Phase III Hydrogeologic Investigation

RS10A – Hydrogeological – Drill Hole Monitoring and Data Collection – Phase 3

PolyMet Mining, Inc.

March 2007

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BARR

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Phase III Hydrogeologic Investigation
NorthMet Mine Site
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1.0 Introduction

This report was prepared for PolyMet Mining Inc (PolyMet) by Barr Engineering Company (Barr) to document the results of the Phase III Hydrogeologic Investigation that was conducted at PolyMet's NorthMet mine site (the Mine Site)(Figure 1). The objectives of this work were to evaluate the possible effects of mine dewatering on the wetland areas in the vicinity of the Mine Site, to gather additional specific-capacity data for wells completed in the Virginia Formation, and to gather additional water-quality data for groundwater within the surficial deposits, the Virginia Formation, and the Duluth Complex.

1.1 Background

A scoping Environmental Assessment Worksheet (EAW) was submitted in June 2005 for PolyMet's proposed NorthMet Mine and Ore Processing Facility, located near Hoyt Lakes, Minnesota. The NorthMet deposit is in the Duluth Complex, a large mafic intrusion that was emplaced into flood basalts along a portion of the Middle Proterozoic Midcontinent Rift System. Underlying the Duluth Complex at NorthMet is the sedimentary Lower Proterozoic Virginia Formation, which in turn, is underlain by the Biwabik Iron-Formation. The Biwabik Iron-Formation will not be intersected during mining operations. The Virginia Formation will likely form a portion of the footwall of the proposed mine pits.

Based on coring data collected by PolyMet, the bedrock surface appears to be hummocky at the Mine Site. Much of the Mine Site is covered by peat/wetland deposits, with the remaining area covered by rolling to undulating topography formed from Wisconsin Rainey Lobe drift. Rainey Lobe drift is generally a bouldery till with high clay content. In the region, only the Embarrass River basin northwest of the Mine Site and the Dunka River basins northeast of the Mine Site appear to have significant quantities of outwash (sand and gravel), with thicknesses greater than 100 feet (Olcott and Siegel, 1978). Elsewhere in the region, including the Mine Site, the surficial deposits form a thin cover over the bedrock.

Two phases of hydrogeologic investigations were previously performed at the Mine Site (RS02 and RS10). The Phase I Hydrogeologic Investigation (Barr, 2006a) studied the hydrogeologic properties and water quality of the Duluth Complex and the surficial deposits. The Phase II Hydrogeologic Investigation (Barr, 2006b) studied the hydrogeologic properties and water quality of the Virginia Formation.

A baseline wetland hydrology study has been implemented at the Mine Site (RS44) and will continue into the future. The objective of this study is to gain a better understanding of the wetland hydrology at the Mine Site, collect baseline hydrology data, and determine the potential for indirect wetland impacts resulting from the project. As part of this work, 24 shallow wetland monitoring wells were installed at the Mine Site. The Phase III Hydrogeologic Investigation was designed, in part, to help determine the potential interaction between the wetlands and the bedrock, which will assist in predicting the potential for indirect wetland impacts resulting from the dewatering of the proposed mine pits.

1.2 Scope of Work

Three main activities were conducted during this phase of investigation at the Mine Site:

- pumping test to evaluate the connectivity of the bedrock and the surficial deposits;
- specific capacity tests to evaluate potential vertical variability of hydraulic conductivity in the Virginia Formation; and
- groundwater sampling to further characterize water quality within the surficial deposits, the Virginia Formation, and the Duluth Complex.

All work was performed in accordance with the Work Plan (Appendix A) unless noted otherwise. The most significant change to the work plan that was made was the duration of pumping for the pumping test, which was increased from 10 days to 30 days. This change was made at the request of the Minnesota Department of Natural Resources.

1.3 Report Organization

This report is organized into four sections, including this introduction. Section 2 summarizes the field activities, data collection methodology, and results from the aquifer performance tests. Section 3 presents the groundwater sampling methodology and results. A summary of the investigation and conclusions are presented in Section 4.

2.0 Aquifer Performance Testing

2.1 Field Activities and Data Collection Methodology

2.1.1 Pumping Test

A 30-day aquifer performance test (i.e., pumping test) was conducted in pumping well P-2. Water levels in pumping well P-2 and six observation wells, Ob-2, 20, 20P, 2P, 12, and 12P, were monitored using pressure transducers and data loggers for 10 days prior to pumping, 30 days during pumping, and 10 days after pumping. Pumping and observation well locations are shown on Figure 2.

Pumping well P-2, completed within the Virginia Formation, and observation well Ob-2, completed within the Duluth Complex, were previously installed during the Phase II Investigation. Observation wells 20, 20P, 2P, 12, and 12P were previously installed in the muck/peat layer in the wetland north of P-2 as part of the Wetland Hydrology Study, which was conducted concurrently with this investigation. Pumping well P-2 is 610 feet deep, observation well Ob-2 is 100 feet deep, observation wells 20P, 2P, and 12P are approximately 7.5 feet deep, and observation wells 20 and 12 are 2.4 and 3 feet deep, respectively.

Water levels were measured using LevelTroll and miniTroll data logging probes, both manufactured by In Situ, Inc. The probes automatically measured and recorded water levels in the wells and also automatically corrected for changes in atmospheric pressure. Background water levels in the pumping well were measured and recorded by the Trolls every hour for 10 days prior to pumping, every 30 minutes during the 30-day pumping test, and every 30 minutes during the 10-day recovery. Additionally, manual water levels were measured at least twice daily during the 30-day pumping test.

A submersible pump was placed in pumping well P-2 at a depth of 302 feet below ground surface (bgs). An inline flowmeter was used to measure pumping rates. In order to avoid hydraulic interference with the pumping test, discharge water was routed via hoses 3000 feet to a down-slope upland (i.e. non-wetland) area shown in Figure 2.

Pumping began on October 19, 2006 at a flow rate of 25 gallons per minute (gpm). After pumping for 4 hours, the flow rate was decreased to 23 gpm. Because the water level continued to drop for the next two days, on October 21, 2006 the flow rate was again decreased to approximately 22 gpm. On November 1, 2006, pumping was briefly interrupted to change generators. With the change in generators, the pumping rate changed to approximately 20 gpm. Two days later, on November 3, 2006, the flow rate was increased to approximately 21.5 gpm; pumping continued at that flow rate until the pump was turned off on November 18, 2006.

The pump was pulled from pumping well P-2 two days after pumping ended and the pump, drop pipe, and cable were cleaned with Liquinox after use. Trolls in all seven wells were left in place to monitor the recovery and were pulled ten days after pumping ended. Water level data from the logging probes is included as supplemental electronic data.

2.1.2 Specific Capacity Tests

Specific capacity tests were conducted in isolated vertical intervals in pumping wells P-3 and P-4 (Figure 2), using a packer assembly and a submersible pump. In order to isolate the upper half of the well from the lower half, a 2.5 foot long packer was set at approximately the midpoint of the well and the pump was set above the packer assembly. The upper half of the well was pumped at a steady rate until the water level became relatively stable. The pumping rate was then increased and the test ran until the water level again stabilized. Both tests lasted approximately four hours.

Water levels were monitored both above and below the packer assembly, using LevelTroll data logging probes, manufactured by In Situ, Inc. The probes automatically measured and recorded water levels in the wells and also automatically corrected for changes in atmospheric pressure; however the Troll below the packer at pumping well P-4 did not correct for changes in atmospheric pressure. Trolls above the packer recorded water levels on a log cycle with a maximum of 10 minutes between readings. Trolls below the packer recorded water levels every 5 minutes. Additionally, manual water levels were recorded during the tests at least every 20 minutes for the zone above the packer assembly. Discharge water was routed via hoses 1,000 feet to a down-slope upland (i.e. non-wetland) area. An in-line flowmeter was used to measure pumping rates. Water level data from the logging probes are included as supplemental electronic data.

Pumping well P-3, installed during the Phase II Investigation, is 610 feet deep and is completed within the Virginia Formation. The packer assembly was placed in the well at an approximate depth of 301.5 – 304 feet below ground surface (bgs). The packer was inflated to 290 psi at 13:39 on October 17, 2006. Pumping began at 13:44 at a flow rate of 27 gpm. At 13:47, three minutes after beginning the test, the pumping rate was turned down to 19.2-19.4 gpm. At 16:08, after 2.4 hours of pumping, the water level was relatively stable and the pumping rate was increased to 25 gpm. Because a higher pumping rate was desired, the pumping rate was again increased at 16:09 to 37.5-

39.5 gpm. At 17:43, after 1.6 hours of pumping at the increased rate, the water level again stabilized and the test was terminated. Packer deflation and pump removal began shortly thereafter. The pump, drop pipe, and cable were cleaned with Liquinox after use.

Pumping well P-4, installed during the Phase II Investigation, is 485 feet deep and is completed within the Virginia Formation. The packer assembly was intended to be placed in this well at an approximate depth of 242 feet bgs. However, an obstruction was encountered approximately 207 feet bgs. As a result, the packer was placed at an approximate depth interval of 198.8 – 201.3 feet bgs. The packer was inflated to 290 psi at 15:38 on November 21, 2006. Pumping began at 15:50 at a flow rate of 17 gpm. At 15:52, two minutes after beginning the test, the pumping rate was increased. At 15:55, three minutes later, the pumping rate was again increased to 19.2-20.6 gpm. At 17:52, after 2.0 hours of pumping, the water level was relatively stable and the pumping rate was increased to 37 gpm. At 19:49, after 2.0 hours of pumping at the increased rate, the water level again stabilized and the test was terminated. Packer deflation and pump removal began shortly thereafter.

2.2 Field Investigation Observations and Results

2.2.1 Pumping Tests

Data collected prior to pumping are shown on Figure 3. Overall, water levels rose during the pre-pumping test period at each of the monitoring locations. Throughout the pre-test period, the responses of piezometers 12 and 20 (both screened in the shallow wetland deposits) are strongly correlated, with a gradual fall in water levels for the first 5 days of monitoring. Both appear to respond with an increase in water levels following a precipitation event on October 11. Following this, water levels at both locations generally fall until an abrupt rise in water levels on October 16. This rise does not correlate with a known precipitation event. Following the abrupt rise, the water levels at these locations generally drop for the last 2 days of the pre-test monitoring period. The responses of the three wetland piezometers screened deeper in the wetland deposits (2P, 12P, and 20P) appear to correlate reasonably well throughout the pre-test period. Water levels in P-2 and Ob-2, completed in the bedrock aquifer, both show a general rise throughout the pre-test monitoring period. Superimposed on this overall rise are shorter period water-level fluctuations (on the scale of hours) that may be the result of “earth tides.” Earth tides are caused by elastic deformation of the Earth as it rotates within the gravitational field of the Sun and Moon.

Pumping at P-2 commenced on October 19. During the pumping period, which lasted until November 18, most of the wetland piezometer locations showed a general decrease in water levels

(Figure 4). Water levels in wetland piezometer 2P fluctuated during the pumping period, but did not display the overall downward trend that was observed in the other piezometers. With the exception of 20P, the deep piezometer located closest to the pumping well, the decrease in water levels in the piezometers are not attributed to pumping. The decrease in water levels in the piezometers generally began on October 17, two days before the pump was turned on, and continued without a discernable change in trend following the start of pumping. When the pump was turned off, water levels in piezometers 2P, 12, 12P, and 20 continued to decrease for the remaining 10 days of the test. In contrast, the water level in piezometer 20P began to increase after the pump was turned off. Because water levels in piezometer 2P appeared to be unaffected by the pumping, data from piezometer 2P were used to filter out the background changes in water levels and to determine which portions of the observed drawdown at piezometers 20P were related to pumping. Results of this analysis are shown on Figure 5.

Pumping test data from P-2 and Ob-2 were evaluated using conventional time-drawdown analysis techniques. The aquifer testing software AQTESOLV (Hydrosolve, 2000) was used to perform the analysis. The pumping test data were analyzed using the Moench method (1984) for drawdown in an unconfined, fractured aquifer with slab shaped blocks (Figure 6). The Moench method is an analytical solution for predicting water-level displacements in response to pumping in a fractured aquifer assuming a dual-porosity model with slab-shaped matrix blocks, fracture skin, and wellbore skin. The Moench method assumes that the aquifer is of infinite areal extent, uniform thickness, and consists of a dual-porosity system with low-permeability, primary porosity blocks and high-permeability, secondary porosity fissures. The skin parameter allows for modeling of variable resistance to flow between the blocks and fractures and between the wellbore and fractures. The effects of wellbore storage, partial penetration, and variable pumping rates are included in the analysis. An aquifer thickness equal to the depth of the pumping well was assumed. The Moench method solves for the hydraulic conductivity and storage for both the fractures and the rock matrix and provides information on the wellbore skin and fracture skin.

The hydraulic conductivity of the fractures estimate obtained from this analysis is 0.047 feet/day. This value is consistent with results obtained during the Phase II Hydrogeologic Investigation (Barr 2006b) which estimated a hydraulic conductivity of 0.072 feet/day at pumping well P-2.

2.2.2 Specific Capacity Tests

The specific capacity test data were analyzed using the Moench method (1984) for drawdown in an unconfined, fractured aquifer with slab shaped blocks. This is the same method that was used to analyze pumping test data as part of the Phase II Hydrogeologic Investigation (RS10). For the test of pumping well P-3, a single set of aquifer parameters was able to match the drawdown data from both steps of the test (Figure 7). Analysis of this test data results in a value of hydraulic conductivity for the fractures in the upper 300 feet of the formation of 0.63 ft/day. The pumping test conducted using the entire 600 foot well had an average hydraulic conductivity value for the fractures of 0.4 ft/day. Each step from the test conducted in pumping well P-4 was analyzed separately and the results are shown on Figures 8 and 9. The calculated average hydraulic conductivity value for the upper 200 feet of the aquifer at P-4 was 0.7 ft/day. The pumping test conducted using the entire 485 foot well had an average hydraulic conductivity value of the fractures of 0.33 ft/day.

3.0 Groundwater Sampling

3.1 Sampling Methodology

Groundwater samples for water-quality analyses were collected from the following permanent wells: monitoring wells MW-05-02, MW-05-08, MW-05-09, observation wells Ob-1, Ob-2, Ob-3, Ob-4, Ob-5, and pumping well P-2. Sampling locations are shown on Figure 10. Analytical reports from NTS are provided as supplemental data.

Monitoring wells MW-05-02, MW-05-08, and MW-05-09 were sampled in October and November 2006. These wells were installed during the Phase I Investigation and are screened in unconsolidated material. Observation wells Ob-1, Ob-2, Ob-3, Ob-4, and Ob-5 were sampled in October 2006. These wells were installed during the Phase II Investigation and are completed as open hole bedrock wells. All wells were developed after well construction. All wells were purged prior to sampling; purging was considered complete when the field measurements stabilized or when six borehole volumes of groundwater were evacuated. However, because MW-05-09 recovered very slowly, only one well volume was purged from the well, the well was allowed to recover, and the sample was collected. Field sampling data sheets are included in Appendix B. Groundwater samples were collected and placed into laboratory-supplied containers and submitted to Northeast Technical Services of Virginia, Minnesota (NTS) for laboratory analysis of general chemistry parameters, dissolved metals, and total metals.

Pumping well P-2 was sampled weekly for the duration of the 30-day pumping test in October and November 2006. Pumping well P-2 was installed during the Phase II Investigation and was completed as an open hole bedrock well. Groundwater samples were collected from a sampling spigot located on the discharge line, at the wellhead. Prior to collecting the sample, the sampling spigot was flushed by allowing it to flow for at least several minutes. Samples were collected by the Barr geologist on-site. Because the first sample from pumping well P-2 was collected after a week of pumping, purging was considered complete at the time the first sample was collected. Field parameters (temperature, conductivity, pH, ORP, and DO) were documented and are included in Table 1. Groundwater samples for laboratory analysis of general chemistry parameters, dissolved metals, and total metals were collected and placed into laboratory-supplied containers and submitted to NTS. Groundwater samples for laboratory analysis of δD, $\delta^{18}O$, tritium, and $\delta^{13}C$ of dissolved inorganic carbon (DIC) were collected, filtered, and placed into laboratory-supplied containers and submitted to Isotech Laboratories, Inc. (Champaign, Illinois).

3.2 Analytical Results

Isotope analysis results of groundwater samples from pumping well P-2 are presented in Table 2. The data indicate that there was very little variability in water quality with time, with the exception of the delta carbon-13 of dissolved inorganic carbon ($\delta^{13}C$ DIC), which increased as pumping progressed. The presence of tritium in the samples (2.77-3.82 TU) suggests that at least a portion of the water pumped is post-1952 water. The water isotope data was plotted with precipitation data from the Marcell Experimental Forest Northern Research Station, located approximately 70 miles west of the Mine Site. The precipitation data was used to estimate a meteoric water line for the Mine Site. The data from pumping well P-2 plots very near this inferred meteoric water line. This suggests that the source of the majority of the water that was pumped was aquifer recharge and not seepage from surface water features, such as the Peter Mitchell Pit or area wetlands. Evaporation from open water enriches the water in the heavier isotopes. Groundwater that is derived from seepage from surface water, as opposed to aquifer recharge, is expected to be enriched in oxygen-18 and deuterium and would not fall on the regional meteoric water line.

Analytical results of groundwater samples from monitoring wells MW-05-02, MW-05-08, MW-05-09, Ob-1, Ob-2, Ob-3, Ob-4, and Ob-5 and pumping well P-2 are presented in Table 3. Analytical results are compared to the Minnesota Surface Water Quality Class 2B Chronic and the Lake Superior Basin Water Quality Class 2B Chronic criteria for comparison. The Minnesota Surface Water Quality Class 2B Chronic standards are designed to be protective of surface water used for recreation and support cool or warm water sport or commercial fish and associated aquatic life. Class 2B surface water is not protected as a drinking water source. The Lake Superior Basin water quality standards protect Class 2B waters within the Lake Superior watershed. A hardness of 100 mg/l was used to derive the criteria.

The groundwater sample from monitoring well MW-05-08 exceeded the nitrogen (ammonia as N) and aluminum criteria, with concentrations of 420 ug/L and 2,620 ug/L, respectively. The sample from monitoring well MW-05-08 had exceedences of aluminum (27,100 ug/L), chromium (55 ug/L), cobalt (8.8 ug/L), copper (99.6 ug/L), and mercury (0.288 ug/L). The sample from observations well Ob-3 exceeded the aluminum and nickel criteria, with concentrations of 368 ug/L and 128 ug/L respectively. The pH criterion was exceeded in the observation well Ob-4 sample (6.1). The sample from observation well Ob-5 had exceedences of pH (6.0), aluminum (181 ug/L) and mercury (0.0049 ug/L). The samples from well pumping well P-2 that were collected on November 7 and November 14, 2006 exceeded the zinc criteria (125 ug/L and 122 ug/L, respectively). The samples from monitoring well MW-05-08 and observation well Ob-2 exceeded the mercury criteria, with concentrations of 0.0016 ug/L. However, based on the blank data validation procedure, these detections are potential false positive values. There were no other exceedences of water quality criteria.

The groundwater samples collected weekly from pumping well P-2 during the pumping test showed some trends in water quality. In general, concentrations of calcium, magnesium, iron, manganese, potassium and strontium increased during the duration of the pumping test, while the concentrations of sulfate and boron decreased. These data suggest a decreasing redox potential for the source water. The decreasing redox potential is likely associated with the collection of water with longer flow paths or older water (i.e. water that has been in the subsurface longer).

3.3 Quality Assurance

A quality assurance and quality control (QA/QC) review was performed on the analytical results from the sampling event. This review was performed in accordance with the Barr Engineering Standard Operating Procedure for data validation, which is based on *The National Functional Guidelines for Organic and Inorganic Data Review* (EPA 1999/2004). All analyses were performed by NTS, except methyl mercury, cyanide, palladium, platinum, and isotope analysis. All methyl mercury analyses were performed by Frontier Geosciences, Inc. located in Seattle, Washington. Minnesota Valley Testing Laboratories, located in New Ulm, Minnesota, performed all cyanide analyses. All palladium and platinum analyses were performed by Pace Analytical, located in Minneapolis, Minnesota. Isotech Laboratories, Inc., located in Champaign, Illinois performed all isotope analyses.

Technical holding times were evaluated for each sample and target parameter, based on the EPA recommendations listed in *40 CFR SW8-46 Test Methods for Evaluating Hazardous Waste*. For one data package, the date of analysis for sulfate and chloride was reported incorrectly. NTS was contacted and a revised report was issued. All holding times were met for all the samples submitted to all laboratories.

One field blank and one pour blank were collected during the sampling event. Mercury was detected in both blanks at concentrations above the reporting limit. Seven samples had detections of mercury above the reporting limit and within 5 times the highest blank value. All seven samples were qualified and should be considered potential false positive values. No other qualifiers were applied based on blank data.

NTS indicated that matrix spike recoveries were below laboratory acceptance criteria for antimony (81%) and silver (84%). Because spike levels were not provided and the recoveries were within standard acceptance criteria of 80-120%, no data were qualified for antimony or silver. NTS did not identify any other issues with their QA/QC parameters in the reports provided for the analyzed samples.

One field duplicate from observation well Ob-4 was collected during this sampling event and analyzed for all parameters. The concentration of sulfate was above the reporting limit in the native sample, but below the reporting limit in the duplicate. The native sample and duplicate were both qualified as estimated for sulfate. All other parameters met acceptance criteria for the field duplicate.

All of the data met the data project requirements and is deemed acceptable for the purposes of this project with the above mentioned qualifications.

4.0 Summary and Conclusions

The objectives of this work were to evaluate the possible effects of mine dewatering on the wetland areas in the vicinity of the Mine Site, to gather additional specific capacity data for wells completed in the Virginia Formation, and to gather additional water quality data for groundwater within the surficial deposits, the Virginia Formation and the Duluth Complex. Three main activities were conducted to meet these objectives:

- pumping test to evaluate the connectivity of the bedrock and the surficial deposits;
- specific capacity tests conducted to evaluate potential vertical variability of hydraulic conductivity in the Virginia Formation; and
- groundwater sampling to further characterize water quality within the surficial deposits, the Virginia Formation, and the Duluth Complex.

Data collected during the pumping test at P-2 showed a small amount of drawdown in the nearest deep wetland piezometer (20P) but no detectable drawdown at other water table or deep wetland piezometers, including piezometer 20, the water table piezometer that is nested with piezometer 20P. Based on the results from this test, it is reasonable to expect that dewatering of the proposed mine pits will increase the vertical gradient through the surficial and wetland deposits at the Mine Site, but that significant and widespread drawdown of the water table within these deposits is not anticipated. This is further supported by the analytical and isotope data collected during the pumping test in well P-2. The only water quality trends that were observed in samples collected weekly from pumping well P-2 suggest decreasing redox conditions in the source water. The decreasing redox potential is likely associated with the collection of water with longer flow paths or older water. There were no trends in the amount of tritium.

Data from the specific capacity tests conducted in wells P-3 and P-4, along with data collected during previous pumping tests in these wells (see RS10), indicate that the upper portion of the Virginia Formation is more permeable than the lower portion. This is consistent with what has been reported for the Duluth Complex, where the upper 200 to 300 feet of the formation is reported to be more permeable due to the increased amount of secondary porosity features such as fractures and joints.[1]

Groundwater samples collected from monitoring wells on site exceeded the Minnesota 2B Chronic water criteria for metals (including mercury, aluminum, cobalt, copper, lead, nickel, and zinc), pH, and Nitrogen (ammonia as N). Samples collected weekly during the pumping of well P-2 showed water quality trends that suggest a decreasing redox potential for the source water. The samples from pumping well P-2 all contained measurable tritium, indicating that at least a portion of the source water is post-1952 water

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[1] Siegel, D.I., and D.W. Ericson, 1980. *Hydrology and Water Quality of the Copper-Nickel Study Region, Northeastern Minnesota.* U.S. Geological Survey Water-Resources Investigations Open-File Report 80-739.

Tables

Table 1 Field Parameters for P-2 Sampling

Location	Date	Time	Temp (°C)	Cond. @ 25 (uS/cm)	pH	ORP (mV)	D.O. (mg/L)
P-2	10/24/2006	1025	5.4	150	7.75	*	*
P-2	10/31/2006	1025	5.0	316	9.04	21.0	6.96
P-2	11/7/2006	1027	6.2	228	7.85	114.7	6.42
P-2	11/14/2006	0932	5.4	257	7.98	219.6	5.78

* Not recorded

Table 2 Isotope Data Summary

Sample Name	δD H_2O ‰	$\delta^{18}O$ H_2O ‰	Tritium TU	Std. Dev.	$\delta^{13}C$ DIC ‰
P-2 10/24/2006	-85.4	-12.25	3.27	0.28	-18.85
P-2 10/31/2006	-85.9	-12.28	2.77	0.28	-17.78
P-2 11/07/2006	-85.9	-12.29	2.99	0.26	-16.86
P-2 11/14/2006	-85.4	-12.27	3.82	0.29	-15.79

Table 3
Analytical Data Summary
Polymet Mining, Inc.
(concentrations in ug/L, unless noted otherwise)

Location	**MN SW Quality**	**MW-05-02**	**MW-05-08**	**MW-05-09**	**OB-1**	**OB-2**	**OB-3**	**OB-4**
Date	**Class 2B**	**11/20/2006**	**11/28/2006**	**10/5/2006**	**10/5/2006**	**10/3/2006**	**10/16/2006**	**10/4/2006**
Lab	**Chronic (1)**							
Dup	**1/31/2000**							**DUP**
Aquifer		**Surficial**	**Surficial**	**Surficial**	**Duluth**	**Duluth**	**Virginia**	**Virginia**
Exceedance Key	Bold							
General Parameters								
Alkalinity, total, mg/L	--	68.3	67.7	26.4	47.4	<10	66.2	17.6
Chemical Oxygen Demand, mg/L	--	<10	<10	<10	10	<10	<10	<10
Chloride, mg/L	230	1.11	1.17	0.69	15.7	0.55	93.1	<0.5
Sulfate, mg/L	--	16.4	11.2	10.4	<37.2	10.9	66.4	8.55 *
Calcium, mg/L	--	18.6	12.1	7.08	29.7	10.8	21	5.48
Magnesium, mg/L	--	5.65	6.47	6.83	7.72	12	21.4	2.52
Phosphorus total, mg/L	--	<0.1	0.14	0.25	<0.1	<0.1	<0.1	<0.1
Fluoride, mg/L	--	<0.1	0.11	<0.1	<0.11	0.22	0.97	<0.1
Hardness, total, mg/L	--	69.7	56.8	45.8	106	76.4	140	24.1
Carbon, total organic, mg/L	--	2.6	1.6	5.2	1.5	1.9	3.2	1.9
Cyanide, ug/L	--	<20	<20	<20	<20	<20	<20	<20
Nitrate + Nitrite, ug/L	--	1420	150	<100	<100	<100	<100	<100
Nitrogen, ammonia as N, ug/L	40	<100	**420**	<100	<100	<100	<100	<100
pH, standard units	6.5-9.0 PH	6.5	6.9	7.5	9.0	7.6	6.6	**5.7**
Metals								
Aluminum	125	31.6	**2620**	**27100**	111	62.4	**368**	62.1
Antimony	31	<3	<3	<3	<3	<3	<3	<3
Arsenic	53	<2	<2	4.8	<2	<2	4.1	<2
Barium	--	<10	28.1	214	<10	<10	<10	<10
Beryllium	--	<0.2	<0.2	0.7	<0.2	<0.2	<0.2	<0.2
Boron	--	<50	<50	<50	<50	93.1	<50	<50
Cadmium	1.1 HD	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium	11 CR6	<1	3.2	**55**	1.7	5	<2.5	<1
Cobalt	5.0	<1	<1	**8.8**	<1	<1	4.1	<1
Copper	9.3 HD	2.4	5.7	**99.6**	<2	2.8	2.1	<2
Iron	--	54.3	1860	29800	87.9	334	7040	<50
Lead	3.2 HD	<1	<1	**6.1**	<2	<1	<1	<1
Manganese	--	61.9	152	584	<10	41.6	383	<10
Mercury	0.0013	0.0005 b	**0.0016 b**	**0.0288**	<0.0005	**0.0016 b**	0.0008 b	0.001 b
Mercury methyl	--	<0.000146	<0.000056	0.000130	<0.000056	<0.000056	<0.000056	<0.000056
Molybdenum	--	<5	<5	12.1	<5	<5	<5	<5
Nickel	52 HD	<2	3	40.2	<2	3.6	**128**	<2
Palladium	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Platinum	--	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.1
Potassium	--	1.93	1.51	6.87	1.81	1.48	2.33	0.99
Selenium	5.0	<2	<2	<2	<2	<10	<2	<10
Silver	1.0 HD	<2	<2	<1	<1	<1	<1	<1
Sodium	--	5.38	7.3	12	7.38	19.7	6.33	<2
Strontium	--	88.6	32.6	65.1	112	58.7	74.8	18.8
Thallium	0.56	<2	<2	<2	<2	<2	<2	<2
Titanium	--	<20	57	1040	<20	<20	<20	<20
Zinc	106 HD	<25	<25	46.3	<25	<25	<25	<25
Aluminum, dissolved	--	<25	199	430	55.2	<25	<25	<25
Cadmium, dissolved	--	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium, dissolved	--	1.1	1.2	1.2	<1	<1	<1	<1
Copper, dissolved	--	<2	<2	7.9	2.2	<2	<2	<2
Molybdenum dissolved	--	<5	<5	8.8	<5	<5	<5	<5
Nickel, dissolved	--	<2	<2	3	<2	<2	100	<2
Selenium, dissolved	--	<2	<2	<2	<2	<2	<2	<2
Silver, dissolved	--	<1	<1	<1	<1	<1	<1	<1
Zinc, dissolved	--	<25	<25	<25	<25	<25	<25	<25

Table 3
Analytical Data Summary
Polymet Mining, Inc.
(concentrations in ug/L, unless noted otherwise)

Location **Date** **Lab** **Dup**	**MN SW Quality** **Class 2B** **Chronic (1)** **1/31/2000**	**OB-4** **10/4/2006**	**OB-5** **10/4/2006**	**P-2** **10/24/2006**	**P-2** **10/31/2006**	**P-2** **11/7/2006**	**P-2** **11/14/2006**
Aquifer		**Virginia**	**Virginia**	**Dul.+Virginia**	**Dul.+Virginia**	**Dul.+Virginia**	**Dul.+Virginia**
Exceedance Key	Bold						
General Parameters							
Alkalinity, total, mg/L	--	17.6	25.5	101	105	74	108
Chemical Oxygen Demand, mg/L	--	<10	<10	<10	<10	<10	<10
Chloride, mg/L	230	0.5	<0.5	1.29	1.4	1.35	1.3
Sulfate, mg/L	--	<1 *	8.24	9.06	7.88	6.53	5.76
Calcium, mg/L	--	5.4	7.66	12.8	13.5	15.5	16.7
Magnesium, mg/L	--	2.48	2.81	7.67	8.48	9.41	10
Phosphorus total, mg/L	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride, mg/L	--	<0.1	<0.1	0.31	0.15	0.13	0.37
Hardness, total, mg/L	--	23.7	30.7	63.5	68.6	77.4	82.9
Carbon, total organic, mg/L	--	2.2	2.0	3.3	3.9	4.5	5.3
Cyanide, ug/L	--	<20	<20	<20	<20	<20	<20
Nitrate + Nitrite, ug/L	--	<100	<100	<100	<100	<100	<100
Nitrogen, ammonia as N, ug/L	40	<100	<100	<100	<100	<100	<100
pH, standard units	6.5-9.0 PH	**6.1**	**6.0**	7.7	7.1	8.4	7.5
Metals							
Aluminum	125	55.4	**181**	<25	<25	<25	<25
Antimony	31	<3	<3	<3	<3	<3	<3
Arsenic	53	<2	<2	<2	<2	<2	<2
Barium	--	<10	<10	<10	<10	<10	<10
Beryllium	--	<0.2	<0.2	<0.2	0.2	0.2	<0.2
Boron	--	<50	<50	194	168	153	148
Cadmium	1.1 HD	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium	11 CR6	<1	2.2	<1	<1	1.1	<1
Cobalt	5.0	<1	<1	<1	<1	<1	<1
Copper	9.3 HD	<2	3.5	<2	<2	<2	<2
Iron	--	<50	548	253	271	325	351
Lead	3.2 HD	<1	<1	<5	<1	<1	<1
Manganese	--	<10	<10	21.7	23.6	26.2	27.3
Mercury	0.0013	0.0009 b	**0.0049**	<0.0005	<0.0005	0.0005 b	<0.0005
Mercury methyl	--	<0.000056	<0.000056	<0.000056	0.000070	<0.000056	<0.000056
Molybdenum	--	<5	<5	<5	<5	<5	<5
Nickel	52 HD	<2	4.6	<2	<2	<2	<2
Palladium	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Platinum	--	<0.1	<0.1	<0.02	<0.02	<0.02	<0.02
Potassium	--	0.98	1.26	1.03	1.04	1.04	1.1
Selenium	5.0	<10	<10	<2	4	<2	<4
Silver	1.0 HD	<1	<1	<1	<1	<1	<1
Sodium	--	<2	<2	24.4	23.2	23.3	23.9
Strontium	--	18.5	19.3	56.5	60.7	69.7	74.9
Thallium	0.56	<2	<2	<2	<2	<2	<2
Titanium	--	<20	<20	<20	<20	<20	<20
Zinc	106 HD	<25	<25	65.4	67.7	**125**	**122**
Aluminum, dissolved	--	<25	<25	<25	<25	<25	<25
Cadmium, dissolved	--	<0.2	<0.2	<0.2	0.2	<0.2	<0.2
Chromium, dissolved	--	<1	<1	<1	<1	<1	<1
Copper, dissolved	--	<2	2.3	<2	<2	<2	<2
Molybdenum dissolved	--	<5	<5	<5	<5	<5	<5
Nickel, dissolved	--	<2	5.9	<2	<2	<2	<2
Selenium, dissolved	--	<2	<2	<2	<2	<2	<2
Silver, dissolved	--	<1	<1	<1	<1	<1	<1
Zinc, dissolved	--	<25	<25	59.1	68.2	134	122

Table 3
Analytical Data Summary
Polymet Mining, Inc.
Footnotes

--	No criteria.
(1)	Criteria represents most conservative value as noted in Minnesota Rules Chapter 7050.0222 and 7052.0100.
*	Estimated value, QA/QC criteria not met.
b	Potential false positive value based on blank data validation procedure.
CR6	Value represents the criteria for Chromium, hexavalent.
DUP	Duplicate sample.
HD	Hardness dependent. The specific analyte should be referenced in Minnesota Rules Chapter 7050.0222 for specific exp. calculations. The value reported is assuming a hardness of 100 mg/L.
PH	Not less than 6.5 nor greater than 9.0.

Figures

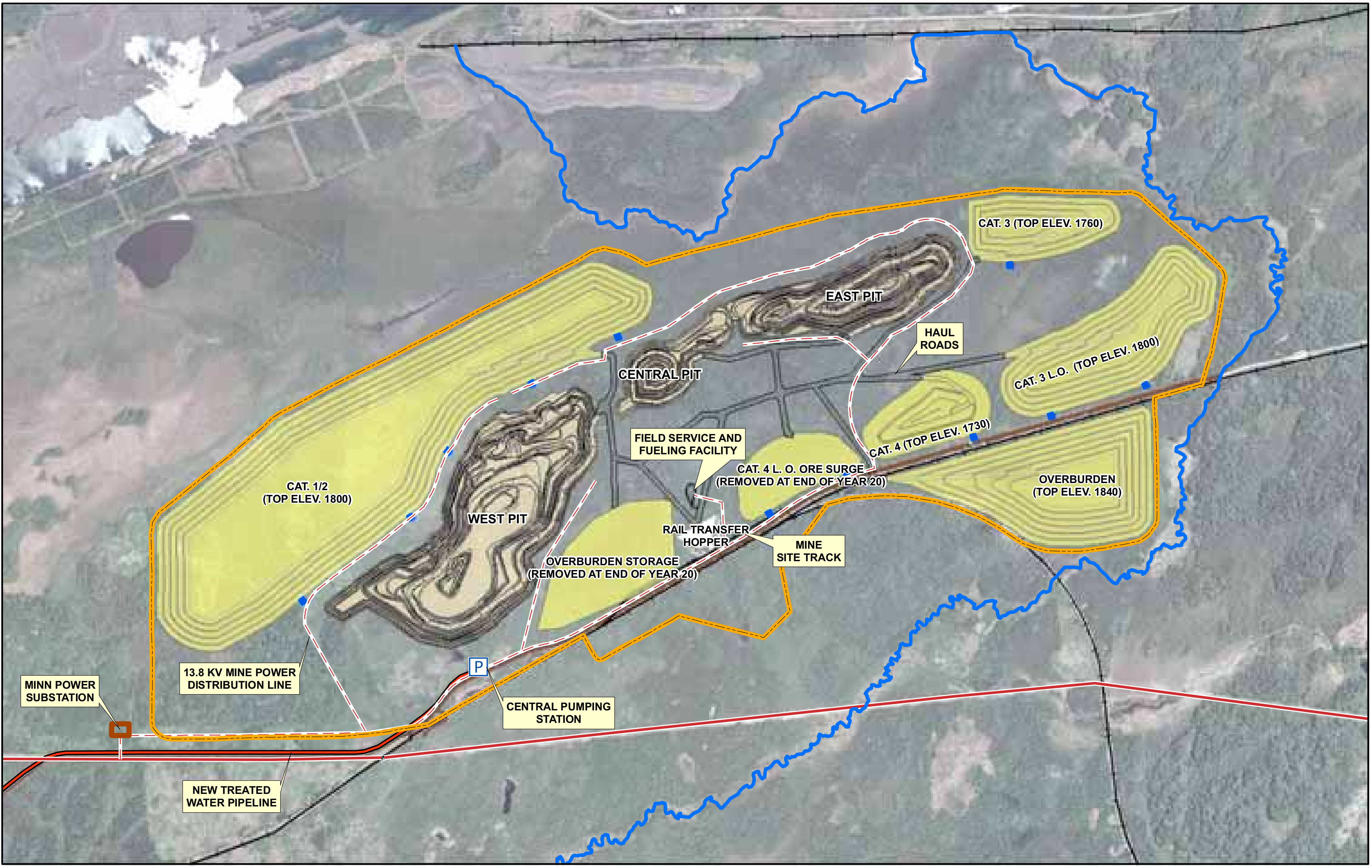
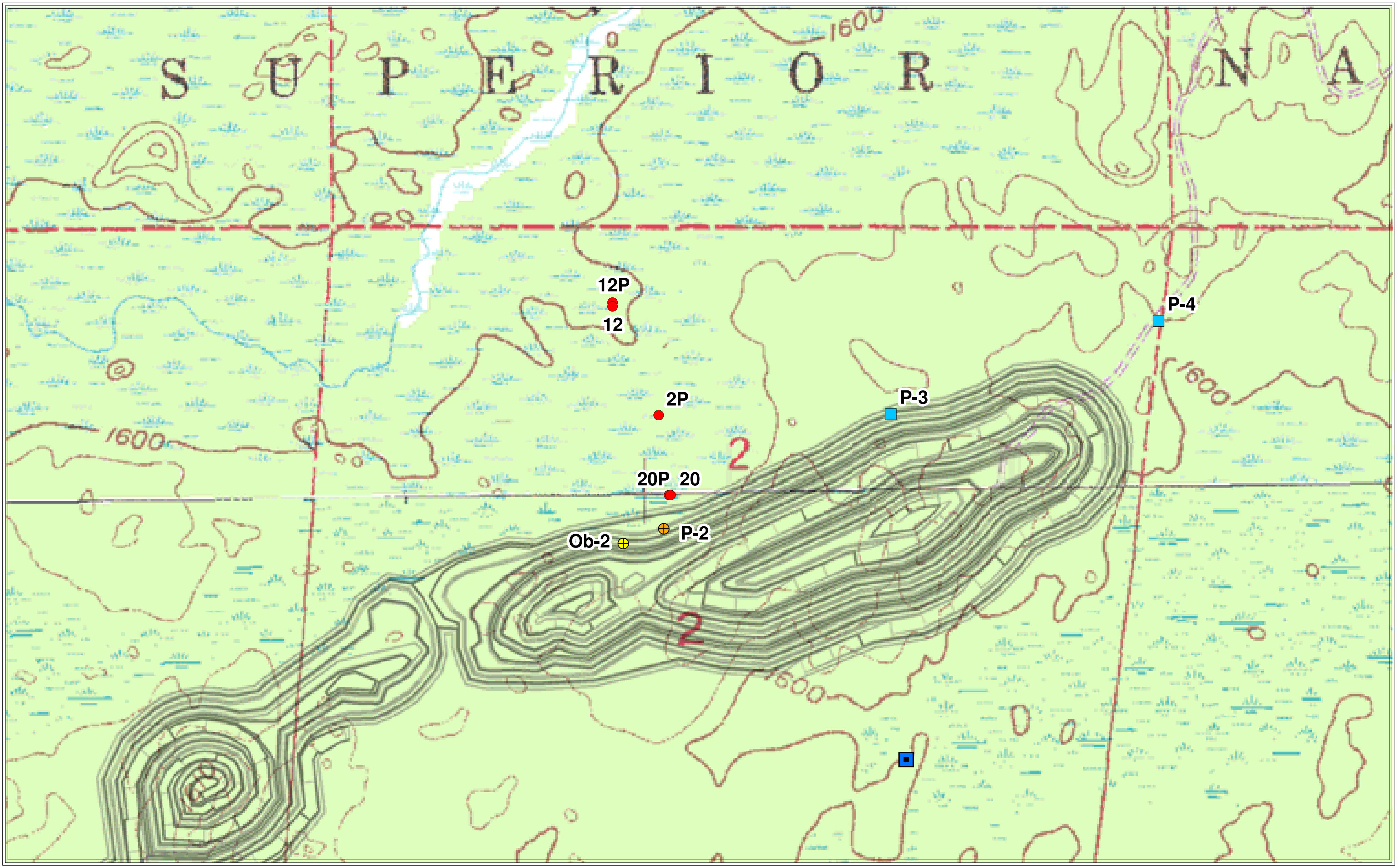


Figure 1
NORTHMET MINE SITE IN YEAR 20
PolyMet Mining Inc.
Hoyt Lakes, MN



- ── 20 Year mine plan
- ⊕ Pumping well
- ⊕ Bedrock observation well
- 🟦 Specific capacity test location
- ● Wetland piezometer monitoring location
- ▣ Pumping test discharge point

N

0 500 1,000
Feet

Figure 2

PUMPING AND OBSERVATION LOCATIONS
PHASE III HYDROGEOLOGIC INVESTIGATION
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Figure 3 Pre-Pumping Test Water Levels

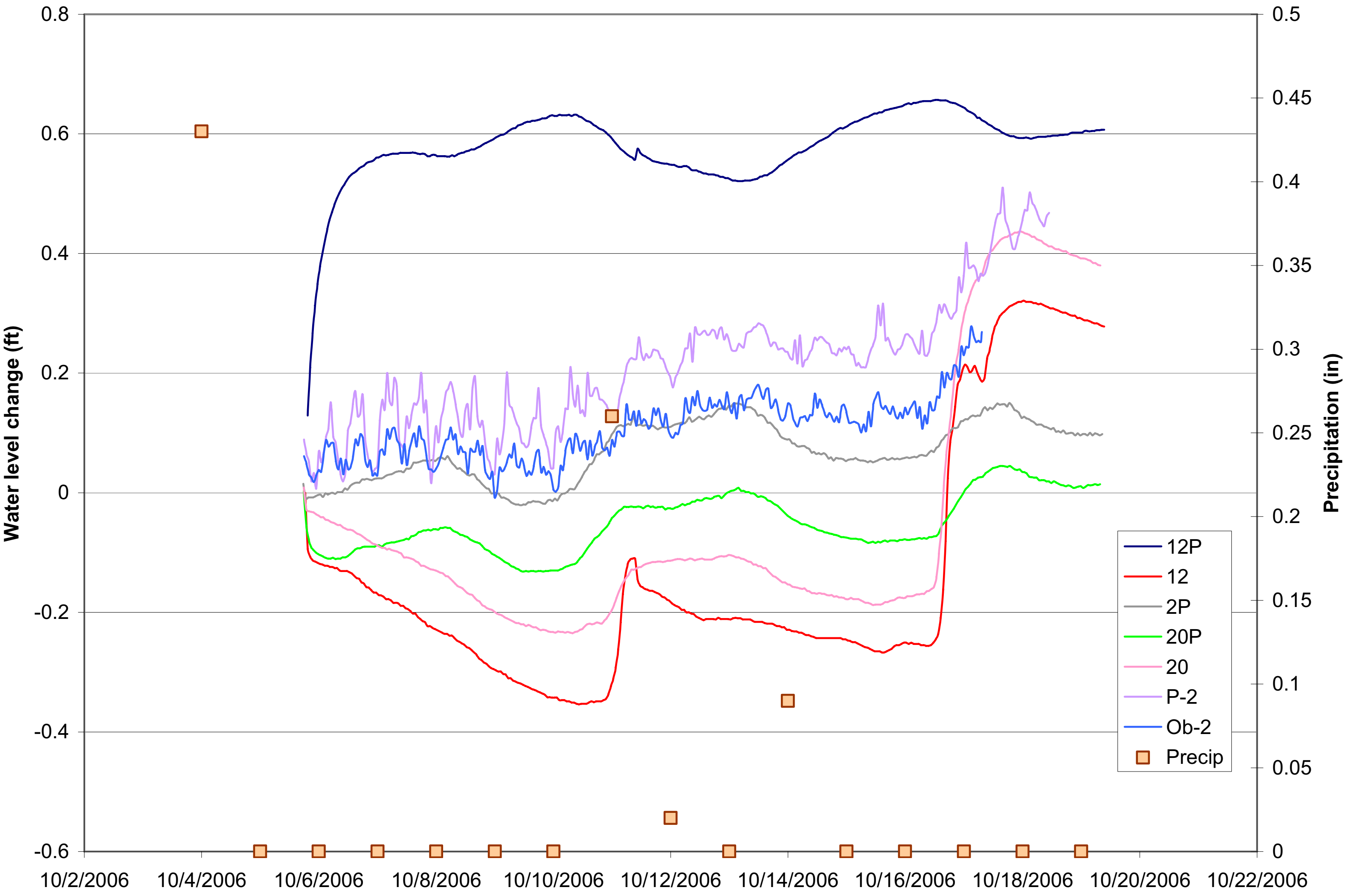


Figure 4 Observed Drawdown and Recovery in Wetland Piezometers

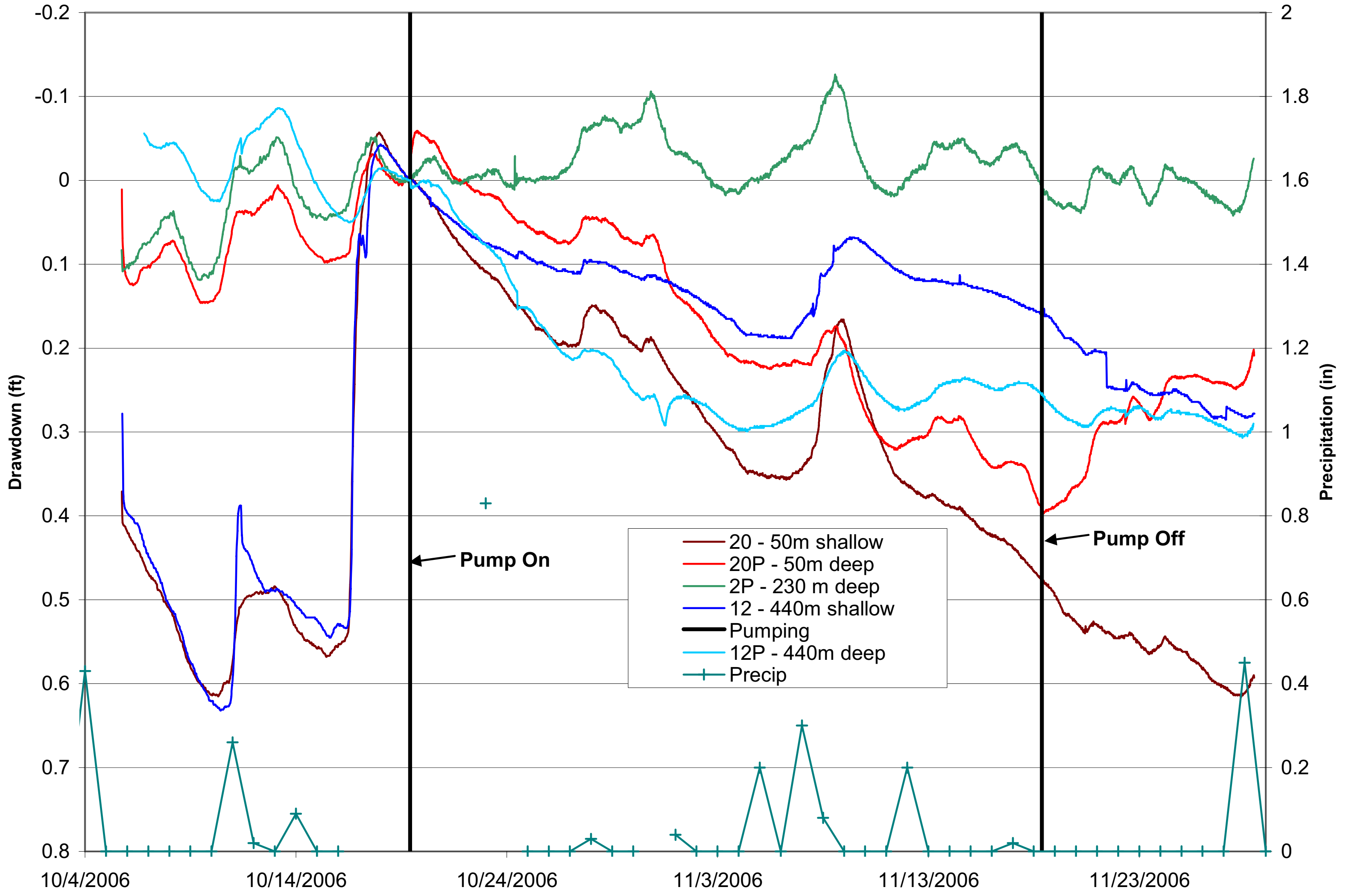


Figure 5   Drawdown and Recovery in 20P Corrected for Regional Water Level Changes

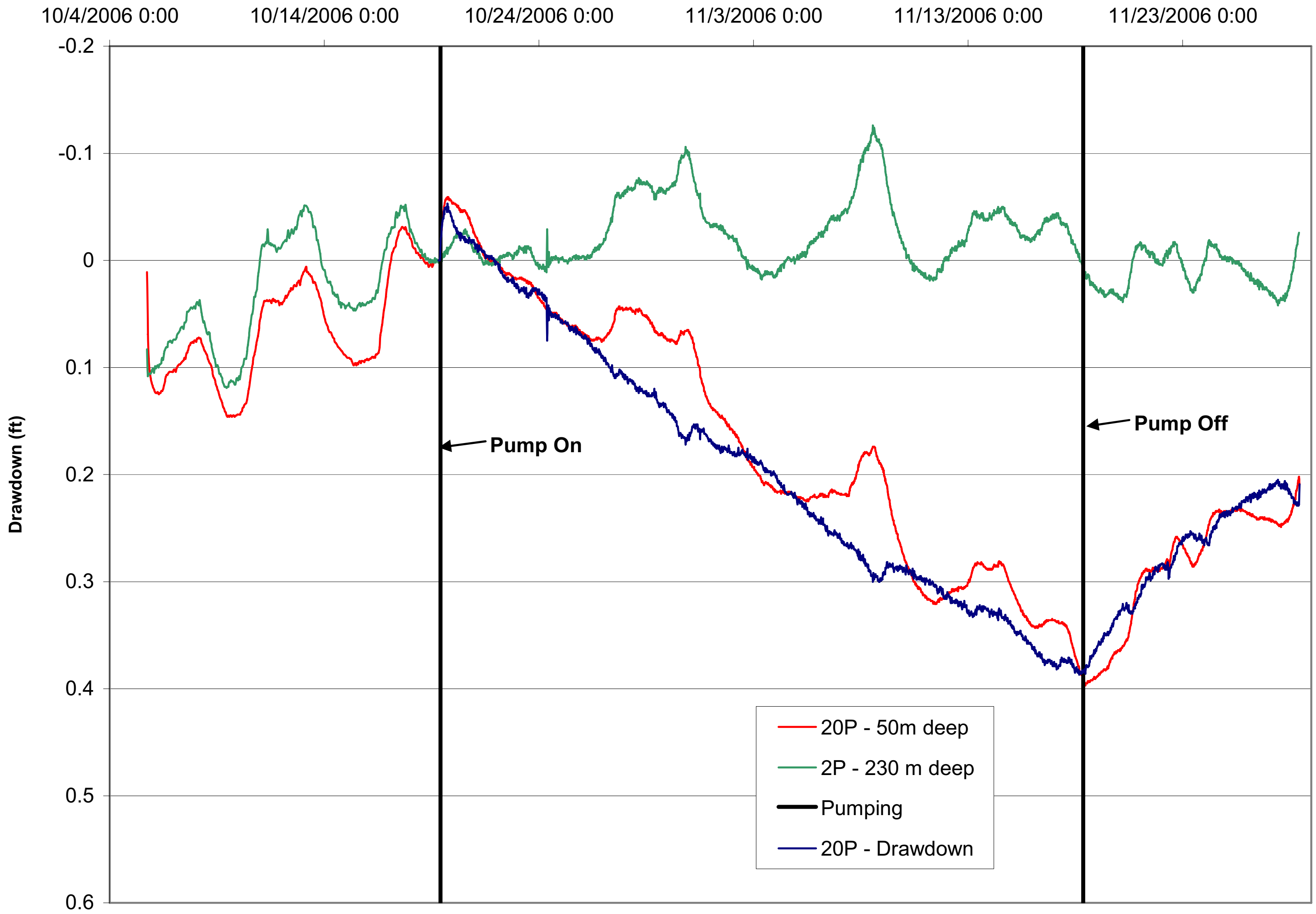


Figure 6 Pumping Test Analysis of Bedrock Wells

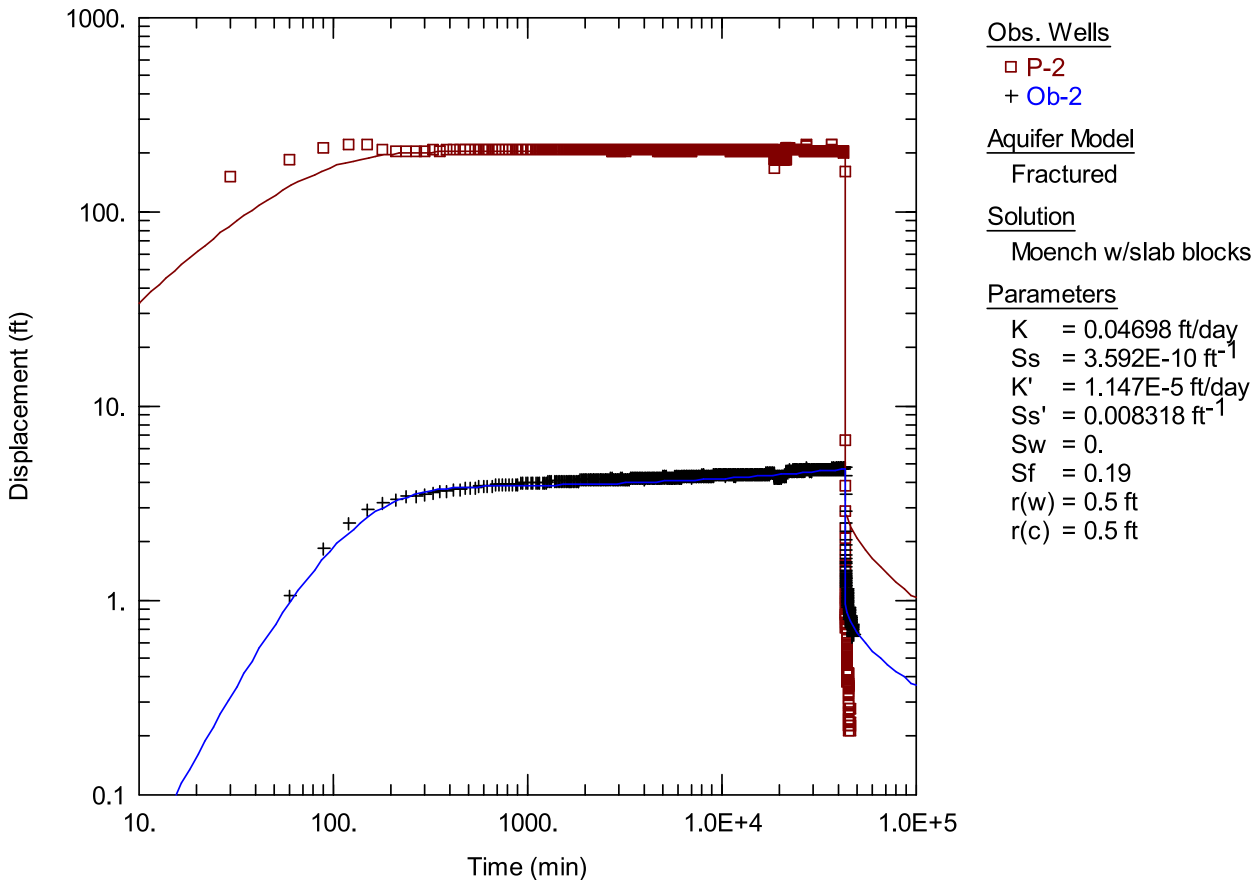


Figure 7 Specific Capacity Test Analysis – P-3

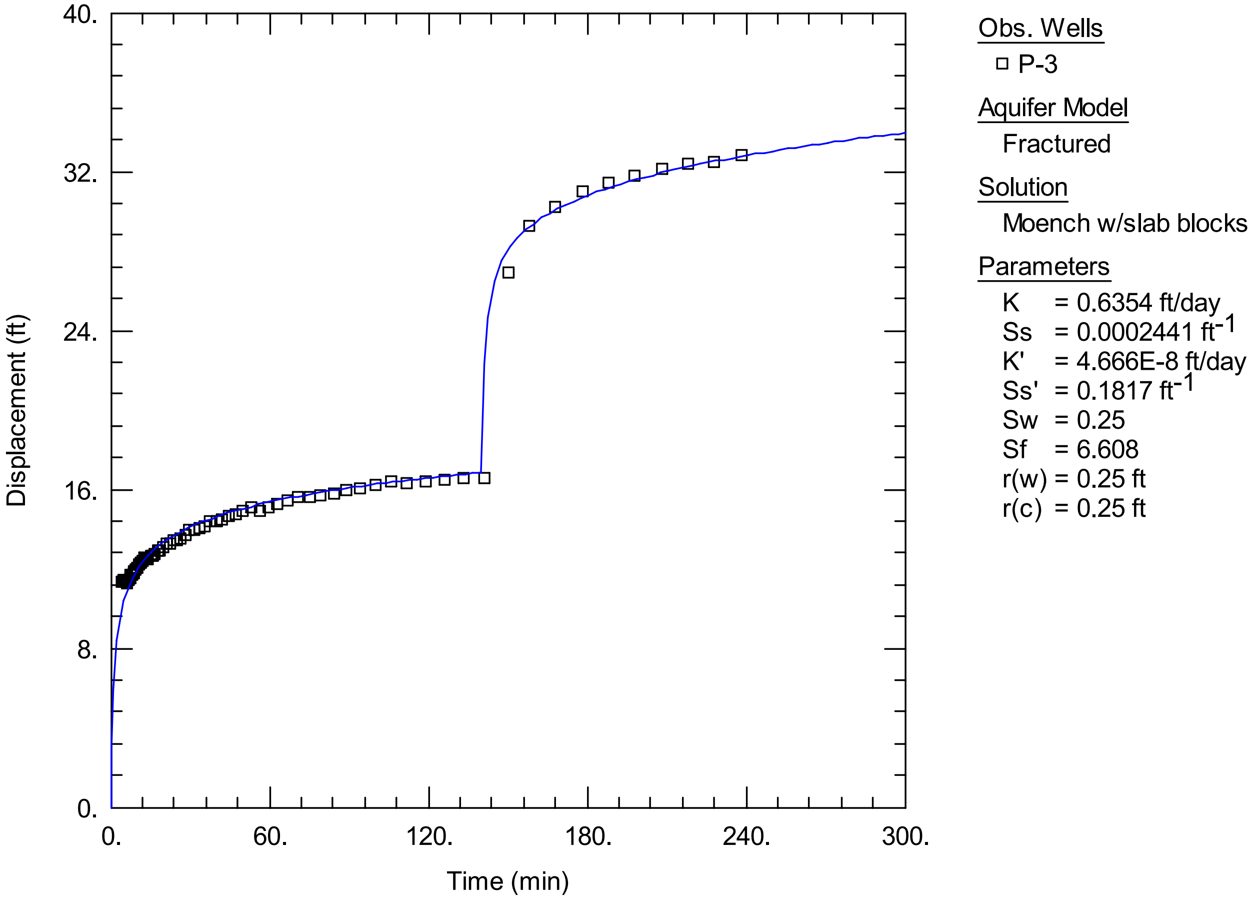


Figure 8   Specific Capacity Test Analysis – P-4 Step 1

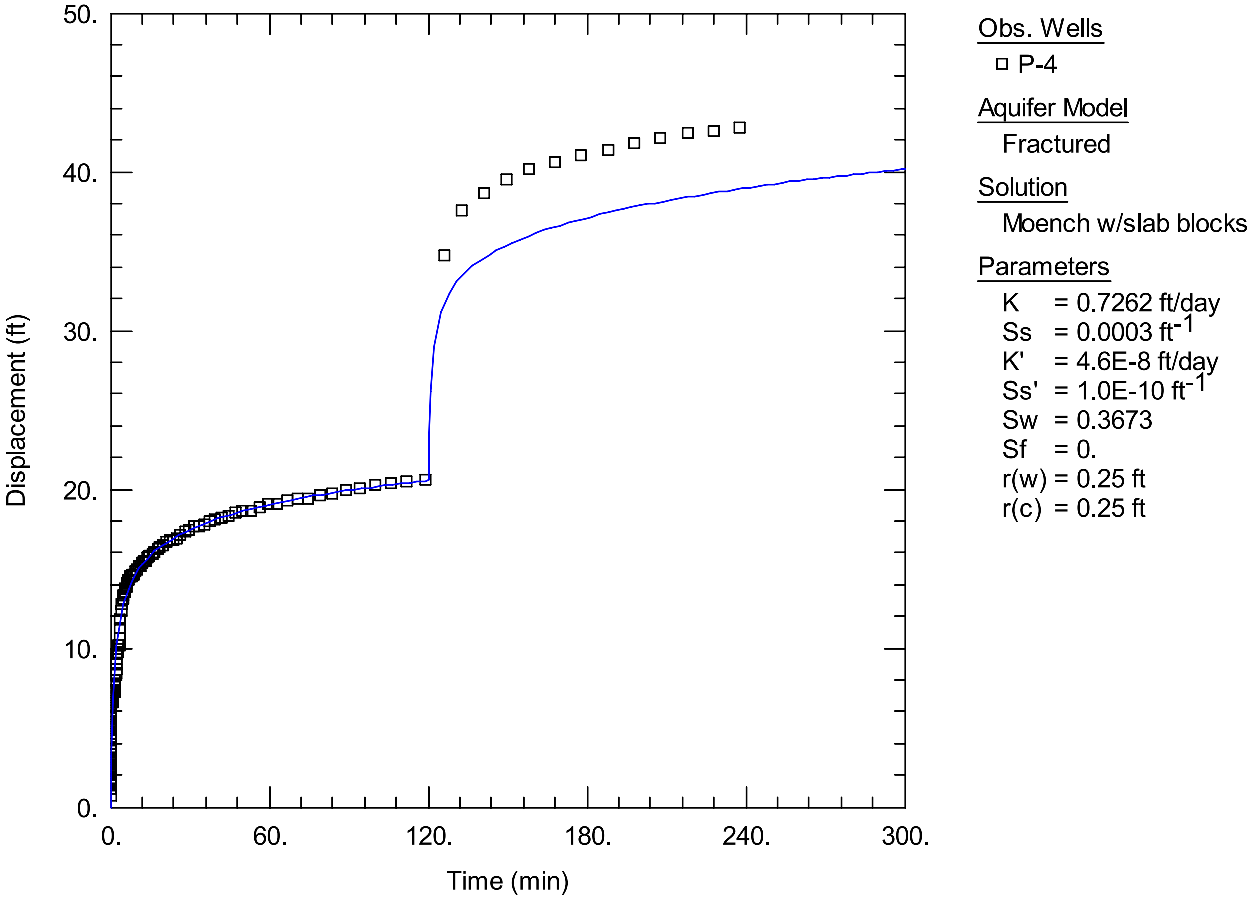
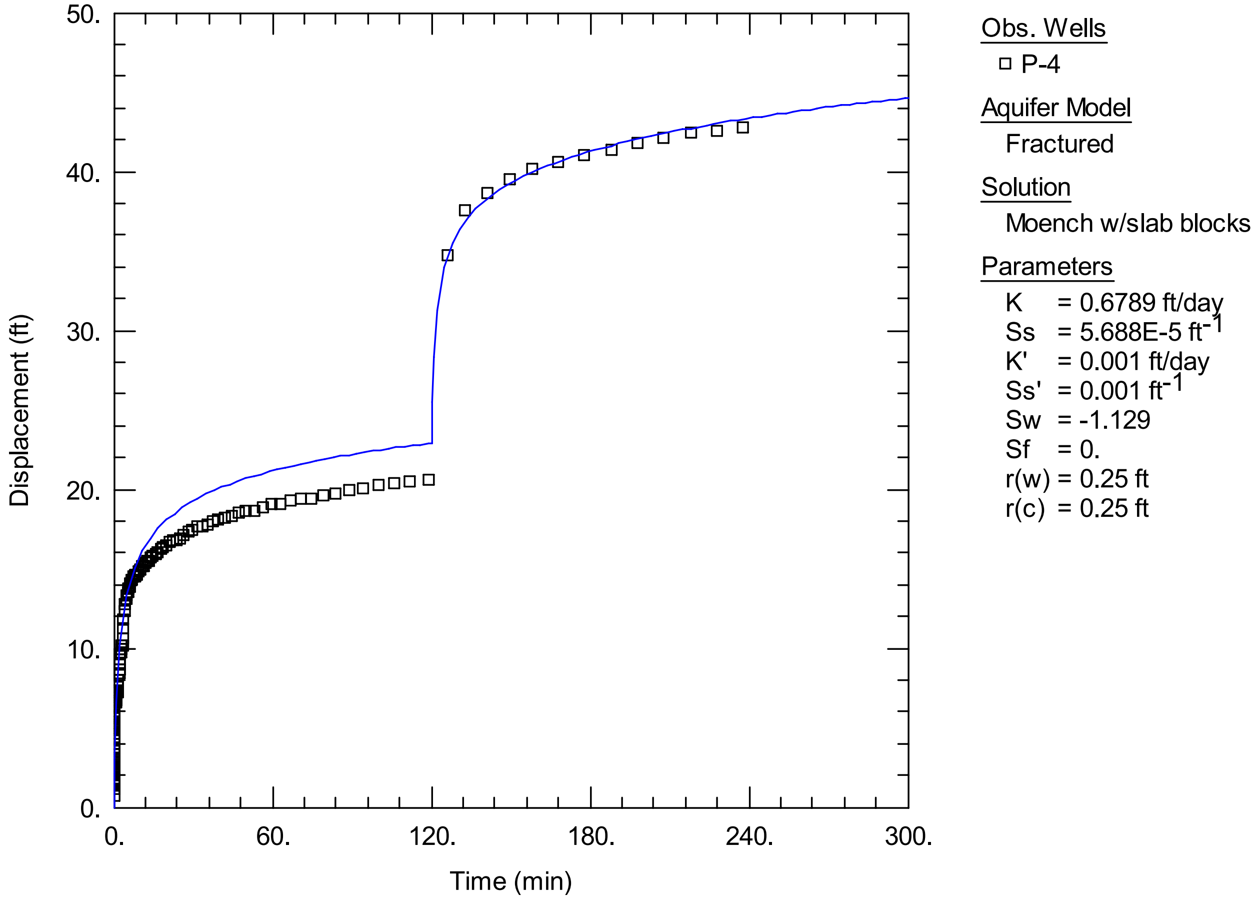
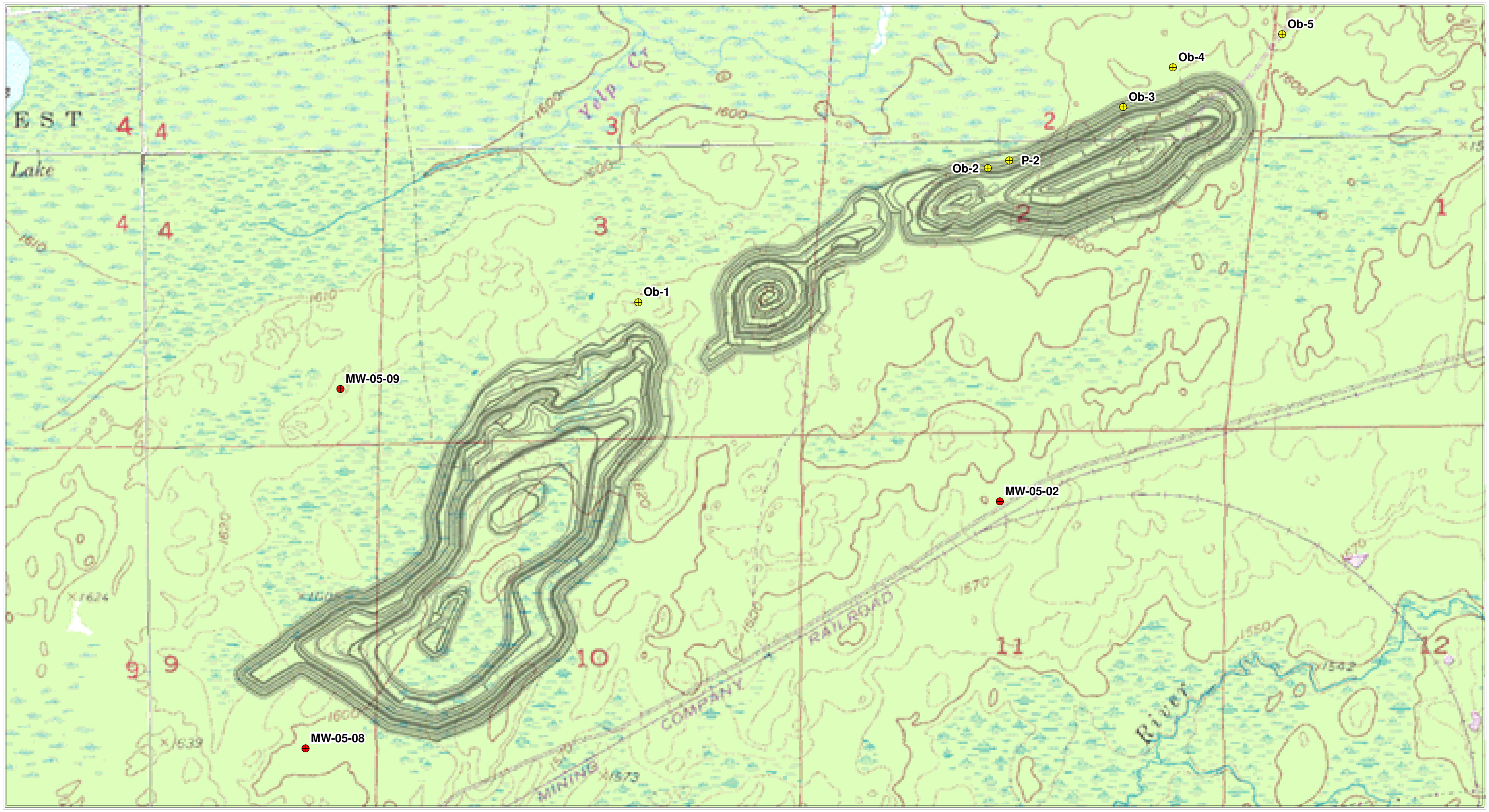


Figure 9   Specific Capacity Test Analysis – P-4 Step 2





—— 20 Year mine plan

Groundwater sampling locations

⊕ Bedrock pumping/observation well

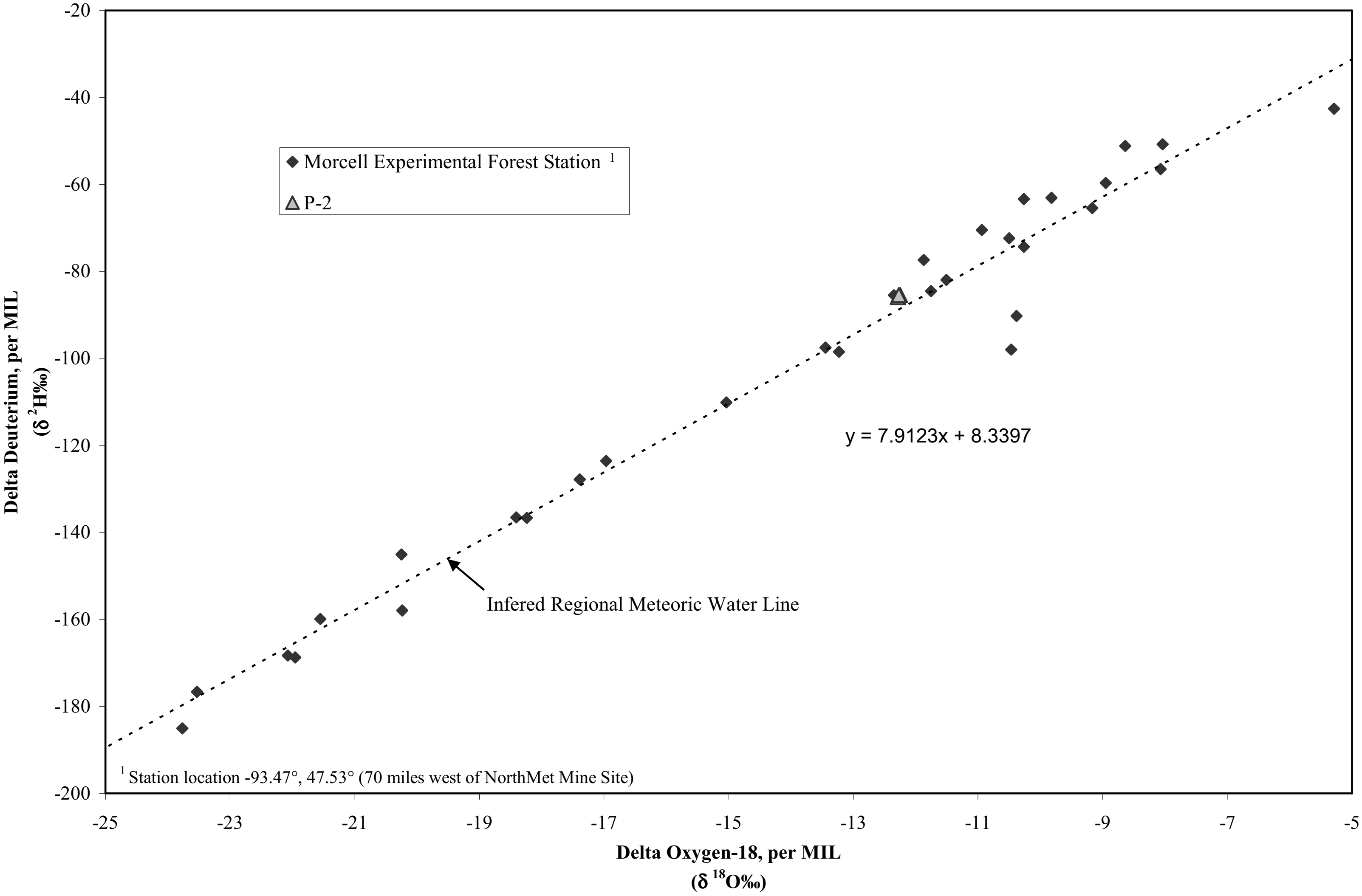
● Surficial aquifer monitoring well

0 1,000 2,000 Feet

Figure 10

GROUNDWATER SAMPLING LOCATIONS
PHASE III HYDROGEOLOGIC INVESTIGATION
PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Figure 11 P-2 Isotope Data Compared to Regional Precipitation Data



[1] Station location -93.47°, 47.53° (70 miles west of NorthMet Mine Site)

Appendix A

Barr Engineering Company
4700 West 77th Street • Minneapolis, MN 55435-4803
Phone: 952-832-2600 • Fax: 952-832-2601 • www.barr.com *An EEO Employer*

Minneapolis, MN • Hibbing, MN • Duluth, MN • Ann Arbor, MI • Jefferson City, MO

July 6, 2006

Stuart Arkley
Ecological Services Division
MN DNR
500 Lafayette Road N.
St. Paul, MN 55155

Re: Hydrogeologic Investigation – Phase III
PolyMet NorthMet Mine Site
Babbitt, Minnesota

Dear Stuart Arkley:

As discussed at the EIS kick-off meeting in May, further hydrogeologic investigative work is proposed for the NorthMet Mine Site, in order to better understand the possible effects of mine dewatering in the bedrock aquifer on the wetland areas in the vicinity of the Mine Site. Pumping tests performed during Phases I and II of the Hydrogeologic Investigation were not designed to investigate the nature of the hydraulic connection between the bedrock aquifer and adjacent wetland areas. This letter describes the proposed scope and schedule of Phase III of the Hydrogeologic Investigation. Phase III will consist of conducting and analyzing the results from a pumping test. The results from the test will be used to better understand the response of water levels within the wetland areas to pumping groundwater (dewatering) at the Mine Site.

The Phase III Investigation will also include focused specific-capacity testing in two of the wells that were installed during the Phase II Investigation. This specific-capacity testing is a follow-up to work conducted in Phase II and is intended to evaluate the relative water supply vs. depth in the bedrock aquifer at the Mine Site. In addition, a round of groundwater samples will be collected from Mine Site monitoring wells.

Objective

The primary objective of the proposed Phase III Hydrogeologic Investigation is to conduct a pumping test to evaluate the response of the wetland areas to future pumping related to mine dewatering at PolyMet's proposed NorthMet Mine located near Babbitt, Minnesota.

The Phase I Hydrologic Investigation completed by Barr Engineering Company (Barr) in June 2005 (RS02) provided information about the surficial aquifer system and the Duluth Complex. The Phase II Hydrologic Investigation completed by Barr in January 2006 (RS10) provided information about the ability of the Virginia Formation to transmit water to the proposed NorthMet pit and to characterize the quality of the water found in this formation. During Phase II, multiple pumping tests were conducted in order to characterize the Virginia Formation at the Mine Site. However, the effects on the adjacent wetland due to pumping at the Mine Site have yet to be quantified. Phase III will provide data to determine the connection between the bedrock aquifers and the surficial aquifer in the adjacent wetland.

A secondary objective of the proposed work will be to evaluate whether the majority of the water in the bedrock aquifer moves through near-surface fractured and weathered zones, or if there may also be one or more deeper zones with significant amounts of groundwater flow. Most evidence leads to the assumption that the primary source of water is the near-surface bedrock. However, during the Phase II drilling activities, there was some indication of a possible void space in the bedrock at depth in well P-4. In order to confirm whether or not there is a high transmissivity zone at depth in the bedrock aquifer (in the eastern portion of the mine site), specific-capacity testing will be conducted in isolated portions of pumping wells P-3 and P-4.

Scope of Work - Aquifer Performance Testing

An aquifer performance test (i.e., pumping test) will be performed in pumping well P-2. The pumping phase of the test will run for 10 days. Pressure transducers and data loggers will be temporarily installed in the pumping well P-2 and in five observation wells in the vicinity of the pumping well (Figure 1). Water level data will be measured “continuously” (approximately one measurement every 10 minutes) for all six wells being monitored.

The installation of pumping well P-2 and observation well Ob-2 was completed during the Phase II Investigation. Piezometers 2P, 12P, 20, and 20P will be installed in the peat/muck layer in the wetland north of P-2 as part of the Wetland Hydrology Study, which is being conducted concurrently with this investigation. Pumping well P-2 is 610 feet deep, observation well Ob-2 is 100 feet deep, piezometers 2P, 12P, and 20P will be 6 feet deep, and piezometer 20 will be 1.5 feet deep.

Water levels from pumping and observation wells will be measured using data logging probes. The probes automatically measure and record water levels in the wells and also automatically correct for changes in barometric pressure. Probes will be installed in pumping well P-2 and in the five observation wells 10 days prior to pumping, in order to record background conditions. The probes will monitor water levels in the piezometers for the 10 days prior to the pumping test, during the test, and during the recovery.

The pumping rate for the test will be established so that the pumping well maintains a stable water column equal to approximately one-third of the original water column height. Based on the results from the pumping test conducted at well P-2 during the Phase II Investigation, a pumping rate of 20 gallons per minute (gpm) is proposed for the Phase III Investigation. Water levels collected by the data loggers will be verified with manual measurements as often as practical. The pumping well will be pumped at a constant rate for 10 days. After reaching this time limit, the pump will be turned off and the water level in the well will be allowed to recover for up to10 days.

Water extracted during the pumping tests will be discharged at the site. In order to avoid hydraulic interference with the pumping test, the chosen discharge location will be approximately 3000 feet from the pumping well and in an upland (non-wetland) area. Water will be pumped directly to the discharge location.

The data collected during the pumping and recovery portions of the tests from both the pumping and observation wells will be analyzed using conventional analytical techniques.

Scope of Work – Specific-Capacity Testing

Specific-capacity tests will be conducted in isolated vertical intervals in pumping wells P-3 and P-4, using a packer assembly and submersible pump. For each of the tests, the packer will be set at an approximate depth of 300 feet, to isolate the upper portion of the aquifer from the deeper portion. The pump will be placed either above or below the packer, depending on the drilling contractor's capabilities. Once the pump is installed in the isolated interval, a short-term (3 to 4 hour) specific-capacity test will be run. The pump will be run at a fixed discharge rate for approximately 2 hours until the water level is relatively stable. The discharge rate will then be increased slightly and pumping will continue until the water level is again relatively stable, at which time the test will be terminated. If possible, water levels will be monitored in both of the isolated zones (i.e., pumped and non-pumped) during the duration of the test. Whether this is possible will depend on the equipment supplied by the drilling contractor. It is anticipated that the specific-capacity testing will be conducted during the two days immediately prior to the start of the pumping phase of the pumping test at well P-2.

The data collected during the specific-capacity tests will be analyzed using conventional analytical techniques.

Scope of Work – Groundwater Sampling

Groundwater samples will be collected from the five bedrock observations wells installed as part of the Phase II Hydrogeologic Investigation (Ob-1 through Ob-5) and the three surficial monitoring wells installed as part of the Phase I Hydrogeologic Investigation (MW-05-02, MW-05-08 and MW-05-09). All wells will be purged and allowed to stabilize before collection of the samples. Groundwater samples will be analyzed for the parameters listed in Table 1.

Investigation Report and Schedule

The results from the pumping test and specific-capacity tests will be summarized and incorporated into a report. The report will include field data, aquifer performance test analysis, pumping and observation well locations, conclusions and recommendations. Documentation supporting the discussion of the results will be included in tables, figures, and appendices, as appropriate.

Based on the assumption that this scope of work is approved by August 4, 2006, it is anticipated that the field work can be initiated by mid-August. Field work will last approximately four to five weeks. It is anticipated that data analysis and preparation of a draft Phase III Hydrogeologic Investigation Report will be completed within approximately four weeks after the end of field work. Based on these assumptions, it is anticipated that the draft report will be completed by late October to mid November, 2006.

Please contact Tina Pint at (952) 832-2692 or Mark Hagley at (218) 529-8206 with any questions or comments related to this proposed scope of work.

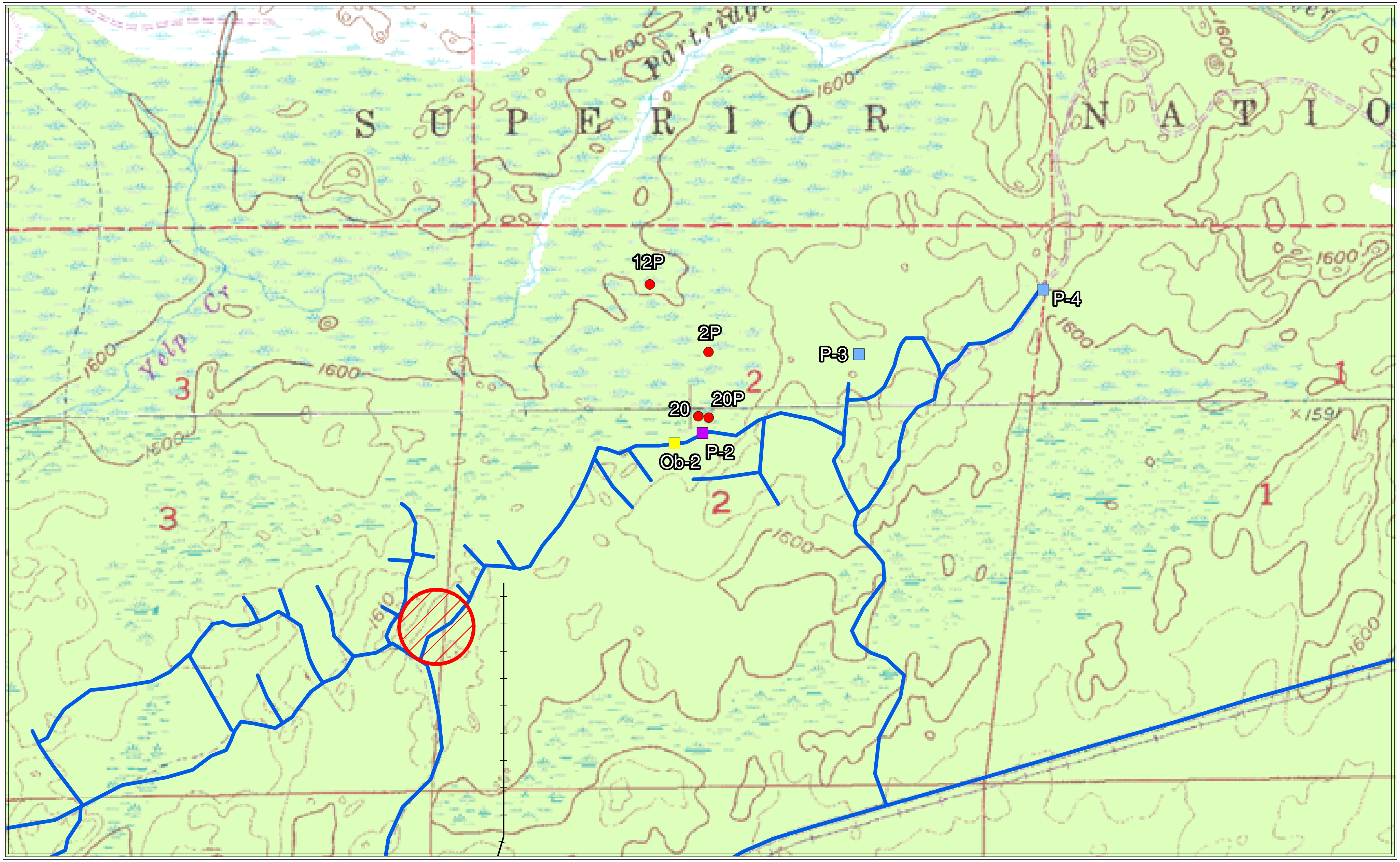
Sincerely,

John Borovsky
Vice President

Table 1. Proposed Parameters for Groundwater Sample Analysis. Detection limits in ug/L unless otherwise noted.

Description	**Method**	**Detection Limit**
Alkalinity, Total as CaCO3	EPA 310.1	10 mg/L
Carbon, Total Organic	EPA 415.1	1 mg/L
Chemical Oxygen Demand	STD METH 5220D, 18TH ED	10 mg/L
Chloride	EPA 325.2	0.5 mg/L
Cyanide Total	EPA 335.2	0.02 mg/L
Fluoride	EPA 340.1	0.1 mg/L
Hardness, Total (calculated)	EPA 200.7	1 mg/L
Nitrogen, Ammonia	EPA 350.1	0.1 mg/L
Nitrogen, Nitrate + Nitrite	EPA 353.2	0.1 mg/L
pH	EPA 150.1	0.1 SU
Phosphorus, Total	EPA 365.2	0.1 mg/L
Sulfate	EPA 375.4	1 mg/L
Aluminum, Total	EPA 200.7	25
Aluminum, Dissolved	EPA 200.7	25
Antimony, Total	EPA 204.2	3
Arsenic, Total	EPA 200.8	2
Barium, Total	EPA 200.7	10
Beryllium, Total	EPA 210.2	0.2
Boron, Total	EPA 200.7	35
Cadmium, Total	EPA 213.2	0.2
Cadmium, Dissolved	EPA 213.2	0.2
Calcium, Total	EPA 200.7	0.5 mg/L
Chromium, Total	EPA 218.2	1
Chromium, Dissolved	EPA 218.2	1
Cobalt, Total	EPA 219.2	1
Copper, Total	EPA 220.2	2
Copper, Dissolved	EPA 220.2	2
Iron, Total	EPA 200.7	0.05 mg/L
Lead, Total	EPA 7421	1
Magnesium, Total	EPA 200.7	0.5 mg/L
Manganese, Total	EPA 200.7	0.03 mg/L
Mercury, Low Level Total	EPA 1631E	2 ng/L
Methyl Mercury, Total	EPA 1631E	0.02 ng/L
Molybdenum, Total	EPA 246.2	5
Molybdenum, Dissolved	EPA 246.2	5
Nickel, Total	EPA 249.2	2

Description	Method	Detection Limit
Nickel, Dissolved	EPA 249.2	2
Palladium, Total	EPA 200.7	25
Platinum, Total	EPA 200.7	25
Potassium, Total	EPA 200.7	1 mg/L
Selenium, Total	EPA 270.2	2
Selenium, Dissolved	EPA 270.2	2
Silver, Total	EPA 272.2	1
Silver, Dissolved	EPA 272.2	1
Sodium, Total	EPA 200.7	0.5 mg/L
Strontium, Total	EPA 200.7	4
Thallium, Total	EPA 279.2	2
Titanium, Total	EPA 283.2	10
Zinc, Total	EPA 200.7	10
Zinc, Dissolved	EPA 200.7	10



🟪 Pumping well

🟦 Specific capacity test well

🟨 Bedrock observation well

● Wetland observation well

▨ Water discharge area

— Roads

N

0 250 500 1,000 1,500 Feet

0 125 250 500 750 Meters

Figure 1

PUMPING AND OBSERVATION WELL LOCATIONS - PHASE III

PolyMet Mining, Inc.
Hoyt Lakes, Minnesota

Appendix B

BARR

Barr Engineering Company
Field Log Data Sheet

Client: PolyMet Mining

Monitoring Point: MW-05-02

Location: NorthMet

Date: 11/20/06

Project #: 23/69-862 004 009

Sample Time: 1202-1230

GENERAL DATA

Barr lock:	yes
Casing diameter:	2" pvc
Total well depth:*	10.34
Static water level:*	9.83
Water depth:*	0.5
Well volume: (gal)	0.083
Purge method:	peristaltic
Sample method:	peristaltic
Start time:	11:24
Stop time:	12:30
Duration: (minutes)	66
Rate, gpm:	11:24-11:32 0.13 gpm 11:32-12:30 0.09 gpm
Volume, purged:	6.1 gal
Duplicate collected?	no
Sample collection by:	LMG

STABILIZATION TEST

Time/ Volume	Temp. °C	Cond. @ 25	pH	ORP ~~Eh~~	D.O.	Turbidity Appearance
1125/0.1 gal	4.6	356	7.37	8.7	7.38	cloudy
1127/0.4 gal	5.9	347	7.17	63	4.51	clear
~~1127~~ 1132/1.0 gal	5.6	342	7.17	72	4.65	"
1136/1.4 gal	5.6	313	7.06	86	4.18	"
1140/1.7 gal	5.7	275	6.89	97	3.15	"
1144/2.1 gal	5.6	241	6.74	113	3.47	"
1147/2.4 gal	5.6	214	6.59	131	3.98	"
1151/2.7 gal	5.8	196	6.55	139	4.39	"
1154/3.0 gal	5.7	180	6.50	138	5.00	"
1157/3.2 gal	5.8	173	6.47	145	4.79	"
1200/3.5 gal	5.8	165	6.50	148	4.95	"

Odor: none detected

Purge Appearance: clear

Sample Appearance: clear

Comments:

CO2- Mn2- Fe(T)- Fe2-

Others present: —

Well Condition: good

[✓ MW]: groundwater monitoring well WS: water supply well SW: surface water SE: sediment other:

VOC- semi-volatile- general- 1 nutrient- 1 cyanide- 1 DRO- Sulfide-

oil,grease- bacteria- total metal- 2 filtered metal- 1 methane- filter-

Others: TOC-1, LLHg-1, Methyl Hg-1

*Measurements are referenced from top of riser pipe, unless otherwise indicated.

BARR

Barr Engineering Company
Field Log Data Sheet

Client: PolyMet Mining	**Monitoring Point:** MW-05-08
Location: NorthMet	**Date:** 11/28/06
Project #: 23/69-862 004 009	**Sample Time:** 0920-0931

GENERAL DATA		**STABILIZATION TEST**						
Barr lock:	yes	Time/ Volume	Temp. °C	Cond. @ 25	pH	ORP ~~Eh~~	D.O.	Turbidity Appearance
Casing diameter:	2" pvc							
Total well depth:*	20.9	0845/ 2.6gal	6.7	125	7.30	86	0.75	clear
Static water level:*	4.02	0855/ 5.2 gal	6.7	119	7.31	52	0.77	"
Water depth:*	16.88	0905/ 7.8 gal	6.8	117	7.28	49	0.69	"
Well volume: (gal)	2.75	0915/ 10.4 gal	6.8	115	7.27	47	0.70	"
Purge method:	peristaltic							
Sample method:	peristaltic							

Start time:	08:35	Odor: none detected
Stop time:	09:31	Purge Appearance: clear
Duration: (minutes)	56	Sample Appearance: clear
Rate, gpm:	0.26	Comments:
Volume, purged:	14.6 gal	
Duplicate collected?	no	
Sample collection by:	LMG, JAMZ	CO2- Mn2- Fe(T)- Fe2-

Others present: —

Well Condition: good

[✓ MW]: groundwater monitoring well WS: water supply well SW: surface water SE: sediment other:

VOC- semi-volatile- general- 1 nutrient- 1 cyanide- 1 DRO- Sulfide-

oil,grease- bacteria- total metal- 2 filtered metal- 1 methane- filter-

Others: TOC-1, LLHg-1, Methyl Hg-1

*Measurements are referenced from top of riser pipe, unless otherwise indicated.

BARR

Barr Engineering Company
Field Log Data Sheet

Client: PolyMet Mining

Monitoring Point: MW-05-09

Location: NorthMet

Date: 10/5/06

Project #: 23/69-862 004 009

Sample Time: 1400

GENERAL DATA

Barr lock: yes
Casing diameter: 2" pvc
Total well depth:* 16.5
Static water level:* 12.65
Water depth:* 3.9
Well volume: (gal) 0.6
Purge method: peristaltic
Sample method: "
Start time: 10:25
Stop time:
Duration: (minutes)
Rate, gpm: 0.1
Volume, purged: ~0.6 gal
Duplicate collected? no
Sample collection by: KSJ

STABILIZATION TEST

Time/ Volume	Temp. °C	Cond. @ 25	pH	ORP ~~Eh~~	D.O.	Turbidity Appearance
1033	9.6	73	6.78	89	1.80	slightly cloudy

Odor: none detected

Purge Appearance: begin- clear, end- slightly cloudy

Sample Appearance: Slightly Cloudy

Comments:
Well purged dry after 1 well volume. Extremely slow recharge. Sampled at 14:00.

CO2- Mn2- Fe(T)- Fe2-

Others present: –

Well Condition: good

[✓ MW:] groundwater monitoring well WS: water supply well SW: surface water SE: sediment other:

VOC- semi-volatile- general- 1/2 nutrient- cyanide- DRO- Sulfide-

oil,grease- bacteria- total metal- 1 filtered metal- 1 methane- filter-

Others: TOC-1, LLHg-1, Methyl Hg-1

*Measurements are referenced from top of riser pipe, unless otherwise indicated.

BARR

Barr Engineering Company
Field Log Data Sheet

Client: PolyMet Mining Corp.	**Monitoring Point:** Ob-1
Location: NorthMet Mine Site	**Date:** 10/5/06
Project #: 23/69-862 004 009	**Sample Time:** 1340

GENERAL DATA		**STABILIZATION TEST**						
Barr lock:	Yes	Time/ Volume	Temp. °C	Cond. @ 25	pH	Eh	D.O.	Turbidity Appearance
Casing diameter:	4"							
Total well depth:*	94.4	1134/142	5.96	170	9.73	-14	0.65	cloudy
Static water level:*	13.22	1215/186	6.90	173	9.93	-53	9.51	clear
Water depth:*	81.2	1256/215	7.16	163	9.75	-48	11.29	clear
Well volume: (gal)	53	1337/262	6.96	158	9.73	-47	9.59	clear
Purge method:	Submersible							
Sample method:	Submersible							

Start time:	0815	Odor: None detected
Stop time:	1340	Purge Appearance: clear, then cloudy, then clear
Duration: (minutes)	325	Sample Appearance: Clear
Rate, gpm:	~~0815-0900 1.5~~ ~~0900~~ see right →	Comments: pumping rates (gpm): 0815-0900 1.5 0900-0945 0.5 0945-1054 0 1054-1200 1.3 1200-1340 0.7
Volume, purged:	262	
Duplicate collected?	no	
Sample collection by:	LMG	CO2- Mn2- Fe(T)- Fe2-

Others present: —

Well Condition:

MW: groundwater monitoring well WS: water supply well SW: surface water SE: sediment other:

VOC- semi-volatile- general- 1 nutrient- 1 cyanide- 1 DRO- Sulfide-

oil,grease- bacteria- total metal- 2 filtered metal- 1 methane- filter-

Others: LL Hg-1, Methyl Hg-1, TOC-1

*Measurements are referenced from top of riser pipe, unless otherwise indicated.

Barr Engineering Company
Field Log Data Sheet

Client: PolyMet Mining	**Monitoring Point:** 06-2
Location: NorthMet	**Date:** 10/3/06
Project #: 23/69-862 004 009	**Sample Time:** 1200

GENERAL DATA

Barr lock:	yes
Casing diameter:	~~2"~~ 4"
Total well depth:*	101.1
Static water level:*	8.86
Water depth:*	92.2
Well volume: (gal)	60
Purge method:	Submersible
Sample method:	Submersible & peristaltic
Start time:	10:35
Stop time:	11:47
Duration: (minutes)	72
Rate, gpm:	2.5
Volume, purged:	180 gal
Duplicate collected?	no
Sample collection by:	KSJ, LMG

STABILIZATION TEST

Time/ Volume	Temp. °C	Cond. @ 25	pH	ORP ~~Eh~~	D.O.	Turbidity Appearance
1059/60 gal	5.6	187	7.90	-132	2.80	clear
1123/120 gal	5.5	189	8.11	-160	2.14	"
1147/180 gal	5.6	187	8.09	-148	2.15	"

Odor: none detected

Purge Appearance: Clear

Sample Appearance: clear

Comments:

CO2- Mn2- Fe(T)- Fe2-

Others present: —

Well Condition: good

[✓ MW:] groundwater monitoring well WS: water supply well SW: surface water SE: sediment other:

VOC- semi-volatile- general- 1 nutrient- 1 cyanide- 1 DRO- Sulfide-

oil,grease- bacteria- total metal- 2 & filtered metal- 1 methane- filter-

Others: TOC-1, LLHg-1, Methyl Hg-1

*Measurements are referenced from top of riser pipe, unless otherwise indicated.

BARR

Barr Engineering Company
Field Log Data Sheet

Client: PolyMet Mining

Monitoring Point: 06-3

Location: NorthMet

Date: 10/16/06

Project #: 23/69-862 004 009

Sample Time: 1215

GENERAL DATA

Barr lock:	yes
Casing diameter:	4"
Total well depth:*	104.0
Static water level:*	10.65
Water depth:*	93.4
Well volume: (gal)	61.1
Purge method:	Submersible
Sample method:	Submersible
Start time:	0909
Stop time:	1215
Duration: (minutes)	186
Rate, gpm:	2.0
Volume, purged:	372 gal
Duplicate collected?	no

Sample collection by: LMG

STABILIZATION TEST

Time/ Volume	Temp. °C	Cond. @ 25	pH	ORP ~~Eh~~	D.O.	Turbidity Appearance
0952/ 61 gal	8.4	209	9.44	-69	1.12	Cloudy
1010/ 122 gal	8.3	206	7.45	-63	0.86	clear
1041/ 183 gal	8.4	205	6.95	-60	1.18	"
1111/ 244 gal	8.2	199	6.81	-63	0.82	"
1142/ 306 gal	8.3	199	6.72	-63	0.81	"
1212/ 367 gal	8.3	198	6.72	-63	0.80	"

Odor: none detected

Purge Appearance: Cloudy, then clear

Sample Appearance: Clear

Comments:

CO2- Mn2- Fe(T)- Fe2-

Others present: —

Well Condition: good

[✓ MW]: groundwater monitoring well WS: water supply well SW: surface water SE: sediment other:

VOC- semi-volatile- general- / nutrient- / cyanide- / DRO- Sulfide-

oil,grease- bacteria- total metal- 2 filtered metal- / methane- filter-

Others: TOC-1, LLHg-1, Methyl Hg-1

*Measurements are referenced from top of riser pipe, unless otherwise indicated.

BARR

Barr Engineering Company
Field Log Data Sheet

Client: PolyMet Mining	**Monitoring Point:** 06-4
Location: NorthMet	**Date:** 10/4/06
Project #: 23/69-862 004 009	**Sample Time:** 1210

GENERAL DATA

Barr lock:	yes
Casing diameter:	4"
Total well depth:*	100.2
Static water level:*	15.68
Water depth:*	84.5
Well volume: (gal)	55
Purge method:	submersible
Sample method:	Submersible & peristaltic
Start time:	08:25
Stop time:	12:03
Duration: (minutes)	221
Rate, gpm:	1.5
Volume, purged:	331 gal
Duplicate collected?	M-1
Sample collection by:	KSJ, LMG

STABILIZATION TEST

Time/ Volume	Temp. °C	Cond. @ 25	pH	ORP ~~Eh~~	D.O.	Turbidity Appearance
0902/ 55gal	7.9	47	6.20	185	6.17	clear
0938/ 110gal	7.9	48	9.55	202	5.91	"
1014/ 166gal	7.9	49	7.66	205	5.77	"
1051/ 221gal	7.9	49	6.18	191	5.63	"
1126/ 276gal	7.9	51	5.87	147	5.57	"
1203/ 331gal	8.0	49	5.80	119	5.47	"

Odor: none detected

Purge Appearance: clear

Sample Appearance: clear

Comments:

CO2- Mn2- Fe(T)- Fe2-

Others present: —

Well Condition: good

[✓ MW: groundwater monitoring well] WS: water supply well SW: surface water SE: sediment other:

VOC- semi-volatile- general- 1+1 nutrient- 1+1 cyanide- 1+1 DRO- Sulfide-

oil,grease- bacteria- total metal- 2+2 filtered metal- 1+1 methane- filter-

Others: TOC- 1+1, LLHg- 1+1, Methyl Hg - 1+1

*Measurements are referenced from top of riser pipe, unless otherwise indicated.

Barr Engineering Company
Field Log Data Sheet

Client: PolyMet Mining	**Monitoring Point:** 06-5
Location: NorthMet	**Date:** 10/4/06
Project #: 23/69-862 004 009	**Sample Time:** 1030

GENERAL DATA

Barr lock:	yes
Casing diameter:	4"
Total well depth:*	99.6
Static water level:*	12.34
Water depth:*	87.3
Well volume: (gal)	57
Purge method:	submersible
Sample method:	submersible & peristaltic
Start time:	07:35
Stop time:	10:30
Duration: (minutes)	175
Rate, gpm:	0.7
Volume, purged:	123
Duplicate collected?	no
Sample collection by:	KSJ, LMG

STABILIZATION TEST

Time/ Volume	Temp. °C	Cond. @ 25	pH	ORP ~~Eh~~	D.O.	Turbidity Appearance
0758/ 16.1 gal	8.8	44	7.43	186	7.16	clear
0821/ 32 gal	8.3	44	6.51	182	7.50	"
0843/ 48 gal	8.7	45	6.32	189	7.38	"
0905/ 63 gal	8.6	45	6.20	190	7.25	"
0927/ 78 gal	8.6	46	6.18	186	7.21	"
1030/ 123 gal	8.3	45	6.24	183	7.04	"

Odor: none detected

Purge Appearance: clear

Sample Appearance: all but LLHg & Methyl Hg - clear
LLHg & Methyl Hg - cloudy

Comments:

Used submersible pump to purge, then sample. Pulled ~~peristaltic~~ submersible pump, put in peristaltic pump. Flow cloudy; flow started clearing; LLHg & Methyl Hg samples collected before completely clear.

CO2- Mn2- Fe(T)- Fe2-

Others present: —

Well Condition: good

[✓ MW: groundwater monitoring well] WS: water supply well SW: surface water SE: sediment other:

VOC- semi-volatile- general- 1 nutrient- 1 cyanide- 1 DRO- Sulfide-

oil,grease- bacteria- total metal- 2 filtered metal- 1 methane- filter-

Others: TOC-1, LLHg-1, Methyl Hg-1

*Measurements are referenced from top of riser pipe, unless otherwise indicated.