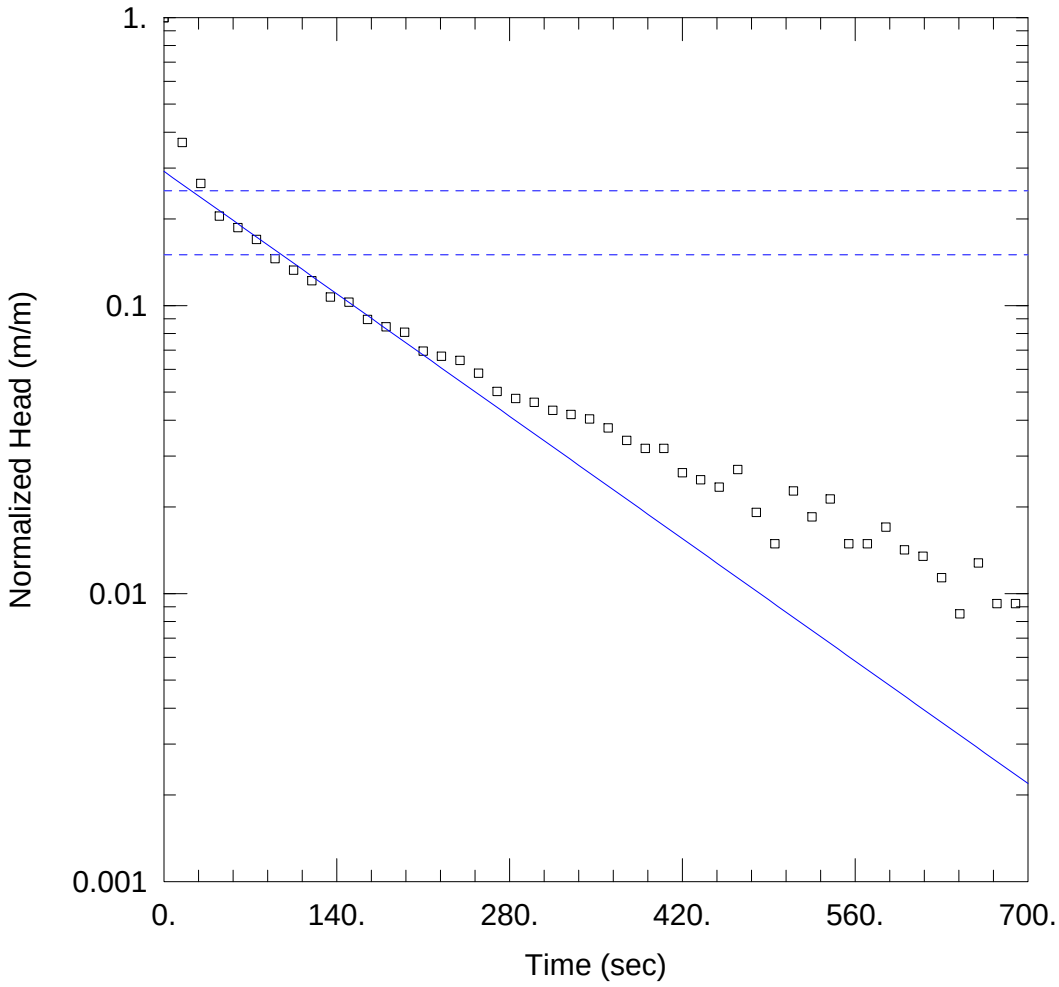
Log Factor: 0.2462

VISUAL ESTIMATION RESULTS

Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.192E-6 | m/sec |
| y0 | 0.0412 | m |

K = 0.0001192 cm/sec
T = K*b = 5.96E-5 m²/sec (0.596 sq. cm/sec)




## MW-H24B (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24B
Test Date: 24 October 2012

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H24B)

Initial Displacement: 0.141 m
Total Well Penetration Depth: 4.64 m
Casing Radius: 0.016 m
Static Water Column Height: 4.64 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

### SOLUTION

Aquifer Model: Unconfined
K = 1.192E-6 m/sec
Solution Method: Hvorslev
y0 = 0.0412 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24C (Rising Head Slug Test)
Date: 08/14/13
Time: 10:22:31

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H24C

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H24C

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.5 m
Static Water Column Height: 10.47 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 10.47 m

No. of Observations: 256

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.5 | 309. | 0.0767 |
| 1. | 0.4905 | 324. | 0.0711 |
| 2. | 0.4836 | 339. | 0.0661 |
| 3. | 0.4777 | 354. | 0.0619 |
| 4. | 0.4733 | 369. | 0.0577 |
| 5. | 0.4685 | 384. | 0.0532 |
| 6. | 0.464 | 399. | 0.0502 |
| 7. | 0.4606 | 414. | 0.0469 |
| 8. | 0.457 | 429. | 0.0442 |
| 9. | 0.4527 | 444. | 0.0415 |
| 10. | 0.4494 | 459. | 0.0388 |
| 11. | 0.4464 | 474. | 0.0368 |
| 12. | 0.4429 | 489. | 0.0344 |
| 13. | 0.4398 | 504. | 0.0324 |
| 14. | 0.4363 | 519. | 0.0298 |
| 15. | 0.4331 | 534. | 0.0275 |
| 16. | 0.4304 | 549. | 0.0255 |
| 17. | 0.4281 | 564. | 0.0247 |
| 18. | 0.424 | 579. | 0.0231 |
| 19. | 0.4216 | 594. | 0.0216 |
| 20. | 0.4191 | 609. | 0.0205 |
| 21. | 0.4151 | 624. | 0.0196 |
| 22. | 0.4127 | 639. | 0.0174 |
| 23. | 0.4106 | 654. | 0.0167 |
| 24. | 0.4079 | 669. | 0.0164 |
| 25. | 0.4052 | 684. | 0.0154 |
| 26. | 0.403 | 699. | 0.0152 |
| 27. | 0.3997 | 714. | 0.0143 |
| 28. | 0.3969 | 729. | 0.0136 |
| 29. | 0.3944 | 744. | 0.013 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 30. | 0.3917 | 759. | 0.0126 |
| 31. | 0.3895 | 774. | 0.0117 |
| 32. | 0.3863 | 789. | 0.0116 |
| 33. | 0.384 | 804. | 0.0113 |
| 34. | 0.3817 | 819. | 0.0107 |
| 35. | 0.379 | 834. | 0.01 |
| 36. | 0.3772 | 849. | 0.0093 |
| 37. | 0.3748 | 864. | 0.0076 |
| 38. | 0.3725 | 879. | 0.0086 |
| 39. | 0.3699 | 894. | 0.0093 |
| 40. | 0.3674 | 909. | 0.0085 |
| 41. | 0.3645 | 924. | 0.0079 |
| 42. | 0.3626 | 939. | 0.0077 |
| 43. | 0.3602 | 954. | 0.0077 |
| 44. | 0.3584 | 969. | 0.007 |
| 45. | 0.3559 | 984. | 0.0074 |
| 46. | 0.3538 | 999. | 0.0072 |
| 47. | 0.3517 | 1014. | 0.0069 |
| 48. | 0.3496 | 1029. | 0.0064 |
| 49. | 0.3472 | 1044. | 0.0065 |
| 50. | 0.3448 | 1059. | 0.0068 |
| 51. | 0.3431 | 1074. | 0.0063 |
| 52. | 0.3403 | 1089. | 0.0058 |
| 53. | 0.3385 | 1104. | 0.0061 |
| 54. | 0.3357 | 1119. | 0.0061 |
| 55. | 0.3343 | 1134. | 0.0062 |
| 56. | 0.3324 | 1149. | 0.0058 |
| 57. | 0.3306 | 1164. | 0.0058 |
| 58. | 0.3289 | 1179. | 0.0062 |
| 59. | 0.3266 | 1194. | 0.0065 |
| 60. | 0.3244 | 1209. | 0.0057 |
| 61. | 0.3233 | 1224. | 0.0053 |
| 62. | 0.3199 | 1239. | 0.0051 |
| 63. | 0.3177 | 1254. | 0.005 |
| 64. | 0.3156 | 1269. | 0.0055 |
| 65. | 0.314 | 1284. | 0.0043 |
| 66. | 0.3119 | 1299. | 0.0049 |
| 67. | 0.31 | 1314. | 0.0055 |
| 68. | 0.3085 | 1329. | 0.0045 |
| 69. | 0.3061 | 1344. | 0.0048 |
| 70. | 0.3044 | 1359. | 0.0044 |
| 71. | 0.3024 | 1374. | 0.0043 |
| 72. | 0.3016 | 1389. | 0.0041 |
| 73. | 0.2991 | 1404. | 0.0046 |
| 74. | 0.2978 | 1419. | 0.0043 |
| 75. | 0.2952 | 1434. | 0.0039 |
| 76. | 0.2937 | 1449. | 0.0039 |
| 77. | 0.2918 | 1464. | 0.0044 |
| 78. | 0.2902 | 1479. | 0.0042 |
| 79. | 0.2886 | 1494. | 0.0044 |
| 80. | 0.2865 | 1509. | 0.0042 |
| 81. | 0.2856 | 1524. | 0.0044 |
| 82. | 0.2832 | 1539. | 0.0041 |
| 83. | 0.2822 | 1554. | 0.0038 |
| 84. | 0.2801 | 1569. | 0.0035 |
| 85. | 0.2793 | 1584. | 0.0035 |
| 86. | 0.2765 | 1599. | 0.0036 |
| 87. | 0.2743 | 1614. | 0.0041 |
| 88. | 0.2736 | 1629. | 0.0043 |
| 89. | 0.2713 | 1644. | 0.0045 |
| 90. | 0.2687 | 1659. | 0.0037 |
| 91. | 0.2688 | 1674. | 0.0047 |
| 92. | 0.2666 | 1689. | 0.0035 |
| 93. | 0.2649 | 1704. | 0.0033 |
| 94. | 0.2632 | 1719. | 0.0034 |
| 95. | 0.2611 | 1734. | 0.0042 |
| 96. | 0.2595 | 1749. | 0.0038 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 97. | 0.2586 | 1764. | 0.0049 |
| 98. | 0.2566 | 1779. | 0.0038 |
| 99. | 0.255 | 1794. | 0.0034 |
| 100. | 0.2536 | 1809. | 0.003 |
| 101. | 0.2519 | 1824. | 0.0036 |
| 102. | 0.2504 | 1839. | 0.0038 |
| 103. | 0.2489 | 1854. | 0.0038 |
| 104. | 0.2472 | 1869. | 0.0034 |
| 105. | 0.2464 | 1884. | 0.0032 |
| 106. | 0.2444 | 1899. | 0.0033 |
| 107. | 0.2435 | 1914. | 0.0028 |
| 108. | 0.2424 | 1929. | 0.0037 |
| 109. | 0.241 | 1944. | 0.0035 |
| 110. | 0.2395 | 1959. | 0.0027 |
| 111. | 0.2379 | 1974. | 0.0029 |
| 112. | 0.2362 | 1989. | 0.0033 |
| 113. | 0.2352 | 2004. | 0.0025 |
| 114. | 0.2334 | 2019. | 0.0036 |
| 115. | 0.2139 | 2034. | 0.0021 |
| 129. | 0.1955 | 2049. | 0.0032 |
| 144. | 0.1801 | 2064. | 0.003 |
| 159. | 0.1659 | 2079. | 0.0035 |
| 174. | 0.1542 | 2094. | 0.0033 |
| 189. | 0.1411 | 2109. | 0.0027 |
| 204. | 0.1305 | 2124. | 0.0026 |
| 219. | 0.1205 | 2139. | 0.0037 |
| 234. | 0.1111 | 2154. | 0.0028 |
| 249. | 0.103 | 2169. | 0.003 |
| 264. | 0.0954 | 2184. | 0.0049 |
| 279. | 0.0883 | 2199. | 0.0022 |
| 294. | 0.0827 | 2214. | 0.0027 |

## SOLUTION

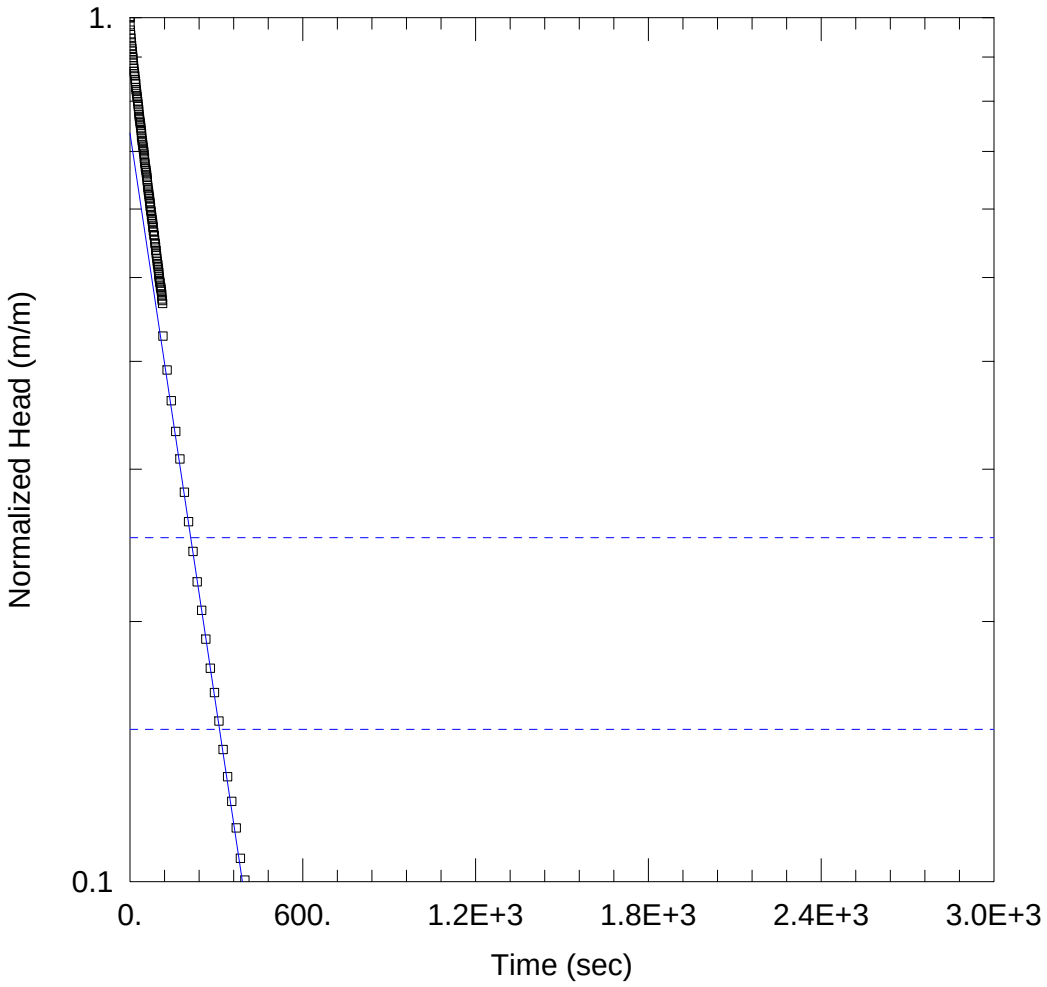
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.228

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 9.404E-7 | m/sec |
| y0 | 0.3672 | m |

K = 9.404E-5 cm/sec
T = K*b = 4.702E-5 m²/sec (0.4702 sq. cm/sec)




## MW-H24C (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H24C
Test Date: 21 July 2013

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H24C)

Initial Displacement: 0.5 m
Total Well Penetration Depth: 10.47 m
Casing Radius: 0.016 m
Static Water Column Height: 10.47 m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 9.404E-7 m/sec
y0 = 0.3672 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H25A (Rising Head Slug Test)
Date: 08/14/13
Time: 10:39:14

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H25A

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H25A

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.35 m
Static Water Column Height: 59.92 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 59.92 m

No. of Observations: 197

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.35 | 99. | 0.0848 |
| 1. | 0.3359 | 100. | 0.0843 |
| 2. | 0.3216 | 101. | 0.0838 |
| 3. | 0.3104 | 102. | 0.0829 |
| 4. | 0.2994 | 103. | 0.0823 |
| 5. | 0.2896 | 104. | 0.0819 |
| 6. | 0.2818 | 105. | 0.0819 |
| 7. | 0.2733 | 106. | 0.0805 |
| 8. | 0.2659 | 107. | 0.0741 |
| 9. | 0.2586 | 108. | 0.0681 |
| 10. | 0.2522 | 123. | 0.0632 |
| 11. | 0.2457 | 138. | 0.0596 |
| 12. | 0.24 | 153. | 0.0555 |
| 13. | 0.2342 | 168. | 0.0522 |
| 14. | 0.2288 | 183. | 0.0492 |
| 15. | 0.224 | 198. | 0.0471 |
| 16. | 0.2191 | 213. | 0.045 |
| 17. | 0.2145 | 228. | 0.0421 |
| 18. | 0.2099 | 243. | 0.0405 |
| 19. | 0.206 | 258. | 0.0387 |
| 20. | 0.2017 | 273. | 0.0369 |
| 21. | 0.1985 | 288. | 0.036 |
| 22. | 0.1946 | 303. | 0.0335 |
| 23. | 0.1914 | 318. | 0.0327 |
| 24. | 0.1878 | 333. | 0.0314 |
| 25. | 0.1841 | 348. | 0.0302 |
| 26. | 0.1814 | 363. | 0.0293 |
| 27. | 0.1785 | 378. | 0.0282 |
| 28. | 0.1759 | 393. | 0.0269 |
| 29. | 0.1728 | 408. | 0.0263 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 30. | 0.1698 | 423. | 0.0258 |
| 31. | 0.1679 | 438. | 0.0247 |
| 32. | 0.1649 | 453. | 0.0243 |
| 33. | 0.1624 | 468. | 0.0227 |
| 34. | 0.1598 | 483. | 0.0224 |
| 35. | 0.1576 | 498. | 0.0214 |
| 36. | 0.1551 | 513. | 0.0209 |
| 37. | 0.1531 | 528. | 0.0204 |
| 38. | 0.1511 | 543. | 0.0203 |
| 39. | 0.1488 | 558. | 0.0193 |
| 40. | 0.1473 | 573. | 0.0185 |
| 41. | 0.145 | 588. | 0.0176 |
| 42. | 0.1427 | 603. | 0.018 |
| 43. | 0.1409 | 618. | 0.0169 |
| 44. | 0.1394 | 633. | 0.0167 |
| 45. | 0.1371 | 648. | 0.0153 |
| 46. | 0.1356 | 663. | 0.0156 |
| 47. | 0.1343 | 678. | 0.0148 |
| 48. | 0.1325 | 693. | 0.0147 |
| 49. | 0.1313 | 708. | 0.0136 |
| 50. | 0.1294 | 723. | 0.0133 |
| 51. | 0.1282 | 738. | 0.0129 |
| 52. | 0.1271 | 753. | 0.0125 |
| 53. | 0.1254 | 768. | 0.012 |
| 54. | 0.1241 | 783. | 0.0115 |
| 55. | 0.1225 | 798. | 0.0111 |
| 56. | 0.1217 | 813. | 0.0108 |
| 57. | 0.1203 | 828. | 0.0108 |
| 58. | 0.1187 | 843. | 0.0105 |
| 59. | 0.1176 | 858. | 0.0101 |
| 60. | 0.1165 | 873. | 0.0098 |
| 61. | 0.1154 | 888. | 0.0097 |
| 62. | 0.1139 | 903. | 0.0097 |
| 63. | 0.1126 | 918. | 0.0088 |
| 64. | 0.1118 | 933. | 0.008 |
| 65. | 0.1106 | 948. | 0.0082 |
| 66. | 0.1101 | 963. | 0.0087 |
| 67. | 0.1091 | 978. | 0.0078 |
| 68. | 0.1077 | 993. | 0.0073 |
| 69. | 0.1073 | 1008. | 0.0068 |
| 70. | 0.1056 | 1023. | 0.0064 |
| 71. | 0.1049 | 1038. | 0.0064 |
| 72. | 0.1043 | 1053. | 0.0065 |
| 73. | 0.1033 | 1068. | 0.0059 |
| 74. | 0.1027 | 1083. | 0.0063 |
| 75. | 0.1016 | 1098. | 0.0057 |
| 76. | 0.1004 | 1113. | 0.0059 |
| 77. | 0.0999 | 1128. | 0.0054 |
| 78. | 0.0994 | 1143. | 0.0054 |
| 79. | 0.098 | 1158. | 0.0049 |
| 80. | 0.0973 | 1173. | 0.0045 |
| 81. | 0.0962 | 1188. | 0.0041 |
| 82. | 0.096 | 1203. | 0.0045 |
| 83. | 0.0947 | 1218. | 0.0042 |
| 84. | 0.0946 | 1233. | 0.0041 |
| 85. | 0.0936 | 1248. | 0.0039 |
| 86. | 0.093 | 1263. | 0.0039 |
| 87. | 0.092 | 1278. | 0.0038 |
| 88. | 0.0915 | 1293. | 0.0039 |
| 89. | 0.0905 | 1308. | 0.0035 |
| 90. | 0.0903 | 1323. | 0.0029 |
| 91. | 0.0897 | 1338. | 0.0029 |
| 92. | 0.0884 | 1353. | 0.003 |
| 93. | 0.0884 | 1368. | 0.0032 |
| 94. | 0.0879 | 1383. | 0.0031 |
| 95. | 0.0862 | 1398. | 0.0022 |
| 96. | 0.0867 | 1413. | 0.0024 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 97. | 0.0863 | 1428. | 0.0024 |
| 98. | 0.0849 | | |

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 4.258E-7 | m/sec |
| y0 | 0.07041 | m |

K = 4.258E-5 cm/sec
T = K*b = 4.258E-5 m²/sec (0.4258 sq. cm/sec)

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H25A Zone 1 (Falling Head Packer Test, vertical interval 58.5-69.2 m)
Date: 08/15/13
Time: 13:38:12

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 31 October 2012
Test Well: MW-H25A Zone 1

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H25A Zone 1

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.5 m
Static Water Column Height: 68.3 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 10.7 m
Total Well Penetration Depth: 68.3 m

No. of Observations: 93

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.5 | 1410. | 0.1645 |
| 30. | 1.197 | 1440. | 0.1616 |
| 60. | 1.011 | 1470. | 0.1583 |
| 90. | 0.8819 | 1500. | 0.155 |
| 120. | 0.7867 | 1530. | 0.1522 |
| 150. | 0.7108 | 1560. | 0.1494 |
| 180. | 0.6526 | 1590. | 0.1448 |
| 210. | 0.6039 | 1620. | 0.1431 |
| 240. | 0.5638 | 1650. | 0.1393 |
| 270. | 0.5301 | 1680. | 0.1368 |
| 300. | 0.5007 | 1710. | 0.1349 |
| 330. | 0.4752 | 1740. | 0.1325 |
| 360. | 0.4501 | 1770. | 0.1298 |
| 390. | 0.4298 | 1800. | 0.1269 |
| 420. | 0.4111 | 1830. | 0.1253 |
| 450. | 0.395 | 1860. | 0.1219 |
| 480. | 0.38 | 1890. | 0.1196 |
| 510. | 0.3661 | 1920. | 0.1173 |
| 540. | 0.3531 | 1950. | 0.1147 |
| 570. | 0.3402 | 1980. | 0.1131 |
| 600. | 0.3284 | 2010. | 0.1103 |
| 630. | 0.3182 | 2040. | 0.1093 |
| 660. | 0.3076 | 2070. | 0.1069 |
| 690. | 0.2983 | 2100. | 0.1052 |
| 720. | 0.2896 | 2130. | 0.1025 |
| 750. | 0.2809 | 2160. | 0.1011 |
| 780. | 0.2726 | 2190. | 0.0986 |
| 810. | 0.2639 | 2220. | 0.0972 |
| 840. | 0.2572 | 2250. | 0.0954 |
| 870. | 0.2501 | 2280. | 0.0947 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 0.2435 | 2310. | 0.0926 |
| 930. | 0.2374 | 2340. | 0.0918 |
| 960. | 0.2317 | 2370. | 0.0894 |
| 990. | 0.2258 | 2400. | 0.0884 |
| 1020. | 0.2203 | 2430. | 0.086 |
| 1050. | 0.2149 | 2460. | 0.0841 |
| 1080. | 0.21 | 2490. | 0.082 |
| 1110. | 0.2047 | 2520. | 0.0803 |
| 1140. | 0.2002 | 2550. | 0.0788 |
| 1170. | 0.1957 | 2580. | 0.0778 |
| 1200. | 0.1921 | 2610. | 0.0759 |
| 1230. | 0.1874 | 2640. | 0.0729 |
| 1260. | 0.1826 | 2670. | 0.0712 |
| 1290. | 0.1789 | 2700. | 0.0698 |
| 1320. | 0.1735 | 2730. | 0.0688 |
| 1350. | 0.1712 | 2760. | 0.0666 |
| 1380. | 0.1677 | | |

## SOLUTION

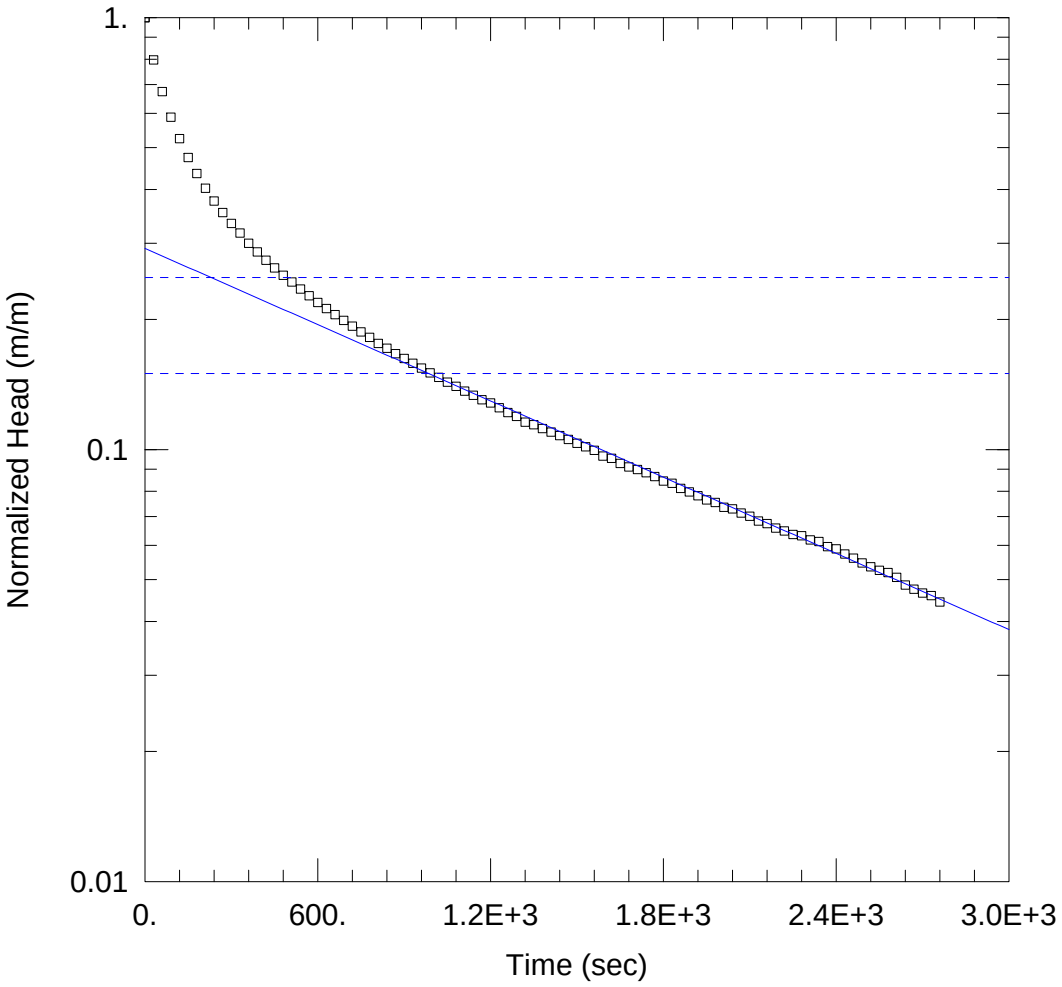
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1773

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 2.578E-7 | m/sec |
| y0 | 0.4382 | m |

K = 2.578E-5 cm/sec
T = K*b = 2.578E-5 m²/sec (0.2578 sq. cm/sec)




MW-H25A ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 58.5-69.2 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H25A Zone 1
Test Date: 31 October 2012

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.578E-7 m/sec
y0 = 0.4382 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H25A Zone 2 (Falling Head Packer Test, vertical interval 69.2-79.9 m)
Date: 08/14/13
Time: 14:22:50

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 31 October 2012
Test Well: MW-H25A Zone 2

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H25A Zone 2

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.8 m
Static Water Column Height: 77.63 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 10.7 m
Total Well Penetration Depth: 77.63 m

No. of Observations: 124

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 2.8 | 1860. | 2.6 |
| 30. | 2.787 | 1890. | 2.598 |
| 60. | 2.778 | 1920. | 2.596 |
| 90. | 2.771 | 1950. | 2.593 |
| 120. | 2.765 | 1980. | 2.591 |
| 150. | 2.76 | 2010. | 2.59 |
| 180. | 2.754 | 2040. | 2.588 |
| 210. | 2.749 | 2070. | 2.585 |
| 240. | 2.745 | 2100. | 2.583 |
| 270. | 2.74 | 2130. | 2.581 |
| 300. | 2.737 | 2160. | 2.579 |
| 330. | 2.733 | 2190. | 2.577 |
| 360. | 2.729 | 2220. | 2.575 |
| 390. | 2.726 | 2250. | 2.573 |
| 420. | 2.722 | 2280. | 2.571 |
| 450. | 2.719 | 2310. | 2.569 |
| 480. | 2.715 | 2340. | 2.567 |
| 510. | 2.712 | 2370. | 2.565 |
| 540. | 2.71 | 2400. | 2.563 |
| 570. | 2.706 | 2430. | 2.561 |
| 600. | 2.704 | 2460. | 2.559 |
| 630. | 2.7 | 2490. | 2.556 |
| 660. | 2.698 | 2520. | 2.555 |
| 690. | 2.695 | 2550. | 2.552 |
| 720. | 2.692 | 2580. | 2.551 |
| 750. | 2.689 | 2610. | 2.549 |
| 780. | 2.686 | 2640. | 2.547 |
| 810. | 2.684 | 2670. | 2.546 |
| 840. | 2.681 | 2700. | 2.544 |
| 870. | 2.678 | 2730. | 2.542 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 2.676 | 2760. | 2.54 |
| 930. | 2.675 | 2790. | 2.539 |
| 960. | 2.671 | 2820. | 2.536 |
| 990. | 2.668 | 2850. | 2.535 |
| 1020. | 2.665 | 2880. | 2.533 |
| 1050. | 2.663 | 2910. | 2.53 |
| 1080. | 2.66 | 2940. | 2.529 |
| 1110. | 2.658 | 2970. | 2.528 |
| 1140. | 2.655 | 3000. | 2.526 |
| 1170. | 2.652 | 3030. | 2.524 |
| 1200. | 2.65 | 3060. | 2.522 |
| 1230. | 2.649 | 3090. | 2.52 |
| 1260. | 2.646 | 3120. | 2.518 |
| 1290. | 2.644 | 3150. | 2.515 |
| 1320. | 2.641 | 3180. | 2.513 |
| 1350. | 2.639 | 3210. | 2.512 |
| 1380. | 2.636 | 3240. | 2.511 |
| 1410. | 2.634 | 3270. | 2.509 |
| 1440. | 2.632 | 3300. | 2.507 |
| 1470. | 2.629 | 3330. | 2.504 |
| 1500. | 2.627 | 3360. | 2.503 |
| 1530. | 2.624 | 3390. | 2.5 |
| 1560. | 2.622 | 3420. | 2.499 |
| 1590. | 2.621 | 3450. | 2.498 |
| 1620. | 2.618 | 3480. | 2.496 |
| 1650. | 2.616 | 3510. | 2.494 |
| 1680. | 2.614 | 3540. | 2.491 |
| 1710. | 2.612 | 3570. | 2.49 |
| 1740. | 2.61 | 3600. | 2.489 |
| 1770. | 2.607 | 3630. | 2.487 |
| 1800. | 2.606 | 3660. | 2.486 |
| 1830. | 2.603 | 3690. | 2.478 |

## SOLUTION

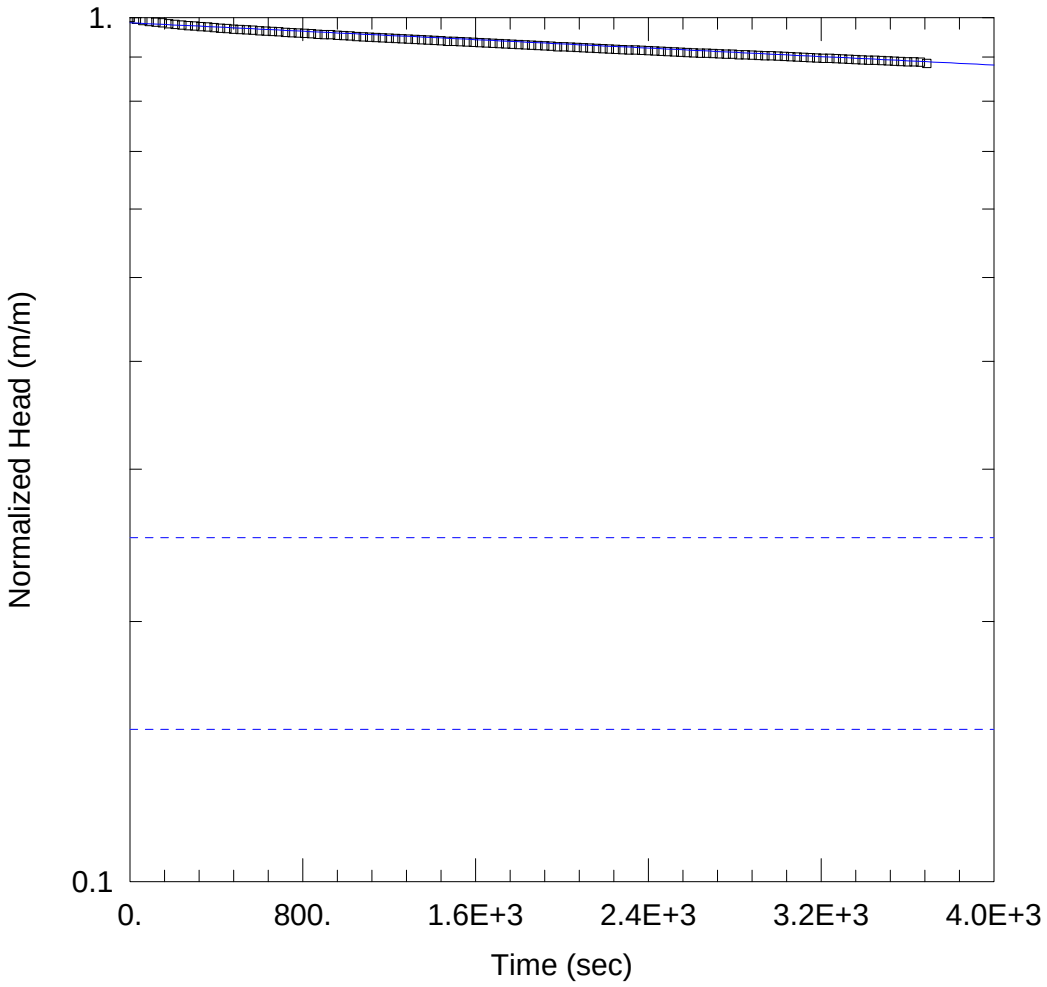
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1773

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.071E-8 | m/sec |
| y0 | 2.761 | m |

K = 1.071E-6 cm/sec
T = K*b = 1.071E-6 m²/sec (0.01071 sq. cm/sec)




MW-H25A ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 69.2-79.9 M)

PROJECT INFORMATION

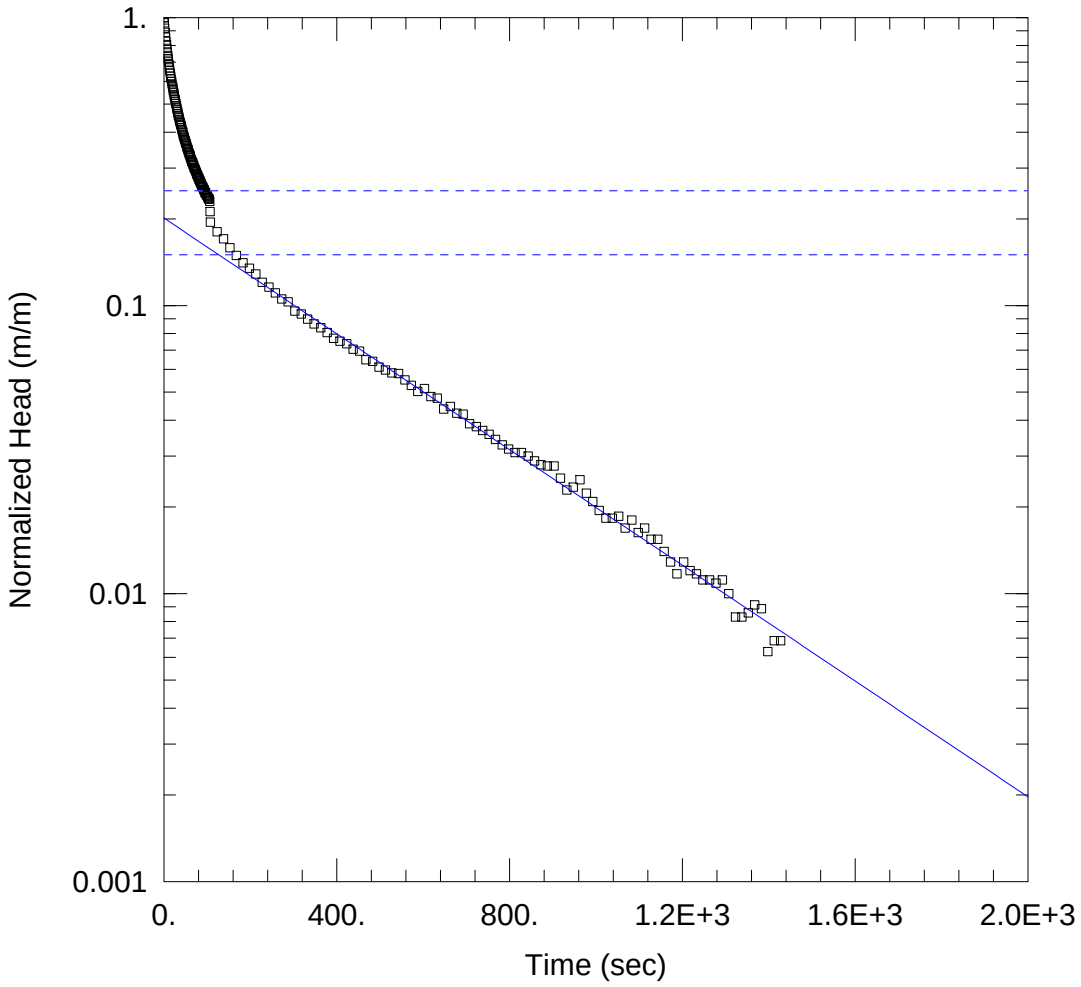
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H25A Zone 2
Test Date: 31 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.071E-8 m/sec
y0 = 2.761 m




## MW-H25A (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H25A
Test Date: 21 July 2013

### AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H25A)

Initial Displacement: 0.35 m
Total Well Penetration Depth: 59.92 m
Casing Radius: 0.016 m
Static Water Column Height: 59.92 m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Confined
K = 4.258E-7 m/sec
Solution Method: Hvorslev
y0 = 0.07041 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H25B (Rising Head Slug Test)
Date: 08/14/13
Time: 10:57:20

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 24 October 2012
Test Well: MW-H25B

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

### Test Well: MW-H25B

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.13 m
Static Water Column Height: 4.068 m
Casing Radius: 0.016 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 4.113 m

No. of Observations: 101

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.13 | 255. | 0.0327 |
| 5. | 0.1159 | 260. | 0.0322 |
| 10. | 0.1097 | 265. | 0.0311 |
| 15. | 0.1043 | 270. | 0.0306 |
| 20. | 0.1012 | 275. | 0.0299 |
| 25. | 0.0983 | 280. | 0.0296 |
| 30. | 0.0944 | 285. | 0.0299 |
| 35. | 0.0915 | 290. | 0.0283 |
| 40. | 0.0874 | 295. | 0.0273 |
| 45. | 0.0858 | 300. | 0.0272 |
| 50. | 0.0828 | 305. | 0.0266 |
| 55. | 0.0807 | 310. | 0.0256 |
| 60. | 0.079 | 315. | 0.025 |
| 65. | 0.0768 | 320. | 0.0251 |
| 70. | 0.0742 | 325. | 0.0243 |
| 75. | 0.0721 | 330. | 0.025 |
| 80. | 0.0716 | 335. | 0.0245 |
| 85. | 0.0695 | 340. | 0.0228 |
| 90. | 0.0683 | 345. | 0.0228 |
| 95. | 0.0656 | 350. | 0.0236 |
| 100. | 0.0641 | 355. | 0.0221 |
| 105. | 0.0624 | 360. | 0.0215 |
| 110. | 0.0605 | 365. | 0.0213 |
| 115. | 0.0593 | 370. | 0.0209 |
| 120. | 0.0583 | 375. | 0.0198 |
| 125. | 0.0573 | 380. | 0.0193 |
| 130. | 0.0554 | 385. | 0.0193 |
| 135. | 0.055 | 390. | 0.0202 |
| 140. | 0.0526 | 395. | 0.0183 |
| 145. | 0.0516 | 400. | 0.0188 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 150. | 0.0513 | 405. | 0.0184 |
| 155. | 0.0488 | 410. | 0.0184 |
| 160. | 0.0483 | 415. | 0.0171 |
| 165. | 0.0482 | 420. | 0.0177 |
| 170. | 0.0462 | 425. | 0.0167 |
| 175. | 0.0456 | 430. | 0.0161 |
| 180. | 0.0432 | 435. | 0.0161 |
| 185. | 0.0434 | 440. | 0.0151 |
| 190. | 0.0426 | 445. | 0.0157 |
| 195. | 0.041 | 450. | 0.0154 |
| 200. | 0.0411 | 455. | 0.0147 |
| 205. | 0.0399 | 460. | 0.0152 |
| 210. | 0.039 | 465. | 0.0144 |
| 215. | 0.0374 | 470. | 0.0141 |
| 220. | 0.0375 | 475. | 0.0133 |
| 225. | 0.0368 | 480. | 0.0134 |
| 230. | 0.0365 | 485. | 0.0131 |
| 235. | 0.0353 | 490. | 0.0127 |
| 240. | 0.0346 | 495. | 0.0122 |
| 245. | 0.034 | 500. | 0.0119 |
| 250. | 0.0331 | | |

## SOLUTION

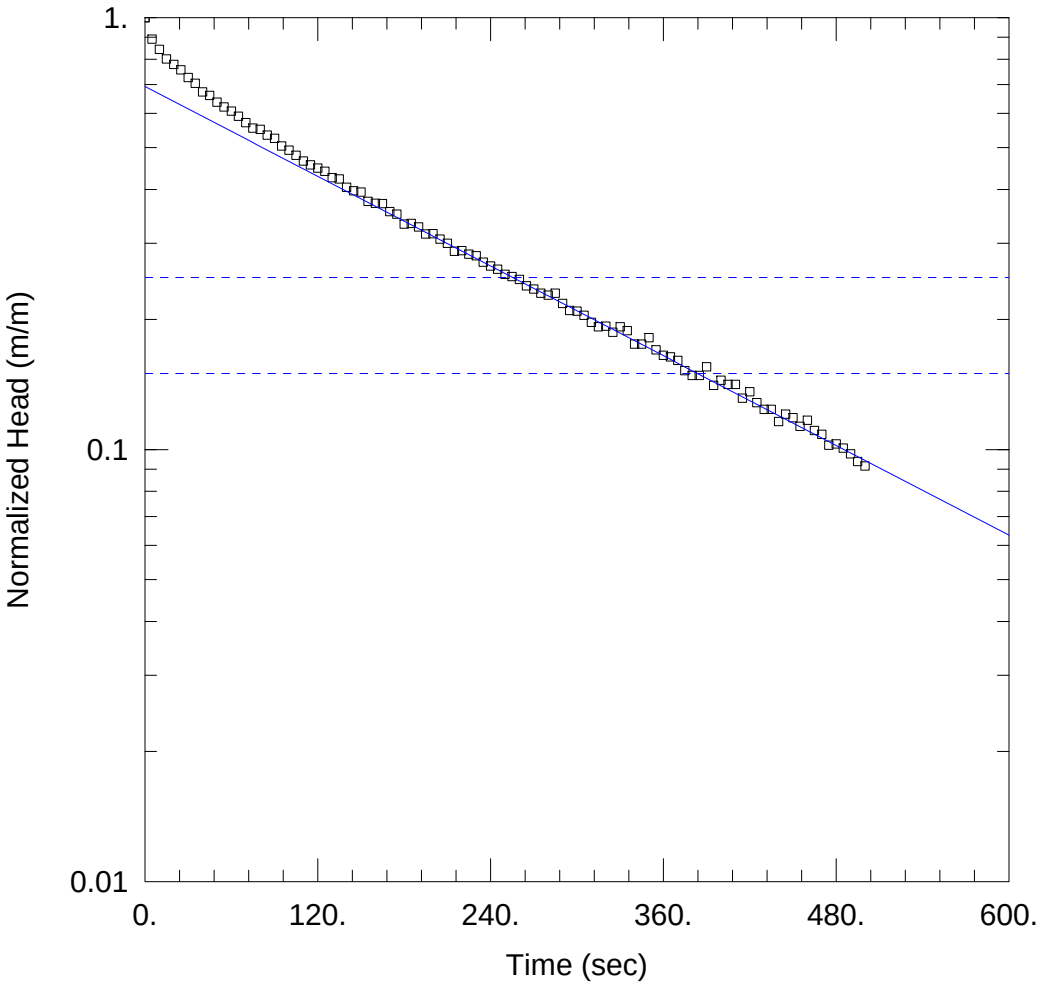
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 6.795E-7 | m/sec |
| y0 | 0.08998 | m |

K = 6.795E-5 cm/sec
T = K*b = 3.397E-5 m²/sec (0.3397 sq. cm/sec)




## MW-H25B (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H25B
Test Date: 24 October 2012

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H25B)

Initial Displacement: 0.13 m
Total Well Penetration Depth: 4.113 m
Casing Radius: 0.016 m
Static Water Column Height: 4.068 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

### SOLUTION

Aquifer Model: Unconfined
K = 6.795E-7 m/sec
Solution Method: Hvorslev
y0 = 0.08998 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H26A (Rising Head Slug Test)
Date: 08/14/13
Time: 10:59:00

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H26A

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H26A

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.4 m
Static Water Column Height: 32.45 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 32.45 m

No. of Observations: 55

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.4 | 420. | 0.0081 |
| 15. | 0.3446 | 435. | 0.0068 |
| 30. | 0.2984 | 450. | 0.0057 |
| 45. | 0.2583 | 465. | 0.005 |
| 60. | 0.2232 | 480. | 0.004 |
| 75. | 0.1926 | 495. | 0.0038 |
| 90. | 0.1664 | 510. | 0.0034 |
| 105. | 0.145 | 525. | 0.0029 |
| 120. | 0.1249 | 540. | 0.0018 |
| 135. | 0.1078 | 555. | 0.0026 |
| 150. | 0.0938 | 570. | 0.0019 |
| 165. | 0.0808 | 585. | 0.0017 |
| 180. | 0.0705 | 600. | 0.0012 |
| 195. | 0.0611 | 615. | 0.0014 |
| 210. | 0.0526 | 630. | 0.0017 |
| 225. | 0.0459 | 645. | 0.0016 |
| 240. | 0.0398 | 660. | 0.0013 |
| 255. | 0.0343 | 675. | 0.0015 |
| 270. | 0.0299 | 690. | 0.0011 |
| 285. | 0.0256 | 705. | 0.0016 |
| 300. | 0.0223 | 720. | 0.0011 |
| 315. | 0.0198 | 735. | 0.0008 |
| 330. | 0.0174 | 750. | 0.0009 |
| 345. | 0.0152 | 765. | 0.0009 |
| 360. | 0.0134 | 780. | 0.0008 |
| 375. | 0.0115 | 795. | 0.0006 |
| 390. | 0.01 | 810. | 0.0012 |
| 405. | 0.009 | | |

## SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.746E-6 | m/sec |
| y0 | 0.3936 | m |

K = 0.0001746 cm/sec
T = K*b = 0.0001746 m²/sec (1.746 sq. cm/sec)

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H26A Zone 1 (Falling Head Packer Test, vertical interval 34.1-48.5 m)
Date: 08/14/13
Time: 14:20:48

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ldt.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 26 October 2012
Test Well: MW-H26A Zone 1

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H26A Zone 1

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3 m
Static Water Column Height: 48.9 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 14.4 m
Total Well Penetration Depth: 48.9 m

No. of Observations: 92

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.3 | 1380. | 0.1643 |
| 30. | 0.2688 | 1410. | 0.1684 |
| 60. | 0.2548 | 1440. | 0.1632 |
| 90. | 0.2397 | 1470. | 0.1647 |
| 120. | 0.2328 | 1500. | 0.1607 |
| 150. | 0.2248 | 1530. | 0.162 |
| 180. | 0.2235 | 1560. | 0.1613 |
| 210. | 0.2183 | 1590. | 0.1571 |
| 240. | 0.2165 | 1620. | 0.1592 |
| 270. | 0.2128 | 1650. | 0.1534 |
| 300. | 0.2114 | 1680. | 0.1578 |
| 330. | 0.2141 | 1710. | 0.151 |
| 360. | 0.2104 | 1740. | 0.151 |
| 390. | 0.2093 | 1770. | 0.1519 |
| 420. | 0.2072 | 1800. | 0.1477 |
| 450. | 0.2045 | 1830. | 0.1497 |
| 480. | 0.2053 | 1860. | 0.1438 |
| 510. | 0.2022 | 1890. | 0.1475 |
| 540. | 0.2014 | 1920. | 0.1455 |
| 570. | 0.199 | 1950. | 0.1403 |
| 600. | 0.1972 | 1980. | 0.1444 |
| 630. | 0.197 | 2010. | 0.139 |
| 660. | 0.1925 | 2040. | 0.1414 |
| 690. | 0.195 | 2070. | 0.1383 |
| 720. | 0.1917 | 2100. | 0.136 |
| 750. | 0.1902 | 2130. | 0.1389 |
| 780. | 0.1902 | 2160. | 0.1314 |
| 810. | 0.1877 | 2190. | 0.1351 |
| 840. | 0.1882 | 2220. | 0.133 |
| 870. | 0.1842 | 2250. | 0.1302 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 0.1844 | 2280. | 0.1317 |
| 930. | 0.1832 | 2310. | 0.1254 |
| 960. | 0.18 | 2340. | 0.1302 |
| 990. | 0.1822 | 2370. | 0.1247 |
| 1020. | 0.1777 | 2400. | 0.1257 |
| 1050. | 0.1796 | 2430. | 0.1262 |
| 1080. | 0.1764 | 2460. | 0.1214 |
| 1110. | 0.1761 | 2490. | 0.1258 |
| 1140. | 0.1749 | 2520. | 0.1183 |
| 1170. | 0.1726 | 2550. | 0.1221 |
| 1200. | 0.1743 | 2580. | 0.1204 |
| 1230. | 0.1709 | 2610. | 0.114 |
| 1260. | 0.1727 | 2640. | 0.1205 |
| 1290. | 0.1682 | 2670. | 0.114 |
| 1320. | 0.1677 | 2700. | 0.1154 |
| 1350. | 0.1688 | 2730. | 0.1132 |

## SOLUTION

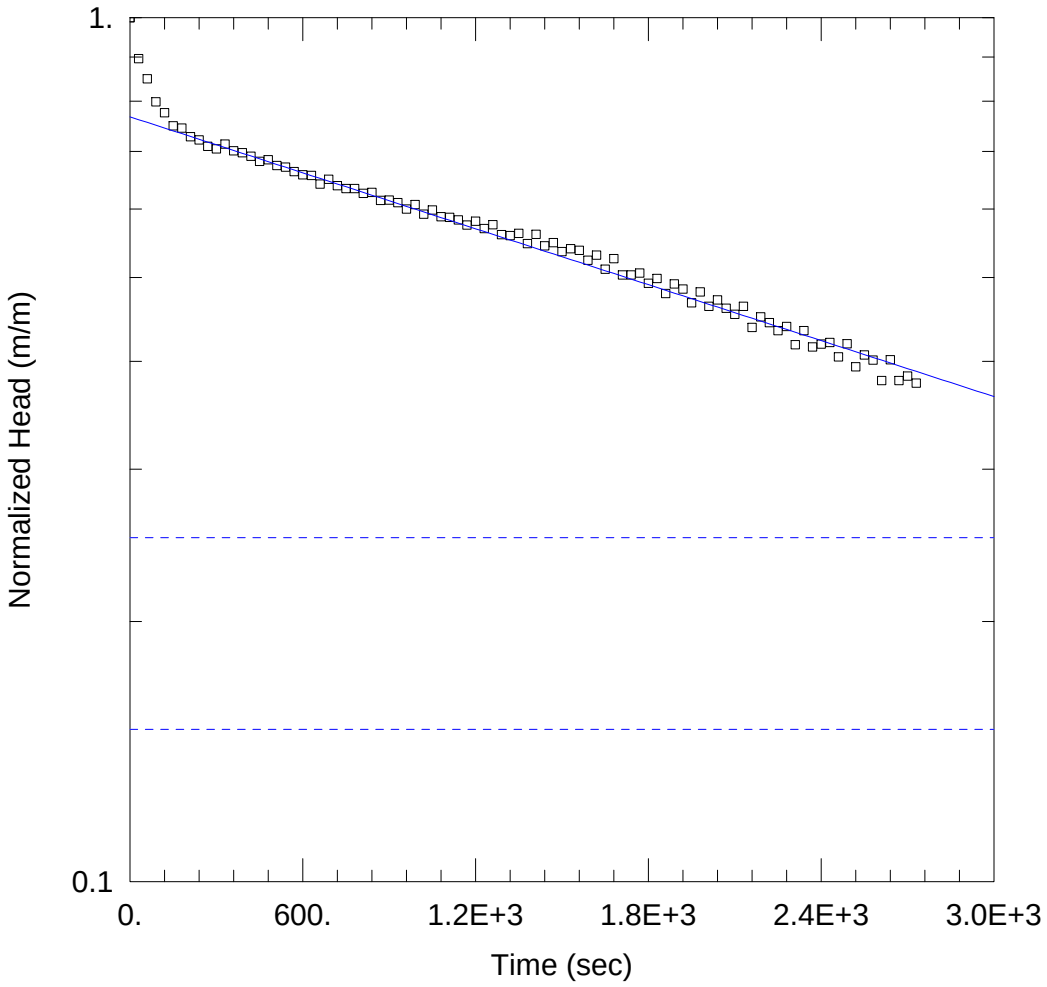
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1684

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 7.396E-8 | m/sec |
| y0 | 0.2302 | m |

K = 7.396E-6 cm/sec
T = K*b = 7.396E-6 m²/sec (0.07396 sq. cm/sec)




MW-H26A ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 34.1-48.5 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ldt.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H26A Zone 1
Test Date: 26 October 2012

## AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 7.396E-8 m/sec

y0 = 0.2302 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H26A Zone 2 (Falling Head Packer Test, vertical interval 49.7-64.3 m)
Date: 08/14/13
Time: 14:31:53

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 27 October 2012
Test Well: MW-H26A Zone 2

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H26A Zone 2

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.45 m
Static Water Column Height: 65. m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 14.6 m
Total Well Penetration Depth: 65. m

No. of Observations: 44

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.45 | 660. | 0.6905 |
| 30. | 1.396 | 690. | 0.6632 |
| 60. | 1.346 | 720. | 0.6369 |
| 90. | 1.304 | 750. | 0.6113 |
| 120. | 1.261 | 780. | 0.585 |
| 150. | 1.222 | 810. | 0.5598 |
| 180. | 1.184 | 840. | 0.5341 |
| 210. | 1.149 | 870. | 0.51 |
| 240. | 1.111 | 900. | 0.4838 |
| 270. | 1.08 | 930. | 0.4599 |
| 300. | 1.044 | 960. | 0.4346 |
| 330. | 1.013 | 990. | 0.4158 |
| 360. | 0.9773 | 1020. | 0.3905 |
| 390. | 0.9488 | 1050. | 0.3672 |
| 420. | 0.9213 | 1080. | 0.3475 |
| 450. | 0.8895 | 1110. | 0.3227 |
| 480. | 0.8549 | 1140. | 0.299 |
| 510. | 0.827 | 1170. | 0.2777 |
| 540. | 0.8016 | 1200. | 0.2592 |
| 570. | 0.7734 | 1230. | 0.2363 |
| 600. | 0.743 | 1260. | 0.2151 |
| 630. | 0.7176 | 1290. | 0.1962 |

## SOLUTION

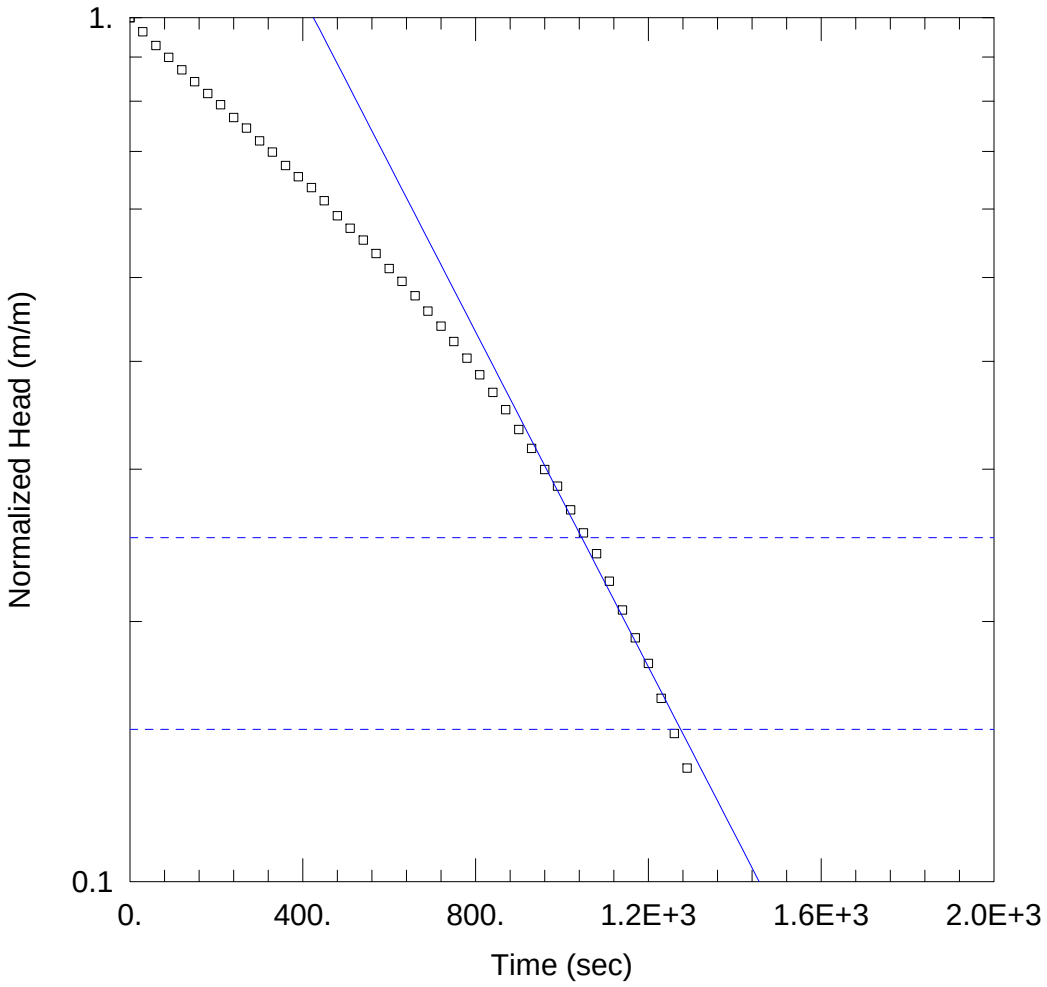
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.168

VISUAL ESTIMATION RESULTS

Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 6.569E-7 | m/sec |
| y0 | 3.742 | m |

K = 6.569E-5 cm/sec
T = K*b = 6.569E-5 m²/sec (0.6569 sq. cm/sec)




MW-H26A ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 49.7-64.3 M)

PROJECT INFORMATION

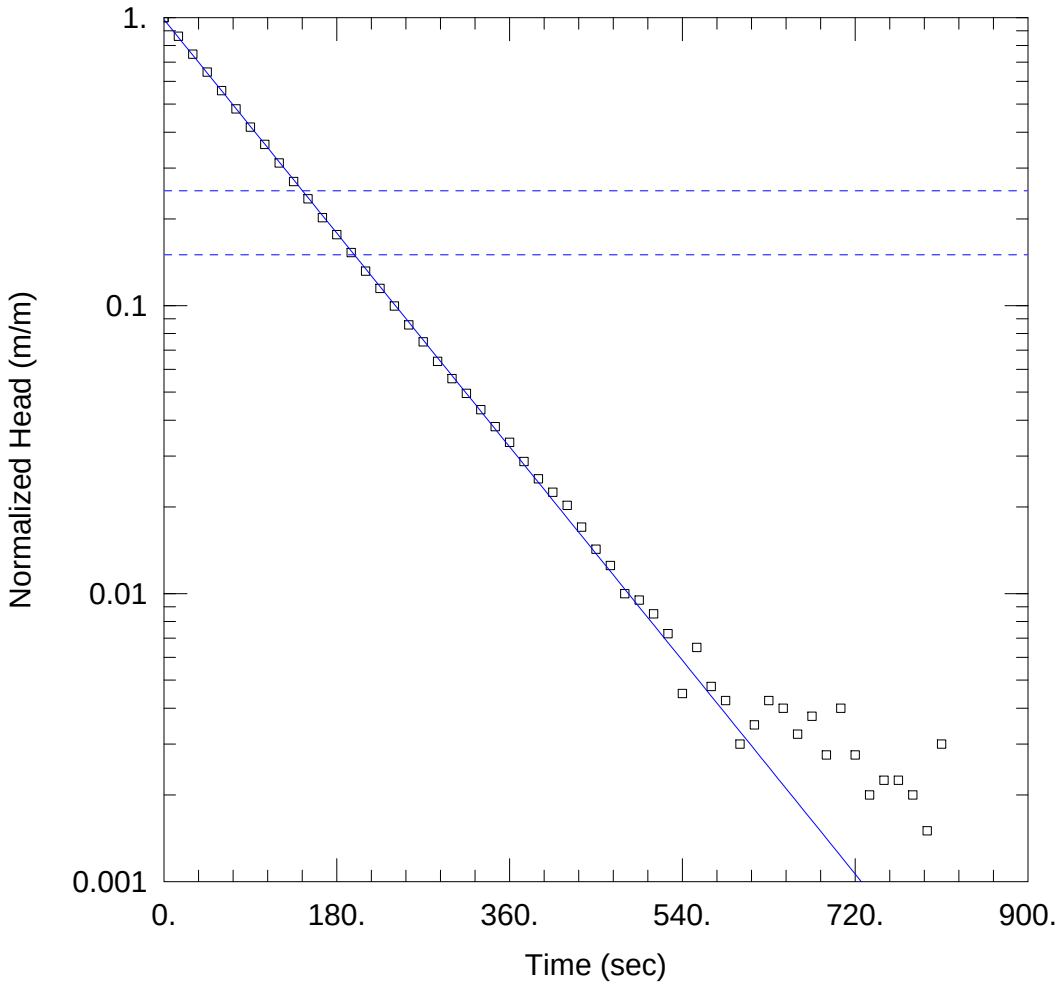
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H26A Zone 2
Test Date: 27 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 6.569E-7 m/sec
y0 = 3.742 m




## MW-H26A (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H26A
Test Date: 21 July 2013

### AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H26A)

Initial Displacement: 0.4 m
Total Well Penetration Depth: 32.45 m
Casing Radius: 0.016 m
Static Water Column Height: 32.45 m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Confined
K = 1.746E-6 m/sec
Solution Method: Hvorslev
y0 = 0.3936 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H26B (Rising Head Slug Test)
Date: 08/14/13
Time: 11:09:31

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 31 October 2012
Test Well: MW-26B

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H26B

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3 m
Static Water Column Height: 3.6 m
Casing Radius: 0.016 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 3.6 m

No. of Observations: 898

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.3 | 2.694E+4 | 0.1567 |
| 60. | 0.2985 | 2.7E+4 | 0.1558 |
| 120. | 0.2989 | 2.706E+4 | 0.1559 |
| 180. | 0.2981 | 2.712E+4 | 0.1553 |
| 240. | 0.2966 | 2.718E+4 | 0.1551 |
| 300. | 0.2963 | 2.724E+4 | 0.1552 |
| 360. | 0.2951 | 2.73E+4 | 0.1547 |
| 420. | 0.295 | 2.736E+4 | 0.154 |
| 480. | 0.2951 | 2.742E+4 | 0.1532 |
| 540. | 0.296 | 2.748E+4 | 0.1534 |
| 600. | 0.2956 | 2.754E+4 | 0.1532 |
| 660. | 0.2938 | 2.76E+4 | 0.1527 |
| 720. | 0.2931 | 2.766E+4 | 0.1533 |
| 780. | 0.2929 | 2.772E+4 | 0.1524 |
| 840. | 0.2944 | 2.778E+4 | 0.1512 |
| 900. | 0.2935 | 2.784E+4 | 0.151 |
| 960. | 0.2932 | 2.79E+4 | 0.1508 |
| 1020. | 0.2918 | 2.796E+4 | 0.1503 |
| 1080. | 0.2922 | 2.802E+4 | 0.1508 |
| 1140. | 0.2914 | 2.808E+4 | 0.1496 |
| 1200. | 0.2917 | 2.814E+4 | 0.1496 |
| 1260. | 0.2906 | 2.82E+4 | 0.149 |
| 1320. | 0.2902 | 2.826E+4 | 0.1494 |
| 1380. | 0.2899 | 2.832E+4 | 0.1483 |
| 1440. | 0.2891 | 2.838E+4 | 0.1485 |
| 1500. | 0.2892 | 2.844E+4 | 0.1487 |
| 1560. | 0.2883 | 2.85E+4 | 0.1478 |
| 1620. | 0.2886 | 2.856E+4 | 0.1476 |
| 1680. | 0.2879 | 2.862E+4 | 0.1468 |
| 1740. | 0.2867 | 2.868E+4 | 0.1462 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1800. | 0.287 | 2.874E+4 | 0.1457 |
| 1860. | 0.2871 | 2.88E+4 | 0.1458 |
| 1920. | 0.2858 | 2.886E+4 | 0.1448 |
| 1980. | 0.2858 | 2.892E+4 | 0.1455 |
| 2040. | 0.2855 | 2.898E+4 | 0.1439 |
| 2100. | 0.2851 | 2.904E+4 | 0.1444 |
| 2160. | 0.2842 | 2.91E+4 | 0.1442 |
| 2220. | 0.2842 | 2.916E+4 | 0.1438 |
| 2280. | 0.2839 | 2.922E+4 | 0.1425 |
| 2340. | 0.2824 | 2.928E+4 | 0.1423 |
| 2400. | 0.2826 | 2.934E+4 | 0.1423 |
| 2460. | 0.2822 | 2.94E+4 | 0.1422 |
| 2520. | 0.2812 | 2.946E+4 | 0.1425 |
| 2580. | 0.2802 | 2.952E+4 | 0.1412 |
| 2640. | 0.2797 | 2.958E+4 | 0.1414 |
| 2700. | 0.2794 | 2.964E+4 | 0.1405 |
| 2760. | 0.2795 | 2.97E+4 | 0.1405 |
| 2820. | 0.2793 | 2.976E+4 | 0.1402 |
| 2880. | 0.2792 | 2.982E+4 | 0.1398 |
| 2940. | 0.2778 | 2.988E+4 | 0.1397 |
| 3000. | 0.2775 | 2.994E+4 | 0.1398 |
| 3060. | 0.2767 | 3.0E+4 | 0.1391 |
| 3120. | 0.2772 | 3.006E+4 | 0.1399 |
| 3180. | 0.2764 | 3.012E+4 | 0.1399 |
| 3240. | 0.2763 | 3.018E+4 | 0.1388 |
| 3300. | 0.2756 | 3.024E+4 | 0.1379 |
| 3360. | 0.274 | 3.03E+4 | 0.1387 |
| 3420. | 0.2746 | 3.036E+4 | 0.1391 |
| 3480. | 0.2735 | 3.042E+4 | 0.1388 |
| 3540. | 0.2732 | 3.048E+4 | 0.1383 |
| 3600. | 0.273 | 3.054E+4 | 0.1367 |
| 3660. | 0.2726 | 3.06E+4 | 0.1379 |
| 3720. | 0.2716 | 3.066E+4 | 0.1374 |
| 3780. | 0.2707 | 3.072E+4 | 0.1374 |
| 3840. | 0.2711 | 3.078E+4 | 0.1373 |
| 3900. | 0.2702 | 3.084E+4 | 0.1366 |
| 3960. | 0.2701 | 3.09E+4 | 0.1361 |
| 4020. | 0.2696 | 3.096E+4 | 0.1352 |
| 4080. | 0.2699 | 3.102E+4 | 0.1352 |
| 4140. | 0.2688 | 3.108E+4 | 0.1351 |
| 4200. | 0.2692 | 3.114E+4 | 0.136 |
| 4260. | 0.2674 | 3.12E+4 | 0.1349 |
| 4320. | 0.2671 | 3.126E+4 | 0.1346 |
| 4380. | 0.2659 | 3.132E+4 | 0.1346 |
| 4440. | 0.2659 | 3.138E+4 | 0.1339 |
| 4500. | 0.2659 | 3.144E+4 | 0.1337 |
| 4560. | 0.2656 | 3.15E+4 | 0.1333 |
| 4620. | 0.2647 | 3.156E+4 | 0.1329 |
| 4680. | 0.2639 | 3.162E+4 | 0.1331 |
| 4740. | 0.2633 | 3.168E+4 | 0.1317 |
| 4800. | 0.2629 | 3.174E+4 | 0.132 |
| 4860. | 0.2619 | 3.18E+4 | 0.1315 |
| 4920. | 0.2614 | 3.186E+4 | 0.1313 |
| 4980. | 0.2616 | 3.192E+4 | 0.1308 |
| 5040. | 0.2611 | 3.198E+4 | 0.1309 |
| 5100. | 0.2607 | 3.204E+4 | 0.1302 |
| 5160. | 0.2591 | 3.21E+4 | 0.1301 |
| 5220. | 0.2596 | 3.216E+4 | 0.1304 |
| 5280. | 0.2589 | 3.222E+4 | 0.1298 |
| 5340. | 0.2568 | 3.228E+4 | 0.1281 |
| 5400. | 0.2574 | 3.234E+4 | 0.1286 |
| 5460. | 0.2568 | 3.24E+4 | 0.1289 |
| 5520. | 0.2557 | 3.246E+4 | 0.1272 |
| 5580. | 0.2556 | 3.252E+4 | 0.1276 |
| 5640. | 0.2549 | 3.258E+4 | 0.1276 |
| 5700. | 0.2555 | 3.264E+4 | 0.1279 |
| 5760. | 0.2545 | 3.27E+4 | 0.1263 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 5820. | 0.2545 | 3.276E+4 | 0.1263 |
| 5880. | 0.253 | 3.282E+4 | 0.1259 |
| 5940. | 0.2535 | 3.288E+4 | 0.1261 |
| 6000. | 0.2526 | 3.294E+4 | 0.1253 |
| 6060. | 0.2524 | 3.3E+4 | 0.1257 |
| 6120. | 0.2512 | 3.306E+4 | 0.1246 |
| 6180. | 0.2514 | 3.312E+4 | 0.1245 |
| 6240. | 0.251 | 3.318E+4 | 0.1244 |
| 6300. | 0.2506 | 3.324E+4 | 0.1238 |
| 6360. | 0.2502 | 3.33E+4 | 0.1238 |
| 6420. | 0.2498 | 3.336E+4 | 0.1238 |
| 6480. | 0.2487 | 3.342E+4 | 0.1237 |
| 6540. | 0.2483 | 3.348E+4 | 0.1226 |
| 6600. | 0.2469 | 3.354E+4 | 0.1217 |
| 6660. | 0.2468 | 3.36E+4 | 0.1222 |
| 6720. | 0.2478 | 3.366E+4 | 0.123 |
| 6780. | 0.2474 | 3.372E+4 | 0.1223 |
| 6840. | 0.2473 | 3.378E+4 | 0.1215 |
| 6900. | 0.2475 | 3.384E+4 | 0.1224 |
| 6960. | 0.247 | 3.39E+4 | 0.1213 |
| 7020. | 0.2467 | 3.396E+4 | 0.1218 |
| 7080. | 0.2452 | 3.402E+4 | 0.1205 |
| 7140. | 0.245 | 3.408E+4 | 0.1208 |
| 7200. | 0.2449 | 3.414E+4 | 0.1205 |
| 7260. | 0.2448 | 3.42E+4 | 0.1197 |
| 7320. | 0.2454 | 3.426E+4 | 0.1201 |
| 7380. | 0.2448 | 3.432E+4 | 0.1195 |
| 7440. | 0.2449 | 3.438E+4 | 0.1189 |
| 7500. | 0.2447 | 3.444E+4 | 0.1193 |
| 7560. | 0.2442 | 3.45E+4 | 0.1187 |
| 7620. | 0.2429 | 3.456E+4 | 0.1191 |
| 7680. | 0.2433 | 3.462E+4 | 0.1174 |
| 7740. | 0.2435 | 3.468E+4 | 0.1184 |
| 7800. | 0.2421 | 3.474E+4 | 0.1172 |
| 7860. | 0.2432 | 3.48E+4 | 0.1178 |
| 7920. | 0.2426 | 3.486E+4 | 0.1167 |
| 7980. | 0.2425 | 3.492E+4 | 0.1165 |
| 8040. | 0.2431 | 3.498E+4 | 0.1167 |
| 8100. | 0.2421 | 3.504E+4 | 0.1162 |
| 8160. | 0.2416 | 3.51E+4 | 0.1161 |
| 8220. | 0.242 | 3.516E+4 | 0.1156 |
| 8280. | 0.2413 | 3.522E+4 | 0.1149 |
| 8340. | 0.242 | 3.528E+4 | 0.1149 |
| 8400. | 0.2412 | 3.534E+4 | 0.1154 |
| 8460. | 0.2401 | 3.54E+4 | 0.1153 |
| 8520. | 0.2404 | 3.546E+4 | 0.1144 |
| 8580. | 0.2398 | 3.552E+4 | 0.1141 |
| 8640. | 0.2397 | 3.558E+4 | 0.1145 |
| 8700. | 0.2398 | 3.564E+4 | 0.1136 |
| 8760. | 0.2401 | 3.57E+4 | 0.1135 |
| 8820. | 0.2387 | 3.576E+4 | 0.113 |
| 8880. | 0.2389 | 3.582E+4 | 0.1116 |
| 8940. | 0.2379 | 3.588E+4 | 0.1116 |
| 9000. | 0.2378 | 3.594E+4 | 0.1116 |
| 9060. | 0.2383 | 3.6E+4 | 0.1117 |
| 9120. | 0.2384 | 3.606E+4 | 0.1113 |
| 9180. | 0.2372 | 3.612E+4 | 0.1111 |
| 9240. | 0.2379 | 3.618E+4 | 0.1112 |
| 9300. | 0.2363 | 3.624E+4 | 0.1111 |
| 9360. | 0.2363 | 3.63E+4 | 0.1103 |
| 9420. | 0.2354 | 3.636E+4 | 0.11 |
| 9480. | 0.2351 | 3.642E+4 | 0.1102 |
| 9540. | 0.2348 | 3.648E+4 | 0.1093 |
| 9600. | 0.2347 | 3.654E+4 | 0.1097 |
| 9660. | 0.2342 | 3.66E+4 | 0.1088 |
| 9720. | 0.2349 | 3.666E+4 | 0.1091 |
| 9780. | 0.2342 | 3.672E+4 | 0.109 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 9840. | 0.2348 | 3.678E+4 | 0.1088 |
| 9900. | 0.2342 | 3.684E+4 | 0.1073 |
| 9960. | 0.235 | 3.69E+4 | 0.1074 |
| 1.002E+4 | 0.2339 | 3.696E+4 | 0.1074 |
| 1.008E+4 | 0.2337 | 3.702E+4 | 0.1062 |
| 1.014E+4 | 0.2334 | 3.708E+4 | 0.1071 |
| 1.02E+4 | 0.2331 | 3.714E+4 | 0.1069 |
| 1.026E+4 | 0.2333 | 3.72E+4 | 0.1055 |
| 1.032E+4 | 0.2326 | 3.726E+4 | 0.1057 |
| 1.038E+4 | 0.233 | 3.732E+4 | 0.1056 |
| 1.044E+4 | 0.2321 | 3.738E+4 | 0.1056 |
| 1.05E+4 | 0.2321 | 3.744E+4 | 0.1053 |
| 1.056E+4 | 0.2313 | 3.75E+4 | 0.1046 |
| 1.062E+4 | 0.2305 | 3.756E+4 | 0.1037 |
| 1.068E+4 | 0.2307 | 3.762E+4 | 0.1036 |
| 1.074E+4 | 0.2309 | 3.768E+4 | 0.1041 |
| 1.08E+4 | 0.2304 | 3.774E+4 | 0.1037 |
| 1.086E+4 | 0.2297 | 3.78E+4 | 0.1035 |
| 1.092E+4 | 0.2299 | 3.786E+4 | 0.1031 |
| 1.098E+4 | 0.2287 | 3.792E+4 | 0.1023 |
| 1.104E+4 | 0.2294 | 3.798E+4 | 0.1023 |
| 1.11E+4 | 0.2291 | 3.804E+4 | 0.1026 |
| 1.116E+4 | 0.2282 | 3.81E+4 | 0.102 |
| 1.122E+4 | 0.2283 | 3.816E+4 | 0.102 |
| 1.128E+4 | 0.2275 | 3.822E+4 | 0.1015 |
| 1.134E+4 | 0.2268 | 3.828E+4 | 0.1023 |
| 1.14E+4 | 0.227 | 3.834E+4 | 0.1002 |
| 1.146E+4 | 0.2265 | 3.84E+4 | 0.1008 |
| 1.152E+4 | 0.2269 | 3.846E+4 | 0.1001 |
| 1.158E+4 | 0.2268 | 3.852E+4 | 0.1005 |
| 1.164E+4 | 0.2258 | 3.858E+4 | 0.0994 |
| 1.17E+4 | 0.2259 | 3.864E+4 | 0.0995 |
| 1.176E+4 | 0.2251 | 3.87E+4 | 0.0995 |
| 1.182E+4 | 0.2244 | 3.876E+4 | 0.0991 |
| 1.188E+4 | 0.2251 | 3.882E+4 | 0.0977 |
| 1.194E+4 | 0.2244 | 3.888E+4 | 0.0987 |
| 1.2E+4 | 0.2245 | 3.894E+4 | 0.0988 |
| 1.206E+4 | 0.224 | 3.9E+4 | 0.0981 |
| 1.212E+4 | 0.2231 | 3.906E+4 | 0.0979 |
| 1.218E+4 | 0.2231 | 3.912E+4 | 0.0973 |
| 1.224E+4 | 0.2227 | 3.918E+4 | 0.0974 |
| 1.23E+4 | 0.2226 | 3.924E+4 | 0.0968 |
| 1.236E+4 | 0.222 | 3.93E+4 | 0.0964 |
| 1.242E+4 | 0.2231 | 3.936E+4 | 0.096 |
| 1.248E+4 | 0.2219 | 3.942E+4 | 0.0965 |
| 1.254E+4 | 0.2215 | 3.948E+4 | 0.0956 |
| 1.26E+4 | 0.2213 | 3.954E+4 | 0.0952 |
| 1.266E+4 | 0.2212 | 3.96E+4 | 0.0962 |
| 1.272E+4 | 0.2206 | 3.966E+4 | 0.0954 |
| 1.278E+4 | 0.2215 | 3.972E+4 | 0.0945 |
| 1.284E+4 | 0.2211 | 3.978E+4 | 0.0949 |
| 1.29E+4 | 0.2212 | 3.984E+4 | 0.0946 |
| 1.296E+4 | 0.2203 | 3.99E+4 | 0.093 |
| 1.302E+4 | 0.2195 | 3.996E+4 | 0.0945 |
| 1.308E+4 | 0.2194 | 4.002E+4 | 0.0929 |
| 1.314E+4 | 0.218 | 4.008E+4 | 0.0937 |
| 1.32E+4 | 0.2183 | 4.014E+4 | 0.0924 |
| 1.326E+4 | 0.2185 | 4.02E+4 | 0.0917 |
| 1.332E+4 | 0.2181 | 4.026E+4 | 0.0918 |
| 1.338E+4 | 0.2175 | 4.032E+4 | 0.0918 |
| 1.344E+4 | 0.2164 | 4.038E+4 | 0.0911 |
| 1.35E+4 | 0.2159 | 4.044E+4 | 0.0905 |
| 1.356E+4 | 0.2165 | 4.05E+4 | 0.0905 |
| 1.362E+4 | 0.216 | 4.056E+4 | 0.09 |
| 1.368E+4 | 0.2159 | 4.062E+4 | 0.0901 |
| 1.374E+4 | 0.2155 | 4.068E+4 | 0.0894 |
| 1.38E+4 | 0.2155 | 4.074E+4 | 0.0895 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.386E+4 | 0.2144 | 4.08E+4 | 0.0888 |
| 1.392E+4 | 0.2149 | 4.086E+4 | 0.0886 |
| 1.398E+4 | 0.2142 | 4.092E+4 | 0.0881 |
| 1.404E+4 | 0.2138 | 4.098E+4 | 0.088 |
| 1.41E+4 | 0.2137 | 4.104E+4 | 0.0872 |
| 1.416E+4 | 0.2135 | 4.11E+4 | 0.0877 |
| 1.422E+4 | 0.2141 | 4.116E+4 | 0.087 |
| 1.428E+4 | 0.2129 | 4.122E+4 | 0.0859 |
| 1.434E+4 | 0.2133 | 4.128E+4 | 0.0863 |
| 1.44E+4 | 0.213 | 4.134E+4 | 0.0867 |
| 1.446E+4 | 0.2127 | 4.14E+4 | 0.0856 |
| 1.452E+4 | 0.2115 | 4.146E+4 | 0.0851 |
| 1.458E+4 | 0.2116 | 4.152E+4 | 0.0858 |
| 1.464E+4 | 0.2122 | 4.158E+4 | 0.0861 |
| 1.47E+4 | 0.2112 | 4.164E+4 | 0.085 |
| 1.476E+4 | 0.2115 | 4.17E+4 | 0.0839 |
| 1.482E+4 | 0.2107 | 4.176E+4 | 0.0838 |
| 1.488E+4 | 0.2095 | 4.182E+4 | 0.0835 |
| 1.494E+4 | 0.2101 | 4.188E+4 | 0.0828 |
| 1.5E+4 | 0.21 | 4.194E+4 | 0.0825 |
| 1.506E+4 | 0.2099 | 4.2E+4 | 0.0828 |
| 1.512E+4 | 0.2092 | 4.206E+4 | 0.0815 |
| 1.518E+4 | 0.2084 | 4.212E+4 | 0.0824 |
| 1.524E+4 | 0.2087 | 4.218E+4 | 0.0818 |
| 1.53E+4 | 0.2082 | 4.224E+4 | 0.0813 |
| 1.536E+4 | 0.2084 | 4.23E+4 | 0.0812 |
| 1.542E+4 | 0.2089 | 4.236E+4 | 0.0799 |
| 1.548E+4 | 0.2075 | 4.242E+4 | 0.0804 |
| 1.554E+4 | 0.2084 | 4.248E+4 | 0.0805 |
| 1.56E+4 | 0.2077 | 4.254E+4 | 0.0792 |
| 1.566E+4 | 0.2065 | 4.26E+4 | 0.0794 |
| 1.572E+4 | 0.2072 | 4.266E+4 | 0.0792 |
| 1.578E+4 | 0.2064 | 4.272E+4 | 0.0782 |
| 1.584E+4 | 0.2069 | 4.278E+4 | 0.0787 |
| 1.59E+4 | 0.2063 | 4.284E+4 | 0.0788 |
| 1.596E+4 | 0.2051 | 4.29E+4 | 0.0778 |
| 1.602E+4 | 0.2061 | 4.296E+4 | 0.0782 |
| 1.608E+4 | 0.2056 | 4.302E+4 | 0.0767 |
| 1.614E+4 | 0.2056 | 4.308E+4 | 0.077 |
| 1.62E+4 | 0.2061 | 4.314E+4 | 0.077 |
| 1.626E+4 | 0.205 | 4.32E+4 | 0.0769 |
| 1.632E+4 | 0.2055 | 4.326E+4 | 0.076 |
| 1.638E+4 | 0.2051 | 4.332E+4 | 0.0766 |
| 1.644E+4 | 0.2047 | 4.338E+4 | 0.0753 |
| 1.65E+4 | 0.2047 | 4.344E+4 | 0.0749 |
| 1.656E+4 | 0.2035 | 4.35E+4 | 0.0748 |
| 1.662E+4 | 0.2047 | 4.356E+4 | 0.0755 |
| 1.668E+4 | 0.2041 | 4.362E+4 | 0.0744 |
| 1.674E+4 | 0.2034 | 4.368E+4 | 0.0748 |
| 1.68E+4 | 0.2029 | 4.374E+4 | 0.0739 |
| 1.686E+4 | 0.2023 | 4.38E+4 | 0.0735 |
| 1.692E+4 | 0.2022 | 4.386E+4 | 0.0737 |
| 1.698E+4 | 0.2013 | 4.392E+4 | 0.0738 |
| 1.704E+4 | 0.2013 | 4.398E+4 | 0.0736 |
| 1.71E+4 | 0.2009 | 4.404E+4 | 0.0733 |
| 1.716E+4 | 0.2009 | 4.41E+4 | 0.0731 |
| 1.722E+4 | 0.1999 | 4.416E+4 | 0.073 |
| 1.728E+4 | 0.2009 | 4.422E+4 | 0.0726 |
| 1.734E+4 | 0.1997 | 4.428E+4 | 0.073 |
| 1.74E+4 | 0.2 | 4.434E+4 | 0.072 |
| 1.746E+4 | 0.2004 | 4.44E+4 | 0.0714 |
| 1.752E+4 | 0.1993 | 4.446E+4 | 0.0708 |
| 1.758E+4 | 0.1989 | 4.452E+4 | 0.0712 |
| 1.764E+4 | 0.1993 | 4.458E+4 | 0.0713 |
| 1.77E+4 | 0.1986 | 4.464E+4 | 0.0702 |
| 1.776E+4 | 0.1978 | 4.47E+4 | 0.072 |
| 1.782E+4 | 0.1977 | 4.476E+4 | 0.0706 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.788E+4 | 0.1981 | 4.482E+4 | 0.0706 |
| 1.794E+4 | 0.1978 | 4.488E+4 | 0.0709 |
| 1.8E+4 | 0.1971 | 4.494E+4 | 0.0701 |
| 1.806E+4 | 0.1966 | 4.5E+4 | 0.0711 |
| 1.812E+4 | 0.1959 | 4.506E+4 | 0.0699 |
| 1.818E+4 | 0.1956 | 4.512E+4 | 0.0694 |
| 1.824E+4 | 0.1952 | 4.518E+4 | 0.0701 |
| 1.83E+4 | 0.1953 | 4.524E+4 | 0.0693 |
| 1.836E+4 | 0.1955 | 4.53E+4 | 0.0691 |
| 1.842E+4 | 0.1949 | 4.536E+4 | 0.0688 |
| 1.848E+4 | 0.1952 | 4.542E+4 | 0.0685 |
| 1.854E+4 | 0.1939 | 4.548E+4 | 0.0684 |
| 1.86E+4 | 0.1931 | 4.554E+4 | 0.0678 |
| 1.866E+4 | 0.1932 | 4.56E+4 | 0.0688 |
| 1.872E+4 | 0.193 | 4.566E+4 | 0.068 |
| 1.878E+4 | 0.1929 | 4.572E+4 | 0.0672 |
| 1.884E+4 | 0.1919 | 4.578E+4 | 0.0673 |
| 1.89E+4 | 0.1924 | 4.584E+4 | 0.0665 |
| 1.896E+4 | 0.1922 | 4.59E+4 | 0.067 |
| 1.902E+4 | 0.1913 | 4.596E+4 | 0.0668 |
| 1.908E+4 | 0.1911 | 4.602E+4 | 0.0653 |
| 1.914E+4 | 0.1911 | 4.608E+4 | 0.0667 |
| 1.92E+4 | 0.1912 | 4.614E+4 | 0.0659 |
| 1.926E+4 | 0.1918 | 4.62E+4 | 0.0654 |
| 1.932E+4 | 0.1901 | 4.626E+4 | 0.0654 |
| 1.938E+4 | 0.1906 | 4.632E+4 | 0.0647 |
| 1.944E+4 | 0.1905 | 4.638E+4 | 0.0649 |
| 1.95E+4 | 0.1892 | 4.644E+4 | 0.0644 |
| 1.956E+4 | 0.1896 | 4.65E+4 | 0.0648 |
| 1.962E+4 | 0.1888 | 4.656E+4 | 0.0635 |
| 1.968E+4 | 0.1885 | 4.662E+4 | 0.0633 |
| 1.974E+4 | 0.1888 | 4.668E+4 | 0.063 |
| 1.98E+4 | 0.1881 | 4.674E+4 | 0.0636 |
| 1.986E+4 | 0.1876 | 4.68E+4 | 0.0624 |
| 1.992E+4 | 0.1879 | 4.686E+4 | 0.0628 |
| 1.998E+4 | 0.1874 | 4.692E+4 | 0.0627 |
| 2.004E+4 | 0.188 | 4.698E+4 | 0.0621 |
| 2.01E+4 | 0.1864 | 4.704E+4 | 0.0626 |
| 2.016E+4 | 0.1853 | 4.71E+4 | 0.0617 |
| 2.022E+4 | 0.1857 | 4.716E+4 | 0.0617 |
| 2.028E+4 | 0.1854 | 4.722E+4 | 0.0614 |
| 2.034E+4 | 0.1853 | 4.728E+4 | 0.0613 |
| 2.04E+4 | 0.1851 | 4.734E+4 | 0.061 |
| 2.046E+4 | 0.1844 | 4.74E+4 | 0.0594 |
| 2.052E+4 | 0.1854 | 4.746E+4 | 0.0598 |
| 2.058E+4 | 0.1844 | 4.752E+4 | 0.0602 |
| 2.064E+4 | 0.1829 | 4.758E+4 | 0.0587 |
| 2.07E+4 | 0.1844 | 4.764E+4 | 0.0594 |
| 2.076E+4 | 0.1839 | 4.77E+4 | 0.0596 |
| 2.082E+4 | 0.1826 | 4.776E+4 | 0.0583 |
| 2.088E+4 | 0.183 | 4.782E+4 | 0.0585 |
| 2.094E+4 | 0.1829 | 4.788E+4 | 0.0588 |
| 2.1E+4 | 0.1821 | 4.794E+4 | 0.0586 |
| 2.106E+4 | 0.1825 | 4.8E+4 | 0.0579 |
| 2.112E+4 | 0.1818 | 4.806E+4 | 0.0581 |
| 2.118E+4 | 0.1806 | 4.812E+4 | 0.0575 |
| 2.124E+4 | 0.1814 | 4.818E+4 | 0.0572 |
| 2.13E+4 | 0.1814 | 4.824E+4 | 0.0573 |
| 2.136E+4 | 0.181 | 4.83E+4 | 0.0569 |
| 2.142E+4 | 0.1799 | 4.836E+4 | 0.0575 |
| 2.148E+4 | 0.1799 | 4.842E+4 | 0.0565 |
| 2.154E+4 | 0.1791 | 4.848E+4 | 0.0564 |
| 2.16E+4 | 0.1796 | 4.854E+4 | 0.0561 |
| 2.166E+4 | 0.1787 | 4.86E+4 | 0.0551 |
| 2.172E+4 | 0.179 | 4.866E+4 | 0.056 |
| 2.178E+4 | 0.1783 | 4.872E+4 | 0.0549 |
| 2.184E+4 | 0.1777 | 4.878E+4 | 0.0549 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2.19E+4 | 0.1772 | 4.884E+4 | 0.0544 |
| 2.196E+4 | 0.1768 | 4.89E+4 | 0.0535 |
| 2.202E+4 | 0.1772 | 4.896E+4 | 0.0545 |
| 2.208E+4 | 0.1771 | 4.902E+4 | 0.055 |
| 2.214E+4 | 0.1767 | 4.908E+4 | 0.0541 |
| 2.22E+4 | 0.1763 | 4.914E+4 | 0.0531 |
| 2.226E+4 | 0.1764 | 4.92E+4 | 0.0531 |
| 2.232E+4 | 0.176 | 4.926E+4 | 0.0527 |
| 2.238E+4 | 0.1753 | 4.932E+4 | 0.0526 |
| 2.244E+4 | 0.1762 | 4.938E+4 | 0.0522 |
| 2.25E+4 | 0.1746 | 4.944E+4 | 0.0523 |
| 2.256E+4 | 0.1742 | 4.95E+4 | 0.0521 |
| 2.262E+4 | 0.1744 | 4.956E+4 | 0.051 |
| 2.268E+4 | 0.1747 | 4.962E+4 | 0.0505 |
| 2.274E+4 | 0.1741 | 4.968E+4 | 0.0507 |
| 2.28E+4 | 0.1741 | 4.974E+4 | 0.0501 |
| 2.286E+4 | 0.1735 | 4.98E+4 | 0.0507 |
| 2.292E+4 | 0.1728 | 4.986E+4 | 0.0499 |
| 2.298E+4 | 0.1736 | 4.992E+4 | 0.049 |
| 2.304E+4 | 0.1721 | 4.998E+4 | 0.0492 |
| 2.31E+4 | 0.1719 | 5.004E+4 | 0.0488 |
| 2.316E+4 | 0.1715 | 5.01E+4 | 0.0483 |
| 2.322E+4 | 0.1719 | 5.016E+4 | 0.0475 |
| 2.328E+4 | 0.1716 | 5.022E+4 | 0.0477 |
| 2.334E+4 | 0.1712 | 5.028E+4 | 0.0466 |
| 2.34E+4 | 0.1705 | 5.034E+4 | 0.0468 |
| 2.346E+4 | 0.1702 | 5.04E+4 | 0.0468 |
| 2.352E+4 | 0.1694 | 5.046E+4 | 0.0469 |
| 2.358E+4 | 0.1696 | 5.052E+4 | 0.0455 |
| 2.364E+4 | 0.169 | 5.058E+4 | 0.0452 |
| 2.37E+4 | 0.1682 | 5.064E+4 | 0.0445 |
| 2.376E+4 | 0.168 | 5.07E+4 | 0.0449 |
| 2.382E+4 | 0.1681 | 5.076E+4 | 0.045 |
| 2.388E+4 | 0.1679 | 5.082E+4 | 0.0444 |
| 2.394E+4 | 0.1673 | 5.088E+4 | 0.0439 |
| 2.4E+4 | 0.1669 | 5.094E+4 | 0.0436 |
| 2.406E+4 | 0.1678 | 5.1E+4 | 0.0437 |
| 2.412E+4 | 0.166 | 5.106E+4 | 0.0427 |
| 2.418E+4 | 0.1674 | 5.112E+4 | 0.0424 |
| 2.424E+4 | 0.167 | 5.118E+4 | 0.0419 |
| 2.43E+4 | 0.1656 | 5.124E+4 | 0.0422 |
| 2.436E+4 | 0.1657 | 5.13E+4 | 0.0414 |
| 2.442E+4 | 0.166 | 5.136E+4 | 0.0408 |
| 2.448E+4 | 0.1662 | 5.142E+4 | 0.0414 |
| 2.454E+4 | 0.1654 | 5.148E+4 | 0.0406 |
| 2.46E+4 | 0.1657 | 5.154E+4 | 0.0406 |
| 2.466E+4 | 0.1654 | 5.16E+4 | 0.0405 |
| 2.472E+4 | 0.1638 | 5.166E+4 | 0.0402 |
| 2.478E+4 | 0.1653 | 5.172E+4 | 0.0407 |
| 2.484E+4 | 0.1646 | 5.178E+4 | 0.0403 |
| 2.49E+4 | 0.1654 | 5.184E+4 | 0.0397 |
| 2.496E+4 | 0.1647 | 5.19E+4 | 0.0397 |
| 2.502E+4 | 0.1638 | 5.196E+4 | 0.0389 |
| 2.508E+4 | 0.164 | 5.202E+4 | 0.0395 |
| 2.514E+4 | 0.1638 | 5.208E+4 | 0.0384 |
| 2.52E+4 | 0.1635 | 5.214E+4 | 0.0378 |
| 2.526E+4 | 0.1635 | 5.22E+4 | 0.0376 |
| 2.532E+4 | 0.1629 | 5.226E+4 | 0.0355 |
| 2.538E+4 | 0.1631 | 5.232E+4 | 0.0362 |
| 2.544E+4 | 0.1617 | 5.238E+4 | 0.0359 |
| 2.55E+4 | 0.1615 | 5.244E+4 | 0.036 |
| 2.556E+4 | 0.1609 | 5.25E+4 | 0.0353 |
| 2.562E+4 | 0.1604 | 5.256E+4 | 0.035 |
| 2.568E+4 | 0.1607 | 5.262E+4 | 0.0348 |
| 2.574E+4 | 0.1598 | 5.268E+4 | 0.0346 |
| 2.58E+4 | 0.1601 | 5.274E+4 | 0.0338 |
| 2.586E+4 | 0.1605 | 5.28E+4 | 0.0337 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2.592E+4 | 0.1602 | 5.286E+4 | 0.0339 |
| 2.598E+4 | 0.1598 | 5.292E+4 | 0.0333 |
| 2.604E+4 | 0.1599 | 5.298E+4 | 0.033 |
| 2.61E+4 | 0.1594 | 5.304E+4 | 0.0321 |
| 2.616E+4 | 0.1589 | 5.31E+4 | 0.0323 |
| 2.622E+4 | 0.1588 | 5.316E+4 | 0.0315 |
| 2.628E+4 | 0.1581 | 5.322E+4 | 0.0324 |
| 2.634E+4 | 0.1576 | 5.328E+4 | 0.0308 |
| 2.64E+4 | 0.158 | 5.334E+4 | 0.0311 |
| 2.646E+4 | 0.157 | 5.34E+4 | 0.0311 |
| 2.652E+4 | 0.1562 | 5.346E+4 | 0.0307 |
| 2.658E+4 | 0.1573 | 5.352E+4 | 0.0302 |
| 2.664E+4 | 0.156 | 5.358E+4 | 0.0294 |
| 2.67E+4 | 0.1557 | 5.364E+4 | 0.03 |
| 2.676E+4 | 0.1559 | 5.37E+4 | 0.0294 |
| 2.682E+4 | 0.1556 | 5.376E+4 | 0.0283 |
| 2.688E+4 | 0.1558 | 5.382E+4 | 0.0282 |

## SOLUTION

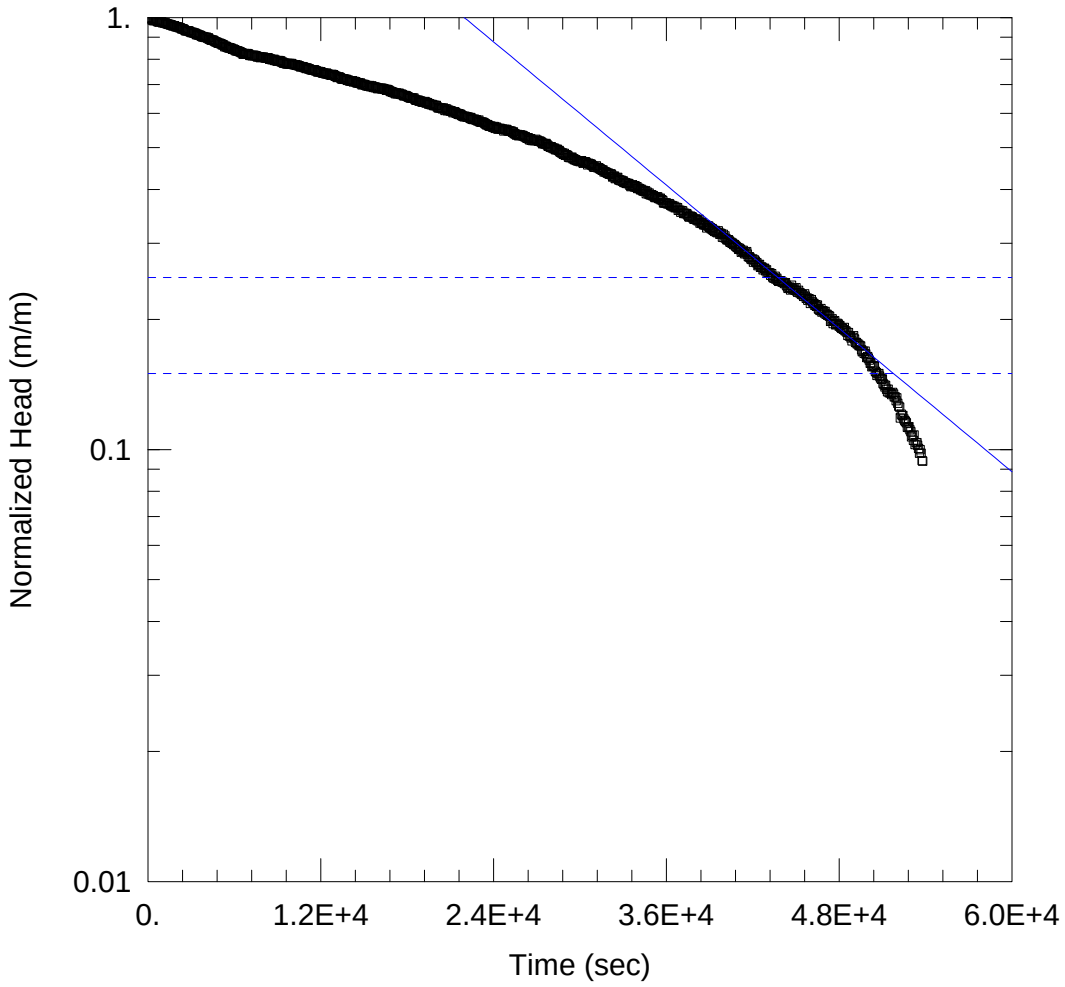
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.085E-8 | m/sec |
| y0 | 1.214 | m |

K = 1.085E-6 cm/sec
T = K*b = 5.426E-7 m²/sec (0.005426 sq. cm/sec)




## MW-H26B (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-26B
Test Date: 31 October 2012

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H26B)

Initial Displacement: 0.3 m
Total Well Penetration Depth: 3.6 m
Casing Radius: 0.016 m
Static Water Column Height: 3.6 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

### SOLUTION

Aquifer Model: Unconfined
K = 1.085E-8 m/sec
Solution Method: Hvorslev
y0 = 1.214 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H27 (Rising Head Slug Test)
Date: 08/14/13
Time: 11:29:30

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 28 July 2013
Test Well: MW-H27

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H27

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.4 m
Static Water Column Height: 27.6 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 27.6 m

No. of Observations: 387

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.4 | 454. | 0.1642 |
| 1. | 0.4085 | 484. | 0.1569 |
| 2. | 0.4153 | 514. | 0.1504 |
| 3. | 0.4028 | 544. | 0.144 |
| 4. | 0.4079 | 574. | 0.1381 |
| 5. | 0.4009 | 604. | 0.1325 |
| 6. | 0.3993 | 634. | 0.1275 |
| 7. | 0.3942 | 664. | 0.1225 |
| 8. | 0.3892 | 694. | 0.1181 |
| 9. | 0.3878 | 724. | 0.1148 |
| 10. | 0.3869 | 754. | 0.1104 |
| 11. | 0.3853 | 784. | 0.1062 |
| 12. | 0.3853 | 814. | 0.1027 |
| 13. | 0.3834 | 844. | 0.0994 |
| 14. | 0.3832 | 874. | 0.0964 |
| 15. | 0.3817 | 904. | 0.0924 |
| 16. | 0.3802 | 934. | 0.0892 |
| 17. | 0.3796 | 964. | 0.0865 |
| 18. | 0.3786 | 994. | 0.0832 |
| 19. | 0.3775 | 1024. | 0.0808 |
| 20. | 0.3766 | 1054. | 0.0785 |
| 21. | 0.3753 | 1084. | 0.0756 |
| 22. | 0.3747 | 1114. | 0.0739 |
| 23. | 0.3735 | 1144. | 0.0717 |
| 24. | 0.3728 | 1174. | 0.0688 |
| 25. | 0.3717 | 1204. | 0.0668 |
| 26. | 0.3706 | 1234. | 0.0651 |
| 27. | 0.3696 | 1264. | 0.064 |
| 28. | 0.3687 | 1294. | 0.0613 |
| 29. | 0.368 | 1324. | 0.0599 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 30. | 0.3672 | 1354. | 0.0582 |
| 31. | 0.3659 | 1384. | 0.0565 |
| 32. | 0.3656 | 1414. | 0.0557 |
| 33. | 0.3642 | 1444. | 0.0547 |
| 34. | 0.3636 | 1474. | 0.0525 |
| 35. | 0.3627 | 1504. | 0.0514 |
| 36. | 0.3615 | 1534. | 0.0501 |
| 37. | 0.3605 | 1564. | 0.049 |
| 38. | 0.3601 | 1594. | 0.0477 |
| 39. | 0.3593 | 1624. | 0.0466 |
| 40. | 0.3584 | 1654. | 0.0456 |
| 41. | 0.3577 | 1684. | 0.0447 |
| 42. | 0.3563 | 1714. | 0.0439 |
| 43. | 0.3557 | 1744. | 0.0425 |
| 44. | 0.3549 | 1774. | 0.0425 |
| 45. | 0.3538 | 1804. | 0.0413 |
| 46. | 0.3532 | 1834. | 0.0404 |
| 47. | 0.3524 | 1864. | 0.0398 |
| 48. | 0.3516 | 1894. | 0.0389 |
| 49. | 0.3509 | 1924. | 0.038 |
| 50. | 0.3501 | 1954. | 0.0373 |
| 51. | 0.3493 | 1984. | 0.0362 |
| 52. | 0.3486 | 2014. | 0.0354 |
| 53. | 0.3473 | 2044. | 0.0349 |
| 54. | 0.3469 | 2074. | 0.0342 |
| 55. | 0.3463 | 2104. | 0.0333 |
| 56. | 0.3458 | 2134. | 0.0323 |
| 57. | 0.3444 | 2164. | 0.0317 |
| 58. | 0.3441 | 2194. | 0.0321 |
| 59. | 0.3438 | 2224. | 0.0308 |
| 60. | 0.3428 | 2254. | 0.03 |
| 61. | 0.3414 | 2284. | 0.0294 |
| 62. | 0.3409 | 2314. | 0.0289 |
| 63. | 0.3401 | 2344. | 0.0286 |
| 64. | 0.3392 | 2374. | 0.0278 |
| 65. | 0.3385 | 2404. | 0.0267 |
| 66. | 0.3378 | 2434. | 0.0272 |
| 67. | 0.337 | 2464. | 0.0266 |
| 68. | 0.3364 | 2494. | 0.0256 |
| 69. | 0.3362 | 2524. | 0.025 |
| 70. | 0.3352 | 2554. | 0.025 |
| 71. | 0.3343 | 2584. | 0.0241 |
| 72. | 0.3336 | 2614. | 0.0239 |
| 73. | 0.3328 | 2644. | 0.023 |
| 74. | 0.332 | 2674. | 0.0235 |
| 75. | 0.3316 | 2704. | 0.0231 |
| 76. | 0.3313 | 2734. | 0.0221 |
| 77. | 0.33 | 2764. | 0.0223 |
| 78. | 0.3301 | 2794. | 0.0217 |
| 79. | 0.3297 | 2824. | 0.0214 |
| 80. | 0.3288 | 2854. | 0.0208 |
| 81. | 0.3274 | 2884. | 0.0212 |
| 82. | 0.3269 | 2914. | 0.0195 |
| 83. | 0.3263 | 2944. | 0.0193 |
| 84. | 0.3254 | 2974. | 0.0192 |
| 85. | 0.3247 | 3004. | 0.0194 |
| 86. | 0.3243 | 3034. | 0.0192 |
| 87. | 0.3236 | 3064. | 0.0176 |
| 88. | 0.3228 | 3094. | 0.0177 |
| 89. | 0.3225 | 3124. | 0.0174 |
| 90. | 0.3214 | 3154. | 0.0168 |
| 91. | 0.3206 | 3184. | 0.0167 |
| 92. | 0.3195 | 3214. | 0.017 |
| 93. | 0.3197 | 3244. | 0.0164 |
| 94. | 0.3186 | 3274. | 0.0168 |
| 95. | 0.3185 | 3304. | 0.0155 |
| 96. | 0.318 | 3334. | 0.0152 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 97. | 0.3171 | 3364. | 0.0149 |
| 98. | 0.3161 | 3394. | 0.0147 |
| 99. | 0.3155 | 3424. | 0.0148 |
| 100. | 0.315 | 3454. | 0.0149 |
| 101. | 0.3144 | 3484. | 0.0145 |
| 102. | 0.3136 | 3514. | 0.0134 |
| 103. | 0.313 | 3544. | 0.0133 |
| 104. | 0.3125 | 3574. | 0.0129 |
| 105. | 0.3114 | 3604. | 0.0125 |
| 106. | 0.3112 | 3634. | 0.0126 |
| 107. | 0.3107 | 3664. | 0.0122 |
| 108. | 0.31 | 3694. | 0.0125 |
| 109. | 0.3098 | 3724. | 0.0118 |
| 110. | 0.3088 | 3754. | 0.0116 |
| 111. | 0.3083 | 3784. | 0.012 |
| 112. | 0.308 | 3814. | 0.0114 |
| 113. | 0.3062 | 3844. | 0.011 |
| 114. | 0.3062 | 3874. | 0.0112 |
| 115. | 0.3062 | 3904. | 0.0111 |
| 116. | 0.3058 | 3934. | 0.0103 |
| 117. | 0.3045 | 3964. | 0.0102 |
| 118. | 0.3039 | 3994. | 0.0107 |
| 119. | 0.3031 | 4024. | 0.0098 |
| 120. | 0.3034 | 4054. | 0.0098 |
| 121. | 0.3026 | 4084. | 0.0095 |
| 122. | 0.3018 | 4114. | 0.0097 |
| 123. | 0.3012 | 4144. | 0.0091 |
| 124. | 0.3003 | 4174. | 0.0083 |
| 125. | 0.3001 | 4204. | 0.0083 |
| 126. | 0.2992 | 4234. | 0.0079 |
| 127. | 0.2987 | 4264. | 0.0084 |
| 128. | 0.2979 | 4294. | 0.0079 |
| 129. | 0.2974 | 4324. | 0.0078 |
| 130. | 0.2975 | 4354. | 0.0079 |
| 131. | 0.2964 | 4384. | 0.0076 |
| 132. | 0.2962 | 4414. | 0.0073 |
| 133. | 0.2952 | 4444. | 0.0079 |
| 134. | 0.2965 | 4474. | 0.0069 |
| 135. | 0.2934 | 4504. | 0.0069 |
| 136. | 0.2931 | 4534. | 0.0071 |
| 137. | 0.2934 | 4564. | 0.0065 |
| 138. | 0.2917 | 4594. | 0.0065 |
| 139. | 0.2919 | 4624. | 0.0064 |
| 140. | 0.2914 | 4654. | 0.0067 |
| 141. | 0.291 | 4684. | 0.0063 |
| 142. | 0.2901 | 4714. | 0.0056 |
| 143. | 0.2897 | 4744. | 0.0062 |
| 144. | 0.2892 | 4774. | 0.0052 |
| 145. | 0.2885 | 4804. | 0.006 |
| 146. | 0.2884 | 4834. | 0.0054 |
| 147. | 0.2879 | 4864. | 0.0051 |
| 148. | 0.286 | 4894. | 0.005 |
| 149. | 0.2863 | 4924. | 0.0047 |
| 150. | 0.2863 | 4954. | 0.0049 |
| 151. | 0.2855 | 4984. | 0.0045 |
| 152. | 0.2844 | 5014. | 0.0042 |
| 153. | 0.2844 | 5044. | 0.0042 |
| 154. | 0.2839 | 5074. | 0.0042 |
| 155. | 0.283 | 5104. | 0.0046 |
| 156. | 0.283 | 5134. | 0.0044 |
| 157. | 0.282 | 5164. | 0.0038 |
| 158. | 0.2818 | 5194. | 0.0039 |
| 159. | 0.2815 | 5224. | 0.0036 |
| 160. | 0.2808 | 5254. | 0.0036 |
| 161. | 0.2802 | 5284. | 0.0032 |
| 162. | 0.2797 | 5314. | 0.0035 |
| 163. | 0.2792 | 5344. | 0.0036 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 164. | 0.2783 | 5374. | 0.0033 |
| 165. | 0.2774 | 5404. | 0.0026 |
| 166. | 0.2775 | 5434. | 0.003 |
| 167. | 0.2765 | 5464. | 0.003 |
| 168. | 0.2763 | 5494. | 0.0028 |
| 169. | 0.2758 | 5524. | 0.0023 |
| 170. | 0.2754 | 5554. | 0.0027 |
| 171. | 0.2751 | 5584. | 0.0026 |
| 172. | 0.2743 | 5614. | 0.0015 |
| 173. | 0.2741 | 5644. | 0.0022 |
| 174. | 0.2735 | 5674. | 0.0022 |
| 175. | 0.2727 | 5704. | 0.0025 |
| 176. | 0.2726 | 5734. | 0.0024 |
| 177. | 0.2717 | 5764. | 0.0024 |
| 178. | 0.2715 | 5794. | 0.0025 |
| 179. | 0.2705 | 5824. | 0.0021 |
| 180. | 0.2707 | 5854. | 0.002 |
| 181. | 0.2695 | 5884. | 0.0021 |
| 182. | 0.2687 | 5914. | 0.0021 |
| 183. | 0.2687 | 5944. | 0.0016 |
| 184. | 0.2683 | 5974. | 0.001 |
| 185. | 0.2546 | 6004. | 0.0011 |
| 214. | 0.2419 | 6034. | 0.0013 |
| 244. | 0.2297 | 6064. | 0.001 |
| 274. | 0.2189 | 6094. | 0.0011 |
| 304. | 0.208 | 6124. | 0.0004 |
| 334. | 0.1983 | 6154. | 0.0009 |
| 364. | 0.1888 | 6184. | 0.0005 |
| 394. | 0.18 | 6214. | 0. |
| 424. | 0.1719 | | |

## SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.907E-7 | m/sec |
| y0 | 0.237 | m |

K = 1.907E-5 cm/sec
T = K*b = 9.537E-6 m²/sec (0.09537 sq. cm/sec)

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H27 (Falling Head Packer Test, vertical interval 32.77 - 39.17 m)
Date: 08/14/13
Time: 14:35:44

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 23 July 2013
Test Well: MW-H27

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H27

X Location: 0. m
Y Location: 0. m

Initial Displacement: 5.066 m
Static Water Column Height: 34.1 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 6.4 m
Total Well Penetration Depth: 34.1 m

No. of Observations: 228

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 5.066 | 1710. | 3.457 |
| 15. | 5.046 | 1725. | 3.444 |
| 30. | 5.029 | 1740. | 3.432 |
| 45. | 5.011 | 1755. | 3.419 |
| 60. | 4.995 | 1770. | 3.406 |
| 75. | 4.979 | 1785. | 3.393 |
| 90. | 4.963 | 1800. | 3.381 |
| 105. | 4.946 | 1815. | 3.368 |
| 120. | 4.93 | 1830. | 3.356 |
| 135. | 4.914 | 1845. | 3.344 |
| 150. | 4.899 | 1860. | 3.331 |
| 165. | 4.884 | 1875. | 3.318 |
| 180. | 4.868 | 1890. | 3.306 |
| 195. | 4.853 | 1905. | 3.294 |
| 210. | 4.838 | 1920. | 3.281 |
| 225. | 4.824 | 1935. | 3.269 |
| 240. | 4.809 | 1950. | 3.257 |
| 255. | 4.795 | 1965. | 3.244 |
| 270. | 4.78 | 1980. | 3.232 |
| 285. | 4.765 | 1995. | 3.22 |
| 300. | 4.751 | 2010. | 3.208 |
| 315. | 4.737 | 2025. | 3.196 |
| 330. | 4.737 | 2040. | 3.184 |
| 345. | 4.708 | 2055. | 3.171 |
| 360. | 4.694 | 2070. | 3.159 |
| 375. | 4.679 | 2085. | 3.147 |
| 390. | 4.665 | 2100. | 3.134 |
| 405. | 4.651 | 2115. | 3.122 |
| 420. | 4.637 | 2130. | 3.11 |
| 435. | 4.622 | 2145. | 3.098 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 450. | 4.608 | 2160. | 3.087 |
| 465. | 4.594 | 2175. | 3.075 |
| 480. | 4.579 | 2190. | 3.062 |
| 495. | 4.565 | 2205. | 3.05 |
| 510. | 4.551 | 2220. | 3.039 |
| 525. | 4.536 | 2235. | 3.027 |
| 540. | 4.522 | 2250. | 3.018 |
| 555. | 4.508 | 2265. | 3.007 |
| 570. | 4.493 | 2280. | 2.994 |
| 585. | 4.478 | 2295. | 2.983 |
| 600. | 4.464 | 2310. | 2.972 |
| 615. | 4.45 | 2325. | 2.96 |
| 630. | 4.436 | 2340. | 2.948 |
| 645. | 4.421 | 2355. | 2.937 |
| 660. | 4.407 | 2370. | 2.925 |
| 675. | 4.393 | 2385. | 2.914 |
| 690. | 4.379 | 2400. | 2.902 |
| 705. | 4.365 | 2415. | 2.89 |
| 720. | 4.35 | 2430. | 2.878 |
| 735. | 4.336 | 2445. | 2.866 |
| 750. | 4.322 | 2460. | 2.855 |
| 765. | 4.308 | 2475. | 2.843 |
| 780. | 4.293 | 2490. | 2.832 |
| 795. | 4.28 | 2505. | 2.821 |
| 810. | 4.266 | 2520. | 2.809 |
| 825. | 4.252 | 2535. | 2.797 |
| 840. | 4.238 | 2550. | 2.786 |
| 855. | 4.224 | 2565. | 2.774 |
| 870. | 4.21 | 2580. | 2.763 |
| 885. | 4.196 | 2595. | 2.752 |
| 900. | 4.181 | 2610. | 2.739 |
| 915. | 4.168 | 2625. | 2.729 |
| 930. | 4.154 | 2640. | 2.717 |
| 945. | 4.14 | 2655. | 2.706 |
| 960. | 4.127 | 2670. | 2.695 |
| 975. | 4.113 | 2685. | 2.683 |
| 990. | 4.099 | 2700. | 2.669 |
| 1005. | 4.086 | 2715. | 2.657 |
| 1020. | 4.072 | 2730. | 2.645 |
| 1035. | 4.058 | 2745. | 2.636 |
| 1050. | 4.045 | 2760. | 2.624 |
| 1065. | 4.03 | 2775. | 2.612 |
| 1080. | 4.016 | 2790. | 2.602 |
| 1095. | 4.002 | 2805. | 2.59 |
| 1110. | 3.989 | 2820. | 2.579 |
| 1125. | 3.976 | 2835. | 2.568 |
| 1140. | 3.962 | 2850. | 2.556 |
| 1155. | 3.948 | 2865. | 2.545 |
| 1170. | 3.935 | 2880. | 2.535 |
| 1185. | 3.921 | 2895. | 2.524 |
| 1200. | 3.908 | 2910. | 2.512 |
| 1215. | 3.895 | 2925. | 2.5 |
| 1230. | 3.882 | 2940. | 2.489 |
| 1245. | 3.867 | 2955. | 2.477 |
| 1260. | 3.854 | 2970. | 2.466 |
| 1275. | 3.841 | 2985. | 2.451 |
| 1290. | 3.827 | 3000. | 2.44 |
| 1305. | 3.813 | 3015. | 2.43 |
| 1320. | 3.8 | 3030. | 2.419 |
| 1335. | 3.787 | 3045. | 2.409 |
| 1350. | 3.774 | 3060. | 2.398 |
| 1365. | 3.76 | 3075. | 2.387 |
| 1380. | 3.747 | 3090. | 2.377 |
| 1395. | 3.734 | 3105. | 2.366 |
| 1410. | 3.72 | 3120. | 2.355 |
| 1425. | 3.707 | 3135. | 2.344 |
| 1440. | 3.693 | 3150. | 2.333 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1455. | 3.681 | 3165. | 2.321 |
| 1470. | 3.667 | 3180. | 2.31 |
| 1485. | 3.654 | 3195. | 2.298 |
| 1500. | 3.64 | 3210. | 2.287 |
| 1515. | 3.628 | 3225. | 2.277 |
| 1530. | 3.614 | 3240. | 2.265 |
| 1545. | 3.601 | 3255. | 2.253 |
| 1560. | 3.588 | 3270. | 2.242 |
| 1575. | 3.574 | 3285. | 2.228 |
| 1590. | 3.561 | 3300. | 2.218 |
| 1605. | 3.548 | 3315. | 2.209 |
| 1620. | 3.535 | 3330. | 2.198 |
| 1635. | 3.522 | 3345. | 2.183 |
| 1650. | 3.509 | 3360. | 2.172 |
| 1665. | 3.496 | 3375. | 2.161 |
| 1680. | 3.484 | 3390. | 2.15 |
| 1695. | 3.47 | 3405. | 2.138 |

## SOLUTION

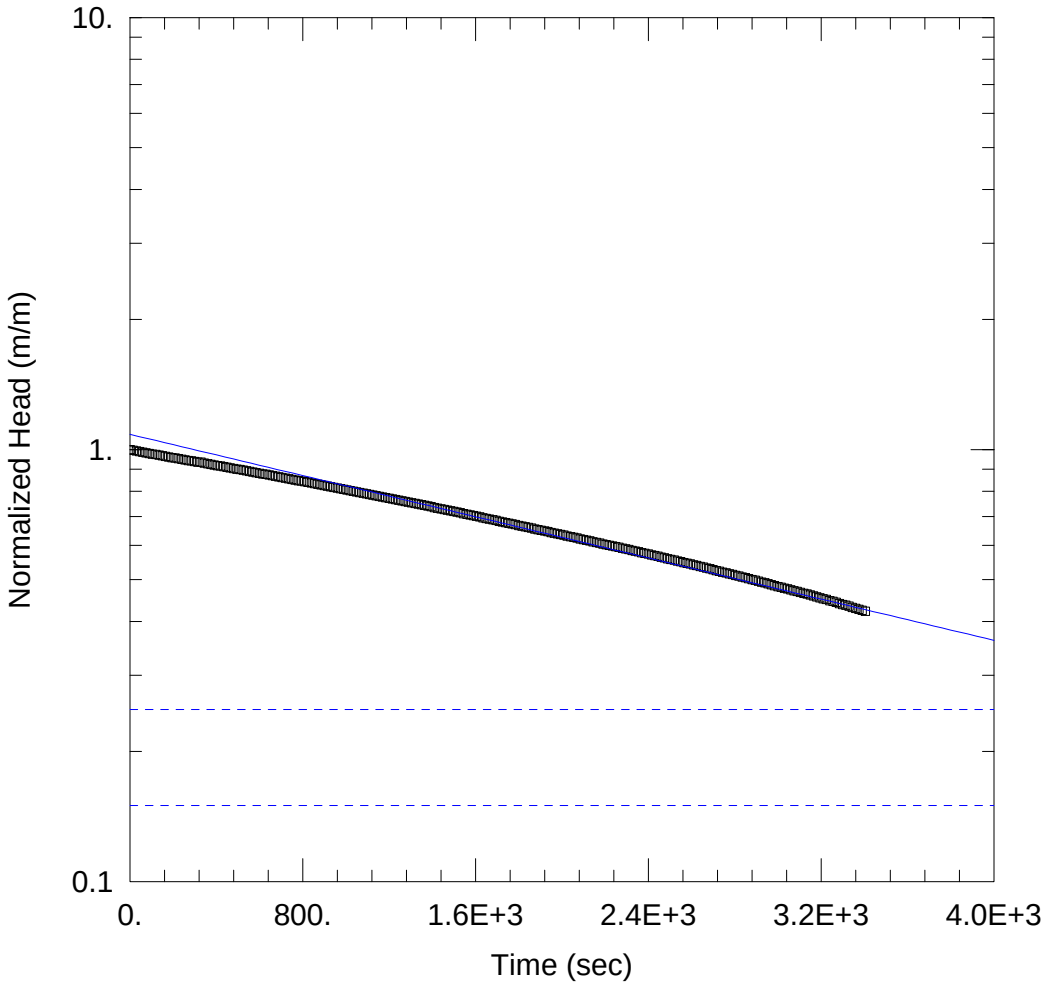
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.2044

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 2.417E-7 | m/sec |
| y0 | 5.492 | m |

K = 2.417E-5 cm/sec
T = K*b = 1.209E-5 m²/sec (0.1209 sq. cm/sec)




MW-H27 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 32.77 - 39.17 M)

PROJECT INFORMATION

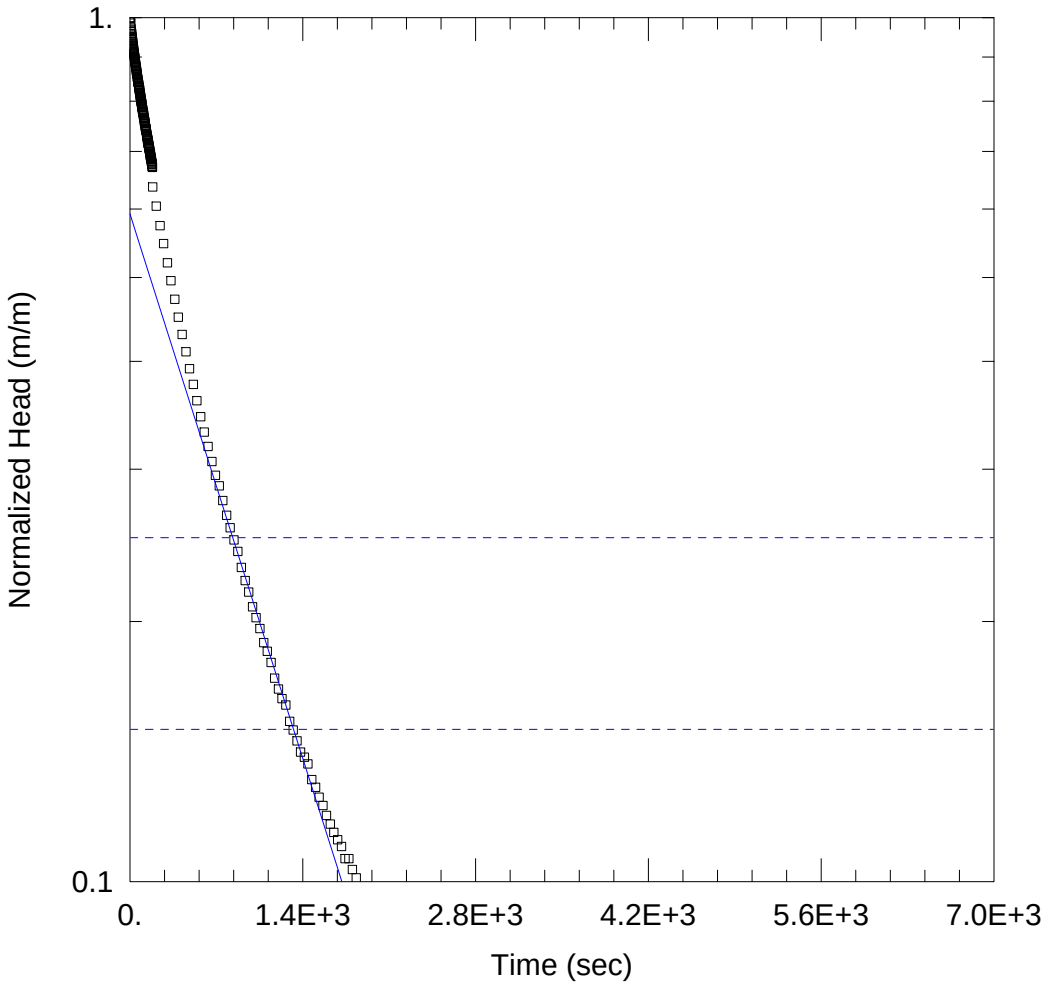
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H27
Test Date: 23 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.417E-7 m/sec
y0 = 5.492 m




## MW-H27 (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H27
Test Date: 28 July 2013

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H27)

Initial Displacement: 0.4 m
Total Well Penetration Depth: 27.6 m
Casing Radius: 0.016 m
Static Water Column Height: 27.6 m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Confined
K = 1.907E-7 m/sec
Solution Method: Hvorslev
y0 = 0.237 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 (Rising Head Slug Test)
Date: 08/14/13
Time: 12:01:57

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 1 August 2013
Test Well: MW-H28

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.1 m
Static Water Column Height: 5.079 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 5.079 m

No. of Observations: 195

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.1 | 2940. | 0.0549 |
| 30. | 0.0997 | 2970. | 0.0552 |
| 60. | 0.1002 | 3000. | 0.0546 |
| 90. | 0.1 | 3030. | 0.0526 |
| 120. | 0.0996 | 3060. | 0.0535 |
| 150. | 0.1005 | 3090. | 0.0529 |
| 180. | 0.1 | 3120. | 0.0532 |
| 210. | 0.0986 | 3150. | 0.0518 |
| 240. | 0.0988 | 3180. | 0.0512 |
| 270. | 0.0989 | 3210. | 0.0508 |
| 300. | 0.0986 | 3240. | 0.0511 |
| 330. | 0.099 | 3270. | 0.0499 |
| 360. | 0.0982 | 3300. | 0.0501 |
| 390. | 0.0995 | 3330. | 0.0501 |
| 420. | 0.0978 | 3360. | 0.0484 |
| 450. | 0.0974 | 3390. | 0.0482 |
| 480. | 0.0976 | 3420. | 0.0487 |
| 510. | 0.0982 | 3450. | 0.0479 |
| 540. | 0.0975 | 3480. | 0.0477 |
| 570. | 0.0978 | 3510. | 0.047 |
| 600. | 0.0968 | 3540. | 0.0469 |
| 630. | 0.0953 | 3570. | 0.0457 |
| 660. | 0.0964 | 3600. | 0.0456 |
| 690. | 0.097 | 3630. | 0.046 |
| 720. | 0.0963 | 3660. | 0.0446 |
| 750. | 0.0954 | 3690. | 0.0451 |
| 780. | 0.0957 | 3720. | 0.044 |
| 810. | 0.0948 | 3750. | 0.0449 |
| 840. | 0.0949 | 3780. | 0.0428 |
| 870. | 0.0944 | 3810. | 0.0434 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 0.0927 | 3840. | 0.0436 |
| 930. | 0.0926 | 3870. | 0.0429 |
| 960. | 0.0923 | 3900. | 0.0414 |
| 990. | 0.0928 | 3930. | 0.0413 |
| 1020. | 0.0923 | 3960. | 0.0415 |
| 1050. | 0.0903 | 3990. | 0.0407 |
| 1080. | 0.0911 | 4020. | 0.0403 |
| 1110. | 0.0902 | 4050. | 0.0388 |
| 1140. | 0.09 | 4080. | 0.0379 |
| 1170. | 0.0895 | 4110. | 0.0381 |
| 1200. | 0.0882 | 4140. | 0.0383 |
| 1230. | 0.088 | 4170. | 0.0379 |
| 1260. | 0.0869 | 4200. | 0.0364 |
| 1290. | 0.0857 | 4230. | 0.0372 |
| 1320. | 0.0857 | 4260. | 0.0365 |
| 1350. | 0.0857 | 4290. | 0.0365 |
| 1380. | 0.0858 | 4320. | 0.0357 |
| 1410. | 0.0847 | 4350. | 0.0343 |
| 1440. | 0.0833 | 4380. | 0.0335 |
| 1470. | 0.0831 | 4410. | 0.0337 |
| 1500. | 0.0826 | 4440. | 0.0344 |
| 1530. | 0.0824 | 4470. | 0.0334 |
| 1560. | 0.0827 | 4500. | 0.033 |
| 1590. | 0.0797 | 4530. | 0.0326 |
| 1620. | 0.0794 | 4560. | 0.0313 |
| 1650. | 0.0792 | 4590. | 0.0308 |
| 1680. | 0.079 | 4620. | 0.0315 |
| 1710. | 0.078 | 4650. | 0.0305 |
| 1740. | 0.0769 | 4680. | 0.0302 |
| 1770. | 0.0767 | 4710. | 0.0296 |
| 1800. | 0.0759 | 4740. | 0.028 |
| 1830. | 0.0749 | 4770. | 0.0289 |
| 1860. | 0.0746 | 4800. | 0.0283 |
| 1890. | 0.0748 | 4830. | 0.0277 |
| 1920. | 0.0738 | 4860. | 0.0264 |
| 1950. | 0.072 | 4890. | 0.0267 |
| 1980. | 0.0715 | 4920. | 0.0266 |
| 2010. | 0.0707 | 4950. | 0.0258 |
| 2040. | 0.0696 | 4980. | 0.0256 |
| 2070. | 0.0683 | 5010. | 0.0256 |
| 2100. | 0.0682 | 5040. | 0.0253 |
| 2130. | 0.0676 | 5070. | 0.0246 |
| 2160. | 0.0674 | 5100. | 0.0234 |
| 2190. | 0.0658 | 5130. | 0.0231 |
| 2220. | 0.0648 | 5160. | 0.0226 |
| 2250. | 0.0651 | 5190. | 0.0218 |
| 2280. | 0.0647 | 5220. | 0.0214 |
| 2310. | 0.0639 | 5250. | 0.0212 |
| 2340. | 0.0624 | 5280. | 0.0205 |
| 2370. | 0.0625 | 5310. | 0.021 |
| 2400. | 0.0615 | 5340. | 0.0205 |
| 2430. | 0.061 | 5370. | 0.0204 |
| 2460. | 0.0604 | 5400. | 0.019 |
| 2490. | 0.0603 | 5430. | 0.0193 |
| 2520. | 0.0602 | 5460. | 0.0174 |
| 2550. | 0.0603 | 5490. | 0.0186 |
| 2580. | 0.0587 | 5520. | 0.0184 |
| 2610. | 0.059 | 5550. | 0.0164 |
| 2640. | 0.059 | 5580. | 0.0167 |
| 2670. | 0.0594 | 5610. | 0.0158 |
| 2700. | 0.0576 | 5640. | 0.0156 |
| 2730. | 0.0579 | 5670. | 0.0157 |
| 2760. | 0.0582 | 5700. | 0.0139 |
| 2790. | 0.0568 | 5730. | 0.0137 |
| 2820. | 0.0565 | 5760. | 0.0136 |
| 2850. | 0.056 | 5790. | 0.0132 |
| 2880. | 0.0563 | 5820. | 0.0126 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2910. | 0.0549 | | |

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.199E-7 | m/sec |
| y0 | 0.6461 | m |

K = 1.199E-5 cm/sec
T = K*b = 1.199E-5 m²/sec (0.1199 sq. cm/sec)

NOTES

Well may not be sufficiently developed due to a slow recovery.

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 1 (Falling Head Packer Test, vertical interval 13.26 - 18.59 m)
Date: 08/14/13
Time: 14:46:11

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 24 July 2013
Test Well: MW-H28 Zone 1

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.35 m
Static Water Column Height: 17.61 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 5.334 m
Total Well Penetration Depth: 17.61 m

No. of Observations: 252

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.35 | 630. | 0.5988 |
| 5. | 1.311 | 635. | 0.5929 |
| 10. | 1.303 | 640. | 0.588 |
| 15. | 1.296 | 645. | 0.582 |
| 20. | 1.289 | 650. | 0.5765 |
| 25. | 1.282 | 655. | 0.5712 |
| 30. | 1.275 | 660. | 0.5658 |
| 35. | 1.269 | 665. | 0.5606 |
| 40. | 1.262 | 670. | 0.5554 |
| 45. | 1.255 | 675. | 0.5499 |
| 50. | 1.248 | 680. | 0.545 |
| 55. | 1.243 | 685. | 0.5397 |
| 60. | 1.236 | 690. | 0.5344 |
| 65. | 1.231 | 695. | 0.5286 |
| 70. | 1.225 | 700. | 0.5236 |
| 75. | 1.219 | 705. | 0.5191 |
| 80. | 1.212 | 710. | 0.5131 |
| 85. | 1.207 | 715. | 0.5086 |
| 90. | 1.201 | 720. | 0.5034 |
| 95. | 1.195 | 725. | 0.4978 |
| 100. | 1.19 | 730. | 0.4928 |
| 105. | 1.184 | 735. | 0.4872 |
| 110. | 1.179 | 740. | 0.4822 |
| 115. | 1.173 | 745. | 0.4773 |
| 120. | 1.167 | 750. | 0.4725 |
| 125. | 1.162 | 755. | 0.4675 |
| 130. | 1.156 | 760. | 0.4621 |
| 135. | 1.15 | 765. | 0.4571 |
| 140. | 1.145 | 770. | 0.4527 |
| 145. | 1.14 | 775. | 0.4478 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 150. | 1.134 | 780. | 0.4426 |
| 155. | 1.128 | 785. | 0.4373 |
| 160. | 1.123 | 790. | 0.4323 |
| 165. | 1.117 | 795. | 0.4279 |
| 170. | 1.112 | 800. | 0.4234 |
| 175. | 1.107 | 805. | 0.4181 |
| 180. | 1.101 | 810. | 0.4125 |
| 185. | 1.096 | 815. | 0.4079 |
| 190. | 1.09 | 820. | 0.404 |
| 195. | 1.086 | 825. | 0.3991 |
| 200. | 1.08 | 830. | 0.3949 |
| 205. | 1.075 | 835. | 0.39 |
| 210. | 1.069 | 840. | 0.3854 |
| 215. | 1.065 | 845. | 0.3808 |
| 220. | 1.06 | 850. | 0.3766 |
| 225. | 1.055 | 855. | 0.3719 |
| 230. | 1.05 | 860. | 0.3678 |
| 235. | 1.045 | 865. | 0.363 |
| 240. | 1.039 | 870. | 0.3582 |
| 245. | 1.034 | 875. | 0.3538 |
| 250. | 1.029 | 880. | 0.3494 |
| 255. | 1.023 | 885. | 0.3455 |
| 260. | 1.018 | 890. | 0.341 |
| 265. | 1.012 | 895. | 0.3361 |
| 270. | 1.007 | 900. | 0.3315 |
| 275. | 1.002 | 905. | 0.3272 |
| 280. | 0.9969 | 910. | 0.3227 |
| 285. | 0.9918 | 915. | 0.3182 |
| 290. | 0.9865 | 920. | 0.3141 |
| 295. | 0.9807 | 925. | 0.3094 |
| 300. | 0.9753 | 930. | 0.3056 |
| 305. | 0.9703 | 935. | 0.3006 |
| 310. | 0.9657 | 940. | 0.2957 |
| 315. | 0.9604 | 945. | 0.2916 |
| 320. | 0.9555 | 950. | 0.2875 |
| 325. | 0.9502 | 955. | 0.2831 |
| 330. | 0.9443 | 960. | 0.2781 |
| 335. | 0.9382 | 965. | 0.2738 |
| 340. | 0.933 | 970. | 0.2698 |
| 345. | 0.9272 | 975. | 0.265 |
| 350. | 0.9216 | 980. | 0.2607 |
| 355. | 0.9155 | 985. | 0.2565 |
| 360. | 0.9095 | 990. | 0.2516 |
| 365. | 0.904 | 995. | 0.2478 |
| 370. | 0.8984 | 1000. | 0.2429 |
| 375. | 0.8926 | 1005. | 0.2393 |
| 380. | 0.8863 | 1010. | 0.2347 |
| 385. | 0.8808 | 1015. | 0.2303 |
| 390. | 0.8747 | 1020. | 0.2259 |
| 395. | 0.8689 | 1025. | 0.2217 |
| 400. | 0.8636 | 1030. | 0.2174 |
| 405. | 0.8571 | 1035. | 0.213 |
| 410. | 0.8511 | 1040. | 0.2085 |
| 415. | 0.8464 | 1045. | 0.2045 |
| 420. | 0.84 | 1050. | 0.2005 |
| 425. | 0.8341 | 1055. | 0.1961 |
| 430. | 0.8279 | 1060. | 0.1914 |
| 435. | 0.8223 | 1065. | 0.1875 |
| 440. | 0.8166 | 1070. | 0.1836 |
| 445. | 0.811 | 1075. | 0.1791 |
| 450. | 0.805 | 1080. | 0.1748 |
| 455. | 0.7997 | 1085. | 0.1709 |
| 460. | 0.7934 | 1090. | 0.1661 |
| 465. | 0.7875 | 1095. | 0.1625 |
| 470. | 0.7814 | 1100. | 0.1581 |
| 475. | 0.7761 | 1105. | 0.1537 |
| 480. | 0.7698 | 1110. | 0.1497 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 485. | 0.7643 | 1115. | 0.1461 |
| 490. | 0.7589 | 1120. | 0.1421 |
| 495. | 0.7526 | 1125. | 0.138 |
| 500. | 0.7477 | 1130. | 0.1339 |
| 505. | 0.7415 | 1135. | 0.1299 |
| 510. | 0.7359 | 1140. | 0.1256 |
| 515. | 0.7302 | 1145. | 0.1218 |
| 520. | 0.7244 | 1150. | 0.118 |
| 525. | 0.7185 | 1155. | 0.1134 |
| 530. | 0.713 | 1160. | 0.1094 |
| 535. | 0.7066 | 1165. | 0.106 |
| 540. | 0.7009 | 1170. | 0.1015 |
| 545. | 0.6954 | 1175. | 0.0973 |
| 550. | 0.6895 | 1180. | 0.0934 |
| 555. | 0.6839 | 1185. | 0.0898 |
| 560. | 0.6783 | 1190. | 0.0859 |
| 565. | 0.6722 | 1195. | 0.0818 |
| 570. | 0.6669 | 1200. | 0.0779 |
| 575. | 0.661 | 1205. | 0.0736 |
| 580. | 0.6552 | 1210. | 0.0699 |
| 585. | 0.6493 | 1215. | 0.0656 |
| 590. | 0.6437 | 1220. | 0.0617 |
| 595. | 0.6379 | 1225. | 0.0577 |
| 600. | 0.6324 | 1230. | 0.0534 |
| 605. | 0.6267 | 1235. | 0.0494 |
| 610. | 0.6207 | 1240. | 0.0457 |
| 615. | 0.6151 | 1245. | 0.0411 |
| 620. | 0.6097 | 1250. | 0.0374 |
| 625. | 0.6044 | 1255. | 0.0337 |

## SOLUTION

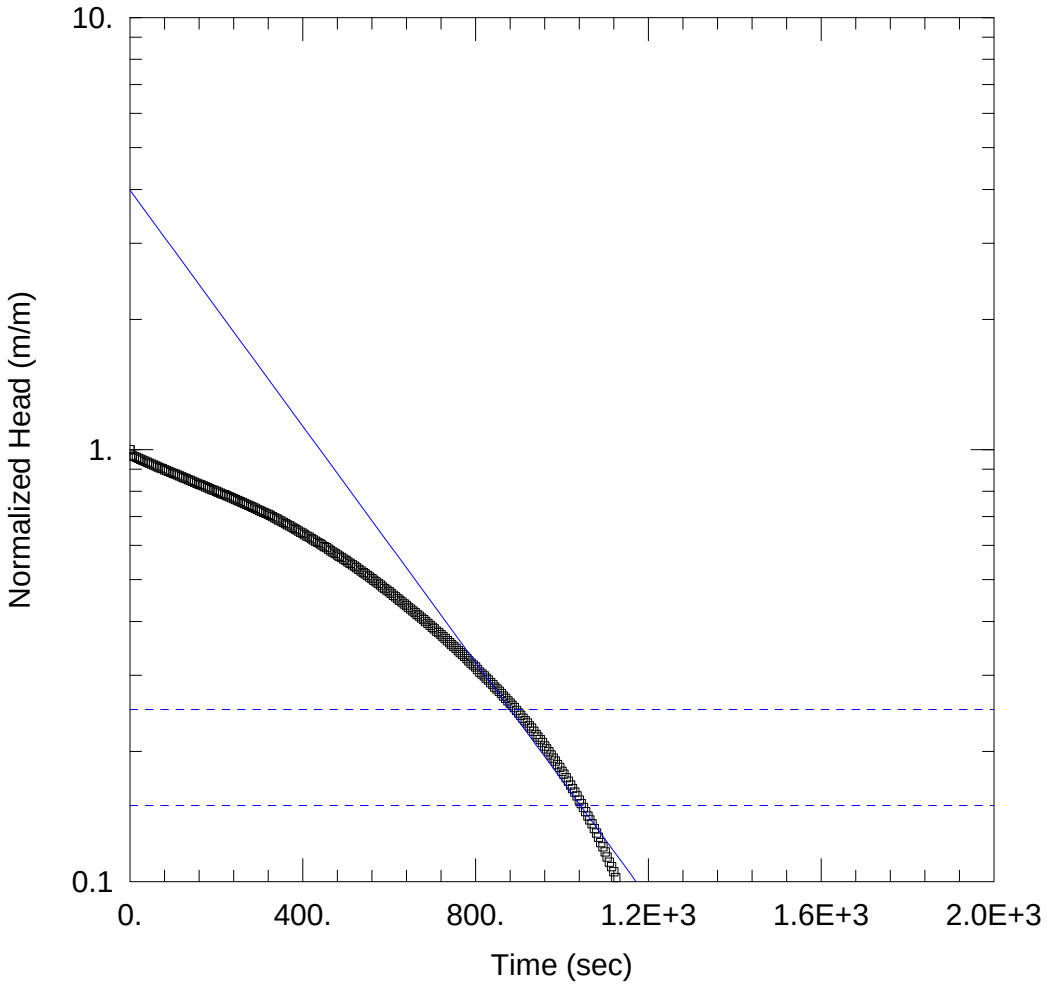
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.2123

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 3.2E-6 | m/sec |
| y0 | 5.379 | m |

K = 0.00032 cm/sec
T = K*b = 0.00032 m²/sec (3.2 sq. cm/sec)




MW-H28 ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 13.26 - 18.59 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 1
Test Date: 24 July 2013

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 3.2E-6 m/sec

y0 = 5.379 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 2 (Falling Head Packer Test, vertical interval 19.05 - 26.82 m)
Date: 08/14/13
Time: 14:55:36

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 24 July 2013
Test Well: MW-H28 Zone 2

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.3 m
Static Water Column Height: 26.54 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: .1 m
Screen Length: 7.7 m
Total Well Penetration Depth: 26.54 m

No. of Observations: 722

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.3 | 1805. | 1.198 |
| 5. | 1.3 | 1810. | 1.198 |
| 10. | 1.299 | 1815. | 1.196 |
| 15. | 1.297 | 1820. | 1.198 |
| 20. | 1.296 | 1825. | 1.198 |
| 25. | 1.295 | 1830. | 1.197 |
| 30. | 1.295 | 1835. | 1.197 |
| 35. | 1.293 | 1840. | 1.197 |
| 40. | 1.293 | 1845. | 1.196 |
| 45. | 1.292 | 1850. | 1.196 |
| 50. | 1.29 | 1855. | 1.196 |
| 55. | 1.29 | 1860. | 1.196 |
| 60. | 1.289 | 1865. | 1.195 |
| 65. | 1.288 | 1870. | 1.195 |
| 70. | 1.288 | 1875. | 1.195 |
| 75. | 1.287 | 1880. | 1.195 |
| 80. | 1.286 | 1885. | 1.195 |
| 85. | 1.285 | 1890. | 1.194 |
| 90. | 1.285 | 1895. | 1.194 |
| 95. | 1.284 | 1900. | 1.193 |
| 100. | 1.283 | 1905. | 1.193 |
| 105. | 1.282 | 1910. | 1.193 |
| 110. | 1.281 | 1915. | 1.193 |
| 115. | 1.282 | 1920. | 1.193 |
| 120. | 1.281 | 1925. | 1.193 |
| 125. | 1.28 | 1930. | 1.192 |
| 130. | 1.279 | 1935. | 1.192 |
| 135. | 1.279 | 1940. | 1.192 |
| 140. | 1.279 | 1945. | 1.192 |
| 145. | 1.278 | 1950. | 1.192 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 150. | 1.278 | 1955. | 1.191 |
| 155. | 1.277 | 1960. | 1.191 |
| 160. | 1.277 | 1965. | 1.191 |
| 165. | 1.277 | 1970. | 1.19 |
| 170. | 1.276 | 1975. | 1.19 |
| 175. | 1.275 | 1980. | 1.19 |
| 180. | 1.275 | 1985. | 1.19 |
| 185. | 1.275 | 1990. | 1.19 |
| 190. | 1.274 | 1995. | 1.19 |
| 195. | 1.274 | 2000. | 1.189 |
| 200. | 1.274 | 2005. | 1.189 |
| 205. | 1.273 | 2010. | 1.188 |
| 210. | 1.273 | 2015. | 1.188 |
| 215. | 1.272 | 2020. | 1.188 |
| 220. | 1.272 | 2025. | 1.188 |
| 225. | 1.272 | 2030. | 1.189 |
| 230. | 1.271 | 2035. | 1.187 |
| 235. | 1.271 | 2040. | 1.188 |
| 240. | 1.271 | 2045. | 1.187 |
| 245. | 1.271 | 2050. | 1.187 |
| 250. | 1.27 | 2055. | 1.187 |
| 255. | 1.27 | 2060. | 1.187 |
| 260. | 1.269 | 2065. | 1.186 |
| 265. | 1.269 | 2070. | 1.187 |
| 270. | 1.269 | 2075. | 1.186 |
| 275. | 1.268 | 2080. | 1.186 |
| 280. | 1.268 | 2085. | 1.185 |
| 285. | 1.267 | 2090. | 1.185 |
| 290. | 1.267 | 2095. | 1.186 |
| 295. | 1.267 | 2100. | 1.185 |
| 300. | 1.266 | 2105. | 1.185 |
| 305. | 1.266 | 2110. | 1.184 |
| 310. | 1.266 | 2115. | 1.184 |
| 315. | 1.266 | 2120. | 1.183 |
| 320. | 1.265 | 2125. | 1.183 |
| 325. | 1.265 | 2130. | 1.183 |
| 330. | 1.264 | 2135. | 1.183 |
| 335. | 1.264 | 2140. | 1.183 |
| 340. | 1.264 | 2145. | 1.183 |
| 345. | 1.263 | 2150. | 1.183 |
| 350. | 1.263 | 2155. | 1.182 |
| 355. | 1.262 | 2160. | 1.183 |
| 360. | 1.262 | 2165. | 1.182 |
| 365. | 1.262 | 2170. | 1.182 |
| 370. | 1.262 | 2175. | 1.182 |
| 375. | 1.261 | 2180. | 1.181 |
| 380. | 1.261 | 2185. | 1.181 |
| 385. | 1.261 | 2190. | 1.18 |
| 390. | 1.261 | 2195. | 1.18 |
| 395. | 1.26 | 2200. | 1.18 |
| 400. | 1.26 | 2205. | 1.18 |
| 405. | 1.26 | 2210. | 1.179 |
| 410. | 1.26 | 2215. | 1.18 |
| 415. | 1.259 | 2220. | 1.179 |
| 420. | 1.258 | 2225. | 1.179 |
| 425. | 1.258 | 2230. | 1.178 |
| 430. | 1.258 | 2235. | 1.178 |
| 435. | 1.258 | 2240. | 1.178 |
| 440. | 1.257 | 2245. | 1.177 |
| 445. | 1.257 | 2250. | 1.177 |
| 450. | 1.257 | 2255. | 1.177 |
| 455. | 1.256 | 2260. | 1.177 |
| 460. | 1.256 | 2265. | 1.177 |
| 465. | 1.256 | 2270. | 1.177 |
| 470. | 1.256 | 2275. | 1.176 |
| 475. | 1.255 | 2280. | 1.176 |
| 480. | 1.255 | 2285. | 1.176 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 485. | 1.254 | 2290. | 1.175 |
| 490. | 1.254 | 2295. | 1.176 |
| 495. | 1.254 | 2300. | 1.175 |
| 500. | 1.254 | 2305. | 1.174 |
| 505. | 1.254 | 2310. | 1.174 |
| 510. | 1.254 | 2315. | 1.174 |
| 515. | 1.253 | 2320. | 1.174 |
| 520. | 1.253 | 2325. | 1.173 |
| 525. | 1.253 | 2330. | 1.173 |
| 530. | 1.252 | 2335. | 1.172 |
| 535. | 1.252 | 2340. | 1.173 |
| 540. | 1.252 | 2345. | 1.172 |
| 545. | 1.252 | 2350. | 1.172 |
| 550. | 1.251 | 2355. | 1.172 |
| 555. | 1.251 | 2360. | 1.172 |
| 560. | 1.251 | 2365. | 1.171 |
| 565. | 1.251 | 2370. | 1.171 |
| 570. | 1.25 | 2375. | 1.171 |
| 575. | 1.25 | 2380. | 1.171 |
| 580. | 1.249 | 2385. | 1.17 |
| 585. | 1.249 | 2390. | 1.17 |
| 590. | 1.249 | 2395. | 1.169 |
| 595. | 1.249 | 2400. | 1.169 |
| 600. | 1.249 | 2405. | 1.169 |
| 605. | 1.249 | 2410. | 1.169 |
| 610. | 1.248 | 2415. | 1.168 |
| 615. | 1.248 | 2420. | 1.168 |
| 620. | 1.248 | 2425. | 1.168 |
| 625. | 1.247 | 2430. | 1.168 |
| 630. | 1.247 | 2435. | 1.168 |
| 635. | 1.247 | 2440. | 1.167 |
| 640. | 1.247 | 2445. | 1.167 |
| 645. | 1.246 | 2450. | 1.166 |
| 650. | 1.246 | 2455. | 1.166 |
| 655. | 1.246 | 2460. | 1.166 |
| 660. | 1.246 | 2465. | 1.166 |
| 665. | 1.246 | 2470. | 1.165 |
| 670. | 1.246 | 2475. | 1.165 |
| 675. | 1.245 | 2480. | 1.165 |
| 680. | 1.245 | 2485. | 1.165 |
| 685. | 1.245 | 2490. | 1.164 |
| 690. | 1.245 | 2495. | 1.163 |
| 695. | 1.245 | 2500. | 1.163 |
| 700. | 1.244 | 2505. | 1.163 |
| 705. | 1.244 | 2510. | 1.162 |
| 710. | 1.244 | 2515. | 1.162 |
| 715. | 1.244 | 2520. | 1.162 |
| 720. | 1.244 | 2525. | 1.161 |
| 725. | 1.244 | 2530. | 1.161 |
| 730. | 1.244 | 2535. | 1.161 |
| 735. | 1.243 | 2540. | 1.16 |
| 740. | 1.243 | 2545. | 1.16 |
| 745. | 1.243 | 2550. | 1.159 |
| 750. | 1.243 | 2555. | 1.159 |
| 755. | 1.242 | 2560. | 1.158 |
| 760. | 1.242 | 2565. | 1.158 |
| 765. | 1.242 | 2570. | 1.158 |
| 770. | 1.242 | 2575. | 1.157 |
| 775. | 1.242 | 2580. | 1.157 |
| 780. | 1.241 | 2585. | 1.157 |
| 785. | 1.241 | 2590. | 1.157 |
| 790. | 1.241 | 2595. | 1.156 |
| 795. | 1.241 | 2600. | 1.156 |
| 800. | 1.24 | 2605. | 1.155 |
| 805. | 1.24 | 2610. | 1.154 |
| 810. | 1.24 | 2615. | 1.155 |
| 815. | 1.24 | 2620. | 1.154 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 820. | 1.239 | 2625. | 1.154 |
| 825. | 1.239 | 2630. | 1.154 |
| 830. | 1.239 | 2635. | 1.154 |
| 835. | 1.239 | 2640. | 1.153 |
| 840. | 1.238 | 2645. | 1.152 |
| 845. | 1.239 | 2650. | 1.152 |
| 850. | 1.238 | 2655. | 1.152 |
| 855. | 1.238 | 2660. | 1.12 |
| 860. | 1.238 | 2665. | 1.154 |
| 865. | 1.238 | 2670. | 1.153 |
| 870. | 1.238 | 2675. | 1.15 |
| 875. | 1.238 | 2680. | 1.15 |
| 880. | 1.237 | 2685. | 1.149 |
| 885. | 1.237 | 2690. | 1.149 |
| 890. | 1.236 | 2695. | 1.149 |
| 895. | 1.236 | 2700. | 1.149 |
| 900. | 1.236 | 2705. | 1.148 |
| 905. | 1.236 | 2710. | 1.148 |
| 910. | 1.236 | 2715. | 1.148 |
| 915. | 1.236 | 2720. | 1.148 |
| 920. | 1.236 | 2725. | 1.148 |
| 925. | 1.235 | 2730. | 1.147 |
| 930. | 1.235 | 2735. | 1.147 |
| 935. | 1.235 | 2740. | 1.146 |
| 940. | 1.235 | 2745. | 1.146 |
| 945. | 1.235 | 2750. | 1.146 |
| 950. | 1.234 | 2755. | 1.145 |
| 955. | 1.234 | 2760. | 1.145 |
| 960. | 1.234 | 2765. | 1.145 |
| 965. | 1.234 | 2770. | 1.144 |
| 970. | 1.234 | 2775. | 1.144 |
| 975. | 1.234 | 2780. | 1.144 |
| 980. | 1.233 | 2785. | 1.143 |
| 985. | 1.233 | 2790. | 1.143 |
| 990. | 1.233 | 2795. | 1.143 |
| 995. | 1.233 | 2800. | 1.143 |
| 1000. | 1.232 | 2805. | 1.143 |
| 1005. | 1.233 | 2810. | 1.142 |
| 1010. | 1.232 | 2815. | 1.142 |
| 1015. | 1.232 | 2820. | 1.143 |
| 1020. | 1.232 | 2825. | 1.142 |
| 1025. | 1.232 | 2830. | 1.142 |
| 1030. | 1.232 | 2835. | 1.141 |
| 1035. | 1.231 | 2840. | 1.141 |
| 1040. | 1.231 | 2845. | 1.14 |
| 1045. | 1.231 | 2850. | 1.14 |
| 1050. | 1.231 | 2855. | 1.14 |
| 1055. | 1.231 | 2860. | 1.14 |
| 1060. | 1.23 | 2865. | 1.14 |
| 1065. | 1.231 | 2870. | 1.139 |
| 1070. | 1.23 | 2875. | 1.139 |
| 1075. | 1.23 | 2880. | 1.139 |
| 1080. | 1.23 | 2885. | 1.139 |
| 1085. | 1.23 | 2890. | 1.139 |
| 1090. | 1.23 | 2895. | 1.138 |
| 1095. | 1.229 | 2900. | 1.138 |
| 1100. | 1.229 | 2905. | 1.138 |
| 1105. | 1.228 | 2910. | 1.138 |
| 1110. | 1.229 | 2915. | 1.137 |
| 1115. | 1.228 | 2920. | 1.137 |
| 1120. | 1.228 | 2925. | 1.137 |
| 1125. | 1.228 | 2930. | 1.137 |
| 1130. | 1.228 | 2935. | 1.136 |
| 1135. | 1.228 | 2940. | 1.136 |
| 1140. | 1.227 | 2945. | 1.134 |
| 1145. | 1.227 | 2950. | 1.136 |
| 1150. | 1.227 | 2955. | 1.135 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1155. | 1.226 | 2960. | 1.134 |
| 1160. | 1.226 | 2965. | 1.135 |
| 1165. | 1.227 | 2970. | 1.135 |
| 1170. | 1.226 | 2975. | 1.134 |
| 1175. | 1.226 | 2980. | 1.134 |
| 1180. | 1.226 | 2985. | 1.134 |
| 1185. | 1.226 | 2990. | 1.133 |
| 1190. | 1.226 | 2995. | 1.133 |
| 1195. | 1.225 | 3000. | 1.133 |
| 1200. | 1.225 | 3005. | 1.133 |
| 1205. | 1.225 | 3010. | 1.133 |
| 1210. | 1.224 | 3015. | 1.132 |
| 1215. | 1.224 | 3020. | 1.132 |
| 1220. | 1.224 | 3025. | 1.132 |
| 1225. | 1.224 | 3030. | 1.132 |
| 1230. | 1.224 | 3035. | 1.131 |
| 1235. | 1.224 | 3040. | 1.131 |
| 1240. | 1.223 | 3045. | 1.131 |
| 1245. | 1.223 | 3050. | 1.131 |
| 1250. | 1.223 | 3055. | 1.13 |
| 1255. | 1.223 | 3060. | 1.13 |
| 1260. | 1.222 | 3065. | 1.13 |
| 1265. | 1.222 | 3070. | 1.129 |
| 1270. | 1.222 | 3075. | 1.129 |
| 1275. | 1.222 | 3080. | 1.129 |
| 1280. | 1.221 | 3085. | 1.129 |
| 1285. | 1.221 | 3090. | 1.129 |
| 1290. | 1.221 | 3095. | 1.128 |
| 1295. | 1.221 | 3100. | 1.128 |
| 1300. | 1.222 | 3105. | 1.127 |
| 1305. | 1.221 | 3110. | 1.128 |
| 1310. | 1.221 | 3115. | 1.127 |
| 1315. | 1.22 | 3120. | 1.127 |
| 1320. | 1.22 | 3125. | 1.127 |
| 1325. | 1.22 | 3130. | 1.126 |
| 1330. | 1.22 | 3135. | 1.126 |
| 1335. | 1.219 | 3140. | 1.126 |
| 1340. | 1.22 | 3145. | 1.126 |
| 1345. | 1.218 | 3150. | 1.125 |
| 1350. | 1.219 | 3155. | 1.125 |
| 1355. | 1.219 | 3160. | 1.125 |
| 1360. | 1.218 | 3165. | 1.125 |
| 1365. | 1.218 | 3170. | 1.124 |
| 1370. | 1.218 | 3175. | 1.124 |
| 1375. | 1.218 | 3180. | 1.124 |
| 1380. | 1.217 | 3185. | 1.123 |
| 1385. | 1.217 | 3190. | 1.123 |
| 1390. | 1.217 | 3195. | 1.123 |
| 1395. | 1.217 | 3200. | 1.122 |
| 1400. | 1.216 | 3205. | 1.122 |
| 1405. | 1.216 | 3210. | 1.122 |
| 1410. | 1.215 | 3215. | 1.122 |
| 1415. | 1.215 | 3220. | 1.122 |
| 1420. | 1.215 | 3225. | 1.121 |
| 1425. | 1.215 | 3230. | 1.121 |
| 1430. | 1.215 | 3235. | 1.12 |
| 1435. | 1.215 | 3240. | 1.12 |
| 1440. | 1.214 | 3245. | 1.12 |
| 1445. | 1.214 | 3250. | 1.119 |
| 1450. | 1.214 | 3255. | 1.119 |
| 1455. | 1.214 | 3260. | 1.119 |
| 1460. | 1.213 | 3265. | 1.119 |
| 1465. | 1.213 | 3270. | 1.118 |
| 1470. | 1.213 | 3275. | 1.118 |
| 1475. | 1.213 | 3280. | 1.118 |
| 1480. | 1.213 | 3285. | 1.118 |
| 1485. | 1.212 | 3290. | 1.117 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1490. | 1.212 | 3295. | 1.117 |
| 1495. | 1.212 | 3300. | 1.117 |
| 1500. | 1.212 | 3305. | 1.117 |
| 1505. | 1.212 | 3310. | 1.117 |
| 1510. | 1.212 | 3315. | 1.116 |
| 1515. | 1.211 | 3320. | 1.116 |
| 1520. | 1.21 | 3325. | 1.115 |
| 1525. | 1.211 | 3330. | 1.115 |
| 1530. | 1.211 | 3335. | 1.115 |
| 1535. | 1.21 | 3340. | 1.115 |
| 1540. | 1.21 | 3345. | 1.115 |
| 1545. | 1.21 | 3350. | 1.114 |
| 1550. | 1.21 | 3355. | 1.114 |
| 1555. | 1.21 | 3360. | 1.114 |
| 1560. | 1.21 | 3365. | 1.113 |
| 1565. | 1.21 | 3370. | 1.113 |
| 1570. | 1.209 | 3375. | 1.113 |
| 1575. | 1.209 | 3380. | 1.112 |
| 1580. | 1.209 | 3385. | 1.113 |
| 1585. | 1.209 | 3390. | 1.112 |
| 1590. | 1.208 | 3395. | 1.112 |
| 1595. | 1.208 | 3400. | 1.112 |
| 1600. | 1.208 | 3405. | 1.111 |
| 1605. | 1.208 | 3410. | 1.111 |
| 1610. | 1.208 | 3415. | 1.11 |
| 1615. | 1.207 | 3420. | 1.11 |
| 1620. | 1.207 | 3425. | 1.11 |
| 1625. | 1.207 | 3430. | 1.11 |
| 1630. | 1.206 | 3435. | 1.109 |
| 1635. | 1.207 | 3440. | 1.109 |
| 1640. | 1.206 | 3445. | 1.109 |
| 1645. | 1.206 | 3450. | 1.109 |
| 1650. | 1.206 | 3455. | 1.108 |
| 1655. | 1.206 | 3460. | 1.109 |
| 1660. | 1.205 | 3465. | 1.108 |
| 1665. | 1.206 | 3470. | 1.108 |
| 1670. | 1.205 | 3475. | 1.108 |
| 1675. | 1.204 | 3480. | 1.108 |
| 1680. | 1.204 | 3485. | 1.107 |
| 1685. | 1.204 | 3490. | 1.107 |
| 1690. | 1.204 | 3495. | 1.107 |
| 1695. | 1.204 | 3500. | 1.107 |
| 1700. | 1.204 | 3505. | 1.106 |
| 1705. | 1.203 | 3510. | 1.106 |
| 1710. | 1.203 | 3515. | 1.106 |
| 1715. | 1.204 | 3520. | 1.105 |
| 1720. | 1.203 | 3525. | 1.107 |
| 1725. | 1.202 | 3530. | 1.106 |
| 1730. | 1.202 | 3535. | 1.105 |
| 1735. | 1.202 | 3540. | 1.104 |
| 1740. | 1.202 | 3545. | 1.104 |
| 1745. | 1.202 | 3550. | 1.104 |
| 1750. | 1.201 | 3555. | 1.103 |
| 1755. | 1.201 | 3560. | 1.103 |
| 1760. | 1.2 | 3565. | 1.103 |
| 1765. | 1.2 | 3570. | 1.102 |
| 1770. | 1.2 | 3575. | 1.101 |
| 1775. | 1.199 | 3580. | 1.101 |
| 1780. | 1.2 | 3585. | 1.101 |
| 1785. | 1.199 | 3590. | 1.101 |
| 1790. | 1.199 | 3595. | 1.1 |
| 1795. | 1.199 | 3600. | 1.099 |
| 1800. | 1.198 | 3605. | 1.099 |

SOLUTION

Slug Test

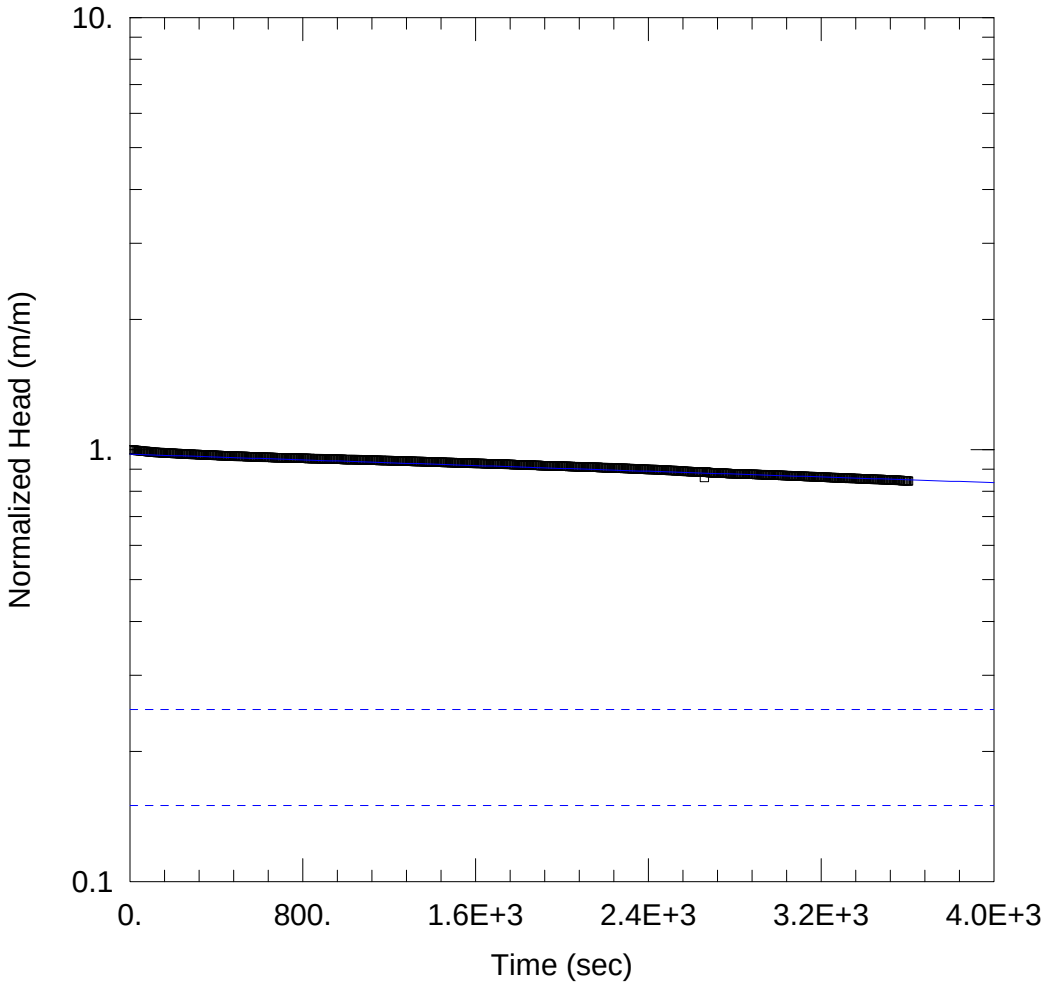
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1969

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 2.876E-8 | m/sec |
| y0 | 1.268 | m |

K = 2.876E-6 cm/sec
T = K*b = 2.876E-6 m²/sec (0.02876 sq. cm/sec)




MW-H28 ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 19.05 - 26.82 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 2
Test Date: 24 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.876E-8 m/sec
y0 = 1.268 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 3 (Falling Head Packer Test, vertical interval 27.28 - 41.76 m)
Date: 08/14/13
Time: 15:01:00

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 25 July 2013
Test Well: MW-H28 Zone 3

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

### Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.5 m
Static Water Column Height: 41.13 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 14.48 m
Total Well Penetration Depth: 41.13 m

No. of Observations: 94

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.5 | 1410. | 1.467 |
| 30. | 1.495 | 1440. | 1.467 |
| 60. | 1.492 | 1470. | 1.467 |
| 90. | 1.489 | 1500. | 1.466 |
| 120. | 1.487 | 1530. | 1.466 |
| 150. | 1.485 | 1560. | 1.466 |
| 180. | 1.484 | 1590. | 1.465 |
| 210. | 1.483 | 1620. | 1.465 |
| 240. | 1.482 | 1650. | 1.465 |
| 270. | 1.482 | 1680. | 1.464 |
| 300. | 1.481 | 1710. | 1.465 |
| 330. | 1.48 | 1740. | 1.464 |
| 360. | 1.48 | 1770. | 1.463 |
| 390. | 1.479 | 1800. | 1.463 |
| 420. | 1.478 | 1830. | 1.463 |
| 450. | 1.478 | 1860. | 1.463 |
| 480. | 1.477 | 1890. | 1.462 |
| 510. | 1.477 | 1920. | 1.462 |
| 540. | 1.476 | 1950. | 1.462 |
| 570. | 1.476 | 1980. | 1.461 |
| 600. | 1.476 | 2010. | 1.461 |
| 630. | 1.476 | 2040. | 1.461 |
| 660. | 1.475 | 2070. | 1.461 |
| 690. | 1.475 | 2100. | 1.46 |
| 720. | 1.474 | 2130. | 1.46 |
| 750. | 1.474 | 2160. | 1.46 |
| 780. | 1.473 | 2190. | 1.459 |
| 810. | 1.473 | 2220. | 1.459 |
| 840. | 1.473 | 2250. | 1.459 |
| 870. | 1.473 | 2280. | 1.459 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 1.472 | 2310. | 1.458 |
| 930. | 1.471 | 2340. | 1.458 |
| 960. | 1.472 | 2370. | 1.458 |
| 990. | 1.471 | 2400. | 1.459 |
| 1020. | 1.471 | 2430. | 1.458 |
| 1050. | 1.471 | 2460. | 1.458 |
| 1080. | 1.47 | 2490. | 1.458 |
| 1110. | 1.47 | 2520. | 1.457 |
| 1140. | 1.469 | 2550. | 1.456 |
| 1170. | 1.47 | 2580. | 1.456 |
| 1200. | 1.468 | 2610. | 1.456 |
| 1230. | 1.468 | 2640. | 1.455 |
| 1260. | 1.468 | 2670. | 1.456 |
| 1290. | 1.468 | 2700. | 1.463 |
| 1320. | 1.468 | 2730. | 1.456 |
| 1350. | 1.468 | 2760. | 1.453 |
| 1380. | 1.467 | 2790. | 1.441 |

## SOLUTION

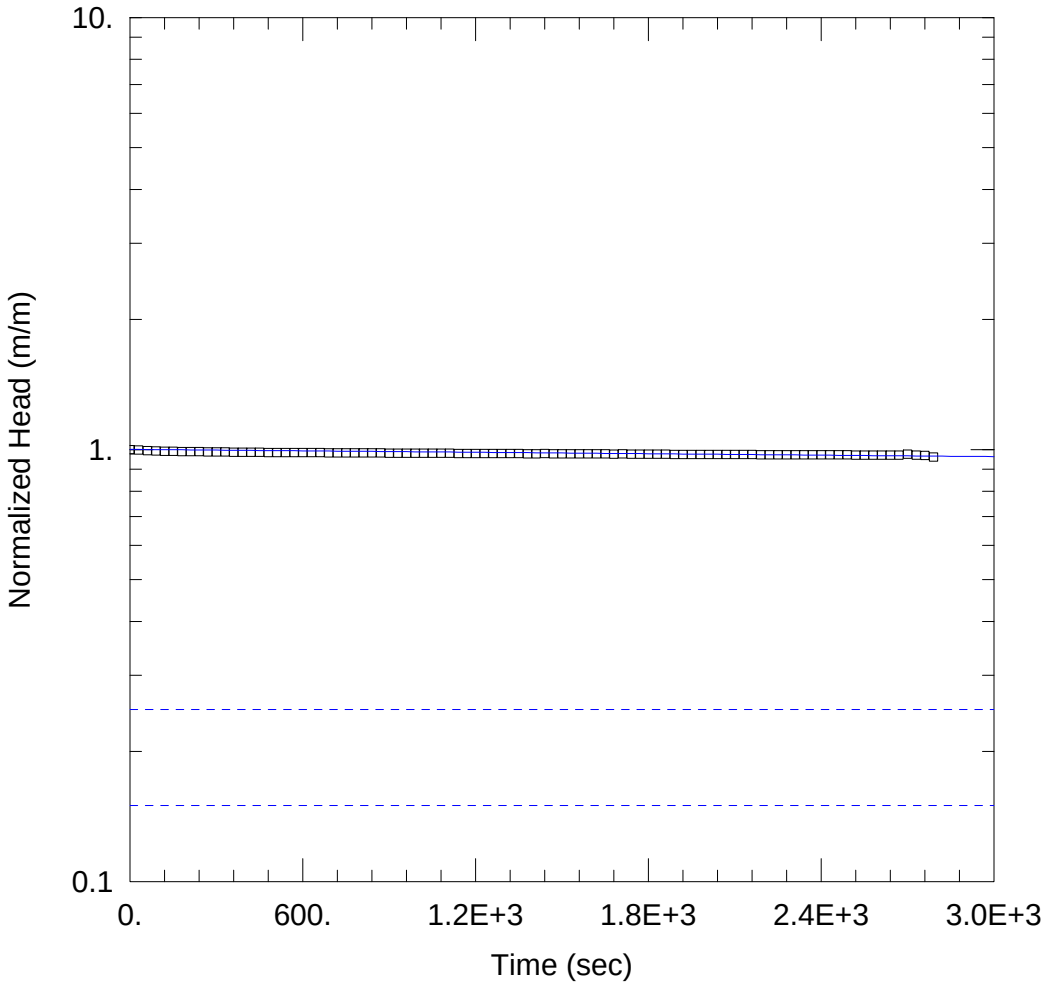
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1752

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 5.821E-9 | m/sec |
| y0 | 1.501 | m |

K = 5.821E-7 cm/sec
T = K*b = 5.821E-7 m²/sec (0.005821 sq. cm/sec)




MW-H28 ZONE 3 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 27.28 - 41.76 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 3
Test Date: 25 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 5.821E-9 m/sec
y0 = 1.501 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 4 (Falling Head Packer Test, vertical interval 42.22 - 56.69 m)
Date: 08/14/13
Time: 15:06:17

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 26 July 2013
Test Well: MW-H28 Zone 4

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.3 m
Static Water Column Height: 44.93 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 14.48 m
Total Well Penetration Depth: 44.93 m

No. of Observations: 90

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.3 | 1350. | 1.043 |
| 30. | 1.29 | 1380. | 1.037 |
| 60. | 1.282 | 1410. | 1.032 |
| 90. | 1.274 | 1440. | 1.027 |
| 120. | 1.267 | 1470. | 1.022 |
| 150. | 1.26 | 1500. | 1.016 |
| 180. | 1.254 | 1530. | 1.011 |
| 210. | 1.248 | 1560. | 1.006 |
| 240. | 1.242 | 1590. | 1. |
| 270. | 1.236 | 1620. | 0.9953 |
| 300. | 1.231 | 1650. | 0.9897 |
| 330. | 1.225 | 1680. | 0.9845 |
| 360. | 1.22 | 1710. | 0.9797 |
| 390. | 1.214 | 1740. | 0.9741 |
| 420. | 1.208 | 1770. | 0.9682 |
| 450. | 1.203 | 1800. | 0.963 |
| 480. | 1.197 | 1830. | 0.958 |
| 510. | 1.192 | 1860. | 0.9527 |
| 540. | 1.186 | 1890. | 0.9469 |
| 570. | 1.181 | 1920. | 0.9417 |
| 600. | 1.176 | 1950. | 0.9368 |
| 630. | 1.171 | 1980. | 0.9314 |
| 660. | 1.165 | 2010. | 0.9264 |
| 690. | 1.16 | 2040. | 0.921 |
| 720. | 1.154 | 2070. | 0.9156 |
| 750. | 1.149 | 2100. | 0.9103 |
| 780. | 1.143 | 2130. | 0.9048 |
| 810. | 1.138 | 2160. | 0.9001 |
| 840. | 1.133 | 2190. | 0.8944 |
| 870. | 1.128 | 2220. | 0.8889 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 1.122 | 2250. | 0.8839 |
| 930. | 1.116 | 2280. | 0.8786 |
| 960. | 1.111 | 2310. | 0.8734 |
| 990. | 1.106 | 2340. | 0.8684 |
| 1020. | 1.101 | 2370. | 0.8633 |
| 1050. | 1.096 | 2400. | 0.8586 |
| 1080. | 1.09 | 2430. | 0.8535 |
| 1110. | 1.085 | 2460. | 0.848 |
| 1140. | 1.079 | 2490. | 0.8428 |
| 1170. | 1.075 | 2520. | 0.8368 |
| 1200. | 1.069 | 2550. | 0.8314 |
| 1230. | 1.063 | 2580. | 0.8258 |
| 1260. | 1.058 | 2610. | 0.8205 |
| 1290. | 1.053 | 2640. | 0.8148 |
| 1320. | 1.048 | 2670. | 0.8106 |

## SOLUTION

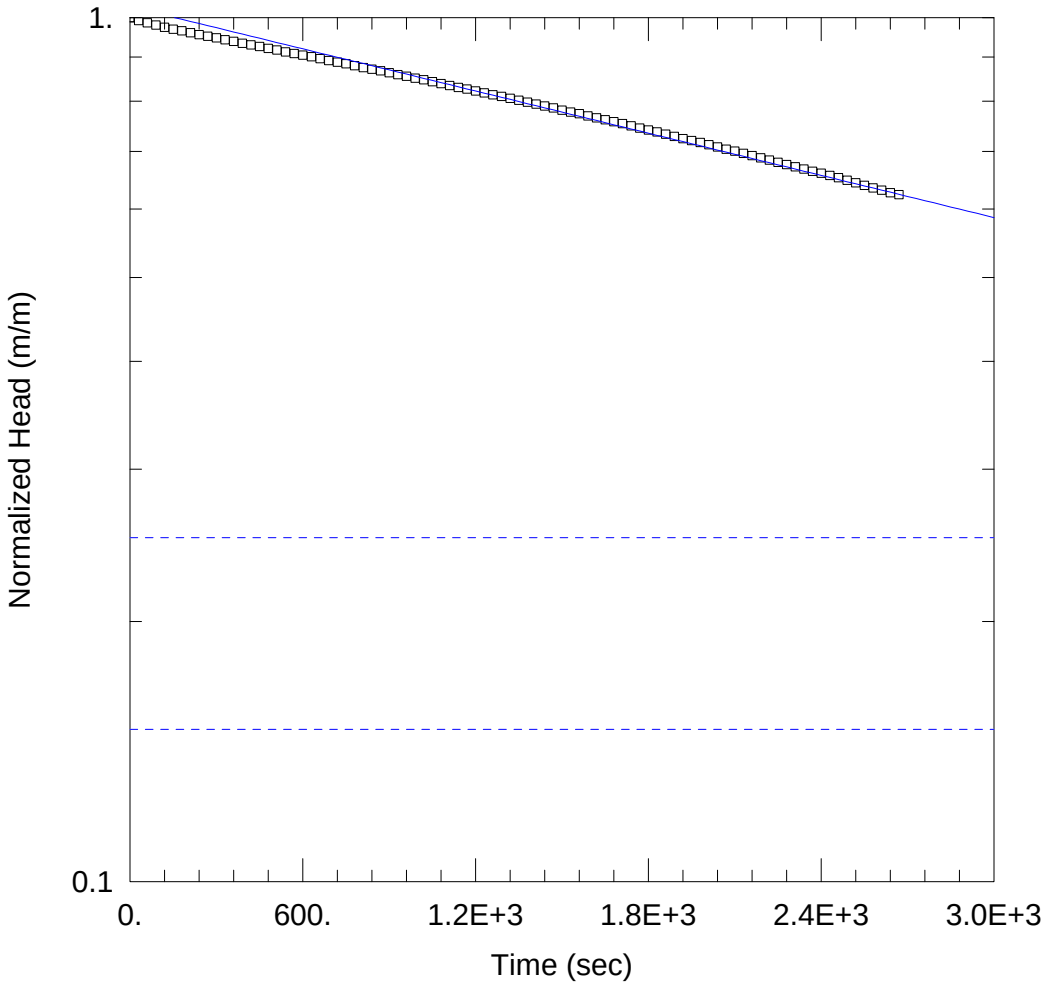
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1752

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 8.509E-8 | m/sec |
| y0 | 1.338 | m |

K = 8.509E-6 cm/sec
T = K*b = 8.509E-6 m²/sec (0.08509 sq. cm/sec)




MW-H28 ZONE 4 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 42.22 - 56.69 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 4
Test Date: 26 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 8.509E-8 m/sec

y0 = 1.338 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 5 (Falling Head Packer Test, vertical interval 57.45 - 76.51 m)
Date: 08/14/13
Time: 15:14:28

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 26 July 2013
Test Well: MW-H28 Zone 5

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 6.7 m
Static Water Column Height: 68.94 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 19.05 m
Total Well Penetration Depth: 68.94 m

No. of Observations: 79

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 6.7 | 1200. | 5.445 |
| 30. | 6.658 | 1230. | 5.416 |
| 60. | 6.625 | 1260. | 5.387 |
| 90. | 6.592 | 1290. | 5.356 |
| 120. | 6.554 | 1320. | 5.329 |
| 150. | 6.521 | 1350. | 5.3 |
| 180. | 6.486 | 1380. | 5.272 |
| 210. | 6.453 | 1410. | 5.243 |
| 240. | 6.419 | 1440. | 5.214 |
| 270. | 6.386 | 1470. | 5.185 |
| 300. | 6.354 | 1500. | 5.157 |
| 330. | 6.32 | 1530. | 5.129 |
| 360. | 6.29 | 1560. | 5.101 |
| 390. | 6.257 | 1590. | 5.072 |
| 420. | 6.226 | 1620. | 5.045 |
| 450. | 6.195 | 1650. | 5.018 |
| 480. | 6.165 | 1680. | 4.99 |
| 510. | 6.13 | 1710. | 4.961 |
| 540. | 6.102 | 1740. | 4.933 |
| 570. | 6.072 | 1770. | 4.904 |
| 600. | 6.04 | 1800. | 4.877 |
| 630. | 6.01 | 1830. | 4.85 |
| 660. | 5.979 | 1860. | 4.822 |
| 690. | 5.949 | 1890. | 4.795 |
| 720. | 5.918 | 1920. | 4.767 |
| 750. | 5.888 | 1950. | 4.74 |
| 780. | 5.859 | 1980. | 4.713 |
| 810. | 5.828 | 2010. | 4.685 |
| 840. | 5.8 | 2040. | 4.657 |
| 870. | 5.769 | 2070. | 4.63 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 5.739 | 2100. | 4.603 |
| 930. | 5.708 | 2130. | 4.575 |
| 960. | 5.679 | 2160. | 4.548 |
| 990. | 5.648 | 2190. | 4.522 |
| 1020. | 5.62 | 2220. | 4.495 |
| 1050. | 5.591 | 2250. | 4.467 |
| 1080. | 5.561 | 2280. | 4.44 |
| 1110. | 5.532 | 2310. | 4.411 |
| 1140. | 5.503 | 2340. | 4.34 |
| 1170. | 5.473 | | |

## SOLUTION

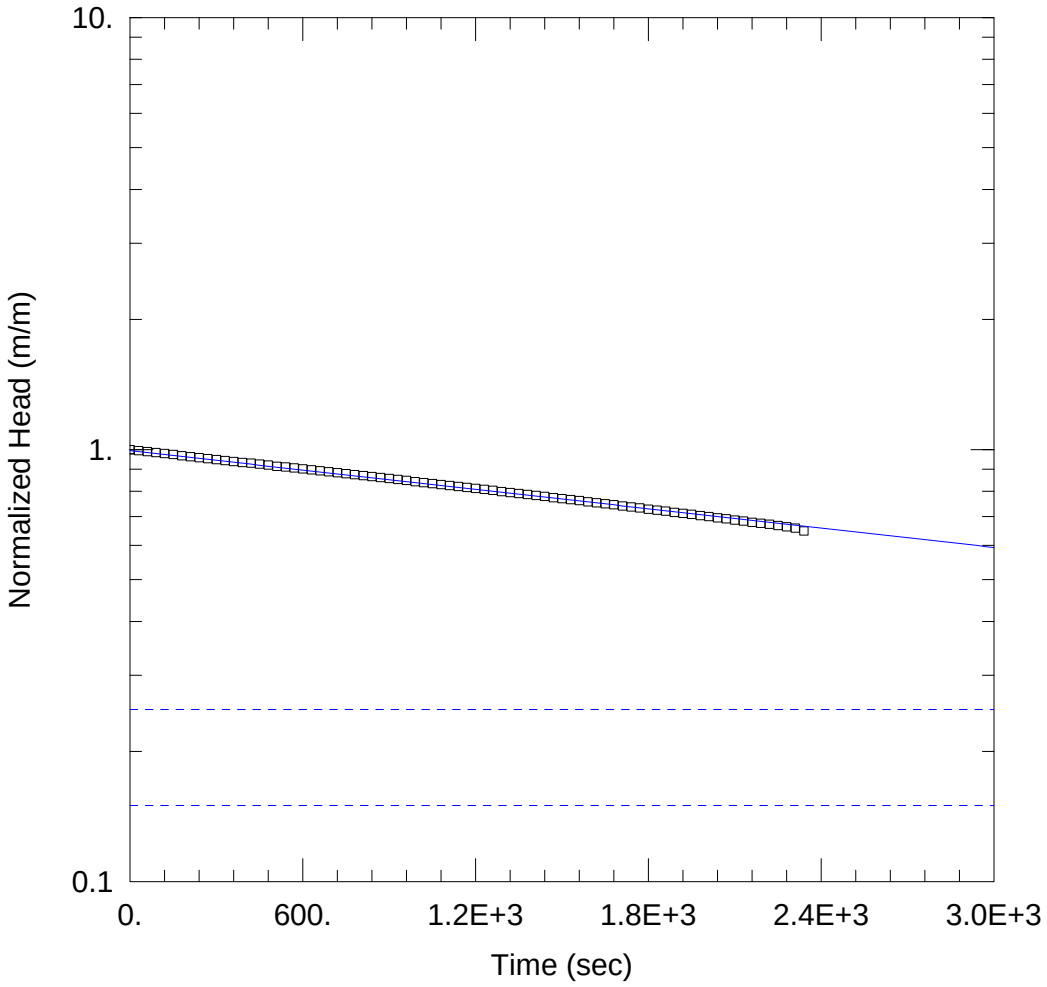
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1671

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 6.219E-8 | m/sec |
| y0 | 6.658 | m |

K = 6.219E-6 cm/sec
T = K*b = 6.219E-6 m²/sec (0.06219 sq. cm/sec)




MW-H28 ZONE 5 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 57.45 - 76.51 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 5
Test Date: 26 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 6.219E-8 m/sec
y0 = 6.658 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 6 (Falling Head Packer Test, vertical interval 77.27 - 93.27 m)
Date: 08/14/13
Time: 15:17:04

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 27 July 2013
Test Well: MW-H28 Zone 6

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

### Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 4.99 m
Static Water Column Height: 88.28 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 16. m
Total Well Penetration Depth: 88.28 m

No. of Observations: 17

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 4.99 | 750. | 4.781 |
| 30. | 4.82 | 900. | 4.779 |
| 60. | 4.805 | 1200. | 4.769 |
| 120. | 4.798 | 1500. | 4.759 |
| 180. | 4.795 | 1800. | 4.754 |
| 240. | 4.794 | 2100. | 4.746 |
| 300. | 4.792 | 2400. | 4.74 |
| 450. | 4.789 | 2700. | 4.735 |
| 600. | 4.784 | | |

## SOLUTION

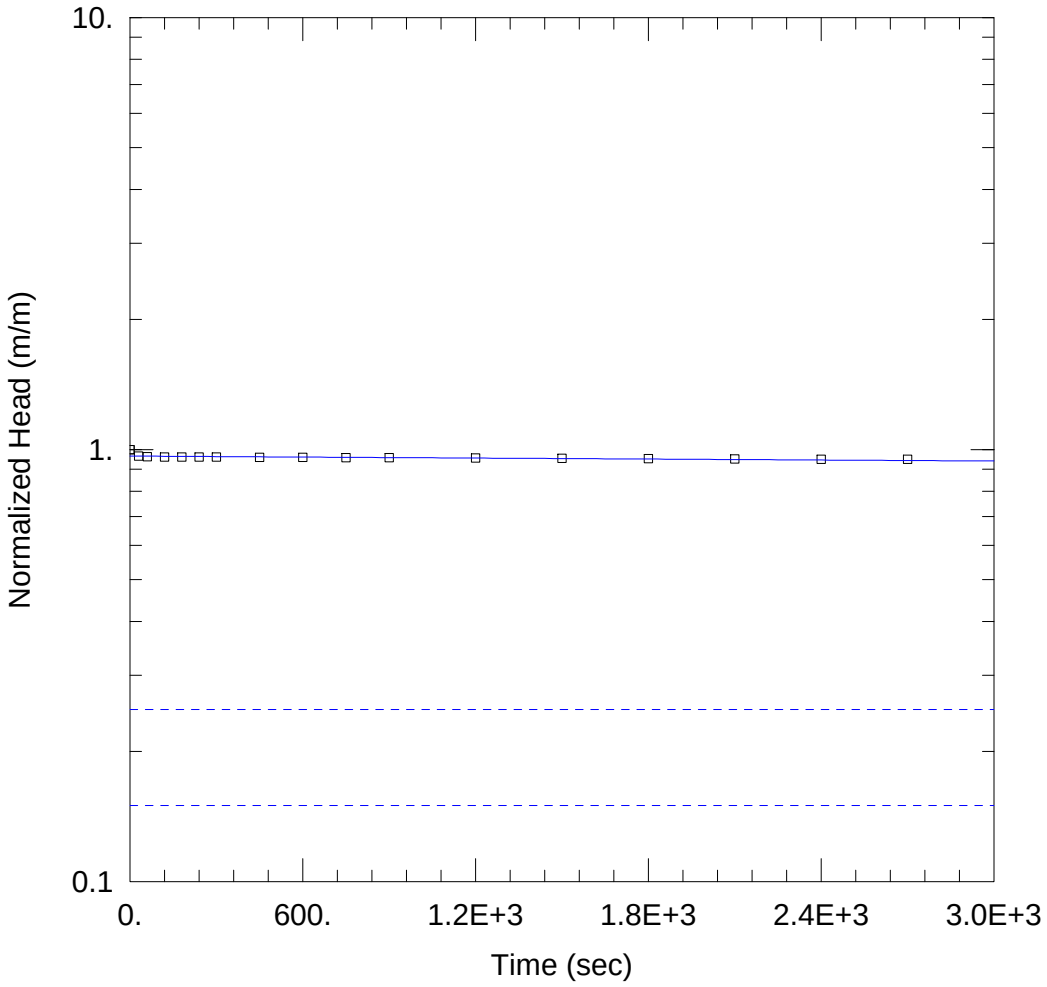
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1721

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 3.668E-9 | m/sec |
| y0 | 4.818 | m |

K = 3.668E-7 cm/sec
T = K*b = 3.668E-7 m²/sec (0.003668 sq. cm/sec)




MW-H28 ZONE 6 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 77.27 - 93.27 M)

## PROJECT INFORMATION

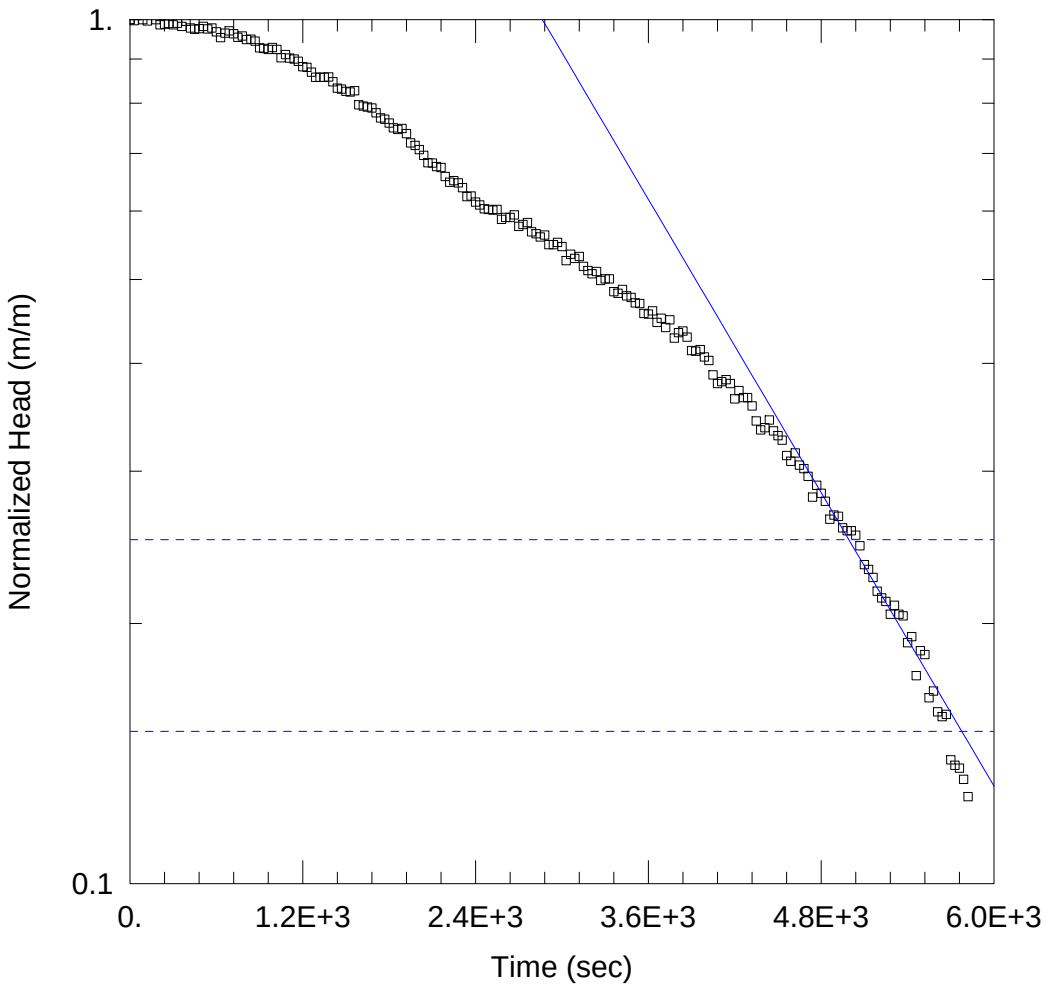
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 6
Test Date: 27 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 3.668E-9 m/sec
y0 = 4.818 m




## MW-H28 (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28
Test Date: 1 August 2013

### AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H28)

Initial Displacement: 0.1 m
Total Well Penetration Depth: 5.079 m
Casing Radius: 0.016 m
Static Water Column Height: 5.079 m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Confined
K = 1.199E-7 m/sec
Solution Method: Hvorslev
y0 = 0.6461 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 (Rising Head Slug Test)
Date: 08/14/13
Time: 11:57:27

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 1 August 2013
Test Well: MW-H29

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.95 m
Static Water Column Height: 6.61 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 6.61 m

No. of Observations: 232

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.95 | 3480. | 0.2804 |
| 30. | 0.9498 | 3510. | 0.2768 |
| 60. | 0.9474 | 3540. | 0.2736 |
| 90. | 0.9418 | 3570. | 0.2696 |
| 120. | 0.9363 | 3600. | 0.2663 |
| 150. | 0.9294 | 3630. | 0.2626 |
| 180. | 0.9216 | 3660. | 0.2596 |
| 210. | 0.9145 | 3690. | 0.2564 |
| 240. | 0.9069 | 3720. | 0.2522 |
| 270. | 0.8991 | 3750. | 0.2487 |
| 300. | 0.8911 | 3780. | 0.2454 |
| 330. | 0.8834 | 3810. | 0.2425 |
| 360. | 0.8746 | 3840. | 0.2394 |
| 390. | 0.8669 | 3870. | 0.2366 |
| 420. | 0.8593 | 3900. | 0.2331 |
| 450. | 0.8511 | 3930. | 0.23 |
| 480. | 0.843 | 3960. | 0.227 |
| 510. | 0.8349 | 3990. | 0.2232 |
| 540. | 0.8268 | 4020. | 0.2201 |
| 570. | 0.8192 | 4050. | 0.217 |
| 600. | 0.8108 | 4080. | 0.2137 |
| 630. | 0.8034 | 4110. | 0.2114 |
| 660. | 0.7961 | 4140. | 0.209 |
| 690. | 0.788 | 4170. | 0.2058 |
| 720. | 0.7808 | 4200. | 0.2029 |
| 750. | 0.7724 | 4230. | 0.2 |
| 780. | 0.7644 | 4260. | 0.1968 |
| 810. | 0.7573 | 4290. | 0.1942 |
| 840. | 0.7493 | 4320. | 0.191 |
| 870. | 0.7423 | 4350. | 0.1883 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 0.7349 | 4380. | 0.1855 |
| 930. | 0.7276 | 4410. | 0.1827 |
| 960. | 0.7202 | 4440. | 0.1796 |
| 990. | 0.7129 | 4470. | 0.1766 |
| 1020. | 0.7057 | 4500. | 0.1744 |
| 1050. | 0.6985 | 4530. | 0.1717 |
| 1080. | 0.691 | 4560. | 0.1686 |
| 1110. | 0.6839 | 4590. | 0.1658 |
| 1140. | 0.6776 | 4620. | 0.1633 |
| 1170. | 0.6705 | 4650. | 0.1621 |
| 1200. | 0.6647 | 4680. | 0.1589 |
| 1230. | 0.6572 | 4710. | 0.1566 |
| 1260. | 0.6509 | 4740. | 0.1542 |
| 1290. | 0.6444 | 4770. | 0.1517 |
| 1320. | 0.6376 | 4800. | 0.1488 |
| 1350. | 0.6313 | 4830. | 0.1462 |
| 1380. | 0.6251 | 4860. | 0.1442 |
| 1410. | 0.618 | 4890. | 0.1416 |
| 1440. | 0.6125 | 4920. | 0.1386 |
| 1470. | 0.6065 | 4950. | 0.1361 |
| 1500. | 0.5991 | 4980. | 0.134 |
| 1530. | 0.593 | 5010. | 0.1315 |
| 1560. | 0.5871 | 5040. | 0.1288 |
| 1590. | 0.5813 | 5070. | 0.1277 |
| 1620. | 0.5749 | 5100. | 0.125 |
| 1650. | 0.5688 | 5130. | 0.1226 |
| 1680. | 0.5627 | 5160. | 0.1202 |
| 1710. | 0.556 | 5190. | 0.1182 |
| 1740. | 0.551 | 5220. | 0.1156 |
| 1770. | 0.5445 | 5250. | 0.1135 |
| 1800. | 0.5388 | 5280. | 0.1114 |
| 1830. | 0.5324 | 5310. | 0.1092 |
| 1860. | 0.5264 | 5340. | 0.1065 |
| 1890. | 0.522 | 5370. | 0.1059 |
| 1920. | 0.516 | 5400. | 0.1031 |
| 1950. | 0.5106 | 5430. | 0.1009 |
| 1980. | 0.505 | 5460. | 0.0989 |
| 2010. | 0.4993 | 5490. | 0.0969 |
| 2040. | 0.4938 | 5520. | 0.0949 |
| 2070. | 0.4887 | 5550. | 0.0931 |
| 2100. | 0.483 | 5580. | 0.0907 |
| 2130. | 0.4778 | 5610. | 0.0888 |
| 2160. | 0.4722 | 5640. | 0.0866 |
| 2190. | 0.4671 | 5670. | 0.0851 |
| 2220. | 0.4625 | 5700. | 0.0826 |
| 2250. | 0.4565 | 5730. | 0.0807 |
| 2280. | 0.452 | 5760. | 0.0787 |
| 2310. | 0.4463 | 5790. | 0.0768 |
| 2340. | 0.4417 | 5820. | 0.0754 |
| 2370. | 0.4372 | 5850. | 0.0733 |
| 2400. | 0.4318 | 5880. | 0.0708 |
| 2430. | 0.4267 | 5910. | 0.0693 |
| 2460. | 0.4213 | 5940. | 0.0685 |
| 2490. | 0.4172 | 5970. | 0.0664 |
| 2520. | 0.4119 | 6000. | 0.065 |
| 2550. | 0.4073 | 6030. | 0.0633 |
| 2580. | 0.4036 | 6060. | 0.0614 |
| 2610. | 0.3988 | 6090. | 0.0598 |
| 2640. | 0.3944 | 6120. | 0.0577 |
| 2670. | 0.3894 | 6150. | 0.0562 |
| 2700. | 0.3848 | 6180. | 0.0543 |
| 2730. | 0.3807 | 6210. | 0.0529 |
| 2760. | 0.3756 | 6240. | 0.0514 |
| 2790. | 0.3717 | 6270. | 0.0499 |
| 2820. | 0.3668 | 6300. | 0.0482 |
| 2850. | 0.3631 | 6330. | 0.0467 |
| 2880. | 0.3587 | 6360. | 0.0453 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2910. | 0.3539 | 6390. | 0.0436 |
| 2940. | 0.3503 | 6420. | 0.0416 |
| 2970. | 0.3458 | 6450. | 0.041 |
| 3000. | 0.3417 | 6480. | 0.0389 |
| 3030. | 0.3376 | 6510. | 0.0371 |
| 3060. | 0.3333 | 6540. | 0.0355 |
| 3090. | 0.3288 | 6570. | 0.0339 |
| 3120. | 0.325 | 6600. | 0.0331 |
| 3150. | 0.3208 | 6630. | 0.0316 |
| 3180. | 0.3177 | 6660. | 0.0296 |
| 3210. | 0.3138 | 6690. | 0.0284 |
| 3240. | 0.3096 | 6720. | 0.0273 |
| 3270. | 0.3056 | 6750. | 0.0254 |
| 3300. | 0.3021 | 6780. | 0.0239 |
| 3330. | 0.2979 | 6810. | 0.0226 |
| 3360. | 0.2947 | 6840. | 0.0209 |
| 3390. | 0.2906 | 6870. | 0.0197 |
| 3420. | 0.2882 | 6900. | 0.0185 |
| 3450. | 0.2847 | 6930. | 0.0176 |

## SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 9.196E-8 | m/sec |
| y0 | 1.643 | m |

K = 9.196E-6 cm/sec
T = K*b = 9.196E-6 m²/sec (0.09196 sq. cm/sec)

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 1 (Falling Head Packer Test, vertical interval 5.79 - 8.84 m)
Date: 08/14/13
Time: 15:29:16

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 28 July 2013
Test Well: MW-H29 Zone 1

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.75 m
Static Water Column Height: 8.459 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 3.048 m
Total Well Penetration Depth: 8.459 m

No. of Observations: 486

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.75 | 1215. | 0.4707 |
| 5. | 0.7497 | 1220. | 0.4694 |
| 10. | 0.7787 | 1225. | 0.4686 |
| 15. | 0.7762 | 1230. | 0.4672 |
| 20. | 0.7737 | 1235. | 0.4659 |
| 25. | 0.7704 | 1240. | 0.465 |
| 30. | 0.7672 | 1245. | 0.4629 |
| 35. | 0.7646 | 1250. | 0.4625 |
| 40. | 0.7631 | 1255. | 0.4625 |
| 45. | 0.763 | 1260. | 0.4601 |
| 50. | 0.7621 | 1265. | 0.4593 |
| 55. | 0.7607 | 1270. | 0.4586 |
| 60. | 0.758 | 1275. | 0.4577 |
| 65. | 0.755 | 1280. | 0.4554 |
| 70. | 0.7516 | 1285. | 0.455 |
| 75. | 0.7503 | 1290. | 0.4539 |
| 80. | 0.7507 | 1295. | 0.4527 |
| 85. | 0.7501 | 1300. | 0.4513 |
| 90. | 0.749 | 1305. | 0.4502 |
| 95. | 0.7459 | 1310. | 0.4499 |
| 100. | 0.7423 | 1315. | 0.4479 |
| 105. | 0.7403 | 1320. | 0.447 |
| 110. | 0.7396 | 1325. | 0.4458 |
| 115. | 0.7406 | 1330. | 0.4448 |
| 120. | 0.7393 | 1335. | 0.4439 |
| 125. | 0.7369 | 1340. | 0.443 |
| 130. | 0.7339 | 1345. | 0.4415 |
| 135. | 0.7309 | 1350. | 0.4407 |
| 140. | 0.7303 | 1355. | 0.4395 |
| 145. | 0.7306 | 1360. | 0.4383 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 150. | 0.7308 | 1365. | 0.4371 |
| 155. | 0.7283 | 1370. | 0.4364 |
| 160. | 0.7252 | 1375. | 0.4351 |
| 165. | 0.722 | 1380. | 0.434 |
| 170. | 0.7213 | 1385. | 0.433 |
| 175. | 0.7217 | 1390. | 0.4319 |
| 180. | 0.722 | 1395. | 0.4311 |
| 185. | 0.721 | 1400. | 0.43 |
| 190. | 0.718 | 1405. | 0.4289 |
| 195. | 0.7143 | 1410. | 0.4276 |
| 200. | 0.7129 | 1415. | 0.4263 |
| 205. | 0.7136 | 1420. | 0.425 |
| 210. | 0.7135 | 1425. | 0.4246 |
| 215. | 0.7122 | 1430. | 0.4228 |
| 220. | 0.7089 | 1435. | 0.4217 |
| 225. | 0.7057 | 1440. | 0.4205 |
| 230. | 0.7046 | 1445. | 0.4198 |
| 235. | 0.7058 | 1450. | 0.4184 |
| 240. | 0.7052 | 1455. | 0.4169 |
| 245. | 0.7039 | 1460. | 0.4161 |
| 250. | 0.7004 | 1465. | 0.415 |
| 255. | 0.6974 | 1470. | 0.4133 |
| 260. | 0.6966 | 1475. | 0.412 |
| 265. | 0.6971 | 1480. | 0.411 |
| 270. | 0.6971 | 1485. | 0.4089 |
| 275. | 0.6952 | 1490. | 0.4083 |
| 280. | 0.6924 | 1495. | 0.4069 |
| 285. | 0.6887 | 1500. | 0.4053 |
| 290. | 0.6883 | 1505. | 0.4044 |
| 295. | 0.6878 | 1510. | 0.4029 |
| 300. | 0.6893 | 1515. | 0.4019 |
| 305. | 0.6877 | 1520. | 0.4007 |
| 310. | 0.6848 | 1525. | 0.3994 |
| 315. | 0.6815 | 1530. | 0.3983 |
| 320. | 0.6792 | 1535. | 0.3967 |
| 325. | 0.6796 | 1540. | 0.3955 |
| 330. | 0.6808 | 1545. | 0.3945 |
| 335. | 0.6794 | 1550. | 0.3932 |
| 340. | 0.6777 | 1555. | 0.3917 |
| 345. | 0.6752 | 1560. | 0.3898 |
| 350. | 0.6721 | 1565. | 0.3894 |
| 355. | 0.6716 | 1570. | 0.3877 |
| 360. | 0.6715 | 1575. | 0.3876 |
| 365. | 0.6699 | 1580. | 0.3854 |
| 370. | 0.669 | 1585. | 0.384 |
| 375. | 0.6672 | 1590. | 0.3832 |
| 380. | 0.6665 | 1595. | 0.3813 |
| 385. | 0.6652 | 1600. | 0.3805 |
| 390. | 0.6638 | 1605. | 0.3791 |
| 395. | 0.6627 | 1610. | 0.3777 |
| 400. | 0.6615 | 1615. | 0.3764 |
| 405. | 0.6597 | 1620. | 0.3753 |
| 410. | 0.6594 | 1625. | 0.3734 |
| 415. | 0.6583 | 1630. | 0.3732 |
| 420. | 0.6565 | 1635. | 0.3714 |
| 425. | 0.6559 | 1640. | 0.3701 |
| 430. | 0.6543 | 1645. | 0.3693 |
| 435. | 0.6531 | 1650. | 0.3679 |
| 440. | 0.6524 | 1655. | 0.3665 |
| 445. | 0.6505 | 1660. | 0.3654 |
| 450. | 0.6497 | 1665. | 0.3645 |
| 455. | 0.6485 | 1670. | 0.3626 |
| 460. | 0.647 | 1675. | 0.362 |
| 465. | 0.6453 | 1680. | 0.3603 |
| 470. | 0.6446 | 1685. | 0.3591 |
| 475. | 0.6429 | 1690. | 0.3577 |
| 480. | 0.6425 | 1695. | 0.3568 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 485. | 0.641 | 1700. | 0.3557 |
| 490. | 0.6399 | 1705. | 0.3542 |
| 495. | 0.6385 | 1710. | 0.3528 |
| 500. | 0.6375 | 1715. | 0.3519 |
| 505. | 0.6366 | 1720. | 0.3502 |
| 510. | 0.6352 | 1725. | 0.3493 |
| 515. | 0.6335 | 1730. | 0.3482 |
| 520. | 0.6329 | 1735. | 0.347 |
| 525. | 0.6315 | 1740. | 0.3459 |
| 530. | 0.6308 | 1745. | 0.3441 |
| 535. | 0.6292 | 1750. | 0.3428 |
| 540. | 0.6275 | 1755. | 0.3419 |
| 545. | 0.6267 | 1760. | 0.3408 |
| 550. | 0.6258 | 1765. | 0.3393 |
| 555. | 0.6244 | 1770. | 0.3377 |
| 560. | 0.6227 | 1775. | 0.3372 |
| 565. | 0.6217 | 1780. | 0.3353 |
| 570. | 0.6213 | 1785. | 0.3338 |
| 575. | 0.6193 | 1790. | 0.3333 |
| 580. | 0.6187 | 1795. | 0.3319 |
| 585. | 0.6171 | 1800. | 0.331 |
| 590. | 0.6157 | 1805. | 0.3293 |
| 595. | 0.6144 | 1810. | 0.3281 |
| 600. | 0.6131 | 1815. | 0.3267 |
| 605. | 0.6118 | 1820. | 0.3253 |
| 610. | 0.6108 | 1825. | 0.324 |
| 615. | 0.6097 | 1830. | 0.3225 |
| 620. | 0.6082 | 1835. | 0.322 |
| 625. | 0.6073 | 1840. | 0.3201 |
| 630. | 0.6063 | 1845. | 0.3198 |
| 635. | 0.6052 | 1850. | 0.3179 |
| 640. | 0.6042 | 1855. | 0.3164 |
| 645. | 0.6029 | 1860. | 0.3154 |
| 650. | 0.6014 | 1865. | 0.3141 |
| 655. | 0.6003 | 1870. | 0.3127 |
| 660. | 0.5994 | 1875. | 0.312 |
| 665. | 0.5981 | 1880. | 0.3098 |
| 670. | 0.5972 | 1885. | 0.3092 |
| 675. | 0.5957 | 1890. | 0.3079 |
| 680. | 0.5919 | 1895. | 0.3067 |
| 685. | 0.5939 | 1900. | 0.3058 |
| 690. | 0.5926 | 1905. | 0.3048 |
| 695. | 0.5913 | 1910. | 0.3027 |
| 700. | 0.5896 | 1915. | 0.3019 |
| 705. | 0.5893 | 1920. | 0.3005 |
| 710. | 0.588 | 1925. | 0.2995 |
| 715. | 0.5864 | 1930. | 0.2986 |
| 720. | 0.5856 | 1935. | 0.2937 |
| 725. | 0.5848 | 1940. | 0.2962 |
| 730. | 0.5834 | 1945. | 0.2943 |
| 735. | 0.5817 | 1950. | 0.2932 |
| 740. | 0.5805 | 1955. | 0.2922 |
| 745. | 0.5797 | 1960. | 0.2906 |
| 750. | 0.5787 | 1965. | 0.292 |
| 755. | 0.5776 | 1970. | 0.2888 |
| 760. | 0.5762 | 1975. | 0.2874 |
| 765. | 0.5751 | 1980. | 0.286 |
| 770. | 0.5783 | 1985. | 0.2848 |
| 775. | 0.572 | 1990. | 0.2838 |
| 780. | 0.5708 | 1995. | 0.2822 |
| 785. | 0.5701 | 2000. | 0.2807 |
| 790. | 0.5683 | 2005. | 0.2799 |
| 795. | 0.5674 | 2010. | 0.279 |
| 800. | 0.5662 | 2015. | 0.2776 |
| 805. | 0.5651 | 2020. | 0.2764 |
| 810. | 0.5643 | 2025. | 0.2746 |
| 815. | 0.5629 | 2030. | 0.2735 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 820. | 0.5621 | 2035. | 0.2726 |
| 825. | 0.5611 | 2040. | 0.2715 |
| 830. | 0.56 | 2045. | 0.2697 |
| 835. | 0.5587 | 2050. | 0.2694 |
| 840. | 0.558 | 2055. | 0.2676 |
| 845. | 0.5565 | 2060. | 0.2666 |
| 850. | 0.5562 | 2065. | 0.266 |
| 855. | 0.5548 | 2070. | 0.2648 |
| 860. | 0.553 | 2075. | 0.263 |
| 865. | 0.5518 | 2080. | 0.2618 |
| 870. | 0.5507 | 2085. | 0.2611 |
| 875. | 0.5497 | 2090. | 0.2595 |
| 880. | 0.5483 | 2095. | 0.2588 |
| 885. | 0.5473 | 2100. | 0.2576 |
| 890. | 0.5462 | 2105. | 0.256 |
| 895. | 0.5445 | 2110. | 0.2551 |
| 900. | 0.5442 | 2115. | 0.2538 |
| 905. | 0.5428 | 2120. | 0.2524 |
| 910. | 0.5415 | 2125. | 0.251 |
| 915. | 0.5399 | 2130. | 0.2501 |
| 920. | 0.5394 | 2135. | 0.2485 |
| 925. | 0.5382 | 2140. | 0.248 |
| 930. | 0.5373 | 2145. | 0.2465 |
| 935. | 0.5358 | 2150. | 0.2456 |
| 940. | 0.535 | 2155. | 0.2443 |
| 945. | 0.5333 | 2160. | 0.2429 |
| 950. | 0.5327 | 2165. | 0.2421 |
| 955. | 0.5312 | 2170. | 0.2406 |
| 960. | 0.5299 | 2175. | 0.2395 |
| 965. | 0.5293 | 2180. | 0.2382 |
| 970. | 0.5277 | 2185. | 0.2376 |
| 975. | 0.5269 | 2190. | 0.2362 |
| 980. | 0.5251 | 2195. | 0.2348 |
| 985. | 0.524 | 2200. | 0.2331 |
| 990. | 0.523 | 2205. | 0.2324 |
| 995. | 0.522 | 2210. | 0.2304 |
| 1000. | 0.5202 | 2215. | 0.2299 |
| 1005. | 0.5192 | 2220. | 0.2279 |
| 1010. | 0.5184 | 2225. | 0.2275 |
| 1015. | 0.517 | 2230. | 0.2261 |
| 1020. | 0.516 | 2235. | 0.2248 |
| 1025. | 0.5148 | 2240. | 0.2236 |
| 1030. | 0.5137 | 2245. | 0.2223 |
| 1035. | 0.5127 | 2250. | 0.2213 |
| 1040. | 0.5119 | 2255. | 0.2201 |
| 1045. | 0.5099 | 2260. | 0.2187 |
| 1050. | 0.5089 | 2265. | 0.2177 |
| 1055. | 0.5081 | 2270. | 0.2168 |
| 1060. | 0.5065 | 2275. | 0.215 |
| 1065. | 0.5061 | 2280. | 0.2137 |
| 1070. | 0.5045 | 2285. | 0.2126 |
| 1075. | 0.5047 | 2290. | 0.2119 |
| 1080. | 0.5043 | 2295. | 0.2105 |
| 1085. | 0.4995 | 2300. | 0.2093 |
| 1090. | 0.5 | 2305. | 0.208 |
| 1095. | 0.4981 | 2310. | 0.2063 |
| 1100. | 0.4967 | 2315. | 0.2053 |
| 1105. | 0.4953 | 2320. | 0.2039 |
| 1110. | 0.494 | 2325. | 0.203 |
| 1115. | 0.4936 | 2330. | 0.2015 |
| 1120. | 0.4911 | 2335. | 0.1999 |
| 1125. | 0.4904 | 2340. | 0.1988 |
| 1130. | 0.4895 | 2345. | 0.1977 |
| 1135. | 0.4863 | 2350. | 0.1967 |
| 1140. | 0.4935 | 2355. | 0.1948 |
| 1145. | 0.487 | 2360. | 0.1945 |
| 1150. | 0.4856 | 2365. | 0.1932 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1155. | 0.4822 | 2370. | 0.192 |
| 1160. | 0.4832 | 2375. | 0.1907 |
| 1165. | 0.4822 | 2380. | 0.1892 |
| 1170. | 0.4809 | 2385. | 0.1886 |
| 1175. | 0.4796 | 2390. | 0.1874 |
| 1180. | 0.4779 | 2395. | 0.1857 |
| 1185. | 0.4777 | 2400. | 0.1855 |
| 1190. | 0.4763 | 2405. | 0.1829 |
| 1195. | 0.4752 | 2410. | 0.1826 |
| 1200. | 0.4742 | 2415. | 0.1808 |
| 1205. | 0.4725 | 2420. | 0.1791 |
| 1210. | 0.4715 | 2425. | 0.1786 |

## SOLUTION

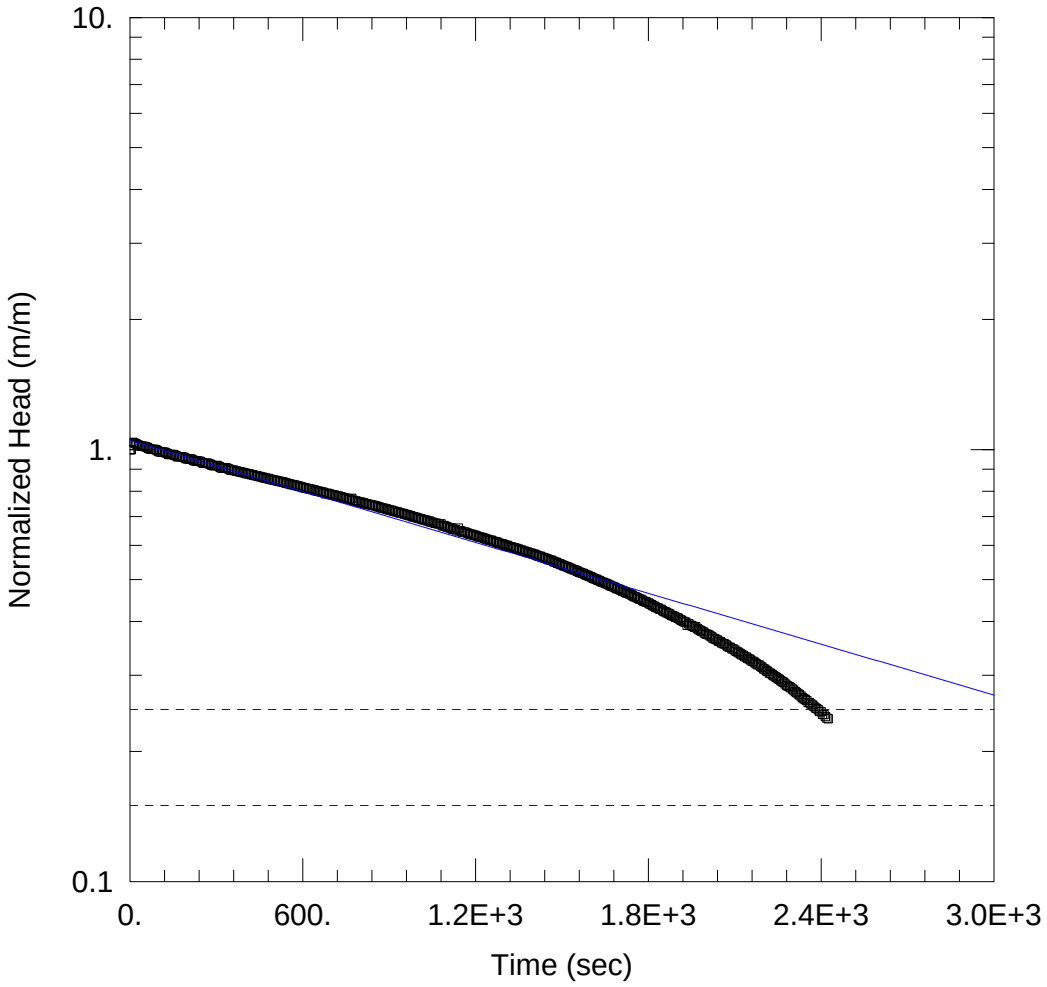
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.2409

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 7.095E-7 | m/sec |
| y0 | 0.7867 | m |

K = 7.095E-5 cm/sec
T = K*b = 7.095E-5 m²/sec (0.7095 sq. cm/sec)




MW-H29 ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 5.79 - 8.84 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 1
Test Date: 28 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 7.095E-7 m/sec
y0 = 0.7867 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 2 (Falling Head Packer Test, vertical interval 9.60- 24.38 m)
Date: 08/14/13
Time: 15:31:55

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 28 July 2013
Test Well: MW-H29 Zone 2

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 6. m
Static Water Column Height: 20. m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 14.78 m
Total Well Penetration Depth: 20. m

No. of Observations: 79

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 6. | 1200. | 2.116 |
| 30. | 5.671 | 1230. | 2.072 |
| 60. | 5.308 | 1260. | 2.029 |
| 90. | 5.037 | 1290. | 1.987 |
| 120. | 4.827 | 1320. | 1.945 |
| 150. | 4.653 | 1350. | 1.904 |
| 180. | 4.503 | 1380. | 1.864 |
| 210. | 4.372 | 1410. | 1.825 |
| 240. | 4.253 | 1440. | 1.786 |
| 270. | 4.142 | 1470. | 1.748 |
| 300. | 4.037 | 1500. | 1.71 |
| 330. | 3.939 | 1530. | 1.675 |
| 360. | 3.845 | 1560. | 1.638 |
| 390. | 3.757 | 1590. | 1.602 |
| 420. | 3.671 | 1620. | 1.567 |
| 450. | 3.59 | 1650. | 1.535 |
| 480. | 3.511 | 1680. | 1.5 |
| 510. | 3.435 | 1710. | 1.467 |
| 540. | 3.361 | 1740. | 1.435 |
| 570. | 3.29 | 1770. | 1.403 |
| 600. | 3.22 | 1800. | 1.372 |
| 630. | 3.152 | 1830. | 1.341 |
| 660. | 3.085 | 1860. | 1.31 |
| 690. | 3.02 | 1890. | 1.28 |
| 720. | 2.958 | 1920. | 1.251 |
| 750. | 2.898 | 1950. | 1.222 |
| 780. | 2.836 | 1980. | 1.194 |
| 810. | 2.777 | 2010. | 1.167 |
| 840. | 2.72 | 2040. | 1.139 |
| 870. | 2.663 | 2070. | 1.111 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 2.608 | 2100. | 1.085 |
| 930. | 2.555 | 2130. | 1.059 |
| 960. | 2.501 | 2160. | 1.033 |
| 990. | 2.45 | 2190. | 1.008 |
| 1020. | 2.399 | 2220. | 0.9828 |
| 1050. | 2.35 | 2250. | 0.9584 |
| 1080. | 2.301 | 2280. | 0.9338 |
| 1110. | 2.253 | 2310. | 0.9101 |
| 1140. | 2.207 | 2340. | 0.8843 |
| 1170. | 2.161 | | |

## SOLUTION

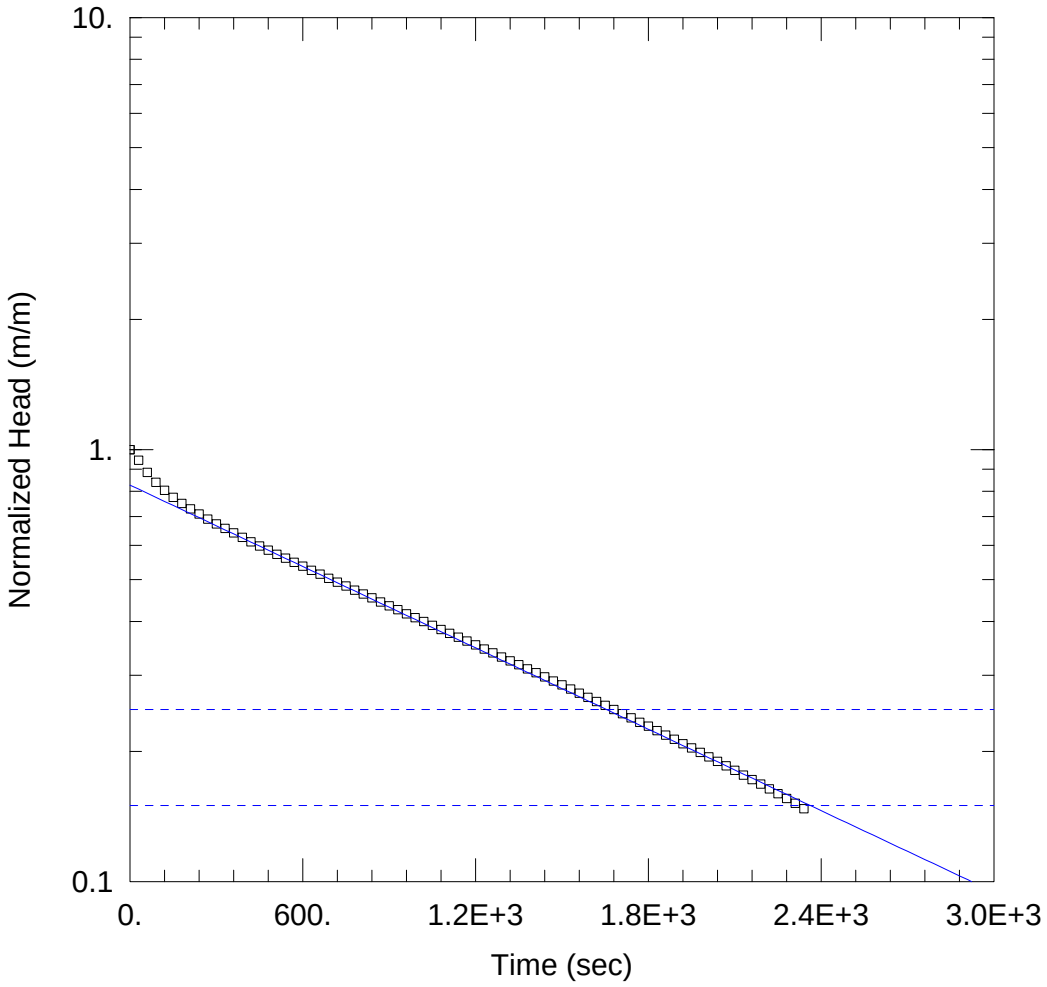
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1745

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 3.229E-7 | m/sec |
| y0 | 4.963 | m |

K = 3.229E-5 cm/sec
T = K*b = 3.229E-5 m²/sec (0.3229 sq. cm/sec)




MW-H29 ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 9.60- 24.38 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 2
Test Date: 28 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 3.229E-7 m/sec

y0 = 4.963 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 3 (Falling Head Packer Test, vertical interval 25.15 - 39.62 m)
Date: 08/14/13
Time: 15:35:35

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 28 July 2013
Test Well: MW-H29 Zone 3

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 3.08 m
Static Water Column Height: 36.54 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 14.48 m
Total Well Penetration Depth: 36.54 m

No. of Observations: 86

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 4.15 | 1290. | 4.047 |
| 30. | 4.135 | 1320. | 4.045 |
| 60. | 4.129 | 1350. | 4.045 |
| 90. | 4.124 | 1380. | 4.043 |
| 120. | 4.12 | 1410. | 4.042 |
| 150. | 4.116 | 1440. | 4.04 |
| 180. | 4.113 | 1470. | 4.039 |
| 210. | 4.11 | 1500. | 4.038 |
| 240. | 4.107 | 1530. | 4.036 |
| 270. | 4.105 | 1560. | 4.035 |
| 300. | 4.102 | 1590. | 4.034 |
| 330. | 4.099 | 1620. | 4.032 |
| 360. | 4.097 | 1650. | 4.032 |
| 390. | 4.095 | 1680. | 4.03 |
| 420. | 4.093 | 1710. | 4.028 |
| 450. | 4.092 | 1740. | 4.027 |
| 480. | 4.089 | 1770. | 4.026 |
| 510. | 4.088 | 1800. | 4.024 |
| 540. | 4.087 | 1830. | 4.023 |
| 570. | 4.085 | 1860. | 4.021 |
| 600. | 4.083 | 1890. | 4.021 |
| 630. | 4.082 | 1920. | 4.019 |
| 660. | 4.08 | 1950. | 4.019 |
| 690. | 4.078 | 1980. | 4.018 |
| 720. | 4.076 | 2010. | 4.016 |
| 750. | 4.074 | 2040. | 4.015 |
| 780. | 4.073 | 2070. | 4.014 |
| 810. | 4.071 | 2100. | 4.013 |
| 840. | 4.069 | 2130. | 4.011 |
| 870. | 4.068 | 2160. | 4.01 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 4.066 | 2190. | 4.009 |
| 930. | 4.064 | 2220. | 4.007 |
| 960. | 4.063 | 2250. | 4.006 |
| 990. | 4.061 | 2280. | 4.005 |
| 1020. | 4.059 | 2310. | 4.004 |
| 1050. | 4.058 | 2340. | 4.002 |
| 1080. | 4.056 | 2370. | 4.001 |
| 1110. | 4.055 | 2400. | 3.999 |
| 1140. | 4.053 | 2430. | 3.997 |
| 1170. | 4.051 | 2460. | 3.995 |
| 1200. | 4.051 | 2490. | 3.994 |
| 1230. | 4.05 | 2520. | 3.993 |
| 1260. | 4.048 | 2550. | 3.991 |

## SOLUTION

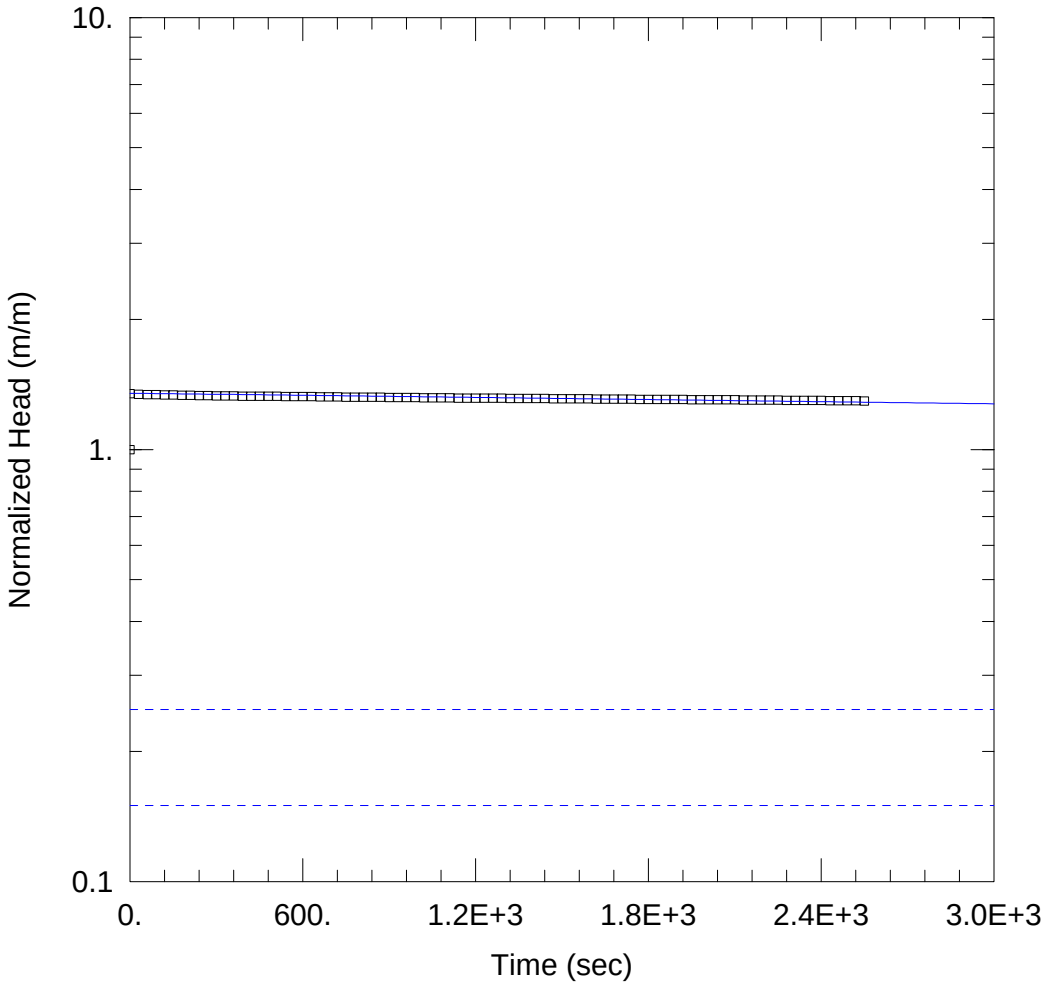
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1752

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 8.535E-9 | m/sec |
| y0 | 4.158 | m |

K = 8.535E-7 cm/sec
T = K*b = 8.535E-7 m²/sec (0.008535 sq. cm/sec)




MW-H29 ZONE 3 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 25.15 - 39.62 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 3
Test Date: 28 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 8.535E-9 m/sec
y0 = 4.158 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 4 (Falling Head Packer Test, vertical interval 40.39 - 59.44 m)
Date: 08/14/13
Time: 15:41:52

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 29 July 2013
Test Well: MW-H29 Zone 4

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.05 m
Static Water Column Height: 59.34 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 19.05 m
Total Well Penetration Depth: 59.34 m

No. of Observations: 92

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 1.05 | 1380. | 1.032 |
| 30. | 1.049 | 1410. | 1.031 |
| 60. | 1.048 | 1440. | 1.031 |
| 90. | 1.046 | 1470. | 1.031 |
| 120. | 1.046 | 1500. | 1.031 |
| 150. | 1.045 | 1530. | 1.03 |
| 180. | 1.045 | 1560. | 1.03 |
| 210. | 1.044 | 1590. | 1.03 |
| 240. | 1.044 | 1620. | 1.03 |
| 270. | 1.043 | 1650. | 1.029 |
| 300. | 1.042 | 1680. | 1.029 |
| 330. | 1.042 | 1710. | 1.029 |
| 360. | 1.042 | 1740. | 1.028 |
| 390. | 1.042 | 1770. | 1.028 |
| 420. | 1.041 | 1800. | 1.028 |
| 450. | 1.041 | 1830. | 1.028 |
| 480. | 1.04 | 1860. | 1.027 |
| 510. | 1.04 | 1890. | 1.028 |
| 540. | 1.04 | 1920. | 1.027 |
| 570. | 1.039 | 1950. | 1.027 |
| 600. | 1.039 | 1980. | 1.027 |
| 630. | 1.039 | 2010. | 1.027 |
| 660. | 1.038 | 2040. | 1.026 |
| 690. | 1.038 | 2070. | 1.027 |
| 720. | 1.038 | 2100. | 1.026 |
| 750. | 1.037 | 2130. | 1.026 |
| 780. | 1.038 | 2160. | 1.026 |
| 810. | 1.037 | 2190. | 1.025 |
| 840. | 1.037 | 2220. | 1.025 |
| 870. | 1.036 | 2250. | 1.025 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 1.036 | 2280. | 1.025 |
| 930. | 1.036 | 2310. | 1.024 |
| 960. | 1.036 | 2340. | 1.024 |
| 990. | 1.036 | 2370. | 1.024 |
| 1020. | 1.035 | 2400. | 1.024 |
| 1050. | 1.034 | 2430. | 1.023 |
| 1080. | 1.035 | 2460. | 1.023 |
| 1110. | 1.034 | 2490. | 1.024 |
| 1140. | 1.034 | 2520. | 1.023 |
| 1170. | 1.033 | 2550. | 1.022 |
| 1200. | 1.034 | 2580. | 1.023 |
| 1230. | 1.033 | 2610. | 1.022 |
| 1260. | 1.033 | 2640. | 1.022 |
| 1290. | 1.032 | 2670. | 1.021 |
| 1320. | 1.032 | 2700. | 1.022 |
| 1350. | 1.032 | 2730. | 1.021 |

## SOLUTION

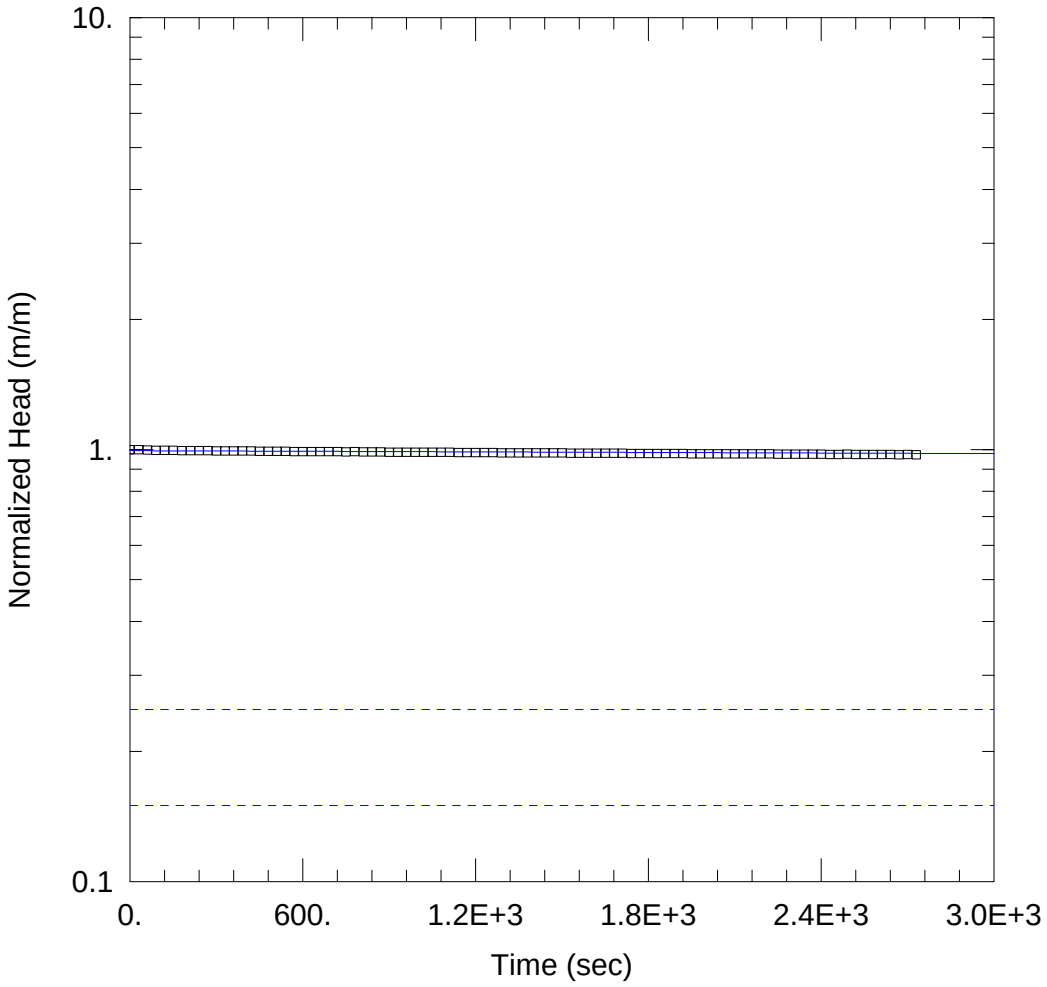
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1671

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.877E-9 | m/sec |
| y0 | 1.043 | m |

K = 1.877E-7 cm/sec
T = K*b = 1.877E-7 m²/sec (0.001877 sq. cm/sec)




MW-H29 ZONE 4 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 40.39 - 59.44 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 4
Test Date: 29 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.877E-9 m/sec
y0 = 1.043 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 5 (Falling Head Packer Test, vertical interval 58.67 - 77.72 m)
Date: 08/14/13
Time: 15:46:40

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 29 July 2013
Test Well: MW-H29 Zone 5

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.1 m
Static Water Column Height: 75.8 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 19.05 m
Total Well Penetration Depth: 75.8 m

No. of Observations: 93

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 2.1 | 1410. | 2.081 |
| 30. | 2.099 | 1440. | 2.081 |
| 60. | 2.098 | 1470. | 2.081 |
| 90. | 2.096 | 1500. | 2.081 |
| 120. | 2.096 | 1530. | 2.08 |
| 150. | 2.095 | 1560. | 2.08 |
| 180. | 2.095 | 1590. | 2.08 |
| 210. | 2.094 | 1620. | 2.08 |
| 240. | 2.094 | 1650. | 2.079 |
| 270. | 2.093 | 1680. | 2.079 |
| 300. | 2.092 | 1710. | 2.079 |
| 330. | 2.092 | 1740. | 2.078 |
| 360. | 2.092 | 1770. | 2.078 |
| 390. | 2.092 | 1800. | 2.078 |
| 420. | 2.091 | 1830. | 2.078 |
| 450. | 2.091 | 1860. | 2.077 |
| 480. | 2.09 | 1890. | 2.078 |
| 510. | 2.09 | 1920. | 2.077 |
| 540. | 2.09 | 1950. | 2.077 |
| 570. | 2.089 | 1980. | 2.077 |
| 600. | 2.089 | 2010. | 2.077 |
| 630. | 2.089 | 2040. | 2.076 |
| 660. | 2.088 | 2070. | 2.077 |
| 690. | 2.088 | 2100. | 2.076 |
| 720. | 2.088 | 2130. | 2.076 |
| 750. | 2.087 | 2160. | 2.076 |
| 780. | 2.088 | 2190. | 2.075 |
| 810. | 2.087 | 2220. | 2.075 |
| 840. | 2.087 | 2250. | 2.075 |
| 870. | 2.086 | 2280. | 2.075 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 900. | 2.086 | 2310. | 2.074 |
| 930. | 2.086 | 2340. | 2.074 |
| 960. | 2.086 | 2370. | 2.074 |
| 990. | 2.086 | 2400. | 2.074 |
| 1020. | 2.084 | 2430. | 2.073 |
| 1050. | 2.084 | 2460. | 2.073 |
| 1080. | 2.085 | 2490. | 2.074 |
| 1110. | 2.084 | 2520. | 2.073 |
| 1140. | 2.084 | 2550. | 2.072 |
| 1170. | 2.083 | 2580. | 2.073 |
| 1200. | 2.084 | 2610. | 2.072 |
| 1230. | 2.083 | 2640. | 2.072 |
| 1260. | 2.083 | 2670. | 2.071 |
| 1290. | 2.082 | 2700. | 2.072 |
| 1320. | 2.082 | 2730. | 2.071 |
| 1350. | 2.082 | 2760. | 2.074 |
| 1380. | 2.082 | | |

## SOLUTION

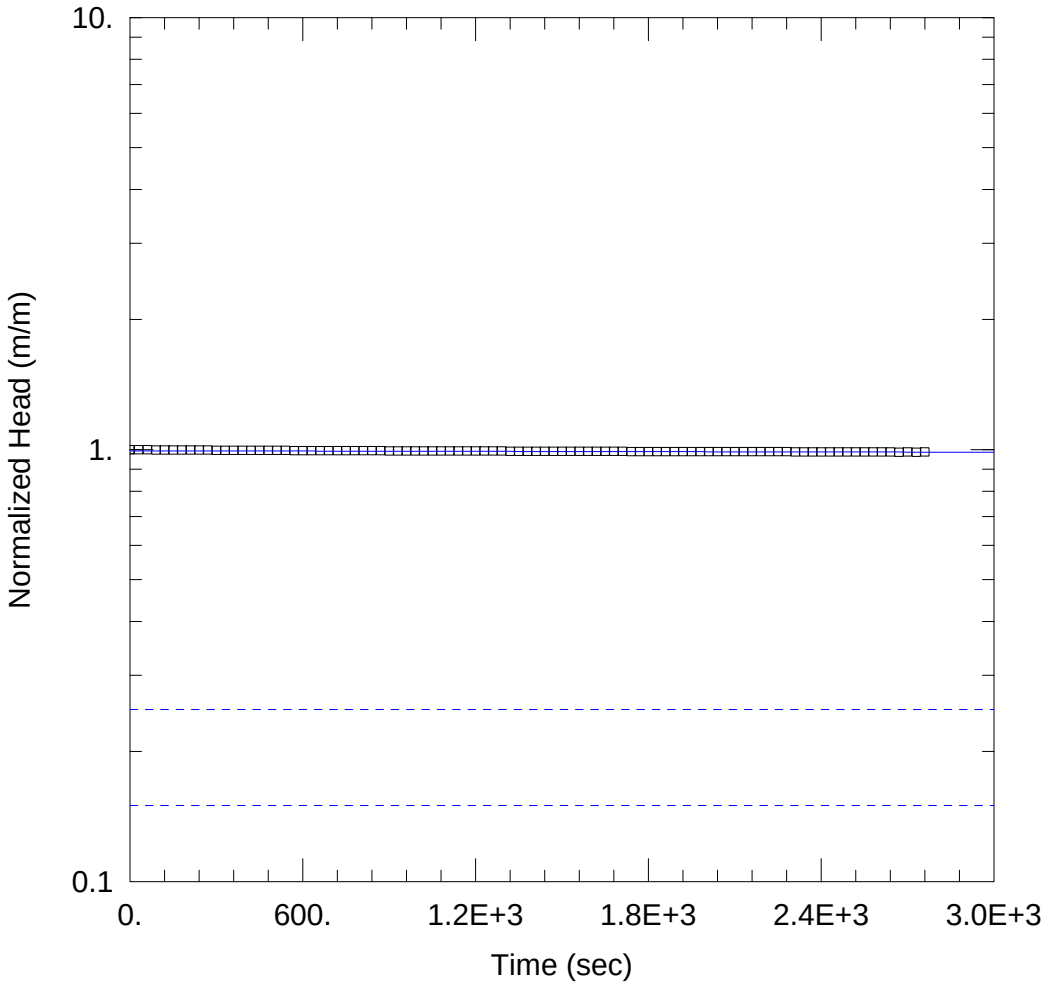
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1671

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 9.152E-10 | m/sec |
| y0 | 2.086 | m |

K = 9.152E-8 cm/sec
T = K*b = 9.152E-8 m²/sec (0.0009152 sq. cm/sec)




MW-H29 ZONE 5 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 58.67 - 77.72 M)

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 5
Test Date: 29 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 9.152E-10 m/sec
y0 = 2.086 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 6 (Falling Head Packer Test, vertical interval 78.49 - 98.45 m)
Date: 08/14/13
Time: 15:50:53

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 30 July 2013
Test Well: MW-H29 Zone 6

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 6.2 m
Static Water Column Height: 98.33 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 19.96 m
Total Well Penetration Depth: 98.33 m

No. of Observations: 49

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 6.2 | 1500. | 6.146 |
| 60. | 6.187 | 1560. | 6.146 |
| 120. | 6.18 | 1620. | 6.144 |
| 180. | 6.174 | 1680. | 6.144 |
| 240. | 6.17 | 1740. | 6.143 |
| 300. | 6.166 | 1800. | 6.143 |
| 360. | 6.164 | 1860. | 6.142 |
| 420. | 6.162 | 1920. | 6.141 |
| 480. | 6.16 | 1980. | 6.14 |
| 540. | 6.16 | 2040. | 6.14 |
| 600. | 6.158 | 2100. | 6.14 |
| 660. | 6.157 | 2160. | 6.139 |
| 720. | 6.156 | 2220. | 6.138 |
| 780. | 6.155 | 2280. | 6.137 |
| 840. | 6.154 | 2340. | 6.137 |
| 900. | 6.154 | 2400. | 6.136 |
| 960. | 6.152 | 2460. | 6.137 |
| 1020. | 6.152 | 2520. | 6.136 |
| 1080. | 6.151 | 2580. | 6.135 |
| 1140. | 6.15 | 2640. | 6.135 |
| 1200. | 6.149 | 2700. | 6.133 |
| 1260. | 6.148 | 2760. | 6.134 |
| 1320. | 6.148 | 2820. | 6.133 |
| 1380. | 6.147 | 2880. | 6.133 |
| 1440. | 6.146 | | |

## SOLUTION

Slug Test
Aquifer Model: Confined

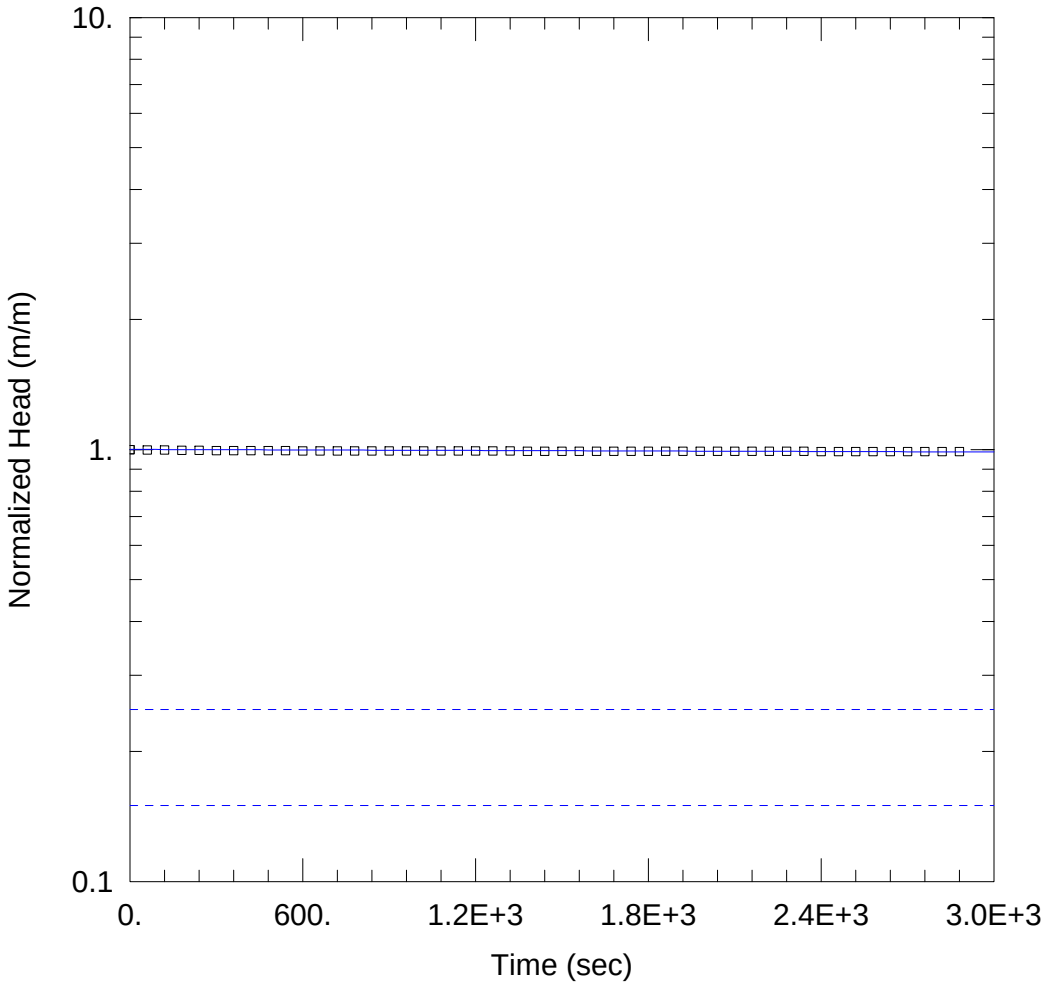
Solution Method: Hvorslev
Log Factor: 0.1658

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.606E-9 | m/sec |
| y0 | 6.203 | m |

K = 1.606E-7 cm/sec
T = K*b = 1.606E-7 m²/sec (0.001606 sq. cm/sec)




MW-H29 ZONE 6 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 78.49 - 98.45 M)

## PROJECT INFORMATION

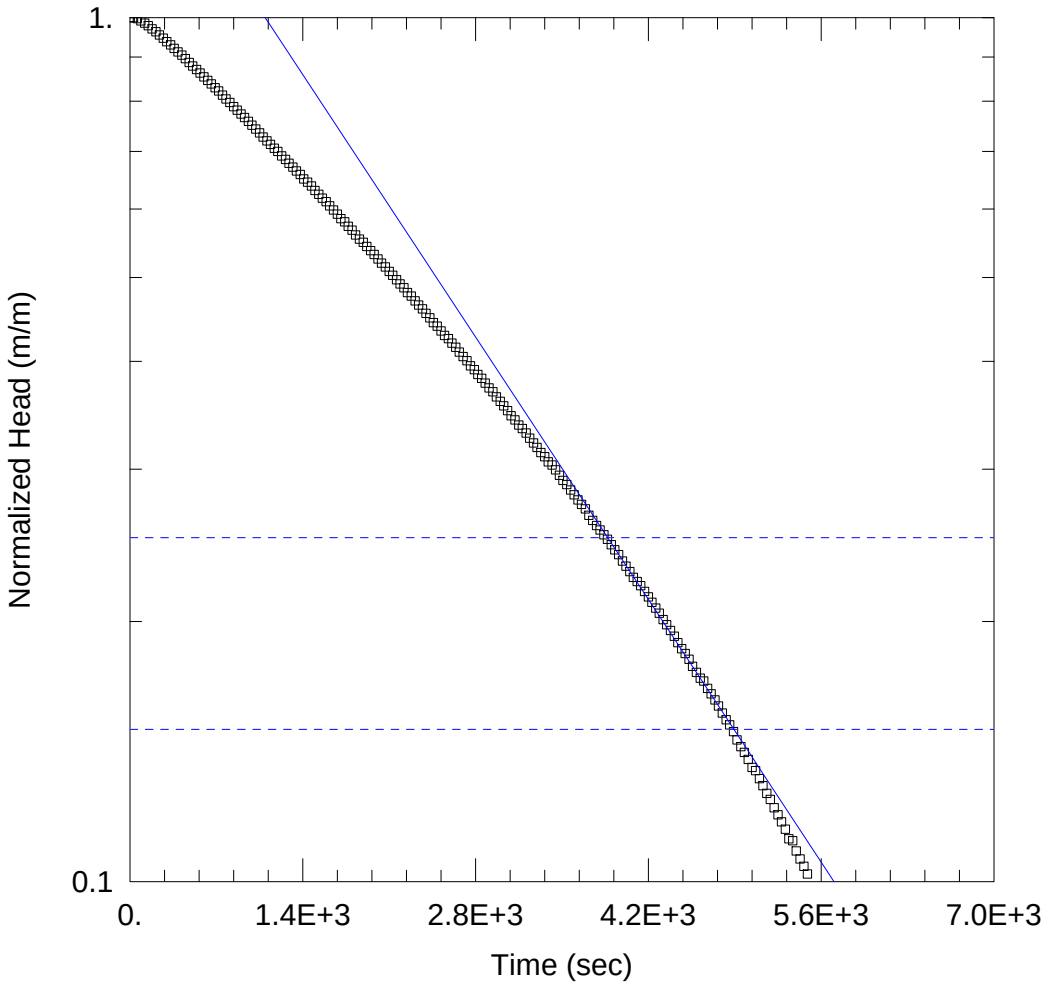
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 6
Test Date: 30 July 2013

## AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.606E-9 m/sec
y0 = 6.203 m




## MW-H29 (RISING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29
Test Date: 1 August 2013

### AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H29)

Initial Displacement: 0.95 m
Total Well Penetration Depth: 6.61 m
Casing Radius: 0.016 m
Static Water Column Height: 6.61 m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 9.196E-8 m/sec
y0 = 1.643 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H30 (Falling Head Slug Test)
Date: 08/14/13
Time: 12:09:05

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 24 July 2013
Test Well: MW-H30

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H30

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.25 m
Static Water Column Height: 2.772 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 2.772 m
Total Well Penetration Depth: 2.772 m
Corrected Casing Radius (Bouwer-Rice Method): 0.016 m
Gravel Pack Porosity: 0.

No. of Observations: 1479

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.25 | 2.22E+4 | 0.1495 |
| 30. | 0.2524 | 2.223E+4 | 0.15 |
| 60. | 0.252 | 2.226E+4 | 0.1496 |
| 90. | 0.2515 | 2.229E+4 | 0.1496 |
| 120. | 0.2508 | 2.232E+4 | 0.1487 |
| 150. | 0.2508 | 2.235E+4 | 0.149 |
| 180. | 0.2503 | 2.238E+4 | 0.1491 |
| 210. | 0.2496 | 2.241E+4 | 0.1486 |
| 240. | 0.2493 | 2.244E+4 | 0.1485 |
| 270. | 0.2487 | 2.247E+4 | 0.1484 |
| 300. | 0.2484 | 2.25E+4 | 0.1487 |
| 330. | 0.2477 | 2.253E+4 | 0.1482 |
| 360. | 0.2472 | 2.256E+4 | 0.1482 |
| 390. | 0.2466 | 2.259E+4 | 0.1475 |
| 420. | 0.2519 | 2.262E+4 | 0.1474 |
| 450. | 0.252 | 2.265E+4 | 0.148 |
| 480. | 0.2509 | 2.268E+4 | 0.1469 |
| 510. | 0.2516 | 2.271E+4 | 0.1473 |
| 540. | 0.2509 | 2.274E+4 | 0.1469 |
| 570. | 0.2505 | 2.277E+4 | 0.1472 |
| 600. | 0.2498 | 2.28E+4 | 0.147 |
| 630. | 0.2491 | 2.283E+4 | 0.1463 |
| 660. | 0.2487 | 2.286E+4 | 0.1469 |
| 690. | 0.2482 | 2.289E+4 | 0.147 |
| 720. | 0.248 | 2.292E+4 | 0.1469 |
| 750. | 0.2476 | 2.295E+4 | 0.1467 |
| 780. | 0.2466 | 2.298E+4 | 0.1468 |
| 810. | 0.2463 | 2.301E+4 | 0.1464 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 840. | 0.2481 | 2.304E+4 | 0.1463 |
| 870. | 0.251 | 2.307E+4 | 0.1462 |
| 900. | 0.2511 | 2.31E+4 | 0.1467 |
| 930. | 0.2506 | 2.313E+4 | 0.1458 |
| 960. | 0.2499 | 2.316E+4 | 0.1456 |
| 990. | 0.2496 | 2.319E+4 | 0.1455 |
| 1020. | 0.249 | 2.322E+4 | 0.1457 |
| 1050. | 0.2488 | 2.325E+4 | 0.1457 |
| 1080. | 0.2483 | 2.328E+4 | 0.1454 |
| 1110. | 0.2478 | 2.331E+4 | 0.1455 |
| 1140. | 0.2476 | 2.334E+4 | 0.1456 |
| 1170. | 0.2468 | 2.337E+4 | 0.1456 |
| 1200. | 0.2466 | 2.34E+4 | 0.1449 |
| 1230. | 0.2461 | 2.343E+4 | 0.1454 |
| 1260. | 0.2495 | 2.346E+4 | 0.1449 |
| 1290. | 0.25 | 2.349E+4 | 0.1451 |
| 1320. | 0.2503 | 2.352E+4 | 0.1449 |
| 1350. | 0.2502 | 2.355E+4 | 0.1446 |
| 1380. | 0.2497 | 2.358E+4 | 0.1444 |
| 1410. | 0.2497 | 2.361E+4 | 0.1445 |
| 1440. | 0.2496 | 2.364E+4 | 0.1444 |
| 1470. | 0.2497 | 2.367E+4 | 0.1442 |
| 1500. | 0.2497 | 2.37E+4 | 0.1445 |
| 1530. | 0.249 | 2.373E+4 | 0.1444 |
| 1560. | 0.2494 | 2.376E+4 | 0.1439 |
| 1590. | 0.249 | 2.379E+4 | 0.1443 |
| 1620. | 0.2493 | 2.382E+4 | 0.1441 |
| 1650. | 0.2486 | 2.385E+4 | 0.1442 |
| 1680. | 0.2489 | 2.388E+4 | 0.1439 |
| 1710. | 0.2488 | 2.391E+4 | 0.1439 |
| 1740. | 0.2482 | 2.394E+4 | 0.1438 |
| 1770. | 0.2481 | 2.397E+4 | 0.144 |
| 1800. | 0.2479 | 2.4E+4 | 0.1442 |
| 1830. | 0.248 | 2.403E+4 | 0.1434 |
| 1860. | 0.2475 | 2.406E+4 | 0.1435 |
| 1890. | 0.2478 | 2.409E+4 | 0.1436 |
| 1920. | 0.2474 | 2.412E+4 | 0.1435 |
| 1950. | 0.2469 | 2.415E+4 | 0.1432 |
| 1980. | 0.247 | 2.418E+4 | 0.143 |
| 2010. | 0.2471 | 2.421E+4 | 0.143 |
| 2040. | 0.247 | 2.424E+4 | 0.1425 |
| 2070. | 0.2467 | 2.427E+4 | 0.1426 |
| 2100. | 0.247 | 2.43E+4 | 0.1427 |
| 2130. | 0.2466 | 2.433E+4 | 0.1425 |
| 2160. | 0.2465 | 2.436E+4 | 0.1425 |
| 2190. | 0.2466 | 2.439E+4 | 0.1419 |
| 2220. | 0.2459 | 2.442E+4 | 0.1416 |
| 2250. | 0.2463 | 2.445E+4 | 0.1419 |
| 2280. | 0.2459 | 2.448E+4 | 0.1414 |
| 2310. | 0.2462 | 2.451E+4 | 0.1414 |
| 2340. | 0.2459 | 2.454E+4 | 0.1417 |
| 2370. | 0.2454 | 2.457E+4 | 0.1409 |
| 2400. | 0.2452 | 2.46E+4 | 0.1407 |
| 2430. | 0.2454 | 2.463E+4 | 0.141 |
| 2460. | 0.2455 | 2.466E+4 | 0.1405 |
| 2490. | 0.2449 | 2.469E+4 | 0.1403 |
| 2520. | 0.2448 | 2.472E+4 | 0.1403 |
| 2550. | 0.2445 | 2.475E+4 | 0.1402 |
| 2580. | 0.2449 | 2.478E+4 | 0.1399 |
| 2610. | 0.2445 | 2.481E+4 | 0.1398 |
| 2640. | 0.2444 | 2.484E+4 | 0.1396 |
| 2670. | 0.2445 | 2.487E+4 | 0.1391 |
| 2700. | 0.2444 | 2.49E+4 | 0.1393 |
| 2730. | 0.2437 | 2.493E+4 | 0.1395 |
| 2760. | 0.2434 | 2.496E+4 | 0.1392 |
| 2790. | 0.2435 | 2.499E+4 | 0.1389 |
| 2820. | 0.2435 | 2.502E+4 | 0.1386 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2850. | 0.2436 | 2.505E+4 | 0.1386 |
| 2880. | 0.2432 | 2.508E+4 | 0.1387 |
| 2910. | 0.2435 | 2.511E+4 | 0.1387 |
| 2940. | 0.2431 | 2.514E+4 | 0.139 |
| 2970. | 0.2431 | 2.517E+4 | 0.1385 |
| 3000. | 0.243 | 2.52E+4 | 0.138 |
| 3030. | 0.2423 | 2.523E+4 | 0.1383 |
| 3060. | 0.2429 | 2.526E+4 | 0.1384 |
| 3090. | 0.2421 | 2.529E+4 | 0.1381 |
| 3120. | 0.2421 | 2.532E+4 | 0.1382 |
| 3150. | 0.2421 | 2.535E+4 | 0.1379 |
| 3180. | 0.2421 | 2.538E+4 | 0.1377 |
| 3210. | 0.2421 | 2.541E+4 | 0.1375 |
| 3240. | 0.242 | 2.544E+4 | 0.1371 |
| 3270. | 0.2419 | 2.547E+4 | 0.1372 |
| 3300. | 0.2418 | 2.55E+4 | 0.137 |
| 3330. | 0.2417 | 2.553E+4 | 0.1372 |
| 3360. | 0.2416 | 2.556E+4 | 0.1373 |
| 3390. | 0.2419 | 2.559E+4 | 0.1371 |
| 3420. | 0.2418 | 2.562E+4 | 0.1372 |
| 3450. | 0.2419 | 2.565E+4 | 0.1368 |
| 3480. | 0.2413 | 2.568E+4 | 0.1372 |
| 3510. | 0.2413 | 2.571E+4 | 0.1369 |
| 3540. | 0.2413 | 2.574E+4 | 0.1367 |
| 3570. | 0.2412 | 2.577E+4 | 0.1365 |
| 3600. | 0.241 | 2.58E+4 | 0.1366 |
| 3630. | 0.2408 | 2.583E+4 | 0.1364 |
| 3660. | 0.2405 | 2.586E+4 | 0.1365 |
| 3690. | 0.2408 | 2.589E+4 | 0.1358 |
| 3720. | 0.2406 | 2.592E+4 | 0.1359 |
| 3750. | 0.2403 | 2.595E+4 | 0.1359 |
| 3780. | 0.2404 | 2.598E+4 | 0.136 |
| 3810. | 0.2403 | 2.601E+4 | 0.1351 |
| 3840. | 0.2401 | 2.604E+4 | 0.1344 |
| 3870. | 0.2401 | 2.607E+4 | 0.1346 |
| 3900. | 0.24 | 2.61E+4 | 0.1348 |
| 3930. | 0.2399 | 2.613E+4 | 0.1343 |
| 3960. | 0.2399 | 2.616E+4 | 0.1338 |
| 3990. | 0.2399 | 2.619E+4 | 0.1334 |
| 4020. | 0.239 | 2.622E+4 | 0.1334 |
| 4050. | 0.2393 | 2.625E+4 | 0.1334 |
| 4080. | 0.2387 | 2.628E+4 | 0.1331 |
| 4110. | 0.2388 | 2.631E+4 | 0.1332 |
| 4140. | 0.2387 | 2.634E+4 | 0.1329 |
| 4170. | 0.2385 | 2.637E+4 | 0.133 |
| 4200. | 0.2383 | 2.64E+4 | 0.1328 |
| 4230. | 0.239 | 2.643E+4 | 0.1322 |
| 4260. | 0.2378 | 2.646E+4 | 0.1323 |
| 4290. | 0.2382 | 2.649E+4 | 0.1321 |
| 4320. | 0.2383 | 2.652E+4 | 0.1317 |
| 4350. | 0.238 | 2.655E+4 | 0.1315 |
| 4380. | 0.238 | 2.658E+4 | 0.1315 |
| 4410. | 0.238 | 2.661E+4 | 0.1317 |
| 4440. | 0.2377 | 2.664E+4 | 0.1314 |
| 4470. | 0.2376 | 2.667E+4 | 0.1312 |
| 4500. | 0.2378 | 2.67E+4 | 0.1313 |
| 4530. | 0.2372 | 2.673E+4 | 0.1312 |
| 4560. | 0.2369 | 2.676E+4 | 0.1306 |
| 4590. | 0.2376 | 2.679E+4 | 0.1304 |
| 4620. | 0.2371 | 2.682E+4 | 0.1305 |
| 4650. | 0.2368 | 2.685E+4 | 0.1302 |
| 4680. | 0.2364 | 2.688E+4 | 0.1302 |
| 4710. | 0.2368 | 2.691E+4 | 0.1304 |
| 4740. | 0.2363 | 2.694E+4 | 0.1303 |
| 4770. | 0.2371 | 2.697E+4 | 0.1303 |
| 4800. | 0.2358 | 2.7E+4 | 0.1296 |
| 4830. | 0.2359 | 2.703E+4 | 0.13 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 4860. | 0.2359 | 2.706E+4 | 0.1295 |
| 4890. | 0.2357 | 2.709E+4 | 0.1299 |
| 4920. | 0.2358 | 2.712E+4 | 0.1297 |
| 4950. | 0.2356 | 2.715E+4 | 0.1295 |
| 4980. | 0.2354 | 2.718E+4 | 0.1298 |
| 5010. | 0.2354 | 2.721E+4 | 0.1293 |
| 5040. | 0.2349 | 2.724E+4 | 0.1289 |
| 5070. | 0.2346 | 2.727E+4 | 0.129 |
| 5100. | 0.2346 | 2.73E+4 | 0.1293 |
| 5130. | 0.2355 | 2.733E+4 | 0.1289 |
| 5160. | 0.2342 | 2.736E+4 | 0.1291 |
| 5190. | 0.2344 | 2.739E+4 | 0.1286 |
| 5220. | 0.2348 | 2.742E+4 | 0.1288 |
| 5250. | 0.234 | 2.745E+4 | 0.1285 |
| 5280. | 0.2341 | 2.748E+4 | 0.1288 |
| 5310. | 0.2343 | 2.751E+4 | 0.1285 |
| 5340. | 0.2338 | 2.754E+4 | 0.1279 |
| 5370. | 0.2337 | 2.757E+4 | 0.1277 |
| 5400. | 0.2336 | 2.76E+4 | 0.1278 |
| 5430. | 0.2337 | 2.763E+4 | 0.1276 |
| 5460. | 0.2336 | 2.766E+4 | 0.1273 |
| 5490. | 0.2333 | 2.769E+4 | 0.1273 |
| 5520. | 0.2334 | 2.772E+4 | 0.127 |
| 5550. | 0.2333 | 2.775E+4 | 0.1268 |
| 5580. | 0.2337 | 2.778E+4 | 0.1269 |
| 5610. | 0.2329 | 2.781E+4 | 0.1266 |
| 5640. | 0.2325 | 2.784E+4 | 0.1269 |
| 5670. | 0.2325 | 2.787E+4 | 0.1268 |
| 5700. | 0.2325 | 2.79E+4 | 0.127 |
| 5730. | 0.2319 | 2.793E+4 | 0.1265 |
| 5760. | 0.2322 | 2.796E+4 | 0.1262 |
| 5790. | 0.2325 | 2.799E+4 | 0.1263 |
| 5820. | 0.232 | 2.802E+4 | 0.1261 |
| 5850. | 0.2316 | 2.805E+4 | 0.1262 |
| 5880. | 0.2311 | 2.808E+4 | 0.126 |
| 5910. | 0.2314 | 2.811E+4 | 0.1258 |
| 5940. | 0.2317 | 2.814E+4 | 0.1256 |
| 5970. | 0.2308 | 2.817E+4 | 0.1258 |
| 6000. | 0.2307 | 2.82E+4 | 0.1257 |
| 6030. | 0.2305 | 2.823E+4 | 0.1258 |
| 6060. | 0.2306 | 2.826E+4 | 0.1257 |
| 6090. | 0.2306 | 2.829E+4 | 0.1257 |
| 6120. | 0.2304 | 2.832E+4 | 0.1252 |
| 6150. | 0.2303 | 2.835E+4 | 0.1252 |
| 6180. | 0.23 | 2.838E+4 | 0.1247 |
| 6210. | 0.2298 | 2.841E+4 | 0.1242 |
| 6240. | 0.23 | 2.844E+4 | 0.1251 |
| 6270. | 0.2301 | 2.847E+4 | 0.1242 |
| 6300. | 0.23 | 2.85E+4 | 0.1237 |
| 6330. | 0.2296 | 2.853E+4 | 0.1237 |
| 6360. | 0.2294 | 2.856E+4 | 0.1238 |
| 6390. | 0.2298 | 2.859E+4 | 0.124 |
| 6420. | 0.2293 | 2.862E+4 | 0.124 |
| 6450. | 0.229 | 2.865E+4 | 0.1241 |
| 6480. | 0.2286 | 2.868E+4 | 0.1235 |
| 6510. | 0.2293 | 2.871E+4 | 0.1234 |
| 6540. | 0.2289 | 2.874E+4 | 0.1241 |
| 6570. | 0.2286 | 2.877E+4 | 0.1235 |
| 6600. | 0.2284 | 2.88E+4 | 0.1232 |
| 6630. | 0.2285 | 2.883E+4 | 0.1236 |
| 6660. | 0.228 | 2.886E+4 | 0.1231 |
| 6690. | 0.228 | 2.889E+4 | 0.1233 |
| 6720. | 0.2276 | 2.892E+4 | 0.1233 |
| 6750. | 0.2271 | 2.895E+4 | 0.1233 |
| 6780. | 0.2269 | 2.898E+4 | 0.123 |
| 6810. | 0.2272 | 2.901E+4 | 0.1228 |
| 6840. | 0.2265 | 2.904E+4 | 0.1229 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 6870. | 0.2267 | 2.907E+4 | 0.1226 |
| 6900. | 0.2267 | 2.91E+4 | 0.1227 |
| 6930. | 0.2265 | 2.913E+4 | 0.1221 |
| 6960. | 0.2268 | 2.916E+4 | 0.1227 |
| 6990. | 0.2263 | 2.919E+4 | 0.1222 |
| 7020. | 0.226 | 2.922E+4 | 0.1218 |
| 7050. | 0.2263 | 2.925E+4 | 0.1221 |
| 7080. | 0.226 | 2.928E+4 | 0.1217 |
| 7110. | 0.2262 | 2.931E+4 | 0.1218 |
| 7140. | 0.2256 | 2.934E+4 | 0.1217 |
| 7170. | 0.2255 | 2.937E+4 | 0.1225 |
| 7200. | 0.2252 | 2.94E+4 | 0.1222 |
| 7230. | 0.2256 | 2.943E+4 | 0.1219 |
| 7260. | 0.2249 | 2.946E+4 | 0.1219 |
| 7290. | 0.2245 | 2.949E+4 | 0.1219 |
| 7320. | 0.2247 | 2.952E+4 | 0.1217 |
| 7350. | 0.2241 | 2.955E+4 | 0.1216 |
| 7380. | 0.2244 | 2.958E+4 | 0.1219 |
| 7410. | 0.2239 | 2.961E+4 | 0.1215 |
| 7440. | 0.224 | 2.964E+4 | 0.1211 |
| 7470. | 0.2241 | 2.967E+4 | 0.1217 |
| 7500. | 0.2237 | 2.97E+4 | 0.1211 |
| 7530. | 0.2234 | 2.973E+4 | 0.1209 |
| 7560. | 0.2238 | 2.976E+4 | 0.1207 |
| 7590. | 0.2234 | 2.979E+4 | 0.1208 |
| 7620. | 0.2234 | 2.982E+4 | 0.1205 |
| 7650. | 0.2231 | 2.985E+4 | 0.1206 |
| 7680. | 0.223 | 2.988E+4 | 0.1203 |
| 7710. | 0.223 | 2.991E+4 | 0.1203 |
| 7740. | 0.223 | 2.994E+4 | 0.1201 |
| 7770. | 0.2232 | 2.997E+4 | 0.12 |
| 7800. | 0.2227 | 3.0E+4 | 0.12 |
| 7830. | 0.2221 | 3.003E+4 | 0.1203 |
| 7860. | 0.2223 | 3.006E+4 | 0.1197 |
| 7890. | 0.2227 | 3.009E+4 | 0.119 |
| 7920. | 0.2219 | 3.012E+4 | 0.1188 |
| 7950. | 0.2226 | 3.015E+4 | 0.1193 |
| 7980. | 0.2219 | 3.018E+4 | 0.1192 |
| 8010. | 0.2216 | 3.021E+4 | 0.1191 |
| 8040. | 0.2213 | 3.024E+4 | 0.1187 |
| 8070. | 0.2215 | 3.027E+4 | 0.1187 |
| 8100. | 0.2215 | 3.03E+4 | 0.1184 |
| 8130. | 0.2212 | 3.033E+4 | 0.1184 |
| 8160. | 0.2212 | 3.036E+4 | 0.1183 |
| 8190. | 0.2209 | 3.039E+4 | 0.1182 |
| 8220. | 0.2211 | 3.042E+4 | 0.1183 |
| 8250. | 0.2208 | 3.045E+4 | 0.1175 |
| 8280. | 0.2203 | 3.048E+4 | 0.1174 |
| 8310. | 0.2208 | 3.051E+4 | 0.1174 |
| 8340. | 0.22 | 3.054E+4 | 0.1178 |
| 8370. | 0.2208 | 3.057E+4 | 0.1172 |
| 8400. | 0.2203 | 3.06E+4 | 0.1169 |
| 8430. | 0.2198 | 3.063E+4 | 0.117 |
| 8460. | 0.2197 | 3.066E+4 | 0.1171 |
| 8490. | 0.2204 | 3.069E+4 | 0.1164 |
| 8520. | 0.2202 | 3.072E+4 | 0.1168 |
| 8550. | 0.2203 | 3.075E+4 | 0.1162 |
| 8580. | 0.2195 | 3.078E+4 | 0.1163 |
| 8610. | 0.2193 | 3.081E+4 | 0.1167 |
| 8640. | 0.2193 | 3.084E+4 | 0.1158 |
| 8670. | 0.2194 | 3.087E+4 | 0.1159 |
| 8700. | 0.2186 | 3.09E+4 | 0.1157 |
| 8730. | 0.2189 | 3.093E+4 | 0.1156 |
| 8760. | 0.2185 | 3.096E+4 | 0.1157 |
| 8790. | 0.2184 | 3.099E+4 | 0.1157 |
| 8820. | 0.2181 | 3.102E+4 | 0.115 |
| 8850. | 0.2181 | 3.105E+4 | 0.1153 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 8880. | 0.2182 | 3.108E+4 | 0.1153 |
| 8910. | 0.2178 | 3.111E+4 | 0.115 |
| 8940. | 0.2152 | 3.114E+4 | 0.1141 |
| 8970. | 0.215 | 3.117E+4 | 0.1143 |
| 9000. | 0.2147 | 3.12E+4 | 0.1145 |
| 9030. | 0.2145 | 3.123E+4 | 0.114 |
| 9060. | 0.2146 | 3.126E+4 | 0.1142 |
| 9090. | 0.2147 | 3.129E+4 | 0.1143 |
| 9120. | 0.2147 | 3.132E+4 | 0.1137 |
| 9150. | 0.2142 | 3.135E+4 | 0.1137 |
| 9180. | 0.2142 | 3.138E+4 | 0.1138 |
| 9210. | 0.2137 | 3.141E+4 | 0.1136 |
| 9240. | 0.214 | 3.144E+4 | 0.1131 |
| 9270. | 0.2136 | 3.147E+4 | 0.1132 |
| 9300. | 0.2131 | 3.15E+4 | 0.1134 |
| 9330. | 0.2132 | 3.153E+4 | 0.1131 |
| 9360. | 0.2127 | 3.156E+4 | 0.1128 |
| 9390. | 0.2129 | 3.159E+4 | 0.1125 |
| 9420. | 0.2125 | 3.162E+4 | 0.1122 |
| 9450. | 0.2124 | 3.165E+4 | 0.1124 |
| 9480. | 0.2122 | 3.168E+4 | 0.1121 |
| 9510. | 0.2122 | 3.171E+4 | 0.1118 |
| 9540. | 0.2118 | 3.174E+4 | 0.1114 |
| 9570. | 0.2115 | 3.177E+4 | 0.1118 |
| 9600. | 0.2108 | 3.18E+4 | 0.1112 |
| 9630. | 0.2107 | 3.183E+4 | 0.1112 |
| 9660. | 0.2106 | 3.186E+4 | 0.1113 |
| 9690. | 0.2099 | 3.189E+4 | 0.1107 |
| 9720. | 0.2098 | 3.192E+4 | 0.111 |
| 9750. | 0.2096 | 3.195E+4 | 0.1104 |
| 9780. | 0.2101 | 3.198E+4 | 0.11 |
| 9810. | 0.2097 | 3.201E+4 | 0.1101 |
| 9840. | 0.2094 | 3.204E+4 | 0.1104 |
| 9870. | 0.2094 | 3.207E+4 | 0.1103 |
| 9900. | 0.2086 | 3.21E+4 | 0.1099 |
| 9930. | 0.2083 | 3.213E+4 | 0.1104 |
| 9960. | 0.2084 | 3.216E+4 | 0.1091 |
| 9990. | 0.2085 | 3.219E+4 | 0.1095 |
| 1.002E+4 | 0.2081 | 3.222E+4 | 0.1096 |
| 1.005E+4 | 0.2078 | 3.225E+4 | 0.1095 |
| 1.008E+4 | 0.2077 | 3.228E+4 | 0.1093 |
| 1.011E+4 | 0.2075 | 3.231E+4 | 0.1094 |
| 1.014E+4 | 0.2072 | 3.234E+4 | 0.1089 |
| 1.017E+4 | 0.2068 | 3.237E+4 | 0.1092 |
| 1.02E+4 | 0.2071 | 3.24E+4 | 0.1092 |
| 1.023E+4 | 0.207 | 3.243E+4 | 0.1087 |
| 1.026E+4 | 0.2066 | 3.246E+4 | 0.1091 |
| 1.029E+4 | 0.2064 | 3.249E+4 | 0.1086 |
| 1.032E+4 | 0.2067 | 3.252E+4 | 0.1088 |
| 1.035E+4 | 0.2067 | 3.255E+4 | 0.1089 |
| 1.038E+4 | 0.206 | 3.258E+4 | 0.1083 |
| 1.041E+4 | 0.2063 | 3.261E+4 | 0.1082 |
| 1.044E+4 | 0.2063 | 3.264E+4 | 0.1084 |
| 1.047E+4 | 0.206 | 3.267E+4 | 0.1083 |
| 1.05E+4 | 0.2057 | 3.27E+4 | 0.108 |
| 1.053E+4 | 0.2055 | 3.273E+4 | 0.1083 |
| 1.056E+4 | 0.2055 | 3.276E+4 | 0.1082 |
| 1.059E+4 | 0.2051 | 3.279E+4 | 0.108 |
| 1.062E+4 | 0.2047 | 3.282E+4 | 0.1077 |
| 1.065E+4 | 0.205 | 3.285E+4 | 0.1081 |
| 1.068E+4 | 0.2041 | 3.288E+4 | 0.1078 |
| 1.071E+4 | 0.2044 | 3.291E+4 | 0.1081 |
| 1.074E+4 | 0.2042 | 3.294E+4 | 0.1077 |
| 1.077E+4 | 0.2038 | 3.297E+4 | 0.1076 |
| 1.08E+4 | 0.2033 | 3.3E+4 | 0.1078 |
| 1.083E+4 | 0.2033 | 3.303E+4 | 0.1069 |
| 1.086E+4 | 0.2034 | 3.306E+4 | 0.1073 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.089E+4 | 0.2027 | 3.309E+4 | 0.1072 |
| 1.092E+4 | 0.2026 | 3.312E+4 | 0.1068 |
| 1.095E+4 | 0.2028 | 3.315E+4 | 0.1065 |
| 1.098E+4 | 0.2025 | 3.318E+4 | 0.1065 |
| 1.101E+4 | 0.2028 | 3.321E+4 | 0.1067 |
| 1.104E+4 | 0.2024 | 3.324E+4 | 0.1062 |
| 1.107E+4 | 0.2023 | 3.327E+4 | 0.1061 |
| 1.11E+4 | 0.2019 | 3.33E+4 | 0.1057 |
| 1.113E+4 | 0.2015 | 3.333E+4 | 0.1057 |
| 1.116E+4 | 0.2022 | 3.336E+4 | 0.1055 |
| 1.119E+4 | 0.2016 | 3.339E+4 | 0.1052 |
| 1.122E+4 | 0.2011 | 3.342E+4 | 0.1055 |
| 1.125E+4 | 0.2014 | 3.345E+4 | 0.1052 |
| 1.128E+4 | 0.2013 | 3.348E+4 | 0.1051 |
| 1.131E+4 | 0.201 | 3.351E+4 | 0.1052 |
| 1.134E+4 | 0.201 | 3.354E+4 | 0.1049 |
| 1.137E+4 | 0.2009 | 3.357E+4 | 0.1046 |
| 1.14E+4 | 0.2004 | 3.36E+4 | 0.1048 |
| 1.143E+4 | 0.2002 | 3.363E+4 | 0.1046 |
| 1.146E+4 | 0.2002 | 3.366E+4 | 0.1043 |
| 1.149E+4 | 0.2002 | 3.369E+4 | 0.1043 |
| 1.152E+4 | 0.1997 | 3.372E+4 | 0.1039 |
| 1.155E+4 | 0.1999 | 3.375E+4 | 0.104 |
| 1.158E+4 | 0.1997 | 3.378E+4 | 0.104 |
| 1.161E+4 | 0.1994 | 3.381E+4 | 0.1033 |
| 1.164E+4 | 0.1988 | 3.384E+4 | 0.1032 |
| 1.167E+4 | 0.1988 | 3.387E+4 | 0.1036 |
| 1.17E+4 | 0.1991 | 3.39E+4 | 0.1028 |
| 1.173E+4 | 0.199 | 3.393E+4 | 0.1027 |
| 1.176E+4 | 0.1985 | 3.396E+4 | 0.103 |
| 1.179E+4 | 0.1985 | 3.399E+4 | 0.103 |
| 1.182E+4 | 0.1986 | 3.402E+4 | 0.1028 |
| 1.185E+4 | 0.1982 | 3.405E+4 | 0.1025 |
| 1.188E+4 | 0.1981 | 3.408E+4 | 0.1026 |
| 1.191E+4 | 0.1982 | 3.411E+4 | 0.1026 |
| 1.194E+4 | 0.1978 | 3.414E+4 | 0.1027 |
| 1.197E+4 | 0.1977 | 3.417E+4 | 0.1027 |
| 1.2E+4 | 0.1975 | 3.42E+4 | 0.1017 |
| 1.203E+4 | 0.1976 | 3.423E+4 | 0.1017 |
| 1.206E+4 | 0.1972 | 3.426E+4 | 0.1016 |
| 1.209E+4 | 0.1972 | 3.429E+4 | 0.1011 |
| 1.212E+4 | 0.1967 | 3.432E+4 | 0.1013 |
| 1.215E+4 | 0.197 | 3.435E+4 | 0.1008 |
| 1.218E+4 | 0.1967 | 3.438E+4 | 0.1008 |
| 1.221E+4 | 0.1964 | 3.441E+4 | 0.1005 |
| 1.224E+4 | 0.1962 | 3.444E+4 | 0.1003 |
| 1.227E+4 | 0.1967 | 3.447E+4 | 0.1003 |
| 1.23E+4 | 0.1962 | 3.45E+4 | 0.0997 |
| 1.233E+4 | 0.196 | 3.453E+4 | 0.1003 |
| 1.236E+4 | 0.1958 | 3.456E+4 | 0.0999 |
| 1.239E+4 | 0.196 | 3.459E+4 | 0.0996 |
| 1.242E+4 | 0.1956 | 3.462E+4 | 0.0997 |
| 1.245E+4 | 0.1954 | 3.465E+4 | 0.0995 |
| 1.248E+4 | 0.1955 | 3.468E+4 | 0.0992 |
| 1.251E+4 | 0.1955 | 3.471E+4 | 0.099 |
| 1.254E+4 | 0.1949 | 3.474E+4 | 0.0989 |
| 1.257E+4 | 0.1946 | 3.477E+4 | 0.0991 |
| 1.26E+4 | 0.1946 | 3.48E+4 | 0.0993 |
| 1.263E+4 | 0.1952 | 3.483E+4 | 0.0991 |
| 1.266E+4 | 0.1947 | 3.486E+4 | 0.0991 |
| 1.269E+4 | 0.1947 | 3.489E+4 | 0.0992 |
| 1.272E+4 | 0.1941 | 3.492E+4 | 0.0989 |
| 1.275E+4 | 0.1943 | 3.495E+4 | 0.0992 |
| 1.278E+4 | 0.1943 | 3.498E+4 | 0.0988 |
| 1.281E+4 | 0.1939 | 3.501E+4 | 0.0986 |
| 1.284E+4 | 0.1938 | 3.504E+4 | 0.0986 |
| 1.287E+4 | 0.1934 | 3.507E+4 | 0.099 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.29E+4 | 0.1934 | 3.51E+4 | 0.0986 |
| 1.293E+4 | 0.1936 | 3.513E+4 | 0.099 |
| 1.296E+4 | 0.1933 | 3.516E+4 | 0.0989 |
| 1.299E+4 | 0.1932 | 3.519E+4 | 0.0984 |
| 1.302E+4 | 0.1926 | 3.522E+4 | 0.0979 |
| 1.305E+4 | 0.1929 | 3.525E+4 | 0.0983 |
| 1.308E+4 | 0.1921 | 3.528E+4 | 0.0983 |
| 1.311E+4 | 0.1923 | 3.531E+4 | 0.0975 |
| 1.314E+4 | 0.1921 | 3.534E+4 | 0.0973 |
| 1.317E+4 | 0.1918 | 3.537E+4 | 0.0977 |
| 1.32E+4 | 0.1922 | 3.54E+4 | 0.0973 |
| 1.323E+4 | 0.192 | 3.543E+4 | 0.0976 |
| 1.326E+4 | 0.1918 | 3.546E+4 | 0.0974 |
| 1.329E+4 | 0.1913 | 3.549E+4 | 0.0968 |
| 1.332E+4 | 0.1912 | 3.552E+4 | 0.0967 |
| 1.335E+4 | 0.1912 | 3.555E+4 | 0.0969 |
| 1.338E+4 | 0.1911 | 3.558E+4 | 0.0968 |
| 1.341E+4 | 0.1908 | 3.561E+4 | 0.0968 |
| 1.344E+4 | 0.1907 | 3.564E+4 | 0.0964 |
| 1.347E+4 | 0.1905 | 3.567E+4 | 0.0968 |
| 1.35E+4 | 0.1905 | 3.57E+4 | 0.0962 |
| 1.353E+4 | 0.1904 | 3.573E+4 | 0.0963 |
| 1.356E+4 | 0.1903 | 3.576E+4 | 0.0967 |
| 1.359E+4 | 0.1903 | 3.579E+4 | 0.0961 |
| 1.362E+4 | 0.19 | 3.582E+4 | 0.0961 |
| 1.365E+4 | 0.1898 | 3.585E+4 | 0.0959 |
| 1.368E+4 | 0.1895 | 3.588E+4 | 0.0954 |
| 1.371E+4 | 0.1894 | 3.591E+4 | 0.095 |
| 1.374E+4 | 0.1888 | 3.594E+4 | 0.0951 |
| 1.377E+4 | 0.1891 | 3.597E+4 | 0.0955 |
| 1.38E+4 | 0.1889 | 3.6E+4 | 0.0952 |
| 1.383E+4 | 0.1883 | 3.603E+4 | 0.0946 |
| 1.386E+4 | 0.1884 | 3.606E+4 | 0.0949 |
| 1.389E+4 | 0.1881 | 3.609E+4 | 0.0948 |
| 1.392E+4 | 0.1878 | 3.612E+4 | 0.0946 |
| 1.395E+4 | 0.1879 | 3.615E+4 | 0.0946 |
| 1.398E+4 | 0.1876 | 3.618E+4 | 0.0942 |
| 1.401E+4 | 0.1869 | 3.621E+4 | 0.0941 |
| 1.404E+4 | 0.1865 | 3.624E+4 | 0.0937 |
| 1.407E+4 | 0.1869 | 3.627E+4 | 0.0939 |
| 1.41E+4 | 0.1863 | 3.63E+4 | 0.0933 |
| 1.413E+4 | 0.1856 | 3.633E+4 | 0.094 |
| 1.416E+4 | 0.1853 | 3.636E+4 | 0.0931 |
| 1.419E+4 | 0.1853 | 3.639E+4 | 0.0934 |
| 1.422E+4 | 0.1858 | 3.642E+4 | 0.0933 |
| 1.425E+4 | 0.185 | 3.645E+4 | 0.0933 |
| 1.428E+4 | 0.1849 | 3.648E+4 | 0.0931 |
| 1.431E+4 | 0.1844 | 3.651E+4 | 0.0929 |
| 1.434E+4 | 0.1843 | 3.654E+4 | 0.093 |
| 1.437E+4 | 0.1843 | 3.657E+4 | 0.0928 |
| 1.44E+4 | 0.184 | 3.66E+4 | 0.0929 |
| 1.443E+4 | 0.1832 | 3.663E+4 | 0.0925 |
| 1.446E+4 | 0.1837 | 3.666E+4 | 0.0929 |
| 1.449E+4 | 0.1834 | 3.669E+4 | 0.0925 |
| 1.452E+4 | 0.1827 | 3.672E+4 | 0.0927 |
| 1.455E+4 | 0.183 | 3.675E+4 | 0.092 |
| 1.458E+4 | 0.1831 | 3.678E+4 | 0.0915 |
| 1.461E+4 | 0.1826 | 3.681E+4 | 0.0915 |
| 1.464E+4 | 0.1826 | 3.684E+4 | 0.092 |
| 1.467E+4 | 0.1823 | 3.687E+4 | 0.0913 |
| 1.47E+4 | 0.1823 | 3.69E+4 | 0.0917 |
| 1.473E+4 | 0.182 | 3.693E+4 | 0.0911 |
| 1.476E+4 | 0.1821 | 3.696E+4 | 0.091 |
| 1.479E+4 | 0.1816 | 3.699E+4 | 0.0903 |
| 1.482E+4 | 0.1816 | 3.702E+4 | 0.0902 |
| 1.485E+4 | 0.1813 | 3.705E+4 | 0.0903 |
| 1.488E+4 | 0.1811 | 3.708E+4 | 0.0902 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.491E+4 | 0.1814 | 3.711E+4 | 0.0898 |
| 1.494E+4 | 0.1812 | 3.714E+4 | 0.0901 |
| 1.497E+4 | 0.1813 | 3.717E+4 | 0.0897 |
| 1.5E+4 | 0.1812 | 3.72E+4 | 0.0896 |
| 1.503E+4 | 0.1807 | 3.723E+4 | 0.089 |
| 1.506E+4 | 0.1804 | 3.726E+4 | 0.0892 |
| 1.509E+4 | 0.1802 | 3.729E+4 | 0.0892 |
| 1.512E+4 | 0.18 | 3.732E+4 | 0.089 |
| 1.515E+4 | 0.1798 | 3.735E+4 | 0.0889 |
| 1.518E+4 | 0.1798 | 3.738E+4 | 0.0887 |
| 1.521E+4 | 0.18 | 3.741E+4 | 0.0888 |
| 1.524E+4 | 0.1798 | 3.744E+4 | 0.0882 |
| 1.527E+4 | 0.1793 | 3.747E+4 | 0.0887 |
| 1.53E+4 | 0.18 | 3.75E+4 | 0.0879 |
| 1.533E+4 | 0.1798 | 3.753E+4 | 0.0875 |
| 1.536E+4 | 0.1796 | 3.756E+4 | 0.0879 |
| 1.539E+4 | 0.1795 | 3.759E+4 | 0.088 |
| 1.542E+4 | 0.1796 | 3.762E+4 | 0.0879 |
| 1.545E+4 | 0.1794 | 3.765E+4 | 0.0873 |
| 1.548E+4 | 0.1792 | 3.768E+4 | 0.0872 |
| 1.551E+4 | 0.1785 | 3.771E+4 | 0.0869 |
| 1.554E+4 | 0.179 | 3.774E+4 | 0.087 |
| 1.557E+4 | 0.1786 | 3.777E+4 | 0.0863 |
| 1.56E+4 | 0.1781 | 3.78E+4 | 0.0859 |
| 1.563E+4 | 0.1785 | 3.783E+4 | 0.0862 |
| 1.566E+4 | 0.1782 | 3.786E+4 | 0.0858 |
| 1.569E+4 | 0.1785 | 3.789E+4 | 0.0864 |
| 1.572E+4 | 0.1779 | 3.792E+4 | 0.0858 |
| 1.575E+4 | 0.1776 | 3.795E+4 | 0.0856 |
| 1.578E+4 | 0.1772 | 3.798E+4 | 0.0856 |
| 1.581E+4 | 0.1774 | 3.801E+4 | 0.0853 |
| 1.584E+4 | 0.1773 | 3.804E+4 | 0.0851 |
| 1.587E+4 | 0.1762 | 3.807E+4 | 0.085 |
| 1.59E+4 | 0.1767 | 3.81E+4 | 0.085 |
| 1.593E+4 | 0.1764 | 3.813E+4 | 0.0848 |
| 1.596E+4 | 0.1762 | 3.816E+4 | 0.0845 |
| 1.599E+4 | 0.1757 | 3.819E+4 | 0.0849 |
| 1.602E+4 | 0.176 | 3.822E+4 | 0.0845 |
| 1.605E+4 | 0.176 | 3.825E+4 | 0.0845 |
| 1.608E+4 | 0.1757 | 3.828E+4 | 0.0838 |
| 1.611E+4 | 0.1754 | 3.831E+4 | 0.0845 |
| 1.614E+4 | 0.1754 | 3.834E+4 | 0.0837 |
| 1.617E+4 | 0.1747 | 3.837E+4 | 0.0839 |
| 1.62E+4 | 0.175 | 3.84E+4 | 0.0836 |
| 1.623E+4 | 0.1744 | 3.843E+4 | 0.0834 |
| 1.626E+4 | 0.1746 | 3.846E+4 | 0.0832 |
| 1.629E+4 | 0.1742 | 3.849E+4 | 0.0833 |
| 1.632E+4 | 0.1745 | 3.852E+4 | 0.0827 |
| 1.635E+4 | 0.1739 | 3.855E+4 | 0.0825 |
| 1.638E+4 | 0.1742 | 3.858E+4 | 0.0828 |
| 1.641E+4 | 0.1744 | 3.861E+4 | 0.0827 |
| 1.644E+4 | 0.1743 | 3.864E+4 | 0.0822 |
| 1.647E+4 | 0.1738 | 3.867E+4 | 0.0822 |
| 1.65E+4 | 0.1738 | 3.87E+4 | 0.0823 |
| 1.653E+4 | 0.1736 | 3.873E+4 | 0.0819 |
| 1.656E+4 | 0.1733 | 3.876E+4 | 0.082 |
| 1.659E+4 | 0.1732 | 3.879E+4 | 0.0817 |
| 1.662E+4 | 0.174 | 3.882E+4 | 0.0814 |
| 1.665E+4 | 0.1736 | 3.885E+4 | 0.0815 |
| 1.668E+4 | 0.1731 | 3.888E+4 | 0.0817 |
| 1.671E+4 | 0.173 | 3.891E+4 | 0.0809 |
| 1.674E+4 | 0.1728 | 3.894E+4 | 0.0811 |
| 1.677E+4 | 0.1727 | 3.897E+4 | 0.0809 |
| 1.68E+4 | 0.1719 | 3.9E+4 | 0.0806 |
| 1.683E+4 | 0.1721 | 3.903E+4 | 0.0806 |
| 1.686E+4 | 0.1722 | 3.906E+4 | 0.0802 |
| 1.689E+4 | 0.1719 | 3.909E+4 | 0.0801 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.692E+4 | 0.1711 | 3.912E+4 | 0.0799 |
| 1.695E+4 | 0.1713 | 3.915E+4 | 0.0796 |
| 1.698E+4 | 0.1708 | 3.918E+4 | 0.0793 |
| 1.701E+4 | 0.1714 | 3.921E+4 | 0.0789 |
| 1.704E+4 | 0.1708 | 3.924E+4 | 0.0792 |
| 1.707E+4 | 0.1704 | 3.927E+4 | 0.0791 |
| 1.71E+4 | 0.1703 | 3.93E+4 | 0.0795 |
| 1.713E+4 | 0.1702 | 3.933E+4 | 0.0791 |
| 1.716E+4 | 0.1705 | 3.936E+4 | 0.0785 |
| 1.719E+4 | 0.1701 | 3.939E+4 | 0.0788 |
| 1.722E+4 | 0.17 | 3.942E+4 | 0.0788 |
| 1.725E+4 | 0.1699 | 3.945E+4 | 0.079 |
| 1.728E+4 | 0.1695 | 3.948E+4 | 0.0785 |
| 1.731E+4 | 0.1694 | 3.951E+4 | 0.0781 |
| 1.734E+4 | 0.1694 | 3.954E+4 | 0.0781 |
| 1.737E+4 | 0.169 | 3.957E+4 | 0.0779 |
| 1.74E+4 | 0.1691 | 3.96E+4 | 0.0773 |
| 1.743E+4 | 0.1694 | 3.963E+4 | 0.0775 |
| 1.746E+4 | 0.1692 | 3.966E+4 | 0.0775 |
| 1.749E+4 | 0.1688 | 3.969E+4 | 0.0776 |
| 1.752E+4 | 0.1689 | 3.972E+4 | 0.0775 |
| 1.755E+4 | 0.1687 | 3.975E+4 | 0.0777 |
| 1.758E+4 | 0.169 | 3.978E+4 | 0.0773 |
| 1.761E+4 | 0.1683 | 3.981E+4 | 0.0771 |
| 1.764E+4 | 0.1681 | 3.984E+4 | 0.0763 |
| 1.767E+4 | 0.1685 | 3.987E+4 | 0.0771 |
| 1.77E+4 | 0.1678 | 3.99E+4 | 0.0767 |
| 1.773E+4 | 0.1677 | 3.993E+4 | 0.0763 |
| 1.776E+4 | 0.1679 | 3.996E+4 | 0.0761 |
| 1.779E+4 | 0.168 | 3.999E+4 | 0.0759 |
| 1.782E+4 | 0.1679 | 4.002E+4 | 0.0762 |
| 1.785E+4 | 0.1676 | 4.005E+4 | 0.0764 |
| 1.788E+4 | 0.1673 | 4.008E+4 | 0.0759 |
| 1.791E+4 | 0.1674 | 4.011E+4 | 0.0758 |
| 1.794E+4 | 0.1676 | 4.014E+4 | 0.0754 |
| 1.797E+4 | 0.1672 | 4.017E+4 | 0.0753 |
| 1.8E+4 | 0.1668 | 4.02E+4 | 0.0749 |
| 1.803E+4 | 0.1677 | 4.023E+4 | 0.0751 |
| 1.806E+4 | 0.1666 | 4.026E+4 | 0.0748 |
| 1.809E+4 | 0.1668 | 4.029E+4 | 0.0747 |
| 1.812E+4 | 0.1663 | 4.032E+4 | 0.0744 |
| 1.815E+4 | 0.1665 | 4.035E+4 | 0.0743 |
| 1.818E+4 | 0.1665 | 4.038E+4 | 0.0742 |
| 1.821E+4 | 0.1663 | 4.041E+4 | 0.0743 |
| 1.824E+4 | 0.1662 | 4.044E+4 | 0.0741 |
| 1.827E+4 | 0.166 | 4.047E+4 | 0.0737 |
| 1.83E+4 | 0.1664 | 4.05E+4 | 0.0738 |
| 1.833E+4 | 0.1655 | 4.053E+4 | 0.074 |
| 1.836E+4 | 0.1657 | 4.056E+4 | 0.0735 |
| 1.839E+4 | 0.1655 | 4.059E+4 | 0.073 |
| 1.842E+4 | 0.1647 | 4.062E+4 | 0.0735 |
| 1.845E+4 | 0.1648 | 4.065E+4 | 0.0732 |
| 1.848E+4 | 0.1643 | 4.068E+4 | 0.0731 |
| 1.851E+4 | 0.1644 | 4.071E+4 | 0.0727 |
| 1.854E+4 | 0.1646 | 4.074E+4 | 0.0727 |
| 1.857E+4 | 0.1637 | 4.077E+4 | 0.0725 |
| 1.86E+4 | 0.1637 | 4.08E+4 | 0.0721 |
| 1.863E+4 | 0.1639 | 4.083E+4 | 0.0723 |
| 1.866E+4 | 0.1631 | 4.086E+4 | 0.0723 |
| 1.869E+4 | 0.1638 | 4.089E+4 | 0.0722 |
| 1.872E+4 | 0.1633 | 4.092E+4 | 0.0719 |
| 1.875E+4 | 0.163 | 4.095E+4 | 0.0711 |
| 1.878E+4 | 0.1632 | 4.098E+4 | 0.0717 |
| 1.881E+4 | 0.1627 | 4.101E+4 | 0.0712 |
| 1.884E+4 | 0.1628 | 4.104E+4 | 0.0713 |
| 1.887E+4 | 0.163 | 4.107E+4 | 0.0712 |
| 1.89E+4 | 0.1632 | 4.11E+4 | 0.0708 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.893E+4 | 0.1632 | 4.113E+4 | 0.0709 |
| 1.896E+4 | 0.1626 | 4.116E+4 | 0.0702 |
| 1.899E+4 | 0.1623 | 4.119E+4 | 0.0705 |
| 1.902E+4 | 0.1628 | 4.122E+4 | 0.0704 |
| 1.905E+4 | 0.1621 | 4.125E+4 | 0.0701 |
| 1.908E+4 | 0.1623 | 4.128E+4 | 0.0697 |
| 1.911E+4 | 0.1616 | 4.131E+4 | 0.0693 |
| 1.914E+4 | 0.162 | 4.134E+4 | 0.0697 |
| 1.917E+4 | 0.1622 | 4.137E+4 | 0.0697 |
| 1.92E+4 | 0.1616 | 4.14E+4 | 0.0696 |
| 1.923E+4 | 0.1617 | 4.143E+4 | 0.0686 |
| 1.926E+4 | 0.1618 | 4.146E+4 | 0.0688 |
| 1.929E+4 | 0.1614 | 4.149E+4 | 0.0682 |
| 1.932E+4 | 0.1607 | 4.152E+4 | 0.0684 |
| 1.935E+4 | 0.1613 | 4.155E+4 | 0.0685 |
| 1.938E+4 | 0.1611 | 4.158E+4 | 0.0678 |
| 1.941E+4 | 0.1608 | 4.161E+4 | 0.0677 |
| 1.944E+4 | 0.1605 | 4.164E+4 | 0.0678 |
| 1.947E+4 | 0.1609 | 4.167E+4 | 0.0677 |
| 1.95E+4 | 0.1599 | 4.17E+4 | 0.0678 |
| 1.953E+4 | 0.1597 | 4.173E+4 | 0.0673 |
| 1.956E+4 | 0.1596 | 4.176E+4 | 0.0672 |
| 1.959E+4 | 0.1594 | 4.179E+4 | 0.0669 |
| 1.962E+4 | 0.1589 | 4.182E+4 | 0.0668 |
| 1.965E+4 | 0.159 | 4.185E+4 | 0.0665 |
| 1.968E+4 | 0.159 | 4.188E+4 | 0.0667 |
| 1.971E+4 | 0.1593 | 4.191E+4 | 0.0666 |
| 1.974E+4 | 0.1586 | 4.194E+4 | 0.0662 |
| 1.977E+4 | 0.1588 | 4.197E+4 | 0.0661 |
| 1.98E+4 | 0.1582 | 4.2E+4 | 0.0659 |
| 1.983E+4 | 0.1587 | 4.203E+4 | 0.0653 |
| 1.986E+4 | 0.1588 | 4.206E+4 | 0.0657 |
| 1.989E+4 | 0.1584 | 4.209E+4 | 0.0658 |
| 1.992E+4 | 0.1586 | 4.212E+4 | 0.0653 |
| 1.995E+4 | 0.1589 | 4.215E+4 | 0.0654 |
| 1.998E+4 | 0.1581 | 4.218E+4 | 0.0647 |
| 2.001E+4 | 0.1578 | 4.221E+4 | 0.0648 |
| 2.004E+4 | 0.1579 | 4.224E+4 | 0.0647 |
| 2.007E+4 | 0.158 | 4.227E+4 | 0.0646 |
| 2.01E+4 | 0.1582 | 4.23E+4 | 0.0644 |
| 2.013E+4 | 0.1577 | 4.233E+4 | 0.0647 |
| 2.016E+4 | 0.1581 | 4.236E+4 | 0.0644 |
| 2.019E+4 | 0.1574 | 4.239E+4 | 0.0638 |
| 2.022E+4 | 0.1572 | 4.242E+4 | 0.0636 |
| 2.025E+4 | 0.1574 | 4.245E+4 | 0.0632 |
| 2.028E+4 | 0.1573 | 4.248E+4 | 0.0633 |
| 2.031E+4 | 0.1571 | 4.251E+4 | 0.0634 |
| 2.034E+4 | 0.1572 | 4.254E+4 | 0.063 |
| 2.037E+4 | 0.1571 | 4.257E+4 | 0.063 |
| 2.04E+4 | 0.1571 | 4.26E+4 | 0.0626 |
| 2.043E+4 | 0.1568 | 4.263E+4 | 0.0627 |
| 2.046E+4 | 0.1565 | 4.266E+4 | 0.0621 |
| 2.049E+4 | 0.1567 | 4.269E+4 | 0.0617 |
| 2.052E+4 | 0.1562 | 4.272E+4 | 0.0615 |
| 2.055E+4 | 0.1561 | 4.275E+4 | 0.0619 |
| 2.058E+4 | 0.1559 | 4.278E+4 | 0.0614 |
| 2.061E+4 | 0.1554 | 4.281E+4 | 0.0616 |
| 2.064E+4 | 0.1554 | 4.284E+4 | 0.0609 |
| 2.067E+4 | 0.1558 | 4.287E+4 | 0.0608 |
| 2.07E+4 | 0.1556 | 4.29E+4 | 0.0607 |
| 2.073E+4 | 0.1554 | 4.293E+4 | 0.0608 |
| 2.076E+4 | 0.155 | 4.296E+4 | 0.0603 |
| 2.079E+4 | 0.1557 | 4.299E+4 | 0.0599 |
| 2.082E+4 | 0.1554 | 4.302E+4 | 0.0602 |
| 2.085E+4 | 0.1555 | 4.305E+4 | 0.06 |
| 2.088E+4 | 0.1549 | 4.308E+4 | 0.0606 |
| 2.091E+4 | 0.155 | 4.311E+4 | 0.0603 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2.094E+4 | 0.1553 | 4.314E+4 | 0.0598 |
| 2.097E+4 | 0.1554 | 4.317E+4 | 0.0596 |
| 2.1E+4 | 0.1547 | 4.32E+4 | 0.0592 |
| 2.103E+4 | 0.1544 | 4.323E+4 | 0.0595 |
| 2.106E+4 | 0.1546 | 4.326E+4 | 0.0592 |
| 2.109E+4 | 0.1543 | 4.329E+4 | 0.0588 |
| 2.112E+4 | 0.1542 | 4.332E+4 | 0.0589 |
| 2.115E+4 | 0.1536 | 4.335E+4 | 0.0584 |
| 2.118E+4 | 0.1543 | 4.338E+4 | 0.0588 |
| 2.121E+4 | 0.1537 | 4.341E+4 | 0.0582 |
| 2.124E+4 | 0.1532 | 4.344E+4 | 0.0581 |
| 2.127E+4 | 0.1536 | 4.347E+4 | 0.0581 |
| 2.13E+4 | 0.1531 | 4.35E+4 | 0.0575 |
| 2.133E+4 | 0.1529 | 4.353E+4 | 0.0576 |
| 2.136E+4 | 0.1526 | 4.356E+4 | 0.0571 |
| 2.139E+4 | 0.1528 | 4.359E+4 | 0.0573 |
| 2.142E+4 | 0.1529 | 4.362E+4 | 0.0566 |
| 2.145E+4 | 0.1524 | 4.365E+4 | 0.0564 |
| 2.148E+4 | 0.1525 | 4.368E+4 | 0.0563 |
| 2.151E+4 | 0.152 | 4.371E+4 | 0.0559 |
| 2.154E+4 | 0.1529 | 4.374E+4 | 0.056 |
| 2.157E+4 | 0.1523 | 4.377E+4 | 0.0556 |
| 2.16E+4 | 0.1522 | 4.38E+4 | 0.0552 |
| 2.163E+4 | 0.1517 | 4.383E+4 | 0.0552 |
| 2.166E+4 | 0.152 | 4.386E+4 | 0.0542 |
| 2.169E+4 | 0.1518 | 4.389E+4 | 0.0546 |
| 2.172E+4 | 0.1517 | 4.392E+4 | 0.0549 |
| 2.175E+4 | 0.1512 | 4.395E+4 | 0.0544 |
| 2.178E+4 | 0.1514 | 4.398E+4 | 0.0546 |
| 2.181E+4 | 0.1511 | 4.401E+4 | 0.0539 |
| 2.184E+4 | 0.1512 | 4.404E+4 | 0.0537 |
| 2.187E+4 | 0.1511 | 4.407E+4 | 0.0537 |
| 2.19E+4 | 0.1511 | 4.41E+4 | 0.0538 |
| 2.193E+4 | 0.1509 | 4.413E+4 | 0.0531 |
| 2.196E+4 | 0.1505 | 4.416E+4 | 0.0531 |
| 2.199E+4 | 0.1504 | 4.419E+4 | 0.0528 |
| 2.202E+4 | 0.1507 | 4.422E+4 | 0.053 |
| 2.205E+4 | 0.15 | 4.425E+4 | 0.0529 |
| 2.208E+4 | 0.1502 | 4.428E+4 | 0.0525 |
| 2.211E+4 | 0.1504 | 4.431E+4 | 0.052 |
| 2.214E+4 | 0.1502 | 4.434E+4 | 0.0519 |
| 2.217E+4 | 0.1498 | | |

## SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.802

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 3.653E-9 | m/sec |
| y0 | 0.278 | m |

K = 3.653E-7 cm/sec
T = K*b = 1.826E-7 m²/sec (0.001826 sq. cm/sec)

## NOTES

Well may not be sufficiently developed due to a slow recovery.

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H30 Zone 1 (Falling Head Packer Test, vertical interval 19.05 - 22.86 m)
Date: 08/14/13
Time: 15:56:25

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 22 July 2013
Test Well: MW-H30

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H30

X Location: 0. m
Y Location: 0. m

Initial Displacement: 8.05 m
Static Water Column Height: 14.75 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 3.81 m
Total Well Penetration Depth: 14.75 m

No. of Observations: 59

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 8.05 | 1800. | 7.934 |
| 60. | 8.045 | 1860. | 7.934 |
| 120. | 8.048 | 1920. | 7.931 |
| 180. | 8.044 | 1980. | 7.927 |
| 240. | 8.041 | 2040. | 7.92 |
| 300. | 8.041 | 2100. | 7.92 |
| 360. | 8.033 | 2160. | 7.916 |
| 420. | 8.028 | 2220. | 7.908 |
| 480. | 8.02 | 2280. | 7.908 |
| 540. | 8.02 | 2340. | 7.904 |
| 600. | 8.017 | 2400. | 7.9 |
| 660. | 8.014 | 2460. | 7.895 |
| 720. | 8.009 | 2520. | 7.892 |
| 780. | 8.005 | 2580. | 7.888 |
| 840. | 8.001 | 2640. | 7.884 |
| 900. | 7.997 | 2700. | 7.878 |
| 960. | 7.992 | 2760. | 7.877 |
| 1020. | 7.99 | 2820. | 7.873 |
| 1080. | 7.984 | 2880. | 7.867 |
| 1140. | 7.981 | 2940. | 7.865 |
| 1200. | 7.976 | 3000. | 7.861 |
| 1260. | 7.973 | 3060. | 7.855 |
| 1320. | 7.97 | 3120. | 7.85 |
| 1380. | 7.965 | 3180. | 7.85 |
| 1440. | 7.96 | 3240. | 7.845 |
| 1500. | 7.958 | 3300. | 7.841 |
| 1560. | 7.953 | 3360. | 7.838 |
| 1620. | 7.946 | 3420. | 7.834 |
| 1680. | 7.945 | 3480. | 7.826 |
| 1740. | 7.939 | | |

## SOLUTION

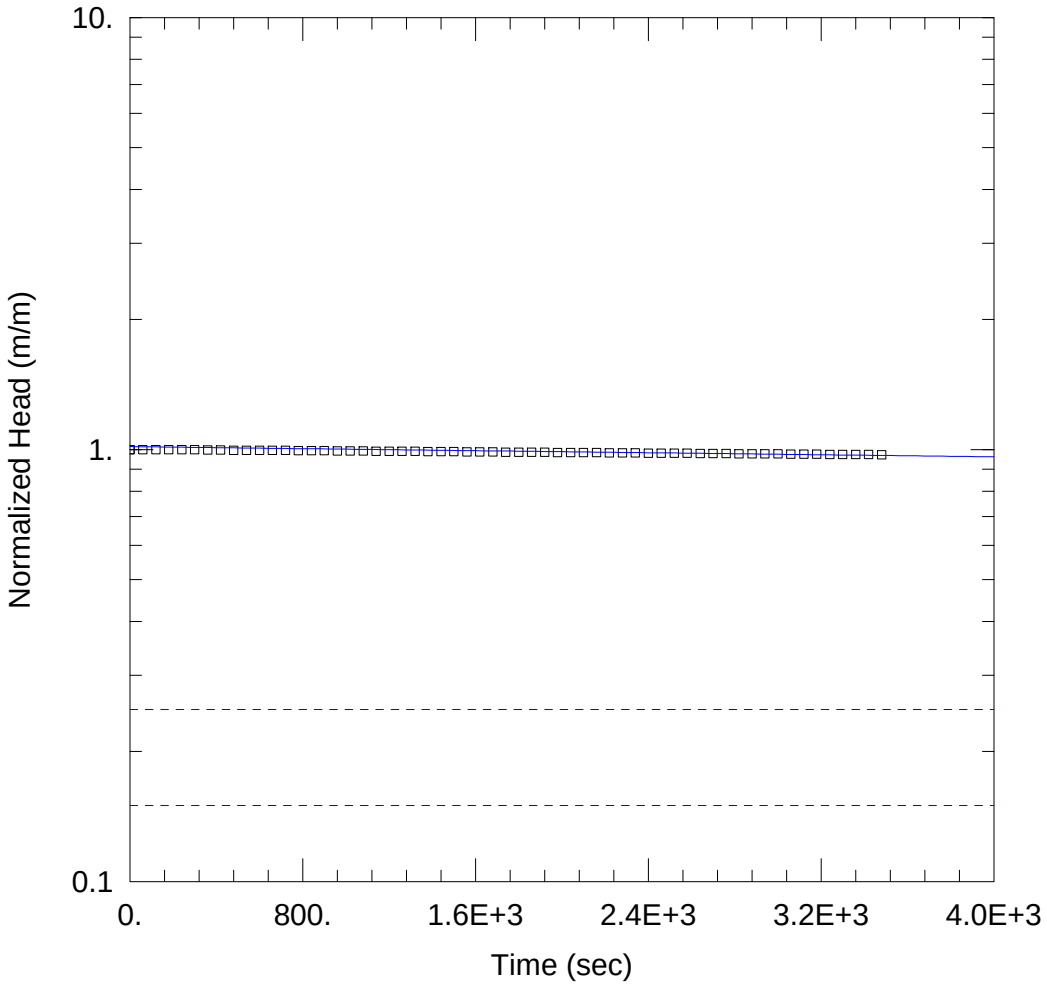
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.2286

## VISUAL ESTIMATION RESULTS

### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 1.792E-8 | m/sec |
| y0 | 8.175 | m |

K = 1.792E-6 cm/sec
T = K*b = 8.959E-7 m²/sec (0.008959 sq. cm/sec)




MW-H30 ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 19.05 - 22.86 M)

## PROJECT INFORMATION

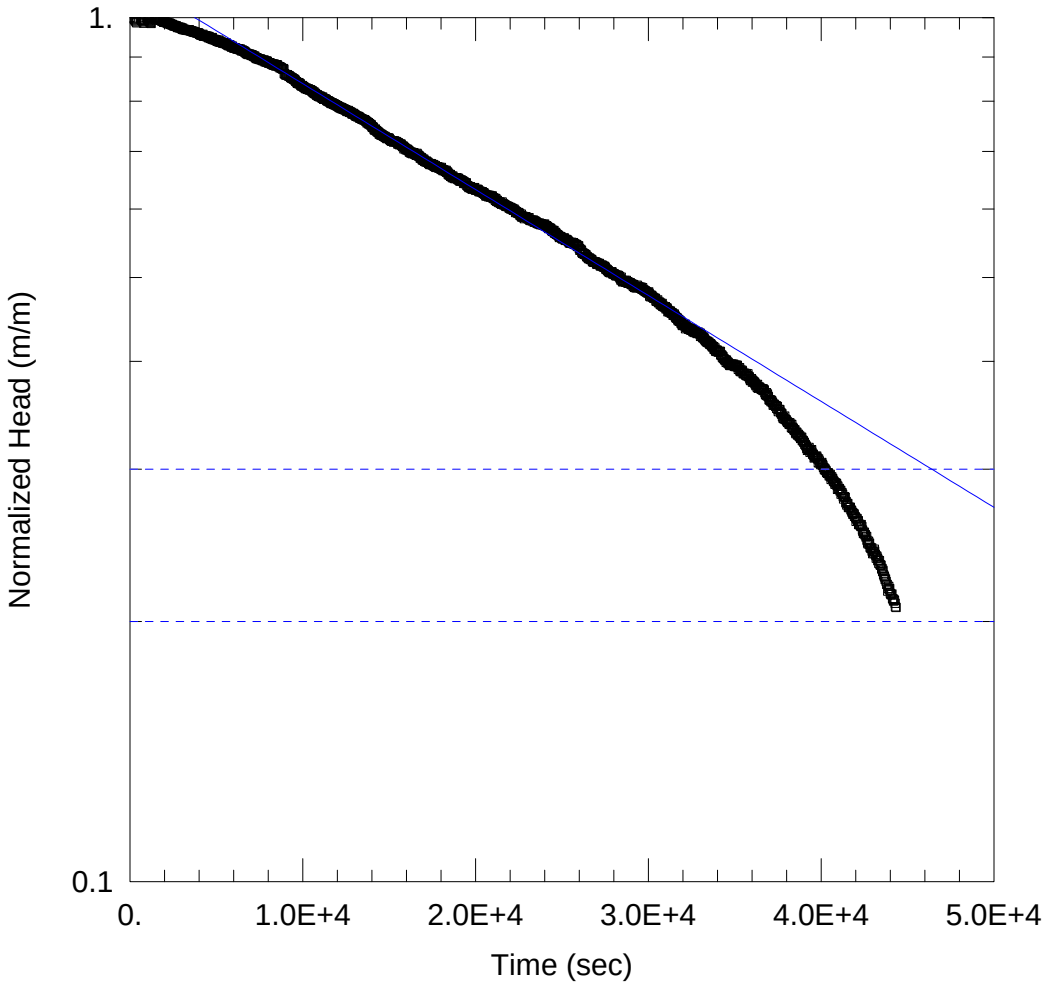
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H30
Test Date: 22 July 2013

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.792E-8 m/sec
y0 = 8.175 m




## MW-H30 (FALLING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H30
Test Date: 24 July 2013

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H30)

Initial Displacement: 0.25 m
Total Well Penetration Depth: 2.772 m
Casing Radius: 0.016 m
Static Water Column Height: 2.772 m
Screen Length: 2.772 m
Well Radius: 0.038 m
Gravel Pack Porosity: 0.

### SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.653E-9 m/sec
y0 = 0.278 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H31 (Falling Head Slug Test)
Date: 08/14/13
Time: 12:15:45

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H31

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H31

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.75 m
Static Water Column Height: 21.91 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 21.91 m

No. of Observations: 2480

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.75 | 1.686E+4 | 0.3689 |
| 1. | 0.7115 | 1.688E+4 | 0.3696 |
| 2. | 0.7329 | 1.689E+4 | 0.3692 |
| 3. | 0.7253 | 1.691E+4 | 0.3675 |
| 4. | 0.7332 | 1.692E+4 | 0.3686 |
| 5. | 0.7296 | 1.694E+4 | 0.3682 |
| 6. | 0.73 | 1.695E+4 | 0.3668 |
| 7. | 0.7321 | 1.697E+4 | 0.3675 |
| 8. | 0.7317 | 1.698E+4 | 0.3669 |
| 9. | 0.7313 | 1.7E+4 | 0.3667 |
| 10. | 0.7322 | 1.701E+4 | 0.3665 |
| 11. | 0.7322 | 1.703E+4 | 0.3649 |
| 12. | 0.7325 | 1.704E+4 | 0.3658 |
| 13. | 0.7336 | 1.706E+4 | 0.3643 |
| 14. | 0.7334 | 1.707E+4 | 0.3654 |
| 15. | 0.734 | 1.709E+4 | 0.3638 |
| 16. | 0.7331 | 1.71E+4 | 0.3648 |
| 17. | 0.7343 | 1.712E+4 | 0.3654 |
| 18. | 0.7322 | 1.713E+4 | 0.3643 |
| 19. | 0.7318 | 1.715E+4 | 0.3643 |
| 20. | 0.7336 | 1.716E+4 | 0.3641 |
| 21. | 0.7334 | 1.718E+4 | 0.363 |
| 22. | 0.7331 | 1.719E+4 | 0.3632 |
| 23. | 0.7336 | 1.721E+4 | 0.3636 |
| 24. | 0.734 | 1.722E+4 | 0.3624 |
| 25. | 0.7334 | 1.724E+4 | 0.3624 |
| 26. | 0.7329 | 1.725E+4 | 0.3621 |
| 27. | 0.7354 | 1.727E+4 | 0.3617 |
| 28. | 0.7346 | 1.728E+4 | 0.361 |
| 29. | 0.7348 | 1.73E+4 | 0.361 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 30. | 0.7342 | 1.731E+4 | 0.3597 |
| 31. | 0.7347 | 1.733E+4 | 0.361 |
| 32. | 0.7344 | 1.734E+4 | 0.3601 |
| 33. | 0.7344 | 1.736E+4 | 0.3594 |
| 34. | 0.7344 | 1.737E+4 | 0.3599 |
| 35. | 0.7346 | 1.739E+4 | 0.3583 |
| 36. | 0.7347 | 1.74E+4 | 0.3595 |
| 37. | 0.7344 | 1.742E+4 | 0.3583 |
| 38. | 0.7349 | 1.743E+4 | 0.358 |
| 39. | 0.7334 | 1.745E+4 | 0.3576 |
| 40. | 0.7348 | 1.746E+4 | 0.3572 |
| 41. | 0.7341 | 1.748E+4 | 0.3578 |
| 42. | 0.7334 | 1.749E+4 | 0.3566 |
| 43. | 0.7345 | 1.751E+4 | 0.3561 |
| 44. | 0.7348 | 1.752E+4 | 0.3558 |
| 45. | 0.7345 | 1.754E+4 | 0.3561 |
| 46. | 0.7348 | 1.755E+4 | 0.3552 |
| 47. | 0.735 | 1.757E+4 | 0.3557 |
| 48. | 0.7342 | 1.758E+4 | 0.3556 |
| 49. | 0.7347 | 1.76E+4 | 0.3545 |
| 50. | 0.7336 | 1.761E+4 | 0.3555 |
| 51. | 0.7334 | 1.763E+4 | 0.3542 |
| 52. | 0.7344 | 1.764E+4 | 0.3538 |
| 53. | 0.7336 | 1.766E+4 | 0.3533 |
| 54. | 0.735 | 1.767E+4 | 0.3514 |
| 55. | 0.7339 | 1.769E+4 | 0.3534 |
| 56. | 0.7349 | 1.77E+4 | 0.3536 |
| 57. | 0.7343 | 1.772E+4 | 0.3525 |
| 58. | 0.7345 | 1.773E+4 | 0.3522 |
| 59. | 0.7333 | 1.775E+4 | 0.3509 |
| 60. | 0.7351 | 1.776E+4 | 0.3521 |
| 61. | 0.7331 | 1.778E+4 | 0.3514 |
| 62. | 0.7341 | 1.779E+4 | 0.3499 |
| 63. | 0.7333 | 1.781E+4 | 0.3505 |
| 64. | 0.734 | 1.782E+4 | 0.3491 |
| 65. | 0.7339 | 1.784E+4 | 0.3499 |
| 66. | 0.7333 | 1.785E+4 | 0.3499 |
| 67. | 0.7343 | 1.787E+4 | 0.3483 |
| 68. | 0.7334 | 1.788E+4 | 0.3485 |
| 69. | 0.7339 | 1.79E+4 | 0.348 |
| 70. | 0.7339 | 1.791E+4 | 0.35 |
| 71. | 0.7337 | 1.793E+4 | 0.3479 |
| 72. | 0.7336 | 1.794E+4 | 0.3478 |
| 73. | 0.7344 | 1.796E+4 | 0.3473 |
| 74. | 0.7346 | 1.797E+4 | 0.3484 |
| 75. | 0.7338 | 1.799E+4 | 0.3472 |
| 76. | 0.7327 | 1.8E+4 | 0.3476 |
| 77. | 0.7333 | 1.802E+4 | 0.3456 |
| 78. | 0.7336 | 1.803E+4 | 0.3459 |
| 79. | 0.734 | 1.805E+4 | 0.3459 |
| 80. | 0.7334 | 1.806E+4 | 0.3441 |
| 81. | 0.7337 | 1.808E+4 | 0.3446 |
| 82. | 0.7343 | 1.809E+4 | 0.3448 |
| 83. | 0.7324 | 1.811E+4 | 0.3442 |
| 84. | 0.7332 | 1.812E+4 | 0.3443 |
| 85. | 0.7346 | 1.814E+4 | 0.3434 |
| 86. | 0.7333 | 1.815E+4 | 0.3431 |
| 87. | 0.7336 | 1.817E+4 | 0.3429 |
| 88. | 0.7335 | 1.818E+4 | 0.3436 |
| 89. | 0.7327 | 1.82E+4 | 0.3431 |
| 90. | 0.7339 | 1.821E+4 | 0.3421 |
| 91. | 0.7328 | 1.823E+4 | 0.342 |
| 92. | 0.7337 | 1.824E+4 | 0.3407 |
| 93. | 0.733 | 1.826E+4 | 0.3417 |
| 94. | 0.7329 | 1.827E+4 | 0.34 |
| 95. | 0.7336 | 1.829E+4 | 0.3413 |
| 96. | 0.7335 | 1.83E+4 | 0.3399 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 97. | 0.7334 | 1.832E+4 | 0.3402 |
| 98. | 0.7338 | 1.833E+4 | 0.3393 |
| 99. | 0.7329 | 1.835E+4 | 0.339 |
| 100. | 0.7334 | 1.836E+4 | 0.3391 |
| 101. | 0.7333 | 1.838E+4 | 0.3387 |
| 102. | 0.7336 | 1.839E+4 | 0.3379 |
| 103. | 0.7344 | 1.841E+4 | 0.3385 |
| 104. | 0.7336 | 1.842E+4 | 0.3379 |
| 105. | 0.7331 | 1.844E+4 | 0.3357 |
| 106. | 0.7334 | 1.845E+4 | 0.3379 |
| 107. | 0.7336 | 1.847E+4 | 0.3364 |
| 108. | 0.733 | 1.848E+4 | 0.3376 |
| 109. | 0.7337 | 1.85E+4 | 0.3371 |
| 110. | 0.733 | 1.851E+4 | 0.3362 |
| 111. | 0.7333 | 1.853E+4 | 0.3364 |
| 112. | 0.7324 | 1.854E+4 | 0.3361 |
| 113. | 0.7322 | 1.856E+4 | 0.3346 |
| 114. | 0.7328 | 1.857E+4 | 0.3359 |
| 115. | 0.7326 | 1.859E+4 | 0.3343 |
| 116. | 0.7335 | 1.86E+4 | 0.3347 |
| 117. | 0.7335 | 1.862E+4 | 0.3336 |
| 118. | 0.7323 | 1.863E+4 | 0.3333 |
| 119. | 0.7343 | 1.865E+4 | 0.3337 |
| 120. | 0.7329 | 1.866E+4 | 0.3336 |
| 121. | 0.7328 | 1.868E+4 | 0.3338 |
| 122. | 0.7336 | 1.869E+4 | 0.3328 |
| 123. | 0.7329 | 1.871E+4 | 0.3328 |
| 124. | 0.7314 | 1.872E+4 | 0.3325 |
| 138. | 0.7311 | 1.874E+4 | 0.3338 |
| 153. | 0.7298 | 1.875E+4 | 0.3308 |
| 168. | 0.7299 | 1.877E+4 | 0.3322 |
| 183. | 0.729 | 1.878E+4 | 0.3314 |
| 198. | 0.7285 | 1.88E+4 | 0.3317 |
| 213. | 0.7286 | 1.881E+4 | 0.3317 |
| 228. | 0.7283 | 1.883E+4 | 0.3312 |
| 243. | 0.7273 | 1.884E+4 | 0.3315 |
| 258. | 0.7274 | 1.886E+4 | 0.331 |
| 273. | 0.7281 | 1.887E+4 | 0.3286 |
| 288. | 0.7276 | 1.889E+4 | 0.3284 |
| 303. | 0.7273 | 1.89E+4 | 0.329 |
| 318. | 0.7267 | 1.892E+4 | 0.3293 |
| 333. | 0.7253 | 1.893E+4 | 0.3285 |
| 348. | 0.725 | 1.895E+4 | 0.3276 |
| 363. | 0.7256 | 1.896E+4 | 0.3274 |
| 378. | 0.7249 | 1.898E+4 | 0.3275 |
| 393. | 0.7253 | 1.899E+4 | 0.3262 |
| 408. | 0.7259 | 1.901E+4 | 0.3267 |
| 423. | 0.7233 | 1.902E+4 | 0.3276 |
| 438. | 0.7241 | 1.904E+4 | 0.3263 |
| 453. | 0.7236 | 1.905E+4 | 0.3261 |
| 468. | 0.722 | 1.907E+4 | 0.3245 |
| 483. | 0.7234 | 1.908E+4 | 0.3248 |
| 498. | 0.7223 | 1.91E+4 | 0.325 |
| 513. | 0.7212 | 1.911E+4 | 0.3247 |
| 528. | 0.7198 | 1.913E+4 | 0.3241 |
| 543. | 0.7213 | 1.914E+4 | 0.3244 |
| 558. | 0.7205 | 1.916E+4 | 0.3241 |
| 573. | 0.7208 | 1.917E+4 | 0.3235 |
| 588. | 0.72 | 1.919E+4 | 0.3233 |
| 603. | 0.7197 | 1.92E+4 | 0.322 |
| 618. | 0.7178 | 1.922E+4 | 0.3235 |
| 633. | 0.7179 | 1.923E+4 | 0.3224 |
| 648. | 0.7182 | 1.925E+4 | 0.322 |
| 663. | 0.7174 | 1.926E+4 | 0.3216 |
| 678. | 0.7176 | 1.928E+4 | 0.3217 |
| 693. | 0.718 | 1.929E+4 | 0.322 |
| 708. | 0.7174 | 1.931E+4 | 0.3208 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 723. | 0.7163 | 1.932E+4 | 0.3201 |
| 738. | 0.7161 | 1.934E+4 | 0.3199 |
| 753. | 0.7159 | 1.935E+4 | 0.3199 |
| 768. | 0.7153 | 1.937E+4 | 0.3197 |
| 783. | 0.715 | 1.938E+4 | 0.318 |
| 798. | 0.7138 | 1.94E+4 | 0.3191 |
| 813. | 0.7143 | 1.941E+4 | 0.3185 |
| 828. | 0.7134 | 1.943E+4 | 0.3176 |
| 843. | 0.7123 | 1.944E+4 | 0.318 |
| 858. | 0.7131 | 1.946E+4 | 0.3179 |
| 873. | 0.7125 | 1.947E+4 | 0.318 |
| 888. | 0.7111 | 1.949E+4 | 0.3175 |
| 903. | 0.7109 | 1.95E+4 | 0.3179 |
| 918. | 0.712 | 1.952E+4 | 0.3169 |
| 933. | 0.7108 | 1.953E+4 | 0.3169 |
| 948. | 0.7103 | 1.955E+4 | 0.3167 |
| 963. | 0.7115 | 1.956E+4 | 0.3163 |
| 978. | 0.7096 | 1.958E+4 | 0.3146 |
| 993. | 0.7092 | 1.959E+4 | 0.3154 |
| 1008. | 0.7093 | 1.961E+4 | 0.3147 |
| 1023. | 0.7085 | 1.962E+4 | 0.3145 |
| 1038. | 0.7092 | 1.964E+4 | 0.3143 |
| 1053. | 0.7078 | 1.965E+4 | 0.3141 |
| 1068. | 0.7076 | 1.967E+4 | 0.3141 |
| 1083. | 0.7073 | 1.968E+4 | 0.3139 |
| 1098. | 0.7065 | 1.97E+4 | 0.3134 |
| 1113. | 0.7058 | 1.971E+4 | 0.3138 |
| 1128. | 0.7064 | 1.973E+4 | 0.3137 |
| 1143. | 0.7064 | 1.974E+4 | 0.3134 |
| 1158. | 0.7058 | 1.976E+4 | 0.3131 |
| 1173. | 0.7057 | 1.977E+4 | 0.3118 |
| 1188. | 0.7058 | 1.979E+4 | 0.3123 |
| 1203. | 0.7047 | 1.98E+4 | 0.3114 |
| 1218. | 0.7042 | 1.982E+4 | 0.3103 |
| 1233. | 0.7045 | 1.983E+4 | 0.3109 |
| 1248. | 0.7034 | 1.985E+4 | 0.3102 |
| 1263. | 0.7038 | 1.986E+4 | 0.3096 |
| 1278. | 0.7033 | 1.988E+4 | 0.3096 |
| 1293. | 0.7027 | 1.989E+4 | 0.3097 |
| 1308. | 0.7028 | 1.991E+4 | 0.3089 |
| 1323. | 0.7018 | 1.992E+4 | 0.3084 |
| 1338. | 0.7021 | 1.994E+4 | 0.3079 |
| 1353. | 0.7018 | 1.995E+4 | 0.3096 |
| 1368. | 0.7004 | 1.997E+4 | 0.3072 |
| 1383. | 0.7002 | 1.998E+4 | 0.3081 |
| 1398. | 0.7009 | 2.0E+4 | 0.307 |
| 1413. | 0.7013 | 2.001E+4 | 0.3074 |
| 1428. | 0.6995 | 2.003E+4 | 0.3062 |
| 1443. | 0.6995 | 2.004E+4 | 0.3068 |
| 1458. | 0.7 | 2.006E+4 | 0.3058 |
| 1473. | 0.6986 | 2.007E+4 | 0.3053 |
| 1488. | 0.6992 | 2.009E+4 | 0.3049 |
| 1503. | 0.6986 | 2.01E+4 | 0.3049 |
| 1518. | 0.6973 | 2.012E+4 | 0.3049 |
| 1533. | 0.6976 | 2.013E+4 | 0.304 |
| 1548. | 0.6973 | 2.015E+4 | 0.3048 |
| 1563. | 0.6965 | 2.016E+4 | 0.3045 |
| 1578. | 0.6979 | 2.018E+4 | 0.3027 |
| 1593. | 0.6968 | 2.019E+4 | 0.303 |
| 1608. | 0.6953 | 2.021E+4 | 0.3025 |
| 1623. | 0.6962 | 2.022E+4 | 0.3022 |
| 1638. | 0.6954 | 2.024E+4 | 0.302 |
| 1653. | 0.6944 | 2.025E+4 | 0.3018 |
| 1668. | 0.6947 | 2.027E+4 | 0.3019 |
| 1683. | 0.6944 | 2.028E+4 | 0.302 |
| 1698. | 0.695 | 2.03E+4 | 0.3005 |
| 1713. | 0.6939 | 2.031E+4 | 0.3005 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1728. | 0.6938 | 2.033E+4 | 0.3004 |
| 1743. | 0.693 | 2.034E+4 | 0.2997 |
| 1758. | 0.6921 | 2.036E+4 | 0.3003 |
| 1773. | 0.692 | 2.037E+4 | 0.3001 |
| 1788. | 0.6927 | 2.039E+4 | 0.299 |
| 1803. | 0.6927 | 2.04E+4 | 0.2994 |
| 1818. | 0.6912 | 2.042E+4 | 0.2986 |
| 1833. | 0.6912 | 2.043E+4 | 0.2988 |
| 1848. | 0.6907 | 2.045E+4 | 0.2989 |
| 1863. | 0.6901 | 2.046E+4 | 0.2983 |
| 1878. | 0.6898 | 2.048E+4 | 0.2977 |
| 1893. | 0.6895 | 2.049E+4 | 0.2967 |
| 1908. | 0.6894 | 2.051E+4 | 0.2969 |
| 1923. | 0.6904 | 2.052E+4 | 0.2959 |
| 1938. | 0.6889 | 2.054E+4 | 0.296 |
| 1953. | 0.6887 | 2.055E+4 | 0.2954 |
| 1968. | 0.688 | 2.057E+4 | 0.2954 |
| 1983. | 0.6869 | 2.058E+4 | 0.2953 |
| 1998. | 0.6881 | 2.06E+4 | 0.2943 |
| 2013. | 0.6877 | 2.061E+4 | 0.2936 |
| 2028. | 0.6867 | 2.063E+4 | 0.2938 |
| 2043. | 0.6864 | 2.064E+4 | 0.295 |
| 2058. | 0.6865 | 2.066E+4 | 0.2931 |
| 2073. | 0.686 | 2.067E+4 | 0.2935 |
| 2088. | 0.6859 | 2.069E+4 | 0.2919 |
| 2103. | 0.6863 | 2.07E+4 | 0.2921 |
| 2118. | 0.6847 | 2.072E+4 | 0.2913 |
| 2133. | 0.6846 | 2.073E+4 | 0.2913 |
| 2148. | 0.6843 | 2.075E+4 | 0.2915 |
| 2163. | 0.6833 | 2.076E+4 | 0.2908 |
| 2178. | 0.6832 | 2.078E+4 | 0.2915 |
| 2193. | 0.6834 | 2.079E+4 | 0.2905 |
| 2208. | 0.6821 | 2.081E+4 | 0.2893 |
| 2223. | 0.6824 | 2.082E+4 | 0.2902 |
| 2238. | 0.6817 | 2.084E+4 | 0.2891 |
| 2253. | 0.6811 | 2.085E+4 | 0.2892 |
| 2268. | 0.682 | 2.087E+4 | 0.2889 |
| 2283. | 0.6808 | 2.088E+4 | 0.2893 |
| 2298. | 0.6808 | 2.09E+4 | 0.2888 |
| 2313. | 0.6802 | 2.091E+4 | 0.2879 |
| 2328. | 0.6803 | 2.093E+4 | 0.2869 |
| 2343. | 0.6788 | 2.094E+4 | 0.288 |
| 2358. | 0.6794 | 2.096E+4 | 0.2884 |
| 2373. | 0.6793 | 2.097E+4 | 0.288 |
| 2388. | 0.6783 | 2.099E+4 | 0.2868 |
| 2403. | 0.6776 | 2.1E+4 | 0.2873 |
| 2418. | 0.6774 | 2.102E+4 | 0.2857 |
| 2433. | 0.6773 | 2.103E+4 | 0.2862 |
| 2448. | 0.677 | 2.105E+4 | 0.286 |
| 2463. | 0.6772 | 2.106E+4 | 0.2852 |
| 2478. | 0.6763 | 2.108E+4 | 0.2849 |
| 2493. | 0.6757 | 2.109E+4 | 0.2848 |
| 2508. | 0.6754 | 2.111E+4 | 0.285 |
| 2523. | 0.6751 | 2.112E+4 | 0.2841 |
| 2538. | 0.6746 | 2.114E+4 | 0.2838 |
| 2553. | 0.6749 | 2.115E+4 | 0.2851 |
| 2568. | 0.6743 | 2.117E+4 | 0.2826 |
| 2583. | 0.675 | 2.118E+4 | 0.2828 |
| 2598. | 0.6736 | 2.12E+4 | 0.2825 |
| 2613. | 0.6741 | 2.121E+4 | 0.2809 |
| 2628. | 0.6732 | 2.123E+4 | 0.2819 |
| 2643. | 0.673 | 2.124E+4 | 0.2817 |
| 2658. | 0.6728 | 2.126E+4 | 0.2819 |
| 2673. | 0.6719 | 2.127E+4 | 0.2809 |
| 2688. | 0.673 | 2.129E+4 | 0.2812 |
| 2703. | 0.6719 | 2.13E+4 | 0.2792 |
| 2718. | 0.6707 | 2.132E+4 | 0.2804 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2733. | 0.6703 | 2.133E+4 | 0.2794 |
| 2748. | 0.6709 | 2.135E+4 | 0.2799 |
| 2763. | 0.6706 | 2.136E+4 | 0.2798 |
| 2778. | 0.6717 | 2.138E+4 | 0.2787 |
| 2793. | 0.67 | 2.139E+4 | 0.2789 |
| 2808. | 0.6701 | 2.141E+4 | 0.2786 |
| 2823. | 0.6701 | 2.142E+4 | 0.2768 |
| 2838. | 0.6697 | 2.144E+4 | 0.2775 |
| 2853. | 0.6686 | 2.145E+4 | 0.2764 |
| 2868. | 0.6684 | 2.147E+4 | 0.2763 |
| 2883. | 0.6678 | 2.148E+4 | 0.277 |
| 2898. | 0.6683 | 2.15E+4 | 0.2751 |
| 2913. | 0.6673 | 2.151E+4 | 0.2757 |
| 2928. | 0.6678 | 2.153E+4 | 0.2757 |
| 2943. | 0.6664 | 2.154E+4 | 0.2768 |
| 2958. | 0.6662 | 2.156E+4 | 0.2749 |
| 2973. | 0.6662 | 2.157E+4 | 0.2754 |
| 2988. | 0.6659 | 2.159E+4 | 0.2751 |
| 3003. | 0.665 | 2.16E+4 | 0.2753 |
| 3018. | 0.6644 | 2.162E+4 | 0.2748 |
| 3033. | 0.6649 | 2.163E+4 | 0.2743 |
| 3048. | 0.6643 | 2.165E+4 | 0.273 |
| 3063. | 0.664 | 2.166E+4 | 0.2738 |
| 3078. | 0.6634 | 2.168E+4 | 0.2718 |
| 3093. | 0.6626 | 2.169E+4 | 0.2719 |
| 3108. | 0.6635 | 2.171E+4 | 0.2724 |
| 3123. | 0.6623 | 2.172E+4 | 0.2727 |
| 3138. | 0.6623 | 2.174E+4 | 0.2721 |
| 3153. | 0.6619 | 2.175E+4 | 0.2715 |
| 3168. | 0.662 | 2.177E+4 | 0.2711 |
| 3183. | 0.6619 | 2.178E+4 | 0.2711 |
| 3198. | 0.6608 | 2.18E+4 | 0.2711 |
| 3213. | 0.6602 | 2.181E+4 | 0.2709 |
| 3228. | 0.6602 | 2.183E+4 | 0.2695 |
| 3243. | 0.6604 | 2.184E+4 | 0.2696 |
| 3258. | 0.6597 | 2.186E+4 | 0.269 |
| 3273. | 0.6588 | 2.187E+4 | 0.2698 |
| 3288. | 0.6588 | 2.189E+4 | 0.2685 |
| 3303. | 0.6578 | 2.19E+4 | 0.2681 |
| 3318. | 0.6581 | 2.192E+4 | 0.2683 |
| 3333. | 0.6578 | 2.193E+4 | 0.268 |
| 3348. | 0.6582 | 2.195E+4 | 0.2668 |
| 3363. | 0.6567 | 2.196E+4 | 0.2683 |
| 3378. | 0.6568 | 2.198E+4 | 0.2671 |
| 3393. | 0.6561 | 2.199E+4 | 0.2673 |
| 3408. | 0.6561 | 2.201E+4 | 0.2662 |
| 3423. | 0.6565 | 2.202E+4 | 0.2662 |
| 3438. | 0.6556 | 2.204E+4 | 0.2659 |
| 3453. | 0.6547 | 2.205E+4 | 0.2662 |
| 3468. | 0.655 | 2.207E+4 | 0.2654 |
| 3483. | 0.6547 | 2.208E+4 | 0.2655 |
| 3498. | 0.6534 | 2.21E+4 | 0.2651 |
| 3513. | 0.653 | 2.211E+4 | 0.2641 |
| 3528. | 0.653 | 2.213E+4 | 0.264 |
| 3543. | 0.6531 | 2.214E+4 | 0.2634 |
| 3558. | 0.6532 | 2.216E+4 | 0.263 |
| 3573. | 0.6521 | 2.217E+4 | 0.2638 |
| 3588. | 0.6523 | 2.219E+4 | 0.2619 |
| 3603. | 0.6508 | 2.22E+4 | 0.2618 |
| 3618. | 0.6513 | 2.222E+4 | 0.2632 |
| 3633. | 0.6509 | 2.223E+4 | 0.2612 |
| 3648. | 0.6506 | 2.225E+4 | 0.2613 |
| 3663. | 0.6501 | 2.226E+4 | 0.2618 |
| 3678. | 0.6487 | 2.228E+4 | 0.2615 |
| 3693. | 0.6498 | 2.229E+4 | 0.2609 |
| 3708. | 0.6493 | 2.231E+4 | 0.2595 |
| 3723. | 0.6486 | 2.232E+4 | 0.2589 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 3738. | 0.6492 | 2.234E+4 | 0.2594 |
| 3753. | 0.6483 | 2.235E+4 | 0.2591 |
| 3768. | 0.6484 | 2.237E+4 | 0.2587 |
| 3783. | 0.6479 | 2.238E+4 | 0.2587 |
| 3798. | 0.6471 | 2.24E+4 | 0.2586 |
| 3813. | 0.6479 | 2.241E+4 | 0.2583 |
| 3828. | 0.6464 | 2.243E+4 | 0.2578 |
| 3843. | 0.6455 | 2.244E+4 | 0.258 |
| 3858. | 0.646 | 2.246E+4 | 0.258 |
| 3873. | 0.646 | 2.247E+4 | 0.257 |
| 3888. | 0.6458 | 2.249E+4 | 0.2562 |
| 3903. | 0.6459 | 2.25E+4 | 0.2569 |
| 3918. | 0.6447 | 2.252E+4 | 0.2567 |
| 3933. | 0.6449 | 2.253E+4 | 0.256 |
| 3948. | 0.6438 | 2.255E+4 | 0.2565 |
| 3963. | 0.6444 | 2.256E+4 | 0.2554 |
| 3978. | 0.6439 | 2.258E+4 | 0.2557 |
| 3993. | 0.6436 | 2.259E+4 | 0.2547 |
| 4008. | 0.6435 | 2.261E+4 | 0.2545 |
| 4023. | 0.6431 | 2.262E+4 | 0.2538 |
| 4038. | 0.6422 | 2.264E+4 | 0.254 |
| 4053. | 0.6417 | 2.265E+4 | 0.2535 |
| 4068. | 0.6414 | 2.267E+4 | 0.2543 |
| 4083. | 0.6409 | 2.268E+4 | 0.253 |
| 4098. | 0.6405 | 2.27E+4 | 0.2529 |
| 4113. | 0.6393 | 2.271E+4 | 0.2523 |
| 4128. | 0.6397 | 2.273E+4 | 0.2528 |
| 4143. | 0.6392 | 2.274E+4 | 0.2516 |
| 4158. | 0.6395 | 2.276E+4 | 0.2518 |
| 4173. | 0.638 | 2.277E+4 | 0.2512 |
| 4188. | 0.6388 | 2.279E+4 | 0.2502 |
| 4203. | 0.6384 | 2.28E+4 | 0.2508 |
| 4218. | 0.6378 | 2.282E+4 | 0.249 |
| 4233. | 0.638 | 2.283E+4 | 0.2499 |
| 4248. | 0.6374 | 2.285E+4 | 0.2499 |
| 4263. | 0.6368 | 2.286E+4 | 0.2488 |
| 4278. | 0.6365 | 2.288E+4 | 0.2489 |
| 4293. | 0.6371 | 2.289E+4 | 0.2497 |
| 4308. | 0.636 | 2.291E+4 | 0.2485 |
| 4323. | 0.6358 | 2.292E+4 | 0.2474 |
| 4338. | 0.6356 | 2.294E+4 | 0.2487 |
| 4353. | 0.6352 | 2.295E+4 | 0.2474 |
| 4368. | 0.6346 | 2.297E+4 | 0.2467 |
| 4383. | 0.634 | 2.298E+4 | 0.2469 |
| 4398. | 0.6335 | 2.3E+4 | 0.2466 |
| 4413. | 0.6339 | 2.301E+4 | 0.2457 |
| 4428. | 0.6342 | 2.303E+4 | 0.2467 |
| 4443. | 0.6337 | 2.304E+4 | 0.2458 |
| 4458. | 0.633 | 2.306E+4 | 0.2455 |
| 4473. | 0.6318 | 2.307E+4 | 0.2449 |
| 4488. | 0.632 | 2.309E+4 | 0.2461 |
| 4503. | 0.6317 | 2.31E+4 | 0.2453 |
| 4518. | 0.6322 | 2.312E+4 | 0.2435 |
| 4533. | 0.6312 | 2.313E+4 | 0.2439 |
| 4548. | 0.6305 | 2.315E+4 | 0.244 |
| 4563. | 0.6302 | 2.316E+4 | 0.2442 |
| 4578. | 0.6298 | 2.318E+4 | 0.2441 |
| 4593. | 0.6305 | 2.319E+4 | 0.2433 |
| 4608. | 0.6298 | 2.321E+4 | 0.2426 |
| 4623. | 0.6289 | 2.322E+4 | 0.2429 |
| 4638. | 0.6294 | 2.324E+4 | 0.2379 |
| 4653. | 0.629 | 2.325E+4 | 0.242 |
| 4668. | 0.6289 | 2.327E+4 | 0.2431 |
| 4683. | 0.6274 | 2.328E+4 | 0.2423 |
| 4698. | 0.6272 | 2.33E+4 | 0.2406 |
| 4713. | 0.6277 | 2.331E+4 | 0.2417 |
| 4728. | 0.6277 | 2.333E+4 | 0.2401 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 4743. | 0.6275 | 2.334E+4 | 0.24 |
| 4758. | 0.6261 | 2.336E+4 | 0.2404 |
| 4773. | 0.6267 | 2.337E+4 | 0.2405 |
| 4788. | 0.6263 | 2.339E+4 | 0.2404 |
| 4803. | 0.6251 | 2.34E+4 | 0.2394 |
| 4818. | 0.6253 | 2.342E+4 | 0.2393 |
| 4833. | 0.6238 | 2.343E+4 | 0.2389 |
| 4848. | 0.6245 | 2.345E+4 | 0.2391 |
| 4863. | 0.6239 | 2.346E+4 | 0.2384 |
| 4878. | 0.6234 | 2.348E+4 | 0.2382 |
| 4893. | 0.6238 | 2.349E+4 | 0.2378 |
| 4908. | 0.6233 | 2.351E+4 | 0.2368 |
| 4923. | 0.6224 | 2.352E+4 | 0.2375 |
| 4938. | 0.6231 | 2.354E+4 | 0.237 |
| 4953. | 0.6228 | 2.355E+4 | 0.2372 |
| 4968. | 0.6226 | 2.357E+4 | 0.2356 |
| 4983. | 0.621 | 2.358E+4 | 0.2364 |
| 4998. | 0.6221 | 2.36E+4 | 0.2352 |
| 5013. | 0.6205 | 2.361E+4 | 0.2363 |
| 5028. | 0.6208 | 2.363E+4 | 0.234 |
| 5043. | 0.621 | 2.364E+4 | 0.2346 |
| 5058. | 0.6207 | 2.366E+4 | 0.235 |
| 5073. | 0.6197 | 2.367E+4 | 0.2339 |
| 5088. | 0.6188 | 2.369E+4 | 0.2336 |
| 5103. | 0.6181 | 2.37E+4 | 0.2338 |
| 5118. | 0.6185 | 2.372E+4 | 0.2331 |
| 5133. | 0.6178 | 2.373E+4 | 0.2327 |
| 5148. | 0.6178 | 2.375E+4 | 0.2331 |
| 5163. | 0.6173 | 2.376E+4 | 0.2329 |
| 5178. | 0.6171 | 2.378E+4 | 0.2315 |
| 5193. | 0.6169 | 2.379E+4 | 0.2308 |
| 5208. | 0.6167 | 2.381E+4 | 0.2312 |
| 5223. | 0.6159 | 2.382E+4 | 0.2322 |
| 5238. | 0.6159 | 2.384E+4 | 0.2305 |
| 5253. | 0.6152 | 2.385E+4 | 0.2312 |
| 5268. | 0.6151 | 2.387E+4 | 0.2297 |
| 5283. | 0.6141 | 2.388E+4 | 0.2298 |
| 5298. | 0.614 | 2.39E+4 | 0.2308 |
| 5313. | 0.614 | 2.391E+4 | 0.2291 |
| 5328. | 0.6143 | 2.393E+4 | 0.2287 |
| 5343. | 0.614 | 2.394E+4 | 0.2287 |
| 5358. | 0.6129 | 2.396E+4 | 0.2292 |
| 5373. | 0.6121 | 2.397E+4 | 0.2293 |
| 5388. | 0.6123 | 2.399E+4 | 0.2272 |
| 5403. | 0.6115 | 2.4E+4 | 0.2276 |
| 5418. | 0.6109 | 2.402E+4 | 0.2283 |
| 5433. | 0.6107 | 2.403E+4 | 0.2268 |
| 5448. | 0.6114 | 2.405E+4 | 0.2267 |
| 5463. | 0.6104 | 2.406E+4 | 0.2255 |
| 5478. | 0.6109 | 2.408E+4 | 0.2239 |
| 5493. | 0.6109 | 2.409E+4 | 0.2251 |
| 5508. | 0.61 | 2.411E+4 | 0.2245 |
| 5523. | 0.6106 | 2.412E+4 | 0.2249 |
| 5538. | 0.6086 | 2.414E+4 | 0.2244 |
| 5553. | 0.6081 | 2.415E+4 | 0.2239 |
| 5568. | 0.6087 | 2.417E+4 | 0.2241 |
| 5583. | 0.6072 | 2.418E+4 | 0.2237 |
| 5598. | 0.6075 | 2.42E+4 | 0.2237 |
| 5613. | 0.6072 | 2.421E+4 | 0.2217 |
| 5628. | 0.607 | 2.423E+4 | 0.2226 |
| 5643. | 0.6071 | 2.424E+4 | 0.2237 |
| 5658. | 0.606 | 2.426E+4 | 0.2224 |
| 5673. | 0.6054 | 2.427E+4 | 0.2219 |
| 5688. | 0.6047 | 2.429E+4 | 0.2216 |
| 5703. | 0.6047 | 2.43E+4 | 0.2213 |
| 5718. | 0.6049 | 2.432E+4 | 0.2219 |
| 5733. | 0.6056 | 2.433E+4 | 0.2204 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 5748. | 0.6047 | 2.435E+4 | 0.2204 |
| 5763. | 0.604 | 2.436E+4 | 0.2199 |
| 5778. | 0.6033 | 2.438E+4 | 0.2197 |
| 5793. | 0.6037 | 2.439E+4 | 0.2182 |
| 5808. | 0.6031 | 2.441E+4 | 0.2197 |
| 5823. | 0.6026 | 2.442E+4 | 0.2188 |
| 5838. | 0.6022 | 2.444E+4 | 0.2194 |
| 5853. | 0.6018 | 2.445E+4 | 0.2184 |
| 5868. | 0.6022 | 2.447E+4 | 0.2183 |
| 5883. | 0.6011 | 2.448E+4 | 0.2183 |
| 5898. | 0.6014 | 2.45E+4 | 0.2179 |
| 5913. | 0.5997 | 2.451E+4 | 0.2178 |
| 5928. | 0.6017 | 2.453E+4 | 0.2175 |
| 5943. | 0.6004 | 2.454E+4 | 0.2158 |
| 5958. | 0.5994 | 2.456E+4 | 0.2178 |
| 5973. | 0.5993 | 2.457E+4 | 0.2156 |
| 5988. | 0.5992 | 2.459E+4 | 0.2159 |
| 6003. | 0.5986 | 2.46E+4 | 0.2153 |
| 6018. | 0.5983 | 2.462E+4 | 0.2144 |
| 6033. | 0.5987 | 2.463E+4 | 0.2153 |
| 6048. | 0.598 | 2.465E+4 | 0.2139 |
| 6063. | 0.5981 | 2.466E+4 | 0.2139 |
| 6078. | 0.5966 | 2.468E+4 | 0.2137 |
| 6093. | 0.5966 | 2.469E+4 | 0.2129 |
| 6108. | 0.5964 | 2.471E+4 | 0.2133 |
| 6123. | 0.5969 | 2.472E+4 | 0.2123 |
| 6138. | 0.5961 | 2.474E+4 | 0.2128 |
| 6153. | 0.5951 | 2.475E+4 | 0.2112 |
| 6168. | 0.5951 | 2.477E+4 | 0.2121 |
| 6183. | 0.595 | 2.478E+4 | 0.2116 |
| 6198. | 0.595 | 2.48E+4 | 0.2123 |
| 6213. | 0.5945 | 2.481E+4 | 0.2123 |
| 6228. | 0.5937 | 2.483E+4 | 0.2114 |
| 6243. | 0.5936 | 2.484E+4 | 0.2104 |
| 6258. | 0.5928 | 2.486E+4 | 0.2103 |
| 6273. | 0.5937 | 2.487E+4 | 0.2097 |
| 6288. | 0.5909 | 2.489E+4 | 0.2099 |
| 6303. | 0.5919 | 2.49E+4 | 0.2092 |
| 6318. | 0.5923 | 2.492E+4 | 0.2083 |
| 6333. | 0.5915 | 2.493E+4 | 0.2084 |
| 6348. | 0.5907 | 2.495E+4 | 0.2074 |
| 6363. | 0.5903 | 2.496E+4 | 0.2075 |
| 6378. | 0.5907 | 2.498E+4 | 0.2082 |
| 6393. | 0.5898 | 2.499E+4 | 0.2085 |
| 6408. | 0.5903 | 2.501E+4 | 0.208 |
| 6423. | 0.5896 | 2.502E+4 | 0.2071 |
| 6438. | 0.589 | 2.504E+4 | 0.2074 |
| 6453. | 0.5883 | 2.505E+4 | 0.2066 |
| 6468. | 0.5889 | 2.507E+4 | 0.2067 |
| 6483. | 0.5877 | 2.508E+4 | 0.2062 |
| 6498. | 0.5874 | 2.51E+4 | 0.2057 |
| 6513. | 0.5875 | 2.511E+4 | 0.2055 |
| 6528. | 0.5869 | 2.513E+4 | 0.2057 |
| 6543. | 0.5859 | 2.514E+4 | 0.2052 |
| 6558. | 0.5865 | 2.516E+4 | 0.2059 |
| 6573. | 0.5854 | 2.517E+4 | 0.2043 |
| 6588. | 0.5855 | 2.519E+4 | 0.2046 |
| 6603. | 0.5854 | 2.52E+4 | 0.2038 |
| 6618. | 0.5843 | 2.522E+4 | 0.2027 |
| 6633. | 0.5835 | 2.523E+4 | 0.2027 |
| 6648. | 0.5842 | 2.525E+4 | 0.203 |
| 6663. | 0.5841 | 2.526E+4 | 0.2033 |
| 6678. | 0.5841 | 2.528E+4 | 0.2033 |
| 6693. | 0.5828 | 2.529E+4 | 0.2029 |
| 6708. | 0.5835 | 2.531E+4 | 0.2031 |
| 6723. | 0.5822 | 2.532E+4 | 0.2021 |
| 6738. | 0.5825 | 2.534E+4 | 0.2019 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 6753. | 0.5813 | 2.535E+4 | 0.2005 |
| 6768. | 0.5817 | 2.537E+4 | 0.2006 |
| 6783. | 0.5812 | 2.538E+4 | 0.2001 |
| 6798. | 0.5808 | 2.54E+4 | 0.2006 |
| 6813. | 0.5808 | 2.541E+4 | 0.1997 |
| 6828. | 0.5794 | 2.543E+4 | 0.1999 |
| 6843. | 0.5795 | 2.544E+4 | 0.1995 |
| 6858. | 0.5798 | 2.546E+4 | 0.1985 |
| 6873. | 0.5797 | 2.547E+4 | 0.1989 |
| 6888. | 0.5789 | 2.549E+4 | 0.1986 |
| 6903. | 0.5789 | 2.55E+4 | 0.1987 |
| 6918. | 0.5792 | 2.552E+4 | 0.1985 |
| 6933. | 0.5779 | 2.553E+4 | 0.1979 |
| 6948. | 0.5774 | 2.555E+4 | 0.1969 |
| 6963. | 0.5777 | 2.556E+4 | 0.1977 |
| 6978. | 0.5773 | 2.558E+4 | 0.1964 |
| 6993. | 0.5771 | 2.559E+4 | 0.1965 |
| 7008. | 0.5763 | 2.561E+4 | 0.1957 |
| 7023. | 0.5759 | 2.562E+4 | 0.1956 |
| 7038. | 0.5757 | 2.564E+4 | 0.1966 |
| 7053. | 0.5751 | 2.565E+4 | 0.1941 |
| 7068. | 0.5746 | 2.567E+4 | 0.1942 |
| 7083. | 0.5745 | 2.568E+4 | 0.1953 |
| 7098. | 0.5742 | 2.57E+4 | 0.1935 |
| 7113. | 0.5744 | 2.571E+4 | 0.1935 |
| 7128. | 0.5729 | 2.573E+4 | 0.1941 |
| 7143. | 0.5733 | 2.574E+4 | 0.1939 |
| 7158. | 0.5729 | 2.576E+4 | 0.1923 |
| 7173. | 0.5727 | 2.577E+4 | 0.193 |
| 7188. | 0.5714 | 2.579E+4 | 0.1923 |
| 7203. | 0.5729 | 2.58E+4 | 0.1919 |
| 7218. | 0.5721 | 2.582E+4 | 0.1912 |
| 7233. | 0.5718 | 2.583E+4 | 0.1915 |
| 7248. | 0.5707 | 2.585E+4 | 0.1902 |
| 7263. | 0.5709 | 2.586E+4 | 0.1905 |
| 7278. | 0.5688 | 2.588E+4 | 0.1909 |
| 7293. | 0.5697 | 2.589E+4 | 0.1905 |
| 7308. | 0.5692 | 2.591E+4 | 0.1897 |
| 7323. | 0.5683 | 2.592E+4 | 0.1896 |
| 7338. | 0.5693 | 2.594E+4 | 0.1878 |
| 7353. | 0.5686 | 2.595E+4 | 0.1893 |
| 7368. | 0.568 | 2.597E+4 | 0.1881 |
| 7383. | 0.5673 | 2.598E+4 | 0.1881 |
| 7398. | 0.5663 | 2.6E+4 | 0.1862 |
| 7413. | 0.5669 | 2.601E+4 | 0.1874 |
| 7428. | 0.5667 | 2.603E+4 | 0.1878 |
| 7443. | 0.5659 | 2.604E+4 | 0.1865 |
| 7458. | 0.5659 | 2.606E+4 | 0.1884 |
| 7473. | 0.5658 | 2.607E+4 | 0.1869 |
| 7488. | 0.5651 | 2.609E+4 | 0.1863 |
| 7503. | 0.5646 | 2.61E+4 | 0.1852 |
| 7518. | 0.5651 | 2.612E+4 | 0.185 |
| 7533. | 0.5633 | 2.613E+4 | 0.1862 |
| 7548. | 0.563 | 2.615E+4 | 0.1849 |
| 7563. | 0.5629 | 2.616E+4 | 0.1855 |
| 7578. | 0.5632 | 2.618E+4 | 0.1862 |
| 7593. | 0.563 | 2.619E+4 | 0.1849 |
| 7608. | 0.562 | 2.621E+4 | 0.185 |
| 7623. | 0.5615 | 2.622E+4 | 0.1831 |
| 7638. | 0.563 | 2.624E+4 | 0.1838 |
| 7653. | 0.5618 | 2.625E+4 | 0.1833 |
| 7668. | 0.561 | 2.627E+4 | 0.1834 |
| 7683. | 0.5606 | 2.628E+4 | 0.1825 |
| 7698. | 0.5597 | 2.63E+4 | 0.1817 |
| 7713. | 0.5597 | 2.631E+4 | 0.182 |
| 7728. | 0.5589 | 2.633E+4 | 0.1816 |
| 7743. | 0.5594 | 2.634E+4 | 0.1817 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 7758. | 0.5595 | 2.636E+4 | 0.1817 |
| 7773. | 0.5586 | 2.637E+4 | 0.1803 |
| 7788. | 0.5588 | 2.639E+4 | 0.1813 |
| 7803. | 0.5575 | 2.64E+4 | 0.1801 |
| 7818. | 0.557 | 2.642E+4 | 0.1787 |
| 7833. | 0.5569 | 2.643E+4 | 0.1784 |
| 7848. | 0.5576 | 2.645E+4 | 0.1784 |
| 7863. | 0.5574 | 2.646E+4 | 0.1791 |
| 7878. | 0.5561 | 2.648E+4 | 0.1782 |
| 7893. | 0.5559 | 2.649E+4 | 0.1795 |
| 7908. | 0.556 | 2.651E+4 | 0.177 |
| 7923. | 0.5557 | 2.652E+4 | 0.1763 |
| 7938. | 0.5561 | 2.654E+4 | 0.1767 |
| 7953. | 0.5542 | 2.655E+4 | 0.1764 |
| 7968. | 0.5543 | 2.657E+4 | 0.1749 |
| 7983. | 0.5538 | 2.658E+4 | 0.1756 |
| 7998. | 0.5537 | 2.66E+4 | 0.1768 |
| 8013. | 0.5538 | 2.661E+4 | 0.1751 |
| 8028. | 0.5526 | 2.663E+4 | 0.1755 |
| 8043. | 0.5527 | 2.664E+4 | 0.1748 |
| 8058. | 0.5522 | 2.666E+4 | 0.1747 |
| 8073. | 0.5513 | 2.667E+4 | 0.1738 |
| 8088. | 0.5525 | 2.669E+4 | 0.174 |
| 8103. | 0.5515 | 2.67E+4 | 0.1726 |
| 8118. | 0.5515 | 2.672E+4 | 0.1723 |
| 8133. | 0.5507 | 2.673E+4 | 0.1723 |
| 8148. | 0.5516 | 2.675E+4 | 0.1715 |
| 8163. | 0.5499 | 2.676E+4 | 0.1717 |
| 8178. | 0.5492 | 2.678E+4 | 0.1709 |
| 8193. | 0.5503 | 2.679E+4 | 0.1707 |
| 8208. | 0.5494 | 2.681E+4 | 0.1711 |
| 8223. | 0.5487 | 2.682E+4 | 0.1715 |
| 8238. | 0.549 | 2.684E+4 | 0.1703 |
| 8253. | 0.5473 | 2.685E+4 | 0.1711 |
| 8268. | 0.5481 | 2.687E+4 | 0.1695 |
| 8283. | 0.5477 | 2.688E+4 | 0.1684 |
| 8298. | 0.547 | 2.69E+4 | 0.1695 |
| 8313. | 0.5469 | 2.691E+4 | 0.1691 |
| 8328. | 0.5467 | 2.693E+4 | 0.1682 |
| 8343. | 0.5472 | 2.694E+4 | 0.1679 |
| 8358. | 0.5463 | 2.696E+4 | 0.1684 |
| 8373. | 0.5455 | 2.697E+4 | 0.1679 |
| 8388. | 0.547 | 2.699E+4 | 0.1667 |
| 8403. | 0.5449 | 2.7E+4 | 0.1685 |
| 8418. | 0.5446 | 2.702E+4 | 0.1662 |
| 8433. | 0.5439 | 2.703E+4 | 0.1666 |
| 8448. | 0.5442 | 2.705E+4 | 0.1667 |
| 8463. | 0.5433 | 2.706E+4 | 0.1664 |
| 8478. | 0.5428 | 2.708E+4 | 0.1657 |
| 8493. | 0.5428 | 2.709E+4 | 0.1649 |
| 8508. | 0.5419 | 2.711E+4 | 0.1656 |
| 8523. | 0.5416 | 2.712E+4 | 0.1655 |
| 8538. | 0.5428 | 2.714E+4 | 0.1645 |
| 8553. | 0.5418 | 2.715E+4 | 0.1643 |
| 8568. | 0.5424 | 2.717E+4 | 0.1644 |
| 8583. | 0.5405 | 2.718E+4 | 0.1638 |
| 8598. | 0.54 | 2.72E+4 | 0.1625 |
| 8613. | 0.5412 | 2.721E+4 | 0.1626 |
| 8628. | 0.5397 | 2.723E+4 | 0.1622 |
| 8643. | 0.5392 | 2.724E+4 | 0.1621 |
| 8658. | 0.5395 | 2.726E+4 | 0.1623 |
| 8673. | 0.5381 | 2.727E+4 | 0.1621 |
| 8688. | 0.5385 | 2.729E+4 | 0.1619 |
| 8703. | 0.5377 | 2.73E+4 | 0.162 |
| 8718. | 0.5374 | 2.732E+4 | 0.1604 |
| 8733. | 0.5367 | 2.733E+4 | 0.1604 |
| 8748. | 0.5374 | 2.735E+4 | 0.1606 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 8763. | 0.5373 | 2.736E+4 | 0.1599 |
| 8778. | 0.5366 | 2.738E+4 | 0.1607 |
| 8793. | 0.5367 | 2.739E+4 | 0.1593 |
| 8808. | 0.5354 | 2.741E+4 | 0.1596 |
| 8823. | 0.5364 | 2.742E+4 | 0.1585 |
| 8838. | 0.5353 | 2.744E+4 | 0.1597 |
| 8853. | 0.5355 | 2.745E+4 | 0.158 |
| 8868. | 0.5352 | 2.747E+4 | 0.1593 |
| 8883. | 0.5337 | 2.748E+4 | 0.1581 |
| 8898. | 0.5346 | 2.75E+4 | 0.1575 |
| 8913. | 0.5339 | 2.751E+4 | 0.1578 |
| 8928. | 0.5333 | 2.753E+4 | 0.1575 |
| 8943. | 0.5333 | 2.754E+4 | 0.1557 |
| 8958. | 0.5329 | 2.756E+4 | 0.1556 |
| 8973. | 0.5329 | 2.757E+4 | 0.1562 |
| 8988. | 0.5325 | 2.759E+4 | 0.1554 |
| 9003. | 0.5329 | 2.76E+4 | 0.1561 |
| 9018. | 0.5327 | 2.762E+4 | 0.1552 |
| 9033. | 0.5323 | 2.763E+4 | 0.1546 |
| 9048. | 0.5313 | 2.765E+4 | 0.1545 |
| 9063. | 0.5297 | 2.766E+4 | 0.1533 |
| 9078. | 0.5294 | 2.768E+4 | 0.1547 |
| 9093. | 0.5296 | 2.769E+4 | 0.1543 |
| 9108. | 0.5303 | 2.771E+4 | 0.1549 |
| 9123. | 0.5294 | 2.772E+4 | 0.153 |
| 9138. | 0.5295 | 2.774E+4 | 0.1532 |
| 9153. | 0.5288 | 2.775E+4 | 0.153 |
| 9168. | 0.5281 | 2.777E+4 | 0.1535 |
| 9183. | 0.5282 | 2.778E+4 | 0.1521 |
| 9198. | 0.5296 | 2.78E+4 | 0.1518 |
| 9213. | 0.5271 | 2.781E+4 | 0.1519 |
| 9228. | 0.5265 | 2.783E+4 | 0.151 |
| 9243. | 0.527 | 2.784E+4 | 0.1509 |
| 9258. | 0.5278 | 2.786E+4 | 0.15 |
| 9273. | 0.526 | 2.787E+4 | 0.1502 |
| 9288. | 0.5253 | 2.789E+4 | 0.1504 |
| 9303. | 0.5254 | 2.79E+4 | 0.1518 |
| 9318. | 0.5245 | 2.792E+4 | 0.15 |
| 9333. | 0.5239 | 2.793E+4 | 0.1496 |
| 9348. | 0.524 | 2.795E+4 | 0.1478 |
| 9363. | 0.5237 | 2.796E+4 | 0.149 |
| 9378. | 0.5241 | 2.798E+4 | 0.1489 |
| 9393. | 0.5238 | 2.799E+4 | 0.1482 |
| 9408. | 0.5225 | 2.801E+4 | 0.1489 |
| 9423. | 0.5223 | 2.802E+4 | 0.1478 |
| 9438. | 0.5223 | 2.804E+4 | 0.1484 |
| 9453. | 0.5222 | 2.805E+4 | 0.1475 |
| 9468. | 0.522 | 2.807E+4 | 0.1458 |
| 9483. | 0.5223 | 2.808E+4 | 0.1466 |
| 9498. | 0.5208 | 2.81E+4 | 0.1462 |
| 9513. | 0.5225 | 2.811E+4 | 0.1456 |
| 9528. | 0.5204 | 2.813E+4 | 0.1456 |
| 9543. | 0.5211 | 2.814E+4 | 0.1469 |
| 9558. | 0.52 | 2.816E+4 | 0.1446 |
| 9573. | 0.5197 | 2.817E+4 | 0.1447 |
| 9588. | 0.5197 | 2.819E+4 | 0.1449 |
| 9603. | 0.5185 | 2.82E+4 | 0.1433 |
| 9618. | 0.5174 | 2.822E+4 | 0.1448 |
| 9633. | 0.5185 | 2.823E+4 | 0.1446 |
| 9648. | 0.5174 | 2.825E+4 | 0.1429 |
| 9663. | 0.5178 | 2.826E+4 | 0.1429 |
| 9678. | 0.517 | 2.828E+4 | 0.1421 |
| 9693. | 0.5166 | 2.829E+4 | 0.1416 |
| 9708. | 0.5171 | 2.831E+4 | 0.1411 |
| 9723. | 0.5162 | 2.832E+4 | 0.1426 |
| 9738. | 0.5165 | 2.834E+4 | 0.142 |
| 9753. | 0.5149 | 2.835E+4 | 0.1412 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 9768. | 0.5153 | 2.837E+4 | 0.1408 |
| 9783. | 0.5157 | 2.838E+4 | 0.1413 |
| 9798. | 0.5145 | 2.84E+4 | 0.1409 |
| 9813. | 0.514 | 2.841E+4 | 0.1405 |
| 9828. | 0.5136 | 2.843E+4 | 0.1405 |
| 9843. | 0.5147 | 2.844E+4 | 0.1388 |
| 9858. | 0.5137 | 2.846E+4 | 0.1399 |
| 9873. | 0.5143 | 2.847E+4 | 0.14 |
| 9888. | 0.5123 | 2.849E+4 | 0.1393 |
| 9903. | 0.5129 | 2.85E+4 | 0.1381 |
| 9918. | 0.5123 | 2.852E+4 | 0.137 |
| 9933. | 0.5117 | 2.853E+4 | 0.1383 |
| 9948. | 0.5117 | 2.855E+4 | 0.1378 |
| 9963. | 0.5128 | 2.856E+4 | 0.1379 |
| 9978. | 0.5113 | 2.858E+4 | 0.1378 |
| 9993. | 0.5109 | 2.859E+4 | 0.1365 |
| 1.001E+4 | 0.5116 | 2.861E+4 | 0.1372 |
| 1.002E+4 | 0.5102 | 2.862E+4 | 0.1364 |
| 1.004E+4 | 0.5103 | 2.864E+4 | 0.1361 |
| 1.005E+4 | 0.5106 | 2.865E+4 | 0.1349 |
| 1.007E+4 | 0.5099 | 2.867E+4 | 0.1353 |
| 1.008E+4 | 0.5089 | 2.868E+4 | 0.1343 |
| 1.01E+4 | 0.5097 | 2.87E+4 | 0.1353 |
| 1.011E+4 | 0.5085 | 2.871E+4 | 0.1354 |
| 1.013E+4 | 0.509 | 2.873E+4 | 0.1348 |
| 1.014E+4 | 0.5078 | 2.874E+4 | 0.1343 |
| 1.016E+4 | 0.5071 | 2.876E+4 | 0.1338 |
| 1.017E+4 | 0.5085 | 2.877E+4 | 0.1341 |
| 1.019E+4 | 0.5058 | 2.879E+4 | 0.1332 |
| 1.02E+4 | 0.5063 | 2.88E+4 | 0.1343 |
| 1.022E+4 | 0.5051 | 2.882E+4 | 0.1337 |
| 1.023E+4 | 0.5057 | 2.883E+4 | 0.133 |
| 1.025E+4 | 0.5063 | 2.885E+4 | 0.1322 |
| 1.026E+4 | 0.5046 | 2.886E+4 | 0.1323 |
| 1.028E+4 | 0.5049 | 2.888E+4 | 0.1313 |
| 1.029E+4 | 0.5051 | 2.889E+4 | 0.1318 |
| 1.031E+4 | 0.5043 | 2.891E+4 | 0.1323 |
| 1.032E+4 | 0.5029 | 2.892E+4 | 0.1314 |
| 1.034E+4 | 0.5036 | 2.894E+4 | 0.1314 |
| 1.035E+4 | 0.5037 | 2.895E+4 | 0.1303 |
| 1.037E+4 | 0.5031 | 2.897E+4 | 0.1307 |
| 1.038E+4 | 0.5036 | 2.898E+4 | 0.1305 |
| 1.04E+4 | 0.502 | 2.9E+4 | 0.1293 |
| 1.041E+4 | 0.5017 | 2.901E+4 | 0.1294 |
| 1.043E+4 | 0.5012 | 2.903E+4 | 0.1295 |
| 1.044E+4 | 0.5023 | 2.904E+4 | 0.1294 |
| 1.046E+4 | 0.502 | 2.906E+4 | 0.129 |
| 1.047E+4 | 0.5012 | 2.907E+4 | 0.1282 |
| 1.049E+4 | 0.501 | 2.909E+4 | 0.1277 |
| 1.05E+4 | 0.4993 | 2.91E+4 | 0.1277 |
| 1.052E+4 | 0.4994 | 2.912E+4 | 0.1286 |
| 1.053E+4 | 0.4984 | 2.913E+4 | 0.1279 |
| 1.055E+4 | 0.4999 | 2.915E+4 | 0.128 |
| 1.056E+4 | 0.4994 | 2.916E+4 | 0.1271 |
| 1.058E+4 | 0.4973 | 2.918E+4 | 0.1266 |
| 1.059E+4 | 0.4979 | 2.919E+4 | 0.1267 |
| 1.061E+4 | 0.4985 | 2.921E+4 | 0.126 |
| 1.062E+4 | 0.4974 | 2.922E+4 | 0.1266 |
| 1.064E+4 | 0.4975 | 2.924E+4 | 0.1256 |
| 1.065E+4 | 0.4973 | 2.925E+4 | 0.125 |
| 1.067E+4 | 0.4976 | 2.927E+4 | 0.1244 |
| 1.068E+4 | 0.4967 | 2.928E+4 | 0.1243 |
| 1.07E+4 | 0.4953 | 2.93E+4 | 0.1236 |
| 1.071E+4 | 0.4962 | 2.931E+4 | 0.1243 |
| 1.073E+4 | 0.4965 | 2.933E+4 | 0.124 |
| 1.074E+4 | 0.4954 | 2.934E+4 | 0.1234 |
| 1.076E+4 | 0.4956 | 2.936E+4 | 0.1239 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.077E+4 | 0.4955 | 2.937E+4 | 0.123 |
| 1.079E+4 | 0.494 | 2.939E+4 | 0.1234 |
| 1.08E+4 | 0.4944 | 2.94E+4 | 0.1225 |
| 1.082E+4 | 0.4934 | 2.942E+4 | 0.1219 |
| 1.083E+4 | 0.4939 | 2.943E+4 | 0.1233 |
| 1.085E+4 | 0.4925 | 2.945E+4 | 0.1214 |
| 1.086E+4 | 0.4929 | 2.946E+4 | 0.1212 |
| 1.088E+4 | 0.4921 | 2.948E+4 | 0.1214 |
| 1.089E+4 | 0.4925 | 2.949E+4 | 0.1204 |
| 1.091E+4 | 0.4918 | 2.951E+4 | 0.1204 |
| 1.092E+4 | 0.4911 | 2.952E+4 | 0.1203 |
| 1.094E+4 | 0.4915 | 2.954E+4 | 0.1198 |
| 1.095E+4 | 0.4909 | 2.955E+4 | 0.1206 |
| 1.097E+4 | 0.4904 | 2.957E+4 | 0.1198 |
| 1.098E+4 | 0.4896 | 2.958E+4 | 0.1189 |
| 1.1E+4 | 0.4893 | 2.96E+4 | 0.1194 |
| 1.101E+4 | 0.4891 | 2.961E+4 | 0.1182 |
| 1.103E+4 | 0.4888 | 2.963E+4 | 0.1185 |
| 1.104E+4 | 0.4886 | 2.964E+4 | 0.1178 |
| 1.106E+4 | 0.4884 | 2.966E+4 | 0.1174 |
| 1.107E+4 | 0.4891 | 2.967E+4 | 0.1158 |
| 1.109E+4 | 0.4883 | 2.969E+4 | 0.117 |
| 1.11E+4 | 0.4879 | 2.97E+4 | 0.117 |
| 1.112E+4 | 0.4879 | 2.972E+4 | 0.1167 |
| 1.113E+4 | 0.4872 | 2.973E+4 | 0.1162 |
| 1.115E+4 | 0.4871 | 2.975E+4 | 0.116 |
| 1.116E+4 | 0.4868 | 2.976E+4 | 0.1151 |
| 1.118E+4 | 0.486 | 2.978E+4 | 0.1148 |
| 1.119E+4 | 0.4849 | 2.979E+4 | 0.1145 |
| 1.121E+4 | 0.4858 | 2.981E+4 | 0.1147 |
| 1.122E+4 | 0.4848 | 2.982E+4 | 0.1142 |
| 1.124E+4 | 0.4853 | 2.984E+4 | 0.1135 |
| 1.125E+4 | 0.4846 | 2.985E+4 | 0.1136 |
| 1.127E+4 | 0.4831 | 2.987E+4 | 0.1132 |
| 1.128E+4 | 0.484 | 2.988E+4 | 0.1138 |
| 1.13E+4 | 0.4817 | 2.99E+4 | 0.1129 |
| 1.131E+4 | 0.4829 | 2.991E+4 | 0.1132 |
| 1.133E+4 | 0.4838 | 2.993E+4 | 0.1126 |
| 1.134E+4 | 0.482 | 2.994E+4 | 0.1113 |
| 1.136E+4 | 0.4826 | 2.996E+4 | 0.1114 |
| 1.137E+4 | 0.4829 | 2.997E+4 | 0.1108 |
| 1.139E+4 | 0.4827 | 2.999E+4 | 0.111 |
| 1.14E+4 | 0.4814 | 3.0E+4 | 0.1109 |
| 1.142E+4 | 0.4821 | 3.002E+4 | 0.1113 |
| 1.143E+4 | 0.4804 | 3.003E+4 | 0.1089 |
| 1.145E+4 | 0.4805 | 3.005E+4 | 0.1095 |
| 1.146E+4 | 0.4803 | 3.006E+4 | 0.1092 |
| 1.148E+4 | 0.4813 | 3.008E+4 | 0.1093 |
| 1.149E+4 | 0.48 | 3.009E+4 | 0.1088 |
| 1.151E+4 | 0.4806 | 3.011E+4 | 0.1094 |
| 1.152E+4 | 0.4804 | 3.012E+4 | 0.1088 |
| 1.154E+4 | 0.4795 | 3.014E+4 | 0.1079 |
| 1.155E+4 | 0.477 | 3.015E+4 | 0.1072 |
| 1.157E+4 | 0.4783 | 3.017E+4 | 0.1084 |
| 1.158E+4 | 0.4762 | 3.018E+4 | 0.1074 |
| 1.16E+4 | 0.4773 | 3.02E+4 | 0.1072 |
| 1.161E+4 | 0.4766 | 3.021E+4 | 0.107 |
| 1.163E+4 | 0.4778 | 3.023E+4 | 0.1065 |
| 1.164E+4 | 0.4757 | 3.024E+4 | 0.1065 |
| 1.166E+4 | 0.4769 | 3.026E+4 | 0.1061 |
| 1.167E+4 | 0.4754 | 3.027E+4 | 0.1063 |
| 1.169E+4 | 0.4756 | 3.029E+4 | 0.1049 |
| 1.17E+4 | 0.4754 | 3.03E+4 | 0.1055 |
| 1.172E+4 | 0.4765 | 3.032E+4 | 0.1036 |
| 1.173E+4 | 0.4746 | 3.033E+4 | 0.1041 |
| 1.175E+4 | 0.4735 | 3.035E+4 | 0.1039 |
| 1.176E+4 | 0.4741 | 3.036E+4 | 0.103 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.178E+4 | 0.4725 | 3.038E+4 | 0.104 |
| 1.179E+4 | 0.474 | 3.039E+4 | 0.1033 |
| 1.181E+4 | 0.4733 | 3.041E+4 | 0.1031 |
| 1.182E+4 | 0.472 | 3.042E+4 | 0.1022 |
| 1.184E+4 | 0.4728 | 3.044E+4 | 0.1018 |
| 1.185E+4 | 0.4722 | 3.045E+4 | 0.1013 |
| 1.187E+4 | 0.4718 | 3.047E+4 | 0.1006 |
| 1.188E+4 | 0.4703 | 3.048E+4 | 0.1005 |
| 1.19E+4 | 0.4721 | 3.05E+4 | 0.1004 |
| 1.191E+4 | 0.4699 | 3.051E+4 | 0.1001 |
| 1.193E+4 | 0.4714 | 3.053E+4 | 0.1004 |
| 1.194E+4 | 0.4704 | 3.054E+4 | 0.0998 |
| 1.196E+4 | 0.467 | 3.056E+4 | 0.1002 |
| 1.197E+4 | 0.4688 | 3.057E+4 | 0.1001 |
| 1.199E+4 | 0.4685 | 3.059E+4 | 0.0996 |
| 1.2E+4 | 0.4689 | 3.06E+4 | 0.0985 |
| 1.202E+4 | 0.4684 | 3.062E+4 | 0.098 |
| 1.203E+4 | 0.4685 | 3.063E+4 | 0.0978 |
| 1.205E+4 | 0.4677 | 3.065E+4 | 0.098 |
| 1.206E+4 | 0.4679 | 3.066E+4 | 0.0969 |
| 1.208E+4 | 0.4671 | 3.068E+4 | 0.0967 |
| 1.209E+4 | 0.4669 | 3.069E+4 | 0.0974 |
| 1.211E+4 | 0.466 | 3.071E+4 | 0.0971 |
| 1.212E+4 | 0.4663 | 3.072E+4 | 0.0968 |
| 1.214E+4 | 0.4653 | 3.074E+4 | 0.0954 |
| 1.215E+4 | 0.4664 | 3.075E+4 | 0.0962 |
| 1.217E+4 | 0.4657 | 3.077E+4 | 0.0949 |
| 1.218E+4 | 0.4655 | 3.078E+4 | 0.0949 |
| 1.22E+4 | 0.4651 | 3.08E+4 | 0.0949 |
| 1.221E+4 | 0.4644 | 3.081E+4 | 0.0943 |
| 1.223E+4 | 0.4637 | 3.083E+4 | 0.0949 |
| 1.224E+4 | 0.4633 | 3.084E+4 | 0.0942 |
| 1.226E+4 | 0.4642 | 3.086E+4 | 0.094 |
| 1.227E+4 | 0.4642 | 3.087E+4 | 0.0937 |
| 1.229E+4 | 0.4627 | 3.089E+4 | 0.0937 |
| 1.23E+4 | 0.4622 | 3.09E+4 | 0.0921 |
| 1.232E+4 | 0.4621 | 3.092E+4 | 0.0922 |
| 1.233E+4 | 0.4616 | 3.093E+4 | 0.0924 |
| 1.235E+4 | 0.463 | 3.095E+4 | 0.0911 |
| 1.236E+4 | 0.46 | 3.096E+4 | 0.0914 |
| 1.238E+4 | 0.4632 | 3.098E+4 | 0.0919 |
| 1.239E+4 | 0.4589 | 3.099E+4 | 0.0924 |
| 1.241E+4 | 0.4602 | 3.101E+4 | 0.0914 |
| 1.242E+4 | 0.4599 | 3.102E+4 | 0.0914 |
| 1.244E+4 | 0.459 | 3.104E+4 | 0.091 |
| 1.245E+4 | 0.4589 | 3.105E+4 | 0.0899 |
| 1.247E+4 | 0.4576 | 3.107E+4 | 0.09 |
| 1.248E+4 | 0.4576 | 3.108E+4 | 0.0902 |
| 1.25E+4 | 0.458 | 3.11E+4 | 0.0885 |
| 1.251E+4 | 0.4569 | 3.111E+4 | 0.0894 |
| 1.253E+4 | 0.458 | 3.113E+4 | 0.0894 |
| 1.254E+4 | 0.4562 | 3.114E+4 | 0.0882 |
| 1.256E+4 | 0.4571 | 3.116E+4 | 0.0881 |
| 1.257E+4 | 0.4565 | 3.117E+4 | 0.0879 |
| 1.259E+4 | 0.457 | 3.119E+4 | 0.0875 |
| 1.26E+4 | 0.4549 | 3.12E+4 | 0.0871 |
| 1.262E+4 | 0.4542 | 3.122E+4 | 0.0864 |
| 1.263E+4 | 0.4545 | 3.123E+4 | 0.0871 |
| 1.265E+4 | 0.4549 | 3.125E+4 | 0.0871 |
| 1.266E+4 | 0.454 | 3.126E+4 | 0.0866 |
| 1.268E+4 | 0.4548 | 3.128E+4 | 0.0863 |
| 1.269E+4 | 0.4542 | 3.129E+4 | 0.0845 |
| 1.271E+4 | 0.4539 | 3.131E+4 | 0.0848 |
| 1.272E+4 | 0.4547 | 3.132E+4 | 0.0854 |
| 1.274E+4 | 0.4529 | 3.134E+4 | 0.0848 |
| 1.275E+4 | 0.4527 | 3.135E+4 | 0.0842 |
| 1.277E+4 | 0.4516 | 3.137E+4 | 0.0839 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.278E+4 | 0.4507 | 3.138E+4 | 0.0834 |
| 1.28E+4 | 0.452 | 3.14E+4 | 0.0833 |
| 1.281E+4 | 0.4501 | 3.141E+4 | 0.0833 |
| 1.283E+4 | 0.45 | 3.143E+4 | 0.0823 |
| 1.284E+4 | 0.4499 | 3.144E+4 | 0.0824 |
| 1.286E+4 | 0.4516 | 3.146E+4 | 0.082 |
| 1.287E+4 | 0.451 | 3.147E+4 | 0.0824 |
| 1.289E+4 | 0.4506 | 3.149E+4 | 0.0817 |
| 1.29E+4 | 0.4502 | 3.15E+4 | 0.0814 |
| 1.292E+4 | 0.4494 | 3.152E+4 | 0.0805 |
| 1.293E+4 | 0.4503 | 3.153E+4 | 0.0812 |
| 1.295E+4 | 0.4484 | 3.155E+4 | 0.0803 |
| 1.296E+4 | 0.4477 | 3.156E+4 | 0.0803 |
| 1.298E+4 | 0.4481 | 3.158E+4 | 0.0806 |
| 1.299E+4 | 0.4475 | 3.159E+4 | 0.0795 |
| 1.301E+4 | 0.4461 | 3.161E+4 | 0.0792 |
| 1.302E+4 | 0.4475 | 3.162E+4 | 0.0784 |
| 1.304E+4 | 0.4472 | 3.164E+4 | 0.0795 |
| 1.305E+4 | 0.4458 | 3.165E+4 | 0.0783 |
| 1.307E+4 | 0.4467 | 3.167E+4 | 0.0776 |
| 1.308E+4 | 0.4458 | 3.168E+4 | 0.0772 |
| 1.31E+4 | 0.4459 | 3.17E+4 | 0.078 |
| 1.311E+4 | 0.4443 | 3.171E+4 | 0.0772 |
| 1.313E+4 | 0.4448 | 3.173E+4 | 0.0771 |
| 1.314E+4 | 0.444 | 3.174E+4 | 0.077 |
| 1.316E+4 | 0.4438 | 3.176E+4 | 0.077 |
| 1.317E+4 | 0.4439 | 3.177E+4 | 0.0763 |
| 1.319E+4 | 0.4431 | 3.179E+4 | 0.0759 |
| 1.32E+4 | 0.4423 | 3.18E+4 | 0.0762 |
| 1.322E+4 | 0.4434 | 3.182E+4 | 0.0744 |
| 1.323E+4 | 0.4425 | 3.183E+4 | 0.0752 |
| 1.325E+4 | 0.4428 | 3.185E+4 | 0.0751 |
| 1.326E+4 | 0.442 | 3.186E+4 | 0.0744 |
| 1.328E+4 | 0.4415 | 3.188E+4 | 0.0752 |
| 1.329E+4 | 0.4419 | 3.189E+4 | 0.0738 |
| 1.331E+4 | 0.4395 | 3.191E+4 | 0.0738 |
| 1.332E+4 | 0.4406 | 3.192E+4 | 0.0729 |
| 1.334E+4 | 0.441 | 3.194E+4 | 0.0728 |
| 1.335E+4 | 0.4392 | 3.195E+4 | 0.0732 |
| 1.337E+4 | 0.4403 | 3.197E+4 | 0.0725 |
| 1.338E+4 | 0.4395 | 3.198E+4 | 0.0722 |
| 1.34E+4 | 0.4383 | 3.2E+4 | 0.0721 |
| 1.341E+4 | 0.437 | 3.201E+4 | 0.072 |
| 1.343E+4 | 0.4383 | 3.203E+4 | 0.0725 |
| 1.344E+4 | 0.4371 | 3.204E+4 | 0.0715 |
| 1.346E+4 | 0.4376 | 3.206E+4 | 0.0705 |
| 1.347E+4 | 0.4374 | 3.207E+4 | 0.0707 |
| 1.349E+4 | 0.435 | 3.209E+4 | 0.0706 |
| 1.35E+4 | 0.4367 | 3.21E+4 | 0.0705 |
| 1.352E+4 | 0.4374 | 3.212E+4 | 0.0702 |
| 1.353E+4 | 0.4358 | 3.213E+4 | 0.0694 |
| 1.355E+4 | 0.436 | 3.215E+4 | 0.0691 |
| 1.356E+4 | 0.4337 | 3.216E+4 | 0.07 |
| 1.358E+4 | 0.4353 | 3.218E+4 | 0.0683 |
| 1.359E+4 | 0.4341 | 3.219E+4 | 0.0679 |
| 1.361E+4 | 0.4352 | 3.221E+4 | 0.0676 |
| 1.362E+4 | 0.4346 | 3.222E+4 | 0.0682 |
| 1.364E+4 | 0.4335 | 3.224E+4 | 0.0672 |
| 1.365E+4 | 0.4325 | 3.225E+4 | 0.0666 |
| 1.367E+4 | 0.4333 | 3.227E+4 | 0.0673 |
| 1.368E+4 | 0.4326 | 3.228E+4 | 0.0675 |
| 1.37E+4 | 0.4318 | 3.23E+4 | 0.067 |
| 1.371E+4 | 0.4318 | 3.231E+4 | 0.0673 |
| 1.373E+4 | 0.431 | 3.233E+4 | 0.065 |
| 1.374E+4 | 0.4305 | 3.234E+4 | 0.0662 |
| 1.376E+4 | 0.4301 | 3.236E+4 | 0.0658 |
| 1.377E+4 | 0.431 | 3.237E+4 | 0.0654 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.379E+4 | 0.4309 | 3.239E+4 | 0.0654 |
| 1.38E+4 | 0.4307 | 3.24E+4 | 0.0654 |
| 1.382E+4 | 0.4299 | 3.242E+4 | 0.0647 |
| 1.383E+4 | 0.4274 | 3.243E+4 | 0.0655 |
| 1.385E+4 | 0.4285 | 3.245E+4 | 0.0654 |
| 1.386E+4 | 0.4288 | 3.246E+4 | 0.0653 |
| 1.388E+4 | 0.4284 | 3.248E+4 | 0.0644 |
| 1.389E+4 | 0.4288 | 3.249E+4 | 0.0636 |
| 1.391E+4 | 0.4282 | 3.251E+4 | 0.0632 |
| 1.392E+4 | 0.4283 | 3.252E+4 | 0.0635 |
| 1.394E+4 | 0.4265 | 3.254E+4 | 0.0627 |
| 1.395E+4 | 0.4261 | 3.255E+4 | 0.0629 |
| 1.397E+4 | 0.4268 | 3.257E+4 | 0.0622 |
| 1.398E+4 | 0.4259 | 3.258E+4 | 0.0622 |
| 1.4E+4 | 0.4271 | 3.26E+4 | 0.063 |
| 1.401E+4 | 0.4253 | 3.261E+4 | 0.0619 |
| 1.403E+4 | 0.4258 | 3.263E+4 | 0.0619 |
| 1.404E+4 | 0.4256 | 3.264E+4 | 0.0616 |
| 1.406E+4 | 0.4244 | 3.266E+4 | 0.0608 |
| 1.407E+4 | 0.4246 | 3.267E+4 | 0.0604 |
| 1.409E+4 | 0.4237 | 3.269E+4 | 0.0611 |
| 1.41E+4 | 0.4243 | 3.27E+4 | 0.0609 |
| 1.412E+4 | 0.4239 | 3.272E+4 | 0.0599 |
| 1.413E+4 | 0.4239 | 3.273E+4 | 0.0599 |
| 1.415E+4 | 0.4232 | 3.275E+4 | 0.0589 |
| 1.416E+4 | 0.4234 | 3.276E+4 | 0.0591 |
| 1.418E+4 | 0.4233 | 3.278E+4 | 0.0591 |
| 1.419E+4 | 0.4226 | 3.279E+4 | 0.0591 |
| 1.421E+4 | 0.4225 | 3.281E+4 | 0.0586 |
| 1.422E+4 | 0.4219 | 3.282E+4 | 0.0582 |
| 1.424E+4 | 0.4212 | 3.284E+4 | 0.0582 |
| 1.425E+4 | 0.4214 | 3.285E+4 | 0.0572 |
| 1.427E+4 | 0.4216 | 3.287E+4 | 0.0578 |
| 1.428E+4 | 0.4215 | 3.288E+4 | 0.0574 |
| 1.43E+4 | 0.4209 | 3.29E+4 | 0.0571 |
| 1.431E+4 | 0.4204 | 3.291E+4 | 0.0563 |
| 1.433E+4 | 0.4202 | 3.293E+4 | 0.0562 |
| 1.434E+4 | 0.419 | 3.294E+4 | 0.0563 |
| 1.436E+4 | 0.4193 | 3.296E+4 | 0.0561 |
| 1.437E+4 | 0.4193 | 3.297E+4 | 0.0559 |
| 1.439E+4 | 0.4187 | 3.299E+4 | 0.0552 |
| 1.44E+4 | 0.4201 | 3.3E+4 | 0.0547 |
| 1.442E+4 | 0.4177 | 3.302E+4 | 0.0543 |
| 1.443E+4 | 0.4183 | 3.303E+4 | 0.0549 |
| 1.445E+4 | 0.4169 | 3.305E+4 | 0.0547 |
| 1.446E+4 | 0.4163 | 3.306E+4 | 0.0534 |
| 1.448E+4 | 0.4174 | 3.308E+4 | 0.0541 |
| 1.449E+4 | 0.4168 | 3.309E+4 | 0.0541 |
| 1.451E+4 | 0.4159 | 3.311E+4 | 0.0534 |
| 1.452E+4 | 0.417 | 3.312E+4 | 0.0534 |
| 1.454E+4 | 0.4157 | 3.314E+4 | 0.0521 |
| 1.455E+4 | 0.4156 | 3.315E+4 | 0.0518 |
| 1.457E+4 | 0.4153 | 3.317E+4 | 0.0525 |
| 1.458E+4 | 0.4135 | 3.318E+4 | 0.0516 |
| 1.46E+4 | 0.4137 | 3.32E+4 | 0.0513 |
| 1.461E+4 | 0.4151 | 3.321E+4 | 0.0517 |
| 1.463E+4 | 0.4133 | 3.323E+4 | 0.0522 |
| 1.464E+4 | 0.4131 | 3.324E+4 | 0.0514 |
| 1.466E+4 | 0.4134 | 3.326E+4 | 0.0503 |
| 1.467E+4 | 0.4142 | 3.327E+4 | 0.0495 |
| 1.469E+4 | 0.4132 | 3.329E+4 | 0.0493 |
| 1.47E+4 | 0.413 | 3.33E+4 | 0.0493 |
| 1.472E+4 | 0.4133 | 3.332E+4 | 0.0492 |
| 1.473E+4 | 0.4126 | 3.333E+4 | 0.0487 |
| 1.475E+4 | 0.4108 | 3.335E+4 | 0.0484 |
| 1.476E+4 | 0.4116 | 3.336E+4 | 0.0484 |
| 1.478E+4 | 0.4105 | 3.338E+4 | 0.0484 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.479E+4 | 0.4103 | 3.339E+4 | 0.0471 |
| 1.481E+4 | 0.4104 | 3.341E+4 | 0.0473 |
| 1.482E+4 | 0.4104 | 3.342E+4 | 0.047 |
| 1.484E+4 | 0.4103 | 3.344E+4 | 0.0469 |
| 1.485E+4 | 0.4102 | 3.345E+4 | 0.0462 |
| 1.487E+4 | 0.4092 | 3.347E+4 | 0.0466 |
| 1.488E+4 | 0.4089 | 3.348E+4 | 0.0467 |
| 1.49E+4 | 0.4086 | 3.35E+4 | 0.0459 |
| 1.491E+4 | 0.4088 | 3.351E+4 | 0.045 |
| 1.493E+4 | 0.4072 | 3.353E+4 | 0.0461 |
| 1.494E+4 | 0.4085 | 3.354E+4 | 0.0448 |
| 1.496E+4 | 0.4078 | 3.356E+4 | 0.0456 |
| 1.497E+4 | 0.407 | 3.357E+4 | 0.0444 |
| 1.499E+4 | 0.4069 | 3.359E+4 | 0.045 |
| 1.5E+4 | 0.4064 | 3.36E+4 | 0.0445 |
| 1.502E+4 | 0.4063 | 3.362E+4 | 0.0434 |
| 1.503E+4 | 0.4064 | 3.363E+4 | 0.0438 |
| 1.505E+4 | 0.4065 | 3.365E+4 | 0.0437 |
| 1.506E+4 | 0.405 | 3.366E+4 | 0.0431 |
| 1.508E+4 | 0.4053 | 3.368E+4 | 0.0425 |
| 1.509E+4 | 0.4045 | 3.369E+4 | 0.0426 |
| 1.511E+4 | 0.4047 | 3.371E+4 | 0.0409 |
| 1.512E+4 | 0.4028 | 3.372E+4 | 0.0414 |
| 1.514E+4 | 0.4034 | 3.374E+4 | 0.0423 |
| 1.515E+4 | 0.4038 | 3.375E+4 | 0.0415 |
| 1.517E+4 | 0.4027 | 3.377E+4 | 0.0407 |
| 1.518E+4 | 0.4037 | 3.378E+4 | 0.0405 |
| 1.52E+4 | 0.4036 | 3.38E+4 | 0.0417 |
| 1.521E+4 | 0.4019 | 3.381E+4 | 0.0404 |
| 1.523E+4 | 0.4011 | 3.383E+4 | 0.0407 |
| 1.524E+4 | 0.4012 | 3.384E+4 | 0.0391 |
| 1.526E+4 | 0.4025 | 3.386E+4 | 0.0401 |
| 1.527E+4 | 0.4011 | 3.387E+4 | 0.0391 |
| 1.529E+4 | 0.4011 | 3.389E+4 | 0.0398 |
| 1.53E+4 | 0.4013 | 3.39E+4 | 0.038 |
| 1.532E+4 | 0.4016 | 3.392E+4 | 0.0384 |
| 1.533E+4 | 0.4007 | 3.393E+4 | 0.0376 |
| 1.535E+4 | 0.3985 | 3.395E+4 | 0.037 |
| 1.536E+4 | 0.3993 | 3.396E+4 | 0.0369 |
| 1.538E+4 | 0.3993 | 3.398E+4 | 0.0372 |
| 1.539E+4 | 0.3998 | 3.399E+4 | 0.0376 |
| 1.541E+4 | 0.3986 | 3.401E+4 | 0.0362 |
| 1.542E+4 | 0.3988 | 3.402E+4 | 0.0367 |
| 1.544E+4 | 0.3981 | 3.404E+4 | 0.0357 |
| 1.545E+4 | 0.3983 | 3.405E+4 | 0.0356 |
| 1.547E+4 | 0.3976 | 3.407E+4 | 0.0364 |
| 1.548E+4 | 0.3983 | 3.408E+4 | 0.0354 |
| 1.55E+4 | 0.3968 | 3.41E+4 | 0.0354 |
| 1.551E+4 | 0.3971 | 3.411E+4 | 0.0353 |
| 1.553E+4 | 0.3953 | 3.413E+4 | 0.0348 |
| 1.554E+4 | 0.396 | 3.414E+4 | 0.0341 |
| 1.556E+4 | 0.3954 | 3.416E+4 | 0.0342 |
| 1.557E+4 | 0.3943 | 3.417E+4 | 0.0338 |
| 1.559E+4 | 0.395 | 3.419E+4 | 0.0335 |
| 1.56E+4 | 0.3954 | 3.42E+4 | 0.0326 |
| 1.562E+4 | 0.3937 | 3.422E+4 | 0.0327 |
| 1.563E+4 | 0.3941 | 3.423E+4 | 0.0326 |
| 1.565E+4 | 0.3938 | 3.425E+4 | 0.0314 |
| 1.566E+4 | 0.3936 | 3.426E+4 | 0.0322 |
| 1.568E+4 | 0.3937 | 3.428E+4 | 0.0316 |
| 1.569E+4 | 0.393 | 3.429E+4 | 0.0309 |
| 1.571E+4 | 0.3928 | 3.431E+4 | 0.0308 |
| 1.572E+4 | 0.3925 | 3.432E+4 | 0.0306 |
| 1.574E+4 | 0.3916 | 3.434E+4 | 0.0306 |
| 1.575E+4 | 0.3911 | 3.435E+4 | 0.0305 |
| 1.577E+4 | 0.3911 | 3.437E+4 | 0.0296 |
| 1.578E+4 | 0.3897 | 3.438E+4 | 0.0302 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.58E+4 | 0.3905 | 3.44E+4 | 0.0286 |
| 1.581E+4 | 0.3905 | 3.441E+4 | 0.0292 |
| 1.583E+4 | 0.3903 | 3.443E+4 | 0.0285 |
| 1.584E+4 | 0.3898 | 3.444E+4 | 0.029 |
| 1.586E+4 | 0.3902 | 3.446E+4 | 0.0283 |
| 1.587E+4 | 0.3883 | 3.447E+4 | 0.0281 |
| 1.589E+4 | 0.3896 | 3.449E+4 | 0.0273 |
| 1.59E+4 | 0.389 | 3.45E+4 | 0.0281 |
| 1.592E+4 | 0.3886 | 3.452E+4 | 0.0276 |
| 1.593E+4 | 0.3888 | 3.453E+4 | 0.0262 |
| 1.595E+4 | 0.3889 | 3.455E+4 | 0.0261 |
| 1.596E+4 | 0.3883 | 3.456E+4 | 0.0263 |
| 1.598E+4 | 0.3874 | 3.458E+4 | 0.0262 |
| 1.599E+4 | 0.387 | 3.459E+4 | 0.0264 |
| 1.601E+4 | 0.3873 | 3.461E+4 | 0.0258 |
| 1.602E+4 | 0.3853 | 3.462E+4 | 0.0254 |
| 1.604E+4 | 0.3848 | 3.464E+4 | 0.025 |
| 1.605E+4 | 0.3855 | 3.465E+4 | 0.0257 |
| 1.607E+4 | 0.3853 | 3.467E+4 | 0.0244 |
| 1.608E+4 | 0.3853 | 3.468E+4 | 0.0248 |
| 1.61E+4 | 0.3846 | 3.47E+4 | 0.0236 |
| 1.611E+4 | 0.385 | 3.471E+4 | 0.023 |
| 1.613E+4 | 0.3833 | 3.473E+4 | 0.0235 |
| 1.614E+4 | 0.3839 | 3.474E+4 | 0.0227 |
| 1.616E+4 | 0.3836 | 3.476E+4 | 0.0232 |
| 1.617E+4 | 0.3822 | 3.477E+4 | 0.0219 |
| 1.619E+4 | 0.3828 | 3.479E+4 | 0.0228 |
| 1.62E+4 | 0.3825 | 3.48E+4 | 0.0225 |
| 1.622E+4 | 0.3822 | 3.482E+4 | 0.0219 |
| 1.623E+4 | 0.3821 | 3.483E+4 | 0.0207 |
| 1.625E+4 | 0.3815 | 3.485E+4 | 0.0204 |
| 1.626E+4 | 0.3814 | 3.486E+4 | 0.022 |
| 1.628E+4 | 0.3813 | 3.488E+4 | 0.0213 |
| 1.629E+4 | 0.3815 | 3.489E+4 | 0.021 |
| 1.631E+4 | 0.3796 | 3.491E+4 | 0.0201 |
| 1.632E+4 | 0.3803 | 3.492E+4 | 0.0191 |
| 1.634E+4 | 0.3796 | 3.494E+4 | 0.0202 |
| 1.635E+4 | 0.3798 | 3.495E+4 | 0.0189 |
| 1.637E+4 | 0.38 | 3.497E+4 | 0.0189 |
| 1.638E+4 | 0.3788 | 3.498E+4 | 0.0196 |
| 1.64E+4 | 0.3794 | 3.5E+4 | 0.0195 |
| 1.641E+4 | 0.3793 | 3.501E+4 | 0.0191 |
| 1.643E+4 | 0.3771 | 3.503E+4 | 0.0183 |
| 1.644E+4 | 0.3773 | 3.504E+4 | 0.017 |
| 1.646E+4 | 0.3769 | 3.506E+4 | 0.0183 |
| 1.647E+4 | 0.3771 | 3.507E+4 | 0.0176 |
| 1.649E+4 | 0.3771 | 3.509E+4 | 0.0171 |
| 1.65E+4 | 0.3777 | 3.51E+4 | 0.0177 |
| 1.652E+4 | 0.3761 | 3.512E+4 | 0.0168 |
| 1.653E+4 | 0.3773 | 3.513E+4 | 0.0167 |
| 1.655E+4 | 0.3752 | 3.515E+4 | 0.0167 |
| 1.656E+4 | 0.3755 | 3.516E+4 | 0.0157 |
| 1.658E+4 | 0.3748 | 3.518E+4 | 0.0147 |
| 1.659E+4 | 0.3752 | 3.519E+4 | 0.0162 |
| 1.661E+4 | 0.3744 | 3.521E+4 | 0.0157 |
| 1.662E+4 | 0.3745 | 3.522E+4 | 0.0153 |
| 1.664E+4 | 0.3734 | 3.524E+4 | 0.0153 |
| 1.665E+4 | 0.3735 | 3.525E+4 | 0.014 |
| 1.667E+4 | 0.3731 | 3.527E+4 | 0.0143 |
| 1.668E+4 | 0.3733 | 3.528E+4 | 0.0134 |
| 1.67E+4 | 0.3731 | 3.53E+4 | 0.0143 |
| 1.671E+4 | 0.3727 | 3.531E+4 | 0.0145 |
| 1.673E+4 | 0.3736 | 3.533E+4 | 0.0129 |
| 1.674E+4 | 0.3714 | 3.534E+4 | 0.0123 |
| 1.676E+4 | 0.3713 | 3.536E+4 | 0.0125 |
| 1.677E+4 | 0.371 | 3.537E+4 | 0.0122 |
| 1.679E+4 | 0.371 | 3.539E+4 | 0.0113 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1.68E+4 | 0.3698 | 3.54E+4 | 0.0113 |
| 1.682E+4 | 0.3701 | 3.542E+4 | 0.0108 |
| 1.683E+4 | 0.3693 | 3.543E+4 | 0.0104 |
| 1.685E+4 | 0.3698 | 3.545E+4 | 0.0104 |

## SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.228

## VISUAL ESTIMATION RESULTS

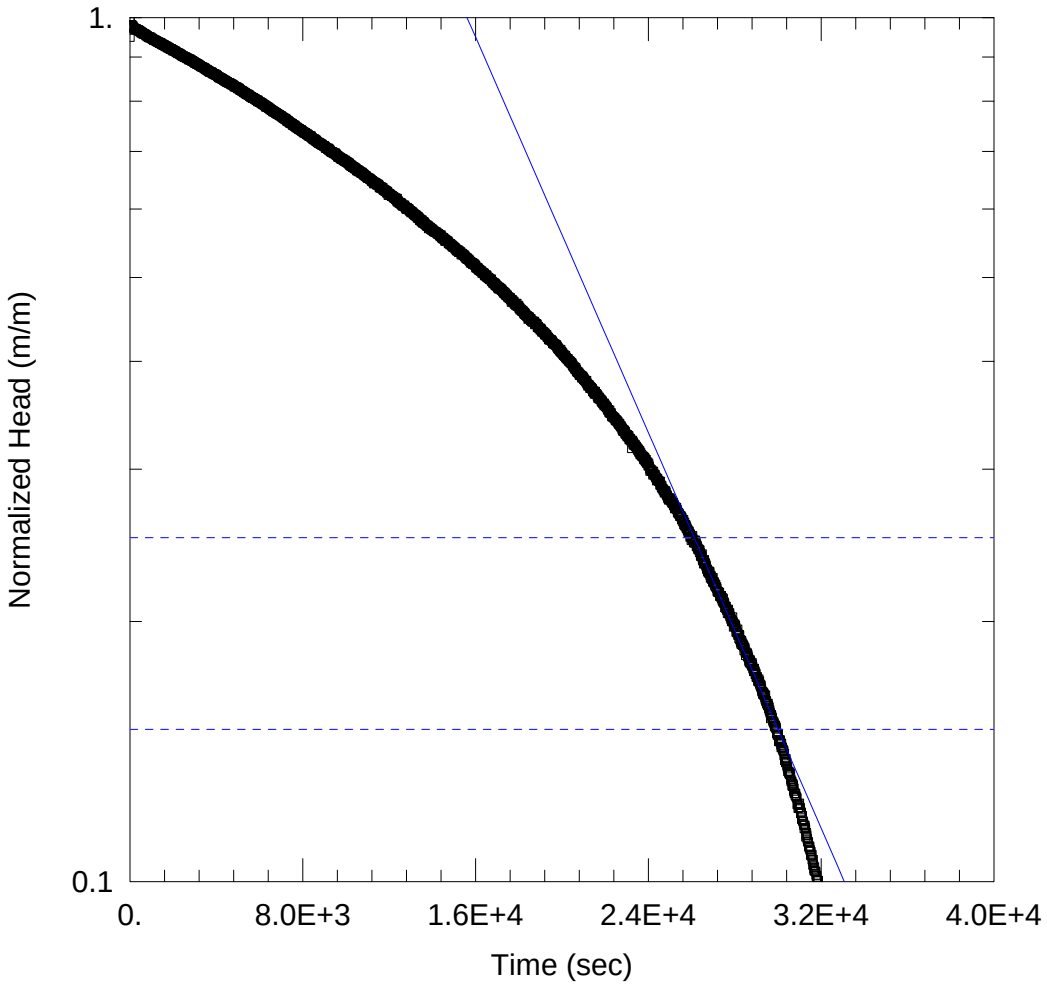
### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 2.426E-8 | m/sec |
| y0 | 5.866 | m |

K = 2.426E-6 cm/sec
T = K*b = 1.213E-6 m²/sec (0.01213 sq. cm/sec)

## NOTES

Well may not be sufficiently developed due to a slow recovery.




## MW-H31 (FALLING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H31
Test Date: 21 July 2013

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H31)

Initial Displacement: 0.75 m
Total Well Penetration Depth: 21.91 m
Casing Radius: 0.016 m
Static Water Column Height: 21.91 m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Unconfined
K = 2.426E-8 m/sec
Solution Method: Hvorslev
y0 = 5.866 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H32 (Fallling Head Slug Test)
Date: 08/14/13
Time: 12:23:38

## PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 22 July 2013
Test Well: MW-H32

## AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

## SLUG TEST WELL DATA

Test Well: MW-H32

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.1 m
Static Water Column Height: 21.28 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 21.28 m

No. of Observations: 1234

Observation Data

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 0. | 0.1 | 9255. | 0.0886 |
| 15. | 0.0994 | 9270. | 0.0882 |
| 30. | 0.0998 | 9285. | 0.0883 |
| 45. | 0.1002 | 9300. | 0.0883 |
| 60. | 0.1003 | 9315. | 0.0885 |
| 75. | 0.1 | 9330. | 0.0876 |
| 90. | 0.1006 | 9345. | 0.0878 |
| 105. | 0.0999 | 9360. | 0.0884 |
| 120. | 0.1 | 9375. | 0.0883 |
| 135. | 0.1001 | 9390. | 0.0879 |
| 150. | 0.1005 | 9405. | 0.088 |
| 165. | 0.1004 | 9420. | 0.088 |
| 180. | 0.1001 | 9435. | 0.0882 |
| 195. | 0.1003 | 9450. | 0.0882 |
| 210. | 0.1003 | 9465. | 0.0881 |
| 225. | 0.0999 | 9480. | 0.0869 |
| 240. | 0.1004 | 9495. | 0.0877 |
| 255. | 0.1002 | 9510. | 0.0874 |
| 270. | 0.0995 | 9525. | 0.0877 |
| 285. | 0.1002 | 9540. | 0.0875 |
| 300. | 0.0998 | 9555. | 0.0883 |
| 315. | 0.0997 | 9570. | 0.0882 |
| 330. | 0.0997 | 9585. | 0.0882 |
| 345. | 0.1002 | 9600. | 0.0883 |
| 360. | 0.0997 | 9615. | 0.0883 |
| 375. | 0.1005 | 9630. | 0.0876 |
| 390. | 0.0996 | 9645. | 0.0876 |
| 405. | 0.0997 | 9660. | 0.0885 |
| 420. | 0.0998 | 9675. | 0.0875 |
| 435. | 0.0999 | 9690. | 0.0888 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 450. | 0.1001 | 9705. | 0.0897 |
| 465. | 0.0997 | 9720. | 0.0872 |
| 480. | 0.0996 | 9735. | 0.0875 |
| 495. | 0.0996 | 9750. | 0.0885 |
| 510. | 0.0992 | 9765. | 0.0872 |
| 525. | 0.0995 | 9780. | 0.0876 |
| 540. | 0.0986 | 9795. | 0.0873 |
| 555. | 0.0993 | 9810. | 0.0878 |
| 570. | 0.0996 | 9825. | 0.0872 |
| 585. | 0.0988 | 9840. | 0.0878 |
| 600. | 0.0994 | 9855. | 0.0879 |
| 615. | 0.099 | 9870. | 0.0875 |
| 630. | 0.0984 | 9885. | 0.0884 |
| 645. | 0.0988 | 9900. | 0.0881 |
| 660. | 0.0992 | 9915. | 0.0876 |
| 675. | 0.0986 | 9930. | 0.0879 |
| 690. | 0.0988 | 9945. | 0.0877 |
| 705. | 0.099 | 9960. | 0.0879 |
| 720. | 0.0991 | 9975. | 0.0881 |
| 735. | 0.099 | 9990. | 0.0878 |
| 750. | 0.0986 | 1.001E+4 | 0.0879 |
| 765. | 0.0986 | 1.002E+4 | 0.0875 |
| 780. | 0.0982 | 1.004E+4 | 0.0877 |
| 795. | 0.0993 | 1.005E+4 | 0.088 |
| 810. | 0.0994 | 1.007E+4 | 0.088 |
| 825. | 0.0992 | 1.008E+4 | 0.0871 |
| 840. | 0.099 | 1.01E+4 | 0.0877 |
| 855. | 0.0987 | 1.011E+4 | 0.0874 |
| 870. | 0.0987 | 1.013E+4 | 0.0865 |
| 885. | 0.0989 | 1.014E+4 | 0.0872 |
| 900. | 0.0985 | 1.016E+4 | 0.0876 |
| 915. | 0.0985 | 1.017E+4 | 0.0884 |
| 930. | 0.0989 | 1.019E+4 | 0.0883 |
| 945. | 0.0987 | 1.02E+4 | 0.0881 |
| 960. | 0.0987 | 1.022E+4 | 0.0879 |
| 975. | 0.0989 | 1.023E+4 | 0.0887 |
| 990. | 0.0988 | 1.025E+4 | 0.0877 |
| 1005. | 0.0983 | 1.026E+4 | 0.0881 |
| 1020. | 0.0984 | 1.028E+4 | 0.0878 |
| 1035. | 0.0987 | 1.029E+4 | 0.088 |
| 1050. | 0.0984 | 1.031E+4 | 0.0877 |
| 1065. | 0.099 | 1.032E+4 | 0.0884 |
| 1080. | 0.0989 | 1.034E+4 | 0.0882 |
| 1095. | 0.0982 | 1.035E+4 | 0.0882 |
| 1110. | 0.0981 | 1.037E+4 | 0.0881 |
| 1125. | 0.0978 | 1.038E+4 | 0.0882 |
| 1140. | 0.0978 | 1.04E+4 | 0.0881 |
| 1155. | 0.0975 | 1.041E+4 | 0.0878 |
| 1170. | 0.0977 | 1.043E+4 | 0.088 |
| 1185. | 0.0985 | 1.044E+4 | 0.0874 |
| 1200. | 0.0981 | 1.046E+4 | 0.0875 |
| 1215. | 0.0971 | 1.047E+4 | 0.0879 |
| 1230. | 0.0969 | 1.049E+4 | 0.0881 |
| 1245. | 0.0974 | 1.05E+4 | 0.0881 |
| 1260. | 0.0969 | 1.052E+4 | 0.0878 |
| 1275. | 0.0967 | 1.053E+4 | 0.088 |
| 1290. | 0.0969 | 1.055E+4 | 0.0883 |
| 1305. | 0.0972 | 1.056E+4 | 0.0874 |
| 1320. | 0.0969 | 1.058E+4 | 0.0879 |
| 1335. | 0.0964 | 1.059E+4 | 0.0875 |
| 1350. | 0.0969 | 1.061E+4 | 0.0874 |
| 1365. | 0.0969 | 1.062E+4 | 0.0874 |
| 1380. | 0.097 | 1.064E+4 | 0.088 |
| 1395. | 0.0976 | 1.065E+4 | 0.088 |
| 1410. | 0.0974 | 1.067E+4 | 0.0873 |
| 1425. | 0.0977 | 1.068E+4 | 0.0878 |
| 1440. | 0.0968 | 1.07E+4 | 0.0877 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 1455. | 0.0969 | 1.071E+4 | 0.0878 |
| 1470. | 0.0976 | 1.073E+4 | 0.0878 |
| 1485. | 0.0975 | 1.074E+4 | 0.0877 |
| 1500. | 0.0973 | 1.076E+4 | 0.0879 |
| 1515. | 0.0974 | 1.077E+4 | 0.0879 |
| 1530. | 0.0968 | 1.079E+4 | 0.0873 |
| 1545. | 0.0953 | 1.08E+4 | 0.087 |
| 1560. | 0.097 | 1.082E+4 | 0.0877 |
| 1575. | 0.0963 | 1.083E+4 | 0.0877 |
| 1590. | 0.0963 | 1.085E+4 | 0.0877 |
| 1605. | 0.0972 | 1.086E+4 | 0.0875 |
| 1620. | 0.0971 | 1.088E+4 | 0.0874 |
| 1635. | 0.0967 | 1.089E+4 | 0.0873 |
| 1650. | 0.0958 | 1.091E+4 | 0.0867 |
| 1665. | 0.0961 | 1.092E+4 | 0.0873 |
| 1680. | 0.0963 | 1.094E+4 | 0.0874 |
| 1695. | 0.096 | 1.095E+4 | 0.0872 |
| 1710. | 0.0969 | 1.097E+4 | 0.0873 |
| 1725. | 0.0964 | 1.098E+4 | 0.0874 |
| 1740. | 0.0974 | 1.1E+4 | 0.0872 |
| 1755. | 0.0935 | 1.101E+4 | 0.0878 |
| 1770. | 0.0964 | 1.103E+4 | 0.0874 |
| 1785. | 0.0962 | 1.104E+4 | 0.0872 |
| 1800. | 0.0958 | 1.106E+4 | 0.0867 |
| 1815. | 0.0971 | 1.107E+4 | 0.0878 |
| 1830. | 0.0949 | 1.109E+4 | 0.0875 |
| 1845. | 0.0967 | 1.11E+4 | 0.0875 |
| 1860. | 0.0966 | 1.112E+4 | 0.0874 |
| 1875. | 0.097 | 1.113E+4 | 0.0882 |
| 1890. | 0.0966 | 1.115E+4 | 0.0866 |
| 1905. | 0.0959 | 1.116E+4 | 0.0876 |
| 1920. | 0.0966 | 1.118E+4 | 0.0881 |
| 1935. | 0.0967 | 1.119E+4 | 0.0876 |
| 1950. | 0.0965 | 1.121E+4 | 0.0877 |
| 1965. | 0.0963 | 1.122E+4 | 0.0876 |
| 1980. | 0.0963 | 1.124E+4 | 0.0873 |
| 1995. | 0.0956 | 1.125E+4 | 0.0875 |
| 2010. | 0.0938 | 1.127E+4 | 0.0871 |
| 2025. | 0.096 | 1.128E+4 | 0.0876 |
| 2040. | 0.0967 | 1.13E+4 | 0.088 |
| 2055. | 0.0953 | 1.131E+4 | 0.0877 |
| 2070. | 0.0945 | 1.133E+4 | 0.0874 |
| 2085. | 0.0955 | 1.134E+4 | 0.0875 |
| 2100. | 0.0959 | 1.136E+4 | 0.0878 |
| 2115. | 0.0958 | 1.137E+4 | 0.0874 |
| 2130. | 0.0955 | 1.139E+4 | 0.0887 |
| 2145. | 0.0951 | 1.14E+4 | 0.0881 |
| 2160. | 0.0953 | 1.142E+4 | 0.0878 |
| 2175. | 0.0958 | 1.143E+4 | 0.0878 |
| 2190. | 0.0958 | 1.145E+4 | 0.0886 |
| 2205. | 0.0959 | 1.146E+4 | 0.0886 |
| 2220. | 0.0953 | 1.148E+4 | 0.0885 |
| 2235. | 0.0964 | 1.149E+4 | 0.0882 |
| 2250. | 0.0961 | 1.151E+4 | 0.0886 |
| 2265. | 0.0968 | 1.152E+4 | 0.088 |
| 2280. | 0.0952 | 1.154E+4 | 0.0876 |
| 2295. | 0.0957 | 1.155E+4 | 0.0882 |
| 2310. | 0.096 | 1.157E+4 | 0.0881 |
| 2325. | 0.0965 | 1.158E+4 | 0.088 |
| 2340. | 0.0959 | 1.16E+4 | 0.0877 |
| 2355. | 0.0957 | 1.161E+4 | 0.0879 |
| 2370. | 0.0957 | 1.163E+4 | 0.0877 |
| 2385. | 0.096 | 1.164E+4 | 0.0877 |
| 2400. | 0.0965 | 1.166E+4 | 0.0879 |
| 2415. | 0.0962 | 1.167E+4 | 0.0877 |
| 2430. | 0.0963 | 1.169E+4 | 0.0881 |
| 2445. | 0.0966 | 1.17E+4 | 0.0882 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 2460. | 0.0962 | 1.172E+4 | 0.0883 |
| 2475. | 0.0964 | 1.173E+4 | 0.0879 |
| 2490. | 0.097 | 1.175E+4 | 0.0884 |
| 2505. | 0.0968 | 1.176E+4 | 0.0883 |
| 2520. | 0.0963 | 1.178E+4 | 0.0878 |
| 2535. | 0.097 | 1.179E+4 | 0.0876 |
| 2550. | 0.0963 | 1.181E+4 | 0.0877 |
| 2565. | 0.0969 | 1.182E+4 | 0.088 |
| 2580. | 0.0961 | 1.184E+4 | 0.0875 |
| 2595. | 0.0963 | 1.185E+4 | 0.0878 |
| 2610. | 0.0962 | 1.187E+4 | 0.0868 |
| 2625. | 0.0956 | 1.188E+4 | 0.0877 |
| 2640. | 0.0959 | 1.19E+4 | 0.0868 |
| 2655. | 0.0958 | 1.191E+4 | 0.0872 |
| 2670. | 0.0958 | 1.193E+4 | 0.0877 |
| 2685. | 0.0964 | 1.194E+4 | 0.087 |
| 2700. | 0.0961 | 1.196E+4 | 0.0866 |
| 2715. | 0.0959 | 1.197E+4 | 0.0872 |
| 2730. | 0.0956 | 1.199E+4 | 0.0859 |
| 2745. | 0.0962 | 1.2E+4 | 0.0869 |
| 2760. | 0.0957 | 1.202E+4 | 0.0872 |
| 2775. | 0.0957 | 1.203E+4 | 0.0872 |
| 2790. | 0.0959 | 1.205E+4 | 0.0871 |
| 2805. | 0.0958 | 1.206E+4 | 0.0871 |
| 2820. | 0.0959 | 1.208E+4 | 0.087 |
| 2835. | 0.0964 | 1.209E+4 | 0.0875 |
| 2850. | 0.096 | 1.211E+4 | 0.0876 |
| 2865. | 0.0953 | 1.212E+4 | 0.0874 |
| 2880. | 0.095 | 1.214E+4 | 0.0873 |
| 2895. | 0.0949 | 1.215E+4 | 0.0871 |
| 2910. | 0.0957 | 1.217E+4 | 0.0873 |
| 2925. | 0.0948 | 1.218E+4 | 0.0873 |
| 2940. | 0.0955 | 1.22E+4 | 0.0873 |
| 2955. | 0.0954 | 1.221E+4 | 0.0872 |
| 2970. | 0.0958 | 1.223E+4 | 0.0868 |
| 2985. | 0.0959 | 1.224E+4 | 0.0871 |
| 3000. | 0.0952 | 1.226E+4 | 0.0868 |
| 3015. | 0.0958 | 1.227E+4 | 0.0871 |
| 3030. | 0.0961 | 1.229E+4 | 0.0874 |
| 3045. | 0.0965 | 1.23E+4 | 0.0867 |
| 3060. | 0.0963 | 1.232E+4 | 0.0864 |
| 3075. | 0.0966 | 1.233E+4 | 0.0871 |
| 3090. | 0.0969 | 1.235E+4 | 0.0865 |
| 3105. | 0.0957 | 1.236E+4 | 0.0871 |
| 3120. | 0.0963 | 1.238E+4 | 0.0872 |
| 3135. | 0.0959 | 1.239E+4 | 0.0866 |
| 3150. | 0.0963 | 1.241E+4 | 0.0864 |
| 3165. | 0.0959 | 1.242E+4 | 0.0868 |
| 3180. | 0.0963 | 1.244E+4 | 0.0864 |
| 3195. | 0.0962 | 1.245E+4 | 0.0865 |
| 3210. | 0.0964 | 1.247E+4 | 0.0865 |
| 3225. | 0.0959 | 1.248E+4 | 0.0868 |
| 3240. | 0.0952 | 1.25E+4 | 0.0868 |
| 3255. | 0.0951 | 1.251E+4 | 0.0865 |
| 3270. | 0.0959 | 1.253E+4 | 0.0868 |
| 3285. | 0.0959 | 1.254E+4 | 0.0865 |
| 3300. | 0.0954 | 1.256E+4 | 0.0864 |
| 3315. | 0.0956 | 1.257E+4 | 0.0865 |
| 3330. | 0.0951 | 1.259E+4 | 0.0863 |
| 3345. | 0.0952 | 1.26E+4 | 0.0862 |
| 3360. | 0.095 | 1.262E+4 | 0.0866 |
| 3375. | 0.0951 | 1.263E+4 | 0.0867 |
| 3390. | 0.0955 | 1.265E+4 | 0.0867 |
| 3405. | 0.0955 | 1.266E+4 | 0.0862 |
| 3420. | 0.0958 | 1.268E+4 | 0.0868 |
| 3435. | 0.0954 | 1.269E+4 | 0.0866 |
| 3450. | 0.0954 | 1.271E+4 | 0.0866 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 3465. | 0.0956 | 1.272E+4 | 0.0865 |
| 3480. | 0.0952 | 1.274E+4 | 0.0869 |
| 3495. | 0.095 | 1.275E+4 | 0.0865 |
| 3510. | 0.0954 | 1.277E+4 | 0.0871 |
| 3525. | 0.0952 | 1.278E+4 | 0.087 |
| 3540. | 0.095 | 1.28E+4 | 0.0872 |
| 3555. | 0.0954 | 1.281E+4 | 0.0855 |
| 3570. | 0.0952 | 1.283E+4 | 0.0873 |
| 3585. | 0.0956 | 1.284E+4 | 0.0863 |
| 3600. | 0.0953 | 1.286E+4 | 0.0873 |
| 3615. | 0.0958 | 1.287E+4 | 0.0873 |
| 3630. | 0.0955 | 1.289E+4 | 0.0874 |
| 3645. | 0.0958 | 1.29E+4 | 0.087 |
| 3660. | 0.0948 | 1.292E+4 | 0.0874 |
| 3675. | 0.095 | 1.293E+4 | 0.0866 |
| 3690. | 0.0948 | 1.295E+4 | 0.087 |
| 3705. | 0.0946 | 1.296E+4 | 0.0872 |
| 3720. | 0.0948 | 1.298E+4 | 0.0878 |
| 3735. | 0.0942 | 1.299E+4 | 0.0877 |
| 3750. | 0.0949 | 1.301E+4 | 0.0871 |
| 3765. | 0.0956 | 1.302E+4 | 0.0871 |
| 3780. | 0.0949 | 1.304E+4 | 0.0866 |
| 3795. | 0.0956 | 1.305E+4 | 0.0869 |
| 3810. | 0.0951 | 1.307E+4 | 0.0868 |
| 3825. | 0.095 | 1.308E+4 | 0.0866 |
| 3840. | 0.0953 | 1.31E+4 | 0.0866 |
| 3855. | 0.095 | 1.311E+4 | 0.0871 |
| 3870. | 0.0947 | 1.313E+4 | 0.0874 |
| 3885. | 0.0942 | 1.314E+4 | 0.0869 |
| 3900. | 0.0944 | 1.316E+4 | 0.0868 |
| 3915. | 0.0951 | 1.317E+4 | 0.0874 |
| 3930. | 0.0943 | 1.319E+4 | 0.0867 |
| 3945. | 0.0949 | 1.32E+4 | 0.0868 |
| 3960. | 0.0941 | 1.322E+4 | 0.087 |
| 3975. | 0.0945 | 1.323E+4 | 0.0868 |
| 3990. | 0.0947 | 1.325E+4 | 0.0865 |
| 4005. | 0.0944 | 1.326E+4 | 0.0872 |
| 4020. | 0.0935 | 1.328E+4 | 0.0866 |
| 4035. | 0.0941 | 1.329E+4 | 0.087 |
| 4050. | 0.0936 | 1.331E+4 | 0.087 |
| 4065. | 0.0944 | 1.332E+4 | 0.0867 |
| 4080. | 0.0943 | 1.334E+4 | 0.0868 |
| 4095. | 0.0943 | 1.335E+4 | 0.0865 |
| 4110. | 0.0936 | 1.337E+4 | 0.0869 |
| 4125. | 0.094 | 1.338E+4 | 0.0871 |
| 4140. | 0.0937 | 1.34E+4 | 0.0872 |
| 4155. | 0.0931 | 1.341E+4 | 0.0866 |
| 4170. | 0.0937 | 1.343E+4 | 0.0874 |
| 4185. | 0.0938 | 1.344E+4 | 0.0874 |
| 4200. | 0.0938 | 1.346E+4 | 0.0872 |
| 4215. | 0.0942 | 1.347E+4 | 0.0875 |
| 4230. | 0.0935 | 1.349E+4 | 0.0866 |
| 4245. | 0.0945 | 1.35E+4 | 0.0866 |
| 4260. | 0.0941 | 1.352E+4 | 0.0879 |
| 4275. | 0.0941 | 1.353E+4 | 0.0873 |
| 4290. | 0.0941 | 1.355E+4 | 0.0875 |
| 4305. | 0.0947 | 1.356E+4 | 0.0877 |
| 4320. | 0.0943 | 1.358E+4 | 0.087 |
| 4335. | 0.0947 | 1.359E+4 | 0.0872 |
| 4350. | 0.0942 | 1.361E+4 | 0.087 |
| 4365. | 0.0944 | 1.362E+4 | 0.0876 |
| 4380. | 0.0937 | 1.364E+4 | 0.0875 |
| 4395. | 0.0947 | 1.365E+4 | 0.0874 |
| 4410. | 0.0946 | 1.367E+4 | 0.0873 |
| 4425. | 0.0943 | 1.368E+4 | 0.0873 |
| 4440. | 0.0941 | 1.37E+4 | 0.0873 |
| 4455. | 0.0943 | 1.371E+4 | 0.0872 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 4470. | 0.094 | 1.373E+4 | 0.0876 |
| 4485. | 0.0939 | 1.374E+4 | 0.0869 |
| 4500. | 0.0937 | 1.376E+4 | 0.0862 |
| 4515. | 0.0942 | 1.377E+4 | 0.0865 |
| 4530. | 0.0938 | 1.379E+4 | 0.0872 |
| 4545. | 0.0937 | 1.38E+4 | 0.0872 |
| 4560. | 0.0936 | 1.382E+4 | 0.0876 |
| 4575. | 0.0935 | 1.383E+4 | 0.0878 |
| 4590. | 0.0941 | 1.385E+4 | 0.0873 |
| 4605. | 0.0939 | 1.386E+4 | 0.0878 |
| 4620. | 0.0941 | 1.388E+4 | 0.0879 |
| 4635. | 0.094 | 1.389E+4 | 0.0878 |
| 4650. | 0.0938 | 1.391E+4 | 0.0873 |
| 4665. | 0.0938 | 1.392E+4 | 0.0879 |
| 4680. | 0.0932 | 1.394E+4 | 0.0875 |
| 4695. | 0.0935 | 1.395E+4 | 0.0877 |
| 4710. | 0.0938 | 1.397E+4 | 0.0883 |
| 4725. | 0.0938 | 1.398E+4 | 0.0873 |
| 4740. | 0.0931 | 1.4E+4 | 0.0877 |
| 4755. | 0.0929 | 1.401E+4 | 0.087 |
| 4770. | 0.0935 | 1.403E+4 | 0.0873 |
| 4785. | 0.0934 | 1.404E+4 | 0.087 |
| 4800. | 0.093 | 1.406E+4 | 0.0875 |
| 4815. | 0.0933 | 1.407E+4 | 0.0875 |
| 4830. | 0.0941 | 1.409E+4 | 0.0879 |
| 4845. | 0.0936 | 1.41E+4 | 0.0877 |
| 4860. | 0.0937 | 1.412E+4 | 0.0878 |
| 4875. | 0.0937 | 1.413E+4 | 0.0872 |
| 4890. | 0.0938 | 1.415E+4 | 0.0876 |
| 4905. | 0.0935 | 1.416E+4 | 0.0873 |
| 4920. | 0.0931 | 1.418E+4 | 0.0874 |
| 4935. | 0.0935 | 1.419E+4 | 0.0874 |
| 4950. | 0.0933 | 1.421E+4 | 0.0877 |
| 4965. | 0.093 | 1.422E+4 | 0.0877 |
| 4980. | 0.0922 | 1.424E+4 | 0.0874 |
| 4995. | 0.0928 | 1.425E+4 | 0.0872 |
| 5010. | 0.0925 | 1.427E+4 | 0.0877 |
| 5025. | 0.0928 | 1.428E+4 | 0.0875 |
| 5040. | 0.0931 | 1.43E+4 | 0.0866 |
| 5055. | 0.0926 | 1.431E+4 | 0.0873 |
| 5070. | 0.0928 | 1.433E+4 | 0.0873 |
| 5085. | 0.0926 | 1.434E+4 | 0.0873 |
| 5100. | 0.0924 | 1.436E+4 | 0.0876 |
| 5115. | 0.0932 | 1.437E+4 | 0.0874 |
| 5130. | 0.092 | 1.439E+4 | 0.0872 |
| 5145. | 0.0925 | 1.44E+4 | 0.0879 |
| 5160. | 0.0933 | 1.442E+4 | 0.0871 |
| 5175. | 0.093 | 1.443E+4 | 0.0865 |
| 5190. | 0.093 | 1.445E+4 | 0.0872 |
| 5205. | 0.0927 | 1.446E+4 | 0.0862 |
| 5220. | 0.0925 | 1.448E+4 | 0.087 |
| 5235. | 0.0925 | 1.449E+4 | 0.0869 |
| 5250. | 0.0925 | 1.451E+4 | 0.087 |
| 5265. | 0.0927 | 1.452E+4 | 0.0869 |
| 5280. | 0.0929 | 1.454E+4 | 0.0868 |
| 5295. | 0.093 | 1.455E+4 | 0.0869 |
| 5310. | 0.0919 | 1.457E+4 | 0.087 |
| 5325. | 0.0927 | 1.458E+4 | 0.0866 |
| 5340. | 0.0922 | 1.46E+4 | 0.0872 |
| 5355. | 0.092 | 1.461E+4 | 0.0865 |
| 5370. | 0.0929 | 1.463E+4 | 0.0864 |
| 5385. | 0.0926 | 1.464E+4 | 0.0868 |
| 5400. | 0.0922 | 1.466E+4 | 0.0871 |
| 5415. | 0.0926 | 1.467E+4 | 0.0865 |
| 5430. | 0.0922 | 1.469E+4 | 0.0868 |
| 5445. | 0.0929 | 1.47E+4 | 0.087 |
| 5460. | 0.0919 | 1.472E+4 | 0.0872 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 5475. | 0.0928 | 1.473E+4 | 0.0864 |
| 5490. | 0.092 | 1.475E+4 | 0.0869 |
| 5505. | 0.0926 | 1.476E+4 | 0.0872 |
| 5520. | 0.0924 | 1.478E+4 | 0.086 |
| 5535. | 0.092 | 1.479E+4 | 0.0868 |
| 5550. | 0.092 | 1.481E+4 | 0.087 |
| 5565. | 0.0919 | 1.482E+4 | 0.087 |
| 5580. | 0.0923 | 1.484E+4 | 0.0865 |
| 5595. | 0.0919 | 1.485E+4 | 0.0874 |
| 5610. | 0.0924 | 1.487E+4 | 0.0873 |
| 5625. | 0.0918 | 1.488E+4 | 0.0875 |
| 5640. | 0.0917 | 1.49E+4 | 0.0875 |
| 5655. | 0.0914 | 1.491E+4 | 0.0876 |
| 5670. | 0.0917 | 1.493E+4 | 0.0871 |
| 5685. | 0.0923 | 1.494E+4 | 0.0876 |
| 5700. | 0.0923 | 1.496E+4 | 0.0881 |
| 5715. | 0.0911 | 1.497E+4 | 0.0876 |
| 5730. | 0.091 | 1.499E+4 | 0.088 |
| 5745. | 0.0916 | 1.5E+4 | 0.0877 |
| 5760. | 0.092 | 1.502E+4 | 0.0877 |
| 5775. | 0.0919 | 1.503E+4 | 0.0871 |
| 5790. | 0.0914 | 1.505E+4 | 0.0873 |
| 5805. | 0.091 | 1.506E+4 | 0.0876 |
| 5820. | 0.0916 | 1.508E+4 | 0.0876 |
| 5835. | 0.0914 | 1.509E+4 | 0.0872 |
| 5850. | 0.0921 | 1.511E+4 | 0.087 |
| 5865. | 0.0913 | 1.512E+4 | 0.0876 |
| 5880. | 0.0913 | 1.514E+4 | 0.0862 |
| 5895. | 0.0908 | 1.515E+4 | 0.087 |
| 5910. | 0.0901 | 1.517E+4 | 0.0877 |
| 5925. | 0.091 | 1.518E+4 | 0.0873 |
| 5940. | 0.0918 | 1.52E+4 | 0.0879 |
| 5955. | 0.0909 | 1.521E+4 | 0.0874 |
| 5970. | 0.0909 | 1.523E+4 | 0.0861 |
| 5985. | 0.0904 | 1.524E+4 | 0.0864 |
| 6000. | 0.0916 | 1.526E+4 | 0.0867 |
| 6015. | 0.0903 | 1.527E+4 | 0.0863 |
| 6030. | 0.0908 | 1.529E+4 | 0.0869 |
| 6045. | 0.0909 | 1.53E+4 | 0.087 |
| 6060. | 0.0907 | 1.532E+4 | 0.0871 |
| 6075. | 0.0902 | 1.533E+4 | 0.0871 |
| 6090. | 0.0909 | 1.535E+4 | 0.0868 |
| 6105. | 0.0913 | 1.536E+4 | 0.0865 |
| 6120. | 0.0911 | 1.538E+4 | 0.0867 |
| 6135. | 0.0908 | 1.539E+4 | 0.086 |
| 6150. | 0.0915 | 1.541E+4 | 0.0869 |
| 6165. | 0.091 | 1.542E+4 | 0.0862 |
| 6180. | 0.0908 | 1.544E+4 | 0.0863 |
| 6195. | 0.0906 | 1.545E+4 | 0.0867 |
| 6210. | 0.0912 | 1.547E+4 | 0.0868 |
| 6225. | 0.0911 | 1.548E+4 | 0.0865 |
| 6240. | 0.0916 | 1.55E+4 | 0.0867 |
| 6255. | 0.091 | 1.551E+4 | 0.0864 |
| 6270. | 0.0906 | 1.553E+4 | 0.0864 |
| 6285. | 0.0908 | 1.554E+4 | 0.0866 |
| 6300. | 0.0911 | 1.556E+4 | 0.0867 |
| 6315. | 0.0912 | 1.557E+4 | 0.0865 |
| 6330. | 0.0901 | 1.559E+4 | 0.0867 |
| 6345. | 0.0905 | 1.56E+4 | 0.0863 |
| 6360. | 0.0912 | 1.562E+4 | 0.0856 |
| 6375. | 0.0908 | 1.563E+4 | 0.0864 |
| 6390. | 0.091 | 1.565E+4 | 0.0866 |
| 6405. | 0.0905 | 1.566E+4 | 0.0867 |
| 6420. | 0.091 | 1.568E+4 | 0.0862 |
| 6435. | 0.0909 | 1.569E+4 | 0.0869 |
| 6450. | 0.0914 | 1.571E+4 | 0.0864 |
| 6465. | 0.0913 | 1.572E+4 | 0.0864 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 6480. | 0.0906 | 1.574E+4 | 0.0854 |
| 6495. | 0.0917 | 1.575E+4 | 0.0861 |
| 6510. | 0.0898 | 1.577E+4 | 0.0862 |
| 6525. | 0.0908 | 1.578E+4 | 0.0862 |
| 6540. | 0.0904 | 1.58E+4 | 0.0868 |
| 6555. | 0.0904 | 1.581E+4 | 0.0862 |
| 6570. | 0.0902 | 1.583E+4 | 0.0867 |
| 6585. | 0.0898 | 1.584E+4 | 0.0861 |
| 6600. | 0.0902 | 1.586E+4 | 0.0859 |
| 6615. | 0.0906 | 1.587E+4 | 0.0865 |
| 6630. | 0.0907 | 1.589E+4 | 0.0864 |
| 6645. | 0.0906 | 1.59E+4 | 0.0861 |
| 6660. | 0.0901 | 1.592E+4 | 0.086 |
| 6675. | 0.0902 | 1.593E+4 | 0.0861 |
| 6690. | 0.0912 | 1.595E+4 | 0.0862 |
| 6705. | 0.0893 | 1.596E+4 | 0.0863 |
| 6720. | 0.0899 | 1.598E+4 | 0.0863 |
| 6735. | 0.0897 | 1.599E+4 | 0.0863 |
| 6750. | 0.0892 | 1.601E+4 | 0.0863 |
| 6765. | 0.0876 | 1.602E+4 | 0.086 |
| 6780. | 0.0903 | 1.604E+4 | 0.0857 |
| 6795. | 0.0905 | 1.605E+4 | 0.0856 |
| 6810. | 0.091 | 1.607E+4 | 0.0859 |
| 6825. | 0.091 | 1.608E+4 | 0.086 |
| 6840. | 0.0906 | 1.61E+4 | 0.0862 |
| 6855. | 0.0912 | 1.611E+4 | 0.086 |
| 6870. | 0.0912 | 1.613E+4 | 0.0858 |
| 6885. | 0.0908 | 1.614E+4 | 0.0862 |
| 6900. | 0.0909 | 1.616E+4 | 0.0861 |
| 6915. | 0.0909 | 1.617E+4 | 0.0862 |
| 6930. | 0.091 | 1.619E+4 | 0.0861 |
| 6945. | 0.0909 | 1.62E+4 | 0.0856 |
| 6960. | 0.0909 | 1.622E+4 | 0.0868 |
| 6975. | 0.0908 | 1.623E+4 | 0.0862 |
| 6990. | 0.0909 | 1.625E+4 | 0.0855 |
| 7005. | 0.0901 | 1.626E+4 | 0.0863 |
| 7020. | 0.091 | 1.628E+4 | 0.0864 |
| 7035. | 0.0914 | 1.629E+4 | 0.086 |
| 7050. | 0.0913 | 1.631E+4 | 0.086 |
| 7065. | 0.0903 | 1.632E+4 | 0.0856 |
| 7080. | 0.0908 | 1.634E+4 | 0.0861 |
| 7095. | 0.0908 | 1.635E+4 | 0.0854 |
| 7110. | 0.0914 | 1.637E+4 | 0.0861 |
| 7125. | 0.0919 | 1.638E+4 | 0.0857 |
| 7140. | 0.0911 | 1.64E+4 | 0.0861 |
| 7155. | 0.0902 | 1.641E+4 | 0.0858 |
| 7170. | 0.0908 | 1.643E+4 | 0.0855 |
| 7185. | 0.091 | 1.644E+4 | 0.0856 |
| 7200. | 0.0912 | 1.646E+4 | 0.0855 |
| 7215. | 0.091 | 1.647E+4 | 0.0858 |
| 7230. | 0.0909 | 1.649E+4 | 0.0855 |
| 7245. | 0.0909 | 1.65E+4 | 0.0849 |
| 7260. | 0.0909 | 1.652E+4 | 0.0853 |
| 7275. | 0.0906 | 1.653E+4 | 0.0854 |
| 7290. | 0.0908 | 1.655E+4 | 0.0855 |
| 7305. | 0.0911 | 1.656E+4 | 0.085 |
| 7320. | 0.0912 | 1.658E+4 | 0.0855 |
| 7335. | 0.0916 | 1.659E+4 | 0.0851 |
| 7350. | 0.0913 | 1.661E+4 | 0.0853 |
| 7365. | 0.0911 | 1.662E+4 | 0.0853 |
| 7380. | 0.0903 | 1.664E+4 | 0.085 |
| 7395. | 0.0907 | 1.665E+4 | 0.0849 |
| 7410. | 0.0906 | 1.667E+4 | 0.0846 |
| 7425. | 0.0904 | 1.668E+4 | 0.0853 |
| 7440. | 0.0893 | 1.67E+4 | 0.0844 |
| 7455. | 0.0902 | 1.671E+4 | 0.0845 |
| 7470. | 0.0896 | 1.673E+4 | 0.085 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 7485. | 0.0898 | 1.674E+4 | 0.0846 |
| 7500. | 0.0898 | 1.676E+4 | 0.0857 |
| 7515. | 0.0899 | 1.677E+4 | 0.0855 |
| 7530. | 0.0897 | 1.679E+4 | 0.0858 |
| 7545. | 0.0891 | 1.68E+4 | 0.0857 |
| 7560. | 0.0898 | 1.682E+4 | 0.0853 |
| 7575. | 0.0905 | 1.683E+4 | 0.0854 |
| 7590. | 0.0896 | 1.685E+4 | 0.0853 |
| 7605. | 0.0897 | 1.686E+4 | 0.0852 |
| 7620. | 0.0895 | 1.688E+4 | 0.0848 |
| 7635. | 0.0899 | 1.689E+4 | 0.0851 |
| 7650. | 0.0894 | 1.691E+4 | 0.0855 |
| 7665. | 0.0895 | 1.692E+4 | 0.0852 |
| 7680. | 0.0899 | 1.694E+4 | 0.0846 |
| 7695. | 0.0895 | 1.695E+4 | 0.0851 |
| 7710. | 0.0897 | 1.697E+4 | 0.0856 |
| 7725. | 0.0885 | 1.698E+4 | 0.0857 |
| 7740. | 0.0891 | 1.7E+4 | 0.0852 |
| 7755. | 0.0901 | 1.701E+4 | 0.0854 |
| 7770. | 0.0894 | 1.703E+4 | 0.0857 |
| 7785. | 0.0898 | 1.704E+4 | 0.085 |
| 7800. | 0.0897 | 1.706E+4 | 0.0857 |
| 7815. | 0.0892 | 1.707E+4 | 0.086 |
| 7830. | 0.0894 | 1.709E+4 | 0.0855 |
| 7845. | 0.0894 | 1.71E+4 | 0.0854 |
| 7860. | 0.0894 | 1.712E+4 | 0.0853 |
| 7875. | 0.0901 | 1.713E+4 | 0.0852 |
| 7890. | 0.0896 | 1.715E+4 | 0.0854 |
| 7905. | 0.0897 | 1.716E+4 | 0.0852 |
| 7920. | 0.0893 | 1.718E+4 | 0.0857 |
| 7935. | 0.0892 | 1.719E+4 | 0.0858 |
| 7950. | 0.0891 | 1.721E+4 | 0.0858 |
| 7965. | 0.0881 | 1.722E+4 | 0.0852 |
| 7980. | 0.0877 | 1.724E+4 | 0.0853 |
| 7995. | 0.0885 | 1.725E+4 | 0.0857 |
| 8010. | 0.0881 | 1.727E+4 | 0.0854 |
| 8025. | 0.0889 | 1.728E+4 | 0.0857 |
| 8040. | 0.089 | 1.73E+4 | 0.0852 |
| 8055. | 0.0882 | 1.731E+4 | 0.0853 |
| 8070. | 0.089 | 1.733E+4 | 0.0854 |
| 8085. | 0.0888 | 1.734E+4 | 0.085 |
| 8100. | 0.089 | 1.736E+4 | 0.0855 |
| 8115. | 0.0889 | 1.737E+4 | 0.0853 |
| 8130. | 0.088 | 1.739E+4 | 0.0855 |
| 8145. | 0.0886 | 1.74E+4 | 0.0854 |
| 8160. | 0.0888 | 1.742E+4 | 0.0851 |
| 8175. | 0.0893 | 1.743E+4 | 0.0856 |
| 8190. | 0.0888 | 1.745E+4 | 0.0852 |
| 8205. | 0.0891 | 1.746E+4 | 0.0852 |
| 8220. | 0.0893 | 1.748E+4 | 0.0855 |
| 8235. | 0.0895 | 1.749E+4 | 0.0858 |
| 8250. | 0.0883 | 1.751E+4 | 0.0857 |
| 8265. | 0.0889 | 1.752E+4 | 0.0856 |
| 8280. | 0.0888 | 1.754E+4 | 0.0859 |
| 8295. | 0.089 | 1.755E+4 | 0.0857 |
| 8310. | 0.0891 | 1.757E+4 | 0.0861 |
| 8325. | 0.0883 | 1.758E+4 | 0.0857 |
| 8340. | 0.0894 | 1.76E+4 | 0.0853 |
| 8355. | 0.0894 | 1.761E+4 | 0.0857 |
| 8370. | 0.0887 | 1.763E+4 | 0.0853 |
| 8385. | 0.0881 | 1.764E+4 | 0.0859 |
| 8400. | 0.0889 | 1.766E+4 | 0.0857 |
| 8415. | 0.0888 | 1.767E+4 | 0.0856 |
| 8430. | 0.0884 | 1.769E+4 | 0.0859 |
| 8445. | 0.0885 | 1.77E+4 | 0.0859 |
| 8460. | 0.0884 | 1.772E+4 | 0.0854 |
| 8475. | 0.0886 | 1.773E+4 | 0.0853 |

| Time (sec) | Displacement (m) | Time (sec) | Displacement (m) |
|---|---|---|---|
| 8490. | 0.0875 | 1.775E+4 | 0.0856 |
| 8505. | 0.0879 | 1.776E+4 | 0.0863 |
| 8520. | 0.0878 | 1.778E+4 | 0.0856 |
| 8535. | 0.0884 | 1.779E+4 | 0.0859 |
| 8550. | 0.088 | 1.781E+4 | 0.0852 |
| 8565. | 0.0878 | 1.782E+4 | 0.0861 |
| 8580. | 0.088 | 1.784E+4 | 0.0858 |
| 8595. | 0.0878 | 1.785E+4 | 0.0855 |
| 8610. | 0.0888 | 1.787E+4 | 0.0854 |
| 8625. | 0.0886 | 1.788E+4 | 0.0858 |
| 8640. | 0.088 | 1.79E+4 | 0.0861 |
| 8655. | 0.0882 | 1.791E+4 | 0.0856 |
| 8670. | 0.0883 | 1.793E+4 | 0.0858 |
| 8685. | 0.0883 | 1.794E+4 | 0.0857 |
| 8700. | 0.0891 | 1.796E+4 | 0.0855 |
| 8715. | 0.0891 | 1.797E+4 | 0.0854 |
| 8730. | 0.0896 | 1.799E+4 | 0.0855 |
| 8745. | 0.0893 | 1.8E+4 | 0.0857 |
| 8760. | 0.0884 | 1.802E+4 | 0.0856 |
| 8775. | 0.0883 | 1.803E+4 | 0.0855 |
| 8790. | 0.0892 | 1.805E+4 | 0.0852 |
| 8805. | 0.0885 | 1.806E+4 | 0.0858 |
| 8820. | 0.0882 | 1.808E+4 | 0.0856 |
| 8835. | 0.0889 | 1.809E+4 | 0.0854 |
| 8850. | 0.088 | 1.811E+4 | 0.0852 |
| 8865. | 0.088 | 1.812E+4 | 0.0858 |
| 8880. | 0.0896 | 1.814E+4 | 0.0852 |
| 8895. | 0.0882 | 1.815E+4 | 0.0854 |
| 8910. | 0.0889 | 1.817E+4 | 0.0856 |
| 8925. | 0.0884 | 1.818E+4 | 0.0854 |
| 8940. | 0.0883 | 1.82E+4 | 0.0853 |
| 8955. | 0.0885 | 1.821E+4 | 0.0853 |
| 8970. | 0.0884 | 1.823E+4 | 0.0855 |
| 8985. | 0.0884 | 1.824E+4 | 0.0857 |
| 9000. | 0.0879 | 1.826E+4 | 0.0858 |
| 9015. | 0.0877 | 1.827E+4 | 0.0855 |
| 9030. | 0.0878 | 1.829E+4 | 0.0858 |
| 9045. | 0.0881 | 1.83E+4 | 0.0858 |
| 9060. | 0.0884 | 1.832E+4 | 0.0854 |
| 9075. | 0.0885 | 1.833E+4 | 0.0849 |
| 9090. | 0.0884 | 1.835E+4 | 0.0862 |
| 9105. | 0.0883 | 1.836E+4 | 0.0858 |
| 9120. | 0.0886 | 1.838E+4 | 0.0856 |
| 9135. | 0.0876 | 1.839E+4 | 0.0859 |
| 9150. | 0.0884 | 1.841E+4 | 0.0857 |
| 9165. | 0.0882 | 1.842E+4 | 0.0861 |
| 9180. | 0.0878 | 1.844E+4 | 0.0862 |
| 9195. | 0.088 | 1.845E+4 | 0.0855 |
| 9210. | 0.0881 | 1.847E+4 | 0.086 |
| 9225. | 0.0881 | 1.848E+4 | 0.0851 |
| 9240. | 0.0882 | 1.85E+4 | 0.0854 |

## SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

## VISUAL ESTIMATION RESULTS

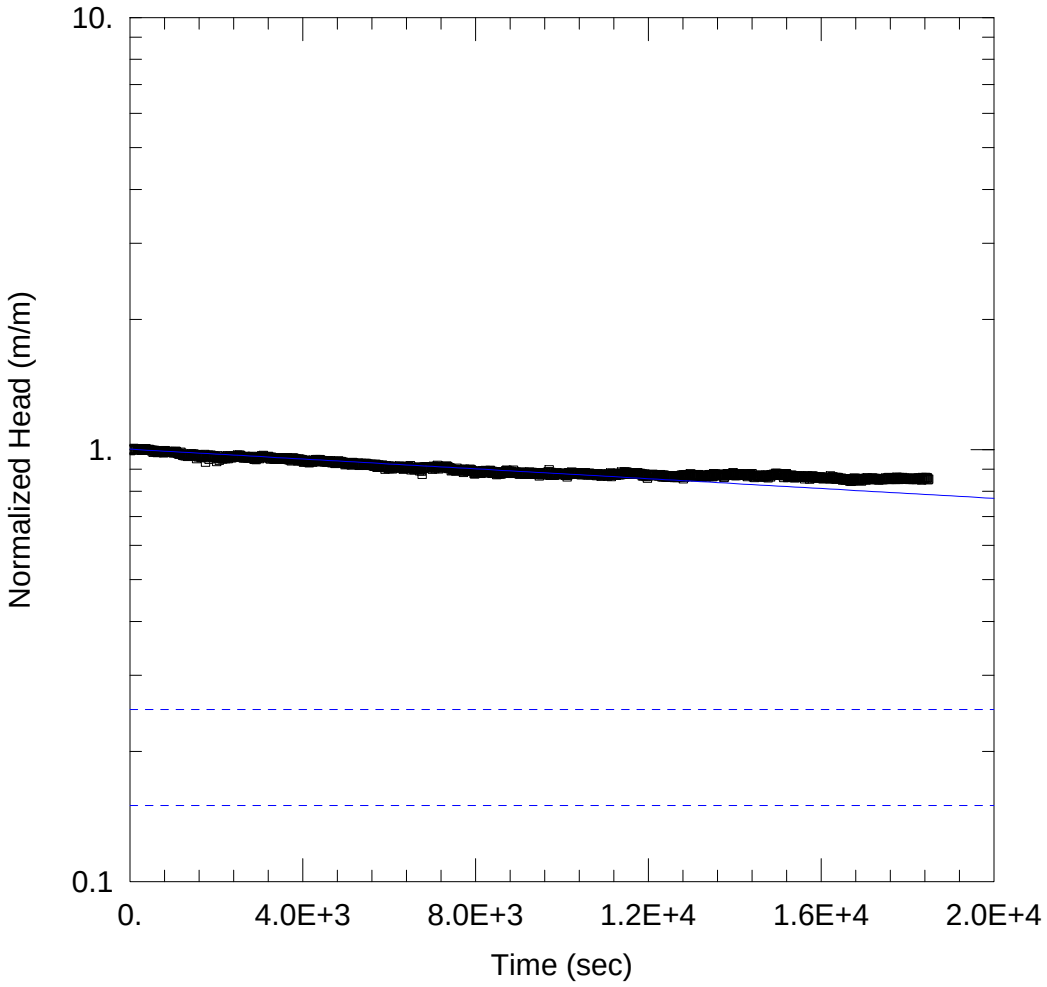
### Estimated Parameters

| Parameter | Estimate | |
|---|---|---|
| K | 2.411E-9 | m/sec |
| y0 | 0.1002 | m |

K = 2.411E-7 cm/sec
T = K*b = 1.206E-7 m²/sec (0.001206 sq. cm/sec)

NOTES

Well may not be sufficiently developed due to a slow recovery.




## MW-H32 (FALLLING HEAD SLUG TEST)

### PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H32
Test Date: 22 July 2013

### AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA (MW-H32)

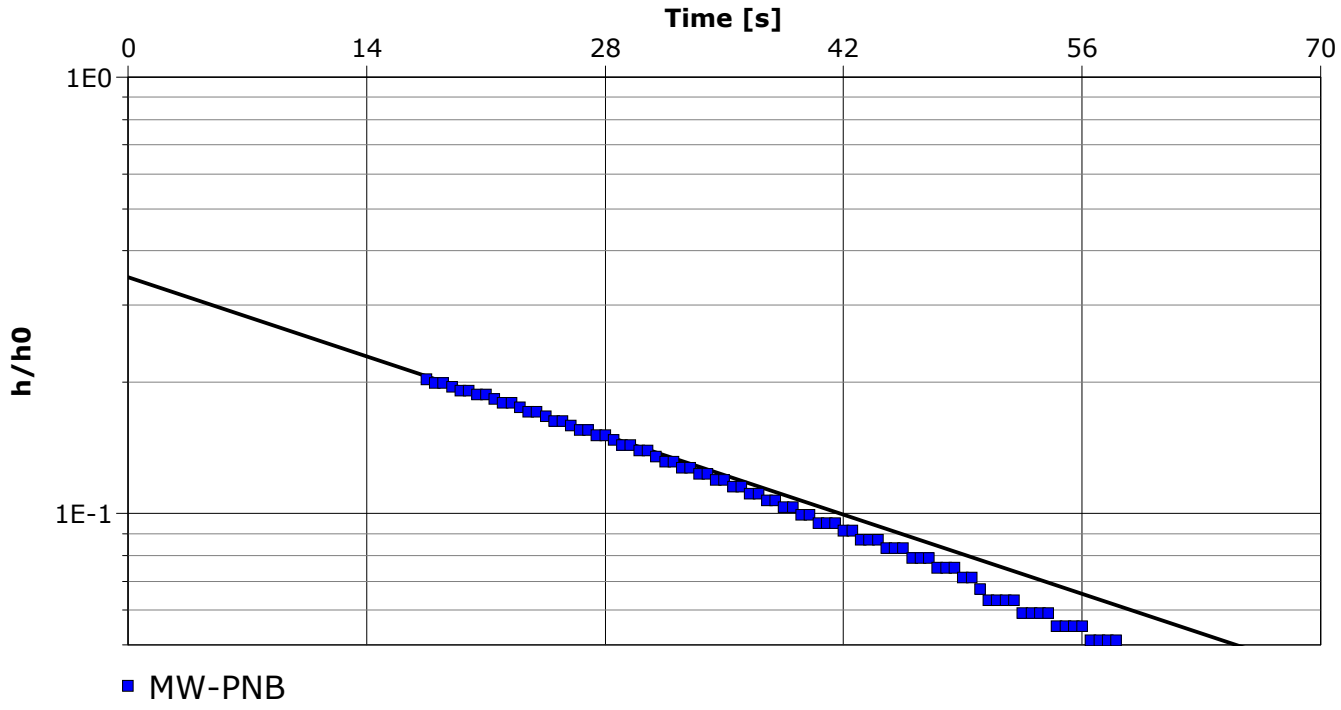
Initial Displacement: 0.1 m
Total Well Penetration Depth: 21.28 m
Casing Radius: 0.016 m
Static Water Column Height: 21.28 m
Screen Length: 3.05 m
Well Radius: 0.038 m

### SOLUTION

Aquifer Model: Confined
K = 2.411E-9 m/sec
Solution Method: Hvorslev
y0 = 0.1002 m

| | |
|---|---|
| ERM Rescan<br>1111 W. Hastings St.<br>Vancouver, BC, V6E 2J3 | **Slug Test Analysis Report** |
| | Project: Murray River Coal |
| | Number: 0194106-0002-0005 |
| | Client: HD Mining |

| | | |
|---|---|---|
| Location: | Slug Test: MW-PNB-Scenario2 | Test Well: MW-PNB |
| Test Conducted by: Tyler Gale | | Test Date: 11/6/2013 |
| Analysis Performed by: Tyler Gale | MW-PNB-Scenario2-Hv | Analysis Date: 11/18/2013 |
| Aquifer Thickness: 40.00 m | | |




Calculation using Hvorslev

| Observation Well | Hydraulic Conductivity [m/s] | |
|---|---|---|
| MW-PNB | $1.36 \times 10^{-5}$ | |

# Appendix D
## Groundwater Level Records

ERM

**Appendix D. Records of Manual Groundwater Level Measurements in Standpipe and Vibrating Wire Piezometers**

| Well ID | Coordinates Northing (m) Zone 10U (NAD83) | Coordinates Easting (m) Zone 10U (NAD83) | Top of Casing Elev. (masl) | Stick-up Height (m) | Top of Casing Elevation (masl) | Screen Interval Top (mbg) | Screen Interval Bottom (mbg) | Date | Time | Water Level mbsu | Water Level mbg | Water Level masl | Annual Mean | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-H2A | 6,101,837 | 620,575 | 1,104.341 | 0.76 | 1,104.341 | 83.00 | 88.00 | 10-Jul-11 | na | 9.350 | 8.590 | 1,094.991 | | |
| MW-H2A | 6,101,837 | 620,575 | 1,104.341 | 0.76 | 1,104.341 | 83.00 | 88.00 | 18-Oct-11 | na | 9.640 | 8.880 | 1,094.701 | | |
| MW-H2A | 6,101,837 | 620,575 | 1,104.341 | 1.19 | 1,104.341 | 83.00 | 88.00 | 13-May-12 | na | 10.818 | 9.628 | 1,093.523 | | |
| MW-H2A | 6,101,837 | 620,575 | 1,104.341 | 1.19 | 1,104.341 | 83.00 | 88.00 | 23-Aug-12 | na | 10.695 | 9.505 | 1,093.646 | | |
| MW-H2A | 6,101,837 | 620,575 | 1,104.341 | 1.19 | 1,104.341 | 83.00 | 88.00 | 6-Nov-13 | 10:00 | 10.877 | 9.687 | 1,093.464 | 1,093.957 | Pressure transducer installed November 2013 |
| MW-H2B | 6,101,831 | 620,567 | 1,103.370 | 0.35 | 1,103.370 | 9.90 | 12.90 | 10-Jul-11 | na | 5.770 | 5.420 | 1,097.600 | | |
| MW-H2B | 6,101,831 | 620,567 | 1,103.370 | 0.35 | 1,103.370 | 9.90 | 12.90 | 18-Oct-11 | na | 7.690 | 7.340 | 1,095.680 | | |
| MW-H2B | 6,101,831 | 620,567 | 1,103.370 | 0.47 | 1,103.370 | 9.90 | 12.90 | 13-May-12 | na | 6.192 | 5.722 | 1,097.178 | | |
| MW-H2B | 6,101,831 | 620,567 | 1,103.370 | 0.47 | 1,103.370 | 9.90 | 12.90 | 23-Aug-12 | na | 7.140 | 6.670 | 1,096.230 | | |
| MW-H2B | 6,101,831 | 620,567 | 1,103.370 | 0.47 | 1,103.370 | 9.90 | 12.90 | 6-Nov-13 | 10:00 | 7.225 | 6.755 | 1,096.145 | 1,096.363 | |
| MW-H3A | 6,102,191 | 621,818 | 1,215.710 | 0.45 | 1,215.700 | 183.00 | 193.00 | 7-Jul-11 | na | 26.700 | 26.250 | 1,189.000 | 1,189.000 | difficult/unsafe site access during trip after this date |
| MW-H3B | 6,102,191 | 621,821 | 1,215.700 | 0.45 | 1,215.700 | 4.50 | 8.80 | 7-Jul-11 | na | 1.830 | 1.380 | 1,213.870 | 1,213.870 | difficult/unsafe site access during trip after this date |
| MW-H5 | 6,100,571 | 620,658 | 1,102.530 | 0.68 | 1,102.500 | 27.50 | 30.50 | 9-Jul-11 | na | na | na | na | | |
| MW-H5 | 6,100,571 | 620,658 | 1,102.530 | 0.68 | 1,102.500 | 27.50 | 30.50 | 18-Oct-11 | na | na | na | na | | |
| MW-H5 | 6,100,571 | 620,658 | 1,102.530 | 0.68 | 1,102.500 | 27.50 | 30.50 | 12-May-12 | na | na | na | na | | |
| MW-H5 | 6,100,571 | 620,658 | 1,102.530 | 0.68 | 1,102.500 | 27.50 | 30.50 | 22-Aug-12 | na | na | na | na | | |
| MW-H5 | 6,100,571 | 620,658 | 1,102.530 | 0.83 | 1,102.650 | 27.50 | 30.50 | 6-Nov-13 | 11:30 | -2.1 | -2.930 | 1,104.750 | 1,104.750 | flowing artesian, pressure gauge reads 3.0 psi |
| MW-H13 | 6,098,569 | 626,086 | 821.580 | 1.27 | 822.070 | 66.00 | 69.00 | 14-Oct-11 | na | 52.710 | 51.440 | 769.360 | | |
| MW-H13 | 6,098,569 | 626,086 | 821.580 | 1.27 | 822.070 | 66.00 | 69.00 | 11-May-12 | na | 54.950 | 53.680 | 767.120 | | |
| MW-H13 | 6,098,569 | 626,086 | 821.580 | 0.78 | 821.580 | 66.00 | 69.00 | 22-Aug-12 | na | 54.688 | 53.908 | 766.892 | 767.791 | |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 1.17 | 854.347 | 94.00 | 100.00 | 13-Oct-11 | na | 52.630 | 51.460 | 801.717 | | |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 1.17 | 854.347 | 94.00 | 100.00 | 14-May-12 | na | 55.992 | 54.822 | 798.355 | | |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 1.22 | 854.397 | 94.00 | 100.00 | 23-Aug-12 | na | 55.214 | 53.994 | 799.183 | | |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 1.22 | 854.397 | 94.00 | 100.00 | 25-Oct-12 | na | 55.488 | 54.268 | 798.909 | | |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 1.22 | 854.397 | 94.00 | 100.00 | 19-Dec-12 | na | 54.880 | 53.660 | 799.517 | | |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 1.22 | 854.397 | 94.00 | 100.00 | 23-Jul-13 | na | 53.745 | 52.525 | 800.652 | | |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 1.22 | 854.397 | 94.00 | 100.00 | 11-Nov-13 | 9:30 | 48.885 | 47.665 | 805.512 | 799.722 | |
| MW-H15 | 6,098,253 | 624,907 | 854.397 | 1.22 | 854.397 | 94.00 | 100.00 | 9-Feb-14 | 8:30 | 50.805 | 49.585 | 803.592 | | |
| MW-H16 | 6,097,821 | 624,891 | 839.467 | 0.86 | 839.467 | 67.50 | 70.50 | 14-May-12 | na | 61.748 | 60.888 | 777.719 | | |
| MW-H16 | 6,097,821 | 624,891 | 839.467 | 0.86 | 839.467 | 67.50 | 70.50 | 21-Aug-12 | na | 61.580 | 60.720 | 777.887 | 777.803 | |
| MW-H16 | 6,097,821 | 624,891 | 839.467 | 0.86 | 839.467 | 67.50 | 70.50 | 8-Feb-14 | 16:30 | > 60.58 | - | - | | |
| MW-H17 | 6,097,925 | 625,520 | 829.960 | 0.66 | 829.960 | 5.50 | 8.50 | 10-May-12 | na | 5.528 | 4.868 | 824.432 | | |
| MW-H17 | 6,097,925 | 625,520 | 829.960 | 0.66 | 829.960 | 5.50 | 8.50 | 22-Aug-12 | na | 5.552 | 4.892 | 824.408 | | |
| MW-H17 | 6,097,925 | 625,520 | 829.960 | 0.66 | 829.960 | 5.50 | 8.50 | 25-Oct-12 | na | 5.740 | 5.080 | 824.220 | | |
| MW-H17 | 6,097,925 | 625,520 | 829.960 | 0.66 | 829.960 | 5.50 | 8.50 | 20-Dec-12 | na | 5.852 | 5.192 | 824.108 | | |
| MW-H17 | 6,097,925 | 625,520 | 829.960 | 0.66 | 829.960 | 5.50 | 8.50 | 23-Jul-13 | na | 5.706 | 5.046 | 824.254 | | |
| MW-H17 | 6,097,925 | 625,520 | 829.960 | 0.66 | 829.960 | 5.50 | 8.50 | 11-Nov-13 | 10:00 | 5.905 | 5.245 | 824.055 | 824.284 | |
| MW-H17 | 6,097,925 | 625,520 | 829.960 | 0.66 | 829.960 | 5.50 | 8.50 | 9-Feb-14 | 13:00 | 5.630 | 4.970 | 824.330 | | Pressure Transducer records available from July 2013 |
| MW-H18 | 6,097,953 | 625,740 | 831.697 | 0.82 | 831.697 | 10.50 | 13.50 | 10-May-12 | na | 11.956 | 11.136 | 819.741 | | |
| MW-H18 | 6,097,953 | 625,740 | 831.697 | 0.82 | 831.697 | 10.50 | 13.50 | 22-Aug-12 | na | 11.747 | 10.927 | 819.950 | | |
| MW-H18 | 6,097,953 | 625,740 | 831.697 | 0.82 | 831.697 | 10.50 | 13.50 | 25-Oct-12 | na | 11.828 | 11.008 | 819.869 | | |
| MW-H18 | 6,097,953 | 625,740 | 831.697 | 0.82 | 831.697 | 10.50 | 13.50 | 20-Dec-12 | na | 11.821 | 11.001 | 819.876 | | |
| MW-H18 | 6,097,953 | 625,740 | 831.697 | 0.82 | 831.697 | 10.50 | 13.50 | 23-Jul-13 | na | 11.707 | 10.887 | 819.990 | | |
| MW-H18 | 6,097,953 | 625,740 | 831.697 | 0.82 | 831.697 | 10.50 | 13.50 | 11-Nov-13 | 10:25 | 11.720 | 10.900 | 819.977 | 819.885 | |
| MW-H18 | 6,097,953 | 625,740 | 831.697 | 0.82 | 831.697 | 10.50 | 13.50 | 9-Feb-14 | 13:45 | 10.595 | 9.775 | 821.102 | | |
| MW-H19 | 6,098,131 | 625,663 | 833.344 | 0.77 | 833.344 | 5.70 | 8.70 | 10-May-12 | na | 4.420 | 3.650 | 828.924 | | |
| MW-H19 | 6,098,131 | 625,663 | 833.344 | 0.77 | 833.344 | 5.70 | 8.70 | 22-Aug-12 | na | 4.134 | 3.364 | 829.210 | | |
| MW-H19 | 6,098,131 | 625,663 | 833.344 | 0.77 | 833.344 | 5.70 | 8.70 | 25-Oct-12 | na | 4.366 | 3.596 | 828.978 | | |
| MW-H19 | 6,098,131 | 625,663 | 833.344 | 0.77 | 833.344 | 5.70 | 8.70 | 20-Dec-12 | na | 4.511 | 3.741 | 828.833 | | |
| MW-H19 | 6,098,131 | 625,663 | 833.344 | 0.77 | 833.344 | 5.70 | 8.70 | 23-Jul-13 | na | 4.090 | 3.320 | 829.254 | | |
| MW-H19 | 6,098,131 | 625,663 | 833.344 | 0.77 | 833.344 | 5.70 | 8.70 | 11-Nov-13 | 10:15 | 4.428 | 3.658 | 828.916 | 829.040 | |
| MW-H19 | 6,098,131 | 625,663 | 833.344 | 0.77 | 833.344 | 5.70 | 8.70 | 9-Feb-14 | 13:50 | 4.290 | 3.520 | 829.054 | | |
| MW-H20 | 6,099,766 | 624,397 | 954.200 | 0.67 | 954.075 | 37.80 | 40.80 | 14-Oct-11 | na | 25.980 | 25.310 | 928.095 | | |
| MW-H20 | 6,099,766 | 624,397 | 954.200 | 0.67 | 954.075 | 37.80 | 40.80 | 11-May-12 | na | 26.638 | 25.968 | 927.437 | | |
| MW-H20 | 6,099,766 | 624,397 | 954.200 | 0.80 | 954.200 | 37.80 | 40.80 | 22-Aug-12 | na | 26.740 | 25.945 | 927.460 | 927.664 | |

*na indicates record not available or not applicable.*

**Appendix D. Records of Manual Groundwater Level Measurements in Standpipe and Vibrating Wire Piezometers**

| Well ID | Coordinates Northing (m) Zone 10U (NAD83) | Coordinates Easting (m) Zone 10U (NAD83) | Top of Casing Elev. (masl) | Stick-up Height (m) | Top of Casing Elevation (masl) | Screen Interval Top (mbg) | Screen Interval Bottom (mbg) | Date | Time | Water Level mbsu | Water Level mbg | Water Level masl | Annual Mean | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-H21 | 6,100,259 | 625,390 | 917.000 | 1.30 | 915.700 | 50.70 | 53.70 | 8-Jul-11 | na | 25.830 | 24.530 | 889.870 | | |
| MW-H21 | 6,100,259 | 625,390 | 917.000 | 0 | 917.000 | 50.70 | 53.70 | 14-Oct-11 | na | 25.310 | 25.310 | 891.690 | | |
| MW-H21 | 6,100,259 | 625,390 | 917.000 | 0 | 917.000 | 50.70 | 53.70 | 11-May-12 | na | 26.638 | 26.638 | 890.362 | | |
| MW-H21 | 6,100,259 | 625,390 | 917.000 | 0 | 917.000 | 50.70 | 53.70 | 22-Aug-12 | na | 26.020 | 26.020 | 890.980 | 25.989 | |
| MW-H22 | 6,096,815 | 624,960 | 784.422 | 0.85 | 784.422 | 22.10 | 25.10 | 11-May-12 | na | 19.558 | 18.708 | 764.864 | | |
| MW-H22 | 6,096,815 | 624,960 | 784.422 | 0.85 | 784.422 | 22.10 | 25.10 | 21-Aug-12 | na | 20.540 | 19.690 | 763.882 | | |
| MW-H22 | 6,096,815 | 624,960 | 784.422 | 0.85 | 784.422 | 22.10 | 25.10 | 28-Oct-12 | na | 21.730 | 20.880 | 762.692 | | |
| MW-H22 | 6,096,815 | 624,960 | 784.422 | 0.85 | 784.422 | 22.10 | 25.10 | 19-Dec-12 | na | 22.022 | 21.172 | 762.400 | | |
| MW-H22 | 6,096,815 | 624,960 | 784.422 | 0.85 | 784.422 | 22.10 | 25.10 | 21-Jul-13 | na | 19.680 | 18.830 | 764.742 | | |
| MW-H22 | 6,096,815 | 624,960 | 784.422 | 0.85 | 784.422 | 22.10 | 25.10 | 6-Nov-13 | 15:50 | 21.510 | 20.660 | 762.912 | 763.460 | |
| MW-H22 | 6,096,815 | 624,960 | 784.422 | 0.85 | 784.422 | 22.10 | 25.10 | 8-Feb-14 | 12:30 | 21.715 | 20.865 | 762.707 | | |
| MW-H23 | 6,096,618 | 624,942 | 785.698 | 0.78 | 785.698 | 22.10 | 25.10 | 11-May-12 | na | 20.937 | 20.157 | 764.761 | | |
| MW-H23 | 6,096,618 | 624,942 | 785.698 | 0.78 | 785.698 | 22.10 | 25.10 | 21-Aug-12 | na | 22.361 | 21.581 | 763.337 | | |
| MW-H23 | 6,096,618 | 624,942 | 785.698 | 0.78 | 785.698 | 22.10 | 25.10 | 28-Oct-12 | na | 23.496 | 22.716 | 762.202 | | |
| MW-H23 | 6,096,618 | 624,942 | 785.698 | 0.78 | 785.698 | 22.10 | 25.10 | 19-Dec-12 | na | 23.773 | 22.993 | 761.925 | | |
| MW-H23 | 6,096,618 | 624,942 | 785.698 | 0.78 | 785.698 | 22.10 | 25.10 | 21-Jul-13 | na | 21.480 | 20.700 | 764.218 | | |
| MW-H23 | 6,096,618 | 624,942 | 785.698 | 0.78 | 785.698 | 22.10 | 25.10 | 6-Nov-13 | 15:40 | 23.294 | 22.514 | 762.404 | 763.056 | |
| MW-H23 | 6,096,618 | 624,942 | 785.698 | 0.78 | 785.698 | 22.10 | 25.10 | 8-Feb-14 | 9:00 | 23.440 | 22.660 | 762.258 | | Pressure Transducer records available from July 2013 |
| MW-H24A | 6,099,756 | 628,116 | 832.000 | 0.90 | 832.000 | 44.85 | 47.90 | 1-Nov-12 | na | 19.720 | 18.820 | 812.280 | | |
| MW-H24A | 6,099,756 | 628,116 | 832.000 | 0.90 | 832.000 | 44.85 | 47.90 | 18-Dec-12 | na | 16.025 | 15.125 | 815.975 | | |
| MW-H24A | 6,099,756 | 628,116 | 832.000 | 0.90 | 832.000 | 44.85 | 47.90 | 7-May-13 | na | 16.462 | 15.562 | 815.538 | | |
| MW-H24A | 6,099,756 | 628,116 | 832.000 | 0.90 | 832.000 | 44.85 | 47.90 | 31-Jul-13 | na | 16.200 | 15.300 | 815.800 | | |
| MW-H24A | 6,099,756 | 628,116 | 832.000 | 0.90 | 832.000 | 44.85 | 47.90 | 7-Nov-13 | 8:55 | 16.345 | 15.445 | 815.655 | 815.771 | |
| MW-H24B | 6,099,756 | 628,119 | 832.000 | 0.40 | 832.000 | 5.55 | 8.60 | 1-Nov-12 | na | 5.956 | 5.556 | 826.044 | | |
| MW-H24B | 6,099,756 | 628,119 | 832.000 | 0.40 | 832.000 | 5.55 | 8.60 | 18-Dec-12 | na | 5.973 | 5.573 | 826.027 | | |
| MW-H24B | 6,099,756 | 628,119 | 832.000 | 0.40 | 832.000 | 5.55 | 8.60 | 7-May-13 | na | 2.842 | 2.442 | 829.158 | | |
| MW-H24B | 6,099,756 | 628,119 | 832.000 | 0.40 | 832.000 | 5.55 | 8.60 | 31-Jul-13 | na | 4.860 | 4.460 | 827.140 | | |
| MW-H24B | 6,099,756 | 628,119 | 832.000 | 0.40 | 832.000 | 5.55 | 8.60 | 7-Nov-13 | 8:55 | 5.898 | 5.498 | 826.102 | 827.442 | |
| MW-H24B | 6,099,756 | 628,119 | 832.000 | 0.40 | 832.000 | 5.55 | 8.60 | 10-Feb-14 | 15:45 | 4.800 | 4.400 | 827.200 | | |
| MW-H24C | 6,099,625 | 627,954 | 825.000 | 0.92 | 825.000 | 9.23 | 12.28 | 31-Jul-13 | na | 2.515 | 1.595 | 822.485 | | |
| MW-H24C | 6,099,625 | 627,954 | 825.000 | 0.92 | 825.000 | 9.23 | 12.28 | 10-Nov-13 | 9:15 | 3.415 | 2.495 | 821.585 | | |
| MW-H24C | 6,099,625 | 627,954 | 825.000 | 0.92 | 825.000 | 9.23 | 12.28 | 13-Feb-14 | 12:45 | 3.200 | 2.280 | 821.800 | 821.957 | |
| MW-H25A | 6,099,615 | 627,334 | 766.000 | 0.70 | 766.000 | 58.95 | 62.00 | 1-Nov-12 | na | 1.315 | 0.615 | 764.685 | | |
| MW-H25A | 6,099,615 | 627,334 | 766.000 | 0.70 | 766.000 | 58.95 | 62.00 | 18-Dec-12 | na | 0.700 | 0.000 | 765.300 | | |
| MW-H25A | 6,099,615 | 627,334 | 766.000 | 0.70 | 766.000 | 58.95 | 62.00 | 7-May-13 | na | 0.890 | 0.190 | 765.110 | | |
| MW-H25A | 6,099,615 | 627,334 | 766.000 | 0.70 | 766.000 | 58.95 | 62.00 | 31-Jul-13 | na | 2.744 | 2.044 | 763.256 | | |
| MW-H25A | 6,099,615 | 627,334 | 766.000 | 0.70 | 766.000 | 58.95 | 62.00 | 5-Nov-13 | 10:00 | 2.765 | 2.065 | 763.235 | 764.555 | |
| MW-H25A | 6,099,615 | 627,334 | 766.000 | 0.70 | 766.000 | 58.95 | 62.00 | 13-Feb-14 | 9:15 | 2.570 | 1.870 | 763.430 | | MW-H25B purged/sampled previous day (2 m away) |
| MW-H25B | 6,099,615 | 627,332 | 766.000 | 0.70 | 766.000 | 1.55 | 4.60 | 1-Nov-12 | na | 0.840 | 0.140 | 765.160 | | |
| MW-H25B | 6,099,615 | 627,332 | 766.000 | 0.70 | 766.000 | 1.55 | 4.60 | 18-Dec-12 | na | 0.790 | 0.090 | 765.210 | | |
| MW-H25B | 6,099,615 | 627,332 | 766.000 | 0.70 | 766.000 | 1.55 | 4.60 | 7-May-13 | na | 0.842 | 0.142 | 765.158 | | |
| MW-H25B | 6,099,615 | 627,332 | 766.000 | 0.70 | 766.000 | 1.55 | 4.60 | 31-Jul-13 | na | 0.776 | 0.076 | 765.224 | | |
| MW-H25B | 6,099,615 | 627,332 | 766.000 | 0.70 | 766.000 | 1.55 | 4.60 | 8-Nov-13 | 14:00 | 0.840 | 0.140 | 765.160 | 765.197 | |
| MW-H25B | 6,099,615 | 627,332 | 766.000 | 0.70 | 766.000 | 1.55 | 4.60 | 12-Feb-14 | 14:00 | 0.670 | -0.030 | 765.330 | | ice at indicated water level, approx. 10 cm thick |
| MW-H26A | 6,098,990 | 627,478 | 792.000 | 0.78 | 792.000 | 29.84 | 32.89 | 29-Oct-12 | na | 0.822 | 0.042 | 791.178 | | |
| MW-H26A | 6,098,990 | 627,478 | 792.000 | 0.78 | 792.000 | 29.84 | 32.89 | 18-Dec-12 | na | 0.800 | 0.020 | 791.200 | | |
| MW-H26A | 6,098,990 | 627,478 | 792.000 | 0.78 | 792.000 | 29.84 | 32.89 | 7-May-13 | na | 1.265 | 0.485 | 790.735 | | |
| MW-H26A | 6,098,990 | 627,478 | 792.000 | 0.78 | 792.000 | 29.84 | 32.89 | 31-Jul-13 | na | 1.175 | 0.395 | 790.825 | | |
| MW-H26A | 6,098,990 | 627,478 | 792.000 | 0.78 | 792.000 | 29.84 | 32.89 | 7-Nov-13 | 10:30 | 1.367 | 0.587 | 790.633 | 790.920 | |
| MW-H26A | 6,098,990 | 627,478 | 792.000 | 0.78 | 792.000 | 29.84 | 32.89 | 10-Feb-14 | 11:10 | 1.490 | 0.710 | 790.510 | | Pressure Transducer records available from July 2013 |
| MW-H26B | 6,098,987 | 627,485 | 792.000 | 0.65 | 792.000 | 1.55 | 4.60 | 1-Nov-12 | na | 2.258 | 1.608 | 789.742 | | |
| MW-H26B | 6,098,987 | 627,485 | 792.000 | 0.65 | 792.000 | 1.55 | 4.60 | 18-Dec-12 | na | 1.810 | 1.160 | 790.190 | | |
| MW-H26B | 6,098,987 | 627,485 | 792.000 | 0.65 | 792.000 | 1.55 | 4.60 | 7-May-13 | na | 1.307 | 0.657 | 790.693 | | |
| MW-H26B | 6,098,987 | 627,485 | 792.000 | 0.65 | 792.000 | 1.55 | 4.60 | 31-Jul-13 | na | 1.476 | 0.826 | 790.524 | | |
| MW-H26B | 6,098,987 | 627,485 | 792.000 | 0.65 | 792.000 | 1.55 | 4.60 | 7-Nov-13 | 10:30 | 1.935 | 1.285 | 790.065 | 790.469 | |
| MW-H26B | 6,098,987 | 627,485 | 792.000 | 0.65 | 792.000 | 1.55 | 4.60 | 11-Feb-14 | 11:15 | 1.705 | 1.055 | 790.295 | | Pressure Transducer records available from July 2013 |

*na indicates record not available or not applicable.*

**Appendix D. Records of Manual Groundwater Level Measurements in Standpipe and Vibrating Wire Piezometers**

| Well ID | Coordinates Northing (m) Zone 10U (NAD83) | Coordinates Easting (m) Zone 10U (NAD83) | Top of Casing Elev. (masl) | Stick-up Height (m) | Top of Casing Elevation (masl) | Screen Interval Top (mbg) | Screen Interval Bottom (mbg) | Date | Time | Water Level mbsu | Water Level mbg | Water Level masl | Annual Mean | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-H27 | 6,098,578 | 627,607 | 810 | 0.47 | 810 | 34.58 | 37.63 | 31-Jul-13 | na | 10.365 | 9.895 | 799.635 | | |
| MW-H27 | 6,098,578 | 627,607 | 810 | 0.47 | 810 | 34.58 | 37.63 | 8-Nov-13 | 12:15 | 10.436 | 9.966 | 799.564 | | |
| MW-H27 | 6,098,578 | 627,607 | 810 | 0.47 | 810 | 34.58 | 37.63 | 10-Feb-14 | 9:15 | 10.510 | 10.040 | 799.490 | 799.563 | |
| MW-H28 | 6,098,772 | 627,715 | 819 | 0.70 | 819 | 13.92 | 16.97 | 31-Jul-13 | na | 12.591 | 11.891 | 806.409 | | |
| MW-H28 | 6,098,772 | 627,715 | 819 | 0.70 | 819 | 13.92 | 16.97 | 8-Nov-13 | 16:15 | 12.798 | 12.098 | 806.202 | | |
| MW-H28 | 6,098,772 | 627,715 | 819 | 0.70 | 819 | 13.92 | 16.97 | 12-Feb-14 | 10:10 | 11.520 | 10.820 | 807.480 | 806.697 | |
| MW-H29 | 6,099,198 | 627,938 | 826 | 0.70 | 826 | 8.26 | 11.31 | 31-Jul-13 | na | 5.578 | 4.878 | 820.422 | | |
| MW-H29 | 6,099,198 | 627,938 | 826 | 0.70 | 826 | 8.26 | 11.31 | 9-Nov-13 | na | 5.788 | 5.088 | 820.212 | 820.317 | |
| MW-H29 | 6,099,198 | 627,938 | 826 | 0.70 | 826 | 8.26 | 11.31 | 10-Feb-14 | 10:00 | 5.260 | 4.560 | 820.740 | | |
| MW-H30 | 6,098,501 | 627,372 | 793 | 0.73 | 793 | 11.46 | 14.51 | 31-Jul-13 | na | 13.644 | 12.914 | 779.356 | | |
| MW-H30 | 6,098,501 | 627,372 | 793 | 0.73 | 793 | 11.46 | 14.51 | 8-Nov-13 | 13:20 | 10.140 | 9.410 | 782.860 | | |
| MW-H30 | 6,098,501 | 627,372 | 793 | 0.73 | 793 | 11.46 | 14.51 | 11-Feb-14 | 11:25 | 9.160 | 8.430 | 783.840 | 782.019 | |
| MW-H31 | 6,099,893 | 627,456 | 798 | 0.68 | 798 | 27.37 | 30.42 | 31-Jul-13 | na | 15.703 | 15.023 | 782.297 | | |
| MW-H31 | 6,099,893 | 627,456 | 798 | 0.68 | 798 | 27.37 | 30.42 | 9-Nov-13 | 17:00 | 16.738 | 16.058 | 781.262 | 781.780 | |
| MW-H32 | 6,099,810 | 628,333 | 840 | 0.37 | 840 | 27.08 | 30.13 | 31-Jul-13 | na | 10.771 | 10.401 | 829.229 | | |
| MW-H32 | 6,099,810 | 628,333 | 840 | 0.37 | 840 | 27.08 | 30.13 | 10-Nov-13 | 16:10 | 11.195 | 10.825 | 828.805 | | |
| MW-H32 | 6,099,810 | 628,333 | 840 | 0.37 | 840 | 27.08 | 30.13 | 13-Feb-14 | 10:45 | 9.270 | 8.900 | 830.730 | 829.588 | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.27 | 778.983 | 45.50 | 48.50 | 6-Jul-11 | na | 13.050 | 11.780 | 765.933 | | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.27 | 778.983 | 45.50 | 48.50 | 15-Oct-11 | na | 13.070 | 11.800 | 765.913 | | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.14 | 778.853 | 45.50 | 48.50 | 11-May-12 | na | 14.820 | 13.680 | 764.033 | | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.14 | 778.853 | 45.50 | 48.50 | 21-Aug-12 | na | 14.057 | 12.917 | 764.796 | | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.14 | 778.853 | 45.50 | 48.50 | 19-Dec-12 | na | 15.206 | 14.066 | 763.647 | | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.14 | 778.853 | 45.50 | 48.50 | 7-May-13 | na | 14.102 | 12.962 | 764.751 | | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.14 | 778.853 | 45.50 | 48.50 | 21-Jul-13 | na | 13.575 | 12.435 | 765.278 | | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.14 | 778.853 | 45.50 | 48.50 | 6-Nov-13 | 16:00 | 14.678 | 13.538 | 764.175 | 764.846 | |
| MW-PNB | 6,097,114 | 625,101 | 778.853 | 1.14 | 778.853 | 45.50 | 48.50 | 8-Feb-14 | 14:45 | 14.615 | 13.475 | 764.238 | | |
| MW-Shaft | 6,098,150 | 625,176 | 846.032 | 0.90 | 846.032 | 2.10 | 5.10 | 9-Jul-11 | na | 3.275 | 2.375 | 842.757 | | |
| MW-Shaft | 6,098,150 | 625,176 | 846.032 | 0.90 | 846.032 | 2.10 | 5.10 | 22-Aug-12 | na | 4.445 | 3.545 | 841.587 | | |
| MW-Shaft | 6,098,150 | 625,176 | 846.032 | 0.90 | 846.032 | 2.10 | 5.10 | 25-Oct-12 | na | 4.785 | 3.885 | 841.247 | | |
| MW-Shaft | 6,098,150 | 625,176 | 846.032 | 0.90 | 846.032 | 2.10 | 5.10 | 20-Dec-12 | na | 3.985 | 3.085 | 842.047 | | |
| MW-Shaft | 6,098,150 | 625,176 | 846.032 | 0.90 | 846.032 | 2.10 | 5.10 | 23-Jul-13 | na | 4.235 | 3.335 | 841.797 | | |
| MW-Shaft | 6,098,150 | 625,176 | 846.032 | 0.90 | 846.032 | 2.10 | 5.10 | 11-Nov-13 | 9:45 | 4.330 | 3.430 | 841.702 | 841.697 | |
| MW-Shaft | 6,098,150 | 625,176 | 846.032 | 0.90 | 846.032 | 2.10 | 5.10 | 9-Feb-14 | 11:00 | 3.815 | 2.915 | 842.217 | | |
| VWP-H7-1MPa | 6,100,872 | 622,015 | 1,131.500 | na | na | 92.50 | | 4-Apr-11 | na | na | -11.099 | 1142.60 | | |
| | 6,100,872 | 622,015 | 1,131.500 | na | na | 92.50 | | 13-May-12 | na | na | -0.292 | 1131.79 | | |
| | 6,100,872 | 622,015 | 1,131.500 | na | na | 92.50 | | 24-Aug-12 | na | na | 2.880 | 1128.62 | | |
| VWP-H7-2MPa | 6,100,872 | 622,015 | 1,131.500 | na | na | 207.50 | | 4-Apr-11 | na | na | -0.740 | 1132.24 | | |
| | 6,100,872 | 622,015 | 1,131.500 | na | na | 207.50 | | 13-May-12 | na | na | 4.076 | 1127.42 | | |
| | 6,100,872 | 622,015 | 1,131.500 | na | na | 207.50 | | 24-Aug-12 | na | na | 6.640 | 1124.86 | | |
| VWP-H12-1MPa | 6,100,659 | 624,446 | 1,120.800 | na | na | 116.00 | | 4-Apr-11 | na | na | 15.609 | 1105.19 | | |
| | 6,100,659 | 624,446 | 1,120.800 | na | na | 116.00 | | 24-Aug-12 | na | na | 24.190 | 1096.61 | | |
| VWP-H12-2MPa | 6,100,659 | 624,446 | 1,120.800 | na | na | 210.00 | | 4-Apr-11 | na | na | 78.288 | 1042.51 | | |
| | 6,100,659 | 624,446 | 1,120.800 | na | na | 210.00 | | 24-Aug-12 | na | na | 81.660 | 1039.14 | | |
| TH12-03* | 6,096,785 | 624,886 | 783.804 | 0.79 | 783.804 | na | na | 25-Aug-12 | na | 20.018 | 19.228 | 763.786 | 763.786 | |

*na indicates record not available or not applicable.*

# Appendix E

## Supplemental Groundwater Quality Inforation

ERM

**Appendix E1. Water Quality Results and Guideline Exceedances for Well Installed in the Camp Creek Basin: Physical Parameters, Anions, Nutrients, and Aggregate Organics**

| Well ID | | | | MW-H2A | | | | MW-H2B | | | | | MW-H5 | | | | | MW-20 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 10-JUL-11 | 18-OCT-11 | 13-MAY-12 | 23-AUG-12 | 10-JUL-11 | 18-OCT-11 | 13-MAY-12 | 23-AUG-12 | 13-MAY-14 | 09-JUL-11 | 18-OCT-11 | 12-MAY-12 | 22-AUG-12 | 08-MAY-14 | 08-JUL-11 | 17-OCT-11 | 14-MAY-12 | 22-AUG-12 |
| Time Sampled | | BC MOE FWAL | DW | 00:00 | 12:00 | 00:00 | 00:00 | 00:00 | 12:00 | 00:00 | 00:00 | 14:00 | 00:00 | 12:00 | 00:00 | 00:00 | 16:00 | 00:00 | 12:00 | 00:00 | 00:00 |
| ALS Sample ID | Units | Gudielines [A] | Guidelines [A] | L1031047-6 | L1074937-1 | L1147583-5 | L1201463-3 | L1031047-1 | L1074937-2 | L1147583-6 | L1201463-4 | L1455515-3 | L1031047-3 | L1074937-3 | L1147583-9 | L1201465-2 | L1453879-1 | L1031047-2 | L1074937-6 | L1147583-2 | L1201465-6 |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | | | |
| pH | - | 6.5-9.0 [D, G] | 6.5-8.5 | - | 8.85 | 8.57 | 8.71 | - | 8.26 | 8.31 | 7.87 | 7.5 | - | 7.9 | 7.48 | 6.87 | - | - | 9.0 | 8.57 | 8.63 |
| Oxidation-Reduction Potential | mV | ng | | - | - | - | -20 | - | - | - | 190 | 50 | - | - | - | 50 | - | - | - | - | -30 |
| Specific Conductance | µS/cm | ng | | - | 1578 | 1596 | 1584 | - | 345 | 435 | 271 | 322 | - | 622 | 648 | 699 | - | - | 1373 | 1458 | 1401 |
| Turbidity | NTU | na | | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - |
| Temperature | °C | na | | - | 4.8 | 5.8 | 5.1 | - | 3.9 | 9.0 | 6.1 | 6.1 | - | 4.8 | 6.1 | 8.0 | - | - | 5.6 | 7.4 | 9.4 |
| **Physical Tests (Laboratory)** | | | | | | | | | | | | | | | | | | | | | |
| Colour, True | | na [D] | | 6.9 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 15.0 | 10.7 |
| Conductivity | µS/cm | ng | | 1200 | 1540 | 1580 | 1510 | 279 | 332 | 280 | 262 | 326 | 587 | 598 | 570 | 548 | 564 | 655 | 1340 | 1350 | 1320 |
| Hardness (as $CaCO_3$) | mg/L | ng | | 27.4 | 29.5 | 32.1 | 28.7 | 134 | 145 | 151 | 140 | 160 | 295 | 293 | 312 | 309 | 309 | 146 | 7.49 | 8.89 | 7.32 |
| pH | | 6.5-9.0 [D, G] | | 8.48 | 8.69 | 8.71 | 8.64 | 7.97 | 8.27 | 8.24 | 8.25 | 8.21 | 7.87 | 8.14 | 8.12 | 8.17 | 7.99 | 8.30 | 8.75 | 8.65 | 8.63 |
| Total Suspended Solids | mg/L | ng | | 6000 | 89.3 | 49.0 | 10.8 | 282 | 4.0 | 745 | 548 | <3.0 | 178 | 10.7 | 19.7 | 3.1 | 5.7 | 554 | 256 | 33.0 | 12.1 |
| Total Dissolved Solids | mg/L | ng | | - | - | 1220 | - | - | - | 162 | - | 200 | - | - | 316 | - | 324 | - | - | 888 | - |
| Turbidity | NTU | na | | >4000 | 712 | 161 | 43.0 | 314 | 4.27 | 76.9 | 105 | 0.53 | 376 | 11.6 | 6.78 | 7.09 | 19.4 | 561 | 612 | 38.8 | 19.8 |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | ng | | <1.0 | <1.0 | <1.0 | <1.0 | 2.8 | 1.3 | 1.8 | <1.0 | <1.0 | 4.0 | 4.1 | 5.0 | 2.4 | 5.1 | <1.0 | <1.0 | <1.0 | <1.0 |
| Alkalinity, Bicarbonate (as $CaCO_3$) | mg/L | ng | | 622 | 804 | 887 | 839 | 134 | 160 | 135 | 134 | 158 | 327 | 320 | 316 | 331 | 319 | 383 | 659 | 724 | 717 |
| Alkalinity, Carbonate (as $CaCO_3$) | mg/L | ng | | 38 | 72.3 | 58.0 | 44.4 | <1.0 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 | <2.0 | <2.0 | 2.3 | 58.5 | 65.6 | 48.2 |
| Alkalinity, Hydroxide (as $CaCO_3$) | mg/L | ng | | <10 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Alkalinity, Total (as $CaCO_3$) | mg/L | ng | | 660 | 877 | 937 | 883 | 134 | 160 | 135 | 134 | 158 | 327 | 320 | 316 | 331 | 319 | 385 | 717 | 773 | 765 |
| Ammonia, Total (as N) | mg/L | 0.45 to 29 [H] | | 0.123 | - | <0.0050 | 0.548 | 0.0195 | - | <0.0050 | 0.0063 | <0.0050 | 0.180 | - | 0.158 | 0.175 | 0.167 | 0.722 | - | 0.0170 | 0.366 |
| Bromide (Br) | mg/L | ng | | <0.50 | <0.50 | <0.50 | <1.0 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.50 | <0.50 | <0.050 |
| Chloride (Cl) | mg/L | 150 [C] | 250 | 10.4 | 9.1 | 10.6 | 13 | 5.67 | 7.90 | 8.31 | 4.81 | 9.65 | 5.35 | 0.78 | <0.50 | <0.50 | <0.50 | 2.99 | <5.0 | <5.0 | <0.50 |
| Fluoride (F) | mg/L | K | 1 [C] | 1.60 | 1.43 | 1.68 | 1.49 | 0.099 | 0.110 | 0.091 | 0.084 | 0.076 | 0.154 | 0.150 | 0.146 | 0.147 | 0.150 | 0.879 | 1.97 | 2.07 | 0.226 |
| Nitrate (as N) | mg/L | 3 [C] | 10 [L] | <0.050 | <0.050 | <0.050 | <0.10 | <0.0050 | 0.0116 | 0.0722 | 0.0775 | 0.407 | <0.0050 | 0.0103 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 | <0.050 | <0.0050 |
| Nitrite (as N) | mg/L | 0.02 [C] | 1 | <0.010 | <0.010 | <0.010 | <0.020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.010 | <0.010 | <0.0010 |
| Total Kjeldahl Nitrogen | mg/L | ng | | 1.02 | - | 0.973 | 0.729 | 0.603 | - | 0.615 | 0.272 | <0.081 | 0.473 | - | 0.238 | 0.250 | 0.172 | 1.41 | - | 0.791 | 0.550 |
| Total Nitrogen | mg/L | ng | | 1.02 | - | 0.973 | 0.73 | 0.603 | - | 0.688 | 0.350 | 0.406 | 0.473 | - | 0.238 | 0.250 | 0.172 | 1.41 | - | 0.791 | 0.550 |
| Orthophosphate-Dissolved (as P) | mg/L | ng | | 0.0947 | 0.222 | 0.186 | 0.158 | 0.0249 | 0.0014 | 0.0015 | 0.0024 | 0.0025 | 0.0015 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.108 | 0.352 | 0.430 |
| Phosphorus (P)-Total Dissolved | mg/L | between 0.005 and 0.015 [B, E] | | 0.131 | 0.220 | 0.0996 | 0.167 | 0.348 | <0.0020 | 0.0022 | 0.0029 | 0.0026 | 0.301 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.00990 | 0.120 | 0.331 | 0.442 |
| Phosphorus (P)-Total | mg/L | refer to dissolved component | 0.01 [E] | 6.45 | 0.567 | 0.376 | 0.261 | 0.379 | 0.0089 | 0.582 | 0.147 | 0.0029 | 0.364 | 0.0287 | 0.0302 | 0.0119 | 0.0057 | 0.255 | 0.487 | 0.475 | 0.518 |
| Sulfate ($SO_4$) | mg/L | 128 to 429 [F] | 500 | 11.9 | <5.0 | <5.0 | <10 | 11.7 | 7.51 | 4.34 | 4.09 | 4.15 | 12.8 | 12.6 | 12.2 | 12.1 | 12.8 | 5.02 | 29.0 | 9.9 | <0.50 |
| **Organic / Inorganic Carbon** | | | | | | | | | | | | | | | | | | | | | |
| Total Organic Carbon | mg/L | na [D] | 4 [M] | 227 | - | 9.6 | 2.52 | 19.9 | - | 5.42 | 4.61 | 0.75 | 5.65 | - | 0.83 | 1.03 | 0.83 | 24.9 | - | 10.0 | 6.29 |
| **Aggregate Organics** | | | | | | | | | | | | | | | | | | | | | |
| COD | mg/L | | | 442 | | 47 | | 117 | | 59 | | | 33 | | <20 | | | 60 | | 47 | |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

[M] *Applicable for treatment with chlorination.*

**Appendix E2. Water Quality Results and Guideline Exceedances for Well Installed at the Mine Sites: Physical Parameters, Anions, Nutrients, and Aggregate Organics**

| Well ID | | | | MW-H15 | | | MW-H16 | | MW-H17 | | | | | | MW-H18 | | | | MW-H19 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 19-OCT-11 | 14-MAY-12 | 23-AUG-12 | 16-OCT-11 | 14-MAY-12 | 10-MAY-12 | 22-AUG-12 | 25-OCT-12 | 20-DEC-12 | 09-FEB-14 | 11-MAY-14 | 10-MAY-12 | 22-AUG-12 | 25-OCT-12 | 20-DEC-12 | 10-MAY-12 | 22-AUG-12 | 25-OCT-12 | 20-DEC-12 |
| Time Sampled | | BC FWAL | DW | 12:00 | 00:00 | 00:00 | 12:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 14:20 | 14:30 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 |
| ALS Sample ID | Units | Gudielines [A] | Guidelines [A] | L1074937-4 | L1147583-3 | L1201463-2 | L1074937-5 | L1147583-4 | L1147583-16 | L1201465-7 | L1230640-5 | L1252558-1 | L1422942-1 | L1453879-8 | L1147583-15 | L1201465-3 | L1230640-3 | L1252558-2 | L1147583-14 | L1201465-4 | L1230640-4 | L1252558-3 |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | | | | |
| pH | - | 6.5-9.0 [D, G] | 6.5-8.5 | 8.8 | 8.82 | - | 9.1 | - | 7.58 | 7.5 | 7.21 | - | 7.59 | 7.25 | 7.65 | 7.19 | 7.32 | - | - | 7.0 | 7.36 | - |
| Oxidation-Reduction Potential | mV | ng | | - | - | - | - | - | - | 190 | 10 | - | 0 | -30 | - | 180 | 20 | - | - | 50 | 40 | - |
| Specific Conductance | µS/cm | ng | | 1028 | 1956 | - | 1137 | - | 570 | 560 | 420 | - | 456 | 526 | 566 | 510 | 480 | - | - | 651 | 339 | - |
| Temperature | °C | na | | 6.5 | 7.7 | - | 5.2 | - | 5.8 | 15.2 | 6.1 | - | 4.0 | 6.1 | 7.0 | 16.4 | 6.1 | - | - | 14.9 | 6.7 | - |
| **Physical Tests (Laboratory)** | | | | | | | | | | | | | | | | | | | | | | |
| Colour, True | | na [D] | | 38.8 | 25.5 | 24.0 | 14.4 | - | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 17.7 | 7.2 | <5.0 | <5.0 |
| Conductivity | µS/cm | ng | | 1800 | 1870 | 1830 | 1090 | - | 529 | 505 | 561 | 548 | 517 | 522 | 494 | 466 | 494 | 503 | 540 | 529 | 500 | 494 |
| Hardness (as $CaCO_3$) | mg/L | ng | | 33.7 | 17.7 | 18.5 | 12.1 | 128 | 267 | 261 | 211 | 227 | 266 | 283 | 188 | 259 | 262 | 264 | 35.0 | 123 | 127 | 136 |
| pH | | 6.5-9.0 [D, G] | | 8.41 | 8.78 | 8.51 | 8.35 | - | 8.25 | 8.10 | 8.19 | 8.13 | 8.23 | 8.03 | 8.22 | 7.94 | 8.02 | 8.00 | 8.24 | 8.10 | 8.09 | 8.27 |
| Total Suspended Solids | mg/L | ng | | 1060 | 122 | 75.8 | 5220 | - | 312 | 36.9 | 86.7 | 66.7 | <3.0 | <3.0 | 2930 | 85.7 | 30.1 | 151 | 794 | 402 | 13.5 | <3.0 |
| Total Dissolved Solids | mg/L | ng | | - | 1250 | - | - | - | 329 | - | - | - | - | 313 | 313 | - | - | - | 678 | - | - | - |
| Turbidity | NTU | na | | 1730 | 97.2 | 40.4 | >4000 | - | 104 | 59.6 | 84.2 | 107 | 2.17 | 2.54 | 1310 | 26.0 | 17.2 | 40.1 | 743 | 401 | 7.23 | 5.86 |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | ng | | <1.0 | <1.0 | <1.0 | <50 | - | 1.2 | 3.8 | 2.6 | 3.9 | 1.5 | 3.6 | 2.0 | 122 | 5.4 | 6.6 | 1.2 | 3.3 | 3.8 | <1.0 |
| Alkalinity, Bicarbonate (as $CaCO_3$) | mg/L | ng | | 514 | 577 | 566 | 615 | - | 278 | 278 | 295 | 282 | 277 | 291 | 260 | 267 | 273 | 266 | 188 | 297 | 284 | 287 |
| Alkalinity, Carbonate (as $CaCO_3$) | mg/L | ng | | <1.0 | 61.9 | 21.4 | 21.6 | - | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 |
| Alkalinity, Hydroxide (as $CaCO_3$) | mg/L | ng | | <1.0 | <1.0 | <1.0 | <1.0 | - | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <1.0 | <2.0 | <2.0 |
| Alkalinity, Total (as $CaCO_3$) | mg/L | ng | | 514 | 631 | 588 | 636 | - | 278 | 278 | 295 | 282 | 277 | 291 | 260 | 267 | 273 | 266 | 188 | 297 | 284 | 287 |
| Ammonia, Total (as N) | mg/L | 0.45 to 29 [H] | | - | 0.206 | 0.814 | - | - | 0.045 | 0.0704 | 0.0576 | 0.0206 | 0.047 | 0.054 | <0.0050 | 0.0608 | 0.0417 | 0.0299 | 0.040 | 0.426 | 0.304 | 0.384 |
| Bromide (Br) | mg/L | ng | | 1.3 | <1.0 | 1.4 | <0.50 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Chloride (Cl) | mg/L | 150 [C] | 250 | 167 | 205 | 205 | 10.4 | - | <0.50 | <0.50 | <0.50 | 0.52 | <0.50 | <0.50 | 0.51 | 0.60 | 0.58 | 0.52 | 2.24 | 0.79 | 0.70 | 0.69 |
| Fluoride (F) | mg/L | K | 1 [C] | 0.69 | 0.70 | 0.86 | 0.84 | - | 0.124 | 0.134 | 0.177 | 0.155 | 0.121 | 0.116 | 0.255 | 0.202 | 0.214 | 0.210 | 0.742 | 0.298 | 0.269 | 0.250 |
| Nitrate (as N) | mg/L | 3 [C] | 10 [L] | <0.10 | <0.10 | <0.10 | <0.050 | - | 0.0601 | <0.0050 | 0.0492 | 0.113 | 0.0209 | 0.0179 | 0.0350 | 0.0840 | 0.125 | 0.215 | 0.0644 | <0.0050 | <0.0050 | <0.0050 |
| Nitrite (as N) | mg/L | 0.02 [C] | 1 | 0.033 | <0.020 | 0.024 | <0.010 | - | <0.0010 | <0.0010 | 0.0033 | <0.0010 | 0.0083 | 0.0047 | <0.0010 | 0.0021 | 0.0011 | 0.0026 | 0.0039 | <0.0010 | <0.0010 | <0.0010 |
| Total Kjeldahl Nitrogen | mg/L | ng | | - | 1.37 | 1.41 | - | - | 0.308 | 0.180 | 0.227 | 0.166 | 0.069 | 0.054 | 4.01 | 0.264 | 0.054 | <0.051 | 2.37 | 0.500 | 0.340 | 0.626 |
| Total Nitrogen | mg/L | ng | | - | 1.37 | 1.43 | - | - | 0.368 | 0.180 | 0.280 | 0.279 | 0.098 | 0.077 | 4.05 | 0.350 | 0.180 | 0.254 | 2.44 | 0.500 | 0.340 | 0.626 |
| Orthophosphate-Dissolved (as P) | mg/L | ng | | 0.0157 | 0.185 | 0.0257 | 0.141 | - | 0.0053 | 0.0061 | 0.0022 | 0.0053 | 0.0044 | 0.0039 | 0.0043 | <0.0010 | <0.0010 | 0.0040 | 0.0095 | 0.0124 | <0.0010 | 0.0067 |
| Phosphorus (P)-Total Dissolved | mg/L | between 0.005 and 0.015 [B, E] | | 0.100 | 0.093 | 0.0482 | 0.155 | - | 0.0048 | 0.0068 | 0.0035 | 0.0058 | 0.0057 | 0.0053 | 0.0058 | <0.0020 | <0.0020 | 0.0041 | 0.0191 | 0.0153 | 0.0028 | 0.0086 |
| Phosphorus (P)-Total | mg/L | refer to dissolved component | 0.01 [E] | 1.14 | 0.332 | 0.280 | 7.60 | - | 0.258 | 0.0773 | 0.123 | 0.137 | 0.0126 | 0.0109 | 1.99 | 0.0796 | 0.0390 | 0.125 | 0.826 | 0.555 | 0.0640 | 0.0240 |
| Sulfate ($SO_4$) | mg/L | 128 to 429 [F] | 500 | 174 | 80 | 75 | 24.8 | - | 24.7 | 21.3 | 49.3 | 35.1 | 11.2 | 11.0 | 17.4 | 12.2 | 19.3 | 24.2 | 44.2 | 15.8 | 14.5 | 13.6 |
| **Organic / Inorganic Carbon** | | | | | | | | | | | | | | | | | | | | | | |
| Total Organic Carbon | mg/L | na [D] | 4 [M] | - | 24.5 | 19.1 | - | - | 5.02 | 2.63 | 6.09 | 3.87 | 1.33 | 1.06 | 48.5 | 4.12 | 2.44 | 1.66 | 12.3 | 11.4 | 4.98 | 2.84 |
| **Aggregate Organics** | | | | | | | | | | | | | | | | | | | | | | |
| COD | mg/L | | | | 90 | | | - | 32 | | | <20 | | | 231 | | | <20 | 95 | | | <20 |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

**Appendix E2. Water Quality Results and Guideline Exceedances for Well Installed at the Mine Sites: Physical Parameters, Anions, Nutrients, and Aggregate Organics**

| Well ID | | | | MW-PNB | | | | MW-H22 | | | | | | MW-H23 | | | | | | MW-SHAFT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 07-JUL-11 | 15-OCT-11 | 11-MAY-12 | 21-AUG-12 | 11-MAY-12 | 21-AUG-12 | 28-OCT-12 | 19-DEC-12 | 08-FEB-14 | 17-APR-14 | 11-MAY-12 | 21-AUG-12 | 28-OCT-12 | 19-DEC-12 | 08-FEB-14 | 17-APR-14 | 09-FEB-14 |
| Time Sampled | | BC FWAL | DW | 00:00 | 12:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 15:30 | 14:00 | 00:00 | 00:00 | 00:00 | 00:00 | 12:00 | 17:00 | 12:00 |
| ALS Sample ID | Units | Gudielines [A] | Guidelines [A] | L1031047-4 | L1074937-7 | L1147583-11 | L1201465-5 | L1147583-13 | L1201465-8 | L1230640-7 | L1252558-5 | L1422942-2 | L1445192-1 | L1147583-12 | L1201465-1 | L1230640-6 | L1252558-6 | L1422942-4 | L1445192-2 | L1422942-3 |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | | |
| pH | - | 6.5-9.0 [D, G] | 6.5-8.5 | - | 8.0 | 8.06 | - | 8.05 | 7.46 | 7.21 | 7.02 | 7.49 | 7.46 | 8.08 | 7.39 | 7.02 | 7.51 | 7.61 | 7.56 | 7.1 |
| Oxidation-Reduction Potential | mV | ng | | - | - | - | - | - | 240 | 140 | 60 | 230 | 80 | - | 250 | 170 | 130 | 220 | 100 | 120 |
| Specific Conductance | µS/cm | ng | | - | 431 | 629 | - | 502 | 564 | 348 | 330 | 524 | 601 | 442 | 446 | 261 | 247 | 403 | 468 | 1180 |
| Temperature | °C | na | | - | 4.8 | 6.1 | - | 7.2 | 9.3 | 3.4 | 2.1 | 5.2 | 4.0 | 6.4 | 10.7 | 3.4 | 2.0 | 4.9 | 3.5 | 1.2 |
| **Physical Tests (Laboratory)** | | | | | | | | | | | | | | | | | | | | |
| Colour, True | | na [D] | | <5.0 | <5.0 | 5.2 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Conductivity | µS/cm | ng | | 401 | 413 | 549 | 519 | 456 | 543 | 576 | 544 | 573 | 586 | 429 | 428 | 430 | 434 | 436 | 452 | 1330 |
| Hardness (as $CaCO_3$) | mg/L | ng | | 215 | 220 | 194 | 194 | 284 | 322 | 336 | 339 | 340 | 340 | 247 | 252 | 230 | 248 | 234 | 253 | 650 |
| pH | | 6.5-9.0 [D, G] | | 8.17 | 8.23 | 8.20 | 8.23 | 8.08 | 8.11 | 8.03 | 8.10 | 8.07 | 7.99 | 8.21 | 8.20 | 8.11 | 8.12 | 8.10 | 8.08 | 7.87 |
| Total Suspended Solids | mg/L | ng | | <3.0 | <3.0 | 17.0 | 17.7 | 1570 | 10600 | 847 | 108 | 40.3 | 29.6 | 91.7 | 33.9 | 48.8 | 247 | 405 | 19.9 | 9.1 |
| Total Dissolved Solids | mg/L | ng | | - | - | 340 | - | 288 | - | - | - | - | 340 | 251 | - | - | - | - | 261 | - |
| Turbidity | NTU | na | | 2.81 | 4.47 | 14.9 | 12.4 | 333 | >4000 | 82.2 | 61.0 | 28.3 | 13.2 | 78.4 | 25.3 | 27.6 | 161 | 354 | 14.5 | 7.85 |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | ng | | 1.3 | 1.9 | 2.9 | 1.6 | 4.8 | 4.2 | 5.9 | 5.3 | 4.1 | 5.7 | 2.4 | 2.2 | 5.0 | 4.2 | 2.2 | 2.9 | 11.7 |
| Alkalinity, Bicarbonate (as $CaCO_3$) | mg/L | ng | | 215 | 214 | 251 | 251 | 263 | 308 | 301 | 343 | 344 | 329 | 241 | 247 | 247 | 255 | 247 | 257 | 372 |
| Alkalinity, Carbonate (as $CaCO_3$) | mg/L | ng | | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| Alkalinity, Hydroxide (as $CaCO_3$) | mg/L | ng | | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| Alkalinity, Total (as $CaCO_3$) | mg/L | ng | | 215 | 214 | 251 | 251 | 263 | 308 | 301 | 343 | 344 | 329 | 241 | 247 | 247 | 255 | 247 | 257 | 372 |
| Ammonia, Total (as N) | mg/L | 0.45 to 29 [H] | | 0.0161 | - | <0.0050 | 0.0096 | <0.0050 | 0.0340 | <0.0050 | <0.0050 | 0.0071 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | 0.017 | <0.0050 | <0.0050 |
| Bromide (Br) | mg/L | ng | | <0.050 | <0.050 | <0.050 | 0.132 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.50 |
| Chloride (Cl) | mg/L | 150 [C] | 250 | <0.50 | <0.50 | 3.91 | 3.25 | 0.74 | <0.50 | <0.50 | <0.50 | 1.64 | 1.29 | <0.50 | <0.50 | <0.50 | <0.50 | 0.56 | <0.50 | 219 |
| Fluoride (F) | mg/L | K | 1 [C] | 0.058 | 0.058 | 0.210 | 0.189 | 0.066 | 0.061 | 0.049 | 0.052 | 0.047 | 0.045 | 0.075 | 0.079 | 0.081 | 0.076 | 0.079 | 0.075 | <0.20 |
| Nitrate (as N) | mg/L | 3 [C] | 10 [L] | 0.394 | 0.260 | 0.0124 | <0.0050 | 0.120 | 0.145 | 0.415 | 0.489 | 0.465 | 0.476 | 0.202 | 0.149 | 0.177 | 0.245 | 0.237 | 0.289 | <0.050 |
| Nitrite (as N) | mg/L | 0.02 [C] | 1 | <0.0010 | <0.0010 | 0.0152 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0023 | <0.0010 | <0.0010 | <0.010 |
| Total Kjeldahl Nitrogen | mg/L | ng | | 0.098 | - | 0.222 | 0.200 | 0.837 | 2.60 | <0.084 | <0.093 | <0.11 | <0.094 | 0.180 | 0.161 | 0.083 | 0.110 | 0.232 | <0.069 | 0.189 |
| Total Nitrogen | mg/L | ng | | 0.492 | - | 0.250 | 0.200 | 0.957 | 2.74 | 0.420 | 0.464 | 0.554 | 0.470 | 0.382 | 0.310 | 0.260 | 0.357 | 0.469 | 0.343 | 0.189 |
| Orthophosphate-Dissolved (as P) | mg/L | ng | | <0.0010 | <0.0010 | 0.0024 | 0.0017 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0049 | <0.0010 | 0.0015 | <0.0010 | 0.0014 | <0.0010 | 0.0019 | <0.0010 | 0.0024 |
| Phosphorus (P)-Total Dissolved | mg/L | between 0.005 and 0.015 [B, E] | | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0062 | - | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0045 | - | 0.0054 |
| Phosphorus (P)-Total | mg/L | refer to dissolved component | 0.01 [E] | 0.0030 | 0.0046 | 0.0714 | 0.0567 | 0.942 | 3.23 | 0.111 | 0.0911 | 0.0579 | 0.0234 | 0.0886 | 0.0380 | 0.0563 | 0.198 | 0.388 | 0.0163 | 0.0226 |
| Sulfate ($SO_4$) | mg/L | 128 to 429 [F] | 500 | 16.0 | 15.3 | 55.1 | 44.9 | 15.3 | 8.46 | 6.00 | 5.44 | 5.14 | 5.28 | 6.36 | 6.28 | 6.89 | 6.82 | 6.98 | 7.03 | 5.4 |
| **Organic / Inorganic Carbon** | | | | | | | | | | | | | | | | | | | | |
| Total Organic Carbon | mg/L | na [D] | 4 [M] | 1.41 | - | 5.19 | 10.2 | 25.5 | 59.7 | 2.99 | 0.90 | 2.03 | 0.64 | 3.87 | 3.32 | 2.46 | 3.56 | 7.2 | 1.14 | 6.43 |
| **Aggregate Organics** | | | | | | | | | | | | | | | | | | | | |
| COD | mg/L | | | <20 | | 32 | | 81 | | | <20 | | | 23 | | | <20 | | | |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

**Appendix E3. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Physical Parameters, Anions, Nutrients, and Aggregate Organics**

| Well ID | | | | MW-H24A | | | | MW-H24B | | | | | | MW-H24C | | | | MW-H25A | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 29-OCT-12 | 20-DEC-12 | 09-MAY-13 | 08-NOV-13 | 22-OCT-12 | 19-DEC-12 | 07-MAY-13 | 23-JUL-13 | 08-NOV-13 | 10-FEB-14 | 23-JUL-13 | 08-NOV-13 | 13-FEB-14 | 09-MAY-14 | 01-NOV-12 | 09-MAY-13 | 28-JUL-13 |
| Time Sampled | | BC MOE FWAL | DW | 00:00 | 00:00 | 00:00 | 12:00 | 00:00 | 00:00 | 00:00 | 00:00 | 12:00 | 16:15 | 00:00 | 12:00 | 14:00 | 14:00 | 00:00 | 00:00 | 00:00 |
| ALS Sample ID | Units | Gudielines [A] | Guidelines [A] | L1233652-2 | L1252558-4 | L1300522-5 | L1390394-1 | L1230640-1 | L1252558-7 | L1300522-6 | L1337870-1 | L1390394-2 | L1422942-5 | L1337870-2 | L1390394-3 | L1422938-5 | L1453879-2 | L1233652-4 | L1300522-3 | L1340620-1 |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | | |
| pH | - | 6.5-9.0 [D, G] | 6.5-8.5 | 11.92 | - | 12.7 | 13.06 | 7.36 | 7.51 | 7.6 | 7.57 | 7.58 | 7.45 | 7.9 | 7.64 | 7.75 | 7.37 | 11.9 | 8.7 | - |
| Oxidation-Reduction Potential | mV | ng | | -60 | - | -30 | -120 | 80 | 0 | 20 | -50 | 0 | 60 | 30 | -110 | -150 | -130 | -40 | 80 | - |
| Specific Conductance | µS/cm | ng | | 881 | - | 4900 | 9760 | 267 | 310 | 338 | 360 | 458 | 389 | 605 | 522 | 507 | 537 | 1087 | 714 | - |
| Temperature | °C | na | | 3.8 | - | 5.0 | 3.1 | 1.0 | 3.1 | 5.1 | 12.5 | 4.6 | 2.2 | 7.3 | 3.8 | 4.9 | 5.7 | 5.2 | 8.0 | - |
| **Physical Tests (Laboratory)** | | | | | | | | | | | | | | | | | | | | |
| Colour, True | | na [D] | | 8.5 | 9.6 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 9.8 | <5.0 | <5.0 | <5.0 | 7.6 | <5.0 | <5.0 |
| Conductivity | µS/cm | ng | | 15300 | 11500 | 5760 | 8760 | 471 | 459 | 518 | 447 | 472 | 449 | 585 | 527 | 515 | 528 | 1430 | 1050 | 1080 |
| Hardness (as $CaCO_3$) | mg/L | ng | | 1750 | 1220 | 577 | 1050 | 247 | 248 | 248 | 224 | 239 | 239 | 262 | 267 | 272 | 293 | 592 | 16.2 | 18.1 |
| pH | | 6.5-9.0 [D, G] | | 12.88 | 12.63 | 12.30 | 12.57 | 8.08 | 8.10 | 8.21 | 8.04 | 8.14 | 8.24 | 8.02 | 8.11 | 8.08 | 8.05 | 11.62 | 8.72 | 8.47 |
| Total Suspended Solids | mg/L | ng | | 123 | 205 | 52.7 | 56.9 | 141 | 594 | 45.3 | 5.1 | 8.5 | <3.0 | 28.6 | 10.5 | <3.0 | 7.2 | 129 | 577 | 28.7 |
| Total Dissolved Solids | mg/L | ng | | - | - | - | - | - | - | - | - | - | - | - | - | - | 305 | - | - | - |
| Turbidity | NTU | na | | 64.0 | 171 | 36.8 | 34.6 | 68.2 | 168 | 33.1 | 3.56 | 4.37 | 1.11 | 16.4 | 20.3 | 13.0 | 13.3 | 18.4 | 2030 | 857 |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | ng | | <1.0 | <1.0 | <1.0 | <1.0 | 6.3 | 4.6 | 3.3 | 5.6 | 2.4 | <1.0 | 6.4 | 3.4 | 3.5 | 3.5 | <1.0 | <1.0 | <1.0 |
| Alkalinity, Bicarbonate (as $CaCO_3$) | mg/L | ng | | <5.0 | <13 | <1.0 | <1.0 | 276 | 277 | 283 | 243 | 270 | 261 | 299 | 311 | 314 | 319 | <1.0 | 600 | 598 |
| Alkalinity, Carbonate (as $CaCO_3$) | mg/L | ng | | 208 | 1410 | 95.4 | 113 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 | 43.5 | 18.9 | 21.7 |
| Alkalinity, Hydroxide (as $CaCO_3$) | mg/L | ng | | 3960 | 1710 | 1550 | 1750 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 | 164 | <1.0 | <1.0 |
| Alkalinity, Total (as $CaCO_3$) | mg/L | ng | | 4170 | 3120 | 1650 | 1870 | 276 | 277 | 283 | 243 | 270 | 261 | 299 | 311 | 314 | 319 | 208 | 619 | 619 |
| Ammonia, Total (as N) | mg/L | 0.45 to 29 [H] | | 3.96 | 6.24 | 3.86 | 4.75 | 0.0452 | 0.0071 | 0.0227 | 0.0234 | 0.0173 | 0.021 | 0.188 | 0.180 | 0.204 | 0.248 | 0.0451 | 0.452 | 0.262 |
| Bromide (Br) | mg/L | ng | | <5.0 | <2.5 | <2.5 | <2.5 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <1.0 | <0.50 | <0.50 |
| Chloride (Cl) | mg/L | 150 [C] | 250 | <50 | <25 | <25 | <25 | <0.50 | <0.50 | 2.12 | <0.50 | <0.50 | <0.50 | 1.00 | <0.50 | <0.50 | <0.50 | <10 | <5.0 | <5.0 |
| Fluoride (F) | mg/L | K | 1 [C] | <2.0 | <1.0 | 1.1 | <1.0 | 0.113 | 0.094 | 0.122 | 0.106 | 0.107 | 0.112 | 0.169 | 0.114 | 0.113 | 0.111 | 0.41 | 0.76 | 0.84 |
| Nitrate (as N) | mg/L | 3 [C] | 10 [L] | <0.50 | 0.42 | <0.25 | <0.25 | 0.0435 | 0.0051 | 0.0850 | 0.0503 | 0.0542 | 0.0821 | 0.0075 | <0.0050 | <0.0050 | <0.0050 | 0.10 | <0.050 | <0.050 |
| Nitrite (as N) | mg/L | 0.02 [C] | 1 | <0.10 | <0.050 | <0.050 | <0.050 | <0.0010 | 0.0072 | 0.0023 | 0.0070 | <0.0010 | <0.0010 | 0.0037 | <0.0010 | <0.0010 | <0.0010 | <0.020 | 0.012 | <0.010 |
| Total Kjeldahl Nitrogen | mg/L | ng | | 4.87 | 94.0 | 4.65 | 5.85 | 0.086 | 0.232 | 0.251 | 0.082 | 0.079 | 0.068 | 5.38 | 0.441 | 0.246 | 0.236 | 0.359 | 0.664 | 0.75 |
| Total Nitrogen | mg/L | ng | | 4.87 | 94.4 | 4.65 | 5.85 | 0.130 | 0.244 | 0.338 | 0.139 | 0.133 | 0.150 | 5.39 | 0.441 | 0.246 | 0.236 | 0.460 | 0.676 | 0.75 |
| Orthophosphate-Dissolved (as P) | mg/L | ng | | 0.0012 | <0.10 | <0.0010 | <0.0010 | 0.0015 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0080 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0209 | <0.0010 |
| Phosphorus (P)-Total Dissolved | mg/L | between 0.005 and 0.015 [B, E] | | 0.0038 | 0.0058 | 0.0038 | 0.0043 | 0.0035 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0141 | <0.0020 | <0.0020 | <0.0020 | 0.0027 | 0.0321 | 0.0032 |
| Phosphorus (P)-Total | mg/L | refer to dissolved component | 0.01 [E] | 0.0347 | 0.0326 | 0.0234 | 0.0353 | 0.104 | 0.327 | 0.0286 | 0.0123 | 0.0112 | 0.0055 | 0.0516 | 0.125 | 0.0669 | 0.0531 | 0.0198 | 1.00 | 0.566 |
| Sulfate ($SO_4$) | mg/L | 128 to 429 [F] | 500 | <50 | <25 | <25 | <25 | 5.46 | 4.44 | 21.0 | 5.38 | 3.76 | 4.63 | 34.7 | 1.01 | 1.43 | 2.36 | 390 | <5.0 | <5.0 |
| **Organic / Inorganic Carbon** | | | | | | | | | | | | | | | | | | | | |
| Total Organic Carbon | mg/L | na [D] | 4 [M] | 21.0 | 25.7 | 12.6 | 25.2 | 3.22 | 2.08 | 5.71 | 2.22 | 1.82 | 1.17 | 23.2 | 2.29 | 1.13 | 1.04 | 7.01 | 37.5 | 12.0 |
| **Aggregate Organics** | | | | | | | | | | | | | | | | | | | | |
| COD | mg/L | | | | 110 | 42 | 79 | | 46 | <20 | <20 | <20 | | 69 | <20 | | | | 144 | 43 |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

**Appendix E3. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Physical Parameters, Anions, Nutrients, and Aggregate Organics**

| Well ID | | | | MW-H25A *(cont'd)* | | | MW-H25B | | | | | | | MW-H26A | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled** | | | | 08-NOV-13 | 13-FEB-14 | 09-MAY-14 | 22-OCT-12 | 19-DEC-12 | 07-MAY-13 | 23-JUL-13 | 08-NOV-13 | 12-FEB-14 | 11-MAY-14 | 30-OCT-12 | 09-MAY-13 | 28-JUL-13 | 08-NOV-13 | 12-FEB-14 | 10-MAY-14 |
| **Time Sampled** | | BC MOE FWAL | DW | 12:00 | 18:45 | 14:30 | 00:00 | 00:00 | 00:00 | 00:00 | 12:00 | 15:00 | 11:00 | 00:00 | 00:00 | 00:00 | 12:00 | 15:30 | 15:00 |
| **ALS Sample ID** | **Units** | **Guidelines [A]** | **Guidelines [A]** | L1390394-4 | L1422945-2 | L1453879-3 | L1230640-2 | L1252558-8 | L1300522-4 | L1337870-4 | L1390394-5 | L1422938-4 | L1453879-7 | L1233652-1 | L1300522-1 | L1340620-3 | L1390524-1 | L1422938-3 | L1453879-4 |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | |
| pH | - | 6.5-9.0 [D, G] | 6.5-8.5 | 8.62 | - | 8.48 | 7.04 | 7.89 | 7.25 | 7.46 | 7.29 | 7.13 | 7.02 | 12.1 | 9.0 | 8.83 | 9.21 | 8.97 | 8.92 |
| Oxidation-Reduction Potential | mV | ng | | -100 | - | -10 | 100 | 120 | 140 | 30 | -60 | -80 | -56 | -60 | 90 | 80 | -30 | -50 | 30 |
| Specific Conductance | µS/cm | ng | | 970 | - | 992 | 440 | 519 | 386 | 661 | 632 | 616 | 670 | 1683 | 721 | 762 | 985 | 960 | 1068 |
| Temperature | °C | na | | 4.5 | - | 9.5 | 1.1 | 3.1 | 4.0 | 13.1 | 7.3 | 4.7 | 4.2 | 4.6 | 8.2 | 7.8 | 4.4 | 4.8 | 9.0 |
| **Physical Tests (Laboratory)** | | | | | | | | | | | | | | | | | | | |
| Colour, True | | na [D] | | <5.0 | <5.0 | <5.0 | 7.7 | <5.0 | <5.0 | 5.5 | <5.0 | <5.0 | <5.0 | 12.4 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Conductivity | µS/cm | ng | | 1010 | 1020 | 1010 | 764 | 612 | 621 | 672 | 653 | 643 | 659 | 2350 | 1090 | 1100 | 1030 | 1050 | 1050 |
| Hardness (as $CaCO_3$) | mg/L | ng | | 15.3 | 14.1 | 15.5 | 406 | 345 | 345 | 346 | 360 | 363 | 379 | 358 | 22.1 | 18.6 | 18.6 | 18.9 | 20.7 |
| pH | | 6.5-9.0 [D, G] | | 8.57 | 8.72 | 8.63 | 7.81 | 8.12 | 8.16 | 7.90 | 8.03 | 7.93 | 7.86 | 12.09 | 8.93 | 8.81 | 9.06 | 8.91 | 8.89 |
| Total Suspended Solids | mg/L | ng | | 7.5 | <3.0 | <3.0 | 1530 | 36.0 | 341 | <3.0 | 3.3 | 10.6 | 12.9 | 157 | 830 | 37.4 | 7.2 | <3.0 | <3.0 |
| Total Dissolved Solids | mg/L | ng | | - | - | 642 | - | - | - | - | - | - | 387 | - | - | - | - | - | 682 |
| Turbidity | NTU | na | | 15.2 | 6.92 | 3.19 | 1920 | 132 | 288 | 2.07 | 3.85 | 10.8 | 8.71 | 60.7 | 595 | 285 | 15.2 | 1.12 | 0.53 |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | ng | | <1.0 | <1.0 | <1.0 | 14.6 | 5.8 | 7.5 | 12.8 | 8.0 | 9.3 | 9.2 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Alkalinity, Bicarbonate (as $CaCO_3$) | mg/L | ng | | 570 | 494 | 509 | 436 | 363 | 369 | 382 | 383 | 392 | 397 | <1.0 | 565 | 591 | 497 | 472 | 531 |
| Alkalinity, Carbonate (as $CaCO_3$) | mg/L | ng | | 31.6 | 37.3 | 51.4 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 | 76.8 | 122 | 64.6 | 100 | 73.8 | 83.1 |
| Alkalinity, Hydroxide (as $CaCO_3$) | mg/L | ng | | <1.0 | <1.0 | <1.0 | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 | 401 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| Alkalinity, Total (as $CaCO_3$) | mg/L | ng | | 602 | 531 | 561 | 436 | 363 | 369 | 382 | 383 | 392 | 397 | 478 | 688 | 656 | 597 | 546 | 615 |
| Ammonia, Total (as N) | mg/L | 0.45 to 29 [H] | | 0.396 | 0.405 | 0.470 | 0.207 | 0.0780 | 0.0689 | 0.0701 | 0.0575 | 0.073 | 0.106 | 1.38 | 0.388 | 0.415 | 0.384 | 0.375 | 0.428 |
| Bromide (Br) | mg/L | ng | | <0.50 | <0.50 | <0.50 | <0.50 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <1.0 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| Chloride (Cl) | mg/L | 150 [C] | 250 | <5.0 | <2.5 | <5.0 | <5.0 | 2.47 | 2.08 | 1.43 | 1.30 | 1.26 | 1.28 | <10 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| Fluoride (F) | mg/L | K | 1 [C] | 0.72 | 0.78 | 0.75 | <0.20 | 0.188 | 0.175 | 0.189 | 0.182 | 0.175 | 0.171 | 0.45 | 0.90 | 0.68 | 0.68 | 0.67 | 0.67 |
| Nitrate (as N) | mg/L | 3 [C] | 10 [L] | <0.050 | <0.025 | <0.050 | <0.050 | 0.0098 | 0.0081 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.10 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrite (as N) | mg/L | 0.02 [C] | 1 | <0.010 | <0.0050 | <0.010 | <0.010 | 0.0012 | <0.0010 | <0.0010 | 0.0013 | <0.0010 | <0.0010 | <0.020 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Total Kjeldahl Nitrogen | mg/L | ng | | 0.450 | 0.450 | 0.462 | 0.790 | 0.250 | 0.477 | 0.170 | 0.139 | 0.204 | 0.201 | 1.59 | 0.581 | 0.63 | 0.460 | 0.489 | 0.485 |
| Total Nitrogen | mg/L | ng | | 0.450 | 0.450 | 0.462 | 0.790 | 0.261 | 0.485 | 0.170 | 0.140 | 0.204 | 0.201 | 1.59 | 0.581 | 0.63 | 0.460 | 0.489 | 0.485 |
| Orthophosphate-Dissolved (as P) | mg/L | ng | | 0.0046 | 0.0365 | 0.0268 | 0.0052 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0012 | 0.0021 | <0.0010 | 0.0622 | 0.0593 | 0.0781 | 0.0710 | 0.0570 |
| Phosphorus (P)-Total Dissolved | mg/L | between 0.005 and 0.015 [B, E] | | 0.0122 | 0.0437 | 0.0267 | 0.0098 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0099 | 0.0669 | 0.0666 | 0.0861 | 0.0802 | 0.0532 |
| Phosphorus (P)-Total | mg/L | refer to dissolved component | 0.01 [E] | 0.0311 | 0.0520 | 0.0330 | 1.27 | 0.080 | 0.315 | 0.0080 | 0.0091 | 0.0216 | 0.0293 | 0.0798 | 0.932 | 0.355 | 0.128 | 0.0824 | 0.0743 |
| Sulfate ($SO_4$) | mg/L | 128 to 429 [F] | 500 | <5.0 | <2.5 | <5.0 | 29.2 | 8.02 | 8.17 | 6.03 | 5.85 | 6.06 | 6.12 | 179 | <5.0 | <5.0 | 5.3 | <5.0 | <5.0 |
| **Organic / Inorganic Carbon** | | | | | | | | | | | | | | | | | | | |
| Total Organic Carbon | mg/L | na [D] | 4 [M] | 1.74 | 1.88 | 1.37 | 11.4 | 4.01 | 11.0 | 4.14 | 2.86 | 4.05 | 3.63 | 14.5 | 10.8 | 8.6 | 2.66 | 3.04 | 2.34 |
| **Aggregate Organics** | | | | | | | | | | | | | | | | | | | |
| COD | mg/L | | | <20 | | | | 22 | 36 | 24 | <20 | | | | 47 | 27 | <20 | | |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

**Appendix E3. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Physical Parameters, Anions, Nutrients, and Aggregate Organics**

| Well ID | | | | MW-H26B | | | | | | MW-H27 | | | | MW-H28 | | | | MW-H29 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 30-OCT-12 | 19-DEC-12 | 08-MAY-13 | 23-JUL-13 | 08-NOV-13 | 11-FEB-14 | 28-JUL-13 | 08-NOV-13 | 10-FEB-14 | 10-MAY-14 | 31-JUL-13 | 08-NOV-13 | 13-FEB-14 | 13-MAY-14 | 01-AUG-13 | 08-NOV-13 | 11-FEB-14 | 10-MAY-14 |
| Time Sampled | | BC MOE FWAL | DW | 00:00 | 00:00 | 00:00 | 00:00 | 12:00 | 14:30 | 00:00 | 12:00 | 17:30 | 16:00 | 00:00 | 12:00 | 15:00 | 00:00 | 00:00 | 12:00 | 15:30 | 14:00 |
| ALS Sample ID | Units | Gudielines [A] | Guidelines [A] | L1233652-3 | L1252558-9 | L1300522-2 | L1337870-3 | L1390524-2 | L1422938-1 | L1340620-2 | L1390524-4 | L1422942-6 | L1453879-5 | L1343263-1 | L1390524-5 | L1422945-1 | L1455515-2 | L1343263-2 | L1390524-6 | L1422938-2 | L1453879-6 |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | | | |
| pH | - | 6.5-9.0 [D, G] | 6.5-8.5 | 6.61 | 7.26 | 7.4 | 7.2 | 7.24 | 7.39 | 8.85 | 8.85 | 8.79 | 8.78 | 8.69 | 8.27 | 8.4 | 8.09 | 8.09 | 8.31 | 7.8 | 7.76 |
| Oxidation-Reduction Potential | mV | ng | | 150 | 60 | 140 | 10 | 20 | 100 | 100 | 100 | 20 | 48 | 80 | -120 | 80 | -120 | 100 | 60 | -60 | -88 |
| Specific Conductance | µS/cm | ng | | 806 | 552 | 435 | 819 | 687 | 648 | 935 | 630 | 1192 | 1269 | 902 | 1098 | 1400 | 1896 | 493 | 614 | 623 | 668 |
| Temperature | °C | na | | 6.1 | 1.1 | 3.8 | 14.2 | 6.8 | 0.5 | 11.2 | 3.5 | 13.3 | 16.4 | 9.6 | 1.8 | 7.3 | 6.4 | 7.5 | 0.0 | 1.4 | 9 |
| **Physical Tests (Laboratory)** | | | | | | | | | | | | | | | | | | | | | |
| Colour, True | | na [D] | | 8.9 | 12.8 | <5.0 | 8.0 | 6.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | 5.1 | 15.7 | 23.0 | 28.6 | 8.2 | <5.0 | <5.0 | <5.0 |
| Conductivity | µS/cm | ng | | 760 | 982 | 681 | 847 | 722 | 720 | 1090 | 1260 | 1260 | 1250 | 1320 | 1160 | 1350 | 1820 | 699 | 689 | 665 | 658 |
| Hardness (as $CaCO_3$) | mg/L | ng | | 393 | 378 | 351 | 377 | 386 | 353 | 20.1 | 14.6 | 12.5 | 13.2 | 16.2 | 42.5 | 55.3 | 72.8 | 26.5 | 8.47 | 8.37 | 8.53 |
| pH | | 6.5-9.0 [D, G] | | 7.95 | 8.05 | 8.11 | 7.88 | 8.00 | 8.30 | 8.65 | 8.72 | 8.79 | 8.77 | 8.62 | 8.40 | 8.55 | 8.47 | 8.20 | 8.34 | 8.57 | 8.23 |
| Total Suspended Solids | mg/L | ng | | 164 | 810 | 106 | 43.1 | 5.4 | 24.5 | 204 | 476 | <3.0 | <3.0 | 80.8 | 270 | 9.8 | 6.2 | 17.6 | 7.4 | <3.0 | <3.0 |
| Total Dissolved Solids | mg/L | ng | | - | - | - | - | - | - | - | - | - | 812 | - | - | - | 1290 | - | - | - | 433 |
| Turbidity | NTU | na | | 115 | 347 | 46.6 | 33.2 | 5.91 | 15.7 | 203 | 818 | 1.15 | 0.86 | 213 | 206 | 9.28 | 3.76 | 282 | 32.7 | 4.92 | 3.70 |
| **Anions and Nutrients** | | | | | | | | | | | | | | | | | | | | | |
| Acidity (as $CaCO_3$) | mg/L | ng | | 8.2 | 6.4 | 4.9 | 12.2 | 6.7 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | 1.3 | <1.0 | <1.0 | <1.0 |
| Alkalinity, Bicarbonate (as $CaCO_3$) | mg/L | ng | | 331 | 343 | 355 | 349 | 351 | 345 | 572 | 676 | 627 | 664 | 692 | 528 | 503 | 264 | 357 | 376 | 344 | 383 |
| Alkalinity, Carbonate (as $CaCO_3$) | mg/L | ng | | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <1.0 | 45.4 | 61.5 | 62.2 | 91.1 | 47.7 | 14.6 | 12.6 | <1.0 | <2.0 | 5.6 | 14.2 | <2.0 |
| Alkalinity, Hydroxide (as $CaCO_3$) | mg/L | ng | | <2.0 | <2.0 | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 | <1.0 | <1.0 | <2.0 |
| Alkalinity, Total (as $CaCO_3$) | mg/L | ng | | 331 | 343 | 355 | 349 | 351 | 345 | 618 | 738 | 689 | 755 | 739 | 542 | 516 | 264 | 357 | 382 | 358 | 383 |
| Ammonia, Total (as N) | mg/L | 0.45 to 29 [H] | | 0.167 | 0.0946 | 0.0492 | 0.176 | 0.0894 | 0.165 | 0.434 | 0.370 | 0.420 | 0.498 | 0.393 | 0.446 | 0.451 | 0.514 | 0.293 | 0.201 | 0.189 | 0.227 |
| Bromide (Br) | mg/L | ng | | <0.50 | <0.50 | <0.050 | <0.50 | <0.25 | <0.050 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 0.52 | 2.1 | <0.50 | <0.25 | <0.050 | <0.050 |
| Chloride (Cl) | mg/L | 150 [C] | 250 | <5.0 | 9.3 | 1.67 | <5.0 | <2.5 | 1.32 | <5.0 | 6.7 | 6.9 | 5.4 | 5.7 | 7.9 | 14.1 | 30 | <5.0 | 3.9 | 2.35 | 2.33 |
| Fluoride (F) | mg/L | K | 1 [C] | 0.28 | <0.20 | 0.126 | 0.32 | 0.13 | 0.133 | 0.84 | 0.93 | 0.98 | 0.95 | 1.13 | 0.53 | 0.68 | 0.72 | 0.63 | 0.35 | 0.381 | 0.351 |
| Nitrate (as N) | mg/L | 3 [C] | 10 [L] | 0.371 | <0.050 | 0.119 | <0.050 | <0.025 | 0.0183 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.10 | <0.050 | <0.025 | <0.0050 | <0.0050 |
| Nitrite (as N) | mg/L | 0.02 [C] | 1 | <0.010 | 0.013 | 0.0035 | <0.010 | 0.0068 | 0.0064 | <0.010 | 0.014 | <0.010 | <0.010 | <0.010 | 0.011 | <0.010 | <0.020 | <0.010 | <0.0050 | <0.0010 | <0.0010 |
| Total Kjeldahl Nitrogen | mg/L | ng | | 0.56 | 0.737 | 0.414 | 0.535 | 0.276 | 0.404 | 0.56 | 0.69 | 0.777 | 0.486 | 0.622 | 1.46 | 1.01 | 1.16 | 0.628 | 0.279 | 0.286 | 0.248 |
| Total Nitrogen | mg/L | ng | | 0.930 | 0.751 | 0.536 | 0.535 | 0.283 | 0.429 | 0.56 | 0.70 | 0.777 | 0.486 | 0.622 | 1.48 | 1.01 | 1.16 | 0.628 | 0.279 | 0.286 | 0.248 |
| Orthophosphate-Dissolved (as P) | mg/L | ng | | <0.0010 | 0.0182 | 0.0019 | 0.0037 | 0.0146 | 0.0064 | 0.0533 | 0.0072 | 0.0858 | 0.0758 | 0.0255 | 0.0025 | 0.0977 | 0.380 | <0.0010 | 0.0687 | 0.0646 | 0.0429 |
| Phosphorus (P)-Total Dissolved | mg/L | between 0.005 and 0.015 [B, E] | | 0.0053 | 0.0259 | 0.0036 | 0.0046 | 0.0138 | 0.0057 | 0.0603 | 0.0460 | 0.0900 | 0.0815 | 0.0449 | 0.0150 | 0.125 | 0.389 | 0.0078 | 0.0755 | 0.0651 | 0.0392 |
| Phosphorus (P)-Total | mg/L | refer to dissolved component | 0.01 [E] | 0.191 | 0.610 | 0.099 | 0.0913 | 0.0368 | 0.0707 | 0.289 | 0.745 | 0.121 | 0.0848 | 0.224 | 0.523 | 0.422 | 0.618 | 0.287 | 0.142 | 0.0857 | 0.0660 |
| Sulfate ($SO_4$) | mg/L | 128 to 429 [F] | 500 | 125 | 223 | 59.7 | 128 | 73.1 | 79.9 | 17.1 | <5.0 | <5.0 | <5.0 | 20.7 | 107 | 195 | 410 | 44.7 | 9.9 | 6.31 | 6.95 |
| **Organic / Inorganic Carbon** | | | | | | | | | | | | | | | | | | | | | |
| Total Organic Carbon | mg/L | na [D] | 4 [M] | 6.16 | 9.25 | 4.99 | 6.85 | 3.48 | 5.69 | 10.3 | 11.8 | 3.57 | 2.03 | 17.2 | 27.7 | 28.9 | 48.1 | 12.4 | 3.03 | 3.05 | 2.39 |
| **Aggregate Organics** | | | | | | | | | | | | | | | | | | | | | |
| COD | mg/L | | | | 41 | <20 | 32 | <20 | | 85 | 86 | | | 111 | 67 | | | 44 | <20 | | |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

**Appendix E4. Water Quality Results and Guideline Exceedances for Well Installed in the Camp Creek Basin: Dissolved Metals**

| Well ID | | | | MW-H2A | | | | MW-H2B | | | | | MW-H5 | | | | | MW-20 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 10-JUL-11 | 18-OCT-11 | 13-MAY-12 | 23-AUG-12 | 10-JUL-11 | 18-OCT-11 | 13-MAY-12 | 23-AUG-12 | 13-MAY-14 | 09-JUL-11 | 18-OCT-11 | 12-MAY-12 | 22-AUG-12 | 08-MAY-14 | 08-JUL-11 | 17-OCT-11 | 14-MAY-12 | 22-AUG-12 |
| Time Sampled | | BC MOE FWAL | DW | 00:00 | 12:00 | 00:00 | 00:00 | 00:00 | 12:00 | 00:00 | 00:00 | 14:00 | 00:00 | 12:00 | 00:00 | 00:00 | 16:00 | 00:00 | 12:00 | 00:00 | 00:00 |
| ALS Sample ID | Units | Gudielines [A] | Guidelines [A] | L1031047-6 | L1074937-1 | L1147583-5 | L1201463-3 | L1031047-1 | L1074937-2 | L1147583-6 | L1201463-4 | L1455515-3 | L1031047-3 | L1074937-3 | L1147583-9 | L1201465-2 | L1453879-1 | L1031047-2 | L1074937-6 | L1147583-2 | L1201465-6 |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | |
| Dissolved Metals Filtration Location | mg/L | | | | | FIELD | FIELD | | | FIELD | FIELD | | | | FIELD | FIELD | | | | FIELD | FIELD |
| Aluminum (Al)-Dissolved | mg/L | 0.05 [B,E] | 0.2 | 4.96 | 0.0996 | 0.0094 | 0.0078 | 0.0086 | <0.0030 | 0.0043 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0065 | 2.00 | 0.0249 | 0.0185 |
| Antimony (Sb)-Dissolved | mg/L | 0.02 [B, R] | 0.06 [B, T] | 0.00246 | 0.00035 | <0.00020 | <0.00020 | 0.00027 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00166 | 0.00768 | 0.00091 | <0.00010 |
| Arsenic (As)-Dissolved | mg/L | 0.005 [B] | 0.025 [B] | 0.00308 | 0.00083 | 0.00039 | <0.00020 | 0.00062 | 0.00027 | 0.00021 | 0.00012 | <0.00010 | 0.00244 | 0.00270 | 0.00272 | 0.00270 | 0.00228 | 0.00085 | 0.00598 | 0.00240 | 0.00152 |
| Barium (Ba)-Dissolved | mg/L | 1 [B, C, R] | 1 [B, T] | 1.20 | 1.59 | 1.51 | 1.47 | 0.259 | 0.421 | 0.204 | 0.184 | 0.286 | 0.136 | 0.117 | 0.116 | 0.115 | 0.116 | 2.67 | 0.732 | 0.386 | 0.437 |
| Beryllium (Be)-Dissolved | mg/L | 0.0053 [B, C, R] | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00020 | <0.00010 |
| Bismuth (Bi)-Dissolved | mg/L | ng | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 | <0.0010 | <0.00050 |
| Boron (B)-Dissolved | mg/L | 1.2 [B] | 5 [B] | 0.173 | 0.196 | 0.193 | 0.192 | 0.013 | 0.016 | <0.010 | <0.010 | <0.010 | 0.026 | 0.026 | 0.029 | 0.028 | 0.029 | 0.144 | 0.200 | 0.185 | 0.180 |
| Cadmium (Cd)-Dissolved | mg/L | B, R, N | 0.005 [B, T] | 0.000060 | 0.000029 | <0.000020 | <0.000020 | <0.000010 | 0.000011 | 0.000017 | <0.000010 | <0.000010 | <0.000010 | 0.000010 | <0.000010 | 0.000016 | <0.000010 | 0.000029 | <0.000020 | <0.000020 | <0.000010 |
| Calcium (Ca)-Dissolved | mg/L | na | | 6.31 | 6.61 | 6.98 | 6.29 | 38.2 | 42.0 | 43.2 | 39.7 | 46.2 | 73.5 | 74.3 | 78.8 | 78.3 | 78.3 | 29.2 | 1.86 | 2.35 | 1.91 |
| Chromium (Cr)-Dissolved | mg/L | 0.0089 [B, P] | 0.05 [B, T] | 0.00225 | <0.00020 | <0.00020 | <0.00020 | <0.00010 | <0.00010 | 0.00013 | <0.00010 | 0.00015 | <0.00010 | 0.00012 | <0.00010 | <0.00010 | <0.00010 | 0.00022 | 0.00096 | <0.00020 | 0.00012 |
| Cobalt (Co)-Dissolved | mg/L | 4 [B, C] | | 0.00087 | 0.00027 | <0.00020 | <0.00020 | 0.00084 | 0.00029 | 0.00024 | <0.00010 | <0.00010 | 0.00028 | 0.00026 | 0.00027 | 0.00025 | 0.00025 | 0.00023 | 0.00030 | 0.00026 | 0.00012 |
| Copper (Cu)-Dissolved | mg/L | 0.0004 to 0.002 [B, C, F] | 0.5 [B] | 0.0050 | <0.0010 | <0.0010 | <0.0010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.0937 | 0.0013 | 0.0030 | <0.00050 |
| Iron (Fe)-Dissolved | mg/L | 0.35 | 0.3 [B, T] | 1.13 | <0.030 | 0.041 | 0.046 | <0.030 | 0.076 | <0.030 | <0.030 | <0.030 | 0.173 | 0.538 | 0.843 | 0.854 | 0.919 | <0.030 | 0.526 | 0.067 | 0.164 |
| Lead (Pb)-Dissolved | mg/L | B, C, H | 0.05 [B] | 0.00103 | 0.00014 | <0.00010 | <0.00010 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000100 | 0.00071 | 0.00021 | 0.000061 |
| Lithium (Li)-Dissolved | mg/L | 0.096 [R] | | 0.825 | 1.25 | 1.20 | 1.32 | 0.00400 | 0.0203 | 0.00203 | 0.00293 | 0.00242 | 0.00486 | 0.00528 | 0.00578 | 0.00603 | 0.00572 | 0.263 | 1.11 | 0.949 | 1.11 |
| Magnesium (Mg)-Dissolved | mg/L | ng | | 2.83 | 3.17 | 3.56 | 3.16 | 9.30 | 9.82 | 10.4 | 9.83 | 10.9 | 27.0 | 26.2 | 27.9 | 27.5 | 27.5 | 17.7 | 0.690 | 0.74 | 0.618 |
| Manganese (Mn)-Dissolved | mg/L | B, C, J | 0.05 [B, T] | 0.0516 | 0.0367 | 0.0329 | 0.0197 | 0.253 | 0.0962 | 0.244 | 0.0292 | 0.00166 | 0.634 | 0.534 | 0.574 | 0.567 | 0.608 | 0.0691 | 0.0122 | 0.159 | 0.168 |
| Mercury (Hg)-Dissolved | mg/L | 0.0000125 to 0.0002 [B, C, K] | 0.001 [B] | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Molybdenum (Mo)-Dissolved | mg/L | 1 [B, C] | 0.25 [B] | 0.00940 | 0.00207 | 0.00159 | 0.00047 | 0.00135 | 0.000721 | 0.000455 | 0.000336 | 0.000248 | 0.00125 | 0.00137 | 0.00139 | 0.00136 | 0.00123 | 0.0252 | 0.0120 | 0.0105 | 0.00625 |
| Nickel (Ni)-Dissolved | mg/L | 0.025 to 0.15 [B, C, R, Q] | | 0.0042 | 0.0013 | 0.00159 | <0.0010 | 0.00285 | 0.00087 | <0.00050 | <0.00050 | <0.00050 | 0.00061 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00102 | 0.0020 | 0.0018 | 0.00065 |
| Phosphorus (P)-Dissolved | mg/L | ---- refer to anions and nutrients ---- | | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | 0.42 | 0.50 |
| Potassium (K)-Dissolved | mg/L | 195 [R] | | 1.48 | 0.94 | 0.88 | 0.76 | 0.649 | 0.472 | 0.537 | 0.496 | 0.623 | 1.04 | 0.987 | 0.990 | 0.931 | 0.943 | 2.48 | 0.71 | 0.82 | 0.646 |
| Selenium (Se)-Dissolved | mg/L | 0.002 [B] | 0.01 [B] | 0.00066 | <0.00020 | <0.00020 | <0.00020 | 0.00043 | 0.00018 | 0.00027 | 0.00025 | 0.00019 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00015 | 0.00081 | <0.00020 | 0.00014 |
| Silicon (Si)-Dissolved | mg/L | ng | | 12.4 | 3.02 | 2.85 | 2.91 | 2.61 | 2.41 | 2.60 | 2.62 | 2.78 | 6.32 | 5.85 | 6.05 | 6.06 | 5.68 | 3.63 | 5.37 | 2.89 | 2.74 |
| Silver (Ag)-Dissolved | mg/L | 0.0005 to 0.0015 [B, C, L] | | 0.000028 | <0.000020 | <0.000020 | <0.000020 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 | <0.000020 | <0.000010 |
| Sodium (Na)-Dissolved | mg/L | ng | 200 [B, T] | 304 | 390 | 368 | 387 | 9.3 | 10.3 | 1.21 | <2.0 | <2.0 | 16.1 | 15.1 | 14.1 | 13.8 | 10.3 | 113 | 347 | 326 | 339 |
| Strontium (Sr)-Dissolved | mg/L | ng | | 0.169 | 0.229 | 0.237 | 0.229 | 0.0766 | 0.0844 | 0.0705 | 0.0655 | 0.0727 | 0.310 | 0.313 | 0.304 | 0.338 | 0.314 | 0.644 | 0.0869 | 0.0833 | 0.0849 |
| Thallium (Tl)-Dissolved | mg/L | 0.0003 [B, R] | | 0.000042 | <0.000020 | <0.000020 | <0.000020 | 0.000018 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000011 | <0.000020 | <0.000020 | <0.000010 |
| Tin (Sn)-Dissolved | mg/L | ng | | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00083 | 0.00021 | <0.00010 |
| Titanium (Ti)-Dissolved | mg/L | 2 [B, R] | | 0.155 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | 0.039 | <0.010 | <0.010 |
| Uranium (U)-Dissolved | mg/L | 0.3 [B, R] | 0.02 [B, T] | 0.0101 | 0.00286 | 0.000991 | 0.000781 | 0.000439 | 0.000179 | 0.000142 | 0.000121 | 0.000139 | 0.00126 | 0.00119 | 0.00135 | 0.00122 | 0.00114 | 0.000725 | 0.0103 | 0.00757 | 0.00449 |
| Vanadium (V)-Dissolved | mg/L | 0.006 [B, R] | | 0.0219 | 0.0045 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0081 | 0.0023 | 0.0014 |
| Zinc (Zn)-Dissolved | mg/L | B, C, M | 5 [B] | 0.0127 | <0.0060 | <0.0060 | <0.0060 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0056 | <0.0030 | <0.0030 | <0.0030 | 0.124 | 0.0213 | <0.0060 | <0.0030 |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

**Appendix E5. Water Quality Results and Guideline Exceedances for Well Installed at the Mine Sites: Dissolved Metals**

| Well ID | | | | MW-H15 | | | MW-H16 | | MW-H17 | | | | | | MW-H18 | | | | MW-H19 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 19-OCT-11 | 14-MAY-12 | 23-AUG-12 | 16-OCT-11 | 14-MAY-12 | 10-MAY-12 | 22-AUG-12 | 25-OCT-12 | 20-DEC-12 | 09-FEB-14 | 11-MAY-14 | 10-MAY-12 | 22-AUG-12 | 25-OCT-12 | 20-DEC-12 | 10-MAY-12 | 22-AUG-12 | 25-OCT-12 | 20-DEC-12 |
| Time Sampled | | | | 12:00 | 00:00 | 00:00 | 12:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 14:20 | 14:30 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 |
| ALS Sample ID | | BC MOE FWAL | DW | L1074937-4 | L1147583-3 | L1201463-2 | L1074937-5 | L1147583-4 | L1147583-16 | L1201465-7 | L1230640-5 | L1252558-1 | L1422942-1 | L1453879-8 | L1147583-15 | L1201465-3 | L1230640-3 | L1252558-2 | L1147583-14 | L1201465-4 | L1230640-4 | L1252558-3 |
| Matrix | Units | Gudielines [A] | Guidelines [A] | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | |
| Dissolved Metals Filtration Location | mg/L | | | | FIELD | FIELD | | - | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved | mg/L | 0.05 [B,E] | 0.2 | 0.130 | 0.0167 | 0.0272 | 0.383 | - | 0.0072 | 0.0040 | 0.0034 | <0.0030 | <0.0030 | <0.0030 | 0.0053 | 0.0092 | <0.0030 | <0.0030 | 0.0268 | 0.0080 | 0.0042 | <0.0030 |
| Antimony (Sb)-Dissolved | mg/L | 0.02 [B, R] | 0.06 [B, T] | 0.00149 | 0.00021 | 0.00025 | 0.0047 | - | 0.00098 | 0.00012 | 0.00069 | 0.00050 | <0.00010 | <0.00010 | 0.00120 | 0.00015 | 0.00017 | 0.00015 | 0.00687 | 0.00091 | 0.00107 | 0.00078 |
| Arsenic (As)-Dissolved | mg/L | 0.005 [B] | 0.025 [B] | 0.00335 | 0.00241 | 0.00267 | 0.0046 | - | 0.00049 | 0.00109 | 0.00305 | 0.00183 | 0.00061 | 0.00055 | 0.00044 | 0.00020 | 0.00019 | 0.00012 | 0.00117 | 0.00172 | 0.00120 | 0.00126 |
| Barium (Ba)-Dissolved | mg/L | 1 [B, C, R] | 1 [B, T] | 0.247 | 0.624 | 0.614 | 0.273 | - | 0.214 | 0.307 | 0.163 | 0.184 | 0.329 | 0.329 | 1.16 | 0.477 | 1.06 | 0.920 | 0.193 | 0.940 | 1.46 | 1.56 |
| Beryllium (Be)-Dissolved | mg/L | 0.0053 [B, C, R] | | <0.00020 | <0.00020 | <0.00020 | <0.0010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Bismuth (Bi)-Dissolved | mg/L | ng | | <0.0010 | <0.0010 | <0.0010 | <0.0050 | - | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Boron (B)-Dissolved | mg/L | 1.2 [B] | 5 [B] | 0.140 | 0.156 | 0.142 | 0.25 | - | 0.016 | 0.016 | 0.018 | 0.013 | 0.015 | 0.017 | 0.056 | 0.023 | 0.018 | 0.020 | 0.143 | 0.216 | 0.253 | 0.241 |
| Cadmium (Cd)-Dissolved | mg/L | B, R, N | 0.005 [B, T] | 0.000020 | 0.000028 | 0.000028 | <0.00010 | - | 0.000032 | 0.000024 | 0.000017 | 0.000028 | 0.000011 | 0.000019 | 0.000025 | 0.000136 | 0.000021 | 0.000023 | 0.000033 | 0.000013 | 0.000022 | 0.000018 |
| Calcium (Ca)-Dissolved | mg/L | na | | 9.21 | 4.92 | 5.19 | 2.74 | - | 75.4 | 72.7 | 60.7 | 65.1 | 74.2 | 80.0 | 50.3 | 71.4 | 72.1 | 71.7 | 10.0 | 29.9 | 31.4 | 32.9 |
| Chromium (Cr)-Dissolved | mg/L | 0.0089 [B, P] | 0.05 [B, T] | 0.00048 | <0.00020 | 0.00038 | <0.0010 | - | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00026 | <0.00010 | 0.00011 | 0.00012 |
| Cobalt (Co)-Dissolved | mg/L | 4 [B, C] | | 0.00133 | 0.00034 | 0.00032 | <0.0010 | - | 0.00078 | 0.00075 | 0.00061 | 0.00026 | 0.00021 | 0.00021 | 0.00074 | 0.00041 | 0.00024 | 0.00021 | 0.00090 | 0.00145 | 0.00177 | 0.00184 |
| Copper (Cu)-Dissolved | mg/L | 0.0004 to 0.002 [B, C, F] | 0.5 [B] | 0.0013 | <0.0010 | <0.0010 | <0.0050 | - | <0.00050 | <0.00050 | <0.00050 | 0.00086 | <0.00050 | 0.00053 | <0.00050 | 0.00071 | <0.00050 | 0.00065 | 0.00289 | <0.00050 | 0.00065 | 0.00093 |
| Iron (Fe)-Dissolved | mg/L | 0.35 | 0.3 [B, T] | 0.118 | 0.079 | 0.098 | 0.087 | - | <0.030 | <0.030 | <0.030 | <0.030 | 0.036 | 0.048 | <0.030 | <0.030 | <0.030 | <0.030 | 0.048 | 0.057 | <0.030 | <0.030 |
| Lead (Pb)-Dissolved | mg/L | B, C, H | 0.05 [B] | 0.00026 | <0.00010 | <0.00010 | <0.00050 | - | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000083 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved | mg/L | 0.096 [R] | | 0.703 | 0.868 | 0.884 | 0.469 | - | 0.0156 | 0.0159 | 0.0217 | 0.0147 | 0.0148 | 0.0155 | 0.0656 | 0.0209 | 0.0147 | 0.0129 | 0.101 | 0.111 | 0.120 | 0.118 |
| Magnesium (Mg)-Dissolved | mg/L | ng | | 2.60 | 1.32 | 1.34 | 1.28 | - | 19.2 | 19.3 | 14.5 | 15.7 | 19.5 | 20.1 | 15.1 | 19.7 | 20.0 | 20.6 | 2.42 | 11.8 | 11.8 | 13.2 |
| Manganese (Mn)-Dissolved | mg/L | B, C, J | 0.05 [B, T] | 0.337 | 0.205 | 0.205 | 0.0625 | - | 0.0725 | 0.119 | 0.145 | 0.0665 | 0.0468 | 0.0397 | 0.0429 | 0.0431 | 0.0157 | 0.00796 | 0.0656 | 0.310 | 0.344 | 0.364 |
| Mercury (Hg)-Dissolved | mg/L | 0.0000125 to 0.0002 [B, C, K] | 0.001 [B] | <0.000010 | <0.000010 | <0.000010 | <0.000010 | - | <0.000050 | <0.000010 | <0.000010 | <0.000010 | 0.000017 | <0.000010 | <0.000050 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Molybdenum (Mo)-Dissolved | mg/L | 1 [B, C] | 0.25 [B] | 0.0529 | 0.0267 | 0.0280 | 0.0657 | - | 0.00706 | 0.00241 | 0.00646 | 0.00379 | 0.000707 | 0.000666 | 0.00136 | 0.000745 | 0.000704 | 0.000699 | 0.0165 | 0.00537 | 0.00392 | 0.00381 |
| Nickel (Ni)-Dissolved | mg/L | 0.025 to 0.15 [B, C, R, Q] | | 0.0069 | 0.0012 | 0.0018 | 0.0065 | - | 0.00205 | 0.00162 | 0.00286 | 0.00266 | 0.00091 | 0.00092 | 0.00298 | 0.00166 | 0.00171 | 0.00176 | 0.00797 | 0.00499 | 0.00534 | 0.00538 |
| Phosphorus (P)-Dissolved | mg/L | ---- refer to anions and nutrients ---- | | <0.30 | <0.30 | <0.30 | <0.30 | - | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| Potassium (K)-Dissolved | mg/L | 195 [R] | | 1.33 | 1.11 | 1.13 | 2.21 | - | 1.29 | 1.11 | 1.68 | 1.44 | 1.08 | 1.05 | 1.44 | 0.953 | 0.860 | 0.837 | 2.73 | 1.67 | 1.61 | 1.73 |
| Selenium (Se)-Dissolved | mg/L | 0.002 [B] | 0.01 [B] | 0.00059 | <0.00020 | 0.00031 | 0.0016 | - | 0.00245 | <0.00010 | 0.00028 | 0.00026 | <0.00010 | <0.00010 | 0.00114 | 0.00047 | 0.00061 | 0.00066 | 0.00258 | 0.00028 | 0.00060 | 0.00022 |
| Silicon (Si)-Dissolved | mg/L | ng | | 3.80 | 3.36 | 3.48 | 4.00 | - | 3.85 | 4.18 | 4.84 | 4.34 | 4.26 | 4.11 | 3.43 | 3.24 | 3.26 | 3.14 | 4.16 | 4.69 | 4.44 | 4.37 |
| Silver (Ag)-Dissolved | mg/L | 0.0005 to 0.0015 [B, C, L] | | <0.000020 | <0.000020 | <0.000020 | <0.00010 | - | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Sodium (Na)-Dissolved | mg/L | ng | 200 [B, T] | 404 | 391 | 440 | 289 | - | 17.6 | 17.0 | 52.9 | 32.2 | 11.2 | 10.6 | 40.6 | 11.3 | 6.5 | 5.3 | 115 | 83.9 | 73.3 | 70.0 |
| Strontium (Sr)-Dissolved | mg/L | ng | | 0.156 | 0.200 | 0.204 | 0.0984 | - | 0.208 | 0.219 | 0.144 | 0.139 | 0.214 | 0.229 | 0.488 | 0.388 | 0.480 | 0.435 | 0.0875 | 0.795 | 0.931 | 0.943 |
| Thallium (Tl)-Dissolved | mg/L | 0.0003 [B, R] | | 0.000056 | <0.000020 | <0.000020 | <0.00010 | - | 0.000014 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000018 | <0.000010 | <0.000010 | <0.000010 | 0.000024 | <0.000010 | 0.000041 | 0.000024 |
| Tin (Sn)-Dissolved | mg/L | ng | | <0.00020 | 0.00057 | 0.00054 | <0.0010 | - | <0.00010 | <0.00010 | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00016 | <0.00010 | 0.00018 | 0.00019 | 0.00197 | 0.00056 |
| Titanium (Ti)-Dissolved | mg/L | 2 [B, R] | | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | 0.011 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Uranium (U)-Dissolved | mg/L | 0.3 [B, R] | 0.02 [B, T] | 0.00276 | 0.00105 | 0.00109 | 0.00734 | - | 0.00316 | 0.00241 | 0.00794 | 0.00509 | 0.00117 | 0.00113 | 0.000716 | 0.000598 | 0.000711 | 0.000599 | 0.00277 | 0.00253 | 0.00176 | 0.00167 |
| Vanadium (V)-Dissolved | mg/L | 0.006 [B, R] | | 0.0021 | <0.0020 | <0.0020 | 0.010 | - | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Dissolved | mg/L | B, C, M | 5 [B] | <0.0060 | <0.0060 | <0.0060 | <0.030 | - | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0050 | 0.0032 | <0.0030 | <0.0030 | <0.0030 | 0.0033 | 0.0059 |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercury (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

**Appendix E5. Water Quality Results and Guideline Exceedances for Well Installed at the Mine Sites: Dissolved Metals**

| Well ID | | | | MW-PNB | | | | MW-H22 | | | | | | MW-H23 | | | | | | MW-SHAFT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 07-JUL-11 | 15-OCT-11 | 11-MAY-12 | 21-AUG-12 | 11-MAY-12 | 21-AUG-12 | 28-OCT-12 | 19-DEC-12 | 08-FEB-14 | 17-APR-14 | 11-MAY-12 | 21-AUG-12 | 28-OCT-12 | 19-DEC-12 | 08-FEB-14 | 17-APR-14 | 09-FEB-14 |
| Time Sampled | | | | 00:00 | 12:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 15:30 | 14:00 | 00:00 | 00:00 | 00:00 | 00:00 | 12:00 | 17:00 | 12:00 |
| ALS Sample ID | | | | L1031047-4 | L1074937-7 | L1147583-11 | L1201465-5 | L1147583-13 | L1201465-8 | L1230640-7 | L1252558-5 | L1422942-2 | L1445192-1 | L1147583-12 | L1201465-1 | L1230640-6 | L1252558-6 | L1422942-4 | L1445192-2 | L1422942-3 |
| Matrix | Units | BC MOE FWAL Gudielines [A] | DW Guidelines [A] | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | |
| Dissolved Metals Filtration Location | mg/L | | | | | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved | mg/L | 0.05 [B,E] | 0.2 | 0.0034 | 0.0032 | <0.0030 | <0.0030 | <0.0060 | 0.0074 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0031 |
| Antimony (Sb)-Dissolved | mg/L | 0.02 [B, R] | 0.06 [B, T] | 0.00015 | 0.00010 | 0.00010 | <0.00010 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Arsenic (As)-Dissolved | mg/L | 0.005 [B] | 0.025 [B] | <0.00010 | <0.00010 | 0.00107 | 0.00094 | <0.00020 | 0.00012 | 0.00012 | 0.00015 | 0.00015 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00012 | 0.00015 | <0.00010 | 0.00022 |
| Barium (Ba)-Dissolved | mg/L | 1 [B, C, R] | 1 [B, T] | 0.204 | 0.195 | 0.113 | 0.126 | 0.246 | 0.341 | 0.315 | 0.310 | 0.252 | 0.257 | 0.206 | 0.228 | 0.249 | 0.253 | 0.245 | 0.252 | 0.717 |
| Beryllium (Be)-Dissolved | mg/L | 0.0053 [B, C, R] | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Bismuth (Bi)-Dissolved | mg/L | ng | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Boron (B)-Dissolved | mg/L | 1.2 [B] | 5 [B] | <0.010 | <0.010 | 0.014 | 0.012 | <0.020 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Cadmium (Cd)-Dissolved | mg/L | B, R, N | 0.005 [B, T] | 0.000024 | 0.000012 | <0.000010 | <0.000010 | <0.000020 | 0.000021 | 0.000015 | 0.000014 | 0.000061 | <0.000010 | 0.000015 | 0.000029 | <0.000010 | 0.000016 | 0.000021 | <0.000010 | 0.000146 |
| Calcium (Ca)-Dissolved | mg/L | na | | 58.8 | 61.1 | 54.3 | 52.8 | 79.6 | 89.3 | 97.4 | 95.6 | 99.1 | 98.3 | 71.1 | 72.3 | 66.3 | 69.1 | 67.1 | 71.3 | 192 |
| Chromium (Cr)-Dissolved | mg/L | 0.0089 [B, P] | 0.05 [B, T] | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | 0.00028 | 0.00057 | 0.00065 | 0.00067 | 0.00076 | 0.00013 | <0.00010 | 0.00013 | 0.00015 | 0.00010 | 0.00011 | <0.00010 |
| Cobalt (Co)-Dissolved | mg/L | 4 [B, C] | | 0.00025 | 0.00015 | 0.00039 | 0.00080 | 0.00027 | 0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00013 | <0.00010 | <0.00010 | 0.00022 | <0.00010 | <0.00010 | 0.00094 |
| Copper (Cu)-Dissolved | mg/L | 0.0004 to 0.002 [B, C, F] | 0.5 [B] | 0.00056 | <0.00050 | <0.00050 | <0.00050 | <0.0010 | <0.00050 | <0.00050 | 0.00064 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00052 | 0.00061 | <0.00050 | 0.00141 |
| Iron (Fe)-Dissolved | mg/L | 0.35 | 0.3 [B, T] | 0.188 | 0.203 | 0.654 | 0.967 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | 0.041 |
| Lead (Pb)-Dissolved | mg/L | B, C, H | 0.05 [B] | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved | mg/L | 0.096 [R] | | 0.00355 | 0.00372 | 0.00309 | 0.00310 | 0.0043 | 0.00467 | 0.00394 | 0.00414 | 0.00334 | 0.00339 | 0.00317 | 0.00421 | 0.00328 | 0.00349 | 0.00314 | 0.00336 | 0.00453 |
| Magnesium (Mg)-Dissolved | mg/L | ng | | 16.5 | 16.3 | 14.3 | 15.0 | 20.7 | 24.0 | 22.4 | 24.4 | 22.6 | 22.9 | 16.9 | 17.4 | 15.5 | 18.4 | 16.1 | 18.2 | 41.4 |
| Manganese (Mn)-Dissolved | mg/L | B, C, J | 0.05 [B, T] | 0.0547 | 0.0381 | 1.12 | 1.13 | 0.0277 | 0.0268 | 0.00327 | 0.00393 | 0.00405 | 0.00737 | 0.00796 | 0.00349 | 0.00324 | 0.0254 | 0.000660 | 0.00169 | 0.0507 |
| Mercury (Hg)-Dissolved | mg/L | 0.0000125 to 0.0002 [B, C, K] | 0.001 [B] | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000050 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Molybdenum (Mo)-Dissolved | mg/L | 1 [B, C] | 0.25 [B] | 0.000606 | 0.000528 | 0.00354 | 0.00269 | 0.00172 | 0.00138 | 0.000813 | 0.000778 | 0.000435 | 0.000423 | 0.000431 | 0.000440 | 0.000417 | 0.000686 | 0.000448 | 0.000375 | 0.000251 |
| Nickel (Ni)-Dissolved | mg/L | 0.025 to 0.15 [B, C, R, Q] | | 0.00135 | 0.00091 | 0.00152 | 0.00113 | <0.0010 | 0.00072 | 0.00056 | 0.00057 | <0.00050 | <0.00050 | 0.00069 | <0.00050 | <0.00050 | 0.00062 | 0.00055 | <0.00050 | 0.00527 |
| Phosphorus (P)-Dissolved | mg/L | ---- refer to anions and nutrients ---- | | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| Potassium (K)-Dissolved | mg/L | 195 [R] | | 0.588 | 0.552 | 0.964 | 0.854 | 0.80 | 0.805 | 0.908 | 1.00 | 1.56 | 0.951 | 0.640 | 0.637 | 0.618 | 0.747 | 1.02 | 0.649 | 1.09 |
| Selenium (Se)-Dissolved | mg/L | 0.002 [B] | 0.01 [B] | 0.00063 | 0.00066 | 0.00027 | 0.00037 | <0.00020 | 0.00034 | 0.00046 | 0.00052 | 0.00073 | 0.00066 | 0.00042 | 0.00044 | 0.00043 | 0.00058 | 0.00053 | 0.00056 | <0.00010 |
| Silicon (Si)-Dissolved | mg/L | ng | | 2.50 | 2.34 | 2.65 | 2.63 | 3.18 | 3.69 | 3.85 | 3.74 | 3.80 | 3.84 | 2.85 | 2.91 | 2.87 | 2.81 | 2.93 | 2.97 | 4.01 |
| Silver (Ag)-Dissolved | mg/L | 0.0005 to 0.0015 [B, C, L] | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Sodium (Na)-Dissolved | mg/L | ng | 200 [B, T] | 2.4 | 2.4 | 50.7 | 40.9 | 2.20 | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 | 2.36 | 2.2 | 2.2 | 2.5 | 2.3 | 2.4 | 24.9 |
| Strontium (Sr)-Dissolved | mg/L | ng | | 0.111 | 0.110 | 0.116 | 0.129 | 0.110 | 0.141 | 0.139 | 0.133 | 0.139 | 0.137 | 0.108 | 0.115 | 0.109 | 0.106 | 0.112 | 0.118 | 0.255 |
| Thallium (Tl)-Dissolved | mg/L | 0.0003 [B, R] | | 0.000011 | 0.000011 | <0.000010 | <0.000010 | <0.000020 | 0.000013 | 0.000013 | 0.000015 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000010 | <0.000010 | <0.000010 | 0.000012 |
| Tin (Sn)-Dissolved | mg/L | ng | | <0.00010 | <0.00010 | <0.00010 | 0.00017 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Titanium (Ti)-Dissolved | mg/L | 2 [B, R] | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | 0.018 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | 0.015 | 0.011 |
| Uranium (U)-Dissolved | mg/L | 0.3 [B, R] | 0.02 [B, T] | 0.000282 | 0.000247 | 0.00110 | 0.000931 | 0.000577 | 0.000492 | 0.000480 | 0.000506 | 0.000440 | 0.000433 | 0.000265 | 0.000245 | 0.000235 | 0.000303 | 0.000247 | 0.000245 | 0.000658 |
| Vanadium (V)-Dissolved | mg/L | 0.006 [B, R] | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Dissolved | mg/L | B, C, M | 5 [B] | <0.0030 | 0.0042 | <0.0030 | <0.0030 | <0.0060 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0049 |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

**Appendix E6. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Dissolved Metals**

| Well ID | | | | MW-H24A | | | | MW-H24B | | | | | | MW-H24C | | | | MW-H25A | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 29-OCT-12 | 20-DEC-12 | 09-MAY-13 | 08-NOV-13 | 22-OCT-12 | 19-DEC-12 | 07-MAY-13 | 23-JUL-13 | 08-NOV-13 | 10-FEB-14 | 23-JUL-13 | 08-NOV-13 | 13-FEB-14 | 09-MAY-14 | 01-NOV-12 | 09-MAY-13 | 28-JUL-13 |
| Time Sampled | | | | 00:00 | 00:00 | 00:00 | 12:00 | 00:00 | 00:00 | 00:00 | 00:00 | 12:00 | 16:15 | 00:00 | 12:00 | 14:00 | 14:00 | 00:00 | 00:00 | 00:00 |
| ALS Sample ID | | BC MOE FWAL | DW | L1233652-2 | L1252558-4 | L1300522-5 | L1390394-1 | L1230640-1 | L1252558-7 | L1300522-6 | L1337870-1 | L1390394-2 | L1422942-5 | L1337870-2 | L1390394-3 | L1422938-5 | L1453879-2 | L1233652-4 | L1300522-3 | L1340620-1 |
| Matrix | Units | Gudielines [A] | Guidelines [A] | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | |
| Dissolved Metals Filtration Location | mg/L | | | LAB | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved | mg/L | 0.05 [B,E] | 0.2 | 0.054 | 0.025 | 0.123 | 0.0590 | <0.0030 | 0.0048 | <0.0030 | 0.0050 | <0.0030 | <0.0030 | 0.0075 | 0.0043 | 0.0042 | 0.0047 | 0.0166 | 0.0042 | 0.0089 |
| Antimony (Sb)-Dissolved | mg/L | 0.02 [B, R] | 0.06 [B, T] | <0.00050 | <0.00050 | 0.00051 | 0.00027 | 0.00095 | 0.00014 | 0.00072 | 0.00028 | 0.00025 | 0.00029 | 0.00096 | <0.00010 | <0.00010 | <0.00010 | 0.00176 | 0.00076 | 0.00170 |
| Arsenic (As)-Dissolved | mg/L | 0.005 [B] | 0.025 [B] | <0.00050 | <0.00050 | <0.00020 | 0.00023 | 0.00024 | 0.00028 | 0.00124 | 0.00086 | 0.00021 | 0.00037 | 0.0409 | 0.00124 | 0.00051 | 0.00070 | 0.00276 | 0.00111 | 0.00206 |
| Barium (Ba)-Dissolved | mg/L | 1 [B, C, R] | 1 [B, T] | 6.91 | 6.96 | 3.60 | 3.67 | 1.08 | 0.699 | 0.615 | 0.810 | 0.904 | 0.859 | 0.296 | 1.05 | 1.03 | 1.11 | 0.392 | 1.27 | 1.37 |
| Beryllium (Be)-Dissolved | mg/L | 0.0053 [B, C, R] | | <0.00050 | <0.00050 | <0.00020 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00010 | <0.00010 |
| Bismuth (Bi)-Dissolved | mg/L | ng | | <0.0025 | <0.0025 | <0.0010 | <0.0010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 | <0.00050 | <0.00050 |
| Boron (B)-Dissolved | mg/L | 1.2 [B] | 5 [B] | <0.050 | <0.050 | <0.020 | <0.020 | 0.013 | 0.011 | 0.014 | <0.010 | 0.012 | 0.011 | 0.024 | 0.025 | 0.023 | 0.023 | <0.020 | 0.193 | 0.202 |
| Cadmium (Cd)-Dissolved | mg/L | B, R, N | 0.005 [B, T] | <0.000050 | <0.000050 | <0.000020 | <0.000020 | 0.000027 | 0.000045 | 0.000018 | <0.000010 | 0.000038 | 0.000034 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 | <0.000010 | 0.000054 |
| Calcium (Ca)-Dissolved | mg/L | na | | 701 | 490 | 231 | 420 | 69.8 | 69.5 | 71.2 | 63.4 | 67.4 | 67.5 | 69.3 | 71.1 | 72.9 | 77.2 | 237 | 3.83 | 4.06 |
| Chromium (Cr)-Dissolved | mg/L | 0.0089 [B, P] | 0.05 [B, T] | 0.0470 | 0.0352 | 0.0206 | 0.0186 | <0.00010 | 0.00032 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0649 | <0.00010 | <0.00010 |
| Cobalt (Co)-Dissolved | mg/L | 4 [B, C] | | 0.00058 | <0.00050 | <0.00020 | 0.00025 | 0.00077 | 0.00055 | 0.00164 | 0.00180 | 0.00082 | 0.00075 | 0.00072 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | 0.00011 | 0.00054 |
| Copper (Cu)-Dissolved | mg/L | 0.0004 to 0.002 [B, C, F] | 0.5 [B] | 0.0047 | 0.0050 | 0.00459 | 0.00632 | <0.00050 | 0.00104 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.0025 | <0.00050 | 0.00142 |
| Iron (Fe)-Dissolved | mg/L | 0.35 | 0.3 [B, T] | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | 0.043 | <0.030 | 0.488 | 0.047 | 0.169 | 0.863 | 3.65 | 2.15 | 1.82 | <0.030 | <0.030 | <0.030 |
| Lead (Pb)-Dissolved | mg/L | B, C, H | 0.05 [B] | 0.00156 | 0.00127 | 0.00064 | 0.00098 | <0.000050 | 0.000052 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.00010 | 0.000076 | 0.000061 |
| Lithium (Li)-Dissolved | mg/L | 0.096 [R] | | 0.244 | 0.215 | 0.143 | 0.100 | 0.00178 | 0.00143 | 0.00328 | 0.00118 | 0.00153 | 0.00141 | 0.0157 | 0.0169 | 0.0165 | 0.0156 | 0.0157 | 0.531 | 0.505 |
| Magnesium (Mg)-Dissolved | mg/L | ng | | 0.040 | 0.032 | 0.036 | 0.043 | 17.8 | 18.2 | 17.0 | 16.0 | 17.3 | 17.2 | 21.6 | 21.8 | 22.0 | 24.3 | 0.225 | 1.62 | 1.92 |
| Manganese (Mn)-Dissolved | mg/L | B, C, J | 0.05 [B, T] | <0.00025 | <0.00025 | <0.00010 | 0.00010 | 0.0546 | 0.0596 | 0.371 | 0.344 | 0.0408 | 0.0469 | 0.212 | 0.327 | 0.105 | 0.0912 | 0.00027 | 0.00616 | 0.00939 |
| Mercury (Hg)-Dissolved | mg/L | 0.0000125 to 0.0002 [B, C, K] | 0.001 [B] | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Molybdenum (Mo)-Dissolved | mg/L | 1 [B, C] | 0.25 [B] | 0.0242 | 0.0214 | 0.0120 | 0.0101 | 0.000933 | 0.000610 | 0.00158 | 0.00121 | 0.000667 | 0.000726 | 0.00650 | 0.00258 | 0.00159 | 0.00174 | 0.0172 | 0.00622 | 0.00725 |
| Nickel (Ni)-Dissolved | mg/L | 0.025 to 0.15 [B, C, R, Q] | | <0.0025 | <0.0025 | <0.0010 | 0.0013 | 0.00166 | 0.00099 | 0.00485 | 0.00191 | 0.00099 | 0.00111 | 0.00171 | <0.00050 | <0.00050 | <0.00050 | 0.0013 | 0.00110 | 0.00422 |
| Phosphorus (P)-Dissolved | mg/L | ---- refer to anions and nutrients ---- | | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| Potassium (K)-Dissolved | mg/L | 195 [R] | | 101 | 72.5 | 18.7 | 11.3 | 0.858 | 1.06 | 1.19 | 0.815 | 0.835 | 0.834 | 2.37 | 0.969 | 0.826 | 0.873 | 6.70 | 0.725 | 1.48 |
| Selenium (Se)-Dissolved | mg/L | 0.002 [B] | 0.01 [B] | 0.00063 | 0.00060 | 0.00048 | 0.00040 | 0.00083 | <0.00010 | 0.00079 | 0.00028 | 0.00028 | 0.00027 | 0.00016 | <0.00010 | <0.00010 | 0.00022 | 0.00125 | 0.00010 | 0.00112 |
| Silicon (Si)-Dissolved | mg/L | ng | | 0.132 | 0.254 | 0.668 | 0.325 | 2.68 | 2.80 | 2.84 | 2.65 | 2.86 | 2.74 | 5.47 | 6.66 | 6.59 | 6.22 | 40.1 | 3.19 | 2.74 |
| Silver (Ag)-Dissolved | mg/L | 0.0005 to 0.0015 [B, C, L] | | <0.000050 | <0.000050 | <0.000020 | <0.000020 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 | <0.000010 | <0.000010 |
| Sodium (Na)-Dissolved | mg/L | ng | 200 [B, T] | 898 | 883 | 528 | 567 | 8.0 | 6.5 | 24.3 | 6.2 | 11.7 | 10.1 | 22.4 | 15.0 | 13.3 | 10.0 | 32.6 | 290 | 248 |
| Strontium (Sr)-Dissolved | mg/L | ng | | 26.3 | 22.3 | 8.17 | 6.67 | 0.237 | 0.180 | 0.307 | 0.186 | 0.188 | 0.191 | 0.381 | 0.523 | 0.483 | 0.506 | 0.842 | 0.139 | 0.144 |
| Thallium (Tl)-Dissolved | mg/L | 0.0003 [B, R] | | <0.000050 | <0.000050 | <0.000020 | <0.000020 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 | <0.000010 | 0.000021 |
| Tin (Sn)-Dissolved | mg/L | ng | | 0.00095 | 0.00383 | 0.00037 | 0.00096 | <0.00010 | 0.00013 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00052 | <0.00010 | 0.00024 |
| Titanium (Ti)-Dissolved | mg/L | 2 [B, R] | | <0.010 | 0.016 | 0.011 | 0.016 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Uranium (U)-Dissolved | mg/L | 0.3 [B, R] | 0.02 [B, T] | <0.000050 | <0.000050 | <0.000020 | <0.000020 | 0.000413 | 0.000519 | 0.00465 | 0.000698 | 0.000469 | 0.000456 | 0.00130 | 0.000147 | 0.000091 | 0.000084 | <0.000020 | 0.000555 | 0.00176 |
| Vanadium (V)-Dissolved | mg/L | 0.006 [B, R] | | <0.0050 | <0.0050 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0258 | 0.0021 | 0.0037 |
| Zinc (Zn)-Dissolved | mg/L | B, C, M | 5 [B] | 0.016 | <0.015 | 0.0143 | 0.0173 | <0.0030 | 0.0077 | 0.0034 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0060 | <0.0030 | <0.0030 |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

**Appendix E6. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Dissolved Metals**

| Well ID | | | | MW-H25A *(cont'd)* | | | MW-H25B | | | | | | | MW-H26A | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled** | | | | 08-NOV-13 | 13-FEB-14 | 09-MAY-14 | 22-OCT-12 | 19-DEC-12 | 07-MAY-13 | 23-JUL-13 | 08-NOV-13 | 12-FEB-14 | 11-MAY-14 | 30-OCT-12 | 09-MAY-13 | 28-JUL-13 | 08-NOV-13 | 12-FEB-14 | 10-MAY-14 |
| **Time Sampled** | | | | 12:00 | 18:45 | 14:30 | 00:00 | 00:00 | 00:00 | 00:00 | 12:00 | 15:00 | 11:00 | 00:00 | 00:00 | 00:00 | 12:00 | 15:30 | 15:00 |
| **ALS Sample ID** | | BC MOE FWAL | DW | L1390394-4 | L1422945-2 | L1453879-3 | L1230640-2 | L1252558-8 | L1300522-4 | L1337870-4 | L1390394-5 | L1422938-4 | L1453879-7 | L1233652-1 | L1300522-1 | L1340620-3 | L1390524-1 | L1422938-3 | L1453879-4 |
| **Matrix** | **Units** | **Gudielines [A]** | **Guidelines [A]** | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | |
| Dissolved Metals Filtration Location | mg/L | | | FIELD | FIELD | | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | | FIELD | FIELD | FIELD | FIELD | FIELD | |
| Aluminum (Al)-Dissolved | mg/L | 0.05 [B,E] | 0.2 | 0.0050 | 0.0061 | 0.0049 | 0.0131 | <0.0030 | <0.0030 | 0.0033 | <0.0030 | <0.0030 | <0.0030 | 0.0573 | 0.111 | 0.0595 | 0.127 | 0.112 | 0.112 |
| Antimony (Sb)-Dissolved | mg/L | 0.02 [B, R] | 0.06 [B, T] | <0.00010 | <0.00010 | <0.00010 | 0.00028 | 0.00017 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00119 | 0.00104 | 0.00073 | 0.00098 | 0.00045 | 0.00038 |
| Arsenic (As)-Dissolved | mg/L | 0.005 [B] | 0.025 [B] | <0.00010 | <0.00010 | <0.00010 | 0.00131 | 0.00130 | 0.00125 | 0.00160 | 0.00166 | 0.00147 | 0.00146 | 0.00211 | 0.00133 | 0.00169 | 0.00087 | 0.00043 | 0.00050 |
| Barium (Ba)-Dissolved | mg/L | 1 [B, C, R] | 1 [B, T] | 1.13 | 1.14 | 1.18 | 0.291 | 0.220 | 0.211 | 0.274 | 0.287 | 0.267 | 0.273 | 0.473 | 0.844 | 0.795 | 0.547 | 0.626 | 0.647 |
| Beryllium (Be)-Dissolved | mg/L | 0.0053 [B, C, R] | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Bismuth (Bi)-Dissolved | mg/L | ng | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Boron (B)-Dissolved | mg/L | 1.2 [B] | 5 [B] | 0.200 | 0.193 | 0.213 | 0.014 | 0.017 | 0.012 | 0.011 | 0.013 | 0.010 | 0.010 | 0.037 | 0.183 | 0.185 | 0.197 | 0.191 | 0.207 |
| Cadmium (Cd)-Dissolved | mg/L | B, R, N | 0.005 [B, T] | <0.000010 | <0.000010 | <0.000010 | 0.000142 | 0.000029 | 0.000017 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000050 | <0.000010 | 0.000105 | <0.000010 | <0.000010 | <0.000010 |
| Calcium (Ca)-Dissolved | mg/L | na | | 3.57 | 3.19 | 3.44 | 109 | 89.3 | 90.0 | 91.7 | 95.3 | 96.2 | 99.1 | 143 | 5.52 | 4.12 | 4.86 | 4.49 | 4.69 |
| Chromium (Cr)-Dissolved | mg/L | 0.0089 [B, P] | 0.05 [B, T] | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.0764 | 0.00019 | 0.00107 | 0.00023 | 0.00015 | 0.00017 |
| Cobalt (Co)-Dissolved | mg/L | 4 [B, C] | | <0.00010 | <0.00010 | <0.00010 | 0.00731 | 0.00204 | 0.00166 | 0.00146 | 0.00128 | 0.00120 | 0.00118 | 0.00012 | <0.00010 | 0.00061 | <0.00010 | <0.00010 | <0.00010 |
| Copper (Cu)-Dissolved | mg/L | 0.0004 to 0.002 [B, C, F] | 0.5 [B] | <0.00050 | <0.00050 | <0.00050 | 0.00082 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00708 | 0.00111 | 0.00189 | <0.00050 | <0.00050 | <0.00050 |
| Iron (Fe)-Dissolved | mg/L | 0.35 | 0.3 [B, T] | 0.062 | 0.070 | 0.061 | 0.047 | <0.030 | 0.094 | 0.372 | 0.367 | 0.526 | 0.525 | 0.034 | 0.066 | <0.030 | 0.054 | 0.048 | 0.044 |
| Lead (Pb)-Dissolved | mg/L | B, C, H | 0.05 [B] | <0.000050 | <0.000050 | <0.000050 | 0.000071 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000099 | 0.000578 | 0.000635 | 0.000159 | 0.000107 | 0.000099 |
| Lithium (Li)-Dissolved | mg/L | 0.096 [R] | | 0.567 | 0.473 | 0.576 | 0.00757 | 0.00713 | 0.00655 | 0.00631 | 0.00724 | 0.00664 | 0.00702 | 0.185 | 0.571 | 0.497 | 0.521 | 0.500 | 0.567 |
| Magnesium (Mg)-Dissolved | mg/L | ng | | 1.56 | 1.49 | 1.68 | 32.7 | 29.5 | 29.3 | 28.3 | 29.7 | 29.8 | 32.0 | 0.123 | 2.01 | 2.08 | 1.58 | 1.87 | 2.17 |
| Manganese (Mn)-Dissolved | mg/L | B, C, J | 0.05 [B, T] | 0.0226 | 0.0206 | 0.0195 | 0.549 | 0.805 | 0.782 | 0.700 | 0.710 | 0.673 | 0.705 | 0.00123 | 0.00460 | 0.00506 | 0.00676 | 0.00818 | 0.00998 |
| Mercury (Hg)-Dissolved | mg/L | 0.0000125 to 0.0002 [B, C, K] | 0.001 [B] | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Molybdenum (Mo)-Dissolved | mg/L | 1 [B, C] | 0.25 [B] | 0.000707 | 0.000580 | 0.000583 | 0.00274 | 0.00317 | 0.00250 | 0.00218 | 0.00218 | 0.00195 | 0.00190 | 0.156 | 0.00791 | 0.00570 | 0.00899 | 0.00626 | 0.00554 |
| Nickel (Ni)-Dissolved | mg/L | 0.025 to 0.15 [B, C, R, Q] | | <0.00050 | <0.00050 | <0.00050 | 0.0204 | 0.00408 | 0.00399 | 0.00372 | 0.00341 | 0.00278 | 0.00272 | 0.00090 | 0.00096 | 0.00188 | <0.00050 | <0.00050 | <0.00050 |
| Phosphorus (P)-Dissolved | mg/L | ---- refer to anions and nutrients ---- | | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| Potassium (K)-Dissolved | mg/L | 195 [R] | | 0.560 | 0.546 | 0.593 | 1.57 | 1.00 | 0.766 | 0.585 | 0.592 | 0.533 | 0.520 | 9.44 | 0.601 | 0.773 | 0.687 | 0.664 | 0.663 |
| Selenium (Se)-Dissolved | mg/L | 0.002 [B] | 0.01 [B] | <0.00010 | <0.00010 | <0.00010 | 0.00138 | 0.00012 | <0.00010 | <0.00010 | 0.00011 | <0.00010 | 0.00025 | 0.00238 | <0.00010 | 0.00018 | <0.00010 | <0.00010 | <0.00010 |
| Silicon (Si)-Dissolved | mg/L | ng | | 3.15 | 3.19 | 3.08 | 5.99 | 5.49 | 5.29 | 5.53 | 5.90 | 5.37 | 5.13 | 17.6 | 4.38 | 3.89 | 4.80 | 4.60 | 4.52 |
| Silver (Ag)-Dissolved | mg/L | 0.0005 to 0.0015 [B, C, L] | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000048 | <0.000010 | <0.000010 | <0.000010 |
| Sodium (Na)-Dissolved | mg/L | ng | 200 [B, T] | 275 | 285 | 277 | 12.2 | 11.5 | 10.2 | 8.5 | 9.2 | 8.3 | 8.1 | 156 | 293 | 259 | 277 | 276 | 285 |
| Strontium (Sr)-Dissolved | mg/L | ng | | 0.139 | 0.124 | 0.136 | 0.271 | 0.274 | 0.264 | 0.251 | 0.262 | 0.256 | 0.258 | 0.708 | 0.139 | 0.132 | 0.134 | 0.134 | 0.140 |
| Thallium (Tl)-Dissolved | mg/L | 0.0003 [B, R] | | <0.000010 | <0.000010 | <0.000010 | 0.000026 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000103 | <0.000010 | <0.000010 | <0.000010 |
| Tin (Sn)-Dissolved | mg/L | ng | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00067 | 0.00012 | 0.00055 | 0.00019 | 0.00014 | 0.00014 |
| Titanium (Ti)-Dissolved | mg/L | 2 [B, R] | | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | 0.011 | <0.010 | 0.011 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Uranium (U)-Dissolved | mg/L | 0.3 [B, R] | 0.02 [B, T] | 0.000020 | 0.000016 | 0.000014 | 0.00435 | 0.00267 | 0.00181 | 0.00142 | 0.00140 | 0.00130 | 0.00130 | <0.000010 | 0.000318 | 0.000512 | 0.000508 | 0.000357 | 0.000327 |
| Vanadium (V)-Dissolved | mg/L | 0.006 [B, R] | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0158 | 0.0011 | 0.0042 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Dissolved | mg/L | B, C, M | 5 [B] | <0.0030 | <0.0030 | <0.0030 | 0.0033 | <0.0030 | 0.0122 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | 0.0031 | 0.0033 | <0.0030 | 0.0037 | <0.0030 | <0.0030 |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

**Appendix E6. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Dissolved Metals**

| Well ID | | | | MW-H26B | | | | | | MW-H27 | | | | MW-H28 | | | | MW-H29 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | 30-OCT-12 | 19-DEC-12 | 08-MAY-13 | 23-JUL-13 | 08-NOV-13 | 11-FEB-14 | 28-JUL-13 | 08-NOV-13 | 10-FEB-14 | 10-MAY-14 | 31-JUL-13 | 08-NOV-13 | 13-FEB-14 | 13-MAY-14 | 01-AUG-13 | 08-NOV-13 | 11-FEB-14 | 10-MAY-14 |
| Time Sampled | | | | 00:00 | 00:00 | 00:00 | 00:00 | 12:00 | 14:30 | 00:00 | 12:00 | 17:30 | 16:00 | 00:00 | 12:00 | 15:00 | 00:00 | 00:00 | 12:00 | 15:30 | 14:00 |
| ALS Sample ID | | BC MOE FWAL | DW | L1233652-3 | L1252558-9 | L1300522-2 | L1337870-3 | L1390524-2 | L1422938-1 | L1340620-2 | L1390524-4 | L1422942-6 | L1453879-5 | L1343263-1 | L1390524-5 | L1422945-1 | L1455515-2 | L1343263-2 | L1390524-6 | L1422938-2 | L1453879-6 |
| Matrix | Units | Gudielines [A] | Guidelines [A] | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | |
| Dissolved Metals Filtration Location | mg/L | | | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | FIELD | | FIELD | FIELD | FIELD | | FIELD | FIELD | FIELD | |
| Aluminum (Al)-Dissolved | mg/L | 0.05 [B,E] | 0.2 | 0.0118 | 0.0066 | 0.0032 | 0.0050 | 0.0043 | <0.0030 | 0.0178 | 0.0076 | 0.0101 | 0.0075 | 0.0259 | 0.0142 | 0.0112 | 0.0073 | 0.0434 | 0.0064 | 0.0044 | 0.0032 |
| Antimony (Sb)-Dissolved | mg/L | 0.02 [B, R] | 0.06 [B, T] | 0.00072 | 0.00098 | 0.00016 | 0.00037 | <0.00010 | <0.00010 | 0.00041 | 0.00036 | <0.00010 | <0.00020 | 0.00087 | 0.00024 | 0.00014 | <0.00020 | 0.00033 | <0.00010 | <0.00010 | <0.00010 |
| Arsenic (As)-Dissolved | mg/L | 0.005 [B] | 0.025 [B] | 0.00096 | 0.00117 | 0.00096 | 0.00290 | 0.00223 | 0.00154 | 0.00071 | 0.00058 | 0.00021 | 0.00021 | 0.00183 | 0.00482 | 0.00330 | 0.00570 | 0.00044 | 0.00118 | 0.00103 | 0.00067 |
| Barium (Ba)-Dissolved | mg/L | 1 [B, C, R] | 1 [B, T] | 0.0947 | 0.0759 | 0.0641 | 0.0729 | 0.0790 | 0.0732 | 0.810 | 0.988 | 1.24 | 1.27 | 0.697 | 0.0491 | 0.179 | 0.160 | 0.114 | 0.0657 | 0.0428 | 0.0906 |
| Beryllium (Be)-Dissolved | mg/L | 0.0053 [B, C, R] | | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00020 | <0.00010 | <0.00020 | <0.00020 | <0.00010 | <0.00010 | <0.00020 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Bismuth (Bi)-Dissolved | mg/L | ng | | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 | <0.0010 | <0.00050 | <0.0010 | <0.0010 | <0.00050 | <0.00050 | <0.0010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Boron (B)-Dissolved | mg/L | 1.2 [B] | 5 [B] | 0.069 | 0.070 | 0.027 | 0.052 | 0.048 | 0.044 | 0.203 | 0.221 | 0.153 | 0.222 | 0.199 | 0.192 | 0.196 | 0.154 | 0.160 | 0.177 | 0.169 | 0.170 |
| Cadmium (Cd)-Dissolved | mg/L | B, R, N | 0.005 [B, T] | 0.000236 | 0.000071 | 0.000083 | 0.000045 | 0.000029 | 0.000038 | <0.000020 | 0.000033 | <0.000010 | <0.000020 | 0.000098 | 0.000020 | <0.000010 | <0.000020 | 0.000038 | <0.000010 | <0.000010 | <0.000010 |
| Calcium (Ca)-Dissolved | mg/L | na | | 107 | 97.6 | 85.3 | 92.9 | 94.4 | 85.0 | 3.30 | 3.90 | 2.85 | 3.27 | 4.25 | 10.3 | 13.7 | 17.3 | 7.81 | 2.72 | 2.84 | 2.88 |
| Chromium (Cr)-Dissolved | mg/L | 0.0089 [B, P] | 0.05 [B, T] | 0.00101 | 0.00017 | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 | <0.00020 | <0.00010 | <0.00020 | 0.00023 | 0.00021 | 0.00022 | <0.00020 | 0.00015 | <0.00010 | <0.00010 | <0.00010 |
| Cobalt (Co)-Dissolved | mg/L | 4 [B, C] | | 0.0123 | 0.00554 | 0.00222 | 0.00341 | 0.00258 | 0.00220 | <0.00020 | 0.00024 | 0.00011 | <0.00020 | 0.00054 | 0.00166 | 0.00087 | 0.00032 | 0.00096 | 0.00036 | 0.00023 | 0.00018 |
| Copper (Cu)-Dissolved | mg/L | 0.0004 to 0.002 [B, C, F] | 0.5 [B] | 0.00645 | 0.00239 | 0.00082 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | 0.00146 | 0.00099 | <0.00050 | 0.00176 | <0.00050 | 0.00066 | <0.00050 | 0.00136 | <0.00050 | <0.00050 | <0.00050 |
| Iron (Fe)-Dissolved | mg/L | 0.35 | 0.3 [B, T] | <0.030 | <0.030 | 0.036 | 1.13 | 0.287 | 0.182 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | 0.396 | 0.090 | 0.305 | <0.030 | 0.148 | 0.135 | 0.117 |
| Lead (Pb)-Dissolved | mg/L | B, C, H | 0.05 [B] | 0.000077 | 0.000104 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.00010 | 0.00013 | 0.000063 | <0.00010 | 0.00018 | 0.000052 | 0.000061 | <0.00010 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved | mg/L | 0.096 [R] | | 0.0133 | 0.00925 | 0.00759 | 0.00531 | 0.00571 | 0.00414 | 0.645 | 0.764 | 0.505 | 0.756 | 0.710 | 0.232 | 0.263 | 0.219 | 0.161 | 0.173 | 0.155 | 0.175 |
| Magnesium (Mg)-Dissolved | mg/L | ng | | 30.5 | 32.7 | 33.5 | 35.1 | 36.5 | 34.1 | 2.89 | 1.18 | 1.30 | 1.23 | 1.35 | 4.11 | 5.11 | 7.19 | 1.71 | 0.406 | 0.312 | 0.322 |
| Manganese (Mn)-Dissolved | mg/L | B, C, J | 0.05 [B, T] | 0.892 | 1.02 | 0.670 | 1.47 | 1.17 | 0.978 | 0.00567 | 0.0102 | 0.0175 | 0.0175 | 0.00674 | 0.520 | 0.638 | 0.730 | 0.0999 | 0.121 | 0.0971 | 0.0757 |
| Mercury (Hg)-Dissolved | mg/L | 0.0000125 to 0.0002 [B, C, K] | 0.001 [B] | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | 0.000012 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Molybdenum (Mo)-Dissolved | mg/L | 1 [B, C] | 0.25 [B] | 0.00438 | 0.00676 | 0.00237 | 0.00338 | 0.00291 | 0.00268 | 0.0110 | 0.0138 | 0.00942 | 0.0102 | 0.0139 | 0.0225 | 0.0204 | 0.0191 | 0.00696 | 0.000566 | 0.000269 | 0.000156 |
| Nickel (Ni)-Dissolved | mg/L | 0.025 to 0.15 [B, C, R, Q] | | 0.0388 | 0.0152 | 0.00524 | 0.00905 | 0.00621 | 0.00612 | <0.0010 | 0.0025 | <0.00050 | <0.0010 | 0.0060 | 0.00946 | 0.00531 | 0.0023 | 0.00574 | 0.00156 | 0.00098 | 0.00095 |
| Phosphorus (P)-Dissolved | mg/L | ---- refer to anions and nutrients ---- | | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 | 0.57 | <0.30 | <0.30 | <0.30 | <0.30 |
| Potassium (K)-Dissolved | mg/L | 195 [R] | | 5.25 | 3.83 | 1.86 | 2.50 | 2.32 | 2.30 | 0.68 | 0.66 | 1.24 | 0.51 | 0.91 | 1.35 | 1.70 | 1.59 | 1.47 | 0.498 | 0.401 | 0.296 |
| Selenium (Se)-Dissolved | mg/L | 0.002 [B] | 0.01 [B] | 0.00404 | 0.00061 | 0.00027 | 0.00026 | 0.00021 | 0.00011 | 0.00209 | <0.00020 | <0.00010 | <0.00020 | 0.00042 | 0.00030 | 0.00019 | <0.00020 | 0.00014 | <0.00010 | <0.00010 | <0.00010 |
| Silicon (Si)-Dissolved | mg/L | ng | | 5.88 | 6.76 | 4.64 | 6.03 | 6.35 | 5.68 | 2.83 | 2.95 | 2.86 | 2.91 | 2.67 | 4.04 | 4.56 | 4.30 | 3.55 | 4.25 | 4.14 | 3.91 |
| Silver (Ag)-Dissolved | mg/L | 0.0005 to 0.0015 [B, C, L] | | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 | <0.000020 | <0.000010 | <0.000020 | <0.000020 | <0.000010 | <0.000010 | <0.000020 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Sodium (Na)-Dissolved | mg/L | ng | 200 [B, T] | 49.9 | 86.3 | 22.6 | 34.3 | 23.5 | 19.2 | 306 | 352 | 339 | 347 | 323 | 295 | 354 | 361 | 173 | 185 | 173 | 175 |
| Strontium (Sr)-Dissolved | mg/L | ng | | 0.332 | 0.329 | 0.279 | 0.336 | 0.316 | 0.341 | 0.118 | 0.150 | 0.120 | 0.151 | 0.116 | 0.127 | 0.201 | 0.326 | 0.0573 | 0.0286 | 0.0243 | 0.0375 |
| Thallium (Tl)-Dissolved | mg/L | 0.0003 [B, R] | | 0.000046 | 0.000011 | 0.000023 | 0.000020 | 0.000014 | 0.000013 | <0.000020 | <0.000020 | <0.000010 | <0.000020 | <0.000020 | <0.000010 | <0.000010 | <0.000020 | 0.000022 | <0.000010 | <0.000010 | <0.000010 |
| Tin (Sn)-Dissolved | mg/L | ng | | 0.0114 | 0.00027 | <0.00010 | 0.00014 | <0.00010 | <0.00010 | <0.00020 | 0.00076 | <0.00010 | <0.00020 | 0.00042 | 0.00020 | <0.00010 | <0.00020 | 0.00022 | <0.00010 | <0.00010 | <0.00010 |
| Titanium (Ti)-Dissolved | mg/L | 2 [B, R] | | <0.010 | 0.010 | <0.010 | <0.010 | 0.012 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Uranium (U)-Dissolved | mg/L | 0.3 [B, R] | 0.02 [B, T] | 0.00543 | 0.0117 | 0.00478 | 0.00761 | 0.00650 | 0.00554 | 0.000684 | 0.000574 | 0.000080 | 0.000080 | 0.00262 | 0.00294 | 0.00256 | 0.00290 | 0.000925 | 0.000539 | 0.000415 | 0.000257 |
| Vanadium (V)-Dissolved | mg/L | 0.006 [B, R] | | <0.0010 | <0.0010 | <0.0010 | 0.0017 | <0.0010 | <0.0010 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0010 | <0.0010 | <0.0020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Dissolved | mg/L | B, C, M | 5 [B] | 0.0194 | 0.0099 | 0.0069 | <0.0030 | 0.0033 | <0.0030 | 0.0031 | 0.0038 | 0.0041 | <0.0030 | <0.0030 | 0.0032 | 0.0042 | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |

*ng = no approved water quality guideline.*

*na = not applicable.*

*Shaded values indicate guideline exceedances.*

*Underlined values indicate not-detection exceeds guideline.*

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

**Appendix E7. Water Quality Results and Guideline Exceedances for Polycyclic Aromatic Hydrocarbons (All Samples)**

| Well ID | | | | MW-H17 | MW-H18 | MW-H19 | MW-H22 | MW-H23 | MW-H24A | MW-H24B | MW-H24C | MW-H25A | MW-H25B | MW-H26A | MW-H26B | MW-H27 | MW-H28 | MW-H29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date Sampled** | | | | 20-DEC-12 | 20-DEC-12 | 20-DEC-12 | 19-DEC-12 | 19-DEC-12 | 20-DEC-12 | 19-DEC-12 | 23-JUL-13 | 28-JUL-13 | 19-DEC-12 | 28-JUL-13 | 19-DEC-12 | 28-JUL-13 | 31-JUL-13 | 01-AUG-13 |
| **Time Sampled** | | | | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 | 00:00 |
| **ALS Sample ID** | | **FWAL** | **DW** | L1252558-1 | L1252558-2 | L1252558-3 | L1252558-5 | L1252558-6 | L1252558-4 | L1252558-7 | L1337870-2 | L1340620-1 | L1252558-8 | L1340620-3 | L1252558-9 | L1340620-2 | L1343263-1 | L1343263-2 |
| **Matrix** | **Units** | **Gudielines [A]** | **Gudielines [E]** | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water | Water |
| **Aggregate Organics** | | | | | | | | | | | | | | | | | | |
| Phenols (4AAP) | mg/L | 0.0045 to 0.05 [C] | | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.0040 | <0.0010 | 0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | | | | | | | | | | | | |
| Acenaphthene | mg/L | 0.006 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Acenaphthylene | mg/L | ng | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Acridine | mg/L | 0.003 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Anthracene | mg/L | 0.004 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Benz(a)anthracene | mg/L | 0.0001 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Benzo(a)pyrene | mg/L | 0.00001 [B] | 0.00001 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Benzo(b)fluoranthene | mg/L | ng | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Benzo(g,h,i)perylene | mg/L | ng | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Benzo(k)fluoranthene | mg/L | ng | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Chrysene | mg/L | ng | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Dibenz(a,h)anthracene | mg/L | ng | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Fluoranthene | mg/L | 0.004 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Fluorene | mg/L | 0.012 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000085 |
| Indeno(1,2,3-c,d)pyrene | mg/L | ng | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Naphthalene | mg/L | 0.001 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000415 | <0.000050 | 0.000346 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000057 | 0.000412 |
| Phenanthrene | mg/L | 0.0003 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | 0.000080 |
| Pyrene | mg/L | 0.02 [B] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Quinoline | mg/L | 0.0034 [D] | ng | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000090 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |

*ng = no approved water quality guideline.*

*Shaded values indicate guideline exceedances.*

[A] *Reference: Approved Water Quality Guidelines for the protection of freshwater aquatic life (BC MOE 2014a), unless indicated otherwise.*

[B] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[C] *Guidelines prescribed for specific phenol compounds range from 4.5 µg/L to 50 µg/L.*

[D] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[E] *Reference: BC Contaminated Sites Regulation Schedule 6 (BC MOE 2014c).*

RESCAN ENVIRONMENTAL SERVICES
ATTN: G. Papini
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 13-JUL-11
Report Date: 25-JUL-11 14:20 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1031047**
Project P.O. #: NOT SUBMITTED
Job Reference: 0791-002-03-05 MURRAY RIVER
Legal Site Desc:
C of C Numbers: 10-175011

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 | L1031047-1 | L1031047-2 | L1031047-3 | L1031047-4 | L1031047-5 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 10-JUL-11 | 08-JUL-11 | 09-JUL-11 | 07-JUL-11 | 07-JUL-11 |
| | Sampled Time | | | | | |
| | Client ID | MW-2B | MW-20 | MW-5 | MW-PNB | MW-PNC |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | <5.0 | 16.1 |
| | Conductivity (uS/cm) | 279 | 655 | 587 | 401 | 400 |
| | Hardness (as CaCO3) (mg/L) | 134 | 146 | 295 | 215 | 212 |
| | pH (pH) | 7.97 | 8.30 | 7.87 | 8.17 | 8.21 |
| | Total Suspended Solids (mg/L) | 282 | 554 | 178 | <3.0 | <3.0 |
| | Turbidity (NTU) | 314 | 561 | 376 | 2.81 | 1.68 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 2.8 | <1.0 | 4.0 | 1.3 | 1.3 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 134 | 383 | 327 | 215 | 213 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | 2.3 | <1.0 | <2.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <2.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 134 | 385 | 327 | 215 | 213 |
| | Ammonia (as N) (mg/L) | 0.0195 | 0.722 | 0.180 | 0.0161 | 0.0152 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | 5.67 | 2.99 | 5.35 | <0.50 | <0.50 |
| | Fluoride (F) (mg/L) | 0.099 | 0.879 | 0.154 | 0.058 | 0.057 |
| | Nitrate (as N) (mg/L) | <0.0050 | <0.0050 | <0.0050 | 0.394 | 0.394 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.603 | 1.41 | 0.473 | 0.098 | 0.129 |
| | Total Nitrogen (mg/L) | 0.603 | 1.41 | 0.473 | 0.492 | 0.523 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0249 | <0.0010 | 0.0015 | <0.0010 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.348 | 0.00990 | 0.301 | <0.0020 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.379 | 0.255 | 0.364 | 0.0030 | 0.0020 |
| | Sulfate (SO4) (mg/L) | 11.7 | 5.02 | 12.8 | 16.0 | 15.9 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 19.9 | 24.9 | 5.65 | 1.41 | 1.41 |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 0.0086 | 0.0065 | <0.0030 | 0.0034 | 0.0033 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00027 | 0.00166 | <0.00010 | 0.00015 | 0.00015 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00062 | 0.00085 | 0.00244 | <0.00010 | <0.00010 |
| | Barium (Ba)-Dissolved (mg/L) | 0.259 | 2.67 | 0.136 | 0.204 | 0.208 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | 0.013 | 0.144 | 0.026 | <0.010 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | 0.000029 | <0.000010 | 0.000024 | 0.000024 |
| | Calcium (Ca)-Dissolved (mg/L) | 38.2 | 29.2 | 73.5 | 58.8 | 57.9 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00022 | <0.00010 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00084 | 0.00023 | 0.00028 | 0.00025 | 0.00023 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | 0.0937 | <0.00050 | 0.00056 | <0.00050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1031047-6 | L1031047-7 | | | |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | | | |
| | Sampled Date | 10-JUL-11 | | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-2A | FIELD BLANK | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 6.9 | <5.0 | | | |
| | Conductivity (uS/cm) | 1200 | <2.0 | | | |
| | Hardness (as CaCO3) (mg/L) | 27.4 | <0.50 | | | |
| | pH (pH) | 8.48 | 5.99 | | | |
| | Total Suspended Solids (mg/L) | 6000 | <3.0 | | | |
| | Turbidity (NTU) | >4000 | <0.10 | | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | 2.8 | | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 622 | <2.0 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 38 | <2.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <10 | <2.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 660 | <2.0 | | | |
| | Ammonia (as N) (mg/L) | 0.123 | <0.0050 | | | |
| | Bromide (Br) (mg/L) | <0.50 | <0.050 | | | |
| | Chloride (Cl) (mg/L) | 10.4 | <0.50 | | | |
| | Fluoride (F) (mg/L) | 1.60 | <0.020 | | | |
| | Nitrate (as N) (mg/L) | <0.050 | <0.0050 | | | |
| | Nitrite (as N) (mg/L) | <0.010 | <0.0010 | | | |
| | Total Kjeldahl Nitrogen (mg/L) | 1.02 | <0.050 | | | |
| | Total Nitrogen (mg/L) | 1.02 | <0.0025 | | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0947 | <0.0010 | | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.131 | <0.0020 | | | |
| | Phosphorus (P)-Total (mg/L) | 6.45 | <0.0020 | | | |
| | Sulfate (SO4) (mg/L) | 11.9 | <0.50 | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 227 | <0.50 | | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 4.96 | <0.0030 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00246 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00308 | <0.00010 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 1.20 | <0.000050 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00020 DLA | <0.00010 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.0010 DLA | <0.00050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.173 | <0.010 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000060 | <0.000010 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 6.31 | <0.020 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00225 | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00087 | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0050 | <0.00050 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1031047-1 WATER 10-JUL-11 MW-2B | L1031047-2 WATER 08-JUL-11 MW-20 | L1031047-3 WATER 09-JUL-11 MW-5 | L1031047-4 WATER 07-JUL-11 MW-PNB | L1031047-5 WATER 07-JUL-11 MW-PNC |
|---|---|---|---|---|---|---|
| **Sample ID** | | | | | | |
| **Description** | | | | | | |
| **Sampled Date** | | | | | | |
| **Sampled Time** | | | | | | |
| **Client ID** | | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Iron (Fe)-Dissolved (mg/L) | <0.030 | <0.030 | 0.173 | 0.188 | 0.209 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.000100 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.00400 | 0.263 | 0.00486 | 0.00355 | 0.00354 |
| | Magnesium (Mg)-Dissolved (mg/L) | 9.30 | 17.7 | 27.0 | 16.5 | 16.4 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.253 | 0.0691 | 0.634 | 0.0547 | 0.0518 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00135 | 0.0252 | 0.00125 | 0.000606 | 0.000596 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00285 | 0.00102 | 0.00061 | 0.00135 | 0.00124 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.649 | 2.48 | 1.04 | 0.588 | 0.588 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00043 | 0.00015 | <0.00010 | 0.00063 | 0.00066 |
| | Silicon (Si)-Dissolved (mg/L) | 2.61 | 3.63 | 6.32 | 2.50 | 2.48 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 9.3 | 113 | 16.1 | 2.4 | 2.3 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0766 | 0.644 | 0.310 | 0.111 | 0.110 |
| | Thallium (Tl)-Dissolved (mg/L) | 0.000018 | 0.000011 | <0.000010 | 0.000011 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.000439 | 0.000725 | 0.00126 | 0.000282 | 0.000283 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | 0.124 | <0.0030 | <0.0030 | <0.0030 |
| **Aggregate Organics** | COD (mg/L) | 117 | 60 | 33 | <20 | <20 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1031047-6 | L1031047-7 | | | |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | | | |
| | Sampled Date | 10-JUL-11 | | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-2A | FIELD BLANK | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Iron (Fe)-Dissolved (mg/L) | 1.13 | <0.030 | | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.00103 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.825 | <0.00050 | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 2.83 | <0.0050 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0516 | <0.000050 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00940 | <0.000050 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0042 | <0.00050 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.48 | <0.050 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00066 | <0.00010 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 12.4 | <0.050 | | | |
| | Silver (Ag)-Dissolved (mg/L) | 0.000028 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 304 | <2.0 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.169 | <0.00010 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | 0.000042 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00020 DLA | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.155 | <0.010 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.0101 | <0.000010 | | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.0219 | <0.0010 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0127 | <0.0030 | | | |
| **Aggregate Organics** | COD (mg/L) | 442 | <20 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Sample Submission Listed:**

| Qualifier | Description |
|---|---|
| SPL | Sample was Preserved at the laboratory - sample # 6 - Total Metals |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.<br>OR<br>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| **COD-COL-VA** | Water | Chemical Oxygen Demand by Colorimetric | APHA 5220 D. CHEMICAL OXYGEN DEMAND |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer APHA 2120 "Color"

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer APHA 2120 Color

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**EC-MAN-VA** Water Conductivity (Manual) APHA 2510 "Conductivity"

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**EC-MAN-VA** Water Conductivity (Manual) APHA 2510 Conductivity

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**EC-PCT-VA** Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**HARDNESS-CALC-VA** Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**P-T-COL-VA** Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

**P-TD-COL-VA** Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**PH-MAN-VA** Water pH by Manual Meter APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

**PH-MAN-VA** Water pH by Manual Meter APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH

# Reference Information

electrode.

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PO4-DO-COL-VA** Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**TKN-SIE-VA** Water TKN in Water by SIE APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total Kjeldahl Nitrogen is determined using an ammonia selective electrode.

**TN-CALC-VA** Water Total Nitrogen (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

**TSS-VA** Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA |

**Chain of Custody Numbers:**

10-175011

**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.*

# Short Holding Time

*Rush Processing*

**10-175011**

ytical Request Form
1 800 668 9878
bal.com

Page 1 of 1

| Report To | | Report Format / Distribution | | Service Request (Rush subject to availability - Contact ALS to confirm TAT) | |
|---|---|---|---|---|---|
| Company: | RESCAN | Standard: ✓ | Other (specify): | X | Regular (Standard Turnaround Times - Business Days) |
| Contact: | | Select: PDF | Excel ✓ Digital ✓ Fax | | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 1111 WEST HASTINGS VANCOUVER | Email 1: | gpapini@rescan.com | | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | | Email 2: | | | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: | 604 687-4277 Fax: | | | Analysis Request | |
| Invoice To | Same as Report ? (circle) Yes or No (if No, provide details) | Client / Project Information | | ( Indicate Filtered or Preserved, F/P ) | |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: | | | |
| Company: | | PO / AFE: | | | |
| Contact: | | LSD: | | | |
| Address: | | | | | |
| Phone: | Fax: | Quote #: | | | |
| Lab Work Order # (lab use only) | L1031047 | ALS Contact: | Ms Springer | Sampler: | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General BC | Metals BC | CaD/NH3/TKN | Number of Containers |
|---|---|---|---|---|---|---|---|---|
| | MW-2B | 10-07-11 | — | water | ✓ | ✓ | ✓ | |
| | MW-20 | 08-07-11 | — | " | ✓ | ✓ | ✓ | |
| | MW-5 | 09-07-11 | — | " | ✓ | ✓ | ✓ | |
| | MW-PNB | 07-07-11 | — | " | ✓ | ✓ | ✓ | |
| | MW-PNC | 07-07-11 | — | " | ✓ | ✓ | ✓ | |
| | MW-2A (very dirty - please do clean up) 2 x 1 L bottles provided | 10-07-11 | — | " | ✓ | ✓ | ✓ | |
| | Field Blank | | | | ✓ | ✓ | ✓ | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

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

Please call me about sample MW-2A. No need to analyse trip blank.

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Adrian Ang | 07/13/11 | 2:15 | WATER | July 12 11 | 15:30 | 13.4 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Max Taylor
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 20-OCT-11
Report Date: 02-NOV-11 14:04 (MT)
Version: FINAL

Client Phone: 867-920-2090

# Certificate of Analysis

**Lab Work Order #: L1074937**

Project P.O. #: NOT SUBMITTED
Job Reference: 791-002-03-05
C of C Numbers: 10-140547
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

| Grouping | Analyte | L1074937-1 WATER 18-OCT-11 12:00 MURRAY RIVER H2A | L1074937-2 WATER 18-OCT-11 12:00 MURRAY RIVER H2B | L1074937-3 WATER 18-OCT-11 12:00 MURRAY RIVER H5 | L1074937-4 WATER 19-OCT-11 12:00 MURRAY RIVER H15 | L1074937-5 WATER 16-OCT-11 12:00 MURRAY RIVER H16 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | 38.8 | 14.4 |
| | Conductivity (uS/cm) | 1540 | 332 | 598 | 1800 | 1090 |
| | Hardness (as CaCO3) (mg/L) | 29.5 | 145 | 293 | 33.7 | 12.1 |
| | pH (pH) | 8.69 | 8.27 | 8.14 | 8.41 | 8.35 |
| | Total Suspended Solids (mg/L) | 89.3 | 4.0 | 10.7 | 1060 | 5220 |
| | Turbidity (NTU) | 712 | 4.27 | 11.6 | 1730 | >4000 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | 1.3 | 4.1 | <1.0 | <50 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 804 | 160 | 320 | 514 | 615 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 72.3 | <2.0 | <2.0 | <1.0 | 21.6 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <2.0 | <2.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 877 | 160 | 320 | 514 | 636 |
| | Bromide (Br) (mg/L) | <0.50 | <0.050 | <0.050 | 1.3 | <0.50 DLM |
| | Chloride (Cl) (mg/L) | 9.1 | 7.90 | 0.78 | 167 | 10.4 |
| | Fluoride (F) (mg/L) | 1.43 | 0.110 | 0.150 | 0.69 | 0.84 |
| | Nitrate (as N) (mg/L) | <0.050 | 0.0116 | 0.0103 | <0.10 | <0.050 |
| | Nitrite (as N) (mg/L) | <0.010 | <0.0010 | <0.0010 | 0.033 | <0.010 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.222 | 0.0014 | <0.0010 | 0.0157 | 0.141 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.220 | <0.0020 | <0.0020 | 0.100 | 0.155 |
| | Phosphorus (P)-Total (mg/L) | 0.567 | 0.0089 | 0.0287 | 1.14 | 7.60 |
| | Sulfate (SO4) (mg/L) | <5.0 | 7.51 | 12.6 | 174 | 24.8 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 42.5 | 0.143 | 0.325 | 26.5 | 178 |
| | Antimony (Sb)-Total (mg/L) | 0.00024 | 0.00011 | <0.00010 | 0.00180 | <0.0010 DLA |
| | Arsenic (As)-Total (mg/L) | 0.00165 | 0.00034 | 0.00317 | 0.0195 | 0.0672 |
| | Barium (Ba)-Total (mg/L) | 2.67 | 0.405 | 0.127 | 1.79 | 12.3 |
| | Beryllium (Be)-Total (mg/L) | 0.00097 | <0.00010 | <0.00010 | 0.00150 | 0.0159 |
| | Bismuth (Bi)-Total (mg/L) | <0.0010 DLA | <0.00050 | <0.00050 | <0.0010 DLA | <0.0050 DLA |
| | Boron (B)-Total (mg/L) | 0.218 | 0.018 | 0.027 | 0.141 | 0.51 |
| | Cadmium (Cd)-Total (mg/L) | 0.000386 | 0.000021 | 0.000026 | 0.00135 | 0.00345 |
| | Calcium (Ca)-Total (mg/L) | 9.49 | 41.8 | 74.2 | 29.9 | 45.3 |
| | Chromium (Cr)-Total (mg/L) | 0.0229 | 0.00058 | 0.00110 | 0.0426 | 0.272 |
| | Cobalt (Co)-Total (mg/L) | 0.00437 | 0.00039 | 0.00042 | 0.0182 | 0.110 |
| | Copper (Cu)-Total (mg/L) | 0.0195 | <0.00050 | 0.00116 | 0.0492 | 0.313 |
| | Iron (Fe)-Total (mg/L) | 8.50 | 0.299 | 1.61 | 41.4 | 177 |
| | Lead (Pb)-Total (mg/L) | 0.00682 | 0.000137 | 0.00138 | 0.0453 | 0.140 |
| | Lithium (Li)-Total (mg/L) | 1.26 | 0.0196 | 0.00518 | 0.689 | 0.839 |
| | Magnesium (Mg)-Total (mg/L) | 6.35 | 9.83 | 26.1 | 11.4 | 56.0 |
| | Manganese (Mn)-Total (mg/L) | 0.115 | 0.106 | 0.558 | 1.11 | 2.16 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1074937-6 | L1074937-7 | L1074937-8 | | |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | | |
| | Sampled Date | 17-OCT-11 | 15-OCT-11 | 15-OCT-11 | | |
| | Sampled Time | 12:00 | 12:00 | 12:00 | | |
| | Client ID | MURRAY RIVER H20 | MURRAY RIVER HPNB | MURRAY RIVER HPNC | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | | |
| | Conductivity (uS/cm) | 1340 | 413 | 414 | | |
| | Hardness (as CaCO3) (mg/L) | 7.49 | 220 | 220 | | |
| | pH (pH) | 8.75 | 8.23 | 8.27 | | |
| | Total Suspended Solids (mg/L) | 256 | <3.0 | 5.3 | | |
| | Turbidity (NTU) | 612 | 4.47 | 6.28 | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | 1.9 | 1.3 | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 659 | 214 | 214 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 58.5 | <2.0 | <2.0 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <2.0 | <2.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 717 | 214 | 214 | | |
| | Bromide (Br) (mg/L) | <0.50 DLM | <0.050 | <0.050 | | |
| | Chloride (Cl) (mg/L) | <5.0 | <0.50 | <0.50 | | |
| | Fluoride (F) (mg/L) | 1.97 | 0.058 | 0.058 | | |
| | Nitrate (as N) (mg/L) | <0.050 | 0.260 | 0.258 | | |
| | Nitrite (as N) (mg/L) | <0.010 | <0.0010 | <0.0010 | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.108 | <0.0010 | <0.0010 | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.120 | <0.0020 | <0.0020 | | |
| | Phosphorus (P)-Total (mg/L) | 0.487 | 0.0046 | 0.0063 | | |
| | Sulfate (SO4) (mg/L) | 29.0 | 15.3 | 15.3 | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 20.0 | 0.0627 | 0.0870 | | |
| | Antimony (Sb)-Total (mg/L) | 0.00538 | 0.00010 | 0.00012 | | |
| | Arsenic (As)-Total (mg/L) | 0.00902 | 0.00014 | 0.00016 | | |
| | Barium (Ba)-Total (mg/L) | 4.84 | 0.188 | 0.190 | | |
| | Beryllium (Be)-Total (mg/L) | 0.00078 | <0.00010 | <0.00010 | | |
| | Bismuth (Bi)-Total (mg/L) | <0.0010 DLA | <0.00050 | <0.00050 | | |
| | Boron (B)-Total (mg/L) | 0.222 | <0.010 | <0.010 | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000187 | 0.000022 | 0.000026 | | |
| | Calcium (Ca)-Total (mg/L) | 2.84 | 59.3 | 61.2 | | |
| | Chromium (Cr)-Total (mg/L) | 0.0176 | 0.00073 | 0.00111 | | |
| | Cobalt (Co)-Total (mg/L) | 0.00461 | 0.00025 | 0.00032 | | |
| | Copper (Cu)-Total (mg/L) | 0.0255 | 0.00089 | 0.00120 | | |
| | Iron (Fe)-Total (mg/L) | 16.6 | 0.471 | 0.685 | | |
| | Lead (Pb)-Total (mg/L) | 0.0106 | 0.000059 | 0.000083 | | |
| | Lithium (Li)-Total (mg/L) | 1.11 | 0.00323 | 0.00332 | | |
| | Magnesium (Mg)-Total (mg/L) | 2.89 | 15.9 | 16.2 | | |
| | Manganese (Mn)-Total (mg/L) | 0.0751 | 0.0503 | 0.0603 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1074937-1 | L1074937-2 | L1074937-3 | L1074937-4 | L1074937-5 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 18-OCT-11 | 18-OCT-11 | 18-OCT-11 | 19-OCT-11 | 16-OCT-11 |
| | Sampled Time | 12:00 | 12:00 | 12:00 | 12:00 | 12:00 |
| | Client ID | MURRAY RIVER H2A | MURRAY RIVER H2B | MURRAY RIVER H5 | MURRAY RIVER H15 | MURRAY RIVER H16 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Mercury (Hg)-Total (mg/L) | <0.00010 | <0.000010 | <0.000010 | 0.00015 | <0.00010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00220 | 0.000790 | 0.00144 | 0.0487 | 0.0661 |
| | Nickel (Ni)-Total (mg/L) | 0.0187 | 0.00145 | 0.00100 | 0.0552 | 0.332 |
| | Phosphorus (P)-Total (mg/L) | 0.59 | <0.30 | <0.30 | 1.30 | 7.97 |
| | Potassium (K)-Total (mg/L) | 5.48 | 0.531 | 1.02 | 5.83 | 46.0 |
| | Selenium (Se)-Total (mg/L) | 0.00034 | 0.00019 | <0.00010 | 0.00142 | 0.0097 |
| | Silicon (Si)-Total (mg/L) | 34.8 | 2.61 | 6.27 | 47.0 | 203 |
| | Silver (Ag)-Total (mg/L) | 0.000137 | <0.000010 | 0.000011 | 0.000837 | 0.00252 |
| | Sodium (Na)-Total (mg/L) | 345 | 9.85 | 13.6 | 357 | 299 |
| | Strontium (Sr)-Total (mg/L) | 0.275 | 0.0847 | 0.314 | 0.272 | 0.963 |
| | Thallium (Tl)-Total (mg/L) | 0.000326 | <0.000010 | 0.000014 | 0.000718 | 0.00303 |
| | Tin (Sn)-Total (mg/L) | <0.00020 DLA | <0.00010 | <0.00010 | 0.00277 | 0.0037 |
| | Titanium (Ti)-Total (mg/L) | 0.272 | <0.010 | 0.012 | 0.216 | 0.203 |
| | Uranium (U)-Total (mg/L) | 0.00322 | 0.000180 | 0.00116 | 0.00386 | 0.0224 |
| | Vanadium (V)-Total (mg/L) | 0.0534 | <0.0010 | 0.0011 | 0.0813 | 0.494 |
| | Zinc (Zn)-Total (mg/L) | 0.0774 | <0.0030 | 0.0647 | 0.284 | 0.948 |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 0.0996 | <0.0030 | <0.0030 | 0.130 | 0.383 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00035 | 0.00012 | <0.00010 | 0.00149 | 0.0047 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00083 | 0.00027 | 0.00270 | 0.00335 | 0.0046 |
| | Barium (Ba)-Dissolved (mg/L) | 1.59 | 0.421 | 0.117 | 0.247 | 0.273 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00020 DLA | <0.00010 | <0.00010 | <0.00020 DLA | <0.0010 DLA |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.0010 DLA | <0.00050 | <0.00050 | <0.0010 DLA | <0.0050 DLA |
| | Boron (B)-Dissolved (mg/L) | 0.196 | 0.016 | 0.026 | 0.140 | 0.25 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000029 | 0.000011 | 0.000010 | 0.000020 | <0.00010 DLA |
| | Calcium (Ca)-Dissolved (mg/L) | 6.61 | 42.0 | 74.3 | 9.21 | 2.74 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00020 DLA | <0.00010 | 0.00012 | 0.00048 | <0.0010 DLA |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00027 | 0.00029 | 0.00026 | 0.00133 | <0.0010 DLA |
| | Copper (Cu)-Dissolved (mg/L) | <0.0010 DLA | <0.00050 | <0.00050 | 0.0013 | <0.0050 DLA |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | 0.076 | 0.538 | 0.118 | 0.087 |
| | Lead (Pb)-Dissolved (mg/L) | 0.00014 | <0.000050 | <0.000050 | 0.00026 | <0.00050 DLA |
| | Lithium (Li)-Dissolved (mg/L) | 1.25 | 0.0203 | 0.00528 | 0.703 | 0.469 |
| | Magnesium (Mg)-Dissolved (mg/L) | 3.17 | 9.82 | 26.2 | 2.60 | 1.28 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0367 | 0.0962 | 0.534 | 0.337 | 0.0625 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00207 | 0.000721 | 0.00137 | 0.0529 | 0.0657 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0013 | 0.00087 | <0.00050 | 0.0069 | 0.0065 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1074937-6 | L1074937-7 | L1074937-8 | | |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | | |
| | Sampled Date | 17-OCT-11 | 15-OCT-11 | 15-OCT-11 | | |
| | Sampled Time | 12:00 | 12:00 | 12:00 | | |
| | Client ID | MURRAY RIVER H20 | MURRAY RIVER HPNB | MURRAY RIVER HPNC | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Mercury (Hg)-Total (mg/L) | <0.00010 | <0.000010 | <0.000010 | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.0128 | 0.000591 | 0.000728 | | |
| | Nickel (Ni)-Total (mg/L) | 0.0156 | 0.00135 | 0.00172 | | |
| | Phosphorus (P)-Total (mg/L) | 0.54 | <0.30 | <0.30 | | |
| | Potassium (K)-Total (mg/L) | 4.42 | 0.558 | 0.561 | | |
| | Selenium (Se)-Total (mg/L) | 0.00121 | 0.00060 | 0.00063 | | |
| | Silicon (Si)-Total (mg/L) | 26.9 | 2.37 | 2.44 | | |
| | Silver (Ag)-Total (mg/L) | 0.000147 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Total (mg/L) | 318 | 2.31 | 2.35 | | |
| | Strontium (Sr)-Total (mg/L) | 0.196 | 0.110 | 0.112 | | |
| | Thallium (Tl)-Total (mg/L) | 0.000250 | 0.000014 | 0.000019 | | |
| | Tin (Sn)-Total (mg/L) | <0.00020 DLA | <0.00010 | 0.00012 | | |
| | Titanium (Ti)-Total (mg/L) | 0.196 | <0.010 | <0.010 | | |
| | Uranium (U)-Total (mg/L) | 0.0106 | 0.000266 | 0.000293 | | |
| | Vanadium (V)-Total (mg/L) | 0.0461 | <0.0010 | <0.0010 | | |
| | Zinc (Zn)-Total (mg/L) | 0.0593 | <0.0030 | <0.0030 | | |
| **Dissolved Metals** | Aluminum (Al)-Dissolved (mg/L) | 2.00 | 0.0032 | <0.0030 | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00768 | 0.00010 | 0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00598 | <0.00010 | <0.00010 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.732 | 0.195 | 0.197 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00020 DLA | <0.00010 | <0.00010 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.0010 DLA | <0.00050 | <0.00050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.200 | <0.010 | <0.010 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000020 DLA | 0.000012 | 0.000012 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 1.86 | 61.1 | 61.4 | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00096 | <0.00010 | <0.00010 | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00030 | 0.00015 | 0.00014 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.0013 | <0.00050 | <0.00050 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.526 | 0.203 | 0.197 | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.00071 | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 1.11 | 0.00372 | 0.00329 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 0.690 | 16.3 | 16.3 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0122 | 0.0381 | 0.0339 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0120 | 0.000528 | 0.000524 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0020 | 0.00091 | 0.00096 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1074937-1 WATER 18-OCT-11 12:00 MURRAY RIVER H2A | L1074937-2 WATER 18-OCT-11 12:00 MURRAY RIVER H2B | L1074937-3 WATER 18-OCT-11 12:00 MURRAY RIVER H5 | L1074937-4 WATER 19-OCT-11 12:00 MURRAY RIVER H15 | L1074937-5 WATER 16-OCT-11 12:00 MURRAY RIVER H16 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Potassium (K)-Dissolved (mg/L) | 0.94 | 0.472 | 0.987 | 1.33 | 2.21 |
| | Selenium (Se)-Dissolved (mg/L) | <0.00020 DLA | 0.00018 | <0.00010 | 0.00059 | 0.0016 |
| | Silicon (Si)-Dissolved (mg/L) | 3.02 | 2.41 | 5.85 | 3.80 | 4.00 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 DLA | <0.000010 | <0.000010 | <0.000020 DLA | <0.00010 DLA |
| | Sodium (Na)-Dissolved (mg/L) | 390 | 10.3 | 15.1 | 404 | 289 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.229 | 0.0844 | 0.313 | 0.156 | 0.0984 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 DLA | <0.000010 | <0.000010 | 0.000056 | <0.00010 DLA |
| | Tin (Sn)-Dissolved (mg/L) | <0.00020 DLA | <0.00010 | <0.00010 | <0.00020 DLA | <0.0010 DLA |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.00286 | 0.000179 | 0.00119 | 0.00276 | 0.00734 |
| | Vanadium (V)-Dissolved (mg/L) | 0.0045 | <0.0010 | <0.0010 | 0.0021 | 0.010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0060 DLA | <0.0030 | 0.0056 | <0.0060 DLA | <0.030 DLA |

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1074937-6 | L1074937-7 | L1074937-8 | | |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | | |
| | Sampled Date | 17-OCT-11 | 15-OCT-11 | 15-OCT-11 | | |
| | Sampled Time | 12:00 | 12:00 | 12:00 | | |
| | Client ID | MURRAY RIVER H20 | MURRAY RIVER HPNB | MURRAY RIVER HPNC | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Potassium (K)-Dissolved (mg/L) | 0.71 | 0.552 | 0.547 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00081 | 0.00066 | 0.00071 | | |
| | Silicon (Si)-Dissolved (mg/L) | 5.37 | 2.34 | 2.34 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 DLA | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 347 | 2.4 | 2.4 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0869 | 0.110 | 0.110 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 DLA | 0.000011 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00083 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | 0.039 | <0.010 | <0.010 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.0103 | 0.000247 | 0.000255 | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.0081 | <0.0010 | <0.0010 | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0213 | 0.0042 | <0.0030 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Sample Submission Listed:**

| Qualifier | Description |
|---|---|
| SPL | Sample was Preserved at the laboratory - sample # 1 - Total Metals |

**QC Samples with Qualifiers & Comments:**

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|---|---|
| Matrix Spike | Nitrate (as N) | MS-B | L1074937-1, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Fluoride (F) | MS-B | L1074937-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1074937-1, -2, -3, -4, -5, -6, -7, -8 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| 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-MAN-VA** | Water | Acidity by Manual Titration | APHA - ACIDITY (2310) |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

# Reference Information

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-MAN-VA** | Water | Conductivity (Manual) | APHA 2510 "Conductivity" |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **EC-MAN-VA** | Water | Conductivity (Manual) | APHA 2510 Conductivity |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

# Reference Information

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-MAN-VA** | Water | pH by Manual Meter | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-MAN-VA** | Water | pH by Manual Meter | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA |

**Chain of Custody Numbers:**

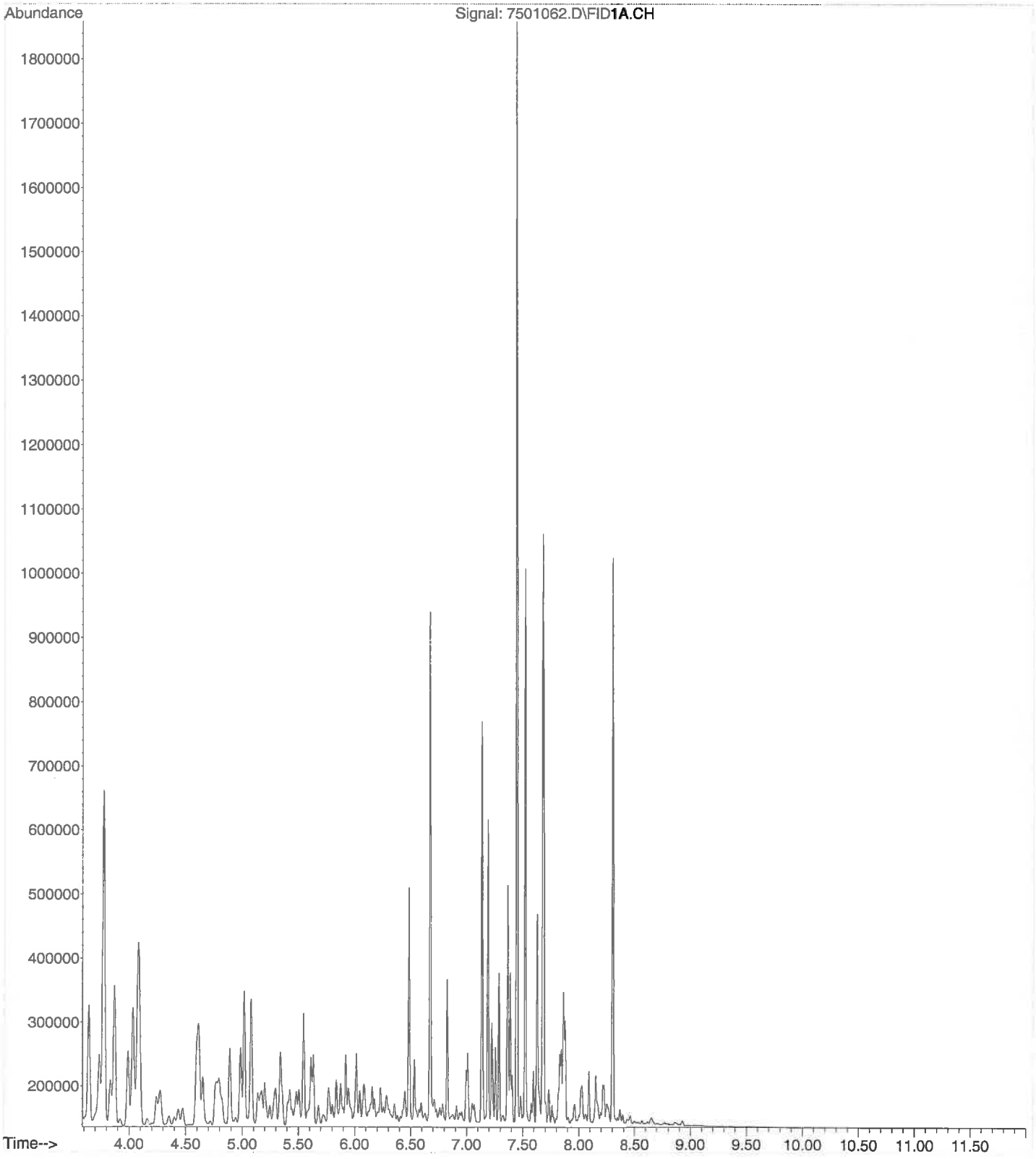
10-140547

**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.*

File :C:\MSDCHEM\1\DATA\111025\7501062.D
Operator : vt
Acquired : 26 Oct 2011 7:42 using AcqMethod CCME-SIM.M
Instrument : VOC #4
Sample Name: L1074934-14
Misc Info : WG1375418
Vial Number: 75



10-140547

ALS | *L1074937-COFC*

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

L1074937

Page ____ of ____

| Report To | | Report Format / Distribution | | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|---|---|
| Company: | Rescan Environmental | Standard: ✓ | Other (specify): | ✓ Regular (Standard Turnaround Times - Business Days) |
| Contact: | Max Taylor | Select: PDF ✓ | Excel ✓ Digital Fax | Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 1111 W. Hastings St. Vancouver | Email 1: | gpapini@rescan.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | | Email 2: | mtaylor@rescan.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: | 604-689-9460 Fax: | | | **Analysis Request** |
| **Invoice To** | Same as Report ? (circle) (Yes) or No (if No, provide details) | **Client / Project Information** | | ( Indicate Filtered or Preserved, F/P ) |
| | Copy of Invoice with Report? (circle) (Yes) or No | Job #: | 791-002-103-05 | |
| Company: | | PO / AFE: | | |
| Contact: | | LSD: | | |
| Address: | | | | |
| Phone: | Fax: | Quote #: | | |
| **Lab Work Order # (lab use only)** | | **ALS Contact:** | **Sampler:** MT/CH | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chem. | Dissolved Metals | Number of Containers |
|---|---|---|---|---|---|---|---|
| H2A | Murray River H2A | 18-Oct | 12:00 | Water | ✓ | ✓ | 2 |
| H2B | " H2B | 18-Oct | | | ✓ | ✓ | 2 |
| H5 | " H5 | 18-Oct | | | ✓ | ✓ | 2 |
| H15 | " H15 | 19-Oct | | | ✓ | ✓ | 2 |
| H16 | " H16 | 16-Oct | | | ✓ | ✓ | 2 |
| H20 | " H20 | 17-Oct | | | ✓ | ✓ | 2 |
| HPNB | " HPNB | 15-Oct | | | ✓ | ✓ | 2 |
| HPNC | " HPNC | 15-Oct | | | ✓ | ✓ | 2 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

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

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Max Taylor | 20-Oct | 19:00 | MT | 20-Oct-11 | 19:00 | -2 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

BP Oct.22 9:53 6°C

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 15-MAY-12
Report Date: 07-NOV-12 15:53 (MT)
Version: FINAL REV. 3

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1147583**

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-002-03
C of C Numbers: 10-173783, 10-173784
Legal Site Desc:

**Comments:** 04-JUN-12: Additional analysis has been added.

07-NOV-12: File reissued.

Amber Springer
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1147583-1 | L1147583-2 | L1147583-3 | L1147583-4 | L1147583-5 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 14-MAY-12 | 14-MAY-12 | 14-MAY-12 | 14-MAY-12 | 13-MAY-12 |
| | Sampled Time | | | | | |
| | Client ID | HASLER | MW-H20 | MW-H15 | MW-H16 | MW-H2A |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 9.0 | 15.0 | 25.5 | | <5.0 |
| | Conductivity (uS/cm) | 71.1 | 1350 | 1870 | | 1580 |
| | Hardness (as CaCO3) (mg/L) | 15.5 | 8.89 | 17.7 | 128 | 32.1 |
| | pH (pH) | 8.03 | 8.65 | 8.78 | | 8.71 |
| | Total Suspended Solids (mg/L) | 69.0 | 33.0 | 122 | | 49.0 |
| | Total Dissolved Solids (mg/L) | 312 | 888 | 1250 | | 1220 |
| | Turbidity (NTU) | 280 | 38.8 | 97.2 | | 161 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 3.3 | <1.0 | <1.0 | | <1.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 32.9 | 724 | 577 | | 887 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | 65.6 | 61.9 | | 58.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 34.0 | 773 | 631 | | 937 |
| | Ammonia, Total (as N) (mg/L) | 0.108 PEHT | 0.0170 PEHT | 0.206 PEHT | | <0.0050 PEHT |
| | Bromide (Br) (mg/L) | <0.050 | <0.50 DLM | <1.0 DLM | | <0.50 DLM |
| | Chloride (Cl) (mg/L) | 2.07 | <5.0 DLM | 205 | | 10.6 |
| | Fluoride (F) (mg/L) | 0.314 | 2.07 | 0.70 | | 1.68 |
| | Nitrate (as N) (mg/L) | 0.359 | <0.050 DLM | <0.10 DLM | | <0.050 DLM |
| | Nitrite (as N) (mg/L) | 0.0040 | <0.010 DLM | <0.020 DLM | | <0.010 DLM |
| | Total Kjeldahl Nitrogen (mg/L) | 1.17 | 0.791 | 1.37 | | 0.973 |
| | Total Nitrogen (mg/L) | 1.53 | 0.791 | 1.37 | | 0.973 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0277 | 0.352 | 0.185 | | 0.186 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0267 | 0.331 | 0.093 | | 0.0996 |
| | Phosphorus (P)-Total (mg/L) | 0.403 | 0.475 | 0.332 | | 0.376 |
| | Sulfate (SO4) (mg/L) | 4.11 | 9.9 | 80 | | <5.0 DLM |
| **Organic / Inorganic Carbon** | Dissolved Organic Carbon (mg/L) | | | | | |
| | Total Organic Carbon (mg/L) | 4.71 | 10.0 | 24.5 | | 9.6 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 7.02 | 2.28 | 1.23 | 0.516 | 8.39 |
| | Antimony (Sb)-Total (mg/L) | 0.00067 | 0.00118 | 0.00031 | 0.00013 | <0.00020 DLA |
| | Arsenic (As)-Total (mg/L) | 0.00249 | 0.00274 | 0.00321 | 0.00118 | 0.00085 |
| | Barium (Ba)-Total (mg/L) | 0.814 | 0.501 | 0.766 | 1.03 | 1.82 |
| | Beryllium (Be)-Total (mg/L) | 0.00041 | <0.00020 DLA | <0.00020 DLA | <0.00010 | 0.00029 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.0010 DLA | <0.0010 DLA | <0.00050 | <0.0010 DLA |
| | Boron (B)-Total (mg/L) | 0.031 | 0.187 | 0.163 | 0.204 | 0.215 |
| | Cadmium (Cd)-Total (mg/L) | 0.000090 | 0.000119 | 0.000114 | 0.000063 | 0.000107 |
| | Calcium (Ca)-Total (mg/L) | 6.66 | 2.76 | 7.40 | 24.7 | 7.67 |
| | Chromium (Cr)-Total (mg/L) | 0.0108 | 0.00331 | 0.00245 | 0.00095 | 0.00783 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1147583-6 WATER 13-MAY-12 MW-H2B | L1147583-7 WATER 13-MAY-12 X2 | L1147583-9 WATER 12-MAY-12 MW-H5 | L1147583-10 WATER 11-MAY-12 X1 | L1147583-11 WATER 11-MAY-12 MW-PNB |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | 5.2 | 5.2 |
| | Conductivity (uS/cm) | 280 | 1580 | 570 | 540 | 549 |
| | Hardness (as CaCO3) (mg/L) | 151 | 32.3 | 312 | 193 | 194 |
| | pH (pH) | 8.24 | 8.71 | 8.12 | 8.03 | 8.20 |
| | Total Suspended Solids (mg/L) | 745 | 27.7 | 19.7 | 16.3 | 17.0 |
| | Total Dissolved Solids (mg/L) | 162 | 1050 | 316 | 340 | 340 |
| | Turbidity (NTU) | 76.9 | 159 | 6.78 | 14.8 | 14.9 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 1.8 | <1.0 | 5.0 | 5.5 | 2.9 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 135 | 864 | 316 | 245 | 251 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | 94.6 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <1.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 135 | 934 | 316 | 245 | 251 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 PEHT | 0.0053 PEHT | 0.158 PEHT | <0.0050 PEHT | <0.0050 PEHT |
| | Bromide (Br) (mg/L) | <0.050 | <0.50 DLM | <0.050 | 0.313 | <0.050 |
| | Chloride (Cl) (mg/L) | 8.31 | 10.7 | <0.50 | 3.88 | 3.91 |
| | Fluoride (F) (mg/L) | 0.091 | 1.61 | 0.146 | 0.208 | 0.210 |
| | Nitrate (as N) (mg/L) | 0.0722 | <0.050 DLM | <0.0050 | 0.0124 | 0.0124 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.010 DLM | <0.0010 | 0.0150 | 0.0152 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.615 | 1.00 | 0.238 | 0.232 | 0.222 |
| | Total Nitrogen (mg/L) | 0.688 | 1.00 | 0.238 | 0.260 | 0.250 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0015 | 0.174 | <0.0010 | 0.0014 | 0.0024 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0022 | 0.095 | <0.0020 | <0.0020 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.582 | 0.388 | 0.0302 | 0.0722 | 0.0714 |
| | Sulfate (SO4) (mg/L) | 4.34 | <5.0 DLM | 12.2 | 54.8 | 55.1 |
| **Organic / Inorganic Carbon** | Dissolved Organic Carbon (mg/L) | | | | | |
| | Total Organic Carbon (mg/L) | 5.42 | 9.8 | 0.83 | 5.57 | 5.19 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 4.98 | 4.70 | 0.0041 | 0.0527 | 0.0554 |
| | Antimony (Sb)-Total (mg/L) | 0.00040 | <0.00020 DLA | <0.00010 | 0.00017 | 0.00018 |
| | Arsenic (As)-Total (mg/L) | 0.00563 | 0.00083 | 0.00408 | 0.00025 | 0.00025 |
| | Barium (Ba)-Total (mg/L) | 0.420 | 1.85 | 0.126 | 0.150 | 0.147 |
| | Beryllium (Be)-Total (mg/L) | 0.00036 | 0.00026 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.0010 DLA | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.020 | 0.203 | 0.034 | 0.013 | 0.012 |
| | Cadmium (Cd)-Total (mg/L) | 0.000573 | 0.000100 | <0.000010 | 0.000074 | 0.000077 |
| | Calcium (Ca)-Total (mg/L) | 64.0 | 7.86 | 79.5 | 64.0 | 63.2 |
| | Chromium (Cr)-Total (mg/L) | 0.00893 | 0.00732 | 0.00059 | 0.00026 | 0.00023 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1147583-12 WATER 11-MAY-12 MW-H23 | L1147583-13 WATER 11-MAY-12 MW-H22 | L1147583-14 WATER 10-MAY-12 MW-H19 | L1147583-15 WATER 10-MAY-12 MW-H18 | L1147583-16 WATER 10-MAY-12 MW-H17 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | 17.7 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 429 | 456 | 540 | 494 | 529 |
| | Hardness (as CaCO3) (mg/L) | 247 | 284 | 35.0 | 188 | 267 |
| | pH (pH) | 8.21 | 8.08 | 8.24 | 8.22 | 8.25 |
| | Total Suspended Solids (mg/L) | 91.7 | 1570 | 794 | 2930 | 312 |
| | Total Dissolved Solids (mg/L) | 251 | 288 | 678 | 313 | 329 |
| | Turbidity (NTU) | 78.4 | 333 | 743 | 1310 | 104 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 2.4 | 4.8 | 1.2 | 2.0 | 1.2 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 241 | 263 | 188 | 260 | 278 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <1.0 | <2.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 241 | 263 | 188 | 260 | 278 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 PEHT | <0.0050 PEHT | 0.040 PEHT | <0.0050 PEHT | 0.045 PEHT |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | <0.50 | 0.74 | 2.24 | 0.51 | <0.50 |
| | Fluoride (F) (mg/L) | 0.075 | 0.066 | 0.742 | 0.255 | 0.124 |
| | Nitrate (as N) (mg/L) | 0.202 | 0.120 | 0.0644 | 0.0350 | 0.0601 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | 0.0039 | <0.0010 | <0.0010 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.180 | 0.837 | 2.37 | 4.01 | 0.308 |
| | Total Nitrogen (mg/L) | 0.382 | 0.957 | 2.44 | 4.05 | 0.368 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0015 | <0.0010 | 0.0095 | 0.0043 | 0.0053 |
| | Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | <0.0020 | 0.0191 | 0.0058 | 0.0048 |
| | Phosphorus (P)-Total (mg/L) | 0.0886 | 0.942 | 0.826 | 1.99 | 0.258 |
| | Sulfate (SO4) (mg/L) | 6.36 | 15.3 | 44.2 | 17.4 | 24.7 |
| **Organic / Inorganic Carbon** | Dissolved Organic Carbon (mg/L) | | | | | |
| | Total Organic Carbon (mg/L) | 3.87 | 25.5 | 12.3 | 48.5 | 5.02 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 2.77 | 9.75 | 7.67 | 6.35 | 2.36 |
| | Antimony (Sb)-Total (mg/L) | 0.00054 | 0.00107 | 0.00462 | 0.00108 | 0.00107 |
| | Arsenic (As)-Total (mg/L) | 0.00252 | 0.0121 | 0.00426 | 0.00588 | 0.00236 |
| | Barium (Ba)-Total (mg/L) | 0.255 | 0.548 | 0.526 | 1.83 | 0.341 |
| | Beryllium (Be)-Total (mg/L) | 0.00013 | 0.00066 | 0.00040 | 0.00047 | 0.00012 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.0010 DLA | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.015 | 0.021 | 0.158 | 0.069 | 0.022 |
| | Cadmium (Cd)-Total (mg/L) | 0.000773 | 0.00356 | 0.000150 | 0.000247 | 0.000212 |
| | Calcium (Ca)-Total (mg/L) | 81.1 | 411 | 10.7 | 55.0 | 89.5 |
| | Chromium (Cr)-Total (mg/L) | 0.00491 | 0.0281 | 0.0127 | 0.0118 | 0.00438 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | Sample ID | L1147583-21 | | | | |
|---|---|---|---|---|---|---|---|
| | | Description | WATER | | | | |
| | | Sampled Date | | | | | |
| | | Sampled Time | | | | | |
| | | Client ID | TRIP BLANK | | | | |
| **Grouping** | **Analyte** | | | | | | |
| **WATER** | | | | | | | |
| **Physical Tests** | Colour, True (CU) | | <5.0 | | | | |
| | Conductivity (uS/cm) | | <2.0 | | | | |
| | Hardness (as CaCO3) (mg/L) | | | | | | |
| | pH (pH) | | 5.86 | | | | |
| | Total Suspended Solids (mg/L) | | <3.0 | | | | |
| | Total Dissolved Solids (mg/L) | | <10 | | | | |
| | Turbidity (NTU) | | <0.10 | | | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | | 1.4 | | | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | <2.0 | | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | <2.0 | | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <2.0 | | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | <2.0 | | | | |
| | Ammonia, Total (as N) (mg/L) | | <0.0050 PEHT | | | | |
| | Bromide (Br) (mg/L) | | <0.050 | | | | |
| | Chloride (Cl) (mg/L) | | <0.50 | | | | |
| | Fluoride (F) (mg/L) | | <0.020 | | | | |
| | Nitrate (as N) (mg/L) | | <0.0050 | | | | |
| | Nitrite (as N) (mg/L) | | <0.0010 | | | | |
| | Total Kjeldahl Nitrogen (mg/L) | | <0.050 | | | | |
| | Total Nitrogen (mg/L) | | <0.0025 | | | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | | <0.0010 | | | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | | <0.0020 | | | | |
| | Phosphorus (P)-Total (mg/L) | | <0.0020 | | | | |
| | Sulfate (SO4) (mg/L) | | <0.50 | | | | |
| **Organic / Inorganic Carbon** | Dissolved Organic Carbon (mg/L) | | <0.50 | | | | |
| | Total Organic Carbon (mg/L) | | | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | | <0.0030 | | | | |
| | Antimony (Sb)-Total (mg/L) | | <0.00010 | | | | |
| | Arsenic (As)-Total (mg/L) | | <0.00010 | | | | |
| | Barium (Ba)-Total (mg/L) | | <0.000050 | | | | |
| | Beryllium (Be)-Total (mg/L) | | <0.00010 | | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.00050 | | | | |
| | Boron (B)-Total (mg/L) | | <0.010 | | | | |
| | Cadmium (Cd)-Total (mg/L) | | <0.000010 | | | | |
| | Calcium (Ca)-Total (mg/L) | | <0.050 | | | | |
| | Chromium (Cr)-Total (mg/L) | | <0.00010 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1147583-1 | L1147583-2 | L1147583-3 | L1147583-4 | L1147583-5 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 14-MAY-12 | 14-MAY-12 | 14-MAY-12 | 14-MAY-12 | 13-MAY-12 |
| | Sampled Time | | | | | |
| | Client ID | HASLER | MW-H20 | MW-H15 | MW-H16 | MW-H2A |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Cobalt (Co)-Total (mg/L) | 0.00370 | 0.00069 | 0.00124 | 0.00034 | 0.00130 |
| | Copper (Cu)-Total (mg/L) | 0.00851 | 0.0141 | 0.0050 | 0.00231 | 0.0063 |
| | Iron (Fe)-Total (mg/L) | 5.19 | 1.16 | 2.23 | 0.692 | 3.05 |
| | Lead (Pb)-Total (mg/L) | 0.00370 | 0.00217 | 0.00224 | 0.000307 | 0.00220 |
| | Lithium (Li)-Total (mg/L) | 0.0152 | 0.933 | 0.872 | 0.268 | 1.27 |
| | Magnesium (Mg)-Total (mg/L) | 1.57 | 1.05 | 1.93 | 16.1 | 4.75 |
| | Manganese (Mn)-Total (mg/L) | 0.0669 | 0.185 | 0.271 | 0.162 | 0.0526 |
| | Mercury (Hg)-Total (mg/L) | <0.000050 DLM | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00351 | 0.0105 | 0.0256 | 0.00465 | 0.00171 |
| | Nickel (Ni)-Total (mg/L) | 0.0110 | 0.0033 | 0.0041 | 0.00096 | 0.0050 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | 0.47 | <0.30 | <0.30 | 0.38 |
| | Potassium (K)-Total (mg/L) | 2.64 | 1.46 | 1.31 | 1.73 | 2.34 |
| | Selenium (Se)-Total (mg/L) | 0.00206 | 0.00023 | 0.00027 | <0.00010 | <0.00020 DLA |
| | Silicon (Si)-Total (mg/L) | 24.3 | 7.10 | 5.02 | 5.47 | 22.5 |
| | Silver (Ag)-Total (mg/L) | 0.000031 | <0.000020 DLA | 0.000028 | <0.000010 | 0.000047 |
| | Sodium (Na)-Total (mg/L) | 5.35 | 326 | 389 | 145 | 360 |
| | Strontium (Sr)-Total (mg/L) | 0.0404 | 0.0890 | 0.213 | 0.639 | 0.265 |
| | Thallium (Tl)-Total (mg/L) | 0.000172 | 0.000040 | 0.000024 | <0.000010 | 0.000098 |
| | Tin (Sn)-Total (mg/L) | 0.00427 | 0.00064 | 0.00283 | 0.00024 | <0.00020 DLA |
| | Titanium (Ti)-Total (mg/L) | 0.195 | 0.048 | 0.014 | 0.018 | 0.289 |
| | Uranium (U)-Total (mg/L) | 0.000445 | 0.00761 | 0.00113 | 0.000217 | 0.00142 |
| | Vanadium (V)-Total (mg/L) | 0.0233 | 0.0090 | 0.0051 | 0.0022 | 0.0172 |
| | Zinc (Zn)-Total (mg/L) | 0.174 | 0.0164 | 0.0196 | 0.0165 | 0.0271 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | LAB | FIELD | FIELD | | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.229 | 0.0249 | 0.0167 | | 0.0094 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00067 | 0.00091 | 0.00021 | | <0.00020 DLA |
| | Arsenic (As)-Dissolved (mg/L) | 0.00093 | 0.00240 | 0.00241 | | 0.00039 |
| | Barium (Ba)-Dissolved (mg/L) | 0.258 | 0.386 | 0.624 | | 1.51 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | <0.00020 DLA | | <0.00020 DLA |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.0010 DLA | <0.0010 DLA | | <0.0010 DLA |
| | Boron (B)-Dissolved (mg/L) | 0.014 | 0.185 | 0.156 | | 0.193 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000010 | <0.000020 DLA | 0.000028 | | <0.000020 DLA |
| | Calcium (Ca)-Dissolved (mg/L) | 5.73 | 2.35 | 4.92 | | 6.98 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00040 | <0.00020 DLA | <0.00020 DLA | | <0.00020 DLA |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00012 | 0.00026 | 0.00034 | | <0.00020 DLA |
| | Copper (Cu)-Dissolved (mg/L) | 0.00087 | 0.0030 | <0.0010 DLA | | <0.0010 DLA |
| | Iron (Fe)-Dissolved (mg/L) | 0.074 | 0.067 | 0.079 | | 0.041 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1147583-6 WATER 13-MAY-12 MW-H2B | L1147583-7 WATER 13-MAY-12 X2 | L1147583-9 WATER 12-MAY-12 MW-H5 | L1147583-10 WATER 11-MAY-12 X1 | L1147583-11 WATER 11-MAY-12 MW-PNB |
|---|---|---|---|---|---|---|
| **Sample ID** | | | | | | |
| **Description** | | | | | | |
| **Sampled Date** | | | | | | |
| **Sampled Time** | | | | | | |
| **Client ID** | | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Cobalt (Co)-Total (mg/L) | 0.00577 | 0.00128 | 0.00027 | 0.00035 | 0.00034 |
| | Copper (Cu)-Total (mg/L) | 0.0153 | 0.0059 | 0.00125 | 0.00131 | 0.00130 |
| | Iron (Fe)-Total (mg/L) | 15.0 | 3.09 | 2.42 | 0.165 DTC | 0.173 DTC |
| | Lead (Pb)-Total (mg/L) | 0.00762 | 0.00205 | <0.000050 | 0.000074 | 0.000094 |
| | Lithium (Li)-Total (mg/L) | 0.00829 | 1.25 | 0.00648 | 0.00423 | 0.00397 |
| | Magnesium (Mg)-Total (mg/L) | 17.2 | 4.82 | 28.4 | 16.7 | 16.7 |
| | Manganese (Mn)-Total (mg/L) | 0.752 | 0.0522 | 0.589 | 0.484 | 0.488 |
| | Mercury (Hg)-Total (mg/L) | 0.000065 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00104 | 0.00159 | 0.00159 | 0.00178 | 0.00164 |
| | Nickel (Ni)-Total (mg/L) | 0.0168 | 0.0053 | <0.00050 | 0.00217 | 0.00221 |
| | Phosphorus (P)-Total (mg/L) | 0.63 | 0.39 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 2.05 | 2.17 | 0.922 | 0.735 | 0.723 |
| | Selenium (Se)-Total (mg/L) | 0.00142 | <0.00020 DLA | <0.00010 | 0.00055 | 0.00054 |
| | Silicon (Si)-Total (mg/L) | 13.4 | 20.7 | 6.22 | 2.58 | 2.62 |
| | Silver (Ag)-Total (mg/L) | 0.000179 | 0.000062 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 1.36 | 369 | 13.8 | 14.0 | 13.7 |
| | Strontium (Sr)-Total (mg/L) | 0.0998 | 0.247 | 0.315 | 0.121 | 0.119 |
| | Thallium (Tl)-Total (mg/L) | 0.000215 | 0.000085 | 0.000016 | 0.000015 | 0.000018 |
| | Tin (Sn)-Total (mg/L) | 0.00022 | <0.00020 DLA | <0.00010 | 0.00026 | 0.00035 |
| | Titanium (Ti)-Total (mg/L) | 0.134 | 0.257 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Total (mg/L) | 0.000570 | 0.00129 | 0.00142 | 0.000723 | 0.000721 |
| | Vanadium (V)-Total (mg/L) | 0.0191 | 0.0164 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Total (mg/L) | 0.0698 | 0.0256 | 0.0032 | 0.0077 | 0.0064 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0043 | 0.0170 | <0.0030 | 0.0058 | <0.0030 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | <0.00010 | <0.00010 | 0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00021 | 0.00037 | 0.00272 | 0.00107 DTC | 0.00107 DTC |
| | Barium (Ba)-Dissolved (mg/L) | 0.204 | 1.53 | 0.116 | 0.112 | 0.113 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.0010 DLA | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.201 | 0.029 | 0.015 | 0.014 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000017 | <0.000020 DLA | <0.000010 | 0.000012 | <0.000010 |
| | Calcium (Ca)-Dissolved (mg/L) | 43.2 | 7.07 | 78.8 | 53.7 | 54.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00013 | <0.00020 DLA | <0.00010 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00024 | <0.00020 DLA | 0.00027 | 0.00040 | 0.00039 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | 0.0314 DTC | <0.00050 | <0.00050 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | 0.047 | 0.843 | 0.651 DTC | 0.654 DTC |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1147583-12 | L1147583-13 | L1147583-14 | L1147583-15 | L1147583-16 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 11-MAY-12 | 11-MAY-12 | 10-MAY-12 | 10-MAY-12 | 10-MAY-12 |
| | Sampled Time | | | | | |
| | Client ID | MW-H23 | MW-H22 | MW-H19 | MW-H18 | MW-H17 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Cobalt (Co)-Total (mg/L) | 0.00303 | 0.0127 | 0.00397 | 0.00497 | 0.00246 |
| | Copper (Cu)-Total (mg/L) | 0.00587 | 0.0302 | 0.0122 | 0.0139 | 0.00508 |
| | Iron (Fe)-Total (mg/L) | 4.39 | 26.1 | 6.78 | 11.4 | 4.31 |
| | Lead (Pb)-Total (mg/L) | 0.00263 | 0.0146 | 0.00424 | 0.00724 | 0.00236 |
| | Lithium (Li)-Total (mg/L) | 0.00581 | 0.0202 | 0.110 | 0.0725 | 0.0186 |
| | Magnesium (Mg)-Total (mg/L) | 19.4 | 65.0 | 3.49 | 18.3 | 23.3 |
| | Manganese (Mn)-Total (mg/L) | 0.114 | 0.888 | 0.0979 | 0.116 | 0.127 |
| | Mercury (Hg)-Total (mg/L) | <0.000050 DLM | 0.000072 | 0.000033 | <0.000050 DLM | <0.000050 DLM |
| | Molybdenum (Mo)-Total (mg/L) | 0.00107 | 0.00551 | 0.0165 | 0.00208 | 0.00717 |
| | Nickel (Ni)-Total (mg/L) | 0.0107 | 0.0430 | 0.0183 | 0.0164 | 0.00809 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | 1.15 | 0.32 | 0.48 | <0.30 |
| | Potassium (K)-Total (mg/L) | 1.59 | 3.29 | 4.84 | 3.26 | 1.95 |
| | Selenium (Se)-Total (mg/L) | 0.00085 | 0.00072 | 0.00302 | 0.00163 | 0.00269 |
| | Silicon (Si)-Total (mg/L) | 10.8 | 21.2 | 18.8 | 17.2 | 8.40 |
| | Silver (Ag)-Total (mg/L) | 0.000026 | 0.000229 | 0.000159 | 0.000157 | 0.000037 |
| | Sodium (Na)-Total (mg/L) | 2.44 | 2.61 | 111 | 40.7 | 17.3 |
| | Strontium (Sr)-Total (mg/L) | 0.124 | 0.493 | 0.107 | 0.528 | 0.226 |
| | Thallium (Tl)-Total (mg/L) | 0.000240 | 0.000787 | 0.000184 | 0.000200 | 0.000098 |
| | Tin (Sn)-Total (mg/L) | 0.00017 | 0.00039 | 0.00041 | 0.00030 | 0.00036 |
| | Titanium (Ti)-Total (mg/L) | 0.141 | 0.195 | 0.134 | 0.128 | 0.071 |
| | Uranium (U)-Total (mg/L) | 0.000425 | 0.00202 | 0.00332 | 0.00155 | 0.00344 |
| | Vanadium (V)-Total (mg/L) | 0.0124 | 0.0532 | 0.0252 | 0.0214 | 0.0088 |
| | Zinc (Zn)-Total (mg/L) | 0.0319 | 0.151 | 0.0366 | 0.0530 | 0.0239 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | <0.0060 DLA | 0.0268 | 0.0053 | 0.0072 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | 0.00687 DTC | 0.00120 | 0.00098 |
| | Arsenic (As)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | 0.00117 | 0.00044 | 0.00049 |
| | Barium (Ba)-Dissolved (mg/L) | 0.206 | 0.246 | 0.193 | 1.16 | 0.214 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.0010 DLA | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.020 DLA | 0.143 | 0.056 | 0.016 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000015 | <0.000020 DLA | 0.000033 | 0.000025 | 0.000032 |
| | Calcium (Ca)-Dissolved (mg/L) | 71.1 | 79.6 | 10.0 | 50.3 | 75.4 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00013 | <0.00020 DLA | 0.00026 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00013 | 0.00027 | 0.00090 | 0.00074 | 0.00078 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.0010 DLA | 0.00289 | <0.00050 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | <0.030 | 0.048 | <0.030 | <0.030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1147583-21 | | | | |
| | **Description** | WATER | | | | |
| | **Sampled Date** | | | | | |
| | **Sampled Time** | | | | | |
| | **Client ID** | TRIP BLANK | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Cobalt (Co)-Total (mg/L) | <0.00010 | | | | |
| | Copper (Cu)-Total (mg/L) | <0.00050 | | | | |
| | Iron (Fe)-Total (mg/L) | <0.030 | | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | | | | |
| | Lithium (Li)-Total (mg/L) | <0.00050 | | | | |
| | Magnesium (Mg)-Total (mg/L) | <0.10 | | | | |
| | Manganese (Mn)-Total (mg/L) | <0.000050 | | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | | | | |
| | Molybdenum (Mo)-Total (mg/L) | <0.000050 | | | | |
| | Nickel (Ni)-Total (mg/L) | <0.00050 | | | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | | | | |
| | Potassium (K)-Total (mg/L) | <0.050 | | | | |
| | Selenium (Se)-Total (mg/L) | <0.00010 | | | | |
| | Silicon (Si)-Total (mg/L) | <0.050 | | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Total (mg/L) | <0.050 | | | | |
| | Strontium (Sr)-Total (mg/L) | <0.00010 | | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Total (mg/L) | <0.010 | | | | |
| | Uranium (U)-Total (mg/L) | <0.000010 | | | | |
| | Vanadium (V)-Total (mg/L) | <0.0010 | | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | | | | |
| **Dissolved Metals** | Dissolved Metals Filtration Location | | | | | |
| | Aluminum (Al)-Dissolved (mg/L) | | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | | | | | |
| | Arsenic (As)-Dissolved (mg/L) | | | | | |
| | Barium (Ba)-Dissolved (mg/L) | | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | | | | |
| | Boron (B)-Dissolved (mg/L) | | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | | | | | |
| | Copper (Cu)-Dissolved (mg/L) | | | | | |
| | Iron (Fe)-Dissolved (mg/L) | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1147583-1 | L1147583-2 | L1147583-3 | L1147583-4 | L1147583-5 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 14-MAY-12 | 14-MAY-12 | 14-MAY-12 | 14-MAY-12 | 13-MAY-12 |
| | Sampled Time | | | | | |
| | Client ID | HASLER | MW-H20 | MW-H15 | MW-H16 | MW-H2A |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Lead (Pb)-Dissolved (mg/L) | 0.000061 | 0.00021 | DLA <0.00010 | | DLA <0.00010 |
| | Lithium (Li)-Dissolved (mg/L) | 0.00900 | 0.949 | 0.868 | | 1.20 |
| | Magnesium (Mg)-Dissolved (mg/L) | 0.28 | 0.74 | 1.32 | | 3.56 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00572 | 0.159 | 0.205 | | 0.0329 |
| | Mercury (Hg)-Dissolved (mg/L) | DLM <0.000050 | <0.000010 | <0.000010 | | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00369 | 0.0105 | 0.0267 | | 0.00159 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00062 | 0.0018 | 0.0012 | | DLA <0.0010 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | 0.42 | <0.30 | | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.440 | 0.82 | 1.11 | | 0.88 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00192 | DLA <0.00020 | DLA <0.00020 | | DLA <0.00020 |
| | Silicon (Si)-Dissolved (mg/L) | 1.20 | 2.89 | 3.36 | | 2.85 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | DLA <0.000020 | DLA <0.000020 | | DLA <0.000020 |
| | Sodium (Na)-Dissolved (mg/L) | 5.24 | 326 | 391 | | 368 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0315 | 0.0833 | 0.200 | | 0.237 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | DLA <0.000020 | DLA <0.000020 | | DLA <0.000020 |
| | Tin (Sn)-Dissolved (mg/L) | 0.00110 | 0.00021 | 0.00057 | | DLA <0.00020 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.000174 | 0.00757 | 0.00105 | | 0.000991 |
| | Vanadium (V)-Dissolved (mg/L) | 0.0012 | 0.0023 | DLA <0.0020 | | DLA <0.0020 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0045 | DLA <0.0060 | DLA <0.0060 | | DLA <0.0060 |
| **Aggregate Organics** | COD (mg/L) | SP 31 | SP 47 | SP 90 | | SP 47 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1147583-6 WATER 13-MAY-12 MW-H2B | L1147583-7 WATER 13-MAY-12 X2 | L1147583-9 WATER 12-MAY-12 MW-H5 | L1147583-10 WATER 11-MAY-12 X1 | L1147583-11 WATER 11-MAY-12 MW-PNB |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.00018 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.00203 | 1.31 | 0.00578 | 0.00315 | 0.00309 |
| | Magnesium (Mg)-Dissolved (mg/L) | 10.4 | 3.56 | 27.9 | 14.2 DTC | 14.3 DTC |
| | Manganese (Mn)-Dissolved (mg/L) | 0.244 | 0.0324 | 0.574 | 1.12 | 1.12 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000455 | 0.00147 | 0.00139 | 0.00350 | 0.00354 DTC |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | <0.0010 DLA | <0.00050 | 0.00156 | 0.00152 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.537 | 0.86 | 0.990 | 0.969 DTC | 0.964 DTC |
| | Selenium (Se)-Dissolved (mg/L) | 0.00027 | <0.00020 DLA | <0.00010 | 0.00029 | 0.00027 |
| | Silicon (Si)-Dissolved (mg/L) | 2.60 | 2.86 | 6.05 | 2.65 | 2.65 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 DLA | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 1.21 | 377 | 14.1 | 51.1 DTC | 50.7 DTC |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0705 | 0.234 | 0.304 | 0.119 | 0.116 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 DLA | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.000142 | 0.000950 | 0.00135 | 0.00113 DTC | 0.00110 DTC |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0020 DLA | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0060 DLA | <0.0030 | <0.0030 | <0.0030 |
| **Aggregate Organics** | COD (mg/L) | 59 SP | 43 SP | <20 SP | 32 SP | 32 SP |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1147583-12 WATER 11-MAY-12 MW-H23 | L1147583-13 WATER 11-MAY-12 MW-H22 | L1147583-14 WATER 10-MAY-12 MW-H19 | L1147583-15 WATER 10-MAY-12 MW-H18 | L1147583-16 WATER 10-MAY-12 MW-H17 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.00010 DLA | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.00317 | 0.0043 | 0.101 | 0.0656 | 0.0156 |
| | Magnesium (Mg)-Dissolved (mg/L) | 16.9 | 20.7 | 2.42 | 15.1 | 19.2 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00796 | 0.0277 | 0.0656 | 0.0429 | 0.0725 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000050 DLM | <0.000010 | <0.000010 | <0.000050 DLM | <0.000050 DLM |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000431 | 0.00172 | 0.0165 | 0.00136 | 0.00706 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00069 | <0.0010 DLA | 0.00797 | 0.00298 | 0.00205 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.640 | 0.80 | 2.73 | 1.44 | 1.29 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00042 | <0.00020 DLA | 0.00258 | 0.00114 | 0.00245 |
| | Silicon (Si)-Dissolved (mg/L) | 2.85 | 3.18 | 4.16 | 3.43 | 3.85 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 DLA | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 2.36 | 2.20 | 115 | 40.6 | 17.6 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.108 | 0.110 | 0.0875 | 0.488 | 0.208 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000020 DLA | 0.000024 | 0.000018 | 0.000014 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | 0.00018 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.000265 | 0.000577 | 0.00277 | 0.000716 | 0.00316 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0020 DLA | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0060 DLA | <0.0030 | <0.0030 | <0.0030 |
| **Aggregate Organics** | COD (mg/L) | 23 SP | 81 SP | 95 SP | 231 SP | 32 SP |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1147583-21 | | | | |
| | **Description** | WATER | | | | |
| | **Sampled Date** | | | | | |
| | **Sampled Time** | | | | | |
| | **Client ID** | TRIP BLANK | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Lead (Pb)-Dissolved (mg/L) | | | | | |
| | Lithium (Li)-Dissolved (mg/L) | | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | | | | |
| | Potassium (K)-Dissolved (mg/L) | | | | | |
| | Selenium (Se)-Dissolved (mg/L) | | | | | |
| | Silicon (Si)-Dissolved (mg/L) | | | | | |
| | Silver (Ag)-Dissolved (mg/L) | | | | | |
| | Sodium (Na)-Dissolved (mg/L) | | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | | | | | |
| | Tin (Sn)-Dissolved (mg/L) | | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | | | | | |
| | Uranium (U)-Dissolved (mg/L) | | | | | |
| | Vanadium (V)-Dissolved (mg/L) | | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | | | | | |
| **Aggregate Organics** | COD (mg/L) | <20 SP | | | | |

* 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) |
|---|---|---|---|
| Duplicate | Iron (Fe)-Dissolved | DLA | L1147583-1 |
| Duplicate | Phosphorus (P)-Dissolved | DLA | L1147583-1 |
| Duplicate | Titanium (Ti)-Dissolved | DLA | L1147583-1 |
| Duplicate | Aluminum (Al)-Dissolved | DLA | L1147583-1 |
| Duplicate | Antimony (Sb)-Dissolved | DLA | L1147583-1 |
| Duplicate | Arsenic (As)-Dissolved | DLA | L1147583-1 |
| Duplicate | Beryllium (Be)-Dissolved | DLA | L1147583-1 |
| Duplicate | Bismuth (Bi)-Dissolved | DLA | L1147583-1 |
| Duplicate | Chromium (Cr)-Dissolved | DLA | L1147583-1 |
| Duplicate | Cobalt (Co)-Dissolved | DLA | L1147583-1 |
| Duplicate | Lead (Pb)-Dissolved | DLA | L1147583-1 |
| Duplicate | Nickel (Ni)-Dissolved | DLA | L1147583-1 |
| Duplicate | Selenium (Se)-Dissolved | DLA | L1147583-1 |
| Duplicate | Silver (Ag)-Dissolved | DLA | L1147583-1 |
| Duplicate | Thallium (Tl)-Dissolved | DLA | L1147583-1 |
| Duplicate | Tin (Sn)-Dissolved | DLA | L1147583-1 |
| Duplicate | Vanadium (V)-Dissolved | DLA | L1147583-1 |
| Method Blank | Chromium (Cr)-Total | MB-LOR | L1147583-1 |
| Matrix Spike | Chloride (Cl) | MS-B | L1147583-1, -10, -11, -12, -13, -14, -15, -16, -2, -21, -3, -5, -6, -7, -9 |
| Matrix Spike | Bromide (Br) | MS-B | L1147583-1, -10, -11, -12, -13, -14, -15, -16, -2, -21, -3, -5, -6, -7, -9 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1147583-1, -10, -11, -12, -13, -14, -15, -16, -2, -21, -3, -5, -6, -7, -9 |
| Matrix Spike | Dissolved Organic Carbon | MS-B | L1147583-21 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Nickel (Ni)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Total Organic Carbon | MS-B | L1147583-10, -12, -16, -9 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1147583-1 |
| Matrix Spike | Boron (B)-Total | MS-B | L1147583-1 |
| Matrix Spike | Lithium (Li)-Total | MS-B | L1147583-1 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1147583-1 |
| Matrix Spike | Potassium (K)-Total | MS-B | L1147583-1 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1147583-1 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1147583-1 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1147583-1 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1147583-1 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MB-LOR | Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required. |
| | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |

# Reference Information

| | |
|---|---|
| MS-B | |
| PEHT | Parameter Exceeded Recommended Holding Time Prior to Analysis |
| SP | Sample was Preserved at the laboratory |

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ALK-COL-VA** | Water | Alkalinity by Colourimetric (Automated) | EPA 310.2 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. | | | |
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.<br>OR<br>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **CARBONS-DOC-VA** | Water | Dissolved organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis. | | | |
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

**COD-COL-VA** Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**EC-PCT-VA** Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**HARDNESS-CALC-VA** Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**P-T-COL-VA** Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

**P-TD-COL-VA** Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

# Reference Information

| | | | |
|---|---|---|---|
| **PH-MAN-VA** | Water | pH by Manual Meter | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-MAN-VA** | Water | pH by Manual Meter | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TDS-VA** | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| **TKN-F-VA** | Water | TKN in Water by Fluorescence | APHA 4500-NORG D. |

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

| | | | |
|---|---|---|---|
| **TN-CALC-VA** | Water | Total Nitrogen (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-173783 10-173784

# Reference Information

**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.*

**10-173783**

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

LIN583 1/2

Page 1 of 2

| Report To | | Report Format / Distribution | | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|---|---|
| Company: | Rescan Environmental Services Ltd | Standard: ✓ Other (specify): | | ✓ Regular (Standard Turnaround Times - Business Days) |
| Contact: | Rusto Martinka | Select: PDF ✓ Excel ✓ Digital Fax | | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 1111 W Hastings St, Vancouver, BC V6E 2J3 | Email 1: | rmartinka@rescan.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| Phone: | (604) 689-9460 Fax: (604) 687-4277 | Email 2: | | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| **Invoice To** | Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | | **Analysis Request** |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: | 791-002-03 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | | PO / AFE: | | |
| Contact: | | LSD: | | |
| Address: | | | | |
| Phone: | Fax: | Quote #: | | |
| **Lab Work Order #** (lab use only) | | **ALS Contact:** | Amber | **Sampler:** RM/JB |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Physical | Total Metals | Dissolved Metals | TOC | Total Metals | Dissolved Metals | Ammonia | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HASLER | 14/05/12 | | grab | ✓ | | | ✓ | ✓ | ✓ | ✓ | 4 |
| | MW-H20 | | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | MW-H15 | | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | MW-H16 | | | | | ✓ | | | | | | 1 |
| | MW-H2A | 13/05/12 | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | MW-H2B | | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | X2 | | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | SHAFT | 12/05/12 | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | MW-H5 | | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | X1 | 11/05/12 | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | MW-PNB | | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |
| | MW-H23 | | | | ✓ | ✓ | ✓ | ✓ | | | | 4 |

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

Hasler sample - total and dissolved metals in one bottle. Not preserved or filtered.

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Rusto | 15 May 12 | 12:00 | HG | 15-May-12 | 11:50 | 8 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

10-173784

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

L1147583

Page 2 of 2

| Report To | | Report Format / Distribution | | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|---|---|
| Company: | Rescan Environmental Services Ltd | Standard: ✓ | Other (specify): | ✓ Regular (Standard Turnaround Times - Business Days) |
| Contact: | Rusto Martinka | Select: PDF ✓ | Excel ✓ Digital Fax | Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 1111 W. Hastings St., Vancouver, BC V6E 2J3 | Email 1: | rmartinka@rescan.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| Phone: | (604) 689-9460 Fax: (604) 687-4277 | Email 2: | | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| **Invoice To** | Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | | **Analysis Request** |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: | 791-002-03 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | | PO / AFE: | | |
| Contact: | | LSD: | | |
| Address: | | | | |
| Phone: | Fax: | Quote #: | | |
| **Lab Work Order # (lab use only)** | | **ALS Contact:** | **Sampler:** RM/JB | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Physical | Total Metals | Dissolved Metals | TOC | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|
| | MW-H22 | 11/05/12 | | grab | ✓ | ✓ | ✓ | ✓ | 4 |
| | MW-H19 | | | | ✓ | | | | 1 |
| | MW-H19 (same) | 10/05/12 | | | | ✓ | ✓ | ✓ | 3 |
| | MW-H18 | | | | ✓ | ✓ | ✓ | ✓ | 4 |
| | MW-H17 | | | | ✓ | ✓ | ✓ | ✓ | 4 |

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

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Rusto | 15 May 12 | 1200 | HB | 15-May-12 | 11:30 | 8 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
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Date Received: 29-AUG-12
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Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1201463**

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-007-24-12
C of C Numbers: 10-240018
Legal Site Desc:

**Comments:** 07-NOV-12: File re-issued.

Amber Springer
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1201463-2 WATER 23-AUG-12 MW-H15 | L1201463-3 WATER 23-AUG-12 MW-H2A | L1201463-4 WATER 23-AUG-12 MW-H2B | L1201463-5 WATER 23-AUG-12 X2 | L1201463-6 WATER 23-AUG-12 FIELD BLANKS |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 24.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 1830 | 1510 | 262 | 1510 | <2.0 |
| | Hardness (as CaCO3) (mg/L) | 18.5 | 28.7 | 140 | 28.9 | <0.50 |
| | pH (pH) | 8.51 | 8.64 | 8.25 | 8.65 | 6.06 |
| | Total Suspended Solids (mg/L) | 75.8 | 10.8 | 548 | 10.5 | <3.0 |
| | Turbidity (NTU) | 40.4 | 43.0 | 105 | 41.2 | <0.10 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | 1.9 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 566 | 839 | 134 | 845 | <2.0 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 21.4 | 44.4 | <2.0 | 49.4 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <2.0 | <1.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 588 | 883 | 134 | 894 | <2.0 |
| | Ammonia, Total (as N) (mg/L) | 0.814 | 0.548 | 0.0063 | 0.525 | <0.0050 |
| | Bromide (Br) (mg/L) | 1.4 | <1.0 DLM | <0.050 | <1.0 DLM | <0.050 |
| | Chloride (Cl) (mg/L) | 205 | 13 | 4.81 | 11 | <0.50 |
| | Fluoride (F) (mg/L) | 0.86 | 1.49 | 0.084 | 1.42 | <0.020 |
| | Nitrate (as N) (mg/L) | <0.10 DLM | <0.10 DLM | 0.0775 | <0.10 DLM | <0.0050 |
| | Nitrite (as N) (mg/L) | 0.024 | <0.020 DLM | <0.0010 | <0.020 DLM | <0.0010 |
| | Total Kjeldahl Nitrogen (mg/L) | 1.41 | 0.729 | 0.272 | 0.650 | <0.050 |
| | Total Nitrogen (mg/L) | 1.43 | 0.73 | 0.350 | 0.650 | <0.050 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0257 | 0.158 | 0.0024 | 0.163 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0482 | 0.167 | 0.0029 | 0.172 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.280 | 0.261 | 0.147 | 0.265 | <0.0020 |
| | Sulfate (SO4) (mg/L) | 75 | <10 DLM | 4.09 | <10 DLM | <0.50 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 19.1 | 2.52 | 4.61 | 3.97 | <0.50 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.669 | 1.73 | 2.37 | 1.78 | <0.0030 |
| | Antimony (Sb)-Total (mg/L) | 0.00040 | <0.00020 DLA | 0.00023 | <0.00020 DLA | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00293 | 0.00033 | 0.00288 | 0.00034 | <0.00010 |
| | Barium (Ba)-Total (mg/L) | 0.659 | 1.53 | 0.348 | 1.55 | <0.000050 |
| | Beryllium (Be)-Total (mg/L) | <0.00020 DLA | <0.00020 DLA | 0.00019 | <0.00020 DLA | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.0010 DLA | <0.0010 DLA | <0.00050 | <0.0010 DLA | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.140 | 0.192 | 0.013 | 0.192 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.000088 | 0.000026 | 0.000361 | 0.000029 | <0.000010 |
| | Calcium (Ca)-Total (mg/L) | 6.54 | 6.43 | 79.6 | 6.36 | <0.020 |
| | Chromium (Cr)-Total (mg/L) | 0.00292 | 0.00282 | 0.00491 | 0.00301 | <0.00010 |
| | Cobalt (Co)-Total (mg/L) | 0.00075 | 0.00035 | 0.00276 | 0.00034 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.0031 | 0.0018 | 0.00824 | 0.0017 | <0.00050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1201463-2 | L1201463-3 | L1201463-4 | L1201463-5 | L1201463-6 |
| | **Description** | WATER | WATER | WATER | WATER | WATER |
| | **Sampled Date** | 23-AUG-12 | 23-AUG-12 | 23-AUG-12 | 23-AUG-12 | 23-AUG-12 |
| | **Sampled Time** | | | | | |
| | **Client ID** | MW-H15 | MW-H2A | MW-H2B | X2 | FIELD BLANKS |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 1.20 | 0.774 | 6.91 | 0.803 | <0.030 |
| | Lead (Pb)-Total (mg/L) | 0.00145 | 0.00057 | 0.00351 | 0.00055 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.841 | 1.25 | 0.00889 | 1.25 | <0.00050 |
| | Magnesium (Mg)-Total (mg/L) | 1.75 | 3.39 | 19.5 | 3.48 | <0.0050 |
| | Manganese (Mn)-Total (mg/L) | 0.239 | 0.0257 | 0.547 | 0.0258 | <0.000050 |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.0283 | 0.00052 | 0.000638 | 0.00058 | <0.000050 |
| | Nickel (Ni)-Total (mg/L) | 0.0046 | 0.0013 | 0.00795 | 0.0013 | <0.00050 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | 0.47 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 1.21 | 1.27 | 1.31 | 1.34 | <0.050 |
| | Selenium (Se)-Total (mg/L) | 0.00028 | <0.00020 DLA | 0.00064 | <0.00020 DLA | <0.00010 |
| | Silicon (Si)-Total (mg/L) | 4.47 | 6.84 | 8.76 | 7.14 | <0.050 |
| | Silver (Ag)-Total (mg/L) | 0.000025 | <0.000020 DLA | 0.000082 | 0.000020 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 415 | 367 | <2.0 | 387 | <2.0 |
| | Strontium (Sr)-Total (mg/L) | 0.208 | 0.229 | 0.107 | 0.238 | <0.00020 |
| | Thallium (Tl)-Total (mg/L) | <0.000020 DLA | 0.000030 | 0.000099 | 0.000033 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | 0.00138 | <0.00020 DLA | 0.00020 | <0.00020 DLA | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.010 | 0.056 | 0.097 | 0.063 | <0.010 |
| | Uranium (U)-Total (mg/L) | 0.00112 | 0.000877 | 0.000458 | 0.000898 | <0.000010 |
| | Vanadium (V)-Total (mg/L) | 0.0036 | 0.0063 | 0.0097 | 0.0064 | <0.0010 |
| | Zinc (Zn)-Total (mg/L) | 0.0119 | 0.0077 | 0.0324 | 0.0074 | <0.0030 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0272 | 0.0078 | <0.0030 | <0.0060 DLA | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00025 | <0.00020 DLA | <0.00010 | <0.00020 DLA | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00267 | <0.00020 DLA | 0.00012 | <0.00020 DLA | |
| | Barium (Ba)-Dissolved (mg/L) | 0.614 | 1.47 | 0.184 | 1.47 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00020 DLA | <0.00020 DLA | <0.00010 | <0.00020 DLA | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.0010 DLA | <0.0010 DLA | <0.00050 | <0.0010 DLA | |
| | Boron (B)-Dissolved (mg/L) | 0.142 | 0.192 | <0.010 | 0.191 | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000028 | <0.000020 DLA | <0.000010 | <0.000020 DLA | |
| | Calcium (Ca)-Dissolved (mg/L) | 5.19 | 6.29 | 39.7 | 6.24 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00038 | <0.00020 DLA | <0.00010 | <0.00020 DLA | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00032 | <0.00020 DLA | <0.00010 | <0.00020 DLA | |
| | Copper (Cu)-Dissolved (mg/L) | <0.0010 DLA | <0.0010 DLA | <0.00050 | <0.0010 DLA | |
| | Iron (Fe)-Dissolved (mg/L) | 0.098 | 0.046 | <0.030 | 0.045 | |
| | Lead (Pb)-Dissolved (mg/L) | <0.00010 DLA | <0.00010 DLA | <0.000050 | <0.00010 DLA | |
| | Lithium (Li)-Dissolved (mg/L) | 0.884 | 1.32 | 0.00293 | 1.31 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1201463-2 WATER 23-AUG-12 MW-H15 | L1201463-3 WATER 23-AUG-12 MW-H2A | L1201463-4 WATER 23-AUG-12 MW-H2B | L1201463-5 WATER 23-AUG-12 X2 | L1201463-6 WATER 23-AUG-12 FIELD BLANKS |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 1.34 | 3.16 | 9.83 | 3.22 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.205 | 0.0197 | 0.0292 | 0.0197 | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0280 | 0.00047 | 0.000336 | 0.00050 | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0018 | <0.0010 DLA | <0.00050 | <0.0010 DLA | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | |
| | Potassium (K)-Dissolved (mg/L) | 1.13 | 0.76 | 0.496 | 0.77 | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00031 | <0.00020 DLA | 0.00025 | <0.00020 DLA | |
| | Silicon (Si)-Dissolved (mg/L) | 3.48 | 2.91 | 2.62 | 2.91 | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 DLA | <0.000020 DLA | <0.000010 | <0.000020 DLA | |
| | Sodium (Na)-Dissolved (mg/L) | 440 | 387 | <2.0 | 389 | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.204 | 0.229 | 0.0655 | 0.228 | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 DLA | <0.000020 DLA | <0.000010 | <0.000020 DLA | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00054 | <0.00020 DLA | <0.00010 | <0.00020 DLA | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | |
| | Uranium (U)-Dissolved (mg/L) | 0.00109 | 0.000781 | 0.000121 | 0.000792 | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0020 DLA | <0.0020 DLA | <0.0010 | <0.0020 DLA | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0060 DLA | <0.0060 DLA | <0.0030 | <0.0060 DLA | |

* 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) |
|---|---|---|---|
| Duplicate | Phosphorus (P)-Total | DLA | L1201463-2 |
| Method Blank | Manganese (Mn)-Total | MB-LOR | L1201463-2 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Silver (Ag)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1201463-2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1201463-3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1201463-3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1201463-3, -4, -5 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1201463-3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1201463-3, -4, -5 |
| Matrix Spike | Sodium (Na)-Total | MS-B | L1201463-2 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| MB-LOR | Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required. |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.<br>OR<br>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-CL-IC-VA** Water Chloride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-F-IC-VA** Water Fluoride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-NO2-IC-VA** Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

**ANIONS-NO3-IC-VA** Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

**ANIONS-SO4-IC-VA** Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**CARBONS-TOC-VA** Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**EC-PCT-VA** Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**HARDNESS-CALC-VA** Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

# Reference Information

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-TOT-COMBUST-VA** | Water | Total Nitrogen in Water by Combustion | BC: TN by Combustion/Chemiluminescence |

This analysis is carried out, on hydrochloric acid preserved samples, following Method BC MOE "Total and Dissolved Nitrogen (TN) by Combustion with Chemiluminescence Detection". Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TKN-F-VA** | Water | TKN in Water by Fluorescence | APHA 4500-NORG D. |

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

| | | | |
|---|---|---|---|
| **TN-CALC-VA** | Water | Total Nitrogen (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

# Reference Information

10-240018

**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.*

10-240018

ALS Environmental



Page 1 of 1

| Report To | | Report Format / Distribution | | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) | |
|---|---|---|---|---|---|
| Company: | Rescan Environmental | Standard or other (specify): | | X | Regular (Standard Turnaround Times - Business Days) |
| Contact: | Rusto Martinka | Select: PDF X Excel X Digital Fax | | | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 1111 W. Hasting St Vancouver BC | Email 1: rmartinka@rescan.com | | | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | | Email 2: | | | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: | Fax: | | | Analysis Request | |
| Invoice To | Same as Report ? (circle) Yes or No (if No, provide details) | Client / Project Information | | ( Indicate Filtered or Preserved, F/P ) | |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: | 0791-007-24-12 | | |
| Company: | | PO / AFE: | | | |
| Contact: | | LSD: | | | |
| Address: | | | | | |
| Phone: | Fax: | Quote #: | | | |
| Lab Work Order # (lab use only) | L1201463 | ALS Contact: | Amber | Sampler: | Rusto |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chem. | Nutrients | TOC | Total Metals | Diss. Metals | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|
| | SHAFT | 23-08-12 | | water | X | X | X | X | X | 5 |
| | MW-H15 | | | | X | X | X | X | X | 5 |
| | MW-H2A | | | | X | X | X | X | X | 5 |
| | MW-H2B | | | | X | X | X | X | X | 5 |
| | X2 | | | | X | X | X | X | X | 5 |
| | Field Blanks | 23-08-12 | | water | X | X | X | X | | 4 |

**Short Holding Time**

*Rush Processing*

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

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: Rusto Martinka | Date: 27-08-12 | Time: 11:00 | Received by: | Date: Aug 29 | Time: 9:15 | Temperature: 11.3 °C | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 29-AUG-12
Report Date: 10-SEP-12 13:19 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1201465**

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-007-24-12
C of C Numbers: 10-240019, 10-240021
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 | L1201465-1 | L1201465-2 | L1201465-3 | L1201465-4 | L1201465-5 |
|---|---|---|---|---|---|
| Description | WATER | WATER | WATER | WATER | WATER |
| Sampled Date | 21-AUG-12 | 22-AUG-12 | 22-AUG-12 | 22-AUG-12 | 21-AUG-12 |
| Sampled Time | | | | | |
| Client ID | MW-H23 | MW-H5 | MW-H18 | MW-H19 | MW-PNB |
| **Grouping** / **Analyte** | | | | | |
| **WATER** | | | | | |
| **Physical Tests** Colour, True (CU) | <5.0 | <5.0 | <5.0 | 7.2 | <5.0 |
| Conductivity (uS/cm) | 428 | 548 | 466 | 529 | 519 |
| Hardness (as CaCO3) (mg/L) | 252 | 309 | 259 | 123 | 194 |
| pH (pH) | 8.20 | 8.17 | 7.94 | 8.10 | 8.23 |
| Total Suspended Solids (mg/L) | 33.9 | 3.1 | 85.7 | 402 | 17.7 |
| Turbidity (NTU) | 25.3 | 7.09 | 26.0 | 401 | 12.4 |
| **Anions and Nutrients** Acidity (as CaCO3) (mg/L) | 2.2 | 2.4 | 122 | 3.3 | 1.6 |
| Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 247 | 331 | 267 | 297 | 251 |
| Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <1.0 | <2.0 |
| Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <1.0 | <2.0 |
| Alkalinity, Total (as CaCO3) (mg/L) | 247 | 331 | 267 | 297 | 251 |
| Ammonia, Total (as N) (mg/L) | <0.0050 | 0.175 | 0.0608 | 0.426 | 0.0096 |
| Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | 0.132 |
| Chloride (Cl) (mg/L) | <0.50 | <0.50 | 0.60 | 0.79 | 3.25 |
| Fluoride (F) (mg/L) | 0.079 | 0.147 | 0.202 | 0.298 | 0.189 |
| Nitrate (as N) (mg/L) | 0.149 | <0.0050 | 0.0840 | <0.0050 | <0.0050 |
| Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | 0.0021 | <0.0010 | <0.0010 |
| Total Kjeldahl Nitrogen (mg/L) | 0.161 | 0.250 | 0.264 | 0.500 | 0.200 |
| Total Nitrogen (mg/L) | 0.310 | 0.250 | 0.350 | 0.500 | 0.200 |
| Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0124 | 0.0017 |
| Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | <0.0020 | <0.0020 | 0.0153 | <0.0020 |
| Phosphorus (P)-Total (mg/L) | 0.0380 | 0.0119 | 0.0796 | 0.555 | 0.0567 |
| Sulfate (SO4) (mg/L) | 6.28 | 12.1 | 12.2 | 15.8 | 44.9 |
| **Organic / Inorganic Carbon** Total Organic Carbon (mg/L) | 3.32 | 1.03 | 4.12 | 11.4 | 10.2 |
| **Total Metals** Aluminum (Al)-Total (mg/L) | 0.477 | <0.0030 | 0.662 | 6.39 | 0.204 |
| Antimony (Sb)-Total (mg/L) | 0.00016 | <0.00010 | 0.00019 | 0.00118 | <0.00010 |
| Arsenic (As)-Total (mg/L) | 0.00068 | 0.00276 | 0.00061 | 0.00635 | 0.00123 |
| Barium (Ba)-Total (mg/L) | 0.233 | 0.116 | 0.491 | 1.10 | 0.121 |
| Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00042 | <0.00010 |
| Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Boron (B)-Total (mg/L) | 0.012 | 0.031 | 0.024 | 0.212 | 0.016 |
| Cadmium (Cd)-Total (mg/L) | 0.000262 | <0.000010 | 0.000075 | 0.000344 | 0.000048 |
| Calcium (Ca)-Total (mg/L) | 73.1 | 77.8 | 70.5 | 25.2 | 50.3 |
| Chromium (Cr)-Total (mg/L) | 0.00108 | 0.00014 | 0.00137 | 0.0125 | 0.00084 |
| Cobalt (Co)-Total (mg/L) | 0.00091 | 0.00029 | 0.00092 | 0.00584 | 0.00097 |
| Copper (Cu)-Total (mg/L) | 0.00198 | <0.00050 | 0.00193 | 0.0159 | 0.00136 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1201465-6 | L1201465-7 | L1201465-8 | L1201465-9 | |
|---|---|---|---|---|---|
| Description | WATER | WATER | WATER | WATER | |
| Sampled Date | 22-AUG-12 | 22-AUG-12 | 21-AUG-12 | 21-AUG-12 | |
| Sampled Time | | | | | |
| Client ID | MW-H20 | MW-H17 | MW-H22 | X1 | |
| **Grouping** / **Analyte** | | | | | |
| **WATER** | | | | | |
| **Physical Tests** Colour, True (CU) | 10.7 | <5.0 | <5.0 | <5.0 | |
| Conductivity (uS/cm) | 1320 | 505 | 543 | 524 | |
| Hardness (as CaCO3) (mg/L) | 7.32 | 261 | 322 | 196 | |
| pH (pH) | 8.63 | 8.10 | 8.11 | 8.26 | |
| Total Suspended Solids (mg/L) | 12.1 | 36.9 | 10600 | 16.5 | |
| Turbidity (NTU) | 19.8 | 59.6 | >4000 TMV | 13.0 | |
| **Anions and Nutrients** Acidity (as CaCO3) (mg/L) | <1.0 | 3.8 | 4.2 | <1.0 | |
| Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 717 | 278 | 308 | 243 | |
| Alkalinity, Carbonate (as CaCO3) (mg/L) | 48.2 | <2.0 | <2.0 | <2.0 | |
| Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <2.0 | <2.0 | <2.0 | |
| Alkalinity, Total (as CaCO3) (mg/L) | 765 | 278 | 308 | 243 | |
| Ammonia, Total (as N) (mg/L) | 0.366 | 0.0704 | 0.0340 | 0.0122 | |
| Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | 0.148 | |
| Chloride (Cl) (mg/L) | <0.50 | <0.50 | <0.50 | 3.33 | |
| Fluoride (F) (mg/L) | 0.226 | 0.134 | 0.061 | 0.195 | |
| Nitrate (as N) (mg/L) | <0.0050 | <0.0050 | 0.145 | <0.0050 | |
| Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| Total Kjeldahl Nitrogen (mg/L) | 0.550 | 0.180 | 2.60 | 0.150 | |
| Total Nitrogen (mg/L) | 0.550 | 0.180 | 2.74 | 0.150 | |
| Orthophosphate-Dissolved (as P) (mg/L) | 0.430 | 0.0061 | <0.0010 | 0.0023 | |
| Phosphorus (P)-Total Dissolved (mg/L) | 0.442 | 0.0068 | <0.0020 | <0.0020 | |
| Phosphorus (P)-Total (mg/L) | 0.518 | 0.0773 | 3.23 | 0.0667 | |
| Sulfate (SO4) (mg/L) | <0.50 | 21.3 | 8.46 | 45.6 | |
| **Organic / Inorganic Carbon** Total Organic Carbon (mg/L) | 6.29 | 2.63 | 59.7 | 10.2 | |
| **Total Metals** Aluminum (Al)-Total (mg/L) | 1.12 | 2.07 | 2.34 | 0.336 | |
| Antimony (Sb)-Total (mg/L) | 0.00031 | 0.00022 | 0.00027 | 0.00011 | |
| Arsenic (As)-Total (mg/L) | 0.00166 | 0.00316 | 0.00184 | 0.00132 | |
| Barium (Ba)-Total (mg/L) | 0.579 | 0.422 | 0.369 | 0.126 | |
| Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | 0.00011 | <0.00010 | |
| Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| Boron (B)-Total (mg/L) | 0.185 | 0.021 | 0.012 | 0.014 | |
| Cadmium (Cd)-Total (mg/L) | 0.000078 | 0.000096 | 0.000255 | 0.000033 | |
| Calcium (Ca)-Total (mg/L) | 2.02 | 71.0 | 90.8 | 53.8 | |
| Chromium (Cr)-Total (mg/L) | 0.00177 | 0.00314 | 0.00533 | 0.00075 | |
| Cobalt (Co)-Total (mg/L) | 0.00045 | 0.00171 | 0.00154 | 0.00102 | |
| Copper (Cu)-Total (mg/L) | 0.00631 | 0.00352 | 0.00508 | 0.00128 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1201465-1 | L1201465-2 | L1201465-3 | L1201465-4 | L1201465-5 |
|---|---|---|---|---|---|
| Description | WATER | WATER | WATER | WATER | WATER |
| Sampled Date | 21-AUG-12 | 22-AUG-12 | 22-AUG-12 | 22-AUG-12 | 21-AUG-12 |
| Sampled Time | | | | | |
| Client ID | MW-H23 | MW-H5 | MW-H18 | MW-H19 | MW-PNB |
| **Grouping** / **Analyte** | | | | | |
| **WATER** | | | | | |
| **Total Metals** Iron (Fe)-Total (mg/L) | 1.06 | 0.835 | 0.857 | 9.10 | 1.50 |
| Lead (Pb)-Total (mg/L) | 0.000723 | <0.000050 | 0.000694 | 0.00628 | 0.000341 |
| Lithium (Li)-Total (mg/L) | 0.00666 | 0.00774 | 0.0187 | 0.153 | 0.00358 |
| Magnesium (Mg)-Total (mg/L) | 17.8 | 27.5 | 19.6 | 9.54 | 14.7 |
| Manganese (Mn)-Total (mg/L) | 0.0330 | 0.606 | 0.0499 | 0.343 | 1.16 |
| Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Molybdenum (Mo)-Total (mg/L) | 0.000581 | 0.00145 | 0.000799 | 0.00808 | 0.00271 |
| Nickel (Ni)-Total (mg/L) | 0.00295 | <0.00050 | 0.00284 | 0.0203 | 0.00171 |
| Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | 0.55 | <0.30 |
| Potassium (K)-Total (mg/L) | 0.791 | 0.944 | 1.06 | 3.10 | 0.891 |
| Selenium (Se)-Total (mg/L) | 0.00047 | <0.00010 | 0.00049 | 0.00066 | 0.00026 |
| Silicon (Si)-Total (mg/L) | 3.75 | 5.91 | 4.44 | 26.8 | 2.90 |
| Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000018 | 0.000207 | <0.000010 |
| Sodium (Na)-Total (mg/L) | 2.2 | 13.6 | 9.5 | 110 | 37.5 |
| Strontium (Sr)-Total (mg/L) | 0.114 | 0.317 | 0.376 | 0.532 | 0.124 |
| Thallium (Tl)-Total (mg/L) | 0.000055 | <0.000010 | 0.000033 | 0.000188 | <0.000010 |
| Tin (Sn)-Total (mg/L) | 0.00019 | <0.00010 | 0.00026 | 0.00073 | 0.00090 |
| Titanium (Ti)-Total (mg/L) | 0.018 | <0.010 | 0.025 | 0.299 | <0.010 |
| Uranium (U)-Total (mg/L) | 0.000268 | 0.00120 | 0.000676 | 0.00387 | 0.000978 |
| Vanadium (V)-Total (mg/L) | 0.0027 | <0.0010 | 0.0025 | 0.0211 | <0.0010 |
| Zinc (Zn)-Total (mg/L) | 0.0080 | <0.0030 | 0.0078 | 0.0492 | 0.0068 |
| **Dissolved Metals** Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| Aluminum (Al)-Dissolved (mg/L) | <0.0030 | <0.0030 | 0.0092 | 0.0080 | <0.0030 |
| Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00015 | 0.00091 | <0.00010 |
| Arsenic (As)-Dissolved (mg/L) | <0.00010 | 0.00270 | 0.00020 | 0.00172 | 0.00094 |
| Barium (Ba)-Dissolved (mg/L) | 0.228 | 0.115 | 0.477 | 0.940 | 0.126 |
| Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| Boron (B)-Dissolved (mg/L) | <0.010 | 0.028 | 0.023 | 0.216 | 0.012 |
| Cadmium (Cd)-Dissolved (mg/L) | 0.000029 | 0.000016 | 0.000136 DTC | 0.000013 | <0.000010 |
| Calcium (Ca)-Dissolved (mg/L) | 72.3 | 78.3 | 71.4 | 29.9 | 52.8 |
| Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00025 | 0.00041 | 0.00145 | 0.00080 |
| Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00071 | <0.00050 | <0.00050 |
| Iron (Fe)-Dissolved (mg/L) | <0.030 | 0.854 | <0.030 | 0.057 | 0.967 |
| Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | 0.000083 | <0.000050 | <0.000050 |
| Lithium (Li)-Dissolved (mg/L) | 0.00421 | 0.00603 | 0.0209 | 0.111 | 0.00310 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1201465-6 | L1201465-7 | L1201465-8 | L1201465-9 | |
|---|---|---|---|---|---|
| Description | WATER | WATER | WATER | WATER | |
| Sampled Date | 22-AUG-12 | 22-AUG-12 | 21-AUG-12 | 21-AUG-12 | |
| Sampled Time | | | | | |
| Client ID | MW-H20 | MW-H17 | MW-H22 | X1 | |
| **Grouping** | **Analyte** | | | | |
| **WATER** | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 0.842 | 2.05 | 3.66 | 1.63 | |
| | Lead (Pb)-Total (mg/L) | 0.00126 | 0.00101 | 0.00188 | 0.000343 | |
| | Lithium (Li)-Total (mg/L) | 0.952 | 0.0186 | 0.00720 | 0.00401 | |
| | Magnesium (Mg)-Total (mg/L) | 0.706 | 23.2 | 24.3 | 15.2 | |
| | Manganese (Mn)-Total (mg/L) | 0.157 | 0.165 | 0.0735 | 1.21 | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | 0.000015 | <0.000010 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00609 | 0.00258 | 0.00183 | 0.00292 | |
| | Nickel (Ni)-Total (mg/L) | 0.00167 | 0.00574 | 0.00640 | 0.00174 | |
| | Phosphorus (P)-Total (mg/L) | 0.49 | <0.30 | <0.30 | <0.30 | |
| | Potassium (K)-Total (mg/L) | 0.913 | 1.93 | 1.59 | 0.938 | |
| | Selenium (Se)-Total (mg/L) | 0.00012 | 0.00030 | 0.00041 | 0.00029 | |
| | Silicon (Si)-Total (mg/L) | 5.11 | 7.32 | 11.7 | 3.85 | |
| | Silver (Ag)-Total (mg/L) | 0.000019 | 0.000020 | 0.000049 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | 316 | 17.8 | <2.0 | 42.7 | |
| | Strontium (Sr)-Total (mg/L) | 0.0877 | 0.209 | 0.142 | 0.134 | |
| | Thallium (Tl)-Total (mg/L) | 0.000019 | 0.000059 | 0.000156 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | 0.00026 | 0.00025 | 0.00017 | 0.00099 | |
| | Titanium (Ti)-Total (mg/L) | 0.030 | 0.042 | 0.148 | 0.019 | |
| | Uranium (U)-Total (mg/L) | 0.00443 | 0.00260 | 0.000617 | 0.00100 | |
| | Vanadium (V)-Total (mg/L) | 0.0050 | 0.0080 | 0.0108 | <0.0010 | |
| | Zinc (Zn)-Total (mg/L) | 0.0072 | 0.0145 | 0.0224 | 0.0067 | |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0185 | 0.0040 | 0.0074 | <0.0030 | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00012 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00152 | 0.00109 | 0.00012 | 0.00094 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.437 | 0.307 | 0.341 | 0.125 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Boron (B)-Dissolved (mg/L) | 0.180 | 0.016 | <0.010 | 0.012 | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | 0.000024 | 0.000021 | <0.000010 | |
| | Calcium (Ca)-Dissolved (mg/L) | 1.91 | 72.7 | 89.3 | 53.2 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00012 | <0.00010 | 0.00028 | <0.00010 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00012 | 0.00075 | 0.00010 | 0.00082 | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.164 | <0.030 | <0.030 | 0.958 | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000061 | <0.000050 | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | 1.11 | 0.0159 | 0.00467 | 0.00327 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1201465-1 | L1201465-2 | L1201465-3 | L1201465-4 | L1201465-5 |
|---|---|---|---|---|---|
| Description | WATER | WATER | WATER | WATER | WATER |
| Sampled Date | 21-AUG-12 | 22-AUG-12 | 22-AUG-12 | 22-AUG-12 | 21-AUG-12 |
| Sampled Time | | | | | |
| Client ID | MW-H23 | MW-H5 | MW-H18 | MW-H19 | MW-PNB |
| **Grouping** / **Analyte** | | | | | |
| **WATER** | | | | | |
| **Dissolved Metals** Magnesium (Mg)-Dissolved (mg/L) | 17.4 | 27.5 | 19.7 | 11.8 DTC | 15.0 |
| Manganese (Mn)-Dissolved (mg/L) | 0.00349 | 0.567 | 0.0431 | 0.310 | 1.13 |
| Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Molybdenum (Mo)-Dissolved (mg/L) | 0.000440 | 0.00136 | 0.000745 | 0.00537 | 0.00269 |
| Nickel (Ni)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00166 | 0.00499 | 0.00113 |
| Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| Potassium (K)-Dissolved (mg/L) | 0.637 | 0.931 | 0.953 | 1.67 | 0.854 |
| Selenium (Se)-Dissolved (mg/L) | 0.00044 | <0.00010 | 0.00047 | 0.00028 | 0.00037 |
| Silicon (Si)-Dissolved (mg/L) | 2.91 | 6.06 | 3.24 | 4.69 | 2.63 |
| Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Sodium (Na)-Dissolved (mg/L) | 2.2 | 13.8 | 11.3 | 83.9 | 40.9 |
| Strontium (Sr)-Dissolved (mg/L) | 0.115 | 0.338 | 0.388 | 0.795 DTC | 0.129 |
| Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00019 | 0.00017 |
| Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Uranium (U)-Dissolved (mg/L) | 0.000245 | 0.00122 | 0.000598 | 0.00253 | 0.000931 |
| Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | 0.0050 | <0.0030 | <0.0030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1201465-6 | L1201465-7 | L1201465-8 | L1201465-9 | |
|---|---|---|---|---|---|
| Description | WATER | WATER | WATER | WATER | |
| Sampled Date | 22-AUG-12 | 22-AUG-12 | 21-AUG-12 | 21-AUG-12 | |
| Sampled Time | | | | | |
| Client ID | MW-H20 | MW-H17 | MW-H22 | X1 | |
| **Grouping** / **Analyte** | | | | | |
| **WATER** | | | | | |
| **Dissolved Metals** Magnesium (Mg)-Dissolved (mg/L) | 0.618 | 19.3 | 24.0 | 15.2 | |
| Manganese (Mn)-Dissolved (mg/L) | 0.168 | 0.119 | 0.0268 | 1.12 | |
| Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| Molybdenum (Mo)-Dissolved (mg/L) | 0.00625 | 0.00241 | 0.00138 | 0.00269 | |
| Nickel (Ni)-Dissolved (mg/L) | 0.00065 | 0.00162 | 0.00072 | 0.00107 | |
| Phosphorus (P)-Dissolved (mg/L) | 0.50 | <0.30 | <0.30 | <0.30 | |
| Potassium (K)-Dissolved (mg/L) | 0.646 | 1.11 | 0.805 | 0.856 | |
| Selenium (Se)-Dissolved (mg/L) | 0.00014 | <0.00010 | 0.00034 | 0.00023 | |
| Silicon (Si)-Dissolved (mg/L) | 2.74 | 4.18 | 3.69 | 2.60 | |
| Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| Sodium (Na)-Dissolved (mg/L) | 339 | 17.0 | <2.0 | 40.1 | |
| Strontium (Sr)-Dissolved (mg/L) | 0.0849 | 0.219 | 0.141 | 0.129 | |
| Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000013 | <0.000010 | |
| Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00020 | |
| Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | |
| Uranium (U)-Dissolved (mg/L) | 0.00449 | 0.00241 | 0.000492 | 0.000940 | |
| Vanadium (V)-Dissolved (mg/L) | 0.0014 | <0.0010 | <0.0010 | <0.0010 | |
| Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 | |

* 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 | Barium (Ba)-Total | MS-B | L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| TMV | Turbidity exceeded upper limit of the nephelometric method. Minimum value reported. |

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.<br>OR<br>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

# Reference Information

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-TOT-COMBUST-VA** | Water | Total Nitrogen in Water by Combustion | BC: TN by Combustion/Chemiluminescence |

This analysis is carried out, on hydrochloric acid preserved samples, following Method BC MOE "Total and Dissolved Nitrogen (TN) by Combustion with Chemiluminescence Detection". Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-240019 10-240021

**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.*

**10-240019**

ALS Environmental

*L1201465-COFC*

Page 1 of 1

| Report To | | Service Request (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: Rescan | Standard: Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Rusto Martinka | Select: PDF X Excel X Digital Fax | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: 1111 W Hastings St Vancouver | Email 1: rmartinka@rescan.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | Email 2: | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: Fax: | | **Analysis Request** |
| **Invoice To** Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | ( Indicate Filtered or Preserved, F/P ) |
| Copy of Invoice with Report? (circle) Yes or No | Job #: 0791-007-24-12 | |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: Fax: | Quote #: | |
| **Lab Work Order #** (lab use only) L1201465 | **ALS Contact:** Amber **Sampler:** Rusto | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chem. | Total Metals | Diss. Metals | TOC | Nutrients | | | | | | | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ~~[redacted]~~ MW-H23 | 21-Aug-12 | | water | X | X | X | X | X | | | | | | | 5 |
| | MW-H5 | 22-Aug-12 | | | X | X | X | X | X | | | | | | | 5 |
| | MW-H18 | 22-Aug-12 | | | X | | | X | | | | | | | | 2 |
| | MW-H19 | 22-Aug-12 | | | X | | | X | | | | | | | | 2 |
| | MW-PN3 | 21-Aug-12 | | | X | X | X | X | X | | | | | | | 5 |
| | MW-H20 | 22-Aug-12 | | | X | X | | X | X | | | | | | | 4 |
| | MW-H17 | 22-Aug-12 | | | X | X | | | | | | | | | | 2 |
| | MW-H22 | 21-Aug-12 | | | X | X | X | X | X | | | | | | | 5 |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | X1 | 21-Aug-12 | | water | X | X | X | X | X | | | | | | | 5 |

Rush Processing

Short Holding Time

**Special Instructions / Regula... ... land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details**

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: Rusto Martinka | Date: 23-Aug-12 | Time: 11:30 | Received by: Britt | Date: Aug 29 | Time: 9:15 | Temperature: 11.3 °C | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

10-240021

ALS Environmental

*L12014 65-COFC*

cal Request Form
00 668 9878
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Page 1 of 1

| Report To | | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: Roscan | Standard: Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Rusto Martinka | Select: PDF X Excel X Digital Fax | Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: 111 W Hasting St. Vancouver | Email 1: rmartinka@roscan.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | Email 2: | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: Fax: | | |

| Invoice To | Same as Report ? (circle) Yes or No (if No, provide details) | Client / Project Information |
|---|---|---|
| | Copy of Invoice with Report? (circle) Yes or No | Job #: 0791-007-24-12 |
| Company: | | PO / AFE: |
| Contact: | | LSD: |
| Address: | | |
| Phone: | Fax: | Quote #: |

| Lab Work Order # (lab use only) | L12014 65 | ALS Contact: Amber | Sampler: Rusto |
|---|---|---|---|

Analysis Request (Indicate Filtered or Preserved, F/P)

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | F/P Diss. Metals | F/P Tot. Metals | F/P Nutrients | F/P TPC | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|
| | MW-H20 | 22-08-12 | | Water | X | | | | 1 |
| | MW-H19 | " | | " | X | X | X | | 3 |
| | MW-H17 | " | | " | X | | X | X | 3 |
| | MW-H18 | 22-08-11 | | Water | X | X | X | | 3 |
| | | | | | | | | | |
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Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

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

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: Rusto Martinka | Date: 23-Aug-12 | Time: 11:30 | Received by: Britt | Date: Aug 29 | Time: 9:25 | Temperature: 12.4 °C | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 30-OCT-12
Report Date: 08-NOV-12 10:44 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1230640**

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-007-24-13
C of C Numbers: 10-274123
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

| Grouping | Analyte | L1230640-1 WATER 22-OCT-12 MW-H24B | L1230640-2 WATER 22-OCT-12 MW-H25B | L1230640-3 WATER 25-OCT-12 MW-H18 | L1230640-4 WATER 25-OCT-12 MW-H19 | L1230640-5 WATER 25-OCT-12 MW-H17 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | 7.7 | <5.0 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 471 | 764 | 494 | 500 | 561 |
| | Hardness (as CaCO3) (mg/L) | 247 | 406 | 262 | 127 | 211 |
| | pH (pH) | 8.08 | 7.81 | 8.02 | 8.09 | 8.19 |
| | Total Suspended Solids (mg/L) | 141 | 1530 | 30.1 | 13.5 | 86.7 |
| | Turbidity (NTU) | 68.2 | 1920 | 17.2 | 7.23 | 84.2 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 6.3 | 14.6 | 5.4 | 3.8 | 2.6 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 276 | 436 | 273 | 284 | 295 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 276 | 436 | 273 | 284 | 295 |
| | Ammonia, Total (as N) (mg/L) | 0.0452 | 0.207 | 0.0417 | 0.304 | 0.0576 |
| | Bromide (Br) (mg/L) | <0.050 | <0.50 DLM | <0.050 | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | <0.50 | <5.0 DLM | 0.58 | 0.70 | <0.50 |
| | Fluoride (F) (mg/L) | 0.113 | <0.20 DLM | 0.214 | 0.269 | 0.177 |
| | Nitrate (as N) (mg/L) | 0.0435 | <0.050 DLM | 0.125 | <0.0050 | 0.0492 |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.010 DLM | 0.0011 | <0.0010 | 0.0033 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.086 | 0.790 | 0.054 | 0.340 | 0.227 |
| | Total Nitrogen (mg/L) | 0.130 | 0.790 | 0.180 | 0.340 | 0.280 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0015 | 0.0052 | <0.0010 | <0.0010 | 0.0022 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0035 | 0.0098 | <0.0020 | 0.0028 | 0.0035 |
| | Phosphorus (P)-Total (mg/L) | 0.104 | 1.27 | 0.0390 | 0.0640 | 0.123 |
| | Sulfate (SO4) (mg/L) | 5.46 | 29.2 | 19.3 | 14.5 | 49.3 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 3.22 | 11.4 | 2.44 | 4.98 | 6.09 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 1.67 | 20.4 | 0.192 | 0.0807 | 1.43 |
| | Antimony (Sb)-Total (mg/L) | 0.00096 | 0.00091 | 0.00022 | 0.00135 | 0.00107 |
| | Arsenic (As)-Total (mg/L) | 0.00072 | 0.0126 | 0.00029 | 0.00116 | 0.00583 |
| | Barium (Ba)-Total (mg/L) | 1.56 | 0.635 | 1.12 | 1.42 | 0.241 |
| | Beryllium (Be)-Total (mg/L) | 0.00011 | 0.00123 | <0.00010 | <0.00010 | 0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.015 | 0.032 | 0.020 | 0.256 | 0.022 |
| | Cadmium (Cd)-Total (mg/L) | 0.000156 | 0.00193 | 0.000029 | 0.000086 | 0.000085 |
| | Calcium (Ca)-Total (mg/L) | 78.1 | 170 | 71.2 | 32.3 | 61.7 |
| | Chromium (Cr)-Total (mg/L) | 0.00278 | 0.0327 | 0.00048 | 0.00047 | 0.00233 |
| | Cobalt (Co)-Total (mg/L) | 0.00237 | 0.0265 | 0.00039 | 0.00182 | 0.00156 |
| | Copper (Cu)-Total (mg/L) | 0.00299 | 0.0487 | 0.00101 | 0.00258 | 0.00436 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1230640-6 | L1230640-7 | | | |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | | | |
| | Sampled Date | 28-OCT-12 | 28-OCT-12 | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-H23 | MW-H22 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | | | |
| | Conductivity (uS/cm) | 430 | 576 | | | |
| | Hardness (as CaCO3) (mg/L) | 230 | 336 | | | |
| | pH (pH) | 8.11 | 8.03 | | | |
| | Total Suspended Solids (mg/L) | 48.8 | 847 | | | |
| | Turbidity (NTU) | 27.6 | 82.2 | | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 5.0 | 5.9 | | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 247 | 301 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 247 | 301 | | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | <0.0050 | | | |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | | | |
| | Chloride (Cl) (mg/L) | <0.50 | <0.50 | | | |
| | Fluoride (F) (mg/L) | 0.081 | 0.049 | | | |
| | Nitrate (as N) (mg/L) | 0.177 | 0.415 | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | | | |
| | Total Kjeldahl Nitrogen (mg/L) | 0.083 | <0.084 | | | |
| | Total Nitrogen (mg/L) | 0.260 | 0.420 | | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0014 | <0.0010 | | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | <0.0020 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.0563 | 0.111 | | | |
| | Sulfate (SO4) (mg/L) | 6.89 | 6.00 | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 2.46 | 2.99 | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.636 | 2.58 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00020 | 0.00034 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00083 | 0.00290 | | | |
| | Barium (Ba)-Total (mg/L) | 0.260 | 0.388 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | 0.00022 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | | | |
| | Boron (B)-Total (mg/L) | <0.010 | 0.012 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000247 | 0.000699 | | | |
| | Calcium (Ca)-Total (mg/L) | 70.3 | 194 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00143 | 0.00760 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00105 | 0.00269 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00211 | 0.00705 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1230640-1 WATER 22-OCT-12 MW-H24B | L1230640-2 WATER 22-OCT-12 MW-H25B | L1230640-3 WATER 25-OCT-12 MW-H18 | L1230640-4 WATER 25-OCT-12 MW-H19 | L1230640-5 WATER 25-OCT-12 MW-H17 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 2.59 | 37.9 | 0.233 | 0.142 | 2.57 |
| | Lead (Pb)-Total (mg/L) | 0.00182 | 0.0190 | 0.000180 | 0.000208 | 0.00172 |
| | Lithium (Li)-Total (mg/L) | 0.00394 | 0.0357 | 0.0148 | 0.121 | 0.0235 |
| | Magnesium (Mg)-Total (mg/L) | 20.6 | 47.8 | 19.8 | 12.1 | 14.8 |
| | Manganese (Mn)-Total (mg/L) | 0.101 | 1.12 | 0.0213 | 0.346 | 0.167 |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | 0.000053 | <0.000010 | <0.000010 | 0.000011 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00110 | 0.00457 | 0.000771 | 0.00398 | 0.00652 |
| | Nickel (Ni)-Total (mg/L) | 0.00606 | 0.0850 | 0.00202 | 0.00575 | 0.00749 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | 0.99 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 1.37 | 5.33 | 0.882 | 1.58 | 2.02 |
| | Selenium (Se)-Total (mg/L) | 0.00098 | 0.00212 | 0.00060 | 0.00064 | 0.00045 |
| | Silicon (Si)-Total (mg/L) | 6.45 | 66.7 | 3.88 | 4.54 | 7.12 |
| | Silver (Ag)-Total (mg/L) | 0.000046 | 0.000361 | <0.000010 | <0.000010 | 0.000029 |
| | Sodium (Na)-Total (mg/L) | 7.9 | 12.2 | 6.4 | 71.2 | 50.8 |
| | Strontium (Sr)-Total (mg/L) | 0.280 | 0.345 | 0.492 | 0.943 | 0.149 |
| | Thallium (Tl)-Total (mg/L) | 0.000061 | 0.000684 | 0.000012 | 0.000043 | 0.000070 |
| | Tin (Sn)-Total (mg/L) | 0.00018 | 0.00032 | 0.00029 | 0.00215 | 0.00050 |
| | Titanium (Ti)-Total (mg/L) | 0.059 | 0.887 | 0.017 | <0.010 | 0.022 |
| | Uranium (U)-Total (mg/L) | 0.000587 | 0.00543 | 0.000728 | 0.00177 | 0.00841 |
| | Vanadium (V)-Total (mg/L) | 0.0062 | 0.0721 | <0.0010 | <0.0010 | 0.0068 |
| | Zinc (Zn)-Total (mg/L) | 0.0136 | 0.165 | 0.0051 | 0.0057 | 0.0162 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | 0.0131 | <0.0030 | 0.0042 | 0.0034 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00095 | 0.00028 | 0.00017 | 0.00107 | 0.00069 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00024 | 0.00131 | 0.00019 | 0.00120 | 0.00305 |
| | Barium (Ba)-Dissolved (mg/L) | 1.08 | 0.291 | 1.06 | 1.46 | 0.163 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | 0.013 | 0.014 | 0.018 | 0.253 | 0.018 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000027 | 0.000142 | 0.000021 | 0.000022 | 0.000017 |
| | Calcium (Ca)-Dissolved (mg/L) | 69.8 | 109 | 72.1 | 31.4 | 60.7 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00011 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00077 | 0.00731 | 0.00024 | 0.00177 | 0.00061 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | 0.00082 | <0.00050 | 0.00065 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | 0.047 | <0.030 | <0.030 | <0.030 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.000071 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.00178 | 0.00757 | 0.0147 | 0.120 | 0.0217 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1230640-6 | L1230640-7 | | | |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | | | |
| | Sampled Date | 28-OCT-12 | 28-OCT-12 | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-H23 | MW-H22 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 1.28 | 6.06 | | | |
| | Lead (Pb)-Total (mg/L) | 0.000890 | 0.00353 | | | |
| | Lithium (Li)-Total (mg/L) | 0.00398 | 0.00791 | | | |
| | Magnesium (Mg)-Total (mg/L) | 16.8 | 46.3 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0355 | 0.217 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | 0.000013 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.000622 | 0.00171 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00338 | 0.0111 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | 0.76 | | | |
| | Potassium (K)-Total (mg/L) | 0.847 | 1.68 | | | |
| | Selenium (Se)-Total (mg/L) | 0.00048 | 0.00059 | | | |
| | Silicon (Si)-Total (mg/L) | 4.12 | 8.31 | | | |
| | Silver (Ag)-Total (mg/L) | 0.000014 | 0.000052 | | | |
| | Sodium (Na)-Total (mg/L) | 2.2 | <2.0 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.116 | 0.240 | | | |
| | Thallium (Tl)-Total (mg/L) | 0.000067 | 0.000173 | | | |
| | Tin (Sn)-Total (mg/L) | 0.00014 | 0.00051 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.026 | 0.062 | | | |
| | Uranium (U)-Total (mg/L) | 0.000304 | 0.00111 | | | |
| | Vanadium (V)-Total (mg/L) | 0.0032 | 0.0162 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0100 | 0.0331 | | | |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | <0.0030 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Dissolved (mg/L) | <0.00010 | 0.00012 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.249 | 0.315 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | | | |
| | Boron (B)-Dissolved (mg/L) | <0.010 | <0.010 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | 0.000015 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 66.3 | 97.4 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00013 | 0.00057 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | <0.030 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.00328 | 0.00394 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1230640-1 WATER 22-OCT-12 MW-H24B | L1230640-2 WATER 22-OCT-12 MW-H25B | L1230640-3 WATER 25-OCT-12 MW-H18 | L1230640-4 WATER 25-OCT-12 MW-H19 | L1230640-5 WATER 25-OCT-12 MW-H17 |
|---|---|---|---|---|---|---|
| | **Sample ID / Description / Sampled Date / Sampled Time / Client ID** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 17.8 | 32.7 | 20.0 | 11.8 | 14.5 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0546 | 0.549 | 0.0157 | 0.344 | 0.145 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000933 | 0.00274 | 0.000704 | 0.00392 | 0.00646 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00166 | 0.0204 | 0.00171 | 0.00534 | 0.00286 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.858 | 1.57 | 0.860 | 1.61 | 1.68 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00083 | 0.00138 | 0.00061 | 0.00060 | 0.00028 |
| | Silicon (Si)-Dissolved (mg/L) | 2.68 | 5.99 | 3.26 | 4.44 | 4.84 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 8.0 | 12.2 | 6.5 | 73.3 | 52.9 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.237 | 0.271 | 0.480 | 0.931 | 0.144 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | 0.000026 | <0.000010 | 0.000041 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00016 | 0.00197 | 0.00013 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.000413 | 0.00435 | 0.000711 | 0.00176 | 0.00794 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | 0.0033 | 0.0032 | 0.0033 | <0.0030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1230640-6 | L1230640-7 | | | |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | | | |
| | Sampled Date | 28-OCT-12 | 28-OCT-12 | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-H23 | MW-H22 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 15.5 | 22.4 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00324 | 0.00327 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000417 | 0.000813 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00056 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | | | |
| | Potassium (K)-Dissolved (mg/L) | 0.618 | 0.908 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00043 | 0.00046 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.87 | 3.85 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 2.2 | <2.0 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.109 | 0.139 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | 0.000013 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000235 | 0.000480 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | | | |

* 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) |
|---|---|---|---|
| Duplicate | Bromide (Br) | DLM | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Duplicate | Chloride (Cl) | DLM | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Duplicate | Fluoride (F) | DLM | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Duplicate | Nitrate (as N) | DLM | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Duplicate | Bromide (Br) | DLM | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Duplicate | Chloride (Cl) | DLM | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Nitrate (as N) | MS-B | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1230640-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Mercury (Hg)-Total | MS-B | L1230640-1, -2, -3, -4, -5, -6, -7 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

# Reference Information

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-TOT-COMBUST-VA** | Water | Total Nitrogen in Water by Combustion | BC: TN by Combustion/Chemiluminescence |

This analysis is carried out, on hydrochloric acid preserved samples, following Method BC MOE "Total and Dissolved Nitrogen (TN) by Combustion with Chemiluminescence Detection". Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-274123

**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.*

10-274123

ALS Environmental

L1230640-COFC

Form

Page 1 of 1

| Report To | Report Format / Distribution | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: Rescan Environmental | Standard: X Other (specify): | X (Regular) Standard Turnaround Times - Business Days) |
| Contact: Rusto Martinka | Select: PDF X Excel X Digital Fax | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: 111 W Hastings St Vancouver BC | Email 1: rmartinka@rescan.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | Email 2: | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: Fax: | | Analysis Request |
| Invoice To Same as Report ? (circle) Yes or No (if No, provide details) | Client / Project Information | ( Indicate Filtered or Preserved, F/P ) |
| Copy of Invoice with Report? (circle) Yes or No | Job #: 0791-007-24-13 | |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: Fax: | Quote #: | |
| Lab Work Order # (lab use only): L1230640 | ALS Contact: Amber | Sampler: Rusto |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Short Holding Time | Rush Processing | Number of Containers |
|---|---|---|---|---|---|---|---|
| ~~MW-H24~~ | MW-H24B | 22-Oct-12 | | Water | X | X | 5 |
| | MW-H25B | 22-Oct-12 | | | X | X | 5 |
| | MW-H18 | 25-Oct-12 | | | X | X | 5 |
| | MW-H19 | 25-Oct-12 | | | X | X | 5 |
| | MW-H17 | 25-Oct-12 | | | X | X | 5 |
| | MW-H23 | 28-Oct-12 | | | X | X | 5 |
| | MW-H22 | 28-Oct-12 | | Water | X | X | 5 |

| F/P | Short Holding Time | Rush Processing | Number of Containers |
|---|---|---|---|
| F | Coarse Grain. | X | 5 |
| F | TOC | X | 5 |
| F | Nutrients | X | 5 |
| F | Total Metals | X | 5 |
| F | Diss. Metals | X | 5 |

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

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

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: Rusto Martinka | Date: 29-Oct-12 | Time: 11:00 | Received by: Brittany | Date: Oct. 30 | Time: 8:25 | Temperature: 2.5 °C | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 06-NOV-12
Report Date: 16-NOV-12 16:06 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1233652**

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-007-24-13
C of C Numbers: 10-274122
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 | L1233652-1 | L1233652-2 | L1233652-3 | L1233652-4 | L1233652-5 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 30-OCT-12 | 29-OCT-12 | 30-OCT-12 | 01-NOV-12 | 01-NOV-12 |
| | Sampled Time | | | | | |
| | Client ID | MW-H26A | MW-H24A | MW-H26B | MW-H25A | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 12.4 | 8.5 | 8.9 | 7.6 | 7.7 |
| | Conductivity (uS/cm) | 2350 | 15300 | 760 | 1430 | 1420 |
| | Hardness (as CaCO3) (mg/L) | 358 | 1750 | 393 | 592 | 623 |
| | pH (pH) | 12.09 | 12.88 | 7.95 | 11.62 | 11.61 |
| | Total Suspended Solids (mg/L) | 157 | 123 | 164 | 129 | 155 |
| | Turbidity (NTU) | 60.7 | 64.0 | 115 | 18.4 | 24.5 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | <1.0 | 8.2 | <1.0 | <1.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | <1.0 | <5.0 | 331 | <1.0 | <1.0 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 76.8 | 208 | <2.0 | 43.5 | 56.7 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | 401 | 3960 | <2.0 | 164 | 146 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 478 | 4170 | 331 | 208 | 203 |
| | Ammonia, Total (as N) (mg/L) | 1.38 | 3.96 | 0.167 | 0.0451 | |
| | Bromide (Br) (mg/L) | <1.0 DLM | <5.0 DLM | <0.50 DLM | <1.0 DLM | <1.0 DLM |
| | Chloride (Cl) (mg/L) | <10 DLM | <50 DLM | <5.0 DLM | <10 DLM | <10 DLM |
| | Fluoride (F) (mg/L) | 0.45 | <2.0 DLM | 0.28 | 0.41 | 0.41 |
| | Nitrate (as N) (mg/L) | <0.10 DLM | <0.50 DLM | 0.371 | 0.10 | 0.12 |
| | Nitrite (as N) (mg/L) | <0.020 DLM | <0.10 DLM | <0.010 DLM | <0.020 DLM | <0.020 DLM |
| | Total Kjeldahl Nitrogen (mg/L) | 1.59 | 4.87 | 0.56 | 0.359 | |
| | Total Nitrogen (mg/L) | 1.59 | 4.87 | 0.930 | 0.460 | 0.500 |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | 0.0012 | <0.0010 | <0.0010 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0099 | 0.0038 | 0.0053 | 0.0027 | 0.0028 |
| | Phosphorus (P)-Total (mg/L) | 0.0798 | 0.0347 | 0.191 | 0.0198 | 0.0293 |
| | Sulfate (SO4) (mg/L) | 179 | <50 DLM | 125 | 390 | 393 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 14.5 | 21.0 | 6.16 | 7.01 | 8.17 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 1.41 | 1.85 | 3.01 | 1.03 | 1.26 |
| | Antimony (Sb)-Total (mg/L) | 0.00211 | 0.00178 | 0.00104 | 0.00268 | 0.00281 |
| | Arsenic (As)-Total (mg/L) | 0.00348 | 0.00198 | 0.00384 | 0.00331 | 0.00381 |
| | Barium (Ba)-Total (mg/L) | 0.531 | 6.94 | 0.174 | 0.350 | 0.410 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00050 DLA | 0.00019 | <0.00020 DLA | <0.00020 DLA |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.0025 DLA | <0.00050 | <0.0010 DLA | <0.0010 DLA |
| | Boron (B)-Total (mg/L) | 0.042 | <0.050 DLA | 0.081 | <0.020 DLA | <0.020 DLA |
| | Cadmium (Cd)-Total (mg/L) | <0.00013 DLM | 0.000061 | 0.000409 | 0.000072 | 0.000083 |
| | Calcium (Ca)-Total (mg/L) | 149 | 711 | 112 | 246 | 247 |
| | Chromium (Cr)-Total (mg/L) | 0.0756 | 0.0521 | 0.00830 | 0.0619 | 0.0696 |
| | Cobalt (Co)-Total (mg/L) | 0.00118 | 0.00187 | 0.0145 | 0.00083 | 0.00101 |
| | Copper (Cu)-Total (mg/L) | 0.0573 | 0.0200 | 0.0273 | 0.0424 | 0.0526 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1233652-1 | L1233652-2 | L1233652-3 | L1233652-4 | L1233652-5 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 30-OCT-12 | 29-OCT-12 | 30-OCT-12 | 01-NOV-12 | 01-NOV-12 |
| | Sampled Time | | | | | |
| | Client ID | MW-H26A | MW-H24A | MW-H26B | MW-H25A | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 2.26 | 1.51 | 6.39 | 1.83 | 2.07 |
| | Lead (Pb)-Total (mg/L) | 0.00251 | 0.00313 | 0.00434 | 0.00256 | 0.00355 |
| | Lithium (Li)-Total (mg/L) | 0.182 | 0.238 | 0.0160 | 0.0159 | 0.0160 |
| | Magnesium (Mg)-Total (mg/L) | 1.23 | 0.569 | 30.7 | 0.976 | 1.18 |
| | Manganese (Mn)-Total (mg/L) | 0.0529 | 0.0484 | 0.938 | 0.0555 | 0.0679 |
| | Mercury (Hg)-Total (mg/L) | 0.000010 | <0.000010 | 0.000013 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.153 | 0.0253 | 0.00512 | 0.0181 | 0.0183 |
| | Nickel (Ni)-Total (mg/L) | 0.00354 | <0.0025 DLA | 0.0443 | 0.0030 | 0.0037 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 8.93 | 100 | 5.72 | 5.72 | 6.49 |
| | Selenium (Se)-Total (mg/L) | 0.00230 | 0.00073 | 0.00394 | 0.00130 | 0.00131 |
| | Silicon (Si)-Total (mg/L) | 23.9 | 7.48 | 12.5 | 40.9 | 43.1 |
| | Silver (Ag)-Total (mg/L) | 0.000088 | 0.000120 | 0.000102 | 0.000106 | 0.000147 |
| | Sodium (Na)-Total (mg/L) | 152 | 899 | 47.3 | 30.4 | 32.0 |
| | Strontium (Sr)-Total (mg/L) | 0.711 | 27.2 | 0.331 | 0.846 | 0.885 |
| | Thallium (Tl)-Total (mg/L) | 0.000020 | <0.000050 DLA | 0.000129 | <0.000020 DLA | <0.000020 DLA |
| | Tin (Sn)-Total (mg/L) | 0.00343 | 0.00443 | 0.0163 | 0.00320 | 0.00404 |
| | Titanium (Ti)-Total (mg/L) | 0.077 | 0.075 | 0.121 | 0.050 | 0.051 |
| | Uranium (U)-Total (mg/L) | 0.000252 | 0.000246 | 0.00564 | 0.000269 | 0.000289 |
| | Vanadium (V)-Total (mg/L) | 0.0196 | <0.0050 DLA | 0.0096 | 0.0244 | 0.0276 |
| | Zinc (Zn)-Total (mg/L) | 0.0569 | 0.068 | 0.0669 | 0.0968 | 0.121 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | LAB | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0573 | 0.054 | 0.0118 | 0.0166 | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00119 | <0.00050 DLA | 0.00072 | 0.00176 | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00211 | <0.00050 DLA | 0.00096 | 0.00276 | |
| | Barium (Ba)-Dissolved (mg/L) | 0.473 | 6.91 | 0.0947 | 0.392 | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00050 DLA | <0.00010 | <0.00020 DLA | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.0025 DLA | <0.00050 | <0.0010 DLA | |
| | Boron (B)-Dissolved (mg/L) | 0.037 | <0.050 DLA | 0.069 | <0.020 DLA | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000050 DLM | <0.000050 DLA | 0.000236 | <0.000020 DLA | |
| | Calcium (Ca)-Dissolved (mg/L) | 143 | 701 | 107 | 237 | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.0764 | 0.0470 | 0.00101 | 0.0649 | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00012 | 0.00058 | 0.0123 | <0.00020 DLA | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00708 | 0.0047 | 0.00645 | 0.0025 | |
| | Iron (Fe)-Dissolved (mg/L) | 0.034 | <0.030 | <0.030 | <0.030 | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000099 | 0.00156 | 0.000077 | <0.00010 DLA | |
| | Lithium (Li)-Dissolved (mg/L) | 0.185 | 0.244 | 0.0133 | 0.0157 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1233652-1 | L1233652-2 | L1233652-3 | L1233652-4 | L1233652-5 |
|---|---|---|---|---|---|---|
| | Description | WATER | WATER | WATER | WATER | WATER |
| | Sampled Date | 30-OCT-12 | 29-OCT-12 | 30-OCT-12 | 01-NOV-12 | 01-NOV-12 |
| | Sampled Time | | | | | |
| | Client ID | MW-H26A | MW-H24A | MW-H26B | MW-H25A | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 0.123 | 0.040 | 30.5 | 0.225 | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00123 | <0.00025 DLA | 0.892 | 0.00027 | |
| | Mercury (Hg)-Dissolved (mg/L) | 0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.156 | 0.0242 | 0.00438 | 0.0172 | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00090 | <0.0025 DLA | 0.0388 | 0.0013 | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | |
| | Potassium (K)-Dissolved (mg/L) | 9.44 | 101 | 5.25 | 6.70 | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00238 | 0.00063 | 0.00404 | 0.00125 | |
| | Silicon (Si)-Dissolved (mg/L) | 17.6 | 0.132 | 5.88 | 40.1 | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000050 DLA | <0.000010 | <0.000020 DLA | |
| | Sodium (Na)-Dissolved (mg/L) | 156 | 898 | 49.9 | 32.6 | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.708 | 26.3 | 0.332 | 0.842 | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000050 DLA | 0.000046 | <0.000020 DLA | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00067 | 0.00095 | 0.0114 | 0.00052 | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | |
| | Uranium (U)-Dissolved (mg/L) | <0.000010 | <0.000050 DLA | 0.00543 | <0.000020 DLA | |
| | Vanadium (V)-Dissolved (mg/L) | 0.0158 | <0.0050 DLA | <0.0010 | 0.0258 | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0031 | 0.016 | 0.0194 | <0.0060 DLA | |

* 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) |
|---|---|---|---|
| Duplicate | Bromide (Br) | DLM | L1233652-1, -2, -3, -4, -5 |
| Duplicate | Bromide (Br) | DLM | L1233652-1, -2, -3, -4, -5 |
| Duplicate | Nitrate (as N) | DLM | L1233652-1, -2, -3, -4, -5 |
| Duplicate | Bromide (Br) | DLM | L1233652-1, -2, -3, -4, -5 |
| Matrix Spike | Orthophosphate-Dissolved (as P) | MS-B | L1233652-1, -2, -3, -4, -5 |
| Matrix Spike | Phosphorus (P)-Total | MS-B | L1233652-1, -2, -3, -4, -5 |
| Matrix Spike | Phosphorus (P)-Total Dissolved | MS-B | L1233652-1, -2, -3, -4, -5 |
| Matrix Spike | Phosphorus (P)-Total | MS-B | L1233652-1, -2, -3, -4, -5 |
| Matrix Spike | Phosphorus (P)-Total Dissolved | MS-B | L1233652-1, -2, -3, -4, -5 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1233652-1, -3, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1233652-2 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1233652-2 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1233652-2 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1233652-2 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1233652-2 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1233652-2 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1233652-2 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1233652-2 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United

# Reference Information

States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**N-TOT-COMBUST-VA** Water Total Nitrogen in Water by Combustion BC: TN by Combustion/Chemiluminescence

This analysis is carried out, on hydrochloric acid preserved samples, following Method BC MOE "Total and Dissolved Nitrogen (TN) by Combustion with Chemiluminescence Detection". Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation.

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**P-T-COL-VA** Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

**P-TD-COL-VA** Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PO4-DO-COL-VA** Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**TKN-CALC-VA** Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

**TSS-VA** Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-274122

# Reference Information

**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.*

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 22-DEC-12
Report Date: 08-JAN-13 12:57 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1252558**

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-24-14
C of C Numbers: 10-033695
Legal Site Desc:

Amber Springer
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1252558-1 water 20-DEC-12 MW-H17 | L1252558-2 water 20-DEC-12 MW-H18 | L1252558-3 water 20-DEC-12 MW-H19 | L1252558-4 water 20-DEC-12 MW-H24A | L1252558-5 water 19-DEC-12 MW-H22 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | 9.6 | <5.0 |
| | Conductivity (uS/cm) | 548 | 503 | 494 | 11500 | 544 |
| | Hardness (as CaCO3) (mg/L) | 227 | 264 | 136 | 1220 | 339 |
| | pH (pH) | 8.13 | 8.00 | 8.27 | 12.63 | 8.10 |
| | Total Suspended Solids (mg/L) | 66.7 | 151 | <3.0 | 205 | 108 |
| | Turbidity (NTU) | 107 | 40.1 | 5.86 | 171 | 61.0 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 3.9 | 6.6 | <1.0 | <1.0 | 5.3 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 282 | 266 | 287 | <13 | 343 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | 1410 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | 1710 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 282 | 266 | 287 | 3120 | 343 |
| | Ammonia, Total (as N) (mg/L) | 0.0206 | 0.0299 | 0.384 | 6.24 | <0.0050 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <2.5 DLM | <0.050 |
| | Chloride (Cl) (mg/L) | 0.52 | 0.52 | 0.69 | <25 DLM | <0.50 |
| | Fluoride (F) (mg/L) | 0.155 | 0.210 | 0.250 | <1.0 DLM | 0.052 |
| | Nitrate (as N) (mg/L) | 0.113 | 0.215 | <0.0050 | 0.42 | 0.489 |
| | Nitrite (as N) (mg/L) | <0.0010 | 0.0026 | <0.0010 | <0.050 DLM | 0.0012 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.166 | <0.051 | 0.626 | 94.0 | <0.093 |
| | Total Nitrogen (mg/L) | 0.279 | 0.254 | 0.626 | 94.4 | 0.464 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0053 | 0.0040 | 0.0067 | <0.10 DLM | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0058 | 0.0041 | 0.0086 | 0.0058 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.137 | 0.125 | 0.0240 | 0.0326 | 0.0911 |
| | Sulfate (SO4) (mg/L) | 35.1 | 24.2 | 13.6 | <25 DLM | 5.44 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 3.87 | 1.66 | 2.84 | 25.7 | 0.90 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.734 | 0.0567 | 0.0341 | 0.999 | 0.434 |
| | Antimony (Sb)-Total (mg/L) | 0.00065 | 0.00015 | 0.00087 | 0.00126 | 0.00011 |
| | Arsenic (As)-Total (mg/L) | 0.00361 | 0.00015 | 0.00136 | 0.00123 | 0.00053 |
| | Barium (Ba)-Total (mg/L) | 0.204 | 0.898 | 1.53 | 6.76 | 0.294 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00050 DLA | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.0025 DLA | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.012 | 0.017 | 0.228 | <0.050 DLA | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.000071 | 0.000026 | 0.000030 | 0.000064 | 0.000069 |
| | Calcium (Ca)-Total (mg/L) | 62.2 | 70.9 | 32.9 | 492 | 96.4 |
| | Chromium (Cr)-Total (mg/L) | 0.00148 | 0.00019 | 0.00022 | 0.0363 | 0.00221 |
| | Cobalt (Co)-Total (mg/L) | 0.00144 | 0.00029 | 0.00193 | 0.00099 | 0.00035 |
| | Copper (Cu)-Total (mg/L) | 0.00427 | 0.00169 | 0.00151 | 0.0176 | 0.00226 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1252558-6 | L1252558-7 | L1252558-8 | L1252558-9 | L1252558-10 |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | water |
| | Sampled Date | 19-DEC-12 | 19-DEC-12 | 19-DEC-12 | 19-DEC-12 | 20-DEC-12 |
| | Sampled Time | | | | | |
| | Client ID | MW-H23 | MW-H24B | MW-H25B | MW-H26B | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | 12.8 | <5.0 |
| | Conductivity (uS/cm) | 434 | 459 | 612 | 982 | 554 |
| | Hardness (as CaCO3) (mg/L) | 248 | 248 | 345 | 378 | 230 |
| | pH (pH) | 8.12 | 8.10 | 8.12 | 8.05 | 8.23 |
| | Total Suspended Solids (mg/L) | 247 | 594 | 36.0 | 810 | 78.0 |
| | Turbidity (NTU) | 161 | 168 | 132 | 347 | 124 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 4.2 | 4.6 | 5.8 | 6.4 | 2.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 255 | 277 | 363 | 343 | 290 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 255 | 277 | 363 | 343 | 290 |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.0071 | 0.0780 | 0.0946 | 0.0211 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <0.50 DLM | <0.050 |
| | Chloride (Cl) (mg/L) | <0.50 | <0.50 | 2.47 | 9.3 | <0.50 |
| | Fluoride (F) (mg/L) | 0.076 | 0.094 | 0.188 | <0.20 DLM | 0.155 |
| | Nitrate (as N) (mg/L) | 0.245 | 0.0051 | 0.0098 | <0.050 DLM | 0.112 |
| | Nitrite (as N) (mg/L) | 0.0023 | 0.0072 | 0.0012 | 0.013 | <0.0010 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.110 | 0.232 | 0.250 | 0.737 | 0.202 |
| | Total Nitrogen (mg/L) | 0.357 | 0.244 | 0.261 | 0.751 | 0.315 |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0182 | 0.0051 |
| | Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | <0.0020 | <0.0020 | 0.0259 | 0.0051 |
| | Phosphorus (P)-Total (mg/L) | 0.198 | 0.327 | 0.080 | 0.610 | 0.124 |
| | Sulfate (SO4) (mg/L) | 6.82 | 4.44 | 8.02 | 223 | 35.5 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 3.56 | 2.08 | 4.01 | 9.25 | 3.45 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 2.60 | 2.03 | 2.11 | 3.06 | 0.880 |
| | Antimony (Sb)-Total (mg/L) | 0.00069 | 0.00040 | 0.00028 | 0.00115 | 0.00067 |
| | Arsenic (As)-Total (mg/L) | 0.00443 | 0.00117 | 0.00224 | 0.00321 | 0.00366 |
| | Barium (Ba)-Total (mg/L) | 0.332 | 1.34 | 0.244 | 0.131 | 0.208 |
| | Beryllium (Be)-Total (mg/L) | 0.00017 | 0.00014 | 0.00012 | 0.00030 | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.011 | 0.012 | 0.018 | 0.069 | 0.014 |
| | Cadmium (Cd)-Total (mg/L) | 0.00126 | 0.000346 | 0.000151 | 0.000358 | 0.000071 |
| | Calcium (Ca)-Total (mg/L) | 87.9 | 80.7 | 89.3 | 102 | 67.1 |
| | Chromium (Cr)-Total (mg/L) | 0.00645 | 0.00542 | 0.00325 | 0.00402 | 0.00158 |
| | Cobalt (Co)-Total (mg/L) | 0.00505 | 0.00260 | 0.00320 | 0.00814 | 0.00146 |
| | Copper (Cu)-Total (mg/L) | 0.00957 | 0.0215 | 0.00415 | 0.0208 | 0.00404 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | Sample ID: L1252558-1 | L1252558-2 | L1252558-3 | L1252558-4 | L1252558-5 |
|---|---|---|---|---|---|---|
| | Description: | water | water | water | water | water |
| | Sampled Date: | 20-DEC-12 | 20-DEC-12 | 20-DEC-12 | 20-DEC-12 | 19-DEC-12 |
| | Sampled Time: | | | | | |
| | Client ID: | MW-H17 | MW-H18 | MW-H19 | MW-H24A | MW-H22 |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 1.36 | 0.068 | 0.052 | 0.726 | 0.896 |
| | Lead (Pb)-Total (mg/L) | 0.00105 | 0.000073 | 0.000073 | 0.00242 | 0.000490 |
| | Lithium (Li)-Total (mg/L) | 0.0143 | 0.0123 | 0.114 | 0.203 | 0.00473 |
| | Magnesium (Mg)-Total (mg/L) | 16.0 | 20.6 | 13.0 | 0.286 | 22.7 |
| | Manganese (Mn)-Total (mg/L) | 0.222 | 0.00961 | 0.358 | 0.0251 | 0.0183 |
| | Mercury (Hg)-Total (mg/L) | 0.000013 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00384 | 0.000695 | 0.00396 | 0.0210 | 0.000834 |
| | Nickel (Ni)-Total (mg/L) | 0.00598 | 0.00198 | 0.00550 | <0.0025 DLA | 0.00171 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 1.60 | 0.836 | 1.67 | 69.3 | 1.11 |
| | Selenium (Se)-Total (mg/L) | 0.00041 | 0.00063 | 0.00029 | 0.00063 | 0.00049 |
| | Silicon (Si)-Total (mg/L) | 5.57 | 3.28 | 4.51 | 3.27 | 4.44 |
| | Silver (Ag)-Total (mg/L) | 0.000030 | <0.000010 | <0.000010 | 0.000075 | 0.000011 |
| | Sodium (Na)-Total (mg/L) | 32.9 | 5.4 | 71.7 | 800 | <2.0 |
| | Strontium (Sr)-Total (mg/L) | 0.139 | 0.442 | 0.980 | 21.9 | 0.137 |
| | Thallium (Tl)-Total (mg/L) | 0.000040 | <0.000010 | 0.000025 | <0.000050 DLA | 0.000035 |
| | Tin (Sn)-Total (mg/L) | 0.00041 | <0.00010 | 0.00112 | 0.00628 | 0.00040 |
| | Titanium (Ti)-Total (mg/L) | 0.016 | 0.010 | <0.010 | 0.049 | 0.025 |
| | Uranium (U)-Total (mg/L) | 0.00494 | 0.000561 | 0.00172 | 0.000114 | 0.000498 |
| | Vanadium (V)-Total (mg/L) | 0.0043 | <0.0010 | <0.0010 | <0.0050 DLA | 0.0022 |
| | Zinc (Zn)-Total (mg/L) | 0.0158 | 0.0053 | 0.0079 | 0.041 | 0.0081 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | <0.0030 | <0.0030 | 0.025 | <0.0030 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00050 | 0.00015 | 0.00078 | <0.00050 DLA | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00183 | 0.00012 | 0.00126 | <0.00050 DLA | 0.00015 |
| | Barium (Ba)-Dissolved (mg/L) | 0.184 | 0.920 | 1.56 | 6.96 | 0.310 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00050 DLA | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.0025 DLA | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | 0.013 | 0.020 | 0.241 | <0.050 DLA | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000028 | 0.000023 | 0.000018 | <0.000050 DLA | 0.000014 |
| | Calcium (Ca)-Dissolved (mg/L) | 65.1 | 71.7 | 32.9 | 490 | 95.6 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00012 | 0.0352 | 0.00065 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00026 | 0.00021 | 0.00184 | <0.00050 DLA | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00086 | 0.00065 | 0.00093 | 0.0050 | 0.00064 |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.00127 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.0147 | 0.0129 | 0.118 | 0.215 | 0.00414 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1252558-6 | L1252558-7 | L1252558-8 | L1252558-9 | L1252558-10 |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | water |
| | Sampled Date | 19-DEC-12 | 19-DEC-12 | 19-DEC-12 | 19-DEC-12 | 20-DEC-12 |
| | Sampled Time | | | | | |
| | Client ID | MW-H23 | MW-H24B | MW-H25B | MW-H26B | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 6.35 | 3.74 | 2.75 | 4.22 | 1.33 |
| | Lead (Pb)-Total (mg/L) | 0.00435 | 0.00346 | 0.00139 | 0.00389 | 0.00109 |
| | Lithium (Li)-Total (mg/L) | 0.00637 | 0.00391 | 0.00889 | 0.0111 | 0.0154 |
| | Magnesium (Mg)-Total (mg/L) | 22.9 | 21.2 | 31.1 | 34.9 | 16.2 |
| | Manganese (Mn)-Total (mg/L) | 0.166 | 0.116 | 0.823 | 1.12 | 0.221 |
| | Mercury (Hg)-Total (mg/L) | 0.000022 | 0.000016 | <0.000010 | 0.000015 | 0.000014 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00183 | 0.00113 | 0.00341 | 0.00721 | 0.00401 |
| | Nickel (Ni)-Total (mg/L) | 0.0147 | 0.00827 | 0.00851 | 0.0223 | 0.00606 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 1.60 | 1.58 | 1.66 | 4.29 | 1.67 |
| | Selenium (Se)-Total (mg/L) | 0.00098 | 0.00036 | 0.00021 | 0.00083 | 0.00040 |
| | Silicon (Si)-Total (mg/L) | 8.20 | 5.72 | 13.7 | 14.0 | 6.00 |
| | Silver (Ag)-Total (mg/L) | 0.000066 | 0.000077 | 0.000029 | 0.000065 | 0.000032 |
| | Sodium (Na)-Total (mg/L) | 2.6 | 6.6 | 11.6 | 83.4 | 33.8 |
| | Strontium (Sr)-Total (mg/L) | 0.125 | 0.216 | 0.270 | 0.345 | 0.143 |
| | Thallium (Tl)-Total (mg/L) | 0.000314 | 0.000086 | 0.000074 | 0.000091 | 0.000042 |
| | Tin (Sn)-Total (mg/L) | 0.00055 | 0.00119 | <0.00010 | 0.00155 | 0.00047 |
| | Titanium (Ti)-Total (mg/L) | 0.081 | 0.044 | 0.143 | 0.099 | 0.023 |
| | Uranium (U)-Total (mg/L) | 0.000516 | 0.000663 | 0.00286 | 0.0129 | 0.00511 |
| | Vanadium (V)-Total (mg/L) | 0.0146 | 0.0071 | 0.0081 | 0.0053 | 0.0045 |
| | Zinc (Zn)-Total (mg/L) | 0.0493 | 0.0571 | 0.0159 | 0.0458 | 0.0161 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | 0.0048 | <0.0030 | 0.0066 | <0.0030 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | 0.00014 | 0.00017 | 0.00098 | 0.00048 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00012 | 0.00028 | 0.00130 | 0.00117 | 0.00196 |
| | Barium (Ba)-Dissolved (mg/L) | 0.253 | 0.699 | 0.220 | 0.0759 | 0.189 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.011 | 0.017 | 0.070 | 0.014 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000016 | 0.000045 | 0.000029 | 0.000071 | 0.000027 |
| | Calcium (Ca)-Dissolved (mg/L) | 69.1 | 69.5 | 89.3 | 97.6 | 65.0 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00015 | 0.00032 | <0.00010 | 0.00017 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00022 | 0.00055 | 0.00204 | 0.00554 | 0.00026 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00052 | 0.00104 | <0.00050 | 0.00239 | 0.00074 |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | 0.043 | <0.030 | <0.030 | <0.030 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | 0.000052 | <0.000050 | 0.000104 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.00349 | 0.00143 | 0.00713 | 0.00925 | 0.0149 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1252558-1 water 20-DEC-12 MW-H17 | L1252558-2 water 20-DEC-12 MW-H18 | L1252558-3 water 20-DEC-12 MW-H19 | L1252558-4 water 20-DEC-12 MW-H24A | L1252558-5 water 19-DEC-12 MW-H22 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 15.7 | 20.6 | 13.2 | 0.032 DLA | 24.4 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0665 | 0.00796 | 0.364 | <0.00025 DLA | 0.00393 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00379 | 0.000699 | 0.00381 | 0.0214 | 0.000778 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00266 | 0.00176 | 0.00538 | <0.0025 DLA | 0.00057 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 1.44 | 0.837 | 1.73 | 72.5 | 1.00 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00026 | 0.00066 | 0.00022 | 0.00060 | 0.00052 |
| | Silicon (Si)-Dissolved (mg/L) | 4.34 | 3.14 | 4.37 | 0.254 | 3.74 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000050 DLA | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 32.2 | 5.3 | 70.0 | 883 | <2.0 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.139 | 0.435 | 0.943 | 22.3 | 0.133 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000024 | <0.000050 DLA | 0.000015 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00056 | 0.00383 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | 0.016 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.00509 | 0.000599 | 0.00167 | <0.000050 DLA | 0.000506 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0050 DLA | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | 0.0059 | <0.015 DLA | <0.0030 |
| **Aggregate Organics** | COD (mg/L) | <20 | <20 | <20 | 110 | <20 |
| | Phenols (4AAP) (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0040 | <0.0010 |
| **Polycyclic Aromatic Hydrocarbons** | Acenaphthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Acenaphthylene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Acridine (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Benz(a)anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Benzo(a)pyrene (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Benzo(b)fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Benzo(g,h,i)perylene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Benzo(k)fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Chrysene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Dibenz(a,h)anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Fluorene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Indeno(1,2,3-c,d)pyrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Naphthalene (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000415 | <0.000050 |
| | Phenanthrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1252558-6 water 19-DEC-12 MW-H23 | L1252558-7 water 19-DEC-12 MW-H24B | L1252558-8 water 19-DEC-12 MW-H25B | L1252558-9 water 19-DEC-12 MW-H26B | L1252558-10 water 20-DEC-12 X1 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 18.4 | 18.2 | 29.5 | 32.7 | 16.5 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0254 | 0.0596 | 0.805 | 1.02 | 0.0678 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000686 | 0.000610 | 0.00317 | 0.00676 | 0.00377 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00062 | 0.00099 | 0.00408 | 0.0152 | 0.00282 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.747 | 1.06 | 1.00 | 3.83 | 1.50 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00058 | <0.00010 | 0.00012 | 0.00061 | 0.00025 |
| | Silicon (Si)-Dissolved (mg/L) | 2.81 | 2.80 | 5.49 | 6.76 | 4.38 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 2.5 | 6.5 | 11.5 | 86.3 | 33.7 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.106 | 0.180 | 0.274 | 0.329 | 0.144 |
| | Thallium (Tl)-Dissolved (mg/L) | 0.000010 | <0.000010 | <0.000010 | 0.000011 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | 0.00013 | <0.00010 | 0.00027 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | 0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.000303 | 0.000519 | 0.00267 | 0.0117 | 0.00497 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | 0.0077 | <0.0030 | 0.0099 | <0.0030 |
| **Aggregate Organics** | COD (mg/L) | <20 | 46 | 22 | 41 | <20 |
| | Phenols (4AAP) (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| **Polycyclic Aromatic Hydrocarbons** | Acenaphthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Acenaphthylene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Acridine (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Benz(a)anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Benzo(a)pyrene (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Benzo(b)fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Benzo(g,h,i)perylene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Benzo(k)fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Chrysene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Dibenz(a,h)anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Fluorene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Indeno(1,2,3-c,d)pyrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Naphthalene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Phenanthrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1252558-1 | L1252558-2 | L1252558-3 | L1252558-4 | L1252558-5 |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | water |
| | Sampled Date | 20-DEC-12 | 20-DEC-12 | 20-DEC-12 | 20-DEC-12 | 19-DEC-12 |
| | Sampled Time | | | | | |
| | Client ID | MW-H17 | MW-H18 | MW-H19 | MW-H24A | MW-H22 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | Pyrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Quinoline (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Surrogate: Acenaphthene d10 (%) | 95.3 | 91.3 | 87.1 | 90.6 | 93.0 |
| | Surrogate: Acridine d9 (%) | 94.9 | 89.3 | 88.8 | 89.4 | 86.9 |
| | Surrogate: Chrysene d12 (%) | 97.2 | 92.7 | 91.6 | 95.2 | 93.8 |
| | Surrogate: Naphthalene d8 (%) | 95.2 | 90.7 | 84.9 | 94.0 | 93.3 |
| | Surrogate: Phenanthrene d10 (%) | 101.8 | 97.2 | 93.9 | 97.5 | 98.4 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1252558-6 | L1252558-7 | L1252558-8 | L1252558-9 | L1252558-10 |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | water |
| | Sampled Date | 19-DEC-12 | 19-DEC-12 | 19-DEC-12 | 19-DEC-12 | 20-DEC-12 |
| | Sampled Time | | | | | |
| | Client ID | MW-H23 | MW-H24B | MW-H25B | MW-H26B | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | Pyrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Quinoline (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Surrogate: Acenaphthene d10 (%) | 92.1 | 101.2 | 94.3 | 89.5 | 95.9 |
| | Surrogate: Acridine d9 (%) | 91.0 | 92.0 | 94.3 | 90.1 | 95.0 |
| | Surrogate: Chrysene d12 (%) | 93.4 | 93.5 | 96.7 | 92.7 | 96.2 |
| | Surrogate: Naphthalene d8 (%) | 93.7 | 92.5 | 94.4 | 90.5 | 95.3 |
| | Surrogate: Phenanthrene d10 (%) | 98.4 | 101.5 | 101.4 | 97.5 | 102.8 |

* 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) |
|---|---|---|---|
| Duplicate | Bromide (Br) | DLM | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Chloride (Cl) | DLM | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Fluoride (F) | DLM | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Nitrite (as N) | DLM | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Bromide (Br) | DLM | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Chloride (Cl) | DLM | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Fluoride (F) | DLM | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Nitrite (as N) | DLM | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Nitrate (as N) | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Nitrate (as N) | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Phosphorus (P)-Total | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-MAN-VA** | Water | Alkalinity (Species) by Manual Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

# Reference Information

**ANIONS-NO2-IC-VA** Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

**ANIONS-NO3-IC-VA** Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

**ANIONS-SO4-IC-VA** Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**CARBONS-TOC-VA** Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

**COD-COL-VA** Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**EC-PCT-VA** Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**HARDNESS-CALC-VA** Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

# Reference Information

| | | | |
|---|---|---|---|
| **N-T-COL-VA** | Water | Total Nitrogen in water by Colour | USGS - 03 - 4174 / NEMI 5735 |

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PAH-SF-MS-VA** | Water | PAH in Water by GCMS | EPA 3510, 8270 |

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

| | | | |
|---|---|---|---|
| **PAH-SURR-MS-VA** | Water | PAH Surrogates for Waters | EPA 3510, 8270 |

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PHENOLS-4AAP-WT** | Water | Phenol (4AAP) | EPA 9066 |

An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| WT | ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

# Reference Information

10-033695

**GLOSSARY OF REPORT TERMS**

*Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.*
*mg/kg - milligrams per kilogram based on dry weight of sample.*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample.*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*
*mg/L - milligrams per litre.*
*< - Less than.*
*D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

**ALS Laboratory Group**
ANALYTICAL CHEMISTRY & TESTING SERVICES

**Environmental Division**

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

10-033695

Page 1 of 1

| Report To | Report Format / Distribution | Service Requested: (Rush subject to availability) |
|---|---|---|
| Company: Rescan Environmental | Standard: X Other (specify): | X (Regular) (Standard Turnaround Times)) |
| Contact: Rusto Martinka | Select: PDF X Excel X Digital Fax | Priority, Date Req'd: _____ (Surcharges apply) |
| Address: 1144 W Hasting St Unit Bc | Email 1: rmartinka@rescan.com | Emergency (1 Business Day) - 100% Surcharge |
| | Email 2: | For Emergency < 1 Day, ASAP or Weekend - Contact ALS |
| Phone: Fax: | | **Analysis Request** |
| **Invoice To** Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | ( Indicate Filtered or Preserved, F/P ) |
| Copy of Invoice with Report? (circle) Yes or No | Job #: 0791-007-25-22 | |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: | Quote #: | |
| **Lab Work Order #** (lab) | ALS Contact: Amber | Sampler: Rusto |

**Short Holding Time**
Rush Processing

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Anion/Cation | TOC | Nutrients/COD/Phenols | Total Metals | Diss. Metals | Phenols | PAHs | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [redacted] | MW-H17 | 20-12-12 | | Water | X | X | X | X | X | X | X | 6 |
| [redacted] | MW-H18 | ↓ | | | X | X | X | X | X | X | X | 6 |
| [redacted] | MW-H19 | ↓ | | | X | X | X | X | X | X | X | 6 |
| [redacted] | MW-H24A * | 20-12-12 | | | X | X | X | X | X | X | X | 6 |
| [redacted] | MW-H22 | 19-12-12 | | | X | X | X | X | X | X | X | 6 |
| [redacted] | MW-H23 | ↓ | | | X | X | X | X | X | X | X | 6 |
| [redacted] | MW-H24B | | | | X | X | X | X | X | X | X | 6 |
| [redacted] | MW-H25B | ↓ | | | X | X | X | X | X | X | X | 6 |
| [redacted] | MW-H26B | 19-12-12 | | ↓ | X | X | X | X | X | X | X | 6 |
| [redacted] | X1 | 20-12-12 | | Water | X | X | X | X | X | X | X | 6 |
| [redacted] | | | | | | | | | | | | |
| [redacted] | | | | | | | | | | | | |

**Special Instructions / Regulations / Hazardous Details**

* Insufficient sample volume (MW-H24A)

L1252558-COFC

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - repor**

| [redacted] SHIPMENT RELEASE (client use) [redacted] | | | [redacted] SHIPMENT RECEPTION (lab use only) [redacted] | | | | [redacted] SHIPMENT VERIFICATION (lab use only) [redacted] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| R. Martinka | 21-12-12 | 10:00 | TN | Dec 22 | 11:05 | -0.5°C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 11-MAY-13
Report Date: 27-MAY-13 10:44 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1300522**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-294658
Legal Site Desc:

Amber Springer
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1300522-7 | L1300522-8 | | | |
|---|---|---|---|---|---|---|
| | Description | soil | soil | | | |
| | Sampled Date | 07-MAY-13 | 07-MAY-13 | | | |
| | Sampled Time | | | | | |
| | Client ID | S-MW-H25A | S-MW-H26A | | | |
| **Grouping** | **Analyte** | | | | | |
| **SOIL** | | | | | | |
| **Particle Size** | % Gravel (>2mm) (%) | <0.10 | <0.10 | | | |
| | % Sand (2.0mm - 0.063mm) (%) | 1.71 | 1.88 | | | |
| | % Silt (0.063mm - 4um) (%) | 43.8 | 40.3 | | | |
| | % Clay (<4um) (%) | 54.5 | 57.8 | | | |
| | Texture | Silty clay | Silty clay | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1300522-1 water 09-MAY-13 MW-H26A | L1300522-2 water 08-MAY-13 MW-H26B | L1300522-3 water 09-MAY-13 MW-H25A | L1300522-4 water 07-MAY-13 MW-H25B | L1300522-5 water 09-MAY-13 MW-H24A |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 1090 | 681 | 1050 | 621 | 5760 |
| | Hardness (as CaCO3) (mg/L) | 22.1 | 351 | 16.2 | 345 | 577 |
| | pH (pH) | 8.93 | 8.11 | 8.72 | 8.16 | 12.30 |
| | Total Suspended Solids (mg/L) | 830 | 106 | 577 | 341 | 52.7 |
| | Turbidity (NTU) | 595 | 46.6 | 2030 | 288 | 36.8 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | 4.9 | <1.0 | 7.5 | <1.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 565 | 355 | 600 | 369 | <1.0 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 122 | <2.0 | 18.9 | <2.0 | 95.4 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <2.0 | <1.0 | <2.0 | 1550 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 688 | 355 | 619 | 369 | 1650 |
| | Ammonia, Total (as N) (mg/L) | 0.388 | 0.0492 | 0.452 | 0.0689 | 3.86 |
| | Bromide (Br) (mg/L) | <0.50 DLM | <0.050 | <0.50 DLM | <0.050 | <2.5 DLM |
| | Chloride (Cl) (mg/L) | <5.0 DLM | 1.67 | <5.0 DLM | 2.08 | <25 DLM |
| | Fluoride (F) (mg/L) | 0.90 | 0.126 | 0.76 | 0.175 | 1.1 |
| | Nitrate (as N) (mg/L) | <0.050 DLM | 0.119 | <0.050 DLM | 0.0081 | <0.25 DLM |
| | Nitrite (as N) (mg/L) | <0.010 DLM | 0.0035 | 0.012 | <0.0010 | <0.050 DLM |
| | Total Kjeldahl Nitrogen (mg/L) | 0.581 | 0.414 | 0.664 | 0.477 | 4.65 |
| | Total Nitrogen (mg/L) | 0.581 | 0.536 | 0.676 | 0.485 | 4.65 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0622 | 0.0019 | 0.0209 | <0.0010 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0669 | 0.0036 | 0.0321 | <0.0020 | 0.0038 |
| | Phosphorus (P)-Total (mg/L) | 0.932 | 0.099 | 1.00 | 0.315 | 0.0234 |
| | Sulfate (SO4) (mg/L) | <5.0 DLM | 59.7 | <5.0 DLM | 8.17 | <25 DLM |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 10.8 | 4.99 | 37.5 | 11.0 | 12.6 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 7.09 | 0.852 | 14.9 | 4.97 | 0.402 |
| | Antimony (Sb)-Total (mg/L) | 0.00146 | 0.00025 | 0.00087 | 0.00025 | 0.00064 |
| | Arsenic (As)-Total (mg/L) | 0.00584 | 0.00130 | 0.0101 | 0.00281 | 0.00043 |
| | Barium (Ba)-Total (mg/L) | 1.20 | 0.0732 | 2.19 | 0.260 | 3.55 |
| | Beryllium (Be)-Total (mg/L) | 0.00039 | <0.00010 | 0.00153 | 0.00024 | <0.00020 DLA |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 DLA |
| | Boron (B)-Total (mg/L) | 0.200 | 0.027 | 0.300 | 0.019 | <0.020 DLA |
| | Cadmium (Cd)-Total (mg/L) | 0.000461 | 0.000166 | 0.000812 | 0.000301 | 0.000026 |
| | Calcium (Ca)-Total (mg/L) | 34.5 | 81.2 | 14.0 | 93.4 | 231 |
| | Chromium (Cr)-Total (mg/L) | 0.0120 | 0.00095 | 0.0230 | 0.00736 | 0.0212 |
| | Cobalt (Co)-Total (mg/L) | 0.00454 | 0.00286 | 0.0113 | 0.00400 | 0.00038 |
| | Copper (Cu)-Total (mg/L) | 0.0193 | 0.00372 | 0.0466 | 0.00823 | 0.0080 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1300522-6 | L1300522-9 | | | |
|---|---|---|---|---|---|---|
| | Description | water | water | | | |
| | Sampled Date | 07-MAY-13 | 07-MAY-13 | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-H24B | X1 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | | | |
| | Conductivity (uS/cm) | 518 | 515 | | | |
| | Hardness (as CaCO3) (mg/L) | 248 | 239 | | | |
| | pH (pH) | 8.21 | 8.24 | | | |
| | Total Suspended Solids (mg/L) | 45.3 | 49.3 | | | |
| | Turbidity (NTU) | 33.1 | 32.1 | | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 3.3 | 1.5 | | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 283 | 280 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 283 | 280 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.0227 | 0.0210 | | | |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | | | |
| | Chloride (Cl) (mg/L) | 2.12 | 2.13 | | | |
| | Fluoride (F) (mg/L) | 0.122 | 0.121 | | | |
| | Nitrate (as N) (mg/L) | 0.0850 | 0.0857 | | | |
| | Nitrite (as N) (mg/L) | 0.0023 | 0.0024 | | | |
| | Total Kjeldahl Nitrogen (mg/L) | 0.251 | 0.269 | | | |
| | Total Nitrogen (mg/L) | 0.338 | 0.358 | | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | <0.0010 | | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | <0.0020 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.0286 | 0.0308 | | | |
| | Sulfate (SO4) (mg/L) | 21.0 | 20.9 | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 5.71 | 5.24 | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 1.54 | 1.23 | | | |
| | Antimony (Sb)-Total (mg/L) | 0.00068 | 0.00072 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00144 | 0.00141 | | | |
| | Barium (Ba)-Total (mg/L) | 0.639 | 0.638 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | | | |
| | Boron (B)-Total (mg/L) | 0.016 | 0.016 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000056 | 0.000064 | | | |
| | Calcium (Ca)-Total (mg/L) | 68.1 | 70.8 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00177 | 0.00149 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00202 | 0.00195 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00191 | 0.00220 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1300522-1 | L1300522-2 | L1300522-3 | L1300522-4 | L1300522-5 |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | water |
| | Sampled Date | 09-MAY-13 | 08-MAY-13 | 09-MAY-13 | 07-MAY-13 | 09-MAY-13 |
| | Sampled Time | | | | | |
| | Client ID | MW-H26A | MW-H26B | MW-H25A | MW-H25B | MW-H24A |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 9.77 | 0.888 | 24.8 | 5.35 | 0.316 |
| | Lead (Pb)-Total (mg/L) | 0.00824 | 0.000662 | 0.0185 | 0.00255 | 0.00098 |
| | Lithium (Li)-Total (mg/L) | 0.549 | 0.00763 | 0.709 | 0.0113 | 0.146 |
| | Magnesium (Mg)-Total (mg/L) | 10.4 | 33.8 | 9.51 | 29.9 | 0.221 |
| | Manganese (Mn)-Total (mg/L) | 0.138 | 0.734 | 0.140 | 0.827 | 0.00654 |
| | Mercury (Hg)-Total (mg/L) | <0.000050 DLM | <0.000010 | <0.000050 DLM | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00966 | 0.00244 | 0.0101 | 0.00295 | 0.0119 |
| | Nickel (Ni)-Total (mg/L) | 0.0157 | 0.00672 | 0.0415 | 0.0124 | 0.0012 |
| | Phosphorus (P)-Total (mg/L) | 0.66 | <0.30 | 1.09 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 2.72 | 2.01 | 4.81 | 2.42 | 17.6 |
| | Selenium (Se)-Total (mg/L) | 0.00068 | 0.00026 | 0.00135 | 0.00020 | 0.00051 |
| | Silicon (Si)-Total (mg/L) | 18.0 | 7.50 | 171 | 17.1 | 1.54 |
| | Silver (Ag)-Total (mg/L) | 0.000227 | 0.000020 | 0.000490 | 0.000051 | <0.000020 DLA |
| | Sodium (Na)-Total (mg/L) | 286 | 22.8 | 262 | 10.0 | 497 |
| | Strontium (Sr)-Total (mg/L) | 0.194 | 0.278 | 0.201 | 0.263 | 8.04 |
| | Thallium (Tl)-Total (mg/L) | 0.000178 | 0.000041 | 0.000362 | 0.000140 | <0.000020 DLA |
| | Tin (Sn)-Total (mg/L) | 0.00093 | 0.00040 | 0.00046 | 0.00025 | 0.00065 |
| | Titanium (Ti)-Total (mg/L) | 0.163 | 0.036 | 3.76 | 0.203 | 0.021 |
| | Uranium (U)-Total (mg/L) | 0.00116 | 0.00480 | 0.00254 | 0.00201 | 0.000049 |
| | Vanadium (V)-Total (mg/L) | 0.0237 | 0.0022 | 0.0526 | 0.0174 | <0.0020 DLA |
| | Zinc (Zn)-Total (mg/L) | 0.0820 | 0.0130 | 0.121 | 0.0436 | 0.0242 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.111 | 0.0032 | 0.0042 | <0.0030 | 0.123 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00104 | 0.00016 | 0.00076 | <0.00010 | 0.00051 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00133 | 0.00096 | 0.00111 | 0.00125 | <0.00020 DLA |
| | Barium (Ba)-Dissolved (mg/L) | 0.844 | 0.0641 | 1.27 | 0.211 | 3.60 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 DLA |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 DLA |
| | Boron (B)-Dissolved (mg/L) | 0.183 | 0.027 | 0.193 | 0.012 | <0.020 DLA |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | 0.000083 | <0.000010 | 0.000017 | <0.000020 DLA |
| | Calcium (Ca)-Dissolved (mg/L) | 5.52 | 85.3 | 3.83 | 90.0 | 231 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00019 | <0.00010 | <0.00010 | <0.00010 | 0.0206 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00222 | 0.00011 | 0.00166 | <0.00020 DLA |
| | Copper (Cu)-Dissolved (mg/L) | 0.00111 | 0.00082 | <0.00050 | <0.00050 | 0.00459 |
| | Iron (Fe)-Dissolved (mg/L) | 0.066 | 0.036 | <0.030 | 0.094 | <0.030 |
| | Lead (Pb)-Dissolved (mg/L) | 0.000578 | <0.000050 | 0.000076 | <0.000050 | 0.00064 |
| | Lithium (Li)-Dissolved (mg/L) | 0.571 | 0.00759 | 0.531 | 0.00655 | 0.143 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1300522-6 | L1300522-9 | | | |
|---|---|---|---|---|---|---|
| | Description | water | water | | | |
| | Sampled Date | 07-MAY-13 | 07-MAY-13 | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-H24B | X1 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 0.914 | 0.840 | | | |
| | Lead (Pb)-Total (mg/L) | 0.000681 | 0.000641 | | | |
| | Lithium (Li)-Total (mg/L) | 0.00409 | 0.00401 | | | |
| | Magnesium (Mg)-Total (mg/L) | 17.4 | 16.9 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.395 | 0.382 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00160 | 0.00164 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00614 | 0.00604 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | | | |
| | Potassium (K)-Total (mg/L) | 1.47 | 1.40 | | | |
| | Selenium (Se)-Total (mg/L) | 0.00076 | 0.00072 | | | |
| | Silicon (Si)-Total (mg/L) | 8.09 | 6.36 | | | |
| | Silver (Ag)-Total (mg/L) | 0.000019 | 0.000019 | | | |
| | Sodium (Na)-Total (mg/L) | 24.2 | 23.7 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.305 | 0.319 | | | |
| | Thallium (Tl)-Total (mg/L) | 0.000022 | 0.000020 | | | |
| | Tin (Sn)-Total (mg/L) | 0.00040 | 0.00037 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.070 | 0.047 | | | |
| | Uranium (U)-Total (mg/L) | 0.00456 | 0.00468 | | | |
| | Vanadium (V)-Total (mg/L) | 0.0036 | 0.0031 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0083 | 0.0084 | | | |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | <0.0030 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00072 | 0.00074 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00124 | 0.00124 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.615 | 0.660 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.014 | 0.014 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000018 | 0.000020 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 71.2 | 68.3 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00164 | 0.00162 | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | 0.031 | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.00328 | 0.00322 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1300522-1 water 09-MAY-13 MW-H26A | L1300522-2 water 08-MAY-13 MW-H26B | L1300522-3 water 09-MAY-13 MW-H25A | L1300522-4 water 07-MAY-13 MW-H25B | L1300522-5 water 09-MAY-13 MW-H24A |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 2.01 | 33.5 | 1.62 | 29.3 | 0.036 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00460 | 0.670 | 0.00616 | 0.782 | <0.00010 DLA |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00791 | 0.00237 | 0.00622 | 0.00250 | 0.0120 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00096 | 0.00524 | 0.00110 | 0.00399 | <0.0010 DLA |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.601 | 1.86 | 0.725 | 0.766 | 18.7 |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 | 0.00027 | 0.00010 | <0.00010 | 0.00048 |
| | Silicon (Si)-Dissolved (mg/L) | 4.38 | 4.64 | 3.19 | 5.29 | 0.668 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 DLA |
| | Sodium (Na)-Dissolved (mg/L) | 293 | 22.6 | 290 | 10.2 | 528 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.139 | 0.279 | 0.139 | 0.264 | 8.17 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | 0.000023 | <0.000010 | <0.000010 | <0.000020 DLA |
| | Tin (Sn)-Dissolved (mg/L) | 0.00012 | <0.00010 | <0.00010 | <0.00010 | 0.00037 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | 0.011 |
| | Uranium (U)-Dissolved (mg/L) | 0.000318 | 0.00478 | 0.000555 | 0.00181 | <0.000020 DLA |
| | Vanadium (V)-Dissolved (mg/L) | 0.0011 | <0.0010 | 0.0021 | <0.0010 | <0.0020 DLA |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0033 | 0.0069 | <0.0030 | 0.0122 | 0.0143 |
| **Aggregate Organics** | COD (mg/L) | 47 | <20 | 144 | 36 | 42 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1300522-6 | L1300522-9 | | | |
|---|---|---|---|---|---|---|
| | Description | water | water | | | |
| | Sampled Date | 07-MAY-13 | 07-MAY-13 | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-H24B | X1 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 17.0 | 16.8 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.371 | 0.364 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00158 | 0.00153 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00485 | 0.00479 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.19 | 1.20 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00079 | 0.00075 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.84 | 2.88 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 24.3 | 24.5 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.307 | 0.301 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00465 | 0.00474 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0034 | 0.0038 | | | |
| **Aggregate Organics** | COD (mg/L) | <20 | <20 | | | |

* 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 | Sulfate (SO4) | MS-B | L1300522-1, -2, -3, -4, -5, -6, -9 |
| Matrix Spike | Total Nitrogen | MS-B | L1300522-1, -2, -3, -4, -6, -9 |
| Matrix Spike | Total Nitrogen | MS-B | L1300522-1, -2, -3, -4, -6, -9 |
| Matrix Spike | Total Nitrogen | MS-B | L1300522-1, -2, -3, -4, -6, -9 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COD-COL-VA** | Water | Chemical Oxygen Demand by Colorimetric | APHA 5220 D. CHEMICAL OXYGEN DEMAND |

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

# Reference Information

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-T-COL-VA** | Water | Total Nitrogen in water by Colour | USGS - 03 - 4174 / NEMI 5735 |

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PO4-DO-COL-VA** Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**PSA-PIPET+GRAVEL-SK** Soil Particle size - Sieve and Pipette 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.

**TKN-CALC-VA** Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

**TSS-VA** Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:**

10-294658

**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.*

10- 294658

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

Page 1 of 1

| Report To | | Report Format / Distribution | | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|---|---|
| Company: | Rescan Environmental | Standard: | Other (specify): | Regular (Standard Turnaround Times - Business Days) |
| Contact: | Rusto Martinka | Select: PDF X | Excel X Digital Fax | Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 111 W Hastings Van BC | Email 1: | rmartinka@rescan.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | | Email 2: | Rusto.Martinka@erm.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: | Fax: | | | |

| Invoice To | Same as Report ? (circle) Yes or No (if No, provide details) | Client / Project Information | Analysis Request (Indicate Filtered or Preserved, F/P) |
|---|---|---|---|
| | Copy of Invoice with Report? (circle) Yes or No | Job #: | |
| Company: | | | |
| Contact: | | | |
| Address: | | | |
| Phone: | | | |
| Lab Work Orde | | Sampler: | |

**Short Holding**

*Rush Process*

L1300522-COFC

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chem | P Total Metals | P Diss. Metals | P TOC | P COD | P Nutrients | | Sieve Analysis | | | | | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW-H26A | | 9May13 | water | X | X | X | X | X | X | | | | | | | 4 |
| | MW-H26B | | 8May13 | | X | X | X | X | X | X | | | | | | | 4 |
| | MW-H25A | | 9May13 | | X | X | X | X | X | X | | | | | | | 4 |
| | MW-H25B | | 7May13 | | X | X | X | X | X | X | | | | | | | 4 |
| | MW-H24A * | | 9May13 | | X | X | X | X | X | X | | | | | | | 4 |
| | MW-H24B | | 7May13 | water | X | X | X | X | X | X | | | | | | | 4 |
| | S-MW-H25A | | 7May13 | soil | | | | | | | | X | | | | | 1 |
| | S-MW-H26A | | 7May13 | soil | | | | | | | | X | | | | | 1 |
| | X1 | | 7May13 | water | X | X | X | X | X | X | | | | | | | 4 |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

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

* High pH

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: Rusto Martinka | Date: 10 May 13 | Time: 11:00 | Received by: TN | Date: May 11 | Time: 10:05 | Temperature: 9 °C | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 25-JUL-13
Report Date: 07-AUG-13 13:00 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1337870**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-283720
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 | L1337870-1 | L1337870-2 | L1337870-3 | L1337870-4 | L1337870-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 |
| | Sampled Time | | | | | |
| | Client ID | MW-H24B | MW-H24C | MW-H26B | MW-H25B | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | 9.8 | 8.0 | 5.5 | 5.4 |
| | Conductivity (uS/cm) | 447 | 585 | 847 | 672 | 671 |
| | Hardness (as CaCO3) (mg/L) | 224 | 262 | 377 | 346 | 357 |
| | pH (pH) | 8.04 | 8.02 | 7.88 | 7.90 | 7.91 |
| | Total Suspended Solids (mg/L) | 5.1 | 28.6 | 43.1 | <3.0 | <3.0 |
| | Turbidity (NTU) | 3.56 | 16.4 | 33.2 | 2.07 | 1.95 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 5.6 | 6.4 | 12.2 | 12.8 | 12.5 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 243 | 299 | 349 | 382 | 383 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 243 | 299 | 349 | 382 | 383 |
| | Ammonia, Total (as N) (mg/L) | 0.0234 | 0.188 | 0.176 | 0.0701 | 0.0725 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.50 DLM | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | <0.50 | 1.00 | <5.0 DLM | 1.43 | 1.43 |
| | Fluoride (F) (mg/L) | 0.106 | 0.169 | 0.32 | 0.189 | 0.188 |
| | Nitrate (as N) (mg/L) | 0.0503 | 0.0075 | <0.050 DLM | <0.0050 | <0.0050 |
| | Nitrite (as N) (mg/L) | 0.0070 | 0.0037 | <0.010 DLM | <0.0010 | <0.0010 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.082 | 5.38 | 0.535 | 0.170 | 0.171 |
| | Total Nitrogen (mg/L) | 0.139 | 5.39 | 0.535 | 0.170 | 0.171 |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | 0.0080 | 0.0037 | <0.0010 | 0.0017 |
| | Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | 0.0141 | 0.0046 | <0.0020 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.0123 | 0.0516 | 0.0913 | 0.0080 | 0.0097 |
| | Sulfate (SO4) (mg/L) | 5.38 | 34.7 | 128 | 6.03 | 6.02 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 2.22 | 23.2 | 6.85 | 4.14 | 4.01 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.0457 | 0.219 | 3.00 | 0.0170 | 0.0183 |
| | Antimony (Sb)-Total (mg/L) | 0.00031 | 0.00098 | 0.00048 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00094 | 0.0420 | 0.00561 | 0.00168 | 0.00154 |
| | Barium (Ba)-Total (mg/L) | 0.873 | 0.290 | 0.126 | 0.292 | 0.265 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | 0.00019 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.011 | 0.025 | 0.062 | 0.013 | 0.012 |
| | Cadmium (Cd)-Total (mg/L) | 0.000023 | 0.000015 | 0.000726 | <0.000010 | <0.000010 |
| | Calcium (Ca)-Total (mg/L) | 65.2 | 73.0 | 99.1 | 103 | 97.8 |
| | Chromium (Cr)-Total (mg/L) | 0.00017 | 0.00050 | 0.00382 | <0.00010 | 0.00011 |
| | Cobalt (Co)-Total (mg/L) | 0.00188 | 0.00089 | 0.00687 | 0.00154 | 0.00145 |
| | Copper (Cu)-Total (mg/L) | <0.00050 | 0.00106 | 0.0112 | <0.00050 | <0.00050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1337870-1 | L1337870-2 | L1337870-3 | L1337870-4 | L1337870-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 |
| | Sampled Time | | | | | |
| | Client ID | MW-H24B | MW-H24C | MW-H26B | MW-H25B | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 0.603 | 1.29 | 6.33 | 0.396 | 0.397 |
| | Lead (Pb)-Total (mg/L) | 0.000095 | 0.000228 | 0.00308 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.00153 | 0.0168 | 0.00715 | 0.00754 | 0.00685 |
| | Magnesium (Mg)-Total (mg/L) | 16.1 | 21.5 | 38.6 | 30.9 | 29.5 |
| | Manganese (Mn)-Total (mg/L) | 0.349 | 0.217 | 1.73 | 0.745 | 0.724 |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | 0.000019 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00128 | 0.00682 | 0.00379 | 0.00251 | 0.00230 |
| | Nickel (Ni)-Total (mg/L) | 0.00202 | 0.00213 | 0.0187 | 0.00370 | 0.00354 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 0.833 | 2.37 | 3.23 | 0.598 | 0.566 |
| | Selenium (Se)-Total (mg/L) | 0.00031 | 0.00018 | 0.00055 | <0.00010 | <0.00010 |
| | Silicon (Si)-Total (mg/L) | 2.84 | 5.91 | 13.0 | 5.76 | 5.29 |
| | Silver (Ag)-Total (mg/L) | 0.000010 | <0.000010 | 0.000087 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 6.6 | 25.3 | 38.8 | 9.1 | 8.3 |
| | Strontium (Sr)-Total (mg/L) | 0.197 | 0.410 | 0.369 | 0.285 | 0.266 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | 0.000172 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | 0.00085 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.010 | 0.010 | 0.097 | 0.010 | <0.010 |
| | Uranium (U)-Total (mg/L) | 0.000745 | 0.00142 | 0.00860 | 0.00155 | 0.00147 |
| | Vanadium (V)-Total (mg/L) | <0.0010 | 0.0010 | 0.0076 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Total (mg/L) | 0.0031 | 0.0034 | 0.0206 | <0.0030 | <0.0030 |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0050 | 0.0075 | 0.0050 | 0.0033 | <0.0030 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00028 | 0.00096 | 0.00037 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00086 | 0.0409 | 0.00290 | 0.00160 | 0.00157 |
| | Barium (Ba)-Dissolved (mg/L) | 0.810 | 0.296 | 0.0729 | 0.274 | 0.275 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | <0.010 | 0.024 | 0.052 | 0.011 | 0.011 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000045 | <0.000010 | <0.000010 |
| | Calcium (Ca)-Dissolved (mg/L) | 63.4 | 69.3 | 92.9 | 91.7 | 96.2 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00180 | 0.00072 | 0.00341 | 0.00146 | 0.00146 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | 0.488 | 0.863 | 1.13 | 0.372 | 0.373 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| | Lithium (Li)-Dissolved (mg/L) | 0.00118 | 0.0157 | 0.00531 | 0.00631 | 0.00682 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Sample ID | L1337870-1 | L1337870-2 | L1337870-3 | L1337870-4 | L1337870-5 |
|---|---|---|---|---|---|
| Description | Water | Water | Water | Water | Water |
| Sampled Date | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 |
| Sampled Time | | | | | |
| Client ID | MW-H24B | MW-H24C | MW-H26B | MW-H25B | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 16.0 | 21.6 | 35.1 | 28.3 | 28.4 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.344 | 0.212 | 1.47 | 0.700 | 0.675 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00121 | 0.00650 | 0.00338 | 0.00218 | 0.00227 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00191 | 0.00171 | 0.00905 | 0.00372 | 0.00369 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.815 | 2.37 | 2.50 | 0.585 | 0.582 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00028 | 0.00016 | 0.00026 | <0.00010 | <0.00010 |
| | Silicon (Si)-Dissolved (mg/L) | 2.65 | 5.47 | 6.03 | 5.53 | 5.28 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 6.2 | 22.4 | 34.3 | 8.5 | 8.0 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.186 | 0.381 | 0.336 | 0.251 | 0.265 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000020 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00014 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.000698 | 0.00130 | 0.00761 | 0.00142 | 0.00144 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | 0.0017 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |
| **Aggregate Organics** | COD (mg/L) | <20 | 69 | 32 | 24 | <20 |
| | Phenols (4AAP) (mg/L) | | 0.0010 | | | |
| **Polycyclic Aromatic Hydrocarbons** | Acenaphthene (mg/L) | | <0.000050 | | | |
| | Acenaphthylene (mg/L) | | <0.000050 | | | |
| | Acridine (mg/L) | | <0.000050 | | | |
| | Anthracene (mg/L) | | <0.000050 | | | |
| | Benz(a)anthracene (mg/L) | | <0.000050 | | | |
| | Benzo(a)pyrene (mg/L) | | <0.000010 | | | |
| | Benzo(b)fluoranthene (mg/L) | | <0.000050 | | | |
| | Benzo(g,h,i)perylene (mg/L) | | <0.000050 | | | |
| | Benzo(k)fluoranthene (mg/L) | | <0.000050 | | | |
| | Chrysene (mg/L) | | <0.000050 | | | |
| | Dibenz(a,h)anthracene (mg/L) | | <0.000050 | | | |
| | Fluoranthene (mg/L) | | <0.000050 | | | |
| | Fluorene (mg/L) | | <0.000050 | | | |
| | Indeno(1,2,3-c,d)pyrene (mg/L) | | <0.000050 | | | |
| | Naphthalene (mg/L) | | 0.000346 | | | |
| | Phenanthrene (mg/L) | | <0.000050 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1337870-1 | L1337870-2 | L1337870-3 | L1337870-4 | L1337870-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 | 23-JUL-13 |
| | Sampled Time | | | | | |
| | Client ID | MW-H24B | MW-H24C | MW-H26B | MW-H25B | X1 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | Pyrene (mg/L) | | <0.000050 | | | |
| | Quinoline (mg/L) | | <0.000090 DLM | | | |
| | Surrogate: Acenaphthene d10 (%) | | 97.0 | | | |
| | Surrogate: Acridine d9 (%) | | 101.8 | | | |
| | Surrogate: Chrysene d12 (%) | | 87.3 | | | |
| | Surrogate: Naphthalene d8 (%) | | 92.5 | | | |
| | Surrogate: Phenanthrene d10 (%) | | 95.1 | | | |

* 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) |
|---|---|---|---|
| Duplicate | Bromide (Br) | DLM | L1337870-1, -2, -3, -4, -5 |
| Duplicate | Chloride (Cl) | DLM | L1337870-1, -2, -3, -4, -5 |
| Duplicate | Nitrite (as N) | DLM | L1337870-1, -2, -3, -4, -5 |
| Duplicate | Nitrate (as N) | DLM | L1337870-1, -2, -3, -4, -5 |
| Duplicate | Bromide (Br) | DLM | L1337870-1, -2, -3, -4, -5 |
| Duplicate | Nitrite (as N) | DLM | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Total Organic Carbon | MS-B | L1337870-2 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1337870-1, -2, -3, -4, -5 |
| Matrix Spike | Total Nitrogen | MS-B | L1337870-1, -3, -4, -5 |
| Matrix Spike | Total Nitrogen | MS-B | L1337870-1, -3, -4, -5 |
| Matrix Spike | Total Nitrogen | MS-B | L1337870-2 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COD-COL-VA** | Water | Chemical Oxygen Demand by Colorimetric | APHA 5220 D. CHEMICAL OXYGEN DEMAND |

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-T-COL-VA** | Water | Total Nitrogen in water by Colour | USGS - 03 - 4174 / NEMI 5735 |

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

# Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PAH-SF-MS-VA** | Water | PAH in Water by GCMS | EPA 3510, 8270 |

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

| | | | |
|---|---|---|---|
| **PAH-SURR-MS-VA** | Water | PAH Surrogates for Waters | EPA 3510, 8270 |

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PHENOLS-4AAP-ED** | Water | Phenols (4AAP) | AB ENV.06537-COLORIMETRIC |

This analysis is carried out using procedures adapted from ENVIRODAT VMV 06537 689, Method Code 154, in "Methods Manual for Chemical Analysis of Water and Wastes" published by the Alberta Environmental Centre. This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide and 4-aminoantipyrine to form a red complex which is measured at 505 nm.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

| Laboratory Definition Code | Laboratory Location |
|---|---|
| ED | ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-283720

# Reference Information

**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.*

10-283720

ALS Environment

L1337870-COFC

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

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| **Report To** | **Report Format / Distribution** | **Service Request:**(Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: Rescan | Standard: X Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Rusto Martinka | Select: PDF X Excel X Digital Fax | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: Vancouver BC | Email 1: rusto.martinka@rescan.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | Email 2: | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: Fax: | | **Analysis Request** |
| **Invoice To** Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | ( Indicate Filtered or Preserved, F/P ) |
| Copy of Invoice with Report? (circle) Yes or No | Job #: 0194106-0002-0005 | |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: Fax: | Quote #: | |
| **Lab Work Order # (lab use only)** L1337870 | **ALS Contact:** Amber **Sampler:** Rusto | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chem | Diss. Metals | Total Metals | Nutrients | Major Ions | TOC | COD | Phenols | PAH | | | | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW-H24B | 23-07-13 | | water | X | X | X | X | X | X | X | | | | | | 4 |
| | MW-H24C | " | | " | X | X | X | X | X | X | X | X | X | | | | 5 |
| | MW-H26B | " | | " | X | X | X | X | X | X | X | | | | | | 4 |
| | MW-H25B | " | | " | X | X | X | X | X | X | X | | | | | | 4 |
| | X1 | " | | " | X | X | X | X | X | X | X | | | | | | 4 |
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**Short Holding Time**

*Rush Processing*

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

MW-H24C → Diss. metals small ~~bottle~~ volume

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: Rusto | Date: 24-07-13 | Time: 11:00 | Received by: Brit | Date: July 25 | Time: 9:30 | Temperature: 9.6 °C | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 31-JUL-13
Report Date: 15-AUG-13 13:04 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1340620**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-283719
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 | L1340620-1 | L1340620-2 | L1340620-3 | L1340620-4 | |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | |
| | Sampled Date | 28-JUL-13 | 28-JUL-13 | 28-JUL-13 | 23-JUL-13 | |
| | Sampled Time | | | | | |
| | Client ID | MW-H25A | MW-H27 | MW-H26A | MW-H26B | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | | |
| | Conductivity (uS/cm) | 1080 | 1090 | 1100 | | |
| | Hardness (as CaCO3) (mg/L) | 18.1 | 20.1 | 18.6 | | |
| | pH (pH) | 8.47 | 8.65 | 8.81 | | |
| | Total Suspended Solids (mg/L) | 28.7 | 204 | 37.4 | | |
| | Turbidity (NTU) | 857 | 203 | 285 | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 598 | 572 | 591 | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 21.7 | 45.4 | 64.6 | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 619 | 618 | 656 | | |
| | Ammonia, Total (as N) (mg/L) | 0.262 | 0.434 | 0.415 | 0.163 | |
| | Bromide (Br) (mg/L) | <0.50 DLM | <0.50 DLM | <0.50 DLM | | |
| | Chloride (Cl) (mg/L) | <5.0 DLM | <5.0 DLM | <5.0 DLM | | |
| | Fluoride (F) (mg/L) | 0.84 | 0.84 | 0.68 | | |
| | Nitrate (as N) (mg/L) | <0.050 DLM | <0.050 DLM | <0.050 DLM | | |
| | Nitrite (as N) (mg/L) | <0.010 DLM | <0.010 DLM | <0.010 DLM | | |
| | Total Kjeldahl Nitrogen (mg/L) | 0.75 | 0.56 | 0.63 | 0.550 | |
| | Total Nitrogen (mg/L) | 0.75 DLA | 0.56 DLA | 0.63 DLA | 0.50 DLA | |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | 0.0533 | 0.0593 | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0032 | 0.0603 | 0.0666 | | |
| | Phosphorus (P)-Total (mg/L) | 0.566 | 0.289 | 0.355 | | |
| | Sulfate (SO4) (mg/L) | <5.0 DLM | 17.1 | <5.0 DLM | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 12.0 | 10.3 | 8.6 | 6.51 | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 1.36 | 0.485 | 5.02 | | |
| | Antimony (Sb)-Total (mg/L) | 0.00130 | 0.00044 | 0.00074 | | |
| | Arsenic (As)-Total (mg/L) | 0.00355 | 0.00108 | 0.00167 | | |
| | Barium (Ba)-Total (mg/L) | 2.26 | 1.13 | 0.970 | | |
| | Beryllium (Be)-Total (mg/L) | 0.00041 | <0.00020 DLA | 0.00028 | | |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.0010 DLA | <0.00050 | | |
| | Boron (B)-Total (mg/L) | 0.208 | 0.206 | 0.201 | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000485 | 0.000121 | 0.000166 | | |
| | Calcium (Ca)-Total (mg/L) | 8.35 | 9.49 | 11.9 | | |
| | Chromium (Cr)-Total (mg/L) | 0.00198 | 0.00110 | 0.00858 | | |
| | Cobalt (Co)-Total (mg/L) | 0.00455 | 0.00082 | 0.00174 | | |
| | Copper (Cu)-Total (mg/L) | 0.0143 | 0.0030 | 0.0102 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1340620-1 | L1340620-2 | L1340620-3 | L1340620-4 | |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | |
| | Sampled Date | 28-JUL-13 | 28-JUL-13 | 28-JUL-13 | 23-JUL-13 | |
| | Sampled Time | | | | | |
| | Client ID | MW-H25A | MW-H27 | MW-H26A | MW-H26B | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 2.41 | 3.25 | 3.64 | | |
| | Lead (Pb)-Total (mg/L) | 0.00807 | 0.00347 | 0.00258 | | |
| | Lithium (Li)-Total (mg/L) | 0.502 | 0.652 | 0.493 | | |
| | Magnesium (Mg)-Total (mg/L) | 3.43 | 5.27 | 3.96 | | |
| | Manganese (Mn)-Total (mg/L) | 0.0434 | 0.0501 | 0.0617 | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00558 | 0.0101 | 0.00491 | | |
| | Nickel (Ni)-Total (mg/L) | 0.0174 | 0.0040 | 0.00777 | | |
| | Phosphorus (P)-Total (mg/L) | 0.56 | 0.57 | <0.30 | | |
| | Potassium (K)-Total (mg/L) | 1.80 | 0.76 | 2.27 | | |
| | Selenium (Se)-Total (mg/L) | 0.00105 | 0.00214 | 0.00023 | | |
| | Silicon (Si)-Total (mg/L) | 4.99 | 3.90 | 17.4 | | |
| | Silver (Ag)-Total (mg/L) | 0.000017 | <0.000020 DLA | 0.000056 | | |
| | Sodium (Na)-Total (mg/L) | 256 | 307 | 253 | | |
| | Strontium (Sr)-Total (mg/L) | 0.186 | 0.147 | 0.155 | | |
| | Thallium (Tl)-Total (mg/L) | 0.000056 | 0.000021 | 0.000113 | | |
| | Tin (Sn)-Total (mg/L) | 0.00054 | 0.00047 | 0.00058 | | |
| | Titanium (Ti)-Total (mg/L) | 0.019 | 0.018 | 0.213 | | |
| | Uranium (U)-Total (mg/L) | 0.00257 | 0.00147 | 0.000705 | | |
| | Vanadium (V)-Total (mg/L) | 0.0115 | 0.0036 | 0.0200 | | |
| | Zinc (Zn)-Total (mg/L) | 0.0459 | 0.0376 | 0.0240 | | |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0089 | 0.0178 | 0.0595 | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00170 DTC | 0.00041 | 0.00073 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00206 | 0.00071 | 0.00169 | | |
| | Barium (Ba)-Dissolved (mg/L) | 1.37 | 0.810 | 0.795 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | <0.00010 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.0010 DLA | <0.00050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.202 | 0.203 | 0.185 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000054 | <0.000020 DLA | 0.000105 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 4.06 | 3.30 | 4.12 | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00020 DLA | 0.00107 | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00054 | <0.00020 DLA | 0.00061 | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00142 | <0.00050 DLA | 0.00189 | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | <0.030 | <0.030 | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000061 | 0.00010 | 0.000635 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.505 | 0.645 | 0.497 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1340620-1 | L1340620-2 | L1340620-3 | L1340620-4 | |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | |
| | Sampled Date | 28-JUL-13 | 28-JUL-13 | 28-JUL-13 | 23-JUL-13 | |
| | Sampled Time | | | | | |
| | Client ID | MW-H25A | MW-H27 | MW-H26A | MW-H26B | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 1.92 | 2.89 | 2.08 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00939 | 0.00567 | 0.00506 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00725 DTC | 0.0110 | 0.00570 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00422 | <0.0010 DLA | 0.00188 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | | |
| | Potassium (K)-Dissolved (mg/L) | 1.48 | 0.68 | 0.773 | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00112 | 0.00209 | 0.00018 | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.74 | 2.83 | 3.89 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000020 DLA | 0.000048 | | |
| | Sodium (Na)-Dissolved (mg/L) | 248 | 306 | 259 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.144 | 0.118 | 0.132 | | |
| | Thallium (Tl)-Dissolved (mg/L) | 0.000021 | <0.000020 DLA | 0.000103 | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00024 | <0.00020 DLA | 0.00055 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00176 | 0.000684 | 0.000512 | | |
| | Vanadium (V)-Dissolved (mg/L) | 0.0037 | <0.0020 DLA | 0.0042 | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | 0.0031 | <0.0030 | | |
| **Aggregate Organics** | COD (mg/L) | 43 | 85 | 27 | <20 | |
| | Phenols (4AAP) (mg/L) | <0.0010 | <0.0010 | <0.0010 | | |
| **Polycyclic Aromatic Hydrocarbons** | Acenaphthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Acenaphthylene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Acridine (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Benz(a)anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Benzo(a)pyrene (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Benzo(b)fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Benzo(g,h,i)perylene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Benzo(k)fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Chrysene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Dibenz(a,h)anthracene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Fluoranthene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Fluorene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Indeno(1,2,3-c,d)pyrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Naphthalene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Phenanthrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1340620-1 | L1340620-2 | L1340620-3 | L1340620-4 | |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | |
| | Sampled Date | 28-JUL-13 | 28-JUL-13 | 28-JUL-13 | 23-JUL-13 | |
| | Sampled Time | | | | | |
| | Client ID | MW-H25A | MW-H27 | MW-H26A | MW-H26B | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | Pyrene (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Quinoline (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Surrogate: Acenaphthene d10 (%) | 87.7 | 95.9 | 89.8 | | |
| | Surrogate: Acridine d9 (%) | 94.4 | 104.7 | 95.8 | | |
| | Surrogate: Chrysene d12 (%) | 83.8 | 89.4 | 83.1 | | |
| | Surrogate: Naphthalene d8 (%) | 90.5 | 98.2 | 93.1 | | |
| | Surrogate: Phenanthrene d10 (%) | 91.8 | 99.7 | 92.7 | | |

* 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) |
|---|---|---|---|
| Duplicate | Total Nitrogen | DLA | L1340620-1, -2, -3, -4 |
| Duplicate | Bromide (Br) | DLM | L1340620-1, -2, -3 |
| Duplicate | Chloride (Cl) | DLM | L1340620-1, -2, -3 |
| Duplicate | Nitrite (as N) | DLM | L1340620-1, -2, -3 |
| Duplicate | Nitrate (as N) | DLM | L1340620-1, -2, -3 |
| Duplicate | Sulfate (SO4) | DLM | L1340620-1, -2, -3 |
| Matrix Spike | Nitrite (as N) | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Total Nitrogen | MS-B | L1340620-1, -2, -3, -4 |
| Matrix Spike | Total Nitrogen | MS-B | L1340620-1, -2, -3, -4 |
| Matrix Spike | Ammonia, Total (as N) | MS-B | L1340620-1, -2, -3, -4 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Aluminum (Al)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1340620-1, -2, -3 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1340620-1, -2, -3 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

# Reference Information

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COD-COL-VA** | Water | Chemical Oxygen Demand by Colorimetric | APHA 5220 D. CHEMICAL OXYGEN DEMAND |

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-T-COL-VA** | Water | Total Nitrogen in water by Colour | USGS - 03 - 4174 / NEMI 5735 |

# Reference Information

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**P-T-COL-VA** Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

**P-TD-COL-VA** Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**PAH-SF-MS-VA** Water PAH in Water by GCMS EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

**PAH-SURR-MS-VA** Water PAH Surrogates for Waters EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PHENOLS-4AAP-ED** Water Phenols (4AAP) AB ENV.06537-COLORIMETRIC

This analysis is carried out using procedures adapted from ENVIRODAT VMV 06537 689, Method Code 154, in "Methods Manual for Chemical Analysis of Water and Wastes" published by the Alberta Environmental Centre. This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide and 4-aminoantipyrine to form a red complex which is measured at 505 nm.

**PO4-DO-COL-VA** Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**TKN-CALC-VA** Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

**TKN-F-VA** Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

**TSS-VA** Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

| Laboratory Definition Code | Laboratory Location |
|---|---|
| ED | ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA |

# Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

**Chain of Custody Numbers:**

10-283719

**GLOSSARY OF REPORT TERMS**

*Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.*
*mg/kg - milligrams per kilogram based on dry weight of sample.*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample.*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*
*mg/L - milligrams per litre.*
*< - Less than.*
*D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

ALS Environmental

L1340620-COFC

10-283719

Page 1 of 1

| Report To | Report Format / Distribution | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: Descan | Standard: Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Rusto Martinka | Select: PDF Excel Digital Fax | Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: Vancouver, BC | Email 1: rusto.martinka@esm.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | Email 2: | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: Fax: | | |

| Invoice To | Client / Project Information |
|---|---|
| Same as Report ? (circle) Yes or No (if No, provide details) | Job #: 0194106-0002-0005 |
| Copy of Invoice with Report? (circle) Yes or No | PO / AFE: |
| Company: | LSD: |
| Contact: | |
| Address: | Quote #: |
| Phone: Fax: | |

**Lab Work Order # (lab use only):** L1340620 | **ALS Contact:** Amber | **Sampler:** Rusto

**Analysis Request** ( Indicate Filtered or Preserved, F/P )

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General | Total Metals | Dis. Metals | Nutrients | TOC | COD | Phenols | PAH | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW-H25A | 28-07-13 | | Water | X | X | X | X | X | X | X | X | 5 |
| | MW-H27 | " | | Water | X | X | X | X | X | X | X | X | 5 |
| | MW-H26A | " | | " | X | X | X | X | X | X | X | X | 5 |
| | MW-H26B | 23-07-13 | | " | | | | X | X | X | | | 1 |

**Short Holding Time**

*Rush Processing*

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

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: Rusto | Date: 30-07-13 | Time: 9:30 | Received by: Brit | Date: July 31 | Time: 9:40 | Temperature: 8.4 °C | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 06-AUG-13
Report Date: 22-AUG-13 16:40 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1343263**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-002-005
C of C Numbers:
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 | L1343263-1 | L1343263-2 | | | |
|---|---|---|---|---|---|---|---|
| | | Description | water | water | | | |
| | | Sampled Date | 31-JUL-13 | 01-AUG-13 | | | |
| | | Sampled Time | | | | | |
| | | Client ID | MW-H28 | MW-H29 | | | |
| **Grouping** | **Analyte** | | | | | | |
| **WATER** | | | | | | | |
| **Physical Tests** | Colour, True (CU) | | 5.1 | 8.2 | | | |
| | Conductivity (uS/cm) | | 1320 | 699 | | | |
| | Hardness (as CaCO3) (mg/L) | | 16.2 | 26.5 | | | |
| | pH (pH) | | 8.62 | 8.20 | | | |
| | Total Suspended Solids (mg/L) | | 80.8 | 17.6 | | | |
| | Turbidity (NTU) | | 213 | 282 | | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | | <1.0 | 1.3 | | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | | 692 | 357 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | | 47.7 | <2.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | | <1.0 | <2.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | | 739 | 357 | | | |
| | Ammonia, Total (as N) (mg/L) | | 0.393 | 0.293 | | | |
| | Bromide (Br) (mg/L) | | <0.50 DLM | <0.50 DLM | | | |
| | Chloride (Cl) (mg/L) | | 5.7 | <5.0 DLM | | | |
| | Fluoride (F) (mg/L) | | 1.13 | 0.63 | | | |
| | Nitrate (as N) (mg/L) | | <0.050 DLM | <0.050 DLM | | | |
| | Nitrite (as N) (mg/L) | | <0.010 DLM | <0.010 DLM | | | |
| | Total Kjeldahl Nitrogen (mg/L) | | 0.622 | 0.628 | | | |
| | Total Nitrogen (mg/L) | | 0.622 | 0.628 | | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | | 0.0255 | <0.0010 | | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | | 0.0449 | 0.0078 | | | |
| | Phosphorus (P)-Total (mg/L) | | 0.224 | 0.287 | | | |
| | Sulfate (SO4) (mg/L) | | 20.7 | 44.7 | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | | 17.2 | 12.4 | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | | 2.39 | 2.57 | | | |
| | Antimony (Sb)-Total (mg/L) | | 0.00090 | 0.00030 | | | |
| | Arsenic (As)-Total (mg/L) | | 0.00290 | 0.00095 | | | |
| | Barium (Ba)-Total (mg/L) | | 0.962 | 0.424 | | | |
| | Beryllium (Be)-Total (mg/L) | | 0.00026 | 0.00032 | | | |
| | Bismuth (Bi)-Total (mg/L) | | <0.0010 DLA | <0.00050 | | | |
| | Boron (B)-Total (mg/L) | | 0.186 | 0.160 | | | |
| | Cadmium (Cd)-Total (mg/L) | | 0.000391 | 0.000196 | | | |
| | Calcium (Ca)-Total (mg/L) | | 10.9 | 9.69 | | | |
| | Chromium (Cr)-Total (mg/L) | | 0.00413 | 0.00406 | | | |
| | Cobalt (Co)-Total (mg/L) | | 0.00240 | 0.00263 | | | |
| | Copper (Cu)-Total (mg/L) | | 0.0093 | 0.00503 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1343263-1 | L1343263-2 | | | |
| | **Description** | water | water | | | |
| | **Sampled Date** | 31-JUL-13 | 01-AUG-13 | | | |
| | **Sampled Time** | | | | | |
| | **Client ID** | MW-H28 | MW-H29 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 6.18 | 1.71 | | | |
| | Lead (Pb)-Total (mg/L) | 0.00568 | 0.00120 | | | |
| | Lithium (Li)-Total (mg/L) | 0.641 | 0.150 | | | |
| | Magnesium (Mg)-Total (mg/L) | 4.11 | 2.34 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0729 | 0.147 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.0121 | 0.00587 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.0118 | 0.00877 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.70 | <0.30 | | | |
| | Potassium (K)-Total (mg/L) | 1.59 | 2.31 | | | |
| | Selenium (Se)-Total (mg/L) | 0.00050 | 0.00013 | | | |
| | Silicon (Si)-Total (mg/L) | 12.5 | 7.41 | | | |
| | Silver (Ag)-Total (mg/L) | 0.000039 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 317 | 172 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.139 | 0.0674 | | | |
| | Thallium (Tl)-Total (mg/L) | 0.000064 | 0.000072 | | | |
| | Tin (Sn)-Total (mg/L) | 0.00122 | 0.00075 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.165 | 0.039 | | | |
| | Uranium (U)-Total (mg/L) | 0.00329 | 0.00116 | | | |
| | Vanadium (V)-Total (mg/L) | 0.0097 | 0.0076 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0339 | 0.0185 | | | |
| **Dissolved Metals** | Dissolved Metals Filtration Location | FIELD | FIELD | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0259 | 0.0434 | | | |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00087 | 0.00033 | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00183 | 0.00044 | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.697 | 0.114 | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00020 DLA | <0.00010 | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.0010 DLA | <0.00050 | | | |
| | Boron (B)-Dissolved (mg/L) | 0.199 | 0.160 | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000098 | 0.000038 | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 4.25 | 7.81 | | | |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00023 | 0.00015 | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00054 | 0.00096 | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00176 | 0.00136 | | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | <0.030 | | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.00018 | <0.000050 | | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.710 | 0.161 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1343263-1 | L1343263-2 | | | |
|---|---|---|---|---|---|---|
| | Description | water | water | | | |
| | Sampled Date | 31-JUL-13 | 01-AUG-13 | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-H28 | MW-H29 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Magnesium (Mg)-Dissolved (mg/L) | 1.35 | 1.71 | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00674 | 0.0999 | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0139 | 0.00696 | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0060 | 0.00574 | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | | | |
| | Potassium (K)-Dissolved (mg/L) | 0.91 | 1.47 | | | |
| | Selenium (Se)-Dissolved (mg/L) | 0.00042 | 0.00014 | | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.67 | 3.55 | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 DLA | <0.000010 | | | |
| | Sodium (Na)-Dissolved (mg/L) | 323 | 173 | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.116 | 0.0573 | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 DLA | 0.000022 | | | |
| | Tin (Sn)-Dissolved (mg/L) | 0.00042 | 0.00022 | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.00262 | 0.000925 | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0020 DLA | <0.0010 | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 DLA | <0.0030 | | | |
| **Aggregate Organics** | COD (mg/L) | 111 | 44 | | | |
| | Phenols (4AAP) (mg/L) | <0.0010 | <0.0010 | | | |
| **Polycyclic Aromatic Hydrocarbons** | Acenaphthene (mg/L) | <0.000050 | <0.000050 | | | |
| | Acenaphthylene (mg/L) | <0.000050 | <0.000050 | | | |
| | Acridine (mg/L) | <0.000050 | <0.000050 | | | |
| | Anthracene (mg/L) | <0.000050 | <0.000050 | | | |
| | Benz(a)anthracene (mg/L) | <0.000050 | <0.000050 | | | |
| | Benzo(a)pyrene (mg/L) | <0.000010 | <0.000010 | | | |
| | Benzo(b)fluoranthene (mg/L) | <0.000050 | <0.000050 | | | |
| | Benzo(g,h,i)perylene (mg/L) | <0.000050 | <0.000050 | | | |
| | Benzo(k)fluoranthene (mg/L) | <0.000050 | <0.000050 | | | |
| | Chrysene (mg/L) | <0.000050 | <0.000050 | | | |
| | Dibenz(a,h)anthracene (mg/L) | <0.000050 | <0.000050 | | | |
| | Fluoranthene (mg/L) | <0.000050 | <0.000050 | | | |
| | Fluorene (mg/L) | <0.000050 | 0.000085 | | | |
| | Indeno(1,2,3-c,d)pyrene (mg/L) | <0.000050 | <0.000050 | | | |
| | Naphthalene (mg/L) | 0.000057 | 0.000412 | | | |
| | Phenanthrene (mg/L) | <0.000050 | 0.000080 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1343263-1 | L1343263-2 | | | |
|---|---|---|---|---|---|---|
| | Description | water | water | | | |
| | Sampled Date | 31-JUL-13 | 01-AUG-13 | | | |
| | Sampled Time | | | | | |
| | Client ID | MW-H28 | MW-H29 | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Polycyclic Aromatic Hydrocarbons** | Pyrene (mg/L) | <0.000050 | <0.000050 | | | |
| | Quinoline (mg/L) | <0.000050 | <0.000050 | | | |
| | Surrogate: Acenaphthene d10 (%) | 91.2 | 89.7 | | | |
| | Surrogate: Acridine d9 (%) | 99.6 | 94.7 | | | |
| | Surrogate: Chrysene d12 (%) | 90.6 | 89.4 | | | |
| | Surrogate: Naphthalene d8 (%) | 88.3 | 88.0 | | | |
| | Surrogate: Phenanthrene d10 (%) | 94.8 | 91.9 | | | |

* 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) |
|---|---|---|---|
| Duplicate | Nitrite (as N) | DLM | L1343263-1, -2 |
| Matrix Spike | Mercury (Hg)-Total | MS-B | L1343263-1, -2 |
| Matrix Spike | Phosphorus (P)-Total | MS-B | L1343263-1, -2 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1343263-1, -2 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1343263-1, -2 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1343263-1, -2 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1343263-1, -2 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1343263-1, -2 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1343263-1, -2 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1343263-1, -2 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1343263-1, -2 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted For Sample Matrix Effects |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.<br>OR<br>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**CARBONS-TOC-VA** Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

**COD-COL-VA** Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**EC-PCT-VA** Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**HARDNESS-CALC-VA** Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**N-T-COL-VA** Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

# Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PAH-SF-MS-VA** | Water | PAH in Water by GCMS | EPA 3510, 8270 |

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

| | | | |
|---|---|---|---|
| **PAH-SURR-MS-VA** | Water | PAH Surrogates for Waters | EPA 3510, 8270 |

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PHENOLS-4AAP-ED** | Water | Phenols (4AAP) | AB ENV.06537-COLORIMETRIC |

This analysis is carried out using procedures adapted from ENVIRODAT VMV 06537 689, Method Code 154, in "Methods Manual for Chemical Analysis of Water and Wastes" published by the Alberta Environmental Centre. This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide and 4-aminoantipyrine to form a red complex which is measured at 505 nm.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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

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

| Laboratory Definition Code | Laboratory Location |
|---|---|
| ED | ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA |
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

# Reference Information

**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.*

L1343263

Chain of Custody

**Short Holding Time**

*Rush Processing*



L1343263-COFC

Rescan Environmental, Vancouver, BC

Rusto Martinka to Amber Springer

Job # 0194106-002-0005 rusto.martinka@erm.com

| | | | |
|---|---|---|---|
| MW-428 | water | 31-July-13 | 5 bottles |
| MW-429 | water | 1-Aug-13 | 5 bottles |

Analysis Request:

General Chem, Total metals, Diss. metals, Nutrients, Ions + major, TOC, COD

Phenols and PAH ⇒ Regular service request

As per all other water samples submitted for this project number. (Murray River, Tumbler Ridge, BC)

Rusto Martinka 2-Aug-13

Recd by Brittany, Aug 6, 13:20, 5.8°C

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 12-NOV-13
Report Date: 26-NOV-13 12:36 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1390394**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-339044
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 | L1390394-1 | L1390394-2 | L1390394-3 | L1390394-4 | L1390394-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 |
| | Sampled Time | 12:00 | 12:00 | 12:00 | 12:00 | 12:00 |
| | Client ID | MW-H24A | MW-H24B | MW-H24C | MW-H25A | MW-H25B |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 8760 | 472 | 527 | 1010 | 653 |
| | Hardness (as CaCO3) (mg/L) | 1050 | 239 | 267 | 15.3 | 360 |
| | pH (pH) | 12.57 | 8.14 | 8.11 | 8.57 | 8.03 |
| | Total Suspended Solids (mg/L) | 56.9 | 8.5 | 10.5 | 7.5 | 3.3 |
| | Turbidity (NTU) | 34.6 | 4.37 | 20.3 | 15.2 | 3.85 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | 2.4 | 3.4 | <1.0 | 8.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | <1.0 | 270 | 311 | 570 | 383 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 113 | <1.0 | <1.0 | 31.6 | <1.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | 1750 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 1870 | 270 | 311 | 602 | 383 |
| | Ammonia, Total (as N) (mg/L) | 4.75 | 0.0173 | 0.180 | 0.396 | 0.0575 |
| | Bromide (Br) (mg/L) | <2.5 DLM | <0.050 | <0.050 | <0.50 DLM | <0.050 |
| | Chloride (Cl) (mg/L) | <25 DLM | <0.50 | <0.50 | <5.0 DLM | 1.30 |
| | Fluoride (F) (mg/L) | <1.0 DLM | 0.107 | 0.114 | 0.72 | 0.182 |
| | Nitrate (as N) (mg/L) | <0.25 DLM | 0.0542 | <0.0050 | <0.050 DLM | <0.0050 |
| | Nitrite (as N) (mg/L) | <0.050 DLM | <0.0010 | <0.0010 | <0.010 DLM | 0.0013 |
| | Total Kjeldahl Nitrogen (mg/L) | 5.85 | 0.079 | 0.441 | 0.450 | 0.139 |
| | Total Nitrogen (mg/L) | 5.85 | 0.133 | 0.441 | 0.450 | 0.140 |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | <0.0010 | <0.0010 | 0.0046 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0043 | <0.0020 | <0.0020 | 0.0122 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.0353 | 0.0112 | 0.125 | 0.0311 | 0.0091 |
| | Sulfate (SO4) (mg/L) | <25 DLM | 3.76 | 1.01 | <5.0 DLM | 5.85 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 25.2 | 1.82 | 2.29 | 1.74 | 2.86 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 1.48 | 0.0932 | 0.0059 | 0.927 | 0.0515 |
| | Antimony (Sb)-Total (mg/L) | 0.00213 | 0.00029 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00195 | 0.00027 | 0.00132 | 0.00037 | 0.00161 |
| | Barium (Ba)-Total (mg/L) | 3.81 | 0.893 | 1.07 | 1.18 | 0.303 |
| | Beryllium (Be)-Total (mg/L) | <0.00020 DLA | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.0010 DLA | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | <0.020 DLA | 0.015 | 0.029 | 0.202 | 0.014 |
| | Cadmium (Cd)-Total (mg/L) | 0.000562 | 0.000067 | <0.000010 | 0.000030 | 0.000030 |
| | Calcium (Ca)-Total (mg/L) | 455 | 73.4 | 73.5 | 3.66 | 97.2 |
| | Chromium (Cr)-Total (mg/L) | 0.0267 | 0.00028 | 0.00133 | 0.00152 | 0.00020 |
| | Cobalt (Co)-Total (mg/L) | 0.00137 | 0.00096 | <0.00010 | 0.00037 | 0.00136 |
| | Copper (Cu)-Total (mg/L) | 0.0288 | 0.00145 | <0.00050 | 0.00132 | <0.00050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1390394-6 | | | | |
| | **Description** | Water | | | | |
| | **Sampled Date** | 08-NOV-13 | | | | |
| | **Sampled Time** | 12:00 | | | | |
| | **Client ID** | MW-H25C | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | | | | |
| | Conductivity (uS/cm) | 523 | | | | |
| | Hardness (as CaCO3) (mg/L) | 266 | | | | |
| | pH (pH) | 8.11 | | | | |
| | Total Suspended Solids (mg/L) | 8.7 | | | | |
| | Turbidity (NTU) | 22.4 | | | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 3.3 | | | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 311 | | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 311 | | | | |
| | Ammonia, Total (as N) (mg/L) | 0.184 | | | | |
| | Bromide (Br) (mg/L) | <0.050 | | | | |
| | Chloride (Cl) (mg/L) | 0.56 | | | | |
| | Fluoride (F) (mg/L) | 0.115 | | | | |
| | Nitrate (as N) (mg/L) | <0.0050 | | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | | | | |
| | Total Kjeldahl Nitrogen (mg/L) | 0.256 | | | | |
| | Total Nitrogen (mg/L) | 0.256 | | | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | | | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0020 | | | | |
| | Phosphorus (P)-Total (mg/L) | 0.0986 | | | | |
| | Sulfate (SO4) (mg/L) | 0.98 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 2.29 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.0054 | | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | | | | |
| | Arsenic (As)-Total (mg/L) | 0.00127 | | | | |
| | Barium (Ba)-Total (mg/L) | 1.09 | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | | | | |
| | Boron (B)-Total (mg/L) | 0.028 | | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.000010 | | | | |
| | Calcium (Ca)-Total (mg/L) | 75.5 | | | | |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | | | | |
| | Copper (Cu)-Total (mg/L) | <0.00050 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1390394-1 | L1390394-2 | L1390394-3 | L1390394-4 | L1390394-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 |
| | Sampled Time | 12:00 | 12:00 | 12:00 | 12:00 | 12:00 |
| | Client ID | MW-H24A | MW-H24B | MW-H24C | MW-H25A | MW-H25B |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 1.94 | 0.181 | 3.95 | 0.873 | 0.388 |
| | Lead (Pb)-Total (mg/L) | 0.00434 | 0.000121 | <0.000050 | 0.000643 | 0.000056 |
| | Lithium (Li)-Total (mg/L) | 0.0953 | 0.00184 | 0.0170 | 0.523 | 0.00708 |
| | Magnesium (Mg)-Total (mg/L) | 0.571 | 18.9 | 23.1 | 1.90 | 32.9 |
| | Manganese (Mn)-Total (mg/L) | 0.0458 | 0.0474 | 0.334 | 0.0277 | 0.765 |
| | Mercury (Hg)-Total (mg/L) | 0.000023 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.0111 | 0.000769 | 0.00285 | 0.000812 | 0.00230 |
| | Nickel (Ni)-Total (mg/L) | 0.0047 | 0.00125 | <0.00050 | 0.00138 | 0.00346 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 10.5 | 0.889 | 0.974 | 0.878 | 0.622 |
| | Selenium (Se)-Total (mg/L) | 0.00040 | 0.00028 | <0.00010 | <0.00010 | 0.00010 |
| | Silicon (Si)-Total (mg/L) | 6.86 | 3.11 | 6.86 | 6.32 | 6.02 |
| | Silver (Ag)-Total (mg/L) | 0.000306 | <0.000010 | <0.000010 | 0.000016 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 514 | 10.5 | 14.4 | 265 | 8.6 |
| | Strontium (Sr)-Total (mg/L) | 7.05 | 0.207 | 0.551 | 0.134 | 0.273 |
| | Thallium (Tl)-Total (mg/L) | <0.000020 DLA | <0.000010 | <0.000010 | 0.000019 | 0.000014 |
| | Tin (Sn)-Total (mg/L) | 0.00742 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.073 | 0.012 | 0.010 | 0.049 | 0.014 |
| | Uranium (U)-Total (mg/L) | 0.000191 | 0.000502 | 0.000152 | 0.000098 | 0.00154 |
| | Vanadium (V)-Total (mg/L) | 0.0039 | <0.0010 | <0.0010 | 0.0033 | <0.0010 |
| | Zinc (Zn)-Total (mg/L) | 0.157 | 0.0033 | <0.0030 | 0.0070 | <0.0030 |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | LAB | LAB | LAB | LAB | LAB |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0590 | <0.0030 | 0.0043 | 0.0050 | <0.0030 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00027 | 0.00025 | <0.00010 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00023 | 0.00021 | 0.00124 | <0.00010 | 0.00166 |
| | Barium (Ba)-Dissolved (mg/L) | 3.67 | 0.904 | 1.05 | 1.13 | 0.287 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00020 DLA | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.0010 DLA | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | <0.020 DLA | 0.012 | 0.025 | 0.200 | 0.013 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000020 DLA | 0.000038 | <0.000010 | <0.000010 | <0.000010 |
| | Calcium (Ca)-Dissolved (mg/L) | 420 | 67.4 | 71.1 | 3.57 | 95.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.0186 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00025 | 0.00082 | <0.00010 | <0.00010 | 0.00128 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00632 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | 0.047 | 3.65 | 0.062 | 0.367 |
| | Lead (Pb)-Dissolved (mg/L) | 0.00098 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1390394-6 | | | | |
| | **Description** | Water | | | | |
| | **Sampled Date** | 08-NOV-13 | | | | |
| | **Sampled Time** | 12:00 | | | | |
| | **Client ID** | MW-H25C | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 3.98 | | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | | | | |
| | Lithium (Li)-Total (mg/L) | 0.0166 | | | | |
| | Magnesium (Mg)-Total (mg/L) | 23.6 | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.342 | | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.00283 | | | | |
| | Nickel (Ni)-Total (mg/L) | <0.00050 | | | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | | | | |
| | Potassium (K)-Total (mg/L) | 0.975 | | | | |
| | Selenium (Se)-Total (mg/L) | <0.00010 | | | | |
| | Silicon (Si)-Total (mg/L) | 7.01 | | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Total (mg/L) | 14.5 | | | | |
| | Strontium (Sr)-Total (mg/L) | 0.562 | | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Total (mg/L) | 0.010 | | | | |
| | Uranium (U)-Total (mg/L) | 0.000150 | | | | |
| | Vanadium (V)-Total (mg/L) | <0.0010 | | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | | | | |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | LAB | | | | |
| | Dissolved Metals Filtration Location | FIELD | | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0040 | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00130 | | | | |
| | Barium (Ba)-Dissolved (mg/L) | 1.02 | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | | | | |
| | Boron (B)-Dissolved (mg/L) | 0.025 | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 70.2 | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | | | | |
| | Iron (Fe)-Dissolved (mg/L) | 3.70 | | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1390394-1 Water 08-NOV-13 12:00 MW-H24A | L1390394-2 Water 08-NOV-13 12:00 MW-H24B | L1390394-3 Water 08-NOV-13 12:00 MW-H24C | L1390394-4 Water 08-NOV-13 12:00 MW-H25A | L1390394-5 Water 08-NOV-13 12:00 MW-H25B |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | 0.100 | 0.00153 | 0.0169 | 0.567 | 0.00724 |
| | Magnesium (Mg)-Dissolved (mg/L) | 0.043 | 17.3 | 21.8 | 1.56 | 29.7 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00010 | 0.0408 | 0.327 | 0.0226 | 0.710 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0101 | 0.000667 | 0.00258 | 0.000707 | 0.00218 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.0013 | 0.00099 | <0.00050 | <0.00050 | 0.00341 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 11.3 | 0.835 | 0.969 | 0.560 | 0.592 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00040 | 0.00028 | <0.00010 | <0.00010 | 0.00011 |
| | Silicon (Si)-Dissolved (mg/L) | 0.325 | 2.86 | 6.66 | 3.15 | 5.90 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000020 DLA | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 567 | 11.7 | 15.0 | 275 | 9.2 |
| | Strontium (Sr)-Dissolved (mg/L) | 6.67 | 0.188 | 0.523 | 0.139 | 0.262 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000020 DLA | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | 0.00096 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | 0.016 | <0.010 | <0.010 | <0.010 | 0.011 |
| | Uranium (U)-Dissolved (mg/L) | <0.000020 DLA | 0.000469 | 0.000147 | 0.000020 | 0.00140 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0020 DLA | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0173 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |
| **Aggregate Organics** | COD (mg/L) | 79 | <20 | <20 | <20 | <20 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1390394-6 | | | | |
| | **Description** | Water | | | | |
| | **Sampled Date** | 08-NOV-13 | | | | |
| | **Sampled Time** | 12:00 | | | | |
| | **Client ID** | MW-H25C | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | 0.0172 | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 22.1 | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.318 | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00260 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 0.956 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 6.63 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 14.8 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.536 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000140 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | | | | |
| **Aggregate Organics** | COD (mg/L) | <20 | | | | |

* 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 | Barium (Ba)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Total Nitrogen | MS-B | L1390394-2, -4, -5, -6 |
| Matrix Spike | Antimony (Sb)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Total Organic Carbon | MS-B | L1390394-1 |
| Matrix Spike | Ammonia, Total (as N) | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1390394-1, -2, -3, -4, -5, -6 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit adjusted for required dilution |
| DLM | Detection Limit Adjusted due to sample matrix effects. |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

**ALK-PCT-VA** Water Alkalinity by Auto. Titration APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

**ALK-SCR-VA** Water Alkalinity by colour or titration EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

**ANIONS-BR-IC-VA** Water Bromide by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-CL-IC-VA** Water Chloride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-F-IC-VA** Water Fluoride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-NO2-IC-VA** Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

**ANIONS-NO3-IC-VA** Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

**ANIONS-SO4-IC-VA** Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**CARBONS-TOC-VA** Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

**COD-COL-VA** Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**EC-PCT-VA** Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**HARDNESS-CALC-VA** Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

# Reference Information

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**N-T-COL-VA** Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**P-T-COL-VA** Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

**P-TD-COL-VA** Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PO4-DO-COL-VA** Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**TKN-CALC-VA** Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

**TSS-VA** Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

**TURBIDITY-VA** Water Turbidity by Meter APHA 2130 Turbidity

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-339044

**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.*

10- 339044

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

L1390394

Page 1 of 1

| Report To | | Report Format / Distribution | | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) | |
|---|---|---|---|---|---|
| Company: | Rescan-ERM | Standard: X | Other (specify): | X | Regular (Standard Turnaround Times - Business Days) |
| Contact: | Tyler Gale | Select: PDF X | Excel X Digital Fax | | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 1111 W. Hastings St. Vancouver BC | Email 1: | Tyler.Gale@erm.com | | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | | Email 2: | Yaming.Chen@erm.com | | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: | 604-689-9460 Fax: | | | Analysis Request | |
| Invoice To | Same as Report ? (circle) (Yes) or No (if No, provide details) | Client / Project Information | | ( Indicate Filtered or Preserved, F/P ) | |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: | 0194106-0000-0005 | | |
| Company: | | PO / AFE: | | | |
| Contact: | | LSD: | | | |
| Address: | | | | | |
| Phone: | Fax: | Quote #: | | | |
| Lab Work Order # (lab use only) | | ALS Contact: | Sampler: | | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chemistry | Nutrients /Toc | Total Metals | Dissolved Metals | Total Hg | Dissolved Hg | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW-H24A | | | Water | | | | | | | 6 |
| | MW-H24B | | | " | | | | | | | 6 |
| | MW-H24C | | | " | | | | | | | 6 |
| | MW-H25A | | | " | | | | | | | 6 |
| | MW-H25B | | | " | | | | | | | 6 |
| | MW-H25C | | | " | | | | | | | 6 |

**Short Holding Time**

*Rush Processing*

L1390394-COFC

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

~~Field pH for MW-H24A was 13.1~~

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Tyler Gale | Nov. 11/13 | Noon | HB | NOV 12 13 | 8:55 AM Drop Box | 1 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

GENF 18.01 Front

Brit Nov. 13 8:50 3.0

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 12-NOV-13
Report Date: 25-NOV-13 16:59 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1390524**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-339045
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 | L1390524-1 | L1390524-2 | L1390524-3 | L1390524-4 | L1390524-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 |
| | Sampled Time | 12:00 | 12:00 | 12:00 | 12:00 | 12:00 |
| | Client ID | MW-26A | MW-26B | MW-26C | MW-27 | MW-28 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | 6.0 | <5.0 | <5.0 | 15.7 |
| | Conductivity (uS/cm) | 1030 | 722 | 474 | 1260 | 1160 |
| | Hardness (as CaCO3) (mg/L) | 18.6 | 386 | 249 | 14.6 | 42.5 |
| | pH (pH) | 9.06 | 8.00 | 8.13 | 8.72 | 8.40 |
| | Total Suspended Solids (mg/L) | 7.2 | 5.4 | 3.1 | 476 | 270 |
| | Turbidity (NTU) | 15.2 | 5.91 | 2.82 | 818 | 206 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | 6.7 | 2.6 | <1.0 | <1.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 497 | 351 | 272 | 676 | 528 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 100 | <1.0 | <1.0 | 61.5 | 14.6 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 597 | 351 | 272 | 738 | 542 |
| | Ammonia, Total (as N) (mg/L) | 0.384 | 0.0894 | 0.0166 | 0.370 | 0.446 |
| | Bromide (Br) (mg/L) | <0.50 DLM | <0.25 DLM | <0.050 | <0.50 DLM | <0.50 DLM |
| | Chloride (Cl) (mg/L) | <5.0 DLM | <2.5 DLM | <0.50 | 6.7 | 7.9 |
| | Fluoride (F) (mg/L) | 0.68 | 0.13 | 0.106 | 0.93 | 0.53 |
| | Nitrate (as N) (mg/L) | <0.050 DLM | <0.025 DLM | 0.0525 | <0.050 DLM | <0.050 DLM |
| | Nitrite (as N) (mg/L) | <0.010 DLM | 0.0068 | 0.0015 | 0.014 | 0.011 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.460 | 0.276 | 0.065 | 0.69 | 1.46 |
| | Total Nitrogen (mg/L) | 0.460 | 0.283 | 0.119 | 0.70 DLA | 1.48 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0781 | 0.0146 | <0.0010 | 0.0072 | 0.0025 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0861 | 0.0138 | <0.0020 | 0.0460 | 0.0150 |
| | Phosphorus (P)-Total (mg/L) | 0.128 | 0.0368 | 0.0072 | 0.745 | 0.523 |
| | Sulfate (SO4) (mg/L) | 5.3 | 73.1 | 3.72 | <5.0 DLM | 107 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 2.66 | 3.48 | 1.52 | 11.8 | 27.7 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 1.07 | 0.107 | 0.0979 | 10.2 | 4.54 |
| | Antimony (Sb)-Total (mg/L) | 0.00101 | 0.00013 | 0.00028 | 0.00095 | 0.00035 |
| | Arsenic (As)-Total (mg/L) | 0.00101 | 0.00211 | 0.00031 | 0.0108 | 0.00636 |
| | Barium (Ba)-Total (mg/L) | 0.581 | 0.0844 | 0.864 | 1.63 | 0.669 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00082 | 0.00032 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.0010 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.229 | 0.056 | 0.014 | 0.231 | 0.200 |
| | Cadmium (Cd)-Total (mg/L) | 0.000068 | 0.000095 | 0.000058 | 0.000597 | 0.000626 |
| | Calcium (Ca)-Total (mg/L) | 5.55 | 91.9 | 73.5 | 15.0 | 14.4 |
| | Chromium (Cr)-Total (mg/L) | 0.00193 | 0.00026 | 0.00022 | 0.0137 | 0.00986 |
| | Cobalt (Co)-Total (mg/L) | 0.00024 | 0.00257 | 0.00097 | 0.00835 | 0.00367 |
| | Copper (Cu)-Total (mg/L) | 0.00112 | 0.00065 | <0.00050 | 0.0273 | 0.00907 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1390524-6 | L1390524-7 | | | |
|---|---|---|---|---|---|---|
| | Description | Water | Water | | | |
| | Sampled Date | 08-NOV-13 | 08-NOV-13 | | | |
| | Sampled Time | 12:00 | 12:00 | | | |
| | Client ID | MW-29 | ALS TRAVEL BLANK | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | | | |
| | Conductivity (uS/cm) | 689 | <2.0 | | | |
| | Hardness (as CaCO3) (mg/L) | 8.47 | <0.50 | | | |
| | pH (pH) | 8.34 | 5.68 | | | |
| | Total Suspended Solids (mg/L) | 7.4 | <3.0 | | | |
| | Turbidity (NTU) | 32.7 | <0.10 | | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | 1.4 | | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 376 | <1.0 | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 5.6 | <1.0 | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 382 | <1.0 | | | |
| | Ammonia, Total (as N) (mg/L) | 0.201 | <0.0050 | | | |
| | Bromide (Br) (mg/L) | <0.25 DLM | <0.050 | | | |
| | Chloride (Cl) (mg/L) | 3.9 | <0.50 | | | |
| | Fluoride (F) (mg/L) | 0.35 | <0.020 | | | |
| | Nitrate (as N) (mg/L) | <0.025 DLM | <0.0050 | | | |
| | Nitrite (as N) (mg/L) | <0.0050 DLM | <0.0010 | | | |
| | Total Kjeldahl Nitrogen (mg/L) | 0.279 | <0.050 | | | |
| | Total Nitrogen (mg/L) | 0.279 | <0.050 | | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0687 | <0.0010 | | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0755 | <0.0020 | | | |
| | Phosphorus (P)-Total (mg/L) | 0.142 | <0.0020 | | | |
| | Sulfate (SO4) (mg/L) | 9.9 | <0.50 | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 3.03 | <0.50 | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 1.25 | <0.0030 | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | | | |
| | Arsenic (As)-Total (mg/L) | 0.00147 | <0.00010 | | | |
| | Barium (Ba)-Total (mg/L) | 0.103 | <0.000050 | | | |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | | | |
| | Boron (B)-Total (mg/L) | 0.186 | <0.010 | | | |
| | Cadmium (Cd)-Total (mg/L) | 0.000070 | <0.000010 | | | |
| | Calcium (Ca)-Total (mg/L) | 2.83 | <0.020 | | | |
| | Chromium (Cr)-Total (mg/L) | 0.00226 | <0.00010 | | | |
| | Cobalt (Co)-Total (mg/L) | 0.00076 | <0.00010 | | | |
| | Copper (Cu)-Total (mg/L) | 0.00176 | <0.00050 | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1390524-1 | L1390524-2 | L1390524-3 | L1390524-4 | L1390524-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 | 08-NOV-13 |
| | Sampled Time | 12:00 | 12:00 | 12:00 | 12:00 | 12:00 |
| | Client ID | MW-26A | MW-26B | MW-26C | MW-27 | MW-28 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 0.432 | 0.313 | 0.185 | 20.4 | 4.97 |
| | Lead (Pb)-Total (mg/L) | 0.000356 | 0.000125 | 0.000114 | 0.0173 | 0.00391 |
| | Lithium (Li)-Total (mg/L) | 0.608 | 0.00657 | 0.00224 | 0.726 | 0.244 |
| | Magnesium (Mg)-Total (mg/L) | 1.93 | 36.7 | 17.9 | 8.06 | 5.49 |
| | Manganese (Mn)-Total (mg/L) | 0.0121 | 1.17 | 0.0486 | 0.124 | 0.567 |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000050 DLM | <0.000050 DLM |
| | Molybdenum (Mo)-Total (mg/L) | 0.00992 | 0.00346 | 0.000780 | 0.0149 | 0.0201 |
| | Nickel (Ni)-Total (mg/L) | 0.00104 | 0.00722 | 0.00121 | 0.0304 | 0.0155 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | 0.89 | 0.38 |
| | Potassium (K)-Total (mg/L) | 0.996 | 2.51 | 0.881 | 2.63 | 2.48 |
| | Selenium (Se)-Total (mg/L) | <0.00010 | 0.00033 | 0.00030 | 0.00175 | 0.00038 |
| | Silicon (Si)-Total (mg/L) | 6.95 | 6.92 | 3.14 | 98.5 | 15.4 |
| | Silver (Ag)-Total (mg/L) | 0.000011 | 0.000013 | <0.000010 | 0.000454 | 0.000102 |
| | Sodium (Na)-Total (mg/L) | 277 | 21.7 | 10.5 | 333 | 278 |
| | Strontium (Sr)-Total (mg/L) | 0.141 | 0.327 | 0.209 | 0.215 | 0.187 |
| | Thallium (Tl)-Total (mg/L) | 0.000016 | 0.000030 | <0.000010 | 0.000276 | 0.000135 |
| | Tin (Sn)-Total (mg/L) | 0.00030 | <0.00010 | <0.00010 | 0.00212 | 0.00290 |
| | Titanium (Ti)-Total (mg/L) | 0.032 | 0.017 | 0.012 | 2.01 | 0.085 |
| | Uranium (U)-Total (mg/L) | 0.000614 | 0.00682 | 0.000542 | 0.00249 | 0.00395 |
| | Vanadium (V)-Total (mg/L) | 0.0040 | <0.0010 | <0.0010 | 0.0234 | 0.0097 |
| | Zinc (Zn)-Total (mg/L) | 0.0057 | <0.0030 | <0.0030 | 0.132 | 0.0393 |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.127 | 0.0043 | <0.0030 | 0.0076 | 0.0142 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00098 | <0.00010 | 0.00026 | 0.00036 | 0.00024 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00087 | 0.00223 | 0.00022 | 0.00058 | 0.00482 |
| | Barium (Ba)-Dissolved (mg/L) | 0.547 | 0.0790 | 0.861 | 0.988 | 0.0491 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00020 DLA | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.0010 DLA | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | 0.197 | 0.048 | 0.012 | 0.221 | 0.192 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | 0.000029 | 0.000036 | 0.000033 | 0.000020 |
| | Calcium (Ca)-Dissolved (mg/L) | 4.86 | 94.4 | 71.7 | 3.90 | 10.3 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00023 | <0.00010 | <0.00010 | <0.00020 DLA | 0.00021 |
| | Cobalt (Co)-Dissolved (mg/L) | <0.00010 | 0.00258 | 0.00082 | 0.00024 | 0.00166 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | 0.00146 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | 0.054 | 0.287 | 0.049 | <0.030 | 0.396 |
| | Lead (Pb)-Dissolved (mg/L) | 0.000159 | <0.000050 | <0.000050 | 0.00013 | 0.000052 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1390524-6 | L1390524-7 | | | |
|---|---|---|---|---|---|---|
| | Description | Water | Water | | | |
| | Sampled Date | 08-NOV-13 | 08-NOV-13 | | | |
| | Sampled Time | 12:00 | 12:00 | | | |
| | Client ID | MW-29 | ALS TRAVEL BLANK | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 0.937 | <0.030 | | | |
| | Lead (Pb)-Total (mg/L) | 0.000476 | <0.000050 | | | |
| | Lithium (Li)-Total (mg/L) | 0.169 | <0.00050 | | | |
| | Magnesium (Mg)-Total (mg/L) | 0.579 | <0.0050 | | | |
| | Manganese (Mn)-Total (mg/L) | 0.132 | <0.000050 | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000050 DLM | <0.000010 | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.000857 | <0.000050 | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00271 | <0.00050 | | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | | | |
| | Potassium (K)-Total (mg/L) | 0.893 | <0.050 | | | |
| | Selenium (Se)-Total (mg/L) | <0.00010 | <0.00010 | | | |
| | Silicon (Si)-Total (mg/L) | 8.23 | <0.050 | | | |
| | Silver (Ag)-Total (mg/L) | 0.000012 | <0.000010 | | | |
| | Sodium (Na)-Total (mg/L) | 176 | <2.0 | | | |
| | Strontium (Sr)-Total (mg/L) | 0.0297 | <0.00020 | | | |
| | Thallium (Tl)-Total (mg/L) | 0.000048 | <0.000010 | | | |
| | Tin (Sn)-Total (mg/L) | 0.00012 | <0.00010 | | | |
| | Titanium (Ti)-Total (mg/L) | 0.058 | <0.010 | | | |
| | Uranium (U)-Total (mg/L) | 0.000635 | <0.000010 | | | |
| | Vanadium (V)-Total (mg/L) | 0.0041 | <0.0010 | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0041 | <0.0030 | | | |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | FIELD | | | | |
| | Dissolved Metals Filtration Location | FIELD | | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0064 | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00118 | | | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0657 | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | | | | |
| | Boron (B)-Dissolved (mg/L) | 0.177 | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 2.72 | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00036 | | | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | | | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.148 | | | | |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1390524-1 Water 08-NOV-13 12:00 MW-26A | L1390524-2 Water 08-NOV-13 12:00 MW-26B | L1390524-3 Water 08-NOV-13 12:00 MW-26C | L1390524-4 Water 08-NOV-13 12:00 MW-27 | L1390524-5 Water 08-NOV-13 12:00 MW-28 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | 0.521 | 0.00571 | 0.00221 | 0.764 | 0.232 |
| | Magnesium (Mg)-Dissolved (mg/L) | 1.58 | 36.5 | 17.0 | 1.18 | 4.11 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.00676 | 1.17 | 0.0413 | 0.0102 | 0.520 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00899 | 0.00291 | 0.000716 | 0.0138 | 0.0225 |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | 0.00621 | 0.00105 | 0.0025 | 0.00946 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.687 | 2.32 | 0.828 | 0.66 | 1.35 |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 | 0.00021 | 0.00032 | <0.00020 DLA | 0.00030 |
| | Silicon (Si)-Dissolved (mg/L) | 4.80 | 6.35 | 2.81 | 2.95 | 4.04 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000020 DLA | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 277 | 23.5 | 10.4 | 352 | 295 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.134 | 0.316 | 0.204 | 0.150 | 0.127 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | 0.000014 | 0.000011 | <0.000020 DLA | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | 0.00019 | <0.00010 | <0.00010 | 0.00076 | 0.00020 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | 0.012 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.000508 | 0.00650 | 0.000465 | 0.000574 | 0.00294 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0020 DLA | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0037 | 0.0033 | <0.0030 | 0.0038 | 0.0032 |
| **Aggregate Organics** | COD (mg/L) | <20 | <20 | <20 | 86 | 67 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1390524-6 | L1390524-7 | | | |
|---|---|---|---|---|---|---|
| | Description | Water | Water | | | |
| | Sampled Date | 08-NOV-13 | 08-NOV-13 | | | |
| | Sampled Time | 12:00 | 12:00 | | | |
| | Client ID | MW-29 | ALS TRAVEL BLANK | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | 0.173 | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 0.406 | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.121 | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000566 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00156 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 0.498 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 4.25 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 185 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0286 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000539 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | | | | |
| **Aggregate Organics** | COD (mg/L) | <20 | <20 | | | |

* 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 | Total Nitrogen | MS-B | L1390524-1, -2, -3, -4, -5, -6, -7 |
| Matrix Spike | Total Organic Carbon | MS-B | L1390524-5 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Lithium (Li)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Total | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Total | MS-B | L1390524-7 |
| Matrix Spike | Calcium (Ca)-Total | MS-B | L1390524-7 |
| Matrix Spike | Copper (Cu)-Total | MS-B | L1390524-7 |
| Matrix Spike | Magnesium (Mg)-Total | MS-B | L1390524-7 |
| Matrix Spike | Strontium (Sr)-Total | MS-B | L1390524-7 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Cobalt (Co)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1390524-1, -2, -3, -4, -5, -6 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit Adjusted For required dilution |
| DLM | Detection Limit Adjusted due to sample matrix effects. |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

**ALK-PCT-VA** Water Alkalinity by Auto. Titration APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

**ALK-PCT-VA** Water Alkalinity by Auto. Titration APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

**ALK-SCR-VA** Water Alkalinity by colour or titration EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

**ANIONS-BR-IC-VA** Water Bromide by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-CL-IC-VA** Water Chloride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-F-IC-VA** Water Fluoride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**ANIONS-NO2-IC-VA** Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

**ANIONS-NO3-IC-VA** Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

**ANIONS-SO4-IC-VA** Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**CARBONS-TOC-VA** Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

**COD-COL-VA** Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**EC-PCT-VA** Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**HARDNESS-CALC-VA** Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the

# Reference Information

American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**N-T-COL-VA** Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**P-T-COL-VA** Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

**P-TD-COL-VA** Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PO4-DO-COL-VA** Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**TKN-CALC-VA** Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

**TSS-VA** Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

# Reference Information

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-339045

**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.*

10- 339045

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

L1390524 Page 1 of 1

| Report To | Report Format / Distribution | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: ERM-Rescan | Standard: X Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Tyler Gale | Select: PDF X Excel X Digital Fax | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: 1111 W. Hastings St. Vancouver BC | Email 1: Tyler.Gale@erm.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | Email 2: Yaming.Chen@erm.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: 604-689-9460 Fax: | | |
| **Invoice To** Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | **Analysis Request** |
| Copy of Invoice with Report? (circle) Yes or No | Job #: 0194106-0002-0005 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: Fax: | Quote #: | |
| **Lab Work Order # (lab use only)** | **ALS Contact:** **Sampler:** | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chemistry | Nutrients | Total Metals | Dissolved Metals | Total Hg | Dissolved Hg | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW-26A | | | Water | | | | | | | 6 |
| | MW-26B | | | " | | | | | | | 6 |
| | MW-26C | | | " | | | | | | | 6 |
| | MW-27 | | | " | | | | | | | 6 |
| | MW-28 | | | " | | | | | | | 6 |
| | MW-29 | | | " | | | | | | | 6 |
| | ALS Travel Blank | | | " | | | | F | | F | 4 |

**Short Holding Time**

*Rush Processing*

L1390524-COFC

Special Instructions / Regulation with water or land use (CCME- Fre... atural/ETC) / Hazardous Details

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Tyler Gale | Nov. 11 2013 | Noon | HB | Nov 12-13 | 9:09 DROP Box | 5 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY GENF 18.01 Front

Brit Nov. 13 8:50 2.1

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 15-FEB-14
Report Date: 26-FEB-14 15:28 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1422938**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-143968
Legal Site Desc:

Amber Springer
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1422938-1 | L1422938-2 | L1422938-3 | L1422938-4 | L1422938-5 |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | water |
| | Sampled Date | 11-FEB-14 | 11-FEB-14 | 12-FEB-14 | 12-FEB-14 | 13-FEB-14 |
| | Sampled Time | 14:30 | 15:30 | 15:30 | 15:00 | 14:00 |
| | Client ID | MW-H26B | MW-H29 | MW-H26A | MW-H25B | MW-H24C |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 720 | 665 | 1050 | 643 | 515 |
| | Hardness (as CaCO3) (mg/L) | 353 | 8.37 | 18.9 | 363 | 272 |
| | pH (pH) | 8.30 | 8.57 | 8.91 | 7.93 | 8.08 |
| | Total Suspended Solids (mg/L) | 24.5 | <3.0 | <3.0 | 10.6 | <3.0 |
| | Turbidity (NTU) | 15.7 | 4.92 | 1.12 | 10.8 | 13.0 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | 9.3 | 3.5 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 345 | 344 | 472 | 392 | 314 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <1.0 | 14.2 | 73.8 | <2.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <2.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 345 | 358 | 546 | 392 | 314 |
| | Ammonia, Total (as N) (mg/L) | 0.165 | 0.189 | 0.375 | 0.073 | 0.204 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.50 DLM | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | 1.32 | 2.35 | <5.0 DLM | 1.26 | <0.50 |
| | Fluoride (F) (mg/L) | 0.133 | 0.381 | 0.67 | 0.175 | 0.113 |
| | Nitrate (as N) (mg/L) | 0.0183 | <0.0050 | <0.050 DLM | <0.0050 | <0.0050 |
| | Nitrite (as N) (mg/L) | 0.0064 | <0.0010 | <0.010 DLM | <0.0010 | <0.0010 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.404 | 0.286 | 0.489 | 0.204 | 0.246 |
| | Total Nitrogen (mg/L) | 0.429 | 0.286 | 0.489 | 0.204 | 0.246 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0064 | 0.0646 | 0.0710 | 0.0012 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0057 | 0.0651 | 0.0802 | <0.0020 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.0707 | 0.0857 | 0.0824 | 0.0216 | 0.0669 |
| | Sulfate (SO4) (mg/L) | 79.9 | 6.31 | <5.0 DLM | 6.06 | 1.43 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 5.69 | 3.05 | 3.04 | 4.05 | 1.13 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.367 | 0.236 | 0.130 | 0.223 | 0.0053 |
| | Antimony (Sb)-Total (mg/L) | 0.00014 | <0.00010 | 0.00044 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00160 | 0.00081 | 0.00042 | 0.00159 | 0.00054 |
| | Barium (Ba)-Total (mg/L) | 0.0752 | 0.0843 | 0.616 | 0.276 | 0.999 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.045 | 0.173 | 0.178 | 0.013 | 0.023 |
| | Cadmium (Cd)-Total (mg/L) | 0.000085 | 0.000030 | 0.000012 | 0.000025 | <0.000010 |
| | Calcium (Ca)-Total (mg/L) | 79.6 | 2.60 | 4.26 | 99.7 | 66.6 |
| | Chromium (Cr)-Total (mg/L) | 0.00069 | 0.00058 | 0.00027 | 0.00040 | <0.00010 |
| | Cobalt (Co)-Total (mg/L) | 0.00242 | 0.00028 | <0.00010 | 0.00139 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.00250 | 0.00060 | <0.00050 | 0.00054 | <0.00050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1422938-1 water 11-FEB-14 14:30 MW-H26B | L1422938-2 water 11-FEB-14 15:30 MW-H29 | L1422938-3 water 12-FEB-14 15:30 MW-H26A | L1422938-4 water 12-FEB-14 15:00 MW-H25B | L1422938-5 water 13-FEB-14 14:00 MW-H24C |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 0.778 | 0.318 | 0.071 | 0.840 | 2.15 |
| | Lead (Pb)-Total (mg/L) | 0.000465 | 0.000310 | 0.000129 | 0.000187 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.00430 | 0.154 | 0.457 | 0.00739 | 0.0144 |
| | Magnesium (Mg)-Total (mg/L) | 32.6 | 0.349 | 1.86 | 30.8 | 22.5 |
| | Manganese (Mn)-Total (mg/L) | 0.900 | 0.0829 | 0.00885 | 0.699 | 0.107 |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00280 | 0.000274 | 0.00637 | 0.00203 | 0.00156 |
| | Nickel (Ni)-Total (mg/L) | 0.00699 | 0.00126 | <0.00050 | 0.00340 | <0.00050 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 2.22 | 0.384 | 0.655 | 0.617 | 0.827 |
| | Selenium (Se)-Total (mg/L) | 0.00017 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Silicon (Si)-Total (mg/L) | 6.48 | 4.64 | 4.77 | 5.89 | 6.62 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 18.6 | 165 | 277 | 8.1 | 13.1 |
| | Strontium (Sr)-Total (mg/L) | 0.326 | 0.0308 | 0.127 | 0.264 | 0.442 |
| | Thallium (Tl)-Total (mg/L) | 0.000026 | 0.000013 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | 0.00018 | 0.00021 | 0.00017 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | 0.020 | <0.010 | <0.010 | 0.015 | <0.010 |
| | Uranium (U)-Total (mg/L) | 0.00565 | 0.000356 | 0.000346 | 0.00132 | 0.000098 |
| | Vanadium (V)-Total (mg/L) | 0.0011 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Total (mg/L) | 0.0037 | <0.0030 | <0.0030 | 0.0034 | <0.0030 |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | 0.0044 | 0.112 | <0.0030 | 0.0042 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00045 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00154 | 0.00103 DTC | 0.00043 | 0.00147 | 0.00051 |
| | Barium (Ba)-Dissolved (mg/L) | 0.0732 | 0.0428 | 0.626 | 0.267 | 1.03 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | 0.044 | 0.169 | 0.191 | 0.010 | 0.023 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000038 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Calcium (Ca)-Dissolved (mg/L) | 85.0 | 2.84 | 4.49 | 96.2 | 72.9 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00015 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00220 | 0.00023 | <0.00010 | 0.00120 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | 0.182 | 0.135 | 0.048 | 0.526 | 2.15 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | 0.000107 | <0.000050 | <0.000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1422938-1 water 11-FEB-14 14:30 MW-H26B | L1422938-2 water 11-FEB-14 15:30 MW-H29 | L1422938-3 water 12-FEB-14 15:30 MW-H26A | L1422938-4 water 12-FEB-14 15:00 MW-H25B | L1422938-5 water 13-FEB-14 14:00 MW-H24C |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | 0.00414 | 0.155 | 0.500 | 0.00664 | 0.0165 |
| | Magnesium (Mg)-Dissolved (mg/L) | 34.1 | 0.312 | 1.87 | 29.8 | 22.0 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.978 | 0.0971 | 0.00818 | 0.673 | 0.105 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00268 | 0.000269 | 0.00626 | 0.00195 | 0.00159 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00612 | 0.00098 | <0.00050 | 0.00278 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 2.30 | 0.401 | 0.664 | 0.533 | 0.826 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00011 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Silicon (Si)-Dissolved (mg/L) | 5.68 | 4.14 | 4.60 | 5.37 | 6.59 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 19.2 | 173 | 276 | 8.3 | 13.3 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.341 | 0.0243 | 0.134 | 0.256 | 0.483 |
| | Thallium (Tl)-Dissolved (mg/L) | 0.000013 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00014 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.00554 | 0.000415 | 0.000357 | 0.00130 | 0.000091 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |

* 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) |
|---|---|---|---|
| Duplicate | Bromide (Br) | DLM | L1422938-1, -2, -3, -4, -5 |
| Duplicate | Fluoride (F) | DLM | L1422938-1, -2, -3, -4, -5 |
| Matrix Spike | Orthophosphate-Dissolved (as P) | MS-B | L1422938-2, -3, -4, -5 |
| Matrix Spike | Sulfate (SO4) | MS-B | L1422938-1, -2, -3, -4, -5 |
| Matrix Spike | Total Nitrogen | MS-B | L1422938-1, -2, -3, -4, -5 |
| Matrix Spike | Total Nitrogen | MS-B | L1422938-1, -2, -3, -4, -5 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1422938-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1422938-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1422938-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1422938-1, -2, -3, -4, -5 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLM | Detection Limit Adjusted due to sample matrix effects. |
| DTC | Dissolved concentration exceeds total. Results were confirmed by re-analysis. |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

# Reference Information

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-T-COL-VA** | Water | Total Nitrogen in water by Colour | USGS - 03 - 4174 / NEMI 5735 |

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

# Reference Information

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-143968

**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.*

10-143968

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

Page ____ of ____

| Report To | Report Format / Distribution | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: ERM-Rescan | Standard: X Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Tyler Gale | Select: PDF X Excel X Digital Fax | Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: 15th Floor 1111 W. Hastings St. Vancouver BC | Email 1: Tyler.Gale@erm.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| Phone: 604 689 9460 Fax: | Email 2: Yaming.Chen@erm.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |

| Invoice To | Client / Project Information |
|---|---|
| Same as Report ? (circle) (Yes) or No (if No, provide details) | Job #: 0194106-0002-0005 |
| Copy of Invoice with Report? (circle) Yes or No | PO / AFE: |
| Company: | LSD: |
| Contact: | |
| Address: | Quote #: |
| Phone: | ALS Contact: Sampler: |

Lab Work Order # ( L1422938-COFC

**Analysis Request** ( Indicate Filtered or Preserved, F/P )

| Sample # | (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chem. | Nutrients P | Total Metals P | Total Hg P | Dissolved Metals F/P | Dissolved Hg F/P | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ~~MW-H26B~~ MW-H26B | 11-Feb-14 | 14:30 | Water | | | | | | | 6 |
| | MW-H29 | 11-Feb-14 | 15:30 | Water | | | | | | | 6 |
| | MW-H26A | 12-Feb-14 | 15:30 | Water | | | | | | | 6 |
| | MW-H25B | 12-Feb-14 | 15:00 | Water | | | | | | | 6 |
| | MW-H24C | 13-Feb-14 | 14:00 | Water | | | | | | | 6 |

**Short Holding Time**

*Rush Processing*

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

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Tyler Gale | 14-Feb-14 | Afternoon | SAIK | 14-Feb-14 | 15:45 | 4 °C | | | | |
| | | | PR | 15FEB | 12:30 | 6 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY GENF 18.01 Front

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 15-FEB-14
Report Date: 28-FEB-14 12:48 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1422942**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-143967
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 | L1422942-1 | L1422942-2 | L1422942-3 | L1422942-4 | L1422942-5 |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | water |
| | Sampled Date | 09-FEB-14 | 08-FEB-14 | 09-FEB-14 | 08-FEB-14 | 10-FEB-14 |
| | Sampled Time | 14:20 | 15:30 | 12:00 | 12:00 | 16:15 |
| | Client ID | MW-H17 | MW-H22 | MW-SHAFT | MW-H23 | MW-H24B |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 517 | 573 | 1330 | 436 | 449 |
| | Hardness (as CaCO3) (mg/L) | 266 | 340 | 650 | 234 | 239 |
| | pH (pH) | 8.23 | 8.07 | 7.87 | 8.10 | 8.24 |
| | Total Suspended Solids (mg/L) | <3.0 | 40.3 | 9.1 | 405 | <3.0 |
| | Turbidity (NTU) | 2.17 | 28.3 | 7.85 | 354 | 1.11 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 1.5 | 4.1 | 11.7 | 2.2 | <1.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 277 | 344 | 372 | 247 | 261 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 277 | 344 | 372 | 247 | 261 |
| | Ammonia, Total (as N) (mg/L) | 0.047 | 0.0071 | <0.0050 | 0.017 | 0.021 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.50 DLM | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | <0.50 | 1.64 | 219 | 0.56 | <0.50 |
| | Fluoride (F) (mg/L) | 0.121 | 0.047 | <0.20 DLM | 0.079 | 0.112 |
| | Nitrate (as N) (mg/L) | 0.0209 | 0.465 | <0.050 DLM | 0.237 | 0.0821 |
| | Nitrite (as N) (mg/L) | 0.0083 | <0.0010 | <0.010 DLM | <0.0010 | <0.0010 |
| | Total Kjeldahl Nitrogen (mg/L) | 0.069 | <0.11 | 0.189 | 0.232 | 0.068 |
| | Total Nitrogen (mg/L) | 0.098 | 0.554 | 0.189 | 0.469 | 0.150 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0044 | 0.0049 | 0.0024 | 0.0019 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0057 | 0.0062 | 0.0054 | 0.0045 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.0126 | 0.0579 | 0.0226 | 0.388 | 0.0055 |
| | Sulfate (SO4) (mg/L) | 11.2 | 5.14 | 5.4 | 6.98 | 4.63 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 1.33 | 2.03 | 6.43 | 7.2 | 1.17 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.147 | 0.400 | 0.188 | 5.45 | 0.0109 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | 0.00011 | <0.00010 | 0.00109 | 0.00027 |
| | Arsenic (As)-Total (mg/L) | 0.00089 | 0.00057 | 0.00038 | 0.00762 | 0.00035 |
| | Barium (Ba)-Total (mg/L) | 0.327 | 0.247 | 0.713 | 0.387 | 0.850 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00033 | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.017 | <0.010 | <0.010 | 0.018 | 0.011 |
| | Cadmium (Cd)-Total (mg/L) | 0.000018 | 0.000173 | 0.000165 | 0.00242 | 0.000042 |
| | Calcium (Ca)-Total (mg/L) | 78.9 | 98.1 | 188 | 99.0 | 67.9 |
| | Chromium (Cr)-Total (mg/L) | 0.00025 | 0.00245 | 0.00034 | 0.0115 | <0.00010 |
| | Cobalt (Co)-Total (mg/L) | 0.00055 | 0.00033 | 0.00132 | 0.0104 | 0.00074 |
| | Copper (Cu)-Total (mg/L) | <0.00050 | 0.00154 | 0.00133 | 0.0168 | 0.00062 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1422942-6 |
|---|---|---|
| | Description | water |
| | Sampled Date | 10-FEB-14 |
| | Sampled Time | 17:30 |
| | Client ID | MW-H27 |
| **Grouping** | **Analyte** | |
| **WATER** | | |
| **Physical Tests** | Colour, True (CU) | <5.0 |
| | Conductivity (uS/cm) | 1260 |
| | Hardness (as CaCO3) (mg/L) | 12.5 |
| | pH (pH) | 8.79 |
| | Total Suspended Solids (mg/L) | <3.0 |
| | Turbidity (NTU) | 1.15 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 627 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 62.2 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 689 |
| | Ammonia, Total (as N) (mg/L) | 0.420 |
| | Bromide (Br) (mg/L) | <0.50 DLM |
| | Chloride (Cl) (mg/L) | 6.9 |
| | Fluoride (F) (mg/L) | 0.98 |
| | Nitrate (as N) (mg/L) | <0.050 DLM |
| | Nitrite (as N) (mg/L) | <0.010 DLM |
| | Total Kjeldahl Nitrogen (mg/L) | 0.777 |
| | Total Nitrogen (mg/L) | 0.777 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0858 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0900 |
| | Phosphorus (P)-Total (mg/L) | 0.121 |
| | Sulfate (SO4) (mg/L) | <5.0 DLM |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 3.57 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.0435 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00033 |
| | Barium (Ba)-Total (mg/L) | 1.24 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.199 |
| | Cadmium (Cd)-Total (mg/L) | 0.000038 |
| | Calcium (Ca)-Total (mg/L) | 3.39 |
| | Chromium (Cr)-Total (mg/L) | 0.00018 |
| | Cobalt (Co)-Total (mg/L) | 0.00011 |
| | Copper (Cu)-Total (mg/L) | 0.00119 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1422942-1 water 09-FEB-14 14:20 MW-H17 | L1422942-2 water 08-FEB-14 15:30 MW-H22 | L1422942-3 water 09-FEB-14 12:00 MW-SHAFT | L1422942-4 water 08-FEB-14 12:00 MW-H23 | L1422942-5 water 10-FEB-14 16:15 MW-H24B |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 0.222 | 0.940 | 0.322 | 12.7 | 0.180 |
| | Lead (Pb)-Total (mg/L) | 0.000124 | 0.000491 | 0.000148 | 0.00823 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.0155 | 0.00417 | 0.00504 | 0.00919 | 0.00157 |
| | Magnesium (Mg)-Total (mg/L) | 20.0 | 23.2 | 42.3 | 24.0 | 17.1 |
| | Manganese (Mn)-Total (mg/L) | 0.0890 | 0.0170 | 0.0633 | 0.471 | 0.0452 |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.000753 | 0.000613 | 0.000331 | 0.00226 | 0.000751 |
| | Nickel (Ni)-Total (mg/L) | 0.00156 | 0.00172 | 0.00584 | 0.0301 | 0.00103 |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | 0.37 | <0.30 |
| | Potassium (K)-Total (mg/L) | 1.15 | 1.67 | 1.15 | 2.81 | 0.811 |
| | Selenium (Se)-Total (mg/L) | <0.00010 | 0.00067 | <0.00010 | 0.00140 | 0.00026 |
| | Silicon (Si)-Total (mg/L) | 4.51 | 4.62 | 4.47 | 15.7 | 2.75 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | 0.000102 | 0.000104 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 10.7 | <2.0 | 24.5 | 2.5 | 9.6 |
| | Strontium (Sr)-Total (mg/L) | 0.226 | 0.142 | 0.260 | 0.144 | 0.197 |
| | Thallium (Tl)-Total (mg/L) | 0.000014 | 0.000031 | 0.000020 | 0.000593 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | <0.00010 | 0.00010 | <0.00010 | 0.00035 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.010 | 0.021 | 0.016 | 0.204 | <0.010 |
| | Uranium (U)-Total (mg/L) | 0.00132 | 0.000475 | 0.000694 | 0.000659 | 0.000475 |
| | Vanadium (V)-Total (mg/L) | <0.0010 | 0.0022 | <0.0010 | 0.0275 | <0.0010 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0069 | 0.0036 | 0.0911 | <0.0030 |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | <0.0030 | 0.0031 | <0.0030 | <0.0030 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | 0.00029 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00061 | 0.00015 | 0.00022 | 0.00015 | 0.00037 |
| | Barium (Ba)-Dissolved (mg/L) | 0.329 | 0.252 | 0.717 | 0.245 | 0.859 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | 0.015 | <0.010 | <0.010 | <0.010 | 0.011 |
| | Cadmium (Cd)-Dissolved (mg/L) | 0.000011 | 0.000061 | 0.000146 | 0.000021 | 0.000034 |
| | Calcium (Ca)-Dissolved (mg/L) | 74.2 | 99.1 | 192 | 67.1 | 67.5 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | 0.00067 | <0.00010 | 0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00021 | <0.00010 | 0.00094 | <0.00010 | 0.00075 |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00141 | 0.00061 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | 0.036 | <0.030 | 0.041 | <0.030 | 0.169 |
| | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1422942-6 | | | | |
| | **Description** | water | | | | |
| | **Sampled Date** | 10-FEB-14 | | | | |
| | **Sampled Time** | 17:30 | | | | |
| | **Client ID** | MW-H27 | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 0.086 | | | | |
| | Lead (Pb)-Total (mg/L) | 0.000408 | | | | |
| | Lithium (Li)-Total (mg/L) | 0.658 | | | | |
| | Magnesium (Mg)-Total (mg/L) | 1.33 | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.0183 | | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | | | | |
| | Molybdenum (Mo)-Total (mg/L) | 0.0121 | | | | |
| | Nickel (Ni)-Total (mg/L) | 0.00062 | | | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | | | | |
| | Potassium (K)-Total (mg/L) | 1.20 | | | | |
| | Selenium (Se)-Total (mg/L) | <0.00010 | | | | |
| | Silicon (Si)-Total (mg/L) | 2.97 | | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Total (mg/L) | 334 | | | | |
| | Strontium (Sr)-Total (mg/L) | 0.151 | | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Total (mg/L) | <0.010 | | | | |
| | Uranium (U)-Total (mg/L) | 0.000104 | | | | |
| | Vanadium (V)-Total (mg/L) | <0.0010 | | | | |
| | Zinc (Zn)-Total (mg/L) | 0.0038 | | | | |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | FIELD | | | | |
| | Dissolved Metals Filtration Location | FIELD | | | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0101 | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | | | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00021 | | | | |
| | Barium (Ba)-Dissolved (mg/L) | 1.24 | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | | | | |
| | Boron (B)-Dissolved (mg/L) | 0.153 | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | 2.85 | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00011 | | | | |
| | Copper (Cu)-Dissolved (mg/L) | 0.00099 | | | | |
| | Iron (Fe)-Dissolved (mg/L) | <0.030 | | | | |
| | Lead (Pb)-Dissolved (mg/L) | 0.000063 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1422942-1 water 09-FEB-14 14:20 MW-H17 | L1422942-2 water 08-FEB-14 15:30 MW-H22 | L1422942-3 water 09-FEB-14 12:00 MW-SHAFT | L1422942-4 water 08-FEB-14 12:00 MW-H23 | L1422942-5 water 10-FEB-14 16:15 MW-H24B |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | 0.0148 | 0.00334 | 0.00453 | 0.00314 | 0.00141 |
| | Magnesium (Mg)-Dissolved (mg/L) | 19.5 | 22.6 | 41.4 | 16.1 | 17.2 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0468 | 0.00405 | 0.0507 | 0.000660 | 0.0469 |
| | Mercury (Hg)-Dissolved (mg/L) | 0.000017 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000707 | 0.000435 | 0.000251 | 0.000448 | 0.000726 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00091 | <0.00050 | 0.00527 | 0.00055 | 0.00111 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 1.08 | 1.56 | 1.09 | 1.02 | 0.834 |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 | 0.00073 | <0.00010 | 0.00053 | 0.00027 |
| | Silicon (Si)-Dissolved (mg/L) | 4.26 | 3.80 | 4.01 | 2.93 | 2.74 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 11.2 | <2.0 | 24.9 | 2.3 | 10.1 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.214 | 0.139 | 0.255 | 0.112 | 0.191 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000012 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | 0.011 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.00117 | 0.000440 | 0.000658 | 0.000247 | 0.000456 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | 0.0049 | <0.0030 | <0.0030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1422942-6 | | | | |
| | **Description** | water | | | | |
| | **Sampled Date** | 10-FEB-14 | | | | |
| | **Sampled Time** | 17:30 | | | | |
| | **Client ID** | MW-H27 | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | 0.505 | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 1.30 | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0175 | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | 0.000012 | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00942 | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | | | | |
| | Potassium (K)-Dissolved (mg/L) | 1.24 | | | | |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 | | | | |
| | Silicon (Si)-Dissolved (mg/L) | 2.86 | | | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Dissolved (mg/L) | 339 | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.120 | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | | | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000080 | | | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0041 | | | | |

* 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) |
|---|---|---|---|
| Duplicate | Bromide (Br) | DLM | L1422942-1, -2, -3, -4, -5, -6 |
| Duplicate | Nitrite (as N) | DLM | L1422942-1, -2, -3, -4, -5, -6 |
| Method Blank | Manganese (Mn)-Total | MB-LOR | L1422942-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Orthophosphate-Dissolved (as P) | MS-B | L1422942-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Total Nitrogen | MS-B | L1422942-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Total Nitrogen | MS-B | L1422942-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1422942-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1422942-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1422942-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1422942-1, -2, -3, -4, -5, -6 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLM | Detection Limit Adjusted due to sample matrix effects. |
| MB-LOR | Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level. |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

# Reference Information

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-T-COL-VA** | Water | Total Nitrogen in water by Colour | USGS - 03 - 4174 / NEMI 5735 |

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

# Reference Information

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-143967

**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.*

10- 143967

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

Page ____ of ____

| Report To | Report Format / Distribution | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: ERM - Rescan | Standard: X Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Tyler Gale | Select: PDF X Excel X Digital Fax | Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: 1111 W. Hastings St., 15th Floor Vancouver BC | Email 1: Tyler.Gale@erm.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| Phone: (604 689 9460 Fax: | Email 2: Yaming.Chen@erm.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| **Invoice To** Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | **Analysis Request** |
| Copy of Invoice with Report? (circle) Yes or No | Job #: 0194106-0002-0005 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: | Quote #: | |
| **Lab Work Order #** L1422942-COFC | **ALS Contact:** | **Sampler:** |

| Sample # (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chem. | Nutrients (P) | Total Metals (P) | Total Hg (P) | Dissolved Metals (F/P) | Dissolved Hg (F/P) | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|
| MW-H17 | 09-Feb-14 | 14:20 | Water | — | — | — | — | — | — | 6 |
| MW-H22 | 08-Feb-14 | 15:30 | Water | — | — | — | — | — | — | 6 |
| MW-Shaft | 09-Feb-14 | 12:00 | Water | — | — | — | — | — | — | 6 |
| MW-H23 | 08-Feb-14 | 12:00 | Water | — | — | — | — | — | — | 6 |
| MW-H24B | 10-Feb-14 | 16:15 | Water | — | — | — | — | — | — | 6 |
| [redacted] MW-H27 | 10-Feb-14 | 17:30 | Water | — | — | — | — | — | — | 6 |

**Short Holding Time**

*Rush Processing*

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

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Tyler Gale | 14-Feb-14 | Afternoon | PR | 15 FEB | 12:30 | 5 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 15-FEB-14
Report Date: 26-FEB-14 17:13 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1422945**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-143969
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 | L1422945-1 | L1422945-2 | L1422945-3 | L1422945-4 | L1422945-5 |
|---|---|---|---|---|---|---|
| | Description | water | water | water | water | water |
| | Sampled Date | 13-FEB-14 | 13-FEB-14 | 12-FEB-14 | 13-FEB-14 | 14-FEB-14 |
| | Sampled Time | 15:00 | 18:45 | 11:00 | 10:30 | 09:30 |
| | Client ID | MW-H28 | MW-H25A | MW-H33 | MW-H34 | MW-H32A |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | 23.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 1350 | 1020 | 1050 | 526 | <2.0 |
| | Hardness (as CaCO3) (mg/L) | 55.3 | 14.1 | 19.0 | 264 | <0.50 |
| | pH (pH) | 8.55 | 8.72 | 8.92 | 8.32 | 6.39 |
| | Total Suspended Solids (mg/L) | 9.8 | <3.0 | <3.0 | 4.9 | <3.0 |
| | Turbidity (NTU) | 9.28 | 6.92 | 0.81 | 12.8 | <0.10 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 503 | 494 | 461 | 299 | <2.0 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | 12.6 | 37.3 | 70.9 | <1.0 | <2.0 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <1.0 | <1.0 | <1.0 | <1.0 | <2.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 516 | 531 | 532 | 299 | <2.0 |
| | Ammonia, Total (as N) (mg/L) | 0.451 | 0.405 | 0.380 | 0.202 | <0.0050 |
| | Bromide (Br) (mg/L) | 0.52 | <0.50 DLM | <0.50 DLM | <0.050 | <0.050 |
| | Chloride (Cl) (mg/L) | 14.1 | <2.5 DLM | <5.0 DLM | 0.51 | <0.50 |
| | Fluoride (F) (mg/L) | 0.68 | 0.78 | 0.70 | 0.118 | <0.020 |
| | Nitrate (as N) (mg/L) | <0.050 DLM | <0.025 DLM | <0.050 DLM | <0.0050 | <0.0050 |
| | Nitrite (as N) (mg/L) | <0.010 DLM | <0.0050 DLM | 0.012 | <0.0010 | <0.0010 |
| | Total Kjeldahl Nitrogen (mg/L) | 1.01 | 0.450 | 0.475 | 0.254 | <0.050 |
| | Total Nitrogen (mg/L) | 1.01 | 0.450 | 0.487 | 0.254 | <0.050 |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0977 | 0.0365 | 0.0727 | <0.0010 | <0.0010 |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.125 | 0.0437 | 0.0790 | <0.0020 | <0.0020 |
| | Phosphorus (P)-Total (mg/L) | 0.422 | 0.0520 | 0.0852 | 0.0518 | <0.0020 |
| | Sulfate (SO4) (mg/L) | 195 | <2.5 DLM | <5.0 DLM | 1.45 | <0.50 |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 28.9 | 1.88 | 2.89 | 1.29 | <0.50 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.192 | 0.241 | 0.117 | 0.0048 | <0.0030 |
| | Antimony (Sb)-Total (mg/L) | 0.00015 | <0.00010 | 0.00051 | <0.00010 | <0.00010 |
| | Arsenic (As)-Total (mg/L) | 0.00371 | 0.00012 | 0.00043 | 0.00054 | <0.00010 |
| | Barium (Ba)-Total (mg/L) | 0.210 | 1.10 | 0.620 | 0.999 | <0.000050 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Total (mg/L) | 0.201 | 0.201 | 0.192 | 0.024 | <0.010 |
| | Cadmium (Cd)-Total (mg/L) | 0.000030 | <0.000010 | 0.000015 | <0.000010 | <0.000010 |
| | Calcium (Ca)-Total (mg/L) | 13.9 | 3.27 | 4.50 | 64.5 | <0.020 |
| | Chromium (Cr)-Total (mg/L) | 0.00071 | 0.00044 | 0.00026 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Total (mg/L) | 0.00093 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Total (mg/L) | 0.00066 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1422945-6 | | | | |
| | **Description** | water | | | | |
| | **Sampled Date** | 14-FEB-14 | | | | |
| | **Sampled Time** | 10:00 | | | | |
| | **Client ID** | MW-H32B | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | | | | |
| | Conductivity (uS/cm) | <2.0 | | | | |
| | Hardness (as CaCO3) (mg/L) | <0.50 | | | | |
| | pH (pH) | 5.91 | | | | |
| | Total Suspended Solids (mg/L) | <3.0 | | | | |
| | Turbidity (NTU) | <0.10 | | | | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | | | | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | <2.0 | | | | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | | | | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | | | | |
| | Alkalinity, Total (as CaCO3) (mg/L) | <2.0 | | | | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | | | | |
| | Bromide (Br) (mg/L) | <0.050 | | | | |
| | Chloride (Cl) (mg/L) | <0.50 | | | | |
| | Fluoride (F) (mg/L) | <0.020 | | | | |
| | Nitrate (as N) (mg/L) | <0.0050 | | | | |
| | Nitrite (as N) (mg/L) | <0.0010 | | | | |
| | Total Kjeldahl Nitrogen (mg/L) | <0.050 | | | | |
| | Total Nitrogen (mg/L) | <0.050 | | | | |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | | | | |
| | Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | | | | |
| | Phosphorus (P)-Total (mg/L) | <0.0020 | | | | |
| | Sulfate (SO4) (mg/L) | <0.50 | | | | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | <0.50 | | | | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | <0.0030 | | | | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | | | | |
| | Arsenic (As)-Total (mg/L) | <0.00010 | | | | |
| | Barium (Ba)-Total (mg/L) | 0.000638 RRV | | | | |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | | | | |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | | | | |
| | Boron (B)-Total (mg/L) | <0.010 | | | | |
| | Cadmium (Cd)-Total (mg/L) | <0.000010 | | | | |
| | Calcium (Ca)-Total (mg/L) | <0.020 | | | | |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | | | | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | | | | |
| | Copper (Cu)-Total (mg/L) | <0.00050 | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1422945-1 water 13-FEB-14 15:00 MW-H28 | L1422945-2 water 13-FEB-14 18:45 MW-H25A | L1422945-3 water 12-FEB-14 11:00 MW-H33 | L1422945-4 water 13-FEB-14 10:30 MW-H34 | L1422945-5 water 14-FEB-14 09:30 MW-H32A |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | 1.26 | 0.252 | 0.073 | 2.08 | <0.030 |
| | Lead (Pb)-Total (mg/L) | 0.000248 | 0.000138 | 0.000160 | <0.000050 | <0.000050 |
| | Lithium (Li)-Total (mg/L) | 0.259 | 0.471 | 0.472 | 0.0146 | <0.00050 |
| | Magnesium (Mg)-Total (mg/L) | 5.20 | 1.52 | 1.83 | 22.3 | <0.0050 |
| | Manganese (Mn)-Total (mg/L) | 0.666 | 0.0226 | 0.00849 | 0.102 | <0.000050 |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.0208 | 0.000727 | 0.00671 | 0.00153 | <0.000050 |
| | Nickel (Ni)-Total (mg/L) | 0.00566 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Phosphorus (P)-Total (mg/L) | 0.41 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 1.67 | 0.610 | 0.616 | 0.784 | <0.050 |
| | Selenium (Se)-Total (mg/L) | 0.00019 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Silicon (Si)-Total (mg/L) | 4.79 | 3.96 | 4.82 | 6.50 | <0.050 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Total (mg/L) | 336 | 276 | 293 | 13.6 | <2.0 |
| | Strontium (Sr)-Total (mg/L) | 0.215 | 0.129 | 0.131 | 0.424 | <0.00020 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Total (mg/L) | 0.00017 | <0.00010 | 0.00018 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Total (mg/L) | <0.010 | 0.013 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Total (mg/L) | 0.00252 | 0.000047 | 0.000392 | 0.000092 | <0.000010 |
| | Vanadium (V)-Total (mg/L) | 0.0016 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0112 | 0.0061 | 0.107 | 0.0030 | <0.0030 |
| | Antimony (Sb)-Dissolved (mg/L) | 0.00014 | <0.00010 | 0.00047 | <0.00010 | <0.00010 |
| | Arsenic (As)-Dissolved (mg/L) | 0.00330 | <0.00010 | 0.00042 | 0.00051 | <0.00010 |
| | Barium (Ba)-Dissolved (mg/L) | 0.179 | 1.14 | 0.594 | 1.01 | <0.000050 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Boron (B)-Dissolved (mg/L) | 0.196 | 0.193 | 0.204 | 0.024 | <0.010 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Calcium (Ca)-Dissolved (mg/L) | 13.7 | 3.19 | 4.57 | 70.9 | <0.020 |
| | Chromium (Cr)-Dissolved (mg/L) | 0.00022 | <0.00010 | 0.00017 | <0.00010 | <0.00010 |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00087 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Copper (Cu)-Dissolved (mg/L) | 0.00066 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | 0.090 | 0.070 | 0.046 | 2.24 | <0.030 |
| | Lead (Pb)-Dissolved (mg/L) | 0.000061 | <0.000050 | 0.000121 | <0.000050 | <0.000050 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1422945-6 | | | | |
| | **Description** | water | | | | |
| | **Sampled Date** | 14-FEB-14 | | | | |
| | **Sampled Time** | 10:00 | | | | |
| | **Client ID** | MW-H32B | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Iron (Fe)-Total (mg/L) | <0.030 | | | | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | | | | |
| | Lithium (Li)-Total (mg/L) | <0.00050 | | | | |
| | Magnesium (Mg)-Total (mg/L) | <0.0050 | | | | |
| | Manganese (Mn)-Total (mg/L) | 0.000083 RRV | | | | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | | | | |
| | Molybdenum (Mo)-Total (mg/L) | <0.000050 | | | | |
| | Nickel (Ni)-Total (mg/L) | <0.00050 | | | | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | | | | |
| | Potassium (K)-Total (mg/L) | <0.050 | | | | |
| | Selenium (Se)-Total (mg/L) | <0.00010 | | | | |
| | Silicon (Si)-Total (mg/L) | <0.050 | | | | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | | | |
| | Sodium (Na)-Total (mg/L) | <2.0 | | | | |
| | Strontium (Sr)-Total (mg/L) | <0.00020 | | | | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | | | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | | | |
| | Titanium (Ti)-Total (mg/L) | <0.010 | | | | |
| | Uranium (U)-Total (mg/L) | <0.000010 | | | | |
| | Vanadium (V)-Total (mg/L) | <0.0010 | | | | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | | | | |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | | | | | |
| | Dissolved Metals Filtration Location | | | | | |
| | Aluminum (Al)-Dissolved (mg/L) | | | | | |
| | Antimony (Sb)-Dissolved (mg/L) | | | | | |
| | Arsenic (As)-Dissolved (mg/L) | | | | | |
| | Barium (Ba)-Dissolved (mg/L) | | | | | |
| | Beryllium (Be)-Dissolved (mg/L) | | | | | |
| | Bismuth (Bi)-Dissolved (mg/L) | | | | | |
| | Boron (B)-Dissolved (mg/L) | | | | | |
| | Cadmium (Cd)-Dissolved (mg/L) | | | | | |
| | Calcium (Ca)-Dissolved (mg/L) | | | | | |
| | Chromium (Cr)-Dissolved (mg/L) | | | | | |
| | Cobalt (Co)-Dissolved (mg/L) | | | | | |
| | Copper (Cu)-Dissolved (mg/L) | | | | | |
| | Iron (Fe)-Dissolved (mg/L) | | | | | |
| | Lead (Pb)-Dissolved (mg/L) | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1422945-1 water 13-FEB-14 15:00 MW-H28 | L1422945-2 water 13-FEB-14 18:45 MW-H25A | L1422945-3 water 12-FEB-14 11:00 MW-H33 | L1422945-4 water 13-FEB-14 10:30 MW-H34 | L1422945-5 water 14-FEB-14 09:30 MW-H32A |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | 0.263 | 0.473 | 0.503 | 0.0153 | <0.00050 |
| | Magnesium (Mg)-Dissolved (mg/L) | 5.11 | 1.49 | 1.84 | 21.1 | <0.0050 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.638 | 0.0206 | 0.00807 | 0.101 | <0.000050 |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.0204 | 0.000580 | 0.00656 | 0.00159 | <0.000050 |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00531 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 1.70 | 0.546 | 0.631 | 0.784 | <0.050 |
| | Selenium (Se)-Dissolved (mg/L) | 0.00019 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| | Silicon (Si)-Dissolved (mg/L) | 4.56 | 3.19 | 4.61 | 6.73 | <0.050 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Sodium (Na)-Dissolved (mg/L) | 354 | 285 | 289 | 13.9 | <2.0 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.201 | 0.124 | 0.137 | 0.476 | <0.00020 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | 0.00017 | <0.00010 | <0.00010 |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.00256 | 0.000016 | 0.000373 | 0.000090 | <0.000010 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 |
| | Zinc (Zn)-Dissolved (mg/L) | 0.0042 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1422945-6 | | | | |
| | **Description** | water | | | | |
| | **Sampled Date** | 14-FEB-14 | | | | |
| | **Sampled Time** | 10:00 | | | | |
| | **Client ID** | MW-H32B | | | | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Dissolved Metals** | Lithium (Li)-Dissolved (mg/L) | | | | | |
| | Magnesium (Mg)-Dissolved (mg/L) | | | | | |
| | Manganese (Mn)-Dissolved (mg/L) | | | | | |
| | Mercury (Hg)-Dissolved (mg/L) | | | | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | | | | |
| | Nickel (Ni)-Dissolved (mg/L) | | | | | |
| | Phosphorus (P)-Dissolved (mg/L) | | | | | |
| | Potassium (K)-Dissolved (mg/L) | | | | | |
| | Selenium (Se)-Dissolved (mg/L) | | | | | |
| | Silicon (Si)-Dissolved (mg/L) | | | | | |
| | Silver (Ag)-Dissolved (mg/L) | | | | | |
| | Sodium (Na)-Dissolved (mg/L) | | | | | |
| | Strontium (Sr)-Dissolved (mg/L) | | | | | |
| | Thallium (Tl)-Dissolved (mg/L) | | | | | |
| | Tin (Sn)-Dissolved (mg/L) | | | | | |
| | Titanium (Ti)-Dissolved (mg/L) | | | | | |
| | Uranium (U)-Dissolved (mg/L) | | | | | |
| | Vanadium (V)-Dissolved (mg/L) | | | | | |
| | Zinc (Zn)-Dissolved (mg/L) | | | | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Individual Samples Listed:**

| Sample Number | Client Sample ID | Qualifier | Description |
|---|---|---|---|
| L1422945-2 | MW-H25A | WSMD | Water sample(s) for dissolved mercury analysis was not submitted in glass container with HCl preservative. Results may be biased low. |

**QC Samples with Qualifiers & Comments:**

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|---|---|
| Duplicate | Bromide (Br) | DLM | L1422945-1, -2, -3, -4, -5, -6 |
| Duplicate | Nitrite (as N) | DLM | L1422945-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Orthophosphate-Dissolved (as P) | MS-B | L1422945-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Total Nitrogen | MS-B | L1422945-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Total Nitrogen | MS-B | L1422945-1, -2, -3, -4, -5, -6 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1422945-1, -2, -3, -4, -5 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1422945-1, -2, -3, -4, -5 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1422945-1, -2, -3, -4, -5 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1422945-1, -2, -3, -4, -5 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLM | Detection Limit Adjusted due to sample matrix effects. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| RRV | Reported Result Verified By Repeat Analysis |

**Test Method References:**

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is

# Reference Information

detected by UV absorbance.

**ANIONS-SO4-IC-VA** Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

**CARBONS-TOC-VA** Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

**COLOUR-TRUE-VA** Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

**EC-PCT-VA** Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

**HARDNESS-CALC-VA** Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**N-T-COL-VA** Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

# Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-143969

**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.*

10- 143969

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

Page ___ of ___

| Report To | Report Format / Distribution | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: ERM-Rescan | Standard: X Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Tyler Gale | Select: PDF X Excel X Digital Fax | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: 15th Floor 1111 W. Hastings St. Vancouver BC | Email 1: Tyler.Gale@erm.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| Phone: 604 689 9460 Fax: | Email 2: Yaming.chen@erm.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| **Invoice To** Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | **Analysis Request** |
| Copy of Invoice with Report? (circle) Yes or No | Job #: 0194106-0002-0005 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: | Quote #: | |
| **Lab Work Order #** L1422945-COFC | **ALS Contact:** **Sampler:** | |

| Sample # | (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | General Chem. | Nutrients (F/P) | Total Metals (F/P) | Total Hg (F/P) | Dissolved Metals (F/P) | Dissolved Hg (F/P) | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW-H28 | 13-Feb-14 | 15:00 | Water | — | — | — | — | — | — | 6 |
| | MW-H25A | 13-Feb-14 | 18:45 | Water | — | — | — | — | — | — | 6 |
| | MW-H33 | 12-Feb-14 | 11:00 | Water | — | — | — | — | — | — | 6 |
| | MW-H34 | 13-Feb-14 | 10:30 | Water | — | — | — | — | — | — | 6 |
| | MW-H32A | 14-Feb-14 | 09:30 | Water | — | — | — | — | — | — | 6 |
| | MW-H32B | 14-Feb-14 | 10:00 | Water | — | — | — | — | — | — | 6 |

**Short Holding Time**

*Rush Processing*

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

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Tyler Gale | 14-Feb-14 | Afternoon | PR | 15FEB | 12:30 | 5 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 12-MAY-14
Report Date: 22-MAY-14 15:50 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1453879**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-202028
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 | L1453879-1 | L1453879-2 | L1453879-3 | L1453879-4 | L1453879-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 08-MAY-14 | 09-MAY-14 | 09-MAY-14 | 10-MAY-14 | 10-MAY-14 |
| | Sampled Time | 16:00 | 14:00 | 14:30 | 15:00 | 16:00 |
| | Client ID | MW-H5 | MW-H24C | MW-H25A | MW-H26A | MW-H27 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | Conductivity (uS/cm) | 564 | 528 | 1010 | 1050 | 1250 |
| | Hardness (as CaCO3) (mg/L) | 309 | 293 | 15.5 | 20.7 | 13.2 |
| | pH (pH) | 7.99 | 8.05 | 8.63 | 8.89 | 8.77 |
| | Total Suspended Solids (mg/L) | 5.7 | 7.2 | <3.0 | <3.0 | <3.0 |
| | Total Dissolved Solids (mg/L) | 324 | 305 | 642 | 682 | 812 |
| | Turbidity (NTU) | 19.4 | 13.3 | 3.19 | 0.53 | 0.86 |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 5.1 | 3.5 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 319 | 319 | 509 | 531 | 664 |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | 51.4 | 83.1 | 91.1 |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <1.0 | <1.0 | <1.0 |
| | Alkalinity, Total (as CaCO3) (mg/L) | 319 | 319 | 561 | 615 | 755 |
| | Ammonia, Total (as N) (mg/L) | 0.167 | 0.248 | 0.470 | 0.428 | 0.498 |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.50 DLM | <0.50 DLM | <0.50 DLM |
| | Chloride (Cl) (mg/L) | <0.50 | <0.50 | <5.0 DLM | <5.0 DLM | 5.4 |
| | Fluoride (F) (mg/L) | 0.150 | 0.111 | 0.75 | 0.67 | 0.95 |
| | Nitrate (as N) (mg/L) | <0.0050 | <0.0050 | <0.050 DLM | <0.050 DLM | <0.050 DLM |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | <0.010 DLM | <0.010 DLM | <0.010 DLM |
| | Total Kjeldahl Nitrogen (mg/L) | 0.172 | 0.236 | 0.462 | 0.485 | 0.486 |
| | Total Nitrogen (mg/L) | 0.172 | 0.236 | 0.462 | 0.485 | 0.486 |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | <0.0010 PEHT | 0.0268 PEHT | 0.0570 PEHT | 0.0758 PEHT |
| | Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | <0.0020 | 0.0267 | 0.0532 | 0.0815 |
| | Phosphorus (P)-Total (mg/L) | 0.0057 | 0.0531 | 0.0330 | 0.0743 | 0.0848 |
| | Sulfate (SO4) (mg/L) | 12.8 | 2.36 | <5.0 DLM | <5.0 DLM | <5.0 DLM |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 0.83 | 1.04 | 1.37 | 2.34 | 2.03 |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | <0.0030 | 0.0049 | 0.220 | 0.136 | 0.0247 |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00040 | <0.00020 DLA |
| | Arsenic (As)-Total (mg/L) | 0.00236 | 0.00066 | <0.00010 | 0.00051 | <0.00020 DLA |
| | Barium (Ba)-Total (mg/L) | 0.114 | 1.07 | 1.12 | 0.631 | 1.28 |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 DLA |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 DLA |
| | Boron (B)-Total (mg/L) | 0.029 | 0.023 | 0.199 | 0.201 | 0.219 |
| | Cadmium (Cd)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 DLA |
| | Calcium (Ca)-Total (mg/L) | 76.3 | 75.1 | 3.66 | 4.71 | 3.30 |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | <0.00010 | 0.00039 | 0.00026 | <0.00020 DLA |
| | Cobalt (Co)-Total (mg/L) | 0.00027 | <0.00010 | <0.00010 | <0.00010 | <0.00020 DLA |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1453879-6 | L1453879-7 | L1453879-8 | L1453879-9 | |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | |
| | Sampled Date | 10-MAY-14 | 11-MAY-14 | 11-MAY-14 | | |
| | Sampled Time | 14:00 | 11:00 | 14:30 | | |
| | Client ID | MW-H29 | MW-H25B | MW-H17 | ALS TRAVEL BLANK | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | <5.0 | <5.0 | <5.0 | |
| | Conductivity (uS/cm) | 658 | 659 | 522 | <2.0 | |
| | Hardness (as CaCO3) (mg/L) | 8.53 | 379 | 283 | <0.50 | |
| | pH (pH) | 8.23 | 7.86 | 8.03 | 5.65 | |
| | Total Suspended Solids (mg/L) | <3.0 | 12.9 | <3.0 | <3.0 | |
| | Total Dissolved Solids (mg/L) | 433 | 387 | 313 | <10 | |
| | Turbidity (NTU) | 3.70 | 8.71 | 2.54 | <0.10 | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | <1.0 | 9.2 | 3.6 | 1.0 | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | 383 | 397 | 291 | <2.0 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <2.0 | <2.0 | <2.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | 383 | 397 | 291 | <2.0 | |
| | Ammonia, Total (as N) (mg/L) | 0.227 | 0.106 | 0.054 | <0.0050 | |
| | Bromide (Br) (mg/L) | <0.050 | <0.050 | <0.050 | <0.050 | |
| | Chloride (Cl) (mg/L) | 2.33 | 1.28 | <0.50 | <0.50 | |
| | Fluoride (F) (mg/L) | 0.351 | 0.171 | 0.116 | <0.020 | |
| | Nitrate (as N) (mg/L) | <0.0050 | <0.0050 | 0.0179 | <0.0050 | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.0010 | 0.0047 | <0.0010 | |
| | Total Kjeldahl Nitrogen (mg/L) | 0.248 | 0.201 | 0.054 | <0.050 | |
| | Total Nitrogen (mg/L) | 0.248 | 0.201 | 0.077 | <0.050 | |
| | Orthophosphate-Dissolved (as P) (mg/L) | 0.0429 PEHT | 0.0021 | 0.0039 | <0.0010 | |
| | Phosphorus (P)-Total Dissolved (mg/L) | 0.0392 | <0.0020 | 0.0053 | <0.0020 | |
| | Phosphorus (P)-Total (mg/L) | 0.0660 | 0.0293 | 0.0109 | <0.0020 | |
| | Sulfate (SO4) (mg/L) | 6.95 | 6.12 | 11.0 | <0.50 | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | 2.39 | 3.63 | 1.06 | <0.50 | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | 0.269 | 0.123 | 0.0643 | <0.0030 | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| | Arsenic (As)-Total (mg/L) | 0.00061 | 0.00135 | 0.00054 | <0.00010 | |
| | Barium (Ba)-Total (mg/L) | 0.0966 | 0.272 | 0.322 | <0.000050 | |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | |
| | Boron (B)-Total (mg/L) | 0.173 | 0.013 | 0.017 | <0.010 | |
| | Cadmium (Cd)-Total (mg/L) | 0.000011 | 0.000017 | 0.000023 | <0.000010 | |
| | Calcium (Ca)-Total (mg/L) | 2.81 | 100 | 79.2 | <0.020 | |
| | Chromium (Cr)-Total (mg/L) | 0.00044 | 0.00025 | 0.00011 | <0.00010 | |
| | Cobalt (Co)-Total (mg/L) | 0.00023 | 0.00136 | 0.00036 | <0.00010 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1453879-1 | L1453879-2 | L1453879-3 | L1453879-4 | L1453879-5 |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | Water |
| | Sampled Date | 08-MAY-14 | 09-MAY-14 | 09-MAY-14 | 10-MAY-14 | 10-MAY-14 |
| | Sampled Time | 16:00 | 14:00 | 14:30 | 15:00 | 16:00 |
| | Client ID | MW-H5 | MW-H24C | MW-H25A | MW-H26A | MW-H27 |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Copper (Cu)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 DLA |
| | Iron (Fe)-Total (mg/L) | 1.38 | 1.87 | 0.158 | 0.060 | 0.032 |
| | Lead (Pb)-Total (mg/L) | <0.000050 | <0.000050 | 0.000068 | 0.000123 | <0.00010 DLA |
| | Lithium (Li)-Total (mg/L) | 0.00495 | 0.0139 | 0.514 | 0.529 | 0.711 |
| | Magnesium (Mg)-Total (mg/L) | 26.9 | 23.8 | 1.76 | 2.12 | 1.23 |
| | Manganese (Mn)-Total (mg/L) | 0.605 | 0.0909 | 0.0222 | 0.0102 | 0.0183 |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | | <0.000010 |
| | Molybdenum (Mo)-Total (mg/L) | 0.00126 | 0.00186 | 0.000648 | 0.00609 | 0.0111 |
| | Nickel (Ni)-Total (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 DLA |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Total (mg/L) | 0.928 | 0.835 | 0.643 | 0.664 | 0.52 |
| | Selenium (Se)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 DLA |
| | Silicon (Si)-Total (mg/L) | 5.67 | 6.21 | 3.59 | 4.62 | 2.99 |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 DLA |
| | Sodium (Na)-Total (mg/L) | 10.5 | 10.3 | 272 | 289 | 350 |
| | Strontium (Sr)-Total (mg/L) | 0.321 | 0.514 | 0.138 | 0.144 | 0.156 |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 DLA |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00019 | <0.00020 DLA |
| | Titanium (Ti)-Total (mg/L) | 0.010 | 0.010 | 0.011 | <0.010 | <0.010 |
| | Uranium (U)-Total (mg/L) | 0.00115 | 0.000088 | 0.000032 | 0.000358 | 0.000088 |
| | Vanadium (V)-Total (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 DLA |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0060 DLA |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | FIELD |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | FIELD | FIELD |
| | Aluminum (Al)-Dissolved (mg/L) | <0.0030 | 0.0047 | 0.0049 | 0.112 | 0.0075 |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00038 | <0.00020 DLA |
| | Arsenic (As)-Dissolved (mg/L) | 0.00228 | 0.00070 | <0.00010 | 0.00050 | 0.00021 |
| | Barium (Ba)-Dissolved (mg/L) | 0.116 | 1.11 | 1.18 | 0.647 | 1.27 |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00020 DLA |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 DLA |
| | Boron (B)-Dissolved (mg/L) | 0.029 | 0.023 | 0.213 | 0.207 | 0.222 |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 DLA |
| | Calcium (Ca)-Dissolved (mg/L) | 78.3 | 77.2 | 3.44 | 4.69 | 3.27 |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00017 | <0.00020 DLA |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00025 | <0.00010 | <0.00010 | <0.00010 | <0.00020 DLA |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 |
| | Iron (Fe)-Dissolved (mg/L) | 0.919 | 1.82 | 0.061 | 0.044 | <0.030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | Sample ID | L1453879-6 | L1453879-7 | L1453879-8 | L1453879-9 | |
|---|---|---|---|---|---|---|
| | Description | Water | Water | Water | Water | |
| | Sampled Date | 10-MAY-14 | 11-MAY-14 | 11-MAY-14 | | |
| | Sampled Time | 14:00 | 11:00 | 14:30 | | |
| | Client ID | MW-H29 | MW-H25B | MW-H17 | ALS TRAVEL BLANK | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Copper (Cu)-Total (mg/L) | <0.00050 | 0.00074 | <0.00050 | <0.00050 | |
| | Iron (Fe)-Total (mg/L) | 0.262 | 0.734 | 0.130 | <0.030 | |
| | Lead (Pb)-Total (mg/L) | 0.000113 | 0.000119 | 0.000057 | <0.000050 | |
| | Lithium (Li)-Total (mg/L) | 0.169 | 0.00759 | 0.0148 | <0.00050 | |
| | Magnesium (Mg)-Total (mg/L) | 0.342 | 32.1 | 19.8 | <0.0050 | |
| | Manganese (Mn)-Total (mg/L) | 0.0763 | 0.723 | 0.0610 | <0.000050 | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| | Molybdenum (Mo)-Total (mg/L) | 0.000251 | 0.00201 | 0.000724 | <0.000050 | |
| | Nickel (Ni)-Total (mg/L) | 0.00107 | 0.00316 | 0.00102 | <0.00050 | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | |
| | Potassium (K)-Total (mg/L) | 0.367 | 0.577 | 1.05 | <0.050 | |
| | Selenium (Se)-Total (mg/L) | 0.00019 | 0.00011 | <0.00010 | <0.00010 | |
| | Silicon (Si)-Total (mg/L) | 4.62 | 5.35 | 4.10 | <0.050 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | 175 | 8.2 | 10.4 | <2.0 | |
| | Strontium (Sr)-Total (mg/L) | 0.0381 | 0.272 | 0.235 | <0.00020 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | <0.00010 | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | <0.010 | 0.017 | 0.012 | <0.010 | |
| | Uranium (U)-Total (mg/L) | 0.000270 | 0.00134 | 0.00115 | <0.000010 | |
| | Vanadium (V)-Total (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | 0.0034 | <0.0030 | <0.0030 | |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | FIELD | FIELD | FIELD | | |
| | Dissolved Metals Filtration Location | FIELD | FIELD | FIELD | | |
| | Aluminum (Al)-Dissolved (mg/L) | 0.0032 | <0.0030 | <0.0030 | | |
| | Antimony (Sb)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Arsenic (As)-Dissolved (mg/L) | 0.00067 | 0.00146 | 0.00055 | | |
| | Barium (Ba)-Dissolved (mg/L) | 0.0906 | 0.273 | 0.329 | | |
| | Beryllium (Be)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Bismuth (Bi)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | | |
| | Boron (B)-Dissolved (mg/L) | 0.170 | 0.010 | 0.017 | | |
| | Cadmium (Cd)-Dissolved (mg/L) | <0.000010 | <0.000010 | 0.000019 | | |
| | Calcium (Ca)-Dissolved (mg/L) | 2.88 | 99.1 | 80.0 | | |
| | Chromium (Cr)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Cobalt (Co)-Dissolved (mg/L) | 0.00018 | 0.00118 | 0.00021 | | |
| | Copper (Cu)-Dissolved (mg/L) | <0.00050 | <0.00050 | 0.00053 | | |
| | Iron (Fe)-Dissolved (mg/L) | 0.117 | 0.525 | 0.048 | | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1453879-1 Water 08-MAY-14 16:00 MW-H5 | L1453879-2 Water 09-MAY-14 14:00 MW-H24C | L1453879-3 Water 09-MAY-14 14:30 MW-H25A | L1453879-4 Water 10-MAY-14 15:00 MW-H26A | L1453879-5 Water 10-MAY-14 16:00 MW-H27 |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | 0.000099 | <0.00010 DLA |
| | Lithium (Li)-Dissolved (mg/L) | 0.00572 | 0.0156 | 0.576 | 0.567 | 0.756 |
| | Magnesium (Mg)-Dissolved (mg/L) | 27.5 | 24.3 | 1.68 | 2.17 | 1.23 |
| | Manganese (Mn)-Dissolved (mg/L) | 0.608 | 0.0912 | 0.0195 | 0.00998 | 0.0175 |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | <0.000010 |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.00123 | 0.00174 | 0.000583 | 0.00554 | 0.0102 |
| | Nickel (Ni)-Dissolved (mg/L) | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.0010 DLA |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | <0.30 | <0.30 |
| | Potassium (K)-Dissolved (mg/L) | 0.943 | 0.873 | 0.593 | 0.663 | 0.51 |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 | 0.00022 | <0.00010 | <0.00010 | <0.00020 DLA |
| | Silicon (Si)-Dissolved (mg/L) | 5.68 | 6.22 | 3.08 | 4.52 | 2.91 |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 DLA |
| | Sodium (Na)-Dissolved (mg/L) | 10.3 | 10.0 | 277 | 285 | 347 |
| | Strontium (Sr)-Dissolved (mg/L) | 0.314 | 0.506 | 0.136 | 0.140 | 0.151 |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | <0.000010 | <0.000020 DLA |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | 0.00014 | <0.00020 DLA |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Uranium (U)-Dissolved (mg/L) | 0.00114 | 0.000084 | 0.000014 | 0.000327 | 0.000080 |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0020 DLA |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | <0.0030 | <0.0030 | <0.0030 |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1453879-6 Water 10-MAY-14 14:00 MW-H29 | L1453879-7 Water 11-MAY-14 11:00 MW-H25B | L1453879-8 Water 11-MAY-14 14:30 MW-H17 | L1453879-9 Water ALS TRAVEL BLANK | |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lead (Pb)-Dissolved (mg/L) | <0.000050 | <0.000050 | <0.000050 | | |
| | Lithium (Li)-Dissolved (mg/L) | 0.175 | 0.00702 | 0.0155 | | |
| | Magnesium (Mg)-Dissolved (mg/L) | 0.322 | 32.0 | 20.1 | | |
| | Manganese (Mn)-Dissolved (mg/L) | 0.0757 | 0.705 | 0.0397 | | |
| | Mercury (Hg)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Molybdenum (Mo)-Dissolved (mg/L) | 0.000156 | 0.00190 | 0.000666 | | |
| | Nickel (Ni)-Dissolved (mg/L) | 0.00095 | 0.00272 | 0.00092 | | |
| | Phosphorus (P)-Dissolved (mg/L) | <0.30 | <0.30 | <0.30 | | |
| | Potassium (K)-Dissolved (mg/L) | 0.296 | 0.520 | 1.05 | | |
| | Selenium (Se)-Dissolved (mg/L) | <0.00010 | 0.00025 | <0.00010 | | |
| | Silicon (Si)-Dissolved (mg/L) | 3.91 | 5.13 | 4.11 | | |
| | Silver (Ag)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Sodium (Na)-Dissolved (mg/L) | 175 | 8.1 | 10.6 | | |
| | Strontium (Sr)-Dissolved (mg/L) | 0.0375 | 0.258 | 0.229 | | |
| | Thallium (Tl)-Dissolved (mg/L) | <0.000010 | <0.000010 | <0.000010 | | |
| | Tin (Sn)-Dissolved (mg/L) | <0.00010 | <0.00010 | <0.00010 | | |
| | Titanium (Ti)-Dissolved (mg/L) | <0.010 | 0.011 | 0.011 | | |
| | Uranium (U)-Dissolved (mg/L) | 0.000257 | 0.00130 | 0.00113 | | |
| | Vanadium (V)-Dissolved (mg/L) | <0.0010 | <0.0010 | <0.0010 | | |
| | Zinc (Zn)-Dissolved (mg/L) | <0.0030 | <0.0030 | <0.0030 | | |

* 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) |
|---|---|---|---|
| Duplicate | Bismuth (Bi)-Dissolved | DLA | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Duplicate | Chromium (Cr)-Dissolved | DLA | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Duplicate | Molybdenum (Mo)-Dissolved | DLA | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Duplicate | Silver (Ag)-Dissolved | DLA | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Duplicate | Tin (Sn)-Dissolved | DLA | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Duplicate | Vanadium (V)-Dissolved | DLA | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Duplicate | Bromide (Br) | DLM | L1453879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Fluoride (F) | DLM | L1453879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Duplicate | Nitrate (as N) | DLM | L1453879-1, -2, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Copper (Cu)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Antimony (Sb)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Phosphorus (P)-Total | MS-B | L1453879-1, -3, -4, -5, -6, -7, -8, -9 |
| Matrix Spike | Selenium (Se)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Silicon (Si)-Total | MS-B | L1453879-9 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |
| Matrix Spike | Sodium (Na)-Dissolved | MS-B | L1453879-1, -2, -3, -4, -5, -6, -7, -8 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|
| DLA | Detection Limit adjusted for required dilution |
| DLM | Detection Limit Adjusted due to sample matrix effects. |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| PEHT | Parameter Exceeded Recommended Holding Time Prior to Analysis |

## Test Method References:

| ALS Test Code | Matrix | Test Description | Method Reference** |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

# Reference Information

| | | | |
|---|---|---|---|
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

| | | | |
|---|---|---|---|
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

| | | | |
|---|---|---|---|
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

| | | | |
|---|---|---|---|
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

| | | | |
|---|---|---|---|
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

| | | | |
|---|---|---|---|
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

| | | | |
|---|---|---|---|
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

| | | | |
|---|---|---|---|
| **HG-DIS-LOW-CVAFS-VA** | Water | Dissolved Mercury in Water by CVAFS(Low) | EPA SW-846 3005A & EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **HG-TOT-LOW-CVAFS-VA** | Water | Total Mercury in Water by CVAFS(Low) | EPA 245.7 |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption

# Reference Information

spectrophotometry (EPA Method 245.7).

| | | | |
|---|---|---|---|
| **MET-D-CCMS-VA** | Water | Dissolved Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-DIS-ICP-VA** | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **MET-T-CCMS-VA** | Water | Total Metals in Water by CRC ICPMS | APHA 3030 B&E / EPA SW-846 6020A |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

| | | | |
|---|---|---|---|
| **MET-TOT-ICP-VA** | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B |

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

| | | | |
|---|---|---|---|
| **N-T-COL-VA** | Water | Total Nitrogen in water by Colour | USGS - 03 - 4174 / NEMI 5735 |

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

| | | | |
|---|---|---|---|
| **NH3-F-VA** | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC |

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

| | | | |
|---|---|---|---|
| **P-T-COL-VA** | Water | Total P in Water by Colour | APHA 4500-P Phosphorus |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

| | | | |
|---|---|---|---|
| **P-TD-COL-VA** | Water | Total Dissolved P in Water by Colour | APHA 4500-P Phosphorous |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H "pH Value" |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PH-PCT-VA** | Water | pH by Meter (Automated) | APHA 4500-H pH Value |

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

| | | | |
|---|---|---|---|
| **PO4-DO-COL-VA** | Water | Diss. Orthophosphate in Water by Colour | APHA 4500-P Phosphorus |

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TDS-VA** | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-202028

**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.*

L1453879-COFC

10-202028

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

Page ____ of ____

| Report To | | Report Format / Distribution | | Service Request: (Rush subject to availability - Contact ALS to confirm TAT) | |
|---|---|---|---|---|---|
| Company: | ERM-Rescan | Standard: | X Other (specify): | X | Regular (Standard Turnaround Times - Business Days) |
| Contact: | Tyler Gale | Select: PDF | X Excel X Digital Fax | | Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: | 1111 W. Hastings St. (15th Floor) Vancouver BC V6E 2J3 | Email 1: | Tyler.Gale@erm.com | | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| | | Email 2: | Yaming.Chen@erm.com | | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| Phone: | 604-689-9460 Fax: | | | **Analysis Request** | |
| **Invoice To** | Same as Report ? (circle) Yes or No (if No, provide details) | **Client / Project Information** | | ( Indicate Filtered or Preserved, F/P ) | |
| | Copy of Invoice with Report? (circle) Yes or No | Job #: | 0194106-0002-0005 | | |
| Company: | | PO / AFE: | | | |
| Contact: | | LSD: | | | |
| Address: | | | | | |
| Phone: | Fax: | Quote #: | | | |
| **Lab Work Order # (lab use only)** | L1453879 | **ALS Contact:** | Amber Springer | **Sampler:** | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Gen. Chem. | P Nutrients | P Total Metals | P Dissolved Metals | P Total Hg | P Dissolved Hg | | | | | | | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW-H5 | 08-May-14 | 16:00 | Water | X | X | X | X | X | | | | | | | | 5 |
| | MW-H24C | 09-May-14 | 14 00 | " | — | — | — | — | — | — | | | | | | | 6 |
| | MW-H25A | 09-May-14 | 14 30 | " | — | — | — | — | — | — | | | | | | | 6 |
| | MW-H26A | 10-May-14 | 15:00 | " | — | — | — | — | | X | | | | | | | 5 |
| | MW-H27 | 10-May-14 | 16:00 | " | — | — | — | — | — | — | | | | | | | 6 |
| | MW-H29 | 10-May-14 | 14:00 | " | — | — | — | — | — | X | | | | | | | 6 |
| | MW-H25B | 11-May-14 | 11:00 | " | — | — | — | — | — | — | | | | | | | 6 |
| | MW-H17 | 11-May-14 | 14:30 | " | — | — | — | — | — | — | | | | | | | 6 |
| | ALS Travel Blank | | | | X | X | X | | X | | | | | | | | 4 |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

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

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SF |
| Tyler Gale | | | Geoff | May 12 | 9am (drop box) | 6/9 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 14-MAY-14
Report Date: 27-MAY-14 11:16 (MT)
Version: FINAL

Client Phone: 604-689-9460

# Certificate of Analysis

**Lab Work Order #: L1455515**

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-147364
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

| Grouping | Analyte | L1455515-1 Water 13-MAY-14 08:30 ALS FIELD BLANK | L1455515-2 Water 13-MAY-14 MW-H28 | L1455515-3 Water 13-MAY-14 14:00 MW-H2B | L1455515-4 Water 13-MAY-14 11:00 MW-H25C | |
|---|---|---|---|---|---|---|
| **Sample ID** | | | | | | |
| **Description** | | | | | | |
| **Sampled Date** | | | | | | |
| **Sampled Time** | | | | | | |
| **Client ID** | | | | | | |
| **WATER** | | | | | | |
| **Physical Tests** | Colour, True (CU) | <5.0 | 28.6 | <5.0 | <5.0 | |
| | Conductivity (uS/cm) | <2.0 | 1820 | 326 | 325 | |
| | Hardness (as CaCO3) (mg/L) | <0.50 | 72.8 | 160 | 155 | |
| | pH (pH) | 6.39 | 8.47 | 8.21 | 8.22 | |
| | Total Suspended Solids (mg/L) | <3.0 | 6.2 | <3.0 | <3.0 | |
| | Total Dissolved Solids (mg/L) | <10 | 1290 | 200 | 189 | |
| | Turbidity (NTU) | <0.10 | 3.76 | 0.53 | 0.49 | |
| **Anions and Nutrients** | Acidity (as CaCO3) (mg/L) | 1.0 | <1.0 | <1.0 | <1.0 | |
| | Alkalinity, Bicarbonate (as CaCO3) (mg/L) | <2.0 | 264 | 158 | 157 | |
| | Alkalinity, Carbonate (as CaCO3) (mg/L) | <2.0 | <1.0 | <2.0 | <2.0 | |
| | Alkalinity, Hydroxide (as CaCO3) (mg/L) | <2.0 | <1.0 | <2.0 | <2.0 | |
| | Alkalinity, Total (as CaCO3) (mg/L) | <2.0 | 264 | 158 | 157 | |
| | Ammonia, Total (as N) (mg/L) | <0.0050 | 0.514 | <0.0050 | <0.0050 | |
| | Bromide (Br) (mg/L) | <0.050 | 2.1 | <0.050 | <0.050 | |
| | Chloride (Cl) (mg/L) | <0.50 | 30 | 9.65 | 9.75 | |
| | Fluoride (F) (mg/L) | <0.020 | 0.72 | 0.076 | 0.077 | |
| | Nitrate (as N) (mg/L) | <0.0050 | <0.10 DLM | 0.407 | 0.412 | |
| | Nitrite (as N) (mg/L) | <0.0010 | <0.020 DLM | <0.0010 | <0.0010 | |
| | Total Kjeldahl Nitrogen (mg/L) | <0.050 | 1.16 | <0.081 | <0.082 | |
| | Total Nitrogen (mg/L) | <0.050 | 1.16 | 0.406 | 0.408 | |
| | Orthophosphate-Dissolved (as P) (mg/L) | <0.0010 | 0.380 | 0.0025 | 0.0024 | |
| | Phosphorus (P)-Total Dissolved (mg/L) | <0.0020 | 0.389 | 0.0026 | 0.0029 | |
| | Phosphorus (P)-Total (mg/L) | <0.0020 | 0.618 | 0.0029 | 0.0035 | |
| | Sulfate (SO4) (mg/L) | <0.50 | 410 | 4.15 | 4.19 | |
| **Organic / Inorganic Carbon** | Total Organic Carbon (mg/L) | <0.50 | 48.1 | 0.75 | 1.22 | |
| **Total Metals** | Aluminum (Al)-Total (mg/L) | <0.0030 | | 0.0097 | 0.0113 | |
| | Antimony (Sb)-Total (mg/L) | <0.00010 | | <0.00010 | <0.00010 | |
| | Arsenic (As)-Total (mg/L) | <0.00010 | | <0.00010 | <0.00010 | |
| | Barium (Ba)-Total (mg/L) | <0.000050 | | 0.284 | 0.281 | |
| | Beryllium (Be)-Total (mg/L) | <0.00010 | | <0.00010 | <0.00010 | |
| | Bismuth (Bi)-Total (mg/L) | <0.00050 | | <0.00050 | <0.00050 | |
| | Boron (B)-Total (mg/L) | <0.010 | | <0.010 | <0.010 | |
| | Cadmium (Cd)-Total (mg/L) | <0.000010 | | 0.000022 | 0.000067 | |
| | Calcium (Ca)-Total (mg/L) | <0.020 | | 47.1 | 45.5 | |
| | Chromium (Cr)-Total (mg/L) | <0.00010 | | 0.00021 | 0.00022 | |
| | Cobalt (Co)-Total (mg/L) | <0.00010 | | <0.00010 | <0.00010 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Sample ID** | L1455515-1 | L1455515-2 | L1455515-3 | L1455515-4 | |
| | **Description** | Water | Water | Water | Water | |
| | **Sampled Date** | 13-MAY-14 | 13-MAY-14 | 13-MAY-14 | 13-MAY-14 | |
| | **Sampled Time** | 08:30 | | 14:00 | 11:00 | |
| | **Client ID** | ALS FIELD BLANK | MW-H28 | MW-H2B | MW-H25C | |
| **Grouping** | **Analyte** | | | | | |
| **WATER** | | | | | | |
| **Total Metals** | Copper (Cu)-Total (mg/L) | <0.00050 | | <0.00050 | <0.00050 | |
| | Iron (Fe)-Total (mg/L) | <0.030 | | <0.030 | <0.030 | |
| | Lead (Pb)-Total (mg/L) | <0.000050 | | <0.000050 | <0.000050 | |
| | Lithium (Li)-Total (mg/L) | <0.00050 | | 0.00272 | 0.00256 | |
| | Magnesium (Mg)-Total (mg/L) | <0.0050 | | 10.2 | 10.5 | |
| | Manganese (Mn)-Total (mg/L) | <0.000050 | | 0.00249 | 0.00242 | |
| | Mercury (Hg)-Total (mg/L) | <0.000010 | | <0.000010 | <0.000010 | |
| | Molybdenum (Mo)-Total (mg/L) | <0.000050 | | 0.000263 | 0.000266 | |
| | Nickel (Ni)-Total (mg/L) | <0.00050 | | <0.00050 | <0.00050 | |
| | Phosphorus (P)-Total (mg/L) | <0.30 | | <0.30 | <0.30 | |
| | Potassium (K)-Total (mg/L) | <0.050 | | 0.615 | 0.622 | |
| | Selenium (Se)-Total (mg/L) | <0.00010 | | 0.00017 | 0.00023 | |
| | Silicon (Si)-Total (mg/L) | <0.050 | | 2.80 | 2.82 | |
| | Silver (Ag)-Total (mg/L) | <0.000010 | | <0.000010 | <0.000010 | |
| | Sodium (Na)-Total (mg/L) | <2.0 | | 2.2 | <2.0 | |
| | Strontium (Sr)-Total (mg/L) | <0.00020 | | 0.0757 | 0.0734 | |
| | Thallium (Tl)-Total (mg/L) | <0.000010 | | <0.000010 | <0.000010 | |
| | Tin (Sn)-Total (mg/L) | <0.00010 | | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Total (mg/L) | <0.010 | | <0.010 | <0.010 | |
| | Uranium (U)-Total (mg/L) | <0.000010 | | 0.000142 | 0.000142 | |
| | Vanadium (V)-Total (mg/L) | <0.0010 | | <0.0010 | <0.0010 | |
| | Zinc (Zn)-Total (mg/L) | <0.0030 | | <0.0030 | <0.0030 | |
| **Dissolved Metals** | Dissolved Mercury Filtration Location | | FIELD | FIELD | FIELD | |
| | Dissolved Metals Filtration Location | | FIELD | FIELD | FIELD | |
| | Aluminum (Al)-Dissolved (mg/L) | | 0.0073 | <0.0030 | <0.0030 | |
| | Antimony (Sb)-Dissolved (mg/L) | | <0.00020 DLA | <0.00010 | <0.00010 | |
| | Arsenic (As)-Dissolved (mg/L) | | 0.00570 | <0.00010 | <0.00010 | |
| | Barium (Ba)-Dissolved (mg/L) | | 0.160 | 0.286 | 0.284 | |
| | Beryllium (Be)-Dissolved (mg/L) | | <0.00020 DLA | <0.00010 | <0.00010 | |
| | Bismuth (Bi)-Dissolved (mg/L) | | <0.0010 DLA | <0.00050 | <0.00050 | |
| | Boron (B)-Dissolved (mg/L) | | 0.154 | <0.010 | <0.010 | |
| | Cadmium (Cd)-Dissolved (mg/L) | | <0.000020 DLA | <0.000010 | <0.000010 | |
| | Calcium (Ca)-Dissolved (mg/L) | | 17.3 | 46.2 | 45.1 | |
| | Chromium (Cr)-Dissolved (mg/L) | | <0.00020 DLA | 0.00015 | 0.00026 | |
| | Cobalt (Co)-Dissolved (mg/L) | | 0.00032 | <0.00010 | <0.00010 | |
| | Copper (Cu)-Dissolved (mg/L) | | <0.00050 | <0.00050 | <0.00050 | |
| | Iron (Fe)-Dissolved (mg/L) | | 0.305 | <0.030 | <0.030 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# ALS ENVIRONMENTAL ANALYTICAL REPORT

| Grouping | Analyte | L1455515-1 Water 13-MAY-14 08:30 ALS FIELD BLANK | L1455515-2 Water 13-MAY-14 MW-H28 | L1455515-3 Water 13-MAY-14 14:00 MW-H2B | L1455515-4 Water 13-MAY-14 11:00 MW-H25C | |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| **Dissolved Metals** | Lead (Pb)-Dissolved (mg/L) | | <0.00010 DLA | <0.000050 | <0.000050 | |
| | Lithium (Li)-Dissolved (mg/L) | | 0.219 | 0.00242 | 0.00233 | |
| | Magnesium (Mg)-Dissolved (mg/L) | | 7.19 | 10.9 | 10.3 | |
| | Manganese (Mn)-Dissolved (mg/L) | | 0.730 | 0.00166 | 0.00166 | |
| | Mercury (Hg)-Dissolved (mg/L) | | <0.000010 | <0.000010 | <0.000010 | |
| | Molybdenum (Mo)-Dissolved (mg/L) | | 0.0191 | 0.000248 | 0.000252 | |
| | Nickel (Ni)-Dissolved (mg/L) | | 0.0023 | <0.00050 | <0.00050 | |
| | Phosphorus (P)-Dissolved (mg/L) | | 0.57 | <0.30 | <0.30 | |
| | Potassium (K)-Dissolved (mg/L) | | 1.59 | 0.623 | 0.607 | |
| | Selenium (Se)-Dissolved (mg/L) | | <0.00020 DLA | 0.00019 | 0.00019 | |
| | Silicon (Si)-Dissolved (mg/L) | | 4.30 | 2.78 | 2.83 | |
| | Silver (Ag)-Dissolved (mg/L) | | <0.000020 DLA | <0.000010 | <0.000010 | |
| | Sodium (Na)-Dissolved (mg/L) | | 361 | <2.0 | <2.0 | |
| | Strontium (Sr)-Dissolved (mg/L) | | 0.326 | 0.0727 | 0.0724 | |
| | Thallium (Tl)-Dissolved (mg/L) | | <0.000020 DLA | <0.000010 | <0.000010 | |
| | Tin (Sn)-Dissolved (mg/L) | | <0.00020 DLA | <0.00010 | <0.00010 | |
| | Titanium (Ti)-Dissolved (mg/L) | | <0.010 | <0.010 | <0.010 | |
| | Uranium (U)-Dissolved (mg/L) | | 0.00290 | 0.000139 | 0.000138 | |
| | Vanadium (V)-Dissolved (mg/L) | | <0.0020 DLA | <0.0010 | <0.0010 | |
| | Zinc (Zn)-Dissolved (mg/L) | | <0.0030 | <0.0030 | <0.0030 | |

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

# Reference Information

**Qualifiers for Individual Samples Listed:**

| Sample Number | Client Sample ID | Qualifier | Description |
|---|---|---|---|
| L1455515-2 | MW-H28 | WSMD | Water sample(s) for dissolved mercury analysis was not submitted in glass container with HCl preservative. Results may be biased low. |

**QC Samples with Qualifiers & Comments:**

| QC Type Description | Parameter | Qualifier | Applies to Sample Number(s) |
|---|---|---|---|
| Duplicate | Bromide (Br) | DLM | L1455515-1, -2, -3, -4 |
| Duplicate | Nitrite (as N) | DLM | L1455515-1, -2, -3, -4 |
| Duplicate | Bromide (Br) | DLM | L1455515-1, -2, -3, -4 |
| Duplicate | Fluoride (F) | DLM | L1455515-1, -2, -3, -4 |
| Duplicate | Nitrite (as N) | DLM | L1455515-1, -2, -3, -4 |
| Duplicate | Nitrate (as N) | DLM | L1455515-1, -2, -3, -4 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Orthophosphate-Dissolved (as P) | MS-B | L1455515-1, -2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Antimony (Sb)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Arsenic (As)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Boron (B)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Manganese (Mn)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Molybdenum (Mo)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Uranium (U)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Total Nitrogen | MS-B | L1455515-1, -2, -3, -4 |
| Matrix Spike | Total Nitrogen | MS-B | L1455515-1, -2, -3, -4 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Silicon (Si)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Barium (Ba)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Calcium (Ca)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Magnesium (Mg)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Potassium (K)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Strontium (Sr)-Dissolved | MS-B | L1455515-2, -3, -4 |
| Matrix Spike | Total Organic Carbon | MS-B | L1455515-2, -3 |
| Matrix Spike | Total Organic Carbon | MS-B | L1455515-2, -3 |

**Qualifiers for Individual Parameters Listed:**

| Qualifier | Description |
|---|---|

# Reference Information

| | |
|---|---|
| DLA | Detection Limit adjusted for required dilution |
| DLM | Detection Limit Adjusted due to sample matrix effects. |
| 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-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 "Acidity" |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ACY-PCT-VA** | Water | Acidity by Automatic Titration | APHA 2310 Acidity |
| This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 "Alkalinity" |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-PCT-VA** | Water | Alkalinity by Auto. Titration | APHA 2320 Alkalinity |
| This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ALK-SCR-VA** | Water | Alkalinity by colour or titration | EPA 310.2 OR APHA 2320 |
| This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.<br>OR<br>This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values. | | | |
| **ANIONS-BR-IC-VA** | Water | Bromide by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-CL-IC-VA** | Water | Chloride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-F-IC-VA** | Water | Fluoride by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **ANIONS-NO2-IC-VA** | Water | Nitrite in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance. | | | |
| **ANIONS-NO3-IC-VA** | Water | Nitrate in Water by Ion Chromatography | EPA 300.0 |
| This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance. | | | |
| **ANIONS-SO4-IC-VA** | Water | Sulfate by Ion Chromatography | APHA 4110 B. |
| This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". | | | |
| **CARBONS-TOC-VA** | Water | Total organic carbon by combustion | APHA 5310 TOTAL ORGANIC CARBON (TOC) |
| This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". | | | |
| **COLOUR-TRUE-VA** | Water | Colour (True) by Spectrometer | BCMOE Colour Single Wavelength |
| This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit. | | | |
| **EC-PCT-VA** | Water | Conductivity (Automated) | APHA 2510 Auto. Conduc. |
| This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode. | | | |
| **HARDNESS-CALC-VA** | Water | Hardness | APHA 2340B |
| Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation. | | | |

# Reference Information

**HG-DIS-LOW-CVAFS-VA** Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**HG-TOT-LOW-CVAFS-VA** Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

**MET-D-CCMS-VA** Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-DIS-ICP-VA** Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**MET-T-CCMS-VA** Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

**MET-TOT-ICP-VA** Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

**N-T-COL-VA** Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

**NH3-F-VA** Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

**P-T-COL-VA** Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

**P-TD-COL-VA** Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PH-PCT-VA** Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

**PO4-DO-COL-VA** Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

# Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

| | | | |
|---|---|---|---|
| **TDS-VA** | Water | Total Dissolved Solids by Gravimetric | APHA 2540 C - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

| | | | |
|---|---|---|---|
| **TKN-CALC-VA** | Water | TKN in Water (Calculation) | BC MOE LABORATORY MANUAL (2005) |

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

| | | | |
|---|---|---|---|
| **TSS-VA** | Water | Total Suspended Solids by Gravimetric | APHA 2540 D - GRAVIMETRIC |

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 "Turbidity" |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

| | | | |
|---|---|---|---|
| **TURBIDITY-VA** | Water | Turbidity by Meter | APHA 2130 Turbidity |

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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 |
|---|---|
| VA | ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA |

**Chain of Custody Numbers:**

10-147364

**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.*

L1455515-COFC

**10-147364**

ALS Environmental

**Chain of Custody / Analytical Request Form**
**Canada Toll Free: 1 800 668 9878**
www.alsglobal.com

Page 1 of 1

| **Report To** | **Report Format / Distribution** | **Service Request:** (Rush subject to availability - Contact ALS to confirm TAT) |
|---|---|---|
| Company: ERM - Rescan | Standard: X Other (specify): | X Regular (Standard Turnaround Times - Business Days) |
| Contact: Tyler Gale | Select: PDF X Excel X Digital Fax | Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT |
| Address: 1111 W. Hastings St. Vancouver BC V6E 2J3 | Email 1: Tyler.Gale@erm.com | Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT |
| Phone: 604-689-9460 Fax: | Email 2: Yaming.Chen@erm.com | Same Day or Weekend Emergency - Contact ALS to confirm TAT |
| **Invoice To** Same as Report ? (circle) (Yes) or No (if No, provide details) | **Client / Project Information** | **Analysis Request** |
| Copy of Invoice with Report? (circle) Yes or No | Job #: 0194106-0002-0005 | ( Indicate Filtered or Preserved, F/P ) |
| Company: | PO / AFE: | |
| Contact: | LSD: | |
| Address: | | |
| Phone: Fax: | Quote #: | |
| **Lab Work Order # (lab use only)** L1455515 | **ALS Contact:** Amber Springer **Sampler:** Tyler Gale | |

| Sample # | Sample Identification (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | Routine | Nutrients | Total Metals | Dissolved Metals | Total Hg | Dissolved Hg | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALS Field Blank preserved → | 13-May-14 | 08:30 | Water | X | X | X | | X | | 4 |
| | MW-H28 | 13-May-14 | | " | X | X | | X | | X | 4 |
| | MW-H2B | 13-May-14 | 14:00 | " | — | — | — | — | — | — | 6 |
| | MW-H25C | 13-May-14 | 11:00 | " | — | — | — | — | — | — | 6 |

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

MW-H28: in Routine bottle please prioritize anions, hardness, turbidity, TDS.

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

**By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.**

| SHIPMENT RELEASE (client use) | | | SHIPMENT RECEPTION (lab use only) | | | | SHIPMENT VERIFICATION (lab use only) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Released by: | Date: | Time: | Received by: | Date: | Time: | Temperature: | Verified by: | Date: | Time: | Observations: Yes / No ? If Yes add SIF |
| Tyler Gale | 14-May-14 | | Geoff | May 14 | 15:45 | 9 °C | | | | |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

# Appendix F

## Murray River Coal Project Geologic Model

ERM

# Memorandum

Refer to File No.: \\server04\publishing\Murray River\2014 Geology Model Memo\0.3 MUR_GC_Geology Model.docx

**Date:** June 04, 2014

**To:** Piotr Rzepecki

**From:** Mark Nelson

**Cc:** Kelsey Norlund, Jason Rempel

**Subject:** **Memorandum: Murray River Geological Model**

A three dimensional (3D) geology model of the stratigraphy above and hosting the coal seams at the Murray River Project was not available to provide cross sections incorporating hydrogeology data. Seismic interpretations were matched to and modified by down hole geology to generate a 3D geology model that can be cut to produce various visualizations of the data.

This 3D geology model was generated to allow for visualization of overall structure within the Murray River Project area. The model is not detailed enough to act aid in any resource or reserve estimation as the error on faults and lithological contacts exceeds ±10m.

## 1. METHODOLOGY

The geology model was generated by blending seismic interpreted cross sections generated by HD Mining (No. 173 Prospecting Party of China National Administration of Coal Geology 2011) with stratigraphic interpretations presented in exploration drill logs.

### 1.1 Limitations

The stratigraphic interpretations do not differentiate between units above the Boulder Creek Formation. All material above Boulder Creek Formation is logged as Hasler Formation. The thickness of the material indicates that some of the material should belong to overlying units (Dunvagen, Cruiser, or Goodrich Formations).

The complexity of the shape of the overlying, undifferentiated material and its uncertain origin made modelling the material difficult and resulted in its exclusion from the final 3D model.

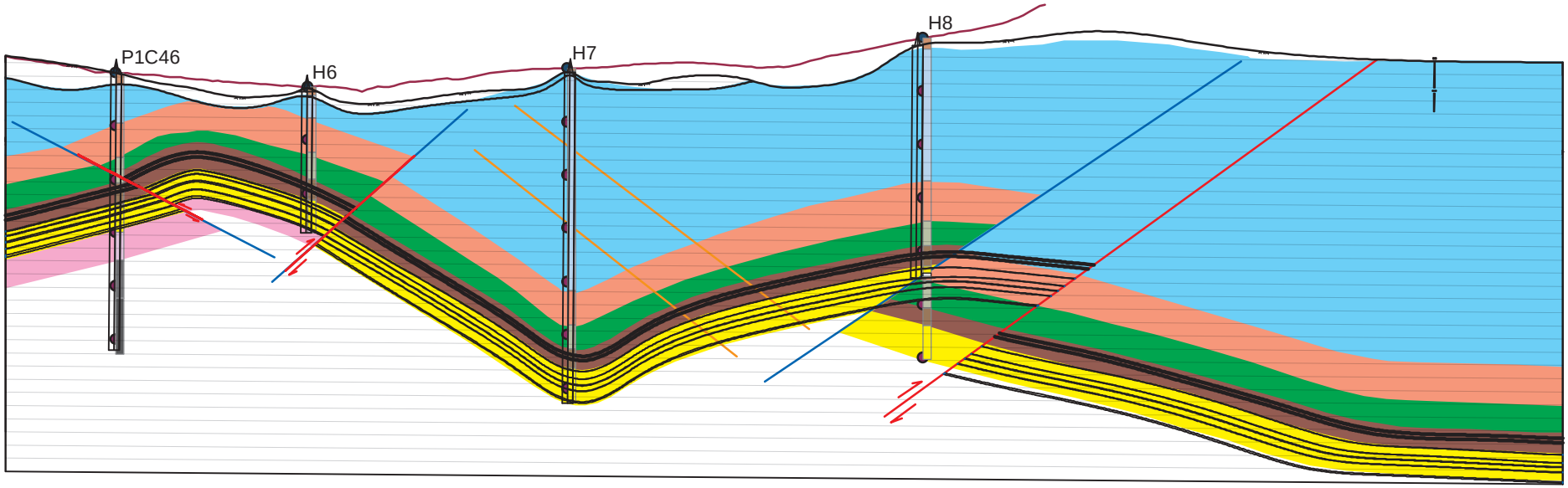
Faults interpreted from the seismic survey did not always match the exploration drill logs. Additionally not all faults were presented in all the HD Mining cross sections. It was assumed that faults interpreted from the seismic survey were large or persistent enough that they should appear in all cross sections. When faults were inferred between sections they were labelled as inferred. An example of this reinterpretation is presented in Figure 1.1-1.

Deep drill holes or seismic survey results do not extend under the proposed Coarse Coal Reject site to the west of the Murray River. Consequently the geological model does not cover that region.

Appendix A contains notes made during the interpretation process.

**Figure 1.1-1**

**Comparison Between Seismic and Exploration Interpreted Geology**



### 1.2 Process

A summary of the process is listed below:

1. Import location and down hole stratigraphy information of exploration and hydrogeology drill holes.
2. Choose eight cross section locations that closely match the seismic interpreted sections and plot preliminary cross sections displaying topography, drill hole trace, and down hole stratigraphy.
3. Import the eight seismic interpreted cross sections generated by HD Mining (No. 173 Prospecting Party of China National Administration of Coal Geology 2011).
4. Georeference the eight seismic interpreted cross sections in the preliminary drill hole cross sections so that they are hanging in 3D space correctly.
5. Compare the seismic interpreted stratigraphy and the down hole stratigraphy sections to determine discrepancies between interpreted and logged coal seams and faults.
6. Adjust seismic interpreted faults to account for potential faults in the exploration drill logs. Add new interpreted faults not present in the seismic interpretations. The new interpreted faults were added to the geology model to help the software interpolate between sections.
7. Digitize geology in each section using the shape of the seismic interpreted coal seams as a guide for the form of the stratigraphic contacts.
8. When each section was complete the geology was interpolated between sections to create volumes.

## 2. RESULTS

The primary result of the modelling exercise was the generation of a 3D geology model. The extent of three cross sections through the model are presented in Figure 2-1. Three cross sections are presented in Figures 2-2 to 2-4 and a 3D perspective of the geologic cross sections used to generate the 3D model are presented in Figure 2-5.

**Figure 2-1**

**Plan Map Illustrating Extents of Cross Sections**

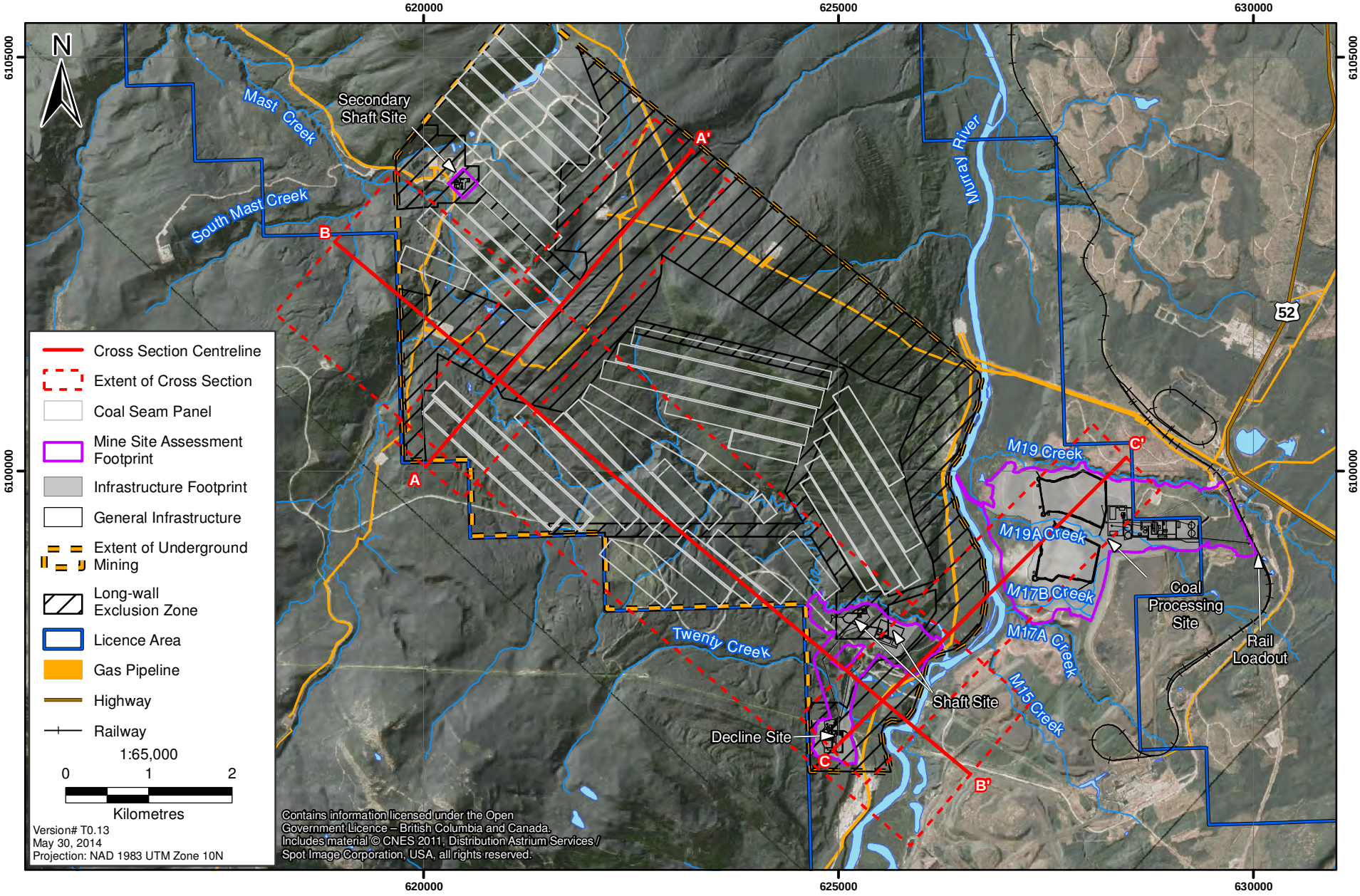
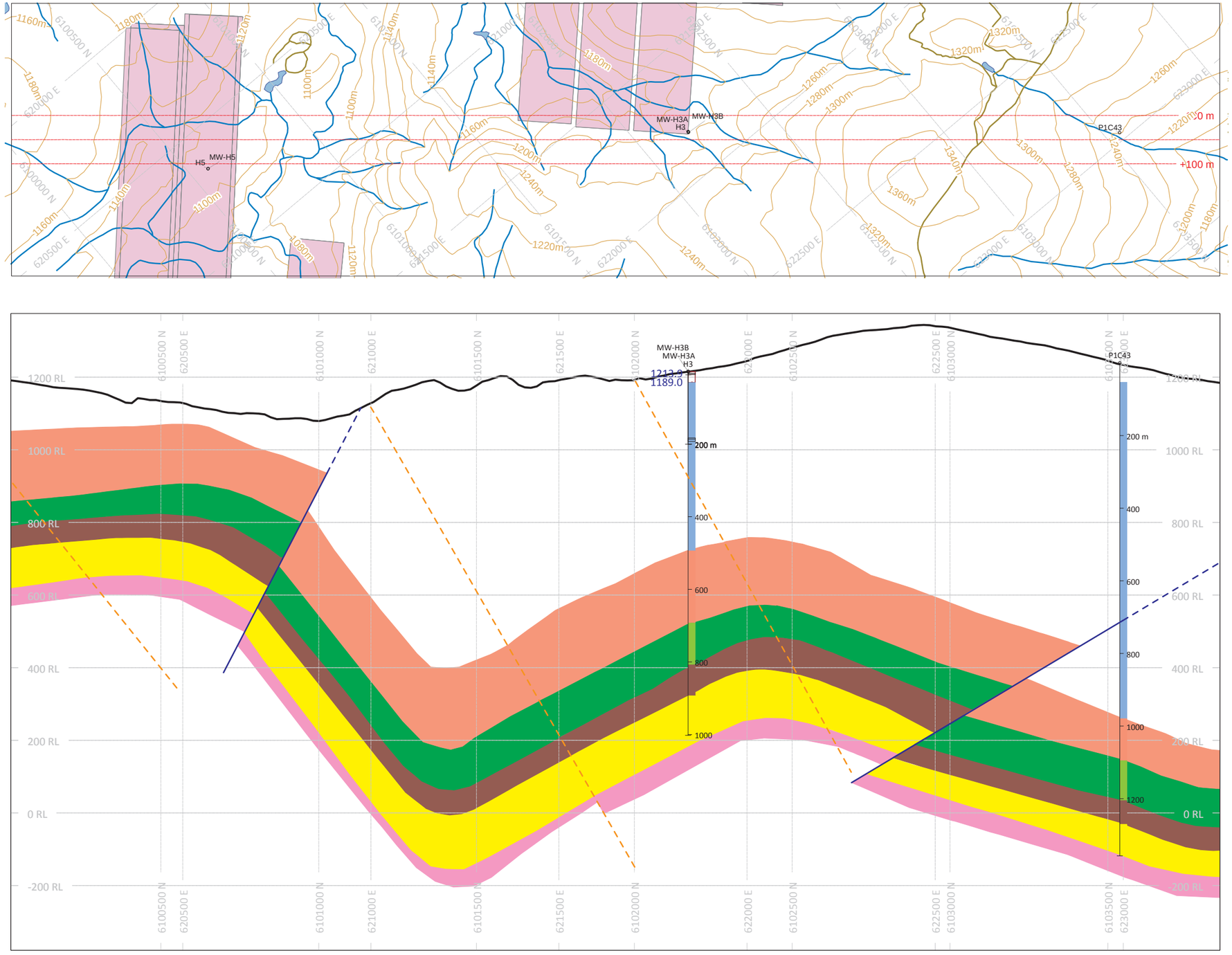


**Figure 2-2**
**Cross Section A-A'**




HOLES PLOTTED

TOTAL 4

H3 MW-H3A MW-H3B P1C43

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel

- Topography
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred

**SECTION SPECS:**

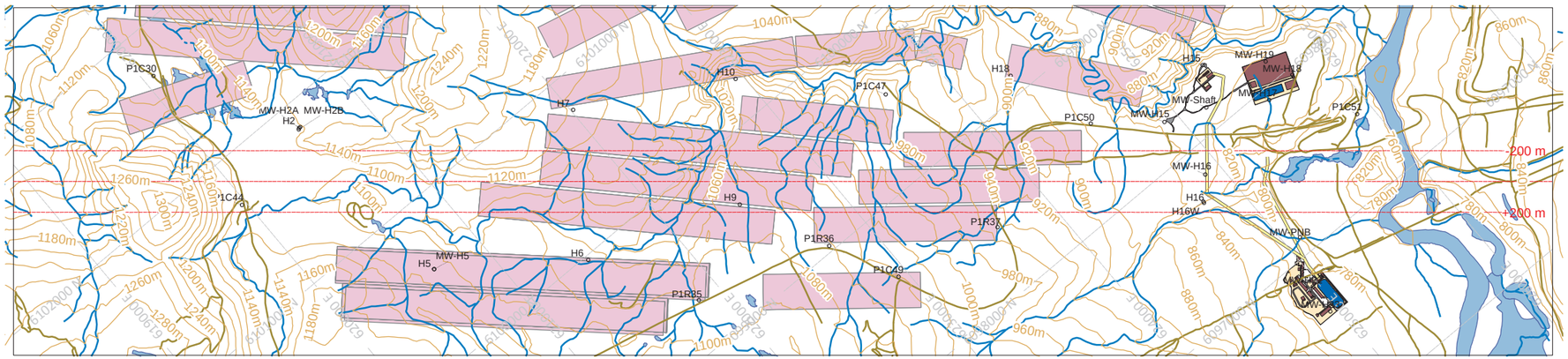
| | | |
|---|---|---|
| REF. PT. E, N | 621650 m | 6101940 m |
| EXTENTS | 5000 m | 1754 m |
| SECTION TOP, BOT | 1375 m | -378.5 m |
| TOLERANCE +/- | 100 m | |
| VERTICAL EXAG. | 1.5 m | |

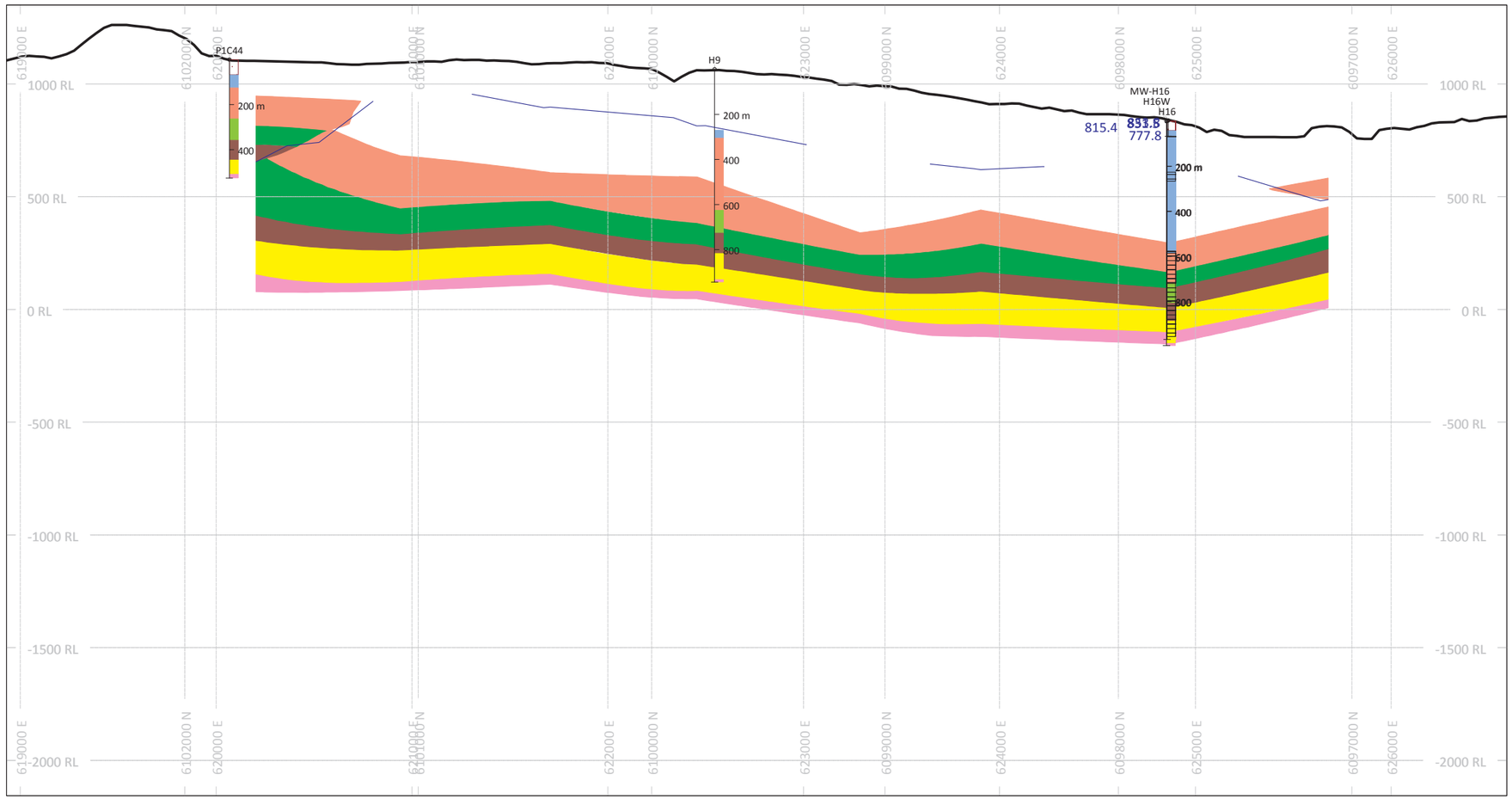
SCALE
(m)
-100 0 100 200 300 400 500
NAD83 / UTM zone 10

AZIMUTH = 45°
N
W E
S

**Figure 2-3**
**Cross Section B-B'**

ERM




HOLES PLOTTED

TOTAL 5

H16 H16W H9 MW-H16
P1C44

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel

- Topography
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred

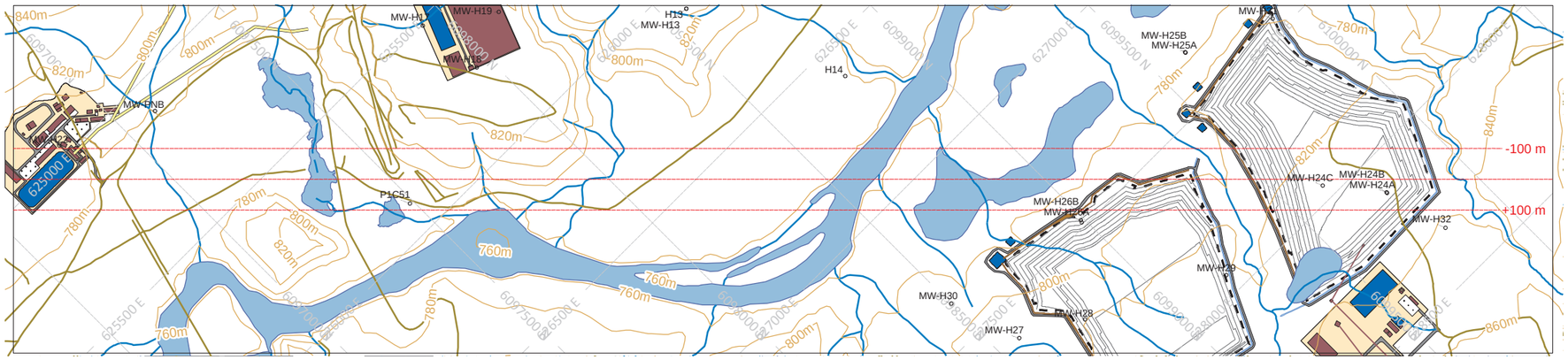
**SECTION SPECS:**

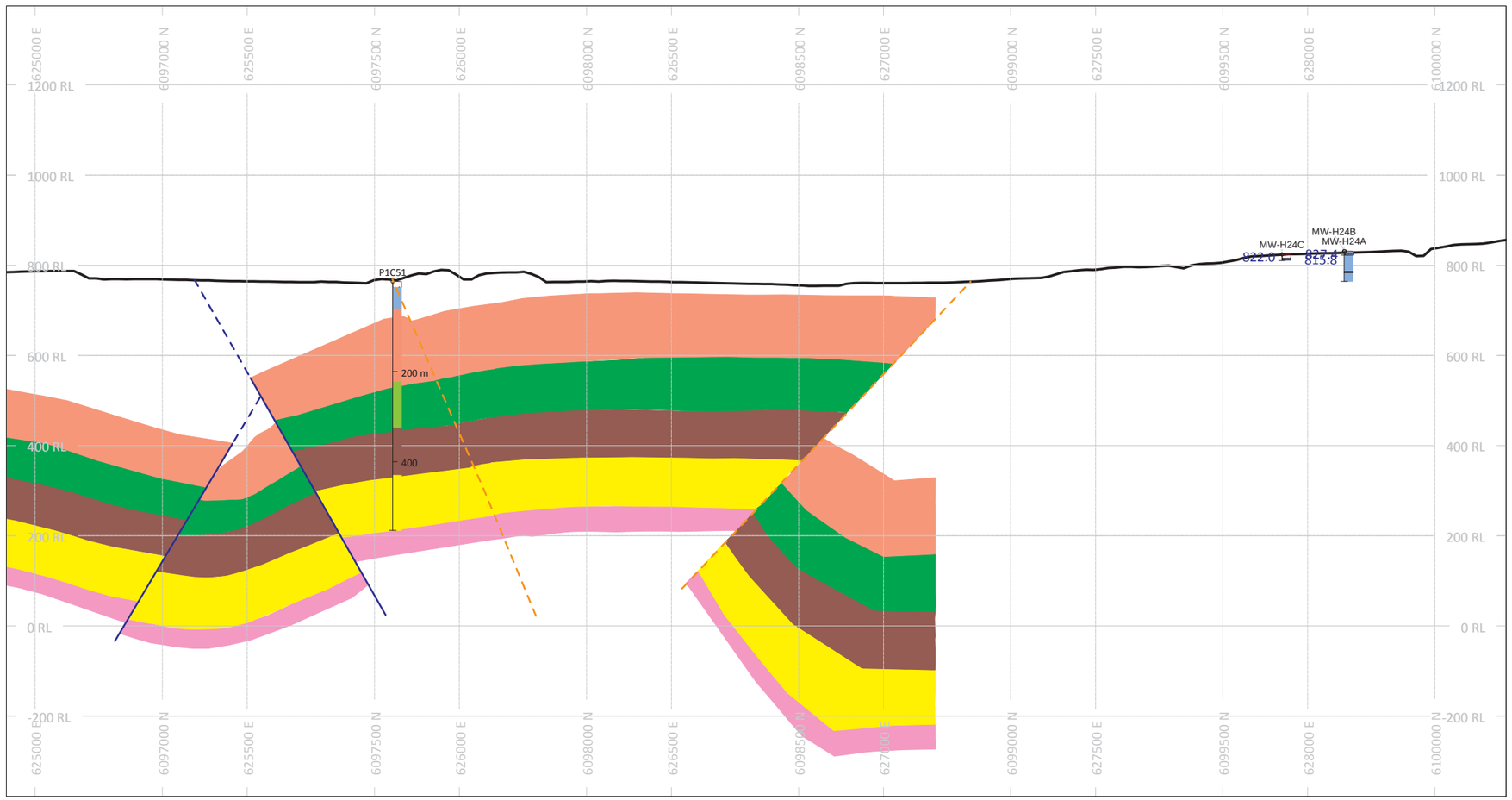
| | | |
|---|---|---|
| REF. PT. E, N | 622760 m | 6099550 m |
| EXTENTS | 10000 m | 3508 m |
| SECTION TOP, BOT | 1351 m | -2157 m |
| TOLERANCE +/- | 200 m | |
| VERTICAL EXAG. | 1.5 m | |

SCALE
(m)
-200 0 200 400 600 800 1000
NAD83 / UTM zone 10

AZIMUTH = 130°
N W E S

**Figure 2-4**
**Cross Section C-C'**




HOLES PLOTTED

TOTAL 4

MW-H24A MW-H24B MW-H24C P1C51

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel

- Topography
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred

**SECTION SPECS:**

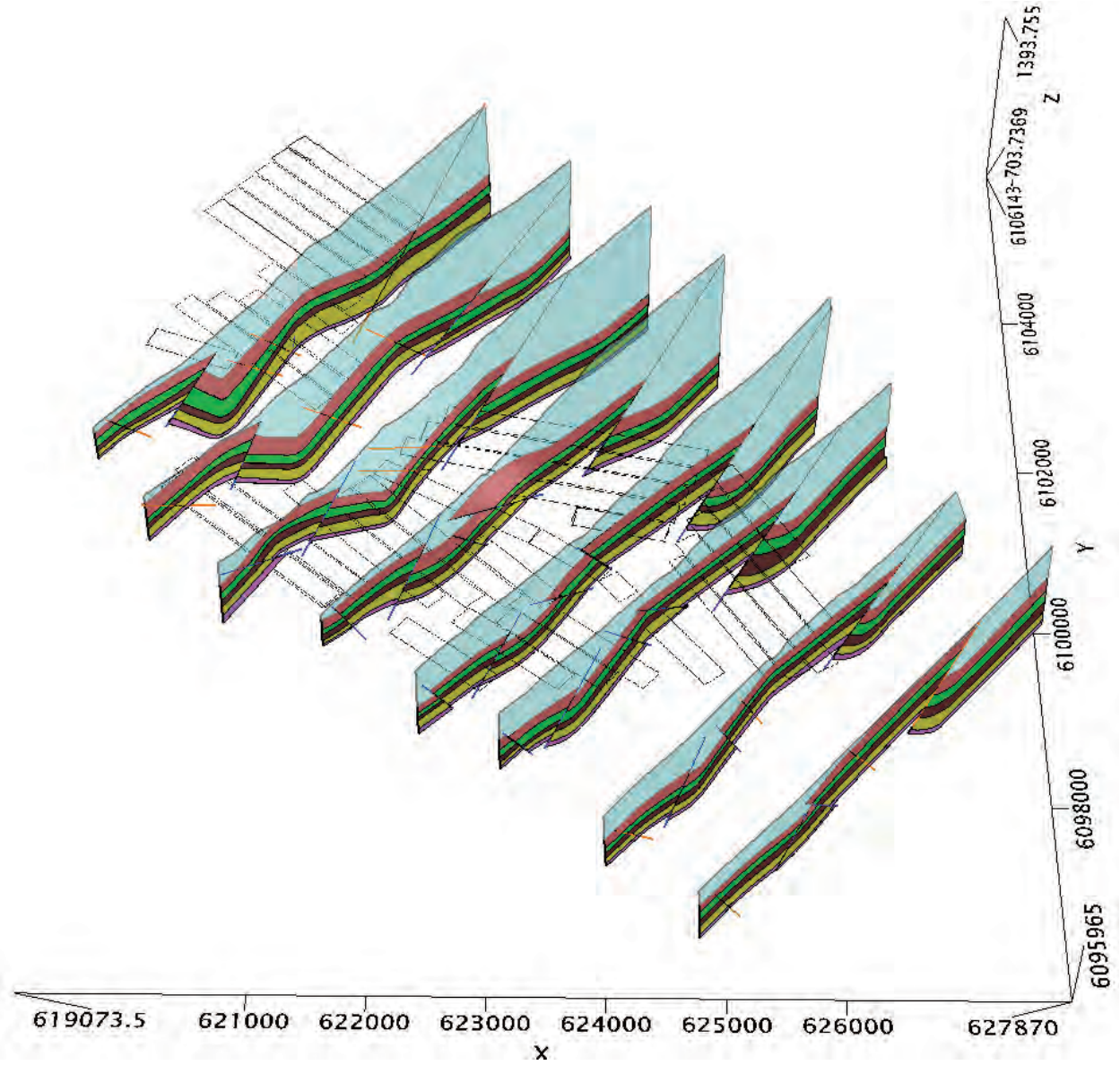
| | | |
|---|---|---|
| REF. PT. E, N | 626700 m | 6098400 m |
| EXTENTS | 5000 m | 1754 m |
| SECTION TOP, BOT | 1375 m | -378.5 m |
| TOLERANCE +/- | 100 m | |
| VERTICAL EXAG. | 1.5 m | |

SCALE
(m)
-100 0 100 200 300 400 500
NAD83 / UTM zone 10

AZIMUTH = 45°
N
W E
S

**Figure 2-5**

**3D Perspective View of Geologic Cross Sections**



Prepared By:



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ERM Rescan

## REFERENCES

No. 173 Prospecting Party of China National Administration of Coal Geology. 2011. *Coal Exploration Report for the First Prospecting Area of the Murray River Coal Property in Northeastern British Columbia, Canada*. Compiled for Huiyong Holding Group Co., Ltd. by No. 173 Prospecting Party of China National Administration of Coal Geology July 2011:

# APPENDIX A

— Notes —

- **Section 09**: no fault adjustments
- **Section 08**: near PIC48 – fault moved down due to repeating lithology in exploration drill logs AND slickenlines mentioned. No breccia/slickenlines mentioned at location of HD interpreted fault location
- **Section 07**: near PIR37 – moved fault up as thickened Boulder Creek and exploration logs indicate polished bedding plane and fractures ~600m down hole
  - near H21 – moved fault down as exploration log indicated bedding plane changes and broken rock at ~740m (Middle Gates)
- **Section 06**: no adjustments
- **Section 05**: near H9 – moved fault down from ~336 to ~420m because thickening of Boulder Creek and exploration logs indicate slickenlines between 426 and 460m. Fractures noted at ~330m
  - near H10 (middle) – moved fault up ~100m as thickened Boulder Creek and exploration log indicates bedding faults at ~480m and no fault fracture info at ~600m
- **Section 04**: not provided
- **Section 03**: near H8 – moved fault up ~450m because exploration log indicated fault unit at ~880m
  - did not modify (add) extra faults on H8 to account for thickening of Hasler Formation. I expect thick Hasler is due to incorrect core logging and should be Dunvegan or other overlying stratigraphy.
  - near H7 – added fault to intersect at ~300m based on exploration log broken core at ~300m and thickened Hasler and evidence of fault in Section 04
- **Section 02**: near PIC43 – moved fault down ~470m, thickening of Hasler with slickenlines mentioned in exploration logs between 680-740m and not in top 100m
  - no additional fractures added to PIC43 because probably incorrect stratigraphy, however broken core is noted in H3 between 200-290m so there is potential, although nothing noted in Section 03
  - near H3 – added fault, thickened Hasler and exploration log with broken core at ~200m and also present in Section 03 and 05. The fault seems out of sequence spatially with Section 03 and 05.
- **Section 01**: near H2 – fault adjusted/extended to account for slickenlines at ~100m. Hasler is still very thickened. Compressional fault noted in exploration log at 425m so a new fault added en echelon to existing