Minto Explorations Ltd.

A SUBSIDIARY OF CAPSTONE MINING LTD.

# APPENDIX M
# Characterization of Groundwater Conditions

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2CM022.017

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**Attention: Anne Labelle, Manager – Sustainability and Legal Affairs**

Dear Anne,

# Minto Mine: Groundwater Baseline Conditions

## 1.0 Requirements and Objectives

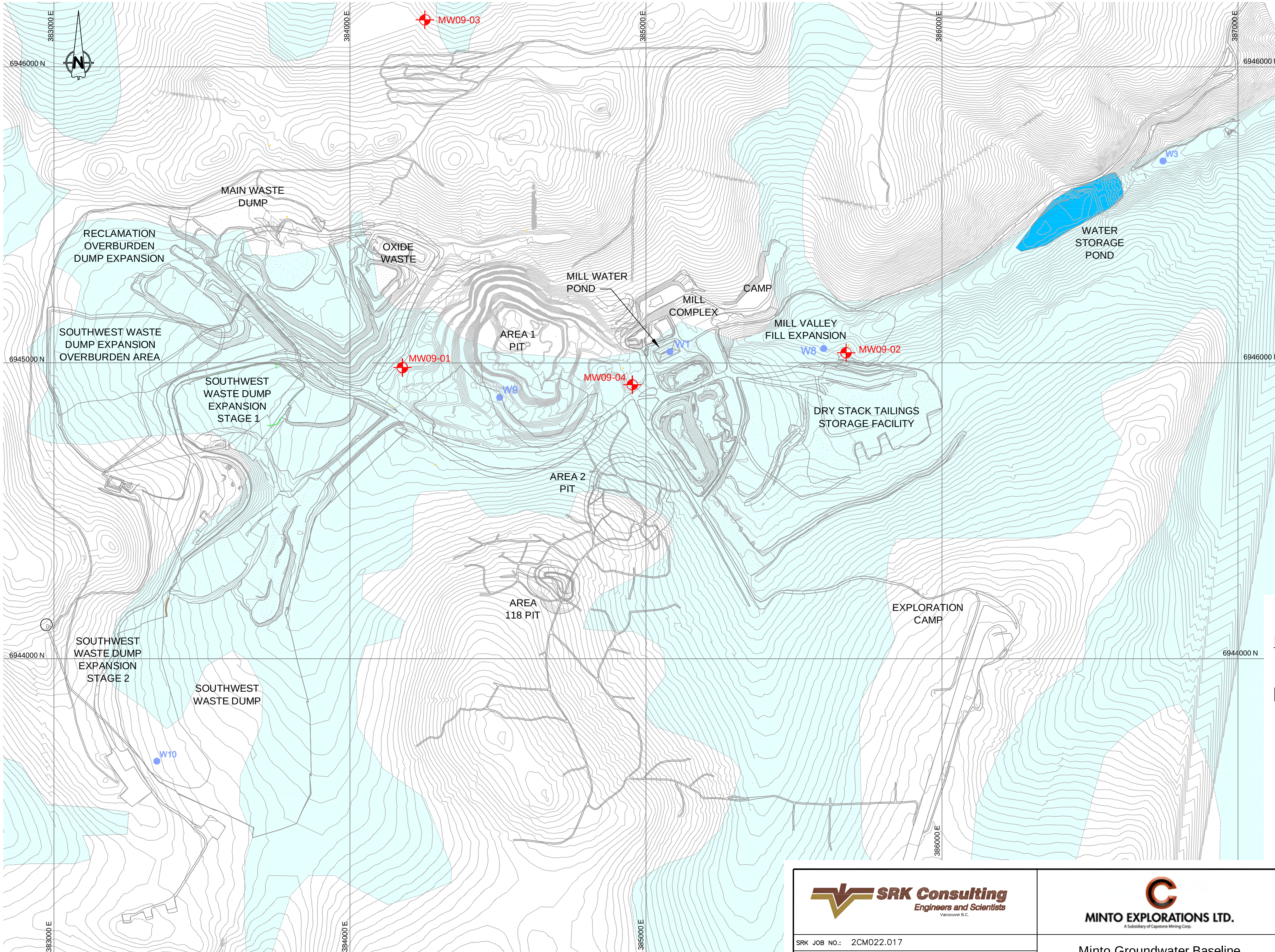
Groundwater baseline conditions found at the Minto Mine site are discussed in this report. The report outlines the work done to date to assess the hydrogeological conditions that are currently observed at the mine site, and the potential impacts of proposed mine design on the hydrogeological system.

### 1.1 Information Requirements

In order to carry out an assessment of the baseline conditions at the site, a conceptual model of the groundwater flow system, and its interaction with receiving surface water bodies, is required. This conceptual model is used to assess the potential flow regime by mapping out the groundwater flow paths, gradients, and geological materials that the water will flow through. These data are used to estimate the volume, or flux of water flowing through the system, and the related impact of groundwater flow on surface water bodies.

### 1.2 Monitoring Objectives

A groundwater monitoring program was designed to collect baseline data and monitor potential effects from the open pits, underground workings, tailings facilities (in-pit and dry stack tailings facility (DSTF), and waste rock and overburden dumps at the Minto Mine site (Figure 1). The objective of the groundwater monitoring program is to provide background and on-going water quality data to serve as an early indication of potential impact of the mine on the local groundwater quality.




LEGEND

- SURFACE WATER MONITORING LOCATIONS
- PERMAFROST (assumed; taken from HKP drawing of solifluction areas, 1994)
- MP WELL LOCATION

0 100 200 300 400 500
Scale in Metres

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# Site Layout and Groundwater Monitoring Locations

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Minto Groundwater Baseline

| DATE: | APPROVED: | FIGURE: |
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# 2.0 Hydrogeological Conditions

To establish baseline conditions, a groundwater monitoring program was carried out in the vicinity of the waste rock, overburden dumps, and the dry stack tailings facility (DSTF) at the Minto Mine site to provide background and on-going water quality data. The objective of the groundwater monitoring program was to provide an early indication of potential impact of the mine workings on the local groundwater quality.

Groundwater at the Minto site will be constrained to the overburden and bedrock flow systems. A complicating factor for monitoring groundwater at the site is the extent of permafrost at the site. The general hydrogeological characteristics are discussed below to give a clearer picture of the conditions that will affect the movement of groundwater on the site, and were used to prepare a conceptual model of the hydrogeological conditions.

## 2.1 Geology

### 2.1.1 Overburden

Throughout the mine site the residual soils grade into weathered bedrock. The overburden soils thin out to the south and east of the DSTSF site.

Geotechnical investigations within the plan area of the dry stack tailings facility (DSTF), as reported in EBA, 2007, indicated overburden thicknesses of up to 45m. These deposits are thought to be an extension of an infilled valley, which also passes through the southern end of the open pit. The overburden soils generally comprise a thin veneer of peat and vegetation overlying a fine-grained silt or silt and sand of colluvium origin. The colluvium is underlain by coarse-grained sand with trace gravel that is considered to be a residual soil. The exception to this is at borehole 94-21, in which a clay layer from ground surface to a depth of 18-9m was observed (EBA, 2007).

Detailed soil logging by SRK in the area of the SW Dump (SRK, 2008) indicated that overburden material is comprised of silty, and in certain locations, clayey material, with fractions of sand, gravel and cobbles. Overburden thickness varies in this area (from 10.7m at 08SWC270 to 51.8m at 08SWC273). Typically, the overburden thickness increased along the valley bed, and decreased on the valley slopes. This is expected to be similar for overburden conditions across the project site.

### 2.1.2 Bedrock

The Minto site is underlain by predominantly igneous rocks of granodiorite composition. Minor amounts of other lithologies consisting of small dykes of simple quartz-feldspar pegmatite, aplite, and an aphanitic textured intermediate composition rock are also observed. Bodies of all of these units are relatively thin and rarely exceed one metre core intersections. These dykes are relatively late, generally postdating the peak ductile deformation event; however, some pegmatite and aplite bodies observed in a rock cut located north of the mill complex are openly folded. Conglomerate and volcanic flows have been logged in drill core by past operators, but have not been recently confirmed as the drill core from previous campaigns was largely destroyed in forest fires and no new drilling has intersected such rocks.

With the possible exception of the lithological contacts of the dykes, the lithology types encountered in the Minto Mine site are not expected to have significant primary porosity as it relates to hydraulic conductivity (K) or transmissivity. The low K values (less than $10^{-9}$ m/s), make it unlikely that significant groundwater flow will occur in competent bedrock. Flow may; however, occur in bedrock that has been fractured/faulted to produce open, secondary porosity/permeability.

Bedrock in the vicinity of the DSTF is located at approximately 45m depth (EBA, 2007). In general, outcrop exposure on the property is poor. Where exposure is available, it has been affected by deep weathering and variable oxidation, as the terrain was not glaciated during the last ice age event.

### 2.1.3 Structure

Secondary porosity/permeability is the dominant flow path in intrusive and metamorphic rocks. For this reason, it is important to have an understanding of the structural and mineralization environment of the site when constructing the conceptual flow model.

The copper-sulphide mineralization at Minto is strongly associated with foliated granodiorite within a deformation zone. The deformation zone forms sub-horizontal horizons within the more massive plutonic rocks of the region and can be traced laterally for more than 1,000 metres in the drill core. The similarity of chemistry and texture of both the deformed and the massive granodiorites suggest the deformation zones are structural in origin and not stratigraphic. The deformation zones are thought to represent healed, shallowly dipping faults that may have formed when the rocks passed through the brittle/ductile transformation zone in the earth's crust in transition from a deep emplacement environment to eventual exhumation of the regional batholith. Because of the inclusion of mineralization and the ductile nature of the main faulting at the site, these healed structures are not expected to represent significant flow paths.

Late, brittle fracturing and faulting is noted throughout the property area and is associated with a conjugate set of regional faults. The DEF Fault strikes more or less east-west and dips north-northwest and cuts off the main zone mineralization at its northern end. This type of faulting can often form significant flow paths within a rock mass. However; recent drilling results and data collected from instrumentation across the DEF fault in the north wall of the Area 1 Pit indicates that a significant hydraulic head is maintained across this feature (SRK, 2009–unreported work in progress). This appears to indicate that the DEF is not a significant flow feature, but rather is holding back water flow across the structure. This characteristic; whereby, fault zones act as barriers to flow has been observed at other mine sites.

Current structural analysis of the site (SRK, 2009 - work in progress) indicates that faults of any sort are not expected to occur within the footprints of the waste and overburden dumps or DSTF.

## 2.2 Permafrost Conditions

Permafrost conditions on the site will make groundwater monitoring problematic. Permafrost on the site has been found to be extensive and deep (SRK, 2008). Data from drilling at several locations has shown permafrost ranging from depths from within 1.0m of ground surface to depths of up to 10 m.

Geotechnical drilling in 1994 and 1996 by EBA observed permafrost in each of the boreholes drilled within the vicinity of the proposed DSTSF (Figure 1), with the base of the permafrost occurring at varying depths (EBA, 2007). Measurements of the active layer in these areas indicated a maximum depth of only about 1.0 m in September 1996, directly under the DSTSF footprint.

The observed ice contents in boreholes downstream of the DSTF (94-11 and 94-21) and within the footprint of the DSTSF (96-G07 through -G12, excluding -G10), typically ranged from frozen ground to visible ice at 10% to 20% of the total volume. Two of the boreholes, 96-G09 and 96-G12, showed ice intervals of 1.5 and 4.0m thick respectively within the upper 10m.

Initial data from the ground temperature cables installed in 94-11, 94-21, and 96-G08 indicate a relatively uniform ground temperature of close to -0.8ºC after equilibration with slight seasonal warming within the top 2 to 4 m. The active layer in 94-G11 and 94-G21 are on existing disturbed trails, and so will be deeper than the surrounding soils. Readings from 2006 for 94-G11 indicate similar ground temperatures and active layer thickness.

In November 2007, vibrating wire piezometers were installed within and down gradient of the existing dry stack tailings storage facility (DSTSF) in boreholes DSP-1 and DSP-2. Each of these piezometers is equipped with temperature sensors at the piezometer tip. At both of the locations, the sensors were installed at 1 m and 1.7 m respectively. No pore water has been measured in the piezometers to date, as ground conditions have remained frozen.

In addition, three more temperature cables providing profile data were installed in the vicinity of the DSTSF in holes DST-1, DST-2, and DST-5. Initial observations from the piezometer temperature probes indicate that temperatures did not rise above -0.3°C at any time and ranged as low as -2.6°C. Temperature cable DST-5 (Figure 1) is located outside of the footprint of the DSTSF and provided a profile reflecting conditions on an un-insulated site. Temperature averaged approximately -0.5°C below 1 m depth, and fluctuated near surface to values exceeding 5°C.

No groundwater was observed in any of the boreholes during the EBA geotechnical drilling program.

Soil investigation drilling in the region of the SW waste rock dump in February to April, 2008 (SRK, 2008), most cores contained non-visible ice, indicating the pore water was frozen; however, clear chunks of ice were also observed in many cases. Data from thermistors installed in the same drill holes indicate that this permafrost is close to 0°C; however, water in any monitoring standpipes would freeze in the permafrost layer.

The results of the temperature and piezometer monitoring near the SW Dump through June 2008 suggest that unfrozen layers at depth may be limited or non-existent, and that shallow perched water tables within the seasonally thawed active layer may provide the only mechanism for transport within this region of the basin.

## 2.3 Historical and Existing Groundwater Monitoring

To date, groundwater monitoring has been installed under various initiatives, including:

- Installation of standpipes in 1994 at the proposed dam alignment (P94-20) and the pit vicinity (P93-E):
  - Water chemistry samples collected between 1994 and 2006
  - Water levels observed at ~15m and 26m depth in P94-20 and P93-E respectively
  - Both destroyed during construction and pit excavation, respectively, in 2006)
- Vibrating wire transducers down gradient of the DSTSF;
- Vibrating wire transducers in the dam core; and
- Standpipes installed during the SW dump foundation investigation.

Besides standpipes P93-e and P94-20, it appears that all standpipes installed on the site to date have frozen, indicating that permafrost conditions exist across most of the site at shallow depths.

### 2.4 Hydrogeological Implications of the Geological Model and Past Monitoring

The implications of the geology (overburden, lithology, and permafrost conditions) found at the Minto site and the past monitoring events are:

- Permafrost:
  - will dominate groundwater flow system below active zone to depths of up to 45m; and
  - Conventional "standpipe" monitoring wells installed through the permafrost into the underlying unfrozen ground will be inoperable as the piezometric levels will be near surface; therefore, the resulting water in them will freeze.
- Shallow flow:
  - will be dominated by permafrost conditions;
  - will occur in the seasonally thawed layer; and
  - will be controlled by overburden composition in the unfrozen areas.
- Deeper flow:
  - will occur below the permafrost within the bedrock;
  - will concentrate in the shallow, weathered zone if unfrozen; and
  - standpipe monitoring wells will not be an effective means of monitoring the deep groundwater system.

Based on this, we expect that groundwater flow related to the waste rock and overburden dumps and the DSTF will only have significant impact on the shallow, active layer system and will report to nearby surface drainages during times of thawed conditions. The deeper, bedrock hosted flow system is expected to be isolated from these facilities, due to the permafrost layer.

Groundwater flow may be impacted by the Area 1 and 2 pits, as well as the 118 Area underground mine, as these penetrate the permafrost and intersect the sub-permafrost groundwater system. However; the impact of these mine components will be controlled by the hydraulic conditions within the deeper bedrock, which is expected to be low K. Furthermore, due to the steep valley walls and location of the pits and underground workings near the Minto Creek catchment centre-line, an upwards gradient (as shown below in the assessment of monitoring data) is expected. Therefore, impact flow would likely report to surface rather than persist as deep groundwater flow.

## 3.0 Monitoring System Design and Operation

### 3.1 Monitoring Locations

To provide a means of monitoring potential impacts on the deep groundwater system, a series of multi-level monitoring wells capable of operating in permafrost conditions were installed in 2009. The wells were installed down gradient of the waste rock and overburden piles at the Main and South West Dump area, Area 1 Pit, North Pit, and DSTF. Monitoring well locations are presented in Figure 1.

All monitoring systems were installed outside the final design footprint of the waste rock and overburden piles, pits, and the DSTF as proposed at the time of installation. Consequently, the installation below the DSTF will need to be changed due to the proposal for the valley fill material placement. This is discussed later in the report. Appropriate monitoring points should be determined for the expanded waste rock dumps proposed in the Phase IV mine plan.

### 3.2 Monitoring Equipment

Multilevel MP System groundwater monitoring systems manufactured by Westbay Instruments (part of Schlumberger Water Services) were installed for the monitoring system. These systems consist of closed PVC pipe that has multiple valved sampling ports that are hydraulically separated using individually inflated external packers. The pressure and water sampling is carried out using a wireline tool system that opens each monitoring zone valve independent of the others, and measure pressures and collects a sample from that zone only. The advantage that the MP System has over other monitoring systems is that, because is it a closed pipe system, it can be operated using anti-freeze inside the pipe to allow for access through the permafrost zone. Currently, this system is used at other mine sites with permafrost conditions in the NWT (Giant Mine, Ekati Mine, and the Hope Bay project) and northern Ontario (Victor Mine), and is deemed the only practical means of long-term groundwater monitoring through permafrost. Details of the monitoring equipment are given in the installation report (Appendix A) and the sampling report (Appendix B).

As well as pressures and groundwater samples, the system can also be used for hydraulic testing. All of the monitoring and sampling methods have been used extensively on mine sites, as well as contaminated waste sites, in Canada, the USA, and many other countries around the world, and are considered to meet the requirements for sampling for low level parameter concentrations.

## 3.3 Groundwater Sampling

### 3.3.1 Monitoring Parameters and Sampling Schedule

Monitoring of the groundwater network will occur on a quarterly basis as laid out in Table 1. The monitoring and sampling frequencies are based upon conditions encountered in the initial sampling rounds.

Groundwater samples collected will be analyzed for the parameters shown in Table 1.

**Table 1: Sample Parameters and Monitoring Frequency for Groundwater and Ground Temperature**

| Monitored Item | Parameters | Frequency |
|---|---|---|
| Groundwater Sample | Conductivity, total dissolved solids, hardness, pH, total suspended solids, dissolved anions, nutrients, cyanides, total metals (trace), dissolved metals (trace). | Quarterly |
| Piezometric Levels | Water Pressure | Quarterly |
| Ground Temperatures | Temperature | Quarterly |

The groundwater monitoring program would be carried out on a scheduled basis until dumps and tailings facility are reclaimed and the mine site has been closed.

### 3.3.2 Sampling Protocol

Groundwater samples were collected using best practice methods. Standard SRK sampling procedures are provided in as an appendix in the appended installation report (Appendix A).

## 3.4 Hydraulic Response Testing

Hydraulic response testing has not been carried out during drilling programs to date. However, these tests can be carried out using the MP System and will be part of the ongoing monitoring program. During installation and initial testing of the MP System, quality assurance (QA) testing of the zones indicated that hydraulic conductivity of all zones was less than $1 \times 10^{-9}$ m/s based on the time for recovery from pulse testing (designed to test packer seal integrity).

## 3.5 Monitoring Program Reporting

Reporting on the findings from the groundwater monitoring plan will be submitted as a component of the Water Use Licence Annual Report. This will include both raw data collected and an interpretive discussion of groundwater quality, elevations and temperature profiles at the monitored locations. An assessment of groundwater flow paths will be made, with a review of suitability of the monitoring locations based on piezometric levels, thermal data, and changes to the geological model as they become available.

Groundwater monitoring reporting would consist of the following:

a. Monitoring system installation and initial sampling report consisting of:

   i. Detailed field report to document the locations and ground conditions at all monitoring points, methods of installation, equipment specifications, and results of initial sampling and hydraulic testing; and

   ii. Initial water quality results.

b. Annual monitoring reports:

   i. Compilation of all monitoring data collected during the reporting period;

   ii. Analysis and assessment of data; and

   iii. Recommendations for changes to the monitoring system if and when deemed necessary.

# 4.0 Baseline Conditions

## 4.1 Groundwater Flow System

Groundwater flow at the site is expected to mimic the steep topography, with influences from the mine infrastructure during dewatering operations. Pressure data from the three multilevel wells are illustrated on Figure 2, and in plan view on Figure 3.

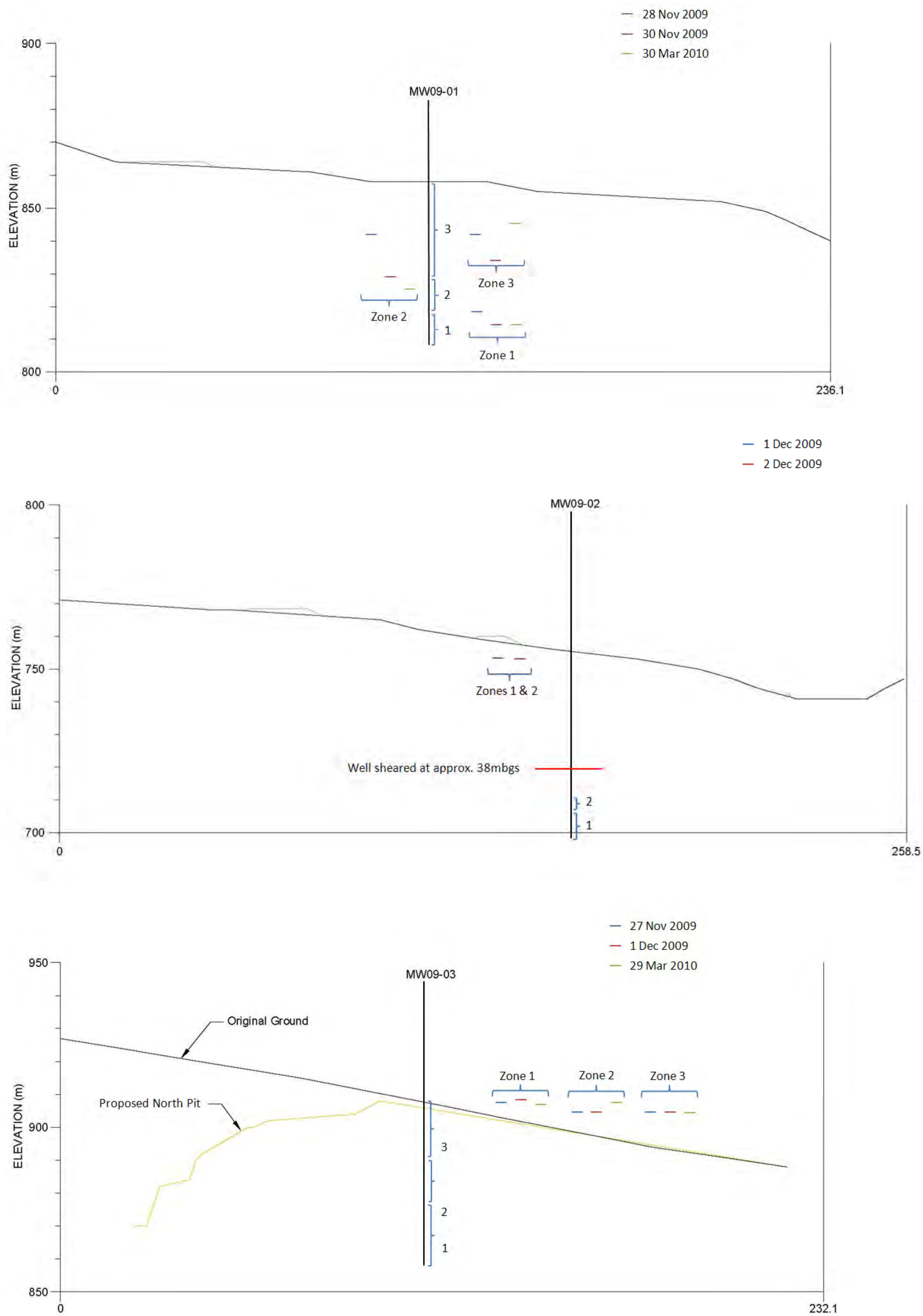
Measured piezometric data from MW09-04 are not available as this well was damaged prior to initial monitoring; however, the static water level in the open hole prior to installation of the monitoring equipment was approximately 4 m below ground surface. The water level seems to be reasonable based on the depth of permafrost observed (ice observed in the core to 44m depth) and the location relative to the Area 1 Pit. This is also illustrated on Figure 3.

Based on the water levels and gradients observed, the expected flow directions on the site are illustrated on Figure 3. All groundwater is expected to report to the Minto Creek as direct discharge, as illustrated in both long section on Figure 4 (section line position shown on Figure 3) and in typical cross section view also on Figure 4.

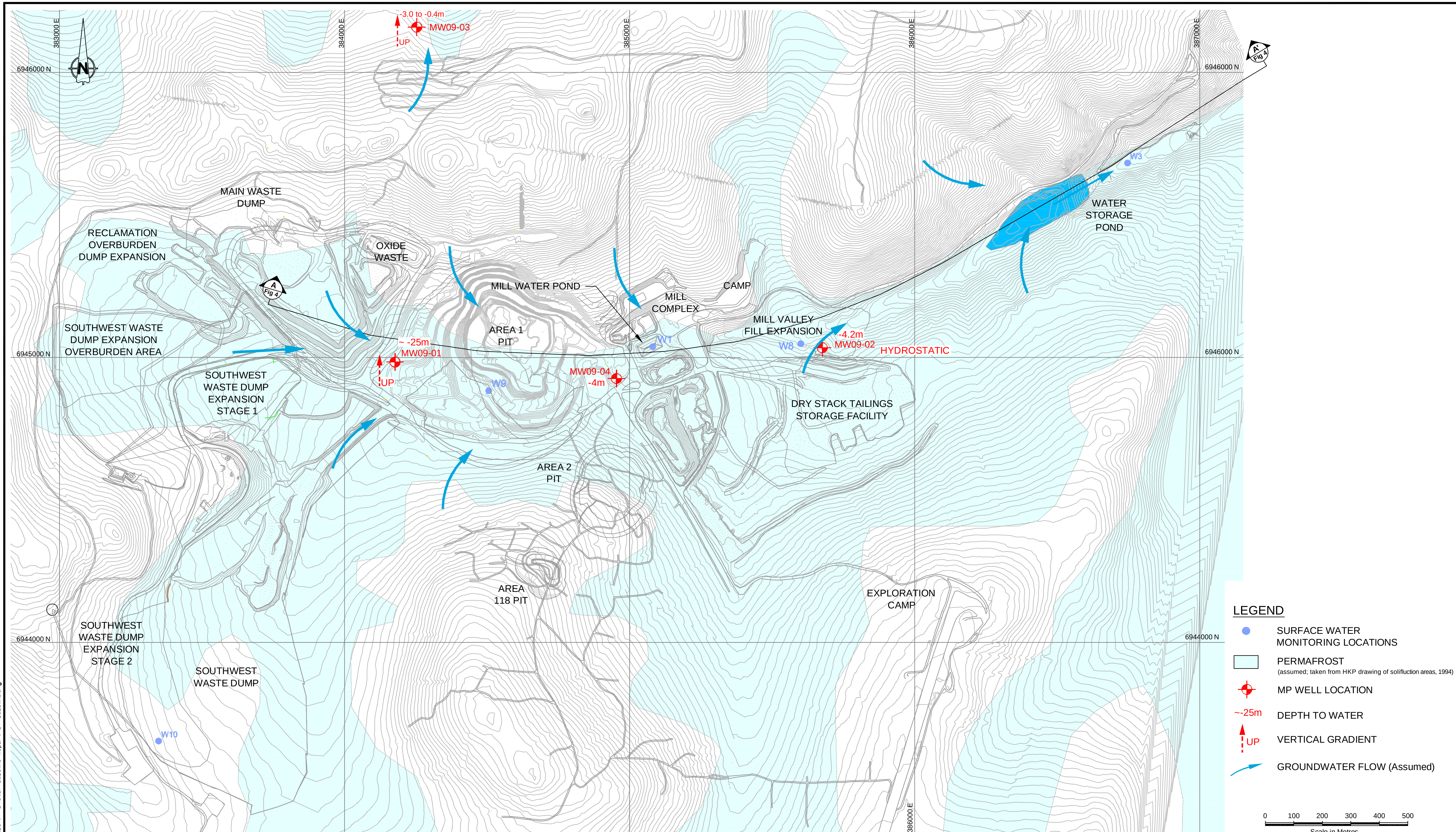
The flow lines are drawn to illustrate the decreasing flux (volume) of flow that will occur with increasing depth in the bedrock. The change in flux is caused by the decreasing hydraulic conductivity found in this type of hydrogeological system, related to higher lithostatic pressure closing open fractures, etc as depth increases.

Upwards gradients from the steep valley walls discharging to the creek along the Minto Creek alignment, plus the reduced infiltration in the northern slopes due to permafrost are also illustrated in the cross section.

A long section through the site from roughly west to east, taking in the main mine infrastructure and natural components of the site is illustrated in Figure 4. The section has the monitoring wells superimposed on it, as well as the general outline of the open pits, underground workings, and waste rock dumps in order to illustrate how each of these will interact with the main drainage (Minto Creek) and the regulated surface water monitoring compliance point (W3).




| SRK Consulting Engineers and Scientists VANCOUVER | MINTO EXPLORATIONS LTD. | PRESSURE PROFILE AND CROSS SECTIONS |
|---|---|---|
| Job No: 2CM022.017<br>Filename: Fig 2_Pressure Profile and Cross Sections.pptx | MINTO MINE | Date: August 5, 2010 · Approved: MR · Figure: 2 |

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Groundwater Piezometric Elevations and Assumed Flow Paths

SRK JOB NO.: 2CM022.017

FILE NAME: GW Baseline.dwg

Minto Groundwater Baseline

DATE: Aug. 10, 2010 | APPROVED: MDR | FIGURE: 3

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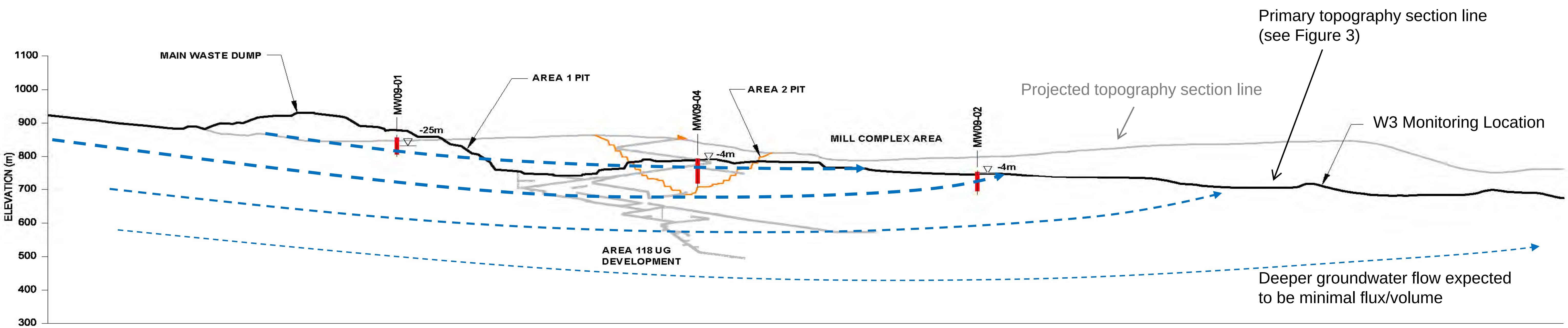
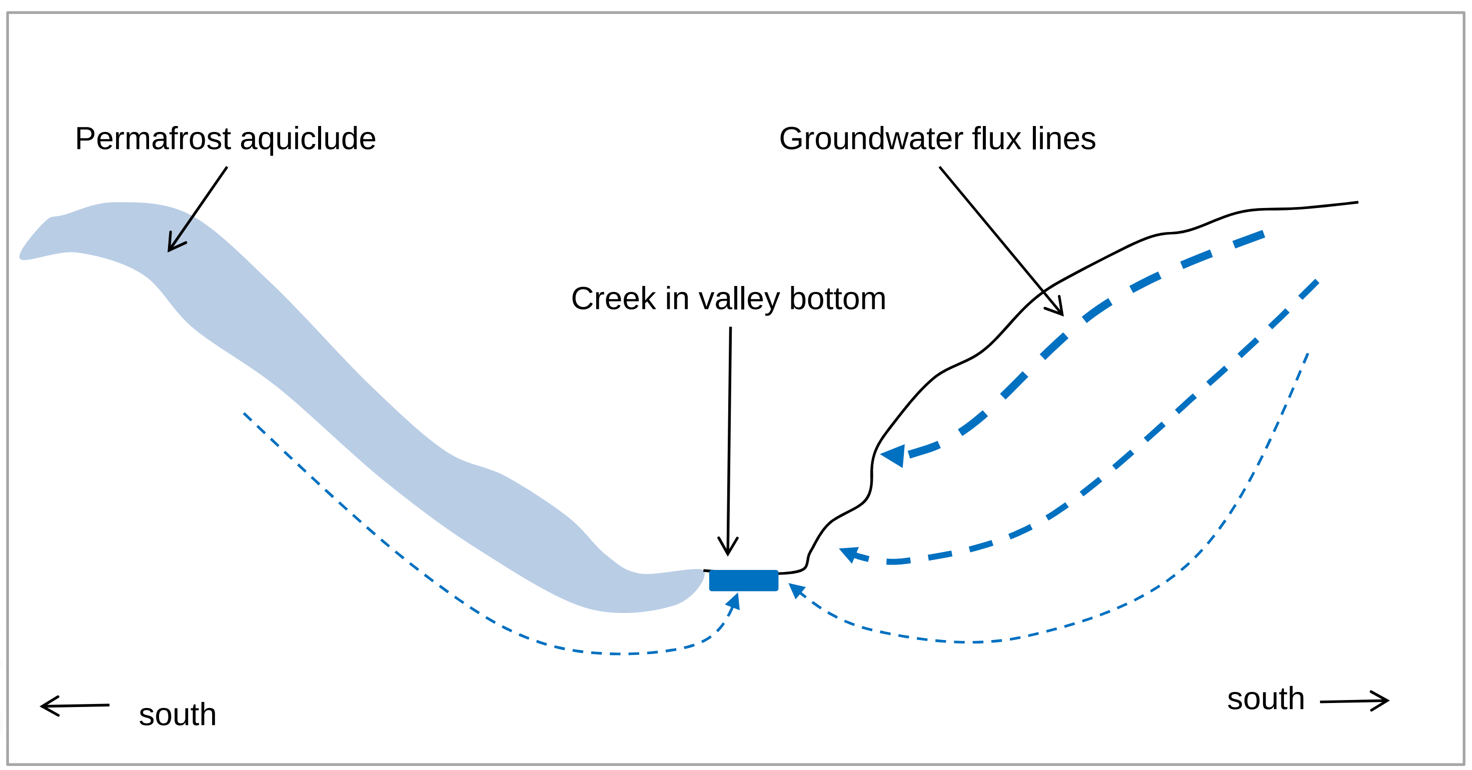
# Long Section




Cross Section (exaggerated)

Legend

MP well (projected onto cross section)

Permafrost

Groundwater flow line (assumed)

Note: Flow lines assume pits have been backfilled with tailings and all mine workings reflooded to static water levels

0 100 200 300 400 500
Scale in Metres

| | | |
|---|---|---|
| SRK Consulting Engineers and Scientists | MINTO EXPLORATIONS LTD. | Schematic Section of Minto Mine Site |
| SRK JOB NO.: 2CM022.017<br>FILE NAME: UG Profile.dwg | Minto Groundwater Baseline | DATE: Aug. 10, 2010 / APPROVED: MDR / FIGURE: 4 |

## 4.2 Hydrogeochemistry

Groundwater samples were collected from the multilevel monitoring wells in December 2009 and April 2010 (see Appendix A and B for details on well development and sampling). Results of the sampling are given in Table 2, and summarised in Figure 5 to Figure 12, are were compared to the mean annual site background water quality (Minnow, 2010), as shown in the plots as a means of benchmarking the hydrogeochemistry for potential loading influence on the surface water bodies.

As can be seen in Figure 5 and Figure 6, the groundwater chemistry is quite similar to the mean annual values in all sample zones, and that samples collected in December 2009 and April 2010 show little variation. The latter indicates that the zones were properly developed in the initial sampling round and that representative samples were collected.

Samples were also analysed for metals concentrations. All samples were analysed for both total and dissolved metals (see detailed lab analysis in Appendices A and B). However, although Total and Dissolved metals results are usually similar (indicating low suspended load in the samples), only dissolved species are presented in this report as these will be more representative of actual groundwater conditions as suspended particles in monitoring well samples are due to drill and well construction, not actual particulate matter moving through the groundwater system.

Results of the metals analysis (aluminum, cadmium, copper, iron, manganese, and selenium) are shown in Figure 7 to Figure 12. All samples show little variation (significantly less than 1 order of magnitude) and compare reasonably with the mean annual concentrations. This appears to indicate that the baseline groundwater chemistry is not significantly different than the baseline surface water chemistry on the site.

The results also indicate that metals concentrations also did not change significantly, so it is assumed that representative samples were collected in both sampling rounds. This also indicates that it would be reasonable to assume that the initial sampling results obtained from the destroyed well (MW09-02) represent groundwater chemistry with little to no impact from drilling and installation, so can be used for baseline assessment purposes.

### Table 2: 2009 - 2010 Grounwater Quality Results

### 2009 Groundwater Quality Data

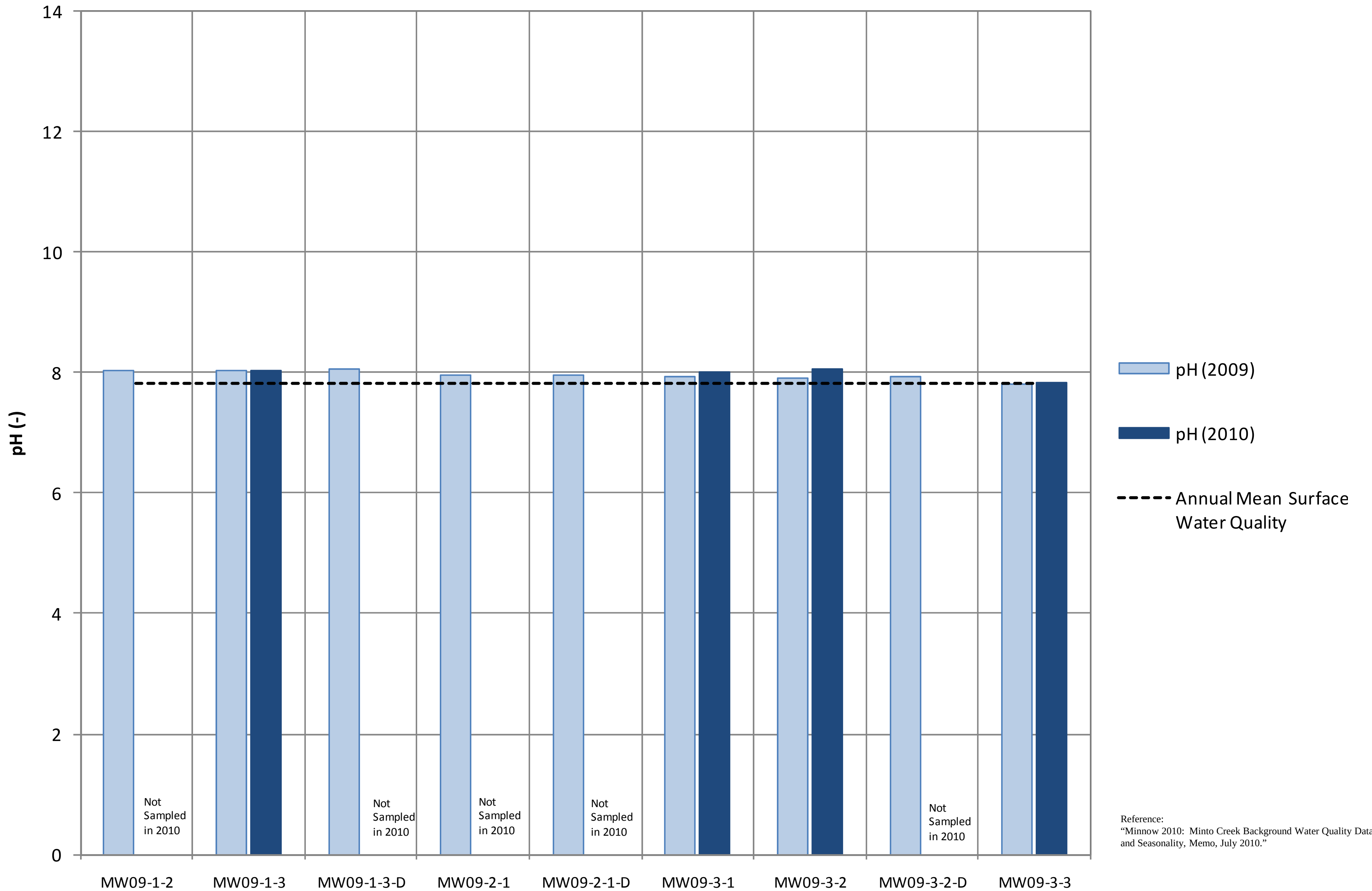
| Parameter | Units | Well-Zone | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MW09-1 | | | MW09-2 | | MW09-3 | | | |
| | | MW09-1-2 | MW09-1-3 | MW09-1-3-D | MW09-2-1 | MW09-2-1-D | MW09-3-1 | MW09-3-2 | MW09-3-2-D | MW09-3-3 |
| **Date** | | 30-Nov-09 | 30-Nov-09 | 30-Nov-09 | 2-Dec-09 | 2-Dec-09 | 1-Dec-09 | 1-Dec-09 | 1-Dec-09 | 1-Dec-09 |
| **Physical Properties** | | | | | | | | | | |
| pH | pH units | 8.03 | 8.02 | 8.06 | 7.95 | 7.95 | 7.94 | 7.91 | 7.92 | 7.8 |
| Conductivity | uS/cm | 729 | 725 | 728 | 1090 | 1090 | 976 | 932 | 947 | 158 |
| TDS | mg/L | 528 | 364 | 442 | 814 | 812 | 652 | 626 | 672 | 110 |
| TSS | mg/L | 7 | 92 | 66 | 30 | 31 | 399 | 146 | 96 | 21 |
| **Misc. Parameters** | | | | | | | | | | |
| Alkalinity - Bicarbonate | mgCaCO3/L | 140 | 100 | 100 | 400 | 410 | 100 | 100 | 100 | 70 |
| Alkalinity - Carbonate | mgCaCO3/L | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 |
| Alkalinity - Hydroxide | mgCaCO3/L | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Alkalinity - Total | mgCaCO3/L | 112 | 100 | 100 | 329 | 333 | 93 | 85 | 81 | 55 |
| Hardness | mgCaCO3/L | 318 | 262 | 274 | 503 | 508 | 253 | 242 | 255 | 60 |
| Turbidity | NTU | 1.1 | 32 | 26 | 13 | 16 | 95 | 49 | 47 | 6.9 |
| Chloride | mg/L | 7.22 | 7.28 | 7.27 | 5.52 | 5.73 | 17.9 | 16 | 16.3 | 0.93 |
| Nitrogen as NH4 | mg/L | 0.72 | 3.85 | 3.03 | 1.29 | 1.26 | 5.79 | 5.32 | 5.6 | 0.26 |
| Nitrogen as NO23 | mg/L | 42.9 | 42.1 | 42.1 | 23.2 | 24.4 | 60.9 | 58.2 | 59.7 | 1.87 |
| Total Kjeldahl Nitrogen | mg/L | 6.79 | 6 | 6.21 | 1.13 | 1.01 | 11.7 | 12.2 | 11.6 | 0.34 |
| Phosphate (total) | mg/L | 0.04 | 0.03 | 0.03 | 0.06 | 0.06 | 0.03 | 0.03 | 0.03 | 0.04 |
| Sulphate (dissolved) | mg/L | 77.4 | 82.5 | 83.3 | 166 | 170 | 117 | 110 | 115 | 10 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminium | mg/L | 0.006 | 0.007 | <0.005 | 0.01 | <0.005 | 0.01 | 0.008 | 0.007 | 0.007 |
| Antimony | mg/L | 0.0053 | 0.0032 | 0.0008 | 0.0136 | 0.003 | 0.002 | 0.0021 | 0.0034 | 0.0021 |
| Arsenic | mg/L | 0.0002 | 0.0002 | 0.0003 | 0.0041 | 0.0047 | 0.0009 | 0.0008 | 0.0005 | 0.0002 |
| Barium | mg/L | 0.034 | 0.1 | 0.095 | 0.11 | 0.111 | 0.106 | 0.088 | 0.091 | 0.011 |
| Berillium | mg/L | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 |
| Bismuth | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | mg/L | 0.045 | 0.052 | 0.044 | 5.37 | 6.09 | 0.32 | 0.218 | 0.2 | 0.044 |
| Cadmium | mg/L | 0.00005 | 0.00008 | 0.00007 | 0.00009 | 0.00006 | 0.0002 | 0.00008 | 0.0001 | 0.00007 |
| Calcium | mg/L | 89.7 | 75.4 | 78.2 | 98.2 | 99.2 | 74.1 | 73.7 | 77.6 | 19.9 |
| Chromium | mg/L | <0.0004 | <0.0004 | <0.0004 | 0.0036 | 0.0038 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Cobalt | mg/L | 0.00102 | 0.00076 | 0.00078 | 0.00065 | 0.00062 | 0.00045 | 0.00057 | 0.00054 | 0.00024 |
| Copper | mg/L | 0.012 | 0.02 | 0.018 | 0.004 | 0.003 | 0.019 | 0.022 | 0.022 | 0.005 |
| Iron | mg/L | 0.05 | 0.04 | 0.04 | 0.11 | 0.09 | 0.03 | 0.02 | 0.02 | 0.02 |
| Lead | mg/L | 0.0001 | <0.0001 | <0.0001 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | <0.0001 | 0.0001 |
| Lithium | mg/L | 0.001 | 0.003 | 0.003 | 0.011 | 0.01 | 0.012 | 0.011 | 0.011 | 0.001 |
| Magnesium | mg/L | 22.9 | 18 | 19.1 | 62.6 | 63.1 | 16.5 | 14.2 | 14.9 | 2.4 |
| Manganese | mg/L | 0.0802 | 0.228 | 0.189 | 0.27 | 0.261 | 0.161 | 0.135 | 0.137 | 0.0184 |
| Mercury | ug/L | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| Molybdenum | mg/L | 0.0341 | 0.0892 | 0.0733 | 0.0442 | 0.0487 | 0.0806 | 0.101 | 0.104 | 0.0267 |
| Nickel | mg/L | 0.004 | 0.002 | 0.002 | 0.004 | 0.003 | 0.008 | 0.004 | 0.004 | 0.002 |
| Phosphorus | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 |
| Potassium | mg/L | 3.2 | 6.6 | 5.8 | 8.2 | 8.4 | 27 | 26 | 25 | 2.6 |
| Selenium | mg/L | 0.0028 | 0.0028 | 0.003 | 0.0067 | 0.0068 | 0.008 | 0.0067 | 0.0068 | <0.0006 |
| Silicon | mg/L | 4.37 | 2.87 | 3.36 | 6.88 | 6.94 | 2.49 | 2.54 | 2.58 | 4.2 |
| Silver | mg/L | 0.00019 | <0.00001 | 0.00002 | <0.00001 | <0.00001 | 0.00005 | 0.00004 | 0.00005 | 0.00001 |
| Sodium | mg/L | 16.8 | 28 | 26.2 | 70.4 | 74.2 | 70.5 | 63 | 66.8 | 5.5 |
| Strontium | mg/L | 1.04 | 1.51 | 1.39 | 2.11 | 2.14 | 2.21 | 1.86 | 1.91 | 0.168 |
| Sulfur | mg/L | 25.8 | 27.5 | 27.8 | 55.4 | 56.7 | 39 | 36.7 | 38.4 | 3.4 |
| Tellurium | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Thallium | mg/L | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |
| Thorium | mg/L | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Tin | mg/L | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0002 | 0.0002 | <0.0001 | <0.0001 |
| Titanium | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Uranium | mg/L | 0.0029 | <0.0004 | 0.0008 | 0.0038 | 0.0039 | 0.001 | 0.0008 | 0.0008 | <0.0004 |
| Vanadium | mg/L | 0.0002 | 0.0001 | 0.0001 | 0.0011 | 0.0012 | 0.0002 | 0.0001 | 0.0001 | 0.0002 |
| Zinc | mg/L | 0.009 | 0.006 | 0.004 | 0.01 | 0.007 | 0.022 | 0.01 | 0.014 | 0.012 |
| Zirconium | mg/L | <0.0001 | 0.0001 | <0.0001 | 0.0001 | 0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Total Metals** | | | | | | | | | | |
| Aluminium | mg/L | 0.141 | 1.46 | 1.02 | 1.03 | 0.765 | 15.3 | 3.85 | 2.62 | 0.681 |
| Antimony | mg/L | 0.0003 | 0.0012 | 0.0003 | 0.003 | 0.0038 | <0.001 | 0.0008 | 0.0032 | 0.0025 |
| Arsenic | mg/L | 0.0003 | 0.0009 | 0.0007 | 0.0053 | 0.005 | 0.0068 | 0.0007 | 0.0006 | <0.0002 |
| Barium | mg/L | 0.037 | 0.138 | 0.122 | 0.136 | 0.132 | 1.35 | 0.183 | 0.16 | 0.028 |
| Berillium | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.005 | <0.001 | <0.001 | <0.001 |
| Bismuth | mg/L | 0.046 | 0.068 | 0.048 | 6.18 | 6.25 | 0.514 | 0.25 | 0.228 | 0.064 |
| Boron | mg/L | <0.00004 | <0.00004 | 0.00004 | 0.00004 | <0.00004 | 0.00066 | 0.00008 | 0.00004 | <0.00004 |
| Cadmium | mg/L | 0.00004 | 0.00008 | 0.00008 | 0.00017 | 0.00016 | 0.00012 | 0.00013 | 0.00011 | 0.00008 |
| Calcium | mg/L | 85.9 | 73.2 | 70.9 | 96 | 95.1 | 85.5 | 74 | 74.4 | 20.4 |
| Chromium | mg/L | 0.0011 | 0.0052 | 0.0037 | 0.006 | 0.0054 | 0.003 | 0.002 | 0.0016 | 0.0013 |
| Cobalt | mg/L | 0.00109 | 0.00156 | 0.00145 | 0.00144 | 0.00121 | 0.0175 | 0.00147 | 0.00128 | 0.00027 |
| Copper | mg/L | 0.015 | 0.04 | 0.035 | 0.013 | 0.01 | 0.056 | 0.047 | 0.042 | 0.01 |
| Iron | mg/L | 0.324 | 2.68 | 1.65 | 1.76 | 1.28 | 44 | 4.93 | 3.47 | 0.673 |
| Lead | mg/L | 0.0001 | 0.0007 | 0.0005 | 0.0008 | 0.0006 | 0.004 | 0.0008 | 0.0006 | 0.0002 |
| Lithium | mg/L | 0.001 | 0.005 | 0.004 | 0.013 | 0.013 | 0.02 | 0.012 | 0.012 | 0.001 |
| Magnesium | mg/L | 22 | 18 | 17.8 | 62.2 | 61.9 | 21.8 | 14.6 | 14.6 | 2.54 |
| Manganese | mg/L | 0.0935 | 0.309 | 0.248 | 0.34 | 0.332 | 6.78 | 0.287 | 0.256 | 0.0384 |
| Mercury | ug/L | 0.05 | <0.01 | 0.02 | <0.01 | <0.01 | 0.02 | 0.02 | 0.02 | 0.01 |
| Molybdenum | mg/L | 0.0356 | 0.0944 | 0.0758 | 0.0481 | 0.0499 | 0.0742 | 0.108 | 0.114 | 0.0288 |
| Nickel | mg/L | 0.004 | 0.005 | 0.004 | 0.006 | 0.005 | 0.01 | 0.005 | 0.005 | 0.002 |
| Phosphorus | mg/L | <0.05 | 0.06 | <0.05 | <0.05 | <0.05 | 0.19 | 0.07 | 0.05 | <0.05 |
| Potassium | mg/L | 3.3 | 7.2 | 5.9 | 8.6 | 8.3 | 31 | 25.2 | 25.2 | 3 |
| Selenium | mg/L | 0.0029 | 0.0032 | 0.0031 | 0.0072 | 0.0073 | 0.011 | 0.0078 | 0.0077 | 0.0007 |
| Silicon | mg/L | 4.54 | 7.01 | 5.12 | 9.32 | 8.46 | 38.1 | 9.99 | 7.55 | 5.49 |
| Silver | mg/L | 0.00037 | 0.00013 | 0.00013 | 0.00024 | 0.00019 | 0.0104 | 0.00613 | 0.00377 | 0.00154 |
| Sodium | mg/L | 16.7 | 28.1 | 23.6 | 73.4 | 71.5 | 65.4 | 66.1 | 66.7 | 5.72 |
| Strontium | mg/L | 1.27 | 1.84 | 1.64 | 2.55 | 2.53 | 2.41 | 2.17 | 2.31 | 0.189 |
| Sulfur | mg/L | 27.6 | 28.5 | 28.2 | 60.5 | 59.9 | 41 | 39.1 | 39.8 | 3.8 |
| Tellurium | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0005 | <0.0001 | <0.0001 | <0.0001 |
| Thallium | mg/L | <0.00001 | 0.00002 | 0.00001 | 0.00001 | <0.00001 | 0.00016 | 0.00002 | 0.00002 | <0.00001 |
| Thorium | mg/L | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.002 | <0.0004 | <0.0004 | <0.0004 |
| Tin | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0005 | 0.0003 | 0.0002 | <0.0001 |
| Uranium | mg/L | 0.0032 | 0.0004 | 0.0008 | 0.0045 | 0.0044 | 0.002 | 0.0009 | 0.001 | <0.0004 |
| Vanadium | mg/L | 0.0006 | 0.0046 | 0.0033 | 0.0036 | 0.0029 | 0.039 | 0.0065 | 0.005 | 0.0012 |
| Zinc | mg/L | 0.007 | 0.029 | 0.019 | 0.024 | 0.018 | 0.13 | 0.036 | 0.033 | 0.033 |
| Zirconium | mg/L | 0.0002 | 0.0006 | 0.0004 | 0.0004 | 0.0004 | 0.0006 | 0.0004 | 0.0004 | 0.0001 |

## 2010 Groundwater Quality Data

| Parameter | Unit | Well-Zone | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | MW09-1 | | MW09-3 | | | | |
| | | MW09-1-3 | MW09-1-5 | MW09-3-1 | MW09-3-2 | MW09-3-3 | MW09-3-4 | MW09-4-4 |
| **Date Sampled** | | 30-Mar-10 | 30-Mar-10 | 29-Mar-10 | 29-Mar-10 | 29-Mar-10 | 29-Mar-10 | 29-Mar-10 |
| **Sample Depth** | m | 24.7 | 83.4 | 37.9 | 24.2 | 10.5 | 92.5 | 15.3 |
| **Physical Tests** | | | | | | | | |
| pH @25°C | (1) | 8.04 | 6.46 | 8 | 8.05 | 7.84 | 7.79 | 6.15 |
| Electrical Conductivity | µS/cm | 941 | 2 | 315 | 502 | 158 | 161 | 1 |
| Hardness as CaCO3 | mg/L | 336 | <5 | 144 | 178 | 69 | 71 | <5 |
| T-Alkalinity as CaCO3 | mg/L | 184 | <5 | 137 | 130 | 63 | 67 | <5 |
| Turbidity | NTU | 64 | 0.4 | 2.5 | 3 | 0.3 | 0.7 | 0.1 |
| Total Suspended Solids | mg/L | 70 | <3 | <4 | <7 | <4 | <4 | <3 |
| Total Dissolved Solids | mg/L | 630 | 32 | 196 | 324 | 114 | 112 | 12 |
| Colour | CU | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| **Major Anions and Cations** | | | | | | | | |
| Carbonate | mg/L | <6 | <6 | <6 | <6 | <6 | <6 | <6 |
| Calcium | mg/L | 93.7 | <0.1 | 41.2 | 56.3 | 23.4 | 24.2 | <0.1 |
| Magnesium | mg/L | 24.7 | <0.1 | 9.9 | 9.2 | 2.4 | 2.6 | <0.1 |
| Sodium | mg/L | 53.3 | <0.1 | 5.7 | 24.9 | 2.6 | 2.7 | <0.1 |
| Phosphorus | mg/L | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Potassium | mg/L | 7 | 0.7 | 4.4 | 6.6 | 2.3 | 2.2 | 0.6 |
| Silicon | mg/L | 3.39 | 3.38 | 4 | 3.7 | 3.85 | 3.98 | <0.05 |
| Bicarbonate | mg/L | 220 | <5 | 170 | 160 | 80 | 80 | <5 |
| Hydroxide | mg/L | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Ionic Balance | % | 106 | | 115 | 108 | 116 | 111 | |
| **Anions and Nutrients** | | | | | | | | |
| Ammonium - N | mg/L | 6.16 | <0.05 | 0.35 | 0.99 | <0.05 | <0.05 | <0.05 |
| Total Kjeldahl Nitrogen | mg/L | 8.89 | <0.06 | 0.4 | 1.22 | <0.06 | <0.06 | <0.06 |
| Total Phosphorus | mg/L | 0.09 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Orthophosphate-P | mg/L | 0.06 | 0.06 | 0.06 | 0.07 | 0.06 | 0.06 | <0.01 |
| Nitrate and Nitrite - N | mg/L | 21.6 | 0.02 | 0.26 | 16.1 | 0.47 | 0.48 | <0.01 |
| Chloride | mg/L | 18.5 | 0.24 | 0.4 | 3.82 | 0.61 | 0.61 | <0.02 |
| Sulfate (SO4) | mg/L | 169 | <0.6 | 23 | 48.9 | 10 | 10 | <0.6 |
| **Dissolved Metals** | | | | | | | | |
| Aluminum | mg/L | 0.048 | <0.005 | <0.005 | <0.005 | <0.005 | 0.013 | <0.005 |
| Antimony | mg/L | 0.0011 | 0.0007 | 0.0009 | 0.0018 | 0.0009 | 0.0012 | 0.0006 |
| Arsenic | mg/L | 0.0007 | <0.0002 | 0.0002 | 0.0012 | <0.0002 | <0.0002 | <0.0002 |
| Barium | mg/L | 0.142 | <0.001 | 0.047 | 0.035 | 0.013 | 0.01 | <0.001 |
| Beryllium | mg/L | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 |
| Bismuth | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | mg/L | 0.095 | 0.007 | 0.106 | 1.99 | 0.04 | 0.042 | <0.004 |
| Cadmium | mg/L | 0.00015 | 0.00002 | 0.00012 | 0.00072 | 0.00002 | <0.00001 | <0.00001 |
| Chromium | mg/L | <0.0004 | <0.0004 | 0.001 | 0.0013 | <0.0004 | <0.0004 | <0.0004 |
| Cobalt | mg/L | 0.00045 | 0.00004 | 0.00014 | 0.0002 | 0.00009 | 0.00008 | 0.00002 |
| Copper | mg/L | 0.021 | 0.001 | 0.004 | 0.006 | 0.005 | 0.004 | <0.001 |
| Iron | mg/L | 0.18 | <0.01 | 0.04 | <0.01 | <0.01 | 0.03 | <0.01 |
| Lead | mg/L | 0.0003 | 0.0001 | 0.0011 | 0.0003 | 0.0007 | 0.0002 | 0.0002 |
| Lithium | mg/L | 0.003 | <0.001 | 0.003 | 0.004 | <0.001 | <0.001 | <0.001 |
| Manganese | mg/L | 0.168 | 0.0003 | 0.109 | 0.0616 | 0.0129 | 0.0087 | <0.0002 |
| Mercury | ug/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Molybdenum | mg/L | 0.148 | <0.0001 | 0.0052 | 0.045 | 0.0064 | 0.0049 | <0.0001 |
| Nickel | mg/L | 0.002 | <0.001 | 0.005 | 0.002 | <0.001 | <0.001 | <0.001 |
| Selenium | mg/L | 0.0018 | <0.0006 | <0.0006 | 0.0028 | <0.0006 | <0.0006 | <0.0006 |
| Silver | mg/L | <0.00001 | <0.00001 | <0.00001 | 0.00001 | <0.00001 | <0.00001 | <0.00001 |
| Strontium | mg/L | 1.41 | <0.001 | 0.863 | 0.739 | 0.125 | 0.12 | <0.001 |
| Sulfur | mg/L | 56.2 | <0.2 | 7.6 | 16.3 | 3.4 | 3.5 | <0.2 |
| Tellurium | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Thallium | mg/L | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |
| Thorium | mg/L | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Tin | mg/L | 0.0003 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Titanium | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Uranium | mg/L | <0.0004 | <0.0004 | 0.0015 | 0.0014 | <0.0004 | <0.0004 | <0.0004 |
| Vanadium | mg/L | 0.0003 | <0.0001 | 0.0001 | 0.0004 | 0.0002 | 0.0004 | <0.0001 |
| Zinc | mg/L | 0.016 | 0.004 | 0.014 | 0.005 | 0.005 | 0.004 | 0.004 |
| Zirconium | mg/L | 0.0002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Total Metals** | | | | | | | | |
| Aluminum | mg/L | 1.31 | <0.005 | 0.043 | 0.03 | 0.01 | 0.014 | <0.005 |
| Antimony | mg/L | 0.0005 | <0.0002 | 0.0002 | <0.0002 | <0.0002 | 0.0003 | <0.0002 |
| Arsenic | mg/L | 0.0012 | <0.0002 | 0.0004 | 0.0015 | <0.0002 | <0.0002 | <0.0002 |
| Barium | mg/L | 0.186 | <0.001 | 0.05 | 0.036 | 0.013 | 0.01 | <0.001 |
| Beryllium | mg/L | 0.00005 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 |
| Bismuth | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | mg/L | 0.095 | 0.016 | 0.29 | 1.92 | 0.034 | 0.034 | 0.01 |
| Cadmium | mg/L | 0.00014 | <0.00001 | 0.00011 | 0.00004 | 0.00001 | 0.00006 | <0.00001 |
| Calcium | mg/L | 98.7 | <0.05 | 42.5 | 59.3 | 24.9 | 24.9 | <0.05 |
| Chromium | mg/L | 0.0072 | <0.0004 | 0.0022 | 0.0014 | <0.0004 | 0.0006 | <0.0004 |
| Cobalt | mg/L | 0.00147 | <0.00002 | 0.00019 | 0.00022 | 0.00007 | 0.00006 | <0.00002 |
| Copper | mg/L | 0.029 | <0.001 | 0.006 | 0.008 | 0.004 | 0.004 | <0.001 |
| Iron | mg/L | 3.37 | 0.026 | 0.183 | 0.175 | 0.027 | 0.047 | <0.01 |
| Lead | mg/L | 0.001 | 0.0001 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | <0.0001 |
| Lithium | mg/L | 0.003 | <0.001 | 0.003 | 0.005 | <0.001 | <0.001 | <0.001 |
| Magnesium | mg/L | 26.8 | <0.05 | 10.4 | 9.76 | 2.62 | 2.63 | <0.05 |
| Manganese (SemiTrace) | mg/L | 0.219 | <0.005 | 0.118 | 0.06 | 0.007 | <0.005 | <0.005 |
| Manganese (Trace) | mg/L | 0.225 | 0.0002 | 0.123 | 0.0677 | 0.0132 | 0.009 | <0.0002 |
| Mercury | ug/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Molybdenum | mg/L | 0.146 | <0.0001 | 0.006 | 0.0468 | 0.0065 | 0.0051 | <0.0001 |
| Nickel | mg/L | 0.006 | <0.001 | 0.007 | 0.002 | <0.001 | 0.001 | <0.001 |
| Potassium | mg/L | 7.2 | 0.1 | 4.2 | 6.8 | 2.1 | 1.9 | <0.1 |
| Selenium | mg/L | 0.0019 | <0.0006 | <0.0006 | 0.0029 | <0.0006 | <0.0006 | <0.0006 |
| Silicon | mg/L | 7 | 3.7 | 4.6 | 4.11 | 4.4 | 4.39 | <0.05 |
| Silver | mg/L | 0.00012 | <0.00001 | 0.00006 | 0.00017 | 0.00004 | 0.00003 | <0.00001 |
| Sodium | mg/L | 56.9 | 0.13 | 7.37 | 25.7 | 3.08 | 3.07 | 0.3 |
| Strontium | mg/L | 1.43 | <0.001 | 0.886 | 0.785 | 0.126 | 0.127 | 0.001 |
| Sulfur | mg/L | 58.3 | <0.1 | 7.3 | 15.8 | 3.4 | 3.4 | <0.1 |
| Tellurium | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Thallium | mg/L | 0.00002 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |

## 2010 Groundwater Quality Data

| Parameter | Unit | Well-Zone | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | MW09-1 | | MW09-3 | | | | |
| | | MW09-1-3 | MW09-1-5 | MW09-3-1 | MW09-3-2 | MW09-3-3 | MW09-3-4 | MW09-4-4 |
| **Date Sampled** | | 30-Mar-10 | 30-Mar-10 | 29-Mar-10 | 29-Mar-10 | 29-Mar-10 | 29-Mar-10 | 29-Mar-10 |
| **Sample Depth** | m | 24.7 | 83.4 | 37.9 | 24.2 | 10.5 | 92.5 | 15.3 |
| Thorium | mg/L | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Tin | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Titanium | mg/L | 0.079 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 |
| Uranium | mg/L | <0.0004 | <0.0004 | 0.0015 | 0.0014 | <0.0004 | <0.0004 | <0.0004 |
| Vanadium | mg/L | 0.0049 | <0.0001 | 0.0003 | 0.0005 | 0.0003 | 0.0004 | <0.0001 |
| Zinc | mg/L | 0.025 | 0.003 | 0.016 | 0.01 | 0.01 | 0.01 | 0.005 |
| Zirconium | mg/L | 0.0005 | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |




Reference:
"Minnow 2010: Minto Creek Background Water Quality Data and Seasonality, Memo, July 2010."

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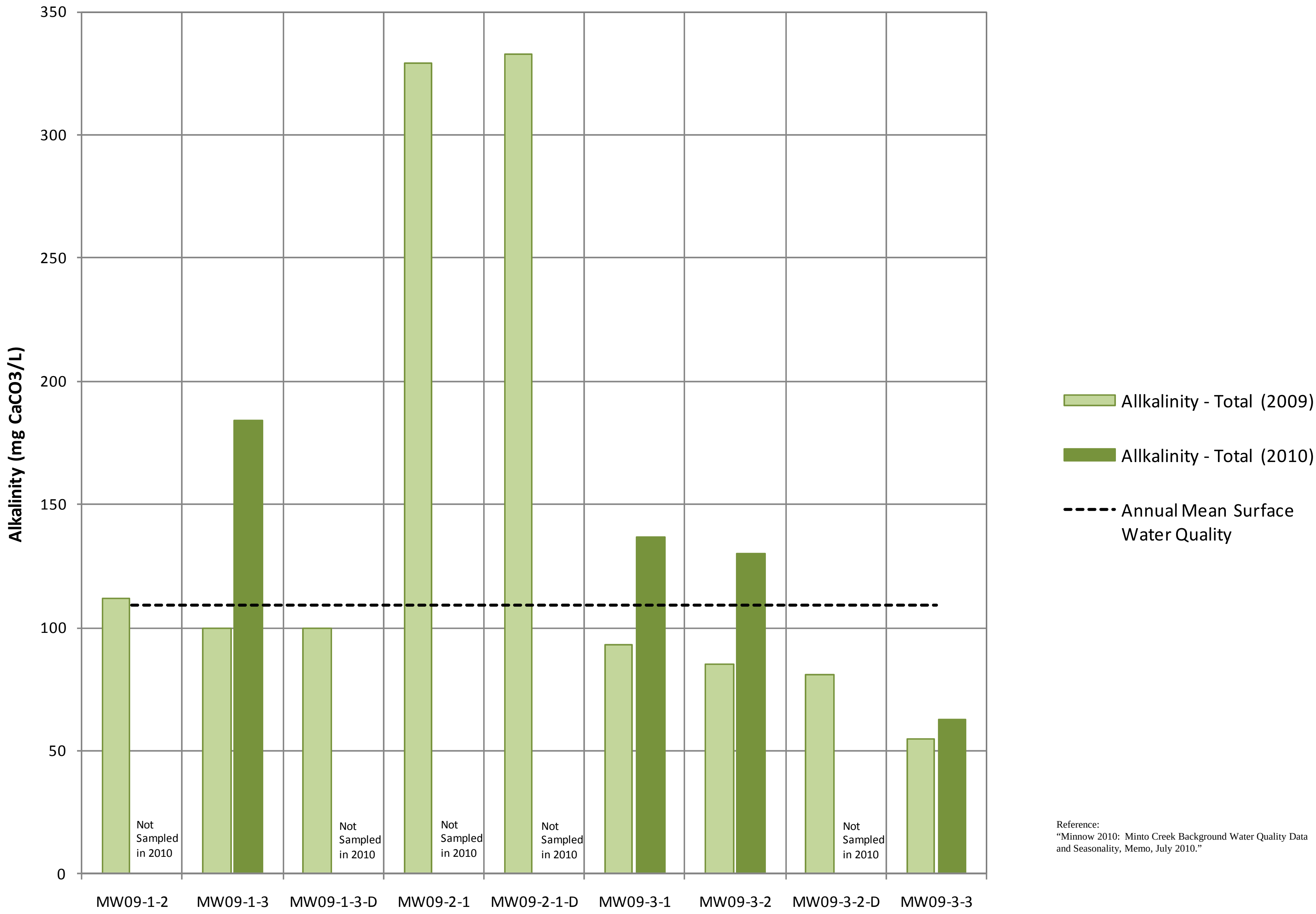
**pH**

Job No: 2CM022.017
Filename: Fig5_pH.gf.20100805.ppt

MINTO MINE

Date: August 5, 2010
Approved: MR
Figure: 5

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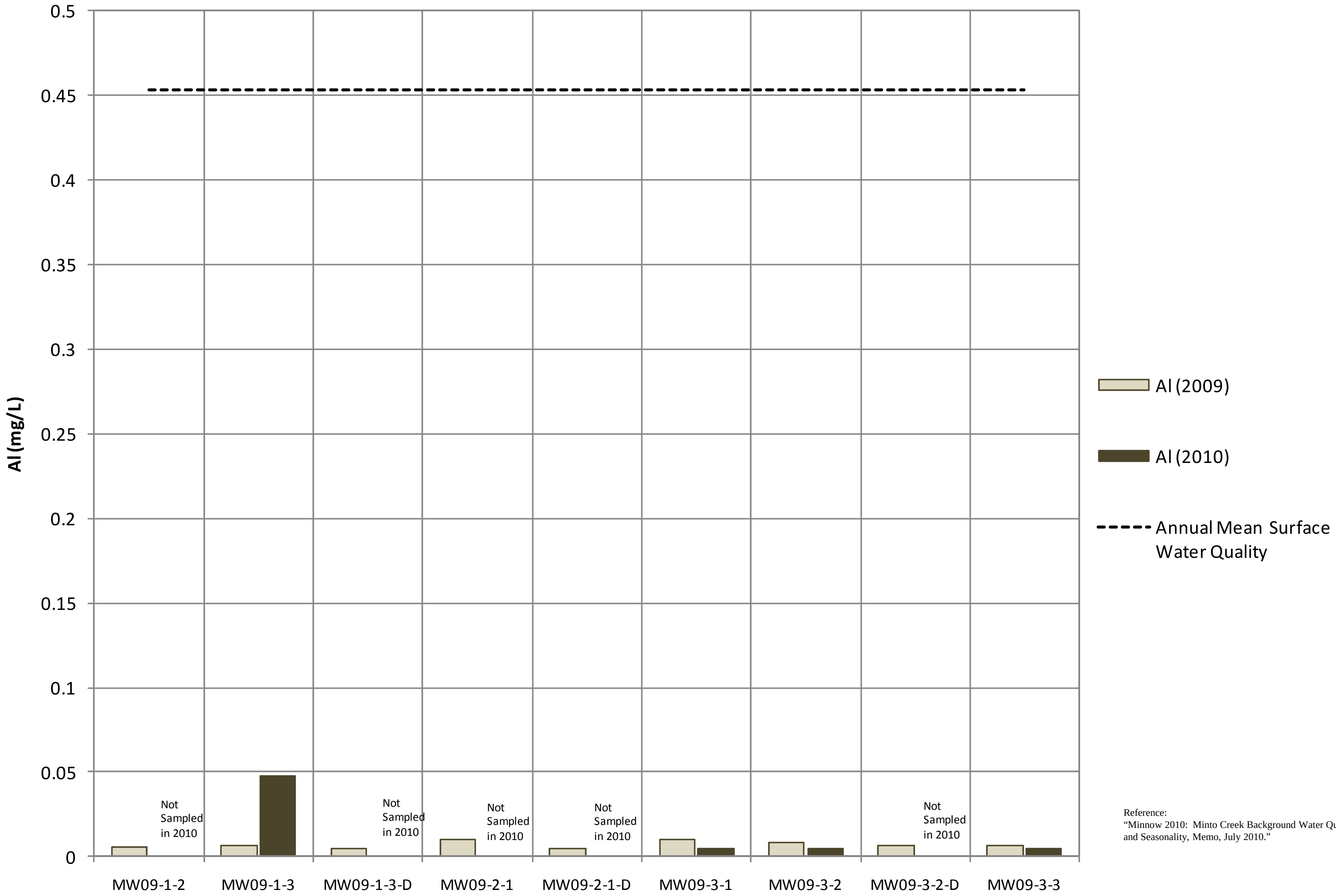
**Alkalinity**

| | | | | |
|---|---|---|---|---|
| Job No: 2CM022.017 | MINTO MINE | Date: August 5, 2010 | Approved: MR | Figure: 6 |
| Filename: Fig6_Alkalinity.gf.20100805.ppt | | | | |




Reference:
"Minnow 2010: Minto Creek Background Water Quality Data and Seasonality, Memo, July 2010."

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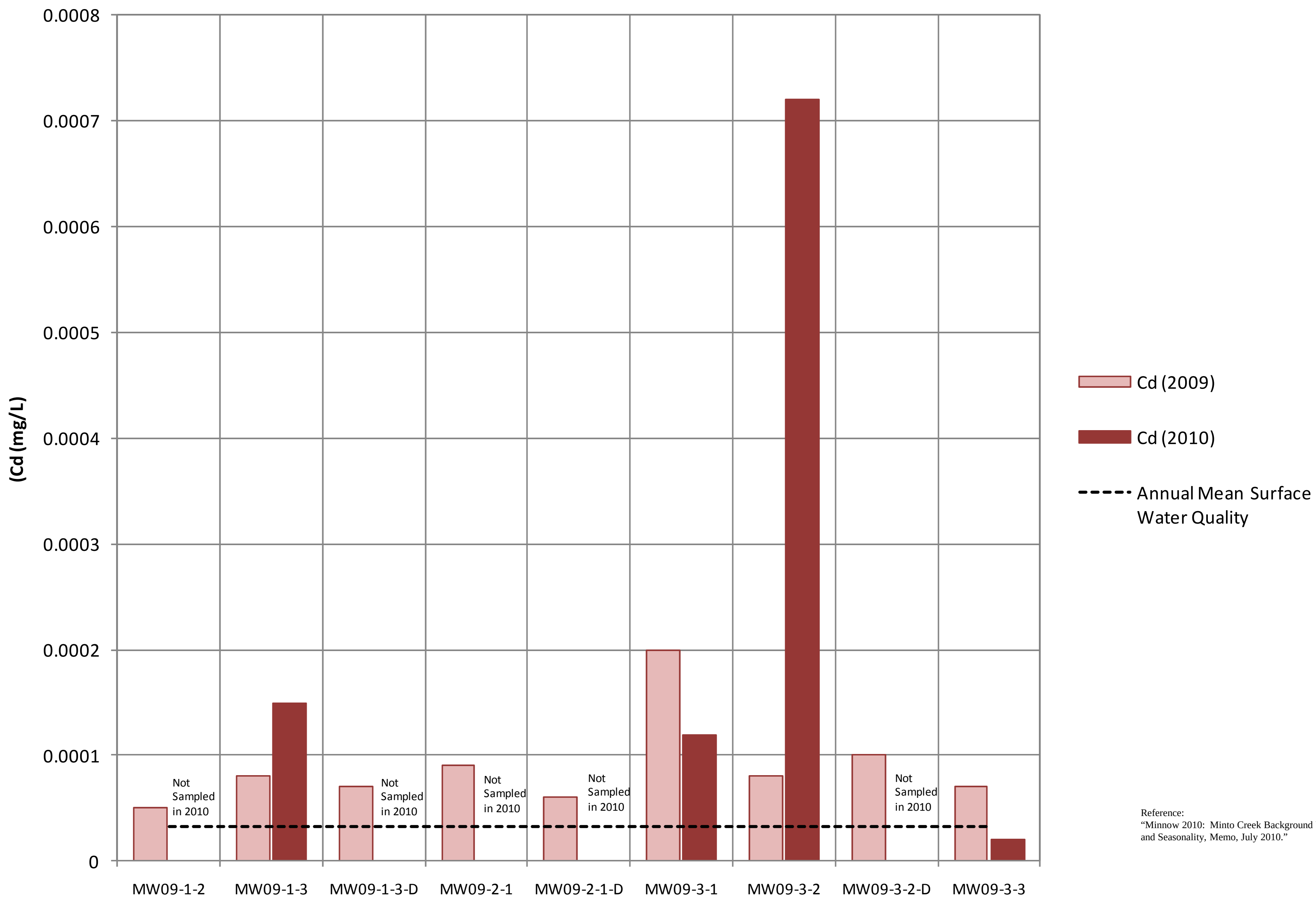
**Alumimium (Dissolved)**

| | | | | |
|---|---|---|---|---|
| Job No: 2CM022.017 | MINTO MINE | Date: August 5, 2010 | Approved: MR | Figure: 7 |
| Filename: Fig7_Aluminium.gf.20100805.ppt | | | | |




Reference:
"Minnow 2010: Minto Creek Background Water Quality Data and Seasonality, Memo, July 2010."

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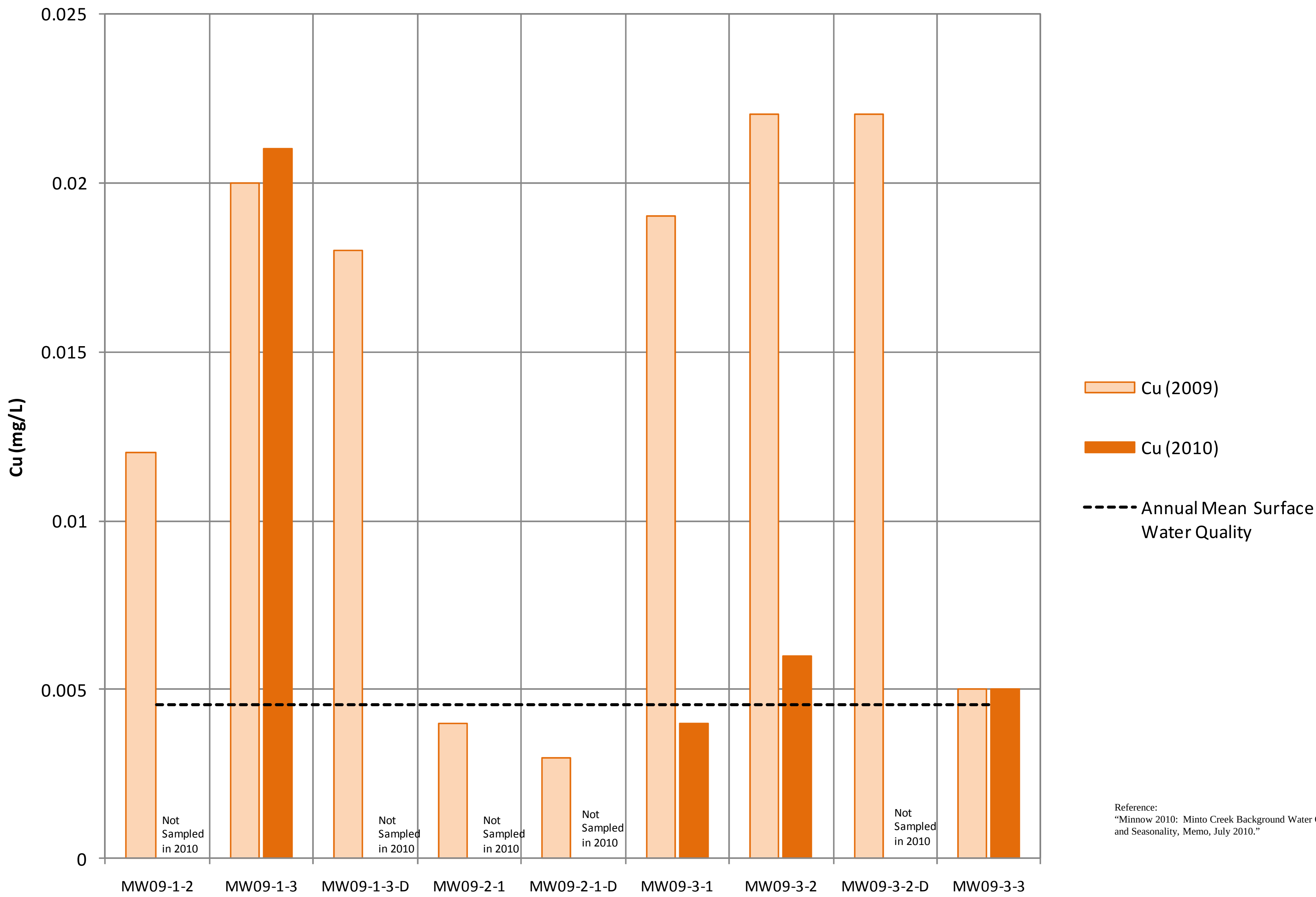
**Cadmium (Dissolved)**

Job No: 2CM022.017
Filename: Fig8_Cadmium.gf.20100805.ppt

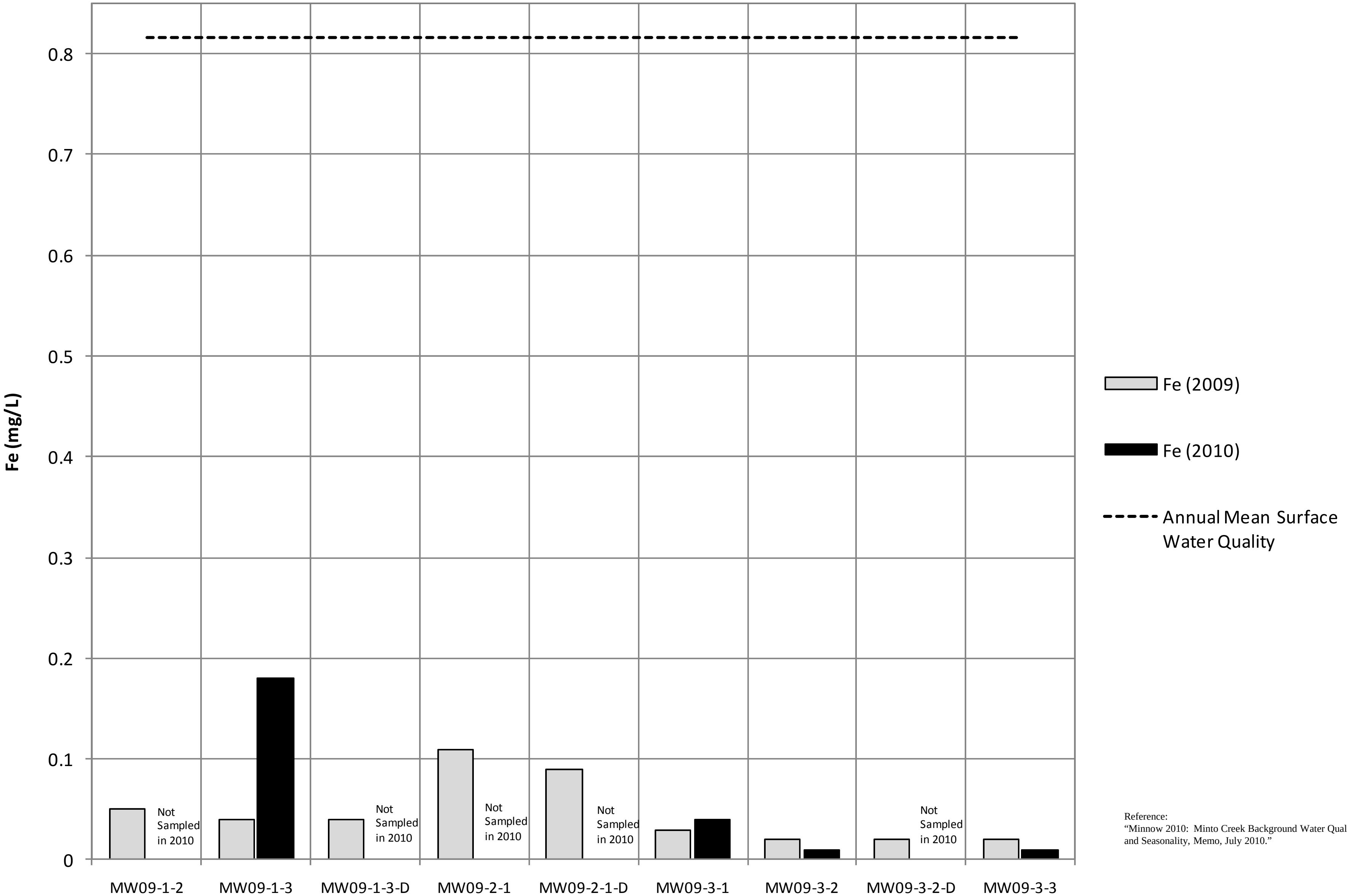
MINTO MINE

Date: August 5, 2010
Approved: MR
Figure: 8




Reference:
"Minnow 2010: Minto Creek Background Water Quality Data and Seasonality, Memo, July 2010."

| SRK Consulting Engineers and Scientists VANCOUVER | MINTO EXPLORATIONS LTD. A Subsidiary of Capstone Mining Corp. | **Copper (Dissolved)** | | |
|---|---|---|---|---|
| Job No: 2CM022.017 Filename: Fig9_Copper.gf.20100805.ppt | MINTO MINE | Date: August 5, 2010 | Approved: MR | Figure: 9 |




Reference:
"Minnow 2010: Minto Creek Background Water Quality Data and Seasonality, Memo, July 2010."

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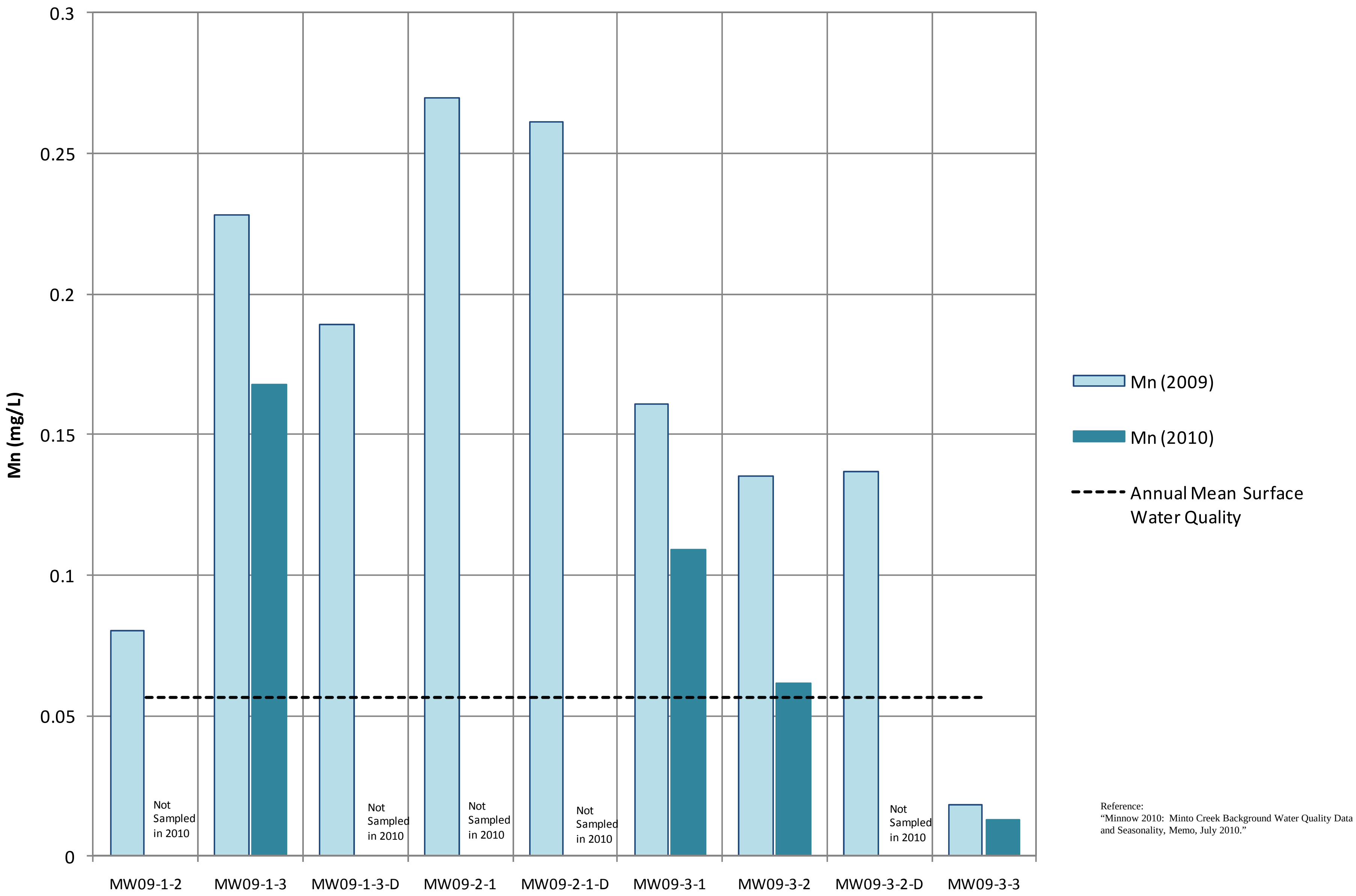
**Iron (Dissolved)**

Job No: 2CM022.017
Filename: Fig10_Iron.gf.20100805.ppt

MINTO MINE

Date: August 5, 2010
Approved: MR
Figure: 10

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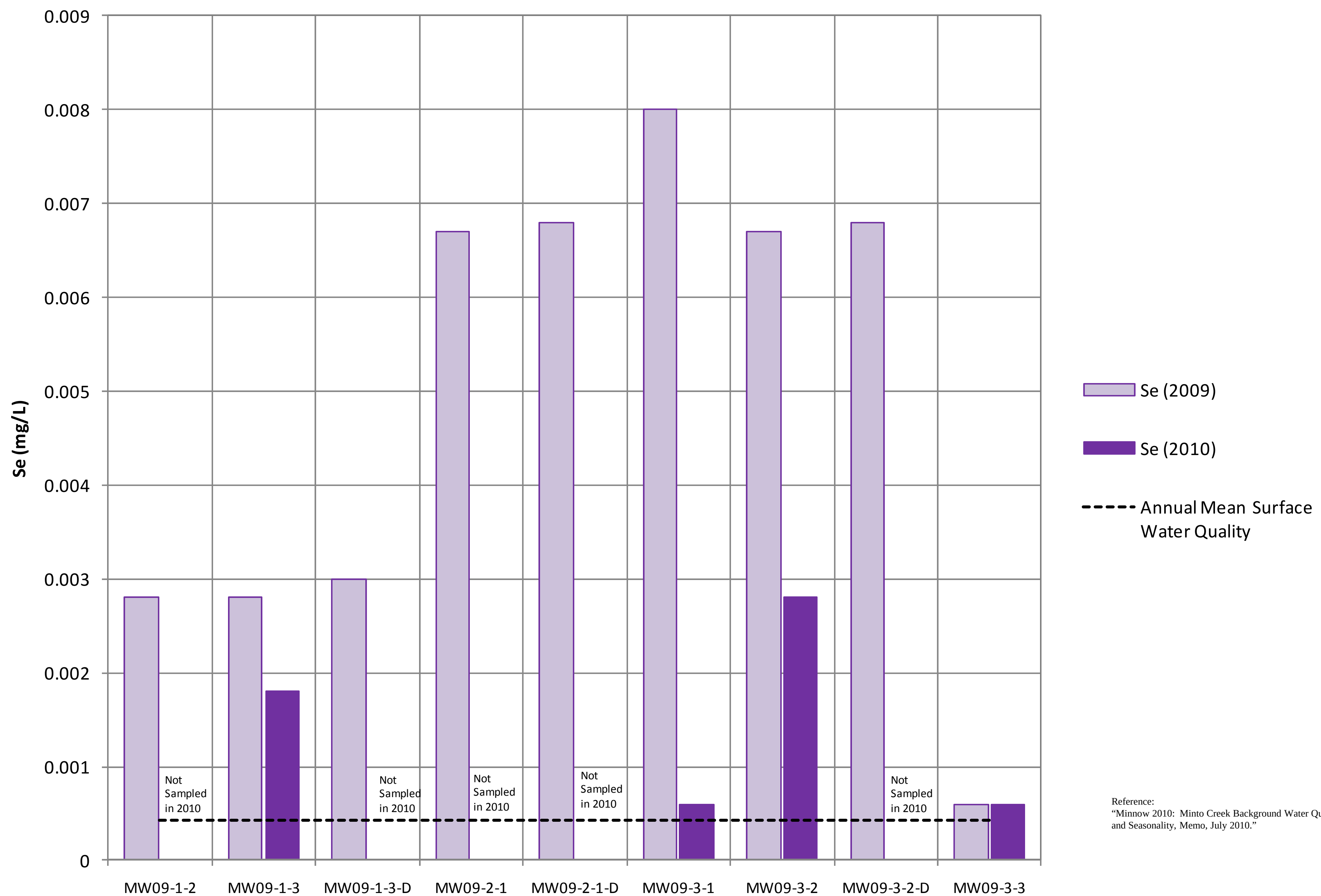
**Manganese (Dissolved)**

Job No: 2CM022.017
Filename: Fig11_Manganese.gf.20100805.ppt

MINTO MINE

Date: August 5, 2010
Approved: MR
Figure: **11**




Reference:
"Minnow 2010: Minto Creek Background Water Quality Data and Seasonality, Memo, July 2010."

| | | |
|---|---|---|
| SRK Consulting Engineers and Scientists VANCOUVER | MINTO EXPLORATIONS LTD. A Subsidiary of Capstone Mining Corp. | **Selenium (Dissolved)** |
| Job No: 2CM022.017<br>Filename: Fig12_Selenium.gf.20100805.ppt | MINTO MINE | Date: August 5, 2010 / Approved: MR / Figure: 12 |

## 5.0 Conclusions and Recommendations

Permafrost and piezometric (water level) conditions observed to date on the site support the conceptual model that groundwater flow will be concentrated in the shallow, active surface materials during summer thaw period and in the deeper, sub-permafrost aquifer system.

Based on the piezometric data and topography observed, the deeper groundwater flow is expected to discharge within the mine site, prior to the W3 compliance point. Therefore; any impacted groundwater will enter the surface water system and contribute to surface water loading. However; the expected flux (volume over time) will be low, so even at baseflow conditions we do not expect significant impact.

Groundwater chemistry across the site appears to be fairly consistent. Based on this observation, it is expected that it will be possible to model groundwater chemistry interactions with reasonable confidence across the site. This will be confirmed through additional monitoring of the ground water wells, and from seeps that are not influenced by mine workings (i.e.: not from the toe of an established waste dump, etc).

Going forward, the groundwater monitoring system will be upgraded to take into account new mine infrastructure and tailings facilities as required. At this time, Minto Exploration has committed to re-establishing connection to the damaged MW09-04 and replacement of the destroyed MW09-02 once the design for the valley fill has been finalised.

For monitoring system operation, Minto will:

- conduct quarterly pressure profiles and sampling for all monitoring locations for a minimum of one year. At the end of this period, a review of all available hydrogeological data will be conducted and monitoring locations prioritized for sampling frequency (e.g., quarterly versus bi-annually or annually).
- maintain a clear record of the installation, development, monitoring, and servicing carried out on each groundwater monitoring installation over time, with a log of these events recorded and included in the annual monitoring report.

This letter report, "**Minto Mine: Groundwater Baseline Conditions**", has been prepared by SRK Consulting (Canada) Inc.:

Yours truly,

**SRK Consulting (Canada) Inc.**

Michael Royle, M.App.Sci., P.Geo.
Principal Hydrogeologist

## References:


1. SRK 2008: Waste Dump Overburden Drilling. Minto Mine, Yukon.

2. EBA 2007: Geotechnical Design Report – "Dry" Stack tailings Storage facility. Minto Mine, Yukon.

3. Minnow 2010: Minto Creek Background Water Quality Data and Seasonality.

# Appendix A

## Minto Mine: Groundwater Monitoring System Installation Report

# Minto Mine
# Groundwater Monitoring System
# Installation Report

*Prepared for*

***Minto Explorations Ltd.***

*Prepared by*

SRK Consulting
Engineers and Scientists

*Project Reference Number*
*SRK 2CM022.007*

***February 2010***

# Minto Mine

# Groundwater Monitoring System Installation Report

## Capstone Mining Corp.

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**SRK Project Number 2CM022.007.0001.01**

**February 2010**

# Executive Summary

The groundwater monitoring system at the Minto Mine was augmented in 2009 with three multilevel monitoring systems. The main objectives of the Multiport (MP) monitoring wells are to:

- improve the understanding of hydrogeological conditions across the mine site, specifically as it behaves below the permafrost layer; and
- collect background data on piezometric levels and geochemistry of the hydrogeological system with respect to potential impact areas (waste rock piles, TMF, DSTF, etc).

This information will be used to establish baseline groundwater conditions at the site that can be directly monitored to detect possible impacts from mine infrastructure planned for the site.

This report summarizes the work carried out by SRK Consulting (Canada) Inc. during November and December, 2009 designed to drill and log four new holes, and install multi-level monitoring wells in each hole.

The new wells were designed to collect data to assess or enhance the understanding of:

- piezometric pressure distributions in depth discrete intervals in all monitoring wells;
- current pattern of groundwater flow across the site; and
- groundwater geochemistry for discrete depths in all wells.

The original plan called for the installation of four monitoring wells (MW09-01 to -04), located at current and future points of potential groundwater impact. The four new drillholes were all completed successfully to target depths; however, one of the installations (MW09-04) was damaged due to collapse of uncased waste rock near the surface soon after installation of the monitoring well had been completed.

MW09-04 may still be recoverable; however, frozen ground conditions do not allow for safe or easy access and so recovery efforts have been put on hold until the summer of 2010. It should be noted that MW09-04 is located up gradient of the currently dewatered Main Zone pit and so would not see any impacts from tailings or waste rock disposal until such time that mining in the pit ceases and it is converted to a tailings management facility (TMF) sometime in 2012. Therefore, a delay in data collection at this point is not considered to be significant with respect to site monitoring requirements.

Monitoring well and protective casing design and packer locations are illustrated for each drillhole to show the hydrogeological features that the data relate to. Installation details for MW09-04 are included for completeness, and to illustrate how this area will be covered by the recovered or replacement well.

Preliminary data were collected from each MP system and presented in this report. At this time, all available pressure and hydrogeochemistry data and the resulting interpretations are considered to be preliminary, as it is uncertain whether the monitoring zones have equilibrated from the drilling and installation disturbances. Future monitoring data will be used to determine when pressures and water chemistry have reached equilibrium with the surrounding rock.

The piezometric data collected from the new and existing multilevel monitoring wells will be used to better define the patterns of groundwater flow in the rock mass surrounding the currently dewatered Main Zone pit and throughout the site, as well as improve the conceptual model with respect to characteristics of hydrogeological features such as faults and regions on the site with little previous groundwater data. Geochemistry samples will be used to delineate flow paths and sources of water as it flows through the site and moves towards receptor bodies.

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# 1 Introduction

This report describes the design and installation of multilevel monitoring wells at the Minto Mine, Yukon. The purpose of the monitoring system is to improve the understanding of hydrogeological conditions across the sire and provide background water levels and hydrogeochemistry for environmental monitoring of the site. Four new drill holes were instrumented with the multilevel MP system. Figure 1 shows the general layout of the mine workings, major faults and all monitoring locations on the site. Information from the new monitoring system will be helpful in establishing the probable flow system in a flooded mine scenario and the hydrogeological controls for water entering and exiting the mine workings.

This report provides initial results of post installation pressure monitoring and makes limited recommendations for future monitoring of the MP well network.

## 1.1 Regulatory Requirements

The Minto Mine is subject to Type "A" Water Use License QZ96-006 (WUL) issued by the Yukon Water Board. Section 7.0 of the WUL require that a groundwater monitoring plan be prepared for the site, and stipulates that the monitoring plan shall:

*Groundwater Monitoring Plan*

71. *On or before the first anniversary of the start up date, the Licensee shall submit to the Board a Groundwater Monitoring Plan.*
72. *The Groundwater Monitoring Plan shall be designed in order to monitor potential groundwater contamination related to the waste rock/overburden dumps.*
73. *The Groundwater Monitoring Plan shall include at least two groundwater monitoring wells below the toe of each of the waste rock and overburden dumps. The siting and depth of these wells shall be based on the hydro geology of the area below the dumps and shall be selected to provide an early indication of the impact of the dumps on local groundwater quality.*

Monitoring of groundwater conditions is also a component to the monitoring program for the Dry Stack Tailings Facility (DSTF) at the site, as prescribed in the document Minto Mine Tailings Management Plan (January 2007), which was submitted as a requirement of the project's Quartz Mining License QML-0001 and approved by Yukon Government, Energy Mines and Resources (YG EMR). The requirements for groundwater monitoring in the DSTF are an element of the site groundwater monitoring regime, but will only be identified and referenced in this plan, as they may change with amendments to the Tailings Management Plan.

## 1.2 Monitoring Objectives

As stipulated in the WUL, a groundwater monitoring program will be carried out in the vicinity of the waste rock, overburden dumps, and the dry stack tailings facility (DSTF) at the Minto Mine site to provide background and on-going water quality data. The objective of the groundwater monitoring program is to provide an early indication of potential impact of the dumps on the local groundwater quality. In addition, this plan contains adaptive management and contingency measures if contamination is detected.

# 2 Hydrogeological Conditions

Groundwater at the Minto site will be constrained to the overburden and bedrock flow systems. A complicating factor for monitoring groundwater at the site is the extent of permafrost at the site. The general hydrogeological characteristics are discussed below to give a clearer picture of the conditions that will affect the movement of groundwater on the site.

## 2.1 Permafrost Conditions

Permafrost conditions on the site will make groundwater monitoring problematic. Permafrost on the site has been found to be extensive and deep (SRK, 2008). Data from drilling at several locations has shown permafrost ranging from depths from within 1.0m of ground surface to depths of up to 10 m.

Geotechnical drilling in 1994 and 1996 by EBA observed permafrost in each of the boreholes drilled within the vicinity of the proposed DSTF (See Figure 1), with the base of the permafrost occurring at varying depths (EBA, 2007). Measurements of the active layer in these areas indicated a maximum depth of only about 1.0 m in September 1996, directly under the DSTF footprint.

The observed ice contents in boreholes downstream of the DSTF (94-11 and 94-21) and within the footprint of the DSTF (96-G07 through -G12, excluding -G10), typically ranged from frozen ground to visible ice at 10% to 20% of the total volume. Two of the boreholes, 96-G09 and 96-G12, showed ice intervals of 1.5 and 4.0m thick respectively within the upper 10m.

Initial data from the ground temperature cables installed in 94-11, 94-21, and 96-G08 indicate a relatively uniform ground temperature of close to -0.8ºC after equilibration with slight seasonal warming within the top 2 to 4 m. The active layer in 94-G11 and 94–G21 are on existing disturbed trails, and so will be deeper than the surrounding soils. Readings from 2006 for 94-G11 indicate similar ground temperatures and active layer thickness.

In November 2007, vibrating wire piezometers were installed within and down gradient of the existing dry stack tailings facility (DSTF) in boreholes DSP-1 and DSP-2. Each of these piezometers is equipped with temperature sensors at the piezometer tip. At both of the locations, the sensors were installed at 1 m and 1.7 m respectively. No pore water has been measured in the piezometers to date, as ground conditions have remained frozen.

In addition, three more temperature cables providing profile data were installed in the vicinity of the DSTF in holes DST-1, DST-2, and DST-5. Initial observations from the piezometer temperature probes indicate that temperatures did not rise above -0.3°C at any time and ranged as low as -2.6°C. Temperature cable DST-5 (Figure 1) is located outside of the footprint of the DSTF and provided a profile reflecting conditions on an un-insulated site. Temperature averaged approximately -0.5°C below 1 m depth, and fluctuated near surface to values exceeding 5°C.

No groundwater was observed in any of the boreholes during the EBA geotechnical drilling program.

Soil investigation drilling in the region of the SW waste rock dump in February to April, 2008 (SRK, 2008), most cores contained non-visible ice, indicating the pore water was frozen; however, clear chunks of ice were also observed in many cases. Data from thermistors installed in the same drill holes indicate that this permafrost is close to 0°C; however, water in any monitoring standpipes would freeze in the permafrost layer.

The results of the temperature and piezometer monitoring near the SW Dump through June 2008 suggest that unfrozen layers at depth may be limited or non-existent, and that shallow perched water tables within the seasonally thawed active layer may provide the only mechanism for transport within this region of the basin.

## 2.2 Overburden

Geotechnical investigations within the plan area of the DSTF (EBA, 2007) indicated overburden thicknesses of up to 45m. These deposits are thought to be an extension of an infilled valley, which also passes through the southern end of the open pit. The overburden soils generally comprise a thin veneer of peat and vegetation overlying a fine-grained silt or silt and sand of colluvium origin. The colluvium is underlain by coarse-grained sand with trace gravel that is considered to be a residual soil. The exception to this is at borehole 94-21, in which a clay layer from ground surface to a depth of 18-9m was observed (EBA, 2007).

Throughout the mine site the residual soils grade into weathered bedrock. The overburden soils thin out to the south and east of the DSTSF site.

Detailed soil logging by SRK in the area of the SW Dump (SRK, 2008) indicated that overburden material is comprised of silty, and in certain locations, clayey material, with fractions of sand, gravel and cobbles. Overburden thickness varies in this area (from 10.7m at 08SWC270 to 51.8m at 08SWC273). Typically, the overburden thickness increased along the valley bed, and decreased on the valley slopes. This is expected to be similar for overburden conditions across the project site.

## 2.3 Bedrock

### 2.3.1 Lithology

Bedrock in the vicinity of the DSTF is located at approximately 45m depth (EBA, 2007). In general, outcrop exposure on the property is poor. Where exposure is available, it has been affected by deep weathering and variable oxidation, as the terrain was not glaciated during the last ice age event.

The Minto site is underlain by predominantly igneous rocks of granodiorite composition. Minor amounts of other lithologies consisting of small dykes of simple quartz-feldspar pegmatite, aplite, and an aphanitic textured intermediate composition rock are also observed. Bodies of all of these units are relatively thin and rarely exceed one metre core intersections. These dykes are relatively late, generally postdating the peak ductile deformation event; however, some pegmatite and aplite bodies observed in a rock cut located north of the mill complex are openly folded. Conglomerate and volcanic flows have been logged in drill core by past operators, but have not been recently confirmed as the drill core from previous campaigns was largely destroyed in forest fires and no new drilling has intersected such rocks.

With the possible exception of the lithological contacts of the dykes, the lithology types encountered in the Minto Mine site are not expected to have significant primary porosity as it relates to hydraulic conductivity (K) or transmissivity. The low K values (less than $10^{-9}$ m/s) make it unlikely that significant groundwater flow will occur in competent bedrock. Flow may; however, occur in bedrock that has been fractured/faulted to produce open, secondary porosity/permeability.

### 2.3.2 Structure

Secondary porosity/permeability is the dominant flow path in intrusive and metamorphic rocks. For this reason, it is important to have an understanding of the structural and mineralization environment of the site when constructing the conceptual flow model.

The copper-sulphide mineralization at Minto is strongly associated with foliated granodiorite within a deformation zone. The deformation zone forms sub-horizontal horizons within the more massive plutonic rocks of the region and can be traced laterally for more than 1,000 metres in the drill core. The similarity of chemistry and texture of both the deformed and the massive granodiorites suggest the deformation zones are structural in origin and not stratigraphic. The deformation zones are thought to represent healed, shallowly dipping faults that may have formed when the rocks passed through the brittle/ductile transformation zone in the earth's crust in transition from a deep emplacement environment to eventual exhumation of the regional batholith. Because of the inclusion of mineralization and the ductile nature of the main faulting at the site, these healed structures are not expected to represent significant flow paths.

Late, brittle fracturing and faulting is noted throughout the property area and is associated with a conjugate set of regional faults. The DEF Fault strikes more or less east-west and dips north-northwest and cuts off the main zone mineralization at its northern end. This type of faulting can often form significant flow paths within a rock mass. However; recent drilling results and data collected from instrumentation across the DEF fault in the north wall of the main Pit indicates that a significant hydraulic head is maintained across this feature (SRK, 2009 – unreported work in progress). This appears to indicate that the DEF is not a significant flow feature, but rather is holding back water flow across the structure. This characteristic; whereby, fault zones act as barriers to flow has been observed at other mine sites.

Current structural analysis of the site (SRK, 2009 - work in progress) indicates that faults of any sort are not expected to occur within the footprints of the waste and overburden dumps or DSTF.

### 2.3.3 Historical and Existing Groundwater Monitoring

To date, groundwater monitoring has been installed under various initiatives, including:

- Installation of standpipes in 1994 at the proposed dam alignment (P94-20) and the pit vicinity (P93-E):
  - Water chemistry samples collected between 1994 and 2006.
  - Water levels observed at ~15m and 26m depth in P94-20 and P93-E respectively.
  - Both destroyed during construction and pit excavation, respectively, in 2006).
- Vibrating wire transducers down gradient of the DSTF;
- Vibrating wire transducers in the dam core; and
- Standpipes installed during the SW dump foundation investigation.

Besides standpipes P93-E and P94-20, it appears that all standpipes installed on the site to date have frozen, indicating that permafrost conditions exist across most of the site at shallow depths.

### 2.3.4 Hydrogeological Implications of the Geological Model and Past Monitoring

The implications of the geology (thermal conditions, overburden, and lithology) found at the Minto site and the past monitoring events are:

- Permafrost:
  - will dominate groundwater flow system below active zone to depths of up to 45m; and
  - SRK expects that conventional “standpipe” monitoring wells installed through the permafrost in to the underlying unfrozen ground will be inoperable as the piezometric levels will be near surface; therefore, the resulting water in them will freeze.
- Shallow flow:
  - will be dominated by permafrost conditions;
  - will occur in the seasonally thawed layer; and
  - will be controlled by overburden composition in the unfrozen areas.
- Deeper flow:
  - will occur below the permafrost within the overburden or bedrock;

- will concentrate in the shallow, weathered zone if unfrozen; and
- standpipe monitoring wells will not be an effective means of monitoring the deep groundwater system.

Based on this, we expect that groundwater flow related to the waste rock and overburden dumps and the DSTF will only have significant impact on the shallow, active layer system. The deeper, bedrock hosted flow system is expected to be isolated from these facilities due to the permafrost layer.

We also expect that standpipe monitoring wells will not be an effective means of monitoring groundwater below the permafrost at the Minto site, and would be effective only seasonally when installed in the active layer.

# 3 Groundwater Monitoring System

## 3.1 Locations

For the 2009 installation program, Westbay MP (multi-port) monitoring wells were installed in four new drillholes (MW09-01, MW09-02, MW09-03, and MW09-04).

MP systems were installed in order to gain as much depth discrete information as possible from each drillhole, and to allow for operation through the permafrost. This latter aspect is possible due to the MP System being a closed pipe system such that fluids inside the pipe are isolated from the surrounding formation fluid or natural groundwater. The formation water is accessed by a wireline tool that opens individual valves to measure pressure and collect groundwater samples. The water inside the MP Casing within the permafrost is kept from freezing by mixing polypropolene glycol (antifreeze).

Table 1 lists locations and purpose for each of the new monitoring systems. The locations for each monitoring system are illustrated on Figure 1.

**Table 1: Monitoring Well Locations and Design Objective**

| Well ID | Drillhole Type and Diameter | Location | Surveyed Coordinates (UTM NAD83) | Purpose |
|---|---|---|---|---|
| MW09-01 | New; HQ | West Pit Access | 384177 E<br>6944984 N<br>858 masl | Establish baseline groundwater conditions down gradient of the Main Dump, and the proposed NW, NE, and SW Dumps |
| MW09-02 | New; HQ | Lower Tailings | 385676 E<br>6945034 N<br>757 masl | Establish groundwater conditions down gradient of the dry stack tailings facility (DSTF) |
| MW09-03 | New; HQ | Minto North | 384253 E<br>6946159 N<br>908 masl | Establish baseline groundwater conditions down gradient of the proposed North Pit |
| MW09-04 | New; HQ | Phase 1 Confluence | 384954 E<br>6944926 N<br>794 masl | Establish baseline groundwater conditions down gradient of the Main Zone Pit tailings management facility |

Monitoring wells were located to intercept expected flow paths from the adjacent mine waste facilities in order to act as a groundwater monitoring system. The flow paths were based on the current understanding of the site geology and conceptual hydrogeological model.

## 3.2 Drilling Techniques and Core Logging

MW09-01 to -04 were drilled as HQ3 diameter (96mm) boreholes using a hydraulic diamond coring drill rig operated by Driftwood Drilling of Smithers, BC. Polymer based drilling additives were only used when drilling through highly fractured surface rock. Drillholes were flushed significantly after use of polymer drilling fluids.

Core was collected over the entire drilled interval, boxed, and logged. Core logging included identification of lithology, structures, and hydrogeological features, such as zones or structures showing iron staining or concretion, interpreted to be a result of subsurface water flow. Rock Quality Designation (RQD), core recovery, and qualitative hammer tests to determine rock strength data were also recorded. Complete drillhole logs are included in Appendix A. Depths in the drill logs represent drillhole depth, and all holes were vertical. All holes were logged using imperial units, but have been converted to metric for use in this report.

Specific attention was paid to identification of ice, or frozen soil/rock, in the core. However, slow drilling conditions usually meant that recovered core had been heated to above 0°C so it was difficult to determine if material was frozen *in situ*. Therefore, delineation of the permafrost base is ambiguous at this point. Future monitoring should be able to define this boundary with reasonable accuracy based on casing fluid temperature profiles, and will be part of the regular monitoring data collection process.

All drill core was digitally photographed before the boxes were sealed. These photos are included on the accompanying disk, but have not been reproduced in this report.

The boxed core will be stored as with all other core on site.

## 3.3 MP Casing Installation Program

### 3.3.1 Installation Procedures

Installation of the Westbay MP casing consists of the following:

1. Design of modular component layout for each well (see component logs in Appendix B) based on drill core observations;
2. Lowering and field testing of components to design depth;
3. Individual inflation of hydraulic packers to hydraulically isolate the sampling zones;

4. Hydraulic integrity testing of MP casing (see if it can maintain a differential water level between it and the open drillhole) to check for leaks; and

5. Initial pressure profile to test for ability to maintain differential pressures across packers.

As the MP casing is watertight, it is buoyant in the drillhole and has to be sunk into position by adding clean water. During installation, propylene glycol was also added to protect the water in the casing from freezing in the permafrost zone. The antifreeze will not enter the sampling zone (groundwater) as the MP Casing is sealed until opened by the sampling tool, at which point fluid enters the casing and does not escape, as the piezometric pressure inside the casing is maintained below the outside pressure. This method of preventing casing fluid entering the sampling zone has been reviewed by the USEPA for use at Superfund sites and found to be technically and operationally acceptable.

### 3.3.2 Details of Installed System

Monitoring zones and related packer locations were identified based on geological logs. The number of monitoring zones for each drillhole was based on a combination of observed features of hydrogeological interest and logical spacing for reasonable sample collection ability in low K rock.

Monitoring zones are numbered from the bottom up. Therefore, zone 1 is at the bottom of the well, and higher numbered zones are shallower. Table 2 summarises monitoring system information at each new location.

**Table 2: Monitoring Zone Details**

| ID | Number of Monitoring Zones | Drillhole Length (m) | Monitoring System Length (m) | Zone Comments |
|---|---|---|---|---|
| **MW09-01** | 3 | 50 | 50 | • Zone 1 did not produce a water sample<br>• Zone 3 extends to the surface as there is no packer above the measurement port |
| **MW09-02** | 2 | 60 | 60 | • Zone 2 did not produce a water sample (possibly frozen) |
| **MW09-03** | 3 | 50 | 50 | |
| **MW09-04** | 3 | 75 | 75 | • Well damaged post installation<br>• To be re-established in summer 2010 |

*NOTE: all depths and lengths rounded to nearest metre

### 3.3.3 Documentation

Well designs and installation QA documentation are provided in Appendix B. Casing depths listed on well design sheets refer to true depth as all drill holes were vertical.

### 3.3.4 MW09-4

Installation of MW09-4 was completed on November 24th 2009. When SRK and Minto staff returned to develop and sample the well on December 3rd, the MP casing was no longer vertical, and the wireline tools could not be lowered past an apparent bend in the casing just below the ground surface. Further investigation suggested that the uncased waste rock near the surface had shifted soon after installation of the monitoring well, causing the MP casing to deviate from its original alignment. Attempts were made to expose and straighten the upper part of the well, but the frozen ground conditions did not allow for safe or easy excavation. The well may still be intact and useable, but recovery efforts have been put on hold until the summer of 2010.

# 4 Monitoring

## 4.1 Pressure Monitoring

Preliminary pressure profiles for each of the monitoring wells are illustrated in Figures 2 through 4. Although no pressure data available at this time, Figure 5 illustrates the geology and well design for MW09-4 for comparison.

Piezometric data is only available for 2 monitoring events; immediately after installation and during the first sampling event several days later. Piezometric levels in each monitoring zone are plotted as the “equivalent depth to water” on the plots. This refers to the depth the water would be observed in an open standpipe if screened across the MP zone. The equivalent depth to water is calculated by adding the pressure head (height of water column calculated from the zone pressure measured) to the depth of the measurement port where the pressure was measured.

Plots also show an “atmospheric line”. This line indicates where the pressure head equals zero (i.e., piezometric head equals elevation head). This condition will occur if the zone is unsaturated (dry), and is analogous to an open borehole where the water level is at, or below, the measurement zone. Therefore, unsaturated zones will plot along the atmospheric line while saturated zones will plot above this line.

Protocols for measuring fluid pressures are given in Appendix C. Tabulated pressure data are included in Appendix D.

## 4.2 Summary of Initial Pressure Data

Due to the low hydraulic conductivity of the rock observed to date at Minto Mine, it is not known whether piezometric pressures had equilibrated by the time the initial pressures were measured. Assuming that they are reasonably close to actual zone pressures, the following preliminary observations are presented:

- Data from MW09-01 indicate that that piezometric pressures in the three zones were slow to equilibrate (ie: significant change over two days) and that pressures are near atmospheric in the zones. This may be due to the proximity of the monitoring system to the dewatered Main Zone pit, and indicate that the slope is mainly dewatered.

- Data from MW09-02 indicate that the two zones have the same piezometric pressure (hydrostatic), indicating either a well connected fracture system in the weathered bedrock, or possibly a suspect seal between packers. The latter will be tested during the next sampling round by monitoring an induced pressure between the zones to verify hydraulic performance.
- Data from MW09-03 indicate that generally hydrostatic conditions between the zones, with a slight upwards gradient as would be expected on a slope.
- No data available from MW09-04.

## 4.3 Development and Sampling

Monitoring wells were developed by opening the pumping ports using a wireline tool and then purging using a Waterra Hydrolift until the water was clear and pH, conductivity and temperature values were stable. The pumping ports were then closed and some of the water in the interior of the MP casing was pumped out in order to maintain a lower head relative to the water outside the casing. Development records are included in Appendix E.

Sampling from the MP wells was completed by attaching sample collection bottles to the wireline pressure measurement tool, and pumping out the air to create a near vacuum inside the bottles. When the tool is connected to a measurement port and the valve to the sample bottles is opened, water flows from outside the casing into the bottles due to the pressure difference. Two sample bottles were used, collecting approximately 500mL with each run. The sample bottles were thoroughly rinsed with distilled water between sampling zones, and with nitric acid at the start of each day. Standard SRK sampling protocols are attached in Appendix C.

Water samples were taken from all monitoring zones in wells MW09-01, MW09-2 and MW09-3, with the following exceptions:

- Zone 1 in MW09-1 showed a pressure reading lower than atmospheric pressure and did not appear to have any water flow; and
- Zone 2 in MW09-2 showed a pressure reading consistent with water in the formation, but no water flowed into the sample bottles on two separate attempts.

A duplicate sample was taken in each of the wells and labelled as if it were an additional zone, as noted on the sampling records, which are included in Appendix E.

Minto staff assisted with well development and sampling in order to become familiar with the MP system, and were trained to use the wireline sampling tools.

## 4.4 Initial Sampling Results

Initial water chemistry results are provided in Table 3 and Figures 6 to 8. Figures 6 and 7 illustrate the pH and alkalinity values from each of the zones sampled. Figure 8 gives the results for dissolved copper, molybdenum, and selenium. All sample results were above minimum detection limits. Results for filtered, dissolved metals have been presented as unfiltered samples are deemed to be unrepresentatively impacted by drill hole cuttings, etc.; therefore, not a good representation of true groundwater.

Table 3 presents detailed chemistry data. It should be noted that these data may be impacted by drilling fluids and should only be viewed as preliminary, and will be compared to future sampling results to determine when data are representative of formation hydrogeochemistry.

## Table 3: Preliminary Sampling Results - December 2009

| Parameter | Units | Well-Zone | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MW09-1 | | | MW09-2 | | MW09-3 | | | |
| | | MW09-1-2 | MW09-1-3 | MW09-1-3-D | MW09-2-1 | MW09-2-1-D | MW09-3-1 | MW09-3-2 | MW09-3-2-D | MW09-3-3 |
| **Date** | | 30-Nov-09 | 30-Nov-09 | 30-Nov-09 | 2-Dec-09 | 2-Dec-09 | 1-Dec-09 | 1-Dec-09 | 1-Dec-09 | 1-Dec-09 |
| **Physical Properties** | | | | | | | | | | |
| pH | pH units | 8.03 | 8.02 | 8.06 | 7.95 | 7.95 | 7.94 | 7.91 | 7.92 | 7.8 |
| Conductivity | uS/cm | 729 | 725 | 728 | 1090 | 1090 | 976 | 932 | 947 | 158 |
| TDS | mg/L | 528 | 364 | 442 | 814 | 812 | 652 | 626 | 672 | 110 |
| TSS | mg/L | 7 | 92 | 66 | 30 | 31 | 399 | 146 | 96 | 21 |
| **Misc. Parameters** | | | | | | | | | | |
| Alkalinity - Bicarbonate | mgCaCO3/L | 140 | 100 | 100 | 400 | 410 | 100 | 100 | 100 | 70 |
| Alkalinity - Carbonate | mgCaCO3/L | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 |
| Alkalinity - Hydroxide | mgCaCO3/L | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Alkalinity - Total | mgCaCO3/L | 112 | 100 | 100 | 329 | 333 | 93 | 85 | 81 | 55 |
| Hardness | mgCaCO3/L | 318 | 262 | 274 | 503 | 508 | 253 | 242 | 255 | 60 |
| Turbidity | NTU | 1.1 | 32 | 26 | 13 | 16 | 95 | 49 | 47 | 6.9 |
| Chloride | mg/L | 7.22 | 7.28 | 7.27 | 5.52 | 5.73 | 17.9 | 16 | 16.3 | 0.93 |
| Nitrogen as NH4 | mg/L | 0.72 | 3.85 | 3.03 | 1.29 | 1.26 | 5.79 | 5.32 | 5.6 | 0.26 |
| Nitrogen as NO23 | mg/L | 42.9 | 42.1 | 42.1 | 23.2 | 24.4 | 60.9 | 58.2 | 59.7 | 1.87 |
| Total Kjeldahl Nitrogen | mg/L | 6.79 | 6 | 6.21 | 1.13 | 1.01 | 11.7 | 12.2 | 11.6 | 0.34 |
| Phosphate (total) | mg/L | 0.04 | 0.03 | 0.03 | 0.06 | 0.06 | 0.03 | 0.03 | 0.03 | 0.04 |
| Sulphate (dissolved) | mg/L | 77.4 | 82.5 | 83.3 | 166 | 170 | 117 | 110 | 115 | 10 |
| **Dissolved Metals** | | | | | | | | | | |
| Ag-D | mg/L | 0.00019 | <0.00001 | 0.00002 | <0.00001 | <0.00001 | 0.00005 | 0.00004 | 0.00005 | 0.00001 |
| Al-D | mg/L | 0.006 | 0.007 | <0.005 | 0.01 | <0.005 | 0.01 | 0.008 | 0.007 | 0.007 |
| As-D | mg/L | 0.0002 | 0.0002 | 0.0003 | 0.0041 | 0.0047 | 0.0009 | 0.0008 | 0.0005 | 0.0002 |
| Ba-D | mg/L | 0.034 | 0.1 | 0.095 | 0.11 | 0.111 | 0.106 | 0.088 | 0.091 | 0.011 |
| B-D | mg/L | 0.045 | 0.052 | 0.044 | 5.37 | 6.09 | 0.32 | 0.218 | 0.2 | 0.044 |
| Be-D | mg/L | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 |
| Bi-D | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Ca-D | mg/L | 89.7 | 75.4 | 78.2 | 98.2 | 99.2 | 74.1 | 73.7 | 77.6 | 19.9 |
| Cd-D | mg/L | 0.00005 | 0.00008 | 0.00007 | 0.00009 | 0.00006 | 0.0002 | 0.00008 | 0.0001 | 0.00007 |
| Co-D | mg/L | 0.00102 | 0.00076 | 0.00078 | 0.00065 | 0.00062 | 0.00045 | 0.00057 | 0.00054 | 0.00024 |
| Cr-D | mg/L | <0.0004 | <0.0004 | <0.0004 | 0.0036 | 0.0038 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Cu-D | mg/L | 0.012 | 0.02 | 0.018 | 0.004 | 0.003 | 0.019 | 0.022 | 0.022 | 0.005 |
| Fe-D | mg/L | 0.05 | 0.04 | 0.04 | 0.11 | 0.09 | 0.03 | 0.02 | 0.02 | 0.02 |
| Hg-D | ug/L | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |
| K-D | mg/L | 3.2 | 6.6 | 5.8 | 8.2 | 8.4 | 27 | 26 | 25 | 2.6 |
| Li-D | mg/L | 0.001 | 0.003 | 0.003 | 0.011 | 0.01 | 0.012 | 0.011 | 0.011 | 0.001 |
| Mg-D | mg/L | 22.9 | 18 | 19.1 | 62.6 | 63.1 | 16.5 | 14.2 | 14.9 | 2.4 |
| Mn-D | mg/L | 0.0802 | 0.228 | 0.189 | 0.27 | 0.261 | 0.161 | 0.135 | 0.137 | 0.0184 |
| Mo-D | mg/L | 0.0341 | 0.0892 | 0.0733 | 0.0442 | 0.0487 | 0.0806 | 0.101 | 0.104 | 0.0267 |
| Na-D | mg/L | 16.8 | 28 | 26.2 | 70.4 | 74.2 | 70.5 | 63 | 66.8 | 5.5 |
| Ni-D | mg/L | 0.004 | 0.002 | 0.002 | 0.004 | 0.003 | 0.008 | 0.004 | 0.004 | 0.002 |
| Pb-D | mg/L | 0.0001 | <0.0001 | <0.0001 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | <0.0001 | 0.0001 |
| P-D | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 | <0.01 |
| Sb-D | mg/L | 0.0053 | 0.0032 | 0.0008 | 0.0136 | 0.003 | 0.002 | 0.0021 | 0.0034 | 0.0021 |
| S-D | mg/L | 25.8 | 27.5 | 27.8 | 55.4 | 56.7 | 39 | 36.7 | 38.4 | 3.4 |
| Se-D | mg/L | 0.0028 | 0.0028 | 0.003 | 0.0067 | 0.0068 | 0.008 | 0.0067 | 0.0068 | <0.0006 |
| Si-D | mg/L | 4.37 | 2.87 | 3.36 | 6.88 | 6.94 | 2.49 | 2.54 | 2.58 | 4.2 |
| Sn-D | mg/L | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0002 | 0.0002 | <0.0001 | <0.0001 |
| Sr-D | mg/L | 1.04 | 1.51 | 1.39 | 2.11 | 2.14 | 2.21 | 1.86 | 1.91 | 0.168 |
| Te-D | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Th-D | mg/L | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Ti-D | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Tl-D | mg/L | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |
| U-D | mg/L | 0.0029 | <0.0004 | 0.0008 | 0.0038 | 0.0039 | 0.001 | 0.0008 | 0.0008 | <0.0004 |
| V-D | mg/L | 0.0002 | 0.0001 | 0.0001 | 0.0011 | 0.0012 | 0.0002 | 0.0001 | 0.0001 | 0.0002 |
| Zn-D | mg/L | 0.009 | 0.006 | 0.004 | 0.01 | 0.007 | 0.022 | 0.01 | 0.014 | 0.012 |
| Zr-D | mg/L | <0.0001 | 0.0001 | <0.0001 | 0.0001 | 0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Total Metals** | | | | | | | | | | |
| Ag-T | mg/L | 0.00037 | 0.00013 | 0.00013 | 0.00024 | 0.00019 | 0.0104 | 0.00613 | 0.00377 | 0.00154 |
| Al-T | mg/L | 0.141 | 1.46 | 1.02 | 1.03 | 0.765 | 15.3 | 3.85 | 2.62 | 0.681 |
| As-T | mg/L | 0.0003 | 0.0009 | 0.0007 | 0.0053 | 0.005 | 0.0068 | 0.0007 | 0.0006 | <0.0002 |
| Ba-T | mg/L | 0.037 | 0.138 | 0.122 | 0.136 | 0.132 | 1.35 | 0.183 | 0.16 | 0.028 |
| Be-T | mg/L | <0.00004 | <0.00004 | 0.00004 | 0.00004 | <0.00004 | 0.00066 | 0.00008 | 0.00004 | <0.00004 |
| Bi-T | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.005 | <0.001 | <0.001 | <0.001 |
| B-T | mg/L | 0.046 | 0.068 | 0.048 | 6.18 | 6.25 | 0.514 | 0.25 | 0.228 | 0.064 |
| Ca-T | mg/L | 85.9 | 73.2 | 70.9 | 96 | 95.1 | 85.5 | 74 | 74.4 | 20.4 |
| Cd-T | mg/L | 0.00004 | 0.00008 | 0.00008 | 0.00017 | 0.00016 | 0.00012 | 0.00013 | 0.00011 | 0.00008 |
| Co-T | mg/L | 0.00109 | 0.00156 | 0.00145 | 0.00144 | 0.00121 | 0.0175 | 0.00147 | 0.00128 | 0.00027 |
| Cr-T | mg/L | 0.0011 | 0.0052 | 0.0037 | 0.006 | 0.0054 | 0.003 | 0.002 | 0.0016 | 0.0013 |
| Cu-T | mg/L | 0.015 | 0.04 | 0.035 | 0.013 | 0.01 | 0.056 | 0.047 | 0.042 | 0.01 |
| Fe-T | mg/L | 0.324 | 2.68 | 1.65 | 1.76 | 1.28 | 44 | 4.93 | 3.47 | 0.673 |
| Hg-T | ug/L | 0.05 | <0.01 | 0.02 | <0.01 | <0.01 | 0.02 | 0.02 | 0.02 | 0.01 |
| K-T | mg/L | 3.3 | 7.2 | 5.9 | 8.6 | 8.3 | 31 | 25.2 | 25.2 | 3 |
| Li-T | mg/L | 0.001 | 0.005 | 0.004 | 0.013 | 0.013 | 0.02 | 0.012 | 0.012 | 0.001 |
| Mg-T | mg/L | 22 | 18 | 17.8 | 62.2 | 61.9 | 21.8 | 14.6 | 14.6 | 2.54 |
| Mn-T | mg/L | 0.0935 | 0.309 | 0.248 | 0.34 | 0.332 | 6.78 | 0.287 | 0.256 | 0.0384 |
| Mo-T | mg/L | 0.0356 | 0.0944 | 0.0758 | 0.0481 | 0.0499 | 0.0742 | 0.108 | 0.114 | 0.0288 |
| Na-T | mg/L | 16.7 | 28.1 | 23.6 | 73.4 | 71.5 | 65.4 | 66.1 | 66.7 | 5.72 |
| Ni-T | mg/L | 0.004 | 0.005 | 0.004 | 0.006 | 0.005 | 0.01 | 0.005 | 0.005 | 0.002 |
| Pb-T | mg/L | 0.0001 | 0.0007 | 0.0005 | 0.0008 | 0.0006 | 0.004 | 0.0008 | 0.0006 | 0.0002 |
| P-T | mg/L | <0.05 | 0.06 | <0.05 | <0.05 | <0.05 | 0.19 | 0.07 | 0.05 | <0.05 |
| Sb-T | mg/L | 0.0003 | 0.0012 | 0.0003 | 0.003 | 0.0038 | <0.001 | 0.0008 | 0.0032 | 0.0025 |
| Se-T | mg/L | 0.0029 | 0.0032 | 0.0031 | 0.0072 | 0.0073 | 0.011 | 0.0078 | 0.0077 | 0.0007 |
| Si-T | mg/L | 4.54 | 7.01 | 5.12 | 9.32 | 8.46 | 38.1 | 9.99 | 7.55 | 5.49 |
| Sn-T | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0005 | 0.0003 | 0.0002 | <0.0001 |
| Sr-T | mg/L | 1.27 | 1.84 | 1.64 | 2.55 | 2.53 | 2.41 | 2.17 | 2.31 | 0.189 |
| S-T | mg/L | 27.6 | 28.5 | 28.2 | 60.5 | 59.9 | 41 | 39.1 | 39.8 | 3.8 |
| Te-T | mg/L | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0005 | <0.0001 | <0.0001 | <0.0001 |
| Th-T | mg/L | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.002 | <0.0004 | <0.0004 | <0.0004 |
| Tl-T | mg/L | <0.00001 | 0.00002 | 0.00001 | 0.00001 | <0.00001 | 0.00016 | 0.00002 | 0.00002 | <0.00001 |
| U-T | mg/L | 0.0032 | 0.0004 | 0.0008 | 0.0045 | 0.0044 | 0.002 | 0.0009 | 0.001 | <0.0004 |
| V-T | mg/L | 0.0006 | 0.0046 | 0.0033 | 0.0036 | 0.0029 | 0.039 | 0.0065 | 0.005 | 0.0012 |
| Zn-T | mg/L | 0.007 | 0.029 | 0.019 | 0.024 | 0.018 | 0.13 | 0.036 | 0.033 | 0.033 |
| Zr-T | mg/L | 0.0002 | 0.0006 | 0.0004 | 0.0004 | 0.0004 | 0.0006 | 0.0004 | 0.0004 | 0.0001 |

# 5 Monitoring System Recommendations

- Pressure profiles and sampling for all monitoring locations should be conducted quarterly for a minimum of one year. At the end of this period, a review of all available hydrogeological data should be conducted and monitoring locations prioritized for sampling frequency (e.g., quarterly versus bi-annually or annually).
- In order to maintain a clear record of the installation, development, monitoring, and servicing that is carried out on each MP installation over time, a log of these events should be recorded in a Monitoring System Well Log. A sample log is attached in Appendix F. This information should be updated any time work is carried out on the MP well(s).

This report, **Minto Mine: Groundwater Monitoring System Installation Report,** has been prepared by SRK Consulting (Canada) Inc.:

**Prepared by**

______________________________
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**Reviewed by**

______________________________
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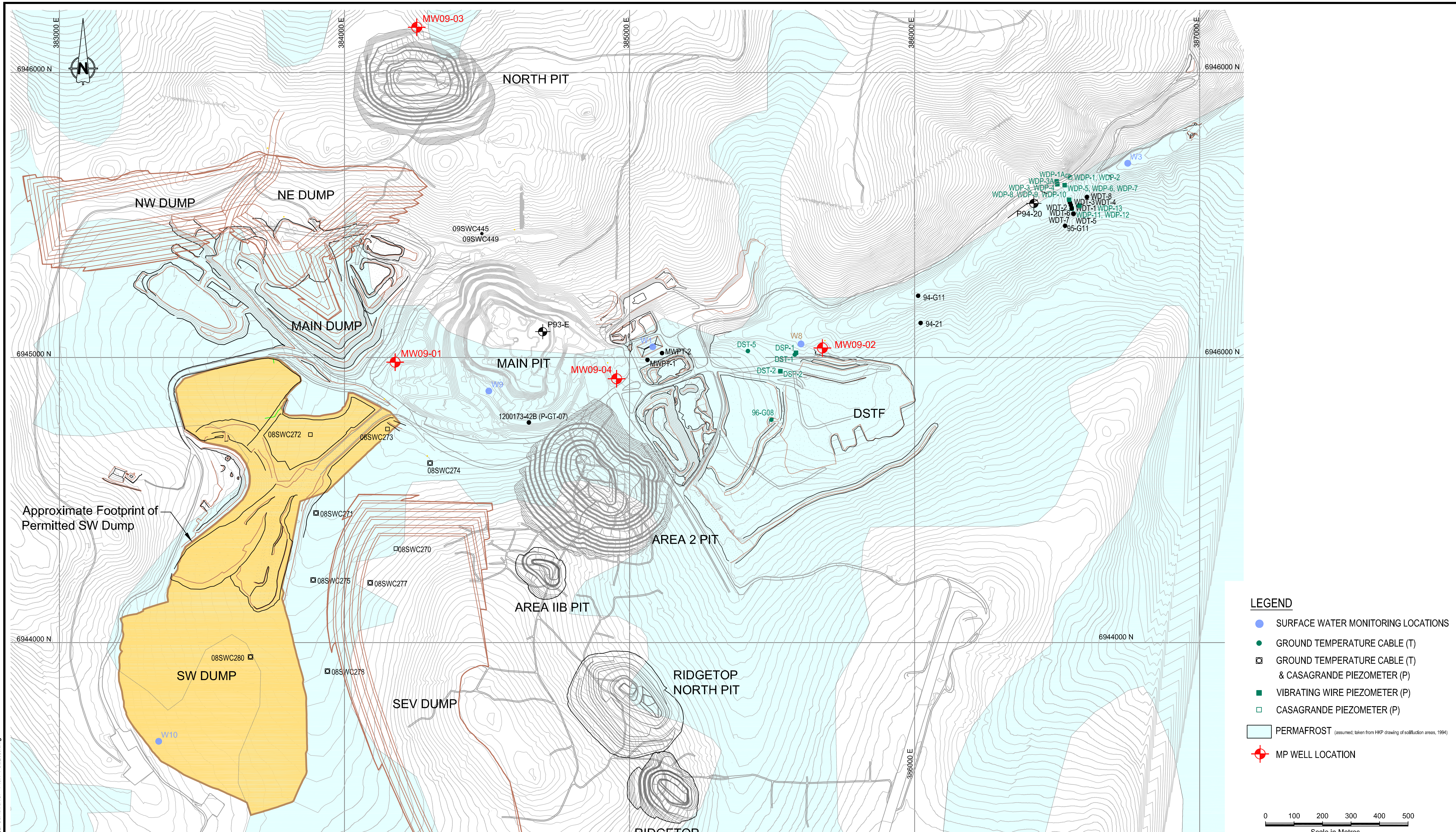
# Figures

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Vancouver B.C.

**Minto Explorations Ltd.**

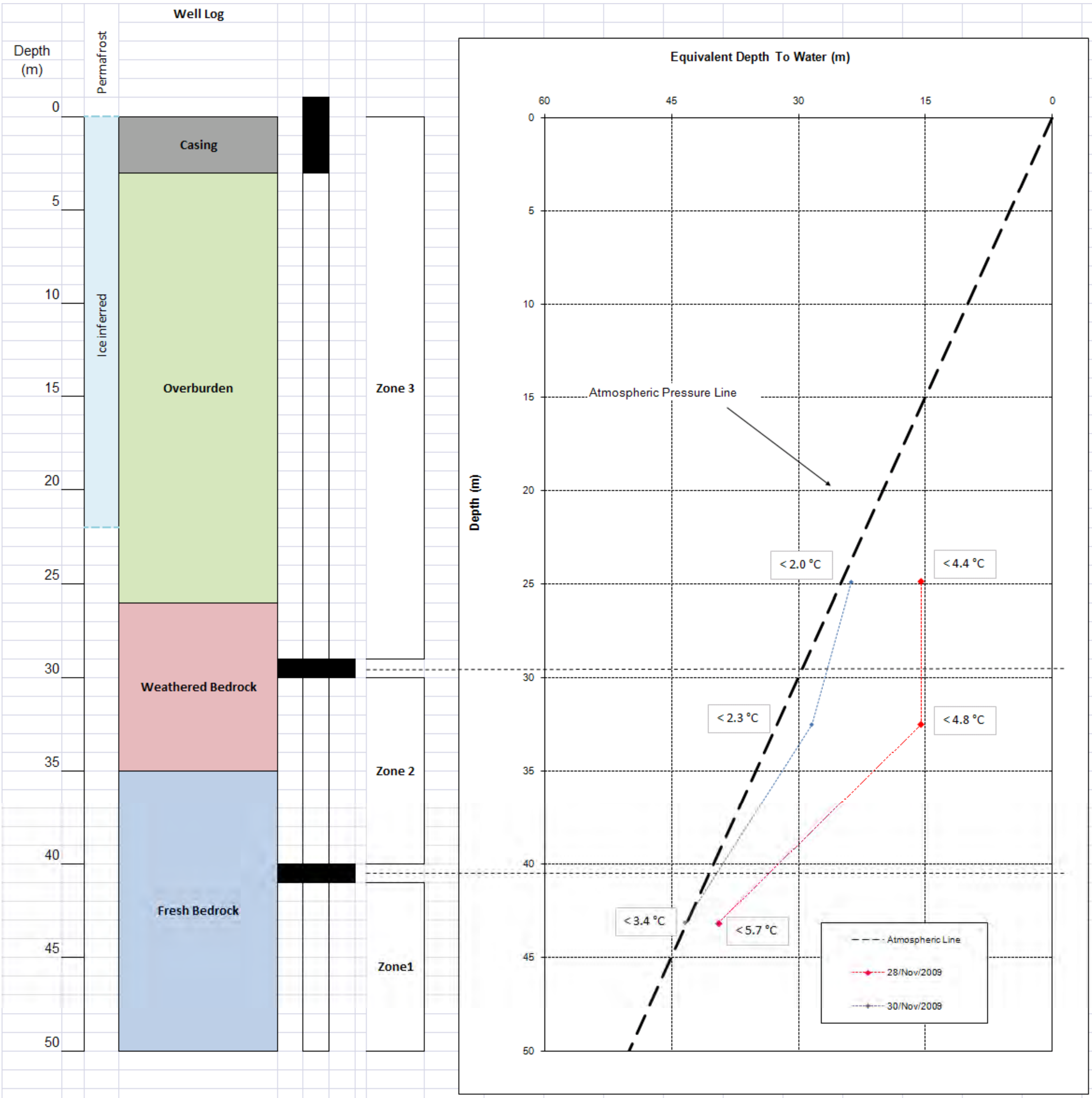
Groundwater Monitoring Locations

SRK JOB NO.: 2CM022.001

FILE NAME: SRK_Minto_Groundwater Plan Feb2010.dwg

Minto Groundwater Monitoring Plan

| DATE: | APPROVED: | FIGURE: |
|---|---|---|
| Feb. 5, 2010 | MDR | 1 |

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**Groundwater Monitoring Locations**

| | | | | |
|---|---|---|---|---|
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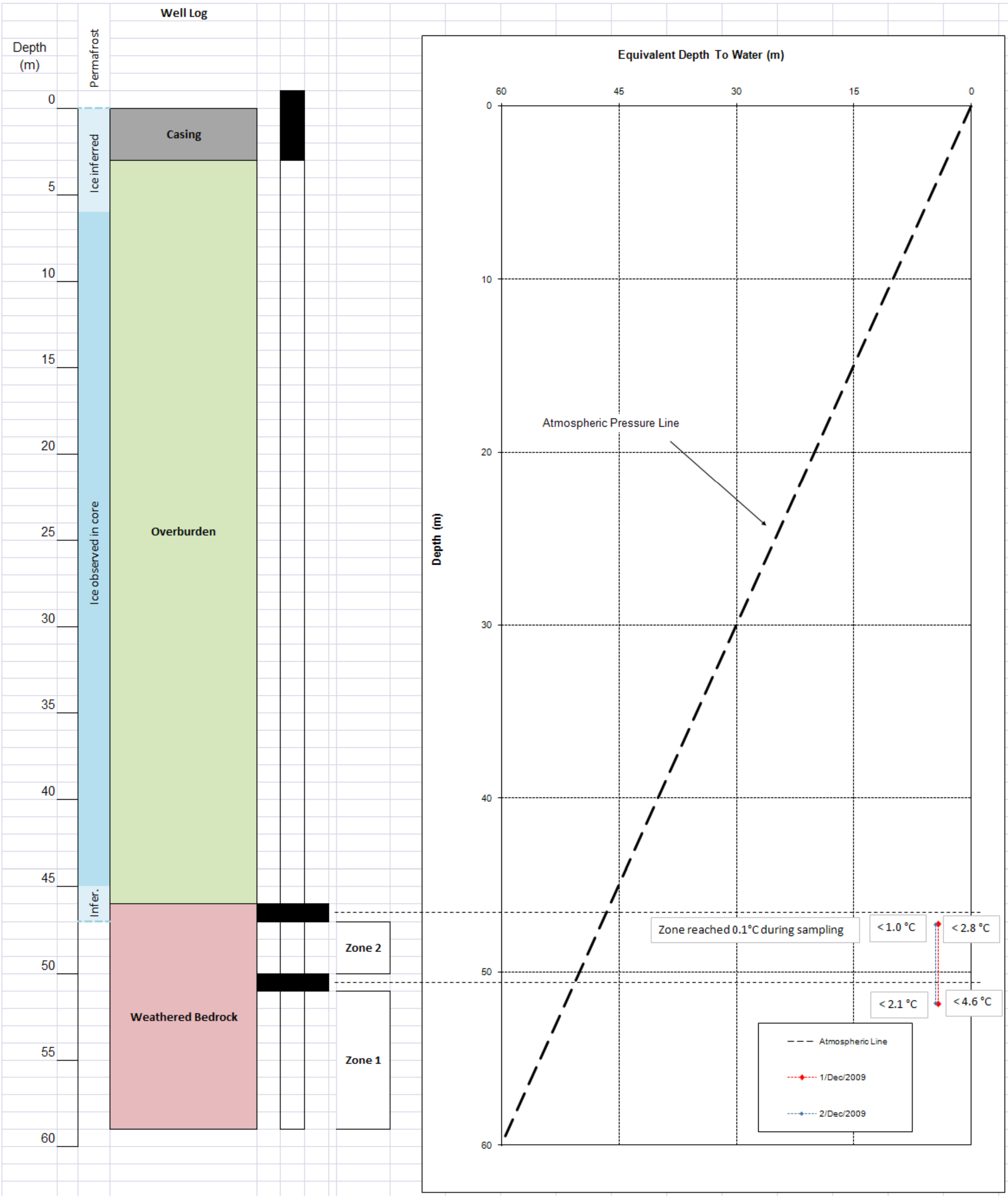


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|---|---|---|---|---|
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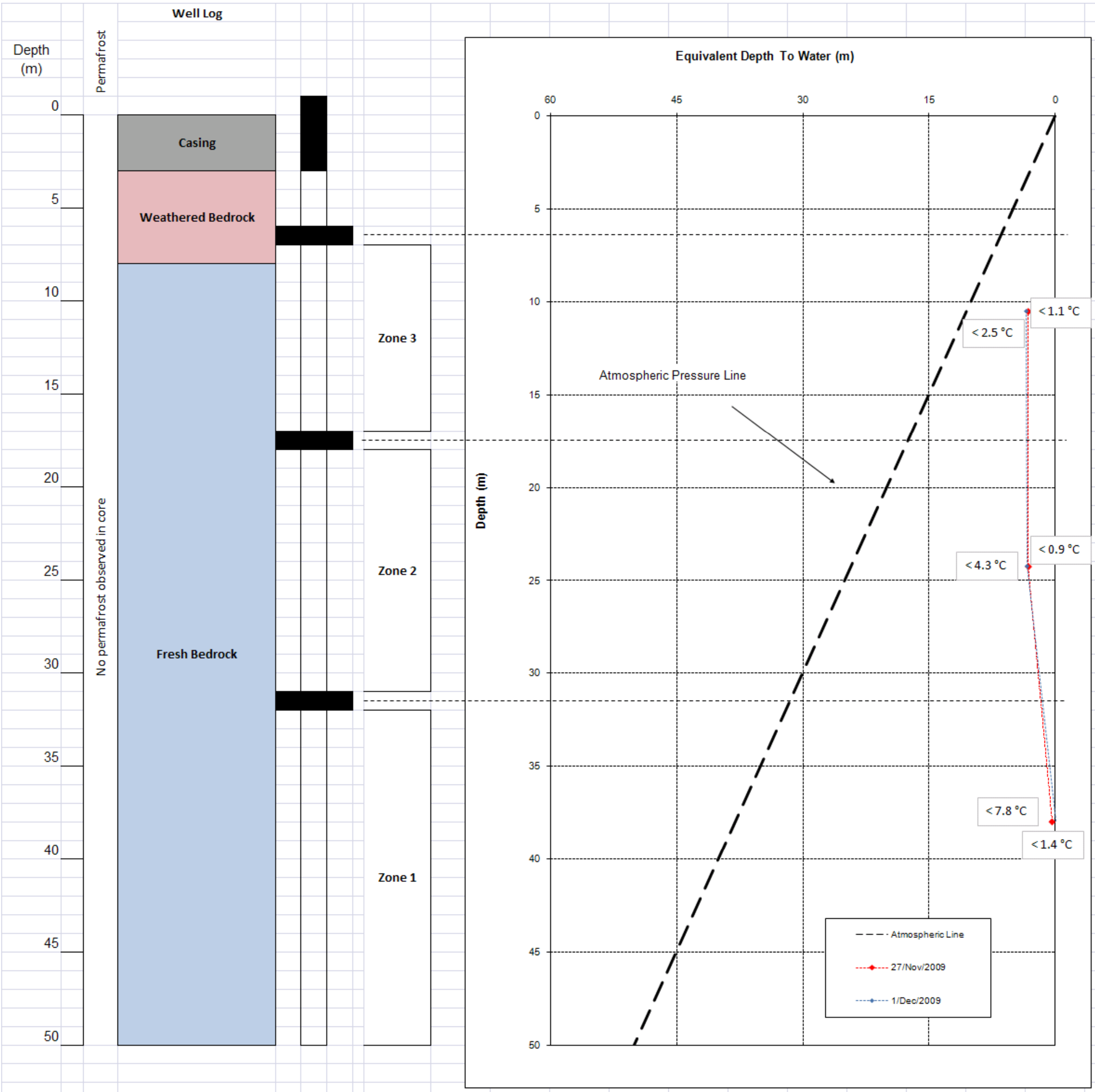


| | | |
|---|---|---|
| SRK Consulting<br>Engineers and Scientists<br>VANCOUVER | **Minto Explorations Ltd.** | **Groundwater Monitoring Locations** |
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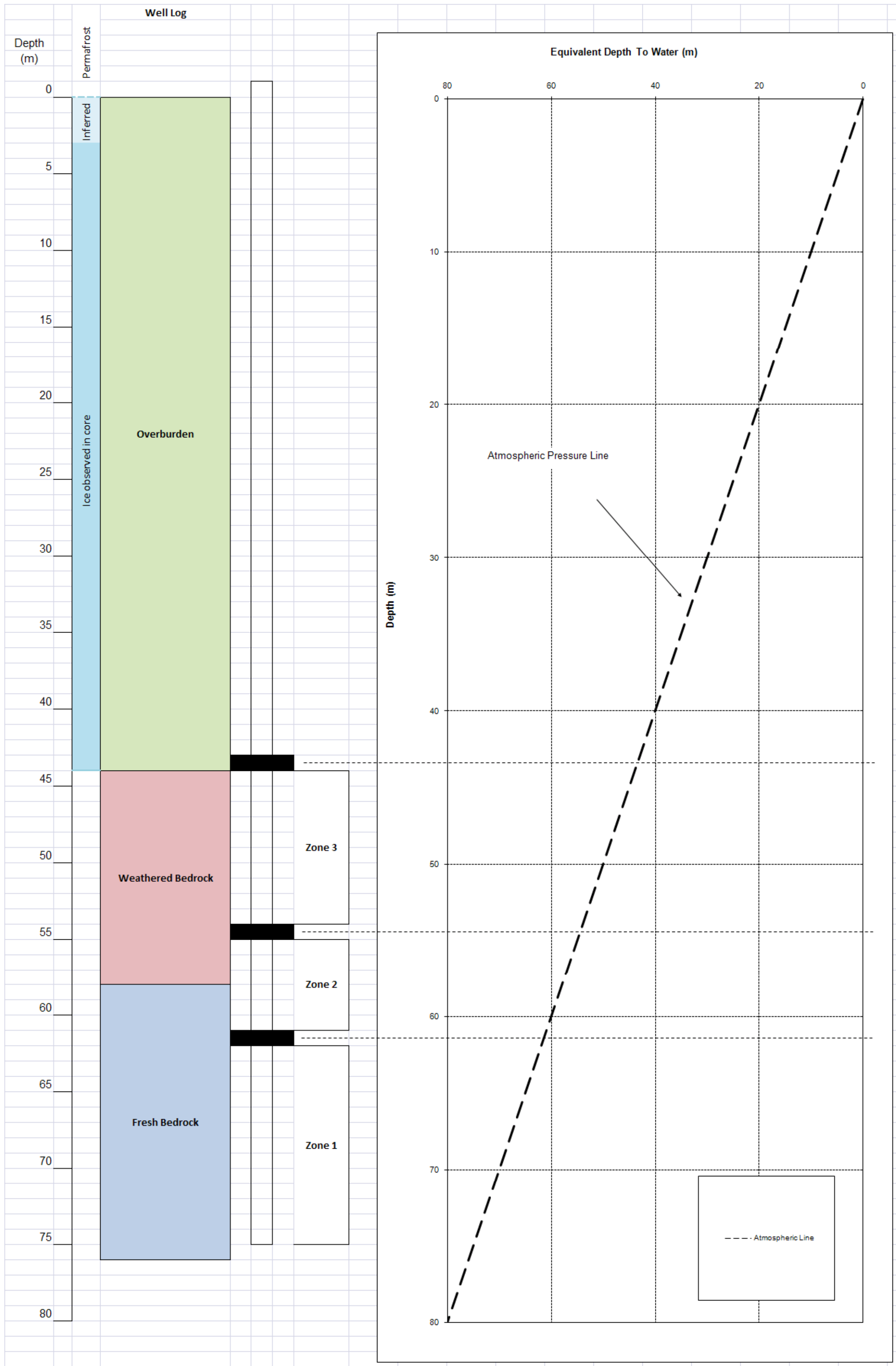


| SRK Consulting<br>Engineers and Scientists<br>VANCOUVER | **Minto Explorations Ltd** | **Groundwater Monitoring Locations** | | |
|---|---|---|---|---|
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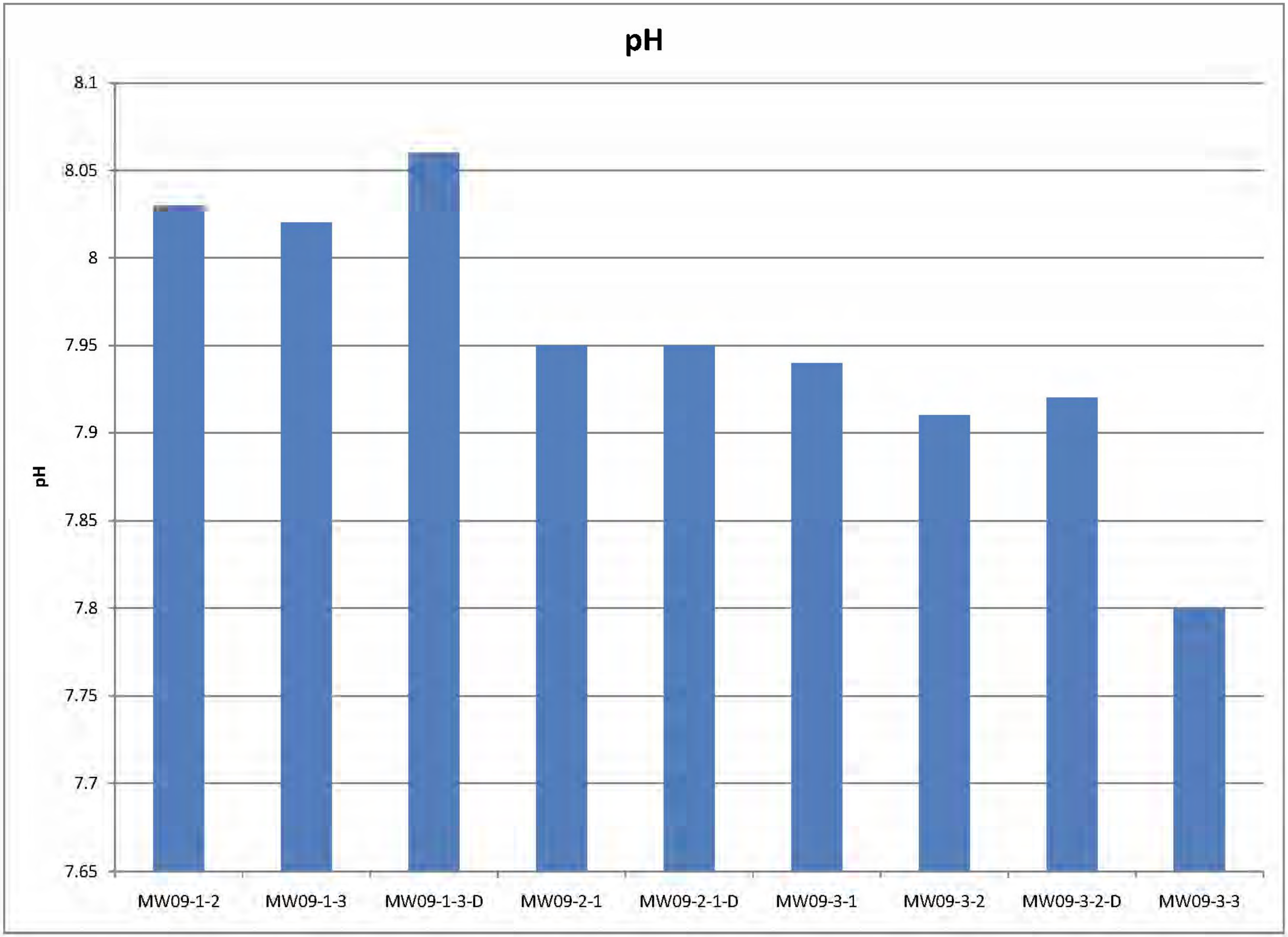
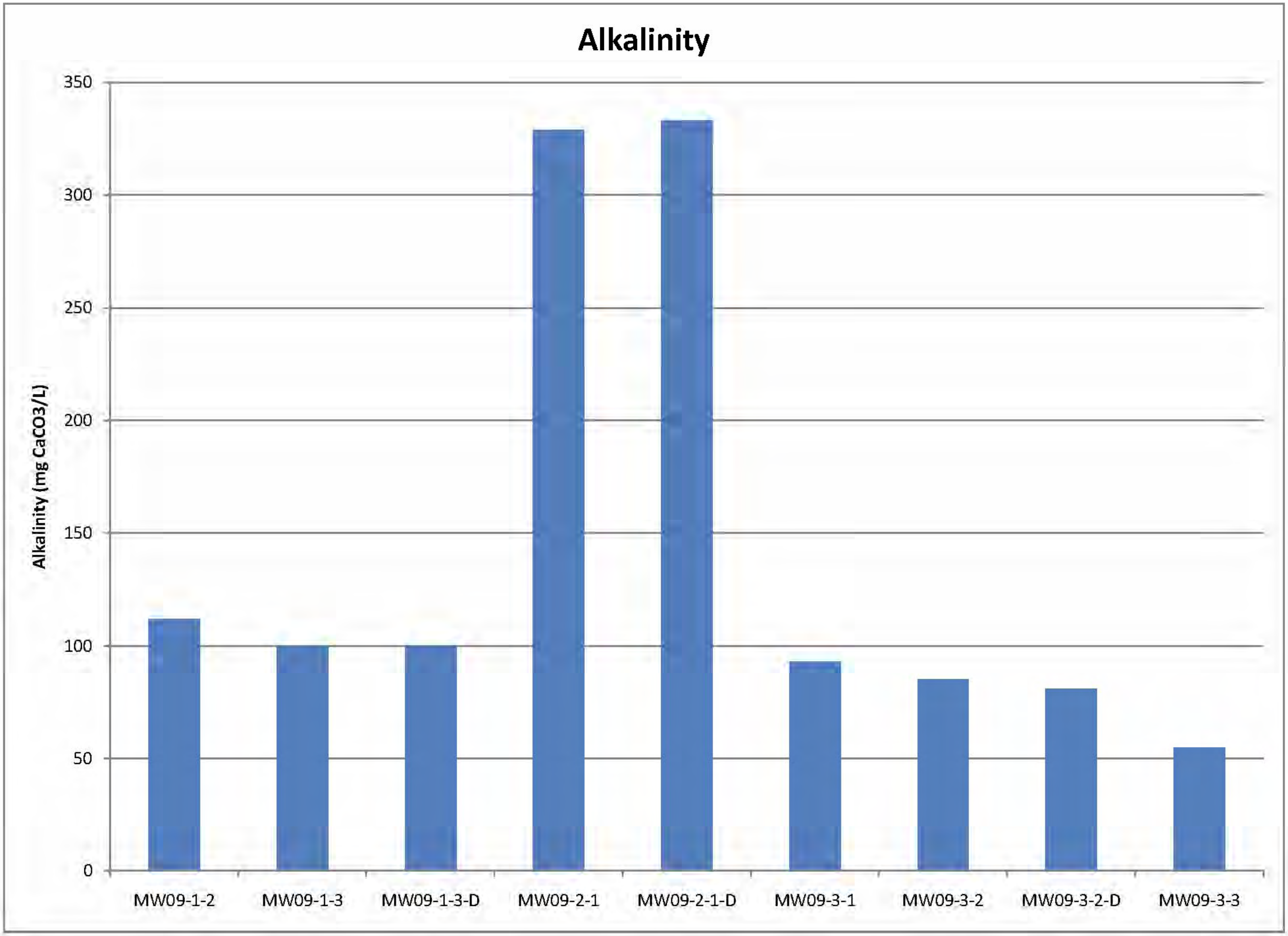
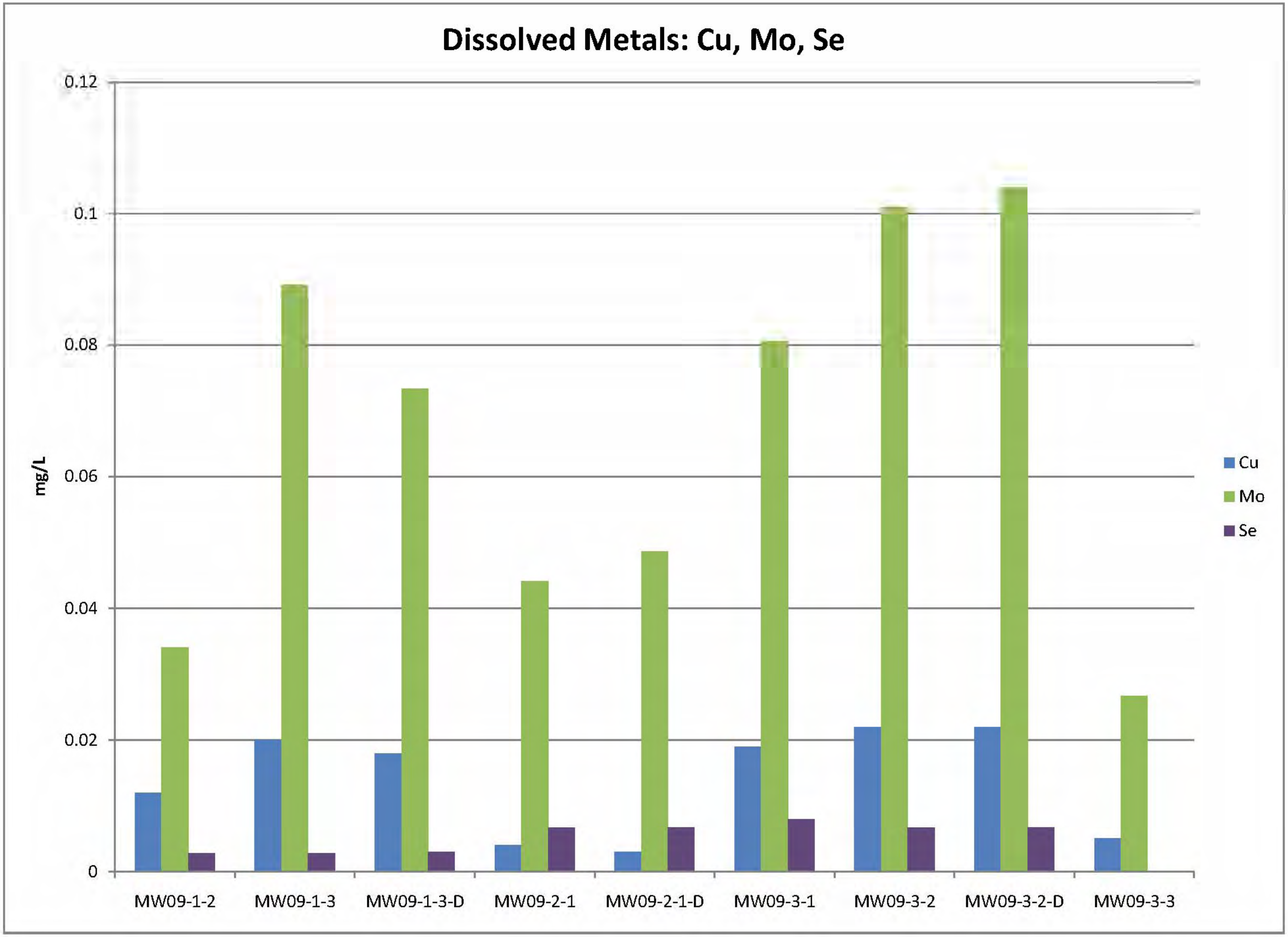



| SRK Consulting<br>Engineers and Scientists<br>VANCOUVER | Minto Explorations Ltd. | Groundwater Monitoring Locations | | |
|---|---|---|---|---|
| Job No: 2CM022.001<br>Filename: Fig 6_pH.ppt | Minto Groundwater Monitoring Plan | Date: February 9, 2010 | Approved: MDR | Figure: 6 |




| | | |
|---|---|---|
| SRK Consulting<br>Engineers and Scientists<br>VANCOUVER | **Minto Explorations Ltd.** | **Groundwater Monitoring Locations** |
| Job No: 2CM022.001<br>Filename: Fig 7_Alkalinity.ppt | Minto Groundwater Monitoring Plan | Date: February 9, 2010 \| Approved: MDR \| Figure: **7** |

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|---|---|---|
| SRK Consulting<br>Engineers and Scientists<br>VANCOUVER | **Minto Explorations Ltd.** | **Groundwater Monitoring Locations** |
| Job No: 2CM022.001<br>Filename: Fig 8_pH.ppt | Minto Groundwater Monitoring Plan | Date: February 9, 2010<br>Approved: MDR<br>Figure: **8** |

# Appendix A
## Drillhole Logs

# MW09-1

overburden | weathered bedrock | fresh bedrock

## Geotechnical log (basic+)

* 10ft rods were used, with 5ft core barrel,
HQ3 bit, with split tubes; casing depth 10ft

| Run # | Run Interval From | To | From | To | TCR | | | | | | | | | | | IRS | | | | comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ft | ft | m | m | ft | inches | decimal ft | m | % | | | | | | | strong | weak | | | |
| 1 | **10** | **15** | 3.05 | 4.57 | 1.5 | | 1.50 | 0.46 | 30 | | | | | | | | | | | |
| 2 | **15** | **20** | 4.57 | 6.10 | 2 | | 2.00 | 0.61 | 40 | | | | | | | | | | | |
| 3 | **20** | **25** | 6.10 | 7.62 | 3 | 2 | 3.17 | 0.97 | 63 | | | | | | | S2 | | | | |
| 4 | **25** | **30** | 7.62 | 9.14 | 1.5 | | 1.50 | 0.46 | 30 | | | | | | | S3 | | | | diamicton material (possibly reworked till) |
| 5 | **30** | **35** | 9.14 | 10.67 | 1 | | 1.00 | 0.30 | 20 | | | | | | | | | | | |
| 6 | **35** | **40** | 10.67 | 12.19 | 1 | 3 | 1.25 | 0.38 | 25 | | | | | | | | | | | |
| 7 | **40** | **45** | 12.19 | 13.72 | | 8 | 0.67 | 0.20 | 13 | | | | | | | | | | | |
| 8 | **45** | **50** | 13.72 | 15.24 | 0 | | 0.00 | 0.00 | 0 | | | | | | | | | | | |
| 9 | **50** | **55** | 15.24 | 16.76 | 1 | 9 | 1.75 | 0.53 | 35 | | | | | | | | | | | |
| 10 | **55** | **60** | 16.76 | 18.29 | 2 | 10 | 2.83 | 0.86 | 57 | | | | | | | S1 | | | | |
| 11 | **60** | **65** | 18.29 | 19.81 | | 5 | 0.42 | 0.13 | 8 | | | | | | | | | | | |
| 12 | **65** | **70** | 19.81 | 21.34 | | 5 | 0.42 | 0.13 | 8 | | | | | | | | | | | |
| 13 | **70** | **75** | 21.34 | 22.86 | 1 | | 1.00 | 0.30 | 20 | | | | | | | | | | | |
| 14 | **75** | **77.5** | 22.86 | 23.62 | 4.5 | | 4.50 | 1.37 | 180 | | | | | | | | | | | sluff from drilling (c.sand), not actual recovery |
| 15 | **77.5** | **85** | 23.62 | 25.91 | 2.5 | | 2.50 | 0.76 | 33 | | | | | | | | | | | overburden bottom |

| Run # | Run Interval From | To | From | To | TCR | | | | | OF | J | CJ | +J from RZ | RQD | | IRS | | micro def. | J - properties | comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ft | ft | m | m | ft | inches | decimal ft | m | % | | | | | cm | % | strong | weak | 0 to 3 | | |
| 16 | **85** | **88** | 25.91 | 26.82 | 3.5 | | 3.50 | 1.07 | 117 | 10 | 10 | | | 0.70 | 66% | R3 | | | rusty colour fill + clay, J surface rough undulating | weathered bedrock, jointed, altered near joints and stained, but fresh away from joints, high FF |
| 18 | **88** | **97** | 26.82 | 29.57 | 3 | 6 | 3.50 | 1.07 | 39 | | | | | | 65% | R3 | | | | poor recovery |
| 19 | **97** | **100** | 29.57 | 30.48 | 3 | | 3.00 | 0.91 | 100 | 10 | 10 | | | 0.56 | 61% | R3 | | | | |
| 20 | **100** | **105** | 30.48 | 32.00 | 5 | | 5.00 | 1.52 | 100 | 7 | 6 | | | | 90% | R4 | R0 | | at 104.6ft v.weathered near Js, R0 near Js, clay in Js, orange colour | |
| 21 | **105** | **110** | 32.00 | 33.53 | 5 | | 5.00 | 1.52 | 100 | 8 | 7 | 1 | | | 90% | R4 | | | same as above | |
| 22 | **110** | **115** | 33.53 | 35.05 | 5 | | 5.00 | 1.52 | 100 | 18 | 14 | 3 | | 1.20 | 79% | R4 | R0 | | same as above | 10 cm R0 zone at 112.5ft |
| 23 | **115** | **120** | 35.05 | 36.58 | 5 | | 5.00 | 1.52 | 100 | 11 | 7 | | | | 60% | R4 | | | same as above | Qz vein present |
| 24 | **120** | **125** | 36.58 | 38.10 | 5 | | 5.00 | 1.52 | 100 | 8 | 7 | | | 1.40 | 92% | R4 | | | high weathering at 3 J's; other Js only stained rusty or black | felsic dike present at 120.3ft |
| 25 | **125** | **130** | 38.10 | 39.62 | 5 | | 5.00 | 1.52 | 100 | 7 | 5 | | | 1.45 | 95% | R4 | | | rusty stained Js | |
| 26 | **130** | **135** | 39.62 | 41.15 | 5 | | 5.00 | 1.52 | 100 | 12 | 12 | | | 1.25 | 82% | R4 | | | rusty stained Js | |
| 27 | **135** | **140** | 41.15 | 42.67 | 5 | | 5.00 | 1.52 | 100 | 7 | 5 | | | 1.47 | 96% | R4 | | | rusty stained Js, or weathered Js | |
| 28 | **140** | **145** | 42.67 | 44.20 | 4 | 9 | 4.75 | 1.45 | 95 | 8 | 5 | | | | 100% | R4 | | | black or rusty staining on Js | |
| 29 | **145** | **150** | 44.20 | 45.72 | 5 | | 5.00 | 1.52 | 100 | 6 | 4 | 2 | | 1.35 | 89% | R4 | | | black staining on Js | pink alteration colour at 148ft |
| 30 | **150** | **155** | 45.72 | 47.24 | 5 | | 5.00 | 1.52 | 100 | 7 | 6 | 2 | | 1.40 | 92% | R4 | | | clean J walls, no weathering | |
| 31 | **155** | **160** | 47.24 | 48.77 | 5 | | 5.00 | 1.52 | 100 | 8 | 7 | | | 1.25 | 82% | R4 | | | rusty/black stained Js, some weathered J walls | |
| 32 | **160** | **165** | 48.77 | 50.29 | 5 | | 5.00 | 1.52 | 100 | 4 | | | | | 100% | R4 | | | rusty/black staining | EOH |

# MW09-1

## Overburden Properties

* core runs with the same properties were combined

| Domain interval | | | | description | permafrost | samples | clay plasticity | clay hardness | |
|---|---|---|---|---|---|---|---|---|---|
| From | To | From | To | | | | | description (as found) | ISRM code |
| ft | ft | m | m | | | | | | |
| 10 | 25 | 3.05 | 7.62 | artificial fill of cobbles, boulders, gravel, soil/reworked till | core hot from drilling, cannot determine ice presence in this borehole | | | soft | S2 |
| 25 | 30 | 7.62 | 9.14 | fill: brown moit clayey sand (f-c), with f.gravel (angular) + c.gravel pieces, crumbly | | S1 at 29.5ft | | | |
| 30 | 55 | 9.14 | 16.76 | fill: cobbles, boulders, gravel (voids found during drilling), fine gr. materials washed out if present | | | medium to low | very soft (reworked by drilling process) | S1 |
| 55 | 60 | 16.76 | 18.29 | grey moist/wet diamict with silty clay matrix, containing angular to sub-round gravel, broken sharp rock pieces, and coarse sand | | S2 at 59.5 ft | medium to low | very soft (reworked by drilling process) | S1 |
| 65 | 70 | 19.81 | 21.34 | grey/white wet clean sub round to ang fine gravel | | | | | |
| 70 | 75 | 21.34 | 22.86 | sandy clay and grey wet clayey f-med sand with f-c gravel, sub ang to round | | | low | very soft (reworked by drilling process) | S1 |
| 75 | 85 | 22.86 | 25.91 | m. gravel, rounded to sub ang, trace silt/clay (washed out) | | | | | |

**clay hardness - quantitative measurements**

| Tor Vane (* 0.1 kg/cm$^2$) | Penetrometer (kg/cm$^2$) | Tor Vane (MPa) | Penetrometer (MPa) |
|---|---|---|---|
| | | | |
| | | | |
| 1.1 | | 0.01 | |
| 1.1 | | 0.01 | |
| | | | |
| 0.8 | | 0.01 | |
| | | | |

**ISRM Standard - Field Estimate of Rock Strength**

| Index | Description | Field Test | ~ UCS (MPa) |
|---|---|---|---|
| **S1** | Very Soft Clay | Easily penetrated by fist (flows between fingers) | < 0.025 |
| **S2** | Soft Clay | Easily penetrated by thumb (>1") | 0.025 - 0.05 |
| **S3** | Firm Clay | Penetrated by thumb with moderate effort (>1") | 0.05 - 0.10 |
| **S4** | Stiff Clay | Indented by thumb but penetrated with great effort | 0.10 - 0.25 |
| **S5** | Very Stiff Clay | Readily indented with thumbnail | 0.25 - 0.50 |
| **S6** | Hard Clay | Indented with difficulty by thumbnail | > 0.50 |
| **R0** | Extremely Weak | indented by thumbnail, crumbles under soft blow of blunt end of hammer; breaks apart when crushed by fingers | 0.25 - 1.0 |
| **R1** | Very Weak | crumbles under firm blow of geologic hammer pick; peeled by knife | 1.0 - 5.0 |
| **R2** | Weak | shallow indentation under firm blow of pick end of geologic hammer | 5.0 - 25 |
| **R3** | Medium Strong | fractured with single firm blow of geologic hammer | 25 - 50 |
| **R4** | Strong | requires more than one blow of hammer to fracture | 50 - 100 |
| **R5** | Very Strong | requires many blows of hammer to fracture | 100 - 250 |
| **R6** | Extremely Strong | can only be chipped with strong blows of hammer | > 250 |

# MW09-2

overburden | weathered bedrock | fresh bedrock

## Geotechnical log (basic+)

* 10ft rods were used, with 5ft core barrel,
HQ3 bit, with split tubes; casing depth 10ft

| Run # | Run Interval From | To | From | To | TCR | | | | | OF | J | CJ | +J from RZ | RQD | | IRS | | micro def. | J - properties | comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ft | ft | m | m | ft | inches | decimal ft | m | % | | | | | cm | % | strong | weak | 0 to 3 | | |
| 1 | **10** | **15** | 3.05 | 4.57 | 1.5 | | 1.50 | 0.46 | 30 | | | | | | 0% | | | | | |
| 2 | **15** | **17** | 4.57 | 5.18 | 2 | 6 | 2.50 | 0.76 | 125 | | | | | | 0% | | | | | |
| 3 | **17** | **25** | 5.18 | 7.62 | 5 | 3 | 5.25 | 1.60 | 66 | | | | | | 0% | S4 | | | | |
| 4 | **25** | **30** | 7.62 | 9.14 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | | | | | |
| 5 | **30** | **35** | 9.14 | 10.67 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S5 | | | | |
| 6 | **35** | **40** | 10.67 | 12.19 | 4 | 10 | 4.83 | 1.47 | 97 | | | | | | 0% | S4 | | | | |
| 7 | **40** | **45** | 12.19 | 13.72 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 8 | **45** | **50** | 13.72 | 15.24 | 5 | 2 | 5.17 | 1.57 | 103 | | | | | | 0% | S4 | | | | |
| 9 | **50** | **55** | 15.24 | 16.76 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 10 | **55** | **60** | 16.76 | 18.29 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 11 | **60** | **65** | 18.29 | 19.81 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 12 | **65** | **70** | 19.81 | 21.34 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S5 | | | | |
| 13 | **70** | **75** | 21.34 | 22.86 | 4 | | 4.00 | 1.22 | 80 | | | | | | 0% | S5 | | | | |
| 14 | **75** | **80** | 22.86 | 24.38 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S5 | | | | |
| 15 | **80** | **85** | 24.38 | 25.91 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S5 | | | | |
| 16 | **85** | **90** | 25.91 | 27.43 | 3.5 | | 3.50 | 1.07 | 70 | | | | | | 0% | S5 | | | | |
| 18 | **90** | **95** | 27.43 | 28.96 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S5 | | | | |
| 19 | **95** | **100** | 28.96 | 30.48 | 2 | 3 | 2.25 | 0.69 | 45 | | | | | | 0% | S5 | | | | |
| 20 | **100** | **105** | 30.48 | 32.00 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S5 | | | | |
| 21 | **105** | **110** | 32.00 | 33.53 | 3.5 | | 3.50 | 1.07 | 70 | | | | | | 0% | S5 | | | | |
| 22 | **110** | **115** | 33.53 | 35.05 | 0 | | 0.00 | 0.00 | 0 | | | | | | | S5 | | | | |
| 23 | **115** | **120** | 35.05 | 36.58 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S5 | | | | |
| 24 | **120** | **125** | 36.58 | 38.10 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S3 | | | | |
| 25 | **125** | **130** | 38.10 | 39.62 | 5 | 2 | 5.17 | 1.57 | 103 | | | | | | 0% | S3 | | | | |
| 26 | **130** | **135** | 39.62 | 41.15 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 27 | **135** | **140** | 41.15 | 42.67 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S5 | S4 | | | |
| 28 | **140** | **145** | 42.67 | 44.20 | 4 | | 4.00 | 1.22 | 80 | | | | | | 0% | S3 | | | | |
| 29 | **145** | **150** | 44.20 | 45.72 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | | | | | |
| 30 | **150** | **155** | 45.72 | 47.24 | 5 | | 5.00 | 1.52 | 100 | | 38 | | 38 | | 0% | R0 | | | | |
| 31 | **155** | **160** | 47.24 | 48.77 | 0.5 | | 0.50 | 0.15 | 10 | | 6 | | 6 | | 0% | R0 | | | | grey brown highly weahered curmbly / jointed rock |
| 32 | **160** | **165** | 48.77 | 50.29 | 4.9 | | 4.90 | 1.49 | 98 | | 30 | | 30 | | 0% | R2 | R0 | | stained J's, smooth, no gouge | R0 crumbly to 163ft, then weak jointed |
| 33 | **165** | **170** | 50.29 | 51.82 | 5 | | 5.00 | 1.52 | 100 | 6 | 25 | | 20 | | 0% | R2 | R0 | | red stained J's, weathered at J's | highly weathered rock |
| 34 | **170** | **173** | 51.82 | 52.73 | 2 | | 2.00 | 0.61 | 67 | | 16 | | 16 | | 0% | R2 | R0 | | red stained J's, weathered at J's | highly weathered rock |
| 35 | **173** | **178** | 52.73 | 54.25 | 1 | 11 | 1.92 | 0.58 | 38 | 5 | 25 | | 20 | | 0% | R2 | R0 | | red stained J's, weathered at J's | highly weathered rock + one Qz vein |
| 36 | **178** | **180** | 54.25 | 54.86 | | 9 | 0.75 | 0.23 | 38 | 4 | 8 | | 4 | | 0% | R3 | R0 | | black staining | highly weathered rock |
| 37 | **180** | **185** | 54.86 | 56.39 | | 10 | 0.83 | 0.25 | 17 | | 32 | | 32 | | 0% | R0 | | | | highly weathered rock |
| 38 | **185** | **190** | 56.39 | 57.91 | | 9 | 0.75 | 0.23 | 15 | 4 | 4 | | | | 0% | R1 | | | | broken Qz pieces of Qz vein included |
| 39 | **190** | **195** | 57.91 | 59.44 | 1 | 8 | 1.67 | 0.51 | 33 | | 40 | | 40 | | 0% | R0 | | | red stained J's | |

# MW09-2

## Overburden Properties

* core runs with the same properties were combined

* descriptions were modified to match quantitative measurements (TorVane and Penetrometer)

** reworked clay (by drill bit) that is caked around harder inner core was ignored here - this soft watery clay does not represent in-situ conditions and is softened by drilling process

| Domain interval | | | | description | permafrost | samples | clay plasticity | clay hardness | | |
|---|---|---|---|---|---|---|---|---|---|---|
| From | To | From | To | | | | | description (as found, usually frozen) | thawed only | ISRM code |
| ft | ft | m | m | | | | | | | |
| 10.0 | 15.0 | 3.05 | 4.57 | wet black/white subangular crs gravel (crs grained rock), rusty staining | N/A | | | | | |
| 15.0 | 20.0 | 4.57 | 6.10 | grey wet clay | N/A (core hot from drilling) | | low-med | | | |
| 20.0 | 20.5 | 6.10 | 6.25 | grey moist clay with organic debris, fine gravel (sub round) | N/A | | | | | |
| 20.5 | 24.0 | 6.25 | 7.32 | dark grey-black frozen soil/clay with ice intervals | ice inclusions Nbe/Vr and some solid ice intervals | | med-high | stiff | | S4 |
| 24.0 | 25.0 | 7.32 | 7.62 | light grey-brown silty clay, with crs gravel (angular clastsa at 25ft depth) | ice in clay | S1 at 22ft | | stiff | | S4 |
| 25.0 | 27.0 | 7.62 | 8.23 | brown-grey frozen silty clay, with ice inclusions | ice inclusions (Vt) | | | | | |
| 27.0 | 28.0 | 8.23 | 8.53 | cobbles with frozen clay matrix | frozen | | | | | |
| 28.0 | 30.0 | 8.53 | 9.14 | grey frozen clayey fine sand with silt with ice inclusions | ice inclusions | | | | | |
| 30.0 | 32.0 | 9.14 | 9.75 | grey-brown clay with crs.sand and f.gravel (sub ang) | N/A | S2 at 31ft | med | | | |
| 32.0 | 34.5 | 9.75 | 10.52 | ice with dark grey frozen clay inclusions, with silt and sand | ice w clay inclusions | | low-med | | | |
| 34.5 | 35.0 | 10.52 | 10.67 | grey frozen clay, some ice | some ice | | med-high | v.stiff | | S5 |
| 35.0 | 50.0 | 10.67 | 15.24 | ice with grey clay inclusions | 70 to 85% ice | S3 at 45ft | high | stiff | | S4 |
| 50.0 | 60.0 | 15.24 | 18.29 | ice with grey clay inclusions, more firm clay between ice | 50 to 70% ice | S4 at 60ft | med-high | stiff | | S4 |
| 60.0 | 65.0 | 18.29 | 19.81 | ice with dark grey clay inclusions, 20cm frozen clay layers (no ice), cut with pure ice intervals | frozen | | mod-high | stiff | firm | S4 |
| 65.0 | 70.0 | 19.81 | 21.34 | dark grey frozen clay with ice inclusions | <20% ice, Vc/Vx | | mod | v.stiff | firm-stiff | S5 |
| 70.0 | 80.0 | 21.34 | 24.38 | dark grey frozen clay with ice inclusions | 30% ice in large veins and smaller ice flakes in clay (Vc/Vs) | S5 at 77ft | mod-high | v.stiff | firm | S5 |
| 80.0 | 100.0 | 24.38 | 30.48 | dark grey frozen clay with ice inclusions | few ice inclusions, but some up to 5cm clear ice, big Vc/Vx | S6 at 89ft | high | v.stiff | firm-stiff | S5 |
| 100.0 | 120.0 | 30.48 | 36.58 | ice with frozen grey clay, and smaller ice inclusions in clay; near 110ft trace med. angular gravel | 70% pure ice, especially from 102.5 to 105ft, some Vr ice incl in clay where clay dominant | S7 at 107ft | high | v.stiff | stiff | S5 |
| 120.0 | 125.0 | 36.58 | 38.10 | grey moist clay with small lenses of clayey crs sand, trace f. gravel (sub round) | N/A | S8 at 120ft | high | | firm-stiff | S3 |
| 125.0 | 128.0 | 38.10 | 39.01 | grey frozen clay with f. sand, tracel sub.ang. f. gravel, and minor ice inclusions | Vt, small veins of ice | | | firm | v.soft | S3 |
| 128.0 | 129.0 | 39.01 | 39.32 | frozen clay with sub.ang. to sub.round. f.gravel, with ice inclusions | Vx (minor) | | | | | |
| 129.0 | 132.0 | 39.32 | 40.23 | frozen clay with clayey f. sand interbeds, with trace gravel | Vx (minor) | S9 at 130ft | | stiff | firm | S4 |
| 132.0 | 134.0 | 40.23 | 40.84 | frozen clay diamict (with sand and f. gravel) | 5% ice, Vx | | | stiff | firm | S4 |
| 134.0 | 135.0 | 40.84 | 41.15 | grey-brown compacted frozen clayey fine sand with ice inclusions | Vx (minor) | | | v.stiff | | S5 |
| 135.0 | 138.0 | 41.15 | 42.06 | interbeds of brown med.sand (with trace clay + f.gravel) AND grey clay with ice inclusions | Vx | S10 at 137ft | mod | v.stiff | firm | S5 |
| 138.0 | 139.0 | 42.06 | 42.37 | frozen clay diamict (with sand and f. gravel - angular) with ice inclusions | minor ice incl. | | | stiff | firm | S4 |
| 139.0 | 139.5 | 42.37 | 42.52 | moist grey clay with f.sand | N/A | | low (crumbly) | | firm | |
| 139.5 | 142.7 | 42.52 | 43.49 | brown frozen slightly clayey f.-crs. sand, with ang.f.gravel | water in sand frozen holding sand grains together, when thawed sand is loose | | | | | |
| 142.7 | 143.0 | 43.49 | 43.59 | clay diamict (f.sand - f.ang-sub.round gravel) | N/A | | med | firm | soft | S3 |
| 143.0 | 144.5 | 43.59 | 44.04 | brown sandy clay (f.-crs. sand) | N/A | | | firm | soft | S3 |
| 144.5 | 145.0 | 44.04 | 44.20 | grey clay with f.sand | N/A | S11 at 144ft | low | firm | soft | S3 |
| 145.0 | 147.0 | 44.20 | 44.81 | grey frozen silty clay w. trace c.sand and f.gravel | frozen | | low | stiff | | |
| 147.0 | 148.0 | 44.81 | 45.11 | brown moist clay with f-crs. sand and silt, res. sand lens (clean) at 148ft (2cm) | N/A | | low | | firm | |
| 148.0 | 150.0 | 45.11 | 45.72 | interbeds of silty clay, f.silty sand, and clayeye crs. sand | N/A | | med | | | |
| 150.0 | 155.0 | 45.72 | 47.24 | frozen coarse grained weathered bedrock fragments (crs.sand to f.gravel size), Qz frags, trace clay | rock core is cold inside but any ice was melted during drilling process and cannot assess | S12 at 153ft | | | | R0 |
| 155.0 | 195.0 | 47.24 | 59.44 | highly weathered crumbly very weak grey-brown/orange-brown stained rock, some joint structures preserved but mostly decomposed | rock core is cold inside and warm outside (from drilling) so its probably that it is frozen to this depth | | | | | R0 |

clay hardness - quantitative measurements

| From (ft) | To (ft) | Tor Vane (* 0.1 kg/cm$^2$) frozen min | frozen max | thawed min | thawed max | Penetrometer (kg/cm$^2$) frozen min | frozen max | thawed min | thawed max |
|---|---|---|---|---|---|---|---|---|---|
| 10.0 | 15.0 | | | | | | | | |
| 15.0 | 20.0 | | | | | | | | |
| 20.0 | 20.5 | | | | | | | | |
| 20.5 | 24.0 | | | | | | | | |
| 24.0 | 25.0 | | | | | | | | |
| 25.0 | 27.0 | | | | | | | | |
| 27.0 | 28.0 | | | | | | | | |
| 28.0 | 30.0 | | | | | | | | |
| 30.0 | 32.0 | | | | | | | | |
| 32.0 | 34.5 | | | | | | | | |
| 34.5 | 35.0 | | | | | 4.6 | | | |
| 35.0 | 50.0 | | | | | | | | |
| 50.0 | 60.0 | 10.0 | | | | 2.0 | | | |
| 60.0 | 65.0 | | | | | 2.5 | 3.5 | | |
| 65.0 | 70.0 | 9.5 | | | | 3.5 | | | |
| 70.0 | 80.0 | | | | | 3.0 | 5.0 | | |
| 80.0 | 100.0 | | | | | 3.0 | 4.5 | 1.0 | 2.0 |
| 100.0 | 120.0 | | | | | 5.0 | | 1.5 | 2.8 |
| 120.0 | 125.0 | | | 5.0 | 9.0 | | | 0.7 | 3.5 |
| 125.0 | 128.0 | | | | | | | 1.0 | 2.0 |
| 128.0 | 129.0 | | | | | | | | |
| 129.0 | 132.0 | | | | | 2.0 | | | |
| 132.0 | 134.0 | | | | | | | | |
| 134.0 | 135.0 | | | | | | | | |
| 135.0 | 138.0 | | | 5.5 | | 5.0 | | 1.0 | 1.5 |
| 138.0 | 139.0 | | | | | | | | |
| 139.0 | 139.5 | | | | | | | | |
| 139.5 | 142.7 | | | | | | | | |
| 142.7 | 143.0 | 4.5 | | | | | | | |
| 143.0 | 144.5 | 3.0 | | | | | | | |
| 144.5 | 145.0 | 4.0 | | | | | | | |
| 145.0 | 147.0 | | | | | | | | |
| 147.0 | 148.0 | | | | | | | | |
| 148.0 | 150.0 | | | | | | | | |
| 150.0 | 155.0 | | | | | | | | |
| 155.0 | 195.0 | | | | | | | | |

| From (ft) | To (ft) | Tor Vane (MPa) frozen min | frozen max | thawed min | thawed max | Penetrometer (MPa) frozen min | frozen max | thawed min | thawed max |
|---|---|---|---|---|---|---|---|---|---|
| 10.0 | 15.0 | | | | | | | | |
| 15.0 | 20.0 | | | | | | | | |
| 20.0 | 20.5 | | | | | | | | |
| 20.5 | 24.0 | | | | | | | | |
| 24.0 | 25.0 | | | | | | | | |
| 25.0 | 27.0 | | | | | | | | |
| 27.0 | 28.0 | | | | | | | | |
| 28.0 | 30.0 | | | | | | | | |
| 30.0 | 32.0 | | | | | | | | |
| 32.0 | 34.5 | | | | | | | | |
| 34.5 | 35.0 | | | | | 0.45 | | | |
| 35.0 | 50.0 | | | | | | | | |
| 50.0 | 60.0 | 0.10 | | | | 0.20 | | | |
| 60.0 | 65.0 | | | | | 0.25 | 0.34 | | |
| 65.0 | 70.0 | 0.09 | | | | 0.34 | | | |
| 70.0 | 80.0 | | | | | 0.29 | 0.49 | | |
| 80.0 | 100.0 | | | | | 0.29 | 0.44 | 0.10 | 0.20 |
| 100.0 | 120.0 | | | | | 0.49 | | 0.15 | 0.27 |
| 120.0 | 125.0 | | | 0.05 | 0.09 | | | 0.07 | 0.34 |
| 125.0 | 128.0 | | | | | | | 0.10 | 0.20 |
| 128.0 | 129.0 | | | | | | | | |
| 129.0 | 132.0 | | | | | 0.20 | | | |
| 132.0 | 134.0 | | | | | | | | |
| 134.0 | 135.0 | | | | | | | | |
| 135.0 | 138.0 | | | 0.05 | | 0.49 | | 0.10 | 0.15 |
| 138.0 | 139.0 | | | | | | | | |
| 139.0 | 139.5 | | | | | | | | |
| 139.5 | 142.7 | | | | | | | | |
| 142.7 | 143.0 | 0.04 | | | | | | | |
| 143.0 | 144.5 | 0.03 | | | | | | | |
| 144.5 | 145.0 | 0.04 | | | | | | | |
| 145.0 | 147.0 | | | | | | | | |
| 147.0 | 148.0 | | | | | | | | |
| 148.0 | 150.0 | | | | | | | | |
| 150.0 | 155.0 | | | | | | | | |
| 155.0 | 195.0 | | | | | | | | |

# MW09-3

overburden | weathered bedrock | fresh bedrock

## Geotechnical log (basic+)

* 10ft rods were used, with 5ft core barrel, HQ3 bit, with split tubes; casing depth 10ft

| Run # | Run Interval | | | | TCR | | | | | OF | J | CJ | +J from RZ | RQD | | IRS | | micro def. | J - properties | comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | From | To | | | | | | | | | | | | | | | | |
| | ft | ft | m | m | ft | inches | decimal ft | m | % | | | | | cm | % | strong | weak | 0 to 3 | | |
| 1 | **10** | **15** | 3.05 | 4.57 | 3.5 | | 3.50 | 1.07 | 70 | 8 | 28 | 0 | 24 | 15 | 14% | R2 | R0 | 2 | brown stained J's | crumbly R0 zones, highly weathered |
| 2 | **15** | **20** | 4.57 | 6.10 | 3 | 1 | 3.08 | 0.94 | 62 | 7 | 12 | 0 | 6 | 30 | 32% | R3 | R0 | 2 | planar rough, stained, alpha 45 deg | weathered rock, jointed, RZ (15cm) R0, minor Qz vein |
| 3 | **20** | **25** | 6.10 | 7.62 | 5 | | 5.00 | 1.52 | 100 | 13 | 9 | 0 | | 123 | 81% | R3 | | 2 | 7, 4 \| 9 \| 0 staining only; alpha 50 to 60 degrees | weathered rock, jointed |
| 4 | **25** | **30** | 7.62 | 9.14 | 5 | 1 | 5.08 | 1.55 | 102 | 10 | 9 | 0 | | 145 | 94% | R4 | R3 | 1 | 4, 7, 8 \| 1, 3, 0 \| 0 brown non softening fill, alpha 60 to 80 degrees | slithly weathered rock / competent rock |
| 5 | **30** | **35** | 9.14 | 10.67 | 5 | | 5.00 | 1.52 | 100 | 6 | 3 | 0 | | 147 | 96% | R4 | R3 | 0 | 4 to 7 \| 0 \| 0, stained brown-orange | 1 Qz vein |
| 6 | **35** | **40** | 10.67 | 12.19 | 5 | | 5.00 | 1.52 | 100 | 8 | 5 | 0 | | 150 | 98% | R4 | R3 | 0 | 4 to 8 \| 0 \| 0, stained brown-orange, alpha 50 to 70 degrees | |
| 7 | **40** | **45** | 12.19 | 13.72 | 4 | 9 | 4.75 | 1.45 | 95 | 12 | 10 | 0 | | 108 | 75% | R4 | R3 | 0 | 7 \| 0 to 3 \| 0 stained orange, alpha 30 to 70 degrees | slightly altered from 41 to 43' |
| 8 | **45** | **50** | 13.72 | 15.24 | 5 | 3 | 5.25 | 1.60 | 105 | 9 | 7 | 1 | | 148 | 92% | R4 | R3 | 0 | 7 \| 0 \| 0 stained orange, alpha 45 | |
| 9 | **50** | **55** | 15.24 | 16.76 | 5 | | 5.00 | 1.52 | 100 | 6 | 3 | 0 | | 150 | 98% | R5 | R4 | 0 | 4 to 7 \| 0 \| 0, stained, alpha 45 to 70 degrees | |
| 10 | **55** | **60** | 16.76 | 18.29 | 4 | 10.5 | 4.88 | 1.49 | 98 | 7 | 4 | 0 | | 149 | 100% | R5 | R4 | 0 | 4 to 7 \| 0 \| 0, slightly stained | very competent fresh rock, crs grained, 1 large vein |
| 11 | **60** | **65** | 18.29 | 19.81 | 4 | 10.5 | 4.88 | 1.49 | 98 | 6 | 5 | 0 | | 149 | 100% | R5 | R4 | 0 | 4 to 7 \| 0 \| 0, no staining | |
| 12 | **65** | **67** | 19.81 | 20.42 | 2 | 2 | 2.17 | 0.66 | 108 | 5 | 4 | 1 | | 66 | 100% | R5 | R3 | 0 | | competent grey/pink rock (logged from photo) |
| 13 | **67** | **70** | 20.42 | 21.34 | 3 | 6 | 3.50 | 1.07 | 117 | 2 | 1 | 0 | | 100 | 94% | R5 | R4 | 0 | | |
| 14 | **70** | **75** | 21.34 | 22.86 | 4 | 10 | 4.83 | 1.47 | 97 | 6 | 3 | 0 | | 148 | 100% | R5 | R4 | 0 | J walls planar, undulating, rough, brown & altered; alpha 30 to 80 degrees | |
| 15 | **75** | **80** | 22.86 | 24.38 | 4 | 10 | 4.83 | 1.47 | 97 | 6 | 5 | 0 | | 138 | 94% | R5 | R4 | 0 | stained J's | grey brown rock, slightly altered |
| 16 | **80** | **85** | 24.38 | 25.91 | 4 | 7.5 | 4.63 | 1.41 | 93 | 6 | 3 | 0 | | 141 | 100% | R5 | R4 | 0 | all J's weathered with non softening fill, altered J wall; alpha 45 to 90 degrees | fluid flow evidence |
| 18 | **85** | **90** | 25.91 | 27.43 | 5 | 2 | 5.17 | 1.57 | 103 | 4 | 4 | 0 | | 149 | 95% | R5 | R4 | 1 | | |
| 19 | **90** | **95** | 27.43 | 28.96 | 5 | | 5.00 | 1.52 | 100 | 11 | 6 | 4 | | 149 | 98% | R5 | R4 | 1 | 1 J with soft fill 0.5mm brown clay, alpha 15 degrees | |
| 20 | **95** | **100** | 28.96 | 30.48 | 5 | 2 | 5.17 | 1.57 | 103 | 12 | 13 | 0 | 4 | 133 | 84% | R4 | R2 | 0 | 1 J at 99' has 1 cm brown clay gauge fill (alpha 50 degrees) | RZ (10cm) jointed at 96'; R2 rock highly altered, brown from 95-96' |
| 21 | **100** | **105** | 30.48 | 32.00 | 5 | | 5.00 | 1.52 | 100 | 6 | 5 | 1 | | 150 | 98% | R5 | R4 | 0 | | |
| 22 | **105** | **110** | 32.00 | 33.53 | 5 | 2 | 5.17 | 1.57 | 103 | 7 | 5 | 1 | | 146 | 93% | R5 | R4 | 1 | 1 J has 0.5mm soft fill | |
| 23 | **110** | **115** | 33.53 | 35.05 | 5 | 1 | 5.08 | 1.55 | 102 | 10 | 11 | 3 | | 122 | 79% | R5 | R4 | 0 | | mineralization around micro defects at 111.5' |
| 24 | **115** | **120** | 35.05 | 36.58 | 5 | 1 | 5.08 | 1.55 | 102 | 12 | 7 | 1 | | 103 | 66% | R5 | R4 | 1 | hard fill in Js | |
| 25 | **120** | **125** | 36.58 | 38.10 | 5 | 2 | 5.17 | 1.57 | 103 | 12 | 6 | 2 | | 140 | 89% | R5 | R4 | 1 | | |
| 26 | **125** | **130** | 38.10 | 39.62 | 4 | 11 | 4.92 | 1.50 | 98 | 10 | 5 | 1 | | 135 | 90% | R5 | R4 | 1 | 1 J has 2mm soft fill | |
| 27 | **130** | **135** | 39.62 | 41.15 | 5 | | 5.00 | 1.52 | 100 | 14 | 14 | 0 | | 62 | 41% | R5 | R3 | 1 | | |
| 28 | **135** | **140** | 41.15 | 42.67 | 5 | 2 | 5.17 | 1.57 | 103 | 8 | 6 | 1 | | 141 | 90% | R5 | R4 | 1 | | |
| 29 | **140** | **145** | 42.67 | 44.20 | 5 | | 5.00 | 1.52 | 100 | 9 | 7 | 0 | | 150 | 98% | R5 | R4 | 1 | | |
| 30 | **145** | **150** | 44.20 | 45.72 | 5 | | 5.00 | 1.52 | 100 | 7 | 5 | 0 | | 137 | 90% | R5 | R4 | 1 | | |
| 31 | **150** | **155** | 45.72 | 47.24 | 5 | | 5.00 | 1.52 | 100 | 7 | 4 | 1 | | 144 | 94% | R5 | R4 | 0 | | |
| 32 | **155** | **160** | 47.24 | 48.77 | 4 | 10 | 4.83 | 1.47 | 97 | 10 | 5 | 1 | | 133 | 90% | R5 | R4 | 1 | 1 J has 2mm soft fill | |
| 33 | **160** | **165** | 48.77 | 50.29 | 4 | 9 | 4.75 | 1.45 | 95 | 9 | 7 | 0 | | 139 | 96% | R5 | R4 | 0 | Js betw 162-163' have 2mm of soft fill | |

# MW09-4

overburden | weathered bedrock | fresh bedrock

## Geotechnical log (basic+)

* 10ft rods were used, with 5ft core barrel, HQ3 bit, with split tubes; casing depth 10ft

| Run # | Run Interval | | | | TCR | | | | | OF | J | CJ | +J from RZ | RQD | | IRS | | micro def. | J - properties | comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | From | To | | | | | | | | | | | | | | | | |
| | ft | ft | m | m | ft | inches | decimal ft | m | % | | | | | cm | % | strong | weak | 0 to 3 | | |
| 1 | 5 | 6 | 1.52 | 1.83 | 1 | | 1.00 | 0.30 | 100 | | | | | | 0% | S3 | | | | |
| 2 | 6 | 11 | 1.83 | 3.35 | 2.2 | | 2.20 | 0.67 | 44 | | | | | | 0% | S4 | | | | |
| 3 | 11 | 15 | 3.35 | 4.57 | 3 | | 3.00 | 0.91 | 75 | | | | | | 0% | S4 | | | | |
| 4 | 15 | 20 | 4.57 | 6.10 | 3.6 | | 3.60 | 1.10 | 72 | | | | | | 0% | S3 | | | | |
| 5 | 20 | 25 | 6.10 | 7.62 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | S2 | | | |
| 6 | 25 | 30 | 7.62 | 9.14 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 7 | 30 | 35 | 9.14 | 10.67 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 8 | 35 | 40 | 10.67 | 12.19 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | S3 | | | |
| 9 | 40 | 45 | 12.19 | 13.72 | 4 | | 4.00 | 1.22 | 80 | | | | | | 0% | S4 | | | | |
| 10 | 45 | 50 | 13.72 | 15.24 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 11 | 50 | 55 | 15.24 | 16.76 | 4.2 | | 4.20 | 1.28 | 84 | | | | | | 0% | S4 | | | | |
| 12 | 55 | 60 | 16.76 | 18.29 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 13 | 60 | 65 | 18.29 | 19.81 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 14 | 65 | 70 | 19.81 | 21.34 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | S3 | | | |
| 15 | 70 | 75 | 21.34 | 22.86 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 16 | 75 | 80 | 22.86 | 24.38 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 18 | 80 | 85 | 24.38 | 25.91 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 19 | 85 | 90 | 25.91 | 27.43 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 20 | 90 | 95 | 27.43 | 28.96 | 0 | | 0.00 | 0.00 | 0 | | | | | | | S4 | | | | |
| 21 | 95 | 100 | 28.96 | 30.48 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 22 | 100 | 105 | 30.48 | 32.00 | 3 | | 3.00 | 0.91 | 60 | | | | | | 0% | S4 | | | | |
| 23 | 105 | 110 | 32.00 | 33.53 | 5.2 | | 5.20 | 1.58 | 104 | | | | | | 0% | S4 | | | | |
| 24 | 110 | 115 | 33.53 | 35.05 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 25 | 115 | 120 | 35.05 | 36.58 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 26 | 120 | 125 | 36.58 | 38.10 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 27 | 125 | 130 | 38.10 | 39.62 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 28 | 130 | 135 | 39.62 | 41.15 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 29 | 135 | 140 | 41.15 | 42.67 | 5 | | 5.00 | 1.52 | 100 | | | | | | 0% | S4 | | | | |
| 30 | 140 | 145 | 42.67 | 44.20 | 4.2 | | 4.20 | 1.28 | 84 | | | | | | 0% | S4 | | | | |
| 31 | 145 | 150 | 44.20 | 45.72 | 4.8 | | 4.80 | 1.46 | 96 | | 60 | | 60 | 0 | 0% | R0 | S4 | | | highly weathered rock (brown and pink rock fragments, light brown-orange crs.sand and f.gravel), low clay content (10%) |
| 32 | 150 | 155 | 45.72 | 47.24 | 5 | | 5.00 | 1.52 | 100 | 51 | 51 | 0 | 48 | 0 | 0% | R2 | R0 | 1 | R0 rock most of this run | highly wethered rock (brown-orange c.sand, clayey, altered rock frags, Qz vein, very weak rock) |
| 33 | 155 | 160 | 47.24 | 48.77 | 5 | | 5.00 | 1.52 | 100 | 7 | 9 | 0 | 8 | 152 | 100% | R3 | R0 | 1 | R0 zone 20cm (also jointed) | highly wethered rock, orange-brown alteration, black/white coarse grains remaining of rock competent rock at 159ft |
| 34 | 160 | 165 | 48.77 | 50.29 | 3 | 4 | 3.33 | 1.02 | 67 | 7 | 6 | 0 | | 24 | 24% | R3 | R1 | 1 | soft/hard fill in J's | very weathered jointed rock |
| 35 | 165 | 170 | 50.29 | 51.82 | 5 | | 5.00 | 1.52 | 100 | 6 | 5 | 0 | | 80 | 52% | R3 | R2 | 1 | soft fill in J's or red staining, | weathered jointed rock |
| 36 | 170 | 175 | 51.82 | 53.34 | 5 | | 5.00 | 1.52 | 100 | 9 | 4 | 0 | | 140 | 92% | R3 | | 0 | crs. fill in J's, red staining | weathered jointed rock |
| 37 | 175 | 180 | 53.34 | 54.86 | 5 | 3 | 5.25 | 1.60 | 105 | 8 | 7 | 0 | | 136 | 85% | R4 | R2 | 0 | | |
| 38 | 180 | 185 | 54.86 | 56.39 | 4 | 10 | 4.83 | 1.47 | 97 | 9 | 8 | 0 | 4 | 137 | 93% | R4 | R0 | 2 | black stained J's or crs.fill | RZ (10cm) at litho change, R0 rock |
| 39 | 185 | 190 | 56.39 | 57.91 | 5 | 2 | 5.17 | 1.57 | 103 | 8 | 2 | 0 | | 140 | 89% | R4 | R2 | 0 | black rusty staining on all J's | |
| 40 | 190 | 195 | 57.91 | 59.44 | 5 | 1 | 5.08 | 1.55 | 102 | 10 | 8 | 0 | | 143 | 92% | R4 | | 0 | black rusty staining on all J's | |
| 41 | 195 | 199.5 | 59.44 | 60.81 | 4 | 5 | 4.42 | 1.35 | 98 | 12 | 8 | 0 | | 82 | 61% | R4 | | 0 | stained J's, various colours and minerals | |
| 42 | 199.5 | 205 | 60.81 | 62.48 | 5 | 3 | 5.25 | 1.60 | 95 | 9 | 6 | 1 | | 136 | 85% | R5 | R3 | 0 | hard fill on J surfaces | |
| 43 | 205 | 210 | 62.48 | 64.01 | 5 | | 5.00 | 1.52 | 100 | 9 | 7 | 0 | | 137 | 90% | R5 | R4 | 0 | hard fill on J surfaces | |
| 44 | 210 | 215 | 64.01 | 65.53 | 5 | | 5.00 | 1.52 | 100 | 10 | 10 | 0 | | 78 | 51% | R4 | R3 | 0 | hard fill on J surfaces | |
| 45 | 215 | 220 | 65.53 | 67.06 | 5 | 2 | 5.17 | 1.57 | 103 | 14 | 10 | 0 | | 93 | 59% | R4 | R1 | 0 | hard fill on J surfaces | |
| 46 | 220 | 225 | 67.06 | 68.58 | 5 | 2 | 5.17 | 1.57 | 103 | 7 | 5 | 0 | | 158 | 100% | R4 | R3 | 0 | hard fill on J surfaces | |
| 47 | 225 | 230 | 68.58 | 70.10 | 5 | | 5.00 | 1.52 | 100 | 11 | 8 | 0 | | 135 | 89% | R4 | | 1 | | |
| 48 | 230 | 235 | 70.10 | 71.63 | 5 | | 5.00 | 1.52 | 100 | 13 | 9 | 0 | | 85 | 56% | R4 | R2 | | | |
| 49 | 235 | 240 | 71.63 | 73.15 | 4 | 11 | 4.92 | 1.50 | 98 | 6 | 1 | 0 | | 150 | 100% | R5 | | | | |
| 50 | 240 | 245 | 73.15 | 74.68 | 5 | | 5.00 | 1.52 | 100 | 10 | 9 | 0 | | 132 | 87% | R4 | R3 | | | |
| 51 | 245 | 250 | 74.68 | 76.20 | 4 | 9 | 4.75 | 1.45 | 95 | 10 | 8 | 0 | | 70 | 48% | R4 | | | bright green mineralization on J surfaces | |

# MW09-4

## Overburden Properties

* core runs with the same properties were combined

* descriptions were modified to match quantitative measurements (TorVane and Penetrometer)

** reworked clay (by drill bit) that is caked around harder inner core was ignored here - this soft watery clay does not represent in-situ conditions and is softened by drilling process

| Domain interval From (ft) | To (ft) | From (m) | To (m) | description | permafrost | samples | clay plasticity | clay hardness: description (as found, usually frozen) | thawed only | ISRM code |
|---|---|---|---|---|---|---|---|---|---|---|
| 5.0 | 6.0 | 1.52 | 1.83 | cobble | | | | | | |
| 6.0 | 11.0 | 1.83 | 3.35 | dark brown silty clay with fine gravel (sub round) | | S1 at 10ft | low | firm | | S3 |
| 11.0 | 15.0 | 3.35 | 4.57 | frozen grey clay with ice inclusions (includes 0.5ft layer of d.brown clay with f.gravel) | Vx / Vr small lenses | S2 at 14ft | med | stiff | soft | S4 |
| 15.0 | 20.0 | 4.57 | 6.10 | dark grey frozen clay, with ice inclusions | 20 to 30% ice, Vr / Vx / Nbe | | med | firm | v.soft | S3 |
| 20.0 | 21.5 | 6.10 | 6.55 | dark grey frozen clay, with ice inclusions | frozen | | med | stiff | v.soft | S4 |
| 21.5 | 25.0 | 6.55 | 7.62 | soft watery clay (reworked by drilling process) | N/A | S3 at 24ft | high | | soft | S2 |
| 25.0 | 32.5 | 7.62 | 9.91 | dark grey frozen clay, with ice inclusions | 10 to 15% ice | | med | stiff | | S4 |
| 32.5 | 35.0 | 9.91 | 10.67 | dark grey frozen clay | frozen | S4 at 33ft | med-high | stiff | firm | S4 |
| 35.0 | 40.0 | 10.67 | 12.19 | grey frozen clay, with ice inclusions AND zones of ice with clay inclusions | Vr, Vx, zones of ice | | mod-high | stiff | firm | S3 |
| 40.0 | 55.0 | 12.19 | 16.76 | ice with grey clay inclusions | >50% ice, random pattern, some stiff clay inclusions | S5 at 45ft | mod-high | stiff | soft | S4 |
| 55.0 | 63.0 | 16.76 | 19.20 | grey frozen clay, with ice inclusions | 5% ice, Vx, Vr | S6 at 58ft | high | stiff | firm | S4 |
| 63.0 | 64.5 | 19.20 | 19.66 | grey frozen clay, with fine sand and fine gravel (sub ang to angular) | frozen | S7 at 63ft | low | stiff | soft | S4 |
| 64.5 | 64.8 | 19.66 | 19.75 | black-grey moist clay | | | mod | stiff | | S4 |
| 64.8 | 65.0 | 19.75 | 19.81 | wet clayey coarse sand with fine gravel (sub-ang) | | | | | | |
| 65.0 | 69.0 | 19.81 | 21.03 | clay diamict (f.-crs. sand, f.-crs. gravel (and - sub ang.), + cobble), frozen | frozen | | | stiff | | S4 |
| 69.0 | 70.0 | 21.03 | 21.34 | clay with ice inclusions | some ice | | | firm | | S3 |
| 70.0 | 73.1 | 21.34 | 22.28 | clay diamict (f.-crs. gravel, ang.-round, cobble) | | | | stiff | | S4 |
| 73.1 | 74.1 | 22.28 | 22.59 | ice | ice | S8 at 74ft | | | | |
| 74.1 | 74.8 | 22.59 | 22.80 | clay | | | | stiff | | S4 |
| 74.8 | 84.7 | 22.80 | 25.82 | grey frozen clay interbeds with clay containing ice inclusions and interbeds of pure ice | frozen, 5% ice, Vr/Vs, some pure ice | | | stiff | | S4 |
| 84.7 | 85.0 | 25.82 | 25.91 | clay diamict (f.gravel) | | | | stiff | | S4 |
| 85.0 | 90.0 | 25.91 | 27.43 | frozen clay with ice inclusions and with f.-crs.gravel | more ice content than above | S9 at 89ft | | stiff | | S4 |
| 90.0 | 95.0 | 27.43 | 28.96 | N/A | | | | | | |
| 95.0 | 124.0 | 28.96 | 37.80 | frozen grey clay with ice inclusions (Vr, Vt) and with trace of crs.gravel (sub-ang.) and few beds of clay diamict (with crs. sand / f.gravel) | frozen, once 10cm ice layer, | S10 at 103ft | | stiff | | S4 |
| 124.0 | 125.0 | 37.80 | 38.10 | frozen clayey f.sand | frozen | S11 at 119ft | | | | |
| 125.0 | 141.0 | 38.10 | 42.98 | clay diamict (c.sand-f.gravel) and beds of clayey f.sand, c.gravel and cobble fragments at 135ft, ice inclusions and small ice layers | ice inclusions | S12 at 130ft | low | stiff | | S4 |
| 141.0 | 141.5 | 42.98 | 43.13 | grey brown clay (thawed) and frozen black/grey clay | frost "flakes" in clay | | | stiff | soft | S4 |
| 141.5 | 144.0 | 43.13 | 43.89 | brown moist clayey crs.sand with f.gravel (angular) and trace crs.gravel | | S13 at 143ft | | | | |
| 144.0 | 145.0 | 43.89 | 44.20 | frozen dark grey clay with crs.sand and f.gravel | frozen | | | stiff | | S4 |
| 145.0 | 146.0 | 44.20 | 44.50 | clay diamict (f.gravel grey rock pieces) and interbeds of medium clayey brown sand | N/A | | | stiff | | S4 |
| 146.0 | 153.5 | 44.50 | 46.79 | highly weathered rock (brown and pink rock fragments, light brown-orange crs.sand and f.gravel), low clay content (10%) | N/A | S14 at 151ft | | | | R0 |
| 153.5 | 155.0 | 46.79 | 47.24 | weathered altered rock, Qz vein, very weak | | | | | | R0/R2 |
| 155.0 | 159.0 | 47.24 | 48.46 | weathered altered rock, black/white crs.grains, orange-rusty alteration | warm core from drilling process in rock | | | | | R0/R1 |

**clay hardness - quantitative measurements**

| From (ft) | To (ft) | Tor Vane (* 0.1 kg/cm$^2$) frozen min | frozen max | thawed min | thawed max | Penetrometer (kg/cm$^2$) frozen min | frozen max | thawed min | thawed max |
|---|---|---|---|---|---|---|---|---|---|
| 5.0 | 6.0 | | | | | | | | |
| 6.0 | 11.0 | 3 | | | | | | | |
| 11.0 | 15.0 | | | | | | | | |
| 15.0 | 20.0 | | 4.5 | | 1 | | | 0.3 | 0.5 |
| 20.0 | 21.5 | | 2.5 | | | | 1.5 | | 0.0 |
| 21.5 | 25.0 | | | | | | | | |
| 25.0 | 32.5 | | 7 | | | | 3.2 | | 0.5 |
| 32.5 | 35.0 | | 3.5 | | | | 4.5 | | 1.5 |
| 35.0 | 40.0 | | | | | 1.9 | 2 | | 1.0 |
| 40.0 | 55.0 | | 7.5 | | 0.5 | 2 | 4 | | 0.3 |
| 55.0 | 63.0 | | | | 4 | | | | 1.5 |
| 63.0 | 64.5 | | | 7.8 | 8 | 3 | 3.5 | | |
| 64.5 | 64.8 | | | | | | | | |
| 64.8 | 65.0 | | | | | | | | |
| 65.0 | 69.0 | | | | | | | | 2.0 |
| 69.0 | 70.0 | | | | | | | | 1.0 |
| 70.0 | 73.1 | | | | | | | | |
| 73.1 | 74.1 | | | | | | | | |
| 74.1 | 74.8 | | 10 | | | | 3 | | |
| 74.8 | 84.7 | | | | | 1.5 | 5 | 0.5 | 2.0 |
| 84.7 | 85.0 | | | | | 2 | 2.5 | | |
| 85.0 | 90.0 | | | | | | | | |
| 90.0 | 95.0 | | | | | | | | |
| 95.0 | 124.0 | | | | 8 | 4 | 5 | 1.5 | 3.0 |
| 124.0 | 125.0 | | | | | | | | |
| 125.0 | 141.0 | | | | | 2.5 | 5 | | 1.5 |
| 141.0 | 141.5 | | | | 3.5 | | | | |
| 141.5 | 144.0 | | | | | | | | |
| 144.0 | 145.0 | | | | | | 4.5 | 0.5 | 1.0 |
| 145.0 | 146.0 | | | | | | | | |
| 146.0 | 153.5 | | | | | | | | |
| 153.5 | 155.0 | | | | | | | | |
| 155.0 | 159.0 | | | | | | | | |

| From (ft) | To (ft) | Tor Vane (MPa) frozen min | frozen max | thawed min | thawed max | Penetrometer (MPa) frozen min | frozen max | thawed min | thawed max |
|---|---|---|---|---|---|---|---|---|---|
| 5.0 | 6.0 | | | | | | | | |
| 6.0 | 11.0 | 0.03 | | | | | | | |
| 11.0 | 15.0 | | | | | | | | |
| 15.0 | 20.0 | | 0.04 | | 0.01 | | | 0.03 | 0.05 |
| 20.0 | 21.5 | | 0.02 | | | | 0.15 | | 0.00 |
| 21.5 | 25.0 | | | | | | | | |
| 25.0 | 32.5 | | 0.07 | | | | 0.31 | | 0.05 |
| 32.5 | 35.0 | | 0.03 | | | | 0.44 | | 0.15 |
| 35.0 | 40.0 | | | | | 0.19 | 0.20 | | 0.10 |
| 40.0 | 55.0 | | 0.07 | | 0.00 | 0.20 | 0.39 | | 0.03 |
| 55.0 | 63.0 | | | | 0.04 | | | | 0.15 |
| 63.0 | 64.5 | | | 0.08 | 0.08 | 0.29 | 0.34 | | |
| 64.5 | 64.8 | | | | | | | | |
| 64.8 | 65.0 | | | | | | | | |
| 65.0 | 69.0 | | | | | | | | 0.20 |
| 69.0 | 70.0 | | | | | | | | 0.10 |
| 70.0 | 73.1 | | | | | | | | |
| 73.1 | 74.1 | | | | | | | | |
| 74.1 | 74.8 | | 0.10 | | | | 0.29 | | |
| 74.8 | 84.7 | | | | | 0.15 | 0.49 | 0.05 | 0.20 |
| 84.7 | 85.0 | | | | | 0.20 | 0.25 | | |
| 85.0 | 90.0 | | | | | | | | |
| 90.0 | 95.0 | | | | | | | | |
| 95.0 | 124.0 | | | | 0.08 | 0.39 | 0.49 | 0.15 | 0.29 |
| 124.0 | 125.0 | | | | | | | | |
| 125.0 | 141.0 | | | | | 0.25 | 0.49 | | 0.15 |
| 141.0 | 141.5 | | | | 0.03 | | | | |
| 141.5 | 144.0 | | | | | | | | |
| 144.0 | 145.0 | | | | | | 0.44 | 0.05 | 0.10 |
| 145.0 | 146.0 | | | | | | | | |
| 146.0 | 153.5 | | | | | | | | |
| 153.5 | 155.0 | | | | | | | | |
| 155.0 | 159.0 | | | | | | | | |

# Appendix B
## MP Monitoring Well Casing Design and Installation Records

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Engineers and Scientists

# MP System Casing Installation Log

Sheet 1 of 2

Project: MINTO 2CM022.007.001.10 WB Ref.:

Location: WEST PIT Hole No.: MW09-1 Installed by: JS, CD

Hole Depth: 165 FT MP Depth: 165 FT Hole Diameter: HQ Date Installed: 28 NOV '09

Measurement Datum: GROUND SURFACE Datum Elevation: 857.6 m Date Drawn: 19 JAN '10

| Depth, FT | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint Test |
|---|---|---|---|---|---|---|---|---|
| | FILL | | 18 | | | 0.23 m from ground surface to top of piece 17. | | |
| 10 | | | 17 | | | | | |
| 20 | | | 16 | | | | | |
| 30 | | | 15 | | | | | |
| 40 | | | 14 | | | | | |
| 50 | | | 13 | | | | | |
| 60 | | | 12 | | | | | |
| 70 | | | 11 | | | | | |
| 80 | | | 10 M | 2801 | | | | |
| 90 | WEATHERED BEDROCK | | 9 | | | | | |
| 100 | | | 8 | 17025 | 600 PSI 6.5 L | VALVE OPEN 170 PSI | | |

MP Casing | MP Packer | Magnetic Collar | Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

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*Engineers and Scientists*

# MP System Casing Installation Log

Sheet 2 of 2

Project: MINTO 2CM022.007.001.10 WB Ref.:

Location: WEST PIT Hole No.: MW09-1 Installed by: JS, CD

Hole Depth: 165 FT MP Depth: 165 FT Hole Diameter: HQ Date Installed: 28 NOV '09

Measurement Datum: GROUND SURFACE Datum Elevation: 857.6 m Date Drawn: 19 JAN '10

| Depth, FT | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint Test |
|---|---|---|---|---|---|---|---|---|
| 100 | WEATHERED BEDROCK | | | | | | | |
| | | | 7 | | | | | |
| 110 | | | M | 2803 | | | | |
| | COMPETENT BEDROCK | | 6 | | | | | |
| 120 | | | | 7955 | | | | |
| | | | 5 | | | | | |
| 130 | | | 4 | 17026 | 670 PSI 4.0 L | VALUE OPEN 165 PSI | | |
| | | | | | | | | |
| 140 | | | 3 | | | | | |
| | | | | 2800 | | | | |
| 150 | | | 2 | | | | | |
| | | | | 7957 | | | | |
| 160 | | | 1 | | | | | |
| | END OF HOLE AT 165 FT | | | | | | | |
| 170 | | | | | | | | |

MP Casing | MP Packer | Magnetic Collar | Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

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Schlumberger WATER SERVICES

Sheet 1 of 2

# Westbay Packer Inflation Record

Project: Minto  Project No.: 2CM022.007.001.10  Well No.: MW 09-1

Location: West Pit  Completed by: CD, JS  Date Inflated: 28 Nov 09

Packer No. 4 Serial # 17026  Depth (ft / m): 130 ft  Inflation Tool No.: ____

Packer Valve Pressure, $P_V$: 165 psi  Final Line Pressure, $P_L$: 677 psi  Tool Pressure, $P_T$: 400 psi

Borehole Water Level: 33.65 (ft / m) = 47.8 psi ($P_W$)

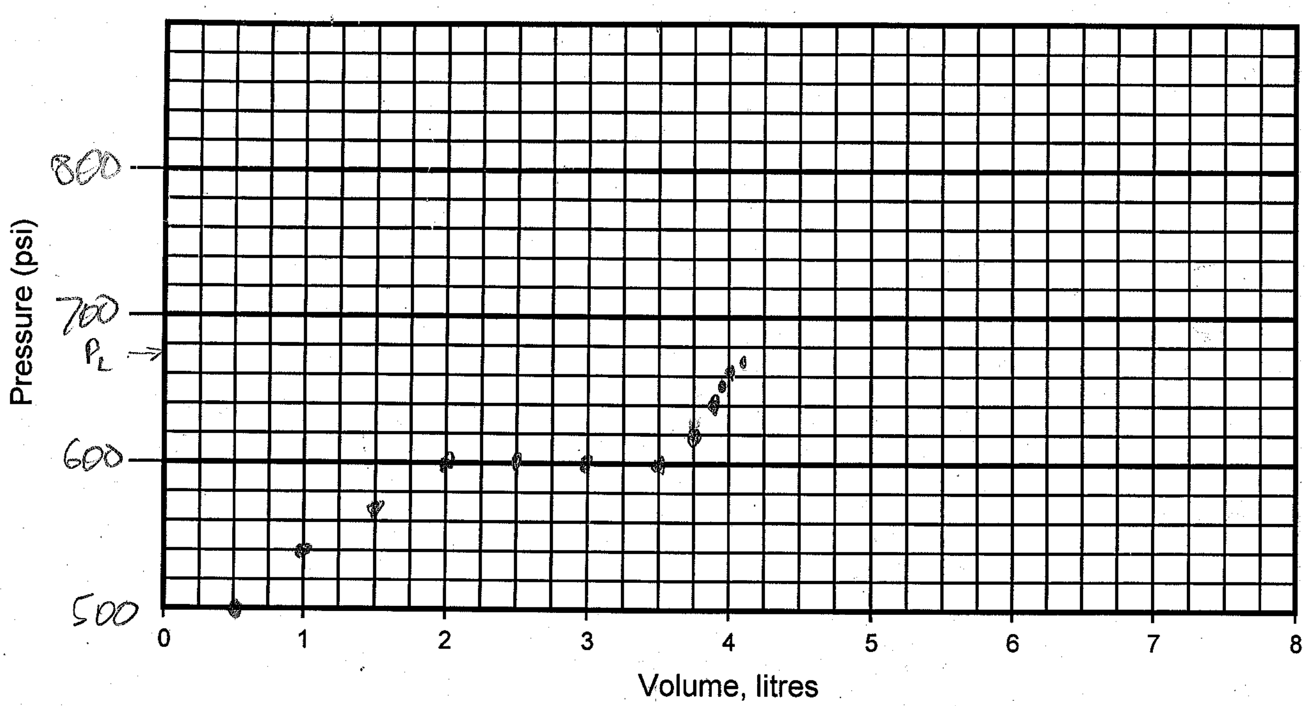
110.4 ft

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T =$ 160 psi

$P_L = P_E + P_V + P_T - P_W = 160 + 165 + 400 - 48 = 677$

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Volume, litres | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 3.75 | 3.85 | 3.95 |
| Pressure, psi | 500 | 540 | 570 | 600 | 600 | 600 | 600 | 620 | 640 | 650 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Volume, litres | 4.05 | 4.10 | | 4.0 L final ✓ | | | | | | |
| Pressure, psi | 660 | 670 | | | | | | | | |




Comments: Packer # normal inflation  Time - 14:10

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# Packer Inflation Record

Project: Minto 2CM022.007.001.10 Project No.: ______ Well No.: MW09-1

Location: West pit Completed by: CD./JS Date Inflated: Nov 27 '09

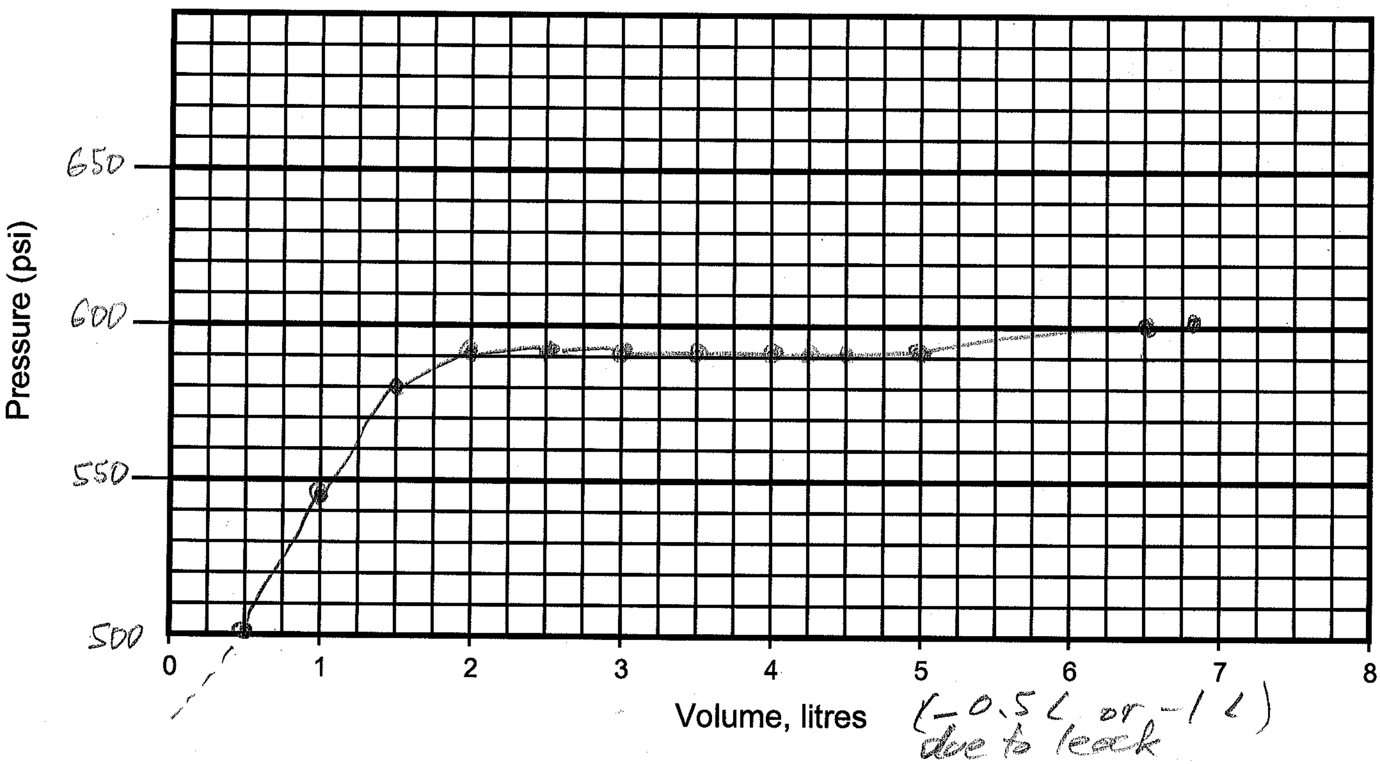
Packer No. 8 s/n 17025 Depth ( ft / m ): 95 ft Inflation Tool No.: ______

Packer Valve Pressure, $P_V$: 170 psi Final Line Pressure, $P_L$: 682 psi Tool Pressure, $P_T$: 400 psi

Borehole Water Level: 33.65 ( ft / m ) = 47.8 psi ($P_W$)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T =$ 160 psi

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Volume, litres | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 3.75 | 4.0 | 4.25 |
| Pressure, psi | 500 | 540 | 580 | 590 | 590 | 590 | 590 | 590 | 590 | 590 |
| Volume, litres | 4.5 | 5.0 | 6.5 | 6.8 | | 6.75 (actual | * final vol. 6 to 6.5 L | | because | of leak) |
| Pressure, psi | 590 | 590 | 600 | 600 | | | | | | |




Comments: Packer # loss of water volume (0.5 L approx Time - 15:00
from water filter leak before pump intake), and perhaps other leak?
- stopped because reached packer vol. limit (inflated in weak weath. rock zone)

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# MP System Casing Installation Log

Sheet 1 of 2

Project: MINTO 2CM022.007.001.10 WB Ref.:

Location: LOWER TAILINGS Hole No.: MW09-2 Installed by: JS, CD

Hole Depth: 195 FT MP Depth: 195 FT Hole Diameter: HQ Date Installed: 26 NOV '09

Measurement Datum: GROUND SURFACE Datum Elevation: 757.5 m Date Drawn: 19 JAN '10

| Depth, FT | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint test |
|---|---|---|---|---|---|---|---|---|
| | | | 22 | | | | | |
| 10 | | | 21 | | | | | |
| 20 | CLAY + ICE PERMAFROST | | 20 | | | | | |
| 30 | | | 19 | | | | | |
| 40 | | | 18 | | | | | |
| 50 | | | 17 | | | | | |
| 60 | | | 16 | | | | | |
| 70 | | | 15 | | | | | |
| 80 | | | 14 | | | | | |
| 90 | | | 13 | | | | | |
| 100 | | | | | | | | |

MP Casing | MP Packer | Magnetic Collar | Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

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# MP System
# Casing Installation Log

Sheet 2 of 2

Project: MINTO 2CM022.007.001.10    WB Ref.:

Location: LOWER TAILINGS    Hole No.: MW09-2    Installed by: JS, CD

Hole Depth: 195 FT    MP Depth: 195 FT    Hole Diameter: HQ    Date Installed: 26 NOV '09

Measurement Datum: GROUND SURFACE    Datum Elevation: 757.5 m    Date Drawn: 19 JAN '10

| Depth, FT | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint Test |
|---|---|---|---|---|---|---|---|---|
| 100 | | | | | | | | |
| | | | 12 | | | | | |
| 110 | | | | | | | | |
| | | | 11 | | | | | |
| | CLAY + ICE | | | | | | | |
| 120 | | | | | | | | |
| | | | 10 | | | | | |
| 130 | | | | | | | | |
| | | | 9 | | | | | |
| | CLAY + SAND + ICE | | | | | | | |
| 140 | | | | | | | | |
| | | | 8 | | | | | |
| 150 | | | M> 7 < | 17022 | 760 PSI 4.75 L | MAG COLLAR AT TOP OF PACKER | | |
| | | | 6 | 2799 | | | | |
| | WEATHERED BEDROCK | | | | | | | |
| 160 | | | | 7958 | | | | |
| | WEAK JOINTED ROCK | | 5 | | | | | |
| | | | M> 4 < | 17021 | 760 PSI 1.75 L | MAG COLLAR AT TOP OF PACKER | | |
| 170 | | | 3 | 2794 | | | | |
| | VERY POOR CORE RECOVERY | | | 7951 | | | | |
| 180 | | | 2 | | | | | |
| 190 | | | 1 | | | | | |
| | END OF HOLE AT 195 FT | MUD | | | | | | |
| 200 | | | | | | | | |

Legend: MP Casing; MP Packer; Magnetic Collar; Filter Sleeve; Measurement Port Coupling; Pumping Port Coupling; Regular Coupling

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Sheet 1 of 2

# Packer Inflation Record

Project: Minto
Project No.:
Well No.: MW09-2

Location: Lower Tailings
Completed by: J Scibek
Date Inflated: Nov 26 '09

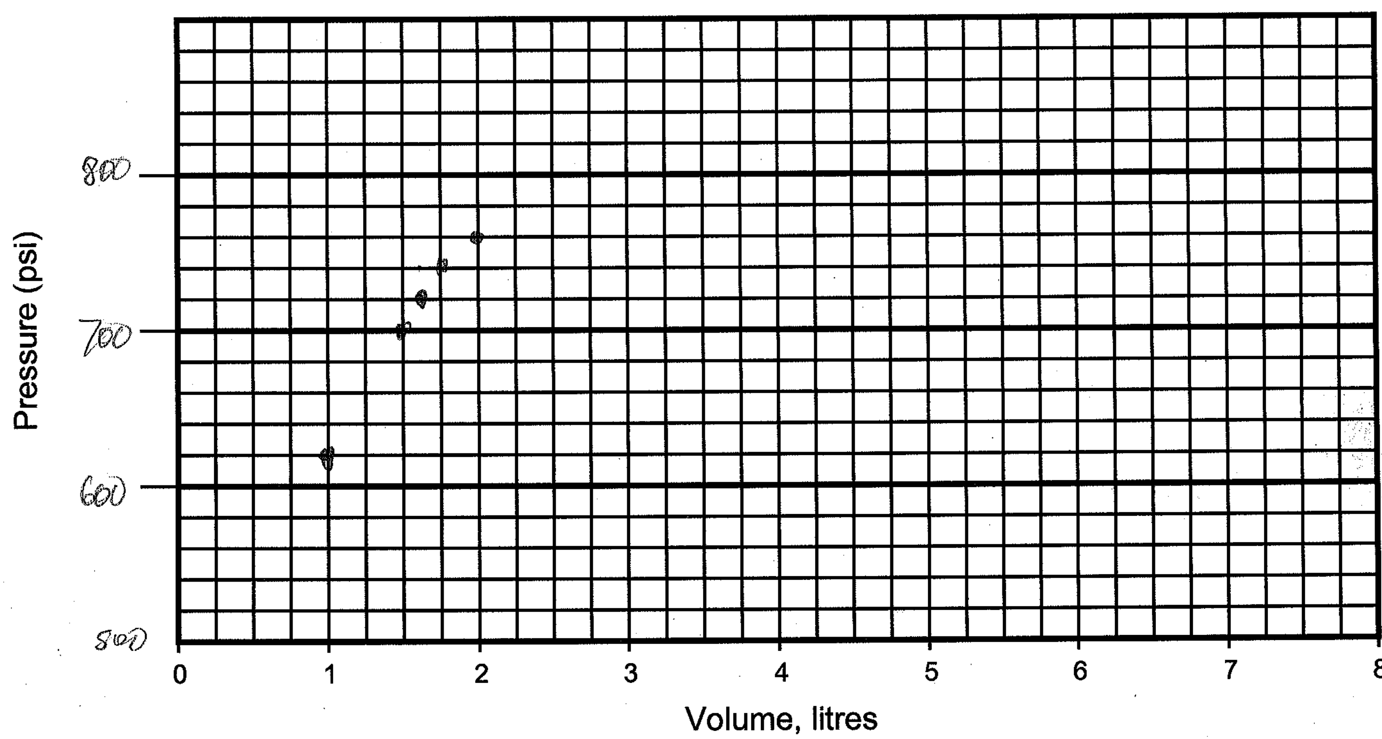
Packer No. 4 s/n 17021
Depth (ft / m ): 170
Inflation Tool No.:

Packer Valve Pressure, $P_V$: 165 psi
Final Line Pressure, $P_L$: 755 psi
Tool Pressure, $P_T$: 425 psi

Borehole Water Level: 3.0 ( ft / m ) = ______ psi ($P_W$)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T =$ 165 psi

| Volume, litres | 1.0 | 1.5 | 1.6 | 1.75 | 2.0 | | 1.75 | L final Volume | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 620 | 700 | 720 | 740 | 760 | Final P | | | | |
| Volume, litres | | | | | | | | | | |
| Pressure, psi | | | | | | | | | | |




Comments: Packer # hole probably collapsed around packer Time - 20:30
resulting in small volume inflated ; packer is just above
zone of weak weath. rock (R0 strength) with poor core recovery

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Sheet 2 of 2

# Packer Inflation Record

Project: Minto  Project No.: ______  Well No.: MW09-2

Location: Lower Tailings  Completed by: J Scibek  Date Inflated: Nov 26'09

Packer No. 7  S/n 17022  Depth ( ft / m ): 160 ft  Inflation Tool No.: ______

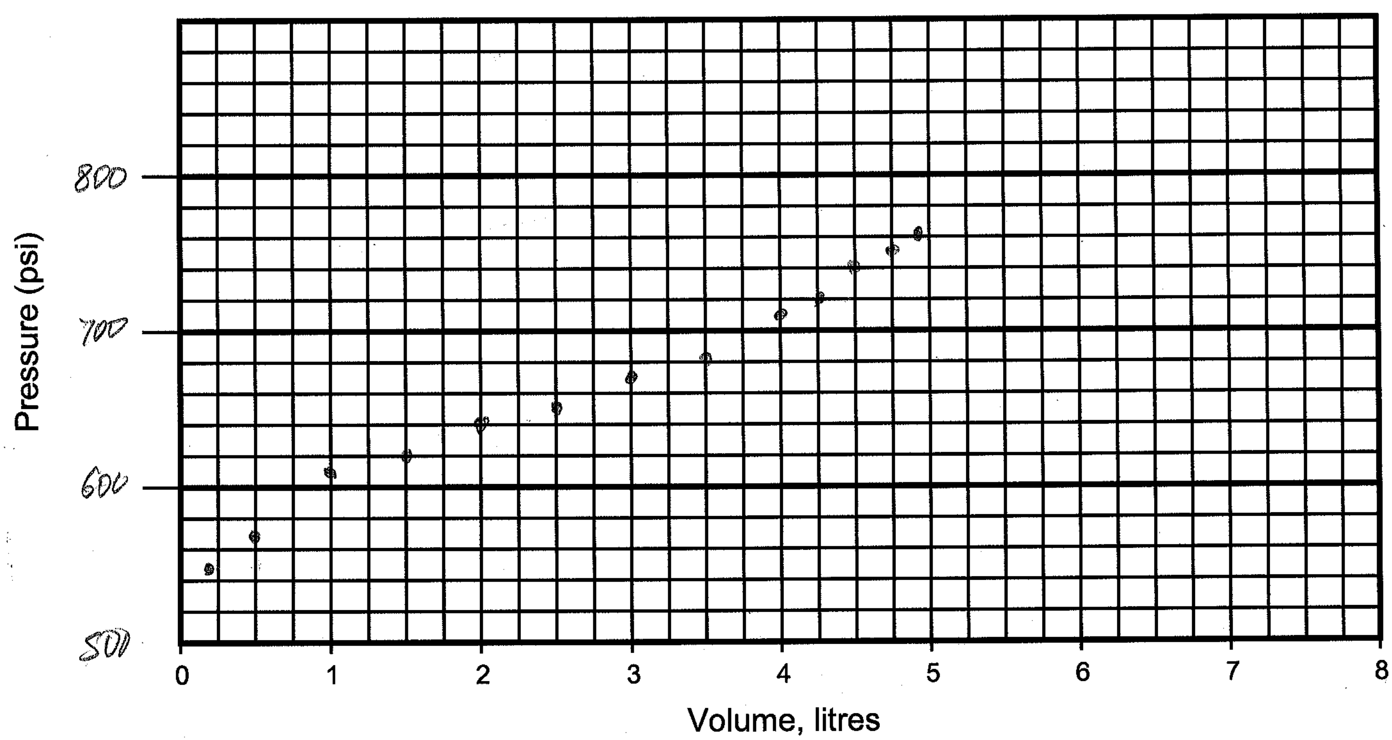
Packer Valve Pressure, $P_V$: 170 psi  Final Line Pressure, $P_L$: 755 psi  Tool Pressure, $P_T$: 425 psi

Borehole Water Level: 3 ( ft / m ) = 4 psi ($P_W$)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 160 psi

| Volume, litres | 0.2 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.25 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 550 | 570 | 610 | 620 | 640 | 650 | 670 | 680 | 710 | 720 |

| Volume, litres | 4.50 | 4.75 | 4.9 | | 4.75 | ← final volume | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 740 | 750 | 760 | | | | | | | |




Comments: Packer # inflated normally  Time - 21:00

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# MP System Casing Installation Log

Sheet 1 of 2

Project: MINTO 2CM022.007.001.10 WB Ref.:

Location: MINTO NORTH Hole No.: MW09-3 Installed by: JS, CD

Hole Depth: 165 FT MP Depth: 165 FT Hole Diameter: HQ Date Installed: 27 NOV '09

Measurement Datum: GROUND SURFACE Datum Elevation: 908.0 m Date Drawn: 19 JAN '10

| Depth, FT | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint Test |
|---|---|---|---|---|---|---|---|---|
| | WELL CASING | | 18 | | | 2.9 m from top of casing to top of piece 17. | | |
| 10 | WEATHERED BEDROCK | | 17 | | | | | |
| 20 | | | 16 | 17023 | 740 PSI 3.9 L | VALVE OPEN 170 PSI | | |
| | COMPETENT ROCK | | | | | | | |
| 30 | | | M> 15 < | | | | | |
| | | | | 2805 | | | | |
| 40 | STAINED JOINTS, ALTERATION | | 14 | | | | | |
| | | | | 7956 | | | | |
| 50 | | | 13 | | | | | |
| | | | 12 | 17028 | 740 PSI 3.75 L | VALVE OPEN 165 PSI | | |
| 60 | | | | | | | | |
| | | | 11 | | | | | |
| 70 | | | | | | | | |
| | | | M> 10 < | | | | | |
| 80 | | | | 2802 | | | | |
| | | | 9 | | | | | |
| 90 | R2 ROCK, HIGHLY ALTERED | | | 7949 | | | | |
| | | | 8 | | | | | |
| 100 | | | | | | | | |

MP Casing · MP Packer · Magnetic Collar · Filter Sleeve · Measurement Port Coupling · Pumping Port Coupling · Regular Coupling

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# MP System Casing Installation Log

Sheet 2 of 2

Project: MINTO 2CM022.007.001.10 WB Ref.:

Location: MINTO NORTH Hole No.: MW09-3 Installed by: JS, CD

Hole Depth: 165 FT MP Depth: 165 FT Hole Diameter: HQ Date Installed: 27 NOV '09

Measurement Datum: GROUND SURFACE Datum Elevation: 908.0 m Date Drawn: 19 JAN '10

| Depth, | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint Test |
|---|---|---|---|---|---|---|---|---|
| 100 | COMPETENT BEDROCK | | 7 | 17027 | 750 PSI 3.75 L | VALVE OPEN 170 PSI | | |
| | | | | | | | | |
| 110 | | | 6 | | | | | |
| | | | | | | | | |
| 120 | | | M>5< | | | | | |
| | | | ● | 2804 | | | | |
| 130 | | | 4 | | | | | |
| | | | 0 | 7950 | | | | |
| 140 | | | 3 | | | | | |
| | | | | | | | | |
| 150 | | | 2 | | | | | |
| | | | | | | | | |
| 160 | | | 1 | | | | | |
| | END OF HOLE 165' | | | | | | | |
| 170 | | | | | | | | |

MP Casing | MP Packer | Magnetic Collar | Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

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Engineers and Scientists

Sheet 1 of 3

# Packer Inflation Record

Project: Minto    Project No.: 2CM022.007.001-10    Well No.: MW 09-3

Location: Minto North    Completed by: CD / JS    Date Inflated: 27 Nov 09

Packer No. 7 Serial# 17027    Depth ( ft / m ): 100 ft    Inflation Tool No.:

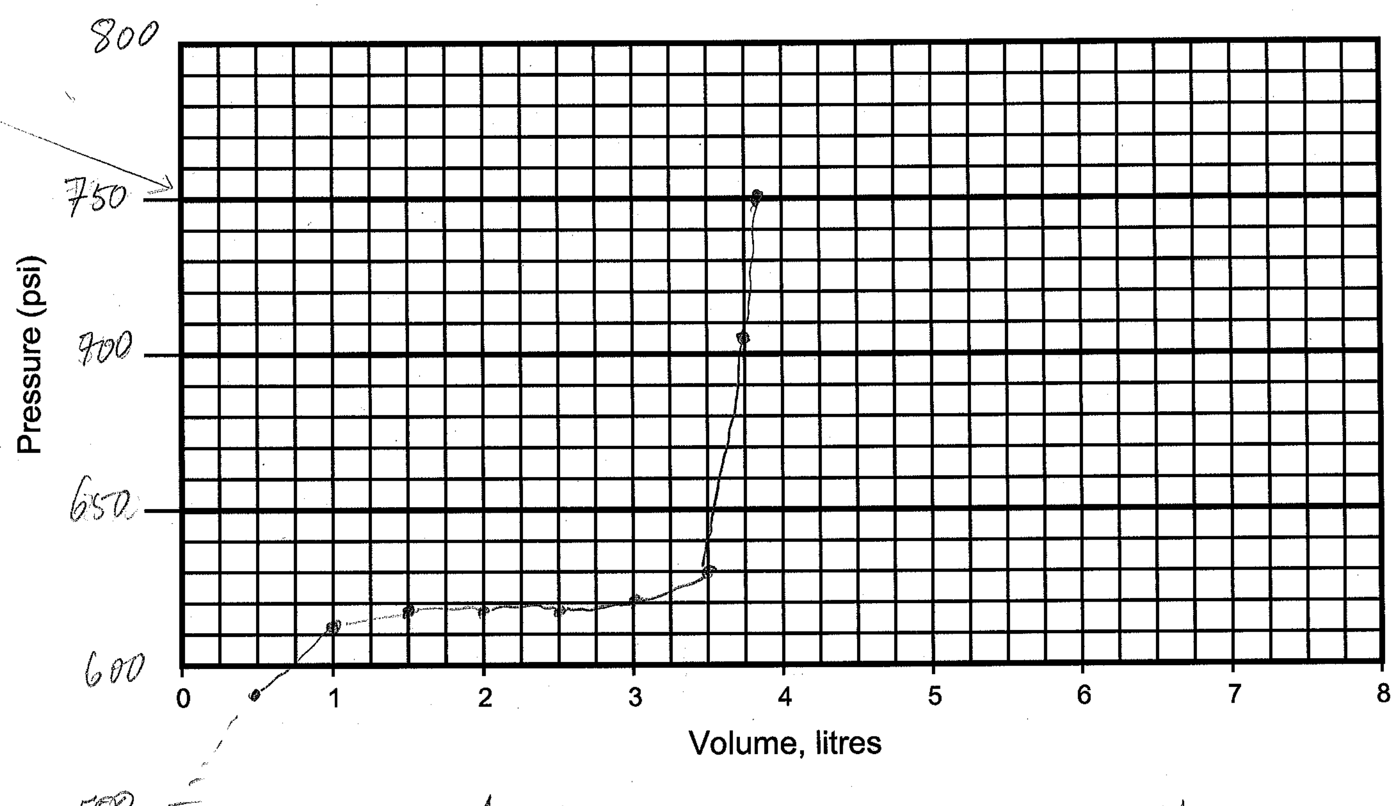
Packer Valve Pressure, $P_V$: 170 psi    Final Line Pressure, $P_L$: 754 psi    Tool Pressure, $P_T$: 425 psi

Borehole Water Level: 4 ( ft / m ) = 1 psi ($P_W$)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T =$ 160 psi

425 + 170 + 160 - 1 = 754 psi

| Volume, litres | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 3.75 | 3.85 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 580 | 625 | 635 | 635 | 635 | 645 | 660 | 710 | 750 | |
| Volume, litres | final volume 3.75 L. | | | | | | | | | |
| Pressure, psi | | | | | | | | | | |




Comments: Packer # normal inflation    Time - 14:35

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Sheet 2 of 3

# Packer Inflation Record

Project: Minto
Project No.: 2CM022.007.001.10
Well No.: MW09-3

Location: Minto North
Completed by: CD, JS
Date Inflated: 27 Nov 2009

Packer No. 12 Serial # 17028
Depth ( ft / m ): 55 ft
Inflation Tool No.:

Packer Valve Pressure, $P_V$: 165 psi
Final Line Pressure, $P_L$: 749 psi
Tool Pressure, $P_T$: 425 psi

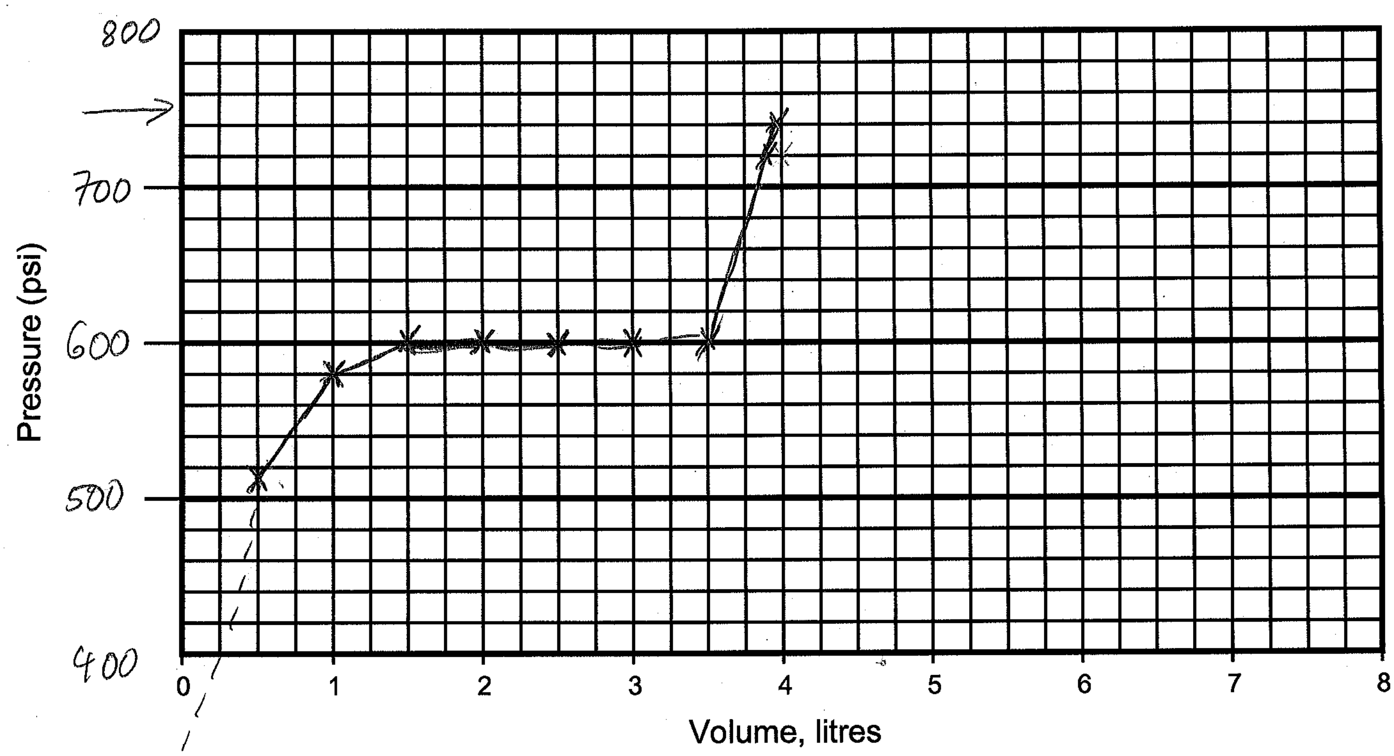
Borehole Water Level: 4 (ft / m) = 1 psi ($P_W$)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 160 psi

425+165+160 −1 = 749 psi

| Volume, litres | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 3.8 | 3.9 | FINAL 3.75 L |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 515 | 580 | 600 | 600 | 600 | 600 | 600 | 720 | 740 | |

| Volume, litres | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | | | | | | | | | | |




Comments: Packer # Normal inflation.
Time -

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# Packer Inflation Record

Project: Minto
Project No.: 2CM022.007.001.10
Well No.: MW09-3

Location: Minto North
Completed by: CD, JS
Date Inflated: 27 Nov 09

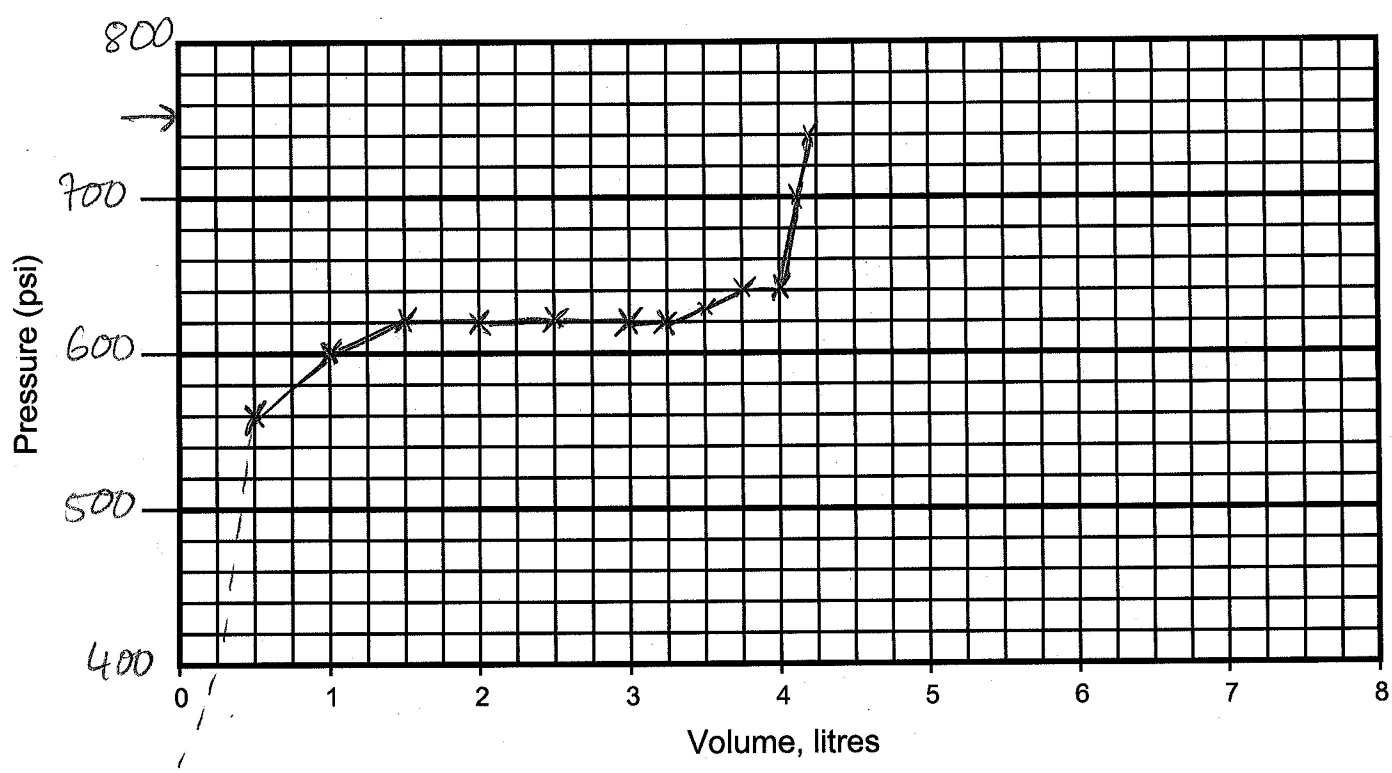
Packer No. 16 Serial # 17023
Depth (ft/m): 20 ft
Inflation Tool No.:

Packer Valve Pressure, $P_V$: 170 psi
Final Line Pressure, $P_L$: 754 psi
Tool Pressure, $P_T$: 425 psi

Borehole Water Level: 4 (ft/m) = 1 psi ($P_W$)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 160 psi

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Volume, litres | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.25 | 3.5 | 3.75 | 4.0 |
| Pressure, psi | 560 | 600 | 620 | 620 | 620 | 620 | 620 | 630 | 640 | 640 |
| Volume, litres | 4.1 | 4.15 | Final volume 3.9L | | | | | | | |
| Pressure, psi | 700 | 740 | | | | | | | | |




Comments: Packer #
Time -

On first pumping, pressure rose then suddenly dropped, then rose again. Packer pushing loose rock until it gave way? Otherwise normal inflation.

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# MP System Casing Installation Log

Sheet 1 of 3

Project: Minto 2CM022.007 WB Ref.:

Location: Phase 1 confluence Hole No.: MW09-4 Installed by: M.Royle / J.Scild C. Doughty

Hole Depth: 250 FT MP Depth: 250 FT Hole Diameter: HQ Date Installed: Nov 24 '09

Measurement Datum: Datum Elevation: Date Drawn: Nov 24 '09

| Depth, | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint Test |
|---|---|---|---|---|---|---|---|---|
| 5 | | ✓ | 27 | | | | | |
| 10 | | | | | | | | |
| 15 | | ✓ | 26 | | | | | |
| 20 | | | | | | | | |
| 25 | | ✓ | 25 | | | | | |
| 30 | | | | | | | | |
| 35 | | ✓ | 24 | | | | | |
| 40 | | | | | | | | |
| 45 | | ✓ | 23 | | | | | |
| 50 | | | | | | | | |
| 55 | | ✓ | 22 | | | | | |
| 60 | | | | | | | | |
| 65 | | ✓ | 21 | | | | | |
| 70 | | | | | | | | |
| 75 | | ✓ | 20 | | | | | |
| 80 | | | | | | | | |
| 85 | | ✓ | 19 | | | | | |
| 90 | | | | | | | | |
| 95 | | ✓ | 18 | | | | | |
| 100 | | | | | | | | |

MP Casing · MP Packer · Magnetic Collar · Filter Sleeve · Measurement Port Coupling · Pumping Port Coupling · Regular Coupling

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# MP System Casing Installation Log

Sheet 2 of 3

Project: Minto 2CM022.007.001.100 WB Ref.:

Location: Phase 1 confluence Hole No.: MW09-4 Installed by: M. Royle / J. Scibek C. Doughty

Hole Depth: 250 FT MP Depth: 250 FT Hole Diameter: HQ Date Installed: Nov 24 '09

Measurement Datum: ground surface Datum Elevation: Date Drawn: Nov 24 '09

| Depth, | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint Test |
|---|---|---|---|---|---|---|---|---|
| 105 | | ✓ | 17 | | | | | |
| 110 | mostly diamict ("till") or firm frozen clay | ✓ | 16 | | | | | |
| 115 | with ice inclusions | | | | | | | |
| 120 | note: clayey fine sand, (frozen) | ✓ | 15 | | | W.L. = 74.52 m - 5 FT after install (30 min) | | |
| 125 | | | | | | | | |
| 130 | | ✓ | 14 | | | | | |
| 135 | small ice layer at 136.5' | | | | | | | |
| 140 | firm clay diamict (compacted) - frozen | $V_o = 165$ $V_r = 140$ | 13 | | | | | |
| 145 | highly weathered bedrock crumbly, clayey | ✓ | 12 | | | | | |
| 150 | | ✓ M | | | | mag. collar | | |
| 155 | weath. altered bedrock, R2 strength, core jointed | ✓ | | 2798 | | | | |
| 160 | | ✓ | 11 | | | | | |
| 165 | | ✓ | | 7954 | | | | |
| 170 | | ✓ | 10 | | | | | |
| 175 | strong rock, jointed | ✓ | 9 | 17031 | | mag collar on bottom of packer | | |
| 180 | | ✓ M | | 2797 | | | | |
| 185 | | ✓ | 8 | | | | | |
| 190 | | ✓ | | 7953 | | | | |
| 195 | | ✓ | 7 | | | | | |
| 200 | | | | | | | | |

stick-up below ground

HQ

Nov 25 16:35 bottom 2 packers inflate with HQ shoe at 160 ft

MP Casing | MP Packer | Magnetic Collar | Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

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# MP System Casing Installation Log

Sheet 3 of 3

Project: Minto 2CM022.007 WB Ref.:

Location: Phase 1 confluence Hole No.: MW09-4 Installed by: M.Royle/J.Scibek/C.Dougherty

Hole Depth: 250 FT MP Depth: 250 FT Hole Diameter: HQ Date Installed: Nov 24 '09

Measurement Datum: ground surface Datum Elevation: Date Drawn: Nov 24 '09

HQ

| Depth | Geological Description | Geologic Log | MP Casing Log | Serial No. Batch No. | Final Packer Pressure/Volume | Comments | Joint Install | Joint Test |
|---|---|---|---|---|---|---|---|---|
| | strong rock, jointed | ✓ | 6 | 17024 | | | | |
| 205 | | | | | | don't put packer below 209' | | |
| 210 | | Vo 170 ✓ Vc=150 | 5 | | | | | |
| 215 | | | | | | | | |
| 220 | | ✓ | 4 | | | | | |
| | ✓ | ✓ | | M 2796 | | mag-collar | | |
| 225 | | ✓ | | | | | | |
| | | ✓ | 3 | | | | | |
| 230 | | | | | | | | |
| 235 | | ✓ | 0 | 7952 | | | | |
| | | ✓ | 1 | | | | | |
| 240 | | | | | | | | |
| | EOH at 243' | EOH | | | | end cap | | |
| 245 | | | | | drill hole | w.l. = ? measure before install | | |
| 250 EDH at 250' | | | | | | | | |
| | | | | | | probed hole = 243.1' | | |
| | | | | | | shortened orig design by 5' by removing #2 pipe (5 ft) | | |

MP Casing MP Packer Magnetic Collar Filter Sleeve Measurement Port Coupling Pumping Port Coupling Regular Coupling

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# Packer Inflation Record

Project: Minto
Project No.: 2CM022.007.001,10
Well No.: MW09-04
Location: Phase 1 Confluence
Completed by: MR/SS/CD
Date Inflated: Nov 25/09
Packer No. 6
Depth (ft/m): 205
Inflation Tool No.:
Packer Valve Pressure, $P_V$: 170 psi
Final Line Pressure, $P_L$: 780 psi
Tool Pressure, $P_T$: 475 psi
Borehole Water Level: ~30 (ft/m) = 15 psi ($P_W$)

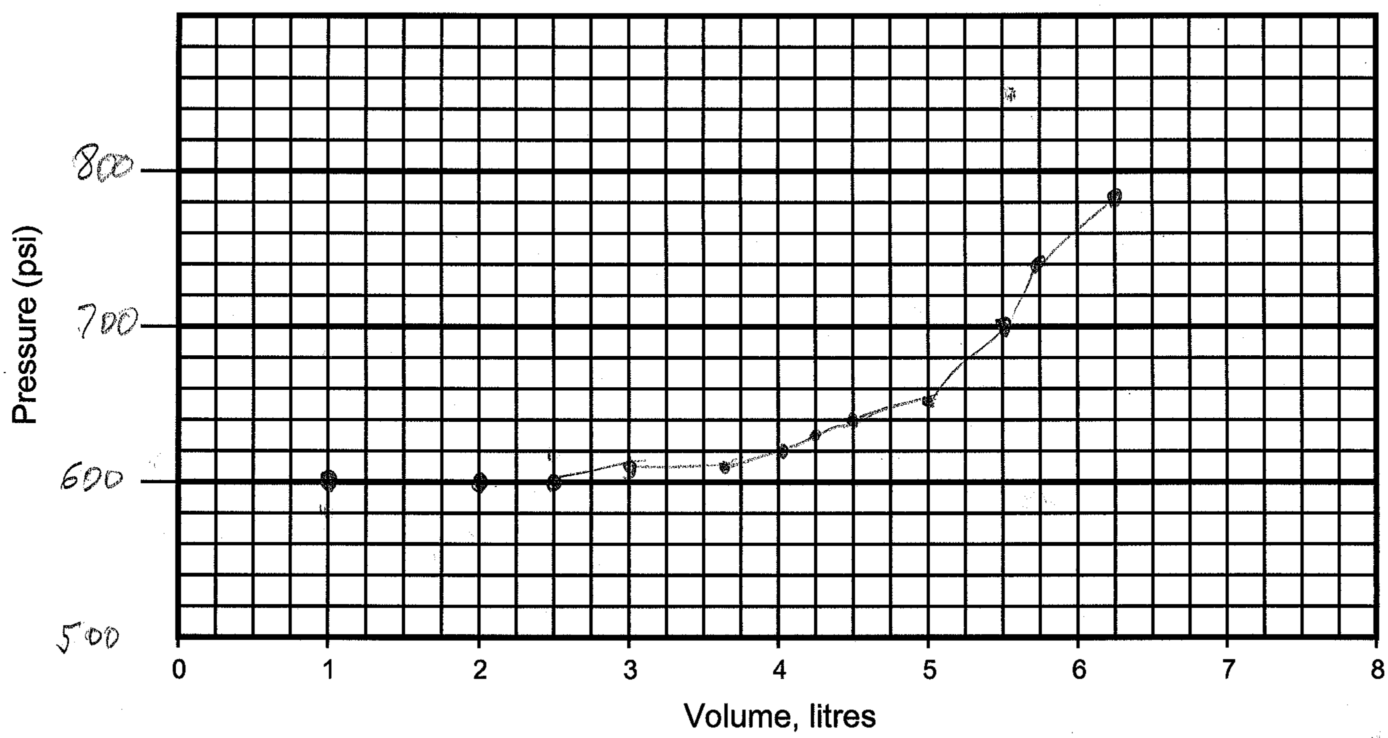
$P_L = P_V + P_T - P_W + P_E$

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T =$ 150 psi
+15 − 170 − 475

$\therefore P_L = +150 - 15 + 170 + 475 = 780$

| Volume, litres | 1 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.25 | 4.5 | 5.0 | 5.5 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 600 | 600 | 600 | 610 | 610 | 620 | 630 | 640 | 650 | 700 |

| Volume, litres | 5.75 | 6.0 | | Final | 5.75 L | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 740 | 780 | | | | | | | | |




Comments: Packer #

Time -

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Sheet 2 of 3

# Packer Inflation Record

Project: Minto
Project No.: 2CM022.007.001.10
Well No.: MW09-04

Location: Phase 1 Confluence
Completed by: JS/MR
Date Inflated: Nov 25'09

Packer No. 9
Depth (ft / m): 180
Inflation Tool No.:

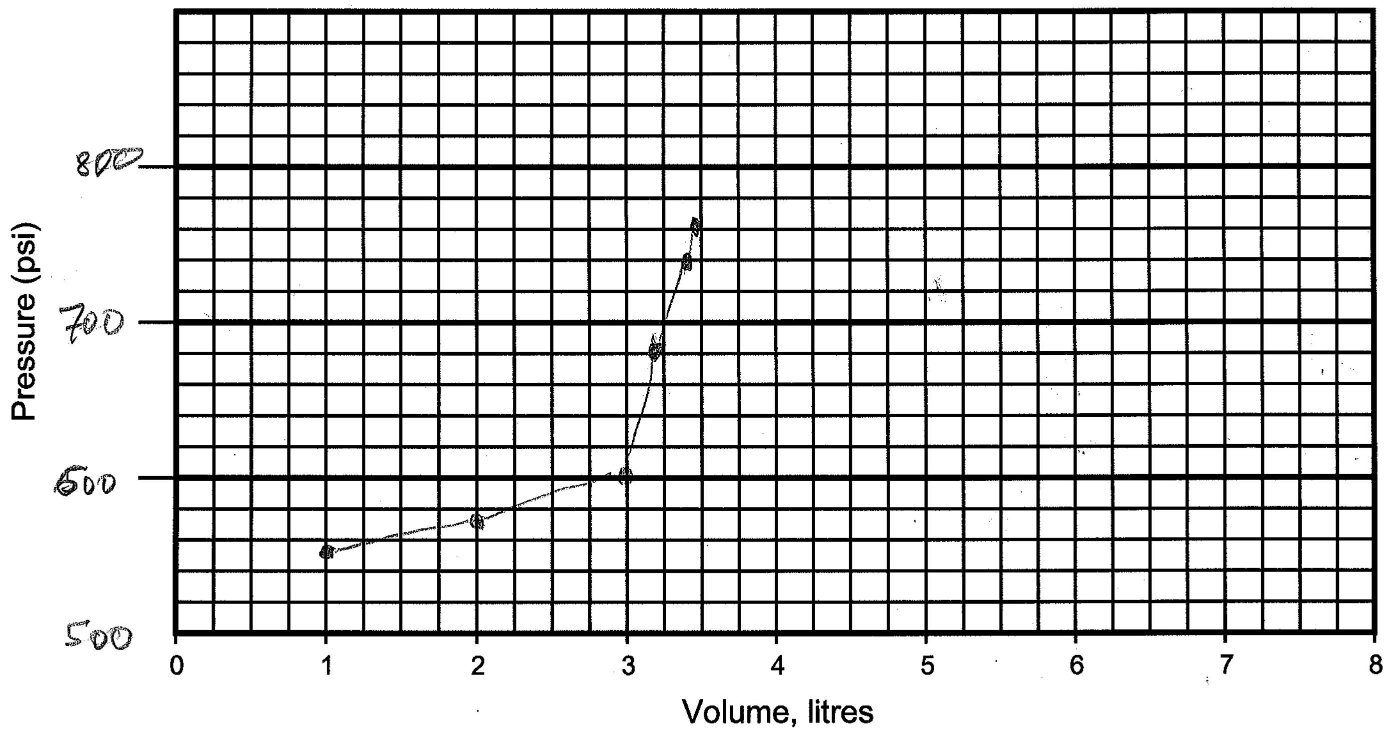
Packer Valve Pressure, $P_V$: 170 psi
Final Line Pressure, $P_L$: 780 psi
Tool Pressure, $P_T$: 475 psi

Borehole Water Level: 25 (ft / m) = 15 psi ($P_W$)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 150 psi

| Volume, litres | 1.0 | 2.0 | 3.0 | 3.2 | 3.25 | 3.3 | | Final Vol = | 3.15 | L |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 550 | 570 | 600 | 690 | 740 | 760 | | | | |

| Volume, litres | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | | | | | | | | | | |




Comments: Packer #
Time -

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Sheet 3 of 3

# Packer Inflation Record

Project: Minto
Project No.: 2CM022.007.001 .10
Well No.: MW09-4

Location: Phase 1 Confluence
Completed by: JS
Date Inflated: Nov 25 '09

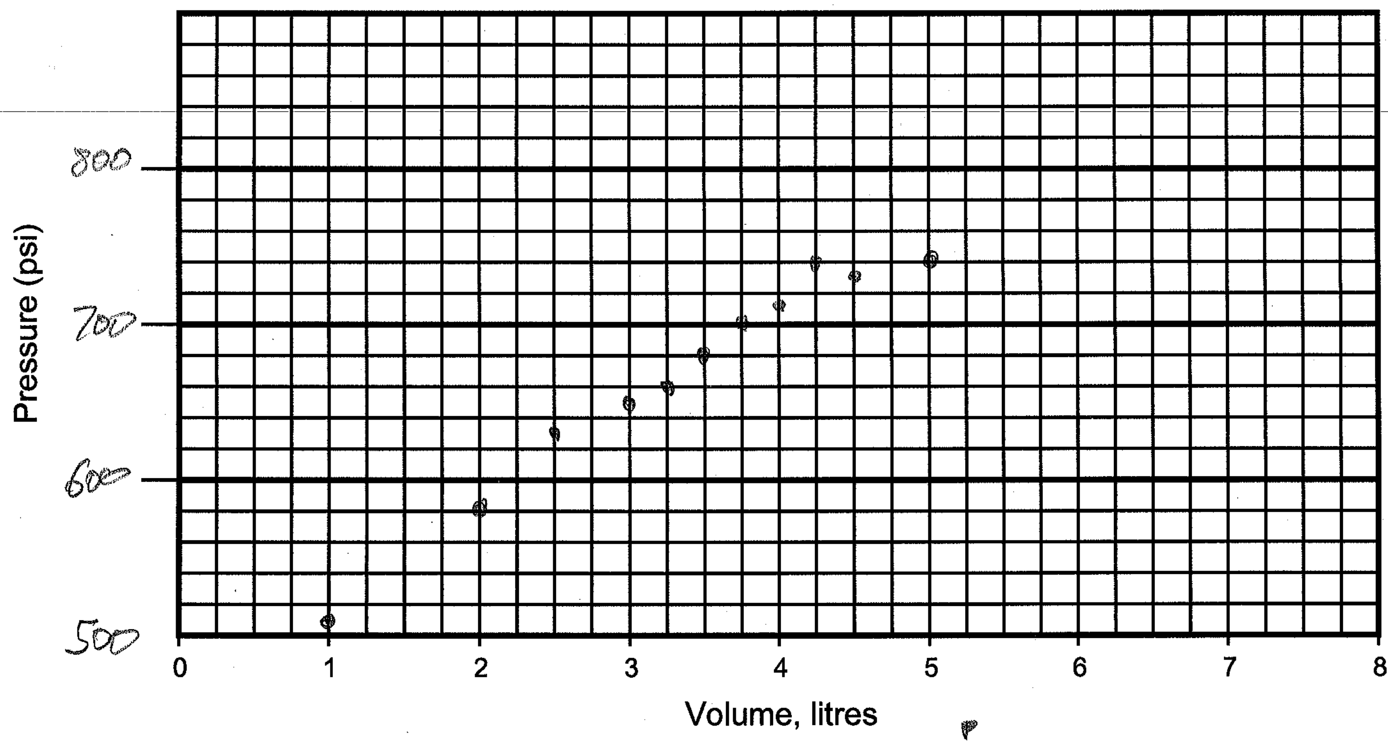
Packer No. 13
Depth ((ft) / m ): 145
Inflation Tool No.:

Packer Valve Pressure, $P_V$: 165 psi
Final Line Pressure, $P_L$: 775 psi
Tool Pressure, $P_T$: 475 psi

Borehole Water Level: ______ ( ft / m ) = ______ psi ($P_W$)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T =$ 150 psi

| Volume, litres | 1.0 | 2.0 | 2.5 | 3.0 | 3.25 | 3.5 | 3.75 | 4.0 | 4.25 | 4.5 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressure, psi | 510 | 580 | 630 | 650 | 660 | 680 | 700 | 710 | 740 | 730 |
| Volume, litres | 5.0 | 5.15 | | 5 L final | | | | | | |
| Pressure, psi | 740 | 420 | | | | | | | | |




Comments: Packer #
Time -

# Appendix C
## MP System: Groundwater Pressure Profiling and Sampling Protocols

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Vancouver, BC.
V6C 3B6

email: vancouver@srk.com
URL: http://www.srk.com
**Tel: 604.681.4196**
**Fax: 604.687.5532**

# TECHNICAL MEMORANDUM

DATE: May 30, 2007

TO: Field Personnel – SRK

FROM: Michael Royle

**RE: MP System: Groundwater Pressure Profiling and Sampling Protocols**

In order to ensure we have consistent pressure monitoring and water sampling methodology and sample QA/QC using the Westbay MP System equipment, the following field procedure is provided for all field staff to follow. This will be used to ensure that all pressure monitoring and water sample collection, handling, and equipment decontamination procedures are same for each monitoring round. Good monitoring QA will also help identify possible errors in pressure measurements and sample chemistry.

**Please make note of sample volume requirement changes in section 3.2**

## 1. General Operating Procedures

When operating the MP probes, the following points must be kept in mind:

1. **<u>The probe must be protected from freezing.</u>** Water in the sampling and transducer channels will expand and can easily damage/destroy the transducer or valve.
2. The probe should always be moved in its case, and never left in an unheated area for any length of time.
3. All connections and o-rings must be kept clean and lubricated. O-rings must be inspected regularly for damage. Failure of the connections can lead to leaks and damage the tool electronics.

## PROBLEMS – when pressure profiling or sampling

If any problems arise during probe operation, remember the following rules:

1. DO **<u>NOT</u>** PULL UP ON THE CABLE IF PROBE OR TAPE APPEARS TO BE JAMMED – this will only jam things in tighter.
2. STOP ALL WORK AND DRAW A DIAGRAM OF WHAT EQUIPMENT IS DOWN HOLE AND IN WHAT POSITION.
3. Check to see if anything may have been dropped down the MP Casing (pens, etc.);

4. Ensure water level tape is removed from drillhole, but DO NOT TRY AND REMOVE IF JAMMED as the tape may pull out of the probe head (yup .. it happens).
5. Make sure probe shoe is retracted (repeat this operation several times if necessary);
6. Gently test to see if probe is still stuck by pulling up GENTLY on the probe by hand. Stop immediately if it seems jammed.
7. If still stuck, call Michael Royle (SRK) at (604-681-4196) or Westbay Technical Services (604-984-4215) for advice

**Note:**

I spent a year at Westbay where I mostly dealt with minor problems that became major problems because people did not follow these steps. Main thing is, as soon as something seems wrong, stop and think about what is going on down the well. Don't worry about wasting a bit of time as most probes that get really stuck are due to haste And really stuck probes usually end up stuck at the bottom of the well, or coming out in pieces after a lot of very expensive work has been spent tearing them apart in order to save the well.

# 2. Pressure Profiling

A copy of the well log and the previous profile data must be taken to the field when conducting a pressure profile. This will provide the operator with a log of the casing to help in locating the magnetic collars and the measurement ports.

Any significant changes in zone pressure between the current and last reading must be noted. This helps spot operation errors (mislocating probe, testing against blank casing wall, etc.), or alerts the operator that the pressures have changed significantly and should be noted.

# 3. Water Sampling

## *3.1. Sampling Supplies*

### 3.1.1. Sample Bottles

Sample bottles will be coordinated through the client. Please ensure that they have at least four days notice to acquire all of the required bottles. Samples will be transported to the appropriate lab by either client staff or SRK staff. This needs to be clarified with the client before sampling takes place.

When ordering the sample bottles for the event, ask the client or lab to supply deionised water from the testing lab suitable for decontaminating equipment, trip blanks and equipment rinsate samples. The lab should be able to provide you with high grade ultra-pure water.

### 3.1.2. Deionised Water

The lab should also be requested to supply sample bottles with blank labels already affixed. Labels must be applied using water-proof adhesive. The DI water must be tested by the lab as part of the QA process to confirm it is not contested.

### 3.1.3. Chain of Custody Forms

Chain of Custody (COC) will be supplied by the lab with the bottles.. The COC forms must be filled in completely and signed by either the client or SRK and the lab when samples are relinquished.

The parameters to be analyzed will also be indicated on the COC.

## *3.2. Sampling Requirements*

As the sampling probe only collects approximately 400 to 500ml per sampling trip, the lab should be informed that reduced volumes will be collected from MP wells in order to make appropriate allowances for sample preparation and QA procedures. The following sample types and volumes will be used for these sampling stations:

| Parameter | Minimum Sample Vol. (ml) | Preservation | Filtration |
|---|---|---|---|
| Dissolved metals | 100 | Store between 2 and 10°C | none |
| Physical Parameters and Major Anions | 200 | Store between 2 and 10°C | none |
| TSS | na | na | na |
| Ammonia | na | na | na |

## *3.3. Decontaminating Sampler and Sample Collection Bottles*

See attached figures for explanation.

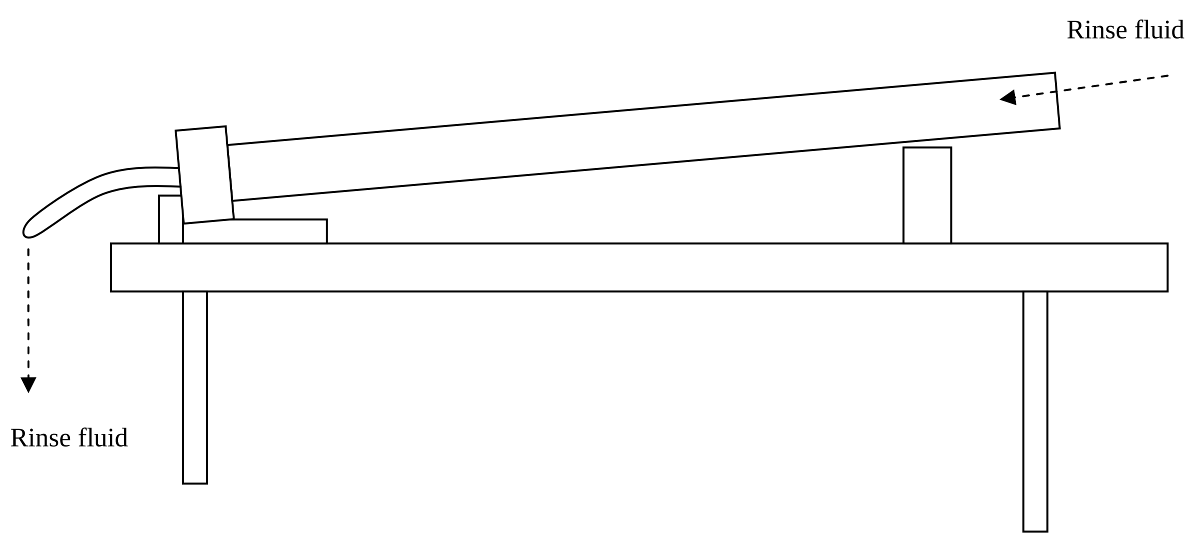
Decontamination procedure for the sampler and collection bottle/hoses is as follows:

.

1. Throughout this procedure, equipment should be handled with clean nitrile or latex gloves and every effort should be made to keep the equipment clean;
2. Hang sampler and collection bottle(s) from tripod on hanger hook, (be careful not to kink cable);
3. Dry off excess water on outside of probe and bottles using a clean, lint free cloth or paper towel;
4. Disconnect sample collection bottles from the string by detaching connecter hose at top of each bottle;

5. Set bottles aside on inclined decon racks (connector hose down);
6. Open sampler valve;
7. Rinse sampler face plate using lab supplied deionised (DI) water from spray bottle;
8. Rinse face plate and sampler internal tubing using dilute (1%) nitric acid solution, allowing fluid to flow through instrument and into collection bucket;
9. Rinse face plate and internal tubing three times more with DI water;
10. Rinse sample collection bottles by removing top cap and washing out with DI, 1% nitric acid, and then 3 DI rinses;
11. Repeat for top cap, making sure all fluids run through sample pathway. Ensure that 0-rings are well rinsed and in good condition.
12. Replace top cap onto clean bottle (do not place on table);
13. Reconnect collection bottles to sampler;
14. Collect rinsate sample by spraying DI water through open sampler valve and out bottom valve of the steel collection bottle (see Figure 1);
15. Let bottles drain and then close bottom valve.

**<u>Bottle shelf (if available)</u>**



## 3.4. Sample Bottle Labelling

All labels MUST be completed in full. Ensure the well and zone ID are on the label, ie:

**"Well ID" – "Zone Number"**

No other information should be added to the sample ID.

Date and time, as well as sampler initials, are required as these are useful for tracking potential sample mix ups in lab. To be consistent, time recorded should be when sample is transferred to sample bottle(s).

## 3.5. Sample Collection

Sample collection procedures are listed in the manual stored in the sampler case lid (under the foam). The general procedures are as follows:

### 3.5.1. Surface Checks and Preparation

1. Set up the MOSDAX Sampler probe following Steps 1 through 8 of Section 2.2 of the manual.
2. Record the results of the Surface Checks on the Groundwater Sampling Field Data Sheet.
3. Attach the sample containers. Make sure that all the valves except the last one on the bottom sample collection bottle are open.
4. Release the location arm (Arm Out command). Locate the probe in the vacuum coupling, making sure that the arm is resting in the groove on the inside of the coupling.
5. Activate the shoe in the vacuum coupling (Shoe Out command).
6. Close the sampler valve, if not already closed. The motor should run for about 5 seconds. The display should indicate one revolution.
7. Use the vacuum pump to apply a vacuum through the vacuum coupling (>18 psi). The vacuum should remain constant. If the vacuum is not maintained, inspect for leaks at the face seal of the probe, the connection to the pump and at the probe sampling valve.
8. Once a vacuum has been maintained, open the sampler valve (pressure should decrease rapidly). Apply a vacuum again (>18 psi).
9. Hold vacuum for at least 10 seconds (pressure remains constant) to ensure no leaks in connections to sample bottles.
10. Close the sampler valve. A vacuum has now been applied to the sample bottles.
11. Retract the shoe (Shoe In command).
12. Retract the arm (Arm In command).

### 3.5.2. Zone Sampling

1. Check recent pressure logs of the hole and ensure that the head inside the MP casing is lower than the head outside the measurement port to be sampled.
2. After completing the surface checks, follow Steps 1 to 5 of Section 2.3 in the manual to locate the sampler at the measurement port in the monitoring zone to be sampled.
3. Record the interior casing pressure ($P_i$) reading.
4. Activate the probe (Shoe Out command) and record the formation/zone pressure.
5. Open the sampler valve. The outer, or zone pressure ($P_o$) should drop and then slowly increase as the bottles fill. When the pressure in the bottle equals the zone pressure from Step 4, the bottle is full. Wait a maximum of two minutes per sample bottle if the pressures do not equilibrate. Record the pressure after filling (should not be significantly different than before opening the valve).
6. Close the sampler valve.
7. Retract the shoe (Shoe In command).
8. Record the interior casing pressure ($P_i$) reading. A reading the same as in Step 3 indicates that the sample is OK. If the interior pressure has dropped, the sample is suspect and may contain MP casing water (assuming $P_i < P_o$).
9. Raise probe 1 to 2 m to remove any slack on the cable and to ensure that the probe is no longer landed. Retract the arm (Arm In command).
10. Reel the sampler to the surface and remove it from the MP casing. <u>Care must be taken not to bend the probe cable excessively when lifting the tool and bottles from the MP casing.</u> Make sure hose connectors are also not bent excessively.
11. Hang probe and bottles from holder on tripod or roof of shack. Spray outside of probe with clean water to remove any soil or dirt on the probe and collection bottles.
12. **Do not open the sampler valve as damage to the probe or injury to the operator could occur if sample under pressure.**
13. Dry off excess water on outside of probe and bottles, using clean, lint free paper towels, to make sure it does not drip into sample bottles in next step.
14. Check sample bottles to ensure labels are correctly, and fully, filled in with all required details;
15. Remove the plastic thread protector cap from the bottom sample bottle and open the valve on the bottom of the bottle to release the pressure and to transfer the sample. Control flow using bottom valve.
16. Open the sampler valve to allow the sample to flow from the steel collection bottles directly into the lab supplied sample bottles. Once the pressure in the sampler and steel collection bottles has decreased to atmospheric, the bottles may be disconnected to speed the process.
17. Take particular care in handling pressurized samples.
18. Thoroughly rinse all equipment, inside and out, with deionised water before continuing to the next sample zone. Equipment does not need to be decontaminated if returning to same sample zone..

## 3.6. Sample QA/QC

To verify that sample results accurately reflect what was actually collected and not contamination during sample handling and laboratory analysis, a strict sample QA/QC protocol will be used.

NOTE: All QA samples should be labelled with a "dummy" ID that mimics actual well or zone samples. The sample will be labelled with a unique identifier that indicates it is a regular sample from a false sampling zone (ie: Zone 12 in a well that only has 11 zones). The sample will be analyzed for the same analytes as the other sampled zones.

All QA sample IDs MUST be recorded on the sample collection forms to prevent errors in data analysis later.

### 3.6.1. Travel Blanks

One unlabelled travel blank will be supplied by the laboratory for each sampling episode. The travel blank will consist of a lab prepared, sealed sample bottle containing lab supplied decontamination rinse water (deionised water). This sample will be carried in the sample cooler to the site and with the sampling gear to ensure it is in the same temperature conditions etc.

This sample should be returned to the lab with a "dummy" ID.

### 3.6.2. Field Blanks

One "field" blank will be prepared by the samplers using the same laboratory supplied DI as that used for the Rinsate Blanks. The field blank will be prepared under clean conditions (indoors or in the back of a clean truck), and will include the steps of rinsing the lab supplied bottles, and filling the bottles. These should be labelled with an ID resembling the sample ID's (as above). This sample is intended to distinguish any constituents that may be present in the lab supplied water from those that may be originating from the sampler.

### 3.6.3. Equipment Rinsate Blanks

Equipment Rinsate blanks should be collected from the decontaminated equipment to ensure proper decontamination is taking place. It is recommended that at least one rinsate sample be collected during each sampling event. This should be modified to one/sampler if staff changes occur during the sampling period.

### 3.6.4. Duplicate or Split Samples

Duplicate or splits will be submitted to test repeatability of the lab analysis. Duplicates and splits should be labelled with dissimilar sample IDs (ie: use false zone number for second sample). Collection of duplicate samples will need to take into account sample volume requirements discussed above.

### 3.6.5. Lab QA

Prior to carrying out the analyses, the lab will be requested to provide a full set of their QA data showing the calibration, detection limit and repeatability of the various analytical methods when they complete the analyses. These should be provided at the same time as the results.

The results of the lab and sample QA procedures should be reviewed at the same time as the data quality review. Any incidences of suspected contamination or mislabelling should be reviewed with the lab and samplers.

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# Piezometric Pressures/Levels
## Field Data and Calculation Sheet

**Well No.:** ____________
**Date:** ____________

Datum: ____________
Elev. G.S.: ____________
Height of MP above G.S.: ____________
Elev. top of MP Casing: ____________
Reference Elevation: ____________
Drillhole angle: ____________

Probe Type: ____________
Serial No.: ____________
Probe Range: ____________
MP Casing Type: ____________
Depth to water in MP: ____________ (at start)
Depth to water in MP: ____________ (at finish)

Client: ____________
Job No.: ____________
Location: ____________
Weather: ____________
Operator(s): ____________

**Ambient Reading ($P_{atm}$) (pressure, temperature, time)**
Start: ____________ Finish: ____________
**$P_{atm}$** ________ **psi**

**Note: "Port position" in angled drillholes refer to position along drillhole. True depth (Dp) needs to be calculated using drillhole angle and deviation data to calculate zone piezometric level (Dz).**

| **Zone No.** | Port Position From Log ( m ) | Port Position From Cable ( m ) | True Port Depth "Dp" ( m ) | Fluid Pressure Readings | | | Probe Temp. (°C ) | Time H:M:S | Pressure Head Outside Port (m) | Piez. Level Outside Port (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inside Casing (P1) | Outside Casing (P2) | Inside Casing (P1) | | | H = (P2-Patm)/w | Dz = Dp - H | |
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Notes: w = 1.422psi/m of $H_2O$ Dz = piezometric level in zone Patm = atmospheric pressure
H = pressure head of water in zone Dp = true depth of measurement port

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# Groundwater Sampling
## Field Data Sheet

Project: ______________________ Date: ______________________
Monitoring Well No: ______________________ Start Time: ______________________
Sampling Zone No(s): ______________________ Angled Drillhole (Y/N): ______________________ End Time: ______________________
Drillhole Angle: ______________________ Technicians: ______________________

| Zone No. | Cable Depth (m) | Log Depth of Mport (m) | Run No. | Surface Function Tests (probe in flushing collar) | | | | | | Position Sampler | Sample Collection Checks (probe located at sampling zone in MP casing) | | | | | | | | Comments (vol. retrieved) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Shoe Out | Close Valve | Check Vacuum | Open Valve | Evacuate Container | Close Valve | Locate port ( ) Arm out ( ) Land probe ( ) | Pressure in MP ( psi ) | Shoe Out | Zone Pressure ( psi ) | Open Valve | Zone Pressure ( psi ) | Close Valve | Shoe In | Pressure in MP ( psi) | |
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Additional Comments: (pH, Turbidity, S.C., etc.)

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## Well Development / Purging Record

**Well:** **Well Inner Diameter :** cm

**Total Depth:** mbtc **Static Water Level:** mbtc **Static Well Volume:** Litres

| **Date/Time** | **Volume Purged** (Litres) | **pH** | **EC** (uS/cm) | **T** (C) | **Eh** (mv) | **dO** (mg/l) | **Comments** |
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N.B. mbtc - meters below top of casing

# Appendix D
## Pressure Profiles

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# Piezometric Pressures/Levels
## Field Data and Calculation Sheet

Well No.: MW09-1
Date: 28 Nov 09

Datum: top of MP well
Elev. G.S.:
Height of MP above G.S.: 1.23 m
Elev. top of MP Casing:
Reference Elevation:
Drillhole angle: 90°

Probe Type: MOSDAX
Serial No.: ~~EMS~~ 2835
Probe Range: 250 psi
MP Casing Type: PVC
Depth to water in MP: 48.8m* (at start)
Depth to water in MP: n/a (at finish)

Client: Minto
Job No.: 2CM022.007.001-10
Location: West Pit
Weather: Cold, sunny
Operator(s): CD, JS

Note: "Port position" in angled drillholes refer to position along drillhole. True depth (Dp) needs to be calculated using drillhole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading ($P_{atm}$) (pressure, temperature, time)
Start: 12.95, 11.7°, 16:16
Finish: 12.99, 4.0°C 17:00
$P_{atm}$ 12.96 psi

| Zone No. | Port Position From Log (m) | Port Position From Cable (m) | True Port Depth "Dp" (m) | Fluid Pressure Readings | | | Probe Temp. (°C) | Time H:M:S | Pressure Head Outside Port (m) | Piez. Level Outside Port (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inside Casing (P1) | Outside Casing (P2) | Inside Casing (P1) | | | H = (P2-Patm)/w | Dz = Dp - H | |
| 1 | 44.2 | 43.6 | 44.2 | 12.96 | 18.34 | 12.99 | <5.7°C | 16:40 | | | |
| 2 | 33.5 | 33.0 | 33.5 | 12.93 | 37.10 | 13.03 | <4.8°C | 16:45 | | | |
| 3 | 25.9 | 25.3 | 25.9 | 13.02 | 26.28 | 12.99 | <4.4 | 16:49 | | | |
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Notes: w = 1.422psi/m of $H_2O$
H = pressure head of water in zone
Dz = piezometric level in zone
Dp = true depth of measurement port
Patm = atmospheric pressure

* measured from top of MP using MOSDAX probe as water tape not working

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*Engineers and Scientists*

# Piezometric Pressures/Levels
## Field Data and Calculation Sheet

Well No.: MW09-1
Date: 30 NOV 09

Datum: TOP OF MP WELL
Elev. G.S.:
Height of MP above G.S.: 0.29m
Elev. top of MP Casing:
Reference Elevation:
Drillhole angle: 90°

Probe Type: MOSDAY
Serial No.: EMIS 3835
Probe Range: 250 psi
MP Casing Type: PVC
Depth to water in MP: 42.46 m (at start)
Depth to water in MP: (at finish)

Client: MINTO
Job No.: 2CM022.007.001.10
Location: WEST PIT
Weather: COLD + SUNNY
Operator(s): CD + RS

Ambient Reading ($P_{atm}$) (pressure, temperature, time)
Start: 13.12, 11.4 11:30 Finish:
$P_{atm}$ 13.12 psi

**Note: "Port position" in angled drillholes refer to position along drillhole. True depth (Dp) needs to be calculated using drillhole angle and deviation data to calculate zone piezometric level (Dz).**

| Zone No. | Port Position From Log (m) | Port Position From Cable (m) | True Port Depth "Dp" (m) | Fluid Pressure Readings | | | Probe Temp. (°C) | Time H:M:S | Pressure Head Outside Port (m) | Piez. Level Outside Port (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inside Casing (P1) | Outside Casing (P2) | Inside Casing (P1) | | | H = (P2-Patm)/w | Dz = Dp - H | |
| 1 | 43.2 | 42.8 | 43.2 | 14.70 | 12.85 | 14.69 | <3.4 | 11:36 | | | |
| 2 | 32.5 | 32.0 | 32.5 | 13.18 | 18.95 | 13.19 | <2.3 | 11:40 | | | |
| 3 | 24.9 | 24.4 | 24.9 | 13.13 | 14.76 | 13.20 | <2.0 | 11:43 | | | |
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Notes: w = 1.422psi/m of $H_2O$
H = pressure head of water in zone
Dz = piezometric level in zone
Dp = true depth of measurement port
Patm = atmospheric pressure

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# Piezometric Pressures/Levels
## Field Data and Calculation Sheet

**Well No.:** MW09-2
**Date:** 1 DEC 09

Datum: TOC
Elev. G.S.:
Height of MP above G.S.: 0.16m
Elev. top of MP Casing:
Reference Elevation:
Drillhole angle: 90°

Probe Type: MOSDAY
Serial No.: EMIS 3835
Probe Range: 250 PSI
MP Casing Type: MP38
Depth to water in MP: 17.44m (at start)
Depth to water in MP: (at finish)

Client: MINTO
Job No.: 2CM022.007.001.10
Location: LOWER TAILINGS
Weather: COLD + CLEAR
Operator(s): CD, RS

**Ambient Reading ($P_{atm}$) (pressure, temperature, time)**
Start: 13.26, 11.01, 19:33 Finish: 13.23, 2.03°C
$P_{atm}$ 13.26 psi

**Note: "Port position" in angled drillholes refer to position along drillhole. True depth (Dp) needs to be calculated using drillhole angle and deviation data to calculate zone piezometric level (Dz).**

| Zone No. | Port Position From Log (m) | Port Position From Cable (m) | True Port Depth "Dp" (m) | Fluid Pressure Readings | | | Probe Temp. (°C) | Time H:M:S | Pressure Head Outside Port (m) | Piez. Level Outside Port (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inside Casing (P1) | Outside Casing (P2) | Inside Casing (P1) | | | H = (P2-Patm)/w | Dz = Dp - H | |
| 1 | 51.8 | 50.0 | 50.0 | 62.10 | 80.89 | 62.09 | <4.6 | 19:38 | | | |
| 2 | 47.2 | 45.3 | 45.3 | 55.36 | 74.39 | 55.35 | < 2.8 | 19:40 | | | |
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Notes: w = 1.422psi/m of $H_2O$
H = pressure head of water in zone
Dz = piezometric level in zone
Dp = true depth of measurement port
Patm = atmospheric pressure

TO TEST PUMP PORTS CLOSED

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# Piezometric Pressures/Levels
## Field Data and Calculation Sheet

Well No.: MW09-2
Date: 2 DEC 09

Datum: TOC
Elev. G.S.:
Height of MP above G.S.: 0.76 m
Elev. top of MP Casing:
Reference Elevation:
Drillhole angle: 90°

Probe Type: MOSDAX
Serial No.: EMIS 3835
Probe Range: 250psi
MP Casing Type: MP38
Depth to water in MP: (at start)
Depth to water in MP: (at finish)

Client: MINTO
Job No.: 2CM022.007.001.10
Location: LOWER TAILINGS
Weather: WINDY + COLD
Operator(s): CD

Ambient Reading ($P_{atm}$) (pressure, temperature, time)
Start: 13.10, 14 °C 16:10pm Finish:
$P_{atm}$ psi

**Note: "Port position" in angled drillholes refer to position along drillhole. True depth (Dp) needs to be calculated using drillhole angle and deviation data to calculate zone piezometric level (Dz).**

| Zone No. | Port Position From Log (m) | Port Position From Cable (m) | True Port Depth "Dp" (m) | Fluid Pressure Readings | | | Probe Temp. (°C) | Time H:M:S | Pressure Head Outside Port (m) | Piez. Level Outside Port (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inside Casing (P1) | Outside Casing (P2) | Inside Casing (P1) | | | H = (P2-Patm)/w | Dz = Dp - H | |
| 1 | 51.8 | 49.8 | 49.8 | 68.03 | 80.32 | 68.03 | <2.1°C | 16:15 | | | |
| 2 | 47.2 | 45.3 | 45.3 | 61.51 | 73.83 | 61.51 | <1°C | 16:18 | | | |
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| | | | | | | | | | | | THEN ADDED ANTIFREEZE |
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Notes: w = 1.422psi/m of $H_2O$
H = pressure head of water in zone
Dz = piezometric level in zone
Dp = true depth of measurement port
Patm = atmospheric pressure

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# Piezometric Pressures/Levels
## Field Data and Calculation Sheet

Well No.: MW09-3
Date: 27 NOV 09

Datum: 0.5magS
Elev. G.S.:
Height of MP above G.S.: 0.35 m
Elev. top of MP Casing:
Reference Elevation:
Drillhole angle: 90°

Probe Type: MOSDAX
Serial No.: EMS 3835
Probe Range: 250 psi
MP Casing Type: MP38
Depth to water in MP: 12.80 m (at start)
Depth to water in MP: (at finish)

Client: Minto
Job No.: 2CM022.007.001.10
Location: Minto North
Weather: Cold, overcast
Operator(s): JS, CD

**Ambient Reading ($P_{atm}$) (pressure, temperature, time)**
Start: 12.84 psi, 19.7 °C 17:18 Finish:
$P_{atm}$ 12.84 psi

**Note: "Port position" in angled drillholes refer to position along drillhole. True depth (Dp) needs to be calculated using drillhole angle and deviation data to calculate zone piezometric level (Dz).**

| Zone No. | Port Position From Log (m) | Port Position From Cable (m) | True Port Depth "Dp" (m) | Fluid Pressure Readings | | | Probe Temp. (°C) | Time H:M:S | Pressure Head Outside Port (m) | Piez. Level Outside Port (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inside Casing (P1) | Outside Casing (P2) | Inside Casing (P1) | | | H = (P2-Patm)/w | Dz = Dp - H | |
| 1 | 38.1 | 37.5 | 38.1 | 49.98 | 66.29 | 50.04 | <1.35 | 17:35 | | | |
| 2 | 24.4 | 23.7 | 24.4 | 30.13 | 42.70 | 30.13 | <0.94 | 17:44 | | | |
| 3 | 10.7 | 10.0 | 10.7 | 12.91 | 23.16 | 12.94 | 1.05 | 17:48 | | | |
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Notes:
w = 1.422psi/m of $H_2O$
H = pressure head of water in zone
Dz = piezometric level in zone
Dp = true depth of measurement port
Patm = atmospheric pressure

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# Piezometric Pressures/Levels
## Field Data and Calculation Sheet

Well No.: MW09-3
Date: 1 DEC 09

Datum: Top of casing
Elev. G.S.:
Height of MP above G.S.: 0.32 m
Elev. top of MP Casing:
Reference Elevation:
Drillhole angle: 90°

Probe Type: MOSDAX
Serial No.: EMIS 3835
Probe Range: 250psi
MP Casing Type: MP 38
Depth to water in MP: 17.78 (at start)
Depth to water in MP: (at finish)

Client: MINTO
Job No.: 2CM022.007
Location: MINTO NTH
Weather: COLD + SUNNY
Operator(s): CD, RS, GH

Ambient Reading ($P_{atm}$) (pressure, temperature, time)
Start: 13.05, 18.06 9:46 Finish: 13.06, 2.27
$P_{atm}$ 13.06 psi

**Note: "Port position" in angled drillholes refer to position along drillhole. True depth (Dp) needs to be calculated using drillhole angle and deviation data to calculate zone piezometric level (Dz).**

| Zone No. | Port Position From Log (m) | Port Position From Cable (m) | True Port Depth "Dp" (m) | Fluid Pressure Readings | | | Probe Temp. (°C) | Time H:M:S | Pressure Head Outside Port (m) | Piez. Level Outside Port (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inside Casing (P1) | Outside Casing (P2) | Inside Casing (P1) | | | H = (P2-Patm)/w | Dz = Dp - H | |
| 1 | 39.0 | 37.6 | 39.0 | 50.18 | 67.13 | 50.18 | <7.8 | 09:50 | | | |
| 2 | 25.3 | 23.8 | 25.3 | 30.26 | 42.75 | 30.25 | <4.3 | 09:52 | | | |
| 3 | 11.6 | 10.1 | 11.6 | 13.06 | 23.13 | 13.05 | <2.5 | 09:54 | | | |
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Notes: w = 1.422psi/m of $H_2O$
H = pressure head of water in zone
Dz = piezometric level in zone
Dp = true depth of measurement port
Patm = atmospheric pressure

# Appendix E
## Sampling Records

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## Well Development / Purging Record

29 Nov 09

CD + JS

**Well:** MW09-1 (MP well) **Well Inner Diameter:** MP 38 cm MINTO

**Total Depth:** mbtc **Static Water Level:** mbtc **Static Well Volume:** Litres

| Date/Time | Volume Purged (Litres) | pH | probe reads + 0.5 EC (mS) | T (C) | Eh (mv) | dO (mg/l) | Comments Started with Waterra full of water/antifreeze. |
|---|---|---|---|---|---|---|---|
| 15:45 | 20 | 9.69 | 1.2 | <4.6 | | | brown/red (antifreeze) |
| 16:00 | 30 | 8.96 | 0.7 | <6.0 | | | brown - very muddy |
| 16:12 | 40 | 8.84 | 0.7 | 6.1 | | | brown - very muddy |
| | ~~50~~ | ~~8.29~~ | | | | | |
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| 16:33 | 50 | 8.29 | 0.5 | 6.9 | | | grey-brown. |
| 16:45 | 60 | 8.21 | 0.5 | 7.7 | | | grey-brown |
| 17:00 | 70 | 8.07 | 0.5 | 6.9 | | | grey-brown |
| 18:20 | 80 | 8.02 | 0.5 | 7.1 | | | grey-brown |
| 18:30 | 90 | 8.02 | 0.5 | 6.3 | | | grey-brown |
| 18:45 | 100 | 7.96 | 0.4 | 9.8 | | | grey-brown |
| 19:20 | 115 | 7.9 | 0.91 | 8.0 | | | cloudy-grey |
| 19:38 | 125 | 7.1 | 0.78 | 7.5 | | | cloudy-grey |
| 19:50 | 150 | 7.80 | 0.81 | 6.4 | | | cloudy-grey. |
| 20:45 | 175 | 7.89 | 0.81 | 7.0 | | | cloudy-grey. |
| 21:20 | 200 | 7.88 | 0.82 | 7.7 | | | cloudy-grey |
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N.B. mbtc - meters below top of casing

This form is for a standpipe → better form for MP well? — find it or make it.

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# Groundwater Sampling
## Field Data Sheet

Well No.: MW 09-1
Date: 30 NOV 09

Zones sampled: 4 *
Drillhole angle: 90 degrees
Start Time: 12:05
End Time: 19:50

Client: MINTO
Job No.: 2CM022.007.001.10
Location: WEST PIT
Weather: COLD + SUNNY
Operator(s): CD + RS

| Zone No. | Sample Bottle Label | Port Position From Log (m) | Port Position From Cable (m) | Run No. | Surface Function Tests (probe in flushing collar): Shoe Out | Close Valve | Check Vacuum | Open Valve | Evacuate Container | Close Valve | Position Sampler: Locate Port ( ) Arm Out ( ) Land Probe ( ) | Sample Collection Checks (probe located at sampling zone in MP casing): Pressure in MP (psi) | Shoe Out | Zone Pressure (psi) | Open Valve | Zone Pressure (psi) | Time to Fill (min) | Close Valve | Shoe In | Pressure in MP (psi) | Volume Retrieved: Filtered & Preserved (mL) | Not Filtered / Not Preserved (mL) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MW09-1-1 | 43.2 | 43.6 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 15.74 | ✓ | 12.82 | ✓ | 12.66 | 0.5 | ✓ | ✓ | 15.73 | 0 | 0 | one tiny drop in bottle. |
| | | | | | | | | | | | | | | | | | | | | | | | → Void with air? |
| 2 | MW09-1-2 | 32.5 | 32.1 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 13.10 | ✓ | 18.42 | ✓ | 18.02 | 5 | ✓ | ✓ | 13.18 | 400 | | Dissolved Metals $HNO_3$ + |
| | | | | | | | | | | | | | | | | | | | | | | | Nutrients $H_2SO_4$ |
| 2 | MW09-1-2 | 32.5 | 32.1 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 13.14 | ✓ | 18.12 | ✓ | 17.79 | 5 | ✓ | ✓ | 13.19 | | 400 | Total metals $HNO_3$ |
| 2 | MW09-1-2 | 32.5 | 32.1 | 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 13.15 | ✓ | 17.89 | ✓ | 17.57 | 5 | ✓ | ✓ | 13.19 | | 200 | Routine Parameters. |
| 3 | MW09-1-3 | 24.9 | 24.0 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 13.14 | ✓ | 14.00 | ✓ | 13.98 | 5 | ✓ | ✓ | 13.18 | 400 | | Dissolved, Total, ½ Nutrients. |
| 3 | MW09-1-3 | 24.9 | 23.8 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 13.14 | ✓ | 13.87 | ✓ | 13.85 | 5 | ✓ | ✓ | 13.14 | | 400 | ½ Nutrients, ½ RP |
| 3 | MW09-1-3 | 24.9 | 23.8 | 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 13.10 | ✓ | 13.81 | ✓ | 13.81 | 5 | ✓ | ✓ | 13.14 | | 400 | ½ RP, ½ RP for zone 4* |
| 4* | MW09-1-4 | 24.9 | 23.6 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 13.12 | ✓ | 13.58 | ✓ | 13.55 | 5 | ✓ | ✓ | 13.13 | | 400 | ½ RP, DM |
| 4* | MW09-1-4 | 24.9 | 23.5 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 13.13 | ✓ | 13.51 | ✓ | 13.49 | 5 | ✓ | ✓ | 13.14 | | 300 | TM, Nutrients. |
| | | | | | | | | | | | | | | | | | | | | | | | |

Additional Comments: (pH, Turbidity, S.C., etc.)

* "Zone 4" is a duplicate of Zone 3 for QA/QC

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**Well Development / Purging Record**

1 DEC 2009 + 2 DEC 2009



Well: MW09-2    Well Inner Diameter : MP38 cm

Total Depth: mbtc    Static Water Level: 3.77 mbtc    Static Well Volume: 46L in MP casing before purging. Litres

| Date/Time | Volume Purged (Litres) | pH | EC (~~uS/cm~~) mS | T (C) | Eh (mv) | dO (mg/l) | Comments |
|---|---|---|---|---|---|---|---|
| 20:45 | 25 | 9.19 | 1.07 | 3.3 | — | — | black mud + antifreeze |
| 20:50 | 50 | 9.01 | 1.34 | 2.4 | — | — | black-grey |
| 20:55 | 75 | 8.54 | 1.16 | 2.3 | — | — | black-grey |
| 21:00 | 100 | 7.68 | 1.03 | 2.0 | — | — | black-grey |
| | | ANTIFREEZE PUT IN OVERNIGHT | | | | | |
| 2 | DEC | 2009 | | | | | |
| 09:48 | 125 | 8.71 | 1.15 | 6.0 | — | — | brown + antifreeze. |
| 09:58 | 150 | 7.97 | 1.08 | 4.1 | — | — | cloudy-grey-brown |
| 10:04 | 175 | 7.75 | 1.05 | 4.1 | — | — | cloudy-grey-brown |
| 10:12 | 200 | 7.59 | 1.05 | 4.0 | — | — | cloudy grey/brown |
| 10:19 | 225 | 7.49 | 1.00 | 2.9 | — | — | cloudy grey-brown |
| 10:25 | 250 | 7.53 | 1.01 | 2.3 | — | — | cloudy grey-brown |
| 10:31 | 275 | 7.49 | 0.99 | 3.1 | — | — | cloudy grey |
| 10:39 | 300 | 7.51 | 0.99 | 3.8 | — | — | cloudy grey |
| 10:46 | 325 | 7.52 | 0.97 | 3.5 | — | — | cloudy grey translucent |
| 10:51 | 350 | 7.51 | 0.99 | 3.1 | — | — | cloudy |
| 10:57 | 375 | 7.53 | 0.98 | 3.4 | — | — | cloudy |
| 11:02 | 400 | 7.53 | 0.99 | 2.5 | — | — | cloudy |
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N.B. mbtc - meters below top of casing

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# Groundwater Sampling
## Field Data Sheet

Well No.: MW09-2
Date: 2 DEC 09

Zones sampled: 3
Drillhole angle: 90 degrees
Start Time: 13:10
End Time: 16:30

Zone 1 51.8
Zone 2 47.2

$P_{atm}$ = 13.12 psi

Client: MINTO
Job No.: 2CM022.007.001-10
Location: LOWER TAILINGS
Weather: COLD, WINDY & SUNNY
Operator(s): CD, GH

RP = routine params
N = nutrients ($H_2SO_4$)
TM = Total metals ($HNO_3$)
DM = Dissolved metals ($HNO_3$)

| Zone No. | Sample Bottle Label | Port Position From Log (m) | Port Position From Cable (m) | Run No. | Surface Function Tests (probe in flushing collar): Shoe Out | Close Valve | Check Vacuum | Open Valve | Evacuate Container | Close Valve | Position Sampler: Locate Port ( ) Arm Out ( ) Land Probe ( ) | Sample Collection Checks (probe located at sampling zone in MP casing): Pressure in MP (psi) | Shoe Out | Zone Pressure (psi) | Open Valve | Zone Pressure (psi) | Time to Fill (min) | Close Valve | Shoe In | Pressure in MP (psi) | Volume Retrieved: Filtered & Preserved (mL) | Not Filtered / Not Preserved (mL) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MW09-2-1 | 51.8 | 49.8 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 60.57 | ✓ | 80.13 | ✓ | 74.36 | 10 | ✓ | ✓ | 60.59 | — | — | Temp <0.1°C |
| | | | | | | | | | | | | | | | | | | | | | | | Sample had antifreeze - [illegible] |
| 1 | MW09-2-1 | 51.8 | 49.5 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 63.12 | ✓ | 80.19 | ✓ | 80.16 | 4 | ✓ | ✓ | 63.13 | 400 | | N, TM, DM - no antifreeze |
| 1 | MW09-2-1 | 51.8 | 49.4 | 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 63.88 | ✓ | 80.21 | ✓ | 80.18 | 2 | ✓ | ✓ | 63.95 | | 400 | RP |
| 3 | MW09-2-3 | 51.8 | 49.4 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 64.05 | ✓ | 80.20 | ✓ | 80.19 | 2 | ✓ | ✓ | 64.10 | 400 | | N, TM, DM |
| 3 | MW09-2-3 | 51.8 | 49.0 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 64.44 | ✓ | 80.26 | ✓ | 80.23 | 2 | ✓ | ✓ | 64.47 | | 400 | RP |
| 2 | MW09-2-2 | 47.2 | 44.3 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 58.70 | ✓ | 73.77 | ✓ | 3.10 | — | ✓ | ✓ | 58.96 | | | NO FLOW → ICE? |
| | | | | | | | | | | | | | | | | | | | | | | | T ≈ 0.2 °C |

Additional Comments: (pH, Turbidity, S.C., etc.)

MW09-2-3 is a duplicate of MW09-2-1

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# Well Development / Purging Record

1 DEC 2009

Well: MW09-3 | Well Inner Diameter: MP38 cm

Total Depth: 50.45 mbtc | Static Water Level: 3.52m with ports open. mbtc | Static Well Volume: ~47 L inside MPwell prior to dev. Litres

| Date/Time | Volume Purged (Litres) | pH | EC ~~(uS/cm)~~ mS/cm | T (C) | Eh (mv) | dO (mg/l) | Comments |
|---|---|---|---|---|---|---|---|
| 11:22 | 25 | N/A | N/A | N/A | — | — | Antifreeze solution |
| 11:35 | 50 | 9.08 | 1.65 | 5.5 | — | — | Antifreeze solution. |
| 11:40 | 75 | 8.80 | 0.57 | 3.1 | — | — | cloudy-brown |
| 11:46 | 100 | 8.38 | 0.34 | 2.4 | — | — | cloudy - brown |
| 11:51 | 125 | 8.00 | 0.30 | 2.2 | — | — | cloudy - brown |
| 11:55 | 150 | 7.97 | 0.26 | 1.7 | — | — | cloudy - brown, clear in small container. |
| 11:59 | 175 | 7.93 | 0.23 | 2.0 | — | — | clear in small container |
| 12:03 | 200 | 7.82 | 0.23 | 1.7 | — | — | " " |
| 12:07 | 225 | 7.85 | 0.22 | 1.7 | — | — | " " |
| 12:11 | 250 | 7.81 | 0.21 | 1.7 | — | — | " " |
| 12:16 | 275 | 7.79 | 0.21 | 1.7 | — | — | " " |
| | | | | | | | |
| | | | | | | | WL 3.74m after purging. |
| | | | | | | | |
| | | | | | | | WL 4.08m from TOC after ports closed |
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |
| | | | | | | | |

N.B. mbtc - meters below top of casing

EC is a little off but abs. values not important for development purposes.

**SRK Consulting**
Engineers and Scientists

# MP Groundwater Sampling
## Field Data Sheet

Well No.: MW09-3
Date: 1 DEC 2009

Zones sampled: 4*
Drillhole angle: 90 degrees
Start Time: 13:10
End Time: 16:45

Atmospheric Pressure = 13.06 psia

Client: MINTO
Job No.: 2CM022.007.001.10
Location: MINTO NORTH
Weather: SUNNY + COLD
Operator(s): CD, RS, GH

| Zone No. | Sample Bottle Label | Port Position From Log (m) | Port Position From Cable (m) | Run No. | Surface Function Tests (probe in flushing collar) | | | | | | Position Sampler | Sample Collection Checks (probe located at sampling zone in MP casing) | | | | | | | | | Volume Retrieved | | DM= dissolved metals ($HNO_3$) filtered<br>TM= total metals ($HNO_3$)<br>N= nutrients ($H_2SO_4$)<br>Comments<br>RP= routine parameters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Shoe Out | Close Valve | Check Vacuum | Open Valve | Evacuate Container | Close Valve | Locate Port ( ) Arm Out ( ) Land Probe ( ) | Pressure in MP (psi) | Shoe Out | Zone Pressure (psi) | Open Valve | Zone Pressure (psi) | Time to Fill (min) | Close Valve | Shoe In | Pressure in MP (psi) | Filtered & Preserved (mL) | Not Filtered / Not Preserved (mL) | |
| 1 | MW09-3-1 | 37.6 | 37.4 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 63.03 | ✓ | 64.86 | ✓ | 62.85 | 6 | ✓ | ✓ | 63.08 | 400 | | DM, TM, Nutrients + brown colour |
| 1 | MW09-3-1 | 37.6 | 37.3 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 63.03 | ✓ | 64.38 | ✓ | 62.73 | 8 | ✓ | ✓ | 63.03 | | 400 | RP brown colour |
| 2 | MW09-3-2 | 23.8 | 23.3 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 43.36 | ✓ | 42.61 | ✓ | 41.87 | 13 | ✓ | ✓ | 43.37 | 400 | | DM, TM, N, clear |
| 2 | MW09-3-2 | 23.8 | 23.2 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 43.33 | ✓ | 42.48 | ✓ | 41.88 | 13 | ✓ | ✓ | 43.35 | | 400 | RP clear. T=0.3°C |
| 4* | MW09-3-4* | 23.8 | 23.1 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 43.30 | ✓ | 42.54 | ✓ | 41.87 | 13 | ✓ | ✓ | 43.31 | 400 | | DM, TM, N clear |
| 4* | MW09-3-4* | 23.8 | 23.0 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 43.28 | ✓ | 42.53 | ✓ | 41.88 | 13 | ✓ | ✓ | 43.28 | | 400 | RP clear |
| 3 | MW09-3-3 | 10.1 | 10.2 | 1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 23.61 | ✓ | 23.05 | ✓ | 23.05 | 4 | ✓ | ✓ | 23.60 | 400 | | DM, TM, N clear |
| 3 | MW09-3-3 | 10.1 | 10.2 | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓✓✓ | 23.60 | ✓ | 23.08 | ✓ | 23.05 | 3.5 | ✓ | ✓ | 23.59 | | 400 | RP clear |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |

Additional Comments: (pH, Turbidity, S.C., etc.)

* MW09-3-4 is a duplicate of MW09-3-2

# Appendix F
## MP Monitoring Well History Log

Appendix E: Sample MP Monitoring Well History Log

| Monitoring Well | Date | Comments | Pumping Port Status |
|---|---|---|---|
| **MW09-1** | Nov28, 09<br>Nov 29, 09<br>Nov 30, 09 | - installed, pressure profile<br>- developed<br>- sampled zones 1 to 4 | - all closed |
| **MW09-2** | Nov 26, 09<br>Dec 1, 09<br>Dec 2, 09 | - installed<br>- pressure profile and developed<br>- sampled zones 1 to 4 | - all closed |
| **MW09-3** | Nov 27, 09<br>Dec 2, 09 | - installed, pressure profile<br>- developed and sampled zones 1 to 4 | - all closed |
| **MW09-4** | Nov 24, 09 | - installed | - all closed |

# Appendix B

## Minto Mine:  Groundwater Monitoring System Sampling Report

# Minto Mine
# Groundwater Monitoring System
# Sampling Report

*Prepared for*

***Minto Explorations Ltd.***
*Suite 900-999 West Hastings Street*
*Vancouver, B.C. V6C 2W2*

SRK Consulting
Engineers and Scientists

*Prepared by*

*Project Reference Number*
*SRK 2CM022.007*

***July 2010***

# Minto Mine

# Groundwater Monitoring System Sampling Report

## Capstone Mining Corp.

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**SRK Project Number 2CM022.007.0001.03**

**July 2010**

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# 1 Introduction

This report provides monitoring results collected in March 2010 from the multilevel monitoring wells at the Minto Mine, Yukon. The purpose of the monitoring system is to improve the understanding of hydrogeological conditions across the site and provide background water levels and hydrogeochemistry for environmental monitoring of the site.

Figure 1 shows the general layout of the mine workings and all monitoring locations on the site.

Drillhole logs, methodologies and MP wells installation details are described in "Minto Mine, Groundwater Monitoring System Installation Report", SRK Consulting, Feb.2010.

# 2 Monitoring

## 2.1 Pressure Monitoring

Pressure profiles were carried out in wells MW09-1 and MW09-3. It was not possible to access the measurement ports in MW09-2 as the pipe had been sheared off by the ground movement, nor in MW09-04 as a large boulder had bent the pipe at shallow depth, preventing the probe to be lowered.

**Table 1: Pressure Measurements in MP Wells**

| Well ID | Zone # | Port Depth | Initial Pressure Reading* | | Pressure Round #1* | | Pressure Round#2* | |
|---|---|---|---|---|---|---|---|---|
| | | Mbgs* | psi | m | psi | m | psi | m |
| MW09-01 | 1 | 43.19 | 18.34 | 39.40 | 12.85 | 43.38 | 12.86 | 43.10 |
| | 2 | 32.52 | 37.10 | 15.54 | 18.95 | 28.42 | 13.48 | 32.00 |
| | 3 | 24.90 | 26.28 | 15.53 | 14.76 | 23.75 | 30.72 | 12.25 |
| MW09-02 | 1 | 51.82 | - | - | 80.89 | 4.26 | - | - |
| | 2 | 47.24 | - | - | 74.39 | 4.26 | - | - |
| MW09-03 | 1 | 37.95 | 66.29 | 0.36 | 67.13 | -0.07 | 65.29 | 0.89 |
| | 2 | 24.24 | 42.70 | 3.24 | 42.75 | 3.36 | 46.76 | 0.21 |
| | 3 | 10.52 | 23.16 | 3.26 | 23.13 | 3.44 | 22.54 | 3.52 |
| MW09-04 | 1 | 68.58 | - | - | - | - | - | - |
| | 2 | 54.86 | - | - | - | - | - | - |
| | 3 | 47.24 | - | - | - | - | - | - |

NOTE:
mbgs. Meter Below Ground Surface
Initial Pressure reading: November 27$^{th}$ and 28$^{th}$ 2009
Round #1: November 30$^{th}$ and December 1$^{st}$ 2009
Round#2: March 29$^{th}$ and 30$^{th}$ 2010

Figure 2 and Figure 3 show piezometric levels measured in each monitoring zone, plotted as "equivalent depth to water" for each time of measurements. "Equivalent depth to water" refers to the depth the water would be observed in an open standpipe if screened across the MP zone, and calculated by adding the pressure head (height of water column calculated from the zone pressure measured) to the depth of the measurement port where the pressure was measured.

Plots also show an "atmospheric line", which indicates where the pressure head equals zero (i.e., piezometric head equals elevation head). This condition will occur if the zone is unsaturated (dry), and is analogous to an open borehole where the water level is at, or below, the measurement zone. Therefore, unsaturated zones will plot along the atmospheric line while saturated zones will plot above this line.

## 2.2 Development and Sampling

Monitoring wells were sampled using equipment consisting of a "pressure probe/sampler" with stainless steel sample collection bottles to the wireline pressure measurement tool. A vacuum is induced in the bottles so that when the tool is connected to a measurement port and the valve to the sample bottles is opened, water flows from outside the casing into the bottles due to the pressure difference. Two 250ml sample bottles were used in tandem, collecting approximately 500mL with each run. The sample bottles were thoroughly rinsed with distilled water between sampling zones, and with nitric acid at the start of each day. Geochemical analyses were conducted by MEL Laboratory.

**Table 2: List of Groundwater Sampling Locations**

| Well ID | Zone # | Port Depth | Sample ID | Sampled | Comments |
|---|---|---|---|---|---|
| | | m | | Yes/No | |
| MW09-01 | 1 | 43.19 | Dry | No | - |
| | 2 | 32.52 | Dry | No | |
| | 3 | 24.90 | MW09-1-3 | Yes | |
| MW09-02 | 1 | 51.82 | - | No | Well broken |
| | 2 | 47.24 | - | No | |
| MW09-03 | 1 | 37.95 | MW09-3-1 | Yes | One Duplicate sample MW09-03-04 |
| | 2 | 24.24 | MW09-3-2 | Yes | |
| | 3 | 10.52 | MW09-3-3 | Yes | |
| MW09-04 | 1 | 68.58 | - | No | - |
| | 2 | 54.86 | - | No | |
| | 3 | 47.24 | - | No | |

Water samples were taken from:

- MW09-01 in Zone 3. Zone 1 and 2 did not appear to have any water flow; and
- MW09-03 in all zones.

One duplicate sample of MW09-03 in zone 3 and two blanks were taken and labelled as if it were an additional zone, as noted on the sampling records, which are included in Appendix A.

## 2.3 Sampling Results

Table 3 shows analyses of the laboratory results using blanks and duplicate sample. QA/QC of the groundwater laboratory results are summarized below:

- Ionic balance range between 106 and 116% which is considered reasonable;
- In both blank samples, parameters analyzed in laboratory remain below or close to the limit of detection. Concentration levels that have been measured above the limit of detection have very low concentrations and considered insignificant in terms of potential external contamination;
- There are no significant variations between measured concentrations in the MW09-03 (zone 3) sample and its duplicate; both of them have identical chemistry. The relative difference between the two samples is for most of the parameters less than 20%. Eleven parameters out of 93 show difference higher than 20%, but all within a very close range of the limit of detection which increase measurement sensitivity.

Results of the groundwater sampling are shown in Table 4.

## Table 3: QA/QC – Blanks and Duplicate Sample

| | Unit | DL | MW09-03 | MW09-03 DUP | Relative diff% |
|---|---|---|---|---|---|
| **Zone#** | - | | **3** | **3** | - |
| **Sample Label** | | | MW09-3-3 | MW09-3-4 | - |
| **Sample Id** | - | - | 3305939 | 3305940 | - |
| **Sample Location** | - | - | Minto North | Minto North | - |
| **Date Sampled** | m/dd/yyyy | - | 3/29/2010 | 3/29/2010 | - |
| **Sample Depth** | m | 0.1 | 10.5 | - | - |
| **Completed Date** | m/dd/yyyy | | 4/12/2010 | 4/12/2010 | - |
| **Matrix** | - | - | Water | Water | - |
| **Physical Tests** | | | | | |
| pH @25°C | (1) | - | 7.84 | 7.79 | 0.6% |
| Electrical Conductivity | µS/cm | 1 | 158 | 161 | 1.9% |
| Hardness as CaCO3 | mg/L | 5 | 69 | 71 | 2.9% |
| T-Alkalinity as CaCO3 | mg/L | 5 | 63 | 67 | 6.2% |
| Turbidity | NTU | 0.1 | 0.3 | 0.7 | 80.0% |
| Total Suspended Solids | mg/L | 1 | 4 | 4 | 0.0% |
| Total Dissolved Solids | mg/L | 5 | 114 | 112 | 1.8% |
| Colour | CU | 5 | 5 | 5 | 0.0% |
| **Major Anions and Cations** | | | | | |
| Carbonate | mg/L | 6 | *6* | *6* | 0.0% |
| Calcium | mg/L | 0.1 | 23.4 | 24.2 | 3.4% |
| Magnesium | mg/L | 0.1 | 2.4 | 2.6 | 8.0% |
| Sodium | mg/L | 0.1 | 2.6 | 2.7 | 3.8% |
| Phosphorus | mg/L | 0.01 | *0.01* | *0.01* | 0.0% |
| Potassium | mg/L | 0.1 | 2.3 | 2.2 | 4.4% |
| Silicon | mg/L | 0.05 | 3.85 | 3.98 | 3.3% |
| Bicarbonate | mg/L | 5 | 80 | 80 | 0.0% |
| Hydroxide | mg/L | 5 | *5* | *5* | 0.0% |
| Ionic Balance | % | - | 116 | 111 | 4.4% |
| **Anions and Nutrients** | | | | | |
| Ammonium - N | mg/L | 0.05 | *0.05* | *0.05* | 0.0% |
| Total Kjeldahl Nitrogen | mg/L | 0.06 | *0.06* | *0.06* | 0.0% |
| Total Phosphorus | mg/L | 0.05 | *0.05* | *0.05* | 0.0% |
| Orthophosphate-P | mg/L | 0.01 | 0.06 | 0.06 | 0.0% |
| Nitrate and Nitrite - N | mg/L | 0.01 | 0.47 | 0.48 | 2.1% |
| Chloride | mg/L | 0.02 | 0.61 | 0.61 | 0.0% |
| Sulfate (SO4) | mg/L | 0.6 | 10 | 10 | 0.0% |
| **Dissolved Metals** | | | | | |
| Aluminum | mg/L | 0.005 | *0.005* | 0.013 | 88.9% |
| Antimony | mg/L | 0.0002 | 0.0009 | 0.0012 | 28.6% |
| Arsenic | mg/L | 0.0002 | *0.0002* | *0.0002* | 0.0% |
| Barium | mg/L | 0.001 | 0.013 | 0.01 | 26.1% |
| Beryllium | mg/L | 0.00004 | *0.00004* | *0.00004* | 0.0% |
| Bismuth | mg/L | 0.001 | *0.001* | *0.001* | 0.0% |
| Boron | mg/L | 0.004 | 0.04 | 0.042 | 4.9% |
| Cadmium | mg/L | 0.00001 | 0.00002 | *0.00001* | 66.7% |
| Chromium | mg/L | 0.0004 | *0.0004* | *0.0004* | 0.0% |
| Cobalt | mg/L | 0.00002 | 0.00009 | 0.00008 | 11.8% |
| Copper | mg/L | 0.001 | 0.005 | 0.004 | 22.2% |
| Iron | mg/L | 0.01 | *0.01* | 0.03 | 100.0% |
| Lead | mg/L | 0.0001 | 0.0007 | 0.0002 | 111.1% |
| Lithium | mg/L | 0.001 | *0.001* | *0.001* | 0.0% |
| Manganese | mg/L | 0.0002 | 0.0129 | 0.0087 | 38.9% |
| Mercury | ug/L | 0.01 | *0.01* | *0.01* | 0.0% |
| Molybdenum | mg/L | 0.0001 | 0.0064 | 0.0049 | 26.5% |
| Nickel | mg/L | 0.001 | *0.001* | *0.001* | 0.0% |
| Selenium | mg/L | 0.0006 | *0.0006* | *0.0006* | 0.0% |
| Silver | mg/L | 0.00001 | *0.00001* | *0.00001* | 0.0% |
| Strontium | mg/L | 0.001 | 0.125 | 0.12 | 4.1% |
| Sulfur | mg/L | 0.2 | 3.4 | 3.5 | 2.9% |
| Tellurium | mg/L | 0.0001 | *0.0001* | *0.0001* | 0.0% |
| Thallium | mg/L | 0.00001 | *0.00001* | *0.00001* | 0.0% |
| Thorium | mg/L | 0.0004 | *0.0004* | *0.0004* | 0.0% |
| Tin | mg/L | 0.0001 | *0.0001* | *0.0001* | 0.0% |
| Titanium | mg/L | 0.01 | *0.01* | *0.01* | 0.0% |
| Uranium | mg/L | 0.0004 | *0.0004* | *0.0004* | 0.0% |
| Vanadium | mg/L | 0.0001 | 0.0002 | 0.0004 | 66.7% |
| Zinc | mg/L | 0.001 | 0.005 | 0.004 | 22.2% |
| Zirconium | mg/L | 0.0001 | 0.0001 | 0.0001 | 0.0% |

## Table 3: QA/QC – Blanks and Duplicate Sample

| | Unit | DL | MW09-03 | MW09-03 DUP | Relative diff% |
|---|---|---|---|---|---|
| **Zone#** | - | | **3** | **3** | - |
| **Sample Label** | | | MW09-3-3 | MW09-3-4 | - |
| **Sample Id** | - | - | 3305939 | 3305940 | - |
| **Sample Location** | - | - | Minto North | Minto North | - |
| **Date Sampled** | m/dd/yyyy | - | 3/29/2010 | 3/29/2010 | - |
| **Sample Depth** | m | 0.1 | 10.5 | - | - |
| **Completed Date** | m/dd/yyyy | | 4/12/2010 | 4/12/2010 | - |
| **Matrix** | - | - | Water | Water | - |
| **Total Metals** | | | | | |
| Aluminum | mg/L | 0.005 | 0.01 | 0.014 | 33.3% |
| Antimony | mg/L | 0.0002 | *0.0002* | 0.0003 | 40.0% |
| Arsenic | mg/L | 0.0002 | *0.0002* | *0.0002* | 0.0% |
| Barium | mg/L | 0.001 | 0.013 | 0.01 | 26.1% |
| Beryllium | mg/L | 0.00004 | *0.00004* | *0.00004* | 0.0% |
| Bismuth | mg/L | 0.001 | *0.001* | *0.001* | 0.0% |
| Boron | mg/L | 0.004 | 0.034 | 0.034 | 0.0% |
| Cadmium | mg/L | 0.00001 | 0.00001 | 0.00006 | 142.9% |
| Calcium | mg/L | 0.05 | 24.9 | 24.9 | 0.0% |
| Chromium | mg/L | 0.0004 | *0.0004* | 0.0006 | 40.0% |
| Cobalt | mg/L | 0.00002 | 0.00007 | 0.00006 | 15.4% |
| Copper | mg/L | 0.001 | 0.004 | 0.004 | 0.0% |
| Iron | mg/L | 0.01 | 0.027 | 0.047 | 54.1% |
| Lead | mg/L | 0.0001 | 0.0002 | 0.0002 | 0.0% |
| Lithium | mg/L | 0.001 | *0.001* | *0.001* | 0.0% |
| Magnesium | mg/L | 0.05 | 2.62 | 2.63 | 0.4% |
| Manganese | mg/L | 0.0002 | 0.0132 | 0.009 | 37.8% |
| Manganese | mg/L | 0.005 | 0.007 | *0.005* | 33.3% |
| Mercury | ug/L | 0.01 | *0.01* | *0.01* | 0.0% |
| Molybdenum | mg/L | 0.0001 | 0.0065 | 0.0051 | 24.1% |
| Nickel | mg/L | 0.001 | *0.001* | 0.001 | 0.0% |
| Potassium | mg/L | 0.1 | 2.1 | 1.9 | 10.0% |
| Selenium | mg/L | 0.0006 | *0.0006* | *0.0006* | 0.0% |
| Silicon | mg/L | 0.05 | 4.4 | 4.39 | 0.2% |
| Silver | mg/L | 0.00001 | 0.00004 | 0.00003 | 28.6% |
| Sodium | mg/L | 0.02 | 3.08 | 3.07 | 0.3% |
| Strontium | mg/L | 0.001 | 0.126 | 0.127 | 0.8% |
| Sulfur | mg/L | 0.1 | 3.4 | 3.4 | 0.0% |
| Tellurium | mg/L | 0.0001 | *0.0001* | *0.0001* | 0.0% |
| Thallium | mg/L | 0.00001 | *0.00001* | *0.00001* | 0.0% |
| Thorium | mg/L | 0.0004 | *0.0004* | *0.0004* | 0.0% |
| Tin | mg/L | 0.0001 | *0.0001* | *0.0001* | 0.0% |
| Titanium | mg/L | 0.001 | *0.001* | *0.001* | 0.0% |
| Uranium | mg/L | 0.0004 | *0.0004* | *0.0004* | 0.0% |
| Vanadium | mg/L | 0.0001 | 0.0003 | 0.0004 | 28.6% |
| Zinc | mg/L | 0.001 | 0.01 | 0.01 | 0.0% |
| Zirconium | mg/L | 0.0001 | *0.0001* | *0.0001* | 0.0% |

## Table 3: QA/QC – Blanks and Duplicate Sample

| | Unit | DL | Blank | Blank |
|---|---|---|---|---|
| **Zone#** | - | | - | - |
| **Sample Label** | | | MW09-1-5 | MW09-04-04 |
| **Sample Id** | - | - | 3305935 | 3305936 |
| **Sample Location** | - | - | West Pit | Camp |
| **Date Sampled** | m/dd/yyyy | - | 3/30/2010 | 3/29/2010 |
| **Sample Depth** | m | 0.1 | - | - |
| **Completed Date** | m/dd/yyyy | | 4/12/2010 | 4/12/2010 |
| **Matrix** | - | - | Water | Water |
| **Physical Tests** | | | | |
| pH @25°C | (1) | - | 6.46 | 6.15 |
| Electrical Conductivity | µS/cm | 1 | 2 | 1 |
| Hardness as CaCO3 | mg/L | 5 | <5 | <5 |
| T-Alkalinity as CaCO3 | mg/L | 5 | <5 | <5 |
| Turbidity | NTU | 0.1 | 0.4 | 0.1 |
| Total Suspended Solids | mg/L | 1 | <3 | <3 |
| Total Dissolved Solids | mg/L | 5 | 32 | 12 |
| Colour | CU | 5 | <5 | <5 |
| **Major Anions and Cations** | | | | |
| Carbonate | mg/L | 6 | <6 | <6 |
| Calcium | mg/L | 0.1 | <0.1 | <0.1 |
| Magnesium | mg/L | 0.1 | <0.1 | <0.1 |
| Sodium | mg/L | 0.1 | <0.1 | <0.1 |
| Phosphorus | mg/L | 0.01 | <0.01 | <0.01 |
| Potassium | mg/L | 0.1 | 0.7 | 0.6 |
| Silicon | mg/L | 0.05 | 3.38 | <0.05 |
| Bicarbonate | mg/L | 5 | <5 | <5 |
| Hydroxide | mg/L | 5 | <5 | <5 |
| Ionic Balance | % | - | - | - |
| **Anions and Nutrients** | | | | |
| Ammonium - N | mg/L | 0.05 | <0.05 | <0.05 |
| Total Kjeldahl Nitrogen | mg/L | 0.06 | <0.06 | <0.06 |
| Total Phosphorus | mg/L | 0.05 | <0.05 | <0.05 |
| Orthophosphate-P | mg/L | 0.01 | 0.06 | <0.01 |
| Nitrate and Nitrite - N | mg/L | 0.01 | 0.02 | <0.01 |
| Chloride | mg/L | 0.02 | 0.24 | <0.02 |
| Sulfate (SO4) | mg/L | 0.6 | <0.6 | <0.6 |
| **Dissolved Metals** | | | | |
| Aluminum | mg/L | 0.005 | <0.005 | <0.005 |
| Antimony | mg/L | 0.0002 | 0.0007 | 0.0006 |
| Arsenic | mg/L | 0.0002 | <0.0002 | <0.0002 |
| Barium | mg/L | 0.001 | <0.001 | <0.001 |
| Beryllium | mg/L | 0.00004 | <0.00004 | <0.00004 |
| Bismuth | mg/L | 0.001 | <0.001 | <0.001 |
| Boron | mg/L | 0.004 | 0.007 | <0.004 |
| Cadmium | mg/L | 0.00001 | 0.00002 | <0.00001 |
| Chromium | mg/L | 0.0004 | <0.0004 | <0.0004 |
| Cobalt | mg/L | 0.00002 | 0.00004 | 0.00002 |
| Copper | mg/L | 0.001 | 0.001 | <0.001 |
| Iron | mg/L | 0.01 | <0.01 | <0.01 |
| Lead | mg/L | 0.0001 | 0.0001 | 0.0002 |
| Lithium | mg/L | 0.001 | <0.001 | <0.001 |
| Manganese | mg/L | 0.0002 | 0.0003 | <0.0002 |
| Mercury | ug/L | 0.01 | <0.01 | <0.01 |
| Molybdenum | mg/L | 0.0001 | <0.0001 | <0.0001 |
| Nickel | mg/L | 0.001 | <0.001 | <0.001 |
| Selenium | mg/L | 0.0006 | <0.0006 | <0.0006 |
| Silver | mg/L | 0.00001 | <0.00001 | <0.00001 |
| Strontium | mg/L | 0.001 | <0.001 | <0.001 |
| Sulfur | mg/L | 0.2 | <0.2 | <0.2 |
| Tellurium | mg/L | 0.0001 | <0.0001 | <0.0001 |
| Thallium | mg/L | 0.00001 | <0.00001 | <0.00001 |
| Thorium | mg/L | 0.0004 | <0.0004 | <0.0004 |
| Tin | mg/L | 0.0001 | <0.0001 | <0.0001 |
| Titanium | mg/L | 0.01 | <0.01 | <0.01 |
| Uranium | mg/L | 0.0004 | <0.0004 | <0.0004 |
| Vanadium | mg/L | 0.0001 | <0.0001 | <0.0001 |
| Zinc | mg/L | 0.001 | 0.004 | 0.004 |
| Zirconium | mg/L | 0.0001 | <0.0001 | <0.0001 |

## Table 3: QA/QC – Blanks and Duplicate Sample

| | Unit | DL | Blank | Blank |
|---|---|---|---|---|
| **Zone#** | - | | - | - |
| **Sample Label** | | | MW09-1-5 | MW09-04-04 |
| **Sample Id** | - | - | 3305935 | 3305936 |
| **Sample Location** | - | - | West Pit | Camp |
| **Date Sampled** | m/dd/yyyy | - | 3/30/2010 | 3/29/2010 |
| **Sample Depth** | m | 0.1 | - | - |
| **Completed Date** | m/dd/yyyy | | 4/12/2010 | 4/12/2010 |
| **Matrix** | - | - | Water | Water |
| **Total Metals** | | | | |
| Aluminum | mg/L | 0.005 | <0.005 | <0.005 |
| Antimony | mg/L | 0.0002 | <0.0002 | <0.0002 |
| Arsenic | mg/L | 0.0002 | <0.0002 | <0.0002 |
| Barium | mg/L | 0.001 | <0.001 | <0.001 |
| Beryllium | mg/L | 0.00004 | <0.00004 | <0.00004 |
| Bismuth | mg/L | 0.001 | <0.001 | <0.001 |
| Boron | mg/L | 0.004 | 0.016 | 0.01 |
| Cadmium | mg/L | 0.00001 | <0.00001 | <0.00001 |
| Calcium | mg/L | 0.05 | <0.05 | <0.05 |
| Chromium | mg/L | 0.0004 | <0.0004 | <0.0004 |
| Cobalt | mg/L | 0.00002 | <0.00002 | <0.00002 |
| Copper | mg/L | 0.001 | <0.001 | <0.001 |
| Iron | mg/L | 0.01 | 0.026 | <0.01 |
| Lead | mg/L | 0.0001 | 0.0001 | <0.0001 |
| Lithium | mg/L | 0.001 | <0.001 | <0.001 |
| Magnesium | mg/L | 0.05 | <0.05 | <0.05 |
| Manganese | mg/L | 0.0002 | 0.0002 | <0.0002 |
| Manganese | mg/L | 0.005 | <0.005 | <0.005 |
| Mercury | ug/L | 0.01 | <0.01 | <0.01 |
| Molybdenum | mg/L | 0.0001 | <0.0001 | <0.0001 |
| Nickel | mg/L | 0.001 | <0.001 | <0.001 |
| Potassium | mg/L | 0.1 | 0.1 | <0.1 |
| Selenium | mg/L | 0.0006 | <0.0006 | <0.0006 |
| Silicon | mg/L | 0.05 | 3.7 | <0.05 |
| Silver | mg/L | 0.00001 | <0.00001 | <0.00001 |
| Sodium | mg/L | 0.02 | 0.13 | 0.3 |
| Strontium | mg/L | 0.001 | <0.001 | 0.001 |
| Sulfur | mg/L | 0.1 | <0.1 | <0.1 |
| Tellurium | mg/L | 0.0001 | <0.0001 | <0.0001 |
| Thallium | mg/L | 0.00001 | <0.00001 | <0.00001 |
| Thorium | mg/L | 0.0004 | <0.0004 | <0.0004 |
| Tin | mg/L | 0.0001 | <0.0001 | <0.0001 |
| Titanium | mg/L | 0.001 | <0.001 | <0.001 |
| Uranium | mg/L | 0.0004 | <0.0004 | <0.0004 |
| Vanadium | mg/L | 0.0001 | <0.0001 | <0.0001 |
| Zinc | mg/L | 0.001 | 0.003 | 0.005 |
| Zirconium | mg/L | 0.0001 | <0.0001 | <0.0001 |

## Table 4: Summary of Groundwater Sampling Results

| | Unit | DL | MW09-01 | MW09-03 | MW09-3-2 | MW09-03 | MW09-03 DUP | Blank | Blank |
|---|---|---|---|---|---|---|---|---|---|
| **Zone#** | - | | 3 | 1 | 2 | 3 | 3 | - | - |
| **Sample Label** | | | MW09-1-3 | MW09-3-1 | MW09-3-2 | MW09-3-3 | MW09-3-4 | MW09-1-5 | MW09-04-04 |
| **Sample Id** | - | - | 3305934 | 3305937 | 3305938 | 3305939 | 3305940 | 3305935 | 3305936 |
| **Sample Location** | - | - | West Pit | Minto North | Minto North | Minto North | Minto North | West Pit | Camp |
| **Date Sampled** | m/dd/yyyy | - | 3/30/2010 | 3/29/2010 | 3/29/2010 | 3/29/2010 | 3/29/2010 | 3/30/2010 | 3/29/2010 |
| **Sample Depth** | m | 0.1 | 24.7 | 37.9 | 24.2 | 10.5 | - | - | - |
| **Completed Date** | m/dd/yyyy | | 4/12/2010 | 4/12/2010 | 4/12/2010 | 4/12/2010 | 4/12/2010 | 4/12/2010 | 4/12/2010 |
| **Matrix** | - | - | Water | Water | Water | Water | Water | Water | Water |
| **Physical Tests** | | | | | | | | | |
| pH @25°C | (1) | - | 8.04 | 8 | 8.05 | 7.84 | 7.79 | 6.46 | 6.15 |
| Electrical Conductivity | µS/cm | 1 | 941 | 315 | 502 | 158 | 161 | 2 | 1 |
| Hardness as CaCO3 | mg/L | 5 | 336 | 144 | 178 | 69 | 71 | <5 | <5 |
| T-Alkalinity as CaCO3 | mg/L | 5 | 184 | 137 | 130 | 63 | 67 | <5 | <5 |
| Turbidity | NTU | 0.1 | 64 | 2.5 | 3 | 0.3 | 0.7 | 0.4 | 0.1 |
| Total Suspended Solids | mg/L | 1 | 70 | <4 | <7 | <4 | <4 | <3 | <3 |
| Total Dissolved Solids | mg/L | 5 | 630 | 196 | 324 | 114 | 112 | 32 | 12 |
| Colour | CU | 5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| **Major Anions and Cations** | | | | | | | | | |
| Carbonate | mg/L | 6 | <6 | <6 | <6 | <6 | <6 | <6 | <6 |
| Calcium | mg/L | 0.1 | 93.7 | 41.2 | 56.3 | 23.4 | 24.2 | <0.1 | <0.1 |
| Magnesium | mg/L | 0.1 | 24.7 | 9.9 | 9.2 | 2.4 | 2.6 | <0.1 | <0.1 |
| Sodium | mg/L | 0.1 | 53.3 | 5.7 | 24.9 | 2.6 | 2.7 | <0.1 | <0.1 |
| Phosphorus | mg/L | 0.01 | 0.03 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Potassium | mg/L | 0.1 | 7 | 4.4 | 6.6 | 2.3 | 2.2 | 0.7 | 0.6 |
| Silicon | mg/L | 0.05 | 3.39 | 4 | 3.7 | 3.85 | 3.98 | 3.38 | <0.05 |
| Bicarbonate | mg/L | 5 | 220 | 170 | 160 | 80 | 80 | <5 | <5 |
| Hydroxide | mg/L | 5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Ionic Balance | % | - | 106 | 115 | 108 | 116 | 111 | - | - |
| **Anions and Nutrients** | | | | | | | | | |
| Ammonium - N | mg/L | 0.05 | 6.16 | 0.35 | 0.99 | <0.05 | <0.05 | <0.05 | <0.05 |
| Total Kjeldahl Nitrogen | mg/L | 0.06 | 8.89 | 0.4 | 1.22 | <0.06 | <0.06 | <0.06 | <0.06 |
| Total Phosphorus | mg/L | 0.05 | 0.09 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Orthophosphate-P | mg/L | 0.01 | 0.06 | 0.06 | 0.07 | 0.06 | 0.06 | 0.06 | <0.01 |
| Nitrate and Nitrite - N | mg/L | 0.01 | 21.6 | 0.26 | 16.1 | 0.47 | 0.48 | 0.02 | <0.01 |
| Chloride | mg/L | 0.02 | 18.5 | 0.4 | 3.82 | 0.61 | 0.61 | 0.24 | <0.02 |
| Sulfate (SO4) | mg/L | 0.6 | 169 | 23 | 48.9 | 10 | 10 | <0.6 | <0.6 |
| **Total Metals** | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 1.31 | 0.043 | 0.03 | 0.01 | 0.014 | <0.005 | <0.005 |
| Antimony | mg/L | 0.0002 | 0.0005 | 0.0002 | <0.0002 | <0.0002 | 0.0003 | <0.0002 | <0.0002 |
| Arsenic | mg/L | 0.0002 | 0.0012 | 0.0004 | 0.0015 | <0.0002 | <0.0002 | <0.0002 | <0.0002 |
| Barium | mg/L | 0.001 | 0.186 | 0.05 | 0.036 | 0.013 | 0.01 | <0.001 | <0.001 |
| Beryllium | mg/L | 0.00004 | 0.00005 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 |
| Bismuth | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | mg/L | 0.004 | 0.095 | 0.29 | 1.92 | 0.034 | 0.034 | 0.016 | 0.01 |
| Cadmium | mg/L | 0.00001 | 0.00014 | 0.00011 | 0.00004 | 0.00001 | 0.00006 | <0.00001 | <0.00001 |
| Calcium | mg/L | 0.05 | 98.7 | 42.5 | 59.3 | 24.9 | 24.9 | <0.05 | <0.05 |
| Chromium | mg/L | 0.0004 | 0.0072 | 0.0022 | 0.0014 | <0.0004 | 0.0006 | <0.0004 | <0.0004 |
| Cobalt | mg/L | 0.00002 | 0.00147 | 0.00019 | 0.00022 | 0.00007 | 0.00006 | <0.00002 | <0.00002 |
| Copper | mg/L | 0.001 | 0.029 | 0.006 | 0.008 | 0.004 | 0.004 | <0.001 | <0.001 |
| Iron | mg/L | 0.01 | 3.37 | 0.183 | 0.175 | 0.027 | 0.047 | 0.026 | <0.01 |
| Lead | mg/L | 0.0001 | 0.001 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0001 | <0.0001 |
| Lithium | mg/L | 0.001 | 0.003 | 0.003 | 0.005 | <0.001 | <0.001 | <0.001 | <0.001 |
| Magnesium | mg/L | 0.05 | 26.8 | 10.4 | 9.76 | 2.62 | 2.63 | <0.05 | <0.05 |
| Manganese (Trace) | mg/L | 0.0002 | 0.225 | 0.123 | 0.0677 | 0.0132 | 0.009 | 0.0002 | <0.0002 |
| Manganese (SemiTrace) | mg/L | 0.005 | 0.219 | 0.118 | 0.06 | 0.007 | <0.005 | <0.005 | <0.005 |
| Mercury | ug/L | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Molybdenum | mg/L | 0.0001 | 0.146 | 0.006 | 0.0468 | 0.0065 | 0.0051 | <0.0001 | <0.0001 |
| Nickel | mg/L | 0.001 | 0.006 | 0.007 | 0.002 | <0.001 | 0.001 | <0.001 | <0.001 |
| Potassium | mg/L | 0.1 | 7.2 | 4.2 | 6.8 | 2.1 | 1.9 | 0.1 | <0.1 |
| Selenium | mg/L | 0.0006 | 0.0019 | <0.0006 | 0.0029 | <0.0006 | <0.0006 | <0.0006 | <0.0006 |
| Silicon | mg/L | 0.05 | 7 | 4.6 | 4.11 | 4.4 | 4.39 | 3.7 | <0.05 |
| Silver | mg/L | 0.00001 | 0.00012 | 0.00006 | 0.00017 | 0.00004 | 0.00003 | <0.00001 | <0.00001 |
| Sodium | mg/L | 0.02 | 56.9 | 7.37 | 25.7 | 3.08 | 3.07 | 0.13 | 0.3 |
| Strontium | mg/L | 0.001 | 1.43 | 0.886 | 0.785 | 0.126 | 0.127 | <0.001 | 0.001 |
| Sulfur | mg/L | 0.1 | 58.3 | 7.3 | 15.8 | 3.4 | 3.4 | <0.1 | <0.1 |
| Tellurium | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Thallium | mg/L | 0.00001 | 0.00002 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |
| Thorium | mg/L | 0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Tin | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Titanium | mg/L | 0.001 | 0.079 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Uranium | mg/L | 0.0004 | <0.0004 | 0.0015 | 0.0014 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Vanadium | mg/L | 0.0001 | 0.0049 | 0.0003 | 0.0005 | 0.0003 | 0.0004 | <0.0001 | <0.0001 |
| Zinc | mg/L | 0.001 | 0.025 | 0.016 | 0.01 | 0.01 | 0.01 | 0.003 | 0.005 |
| Zirconium | mg/L | 0.0001 | 0.0005 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |

## Table 4: Summary of Groundwater Sampling Results

| | Unit | DL | MW09-01 | MW09-03 | MW09-3-2 | MW09-03 | MW09-03 DUP | Blank | Blank |
|---|---|---|---|---|---|---|---|---|---|
| **Zone#** | - | | 3 | 1 | 2 | 3 | 3 | - | - |
| **Sample Label** | | | MW09-1-3 | MW09-3-1 | MW09-3-2 | MW09-3-3 | MW09-3-4 | MW09-1-5 | MW09-04-04 |
| **Sample Id** | - | - | 3305934 | 3305937 | 3305938 | 3305939 | 3305940 | 3305935 | 3305936 |
| **Sample Location** | - | - | West Pit | Minto North | Minto North | Minto North | Minto North | West Pit | Camp |
| **Date Sampled** | m/dd/yyyy | - | 3/30/2010 | 3/29/2010 | 3/29/2010 | 3/29/2010 | 3/29/2010 | 3/30/2010 | 3/29/2010 |
| **Sample Depth** | m | 0.1 | 24.7 | 37.9 | 24.2 | 10.5 | - | - | - |
| **Completed Date** | m/dd/yyyy | | 4/12/2010 | 4/12/2010 | 4/12/2010 | 4/12/2010 | 4/12/2010 | 4/12/2010 | 4/12/2010 |
| **Matrix** | - | - | Water | Water | Water | Water | Water | Water | Water |
| **Dissolved Metals** | | | | | | | | | |
| Aluminum | mg/L | 0.005 | 0.048 | <0.005 | <0.005 | <0.005 | 0.013 | <0.005 | <0.005 |
| Antimony | mg/L | 0.0002 | 0.0011 | 0.0009 | 0.0018 | 0.0009 | 0.0012 | 0.0007 | 0.0006 |
| Arsenic | mg/L | 0.0002 | 0.0007 | 0.0002 | 0.0012 | <0.0002 | <0.0002 | <0.0002 | <0.0002 |
| Barium | mg/L | 0.001 | 0.142 | 0.047 | 0.035 | 0.013 | 0.01 | <0.001 | <0.001 |
| Beryllium | mg/L | 0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 | <0.00004 |
| Bismuth | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | mg/L | 0.004 | 0.095 | 0.106 | 1.99 | 0.04 | 0.042 | 0.007 | <0.004 |
| Cadmium | mg/L | 0.00001 | 0.00015 | 0.00012 | 0.00072 | 0.00002 | <0.00001 | 0.00002 | <0.00001 |
| Chromium | mg/L | 0.0004 | <0.0004 | 0.001 | 0.0013 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Cobalt | mg/L | 0.00002 | 0.00045 | 0.00014 | 0.0002 | 0.00009 | 0.00008 | 0.00004 | 0.00002 |
| Copper | mg/L | 0.001 | 0.021 | 0.004 | 0.006 | 0.005 | 0.004 | 0.001 | <0.001 |
| Iron | mg/L | 0.01 | 0.18 | 0.04 | <0.01 | <0.01 | 0.03 | <0.01 | <0.01 |
| Lead | mg/L | 0.0001 | 0.0003 | 0.0011 | 0.0003 | 0.0007 | 0.0002 | 0.0001 | 0.0002 |
| Lithium | mg/L | 0.001 | 0.003 | 0.003 | 0.004 | <0.001 | <0.001 | <0.001 | <0.001 |
| Manganese | mg/L | 0.0002 | 0.168 | 0.109 | 0.0616 | 0.0129 | 0.0087 | 0.0003 | <0.0002 |
| Mercury | ug/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Molybdenum | mg/L | 0.0001 | 0.148 | 0.0052 | 0.045 | 0.0064 | 0.0049 | <0.0001 | <0.0001 |
| Nickel | mg/L | 0.001 | 0.002 | 0.005 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium | mg/L | 0.0006 | 0.0018 | <0.0006 | 0.0028 | <0.0006 | <0.0006 | <0.0006 | <0.0006 |
| Silver | mg/L | 0.00001 | <0.00001 | <0.00001 | 0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |
| Strontium | mg/L | 0.001 | 1.41 | 0.863 | 0.739 | 0.125 | 0.12 | <0.001 | <0.001 |
| Sulfur | mg/L | 0.2 | 56.2 | 7.6 | 16.3 | 3.4 | 3.5 | <0.2 | <0.2 |
| Tellurium | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Thallium | mg/L | 0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 |
| Thorium | mg/L | 0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Tin | mg/L | 0.0001 | 0.0003 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Titanium | mg/L | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Uranium | mg/L | 0.0004 | <0.0004 | 0.0015 | 0.0014 | <0.0004 | <0.0004 | <0.0004 | <0.0004 |
| Vanadium | mg/L | 0.0001 | 0.0003 | 0.0001 | 0.0004 | 0.0002 | 0.0004 | <0.0001 | <0.0001 |
| Zinc | mg/L | 0.001 | 0.016 | 0.014 | 0.005 | 0.005 | 0.004 | 0.004 | 0.004 |
| Zirconium | mg/L | 0.0001 | 0.0002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |

This report, **“Minto Mine: Groundwater Monitoring System Sampling”,** has been prepared by SRK Consulting (Canada) Inc.:

**Prepared by**

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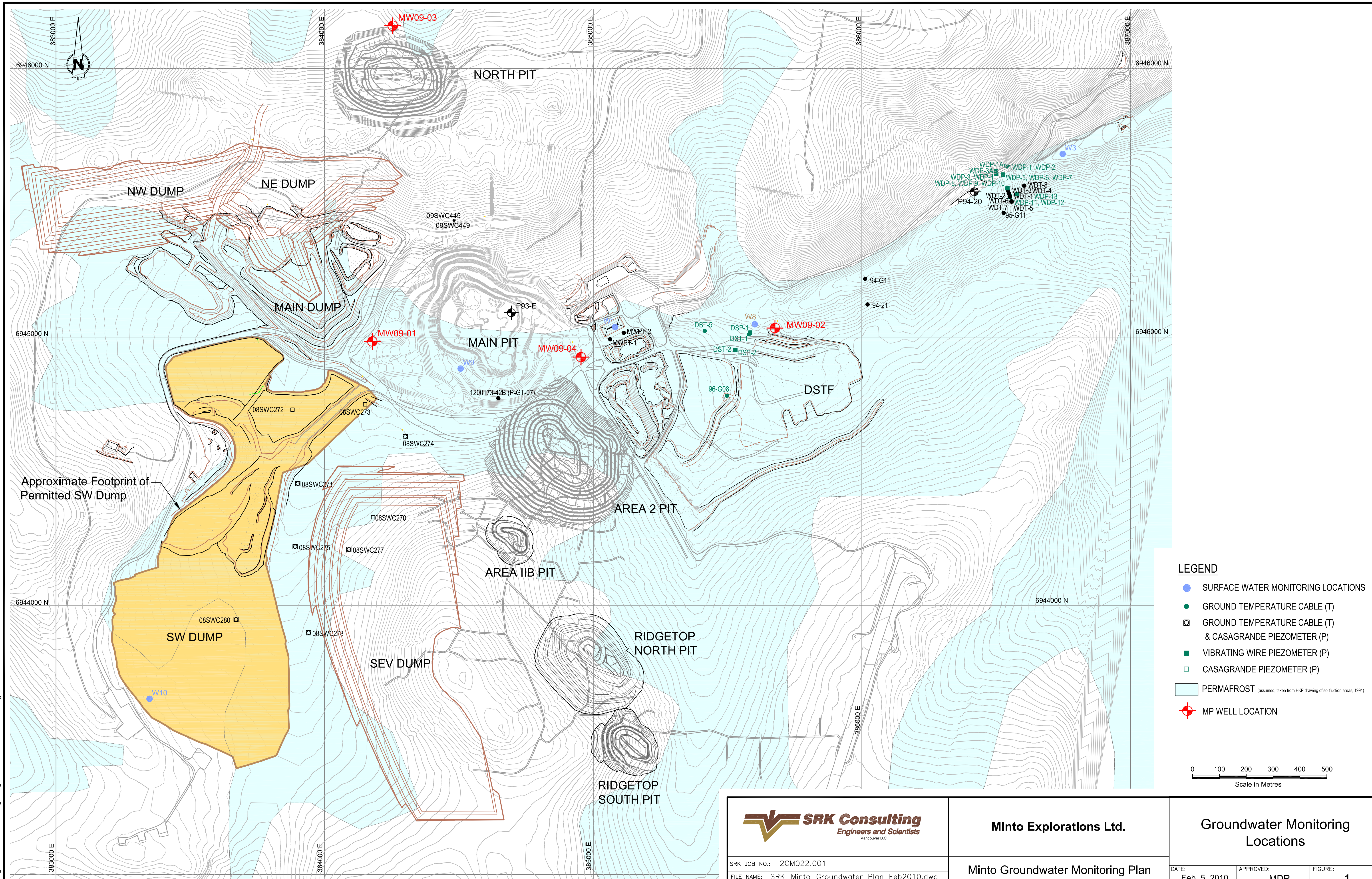
Principal Hydrogeologist

# Figures

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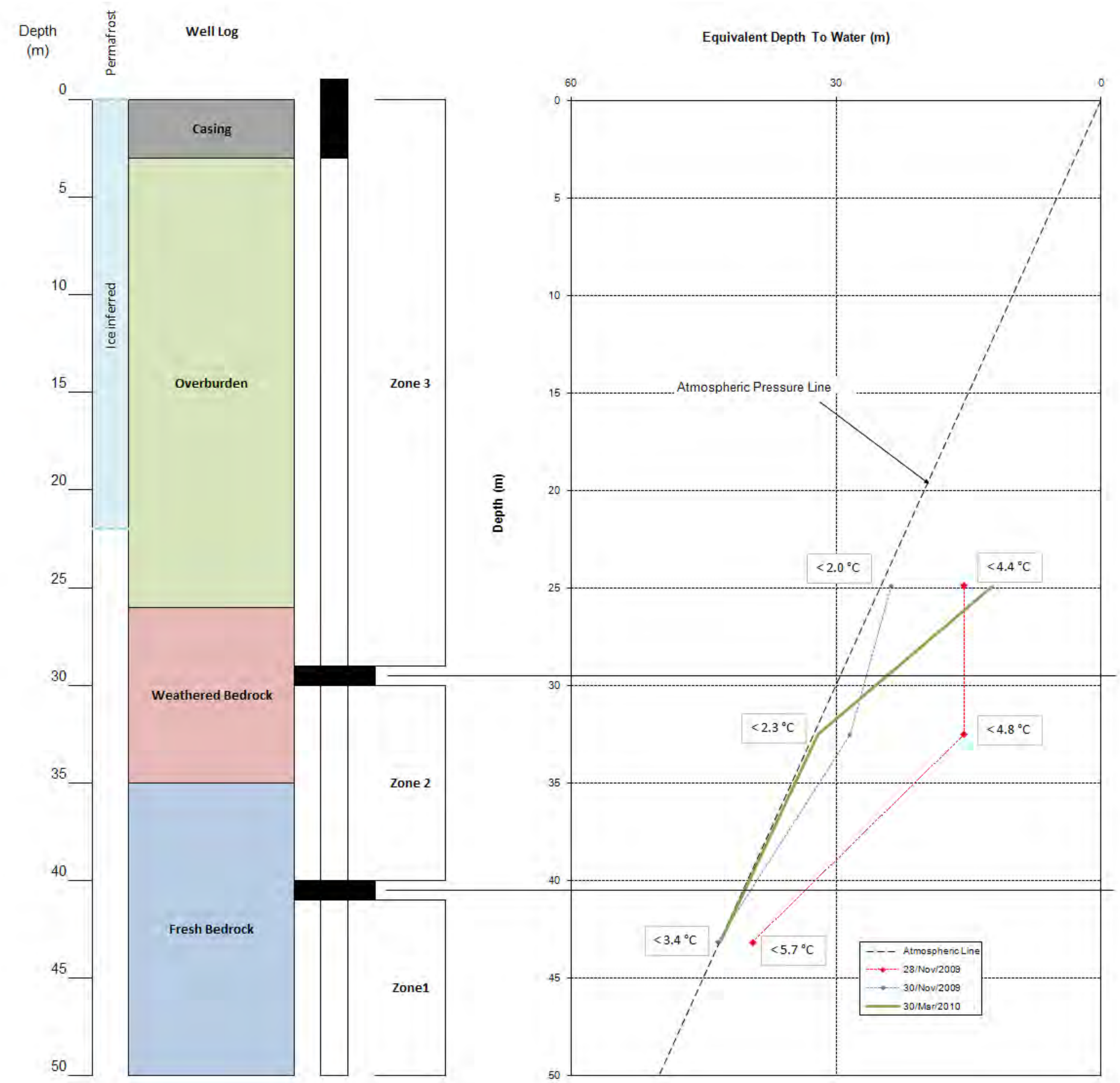
## MW09-01

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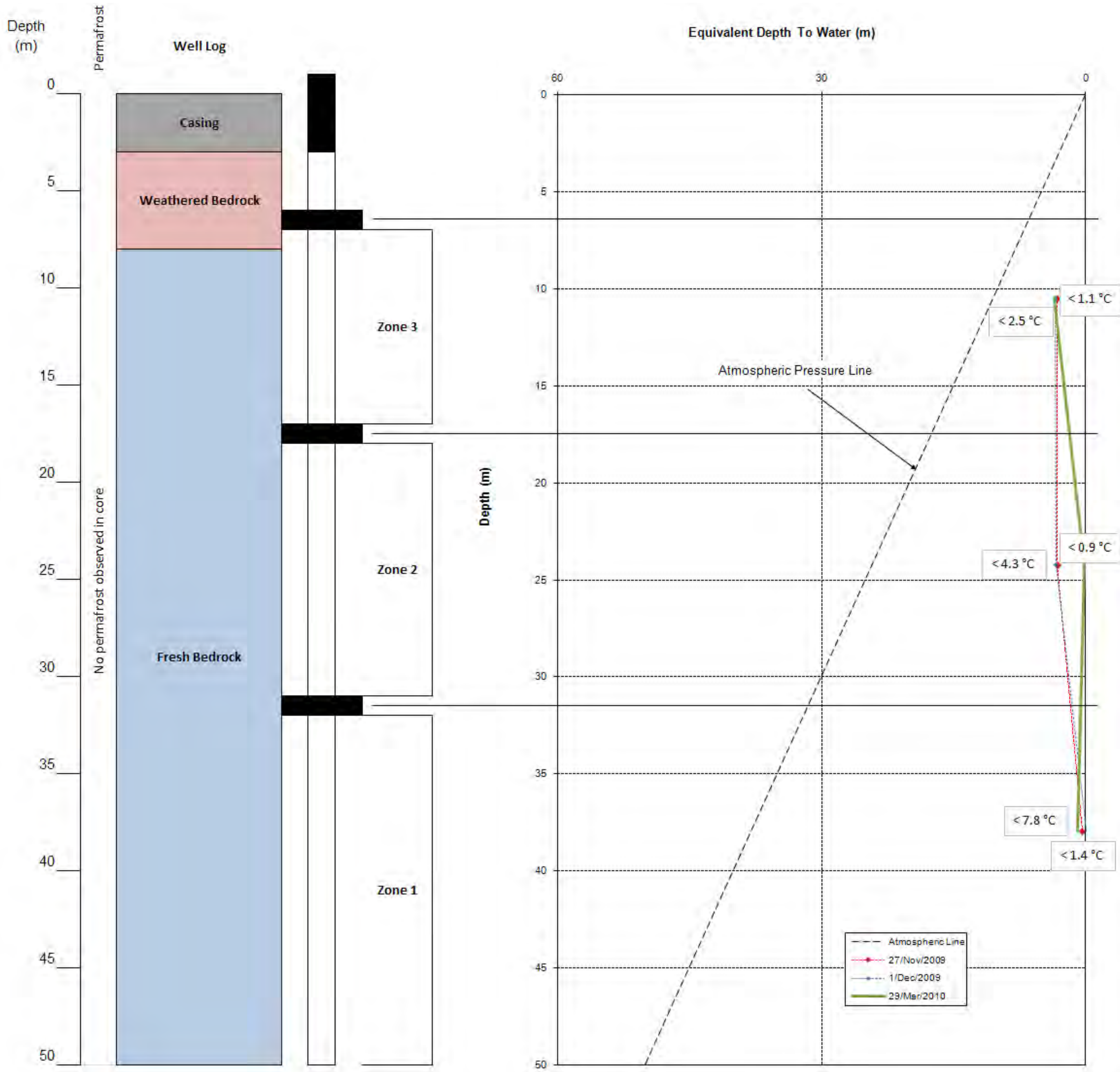
| Job No: 2CM022.001<br>Filename: Fig2_MW09-01_MPLog&Pressure _Apr10 | Minto Groundwater Monitoring Plan | Date: May 12, 2010 · Approved: MDR · Figure: 2 |

## MW09-03

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| Job No: 2CM022.001<br>Filename: Fig3_MW09-03_MPLog&Pressure_Apr10 | Minto Groundwater Monitoring Plan | Date: May12, 2010 / Approved: MDR / Figure: **3** |