

August 5, 2010  
2CM022.017

Minto Explorations Ltd.  
Suite 900 – 999 West Hastings St  
Vancouver, BC V6C 2W2  
Canada

**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.

#### **Group Offices:**

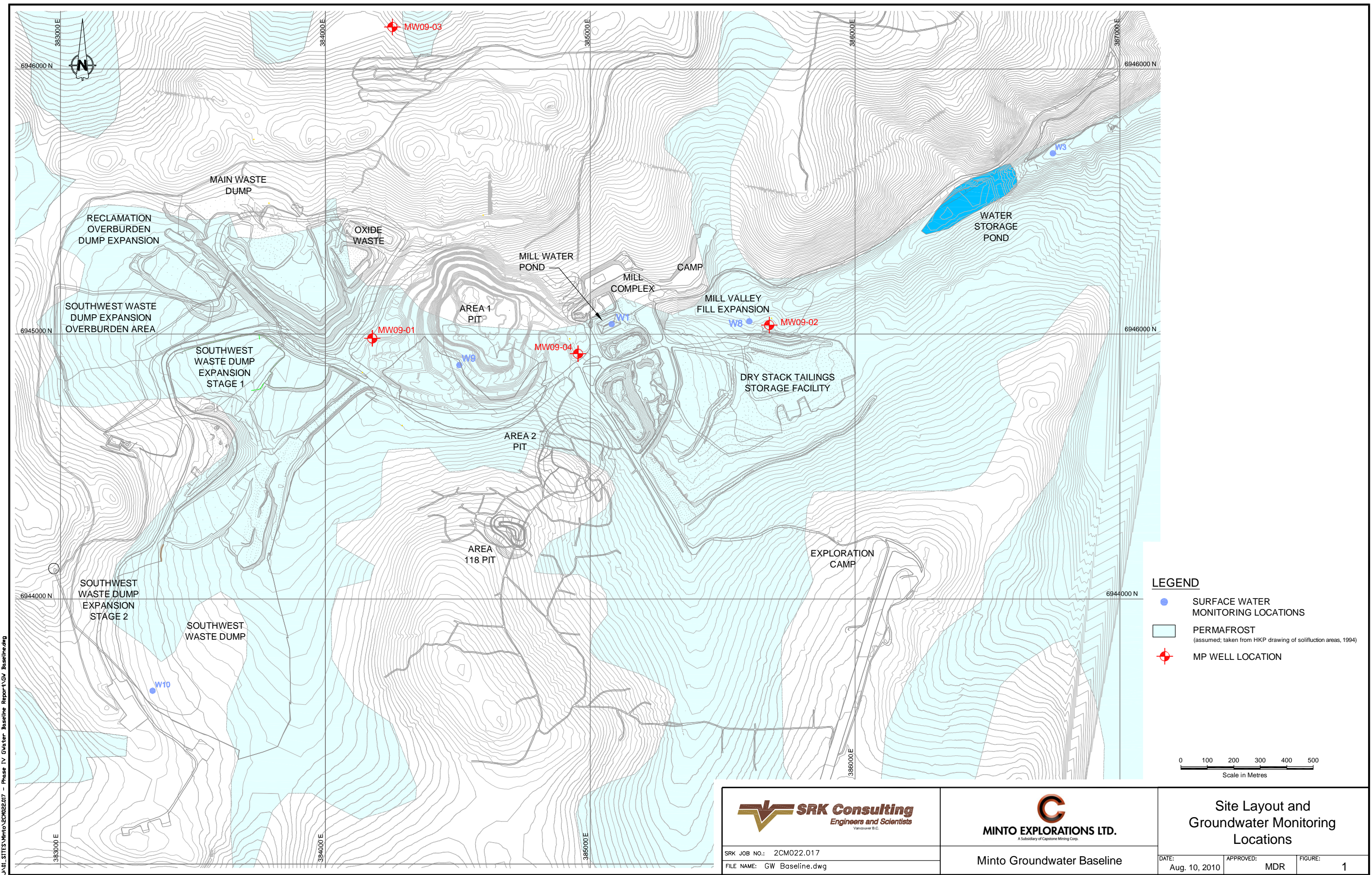
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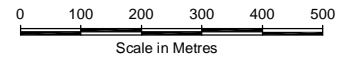
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- LEGEND**
- SURFACE WATER MONITORING LOCATIONS
  - PERMAFROST (assumed; taken from HKP drawing of solifluction areas, 1994)
  - ✠ MP WELL LOCATION



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 <b>SRK Consulting</b> <i>Engineers and Scientists</i> <small>Vancouver B.C.</small>	 <b>MINTO EXPLORATIONS LTD.</b> <small>A Subsidiary of Capstone Mining Corp.</small>	<b>Site Layout and Groundwater Monitoring Locations</b>	
SRK JOB NO.: 2CM022.017 FILE NAME: GW Baseline.dwg	<b>Minto Groundwater Baseline</b>	DATE: Aug. 10, 2010 APPROVED: MDR	FIGURE: 1

## 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 -0.8°C 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  $-0.3^{\circ}\text{C}$  at any time and ranged as low as  $-2.6^{\circ}\text{C}$ . 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  $-0.5^{\circ}\text{C}$  below 1 m depth, and fluctuated near surface to values exceeding  $5^{\circ}\text{C}$ .

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  $0^{\circ}\text{C}$ ; 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 it is 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 sampling reports (Appendix A and B).

### 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.

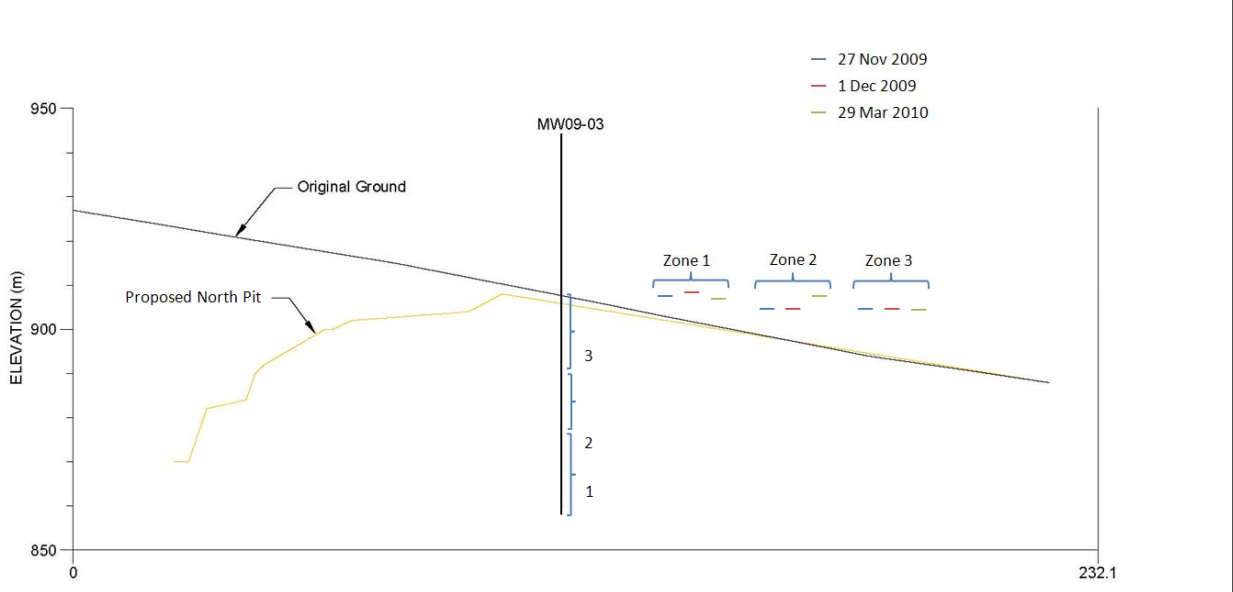
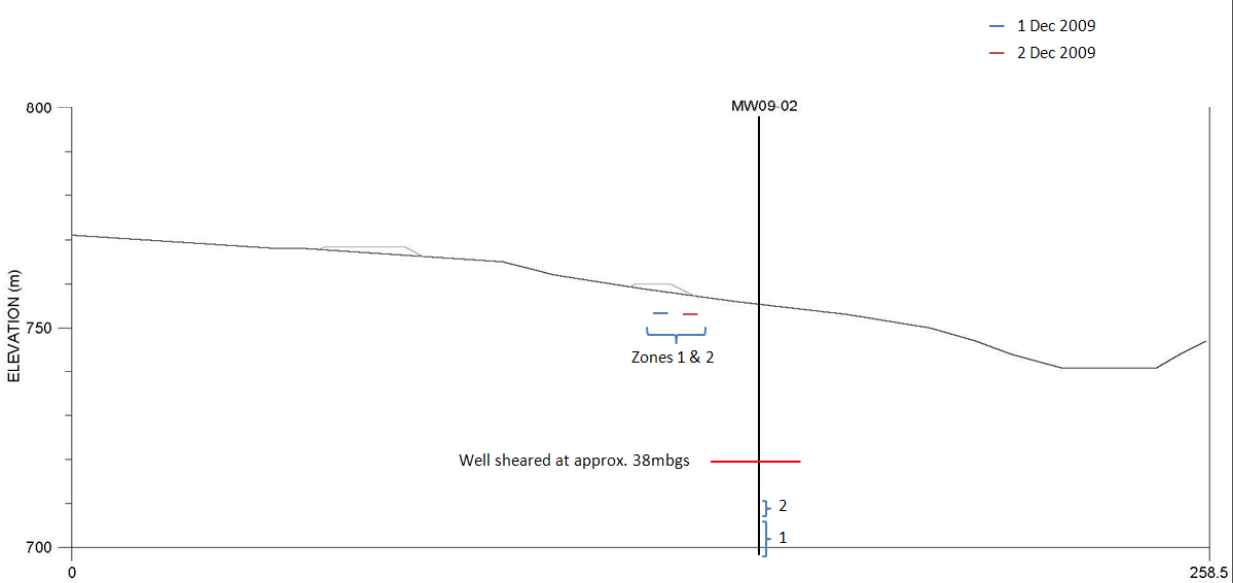
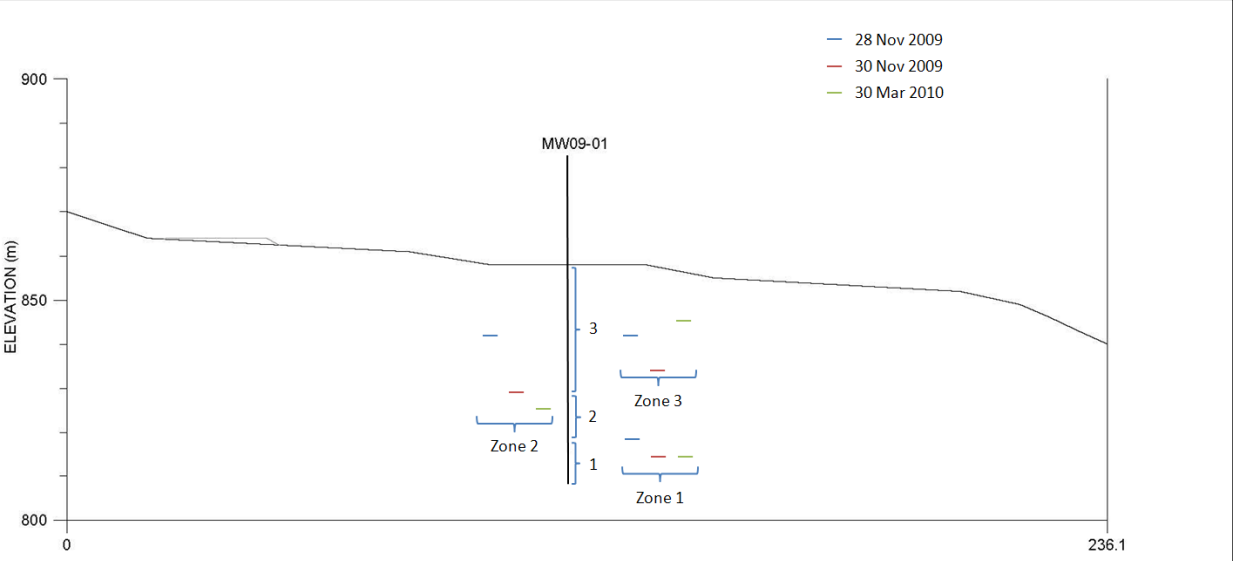
Based on the water levels and gradients observed, the expected flow directions on the site are illustrated on Figure 3. All groundwater is expected to report to the Minto Creek as direct discharge, as illustrated in both long section on Figure 4 (section line position shown on Figure 3) and in typical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

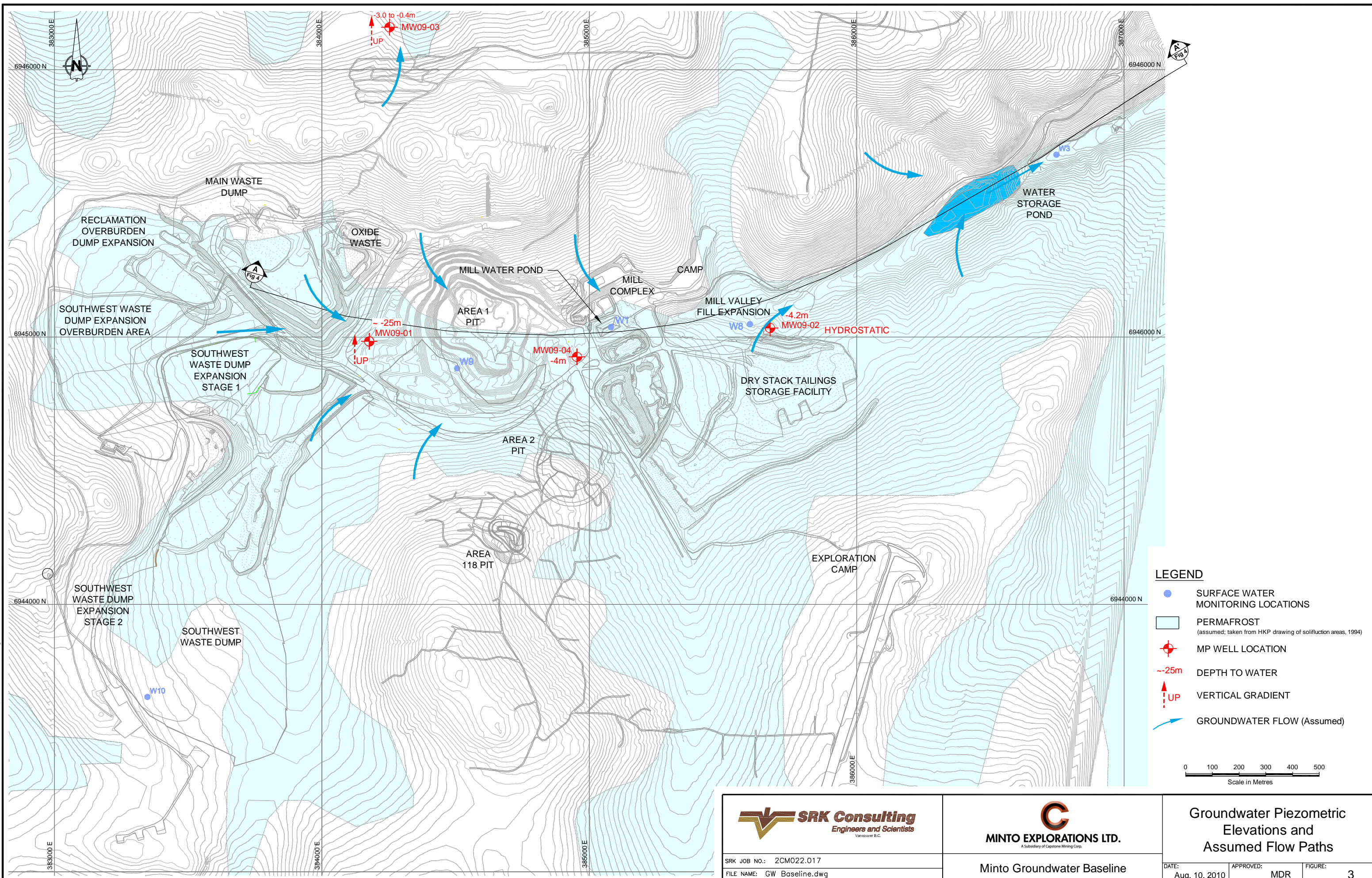
The flow lines are drawn to illustrate the decreasing flux (volume) of flow that will occur with increasing depth in the bedrock. The change in flux is caused by the decreasing hydraulic conductivity found in this type of hydrogeological system, related to higher lithostatic pressure closing open fractures,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







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Engineers and Scientists  
Vancouver B.C.

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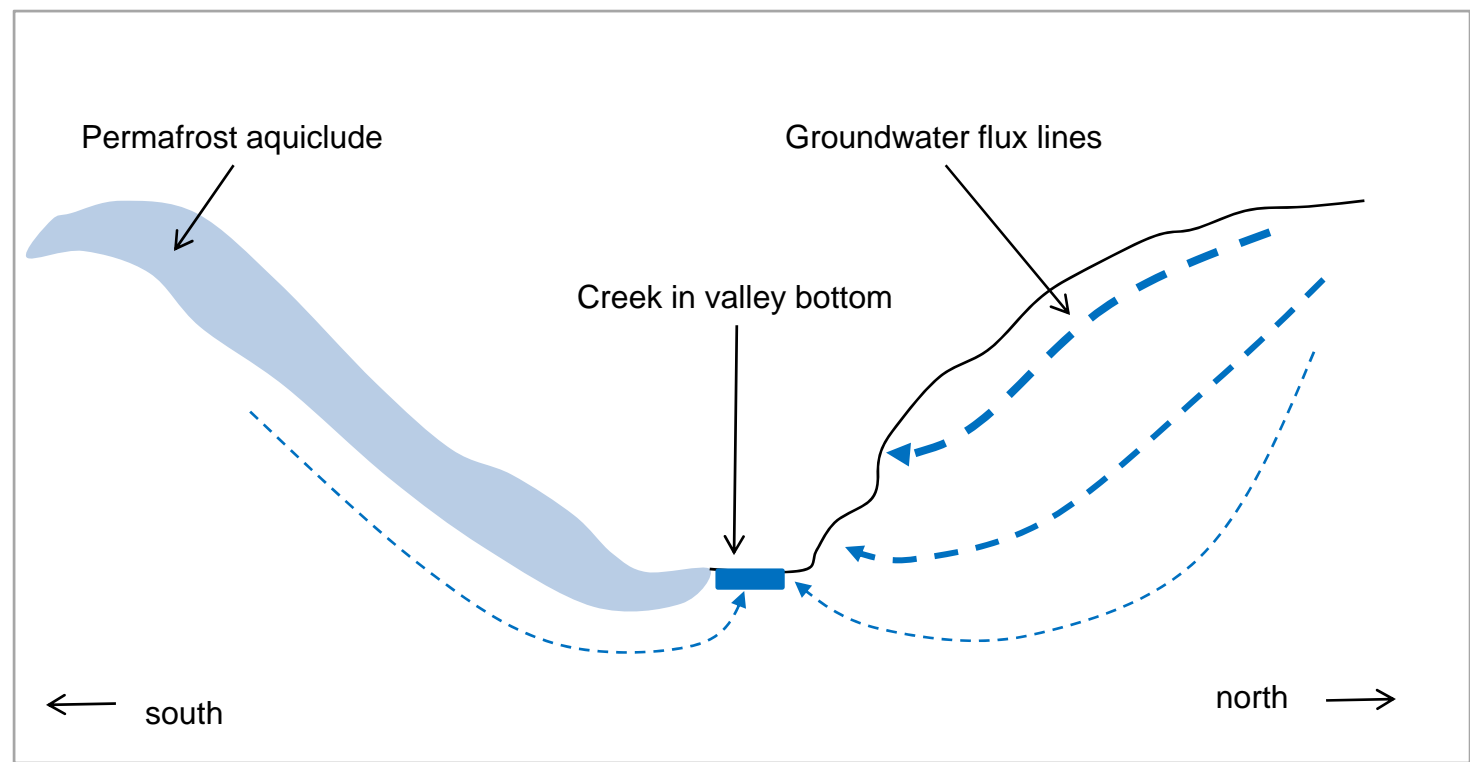
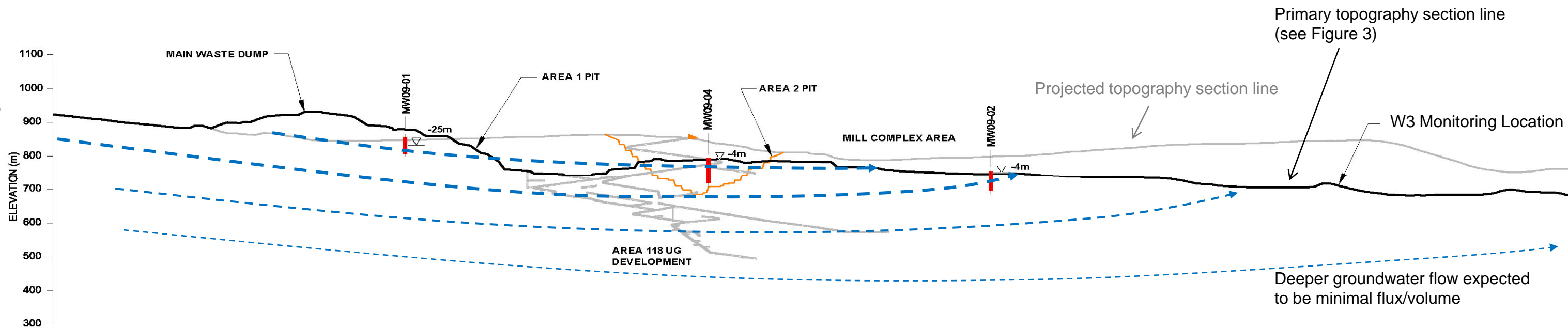
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Minto Groundwater Baseline

**Groundwater Piezometric Elevations and Assumed Flow Paths**

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

# Long Section

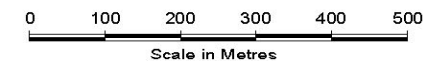


Cross Section (exaggerated)

### 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



	<b>MINTO EXPLORATIONS LTD.</b>	Schematic Section of Minto Mine Site	
	Minto Groundwater Baseline	DATE: Aug. 10, 2010	APPROVED: MDR
SRK JOB NO.: 2CM022.017 FILE NAME: UG_Profile.dwg		FIGURE: 4	

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## 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 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.

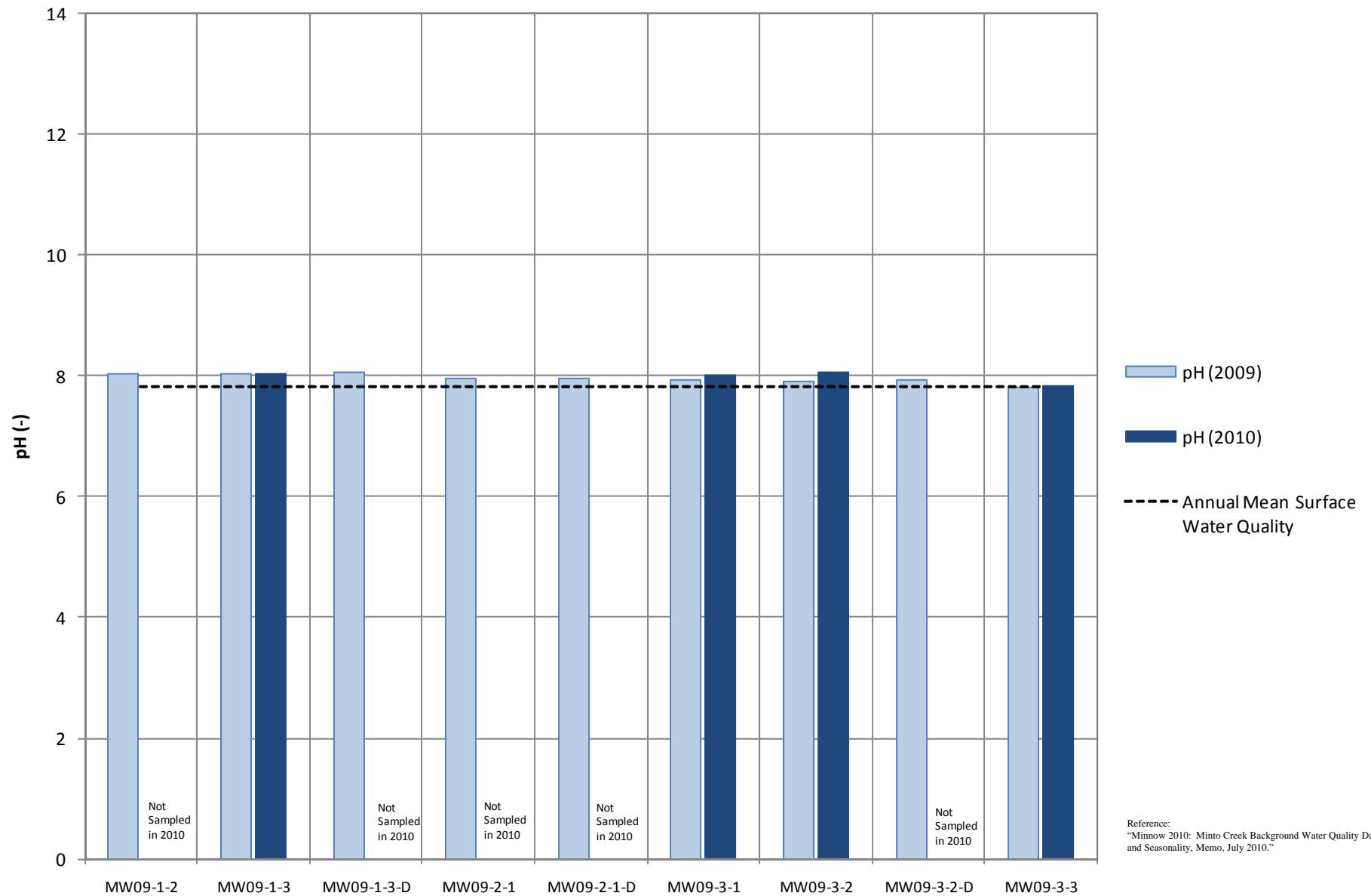


**2010 Groundwater Quality Data**

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	
<b>Physical Tests</b>									
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	
<b>Major Anions and Cations</b>									
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		
<b>Anions and Nutrients</b>									
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	
<b>Dissolved Metals</b>									
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	
<b>Total Metals</b>									
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	
<b>Date Sampled</b>		30-Mar-10	30-Mar-10	29-Mar-10	29-Mar-10	29-Mar-10	29-Mar-10	29-Mar-10	
<b>Sample Depth</b>	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."



Job No: 2CM022.017  
 Filename: Fig5\_pH.gf.20100805.ppt

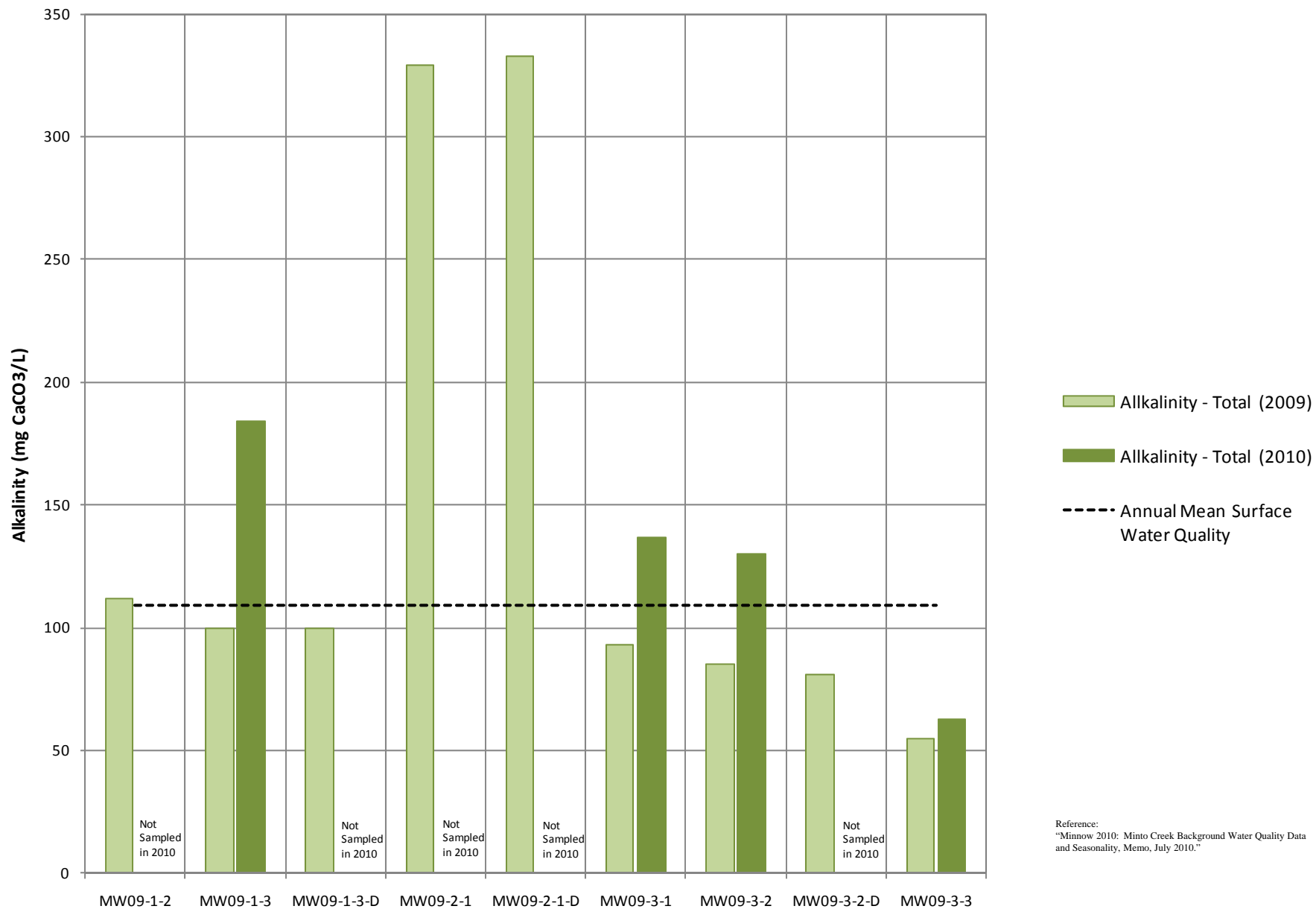


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pH

Date: August 5, 2010	Approved: MR	Figure: <b>5</b>
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Reference:  
 "Minnow 2010: Minto Creek Background Water Quality Data and Seasonality, Memo, July 2010."



Job No: 2CM022.017  
 Filename: Fig6\_Alkalinity.gf.20100805.ppt

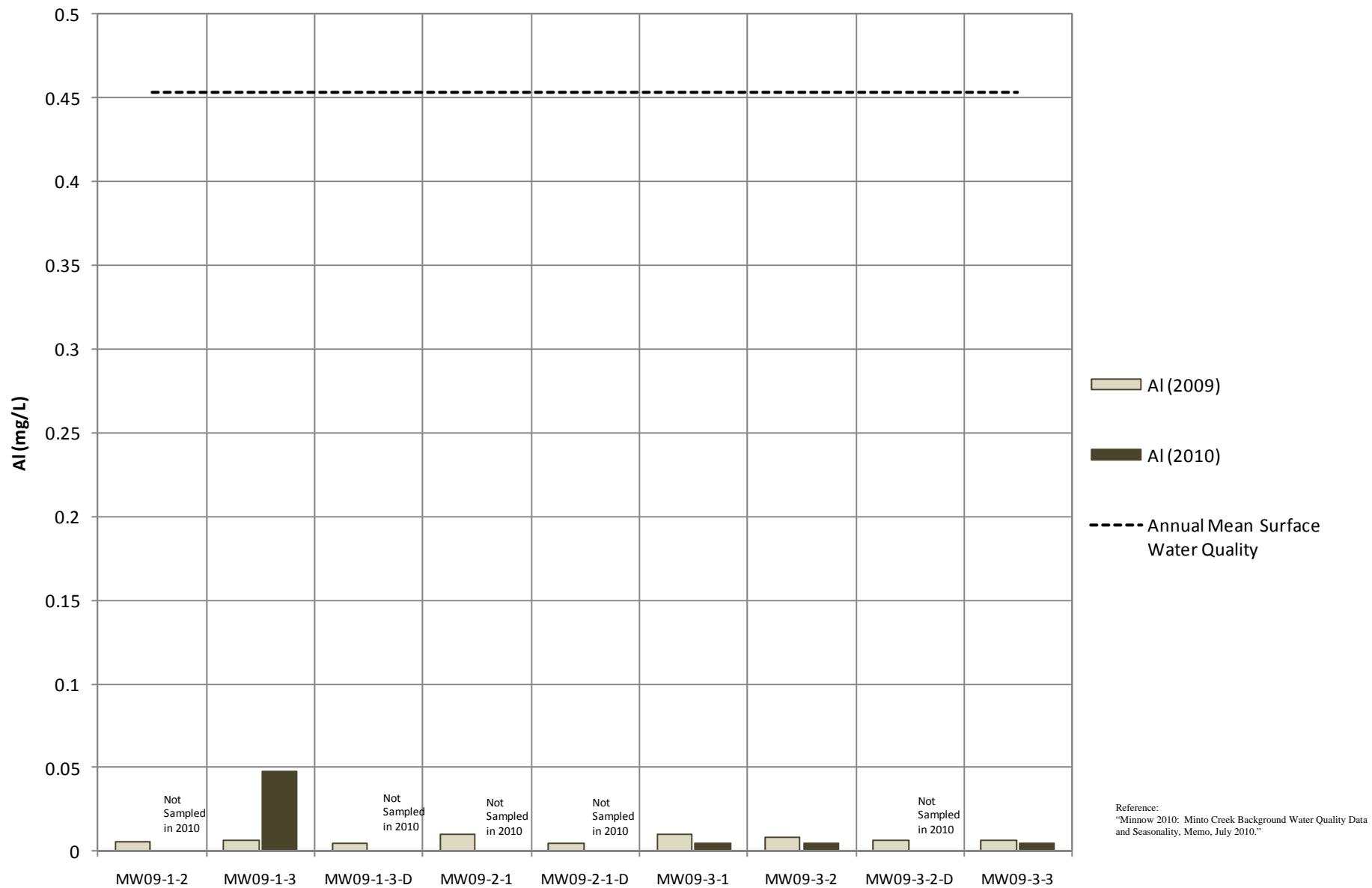


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**Alkalinity**

Date: August 5, 2010	Approved: MR	Figure: <b>6</b>
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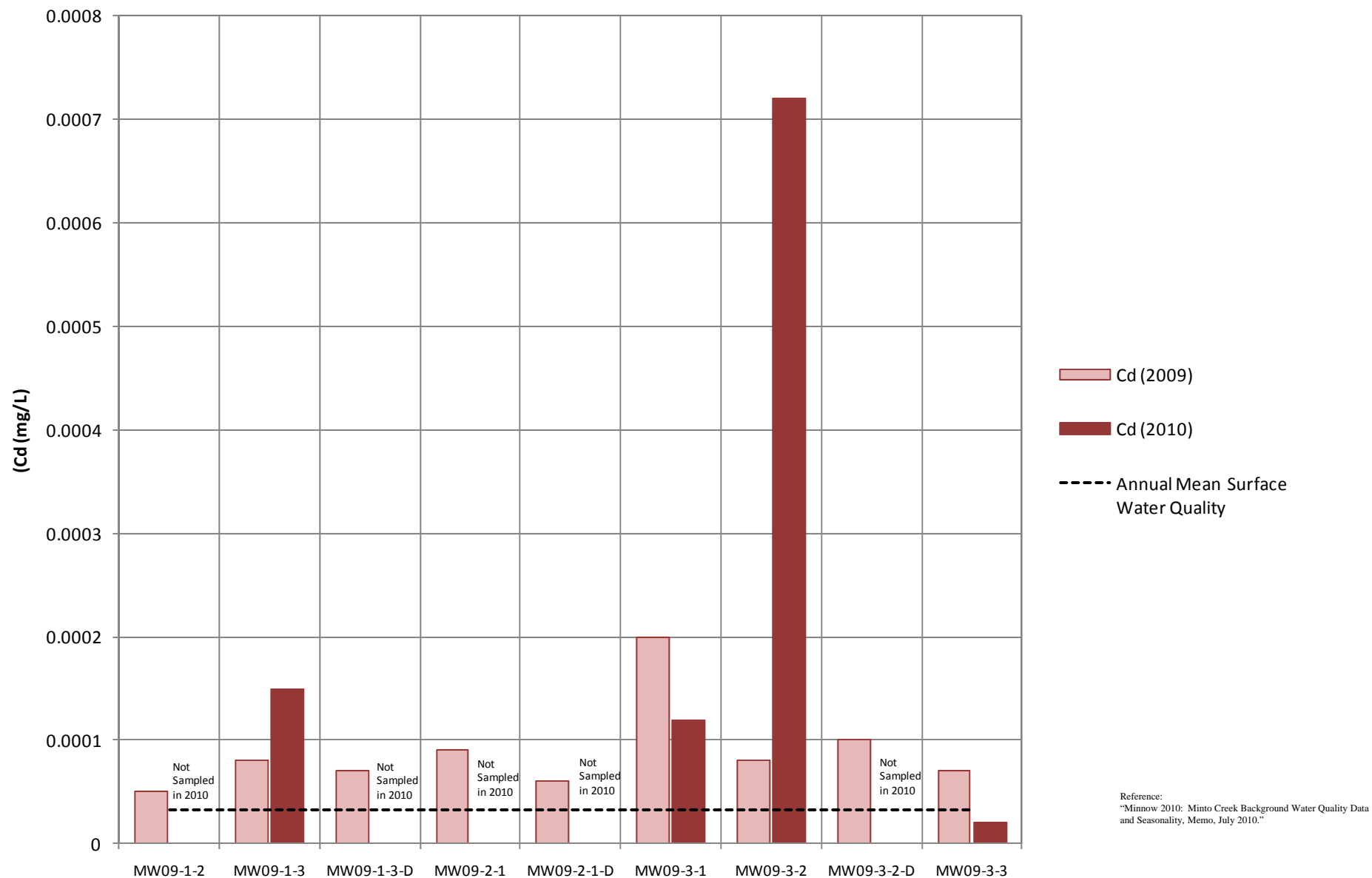


**Aluminium (Dissolved)**

Job No: 2CM022.017  
 Filename: Fig7\_Aluminium.gf.20100805.ppt

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Date: August 5, 2010	Approved: MR	Figure: <b>7</b>
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Job No: 2CM022.017  
 Filename: Fig8\_Cadmium.gf.20100805.ppt

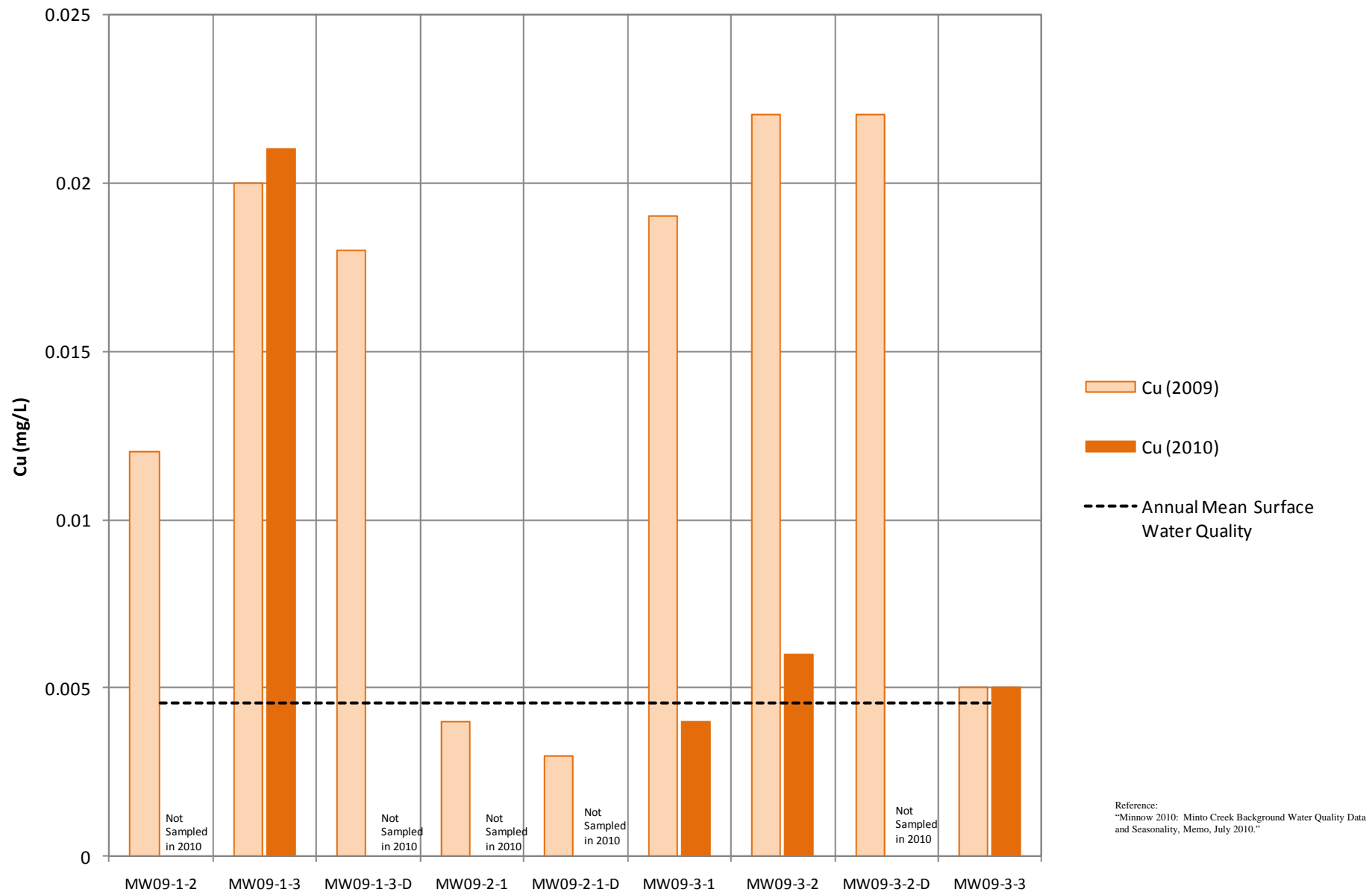


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**Cadmium (Dissolved)**

Date: August 5, 2010	Approved: MR	Figure: <b>8</b>
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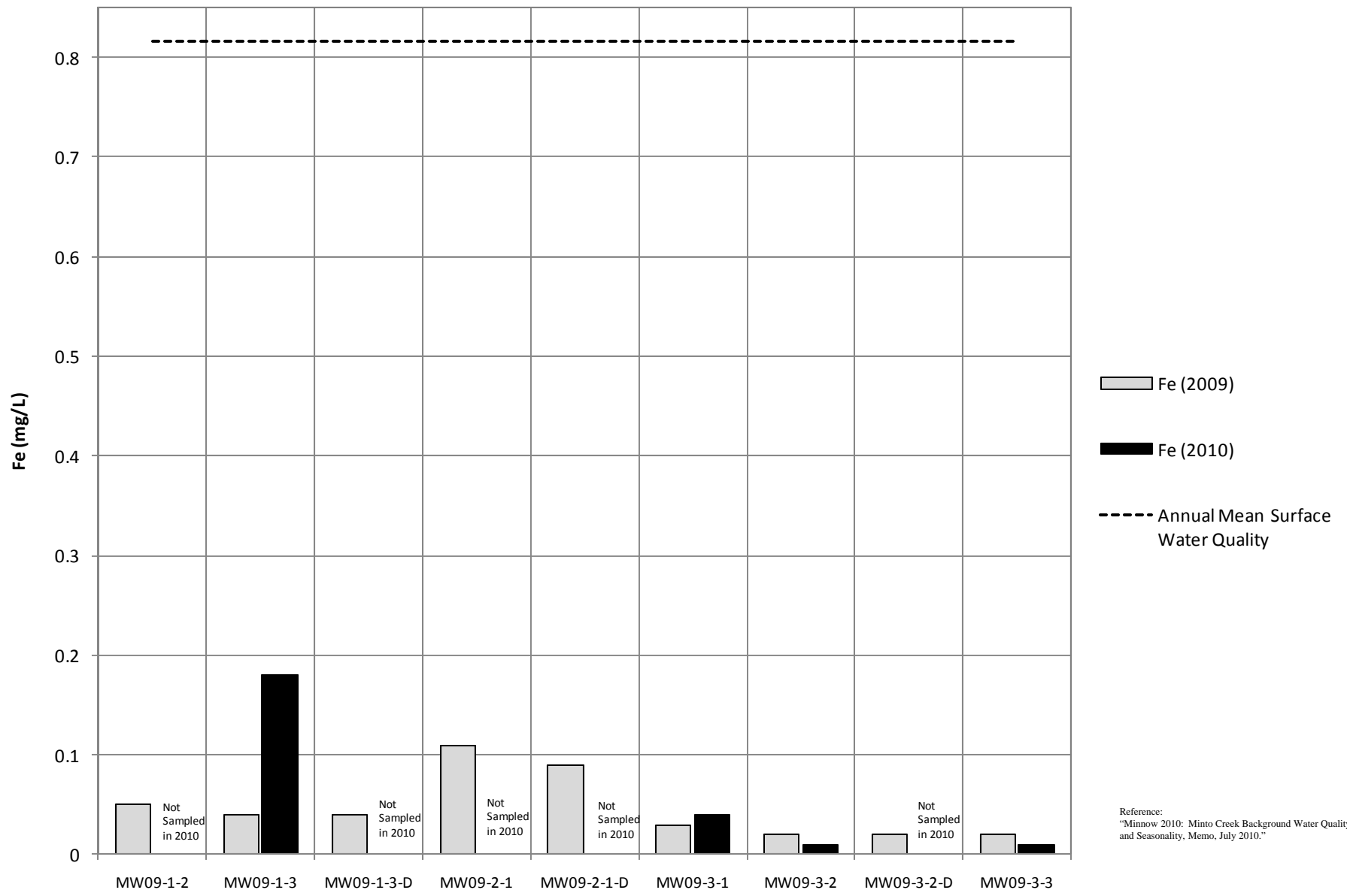
Job No: 2CM022.017  
 Filename: Fig9\_Copper.gf.20100805.ppt



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**Copper (Dissolved)**

Date: August 5, 2010	Approved: MR	Figure: <b>9</b>
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Reference:  
 "Minnow 2010: Minto Creek Background Water Quality Data and Seasonality, Memo, July 2010."



Job No: 2CM022.017  
 Filename: Fig10\_Iron.gf.20100805.ppt

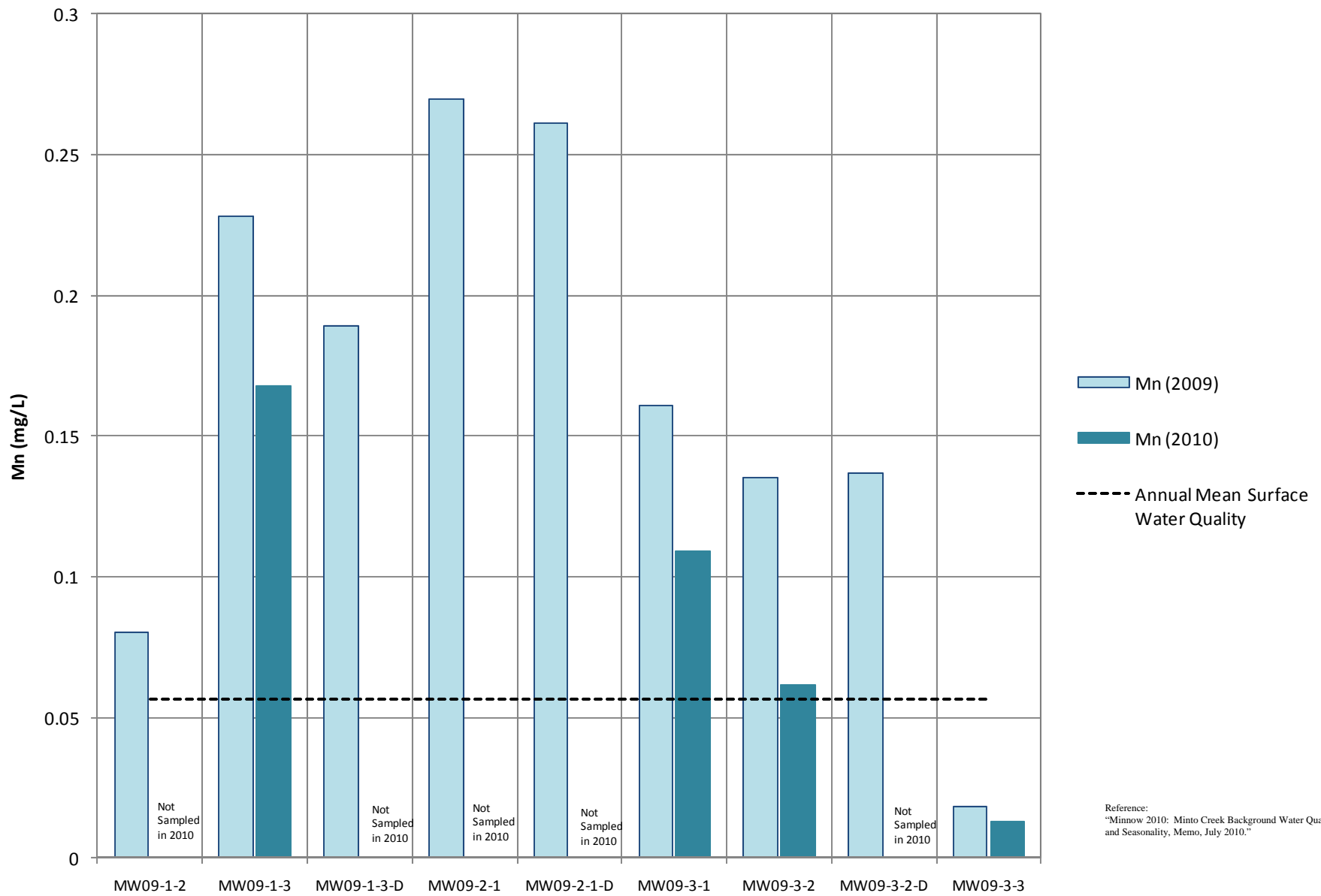


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**Iron (Dissolved)**

Date: August 5, 2010	Approved: MR	Figure: <b>10</b>
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Job No: 2CM022.017  
 Filename: Fig11\_Manganese.gf.20100805.ppt

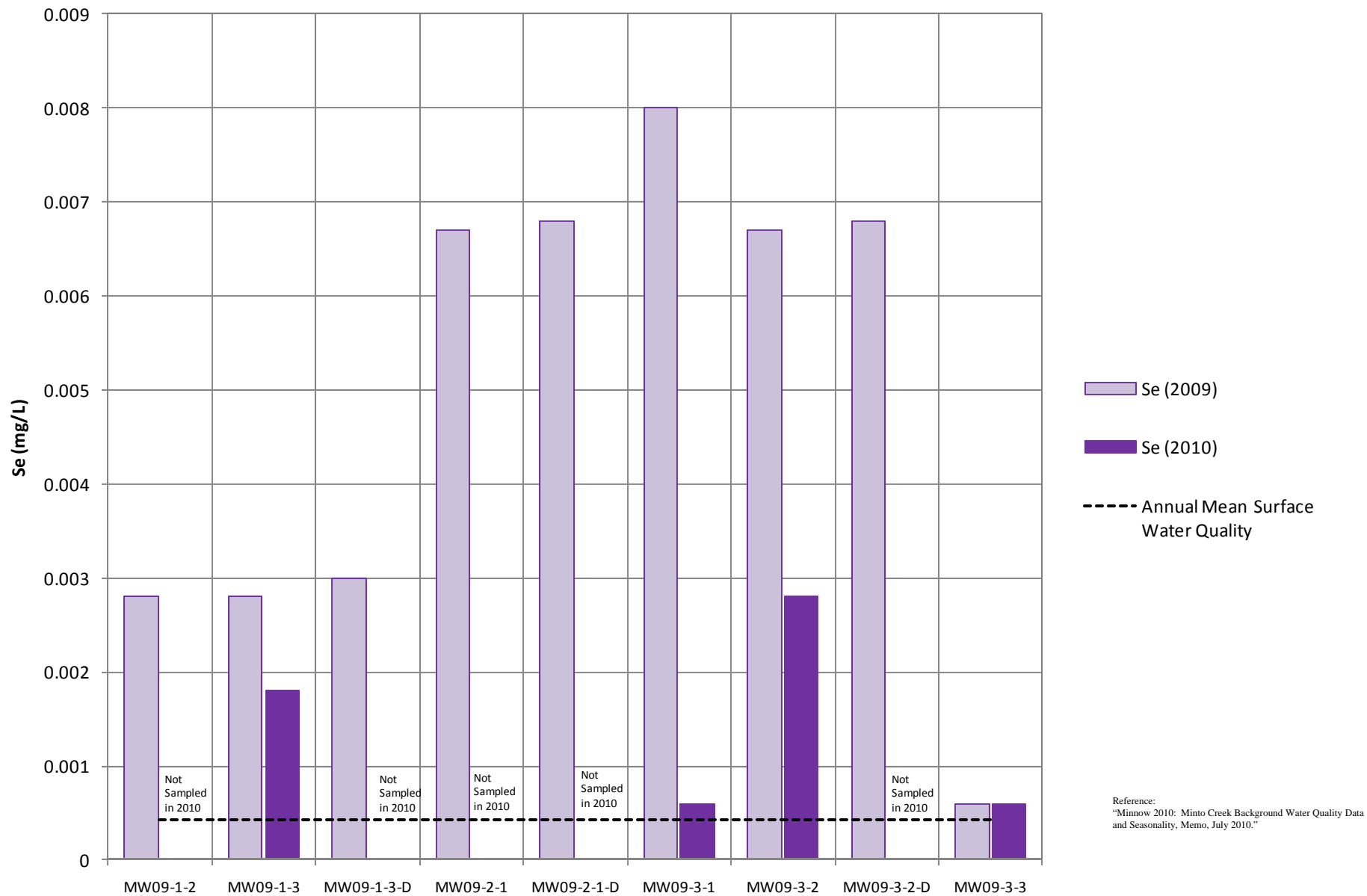


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**Manganese (Dissolved)**

Date: August 5, 2010	Approved: MR	Figure: <b>11</b>
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**Selenium (Dissolved)**

Job No: 2CM022.017  
 Filename: Fig12\_Selenium.gf.20100805.ppt

MINTO MINE

Date: August 5, 2010	Approved: MR	Figure: <b>12</b>
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## 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



# Minto Mine Groundwater Monitoring System Installation Report

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*Prepared for*

***Minto Explorations Ltd.***

*Prepared by*



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

***February 2010***

**Minto Mine**  
**Groundwater Monitoring System**  
**Installation Report**

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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 site 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 -0.8°C 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  $-0.3^{\circ}\text{C}$  at any time and ranged as low as  $-2.6^{\circ}\text{C}$ . 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  $-0.5^{\circ}\text{C}$  below 1 m depth, and fluctuated near surface to values exceeding  $5^{\circ}\text{C}$ .

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  $0^{\circ}\text{C}$ ; 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 polypropylene 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 6944984 N 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 6945034 N 757 masl	Establish groundwater conditions down gradient of the dry stack tailings facility (DSTF)
MW09-03	New; HQ	Minto North	384253 E 6946159 N 908 masl	Establish baseline groundwater conditions down gradient of the proposed North Pit
MW09-04	New; HQ	Phase 1 Confluence	384954 E 6944926 N 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	<ul style="list-style-type: none"> <li>• Zone 1 did not produce a water sample</li> <li>• Zone 3 extends to the surface as there is no packer above the measurement port</li> </ul>
MW09-02	2	60	60	<ul style="list-style-type: none"> <li>• Zone 2 did not produce a water sample (possibly frozen)</li> </ul>
MW09-03	3	50	50	
MW09-04	3	75	75	<ul style="list-style-type: none"> <li>• Well damaged post installation</li> <li>• To be re-established in summer 2010</li> </ul>

\*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 24<sup>th</sup> 2009. When SRK and Minto staff returned to develop and sample the well on December 3<sup>rd</sup>, 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.

Tabulated pressure data are included in Appendix C.

### 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 D.

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.

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 D.

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.



## 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 E. 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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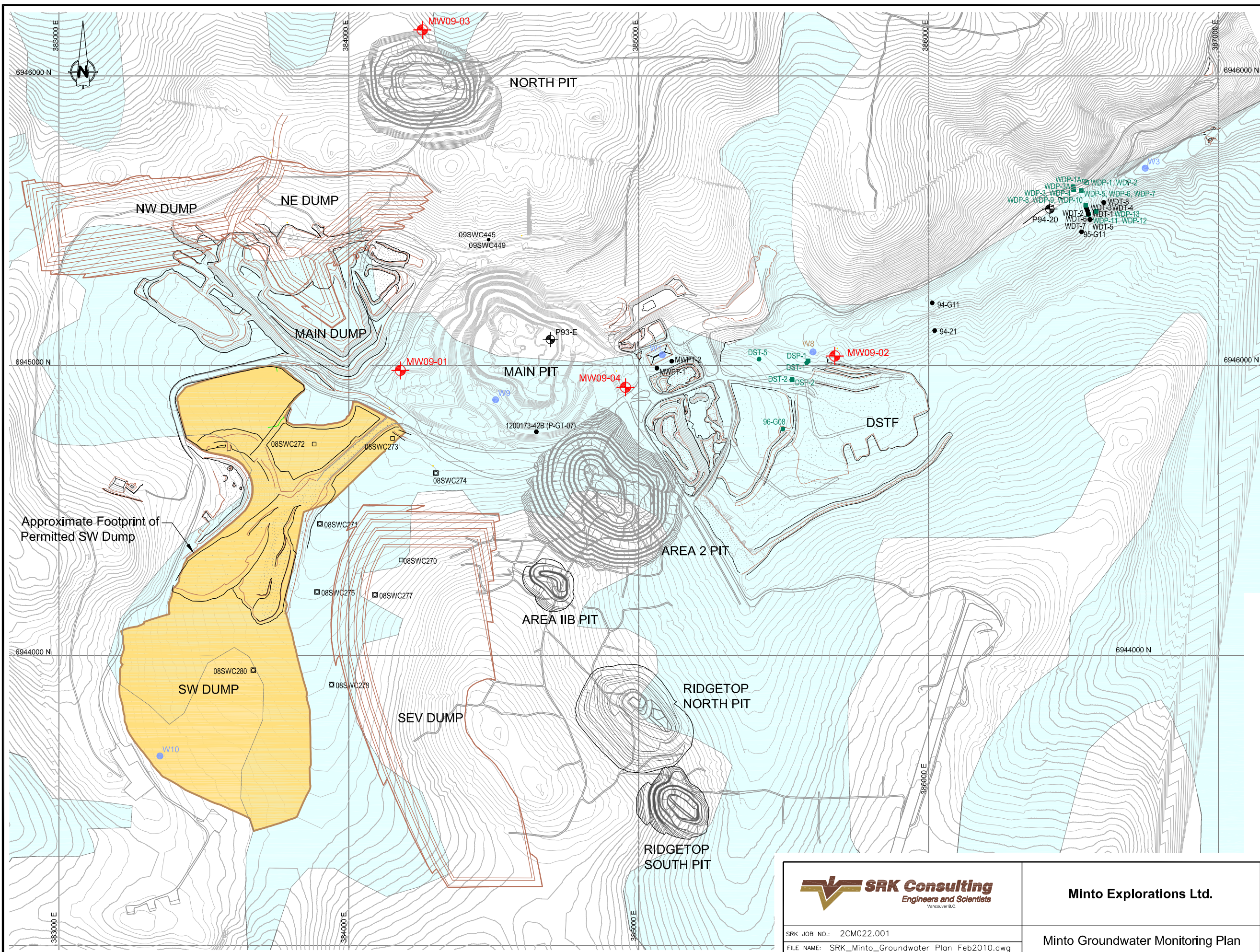
Chris Doughty, BSc, GIT  
Hydrogeologist

**Reviewed by**

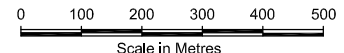
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Michael Royle, M.App.Sci., P.Geo. (BC & NT)  
Principal Hydrogeologist

**Figures**



- LEGEND**
- SURFACE WATER MONITORING LOCATIONS
  - GROUND TEMPERATURE CABLE (T)
  - GROUND TEMPERATURE CABLE (T) & CASAGRANDE PIEZOMETER (P)
  - VIBRATING WIRE PIEZOMETER (P)
  - CASAGRANDE PIEZOMETER (P)
  - PERMAFROST (assumed; taken from HRP drawing of scollification areas, 1994)
  - ⊕ MP WELL LOCATION



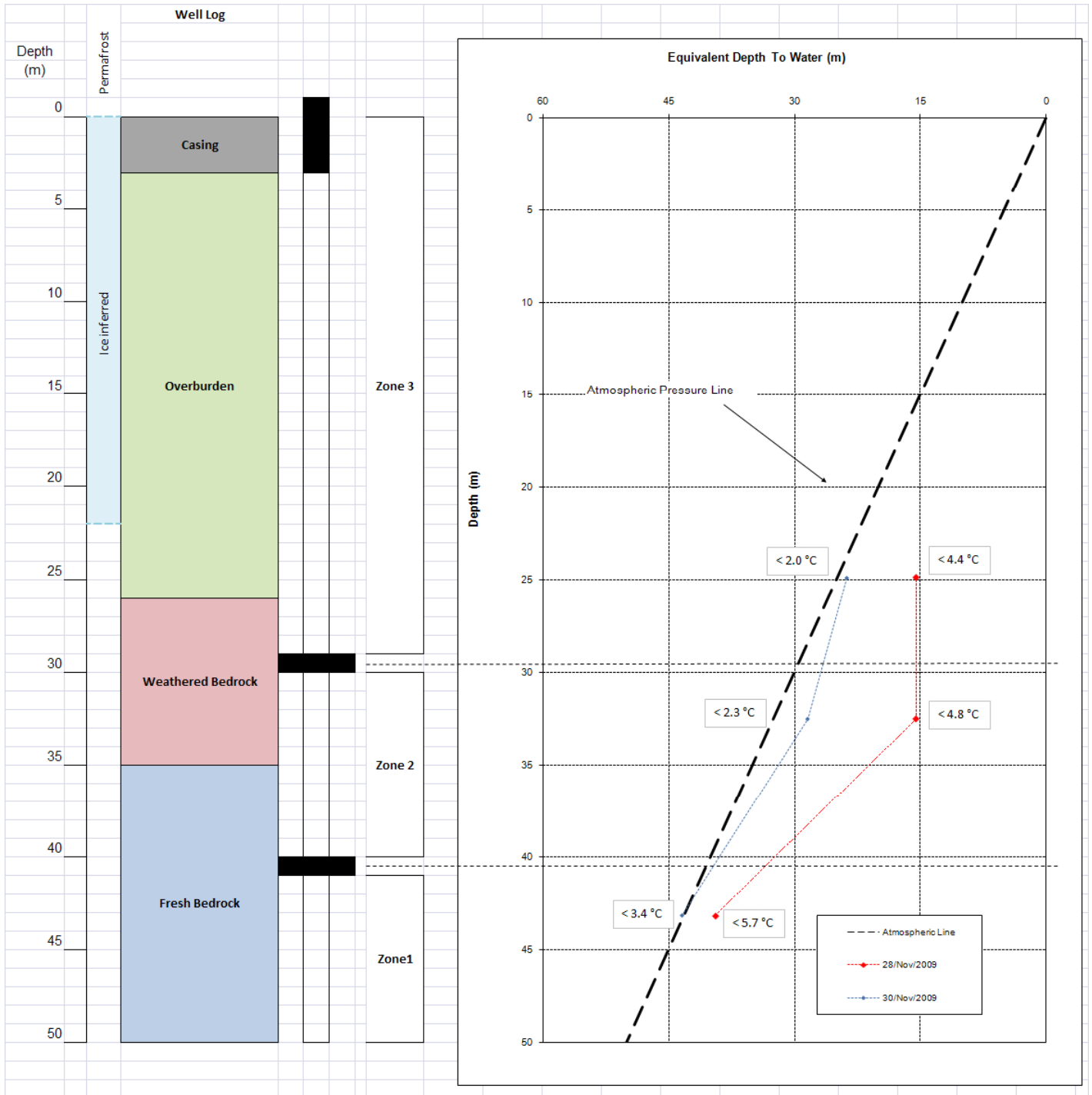
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Minto Explorations Ltd.  
 Minto Groundwater Monitoring Plan

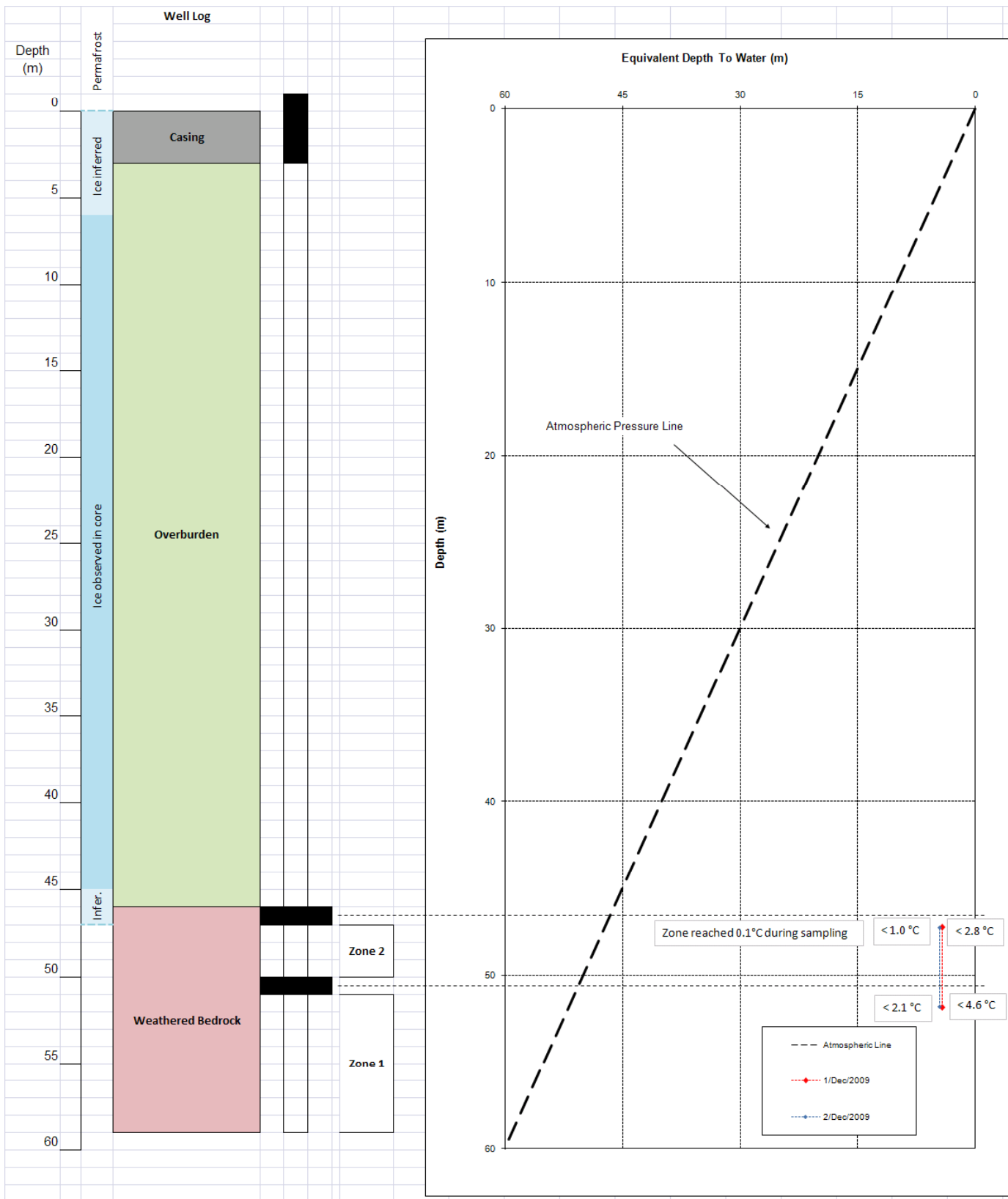
Groundwater Monitoring Locations

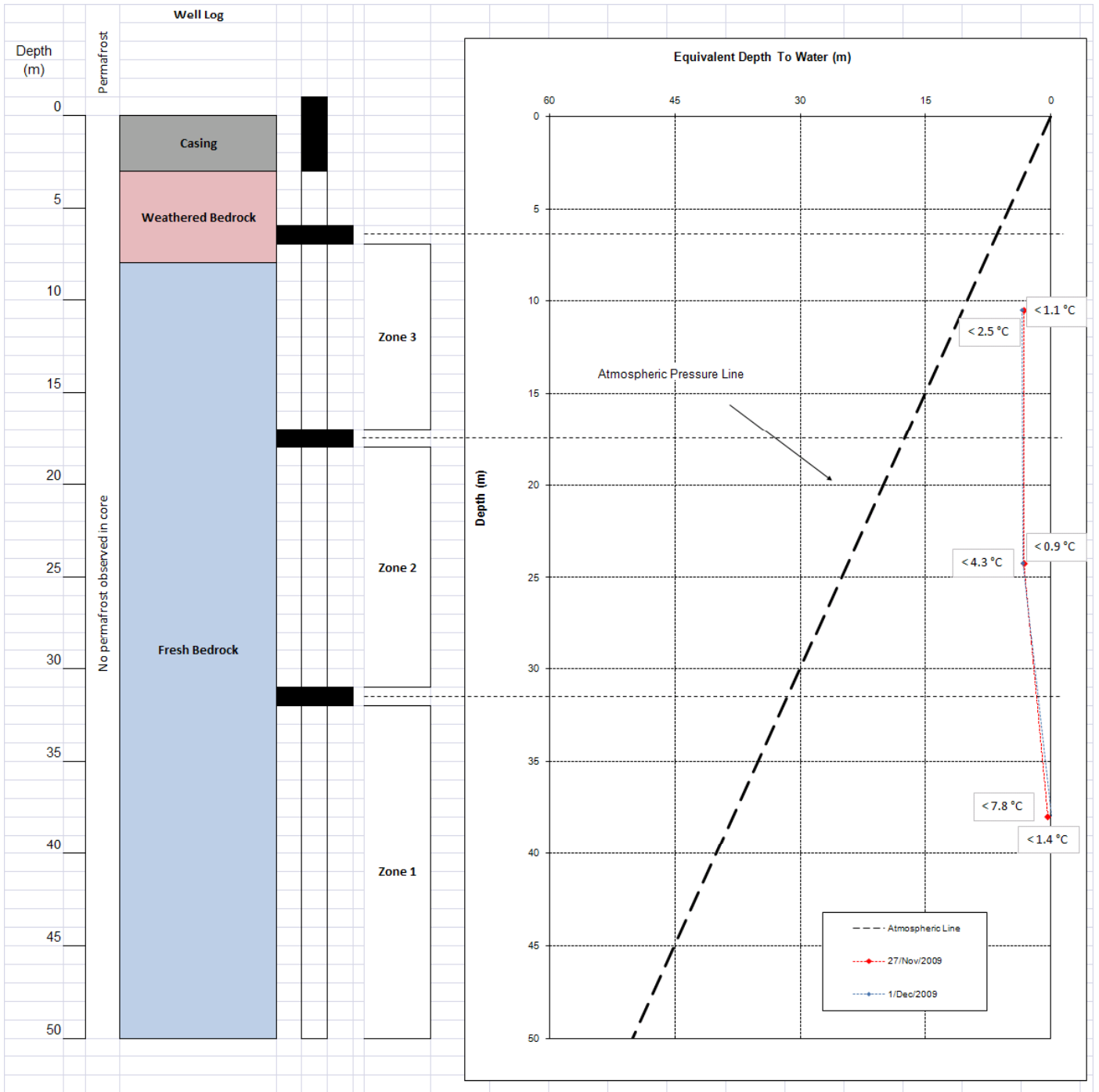
DATE: Feb. 5, 2010	APPROVED: MDR	FIGURE: 1
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Minto Explorations Ltd.

**Groundwater Monitoring Locations**

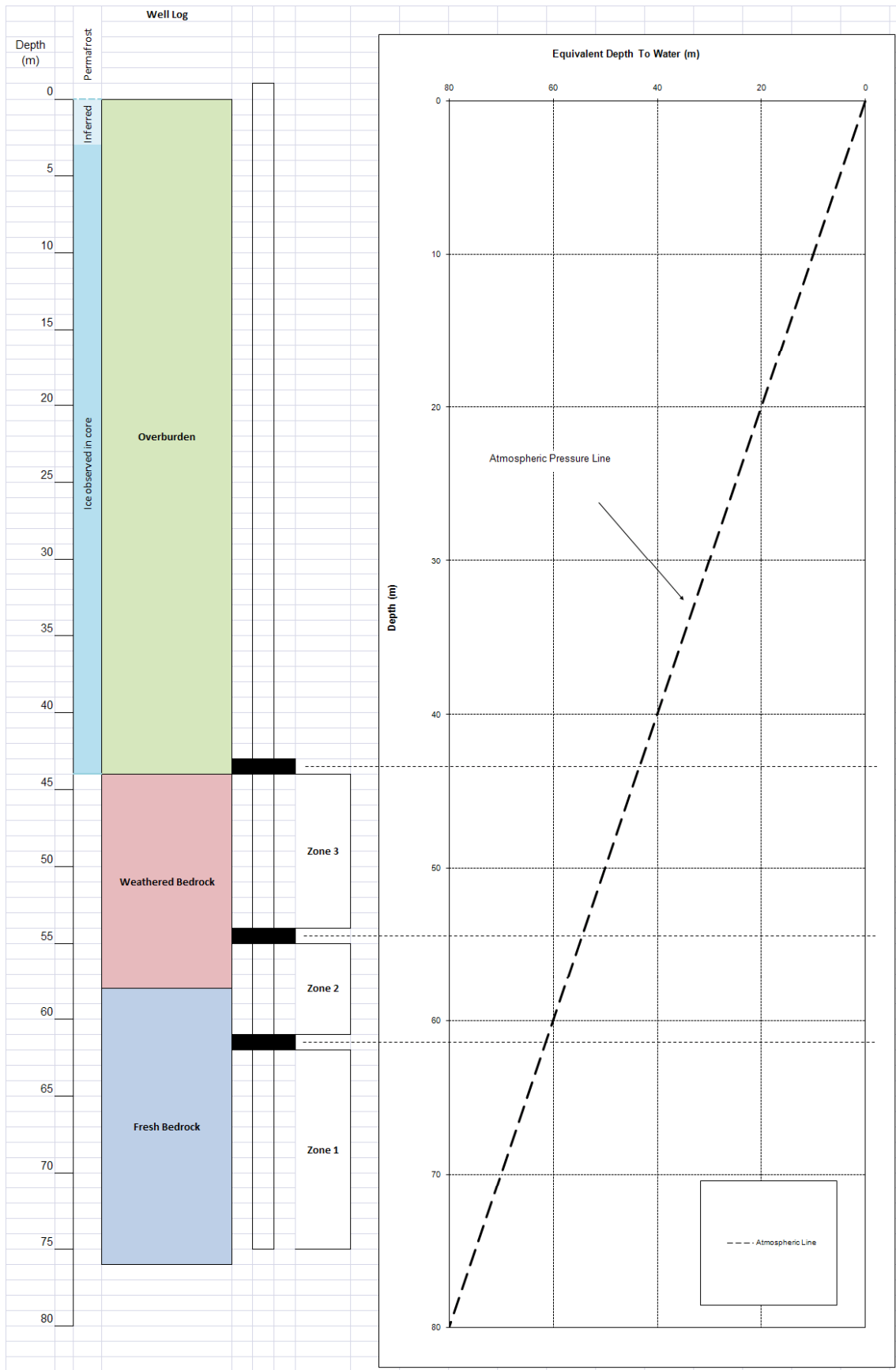
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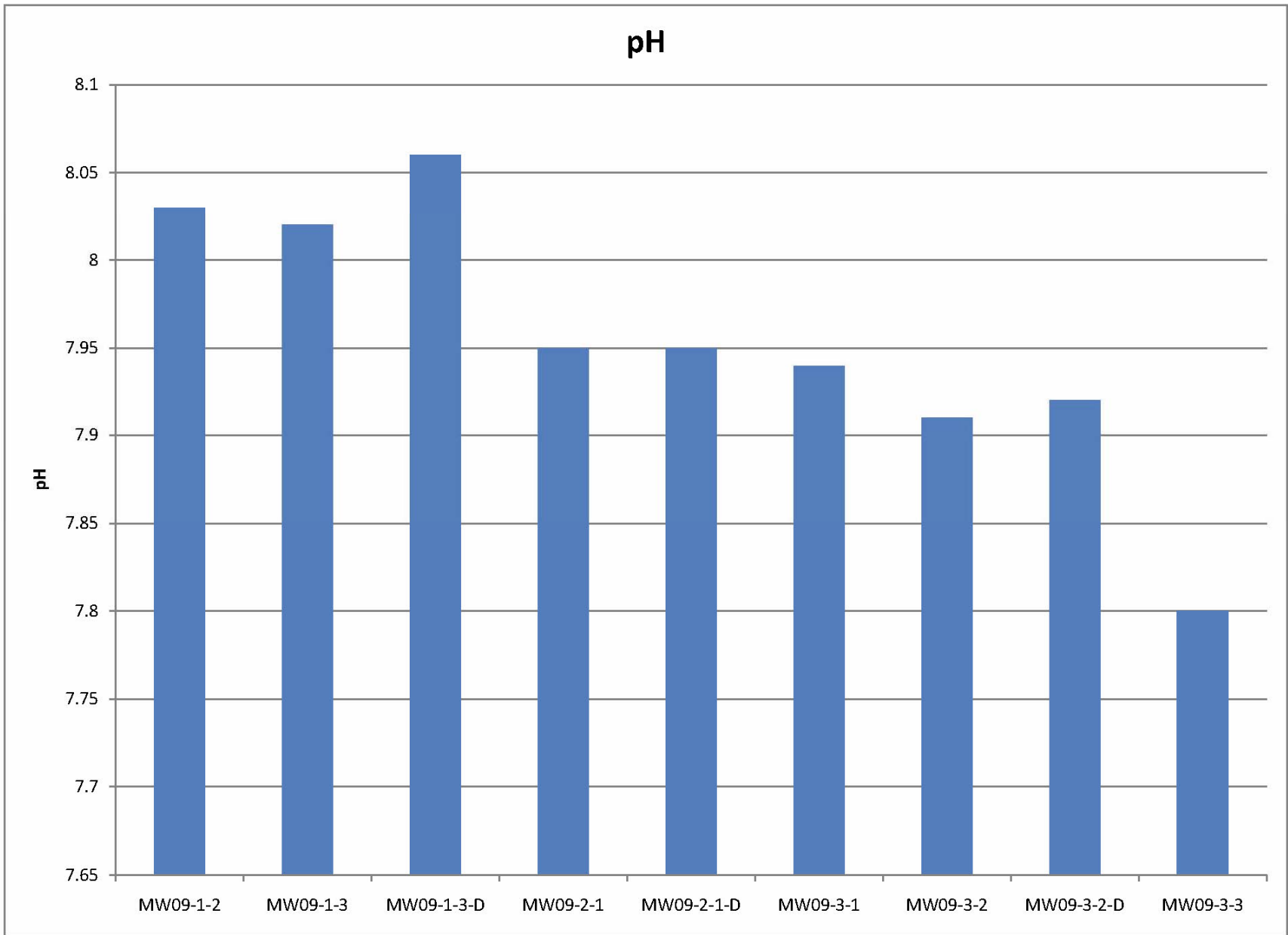
Minto Groundwater Monitoring Plan

Date: February 9, 2010

Approved: MDR

Figure: 4





Job No: 2CM022.001  
 Filename: Fig 6\_pH.ppt

**Minto Explorations Ltd.**

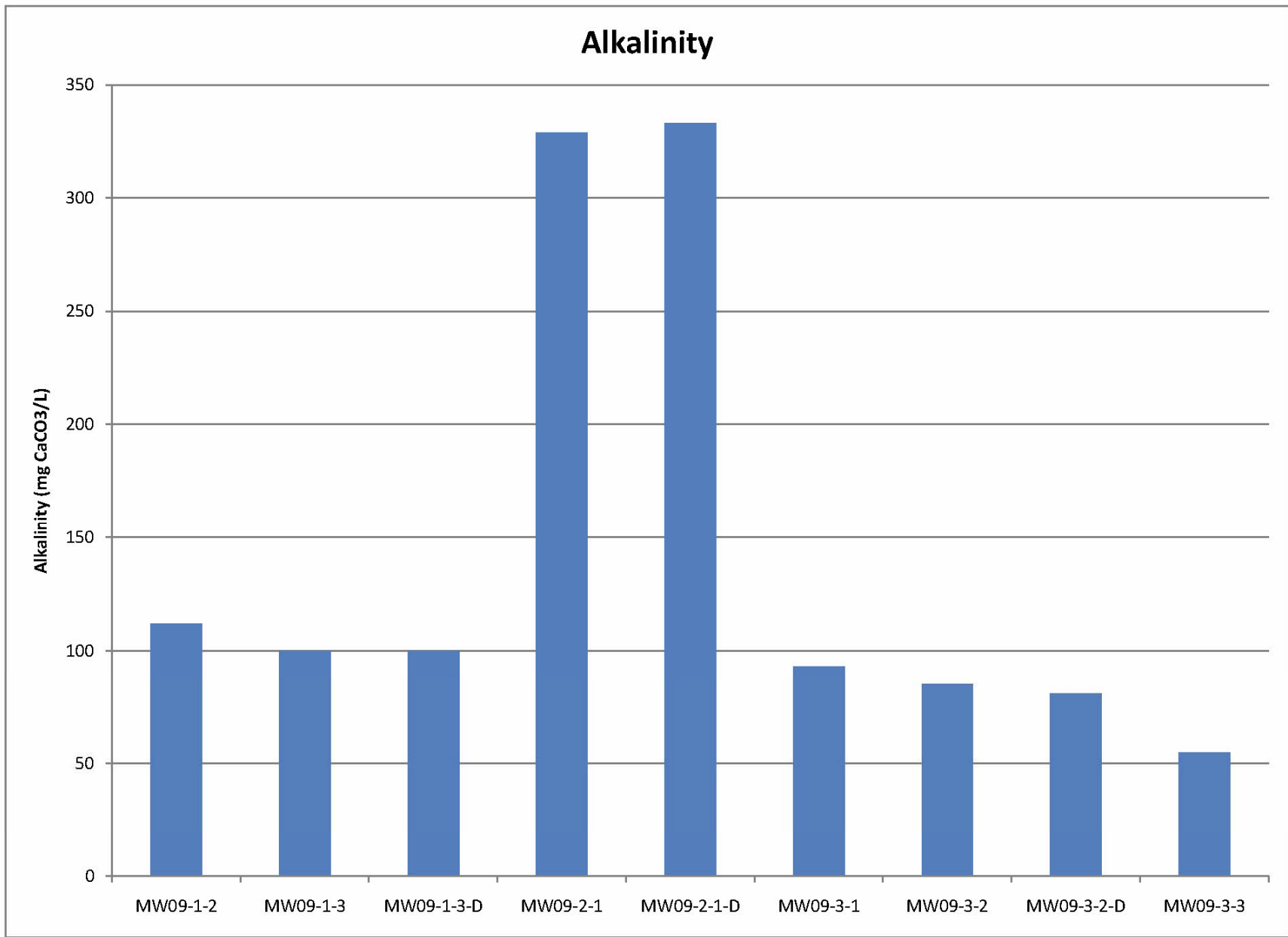
Minto Groundwater Monitoring Plan

**Groundwater Monitoring Locations**

Date:  
February 9, 2010

Approved:  
MDR

Figure:



**Minto Explorations Ltd.**

**Groundwater Monitoring Locations**

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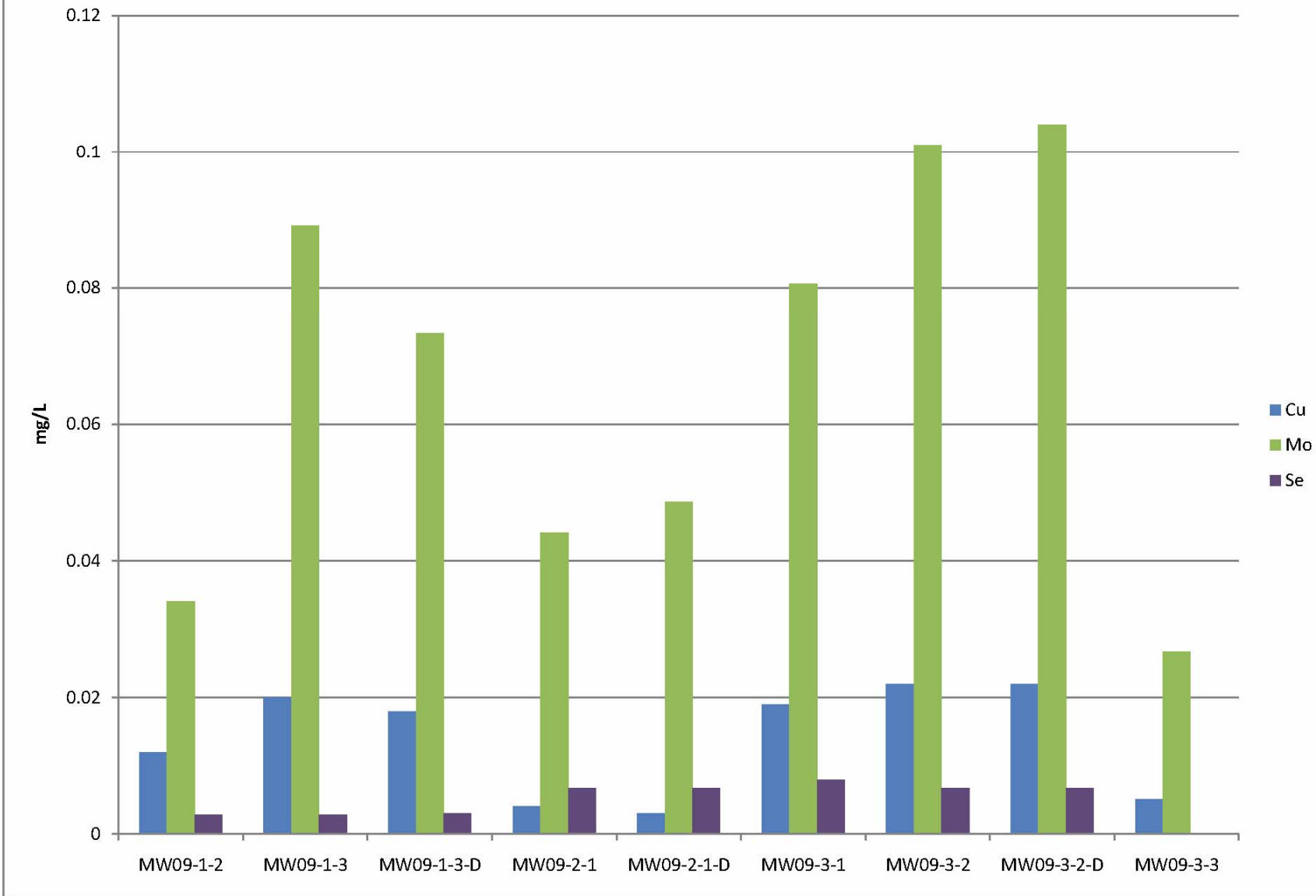
Minto Groundwater Monitoring Plan

Date:  
February 9, 2010

Approved:  
MDR

Figure: **7**

### Dissolved Metals: Cu, Mo, Se



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Groundwater Monitoring Locations

Job No: 2CM022.001

Filename: Fig 8\_pH.ppt

Minto Groundwater Monitoring Plan

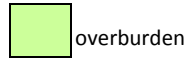
Date:  
February 9, 2010

Approved:  
MDR

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				TCR					IRS		comment
	From	To	From	To	ft	inches	decimal ft	m	%	strong	weak	
	ft	ft	m	m								
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				TCR					OF	J	CJ	+J from RZ	RQD		IRS		micro def. 0 to 3	J - properties	comment
	From	To	From	To	ft	inches	decimal ft	m	%					cm	%	strong	weak			
	ft	ft	m	m																
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	RO		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	RO		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 moist 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 <sup>2</sup> )	Penetrometer (kg/cm <sup>2</sup> )	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)
<b>S1</b>	Very Soft Clay	Easily penetrated by fist (flows between fingers)	< 0.025
<b>S2</b>	Soft Clay	Easily penetrated by thumb (>1")	0.025 - 0.05
<b>S3</b>	Firm Clay	Penetrated by thumb with moderate effort (>1")	0.05 - 0.10
<b>S4</b>	Stiff Clay	Indented by thumb but penetrated with great effort	0.10 - 0.25
<b>S5</b>	Very Stiff Clay	Readily indented with thumbnail	0.25 - 0.50
<b>S6</b>	Hard Clay	Indented with difficulty by thumbnail	> 0.50
<b>R0</b>	Extremely Weak	indented by thumbnail, crumbles under soft blow of blunt end of hammer; breaks apart when crushed by fingers	0.25 - 1.0
<b>R1</b>	Very Weak	crumbles under firm blow of geologic hammer pick; peeled by knife	1.0 - 5.0
<b>R2</b>	Weak	shallow indentation under firm blow of pick end of geologic hammer	5.0 - 25
<b>R3</b>	Medium Strong	fractured with single firm blow of geologic hammer	25 - 50
<b>R4</b>	Strong	requires more than one blow of hammer to fracture	50 - 100
<b>R5</b>	Very Strong	requires many blows of hammer to fracture	100 - 250
<b>R6</b>	Extremely Strong	can only be chipped with strong blows of hammer	> 250



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	inches	decimal ft	m	%					cm	%	strong	weak			
	ft	ft	m	m																
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



# MW09-3



overburden



weathered bedrock



fresh bedrock

## Geotechnical log (basic+)

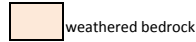
\* 10ft rods were used, with 5ft core barrel,  
HQ3 bit, with split tubes; casing depth 10ft

Run #	Run Interval				TCR					OF	J	CJ	+J from RZ	RQD		IRS		micro def. 0 to 3	J - properties	comment
	From	To	From	To	ft	inches	decimal ft	m	%					cm	%	strong	weak			
	ft	ft	m	m																
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	slightly 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

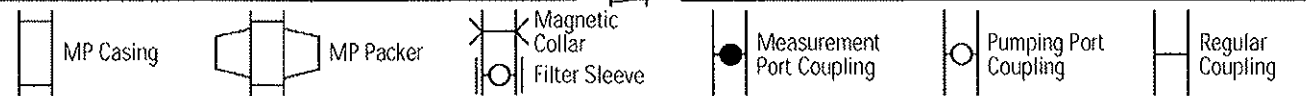
Run #	Run Interval				TCR					OF	J	CJ	+J from RZ	RQD		IRS		micro def.	J - properties	comment	
	From	To	From	To	ft	inches	decimal ft	m	%					cm	%	strong	weak				0 to 3
	ft	ft	m	m																	
1	5	6	1.52	1.83	1		1.00	0.30	100					0%	S3						
2	6	11	1.83	3.35	2.2		2.20	0.67	44					0%	S4						
3	11	15	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	R2	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	R2	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	R2	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	R2	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		4.92	1.50	98	6	1	0		150	100%	R5	R3				
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	R4			bright green mineralization on J surfaces	



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

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

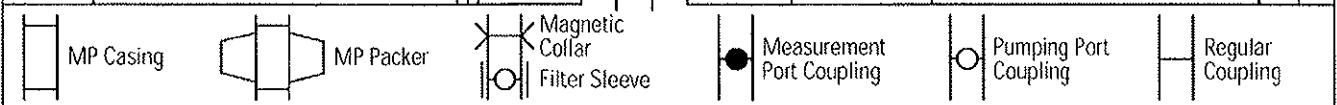
Depth, FT	Geological Description	Geologic Log	MP Casing Log	Serial No. Batch No.	Final Packer Pressure/Volume	Comments	Joint	
							Install	Test
			18			0.23 m from ground surface to top of piece 17.		
10	FILL		17					
20			16					
30			15					
40			14					
50			13					
60			12					
70			11					
80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





Project: MINTO ZCM027.007.001.10 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	Test
100	WEATHERED BEDROCK		7					
110			6	2803				
120	COMPETENT BEDROCK		5	7955				
130			4	17026	670 PSI 4.0 L	VALVE OPEN 165 PSI		
140			3	2800				
150			2	7957				
160	END OF HOLE AT 165 FT		1					
170								



SRK Consulting.



Sheet 1 of 2

# Westbay Packer Inflation Record

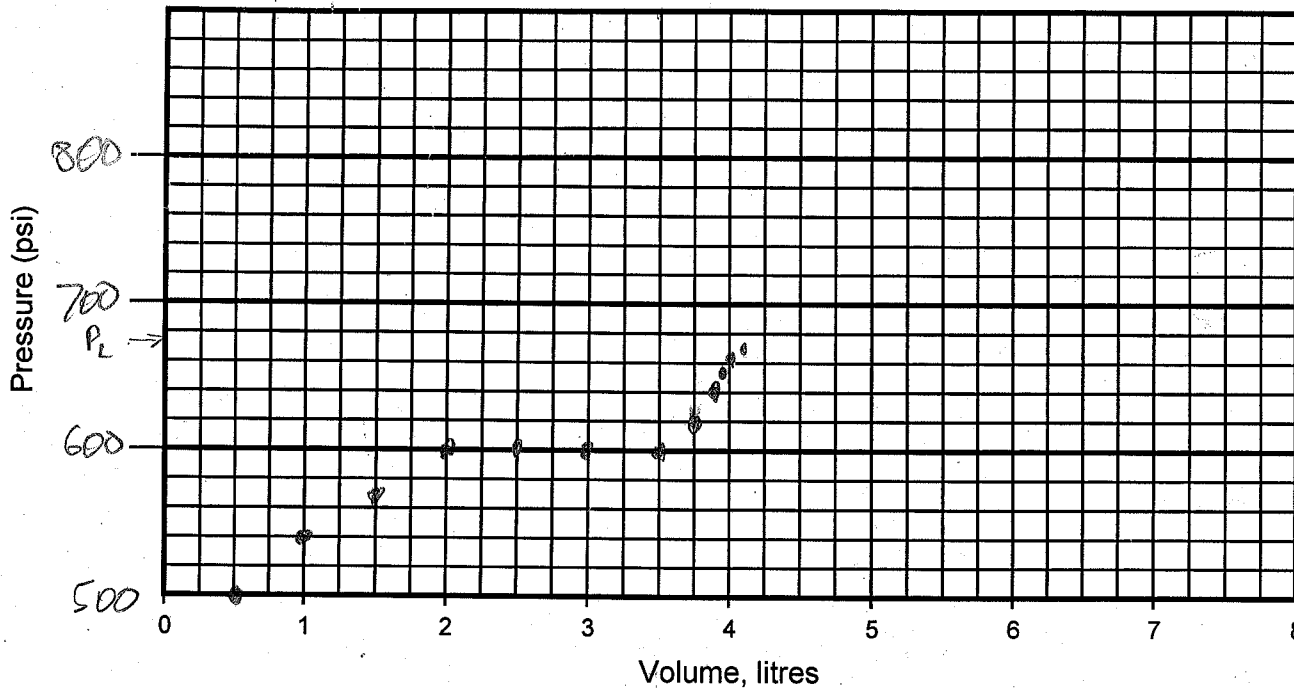
Project: Minto Project No.: 2CM022-007-001.10 Well No.: MW09-1  
 Location: West Pit Completed by: CD, JS Date Inflated: 28 Nov 09  
 Packer No. 4 Serial # 17026 Depth (ft/m): 130 ft Inflation Tool No.: \_\_\_\_\_  
 Packer Valve Pressure, P<sub>V</sub>: 165 psi Final Line Pressure, P<sub>L</sub>: 677 psi Tool Pressure, P<sub>T</sub>: 400 psi  
 Borehole Water Level: 33.65 (ft/m) = 47.8 psi (P<sub>W</sub>)

$$P_L = P_E + P_V + P_T - P_W$$

$$= 160 + 165 + 400 - 48 = 677$$

Calculated Packer Element Pressure, P<sub>E</sub> = P<sub>L</sub> + P<sub>W</sub> - P<sub>V</sub> - P<sub>T</sub> = 160 psi  
 110.4 ft

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 V						
Pressure, psi	660	670								



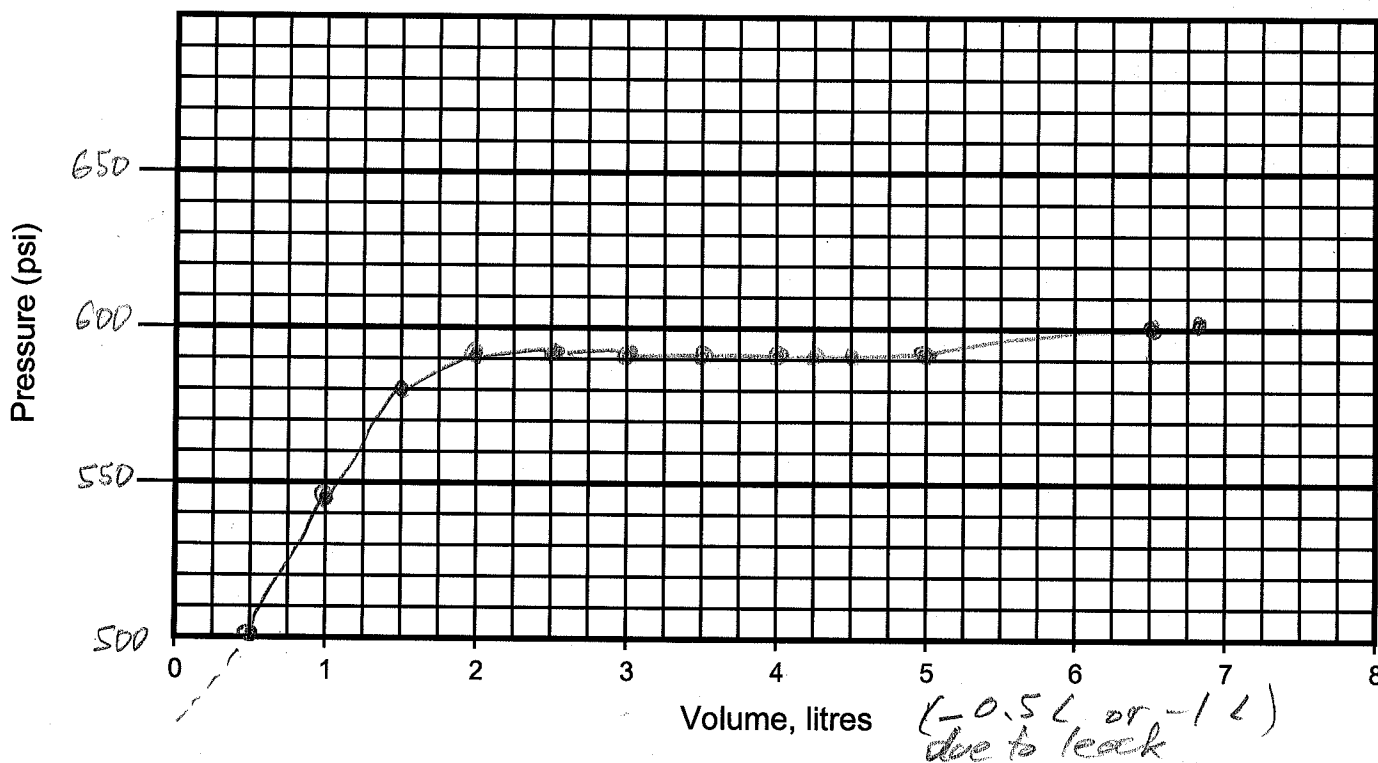
Comments: Packer # normal inflation

Time 14:10

# Packer Inflation Record

Project: Mato 2CM022.007.001.10 Project No.: \_\_\_\_\_ Well No.: MW09-1  
 Location: West pit Completed by: C.D./JS Date Inflated: Nov 27 '09  
 Packer No. 8 s/n 17025 Depth (ft/m): 95 ft Inflation Tool No.: \_\_\_\_\_  
 Packer Valve Pressure, P<sub>V</sub>: 170 psi Final Line Pressure, P<sub>L</sub>: 682 psi Tool Pressure, P<sub>T</sub>: 400 psi  
 Borehole Water Level: 33.65 (ft/m) = 47.8 psi (P<sub>w</sub>)  
 Calculated Packer Element Pressure, P<sub>E</sub> = P<sub>L</sub> + P<sub>w</sub> - P<sub>V</sub> - P<sub>T</sub> = 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*	* pinned vol. (actual 6.75 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 weak  
rock zone)

Project: MINTO 2CM022.007.001.10 WB Ref.: \_\_\_\_\_

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

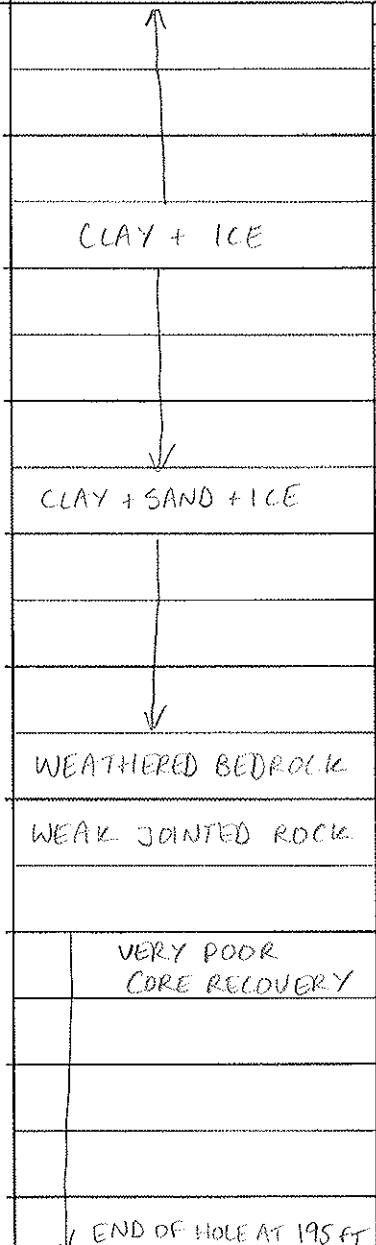
Hole Depth: 195 FT MP Depth: 195 FT Hole Diameter: HQ Date Installed: 26 NOV '09

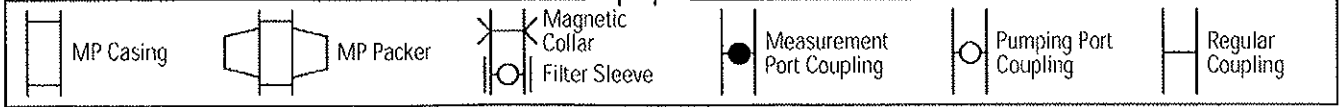
Measurement Datum: GROUND SURFACE Datum Elevation: 757.5 m Date Drawn: 19 JAN '10

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



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

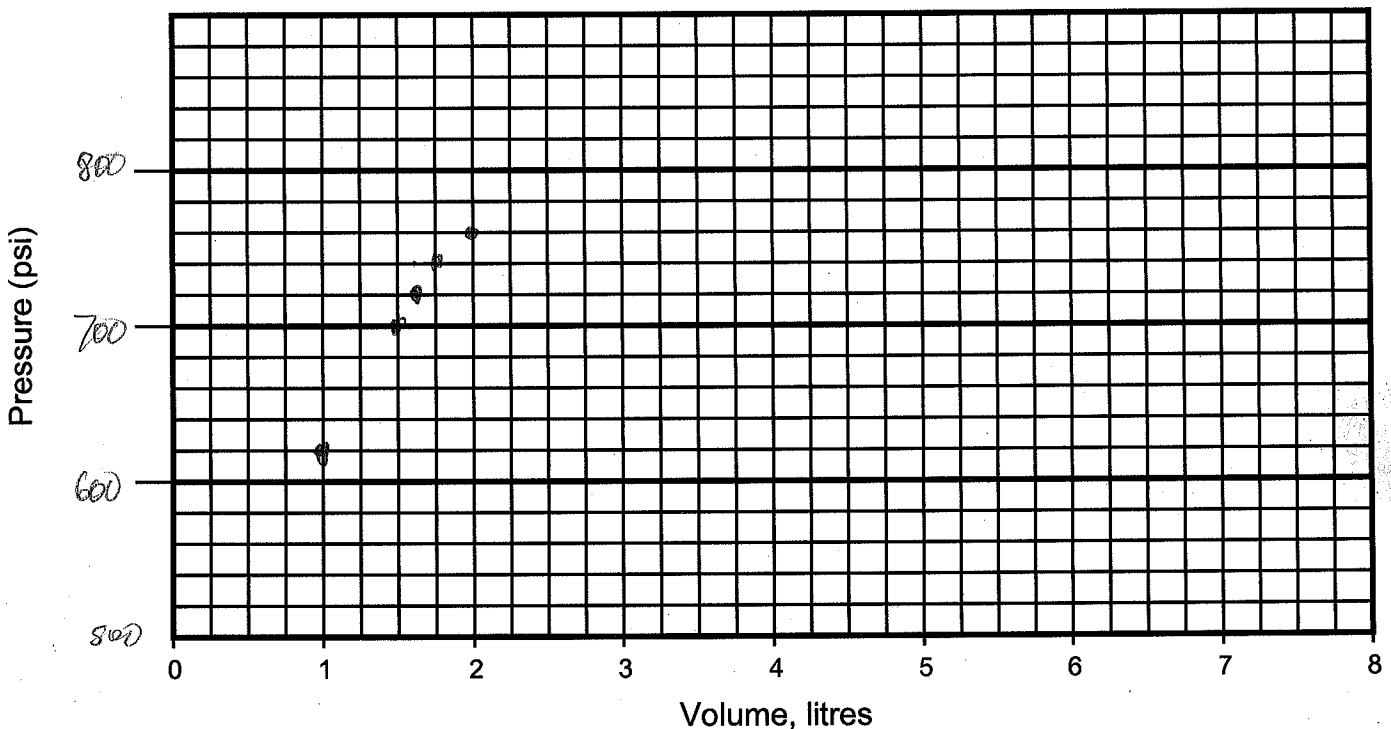
Depth, FT	Geological Description	Geologic Log	MP Casing Log	Serial No. Batch No.	Final Packer Pressure/Volume	Comments	Joint		
							Install	Test	
100			12						
110			11						
120			10						
130			9						
140			8						
150			7	M	17022	760 PSI 4.75 L	MAG COLLAR AT TOP OF PACKER		
160			6		2799				
170			5		7958				
180			4	M	17021	760 PSI 1.75 L	MAG COLLAR AT TOP OF PACKER		
190			3		2794				
200	2		7951						
	1								



# 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<sub>V</sub>: 165 psi Final Line Pressure, P<sub>L</sub>: 755 psi Tool Pressure, P<sub>T</sub>: 425 psi  
 Borehole Water Level: 3.0 (ft) (m) = \_\_\_\_\_ psi (P<sub>W</sub>)  
 Calculated Packer Element Pressure, P<sub>E</sub> = P<sub>L</sub> + P<sub>W</sub> - P<sub>V</sub> - P<sub>T</sub> = 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									

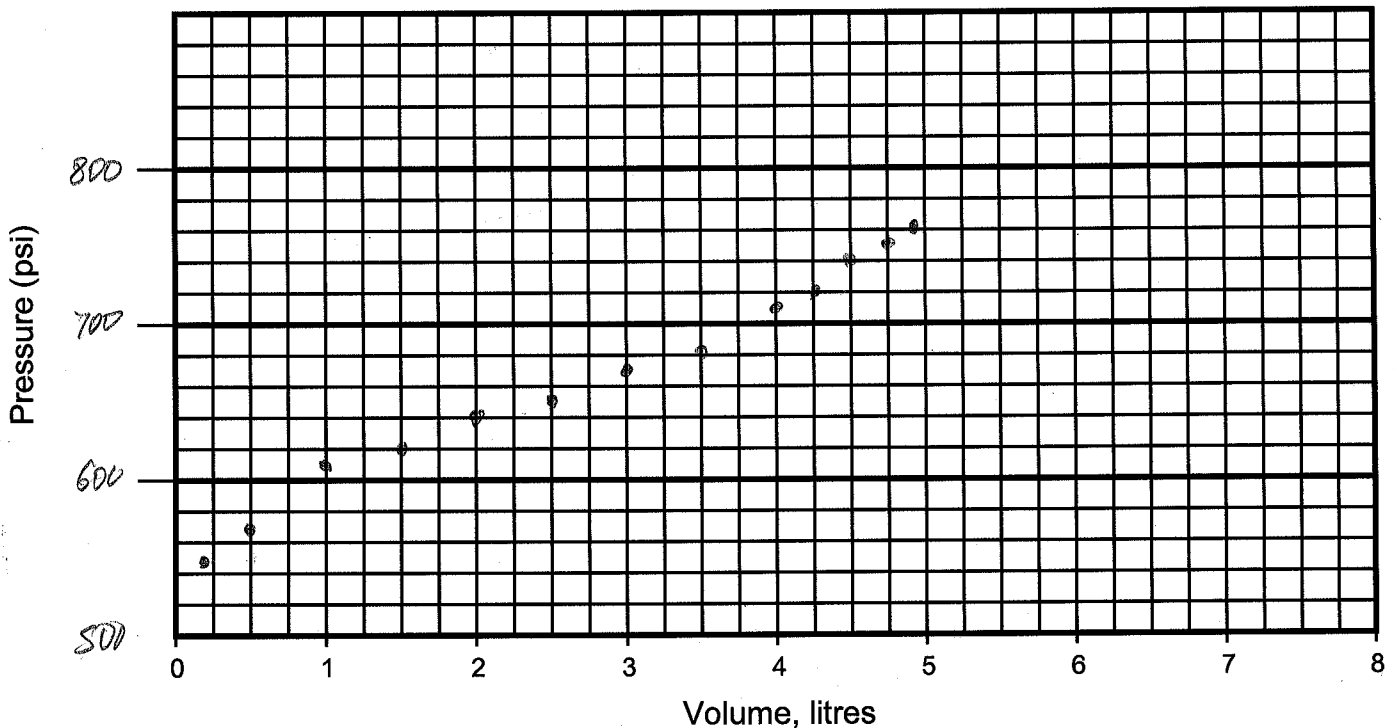


Comments: Packer # hole probably collapsed around packer, Time - 20:30  
resulting in small volume inflated; packer is just above  
zone of weak weath. rock (R<sub>2</sub> strength) with poor core recovery

# 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<sub>V</sub>: 170 psi Final Line Pressure, P<sub>L</sub>: 755 psi Tool Pressure, P<sub>T</sub>: 425 psi  
 Borehole Water Level: 3 (ft / m) = 4 psi (P<sub>W</sub>)  
 Calculated Packer Element Pressure, P<sub>E</sub> = P<sub>L</sub> + P<sub>W</sub> - P<sub>V</sub> - P<sub>T</sub> = 160 psi

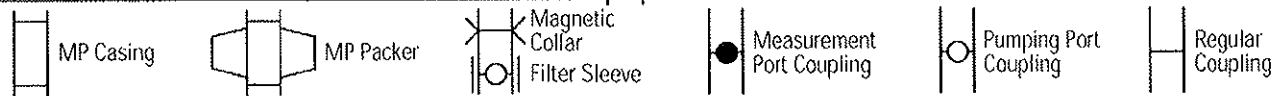
Volume, litres	0.2	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.25
Pressure, psi	550	570	610	620	640	650	670	680	710	720
Volume, litres	4.50	4.75	4.9		4.75 L final volume					
Pressure, psi	740	750	760							



Comments: Packer # inflated normally Time - 21:00

Project: MINTO 2CM027.007.001.10 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

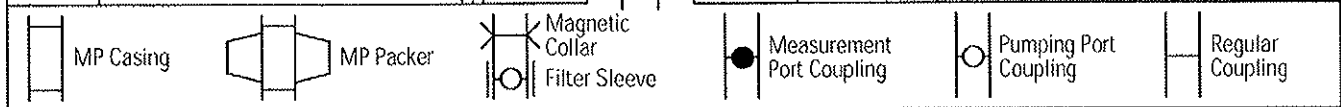
Depth, FT	Geological Description	Geologic Log	MP Casing Log	Serial No. Batch No.	Final Packer Pressure/Volume	Comments	Joint	
							Install	Test
	WELL CASING		18			2.9 m from top of casing to top of piece 17.		
10	WEATHERED BEDROCK		17					
20	COMPETENT ROCK		16	17023	740 PSI 3.9 L	VALVE OPEN 170 PSI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





Project: MINTO 2CM027.007.001.10 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	Test
100	COMPETENT BEDROCK		7	17027	750 PSI 3.75 L	VALVE OPEN 170 PSI		
110			6					
120								
130			M75K 4	2804				
140			0	7950				
150			3					
160	END OF HOLE 165'		2					
170			1					

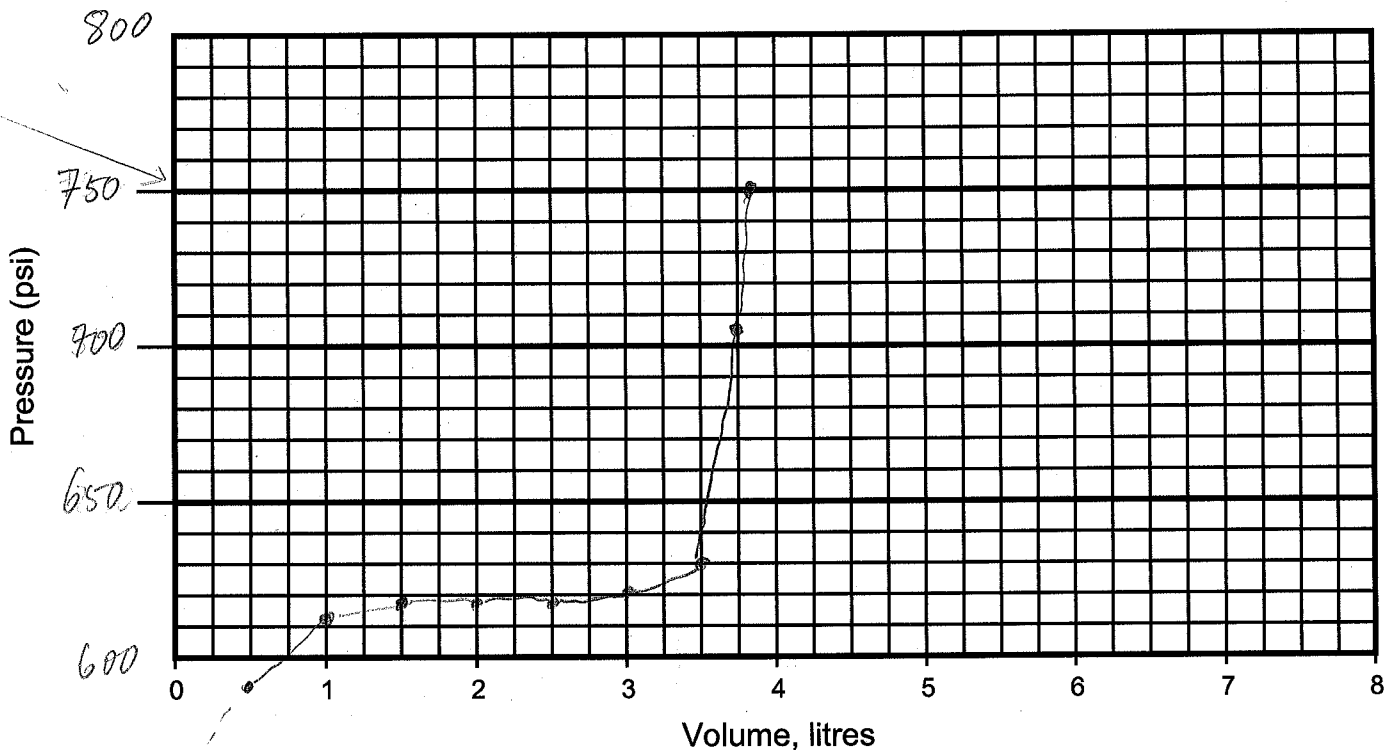


# Packer Inflation Record

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. 7 Serial# 17027 Depth (ft/m): 100 ft Inflation Tool No.:         
 Packer Valve Pressure, P<sub>V</sub>: 170 psi Final Line Pressure, P<sub>L</sub>: 754 psi Tool Pressure, P<sub>T</sub>: 425 psi  
 Borehole Water Level: 4 (ft/m) = 1 psi (P<sub>W</sub>)

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

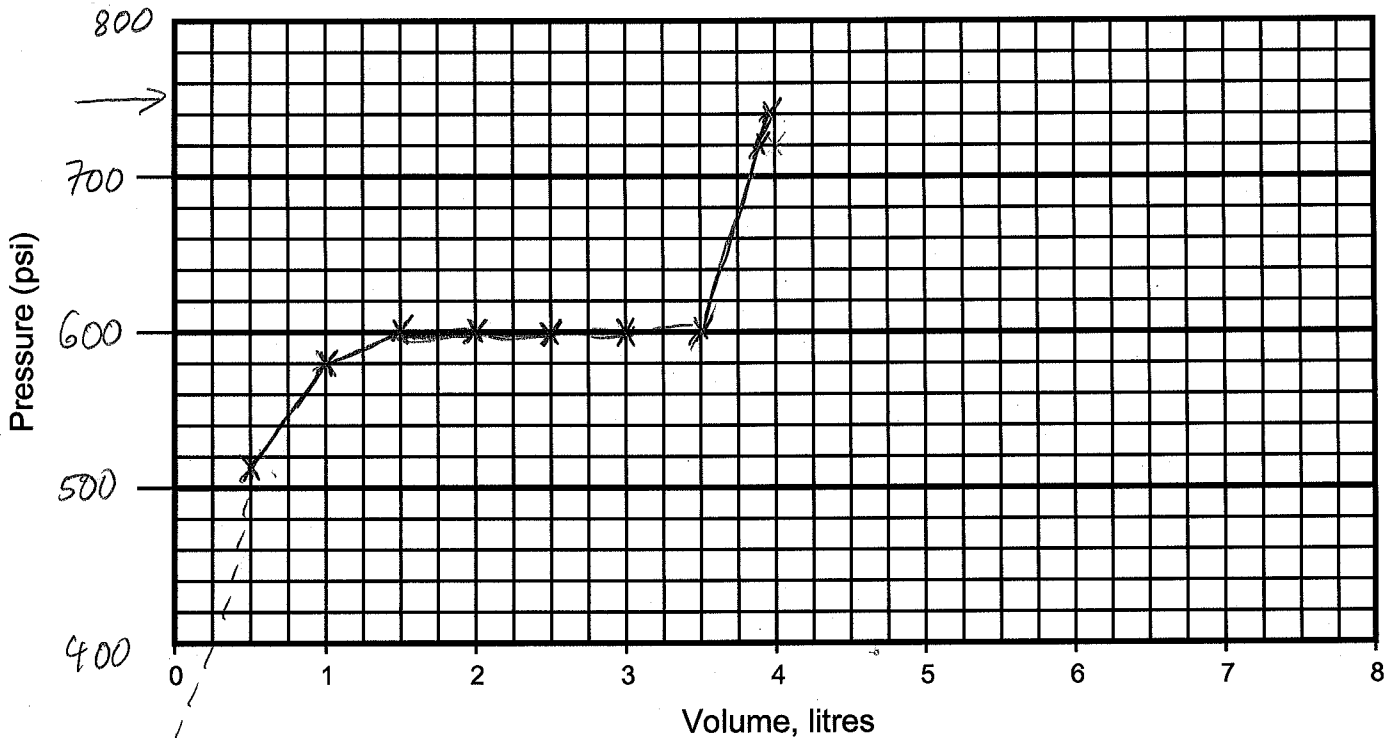
Time - 14:35

# Packer Inflation Record

Project: Minto Project No.: 2LM022.007.001.10 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<sub>V</sub>: 165 psi Final Line Pressure, P<sub>L</sub>: 749 psi Tool Pressure, P<sub>T</sub>: 425 psi  
 Borehole Water Level: 4 (ft/m) = 1 psi (P<sub>W</sub>)

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 375L
Pressure, psi	515	580	600	600	600	600	600	720	740	
Volume, litres										
Pressure, psi										

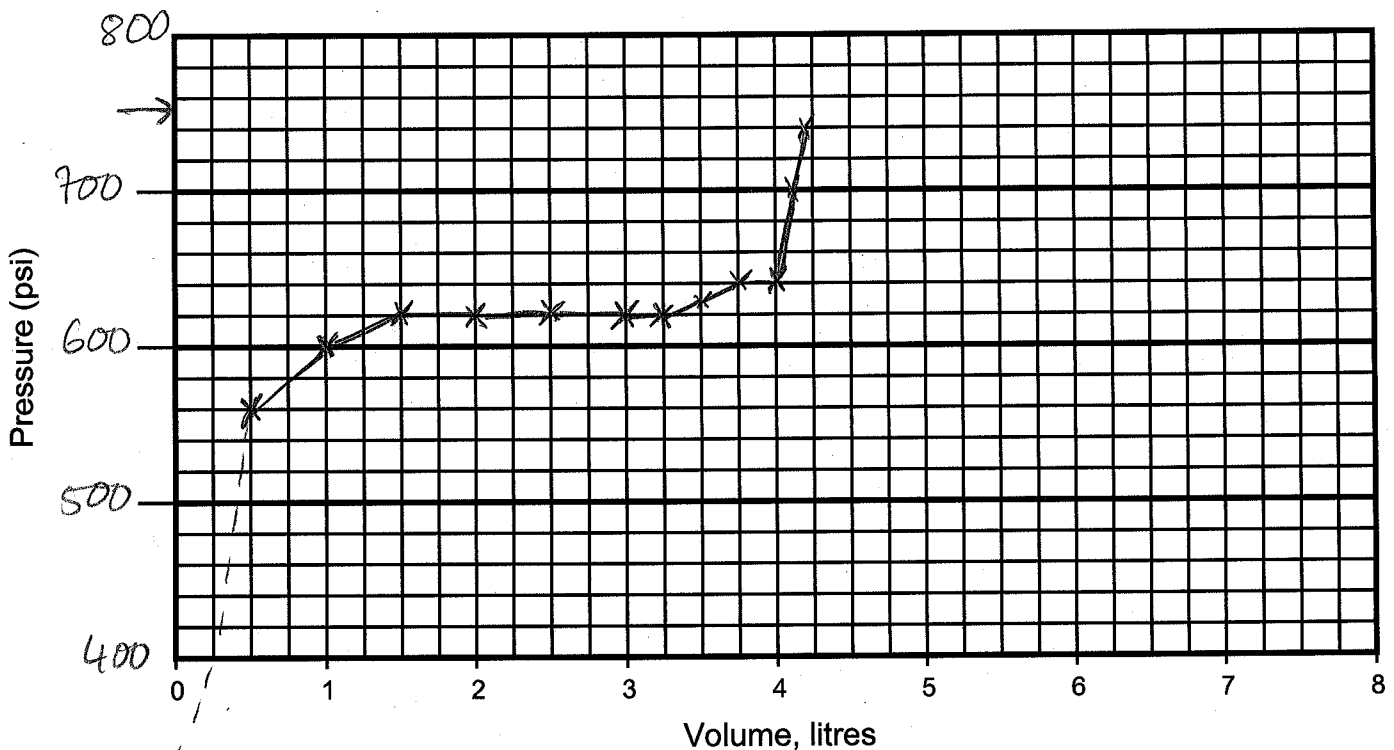


Comments: Packer # Normal inflation. Time - \_\_\_\_\_

# Packer Inflation Record

Project: Minto Project No.: 2CM022-007 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<sub>V</sub>: 170 psi Final Line Pressure, P<sub>L</sub>: 754 psi Tool Pressure, P<sub>T</sub>: 425 psi  
 Borehole Water Level: 4 (ft/m) = 1 psi (P<sub>W</sub>)  
 Calculated Packer Element Pressure, P<sub>E</sub> = P<sub>L</sub> + P<sub>W</sub> - P<sub>V</sub> - P<sub>T</sub> = 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.

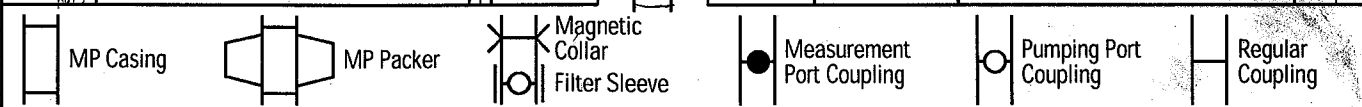
Project: Minto 2CM022.007 WB Ref.: \_\_\_\_\_

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

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

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

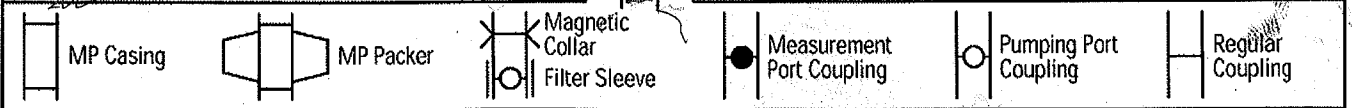
Depth,	Geological Description	m ↓ FT	Geologic Log	MP Casing Log	Serial No. Batch No.	Final Packer Pressure/Volume	Comments	Joint	
								Install	Test
5			✓	27					
10									
15			✓	26					
20									
25			✓	25					
30									
35			✓	24					
40									
45			✓	23					
50									
55			✓	22					
60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



Project: Minto 2CM022.007.001.100 WB Ref.: \_\_\_\_\_  
 Location: Phase 1 confluence Hole No.: MWD9-4 Installed by: M. Royle / J. Seibel  
 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	Test
105	↓ mostly diamict (14 ft) or firm frozen clay	✓	17					
110		✓	16					
115	with ice inclusions	✓	15					
120	note: clayey fine sand (frozen)	✓	14					
125		✓	13			W <sub>f</sub> = 74.52 m <sup>3</sup> -5 FT stuck after install (30 min)		stick below ground
130		✓	12					
135	small ice layer at 136.5'	✓	11					
140	firm clay diamict (compacted) - frozen	V <sub>0</sub> = 165 V <sub>r</sub> = 140	10					
145	highly weathered bedrock crumbly, clayey	✓	9					
150		✓ M	8			mag. collar		
155	weath. altered bedrock, R2 strength, core jointed	✓	7	2798				
160		✓	6					
165		✓	5	7954				
170		✓	4					
175		✓	3					
180	strong rock, jointed	✓ M	2	17031 2797		mag collar on bottom of packer		
185		✓	1					
190		✓	0	7953				
195		✓	0					
200								

Nov 25  
15:35  
bottom  
2 packers  
inflated  
with  
HQ shoe  
at 160 ft



Project: Minto 2CM022.007

WB Ref.: \_\_\_\_\_

Location: Phase 1 confluence

Hole No.: MWD9-4

Installed by: M. Royle / J. Scribek / C. Doughty

Hole Depth: 250 FT MP Depth: 250 FT

Hole Diameter: HQ

Date Installed: Nov 24 '09

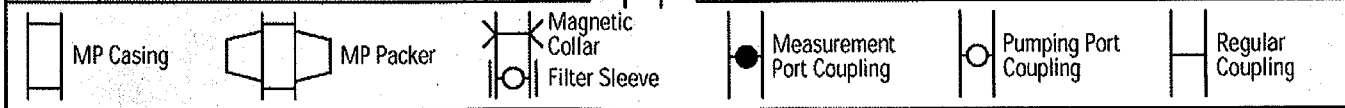
Measurement Datum: ground surface

Datum Elevation: \_\_\_\_\_

Date Drawn: Nov 24 '09

U.HQ

Depth	Geological Description	Geologic Log	MP Casing Log	Serial No. / Batch No.	Final Packer Pressure/Volume	Comments	Joint	
							Install	Test
205	strong rock, jointed	✓	6	17024				
210		1/8" TO 1/4" SD ✓	5			don't put packer below 205'		
215								
220		✓	4					
225	✓	✓	3	M 2796		mag-collar		
230		✓	0	7952				
235		✓		7952				
240		✓						
245	EDH at 243'	EDH				end cap		
250	EDH at 250'					drill hole w.l. = ?		
						measure before install		
						probed hole = 243.1'		
						shortened orig design by 5' by remains		
						#2 pipe (5ft)		



# Packer Inflation Record

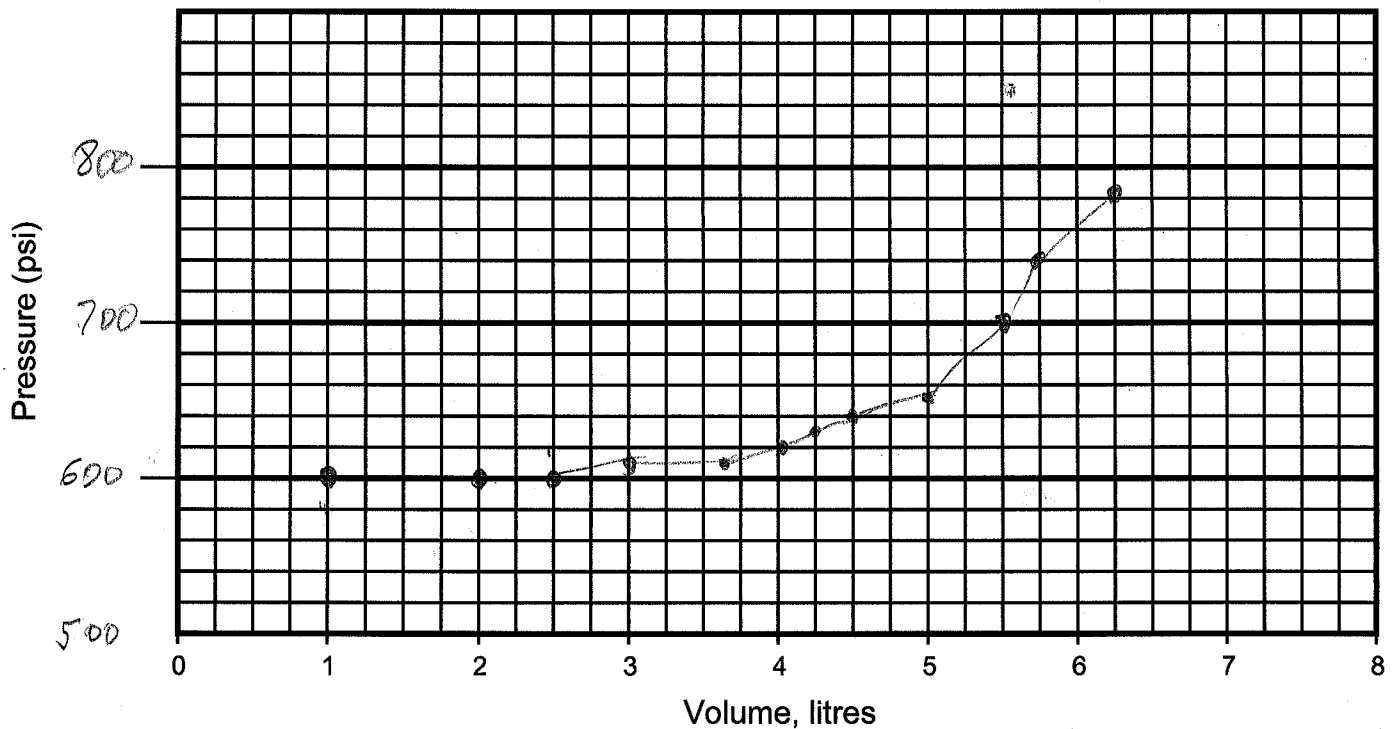
Project: Minto Project No.: 2CM022.007.001 Well No.: MW09-04  
 Location: Phase 1 Confluence Completed by: MR/SS/CD Date Inflated: Nov 25/09  
 Packer No.: 6 Depth (ft/m): 205 Inflation Tool No.: \_\_\_\_\_  
 Packer Valve Pressure, P<sub>V</sub>: 170 psi Final Line Pressure, P<sub>L</sub>: 780 psi Tool Pressure, P<sub>T</sub>: 475 psi  
 Borehole Water Level: ~30 (ft/m) = 15 psi (P<sub>W</sub>)

$$P_L = P_V + P_T - P_W + P_E$$

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

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

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	575 <sub>L</sub>					
Pressure, psi	740	780								



Comments: Packer #

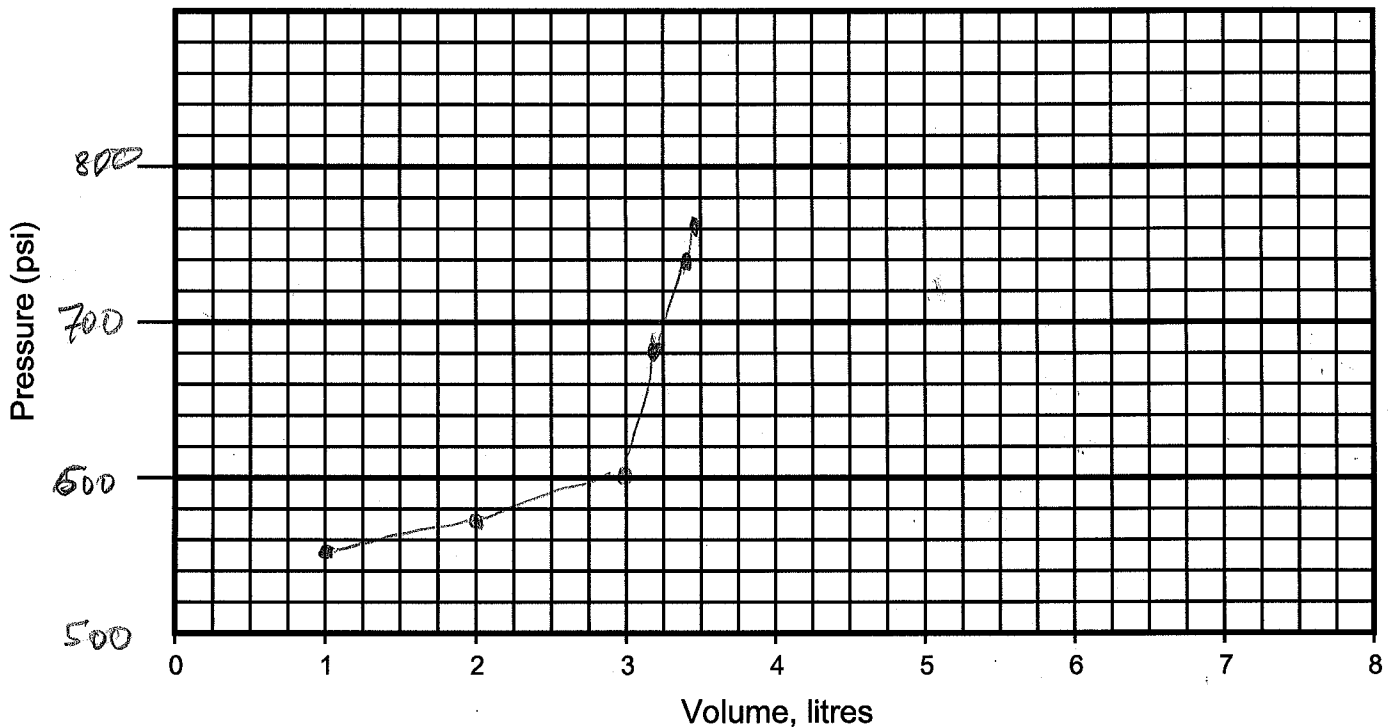
Time - \_\_\_\_\_



# Packer Inflation Record

Project: Minto Project No.: 2CM022.007.00.10 Well No.: MWD09-04  
 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<sub>v</sub>: 170 psi Final Line Pressure, P<sub>L</sub>: 780 psi Tool Pressure, P<sub>T</sub>: 475 psi  
 Borehole Water Level: 25 (ft/m) = 15 psi (P<sub>w</sub>)  
 Calculated Packer Element Pressure, P<sub>E</sub> = P<sub>L</sub> + P<sub>w</sub> - P<sub>v</sub> - P<sub>T</sub> = 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										



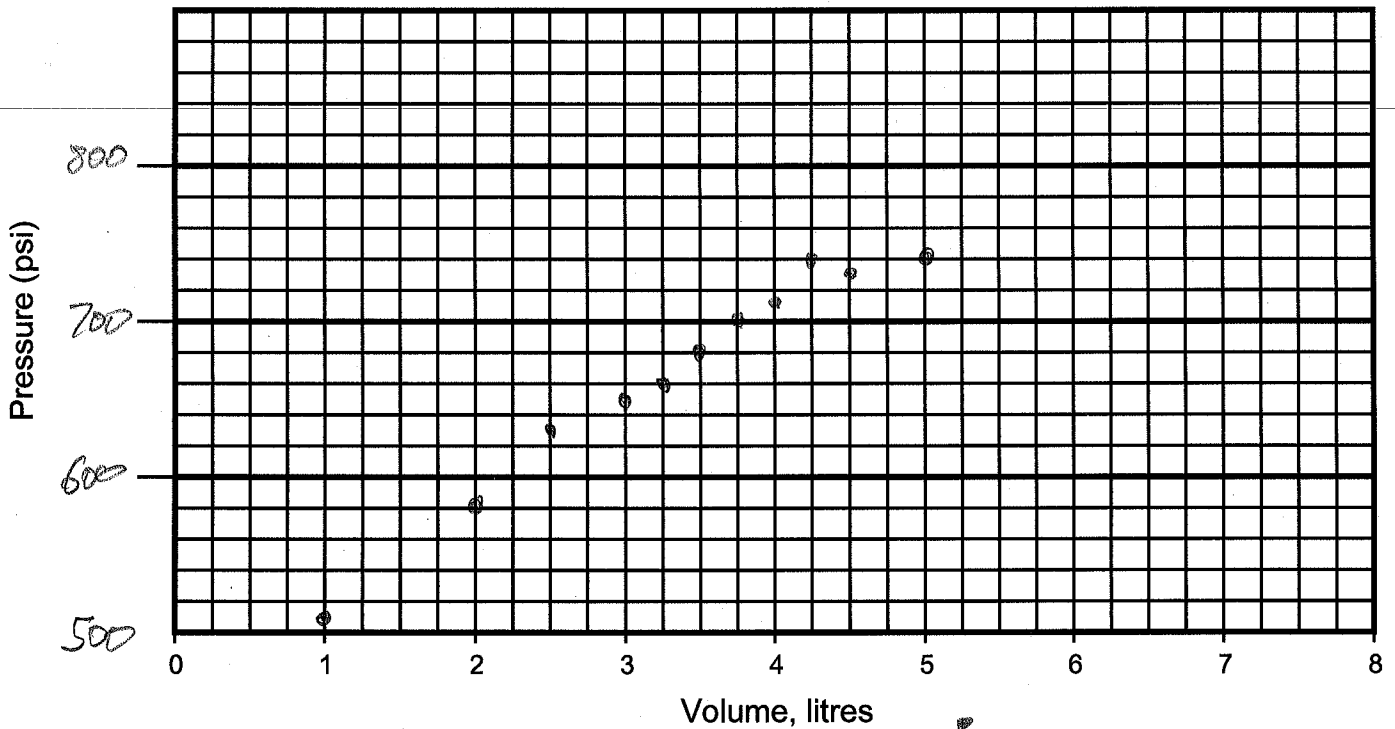
Comments: Packer #

Time - \_\_\_\_\_

# Packer Inflation Record

Project: Minto Project No.: 2CM022.007.001 Well No.: MWD9-4  
 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<sub>v</sub>: 165 psi Final Line Pressure, P<sub>L</sub>: 775 psi Tool Pressure, P<sub>T</sub>: 475 psi  
 Borehole Water Level: \_\_\_\_\_ (ft/m) = \_\_\_\_\_ psi (P<sub>w</sub>)  
 Calculated Packer Element Pressure, P<sub>E</sub> = P<sub>L</sub> + P<sub>w</sub> - P<sub>v</sub> - P<sub>T</sub> = 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**  
**Preliminary Pressure Profiles**



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<sub>atm</sub>) (pressure, temperature, time)  
Start: 12.95, 12.7° Finish: 12.95, 14.0° 17:00  
16:16 P<sub>atm</sub> 12.95 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) H = (P2 - Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Inside Casing (P1)					
1	44.2	43.6	44.2	12.96	19.34	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			

Notes: w = 1.422psi/m of H<sub>2</sub>O      Dz = piezometric level in zone      Patm = atmospheric pressure  
H = pressure head of water in zone      Dp = true depth of measurement port

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



**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: MDS0AY  
Serial No.: PM15 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

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<sub>atm</sub>) (pressure, temperature, time)

Start: 13.12, 11.4 Finish: \_\_\_\_\_  
11:30 P<sub>atm</sub> 13.12 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	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			

Notes: w = 1.422psi/m of H<sub>2</sub>O      Dz = piezometric level in zone      Patm = atmospheric pressure  
H = pressure head of water in zone      Dp = true depth of measurement port



**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.: 0.16 m  
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: 17.44 m (at start)  
Depth to water in MP: \_\_\_\_\_ (at finish)

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

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<sub>atm</sub>) (pressure, temperature, time)  
Start: 13.26, 11.01, Finish: 13.23, 2.03°C  
19:33 P<sub>atm</sub> 13.26 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) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Inside Casing (P1)					
<u>1</u>	<u>51.8</u>	<u>50.0</u>	<u>50.0</u>	<u>62.10</u>	<u>80.89</u>	<u>62.09</u>	<u>&lt; 4.6</u>	<u>19:38</u>			
<u>2</u>	<u>47.2</u>	<u>45.3</u>	<u>45.3</u>	<u>55.36</u>	<u>74.39</u>	<u>55.35</u>	<u>&lt; 2.8</u>	<u>19:40</u>			

Notes: w = 1.422psi/m of H<sub>2</sub>O      Dz = piezometric level in zone      Patm = atmospheric pressure  
H = pressure head of water in zone      Dp = true depth of measurement port

TU TEST PUMP PORTS CLOSED



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.: 0.16 m  
Elev. top of MP Casing: \_\_\_\_\_  
Reference Elevation: \_\_\_\_\_  
Drillhole angle: 90°

Probe Type: MDS DAX  
Serial No.: EMS 3835  
Probe Range: 250 PSI  
MP Casing Type: MP38  
Depth to water in MP: \_\_\_\_\_ (at start)  
Depth to water in MP: \_\_\_\_\_ (at finish)

Client: MINTO  
Job No.: ZCM022.007.001.10  
Location: LOWER TAILINGS  
Weather: WINDY + COLD  
Operator(s): CD

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<sub>atm</sub>) (pressure, temperature, time)  
Start: 13:10, 14 °C Finish: \_\_\_\_\_  
16:10 pm P<sub>atm</sub> \_\_\_\_\_ 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) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Inside Casing (P1)					
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			
											THEN ADDED ANTIFREEZE

Notes: w = 1.422psi/m of H<sub>2</sub>O      Dz = piezometric level in zone      Patm = atmospheric pressure  
H = pressure head of water in zone      Dp = true depth of measurement port



**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: MOSDAY  
Serial No.: EMIS 3835  
Probe Range: 250 psi  
MP Casing Type: MP 38  
Depth to water in MP: 12.80 m (at start)  
Depth to water in MP: \_\_\_\_\_ (at finish)

Client: Minto  
Job No.: ZCM022,007,001.10  
Location: Minto North  
Weather: Cold, overcast  
Operator(s): JS, CD

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<sub>atm</sub>) (pressure, temperature, time)

Start: 12.84 psi, 19.7 °C Finish: \_\_\_\_\_  
17:18 P<sub>atm</sub> 12.84 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) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Inside Casing (P1)					
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			

Notes: w = 1.422psi/m of H<sub>2</sub>O      Dz = piezometric level in zone      Patm = atmospheric pressure  
H = pressure head of water in zone      Dp = true depth of measurement port

Log depths were verified to





### 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: MOSBY  
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.: ZCM022.007  
Location: MINTO NTM  
Weather: COLD + SUNNY  
Operator(s): CD, RS, GH

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<sub>atm</sub>) (pressure, temperature, time)  
Start: 13.05, 18.06 Finish: 13.06, 2.27  
9.46 P<sub>atm</sub> 13.06 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) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Inside Casing (P1)					
				1	39.0	37.6					
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			

Notes: w = 1.422psi/m of H<sub>2</sub>O      Dz = piezometric level in zone      Patm = atmospheric pressure  
H = pressure head of water in zone      Dp = true depth of measurement port

**Appendix D**  
**Sampling Records**

Well Development / Purging Record

29 Nov 09

CD  
+JS

Well: MW09-1 (MP well)		Well Inner Diameter: MP 38		cm		MINTD	
Total Depth:		Static Water Level:		Static Well Volume:		Litres	
Date/Time	Volume Purged (Litres)	pH	EC (µS/cm) <sup>probe reads + 0.5</sup>	T (C)	Eh (mv)	dO (mg/l)	Comments
15:45	20	9.69	1.2	<4.6			Started with water full of water/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
	<del>80</del>	8.29					
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	7.8			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

N.B. mbtc - meters below top of casing

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



# Groundwater Sampling Field Data Sheet

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

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

Client: MINTO  
Job No.: 2EM022-007,001.10  
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)						Position Sampler	Sample Collection Checks (probe located at sampling zone in MP casing)							Volume Retrieved		Comments										
					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	MW09-1-1	43.2	43.6	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	one tiny drop in bottle. → Void with air?
2	MW09-1-2	32.5	32.1	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Dissolved Metals HNO <sub>3</sub> + Nutrients H <sub>2</sub> SO <sub>4</sub>	
2	MW09-1-2	32.5	32.1	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Total metals HNO <sub>3</sub>	
2	MW09-1-2	32.5	32.1	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Routine Parameters.	
3	MW09-1-3	24.9	24.0	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Dissolved, total, 1/2 Nutrients.	
3	MW09-1-3	24.9	23.8	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1/2 Nutrients, 1/2 RP	
3	MW09-1-3	24.9	23.8	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1/2 RP, 1/2 RP for zone 4*	
4*	MW09-1-4	24.9	23.6	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1/2 RP, DM	
4*	MW09-1-4	24.9	23.5	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	TM, Nutrients.	

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

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

Well Development / Purging Record

+ 2 DEC 2009

Well: MW09-2		Well Inner Diameter: MP38 cm					
Total Depth: mbtc		Static Water Level: 3.77 mbtc		Static Well Volume: 46 Litres MP casing before purging.			
Date/Time	Volume Purged (Litres)	pH	MS EC (µS/cm)	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 PAT 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

N.B. mbtc - meters below top of casing



**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

$P_{atm} = 13.12 \text{ psi}$

Client: MINTO  
Job No.: ZCM022.007.001-10  
Location: LOWER TAILINGS  
Weather: COLD, WINDY, SUNNY  
Operator(s): CD, 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		Comments							
					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	MW09-2-1	51.8	49.8	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Temp < 0.1°C Sample had antifreeze - leak.
1	MW09-2-1	51.8	49.5	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	400	N, TM, DM - no antifreeze
1	MW09-2-1	51.8	49.4	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	400	RP
3	MW09-2-3	51.8	49.4	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	400	N, TM, DM
3	MW09-2-3	51.8	49.0	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	400	RP
2	MW09-2-2	47.2	44.3	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NO FLOW → ICE? T ≈ 0.2°C

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

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

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: ~476 inside MPwell prior to dev. Litres			
Date/Time	Volume Purged (Litres)	pH	EC (µS/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

N.B. mbtc - meters below top of casing

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

# MP Groundwater Sampling

## Field Data Sheet

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

 Zones sampled: 4\*  
 Drillhole angle: 9.0 degrees  
 Start Time: 13:10  
 End Time: 16:45

 Atmospheric Pressure = 13.06 psi

 Client: MINTO  
 Job No.: ZCM022,007.001.10  
 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		Comments				
					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 <sup>filtered</sup>
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%
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 E**  
**MP Monitoring Well History Log**

Appendix E: Sample MP Monitoring Well History Log

Monitoring Well	Date	Comments	Pumping Port Status
<b>MW09-1</b>	Nov28, 09 Nov 29, 09 Nov 30, 09	<ul style="list-style-type: none"> <li>- installed, pressure profile</li> <li>- developed</li> <li>- sampled zones 1 to 4</li> </ul>	- all closed
<b>MW09-2</b>	Nov 26, 09 Dec 1, 09 Dec 2, 09	<ul style="list-style-type: none"> <li>- installed</li> <li>- pressure profile and developed</li> <li>- sampled zones 1 to 4</li> </ul>	- all closed
<b>MW09-3</b>	Nov 27, 09 Dec 2, 09	<ul style="list-style-type: none"> <li>- installed, pressure profile</li> <li>- developed and sampled zones 1 to 4</li> </ul>	- all closed
<b>MW09-4</b>	Nov 24, 09	- installed	- all closed



# Minto Mine Groundwater Monitoring System Sampling Report

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*Prepared for*

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*Project Reference Number  
SRK 2CM022.007*

**July 2010**

**Minto Mine**  
**Groundwater Monitoring System**  
**Sampling Report**

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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<sup>th</sup> and 28<sup>th</sup> 2009

Round #1: November 30<sup>th</sup> and December 1<sup>st</sup> 2009

Round#2: March 29<sup>th</sup> and 30<sup>th</sup> 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	-
<b>Physical Tests</b>					
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%
<b>Major Anions and Cations</b>					
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%
<b>Anions and Nutrients</b>					
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%
<b>Dissolved Metals</b>					
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	-
<b>Total Metals</b>					
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
<b>Physical Tests</b>				
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
<b>Major Anions and Cations</b>				
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	%	-	-	-
<b>Anions and Nutrients</b>				
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
<b>Dissolved Metals</b>				
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
<b>Total Metals</b>				
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	HW09-03 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
<b>Physical Tests</b>									
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
<b>Major Anions and Cations</b>									
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	-	-
<b>Anions and Nutrients</b>									
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
<b>Total Metals</b>									
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
<b>Dissolved Metals</b>									
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**

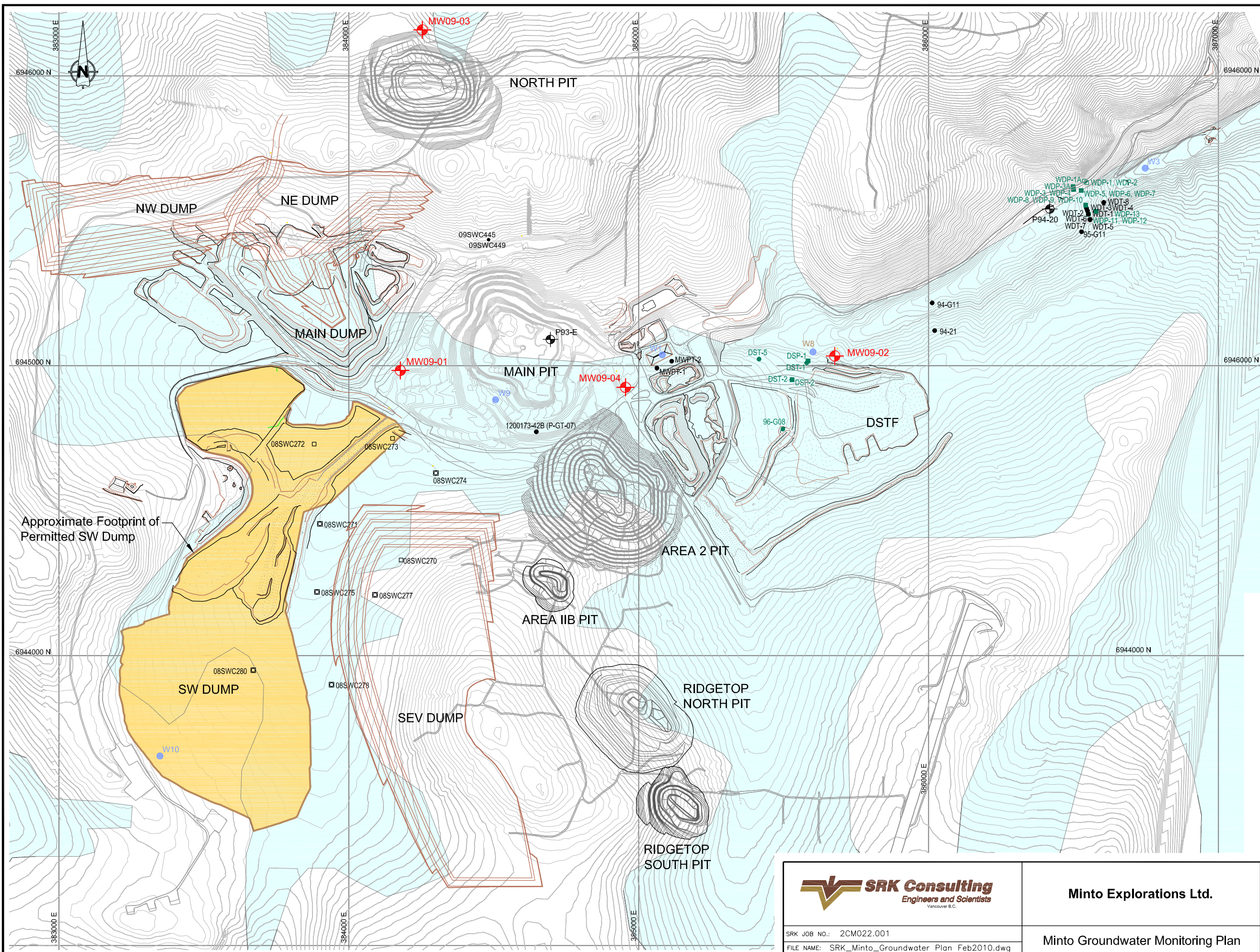
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Michael Royle, M.App.Sci., P.Geo. (BC & NT)  
Principal Hydrogeologist



## Figures


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**LEGEND**

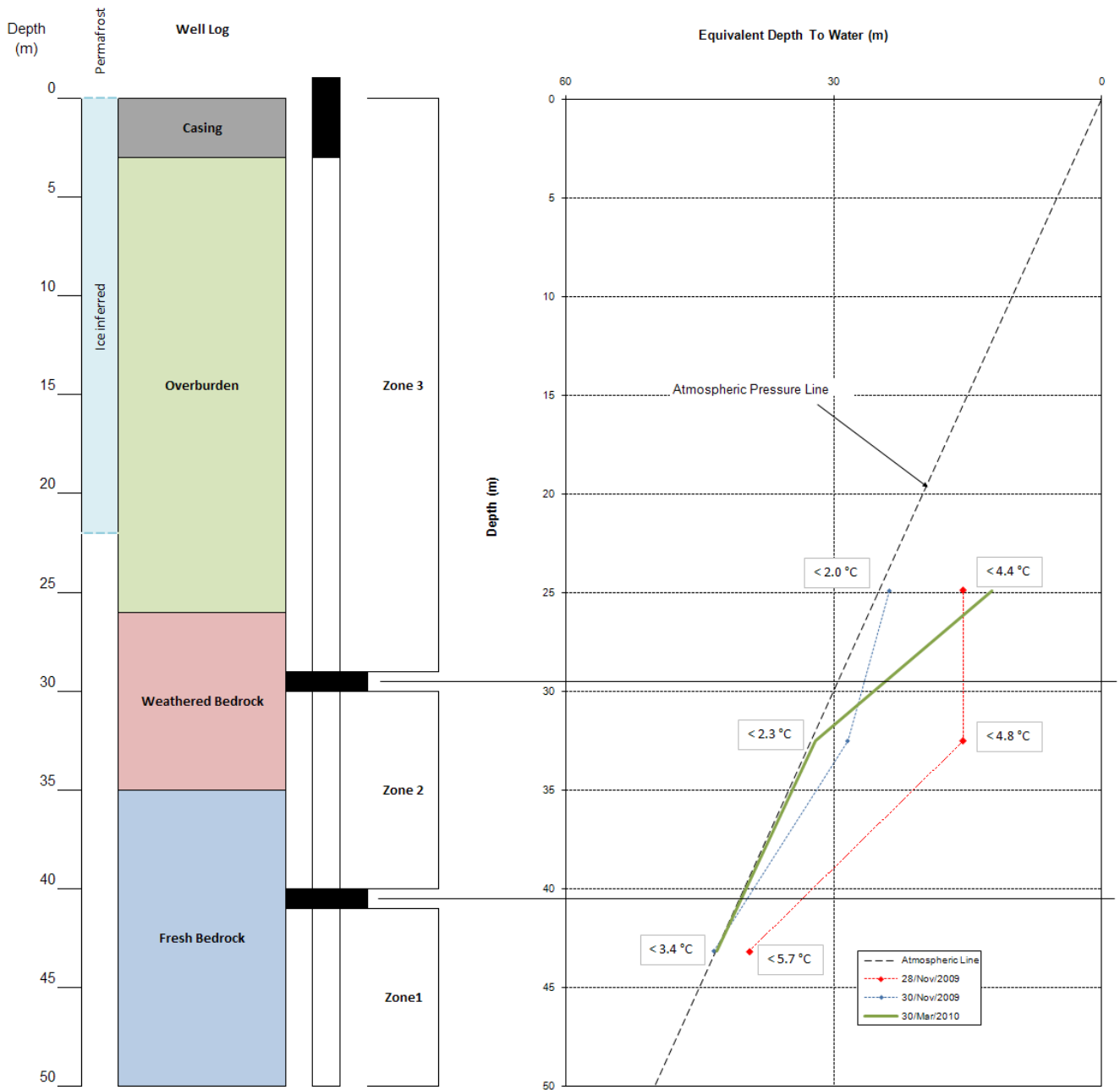
- SURFACE WATER MONITORING LOCATIONS
- GROUND TEMPERATURE CABLE (T)
- GROUND TEMPERATURE CABLE (T) & CASAGRANDE PIEZOMETER (P)
- VIBRATING WIRE PIEZOMETER (P)
- CASAGRANDE PIEZOMETER (P)
- PERMAFROST (assumed; taken from HRP drawing of scollification areas, 1994)
- ⊕ MP WELL LOCATION

0 100 200 300 400 500  
Scale in Metres

 <p><b>SRK Consulting</b> Engineers and Scientists Vancouver B.C.</p>	<p><b>Minto Explorations Ltd.</b></p>	<p><b>Groundwater Monitoring Locations</b></p>			
SRK JOB NO.: 2CM022.001 FILE NAME: SRK_Minto_Groundwater Plan Feb2010.dwg	<p><b>Minto Groundwater Monitoring Plan</b></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">DATE: Feb. 5, 2010</td> <td style="width: 33%;">APPROVED: MDR</td> <td style="width: 33%;">FIGURE: 1</td> </tr> </table>	DATE: Feb. 5, 2010	APPROVED: MDR	FIGURE: 1
DATE: Feb. 5, 2010	APPROVED: MDR	FIGURE: 1			

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# MW09-01



Minto Explorations Ltd.

Groundwater Monitoring Locations

Job No: 2CM022.001  
 Filename: Fig2\_MW09-01\_MPLog&Pressure\_Apr10

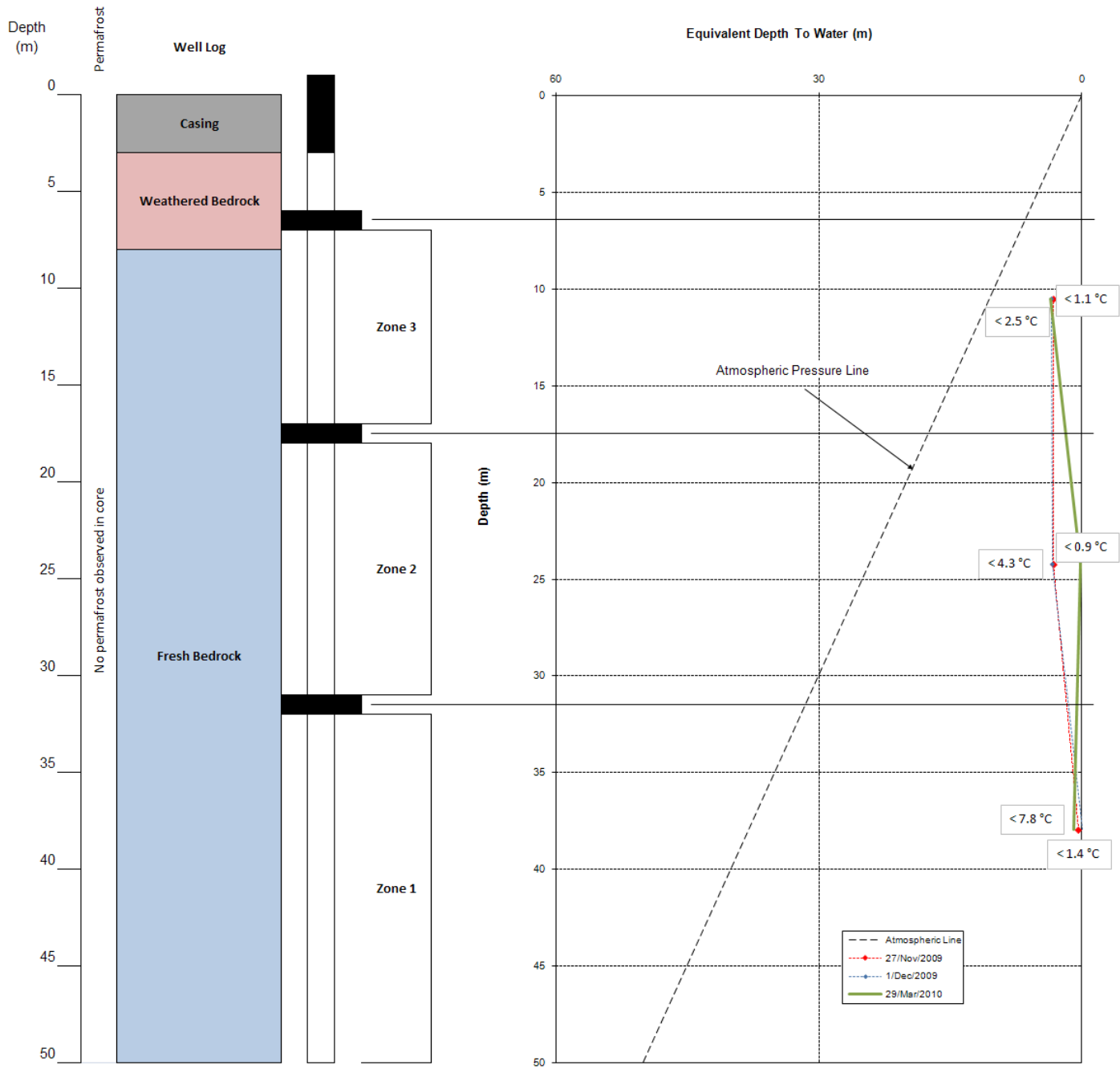
Minto Groundwater Monitoring Plan

Date: May 12, 2010

Approved: MDR

Figure:

# MW09-03



Minto Explorations Ltd.

Groundwater Monitoring Locations

Job No: 2CM022.001  
 Filename: Fig3\_MW09-03\_MPLog&Pressure\_Apr10

Minto Groundwater Monitoring Plan

Date: May12, 2010	Approved: MDR	Figure: <b>3</b>
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**Appendix A**  
**Sampling Records**

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